824 KEEA91

LIBRARY
INTERNATIONAL REFERENCE CENTRE
FOR COMMUNITY WATER SUPPLY AND
SANITATION

P L A N / E M B U B O R E H O L E W A T E R P R O J E C T - E V A L U A T I O N

KENYA

APRIL 15, 1991 TO JUNE 25, 1991

No community emphasis

REPORT BY PLAN INTERNATIONAL/EMBU

PREPARED BY PATRICK MUNGAI NGURURI
RESEARCH & EVALUATION COORDINATOR

824-KEEA91-11373

P L A N / E M B U B O R E H O L E W A T E R P R O J E C T - E V A L U A T I O N

APRIL 15, 1991 TO JUNE 25, 1991

REPORT BY PLAN INTERNATIONAL/EMBU

PREPARED BY PATRICK MUNGAI NGURURI
RESEARCH & EVALUATION COORDINATOR

IBN 11373
824 KEEA91

P L A N / E M B U B O R E H O L E W A T E R

P R O J E C T - E V A L U A T I O N

APRIL 15, 1991 TO JUNE 25, 1991

REPORT BY PLAN INTERNATIONAL/EMBU

PREPARED BY PATRICK MUNGAI NGURURI
RESEARCH & EVALUATION COORDINATOR

EXECUTIVE SUMMARY

I. Purpose of Study

This report presents findings from the Plan/Embu Borehole Midterm Evaluation. This evaluation was commissioned by PLAN/Embu Field Office with three principal objectives:

(1) Assess the impact of the project on the target population with a focus on the boreholes already operating.

(2) Assess the performance of the hardware (technical) aspect: quantity and quality of water, its reliability, pump functioning, level of community training in simple maintenance, adherence to pump specifications and other technical concerns.

(3) Assess the likelihood of sustainability, and the degree of community participation: assess the project's progress toward becoming self-sustaining technically, institutionally and financially.

II. Contributors and Timing

The survey was carried out by a multi-disciplinary team of four highly experienced professionals in water-related projects. The team was composed of the following:
Community Water Engineer: studied the hardware aspect.
Community Sociologist: studied the software special emphasis on community mobilization.
Health Officer: studied software with a special emphasis on health.
PLAN/Embu Evaluator: studied software with a special emphasis on financial organization.

The survey design took about two weeks; the pre-test eight days, and the actual data collection two weeks. The whole survey from design to analysis took about 60 working days, commencing on 15 April 1991 and ending on 25 June 1991.

III Methodology

All operating boreholes were studied, as well as some without handpumps; a total of 28.

Data was collected by observing drawers of water using the handpumps, interviews with groups and individuals, technical measurements and studying written records and reports. The team also held discussions with the program water engineers and the community leaders.

IV. Summary of Findings

1. **Impact of Project on the Target Population**

The major impact was the availability of clean water to many families within a radius of 5 kilometers of their homes. Borehole sites are fairly distributed within the Division, though a larger percentage were sited in Mbeti Location. For those using the boreholes, the average round trip time used to fetch water has decreased from 4 hours and 20 minutes, to one hour. This has allowed women more time to work in their shambas and care for their children. Although community awareness of the benefits of clean borehole water has increased somewhat, evidence showed that the majority still use traditional, albeit contaminated, sources of water. The use of borehole water appears to be hindered by maintenance payments required, dislike of queuing for water, and traditional attitudes and practices. More health education is needed to stress the difference between borehole water and that from traditional sources, to teach proper water storage, and to emphasize the importance of proper excreta disposal.

payment

Hygiene/san

The boreholes located at Rwika and Kiambere Health Centers have had a strong positive impact on the health of the surrounding communities. These Health Centers reported that fewer people have been diagnosed with water-related diseases, notably amoebas, since the boreholes became operational. However, for the other boreholes, no impact on health was evident at this time.

The Rwika Family Life Center will be able to admit its first trainees due to the availability of clean water. The nearby Technical Institute had a history of student strikes because of water shortages; these have ceased since borehole water has been available on a reliable basis. Schools noted that the time saved by students in fetching water allows them more time for study and recreational activities.

Overall, clean water has become more accessible to the target population. Time and labor needed to fetch water on a day-to-day basis has been substantially reduced.

2. **Performance of Hardware**

28 handpumps were technically evaluated for manufacturing faults, borehole construction and handpump installation,

in terms of sustainability, ease of operation and maintenance. 21 handpumps were operational, 5 were not and 2 were awaiting installation.

All boreholes have a casing diameter of 110 mm. High-yielding boreholes(suggested 6.0 cubic meters per hour) should have casings of at least 150 mm. diameter, allowing for high-capacity submersible pumps to be installed when the need arises.

Handles had been broken and welded on 8 pumps; 4 had the fulcrum, hangar pin or anti-rotation lock pin sheared. 6 pumps had problems with the bolts resulting in difficulties in opening the pumps. 12 pumps had poorly constructed aprons and pump pedestals. The Afridev pump installation manual was not adequately followed.

Because communities were not deeply involved in planning and implementation, protective fencing, water basins and livestock watering facilities were not included in the design. In addition, committees were not adequately trained to handle pump operation and maintenance; very few women were involved in the little training conducted. Women, as drawers of water, must be more heavily involved in the operation and maintenance of the handpumps.

The availability of spare parts close to the community is critical to adequate maintenance, and needs to be addressed at the program level. PLAN/Embu should provide for regular monitoring and servicing of the installed handpumps while communities are being prepared to take over the running of the handpump projects.

3. Sustainability and Community Participation

For any community-based water project to succeed, community participation is very crucial. The community should be totally involved from the project's conception and throughout its implementation for the project to be self-sustaining. In the case of boreholes, community participation during site identification and investigation, handpump installation and monitoring/evaluation is critical.

The mid-term evaluation found that the <u>software aspect</u> of the borehole program was not given maximum attention. The community was not well prepared, their contributions were insignificant and their involvement in implementation was minimal. This was evident from the number of meetings held (<u>68%</u> reported not being aware of any meetings being called by Plan), records of community activities and lack of community contributions of

training on simple maintenance, adherence to pump specifications and other technical concerns.

