CARE

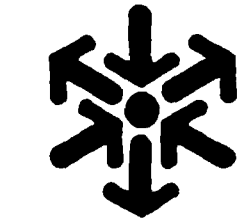
WATER AND SANITATION
FOR HEALTH PROJECT

WASH FIELD REPORT NO. 227

EVALUATION OF CARE SUDAN
INTERIM WATER SUPPLY AND MANAGEMENT PROJECT

Prepared for the USAID Mission to Sudan
and CARE
under WASH Activity No. 412

May 1988



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by

Richard McGowan
and
Katherine Burns

May 1988

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ACKNOWLEDGMENTS

The evaluation team wishes to express its appreciation to those people who helped expedite the evaluation of the Interim Water Supply and Management Project (IWP). For nearly all of the fieldwork, the CARE Khartoum Assistant Programming Officer, Mr. Isam Ghanim, was of particular assistance. He not only acted as primary translator, but was extremely effective in helping the team understand the complex interactions of water users and suppliers in rural Sudan.

The team would also like to thank other CARE Khartoum staff, including the Programming Officer, Mr. Steve Wallace, who accompanied the team on several site visits, explained project subtleties, and ably managed logistics for the evaluation, and the CARE Sudan Director, Mr. Earl Goodyear. CARE El Obeid staff who provided assistance included IWP's Project Manager, Mr. Haile Gebreselassie; Water Extension Supervisor, Mr. Kamal Awad; and CARE/National Water Corporation (NWC) Water Engineer, Mr. Mohamed Gouda.

The team also wishes to thank U.S. Agency for International Development (USAID)/Sudan mission personnel, including the AID Project Officer for IWP and Chief Engineer, Mr. Ken Rickert, and staff engineers, Mr. Mohamed Yahia and Mr. Carl Maxwell. The team appreciates the assistance of NWC senior management staff in El Obeid and Khartoum, and the many water-yard operators and clerks spoken with during the evaluation.

Finally, special thanks go to the people of the Bara and En Nahud regions of North Kordofan Province, who extended their exceptionally warm hospitality during the team's field site visits. They never failed to patiently provide useful suggestions in spite of the team's never-ending questions. It is hoped that they will continue to work together to operate and maintain their water systems for the better health of their villages in the future.

ACRONYMS

AID	U.S. Agency for International Development
ARD	Associates in Rural Development, Inc.
CDSS	Country Development Strategy Statement
gph	gallons per hour
GOS	Government of Sudan
IES	Institute for Environmental Studies, University of Khartoum
IG	Imperial gallon (4.55 liters)
IWP	CARE Interim Water Supply and Management Project
KAP	knowledge, attitudes and practices
lpcd	liters per capita per day
MFP	Ministry of Finance and Planning
MOH	Ministry of Health
NKWSP	North Kordofan Water Supply Project
NGO	nongovernmental organization
NRWDC	National Rural Water Development Corporation
NWA	National Water Administration
NWC	National Water Corporation
O&M	operation and maintenance
ORS	oral rehydration salts
PHC	primary health care
PIE	Planning, Implementation, and Evaluation (a CARE procedure)
PIR	Project Implementation Review (an AID procedure)
PVO	private voluntary organization
QARQ	quantity, accessibility, reliability, and quality
RAW	Rural Administration for Water

REDSO/ESA	Regional Economic Development Services Office/East and Southern Africa, USAID
RFPP	Regional Finance and Planning Project
RWSMU	Rural Water Supply Maintenance Unit
RTA	regional technical assistance
SCF	Save the Children Federation
SREP	Sudan Renewable Energy Project
TDS	total dissolved solids
UNICEF	United Nations Children's Fund
USAID	U.S. Agency for International Development
VWC	Village Water Committee
WASH	Water and Sanitation for Health Project
WID	Women in Development

Currency: Sudanese pound

S£ 4.4 = U.S. $1.00 (as of November 1987)

S£ 2.5 = U.S. $1.00 (as of start of project, March 1986)

1 piaster = S£ 0.01

GLOSSARY

Borehole--a drilled and cased well, usually 60 to 300 feet deep, with a four- to six-inch steel casing. Replacement boreholes were drilled using the CARE drilling rig and, where necessary, cleaned by either NWC compressor rigs or subcontracted to firms such as BRGM.

Filling bench--a concrete slab on which water containers are placed for filling. Water distribution pipes and taps are mounted over the bench. At IWP sites, there is a concrete lip around the bench where spilled water is collected and gravity-fed into sump tanks in adjacent gardens. Tap heights have been standardized so that the most common water container, a jerry can, will fit under the tap with about a one-inch clearance, thereby minimizing spillage. There are two standard sized benches--one at hip height, for women carrying jerry cans, and the other just above ground level, which is convenient for children and for filling goat skins.

Hafir--a water-storage pond, usually occurring in a natural depression or catchment area, which is modified (dug out and diked) and lined to increase water retention where the clay content of soils is inadequate. At sites that have not been rehabilitated, people and animals walk right into hafirs to get water, thereby polluting the water. However, at rehabilitated or new sites, thorn-tree fences keep out both people and animals. Collection wells are provided outside the hafir perimeter for water access.

Low-capacity system--generally used synonymously with open wells and hand-pump systems. Hafirs and diesel water-yards are considered high-capacity systems. Low-capacity systems generally have a capacity of less than five cubic meters per day.

Open well--hand-dug, uncased wells. Rehabilitated or new project open wells are lined with concrete blocks. Many non-project open wells are unlined, which makes them very dangerous to dig (sometimes collapsing when workers are inside). They also require frequent re-digging, since they collapse much more often than lined wells. Open wells vary in depth from 30 feet (near Bara) to over 250 feet and in width from about six feet for the deeper wells to about 15 for shallower wells. Some open wells have been capped with concrete, and handpumps have been installed. At some non-project open wells, camels are used to pull buckets of water to the surface.

Overhaul--complete replacement of all replaceable parts (i.e., a complete overhaul) for diesel engines and any type of pump (Edeco piston pumps for diesel systems and India Mark II-type handpumps). Minor overhauls (e.g., decarbonization of diesel engines or replacement of cylinder leathers on piston pumps) are specified by the particular type of maintenance or repair procedures undertaken.

QARQ--quantity, accessibility, reliability, and quality: The CARE primary evaluative criteria for measuring the impact of water projects.

Rehabilitation--for diesel water-yards, rehabilitation means overhaul or replacement of all pumping and water distribution-related equipment, with the major exception of water storage tanks, which were often only painted to reduce rusting. Boreholes were cleaned and tested. Where yields were inadequate, replacement boreholes were drilled. For open wells, rehabilitation is fixing or installing a lining, re-digging, installing above-ground well collars and drainage aprons, and wood for rope skids. Sometimes, pulleys were mounted on well collars to facilitate rope-and-bucket lifting. For hafirs, rehabilitation means dredging or de-silting, reinforcing or constructing catchment barriers, refurbishing or installing pumps, engines, sediment basins and water treatment facilities, where used.

Villages, project sites, communities, and satellite villages--villages are sometimes (but not always) grouped around water points. A project site is the specific village where rehabilitation or other efforts have been undertaken. The community may include the main village (the project site), in addition to one or more satellite villages, from which people travel to the project site to collect water.

Water-yard--physical location of the water distribution system for diesel-pumped village water supplies. The borehole (drilled well), water-storage tank, and pump house are usually nearby. At project sites, water taps are in an area enclosed by thorn tree fencing or sometimes barbed wire with steel fenceposts. Areas for human and animal use are also separated by fencing at project sites.

EXECUTIVE SUMMARY

At the request of CARE Sudan and USAID/Sudan, a two-person team from the Water and Sanitation for Health (WASH) Project and CARE's East African Regional Technical Assistance team in Nairobi conducted an end-of-project evaluation of CARE's Interim Water Supply and Management Project (IWP). The evaluation had two purposes:

- evaluate IWP from a technical standpoint, and conduct a process evaluation of water extension curricula/ planning currently being developed and used in conjunction with the project; and
- review draft project proposal(s) for continued water development assistance to the Kordofan Region, beginning in 1988, and offer a technical critique of the plan with recommendations for any modifications.

The team performed the evaluation in Khartoum, El Obeid, and various project and non-project sites in North Kordofan from November 2 through 16, 1987. In addition to reviewing project reports and related documents, the team interviewed CARE IWP personnel, members of Village Water Committees where project activities occurred, water users at project water sites as well as non-project sites, National Water Corporation (NWC) personnel at all levels, CARE personnel, and representatives of other organizations working in the water sector in Sudan.

The report contains a description of the IWP, including the history of its development through the CARE/AID and CARE/NWC agreements, its design and implementation, and actual results as of November 1987. (The project end date is March 1988.) Chapters 3, 4, and 5 address engineering and construction; extension activities; and training, sustainability, cost recovery, and various impacts of the project. The evaluation team reviewed two follow-on activities which CARE plans to undertake; these are addressed in Chapter 6. The final two chapters cover conclusions and recommendations.

Findings

At the time of this evaluation, November 1987, the project had completed most of its major technical tasks:

- rehabilitation of 12 diesel water-yards--including the rehabilitation of 24 existing boreholes and drilling three new ones,

- rehabilitation of nine existing open wells in eight communities and the digging of seven new ones (five of which were successful),
- rehabilitation of three hafirs (water collection ponds) in two different communities, and
- installation of handpumps at two open-well sites.

As an emergency relief response and a pilot project, IWP was successful in designing and implementing a water-supply-related extension/health education program to accompany rehabilitation efforts at all village sites. While IWP did develop a well-conceived approach (which will undoubtedly find application in future projects), active community participation occurred only during the second half of the project due to staff turnover in the first months of the project and the delay in signing the CARE/NWC counterpart agreement.

In terms of CARE water project evaluation criteria--quantity, accessibility, reliability, and quality (QARQ)--the project had a decidedly positive impact by increasing the QARQ of water at project sites. However, the project has not made major progress in solving the essential problem of village water supply in rural Sudan. Significant differences in perspective exist between Village Water Committees (VWCs) and NWC with respect to centralized and decentralized control of water system management and the closely related issue of water-user fee collection and allocation. These differences may well have a significant impact on the sustainability of IWP rehabilitation efforts.

Since baseline studies of pre-intervention conditions at project sites were not done, an evaluation of the health, social, economic and environmental intermediate indicators of the project is not possible. However, qualitative judgments, based on comparison of a limited number of project and non-project sites, indicate significant improvements in terms of health impacts. The impact on other aspects of community life is also difficult to assess.

Recommendations

The water-yard design and community participation model developed by CARE during the IWP implementation provides a useful model that should be adopted by other private voluntary organizations (PVOs) involved in water resources development.

The development of multiple types of water supply systems in Kordofan--open wells, water-yards, and hafirs--is sound. Future projects should avoid focusing solely on water-yard rehabilitation, although this is certainly a very important component of water development.

Future projects will have to be more direct in addressing problems of long-term sustainability, especially those of operations and maintenance and cost recovery. This means reconciling differences of NWC, VWCs, and PVO/donors. Currently, the differences between village water users and NWC (which is responsible for water-yard operation, maintenance, repair, revenue collection, and allocation) presents significant obstacles to the sustainability of water

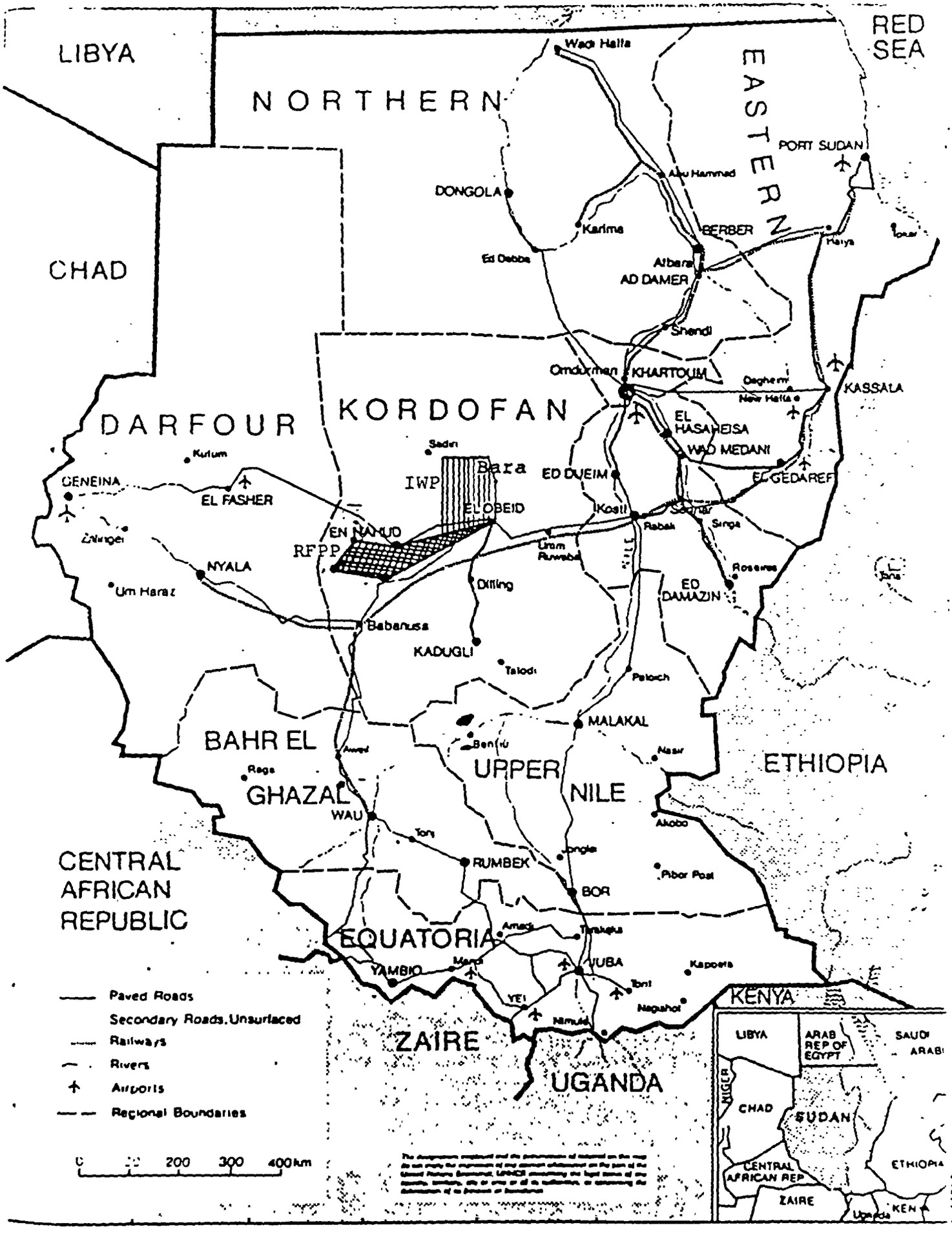
projects. As long as NWC believes its revenues are insufficient due to misallocation of funds at the village level and VWCs believe revenues paid to NWC do little to ensure the continued operation of their water systems, sustainability will be very difficult to achieve. Future projects should examine more closely the role of community participation in O&M and cost recovery schemes.

In its upcoming water-sector review, AID should negotiate with NWC current and future cost-recovery schemes. The objective should be to develop cost-recovery strategies that would support NWC's long-term policy goals, address the concerns of village water users, and help ensure the sustainability of donor-assisted water-source rehabilitation.

CARE should make an effort in future projects to document the successes and failures of past projects and, in future projects, establish monitoring and evaluation procedures for both technical and extension components. To determine the impact of specific project interventions, CARE needs to establish indicators and baselines with which to monitor and evaluate project progress.

CARE should examine other types of equipment for future projects including self-closing taps, low-cost modifications to open-well rehabilitation, and alternative energy sources for low- to medium-capacity water pumping.

The most problematic water sites in the IWP were in large, heterogeneous communities that were suggested by NWC but that did not match CARE site selection criteria. CARE should focus its water development efforts in smaller, more homogeneous communities, where community interest and participation are apt to be more coherent, thus increasing the probability that project interventions will be more sustainable over the long term.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Dagheim
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Chapter 1

INTRODUCTION

1.1 Background

North Kordofan Province is located in west/central Sudan (see Map, page xv) and is a semi-arid region (an average of 300 to 450 millimeters of rainfall annually) where the major economic activities are raising livestock and primarily rain-fed agriculture. Much of the province is relatively fertile. The principal crops are sorghum, millet, and hashab (gum arabic). In nearly all of North Kordofan, inadequate, unreliable water supplies have been and still are the main impediment to rural development.

There was a severe drought and subsequent famine in much of Sudan in 1984-85 which caused considerable dislocation of rural people searching for food and water. CARE has been operating in the province since 1983, implementing a series of rural development initiatives such as North Kordofan Water Supply Project (NKWSP). That project's major objective was the rehabilitation of 17 diesel-pump water-yards over a two-year period. No open wells, hafirs, or handpumps were included in NKWSP. This water resources development effort has assumed additional importance as part of the multi-donor and Government of Sudan (GOS) emergency relief response to the drought.

There are four main types of water supply systems in North Kordofan:

- Water-yards: Diesel engines drive piston pumps mounted on boreholes, and water is pumped to a storage tank and then distributed to nearby water distribution taps and troughs for human and animal use.

- Open wells: At these hand-dug wells water is drawn by people (usually by women) using ropes, buckets, or leather/rubber containers and sometimes by animals pulling the ropes or simple winches. In rare cases handpumps are installed on open wells.

- Hafirs: These natural depressions are used for rainwater catchment and storage, sometimes modified to increase capacity or facilitate water collection and distribution. Hafirs occur only in areas where clay soils are found. Sometimes an artificial lining (polyethylene) is used to minimize leakage losses.

- Cisterns: Cisterns are used for private water storage at homes or by public or local water vendors in areas where no water is available and must be transported by truck or donkey to the site.

Cisterns (and some hafirs) are occasionally used in conjunction with slow sand-filtration systems. No cistern systems were visited by the evaluation team, since they were not an emphasis of IWP.

In many of the more heavily populated areas of North Kordofan, particularly where hafirs are inappropriate (e.g., low clay content in the soil, no natural depressions) and rainfall has been especially inadequate, water-yards are the primary source of water for much of the population. They have distinct advantages and disadvantages as water sources.

First, it is not always possible to develop water-yards because of variable subsurface hydrogeology. Many areas of North Kordofan are underlain by the basement complex, a geological formation where water is rare or completely lacking.

Second, mechanized water-yards are capital-intensive requiring equipment, fuel, spare parts, and skilled labor to operate reliably. Such resources are not readily available and are inordinately expensive.

Finally, mechanized water-yards often generate environmental degradation, particularly during droughts. When traditional water sources simply dry up, people and animals are forced to migrate to alternative water sources--often, the nearest water-yard. With such abnormally high concentrations of people and animals and their demand for water, these sources of water also give out. In addition, the surrounding area is denuded of vegetation which is used for wood or charcoal and animal food. The increased populations may be sedentary, those who settle more or less permanently, or nomadic, people who stop at water points on their way to either grazing areas or markets.

Extreme environmental degradation seldom occurs near low-capacity water sources, such as open wells, simply because well supplies cannot sustain many people or animals.

Water supplies in rural areas of Sudan are the responsibility of the National Water Corporation (NWC). Accordingly, CARE's North Kordofan Water Supply Project (NKWSP) was implemented in conjunction with NWC (or the National Water Administration (NWA) or the National Rural Water Development Corporation, NRWDC, as it has also been known). NWC's major responsibilities include:

- borehole drilling and development;
- water-yard construction, operation and maintenance (except for some community responsibilities discussed below);
- operation and maintenance of mechanized pumping systems--diesel engines, pumps, water storage tanks and distribution systems;
- installation, operation and maintenance of boreholes equipped with handpumps (NWC crews work in conjunction with UNICEF);

- collection and distribution of water-user fees at water-yard sites, but not low-capacity systems such as open wells or boreholes with handpumps;
- provision of technical training and other technical and managerial support; and
- periodic rehabilitation of some open wells by NWC crews.

Because of NWC's concern with providing water to the greatest possible number of clients, its primary emphasis is on the development and operation of water-yards and hafirs--tanks or depressions for collecting water. It has understandably encouraged donors and PVOs that are interested in working in the water sector to focus on accelerated development of these two sources. In addition, in conjunction with UNICEF, NWC has installed several thousand India Mark II handpumps at small boreholes around Kordofan and in other provinces as well.

The water-user fee structure is based on fixed rates for certain types of containers and animals. For example, the most common type of container is the ubiquitous jerry can, which holds four Imperial gallons or about 18 liters. The official fixed fee for one jerry can water is 1.5 piasters (or S£0.015, equivalent to about US$0.19 per cubic meter at an exchange rate of US$1.00=S£4.4). For livestock watering, rates have been established based on the type of animal--camels, goats, sheep, cows and donkeys. Typical rates and their range of variation are discussed in Section 5.3 on cost recovery.

As mentioned above, one of NWC's responsibilities is the operation and maintenance services to community water-yards. User fees are collected by the NWC clerk assigned to each water-yard and returned to NWC, theoretically to cover the O&M costs at the site. In addition, a second "self-help" fee is collected at the water-yard gate which is used by the village water committee (VWC) to cover their costs (see Section 5.3). Village water users are represented by these VWCs, which have been organized in each water-yard community. The water revenues collected by NWC are supposed to cover all the costs of operation, maintenance, and repair of all village water-yards.

Several other groups are working in the North Kordofan area on water supply. Save the Children Federation (SCF) is doing water-yard rehabilitation in the Um Ruwaba area, though on a smaller scale than IWP. UNICEF has been working with NWC for several years in North Kordofan and other provinces of Sudan, primarily installing India Mark II handpumps on small-diameter boreholes for village water supply. As part of the upcoming AID-funded Regional Finance and Planning Project (RFPP), CARE, SCF and other PVOs are expected to continue along the lines of existing water projects, focusing on the rehabilitation of smaller water-yards and open wells. CARE's experience with water-source rehabilitation could serve as a model for these groups.

