Government of Malawi
Ministry of Works and Supplies
Water Department

Report on

Workshop on National Strategies for Operation and Maintenance of Rural Groundwater Supplies

Mangochi, Malawi
1-4 December 1986

UNDP/World Bank
Handpump Project
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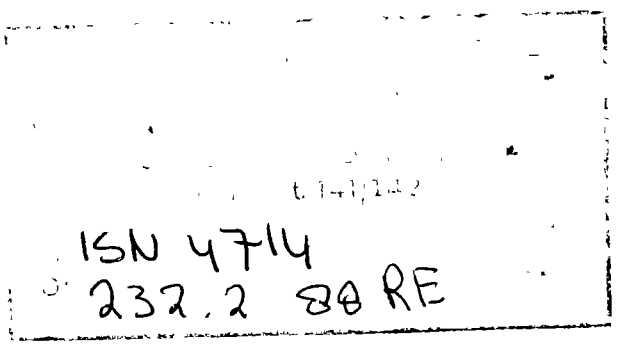

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Report Contents

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Warmest thanks of all go the participants, whose willingness to contribute to the open discussion of the challenging and often daunting subject of handpump maintenance. Without their enormous contribution the Workshop could not have been the success it was.

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Workshop on National Strategies for Operation and Maintenance of Rural Groundwater Supplies

Executive summary

In Malawi, 1.5 million rural people should today be served with potable water supplies close to their homes by 5,000 boreholes and 3,000 dug wells, all equipped with handpumps.

However, despite considerable investment of manpower and financial resources in maintenance, it is estimated that 3,000 to 4,000 of these pumps are out of order at any one time, with severe consequences for the users. It is also estimated that over 20,000 more boreholes and wells are required, and the need for a solution to the serious maintenance problems of today is clear.

The Workshop set out to address this issue and its **key conclusion** was that:

> **"Self-help should play an important role in the maintenance of wells and boreholes, as it does in most spheres of rural development in Malawi. Communities must be involved to the maximum extent possible in the planning, siting and construction of their wells and boreholes and then should undertake the management of their water supply, including the execution of routine repairs and the purchase of routinely wearing spare parts. Government has a major role to play in extension and training, and the execution of major repairs that communities cannot handle themselves."**

In reaching this conclusion, there was agreement on the following:

1. The existing maintenance system needs restructuring.

2. A Procedure must be developed, tested and adopted for the achievement of community management of rural groundwater supplies. This Procedure must then be followed in the construction and rehabilitation of all boreholes and wells.

3. Communities cannot be expected to take over the management of either old boreholes and wells in poor condition, or those fitted with heavy and complex pumps. A substantial rehabilitation programme is needed to rehabilitate or reconstruct old boreholes and wells and to replace old pumps.

4. Standard handpumps should be locally manufactured, be simple enough for communities to maintain with minimal tools and skills, and use easily replaced and readily available spare parts that communities can afford to purchase.

5. The Ministry of Community Services should have a formal, fully funded role to play in community mobilisation for management of rural groundwater supplies.

6. The Ministry of Health should run a formal, fully funded, programme of Health Education and Sanitation Promotion (HESP), in parallel with all rural groundwater development.

1. Restructured maintenance system

Analysis

- Between 30 and 40% of Malawi's handpumps are out of action at any time, and it takes an average of 1-2 months before they are repaired.
- Handpumps used in the national borehole programme are difficult and costly (K350 per pump per year) to maintain. A truck and winch is needed to lift the heavy pumphead and a skilled team with specialist tools is required. Spares are imported, expensive, and often in short supply.
- The need for mobile units makes the system very expensive to operate and transport costs account for a high proportion of total costs. Because many of the vehicles are old, they are under repair frequently and for long periods. Repair costs are high, and when a unit is without its vehicle, no handpump repairs can be undertaken.
- The present system of mobile units is so stretched that it can only respond to breakdowns. No preventive maintenance is possible, though its desirability is recognised. The system is difficult to supervise and manage because of inadequate numbers and poor training of staff. Reporting of breakdowns is inefficient because of poor communication within the system and the district unit being to remote from the users.
- There was minimal community mobilisation or education in the planning or implementation of the national borehole programme, and so there is very little interest in maintenance or feeling of responsibility for the pump.
- There is no formal structure or budget allocation for maintenance of dug wells. Maintenance is carried out on an *ad hoc* basis by construction staff. Within the overall maintenance budget for borehole handpumps there are no allocations to the regions, which would encourage proper planning and utilisation of the funds.
- The shallow lift handpump for dug wells needs further development work to make it more reliable and easier and cheaper to maintain

Recommended actions

- A committee in **every village** to be responsible for management of the water supply, collection of funds and purchase of spare parts. Pump caretakers within the village need to be trained in proper use, care and repair of pumps. The need for repair teams at Area level will depend on the ease of repair of the chosen handpump.

- A new cadre of Monitoring Assistants (as in the Rural Piped Water Programme) to be established, living within the **Area** (or EPA). The Monitoring Assistant (a Technical Assistant) has an important extension role and will be the cornerstone of the Government's support to community-based maintenance. Each Monitoring Assistant will be provided with a loan to buy a bicycle, and will cover 100 to 200 pumps.

- A strengthened and streamlined **District Maintenance Team (DMT)**, to repair heavy pumps and to assist the Monitoring Assistants with complex repairs. The DMT will be led by a Senior Technical Assistant, who will also supervise the Monitoring Assistants. It will be staffed by a reduced team of driver-mechanic and 2 mechanics, and equipped with a motorcycle and specially fitted light truck. The District Works Supervisor will have a supervisory role, in particular with regard to authorising vehicle use.

- Regular activities of the DMTs will be supervised at the **regional level**, which is currently staffed by a Regional Works Controller and a Regional Hydrogeologist. Further restructuring of the maintenance system at regional level may be necessary, to take full account of the maintenance needs of both rural piped water supplies and rural groundwater supplies.

- The maintenance programme will continue to be planned and supervised at **national level**. The existing Maintenance Unit at headquarters must be substantially strengthened, to include: a Training Officer responsible for designing and organising training programmes for DMTs, Monitoring Assistants and Community members; and a Mechanical Engineer to manage the national operation and specifically to supervise handpump design, procurement, quality control, and performance monitoring issues. In the short term, the Principal Hydrogeologist will continue to have responsibility for the programme. However, maintenance needs of the rural water supply programmes will have a major overlap in the field of extension support to and training of communities, and the technical differences are not too complex. This may justify a unified rural water supply maintenance structure, from Branch level at Headquarters through the Regions and Districts to Area level.

2. Procedure to achieve community management

Analysis

- The existing national programme for maintenance of handpumps consists of units or teams based at various centres across the country. These are primarily equipped to deal with borehole handpump breakdowns only.
- There is as yet no established shallow well pump maintenance organisation, and maintenance is carried out on an ad hoc basis by construction personnel .
- A centrally based system is characterised by high costs arising from the increased logistical inputs. It is also fraught with many other constraints or problems .
- Transport invariably accounts for the greatest proportion of the cost, about 42% of the annual budget in the year 1985/86. The current system of operation is that of responding to reports on breakdowns only.
- Owing to the large number of boreholes and to the large travel distances involved per maintenance unit, there is very little scope for the preventive maintenance, which is so essential to prolonging pump life.
- There is very little scope for the recipient community to participate in the operation and maintenance, i.e. management, of their own water source.
- In recent years, the shortcomings of centralised maintenance have been generally recognised, as has the importance of community ownership and community responsibility for handpump maintenance. As a result, the demand for handpumps which can be maintained by village repairers has increased greatly.
- From experience with maintenance systems throughout the world, it is becoming clear that most successful programmes have in common the achievement of maximum community involvement in the maintenance of handpumps and minimum dependence on central government support. Experience has also shown that this must be preceded by the maximum possible community involvement in all stages of planning and implementing handpump projects, so that a strong feeling of community ownership of and responsibility for the pump is established from the outset.

Recommended actions

If community management of maintenance of wells and boreholes equipped with handpumps is to be successfully achieved, a clear **Procedure** must be developed, tested and adopted. This Procedure must then always be closely followed, not only when new waterpoints are being constructed, but also when existing waterpoints are being rehabilitated. The Procedure is equally important whether the Government or a contractor is drilling boreholes - it is possibly more important in the latter case. The Workshop discussed the development of this Procedure, and the possible benefits of involving social scientists from the Centre of Social Research (CSR) were considered. Draft Terms of Reference for a study by CSR are given in *Annex 15*. The Procedure is likely to include the following stages:

EXTENSION, where the Monitoring Assistants are in place and dialogue begins.

AWARENESS, where the community is able to discuss its needs and aspirations, its willingness to contribute (in kind and cash), its capacity to manage.

CHOICE, where the community decides whether it wants an improved waterpoint, which brings with it the responsibility for management.

ORGANISATION AND TRAINING, where the community forms a management committee and initiates funds collection, and extension staff begin a training programme (an extension process that will continue for years).

CONSTRUCTION (OR REHABILITATION), where the community participate to the maximum extent possible.

PUMP INSTALLATION AND SPARES DISTRIBUTION, where a pump that the community can maintain is installed and a spare parts distribution system established.

HANDOVER, where communities formally undertake the responsibility for managing their own water supply.

MAINTENANCE BACKUP, where the Government maintenance structure (comprising Monitoring Assistants, District Maintenance Team, Regional and National supervision) is in place to assist communities in need.

3. Rehabilitation

Analysis

- For community management to be successful, boreholes and wells must be in good condition and pumps must be suitable for village-level maintenance.
- Many boreholes in Malawi are very old (some over 30 years) and in very poor condition, either due to siltation or to corroded casings. This situation can only be improved through cleaning, relining and redevelopment, or, in some cases, by abandoning the old borehole and drilling a new one.
- Many pumps have exceeded their economic life and are thus very expensive to keep in operation. These pumps will need to be replaced with pumps that villagers can themselves maintain.

The principal technical problems can be summarised as:

- poor borehole design, resulting in silt and sand being drawn into the borehole causing silting up of boreholes and accelerated wear of pump components;
- the borehole handpumps used are difficult and expensive to maintain because they require heavy lifting equipment and specialised tools to remove the pumphead before any maintenance work can be carried out on the below-ground components.

Recommended actions

- To achieve community management of existing wells and boreholes, a major rehabilitation programme is needed. Ideally this should be carried out on a district-by-district basis, to rationalise community mobilisation, implementation and maintenance system establishment.

- Modifying the maintenance structure to incorporate a much greater level of participation by the user communities makes the rehabilitation requirements massive, and the costs enormous. It is necessary, therefore, to evaluate the borehole rehabilitation programme carried out so far.

- The specific terms of reference are:

  1. Review the planning of borehole rehabilitation with particular reference to the criteria used for choosing boreholes to be rehabilitated and selecting the approach to rehabilitation to be used in each case. This should include review of the data from construction, from maintenance records and from water quality records, and the information (from inspection of the site) on pump condition and usage, condition of surround, site location in relation to pollution risk and attitude of the user community towards the existing pump and towards rehabilitation.

  2. Examine in detail the methodology of borehole rehabilitation, including: Methods of cleaning and re-testing the boreholes, design of remedial measures, such as inner linings and gravel packs and other alternative methods of implementing the remedial measures. Design and implementation of improved surface works.This detailed examination should include the removal of handpumps, plumbing of borehole depths and re-testing procedures to compare borehole condition and performance with that immediately following rehabilitation, immediately pre-rehabilitation and at the time of construction. Make detailed recommendations, if appropriate, for improvement to or alternatives for the methodology of rehabilitation.

  3. Assess the technical effectiveness of borehole rehabilitation by carrying out a comprehensive and detailed examination of the maintenance records of rehabilitated boreholes before and after rehabilitation to determine the extent of reduction in both frequency of repairs and periods of inoperation of the handpumps. Within this detailed examination, make a comparison between boreholes at which the handpump was replaced with those at which it was not.

  4. Assess the financial effectiveness and impact of borehole rehabilitation in reducing the recurrent cost of maintenance by carrying out a detailed costing analysis of maintenance before and after rehabilitation.

  5. Review the technical and financial effectiveness of borehole rehabilitation with particular reference to the alternative approach (on a site-by-site basis) of replacement of seriously defective boreholes by newly drilled, properly designed and constructed boreholes. Establish technical and financial criteria for the choice between rehabilitation and replacement for each borehole.

  6. Review the overall requirements for borehole rehabilitation on a national scale, and define the current needs for rehabilitation and/or replacement boreholes.

  7. Examine the current and proposed projects in which borehole rehabilitation is a principal component and assess the impact of those on the overall rehabilitation requirements. Define areas of the country where rehabilitation requirements are significant but which are not covered by present proposals.

  8. Review the plant and equipment currently being used to implement borehole rehabilitation, and make recommendations, if appropriate, for alternatives.

  9. Assess by direct observation and enquiry the impact of borehole rehabilitation on the attitude of the user community to the borehole and handpump, in cases both where the handpump was replaced and where it was not.

  10. Review the present methods of recording technical and financial information regarding borehole rehabilitation and assess their effectiveness in providing a basis for monitoring rehabilitation. Recommend ways in which this could be improved.

4. The Handpump

Analysis

- Community management can only be achieved if handpumps are used that villagers can repair, and spare parts that villagers can afford to buy are readily available.
- Few pumps in the field trials, in Malawi and elsewhere, have proved suitable for village-level maintenance. As a consequence, much attention has been given to technological development of handpumps for rural water supplies.

Recommended actions

- In East Africa, development of handpumps for village-level maintenance has taken place over 5 years, with the objectives that pumps should be:

  - modular in design, so that the same cylinder, rising mains and standard wearing parts can be used for direct action pumps to 12 m and deepwell pumps to 50 m.

  - as simple as possible to install and maintain with minimal tools, skills and effort.

  - relatively simple to manufacture in medium-sized, well managed workshops, requiring straightforward production engineering and minimal quality control.

  - designed so that scheduled servicing should result in the virtual elimination of breakdowns and that such servicing involves only routine and simple replacement of low-cost wearing parts, such as bearings, seals and valves.

  - suitable for use in aggressive groundwater through the use of corrosion- resistant materials below ground; and capable of resisting sand abrasion.

  - designed to minimise forces, allowing the use of lighter components which can incorporate a larger design safety factor.

  - low cost, so that user communities can generally afford to purchase the pump (perhaps with credit) and can always afford to maintain it.

- The new generation Malawi pump (known as the Afridev Pump by the Handpump Project, the Nyayo Pump in Kenya and the Ibex Pump in Ethiopia) is the result of this development work and is now ready for full scale production. During 1987, production will be established in Malawi, hopefully including the injection moulding of bearings and cylinder valves and the full assembly of cylinders. With these pumps it should be possible for communities to manage their own boreholes and wells, with training by and extension support from Government.

5. Role of the Ministry of Community Services

Analysis

- The Ministry of Community Services (MoCS) is a service ministry, with an Assistant Community Development Officer and several Community Development Assistants in each district.
- MoCS has had a long association with rural water supply development in Malawi, having initiated the rural piped water programme in 1969 and managed it up to 1980. Many of the lessons learned and the methods adopted in this programme are directly applicable to the rural groundwater supply programme.

6. Role of the Ministry of Health

Analysis

- The Ministry of Health (MoH), through its Environmental Health Division, is currently implementing a Health Education and Sanitation Promotion (HESP) programme within several rural piped water supply projects. The HESP programme, under the direction of the Principal Health Coordinator, is regarded as an outstanding success.
- In order to maximise the health benefits of investments in rural water supplies, it is generally recognised that health education and sanitation improvements are essential parallel activities.

Recommended actions

- The MoCS should play a formal, specific and fully funded role in community mobilisation and training for community management of rural groundwater supplies. This role needs clear definition within the Procedure described in 2. above, and should be developed by the proposed CSR study.
- It is possible that additional charges could be added to the construction cost of boreholes and wells, to meet the cost of community mobilisation and thus to ensure that MoCS has adequate resources to perform this crucial task.
- MoCS should be incorporated into a national, inter)ministerial steering committee which should oversee the rural groundwater supply programme.

Recommended actions

- As a consequence of the success of the current HESP programme, a fully funded HESP component should be incorporated into the rural groundwater supply programme.
- MoH should also be represented in the inter-ministerial steering committee described in 5. above.

Workshop introduction and background

Introduction

This report describes the **Workshop on National Strategies for Operation and Maintenance of Rural Groundwater Supplies** held at Club Makokola, Mangochi, **Malawi** during **1-4 December 1986.**

The Workshop was organised by the Government of Malawi, in collaboration with the UNDP/World Bank Rural Water Supply Handpumps Project and UNICEF. The Workshop was jointly funded by the UNDP/World Bank Project and UNICEF.

This report was prepared in draft by the workshop organiser and rapporteur in Malawi in the week following the Workshop.

Background to workshop

Rural groundwater supplies, comprising dug wells and boreholes equipped with handpumps, currently supply about 1.5 million rural people in Malawi (about 25% of the total rural population) through about 8,000 handpumps. It is understood that planned coverage of this type of water supply could exceed 60% of the rural population.

Borehole handpumps have traditionally been maintained by mobile units, with 24 teams, each equipped with a truck, based at different centres across the country. Although this system has been fairly effective in keeping relatively small numbers of handpumps working, costs have escalated in recent years, as have logistical problems as the numbers of boreholes have increased.

It is estimated that:

- the annual cost of handpump maintenance on the dispersed programme is K350 per pump per year;
- about 60-70% of pumps are operating at any one time; and
- that response time between breakdown and repair is typically 1-2 months, and sometimes greatly exceeds this.

In 1981/2 the then Department of Lands, Valuation and Water initiated a programme of **Integrated Projects for Rural Groundwater Supplies**, a new approach based on a high degree of community involvement in both construction and maintenance of water supplies. The first integrated project was the **Livulezi Project** in Ntcheu District, and the Water Department of the Ministry of Works and Supplies has subsequently initiated several other integrated projects across the country.

In the Livulezi Project, some preventive maintenance of handpumps is carried out by trained villagers (mostly women) and repairs are carried out by maintenance assistants, equipped with bicycles and tools, with substantial help from villagers. Each maintenance assistant looks after about 100 pumps and lives amongst the community that he serves.

The Water Department has been monitoring technical, social and financial aspects of handpumps performance in the Livulezi Project since 1982. The results of the monitoring have been consolidated into a substantive report.

Key observations regarding the maintenance system during 1984/85 (when most pumps were 2-3 years old) are that:

- the actual costs (both direct and indirect) of maintenance were about K40 per pump per year;
- about 95% of the pumps are operating at any one time; and that
- the response time between breakdown and repair rarely exceeds 2 weeks.

However, this apparently good record conceals the one critical bottleneck, and that is ensuring the movement of spares from centralised stores to the maintenance assistants. Whilst this pilot decentralised maintenance system may not be fully replicable across the country, there are clearly many lessons to be learned. The implication for up to 30,000 handpumps are that *centralised* maintenance would cost over K9 million per year (at present prices) to give a level of service with a very slow response time and with several thousand pumps out of order at any one time.

In contrast, a *decentralised* maintenance system for the same number of pumps could cost less than K1.5 million, with a rapid response time and only a few hundred pumps out of order at any time.

There are various options that can be considered for the design and management of decentralised, national handpump maintenance system, and each option will have different implications in terms of policy, costs, allocation of responsibilities, and training needs. The Workshop was held to review the findings of the monitoring programme and the implications for the rest of the country, and to consider national strategies for operation and maintenance of the rural groundwater supply programme.

Workshop objectives

The proposed objectives of the Workshop were:

1. To discuss the findings of the handpump testing programme. These findings relate to:

   - the technical performance of the handpumps, including both locally made and imported units.
   - the social acceptability of the handpumps.
   - the involvement of villagers in handpump maintenance.
   - the effectiveness of different maintenance systems.
   - the cost of handpump maintenance.

2. To discuss the findings in relation to the national rural groundwater supply programme, including the following issues:

   - selection of suitable pump types, and whether they should be locally manufactured or imported.
   - if locally manufactured, the tendering procedures and execution of quality-control procedures.
   - the role, if any, of the community in siting, installing and paying for handpumps.
   - the design of pump installations, to ensure optimum amenity value and minimal pollution risk.
   - the role, if any, of the community in carrying out and paying for maintenance.
   - the role, if any, of others (e.g. NGOs, the private sector) in carrying out maintenance.
   - the role of Government in carrying out and paying for maintenance, and the identification of appropriate distribution of responsibilities (i.e. to Water Department, District Councils, ADDS etc.).
   - the organisation of an operation and maintenance system that will ensure speedy repairs at minimum cost.

3. To make detailed recommendations (including: a timetable, allocation of responsibilities, the inputs required, if any, from donors or other agencies) regarding the selection, manufacture, installation, operation, maintenance and financing of handpumps for rural water supplies in Malawi. These recommendations could be considered by the Government in formulation of policy for the Rural Groundwater Supply Programme.

