

**OPERATIONS AND MAINTENANCE IN THE NORTHERN
REGION OF SUDAN - CASE STUDY OF COMMUNITY BASED
OPERATIONS AND MAINTENANCE**

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Introduction

The Northern Region of the Sudan is located between Lat. 16' and 22'N. The total land area of the Region is 477,074 sq. km. predominantly constituted of desert and semi-desert land, with the Nile crossing it and acting as the main axis around which the population is concentrated. According to the 1983 census, the Region has a total population of 1.07 million persons.

The widespread aridity of the areas has restricted population and economic activity to the Nile Valley and to the few basins linked to it where flood irrigation and the extraction of groundwater support perennial agriculture. Only a few small dispersed communities of pastoralists live away from the Nile in Wadis which carry some rain during the rainy season; mostly to be found in the southern districts of the Nile Province. The breakdown of population by mode of living, according to the 1983 census, is reflective of the general occupational pattern and form of residence in the Region. (Table 1)

**Table 1
Form of Residence**

Urban settled	%	Rural settled	%	Nomadic	%	Total Northern Region
230,341	21.45	793,414	73.8	50,269	4.7	1,074,024

Agriculture is the base of the economy and the economy and the source of the livelihood of the population. The prevalence of fertile soils, coupled with the availability of perennial irrigation and favourable climatic conditions have led to the growth of a diversified agriculture, with field and horticultural crops being produced. Wheat, faba beans, fasolia, lentils and clover are the most important field crops and dates, bersim and mangoes are the main horticultural crops.

The smallness of the cultivated area and its concentration along the banks of the Nile have resulted in the existence of a high population density, and a linear pattern of settlement, with a continued alignment of villages, small centres and urban places on both banks of the river. Settlement size ranges between 1,000 and 20,000 persons in the Nile Province and 850 and 15,000 persons for the Northern Province. The average settlement size for the Region is 6,000 persons.

These features of high population density and growth of settlements have provided favourable conditions for the provision and the development of an infrastructure of community

services, including water supplies. Administratively, the Region is comprised of two provinces; the Northern Province and the Nile Province. The first has a population of 424,391 persons, and the second a population of 649,633 persons.

The provinces are divided into Districts (Area) Councils, with each council divided into a number of Rural Councils. In total there are 4 districts and 10 rural councils in the Northern Province, and 3 districts and 11 rural councils in the Nile Province.

Water Supply Source

The Nile is still the main source of community water supply in the Northern Region with drinking water obtained directly and untreated from the river and the irrigation canals, or after some slow sand filtration. Tube wells are the other important source of supply, established at places where the geological conditions favour the drilling of wells. The water resources of the Region include:

1. Surface waters: The River Nile, Atbara River and seasonal Wadis, i.e. Wadi El Mugadam, El Hawad, etc.
2. Groundwater: The Nubian Sandstone aquifer (best aquifer in Sudan), the alluvial deposits (of minor importance), the weathered Basement Complex aquifer (of minor importance).

From data collected from a sample of 30 settlements in the Region, the water supply situation of the Region may be summarized as follows:

In the Northern Province, there exists 127 wateryards (of which 45 are incomplete), 13 slow sand filters, 1 raw water station, and 66 systems of house connections.

In the Nile Province there exist 176 wateryards (of which 49 are incomplete), 1 slow sand filter station, 39 raw water connections and 74 systems of house connections.

Open wells are dug in the Nile alluvium to tap the sub-surface waters which are directly recharged from the Nile. Alternatively they are dug at favourable geological locations to tap groundwater for domestic use and irrigation. Manual extraction of water and the use of the waterwheel (Mataras) were the traditional methods of water extraction. However, handpumps have now been introduced especially to shallow wells in the Central District of the Northern Province. Dependency on open large diameter wells for domestic supply has been undermined by the fluctuations in water levels and the pollution from pit latrines especially in densely settled areas.

Deep tube wells and slow-sand filters came at a later stage in the progress of water provision in the Northern Region. Tube wells are provided in areas that are geologically favourable, while slow-sand filters are installed at places which fall within the Basement Complex formation and where surface water is the major water source.