1.2 Project Design

The CARE Interim Water Supply and Management Project (IWP) was designed both to assist NWC in meeting its responsibilities for water-yard and hafir O&M and to focus additional efforts in areas that are not normally the responsibility of NWC, such as the development or rehabilitation of open wells, handpump systems and community cisterns. The project was designed to address the following technical, water management, community education, and health needs:

- borehole rehabilitation (occasionally drilling new boreholes where rehabilitation was not feasible);
- equipment rehabilitation (e.g., engines, pumps, distribution lines, but not storage tanks, which were welded or painted if required, but not replaced) or installation of new equipment where rehabilitation was not possible;
- water-yard development, including the construction of distribution taps, water troughs, fencing, pump houses, and drainage lines;
- community organization, such as assisting VWCs with water management training;
- development and implementation of health and sanitation extension curricula; and
- technical training.

While not specifically part of IWP, at many IWP sites, gardens were established to utilize spilled and runoff water--some of these were part of the CARE Agroforestry Project.

Three major groups were involved in the planning and implementation of IWP--CARE, NWC, and AID. The project proposal, developed by CARE and NWC, did not initially involve AID funding. When USAID/Sudan approached CARE with an offer of supplemental funding if some additions were made to the original project design, CARE accepted. The project design then had to be renegotiated with NWC. Thus, the goals and purposes of the project varied somewhat between the CARE/AID and the CARE/NWC agreements.

The project proposal for IWP was first drafted by CARE in August 1985. It focused primarily on the rehabilitation of open wells and hafirs, with a small handpump installation component, and did not include a component dealing with the rehabilitation of mechanized water-yards. Two surveys were also included in the original project proposal, one on the geophysical aspects of the proposed project area and another on watersheds and watercourses. After later discussions with USAID/Sudan, during which AID offered supplemental funding if water-yard rehabilitation were included in the project, the original CARE proposal was revised and the funding considerably increased to include

provisions for the rehabilitation of 15 water-yards. In addition to work on hafirs, open wells, and a small handpump installation component, the project included development of a water-and-health extension curriculum and a community education program. The CARE/AID agreement was signed in March 1986.

While NWC was involved in the formulation and preparation of the project proposal, the general description of project sites, implementation activities, and respective responsibilities contained in the CARE/AID agreement was not completely acceptable to NWC at the time. Negotiations continued between CARE and NWC until October 1986, when the CARE/NWC counterpart agreement was signed. Since the CARE/NWC agreement is the more recent project agreement, it was used as the primary reference for project purposes, goals, and objectives reviewed in this evaluation. Significant differences between the two documents are noted, where appropriate.

According to the CARE/NWC counterpart agreement, the goals (objectives) of the project were to:

- assure the reliable provision of potable water to 26 communities;
- assist VWCs in those communities with planning, managing, and maintaining their water systems; and
- introduce a variety of nonformal training and extension activities related to water.

Specific activities to be performed to reach these goals included:

- de-siltation of two hafirs in the town of Mazroub;
- rehabilitation of 12 water-yards, including boreholes (and if this was impossible due to excessive deterioration, drilling up to a maximum of four new boreholes), and providing standardized pumping equipment and spare parts--24 boreholes were to be rehabilitated and three replaced;
- construction and/or sanitary rehabilitation of low-capacity systems (open wells) in 13 communities, installing handpumps where appropriate;
- introduction of sanitation measures at all water points, including well collars, taps, drainage-ways and simple practical rules for water collection;
- introduction of health and sanitary education at each site; and
- provision of assistance to local private workshops on the servicing and repair of handpumps to improve long-term maintenance capabilities.

The major differences between these objectives and those in the CARE/AID agreement were in the number of communities to be supplied with water, number of sources (particularly boreholes) to be rehabilitated in each community and specific technical training to be provided. The CARE/AID agreement specified that the project should

- establish 30 village water committees;
- provide 30 villages with water supplies of acceptable quantity, accessibility, reliability, and quality;
- provide assistance with water-yard design and management;
- help establish private workshops for handpump repair;
- "train a high-level counterpart to the Project Extensionist"--this was not mentioned in the NWC agreement and was not a part of the project;
- develop a nonformal curriculum for pump repair workshop management, finances, and techniques--this was mentioned only as "assistance to local private workshops" in the NWC agreement; and
- rehabilitate water-yards, though no specific number is given. This contrasts with the NWC agreement, which specified that 12 water-yards, most with more than one borehole, were to be rehabilitated, but the budget in the AID agreement includes funding for parts to rehabilitate 15 boreholes (the assumption being that each water-yard had only one borehole, whereas there are normally two and sometimes as many as four per water-yard).

No logical framework (log frame) per se was established for the project, so precise comparisons of planned and achieved objectives cannot easily be made.

It should also be noted that final site selection was completed prior to signing of the CARE/NWC agreement. In addition, it was specified in the agreement exactly what activities (borehole rehabilitation or drilling, equipment maintenance or replacement, etc.) would be undertaken by CARE and seconded NWC employees at each site.

According to the CARE/NWC counterpart agreement, IWP's purpose is to enable a number of water-poor villages in the Bara and En Nahud Districts of North Kordofan to satisfy their potable water needs. Implicit in both project agreements is the intent to increase the institutional capabilities of CARE, NWC, and local villages to plan and implement long-term, sustainable, water development projects. Thus, IWP was both a pilot project (building on the

experience gained by CARE during NKWSP) to develop CARE's capabilities for the implementation of water resources development projects and a continuation of the emergency relief efforts begun during NKWSP. As such, it provided an opportunity for CARE to

- continue to maintain an active presence in the water sector,
- make good use of available donor funding for drought response, and
- develop an effective water extension component that could be replicated by other PVOs (such as SCF) in current and future projects.

1.3 Evaluation Purpose and Methodology

The overall objective of this end-of-project evaluation was to provide CARE and USAID/Sudan with an assessment of the CARE Interim Water and Management Project (IWP) in terms of the achievement of project objectives, appropriateness of the project design, and suitability of specific activities in achieving its goal of increasing the quantity, accessibility, reliability, and quantity (QARQ) of the potable water supply for people in the villages of North Kordofan Province. Findings from this evaluation and a preceding project, the North Kordofan Water Supply Project (NKWSP), were to be used in a critical assessment of follow-on activities proposed by CARE in the water resources development sector in North Kordofan, as well as water-related activities in the upcoming Regional Finance and Planning Project (RFPP).

1.3.1 Purpose

This evaluation was requested by CARE Sudan as an integral part of project implementation. Specifically, its purpose was twofold:

- to evaluate IWP from a technical standpoint and conduct a process evaluation of water extension curricula/ planning currently being developed and used in conjunction with the project; and
- to review draft project proposal(s) for continued water development assistance to the Kordofan Region, beginning in 1988 and to offer a technical critique of the plan with recommendations for any modifications.

1.3.2 Methodology

The evaluation team consisted of Rick McGowan, the WASH team leader and water engineer, senior engineer for Associates in Rural Development, Inc., and Kate Burns, a public health specialist, CARE East African Regional Technical Advisor for Primary Health Care, Nairobi.

To involve CARE project staff in the evaluation and make it as collaborative as possible, the team and IWP CARE project staff met to discuss the project and the team's approach. The following methods, purposes, and/or objectives were suggested:

- compare planned and achieved objectives and provide explanations for any unachieved objectives;
- apply lessons learned from the evaluation to the design of upcoming CARE water (and other) projects and provide this information to other local PVOs working on water resources development projects;
- determine CARE's ability to design and implement water projects, thereby establishing viable credentials for new projects with AID and NWC;
- provide a stimulus to NWC, the Ministry of Health (MOH), and the Department of Planning for better approaches to planning more effective water projects, especially ways to increase community participation in project planning, design, and evaluation; and
- explore ways to encourage greater interaction between CARE and PVO projects in other sectors.

The evaluation team interviewed

- CARE IWP personnel;
- VWCs at village project sites;
- random groups of water users at project water sites;
- random groups of water users at non-project sites;
- NWC representatives (management staff as well as water-yard operators and clerks) at project and non-project sites and both regional and national management staff;
- CARE personnel from other projects in the area; and

- representatives from other PVO and donor groups working in the water sector--e.g., UNICEF and Save the Children Federation (SCF).

Finally, the team reviewed an extensive collection of project reports and related documents (see Appendix C).

The team leader arrived in Khartoum on 2 November 1987 and began assembling and reviewing relevant project documentation and conducting initial interviews with CARE Sudan personnel. Pertinent USAID mission staff and NWC personnel were not available during this period for initial discussions. The CARE Nairobi Regional Technical Advisor for Primary Health Care arrived several days later. She and the team leader then flew to El Obeid to interview CARE El Obeid project personnel and schedule the week-long series of field visits. The first day at CARE El Obeid was spent planning the course of the evaluation and, in conjunction with CARE field staff, the series of visits conducted over the following week.

Visits were made to:

- sites completed early in the project and those completed only recently, so that evolving differences in engineering design, extension program efforts, and community participation approaches could be noted;

- sites that represented the range of system types, including rehabilitated water-yards, open wells, open wells with handpumps, and hafirs (natural depressions modified to serve as rainwater catchment and storage basins) in order to assess the relative importance of each in the overall project;

- sites representative of both major geographic foci of project activity--the Bara and En Nahud areas; and

- non-project sites covering the range of technologies (water-yards, open wells, handpumps and hafirs) so that direct comparisons could be made about the impact of project water development efforts compared to pre-existing conditions.

On their return to Khartoum, the evaluation team interviewed USAID/Sudan personnel, NWC national staff, CARE Khartoum staff, and UNICEF and SCF personnel involved in water projects. During this period, the initial draft of this report was also developed. Debriefings were held with CARE and USAID personnel on 16 November, and the evaluation team departed the following day.

Chapter 2

PROJECT DESIGN AND IMPLEMENTATION

2.1 Project Design

IWP was designed as a bridge between drought-relief activities and long-term development initiatives. As such, IWP was not only concerned with long-term development of the water sector but, more importantly, needed to address a very critical shortage of water in the drought-stricken area of North Kordofan. Moreover, the project was designed as a pilot project to aid CARE in learning more about how to implement effective water development projects (and to complement its ability to supply emergency relief) and assure the sustainability of water systems in the region.

IWP had the opportunity to build upon lessons learned from CARE's earlier North Kordofan Water Supply Project (NKWSP) implemented from 1983 to 1985. NKWSP focused exclusively on the rehabilitation of diesel water yards. The NKWSP was evaluated (Bjornson 1985) and changes recommended for the follow-on project (IWP). The three major lessons emerged from NKWSP:

- Maintenance and repair of mechanized boreholes is very costly, and in most cases it is beyond the means of NWC to procure the needed spare parts and maintain the numerous systems in good operating condition. Limited foreign currency available to NWC makes importing adequate number of spare parts impossible.
- Diesel fuel is generally unreliable and often subject to high black market inflation.
- Poorly managed, high-capacity water-yards can generate desertification and severe land degradation due to overgrazing.

From this evaluation, CARE realized the need to broaden its water resources development activities to include assistance in low-capacity systems such as hand-dug open wells, handpumps, and hafirs and to de-emphasize borehole rehabilitation. IWP included these other water resources in its implementation. The one notable problem not addressed in the project design was long-term operation and maintenance (O&M) of rehabilitated systems. There was no clear plan to address the critical needs of fuel procurement, spare parts replacement, and overall infrastructure-building within NWC to allow villagers and NWC to work together to provide adequate operation, maintenance, and repair of the rehabilitated water-yards. This lack of a well-developed O&M component should have been addressed at the project design stage. The decision not to include such a component was largely due to the emergency relief nature of the project, pressures from NWC and USAID to provide water quickly, and the relative brevity of the project (18 months).

Also absent from the project design was the monitoring and evaluation of NKWSP water project sites. Monitoring these water systems would have provided important information on:

- sustainability and reliability of previous CARE rehabilitation efforts;
- how communities address water system management problems (to help in the development of the extension curricula in IWP);
- frequency and extent of fuel shortages, most frequent types of mechanical breakdowns, availability of skilled mechanics (from both private and public, formal and informal sectors); and
- cost estimates of long-term O&M expenses (to include in follow-on project budgets). This would have increased CARE's knowledge of how to better insure the long-term sustainability of rehabilitated water-yards.

Geophysical surveys and watershed and watercourse surveys were initially included in the project to provide information on potential water supplies for those communities located above the geological formation known as the precambrian basement complex. These surveys were meant to augment the Institute of Environmental Studies (IES) Baseline Survey conducted in 1982. They were not included in the NWC/CARE agreement and therefore were deleted from the project implementation plan. CARE's decision to eliminate the surveys from the project also stemmed from the change in the project's geographical focus, which came about during the site selection visits with NWC. Few sites were selected from the basement complex area. Therefore, the importance of watercourse and geophysical surveys was reduced.

The CARE/NWC agreement was not specific regarding the technical assistance expected by each party. The exact number and type of spare parts, diesel engines, etc. to be provided by CARE or the number of skilled and unskilled laborers to be provided by NWC could hardly be stipulated at the beginning of the project. However, responsibility for specific types of assistance critical to the long-term success of the project was sometimes stated in vague terms if at all. The most obvious example relates to O&M requirements. The CARE/NWC agreement states that CARE will be responsible for providing (among other things) spare parts, but does not say how many, when, or for how long CARE would be responsible for the rehabilitated systems until the NWC took over complete responsibility. Without these clear guidelines, it is difficult to determine when CARE would withdraw its support from a particular site and when NWC would take over.

Table 1

CARE Interim Water Supply Project - Actual Expenditures

Item	USAID	CARE USA	CARE Italy	CARE France	USA for Africa	TOTAL
Personnel	$126,951	$68,750	$0	$0	$0	$195,701
Materials & Equip	$467,313	$0	$20,000	$54,968	$9,481	$551,762
Vehicles	$0	$0	$0	$25,032	$36,848	$61,880
Vehicles Operation	$71,428	$856	$0	$0	$0	$72,284
Travel Allowance	$41,858	$2,533	$0	$0	$0	$44,391
Insurance	$2,064	$1,539	$0	$0	$3,671	$7,274
Office Operations	$36,142	$59,343	$0	$0	$0	$95,485
Office Equipment	$7,726	$4,182	$0	$0	$0	$11,908
Miscellaneous	$92	$0	$0	$0	$0	$92
Total	$753,574	$137,203	$20,000	$80,000	$50,000	$1,040,777
Overhead	$63,129	$0	$0	$0	$0	$63,129
GRAND TOTAL	$816,703	$137,203	$20,000	$80,000	$50,000	$1,103,906

Budget Summary By Donor	USAID Grant	CARE USA	CARE Italy	CARE France	USA for Africa	TOTAL
BUDGET	$816,000	$193,000	$20,000	$80,000	$132,000	$1,241,000
EXPENDITURES	$816,703	$137,203	$20,000	$80,000	$50,000	$1,103,906
BALANCE	-703	$55,297	$0	$0	$78,000	$137,094

Note: (1) Incorporated in USAID budget is local Sudanese Pounds equivalent to $66,000. Original USAID Grant was $750,000.
(2) USA for Africa has committed $135,000 of which $50,000 has been received.

2.2 Project Implementation

USAID/Khartoum, as the major financing agency, provided CARE with $750,000 and local currency in the amount of 165,000 Sudanese pounds (US $66,000 at $1=2.5 Sudanese pounds, the exchange rate at the start of the project period) for project implementation over the 18-month period. CARE USA contributed $193,000. CARE France and CARE Italy supplied $80,000 and $20,000 respectively. USA for Africa initially committed $132,000, but CARE had received only $50,000 as of November 1987. The total funds committed for IWP equal $1,244,000. A budget summary for IWP is given in Table 1.

NWC provided in-kind contributions of all equipment and parts remaining from the initial CARE water project in Kordofan. In addition, it provided technical counterpart staff (two extension workers and one graduate engineer), qualified and salaried construction crews, and regional workshop facilities and heavy equipment to rehabilitate the Mazroub hafirs.

Communities contributed unskilled labor crews to collect fencing materials and assist the NWC skilled labor teams. Communities also provided lodging and food to the teams during the construction stage. In at least two open-well renovations, the community contributed cash for the purchase of materials. This financial participation did not exceed 10 percent of the total material input to the renovated system.

The project was planned to run for 18 months. However, the USAID agreement signed in March 1986 and due to expire in November 1987 was extended. The NWC agreement signed in October 1986 is due to terminate in March 1988. The majority of the technical activities were complete as of November 1987. However, extension activities are still in progress and expected to be finished by late 1987 or early 1988.

The project targets changed from the USAID proposal to the NWC/CARE agreement. The USAID agreement states that 30 communities will be assisted in improving their water systems. The NWC agreement decreases this number to 26 because CARE initially planned and budgeted for one borehole to be rehabilitated at each water-yard. In reality, many of the water-yards in Kordofan have more than one borehole. After the site selection visits were completed in July 1986, CARE had a more detailed idea of the type of work that would be needed to improve each water-yard site. Therefore, the number of water-yards to be renovated was decreased from 15 to 12 to stay within the original budget for the project. In actuality, CARE completed renovations on 12 water-yards, which included the rehabilitation of 24 existing boreholes and the drilling of three replacement boreholes.

In the case of the low-capacity systems, there were also changes in the two agreements which stemmed from a misunderstanding of communities versus water points to be rehabilitated. CARE assisted eight communities with open dug wells. Seven new wells were dug, five of which were successful. The two unsuccessful wells were dug to a depth of 260 feet without reaching the aquifer. Nine open dug wells were rehabilitated. Three hafirs were rehabilitated in two communities. In total, CARE assisted 22 communities in improving their water systems. Additional targets and differences in the USAID and NWC agreements and the actual completion of these targets are given in Table 2. A more detailed summary list of IWP technical activities is given in Appendix F.

Table 2

Project Activity Targets (Planned vs. Actual)--
Differences between USAID and NWC Agreements

Activity	USAID Agreement	NWC Agreement	Actual Completed
# of communities to receive water	30	26	22
Systems Improvement:			
# of water-yards to be rehabilitated	15	12	12
# of communities to receive hand- dug well assistance	13	13	8
# of communities to receive hafir renovations	2	1	2
Training Curriculum:			
developed for mechanics	1	0	0*
# of workshops to receive training	3	ns	0
Extension Curriculum:			
developed in health and sanitation	1	ns	1
extension courses conducted	30	26	27
Watercourse/Geophysical:			
surveys conducted	1	0	0

ns = Number of sites to be completed not stipulated in the agreement.

* Handpump training was subcontracted to the existing UNICEF handpump program, thereby obviating the necessity of CARE developing a separate program.

The project experienced significant delays during the early stages of implementation due principally to high turnover in CARE/IWP project management and to the long delay in reaching accord on the project agreement with NWC. The IWP project manager changed three times during the early part of the project. The current project manager is a well-qualified graduate water engineer who had been working as the CARE water engineer. He became project manager in October 1986. The extension coordinator also was changed which thus caused a delay in the start-up of the extension activities until early 1987, four months after signing the NWC agreement and almost ten months after the USAID project start-up date. The extension staff, comprised of three males and three females, has stayed constant until just recently when one of the women left the project. The organizational chart for the project is given in Figure 1.

CARE/Khartoum provided assistance to the IWP staff for overall programming and implementation issues. It also established good working relationships with NWC in Khartoum and acted as liaison between the project and USAID. IWP was initially monitored under the Health, Nutrition and Population Office of USAID/Sudan but was later transferred to the Office of Engineering which provided technical support to get the project back on schedule. REDSO/ESA engineering staff also visited the project and provided assistance.

The IWP reporting system provided a wealth of information for this evaluation. Project records are up to date regarding technical and extension information. CARE's routine monitoring and reporting system, including the PIE (Planning, Implementation, and Evaluation) document done on a trimester basis and the Bi-Monthly Reports, provided good documentation on all aspects of IWP. The project manager also submits monthly reports to the regional NWC detailing technical activities during the month.

2.2.1 Water-Yard Site Selection

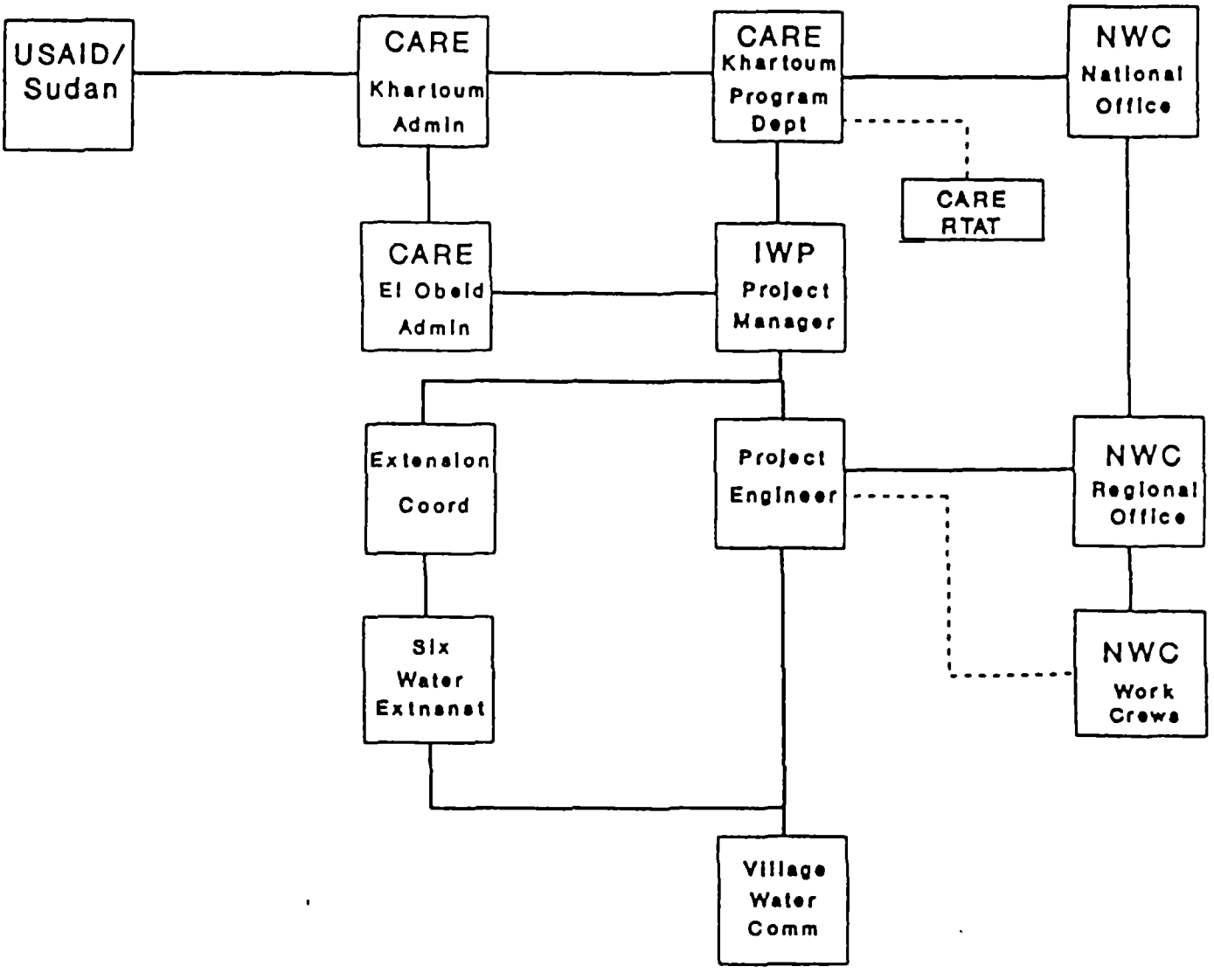
The method of selection of water-yard sites changed from the original design to the NWC agreement. Instead of choosing several sites and completing the construction in discrete phases in order to learn from each phase, NWC demanded that all water-yard sites be chosen prior to the signing of the agreement. Therefore, during July 1986, a team of seven people--made up of NWC regional personnel, Ministry of Finance and Planning (MFP), and CARE technical and extension staff--visited 23 potential communities to select sites for water-yards. The team visited Western Bara and Eastern En Nahud--districts where CARE has other development projects, such as Agroforestry, Women in Development (WID), and Primary Health Care (PHC). This region is also a focus for regional government plans.