(3) Assess the likelihood of sustainability, and the degree of community participation: assess the project's progress toward becoming self-sustaining technically, institutionally and financially.

III. Contributions and Timing

The survey was carried out by a multi-disciplinary team of four highly experienced professionals in water-related projects. The team was composed of the following:
Community Water Engineer: studied the hardware aspect.
Community Sociologist: studied the software special emphasis on community mobilization.
Health Officer: studied software with a special emphasis on health.

PLAN/Embu Evaluation: studied software with a special emphasis on financial organization.

The survey design took about two weeks: the pre-test eight days, and the actual data collection two weeks. The whole survey from design to analysis took about 60 working days, commencing on 15th April 1991 and ending on 25 June 1991.

(IV) METHODOLOGY

(I) Area Studied

Gachoka Division is the geographical area that was studied. This is one of the four divisions that make up Embu District in the Eastern Province of Kenya. This division is divided into six locations, namely Mavuria, Karaba, Makima, Kiambere, Mbeti and Embu municipality. The borehole drilling took place in all locations except the Municipality, since it is supplied with a piped water system. The table below shows the geographical distribution of the boreholes at the time of the evaluation.

TABLE 1

LOCATION	+ve B/H drilled	% OF total
Kiambere	17+	20
Mavuria	18+	21
Mbeti	23+	29
Makima	12+	14
Karaba	14+	16
TOTAL	84	100

SOURCE: PLAN/EMBU WATER ENGINEER

5 1/2 7 missing

The Gachoka population is estimated to be about 120,000, the majority of whom are women and children.

(2) Projects Evaluated

PLAN/Embu intends to implement a total of 100 boreholes. This mid-term evaluation studied all boreholes that have been operating since 1984. In addition, a few boreholes without handpumps were studied to find out which pre-requisites were met or not met in terms of community preparation, awareness, land issues, siting, drilling, pump testing and other software issues. In total, we studied 28 boreholes, of which 7 were not operating for one reason or another at the time of the evaluation.

25% not operating

(3) Methods of Data Collection

In view of the complexity of the issues a variety of evaluation methods was used. Individuals (Plan staff, teachers, nurses, drawers of water, schoolchildren, community leaders and committee members) were interviewed using a prepared questionnaire. Group discussions were held, using the same questionnaire as a guide. In some group discussions, women were separated to accurately assess their degree of participation. Measurements were used for technical assessment. The evaluation team observed drawers of water using the handpumps. Records, correspondence, meeting reports and minutes and other available documents were studied.

4. THE EVALUATION FINDINGS

(V) TECHNICAL (HARDWARE) EVALUATION

(1) Introduction

During the period 1984-1986 World Bank/UNDP conducted a handpump testing program for the Kwale Water and Sanitation Project in the Coast Province of Kenya. The objective was to develop and set standards for a handpump which was simple to operate and maintain, affordable, and of appropriate technology for the rural community.

Characteristics of this target handpump were:
- Locally manufactured, with spare parts made cheaply and easily available
- Easy to operate and have reasonable pumping capacity
- Simple construction that could be easily understood by novices
- Able to be maintained using only one spanner and few other tools.

For the purpose of meeting these criteria, the Afridev handpump standardization was developed. This pump is currently manufactured by Pwani Fabricators in Mombasa and East African Foundry Works in Nairobi. Most handpump spare parts are manufactured by Industrial Plastics in Nairobi. (See Appendix A for technical drawing.)

(2). Evaluation Objectives

The objective of the borehole technical evaluation was to determine the level of efficiency of operation and the potential for community maintenance. These factors affect the level of sustainability of the project.

Optimum efficiency can only be achieved if:

(a) The handpumps are manufactured to the specified standards (World Bank/UNDP)

(b) The borehole constructions are able to sustain the intended life of the pumps and pump accessories installed

(c) The installations are done according to the established standards and specifications

(d) Spare parts are available and affordable

(3) Technical Evaluation Findings

(i) Handpump Manufacturing Specifications

In the handpumps studied, the following manufacturing problems were identified:

Handpump Handle: 36% of the pumps had handles broken at or near the fulcrum point. The communities took the handles for welding. Among these, a few handles had broken twice and show signs of breaking again. At the present time, new handles are being re-welded by PLAN prior to installation.

Fulcrum and Hanger Pin/Anti-Rotation Pin: In (4) pumps the anti-rotation pins had been sheared off. This made it difficult to open up the fulcrum and hanger pins for routine inspection of the bearing bushes. The lock pin thickness is 5 mm. Manufacturers had earlier been advised by the World Bank evaluation team to increase the pin thickness to 6 mm. This has not been implemented.

Pump Head Bolts: The pump head bolts and nuts are

supposed to be of size M16. A guard weld is supposed to be incorporated to prevent the bolts from rotating. In 8 pumps the bolts were either rotating, or are smaller than the specification.

Rubber Centralizers: It was evident that the nitrile rubber centralizers were getting worn out faster than anticipated. This may be attributed to pump over-use and, as was noted in a few cases, centralizer material of inferior quality and poor fabrication. The most common failures were cracking of the centralizers along one edge.

In some pumps centralizers tended to wear asymmetrically, probably due to small irregularities in rising main alignment or pump rod straightness. Centralizers are expected to last between two and three years. In the pumps examined they lasted less than the intended period.

Pump Rods: In (8) cases the pump rods had undergone some corrosion, though it was not very severe. The best solution to corroding rods is to use stainless steel rods. However they are more expensive than galvanized steel rods. Communities experiencing the problem should regularly check the rods and be advised to keep spare pump rods.

(ii) Borehole Construction

Proper construction in readiness for handpump installation contributes to project sustainability. For this reason, the Afridev pump manual specifies construction details to be followed.

The following aspects were studied:

Borehole Drilling and Casing: Drilling and final casing should be done in a way that enables communities to adapt other handpump technologies that can provide more water and serve them better as their economic status improves. All the boreholes drilled in the program had casings of 110 mm. diameter, which limits communities to the Afridev handpump.