Drilling for water for domestic use started in the early 1960's in the Nile Province and in the early 1970's in the Northern Province. The drilling programmes are being implemented in the areas of Nubian Sandstones formation where groundwater is available in large amounts and the

quantity is excellent. For the areas falling within the Basement Complex where groundwater availability is generally poor, like Wadi Halfa, Abri, Dalgu, Abu Hamad, and Wad Hamid Rural Councils, the use of water began in 1966 and 1982 in the Nile and Northern Provinces respectively.

House connections came at a late stage in the water provision in the Region. It was introduced in the 1970's and has now become a basic request of the rural communities there as a result of the socioeconomic transformation that is taking place. Starting in the seventies, the people of the Region realized the importance of a reliable and hygienic drinking water supply. The change has come as a result of the fluctuations in the river's level, increased awareness that good quality water is a preventive measure against water-borne diseases and also because of improvements in the socioeconomic life in the rural areas, instigated by the adoption of urban attitudes.

Water Supply Technologies

The technologies in use are conditioned by the type of water resource utilized.

River water, sand-filtered or in raw form, is pumped to the filtration system (in case of slow-sand filters) or directly to the storage tanks. Water is usually obtained at the tanks which are fitted with taps.

Groundwater is tapped by 3 types of wells:

- Hand-dug well:
- Driven wells; and
- Boreholes.

Hand-dug wells are the oldest type of wells in the Region. They are easy to construct and operate and require no particular technology or instruments. This type is gradually disappearing and is being replaced by driven wells.

Driven wells represent a good example of the use of a simple technology, adopted and improved by people to fit local conditions. All wells constructed by means of driven iron pipes fit into this category. Tube-wells fitted with handpumps are very popular in the Northern Region for producing small quantities of water for domestic use only. Driven wells for agricultural purposes are usually equipped with lifting mechanical units.

Boreholes are constructed by means of percussion or rotary drilling machines. The boreholes are usually fitted with steel casing, screen, gravel pack and equipped with either turbine or reciprocating pumps powered by diesel engines.

House connections are a community-founded activity, in response to changes in ways of living, leading to an increase in household consumption. Local communities organize member-households in a settlement to support the water network project, throughout the various stages from initiation to project management. Distribution projects are usually carried out as a joint activity between rural communities and the national Rural Water Corporation.

Duties and Responsibilities of the National Rural Water Corporation

The main objective of the NRWC is to provide adequate and safe drinking water to the rural population. The NRWC realizes this objective through the following means:

- Drilling of boreholes and fitting them with pumping units in areas where groundwater is available;
- Construction of slow-sand filters and water pumping units from the Nile in areas where groundwater is not available;
- Maintenance of wateryards and slow-sand filters;
- Repair and maintenance of the Corporation's vehicles, machinery and equipment;
- Installation of house connections throughout the Region at the people's cost;
- Continuous monitoring and evaluation of groundwater; and
- Institution building in the area of water supply provision, and administration of the activities of the Corporation.

In order to achieve these functions the NRWC created the appropriate administrative structures in both the Nile and Northern Provinces.

In addition to the regional and provincial offices, the Corporation has succeeded in establishing maintenance centres with workshops. (Table 2)

Table 2
Maintenance Centres

Province and Name of Centre	Date of Establishment
1. <u>Northern Province</u>	
Abri	1982
Dongola	1982
Ed Debba	1988
Qoz Gorafi (Merowe Rural Council)	1983
Karima	1987
2. <u>Nile Province</u>	
Abu Hamad	1988
Ed Damer	1982
El Metamma	1987
Shendi	1983

The maintenance situation in the Northern Province is satisfactory. Only about 5 wateryards are out of order in the whole Region, and few mechanical units need to be replaced.