Workshop participants

In view of the importance attached by Government to the workshop, and the fact that the level of performance of handpump maintenance has a major bearing on the rural development activities being carried out by other ministries, donors and non-government organisations, it was proposed to invite a wide range of participants. Invited ministries and organisations were requested to send senior representatives who were responsible for the planning, implementation and management of rural development, and who would have an active interest in the provision of rural water supplies.

Thus the **Ministries of Health, Community Services, Finance, Office of the President and Cabinet, and Local Government,** as well as the **Water Department and Ministry of Works headquarters** were represented by senior and experienced staff, who were able to contribute significantly to the discussions and the successful outcome of the Workshop. The principal donors and non-government organisations involved in the water and health sectors were well represented.

UNICEF, a major contributor to the national wells programme, is currently funding an integrated project at Emcisweni in the Northern Region, and is also supporting health education, literacy, nutrition and other programmes in the Ministries of Health and Community Services.

The **Christian Services Committee** has been a long-standing supporter of the national borehole programme, and has many times expressed concern to the Water Department about the problems of borehole and handpump maintenance.

USAID is the major current donor in the rural piped-water programme and has been very keen to encourage community mobilisation for maintenance in the programme, and to expand the linked health education and sanitation components of the programme.

The **Save the Children Federation** is carrying out a programme of water, health and nutrition development linked to the Rural Growth Centres. The **International Eye Foundation** is concerned about high incidence of eye infections in the Lower Shire Valley, and has suggested a programme of borehole rehabilitation to improve the reliability of the rural groundwater supplies there.

Lastly, the **Mechanical Engineering Department of the Polytechnic** has been involved in the past in the development of the Malawi Mark I to Mark V series of direct)action, shallow well pumps, and could perhaps be involved again in the future.

Several of the invited organisations were unable to send representatives. The Workshop organisers had invited the Ministry of Agriculture, and requested them to send a senior representative involved in planning and managing the National Rural Development Programme (NRDP) and the Agricultural Development Divisions (ADDs). A significant proportion of the current funding for rural groundwater development comes from NRDP projects through the ADDS, and they have been one of the most persistent critics of the Water Department's maintenance record. It was, therefore, a great pity that they were unable to send anyone; the rural farming communities of Malawi are the principal sufferers from poor maintenance of handpumps.

Also, the Ministry of Agriculture has probably the most widespread and best developed extension services in the country. During the discussions in the Workshop on the establishment of a modified maintenance system, it was suggested that their basic unit, the Extension Planning Area (EPA) might be the most appropriate area of responsibility for the proposed cadre of handpump monitoring or maintenance assistants. The absence of the Ministry of Agriculture was greatly regretted by organisers and participants alike.

Other organisations who were invited but were unable to attend were the Centre for Social Research (CSR) of the University of Malawi, the World Health Organisation, World Vision International and DANIDA. With his wide experience of the rural piped-water programme and deep knowledge of the rural communities in Malawi, Dr Louis Msukwa of CSR would have been of the utmost value as a resource person for the Workshop. He was unable to attend because of a prior commitment to attend a regional meeting in Lesotho.

DANIDA is currently funding an integrated groundwater project for the construction of new boreholes and rehabilitation of existing boreholes in the Karonga Lakeshore area, with a high level of planned community and inter-departmental involvement. Its resident project hydrogeologist from Karonga could have made a useful contribution to the Workshop.

A list of participants' names appears in *Annex 16.*

Workshop proceedings

This section, the main body of the report, describes the most important points arising from the formal presentations, plenary sessions and group discussions. Many of the issues raised early in the programme became more clearly defined as the Workshop proceeded, and the agendas set for the group discussions were intended to help facilitate this. All of the material distributed during the workshop is included as Annexes to this report.

Day 1: An Overview

The Workshop was opened by the Guest of Honour, **Mr C Clarke, the Secretary for Works and Supplies.** His speech (reproduced in full as *Annex 1*) left the participants in no doubt as to his own personal concern about the problems of maintenance of rural groundwater supplies and his view that the Workshop was of great importance to Malawi.

He referred to the inadequacy of the present maintenance system to deal with the existing 5,000 borehole and 3,000 dug-well handpumps. Up to 40% of the pumps are estimated to be out of action at any one time, representing no return on a financial input of many millions of kwacha, and resulting in great inconvenience, increased health hazards and disillusionment for the potential users.

With about 1.5 million people in the rural areas served by the gravity-fed piped-water projects, and relatively few suitable protected sources still untapped, the remaining 4.5 million of the present rural population will need to be served by groundwater supplies with handpumps. Allowing for population growth, there is a total requirement of perhaps 30,000 handpumps. Clearly a significant change in approach to the provision and maintenance of rural groundwater supplies is required; one in which the spirit of self-help plays the same crucial role that it plays in other rural development activities in Malawi.

The Secretary for Works concluded by assuring the participants that they had a very important job to do in a very short time, and urged them to begin to define the ways in which this change of emphasis might be translated into an effective and viable maintenance system.

The second session commenced with all of the participants introducing themselves and the ministries or organisations they represented. The aim of the organisers in so doing was to provide everyone present with an opportunity to say a few words informally about their organisation's activities within or associated with the rural water supply programme, and to add their own preliminary observations on the problems of maintenance of handpumps.

The first speaker was the Water Department's Principal Hydrogeologist, **Mr SMN Mainala,** who gave a brief resume of the history of groundwater development in Malawi, and described the existing maintenance system for the national borehole and dug well programmes:

The maintenance organisation is headed by the Senior Borehole Maintenance Officer (STO) based at Water Department headquarters. He is supported by his deputy, the Borehole Maintenance Officer (TO) who is presently based at Zomba. Below this, in a supervisory capacity are four maintenance foremen (STA) based in Balaka, Lilongwe, Mzuzu and Karonga.

Maintenance of borehole handpumps is carried out by 24 mobile units, based generally at District level but also taking account of the distribution of boreholes. Each team, consisting of a driver and 4 to 6 semi-skilled operators, has a 5 or 7 ton truck equipped with an electrically operated winch for lifting pumpheads and removing downhole pump components. The current organisation is shown in *Figure 1.*

There is at present no formal maintenance organisation for the maintenance of the 3,000 or so dug-well handpumps; maintenance is carried out by wells programme staff on an ad hoc basis and is completely inadequate.

He went on to give an indication of the current cost of borehole maintenance. The average cost of maintaining a borehole handpump in the national programme now stands at about K350 per year. The present accounting system does not readily permit the calculation of exact maintenance costs on a borehole by borehole basis. Boreholes which are visited very frequently will have incurred costs much greater than this average, and may be so uneconomical as to require replacement. Others which require less frequent repairs may be costing much less than this average.

Some useful stimulus for later discussions was provided by the budget figures presented by Mr Mainala. Of the total 1985/86 budget of about K 750,000, transport operating costs accounted for just over 40%, staff costs for about 28% and

handpump spares for about 20%, the balance being various office and overheads expenses. He concluded by picking out some of the major problems of the existing maintenance system, which were taken up, discussed and defined later in the Workshop. Mr. Mainala's paper is included as *Annex 2* of this report.

He also referred to his recent visit to Abidjan to attend the All Africa Seminar on Low-Cost Rural and Urban-Fringe Water Supply. At the meeting, representatives of 30 countries in sub-Saharan Africa and 15 external governmental and non-governmental support agencies endorsed the *Abidjan Statement.* Its five-point strategy, Mr. Mainala declared, was particularly relevant to the present Workshop.

The emphasis in the Statement on the adoption of low-cost technologies, decentralisation of responsibilities, increasing community participation in planning, implementing and maintaining supplies and the integration of health education, sanitation and other complementary activities, he felt, was a useful starting point for our own discussions. The Abidjan Statement is included in this report as *Annex 3.*

Speakers from the other government ministries and non-government organisations raised a number of important points in this session. The relationship between water and health was discussed by several, water-related diseases being a major health problem in the rural areas.

During one outbreak of cholera in the Lower Shire, a direct relationship was observed between cases reported and the state of repair of borehole handpumps. An emergency programme of handpump repairs was carried out and the number of cases of cholera immediately dropped.

The relationship between poor water supplies and serious eye infections was also emphasised; there is a planned project of borehole and handpump rehabilitation in the Chikwawa District to help alleviate this. The possibility of a major project for rehabilitation of existing wells and boreholes and construction of new ones in Nsanje District was raised.

The attention of the participants was drawn to the relationship between "hardware" and "software" issues in the improvement of rural water supplies. They heard the story of the initiation and expansion into the gravity-fed water projects of consultation, participation and responsibility in ensuring the lasting success of rural development activities. Education and training of both project staff and participating communities are essential elements of the development of human resources, which must receive equal or even greater attention than the development of the physical resources. The experience of the Ministry of Community Services could be very useful in this respect.

A number of the problems with the existing maintenance system were touched on. Financial responsibility for handpump maintenance in the national programme had rested with local government until 1980. However, the District Councils increasingly found their funds to be too limited for this in addition to all their other responsibilities and, after lengthy discussions, borehole maintenance became a central government responsibility. It remains a very heavy financial burden for an over-committed revenue budget.

The role of the District Development Committees (DDCs) was briefly discussed. The DDC (of which the District Commissioner is Chairman) is involved in the selection of priority villages for boreholes to be construction under the national programme. However, site selection, construction and pump installation are carried out by government. There is no proper consultation with the actual users themselves (as opposed to their representatives at district level), no proper handing over of the pump and no real sense of community ownership of the supply. When the handpump breaks down, all the users can do is report the breakdown to a remote and busy official.

In early 1986, a series of meetings with the DDCs were initiated by the Water Department to discuss ways of improving the situation by investigating the possibility of establishing village water committees for all pumps. However, this would be likely to meet with very limited success because of the difficulty of mobilising communities who have had no previous inputs to the site selection, construction or maintenance of the borehole and handpump and which they have viewed as entirely government's responsibility, perhaps for many years in the case of the older-established boreholes.

The third session began with a panel presentation on the Livulezi Groundwater Project. First, **Mr LWC Munthali,** the Senior Borehole Maintenance Officer (see *Figure 1*) provided some additional details of the existing maintenance organisation and some of its problems. These included the difficulty of keeping the vehicles operational, occasional shortages of spare parts, manpower constraints and the difficulties of communication and supervision. These were expanded on later in the Workshop.

The existing 24 units are distributed as follows:

Northern Region	5
Central Region	9
Southern Region	10

reflecting the overall distribution of population and the borehole density. The presentation was continued by **Mr FBJ Msonthi,** hydrogeologist in the Water Department and Project Manager of the Livulezi Project during its implementation. He provided some background to the project and described the way in which the maintenance system had been established there. The project covers

180 sq km in the Livulezi Valley in Ntcheu District. A total of 201 wells and boreholes serve nearly 50,000 people in 90 villages. Construction was carried out in a pilot phase in early 1981 and in the main phase from early 1982 to late 1983.

An essential feature of the project was the involvement of the community right from the planning stage. Through the District Commissioner and local political and traditional leaders, large public meetings were held to announce the project and to encourage community participation in the project.

This was followed up by extensive and intensive efforts throughout the project to encourage the formation of village water committees well in advance of water- point construction. This was in turn followed by considerable participation by the communities during implementation, by choosing the site of the water point, clearing access, providing labour, providing bricks, sand, stone and water for apron construction and other assistance.

In this way, a strong sense of community ownership of the well or borehole and pump was built up during preparation and implementation of the project, to provide a sound basis for community participation in maintenance.

To ensure there is adequate provision for maintenance:

Each village water committee selects one person as the caretaker for the pumps in that village. The committees consist largely of women and most caretakers are women. The caretaker's main responsibility is to carry out preventive maintenance by weekly checking and, if necessary, tightening the bolts on the Malawi pumphead. To do this, the caretaker is provided with two universal spanners and a diary to record these activities.

The caretaker and committee have additional responsibilities for keeping the surroundings clean, ensuring correct operation of the pump, reporting breakdowns to the maintenance assistants and organising community support for repairs.

The caretakers are assisted, trained and supported by two government maintenance assistants, each provided with a house, store, bicycle, and tools and supplied with spare parts. Each is responsible for 100 pumps serving 25,000 people. They were trained in the installation and repair of the handpumps during construction and with the help of the caretakers and committee are able to carry out almost all repairs to the handpumps in the project.

Mr Msonthi handed over to **Mr KG Liyanage**, the UN Volunteer acting as Country *Monitoring Engineer for the UNDP/World* Bank Handpump Testing and Development Project. He continued the panel presentation by describing experience of the maintenance system in the Livulezi from 1983 to 1986, based on the careful collection of monitoring data on the frequency, type and cost of repairs.

Throughout this period, the project has operated at 90 to 95% effectiveness; only 5 to 15 pumps have been out of operation at any one time. The average response time is one or two weeks, frequently much shorter but sometimes longer in the case of more difficult repairs. A careful costing study, including staff, transport, overheads and spares has indicated that the average annual maintenance costs are about K40.00 per pump, about K1 per family, of which the spare parts component is about K0.12 per family.

Further details were given in the paper which was distributed to participants, and which is included as *Annex 4* of this report.

Mr Liyanage concluded his presentation with a brief description of the handpump testing programme in the Livulezi Project. The overall objective of the Handpump Testing and Development Project is to monitor social, technical and financial aspects of handpumps and handpump performance, and to develop pumps which communities can afford to maintain and are able to maintain. The full details of the testing programme and description of the handpumps is given in the paper distributed to the participants and included here as *Annex 5.* The panel presentation produced responses from several participants and a number of important points were raised. It was pointed out that the experience of maintenance in the Livulezi was very impressive but there was some concern that this might be a special case. It was proving difficult to replicate this fully in subsequent integrated projects.

There were also important points raised concerning the communities' part in the selection of technology options, and a cautionary word on the potential dangers of government completely withdrawing from maintenance responsibilities. The role of government would remain a key one. This was illustrated by the one major problem of maintenance in the Livulezi Project. The supply of spare parts to the project had at times been irregular due to budget constraints, logistical difficulties of distribution and occasional non-availability in Malawi.

Each of these points was taken up later in the group discussions, and will be commented on again at an appropriate point in these proceedings.

The last formal presentation of the first day was a paper by **Mr PJ Chilton** outlining possible options for maintenance systems for handpumps. Three general options were presented:

A *central managed system* usually consisting of a public sector organisation with mobile maintenance teams, based at district

centres, which respond to breakdowns reported by user communities.

A *community managed system* in which full responsibility and capability for carrying out maintenance rests with the user community. In such a system, the community collects money, enters it into a maintenance fund and draws on the account to purchase spare parts and perhaps pay local repairers to maintain the pump.

A system in which *management is shared.* This typically involves the user community in carrying out preventive maintenance and simple repairs. Major repairs are the responsibility of an external agency, often using area mechanics equipped with basic tools and a bicycle and paid by the agency, who may also be responsible for the distribution of spare parts. In some cases contributions are made by the users to help pay part of the costs of maintenance.

The features of each of these are further explained in the paper, which is included as *Annex 6* of this report. Several options exist for who actually carries out the maintenance and how it is financed, and there are a number of conditions which need to be met to enable user communities to participate fully and effectively in the maintenance of handpumps.

A supporting paper was also distributed, containing notes on several case studies of maintenance systems in a wide range of countries, to be used as examples to promote discussion. Several, for example Thailand and Ghana, were experiencing exactly the same kind of problems as Malawi, particularly the high cost of transport and personnel in relation to the cost of the spare parts for the handpumps. In many of the examples, the communities' involvement in routine maintenance is being promoted and encouraged by education and training, supported by government staff from increasingly decentralised maintenance organisations. This supporting paper is included as *Annex 7*.

This concluded the formal presentation of background papers for the opening day of the Workshop. The participants divided into their four groups to consider the points on Agenda 1, and reported back to the full plenary session at the end of the day.

Agenda 1

1. Review and identify key points from the opening speech;
2. Review the principal points of the Abidjan Statement;
3. Review the paper describing possible maintenance options;
4. Discuss and report on the possible ways in which community participation in maintenance can be encouraged;
5. Discuss constraints on the community participation in maintenance;
6. Suggest possible additional agenda items for discussion on the third day of the workshop, by listing the main problems of handpump maintenance.

There was an almost unanimous feeling that there were too many items on the agenda and that time was too short to do them justice. Nevertheless, a number of subjects received a preliminary airing (which was the organisers' intention) and became recurrent and gradually more closely defined themes later in the Workshop. There was already general agreement on the need for community mobilisation, education and participation early enough in a rural water supply programme that a sense of ownership would be fostered. In commenting on the Abidjan Statement, the importance of a multi-sectoral approach to the provision of rural water supplies, incorporating health education, sanitation and community developed, was endorsed.

Day 2: The Field Visit

Some of the problems of borehole maintenance in the national programme, some possible solutions to these problems, and many of the issues raised on the first day were well demonstrated by the field visit.

The participants travelled to Ntcheu, stopping near Balaka at a Climax handpump. They noted the poor condition of the pump, with a great deal of waste water lying around the pump. The participants talked about the pump to the users, who informed them that it belonged to government and was entirely government's responsibility to repair.

At Ntcheu, the existing maintenance system was illustrated by the Balaka Maintenance Unit, who demonstrated the lifting and removal of the Climax pumphead and below-ground components from a borehole at the market. The participants saw the team with their 5-ton truck and specialist equipment, and watched them assemble the legs of the lifting frame which goes with the front-mounted winch. The pumphead, weighing about 80kg was lifted and laid beside the borehole, and the six 3-metre lengths of galvanised steel rising main and pump rods and the brass cylinder were removed in about 30 minutes. The cylinder was dismantled to reveal the worn cup leathers with abrasive material embedded in them; material drawn into the borehole because of poor borehole construction, especially lack of properly designed slotted screen and gravel pack.

With this make of pump, and several others used in the national borehole programme, the pumphead and all the below-ground components have to be removed in this way to replace the most rapidly wearing parts, the leather seals on the plunger. This maintenance task had already

been carried out twice before in 1986; at boreholes with severe problems of sand in the pump discharge this may rise to more than six times a year. The common problem of corrosion and high iron content of the discharge water was seen in the eaten-away pump rods and flaky coating on the rising main.

Leaving the mobile team to complete the repair, the Workshop then moved on to Mphepozinai at the southern end of the Livulezi Project, where one of the project maintenance assistants is based. The participants were able to discuss his work with him and examine his store of spare parts and tools. He told the participants that three of his borehole handpumps and two dug well pumps out of 100 were not operative at present. The participants were able to have similar discussions with the second maintenance assistant during a stop for lunch at his house in Kandeu.

The second pump visited was a Malawi borehole pump with similar downhole components to those at Ntcheu. The participants were able to meet members of the village water committee and the pump caretaker, and see her diary and maintenance spanner. The participants also noted the improved sanitary condition of the borehole and surround, the lack of waste water spillage close around the borehole (because of the long outlet pipe) and the general cleanliness of the site.

After the caretaker had removed the cover plate of the pump, the maintenance assistant helped the committee members, who were all women, loosen the fulcrum, hanger and pedestal bolts and then remove the handle, pumphead and hanger unit. They then called on some of the men of the village to assist in lifting the rising main. By using large wrenches and several people, the community and the maintenance assistant between them were able to lift the same length of rising main as the team at Ntcheu.

The third pump visited was an Afridev pump from Kenya. The pump features the results of extensive development work over the last two years - relatively cheap but hard-wearing plastic fulcrum and hanger bushes, easily retractable plunger and footvalve and easily dismantled, hooked pump rods. The pump had only been installed the previous week, but the maintenance assistant had already been able to train the pump caretaker and committee members to dismantle the pump to replace the wearing parts.

With only a single small spanner, the women were able to open the pumphead, loosen the handle and hanger bolts, remove the plastic bushes, remove the plunger on the hooked rods and remove the foot valve with a specially designed catcher on a nylon rope from the same depth as in the other two boreholes. The dismantling operation was completed in a few minutes and then all wearing parts - bushes, seals and valve bobbins could be replaced equally quickly.

The women were able to re-assemble the pump in a few minutes, first dropping the foot valve into its specially designed receiver at the bottom of the PVC rising main, then lowering the plunger on its hooked rods and carefully replacing the bushes and re-assembling the hanger and handle, tightening the bolts and replacing the cover. The whole operation took about 25 minutes, and could have been even quicker if there had been no questions to answer!

The Workshop participants were clearly very impressed by this demonstration. The Afridev pump could be the basis for a fully community-managed system, with relative cheap, easily manufactured locally, and therefore readily available, spare parts which are simple to replace. This raises the possibility of routine maintenance being carried out on a *scheduled* basis, probably annually, in which all the wearing parts are replaced as a package costing perhaps K15-20. This is an exciting prospect.

