ALL-AFRICA SEMINAR ON LOW-COST RURAL AND URBAN-FRINGE WATER SUPPLY

ABIDJAN, OCTOBER 13 - 18, 1986

Studies / Case studies / projects / ~~etc.~~

CS 1. Afridev Hand pump

CS 2. Singida integrated Rural Dev. proj (Tanzania casestudy)

CS 3. Handpump: Leveraction to direct action Tanzania experiences

CS 4. Unicef assisted WS&S programme Luwero, Uganda.

The Afridev Hand Pump

Designed For Community Management

The Afridev Pump:

* * is designed for very simple maintenance, using minimal skill and few tools.

* * is designed to minimise forces, without reducing the discharge, by using a small diameter, long cylinder.

* * is designed to minimise the number of spares by using the same cylinder size for all depths.

* * is designed to exploit modern materials and technology to simplify mass production and minimise corrosion.

* * is designed for local manufacture.

BACKGROUND

The **Afridev** started life in Malawi in early 1981. From the start, the aim was to produce a deep well handpump that was very easy to maintain at village level and could be manufactured in countries like Malawi, where industrial resources are limited. The **Maldev** pumphead went into production in early 1982, and was a significant step forward in head design, with the users' needs given first priority.

Early in the field-testing of **Maldev** pumps, the ball bearings caused problems and the first **Afridev** pumphead, which uses plastic bearings, was installed in Malawi in late 1982. Major efforts to resolve the "bearing problem" continued up to early 1985, when a plastic bearing design was finalised.

The focus of **Afridev** development shifted to Kenya in early 1983, although testing continued in Malawi and important contributions were being made by field workers in several East African countries, as well as by experts from organisations in Europe, who provided specialist advice or laboratory testing facilities. International handpump design meetings were held in Kenya in late 1984 and early 1986, and throughout this period design and testing of pumpheads, cylinders, rods and rising mains continued. At all times, the primary objectives were absolute simplicity of maintenance, and minimum quality control requirements to simplify manufacture.

Plastics research and development has played a vital role in the success of this project, of which the outcome is the **Afridev** pump system.

The **Afridev** handpump is now going into production and is demonstrating that deep well handpumps **can** be maintained by village men and women, **can** be manufactured in most developing countries and **can** still be affordable and reliable.

* * Simple Maintenance

Simple Maintenance

Simple Maintenance

* **Villagers can carry out all routine maintenance after a few hours training.**

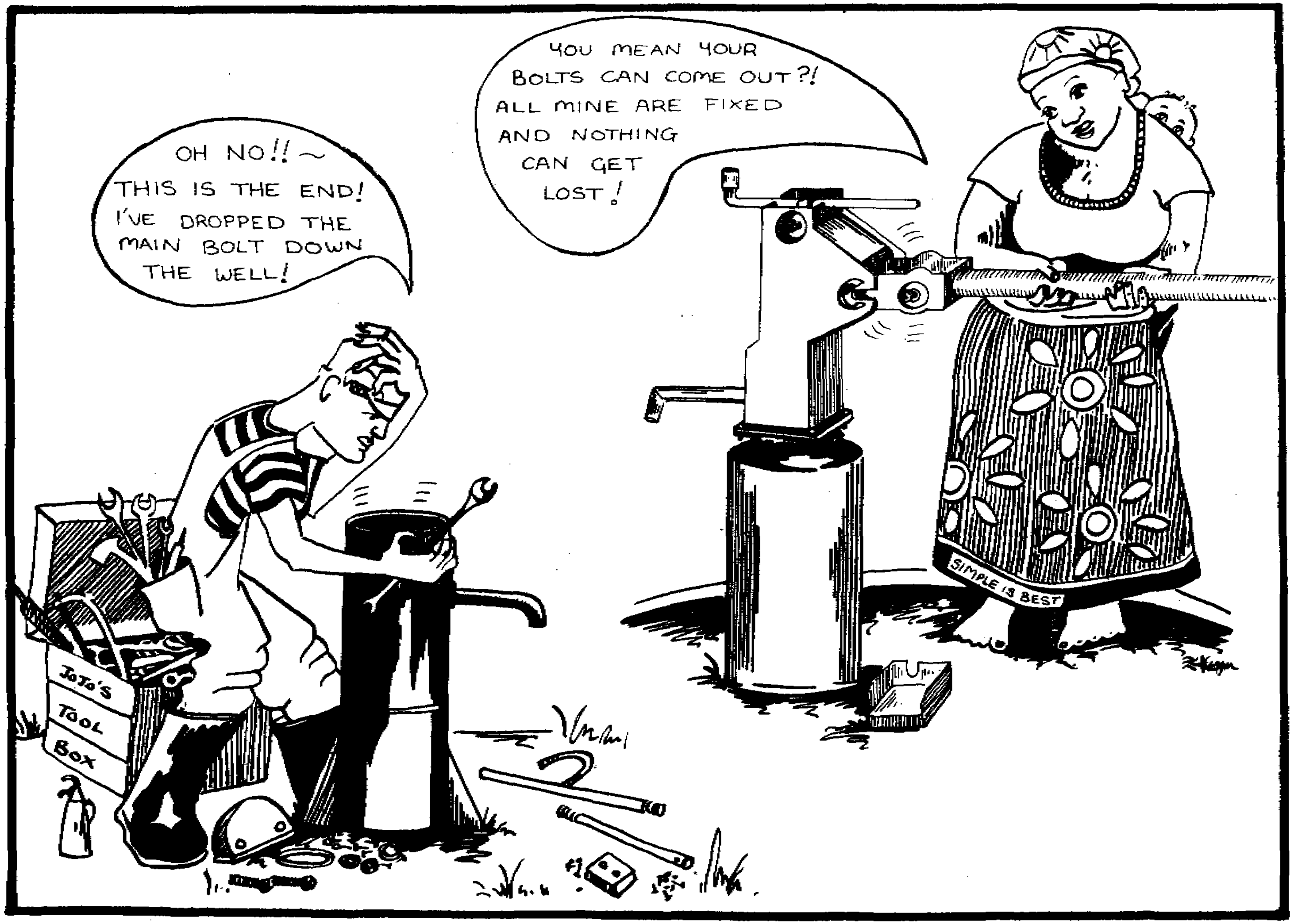
* **One spanner is needed to open the pumphead, replace the bearings and give access to the pump rods.**

* **Planned annual replacement of all, wearing parts is recommended, and is quick and inexpensive.**

The pumphead is an all steel fabrication especially designed for easy maintenance and manufacture. The only maintenance needed on the pumphead is replacement of the fulcrum and hanger bearings. This can be carried out quickly and simply with a single spanner.

Routine annual replacement of wearing parts is recommended as this minimises both the risk of breakdown and the subsequent need for diagnosis of failure. This annual preventive maintenance will simplify training needs and spares purchasing, as well as sustaining skill levels through regular practice,

Simple Maintenance

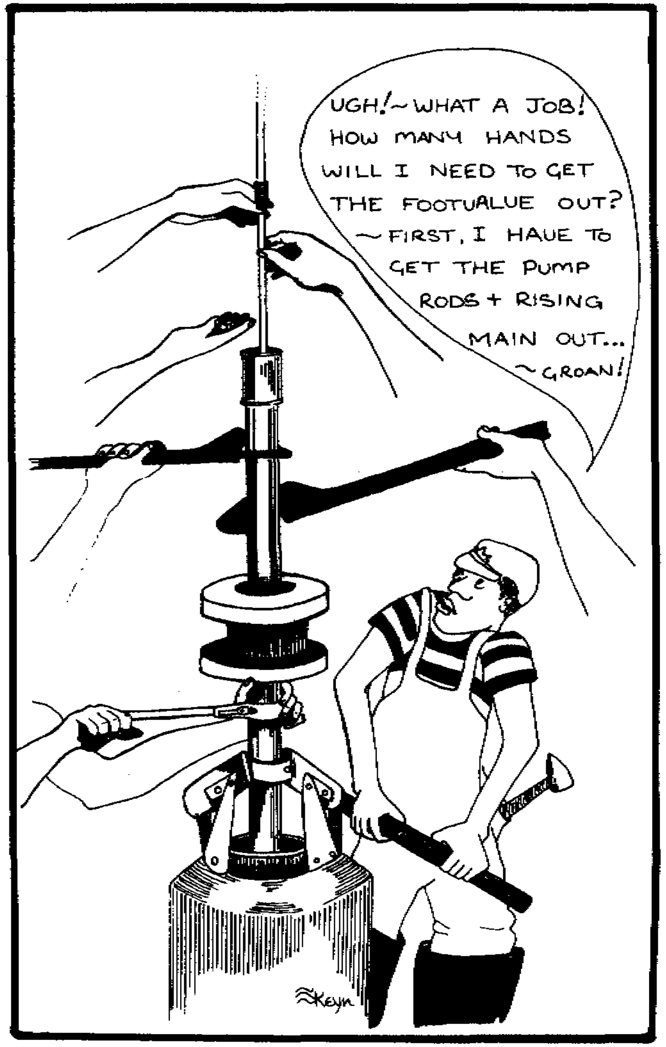


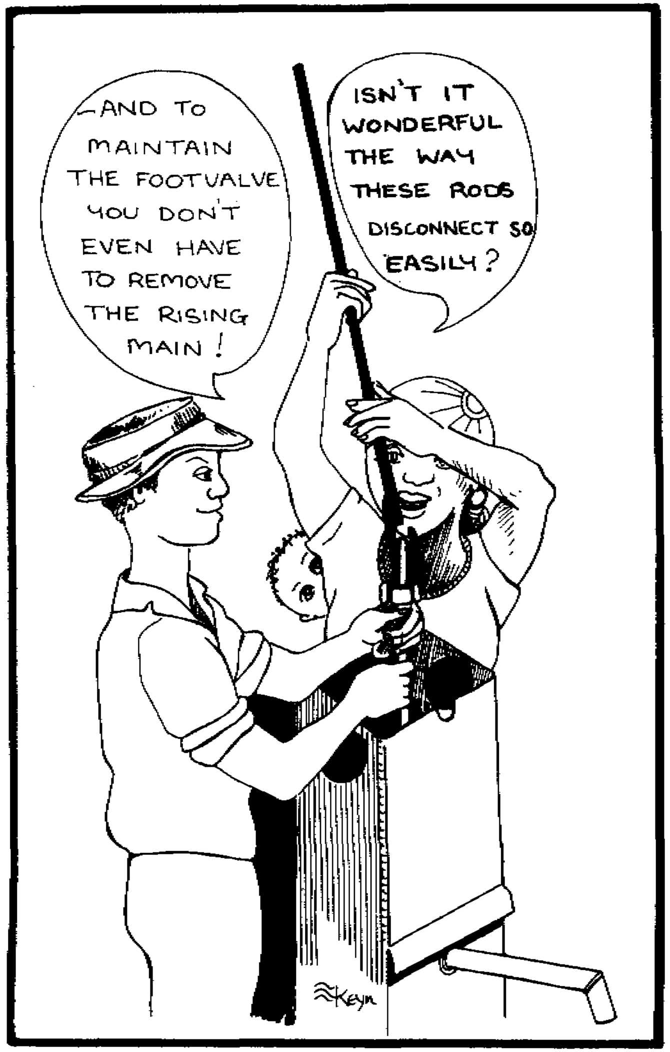
Simple Maintenance

* For routine maintenance, nuts need only be slackened; they cannot be removed.
* All nuts and bolts are the same size.
* The spanner doubles as a rod-support and lifting tool.

The nuts and bolts used to secure the pumphead cover and bearings are "captive", and only need to be loosened a few turns. This prevents nuts from being lost, dropped into the well or cross-threaded during routine maintenance. All nuts and bolts are M16. The spanner actually serves 2 purposes - to loosen nuts and to support pump rods suspended in the well.

