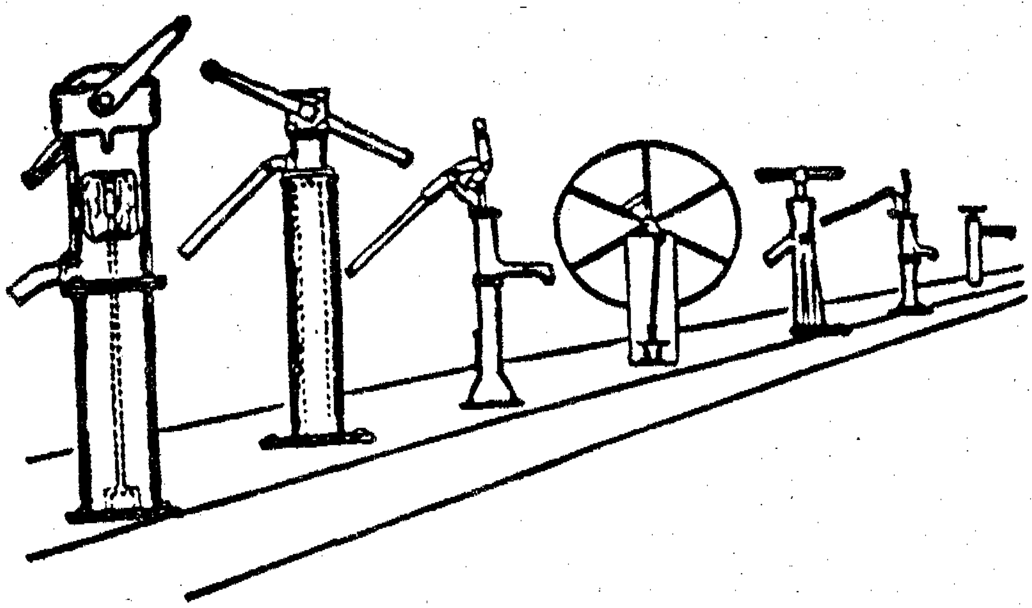
FIRST NATIONAL HAND PUMP WORKSHOP



Proceedings of a Workshop Held in Addis Ababa, Ethiopia
December 14, 1989.

Organized by The Water Resources Commission
in cooperation with UNICEF, Addis Ababa
and UNDP/World Bank Regional Water
and Sanitation Group for East Africa.

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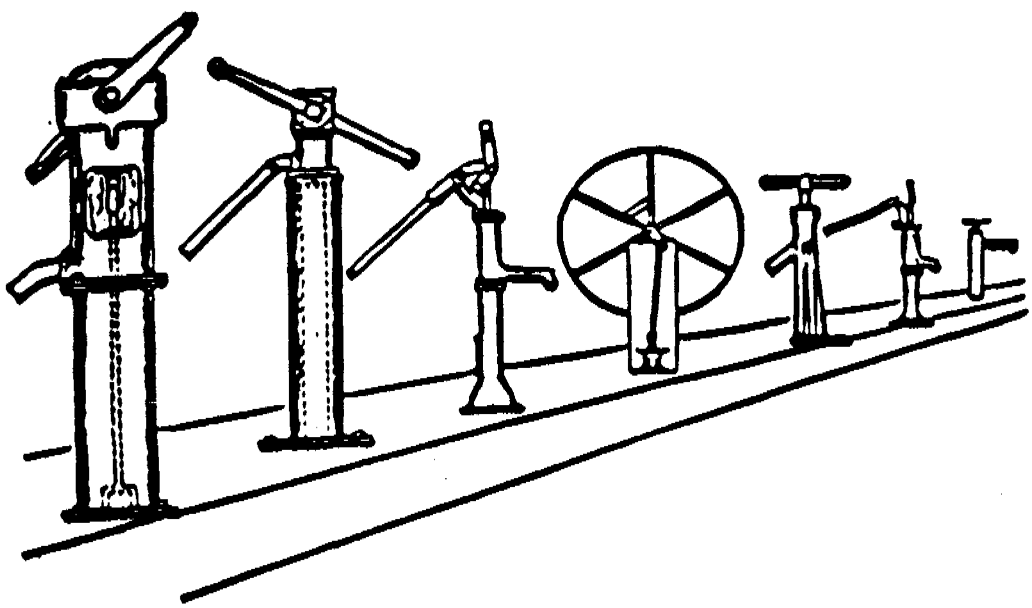

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List of Acronyms & Abbreviation

1. AAU - Addis Ababa University
2. CRDA - Christian Relief & Development Association
3. ESA - Ethiopian Standards Authority
4. EWWCA - Ethiopian Water Works Construction Authority
5. IDRC - International Development Research Center (Canada)
6. NGO - Non-Governmental Organizations
7. RADS - Research and Development Service (EWWCA)
8. RWSG-EA- Rural Water and Sanitation Group - East Africa
9. UNDP - United Nations Development Program
10. UNICEF- United Nations Children's Fund
11. UNIDO - United Nations Industrial Development Organization
12. VLOM - Village Level Operation and Maintenance
13. WB - World Bank
14. WRC - Water Resources Commission
15. WSSA - Water Supply and Sewerage Authority

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1. FOREWORD

The provision of rural water supply in Ethiopia is estimated at 11% which is very poor even compared to other countries in Sub-Saharan Africa. A series of natural and man-made calamities in recent years have made the situation even worse. It therefore in recent years have made the situation even worse. It therefore becomes imperative to use available resources more economically. The handpump is one technology that has a wide application for rural water supply with potential for local manufacture.

The first national handpump workshop was held on December 14,1989 and was attended by all major governmental and non-governmental organizations that are active in the water sector in Ethiopia. It is the first of two such workshops intended to lead to standardization of handpumps and related equipment.

The proceedings are presented as much as possible in the same chronology as in the Workshop. Notably, discussions are recorded after every presentation. The general discussion at the end of the Workshop has been condensed and that leading to the workshop conclusion has been omitted. Workshop conclusions, flyers, invitations and list of participants then follow.

The meeting was chaired in the morning by Deputy Commissioner Kefyalew Achamyeleh and in the afternoon by Dr. John Skoda of the RWSG - EA. Rapporteur were Ato Tekka Gebru (UNICEF), Mr. Andy Meakins (CRDA) and Ato Aseged Mammo (WRC). Coordinator of the Workshop was Com. Atnafe Beyene, WRC, whose office was also responsible for having the proceedings printed.

The Water Resource's Commission is indebted in particular to the Water and Sanitation Section, UNICEF-AAO who supplied most of the funds for the workshop. A special word of thanks is due the Assistance Coordination Service and Public Relations Office of the WRC who made the physical preparations for the workshop.

A special word of gratitude is in order to Com. Alem Alazar, former Commissioner of the WRC, who had the foresight to start R & D work at EWRA and was instrumental in organizing this workshop.

2. Keynote Address

By Com. Kefyalew Achamyeleh, D/Commissioner, Water Resources Commission

Dear Participants,

About 90% of the total population of Ethiopia, or over 41 million people, do not have access to improved water supply. They depend mainly on traditional sources like small streams, unprotected springs and ponds which in many cases are more than half a day's travel from home. The quality of water thus obtained is not acceptable in most cases with the result that the population is victim of high mortality and morbidity rates.

In the past, rural water supply activity in Ethiopia concentrated on boreholes. But since the late seventies, the construction of hand-dug wells has been practiced on a larger scale. This has introduced the use of handpumps in many parts of the Country. We believe handpumps should be further popularized to serve a considerable proportion of the rural population. However, the great diversity of handpumps hitherto imported leads to difficulties in finding the right spares. Certain equipment have been found unsuitable for the users, principally women and children in most parts of Ethiopia.

Modern handpump technology combined with small diameter drilled wells or protected dug wells have been proven in many parts of the world to be the most cost effective solution to rural water supply problems. WRC recognizes this and wishes to benefit from recent developments which has made this approach economically and technically attractive.

Our handpump requirements have been studied and a great deal of ground work has been accomplished. We will hear today how WRC through its Research and Development Services has been working in partnership with specialists in the field from around the world in the development of handpumps that can be manufactured in Ethiopia and which can be maintained by the communities which use them.

We have tested our handpumps - a direct action pump for shallow wells and a conventional pump for medium deep wells - through pilot projects, and we feel we are advanced in research and testing of pumps for medium deep wells and boreholes and wish to move as soon as possible with small scale production.

The shallow well pump may need further refinements; however, much of the basic research has already been done. For the deeper lifts, we feel there is still more scope for research and development.

While appreciating the commendable efforts of all those who have actively been involved in the development of handpumps that can be manufactured in Ethiopia, I appeal to all NGO's and bilaterals present to seriously examine our research, development and trial production efforts. While many of the approaches initiated by NGO's may be specific to a particular part of the Country it is important for everyone to adopt a common strategy whenever this is possible. Standardization of handpumps is one obvious example.

Maintenance of handpumps is one single constraint that must be overcome to warrant their large scale use. Attempts have been made to overcome this problem by introducing a centralized system in which a maintenance team tours around repairing and maintaining pumps in the villages. This has proven ineffective and expensive. The users have to be trained to operate and maintain their water supply systems. They must, in the long run, manage all the affairs of their water point, including supplying of spare parts. And that leads us to another area of concern in our rural water supply program: community participation.

The main objective of community participation is to develop and increase people's awareness and a sense of responsibility thereby ensuring reliable village water supply systems. It is not uncommon to see abuse, vandalism and high levels of breakdown of water points in areas where communities are not involved in caring for the water system.

Indeed, it is also to provide opportunities for close and continuous communication between the WRC and the rural people that the Community Participation Promotion Department was established under the Water Supply and Sewerage Authority.

A number of encouraging examples of rural water supply projects accomplished with the participation of the people can be mentioned. One fine example is the Mio-Gassera water supply Project benefitting more than sixty thousand people in the Bale Administrative Region. Another rural water supply project successfully accomplished with genuine participation of the people is the gravity piped water supply system benefitting more than 15,000 people in Dodota district, Arssi Region. To ensure sustainable operation of the system, 132 women were trained in various vocations, including system maintenance. The water supply project which was implemented by the Revolutionary Ethiopia Womens' Association (REWA) is now self sufficient with respect to repair and maintenance.

With regard to handpumps, a multi-disciplinary research is also going on to effectively answer their maintenance with participation of the community. The maintenance question can be solved if availability of spare parts is guaranteed locally, which in turn can be guaranteed only if parts are locally manufactured. Other advantages of local manufacture are, in addition to opening up of new job opportunities, the creation of improved local expertise on the technology, cost reduction and enhancing the development of indigenous technological capability.

We are still some years away from large scale production. Nevertheless, we must define means of controlling the quality of locally produced pumps and spares, even if initial production runs are small.

The use of our handpumps will be considered more appropriate only when they get wide scale acceptance from the users. Hence, creating awareness and popularization of technology is seen as a major component in our rural water supply program.

We are looking for increased coordination between projects carried out by all those engaged in water supply programs in the Country; improvements in monitoring and strengthening of feed-back mechanisms so that WRC is more aware of your activities, your successes and failures for the benefit of our national program. As we progress the focus of monitoring may change; but the need for it will always be there. It is a means of acquiring the knowledge necessary to ensure the complementarily of all the efforts to effectively improve the lives of our rural population.

Together, we have accomplished many rural water supply projects. We will continue, I am sure, to work in close cooperation with mutual understanding and within a climate of shared responsibility to avoid duplication of efforts and wastage of resources.

We do not anticipate change overnight. Nevertheless, we must make a beginning now if we are to increase a sustainable and reliable service coverage of potable water supplies to rural Ethiopia. The task is enormous; but with the concerted action of the WRC, NGO's, bilaterals and multilaterals, it is not impossible.

We have organized this "First National Handpump Workshop" as an orientation and learning opportunity for all of us. We are informing you, our partners in the water sector, of our plans to increase potable water supply to rural communities through standardization and local manufacture of proven, low cost, community maintained technology. We invite all of you to suggest workable strategies to this end.

I look forward to the deliberations of this workshop and welcome your participation.

THE INTERREGIONAL HANDPUMPS PROJECT AND THE VLOM APPROACH

BY
DR. JOHN D. SKODA, REGIONAL PROJECT OFFICER
AND
JOHN KEEN, DESIGN AND PRODUCTION ENGINEER
RWSSG - EA (UNDP-WORLD BANK PROJECT)

The UNDP/World Bank Program

The handpump project is one of the components of the UNDP/World Bank Water and Sanitation Program. The overall goal of the Program is to increase in country capacity to deliver water supply and sanitation services to low income groups. It seeks to encourage sustainable systems and this requires appropriate technology and community based approaches.

The program was launched in the late 1970s when it was realized that technologies being used in many cases were neither affordable nor sustainable. A research program was initiated by the World Bank to develop and field test affordable technologies. With UNDP support this was expanded to promote implementation of community water supply and sanitation for low-income communities.

The overall program embraces five areas:

i) rural water supply;

ii) low cost sanitation;

iii) solid waste management (including recycling);

iv) training and human resources development; and

v) development of sectoral institutions and organizations so they can cope with the increased level of investment that is needed.

The Program supports research and the preparation of technical reports, manuals, guidelines, specifications, etc. Its staff are often engaged in project formulation, review and evaluation. They may also be involved in project planning and implementation. Other important activities are the promotion of local manufacture and investment promotion and follow up.

The Program is executed by the World Bank and funded by UNDP and a significant number of bilaterals (e.g. Norway, Canada, Switzerland, Germany, Uk, Finland, Denmark, Sweden, Italy). Most field activities are managed by two Regional Water and Sanitation Groups (RWSGs) in Africa and two in Asia.

Choosing the Handpump Option

Ideally the choice of technology and the service level chosen should be based on the benefits and costs. The option chosen should be one that maximizes the net benefit. Although health benefits are an important objective they are often hard to quantify and they also depend on health related behaviour. Therefore savings in time and energy used to fetch water have been used to estimate the benefits and to compare these for various possible choices of technology and services level.

A summary comparison of such benefit/cost analysis for various community water supply options is presented in Annex 3 of 'The Handpump Option' report. Fuller and more detailed results of such calculations can be found in World Bank Discussion Paper Number 18 titled 'Rural Water Supply and Sanitation: Time for a Change'. This analysis shows how net benefits can be maximized. It also shows how sensitive the net benefits are to factors like well cost, housing density, number of persons per handpump, and value of peoples' time.

THE VLOM APPROACH

This section describes the rationale behind the Village Level Operation and Maintenance (VLOM) approach to community water supplies. It then summarizes the various engineering solutions which have been developed to fulfil the need for hardware which is suitable for VLOM management systems. The paper concludes by reviewing the issues of handpump standardization and monitoring.

RATIONALE

Traditionally, rural water supply schemes have been characterized by the use of expensive and sophisticated imported equipment. This has been operated and maintained under a centralized system using skilled personnel who rely on considerable engineering back-up. Usually the full recurrent costs have been borne by government departments.

Often, communities themselves have had little involvement in the planning and implementation process. Such schemes have generally proved to unsustainable due to high cost and to the logistical problems inherent in carrying out centralized maintenance over widely dispersed rural communities.

The lack of community involvement in the planning, implementation and financing process has resulted in communities not feeling a sense of ownership, and therefore responsibility, for the supply.

These factors, together with the need to import spare parts, have led to unacceptably long equipment down-times, with significant proportions of equipment out of action at any given time.

Work carried out in first years of the International Drinking Water Supply and Sanitation Decade by UNDP/World Bank and others, emphasized the need for affordable and sustainable solutions to the problem of providing clean water supplies to communities in rural areas. The work also indicated the need for full recovery of recurrent costs wherever possible.

The technology chosen to meet these needs should give a community the highest service level that it is willing to pay for, will benefit from, and has the institutional capacity to sustain. For many people in rural areas ground water extracted by handpumps is the most promising choice. However, to obtain the maximum potential for cost recovery, and therefore sustainable, it is necessary for the water point to be managed by the users themselves.

This led the UNDP/World Bank Handpump Testing Project to support development of new handpump designs which would fulfil these requirements. Between 1981 and 1986 the Project monitored pump performance and operating costs by field testing a total of 2,700 handpumps, including 70 different types in 17 countries. The data obtained enabled the strengths and weaknesses of the various designs to be assessed and pointed the way to future developments needed for improved handpumps suitable for VLOM management and local manufacture.

ENGINEERING SOLUTIONS

Design Features

- ease of maintenance

    few tools
    minimal skills and training
    no lifting equipment
    simple information

- reliability

    availability of pump (uptime) is more important than reliability

- corrosion resistance
    above/below ground
    ground water/environmental
    physical deterioration or failure

other effects such as taste

stainless rods

- abrasion resistance

    sand ingress
    well construction quality
    seal design/choice of materials
    cylinder liner - finish/material

- manufacturing needs

    low/medium/high industrial base
    plastics rapidly developing DCs
    capital cost relatively low
    local availability of processing materials less important than ability to import readily (tariffs)

New Concepts for VLOM Handpumps

- availability/reliability

- wearing parts/non-wearing parts

- pump designed for VLOM maintenance systems

- local manufacture - of complete pump is desirable - of spare parts is essential.

- single, relatively small cylinder diameter - reduces pump internal forces - reduces number of spare parts - reduces weight of downhole components, simplifying installation and maintenance. Pump water output is NOT reduced!

- adjustable handle to optimise operating force and water delivery

- easy connect/disconnect pump rods

- extractable plunger and footvalve without removal of rising main

- rationalise pump components and spare parts

Lever Action/Direct Action

Direct- action pumps can be used at water levels down to around 12-15 meters. They are simpler and cheaper than lever-action pumps and easier to maintain. Training of pump caretakers is therefore simplified.

The main difference between the two pump types is that in direct-action pumps the operator applies the pumping effort directly to the pump rod, usually by means of a 'T-bar' handle, and the pump lever with its associated hanger and fulcrum bearing assemblies is eliminated. In other respects direct-action pumps share the same advantages as VLOM lever-action pumps: downhole components are extractable without removing the rising main, maintenance is straightforward using few tools, and spare parts are cheap, locally available and easy to fit.

Direct-action pumps have a further important advantage. Unlike suction pumps which are limited by the atmospheric head and can only pump from water levels of around 7 meters maximum, direct-action pumps can work down to 12-15 meters. Furthermore, because direct-action pumps have their cylinders below the water level they do not require priming. They offer the same levels of sanitary protection as lever-action pumps.