A number of the participants cautioned that the pump was still new and relatively untried in Malawi. The Afridev pumphead has been subjected to extensive field trials and is now going into full-scale production in Kenya. The retractable downhole components and hooked pump rods are undergoing field testing in Kenya and now Malawi and will go into full production in 1987. The UNDP/World Bank Project has great confidence in the potential for this pump, the result of 5 years' development work, to form the basis for a truly community-managed maintenance system. A leaflet describing the Afridev pump was distributed to the Workshop participants. The three pumps visited could be said to represent three maintenance options:

The Climax pump at Ntcheu, requiring a truck and winch and special tools, representing the centrally managed system;

The Malawi pump, requiring the maintenance assistant, several specialised tools and help from the committee and villagers, representing the shared system; and

The Afridev pump, in which all operations were carried out by the committee and caretaker with one spanner, a length of rope and a special fishing tool, representing the potential for a community-managed system.

The contrast in handpump maintenance seen on the field visit completed the background needed by the Workshop participants for the intensive discussions to follow.

Day 3: Problems, Solutions and Structures

The only formal presentation of the morning was a short paper by **Mr WRG Mandowa,** which is included as *Annex 8* of this report. He described the arrangements for maintenance in the rural

piped-water programme, including the roles of the several committees and the Water Department monitoring staff and the types of maintenance operation that each carries out.

The principle of the user communities making small cash contributions to the cost of maintenance is well established in the rural piped-water programme, although the actual mechanisms and amounts vary from project to project. The Tap Committee collects funds from each household for purchase of bib-cocks and cement to repair the apron and in some projects also to pay the caretakers who look after the intake.

Dr LAH Msukwa of the Centre for Social Research has recently completed an extensive survey of a number of piped-water projects and has discussed the communities' contributions to the cost of maintenance. These were summarised in a table in Mr Mandowa's presentation. By calculating a shadow cost of labour for the time spent by the community on maintenance and adding this to the cash contribution, the community share of total maintenance costs in five schemes varied from 26% to 77%. The cash contribution varied between 3% and 8% of the total maintenance costs in the same five schemes.

A further interesting point is mentioned in his survey. In several of the schemes the local leaders were asked whether the Water Department or local authorities should take over the maintenance of the schemes from the community. In all cases the answer was an emphatic "No"! They feel that they have so far managed to maintain the schemes and are sure they can continue to do so provided government support is maintained and in some cases improved.

They pointed out that borehole handpumps, which are the responsibility of government to maintain, are often broken down for long periods. On the other hand, because the piped-water schemes are partly maintained by the beneficiaries, the repairs are carried out very quickly. The communities feel they can do, and are actually doing a better job than the government.

The last formal presentation of the Workshop was paper by **Mr F Kwaule** of the Urban Communal Water Points Project. He described the system of committees responsible for the operation and maintenance of the water points.

Two particular problems were highlighted by the speaker. Firstly, the maintenance policy for the communal water points was not properly defined and explained to the communities, many of whom therefore still expect government to carry out all maintenance tasks. Secondly, the tap committees quickly become inactive because of lack of proper guidelines as to their functions and lack of regular follow-up and monitoring of their effectiveness. The paper is included as *Annex 9* of this report.

Almost the whole morning was given over to discussions in the same four groups. Following the complaints on the first day about the large number of agenda items, a smaller and much more specific agenda was set:

Agenda 2

1. Discuss the reasons for the poor performance of handpumps maintenance in Malawi.
2. Design a maintenance system that will work effectively in Malawi.

Asking the groups to design a system concentrated their minds wonderfully! In their presentations, the group spokesman listed the many problems of the present maintenance system, and from them it was possible to summarise a consensus view of the problems:

Poor borehole design, particularly the lack of properly graded gravel pack, results in the pumping of silt and sand which produces infill of the boreholes and increased cylinder and cup leather wear and hence frequent and costly repair visits.

The handpumps used in the national borehole programme are difficult and costly to maintain. A truck and winch are needed to lift the heavy pumphead and rising main and a skilled team with specialist tools is required. Spares are imported, expensive and often in short supply. The pumps are not appropriate for the community to maintain.

The need for mobile units makes the system very expensive to operate, and transport costs are a high proportion of the total costs.

Because many of the vehicles are old, they are under repair frequently and for long periods. Repair costs are high, and when a unit is without its vehicle no handpump repairs can be undertaken.

The present system of mobile units is so stretched that it can only respond to breakdowns. No preventive maintenance is possible although its desirability is recognised.

The present system is difficult to supervise and manage because of inadequate numbers and poor training of staff.

The method of reporting breakdowns is inefficient because of poor communication within the system and the district unit being too remote from the users.

There was minimal community mobilisation or education in the planning or implementation of the national borehole programme, and there is very little interest in maintenance or feeling of responsibility for the pump.

There is no formal structure or budget allocation for maintenance of dug wells. Maintenance is carried out on an ad hoc basis by construction staff.

The shallow lift handpump for dug wells needs further development work to make it more reliable and easier and cheaper to maintain.

With the overall maintenance budget there are no allocations to the regions to enable proper planning and utilisation of the fund.

Having defined the problems so clearly, it was relatively easy for the groups to propose solutions. There was consensus on the need for standardisation on a handpump which could be locally manufactured, easily maintained and for which the spare parts would be cheap and readily available. At institutions requiring water to be raised by a handpump to an overhead tank, there would still be a place for the Climax pump, and government maintenance staff would be required to maintain them.

All the groups agreed that the user communities should then carry out routine preventive maintenance and minor repairs themselves. However, this would require:

- a much greater level of community mobilisation even before a project begins, to establish a sense of ownership of the supply and a desire to maintain it.

- a much more decentralised maintenance structure so that the lowest level of the government system was close enough to the community to be able to train and support them and monitor their activities.

It was emphasised by several groups that these requirements implied a massive education and training programme, for both communities and maintenance staff, which the Water Department would be unable to undertake on its own, and was in any case not necessarily the best equipped organisation to undertake it. There was general agreement that the expertise of the Ministries of Health, Community Services and Agriculture in particular, through their existing trained staff in the rural areas, could be very usefully employed in this mobilisation, education and training exercise.

There was active and open discussion about willingness and ability of user communities to pay towards the cost of maintenance. Two papers were distributed to provide background for these discussions. The first was a brief presentation of options for the financing of handpump maintenance, supplementing the presentation on maintenance options given on the first day of the Workshop. The second was a brief description of the organizational and financial arrangements for maintenance that were being tested in the South Coast Handpump Project in Kenya. These papers are included as *Annexes 10 and 11* of this report.

There was general, but perhaps not unanimous agreement that, like the communities in the piped-water projects referred to by Mr Msukwa, people would prefer to pay a little for something that works, rather than having something for free which does not work. Two of the discussion groups were strongly in favour of communities paying towards at least the cost of the spare parts. They felt we should not underestimate the willingness and ability of the user communities to contribute towards maintenance costs. All groups agreed that there might need to be further study of this issue.

These suggested solutions to the problems of handpumps maintenance were incorporated into the group presentations of the maintenance system they would like to see, and it was not surprising that the proposals were broadly similar. The main features were:

- Water committees and pump caretakers at village level.

- Maintenance or monitoring assistants at area level.

- A more strongly regional, decentralised government maintenance organisation.

These features were summarised for the plenary session, as shown in *Figure 1.*

The Workshop participants then separated into their four groups again, having been asked to define their proposed maintenance structure in more detail. They discussed the functions and duties of each level in the structure, and the additional inputs required.

Agenda 3

Define the structure in detail:

How do we achieve the structure?

- geographically, area by area?

- institutionally? which ones?

- financially? do we need additional funds?

From the group presentations, a summary composite proposal for the structure in given in *Table 1* and *Figure 1.* The area and village levels follow the general model established in the Livulezi Project but with significant additional responsibilities.

If communities are eventually going to collect and manage funds, the communities will need to be stronger and more closely monitored. Both the committees and the monitoring assistants will need more and broader training then at present in

the integrated projects. It was suggested that the monitoring assistants could be based at Extension Planning Area (EPA) level, as this is the basic planning unit for agricultural and other rural development activities within the NRDP.

The district level would have a crucial role to play in liaison with other government departments to plan and coordinate the multi-sectoral approach to the community within the district. The regional and headquarters levels would be strengthened to enable them to perform the tasks of planning, management and supervision and training.

The second question on the agenda could be rephrased as "How do we go from what we have to what we want?" In discussing this, the Workshop agreed that a programme of borehole rehabilitation and handpump replacement would be required, on a district by district basis, to enable the new system to be established. This would require considerable planning and supervision at headquarters and regional levels, and a substantial injection of funds.

A suggestion was made that the massive additional training requirements could be met by a new maintenance training unit based at headquarters, but organising and presenting training courses throughout the country as the new system was being established. This new unit would also require additional, specific funding. There was further agreement that the maintenance headquarters would need to be strengthened with mechanical engineering expertise to enable it to carry out the vitally important work of continuing handpump development and the establishment and implementation of tendering, purchase and quality control procedures for new handpumps and spare parts. A warning was given that government should carefully monitor prices and see that there was adequate manufacturing capability and interest to ensure proper competitive bidding for pump manufacture.

One of the discussion groups made a particularly useful contribution by trying to define a process that could be followed to ensure the sustainability of rural groundwater supplies. This was summarised as a series of steps or tasks:

- making the community fully aware of the objectives, implications, responsibilities and benefits of a programme of improving rural groundwater supplies;
- perhaps allowing the communities to choose whether they want an improved water source;
- organisation and training of the community in preparation for them to manage their own water supply;
- construction of a new water point or rehabilitation of an existing one;
- installation of an easily maintained pump;
- training in maintenance of the pump;
- establishment of a spares distribution system;
- continuing support and backup from the government maintenance organisation, and establishing a monitoring and extension services;

The group went on to propose a programme of water point rehabilitation over a number of years, on a district by district basis, perhaps one in each region concurrently. The community mobilisation and extension tasks would be allocated to other ministries (Health, Community Services) and separately and specifically funded. Detailed planning and supervision of the work would be carried out at regional level and a regional team would be established to carry out the work.

Day 4: The Way Forward

The last session of the Workshop was opened with the distribution of and comments on the composite maintenance structure given in *Table 1* and *Figure 1*. The Workshop then split for the last time into the four groups to consider the final agenda:

Agenda 4

Following the consensus yesterday on the importance of a multi-sectoral approach to community management of water supplies:

1. Discuss whether the Ministry of Community services should have a formal role in community mobilisation or handpump maintenance.
2. Discuss whether the Ministry of Health should run a complementary programme of Health Education and Sanitation Promotion (as in the rural piped-water programme) coupled with the programme of community mobilisation for handpump maintenance.
3. Continue yesterday afternoon's second discussion item rephrased as follows:
   Discuss and present well-defined programme or project for the implementation of the proposed maintenance structure.

Table 1. Proposed maintenance structure

Level	*Staff*	*Transport*	*Duties*
5. Headquarters	Principal Hydrogeologist		Plan and supervise national programme
	Maintenance Section Engineer		Borehole record system
	Training Officer	Mobile Training Unit	Budget preparation (Bulk spares procurement)
			Pump design, purchase, monitoring and quality control
			Maintenance training
4. Region	Regional Hydrogeologist		Vehicle workshop (distribute spares)
			Supervise districts
			Detailed planning and supervision of rehabilitation
			Regional budget preparation
3. District	STA (TO) Driver and crew	Light truck motorcycle	(Distribute spares) Repair institutional & private pumps . Supervise monitoring assistants. Report to region. Liaise with DDC and other ministries at district level Backup support - major repairs.
2. Area (EPA)	Monitoring Assistant (TA)	Bicycle	Major repairs Training caretakers Report to district (stock spares and distribute) Health education
1. Village	Water Committee Pump caretaker		Report breakdowns Care of pump and surrounds. Preventive maintenance. Collection and Management of funds, purchase of spare parts, Education to rest of community

The groups differed somewhat in their approaches to this final discussion period. There were hints that some felt they had covered the ground adequately and had little further to add. Others had specific proposals to make. Three of the groups felt that the roles of the Ministries of Health and Community Services in education and mobilisation should be made formal, so that a properly planned and adequately funded programme could be prepared.One group felt that the existing multi-sectoral approach of the government adequate to cover these requirements.

Two of the groups made outline proposals for borehole and handpump rehabilitation programmes. Both included cleaning out of boreholes, replacement of handpumps, improved surface completion works, establishment of an improved maintenance system of the type defined the previous day and strengthening of the management and training capability of the government maintenance staff. Both included formal roles for the Ministries of Health and Community Services. One group felt the onus was now on the Water Department to provide active follow-up to the Workshop by preparing detailed proposals for consideration by the other participating ministries and interested donors.

The fourth group, which had made the project proposal on the previous day, had modified its approach somewhat. Rather than proposing new projects, they suggested that the process they had described the previous day should be

incorporated into all existing projects. This would include separate funds for health education, sanitation and community development activities. While these might be covered by some of the existing projects, others might require additional funding for these components. There was a suggestion that this could possibly be done by adding a supplementary charge onto the borehole cost to cover community mobilisation, health education, sanitation promotion and maintenance training.

All groups agreed that some additional funding would be required, for several specific purposes in addition to those described above. The most substantial requirement could be for training courses, preparation of training materials and vehicles and staff for a maintenance training unit.

The establishment of a new and expanding cadre of monitoring assistants could imply substantial additional staff costs for the government. However, these could be partly absorbed by the re-deployment of existing staff, as the change in emphasis of the duties of the district team could lead to its reduction in size. The increased staff costs could also be partly offset by savings from the expected reduction in transport costs. Funds might also be required for equipping the monitoring assistants with tools and bicycles, and providing them with houses and stores.

Following this final presentation by the four groups, and comments from the floor, the Workshop rapporteur made a verbal summary of the deliberations and findings of the Workshop, highlighting the main points of agreement and noting the areas where participants had expressed reservations, as has been done in a more expanded from in the proceedings.

The Workshop was then closed by **Mr BH Mwakikunga** of Ministry of Works headquarters. He welcomed the overall conclusions and recommendations arrived at by the Workshop participants. He undertook to report back to the Principal Secretary in the Ministry (our Guest of Honour at the opening of the Workshop). He asked the Water Department to review as a matter of urgency all current and imminent groundwater development projects to ensure that the detailed proposals for a process of multi-sectoral community mobilisation and education could be adequately catered for.

He urged the representatives of the other ministries and organisations to carry the message of the Workshop home with them, and to use their new-found appreciation of the problems of handpumps maintenance to improve their organisation's understanding of the difficulties the Water Department was facing. Mr. Mwakikunga thanked all the participants for their contributions to the Workshop and all who had taken part in its organisation and declared the Workshop closed.

Additional conclusions and recommendations

The principal conclusions and recommendations of the Workshop have been extracted as the Executive Summary, which was prepared immediately following the Workshop and in advance of this report. A number of additional conclusions and supporting points are included here.

The Workshop was impressed by the achievements of the maintenance system in the Livulezi Project, but there was concern and discussion about the difficulty of fully replicating this success in subsequent integrated projects. Cultural and social differences between the Livulezi and other areas and more difficult hydrogeological conditions were advanced as possible reasons, but neither of these was accepted.

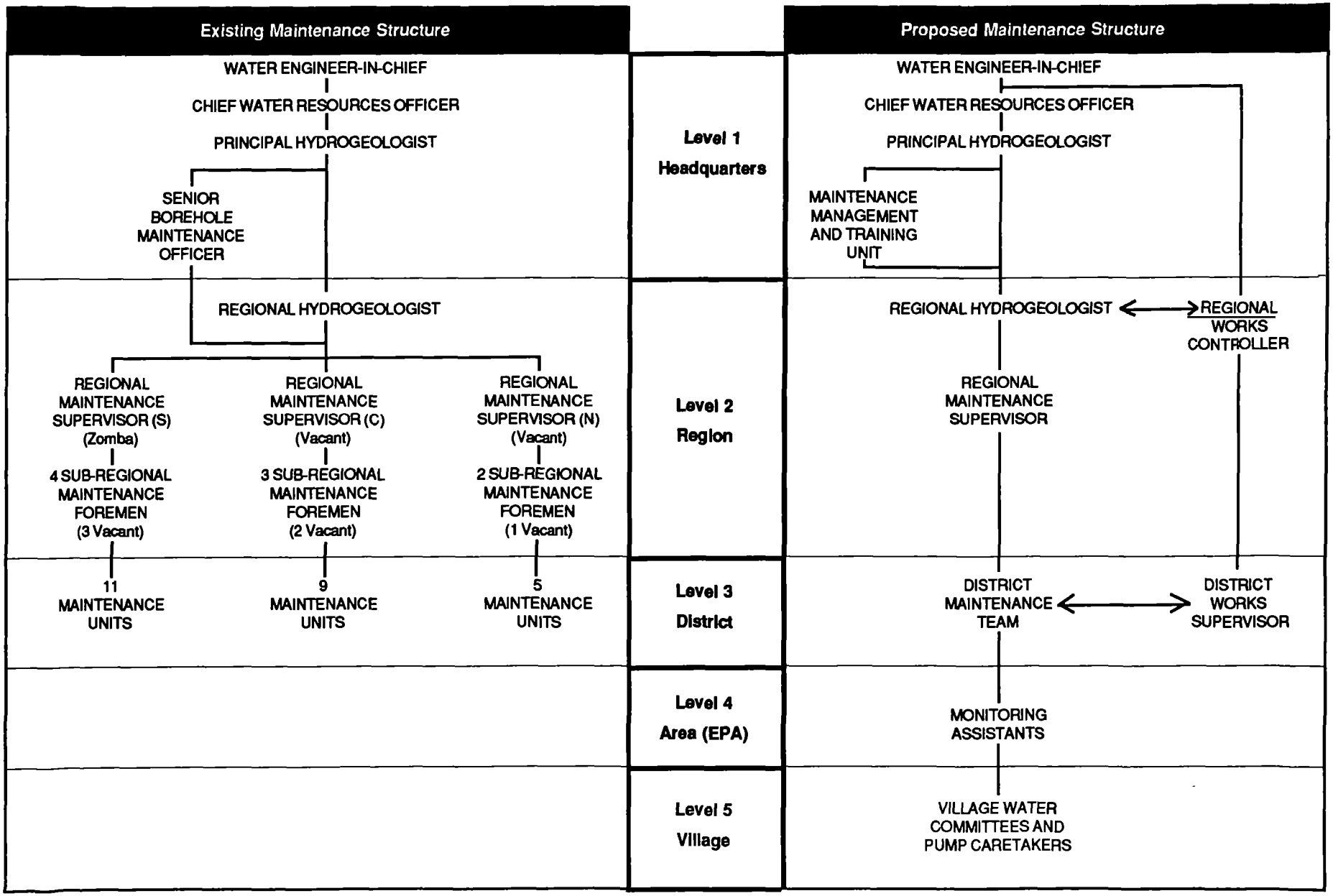
The success of the Livulezi Project depended largely on the careful fostering of community participation in all aspects of the project. This was facilitated by having one and often two hydrogeologists stationed full time in the project. Unfortunately, severe manpower constraints prevented there being full time hydrogeological supervision of Dowa West or Lilongwe North East Integrated Projects. In these circumstances it is inevitable that, amongst all the other duties of the Project Hydrogeologist, the community consultation and mobilisation tasks will be neglected.

It is not the communities which differ from project to project, but the approach to the communities. This reinforces the need for strengthening the community mobilisation component of rural groundwater development by using the expertise and resources of other government departments.

If the "engineering" emphasis of handpumps maintenance is reduced by the use of simpler and more easily maintained pumps, and if the "extension and monitoring" emphasis is correspondingly increased, then the approach to maintenance in the groundwater programme will become more similar to that in the rural piped-water programme. In the longer term, consideration should therefore be given to establishing a unified rural water supply maintenance structure from headquarters, through the regions and districts to area level.

There is some evidence that the maintenance system in the Livulezi Project is getting stronger with time, as the communities become increasingly used to and dependent on their handpump supplies, and become more confident of their ability to maintain them.

Figure 1 Existing and proposed maintenance structures



Annexes

Opening Speech: Workshop on Operation and Maintenance of Rural Groundwater Supplies

C. Clarke, Secretary for Works and Supplies

The District Chairman, Malawi Congress Party
Members of Parliament
Members of the Diplomatic Corps
Visitors from Donor Agencies
Distinguished Guests
Ladies and Gentlemen

It is my very great pleasure to welcome all of you to this Opening Session of what I regard as one of the most important workshops I have had the privilege of either opening or attending. I would like to extend a special welcome to the representatives of Donor Agencies who I believe can and will assist us in our attempts to identify and solve our undoubted problems concerning the operation and maintenance of rural groundwater supplies. I would particularly wish to thank UNICEF and the World Bank for recognising the existence of these problems and agreeing to make this Workshop possible by providing the funds to ensure that it was held.