Pump Pedestals and Aprons: (40%) of the handpumps examined had poorly constructed aprons and concrete pedestals; Afridev handpump manual specifications were not followed. Several sites exhibited cracks or concrete peeling off due to poor workmanship and inferior quality materials. Poor quality sand from seasonal streams near the borehole sites may have been used. We were told that construction of many borehole sites was going on concurrently; thus

supervision became difficult. During peak water draw periods the aprons became very overcrowded with people, containers and animals. This overcrowding and congestion leads to breakdowns, as the aprons were not built to sustain this much traffic.

Other Facilities (Wash Basins and Livestock Watering): It was evident that some communities (i.e. Kiambere) valued livestock highly, and improvised facilities for them at the borehole sites. Basins were used to water livestock at the handpump area. Other communities blocked the drainage channels to act as cattle troughs. Some communities (i.e. Muraru) are raising money to construct cattle troughs. In another site (Kanyaga) members of the community could be seen washing clothes near the handpump. Discussions between the community and the engineers prior to construction would have identified facilities to be added as part of the project.

(iii) Borehole Installations

It is only when handpumps are properly installed that they become affordable, easily maintained and consequently sustainable. Minor specifications being ignored adversely contributed to the project cost and made pumps difficult to maintain.

Clearance Between Concrete Pedestal and Pedestal Flange: Afridev manual specifications call for a 90 mm allowance to facilitate the use of the handpump spanner. This specification was not met in 46% of the sites visited. Thus, these communities cannot open up the pump bolts with the handpump spanner provided. They must locate other types of spanners, escalating the cost and time involved in maintenance.

Hanger Rod Clearance: The top (hanger) rod is specified to be cut leaving an allowance of 50 mm from the top sleeve to the cut mark. In sites where this specification was not followed, lower pump efficiency was evident in the measured discharge. At other pumps the hanger housing dented the pump cover; in one of them the cover edge was split by the impact.

Rising Mains: These are made of UPVS pipe class E. When improperly installed, parts wear out faster than expected, and installing the pump plunger and pump rods becomes difficult. The main was not properly installed in one pump; in 2 cases the main was improperly repaired.

(iv) RECOMMENDATIONS

1. Manufacturing Faults

The Afridev handpumps manufactured by Pwani Fabricators have manufacturing faults such as weak handle fabrication, shearing of the lock pin, thin pump head plate, non-fitting fulcrum house, and the omission of a weld to prevent rotation of the bolts.

The nitrile rubber centralizers should meet manufacturing specifications. Users should insist that manufacturers provide parts that meet the most recent specifications (e.g. lock pin thickness).

When faults are noted, they should be referred to the manufacturer for rectification.

East Africa Foundry Works handpumps have fewer manufacturing faults than those made by Pwani Fabricators, and should be used in the future.

2. Construction Mistakes

Contractors must be closely supervised to ensure that specifications are followed and that good workmanship is demonstrated. Construction materials should always be inspected before use. The Afridev handpump manual should always be followed.

For project sustainability, all aprons, pedestals and bucket stands with evidence of failure should be redone to specification by the contractor prior to the projects being turned over to communities for maintenance.

Handpump areas should be fenced to prevent pump misuse and to prevent animals from destroying the handpump sites.

High-yielding boreholes should have casings of not less than 150 mm to allow future use of higher-capacity pumps as the need arises.

Correct bolt sizes should be used and a guard weld and metal plate incorporated to prevent the bolts from rotating when opening up the pumps. This will enable the communities to use the spanner supplied with the pump instead of having to find others.

3. Modifications

At every handpump, communities had fabricated funnels or turned pump spouts to prevent the spilling of water and to save time in pumping. The spout should be funnel-tapered to reduce spillage, eliminating the need for homemade funnels which may contaminate the water.

Wash basins and cattle troughs should be added if the communities so desire. However, guidance from engineers is needed to place these facilities where they will not pollute the water sources.

It is recommended that apron dimensions and shape be increased to 2.0 m. diameter for ease in construction, maintaining cleanliness and for the convenience of the user.

4. Handpump Installation

The Afridev handpump manual is very simple and clear, and was developed only after a pump test study. Its specifications should be strictly followed. All major modifications should be publicized so that manufacturers and implementors can adopt the modified specifications.

5. Monitoring of Handpump Performance

It was clear that no monitoring activities had been carried out. Pumps as old as two years had never been serviced. In a few cases pumps had been opened up, but only in cases of breakdown. Lack of maintenance has resulted in some parts (e.g. centralizers and bearing bushes) wearing out completely and causing damage to adjoining parts.

The pumps were simply handed over to the communities permanently without preparation. It is recommended that PLAN/Embu organize a pump servicing program as communities are being prepared to take over the projects.

(V) SOFTWARE EVALUATION

(1) INTRODUCTION

Community preparation in planning and implementing a community-based borehole program is absolutely essential. Success depends on awareness creation and community mobilization. Installation of a rural water supply is much more easily achieved than long-term success, which depends on effective maintenance and sensible management.

ES

focused on the following:

rehole program on people within the titutions (schools, health centers, itutes) and on improvements in on.

PLAN staff to the borehole projects ir user groups.

tion, involvement, organization and

tion

committees; training of leaders and ees

ent

sustainability

INGS

e Program

e fairly well distributed within the a larger percentage are in Mbeti the 28 handpumps served a minimum ople.

vailable to some families within a s, eliminating the need for women to looking for water. For those using average round time used to fetch rom 4 hrs and 20 minutes to 1 hour. eing utilized for other economic enerating projects, planting and hild care. Some women interviewed up to 12 hours per day scooping for

was found in institutions such as schools, health centers, the Family technical institutes and churches ir compound. The Rwika Family Life be registering its first trainees new availability of clean water. al institute, there have been no

ted by water shortages as there

to suggest that formal hygiene in any borehole project specially true for the early mented before US AID came onto since that time, the health much stressed in the logical sal to US AID, remained only on ddressed health needs through alth Workers, that program was y separate basis, and was not ole project.

lachoka community still uses ter rather than borehole water. payment required for borehole get water from the borehole and he difference between borehole itional sources. Attitudes and e also found to discourage some g water from boreholes.

e demand for borehole water rose rainy season, about 60% of the access to operational boreholes water from the sand, or drawing ed in dirty depressions and

l officers at Rwika and Kiambere reholes have had a very positive and the health of surrounding ence of water-related diseases, dropped drastically since the . But for the other boreholes, ct on health was found. Formal safe and plentiful water, safe andling and storage of water and water had not been implemented sited.