Simple Maintenance





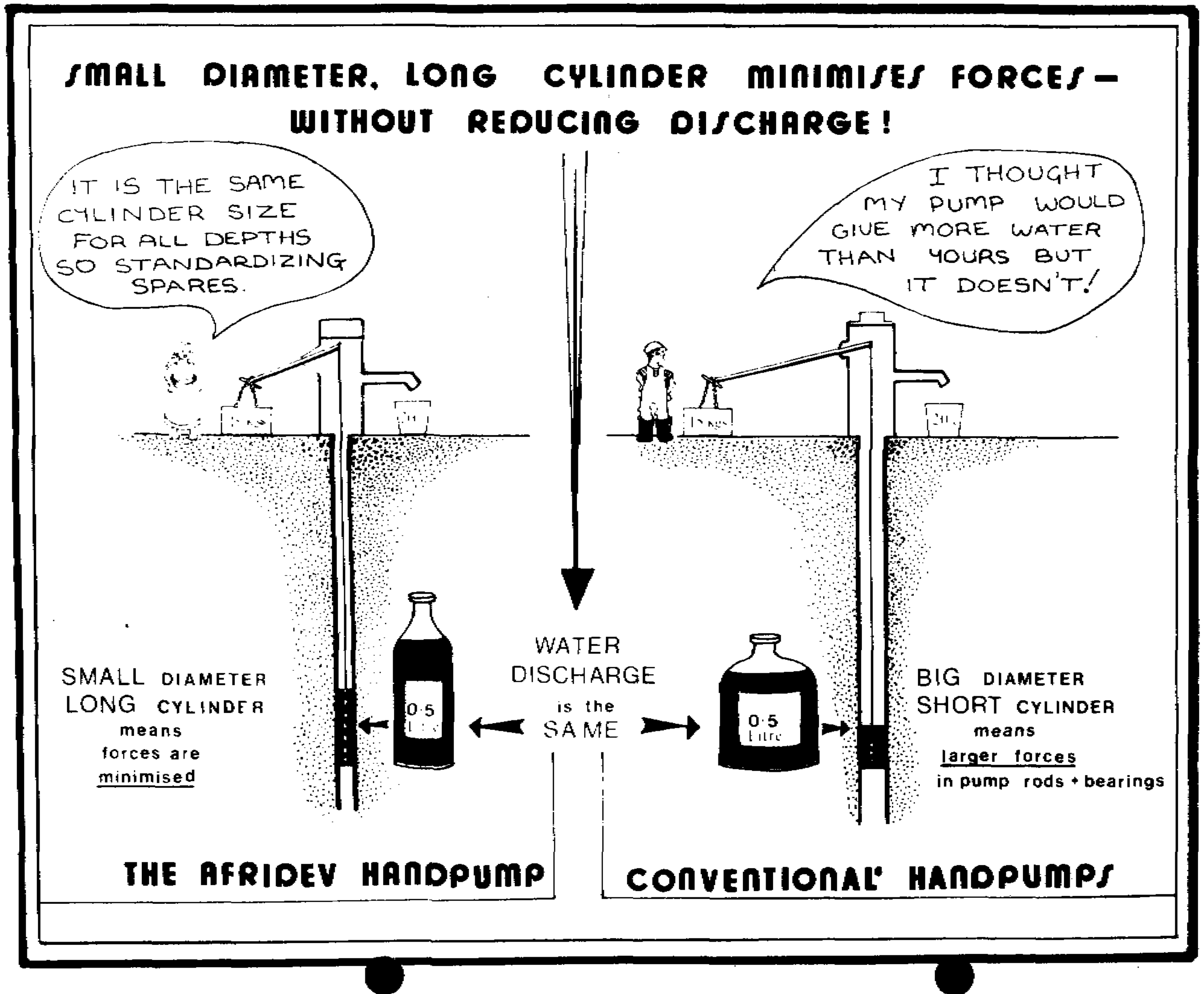
Simple Maintenance

* Lightweight, easy-connect rods.
* Two or three villagers can remove rods and plunger from a deep well without tools.
* The plunger and footvalve are identical components and have wearing parts fitted by hand.
* A small fishing-tool is supplied to remove the footvalve when necessary.

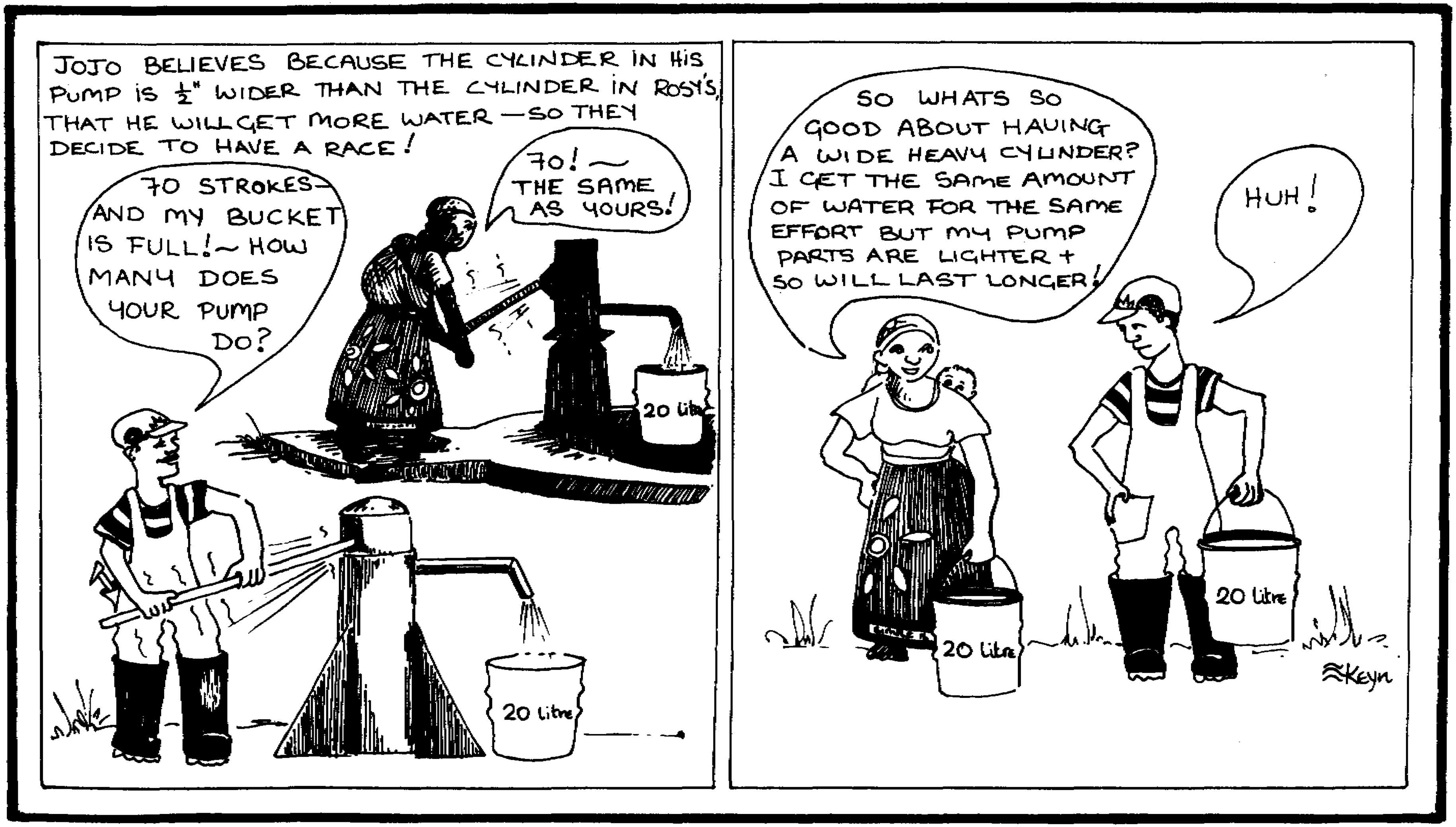
Pump rods, made from galvanised mild steel or stainless steel, are joined without tools using special, easy-to-fasten hooked connections. Alternative, easy-fit rod connections are under development, to simplify mass production. Plastic centralisers locate the pump rods in the rising main.

The footvalve is removed using a simple fishing tool fastened to the end of a rope.

** Small Diameter, Long Cylinder
** One Standard Cylinder Size



Small Diameter, Long Cylinder



Small Diameter, Long Cylinder

- * **Pump design gives good yield from small diameter, long cylinder.**
- * **Small diameter cylinder means reduced forces in the pump.**
- * **Reduced forces mean lighter components which are cheaper, and easier to remove for maintenance.**

For a given handle effort and handle vertical movement, discharge from the small-diameter Afridev cylinder can be made identical to that of a pump employing a larger diameter cylinder and greater handle leverage. This is achieved by designing the Afridev handle system such that the swept volumes of the two cylinders are the same. An operator would be unaware of the differences in geometry between the pumps. However, for pump design and manufacture there are several important advantages in using a constant, relatively small cylinder diameter. Pump rod forces are reduced so that for a given stress, smaller diameter and therefore lighter pump rods can be used. These are cheaper and induce less inertia. Forces on the handle bearings are also minimised.

There are further advantages from using the 50 mm diameter cylinder. The use of a relatively small diameter cylinder means that moderate diameter rising main pipe can be used, while still retaining the facility to extract the plunger and footvalve. This is cheaper and minimises the weight of water in the rising main thus reducing static and dynamic forces on the uPVC pipe which is used for the rising main in the Afridev. In addition, smaller diameter borehole casings can be used.

One Standard Cylinder Size

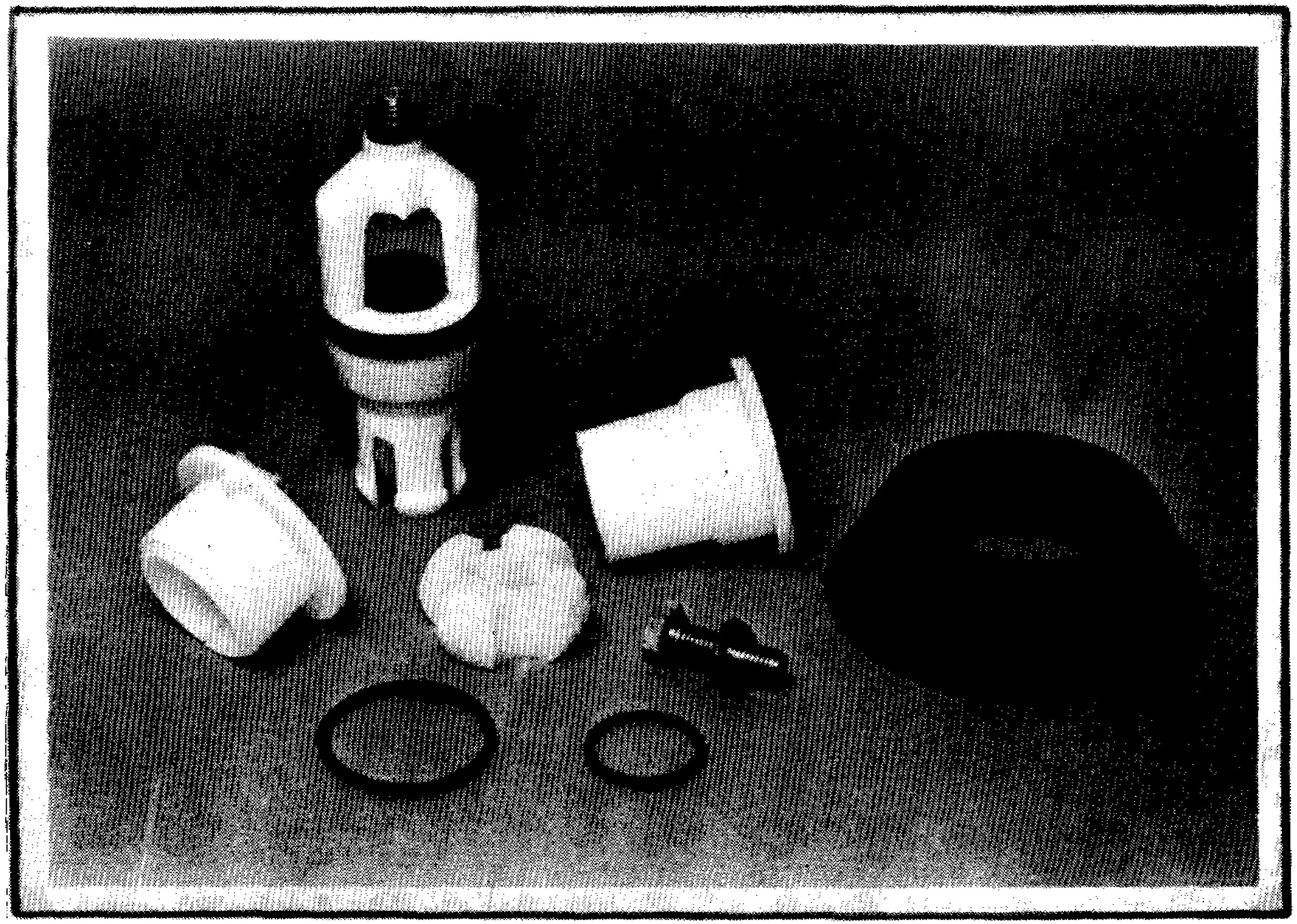
One Standard Cylinder Size

- * Optimized discharge from all depths resulting from variation of handle length, with one cylinder size.
- * One standard cylinder diameter means that spares of only one size are needed.