However, I am sure our overseas visitors and the members of the donor community who have been so generous in the past will forgive me if on this occasion I save an extremely warm and special welcome for the Malawian participants at this Workshop. I am particularly glad to see those who represent the local rural communities. If I can be excused for perhaps pre-empting the recommendations and conclusions of the Workshop before it is even opened, I believe that this gathering can prove to be amongst the most important which the District Development Committees, local politicians and the various representatives of the rural population will ever attend. Malawi have every reason to be proud of her water development programme. It is true that God has endowed this land with water resources that could be the envy of all but these have not been left unexploited. For this thanks go to the pioneering done in Malawi by both Malawians and visiting engineers in ensuring that our resources are properly tapped and explored. When considering the work which has been done in ensuring that nature's gift is made available to as many as possible, I am reminded of the rather flippant story told of the Minister of the Church who, looking at a beautiful garden, remarked to the gardener on the wonderful things that could be created in a garden when man and God worked hand in hand, to which the gardener replied that the Heavenly Father did not make a very good job of it when He had it all to Himself.

Our urban water schemes, feeding a population who are basically wage earners and thus can contribute to the cost, are growing steadily, based on the principle of economic viability. In the rural areas we have in the past accepted the policy of free water for the rural population. Admirable as this policy is, it is not achieved without some soul searching. Our rural gravity-fed piped-water programme is undoubtedly a beacon in Africa. It has been admired and copied in many areas and could well be seen as the flag ship of His Excellency the Life President's policy of improving conditions for his people in the rural areas and thus providing an anchor to prevent a drift to the towns. In so doing the economy of the rural areas is improved and the importance of such improvement and growth cannot be over-emphasised because it is in the rural areas that both the present stability and the future prosperity of Malawi is founded.

However, there is a limit to the numbers that can be accommodated under gravity-fed schemes. At present approximately 1.5 million of the rural population are fed or will be fed from such projects. Another 1/4 million is accommodated by our urban district water supplies. This leaves approximately 4.5 million for whom water will have to be found utilising means other than the urban district water schemes or the rural gravity-fed scheme. Inevitably, these alternative means will principally be based on groundwater.

My experts advise me that a dug well supplies about 125 people and a borehole supplies 250. On that basis it is obvious that 18,000 boreholes would be needed, assuming a static population.But Malawi does not have a static population. If one works on the basis of a conservative population growth of 2.5%, it would be prudent to plan for 30,000 boreholes being required as quickly as physical and financial resources will allow.

The Ministry of Works and Supplies and the Government in general recognises the need for an intensified drilling programme and every endeavour is being made to enlist the services of contractors to attempt to fill the gap as quickly as money and muscle permit. In these circumstances, I have no doubt that the donors will recognise the problem and assist in providing solutions.

However, although I believe that the possibility of beating the capital investment problem exists, I find myself at this Workshop concerned about our will, enthusiasm and courage to beat the inevitable maintenance problem that will arise from such an intensive

groundwater programme. At present the financial responsibility for the maintenance of rural groundwater schemes other than those within private organisations rests with Treasury to provide the funds and the Ministry of Works and Supplies to provide manpower.

The present allocation in financial terms is approximately K 1 million. The present physical capacity is centred on 24 maintenance units, namely one for each district. One does not have to be a statistician to realise that a million Kwacha and 24 teams will be totally inadequate to deal with 30,000 boreholes. It is indeed already inadequate to deal with the existing 6,000, as can be seen by the poor maintenance record presently existing. A conservative estimation would be that 40% of the country's boreholes are out of action at any one time, representing no return on a financial input of K 20,000,000 and untold misery for the potential users.

Therefore, Distinguished Guests, the options to us are clear. We either demand more from Treasury in the knowledge that Ministry is already hard pressed and that our allocation would need to be increased 7-fold to meet our new maintenance demands. Our manpower demand would also be pushed up accordingly and in my opinion unrealistically. Or we look for an alternative method of meeting our obligations and our desires for our rural population. If so we have to explore new ideas and chart out a new path in virgin territory.

Considerable input and research has been put into what is evocatively termed an integrated groundwater scheme which aims to produce a system that places the onus and responsibility for maintenance back with the people who use the boreholes in the rural areas and thus make them the masters of their own destiny and the controllers of their prosperity.

You will learn during this week of what the Livulezi Project has proved. Its potential is enormous. It can bring the maintenance costs of individual boreholes down from the high level to a figure attainable by every village. More important perhaps, it has given the local community a purpose and an interest in the provision of their own water supplies and in so doing has ensured an increase in the quality of life which cannot be assessed in financial terms.

The Workshop on which we embark this week can be the fore-runner of the expansion of the Livulezi experience throughout Malawi. The example of local communities accepting the challenge is already there in the gravity-fed water schemes. Expertise to build on this is available both through my Ministry and the External Donor and their water experts. The people of Malawi have the background of self-help and resourcefulness that is necessary to allow them to accept the challenge. The nation has listened to His Excellency's exhortation to build and improve on what we found. However, in many respects, it will be a novel experience and will need much dedication on all our parts to ensure the role of the local communities is properly organised. If we seek help from outside for the task I am sure it will be forthcoming but of one thing I am certain for the sake of our children and our children's children we must move in the direction of community participation in this vital area and stop relying entirely on central government to provide.

I would beg you therefore to begin to plot out the path this week. With no more ado and to avoid wasting any more of your vital time, let me declare this Workshop open and wish you God's speed in your task.

Thank you.

Existing borehole and dug well pump maintenance organisation in Malawi

S M N Mainala, Principal Hydrogeologist, Department of Water, Ministry of Works and Supplies

1.0 Introduction

Although Malawi is endowed with a reasonable amount of surface water resources in rivers and lakes, the special distribution of these resources makes it both economically unsound and technically unfeasible to provide domestic water supplies exclusively from them. Thus the development of surface water resources has been, is and will continue to be complemented by the concurrent development of groundwater resources in virtually all parts of the country.

1.1 POPULATION DISTRIBUTION

The 1977 census of the country showed a population of 5.5 million of whom 5.0 million were rural based. Agricultural potential of, and availability of water in, an area have been the most important factors controlling population distribution. The current and projected population distribution between urban and rural areas is shown in Table 1 below. The distribution pattern is estimated to remain fairly close to the 10 to 1 ratio between rural and urban.

Table 1 Population Distribution in Malawi (millions)

YEAR	*RURAL*	*URBAN*	*TOTAL*
1985	6.39	0.71	7.1
1990	7.47	0.83	8.3
2000	10.44	1.16	11.6

1.2 BOREHOLE AND DUG WELL DISTRIBUTION IN MALAWI

Protected water supplies for rural domestic purposes are obtained predominantly from boreholes, dug wells and piped water schemes. The first boreholes were drilled, and dug wells constructed in the early 1930s in the Lower Shire by Colonial Development Schemes. The development of hand dug wells then continued sporadically, becoming a major concern of the Water Department only since 1980. The drilling of boreholes, on the other hand, continued rapidly since the first few in the Lower Shire and, between 1947 and 1969, about 100 boreholes were drilled each year. The programme expanded considerably in the early 1970s, during which approximately 500 boreholes were being drilled each year.

By 1979, some 4,200 boreholes had been drilled across the country. The number has since increased steadily as a result of increased demand and improved programming, especially in integrated project areas. There are now approximately 5,800 boreholes in the country, but the figure grows each day as more and more boreholes are drilled in various parts of the country.

The construction of hand dug wells has been organised into a major development programme only since about 1980. By that year, there were only approximately 1,000 wells properly equipped with handpumps. The majority of wells are in areas underlain by fairly shallow water tables, and are thus restricted in distribution to only certain parts of the country. There are now about 3,000 wells, mostly in the Lower Shire Area, along the Lakeshore area and in Mzimba Dowa and Lilongwe Districts.

2.0 Existing maintenance organisation and costs

2.1 NATIONAL MAINTENANCE PROGRAMME

The existing national programme for maintenance of handpumps consists of units or teams based at various centres across the country. These are primarily equipped to deal with borehole handpump breakdowns only. There are now 24 units spread across the country, each station or team being located on the basis of borehole density and logistical ease. Each team consists of between 5 and 7 people, semi-skilled operators, provided with a 5/7 ton truck equipped with a mast and winch. Each team is (supposed to be) headed by a maintenance assistant, who directs on a daily basis maintenance trips from station.

The maintenance organisation is headed by a senior Borehole Maintenance Officer (STO) based at Water Department HQ. He is supported by his deputy, the Borehole Maintenance Officer (TO) who is now based at Zomba. There are, immediately under this supervisory level, four maintenance foremen (STA) based at Balaka, Lilongwe, Mzuzu, and Karonga.

As pointed out before, there is as yet no established shallow well pump maintenance organisation, and maintenance is carried out on an ad hoc basis by construction personnel .

2.2 MAINTENANCE COSTS

The average cost of maintaining a borehole pump now stands at about K350 per year, giving an annual budget of about K1,000,000 for an estimated 3,000 visits made to installations per year. This also gives an estimated per capita cost of about K1.5 based on the total number of people actually using boreholes today. Transport invariably accounts for the greatest proportion of the cost, about 42% of the annual budget in the year

1985/86. Wages account for about 20% and pump spares about 15%. Actual expenditure figures for the 1985/86 fiscal year are given below.

3.0 Problems of the existing systems and some solutions

The current system of operation is that of responding to reports on breakdowns only. Owing to the large number of boreholes and to the large travel distances involved per maintenance unit, there is very little scope for the preventive maintenance so essential to prolonging pump life.

It must be pointed out at the outset in general that there are only two main categories of maintenance schemes for rural domestic water supplies. The first consists of the various types of schemes characterised by a pronounced centralisation of control and supervision with all necessary inputs being organised and distributed from a central national office and little or no scope exists for all of those schemes that rely on local management (which may not necessarily mean funding as well) of individual installations. Essential to the former category is the existence of a properly established supervisory capacity. Essential to both categories, however, is the awareness and appreciation of the local ownership of an installation by the beneficiary community. In Malawi, the long, traditional system has been of the first category.

A centrally based system is characterised by high costs arising from the increased logistical inputs. It is also fraught with many other constraints or problems some of which are explained below.

The most important requirement is that there must be adequate competent personnel for supervision to minimise undue overheads arising from irresponsible actions of low ranking personnel. It is also vitally dependent on adequate and reliable means of transport. Presently, we operate 5/7 ton trucks that are not easy to manoeuvre, are not suitable for most rural roads and are very expensive to run and maintain in the terms of fuel, spares and repairs.

In summary, it is inoperable without a proper programming capability. In Malawi, one of the major problems in maintenance is that, over the years, many pump types acquired abroad have been installed and their maintenance requires a reliable supply of spares from the same supplier. Some of these suppliers have now gone out of business, leaving us with a number of unmaintainable borehole and shallow well pumps.

Among the many serious handicaps of a centrally organised system is that there is very little scope for the recipient community to participate in the operation and maintenance i.e. management, of their own water source. The current workshop should therefore, address itself to the central problem of direction as to where we go from here in terms of what maintenance system or systems. The time is now ripe to make these choices of options.

Ministry of Works and Supplies: Borehole Fund - Maintenance
Trading and profit and loss account for the year ended 31 March 1986

1985 K		*1985/6* K	*1985/6* K
185074	Sales		39,120 00
-	Government subsidy		750.000.00
			789,120.00
274050	Opening Stock	99,275.00	
18382	Add: Purchases (Materials)	72,131.00	
292432		171,388.00	
99251	Less: Closing Stock	20,270.00	
193175	Cost of goods sold		151,118.00
(8101)	Gross profit		638,002.00
	LESS EXPENSE		
52588	Vehicle Repairs and Spares	118,600.00	
17193	Tyres, Tubes and Batteries	8,365.00	
-	Electricity	560.00	
958	Water Rates	1,391 00	
920	Office Expenses and Stationery	7,603 00	
168938	Fuel and Lubricants	165,147.00	
16463	Transport and Travelling	39,670.00	
110146	Wages	115,810 00	
-	Postal Service Charges	(8 00)	
-	Refunds to Clients	1,697.00	
250	Audit Fees	250.00	
3550	Pension Contribution	7,346 00	
-	Reimbursements	71,337.00	
9105	Uniforms and Protectives	16,186 00	
13639	Salaries	29,636 00	
578	Capital Expenditure	-	
63	DEPRECIATION		
-	Camping Equipment and Hand Tool	6,574.00	
-	Motor Vehicles	2,919.00	593,080.00
(402492)	Net Loss/Profit		**44,922.00**

ANNEX 3

The Abidjan Statement

Lasting health and economic benefits for the rural and urban-fringe populations of Africa can be achieved through increased community management of water supply and sanitation systems based on proven low-cost technologies. African governments and donors are urged to identify and commit adequate resources and provide all necessary support for the direct involvement of communities in choosing, managing and paying for their water and sanitation systems.

Representatives of 30 countries of sub-Saharan Africa and 15 external governmental and non-governmental support agencies, together with other specialists from Europe, Asia and Latin America, meeting in Abidjan, Cote d'Ivoire, in October 1986, have endorsed this statement and a 5-point strategy which they believe can assist in achieving substantial improvements in the health and living conditions of hundreds of millions of people.

Recognizing the serious threat to the health and well-being of more than 200 million people living in rural and urban-fringe areas of Africa who presently lack access to safe water and adequate sanitation facilities, delegates at the All-Africa Seminar on Low-Cost Rural and Urban-Fringe Water Supply see the achievements of the first half of the International Drinking Water Supply and Sanitation Decade (IDWSSD) as a foundation for accelerated progress.

Policies based on some or all of the five points in the strategy have seen an estimated 30 million additional rural people provided with improved water supply and sanitation facilities in the first five years of the IDWSSD. However, 70% of Africa's rural people are still without these basic services, and too many projects are abandoned or functioning well below capacity because of failure to provide for essential maintenance needs. While communities are paying the price in high child mortality, debilitating disease and unsanitary living conditions, governments are faced with increased medical care, reduced food production, and productive time and energy lost in collecting water, costs which can be ill afforded in times of severe austerity.

The outcome of the Abidjan Seminar adds further impetus to the momentum of the IDWSSD, and reflects a growing consensus among African nations of the political commitment and economic policies needed to meet the continent's urgent needs.

In endorsing this Abidjan Statement, the 100 delegates were united in believing that African countries, with sustained donor support, have the potential to make substantial progress in the second half of the International Drinking Water Supply and Sanitation Decade and beyond.

1. GOVERNMENT have recognized that affordable and sustainable progress depends on adoption of low-cost technologies. That recognition should now be translated into long-term commitments and establishment of the institutional framework in which community management of water supply systems can be effective. Decentralization of responsibility for planning and management means optimizing the use of public and private sector resources. Central and district government have a key role in organizing and supporting training programs at all levels, standardization policies, and distribution facilities for spare parts and materials. Governments should request donors to support the implementation of projects compatible with the policy of sustainability and replicability. Donors have again declared their collective support for such policies and will intensify their efforts to ensure full inter-agency coordination, as stressed during recent External Support Consultation meetings.

2. COMMUNITIES will be willing to take effective responsibility for running their own water supply systems, provided that they obtain the system that they have chosen, can afford, and have the resources to sustain. Successful projects involve community members - with women having a vital role - in all stages, beginning with their motivation by skilled community workers well ahead of implementation. Local committees can and should be involved in planning, site selection, construction and installation. With initial training and sustained support from government and other agencies, the committee should take over responsibility for organization of system maintenance, and for the collection and management of funds.

3. AN INTEGRATED APPROACH to health-related development brings maximum benefits from investments in the water supply and sanitation sector. There is strong evidence that water supply improvements planned alongside complementary activities in sanitation and health education have a multiplier effect on health and economic benefits. Similarly, introduction of community water supply components into primary health care programs, or into specific programs promoting food production, environmental protection, livestock watering, and general rural and urban-fringe development activities will enhance the benefits from each individual investment.

4. TECHNOLOGY CHOICE must match the community resources available for upkeep of the system. Research into low-cost community water supply and sanitation technologies has demonstrated that equipment is now becoming available to match the favored strategy of full community management of completed systems. Experience has shown, for example, that properly chosen handpumps, suitable for maintenance by trained caretakers, supported where necessary by area mechanics, are the best guarantee of dependable long-term water supplies. In-country manufacture and planned distribution of pumps brings added reliability.

5. MAINTENANCE is the key to long-term success. Community maintenance supported by a national strategy of standardization and well-organized distribution of spare parts, brings substantial increases in reliability and reductions in recurrent costs - bringing per capita costs down appreciably when compared with the alternative of centralized maintenance practised in many countries. The result is more dependable supplies of safe water, and continuing improved health.

The Livulezi maintenance system

KG Liyanage

1. Description of the system

The project covers an area of about 180 square kilometres. The estimated 1990 population in this area is about 50,000 people. There are 201 water-points with handpumps supplying clean drinking water to the above mentioned population in 90 villages. Waterpoint construction started in early 1981, was largely completed by the end of 1982 and was fully completed by late 1983. A borehole was planned to serve a community of 250 people and a dug well to serve 125. Thus the number of water-points in each village varies according to its population.

Presently 10 types of borehole and shallow well pump are installed in the Livulezi Groundwater Project as the Handpump Testing Programme is being carried out there. Maintenance of these 201 handpumps is looked after by two "maintenance assistants" who are government employees. They were trained in the installation and repair of handpumps during the construction of the project and each takes care of 100 pumps serving about 25,000 people. One maintenance assistant is living in the village of Kandeu and the other in Mphepozinai. Both have been provided by the project with houses and with bicycles so they can reach the pump to carry out maintenance. They keep a stock of some spare parts and the tools needed for repairs in store rooms next to their houses.

Each waterpoint in a village has a pump committee with one person from the committee selected as the pump caretaker. These committees consist largely of women and most caretakers are women. The pump caretaker's main responsibility is to carry out the preventive maintenance requirements for the pumps in the village, such as weekly checking for loose nuts and bolts on the pump. Where Malawi pumps are installed, the caretaker is provided with two "universal" spanners to carry out preventive maintenance. The maintenance assistant signs the pump caretaker's diary every month after inspecting the pump.The functions of the pump committee are:

1. Keeping the pump surrounding clean.
2. Ensuring correct operation of the pump.
3. Reporting of pump breakdowns to the maintenance assistant.
4. Organising community support for repairs on pumps.

When a pump breaks down, the caretaker or a member of the pump committee informs the maintenance assistant responsible for that area by sending a message with a villager. The maintenance assistant then goes to check the broken down pump.If he is unable to repair it immediately he sets a date for repair and organises community support. On the day before the repair several villagers (mostly women) come to the maintenance assistant's house to collect the tools and spare parts needed for the job.

One reason for this arrangement is that the maintenance assistant cannot carry heavy spanners or spare parts like pipes on his bicycle. The maintenance assistant gets the help of the villagers (men) to lift the rising main pipes, tighten the pipes etc. during the repair. The tools are brought back by the villagers on the following day. During the almost four years of operation of this system, there is no record of loss of any tools through non-return or other negligence by the villagers.

2. Effectiveness of the system

At any time, 90-95% of the pumps are working, according to the statistics collected during the last four years. The average down time (time between breakdown and repair) of a pump is 1 - 2 weeks.

3. Costs of maintenance

A complete costing study of the Livulezi Project has been done recently. All overheads were considered even at headquarters level in Lilongwe for this study. It revealed that the average cost of maintenance of a pump in the Livulezi project is about K 40.00 per year (for all 10 types of handpumps; some - such as the Malawi pump and the India MK II pump - have lower costs than this). The cost breakdown is given below:

	Annual cost per pump (Kwacha)	*Annual cost per person (Kwacha)*
Direct costs		
Spare parts	4.8	0.02
Maintenance staff	7.9	0.03
Subtotal	12.7	0.05
Indirect costs		
Share of overhead staff	17.3	0.07
Transport	10.6	0.05
Subtotal	27.9	0.12
Total	**40.6**	**0.17**

Thus the total costs per family of 6 is K1 per year, and the spare parts cost is only K 0.12 per family per year.

4. Discussion

Since the Livulezi Project is the testing ground for the Handpump Testing Project, several different types of handpumps are installed for testing, some of which are very difficult to maintain. If one or two standard and easy-to-maintain pumps were installed in the project, maintenance would be even easier. Then we could certainly expect a more effective system than the present, with even lower downtime and thus a lower percentage of pumps broken down at any one time, and also logistical problems would be reduced because fewer types of spare parts would be needed for repairs and it would be easy to maintain stocks.

A time and motion study was carried out to analyse the time involvement of each maintenance assistant on repairs. The average utilisation of time by each maintenance assistant on repairs, including time spent travelling on a bicycle, is 18% of the available working time. Each maintenance assistant could therefore theoretically look after more than 100 pumps. If one maintenance assistant was looking after all the 200 pumps in the project his utilisation of time on repairs should only be 27 % of the available time.