Direct-action pumps should be considered for installation on dugwells or boreholes wherever water levels permit and should form part of the technical strategy for all rural handpump programs.

New VLOM Handpump Products

The UNDP/World Bank Program has carried out development work on handpumps and worked closely with other agencies such as UNICEF on handpumps suitable for village level operation and maintenance. The following handpumps are now in production and available commercially.

Tara

This direct-action pump was developed in Bangladesh and is suitable for user groups where pumping requirements do not exceed around 1.5 cubic meters per day.

The pump is cheap, simple to maintain and is in production in large numbers in Bangladesh. Production is also starting in India.

Afridev

This is a deepwell community handpump suitable for water levels from 10-45 meters. It features many innovative design features including the use of plastic bearing bushes for the handle bearing assemblies.

Following several years development and field testing, the pump is now in production in Kenya, India, Pakistan and England. Production is expected in Malawi in 1990. The IBEX pump, based closely on the Afridev, has been produced in small numbers in Ethiopia. The Afridev Standard which gives full product definition for the pump was published in October 1989 and is available from SKAT, Switzerland.

Afridev Direct-Action

This pump is designed for community use and prototypes are currently being tested in Kenya and Malawi with encouraging results. The Afridev direct-action uses the same downhole components as the Afridev deepwell pump, giving a useful rationalization on components and spare parts. It also shares other features such as the flange mounting and rising main suspension system.

The pump is expected to go into production in Kenya and Malawi in 1990 at around half the cost of the deepwell version.

India MK III

This is a deepwell community handpump developed from the India MK II. Maintenance has been considerably simplified by modifying the pumphead and making the plunger and footvalve extractable without the necessity of removing the rising main. It has been field tested in India and has recently gone into production there. An Indian Standard for the MK III is expected shortly. Cost is around 30% higher than the India MK II, although this is expected to be recovered in the first few years of operation due to simpler maintenance.

The above pump designs are in the public domain and full information on design and material specifications is freely available. The UNDP/World Bank Programme is collaborating with other agencies to produce training materials and engineering specifications for the pumps.

Other VLOM Handpumps

Nira AF 85

This is another direct-action pump suitable for community use and manufactured for several years by Vamalan Konepaja in Finland. The company is also planning local manufacture in Tanzania in mid-1990.

It uses all-plastic extractable downhole components. The pumphead is a steel fabrication with a stainless steel handle tube. It is in use in several countries in East and West Africa and Asia.

STANDARDIZATION

Most countries with handpump schemes use a variety of different types of pump. These invariably use different spare parts and methods of fixing the above ground parts onto boreholes or dug wells. This means that spares have to be imported from the country of origin for each type of pump and also that it is not possible to remove one type of pump and replace it with another.

Several of the design concepts incorporated into the latest generation of VLOM handpumps are intended to rationalize as far as possible pump components and spare parts. The use in the Afridev of a single cylinder diameter for all pumping applications and a standard fixing flange for direct-action and lever-action pumps is an example of this approach.

Standardization on pump hardware can have significant advantages within a country. As well as reducing the number of different spare parts and permitting pumps to be replaced with different ones, it has important benefits in reducing the cost of stocking and distributing spares. It also simplifies the training of caretaker and pump mechanics, and production quality control during local manufacture.

Ideally sector agencies should settle on a limited number of handpumps for a country's water programs. When different pumps are in use efforts should be made to standardize dimensions and spare parts wherever possible.

MONITORING

Improvements in pump design and operation are always possible even when a pump has been thoroughly developed and tested during its prototype phase. The UNDP/World Bank Program is co-operating with other agencies in the water sector in setting up and operating field monitoring systems for the latest generation of VLOM handpumps. Sampling and data analysis are carefully controlled to ensure that the information obtained in representative of the full range of conditions under which the pumps operate.

The information is used to improve the design of the pumps to further enhance their suitability for community management in terms of performance, ease of maintenance and cost. There are also opportunities to improve manufacturing operations, and for this reason the Program works closely with handpump manufacturers on monitoring and production.

EXAMPLES FROM EAST AFRICA AND INDIA

Kenya Background

Community participation in projects such as schools, clinics and improved water supply has a long history in Kenya and the local word 'Harambee' conveys a sense of all pulling together towards a common objective. In the case of rural water supply there has long been a policy of requiring peoples' contributions. Another important policy is that called the District Focus for Development. Though not a new policy, the procedures for implementation are revised periodically and many older projects launched five or ten years ago were developed with less emphasis on this than those currently being developed. The need for the development projects comes from the village level and then is subjected to scrutiny by professional staff at divisional and district level in order to assess feasibility, impact etc. At district and national level projects must be prioritized and must be responsive to national policy and strategy for the particular sector such as rural water supply.

Kwale Project

Kwale District is on the Indian Ocean south of Mombasa. Handpump testing activities were launched in 1981 in both dug and drilled wells. SIDA supported these efforts and has supported the expansion of the project now called the Kwale District Community Water Supply and Sanitation Project.

Following the handpump testing high priority was given to developing pumps for village level operation and maintenance/management (VLOM) handpumps. From this emerged the Afridev design. Also a prototype direct-action version for shallow wells was designed and is undergoing initial field testing. Other technology issues were also addressed. These include improved siting/drilling techniques and better screening/ gravel packing of boreholes.

A study by the African Medical Research Foundation (AMREF) 1983 noted the inadequacy of community participation both in terms of definition of objectives and in terms of resources allocated to this vital component. The project responded by bringing in a Kenyan NGO, Kenya Water for Health Organization (KWAHO).

The role of the NGO was to help provide training to community groups and adequately involve both men and women. This is to ensure that the facilities are properly used, cared for and sustained. The NGO also helped to synchronize the construction activities with the community organization work. NGOs could be used in different ways to reach the same objective. For example an NGO could be used to train government staff to carry out community organization, training and liaison with technical or specialized departments. Another possible role for a national NGO would be to work with local NGOs in order to train them to carry out necessary community work in preparation for improved rural water supply.

The project has completed about 200 wells (mostly boreholes) with handpumps. More than half have already been handed over to water committees for all routine operation and maintenance. The committees have raised money and maintained bank accounts for procurement of spare parts and eventual pump replacement. At present spare parts are purchased from the project store; however it is envisaged that as local production increases in Kenya spare parts distribution will be possible on a commercial basis. Spare parts kits for the handpump cost about US$ 10 and these parts should be changed once a year. The average per capita cost of a borehole is about US$ 50 and about 10-15% of the project cost is spent on community development and training of water committees and caretakers.

PROWESS/UNDP prepared a case study of this project in 1988 as part of their technical series on involving women in water and sanitation programs. All those involved with the project have had to interact in new ways so that course corrections could be made as feedback from the field indicated the need for change.

These changes applied to almost all aspects of the project from well and handpump design to interaction between ministries and the NGO's between traditional community leaders and the men and women working as water committee members and caretakers. These changes took time as problems were identified and solutions proposed and proved. The basis of this relatively successful project has been the persistent pursuit of a common goal by the ministries, communities, the NGO, and the donors. They have succeeded in launching and sustaining community owned and operated water points.

Lake Basin Development Authority (LBDA)

This project is active in four districts draining into Lake Victoria. LBDA is a regional development authority which has been assisted by the Netherlands in a Rural Domestic Water Supply and Sanitation Program. A shallow wells project began in 1982. Two types of surveys were undertaken in all the districts and their diversions. One was a socio-economic survey of the communities; the other was a comprehensive survey of existing water supplies and opportunities for development of improved water supplies - especially ground water.

The specific handpumps chosen were SWN 80 and 81. Although these pumps given adequate discharge and have good abrasion and corrosion resistance, they are not that easy to maintain - especially for lifts greater than 12 meters. Local assembly and manufacturing of pumpheads is taking place but on a small scale (about 100 per year). Repairs are carried out by maintenance officers on bicycles; however, heavy tools are transported by vehicle in advance of the repair work. The most common repair problems are broken pump rods and tasting main pipes (cylinders also become disconnected or blocked).

In the initial phase the project work was planned and supervised from LBDA headquarters; however, following review missions' recommendations there has been considerable decentralization towards the district level. District implementation units now have staff specialized in the technical aspects of water resource development, extensionists trained to carry out socio-economic surveys and community development work, and sanitation foremen. The headquarters staff now act more as survey and design consultants on technical and social aspects. They also perform overall monitoring and reporting and provide advice to a considerable number of bilateral and NGO assisted projects in the region.

The community development work starts with the socio-economic survey.

This includes:

- household questionnaires (at least three per village);

- key informant questionnaires; and

- formal discussion questionnaires agreed during meetings chaired by an assistant Chief.

This initial work is done in consultation with the local authorities and results in the selection of priority sites. As the objective is to place ownership of the water points in the hands of the community of beneficiaries, the extensionists have to see that:

- land is formally set aside for the water point;

- a registered water committee is formed and trained;
- a pump attendant is chosen and trained; and

- that money (about US$ 100) for maintenance is put into the water committee's account.

The community development workers help synchronize the water committee formation and training with the construction activities. The project has trained local contractors to do as much as possible of the construction. This has been successful and well digging, platform construction, and pump installation is done by such local contractors. Machine drilling is also contracted; however, handpump maintenance is still done by project staff to a large extent.

By late 1987 the program had completed 244 water points and was able to do an additional 200 points in 1988. The average cost of a 70 meter deep drilled will complete with handpump was about US$ 7,200 and a typical 18 meter dug well installation cost about US$ 3,600. The variation in costs for dug wells deeper than 20 meters is much greater than the costs for drilled wells in the same depth range. Of the total project budget 19% was allocated for community development work including the socio-economic survey. Additional budget allocations totalling 13% were made for training (including higher level technical and community level education).

The estimated annual maintenance cost per handpump was about US$ 100. Villagers pay for spare parts, but do not pay for any breakdown or defect which occurs within the first six months of installation. Considerable staff and transport cost for maintenance could be saved if routine maintenance and repair could be done at village level; however, this will require some changes in the design of the pump - especially the down-hole components.

<u>Kenya/Finland Western Water Supply Program</u>

This program works in an area covering parts of four districts in Western Kenya. Investigation and planning was done from 1981 to 1983 and implementation has been going on since then. A primary health care project is also being implemented with Finnish support in the region.

Although this is a regional program, it has moved towards the District Focus and is responding to district priorities. The program contracts as much of its required goods and services as possible from within each district. It has a training and community development section which works with communities in planning, constructing and maintaining water points. Typical activities include:

- formation and registration of water committees and land easements;

- seminars for community leaders and extension workers;

- training of women pump attendants;

- health education; and
- obtaining feedback from consumers regarding their water points.

The budget for these activities is about 11% of the program cost.

The program has tested many types of handpumps and worked with a supplier and the UNDP/World Bank Program in developing a VLOM direct-action pump (Nira AF 85) with good performance in shallow wells down to 12 meters. For deeper wells other NIRA handpumps, Afridevs and India MK II pumps have been used. Currently the management has expressed the desire to standardize on VLOM handpumps and have these produced locally in order to achieve the goal of locally sustainable operation and maintenance.

Since the start of implementation in late 1983 the program has completed about 3,000 new water points. About one third of these are protected springs, one third dug wells and one third boreholes. Dug wells with handpumps cost about US$3,300 each, and boreholes with handpumps cost about US$ 7,300 each. Handpump maintenance is facilitated by use of a VLOM direct-action pump in many of the wells (direct-action pumps are suitable because of shallow ground water in much of this region). Annual maintenance costs for handpumps depend on the type and depth, and on whether VLOM Nira AF 85s are used. Deepwell handpump maintenance cost ranges from about US$ 150-200 per year. Shallow wells with VLOM pumps can be maintained by the villagers themselves for US$ 20-30 per year. The downtime for maintenance and repair of VLOM pumps is also reduced correspondingly.

Malawi

The history of rural water supply by means of wells with handpumps has not been as smooth and successful in the early stages as was the well-known community implemented gravity feed program. Early on dispersed drilling activities led to high implementation costs. Maintenance from District level was not successful, but shifting responsibility to the center did not improve results. Drilling efficiency was eventually improved by concentrating the work and by improving logistics and communications (greater use of private sector drilling has also boosted production rates). Development of VLOM handpumps has opened the way for more effective and affordable maintenance.

RWSG-EA is working with the government on several levels. A position paper and action plan for water supply and sanitation has been prepared. With help from the local UNDP and UNICEF offices a Workshop on National Strategies for Operation and Maintenance of Rural Ground water Supplies was held in late 1986. A project has been drawn up to implement the reorganization recommended by the Workshop. This calls for decentralization of handpump maintenance and the creation of support and monitoring mechanisms for the new system. Local production of Afridev pumps is also being supported.

Tanzania

A Workshop on National Strategies for Operation and Maintenance of Rural Water Supplies was held in 1988. The key conclusions of the workshop were:

- operation and maintenance of rural water supply scheme are local responsibilities to be met at village level;

- village capacity for preventive maintenance needs to be increased;

- local and central government bodies shall continue for the time being to provide backstopping support services;

- standardization of procedures is required;

- a reporting system needs to be developed to cover village, ward, district, regional, national levels;

- government will vigorously pursue local production of handpumps; and

- to help the standardization process, more extensive local production of all types of equipment and materials needs to be developed.

India

The UNDP/World Bank program has worked with the government and UNICEF to apply the VLOM concept to the India Mk II. A minimum number of changes were made. The main cost implication has been the increased cost of large diameter rising main required for plunger and footvalve extraction. This extra cost is offset by major savings in maintenance cost and by reduction of downtime. One of the costliest items in maintaining India Mk IIs is the transport of maintenance personnel and equipment. This is expected to be cut by 50-75% with the modified pump, designated India Mk III; however, each country should obtain actual field data on maintenance cost as they vary significantly from country to country depending on field conditions and on the way maintenance is organized.

In addition to an improved and easier to maintain handpump, Indian experts meeting in Nagpur in 1988 also stressed the need for action to:

- mobilize local resources because central and state government services are overloaded;

- intensify training programs for preventive maintenance;

- encourage participation of voluntary agencies in rural water supply;

- employ more sociologists and economists in water departments to better deal with community and cost-sharing issues; and

- to increase involvement and training of women for work on water committees and for work as caretakers.

Discussion on RWSG - EA Presentation

1. How long has the Afridev been in Service and how much modification has been made on its design?

   Testing started in 1984 and design almost finalized in 1986. It has been in service for about 3 years in the final form since modifications were made in its bearing system. Production exists now in Kenya, Pakistan, West Africa, England and Ethiopia. Latest additions are use of extended cover on the head and use in rubber pump rod centralizers instead of HDPE. Research is also being done on "extra-deep"handpumps, for water levels deeper than 45m.

2. Do you think injection moulding techniques are appropriate in Ethiopia?

   Yes. Ethioplastic factory in Addis Ababa have long experience in injection moulding of commodity plastics. Although they have no experience with engineering plastics, the major parameters for injection moulding, (eg. pressure, temperature) are very similar and the equipment is the same for both types of plastics. Moulding in engineering plastics should start early 1990.

3. What is your experience of involving women in the management of water supply systems?

   Besides getting training on pump caretaking, women are in the water committees often chairing and having the leading rule.

4. Have you studied the possibilities for cost recovery on pump installation and maintenance?

   The cost of water projects in Kenya is based on grant, not on loan basis and therefore is not a cost recovery program with approximate expenses of Government 10%, the community (15%) and the donor (75%). If the community's contribution could reach 30% - 40%, it would be good cost sharing proportion.

5. The maintenance on handpumps in Kenya seems to be well organized and supported with trained manpower; is this replicable in other countries?

   Yes it is. The manpower needed for this work will have to be from the beneficiaries with basic training local people, like the lady in the video, can be effective trainers. Professional sociologists are not necessary for this job.

6. Concern was expressed from the floor about the apparent difficulty of replacing the pump cylinder of an Afridev pump when a glued PVC rising main is used.

   It was pointed out that the PVC cylinder is lined with brass or stainless steel and is considered a non-wearing part that would not need replacing during the 10 year target life of the pump. However, unlined cylinders may be appropriate for direct action pumps and they are currently being tested. One of the presenters said that an easy to disconnect riser was being looked into as the threads on screwed risers become a point of stress build-up which can cause failure. Rubber centralizers on the pump rod are now being used to prevent wear on the PVC riser pipe. Work is currently going on in U.K. and Holland on fatigue in PVC. The use of rising main centralizers to keep the riser from moving in the borehole is considered beneficial in reducing fatigue.

INDIA MK II AND INDIA MK III HANDPUMP DEVELOPMENT - A PROGRAMME INVOLVING NGO'S, BILATERALS, UNICEF GOVERNMENT OF INDIA

BY
RUPERT TALBOT, CHIEF WATER SUPPLY UNICEF - AAO

BACKGROUND

UNICEF has been involved in handpump programmes for more than 25 years. During this period, many mistakes have been made both in terms of engineering practice and theoretical concepts. At the same time and often by trial and error, a great deal has been learned and the experience gained has benefitted UNICEF's cooperation in handpump programmes in many countries of the world.

This presentation traces the background to UNICEF's involvement in the handpump programme in India, up to the present time. It highlights our failures and successes. With hindsight and with the benefit of experience we might say that our initial efforts and approaches were naive. In 1989 as we enter the final year of the International Drinking Water and Sanitation Decade, and with many successful handpump programmes on the ground we could criticise the pioneers of community handpump programmes for their faulty concepts and mistaken ideas. At the same time, it should be appreciated that in the 1960's Rural Water Supply through community handpumps had never been attempted before by Governments on a mass scale. No one knew very much about handpump design either, other than what had been developed perhaps a hundred years before. And such pumps were intended for family use or at most a group of families or a farmyard - not for communities of up to 1000 as was common for example, in the early days of the India Rural Water Supply Programme. In addition, the whole issue of Community involvement in their own water supply from the siting of wells, to participation in pump maintenance and the role of women, was still in the distant future.

Nevertheless, it was those early pioneering efforts, often by NGO's working at the community level, that devised and then developed the ideas that eventually crystallized into today's clearer strategies. It was through the NGOs for example, that better handpump designs emerged combined with the gradual realisation that Community Participation was in fact the very cornerstone on which a successful Rural Water Supply Programme could be built.