AN, the Projects and the User

was seen by community members program with only 39% claiming has not yet reached its goal of program that gets assistance from ery large emphasis on end results not enough attention paid to

generating full commitment from the beneficiaries. The objectives of the program were not clearly explained to the communities, and when we asked people if the role of the community in borehole planning and implementation was clear, 75% said "no".

Most of the problems with handpumps (70%) were reported to CDWs, in many cases by caretaker committees. With the exception of schools, communities took little initiative in solving their own problems. Moreover, the borehole project was not integrated with other projects in the program like Small Business Department and Education..

Community Preparation

No reports, records or other evidence of a well-developed methodology for obtaining community participation was found. Records available indicated that a lot of this work was left to the drilling team, consultants, engineers and contractors. However, the main interest of these technical people was to attain physical goals. They had neither the time nor the resources to mobilize the community effectively. Consequently, community preparation, the foundation of successful programs, was found lacking.

Role of the Communities in Siting

Interviews indicated that identification of sites was done hurriedly without much time for community involvement. Many community members told us that the selection of sites was not done according to the wishes and expectations of the beneficiaries.

Lack of involvement of local leaders was a very serious oversight, and has led to land issue problems on some sites. In Mbeti location, where the area chief said he was not consulted, land disputes have already emerged.

At the Irabari borehole in Mavuria Location, the land issues appear to be very complicated. The person who had allowed the borehole site to be used as a public utility lost his case of ownership of the land. The new owner and his family refused to allow people to draw water because, according to their religious beliefs, pumping water on the sabbath was a sin. Thus the handpump had to be dismantled on the eve of every sabbath to avoid use by the community. Eventually the pump broke down and it remains in that condition to date. Some community members now feel that the borehole should be abandoned and another drilled somewhere else. This issue is being dealt with by the area District Officer (DO).

In Makima there is an accessibility issue. While the owner of the land on which the borehole is located is cooperative, the owner of the land over which people pass to draw water has refused to allow people to trespass on his land.

In Mbeti, one case involves a landowner who insisted that the water be pumped to a water tank next to the road. She preferred an electric pump and was opposed to equipping the borehole with a handpump as long as it is on her land. The issue of paying the recurrent costs of electricity made sustainability very cloudy. To date, this borehole has not been equipped with a pump.

The evaluation team did not find a single document written and duly signed authorizing the use of the borehole site land by the public.

Available evidence shows that no particular criteria were set to guide the siting of boreholes except the availability of ground water. Socio-cultural factors that would adversely affect the use of the boreholes were not addressed. Consequently, at some boreholes factors such as religion, land ownership disputes and lack of accessibility made the pumps useless to the intended beneficiaries.

Siting criteria needed to have been set right from the beginning. In most borehole programs the following criteria are used:

(1) The site should be chosen principally on hydroelectric (or related) geographical grounds so that the greatest chance of obtaining an adequate yield is achieved.

(2) The site should be free from potential pollution by latrine and animal wastes.

(3) The site should be within 4 kms of the community, preferably less, with the actual location being easily accessible to the community. Where possible, the water point should be central to the intended beneficiaries.

(4) The site should either be free from risk of flooding or capable of being protected from flooding by suitably designed headwork (i.e. a raised concrete plinth).

(5) The site should be one which is not at risk of erosion due to usage by animals.

(6) There should be no land dispute where the borehole is to be drilled. There should be a written agreement duly

signed by the owner and witnessed by local leaders.

(7) The population of beneficiaries (Baseline Survey of Population) should prioritize sites.

It is not always possible to achieve all these criteria at every site since the overriding criterion is that of finding water. But it is imperative to assess the effects of not adhering to some of them.

Even though siting was contracted to a private consultant, the evaluation team felt that these criteria could have been given more serious consideration. Ensuring community participation in siting was simply overlooked in developing the contract between PLAN and the consultant.

Community Involvement, Organization and Contributions

The evaluation team found little evidence of organized activities to achieve effective cooperation between organized community groups and sources of technical and material support provided by PLAN. There was little involvement of communities in analysis and planning, although some community members participated in the clearance of bushes to the sites.

Discussions with some leaders showed that many actually were unaware that the project had begun. It was the movement of drilling machines that attracted their attention.

There was no evidence of any significant village organization structure in place during implementation. There was little mobilization of locally available resources from the community; thus, contributions by community members, either in cash or kind were not significant. Beneficiaries did not become involved enough to make borehole water use a priority and insure the sustainability of the project.

Participation of Women

Women, the primary drawers of water, were not actively involved in the implementation of the program, which was a serious omission. The Afridev pump's simple design was intended for ease of use by women and children.

Discussions with women at most boreholes showed a high degree of willingness and interest in learning how to operate the handpump. At Kaseve, the evaluation team was forced to conduct some small training on the spot.

Community women's group leaders (such as KANU Maendeleo ya Wanawake) were not involved in the borehole project. Representation of women on water committees was found to be minimal, with men outnumbering women on (90%) of committees, and 3 committees having no women at all. In some areas, while women were officially committee members, their presence was not recognized by men. In other established programs, generally 2-3 women participate fully on water committees.

Water Committees

In all the water committees formed except for 2 in Makima, many members were selected by chiefs. These members were not always representatives of consumer groups. Most committees were formed hastily without thoroughly discussing the roles and responsibilities of each member. This type of selection denied the beneficiaries a chance to elect people of their own choice democratically. Most committee members interviewed did not demonstrate an understanding of the role of the committee in the borehole program.

Not one of these committees has ever called a meeting on its own initiative. None maintain records on the progress of their projects. For some sites, committee members are not even beneficiaries of the projects, they live far from the water points.

In some areas, committee organization was quite confusing. There was some indication that Ciorindagwa had two committees which had not agreed as to which should be in charge of the borehole. While school committee members felt that the borehole was their responsibility, the community insisted on having its own committee.