However, the travelling distances for a bicycle becomes a constraint on further expansion of the maintenance assistants responsibilities, unless a large number of pumps occur in a relatively small area. This relatively low utilisation of time on actual repairs also implies that there would be time available for other activities such as committee monitoring and training, and health education.

5. Constraints

One extremely important condition for the maintenance system to function properly is timely supply of spare parts to the maintenance assistants. For this, spares should be readily available off the shelf from suppliers and they should be distributed in good time. As an example, there have been occasions where the ball bearings needed for the Malawi pump were not available in Malawi.

Supply of spare parts (not only for pumps, but also for the maintenance assistants' bicycles) has been regular during the periods when an UN Volunteer (UNV) has been involved in the testing programme. This is because the UNV is travelling down to the project once a month from Lilongwe. On these trips, he carries the spares required for maintenance to the project if they are available in Water Department stores. This supply was not regular during a period of 7 months where there was no UNV involved in the project. During this period the maintenance assistants continued to carry out their tasks efficiently, but no spares were delivered and the situation quickly became critical.

A further important constraint is a lack of career structure for the maintenance assistants, who are currently employed and paid as unclassified workmen. There is therefore a risk of losing these very skilled people, due to their low salaries, limited associated benefits and poor career prospects.

If pumps were standardised, locally manufactured, maintained by villagers themselves and spare parts distributed through retail shops, many of these constraints could clearly be reduced.

6. Comparison of the maintenance system in Livulezi with the centralised national maintenance system

There are about 8,500 water-points in the National Programme equipped with deep-lift and shallow-lift pumps. These would provide almost 2 million people with water supplies, if all pumps were operational. Most of the boreholes are fitted with Climax and National pumps, which are heavy and difficult to maintain. There are 24 maintenance teams strategically located across the country, each equipped with a 5 ton truck with a winch. Once a pump is broken down, the village fills in a small card with details of the water point and sends it to the District Commissioner's Office. The card is collected by the district maintenance team.

The following figures give some indication of the differences between the centralised maintenance system and the decentralised system on trial in the Livulezi Project.

	Livulezi	*National Programme*
Percent of pumps working at any one time	90-95	55-65
Response time	1-2 weeks	2-3 months
Cost of maintenance (per pump.year)	40.00K	300.00K

It is clear that the potential effectiveness of a decentralised national maintenance system could be an order of magnitude greater than the current centralised system.

ANNEX 5

Handpump field trials in the Livulezi Project

1. The Field Trials

1.1 OBJECTIVES & JUSTIFICATION

It is estimated that more than 2,000 million people in the developing countries lack adequate supplies of safe water and adequate sanitation facilities. The goals of the United Nations International Drinking Water Supply and Sanitation Decade include the provision of sanitation facilities and reasonable access to safe drinking water to as many people as possible in developing countries. The UNDP/World Bank Handpumps Project is part of the UN effort to achieve these goals.

In the past, there have been serious problems with the poor performance and short working life of most handpumps used for community water supply. Some of these problems are associated with handpump design, selection and quality of manufacture. Others are rooted in the organization of handpump installation and maintenance programmes. Until recently, data on evaluating and improving handpump performance, including the non-technological factors which influence it, were sparse and inconclusive. Likewise, there was also a lack of reliable data on the comparative performance of various handpumps.

In response to the above problems, the UNDP and the World Bank undertook a project to monitor social, technical and financial aspects of handpumps and to foster the technological development of handpumps, in order to improve the reliability and reduce the cost of rural water supplies from wells equipped with handpumps.

1.2 THE LIVULEZI PROJECT

The Malawi Government is collaborating with the UNDP/WB Project in a testing programme which is being carried out in the Upper Livulezi Groundwater Project in Malawi. The Livulezi Project is situated in Ntcheu District, about 130 km south of Lilongwe, and covers an area of about 185 sq km.

The overall aim of the project is to supply clean, potable water to an estimated 1990 population of 60,000 people. The objectives of the project were:

- to implement an integrated system of providing dug well protection and borehole rehabilitation together with the construction of low cost boreholes and dug wells in the Upper Livulezi Valley;
- to optimise the utilization of ground water resources;
- to provide minimum-cost development of groundwater for rural domestic supplies;
- to introduce the self-help concept into the borehole drilling programme;
- to involve the community in handpump maintenance.

The project was designed and implemented by the Groundwater Section of the Department of Lands, Valuation and Water (now the Water Department), and was financed by DANIDA and UNICEF. The pilot phase was completed in 1981 and the main construction phase was carried out in 1982 and 1983. Detailed monitoring of technical and financial aspects of the water supplies and the handpumps in particular has been underway from late 1982 to the present.

1.3 METHODOLOGY

The field testing of handpumps and related activities are taking place in 17 countries in Western Africa, Eastern Africa, South Asia, East Asia and Pacific, and Latin America and the Caribbean. This is done in collaboration with national and international institutions in each country. In each country a Country Monitoring Engineer, who is usually a United Nations Volunteer, is assigned to monitor the field trials. The CME observes, advises, and reports on the installation, operation and maintenance of all project pumps in his area, for which standard monitoring forms have been developed.

Type of Monitoring Forms	*Source of Information*	*Compiled by Whom*
1. Well and pump characteristics (summary file)	Office	Monitor
2. Repair and maintenance report (repair file)	On site or Workshop	Monitor
3. Site inspection report	On site	Monitor
4. Village caretaker diary	Village	Village Caretaker
5. Maintenance assistant's diary	On site	Project maintenance assistant
6. Social and cultural factors	Village	Anthropologist or monitor
7. Maintenance cost data	Office	Monitor

2. Evaluation of Pumps

SHALLOW WELL PUMPS

Perhaps 50 % of handpumps required in Malawi will lift water from less than 8 m. These shallow heads allow the use of very simple direct-action handpumps. An underlying principle of a direct-action pump is that no lever or other force-reducing mechanism is used due to the pump's shallow application. The absence of a lever eliminates any wear related to bearings in a fulcrum and the direct-lift action greatly simplifies manufacture. A further advantage is that high plunger speeds are achieved, which allow the use of plungers without seals.

2.1 MK V SHALLOW WELL HANDPUMP

The introduction of a simple, cheap and easily assembled handpump was a focal part of the Community Protected-Wells Programme, which started in 1975. Since that time six "Marks" have been developed each being an improvement on the earlier version. The Mark V is a direct-action handpump. Over 3,000 MK V pumps have been manufactured in the Water Department Workshop since July 1980.

Reliability: The most common breakdown with this pump is breakage of the PVC pump rod at its connection to the handle. This is a solvent-cemented joint and the pump rod fails at a weak point on its collar. Due to this weak point, the intervention rate (repair rate) is high with the MK V pump compared with similar dug well pumps.

Ease of installation and repair: Installation of the pump is fairly easy. One disadvantage of the pump is that the footvalve or the plunger have to be replaced frequently for minor faults. Replacement is not simple since rising main pipe and pump rod have to be cut and jointed each time. This pump needs a lot of improvement to make it reliable and easy to maintain.

User acceptance: This pump has a high delivery rate and therefore users like the pump. But they commonly have little faith in the pump due to its frequent breakdowns.

Costs: Generally spare parts are cheap and easily obtainable. Present cost of the pump is around K250.00 for a 6m-deep installation.

2.2 TARA HANDPUMP

Six Tara direct-action pumps made in Bangladesh, were installed in August/September 1985 on dug wells, with a pumping head ranging from 2 to 4m.

Reliability: The common failure with the Tara pump is disconnection between pump rod and handle, as in the Mark V pump. The pump rod is connected to the handle by screw threads and this failure occurs due to wearing out of the female threads on the handle. Another common problem with the pump which contributes to the above failure is the sealed pump rod filling with water. This makes the pump extremely heavy to operate. Generally the pump has very good design features to simplify maintenance, but it appears that poor quality control has led to the pump being unreliable.

Ease of installation and repair: Easy pump to install and repair at village level.

User acceptance: In the initial stage after installation, users like the pump because of its lightness in operation (due to its buoyant pump rod) and high delivery. As the pump becomes heavy to operate (when pump rods are filled with water), users dislike the pump, and this dislike is intensified by frequent breakdowns.

Costs: The pump and all spare parts could be locally manufactured fairly cheaply (less than the MK V).

2.3 MADZI (BLAIR) HANDPUMP

This direct-action pump was designed by the Blair Research Laboratory of the Ministry of Health in Zimbabwe and is now manufactured in modified form by Pipe Extruders Ltd in Malawi. Five pumps are installed on boreholes with pumping heads to 10m and five pumps on shallow wells with pumping heads to 5m.

Reliability: Failures with this pump are breakage of both the inner PVC rising main pipe and the outer PVC casing pipe at their threaded connections to steel adapter unions. This failure has been more common in deep settings than in shallow settings.

Ease of installation and repair: Easy to install. With a certain amount of training it is possible to repair and maintain at village level.

User acceptance: This pump is not very popular among users for the following reasons:

(a) low delivery.

(b) messy (their feet and clothes get wet and pumped water can get polluted if users hands are dirty).

(c) only specific containers can be used for collecting water (narrow high containers are difficult to use).

Costs: The Madzi pump is similar in cost to the MK V pump above.

2.4 NIRA AF85 HANDPUMP

Nine Nira AF85 direct-action pumps, manufactured in Finland, of two cylinder sizes (63 mm dia and 75 mm dia) have been tested since February 1986. Pumping heads range from 2-10m.

Reliability: Only one case of breakdown has been reported to date. The handle became unscrewed from the pump rod, probably caused by children rotating the handle anticlockwise. Reliability of the pump is very high because of good quality material and strict quality control in manufacturing.

Ease of installation and repair: Easy to install and repair at village level.

User acceptance: Users are happy with the pump because of its high delivery rate and its reliability.

Costs: The pump is very expensive (approximately K700 for a 10m setting).

2.5 WAVIN PUMP

One Wavin Pump, manufactured in the Netherlands was installed in March 1986 and two others in August 1986. All three pumps are installed on shallow dug wells with a maximum pumping head of 4m.

Reliability: A breakdown was recorded on the first pump in early October 1986. The failure was at the PVC threads in the pump rod to handle connection.

Ease of installation and repair: Once the mild steel socket is set into concrete, properly installing the pump is easy. Repairs on the pump are simple.

User acceptance: Users are happy with the pump because of its high delivery and good reliability.

Costs: No information has been received regarding costs as the pumps are prototypes.

2.6 PEK PUMP

Two PEK direct-action pumps, manufactured in Canada, have been monitored since August and November 1985. Pumping heads are about 6m and 2m respectively.

Reliability: The pump with a deeper setting of 10m installed on a borehole has given two breakdowns since it was installed in November 1985. In the first instance it was pump rod to handle disconnection at the joint and on the second occasion was breakage of the spring in the foot valve. The pump with the shallow setting has had no breakdown so far.

Ease of installation and repair: Easy to install. Repairing the footvalve may be complicated at village level.

User acceptance: Since the delivery is low, the pump is not very popular.

BOREHOLE HANDPUMPS

Borehole pumps, which can be used to pumping heads of 60m or more, generally use levers or other force- reducing mechanisms. Until recently, most borehole pumps have been expensive, complex and difficult to maintain. In the last few years, a new generation of **Village Level Operation and Maintenance (VLOM)** handpumps have been the subject of intensive development and testing.

2.7 MALAWI HANDPUMP

Development of the Malawi pump, an early VLOM design, started in 1981 in Malawi. In January 1982, a pre-production run of 25 pumps was built at Lilongwe Mechanical Development Ltd without any jigs and fixtures. Many problems were encountered due to assembly faults in these pre-production pumps. Between April and June 1982, 22 of these pumps were installed in the Livulezi Project. In the meantime, drawings were prepared for a full scale production run and a full range of jigs and fixtures were built for pumphead assembly and quality control. Seventy- seven of these production units, with greatly improved quality, were installed in the Livulezi Project between August 1982 and November 1983. Pre-production pumps (prototypes) have had a greater number of interventions than production units. Bearing failures in the prototype pumps have been greater in number than in the production pumps. This clearly shows the benefits of good quality control in the production units.

Reliability: With 99 Malawi pumps in the field trials, extensive performance data has been collected. The most common failures have been hanger bearings, fulcrum bearings and seals. Plunger (piston) failures were generally a result of disconnections, and foot valve failures were a consequence of severe leakage due to embedded foreign matter. With approximately 1.5-2 years between breakdowns, the reliability of the Malawi pump is high.

Ease of installation and repair: Although originally designed to use plastic rising mains and extractable plunger and footvalve, production designs of these components are only now being finalised. In the interim, down-hole components for the Malawi pump comprise 50mm galvanized mild steel rising main pipes, 16mm mild steel pump rods and 2.5" dia or 3" dia brass piston, cylinder and footvalve. Since these components are heavy to handle, installation and repair of the Malawi pump is a difficult and skilled job. However, the few Malawi pumps with prototype extractable down-hole components are very simple to repair and have set targets for the development of a standard VLOM Malawi pump. This development work is almost complete and is described below.

User acceptance: Because of its high delivery and reliability users like the pump.

2.8 INDIA MK II HANDPUMP

India MK II pumps, manufactured in very large numbers in India, have had few interventions compared to other borehole handpumps. Out of the few interventions on the India MK II pumps during the period of four years monitoring, most interventions are on down-hole components. This clearly shows the good quality control on the pumphead. However, this need for a high level of quality control reduces the potential for local manufacture of the India MK II pump in Malawi. The reliability of the India MK II pump has been very high indeed.

Standard down-hole components for the India MK II pump are 32mm diameter galvanised

rising-main pipes, 12mm mild steel pump rods and 63mm ID brass cylinder. Handling these components in installation or repair is a difficult and skilled job, with very limited potential for community involvement.

Reliability: The India MK II pump has been very reliable.

User acceptance: Users are happy with the pump, mainly because of its reliability.

2.9 CONSALLEN HANDPUMP

The Consallen pump has had a very high number of interventions compared with the Malawi pump and the India MK II pump. The main failure has been the breakage of the rising main at the threaded joints. Due to this frequent failure, the Consallen pump has become unpopular among the users. Standard Consallen down-hole components are 32mm dia ABS rising main, 9.5mm stainless steel pump rods and 50mm ID stainless steel cylinder. Although the cylinder valves are not extractable, all these components are very light compared with the conventional down-hole components described above. For installation or repair, less skill is needed than for the India MK II pump or the standard Malawi pump.

Reliability: Unreliable, with frequent breakdowns.

User acceptance: Users dislike the pump mainly because of its unreliability and low delivery.

3. Pump Design and Development

As a consequence of problems recognised with pumps in the field trials in Malawi and elsewhere, much attention has been given to technological development of handpumps for rural water supplies. In East Africa, this development have taken place over 5 years, with the objectives that pumps should be:

- modular in design, so that the same cylinder, rising mains and standard wearing parts can be used for direct action pumps to 15m and deepwell pumps to 50m;
- as simple as possible to install and maintain with minimal tools, skills and effort, including an extractable piston and footvalve;
- relatively simple to manufacture in medium-sized well-managed work-shops in East Africa, requiring straightforward production engineering and minimal quality control. Designs make maximum use of stock size materials, to minimize the amount of machining required;
- designed so that scheduled servicing should result in the virtual elimination of breakdowns and that such servicing involves only routine and simple replacement of easily accessible low-cost wearing parts, such as bearings, seals and valves;
- suitable for use in aggressive groundwaters through the use of corrosion-resistant materials below ground, and capable of resisting sand abrasion through proven seal and cylinder-wall combinations and intake configurations;
- designed to minimize forces, allowing the use of lighter components which can incorporate a larger design safety factor. This can improve fatigue life for relatively highly stressed components, such as pump rods and rising mains;
- low cost, so that user communities can generally afford to purchase the pump (perhaps with credit) and can always afford to maintain it. Target figures are: US$400 for a complete pump set at 25m depth, with full recurrent costs of less than US$30 per year.

The new generation Malawi pump (known as the Afridev pump by the Handpump Project, the Nyayo Pump in Kenya and the Ibex Pump in Ethiopia) is the result of this development work and is now ready for full scale production. During 1987, full production will be established in Kenya, hopefully including the injection moulding of bearings and cylinder valves and the full assembly of cylinders suitable for pumping heads to 60m.

With these pumps it should be possible for communities to manage their own boreholes and shallow wells, following training by and with extension support from government. Further details of the pump are given in *Annex 8*.

Handpump maintenance systems

PJ Chilton

Introduction

Experience has shown that the use of handpumps in rural water supplies has often met with serious problems of inadequate design, poor quality of manufacture, lack of durability, poor maintenance practice and over-extended administrative organisation. Failure rates of over 50 % within two years of installation have been reported. The problems are on a world-wide scale and have been encountered to a greater or lesser degree in all countries where handpumps are used on a large scale.

The financial burden on the governments of developing countries from the maintenance costs of handpumps is rapidly increasing in those countries where rural water supplies are considered to be a free social service. In recent years and in many countries, those responsible for planning, funding and implementing rural water supplies are concluding that at least the direct costs of maintenance must be born by the beneficiaries, otherwise handpumps could be going out of service almost at the same rate as they are being installed. It is worth noting that where communities themselves are able to carry out maintenance, these direct costs can be extremely low, and affordable even to the poorest communities. People prefer to pay for handpumps that work, rather than not to pay for handpumps that do not work.

There are probably no fixed rules to determine whether a government or community-based maintenance system, or some balance between the two is the right choice. The exact details of the design of a maintenance system will be specific to a country, and will depend on many technical, social, financial and administrative considerations. The aim of this summary paper is to identify some of these considerations, to present a number of options for the design of maintenance systems, and to illustrate these briefly by a number of examples from other countries.

Maintenance systems

The type of maintenance system that is viable in a given situation depends to a large degree on the level of skill that is needed to repair the pump and the ease of removing its down-hole components. If specialised tools and lifting equipment are required, a central maintenance team or a well trained and well equipped area mechanic will be required. If repairs are simple to make and down-hole components can be easily removed and serviced, it is likely that someone in the user community can repair the pump. In the past, relatively sophisticated skills and equipment have been required to repair nearly all types of deep lift pumps, including those used in the national borehole programme in Malawi. As a result, a centralised maintenance system has grown up in Malawi and has been the most common in Africa.

While a maintenance system is partly defined by who repairs the pumps - village repairer, area mechanic or central maintenance team - it is perhaps more fundamentally determined by its management structure. Management can be the responsibility of a central authority or the community, or shared between the two.

Central management

A maintenance system based on central management usually consists of a public sector organisation with mobile maintenance teams, based at district offices, which respond to breakdowns reported by user communities. In a few cases, repairs are also made according to a regular schedule, but experience has shown that timely routine preventive maintenance is very difficult to achieve with mobile teams. One of the major disadvantages of a centralised maintenance system is that, even if it is run effectively, the transport costs are inevitably high. The present national borehole maintenance system in Malawi is exactly summarised by the first sentence of this paragraph. The main features of the existing system and the major problems which it has are described in a separate paper and are not repeated here.

Community management

In recent years, the shortcomings of centralised maintenance have been generally recognised, as has the importance of community ownership and community responsibility for handpump maintenance. As a result, the demand for handpumps which can be maintained by village repairers has increased greatly.

From experience with maintenance systems throughout the world, it is becoming clear that most successful programmes have in common the achievement of maximum community involvement in the maintenance of handpumps and minimum dependence on central government support. Experience has also shown that this must be preceded by the maximum possible

community involvement in all stages of planning and implementing handpump projects, so that a strong feeling of community ownership of and responsibility for the pump is established from the outset. With completely village-based maintenance, full responsibility and authority for carrying out maintenance rests with the user community. In such a system, the community collects money, enters it into a maintenance fund, and draws on the account to purchase spare parts and perhaps to pay local repairers to maintain the pump. In the ideal case, spare parts are readily available and widely distributed on the local market.

Community management need not necessarily mean that the actual repairs have to be carried out by the user community. The community could hire the services of a specialised handpump mechanic. This system reduces somewhat the overriding desire for simplicity, as the pump repairer would be expected to carry a basic tool kit and be trained to make nearly all types of repairs. However, the simpler the pump and the easier its down-hole components are to remove, the more likely it is that a local mechanic will be able to successfully maintain the pump. However, there may be times when even a simple pump cannot be repaired by the community. The rising main may need to be replaced, or down-hole components may be accidentally dropped into the borehole, a borehole may have to be redeveloped or a well deepened. In such cases, the community is likely to need the assistance of an area mechanic or central maintenance team, and so a maintenance system in which responsibility is shared between the community and central authority may be the most effective.