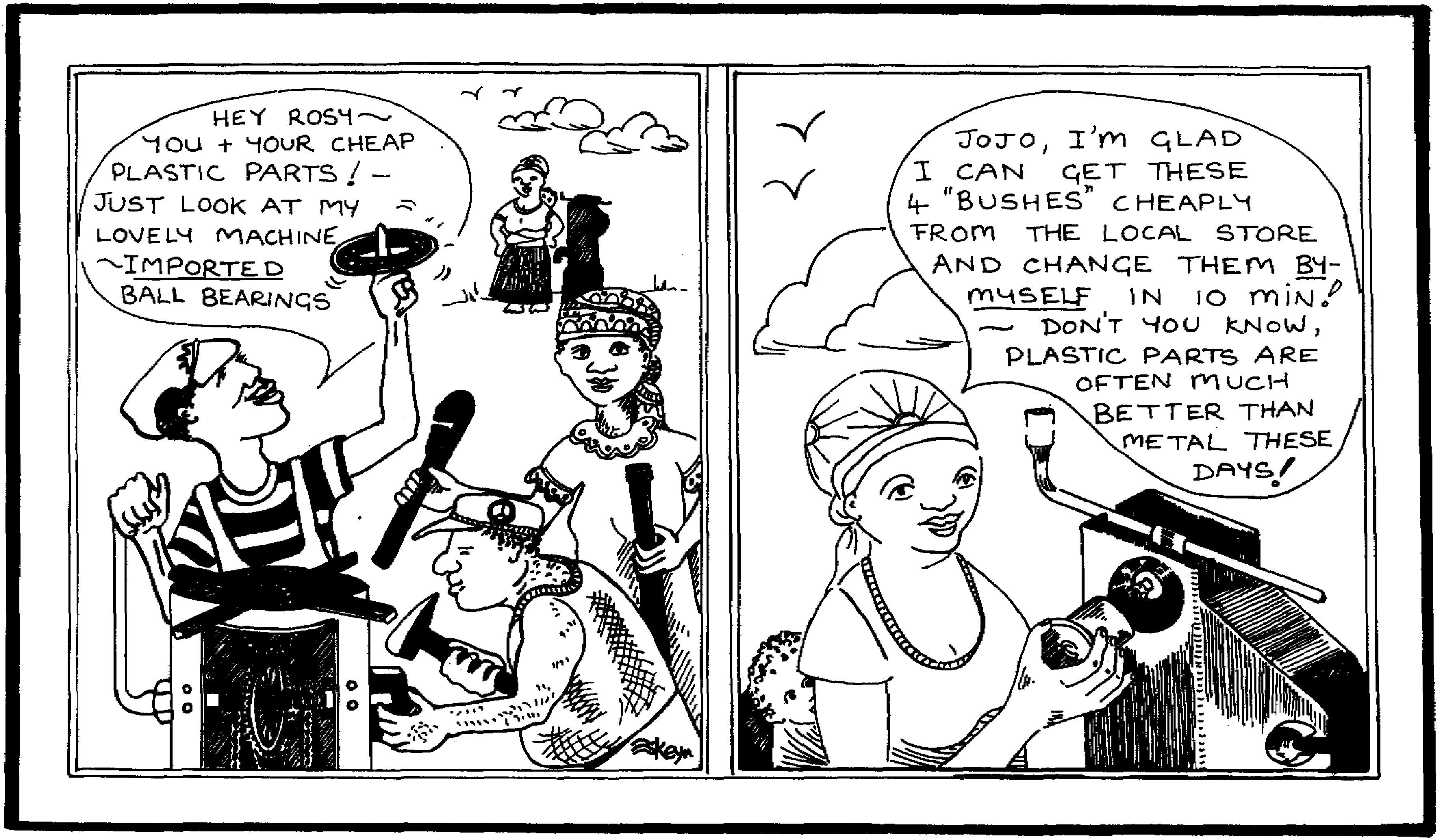
The use of a single 50 mm cylinder for all pumping depths challenges the conventional wisdom that a range of cylinder diameters should be provided. On the Afridev the mechanical advantage of the handle is altered instead, to ensure that pumping forces remain withing a range acceptable to users, whilst still giving similar yields per stroke for the same handle movement as that obtained with a larger diameter cylinder.

One standard cylinder diameter means that spares of only one size are needed. The spare parts stock is thus reduced and simplified, and the turnover of individual parts will be increased as one size fits all pumps.

**Modern Materials and Technology



Modern Materials and Technology



Modern Materials and Technology

* Modern plastics are ideal materials for many pump components
* High quality plastic components can be mass produced at low cost.
* All the wearing parts of the pump are either plastic or rubber.
* Pumphead bearings use two parts of different plastics snapped together.

The modern processes used in the design and manufacture of the Afridev have been available in industrialised countries for many years. Now they have been used to solve some of the problems of providing water supplies to rural communities in developing countries as well. For example, the Afridev pumphead bearings comprise a twin bush system that has an outer acetal bush running on an inner nylon sleeve which forms the counterface. The two parts snap together to give a neat, easy-to-replace bearing assembly. Field and laboratory tests have shown this material combination to have low wear characteristics while providing the great advantage that both bush and counterface sleeve are cheap injection moulded components. Expensive metal counterface pins, which all too often have a limited life, are thus eliminated.

Modern Materials and Technology

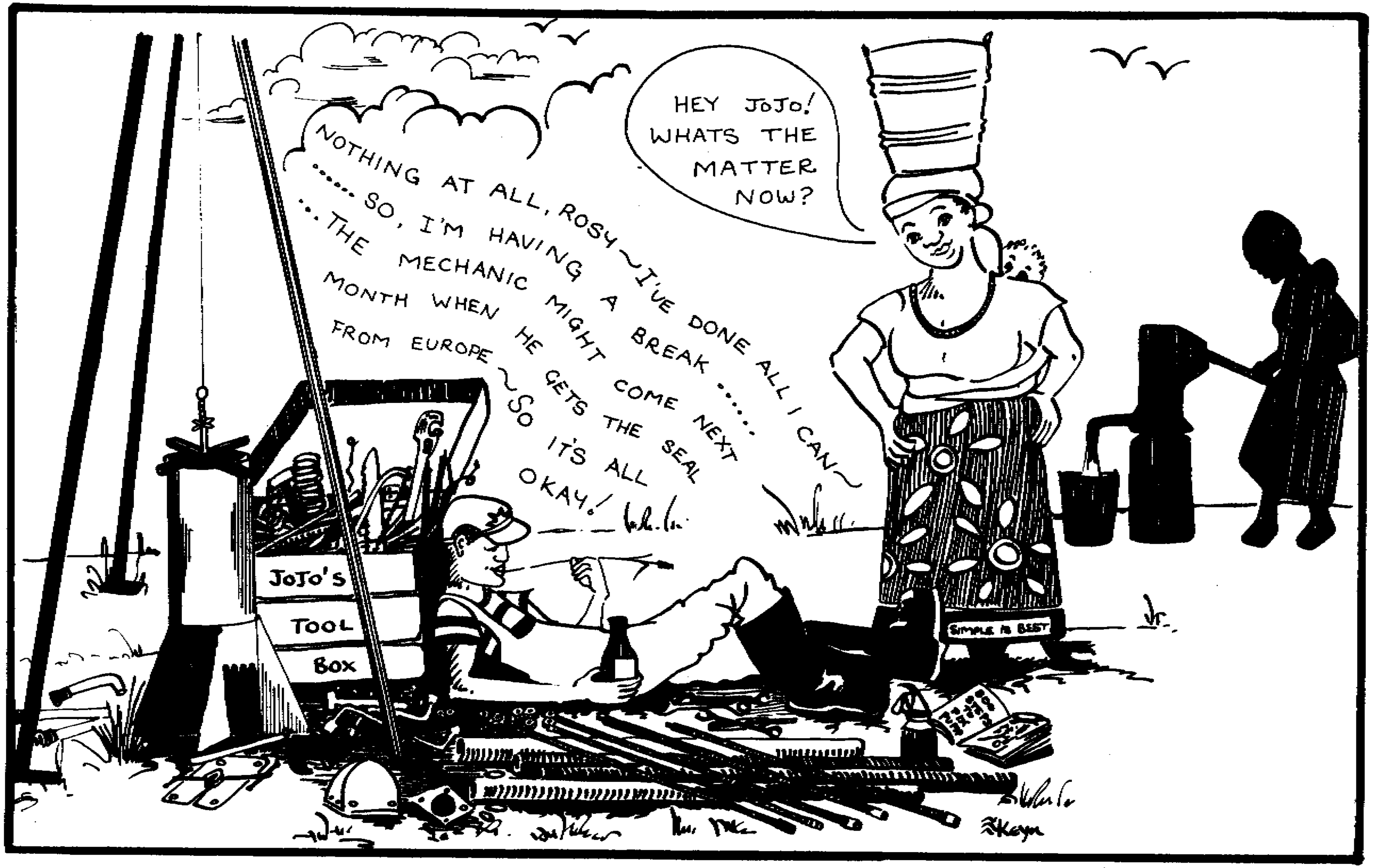
Modern Materials and Technology

- **Complex looking parts can be moulded from modern plastics in most countries.**
- **Plunger and footvalve bodies are interchangeable and cannot be dismantled.**
- **The wearing parts of these components are snapped in place by hand.**

The plunger and footvalve are identical components, and consist of two mouldings permanently spin-welded together. In both cases a simple one-piece moulded rubber valve bobbin is used, and this " snaps" into the valve housing through one of the ports by hand. The plunger seal is also of the snap-on type, being fitted by hand and removed with the help of a household knife. The footvalve is located in a receiver at the bottom of the cylinder, and again, a snap-fit is used. A simple "fishing" tool, consisting of a small grappling device on the end of a length of rope, grips the footvalve so that it can be removed for maintenance.

* * Local Manufacture

Local Manufacture



Local Manufacture

* **Local manufacture means local distribution of pumps and spare parts without foreign exchange and import licenses.**
* **Local distribution means that villagers can buy parts for their pumps.**
* **Straightforward pump design uses off-the-shelf materials wherever possible and simple manufacturing processes, with minimised quality control**
* **Pump design is adaptable to take account of local needs and resources.**

The pumphead is an all-steel fabrication specifically designed for easy manufacture. It consists largely of stock sections and incorporates a minimum of close tolerance machining. Widely available extruded uPVC is used for the rising main. Pump rods can be fabricated locally. Rubber is used for the valve bobbins and plunger seal and can also be locally moulded. Plastic components (bearings, plunger/footvalve, rod centralisers) are all designed to be locally moulded. Cylinders are also produced in Kenya using mainly locally manufactured components, although stainless steel cylinder liners are imported.

Technical Specification

Pumphead	—	All steel, welded fabrication designed for easy manufacture.
	—	Hot dipped galvanised (alternative finishes can be used).
	—	Universal mounting flange with 180 x 140 mm bolt centres provides interchangeability with India Mark II and Maldev.
	—	All nuts and bolts are M16, and those loosened for maintenance are captive.
	—	T bar handle for easy 1 or 2 person use, with handle force not exceeding 20 kg-f, with: 3:1 advantage for 10 - 30 m lift. 4.5:1 advantage for 30 - 45 m lift.
	—	Direct-action pumphead for up to 10 m lift under development.
	—	Concrete pedestal recommended for low-cost, rigidity and contamination protection (steel pedestal can be used).
Handle Bearings	—	Twin polymer bush assembly specially designed for pumphead hanger and fulcrum bearings.
	—	Twin bushes using outer polyacetal bush (Delrin 500) running on inner nylon 66 bush (Zytel 101).
	—	Two parts snap together to give neat, easy-to- replace bearing unit.
	—	Field and laboratory tests indicate very low wear rates
	—	Cheap, mass-produced spare part.