The National Rural Water Corporation faces a series of constraints in providing water to the Northern Region. These include:

- Shortage of spare parts;
- Shortage of transport facilities; mainly support trucks and reliable vehicles in the maintenance centres for the movement of personnel, equipment and spare parts;
- Lack of an appropriate system of procurement of supplies to raise the efficiency of field operations and maintenance;
- Shortage of skilled labour, mechanical technicians and daily paid labourers, especially in the Northern Province, as people prefer to emigrate or work in agriculture;
- The introduction of a myriad of new types of pumps and engines which complicates the maintenance situation.
- The continuous delay in receiving budget instalments to carry out the implementation of the development programme and the running and operation of the water sources; and
- The introduction of a myriad of new types of pumps and engines which complicates the maintenance situation.

Community Involvement

It has become almost a characteristic of the effort of water provision in the Northern Region that local communities are involved in one form or the other in the provision and management of domestic water sources. This widespread participation of rural communities in the provision and management of water sources arises from a growing awareness beginning in the mid-1970's by local communities that an adequate and reliable supply of domestic water is an essential requirement for the comfort of the household. Prior to 1970, little attention was given to the Northern Region in the national programmes of water provision as it was believed that the Region had an established dependency on the Nile as a permanent source of domestic water supply. Since the 1970's, the National Rural Water Corporation has supported water provision in the Northern Region, and the adoption and promotion by the Corporation of a self-help input from local communities in water supply has drawn public interest into the effort and strengthened community participation. It has thus become an established practice for communities to initiate water supply projects and approach the Corporation for joint implementation. However, there are certain socioeconomic factors common to the population of the Northern Region which have enhanced the community participation approach.

Population Homogeneity

Many factors contribute to give a homogeneous rural community in the Northern Region. From the ethnic perspective there is a dominance by the people of the same tribal origin in any specific locality. This has facilitated a common stand towards problems in general, and a cooperative attitude towards solving them.

Population Stability

Despite a continuous trend of out-migration from the Region to other parts of the country, the settlements there still have sizeable populations working on the land and managing the different forms of the agrarian economy. The stability of the population is a factor contribution to the economic stability of the area, based on irrigated agriculture with its low risk, in comparison to populations and settlements in rain-fed areas.

Enlightenment

Since early times the Northern Region has had close links with Egypt. The spread of migrants into almost all other parts of the Sudan and recently to the neighbouring petroleum exporting countries has added to the knowledge and experience of the population. At present the Region has one of the highest levels of primary education enrolment in the country. Enlightenment increases population awareness for a higher standard of life, and enhances their organizational capabilities.

Spirit of Cooperation

There is an observed spirit of cooperation among the population of the Region. The Nile has been a common enemy and people have come together to safeguard their property against its floods. Kinship and neighbourly relations call for reciprocation at different occasions. People cooperate in carrying out agricultural operations, in the use of machinery and in the sharing of irrigation water. The development of irrigation schemes under the Northern Agricultural Production Corporation, or privately, has strengthened and formalized the cooperative relationships. The spirit of cooperation extends to other facets of life, including the organization and management of the settlements' water supply projects.

Connectivity

The rural communities of the Northern Region are well-connected to their relatives residing in urban areas, to a large segment of government employees, to emigrants in the neighbouring countries, and to local and national politicians. This has aided the implementation of community water supply projects by providing financial donations, equipment; and the securing of government agencies for the execution of the project.

Emigration

In the majority of the settlements surveyed, the contribution of the emigrants to community water supply projects has been substantial. In nearly all of the cases studied, the emigrants assisted by collecting money and purchasing equipment and sending both home. The large diversity in diesel engines and pumping units mentioned earlier has partly resulted from emigrants' equipment donations.

Flow of Wealth and Capital

As previously mentioned there is a continuous flow of capital and investment into the Region. These funds are invested in agricultural activities, including reclamation of new areas and improvements of existing farms, and in housing. Investment in housing could be judged from the new extensions of settlements and the improvement of old housing. The availability of cash definitely helps in raising funds for the implementation of community development projects.

Competition Between communities

The closeness of rural settlements in location, the familiarity of people in neighbouring settlements with the on-going activities at each settlement, and the concern of the population about improving living conditions, has created a sense of competition between rural settlements to undertake community projects including rural water supply.