Shared management

Increasingly the responsibility for carrying out and financing maintenance is being shared between the community and an outside agency, usually the government but sometimes a non-government organisation. Shared management typically involves village repairers within a community undertaking preventive maintenance and perhaps simple repairs. Major repairs are then the responsibility of the external agency, often area mechanics equipped with tools and a bicycle and paid by the agency, who may also be responsible for provision and distribution of spare parts. In some cases charges or contributions are collected from the users to help pay part of the cost of maintenance. The objective of current handpump development work, with the Afridev pump for example, is to increase greatly the proportion of maintenance and repair tasks that can be regularly and successfully carried out at village level.

The proper functioning of a shared system will depend on both the user community and the central government agency. It is essential that the responsibilities of each are allocated in considerable detail and should be discussed, understood and agreed upon before the handpump is installed. There are thus two, more or less equal, partners to the maintenance system, and difficulties with either may lead the system to fail. For example a major potential disadvantage of the shared system is that policy changes or budgeting restrictions in the central authority can seriously interfere with maintenance.

In addition to who makes the repairs and the management structure, several other factors interact to define a maintenance system. These include whether repairers are employed in the public or private sector and how payment is made. Many combinations of repairer, management structure and payment mechanism are possible. By selecting one item from each of the four columns in Table 1, a maintenance structure can be defined. Most combinations are possible, but some are more typical than others. Also, various combinations of repairer are possible in a tiered system of maintenance. The approaches to maintenance in the national programme and in the Livulezi Project are indicated on Table 1.

Table 1. Possible Options for Maintenance Community

Management structure	*Repairer*	*Employment sector*	*Payment mechanism*
Central[1]	Central[1] team	Public[1,2]	Financed by[1,2] central authority
Shared[2]	Area[2] mechanic	Private	Community signs maintenance contract
Community	Village repairer		Community pays user fee or water rate to central authority. Community pays for services rendered and/or spares on ad hoc basis

1. Indicates national borehole maintenance programme
2. Indicates Livulezi Project

Once a policy decision has been made to minimise government involvement in maintenance and to require user communities to pay for maintenance, what remains to be decided is whether repairs will be made by area

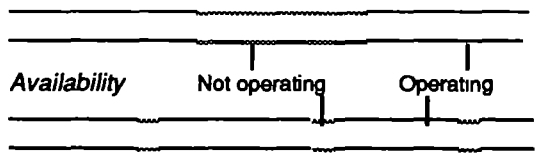
mechanics or village repairers, and whether the community pays for services rendered or enters into a maintenance agreement with a repairer. These issues are discussed in a separate paper. However, there are a number of other factors which can be considered requirements for or constraints on community participation in the maintenance of handpumps. The first requirement is community participation in planning and implementing the handpump project. For even a minimal degree of community participation in handpump maintenance, the community attitude to and interest in safe drinking water is a decisive factor. If a well or borehole and handpump are provided without adequate introduction and discussion, and without community participation in construction, then the improved water supply will be seen as something provided by government without the village having requested it or having been consulted. In such a situation, the community will expect the government to maintain the pump as well as providing it.

The community's attitude to the pump and their desire to maintain it are also dependent on their perception of the benefits from the pump. Awareness of the importance of safe drinking water should not be expected to exist at village level. Health education is therefore a vitally important component right from the very early stages of a handpump project. In addition, it is important for the pumps to be sufficiently reliable that they operate for long enough for the community to get accustomed to the improved supply and actually to experience the benefits from it.

A further important factor which has an influence on the design of a maintenance system is the distribution of population (and hence the distribution of handpumps). In the Livulezi Project and in other integrated project areas in Malawi, population densities are in the range of 100 to 250 persons per square kilometre, and villages are strongly nucleated and often of considerable size. In this situation, a maintenance system incorporating village caretakers and project maintenance assistants with bicycles can be established, and 80 to 100 handpumps are likely to be within bicycle range. In contrast, the drier parts of southern Zambia, for example, have a population density 10 to 15 times smaller, and villages are often more than 10km apart. In that situation, there can be no place for a maintenance assistant or area mechanic on a bicycle. With such widely dispersed handpumps, the cost of a central government mobile team would be very high. The only effective solution in this situation is a repair capability in each village (which might have several pumps), emphasising the need for a handpump which is as easy to maintain as possible.

In discussion of handpump water supplies, people often refer to the pump being reliable. Strictly defined, the *reliability* of a water supply is the length of time that it operates between major repairs. A reliable handpump may be well designed and very robust, and operate for a relatively long period of time, but when it breaks down (and all pumps do), it may be difficult and expensive to repair. The pump may be out of operation for weeks if the parts required for repair are sophisticated and expensive and the skills and equipment needed are very specialised. In contrast, a handpump which requires more frequent but very simple maintenance may be out of action for only a day or two at any one time. This latter supply is said to have a high level of *availability*. Availability defines the total amount of time that a supply is operating in any given period, and ensuring the maximum availability of the supply must be a prime objective of the maintenance system.

Reliability



One approach to improving availability is the concept of scheduled maintenance. If the main wearing components of the handpump, for example the fulcrum and hanger bushes, the piston seal and the plunger and footvalve seals can be made locally and very cheaply as well as being easy to replace, then it is possible that replacement of these at each pump on a regular, (e.g. annual), basis may ensure the highest possible level of availability of the water supply.

In conclusion, it could be said that, if rural communities:

- need and want an improved water supply;
- can afford to pay for its maintenance;
- can acquire the skills to maintain it (or can locate and pay someone from nearby)
- can obtain the spare parts to repair it ;
- can acquire the organisational skills to manage it;

then the potential for sustainability is as high as it can ever be.

Community management still leaves a major role for the government, in planning and promoting water supply development, in extension support and training of communities and in ensuring local manufacture and quality control of appropriate handpumps.

Examples of handpump maintenance systems

Summary notes from case studies

Introduction

The following notes on a number of case studies are intended to illustrate some of the options for establishing a maintenance system, which have already been described. They are from a wide range of countries, some of which may have physical, social and economic conditions very different to Malawi. They should, therefore, be taken as examples to promote discussion, rather than statements of the type of maintenance system that should or should not be established in Malawi.

Bangladesh

Previously in Bangladesh, a government-organised handpump maintenance system had been established. Government purchased spare parts and distributed them from a central store to district and sub-divisional level. At the next lower level, the *thana*, maintenance mechanics were employed by government and each had responsibility for 200 handpumps. They obtained spare parts from the sub-divisional stores and bicycled to the villages to repair the pumps. There was no contribution by the community towards the cost of spare parts.

The mechanics were, in theory, responsible for routine preventive maintenance, but in practice they were only able to respond to breakdowns as the pump was one which required frequent maintenance. Nevertheless, the system was reasonably successful. Several evaluations showed that 65-75% of pumps were working at any one time, a relatively good service level compared to the performance rates in some other countries, and at a relatively low unit cost. Contributing factors to this success were the fact that the pump was a shallow lift pump and a high level of standardisation was possible, the communities were highly motivated towards handpump supplies, and the maintenance was relatively well organised and supervised.

However, with 25-35% of handpumps out of order at any one time, this failure rate was considered to be too high. Moreover, Bangladesh is one of the countries with the greatest number of handpumps, probably 800,000 by now and the total expenditure for a completely government-financed maintenance system would amount to several million US dollars, even at the relatively low annual unit cost of 5 to 10 US dollars. It was therefore decided to transfer at least part of the cost of handpump maintenance from the government to the user communities.

The system was modified in the following way. Government would continue to purchase all spare parts, store them centrally and distribute them to its stores at sub-divisional level. Government would establish a further level of local stores at *thana* level with a sub-assistant engineer supervising a group of government-employed maintenance men. At the next lowest level, each district would appoint a maintenance man, paid by the district and responsible for all pumps in the district. The cost of the spare parts required in the district would be paid from the district budget, and recovered by local taxation or by directly charging for spare parts.

The district maintenance man would maintain and repair the pumps in his district, drawing any necessary spare parts from the *thana* stores. Each handpump has a caretaker with some training in proper use of the pump and health education. He also keeps the area around the pump clean, carries out minor routine maintenance, keeps a record of visits by the district maintenance man and reports breakdowns.

India

Previously in India the government used to construct wells and install handpumps without making any formal provisions for maintenance and repair of the pumps. An advantage of this approach was that the government was able to standardize on a suitable handpump and ensure satisfactory completion of the well. A great disadvantage was that the government did not have an opportunity to promote health education through an established pump maintenance network. Pump maintenance was left to the local communities, but without any provision for the supply of spare parts or for training. As a result, as many as 80% of the handpumps were not operating two years after installation.

Considerable efforts, supported by UNICEF, were made to develop a better handpump, which resulted in the India Mark II, and to provide for its maintenance. The "three-tier" system was first developed in Tamil Nadu.

At village level, a responsible person living near the pump is chosen with the consent of the village. He or she is given a two-day course on the importance of safe drinking water supply, the mechanism of the pump and the failures that might occur. The caretaker is trained to attend to minor repairs and is supplied with basic tools and pre-stamped postcards to report breakdowns and indicate the repair required, which are sent one each to the block-level fitter and the district

mobile team.

At sub-district or block level, a fitter is appointed for every 100 pumps, under the administrative control of the Block Development Officer and the technical supervision of the District Engineer. When a request is received from a caretaker, the fitter goes to the village and attends to the repair. In the case of major repairs, the district-level team goes to the village upon receipt of the request.

It was intended that each district mobile team would cover 1,000 handpumps, but experience has shown that they can only effectively cover 500. The costs of maintenance, including the block-level fitters and the district teams and all spare parts are borne by the government. Much of the actual burden of carrying out maintenance and all of the costs falls on the government. The India Mark II handpump on which the programme was based (and which is installed in the Livulezi Project) is a very strong and reliable handpump, but not one for which much of the maintenance could be done by village caretakers. More recently the pump has become the subject of extensive modification, partly sponsored by the UNDP/WB Handpump Project, to allow a greater level of simple maintenance.

Thailand

The main approach to handpump maintenance in Thailand has been for water supply agencies to have their own maintenance units. These have mobile teams equipped with a medium-sized truck and repair equipment and each team is responsible for maintaining 250 pumps. Each month they service about 125 pumps, so in two months nearly all pumps should be covered. Supervisors check whether the scheduled maintenance visits are properly carried out and make random inspection visits to pumps.

The costs of the mobile units are met by the government and are as follows:

Cost of mobile maintenance team (responsible for 250 pumps)

Item	*Annual cost* (baht)	(per cent)
Spares for vehicles	7 200	3.1
Fuel	30 000	13.2
Repairs	6 000	2.6
Transportation	3 60	0.6
Personnel (3)	54 000	23.7
Travel allowance	60 000	26.3
Handpump spares	9 200	4.0
Depreciation of vehicles	20 000	8.8
Overheads (20 %)	38 000	16.7
	228 000*	100.0

* Equivalent to 14 250 US dollars.

Maintenance cost per handpump 57 US dollars per year or approximately 0.25 US dollar per person.
(1 US dollar = K 2 approx).

Although these costs and the dollar conversion may be out of date, the percentages are useful. The actual cost of the spare parts is only 4% of the total. Labour, vehicle costs and overheads make up the bulk of the costs, as they do in the national maintenance system in Malawi. Within this system, getting the community to pay for spare parts would have little impact on the overall costs to government. It is an easily maintained pump and a change in the whole maintenance structure which is required.

Experience with this system in Thailand has shown it to be not very effective. Therefore the Public Health Department is adopting a modified system with village health volunteers trained in routine maintenance such as lubrication and changing worn parts. Technicians of the Provincial Public Health Unit, with vehicles and all necessary equipment are able to undertake major repairs on request.

Ghana

In the Upper Region of Ghana, a regional handpump maintenance system was set up between 1974 and 1978 for the 2,400 handpumps in the area. The system was operated from five district centres and maintenance was carried out as two separate activities:

a) inspection and minor repairs every 2 or 3 months; and

b) complete pump servicing on an "as required" basis.

The system had 250 field and workshop staff, vehicles and motorcycles for the routine inspections. Each mechanic with a motorcycle would visit 50-110 handpumps each month and report major repair requirements to the mobile team, which had a one-ton truck with winch to remove the pumphead and down hole components. The Regional Stores procured equipment, vehicle parts and handpump spares and distributed them to the districts. The system was thus very similar to the national borehole maintenance system in Malawi.

Experience of operation of the system revealed a number of major problems. The inspections by motorcycle-mounted mechanics were able to cover about 80% of the handpumps on a regular basis, but the motorcycles themselves were out of operation for almost 50% of the time. Their useful life proved to be only 1 to 2 years. The trucks were out of operation due to breakdowns for about 40% of the time, and the estimated service life of the vehicles was 3 to 4 years. The operating costs were therefore very high, but, as the handpump maintenance units were an integral part of the Ghana Water and Sewerage Corporation, it was difficult to assess precisely the operating costs.

A survey was carried out at the end of the third year's operation to assess the performance of the maintenance system. Some 83% of the handpumps were found to be in operation. Of the pumps which were out of service, about 11% had problems with the above ground components which the motorcycle inspector was able to repair, and the remaining 89% needed the service trucks to lift the below ground components. Of the operating pumps:

63 % were in good condition
28 % were in fair condition
5 % were in poor condition
4 % were in very poor condition.

Togo

The need to maintain properly the hundreds of handpumps installed in the country led the government to organise a two-tier, decentralised maintenance system. At the district level, a mobile maintenance unit of the regional subdivision of the National Water Agency pays regular maintenance and repair visits to each handpump. At the village level, unpaid village caretakers are selected by the village and trained to repair the above ground components of the Vergnet handpump. They also carry out routine maintenance, clean the well surrounds and report breakdowns. An instruction manual and tools were provided.

An existing commercial chain of department stores with its sales points widely distributed in the country agreed to stock the spare parts. In the first year of the project, all spare parts were guaranteed by the pump manufacturer, and after the first year the villagers were expected to buy the spares commercially. The costs of setting up the maintenance system were subsidised by the European Development Fund until 1984.

The early experience with this system showed that the trained villagers, who were often bicycle repair men, were quite capable of replacing pump parts and connecting rods. However, the results of the health education were disappointing,and showed that much more time was needed for this than the mechanics were able to provide.

In the first year of operation, 1980-81 the costs were as follows:

Staff	30 %
Transport	65 %
Materials (not pump spares)	5 %

About 50-60% of the total transport costs were for fuel. The maintenance costs per handpump were estimated at 147 US dollars, excluding spare parts. The cost of spares was 90 US dollars per year, giving a total of 237 US dollars per year. The Vergnet is thus an expensive pump to maintain.

Burkina Faso

By 1985, the government was responsible for about 10,000 handpumps. The past record of maintenance had been very poor. A centralised government system, with all maintenance teams operating from the capital, was unable to reach many of the pumps, and spare parts were often unavailable. There was no provision for training of caretakers at village level, and the required financial resources for maintenance were more than double the annual budget of the whole of the Water Department.

An improved maintenance system is being set up, with regional offices to carry out major repairs and support village-level routine maintenance. A spare-part distribution system is to be set up, with a new revolving fund at each district to meet the costs of maintenance. Trained local artisans will be paid by the villagers to carry out simple repairs, and a pump attendant will be appointed by the village water committee to carry out preventive maintenance. The village water committee will be responsible for collecting the money to pay for pump maintenance and repair by the district team.

Economic feasibility studies have concluded that it is within the villagers' means to pay for handpump maintenance, by collecting 4 US dollars per year from each of an average of 50 families using each handpump. This amount would cover the fees of the local artisan and the cost of spare parts and probably the cost of repairs by the district team, but depending on the type of pump in use.

Two possibilities for handling the revenue were suggested. In one, 75% of the revenue would be used to pay the local artisan and for the spare parts and repairs done by the district team, and 25% would be paid to the Water Department headquarters to cover overhead costs. The second possibility under consideration is that the village committee would simply pass on the money to the regional office, which would itself in turn pay the bills presented by both the pump attendants and district teams. At the time of writing (1984) it was not clear which was going to be used, but both are likely to face major administrative and accounting problems. A further, major, technical problem is that of the handpumps presently employed (ABI, India Mark II) are not very suitable for village level maintenance.

Note

The above notes have been summarised from *Practical Handpump Maintenance Systems* by E.H. Hofkes, IRC, 1984.

ANNEX 8

Community participation in maintenance of piped water projects

WRG Mandowa

1.0 Introduction

There are now over 1 million people in Malawi's rural areas who are served by about 8,000 village taps which they themselves have installed by laying 5,000km of piping. Community participation in rural piped water projects starts in the early stages of project conception. In order for one to appreciate the structure that has emerged for the maintenance of completed projects, it is important to understand the role the community plays during construction and the organisational structure that is set up to accomplish the work.

2.0 The role of the community during construction

The key to success of gravity rural piped water projects is the involvement of the whole community and the setting up of an organisation which can handle the large amount of work which has to be done and to ensure that everyone does his share.

A public meeting is held to announce the project at which all leaders are present: Members of Parliament, Chiefs and Party Leaders. This meeting will ascertain that the people want the project and are willing to work for it. The meeting then appoints a Project Main Committee to organise the work. This Committee has the authority of the Chief and all the leaders and people. It is therefore able to control the work which has to be done and is able to overcome any problems which may arise. It is important that these committees are not appointed by the Government but that they derive their authority from people, chiefs and other leaders.

Under the Main Committee, in a large project, there will be a number of Section Committees, which will be responsible for different sections of the pipeline. Finally, there will be a Village Committee in each village to see to the construction of the tap site, apron and soakaway pit. This Committee will have a number of women and will also be responsible for the cleanliness of the tap surrounds and for maintenance of the tap (replacing the washer etc.)

3.0 Organisation for maintenance

Four institutions are crucial for the proper maintenance of completed projects. These are the Main Committee, the Repair Team, the Tap Committee and the Water Department Monitoring staff. In addition to these four institutions, mention should be made of the important role played by the caretaker. This refers to the person appointed by the community to take care of the project intake.

3.1 THE MAIN COMMITTEE

The Main Committee is perhaps the most important local institution in the maintenance of completed projects. Generally, the duties of the Main Committee include:

a) To supervise the activities of the Repair Teams and Tap Committees and ensure that these organisations are functioning properly.
b) To check the pipeline and report any major problems to the monitoring assistant or ask the Repair Team to take necessary action where it is judged the latter could do the work.
c) To organise fund raising for the maintenance of the project either through village headmen or through tap committees and to pay the project caretaker.
d) To supervise the caretaker.
e) To report to the Area Action Group on the functioning of the water project and seek assistance of the AAG where necessary.
f) To consider any requests for additional taps and submit these to the project staff.
g) To organize self-help labour whenever this is required.
h) To settle any dispute or disagreements which may arise from various tap committees and repair teams.

3.2 THE REPAIR TEAM

Several projects have now got repair teams which are distinct from the main committee. In a way these teams are the technical arm of the main committee. Members of the repair team receive training in simple maintenance work and are expected to be able to repair any breakage on pipes except asbestos cement pipes, which can only be repaired by the project staff. One member of the team, usually the Chairman, keeps all the tools, equipment and spares required for maintenance work, although in some projects such

responsibility is given either to the chairman or secretary of the Main Committee.

3.3 THE TAP COMMITTEE

Every tap has its own tap committee charged with the following responsibilities:

a) to check that the tap site is always clean;
b) to organise work for cleaning of the soakaway pit whenever necessary;
c) to charge anybody who deliberately breaks the tap;
d) to raise funds from users for the replacement of a worn-out tap or repair of the apron or for paying the project caretaker;
e) to ensure that children do not play at the tap site;
f) to report any breakages on the pipeline to the repair team.

3.4 THE WATER DEPARTMENT MONITORING STAFF

The purpose of the monitoring programme is to monitor the performance of the water projects and to support the local maintenance organisation consisting of self-help consumer committees. Maintenance and repair of the projects is the responsibility of the communities served by the water projects. The monitoring staff performs routine inspections and provide technical and organisational support to the local communities. The primary aim of the information collected during inspections is to help monitoring staff in the performance of their duties and give early warning of potential problems within the water projects.

4.0 Role of committees in collection of funds for maintenance

The committee which is involved in collection of funds for maintenance is the Tap Committee. The Tap Committee collect funds from each household for purchase of bib-cocks and cement for repair of tap apron.

5.0 Types of maintenance

5.1 ROUTINE OPERATIONS AND MAINTENANCE

Routine operations and maintenance on the water systems are the responsibility of the repair teams, which work under the general direction of monitoring assistants. Repair teams are expected to repair PVC pipe breakages, replace taps and repair broken aprons around taps. Usually they must carry out minor repairs without any direct supervision of the monitoring assistants. In addition to the work of the repair teams, inhabitants of project villages are expected to rebuild the earthen ridge over the pipeline route every year and also clean storage tanks once or twice a year.