Rising Main	–	63mm OD, 53mm ID, 15 bar uPVC pipe.
	–	Suspended from pumphead by compressed rubber cone, giving simple joint that eliminates load concentration.
	–	Solvent welded uPVC pipe joints (snap together, easy-fit joints are under development).
	–	Rubber centralisers to locate rising main in borehole.
Pump Rods	–	Hooked 10 mm galvanised mild steel rods, with stainless steel option at extra cost for corrosive groundwater.
	–	Joined by special, easy-connect hooks, eliminating threads and tools.
	–	Hook connection incorporates plastic rod guides.
	–	Alternative, easy-fit rod connections are under development, to simplify mass-production.
Cylinder*	–	50 mm ID (53mm OD) x 700 mm long stainless steel (304) tube sleeved into 63mm OD, 53mm ID 15 bar uPVC pipe.
	–	Stainless steel cylinder lining ensures long life and corrosion resistance.
	–	Incorporates polyacetal (Delrin 500) footvalve receiver.

*Note: The discharge per full stroke (225 mm) is 0.44 litres. However, this much-quoted measurement is virtually irrelevant, as users rarely use this full stroke. A typical user moves a pump handle about 300mm, and the discharge for this typical handle movement will then depend on the mechanical advantage of the handle and the cylinder diameter. The Afridev aims to optimise the discharge for this typical stroke length at any given pumping head.

	—	Employs 1m long, 75 mm OD x 67mm ID suction pipe to give low water velocities thus minimising sand transport.
Plunger/Footvalve	—	One component used for body of both plunger and foot-valve.
	—	Valve body comprises two injection moulded parts, permanently spin-welded together.
	—	Valve body is polyacetal (Delrin 500), an engineering plastic with excellent mechanical properties and low water absorption.
	—	When used as footvalve, the snap-legs on valve body "plug-in" to receiver at base of cylinder.
	—	When used as plunger, valve body uses snap-in rubber "U" seal, fitted by hand and removed with a household knife.
	—	A simple, one-piece, moulded rubber bobbin is used in plunger and footvalve, snapping into valve body by hand through one of the ports.
Tools	—	Only two required.
	—	Forged socket spanner 24 mm across flats.
	—	Footvalve "fishing" tool uses simple grappling device on end of rope.
Spare Parts Pack	—	For routine replacement of wearing parts, a spare parts pack is provided. This comprises 4 plastic bearings, 1 rubber seal, 2 rubber valve bobbins and 1 "O" ring.

Afridev Production

The Afridev is now in limited production in Kenya. About 300 pre-production pumps had been produced by the end of 1986 by several different manufacturers. Following field trials of these pumps, a few design modifications are being made in early 1987. Large scale production is then expected, and full quality control systems will also be implemented. Production of the pumphead has also started in small numbers in Malawi, as a second generation Maldev (or Malawi pump). It is planned that tooling up for production of cylinders and bearings in Malawi will be undertaken by a manufacturer during 1987. Production of the Afridev, in modified form to suit local conditions and known as the Ibex pump, has started in Ethiopia and will be consolidated during 1987.

A production manual is also planned. This will be a comprehensive but straightforward document containing all the information needed to manufacture the pump. As well as drawings, it will include data on jigs and fixtures, gauges, materials and production processess. All this information is in the public domain and will be available to any potential manufacturer, in any country.

Pump Prices

The target price in Kenya and Malawi (inclusive of duties) of a complete pump to 30 meters is approximately $450. Components will be available separately if required. The price of a spare parts pack (containing all routinely wearing parts) for the proposed annual scheduled maintenance is around $12. Villagers should be able to purchase spares from a village store or a local bicycle mechanic, and the price quoted includes a margin for distribution costs and profit.

Acknowledgements

Development of the Afridev concept has involved many collaborators. The UNDP financed, World Bank executed Rural Water Supply Handpumps Project (INT/81/026) team has led the development, and gratefully acknowledges the contribution made by government staff from Kenya, Malawi, Tanzania, Sudan and Ethiopia. Particular mention must be made of: the major inputs of a design engineer from the Kenya Industrial Estates (from Project KIE/REP); project staff of the Kwale District Water Supply and Sanitation Project in Kenya; Kenya Water For Health Organisation (KWAHO); project staff of the Livulezi Integrated Rural Groundwater Supply Project in Malawi.

Thanks are also due to staff on projects financed by the United Kingdom (ODA), West Germany (GTZ), Sweden (SIDA), Switzerland (SDC), Finland (FINNIDA), Denmark (DANIDA) and the Netherlands (DGIS). Participating institutions have included Kenya Industrial Estates (KIE), Consumers' Association Testing & Research (CATR, UK), and the Swiss Center for Appropriate Technology (SKAT).

Finally, the Project has received assistance from many specialist suppliers, manufacturers and trade associations, of which special mention should be made of: Dupont de Nemours Ltd, Treff AG and Optimold AG (all Switzerland), Industrial Components Ltd. (Kenya), Petroleum Services Ltd. (Malawi), and Production Engineering Research Association (UK).

For further information on the Afridev handpump, its suppliers, and the production manual, write to:

The Regional Project Officer,
Rural Water Supply Handpumps Project,
The World Bank,
P.O. Box 30577,
Nairobi,
Kenya.

Tel: 338868.
Tlx: 22022

This booklet has been produced by the East African team of the UNDP/World Bank Rural Water Supply Handpumps Project (INT/81/026), in order to explain the main principles of the Afridev Handpump, a pump that demonstrates that villagers in rural areas of developing countries can manage their own water supplies. It is hoped that this will encourage other designers and manufacturers to work towards similar targets of village level operation, maintenance and management (VLOM), as well as local manufacture.

Graphics by Juliet Waterkeyn, Educational Material for Community Development Division of Kenya Water for Health Organisation, Nairobi.

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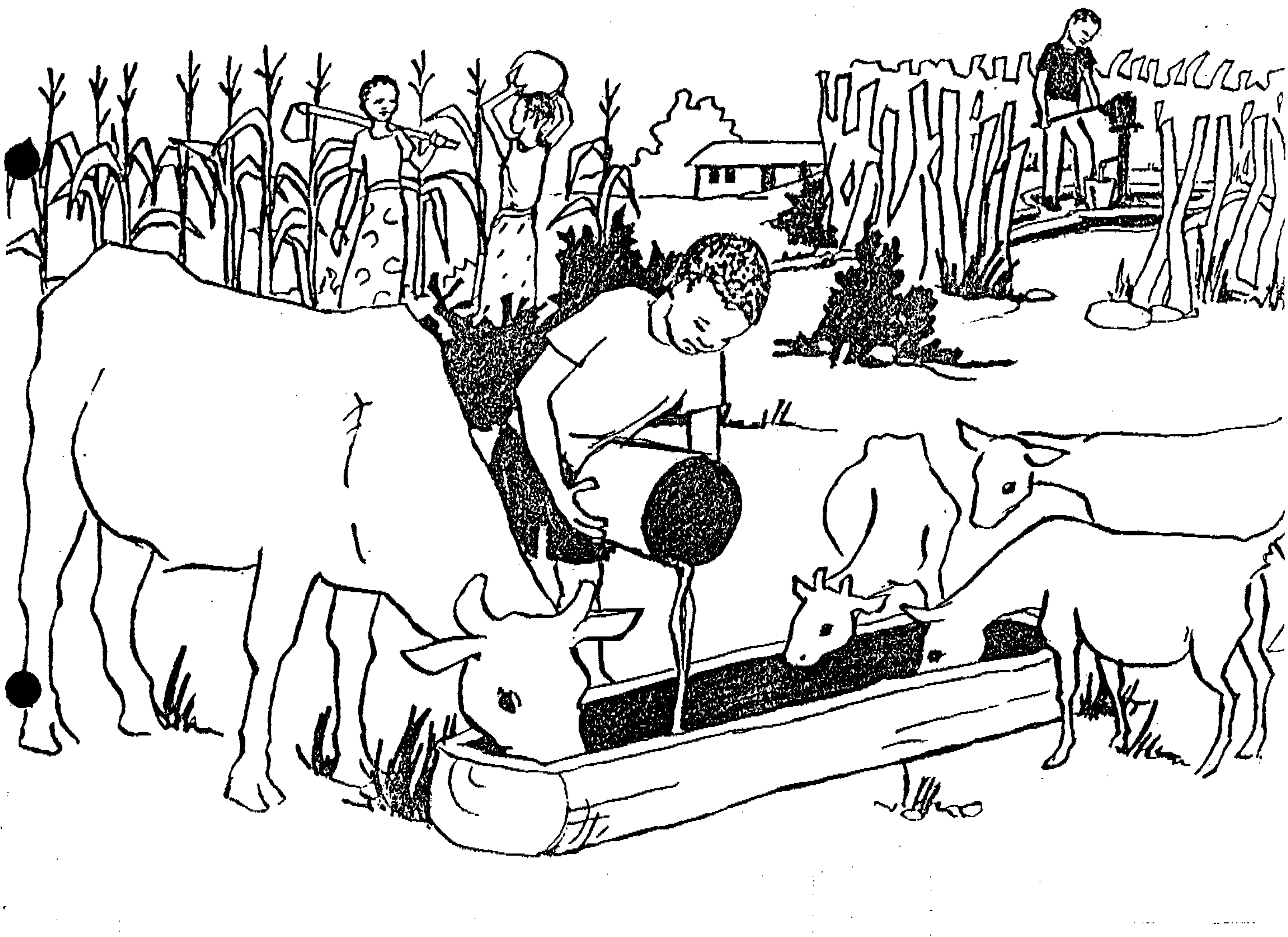
February 1987

TANZANIA

C.S 2

SINGIDA INTEGRATED RURAL DEVELOPMENT PROJECT

CASE STUDY OF LOW COST RURAL WATER SUPPLY PROJECT



CASE STUDY OF LOW-COST RWS PROJECT

Paper presented at 'All-Africa Seminar on low-cost rural and urban-fringe water supply systems', 13-18 October, 1986
Abijan, Ivory Coast.

Prepared by: Nathan Simonson, LWF/TCRS Water Engineer
Singida, Tanzania.

The Singida Integrated Rural Development Project is working in Singida Region, located in the central part of the United Republic of Tanzania and having an area of 49,314 sq.km. At the time of the last census (1978) the population was 616,000 in 322 registered villages and the district towns of Singida, Manyoni and Kiomboi. The current population is estimated to be about 750,000 and predominantly rural (estimated at 87.8% in 1978).

The rural population served with an improved water supply within their village, was calculated as 19.5% based on 1978 census figures. A more realistic proportion is 8.1% effective beneficiaries, which is derived by considering reliability and population served effectively. This does not however include those going to traditional water sources because of distance, lack of wind (windmills), fuel (diesel driven Mono pumps), or breakdown of the reticulation system. These figures have not changed significantly as there has been no major rehabilitation of existing systems and progress in constructing new systems is small.

Within Singida Region, there are both boreholes and shallow wells serving the rural population. Boreholes equipped with either windmills or diesel driven Mono pumps was the main emphasis for rural water supplies prior to 1981, with shallow well construction commencing in mid 1979 and now being the major type of system being developed. Table 1 gives borehole status from a survey in 1982, and Table 2, shallow well status at June 1986:

The Singida Project is implemented in close cooperation with the Government at a National (Ministry), Regional and District level. The majority of the staff are seconded so that at the completion c the Project there should be a smooth continuation of water related activities and the experience gained will not be lost.