But the catch phrases of today such as 'Community Participation', 'Appropriate Technology', 'Sustainability', 'Community Managed and Maintained' and the whole 'VLOM' approach, came much later - together with the knowledge that standardisation through local manufacture of a proven, tried and tested handpump formed the basis for in-country replication of a successful handpump programme, enabling the bright ideas of the NGOs' to be carried forward and expanded at the national level. Only then did this technology choice for rural water supply become a genuine ' low cost option' for

Governments seeking solutions to the problems of providing drinking water to their rural communities.

India embarked on this approach in 1969. Through total Government commitment, the benefit of a strong industrial base, replication on a massive scale, standardisation and quality control of an outstanding order, coverage in Rural India is now close to 100%. In Ethiopia - barely 12%. With a similar approach to India's is it possible to achieve a far wider coverage in the Rural areas of Ethiopia with this technology than presently exists? While it is dangerous to make comparisons between countries and the differences are obvious there are too, similarities including a predominantly rural population with the potential to manage their own water systems; an abundant supply of ground water and a Government committed to increase the coverage of rural communities with a protected drinking water supply, through sustainable technologies at a cost it can afford. In addition, Ethiopia has a fledgling industry capable of producing handpumps, a Government that recognises the need to achieve quality in production and a Standards Authority to help maintain it.

What is now needed is a commitment from the Government's partners in the Water Sector, from the smallest NGO to the largest and most influential bi-lateral to combine forces and work together with Government toward this common goal - as one solution to the problem of rural water supply.

UNICEF - The Early Years.

In the 1960's UNICEF's approach was to provide handpumps to schools and the occasional health clinic, not as a planned approach to drinking water supplies but as circumstances dictated and when dug wells offered the possibility to cover and install a pump. The cast iron American Dempster pump of traditional design was often used. And perhaps, with controlled, careful and limited use, the pumps of those days served a purpose.

But UNICEF's decision to embark on a handpump programme as a major contribution to rural water supply stemmed from an emergency, as so many of UNICEF's long-term development programmes - indeed UNICEF itself - began. In this case it was the drought in Bihar and Uttar Pradesh in North and Eastern India in 1966 that signalled the beginnings of a long-tern commitment to handpump programmes, almost, as it were, by chance.

In 1967, impressed and encouraged by the successes of a small number of NGOs drilling wells in the drought-hit hard rock areas of South Bihar and Uttar Pradesh, UNICEF air-freighted into India II drill rigs to work along side them but manned by Government crews. Within two months over 200 villages had benefitted from their work. But more than this, the most important achievements were to have shown that a well could be drilled in hard rock in a single day, and tap ground water beyond the reach of hand dug wells, using modern machinery run by Indian Government crews. And second, that into this 4" diameter well, a simple hand operated pump could be fitted, to supply perennial, potable water to rural communities. The technology had been demonstrated before of course by the NGO's but on a micro, 'project' level. The Bihar drought showed that the Government could do it too; efficiently and on a bigger scale. But at this stage no one had any idea just how big that scale was to be, of the dramatic failures that were to occur or of the eventual success.

The India Rural Water Supply Programme 1969 - 1974

The follow up to the success of the Government run drilling and handpump programme during the drought of 1966 and 1967 was the decision by UNICEF to support a drilled well handpump programme in Southern and Central India, during India's fourth plan period from 1969 - 1974. UNICEF was to provide the drilling equipment; the Government the pumps and maintenance systems. And the Community? The Community had very little to do with the programme at all. This was an engineering exercise on the grand scale. $5.9 million UNICEF investment for sophisticated hardware and millions of Government Rupees for a new untested programme, aimed to accelerate coverage of Rural communities with potable water from handpumps. The target: 120,000 villages; 12,000 in the first four years alone.

UNICEF imported 80 drill rigs for the programme, phased over a four year period, each capable of drilling 8-10 wells a month. Within a year, state Government crews had demonstrated their ability by drilling hundreds of successful wells in rural drought prone India. At the same time, the Government's commitment to maintain the locally produced cast iron handpumps, poor copies of old fashioned European and American designs proved impossible. Faced with usage patterns of anything up to 1000 people for sometimes 20 hours a day, the pumps were destroyed in a matter of weeks or in some recorded instances, the day they were installed. No maintenance system could hope to cope with such a situation and more often that not, villages were left with no more than a hole in the ground surmounted by a broken handpump to contemplate.

In 1974 and already suspecting the worst, UNICEF commissioned an NGO to carry out a handpump survey in the state of Maharashtra and a second in Tamilnadu. The results, to a disbelieving Government, showed a failure rate of 85%. UNICEF was then left with the option to abandon the programme or try to salvage something from the heavy investment already made. And it must be remembered, that while the organization was deliberating over its unenviable position, the drill rigs now numbering more than 80 continued to produce wells at the rate of around 500 a month - 6000 a year. Ultimately, the decision was taken to find a solution to the problem. And once again it was to the NGO's that UNICEF turned for help.

The Handpump Revolution

The Church of Scotland Mission at Jalna, in Maharashtra state, had been the first to experiment with modern drilling equipment. To a Government administrator's observation that he " liked their wells but not their pumps" the Jalna Mission quickly responded. Recognizing that existing handpump designs were inappropriate for community use, the Jalna Missicn, designed the Jalna handpump. Made of fabricated steel sections, with a single sealed ball bearing pivot and a chain operating over a quadrant to link the handle to the connecting rods, it bore a striking resemblance to the India MK II handpump as we know it today. However, it was the Swedish Mission at Sholapur, also in Maharashtra, which designed and engineered a pump similar in many ways to the ' Jalna', which was used by UNICEF as the basis for the pump that actually became the India MK II.

Working with a Government run Research and Development facility in Madras, and a Government engineering undertaking, twelve prototype pumps were produced and installed in Coimbatore district, an area with static water levels below 40 meters and where heavy usage was anticipated. The results were spectacular. One pump breakdown in twelve months exceptionally heavy use of up to 18 hours a day. Pump production soon followed.

The India MK II Programme

From the inception of the handpump development programme, a number of interrelated activities were recognised as being necessary for the eventual success of a drilled well, handpump programme. In addition to the supply of a pump that could withstand community use for a year without breakdown - that would be 'boy proof' - were the need for:-

- The development of tools to facilitate maintenance.

- A maintenance system involving both community and Government that would be affordable.

- Training in maintenance and the dissemination of training material.

While the pump itself was a success in terms of ease of use and reliability from an engineering view point, it only facilitated other activities. For example it didn't eliminate maintenance; it made it possible. Neither did it avoid the need for community involvement from the siting of a well, to the upkeep of the pump. However, it did cause villagers to become dependent upon it for their water supply, to an unprecedented degree. And suddenly it became clear that through this new found reliability, things that had only been talked about in theory were now possible. Drinking water <u>could</u> be supplied through handpumps in rural areas and maintenance <u>could</u> now be managed by Government at an affordable cost (See Annex I). And even more important, health education could be conducted with confidence using handpumps as the focus. With the India MK II, there came too, a real prospect of reducing the workload of women - the traditional carriers of water and - within sight was health improvement through a reduction in water borne disease. As the trainers at caretaker camps were fond of saying, the India MK II became " an instrument of health."

Three Tier Maintenance

The maintenance system devised for the India MK II handpump consisted of three levels or 'tiers'. First, at the village, second the block (a small administrative area with perhaps a hundred villages) and third the district. (In Ethiopia these might equate with village, Awraja and Region) Each tier was responsible for one aspect of maintenance. Tightening nuts and bolts, greasing the chain and environmental cleanliness by the villagers; pump head repairs and part replacement from the block level, major repairs and replacement by the district level. The tiers were intended to overlap with each other so that if one failed, backstopping was provided by the next, pump inspections being carried out as a routine by each. (In practice over-lapping did not occur easily and the cost of deploying the district based mobile team for routine inspection soon ruled out the approach.)

For the first time the village was responsible for selecting a handpump caretaker from their own number to be trained in simple maintenance tasks, be provided with a two spanner tool kit, be educated in health improvement and hygiene practice - and receive a certificate in recognition of his or her training and new position. A mechanic at the block level became responsible for the second tier. Equipped with a comprehensive set of tools he would maintain roughly 50 pumps. The third tier at the district level - the mobile team - covered as many as 500 pumps. Comprised of several men including mechanic, mason and helpers, they were equipped with tools and spare parts and moved from site to site in a specially designed pickup truck. The third tier could handle any repair or replacement task from component renewal to retrieving pump parts dropped in boreholes.

The three tier maintenance system, experimented with initially in Tirunelvelli district of Tamilnadu State, worked to a remarkable degree and caretaker training became a standard feature of the India handpump programme. Community involvement in the maintenance of their water system was shown to be possible, if at this early stage their role was somewhat limited in scope.

The design of the India MK II is such that its maintenance is heavily dependent on the centrally based mobile team, necessary to extract the below ground components with special lifting tools: The weightage for MK II maintenance therefore, lies with the central team.

With the later development of the pump and the incorporation of features that obviated the need to extract the heavy rising main, the first and second tiers took on greater maintenance responsibilities with the district based third tier mobile team relegated to a lesser but nonetheless critical backstopping function.

The India MK II as the National Deep Well Handpump

The Government of India determined that the India MK II deepwell handpump should become the national standard to be used by all state Governments. The benefits would include lower costs, readily available spare parts, interchangeability of components and standardised training programmes. Donors to the Water Sector would be required to purchase pumps from within the country thereby supporting standardization and at the same time encouraging self-reliance in manufacture.

The Indian Standards Institute (now the Bureau of Indian Standards) brought out the first standard for the pump in 1979 (1S-9301 Annex II). It has been revised thrice since then, Production increased from a few hundred units a year from two manufacturers in 1979 to over 250,000 units a year from 40 manufacturers in 1987, a year declared by the Government of India to have brought with it " the worst drought of the century" - worse even than the Bihar drought of 1966 and one which was tackled with great effect using the drilling and handpump technology that had evolved over the intervening 20 years.

Research and Development and Quality Control

Recognised from a very early stage was the need for quality assurance in manufacture, not simply as a means of approving a pump according to design and specification but as an integral part of the manufacturing process and as an essential contribution to research and development for product improvement. Consequently, and with the support of the Government of India, UNICEF employed external or 'third party' quality control inspectors whose tasks went further than inspection of the final product. They confirmed premises appropriate to the manufacture of handpumps by means of a 'Works Inspection'; followed up with the rigorous inspection of a trial batch of 25 pumps and only if passed would the manufacturer be approved as a 'qualified' supplier to State Governments.

By this method, the quality of pumps produced throughout the country was consistent and by labelling and stamping batches, field defects could be traced back to the supplier.

The Status of the India MK II today

As of 1989 over one million India MK II handpumps have been produced for the Indian domestic market with thousands more exported to over 30 different countries. The India MK II had become the handpump of the Water and Sanitation decade, a pump by which manufacturers set their standards and against which their products were often measured.

In 1984 UNICEF commissioned a survey on the functioning and use of handpumps in four states. The conclusion: over 87% working at any one time. A complete reversal of the dismal picture in 1974, although the 13% not working still raised questions on maintenance.

The India MK II has been a success story thanks to the co-operation between partners with Government in the Water Sector. From the NGOs who contributed so much with their original ideas in the early days, to the bi-laterals who supported the standardization approach and procured India MK II handpumps for their own projects as well as funding UNICEF's efforts. UNICEF too, had used its unique position and capacity to work at the national level to coordinate the whole venture and advocate the ideas of diverse non Government organizations as well as its own, while the Government of India pressed ahead with its programme in the face of increasing criticism because of the early failures, but had kept faith and ultimately showed that handpump programmes on a very large scale, can be successful.

Research and Development as a Continuous Process

The primary aim of the India MK II development programme was to put into a village a handpump that would withstand community use and last a year before requiring attention and thereby make maintenance possible. To this end the objective was achieved. But at a time when UNDP/World Bank was embarking on its own handpump research and development programme, and 'VLOM' was the latest catchword, the MK II, successful in the India context with its well developed industry, infrastructure, communications network and fleets of mobile teams, lagged behind in its appropriateness to other countries in which these conditions did not exist. What was needed was a pump whose design would swing the weightage for maintenance away from the central team and on to the village level so that the communities themselves could keep their pumps going without waiting for the Government operated, centrally managed mobile team. The advent of 'VLOM' meant that reliability had taken on a new meaning. Reliability from the engineers' perspective meant "how long before it breaks down?" While from the Community view point it meant "how long is it broken down before it is repaired?" What was important then was the time the pump functioned to produce water against total elapsed time. It therefore became apparent that what was needed was a pump that could be more easily maintained using simple tools and no heavy lifting equipment.

In India too it became evident that even there, dependence on the mobile team would soon overload the system as handpumps proliferated throughout the country. The cost of diesel fuel alone, for example, would soon reduce the benefits of this "Low Cost Option".

Research and Development, recognised as a continuous process from the early days of the Mark II programme had been effective in strengthening and improving the basic design. Field feed back from users, observations from NGOs', recommendations from the quality control inspectors and UNICEF engineers had all made significant contributions to the pumps' development. While it became still more reliable from an engineering standpoint, tools were further developed to make maintenance easier and thousands of caretakers were trained, its inherent design and the commitment to the standard which carried with it so many benefits, ultimately led to a degree of stagnation. Changes that were necessary to achieve genuine village-based maintenance could not be incorporated without interfering with interchangeability of parts. Each small change brought with it the need to modify or abandon jigs and fixtures at 40 manufacturers with resultant cost increases.

Ultimately, work on an easier to maintain, India MK III was initiated by UNICEF with the UNDP/World Bank hand pumps project. Prototypes incorporating VLOM features such as open top cylinders, large bore riser pipes and extractable footvalves together with "quick change" head assemblies were successfully developed, though not yet incorporated in the Indian standard.

The India MK III and the Afridev

The India MK III, produced in prototype form in 1989, owes much to the work, once again, of NGOs involved in handpump research and development since the mid 1960s, notably Sholapur Well Service. Contributions also came from individuals, from Government engineers responsible for the pumps' installation and maintenance as well as from the UNDP/World Bank handpump team and UNICEF. It was developed as a direct response to the obvious attractions of the emerging Afridev handpump, itself designed from inception for village maintenance - and reliability from the Community view point.

Although there may be some sharing of ideas, the possibility of combining the best features of the MK III with the best features of the Afridev into a single pump design is unlikely. The starting point for each as been different - engineering reliability for the MK II; village based maintenance for the Afridev. The most probable outcome will be that India, for which heavy investment in the MK II programme has already been made, will be well satisfied with the India MK III for which a high degree of interchangeability of parts with the MK II will be possible.

Technology Choice

While individual countries should learn from the experience of others and avoid 'reinventing the handpump', each must determine its own course of action based on local circumstance, manufacturing capacity and hydro-geological setting.

For countries in which community-based maintenance will prove the key to sustainability, local facilities lend themselves to injection moulding processes and such components as ball bearing races, chains and gun metal, used extensively in the MK II and MK III are too costly to contemplate, the Afridev may prove the more appropriate alternative.

For Ethiopia, the wide range of static water levels that exist in different areas of the country will require the development of several pump types. There will not be a single solution. Nevertheless, possibly more than 80% will be needed for water levels within 40 meters, which compares favourably with global statistics. For static water levels between approximately 7 meters and 40 meters the Afridev, now being produced in prototype form in Ethiopia but in full scale production in several countries, with excellent local manufacturing potential and proven VLOM characteristics, is likely to provide the most satisfactory solution. For shallow wells with static water levels within 7 meters, the direct action pump, produced in various guises in several countries is proving cost effective to manufacture and maintain and has potential for Ethiopia. For water levels below 40 meters, only specially designed handpumps will be effective, such as the 'extra deep well' India MK II, although here, the prospect of community maintenance is remote and strong support from a central team will be needed, as for power pumping situations.

References:-

- Water and Sanitation in UNICEF - 1946-1986.
  Martin Beyer
- Community Water Supply - The Handpump Option.
  Arlosoroff et al.
- The Children and the Nations. The story of UNICEF.
  Maggie Black.
- The story of the India MK II handpump(World Water Magazine) Gray/Talbot.

ANNEX I

Small Diameter Drilled Wells Plus India Mark-II Handpumps Offer the Lowest Cost Solution to Year Round Supply of Potable Water in Rural Areas

		AVERAGE COST*
TYPICAL INSTALLATION		
1. WELL DRILLED IN HARD-ROCK (115-150 MM DIAMETER, 50 METERS DEEP)		US$ 1,500
2. INDIA MARK II HANDPUMP		US$ 200
3. PLATFORM AND DRAIN		US$ 100
	TOTAL	US$ 1,800
	COST PER CAPITA	US$ 7
MAINTENANCE		
MAINTENANCE PER HANDPUMP PER YEAR		US$ 35
MAINTENANCE PER HAND PUMP PER CAPITA		US$ 0.14
COST OF WATER		
COST OF WATER PER CAPITA PER YEAR		US$ 0.56

* COST BASED ON : 250 USERS PER HANDPUMP
40 LITRES PER CAPITA PER DAY
20 YEAR AVERAGE LIFE OF WELL
10 YEAR AVERAGE LIFE OF HANDPUMP

Indian Standard

SPECIFICATION FOR DEEP-WELL HAND PUMPS

(Second Revision)

Pumps Sectional Committee, EDC 35; Hand Pumps Subcommittee, EDC 35 : 6 [Ref : Doc : EDC 35 (4236)]

1. Scope — Covers hand pumps for lifting water from wells of depth 20 m or more.

Note 1 — The pumps covered in this standard should normally be used up to a depth of 50 m, as below this depth, the efforts put in may not give adequate results in terms of discharge of water.

Note 2 — They shall be used for bores fitted with casing pipes of nominal diameters from 100 to 150 mm.

2. Nomenclature — As shown in Fig. 1. A brief description of some of the pump components is given below :

a) *Pump Head Assembly* — The mechanism above the ground level and operating the plunger.

b) *Cylinder Assembly* — Contains plunger, valves, etc, lifting water upward in each stroke.

c) *Connecting Rod* — Provides linkage between pump head and cylinder.

d) *Rising Pipe* — Carries water from cylinder to the water tank.

3. Dimensions and Construction — *See* Fig. 2.

3.1 *Head Assembly* — *See* Fig. 3.

