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AFFORDABLE WATER SUPPLY AND SANITATION



Using the Afridev handpump Norrip's experience

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THE INTEGRATED VILLAGE WATER PROJECT (IVWP) is one of the five village based Projects of the Northern Region Rural Integrated Programme (NORRIP). This project was funded jointly by the Government's of Ghana and Canada and started in 1989 with the provision of a sustainable potable water supply and sanitation as its main objective. The water project involves the drilling of 350 boreholes fitted with VLOM handpumps in two selected districts (Yendi and East Mamprusi) of the Northern Region of Ghana.

The type of VLOM pump selected for the IVWP was the AFRIDEV. So far, over 200 of the pumps are in operation, making the project one of the largest users of the AFRIDEV in Ghana now.

Since these pumps were installed, some lessons have been learnt regarding the technical and maintenance aspects, and this paper is intended to share these lessons in relation to the issue of sustainability.

The maintenance system

The handpump maintenance system involves village handpump mechanics (VHPM's) at the community level, supported by a trained two-man unit, the VLOM Support Unit (VSU) at the District level. The role of the VSU's are being taken over by trained private mechanics known as Districts Mechanics.

Handpump performance

Since the inception of the project, the performance of the handpumps have been closely monitored by the project. Special formats were designed for recording when faults were reported; types of fault; how and when repairs were done and spare parts used.

A study which was conducted using data on some fifty-three pumps covering the first twenty-four months of their operation enabled a better assessment of the performance of the pumps to be made. These are summarised below:

Total number of faults

Total number of faults recorded was 135.

The breakdown is as follows:

Fault	Number	%
Broken rod	109	80
Riser main cracks	9	8
Others	17	12

Rod breakages

An analysis of the records showed that there was a total of 109 breakages recorded within the period. The following were also found:

- 70% of pumps experienced rod-breakages, ranging from one to eleven times per pump.
- 45% of the pumps had between one and three rod-breakages per pump.
- 13% of the pumps studied had more than 5 rod-breakages per pump.
- the average rod-breakage rate was 1.5 breakages per pump per year.

Cracking of riser main

Another type of fault recorded was the cracking of the riser main. Only 9 riser main problems were recorded on 6 (11%) pumps.

Other faults

Other faults like disconnected plunger rods, leaking cylinder and broken lock-pin on fulcrum pin also occurred. 17 of such faults were recorded, altogether.

Spare parts used

Figure 1 indicates the distribution of the various kinds of spare parts between 1991 and 1993.

Pump-rods were most frequently used, followed by o-rings, u-seals and bobbins.

Handpump functioning rate

Given the above, one may get the impression that most of the pumps would be out of use at any time. This was however not the case. NORRIP'S monitoring unit has always recorded a functioning pump/non-functioning pump ratio of over 90%. (This is above the project's target of 85%). This has all been possible because now most of the rod-breakage problems can be handled at the village level by the village pump mechanics, without the need for the district mechanics. The district mechanics are mainly in-charge of more difficult problems which are beyond the HPM's.

Pump reliability

A better assessment of the reliability of a handpump is a critical consideration of the amount of time that it can be expected to be functioning satisfactorily (Arlosoroff et al, 1987).

Two most important factors are length of time before failure, that is, the mean time before failure (MTBF) and

the time taken before repairs are carried out, known as the average repair time or downtime. The MTBF is the time that elapses before the pump experienced its first breakdown.

The repair time or downtime is the average time that elapses from the time a fault is reported to the time it is repaired.

The MTBF or functioning time for the handpumps on the project was found to be 10 months. The average repair time was 5 days.

The reliability of the pumps, given as:

$$\frac{\text{MTBF}}{\text{Total elapsed time}} \times 100\% = \frac{10 \text{ months}}{10 \text{ months } 5 \text{ days}} \times 100\% = 98\%$$

Cost of operation and maintenance

On the average, it will cost a community about US\$45 to get a pump repaired every year. Added to the cost of replacing fast-wearing parts like, bobbins, U-seals, O-rings and bearings, the total operation and maintenance cost will be about US\$60. (This cost will however vary only slightly in the first three years when most of the very expensive parts will not need replacement). Some calculations made at the beginning of the project as to what amount was required on the average by communities to maintain a pump in a year gave a figure which was twice as much.

Major constraints

Some of the major constraints encountered by the IVWP so far as the use of the Afridevs was concerned were:

Routine maintenance

Routine maintenance, involving the tightening of bolts and nuts, and performing of “stroke”, and “bucket” tests are the responsibilities of the village HPM’s. A survey conducted two years after installation of the pumps, showed that the majority of the HPM’s were either not doing it at all or were not consistent.

To address this issue, the project has planned a half-day refresher course for all HPM’s at the zone level. Courses will be organized on a regular basis.

Handpump maintenance fund (HPF)

All beneficiary communities are expected to set up their own HPFs against all operation and maintenance costs. Though this system forms a significant part of the animation process at the village-level, contributions into the fund have not been encouraging. Of the 104 communities

in the Yendi District, 62 (60%) of them had established the funds.

This notwithstanding, communities are able to keep their pumps operational, most of the time; bringing out the fact that in most cases communities people will normally not want to part with money until there is an immediate need for it.

Rod breakages

During 1991 and 1992, the frequency of breakages in the welded hook-and-eye rods were so high, (especially with pumps installed at 30m or more) creating doubts in the minds of both project staff and pump users as to the efficiency of the Afridev pump itself. After sometime, however, we realised that the pump could be good if the rod problem could be solved. Consequently, a decision was taken to replace all rods with fibreglass rods. A few were ordered and tried on some thirty pumps, but these also failed. About 30% of them broke a few months after being installed. Until the SKAT AFRIDEV pump specifications were revised, the project had to cope with the rod-breakage situation. In order not to overburden user communities, broken rods were replaced for communities free-of-charge. Now, with the introduction of the forged hook-and-eye rod, all the welded hook-and-eye rods are being replaced with forged hook-and-eyes, as they break. Forged rods which have so far been installed have been found to be very sturdy. Within a period of 12 months, only 15% of pumps installed with forged rods experienced breakages.

Conclusions

There is no doubt that the AFRIDEV handpump like any other mechanical system, has its problems. It is however very reliable if both project staff and pump users address the problems from a pro-active standpoint. The IVWP has been able to surmount the most difficult of the problems associated with the pump. This was possible because of the high level of co-operation and the patience of the communities.

References

- ¹ Arlosoroff et al (1987), Community Water Supply - The handpump option, World Bank, Washington D.C., USA.
- ² Norrip II, 1991-1992, Handpump logs - Yendi District, Ghana.
- ³ Stanley W.A. Inc (1990) Norrip, IVWP, Sector paper, Norrip, Tamale, Ghana.

U'S = u-seal, O'R = o-ring, BB = bobbin, FP = fulcrum pin, HP = hanger pin, RM = rising main,
W'R = welded rod, FR = forged rod, BR = bearing, CYL = cylinder, PBC = plunger body/casing

Figure 1.