Knowledge of Technology

People in the Region have been familiar with technology for quite a long time. This started with the traditional peasant technology of the water wheel and animal traction for land preparation. These were gradually substituted for irrigation pumps and tractors. Other forms of mechanization in use are flour mills, trucks, small vehicles, simple factories, workshops, etc.

Management Experience

This is revealed by the involvement of individuals and communities in various management situations, for example in the Northern Region there is the Agriculture Production Corporation Schemes. In two cases the relationship between the farmer and the owner is organized through certain production relations. Cooperatives established for different purposes is another forum which brings many beneficiaries together. Local Government Councils also provide organizational experiences from which management capabilities are drawn. These learning situations provide foundations for the management of community water supply projects.

Community Representation

Out of the surveyed 30 supplies, 27 water sources (90%) are community managed. Almost all of these sources stand as community initiated projects. Only in 4 cases was a strong individual influence on the community mentioned. There is a common understanding that the implementation of water projects is a joint activity between the NRWC and communities, which entails a community representative body to approach the NRWC.

Once the community realizes the need for having a water project, whether it is the installation of a water facility or the construction of house-networks, a "water committee" is established by the community to look after the implementation of the project. Committees are usually elected in public meetings organized for this purpose. Only in 3 out of the 30 sites studied did no election of committees take place. In one instance the project is run by a group appointed by the management of an irrigation scheme, and in the other two cases by persons taking the initiative to act on behalf of the community.

The 30 supplies studied revealed that none of the communities have written laws to regulate the elections of members of their annual activities. Instead the activities of the water committees are regulated by community consensus. The terms of office of the committees were found to be 4 to 5 years. Twenty of the committees are operating within their elected term while the remaining 10 have exceeded their elected period by a number of years. In most cases, the same committee members are elected for successive terms of office for reasons related to efficiency.

The size of the committee varies from 5 to 10 members. In selecting committee members the main qualities required are the interest and ability of choice on prestige and status considerations, including education, wealth, leadership positions and a good family history, as was indicated in 8 of the sample communities. Each committee would be comprised of a president, a secretary and a treasurer with the rest as committee members.

Implementation of a Community Project

Whether the community water project is a wateryard, a lifting station for river water with or without a slow-sand filter unit or a house connection scheme project implementation follows certain steps, from initiation to completion with the responsibilities for execution of the project falling on the water committee. These steps include:

1. Meetings

Holding a series of meetings with the community members at the various stages of the project to review progress and report on the obstacles encountered and to agree on possible solutions. Twenty-five of the 30 cases studied reported convening regular meetings to address the above issues.

2. Fund Raising

Fund raising involves the collection of money to meet the contributions of the community to the project costs. The amount to be collected varies according to the size of the project. In some projects the community contributed to the initial drilling costs of the borehole/s or to the costs of the slow-sand filter/s. Amounts in the range of 300,000 Sudanese pounds were reported as being raised by committee for this purpose. In other projects the amounts required would be to cover the costs of the installation of the engine, pump, and tank; and the construction of the water network.

Fund raising may be staged, by a collection of a certain amount at the start of the project (the average was LS 50 per household) to be added to at the later stages of the project as the need arose.

3. Contact with Government Agencies

The authorities, usually the Regional offices of the NRWC, the Regional Ministry of Finance and Economic Planning and the Local District Council Headquarters give approval for the project, agree on community obligations towards project costs, agree on the operations to be carried out by each side, and schedule project execution. Twenty-four of the communities studied had gone through this approval process.

4. Travel to Khartoum

Project approval, the raising of funds from relatives residing in Khartoum, and the purchase of project equipment including engines, pumps, and pipes may entail travel of the committee to Khartoum. In some cases a bench committee for fund raising is formed in Khartoum to pursue some of these matters, and also in the countries where the emigrants work. Twenty-four of the 30 communities studied had applied these practices.

5. Organization of Manual Labour

Usually the NRWC would survey and design the network where house connections were to be installed. The water committees would provide help with the transport and the accommodation of the team. Executing the design would require manual digging for the laying of the pipelines, which is normally organized and paid for by the water committee. This activity was carried out in twenty-two of the settlements surveyed.