3.1.1 *Head assembly parts* — *See* Fig. 4.

3.2 *Handle Assembly* — *See* Fig. 5.

3.2.1 *Handle assembly parts* — *See* Fig. 6.

3.3 *Water Tank Assembly* — *See* Fig. 7.

3.3.1 *Water tank assembly parts* — *See* Fig. 8.

3.4 *Stand Assembly* — *See* Fig. 9.

3.4.1 *Stand assembly parts* — *See* Fig. 10.

3.5 *Connecting Rod* — *See* Fig. 11.

3.6 *Cylinder Assembly* — *See* Fig. 12.

3.6.1 *Cylinder assembly parts* — *See* Fig. 13.

4. General Requirements

4.1 The material, tolerances, etc, shall be as given in respective figures.

4.2 The bolts and nuts used for hand pump assembly shall conform to the relevant part of IS : 1367 'Technical supply conditions for threaded steel fasteners (*second revision*)'.

4.3 The washers shall conform to Type A of IS : 2016-1967 'Specification for plain washers (*first revision*)'.

4.4 The riser pipe holder welded in the water tank shall be either forged or turned.

4.5 The riser pipe shall be of 32 mm nominal bore screwed and socketed of medium grade hot dipped galvanized pipe conforming to IS : 1239 (Part 1)-1979 'Specification for mild steel tubes, tubulars and other wrought steel fittings : Part 1 Mild steel tubes (*fourth revision*)'. Each riser pipe shall be 3 m in length with a tolerance of $^{0}_{-25}$ mm, with tapered threads on both ends.

Adopted 22 August 1984 Gr 9

INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Discussion on Mr. Talbot's Presentation

1. Where do we stand on the development of India MK III at present?

   Fully developed and under field testing in India by UNICEF and UNDP/World Bank. It has now been exported to some counties in Africa on a trial basis (eg. Nigeria). The India MK III is not yet incorporated in the Indian Standards. The draft standard is with UNICEF India.

2. What is your opinion on production of the India MK II in developed countries, eg. Germany?

   Handpumps have no place in the factories of Europe and America. However, research and development and prototype manufacture can often be successfully carried out overseas. Mass production should always be encouraged within the countries that will use them.

3. India MK III is appropriate for India. Is it also appropriate for Africa?

   Yes. But maintenance depends to a great extent on strong central support. Also manufacturing of the pump is very precise and it does not lend itself so easily to community maintenance as, say, the Afridev. Bearing replacement, for example, must be accurately carried out?

4. What is the magnitude of community involvement in the India programme?

   In India, community maintenance means caretakers. Caretakers' training has been carried out widely, including for women. Health education and sanitation is part of caretaker training, which though started by UNICEF, has now been taken over by Government. Real community involvement in pump maintenance is possible only when the pump has been appropriately designed. For India, in which water is provided free of cost to the users in rural areas, it may be difficult to involve communities in schemes which must be financially sustained by themselves.

HAND PUMP R & D EXPERIENCE AT THE WATER RESOURCES COMMISSION

BY

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SUMMARY

Four handpump designs (Types A,B,C, and D) developed in 1974-76. Campaign are described. Type B is found to be more suitable for manufacture, operation and maintenance. Lab and field trials by R & D Services on Type BP (mainly with plastic components) are then described, where maintenance in the field is found to be a major problem. The Village Level Operation and Maintenance Concept behind a shallow well pump "Shalla" and a deep well pump "Afridev/Ibex" is described. Outline of what remains to be done regarding large scale production of handpumps in Ethiopia is given last.

1. BACKGROUND

During the Development Through Cooperation Campaign of 1974-1976, all higher education in Ethiopia was curtailed and students and teachers sent for work in rural areas. At that time, staff and senior students of the Mechanical Engineering Department of the Faculty of Technology, Addis Ababa University - recognizing the problems of rural water supply in Ethiopia - engaged in research and possible development of low cost water lifting devices.

Toward the end of the Campaign, the then Ethiopian Water Resources Authority (EWRA) got interested in hand and wind powered pumping research, and in 1977 restarted the R & D project with aid from UNDP/UNIDO and IDRC (International Development Research Centre) of Canada. Hand pump R & D activities have since continued with financial assistance from IDRC, and the Ethiopian Government.

In 1981, the Water and Waste Disposal sector in Ethiopia underwent a major reorganizing and the National Water Resources Commission (WRC) was established. The Research and Development Services (RADS) was put under one of NWRC's Authorities- the Ethiopian Water Works Construction Authority (EWWCA) and given legal status in late 1987.

The research program concentrated on hand & wind pumps. On the wind power research, six wind pumps were designed, fabricated and field installed in the first phase of the R & D program. They are mainly of the medium and fast runner types ranging from 6m to 10m in diameter - with maximum rotor output range of 2 to 8kw. R & D activities in the second phase concentrated on a slow runner, multi-bladed rotor more appropriate for the wind regime in Ethiopia.[1] Per what has been done so far and independently confirmed [2], wind energy harnessing for water pumping applications supply over most of Ethiopia is a viable option.

Handpump R & D included manufacture and tests - laboratory and mainly field trials - in various parts of the country. Presently, development work is continuing at the RADS workshops with financial assistance from the Canadian International Development Agency (CIDA) while large scale production of one handpump model is being considered at the Akaki handpump plant.

The R & D services was located at the Mechanical Engineering Workshops of the Addis Ababa University as EWRA didn't have adequate facilities at the start of the R & D program in 1978. It has, however, transferred to its own premises in Kaliti - some 10 km south of Addis Ababa since mid-1986.

2. DEVELOPMENT HISTORY

Handpump R & D restarted in 1978 at EWRA with the result of the "Development Through Cooperation Campaign" as springboard. Four handpump types (A,B,C and D) were tried. Only type B was found suitable for manufacture and performed well in field trials.

Below is a recount of the chain of events that led to the choice of a conventional piston pump for further development work.

2.1 Type A - Single Valve Piston Pump

This pump consists of a 2" g.s (galvanized steel) pipe as riser and pump stand, fitted with a discharge spout at its upper end and a foot valve at its lower end. The pump employs a valveless, wooden piston about 100mm long having a diameter of about 48mm, giving a diametral clearance between dry wooden piston and 2" g.s pipe of 4mm.[3,4]

The piston is attached to a wooden pump-rod the rod being operated by pulling on a cross-bar attached to the upper end like in a bicycle pump. This mode of operation and the use of a buoyant pump rod allows relatively high piston speeds in the up-stroke.

The obvious advantage of this pump is that it requires very little machining and would thus be inexpensive as it is easily manufactured. However, this pump was excluded from the research activities at an early stage because there is excessive chaffing of pumprod/piston on the riser, resulting in heavy up-stroke and very short life of the piston.

2.2 Type B - Piston Pump with Two Valves

This pump is similar to type A, except that it incorporates a flap - valve on the piston. It was an attempt to achieve higher pumping heads while maintaining, as far as possible, the simplicity of the A-type pump.[4]

The pump, in principle, was found to be workable but was comparatively heavy to operate. It was thus decided to abandon the wooden pump rod and piston in favour of plastic components while retaining the principle of having an additional valve on the piston.

Originally this pump employed PVC on the riser, cylinder and pump rod and high density polyethylene (HDPE) on the piston and foot valves, per the Waterloo pump design [5] but with more generous valve flow areas and locally available materials. [fig.1]

Subsequent evaluation and endurance testing for 4000 hours of Type BP50 (type B - Plastic - 50 mm nominal cylinder diameter) was carried out by Consumers' Association, England. The results were encouraging. No failures occurred and PVC/HDPE appears to be an acceptable, wear - resistant combination. The elimination of the traditional cup-seals in favour of sealless HDPE pistons allowed higher overall efficiencies. The CA verdict was that the pump was of "... inherently simple, straight - forward design, suitable for manufacture in developing countries and satisfying many of the requirements for VLOM.... More likely to wear out than breakdown. Inexpensive." [6]

Its PVC riser pipe is locally extruded and injection molding in other plastics, notably polyethylene, can easily be done in the local plants. Manufacturing costs by injection molding of HDPE should not appreciably exceed the cost of inferior piston pumps previously considered in the R & D program.

Two sizes of direct action pump were initially envisaged: BP50 (nominal 50mm cylinder) for heads up to 10m, and BP40 (nominal 40mm cylinder) for heads of 10 - 15m. About 15 BP40's were field tested. Initial tests were encouraging as heads of up to 22m were tackled quite successfully even with sealless pistons. The users quickly adapted to the short and fast strokes that were necessary for direct action pumping at relatively higher heads.

However, there was rapid loss of volumetric efficiency. Wear on the cylinder was also faster because shorter and thus more localized strokes are used. The use of HDPE piston rings was not successful either. Further research on the BP40 was thus curtailed.

2.3 Type BPL (type B-Plastic-with lever)

This pump is similar to type BP, except that its pump stand (fig.2) is fitted with lever in order to permit pumping from deeper wells. Riser, foot valve and initially the piston were inter-changeable with the direct action model. Other good points of this design were the use of one single size of below-ground components, PVC riser and pumprod, and plastic or wood bushes, as opposed to ball bearings.

Three of the first model of this pump were field tested, mainly around Awara Melka, some 200 km south of Addis. The first finding was that sealless pistons led to unacceptably low volumetric efficiency a few days after installation.[4] Their use was thus curtailed after a few unsuccessful attempts to replace them with oversize pistons. Ring seals in HDPE and cup seals also in HDPE were tried unsuccessfully. It was then decided to employ a conventional brass piston with leather cup seals - both materials being locally available.

Initially, the standard PVC riser was also used as cylinder. However, piston rings expanded at joints between pipes and leather cup installation and withdrawal were difficult. A different diameter of riser and cylinder had thus to be used.

The pumprod - which was 3/4" standard PVC pipe - out lasted the HDPE pistons, piston rings and bearings but sometimes developed cracks; conventional steel rods had thus to be used.

Many materials were tried for the fulcrum and rod hanger bearings. HDPE, general purpose nylon (Nylon 66), and eucalyptus wood boiled in oil were the major ones. The HDPE bearing was a total failure whereas the others had a somewhat reasonable life in the field. The pins on which the bearings rolled were also failing frequently.

The other design details and criteria that led to the development of Afridev/Ibex are given in 4.3 below.

2.4 Type C - Oscillating Pipe Pump [4]

This pump consists of a pipe fitted with a foot valve. The pipe is suspended on a spring mounted on the well cover. If the pipe is brought to oscillate while the foot valve remains submerged, the water will commence to rise in the pipe when a sufficient amplitude of vibration at a given angular velocity is reached.

The pipe is closed at its upper end a distance above the discharge spout. A short length of flexible hose would be connected to the oscillating spout facilitating collection of the water.

This pump is attractive in that its inherent high efficiency allows lightly built women and children to pump from deeper wells easily. The major disadvantage is the difficulty in obtaining springs with proper dimensions and life. Maximum life of such a locally available spring has been 26 days or 370,000 Hz only.

Springs specifically designed to accommodate such large deflections for a long life at suitable operating frequencies were out of standard and were too expensive to custom make in Europe and America. Further tests on this pump were thus curtailed.

2.5 Type D - Stationary Pipe Oscillation Pump

This pump consists in principle of a pipe fitted with an air vessel and foot valve at its lower end which is submerged in the well water. The water inside the pipe is made to oscillate at its natural frequency of vibration, the mass of water being suspend-ed on the air cushion. Excitation is accomplished by a piston and cylinder arrangement at ground level. [3,4]

Early laboratory test of this pump were encouraging, for use as a sludge pump because the actuating mechanism could be arranged offset from the well. Induced stresses on the riser are lower as it is stationary. The pump is not self priming, however.

Field tests proved the pump to be ergonomically awkward.[4] Only few people could acquire the necessary skill to operate the pumps and efficiencies were generally low. Further work on this pump was therefore terminated.

3. MAINTENANCE

Early in the project period, it was noticed that ease of maintenance of pumps in the field was a carnal point in design. Field trials at that time were concentrated in the Rift Valley (Aware Melka and Meki regions) in the Central Region, a maximum of some 200 km from Addis Ababa. Despite its nearness to the R & D Headquarters, the maintenance problem was proving difficult for the R & D team or the EWWCA Central Region field crews.[7] It was then (ca.1980) felt that the users had to be involved for an effective maintenance on handpumps. Admittedly, not sufficient attention was given to this problem at that time because the frequent breakages were ascribed to the rather light designs we were following.

In the second phase of the R & D project supported by IDRC (since 1983), village level maintenance was one of the main objectives. It was tried in the Bale Region of Ethiopia (some 450km SE of Addis Ababa) on Shalla pumps. Some 60 pumps were installed in 12 villages around Robe town.

Two batches of trainees totalling 47 people, about half of whom were woman, were selected from the villages and were trained on one location. It was originally planned to train only women, but there were cultural pressures such that only half could be women per batch - married women who had less tendency to leave their villages.

There was not sufficient agitation done before the training and there were few volunteers. This was difficult at the start, but the participants (assigned by the peasant associations) changed their mind, once they saw the course content and training environment.

After the training, tools were left with the Peasant Associations as only one set of equipment was available per village. Most of the necessary spares that could be needed in the next one year or so were also given out to the trainees. Field maintenance by the trainees went well for about one year, but with little participation from the users afterwards. The main reasons was that there is little or no incentive for the trainees to continue the maintenance. The Peasant Association didn't give as much credit to the Water Committee as the trainees would have liked.

In addition, there was little follow-up from RADS. It is far from Addis Ababa (Ca. 450 km) mostly over rough secondary road. In addition, the social part of the project was not effectively done by engineers and technicians of RADS as they did not have the training or the "patience" for any discipline other than their own.

Some of the non-technical errors made were that there was little consultation of the users in the planning phase of the dug-wells, although they supplied the labour free during the well digging. The ownership question was therefore not fully answered in that the handpumps didn't really belong to anyone. WSSA (Water Supply and Sewerage Authority - who, de jure, are owners of projects constructed by EWWCA) - didn't exist in the Region at that time.

There was, in some instances, no felt water need: There is a perennial stream going through some of the villages such that people had an alternative "traditional" water source. Also, the wells run dry in many villages such that there was no pumping system to work on.

The project, therefore, had to be extended to answer the maintenance problem more systematically.[8] The test villages are now close to Addis Ababa (within about 200 km) and by a main road for easy access all year round. In most sites there is a genuine demand for water. The users are consulted, even prior to well digging so that they consider the pump their own. The village water-committees are set up early and are over seeing the operation, maintenance and incentive questions and deal with it as they saw it fit.

A multi-disciplinary approach is now considered more appropriate. The Institute of Development Research (IDR) of the Addis Ababa University in cooperation with the Community Participation and Promotion Unit (CPPU) of the WSSA will do the socio-economic research. A Steering Committee for handpumps research, composed of staff from EWWCA, WSSA, NWRC and IDR but reporting to NWRC, has, therefore, been established.

4. DESIGN RATIONALE

4.1 General

At the start of the R & D program, the main design criteria had been that the local pump must 1) be inexpensive, 2) be simple in design, 3) use locally available materials and must be completely locally manufactured. Due to their cheaper initial cost, direct action pumps will be used for shallower wells. Deeper wells will be tackled through 'conventional' handpumps, employing a lever mechanism. The direct and non-direct handpumps should have, as much as possible, inter-changeable parts.

This still holds true. However, all the above three criteria have had to be modified over the years:

1. The idea of village level operation and maintenance (VLOM), which was considered a subset of the above, is the most important criterion on its own. Handpumps are now designed for VLOM.

2. A higher initial cost of a pump has to be accepted. A cheap handpump which "paid" for itself one or two years after installation was considered good enough.

Present tendencies are, however, that the pump should serve - with interventions for maintenance - for about 10 years, in normal village use. This would greatly increase the reliability of the pump and enhance the trust of the user on the local product. Unfortunately, it increases the initial cost.

3. Because of VLOM and a higher level of life expectancy in handpumps, it is now accepted that some select pump components have to be imported - at least in the short- run. Besides materials once considered to be cheap and locally available, are no more so. - eg. wood.

4.2 "Shalla" Pump Design.

The "Shalla" direct action pump above-ground assembly evolved as shown in Annex 1, fig 3. The PVC pumprod described in 2.3 failed in the field due to rubbing with steel risers. (PVC risers were short in the market.) Fatigue failures of the rod, just below the bell end sometimes occurred and larger diameter PVC pipe was not available. The rod had to be replaced, therefore, with a conventional steel rod which made pumping heavier.

A short 'pedestal' of steel, the top of which is about 50 mm from the surface, is now anchored in the concrete well cover apron. This replaces casting of the anchor bolts in the concrete, which frequently broke due to corrosion. Also leakage of pumped water back into the well is now minimal. The bolt center distance, holes now are at 160mm square with diameter of 16mm. A 140x180mm center, interchangeable with the deep-well version (item 4.3) is envisaged in the next variety.

Some of the other details of the next 'Shalla' variety will have:

a. one bolt size (probably M12), and thus one wrench size only required for routine maintenance.

b. buoyant PVC pumprod, very much like the earliest version.

c. a relatively loose fitting, low height nitrile rubber cupseal or a sealless piston.

d. an extractable footvalve.

4.3 "Ibex" Deep well Handpump Design

The deep well version of the BP pump - the BPL - originally used had numerous failures in the field. The pumpstand (fig 2) made from welded 2 "and 2 1/2" galvanized steel pipes - had the most problems.

It was generally not rigid enough. The anchor bolts sometimes came loose off the concrete well cover apron, and the whole stand moved relative to the apron. Pumped water leaked under the base plate back into the well. The handle was so light it sometimes broke near the grip. Sideways movements of the handle were quite noticeable, especially after slight wear of the fulcrum bushing.

But more important, cracks, and sometimes complete shearing occurred on the pumpstand near the stop. This occurred due to the shock-load on the stand, when the handle came in contact with the stop. Rubber shock absorbers on the stand were installed, but were worn or came off after a few months.

A radical design change of the BPL pumpstand was therefore called for. And this was addressed towards the end of 1984, when the 'Afridev' pump-head was developed by the UNDP funded and the World Bank executed project, INT/81/026. Engineers of RADS, together with others active in the water sectors from mainly Eastern Africa, participated in the development of the 'Afridev'.

