International Reference Centre

for

Community Water Supply and Sanitation

HANDPUMP MAINTENANCE

Guidelines for Organising Handpump Maintenance Systems

Prepared by

E.H. Hofkes

October 1983

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PREFACE

Although appreciable progress is being made, in many developing countries, with regard to well drilling and handpump installation for rural water supply, the same is unfortunately not true of the maintenance of the pumps once they are installed. The wells and pumps are intended to cater for one of the basic needs, perhaps the first need of the village communities: safe drinking water. Yet handpumps break down by the thousands, in some countries even by the tens of thousands, and remain unrepaired for long periods of time because there is no adequate maintenance. Concentrated efforts are needed to improve this situation. Wise pump design may prevent many difficulties, but regular and proper maintenance is the key to reliable pump performance.

The importance of the maintenance of handpumps cannot be stressed too strongly. Unless maintenance is organised effectively, handpumps will break down on an ever-increasing scale, and the benefits of handpump installation programmes will be negible.

A central principle in any handpump water supply project should be that in the selection of pumps full consideration is given to the maintenance requirements, and the needed skills, tools and spare parts. Just as the technical design of the pump should be cost-effective and suited to the conditions, so should the maintenance requirements be financially and technically feasible.

The present guidelines are directed to chief officers in government departments and water supply organizations who are responsible for organizing the maintenance of handpumps in rural areas. It draws on the approaches followed and experience obtained in the rural water supply programmes of a number of countries in Asia and Africa, each very different from the others, yet sharing the same goal: bringing an acceptable water supply to their rural population, and using handpump installation as an important means in that effort.

ACKNOWLEDGEMENTS

The present document has been compiled on the basis of information collected from many sources.

The first major input was provided in 1978 by Mr. John Shawcross, then UNICEF's Water Supply Programme Manager in Dhaka (Bangladesh), who acting as IRC consultant developed the initial framework of the guide. The study continued, in a intermittent way, by review and analysis of such additional information as could be obtained from rural water supply programmes under implementation in various countries. The scarce literature on the subject was studied in depth.

We are indebted to all those who, knowing that IRC was studying the problems and experiences in handpump maintenance, were kind enough to feed selected documentation into IRC's information base. A major contribution was made by Mr. Raymond Janssens, UNICEF Project Officer (Water Supply and Environmental Sanitation), who worked as an IRC consultant during a two-month period in 1982. He greatly assisted in the further development of the guidelines.

Grateful mention is made of those who helped by reviewing the various drafts of the guide; their comments and suggestions were truly invaluable as a basis for improvements. The contributions from the following persons are especially acknowledged:
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Skilled people are needed to carry out the major maintenance tasks.

1. INTRODUCTION

1.1 General

Data published by WHO and other international agencies show that an estimated 1800 million people in developing countries will need to be provided with an adequate supply of safe water during the period 1981-1990 in order to meet the goals set for the International Drinking Water Supply and Sanitation Decade. The majority of the people to be served live in rural areas.

Massive capital investments would be required to bring safe drinking water to the rural areas of developing countries. A document prepared by WHO, in collaboration with the World Bank, states that if acceptable coverage for all rural populations is to be achieved by the year 1990, the required investment rate would have to be four times the 1971-1975 average level of investment, sustained throughout the 1981-1990 period.

These estimates clearly indicate the need for low-cost water supply technology such as handpumps. In areas where groundwater is readily available at moderate depth, constructing a number of wells with handpumps is by far the cheapest means of providing an adequate supply of safe water. Groundwater, in contrast to surface water, generally needs little or no treatment to render it safe for drinking and domestic use.

Although it may be economically feasible in some areas to tap groundwater with motor-driven pumps (diesel engines, electric motors, etc.), it is certain that in many more situations handpumps will play a major role in the provision of rural water supply. The effective use of handpumps is essential to the success of many rural water supply programmes.

1.2 The Current Situation

Experience shows that the use of handpumps in rural water supply meets with serious problems of inadequate design, poor quality of manufacture, lack of durability, poor maintenance practice, and weak administrative organisation generally. Failure rates over 50% within two years after installation of the

pumps have been reported. The problems have a world-wide dimension, as they are encountered in all countries where handpumps are used on a large-scale.