The criteria for selecting sites was determined by CARE prior to the visits and included socioeconomic, environmental, and technical factors. Each site was evaluated with respect to current and potential water quality, accessibility, reliability, and quantity (QARQ). Socioeconomic and environmental factors included:

- identification of tribes, clans, population, and social relations;

Figure 1

Organizational Chart for IWP



- presence of settlements, transhumance, and nomadism;
- presence of routes of migration and history of land ownership;
- indications of social stability and community aspirations;
- assessment of alternative water sources within the area, their type, reliability and distance;
- economic activities, including off-season economic pursuits;
- existence of available/approved social overhead capital, especially government institutions;
- assessment of the ecosystem, extent of denudation, and environmental hazards;
- identification of possible linkages with other agencies and other CARE projects; and
- determination of community understanding of equity regarding the new water system and review of the community's history of self-help projects.

CARE/technical criteria for site selection were as follows:

- borehole should provide standard and acceptable range of water quality;
- chemical quality test should be certified by the Ministry of Health;
- borehole should provide a quantity of 900 to 1,200 gallons per hour (gph), or borehole yield should show a decline in productivity through the past years of operation;
- water-yard should be accessible to water-deficient villages with no (explicit) limitation on quantity drawn; and
- water-yard should be the only reliable and appropriate source of water in the vicinity.

Fifteen water-yards were recommended for consideration--seven from Western Bara and eight from Eastern En Nahud. The information gathered on this visit provided the details necessary for drawing up the NWC/CARE agreement. This agreement was not signed until October 1986. Negotiations caused considerable delay in project activities. Usually the NWC receives direct donor funding and has total control over the use of materials, vehicles, etc. Working with NGOs is rather new to NWC, and the issues of management and control of resources are different. The NWC/CARE agreement, therefore, is considered a ground-breaking exercise for NWC, and could serve as a model for other NWC and NGO agreements.

2.2.2 Low-Capacity Systems

CARE criteria for communities to be selected for open wells included:

- low-income, permanently settled communities with insufficient water, striving to construct or complete construction of an open well using their limited resources;
- communities with unreliable open wells that are not deep enough to reach the aquifer in the dry season;
- communities with schools, health units, and other institutions dependent on water;
- water-yard satellite villages where yard will be rehabilitated by CARE, thus decreasing the demand on the water-yard source;
- communities demonstrating commitment to participation in the water program, as evidenced by a history of self-help projects;
- communities generating income and exploiting agriculture potential;
- communities that are centers for several satellite villages;
- areas free of tribal conflict; and
- sites which are readily accessible by CARE in terms of logistical support.

Eight communities were selected using these criteria. Seven new wells were dug, of which five were successful. Nine open wells were rehabilitated, and handpumps were installed on two open wells. At one site where there was only one water source, the handpumps were later removed from the well due to the

community's fears that it might not have adequate access to water should the pumps fail. This indicates that if there are handpump components in future water projects, only sites with more than one water source should be considered for handpump installations.

Three hafirs were rehabilitated in this project, two in one community (Mazroub) and one in Umm Dubban. Criteria for selection of this type of system were not predetermined. In one of the two hafir sites, CARE had no role in selection as it was specified by NWC. This proved to be the most problematic site in the project, due to the sociopolitical and cultural heterogeneity of this community. CARE realized early that political infighting in the community was causing construction delays. After repeated attempts to solve the problem, CARE was forced to withdraw extension activities until local leadership problems were resolved. Construction activities were eventually completed, but the hafir has not been used as it was designed due to continuing local management problems. Clearly established hafir selection criteria, jointly agreed upon by CARE and the NWC, are needed in the future to prevent the occurrence of this sort of situation.

2.2.3 Community Participation

Community participation in IWP has evolved over the course of the project. While extension activities were largely ignored during the first eight months of the project, they have developed rapidly since that time. The community is primarily responsible for providing unskilled labor for the construction phase of the project and logistical support to the construction teams. The communities were generally not involved in the site selection process per se, especially regarding water-yard selection or the specific type of assistance to be provided at a particular site. The type of technical assistance for water source development was decided upon by the water engineers from CARE and NWC. Since most of the work focused on rehabilitation of existing systems, the intended assistance was generally clear to the communities. However, community expectations did differ from project intent in some instances, such as when communities expected that they would receive a new water storage tank as part of the rehabilitation.

In terms of the specific design of water-yards (size, numbers, and location of taps and animal watering troughs, size and location of animal and human water access areas, etc.), communities were generally not involved in the design prior to construction, especially in the earlier phases of the project. It is likely that villagers could have provided some useful ideas had they been asked. Toward the end of the project, once the extension team was in place, communities did become more involved in the design of their systems. They appeared to appreciate this involvement, although requests for assistance (new boreholes, new tanks) were usually greater than what CARE was prepared to provide.

During the construction phase of the project, the communities did participate in providing unskilled labor and logistical assistance to the construction teams. There were no cases of communities reneging on their commitments to assist in the construction phase. The roles and responsibilities of the

different participants (community, CARE, and NWC) were discussed informally prior to initiation of activities in some communities, but in general during the early portion of the project, due to the delay of getting started and the pressures to finish the work as soon as possible, communities were often poorly informed as to the roles and responsibilities of each party. Communities most often donated labor for the collection and installation of fences and to assist the construction teams when and where possible.

During the post-construction phase, communities willingly participated in the extension lessons provided for the women's groups and village water committees.

In general, the communities did not contribute cash for the water system improvements, nor were they requested to do so. For one hand-dug well in El Zoom, the community supported the work crews but did not contribute material. However, at a site being improved recently by CARE under separate funding, the community was willing to contribute 6,000 Sudanese pounds toward the cost of the work. This sum represents approximately 10 percent of the total materials and equipment cost for digging a new well. From this example, it does appear that communities are willing to contribute to water system rehabilitation, and CARE will need to decide if cash contributions should be encouraged in future water projects.

The IWP experience seems to indicate that a higher level of community participation occurs in smaller project sites, where the population is more homogeneous. One of the site selection criteria was the absence of tribal groups that conflict over the leadership and control of water source management. In the three larger rural council towns (populations greater than 10,000) that CARE assisted, VWC involvement in management and decision-making for the water-yards is considerably less than in small villages. This is due mostly to involvement of the local government authorities in decisions about management of the water-yard, and to the disposition of revenues. In most smaller villages, the self-help funds generated by the sale of water are in the control of the VWCs. In larger towns, rural council authorities dictate the use of self-help funds. Therefore, funds for routine operation and maintenance are sometimes caught up in the local bureaucratic machinery.

For each diesel water-yard, there is an NWC clerk to collect fees and an NWC operator to operate and maintain the equipment. Since the mid-1970s, rural communities have placed a community member as a counterpart to the NWC clerk. In some communities there is also a community counterpart to the NWC operator. While this arrangement has increased the communities' ability to monitor the water-yard operations, it is dependent on the relationship between the local NWC personnel and the community. If the relationship is based on mutual trust, the community then feels it has a greater understanding of and participation in the management of the water-yard, especially supervision of the revenue collected. If not, then system management and the distribution of revenues are brought into question, and the community feels uninvolved and uninformed.

CARE cannot formally influence the structure of the relationship between the local NWC and the community. CARE has attempted to build awareness and disseminate information to both sides about the roles and responsibilities of each, and to assist where possible in improving this relationship. But the relationship between the community and NWC will not improve unless clearer guidelines are established as to the roles and responsibilities of each. Community participation workshops would likely help to develop such guidelines. The communities visited during this evaluation continuously requested assistance in formalizing these responsibilities and the mechanisms for their implementation.

The advent of CARE's assistance in water resource development in North Kordofan creates another actor in the field, which sometimes causes confusion to both NWC and the community. It is understood by the communities that the water-yards are owned by NWC and that the assistance given by CARE is through NWC. However, it appears that the communities sometimes transfer their expectations and demands to CARE, hoping that CARE will supply the much-needed long-term technical assistance and materials that NWC cannot. The communities do not seem to have a clear picture of what CARE can provide or when CARE's responsibilities in a given community will end. The policies of NWC toward participation in water-yard management definitely dictate the extent to which CARE can involve the community in overall management of the community water systems. NWC says it wants the community to be involved in some of the day-to-day management of the water-yards, such as setting rules and monitoring appropriate use of the system, but NWC does not want the communities to continue to receive revenue from water, or to be involved in any technical matters such as maintenance and routine repair. From discussions with the national and regional NWC authorities, it appears that community involvement in management of the water-yard, especially in revenue allocation, will decrease over the next few years. CARE will need to keep informed of this change and adjust its interventions accordingly.

Chapter 3

ENGINEERING AND CONSTRUCTION*

Diesel water-yards consist of a diesel engine, reciprocating piston pump, storage tank, distribution lines, taps mounted on filling benches, watering troughs for animals, thorn (and sometimes barbed wire) fences, and a sectional layout to separate human and animal users. Boreholes are usually 200 to 250 feet deep, with four- to six-inch casings. Water is usually stored in 12,000-gallon tanks of varying height and condition.

There are usually between two and four boreholes (drilled wells) per water-yard. Not all are necessarily equipped with engines and pumps. After drilling, some are simply cased, capped, and left for future use. As a rule, CARE activities focused on water-yards with two existing boreholes (at two sites there were as many as four). According to the CARE/NWC counterpart agreement, CARE was to drill several new boreholes where rehabilitation of existing boreholes was not feasible.

There are two types of open wells found in the area--lined and unlined. The former are concrete-block lined and are sometimes flush with ground level (hence dangerous to children, animals, or people walking at night). They usually have well collars and concrete aprons for drainage. While pulleys or winches are occasionally used to facilitate water lifting, more commonly, tree trunks against which ropes can be pulled are mounted over the well opening. The wood is usually deeply grooved from rope wear. The wells vary in depth from 50 to 270 feet, and generally have a capacity of less than two cubic meters of water per hour.

Hafirs are natural depressions modified to increase rainwater catchment and storage capacity. They are used in areas where the soil has a relatively high clay content and are sometimes polyethylene-lined. Although most hafirs are poorly fenced, if fenced at all, newer ones usually have thorn and/or barbed-wire fences around them to prevent animal or human access and subsequent contamination. Instead, water is piped (but not usually pumped) to shallow wells just outside the hafir perimeter for user access. Hafir capacity ranges from about 5,000 to 50,000 m^3. The water is usually of poor quality in regard to total dissolved solids (TDS), and when hafirs are not adequately fenced the water is polluted by people and animals walking into them to get water.

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* All gallons mentioned here are Imperial gallons (IG), where one IG equals 4.55 liters.

Cisterns are used in areas where water is not available or is available only on a seasonal basis. Cisterns are usually hand-dug and lined with concrete blocks and mortar. Water is carried to the cisterns by truck or donkey from a distant water source and stored for use. In some villages, cisterns are not only for private domestic use, but are also kept by merchants who purchase the water from a transporter and store it for later sale to villagers. CARE did not focus on cistern development or rehabilitation during IWP. Therefore, this evaluation does include cisterns.

3.1 Major Equipment for Water-Yards

The standard NWC diesel engine (at least in the Bara and En Nahud areas of North Kordofan) is the Lister 8-1 (or Indian versions of the same engine). These are slow-speed (650-800 rpm), single cylinder, 6-8 rated horsepower, water-cooled engines with average fuel consumption rates of about 0.5 liters per hour. They are usually operated between 4 and 24 hours per day. The expected useful lifetime of these engines is approximately 10 to 20 years (assuming major overhauls every 2 to 4 years). Some existing units are now over 40 years old. Yugoslavian Torpedo pumps were also in evidence at the NWC workshops, but only one was seen in operation at a water-yard. Since the withdrawal of donor support for these engines, parts have become increasingly scarce, and few are still in operation.

The standard NWC pump in the project area is the Edeco reciprocating piston pump (versions MK3 and MK3M) from the United Kingdom. These large but sturdy machines are particularly appropriate for pumping relatively small quantities of water (less than 100 m^3/day) at high heads (greater than 50 meters). Because NWC is concerned about the increasingly high cost of the Edeco pumps (largely due to the fact that they are specially made to order for NWC, since few others use them now), it is reconsidering its equipment standards for pumps. In discussions between senior NWC officials and the evaluation team, the possibility of using Mono pumps was discussed at some length.

Some Monos have been used (with variable success) in Sudan, and the NWC personnel expressed some reservations. Monos have been used with considerable success in countries with pumping conditions similar to Sudan (e.g., Botswana), specifically with the NWC standard Lister 8-1 engine. Monos are very tolerant of wide fluctuations in head (i.e., in low-yielding boreholes common in Sudan), very robust, and considerably less expensive then the Edeco. The evaluation team recommended that discussions be initiated between NWC and Mono to determine the costs and appropriateness of using Monos on a larger scale in Sudan and to determine the cause of the problems experienced with the Monos already installed in Sudan.

Water storage tanks are usually made of sectional steel. Capacity varies, depending on the number of sections used, but is most commonly 12,000 Imperial gallons. This is based on a pump output of 1,200 gallons per hour operating over a 10-hour day and so provides about one day of storage. The tanks are sometimes on concrete piers, but usually on steel towers of widely varying height, most commonly 6 to 12 feet. Low tanks cause inadequate water pressure in taps and troughs. Tanks were not included in the overall CARE water-yard rehabilitation, except to be painted and welded as necessary. Tanks at

non-project sites visited by the evaluation team were often very leaky and appeared fragile. According to NWC, the tanks have an expected lifetime of 10 years, but those at non-project NWC sites are often older than 20 years. The evaluation team believes that CARE should, in future projects, rehabilitate or replace tanks as required. Leaving a marginally adequate tank in an otherwise completely rehabilitated system seems shortsighted.

Initially it was proposed that subcontracts be let to private-sector firms to do the the civil works construction at all water-yards and open wells. At the request of USAID, CARE solicited and reviewed a number of bids from local private-sector contractors (all based in Khartoum), and found that proposed costs would be on the order of double what NWC was prepared to charge for its services. The private-sector initiative was dropped soon thereafter. The primary reason for the high bids is that none of the contractors had established offices in the El Obeid area, and all of them were including the necessary mobilization costs of getting their equipment and crews from Khartoum out to the project area. NWC, on the other hand, already had established crews and equipment in the area.

Construction crews typically camped on site until construction was completed, then moved on to the next site. The crew foreman or supervisor was always on hand during construction, and sites were visited by the project engineer and project manager (also an engineer) at least weekly and usually more frequently.

When considering water-yards, if possible, it is best to avoid selection of sites where new boreholes must be drilled to replace existing ones that cannot be rehabilitated. Because NWC has drilling rigs but insufficient pumping equipment, it has already drilled considerably more boreholes than it can currently equip with existing inventories. In addition, the drilling rig purchased by CARE during NKWSP does not currently have the compressor required for borehole cleaning after drilling has been completed (although apparently one is being mounted on a trailer to be hauled behind the drill rig).

At one site (Saata Bertilla, where there are now four boreholes--two rehabilitated, one newly drilled, and one abandoned for low yield), in spite of the fact that the project has drilled one new borehole and equipped it with a completely new pump and engine, no water is being pumped because the CARE drilling rig had no compressor. CARE has subcontracted to a French firm, BRGM, to clean the borehole with its rig when it arrives in the area. The villagers in Saata Bertilla find it difficult to understand why all the effort was put into this one installation and yet no water is being pumped.

3.2 Water-Yard Layout

Water-yards are normally comprised of two to four sections--for people, animals, nursery/garden, and pump house. A schematic diagram of a typical water-yard is given on the following page. Water-yards rehabilitated by IWP always have separate sections, at least for access by people and animals. Fences were installed at all project sites, but there are few if any at non-project sites (or they had deteriorated to the point of not being useful). Fences at project sites consisted of steel fence posts, two to four strands of

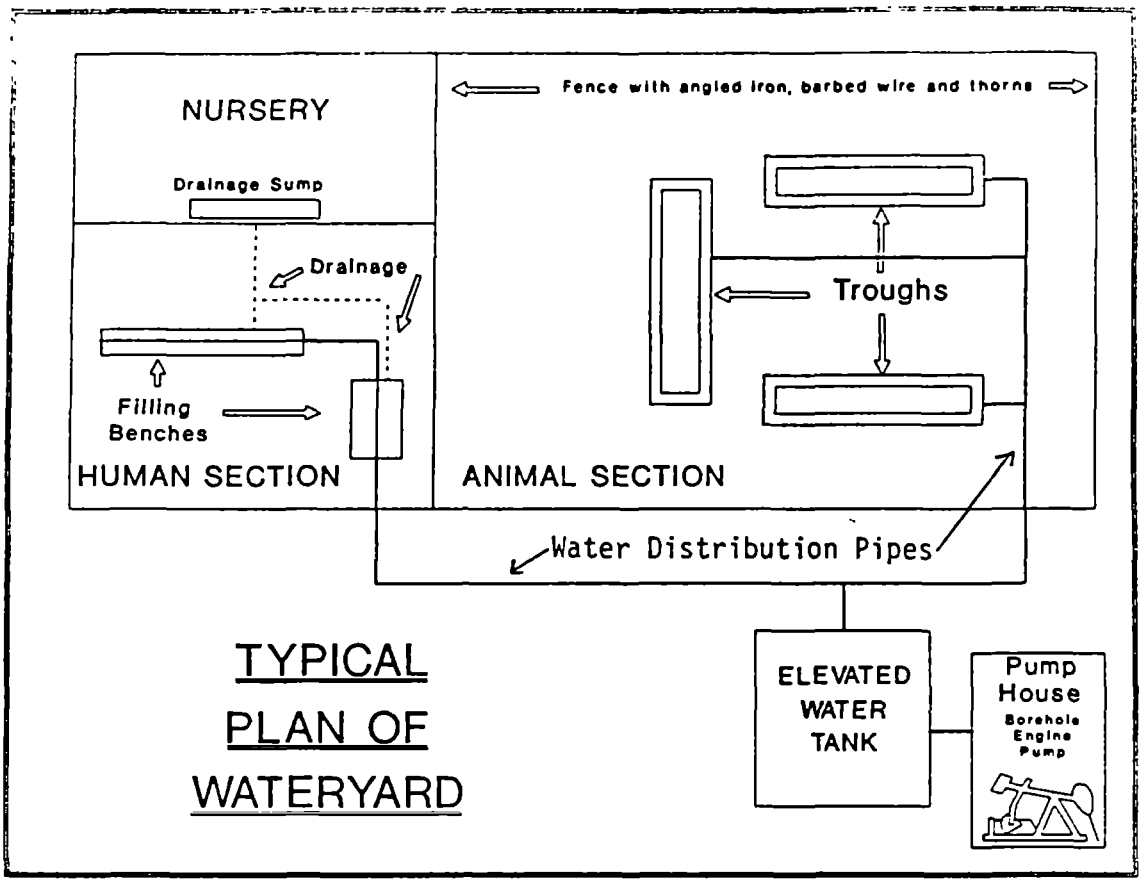

Figure 2. Typical Plan of Water-yard

barbed wire, and thorn-tree branches stuck in the ground and sometimes wired together. Newer fences, built later in the project, tended to be much more robust than those built earlier. Distribution systems usually consisted of three-inch steel pipes from the storage tank, through a covered (and usually locked) water meter, to the taps on the filling benches and the animal-watering troughs. The smaller sites usually had two water-filling benches. One was a raised concrete platform about waist height (so that women could easily place and remove water containers) with six taps. The second was a low concrete trough/bench whose bottom was at ground level. These low benches had six taps so that children could more easily fill containers. People commonly used jerry cans (four-gallon plastic jugs with lids), sewn and sealed goatskins, and sewn rubber bags (carried like saddlebags on donkeys) with rag-filled spouts. Taps were designed (height, diameter) for use with these typical containers.