Management of a Community Project

Community involvement in the provision of water sources involves the management of the water source and its operation once it becomes operative. The management responsibility is carried out by the water committee. It involves many functions including working closely with the NRWC which caters for the maintenance of the source and the network, contacting the local council authorities to obtain diesel and lubricants at the official prices to run the pumping units, purchasing the spare parts and the other needed equipment including fittings and pipes, supervision of the staff working at the water source including payment of the salaries for some of them, collection of the water fees from customers and the daily supervision of the operation of the water source.

Community management of water sources is only effective through the roles played by the NRWC and the services rendered by it. A community managed water supply is a joint activity shared between the NRWC and the local water committee.

In essence, the task of the communities in the provision and management of the water source was initially engineered by the NRWC with the target of promoting self-help contributions by local communities in the field or rural water supplies. Hence, the way the process has evolved dictates maintaining a strong link between the NRWC and the water committees.

The NRWC provides most of the technical services required for the operation of the diesel engines and the pumping units, and assists in the major maintenance operations of the networks. It provides most of the engine operators (mechanics) and the guards, pays their salaries, and undertakes training of mechanics to upgrade their efficiently. The Corporation renders these services through its maintenance centres, located in the different districts.

The NRWC, as the caretaking body for rural water supplies in the Region, has the responsibility for maintenance. However, due to shortages in annual budgets, inadequate transport facilities, lack of spare parts and skilled manpower, the local committees often use the market mechanics and purchase spare parts to run the water sources. Judged on last seasons (1987/88) performance, 20 water committees depended on the NRWC for maintenance operations, while 10 committees utilized the NRWC as well as private workshops.

Regarding spare parts, out of the 30 sources surveyed, 10 depended solely on the NRWC, and 15 on the NRWC and local and Khartoum markets.

The water committees obtain a monthly fixed quota of diesel and lubricants at the official price rate from the Rural Councils for the running of their water source. However, it often happens that the local council does not receive their quotas in time, which forces committees to opt for the "black" market. At present the obtaining of their fuel requirements at official prices seems to be the only official link between the committees and the Rural Council authorities.

The Rural Council executive officers complain about the weak link presently existing between the councils and the water committees. The executive officers mentioned that the committees approach the councils in the early preparatory stages of the project for the approval of some of the matters related to project implementation and then disappear, and only reappear when the project is operated to be issued with fuel. While this weak relationship with the councils does exist, however, when conflict arises between the committees and the participants in the project, people approach the councils to settle these disputes as administrative and legal bodies.

The annual maintenance and the major maintenance operations for the tube wells and the slow-sand filter units are usually carried out by the NRWC. The water committees contribute spare parts for the maintenance operations, whether these are carried out by the NRWC or by a local mechanic.

As to which parts of the system (engine pump, tower or distribution system) require more frequent maintenance, the following responses were recorded from the 30 sites studied, which indicate that the distribution system, the engine and pump cause the main maintenance problems. (Table 3).

Table 3
Type of Equipment Requiring Frequent Maintenance

System	More frequent	Less frequent
Well	9	21
Engine	17	13
Pump	15	15
Tower	7	23
Distribution system	21	9

A limited number of staff are employed in the running of the water systems. The permanent staff includes the mechanics and guards. Their number per water source fluctuates between 1 and

5, in the case of mechanics, and 1 and 3 in the case of guards, depending on the number of pumping units, and whether the system includes a network or not.

Mechanics and guards are the two categories of the regularly salaried staff. Mechanics are usually young men chosen from the community, and trained for a short period by the NRWC to operate the diesel engine and the pumping units. The salaries of the mechanics and guards are mostly met by the NRWC. A few of them are paid by the water committees, which should not be the case, since in the policy of the NRWC it is stipulated that this component should not be part of the responsibility of the water committees.

