

INTERNATIONAL DEVELOPMENT RESEARCH CENTRE

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MANUSCRIPT REPORT

IDRC Handpump Network

**Proceedings of the Meeting held in Bangkok,
Thailand, 1–3 October 1986**

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IDRC HANDPUMP NETWORK

Proceedings of the Meeting held in Bangkok, Thailand,
1-3 October 1986

Editor: Emelina S. Almario

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NOTE FROM THE EDITOR

Through its handpump project, the International Development Research Centre (IDRC) is helping solve the water problem of developing countries where barely 13% of the population has piped water connections. The project is now entering its third phase and the papers in this manuscript report were read at the second phase end-of-project seminar held in Bangkok in October 1986.

The papers have been arranged according to the evolution of the handpump project which began with the development of a prototype at the University of Waterloo in Ontario, Canada. From this prototype developed the handpumps of Sri Lanka and Ethiopia. So did the polyvinyl chloride (PVC) handpump of Malaysia which was then tested in Malaysia, Thailand, Indonesia and the Philippines. The four country papers are preceded by a discussion on plastic technology and followed by a socioeconomic assessment. Papers on four other countries intending to test the handpump make up the remaining articles: Kenya, Mali, Costa Rica and Guatemala.

The background and experience of the participants who presented the papers are varied. They included engineers, economists, social scientists, government officials in charge of rural water supply programs and community development workers. This broad spectrum accounts for the variability of the papers in depth and emphasis. Another reason for the variability is the different phase of the handpump project in the participating countries. It is therefore suggested that these Proceedings be read in their totality.

The papers have been edited to improve their readability. The editor and IDRC do not take responsibility for the technical accuracy of the article. Inquiries of a technical nature should be directed to the authors concerned.

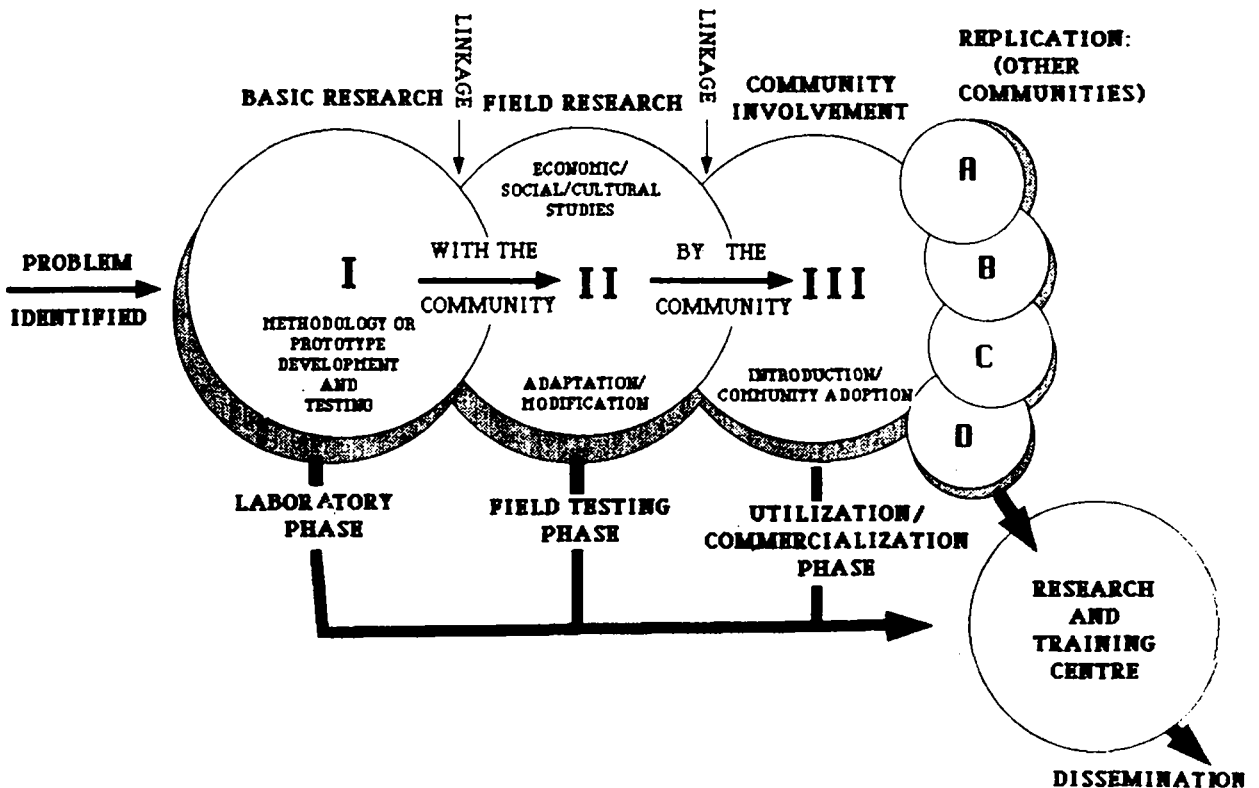
INTRODUCTION

Donald Sharp
International Development Research Centre
(IDRC)

The International Development Research Centre (IDRC) has long recognized the important role safe drinking water and adequate sanitation plays in protecting the health of people in developing countries. Since 1976, IDRC has been supporting research aimed at improving water delivery systems in the rural areas of the developing world. As piped water delivery systems are a long way off in most developing countries, the development of a handpump which is low in cost, simple in design and capable of being manufactured and repaired at the village level is a priority.

IDRC's three-phased approach to technology introduction, illustrated in the following figure is the basic framework of the handpump project.

THREE-PHASED APPROACH TO TECHNOLOGY INTRODUCTION



Designing a handpump using polyvinyl chloride (PVC), a low-cost material readily available in many developing countries, was the focus of the first stage in the IDRC-supported research. A prototype was developed at the University of Waterloo in Ontario, Canada and tested at the Consumer's Association Testing Facility in England.

With the newly-designed pump ready to be tested in developing countries, IDRC financed first phase projects in Malaysia, the Philippines, Sri Lanka and Thailand in 1978. The overall objective of these projects was to determine what modifications had to be made to the new pump in order for it to function well under varied social, environmental and hydrogeological conditions. Other objectives included: determining the durability of the pumps under actual operating conditions, the cost of producing them locally as well as the communities' capacity for maintaining the pumps at the village level. In Malaysia, the recipients of the IDRC grant were researchers at the University of Malaya working jointly with the Ministry of Health. In the Philippines, IDRC worked first with the Institute of Small-Scale Industry of the University of the Philippines and later with the Philippine Business for Social Progress (PBSP), a local NGO. In Sri Lanka, research was conducted by the Sarvodaya Movement and in Thailand the Asian Institute of Technology was the initial IDRC client later replaced by the Population and Community Development Association (FDA).

The first phase of the four projects revealed that with some adaptation (e.g. changes in the materials used) the new PVC pumps had potential for widespread use. While the first phase proceeded relatively smoothly, problems were encountered which led to a rethinking of the IDRC strategy for the wide-scale dissemination of this technology. In the Philippines, cottage industries copied the PVC pump, but were insufficiently aware of its design weaknesses. There was therefore no quality control in the final product and the pumps that were delivered failed very shortly after installation. From this experience it was learned that if the transfer of technology is to be effective, the recipients or implementors must have time to develop a thorough understanding of all aspects of its design, installation and operation. In addition the design must be thoroughly examined through fieldtests, and if needed, modified to take into account the shortcomings of local materials, available technical expertise and user preferences.

The conclusion of the Phase I projects prompted an end-of-project seminar, which was held in Kuala Lumpur on August 16-19, 1982. During the seminar project leaders presented the results of their laboratory and field tests to representatives from national, international, public and private agencies involved with rural water supplies. The results of Phase I prompted IDRC to continue supporting the research into a second phase.

In response to requests from the University of Malaya and the Ministry of Health in Malaysia, and NGOs in the Philippines, Sri Lanka and Thailand (the FBSP, the Sarvodaya Movement and the FDA, respectively), IDRC sponsored another network of research projects focusing on more extensive field tests designed to evaluate the pumps' technical performance and investigate strategies to ensure social acceptance, and develop appropriate financing and maintenance schemes. The importance of community participation in the development of new water delivery systems, was highlighted. As part of the Phase II projects, researchers consulted with villagers on the best location for the test pumps and with the help of the villagers, assessed the socioeconomic implications of the new technology. Discussions with villagers allowed the researchers to design and test implementation strategies sensitive to the concerns and needs of the local community.

While it is difficult to measure the impact of a process that is ongoing, some important observations can be made about the effect of IDRC-supported research in the development of improved water delivery systems in Malaysia, the Philippines, Sri Lanka and Thailand. In Malaysia, handpump research has provided an outlet for the government's commitment to improving access to clean water supplies in rural areas. The new technology has engaged the interest of the Prime Minister and mention has been made in political circles of the possibility of exporting it to Papua New Guinea.

In Thailand, individuals interested in purchasing handpumps have signed contracts and have made down payments. The Population and Community Development Association, in addition to assuming responsibility for the social marketing and introduction of the new technology, has undertaken concessional financing arrangements with villagers and intends to begin manufacturing as part of Phase III.

In Sri Lanka, the research and development of a new water delivery system, executed by the Sarvodaya Movement, an organization committed to involving the primary users in development projects, has received global recognition. Sri Lankan women have been involved in all stages of the evolution of the handpump in that country and have gained valuable, income-generating skills. Due to this project, the role of women in what has been traditionally a male domain, has been transformed. Responsibility for the manufacture, operation and maintenance of the water delivery system by those who understand the importance of an accessible, uninterrupted water supply, may prove to be this country's key to success.

The handpump projects supported by IDRC in Malaysia, the Philippines, Sri Lanka and Thailand reflect the Centre's belief that in order for a technology to be effectively adopted, it must be examined, modified, tested and maintained by its end-users. It must be noted, however, that one defining characteristic of

the IDRC handpump projects in Asia is the central role played by women at each stage in the process. As a reliable source of water affects the well-being of every household, the involvement of women in all stages of its introduction deserves further attention.

This end-of-project seminar for second phase projects once more brings together project leaders from different countries to share with each other varying experiences and expertise which will serve as the springboard for the project's third phase. The different projects reinforce IDRC's belief that the key element to successful introduction is the involvement of the users in the actual research. The end result must be a technology which meets the perceived needs of the user community. It must be socially/culturally acceptable, economically viable, able to be understood by villagers, and capable of being manufactured and repaired locally with available expertise and materials.

On the basis of the success of the Asian projects, IDRC is extending its support of handpump research to China, Africa and Latin America. In these regions, self-supporting training centres will be established for the further dissemination of the technology to those who need it most, the rural poor.

The third phase will bring the technology to the commercialization stage. The goal is to set up a mechanism for a self-generating handpump production and delivery system. The cornerstone of the Phase III projects will be the establishment of a Research Training Centre in Malaysia at the University of Malaya. Such a centre will expose potential manufacturers in both the public and private sectors, as well as villagers, to all matters relating to the design, manufacture, assembly, installation and maintenance of the PVC handpump. The Centre will be equipped to carry out further research on this pump and other pumping devices, as well as serve as focal point for disseminating the technology to other countries. Safeguards to quality control and pricing guidelines will be established through licensing or franchising agreements and enforced through local consumers' associations or other similar agencies.

The goal of improving the health of rural villagers by providing them with upgraded water delivery systems is by nature a long term one. The degree to which the IDRC-supported network of rural water supply projects, including the handpump project, reached this goal will become fully apparent in the next few years.

TECHNICAL REPORT ON THE ETHIOPIAN HANDPUMP

Jirma Jemah
Rural Pumping Research
Ethiopia

INTRODUCTION

The Ethiopian handpump research group has come up with two pump designs. This paper presents the results of this research and the problems encountered.

It has been necessary to identify the handpumps developed by the research team by other than their technical names. The Type BP 50 handpump has been designated "SHALLA" after the Oromo word for "Pelican" while the type BFL handpump for deep wells has been named "IBEX". The names given are those of two animals which are indigenous to the handpump test areas: the Bale and the Rift valleys, respectively.

Shalla Handpump

The Rural Pumping Research of Ethiopia produced one prototype of a Shalla pressure pump which is capable of delivering water to roof (overhead) tanks. With a little modification, it can be made to deliver water to showers.

While a standard accessory is being designed to fit a standard two inch pump stand, the Consumer Association Laboratories of the United Kingdom has volunteered to test the pump together with its spare parts, free of charge.

For the International Development Research Centre (IDRC)- funded portion of the project, 64 Shalla handpumps have been installed in the Bale Region. Another 22 have been shipped to Bale and are awaiting wells. Pump stands for another 50 are available at the research and development (R & D) workshops. Five pumps were given out to the eastern region in February, 1985 and three were installed in Yifat, Northern Showa in July 1986.

Observations show that installation and maintenance errors may be reduced when an instruction manual is disseminated. In fact, though the first attempt at producing a manual already includes helpful illustrations, several improvements are still envisioned to be made.

Ibex Handpump

There is a lack of sufficient number of deeper wells for testing the IBEX handpump. In three sites near Maki, the deepening of the water depth was done by the villagers on a subcontract from the R & D team, after it became "too deep" for the EWWCA technicians. The reason often given is the lack of dewatering pumps.

Hence, the test program on the IBEX deep well pumps was delayed due to lack of test sites near Maki. Many wells were abandoned when villages were relocated during the "villagization" program. Well supply will be a major constraint once bulk manufacture is started. Studies of shallow boreholes therefore have to be made now.

DESIGN HANDLING

The research project resulted in the following findings on design.

Mounting. The IBEX handpump was tried in two versions: standard floor mounting and pedestal mounting. The pedestal mounting needed more concrete work but less steel sections and welding. It was also more rigid and more aesthetically appealing than the floor mounting. It was the preferred design, so far. However, the GI riser of six meter unit lengths was difficult to install without a tripod, due to the additional height (60 cm) of the pedestal. Therefore, the unit lengths of the riser must be shortened to 3m.

Piston. Extractable piston design has been used so far in both SHALLA and IBEX handpumps because it facilitates piston maintenance. However, due to the reliability of foot valves, they have not been extracted so far.

Similar designs of foot valves and pistons could be made of injection moulded plastics if facilities for injection moulding were available. Extractable foot valves would then be less complex, and could be adapted locally. This direction has to be considered seriously because the present stock of HDPE will last only for a few hundred foot valves.

Leather cup. The performance of the leather cup on pistons did not appear as satisfactory in the Ibex as in the Shalla. Maximum life has so far been six months, with about six hours pumping per day. In three instances, the cup sheared in about a month's time due to an over tight assembly. The cups were not soaked in wax very well. Rubber (natural and nitrile) has a reportedly superior performance. Its use, along with a plastic body for both piston and foot valve, may prove feasible even in Ethiopia

in the long run. It is to be noted that the use of brass and leather was encouraged only because they are available in Ethiopia in any quantity, although they are more expensive.

Bushings. Bushings made of general purpose nylon (nylon 66) were used for the fulcrum pin and rod hanger. This material may be adequate for a moderately used pump (eg. 4 hrs/day, 15m head). However, use of nylon together with polyacetyl bushings resulted in a much better performance even for deep well applications. Provided they are injection moulded, they are very inexpensive. Installation in the field is easy, and compared to a ball bearing, shelf life for all plastic bushings is higher.

The diameter of the rod hanger bushing will be increased from 16mm to 25mm and then used as an experiment.

Pump rod. A standard unit length of 3m for the pump rod may help because the rod will be stiff and will not bend as much during transport and handling. The riser must also be short for easy handling and mounting especially for pedestal mounting. Rubbing of the longer rod against the inside walls of the riser should also be decreased.

Jam nuts. To reduce the possibility of forgetting to use the jam nut it will be installed on the rod at the workshop.

PVC riser. The PVC riser adapted as a standard on the SHALLA could not be used on IBEX because the threaded connection near the pump stand failed. However, if the extractable foot valve design and a friction type clamping at the pump stand could be adapted, use of the PVC riser would be more economical and would also greatly facilitate maintenance. The connections of the steel pump rod (which are of larger diameter) will have to be covered by some plastic (eg. PVC) to protect the steel rubbing on the PVC riser.

PROBLEMS ENCOUNTERED IN THE FIELD

Installation errors. Due to lack of an instruction manual to guide the workers.

Factory defects. Due to lack of quality control. Flanges were found not to fit properly. Wooden bushings were sometimes not sufficiently oiled (thus failing on contact with water). Pistons have very high valve lifts. Welded surfaces were either ground too much or too little. Even the painting components used were not proper.

The right lift in the foot valve and piston are essential for pumping efficiency. A consistent, rather low valve lift (6mm) will have to be maintained throughout.

Also, the dimension of the valve weight in the piston was inconsistent. In more than five instances in Bale, the weight rotated in the piston guide and was not sealed at all. The height and diameter will have to be kept (27 x 20) strictly and no HDPE screwed on to the weight (for less wear) anymore.

To ensure quality, a name plate, describing the pump type, installation date, manufacturers' identity etc., must be required to identify the pumps developed by the R & D Group. A proper name plate should be devised, and affixed to the handpumps during manufacture.

Wells running dry. Due to unsatisfactory quality of hand dug wells. In many instances, the wells run dry for a considerable portion of the year. Well digging has to be done during the dry season far from the river banks where the water level does not fluctuate too much.

Vandalism. Due to lack of community concern and awareness. Sometimes flange bolts have disappeared.

Corrosion. Due to anchor bolts which have easily corroded in many sites in Bale while some have sheared during unscrewing. As a result, at least one well in Bale has been abandoned.

A new design employing anchoring of a 3" pipe with a flange on it should highly improve the design. As the bolts (or nuts) are not anchored, they can be replaced if and when corroded, without any impairment to the concrete work.

Application of paint just before installation should also improve performance.

SELECTING AND TRAINING THE PARTICIPANTS

Participants were chosen by their community chiefs, provided they were peasant "mechanics", literate, at least 25 years old or over, and not engaged in any other community affairs.

Volunteers were hard to recruit because of the presence of other community activities. Two men and two women per village were finally selected and their training was conducted in two batches (October 85 and March 86).

Venue. The Robe district Adult Skills Training Center was originally scheduled to be the training site. However, due to lack of hand dug wells to be used in demonstrating handpump installation, the training site was moved to the village of Ashuta, some 20 kms. east of Robe. Two halls served as dormitory and one large hall as the classroom.

Number of participants. Training for the use and maintenance of the Shalla handpump was done in the Bale Region. A total of 46 peasants (20 women, 26 men) were trained, by Ato Mulugetta Abebe, a project senior technician.

Cost of training. Without the per diem expense and transport of the senior technician, - the cost amounted to Br. 3.85 per person per day for the first batch of trainees, and to Br. 4.20 per person per day for the second. The second batch was more expensive because the participants came from more distant villages. These costs were minimal, because the village of Ashuta provided the dormitory, classroom and kitchen facilities for free.

Mode of training. A handpump sample with transparent pipe was used for demonstration in class. The installation and maintenance manual was ready for the second batch of trainees.

Besides the training on the handpump, general education on health and water was also given to the participants so they could in turn teach the village population. However, because this resulted in some problems, health education has subsequently been left to the community health agent or a similar person.

The training program lasted for about a week per batch. Keeping the participants, especially the women, overnight at the training site will eventually prove difficult in the long-run. Entertainment, mainly movies, at night proved invaluable. An added incentive was the awarding of certificates to the participants at the end of the program.

SETBACKS

Looking back, the weak point of the handpump training program, was that the community was not consulted in the planning phase before the handpumps were installed. The people therefore did not always regard the pump as their own. Coordination with the technicians of Water Supply and Sewerage Authority (WSSA) - who were supposed to maintain the handpumps - was also difficult.

There is no single well cover apron design for dry wells being consistently used by EWWCA's different regions. The masonry work sometimes fails even before the pump. Water points are generally unclean, because the spilled water is not drained properly. Few sites have a fence around them, to keep cattle away. A preliminary design has been suggested to EWWCA Construction Department, per the requirements of the handpump developed by the R & D team.

The chemical quality of well water is dubious especially in the Rift Valley area of Ethiopia. Some tests have been made by the project and the fluoride content is unacceptably high in a number

of wells. Water from these wells continues to be used for lack of other sources. A standard understandably more pragmatic than the one set by WHO must be set for Ethiopia, and adhered to, especially with regard to fluoride content.

CONCLUSION

A total of 64 Shalla handpumps have been installed in the Bale region while 22 have recently been shipped out and are just awaiting the construction of their corresponding wells.

For the IBEX, 15 handpumps have been produced, six of which have already been installed in Maki (4), Makanissa (1) and Ogaden eastern region (1).

The National Metal Works Corporation of the Ministry of Industry is building a water pump factory at Akaki, some 20 kms. south of Addis Ababa. The plant being set up with aid from North Korea will reportedly produce centrifugal pumps of various sizes and handpumps as well. But to date the design of the handpumps to be manufactured is not known.

THE HANDPUMP TECHNOLOGY PROJECT
IN SRI LANKA

Dulan de Silva

and

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Sri Lanka

INTRODUCTION

This paper will present the details relating to the commercial production and sale in an open competitive market of the International Development Research Centre (IDRC) handpump in Sri Lanka as well as the perceived role of women in the introduction of this technology.

BRIEF COUNTRY DESCRIPTION

The island of Sri Lanka has a total land area of 65,000 square kilometers. Out of the country's 1.6 million inhabitants, 74% are Sinhalese. Tamils and Moors account for 18% and 7%, respectively and the remaining 1% belong to other ethnic groups.

Sri Lanka can be divided into two main climatic areas: the wet zone and the dry zone. About 75% of the total area comes under the dry zone, where the average annual rainfall is 1400 mm.

LANKA SARVODAYA SHRAMADANA SANGAMAYA (LSSS)

LSSS was established by Dr. A.T. Ariyaratne in 1958 and has since become the largest non-governmental organization in the island. Its main area of concentration is rural development. Through the introduction and implementation of integrated development programs, it aims to address the basic human needs. Besides developmental work which included the construction and repair of village roads, bridges, and housing for the poor. LSSS has gone into other areas such as health, nutrition, and education at the village level.

Today, LSSS has over 3700 preschools in 5000 villages, making it the leading development education institute in Sri Lanka. It offers courses in village leadership, children's services and vocational training to over 13,000 village youths per year.

Other areas of activity include relief and rehabilitation of people who have been affected by natural calamities and ethnic violence.

Sarvodaya Economic Enterprises Development Services (SEEDS)

SEEDS, a new area of the Sarvodaya Movement, commenced operations in September 1986. It has two objectives: promotion of village-level enterprise through issues of credit to assist the rural population of Sri Lanka; and, to organize/manage small/medium size businesses to generate income for Sarvodaya's welfare activities. It's manned by professionals whose work is monitored by a team of consultants from CIDA/NOVIB/ITDG. Amongst the projects already managed by SEEDS are a rice mill, several metal and wood workshops, a bakery, and a printing press. Rural credit programmes have been drawn up for 5 Districts in Sri Lanka.

SEEDS also has set up a Management Training Institute which conducts courses in general management, accounting, feasibility report writing, savings, etc.

Economic Activities

Along the years the Sarvodaya Movement has begun numerous small economic units mainly with the intention of providing vocational training to village youth. There are over 50 such units spread across the country. Of these, some have grown and developed into medium size enterprises.

The Metal Work Unit - Moratuwa

This unit is being considered for expansion by donor agencies and is waiting for a definite funding commitment because of its involvement with the IDRC handpump project. The Unit produces and sells metal furniture and other metal products in addition to handpumps. At present, it has an annual turnover of Rs.3,000,000/=-, a net profit of Rs.300,000/=-, and provides employment to 34 persons.

THE HANDPUMP PROJECT

Because water is the second basic human need, the Movement has worked for the installation of a mechanical device - the handpump - so that a clean and adequate supply of water can reach the largest number of people.

Wells, whether hand dug or drilled, always tap water resources lying below the earth's surface because ground water does not usually flow out of a well by its own energy. A lifting equipment is needed to raise the water out of the well. The most common lifting equipment for an open and dug well is the rope with a bucket, while, in the case of a drilling tube well, some kind of mechanical pumping installation is required.

An open hand dug well, allows easy access to the ground water, but it also allows easy contamination. The wind may blow in dust, leaves and dirt. Animals too may pollute the water. Buckets and ropes used may be infected by hand and ground contact. The risk of water contamination and subsequent spreading of water borne diseases increases a great deal with increasing number of users unless adequate measures are taken to protect the ground water. The installation of handpumps is often the most beneficial and hygienically safe for rural water supplies.

In short, the main advantages of a handpump are:

- a) extraction of ground water easy and hygienically safe.
- b) maximum protection of drinking water from pollution*.
- c) minimal operating cost.
- d) minimal maintenance requirements and local level maintenance.

In order to reap the full benefits of a handpump, it must always be:

- o kept in proper working order.
- o intact.

The Handpump Experiment

The Sarvodaya Engineering Division experimented with three types of handpumps based on the IDRC-University of Waterloo design.

Five years of implementation and research (1978-1983) led to the design and manufacture of a unique handpump from readily available local materials that can be easily maintained.

*

hygienic benefit of sealing a well normally far exceeds the benefit of direct sunlight (ultraviolet radiation) reaching the water in an open well

The handpump is known as the SL/5 type. Its success so far can be attributed to the following design features which were set at the beginning of the project and which have been met:

Features

- o The pump is resistant to rough handling.
- o The pump prevents water contamination.
- o All below-ground parts are made of non-corrosive materials.
- o The pump raises water from a 30 meter intermediate depth.
- o All parts can easily be replaced.
- o Maintenance of the pump is simple with minimal manpower.
- o Skills and equipment are available.
- o Construction materials are easily available.
- o Manufacturing of the pump is simple.

The Marketing of Handpumps

The marketing of pumps has been handled through the metal work unit. The volume of pumps marketed so far has not been more than 150, and most of these have been taken on an experimental basis by the users. The breakup of sales are as follows:

Rural Technical Services (Helvetas Project with Sarvodaya)	SL5	60
	Others	47
		<hr/>
		107
UNICEF		37
Mahaweli Authority (For Experiments)		2
Integrated Rural Project-Kurunegala (German Aided Project)		2
Plan Centre (Kandy-Finnish NGO)		2
		<hr/>
		150
		===

In addition Sarvodaya has used 30 pumps in its own village development programs.

Demand

The total handpump market in Sri Lanka is around 2800 per year. This is a sharp increase from the demand for handpumps in the last 5 years which was around 1000 per annum. Sarvodaya has now introduced its pump SL5 to the market on an experimental basis as detailed earlier. Table 1 gives an overview of demand for handpumps.