None of the water committees interviewed were officially registered with the Ministry of Culture and Social Services.

None of the committees interviewed had developed active, effective lines of communication between their members and the village. At Kaseve and Irabari, these committees commanded no respect at all and were unable to convene a meeting; these two boreholes have been abandoned.

Training of Caretaker Committees

In all the boreholes visited the evaluation team asked that training committee members dismantle and assemble the handpumps. It was thus established that very few

committee members could do these tasks. Because an attempt at training was made only once during the installation time, most lacked knowledge of parts requiring routine inspection. Most committee members had never actually participated in assembling handpumps before.

Records available indicated that training was to be done in two phases. The initial training was conducted by the contractor. Interviews with community members however, indicated that the training was quite brief, and participants did not have adequate time to understand handpump operation. This training had little impact on the community.

The next phase of training was to be conducted by the project engineers. Committees trained by engineers appeared to have more skills and knowledge than those trained by contractors. However, no single trained committee member was capable of dismantling and assembling the handpump without guidance. Committee members were unable to diagnose problems or trouble-shoot parts.

No evidence of monitoring or follow-up to check the level or impact of training offered was found. This oversight led to cases such as that in Itabua, where the handpump remained broken and unused for six months. The only problem was that a piece of rubber had entered the plunger seal and opened up the bobbin, so people could not get water when they pumped. If adequate training and monitoring had been done, this minor problem could have been diagnosed and repaired immediately.

The detailed training plans found in project files were not put into practice. Training was actually limited to removal and replacement of the pump rods. That appeared to be all the communities knew about maintenance. They did not know how to diagnose handpump problems .

Overall, evidence showed that community training was not sufficient for proper routine maintenance of the handpumps, for financial management or for community organization.

Financial Management

In all boreholes visited except one (Gwakarigo), we found that financial management was very poor. Program staff for Gwakarigo held a basic accounting training with the caretaker committee, and contributions and expenses were well documented at that site. For the rest of the

boreholes, proper financial records were found to be missing or never kept at all. Only 10% of all boreholes visited had records of the cash they had collected from beneficiaries, and these records were lacking in detail.

Discussions with committees revealed that they had not opened bank accounts. Money collected for maintenance was in the custody of some members of the committees, which inevitably led to suspicions about the misuse of funds.

At Kaseve borehole, financial contributions were kept by the Treasurer and the Secretary, and attempts to get a consolidated report proved futile. The Treasurer had paid himself all the money he had contributed and the Secretary claimed that he had been using his own money for repairs in the past. But further discussion with the community revealed that he had secretly kept about ksh 2,500/= meant for borehole maintenance and the money could not be found anywhere. After pressing him hard about the whereabouts of the money, he admitted that he had used the money to stock his shop. At the time, that borehole needed very simple repairs, but there were no funds available to meet repair costs. The consumers of Kaseve water are not willing to contribute anything until a proper committee is democratically elected by those who draw water there. This is the kind of picture we got in several of the boreholes that were evaluated.

The evaluation team was able to determine the total number of households drawing water from each borehole and the amount each was supposed to pay. However, when we asked for lists of those who pay regularly, such lists were nowhere to be found.

Many water committees had no well defined cash contribution methodology to be used. In many cases there were no repercussions for defaulters on contributions for maintenance and operations. PLAN never defined the community's participation and responsibility for handpump maintenance, which affected fund contributions negatively. Many communities interviewed felt that PLAN was solely responsible for all maintenance and repair costs.

Affordability and Sustainability

People in Gachoka Division have various sources of income (cotton, millet, peas, and livestock rearing). They actually have enough resources to maintain the handpumps. While the potential exists, it has not been tapped.

Training of committees in contribution procedures and proper management has not been adequate.

(IV) RECOMMENDATIONS

Re-Organizing and Registering Water Committees

As top priority, caretaker committees should be restructured. The number of women on committees should be increased, with the minimum being five on a 9-member committee. Local leaders such as chiefs can be co-opted as honorary members for guidance, but they should be discouraged from interfering with the actual management of projects.

All water committees should be registered through locational Social Development Assistants with the Ministry of Culture and Social Services. Where boreholes are located on school compounds, existing Parent/Teacher Association Committees should be in charge of borehole management and maintenance. However, this should not be the case where boreholes are located outside the school compound.

All committees should be renewed after a set period of, say, two years. All committees should open bank accounts to safeguard contributions.

Caretaker committees should be taught basic accounting procedures and bookkeeping to ensure proper record keeping of expenses and contributions.

Research

An intensive survey should be carried out to ascertain the actual number of beneficiaries. This can be very useful when fixing the amount to be contributed by each family. Baseline surveys should be extended to cover identified sites for future drilling, to give insight into issues of convenience and accessibility of sites.

Title Deeds and Access to Land

All borehole sites should have their own title deeds to avoid potential land disputes.

Access footpaths/roads should be established, and should be adequate to accommodate people, and animals where there will be cattle troughs.

It is recommended that these issues be introduced and discussed in locational sub-DDC meetings.

Training

A team composed of engineers, sociologists/social workers and public health officers should be formed. This team should concentrate on public health education and thorough training of all committees on management, operation and maintenance.

An education tour should be organized to visit on-going community-based water projects such as the Kwale water and sanitation project, the Kifinco water project in Kakamega or the Tharaka water and sanitation project in Meru District. This would expose project personnel and water committees to successful approaches to community-based water supply programs.

Regular seminars and workshops should be conducted with borehole committees to exchange ideas, and propose solutions to problems encountered in the field.