The management of the mechanics and guards is divided between the NRWC and the committees. For the remainder of the management including daily supervision, the collection of water fees, the execution of new house connections, the procurement of fuel, spare parts and other inputs, and the keeping of accounts; the president, the secretary and the treasurer of the committee are in direct charge. They may also assign certain responsibilities to some of the committee members plus other individuals in the community. The collection of the water fees for example is carried out in some cases by the treasurer and in others by a person who is paid a fixed salary. A third method applied would be through certain shopkeepers, to whom customers would pay fees.

Collection of Water Fees

Of the 30 settlements surveyed, 26 have house connections, and 4 are without networks. However, except for 2 committees, the existing 26 networks do not cover all of the housing in the settlements. The following ranges of coverage reflect the situation. (Table 4)

Table 4
Percentage of Settlements Covered by House Connections

Percentage Coverage	Number of Settlements
Less than 10	3
10 - 19	4
20 - 39	6
40 - 59	5
60 - 79	4
80 - 99	4

The water rates vary between settlements and within the same settlement, depending whether water is obtained directly from the source or from the household distribution system. The following ranges reflect the current water pricing rates per household per month. (Table 5)

Table 5
Range of Water Rates

Range in LS	Number of Settlements
Free	3
Less than 5	3
5 - 10	22
11 - 15	1
16 - 30	1

The average paid by a household for the sample surveyed is 8.6 pounds.

No water meters are used to measure household consumption, either at the source or in the houses. All households in a settlement have equal access to water for domestic purposes, and pay the same monthly rate, irrespective of the amount each household draws for domestic use. Uses for gardening, or drawing of extra amounts for house construction are charged additional fees. Controlling the use of non domestic water is one of the day-to-day supervisory responsibilities of the water committees. This is commonly one of the areas of conflict between the committees and users.

Communities do not see a need for installing water meters. The reason for this, as gathered from the survey findings, centres around the belief that water meters are costly and require elaborate management; the expenses of which are beyond the resources available to the community, that there are no big variations in household consumption, and that there is scope for adjusting the rates any time through community consent.

As explained previously, water fees are collected directly for the water committees by an assigned member, the treasurer in most cases, or through paying at special shops. It is noted that adherence to month-by-month payment is not strictly followed by customers, resulting in arrears. However, committees usually try to have all arrears paid before closing the accounts for the fiscal year.

The success of the community managed water sources could be judged on many yardsticks. One of them would be the ability of the community to install the system and satisfy a felt need. Another would be the provision of domestic water to satisfy the daily requirements of the household. A third would be the financial performance and to what degree it is self supporting.

On investigating this last point, the following data (Table 6) provide a good basis for the discussion of the financial performance of the water committees.

The information covers 23 out of the 26 settlements with networks from which the survey team was able to collect data on revenue and expenditures at the time of the survey. The missing data on the 3 settlements was either due to the committee member in charge of the accounts not being available, or that the accounts were not ready.

It is apparent from the data (Table 6) that the annual revenue collected ranged from 4,200

to 156,000 pounds, and the annual expenditure from 5,620 to 53,300 pounds. The size of the revenue is a function of the number of customers and the efficiency of collection. Expenditure covers the normal operation costs and the major replacement and development requirements of the water system.

Table 6
Revenue, Expenditure, Surplus/deficit (LS)
for 23 Water Sources with House Connections
1987/88

Settlement	Revenue	Expenditure	Surplus/deficit
<u>Northern Province</u>			
Dalga	4,200	40,380	- 36,180
Akked/Sareg	13,800	17,680	- 3,880
Kerma El Balad	156,000	53,300	+ 102,700
Labab	13,800	10,800	+ 3,000
Dumbo	12,600	8,610	- 3,990
El Golid Bahri	12,260	12,230	- 0,030
El Gaba	18,000	12,080	- 5,990
El Debba	28,000	28,076	- 0,076
Genette El Onia	12,000	5,620	+ 6,380
Hissain Narti	7,800	6,780	+ 1,020
Korti	10,500	11,180	- 0,680
Qoz Gurafi	10,500	8,460	+ 2,040
Abu Dom	18,000	21,000	- 3,000
Merowe	78,600	22,200	+ 56,400
<u>Nile Province</u>			
El Bauga	10,800	8,260	+ 2,540
Gdalla	9,000	8,618	+ 382
Kedebas	23,040	14,480	+ 8,560
Sidon	3,540	9,480	- 5,940
El Hudaiba	6,000	10,000	- 4,000
Abu Seleim	9,600	5,312	+ 4,288
El Zeidab	45,000	26,400	+ 18,600
El Aigeida	3,240	7,840	- 4,600
Kelley	25,200	21,600	+ 3,600