Some larger sites (e.g., Um Kredium) also had a third filling bench for commercial vendors, who would fill donkey-mounted rubber bags for resale in town. Hoses inserted into the 3/4-inch brass taps were used to fill the rubber bags. Where this occurred, there were usually considerable (roughly 25 percent) losses, made obvious by the muddy areas around these filling benches. The open ditch drain in this case flowed back through the people's side of the water-yard enclosure and to the garden drain on the outside fence. In all

cases, drains (usually partially buried pipes but occasionally open ditches) carried wasted water outside of the enclosures, most often to a sump tank for garden use. Sometimes a second drain went to an open puddle where animals drank. The evaluation team recommends that this last feature be avoided in the future.

At no sites were off-site distribution points provided, even though there was considerable pressure to do so in some places (such as Mazroub). NWC officials suggested that in future projects distribution points might be provided at schools, clinics, and police stations. Since funding is inherently limited, installing off-site distribution taps will undoubtedly cause considerable argument about the number and placement of distribution points as well as requiring considerable additional pressure head (higher, more expensive towers) to insure even and adequate water distribution from the storage tank. The intent of the project is to make water available, not necessarily to make it convenient. It is recommended that the project continue this practice of focusing on the basic provision of water. Incurring the additional cost of wider distribution at each site would necessarily reduce the number of sites at which basic water provision is possible.

The animal yards had from two to six troughs. Animals were kept in generally well-defined groups, either inside the enclosure waiting their turn or outside if the enclosure was full. This evaluation was conducted during what is normally the lowest demand time of year, not near the end of the dry season when other natural water sources are least available. During that time, human and animal pressure on water-yards peaks and, from user observations, chaos reigns.

Many of the water-yard rehabilitation sites were also sites for the CARE agroforestry project. In these cases, there were nurseries and/or gardens with both small vegetable plots and seedling nurseries, sometimes equipped with overhead shading. Vegetables included tomatoes, aubergines (eggplant), lettuce, and okra. Trees included hashab, neem, and occasionally other types. Plants were watered with wasted water overflowing from the filling benches. Gardens were usually basin- rather than furrow-irrigated. Villagers often expressed considerable enthusiasm about cash income as well as consumable produce from the gardens. Community participation workshops would likely help to develop such guidelines. Expansion of the garden had already taken place at one site, and further expansion was planned.

In general, the design of the water-yard layout seemed very reasonable. Villagers and VWC members frequently expressed satisfaction with the design and occasionally had suggestions for further improvements. It would have been useful to include villagers in decisions on water-yard layout and design. Not only would it have made them more interested in helping with the project, but they no doubt could have provided some useful suggestions for improving design. One of the design changes that occurred over the life of the project was the decrease in water losses due simply to lowering the height of the water taps so that they would be only about one inch instead of 8 to 10 inches above the jerry can spout, reducing splashing, wind effects, and actually saving 10 to 20 percent of the water used to fill those containers. At one site (Um Sot), people had hoses connected directly to the taps so that pressurized water was used for watering the garden. This practice should be discouraged, since it may lead to additional problems with NWC clerks about water which must be paid for versus wasted water.

Chapter 4

EXTENSION ACTIVITIES

The extension component of IWP was designed as a pilot activity. As such, it has been a rewarding process and provided insights that have led to considerable useful knowledge for CARE staff at the project, national, and regional level. Lessons learned from this experience have positively affected decisions regarding project design, site selection, and project implementation for CARE's continuing presence in water resource development in the North Kordofan region and are filtering down to other CARE water projects in East Africa.

Delayed until January 1987 due to staffing problems, the extension component has had a relatively short time for designing, pre-testing and implementing the extension strategy in the project areas, but to date it generally has been very successful in its endeavors. In brief, this strategy has concentrated on the post-construction phase of the project cycle and has two major target groups: the all-male VWCs and a self-selected group of village women. IWP has three extension teams, each comprised of a male and female extension worker. These teams are managed and supervised by a male extension coordinator. All of these staff spend approximately 20 working days a month in the field.

As the post-construction extension activities became well established, the staff began to work more closely on strategies for the pre-construction and construction phases. These two phases have received less attention due to the delay in getting the extension program started, but IWP staff have articulated activities for each of the phases.

Pre-construction is considered an information-sharing and awareness-building phase. Extension staff work with technical personnel to review the proposed technical rehabilitation and work with the community, especially the VWC, in identifying roles and responsibilities of all parties in the design, construction, and supervision of the new water system. Extension staff also take the opportunity to learn what the community's expectations for the project are and which among these are to be met by CARE's proposed assistance.

The construction period is seen as a community-mobilization phase. Extension teams work jointly with the community and the technicians to mobilize community labor for construction activities. Post-construction is considered the educational phase. At this time extension workers conduct ten lessons for each of the target groups. This phase lasts for five to six months during which the team visits the community twice a month.

Objectives of Extension

In the initial USAID/CARE project document, two intermediate goals were established as a guide for the design of the project's extension component:

- Self-managed water committees were to be created in all project sites. These committees would not dissolve at the completion of the construction or rehabilitation phase of the project but would continue to manage the resource, hold meetings, and sensitize the population to its responsibility in managing its improved water source.

- Shelters, protective barriers, and/or rules and regulations for use would be established at all sites so that the water produced at the source remains potable.

With the assistance of a short-term community education specialist, the extension component objectives were further defined as (1) to enhance the local capability of managing and maintaining improved water systems, and (2) to promote better water-related health and sanitation practices in village households.

The results expected from these two objectives were more specifically stated as:

- improved personal hygiene and community sanitation;

- greater care in collection, transport and storage of water;

- a reduction in water-related diseases;

- better management of animals at the water point;

- improved safety and convenience for water drawers;

- more resourceful use of wasted water;

- a clearer picture of the role of water points in desertification; and

- a more self-reliant attitude about upkeep of the improved water system.

4.1 Creating the Extension Teams and Conducting In-Service Training

Prior to the start up of extension activities, the extension teams underwent an intensive training workshop. This workshop was held in February 1987 and consisted of an intense review of objectives, training in extension techniques, and pre-testing of the proposed education lessons. A community survey had been conducted prior to this training and formed the basis of the educational messages developed.

Women and men in Kordofan usually do not interact in a formal sense. Trying to establish integrated committees is against cultural norms. Therefore, the IWP extension component was designed to involve women in the project, but as a separate focus group. Extension teams were thus created and trained with one male and one female extension worker, each concentrating on their particular target group. Though much of the content of the extension and education lessons are duplicated by the team members, it is not possible for a male extension worker to teach women or vice versa.

4.2 Needs Assessment

Extension workers conducted a needs assessment survey in a few villages prior to developing the education lessons. This survey was general in nature and gathered information on the socioeconomic and cultural make-up of the community. The survey also elicited from village women their community's most common water-related health problems. The survey was not a true needs assessment for all health problems. It was too general to gather hard data on health problems and as such does not provide useful information for the project. This specific survey tool will need revision if it is to be used in the future. Specific objectives for its design, implementation, and use will need to be better defined if useful data are to be collected. Village men and women could be encouraged to take part in this data collection exercise so that they have a clearer understanding of the health and sanitation situation in their villages.

4.3 Curriculum Development and Design of Visual Aids

Ten lessons for each of the two target groups (men and women) were developed and pretested, and large flipcharts were created to support each lesson. The lessons are sequential in nature; successive classes build on the learning from the previous sessions. The lessons focus on changing attitudes and motivating certain behavioral changes. The following topics are included for the women's group:

- disease transmission and illness;
- how to avoid disease through personal hygiene;
- careful use of water;
- etiquette at the water source;

- water in the kitchen;
- other uses of water in the home;
- water as medicine;
- traditional methods of water purification;
- water and diarrhea; and
- water and malaria.

Topics for the male water committees' lessons include:

- village water committee procedures;
- water supply--rules and regulations;
- routine maintenance and minor repairs;
- financial control of water-yards;
- sources of water;
- desertification--causes and consequences;
- village sanitation;
- water-yard nurseries;
- wells and handpumps; and
- health and sanitation.

A local artist was employed by the project to develop visual aids for each lesson. He drew a series of flipcharts for each lesson. These were tested in the field, and necessary changes were made. The artist than drew three copies of each set, one for each extension worker. The flipcharts were covered with heavy plastic and thin strips of wood were affixed around the border to make them more durable. The use of a local artist and all locally available materials proved to be both cost effective and appropriate for the project. The cost of professionally printing color posters is extremely high in Sudan and would seem a waste of precious resources when locally available materials and people can be used with the same and perhaps better results.

4.4 Target Groups

IWP created the women's groups who would receive the 10 lessons in a rather novel way. Criteria for selection in this group were broad and included any woman with young children and no two women from the same house compound.

Women in the village with the water system were asked to volunteer to participate in the lessons. Groups were kept to 20 to 30 women per village. In some larger villages, two groups were formed and lessons given to each. On the day the extension worker arrived in the village, all households of women participants were visited to observe directly what behaviors were being adopted, to reinforce messages, and to build a good relationship with each woman. The lessons were then held in the late afternoon in one of the participants' homes. On each subsequent visit, the lesson was held in a different household.

The scope of this evaluation did not permit an in-depth study of the impact of the lessons on the two target groups. However, from observations gathered during the field visits and during visits to a few homes of women participants, it appeared that women were very pleased with the lessons and were able to explain in detail what they had learned. The attention the extension worker gave these women during the five- to six-month series was unprecedented in these small rural villages. The male leaders of the community expressed their approval of the lessons for the women and noticed positive changes in the household, especially related to cleanliness of the home.

In addition, since the classes were limited in number and not all the village women could participate, there was evidence that participants shared information from the lessons with non-participant women. Due to the strong social bonds of women in the villages, educational messages from the lessons seemed to permeate a good portion of the village. Satellite communities most likely did not gain from this sharing. More intensive surveys would need to be done to understand the way the messages are shared in the different communities served by the water system.

The male-focused lessons were given to the established VWCs. Other village men usually joined this group. On rare occasions, men from satellite communities participated. Satellite villagers were not represented on the VWC for the site village. At many village sites, the VWCs established sets of rules and regulations which were enforced by levying fines on violators. The evaluation team was shown VWC records at several sites, including both financial records of expenditures as well as detailed minutes from the periodic VWC meetings. Since the team did not formally meet with VWCs at non-project sites, it is difficult to compare the two groups in terms of organization and the impact of the extension lessons. There was, of course, the obvious evidence obtained from examining the condition of their respective water-yards, considering the areas over which they had control.

4.5 Gala Days

Another creative way to increase interest in and awareness of water-related issues used by the IWP extension teams was a "Gala Day" event. This one-day affair was held in a community with a recently rehabilitated water-yard after all extension lessons had been completed. The extension team worked with local villagers, especially schoolteachers and youth groups, to prepare the Gala Day festivities. The activities included puppet shows, presentations of lessons, demonstrations of technical materials and spare parts, drama and

poetry contests based on the theme of water, and local cultural handicrafts and sporting events. Satellite communities and local officials were invited from the nearby area. IWP held four such events in the project area. On average, several hundred people participated in each of these events.

The Gala Days were launched to try and disseminate information similar to that given in the lessons to a wider audience, with specific focus on the satellite communities. Again, it was not possible to measure the impact of this type of educational strategy during this evaluation, but some observations were made. As the Gala Days progressed, the IWP extension team realized the need to have greater participation by the community in the event. At the last Gala Day, for example, instead of the female extension workers giving the lessons, village women who had participated in the ten-lesson series acted as teachers to Gala Day participants. Extension workers stood by to answer more difficult questions. It was amazing to see a young village woman stand up in front of male leaders and give one of the lessons she had learned. The status of women in the eyes of the male villagers seemed to have improved.

High-technology equipment, such as generators, movie projectors, and slide shows, was used in the planning of the first Gala Days. IWP staff realized that this type of technology was not sustainable by the community and tried to return to simpler technology, more appropriate lighting and sound systems. Unfortunately, a precedent had been set in the project area, so that all communities wanted the "high-tech" approach. The use of high technology for future Gala Days should be reviewed and the community brought into the decision-making process.

The main outcome of the Gala Day activity seems to be the creation of a cohesive community, including all the satellite villages that use a common source of water. This event cannot replace the intensive five- to six-month series of lessons provided the central community where the water source is found. Greater participation of the villagers in the design and planning for the event does have a positive outcome. Whether the community can or will replicate this type of event is questionable.

Planning for and implementation of the event, however, does give the villagers some organizational skills that could be used for future events. In addition, the assistance of the extension workers in helping the villagers use local drama and poetry as a means to disseminate information has been reinforced in this exercise, and this input could be one of the most important benefits of the Gala Day event. Pre- and post-Gala Day meetings should be held with the villagers to explain the objectives of such an event, review lessons learned from the activities, and explore how the community intends to use this type of event in the future.

4.6 Supervision of Extension Activities

The staffing pattern for the extension component of IWP is such that there is one supervisor for all the teams. Since this person is a male, he cannot actively supervise the women's extension activities as well as he can the men's VWC lessons. The IWP staff recognizes this weakness and plans to include a female extension supervisor in the future. Another way to achieve

this would be to have a rotating supervisor among the teams. Colleagues would monitor and supervise each others' work, thus breaking up the monotony and the work schedule and allowing for internal monitoring of the quality of work performed. Monthly meetings are held in El Obeid for review of activities, in-service training, and planning the upcoming month's schedule. These monthly meetings, called mini-workshops, are an effective way to coordinate activities, share information and lessons learned among extension workers, and adapt program implementation strategies accordingly.

The reporting and documentation of extension activities are very complete. Trip report forms are completed after each visit to a community and placed in the project file. The extension coordinator reviews these reports on a regular basis as a means of monitoring and supervising his teams. The quality of these reports improved once it was decided that the extension workers would report in Arabic rather then English. However, the reports are still general in nature, reporting on whom the extension worker contacted, what activities took place, and the dates of the visit. These reports could be even more informative if the worker was encouraged to answer a few specific questions related to a visit, such as:

- What specific activities were successful, and what would you do differently next time?
- Which activities were not successful and why?
- What follow-up activities are needed in this community? By whom and when?
- Are there any problems in the community? If so, what plans are needed to address these problems?
- List one thing you want to share with your fellow extension workers that may help them improve their extension skills.

This format is copied from the CARE Sudan bi-monthly reporting system, which aims at assisting project workers to focus their reporting on specific questions rather than giving a complete description of everything that took place on a field visit. Another method of achieving the same objective is the use of field diaries. Workers could keep daily records based on similar questions. These diaries would then be reviewed by the supervisor on a routine basis and shared during staff meetings.

4.7 Monitoring and Baseline Data

As the extension lessons were created, evaluation indicators of behavior change were developed for each set of 10 lessons. Baseline indicators were collected from each of the women's households and from the community for the men's groups. There were 35 indicators for the men's lessons and 30 for the women's groups. Individual household information was compiled to provide the

baseline data for the whole village and given as a percent of all households exhibiting a particular behavior. Women's group indicators were divided into the following areas: collecting water, storing water, personal hygiene, food hygiene, and household sanitation. VWC indicators were divided into four areas: efficient conduct of committee business, management and maintenance, sanitation at the water point, and constructive use of water (see Appendix E for sample indicator lists).

The indicators were supposed to be quantitative and observational in nature, but some proved to be impossible to measure with any accuracy. The indicators for the VWC are easier to measure because they can be observed. The presence or absence of a village nursery or proper drainage at the water point is much more easily observed than whether people are washing their hands before eating or houses are cleaned on a daily basis. Due to the subjective nature of some of the indicators, no change in behavior was noticed from the baseline information to the follow-up data collection. IWP recognizes the difficulty in measuring these behavior changes and has set out to modify the indicators. The intent to establish measurable indicators of change for the education program is a good one.

More intensive training of the extension workers in collecting the information at both baseline and follow-up is needed to assure the accuracy and reliability of the data collected. Colleague supervisors could have this activity as part of their job description in the future. In addition, village women should be included in establishing the evaluation indicators for each lesson.

4.8 Sustainability of Extension Activities

The main purpose of the extension and education lessons is to teach the participants some ways to improve their lives. This is done through dissemination of easily understood messages and demonstration of practical activities such as cleaning water storage containers and regulating the use of water at the water point. Thus the lessons aim to enable the participants to understand certain relationships between behavior and health and disease and to take the initiative to change certain behaviors, decreasing water wastage and water-related diseases.

The question arises as to whether the extension lessons, as they are currently given by the IWP extension workers, are sustainable. The answer to this question is most likely "no." The IWP, while coordinating with NWC on technical activities, has little coordination with NWC or the Ministry of Health in the extension component. There was an attempt on the part of IWP to have seconded staff from NWC and the Ministry of Health, but only two of the six extension workers were seconded from NWC. No seconded staff were obtained from the Ministry of Health. However, seconded personnel alone are not enough to make such an intensive health education program sustainable. The few health workers that exist in these rural communities have been asked by the IWP staff to be involved in the lessons and have done so willingly. However, due to the curative health focus of these workers and the lack of salary incentives, it is not possible to expect them to conduct these lessons without the continued support and supervision of IWP staff.

The more important question is whether the lessons as such can be replicated, thus expanding the audience, for example, to the women of the satellite villages. The IWP extension teams cannot continue to replicate these lessons in a particular village due to the number of project villages, and have thought about training short-term local volunteers to repeat the lessons to other women in the area. This would depend on the motivation of the communities, and the interest they may have in replicating the extension lessons to a greater audience. IWP will need to review the strengths and weaknesses of existing projects in Sudan that have included training of village volunteers. Planning to sustain the lessons as given by IWP for the long term may not be practical or appropriate. Short-term replicability is perhaps more easily accomplished and results in dissemination of the messages to a larger number of people. Existing government structures, such as NWC or MOH, cannot be expected to sustain such activities.

4.9 Cost-Effectiveness

The extension component of IWP is estimated to consume 10 to 15 percent of the total project budget, the most expensive items being vehicles and their maintenance and operation. The extension component has four four-wheel-drive vehicles. Expenditures for extension equipment and materials have been minimal. Field allowances for workers in the field more than 20 days a month are another relatively expensive component of the extension activities. All in all, however, compared to the technical materials and equipment, the cost for the extension component is minimal and approximately equal to the installation of one new water-yard (with a new engine/pump and borehole).

It is too soon to tell whether the extension component will be effective in sustaining community water systems over the long term. In the case of the water-yards, the re-centralization thrust of NWC policies will influence the communities' ability to assist in the management and upkeep of their systems. CARE staff will need to continue to monitor the villages assisted during IWP to ascertain the effectiveness of the extension strategy. Communities being assisted directly by NWC or any other organization not having an extension component should also be monitored as a control. Communities assisted by CARE in the first water project (1983-85) could also be evaluated as a control since no extension component was included in that project.

CARE has the opportunity to document its success in implementing a well-conceived extension component in the North Kordofan region. Cost figures for extension activities, such as Gala Days, should be tracked to get a better idea of the cost involved.

4.10 Lessons Learned

CARE has continued to learn from its field experiences. The lessons learned are being shared with other PVOs (e.g., Save the Children Federation) and, over time, it is hoped NWC will see the benefit of the extension component. Some of the major lessons learned are summarized below.

First, extension activities should start during the site selection phase, allowing time for extension workers to disseminate information and build awareness of the proposed project activities so that communities have reasonable expectations of what CARE and NWC can and cannot do.

Second, smaller, more homogeneous communities generally participate more actively in project activities and have greater control over the management of self-help revenue. Larger communities are often more difficult to work with due to their greater heterogeneity and the influence of local government officials in the control of self-help revenue.

Third, educational messages given to the women's groups seem to permeate the whole community due to the close knit social make-up of women in the rural villages of North Kordofan.

Finally, roles and responsibilities of all parties should be better defined. This would eliminate false expectations and make all parties accountable to predetermined agreements.

Chapter 5

TRAINING, SUSTAINABILITY, COST RECOVERY, AND IMPACTS

5.1 Technical Training

The CARE/USAID project agreement stipulated that IWP was to introduce a rudimentary technical, managerial, and financial training program for the small private-sector repair shops from which villages would seek maintenance and repair services for the handpumps installed by the project. Presumably, this was also intended to help support the much larger number (several thousand) of India Mark II handpumps installed on small-diameter boreholes as part of the NWC/UNICEF Program. IWP was to develop the training curricula for handpump maintenance and repair and to provide the training to at least three small pump repair shops. Neither of these happened.

In accomplishing these two objectives, it was intended that service and repairs--provided by CARE-assisted, private workshops--would be available to all VWCs who were using handpumps and, "to the extent possible, motorized pumps." In the CARE/NWC counterpart agreement, this was all condensed into one general activity, wherein CARE was committed to provide assistance to local private repair workshops in the servicing and repair of handpumps. This reflects NWC's mandate to be responsible for all maintenance and repair of diesel pumping systems.

With the exception of the general water-yard management training developed as part of the water extension work and taught to the VWCs, the only technical training that took place during IWP was conducted by a UNICEF crew hired by the project. As part of the NWC/UNICEF handpump effort, a curriculum had been developed to train people from each village where a handpump had been installed (thereby obviating the need for CARE to develop such a program independently). This was intended to enable them to provide as much of the necessary basic maintenance as possible, with a limited number of tools, in order to keep their own village handpump operating. This training was provided for ten individuals who were chosen from villages where CARE expected to install handpumps. Since only two of these installations actually occurred, much of the training will not be immediately useful. This component of the project agreement simply did not receive a high priority.

While the evaluation team feels that developing a private- and public-sector capability for servicing pumps (both hand and diesel) would certainly be a worthwhile endeavor, any meaningful intervention in this area seems well beyond the immediate scope of the project. As mentioned elsewhere in this evaluation report, NWC is in the process of developing a maintenance unit which will attempt to address specifically the major shortfall of institutionalized O&M support within NWC. Since this unit is still in the design stage, it is not possible to evaluate its probable efficacy. However, the problems of size and complexity involved in developing such a unit are clearly beyond the scope of any current or planned PVO project. CARE should continue to focus its efforts on what it does well, which is to rehabilitate open wells and small water-yards.

5.2 Sustainability

While the importance of operations and maintenance was emphasized in every project document reviewed by the evaluation team, the focus of IWP was on rehabilitation, not necessarily ensuring the sustainability of such efforts over the long run. While NWC is nominally responsible for all water-yard O&M, water revenues are usually inadequate to cover the costs of these services. Often villagers are forced to buy their own fuel and spare parts on the local market and do their own maintenance and repairs. Spare parts, lubricants, and fuel are sometimes simply unavailable, so systems often sit idle due to a lack of fuel or necessary repairs.