Training should not be limited to dismantling and assembling the handpump, but should include the following:

A. Handpump Information and Operation
   - Introduction to handpump
   - Pump parts
   - Mode of working
   - Handpump tool kit
   - Pump faults
   - Identification of pump faults
   - Correction of pump faults
   - Steps in pump removal and installation
   - Organization of helpers
   - Cleanliness of apron
   - Development of well site
   - Community involvement in pump repair
   - Practical removal and re-installation of pump
   - Pump performance report
   - Sources for spare parts
   - Test

B. **Health Education**
   - Relationship between borehole water and health
   - Environment and sanitation
   - Communicable parasitic diseases

C. **Financial Management**
   - Simple bookkeeping
   - Importance of having bank accounts
   - Methodologies for contributions

- Handling of non-contributors
- System of checks and balances

D. **Effective Organization Structure**
- Composition of caretaker committees
- Organizational dynamics (internal)
- Liaison with community
- Degree of involvement of PLAN, the community and the caretaker committee (inter-relationship)

Community Participation

There should be maximum reliance on community involvement in planning, design and implementation. Local resources should be mobilized and beneficiaries encouraged to contribute positively in cash and kind. All decisions must be made with beneficiaries.

To ensure maximum community participation, the timing of activities should be carefully planned. Training workshops should not be conducted, for example, when agricultural activities are at peak and people are not available.

5. CONCLUSION

The success of the borehole program depends entirely on the ability to organize the people and resources required. It requires understanding the long-term nature of the organization, and the purpose of coordinating activities. A good organization must be built, in which group activities, ideas, facts, and materials are organized to get the best performance with the least effort. There must be community-wide awareness of the objectives of the borehole program. Above all, success requires a multi-faceted approach, with a deep commitment by the program staff.

Effective management and proper routine maintenance are necessary for the success of the project. Of the 28 sites we visited, 7 handpumps are already un-operational. Based on observations in the field, many others can be expected to break down, due to management/maintenance deficiencies within the beneficiary communities.

Adopting the recommendations contained in this report will greatly improve the borehole project's likelihood of sustainability. It is only in that way that our target population will benefit from the availability of the nearby clean, potable, reliable water this project.

ANNEX I

LR NO. DATE INSTALL.	LOCATION	POPU SERVED	PUMP DEPTH (M)	B/HOLE YIELD/ PUMP YIELD	PUMP RATES PERFORMANCE	CONSTRUCTION	INSTALL PROBLEMS	OTHERS
Nyangwa C9099 2/4/91	Mavuria	300 House-holds, 500 Students and Teachers	45.4	2.0m3/hr 867 lts/hr	One bolt rotates Pieces of rubber from centraliser detected in the water Handpump is hard to operate Centralisers wearing mainly on one side Rising main suspected not to be vertical	Apron constructed as specified but look congested dimensions may be changed from 1.5m 0 to 2.0 m 0 Pedestral flunge was not aligned with drainage channel and apron hence pump facing wrong direction	Handpump is hard to operate Centralisers sticks to the raising main hence wearing out Rising main is suspected not to be straight U-seal is inserted on the foot valve	
Irabari 1985	Mavuria		40.0	Pump not working from Dec. 1990	Pump rod rusty Two of 13No rods are worn out due to abrasion against the rising main. Most of the centralisers are worn out. All the four pump nuts are smaller than specified Bearing bushes are worn out Bearing pin unti-rotating lock sheared and hence difficult to remove the pin	Cracks have started developing on the apron	Pump was serviced but pump does not deliver water Rising main suspected to be cracked.	
Muraru C8285 April 1990	Mbeti	200 house-holds and 60 cows	19.0	3.6 m3/hr 900 ltr/hr	Centralisers worn out	Concrete pedestal and buck stand poorly constructed. Apron area is congested and area may be increased from 1.5m to 2.0m Inco-operated standing area on the apron is not used and should be ommitted.	Hanger rods clearance 25 mm instead of 50 mm as specified	
ari C8117	Mavuria		30.2	1.02 m3/hr	The pump is very new	Apron, pedestal and channel casting good	Handle length 1110 mm Clearance between the concrete	Accessibility to the water point is difficult

30/4/91				900 lts/hr			pedestal and flange is 85 mm Hanger rod clearance 65 mm	
Ngenge C8284 Nov. 1989	Mbeti North	300 house-holds	25.0	0.15 894lts/hr	Handle broke at the fulcrum and was welded Bearing bushes and pump rod centra-lisers worn out	Apron construction very good	Installation guidance not Hanger rod clearance 25 mm instead of 50 mm Concrete pedestal and flange clearance 80 mm	Ground water is not reliable community have to wait for borehole to recharge Some community members draw water from nearby well to avoid congestion.
Kaninwanthiga C8286 Dec. 1989	Mbeti	50 house-hold, 200 pupils and teachers	36.7	0.36m3/hr 857lts/hr	Bush bearing worn out Pump head bolts are small m12 making it impossible to open the pump with the spanner alone	Apron construction good.	Pumping is hard due to overstretching of the u-seal	Pump apron is not maintained cleanly
Itabua C8507 OCT. 1989	Mbeti	400 house-holds, 1000 pupils	33.6	4.0m3/hr 869lts/hr	Fulcrum pin studs worn out. The nuts are seized. Two m16 nuts rotating Pump stopped working on August 1990 Bearing bushes, u-seal bobbin, and centra-lisers worn out	Apron construction good Standing area not necessary Concrete pedestal clearance okey hence the soccket spanner works very well	Hanger rod clearance not maintained	In school compound
Kanyariri C9124 24/6/90	Mbeti South		13.0	4.0m3/hr 910 ltr/hr	Handle broken at fulcrum and has been welded pump rods rusty bearing bushes worn out. M16 bolts rotating	Apron construction good	Hanger rod clearance not maintained	Site not fenced Livestock wated at pump with basins
Kimangaru P S C9151 Sept. 1989	Mbeti South		39.0	0.2 m3/hr Pump not working	Handle broken and welded Hanger pin studs worn out and hence nuts seized Bearing bushes worn out Centralisers worn out	Apron construction good	Hanger rod clearance not maintained Difficult to return the pump Rising main was not properly installed	Water level drops below the pump intake and hence no water is pumped Water is only pumped very early in the morning
Gatondo P S C8504	Mbeti North		28.0	2.0 m3/hr	Fulcrum pin rotate Lock pin sheared and	Pedestal wearing out, constructed	Could not open the pump since the	Site drainage poor