TABLE 1
HANDPUMP MARKET IN SRI LANKA
1980 - 1985

	Total	Handpumps for Deep Wells (Decade Plan)	Handpumps for Deep Wells (Others)	Handpump for Shallow Wells
1980 - 1983		1340	600	200
1984		1150	100	120
1985		1665	-	-
	5325	4155	700	470
	=====	=====	====	====

The construction of deep wells is largely based on the Decade Plan for Water Sanitation (1980 - 1990) of the Government of Sri Lanka's Water and Drainage Board. This is implemented through financial assistance from UNICEF, G.T.Z. and Red Barna. The main buyer for pumps is UNICEF.

1986 - 1990

The estimated demands for handpumps from 1986 to 1990 are:

	Total	Deep Wells (Decade Plan)	Deep Wells (Others)	Shallow Wells
1986 - 1990	14000	11800	1000	1200

REPLACEMENT OF BELOW-GROUND COMPONENTS

It is estimated that around 50% of the below-ground components of the pumps installed so far have to be replaced. The total that needs to be replaced ranges between 2000 to 3000. UNICEF is considering seeking suppliers for this purpose.

Channels

At present, there are about twenty manufacturers/importers of handpumps in Sri Lanka. The price of these pumps vary from RS 4500 for local ones to Rs. 27000 for imported ones. Although there are a variety of designs available, a fair proportion of the pumps are either Indian Mark II or modified versions of the same.

Most of the pumps sold in the country are sold by manufacturers and importers directly or through agents to organizations involved in drilling tube wells and installing handpumps.

There are both public sector and private sector organizations involved in tubewell drilling in the country. Most of the drilling rigs in the country are owned by public sector organizations.

The main buyers of handpumps among the installing organizations are the Water Supply and Drainage Board (WSDB) and the Water Resources Board (WRB). Other buyers of handpumps have been government bodies like the Coconut Cultivation Board, The Petroleum Corporation, The Fisheries Corporation, The Sri Lanka State Plantation Corporation (SLSPC) and the Mahaveli Economic Agency (MEA).

The UNICEF has been responsible for the installation of 3000 handpumps. An estimated 2% to 3% of the handpumps sold have been sold to private individuals, or organizations.

Practices

The general practice in Sri Lanka for the selection and purchase of handpumps is to call for tenders from manufacturers and importers. The quantities tendered at any one time vary between 100 to 400 handpumps. The tender generally is for the handpump together with 30 to 40 metres of rising pipes for the below-ground components.

Typical Specifications for the Tender of Handpumps

- o The pump should be capable of pumping water from 4 1/2 inch diameter boreholes from a depth of 30 to 40 metres.
- o The pumphead and pumpstand should be completely hot dipped galvanized.
- o The pump should be totally of non-corrosive material such as high impact PVC stainless steel, epoxy glass fibre (reinforced) or other similar material. Minimum internal diameter of cylinder should be 2".

- o The rise pipes should be in 3m - 4m lengths of non-corrosive material such as high impact PVC or S-1on, along with connecting sockets out of non-corrosive material.
- o The connecting rods should be a minimum of 10 m.m. diameter in 3m-4m lengths of non-corrosive material such as epoxy glass fibre, stainless steel or similar material including the necessary connections.
- o All pipes, sockets, pump rods, connectors, lock nuts, washers etc. should be of non-corrosive material.
- o Each pump should be provided with 30m to 40m of connecting rods and rising pipes.
- o Pumps should be supplied with all necessary fittings and pipe nuts and bolts etc. for proper installation and operation.
- o Spare cup washers (10 Nos) should be supplied.
- o One set of tools for the installation of handpumps per fifty handpumps should be provided.

Competitors

Jinasena Ltd. which manufactures a modified version of Indian Mark II named Jinasena MK II is the leading supplier. There are also other local manufacturers such as Dias & Dias Co. Ltd. The imported products come from India, Japan and Germany more expensive.

Price-wise, Sarvodaya's pump is very competitive and the present selling price is also in the lower range of the market.

Planned Expansion

Sarvodaya through SEEDS and foreign assistance will make a major expansion of its manufacturing and marketing unit. One of the key constraints at present is the manufacturing capacity, particularly lathe capacity for manufacture of brass joints. Sarvodaya will invest Rs. 420,000 in the first stage and Rs. 747,500 in the second stage for equipment required for expansion.

The increase in machinery capacity will enable Sarvodaya to compete in most governmental/UNICEF tenders which demand at least 60 pumps a month. Its present capacity of only 35 pumps per month disqualifies Sarvodaya from most tenders. Sarvodaya's sales target for the coming years from 1987 is 500 pumps per annum or approximately 20% of the total market. This is an ambitious target but SEEDS will strengthen the division with strong marketing personnel who will be able to give assistance to

promote this production. Already SEEDS has contacted major buyers such as Mahaveli Authority, UNICEF, Water Resources Board, Water Drainage Board, etc.

As Sarvodaya has a strong working relationship with UNICEF who buys nearly 50% of the total pumps sold in Sri Lanka, it is very reasonable to expect that Sarvodaya could obtain a large share of the order placed by this buyer. The main thrust in the marketing effort at the initial stages will be to introduce the pump to major buyers some of whom are still not aware of the quality and performance of the pump. UNICEF is the only major buyer who has recognized its quality and has acknowledged that the below-ground portion is one of the best in the market. In a recent tender for below-ground components, UNICEF went to the extent of using a modified version of Sarvodaya's SLS design as the specification when calling for offers.

Other changes that are expected with the expansion follow. The present practice is to buy raw materials when orders are received. This sometimes results in non-availability of essential raw materials in the market at the time it is needed. Hence, with the increase in working capital the metal work section will be able to stock imported raw material which may be difficult to buy at short notice. Further discount for bulk purchases will also be available.

A vehicle will be made available to the unit to transport raw materials, to deliver goods and to meet potential customers. At present, this is a major constraint.

Separate sections for stores will be made available and better store keeping records maintained. The absence of proper storage facilities is hampering the smooth flow of raw materials.

Increase in production capacity initially to 60 hand pumps per month and later to 100 is the key requirement. The key constraint is the lathe capacity and the proposal is to buy one lathe immediately, thus increasing the present capacity per month, from 35 to 60 hand pumps. This does not include a major increase in labour force but a further increase to 100 pumps will require an investment in additional labour.

At present Sarvodaya's wages rates are below the market rates. Hence an increase in wages as well as an incentive scheme will take place with the expansion.

At present, the overhead absorption is not satisfactory. A revised costing system will be introduced. More study has to be done in this area. Sarvodaya also has to explore the possibility of patenting the design.

The financial implications of the expansion follow:

Working Capital - Raw Materials*	151,875
Labour (2 months)*	32,000
Consumable Tools (3 months)	6,000
Power & Fuel (1 month)	6,000
Contingencies	8,000
	<hr/>
	203,875
Machinery	420,000
	<hr/>
	Rs 623,875

THE ROLE OF WOMEN IN THE PROJECT

Normally, the personnel required for the production, installation and maintenance of a handpump are men. In Sri Lanka, women find it easier to devote part of their time operating and maintaining a handpump. The women are equally capable of working on the technical side of the project. A group of motivated, intelligent young women have been selected and trained as pioneer technicians in this field over a 26-month period.

The ultimate aim of the handpump project is to raise the health and economic standards of the target population. As a supplement to the Integrated Development Programme of Sarvodaya, this project enlisted the fullest cooperation of various Sarvodaya groups, such as the youth, mothers' and farmers' groups. These groups were organized at the village level and the young women for the project were nominated by the respective Sarvodaya societies.

These female handpump technicians now play a vital role as development technicians and liaison officers between Sarvodaya's project and other extension services that are available.

CONCLUSION

The projected strategy of expansion may be very ambitious. Nevertheless if a good product is available and a major investment in production facilities, working capital and marketing abilities is undertaken, there is no reason why the IDRC handpump cannot become one of the key pumps in use in Sri Lanka in the years ahead. At the same time, it shows how women can contribute significantly to a development project traditionally associated with men.

PLASTIC TECHNOLOGY FOR HANDPUMP APPLICATIONS

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INTRODUCTION

There are more than thirty types of plastic materials and no less than thirteen processes have been used to convert resins into useful plastic materials used in the production of handpumps. The main processes include injection moulding, extrusion and fabrication of parts that involve machining, turning, drilling, sawing and threading. The main plastic materials are unplasticized Polyvinyl Chloride (uPVC) also known as rigid PVC, acetal, polyethylene and its composites.

PROCESSES

Table 1 presents the main processes used in plastics manufacturing and resulting products.

TABLE 1
PROCESSES USED IN PLASTICS MANUFACTURING

Processes	Product
Injection Moulding	Household items, containers, fittings, industrial components
Extrusion	Pipes, sheets, profiles
Film Extrusion	Film
Extrusion blow moulding	Bottles, containers
Compression Moulding	Thermosett dinner wares and electronic components
Calendering	PVC film
Coating	PVC-fabric coating, wirecoating
Lamination	Multiple-layer films
Rotational moulding	Large container

Processes	Product
Spiral Winding	Large diameter pipes
Vacuum & Thermoforming	Fast food containers
Foam Forming	Packaging foams and furniture foams
Hand Lay Up	Fiber Reinforced Polyester Products

Injection Moulding Process

Injection Moulding Machine

Injection moulding is one of the most common processing methods for plastics. In principle, injection moulding is a simple process. The thermoplastic material, in the form of granules or powder, is taken from a feed hopper and heated in a barrel where a screw rotates to soften it. It is then forced through a nozzle into a relatively cold mould which is clamped tightly closed. When the plastic article cools down to become solid, the mould opens, then the article is ejected and the cycle is repeated. The major advantages of the process are its versatility in moulding a wide range of products, the ease with which automation can be introduced, the possibility of high production rates and the manufacture of articles with close tolerances. Normally, a reciprocating screw machine is used.

The moulding process involves the following steps:

- a) the mould closes.
- b) the screw moves along the barrel, acting like a plunger, and injects plasticized material into the mould.
- c) the screw remains forward for some time, maintaining pressure through the nozzle while the material in the mould is being cooled.
- d) after the material solidifies, the screw starts to rotate and draws new material from the hopper, plasticizes it and feeds it to the front of the screw.
- e) when the moulding is sufficiently cold, the mould opens and the article is ejected. The mould then closes and the cycle is repeated. The moulding cycle can take a few seconds (10 seconds) to a few minutes (3 minutes) depending on the weight of the article.

Moulds

Besides the injection moulding machine, mould is the most important item that determines the quality of a product. If the mould is properly designed and manufactured, a good plastic article will be obtained.

In order to facilitate mounting the mould in the machine, cooling and ejection of the moulding, several additions are made to the basic mould halves. First, backing plates permit the mould to be clamped on to the machine plates. Secondly, channels are machined into the mould to allow circulation of water or oil to cool or heat the mould. Thirdly, ejector pins are included so that the moulded article can be freed from the mould.

A production injection mould is a piece of high precision engineering manufactured to very close tolerance by skilled mould makers. After the cavity and core have been made, they then need to be texturized or polished to produce the required surface finish on the moulding article. Eventually, when the mould is working properly it will be hardened to a hardness of Rc 50 to 55 (Rockwell Hardness of C scale).

The mould cavity and core are made from special tools and die steels.

TABLE 2

TOOL AND DIE STEELS (AISI) CLASSIFICATION

Type	Prefix	Description
Water hardening	W	
Shock resisting	S	
Cold work	O	Oil hardening
	A	Air hardening - medium alloy
	D	High carbon - high chrome
Hot work	H1-H19	Chromium base
	H20-H39	Tungsten base
	H40-H59	Molybdenum
High speed	T	Tungsten base
	M	Molybdenum base
Special purpose	L	Low alloy
	F	Carbon Tungsten
Mold steels	P1-P19	Mold steels - low carbon
	P20-P39	Mold steels - other types

The F-1 steels are easily hobbled because of their low alloy and carbon content. Since they are water hardening steels, they have a high tendency to distort during heat treatment. The P-4 and P-5 are more difficult to hob because of their chromium content.

They are used because the chromium permits oil hardening and less distortion, as well as increased cores strength and resistance to wear. The P-2 and P-6 steels are more difficult to hob but give a tougher finished cavity than the other steels.

Steels for hob are usually of the S-1, A-6 or O-2 types. The H-13 and H-23 steels are used for hot hobbing beryllium. H-13 steel is commonly used for cores because of its low dimensional change in hardening and its good toughness. The P-20 steels are very tough and generally supplied in a prehardened condition of approximately Rc 30. It can be carbonized and hardened later. Other types of prehardened steels are supplied with hardness up to Rc 42. The advantages of a prehardened steel evolves from the fact that they do not have to be hardened. Hardening can cause distorting and on rare occasions cracking. It also increases the polishing time.

Stainless steel is used in moulds to eliminate the effect of corrosion. Corrosion can be caused by water or moulding compounds, particularly PVC. By commercial usage they are defined as steels containing 11.5% to 20% chromium. Type 420 is most often used. It is magnetic and can be hardened by oil quenching to approximately Rc52. Inserts of stainless steel are valuable as they have lower thermal conductivity than tool steel, hence can reduce warpage due to non-uniform cooling of plastic. As mentioned earlier, stainless steel 420 (or ASSAB Stavex) was used for PVC moulds and P-20 (or ASSAB 718) was used for Acetal or HDPE moulds.

Extrusion Process

Extruder

Extrusion of thermoplastics consists of the melting and compressing of plastic granules or powder while they are being forced through a long passage by a screw conveyor turning in that passage. The opening at the end of the passage takes various shapes depending on the cross section; for example an annular opening makes a pipe.

There are two types of extruder - the simple screw extruder and the twin-screw extruder. Twin-screw extruders are commonly used for PVC - both for compounding powder mixtures into pellets for re-extrusion, and for one-step extrusion of these mixtures into finished products such as pipes. The advantage of the twin-screw is the positions-displacement nature of the machine which allows easy feeding of the powder mixture. It is designed for good mixing at low total shear, thus keeping the temperature down, which is important to prevent decomposition of the PVC compound.

The Extruder Dies

When the plastic melt comes out of the extruder, it is shaped by a die. The cross section of the outlet opening of the die is the same as the one of the profile to be extruded.

When designing the dies, it is important that the flow canals do not have sharp edges or dead angles in order to avoid the melt to be exposed to the high temperature for too long because this may cause the material to be degraded. After the melt has passed by the narrow pass between cylinder and die head, it must be guided in the head in a way that it can take on the shape of a pipe. For this purpose, the melt is induced to flow round a body by means of an apex of the cone. This body is fixed in the die head, i.e. it is carried by several bars or other holders. The pipe die must easily be disconnected for cleaning. Several heater bands are placed around the die which keep the melt temperature constant when the extruder is working.

Machining Process

In some cases, the moulding operation may not produce a finished article or because the product is too big in size, a flat surface is difficult to be achieved. Then the part has to be machined. There are also occasions when moulding cannot be done because of the small number of parts that must be produced which do not justify the expensive mould. In these circumstances the plastic would be drawn from standard stocks of sheet, bar or rod and the fabrication procedures would be generally similar to those used for metal or wood.

In general, the machining methods for plastics are similar to those used for metals. Most plastics can be machined with excellent results using conventional wood or metal working machinery with slight modifications to the tools. Plastics have low values of thermal conductivity so that only very little of the heat generated in the machining area will be conducted away through the material. Heat build up causes thermal expansion of the material, increases friction and tool wear which can lead to a rapid deterioration in the machining process. Localized melting of the material will occur and manifest itself in the form of bad surface finish and poor dimensional tolerances. Steps which may be taken to avoid excessive heat build up include the use of coolants, sharp tools with adequate clearances and high rotational speeds with slow feeds.

Turning

Conventional metal and wood working lathes may be used for plastics. Cutting speeds and tool geometry are selected according to the material. During machining there are two components of force acting on the material - one normal to the workpiece and one paralalled to it. The relative values of these forces depend on the rake angle. A critical rake angle has been

defined as the value which produces zero force normal to the materials surface. In most cases of the simple edge cutting of plastics the critical rake angle is also the optimum value as regards to accuracy of the machined surface. It is therefore recommended that the rake angle should always be equal to or exceed the critical value. The critical rake angle depends on the work material cutting speed and the depth of cut.

To minimize the heat generated by friction, it is essential to have a large front clearance angle so that the tool face is clear of the freshly cut surface.

Drilling

Drilling holes in plastic tends to produce a greater heat build up than any other machining method. The actual cutting of the material occurs at the bottom of the hole by two cutting edges on the end of the drill. Special drills may be obtained for drilling plastics but in most cases standard twist drills may be all that are available.

Sawing

Plastics may be cut to shape using band saws or circular saws. Skip tooth blades give the best results mainly because the teeth do not clog easily. Normally 2 - 4 teeth per cm and zero front rake will give satisfactory results on most plastics. For material thickness up to 12 mm, blade speed in the range of 15-25 m/s should be used with lower speeds for thicker sections.

Circular saws with a diameter in the range of 225 - 300 mm with buttress type teeth are suitable for most plastics. The rake angle should be in the range of -5 to 10 with a clearance of about 20. Best results are achieved with 4-5 teeth per cm and high blade speeds, e.g. 30 - 50 m/s.

Joining of Plastics

Solvent Adhesives

Solvent adhesives are commonly used in joining various plastics such as polystyrene, PVC, PMMA and others. This type of adhesive may be either a pure solvent which attacks the surfaces to be joined so that they may fuse together or it may be a solvent containing some of the adherend material.

TABLE 3
TYPICAL SOLVENTS FOR SOME COMMON PLASTICS

Material	Solvents
ABS	Methyl ethyl ketone
Cast PMMA	Acetone, ethylene dichloride, toluene
Nylon	Aqueous phenol, meta cresol
PVC	Dichlorobenzene
Polycarbonate	Ethylene dichloride
Polystyrene	Ethylene dichloride, trichlorethylene
Cellulose Acetate	Acetone, methyl ethyl ketone

Epoxy Adhesives

Epoxy resins is the most versatile adhesive used in joining various plastics. They are usually two part adhesives in that the epoxy resin is mixed with a hardener just before use.

Cyanacrylate Adhesives

The unique property of these types of adhesive are that they can produce very strong bonds in a very fast cure time (few seconds only) to dissimilar materials. They are usually in liquid form and the polymerization reaction is triggered off by water or another weak base on the surfaces to be bonded. The main disadvantage is that they are expensive.

PLASTIC PART DESIGN CONSIDERATION

Plastic parts should be designed with minimum wall thickness consistent with end-use requirements and mould filling. Thick sections cool slowly and require a longer cycle. Uniform wall thickness throughout the part constitutes optimum design. This minimizes moulded in stresses, differential shrinking (which results in warping) and void formation in thick sections. In all

sections, the material solidifies from the outside towards the center. When different wall thicknesses are unavoidable, walls should be made to merge gradually. Parts should normally be gated in the thickest section. Sharp corners should be avoided in part design and instead a radius should be incorporated. Sharp corner in parts will lead to impact failure.

Threads

Normally, the Unified Thread Standard is the most suitable for moulded threaded parts. This is due to the elimination of the feathered edge at both the root and tip of the thread. The "V" shaped thread contour should not be used with plastic parts. The notch of the "V" tends to have increased stresses at this sharp corner which under load could fail and initiate a crack which could propagate through the part.

Tolerances

An important consideration in design is to keep costs to a minimum. Since all post-treatments add to the cost, they should be specified only when required. The same reasoning applies to tolerances - to specify close tolerances when they are not required only adds unnecessarily to the cost of manufacture. Tolerances that are possible for different materials can be referred to in standard reference texts.

PLASTIC MATERIALS

Plastic materials used in handpump manufacturing are Polyvinyl Chloride (PVC), Acetal and High Density Polyethylene (HDPE). Only these three materials are discussed here.

PVC

PVC is obtained from the polymerization of Vinyl Chloride Monomer (VCM). PVC in its pure form is of not much use because of its difficulty in processing and brittleness. Therefore, PVC must be mixed with various chemicals such as processing aid, impact modifier, heat stabilizer, lubricant, pigment and others to produce a useful compound. PVC can be compounded into rigid PVC or sometimes called unplasticized PVC (uPVC) which is used as pipe and fitting material. It can be compounded into soft and flexible PVC by adding sufficient plasticizer and is being used to produce garden hoses, etc.

For potable water pipes, suitable burst strength is obtained through the thickness of the pipe and also through using a resin that has the highest molecular weight compatible with ready processibility. A resin of medium-high molecular weight has generally been used.

The choice of stabilizer will depend on the limitations the regulating bodies in the country impose on the potable water pipe to be used. In the United States, regulations concerning potable water pipe are under the auspices of the National Sanitation Foundation (NSF), which allows the use of selected tin mercaptide stabilizers and also calcium-magnesium-zinc nontoxic stabilizers. In some European countries (Germany, Holland, Great Britain) lead stabilizers are allowed, on the assumption that the amount of lead salt that can be extracted from the pipe by water is not a significant toxic factor.

A typical pipe formulation is as follows:

PVC (medium-high MW)	100 parts
Processing aid	2 - 5
Impact modifier	8 - 15
Stabilizer (Tin mercaptide)	0.5 - 2.0
Lubricant	0.5 - 2.0
Pigment	1 - 2
U-V stabilizer	1 - 2

Normally, PVC pipes and fittings are produced according to standards such as the ASTM standard, the BS standard, the DIN standard, and the ISO standard. In Malaysia, a locally-derived standard is used. The main difference in the various standards are the dimensions of the pipes and fittings. For example, a normal 3 inch pipe in BS and Malaysian standard has an outside diameter of 3.49 inches, but this may not be the same in ASTM or ISO standard. Therefore, for joining pipes and fittings, parts from the same standard must be used. Otherwise, good results cannot be obtained. PVC parts can be joined with fittings using solvent cement. Pipes are produced by extrusion and fittings are produced by injection moulding.

Acetal

Bolts and nuts, bearings and other components can be produced by using acetal material with injection-moulding method. Acetal is made by the polymerization of formaldehyde, which is a gas under ordinary conditions. Acetal is a crystalline thermoplastic. The melting point of acetal is 175 C. Acetal has good thermal stability for normal processing, but as with all plastics, there can be problems under unusual conditions. If the resin is overheated, it decomposes to formaldehyde from which it is made. As formaldehyde is a gas, decomposition can result in slay marks on moulding, and bubbles in the melt. Decomposition depends on two factors: time and temperature; therefore these two parameters must be properly controlled.

The most important piece of auxiliary equipment used in moulding acetal is a mould heater for carefully controlling the temperature of the mould. For obtaining mouldings with a smooth and glossy surface it is sometimes desirable to operate with the

cavity surfaces in the range of 90 - 130 C. Commercial units which circulate oil are available for controlling mould temperature of this temperature level.

High Density Polyethylene (HDPE)

Polyethylene (PE), while having one of the simplest structures of all polymers, can be produced with such varied properties as to make nearly impossible a simple descriptive statement. In general, PE is inert to many chemicals and does not embrittle at temperature as low as - 100 F.

Polyethylene is produced by the addition polymerization of the monomer ethylene. With different processes, four different types of PE can be produced, they are: High Density Polyethylene (HDPE), Low Density Polyethylene (LDPE), Linear Low Density Polyethylene (LLDPE), Ultra-high Molecular Weight Polyethylene (UHMWPE). High density polyethylene has much less branching, thus is more linear in structure, and the chains fold in a more orderly manner. The result is a more crystalline, denser and harder solid.

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FROM RESEARCH AND DEVELOPMENT TO MASS-PRODUCTION OF HANDPUMPS

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INTRODUCTION

The Water Pumping Technology - Global (Malaysia) Project, a joint research project between the University of Malaya, the Ministry of Health (Malaysia), and the International Development Research Centre (IDRC), was initiated in 1979, with the objective of developing a handpump that is inexpensive and easy to maintain at the village level because it could be produced from locally available materials.

The first phase of the research project involving a laboratory investigation to determine the optimum design of the plastic handpump and field testing of prototype handpumps in the rural areas was completed in 1981. Members of the research project are listed in the appendix.

The second phase of the research project seeks to develop a small-scale handpump fabrication unit, to acquire empirical experience in the manufacture and assembly of handpumps, and to assess the technical and economic viability of duplicating the experience of the pilot plant on a commercial production scale.

Concurrent with these aims, the research effort also attempted to refine the design of the various components of the handpump in order to reduce production costs, and to conduct further field tests to verify its performance as well as its acceptance at the village level.

FRAMEWORK OF ACTIVITIES

The three-year duration of the project is broken down into the following stages of implementation:

IMPLEMENTATION STAGE	MAJOR ACTIVITIES/PROGRAMS	DURATION
First Stage	Planning & Development	Sept. 1983 to Feb. 1984
Second Stage	Organizing a Pilot Fabrication Unit	March 1984 to August 1984
Third Stage	Pilot Production, Field- Testing, Sociological- Survey & Extension to Commercial Production	Sept. 1984 to August 1986

TECHNICAL ASPECTS

Research Study Trip

The second phase project commenced with an IDRC-sponsored study trip by the principal researcher, Prof. Goh Sing Yau, and the local consultant, Mr. Chee Kim Meng, to tap Canadian know-how in the field of plastic technology, with the aim of improving the Malaysian-developed PVC handpump at reduced cost.

Subsequent to the study trip, the project team reviewed the entire PVC handpump, specifically:

- its basic design
- selection of appropriate materials for the various components
- manufacturing process for the various components
- injection moulding and tooling equipment to explore cost reduction opportunities by having most of the component parts moulded in plastic and simplifying the entire production process to encompass only the basic workshop skills like machining, cutting, welding and assembly work.

Material Substitution And Process Changes

To reduce production cost, the following material substitution and process changes were effected:

<u>Component</u>	<u>Original Material, Production Process in Prototype Design</u>	<u>Substitute Material & Revised Process in Mark I&II Design</u>
Bolt & nut sets for the piston & foot valve assemblies	Machined out of brass	Injection moulded using acetal plas- tic
PVC piston	Machined out of solid PVC Block	Injection moulded using PVC
Piston rings	Machined out of polyethylene	Injection moulded using polyethylene
Above-ground steel pipe stand	Roll-formed from steel sheet	Cut from standard pipe size available commercially
PVC flange	Purchased from commercially available flanges	Developed mould to specially injec- tion mould the PVC flange to dimensions to suit handpump design
Bearing plate for lever system	Timber block used as bearing plate	Steel bearing plate flame-cut from steel plate

Further simplifications and cost reductions were achieved through the development of the Mark III design. In this later design, the number of parts for the pump cylinder and leverage system was reduced and the manufacturing operations simplified. The number of pieces of machinery was also reduced from 11 to 9. The detailed components, manufacturing operations and equipment required for the Mark III design are presented in Table 1 and at the end of this paper.