Some of the design criteria behind Afridev (called Ibex in Ethiopia) are as follows:

1. It is designed primarily for easy maintenance by the user and then ease of fabrication in a developing country.
2. there is only one spanner and a fishing tool required for routine maintenance.
3. piston and footvalve are extractable. Pump rods are easily disconnected, without tools.
4. there is only one set of below-ground components.
5. extensive use of plastics is made, which makes in addition to maintenance, fabrication in a developing country and field installation easier.
6. standard steel sections are used to still facilitate pumphead production in a developing country.

5. TOWARDS LARGE SCALE PRODUCTION

This section summarizes the activities yet to be completed or attempted prior to large scale production in Ethiopia.

5.1 Maintenance

The question of village level maintenance must be answered satisfactorily prior to large scale use of handpumps locally. The most feasible answer is the involvement of the user communities. Locating and digging the well, selection and training of the pump caretakers should be done in close cooperation with the community. However, the remuneration of the caretakers should be done entirely by the community, who should do this any way they saw it fit.

5.2 Material and Facilities

The current shortage of construction materials in the local market will dictate large scale production at least in the short run. Availability of semi-finished materials (eg. PVC pipes), services (eg. galvanizing) and machinery and tooling (eg. injection molding and dies) come under this category.

The solution in the short run may be to import the necessary raw materials from government funds or assistance from donors. In the long term, however, handpumps purchased for local use by NGO's and bilaterals must be paid for in hard currency. This is an incentive for local producers, which should also have an impact on the quality of products. Coordination of the different sub-manufacturers may also prove to be very difficult without the proper incentive.

5.3 Quality Control

The handpumps turned out by the plant(s) must conform to rigid standards. This has been verified by the experience on other handpump types, and is especially important if the export market is to be considered.

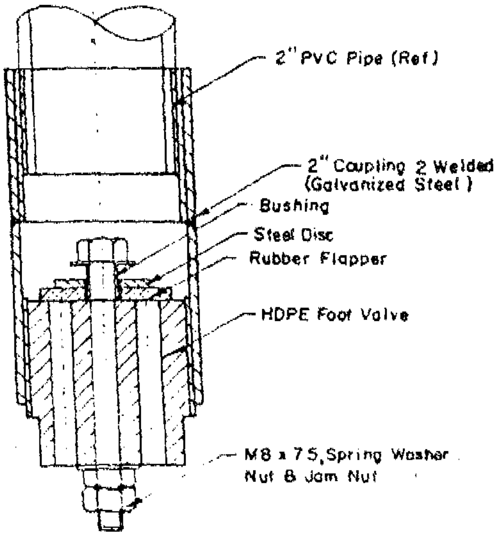
5.4 Wells

Once production of handpumps is reasonably established, the production of wells would be the bottleneck. Hand-dug wells are generally made with the cooperation of the communities involved, but don't come up fast and could also dry up after a few years. (9,10)

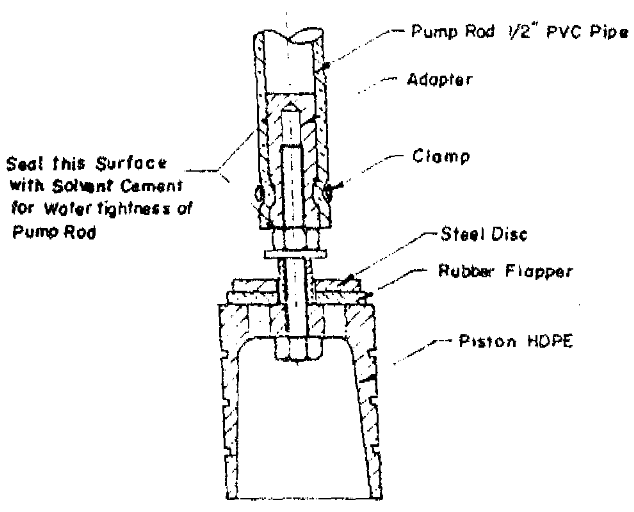
The envisaged solution is machine drilled wells. The machines should be standardized, say for a casing diameter of 4 in. (100mm) and maximum capacity to depth of 100m. Meantime, shallow aquifers could be tackled with hand-dug wells, but properly made with mechanical de-watering. Construction of the well cover apron should also be made to a rigid standard.

5.5 Popularization [10]

Introduction of handpumps for potential users, and even to some government agencies and NGO's must not be neglected. This must be strengthened such that the present local demand for handpumps (roughly about 1000 units per year [11]) increases considerably. Otherwise, it is going to take far too long to supply clean water to rural Ethiopia.



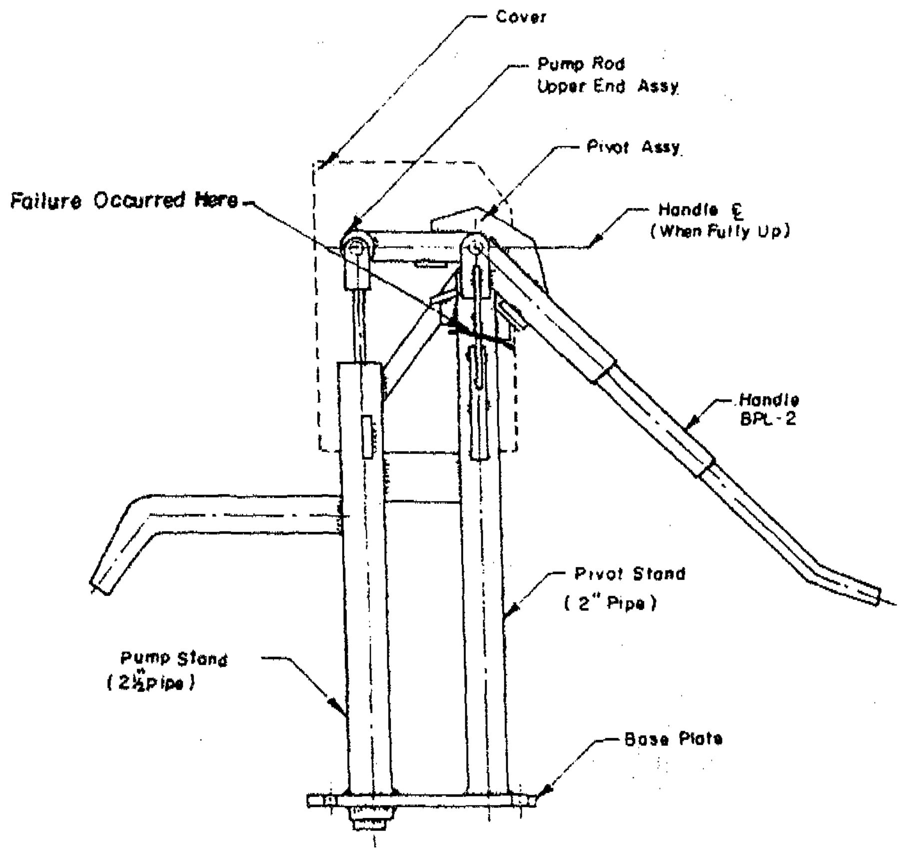
FOOT VALVE



SEALESS PISTON

Designed	Aseged M.	EWWCA	RESEARCH & DEVELOPMENT SERVICES
Drawn	GizachewT		
Checked			
Approved	Aseged M.		
Scale	~ 1:2	Title: Type BP Hand Pump Foot Valve & Piston Assembly	
Date	8-12-89		Drawing Nº
			Sheet Nº

Fig. 1



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Checked				
Approved		Aseged M		
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Date	8-12-89			Drawing Nº
				Sheet Nº

Fig. 2

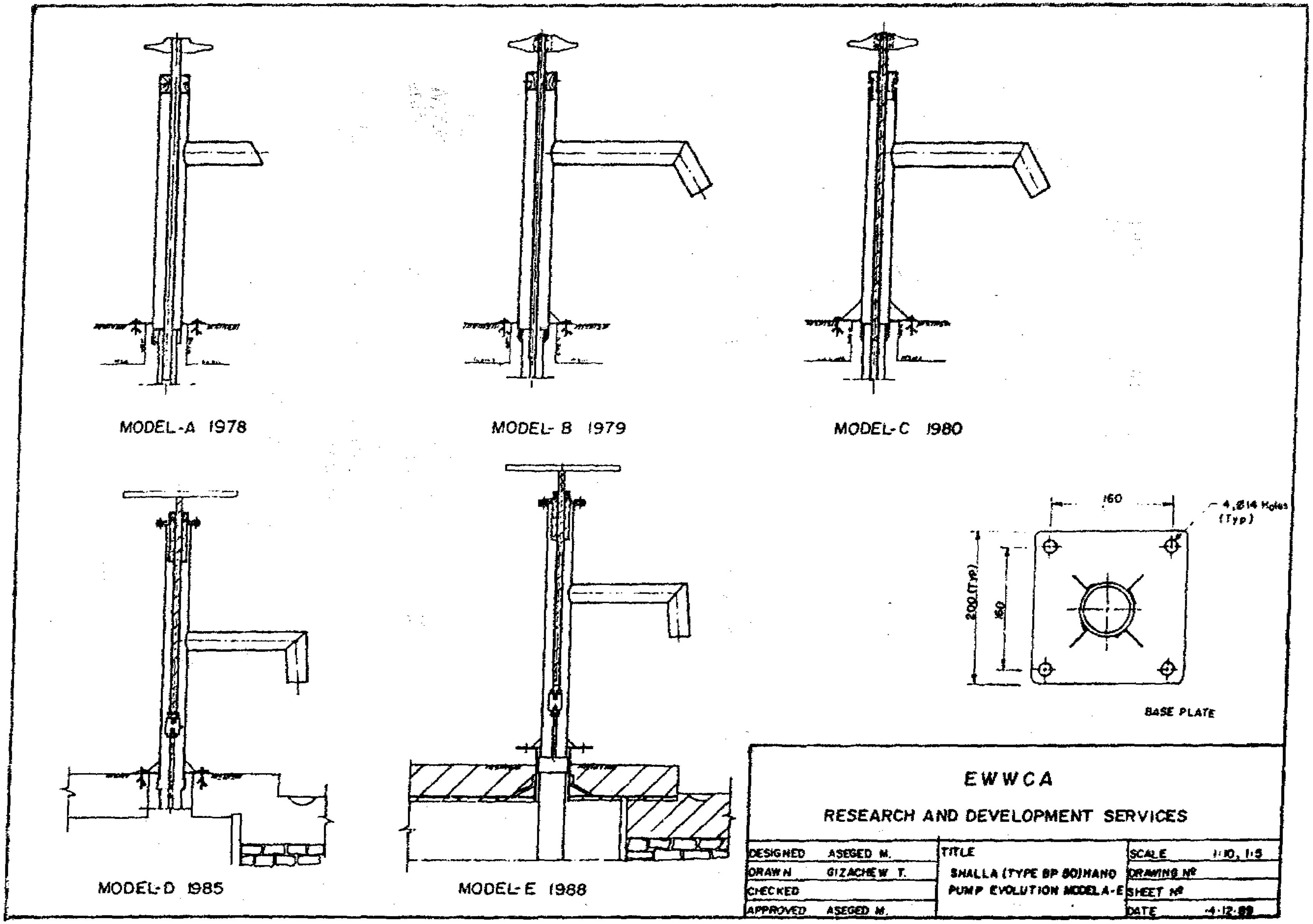
MODEL-A 1978
MODEL- B 1979
MODEL-C 1980
MODEL-D 1985
MODEL-E 1988
160
4, Ø14 Holes (Typ)
200 (Typ)
160
BASE PLATE
EWWCA
RESEARCH AND DEVELOPMENT SERVICES
DESIGNED ASEGED M.
DRAWN GIZACHEW T.
CHECKED
APPROVED ASEGED M.
TITLE
SHALLA (TYPE BP 80) HAND PUMP EVOLUTION MODEL A-E
SCALE 1:10, 1:5
DRAWING Nº
SHEET Nº
DATE 4·12·89

Fig. 3

REFERENCE

1. Teferi T., and Girma J., Slow Running Windpump, R & D Workshop by the Ethiopian Science and Technology Commission and SAREC, Addis Ababa, 1986.

2. Wolde-Ghiorgis W., Wind Energy Survey in Ethiopia; Solar and Wind Technology, Vol.5 No. 4 pp 341 - 351, Pergamon Press plc, 1988.

3. Jensen, K. Simple Novel Pumps, Faculty of Technology, Addis Ababa University, Feb. 1977, Addis Ababa. (mimeographed)

4. Aseged M., Jensen, K., Technical Report Handpumps, Research and Development in Water Pumping Technology for Rural Areas, UNDP/UNIDO Project ETH/77/013, June 1981.

5. Rudin, A., Plumtree, A., Design for Plastic Handpump and Well, IDRC file 3-P-76-0158, Report No. 3, March 1978.

6. Rural Water Supply Handpumps Project, Laboratory Testing of Handpumps for Developing Countries: Final Technical Report, World Bank Technical Paper No. 9, page 171, Washington, 1984.

7. Aseged, M., Role of Operation and Maintenance in Training (With Emphasis on Handpumps), Rural Water Supply in Developing Countries, IDRC-167e, Proceedings of Workshop on Training in Zomba, Malawi, August 1980.

8. Pumping Technology Research (Ethiopia) Phase II, IDRC Supplemental Project Document, 3-9-83-0244/ S1, March 1987

9. Aseged M., Handpump R & D Status in Ethiopia, Paper presented at the Commonwealth Science Council Workshop on Handpumps in Water Supply and Small Scale Irrigation, Lusaka, Zambia, June 1988. (to be published)

10. Aseged M., Handpump R & D in Ethiopia. Paper presented at the IDRC Global Handpump Network Meeting, Nairobi, Kenya, 26-29 September, 1989 (to be published)

11. Aseged M., Handpump and Wells Survey in Ethiopia, R & D Services, EWWCA, June 1989 (Draft, mimeographed)

Discussion on Ato Aseged's Presentation

1. WRC is conducting a survey of handpumps and wells in use in Ethiopia. What is the result of the Survey? We (CRDA) - Water Section) made a similar survey with 19 NGO's and found that 8 different handpump types were used. Is your finding similar?

   The number of the different types of handpumps presently used is not very different; 8 or perhaps 10. The survey on wells was more interesting:

   1) The average depth of a handdug well whether dug by EWWCA or NGO'S - is around 10m.deep. On the whole, its seems that 40% of wells are 10m or below, 50% are 10-45m and perhaps 10% are deeper than 45m. The tendency is for wells to be getting deeper every year.

   2) NGO's dug wells tend to be deeper than those dug by EWWCA.

      According to the data obtained, this means that Shalla and Ibex can meet practically 100% of EWWCA's demand and at least 80% of the demand by NGO's.

   3) The tendency at EWWCA is to order handpumps complete to 45m, while it should be for the average max.depth: ie. 25 or max to 30m. However, the pumps should be capable of pumping to 45m.

   4) Total projected handpump requirement for Ethiopia in 1989 is about 1000 units.

2. Is there any plan to bring the 10 - 15% imported components of Ibex down through local production?

   Yes. Most of the imported components are plastics and rubber-and the basic machinery and trained manpower for injection and compression moulding already exist in Ethiopia at Ethioplastics and Addis Tyre companies. What really remains to be done is to manufacture or procure the necessary moulds and raw materials.

   There is plan to injection mould Ibex footvalve and plunger at Ethioplastics with moulds borrowed from World Bank in the first quarter of 1990. Moulds to make rubber seals are on the drawing board at RADS. Brass cylinders can be cast at the Spare Parts factory at Akaki. However, stainless steel and other raw materials (notably plastic resins) will have to be especially imported for a long time, even if their processing can be done locally.

3. How can small NGO's contribute to the research and development efforts at RADS,EWWCA?

They can supply relatively small quantities of raw materials. However, the main assistance they could offer is in monitoring. It would be a great asset if NGO's shared with RADS their field experiences, like in organizing community managed operation and maintenance, the supply of spares, the field performance of particular equipment etc....

4. LVIA through their Country representative informed the participants that they have installed 80 simple cast-iron suction pumps in their project area around Mendida - near Debre Berhan. The pumps were originally bought from the market in Addis, but were later imported from Italy (model Egeo - 3) because none were available locally any more. The pumps have few parts and are simple to maintain. LVIA trained village pump care-takers, but their remuneration is done entirely by the community they serve. The pumps can be locally fabricated by the Akaki Spare Parts Factory, who have expressed interest to manufacture them.

   In response, the speaker said that efforts of LVIA in community managed water systems were very commendable. However, besides problems of contamination, he expressed strong reservations about wide scale use of cast - iron pumps for community water supply and as such what is appropriate in Mendida may not be replicable elsewhere.

5. Is it not because your request for smooth round bars was a non-standard product that NMWC did not supply you quickly?

   It may be because our requests have been non-standard; but our other requests to, say, Addis Tyre are also non-standard but we usually get a prompt and positive response from them. The main problem at Akaki Steel Factory is the general high demand for reinforcing bars in the country which is not met by the plant: and this is understandable. However, the original statement that more assistance is mandatory from factories of the NMWC is directed more at the galvanizing plant (Akaki Metal Products). They were too bureaucratic to galvanize the Ibex handpump components. Their prices were also too high e.g. Pumprod galvanizing per linear meter cost nearly double the price of the raw material for the rod!

   Dr. John Skoda from the floor added that NGO's and bilaterals could pay in hard currency for handpumps produced in Ethiopia and intended for the local market. This method is, elsewhere, a usually strong incentive for local factories to produce or give services of acceptable quality at competitive prices and relatively quickly.

6. Do you (RADS) monitor ground water levels in the Country?

   No. But from the hand dug wells used for handpumps some lowering of the water table is noted. Some handdug wells that supplied sufficient water over many years have now dried up. However, RADS has no information for machine - dug wells.

   A representative of SIDA from the Eastern Region of EWWCA said that the water table in the Ogaden region is indeed constantly getting lower.

Mr. Rupert Talbot noted that drilling costs in Ethiopia are extremely high and ground water levels are getting lower. However, there is a need of drilled wells on a large scale. In some cases the well diameters were too large and do not match the requirements of a handpump program. In India it has been possible to introduce small diameters for wells up to around 45m.

He had observed that among the NGO's and bilaterals the high production cost was being reduced. UNICEF is about to embark on a pilot project in Western Ethiopia aimed at high production at low costs.