On relating expenditure to revenue, 15 of the committees have a surplus income and 8 a deficit. The main reason behind the deficits is due to one of the following factors:

- Spending on major maintenance operations;
- Cost of replacement of machines; and
- Inefficient collection.

Financial deficits are usually made up for by subscriptions from the community which are collected as additional funds. Surpluses, on the other hand, are kept as reserves carried into the next years budget. Some communities, however, are contemplating organizing new community-funded projects (such as electricity connection to houses) and applying the surpluses from water revenues to these purposes.

In the final assessment of the financial performance of the community managed water sources, the picture would not be complete if the support given by the NRWC is not taken into consideration.

The field survey revealed that there are two types of subsidies provided by the NRWC:

1. Provision of all the fixed costs.
2. Sharing of the fixed costs between the NRWC and the beneficiary communities.

The share of the community is represented by the payment in the drilling phase (including transport of material to site) partial payment of the cost of the installation (engine, pump and tank) and full payment of the network cost. The running cost is shared between the community and the NRWC. The NRWC share appears in the technical supervision and the maintenance, besides the salaries of the mechanics and guards, at most wateryards.

In the 30 supplies analyzed, the water committees do not include the Corporation's expenditures on maintenance and the salaries of the mechanics and guards in their accounts. Costing the maintenance services of the Corporation by water source is not easy due to the lack of this kind of accounting. However, an amount of LS 5,000 per annum is estimated as an average maintenance cost per water source which is incurred by the Corporation. Added to that, an amount of LS 4,800 as the salaries of the mechanic and guard, it is estimated that on average, a community managed water source receives a subsidy of about LS 9,800 per annum from the NRWC.

Principle Findings

This final section aims at assessing the capabilities of community managed water sources, identifying the key lessons to be learned, making recommendations as to how their performance could be improved within the Region, and pointing to the possibilities and problems of replicating the Northern Region experience in the other parts of the country.

Data collected through a questionnaire given to 70 community members (Community Perception Questionnaire) and one given to 22 government officials (Official Perception Questionnaire) provided a basis for evaluating the success of these community managed sources.

The systems' capability is judged from the users' point of view, as to whether it provides adequate and timely water or not. Data from the 30 settlements reveal an average daily household consumption of 56 gallons, which is effectively provided by the community managed systems. All respondents confirmed that they obtain their daily requirements of water when the system is working. However, stoppages from time to time were reported, due to various kinds of breakdown, which resulted in either a complete failure or a shortage of supply. In both cases, people resorted to the Nile or to open diameter wells as a substitute. The irregularities of supply are a continuing source of dissatisfaction to communities. Overall, 47% of the respondents are satisfied with their systems and 53% are dissatisfied.

Whether the community managed water supply system is reliable or not was one of the issues put before the group of officials and resource persons interviewed and the users of the system. The responses gathered from the first category confirm that the system is judged to be 90% reliable.

Overall, users were positive about the performance of the management committees, with 71% satisfied with the performance of the committees and 20% dissatisfied. Answers received from the officials and the resource persons confirm similar results: good (66%), obstacles by friction (17%), and inefficient accounting (17%)>

Frictions due to competition over leadership, mostly stimulated by political rivalry (a factor which emerged recently with party politics) was mentioned in many settlements. Inefficient accounting was also raised; sometimes elevated to an accusation of the committee members of financial violations of the cash resources under their disposal.