The sustainability of O&M is critically dependent on resolving the cost-recovery issue discussed in Section 5.3. Community participation in O&M activities is officially discouraged by NWC. In fact, NWC is re-centralizing rather than decentralizing power within its organization. However, it is in the process of developing the design for a Rural Water Supply Maintenance Unit (RWSMU). This unit will attempt to bring the level of NWC maintenance and repair services up to that common in the 1950s and 60s, when most systems were regularly and properly operated and maintained. Unfortunately, there is no reason for assuming that RWSMU will be able to address O&M problems any more efficiently than NWC does currently.

The fundamental limitations on NWC's O&M capacity include an almost total lack of adequate transportation, fuel and lubricant supplies, spare parts inventories, and the foreign exchange with which to purchase equipment and materials. While there are many well-trained technicians in NWC, their morale and motivation have dropped dramatically due to these obstacles to providing services. VWCs feel that fees paid to NWC go only to support a bureaucracy, rather than ensuring the delivery of services. Villagers feel that since they have to provide fuel, parts, and maintenance, there is little reason to divert monies to NWC. The collection of revenues to support NWC is rife with problems at the water-yard level. Until some resolution of this situation occurs, the provision of O&M will remain at its current level, which is totally inadequate. This issue is discussed at greater length below.

From its experiences in several projects on village water supply, CARE should try to develop a set of suggestions to submit to NWC to be incorporated in the design of RWSMU. However, the issue of community participation in O&M, and responsibility and control which that implies, will not be an easy issue to resolve.

5.3 Rehabilitation Costs and Cost Recovery

Some questions have been raised about the civil works costs during the IWP. Costs of the various categories of civil works undertaken during the project were examined in some detail to determine if these were in fact reasonable compared to estimates from several other sources for similar work done in Sudan.

CARE supplied engineering and cost data for the IWP sites so that the following average costs could be calculated:

Table 3

Average Costs for IWP Sites

PROCESS/ITEM		UNIT COST	NUMBER	TOTALS
Borehole cleaning	(1)	$ 4,750	7	$ 33,250
Borehole drilling	(2)	25,080	3	74,628
Engine/pump/pipe	(3)	22,088	11.5	232,000
Engine/pump overhaul	(4)	5,670	10.5	60,000
Borehole rehab. local materials/ labor cost	(5)	13,034	24	312,816
Open well rehab.	(6)	3,100	9	27,900
Open well digging	(7)	10,010	7	70,070
Handpump installation	(8)	2,600	2	5,200
Extension cost per site		7,016	28	196,448
	TOTAL			$1,012,312

Notes:

(1) Borehole cleaning based on typical 400' borehole depth, including labor/materials.

(2) Drilling new borehole @ $57/ft, drilled, cased and screened, typical 440' depth.

(3) Includes Lister 8/1 plus Edeco jack pump and fittings ($16,255), valves, rising main (300') and sucker rods (300'). 11.5 indicates twelve engines and eleven pumps.

(4) Exact cost unknown, but engine/pump overhauls estimated to cost 1/3 of original equipment cost if original Lister parts are used.

(5) Includes pipes, fittings, valves, cement, fencing, fuel, truck rental, labor, etc.

(6) Open well rehabilitation for deepening and re-lining--headwall and apron cost is $3,102 + $93/foot for block lined well, typical depth 150 ft.

(7) Open well digging--the cost per foot of digging new wells is less than that for deepening and re-lining existing wells because new ones were dug primarily in soft formations which did not require much blasting.

(8) Includes construction of pump base (well cover), drainage apron and installation of twin handpumps on each well.

Note that these figures cut across the cost categories given in Table 1 (page 14) of the actual project expenditures. Figures given in Table 3 for specific operations include personnel, materials and equipment, vehicles, vehicle operation and travel allowances. They do not include overhead, office support, etc. The two tables do not balance exactly, since the insurance, office operations, office equipment, miscellaneous and overhead entries add up to $177,888. That would indicate a total project expenditure of $1,190,200 or $86,294 more than is given in Table 1. These cost differences will be resolved in the final project report written by CARE.

While it is somewhat more difficult to directly compare these civil works costs with costs incurred for these activities under similar circumstances, some data are available. Three sources of borehole drilling and equipping costs are given here for comparison. First, one private drilling contractor in Khartoum quotes typical costs of cased drilled wells on the order of S£215/foot (1988 prices, for slightly larger boreholes). A second source, Gemarsoun Well Drilling Company, quotes S£190/foot for cased, screened boreholes. These costs are roughly equivalent to the CARE costs of S£138/foot (in 1987 prices) when inflation and borehole diameter differences are included.

More detailed costs for borehole drilling and equipping are given in the report Existent Water Supply Potentials and Needs, Pumping Equipment, and Potential for Pumping Systems with Renewable Energies in Sudan (GTZ Special Energy Program, Energy Research Council, January 1988). In that report, GTZ quotes some typical water-yard development costs (for deep borehole water-yards) provided by the NWC (converted to dollars by using the $1 = S£2.45 rate):

• typical well drilling cost per foot	$67
• cost of drilling typical 450 foot deep well, including casing and screen	$30,000
• cost of erecting water-yard (including pump house, tank, distribution, pumping equipment, etc.)	$51,000
• cost of constructing water-yard complete with accessories for 10,000 gallon tank	$81,000

While it is difficult to compare these numbers exactly due to the imprecision in specifying the exact exchange rates, it is apparent that the CARE per foot drilling cost is comparable with NWC costs. To compare the overall water-yard rehabilitation cost, it is necessary to subtract out the tank cost (about $8,000) and pump house cost (about $4,000) from the total water-yard construction cost, since CARE did not install or rehabilitate water storage tanks or pump houses. The CARE cost for the complete rehabilitation (drilling + equipment + labor + materials) is $60,202, compared to $69,000 for the NWC prices. It is also important to remember the emergency relief response focus of the project, at least at its beginning.

The point is not that CARE can develop water-yards less expensively than the NWC, but rather that costs incurred are roughly equivalent, and that both are considerably higher than typical costs in countries such as the United States, where drilling costs are typically $25/foot of cased 6" well. This is no doubt largely due to higher equipment, material and fuel costs (which more than outweigh reduced labor costs) in Sudan, and the often considerable distances which men and equipment must travel to the borehole sites often under adverse circumstances.

The second point worth mentioning is the very high cost of rehabilitating open wells ($93/foot plus fixed well head costs), particularly compared on a per foot basis with the cost of drilling boreholes ($60/foot). Several things must be considered when comparing open wells and boreholes. First, open wells are often dug in shallower, lower-yielding aquifers than boreholes, and often would simply not support the higher yield required for a pumped water supply (greater than 1.5 m^3/hour is the NWC minimum yield for borehole development). Second, the use of open wells does not require supporting high capital costs (engines, pumps, pump houses, storage tanks, distribution lines, etc.) and the typically high recurrent operation and maintenance costs associated with pumped water supplies, since typically low-cost human labor (and sometimes animals) is used for water lifting from open wells. It would be interesting to compare the per unit volume cost of water supply from open wells versus boreholes, but this has not to our knowledge yet been done for Sudan.

It is very difficult to collect accurate information on the revenue generated or the amount of money spent on routine maintenance and repair of water-yards. Several times during the evaluation, the VWCs were asked about revenue generated and expenditures for routine operation and maintenance. In all cases, the expenditures for fuel, oil, salaries, etc., far exceeded what the community said it was receiving in revenue. This makes it impossible, in a short period of time, to ascertain whether the water-yards can be sustained from the existing revenue collected.

The revenue collection system functions as follows. The NWC clerk collects all revenue and is responsible for paying the community the self-help component of the revenues. This division of revenue varies from community to community and is based on fees charged for various-sized containers used to collect water and for a variety of different stock animals (see Table 4, below).

Table 4

Water User Fees (in Piasters)

(including total charged to users and official NWC share)

Container/Animal	Amount Charged to Consumer	Official NWC Rate
jerry can (20 liters)	3-5	1
leathers (skins)	10	3
rubber bag (vendors)	25	12.5
goat/sheep	2-5	1
cow	10-15	4
camel	15-25	8

Note: 25 piasters = US $0.06 at an exchange rate of $1= S£4.4

The NWC clerk is visited monthly by an NWC supervisor who reads the meter and collects the NWC portion of the revenue. The meters are usually locked up so that the community has no idea of the amount of water being used. In many cases, the meters were no longer functioning. In these cases, NWC calculates the revenue on the basis of how much fuel was used to operate the system during a month's time.

For a typical installation, the amount of water that can be pumped by a liter of fuel is approximately 2,000 gallons. Communities usually purchase their fuel on the local market out of VWC funds. For each liter of fuel used to operate the system during a month's time, the NWC clerk reimburses the community 2.5 Sudanese pounds out of water fees collected. The community receives from NWC 6.5 Sudanese pounds for each liter of lubricant or oil used for routine operations. However, the community pays considerably more for fuel and oil than that which NWC reimburses. Black-market rates for fuel were quoted as 10 to 15 Sudanese pounds per liter and as high as 150 pounds for a liter of oil or lubricant. Therefore, the amount NWC reimburses the communities for the fuel and oil, which are essential for the functioning of the water-yard, does not come close to the actual expenses incurred by the community.

In fact, NWC has often been unable to provide these O&M services to all water-yards, due, among other things, to inadequate funding. NWC personnel are often unable to perform their duties due to a lack of vehicles, fuel for operating pump engines as well as vehicles, vehicle and pump system parts, and sometimes training. Unfortunately, this has led to an adversarial relationship between water users and NWC. Users often feel that NWC simply absorbs water-yard generated revenues but does not provide the associated "paid-for" O&M services. In fact, it has been estimated that up to 80 percent of NWC revenue goes to pay salaries, leaving little for transportation, spare parts inventories, and fuel.

NWC, on the other hand, feels not only that user fees generated at water-yards are insufficient to cover the actual O&M costs (not to mention capital equipment costs and overhead), but that user fees, for various reasons, sometimes do not even reach NWC. This situation further exacerbates NWC's shortage of operating funds, thereby reducing the level of services provided to the water-yards, "verifying" villagers' suspicions that funds are being diverted to other activities.

NWC was not always in this predicament. NWC operated very efficiently and was able to meet all of its responsibilities in a timely fashion in the 1950s and 1960s. Changes in GOS policy after that time have detracted significantly from NWC's ability to meet its responsibilities. Some of these policies have since been or are in the process of being reversed. Others remain.

In discussions with NWC officials in Khartoum, the evaluation team was informed of a pilot project now under way in the Darfour region which is experimenting with placing all O&M responsibilities back on NWC's shoulders. In the Western Savannah project in Darfour, all revenues generated by the sale of water are being collected by NWC, and it is responsible for all routine operations and maintenance. The self-help component has been abolished at these pilot sites. Senior NWC officials said that this pilot was very successful and that the communities were satisfied with NWC assuming all O&M responsibilities. No one from the project could be contacted, nor was the report on this experiment made available to USAID, CARE, or other NGOs working in the water sector.

The success or failure of this project will be very important to CARE and other NGO efforts in water-yard rehabilitation. CARE should plan a visit to Darfour to learn more about this pilot project and review the progress to date. NWC officials informed the evaluation team of their interest in repeating this pilot with CARE, possibly in the upcoming project.

From discussions with both regional and national NWC officials, it is clear that NWC believes it has the capability to provide for all O&M services from water-yard revenues (as was done in the 1950s and 1960s), if the infrastructure is rebuilt within NWC. The truth of the matter is, no one knows with any precision what it costs to run a water-yard and at what price to the consumer the water-yard will be self-sustaining. It appears that people in the rural areas are willing to pay very high prices for water, as evidenced by the role water vendors play in the community. Young boys with donkeys sell water to homes for approximately 25 piasters per 20-liter jerry can. This is a 500 percent markup over the price of water sold at the water-yard.

Information about the costs of running a water-yard is sorely needed. Only with this information can cost recovery schemes be tried. Costs have to be factored in for salaries, fuel for transporting teams to the field, overhead (not to mention spare parts), workshop development, and maintenance. NWC officials state that all they need is for the donor community to provide the capital for vehicles and rebuilding of the crumbled infrastructure and to establish a ready supply of spare parts and new equipment that can only be purchased with foreign currency. With this support, NWC believes it will be able to do all the work needed to run and repair the water-yards.

USAID's Sudan Renewable Energy Project (SREP) will begin the second phase of its implementation shortly. A major component of SREP is a testing and evaluation component for water pumps, including diesel, wind, and solar pumps. As part of the pump program design, SREP is to initiate a program to determine typical costs of pumping water with diesels. It would be mutually beneficial to both CARE and SREP if the SREP researchers had access to information being gathered at the CARE water-yard sites. This would broaden the scope of the diesel pumping data being collected by SREP, thus making its analytic results more accurate. In addition, the results could then be used by CARE, NWC, other NGOs and donor organizations to improve planning of their water resources development efforts. This cross-pollination of USAID-funded projects should be encouraged where possible.

During this evaluation, VWCs were asked about long-term savings plans for setting aside funds that would eventually be needed to keep their systems operational. The VWCs did not have many ideas on how to accomplish this. Some members said that they might be willing to save (by additional fee levy), say, one piaster per jerry can, and put it in the bank to cover major repairs and eventual major equipment purchases. They said that they would do this only if they, the VWCs, had full control of the disposition of the funds. In general, however, the communities were still skeptical about this idea of saving now to address future needs.

Normally, when a major expense (e.g., complete engine overhaul) occurs, meetings are held in the villages and funds solicited from village members to cover costs. As can be imagined, collecting an additional piaster for each jerry can at the wellhead might well be an easier way to accumulate the needed funds.

Water-user fees are not collected at open wells (with or without handpumps), nor do the communities have the cash flow requirements to sustain a water-yard. Hafirs do need periodic de-siltation, but time did not permit the evaluation team to explore with these communities how they would generate funds for periodic maintenance and repair.

5.4 Project Impacts on Health

Since establishment of baseline data on various important health indicators at project sites was not an activity included in the project design or implementation, the impact of this project on the overall health status of the communities served can only be estimated. Accurate determination of the health impacts due to improvement of water supply is known to be difficult under the best of circumstances.

In addition, the project went beyond simply improving water sources by supplying (through the extension component) an intensive health and hygiene education program for women. It would be very costly to try and measure the impact of this educational program or to try to separate out which project component (educational or technical improvement of the water systems) was responsible for any health improvements observed. Furthermore, there are other development projects--such as the CARE Child Survival Project, which

provides immunization services and trains mothers in the management of diarrheal diseases--in some of the same villages as IWP. CARE's Women in Development (WID) Project is also working in the same geographical area and also provides education to women in basic health and hygiene.

Therefore, establishing IWP's impact on health status is not only difficult, but is most likely not the best use of project funds and staff time. In future projects, CARE could measure more tangible intermediate indicators that would assist in coming to some broad conclusions on the health impact of water systems improvement. Some of these indicators are listed below, along with a brief summary of IWP's probable impact (using the CARE QARQ framework) on the health of the communities served.

5.5 Project Impact on Water Quality

Visits to a half dozen non-project sites revealed that at water-yards usually only one borehole (out of two or more) was in use due to nonfunctioning equipment (from lack of fuel, parts, repairs, etc.). Often there was limited fencing or none at all to separate humans and animals. The team also found rusting and leaking tanks, often installed at such low heights that water pressure was very low at the taps.

Pump houses had dirty engines covered with fuel or lubricants. The pumps leaked at the discharge point and sometimes there were no well seals. Pump bearings were often severely worn. There was an inadequate number of drive belts. Pulley bearings were worn, and there were holes in pump-house roofs where the pump's rocker arm had punched through. Storage for spare parts was inadequate, there were few (if any) tools, and muddy puddles had formed around the outside of the pump houses due to water leaks. Concrete filling benches were cracked or falling apart. Taps were broken or missing. Tap handles were missing and pipes were leaking. Areas around filling benches and troughs were muddy, with little or no provision for runoff of drainage. Animals and humans often used the same water source, sometimes troughs.

Open-wells were often unlined and frequently collapsed and had to be re-dug, often every year. Several people had been killed during digging of an unlined well at one site visited by the team. There were no well collars. The top of the well was flush with ground level, so that it was not only dangerous for people and animals but also very easy for the water to be contaminated by dirt, sand, animal droppings, etc. There were no troughs or fencing around wells to keep animals away, and few, if any, devices to assist in drawing water (e.g., winches, pulleys). And, finally, no provision had been made for the runoff of spilled water, such as a drainage apron around the well.

These conditions were in great contrast to dramatic improvements made at water-yards and open wells after IWP rehabilitation.

Project impact on the quality of water is probably greater for the low-capacity systems rehabilitated, i.e., open wells. The addition of a well collar (an elevated rim around the top of the well) to existing open wells and, in some cases, the installation of handpumps have decreased the level of contamination of these sources. The collars significantly reduce the volume of debris that falls, is blown, or is inadvertently kicked into the well by

people collecting water. For wells where handpumps were installed, the well cover has a similar but even greater positive effect. At El Murra, for example, people were lined up 15 deep to pump drinking water from the IWP-installed handpump, even though a much less crowded open well was less than 200 meters away. The people felt that the difference in water quality (not effort to lift the water) was significant enough that they preferred to wait and use the handpumps, and the open well was used to draw water for washing and watering animals. Drainage aprons on open wells also reduced the amount of contaminated surface water flowing back into the wells.

At un-rehabilitated water-yards, the lack of proper water distribution facilities often negates the advantage of providing relatively high quality groundwater, since the water becomes easily contaminated after it is delivered to the distribution point. For rehabilitated water-yards, the design and construction is such that water quality at the source is much more readily preserved. In IWP-rehabilitated water-yards, separation of humans and animals was ensured by building stout fences in and around the water-yards. Installing raised platforms (filling benches) for collecting water also improves the quality of water drawn. Drainage lines at water-yard distribution points significantly reduce the amount of standing, contaminated surface water. An exception to this was at Um Kredium, where separate filling benches were being used for commercial water collection for resale and where there was an open drainage ditch rather than a pipe, which ran from the donkey-loading site back through the side of the water-yard where people collect water. However, at most IWP sites, rather than serving as a conveyer of disease through animal and insect vectors, the wasted water was used to improve nutrition through increased availability of fresh garden vegetables.

Finally, for the hafirs rehabilitated in Mazroub, water quality was significantly increased by rehabilitating a slow sand filtration system and a chlorination tank for water treatment prior to pumping water up to the central village distribution point.

More importantly, however, is the IWP extension component's work, educating women on how water becomes contaminated and instructing them on better ways to carry and store water in the home. Teaching women to clean their water-carrying and storage containers and to raise storage containers off the ground and keep them covered should lead to better water quality, especially for drinking. The quality of water available at the tap, especially at water-yard sites, is good, but traditional carrying and storage practices often permit easy contamination.

The level of contamination has apparently been reduced as villagers have adopted lessons learned in the extension training. To validate this assumption in the future, CARE should take periodic random samples of water from different carrying and storage containers, before and after the extension lessons, to see whether water quality is improved and maintained by the educational program.

Along with the improved quality of water, the extension teams have also taught mothers the importance of hygiene in the home, especially with regard to the care of young children. Educating mothers on the danger of diarrhea and how to treat it using oral rehydration salts (ORS) enables them to care for young children with this common and potentially life-threatening disease. Baseline measurements of the knowledge, attitudes, and practices of home treatment of diarrhea and the use of ORS should be taken at the household of each woman involved in the extension lessons. After the lessons are completed, mothers could be re-surveyed to determine any changes in the home management of diarrhea.

5.6 Impact on Accessibility

IWP's efforts in improving both water-yards and open wells have helped to reduce the time required to collect water. IWP has increased the capacity of open wells through cleaning or re-digging, improved filling benches, and increased size of distribution pipes resulting in higher water pressure and faster filling at water-yards. Because women spend less time collecting water, they have more time at home to care for children and engage in handicrafts and gardening. In the future, CARE extension workers could easily measure the time spent collecting water before and after the improvement to the water system. Since the female extension workers already make routine visits to the homes of women participants, ascertaining time spent collecting water should not be difficult.

5.7 Impact on Reliability

IWP's assistance to rural water systems in the North Kordofan area has improved the reliability of water supply, especially through the critical dry season. While diesel water-yards are still prone to mechanical breakdowns, the newly rehabilitated water-yards should ensure year-round reliability of water. Assistance in deepening and lining open wells also improves the reliability of these sources through the dry season. By doing so, the project has probably increased population stability with attendant economic advantages, since many villagers will not have to migrate to other areas to find water during the dry season. For agricultural communities such as those harvesting hashab (as are many of the villagers served by IWP), families can stay and work on the land during the harvesting season and not fear that their water sources will dry up. At the community level, measurements could be taken of the reliability of the old or unimproved water sources, and later of the reliability (in terms of frequency and duration of outages) of the newly constructed or improved systems. This information would demonstrate the impact of CARE's assistance in terms of improving the reliability of water systems it has served.

5.8 Impact on Quantity

The per capita consumption of water is marginal at best in IWP's project area. Studies conducted by the Institute of Environmental Studies of the University of Khartoum (IES 1982) have shown that the per capita consumption of water is approximately 18 to 20 liters per day. Others have estimated even less. This is well below the WHO standard of 30 liters per day. CARE should attempt to measure the quantity of water consumed before and after rehabilitation or construction of a new water system. Extension workers could collect this information during their routine home visits. If the project could demonstrate a considerable increase in the quantity of water available per capita, then many assumptions regarding improved health could be justified.

In summary, the impact on health in the communities served by IWP is difficult to quantify without detailed, expensive, and time-consuming studies. However, the above-mentioned indicators, if collected accurately, could assist in making some general assumptions of the impact IWP is having on the health status of the community.

