

Performance of Afridev Pumps

in the CARE Community Water and Sanitation Project, Inhambane, Mozambique

The project, implemented by CARE Mozambique, has closely monitored the performance of Afridev pumps since 1993. The comprehensive data collected over several years was recently reviewed and analysed by Ana Lucia Obiols, CARE's project manager in Inhambane until the end of 1997. Her report forms the basis of this article. HTN is grateful to CARE for releasing the report so that the lessons learned from the project can be made public.

Background

Since 1993, the Afridev and the Volanta pumps have been the only two handpumps officially authorised for installation in Mozambique. Both the Government of Mozambique and UNICEF supported the handpump standardisation programme, gradually reducing their financial support until full commercialisation of the market in 1996.

The Afridev was originally designed for lifts of up to 45 meters, but in 1994 the Government of Mozambique permitted the use of the Afridev up to 60 meters.

Afridev Manufacturing

Stenaks, a Dutch trading company, was the first dealer allowed to sell the pump in the country. Stenaks imports all raw materials for metallic components, and the parts are then locally manufactured in Mozambique by Industrias Collison. Today, three companies market the pump: Stenaks, Agro Alfa and Kanés. The Engineering Department of University of Eduardo Mondlane has provided third party inspection of all parts of the pump since 1995, based on SKAT's technical specifications.

The total manufacturing capacity outstrips the local demand; Industrias Collison can make 2,000 pumps per year and Agro Alfa 500 pumps. In November 1997, Mozambique celebrated the manufacture of the 5,000th Afridev.

Afridev Spare Parts Distribution

Afridev pumps regularly require low-cost spare parts, and every few years high value replacement parts. One of the bottlenecks encountered for effective operation and maintenance has been the provision of spare parts at village level. Initially PRONAR (the National Rural Water Programme) delivered spare parts through provincial and rural water workshops (EPARs and ERAs). Since 1996, PRONAR has supported the involvement of local vendors. EPARs provide an initial stock free of charge to local vendors, and the spare parts are sold by the vendors at pre-established prices authorised by EPAR. To renew stocks, local vendors order the parts they require from EPARs and pay for them at ex-factory prices plus 5 percent for handling. Few local vendors are directly linked with the wholesalers.

CARE has supported government initiatives of involving private dealers in the distribution of spare parts for the Afridev since 1994. In 1996, CARE re-designed its strategy and encouraged the participation of the private sector in the whole process of distribution of spare parts. CARE's role was to facilitate the purchase of pumps and spare parts at the district level and to promote linkages between manufacturers and suppliers in Maputo, local vendors and communities. Three local vendors in the project area sell spare parts and renew stocks on their own according to the local demand. They have spare parts for routine maintenance and some other smaller parts in stock. One vendor also keeps a few rods and one pump-head. A tiered system is beginning to develop, with the major trader stocking a

wider variety of parts, and supplying to smaller traders upon request. CARE is one of the few NGOs that has been successful in setting up a private system that is now working without subsidy.

Afridev Maintenance

Since 1993, the Government of Mozambique has been supporting the village level operation and management of maintenance (VLOM) concept. Originally, the VLOM system required that communities had to pay only for parts for routine preventive maintenance, which would avoid or reduce the need for major repairs. However, under the prevailing operational conditions (deep installations and large user groups) the Afridevs needed major repairs as well as routine maintenance. Until recently, the Government of Mozambique and NGOs performed major repairs providing all spare parts free of charge. Such a strategy discouraged communities from paying for parts for routine maintenance since they could wait for ERAs or NGOs to undertake major repairs free.

CARE started transferring all maintenance and repair responsibilities to communities in February 1996. CARE trained Maintenance and Repair Groups (MRGs) to improve the capacity to maintain the pumps and perform all types of repair.

CARE's strategy to attain greater sustainability included the creation of Executive Committees (ECs) made up of leaders from the community. "On-the-job" training given to ECs ensured the ability of communities to analyse, prioritise and find solutions for the operation and maintenance of their water sources and other project activities. The training included information of the cost of spare parts and the financial consequences of omitting preventive maintenance.