7. Research, development and small scale production of Afridevs is going on in many countries, (eg. Kenya) with the assistance of the World Bank Rural Water and Sanitation Group (RWSG). Don't you think that your efforts to do R & D independently on the Ibex is sort of re-inventing the wheel?

No, because RADS has been working in close cooperation with the World Bank RWSG since 1984. For example, analysis of stresses on hooked type of pumprod connections, load carrying capability of friction type of Afridev pumprod clamps and some field test on a quick disconnect type of rod design were done in Ethiopia by RADS.

Mr. John Keen from the World Bank RWSG informed that Ato Aseged was one of the engineers actively engaged in the design of the Afridev, starting with the initial design meeting in Kenya (October, 1984) organized by the World Bank.

OPERATION AND MAINTENANCE "SPECIAL REFERENCE TO HANDPUMPS"

BY

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HEAD, OPERATION & MAINTENANCE DEPARTMENT, WSSA

1. INTRODUCTION

The Water Resources Development Authority (WRDA), the Ethiopian Water Works Authority (EWWCA), the Water Supply and Sewerage Authority (WSSA) and the National Meteorological Services Agency (NMSA) are the three authorities and one agency which are supervised by the Water Resources Commission.

Among these authorities, the Water Supply and Sewerage Authority (WSSA) is responsible for providing safe and adequate water supply for both the Urban and Rural areas of the country, and for the provision of Sewerage Services to the urban towns. These responsibilities do not include the city of Addis Ababa.

In brief WSSA's objectives are:

- Conducting feasibility studies to successfully provide water supply services.
- Planing and designing of Water Supply Systems.
- Controlling and Supervising major construction of water supply systems.
- Operation, repairing, maintaining and improving the water works under its jurisdiction.
- Coordinating, organizing and assisting the rural population to participate in the construction of hand-dug wells, ponds, spring development excavation of pipe trenches, etc. and as well as in the operation and minor maintenance of the rural water supply systems.
- Provision of sewerage services for the urban towns.

1.1 The Main Technical Departments of WSSA

WSSA has five services and seven departments at the head office and seven regional offices in different parts of the country. Among these the main technical departments are Engineering Services Department, Construction Control Department, and Operation and Maintenance Department. These three departments including

Community Participation and the regional offices are directly supervised by the office of the Chief Engineer. (See the Organization Chart in Annex).

1.1.1 Engineering Services Department

This department is responsible for the entire operations of the Engineering Services Department which shall include the Survey and Design, Studies and Research, and quantity and cost estimation divisions. In brief, the objectives of the department are to conduct feasibility studies, design and research works through consultants and also by its own manpower as required.

1.1.2 Construction Control Department

The Construction Control Department is responsible for the entire operations of the department which shall include the Urban Water Supply Construction Control Divisions. In brief, the objectives of the department are:

- Controlling and supervising major constructions carried out by contractors.
- Review and approve Payment Certificates.
- Approve and certify the provisional and final acceptance of completed projects.
- Conducting small scale constructions like offices, extension work, fencing etc.

1.1.3 Operation and Maintenance Department

This department is responsible for the overall activities of the Operation and Maintenance Department which shall include:

- The Urban Water & Sewer Works Operation and Maintenance Division.
- The Rural Water Supply Operation & Maintenance Division.
- The Water Quality Control Service.
- And the Leakage Control Section.

The objectives of this department in brief are:

- Planning, organizing, directing, administering, coordinating and controlling the operation and maintenance of the different parts of the water supply and sewerage systems.
- Directing and Supervising the maintenance of proper water quality control and sanitation standards at each and every water & sewerage units.

- To conduct leak detection at each and every water supply units.

- Ensuring that all the necessary support services are provided to the Regional Offices and Water & Sewerage Services.

2. BACKGROUND

2.1 Sanitation

In Ethiopia, the water supply and sanitation situation is very poor. The provision of sanitation facilities is further behind than water supply. Hence both urban and rural population suffer from improper sanitation. Where sanitation exists in urban areas, it is either the pit latrine or the septic tank system. In most cases, even the cities of Addis Ababa and Asmara which have partial Sewerage Service, use the pit latrines and septic tanks. Very few towns have even vacuum truck services for emptying septic tanks or pit latrines. Solid waste collection and disposal is practiced in only a few larger towns.

In the villages even the pit latrines are very rare and open field defection and urination is common practice. The responsibility for the provision of sanitation facilities is shared between three government offices.

- The Ministry of Urban Development and Housing (MUDH) is responsible for overall sanitation policy, planing and providing technical advice to the urban towns.

- The Ministry of Health (MOH) is responsible for rural sanitation, in addition to its main responsibility for health in both urban and rural areas.

- The Water Supply and Sewerage Authority (WSSA) is responsible for the provision of sewerage services to the urban towns except the city of Addis Ababa.

WSSA at present is not fully concentrating on the sewerage works. This is mainly due to financial constraints. Nevertheless, WSSA has recently started focusing on using vacuum trucks and based on this 3 vacuum trucks have been imported last year. These trucks are now giving service in Dire Dawa, Jimma and Bahr-Dar towns.

2.2 Water Supply

The water supply service levels in the country especially in the rural areas are very low. At present the estimated population of the country is about 46 million and only 17% of this population is estimated to have access to safe water supply.

2.2.1 Urban Water Supply

Of the total estimated 4.6 million urban population only about 80% are supplied with potable water including those with low level of services. The total number of water supply systems treated as urban and semi-urban are 197.(Table 1) Out of these the towns having reliable, safe and adequate water supply are not more than 20. The rest of the towns suffer from low production, inadequate distribution, leakage of water, old age of the system, etc.

Table 1 Urban Water Supply Schemes

	Name of the Region	Bore hole	Spring	River Intake	Impounding Reservoir	Lake	Infiltration Gallery	Total	Main Water Sup. Ser	Satellite Water Supply Service	Total
1	Central	25	7	6	2	-	-	40	23	17	40
2	Southern	20	6	9				35	16	19	35
3	Eastern	14	12	2	-	1	1	30	14	14	28
4	Western	21	6	5	-	-	-	32	13	18	31
5	North Western	25	5	-	-	1	-	31	14	14	28
6	North Eastern	23	1	-	-	-	-	24	8	16	24
7	Northern	10	-	-	-	-	1	11	9	2	11
	Total	138	37	22	2	2	2	203	97	100	197

* Some towns use multiole sources and the town aoears in different columns. So the excat number of urban water supplv systems are 197.

Even though it is not possible to solve this problem shortly, WSSA is trying its best to improve the water supply situation of these urban areas. As a result at present:-

- Construction is underway is 5 towns.
- Detailed engineering design has been completed for 3 towns.
- Detailed engineering design in 5 towns is underway.
- And there are 39 towns with completed feasibility studies, looking for finance for upgrading the study, detailed engineering design and implementation. The city of Asmara is among these towns and in order to reduce the serious shortage of the water supply, part of the feasibility study is handed over for construction.

2.2.2 Rural Water Supply

Of the total estimated 40.4 million rural population only about 11% have access to safe water supply. Available data indicates (Table 2) that these 11% are served water from 2083 shallow wells, 418 springs, 851 deep wells, 1 pond and 2 roof catchments. These water points are those under the control of WSSA, and those controlled by the Ethiopian Water Works Construction Authority in the Northern Region ; those constructed by some of the NGO's and other Government bodies are not included.

Table 2 Rural Water Supply Service Under the Control of WSSA

Item No.	Name of the Region	Shallow wells	Spring	Deep wells	Other	Total
1	Central	432	16	113	1 pond	562
2	Western	323	107	84		514
3	North Eastern	254	2	310		566
4	Southern	767	265	177	2 roof catchment	1211
5	Eastern	218	24	89		331
6	North Western	89	4	78		171
	Total	2083	418	851	3	3355

The remaining vast majority of the rural population rely on unsafe traditional sources, often located at long distances. Rural water supply construction and maintenance are mainly assisted through bilateral and multilateral aids from UNICEF, UNCDF, SIDA, CIDA, ODA, the Governments of Italy and China. Projects with GTZ,EEC & FINNIDA are expected to be commissioned soon. Other NGO's have also made significant contribution to the development of rural water supply activities.

3. WSSA'S OPERATION AND MAINTENANCE STRATEGY AND PRACTICE

The Operation and Maintenance department is responsible for the Operation and Maintenance of 197 urban and semiurban water supply systems and for the maintenance of about 3355 rural water services. In addition the department is responsible for controlling the water quality and checking water leakages of the above mentioned water supply systems.

3.1 Operation and Maintenance of Urban Water Supply Systems

The urban water supply systems are operated and mostly maintained by the water supply services. If maintenance becomes beyond the capacity of the water supply services, they can call the regional offices for assistance. When a major maintenance of pumps or generators required, the equipment can be maintained at the head office central workshop.

3.2 Operation and Maintenance of Rural Water Supply Systems

The rural water supply systems are practically operated by the communities and the maintenance is done:

- At the water point by the community (village level maintenance).
- At the water point or at the regional office workshop by the regional office maintenance crew.
- At the head office central workshop.

3.2.1 Village Level Maintenance

Village level maintenance is done by the caretakers or pumps attendants. These caretakers are selected from the communities and are accountable for the water committees of the respective villages. The caretakers will be trained on site or at the regional workshop by the technicians of the regional office. Then they will be equipped with the necessary hand tools if available, to enable them carry out minor maintenance and operate the equipment they are taking care of.

3.2.2 Maintenance by the Regional Office

The second stage of maintenance is done by the mobile maintenance crew assigned by the regional office. Most of the sites are located on a map region-wise, centering on the regional office headquarters. In every region water supply schemes are allocated in respective maintenance routes. For each route a maintenance crew consisting of an electrician and a mechanic is assigned. The crew is equipped with maintenance tools and vehicle for transport. The crew is mainly responsible for the electro-mechanical maintenance. The crew visits the sites based on the programme prepared by the regional office.

Whenever a breakage or a problem that hinders the supply or water occurs, the water committees report to the regional office or to the nearest WSSA's Urban Water Supply Service office, so that the message will be transferred to the regional office or to the maintenance crew, if they are on duty around the area.

When the mobile maintenance crews move from the region, they have first to refer to the respective files of each water supply in the route, and prepare themselves with the necessary tools and spare parts, if there are any complaints or failures reported prior to their departure. Whenever the maintenance crew does any repair work or change of spare parts on one particular site, the work performed will be countersigned by the water committee on the formats prepared and is filed in the respective file at the regional office.

If the problem regarding maintenance could not be solved by the mobile maintenance crew and if there is no stand-by equipment on site a heavy duty mobile workshop will be assigned to do the repair work on site. If the maintenance on site is time consuming or can not be done on site, then the equipment will be transported to the regional workshop for maintenance.

3.2.3 Maintenance at the Head Office Central Workshop

The third stage of maintenance is the maintenance done at the head office central workshop. The headquarters workshop is meant for all major maintenance work of pumps, generators, vehicles etc. belonging to all regional offices and the vehicles of the headquarters. Hence, if the maintenance of all pumps, generators, vehicles etc. are beyond the capacity and capability of the regional offices, they will be referred to the central workshop. Accordingly the central workshop also will do the required maintenance and the maintained equipment will be sent back to the respective regional office, and the regional office will take it to the site and install it back.

The regional offices have the following manpower to control, maintain, administer etc., the above mentioned Urban and Rural Water Supply schemes.

3.3 Main Problems Encountered in the Operation and Maintenance of Rural Water Supply Schemes.

3.3.1 The Ethiopian Water Works Construction Authority (EWWCA) constructs the rural water supply schemes on a programme basis. Additionally, there are also construction going on by other government bodies and NGO's. And this yearly increase of the water supply schemes can be a burden to WSSA for maintenance and control because:-

- The employment of skilled manpower can not satisfy the yearly increase of the schemes. (See Table 3)
- The assistance of donating agencies in terms of the vehicles, tools, spare parts etc. will not go parallel to the yearly increase of the schemes.
- The yearly budget allocated for the regional offices will not go parallel to the yearly increase of the schemes.
- And as a result the frequency of the visit to each schemes by the maintenance crew will decrease.

Table 3 Manpower in the Regional Office

Region	Technical	Finance	Admins.	Total
North	4	3	9	16
Western	18	4	24	46
North Eastern	38	5	15	58
Southern	33	6	21	60
Eastern	24	7	24	55
Central	27	6	36	69
North Western	17	5	29	51
Total	161			355

3.3.2 Lack of standardization of the equipment, will create difficulty in the operation and maintenance of the schemes.

- Donating Agencies and NGO's import different pumping and generating units manufactured in different countries.

- The technical peoples of the regional office and caretakers will be new for the equipment and their maintenance capability will decrease.

- It will be difficult to have sufficient stock of spare parts for the different equipment.

- It will create a problem to equip the village level caretakers with the appropriate tools for the operation and maintenance.

- Whenever new equipment are installed the caretakers require training. And this requires fund and skilled manpower.

In order to minimize the above mentioned main problems and to effectively operate and maintain the water supply schemes:

- The existence of active community participation,

- Standardization of the equipment,

- As much as possible the use of appropriate technology suitable for the communities, are very essential.

3.4 <u>The Need of Community Involvement and the Role of WSSA's Community Participation Department</u>

The involvement of the community in rural water supply schemes is an essential factor. The community has to create a sense of ownership on the project. Inorder to create this sense of ownership the community has to involve in all phases of the project, starting from the planning stage. The project constructed by people's involvement in decision, free labour and materials and finally involving in the operation and management of maintenance will create the feeling of ownership and responsibility.

As a result:

- The investment cost will be cheaper and part of the cost will be covered by the community through the contribution in free labour, materials and in some cases by cash.

- The project will be taken care of by the community and its service time will be longer.

- Reduces WSSA's involvement in maintenance, and avoids central maintenance system, requiring vehicles and crew to travel long distances from the base camp.

- The cost of operation and maintenance can be covered by the community.

For these advantages and for the sustainability of the project the community has to be well organized and has to participate actively. In order to achieve this goal WSSA opened Community Participation Department which is supervised by the office of the Chief Engineer.

The policy and objective of this department is:-

- Organizing the user communities to carry out water supply projects.

- Encouraging the communities to participate in the decision, construction, operation and maintenance of the water supply project.

- Encouraging the communities to mobilize their resources for the construction of the water supply project.

- Developing and increasing the community's awareness and sense of belonging and responsibility.

- Preparing educational materials.

- Collecting socio-economic data.

- Organizing water committees.

- Selecting pump attendants (caretakers).

Based on this policy of WSSA's Community Participation Department, the community promoters organize a water committee which usually consists of 5 members, i.e, chairman, accountant, cashier, store keeper and auditor. The committee will select caretaker and will be trained by the regional office. Then the committee will take over the completed water supply scheme and will be responsible for the operation and taking care of it.

3.5 Importance of Appropriate Technology

The aim of applying appropriate technology is that to allow the beneficiary communities to benefit from, to be willing to pay for and to make the project sustainable by the capacity of the communities. For this reason the project should be of low cost, simple for operation and maintenance, and accepted by the users.

Of the many alternatives, springs are widely regarded as the cheapest source of safe water, if they are available, can be served by gravity and is near by the users. The other option which is reliable, low in cost and simple for operation and maintenance is the use of hand pump operated systems.

3.6 Comparison of Hand Pumps with Other Types of Rural Water Supply Systems

Advantage of Hand Pump Operated Systems

- Have low initial or capital cost and is affordable by the users.
- Simple for operation: children, women, adults etc. from the village can operate it.
- Simple for maintenance: require minimal skills and few tools, and can be easily maintained by a village caretaker.
- Easy for handling: don't require heavy machinery for installing, dismantling or maintenance, thus more feasible for off-road sites.
- Operation and Maintenance cost is low.
- Cost for training of the caretaker is also low.
- Require few spare parts and is low in cost, and simple for stocking.

Disadvantage of Hand Pump Operated Systems

- Low discharge to serve a number of people.
- Not convenient to serve many people at a time, like public fountains.
- Frequent wear and tear of parts.

From the above comparison of advantage and disadvantage of hand pump operated systems, it can be concluded that the use of hand pump for the rural water supply is more advantageous. The statistical data available shows that about 62% of the rural water supply schemes are hand pump operated systems. And these systems use different types of hand pumps. The major types of hand pumps in use are:-

I Piston Type:- Consallen, Boswell, India Mark II, Clayton Mark, Afridev, Inalsa

II Rotary Type:- Mono, Moyno, Robbins and Myers

III Local Research Pumps :- Ibex, Shalla

All these pumps have a variety of models and as a result:

Some may be expensive, poor in quality and/or difficult to maintain because they require different types of spare parts and tools for maintenance.

In order to minimize these problems and complications and to make the project more simple for community operation and maintenance, standardization of the hand pumps is very important.

4. CONCLUSION

As the number of rural water supply schemes are increasing from time to time, the centralized maintenance approach from the regional offices will not be efficient and effective and thus every approach should be made to strengthen and build up the communities capacity to handle the operation and maintenance duty self-sufficiently. And in order to meet this goal:-

- The community should involve from the very inception of the rural water supply project and the community should feel the sense of ownership.
- An appropriate technology should be introduced and the equipment selected or installed should be in the concept of village level operated, maintained and managed (VLOM concept)
- The usage of hand pumps should be of high priority
- To save in training, spare parts stoking, costs and easy operation and maintenance, the hand pumps in our country should be standardized.
- For standardization, all organizations involved in the rural water supply schemes should work in close contact with the Water Resources Commission.
- For standardization and to ensure the availability of spare parts, manufacturing of hand pumps locally is of high importance. Therefore, the research work going on the hand pumps in the WRC should be encouraged highly.

Discussion on Ato Solomon's Presentation

A question was raised about quality control of construction before works are taken over by WSSA. The speaker said that there are Construction Control Crews of WSSA but were limited in their effectiveness.

One member of the NGO community stated that their strength lies with the contact they have at village level. He asked how could they also form a relationship with WSSA. The speaker urged NGO's to work closely with WRC, even though they may have an agreement signed with RRC. He recounted the problem that many NGO's hand over a completed scheme to the villagers and WSSA is not informed of its existence until there is a breakdown. Closer cooperation would avoid this. It was further stated that 10 tripartite agreements (NGO/WRC/RRC) had been signed to date and they do not constrain the NGO's in their activities.