5.2 MAJOR MAINTENANCE

Major maintenance activities include the replacement of pipelines and the repair of river crossing, washouts and damaged intakes. Such activities are beyond the capabilities of local pipe repair teams. The Water Department at the moment has technical and financial responsibility for all major maintenance, although communities are required to provide self-help labour where such inputs are appropriate.

6.0 Cost of Maintenance

Louis Msukwa of Centre for Social Research in his evaluation report (*Institution Building for the Maintenance of Rural Piped Water)* has made an attempt to assess the total cost of maintaining the completed piped water schemes and the proportion met by the community.

From the five projects on which maintenance costs were calculated, he noted that community input as a proportion of total maintenance costs varies from 77.7% to 26%. Total per capital maintenance cost varies from K1.34 to K0.07. Government annual per capita maintenance expenditure is K0.13.

References

1. *Institution Building for the Maintenance of Rural Piped Water* by LAH Msukwa, Centre for Social Research.
2. WASH Field Report No 186 - *Malawi Self-Help Rural Water Supply Program: Final Evaluation*

Table 1: Summary community input for 5 Projects

	Lufira	Ng'onga	Mchinji	Sumulu	Mulanje West
Cash contribution	1,048.00	210.00	272.00	448.50	1,433.50
Contribution in kind					
Main Committee	307.84	483.96	269.36	240.50	257.52
Repair team/Caretaker	227.18	83.40	218.22	697.08	1,185.48
Tap Committee	2,597.40	1,152.92	815.48	262.70	802.90
AAG	60.00	60.00	30.00	-	-
General community	1,850.00	2,368.00	592.00	1,739.00	7,999.40
Total community contribution	**6,090.42**	**4,358.28**	**1,925.06**	**2,939.28**	**10,245.30**

Table 2: Summary of contribution from government on maintenance of 5 projects

	Lufira	Ng'onga	Mchinji	Sumulu	Mulanje West
Wages	1,385.00	704.00	1,220.00	1,009.00	915.00
Bicycle allowance	97.00	97.00	97.00	97.00	97.00
Training	100.00	100.00	100.00	100.00	100.00
Supervision	200.00	200.00	250.00	610.00	315.00
Repairs	200.00	50.00	30.00	150.00	400.00
Housing	-	-	4,500.00	-	-
Total for minor maintenance	**1,982.00**	**1,151.00**	**6,247.00**	**1,966.00**	**1,827.00**
Major maintenance	6,500.00	100.00	-	2,866.00	5,500.00
Total	**8,482.00**	**1,251.00**	**6,247.00**	**4,832.00**	**7,327.00**

Community participation in operation and maintenance of urban communal water points

Fabiano Kwaule

Introduction

In December 1981, Malawi launched the UNCDF/UNDP/WHO-assisted Urban Communal Water Point Project, whose objective was to supply potable water to low-income urban groups. A total of 600 communal water points were constructed and are now in operation in 50 urban centres.

The main feature of the project is that community participation did not take the form of self-help labour during construction of the water points. Communities were only consulted in siting of the water points and were asked to organise themselves into Tap Committees to be responsible for operation and management of the communal water points and collection of water rates from consumer groups.

In each centre, a Centre Water Council was formed under the chairmanship of the District Commissioner, to monitor and support the Tap Committees.

Operation and maintenance

Consumer groups usually numbering 10-40 family units elect the Tap Committees. The committees are responsible for fixing the opening and closing times of the water points, assigning households to clean soakaway pits and the tap surroundings and collecting monthly contributions from consumer groups.

The procedure of payment for water consumed is such that every month a meter is read and a bill issued to the committee. The committee then decides how much will be contributed by each household. After collecting the contributions from consumers, the committee deposits the money at a Government Cashier's office. The committees are encouraged to deposit all surplus funds in order to maintain credit balances on their accounts.

The policy of the Communal Water Point Project as regards maintenance of the standposts is that breakdowns caused by wear and tear of the facilities should be maintained by the Water Department, using the department's own resources and maintenance staff. Breakdowns caused by negligence or vandalism are supposed to be paid for by the communities, using community funds to purchase necessary spare parts while actual fixing of the parts is done by the department's maintenance team.

Problems

Monitoring and studies carried out in four communal water point centres, under the International Reference Centre (IRC) sponsored Public Standpost Water Supply Project, have shown that the major problem with this arrangement is that it is sometimes difficult to assess whether a technical problem has been caused by negligence or wear and tear. This often leads to taps taking a long time to be repaired, and hence causes disruption to the supply of water.

Secondly, it appears that the Communal Water Point Project's maintenance policy was not clearly defined and explained to the communities, most of whom still look to the department for maintenance of any type including replacement of stolen or lost valve box locks/keys and maintenance of cracked pillars or aprons.

However, the studies in the demonstration centres have shown that there is great need now to involve the communities in simple maintenance of the standposts in order to overcome some of the delays in fixing broken taps while assessments are made of the actual causes of the breakdowns and who should be responsible for paying for their maintenance.

So far on a trial basis some communities have managed to replace broken taps and valve box locks using their own funds. It however required great effort to convince them that because the water points belong to them, they should take the initiative to attend to minor technical problems through small money contributions to purchase spare parts, instead of waiting longer for the Department's repair team to procure the parts.

Tap Committees

Experience in the four PSWS demonstration centres has also shown that a strong Tap Committee is a prerequisite to a successful community-based operation and maintenance system. Unless a strong and active committee is instituted at the outset of the project, community participation in operation and maintenance will be greatly hampered leading to the systems over-dependence on plant operators and monitoring assistants.

On the other hand, Tap Committees tend to fall inactive soon after they are instituted due to lack of proper guidelines on the objectives of the

project, functions of the committees and what is expected from individual members of the committees in order to make the project a success.

If possible, guidelines should be written in a simplified form and be distributed to the committees. The guidelines should outline committee procedures such as frequency of meetings and agendas, methods of re-electing officials, and defining roles for each of the members. The committees should also be monitored on a regular basis to ensure that they are operating effectively.

Training

A successful community-based operation and maintenance system should also include a training component for caretakers. These caretakers should be individuals elected by the communities themselves to undertake maintenance work.

User education

User education is also an important component in a community-based operation and maintenance system. If users are not properly briefed on the objectives of the project, they may not be readily willing to contribute labour or money towards maintenance of the facilities. On the other hand, users have also to be instructed properly in the operation of the water supply, not only to teach them what to do in case of a problem with the system, where to report and what to report when the water stops, but also to teach them the rules and regulations of the supply.

Experience in the demonstration centres has shown that user education is especially essential in the initial stages of the project and that it should be an ongoing process throughout the lifetime of the project. If possible some methods should be devised whereby objectives of the project should also be clearly defined to those who have joined the project at a later date. It is evident that community participation will not be sustained by communities who do not fully comprehend the objectives of the project.

Conclusions

Although the Urban Communal Water Project is not completely parallel to rural water supply projects, as many of the people using communal water points are wage earners, traders and businessmen, there are still common areas of interest. For example, both projects require committees to oversee the operation and maintenance of the systems. The experience on Tap Committees and their problems acquired in the Urban Communal Water Point Project could be successfully applied to the rural setting and vice versa.

Also the success in financial management by communities themselves in the urban setting could perhaps find a place in the rural setting as well.

Who shall pay for maintenance and how?

Group discussions

Introduction

A crucial factor in the viability of any maintenance system for handpump water supplies is how the maintenance costs are to be met. The financial arrangements for meeting maintenance costs will reflect the government's policies and commitment towards improving rural water supplies, and will also take account of arrangements made under a joint plan of action with international organisations and bilateral aid agencies.

It has often been the desire of funding organisations to leave the question of maintenance of development projects entirely in the hands of government, and this has contributed to the difficulties of maintaining handpump projects. It is understandable that the main burden of financing maintenance should rest with the beneficiaries (government and/or communities).

However, it is essential that donors take an active part in designing, planning and establishing maintenance systems in parallel with project implementation, in order that their investment is not wasted by massive and prolonged handpump failure.

Methods of financing maintenance costs

Several possible options exist:

1. GOVERNMENT PAYS

The government pays the full costs of maintenance including labour, buildings, overheads, vehicles, fuel and spare parts.

2. GOVERNMENT SUBSIDISES

The government pays the cost of the central maintenance organisation; staff, vehicles, operating costs, buildings and so on, and the user community contributes the cost of the spare parts and the voluntary pump caretakers. The community could, in another alternative, also pay a service charge for the actual maintenance work carried out on the pump. Or the community may organise themselves to pay for and carry out simple maintenance tasks and minor repairs, with the government carrying out and paying for major repairs.

The method of financing can incorporate a wide range of options, with many different proportions of government and community contribution to the overall costs. Thus it may also lend itself to a scheme in which the level of community contributions to financing is increased over a period of time.

The collection of and accounting for community contributions may present major administrative problems for government. It may be difficult to recycle revenue to meet the costs of spare parts, where, for example, revenue is normally paid into a general government account. Thus, where there is a system in which both government and community are contributing, it is likely to be preferable for the community to organise the collection and payment for spares themselves, buying them from local private sector suppliers, parallel to but independent of the government contribution.

3. THE COMMUNITY PAYS ALL COSTS

In this case the users may either pay the full charge for the maintenance service provided by government, or the full cost of hiring local mechanics to carry out maintenance and repair work. If this is to be feasible then maintenance requirements must be as simple as possible and the cost must be kept very low. In existing maintenance systems, costs vary widely depending on local conditions and the type of pump and type of maintenance system employed. The range is from 5 to 250 US dollars per year per pump. Higher pump densities implied by a more complete coverage of the rural population would bring down the upper limit to perhaps 120 US dollars. Based on 200 to 250 people served by each pump, the per capita cost would then range up to 0.6 US dollar per year.

These may not seem very large amounts of money, but may be quite difficult to raise in the rural areas, and the costs must be seen in the context of the local levels of income. It has been suggested (World Bank,1976) that any charges for water should not exceed 5% of family cash income, and should preferably be less (2.5 to 3%).

4. DONOR SUBSIDISES

In this case, the donor providing funds for the implementation of the project would also provide funds for the establishment of the maintenance system, training, vehicles if necessary, tools, initial stocks of spare parts and then a level of subsidy to the actual cost of maintenance which could be gradually reduced on a year by year basis.

5. OTHER OPTIONS

Other options for the financing of handpump maintenance costs may also be possible, and have been considered in some countries. One such option would be some form of cross-subsidy, using income generated from another source of revenue to subsidise the costs of handpump maintenance. A further option is to encourage the development of income-generating activities associated with the improved water source, such as vegetable gardens using the waste water.

The South Coast Handpump Project, Kenya

Anne Malm

The South Coast Handpump Project in Kenya, like the Handpump Testing in the Upper Livulezi Project in Malawi, is a part of the UNDP/WB Handpump Testing Programme. The Project area is about 300 sq km and is situated on the coast of Kenya in Kwale District about 50 km south of Mombasa . It has an estimated population of 50,000 people in 35 villages.

In July 1983, AMREF (African Medical and Research Foundation) carried out a study in the project area, to find ways to involve local communities in the planning, installation and maintenance of handpumps. The study consisted of informal discussions and interviews with administration officers, community leaders, opinion leaders, ordinary community members and project personnel who were already in place. The study made the following recommendations:

1. Health education should be incorporated both in water handling and excreta disposal practices because it was realized that although the handpump may deliver water free from contamination, improper handling may cause contamination after collection. Women, being directly involved in water collection were identified as the main target group.
2. The project should employ a social scientist with skills in community organisation and mobilisation.
3. The decision on which well is to be protected, where a new borehole should be sited and the timetable of work should be based on discussion and agreement with the relevant community.
4. The community should be consulted with regard to handpump performance, any necessary modification required as a result of their experience during actual use and how well-covers should be constructed to allow easy access in the event of pump failure.

A Kenyan Non-Governmental Organisation, KWAHO (Kenya Water for Health Organisation) whose main objective is to help Kenyan men and women to obtain safe drinking water and sanitation facilities towards improved health, was approached by the Government and UNDP. This resulted in a new project, Training of Women in the Development, Maintenance and Use of Simple Water Supply Systems, to be implemented in collaboration with The South Coast Handpump project. Two social scientists were employed in the Project and in 1984 five extension workers were recruited to assist in community mobilisation. The recruitment was done in phases to allow on the job training and to reflect increasing community liaison activities. This training comprised meetings and discussions with key community elders and government administrative officials and community *barazas*.

These five extension workers became responsible for one part of the area each, where they worked with community mobilisation and education in pump maintenance, sanitation and health. The extension workers also help the village committees to open bank accounts for the money they collect for pump maintenance.

The price for the standardised locally manufactured handpump will be around Ksh 7000 ($450) and the spare parts for yearly replacement Ksh 200 ($13). It has been decided that the villagers should pay for the spare parts.

The replacement of the test pumps by the standardised pump started in November 1986, so to begin with, the project team made an "Operation and Maintenance Study" in which 10 villages were picked out for the start of the replacement of pumps and the first pilot trials of an Operation and Maintenance system. Meetings were arranged with the villagers and water committees and the administrative leaders (chief and subchiefs) in the area were informed. The extension workers arranged meetings in the communities at which there were discussions concerning training, collection of money, spare parts distribution, and the role of the pump committee. After these discussions, the villagers asked for more time to discuss among themselves, and times for a second round of meetings were decided. The meetings the communities arranged themselves included representatives from 5-7 water committees which made it possible to exchange experiences and ideas between different committees. The following is a summary of the suggestions from the communities concerning the operation and maintenance issue:

1. More people should be trained in pump maintenance within the communities. (So far 24 women have been trained).
2. Older men and women should be trained. (The reason is that younger people move more often and may leave the community).
3. Each water committee should raise a fixed amount for pump maintenance. When the fixed amount is reached, the collection should stop, but as soon as a substantial part of the money is used the collection should start again.

4. The distribution and selling of spare parts should be organised by the project initially, and eventually spares should be available from shops.

The "Training of Women in Maintenance of Rural Water Supply Project" has now been extended for another 15 months which will allow more training in pump maintenance, but also allow recording of the experiences from the previous two years.

At the beginning, spare parts will be stocked at the project camp, but as soon as possible that responsibility will be given over to local shopkeepers. One idea is to place the parts on consignment with the shopkeepers. This means that the shopkeeper pays for the part when sold and not beforehand. Training and support will continue until the communities feel that they can take over the responsibility for the handpump. When this time comes a formal handing over procedure will emphasise the community's ownership of the handpump.

There are still doubts about the villagers' capabilities for carrying out the maintenance and minor repairs, so investigations will continue to see if there is a need for a skilled mechanic to assist in difficult repairs. Cases like silted boreholes and caved in wells will require involvement of Ministry of Water, but, as there is quite a long period between these serious breakdowns, the overall cost will be much lower than if the Ministry were to carry out all maintenance.

So far, the communities have shown a lot of interest, responsibility and capability in the operation and maintenance of the handpumps. Even if the area has a lot of rivers and swamps the people appreciate their handpumps because they have understood the importance of clean water. Even though the pump maintenance works quite well now, (with the support from the project), it will be much easier when all the test pumps are replaced with the standardised Afridev handpump. The trainees can then concentrate on one pump and they will not have to hesitate when it comes to choosing spare parts and tools to fit the pump.

The South Coast Handpump Project ended in December 1986 and all personnel and equipment will be transferred to the new, larger Project. A final report on the handpump testing, borehole drilling, well recovery, operation and maintenance system and community involvement is expected to be finalised in the beginning of 1987.

ANNEX 12

Strengthening the maintenance system at national level

Draft proposal

Rural groundwater supplies, comprising dug wells and boreholes equipped with handpumps, currently supply about 1.5 million people in Malawi, about 25% of the rural population. Planned coverage of this type of water supply could exceed 60% of the rural population, and a total of 30,000 handpumps could be required.

Borehole handpumps have traditionally been maintained by mobile units with a truck. This system was fairly effective in keeping relatively small numbers of handpumps working, but costs and logistic problems have escalated as the number of boreholes has increased. It is now estimated that the annual cost of handpump maintenance in the national programme is K350 per pump, that about 60-70% of pumps are operating at any one time and that the response time between breakdown and repair is typically 1-2 months and sometimes greatly exceeds this.

The rural piped-water programme is successful primarily because of the role that communities play in managing their own schemes. Both the willingness and the ability to undertake this management develops during and as a consequence of the participation of the community in the planning and construction of each scheme, when a strong sense of ownership and responsibility is firmly established.

In 1981/2 the then Department of Lands, Valuation and Water initiated a programme of Integrated Projects for Rural Groundwater Supplies, a new approach based on a similar high degree of community involvement in both construction and maintenance of the supplies. In the Livulezi Project, completed in 1983, an equally strong sense of ownership has been achieved. Preventive maintenance is carried out by trained villagers (mostly women) and repairs are carried out by maintenance assistants with substantial help from the villagers. Careful monitoring of the maintenance system in the Livulezi has shown that the actual costs of maintenance are about K40 per pump per year, about 95% of the pumps are operating at any one time and the response time between breakdown and repair rarely exceeds two weeks.

A Workshop on National Strategies for Operation and Maintenance of Rural Groundwater Supplies was held in Malawi in December 1986. Its objectives were to review the findings of the handpump testing and maintenance monitoring in the Livulezi Project, and to discuss the findings in relation to the national rural groundwater supply programmes.

The major conclusion of the Workshop was that self-help should play an important role in the maintenance of wells and boreholes. In reaching this conclusion, there was full agreement that the present maintenance system needs to be restructured, and a modified structure was drawn up.

There was full agreement that Government would continue to have a major role to play in planning and promoting the development of rural water supplies, in extension support and training of communities, and in ensuring local manufacture and quality control of appropriate handpumps. To fulfil this role adequately, the maintenance organisation requires strengthening at national headquarters level. It is proposed, therefore, to establish a Maintenance Management and Training Unit (MMTU).

Posts and duties

The establishment of a new, expanding cadre of monitoring assistants implies a massive training requirement. There is a need for a maintenance training capability at headquarters, headed by a professional Training Officer with responsibilities for:

- designing training programmes for District Maintenance Teams (DMTs) Monitoring Assistants, Pump Caretakers and Village Water Committees;
- planning, organising, monitoring and evaluating a programme of training courses for DMTs and Monitoring Assistants (training of trainers) in handpump maintenance, health education, management and record-keeping, communication and community mobilisation;
- planning, monitoring and evaluating the training of communities by the Monitoring Assistants in a wide range of skills, including pump maintenance, water usage, hygiene, sanitation improvements and book-keeping;
- development and production of training materials including pump maintenance posters, caretaker diaries and monitoring forms;
- liaison with the Mechanical Engineer (see below) in the planning and organising of training programmes and the preparation of training materials;
- liaison with the extension, education and training sections of the ministries of Agriculture, Health and Community Services in the designing, organising and monitoring of joint training programmes and training materials.

The training officer would require a small number of training staff at Technical Officer level

to organise and manage training courses in the districts. These courses would include major training sessions for groups of newly recruited or transferred monitoring assistants, and shorter, regular courses and workshops for monitoring assistants in areas or districts in which the modified structure had been established. The unit would need a specially designed vehicle (perhaps similar to those used by Extension Aids) to transport training materials and to show films or slide shows at training courses. The unit would also need a separate budget for operating costs, production of training materials and holding training courses.

The maintenance section should also have (and perhaps eventually be led by) a Mechanical Engineer at headquarters, with the following responsibilities:

- liaise with the Principal, Senior and Regional Hydrogeologists responsible for groundwater development projects to plan timely procurement and delivery of handpumps and spare parts;
- plan and manage handpump and spares procurement by the preparation of tender documents, evaluation of manufacturing capabilities and evaluation of tender bids, placement of orders through established government purchasing procedures;
- preparation of quality control procedures and monitoring of quality control;
- evaluation of handpump and maintenance performance by preparation and monitoring of reporting procedures;
- liaise with the Training Officer in the preparation of training materials;
- liaise with the Training Officer in the planning and organising of training programmes.

The Principal Hydrogeologist will, in the short term at least, continue to have overall responsibility for handpump maintenance and both the Training Officer and Mechanical Engineer would report to him, and through him to the Chief Water Resources Officer and Water Engineer-in-Chief.

Costs

		Kwacha
1.	Establishment Costs	
	i) vehicle for maintenance training unit; specially equipped, 4WD station wagon with visual aids facilities	60,000
	Sub-total	60,000
2.	Operating Costs	
	Annual Budget	
	i) two professional officers	15,000
	two technical officers	8,000
	two drivers	5,000
	ii) vehicle running costs	30,000
	iii) production of training materials	25,000
	iv) costs of holding training courses	40,000
	Sub-total	123,000

Evaluation of borehole rehabilitation in Malawi

Draft terms of reference

Background

Rural groundwater supplies, comprising dug wells and boreholes with handpumps currently supply about 1.5 million people in Malawi (about 25% of the rural population) through nearly 9,000 handpumps. It is anticipated that approximately 70% of the rural population will need to be served by groundwater supplies, where no suitable protected sources exist for gravity-fed piped-water projects. It is likely, therefore, that up to 30,000 boreholes and dug wells with handpumps will be required as quickly as physical and financial resources will allow.