The technical training given to the ECs and MRGs included: knowledge of each pump part; routine maintenance; diagnosis of frequent breakdowns and how to repair them; training of one member of the MRG as a mason to build the apron and drainage; and installation of two or three pumps in adjacent communities together with their MRGs. All sessions emphasised hands-on training with visual aids and cross-visits to neighbouring communities. Communities were responsible for the installation of their own handpump with the technical assistance from CARE.

CARE, jointly with communities, analysed the Afridev performance by monitoring the pumps closely over two years. In December 1997, 97 percent of the total 135 pumps were functioning and the average downtime for pumps was less than 10 days. CARE has gained considerable experience of what factors influence the type and frequency of breakdowns.

The project has shown the community's ability and willingness not only to maintain but also to repair the handpump, fully financing costs for spare parts. Two thirds undertake routine maintenance and collect water fees periodically. Another 30 percent solve problems and breakdowns when they appear and collect funds when needed. Only three percent decided not to maintain their pumps.

Afridev Performance

Analysis of Breakdowns by Type of Maintenance System

At the request of PRONAR, CARE has monitored the handpumps since 1994, recording pump breakdowns in 62 communities. These monitoring data were first analysed by SKAT in 1996. The main conclusion was that the breakdowns in rods and rising main increase dramatically in installations deeper than 45 meters. SKAT recommended trying glass-fibre rods and/or the use of the Volanta pump. However, the high cost of the Volanta and its less than flawless performance in deep installations prompted CARE to continue with Afridev pumps in Phase II and to monitor costs and performance closely.

The monitoring showed that, after the transfer of responsibility for O&M to the community, 77 percent of breakdowns were repaired wholly by communities, 19 percent needed some external assistance, and only 4 percent of breakdowns were repaired by ERAs or CARE.

There was a very noticeable change in the source of spare parts. Since February 1996, private vendors have supplied spare parts at commercial prices in the northern districts of Inhambane Province, obtaining them directly from manufacturers and selling them to communities.

The analysis of data collected by CARE's monitoring system reveals that the Afridev performance depends on four main factors:

- Quality control of pump manufacturing
- Quality control of pump installation and maintenance
- Depth of installation, and
- Number of users

The following table lists the percentages of breakdown types according to project phase and pump setting.

	Phase I		Phase II	
	<45m	>45m	<45m	>45m
Pump setting				
Breakdowns related to production quality	32%	15%	22%	8%
Breakdowns related to normal wear and preventive maintenance	40%	42%	39%	28%
Breakdowns related to depths of cylinder	18%	33%	29%	54%

It is important to highlight the differences between Phase I and II. At the beginning of Phase II, the responsibility for maintenance, repair and purchase of spare parts was transferred to the communities.

Quality Production Problems

Manufacturing quality control improved and quality-related problems were considerably reduced in Phase II.

Until 1994, pumps delivered by Stenaks had quality problems with rod hooks, fulcrum and hanger pins. Stenaks changed the manufacturing process of the hooks and replaced broken rods with new ones. However, it took a long time to resolve all the problems associated with cracks in the hooks.

Many breakdowns in Phase I were related to fulcrum and hanger pins. These failures are not related to load or cylinder depth. It appears that some improvements were made in the production and quality control. Although fewer failures were encountered during Phase II, the quality of these components remains a problem.

Pump Operating conditions

The Afridev was designed for settings up to 45 meters and 100 families. In Mozambique the pumps often serve more than 100 families and are installed deeper. Of the pumps monitored by CARE:

- 15 are within the parameters defined by SKAT (100 families, 45 meters);
- 6 are within the parameters set by the Government of Mozambique (100 families, between 45 and 60 meters);

- 20 pumps serve more than 100 families but still within 60 meters; and
- 10 pumps serve more than 100 families and are deeper than 60 meters.

The following table shows the effects of severe operating conditions due to deep cylinder installation and number of users. It suggests that stress due to the number of users affects the Afridev performance more drastically than the pumping lift.