Development of Moulds & Jigs

It may be noted that the moulds are redesigned and upgraded as and when necessary to incorporate improvements in the handpump design. Some of the moulds or jigs may become obsolete as and when new ones replace them. For example since the Mark III design does not use timber parts, the jigs for working on the timber lever arms and bearing blocks are no longer used. Also

since the Mark III stand is completely different from the Mark I and II stand, a new set of jigs is required to produce the latter Mark III design. Table 2 lists all the moulds and jigs required.

Equipment

The following equipment donated by the Canadian High Commission were installed in the small-scale handpump fabrication unit:

<u>Equipment</u>	<u>Quantity</u>
Universal Centre Lathe Model SN40B/1000	1 unit
Round Plate Bending (Rolling) Machine Type PA 130	1 unit
Hitachi Band Saw Model B 750 A	1 unit
Shaping Machine Model B 6050 B	1 unit
Radial Drilling Machine Model RBM 28 B	1 unit
Drilling & Milling Machine	1 unit
Hitachi AC Arc Welder Model A7 SSS	1 unit

Plant Layout

As all injection moulded parts are produced by a contract manufacturer, the pilot fabrication unit concentrates on the more basic production skills like cutting, welding and assembly work. Figure 1 presents the proposed plant layout.

SOCIOLOGICAL SURVEYS

A survey questionnaire was drawn up to study the following sociological aspects:

- Rural household attitudes and preferences regarding well water as opposed to stream or other water sources.
- The effects of different arrangements regarding the use of handpumps, for example, the sharing of pumps among groups of households as opposed to individual ownership of handpumps.
- Sociological factors affecting the maintenance cost and economic life of handpumps.
- Impact of handpumps on rural health and well being.

Two sites were chosen for this sociological survey. They are located in the districts of Termeloh, Pahang and Alor Setar, Kedah.

INSTRUCTION MATERIALS AND MANPOWER TRAINING

Instruction Materials

Two thousand manuals of the Mark I suction handpump for the installation and maintenance were printed - one thousand in English and one thousand in Bahasa Malaysia. Copies of this manual were distributed with each of the 550 pumps sent for installation by the Ministry of Health while a new manual for the installation and maintenance of the Mark III suction handpump has now been printed.

Manpower Training

The Ministry of Health has incorporated into its regular training courses one or two day training sessions on the installation and maintenance of the PVC handpump. For three years, the project team participated in six such courses which cater to a total of 215 Ministry of Health staff consisting of public health overseers, public health inspectors, public health engineers and medical officers.

No. of Participants

10th Rural Water Supply Seminar for Health Inspectors at Batu Rakit, Kuala Terengganu, Terengganu from 14th - 28th April, 1984.	35
1984 Annual Meeting for Environmental Cleanliness Program at Kuala Lumpur from 8th - 10th October, 1984.	35
11th Rural Water Supply Seminar for Health Inspectors at Alor Setar, Kedah from 6th July - 19 August 1985.	35
One day Special Course on Installation and Maintenance of PVC Handpump for Health Inspectors, Health Overseers and Medical officers at Kampong Meriang, Malacca on 26th November 1985.	50

One day Special Course on Installation and Maintenance of PVC Handpumps at Kampong Paya Batu 4, Segamat, Johore on 17th December 1985. 30

Short course on Installation and Maintenance of PVC Handpumps for Health Inspectors at Ipoh, Perak on 25th - 26th June, 1986. 30

The project also provided training for visitors from other projects in the IDRC network in the fabrication, installation and maintenance of the handpump.

Project -----	No. of Personnel -----	Duration -----
FDA, Thailand	2	2 weeks
PBSP, Philippines	2	2 weeks
Yayasan Dian Desa, Indonesia	2	2 weeks
Costa Rica	3	2 weeks
Institute of Medical Research, Kenya	1	1 week
EWVA, Ethiopia	1	1 week

SUPPORT ACTIVITIES

A total of 184 sets of below-ground components have been sent to complementary projects in the region - 40 to FDA, Thailand; 36 to PBSP, Philippines; 50 to Sarvodaya, Sri Lanka and 40 to Yayasan Dian Desa, Indonesia. In addition, 12 complete handpumps were sent to a project in Kenya, four to Botswana and another two to the Consumer Association for testing.

CONCLUSION

The major objectives of the project have been achieved. A small-scale handpump fabrication unit has been set up at the University of Malaya. A new handpump design has been developed which not only has a superior performance than the original prototype handpump design but can also be mass-produced at a lower cost. Handpump performance and endurance testing facilities were also established to provide for quality control checks on the technical performances of the mass-produced handpumps.

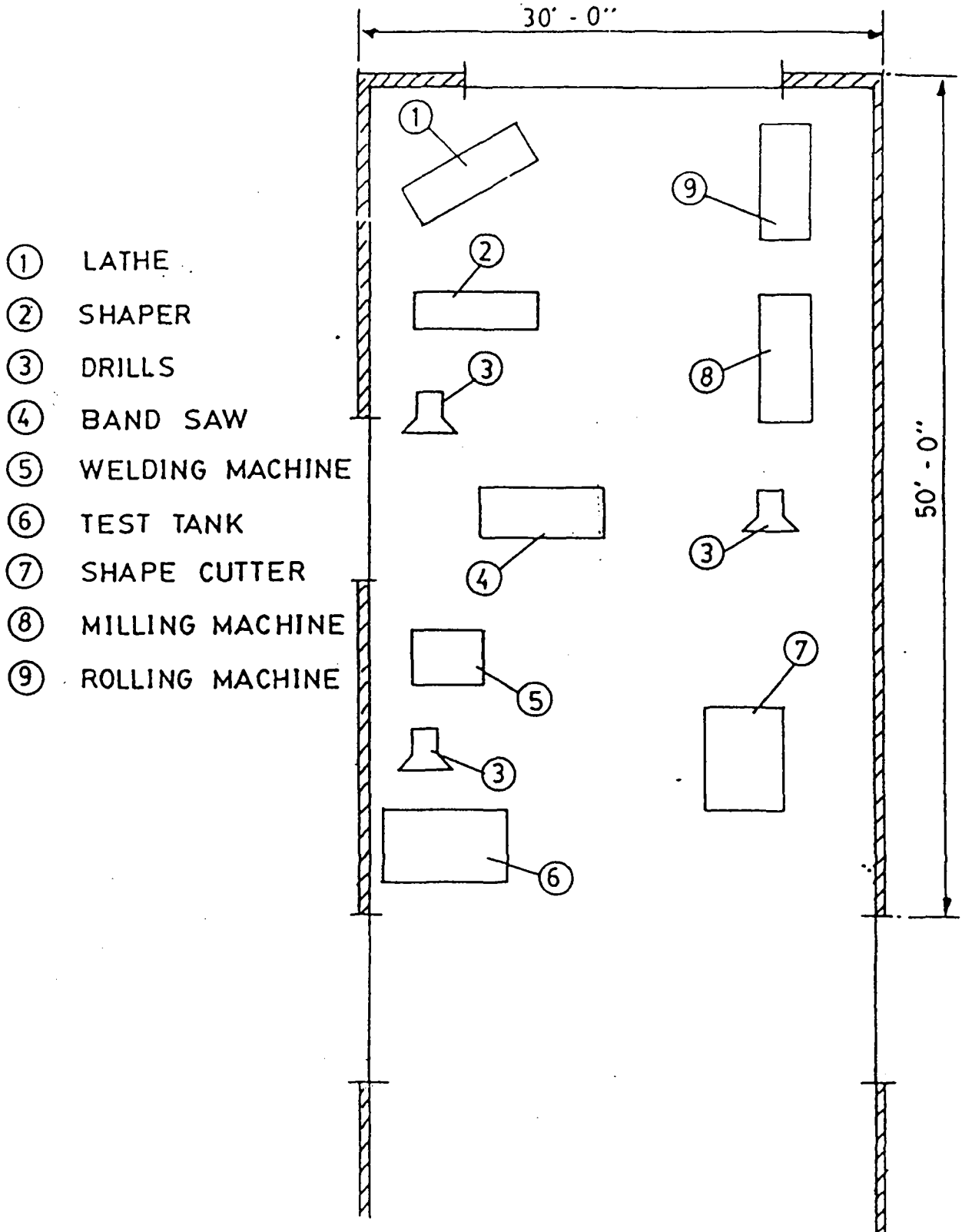
TABLE 1 (con't)
COMPONENTS, MANUFACTURING OPERATIONS AND EQUIPMENT FOR MARK III HANDPUMP

UNIMADE MARK III MODEL					EQUIPMENT									
Ref No.	Component	No. Reqd	Material	Manufacturing Operations	Lathe Machine	Radial Drill	1/2" Upright Drill	Metal cut-off Saw	12" Blue Cut-off S	Electric Arc Welder	Oxy-Acetylene Copy Cutter	Injection Moulding Machine	Compression Moulding Machine	Special Jig
1. 1.1	Piston & Footvalve Barrel	4	PVC	- Injection moulding								X		
				- Facing of valve seat	X									
1.2	Bolt set	2	Acetal	- Injection moulding								X		
1.3	Nut set	2	Acetal	- Injection moulding								X		
1.4	Valve flap	2	Rubber	- Compression moulding									X	
1.5	Double-lip seal	1	Rubber	- Compression moulding									X	
				- Part assembly										X
2. 2.1	Pump cylinder Cylinder	1	PVC	- Cut-off					X					
				- Drill outlet hole		X								X
				- Taper cylinder	X									
2.2	Flange	1	PVC	- Injection Moulding								X		
2.3	Reducer	1	PVC	- Injection Moulding								X		
				- Part assembly										X
3. 3.1	Pump Stand Stand	1	Mild steel	- Cut-off				X						
				- Cut flanges						X				X
				- Drill holes in flanges		X								X
				- Weld flanges					X					X
3.2	Spout	1	Mild steel (galvanised)	- Cut-off				X						
				- Cut flanges and spout			X			X			X	
				- Drill holes in flanges		X							X	
				- Weld flanges and spout					X				X	
3.3	Cover	1	Mild steel	- Cut-off				X						
				- Cut flanges and webs						X			X	
				- Drill holes		X							X	
				- Weld flanges and webs					X				X	
4. 4.1	Leverage Assembly Handle	1	Mild steel (galvanised)	- Cut-off				X						
				- Drill holes		X						X		
				- Weld					X			X		
4.2	Connecting rod/arm	1	Mild steel (galvanised)	- Cut-off				X						
				- Drill holes		X						X		
				- Weld					X			X		
5.1	BEARING BUSHES	4	Stainless steel	- Part off	X									X
				- Injection moulding								X		

TABLE 2
MOULDS AND JIGS

	MOULDS	PART MATERIAL	YEAR 1	YEAR 2	YEAR 3
1.	Piston rings	Polyethylene	Mould no. 1	Improved mould No. 2	
2.	Bolt set	Acetal	Mould no. 1	Improved mould no. 2	
3.	Nut set	Acetal	Mould no. 1	Improved mould no. 2	Mould no. 2 upgraded
4.	3" dia. flange	PVC	Mould no. 1	Improved mould no. 2	Mould no. 1 upgraded
5.	Piston barrel	PVC	Mould no. 1	Improved mould no. 2	Mould no. 2 upgraded
6.	3" to 1.5" reducer	PVC	-	Mould no. 1	-
7.	Footvalve extractor	Acetal	-	Mould no. 1	-
8.	Bearing bushes	Acetal	-	-	Mould no. 1
9.	Footvalve double-lip seal	Rubber	Mould no. 1	-	-
10.	Valve flap	Rubber	Mould no. 1	-	-
	JIGS				
1.	Assembly of piston & footvalve		Jig no. 1	Improved Jig no. 2	
2.	Drilling of spout hole in steel pump stand		Jig no. 1	-	
3.	Positioning and welding of steel spout and base flange to pump stand		Jig no. 1	Improved Jig no. 2	
4.	Oxy-acetylene copy-cutting of steel base flange		Jig no. 1	-	
5.	Positioning and drilling of holes in timber lever arms and bearing blocks		Jig set no. 1	-	

FIGURE 1



EVALUATION OF THE LARGE SCALE IMPLEMENTATION PROGRAMME
OF IDRC-UM HANDPUMPS IN MALAYSIA

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INTRODUCTION

In Malaysia, water supply, being the responsibility of the various state governments, is undertaken by the Public Works Department of the State and the State Water Authorities. In rural areas, where the villages are unlikely to be supplied with potable water within the framework of the state department's programmes, the Ministry of Health has been assisting these villages to obtain some water supply facilities under the Rural Environmental Sanitation Programme which was initiated in 1974.

The types and levels of services provided for rural population consist of one of the following:

- o piped water supply (fully/partially treated) with individual house-connection.
- o piped water supply (fully/partially treated) with public stand pipes or stand posts.
- o community well water supply consisting of shallow or deep sanitary wells fitted with handpumps, serving 5 to 15 households (some of these wells have further developed to provide house connection, operated with handpumps).
- o rainwater catchment systems, which are designed to provide sufficient water for drinking and cooking requirements only (the villager has to use other sources for washing and other uses).
- o other point source systems such as infiltration gallery, etc.

The project implemented through the Ministry of Health involves the rural community, on a voluntary community participation basis not only in the planning and construction of the physical facilities but also in the operation and maintenance of the facilities. As such, the facilities provided need to be planned and designed for village level operation and maintenance.

WELL WATER SUPPLY

Under the Rural Water Supply Programme, the Ministry of Health provides well water supply system for the next five years to villagers who have no access to public potable water. Generally, one well is provided for every 5 to 15 households. The government provides all materials including the handpump and the construction of the communal wells at no cost. The villagers, on the other hand, provide the voluntary labor for the construction of wells. The wells are either dug wells, up to 1 m in diameter (lined with precast concrete ring or brickwall_ or borehole wells (augered, driven or drilled wells). Most of the wells are within the practical suction lift (6.7 m), except in the hilly terrain areas, whereby lift pumps (with submerged cylinders) are required.

For a community which is willing to operate and maintain a system with pipe connection to each household, one well is provided for every 5 houses or less (depending on the distance from the well). In this case, the community has to make a further nominal contribution towards the cost of pipes and elevated storage tank, amounting to \$20.00 per household.

Since the inception of the above-mentioned programme in 1974, the Ministry of Health has installed 17,075 community sanitary wells fitted with handpumps, serving 873,000 rural population. Of these, 1,403 wells are provided with individual house connections.

THE HANDPUMP EXPERIENCE

Due to the large number of handpumps used in the programme, the Ministry has a central contract for the supply of handpumps. Prior to 1985, the handpump made available under this central contracts consisted of the Dragan, Gibson and Bulaji pumps. In addition to these, the Dempster, India Mark II and Rover pumps have been supplied to the Ministry by UNICEF and other international agencies. Some communities have also installed other pumps like Fuji, Thien Thean, Jetmatic and the like, on their own initiative, using funds provided by the other government agencies.

These imported pumps have cast-iron or cast-bronze bodies with plunger type suction valve assembly. Apart from the contractual problems of the supplier in delivering the pumps on time, other problems have been experienced. In terms of mechanical failures, the frequent problems include the rubber/leather flap, foot valve, inner lining for the cylinder and grease packing at the pump head. In addition to this, due to the difficulty in quality control, many pumps were found defective.

A nationwide survey carried out in late 1983 indicated that at least 55% of the wells constructed under the Ministry of Health's programme were non-functioning due to various reasons. Of these only 10% of the wells could be revived by repairing the handpumps. In all other cases, the handpumps required total replacement. They were beyond repair, because no spare parts were available.

MINISTRY OF HEALTH'S EXPERIENCE WITH PVC HANDPUMPS

In 1979, the Ministry of Health agreed to cooperate with the University of Malaya in the IDRC funded research project to develop and test a suitable handpump utilizing PVC materials, similar to the Waterloo model. A total of 17 pumps were manufactured by the University of Malaya and installed in two villages in separate locations. After three years of testing in the field, the Ministry found that these pumps were suitable for the rural water projects. Hence, the Ministry further cooperated in the Phase II project whereby 550 handpumps were manufactured on commercial basis and installed in various locations throughout the country, as presented in Table 1. The feedback from our sanitarians indicated that the IDRC-UM pumps were better received by the villagers, easier to install and faced fewer mechanical problems/defects.

Training Programme

In order to ensure proper installation of the IDRC-UM handpumps under the Phase II project, a network of training activities were instituted. These include the following:

1. Training at National Level

- o A one-day training seminar held in 1984 at Kuala Lumpur, in conjunction with the annual meeting between the Programme coordinators and implementors at State Levels, this training programme included theoretical aspects of installation. This training was provided to the public health engineers and chief/senior health inspectors from all the states. These officers are responsible for the implementation of the Rural Water Supply Programme at their respective states, and hence provide the necessary training to the health inspectors and public health overseers at their state levels.
- o The Division of Engineering Services also included in their annual training programme for Rural Water Supply Systems, 2 sessions in the IDRC-UM handpumps: the first session is on the installation of handpumps. The training programme, which covers the design and

installation of various water supply systems, is attended by Health Inspectors and Public health Overseers.

2. Training at the State Level

- o The various States had in turn organized training programmes similar to that of the national level for the various officers at the district levels, which includes senior health inspectors, health inspectors and public health overseers. Some of the states obtained the assistance of University of Malaya (Prof. Goh Sing Yau) in conducting the training programme.
- o Ad-hoc training was provided to public health overseers/health inspectors who encountered specific problems with the installation of handpumps. The University of Malaya provided valuable assistance in this area of training.

3. Training at the Village level

- o While formal training programmes are not organized at the village level, the public health overseers provide informal training to the caretakers of the pumps. The training activities covered installation, maintenance and repair of the pump. The caretakers are given instructions on various components of the pumps, and on how to use the operation and maintenance manuals which are supplied together with the pumps.

SURVEY OF NON-HANDPUMP USERS

A survey of 61 rural households in two villages in the district of Temerloh was carried out in May 1985. The two villages selected in Bintang and Lebak Seberang - represent different stages of development in terms of the provision of social infrastructure. Bintang is currently served with electricity, telephones, schools and rural clinics while the children of Lebak Seberang have to cross the Pahang River to attend school.

Another survey of 58 rural households in the district of Alor Setar was carried out in December 1985. It covered two villages - Belukar and Derang, both of which are approximately 20 kilometers from the state capital of Alor Star. The residents of Belukar are mainly farmers, each with about one hectare of land. The residents of Derang are primarily school teachers or those working as supporting staff in the nearby schools.

All the four villages surveyed reveal some similar characteristics. They are as follows:

- a) These villages are far from the main road and do not have access to piped water supply.
- b) The residents' incomes are below the poverty line income of Mal \$4,500 per household per year.
- c) These villages are served by the rural health unit of the Ministry of Health, that is, they are provided with rural clinics and are given assistance and advice on health care and sanitation.
- d) These villages have been selected to receive a few units of the IDRC-UM plastic handpumps in 1985 and/or 1986. At the time of the survey, only one village - Bintag in Temerloh district has received and installed one of these handpumps.

ANALYSIS OF THE MAJOR FINDING - "Rural Water Supply and Sanitation Survey"

General Information (Table 2)

The average age of the respondents is 47. It is higher for the villagers in Temerloh than those in Kedah. The average family size is 5.38, with the smallest in Bintang (4.80) and the highest in Lebak Sebarang (6.06). The average figures for age and family size found in this survey are quite typical for villages in Malaysia, where many of the farmers tend to be above 40 years of age. Many of the rural youth have migrated to urban centres in search of more lucrative employment.

The villages have relatively small plots of land and the average size of land area per family is only 1.3 hectares. Their average yearly income - Mal \$2.447 - is low. This is well below the government poverty income level of Mal \$4,500 per family.

Source of Water Supply (Table 3)

The main source of water supply for these villages are the rivers and unprotected wells. The collection of rain-water is only important in one village - Sebarang in Kedah. Only 13 percent of the respondents indicated that they obtained water from handpumps. Approximately 15 percent of the respondents use pumps to obtain their water from nearby rivers. The use of protected wells is the least important source of water and is only utilised by 12 percent of the respondents. Most of them rely on at least two sources of water supply - the most widely reported combination being the unprotected well and the river.

The average distance that the villagers have to travel for their water supply is 82 meters. It is furthest for Bintang (107 meters) and shortest (64 meters) for Sebarang.

Water Usage (Table 4)

The average household uses 9.3 liters per capita per day for drinking and cooking, and 48.1 liters per capita per day for washing and bathing. These figures are well below the figure of 401 liters per person per day used by the Malaysian Government in planning the coverage for treated piped water. All the respondents have water containers to store some water in their houses. The average size of these containers is 237 liters. However, this figure is not a good indication of the actual situation prevailing in these villages, since it is inflated substantially by a few households that have constructed large ponds to store water. More than half of the respondents (62 out of 119) have water containers with a capacity of less than 50 liters.

The average time spent in collecting and carrying water is 1.4 hours per household.

Improvements in Water Supply (Table 5)

Over 78 percent of the respondents indicate a willingness to pay for improvements in their water supply. The average monthly payment that they consider reasonable is Mal \$7.60.

There is good response to the question whether they would like to have a handpump installed near their homes. Eighty-five (85) out of the 119 respondents would like to have handpumps. Of this number, 61 are willing to pay for the installation, monthly repairs and maintenance of these pumps. The majority are willing to pay 25% of the installation cost of the pump, and between Mal \$5.00 to Mal \$8.00 per month for repairs and maintenance. Virtually all respondents are willing to contribute the labor required for the installation of the handpump.

Water Treatment (Table 6)

Nearly all the respondents boil their water before drinking. Respondents from a few villages allow water to first settle before boiling four respondents use chemicals such as alum and others. Four villagers in Kampong Derang do not treat their water at all, but drink it directly from the source.

The major problem encountered is insufficient supply (21), followed by distance to water supply (20) and poor quality of the water (15).

SURVEY OF HANDPUMP USERS

The IDRC-UM handpump was first field-tested in the sub-district of Terachi (district of Kuala Filah) in the 1980 - 1981 period. A total of 23 of these pumps are now installed in this area, and the bulk of them have been used continuously over a five-year period.

In the survey conducted in September 1986, a total of 40 households were selected at random for further investigations. Information on their family income, sources of water supply and their views on handpumps were obtained.

The main findings from the analysis of their response are as follows:

Average Income

The average income of these villagers is Mal \$3,200 per year or 31 percent higher than the villagers in the two areas surveyed, where the IDRC-UM handpumps have not been installed.

Sources of Water

The main source of water for the villagers in Terachi is the handpump (47 percent) and piped water (44 percent). This is in contrast to the other two areas surveyed where the main sources of water are from wells (37 percent), rivers (35 percent) and rain (19 percent). Many of the households (45 percent) in Terachi have both piped water and handpumps, while 62 percent of the households provided with handpumps five to six years ago are now also having access to piped water.

Payment for Water

The average monthly payment for water supply is Mal \$6.35. There is no significant difference in the monthly water bill of villagers who have no access to handpumps.

Condition of the Handpumps

All the 28 handpumps in this sub-district appear to be in satisfactory condition. Only seven of these pumps need some minor repairs.

Preference for Pumps

Over 72 percent of the villagers interviewed would like to have their own handpump. This preference for individually-owned and operated handpumps is an indication that the present arrangement where each handpump is shared by four or five households is not ideal. The main complaint relating to the current situation

centers on inadequate water supply for all users and the distance from the house to the handpump.

Problem of Water Supply

Nearly 24 percent of the villagers are unhappy with the quality of water supplied to them through pipes and handpumps.

Willingness to Pay

More than 80 percent of the villagers indicated a willingness to pay for their individually operated handpump. The mode of payment preferred is a monthly charge of Mal \$5.00 to Mal \$10.00 per month.

Ability to repair handpumps

Only 40 percent of the villagers with handpumps indicate that they are able to repair their own handpump.

BENEFITS DERIVED FROM THE PROJECTS

Some of the benefits derived by the Ministry of Health from the Phase I and II projects in the development of the PVC handpump include:

- (a) closer cooperation between the University and the Ministry in terms of research projects.
- (b) better understanding and appreciation of the design and manufacture of handpumps.
- (c) regaining the confidence of villagers, implementing the well water projects.

Following the completion of Phase II project, the Ministry entered into a one-year contract with the University of Malaya for the supply of the various types of PVC handpumps. To date, about 900 pumps have been purchased and installed.

TABLE 1

MINISTRY OF HEALTH
EXPERIENCE WITH 550 HANDPUMPS MANUFACTURED
IN PHASE II OF THE
IDRC-UM HANDPUMP DEVELOPMENT PROJECT

STATE	Suction	Lift	Total
Kedah	88	11	99
Perak	130	6	136
Selangor	-	2	2
Negeri Sembilan	18	1	19
Melaka	4	-	4
Johor	28	1	29
Pahang	65	14	79
Terengganu	63	-	63
Kelantan	90	9	99
Sabah	10	-	10
Sarawak	10	-	10
TOTAL	506	44	550

Problems Experienced with Installation, Operation and Maintenance of Pumps	Response of Community
1. Installation a. Suction Pumps - no problems b. Lift Pumps - piston rings originally got stuck between the delivery pipe joints. But this problem was readily solved by chamfering the inner edge of pipes prior to jointing c. Piston rings - affected by silt in water: solved by proper well development and improved ring design	1. Generally well received and satisfied with performance 2. Some communities still depend on Health personnel for maintenance - hopefully with the instruction manuals and training, this will be lessened in the future. 3. There is an increasing demand by villagers for installing their own handpumps. This will require the University to look into the marketing of the pumps.

TABLE 2
GENERAL INFORMATION

Location	Number of respondent	Average age	Average family size	Average land area/ respondent (ha)	Average yearly household income RM (\$)
Alor Star					
Belukar	30	43.1	5.37	1.00	2,770
Derang	28	41.2	5.25	0.65	2,200
Temerloh					
Bintang	30	52.2	4.8	1.13	2,790
Sebarang	31	50.8	6.06	1.97	2,290
Total/ Average	119	47.0	5.38	1.30	2,447

TABLE 3
SOURCES OF WATER SUPPLY

Location	Number of respondent	Source*					Average distance source to home (m)
		Protected well	Unprotected well	River	Rain	Pump	
Alor Star							
Belukar	30	2	28	-	-	-	77
Derang	28	9	3	19	-	4	81
Temerloh							
Bintang	30	1	15	11	3	7	107
Sebarang	31	-	5	28	29	4	64
Total/ Average	119	12	51	58	32	15	82

* Some households have more than one source for their water supply.