5.9 Economic Impact of IWP

Here again, since baseline studies were not a part of the project design or implementation, only qualitative estimates can be made of IWP's economic impact. Increasing the year-round reliability of water supply has been shown to reduce transhumance. With a year-round dependable water source people do not have to leave water-short areas during the height of the dry season (IES 1982; RFPP proposal, CARE 1987). This reduction in seasonal migration generally has the following effects in the areas of Kordofan where IWP has been implemented:

- increased exploitation of hashab (gum arabic) forests, which is a significant generator of foreign exchange;
- stabilization of community markets for local merchants, allowing them to stock larger inventories because of the greater and more constant local demand for goods; and
- reduction of household expenses related to moving households and livestock.

A more directly measurable economic benefit, associated particularly with IWP water-yard rehabilitation efforts, arises from the use of distribution-point wasted water for growing vegetable gardens and tree nurseries. Villagers at many project sites expressed considerable enthusiasm about both dietary benefits and income generation as a result of the gardens raised with wasted water. Filling benches were designed so that spilled water was collected by a drainage system and gravity-piped to a sump tank in the garden area. The water was then carried by workers to irrigate small vegetable plots. For example, at Saata Bertilla, villagers had already expanded (nearly doubled) the initial garden area to take advantage of available wasted water, and were considering a further expansion due to the unmet local demand for vegetables.

Another economic impact associated with increased water accessibility is reduction in the time needed to collect water. Two-hour round-trips are common, sometimes twice a day. Time savings can be used for productive activities or leisure. Under certain circumstances, productive activities, such as handicrafts, can be a significant source of income in rural areas.

5.10 Social Impact

The focus on women of the IWP extension and education is impressive when compared to other water projects in the region. Though the women are not involved in a formal sense in regulation of the water system or its maintenance and repair, they are very much involved informally and have an impact on the male water committees. In villages with low-capacity systems, especially in El Zoom (the site of an IWP-rehabilitated open well), it was the women who encouraged the male leaders to seek CARE's assistance in improving the village water source. CARE's WID project, working in the same geographic area as IWP, assists women in understanding how and where to seek assistance from government and nongovernment agencies in improving services in their communities. The clustering of such mutually compatible CARE projects (IWP, WID, and often agroforestry) improves community participation in and management of the improved water system.

The attention given women through the extension lessons is raising the awareness and educational level of women in these rural villages. This initiative can only improve the social standing of women in these communities, as evidenced by the unsolicited acclaim some male leaders have expressed for the emphasis given to women by the CARE extension component. Enabling women to stand up in front of an all-male group and share the information gained from the extension lessons is impressive in this cultural context and worthy of continued efforts.

The Gala Day event conducted during the final stages of the extension component does have substantial impact on the social cohesiveness of the various villages using a common water point. This event brings the population together to exchange information and clarify the roles and responsibilities of the villages in insuring long-term sustainability of the improved water system.

5.11 Environmental Impact

The general environmental impact of poorly planned water resources development is discussed in many references (e.g., IES, 1982, and El Faki, 1987) and is principally the result of increased human and animal populations drawn to the site by the availability of water. According to El Faki (1987), these impacts include:

- increased clearing of nearby land for cultivation;
- clearing land to meet increased needs for housing;
- increased cutting of nearby wood supplies to meet heightened demand for fuel wood and charcoal;

- effects of greater numbers of brush fires caused by increased human population;
- overgrazing exacerbated by increased numbers of animals;
- greater soil compaction from larger herds; and
- concentration of disease vectors (insect and waterborne).

Again, since no baseline data were collected at the beginning of the project, an evaluation of its environmental effects was not possible. The evaluation team observed barren lands stripped of vegetation around both project and non-project villages, particularly those with water-yards, but there was no way to determine whether this was a result of water-yard rehabilitation or the recent drought or whether, in fact, it was a recent or long-standing phenomenon. Given the short life of the project to date, it would probably not be possible to draw any significant conclusions even if baseline data did exist.

For the same reason, since numbers of both sedentary and nomadic livestock have varied so much due to the recent drought, it is difficult to attribute recently increased stock numbers (and their subsequent impact on vegetation in IWP villages) to better rains in the last two years or to rehabilitated water supplies in the last 12 months.

Chapter 6

REVIEW OF UPCOMING CARE WATER SUPPLY PROJECT PROPOSALS

The evaluation team was initially led to believe that there was only one follow-on activity planned by CARE in the water sector. In fact, there are two separate but very closely related activities:

- a follow-on project to IWP (referred to as IWP-2), dealing primarily with water resources development; and
- a multi-component project (referred to as the Regional Finance and Planning Project or RFPP), of which water development is only one activity.

The first water-related project proposal (IWP-2), still in draft form, is a stand-alone project in the same area as CARE's clustered programs--that is, the Bara and En Nahud districts of the North Kordofan region. The projects would include both technical and extension components.

The stand-alone water project proposes to assist 50 rural communities to improve their water systems over a three-year period. The technical component will be divided equally between water-yards and low-capacity systems (open dug wells and installation of handpumps). Hafir rehabilitation is also included in the project. The extension component, similar to IWP, will continue in the new project to provide education and information to VWCs and women's groups. The proposed budget for this project is an estimated US $3.6 million.

The second of the CARE Sudan water-related proposals is an integrated rural development project under USAID's Regional Finance and Planning Project based in En Nahud, El Odayia and Gubeish areas of En Nahud District in North Kordofan region (RFPP Proposal, CARE Sudan 1987). CARE's proposal for funding has recently been submitted and has four integrated components: water resources development; women in development; agroforestry; and agricultural credit.

The RFPP proposes, through extension and education efforts in the early part of the project, to work with communities in the water subproject. These efforts would include linking villages with NWC or private-sector crews to:

- assist in establishing locally managed cost-recovery systems;
- assist in setting up systems to procure special mechanical parts and equipment;
- provide for an ongoing maintenance and monitoring system to link the site with NWC regional workshops; and

- further refine and teach participating villages the water extension curriculum developed during IWP.

Villages selected as project sites will most likely be sites of multiple interventions involving not only water source rehabilitation, but agroforestry (community nurseries and gardens), agricultural credit and women's micro-projects related to the other three subproject areas. After proposed subprojects are approved by the District Council and a technical selection committee, CARE will then provide the technical expertise to implement the subprojects.

The critique in this section is based on the following questions:

- Does the proposal take into account lessons learned in IWP (and previous) project(s)?
- Are changes of direction and emphasis acceptable to major participants (NWC, CARE, USAID, VWCs)?
- Are expected outputs reasonable based on past experiences (NKWSP, IWP, other donor/PVO water resources development efforts in the area)?
- How might the project be improved?

The RFPP and the IWP-2 proposals, except for the strong focus on clustering in the RFPP, are quite similar in their specific approach to water source rehabilitation. The major difference between the two proposals is not one of approach, but rather the total number of systems to be rehabilitated (50 for IWP-2, 25 for RFPP), and the extent to which subproject clustering is emphasized in the proposals.

6.1 Technical Interventions

The primary objective with respect to water resources development in the RFPP is to satisfy the needs of at least 25 communities for potable water meeting the following criteria:

- quantity: increase from the existing level of approximately 7 liters per capita per day (lpcd) to at least 18 lpcd
- accessibility: source to be no more than 30 minutes' walk from home
- reliability: system operation, maintenance, and repair to be ensured by an appropriate cost recovery system, with O&M covered by water-user fees acceptable to both villagers and NWC

- quality: water quality to meet WHO standards.

In terms of the quantity and quality these criteria imply the necessity for dealing only with water-yards. It seems unlikely that open wells, with or without handpumps, will be able to meet WHO water-quality standards without also introducing slow sand filtration systems. Quantity criteria may also be difficult to meet using open wells (without mechanized pumping), depending upon the size of the local population. The volume of water typically drawn from open wells has been mentioned in several references as about five cubic meters a day, so that using the 18 lpcd standard, only about 300 people would be served by each open well. CARE's interventions in open well rehabilitation have been quite successful. Care should be taken during further negotiations with principal participants (USAID, NWC, CARE) to ensure that an emphasis on open well rehabilitation is not lost by focusing primarily on water-yard rehabilitation.

For water-yard rehabilitation, new storage tanks will be installed where needed. This is an improvement over the IWP approach, where water tanks--a critical part of the overall system--did not receive the rehabilitation emphasis they should have. The proposal does, however, specify replacement of boreholes that cannot be rehabilitated. The evaluation team recommends that CARE consider whether the probable need for drilling a new borehole might be adequate reason to reject a site for consideration during the site selection phase of the project. This is particularly true if an adequate number of potential sites exist which could be completely rehabilitated without drilling additional boreholes--a very expensive additional component to water-yard rehabilitation.

The proposal (as in the NKWSP and IWP proposals) recommends that where open wells currently exist or are feasible, they be either rehabilitated or constructed. The CARE approach to each of the types of water sources in the project area is a sound one and should be pursued. The "economic feasibility studies" referred to below might be useful in estimating the per capita investment required to deliver water using each of the technologies (water-yards, open wells, open wells with handpumps, and hafirs--of which there are very few within the proposed project area). This information could prove useful in future project design and would certainly tie in with studies to be conducted under the USAID-funded SREP water-pumping program.

6.2 Community Participation

The RFPP proposal specifies that all CARE projects must demonstrate the full participation of the target group and counterpart agencies involved. This means the VWCs (or the villagers themselves where VWCs do not yet exist) as well as NWC national and regional management. Both parties are to participate in all phases of the project, including design, implementation, and evaluation. While, in principle, this is a very reasonable approach, CARE must ensure that the project emphasize sustainable development rather than simply technical interventions (e.g., X number of water-yards rehabilitated).

There are obvious trade-offs between the two approaches, which was amply demonstrated in IWP. To meet the specific technical goals of the project, extension efforts received less emphasis than technical interventions. Due primarily to the emergency relief nature of IWP, communities were not involved in project design. Care should be taken to preserve a balance in project intervention, one which emphasizes the sustainability and replicability of subprojects by encouraging the active participation of villagers during all stages of the project.

However, the proposal also makes reference to emphasizing "locally determined management decisions and practices that can be replicated without external support" and a "user community which accepts full responsibility" for system support. If this is a reference to VWCs' assuming full local responsibility for water system management, CARE has still not explained how to convince NWC of the wisdom of this approach. This applies especially to water-yards as opposed to open wells. The trend in NWC policy seems to be towards re-centralization of control.

While the problem of local versus centralized responsibility for water system technical support has not been solved, in fact, it seems that NWC will not perceive it as an insurmountable obstacle in project design. In spite of the fact that NWC is in the process of developing a new Regional Water Supply Maintenance Unit (RWSMU), the boundaries and responsibilities of this unit are still in the development stage. In addition, it seems reasonable to assume that the RWSMU will initially be implemented on a region-by-region basis, with modifications made to its design and modus operandi as experience is gained with its operation. This implementation process is likely to take several years and not interfere substantially with the proposed implementation of CARE's water development efforts. However, CARE should continue to monitor the development of this unit and should try to the extent possible to incorporate its evolving design in project planning.

The proposal makes reference to private-sector alternatives, should development of the RWSMU proceed as currently envisioned by NWC. During IWP, private-sector bids were actively solicited for provision of water source development technical assistance. After the bids were reviewed, they were all rejected because of the unacceptably high prices quoted. While CARE should continue to seek to employ (and therefore provide experience to) private-sector firms where possible, it seems unlikely that significant private-sector technical assistance will be available in the near term in the project's geographical areas, at least for the skills and service for which IWP solicited assistance.

Finally, the clustering approach seems to have served CARE well in IWP, particularly in terms of combining water-yard rehabilitation with gardens and nurseries. This should be encouraged in any follow-on water development efforts.

6.3 Monitoring and Evaluation

Evaluation of project impact will not be possible without first establishing a baseline against which to evaluate. A concerted effort should be made, after the site and subproject selection phase, to document existing conditions in terms of health, economic, social, and environmental status to be used for post-project comparisons. This documentation need not, and should not, require detailed village assessments, which sometimes tend to become studies in themselves. This would both detract from the intended focus of the subprojects as well as consume limited project funds.

The RFPP proposal mentions the need to carry out needs assessments and technical, economic, and political feasibility studies in collaboration with water users (and presumably with water suppliers). This suggestion should not be slighted in further project design or site selection. Among the most problematic sites in IWP were those characterized by large heterogeneous populations and by subsequent power struggles between opposing tribal or political groups, which, in some cases, had significant deleterious effects on the operation of the local water systems.

6.4 O&M and Cost Recovery

These project proposals, like those of NKWSP and IWP, specify that a local maintenance organization, recognized and respected by the community and government, is essential to ensure long-term reliability of the systems. Again, it is not clear how this deals with the NWC/VWC conflict that cropped up during implementation of the previous project. While the regional or national technical support system referred to is obviously NWC, evaluations and final reports from previous projects have repeatedly stated that NWC has shown little capacity for ensuring proper and timely O&M in villages in North Kordofan. There is little reason to believe that this situation has changed or will change substantially in the near future.

The demonstrated inability of NWC to deal with O&M support of water-yards is a strong function of the cost recovery issue, which is also mentioned as essential for long-term reliability and sustainability of project interventions. Cost recovery systems that are acceptable to both villagers and NWC must be developed. Villagers have repeatedly demonstrated their willingness to pay (often exorbitantly high) water fees. Water-fee studies currently under way at NWC may provide a basis for establishing water fees and an associated cost recovery system that can address both groups' needs. NWC needs sufficient revenues to cover the high costs of O&M (not to mention capital equipment costs), and villagers need to cover costs currently met by the "self-help" component of water charges. However, given NWC's reluctance to have water charges cover non-water-related expenses, this may prove difficult.

The cost recovery systems to be developed during this project are to incorporate emergency funds to purchase spare parts and fuel, finance self-help activities, and even purchase capital equipment. The subject of establishing funds to cover both major periodic maintenance requirements as well as immediate demands for moneys to deal with unexpected breakdowns was discussed with several VWCs during the evaluation team's site visits.

Villagers seemed to feel comfortable with such funds only if they had complete local control over disposition of the funds. Given that this funding would presumably come directly from water fees charged at the water-yard and collected by the local NWC clerk, it is difficult to understand how CARE reconciles the apparently diametrically opposed views of villagers and NWC on the control of such funds. The project proposal states that one of the "short-term conditions" (objectives) for the RFPP (and IWP-2) water-sector effort will be the establishment of a water-yard maintenance system within the En Nahud District offices with training, monitoring, and mobile maintenance/ repair capability. Does CARE intend to fund the establishment of the maintenance unit, including vehicles (mobility), training (technical and extension), and tools and spare parts (for maintenance and repair)? This would require considerably more elaboration in terms of the specific project goal to which it is directed and the manner in which it will be achieved. In its present formulation, this objective lends itself to a wide range of interpretation and may be a potential source of conflict among project principals.

6.5 Recommendations

This section summarizes the project design recommendations made in the preceding section. The general recommendations given in Chapter 8 apply to IWP as well as to both follow-on proposals and will not be repeated here.

6.5.1 Extension

CARE should consider the extension component of the project in the phased approach as discussed in Chapter 4 above. There has been a tendency to talk of the extension component only in terms of the education lessons developed for the male water committees and the womens' groups. In actuality, the extension component should place greater emphasis on the Phase 1 or pre-construction phase of the project. The most important issues in this stage include the following two points:

Identification of roles and responsibilities: extension teams should work with the VWCs to agree on the roles and responsibilities of all parties in the proposed improvement of the water system. Some water projects in other countries of East Africa have used formal contracts or agreements between the community and NGO. In this way, a clear understanding is reached among all parties. Preparing formal agreements may not be appropriate considering the role of NWC in maintenance and operations, but CARE is encouraged to experiment with this method of formal contracts to assure that all parties are aware of their responsibilities for the construction and long-term sustainability of the improved water system.

Planning CARE's exit from the community: CARE staff should lay the groundwork for their exit from the community from the very initial stages of contact. Planning and scheduling events with the community right from the start is important so that the community does not become dependent on CARE. CARE needs to decide how long it will be responsible for maintenance, repair, and supervision of the new system once construction is completed. Once the decision is made and agreed upon by NWC the communities must understand this time frame and demonstrate their ability to manage the system after CARE has departed.

6.5.2 Technical Issues

Concentrate rehabilitation of water-yards in small to medium-size villages: CARE's effort should be focused on villages where homogeneous populations reside and there is demonstrated leadership. Communities assisted by CARE's other development projects, especially the Women in Development Project, should be the focus of assistance considering the work this project is doing in mobilizing women to improve the provision of services in their communities.

Water-yards and open wells: Water-yard rehabilitation is an important part of water resources development in the proposed project area. However, it should not be allowed to consume the great majority of project funding at the expense of other technical components such as open well rehabilitation. NWC appears to prefer that CARE focus exclusively on water-yards. This does not match CARE's approach of trying to address the range of water development activities in the project area.

Operation and maintenance and cost recovery: CARE does not appear to have adequately resolved the recurrent issue of ensuring system sustainability by balancing local involvement in system management with NWC's position that all ownership and therefore control of water-yards resides with NWC. One objective of the follow-on project might be to develop a clear set of recommendations about an approach to O&M and cost recovery that has at least the implicit if not explicit agreement of NWC and which would be acceptable to VWCs. Such a set of recommendations would be very useful to other PVOs involved in similar water resources development projects.

A balanced approach: The technical component should not be the driving force of the project. Extension work takes much longer, in many cases, than does the technical component. A three-year project cycle should have a period in the beginning, say three or four months, for community mobilization and awareness-building, before technical activities are scheduled to begin. Also, if all project activities are to be completed within the three-year period, then technical activities should wind up about four to six months before the end of the three years to allow completion of the extension activities and to complete project monitoring and evaluation. Therefore, it appears that the number (50) of rehabilitation or construction activities proposed in IWP-2 is very ambitious and may not allow adequate time for extension efforts.

Overall, the quality of project design evidenced by the RFPP and IWP-2 proposals has noticeably improved over the earlier NKWSP and IWP project designs and reflects the experience CARE has gained during implementation of those projects.

Chapter 7

CONCLUSIONS

7.1 Project Design Issues

Technical/extension activities vs. emergency response: The 1984-85 drought brought on the force of immediacy, and there were initial delays in project implementation resulting from rapid turnover of early project management personnel. Thus, the project was under pressure from both AID and NWC to quickly install as many systems as possible, rather than focusing equally on institutional development and village extension activities to ensure long-term sustainability of the systems. In spite of this emergency relief orientation, the project was designed to focus on both extension and technical installations so that CARE would be able to build on its experiences in designing and implementing future water projects.

Project administration: The project had well-qualified staff and adequate and timely support from the CARE/Sudan national office. Reporting procedures were taken seriously at all levels, thus the project was exceptionally well documented.

Project implementation: Early in the project, high turnover among senior IWP staff caused considerable delay in project implementation. In spite of this, the project accomplished most of its technical objectives with the exception of technical training (see below) and the number of handpump systems installed. The number of sites and systems estimated in the project design appropriately reflected the time, manpower, and funding resources available to the project.

Project agreements: The IWP CARE/NWC and CARE/USAID agreements left much to be desired in terms of specifying exactly what was to be done by whom and when. This is not to imply, for instance, that all sites should have been chosen at the onset of the project. Rather, responsibility for timely delivery of all project components, (materials, labor, equipment, training, funding) and activities (by category, such as equipment overhauls and system designs) should be specified precisely so that ongoing project monitoring and evaluation procedures can help assure completion of all project objectives. Enough flexibility must be maintained in project agreements to allow for reorientation of project efforts as lessons are learned during project implementation. No planned implementation schedule was included in any of the project documents reviewed by the evaluation team.

Site selection: In general, it appears that larger, more sociopolitically diverse communities are more problematic sites for CARE interventions. Smaller, more homogeneous communities, where there are fewer sociopolitical divisions and consequently greater community coherence, have generally been more successful sites in terms of organizing community participation and management.

For IWP, the first major activity was site selection, and it was determined whether boreholes were to be rehabilitated or whether new boreholes needed to be drilled. CARE might want to reconsider whether sites where new (and very expensive) boreholes have to be drilled are appropriate for inclusion in water-yard rehabilitation efforts. For a smaller investment in an alternative site where only rehabilitation (not drilling) is needed, CARE could have a fully functioning site. This would allow the project to spread its resources over a greater number of sites.

Water-yard development model: The CARE approach to water-yard design and community participation provides a useful model for both NWC and other donor/PVO groups working in water resources development. Linkages among some of these groups (e.g., Save the Children Federation, UNICEF) have already been established and are likely to develop further.

7.2 Technical Issues

Evaluation criteria: In terms of the general CARE water system evaluation criteria (QARQ), there are distinct differences among water-yards, hafirs, open wells, and open-well/handpump systems. The CARE project had the following effects on each of these system types:

- water-yards--increased quantities, slightly better accessibility because of installation of better distribution points, increased short-term reliability, little change in source water quality (but better at distribution points due to separation of humans and animals);

- open wells--somewhat increased quantity where wells were deepened, increased accessibility and water quality (due to well collars and drainage aprons), greatly increased reliability where wells were lined;

- open wells with handpumps--most likely unchanged quantity, increased water quality, accessibility somewhat reduced (since wells were capped where handpumps were installed), system reliability probably somewhat decreased (handpumps, unlike lined open wells, will eventually breakdown); and

- hafirs--increased quantity due to expansion of catchment areas and de-siltation of storage area, increased water quality where fences and/or slow sand filters were installed; accessibility somewhat reduced (since people and animals are no longer walking into hafirs to get water) but water quality was greatly improved and reliability increased (due to pumping system rehabilitation and reconstruction of catchment civil works).

Site design approach: Technical design and construction of the systems were generally sound. Systems are all in operating condition, and people are satisfied with their new or rehabilitated water systems. The water-yard layout (e.g., separation of human and animal water points, stout fencing, drainage, and use of wasted water for nurseries/gardens) was generally well received by villagers. In terms of replicability, other PVOs (such as Save the Children Federation) are adopting the CARE design in their water-yard rehabilitation programs.

Operation and maintenance: The project did little to address O&M training and responsibility issues. While this was admittedly not a major focus of IWP, it was mentioned as a project objective in the CARE/NWC and CARE/USAID agreements as:

> "assisting VWCs in maintaining their water systems and non-formal training" and "assistance to local private workshops to improve their maintenance capability" in the CARE/NWC agreement"; and
>
> "development of pump repair workshop management, finances and techniques" and "providing managerial, financial and technical training" to the same shops in the CARE/USAID agreement.