A number of obstacles to community managed systems were raised. Some of the constraints are physical, and others are management. The ones most frequently mentioned include: lack of spare parts (32%), shortage of fuel and lubricants (sometimes bought at "black" market prices) (27%), low quality and capacity of engines (13%), continuation of committees beyond their terms of office (12%), inefficient design and poor construction of networks (8%), and the non-legal and non-institutionalized status of the water committees (8%).

The solutions to the above problems are indicated by the answers to the question: "what are the best conditions required to run an efficient community managed water system", which was asked of officials, resource persons, and users. The answers suggested the following solutions:

- Improvement of the designs and the laying of the network (26%);
 - Better availability of spare parts (21%);
 - Financial support by the government to replace inefficient engine and pumping units (20%);
 - Legalizing and institutionalizing the status of the committees (19%);
 - Introducing a system of official/public monitoring of the work of the committees (11%); and
 - Minimizing the conflicts arising from political rivalry (3%).
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The main findings of the study can be summarized as follows:

1. Domestic water sources in the Northern Region used to be provided by the NRWC but recently and increasingly, their provision has become a joint activity between the NRWC and the beneficiary communities.
2. The management of the water sources, as well as the development of the network, is fully the responsibility of the local communities with the Corporation assisting in some of the technical matters such as the maintenance of the source, the engine and the lifting units.
3. There are certain socioeconomic factors that are characteristic of the Northern Region which provided the preconditions for the success of community managed systems in the Region.
4. Through the approach of management by the communities was initially introduced and encouraged by the NRWC, communities are presently taking the lead and are promoting the approach, while the NRWC lags behind in matters relating to the institutional development of the system.
5. In implementing projects, people have relied on their system of social organization of relationships in organizing the participants and raising funds, borrowing from the modern systems the election of committees, without realizing a need for any written laws.
6. Though the system, communities have succeeded in obtaining adequate water for their domestic needs. Water from the tube-wells is of good quality, while that from the Nile is potable and its quality was not identified in the survey as an urgent priority at present.
7. The cost of running the system is reduced by the free-of-charge management and supervision responsibilities carried out by committee members and the other assigned individuals in the community. The subsidy given by the NRWC enhances the capabilities of the system. The revenues collected generally meet expenditures in the majority of cases and when there is a deficit the community is prepared to make up for it through subscription and donations.
8. Generally people are satisfied with the performance of the system and see no alternative to it. The major problems encountered by community management centre around shortage of spare parts, irregularity of fuel supplies, poor quality engines in some cases, limited capabilities of engines in others, inefficiency and inadequacy of housing connections, and lack of controlling laws on the activities of the committees.

Recommendations

Based on the study the following recommendations are proposed to improve the provision of water supply in the Northern Region.

The system of community managed water sources in the Northern Region seems to have developed under a *laissez faire* atmosphere. It requires to be controlled through definition of responsibilities and roles, and the linkages with the related agencies, namely the NRWC and the Local Government councils. This would entail legislating the activity through the issuing of a departmental law or Local Government Ordinance.

So as not to be a top-down official move, local communities through their representative water committees should be consulted about any proposed legislation. The purpose of the legislation is not to undermine the efforts of the communities in improving their water supply situation, but to enhance these efforts by enabling both communities and the government agencies (that have dealings with water provision and the welfare of the local communities) to effectively monitor the performance of the system.

The legislative move should be followed by an effort to improve the institutional and the management capabilities of the water committees through timely elections, training in accounting, budget preparation and record keeping.

Despite the market limitations regarding the availability of the right kind of machines for the pumping units, the NRWC should work towards implementing a scheme for the standardization of the mechanical units (mainly engines and pumps) in use and should assume a leading role in this.

This scheme of institutional development should consider creating an association which would bring together the water committees of each province. One of the tasks of the association would be to develop a revolving fund for the procurement of spare parts. The fund should be built from fixed contributions by the water committees, and subscriptions by the NRWC and the Regional Government. The spare parts should be sold at market price to the committees.

House connections present one of the drawbacks of the system due to the fact that they are poorly designed and, over time, networks expand beyond the capacity of the system as a result of uncontrolled connections. This is an area which require attention and revision by both the water committees and the NRWC.

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