TABLE 4
WATER USAGE AND AVERAGE TIME SPENT IN WATER COLLECTION

Location	Number of respondent	Water usage			Average size of water container in household (1)	Time spent in carrying water (hour/day)
		Drinking and cooking	Washing and bathing	Total		
		(litres/person)				
Alor Star						
Belukar	30	12.5	18.3	30.8	72	0.5
Derang	28	11.3	72.0	83.3	808	0.5
Temerloh						
Bintang	30	4.4	72.8	77.2	188	3.7
Sebarang	31	9.2	31.5	41.7	40	0.7
Total / average	119	9.3	48.1	57.4	237	1.4

TABLE 5
IMPROVED WATER SUPPLY AND HANDPUMPS

Location	Number of respondent	No. willing to pay for better water supply	Average payment per month Mal (\$)	Number requesting for hand-pump	Number able to pay for hand-pump	Average payment Instal- Monthly lation repair Mal (\$)
Alor Star						
Belukar	30	30	9.7	30	27	25% of cost 8.3 *
Derang	28	11	6.0	15	8	25% of cost 8.0 **
Temerloh						
Bintang	30	23	5.5	12	9	12.8 1.8
Sebarang	31	30	7.6	25	17	23.8 5.2
Total / average	119	94	7.6	85	61	- -

* Average of only 3 respondents

** Average of only 5 respondents.

TABLE 6
WATER TREATMENT AND MAJOR WATER PROBLEMS

Location	Number of respondent	No. reporting water treatment			No. reporting major problems		
		Boiling	Allow sediment to settle	Others	Insufficient supply	Poor quality	Distance to supply
Alor Star							
Belukar	30	24	3	-	8	2	5
Derang	28	25	8	-	5	8	6
Temerloh							
Bintang	30	29	-	4	8	5	9
Sebarang	31	31	-	-	-	-	-
Total / Average	119	109	11	4	21	15	20

THE PDA/IDRC HANDPUMP PROMOTION PROJECT

Pairojana Sornjitti
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INTRODUCTION

The Population and Community Development Association (PDA) was founded as a family planning and health services organization in 1974 when Mr. Mechai Viravaidya established the Community Based Family Planning Services. Since then, PDA has branched out into various rural development initiatives. In keeping with its original community based philosophy, PDA concentrates on maximizing community education and participation at all levels of project planning and implementation to ensure that the benefits of development are self-sustaining. The health implications of the Handpump Promotion Project, in which PDA cooperated with the International Development Research Centre (IDRC), are difficult to document; however, the success of PDA's strategies for community participation have made this project one of its most successful, and thus most sustainable, development efforts.

PDA's philosophy teaches villagers to recognize their direct role in the development process, increases their self-esteem, and thus creates conditions for development to be self-sustaining in the long run. In addition, when the community participates, the project costs less to complete.

In health-related matters, such as water supply and sanitation, the engaging organization must provide education with the community participating actively. Irrespective of the numbers of wells constructed and handpumps installed by the villagers, the health gains will be minimal or undetectable if the villagers have the same unsanitary habits as before the project, such as using dirty containers to store water from the handpumps. Community health education must go hand-in-hand with the provision of facilities.

STEPS OF IMPLEMENTATION

The Handpump Project was implemented in five main steps: planning and preparation; social orientation; construction and supervision; follow-up, maintenance and monitoring; and education and training.

Planning and Preparation

This step concerns all detailed planning and coordination among all units of PDA involved in the project activities. Project staff are hired and trained in the technical aspects of construction, PDA's revolving loan fund system, and the concept of community development. Also, raw materials and necessary tools are purchased.

Another important planning step is the survey of the operational area. The project staff visit villages to consult with the village headman, the villagers, and the local government officials about their needs and readiness to participate in the program. In general, the criteria used in selecting the operational villages are that: 1) clean water is in short supply or lacking; 2) the village has cooperated and collaborated in the past development efforts; 3) the village is in the government's development plan that targets poverty-stricken areas; and 4) family planning is well accepted.

Social Orientation

Once a village has been selected, the project staff explain the details of the project and solicit the villagers' response at village meetings. The health aspects of water supply and sanitation are explained in detail, covering such topics as: 1) water and health; 2) construction techniques; and the 3) responsibilities of both PDA and the villagers.

After the villagers understand the details of the project, the PDA staff then invite them to apply to participate in the project. Usually, more villagers apply than the available funds can accommodate. Thus participants must be selected on the basis of their willingness to own a handpump; their reputation for involvement in community development; their ability to pay back the costs of raw materials for the well and handpump into the revolving fund; and whether the family practices family planning.

Construction and Supervision

Training is an integral part of any project. The project staff train the participants in construction techniques to ensure that they fully understand the technology and to enable them to maintain and repair their handpumps.

The participating villagers help each other construct their own wells and install their handpumps with some supervision from the project staff.

The villagers pay for the raw materials which PDA purchases in bulk to minimize the cost. After construction in each village is completed, the villagers make a down-payment and sign a contract to repay the PDA revolving fund through a monthly installment system.

Follow-up, Maintenance and Monitoring

Although the project participants are encouraged to maintain and repair their handpumps, a project staff member visits each village at least once each month to inspect the handpumps and collect the monthly payments. During these visits, the PDA staff discuss any problems with handpump owners. The PDA staff maintain a close rapport with the villagers and this encourages them to solve their problems using local resources as much as possible. In this way, the project staff also reinforce the messages regarding health and general community development, which were emphasized during earlier stages of the project.

The project staff perform any necessary repairs during their routine visits; however, the villagers are given postcards which they can use to contact the PDA staff if repairs are needed in between visits.

As part of the monitoring activities of the project, PDA's Research and Evaluation Division surveyed the project participants to document their attitudes towards the project. The results of the survey were used to assess the acceptability of the pumps and the various ownership schemes used to promote the handpumps.

Education and Training

To ensure that the benefits of the handpumps are self-sustainable, PDA makes a concerted effort to educate the villagers and handpump users in health issues and to train them to construct and improve the wells and to install, maintain and repair the handpumps. Only when the villagers understand the importance of clean water and when the handpump users can maintain and repair their wells and handpumps will the benefits of the handpumps become self-sustaining. From the first village meeting, the project is introduced in the context of health. The cycle of village health is explained, and clean water supplies through a well maintained well and handpump are identified as a viable solution to the vicious cycle of intestinal infection. Water-treatment techniques are fully explained as are the health considerations of maintaining and repairing the handpump.

PDA STRATEGIES IN COMMUNITY PARTICIPATION

Working with the villagers in the family planning and subsequent handpump project has given PDA considerable experience and understanding of the strategies needed to get people to participate in its programs. PDA's ability to do so relies on the following factors and strategies: its reputation; the cooperation from the villagers and government agencies; the use of appropriate technology; the revolving loan fund mechanism; the sharing of responsibility; and education and training.

Reputation of the Organization

Most villagers have worked with outside private agencies and individuals. They have seen that, very often, these agencies and individuals have taken advantage of them. Therefore, a reputation of honesty and reliability of the organization is essential if the villages are to cooperate. Adequate staff support and rapport is also important, because the staff must work with the villagers to guarantee project success.

Cooperation from the Villagers and Government Officials

During the social preparation step, PDA explains frankly and honestly the benefits and associated costs of a handpump. Once the villagers understand the health benefits, they will be motivated to join the project and cooperate fully to ensure that it is completed successfully. The government officials also cooperate fully with PDA because they have been informed about the project from the start and their advice and suggestions have been incorporated into the project as far as possible. Because PDA works to supplement the work of the government, the local government officials support the project and can coordinate the villagers' and PDA's activities.

Use of Appropriate Technology

Because PDA uses appropriate technology in its handpump project, the villagers can understand and accept the handpump easily. They can construct and maintain the wells and handpumps easily with only a few tools and basic training. The appropriate technology also helps reduce the cost of construction and maintenance.

Revolving Loan Fund Mechanism

The revolving loan fund was conceived as a way to increase villagers' participation and to assure continued activities after the original funding from external sources has been used up. Through this scheme, the villagers can own a handpump more easily because the cost can be repaid in small amounts with a down payment and monthly installments.

Sharing of Responsibility

The villagers work together to build wells and install handpumps with each recipient household providing a laborer. PDA and villagers also have clearly defined responsibilities to give the villagers a sense of pride and self worth. The cooperative approach also uses Thailand's traditions, where villagers work together during the harvest, moving from one field to another helping their neighbors.

Education and Training

The education and training component is an integral part of the handpump project. Villagers benefit in two ways from it. First, they learn the skills needed to build the wells and install the handpumps. Second, one or two members of the work crew who show particular skill at construction are specially trained to become village volunteer technicians. Such training consists of learning by doing as well as some lectures on construction theory and techniques, health issues, etc. In this way, knowledge of the construction technique remains in the village after PDA has gone. Such knowledge can be valuable to the villagers in their future development efforts. Second, PDA provides not only the low-cost raw materials and supervision, but also health education and training that results in improved knowledge and practices in basic health-related matters. Users' manuals are provided which the villagers can refer to later. The usefulness of this educational aspect of the project is obvious and recognized by the villagers.

CONCLUSION

The PDA/IDRC Handpump Promotion Project has succeeded because the target villagers have cooperated. Because they realize the benefits of such a project for themselves and their community, they are ready and willing to help. The project offers a system for clean water that the villagers can afford. It is simple and

uses a technology that is appropriate to the village environment. Because technology is simple, the villagers can help prepare, construct and maintain the system and this motivates them strongly. The project also provides education and training to the villagers, which enable them to work for the success of the project. Thus, the project becomes theirs, giving them a sense of belonging and pride in the results of their efforts.

INTRODUCING THE PVC HANDPUMP IN INDONESIA

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INTRODUCTION

Since 1976, the International Development Research Centre (IDRC) has been sponsoring research and development work on a PVC plastic handpump design for use in developing countries. An essential feature of the design is that it must be a village level operated and maintained handpump. It must also be capable of being produced locally by the developing country. This is to guarantee technology transfer in terms of technical know-how with an assurance that spare parts are readily available locally. The development of the PVC plastic handpump is considered as Phase I.

In 1983, a project on the "Development of a Small Scale Handpump Fabrication Unit" was started in Malaysia by IDRC to study mass production techniques for the IDRC-UM (University of Malaya) Handpump with the view to substantially reduce its cost and therefore make it more readily available to the rural poor.

In order to ensure that the technology developed is transferred to the villagers, IDRC also organized research projects in cooperation with local NGOs in the respective countries.

Yayasan Dian Desa, (YDD) an appropriate technology group based in Yogyakarta, Indonesia which has dealt with water supply projects in the rural areas, is interested in the dissemination of the IDRC-UM PVC handpump. The handpump research project in Indonesia started in early 1986.

PROJECT PREPARATION

The project preparation was divided into three activities, namely:

- Two YDD staff were assigned to the University of Malaya for a two-week training stint on the construction and installation of pumps as well as a discussion on the various aspects of the pumps. This took place in January 1986.
- Simultaneously, a research team was organized. Questionnaires were then developed and used as the basis for interviews of potential recipients of the PVC handpumps in the community. The interview was a means, among others, to get the following data:

- Respondents' identity and family size.
 - Socioeconomic condition of respondents; their monthly income.
 - Domestic water source and water quality.
 - Respondents' opinion on handpumps in general.
 - Respondents' interest in PVC handpump after an explanation of the PVC handpump by the interviewer.
 - Pattern of ownership.
 - Preferred repayment scheme.
- A preliminary survey to determine the location of the PVC handpump project was made in February 1986 both by the technicians and the social scientists. After considering several areas especially their ground water level due to the limitations of the handpump, it was decided that three villages consisting of ten hamlets and five slum areas would be surveyed.

The survey was conducted in March/April 1986 among 200 respondents. It was assumed that only 1/5 or 1/4 of the respondents would be interested to get the PVC handpump because of the many past failures of handpump projects and the donation system of existing handpump projects.

The result of the survey, however, was surprising because 118 respondents showed interest in the PVC handpumps. They were even willing to pay an affordable amount on a repayment scheme basis.

Survey Results

Community Acceptance

In spite of the past failure of handpump programs in the respective areas, the community, in general, showed enthusiasm for the PVC handpump although the people had not seen it yet. Some of the reasons for the high interest were:

- The need for clean water nearer the house
- The fact that PVC is rust proof and produces no chemical reaction that may influence either the colour or taste of the water.
- A guarantee for the durability of the handpump since YDD fieldworkers would continuously monitor the handpumps for at least 20 months.

TABLE 1
AREAS AND NUMBER OF HANDPUMPS

Province	District	Sub-district	Village	Hamlets	Pumps
Yogya- Karta	Sleman	Kalasan	Selomartani	Kringinan	1
				Demangan	3
				Gatak II	3
				Maredan	
	Berbah	Sendang tirta	Kemasan	2	
			Sendang	2	
			Jetak	2	
			Maredan	2	
	Sleman	Caturharjo	Mangunan	4	
Karta	Ngampilan Tegalrejo	Notoprajan Bener	Serangan	5	
			Sidomulyo	4	
			Kricak Kidul	3	
	Danurejan	Suryatmajan	L. Tungkangan	5	

TABLE 2
OWNERSHIP PATTERN

Ownership Pattern	Number of PVC Pumps
Individual	35
Group (of two families)	2
Group (of four families)	1
Communal	2

- A chance to learn how to maintain the handpumps on their own as a result of the training given.
- Payment in kind or on an installment basis.

It should be noted that if the real cost of the handpump and its installation were to be shouldered by the community, only a few (six) would be able to afford to buy the handpumps. Therefore, after considering the community's monthly income, it was decided that the community should only assume approximately 50% of the total cost, about US\$100 per pump.* The amount would be repaid in 20 months. Other estimates on the cost of the handpump installation will be discussed separately.

Ownership Pattern

Most people preferred to own the handpump individually rather than with a group or on a communal basis even if a group or communal ownership would lower the per household cost. The reason is mainly based on former experiences with communal or group ownership and the required trustworthiness and conscientiousness among the owners.

Repayment Scheme

Two repayment schemes were agreed upon. The first is on a monthly basis, the second is on a harvest time basis which is every four months. Both, however, should be completed within 20 months.

Selection of Handpump Recipients

Based on the data collected from the survey, 40 handpump recipients were chosen. A price was fixed for the handpumps as well as the repayment scheme by considering both the community's capacity to pay and the real cost of the handpumps.

The selection of recipients was mainly based on difficulty in getting clean water for domestic use. Some of them, though they already have wells, were chosen as recipients. They will be used as a basis for a comparative study on the community's interest to use the PVC handpumps.

Tables 1 and 2 give further details about the recipients.

* Due to the devaluation of the Indonesian Rupiah, all prices are provided in US\$ for comparative purposes.

Before the installation of the handpumps, meetings were held between interested parties and village/government officials. The objectives of the meetings were to acquaint them with the PVC handpumps, and to discuss the costs of installation, the repayment scheme, and the community's contribution.

THE ACTUAL PROJECT

Handpump Production

The production of the PVC handpumps was divided into two parts:

- The below-ground components were made at the University of Malaya.
- The above-ground components were made in Indonesia with modifications to suit local materials and costs. The main change made was the handpump stand, which instead of using metal, used a concrete pipe. This reduced the cost of the handpump unit by more than 50%.

The production of the 40 above-ground components started in February, and was completed in April.

Handbook Production

Some modifications were made in the original handbook to suit the local conditions and include changes especially in the installation of pumps for dug wells.

Handpump Installation

The first installation of two handpumps, the suction type and the lift type, were done in late May. It coincided with the visit of Mr. Rishyakaran, a consultant from Malaysia.

Preparations for the installation of other handpumps were made in June while the actual installation began at the end of the month. All the 40 handpumps had been installed by September 5, 1986.

Maintenance Training

Training for the handpump maintenance was scheduled as soon as all the handpumps had been installed. The training was conducted by hamlets to limit the number of people per training session. Training was conducted from September 10 to September 15, 1986.

For better maintenance of the handpumps, each handpump owner was given a monkey wrench and a copy of the handbook.

PROBLEMS

The following problems emerged in the project.

- The actual cost of the PVC handpump is too high when compared to the locally made handpump which costs only Rp. 15,000.
- The amount of water delivered in one stroke is only 0.6 to 0.8 litre.
- Some technical problems were encountered during the installation of the handpumps especially the lift type. The basic problem encountered was the difference in size or thickness of the Indonesia PVC pipe standard from that of the Malaysian standard.
- The size of the 3/4" PVC pipe in Indonesia is too small for the available piston. Hence, it has become necessary to solvent weld them together. The glue, however, does not prevent the separation of the piston from the rod after several strokes.
- Retrieving the piston and reconnecting it with the pipe by cutting the 3" PVC cylinder into two and having two connecting rings or sockets made was found to be a problem, as the locally-made sockets used were found to be too thin and lacked durability.
- A similar problem was encountered when additional pipes had to be connected when the water level in the well gets very low.
- In the installation of the 20 lift type handpumps, the 3/4" PVC was boiled to fit the size of the local PVC. However, the quality of the PVC then suffers.
- For the lift pump, the old model which has a double piston may be more suitable for the conditions in Indonesia. The PVC 3/4" pipe used as rod is not thick or strong enough and the water lifted is quite limited.

MONITORING

Monitoring of the technical performance and pump owners is done once a month by the YDD technicians. The first monitoring was done from September 15 to 20, 1986.

- While the handpumps were registered as individually owned, in fact several families were using them. At least three pumps were being shared by six families each.
- No serious technical problems were encountered. Many of the pump owners, however, had a problem with the water level because of the season and the inappropriate digging time.
- Water from the pumps was generally potable and used for bathing, washing, and cooking. Three families used the water only for bathing and washing.

VILLAGE HANDPUMP (PHILIPPINES) PROJECT

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FOREWORD

In February 1984, the International Development Research Centre (IDRC) approved the Village Handpump (Philippines) Project to be implemented by the Philippine Business for Social Progress (PBSP). The project aimed to develop the abilities of groups in managing their own water supply project using a village level operated and maintained handpump with plastics as below-ground parts.

The project involved 36 handpumps that yielded water supply to about 180 families or 1,000 individuals in selected villages - eight in Camarines Sur, four in Jala-Jala, Rizal, two in Hinigaran, Negros Occidental and one in Calauan, Laguna.

Through this report prepared for IDRC, PBSP shares its experiences and learnings in managing the project. The report can also be used as referral for agencies, other groups and individuals who are interested in similar water-related projects.

Our sincere thanks to the Science and Technology Research Center for their technical assistance, to the Naga Social Action Center and the Dairy Training Research Institute of the University of the Philippines, Los Banos for their cooperation, the project actors (both staff and beneficiaries) for their active participation, to Dr. Donald Sharp and Mr. Lee Kam Wing for their consistent support and most especially to IDRC for answering a basic need - WATER.

INTRODUCTION

Background of the Project

As in other developing countries, the Philippines is faced with the need for clean and reliable sources of water supply. In 1980, only 43% or 21.2M people out of a total population of 49.4M were served by public water supply. Thirty-three percent (about 70% of the entire population) received water from public supply systems, while the rest depended on handpumps, open wells, rainwater cisterns and streams. UNICEF statistics show that while there are 23,572 public artesian wells serving about 4M people, only 16,000 are operational. It is also reported that the Philippines has a large reserve of ground water with an average annual precipitation of 2,260 mm. 1

The need for clean and adequate water supply for depressed areas has been a concern of both government and private sectors. Even with various ongoing programs, the facilities under the rural water supply and sanitation development programs have not yet been effectively used or maintained.

In response to the need for safe sources of water supply in the country, the Philippine Business for Social Progress (PBSP), a private development organization involved in improving the lives of the Filipino poor assisted communities to improve their health and environmental sanitation. From 1978-1983, PBSP assisted 23 potable water supply projects that complemented government efforts to provide water resources for every village in the country by the year 2000. Backed up by its own experiences in social development approaches and technology transfer, PBSP sought the assistance of the International Development Research Centre (IDRC) in developing the abilities of groups to manage their own water resources using a particular village level operated and maintained (VLOM) handpump.

The Project Plan

In February 1984, IDRC approved "The Village Handpump (Philippines) Project" as part of a network of IDRC assisted research projects in Asia and Africa on the use of a low-cost handpump with plastics as materials for the below-ground parts.

1
Tan Bock Thiam, Water Pumping Technology-Global Economic Analysis and Potential Market (Village Handpump Technology Seminar, August 16-19, 1982, University of Malaya, Kuala Lumpur), pp. 13-14.

The project would cover eight areas in three villages in the province of Camarines Sur with PBSP implementing the project in cooperation with the Naga Social Action Center (SAC), a service arm of the local Catholic church development work for depressed communities.

Using the community organization (CO) approach, the project would enable village groups acquire skills to operate and maintain the IDRC handpump developed at the University of Malaya (UM). It would also determine the technical efficiency and its social acceptance in the rural areas.

The Science and Technology Research Center (STRC), a private-owned innovation center in the Philippine would manufacture the above-ground parts of the handpump and provide technical assistance in the installation and maintenance.

The two year project would provide training to two technical officers on the handpump fabrication, installation, operation and maintenance who would in turn train 60 end-users to maintain and carry out minor repair. A total of 30 handpumps would be installed to benefit some 150 families. Water quality over the study period would be monitored.

As a component of the project, a built-in monitoring and evaluation scheme would be developed by PBSP.

PROJECT IMPLEMENTATION

Pre-Operations Activities

Shortly after project approval, PBSP formulated a program plan of action which was agreed upon by the participating agencies. Based on this program, a built-in monitoring and evaluation (M & E) scheme was designed for implementation.

Operations Activities and Results

Year I (March 1984 - February 1985)

-- Social Preparation

As an initial activity, the PBSP program staff discussed the scheme with the cooperating agencies for implementation.

At the onset of the project, three villages (Barangay Sta. Cruz in Canaman, Pugay in San Jose and Santiago in Iriga) were identified as target sites considering the following: problem of lack of potable water; presence of SAC operations in the area; presence of organized groups with community development activities; and, expressed willingness of residents to run a potable water project.

These villages were then visited by the program team together with the consultant, Dr. Goh Sing Yau. Because the water level in Santiago, Iriga was about 40 meters deep, requiring some modifications in the handpump design, the team identified other sites.

The community organization workers (COWs) oriented the participants on the project scheme. Informally and during community assemblies, the staff discussed the project objectives and requirements to ensure participation.

Meanwhile, a baseline survey was conducted in all the project sites. The findings which presented the socio-demographic characteristics of the residents, described the water supply situation and determined potential acceptance of the handpump project, were shared with the participants for specific program planning and providing benchmark data to measure project impact.

- Technical Preparation

Two technical officers (TOs), one from STRC and the other a practical driller and community organization volunteer of Naga SAC, went to the UM in Kuala Lumpur for training on the handpump technology specifically on the fabrication, installation, maintenance and repair. Upon their return, they were expected to provide training and technical assistance for the entire project duration.

As agreed upon, the above-ground parts of the thirty (30) handpumps were fabricated by STRC at the cost of P1,273.13 (about US \$63.65) per unit. The below-ground parts were provided by the UM.

The project provided for a handpump demonstration unit which was installed by the technical officers under the supervision of Dr. Goh. It was initially used for training the groups from Sta. Cruz, Canaman and Sto. Domingo, Bombon, an alternative site.

To assure water potability, the project provided two portable millipore quality testing kits. Water samples from the sites were taken for testing and analysis. Results showed that water in some of the areas was extremely polluted. Inasmuch as some villages insisted that they be provided water sources, these areas were also maintained as project sites. The project staff then coordinated with the district offices of the Ministry of Public Works and Highways for regular physical and chemical tests of water samples, and the Ministry of Health for regular water treatment in the project areas.

- Initial Handpump Installation and Repair

For Year I, only eight (8) handpumps were installed. The desired number (15) was not reached due to the delayed arrival of the below-ground parts. There were problems in securing the requirements for the release of the shipped parts.

The technical officers assisted by the working team and the participants were responsible for drilling and installation. Drilling took an average of 1-2 days while installation lasted for only a few hours. Average drilling cost amounted to P1,500/unit (US \$75) and cementing of apron totalled approximately P500 (US \$25). Variable costs included PVC casings and other installation materials. Total drilling and installation for a suction pump at average water level of 20 ft. amounted to P3,500 or (US \$175).

During actual drilling and installation, the participants provided voluntary contribution in the form of labor, cash or in kind. Although the TOs encouraged them to participate in actual work, it was only after installation that technical training was conducted. Demonstration sessions were held using the manual prepared for IDRC by the Kabalikat ng Familyang Pilipino.

In their regular monitoring visits, the TOs provided repair and maintenance service for the installed handpumps. Among the difficulties encountered were: presence of sand particles coming out of the pump together with the water; worn-out rubber foot valve and copper wire of the demo unit; missing brass pin; rusty metal plates, bolts and nuts; and warped wooden cover pieces. To filter the water, fine nylon net was placed around the pipes as specified although it was suspected that the couplings for the casings of the demo unit were not intact or properly glued. It is interesting to note that the villagers repaired the worn-out rubber foot valve by replacing this with an improved rubber sole of a slipper. The rubber had to be immediately replaced with a spare part. Also, the copper wire replaced the ordinary wire tied by the villagers. The ordinary nail was taken off and replaced by a spare brass pin. It was found that the wooden cover pieces were not adequately soaked in oil and that the rusty parts were not galvanized. So, STRC had to replace the rusted bolts and nuts. To minimize exposure to elements causing the metal stand to rust easily, the villagers were told to put a shade over the pump and to repaint the stand as necessary.

The villagers pointed out that the demo unit would be affected by the dredging of the irrigation canal near the place where the handpump was installed. It was therefore agreed that if the handpump would be found non-operational, the National Irrigation Administration would then shoulder

any expenses incurred in the transfer of the unit. Because of the situation of the demo handpump in Canaman, another unit was installed at the Fatima Training Center in Iriga City. This unit served not only for training purposes but also for providing water to the residents of the orphanage inside the compound and the settlers nearby.

- CO Implementation

While the handpumps were being installed and monitored, the group/community building component was well on stream. This means that the COWs assigned in the areas continuously conducted activities to strengthen the existing structures (organizations, councils or groups) in planning, implementing and evaluating community projects, one of which was the handpump. Among the inputs provided were basic community leadership skills development, self and group awareness, organizational mechanics, small business management and project management. These were supplemented by spiritual activities such as bible sessions, faith-life experiences and spiritual recollection/retreats.

- M & E Trial Implementation

The built-in monitoring and evaluation scheme designed for the project was put on trial implementation. Tools to be accomplished at different levels by the various project actors included forms on Installation of Handpumps and Technical Training Information, Quarterly Information on Repair, CO Training Report, Technical Officer's Report, Report on Bacteriological Analysis and Report on Physical and Chemical Analysis.

After initial trial implementation, revisions were made on the forms to streamline data requirements and reporting.

Year II (March 1985-February 1986)

- Additional Demonstration Units

Because of the initial experiences in Year I operations, PBSP requested IDRC's approval to install additional handpump demonstration units in other areas. Two units were installed in Hinigaran, Negros Occidental - one in Sitio Olimbo and the other in Candumarao. A unit was also installed at the Center for Rural Technology Development, a PBSP-managed program with a training center in Calauan, Laguna. These handpumps served not only as models but also sources of water supply to the communities in the area.