Handpumps are used under a wide variety of conditions. They may serve on shallow or deep wells, with many or few users. Their usage may range from almost continuous to infrequent, and maintenance from adequate to none whatsoever. Numerous handpump models, from many different manufacturers are on the market. Frequently, the pumps are imported from distant countries on the basis of very limited information.

Estimates of the worldwide requirements for handpumps are necessarily crude due to lack of sufficiently detailed data. However, a reasonable estimate indicates that handpumps are presently the source of drinking water for some 250 to 400 million people. Rural water supply programmes envisaged by developing countries to meet the targets set for the International Drinking Water Supply and Sanitation Decade would provide an additional 500 to 800 million people with a hand pump water supply. In the same period, handpumps currently serving some 150 to 250 million people would require replacement. Population growth would probably result in an additional 200 million people requiring a handpump water supply by 1990.

1.3 The Basic Issues

The financial burden on developing countries' governments from the maintenance costs of handpumps is rapidly increasing in those countries where rural water supply has been, and continues to be, undertaken as a social service. It appears that at least the direct costs of maintenance must be born by the benificiaries, or handpumps will be going out of service almost at the same rate as they are being installed.

There probably are no fixed rules to determine whether a governmental or village-level maintenance system, or whichever balance of both systems, is the right choice. The point that must be stressed is simply that one should be clear from the outset about the kind of maintenance system which is to be used in a rural water supply programme. To plan for governmental maintenance, and then find that it is provided only on a patchy basis, or not at all, is to invite failure.

A successful handpump programme requires coordinated and planned activity at all stages of implementation. The planning of such a programme should cover all stages from well drilling, community consultation and education, selection and installation of handpumps, on to proper maintenance.

1.4 The Basic Approach

Basically, two things are necessary:

1) Select or develop pumps that can be operated and maintained efficiently at the village level, and ensure that these are properly installed;
2) Organise a maintenance system to provide the necessary back-up service and the supply of spare parts.

Patchy maintenance is not good enough.

2. ANALYSIS OF MAINTENANCE PROBLEMS

2.1 General

This study concentrates on maintenance*) systems for handpumps fitted on covered (or"protected") dug wells or tubewells installed for community water supply purposes.

To keep a single handpump in operating condition is not so difficult if it is lavished with care and qualified maintenance attention. In contrast, it is extremely difficult to keep a large number of handpumps continually operating, particularly when these pumps are widely distributed in difficult terrain, in a country with a low level of development and with relatively few people with technical training and management experience.

In areas where handpump water supplies are vital, the introduction of a well and pump to a village community frequently is a major event. To obtain the maximum benefit, the future users are to be informed on the health aspects of water and sanitation, and involved in the siting of the wells to facilitate its proper use.

Once a water supply is provided, it is important to ensure that the community continues to rely upon it. Thus, it is essential that the pump be continuously kept operating. If it breaks down, and remains inoperative for long periods of time due to a poor maintenance, people will return to their traditional, polluted water sources and the opportunities for improving the attitude towards safe water supply will be lost, probably for years. Furthermore, where the handpump water supply was installed with contributions from the community, they may view its failure as evidence that their contribution has been wasted.

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*) Generally, maintenance means to nurse, to sustain, to keep operating, etc. Technically it means to keep an installation in proper working conditions.

There are several social and cultural reasons which may cause handpump maintenance systems to fail:

(a) The new handpump water supply was forced upon the local population and they did not really want it. They may fear that their own priority (e.g. a primary school) will be postponed indefinitely. Blaming the handpump for this, they may refuse to maintain it.

(b) The new handpump will also be neglected, or even rejected, when the existing water resources are regarded as holy, such as a hafir built by a well-known religious man, or a holy river or stream.

(c) People do not always understand the importance of a safe water supply for their health. For them, the important water quality standard is clarity and absence of colour, taste and odour. Bacteriological contamination is seldom recognized as important. Thus, the handpump water supply may be rejected and not maintained when the water from it is salty or tastes bitter.

(d) Women may resent the change in social life brought by the new water supply, e.g. the loss of privacy when new water points are placed nearby the houses. The washing of clothes at the village pond or on the river is often appreciated by the women as one of the sometimes few opportunities to get together and exchange news about family and village affairs. They may not like that to change.