THE ROLE OF STANDARDIZATION IN THE DEVELOPMENT OF APPROPRIATE TECHNOLOGY IN ETHIOPIA

BY

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Introduction

Being a typical developing country, the basic development objectives in Ethiopia are geared towards the achievement of economic and technological self-reliance and the overall improvement of living standard. Such an end by itself poses a formidable challenge. This is further complicated by the recurring natural calamities and by the high rate of population growth, therefore, the long-term development strategy should be supplemented and paralleled by the application of short-term economic plans and development activities capable of providing sufficient and quick solutions to the immediate socio-economic problems. This, naturally, presupposes the optimal use of the existing human and material resources, improvement of living conditions and the provision of productive employment to the population in general.

This issue calls for a prompt mobilisation of resources in a fast and efficient way. In this process the use of technologies which have a positive multiplier effects is of paramount importance. In this context the use of appropriate technology becomes both an inevitable and imperative task. When pursued to its logical conclusion such agreement implies the development of appropriate technology. In this connection, standardization as an activity has a share to contribute.

What is appropriate technology?

In the past three decades appropriate technology has evolved into a broad concept and has gained a remarkable momentum as an international movement. For these constant changes and other reasons, it has been variously and inadequately defined. The short-comings of these interpretations and their implications have been recognized by the relevant international and governmental circles and proper definitions emphasized. As a result, the present universal view regards appropriate technology as a technology mix contributing most to economic, social and environmental objectives, in relation to resource endowments and conditions of application in each country. Further, it is stressed as being a dynamic and flexible concept, which must be responsive to varying conditions and changing situations in different countries.

What is standardization?

The current definition of standardization adopted by the International Organization for Standardization (ISO) states that.

> " Standardization is an activity giving solution for recurring problems essentially in the spheres of science, technology and economics, aimed at the achievement of the optimum degree of order in a given field. Generally, the activity consists of the process of formulating, issuing and implementing standards."

Standardization offers important solutions to several economic and technological problems which affect all countries but which are particularly pressing and crucial to developing economies. Moreover, it permeates the whole functioning of an economy because it has a profound influence on the productivity and efficiency of each and every enterprise.

Standardization in Support of the Development of Appropriate Technology.

The development of appropriate technology, in general requires, the existence and/or creation of conducive environment which varies from government policies to socio-economic infrastructures and scientific and technological supports. For the purpose of this paper however, a great deal of simplification any generalization has been necessary. After all, it was felt to be sufficient enough to reflect the main points on such a short time and space.

Appropriate technology may be developed in three ways: improvement of traditional technology, usage of new technology and by a mixed approach of the two.

Improvement of traditional technology

Traditional technology is by far the most prominent among the bulk majority of the farming society and rural artisans. Indeed, this sector occupies a unique position at national level as a provider of employment and livelihood. Hence the rationale of improving traditional technology is self-evident.

The improvement of traditional technology can be effected by the provision of better implements and production techniques which directly enhance efficiency. This essentially includes they dissemination of improved designs and prototypes to artisans and other manufacturers and the extension of proper infra-structure and services.

The overall contribution of standardization can be highlighted as follows:-

To stimulate producers to upgrade product quality. This is expressed in the form of standard specifications which provide information and guidance, as well as reference points for comparison and action. Quality helps to maintain market share and revive others which have disappeared in the face of alien competition.

To aid handicraftsmen and small-scale industries in the acquisition of appropriate tools and other inputs. This is usually conducted by providing information pertaining to the necessary parameters and characteristics required and through the implementation of mandatory standards at national level which discriminate the importation or mass production of substandard tools, materials and accessories.

Introduction of new, improved designs. Though a lot of the traditional implements are most suited to their localities, there exists quite a space for improvement. This includes the upgrading of the existing ones and introducing others, with proper modifications, from one region of the country to the other or from foreign countries. Standardization can be of use, in this respect, as initial reference material and to pool knowledge which can serve as a background for further development.

Another alternative for developing appropriate technology is the generation or importation of new technologies suitable for local situations. The former requires the development and utilization of indigenous technological capability. This is materialized in the form of the ability to design and manufacture, and conducting research directed towards import substitution and self-reliance. The ability to choose, evaluate and improve the imported technology also occupies a significant position.

In this activity standardization is vital for the orderly and efficient development of this capability with overall economy and minimum time. This also includes the relevant achievements in safety and experience. A useful example can be a civil construction where the use of standardization can reduce the time required for design appreciably. The data available due to standardization will also help reduce unduly safety factors. This enables economy in material without compromise to safety. Codes of practice also contributes to take proper safety measures. Research offers safety measures. Research also benefits from standard test methods, standard measurement systems and accurate measurement instrumentation.

As for management it is presented with a better opportunity for long-term planning and simplified technical and financial auditing with overall reduction in effort and time. For all these activities standardization establishes an effective link in communication and understanding.

The other aspects of standardization i.e. interchangeability and simplification are important in the reduction of production cost and in the amelioration of utility of equipment. The importation of new technology is one of the means for developing appropriate technology. It consists of capital equipment, process and know-how.

A limited amount of technology transfer may take place through the acquisition of foreign standards, in the form of technical information. In the main, however, the role of standardization is confined to the assistance of the imported technology to fit efficiently into the existing technological infrastructure and socio-economic conditions. The significance of this role is dependent on the type and level of the technology involved. In some cases standardization helps to desegregate complex technology packages into their logical elements and components, thus simplifying the transfer of technology by attending to essential elements of processes and items of equipment rather than on entire operation of complete plants.

Under another set of circumstances, it helps to choose capital equipment and component parts of limited varieties which minimize the cost of and the need for repair and maintenance and the unnecessary dependence on a single source for supply of skill and spare parts. This is vital to reduce down time of equipment and premature obsolescence.

A mixed approach to development of appropriate technology.

This approach draws upon the virtues of the traditional and modern technologies by making optimal compromises. Therefore, it encompasses technologies of different levels and economies of various scales.

Standardization contributes a lot to the harmonic functioning of this system by warranting appropriate interface between the various products, services and functions involved. Principally, this is realized in a way of uniform and adequate system of measurement, quality specifications, terminology, symbols, etc. essential to the basic interactions. In this conjuncture standardization in form of standards becomes instrumental in precluding disputes and for an unbiased arbitration. Standardization is also very important to reduce wastage of resources during production, storage, transportation and consumption.

The contribution of standards in facilitating and promoting trade extends through the whole spectrum of standardization; from negotiation between individuals or single enterprises to international trade in raw materials and agricultural and industrial products. However, to fully realize the potential benefits offered by standardization, the operation of a certification scheme is imperative. Certification, ensures that commodities earmarked for export fulfil the quality, packaging, labelling etc. required at international markets. Thereby it improves the competitive position and safeguards the reputation of the country as an exporter. Conversely, certification provides a means of defense against the dumping in the country substandard products unacceptable elsewhere. In the end, it maximizes foreign exchange earnings and minimizes its wasteful expenditure.

Just as important, certification serves a functional purpose in the domestic production-consumption process. Only this time it is geared towards the attainment of overall economy and consumer protection. The point is most pronounced in areas where the commodity is mass-produced and where market competition is conspicuous through its absence. The experience of other developing countries shows that the policy of protection by high tariff and import restriction intended to encourage, industrialization, although sometimes essential, can become a dangerous instrument if it is not applied properly. It can easily become an incentive to a poor industry with low quality and high cost, rather than a factor producing healthy industrial growth. In cases where such industries are the suppliers of components to assembly plants or other manufacturers the lack of standardization and nonexistence of certification creates a great problem in the procurement of parts and components. This contributes not only to a slow start and low quality of the final product but also in increase in the final cost of the product, which forces the import of parts or to compromise with a lower quality product, in both cases to the detriment of the consumer.

It should be noted, however, that the producer is not the ultimate loser. As stated earlier he benefits in two ways, by the reduction of the cost of production, and as a purchaser of production inputs. After all standards are prepared and implemented by the common agreements and active participation of producers, consumers and general interest groups.

CONCLUSION

The development of appropriate technology is a timely issue which deserves the favourable approval and active support of all relevant governmental and non-governmental bodies. As mentioned previously, the need for developing appropriate technology can hardly be over emphasized. Its practical implementation, however, requires the solution of several problems. In our situation, where constraints are rather plenty, its success lies in making the best use of available resources with minimal wastage. In this process, standardization as on interdisciplinary approach to technical and socio-economic problems contributes a lot in ensuring the rational usage of resources and in coordinating the various activities.

References

1. Standardization and Transfer of Technology
   By Zawdu Felleke

2. Conceptual and Policy Framework for Appropriate Industrial Technology.

   UNIDO Publication No. 1

3. Dunn, P.D. Appropriate Technology(The McMillan Press LTD. London, 1978).

ROLE OF THIRD PARTY INSPECTION AND QUALITY ASSURANCE OF HANDPUMPS IN INDIA

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Why Third Party Inspection?

It is frequently argued that inspection by the purchaser, so called 'Third Party Inspection' is unnecessary since the supplier has a legal obligation to supply in accordance with contract specifications and to ensure supplies to an acceptable standard of quality. However, receipt at site of defective materials or equipment can result in costly delays in the completion of projects or increased maintenance and operating cost, whilst legal sanctions taken against the contractor subsequent to delivery can never wholly compensate for such delays and costs. The consequences of incorrect, sub-standard or faulty supplies have far reaching effects of time and cost overruns. Deficient supplies adversely affect the creditability of an entire programme, which ultimately may not provide the promised community benefits and if the quality of supplies is so bad that they do not serve the intended purpose, the affected projects may even be abandoned.

Third Party Inspection is aimed at ensuring that the goods comply with the contract specifications, that the manufacturing processes have been properly carried out and that the goods are adequately packed for despatch. The very inclusion of the Purchasers Inspection Clause in a contract cautions a supplier to be disciplined in his approach because he is made aware that a professional third party Inspection Agency will probe into his quality system and deficient supplies cannot be accepted. Insufficient or unclear specifications, are discussed with the buyer at an early stage and difficulties resolved to ensure that the manufacturer produces goods which fully comply with the purchasers requirements.

THIRD PARTY INSPECTION is not a duplication of or a substitution for the QUALITY CONTROL function exercised by the manufacturer, but rather a means whereby the adequacy of such control can be determined and verified. Obviously, the better the control exercised by the manufacturer, the less stringent need be the inspection instituted by the purchaser. In any event, Inspection by the purchaser or his representative does not in any way relieve the supplier of his responsibilities under the contract.

No system of inspection can guarantee one hundred percent perfection, but the process of Inspection encourages the WILL to do things right thus fostering excellence. In short, a system of planned and organised Third Party Inspection CAN and DOES reduce the risk of goods arriving at site in an unsatisfactory condition.

HAND - PUMP PROGRAMME IN INDIA

A case Study

Drinking Water - A Basic Need

We all recognise that safe drinking water is one of the basic needs of life. Sources of quality drinking water are scarce and therefore there is an urgent need to develop them, particularly for the rural population. For any community to enjoy better health and hygiene, availability of safe drinking water in sufficient quantity is essential.

India is a vast country with a very large population. Water Management in India is vital for its people and their development. In any developing country, the lives of millions of people, mainly in rural areas, depend on a reliable low cost supply of drinking water. This is usually achieved by systems based on extraction of ground water by hand-pumps.

It is believed that the development of the India Mark II Hand-pump is one of the significant achievements of the Water Decade. Today, ask any group of Indian villagers which kind of deep well hand-pump they would choose to replace their existing one and you invariably get the same answer - an India Mark II.

Over the last decade an estimated two million standardised Mark II's have been installed in India and these pumps are providing a dependable source of drinking water to some 400 million people living in the rural areas.

The pumps success has been due to the efforts of many agencies working together. At UNICEF's initiative, a well defined Inspection and Quality Assurance system has functioned in an organised and planned manner, providing technical inputs and feed back to the buyer at different stages of the programme. The stages in which the hand-pump programme has gone through to become a success in India, owes a lot to the contributions made by the Crown Agents, are described in the following pages.

Selection of an Appropriate Hand-Pump

At the start of the United Nations International Drinking Water and Sanitation Decade, UNICEF in India, carefully evaluated the performance and capabilities of many hand-pumps before narrowing down the choice to the " INDIA MARK II DEEP WELL HAND-PUMP ". It is extremely important that the selection of an appropriate pump is based on proper evaluation of the technology available and the choice is limited to standardization of only one pump. If more than one design is chosen, an effective maintenance programme can never be built up and brings with it additional problems such as: the interchangeability of pump parts, spares, inventory control, training, maintenance and upkeep etc.

The Mark II Pump's success is not only due to its well thought out design but also due to its reliability, which has over the years proved to be excellent. Both these facets are due to the initiative of the United Nations Children's Fund which played a leading role in the Mark II's success. Not only has UNICEF arrived at the design of an acceptable pump which will stand up to the rigours of life in an Indian village but in its selection has introduced a system of quality control among approved pump manufacturers which is the key to the manufacture of quality pumps in India.

Hand-Pump Specifications and Standardization

Whilst it is important to select a pump, it is equally important to define it, ie. specify it. The specification is essentially a very comprehensive statement of intent. It is a document whose provisions must be honoured, because once agreed they are legally binding. The specification is not something designed to penalise a supplier, it exists for the protection of both parties to the commercial transaction. Neither party is entitled to alter it without the consent of the other.

In India, the Mark II Hand-Pump has a comprehensive and well documented specification which is adopted as a national standard for the pump. A copy of the Indian Standard IS 9301-1984 with its latest amendments is available for reference.

In the Indian context, an important role of UNICEF's Inspection Agency, Crown Agents, has been their unbiased recommendation on developing a realistic specification, whose requirements are within the capabilities of known production processes and which are truly representative of the customers' needs. The Crown Agents contributions to updating pump technology are very significant in view of its interaction with various manufacturers, technologists and professionals in the field, and by its contributions to various forums such as II meetings, UNICEF Workshops, UNICEF - organised Conferences, etc.

A regular feed back from the Crown Agents Inspection Engineers not only helps maintain the high standards of quality required for the pump but also in updating of pump specifications, research and development efforts, and design improvements.

WORKS INSPECTIONS

Selection and Registration of Potential Manufacturers

Once a firm decision on the selection of a suitable pump and its intended specifications is made, the next step is to identify and select suitable hand-pump manufacturers.

A discriminating buyer will not take a sales representative's promises at face value. He will demand the re-assurance of inspecting the proposed suppliers quality set up and ask for a Quality Assurance audit. The last thing a professional buyer will tolerate is a sub-standard product from suppliers who have promised to supply acceptable quality. This is where the need for a professional evaluation of the suppliers works is necessary.

A significant step formulated by UNICEF in the Hand-pump Programme is to qualify prospective vendors interested in manufacturing hand-pumps. The intending manufacturers initially apply to UNICEF with a request to enrol them on UNICEF 's list of recognized firms. In selected cases UNICEF will commission the Crown Agents to professionally evaluate the manufacturers works and confidentially report on the firms capacity and capability to produce quality pumps. In effect, a Works Inspection is authorised.

A typical Works Inspection is a pre-order investigation of the manufacturers works which includes, but is not limited to, assessment of the following:

Managerial capability;
Manufacturing processes and capacity;
Quality Control Systems;
Facilities for testing to recognised standards;
Qualifications of key personnel;
General appearance of the works;
Handing facilities;
Plant, machinery and infrastructure;
Packing and Shipping departments;
Storage facilities, etc.

In order to assess the above during Works Inspections, searching questions are asked to determine the quality organization within the plant. Questions such as ... Who is responsible for quality? ...To whom does he report? ... Is he qualified? ... How does he control his quality? ... Where are the Jigs and Fixtures? ...are the test gauges calibrated? ... What about Routine test rigs, and Type test? ... Are records kept? ... Where are the records? ... May I see them please? ... and so on.

On receipt of a satisfactory report from the Crown Agents, UNICEF will place a trial order on the firm to evaluate the performance of the manufacturer and to give him an opportunity to demonstrate his capabilities as a manufacturer of quality hand-pumps to the contractually agreed specification.

Once a firm qualifies, it is registered as an approved UNICEF supplier and it is authorised to supply pumps with the prestigious advantage of being able to stamp them with the UNICEF seal of approval.

It is worth mentioning that certain firms, though initially registered, often slip or falter in their performance. UNICEF in India, again usefully utilises the Works Inspection services of Crown Agents to update the approved list of hand-pump manufacturers from time to time. Those manufacturers whose performance is unsatisfactory are dropped from the list of approved suppliers by UNICEF.

Besides registering the qualified pump manufacturers, UNICEF has made a well intended effort to encourage the State Governments in India to buy their pumps from approved manufacturers only and with UNICEF approved inspection of each consignment. This is a very important step in the programme because without a proper selection of vendors and watch over quality, it is not uncommon for some firms to copy the Mark II design and produce cheaper models, with poor welds, inferior materials, re-conditioned bearings, incorrect sections and poor workmanship etc. By encouraging a well planned system of Quality Assurance and Inspection, the strict discipline in quality supplies is maintained, not only for UNICEF's direct contracts but also for State Governments procurement.

The success of the Water Programme in India has much to do with the identification, selection and licensing of potential hand-pump manufacturers. Banking upon the experience, expertise and recommendations of its third party Inspection Agency, Crown Agents, UNICEF has scrutinised over 200 firms and has finally registered some 35 hand-pump manufacturers in India. The combined capacity and capability of these firms is considered sufficient to meet the entire need of hand-pumps in the sub-continent.

ADVISORY SERVICES

Development of Vendors

There are instances when an interested manufacturer, sometimes located in a remote area, though sincerely interested to develop his produce, is unable to do so due to lack of sufficient know-how or technical expertise. In the initial stages of the UNICEF's Water Programme in India, many manufacturers were not sufficiently equipped to produce quality pumps. Once again, Crown Agents played a vital role in sharing its expertise with vendors and helping them overcome problems in manufacturing technology.

The assistance provided by the Crown Agents included:-

- Stressing the importance of Jigs and Fixtures and helping in their design;
- Discussing techniques of production to attain a uniform and consistent standard of production;
- Appraisal of quality standards necessary for each component and increasing awareness to detail;
- Advice on selection and use of measuring tools and gauges;
- Development of templates;
- Selection of raw materials based on specified physical and chemical requirements, etc.