- Handpump Installation, Maintenance and Repair

In addition to the demo units, all the twenty handpumps were installed in Year II in seven (7) villages in Camarines Sur: San Jose Pugay, Sta. Elena in Nabua, Sugod in Tinambac, Sto. Domingo in Tinambac, Sto. Domingo in Bombon, Bula, San Fernando and San Cruz in Camarines Sur. One was installed in San Ramon, Iriga City.

The original timetable was not followed due to some problems encountered such as non-availability of materials in the area, inclement weather, difficulties in drilling, lack of readiness on the part of the beneficiaries and the resignation of the technical officer from SAC last December 1985.

Regular visits were conducted to train the beneficiaries on the handpump and to monitor the performance of the handpumps. During these instances, the technical officers checked on the status of the handpump, provided assistance in repair and advised the end-users on proper use and maintenance of the unit. The most frequent repair was on replacement of piston rings, piston acetal bolt, copper wire and brass pin.

Other technical problems were attended to with the assistance of Mr. Ng Wah Lok an engineer sent by UM to visit the project. It was during this time that the demo unit at the Fatima Training Center was converted from a suction to lift pump.

Maintenance was done at the village level usually by the women beneficiaries. For those who had easy access to the extractor rod, regular cleaning of parts was done. The rural sanitary inspector initially chlorinated the water. This function, however was eventually assumed by the beneficiaries themselves.

- Community Building and Project Management

The CO workers sustained group/community activities at the village level. The organizations were assisted in formalizing their structure for the water project, setting systems and procedures in managing the program as well as in undertaking other organizational activities (i.e., income-generating, fund-raising, social and religious activities).

- Program Expansion in Jala-jala, Rizal

In an IDRC sponsored conference on Women Issues in Water and Sanitation held in Manila in 1984, guest speaker Dr. Gelia Castillo of the University of the Philippines Los Banos (UPLB) cited the case of the unsuccessful Phase I field testing of the IDRC handpump in Jala-jala, Rizal.

To respond to her concern, IDRC requested PBSP to undertake a similar project in Jala-jala. PBSP coordinated with the Dairy Training and Research Institute (DTRI) of UPLB to act as the co-implementor of the handpump project.

Two technical staff of DTRI were then trained by PBSP on group/community building as a strategy to introduce the handpump project. Immediately, the two were fielded in the area to provide the necessary social preparation. As a result, four beneficiary groups were formed and made responsible for managing the handpump project. Six sites were identified for handpump installation.

Six complete sets of handpumps were sent from UM for Jala-jala. Again, due to substantial delay in the release of the shipped handpumps, installation was postponed to a much later schedule.

Since the Jala-jala component required six months of operation, PBSP requested that the project timetable be extended from February to June 1986. Prior to the completion date however, PBSP had to ask for another three months extension to enable the project to meet all its set objectives.

Project Extension (March - September 1986)

- Installation in Jala-jala

Because of the substantial delay in the release of the shipped handpump units from Malaysia, installation in Jala-jala could only be scheduled in July.

As of project completion date, all the six units have been installed in four target areas in Jala-jala. These include two in Ik-ik, one in Naglabas, two in Lubo and one in Llano.

- Project Monitoring

In both Camarines Sur and Jala-jala, regular monitoring visits were conducted by the program staff. While the COWs followed up the organizing component, the TOs provided technical assistance in handpump maintenance and repair.

Monitoring the technical performance of the pump through the use of the veeder root counter was discontinued because the instrument rusted making the figures in the counter illegible.

- Project Assessment and Documentation

Throughout operations, the project was regularly reviewed by the program staff and assessment reports were prepared.

A consolidation of project operations has been conducted after the initial seven months of implementation. An annual review of the project was also made and its findings shared with the project actors and other interested agencies.

Technical manuals on handpump installation and water potability testing have been completed as supplementary reference materials.

The terminal report includes an initial impact assessment based on beneficiary interviews.

Towards project completion, consultants Dr. Tan Bock Thiam and Dr. Tee Tiam Ting visited the project as part of a more in-depth study on the program.

Problems Encountered and Action Taken

- On Site Selection

Using the guidelines for the selection of the handpump sites, the project team realized that some areas initially identified could no longer be considered. This was clarified to the villagers so other alternative sites were subsequently identified.

- Non-operational Demo Unit

The demo unit in Sta. Cruz, Canaman became non-operational. The first shortcoming was the failure to glue together the adapter assembly or PVC reducer to the pump cylinder before joining it to the drop pipe. After the adapter and the broken pump cylinder had been replaced, it was observed that the water being emitted was not potable. This may have been due to a possible seepage through the straight couplings that connected three pieces of 10 ft. PVC casings. Efforts to rehabilitate the pump were not pushed through because of the plan to dismantle and transfer this to a new site inasmuch as the area was to be affected by the dredging of a canal.

- On Water Potability

Results of the laboratory analysis showed that water samples taken from some of the areas were positive for coliform and non-coliform bacteria. The residents were advised to treat or boil the water for drinking, practice filtration, and use coagulants.

Upon the initiative of the participants, the group leaders tapped the services of the rural sanitary inspector to chlorinate the water. Given proper instructions, the villagers easily acquired the skill to chlorinate.

- Delayed Release of Handpumps, Spare Parts and Accessories

This has been caused mainly by bureaucratic procedures in the Ministry of Finance and Bureau of Customs which are responsible for issuing tax exemption clearances to PBSP. Since this caused substantial delay in operations, the project timetable had to be postponed accordingly.

- Technical Problems in Drilling

Difficulties were encountered in areas that were either rocky, muddy or unfit for drilling and installing the casing. Other alternative sites were identified.

At times, the level of potability was not reached. This problem later led to disturbances in handpump performance. For example, grains of sand were found in the water being emitted and these corroded the pump cylinder.

- Broken Spare Parts

Among the spare parts that easily wore out were the piston rings, copper wire, rubber foot valve and the brass pins. One time, the piston acetal bolt was broken. Spare parts had to be made available otherwise the villagers temporarily resorted to improvise replacements which at times proved harmful to the unit.

- On the Above-ground Parts

The top plates, bolt and nuts were not galvanized. The wooden cover pieces were slightly warped. Some metal stands rusted and showed a slight misalignment in the spout outlet. These were discussed with STRC.

It was also noted that the fabrication cost was high.

- Technical Problems in Installation

There were also problems caused by shortcomings in installation. These included malfunctioning due to leakage in joints, differences in classification of PVC materials used, and inaccurate length of GI piston pipe.

- Incohesive Group

One group which had not yet been fully strengthened in terms of management disbanded leaving the handpump in an abandoned condition. It was agreed that the unit would be transferred to another site and be managed by another group.

Project Management

- Personnel

The project was carried out under the PBSP executive director, Mr. Ernesto Garilao as project director. Ms. Mediatrix P. Valera research and development unit Manager acted as the principal investigator. She was assisted by Ms. Wilma Lazarte, research officer.

The two trained technical officers were responsible for supervising the drilling and installation, beneficiary technical training as well as providing assistance on handpump repair and maintenance. Upon the resignation of Mr. Mulleda, a CO worker (Mr. Esteban Beltran) was trained to take over the TO position.

Msgr. Alberto Nero's position as SAC project director was assumed by Fr. Pete Capucan in Year II. Field coordinator was Mrs. Cecile Cielos who also took charge of overseeing the CO component.

For the Jala-jala operations, Professor Pedro Ocampo was the project director assisted by two technical staff, Mr. Nöe Velasco and Mrs. Mercedes Gaglac.

The program team met regularly to review and assess project status, discuss and resolve problems encountered and formulate quarterly plan of action.

- Financial

Over-all program cost totalled P521,646.40. An amount of CAD \$51,607 was approved for the entire program. Because of some considerations and adjustments made in the project, there was a need to request for budgetary revisions. These were immediately responded to by IDRC and the needed assistance made available. The participating agencies shouldered their counterpart correspondingly: PBSP provided P186,900; Naga SAC P110,800; and UPLB-DTRI P16,500.

The required financial reports have been made on the project and submitted to IDRC.

PROJECT EVALUATION

Attainment of Project Objectives

A review of operations shows that the project is geared towards full attainment of objectives:

- Preparation and mobilization local village groups to manage the handpump

Using the CO approach, the project has resulted in organizing, strengthening and developing indigenous groups in planning and implementing a handpump project. Among these are farmers associations, fishermen's organizations and women's groups engaged in health-related and income-generating activities.

The handpump project was either integrated as an ongoing project of existing organizations, introduced as an entry point to organizing or considered as a starting project that paved the way to other water and health-related activities such as backyard/school gardening and sanitation education. The handpump project even served as a source of additional income for enterprising beneficiaries who sold water to non-participants in the community.

The groups, having formulated their own systems and procedures in managing the project were able to undertake the activity with the assistance of the COW, and can now carry on the project on their own.

- Two Trained Technical Officers

Three technical officers, two of whom were trained in UM provided assistance and supervision in the fabrication, drilling and installation of the handpumps. They also monitored handpump operations, providing necessary repair service.

- Thirty Pumps Installed and Operational

To date, thirty-seven handpumps have been installed. These include 28 units in Camarines Sur (one was a demo unit in Canaman and another demo unit installed in Fatima Training Center while all the rest serviced the groups); two demo units in Hinigaran, Negros Occidental (one in Sitio Olimbo and the other in Candumarao); one demo unit in Calauan, Laguna and six in Jala-jala, Rizal.

Two lift pumps were installed in Jala-jala and one at the Fatima Center. All the rest are suction pumps. The most common manner of installing was over PVC casings drilled in the ground. However, another system of installing that is, using culvert pipes was done in three areas while two handpumps were set in existing wells. This proves that the handpump technology can be adjusted to prevailing situations and resources in the area.

Of the installed handpumps, four are not operational at present. Two need to be transferred due to drilling problems; one needs piston ring replacements and one has to

be transferred because the group (apparently disorganized) abandoned the unit.

- Sixty Villagers Trained in Pump Maintenance and Repair

Approximately 150-180 villagers have been trained in maintaining the pump and carrying out minor repairs. This was made possible through the technical training and demonstration sessions provided by the TOs and the COWs assigned to the areas.

- Project Monitoring and Evaluation

As a result of the built-in monitoring and evaluation scheme, not only was the project reviewed and assessed regularly but it was also adequately documented in slides and in print. Among the reports prepared on the project are the following:

- o Village Handpump (Philippines) Project:
A Report on the Initial Seven Months of Implementation
- o A Baseline Survey of the Village Handpump (Philippines) Project
- o First Annual Review of the Village Handpump (Philippines) Project
- o Terminal Report

A manual on installation and another on water potability testing have also been prepared as reference materials.

Benefits Derived from the Project

Through the project, the participants acquired benefits that somehow improved their living conditions. The most significant is the availability of potable water supply for their drinking, cooking, bathing and washing purposes. In addition, they cited their acquired knowledge and skills in handpump installation, maintenance and repair.

The project proved beneficial not only to the community residents but also to the school children who availed of water for their personal use and for their gardening project. Two handpumps were installed near two village schools and one in an orphanage. Thus, in terms of direct participants, approximately 180 families or 1,000 individuals, excluding the school children benefitted from the project. Specifically in Jala-jala, the water project complemented the dairy project being undertaken by DTRI in the area. Moreover, longer time for other household chores could be allotted since time spent for collecting water from far away sources had been greatly reduced.

It was also observed that the villagers showed a spirit of cooperation in managing the project. Evident was the development of a sense of ownership and responsibility over the handpump.

In addition, the program staff had their own share of project benefits. They acquired knowledge on handpump technology and usage.

Specifically, the principal investigator participated in the project meetings and in two IDRC sponsored conferences: one on Women's Issues in Water and Sanitation and the other on Research Management.

PROJECT DIRECTIONS

As the project nears its completion, possible future directions and output diffusion are emerging.

Project Continuity

As IDRC and PBSF phase out their assistance, the local implementing agencies and beneficiary groups gradually gear themselves for project continuity in terms of handpump maintenance and repair. Inasmuch as the spare accessories are not yet available, the worn-out parts have still to be replaced.

The groups will then have to take over complete project management and be responsible for providing the follow up support. Contributions for the revolving fund for maintenance purposes and for possibly starting new projects in other areas have to be regularly collected and turned over accordingly. The trained end-users will continue to carry out the regular servicing of the pumps in the absence of the hired technical officer. Similarly, the beneficiary-members of the organization will sustain their water-related activities on their own. The CO worker, if still available in the area, would then focus his assistance on possible viable projects/activities responding to other priority group/community concerns. If the COW is to be phased out, his functions would then be taken over by the indigenous community leaders/volunteers.

Naga SAC, on the one hand can institutionalize the water project by mobilizing available sources for project extension/expansion. UPLB-DTRI, on the other hand can further integrate the water project into its existing CO activities to improve the conditions in Jala-jala.

The demonstration units while continuously servicing the community exist as models for other groups/agencies interested in undertaking water projects.

DEVELOPMENT OF A MANUAL FOR THE
ACCEPTABILITY AND USE OF THE IDRC-UM HANDPUMP
IN THE PHILIPPINES

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INTRODUCTION

The project formally began in September 1983. Its aim was to promote acceptability and proper use of the International Development Research Centre (IDRC) - University of Malaya (UM) handpump at the village level through the development of instructional materials on the pump. Crucial to the project therefore was the actual use of the materials by the village pump users.

Initial meetings were held with local consultants on the handpump such as Cesar Yniguez of Rural Waterworks Development Corporation and Ernesto Garilao of Philippine Business for Social Progress (PBSP). PBSP had received a grant to install the IDRC-UM handpump in three pilot areas and manual development could be carried out within this program.

A start-up meeting was held at the University of Malaya, Kuala Lumpur in May 1983. A field visit to an IDRC-UM handpump-using village was made and initial photos taken of the installation, repair and maintenance of the handpump. The process was discussed with the group by Dr. Goh, the handpump designer, and a general protocol agreed upon. Upon arrival in Manila a draft photo manual was put together and subsequently pretested in Malaysia. More photos were taken during focus group discussions (FGDs) in Malaysia to fill in the missing steps. Based on the results of this pretest, a revised installation photo manual was compiled and an illustrated repair and maintenance manual produced in Manila. These two materials then underwent further pretesting in Malaysia, Sri Lanka and the Philippines.

OBJECTIVES

The study had the following objectives:

- To obtain qualitative data on villagers' attitudes toward the IDRC-UM handpump.
- To develop instructional materials for semi-literate villagers on the installation, maintenance and repair of the IDRC-UM handpump.

METHODOLOGY

The methodology for developing the manual involved these steps:

- Conduct of in-depth qualitative research on the villagers' knowledge of and perceptions about water potability, water use and its relation to health, as well as experiences with water supply systems, including handpumps.
- Identification of key technical instructions.
- Visualization of messages.
- Repeated pretesting until a targeted level of comprehension has been reached.
- Fieldtesting.

HIGHLIGHTS OF FINDINGS

Focus Group Discussions

Once the revised photo manual based on the FGDs conducted in Malaysia and the draft illustrated repair and maintenance manual were finalized, five focus group discussions were conducted in the Philippines. The FGDs were held among two categories: those with ready access to handpumps and those without easy access to handpumps (i.e. distances from the pumps range from 500 to 700 meters thus making the pumps only a secondary source of water). Two groups belonging to the "with handpump" category were studied with one group composed of men and the other composed of women. Three groups were studied from the "without-handpump" category, two composed of men and one composed of women. Respondents from the "with-handpump" group came from the PBSP pilot areas and would eventually be users of the manuals.

A discussion guide was used focusing on six main topics: (a) concept of water potability and quality; (b) sources of water; (c) water use; (d) perception of handpumps; (e) installation, repair and maintenance of handpumps; and (f) handpump manual.

FGD Results of Groups "with-Handpumps"

Water. Clean and potable water was determined by its good taste and clear appearance. The water should be clear, containing no rust and not leaving residues. It should have a good and fresh taste, not fishy or rusty. The group's main source of water was the handpump. Those who did not own handpumps, fetched water for drinking and cooking from nearby pumps, and relied on the spring, well or river for the rest of their water needs. Before the use of pumps, the spring served as the main source for drinking and cooking, while the well, river or creek served other purposes like bathing, washing, etc. In differentiating water obtained from different sources, they mentioned the spring as cleaner than the river or well, and the handpump as the safest and most convenient source.

Handpumps. They used two types of handpumps: the pitcher pump and the jetmatic pump. These pumps had been constructed and were repaired either by themselves or a hired personnel. All of them including the women were willing to learn to construct, maintain and repair their pumps in order to save money and time.

The advantages of handpumps included: (a) convenience; (b) hygiene; (c) safety; and (d) their saving time.

The disadvantages included: (a) difficulty of repair and part replacement; (b) difficulty of pumping out water during the dry season; (c) fishy taste of water; and (d) reddish appearance of water.

The groups were generally satisfied with their present pumps except for the problems listed as disadvantages. They even wanted to encourage others to build pumps. All of them preferred to own individual pumps although the feasibility of communal pumps was assured by the men's groups in Ocampo.

IDRC-UM Handpumps. The group found the illustrated IDRC-UM manual clearer and more understandable than the photo manual. The groups were willing to adopt the handpump for its reported durability, the convenience it would provide, its safety and hygienic quality and use, its good appearance, and modernity. Their main reservation, though, was the cost involved. The immediate reaction of the groups to the pump was that it had many parts and therefore was more expensive than their present pumps.

In other words, the features of the handpump that should be capitalized on were its (a) convenience; (b) durability; (c) safe and hygienic quality; (d) good appearance; (e) "modernity" or being up-to-date or in-style.

Many of them were aware of the effects of water on man's health, so foremost among their reasons for using handpumps was the need for a source of clean and potable water. Upon learning that some of the pump's parts were plastic, people asked about its effect on man's health. Assured that it was not harmful to the body, many wanted this kind of pump installed in their homes. Since most of them experienced the difficulty of fetching water from a distance, they wanted a less tiresome, time-saving and accessible source of water like the handpump. It was surprising to note that people wanted to try out new ways and means as evidenced by their enthusiasm to adopt this new type of pump. While appearance was important to the people, another critical factor was cost.

FGD Results of Groups "without-Handpumps"

Water. Generally, water among those who have less access to handpumps is described in terms of its taste and appearance. It should have a fresh and good taste and give a good feeling to one who drinks it. It should be clear and not yellowish. It should not have dirt, rust, floating objects nor residues in it. Some stated that clean water should not smell like mud or rust. It should come from a natural source and flow continuously like a spring. Another indicator of clean water was the presence of shrimps. But one said that they could never be sure about the potability of water unless it is examined in a laboratory.

The FGD groups from Cawit fetched water from the handpumps of their relatives or neighbors which were far from their own homes. A few used the river. Water was used for drinking, cooking and washing dishes and feeding and bathing animals. On the other hand, the group of men from Sawi got water for the same uses from the spring or well, with one obtaining water from a piped water source connected to a spring. Sources for all groups were 200-700 meters away from their homes and had been used for about 10-50 years, some since childhood.

All the respondents believed that water affects man's health. Clean water keeps man's body healthy and quenches his thirst. It helps maintain good hygiene. Dirty water on the other hand, causes abdominal pain, vomiting, diarrhea, skin diseases, sticky perspiration and bad body odor.

Handpumps. Problems encountered with handpumps at their current water source ranged from embarrassment towards the owner of the handpump due to frequent use, difficulty and length of time involved in fetching water from a distant source, to poor hygiene. Problems encountered with spring or well water concerned its being muddy during rains or floods. One group remarked that they had no problem since they were used to spring water and had no alternative source.

Most of the pumps used were the pitcher type estimated to cost about P300. Very few used the jetmatic which costs about P1,000.

The perceived advantages of acquiring a handpump were: (a) convenience and being easy to use; (b) accessibility; (c) hygiene; (d) privacy; and (e) efficiency.

The perceived disadvantages were: (a) tendency to break down with too much use; (b) difficulty of repair; (c) mud in the handpump area; and (d) difficulty of starting up with limited use.

Most of them would like to own individual handpumps for convenience, accessibility, efficiency and ease of use. However, although a few preferred the installation of individual pumps, some wanted communal pumps that could be built in a central location among adjacent households, neighbors, or relatives. This would make the pump more affordable as well as keep the water clean and its taste not fishy because of continuous use. For communal pumps, the installation, repair and maintenance would be a shared responsibility among members.

Most of them preferred the pitcher type because it has a simple structure and few parts, can be installed by 3-4 people and is therefore less expensive. The cost they were willing to pay for pumps ranged from P300-600 with some suggesting installment payments of P10/month.

All of them wanted to learn to install, repair and maintain pumps for reasons of economy and convenience. Many volunteered their wife or husband or themselves for training.

IDRC-UM Handpump. The groups' immediate reaction to the IDRC-UM handpump was that it has many parts and therefore must be expensive. The men's groups said they would try this type of pump for communal use but would prefer the pitcher pump for individual use. On the other hand, the women's group did not want this handpump at all and preferred the pitcher pump since they saw it as less expensive, easier to maintain and having fewer parts.

A primary consideration was the cost of the pump. Many preferred the pitcher pump because it is simple and thus less expensive. Manageability was another factor they considered, in terms of use, installation and repair. Other factors included convenience, accessibility, efficiency and hygiene.

First Pretest

Almost simultaneous with the holding of the FGDs was the conduct of the first pretest among seven groups belonging to the two categories: with-handpumps and without-handpumps. Three groups of women and four groups of men were tested with the two manuals.

Two copies of the initial draft materials developed were shown to the groups. About 20 minutes were spent going through each manual. Then a discussion followed on their perception of the manual and their description of every picture or illustration.

Comprehension of the Photo Manual

<u>Subject</u>	<u>Assessment</u>	<u>Observations/Comments</u>
Can get the general idea that the manual is about the installation of the handpump.	High	The groups easily understood this main message. They noted that necessary parts and materials for installation were shown. A few noted that they need others to help them install the pump (joint activity) while repair can be done by one person.
Can follow the sequence of steps involved in the installation of pumps.	Medium	The groups could generally follow the steps but had difficulty identifying some processes and their corresponding reasons.
Can identify instruments and their use.	Medium	The groups identified all instruments correctly except for the concrete chisel which was identified as a screw driver. In particular, the women incorrectly labelled the tools, i.e., ordinary hammer instead of mallet, pipe wrench instead of adjustable wrench, and jack instead of pipe wrench.
Can identify pump parts.	Medium	The groups identified pump parts according to their use rather than by name. A few parts were not correctly identified such as the leverage assembly and the piston, drop pipe, piston cylinder.

Comprehension of the Illustrated Manual

<u>Subject</u>	<u>Assessment</u>	<u>Observations/Comments</u>
Can get the general idea that the manual is about the repair and maintenance of the handpump.	Medium/High	It was generally perceived as a manual for repairing and installing handpumps. Although the groups mentioned the concept of maintenance, they did not verbalize the term maintenance.
Can follow the process of pump maintenance.	Medium	Although the groups had some correct interpretations of the procedures shown, some causes and solutions were misunderstood. This can probably be explained by their lack of knowledge or unfamiliarity with the handpump since they did not own one.
Can follow the process of pump maintenance.	Medium	The groups identified parts according to their use rather than by name.

Overall Comments

The respondents found the illustrated manual clearer and could understand it more easily than the photo manual. The step by step processes were more comprehensible and both the men and women with-handpump and without-handpump groups could follow them.

The following suggestions were made:

- Parts of the handpump and tools should be named to facilitate replacement for wornout or broken parts.
- Pictures should carry instructions and procedures should be described.
- Text should be in Filipino.

The respondents also expressed their eagerness to see the actual pump and try it out.

Revision of Manuals

Based on the findings of the focus group discussions and the first pretest, messages and illustrations/photographs were decided on, revised or discarded. Two second draft manuals were prepared using the new photographs taken in Malaysia and incorporating the suggestions of the groups. They primarily addressed the missing gaps in the manuals by adding illustrations showing the missing steps.

Second Pretest

The second prototype manuals then underwent a second pretest. This time, respondents were men and women from the with-handpump area alone. In a similar manner to the first pretest, copies of the manuals were handed out and studied by the group. A discussion followed on their understanding of the manuals and the message of each picture or illustration.

Comprehension of the Photo Manual

<u>Subject</u>	<u>Assessment</u>	<u>Observations/Comments</u>
Can get the general idea that the manual is about the installation of the handpump.	High	This main message was easily understood by all groups.
Can follow the sequence of steps involved in the installation of pumps.	Medium/High	The overall process could be understood except for certain portions.
Can identify instruments and their use.	Medium/High	All the instruments were correctly identified except for the pipe wrench among the Pugay women. The men and women's groups of Santiago could not decide whether the copper wire was a string, cable or just a wire.

<u>Subject</u>	<u>Assessment</u>	<u>Observation/Comments</u>
Can identify pump parts.	Medium	Almost all the parts were described or identified by their functions rather than by name. There was a general difficulty in perceiving and telling the difference between the two valves. The two women's groups thought that the piston valve with the rod was the result of putting the foot valve and extractor rod together.

Comprehension of the Illustrated Manual

<u>Subject</u>	<u>Assessment</u>	<u>Observations/Comments</u>
Can get the general idea that the manual is about the repair and maintenance of the handpump.	Medium/High	The main message perceived by groups was pump repair and installation. Two groups stated that the manuals included pump maintenance.
Can follow the process of repair and maintenance	Medium	The procedures were generally understood except for the processes involving the two valves.
Can identify pump parts.	Medium/High	The parts were generally identified through their functions rather than by name. Again, no distinction between the two valves was made.

Overall Comments

The second set of manuals resulted in a higher comprehension level among the respondents because of the revision of unclear photos/illustrations as well as provision of missing step photos/illustrations. Again the respondents preferred the illustrated manual.

The following suggestions were made:

- Parts should be labelled.
- Procedures should be described step by step.
- Parts should be made available in local stores.

Revision of manuals

Further revision of the manuals was then made. The artist prepared more illustrations to supplement the photographs used. Several illustrations in the repair and maintenance manual had to be changed to clarify the points that the respondents incorrectly perceived.

Final Fieldtest

A total of 28 participants divided into five groups were chosen for the final fieldtest of the manuals. They were members of communities not yet familiar with the IDRC-UM manual but would be future sites for the prototype IDRC-UM handpump. Forty six percent of the participants had an educational attainment of an elementary degree or less.

The participants were given an introduction to the project and its objectives. After the briefing, members of each group were given copies of the manual and were asked to study it for about fifteen minutes. Each group was then asked to install the pump by following the procedure shown in the photo manual. During the process, errors/mistakes and problems were listed down. Inputs on the correct (proper) installation process were then given by the technical consultant from Science and Technology Resource Center (STRC) and a University of Malaya trained technician from Naga Social Action Center.