In fact, little of this technical training occurred. The VWCs did receive the ten-lesson water extension curriculum developed by the IWP water extension group, but the only training that occurred was when the UNICEF handpump O&M crew was hired to provide a 7-day technical training course in minor handpump maintenance for about 16 local villagers.

The emergency response nature of the project forced IWP to focus on completed systems rather than insuring that adequate support systems were developed. A more concerted effort to institutionalize O&M would have helped to insure that the systems installed or rehabilitated by IWP would not need to be rehabilitated again in the near future. The project design assumed that villagers would perform their own operation and maintenance, even for water-yards. While this is a reasonable objective, it seems highly unlikely that NWC will formally accept this approach, since it would probably be perceived as competition for limited resources rather than as complementary.

Cost recovery: No cost recovery system has been developed that is acceptable to all major participants of water resources development (NWC, VWCs and CARE). While there is an obvious willingness among water users to pay for the water they consume, the major problem is collection and allocation of adequate water fees. Fees are divided into NWC and self-help components. VWCs (or sometimes Rural Councils) receive the self-help fees, which are sometimes used to finance other than water-related activities, while NWC feels that they should only be used for support of water-yards. Without these additional fees, NWC is not able to meet its O&M responsibilities. Studies are under way to investigate alternative methods to insure that the fee structure is appropriate for both capital and O&M costs of water-yards. This and the associated responsibility for O&M are the central problems in village-scale water development in the project area.

Sustainability: The issue has not been addressed well by this project, due in part to the emergency nature of its implementation. NWC was particularly concerned to insure that additional site rehabilitation would not be required two or three years after the project ended. The nature of the technologies used in water-yards has depended and will continue to depend on fuel distribution using a sometimes tenuous transportation infrastructure, spare parts from abroad (and associated procurement delays), and high foreign-currency demands. While sustainability was mentioned in project documents, it was not adequately addressed during implementation.

Environmental impact and system size: It is very difficult to measure precisely the relationship between system size and environmental impact because of nomadism, transhumance, and the willingness (and necessity) of people to travel relatively long distances to get water. Thus, increasing capacity or accessibility at any given site will automatically result in increased demand, sometimes greatly increased. This increased demand and its impact on the environment is difficult if not impossible to measure. While the detrimental effects of large-capacity water-yards were duly noted in pre-project documents, mitigating measures were neither suggested nor implemented during the project. At present, the health and environmental impact of project interventions is not measurable because of the lack of baseline data in these areas. While some such baseline studies were conducted for the previous project (NKWSP), they do not provide data for the current project areas.

7.3 Extension Activities

In spite of its "emergency" orientation, as the project progressed a concerted effort was made to develop and implement well-conceived extension activities that would serve to strengthen community participation in water development over the long term. The extension curriculum has been upgraded continuously to reflect villager feedback on the subject matter and presentation of lessons.

Approach: The extension component of the project is sound and has continuously adapted its approach based on field experiences. However, the emphasis thus far has been on post-construction activities, in particular conducting the series of lessons for the two target groups.

Expectations: Villagers at some sites have come to expect that CARE will continue to remain responsive to their O&M needs well after the systems rehabilitated or installed by CARE are brought on line. This has led some NWC senior staff to claim that CARE has been "telling people that they own the water-yards." This can have very negative consequences for the critical CARE/NWC operational relationship.

Village Water Committees: In nearly all villages visited, CARE's assistance in rebuilding and training VWCs, particularly in smaller communities, has been relatively successful. At most sites, appropriate management practices were evidenced by recorded minutes of periodic meetings, orderly financial records, and established rules and regulations for water-yard use. The VWCs seemed to be representative of the wishes of the community at large, and communications were good between VWCs and their constituents.

7.4 IWP Linkages to CARE Program Objectives and USAID/Sudan Portfolio

In nearly every assessment of development in Sudan, particularly in North Kordofan, water resources are cited as the single most important factor. Water development is acknowledged by CARE as the cornerstone upon which its other projects are based. The structure of the RFPP proposal takes this position into account, interweaving subprojects in agricultural credit, women in development and community nurseries into the basic foundation of water development. Given its dual focus as both an emergency relief effort and a pilot project, IWP's design did not take full advantage of possible complementarity with other CARE programs. At many sites, IWP implementation did take advantage of the closely related CARE agroforestry program, and wasted water from water-yards was used to support seedling nurseries and community gardens. Similarly, the water extension component focusing on health and hygiene reinforces the CARE Child Health Project. Opportunities for expanding this complementarity should be further examined, particularly in the design of IWP-2.

The entire USAID/Sudan mission portfolio is currently under review as part of a periodic Project Implementation Review (PIR). USAID water-sector activities themselves will be reviewed during a series of discussions in January 1988, involving USAID mission engineering, health, and other interested personnel. There is increasing evidence of a growing need for another emergency relief effort, due both to failed harvests in some areas in Kordofan and elsewhere and to an apparently increasing flow of refugees from other areas. Thus, mission planners will be formulating a response to these conditions that will focus heavily on water resources development as the crucial input. It would be premature to evaluate current CARE project planning in terms of the previous mission Country Development Strategy Statement (CDSS) before this mission water sector review takes place. It is hoped that this evaluation will provide useful input for the sector review.

Chapter 8

RECOMMENDATIONS

8.1 General

Project agreements should be more specific in their delineation of the implementing groups' responsibilities, financial and equipment/materials resources, and implementation schedules. CARE now understands the magnitude and scheduling of project resources (time, personnel, equipment, funds) needed to implement specific activities (e.g., rehabilitating a water-yard, digging a new open well). Thus, project implementation schedules should be developed as part of proposal preparation. This will provide all interested parties with a much better understanding during the planning phase of realistic potential project accomplishments.

8.2 Multisystem Approach

CARE should continue to focus on the variety of water sources used in project areas, including open wells, water-yards, hafirs, and cisterns, avoiding an exclusive focus on water-yard rehabilitation. CARE's approach to providing village water supplies by rehabilitation rather than developing completely new sites is sound and helps reduce the project investment per site to produce completely operational water points.

8.3 Management

1) There should be an overall project manager, one extension program coordinator, and one technical program coordinator (engineer). This would give the project a much more balanced perspective and ensure that both extension and engineering are given equal attention.

2) The current configuration for the IWP extension teams of one man and one woman should be continued. Then, two rotating positions for supervisor of male extensionists and supervisor of female extensionists should be established. The supervisor's responsibilities would include monitoring and evaluating the efficacy of lessons, recommending any necessary revisions, and evaluating the performance of colleagues. This would not only provide personnel management training for extensionists, but would also allow them time to review and adapt the extension training curriculum to reflect their teaching experiences.

8.4 Site Selection

1) During the first phase of project implementation, a multi-disciplinary team of CARE and NWC staff should review the site-selection criteria established during IWP and make suggestions for modifications based on experience gained during implementation of IWP and NKWSP. The distribution of sites throughout the proposed project areas should take into account the extent of potential environmental degradation associated with site development.

2) A two-tiered approach to selection should be used. For example, for a project where the objective is to rehabilitate 30 sites, a list of possible sites should be assembled, perhaps twice as many as the project has resources to rehabilitate. Then, an extension team should evaluate each site in terms of local institutions, social organization, interest in participating in the project, etc. Based on this assessment, the number of potential sites should be reduced from 60 to 45. Then, a team should be sent to determine what technical interventions are required, thus permitting a quick cost estimate of the technical interventions needed to completely rehabilitate each site. On the basis of this information, the number of sites should be further reduced to 35. These sites should be ranked by the joint agreement of the technical and extension teams. The five sites ranked lowest could be designated as alternate sites in case additional funds or time become available.

3) In terms of timing, site selection should be done on a yearly basis rather than all at once at the beginning of the project. This will allow for changes at the sites (new systems installed, other donor interventions, etc.) to be incorporated into project planning. The project should avoid being forced into unduly premature site selection.

4) When possible, the sites chosen should be where existing CARE projects are being implemented. Site clustering with other CARE projects (especially Women in Development and agroforestry) should be encouraged.

5) To reduce the cost of interventions, CARE should avoid choosing sites where drilling new boreholes will be necessary. The NWC inventory includes more boreholes than can currently be equipped with available pumps and engines. Since the objective of the proposed projects is to develop as many (sustainable) water points as possible within constraints and with the resources available to the project, CARE should choose sites where minimal interventions can produce operational sites.

6) CARE should consider for inclusion as project sites only those systems that it can bring to complete operational status without the active intervention of any outside agencies (e.g., NWC). This would prevent the occurrence of situations like that at Saata Bertilla, where a nearly completed system (admittedly, a third back-up borehole) awaits a simple cleaning before it can become fully operational. This procedure was to have been performed by NWC. Since undue delays occurred in the provision of services, the job was subcontracted out to a French firm, BRGM, but its rigs have not yet reached the site.

7) One approach to site selection would be to advertise the fact that communities in a particular area are under consideration for water-system rehabilitation. During site review, the extension member of the site selection team could assist interested villages in completing "site-selection applications," which would address the site-selection criteria. This would help to disseminate information and build awareness among villagers about the projects' goals. The role of the site-selection teams would then be to verify the accuracy of the information provided on the application. Communities could be encouraged to make financial contributions to the development of their own water supplies, which would increase the likelihood that their application would be accepted. Disadvantages of this approach might include the following:

   - communities might be inclined to create temporary institutions or alliances just to be selected;
   - CARE might be inundated with applications; and
   - NWC may not favor such an approach, since so much community initiative is involved.

8) An additional site selection criterion should be included: no water-yard that is close to an existing, functioning water-yard should be a primary candidate for rehabilitation. The distance needs to be determined. This will help decrease the risk of overgrazing and human population concentration in one area and the consequent adverse environmental impacts.

8.5 O&M Cost Recovery

1) NWC and village operators and "lubricators" should receive refresher technical training in diesel-engine and piston-pump O&M. This might help prevent the common occurrence of installing inappropriate parts in response to unexpected break-downs just to get engines operating again quickly. Of course, this assumes the existence of an adequate, reliable source for the spare parts required, which is another major constraint on successful O&M.

2) As an approach to O&M, CARE should continue to carefully follow the development of the NWC Rural Water Supply Maintenance experience in water extension and community participation at NKWSP and IWP project sites. This may help ensure the design of a RWSMU system that better reflects the realities of water supply sustainability and replicability of project and non-project interventions in the long run. In its upcoming water-sector review, USAID should prepare a strategy to initiate policy dialogue with NWC to develop cost-recovery schemes to help ensure the sustainability of future project interventions in water-source rehabilitation.

3) In terms of revenue collection, people will need to pay more than they currently do to provide sufficient revenues to cover O&M costs (not to mention capital equipment costs). However, they seem more than willing to do so, particularly if they can see direct evidence that the additional revenue increases the quantity, accessibility, reliability, and quality of their water supply. In concert with other USAID-funded activities (e.g., the SREP Water Pump Testing and Evaluation Program), a study should be conducted (in conjunction with the one currently under way as part of NWC's RWSMU design and development) to determine the actual costs of water delivery. Recommendations should then be made to NWC and VWCs to begin to raise user fees to these actual levels on a regional basis. According to NWC officials, this approach has shown promising results in projects in Darfour. CARE should follow the progress of those projects to determine the success of this approach to cost recovery.

4) To ensure the performance of O&M the following recommendation is offered only as a suggestion. The perennial question raised in several documents reviewed for this evaluation is how to ensure that NWC will perform the O&M function that is ostensibly paid for by village water revenues. One possibility might be setting up a "loan" with the village as the creditor and NWC as the credit source. Village pumping equipment and the cost of drilling the borehole would be the loan principal, with a possible amortization period of 30 years at ten percent interest. The loan payment would be the minimum amount that the VWC must pay NWC every month or the delivery of services (i.e., water) would cease. A fixed schedule for providing maintenance services could be developed (approximately according to manufacturers' specifications) with provisions for addressing the certain occurrence of unexpected breakdowns. As maintenance services are performed, the VWC could use its self-help money to pay a previously established fee to NWC for the maintenance procedure. If the fee were not paid by the VWC upon receipt of the services, subsequent provision of NWC services (i.e., fuel, operators) would cease immediately. Based on villagers' reluctance to depend on NWC's timely and appropriate provision of services, some sort of arrangement such as this must be developed whereby each of the two main parties have some degree of leverage over the other in the exchange of revenue for services. However, given NWC's reluctance to relinquish any degree of control over water-yard management and revenue collection and distribution, this may be an unlikely scenario.

8.6 Extension

1) The current CARE approach to encouraging community participation is not congruent with NWC's policy of retaining complete control over all technical and managerial decisions regarding water-yards. In discussions with NWC personnel, CARE planners should develop a mutually acceptable approach to involving communities in water-yard operation that will take advantage of potential community inputs to assist NWC in water-yard management and also deal with NWC's reservations about formalizing a division of responsibilities with VWCs.

2) To help avoid possible misunderstandings among communities, NWC, and CARE, guidelines should be established that carefully delineate all future project responsibilities (especially after installation) to all VWCs so that the limitations of CARE commitment are known to all major actors (NWC, VWCs, CARE, AID and other donors). Perhaps this could be expedited by drawing up contracts that specify the responsibilities, inputs and outputs for all the parties involved. In the case of NWC, it would be useful to break down these responsibilities among NWC local operators and clerks, regional staff (maintenance and repair crews), and national staff (policy makers, designers of the RWSMU program).

3) As an ongoing review of past extension programs, future projects should continue to monitor the success of extension programs undertaken during IWP and the impact of specific lessons, if possible, to provide feedback for the design and modification of current water extension activities. Currently, there is little, if any, formal review (either technical or extension) of past project efforts (NKWSP). A review of past efforts, in concert with baseline studies to determine pre-intervention health, social, economic and environmental conditions at the site, will permit a better determination of project impacts and, consequently, improved project design.

4) Extension efforts in follow-on work should use a phased approach (before, during, and after construction), where extension teams begin working with villagers prior to any technical project interventions and continue to encourage active community participation throughout all implementation phases.

8.7 Technical and Equipment Issues

1) For equipment, water tanks should be included in the overall process of water-yard rehabilitation. They are an integral part of the overall system and should not be ignored simply because of the additional cost. At many rehabilitated sites, storage tanks appear to be the weak link in the system since they were usually only painted (or welded where leakage was excessive). This has been mentioned in the RFPP proposal and should be a part of IWP-2, if it is implemented.

2) CARE should carefully track policy development within NWC regarding equipment standardization. For example, if NWC decides that Mono pumps are an acceptable substitute for the increasingly expensive Edecos, CARE may want to use this type of equipment in future water-yard rehabilitation efforts.

3) AID and WASH have subsidized the development of automatic closing valves called robo-valves. To open them, the water user must push a button. Once released, the water stops flowing. The use of these plastic valves can significantly reduce water wastage, and they can be manufactured locally under many circumstances. Since there are considerable problems with tap longevity, as well as the difficulty of replacing them since they must be imported, robo-valves should be reviewed for possible inclusion in future CARE projects. However, this may produce problems in terms of nursery projects that use wasted water.

4) In terms of open-well equipment, the installation of an overhead pulley system (with multiple pulleys) at rehabilitated open-well sites would make water-lifting considerably easier for a nominal additional cost. The installation of pulleys would also facilitate the use of animals for drawing water, which was observed at some sites but is not common. Partially covering open wells with reinforced concrete to decrease the open area by approximately 50 percent should be examined as a possible rehabilitation component. People would then be unable to put their feet on the well collar and inadvertently introduce manure or other contaminants into the well, which should reduce contamination levels. This additional feature was included at some sites visited by the evaluation team.

5) For handpumps on open wells, a technical evaluation of the installation of a double handpump system on capped open wells should be undertaken to review technical, economic, and reliability issues. It would also be helpful to establish a set of site selection criteria for handpump installations, analogous to those developed for water-yards and simple open-well site selection. Handpumps should not be installed unless there is a second open well available nearby, in case of problems with the handpump.

6) It has been suggested in the IWP-2 proposal that one windmill should be installed at a project site to pump water. It is very likely that if only one such system is installed, it would quickly assume the status of an orphan and cause problems for all involved if technical assistance is later required. However, since the USAID-funded SREP/CWD water-pumping effort will be testing and evaluating the cost and performance of wind pumping systems in Sudan, CARE should consider soliciting their cooperation in installing no fewer than two units at sites that

are jointly chosen by the two projects. Having CARE take responsibility for the social/institutional aspects of this effort, and SREP for equipment installation and O&M, will help ensure that:

- a more representative evaluation of wind pump costs and potential in Sudan results from the joint CARE/SREP collaboration; and
- O&M support will be available if anything other than minor problems occur with the units, which will help assuage villagers; possible concerns about dealing with an unfamiliar system.

7) CARE and some of the other PVOs have expressed interest in solar PV pumps. SREP may be willing to provide some equipment under the same circumstances as discussed in the recommendation on windmills above. CARE should investigate the possibility of such collaboration after the arrival of the new AID contractor for the second phase of SREP, which is currently scheduled for start-up around February 1988.

8) IWP technical interventions at water-yards have focused on the provision of water via distribution points in the water-yards. CARE should continue this focus on delivery, as opposed to extending current water-yard rehabilitation practice to include off-site distribution for selected users. This would allow project funds to be used to extend the number of rehabilitation sites, rather than spending considerably more per site for additional distribution facilities.

8.8 Monitoring and Evaluation

1) To review previous efforts, the operational status of sites rehabilitated in previous projects should be assessed every six months to evaluate the effectiveness of O&M training efforts (if any) and sustainability.

2) There should be community involvement in ongoing project monitoring and evaluation. Communities have been shown to be astute observers of the condition of water systems (their own as well as others). Incorporating their suggestions in the evaluation of local project interventions would likely yield observations that might not come from outsiders. Villagers should be asked to suggest evaluation indicators for the operational status of systems. After a set of these indicators is established, a monitoring system should be established wherein VWC members perform periodic (perhaps every month) reviews of the status of their system (leaky tank, taps broken or missing, etc.).

3) Baseline studies are needed to permit future determination of the health and social impacts of project interventions, in addition to the economic and environmental baseline studies mentioned above.

4) In terms of reporting, future projects should continue to devote time and resources to documenting the project in as complete a fashion as was the case with IWP. Such an effort greatly facilitates project management and review.

5) To determine overall project impacts, baseline surveys must be undertaken to establish pre-intervention, base-case conditions at project sites. Such impact evaluation should employ indicators similar to those in the IES survey (NKRWS Baseline Survey, IES, 1982) to determine site-specific impacts. The project should develop a set of proposed mitigation measures for the environmental impacts of large-capacity water-yard development, and implement those measures after their review by a joint committee of project principals.

PHOTOGRAPHS

Photo 1. Situation in a typical hafir.

Photo 2.

Water vendors at distribution point in Um Krediem.

Photo 3. Camel watering area at Haj Elan Wateryard.

Photo 4. Filling bench at rehabilitated wateryard.

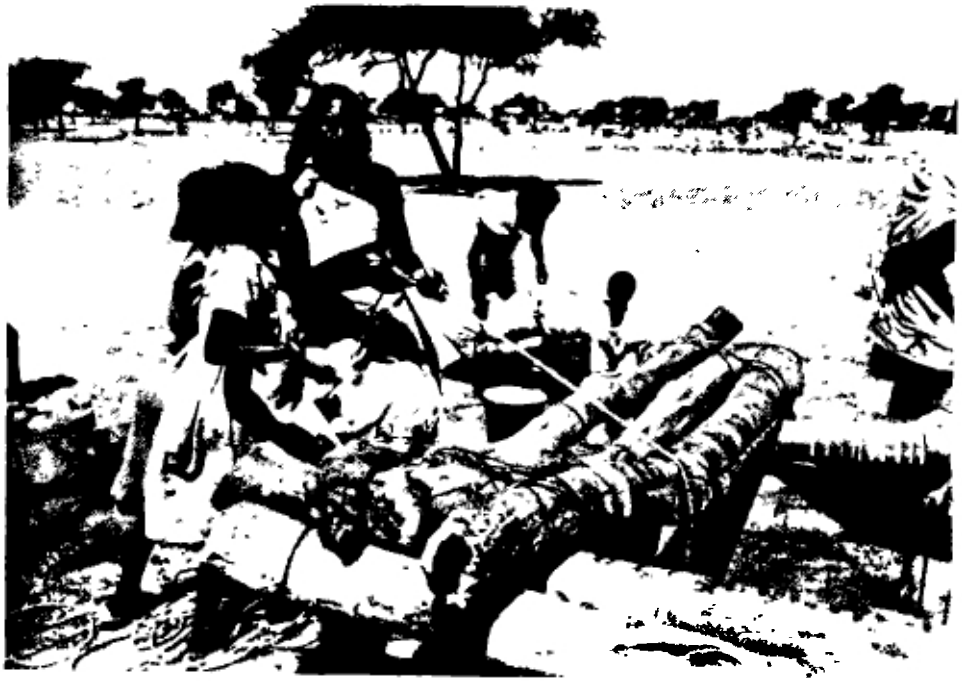

Photo 5. Women drawing water at newly-dug open well, El Murra.

Photo 6. Hand- and animal-drawn water at a traditional open well.