More importantly, the manufacturer is encouraged to manufacture sample pumps during which the various stages of production and his Quality Control system are monitored by Crown Agents. Areas requiring improvements are identified and measures are suggested to achieve desired quality standards.

Records of each Advisory Service visit are maintained and conveyed to the buyer. Once a minimum standard of production and quality control is achieved, the firm is enlisted as an approved supplier to UNICEF.

In this manner the Advisory Services provided by Crown Agents help the vendor in a better understanding of the pump specifications and improvements in methods of production and quality control. An increase in the levels of awareness to detail, undoubtedly, always helps the vendor to produce a vastly improved pump.

PRE-DELIVERY INSPECTION
At the Manufacturer's Works

The scope of inspection by the Crown Agents begins as soon as the contract is awarded to the manufacturer. The Crown Agents Inspector is contractually given free access to the manufacturer's works and is empowered to monitor quality of production at any time during the validity of the contract.A pre-inspection meeting is often held to review documentation, determine the status of engineering,check vendor's QC and test plans, determine the extent, stage and methods of Inspection involvement, establish scheduled dates for supply etc. Stage inspections are made so that mistakes if any, can be corrected and risks of incorrect manufacturing, resulting in losses of both time and money are reduced. At each stage of inspection, a record of inspection findings is kept and conveyed to the buyer. Relaxations of contract requirements can only be authorised by the buyer.

A consignment of hand-pumps, duly passed by the manufacturer's internal QC system, is kept ready for independent quality assessment by the Crown Agents. An Inspection call notifying the readiness of the consignment is sent both to the buyer and the Crown Agents.

Inspection of a big consignment, often 200 to 400 hand-pumps is not an easy task. The check-list for inspection is extensive and involves thorough probing of many aspects of hand-pump manufacture. If a systematic and planned method of inspection is not followed, such a batch of pumps would take many days to complete and the potential for mistakes in inspection occur.

The system adopted for hand-pump inspections is essentially based on a methodical display of the entire consignment. In this manner each pump assembly is neatly laid-out in racks (or fully assembled), easily accessible for examination for quality of workmanship and finish. Pump heads in particular are fixed on racks, to facilitate checks for the quality of welding, the absence of handle play, the alignment and matching of flange holes etc. Each pump is closely examined and alignments are checked very carefully. Internal welds are examined by means of a mirror and a torch. Particular attention is paid to ensure use of a genuine pump handle axle bearings and their proper fitment in the housings. Dimensions are checked to the drawing requirements and are easily determined to an accuracy of 0.5mm by a trained inspector.

In general, the following are some of the basic requirements that need to be checked in a hand-pump consignment.

- Quality of Workmanship and finish;
- Adherence to dimensions and design aspects as per drawings;
- Use of correct materials;
- Satisfactory weld profiles and free of all slag;
- Alignment of bushes;
- Gauging of machined and threaded components;
- Check for matching of flange holes;
- True and easy function of assemblies;
- Interchangeability of similar components;
- Discharge test on suitable test rig;
- Checks for quality of galvanising using special instruments;
- Check for hardness of rubber parts;

If a recurring defect is found during investigations, the inspection stops at that point and the batch of pumps is returned to the production line for correction. The Inspection agency is authorised to take such steps to ensure discipline in manufacturing and that faults once detected are not repeated.

After careful inspection and testing of a hand-pump consignment, a decision is taken to ACCEPT or REJECT the batch. A batch with CRITICAL defects must always be rejected. If no apparent deficiencies are seen each inspected pump is stamped with the CA logo and permission is granted for despatch after packing. The method of packing is verified.

CERTIFICATION

For each inspection visit a record of Inspection and Testing is maintained and findings are reported to the buyer. Depending on whether or not a lot is passed, a RELEASE NOTE (RN) or a NON-ACCEPTANCE NOTE (NN) is issued to the manufacturer with a copy to the buyer. In this report, the inspection findings are listed out, duly signed and acknowledged by the manufacturer. (Typical reporting formats, RNs and NNs are attached as annexes to this paper.

COMPLAINT INVESTIGATION

Inspection at Consignee Stores

This is yet another role that Crown Agents undertake on behalf of UNICEF in India. Some times there are complaints from Consignee Stores about faulty or incorrect supplies and it is necessary for a buyer to ensure whether the complaint is legitimate or not. Doubts are expressed on the quality of supplies actually reaching the stores compared to the quality apparently offered at the manufacturer's works.

Being familiar with the product specifications, product quality at the approved manufacturer's works and standards in marking and packing, the Crown Agents are best qualified to investigate. These findings are unbiased favouring neither the manufacturer nor the complainant. An occasional inspection by Crown Agents at Consignee Stores helps to reconfirm whether or not the hand-pumps reaching destination are correct. Recommendations from the Crown Agents thus helps the buyer in initiating remedial action against the defaulting party.

Discussion on Mr. Vaish's Presentation

The point was raised that small companies could not financially survive if they had to wait for 200 pumps to be inspected as had been described in the presentation. This speaker made it clear that small numbers can be put up for inspection especially in the early stages of production. The purpose is to help the manufacturer improve his product by working closely with him, not just inspecting the final product. However, the inspection cost per pump would be high if small batches are used.

There was a question from the floor about the relative cost of quality assurance and inspection in an India MK II. The speaker however, couldn't give figures, except to say that it was a small fraction of the pump cost. A figure of about 1.3% of pump cost was volunteered from the floor, (Mr. R. Talbot)

4. General Discussion

There was a long discussion on the private sector producing the Afridev. It was pointed out that the ensuing competition would reduce costs and improve quality. It was also reiterated that payment in hard currency to manufacturers and their local suppliers would enhance efficiency.

There was discussion from the floor regarding a suitable size well for handpump installation. In Harerge an NGO had been insisted upon to drill 6" diameter wells, which had increased their drilling costs. It was pointed out that a 4" will may be suitable for shallow wells but 6" should be standard for deep wells. Furthermore a 4" well would not be useful should a village increase in size and require a motorized unit. Mr. Rupert Talbot concluded by saying that a 4" well may not be appropriate in some situations but that for rural wells up to 40m there is no justification for 6" wells. The emphasis should be on reducing costs and increasing production.

FIRST NATIONAL WORKSHOP ON HANDPUMPS ADDIS ABABA, ETHIOPIA

14 DECEMBER, 1989 WORKSHOP SUMMARY

1. There should be a move toward the increased use of VLOM handpumps in order to shorten down-time and to allow villagers to take over all routine operation, maintenance and minor repairs.

2. Standards should be developed, adopted and utilized for production of shallow (up to 12m pumping head), deep (10m to 45m) and extra-deep (more than 45m) well handpumps. For shallow wells the handpump design should be refined and field tested as a matter of priority. The IBEX/Afridev standard can be adopted and utilized for deep wells. Research should also be tackled for extra-deep installations.

3. Improved monitoring of handpumps for all depths is required. This information is needed from all programmes and results should be fed back periodically to all concerned.

4. Community development and training of both men and women water committee members and caretakers must be included in all handpump programmes in order to achieve sustainable systems that can be managed by the local beneficiaries.

5. Suitable training and promotion materials for policy makers, implementors and users are needed in order to create an understanding and enthusiasm for the benefits which well-developed VLOM handpump systems can deliver.

6. Local production of VLOM handpumps and spare arts should be developed in order to have a sustainable supply of pumps and spares. In order to ensure competition and inter-changeability of components such production should be to international standards with regard to specifications and quality control. As has been the case in other countries when launching local production, external support agencies can address the issue of scarcity of convertible currency and/or raw materials by either providing the raw materials or paying for finished products in convertible currency.

7. Producers must implement internal quality assurance and control measures. Third party inspection and certification of this are essential for all handpump procurement. The Ethiopian Standards Authority may have a role in carrying out this function.

8. Standards and guidelines for appropriate well construction in terms of depths and diameters, screening, well-head protection, etc. need to be developed and enforced. Control of costs and maintaining a reasonable speed of work are required if adequate numbers of wells are to be available for handpump programmes.

3.3.2 Lack of standardization of the equipment, will create difficulty in the operation and maintenance of the schemes.

- Donating Agencies and NGO's import different pumping and generating units manufactured in different countries.
- The technical peoples of the regional office and caretakers will be new for the equipment and their maintenance capability will decrease.
- It will be difficult to have sufficient stock of spare parts for the different equipment.
- It will create a problem to equip the village level caretakers with the appropriate tools for the operation and maintenance.
- Whenever new equipment are installed the caretakers require training. And this requires fund and skilled manpower.

In order to minimize the above mentioned main problems and to effectively operate and maintain the water supply schemes:

- The existence of active community participation,
- Standardization of the equipment,
- As much as possible the use of appropriate technology suitable for the communities, is very essential.

3.4 <u>The Need of Community Involvement and the Role of WSSA's Community Participation Department</u>

The involvement of the community in rural water supply schemes is an essential factor. The community has to create a sense of ownership on the project. In order to create this sense of ownership the community has to involve in all phases of the project, starting from the planning stage. The project constructed by people's involvement in decision, free labour and materials and finally involving in the operation and management of maintenance will create the feeling of ownership and responsibility.

As a result:

- The investment cost will be cheaper and part of the cost will be covered by the community through the contribution in free labour, materials and in some cases by cash.
- The project will be taken care of by the community and its service time will be longer.

9. Emphasis should be given to stronger coordination of government and non-government organizations working in the water sector. NGO's operating with agreements with the Relief and Rehabilitation Commission should be encouraged to liaise more closely with the Water Resources Commission.

10. Agencies interested in supporting handpump programmes are encouraged to review their experiences, to identify issues and prepare papers for presentation at the main Handpump Workshop proposed to be held at end of the first quarter in 1990.

CONCLUDING REMARKS

By Com. Kefyalew Achamyeleh, D/Commissioner, WRC

Dear Participants,

With great satisfaction I declare that our First National Handpump Workshop has been a success much beyond our expectation in achieving its intended objective. The large turn-out of organizations engaged in water supply to attend the workshop in response to our invitation has been a clear demonstration of their desire to see an organized action to popularize handpumps in rural Ethiopia. The level of representation has been high in most cases and this is further proof to us of the genuine interest to hear and do something about our call.

The active participation of members in the discussions has been high and spontaneous, and this has been an encouragement for us to proceed with further follow-up action. The papers presented by the speakers have been of high quality and of very educational nature as intended.

The genesis of the development of the India Mark II Handpump to a successful sturdy equipment gaining wide acceptance of use within and outside India has indeed been interesting with many lessons to be drawn for our situation.

The UNDP/WB - Group activities on introducing VLOM ideas into hand-pumps; the Shalla and Ibex pumps, the first one still needing further refinement while the latter can proceed to production and popularization as a VLOM handpump.

Our conviction has been strengthened by the conclusion of the workshop expressed through the summary read out to us by the Rapporteur. We recognize the necessity of expanded drilling of appropriate shallow wells commensurate to the needs of the handpumps for the purpose of keeping costs down and maintaining a reasonable speed of coverage.

I wish to appeal to you to actively participate in our next work-shop after about three months by preparing papers about your experiences in rural water supply development in this country. We will get in touch with each one of you with specific details about the workshop.

It is also our wish to contact you in order to familiarize you with the format of the Commissions system of liaising with NGO's activities in water. The Commission's interest is to ensure sustainable water supply systems for rural Ethiopia. We know NGO's are investing considerable amount of funds to improve rural water supply. All we want is to ensure as much as you also do that your systems last long. This is more rationally done by standardizing construction and equipment and introducing appropriate technology to the community.

All systems are eventually handed over to the communities and these communities with inevitable support from the Commission will have to carry on maintaining and operating them. We have been working with many NGO's closely and successfully. All what is needed is to create a system of communication between us to facilitate exchange of data and ideas. This workshop has been organized with close cooperation and assistance and encouragement of UNICEF/WB group.

I wish to thank them both for their enthusiastic help and for making available their senior staff who are, as we have seen, very knowledgeable about handpumps and their development.

Hoping to see you in our next meeting, I wish to declare that our workshop is now officially closed.

Thank you.

ANNEX 1 - FLYER OF THE WORKSHOP

Dear Sirs,

Subject :- <u>First National Handpump Workshop</u>

The Water Resources Commission as the nodal organization for the supply of drinking water to the population of Ethiopia, promotes the development of appropriate technology and the search for low cost sustainable options in its Water Supply Programmes.

Towards these endeavors, the commission has supported a programme of handpump research and development for several years.

On this subject, WRC is organizing the First National Handpump Workshop in cooperation with UNICEF and the UNDP/World Bank Regional Water and Sanitation Group for East Africa (RWSG-EA) and with the participation of several Government, public, UN, bilateral and non-government organizations.

The date of the Workshop is Thursday December 14th. The purpose will be to orient our partners from organizations active in the Water Sector on the need to introduce handpumps suitable for operation and maintenance at the village level (VLOM), through a programme of local manufacture and standardization. (Please refer to the agenda enclosed for further details).

Your organization, recognised for its' knowledge of, contribution to and involvement in the Water Sector in Ethiopia, is cordially invited to participate in the Workshop by sending one delegate with direct responsibility and experience of the Water Sector in Ethiopia and/or knowledge of the Workshop subject.

We would appreciate written confirmation of your delegates' nomination by Friday December 1st so that we can finalize seating and other arrangements.

We look forward to your participation.

Sincerely yours,

FIRST NATIONAL HANDPUMP WORKSHOP

Organized by The Water Resources Commission In cooperation with UNICEF and the UNDP/World Bank Regional Water and Sanitation Group for East Africa. (RWSG - EA)

Date: Thursday, December 14th 1989

Place: Design Center, Water Resources Development Authority, Addis Ababa.

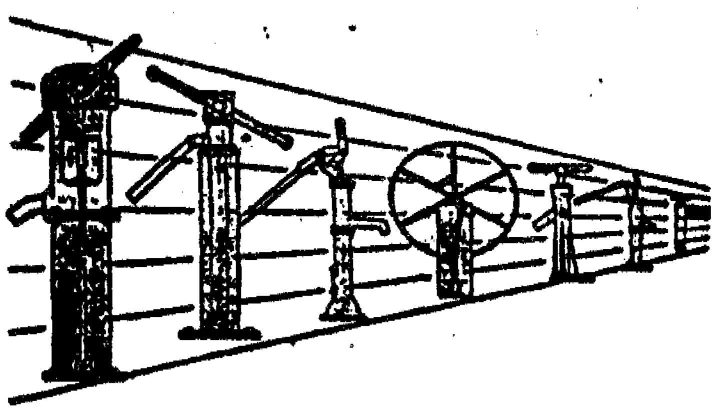
Objectives:

1) Review of EWWCAs Handpump Research and Development Programme within the framework of interregional efforts to promote the standardization and in country manufacture of VLOM handpumps.

2) Emphasize the importance of community involvement in O & M.

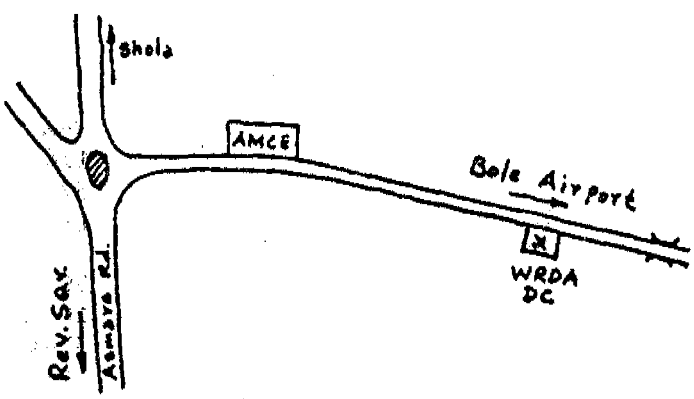
3) Highlight the need for standardization through a programme of local manufacture and quality control of VLOM handpumps.

4) Decide on a course of action for follow up.



A G E N D A

Time	Topic	Responsibilites
08:00-08:30	Registration	WRC
08:30-08:45	Keynote address	Comrade Kefyalew Achamyeleh Deputy Commissioner WRC
08:45-09:00	Workshop Procedures Appointment of Chairpersons & Rapporteurs.	WRC
09:00- 10:30	The interregional handpumps project and the VLOM approach	RWSG - EA
10:30-11:00	Coffee Break	
11:00-11:30	The India Mk II and MK III handpumps	UNICEF
12:30-12:15	EWWCA's handpump research and development programme	RADS
12:15-13:00	Discussion	Participants
13:00-14:00	Lunch	
14:00-14:30	Operation & Maintenance with especial reference to handpumps	WSSA
14:30-15:00	The role of standards in appropriate technology in Ethiopia	ESA
15:00-15:30	Quality Control and the need for third party quality assurance in handpump manufacture	Crown Agents
15:30-16:00	Discussion	Participants
16:00-16:30	Coffee Break	
16:30-16:50	Workshop summary	Rapporteurs
16:50-17:00	Closing remarks	Comrade Kefyalew Achemyeleh Deputy Commissioner WRC



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24	HOLS P.	WORKSH.SUP.INTENDANT	SIDA/EASTERN REG.	161 D.D.	05/11 26 76
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46	SHAWEL ASTATKE	R.W.S.U.	AGRI.SERICE ETH.		16 48 11
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50	TADESSE DAMTE	CROWN AGENTS REP.	C.A. A/A	3424	15 94 17
51	TALBOT R.	CHIEF WATER SUPP.	UNICEF	1169	51 13 44
52	TAYE TADESSE	DIVISION HEAD	WSSA	5744	18 27 66
53	TEKKA GEBRU	PROJECT OFFICER	UNICEF	1169	51 33 04
54	TEREFE HAILU	HD/ETH. H ARSI	A/RHS		31 10 61
55	TESFAYE DAMA	DEPT. CHAIRMAN	AAU	385	55 10 22X
56	TESFAYE ESHETE	HD/OF PUB. REL. DEPT.	WRC	1045	18 52 79
57	TESFOM HAILE	D/HEAD OF CPPS	WSSA	5744	18 53 44
58	THORSEN J.	RES. REPRESENTATIVE	NCA	1218	51 45 65
59	VAISH D.	TECHN. OFFICER	CROWN AGENTS		
60	WUBNEH ASFAW	EXP. ASST. COORD.	WRC	1045	18 52 77
61	ZERAZION TSEHAY	MECH. ENGINEER	ETH.STAND.AUTH.	2031	61 01 11X