Parallel to the establishment of the handpump maintenance system, a health education programme should be carried out to make people more aware of the health implications of a safe and reliable water supply, and to help them improve hygiene and health care.

2.2 Organisational Deficiencies

One reason why maintenance of handpumps is often neglected and not provided for, is that the organisation or community which is responsible - or is made responsible - for pump maintenance, frequently is a different one than the organization that is responsible for handpump installation which is again different from the organisation responsible for constructing or drilling the well. Too often, without any real justification, it is assumed that the local community will somehow maintain the handpump.

Generally, the well drilling activity will be separate from the pump installation and maintenance programme. Drilling work has its own set of objectives and priorities which are seldom in keeping with the timing and organisation of the pump installation and maintenance. The pump installation team, of course, should coordinate its programme with the drilling operation, so that the pumps will be installed as soon as possible after completion of the well.

Water supply organisations frequently tend to restrict their planning to drilling and installation activity only, to the exclusion of other aspects. Especially adequate staffing for maintenance back-up and for spare parts provision are neglected. As a result, these activities are often not budgeted for, or are inadequately provided. Poor planning then becomes evident when the maintenance system proves ineffective.

2.3 Bias towards New Construction and Installation

It is not uncommon to find that attention is mainly or exclusively focussed on the construction of new wells, and new installation of pumps. Frequently, no provision is made for the maintenance of the pumps. In fact, maintenance is one of the most neglected aspects of water supply installations.

International and bilateral agencies offer funds for new construction but are not so readily prepared to finance maintenance, considering this to be the responsibility of the recipient country. For their part, the countries receiving assistance have a legitimate need for additional water supplies but at the same time, find it difficult to make adequate provision for the maintenance of the existing ones. It happens therefore, that new handpump installation is sometimes used to replace existing pumps which could have been rehabilitated at much lower cost.

In many countries there are considerable problems caused by lack of funds and manpower for maintenance tasks, and inadequate procedures for reporting and repairing pumps that have broken down. Non-operating pumps deteriorate very quickly as people tend to damage them when they do not deliver the desired water.

2.4 Financial Constraints

A national handpump programme requires a long-term commitment to handpump maintenance and the provision of spare parts. Regardless of whether the funds come from national or external sources, the relationship between new installation and maintenance exists, and should be considered from the start. Neglecting the need for maintenance implies risking the investments made in the programme partly or totally.

But most governments of developing countries have only a very limited or non-existent budget for meeting the maintenance costs of installed handpumps. Resources required for maintenance are frequently underestimated in project proposals for rural water supply, and it is not unusual for budget authorities to make further reductions of the requests when it comes to actual allocations.

The cost of maintaining handpumps can be quite substantial, and there are situations (e.g. long distance between pumps) where any attempt at government-organized maintenance, however modest, would incur prohibitive costs. The key point for the government or central water supply agency is to avoid an accumulation of recurrent costs which cannot be financed within the regular budget. The degree of centralization in the maintenance system has a great influence on the costs that are to be met from the government budget.

2.5 Impact of Poor-quality Handpumps

The effectiveness of any handpump maintenance system can be marred by the installation of poor-quality handpumps. A handpump with inherent technical defects will not be economically to maintain, and any savings effected in the initial cost of the handpump are likely to be more than offset by heavy maintenance costs.

In view of the urgency of providing safe drinking water to rural areas in developing countries, and the limited supply of good-quality handpumps, water supply programmes sometimes make the mistake of relaxing quality requirements. This results in the use of hundreds of poor-quality pumps, which will first strain and, then, probably break the maintenance system.

Handpumps should always be obtained from firms which apply recognised specification standards as well as quality control procedures in the manufacture of their pumps. To ensure that handpumps acquired for rural water supply programmes are actually of satisfactory quality, they should be inspected by a specialised agency prior to delivery.

Few handpump programmes have meticulously insisted on standardisation and quality control of their supplies of pumps, and this in turn has considerably contributed to the poor maintenance record.

2.6 Absence of Preventive Maintenance*

In practice, preventive maintenance of handpumps is very rare, and the organisations that are responsible for maintenance merely send out repair teams when breakdown occurs. This is regrettable, because considerable economic savings can be achieved when preventive maintenance is provided instead of repair after breakdown.