C8079				896 lts/hr	cracked and others wearing out. Bearing bushes worn out Pump rod hook broke and a spare rod inserted Pump rods are rusting	and channel okay Community advised to add concrete along the drainage channel foundation to prevent further erosion	clearance 70 mm hence bolts can not be opened using the socket spanner	
Koma C8479 JULY 1990	Karaba	400 house-holds	25.0	3.6 m3/hr 834 lts/hr	Nitrile rubber centralisers worn out Hanger bushes worn out U-seal worn out	Pump apron/pedestal concreting poorly done	Hanger rod clearance specification not followed - 110 mm contributed to the hanger housing knocking the pump cover and dented it. Also reduced pump efficiency Hanger rod over -threded and unecessary nut added	Pump situated very near a valley Community have intention of inco-operating a cattle trough
Kabuguri C8151 1987	Kiambere	66 house-holds		7.2 m3	Handle broken at fulcrum and welded Pump was not working	Apron and concrete pedestal are strong and sound	The pump was not opened up	
Karura C8080 24/2/1989	Kiambere		45.5	0.4 m3/hr Pump not working	Handle broke at the fulcrum on Nov. 1989 and welded. Bushes worn out and grease applied on them U-seal was over stretched Plunger rod manufactured without a centraliser support (see photo)	Concrete pedestal cracking	Pedestal clearance not maintained U-seal inserted on the foot valve hence was difficult to extract Specified hanger rod clearance not maintained	
Rugogwe 1 (Gatutori) C8639 17/4/91	Mavuria	50 house-holds	15.4	4.0 m3/hr 910 ltr/hr	Okey	Okey	Foot valve had u-seal and o-ring inserted Hanger rod clearance 85 mm	
Rugogwe 2 C8945 18/4/91	Mavuria		45.3	0.58 m3/hr 856 ltr/hr	Okey	Crack on the drainage channel	Hanger rod clearance 85 mm Pedestal clearance 80 mm hence makes the opening of the pump head impossible with the socket spanner	

Kaseve '8 JULY 1990	Karaba	200 house-holds	19.0	5.1 m3/hr Pump not working	Pump handle broken twice, not welded after second time Pump plunger broken by a piece of metal bropped in the borehole	Pump apron poorly constructedd and wearing out Concrete pedestals and buchet stand crocked	Concrete pedestal clearance 50 mm Hanger rod is over-threaded and un-necessary nut added. Hanger rod clearance 115 mm. The hanger housing has dented the pump cover and has cracked at one edge	Borehole situated in a depression and makes drainage difficult
Kamukunga C8148	Kiambere	131 house-holds	30.5	3.6 m3/hr	One bolt smaller than m16 hence could not be unscrewed Bolts rotates Corrosion evident on the rods	Pump pedestal honey combed	Foot valve had u-seal and oring Rising main had repairs done but not satisfactory hence problem when removing and putting back the pump	
Kunyaga C9140 MARCH 1991	Kiambere	80 house-holds	15.0	2.0 m3/hr 912 ltr/hr	Two of the four bolts are rotating hence difficult to open up the bolts	Pump pedestal and buchet stand honey combed	Concrete pedestal clearance 70 mm Hanger rod clearance 110 mm Pump handle 1125 mm	
Kavondori C8939 3/4/91	Mavuria		45.2	0.6 m3/hr	Okey	Crack at the apron	Pedestal clearance 80 mm Hanger rod clearance 100 mm. Pump handle length 910 mm.	
Mashamba C9109	Makima		Not installed		Not installed	Borehole left open Pedestal flange not level. Crack already developing on apron	Pedestal clearance 60 mm	
Kwika 2 C9130	Mbeti North		Not installed	2.4 m3/hr	Not installed			
Ciorindagwa C8633	Kiambere		22.0 m3/hr	0.32 m3/hr	Pump handle welded twice. Hanger housing poorly fabricated. Bolts are rotating Hanger housing has un-necessary clearance 10 mm	Concrete pedestal honey combed	Pedestal clearance not as specified Hanger rod clearance not as specified	

B.HOLE No. ATE INSTALL.	LOCATION	PUMP SERVED	PUMP DEPTH (M)	B.HOLE YIELD PUMP YIELD	PUMP RATES PERFORMANCE	CONSTRUCTION	FAILURE REASONS	OTHERS
Nyangwa	Mavuria	300 House-holds. 500	45.4	2.0m3/hr	One bolt rotates	Apron constructed	Handpump is hard	
C9089		Students and Teachers			Pieces of rubber from centraliser detected in the water	as specified but look congested dimensions may be changed from 1.5m to 2.0 m 0	to operate Centralisers sticks to the raising main hence wearing out	
2.4.91				867 lts/hr	Handpump is hard to operate Centralisers wearing mainly on one side Rising main suspected not to be vertical	Pedestral flumge was not aligned with drainage channel and apron hence pump facing wrong direction	Rising main is suspected not to be straight O-seal is inserted on the foot valve	
Irabari	Mavuria		40.0	Pump not working from Dec 1990	Pump rod rusty Two of 13No rods are worn out due to abrasion against the rising main Most of the centralisers are worn out All the four pump nuts are smaller than specified bearing bushes are worn out Rearing pin anti-rotating lock sheared and hence difficult to remove the pin	Cracks have started developing on the apron	Pump was serviced but pump does not deliver water Rising main suspected to be twisted	
1985								
Muraru C8285 April 1990	Mbeti	200 house-holds and 60 cows	19.0	3.6 m3/hr 900 lts/hr	Centralisers worn out	Concrete pedestal and lock stand poorly constructed. Apron area is congested and area may be increased from 1.5m to 2.0m Inco-operated standing area on the apron is not used and should be omitted	Hanger rods clearance 25 mm instead of 50 mm as specified	
Gatirari 117	Mavuria		30.2	1.0% m3/hr	The pump is very new	Apron, pedestal and channel casting good	Handle length 1112 mm Clearance between the concrete	Accessibility to the water point is difficult