Table 1:

Water Supply	Total Units	Operable	Proportion Operable
Abandoned	184	-	-
Not equipped	50	-	-
Status not known	20	NA	NA
Windmills	70	56	80%
Diesel Monos	78	42	54%
Other	31	NA	NA
Total	433	98+	NA

Table 2:

	SINGIDA DISTRICT	IRAMBA DISTRICT	MANYONI DISTRICT	TOTAL
No. of wells	199	18	18	235
Villages served	39	3	2	44
Total villages	145	118	59	322

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Table 3: PER CAPITA COSTS OF WATER SUPPLY SYSTEMS*

	IMPROVED DUG HOLE/OPEN RING WELL	RING/TUBE WELL PUMP & SEAL	BORE/MILL/ TANK/LIMITED RETICULATION	BORE/MILL MONO/TANK/ FULL RETIC LATION.
Estimated potential Population served	200	300	1 200	1 800
Actual population Served (a)	200	270	710	1 060
Reliability(b)(%)	100	90	64	54
Effective Population Served	200	243	450	570
Capital Cost(c)(US$)	1 100	1 820	77 500	80 500
Operating Costs/Year				
Repairs(d) (US $)	10	78	1 700	2 350
Depreciation(e)(US$)	30	98	2 300	3 300
Fuel (f)(US $)	-	-	-	2 200
Pump Attendant(US $)	-	-	680	680
Total Annual Cost	40	176	4 680	8 530
Per Capita Costs (g)				
Capital Costs(US $)	5.50	7.50	172.00	140.00
Operating Costs/Year(US$)	.20	.72	10.40	15.00
Advantages	Reliable Very low cost Sustainable Participation Affordable Accessibility? Low maintenance	Reliable Ease of Operation Low cost Sustainable? Participation Low Maintenance Affordable?	Water quality Health No fuel costs? Reasonably high quantity	Water Quality Health Quantity/ usage Accessibi- lity.
Disadvantages	Health?	Health? Vandalism?	High Capital operating cost Lack of water if breakdown Need for augmentation Lack of Participation Reliability Spares Vandalism Taste	Fuel avail ability? High capit & operatir costs. Lack of water if breakdown. Lack of participa- tion Vandalism Spares Taste.

NOTES:
a) See paragraphs 6.032-6.034
b) Windmill reliability takes account of no-wind periods, estimated at 20% of the year.

NOTES (Contd.)

c) Direct construction labour and materials only. No allowance for overheads or expatriate salaries and on-costs.

d) Equipment + allowance for cleaning/rehabilitation.

e) Pump and motor 10%, well, bores, mills, reticulation 3%

f) 9 L/day @ US $ .58 + 15% oil and filters.

g) Based on effective population served.

Source: Review Team Estimates, Project Records.

* This is a copy of Table 5.13 from Tanzanian Village Water Development Project: Evaluation Final Report, April 1984.

Figures have been converted to US $ at a rate of 12.3 T.Sh per US $ plus 10% annual inflation.

Table 3 above was compiled by the previous implementers of the Project who had a different Memorandum of Understanding with the Ministry of Water, Energy and Minerals than the present implementers (Lutheran World Service as Tanganyika Christian Refugee Service). The major difference is that the present project is concentrating work in village clusters, as opposed to scattered villages, and are completing the coverage (1 well per 250-300 people) of each village before starting a new village. This is hoped to make the progress more efficient and reduce overheads such as transportation.

Drilling and digging methods:

The previous boreholes were drilled using a rotary drill with supplementary compressor used to operate a down-the-hole hammer or roller bit.

The present drilling/digging method for shallow wells is dependent on the yield of the survey hole. For yields greater than 500 l.p.h a ring well is constructed, and for yields greater than 1000 l.p.h a tube well is considered.

Ring wells are constructed with reinforced concrete rings (caissons) of 1.25m diameter of 4 differing fabrications. The first is a shoe ring which has a cutting edge of larger diameter with its middle section being porous to allow infiltration. The second is a filter ring, which is rebated on both top and bottom and having a porous middle. The other two types are both of solid fabrication with one having rebates on both ends and the top ring having a rebate only on the bottom. These rings are lowered into the excavated hole, with the assistance of a tripod and hand-winch, when a collapsing strata is encountered or when the excavation is completed. The well is topped off with a precast cover incorporating a manhole for future cleaning and disinfecting as required. A drainage channel of approximately 6 metres in length is then added to complete the construction. The villager then plant a fence (approximately 15metres diameter) around the well site to restrict animals from entering.

A manually rotated auger (300mm diameter) is used to drill a tube well, which is then constructed, by lowering PVC casing and screen into the well, once the required depth is reached. The portion of screen pertaining to the aquifer is gravel packed, with the remaining section being clay packed to restrict surface water infiltration.

Maintenance:

The maintenance of the shallow well systems is set up to be carried out at the village level by the users. A group of four pump attendants is selected by the village to receive adequate training in maintenance procedures and fault finding. The village purchases the required tools necessary to carry out the work. Spare parts are presently being purchased from a project central store, but this will hopefully be changed to a more decentralized system. Possibly the villages will keep in stock adequate spares for their pumps or the village shop will stock them and then sell to the village as required.

The maintenance of existing borehole systems is currently carried out by the District Water Authorities concerned. This results in costly centralised maintenance which is often long overdue.

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An attempt was previously made at training village level pump attendants for maintenance of these systems, however lack of committment on the part of the village and poor local government salaries did not instill any sense of ownership of the system by the users. Thus it was of no major concern if it worked or not.

The Government has since changed their policy on maintenance, rehabilitation and operation of water systems, and has put the responsibility and costs more on the users. This has not been operating long enough to produce noticeable improvements, thought it is felt it should benefit overall maintenance in the future.

Community Participation:

The recognized need for community participation in the development of rural water supply systems to assure their maintenance was the main reason for the shift from borehole systems to shallow wells.

With a shallow well programme the users are able to participate from the planning stage, through the execution and then be able to carry out all maintenance at the village level of their own water supply. This is felt to be a necessity if the village is to have a sense of ownership and pride in their water system.

A Social Survey is first conducted of a large area (approx.20 villages) in which there is known to be many villages which have had no previous assistance with an improved water supply. The survey provides an overview of each of the villages and establishes their felt needs and priorities. The selection of the village cluster (6 to 10 villages) is done in consultation with the Regional and District Authorities involved.

Meetings are then held at village level, including all members of the village, to discuss in detail the processes required to develop a water supply and the commitment necessary by both the village and the Project. If an agreement is reached, then a contract is signed. This spells out the inputs of labour and

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materials which each party will contribute towards the development of the system, and also what action will be taken if the contract is broken.

The Project generally supplies expertise, equipment and all materials, whilst the village provides all labour on a self-help basis.

Operation and Maintenance Costs:

Operation and maintenance costs are all met by the village, with assistance given by the Project in initial training and provision of a spare parts store from which the village can purchase.

Costs per well per year:

Initial cost of Maintenance tools		35.00
Pump head replacement(over 4 years)		85.00
Pump cylinder replacement (2 years)		55.00
	US $	175.00

Assuming 275 users per well
then annual costs per capita is approximately $ 0.65

The mechanism for payment is left up to the village and at present this system seems to work, since most pumps are operationa
If spares have been required, the village has purchased these from the Project.

Sanitation facilities:
The Regional Health Officer provided the following statistics in April 1986:

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Table 4:

DISTRICT	TOTAL HOUSE-HOLDS	HOUSE-HOLDS $\bar{C}$ PIT LATRINES	HOUSE-HOLDS $\bar{C}$ POOR PIT LATRINES	PIT LATRINES IN 1985	HOUSES WITHOUT PIT LATRINES	% COVERAGE
Singida Urban	8462	5515	-	-	2947	65%
Singida Rural	18434	12892	-	2173	3632	70%
Iramba	7784	4093	979	1010	2712	53%
Manyoni	4769	4316	-	1835	453	40%
Total	39449	26816	979	5018	9744	57%

The standard of latrines are generally poor, consisting of simple pits of 1 to 3 metres depth. The cover slab is made with wooden logs and clayfill, with superstructure generally a spiral of bullrush and no roof. Life expectancy is generally 1 or 2 years. Occasionally concrete simple pit latrines are seen at Institutions and residences of wealthier individuals, more often in the urban environment.

Government policy insists on one pit latrine per household, which has to be built at the users expense. Latrines are generally constructed of local materials by the user at minimal cost.

The Project is offering assistance to individuals within the cluster villages, to construct Blair type spiral V.I.P latrines. These have a reinforced concrete slab and mortar lining (in upper part of pit). The slab is placed on a ring beam for support. The individual contributes two-thirds of the cost (approx US $ 20) and is responsible for all labour inputs. The demand has been high, mainly due to durability (5 to 10 times life expectancy of traditional pit) and lack of odour and flies.

Health Education:

This is the responsibility of the Regional Health Officer, but due to lack of sufficient staffing (Health Officers and Health Assistants), the coverage is minimal.

The Project is working in coordination with the Regional Health Officer to conduct village seminars on well hygiene and utilization, personal hygiene, home environment, nutrition and family planning. These seminars are conducted within cluster villages and a few urban district villages so coverage on a regionwide basis is still minimal.

Financial Summary (Shallow wells):

Using the year July 1985 to June 1986 as a basis for estimating cost per capita for shallow well construction.

These figures are only approximate and therefore the final results are for comparative purposes only.

Total Costs for year (which includes all expenses related to shallow well construction): US $ 187,500

Total number of wells constructed: 40
Average of one well per 280 people
Population served 11,200

Therefore cost per well was approx: US $ 4,700

or on a per capita cost of US $ 16.70 *

*This figure can be used to compare costs of the former project which was calculated in 83' at 740/= T.Sh (US $ 78.0 Est.) and one other similar project in Tanzania with an estimated of 491/= T.Sh (US $ 52.0 Est.) per capita cost. However both of these estimates take the initial cost of setting up the Project such as Workshop, Housing etc which was not incured by the present Project.

SUMMARY OF LWF IMPLEMENTED WATER PROJECTS ON GLOBAL BASIS

The Lutheran World Service (Department of World Service of the Lutheran World Federation) is involved in the water supply and sanitation sector both through the Operational Service Programs and through the Community Development Service (CDS).

CDS has since 1962 channelled support to approximately 100 projects and programs that have a water supply component or were established primarily for that purpose. Some of these aim at providing schools, hospitals and other church-operated institutions with water. Other projects go beyond that by engaging in the establishment of water supplies for drinking and general domestic and agricultural use in village communitie

The most recent water development projects approved by the CDS Governing Committee (1980-1984) number 34 in the total amount of US$ 3,8 million. Some of these projects are for multi-year programs and others are still to be implemented.

The major church-related water development projects so far have been in India, Indonesia, Brazil and Bolivia. In Ethiopia LWS started a water project in 1974 which was later turned over to the Evangelical Ethiopian Church Mekane Yesus (EECMY). It is involved in drilling boreholes for wells, protecting springs, and installing and maintaining handpumps. This has now extended to all the eight synods of the Ethiopian Evangelical Mekane Yesus. CDS has also supported water project in Tanzania, Cameroon, Zimbabwe, Bhutan and Colombia, besides small projects in other African, Asian and Latin American countries.

A number of LWS Service Programs have included water projects in their overall schemes. In Bangladesh the agriculture program has developed an inexpensive foot treadle pump for irrigation purposes.

Water, though only available in sparse amounts, has been crucial to the reafforestation project in Mauritania. A method of sanddune fixation involving seedlings and regular irrigation has been utilised to attempt to halt the encroaching desert.

Since 1980 a major effort to repair and reequip village water supplies has been undertaken in Zimbabwe. This involves the construction of hand-dug wells and small dams and providing irrigation for fields.

Beginning in 1983 a major water project in the Indian States of West Bengal, Orissa, and Bihar is being undertaken, known as the Water, Health, and Agricultural Trident (WHAT). This project extends the previous Water Resources Project, begun in the Purulia district of West Bengal and establishes a regional, integrated project which emphasises not just water supplies, but also village health services, adult education, agriculture and village crafts and industries. The WHAT project hopes to drill about 385 boreholes, drill or dig up to 300 wells, construct 10 dams, assist 50 families with village crafts and industries, establish 15 adult education centers, and train health workers to serve about 1000 people per year over the next several years.

A major task aspect of the Community Motivation and Development project in Mozambique is to provide irrigation and water supplies throughout the nation. A major effort will be made in the rural areas to install water engines and pumps and create wells to assure clean water supplies.