After the demonstration, a discussion on the manual followed. In particular, the participants were asked to comment on the illustrations on the repair and maintenance of the pump in order to check its clarity and correctness.

Fieldtest Results

On Pump Installation and the Photo Manual. Problems encountered were:

- Group 1 was not able to actually install the pump from the beginning since the piston/pump cylinder was broken and the drop pipe to be used fell inside the metal stand. They came back the next day and were then able to install it.
- The second group had a hard time inserting the drop pipe inside the metal stand since the pipe was very long and the local PVC used was brittle, thus breaking the drop pipe.

- There were no available tools (e.g. pipe wrench, adjustable spanner, etc.) which the participants could use in removing the tightening parts.

General errors/mistakes incurred were:

- Two of the groups failed to place sealing tape on the thread of the drop pipe before connecting it to pump cylinder.
- Two groups did not align the spout of the pump cylinder with the metal stand spout before insertion.

In general, the participants were able to follow the steps shown in the photo manual. According to them, the procedures shown were easy and therefore could easily be followed. During the process, however, some technical steps were found to be lacking in the manual. In addition, the technician noted some mistakes in the sequence and illustrations.

On Repair and Maintenance and the Illustrated Manual. The respondents' comments on the manual were:

- They found the manual very practical for use by everybody, even those without any experience in pump installation. Even women could follow the sequences.
- They found the manual very informative since it provided them with an idea of how the pump is installed, how it should be repaired when broken down and also how it should be maintained.
- Majority of the women said that with the manual, they would not have to spend money to hire technicians or plumbers to repair the pump. They themselves could carry out the repair by just following the instructions shown in the manual.

Their suggestions/recommendations were:

- Verbal instructions on the repair and maintenance of the handpump should be included to clarify the illustrations.
- The text should be big enough so as to be seen clearly by all even those with eye defects.
- If possible, information should be included on how and when to determine water potability.

Prototype Printing

After the final fieldtest, the materials underwent additional revisions prior to printing of the final version of the illustrated manual: Gabay sa Paggawa, Pag-aayos at Pangangalaga ng Bomba ng Tubig IDRC-UM.

POSTSCRIPT

The printed illustrated manual has been distributed to agencies promoting or communities about to use the IDRC-UM handpump. Since its initial release, a lot of inquiries about it and requests for it have been made to Kabalikat ng Pamilyang Filipino Foundation, Inc.

A more important indicator for its usefulness however, is how it is accepted by the IDRC-UM handpump beneficiaries of the FBSF Potable Water Systems project. Each group of beneficiaries received a copy of the manual. Those who used the manual in the installation of pumps found it helpful.

In June 1986, a trip was made to the sites where IDRC-UM handpumps had been installed in Bicol. Informal conversations with the beneficiaries again brought out the usefulness of the manual. However, areas for improvement also emerged such as the need for illustrating that the pump should have some type of shelter from the rain and that certain improvisations should not be made when parts of the handpump break down.

Should future revisions of the manual be considered, a survey of actual users will be a necessary input.

FEASIBILITY OF COMMERCIALY PRODUCING AND
MARKETING OF THE IDRC-UM HANDPUMP
IN THE PHILIPPINES

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Because the feasibility study on the commercial production and marketing of the International Development Resource Centre (IDRC) - University of Malaya (UM) handpump in the Philippines has not officially begun, this initial report has only two sections: the proposed methodology of the study and preliminary findings on the Philippine handpump market.

PROPOSED METHODOLOGY

The objectives of the study are:

- to determine if the manufacture and sale of the IDRC-UM handpump in the Philippines is a sufficiently attractive business proposition to arouse entrepreneurial interest.
- to determine the project's suitability, if viable on a commercial basis, for support funding from Program for Appropriate Technology in Health (PATH).

With these objectives, the study will result in a final document that will be the basis for preparing a project prospectives to invite entrepreneurial interest in the manufacture and distribution of the IDRC-UM handpump in the Philippines, as well as for determining funding support from PATH or other financing sources.

The study will consist of four areas of inquiry. These, and their specific objectives, follow:

Market Situation Analysis

- Identify the users of the generic product and market segments on the basis of relevant socioeconomic and geographic characteristics.
- Determine the market size for the generic product and identify the probable target segments for the IDRC-UM handpump if it were to be commercially distributed.

- Determine the existing structure of distribution channels for the generic product and determine its suitability for use in reaching the identified target market segments for the IDRC-UM handpump.
- Analyze the competitive situation: IDRC-UM handpump vis-a-vis its competitors in terms of technical qualities; price; technical services, including repair and maintenance; product awareness; product sources and market shares.
- Analyze, separately, the government as a market.

Production Cost Analysis

- Analyze three alternative approaches to local production and the resultant direct costs per unit of each approach at certain annual volumes of production. These are:
 1. Local assembly of the handpump, using components fabricated at the University of Malaya.
 2. Importing of moulds from Malaysia, local moulding and assembly.
 3. Fully integrated injection moulding and assembly.

Marketing Cost Analysis

- Analyze marketing costs assuming the use of existing distribution channels.
- Analyze marketing costs if government is the principal market.

Business Analysis

- Determine whether a single large national producer or several small regional producers would be the preferred approach or if both are commercially feasible under one or more of the three basic modes of production.
- Determine the investment required under the preferred approach and the financial return to the entrepreneur from such an investment.
- Determine the risk complexion of such an investment in terms of breakeven analysis, degree of market penetration required for breakeven and/or to attain attractive returns on investment; and other relevant risk parameters identified from research findings.

PRELIMINARY MARKET FINDINGS

Because the government sector seems to be the most promising segment of the Philippine handpump market and also because of more available secondary data, preliminary findings for this report deal primarily with this sector.

To date, highlights of the government market are:

- The government classifies the Philippine water system according to three levels. Their characteristics and coverage are:

Level	Description	Number	Population Served (In Millions)
1	Handpumps		
	Deep Well	89009	5.42
	Shallow Well	22587	9.60
	Spring Development	40000	.95
2	Community Water System	1469	.90
3	Household Connections	503	1.81

- Government targets in terms of percent of rural households served by potable water supply are 62% by 1987 and 78% by 1992, up from an actual 53.52% as of December 1985. In 1979 the government began a program to construct 500,000 wells over 20 years, 60% of which would be shallow wells and 40% deep wells
- Several government agencies are involved in the water supply program. These are the Ministry of Public Works and Highways (MPWH), Rural Waterworks Development Corporation (RWDC), Local Water Utilization Administrative (LWUA), Metropolitan Waterworks and Sewerage System (MWSS), and Ministry of Local Government (MLGCD) through its Barangay Water Program.
- There are at least 15 ongoing waterworks projects of the Ministry of Public Works and Highways; all of these have a shallow/deep well component.
- The handpump models tested by MPWH-RWDC are the Jetmatic Dragon, Blair, Lutheran, New Zealand PVC and Malawi handpumps for shallow wells and Mono Rotary, Volanta Flywheel, Eureka and Takasago 2 handpumps for deep wells. For the shallow well, the Jetmatic Dragon is preferred.
- The top handpump suppliers of handpumps in the Philippines are SEACOM, Leong Seng, Phelman and Mechanical Center.

SOCIO-ECONOMIC ASSESSMENT OF HANDPUMPS
IN ASEAN COUNTRIES

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INTRODUCTION

Over 230 million people living in Indonesia, Malaysia, Philippines and Thailand are consuming water of doubtful quality, and are thus exposing themselves to water borne or water-related diseases. Out of the total population, 1450 million or 60 percent of them are located in the rural areas. The governments in these four countries are currently placing a high priority on implementing water supply programmes with the aim of supplying 66 to 95 percent of the population with potable water by the year 1990.

This paper reviews the current status and programmes drawn up by the governments of these four countries to provide potable water to an increasing proportion of the population in the next few years. The role of handpumps as a source of potable water supply particularly for rural households will be analyzed. Some preliminary findings relating to the wider acceptance of the IDRC-UM pump will also be reviewed.

Data used in this paper was collected during field visits to these four countries in 1984. In the case of Malaysia, Philippines and Thailand, additional visits were made in 1986.

A summary of the current status and goals of Indonesia, Malaysia, Philippines and Thailand's water supply programmes is shown in Table 1.

Currently, the percentage of the population enjoying potable water for the four countries ranges from 31 to 66 percent. However, in the case of the rural population, the range is only between 25 to 57 percent. All the four countries are presently embarking on an intensive construction programme to increase this percentage by the year 1990 from 66 to 95 percent for the total population, and from 60 to 90 percent for the rural population. Even if these goals are met, 10 to 40 percent of the latter group will continue to remain without access to potable water by 1990.

The unit of currency used in this paper is the United States dollar.

TABLE 1

SUMMARY OF STATUS AND GOALS OF COUNTRY, PROGRAMMES

Items	Indonesia	Malaysia	Philippines	Thailand
Population in 1983 (millions)	158	15	52	51
Percent of population in rural areas	78	63	68	75
Estimated number of rural households (millions)	20.54	1.58	5.89	6.38
Water Supply				
Percent served with potable water				
Total - 1983	31	66	53	42
Urban - 1983	50	91	66	65
Rural - 1983	25	57	47	34
Total planned - 1990*	66	95	82	na**
Urban planned - 1990*	75	100	100	na
Rural planned - 1990*	60	90	70	na

* For Philippines, this target is for the year 2000.

**na - not available

Source: Indonesia (1984)
Malaysia (1984)
Philippines (1982)
AIT (1984)

INDONESIA

Public water installation in the rural areas in Indonesia can be classified into six major types. The number of units constructed from 1969 to 1981 is given in Table 2.

TABLE 2
NUMBER OF UNITS OF PUBLIC WATER INSTALLATION
CONSTRUCTED IN RURAL INDONESIA

Water System	1969-74	1974-79	1980-81	Total
Well with handpump	2,882	84,682	48,000	135,564
Deep well pump	-	1,061	4,500	5,561
Rainwater collector	24	2,108	1,000	3,132
Protected spring	16	1,000	400	1,416
Simple piping system	108	692	300	1,100
Artesian well	3	188	100	291
Total	3,033	89,731	54,300	147,064

Source: Indonesia (1984)

From this table, it can be seen that a large section of the population is provided with drinking water from wells with handpumps. These 147,064 installations, however, cater to only about 3 percent of the total rural population, the majority of whom secure their supply of drinking water from either private installations or from shallow hand-dug wells, rivers and irrigation canals.

The problem of lack of access to adequately supply potable water is, in many cases, more serious in urban than in rural areas. Out of the 140 cities which have installed piped water supply, only four - Jakarta, Bandung, Semarang and Surabaya - have their own treatment plants.

Urban consumption in Indonesia is estimated at 200 litres per capita per day, while rural use approximates 60 litres per capita per day. Based on this assumption, the total demand for potable water will rise from 4,900 million m³ in 1981 to 11,037 million m³ in the year 2001. If this demand for domestic water is added to that of irrigation, hydro-power generation, industry, navigation, fishing, mining and recreation, it is envisaged that a shortage will occur in the year 2001 in such areas as Java, Bali and Nusa Tenggara. This shortfall will, in all probability, reduce the land area that can be irrigated, and hence lead to a reduction in food production.

Between the years 1981 and 1984, the Directorate of Clean Water Supply in the Ministry of Public Works was allocated a sum of \$26 million for the provision of potable water to 390 small communities. Nearly 20 percent of this allocation came from foreign sources, either in the form of loans or grants. For the period 1984 to 1989, the Directorate plans to spend an additional \$315 million to supply water to 1,800 more small communities.

The three primary types of water supply planned are gravitational systems, deep wells with pumps, and piped distribution systems with household connections. In all these projects, the users are expected to pay 50 percent of the construction and maintenance cost. The average cost of these systems for the rural sector is given in Table 3.

TABLE 3
MONTHLY CHARGES FOR WATER SUPPLY BORNE BY USER

System	Construction Cost	Maintenance Cost
Spring - gravitational	\$.32 - \$.72	\$.10 - \$.24
Deep well - pump	2.30 - 4.00	.77 - 1.36
Household connection	\$3.00 - \$4.87	\$.99 - \$1.63

Source: Indonesia (1984)

The range in the charges shown in Table 3 is due to the varying quantities of water supplied daily to different communities.

The Ministry of Health is responsible for improving the quality of water supply and the sanitary environment of the rural population who live outside the small communities of 3,000 to 20,000 people. It plans to construct, by the end of 1988, potable water sources to serve an additional 67 million people. By then, 47 percent of them will be provided with shallow wells, and 21 percent with deep wells.

The unit cost of different types of water supply systems is given in Table 4.

TABLE 4

UNIT CONSTRUCTION COST FOR DIFFERENT WATER SUPPLY SYSTEMS

System	Construct- ion cost	Yearly main- tenance cost	No. of Users	Construct- ion cost per user	Main- tenance cost per user
Dug well	\$ 200	\$ 6	100	\$ 2	\$0.06
Shallow well and pump	90	15	100	0.9	0.15
Deep well and pump	400	17	100	4	0.17
Artesian well	6,000	200	500	12	0.40
Deep well and pump with distribution systems	\$40,000	\$270	3,000	\$13.2	\$0.09

Source: Indonesia (1983)

MALAYSIA

By the end of 1983, 66 percent of the country's total population had been supplied with potable water. This supply reached 91 percent of the urban and 57 percent of the rural areas. But, on the whole, the figures vary substantially for different regions of the country. For example, the percentage of the rural population supplied with water in the states of Kelantan, Sabah, Sarawak, Trengganu and Johore is 24, 29, 29, 33, and 39 percent respectively.

The government had in the Fourth Malaysia Plan (1981-1985) invested a sum of \$550 million to expand water supply to both the rural and urban sectors. About 70 percent of this sum was for urban water supply. An additional \$464 million was spent in 1984 under a similar programme.

Between 1981 and 1983, a total of 2,037 projects to supply treated piped water to the entire nation was completed, thereby benefiting one million people or 167,000 households. Their total capacity was 368 million litres per day or 401 litres per person per day.

Besides this piped water programme, the government, during the same period, also constructed 78 production wells (benefiting 120,000 people in rural Malaysia), and completed 4,279 wells with handpumps, 325 wells with reticulation systems, 611 gravity water supply schemes, 47 pumped water supply schemes and 9,837 rainwater collection systems. The latter was installed in Sabah and Sarawak.

The aim is to increase the percentage of the rural population supplied with potable water to 70 percent in 1985, and to 90 percent by the year 2000. This 90 percent target represents the maximum figure that can be achieved, after which, it would be considered uneconomical to supply the remaining 10 percent of the population residing in the remote pockets of Peninsular Malaysia, Sabah and Sarawak.

For the years 1984 and 1985, the government plans to construct the following waterwork facilities for the rural areas:

- o 5,319 shallow wells with handpumps.
- o 1,762 deep wells with reticulation systems.
- o 1,363 rainwater collection systems.
- o 666 gravity water supply systems.

These are projected to benefit 469,000 people or 78,000 rural households in Peninsular Malaysia, Sabah and Sarawak.

The Public Works Department (PWD) located within the Ministry of Public Works is responsible for the provision of treated water to all urban centres in Malaysia, including rural areas which are located on the main roads and are linked or adjacent to urban centres. Unlike the Ministry of Health, its rural water supply is confined to mobile tanks which operate during periods of drought, and to static tanks which serve peat areas where the surface water is unfit for human consumption, and areas where piped water is currently unavailable.

The PWD also oversees water supply projects for government land development schemes such as the Federal Land Development Authority (FELDA) and regional development schemes.

The Ministry of Health has, for some years, been involved in the Rural Environmental Sanitation Programme which provides gravity-feed piped water supply systems, shallow wells with handpumps and rainwater catchment systems to the more remote rural areas which are currently not covered by the Public Works Department. Households in some rural areas where both the PWD and the Ministry of Health have installed piped water systems or completed water projects have a choice of opting for whichever system they prefer.

One important difference between the Ministry of Health and the PWD programmes lies in the former's non-imposition of any charges on users to recover the investment, operations or maintenance cost. Some of its projects are undertaken on a self-help basis. It supplies the materials while the villagers provide the labour required. The PWD on the other hand, levies some kind of payment on users for the piped connection between the main line and their homes, and a monthly charge which varies with the amount consumed. Water rates in the country, however, differ from area to area, depending on the decision of the local authorities, but they, as a rule, do not cover the full cost of water supplied due to the considerable amount of government subsidy which compensates for the cost of construction, yearly operations and maintenance.

Until the last two years, financial investments in water projects did not pose a serious constraint in achieving the goals of supplying treated piped water to 100 percent of the urban and 90 percent of the rural areas. However, the current government trend of exercising greater fiscal restraint on public spending will, in all probability, cause some delays in realizing these targets.

The cost of supplying treated piped water to both the urban and rural sectors is relatively high. For example, between 1981 and 1983, the government spent \$546 million to supply piped water to 200,000 households. This works out to a cost of \$2,730 per household. It includes the cost of supply to industrial users.

In contrast, the Ministry of Health's rural water supply programmes for the period from 1981 to 1985 incurred the government a sum of \$8 million only. Table 5 shows the cost figures per household for the different water supply systems.

TABLE 5
INVESTMENT COST PER HOUSEHOLD FOR DIFFERENT SYSTEMS

System	\$/Household
Shallow wells with handpump	\$152
Rainwater catchment	174
Gravity feed system*	280
Deep well with pump and household connection	\$348

*

Assuming each system serves 40 households.

Source: Malaysia (1983)

It is important to note that the water supplied under the Ministry of Health programme is untreated water, while that of the FWD is treated. In view of this, it can be assumed that the Malaysian government regards the Ministry of Health programme as only an interim measure. In the long term, it intends to supply treated piped water to all except the most remote rural households.

PHILIPPINES

From 1975 to 1981, only approximately 30 percent of the total public investment expenditure for infrastructure was spent on water projects, with the bulk of the allocation - 80 percent - going to the urban sector.

The government has constructed about 15,600 deep wells with an average drilled depth of 60 metres in rural areas, but only 13,700 of these are still operational. On the average, each well serves 470 people. The majority of them are between ten to twenty years old, 40 percent of which require rehabilitation.

In addition to deep wells, 3,000 springs were developed in the rural sector, each serving the needs of 1,800 people. The other main source of rural potable water supply is the public standpipe system. A total of 1,100 standpipes are in operation, each supplying water to 670 inhabitants.

Based on the results of a survey carried out in 1981 by the Ministry of Local Government (Philippines, 1982), public sources of potable water represent only 13.5 percent of total water sources in the Philippines. Private sources include 250,000 drill wells, 41,000 dug wells and 8,000 springs. The number of rain collectors in the country is only 190, indicating that they are not an important source of potable water for rural Philippines.

The average depth of drill and dug wells is ten metres, and less than 4 percent of the pumps utilized are electrically driven or powered by diesel engines.

The government's target is to provide communal faucet systems with public standpipes which are situated not more than 25 metres from the furthest user to 70 percent of all rural communities by the year 2000. The plan is to provide the remaining 30 percent with protected wells or spring sources without any distribution systems. In these cases, the furthest users will not be more than 250 metres from a potable water source.

From 1981 to 1985, the investment required for the country's water supply projects was estimated at \$541 million. It is envisaged that 36 percent of this allocation would be funded by foreign sources either in the form of loans or grants.

The following factors determine the government's priorities in the selection of and investment in rural water supply projects:

- o communities who form rural waterworks and sanitation associations, and are willing to contribute to the required equity, and pay for the annual service fees.
- o communities who experience the greatest inadequacy in quantity, accessibility and quality of water supply.
- o areas with economic potential, but are currently in poor or depressed conditions.
- o projects whose costs entail the lowest project investment per capita for a given level of service.
- o communities whose existing wells and springs can, through rehabilitation, prolong their usefulness, and thereby reduce the need for costly new projects.

The Philippine Rural Water Supply and Sanitation Master Plan (1982) indicated that the problems encountered in implementing

government programmes are relatively minor in nature. This is due mainly to the increased government allocation for water supply and sanitation works in recent years. In 1982, \$79 million was given for rural water programmes. Of this amount, \$53 million was from foreign loans and grants. For the next five years, it is envisaged that rural water supply programmes will receive 1.6 percent of the government's total infrastructure budget.

Coordination among the agencies involved in rural water supply is undertaken by the National Water Resources Council which identifies potential projects and draws up a framework for their implementation by the relevant agencies. In this manner, they can better appreciate the issues and problems which arise outside of their own areas of responsibility. However, the National Economic Development Authority exercises budgetary control over water resource development and regulation. The budget development procedure is primarily planning from top-down rather than from bottom-up.

The government provides some kind of subsidy for rural water supply projects. This can take the form of engineering and technical services, grants or loans at lower than commercial interest rates. The subsidy can range from 10 to 100 percent, depending on the agency involved. The government also extends a maximum of 90 percent grant to construct wells and springs which are without distribution systems. The remaining 10 percent is drawn from equity contribution of the local waterworks association as an indication of its commitment to the project. In areas where communal faucet systems are provided, the villagers are expected to provide 10 percent of the total cost, while the other 90 percent is extended in the form of a government loan, repayable at an annual interest rate of 4 percent.

The monthly water fees for individual households range from 2.5 cents to 5 cents for areas which receive 90 percent grant, and 25 cents to 50 cents for those receiving 90 percent loan.

The following summarizes the investment cost per household, and the volume of water supplied under the three kinds of services:

- o Level I -- where the point source constitutes shallow or deep wells or developed springs suited to small communities. Each shallow well serves about 5 to 40 households, while a deep one serves about 40 to 100 families. The construction cost for shallow and deep wells is \$60 and \$750 or \$12 to \$19 per household respectively. The yield or discharge ranges from 40 to 150 litres per minute, and each family is provided with 30 litres of water a day.
- o Level II -- where water from a point source is pumped into a storage tank and distributed via a network of pipes until it reaches the public faucets, each of which serves 4 to 6

households. Each household is provided with 40 to 80 litres of water per day. The construction cost is \$50 per household.

- o Level III -- where each family is connected with the conventional system, metered or unmetered, and it is suitable for small urban communities. The average cost of construction is \$105 per household, and each household is provided with 100 litres of water per day.

The monthly cost of operation and maintenance per household for these three levels of service is 2.5 cents to 5 cents for Level I, 25 to 75 cents for Level II and 30 cents to \$1.00 for Level III.

THAILAND

The Asian Institute of Technology (AIT, 1984) estimated that by 1983, 69.4 percent of the rural populace would have been supplied with water for domestic consumption. Nearly half of this supply originates from supplementary agricultural water projects - as a result of the construction of ponds, irrigation canals and reservoirs designed primarily to provide water for agricultural crops. Table 6 shows the percentage of the population served by different water sources. It is interesting to note that if the water (which is untreated and hence may not be safe for domestic use) from ponds, irrigation canals and reservoirs is deducted, only 35.9 percent of the rural population can be considered as having access to potable water.

In 1982, a study by Mahidol University revealed that more than 95 percent of villagers do not drink deep well water because of its unpleasant, brackish and insipid taste and odour. They also do not drink piped water because of its strong chlorine taste. This study also noted that of the 80 percent of deep wells currently in use, only 12.4 percent are used for drinking water. Villagers prefer water from traditional sources such as shallow wells, canals, swamps and rainwater.

The decision on the type of water source to develop will, however, depend on individual villages and the technical and economic feasibility of each type for different areas of the country. Factors such as the characteristics of the locally available water source, villagers' preferences, and the cost of installing the system for a particular village are important considerations. On a regional basis, it has been found that deep ground water and surface water are most appropriate for the northern region; surface water for the northeast region, shallow ground water, deep ground water, surface and rainwater for the central region; and rainwater, surface and shallow ground water for the southern region.

TABLE 6

PERCENTAGE OF POPULATION SERVED WITH DOMESTIC WATER SUPPLY, 1983

Water Source	Government	Private	Total
Wells			
Deep	14.37	1.35	15.72
Shallow	5.96	0.89	6.85
Tube			
Rainwater cisterns			
3			
150m RFC	0.23))	
150m ³ metal tank	0.25))	
3m ³ RFC/5m ³ BFC tank	0.09)	3.28)	3.88
Jar/water supply	0.03))	
Piped water supply			
Rural	0.29	-	0.29
Small-scale	3.43	-	3.43
Supplementary			
Small pond	0.13	-	0.13
Standard pond	0.38	-	0.38
Natural pond	18.68	-	18.68
Irrigation canals/ reservoir	16.89	-	16.89
Total population coverage	63.85	5.52	69.37

Source: AIT (1984)

The amount of water consumed per capita from the various water sources varies considerably. It ranges from 4 litres per capita per day for rainwater to 30-40 litres per capita per day for piped water.

Table 7 shows the investment and yearly operating costs of the different water supply systems. They are lowest for shallow wells and highest for rainwater collectors (150m³) and deep wells with handpumps.

TABLE 7

COST COMPARISON FOR RURAL WATER SUPPLY SYSTEMS

Type of Facility	Investment cost per capita	Operations and maintenance cost per capita per year
Shallow wells (unprotected)	\$ 13	\$ 0.06
Shallow wells with handpump	17	0.30
Deep wells with handpump	103	0.30
Deep wells + motor pump + distribution system	23	2.50
Rainwater collector 5m ³	50	4.00
Rainwater collector 150 m ³	190	0.40
Spring capitation with gravity distribution system	14	1.40
Slow sand filter + distribution system	36	2.30
Horizontal filter + slow sand + distribution system	30	2.50
Conventional treatment distribution system	\$ 37	\$4.10

Source: AIT (1984)

However, an analysis of all water used by villagers in 1981 revealed the following:

	Excellent	Fair (%)	Poor
- bacteriological content	16.5	3.5	80.0
- chemical and physical content	20.2	67.0	12.8

This indicates that only less than 20 percent of the water currently used by villagers is considered safe for domestic consumption.

Table 8 gives the targets for the different projects and their average cost.

TABLE 8
TARGETS AND COSTS OF VARIOUS PROJECTS

Projects	Targets for 1983 (No.)	Total cost (Million \$)	Average cost (\$)
Deep well-drilling	5,140	\$16.89	\$ 3,286
Deep well-maintenance	26,800	3.03	113
Shallow well	1,250	0.33	266
Piped water system	270	2.97	11,012
Water storage tank	4,030	0.69	172
Dredging of natural pond	644	3.96	6,149
Standard pond	94	\$1.13	\$12,060

ESTIMATED POTENTIAL DEMAND FOR HANDPUMPS

Data on the number of handpumps installed in the four Asean countries are not readily available. Estimates obtained from published sources and from interviews with senior government officials involved with rural water supply programmes often vary quite considerably. In view of this, the estimates presented in Table 9 should be regarded as only preliminary in nature.