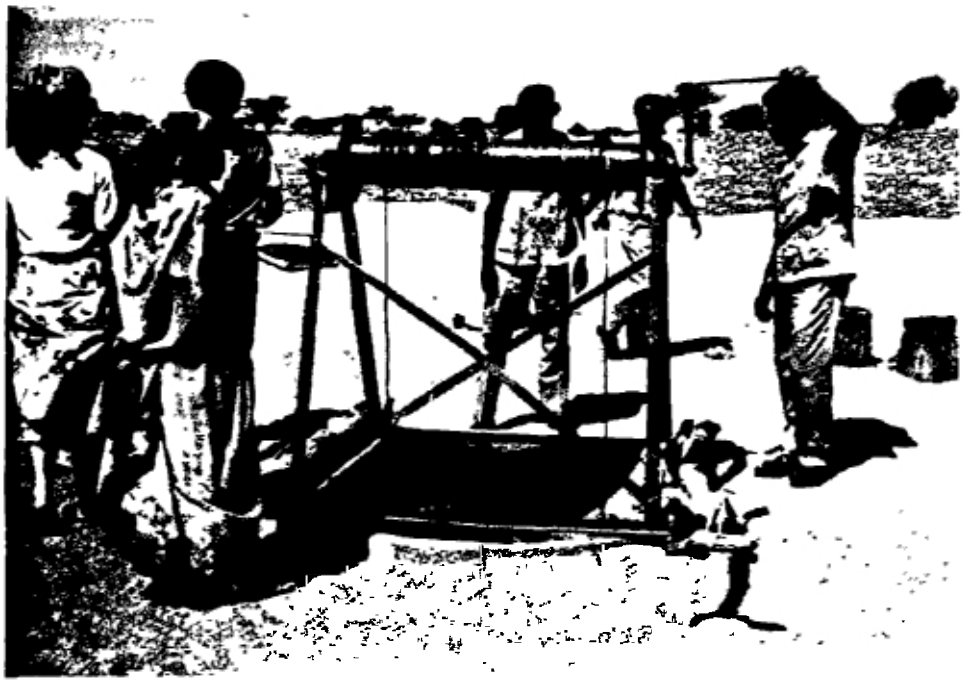

Photo 7. Digging a new open well with lifting winch near El Murra.

Photo 8. Wastewater garden adjacent to Saata Bertilla Watervard.

Photo 9.

Children operating India Mark II handpump installed over open well.

Photo 10. People watching health education puppet show during Gala Day celebration at Um Defais.

APPENDIX A

Site Visit Discussion Questions

APPENDIX A

Site Visit Discussion Questions

The following list of questions, grouped by subject matter, were the essence of discussions with the Village Water Committees.

Site Selection Criteria

Were site selection criteria strictly or reasonably well adhered to during initial site selection?

Were selection criteria clearly understood, reasonable, appropriate, easy to apply, and did they result in an intuitively "correct" list of sites to be developed?

How much did criteria other than those stated in the list affect the eventual choice of sites?

Was there significant disagreement among the site selection committee on the application of the criteria to any particular sites? Was there disagreement among the funding agencies or other interested groups (USAID, CARE, NWC, MOH, DOP) on the initial or final choice of sites? If so, why? How were these disagreements resolved?

Choice of Construction or Rehabilitation Tasks at Individual Sites

Were users consulted (indirectly or otherwise) on the choice of civil works at their sites?

After site selection, what were the criteria used to determine construction or rehabilitation plans for a given site? Were they purely technical criteria or did they depend on other considerations? What were these technical criteria (QARQ) or other considerations?

Were users generally satisfied with the extent of civil works construction or repairs undertaken?

Water-Yard Design

Design issues of interest: division and overall size of access area, fencing, number of taps, height and location of taps and troughs, division of animal and human sources, provision and location of drainage, size, number and height (delivery pressure) of storage tanks, existence and condition of garden plots,

management of water consumers (human and animal), water use (personal/commercial), differential access to water (local users, commercial vendors, nomads, satellite villages.

Do these water-yard design parameters vary from site to site?

Do users have any suggestions on how to vary these parameters to better meet their particular needs or desires?

Choice of Equipment

Upon what was equipment choice based? Who chose the particular combination of Lister/EDECO? Did this fulfill capacity requirements in all cases? If not, what actions were taken to increase capacity?

Was equipment choice based upon any consideration of standardization of equipment either within the nearby area or on equipment already available in other parts of Sudan?

Were adequate inventories of spare parts included in initial equipment purchase orders? Upon how many years of use were inventories based?

Operation and On-Site Maintenance

After construction or rehabilitation, did the water supply meet villagers' expectations for quantity, accessibility, reliability and quality? How about those of the designers? What can (or is) typically done if the answer to any of these questions is no?

Who was officially responsible for operation and on-site maintenance? Who actually carried out these activities?

Is there typically only one person trained in operation and preventive maintenance procedures, or are there back-up operators? Who pays them?

Were villagers and local NWC pump operators given training in operation and on-site routine maintenance procedures? What did the program consist of? Were training programs reinforced by follow-up training sessions?

Were spare parts required for routine maintenance provided to villagers or inventoried in regionally centralized locations? Were these parts readily and quickly available upon request? Were there different sources for different parts? How were spare parts paid for, or were some supplied gratis?

How were fuel/lubes obtained and stored? Were they rationed or provided on an as-needed basis? Was theft a problem? Who was responsible for providing fuel? What were village options in the event of lack of official supplies? How were fuel/lubes paid for?

How were parts and fuel/lubes obtained if not available through official channels?

Were records kept of O&M requirements (operating hours, fuel/lubes consumed, water pumped, expected and unexpected system outages, etc.)?

Off-Site Maintenance and Repairs

Who was responsible for off-site repairs? Who usually carried them out?

How were responsible authorities notified when repairs were necessary? Was response usually timely? If not, what alternative sources (other ground or surface water sources, trucked-in water) of water were employed? What constraints (limited capacity or availability, additional expense) were involved in the use of these alternative sources?

Were parts and service typically available for all required off-site maintenance and repair work through official channels? If not, where were necessary parts obtained? Was the cost difference significant?

Were detailed records kept of off-site maintenance and repairs? Did these records include costs incurred, parts supplied and procedures undertaken?

Were loaner engines or other components supplied during repair periods so that water delivery was carried on as usual?

User Fees

How were user fees determined? What was the fee structure? Did water price vary depending on the user?

How, by whom and when are user fees collected?

What is the normal disposition of these fees? (Do they go to the VWC, NWC, Rural Council, other individuals or groups)?

Was there a general willingness to pay fees? Does this vary by user group?

What portions of the actual costs of water delivery do user fees typically cover (capital equipment cost, recurrent cost of O&M, spare parts inventories, off-site repair and overhauls)? What were they supposed to cover? If unknown, do data exist to determine the answers to these questions?

Have user fees varied over the course of the project? Do they vary from site to site? If so, why and how much?

Village Water Committees (VWCs)

How are members of VWCs chosen? Do the committees operate democratically or is power concentrated in the hands of only a few (or one) member(s)?

What are the responsibilities and powers of the VWCs? Do these vary from site to site? Are these powers and responsibilities ever shared with or usurped by other groups or organizations?

What management activities do they typically undertake?

What enforcement powers do they have to back up their decisions in matters of arbitration?

How do they approach matters such as collection of fees to address emergency situations? Are such fees equitably applied?

How do they insure that the water supply system will continue to provide water to villagers (i.e., insure that proper preventive maintenance procedures are undertaken in a timely manner, collect additional fees to create an emergency fund, etc.)?

When civil works activities are undertaken by NWC, CARE or other PVOs, how do VWCs typically decide what contributions to make (in cash, food, labor or other payments-in-kind)? How are these one-time fees distributed over the user population?

Extension Issues

(Derived from meeting with evaluation team, 5 November.)

How does the community perceive the extension component of the water project?

Do the two components of the project (technical and extension) complement each other?

Are the three phases of the extension components appropriately designed in the right sequence? Do they have the expected impact on the community?

Phase 1 -- Pre-Construction
Information Sharing, Awareness Building

Phase 2 -- Construction
Organizing Community for Labor

Phase 3 -- Post Construction
Lessons for VWC and Women's Groups

Is the extension methodology (i.e., team approach) effective? Specifically:

1. How are the groups created and is this method appropriate?

2. Are there any differences in the men and women extension teams?

3. What are the strengths and weaknesses of each?

Are the extension lessons for the two groups appropriate?

Is the extension component sustainable?

Is there evidence of behavioral modification due to the extension lessons? What is KAP on health and sanitation before and after extension lessons?

Explore characteristics of successful and unsuccessful VWCs. This information will assist in modifying site selection criteria.

Community Water Committees are not officially recognized by NWC. How does this affect the functioning of NWCs?

A Site Visit Form for extension activities is included on the following page.

Site Visit Form

Name of Site _____
Of WC _____ Women _____
of lessons given WC ____ WG ___

Extension Issues

1. How does community perceive water improvements?

	WC	Women
Quality		
Quantity		
Reliability		
Accessibility		

2. What were expectations for project and were they met?

WC _____

Women _____

3. How does the community perceive the two teams?

Technical _____
Extension _____

4. Impact of Phases -

Phase 1 _____
Phase 2 _____
Phase 3 _____

5. Extension Lessons
Questions to the Group - What did you learn from the lessons and what additional topics should be included?

WCs	WG

6. Visits to Households

	hh 1	hh 2	hh 3	hh 4
Water Storage				
Water Container				
Food Storage				
Drying Table				
HH cleanliness				

7 Perception of Health Problems

Before	After

8. Water Committee

Strengths	Weaknesses

APPENDIX B

Site Visit Schedule

CARE/Sudan - Water Evaluation November 1987
Schedule for Visits

Sites to be Visited

Water Yards	Hafir	Wells
1. Umm Sot	1. Mazroub	1. El Zoom
2. Um Kreidem		2. El Moura
3. Haj El Lain		
4. Sa'ata Bertilla		
5. Um Defeis		

	Fri-11/6	Sat-11/7	Sun-11/8	Mon-11/9	Tues-11/10	Wed-11/11
am		Mazroub	El Zoom Haj El L.	El O.	Saata B.	Um Defeis Gala Day
pm	Umm Sot	Um Kred. Sleep at Um Kredum	El Moura Return to El O.	Office Work and NWC Visit	Um Defeis Sleep at Um Defeis	Return to El Obeid

Thursday - November 12 - Return to Khartoum

APPENDIX C

List of Documents Reviewed

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List of Documents Reviewed

Agreement for the Interim Water Supply and Management Project in North Kordofan Province - Sudan, CARE and NRWDC, October 7, 1986.

CARE-Sudan Multi-Year Plan, 1988-1990, CARE, Khartoum, May 1987.

Community Water Supply and Sanitation in Sudan, WASH Field Report No. 37, C. Chandler and E. Low, WASH, March 1982.

Environmental Review of Water Pumping, Gaafar El Faki Ali, SREP, August 1987.

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Kordofan Emergency Water Supply and Management Project, Proposal Outline and Operational Proposal Grant (OPG), CARE Sudan, E. Steinkrauss and S. Wallace, Khartoum, March 1986.

Kordofan Development Strategy Statement, Draft, E. Steinkrauss, CARE Sudan, May 1985.

North Kordofan Interim Water Supply and Management Project, Water Extension Curriculum, CARE Sudan, El Obeid, May 1987.

North Kordofan Rural Water Supply Baseline Survey, Institute of Envirnomental Studies, University of Khartoum, 1982.

North Kordofan Rural Water Systems Development Project, Project Design Pre-Condition, CARE Sudan, 1987.

North Kordofan Water Supply and Management Project, Bi-Monthly Project Progress Reports, September 1986 to August 1987, H. Gebreselassie, Alemayehu, Rowland Roome.

North Kordofan Water Supply and Management Project, Project Proposal, S. Wallace, CARE Sudan, August 1985.

North Kordofan Water Supply Project - Final Project Report, CARE Sudan, December 1985.

North Kordofan Water Supply Project - Internal Evaluation, B. Bjornson, CARE Sudan, October 1985.

North Kordofan Water Supply Project - Site Information Files, grouped by category of open wells, hafirs and water-yards, and by specific sites, CARE-El Obeid, 1986-87.

Regional Finance and Planning Project Proposal, En Nahud District, Koordofan Region, S. Wallace and I. Ghanin, CARE International in Sudan, October 1987.

"Rehabilitation of Hafirs in Sudan," C. Dodge and M. Zelinika, UNICEF, Waterlines, Vol. 6, No. 1, July 1987.

Sudan - Development of Possible Water Projects in Kordofan and Darfur, memorandum by F. Guymont, REDSO Engineer, USAID/REDSO/ESA, April 24, 1985.

APPENDIX D

List of Individuals Contacted

APPENDIX D

List of Individuals Contacted

CARE/Khartoum

Earl Goodyear, Director
Tom Alcedo, Deputy Director
Steve Wallace, Programming Officer
Isam Ghanim, Assistant Programming Officer
Teresa Williams, Accountant

CARE/El Obeid

B. B. Saha, Regional Coordinator
Haileselassie Gebrelassie, IWP Project Manager
Kamal Awad, IWP Project Extension Coordinator
Mohamed Gouda, IWP Project Engineer (seconded from NWC)
Bob Clausi, Agroforestry Project Manager
water extensionist teams

USAID/Khartoum

Ken Rickert, Project Officer
Mohamed Yahia, Staff Engineer
Carl Maxwell, Staff Engineer
Paul McVey, Project Coordinator, RFPP
Red Ketcham, Interim Project Manager, SREP

National Water Corporation

Osman Taha, Executive Director
Abbas Hamser, Director, Rural Water Supply Maintenance Unit
Regional Director, El Obeid
Assistant Regional Director, El Obeid
water-yard operators and clerks at sites in Bara/En Nahud

Others

Mladen Zelinika, Chief Engineer, UNICEF, El Obeid
Ed Resor, Director, Save the Children, Sudan Field Office
Wendy Wakeman, Assistant Director for Programming, SCF

Village Water Committee members and villagers at 12 water sites (both project and non-project) in the Bara and En Nahud Districts.

APPENDIX E

Sample Indicator Lists

CARE - SUDAN

NORTH KORDOFAN INTERIM WATER SUPPLY AND MANAGEMENT PROJECT

EVALUATION

OF IMPACT OF EXTENSION PROGRAMME ON BEHAVIOURAL CHANGES CONCERNING WATER-RELATED HEALTH AND SANITATION PRACTICES BY WOMEN'S GROUPS

VILLAGE: UMM ARBA'A EL ZERGA

NUMBER OF HOUSEHOLDS: 44

DATES OF SURVEYS:	23MAR.87			
BEHAVIOURAL CHANGE INDICATORS	% Yes	% No	% Yes	% No
A. Collecting water:				
1. Washing container before filling	-	100		
2. Construction of drying table	50	50		
3. Placing washed container on table in sun	-	100		
Sub-Total	17	83		
B. Storing water:				
1. Separate container for storage	68	32		
2. Storage container on raised stand	-	100		
3. Cover for storage container	34	66		
4. Specific cup for drinking	-	100		
5. Absence of flies around container	-	100		
6. Storage container kept clean	-	100		
Sub-Total	17	83		
C. Personal hygiene:				
1. Washing hands after defecating	50	50		
2. Washing hands before eating	98	2		
3. Washing body at least weekly	-	100		
4. Washing children at least twice weekly	-	100		
5. Using soap	100	-		
6. Brushing teeth daily	59	41		
7. Keeping fingernails short	-	100		
Sub-Total	44	56		
D. Food hygiene:				
1. Washing fruits/vegs in clean water	-	100		
2. Washing/cleaning meat before cooking	34	66		
3. Keeping food covered	91	9		
4. Reheating cooked food	7	93		
5. Washing dishes etc. after use	2	98		
6. Drying dishes on table	2	98		
7. Sick people eating from separate dish	-	100		
8. Food stored above ground	45	55		
Sub-Total	22	78		
E. Household sanitation:				
1. Kitchens cleaned daily	-	100		
2. House swept daily	-	100		
3. Trash safely disposed of	-	100		
4. Children's faeces safely disposed of	-	100		
5. Defecating safe distance from house	32	68		
6. Animals kept away from house	-	100		
Sub-Total	5	95		
GRAND T O T A L : --	23%	77%		

CARE - SUDAN

NORTH KORDOFAN INTERIM WATER SUPPLY AND MANAGEMENT PROJECT

EVALUATION

OF IMPACT OF EXTENSION PROGRAMME ON BEHAVIOURAL CHANGES RELATED TO MANAGEMENT AND MAINTENANCE OF WATER SUPPLY BY VILLAGE WATER COMMITTEES

VILLAGE: MURKAB

DATE OF SURVEY 1987:	MAR	JUN	SEP	DEC
BAHAVIOURAL CHANGE INDICATORS:				
A. Efficient conduct of committee business				
1. VWC established	No			
2. Chairman appointed	No			
3. Vice-chairman appointed	No			
4. Treasurer appointed	No			
5. Secretary appointed	No			
6. Meet at least monthly	No			
7. Follow an agenda	No			
8. Keep minutes	No			
B. Management and maintenance				
1. Public notice board at site	No			
2. Number rules/regulations made	No			
3. Have been enforced	No			
4. Systematic accounting system	No			
5. Counterpart to NWC Clerk	No			
6. Counterpart to NWC Operator	No			
7. Counterpart to NWC Watchmen	No			
8. Cash collected daily from NWC Clerk	No			
9. Tanks,pipes,taps etc. checked daily	No			
10.Repairs to above made immediately	No			
11.Pump in good working order	No			
12.Repairs to pump made quickly	No			
13.Adequate stock of diesel	No			
14.Adequate stock of oil	No			
15.Adequate stock of grease	No			
16.Adequate stock of spare parts	No			
C. Sanitation at water point				
1. Adequate drainage	No			
2. Absence of mud	No			
3. Separation of animals and people	No			
4. Presence of caretaker/watchman	No			
5. Absence of trash	No			
6. No washing of bodies/clothes/etc.	No			
D Constructive use of waste water				
1. Nursery/veg. garden established	No			
2. Waste water adequately collected	No			
3. Absence of mud and stagnant water	No			
4. Drainage pipes kept clear	No			
5. Effective irrigation system	No			

APPENDIX F

Summary of IWP Technical Activities

APPENDIX F

Summary of IWP Technical Activities

Name of Site	Rural Council	Type of System (Depth)	Number of Villages	Number of Beneficiaries	Maxium Distance To Source	Project Activities
Mura	Teiba	2 open wells (120 feet)	3	2,224	8 kms	- New lined open well with handpump which was later removed - redeepened and afixed a pulley device
Zoom	Um Kredium	1 open well (135 feet)	3	1,210	10 kms	- New lined open well - Elevated well head - Installed 2 handpumps
Ubu Nuwar	Teiba	2 open wells (124 feet)	4	1,446	15 kms	- New lined open well - Elevated well head - Redeepened old well
Shawa	Teiba	2 open wells (135 feet)	8	1,713	15 kms	- New lined open well - Elevated well head - Redeepened old well
Um Dubban	Teiba	4 open wells (72 feet) 1 hafir	46	6,800	17 kms	- Dug new well and - Redeepened old well - Renovation of hafir
Abu Hugar	Teiba	1 open well (180 feet)	7	2,310	10 kms	- New lined open well - Elevated well head - Redeepened old well
Zera	Um Kredium	1 open well (260 feet)				- Failed - Digging depth 260 feet with no results
Harage	Um Kredium	1 open well (260 feet)				- Failed - Digging depth 260 feet with no results
Um Sot	Bara	1 Water Yard 2 boreholes	4	1,400	9 kms	- Cleaned 2 boreholes - Installed new pump/engine - Rehabilitated Water Yard (fencing, distribution line, and pump house)
Um Kredium	Um Kredium	2 Water Yards 3 boreholes	46	51,800	112 kms	- Overhauled existing units - Installed new pump/engine - Rehabilitated Water Yard (fencing, distribution line, troughs, filling benches and pump house)
Haj El Lain	Teiba	1 Water Yard 1 borehole	4	4,500	12 kms	- Replaced engine (Lister) - Overhauled Edeco pump - Rehabilitated Water Yard (fencing, distribution line, troughs, filling benches and pump house)
Teiba	Teiba	1 Water Yard 1 borehole 2 open wells	11	14,367	10 kms	- Installed new pump/engine - Rehabilitated Water Yard (fencing, distribution line, troughs, filling benches and pump house)
Um Sadoon	Teiba	1 Water Yard 2 borehole	5	2,340	16 kms	- Installed new pump/engine - Rehabilitated Water Yard (fencing, distribution line, troughs, filling benches and pump house) - Overhauled Schweller/Lister

Name of Site	Rural Council	Type of System (Depth)	Number of Villages	Number of Beneficiaries	Maxium Distance To Source	Project Activities
Sa'ata Bertilla	Khuwei	1 Water Yard 3 boreholes	4	1,200	11 kms	- New borehole drilled - Installed new pump/engine - Overhauled 2 existing units - Rehabilitated Water Yard (fencing, distribution line, troughs, filling benches and pump house)
Sa'ata Zarga	Bau Zabad	1 Water Yard 3 boreholes 2 old, 1 new	13	15,000	13 kms	- New borehole drilled - Installed new pump/engine - Rehabilitated Water Yard (fencing, distribution line, troughs, filling benches and pump house)
Dodiya	Khuwei	1 Water Yard 3 boreholes 2 old, 1 new	38	8,000	110 kms	- New borehole drilled - Installed new pump/engine - Rehabilitated Water Yard (fencing, distribution line, troughs, filling benches and pump house)
Khuwei	Khuwei	1 Water yard 4 boreholes	10	12,000	89 kms	- Cleaned 2 boreholes - Overhauled mechanical units - Installed new pump/engine - Rehabilitated Water Yard (fencing, distribution line, troughs, filling benches and pump house)
Murkab	Khuwei	1 Water Yard 2 boreholes	7	2,700	24 kms	- Cleaned 2 boreholes - Overhauled mechanical units - Installed new pump/engine - Rehabilitated Water Yard (fencing, distribution line, troughs, filling benches and pump house)
Khannas	Abu Zabad	1 Water Yard 2 boreholes	3	3,000	7 kms	- Cleaned 1 boreholes - Overhauled Edeco III/Lister - Installed new pump/engine - Rehabilitated Water Yard (fencing, distribution line, troughs, filling benches and pump house)
Um Deffais	Abu Zabad	1 Water Yard 2 boreholes	10	13,000	17 kms	- Installed new pump/engine - Rehabilitated Water Yard (fencing, distribution line, troughs, filling benches and pump house)
Nazroub	**Nazroub**	**2 hafirs**	**32**	**35,848**	**55 kms**	- Renovated 2 hafirs - Extended distribution lines
TOTALS			**258**	**180,858**	**xxxxx**	**xxxxx**