30/4/91				900 lts/hr			pedestal and flange is 85 mm Hanger rod clearance 65 mm	
Nzeve C8284 Nov. 1989	Mbeti North	500 house-holds	25.0	0.15 694lts/hr	Handle broke at the fulcrum and was welded Bearing bushes and pump rod centra-lisers worn out	Apron construction very good	Installation guidance box Hanger rod clearance 65 mm instead of 85 mm Concrete pedestal and flange clearance 50 mm	Ground water is not reliable Community have to wait for borehole to recover Some community members draw water from nearby well to avoid congestion
Kasinwanthiga C8256 Dec. 1989	Mbeti	50 house-hold. 200 pupils and teachers	36.7	0.06m3/hr 857lts/hr	Bush bearing worn out Pump head bolts are small M12 making it impossible to open the pump with the spanner alone	Apron construction good.	Pumping is hard due to overstretching of the U-seal	Pump area is not maintained cleanly
Itabua C8507 OCT. 1989	Mbeti	400 house-holds. 1000 pupils	33.6	4.0m3/hr 869lts/hr	Fulcrum pin studs worn out. The nuts are seized. Two M16 nuts rotating Pump stopped working on August 1990 Bearing bushes. U-seal bobbin. and centra-lisers worn out	Apron construction good Standing area not necessary Concrete pedestal clearance okey hence the socket spanner works very well	Hanger rod clearance not maintained	In school compound
Kanvariri C9124 24/6/90	Mbeti South		15.0	4.0m3/hr 910 ltr/hr	Handle broken at fulcrum and has been welded pump rods rusty Bearing bushes worn out M16 bolts rotating	Apron construction good	Hanger rod clearance not maintained	Site not fenced Livestock waled to pump with basins
Kimangaru P S C9151 Sept. 1989	Mbeti South		39.0	0.2 m3/hr Pump not working	Handle broken and welded Hanger pin studs worn out and hence nuts seized Bearing bushes worn out Centralisers worn out	Apron construction good	Hanger rod clearance not maintained Difficult to return the pump Rising main was not properly installed	Water level drop-below the pump intake and hence no water is pumped Water is only pumped very early in the morning
Watondo P S C8504	Mbeti North		28.0	2.0 m3/hr	Fulcrum pin rotate Lock pin sheared and	Pedestal wearing out. constructed	Could not open the pump since the	Site drainage poor

JAN. 1990				900 ltr/hr	hence impossible to open the pump with the standard spanner alone Bearing bushes worn out	poorly	fulcrum pin seized	
Kwika P & C C9030 22/3/91	Kheti South	350 households	45.0	1.6 m3/hr 857 ltr/hr	Pump rod centralisers worn out	Construction of the apron is good	Concrete pedestal clearance not maintained measured 65 mm. Plunger fitted with u-seal o-ring Pump handle 1275 mm	The handpump is inside the institution compound
Kwika Health Centre C8283 1989	Kheti South	300 households	45.0	3.4 m3/hr 845 ltr/min	Pump rod not broken at the hook Rising main cracked and repaired Handle broken at the fulcrum and was welded Fulcrum pin lock sheared hence fulcrum pin could not be removed Bolts smaller than specified	Construction of apron not according to specification		
Mashamba B C9109 10/4/91	Makima	60 households and 100 cows	15.65	4.0 m3/hr 1200 lts/hr	Parts okay U-seal was fixed on the foot valve which is wrong	Pedestal has cracked at the foundation Apron worn out and a pool of water evident in a hole Pump supported by the borehole casing	Concrete pedestal clearance not maintained hence bolts could not be opened Handle length 880 mm long	Drainage channel should have been extended
Irare C9111 11/4/91	Makima		40.0	1.5 m/hr Pump not working	Pump worked for only two days	Pedestal was poorly constructed leading to collapsing Pedestal not reinforced as specified	The pump was removed and kept store	
Makima C9104 13/4/91	Makima	125 households	50.25	1.0 m3/hr 800 lts/hr	Fulcrum pin lock sheared making it difficult to open up the pin.	Concrete pedestal cracking Apron wearing out due to use of poor quality material	Concrete pedestal clearance not maintained hence bolts can not be opened Foot valve installed with u-seal inserted	The borehole has no access road
	Kiambere		44.0	0.5 m3/hr	Polythene centralisers	Construction of apron	Concrete pedestal	

Kaseve C8478 JULY 1990	Karaba	[illegible] house-holds	19.0	5.1 m3/hr Pump not working	Pump handle broken twice, not welded after second time Pump plunger broken by a piece of metal dropped in the borehole	Pump apron poorly constructedd and wearing out Concrete pedestals and bochet stand cracked	Concrete pedestal clearance 50 mm Hanger rod is over-threaded and un-necessary nut added. Hanger rod clearance 115 mm The hanger housing has dented the pump cover and has cracked at one edge	Borehole situated in a depression and makes drainage difficult
Kamukunga C8148	Kiambere	131 house-holds	30.5	3.6 m3/hr	One bolt smaller than m16 hence could not be unscrewed Bolts rotates Corrosion evident on the rods	Pump pedestal honey combed	Foot valve had u-seal and oring Rising main had repairs done but not satisfactory hence problem when removing and putting back the pump	
Kunvaga C9140 MARCH 1991	Kiambere	80 house-holds	15.0	2.0 m3/hr 912 ltr/hr	Two of the four bolts are rotating hence difficult to open up the bolts	Pump pedestal and bochet stand honey combed	Concrete pedestal clearance 40 mm Hanger rod clearance 110 mm Pump handle 1125 mm	
Kavonduri C8939 3/4/91	Mavoria		45.2	0.6 m3/hr	okey	Crack at the apron	Pedestal clearance 80 mm Hanger rod clearance 100 mm. Pump handle length 910 mm.	
Mashamba C9109	Makima		Not installed		Not installed	Borehole left open Pedestal flange not level. Crack already developing on apron	Pedestal clearance 60 mm	
Rwika 2 C9130	Mbeti North		Not installed	2.4 m3/hr	Not installed			
Ciorindagwa C8633	Kiambere		22.0 m3/hr	0.32 m3/hr	Pump handle welded twice. Hanger housing poorly fabricated. Bolts are rotating Hanger housing has un-necessary clearance 10 mm	Concrete pedestal honey combed	Pedestal clearance not as specified Hanger rod clearance not as specified	