The number of handpumps installed by the governments of the four countries each year is based on the figures supplied by the main implementing agency. However, these figures show the number of pumps that these agencies plan to install and not the actual number installed. The actual number is usually 20 to 50 percent less than the planned figure.

The estimated public demand is obtained by assuming that the existing pumps will have to be replaced after 6.67 years, that is, 15 percent of existing pumps will be replaced annually.

Table 9 shows that Philippines and Indonesia have the largest number of handpumps - approximately 300,000 for both deep and shallow wells in each country. The estimated number in Thailand and Malaysia are 60,000 and 15,000 respectively.

The number of handpumps installed by the government each year varies from 2,000 in Malaysia to 30,000 in the Philippines. The Philippines has the most active handpump installation programme with an estimated annual demand of 75,000. The comparable figures for Indonesia, Thailand and Malaysia are 56,000, 12,000 and 4,250 respectively.

TABLE 9
ESTIMATED NUMBER OF HANDPUMPS INSTALLED AND POTENTIAL ANNUAL DEMAND

Country	Estimated number of handpumps installed in the country	Potential annual demand		
		Public	Private	Total
Indonesia	300,000	20,000	45,000	65,000
Malaysia	15,000	2,000	2,250	4,250
Philippines	300,000	30,000	45,000	75,000
Thailand	60,000	3,000	9,000	12,000
Total	675,000	55,000	101,250	156,250

Notes and assumptions:

- 1) Includes handpumps for shallow and deep wells.
- 2) Potential annual public demand is based on the individual country's government targets for providing potable water to a large proportion of the rural population over the next 10 years.
- 3) Potential annual private demand is based on an estimated 15 percent of the existing pumps being replaced annually.

- 4) In the case of Philippines, nearly 4,000 pumps are installed annually with assistance from international organizations such as the World Bank, UNICEF, Asian Development Bank, Australian Development Assistance Bureau and the Overseas Economic Corporation Fund.

Source: Tan (1982)

IDRC-UM HANDPUMPS IN MALAYSIA, PHILIPPINES AND THAILAND

Over the last two years, the International Development Research Centre (IDRC) - University of Malaya (UM) handpumps have been installed and fieldtested in the three countries. In Malaysia, both the above and below-ground components are made locally, whereas, for Philippines and Thailand, the below-ground components are made in Malaysia and sent to the cooperating agencies in these two countries. These two agencies then fabricate the above ground components locally.

The cost of the IDRC-UM handpump in these three countries is shown in Table 10. It can be observed from this table that the cost is \$65.84 for Thailand, \$73.46 for Malaysia and \$92.37 for the Philippines. Thailand is able to produce the above-ground components at 27 percent cheaper than Malaysia, whereas in the case of the Philippines, this cost is 33 percent higher than in Malaysia. For the Philippines, it would appear that unless the agency is able to reduce the cost of manufacturing the above ground components, it would be cheaper to buy the complete unit from Malaysia than to attempt to make part of the pump locally. This conclusion, however, does not take into consideration the import duty that may be charged on importing the complete unit.

A brief report of the handpump testing programme in these three countries is presented below:

Malaysia

A total of 2,000 pumps have been purchased by the Ministry of Health and installed as part of the rural water supply project. The cost of installing these pumps is also borne by the Ministry of Health, and the beneficiaries are only expected to provide some labour for installation, after which, the personnel from this Ministry are made responsible for the maintenance of these pumps.

In this instance, the villagers' participation in terms of cost sharing and maintenance is minimal. The Ministry of Health can also turn to the University of Malaya for assistance in overcoming any minor problems experienced in the operations and maintenance of these pumps.

No major problems have been reported in the IDRC-UM Handpump Programme in Malaysia. The main factor determining the number of handpumps that the Ministry of Health will install in the next few years is the budget allocated to this programme by the federal government.

Between 90 to 95 percent of these pumps installed were suction pumps designed for shallow wells.

Philippines

A total of 28 handpumps have been installed and monitored for more than a year in the Camarines Sur province of the Philippines by the Philippine Business for Social Progress (PBSP). These pumps were all suction pumps, and each was to be used by 4 to 5 households. These households are to repay the sum of \$64.80 per pump over a period of two years. To meet this repayment schedule, one or two pump group leaders are charging the user either on a per pail basis or a per pump basis. The rate charged varies from 0.0075 cent to 0.0125 cent per two-gallon pail and from 0.05 cent to \$4.50 per month. This cost is quite high considering that the average income of these villagers is in the range of \$40 to \$100 per month. The contributions from the beneficiaries of these IDRC-UM pumps are considerably higher than those borne by the beneficiaries of the government handpump programme. For the pumps provided by the Rural Waterworks Development Corporation, the beneficiaries have only to pay 10 percent of the material cost and provide some labour during installation.

TABLE 10

COST OF IDRC-UM SUCTION PUMP IN MALAYSIA,
PHILIPPINES AND THAILAND

Pump Components	Malaysia	Philippines (US\$)*	Thailand
Above ground			
Metal stand	\$21.15	\$19.03	\$12.45
Lever arm assembly	8.08	4.45	3.72
Misc.	5.77	3.61	3.51
Labour	7.69	9.70	11.54
Overhead	-	20.00	-
Sub-total	42.69	56.79	31.22
Below ground			

Piston and footvalve	13.46	13.46	13.46
Pump cylinder	17.31	17.31	17.31
Transport	-	4.81	3.85
	-----	-----	-----
Sub-total	30.77	35.58	34.62
Total Cost	\$73.46	\$92.37	\$65.84
Labour-mandays/pump	0.9**	3.4	5.0

Note and assumption:

* Exchange rate used is US\$1.00 = M\$ 2.60
 = P 20.00
 = 26.00 Baht

** 200 pumps a month +

Source: Figures supplied by the University of Malaya, Malaysia, Population Development Agency, Thailand and Science Technology Research Centre, Philippines.

The major problem encountered is the damage to the piston ring. This is quite a serious problem because in the field visits made in August this year, it was observed that six of the pumps were completely out of order. They could not be repaired since no spare parts were available. The delay encountered in securing spare parts from Malaysia poses a serious problem for the future expansion of this programme, and points to a need to seriously consider manufacturing both the above-ground and below-ground components in the Philippines.

Besides the performance of the pump, another important factor that will affect the large scale acceptance of this pump is its price. The two most common suction pumps used in the Philippines at the moment are the pitcher pump and the Jetmatic pump. Both these pumps are made of cast iron and the cost ranges from \$8.50 to \$22.00 per unit. Thus, the IDRC pumps are three to eight times more expensive than those which are already widely used.

However, the cost of the Clayton pump commonly used in the Philippines for deep wells - those of more than 12 meters - is \$165.00. ¹ The IDRC-UM lift pump which can be used for deep wells costs only \$81.00 if manufactured in Malaysia. Thus, on a cost basis, the IDRC-UM lift pump appears to have an edge over the Clayton pump.

Thailand

A total of 42 IDRC-UM suction handpumps have been installed in Thailand. Unlike the case in Malaysia and the Philippines, nearly all these pumps are individually owned and operated. There seems to be no serious problems with the operation and maintenance of these pumps, and the villagers are generally quite satisfied with their performance. All of them are installed in hand dug wells. Only in one or two cases have the wells run dry.

The cost of alternative suction pumps ranges from \$11.50 for the Abadah pump, to \$23.90 for the Lucky pumps, and \$36.60 for the Ace pump. All these pumps are made locally from cast iron. A new factor determining the choice of pumps is the recent introduction of an electric pump made in Thailand. This 1/4 horsepower pump costs only \$50.00, which is less than that of the IDRC-UM pump. The operating cost of this pump is only about \$4.00 per month. During field visits, it was observed that some households have added the electric pump to existing wells served by handpumps. This gives them the option to use either the handpump or the electric pump. The latter is usually connected to a pipe leading to a storage tank in the user's household, and this pump needs only to be operated for short periods of 20 to 30 minutes each time to fill the storage tank.

CONCLUSION

In the four countries, the IDRC-UM pumps have only been introduced on a large scale in Malaysia. Malaysia's Ministry of Health has accepted this pump as its standard model for its rural water supply programme. Important factors in the selection of the IDRC-UM handpump are the fact that there are no suitable locally manufactured pumps available, and it is less expensive and more reliable than the imported pumps tested.

¹ There is a made in Philippines Clayton pump which costs only \$32.00. The PBSP has been offered a special price of \$50.00 for the imported model of the Clayton pump.

The market for this handpump in Malaysia is, however, quite limited assuming that the government intends to supply virtually all urban and rural households with piped water within the next ten years. Thus, handpumps will only be a temporary source of potable water until piped water systems are implemented.

In the case of Thailand, the availability of relatively lower cost handpumps and electric pumps of comparable cost raises some doubts regarding the possibility of establishing a large market demand for the IDRC-UM handpump. Since nearly 80 percent of Thailand's rural population are being supplied with electricity, it appears highly likely that many rural households will prefer to buy electric pumps vis-a-vis similar priced handpumps.

The market potential for this handpump in the Philippines, on the other hand, appears to be very promising. This country has a long history of using handpumps for potable water. In addition, there are large numbers of existing handpumps that will be requiring replacement annually. The government is also actively involved in promoting the use of handpumps in its rural water supply projects. The cost of the IDRC-UM suction pump, however, will need to be lowered in order for it to be competitive with the existing cast iron pumps used in government programmes. However, the IDRC-UM lift pump has a cost advantage over the currently used deep well pumps, and this factor should be exploited in promoting the greater use of the IDRC-UM lift pump in this country.

Other factors that will assist in the further utilization of the IDRC-UM handpumps in the Philippines are:

- o the local manufacture of the pump.
- o the local research and development capability to modify these pumps to suit the local situation such as resistance to rust as well as use of locally available materials to lower cost.

Both these factors should be given serious consideration in future programmes to promote the widespread adoption of the IDRC-UM handpump in the Philippines.

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WATER SUPPLY USING HANDPUMPS IN RURAL KENYA

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BACKGROUND

Due to the need for developing countries to increase food production through development of agricultural potential, many countries have resorted to the construction of dams and the establishment of irrigation settlement schemes. Kenya has not been spared of the aftermath of such developments. These include diseases like schistosomiasis (bilharzia), diarrhoeal diseases, malaria, and intestinal worms, as well as malnutrition.

In September 1983, researchers at the Medical Research Centre launched a community based study to test the impact of a combination of control strategies on schistosomiasis (bilharzia) in Mwea, which is one such irrigation settlement scheme in Kenya. The control strategies include health education and improvements in water supply and sanitation.

Mwea, where the study area is located, is an irrigation settlement in the Tebere location of Mwea division. It is at the foot of Mount Kenya with an altitude of about 1100 meters above sea level. The irrigated land covers a total of fifteen thousand acres of rice plantations.

The area is a fairly flat land dissected by three major rivers. Nyamindi in the North, Murubara in the center and Thiba in the extreme south.

The main sources of water are the rivers and the canals which flow through the paddy fields. Due to lack of sanitary facilities in the 15,000 acres of paddy, farmers, who spend about 90% of their time there, use the canals as latrines. The banks of the rivers have been known to nurture snails which transmit bilharzia. As a result, the water courses are contaminated with biological pollutants as well as agro-chemical pollutants used such as fertilizers, pesticides and molluscides.

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OBJECTIVES

The main focus of the study is to reduce transmission of schistosoma mansoni (an intestinal type of bilharzia found in Mwea) through different interventions. These interventions include improvement of water sources and sanitation as well as health education. Specifically, the project intends to mobilize the community to

- improve their water resources.
- construct bridges, laundries, bath units and latrines to avoid contact with infected waters.
- train field workers who will educate the community on the importance of the use of clean water and waste disposal to break the transmission cycle of schistosomiasis.
- involve the community in all aspects of the programme.
- evaluate the impact of the interventions on the transmission of schistosomiasis.

STUDY DESIGN

In order to be able to evaluate the impact of the interventions on the control of schistosomiasis, it was necessary first to bring down the prevalence rate as low as possible. This was accomplished by mass chemotherapy in both the study and control areas. Lactating mothers with babies less than six months old and pregnant mothers were exempted. The drug used was praziquantel. This drug is also capable of clearing certain other types of intestinal worms.

One month after treatment, a sample of the population was selected for stool examination. This sample did not exclude those who for one reason or another might not have been treated. The following is a summary of the results:

	Study area	Control area
Total number examined	270	326
positive for schistosoma mansoni	76	102
per cent ± ve	28.14	31.28
Highest egg load/gm stool	2400	1190
Lowest egg load/gm	10	10

Other worms detected were as follows:

Other worms identified	Study area	Control area
Ascaris	34	52
Trichuris Trichuria	Nil	Nil
Teania species	Nil	Nil

It should be noted that some of the positive cases have very low egg load and may still be in the process of clearing out. The next stool examinations will be performed at intervals of three months after treatment for two years. It is expected that the next stool examination will indicate further reduction in the prevalence rate.

After this period, it will be possible to evaluate the impact of the interventions described above.

The next phase of the project will involve follow up of the populations in both the experimental and control areas. It is expected that the population in the control area will become reinfected within six months to close to baseline levels while the population in the experimental area will exhibit low levels of infection and of egg load.

STUDY AREA

This area is divided into two: the main study area and the control area. The study area has a total of 360 homesteads with a population of 2500. It is made up of three villages viz. Haraka, Maendeleo and Jericho.

The control area is composed of three villages, namely Matandara, Mathangauta and Mahigaini. The total population in the three villages is 2200, with 286 homesteads. The control and the study area are similar in most respects and have a separating distance of 20 kms.

Each village has a natural river flowing through it and several canals. Every farmer in the settlement is provided with four acres of land to plant rice. The rice is then stored by the National Irrigation Board for drying and milling. The board after deducting all their expenses, which include ploughing, fertilizers, seedlings and transport, give the balance to the farmer. An average farmer earns about KShs.8,000/= or about US\$ 500 a year in a single crop per year system.

Stool examinations carried out when the study was started indicated the prevalence rate for schistosoma mansoni in the study area to be 71.2%.

Prevalence rate of schistosmiasis prior to interventions was as follows:

	Study area	Control area
Total number examined	2223	1971
Number positive for Schistosoma Mansoni	1583	888
% Positive	71.2%	45.0%
Highest egg load per gm of stool	10,000	10,050
Lowest egg load per gm of stool	10	10

Other Worms detected during the same stool examination

	Study area	Control Area
Hook worms	32	14
Ascaris	549	527
Trichuris Trichuria	21	20
Taenia Species	8	2
Enterobius vermicularis	2	1
Hymenoleptis nana	21	22

MATERIALS AND METHODS

Three intervention strategies for the control of schistosomiasis were to be implemented in the course of the study:

- community mobilization through health education
- provision of improved water supply
- provision of basic sanitary facilities including pit latrines in paddy fields, bridges, bath units and laundries

Community Mobilization through Health Education

In order to motivate the villagers by educating them on the life cycle of schistosoma mansoni, and the prevention, control and management of schistosomiasis, an intensive health education programme was undertaken.

Community health workers were selected by the community and were trained by the investigators. Their duty was to collect the necessary data as well as to educate the villagers. Health education was either done in public barazas (meetings), schools, person to person or house-to-house.

The health worker educated the villagers on the life cycle of schistosoma mansoni: that the infected human being releases eggs of the schistosome in his stool which gets into a snail host, develops into a fully developed cercariae which emerges from the

snail into the water that then infects a person who gets into contact with infected water, through its penetration of his intact skin or through a mucous membrane should he drink the water.

As a result of the health education programme, it was observed that the villagers kept the vegetation along the Mokau stream clean. Before the health education programme started, people defecated along the water contact site. It appears that the defecation pattern has changed. On a day's survey, there were hardly any faeces seen along the water contact sites.

In addition to a village health committee, a fund raising committee was formed in each of the three villages. The village health committee organized labour such that groups of villagers were assigned to specific jobs on a specific day collectively.

The fund raising committee, with the consent of the villagers, decided to collect money as follows:

Ksh.23,120	136 houses in Maendeleo village	Ksh.170 per hse = 11 US\$
Ksh.19,590	103 houses in Jericho village	Ksh.190 per hse = 12.5 US\$
Ksh.15,400	77 houses in Haraka village	Ksh.200 per hse = 14.5 US\$

Total amount collected from the three villages was
Ksh.58,090.00 = US\$ 3630

The villagers also agreed to raise money to pay for any skilled labour for water works as follows:

Haraka	KSh. 1,520.00 = US \$ 95
Maendeleo	KSh. 305.00 = US \$ 19
Jericho	KSh. 920.00 = US \$ 57.5

Water Supply and Sanitation

Since Mwea is a flat land with a high water table, it was decided that underground water would be suitable. The villagers also decided on the use of handpumps. The idea of using a hydram to pump water from the river was also suggested, but the use of pipes, and their security posed a problem. It was finally decided that wells should be dug at suitable sites in the villages, and that handpumps be installed.

Since the wells are dug close to homes where pit latrines are used, utmost care was taken to avoid faecal contamination. Due to the flat nature of the ground, surface water and storm water may contaminate the wells. There is also the possibility of agrochemical pollution of the canals from paddy fields which pass through the villages.

Due to these problems, both bacteriological and chemical analysis of the well water was undertaken.

The following are the results of the chemical analysis:

CHEMICAL ANALYSIS OF WATER

	P.P.M. (milligram per litre)		
	Haraka Well	Jericho Well	Maendeleo Well
Colour	Less than 5	< 5	< 5
Turbidity	Nil	Nil	Nil
Deposit	"	"	"
Odour	"	"	"
P.H.	7.9	7.6	7.0
Free Carbon Dioxide	1.0	10.0	10.0
Free Saline Ammonia as Nitrogen	Nil	0.12	Nil
Albuminoid Ammonia as Nitrogen	Nil	Nil	Nil
Nitrates as Nitrogen	1.0	12.0	Nil
Nitrites as Nitrogen	Traces	Nil	Nil
Oxygen absorbed (4 hrs. at 27 C)	0.95	0.3	0.3
Alkalinity as Caco	Nil	Nil	Nil
Methyl orange (Bicarbonate)	190.0	310.0	300.0

Table continued on next page

Carbonate Hardness as Caco	140.0	562.0	348
Non-Carbonate Hardness as Caco	Nil	252	Nil
Chloride (Cl)	14.0	130.0	44
Sulphate (SO)	19.0	60.0	12.0
Silica (SiO)	55.0	55.0	30.0
Flouride (F)	2.2	2.5	1.7
Potassium (K)	6.0	2.0	1.5
Sodium (Na)	42.5	85.0	62.0
Calcium (Ca)	37.0	105.0	83.5
Magnesium (Mg)	11.5	72.0	33.5
Manganese (Mn.)	Nil	Nil	0.2
Iron (Fe)	0.12	Nil	0.4
Lead (Pb.)	< 0.01	< 0.01	< 0.01
Copper (Cu.)	< 0.01	< 0.01	< 0.01
Zinc (Zn)	< 0.11	< 0.1	< 0.1
Remark	Chemically potable	*nitrate content high	the water is slightly hard

* Sample taken during construction work.

A bacteriological analysis was also done and although it still showed coliform, it is hoped that the quality of water is likely to improve after some time due to the natural process of filtration and sedimentation under ground.

The following were the results of the bacteriological analysis, confirmatory coliform count.

Haraka village well 1 - 2 bacili/100 ml.

Jericho village well 1 - 6 bacili/100 ml.

Jericho village well 11 - 8 bacili/100 ml.

Maendeleo village well 1 - 12 bacili/100 ml.

Well Construction, Cost and Usage

The wells are hand dug with a diameter of about 4 ft. The well depths vary from 6m. to 10m. which is equal to 18 ft to 30 ft. Due to the lack of mechanized drilling, hand digging is quite difficult, especially when the water has to be removed whenever digging must continue. When the adequate depth and yield are attained, the well is then protected by sinking concrete rings of 1m. diameter and 1m. length. The bottom rings are perforated to allow water to percolate through. The rings are projected one to two ft. above ground to avoid any surface contamination. The sides of the perforated rings are filled with river bed pebbles or coarse aggregates to allow filtration of water from the sides of the well. The rings are designed to interlock into each other and joints are cement plastered.

A precast well cover is made heavy enough so that it cannot be easily lifted by children. This is cemented to the concrete rings below. The well is also fitted with an inspection cover. The cover provides access to the well when need arises without having to remove the whole lid.

Most of the construction work is done communally and very little is paid for labour. Most of the expenses are material costs. Total cost of one well is about KSh. 8,000/-US\$ 500

	KSh.	Total in KSh
10 concrete rings @	600/-	6,000.00
5 bags cement @	85/-	425.00
Sand @	200/-	300.00

Ballast @	100/-	100.00
Hardcore @	150/-	250.00
Timber @	200/-	200.00
Wire mesh @	120/-	120.00

The study area has a total of 360 households. Considering that only six wells have been installed, each is used by about 60 families at an average of seven persons per family.

Pump Installation

The lid cover is precast with a hold on one side with a diameter equivalent to the diameter of the metal stand. The stand is then placed on the hole. We have had to modify the metal stand with a tripod-like support welded on it. This is to make stable the stand base.

Before the final cementing is done, the raising main is connected to the pump cylinder using a sealing tape on the threadings and PVC cement.

When the drop pipes are connected and the stand placed in position, the foot valve is immersed in disinfected water and pushed to the bottom of the cylinder. The piston is also immersed in the disinfected water and rings adjusted to face opposite directions, before being pushed into the pump cylinder. Calcium hypochloride is used as a disinfectant. Then the pin is fixed on the connecting rod and the handle bolts and nuts tightened. The cylinder is filled with disinfected water. The cover on the pump cylinder is tightened.

The spout is screwed in place and the water is then pumped. Then the metal stand is heavily cemented to the well cover to avoid any vertical stand movement.

An apron is built one meter around the concrete ring sloping towards the soakage pits or where space is available. The water drains to the vegetable gardens adjacent to the well. Steps are constructed at convenient positions to allow a good grip on the handle by well users of different ages and heights.

Operations and Maintenance of the Handpumps

In the study area there are three field workers and one supervisor for the water supply programme. Each field worker is responsible for one village. The field workers have been trained in the operation of the handpumps. They in turn train the villagers, including women and children, on the proper use of the

handpump. The village health committees have also selected people living in houses near the wells as caretakers. These caretakers are trained on simple operation and maintenance of the wells. They keep the tools. They can identify the problem of the pump in case of handpump failure, and can correct the situation. In case of major breakdowns which will require replacement of any item, they notify the supervisor, who takes immediate action.

There is also a group that is selected to keep the well compound clean. The compound is communal property.

Problems Encountered with the Handpump

The UNIMADE mark I handpump appears to have been designed for a few families. Our report on the pump is limited to about six months since the six handpumps were only installed in February and March 1986. Each pump is used by up to 50 families.

- The connecting pins connecting the rod to the handle breaks down quickly. We have welded the joint tight.
- Due to a great deal of vertical movements on the rod connected to the handle, the internally threaded piece of plastic to which the piston bolt is screwed also breaks down quickly. The plastic piece was changed to brass and a metal bolt used. It is now working well.
- There is excessive vertical play of the piston rod resulting in the timber bushing on the cylinder cover wearing out. This necessitates regular replacement, at about two or three months intervals.
- The steel spring inside the piston ring slides out causing the piston ring to become loose. The ring quite often slides out and has to be returned. The field workers have been advised to train the villagers on how to put back the piston ring until a solution is found.
- The metal stand supports do not provide a stable mounting on raised wells. We welded three pieces of triangular angle metal to the base of the pump stand to give the pump a tripod base. This is then embedded in the well cover and cemented.
- The timber handle knocks against the metal stand wearing out timber which has to be replaced frequently.
- The spout is too wide and too short resulting in over 50% of the water drawn to pour out. This creates an additional drainage problem and a possible health hazard due to

mosquito breeding. At present we have extended the spout by adding a 1 1/2" PVC pipe which is melted and narrowed at the tip.

Most of the repairs and modifications have been done at the village level except the brass which was done in Nairobi.

Recommendations

For our purposes in Mwea we need a pump with steadier above-ground components possibly the UNIMADE Mark III.

Since the villages surrounding the study area including the control villages have similar water problems, we would like to expand the coverage of the handpump programme to those villages. A great deal of interest has been shown by the neighbouring villages. They are prepared to raise funds for this purpose. This will also expose us to a broader range of handpump experience when we move to local manufacture and commercialization of the pump.

Laundries and Bath Units

A survey was conducted to determine the water contact behaviour of the villagers in order to be able to interrupt the chain of transmission of schistosomiasis. It was discovered that people went to water sites for the following reasons:

A total of 5305 persons were observed

Activity	Number	%
Fetching water	1856	34.5
Swimming	711	13.3
Herding	70	1.3
Crossing	924	17.6
Washing clothes & utensils	224	4.2
Bathing	628	11.7
Drinking	169	3.2

It was also observed that out of this total, 63.4% were females and only 36.6 were male.

In order to determine how long the people were exposed to possible infection the duration of contact was also studied:

Minutes	Number	%
0 - 1	1533	29
1.1 - 5	2498	47.3
5.1 - 10	650	12.3
10.1 - 30	497	9.4
30.1 - 60	76	1.4
760	29	0.6

To interrupt the chain of transmission it was necessary to provide the villagers with facilities that will reduce their contact with the infected water. These included laundry and bath units. In each well site there is a laundry unit and four bathrooms. Two bathrooms are for males, one being for adults and the other for children and the other two are for female adults and children. The original design of the laundry units was 5 or 6 basin-like structures on each side of the concrete block with a channel in between to drain off the water. This design was found to be suitable for persons using detergents. The present design has basins on one side, with the other side flat with a slope towards the centre channel. This caters for both detergent and bar soap users. It also avoids any possibility of blockage.

Each bathroom cost about KShs.2,000/- = US \$ 125. One laundry unit cost about KShs.3,500/- = US \$ 218

Pit Latrines in the Paddy Fields

As a component of the interventions of control of schistosomiasis sanitary fecal disposal is necessary. In the villages this is well provided for as in every home there is a pit latrine. The paddy fields where the farmers at times spend up to 90% of their time have no such facilities.

The programme provides that every four farms of four acres each will share one pit latrine. The farmers will dig the pits as

communal work. Due to the high water table in the paddy fields the most suitable type of pit latrine is the mounted type.

Past experience shows that vandalism could be a major problem if the latrines are not well designed. People have been known to remove timber frames from the super structure for firewood. To overcome this our present design should have solid monolithic structures. The use of doors has also been avoided.

Both the ground slab and roof slab are precast. Six inch (6") quarry stones are used for lining the pit and the projection above ground level. Four inch (4") quarry stones are used for the superstructure.

The pit latrines will be ventilated to avoid smells and fly breeding. The vent will be made of 3" diameter PVC. It will be covered with a fibre glass screen.