Number of breakdowns per pump		Depth of Cylinder			Grand Total
		<45 meters	46-60 meters	>61 meters	
# of families	# of Pumps	31	10	10	51
<100	27	2.5	6.8	2.2	3.4
101-200	10	2.6	7.3	1.0	3.6
201-300	9	6.6	N/A	3.0	6.3
>301	5	5.7	10.0	7.0	6.7
Grand Total	51	3.9	7.3	2.5	4.3

The graph to the right shows the results of the analysis of 65 pumps monitored between 9 to 55 months. The number of breakdowns decreases for installations of over 60 m. CARE reckons that this phenomena could be due to the fact that installation and maintenance is done more carefully in deep boreholes.

Sixteen percent of the cracks reported in the rising main were in the pipe-bell. CARE decided to cut off all pipe-bells for installations deeper than 60 metres and replace them with locally manufactured unions. Community mechanics were trained to produce the unions using hot oil. The use of these unions resulted in a decrease of rising main failures, and may also explain the fewer depth-related failures in the very deep installations.

Quality Control of VLOM Performance

Until 1996, when communities were responsible for routine maintenance but not repair, 32 percent of the breakdowns were related to O-rings, U-seals and bearings. These parts were changed by the ERAs or CARE on failure and not by the communities as part of routine maintenance. After 1996, when the communities were responsible for routine maintenance and repair, the incidence of this type of failure reduced.

Eight percent of the breakdowns in Phase I were related to the procedures for gluing PVC pipe joints, and the shelf life of the glue itself. Several times the glue sold to CARE was out of date. The glue was supplied in one-litre containers and any glue not used after the tin was first opened, tended to lose its adhesive properties. CARE encouraged local vendors to sell containers of 250 ml. However, the gluing of pipes in the field continues to be a problem.

CARE has trained communities to undertake major repairs, e.g. cracked rising mains. Communities prefer to remove the entire rising main in one piece rather than the recommended and more expensive procedure of cutting into sections and then reassembling with unions and glue. Removing the pipe in one piece sometimes results in damage due to excessive bending.

The cost of maintenance and repair per community is US\$ 50 to 65 annually. This amounts to approximately US\$ 0.05/household/month.

Conclusions and Recommendations

CARE has used the Afridev in operating conditions well above SKAT's and the Government of Mozambique's specifications. Both the lift and the number of users affect the handpump performance. The effects of large user groups appear to be more severe than those of high lifts. When both conditions exceed the specification, reliability is adversely affected but may still be acceptable to the community.

The intensified training of community Maintenance and Repair Groups in installation and repair resulted in a distinct improvement of pump performance in Phase II compared with Phase I. The efforts by CARE to invest in human resources paid dividends. Special emphasis should be placed on training for and supervision of installation.

Due to the improved control of production quality in Mozambique, many avoidable breakdowns were eliminated.

The Afridev is popular among users and community maintenance teams can be trained to perform effectively. However, a backstopping system of local mechanics should be established to support communities in activities that require confidence and skill such as changing the rising main and fishing for dropped pipes and rods.

Communities have demonstrated their capacity to pay for routine maintenance and repairs. However, their capacity to pay for major repairs such as the replacement of the entire rising main is uncertain.

CARE's policy to involve the private sector in the sale of pumps and the distribution of spare parts led to unsubsidised spare parts being locally available at acceptable prices.

Recommendations (Lessons learned)

Pumps used in operating conditions beyond the SKAT specification should have an established system of follow-up similar to CARE's monitoring system.

R&D is needed to find reliable solutions for deep installations. Such solutions should if possible avoid jointing with glue during installation or repairs.

The inspection of the pumps before delivery and by the consignee on receipt is essential. These inspections ensure that the communities receive an acceptable product and the feedback to manufacturers helps to improve the manufacturing processes.

Extensive and well conducted "on-the-job" training for installation, maintenance and repair groups as well as pump committees is the key to Village Level Operation and Management of Maintenance.

Ana Lucia Obiols, CARE / Erich Baumann, SKAT