For example, a country may have some 40,000 handpump water supplies, representing an average investment of US $ 2,500 each. If only 60% of the pumps are functioning, then 16,000 pumps are out of operation at any given time. Should an improved maintenance system result in the proper and continuous functioning of 8,000 out of these 16,000 pumps this would be equivalent to recovering a capital investment of US $ 20 million!

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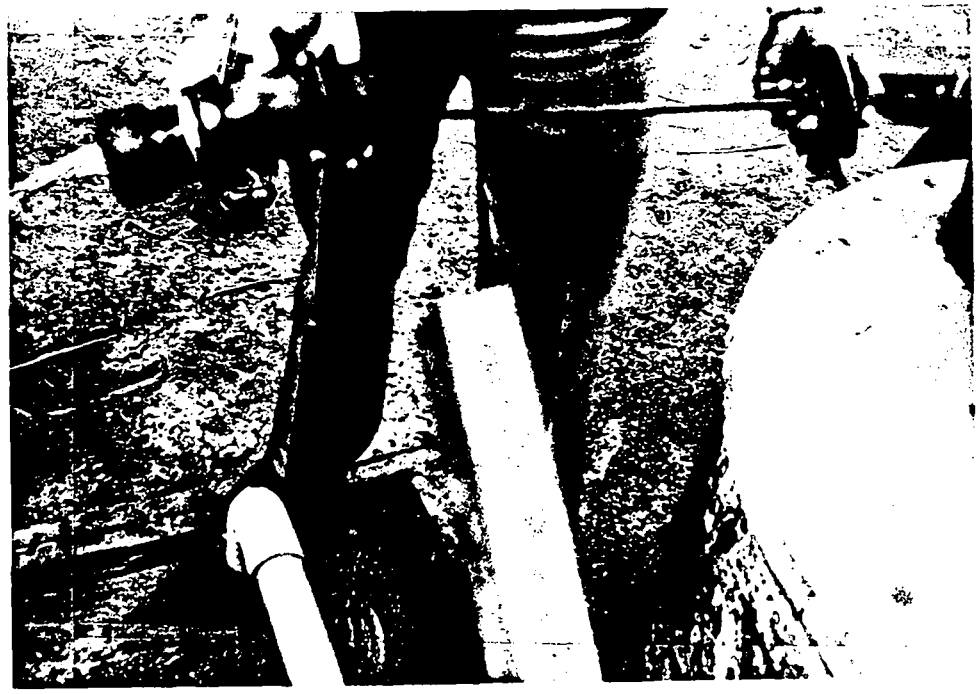
* Preventive maintenance involves regular maintenance carried out to keep handpumps in satisfactory condition by providing scheduled inspection, and correction of minor failures before they occur or develop into major problems. Lubrication, fitting of new parts and overhauls are made at regular, pre-determined intervals.



For skilled maintenance on a regular basis a maintenance system is needed.

3. HANDPUMP MAINTENANCE SYSTEMS

3.1 General

To organise a maintenance system for handpumps is not an easy task. It calls for setting up an organisation with the necessary personnel, equipment and materials, to do the maintenance job required at the time it needs doing. The following questions need to be considered when organising a maintenance system:

- Where is the work to be done? On site? In a workshop?
- Who should do the work? The level of technical expertise and the number of needed personnel.
- When should it be done?

Several different approaches have been applied with the aim of keeping large numbers of handpumps operating. Broadly speaking, these fall into the categories of:

(a) government-organised maintenance;
(b) village-level maintenance;
(c) private maintenance;
(d) varying combinations of these types of maintenance system.

Most handpump maintenance systems can be characterized as one-tier, two-tier or three-tier systems. An example of a one-tier system is where all maintenance tasks are the responsibility of a government organization, or where they are undertaken exclusively by the communities. In the two-tier system, maintenance is shared between the government agency and the local communities. In the three-tier system, the intermediate level of government (e.g. province; district) assumes a specific part of the maintenance duties.

In the two-tier and three-tier systems the local community, or a resident working on a voluntary basis or as a government employee, assumes responsibility for basic village-level handpump caretaking, maintenance and failure reporting. Where villagers deal with only the basic maintenance tasks, it is necessary for a technical support team to visit the pump at regular intervals (e.g. every three months) for a thorough servicing of the handpump.