In cooperation with the government of Uganda the LWS program there is giving a high priority to a new rural water development scheme in the Karamoja region involving reconstruction and construction of new dams and valley tanks to collect seasonal rain water. A maintenance unit has also been trained. A new drilling rig assists with the efforts to create new wells and boreholes. In addition, a pilot scheme involving four windmills is expected to provide water for human consumption as well as for livestock and irrigation purposes.

SELECTED STATISTICS FROM SERVICE PROGRAMS-1985

1. L.W.S. (INDIA)

DRINKING WATER (TUBEWELLS) 1985

Programme	Area	Total No. of Tubewells sunk	Average depth of each Tube-well (approx.)
Drought	West Bengal	30	109Mtrs
	Orissa	30	181Mtrs
Flood	West Bengal	79	110Mtrs
	Orissa	151	80 Mtrs
	Total(W.Bengal/Orissa)	290	

Drilled manually or with calyx rigs or other power rigs.

2. L.W.S. (KAMPUCHEA)

14 wells with average depth 32.9m and varying in diameter from 10cm to 100cm were drilled in 6 month training period.

By end of 1985, 53 wells drilled providing water for 51,900 persons in villages and at district hospitals, schools and clinics in seven provinces. The deepest well drilled was 72m and produced 4320 litres/hour. India Mark 11 hand pumps were installed on all wells servicing rural communities.

3. L.W.S. (UGANDA)-Karamoja Development Project.

Since March 1984 up until December 1985, some 68 boreholes (average depth 70m) have been drilled using a rotary drilling rig. Dry hole rate of less than 15% (National average 23%).

Local communities have borne the total cost of fuel required for drilling 4 boreholes. Siting priorities is given to schools, hospitals, clinics and resettlement schemes.
Pump installation teams installed 57 new Unicef 11 pumps on either new boreholes or old boreholes that have been rehabilitated.

During 1985 over 181 major repairs on boreholes were carried out, including removal of old pumps and pipes redrilling of boreholes filled with stones, fishing for dropped pipes and pump parts and cleaning of boreholes prior to the installation of new pumps.

4. L.W.S. (ZIMBABWE)

Progress chart at the end of 1985

PROJECT	WP ONE Matabeleland South	Midlands		WP TWO Masvingo		WP THREE Matabeleland North			WP FOUR Manicaland	
	Gwanda +Beit-Bridge	Matobo	Mberengwa Zvishavane	Mwenezi	Chibi Chiredzi	Lupane	Tsholotsho	Nkayi	Chipinge Mutare Maungwe	Total
Well completed										
-1985	146	13	130	10	102	45	60	5	44	5
-Total	721	20	444	118	152	50*	77*	39*	44	16
Wells under Constr.	49	35	74	65	176	33	37	57	60	5
Wells abandoned	142	3	119	34	19	10	5	2	11	3
Wells proposed	0	25	0	0	0	110	105	75	100	4
Old wells or boreholes rehabilitated.	165	0	7	0	4	5	10	0	6	1
Dams completed										
-1985	9	1	10	0	0	3	1	0	0	
-Total	28	1	30	2	0	4	3	0	0	
Dams under constr.	10	1	19	3	6	7	2	0	0	
Irrigated gardens	15	o	18	5	7	0	1	0	0	
-established										
-in progress	14	0	26	2	2	0	3	0	0	
-proposed	5	0	3	0	0	0	1	1	0	

*these figures include wells that were started by D.D.F. but left uncompleted.

5. L.W.S. (NEPAL)

Since inception of the program in 1984 in Baglung district the LWS has completed drinking water schemes in eight villages with government support, providing around 25,000 people with safe drinking water. These schemes are gravity-fed with pipelines of up to 3,500m and up to 19 public tapstands per village. The district is moderately remote with the nearest roadhead some 2 to 4 days walk, necessitating project materials to be carried by porters in loads of up to 80kg along trails leading over steep slopes, precarious suspension bridges or through river fords in the Himalayas a further 4 village schemes are being implemented in 1986, with pipelines of 7,700m, 1,200m, 2,500m, and 2,480m and a total of 54 tapstands.

6. L.W.S. (BANGLADESH)

During 1985, the Programme supplied 13,169 treadle pumps for irrigation and 9,841 handpumps for household drinking water. This pump was developed at the Project for mounting on a bamboo tubewell. The project, known as the Rangpur Dinajpur Rural Service (RDRS), has an appropriate technology workshop with a production capacity of 40,000 pumpheads per year. There are different models with varied cylinder diameters and water pumping capacities. Of these the most popular ones are the 8.9cm (3.5in) diameter twin pump and the 7.6cm (3in) diameter household drinking water handpump.

The simplest twin cylinder model delivers 128 litres per minute from a water table of 3 metres or 72 litres from 6 metres. It can sufficiently irrigate more than 0.2hectare of rice or 0.4 hectare of wheat in 3-4 hours. The pumphead, made of mild steel, costs $ 7.50 while the farmer provides the bamboo and hires a pump sinker who charges an average of $0.10 per foot for the sinking. Thus the total cost comes to about $13-17. Against this, the traditional cast iron handpump with GI pipe tubewell and filter costs about $100 and provides only 45 litres of water per hour. Similar costs relate also to the household drinking water handpump manufactured by RDRS.

C.S 3

ALL-AFRICA SEMINAR ON LOW-COST RURAL AND URBAN

FRINGE WATER SUPPLY, ABIDJAN

OCTOBER 13 - 18, 1986

DEVELOPMENT OF HANDPUMPS FROM LEVER ACTION TO DIRECT ACTION, EXPERIENCES IN MTWARA - LINDI, TANZANIA

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1. HISTORY OF THE RURAL WATER PROJECT, MTWARA - LINDI

The implementation of Rural Water Supply Project in Mtwara and Lindi Regions started in 1978. To date, the Project has improved the water supply of about 900,000 people.

The costs of the Project have been shared by the Government of Tanzania (GOT) and foreign donors in the following way : FINNIDA about 70%, GOT 10%, UNICEF 10%, UK 10%.

The rural water supplies include 2200 handpump wells and 14 piped schemes. The Project has been implemented by Finnwater Consulting Engineers. The implementation and the operation and maintenance will be completely the responsibility of the local authorities and communities by 1988.

Handpump development has been an essential part of the development of a village level operation and maintenance system. The Project has collaborated with the UNDP/WB handpump testing programme since 1983.

2. HANDPUMP DEVELOPMENT

2.1 GENERAL

The handpump wells are constructed by the following means:

1. Hand digging (depth 4 - 7m)
2. Hand auger drilling (7 - 16m)
3. Cable-tool drilling (15 - 30m)
4. Down the hole hammer drilling (25 - 60m)

A design criteria of 250 consumers per well has been applied.

Eighteen different types of handpumps have been installed in Mtwara and Lindi Regions. This large number of different types of pump has mainly been due to co-operation with the UNDP/WB handpump testing programme. The list of different pump types is as follows:

		Pcs	Currently in use
NIRA	AF-85	300	300
NIRA	AF-76	1700	1700
NIRA	AF-83	20	10
NIRA	AF-84	5	-
INDIA	Mk 11	70	70
SWN	81	19	19
KANGARO		6	2
TARA		2	-
WAVING		3	-
MALDEV		10	10
AFIRDEV		2	2
KATE		5	1
BLAIR		18	-
SHIRAZI		1	-
TANDA		3	-
PEK		2	2
SHINYANGA-Type		20	-
MONO		2	-
18			

Until 1983, only lever action handpumps were used. The Project started an experimental development of direct action (DA) handpump in 1983 after discussions with the UNDP/WB-Project personnel

By the end of 1983 a direct action handpump was manufactured in Mtwara using imported pump cylinders and piston rods. The pump was easy to maintain but heavy to operate. Still, it was accepted by the consumers. The successful introduction of this pump encouraged the Project to continue work on the development of direct action pumps.

The manufacturer of Nira pumps in Finland started the development of a direct action pump in 1984. The output was Nira AF-85 DA-pump. Field testing of this pump started in 1984. Up to now, 300 Nira AF-85 pumps have been installed in Mtwara and Lindi.

The Nira DA-pump has been undergoing testing and modification for about two years. Only few improvements on the original design have been necessary but laboratory and field tests are still continuing.

The installation of lever action pumps in shallow wells was stopped in 1985. Lever action pumps are only used in borehole wells with a water table deeper than 13 m.

2.2 TECHNICAL FEATURES OF THE DIRECT ACTION PUMP NOW USED BY THE RURAL WATER PROJECT

The DA-pump is presented in figure 1. The pump consists of steel, brass, rubber and plastic parts as follows:

Materials

Steel	- handle
	- pump stand column, plastic coated
	- base plate
	- screws

Brass	-	drop pipe sockets
Rubber	-	shock absorber of the handle
	-	plugs of the pump rods
Plastics (HDPE/PUR)	-	bush bearing
	-	drop pipes
	-	pump cylinder with foot valve housing and foot valve
	-	pump rods and sockets
	-	plunger/plunger valve/sealing ring

Design of the above-ground components

The average stroke length and height of the handle grip during pump use have been studied. The stroke length was 15 - 35 cm and the minimum distance from the lowest position to the foot bearing was about 65 cm. The height of the pump stand and the length of the handle have been designed accordingly. The design increases pumping comfort and the effort required is acceptable to the users.

As few threads as possible are used with the above-ground components to minimize corrosion risks. The pump rods and the plunger are extractable after removing the bush bearing from the top of the pump stand. The pump is fixed with four bolts on the well cover.

The design of the above-ground parts has been found satisfactory. Slight wear of the bush bearing has been observed.

Design of drop pipes and pump rods

The below-ground modules of the pump consist of 0.5 - 3.0 m long pieces of drop pipes with respective pieces of pump rods inside.

To prevent wearing of the drop pipes, the pump rods are joined with inner sockets. The threads of the joints have a wide pitch to avoid misthreading when the installation and maintenance is carried out.

The HDPE-pipes are storng against shearing and tension forces. The weight of the piston rods is eliminated by making them buoyant. This leads to a light upward storke and a heavier downward stroke. The body weight of the operator can be utilized.

Piston assembly and foot valve

The piston assembly consists of plunger, plunger valve and sealing ring. Thirty and severty per cent of the pumps total yield are received during the upward and downward strokes repsectively. It has been discovered that water can be pumped even without a plunger if pumping intensity is increased.

An identical valve to the plunger valve is used as a foot valve. The pump is not operational if the foot valve is damaged. Valve damage used to cause problems after a few months' use, but after redesigning their life time is expected to be extended upto several years. The valves are currently being tested. All wearing parts are cheap and easy to replace.

Maintenance of the DA-pumps

The DA-pumps do not require regular maintenance. Actually, the two valves and the bush bearing are the only wearing parts. They are expected to operate several years without replacement. The spares are cheap and easy to carry.

A pump can be dismantled and assembled by two men or women in ten minutes. Only a simple belt spanner and a 10 mm allen key are needed for the maintenance of the pump. Most maintenance operations can be carried out with the belt spanner only. A 19 mm spanner is needed when the pump is installed on a well cover for the first time.

2.3 TECHNICAL, ECONOMICAL AND OTHER ASPECTS FAVOURING THE USE OF THE DIRECT ACTION PUMPS

About 1700 NIra AF-76 lever action pumps have been installed in Mtwara and Lindi Regions. Currently about 90% of all new wells are equipped with direct action pumps. About 10% of the new wells are equipped with India Mk 11 pumps. When an old pump has to be replaced a new direct action pump is installed.

The following aspects are favouring the "new generation" of handpumps in Mtwara/Lindi:

Technical Aspects favouring the use of DA-pumps

- The DA-pump is easy to use when the cylinder is not deeper than about 13 m. Cylinder can be installed at 20 m.

- The DA-pump is easy to install and maintain, with 3 tools. Below-ground parts, except the drop pipe sockets, are made of plastics.

- The DA-pump is durable. Wearing parts are few and they are easy to be replaced if needed.

- The DA-pump is very suitable for the village level maintenance.

- The DA-pump is suitable for local manufacture in Tanzania.