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THE REPUBLIC OF MALI: A DRY TROPICAL COUNTRY

Located at the centre of West Africa, Mali has a total land area of 1,240,000 square kms. and an estimated population of 8 million. Most of the area is made up of plateaus and valleys. The plateaus correspond to the ancient crystalline plateau of West Africa covered with almost horizontal primary sediments, mainly siliceous and sometimes ferruginous grits. Despite the level and uniform landscapes, the physical geography is complex:

- in the southwest, the Futa Djallon presents a relief of hills, low plateaus and deep valleys.
- in the southeast, the Dogon plateau has steep slopes of the Bandiagara "cliffs".
- in the northeast, the Adrar of Iforas, a crystalline mountain mass with heavy shapes was carved out by the erosion.
- amidst these mountainous terrain, the Niger River basin constitutes a large sunken area, a succession of flat-bottom valleys covered with alluvial deposits. These hollows either swampy like the Niger Central Delta or dry, generally do not have any waterflow but become covered with water during scarce rainfalls.

The hydrographical system of Mali of the upper Senegal basin and the Mid-Niger basin is located in the south of the country, the north being characterized by fossil valleys like those of Tilemsi and Asaouad, a reminder of the period when the Sahara was more humid. This imbalance in the location of the water resources partially explains the unequal occupation of the country by men: more than 90% live in the southern third of the country. Comprised between the 11th and 25th degrees North, Mali belongs to the inter-tropical zone: Sudanian between 11 and 16 degrees, desertic north to the 17th degree and Sahelian in between.

In the Sudanian and Sahelian zones, the climate has a tropical character marked by alternation of one dry season (8 to 9 months) and one rainy season (3 to 4 months). There is rain from June to October. The rainfall decreases from south (1100 mm) to north (200 mm). Beyond the isohyet 200, there are the desert regions where the dry season practically stretches all throughout the year. During the dry season, the harmattan - the dry wind blowing from the east and responsible for the high temperatures

of more than 40 degrees C in April, May and June - blows everywhere in the country. The combination of these factors lends to a shortage of surface water in all the regions except for the minor beds of the big rivers. However, there are many signs that there are important quantities of underground water and it is thought that proper management of this resource can help solve the water problem.

MALI AND THE INTERNATIONAL DRINKING WATER AND CLEANING DECADE

In Mali, as in many countries in the sub-region, there is practically no system of drinking water supply for the rural areas. For lack of something better the villagers use the water from the river, the pond or from an open well. Very often, the people are not aware that most of the diseases in the region thrive in these waters.

In fact, 80% of the morbidity in the rural areas of Mali is possibly transmitted by the water. So, providing the people with adequate drinking water has become a priority under the strategy of health for all by the year 2000.

The drought in the recent years marked by the degradation of the climatic conditions has shown the precariousness of these conditions: to the problem of the quality of the water is added the more serious one of quantity.

Since 1981 several formulas have been experimented to provide drinking water to an increased portion of the population. More than 1000 water points have been set up, among which include open wells, and wells equipped with hand, diesel, solar or eolian pumps.

Despite these achievements, we are still far from totally answering the need. Using the framework of the International Drinking Water Decade, an important programme has been drawn up by the authorities of Mali to meet the basic need of both the urban and rural populations for drinking water, on the occasion of two workshops organized in Bamako in 1981 and 1984.

These workshops committed among other things:

- to define some concepts
- to assess the needs in the sector
- to identify the constraints, and
- to formulate a strategy.

The Concept

From the last workshop, we note the following points regarding the definition of the concepts:

1. The supply of drinking water consists in providing the rural population with water of sufficient quality and quantity for their basic household needs. These needs include: drinking, cooking, washing clothes, cleaning and personal hygiene and cleanliness.
2. The words "rural area" mean all the villages and hamlets having less than 5000 inhabitants. These exclude the chief towns of "cercles" which are considered semi-urban centres regardless of the number of their inhabitants. According to the general census made in 1976, the rural population reached 5,300,000 in a total of 10,208 villages. With an annual growth rate of 2.37%, population is expected to reach 7,360,000 in 1990.
3. A village water point is a water catchment work for underground and surface water utilized temporarily or permanently by the village people for their water needs. A water point is said to be satisfactory when it fulfills the following criteria:
 - quantity: it can provide at least 8 cubic meters a day.
 - quality: water drawn from it is not likely to impair the health of those who consume it, i.e., drinking water.
 - accessibility: it is located at a maximum distance of 500 meters from its users.

The Needs

The participants in the two workshops estimated the basic daily need for water to be 40 litres per inhabitant including the drinking needs of the domestic livestock. Thus one water point for every 200 people would be sufficient.

On the basis of these criteria, the present coverage rate has been estimated to be 8% and the needs would be 36.785 water points by 1990.

Identification and Analysis of the Constraints

1. At the physical geographical level:

- the largeness of the country and the dispersion of the houses.
- the inadequacy of the available hydrogeological studies: they do not provide an absolute guarantee of finding water.
- the lack of a systematic inventory of the existing water points.

2. At the human level:

- the lack of qualified personnel or specialized staff to attend to the implementation of programmes for a sufficient number of the population.
- the sociological problems of the acceptance and total integration of the water point in the village life by the people. We encounter the problem of having to making the villagers aware of the advantages of the consumption of clean drinking water compared to the existing low quality water.

3. At the financial level:

- the scarcity of the resources of the State and organized groups as well as the low purchasing power of the population necessitated the creation of the National Water Fund. This is an important step towards the greater participation of the local resources in the development of the water sector.

4. At the technical level:

- low quality of locally produced equipment.
- insufficient training programmes for the upkeep, the maintenance and the repair of the pumps.

The Strategy

To reach the objectives of the International Decade, a number of priorities have been defined:

1. Conduct of hydrogeological studies to arrive at a better knowledge about the water resources.

2. Creation of awareness among the population on the problem of drinking water supply so as to be able to mobilize them to participate in the setting up and maintenance of appropriate water points.
3. Promotion of the local production of equipment.
4. Training of specialized technical staff and auxiliary staff belonging to grass roots/people's organizations.

In implementing this strategy, both Malian and foreign governmental and non-governmental organizations should undertake actions towards supplying drinking water for the population. It is deplorable however that there has been a lack of coordination of efforts, a shortage of means and some inadequate interventions. As a result, many types of pumps have been used in Mali which unfortunately are all imported, except for one. This lack of emphasis on the local possibilities of making and maintaining of pumps has led to an almost catastrophic situation twice. That is, the imported pumps attached to drilled wells (as it is most frequent) make the supply of water very hazardous because of the breaking down of the pumping system in areas where the pump equipped wells are the only water points.

It is in order to give a new dimension to the interventions in the water sector and help solve the numerous problems encountered by the population that, starting from 1983, AMRAD has undertaken local manufacture and distribution of a low cost PVC handpump.

AMRAD AND THE PVC HANDPUMP PROJECT

To reach its objectives: i.e., to make, test and popularize a low cost local PVC handpump - the following successive actions were taken: the recruitment and training of specialists, the manufacture and the tests of the handpumps, the selection and the education of beneficiaries, the installation and the follow up by a civil servant in charge of pumps and the acceptance of the latter by the beneficiaries.

Recruitment and Training of Specialists

At its initiative, AMRAD had technicians of the Central School for Industry, Commerce and Administration (CSICA = ECICA) of Bamako, a technical and professional college, train intermediate level officials.

Since we had no workshop, our technician resorted to asking some workshop owners to assist in the project. He immediately convinced two of these owners to allow him to use their workshop, tools and personnel.

At this point a prospectus about the training was developed with the assistance of the following contacts/institutions:

- the technological studies and research group (GRET) in Paris.
- the Montmorenay, Paris, an association specialized in appropriate technology.
- Father Plasteig who tried in Segou to implement a factory of handmade pumps.

Finally, we agreed with Father Plateig on the training of specialists. Trainees were sent to Segou for a two-week training that allowed them to become more familiar with pumps, their assembling and their dismantling.

The Design and Testing of the "AMRAD Prototype"

We discovered very early that in the market of Bamako we could purchase most of the parts of the pumps. In the workshop, we initiated a reduced model which could still pump water.

With a two meter slope and a PVC pipe of 10 cm in diameter, the prototype could pump an average 0, 40 l of water per stroke and an average of 40 strokes per minute.

Then a pump of the same model was designed and installed in a well 15 m deep. The result was 0, 30 l per stroke at 35 stroke per minute.

The total cost of this pump is about 75.000 F. In a month technicians were able to observe the functioning of the pump, note its output, its breakdown and the repairs.

During this phase of experimentation, the result was very satisfactory with regards volume of water produced as well as the mechanical requirement. Minor breakdowns were registered. This encouraged us to experiment with the AMRAD pumps in villages.

Thus, eight pumps were built at a total unit cost of 67.000 F.

Choice and Training of Beneficiaries

To facilitate follow up of projects, we chose villages close to Bamako where the water problem is acute: Djoliba and Dalakana. These localities are respectively 40 and 50 km away southwest of Bamako.

The first village has more than 2,000 inhabitants while the second has 400 inhabitants.

Each village has a public well of great diameter and some families have traditional wells. None of the wells however are equipped with pumps so the quality of the water remains doubtful.

After consultations with the political and administrative authorities of the villages, two general assemblies were held with open debates within a month. This was to give time for the people to reflect and not to act too hastily.

After many debates it was decided not to install the pumps in public wells. Because four to five persons could take water from them at the same time, it would be very difficult to establish any order around the wells. This then would not be favorable for conditions of experimentation/testing. The family wells were also left out because these were not frequently used so that testing of the efficiency and viability of the pumps on the mechanical aspect would be impaired. It was then decided to test the pumps in vegetable gardens where pails were used for watering. Often these wells had no trollies. The villagers chose the place where the pumps were installed. Four wells in each of the villages were put in neighbouring gardens. This was to allow one farmer to use his neighbour's pumps in case his broke down and awaited repair.

Installation and Follow Up of the Functioning of the Pumps

Before the pumps were installed, the beneficiaries were trained. Thanks to information given by the technicians, the villagers became familiar with the elements of the pump, i.e. its mounting, dismantling, maintenance and repair of the mechanism.

The mechanism and mastery were taught: "the appropriateness of this new technology". Later in the evaluation phase, we realized the importance of this psychosociological and technical preparation in winning over the peasants to adopt the new technology represented by the handpump.

The follow up files were drafted and given to the village teacher in charge of the collection of AMRAD information during the campaign. Each month a man was sent to monitor the AMRAD pumps. From February 1985 (date of installation of these pumps) to June 1985 the follow up has been regularly carried out.

While the acceptance of the pumps has been easy, their functioning has not been satisfactory for numerous reasons.

First of all the average output of water is less than that in the workshop. Only two wells had a depth superior to trial wells. The average is 30 strokes per minute with an output of 0,21 l per stroke.

Numerous and frequent breakdowns have been registered due to the defects of the above-ground and below-ground parts.

Three months after their installation, two pumps were withdrawn from the wells. A month later, a third pump was taken out. By the end of the campaign in June only three pumps were operating. The pumps which remained operational were those whose owners followed strictly the instructions concerning its maintenance. Handpumps whose owners mastered the dismantling, mounting and repair techniques also lasted longer.

The poor performance of the defective pumps can further be explained by the fact that their owners left them to children who played with them.

We thus arrived at the conclusion to reexamine the pumps within the confines of the workshop and see how we could improve the performance of AMRAD pumps.

We went through new documentation and contacted others to benefit from their experience. Thus in 1985, during the visit in Mali of Professor Goh of Malaya University, we showed him the pumps fixed by AMRAD, and talked to him about our difficulties. He advised us to try to adapt to Malian conditions a PVC manual handpump that has been proven successful.

After a study of the proposal and existing possibilities we submitted to the International Development Research Center (IDRC) a request to try out the UNIMADE pump, designed by IDRC and the University of Malaya, in Mali.

IDRC assured us of its interest in the project. We hope that in the near future, the experiment will be launched in Mali.

A PRELIMINARY REPORT ON COSTA RICA

Elias Rosales Escalante
Centro de Capacitation para el Desarrollo
(CECADE)
Costa Rica

The Republic of Costa Rica is located in Central America. It is between Nicaragua and Panama. The Caribbean sea is to the east while the Pacific ocean is to the west of the republic.

The Costa Rican territory is 51,000 square kilometers. Its population is 2,460,226 (1984 census). Fifty five percent of the population is rural.

In Costa Rica, the Ministry of Health estimates that 82% of the rural population is without a protected water supply. Over 30% of this population draws its domestic water from unprotected wells and rivers. The Division of Rural Programs of the Ministry takes care of the dispersed population and those living in villages of less than 200 people. It has a rural supply program which installs an annual average of 400 handpumps and repairs an annual average of 260 handpumps. Two types of pumps have been installed: the Dempster from the United States and the Kawamoto Dragon from Japan. Neither is manufactured locally. All spare parts are also imported. The present economic crisis has affected the Ministry's handpump installation program.

A brief overview of the rural water supply situation in Costa Rica shows the urgent need for a new handpump technology. In order to help and solve this problem, the International Development Research Centre - Canada signed an agreement with CECADE of Costa Rica. CECADE is a non-governmental organization involved in the training and improvement of small social groups. CECADE helps people achieve better living standards by opening new job opportunities, adapting or creating appropriate technologies, and promoting self-reliance and confidence. This agreement intends to investigate the acceptability of the UNIMADE handpump in rural Costa Rica. Acceptability will be measured from the technical point of view and from the sociocultural response.

The project will involve two different communities. One community is Finca Chaves. It has 84 small farms. Fifty six percent of its population are men. The same percent are between 20 to 30 years old.

The study site is located to the north of the country, on the Atlantic coast plain, on land parcelled out to rural people by a government office. The standard of living there is low, as the population lacks basic social services, such as electricity, public transportation, potable water and latrines.

The other target community is Ticari. It has 86 small farms. Fifty two percent of the people are men while 30% of the people belong to the age range of 20-30 years old.

Our project results will include the installation and the continuous operation of 50 UNIMADE handpumps in the two study communities. As part of the agreement signed and the requirements of the Ministry of Health, there will be an investigation of the use of hand held drills as an inexpensive and quicker way to construct wells.

The project will develop training programs for the handpump users. At this stage, all the accumulated experiences of CECADE's audiovisual technical staff will contribute to this work. Special attention will be given to women in relation to operation and maintenance tasks.

The project will monitor the water quality, the technical performance and costs of the handpumps.

It is very important that an evaluation be made of the communities' acceptance of the pump design and of the handpumps' effect on their normal water related behavior. At the same time, an epidemiological survey will be implemented to evaluate the handpump's impact on the health conditions of the communities.

As a result of this handpump installation project, Costa Rica may eventually explore the possibilities of manufacturing and promoting the adoption and dissemination of plastic handpumps nationwide.

A PRELIMINARY REPORT ON GUATEMALA

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Guatemala

The Republic of Guatemala is located in Central America, south of Mexico. On opposite sides are the Caribbean Sea and the Pacific Ocean. Its territory totals 100,000 square kilometers, populated by 8 million people. More than 60% of the population live in the rural areas. Most are paid labourers on large estates, cultivating cash crops for export (coffee, sugar, bananas, and sugar cane) or breeding cattle, or subsistence smallholders, producing maize, beans, squash, and vegetables. The former type of plantation is located in the low and flat areas of the country, while the latter tend to be located in the highlands.

The health situation in Guatemala is precarious, with a very low life expectancy of 57 years, a high infant mortality rate of 80/1000 live births, and a very low coverage of 25% of the population for public health services. Only 40% of the population have by potable water at home, and only 20% are served by a sewage system. Most of those with water and sewage service are urban residents. As far as official or non-governmental programs are concerned, only limited dissemination of handpump technology has taken place.

The Center for Meso-American Studies on Appropriate Technology (CEMAT) is a non-governmental, non-profit organization, with ten years experience in rural development. Its strong emphasis has always been in the introduction of alternative technologies which address the plight of small-scale landholders, most of whom belong to the Mayan ethnic groups who have been traditionally discriminated against in terms of land, culture, health services, and political rights.

A quick review of some of the technologies introduced and the positive response from the beneficiary communities follow:

Better nutrition has been achieved through the promotion of mixed family gardens; reappraisal of forgotten high protein crops; installation of day care centers with nutritional and educational goals; and, the promotion of small-animal husbandry projects (rabbits and pigs), fisheries, and bee-keeping.

Decreased fecal contamination has resulted through the diffusion of dry alkaline fertilizer family latrines, which compare favorably with the "officially-promoted" pit latrines; and, several types of anaerobic biodigestors (continuous, semi-continuous, and discontinuous) which, aside from producing much needed fertilizer, can yield combustible gas as a by-product to run stoves, lamps, and engines.

Improved wood-burning stoves have been introduced to decrease the rate of deforestation and domestic pollution, and to free the housewife of as much as one half of the usual amount of time spent cooking. The most common model (the Lorena stove) is made of clay and sand, and is designed to meet the specific requirements of rural cooking (beans and 'tortillas').

Alternative therapeutics have been investigated, taught and disseminated to furnish the rural poor with viable and effective means of healing themselves. These include the production, research, and commercialization of medicinal herbs, which are part of a very rich but threatened heritage, and the introduction of acupuncture, which adapts well to traditional healing practices of massage, puncturing, and suction.

Water availability has been improved by the installation of rainwater catchment cisterns, or by gravity-conducted pipelines. However, analysis of water quality has shown a high degree of contamination.

A metal mechanic workshop has been established to construct simple implements, such as chimneys, biogas burners, and lamps. A prototype biomass gasifier was developed recently. It produces 15 - 25 horsepower, which can be used to pump water and mill corn. The gasifier is fuelled by charcoal, but can be adapted to run on rice husks or corncobs.

This short overview intends to provide an idea of the projects which have been successfully implemented by CEMAT. Though no handpump project has yet been developed, the capability and need to carry out such a project exist. However, its success would depend on the local capacity to drill wells, maintenance of a clean source of water, as well as local maintenance of the handpumps. A social agreement on usage, ownership, and sharing of maintenance costs and responsibilities has to be developed. The availability of capital for initial investment in handpumps could be insured through a revolving fund.

Thailand needs a feasibility study on all aspects of mass production, technical, economics, and marketing, as well as a funding source for the study. Mass production seems possible with some parts of the pump being imported from Malaysia initially, specifically the moulds. A subsidiary of PDA will serve as the marketing arm. The government is not seen as a market at the moment, since it has its own source of handpumps. The handpump will be directed towards private ownership through dealers and PDA. PDA will propose to the Canadian International Development Agency (CIDA) the establishment of a production workshop with a capacity to produce 1000 to 2000 pumps per year.

WORKSHOP REPORTS AND RECOMMENDATIONS

The participants were divided into three workshops to discuss strategies to promote the adaptation, adoption and commercialization of IDRC-UM handpump. Before the group discussions began, Donald Sharp highlighted certain issues:

- o The Waterloo prototype pump has undergone certain stages of evolution. The first stage was its adaptation in Sri Lanka, Ethiopia and Malaysia. The Malaysia model, the original IDRC-UM handpump now called the Unimade handpump, has been installed in Malaysia, Philippines, Thailand and Indonesia. It will soon be tested in Costa Rica, Cameroon and India, to be followed by China and Mali and at a later stage, Kenya and Guatemala.
- o Strategies for introduction/production can either take the top down approach with a centralized agency mass-producing the handpump or the bottom-up approach with production starting at a decentralized, cottage industry level.
- o Requirements for the third phase of the handpump project include both hardware: wells; design changes/improvements, materials, modification for different environmental conditions; and software: financial requirements, financing/income generating schemes, marketing/economic analyses, quality control, maintenance, licensing, community involvement, training, communications and technical support.

WORKSHOP A

Leader: M. Rishyakaran
Rapporteur: Christina Aristanti

The discussion first covered the strategies needed by individual countries represented in the group.

Indonesia

In Indonesia, the IDRC-UM had been introduced by Yayasan Dian Desa (YDD). Although handpump installation had been completed only in early September, the village community showed great interest in the technology, an interest tempered by the financial requirements of the project and the community's income level. YDD observed that a possible market that exists in Indonesia for the handpump are the NGOs and development agencies. A marketing feasibility study should be carried out before discussion of local manufacture. The study should look into the potential market (who and how many are the buyers, cost, market strategy), alternative water sources, competing handpumps, financial resources and community involvement.

Mali

Mali is still in the process of introducing and adapting the PVC handpump. However, if the demand for the PVC handpump is big enough, Mali may not have difficulties producing it since there is already more than one PVC manufacturer in Mali.

Guatemala

Guatemala is still at too early a stage to talk about commercialization and mass production of the PVC handpump. But Guatemala would like to take the IDRC-UM PVC handpump design and if possible, modify it to suit local conditions. Potential demand for clean water is identified to be very great but drilling wells may be a problem due to high cost.

Malaysia

Malaysia has already started manufacturing the PVC handpump. The market is very good because of the project's tieup with the government, through the Department of Health.

Thailand

Having completed the introduction phase, PDA has seen the need and interest of the community for the IDRC-UM handpump. PDA is now looking into the manufacture of the PVC handpump. But first it should undertake a feasibility study on the marketing and local manufacture of the PVC handpump. At present, PDA sees the market for the handpump to consist of NGOs. However, it intends to approach the Thai government as well.

Overall Conditions

After discussing each country's situation, the discussion concentrated more on the local manufacture of the handpump. Several aspects discussed were:

- availability of handpumps
- availability of spare parts
- availability of installation services: possibility of a do-it-yourself kit
- cost
- stages of local manufacture
 - a) use of local PVC manufacturer for the mould
 - b) importing only below-ground components and modifying the above-ground components using local materials
 - c) importing only parts such as foot valves and pistons
 - d) local manufacture only of spare parts.

All these aspects should be studied after the feasibility study.

WORKSHOP B

Leader: Tan Bock Thiam
Rapporteur: Mediatrix Valera

The group members first of all discussed the guidelines to be followed in formulating strategies to promote the adaptation, adoption and commercialization of the IDRC-UM handpump. They are:

- o The extent of local production, whether partial or total, should depend on local resources, capabilities and demand.
- o The possible schemes for local fabrication range from NGO with a workshop to a full commercialized venture.
- o The design of the above-ground components should consider cost, accessibility and quality of materials.
- o Local fabrication includes producing tools/spare parts.
- o The local production of moulds based on the UM design should be explored.
- o Needs of the participating countries should be fed back to the Research and Development Centre.

Given these guidelines, the group arrived at the following recommendations:

- o Each country should situate itself on the continuum from full importation to local production. Countries with a small demand (less than 2000 units/year) can produce the above-ground components and import the below-ground components. Countries with a large demand (more than 2000 units/year) can look at several options
 1. Modify/reduce cost of above-ground components.
 2. Get mould for piston rings and locally produce spare rings.
 3. Produce below-ground components by using moulds from UM or making our moulds based on UM design.
- o The Research Centre at UM should
 1. Provide moulds or mould design.
 2. Check/monitor quality and performance of locally produced below-ground components.
 3. Test models based on feedback from implementing countries.

- o The possibility of setting up regional centres (fabrication, training, technical assistance) should be explored
- o The licensing agreement should be reviewed to include subcontractors to do local fabrication and/or allow for the transfer of technology.

The group then discussed the experiences of the participating countries pertinent to the workshop theme. For Thailand, FDA will locally produce the handpump through its workshop. Costa Rica will import 55 complete sets from UM for installation. In the Philippines, the FBSP will undertake Phase 3 under the Tulungan sa Tubigan Program, with another entity, a vocational institute or proponent, pending the results of the feasibility study to be conducted by Kabalikat. In the meantime, it will continue to field test the deep well design, disseminate the IDRC-UM handpump, tap other funding sources and tap UM for technical consultancy.

WORKSHOP C

Leader: Goh Sing Yau
Rapporteur: Mohamed Karama

The group also discussed the strategies to take per country.

Thailand

Thailand needs a feasibility study on all aspects of mass production, technical, economic and marketing, as well as a funding source for the study. Mass production seems possible with some parts being imported from Malaysia initially, specifically the moulds. A subsidiary of FDA will serve as the marketing arm. The government is not seen as a market at the moment since it has its own source of handpumps. The handpump will be directed towards private ownership through dealers and FDA. FDA will propose to the Canadian International Development Agency (CIDA) the establishment of a production workshop with a capacity of 1000 to 2000 pumps per year.

Sri Lanka

The Sarvodaya Movement has already produced 150 SL handpumps in the last 18 months; however, a feasibility study especially with respect to financing, is needed. The Movement has already submitted a proposal to CIDA-IDRC for a production workshop. The market for the handpump consists of the government sector and NGOs, such as UNICEF. About 700 deep wells and 300 shallow wells are needed per year. SEEDS deals with the marketing aspects of the handpump. In terms of technology, the Movement will rely on UM for technical assistance; also, initially, pistons will be imported from Malaysia.

Ethiopia

Mass production of the handpump is considered uneconomical because of the present use of brass pistons. A financial grant for injection moulding facilities for PVC pistons will be requested. A workshop already exists under the Public Waterworks division.

Kenya

Kenya is still in Phase I but will try to catch up with the other participating countries. It also needs a feasibility study for mass production.

RECOMMENDATIONS AND IDRC RESPONSE

Six recommendations were articulated by the workshop participants.

- o Feasibility studies of the different countries should be coordinated.
- o IDRC should not limit itself to handpumps but should also assist in drilling of wells, providing equipment and assisting in water table measurement.
- o The University of Malaya should be seen not as the only centre but as a first centre to be followed by another possibly in Africa. UM should not limit itself to technical and mechanical aspects but should include water quality analysis and underground water testing.
- o IDRC should provide information on loan resources.
- o IDRC should establish a communication network for all the countries involved as well as hold regular meetings to ensure that everything proceeds well.

In response, Donald Sharp reported that

- o Some Phase 2 projects include support for drilling of wells.
- o All Phase 2 projects will become centres of dissemination as well as provide training.
- o The Ministry of Health is at present carrying out work on water quality that includes training programs.
- o IDRC is looking for funds for Phase 3 from other agencies such as CIDA and FATH.

- o Regarding communications, IDRC is looking into the feasibility of establishing a telecommunication network across all the countries, as presented by Robert Valentine in an earlier session. The network recognizes the need for timely information regarding technical failures. IDRC will also try to provide funds for annual meetings.

During the general discussion, one participant asked what steps the different countries should take in the future. IDRC expects proposals to come from individual countries on what should be done. For the third phase, the proponent should take the initiative because IDRC has already gone beyond the original mandate of the implementation phase. While IDRC will continue to be supportive, the proponent should be more active in this final and critical phase of the adaptation, adoption and commercialization of the IDRC-UM handpump.

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