In Malawi, borehole handpumps have traditionally been maintained by mobile units equipped with a 5-ton truck, based at various (mainly district) centres cross the country. There are now 24 such units. Although this system was fairly successful in keeping a relatively small number of handpumps working, costs have escalated and effectiveness has decreased in recent years due to a number of major administrative, logistical and technical problems. The principal technical problems can be summarised as:

- poor borehole design, resulting in silt and sand being drawn into the borehole causing silting up of boreholes and accelerated wear of pump components;
- the borehole handpumps used are difficult and expensive to maintain because they require heavy lifting equipment and specialised tools to remove the pumphead before any maintenance work can be carried out on the below ground components.

Recognising this, the Groundwater Section of the then Department of Lands, Valuation and Water proposed in 1981 a programme of Integrated Projects in which the construction of new wells and boreholes would be combined with the rehabilitation of existing wells and boreholes, and a new and unified maintenance structure established in those projects. This programme has been underway since 1981, and borehole rehabilitation has been carried out in the Livulezi and Dowa West Projects, is currently underway in Lilongwe North East, Emcisweni and Karonga, and is planned in several other project areas.

Over approximately the same timespan, a UNCDF project for maintenance of boreholes has been underway. Plant, including drilling rigs and vehicles and workshop equipment and tools was provided by UNCDF and technical assistance by UNDTCD between late 1981 and the end of 1984. Within this project, there were no funds for actually carrying out borehole rehabilitation, but limited funding was obtained from other sources for rehabilitation of boreholes in the Lower Shire and Salima Lakeshore areas. To date, the number of boreholes rehabilitated is:

Integrated projects:	
Livulezi	5
Dowa west	35
Lilongwe North East	) about to begin
Emcisweni	) rehabilitation
Karonga	)
Lower Shire	99
Salima Lakeshore	60
Total	**239**

However, if the maintenance of boreholes and the reliability of rural groundwater supplies is to be significantly improved on a national scale, by modifying the maintenance structure to incorporate a much greater level of participation in the maintenance and management of their supplies by the user communities, then the rehabilitation requirements are massive, and the costs enormous. It is necessary, therefore, to evaluate the borehole rehabilitation programme carried out so far.

The general terms of reference for the evaluation are to assess the technical and financial effectiveness of borehole rehabilitation, and determine its impact on borehole and handpump maintenance, and recommend measures to improve the planning, design, implementation and monitoring of borehole rehabilitation. The specific terms are set out on the next page.

The specific terms of reference are:

1. Review the planning of borehole rehabilitation with particular reference to the criteria used for choosing boreholes to be rehabilitated and selecting the approach to rehabilitation to be used in each case. This should include review of the data from construction, from maintenance records and from water quality records, and the information (from inspection of the site) on pump condition and usage, condition of surround, site location in relation to pollution risk and attitude of the user community towards the existing pump and towards rehabilitation.

2. Examine in detail the methodology of borehole rehabilitation, including: Methods of cleaning and re-testing the boreholes, design of remedial measures, such as inner linings and gravel packs and other alternative methods of implementing the remedial measures. Design and implementation of improved surface works. This detailed examination should include the removal of handpumps, plumbing of borehole depths and re-testing procedures to compare borehole condition and performance with that immediately following rehabilitation, immediately pre-rehabilitation and at the time of construction. Make detailed recommendations, if appropriate, for improvement to or alternatives for the methodology of rehabilitation.

3. Assess the technical effectiveness of borehole rehabilitation by carrying out a comprehensive and detailed examination of the maintenance records of rehabilitated boreholes before and after rehabilitation to determine the extent of reduction in both frequency of repairs and periods of inoperation of the handpumps. Within this detailed examination, make a comparison between boreholes at which the handpump was placed with those at which it was not.

4. Assess the financial effectiveness and impact of borehole rehabilitation in reducing the recurrent cost of maintenance by carrying out a detailed costing analysis of maintenance before and after rehabilitation.

5. Review the technical and financial effectiveness of borehole rehabilitation with particular reference to the alternative approach (on a site by site basis) of replacement of seriously defective boreholes by newly drilled, properly designed and constructed boreholes. Establish technical and financial criteria for the choice between rehabilitation and replacement on a borehole by borehole basis.

6. Review the overall requirements for borehole rehabilitation on a national scale, and define the current needs for rehabilitation and/or replacement boreholes.

7. Examine the current and proposed projects in which borehole rehabilitation is a principal component and assess the impact of those on the overall rehabilitation requirements. Define areas of the country where rehabilitation requirements are significant but which are not covered by present proposals.

8. Review the plant and equipment currently being used to implement borehole rehabilitation, and make recommendations, if appropriate, for alternatives.

9. Assess by direct observation and enquiry the impact of borehole rehabilitation on the attitude of the user community to the borehole and handpump, in cases both where the handpump was replaced and where it was not.

10. Review the present methods of recording technical and financial information regarding borehole rehabilitation and assess their effectiveness in providing a basis for monitoring rehabilitation. Recommend ways in which this could be improved.

ANNEX 14

Community management of maintenance of handpumps

Draft Terms of Reference for a Study by the Centre for Social Research

Background

Rural groundwater supplies, comprising dug wells and boreholes equipped with handpumps, currently supply about 1.5 million people in Malawi, about 25% of the rural population. Planned coverage of this type of water supply could exceed 60% of the rural population, and a total of 30,000 handpumps could be required.

Borehole handpumps have traditionally been maintained by mobile units with a truck. This system was fairly effective in keeping relatively small numbers of handpumps working, but costs and logistical problems have escalated as the number of boreholes has increased. It is now estimated that the annual cost of handpump maintenance in the national programme is K350 per pump, that about 60-70% of pumps are operating at any one time and that the response time between breakdown and repair is typically 1-2 months and sometimes greatly exceeds this.

The rural piped-water programme is successful primarily because of the role that communities play in managing their own schemes. Both the willingness and the ability to undertake this management develop during and as a consequence of the participation of the community in planning and construction of each scheme, when a strong sense of ownership and responsibility is firmly established.

In 1981/2 the then Department of Lands, Valuation and Water initiated a programme of Integrated Projects for Rural Groundwater Supplies, a new approach based on a similar high degree of community involvement in both construction and maintenance of the supplies.

In the Livulezi Project, completed in 1983, an equally strong sense of ownership has been achieved. Preventive maintenance is carried out by trained villagers (mostly women) and repairs are carried out by maintenance assistants with substantial help from the villagers. Careful monitoring of the maintenance system in the Livulezi has shown that the actual costs of maintenance were about K40 per pump per year, about 95% of the pumps are operating at any one time and the response time between breakdown and repair rarely exceeds two weeks.

A workshop on National Strategies for Operation and Maintenance of Rural Groundwater Supplies was held in Malawi in December 1986. Its objectives were to review the findings of the handpump testing and maintenance monitoring in the Livulezi Project, and to discuss the findings in relation to the national rural groundwater supply programme. The key conclusion of the Workshop was that:

Self-help should play an important role in the maintenance of wells and boreholes, as it does in other spheres of rural development in Malawi. Communities must be involved to the maximum extent possible in the planning, siting and construction of their wells and boreholes and then should undertake the management of their water supply, including the execution of routine repairs and the purchase of routinely wearing spares parts. Government has a major role to play in extension and training, and the execution of major repairs that communities cannot handle themselves.

In reaching this conclusion there was agreement that, if community management of maintenance of wells and boreholes with handpumps is to be successfully achieved, a clear procedure must be developed, tested and adopted. This procedure is likely to include the following stages:

AWARENESS; the community is able to discuss its needs and aspirations, its willingness to contribute in kind and cash and its capacity to manage.

CHOICE; the community decides whether it wants an improved water point, which brings with it the responsibility for management.

ORGANISATION AND TRAINING; the community forms a management committee and initiates collection of funds and extension staff begin a training programme.

CONSTRUCTION OR REHABILITATION; the community participates to the maximum extent possible.

PUMP INSTALLATION AND SPARES DISTRIBUTION; a pump that the community can maintain is installed and a spare parts distribution system established.

HANDOVER; the community formal undertakes responsibility for managing their own supply

MAINTENANCE BACKUP; the government maintenance structure assists communities in need.

The Workshop discussed this procedure, and the possible benefits of involving social scientists from the Centre for Social Research (CSR), in a study of issues related to the development of the procedure. The study could include the following issues related to the community management of rural water supplies:

1. How can responsibilities for maintenance be apportioned in the rural communities? Are there existing structures or committees which could take on these responsibilities?

2. What is the role of the community in planning, siting, construction and maintenance of the water supply? How can community participation be most effectively encouraged? When and how should the community be approached and over what time period in relation to other project activities.

3. To what extent are the requirements for community management similar in the piped-water and groundwater programmes, and to what extent can the experience of the former be applied to the latter?

4. To what extent are communities willing and able to pay for spare parts and routine maintenance? How should the collection and management of funds be arranged?

5. How can the communities' sense of ownership of the supply be emphasised?

6. How should training in pump maintenance be carried out? By whom, when, where and how often?

7. How can the procedure outlined above be established at already existing boreholes which are to be rehabilitated?

8. What is the role of other government departments in establishing community management of handpump supplies?

Organisation of workshop

The Workshop was first proposed at the end of April during a regular visit to Malawi by the Regional Project Officer, Mr Grey. It was originally scheduled for September, but later postponed to early December. A small, local steering committee was set up in October, consisting of:

Mr S Malnala	Principal Hydrogeologist, Water Department
Mr H Vokhiwa	Principal Administrative Officer, Water Dept.
Mr J Liyanage	Country Monitoring Engineer, UNDP/World Bank
Mr J Townsend	Project Officer, UNICEF

The committee met several times in the weeks preceding the Workshop. Their tasks were mainly administrative, namely to prepare an invitation list, issue invitations and follow these up to make the participants list, make accommodation arrangements at Club Makokola, organise transport and make all arrangements for the Workshop secretariat.

In addition, there was a need for technical preparation for, organisation of, and reporting on the Workshop. It was felt that **Mr J Chilton**, former Hydrogeological Adviser to the Water Department would be of great assistance in this role, and the British Geological Survey agreed to release him and the UK Overseas Development Administration agreed to support him for three weeks. **Mrs A Malm**, a member of the Regional Project Office in Nairobi would assist in the technical preparation and organisation of the Workshop.

Accordingly, Mr Chilton and Mrs Malm arrived in Malawi on 22 November. Their first task was to produce an outline programme for the Workshop, which was discussed by the steering committee, revised and presented to the Water Engineer-in-Chief and Ministry of Works Headquarters. They also prepared a number of background papers, which were distributed to participants during the Workshop and are included as Annexes to this report.

Preparations were made for the field visit, and to do this Mrs Malm, and Mr Liyanage visited the Livulezi Project a few days before the Workshop. The steering committee met twice during this week. Another important task was to make a final list of participants, following up invitees who had not replied, and ensuring that appropriate and senior representatives were coming from each organisation.

A technical steering committee for the Workshop was established the evening before the Workshop began.

This committee consisted of:

Mr S Malnala	Principal Hydrogeologist
Mr M Kumwenda	Senior Asst. Secretary, Ministry of Finance
Mr D Manda	Principal Community Development Officer
Mr L Chipunga	Principal Public Health Officer
Mr J Chilton	Workshop organiser and rapporteur
Mr D Grey	World Bank

The task of this committee was to provide technical direction of the Workshop, revising the outline programme on a day-to-day basis to take account of the timing requirements for group discussions, presentations and plenary sessions, and setting the agenda items for the group discussions. The committee also divided the participants into their four discussion groups:

Discussion groups

A	B
Mr F Msonthi	**Mr G Chavula**
Mr D Manda	**Mr L Chipungu**
Mr F Kwaule	**Mr R Joseni**
Mr S Malnala	**Mr L Munthali**
Mr S Zembere	**Mr A Lwanda**
Mr J Townsend	**Mr J Kayenda**
Mrs A Malm	**Mr K Liyanage**
Mr E Jumula	**Mr J Chilton**

C	D
Mr P Mkandawire	**Mr C Govati**
Mr D Grey	**Mr S de Souza**
Mr K Msowoya	**Mr B Chandiyamba**
Mr W Mandowa	**Mrs C Sinoya**
Mr S Njirenda	**Mr J Nasungwi**
Mr J Barrows	**Mr C Gurney**
Mr B Mwakikunga	**Mr M Kumwenda**

During the workshop, day-to-day administrative matters were dealt with by Mr Vokhiwa. Secretariat services were provided by:

Mr D Pereya	Secretary, Ministry of Works HQ
Miss E Phiri	Secretary, Ministry of Works HQ
Miss C Dula	Secretary, Water Department
Mr N Nam'gododa	Machine Operator, Office Equipment Department

Workshop costs

In the planning and preparations for the Workshop it had been agreed that the co-sponsors, the UNDP/World Bank Handpumps Project and UNICEF, could share the local costs equally. These were estimated at about 10,000 US dollars (K20,000). It was further agreed that, for ease of administration, the UNDP/World Bank would pay the running costs and UNICEF the accommodation costs of government participants.

The actual costs of the Workshop are summarised below:

A) Operation Costs

1. At Club Makokola	*Kwacha*
1.1 Hire of conference facilities	504.00
1.2 Packed lunch for field visit	252 00
1 3 Tea and coffee breaks	386.33
1.4 Drinks on opening day	42.67
1.5 Reception on opening day	1519 68
1.6 Soft drinks for field visit	10 20
1 7 Hire of public address system	60.00
1.8 Repairing film projector	82.17
1.9 Telephone calls	14 80
Sub-Total	2871.65
2. Transport	
2.1 Vehicle hire charges	3058.17
2.2 Fuel	633.85
2.3 Drivers' subsistence allowance	250.00
2.4 Other transport charges	188 30
Sub-Total	4130.32
3. Stationery	450.06
4. Subsistence allowance for Mr Liyanage	396 00
Total	**7848.03**
B) Daily subsistence allowance for government participants	10395.00

The travel and subsistence costs of the Workshop organiser and rapporteur were met by the UK Overseas Development Administration, who also reimbursed the British Geological Survey for three weeks of his time. All non-government participants to the Workshop were responsible for their own travel and accommodation costs.

List of participants

MINISTRY OF WORKS HEADQUARTERS

Mr BH Mwakikiunga	Engineer-inChief

WATER DEPARTMENT, MINISTRY OF WORKS

Mr SC de Souza	Water Engineer-in Chief
Mr SMN Mainala	Principal Hydrogeologist
Mr FBJ Msonthi	Hydrogeologist
Mr PP Mkandawire	Regional Hydrogeologist (N)
Mr GMS Chavula	Regional Hydrogeologist (C)
Mr CC Govati	Regional Hydrogeologist (S)
Mr LWC Munthali	Senior Borehole Maintenance Officer
Mr WRG Mandowa	Engineer, Rural Piped Water Programme
Mr F Kwaule	Project Officer, Public Standpost Water Supplies

MINISTRY OF HEALTH

Mr LL Chipungu	Principal Public Health Officer
Mr EP Jumula	Chief Health Inspector (N)
Mr BB Chandiyamba	Chief Health Inspector (C)
Mr KEK Msowoya	Chief Health Inspector (S)

MINISTRY OF COMMUNITY SERVICES

Mr DM Manda	Principal Community Development Officer
Mr CE Sinoya	Senior Community Development Officer

OFFICE OF THE PRESIDENT AND CABINET

Mr SA Nyirenda	Senior Administrative Officer, Administration
Mr RA Joseni	Chief Works Supervisor, Rural Growth Centre Project

MINISTRY OF FINANCE

Mr MLC Kumwenda	Senior Assistant Secretary

MINISTRY OF LOCAL GOVERNMENT

Mr AC Lwanda	Chief Technical Officer

UNIVERSITY OF MALAWI

Mr SN Zembere	Lecturer in Mechanical Engineering, Polytechnic

UNICEF

Mr J Townsend	Water and Sanitation Projects Officer

CHRISTIAN SERVICES COMMITTEE

Mr JJ Kayenda	Water Engineer
Mr J Nasungwi	Assistant Water Engineer

USAID

Mr C Gurney	Health Coordinator

SAVE THE CHILDREN FEDERATION

Mr J Barrows	Health Coordinator

INTERNATIONAL EYE FOUNDATION

Mr G Demisse	Project Manager

UNDP/WORLD BANK

Mr PJ Chilton	Hydrogeologist (ODA)
Mrs A Malm	Civil Engineer, World Bank Regional Office
Mr DRC Grey	Regional Project Officer
Mr KG Liyanage	Country Monitoring Engineer

Workshop programme

Monday 1 December

	9.00-9.00	Registration
Chairman: Mr B. Mwakikunga	9.00-9.45	Opening Ceremony Mr.C.Clark - Secretary for Works and Supplies
	9.45-10.15	Coffee/Tea
Chairman: Mr. S. de Souza Water Engineer-in-Chief	Session 2	*Maintenance of wells and boreholes: an overview*
	10.15-10.45	Opening remarks and introduction of participants
	10.45-11.00	Introduction to Water Department and borehole maintenance system. Mr. S. Mainala- Principal Hydrogeologist
	11.00-12.30	Introductory remarks from all ministries, donor agencies and non-governmental organisations
	12.30-14.00	Lunch
Chairman: Mr. L. Chipungu Principal Public Health Officer	Session 3	*Maintenance of wells and boreholes: Systems and options and the Livulezi Model*
	14.00-15.00	Panel Presentation by: Mr. L. Munthali- Senior Borehole Maintenance Officer Mr. F. Msonthi- Former Manager of Livulezi Project Mr. K. Liyanage- Country Monitoring Engineer Mr. D. Grey- Regional Project Officer
	15.00-15.30	Maintenance systems options and introduction to discussion groups. Mr. S. Mainala and Mr. J. Chilton
	15.30-15.45	Coffee/Tea
	15.45-17.15	Discussions in four groups of Agenda 1
	17.15-17.45	Presentation of findings by the spokesman from each group, followed by general discussion
	18.30	Reception/Cocktail Party

Tuesday 2 December

Field visit to Ntcheu and Livulezi Project

8.00-10.30	Travel to Ntcheu
10.30-11.15	Removal of Climax pumphead and below ground components from national programme borehole at Ntcheu by Balaka maintenance unit
11.45-12.15	Discussion with maintenance assistant at Mphepozinai
12.45-13.15	Lunch at Kandeu and discussions with maintenance assistant, pump caretakers and villagers
13.30-14.45	Visit to Malawi pump and demonstration of dismantling pump by caretakers and villagers
15.00-15.30	Visit to Afridev pump and demonstration of complete removal and replacement of bearings and downhole components by villagers
15.30-17.30	Return to Club Makokola
20.30-22.00	Video films (Water and sanitation)

Wednesday 3 December	Session 4	*Maintenance of wells and boreholes: Problems, solutions and possible structures*
Chairman Mr M Kumwenda Senior Assistant Secretary, Ministry of Finance.	8.00-8.15	Opening remarks and introduction to group discussions
	8.15-10.00	Discussions in four groups of Agenda 2
	10.00-10.30	Coffee/Tea
	10.30-10.45	Short presentation on community participation in maintenance of rural piped water projects. Mr. Mandowa
	10.45-12.00	Discussion in four groups of agenda 2
	12.00-12.30	Presentation of findings by the spokesman from each group, followed by general discussion
	12.30-14.00	Lunch
	Session 5	*Maintenance of wells and boreholes: Defining the structure*
Chairman: Mr D Manda Principal Community Development Officer	14.00-14.15	Opening remarks and short presentation on community participation in maintenance in the communal water points project. Mr Kwaule
	14.15-14.30	Introduction for group discussions
	14.30-15.45	Discussions in four groups of Agenda 3
	15.45-16.00	Coffee/Tea
	16.00-17.15	Discussions in four groups of Agenda 3
	17.00-18.00	Presentation of findings by the spokesman from each group, followed by general discussion

Thursday 4 December

	Session 6	*Maintenance of wells and boreholes: The way forward*
Chairman: Mr S Mainala Principal Hydrogeologist	8.30-8.45	Opening remarks and introduction to group discussions
	8.45-10.00	Discussion in four groups of agenda 4
	10.00-10.30	Coffee/Tea
Chairman: Mr. B. Mwakikunga Engineer-in-Chief	10.30-11.00	Presentation of findings from each group, followed by general discussion
	11.00-11.30	Summing up of workshop findings by rapporteur
	11.30-12.00	Concluding speech and formal closing of workshop by Mr. Mwakikunga