Economical aspects favouring the use of DA-pumps

- Prices	Direct action	350 USD
	Lever action	540 USD
- Village tool set	Direct action	41 USD
	Lever action	310 USD
- Maintenance cost per year estimated	Direct action	20 USD
	Lever action	62 USD

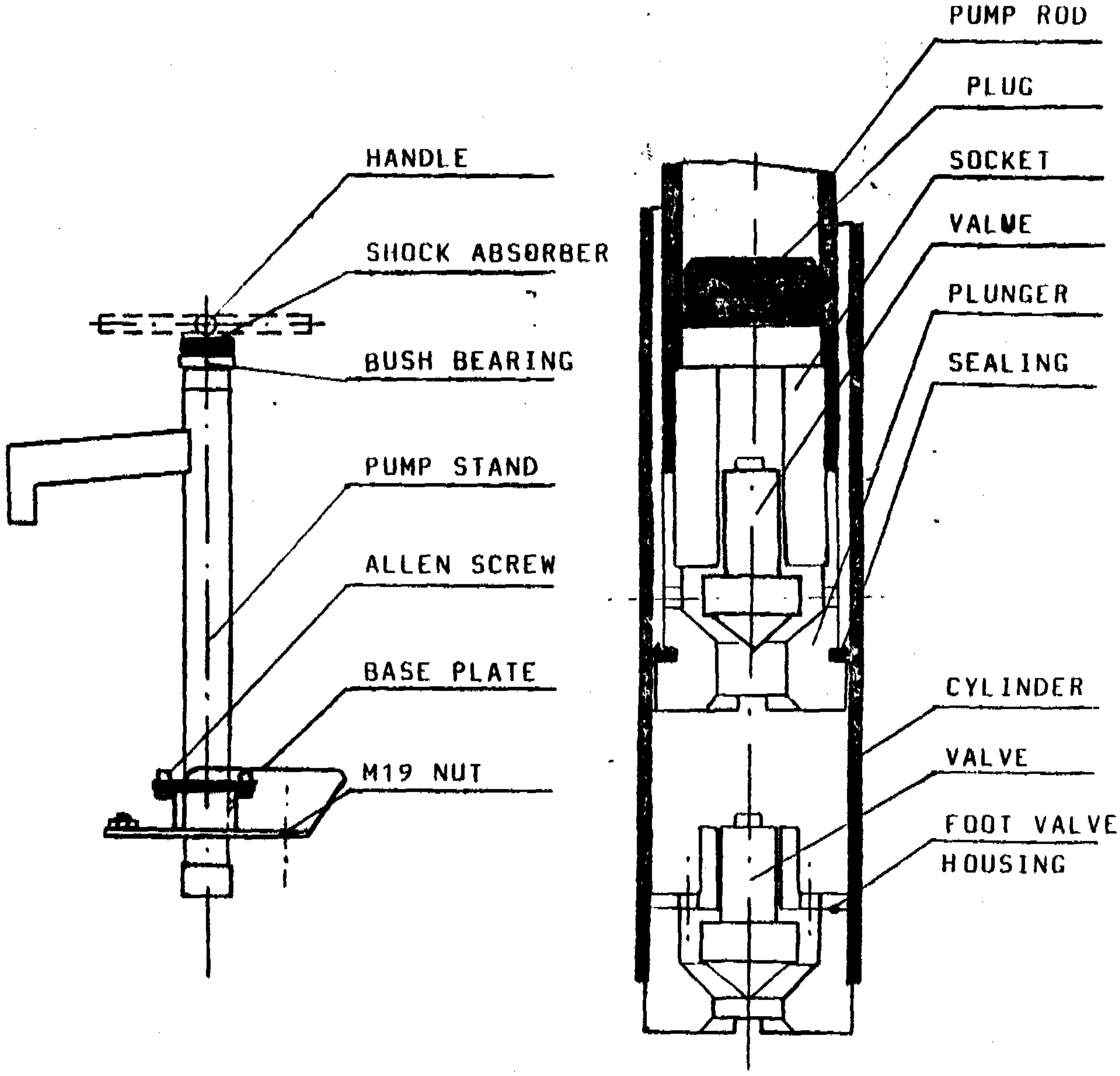
Other Aspects

- The DA-pump is simple and can be maintained by people with low skills.

- Due to higher reliability and ease of maintenance greater number of pumps are in operation, providing villager's with safe water.

- According to a field survey, the villagers prefer AF-85 pumps to AF-76, however, other aspects such as reliability, taste of water and hauling distance are given a higher priority than to the pump type.

- UNDP/Wold Bank Handpump Testing Project has recommended NIRA AF-85 pump as a very reliable and sufficient pump for countries like Tanzania.



(a) (b)

Figure 1: (a) DIRECT ACTION HANDPUMP (b) PUMP CYLINDER

CS 4

UNICEF ASSISTED EMERGENCY ASSISTANCE PROGRAMME FOR RURAL WATER SUPPLY AND SANITATION IN LUWERO DISTRICT (UGANDA) APRIL - DECEMBER, 1986

1. INTRODUCTION/BACKGROUND

Luwero district is part of Luwero triangle, which area was among those devasted during the 5 years of guerrillar warfare.

During this period many lives were lost, people displaced, social and economic activities and services were disrupted and virtually came to a stand still. Today Luwero is safe and secure. Many people have returned to their homes.

One of the first priorities of the new National Resistence Movement government is to re-build such areas as Luwero triangle which were destroyed during the war. In line with this the new government has invited assistance which can best help the returning people of such areas as Luwero.

Within the Luwero District the government of Uganda and UNICEF have identified a compact project area where it is operating an emergency programme. This was the area worst hit by military operations and traditionally the most densely populated area of the district (See map attached).

The whole programme package is integrated and includes:
- Borehole drilling,
- Borehole rehabilitation and replacement of the old-U-I-pump (Uganda wooden "bush" pump) with U-II pumps (All steel version of the Indian Mark II pump).
- Spring protection
- Sanitation and social mobilization.

This programme is supplement to UNICEF assisted Uganda country programme 1985 - 1990. It started operating in April, 1986.

2. OBJECTIVES:

The primary overall objective is to reduce child mortality and morbidity in the project area.

Community education and mobilization are being stressed as a process for implementation, one of the outputs of which will be community based maintenance networks - to ensure that the water supply sites remain operational after the project is completed.

The second objective is to consider Luwero as a pilot project to build a model integrated rural water and sanitation programme for expanded implementation.

I am however, going to dwell mainly on borehole drilling part of the programme and mobilization.

3. COMMUNITY MOBILIZATION EDUCATION:

An aggresive programme of social mobilization to realise the full potential of community participation and to ensure that the water source maintenance network is sustained is accompanying the provision of water and sanitation.

3.1 Aim:

One of the main aims is to install a sense of community ownership of improved water sources and hence promote local responsibility for upkeep and maintenance.

3.2 Progress:

An orientation workshop for members of community mobilization, information and education team in Luwero district was held in April. Participants included representatives of government ministries and departments, heads of departments at district level, NGOs and members of the Resistance Committees at sub-county level (R.C. 3s).

The objective was to crystallize the existence of the group as a community mobilization committee, to identify problems encountered in the exercise of mobilization, informing and educating the people for purposes of rehabilitating the quality of their lives through improved health, environmental sanitation and personal hygiene.

Another workshop for the district community mobilization team was held later in April. Participants were drawn from government extension workers at county and sub-county level, representatives of R.C.3s, school system, religious leaders and other opinion leaders in the area.

The objective was to ensure that participants realize and internalise the importance of community mobilization as an essential tool for rehabilitation and development.

A district mobilization team was thereafter formed to direct activities of the district. Mass rallies led by the team and sub-county mobilization team to create awareness and build support for community participation have been held in all the project sub-counties. The team makes regular visits to sub-county and community level to monitor the progress of mobilization.

3.4 Community activities include:

Clearing access roads to sites and the sites themselves.

Site identification and selection.

Selecting water source caretakers.

Selecting a local person for training as pump mechanic.

Helping in water source construction or protection.

Assisting U-Two pump mechanic in repairing pumps.

Responsible for costs of maintenance and repair of the water sources.

4. BOREHOLE DRILLING PROJECTS:

A constant return of refugees to the area increased the necessity of new water sources. Because of the insignificant number of existing boreholes and perennial springs in the project area, there was an urgent need to drill additional boreholes.

4.1 General Description:

Four high speed, down the hole hammer rotary drilling rigs have been diverted from the regular country programme for the Luwero emergency. Each rig is manned by government staff from the Water Development Department (W.D.D.) all of whom have undergone on the job training with UNICEF technical assistance.

4.2 Target:

The target is to provide about 75,000 people with at least 20 litres of safe water per person daily by drilling 375 boreholes and equipping them with U-II hand pumps. (all-steel Uganda version of the Indian-Mark II pump).

4.3 Implementation:

A base camp has been established in Luwero consisting of government staff for the project, technical assistance staff, four drilling rigs, support equipment, transport, U-II hand pump installation equipment, mobile maintenance workshop, stores, communications equipment information mobilization staff.

An approach whereby the recepient communities are deeply involved at all stages-planning, siting, constructing and maintaining is being applied. With the cooperation of villagers and their participation in decision making there are high chances of programme success.

4.4 General Organisation:

4.4.1 Rig deployment and personnel:

The four units (rigs) are operated from the base camp.

Each drill crew consists of:

- Senior driller, driller, apprentice driller, rig drivers, tender truck driver, helper, turnboy, mechanic welder, 2 (No) watchmen

A Pump Installation Team attached to each rig consists of:

- Senior pump installer, mason, helper, truck driver, turn boy, electrician/helper

4.4.2 (ii) Logistical support, stores control and equipment maintenance:

A project base camp workshop and stores have been set up for all maintenance and repairs of equipment/vehicles and for storage of all the supplies.

The unit consts of:

- Mechanical engineer, 2 (no) senior mechanics, 2)no) 2 (no) mechanics, 6 (no) welders, 2 (no) stores personnel 5 - 4 (no) helpers/spanner boys, 2 (no) carpenters

4.4.3 (iii) Hydrogeologic, site selection and records section:

A survey team is attached to the base camp for site sele tion, rig access preparation and hydrogeologic analysis

The team consists of:

- Hydrogeologist, geologist (hydrogeogist trainee), 2 (no) field assistants, driver

4.4.4 (iv) Other project staff includes:

- Records clerk, typist, messengers, hydrofrac/well development staff

4.4.5 Technical assistance by UNICEF:

- One drilling superintendent, one master driller, one pump installation supervisor, one maintenance engineer

4.4.6 Summary of Project Staff:

	UNICEF	National (W.D.D.)
Field staff	2	78
Base camp & stores	2	22
Clerical support	-	3
Headquarters	-	20
P.S.C.	3	
	7	123

4.5 OPERATION:

4.5.1 Drilling Method:

The four rigs - British make can do "Rotary" drilling using mud or foam and "down-the-hole hammer" drilling with the help of compressed air. The latter method is most used and the former (using foam) is applied in collapsing formations.

4.5.2 Borehole site selection:

The local communities through their resistance committees are involved in the selection of all the borehole sites. The hydrogeologist approves of the sites technically and maps them.

4.5.3 Monitoring:

The completion of each borehole is followed by a properly completed log filed by the senior driller.

The senior pump installer files a report for each hand pump installed.

The senior driller files a monthly report on all fuel, spares and consumables used by the rig.

All reports are compiled and a monthly report made.

4.5.4 Indicators for Evaluation include:

Decrease in incidence of diarrhoea in children under five years of age. A survey was done and a follow up survey will be done later.

Decrease in walking distances for fetching water.

Increase in the number of people provided with portable water

Metres drilled.

Number of successful boreholes completed.

Number of handpumps installed.

4.6 PROGRESS, RIG UTILIZATION: (see appendix I)

1. Working hours:

Government staff officially work a 5 day week but saturdays are normally worked by all project staff. A footage bonus is paid to compesate for overtime. Drilling and installation crews work an average of 10 hours per day. They are given 10 days home break every four months (in additional to normal annual leave) as compensation for these long hours.

2. Rig utilization:

Sundays, Public holidays and home break days have not been deducted to arrive at overall project utilization of 73% .
Deduction of these days gives overall rig utilization of approximately 87%.

3. Drilling hours:
Include in drilling hours is time spent installing casings, cementing, tripping to change bits and air lifting developing/testing of boreholes.