Sometimes, an attempt is made to allow for very little or no maintenance at all, by using very robust handpumps which are not likely to need any servicing or repair for a long time.

This always is a fallacy. An example can perhaps serve to illustrate the inherent implications of not providing for maintenance, even where it concerns simple and robust devices. The ox-drawn farm implements used widely in Africa are often viewed as needing no maintenance at all. These are strongly made of steel and rarely break. But with use, the optimum shape of tines and ploughshares is gradually lost. Angles and edges are distorted by wear and sometimes by bending. The result is that more and more effort is needed by the oxen to draw the implements through the soil, and in the end the work becomes impossible.

The key argument in this study is that, for a pump installation programme to be effective, clear choices need be made as to which maintenance tasks are to be taken up by the local community, and which will be the responsibility of the government water supply agency. That is, the choice of "zero maintenance" is not a real option! The "zero maintenance" concept is often used as a claim to justify a high-priced handpump. While it is true that well-designed, heavy-duty pumps require less repair, they really do need a certain amount of maintenance.

Increasingly, we see that the local community, through a resident working on a voluntary basis or paid by the government, is required to assume responsibility for the basic village-level maintenance duties and the reporting of breakdowns. This routine maintenance work includes lubrication, bolt tightening and minor repairs. A mobile maintenance team operating from the district centre is then needed for back up support to provide major maintenance work and the regular servicing of each handpump installation.

As the functioning of a maintenance system in this way, in more and more cases, will depend on both the local community and the government agency, it is absolutely essential that it is clear which maintenance tasks are assigned to the local community and which will be provided by the central maintenance organization. The responsibilities of each must be allocated with a considerable degree of detail, and should be discussed and agreed upon before the handpump is installed.

A handpump programme without a parallel maintenance system is incomplete. Maintenance is a tangible requirement, and the question should not be whether or not to have maintenance but how it should be organised.

3.2 Key Considerations

Organising handpump maintenance, i.e. establishing a viable maintenance system, should be viewed as an investment - and a sound investment indeed! A handpump maintenance system, if working effectively, not only protects the initial investment in well drilling and pump installation, it also provides a basis that can be extremely useful for further community development programmes.

Investment in maintenance, therefore, also is investment in institutional development. A handpump maintenance system should be considered in this broad sense.

The development of a handpump maintenance system requires policy decisions and long-term commitment to implement it as planned, stressing maintenance as a priority activity. This is necessary in order to support the management and funding of a maintenance system. Maintenance is a demanding activity requiring the building up of capacities at various levels, and this needs careful planning.

The strict time frame of many handpump installation projects receiving foreiegn assistance often makes it difficult to deal with maintenance requirements from the outset. There needs to be direct contact between the bilateral aid agencies and the national agency at an early stage, and not only after a project has been completed.

When organising a handpump maintenance system, an important factor is the rate of expansion of the handpump installation programme. There always is the danger of trying to expand too quickly. It takes years to train staff, to arrange for procurement of pumps and spare parts, and to establish a spare parts distribution network. Most difficult of all is the requirement to educate and train the people for their role in the maintenance system. Working continuously and starting from a zero base it could take as long as five to ten years before a country can absorb a massive handpump programme.

The spare part distribution and local manufacturing capacity of pumps would be built up. In this way, the maintenance system would develop gradually and sufficiently to be able to accomodate later expansion of the handpump programme.

Gradual, step-wise expansion is not always easy to achieve. The New No.6 pump used in Bangladesh, for instance, had a design problem in that four bolts were used in the headcover where three bolts would have been much better. Maintenance crews reported this time and again to the government department concerned. But, what should be done? Should the head cover be re-designed, and be replaced on the 500,000 pumps that were already installed? Who would pay the costs of such an enormous operation?

Some tasks need to be performed so frequently that the only practical solution is to undertake them at the village-level. These include the greasing of hinge-pins and sliding parts, and a daily cleaning of the well-head and platform. Other maintenance tasks suitable for a pump caretaker at the village level, are those which do not require any special equipment, except spanners of the relevant size. In deep wells, changing the pump leathers involves lifting and unscrewing a very long length of pump rod, which is perhaps best left until a technician is present to help. On shallow wells, however, a trained villager could do the job. Every detail needs to be thought out like this. It is the only way to arrive at a clear allocation of responsibilities between visiting maintenance technicians and the village pump caretaker(s).