4. Moving hours: (15%)

Includes moving the rig between sites and daily moving of crews from base camp to the drill site.

5. Maintenance hours: (7%)

Includes time spent on daily and routine maintenance of all equipment in the field.

6. Breakdown repairs (10%)

Includes all time spent on actual repairs as well as time waiting for delivery of spares.

7. Other downtime hours (8%)

Includes all downtime not covered above such as:

waiting for fuel or materials
bogged down/rain
waiting for site selection/preparation
work planning
absenteism.

1. Rig utilization:

$\frac{\text{358 days operated}}{\text{488 days available}}$: 73%

2. Drilling rate:

Borehole completion rate

$\frac{\text{488 (Days available)}}{\text{168 (Boreholes completed)}}$: 2.9 days per B/H

3. Drilling rate:

$\frac{\text{358 (Days operated)}}{\text{168 (boreholes completed)}}$: 2.1 working days per B/H

4. Penetration rate:

$\frac{\text{11583.3 (metres drilled)}}{\text{2066 (hours drilling)}}$: 5.6 m/hr.

4.7 Costing of Borehole Construction: (see appendix 2 & 3)

Due to shortage of time, it has not been possible to cost the Luwero emergency project.

An analysis was made of the 1985 borehole drilling cost for the same four high speed rigs now operating in Luwero.

The costs are not expected to be different since almost the same set up and organisation is being used in Luwero as the one which was used in 1985 for these same rigs.

So these costs have been utilized to give an estimate in the meantime.

In the analysis:

- All costs are in US$: supplies, equipment or services procured in other currencies were converted inot US$ at therelevant exchange at the time of procurement/expenditure

- Depreciation is calculated on the basis of historical cost The cost value is depreciated in a straight line over its economic life at the end of which it is assumed to have zero value.

Also:-

- No insurance is charged on the project
- No interest is payable on capital employed
- No taxes are payable
- No costs for replacement plant is charged
- Costing include hydrogeological surveys and test pumping

<u>EXECUTIVE SUMMARY</u>:

- cost per borehole with casing and hand pump installed including cost for hydrogeological survey and tesg pumping 1985 US $: 3,121.

- cost per metre of drilling with 115mm diameter in bottom excluding cost of hand pump installation, casing hydrogeological survey and test pumping 1985: US $28.8

  average depth per borehole 1985: 71m.

5. HAND PUMP AND HAND PUMP MAINTENANCE

5.1 Hand Pump:

In 1980 the Government, with the assistance of UNICEF embarked on project of emergency rehabilitation of 5,000 existing hand pumps fitted on boreholes in rural Uganda. At the time a conservative estimate of hand pumps broken down was 75%.

In 1983 a survey was made of all hand pumps in rural Uganda which revealed that 67% of the pumps were broken down.

Following this survey a decision was made by water Development Department to replace the conventional Uganda type pump with the U-Two or (Indian MK II) hand pump - a more durable pump.

- requires less maintenance and can be maintained by local people
- with a proven record of success from India and other countries

  there was also the possibility of local manufacturing and production is going to start next year 1987

5.2 Hand Pump Maintenance System

In the long run, the success of this rural water supply programme will not be judged according to the number of boreholes that were drilled, but how well the hand pumps have been maintained/how many will be working by then.

Therefore of prime consideration in implementation of the water programme has been to establish viable operation and maintenance system.

5.2.1 Aim - The principal guide in forming this system is to have an independent capability at community level to maintain and repair the hand pumps; so that villages can be able to maintain pumps for long periods by locally trained personnel within the community without assistance from outside.

The major responsibility for maintenance is being left to the beneficiaries.

5.2.2 Progress

1. Selection - In consultation with local communities, each RC 3 has selected at least two candidates for training in the maintenance and repair of the U-Two hand pump. He will be responsible for 20 - 30 pumps - one is standby.

2. Training - They are being trained on the job by the pump installation crew on the project. 7 have already qualified as local pump mechanics and will be awarded with certificates.

3. <u>After Training</u> - Water Development Department with the , assistance of UNICEF will give each RC 3:

(i) a complete U-Two pump repair and maintenance kit
(ii) a bicycle to be used by U-Two pump mechanic
(iii) a set of spares to last 2 years

4. <u>Maintenance and Repair Costs</u> - However, it will be the responsibility of the RC 3 and hence the beneficiaries to

- replace any broken or lost tools
- maintain and repair the bicycle
- replenish the stores of spares when exhausted in an arrangement being worked out

5.3 <u>Reporting</u> - One completion of repair work, the pump mechanic will be filling in the U-Two repair record form stating what work was carrried out and spares used.

From the yearly reports on pump spare parts usage, it will be possible to estimate what spare parts need to be ordered and also to predict the consumption.

6. SANITATION

To have remarkable effect on health conditions, provision of clean water is being coordinated with sanitaion.

6.1 <u>Aim</u> - Is to show to the people and re-emphasizing to them the importance of the proper disposal of wastes and the prevention of fly contamination in the control of feacal oral routed diseases.

6.2 <u>Progress</u> - Demonstration ventilated improved pit latrines (V.I.Ps) are being constructed at various centres such as schools, health centres and markets.

Slabs are being cast at the base camp. They will be deposited at sub-county Headquarters from where people will collect them after the public health staff have checked to ensure that the required conditions have been met.

UNICEF ASSISTED EMERGENCY BOREHOLE DRILLING PROJECT
DRILL RIG ANALYSIS PROJECT SUMMARY FOR APRIL TO JULY 1986

UNIT	17		18		19		20		PROJECT	
	HRS	%	HRS	%	HRS	%	HRS	%	HRS	%
Rig day operated	98		86		85		89		358	
Drilling hours	614	65	486.5	5	498	64	467.5	59	2066	60
Moving hours	135.5	14	115	12	114.5	15	139.5	18	504.5	15
Maint. hours	82	9	71.3	8	52	6	46	6	251.3	7
B/down repair	42.5	5	162	17	60.5	8	78	10	343	10
Other downtime	63.5	7	95.5	11	53.5	7	62.8	7	275.3	8
Total hrs worked	937.5		930.8		778.5		793.8		3440.6	
B/holes completed	55		34		41		38		168	
Metrics drilled	3775.3		2409.2		2979.7		2419.1		11583.3	
B/holes completion time (working hrs.)	17.0 hrs		27.4 hrs		19.0 hrs		20.9 hrs		20.5 hrs	

Appendix II

SUMMARY OF COSTS BY YEAR
1985

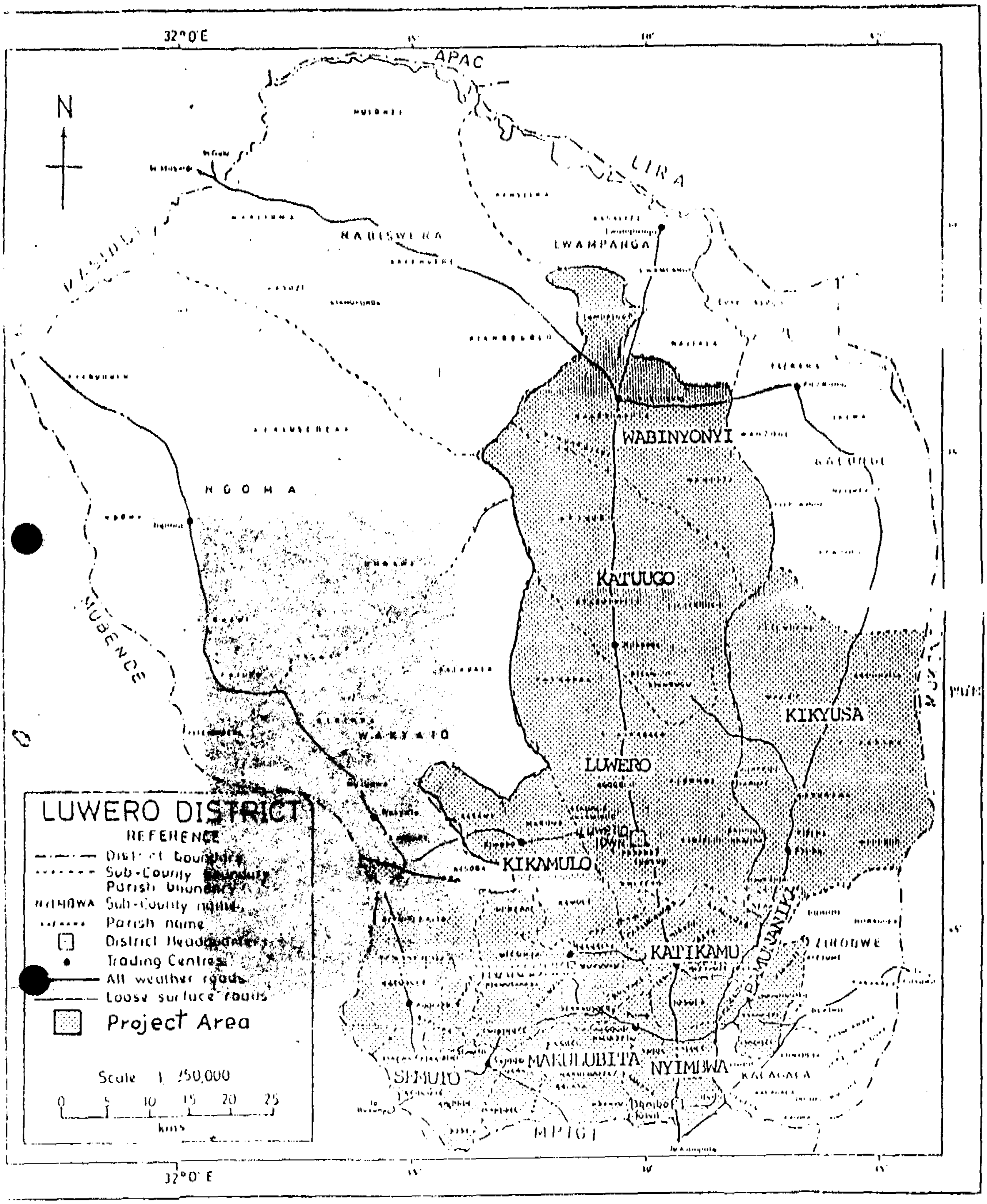
	Total Expenditure	Expenditure per Borehole with Pump Installed	
Depreciation			
Fixed assets	6,290.0	26.0	0.83
Mobile Plant	184,190.0	761.1	24.38
Spare Parts	35,145.0	145.0	4.64
Recurring costs			
WDD Sararies	42,910.0	177.0	5.67
UNICEF Salaries	167,500.0	692.0	22.17
Consumables			
Pumps	106,802.0	441.0	14.13
Casing	62,018.0	256.0	8.20
Drill String Parts	18,149.0	75.0	2.40
Fuel and Lubricants	92,808.0	384.0	12.30
Petty Cash Purchases	8,548.0	35.0	1.12
Bonus Payments	26,762.0	112.0	3.59
Others			
Misc. Expenses	2,964.0	12.0	0.38
Training	1,390.0	6.0	0.19
Total	755,476.0	3,122.0	100.00
Total No. boreholes	242		
Cost per borehole	3,122.0		

Appendix III

SUMMARY OF COSTS PER METER DRILLED

Cost of Pump Installation/Test Pumping/Hydrogeological Surveys to be deducted to arrive at actual meter cost of drilling

Depreciation of 4 Bedford Trucks	7,906
Depreciation of 6 Landrover Pickups	8,839.0
Depreciation of equipment	9,450.0
Spare Parts Depreciation of above	4,833.0
Salaries and bonuses to staff	43,290.0
Pumps, and consruction materials	106,802.0
Casing	62,018.0
Fuel and Lubricants	20,207.0
TOTAL	263,345.0
Cost of furnished boreholes	755,345.0
Less cost of pump installation, test pumping and hydrogeological surveys	263,345.0
Cost of Drilling	492,131.0
Total Meters drilled (m)	17,088.0
Cost per meter	28.8



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NYIMBWA
SEMUTO
MPIGI
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REFERENCE
District boundary
Sub-County boundary
Parish boundary
Sub-County name
Parish name
District Headquarters
Trading Centres
All weather roads
Loose surface roads
Project Area
Scale 1: 250,000
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kms
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