An important consideration is the extent of existing community organisation. The chances of effective village-level maintenance are small where the community structure is not strong enough to provide the requirements of handpump maintenance. These include:

- awareness of the importance of safe drinking water;
- purchase and storage of spare parts;
- technical skills;
- funds and local administration.

For even a minimal degree of community participation in handpump maintenance, the community attitude and interest in safe drinking water is a decisive factor. Where the well and handpump are provided without adequate

introduction and communication, the safe water supply will be seen as something provided by the government without request or consultation. Frequently, under such conditions the community will expect the government to maintain the pump as well.

Awareness of the importance of safe drinking water should not be expected to exist at the village level. Rural populations often are unaware of the relationship between their traditional, polluted water sources and the incidence of water-related disease. Thus, there is a very real need for health education which should aim at developing a practical understanding of how water-related diseases are transmitted in the local community and what people can do to improve hygiene and avoid health risks. Encouraging communities in the use of safe drinking water is not a simple task; it entails changing traditional beliefs, and behaviour that frequently are deeply ingrained.

The water supply agency cannot do such things alone. It can include information on health aspects in the well surveying and construction activity, and provide health education in the training of village pump caretakers. But other agencies responsible for public health, education and community development will have to take over, to help village identify what particular risks of transmission of water-related diseases exist in their community, and how hazardous conditions and unhygienic behaviour patterns can be changed.

3.3 Government-Organised Maintenance

Where the government assumes all responsibility for maintenance, it would have to arrange for the procurement and distribution of spare parts, provide staff, equipment and transportation, meet training requirements, establish workshops, ensure installation quality, carry out major handpump repairs, and when necessary replace handpumps or renovate them. Apart from these tasks, it would have to extend its infrastructure to the community level to communicate the safe drinking water concept to the village communities, to instruct villagers in the use and care of the handpump, and most importantly, undertake responsibility for failure reporting. However, no amount of maintenance infrastructure at other levels can substitute for pump caretaking at the village level.

There are several ways the government might organise these duties. A special government agency may be established which would be responsible for the maintenance of all handpumps installed by the government. It may have offices at the lowest level at which the government can maintain such units.

One advantage of the government taking all responsibility for handpump maintenance would be that there will be no doubt where the responsibility rests. This is particularly relevant, where more than one organization is involved in installation and maintenance of the pumps. Especially where one central organization would handle both handpump installation and maintenance, the value of proper installation will be recognized in terms of reduced maintenance costs.

Obviously, the costs involved in providing all the maintenance and repair tasks would be substantial for one agency to bear, as would be the requirements of professional skill and capacity. The centrally-organised type of maintenance system always will incur high, and frequently even prohibitive costs to the government*.

Sometimes, the government establishes a technical organisation which is responsible for a group of utilities or basic amenities such as water supply pumps, roads, power, housing construction and other services which may conveniently be grouped together. However, when a number of activities which are <u>not</u> connected with handpump maintenance are grouped under a government regional or district office, there is always the disadvantage that the other demands will probably overshadow the requirements for handpump maintenance. The road construction programme, for example, could easily take precedence over the maintenance of handpumps. This approach also often requires simultaneous completion of services, a considerable administrative strain.

Experience has shown that although centrally-organized agencies may be effective in the initial stages of a handpump programme, they usually do not grow commensurate with the expansion of the programme. Often, after some time, they become understaffed, undermotivated, and physically incapable of

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* For example, in Tanzania the estimated costs of such a maintenance system would amount to TAS 1,000-1,500 (about US $ 130-200) per year, per pump.

meeting the monitoring and logistical requirements of the maintenance programme. In the absence of detailed and continuous data collection, the planning (including budgetary implications) tends to become unrealistic and inadequate, and the maintenance structure will gradually begin to disintegrate. Furthermore, such agencies often do not have units at the village level, and consequently no first-hand information on the actual working condition of the handpumps.

In practice, the distant government agency is likely to regard it as too costly to send a technician a long distance just for the routine servicing of a handpump. The pump will be used by the people for as long as it works, but when the inevitable happens and the pump breaks down, the cover of the well will be opened and buckets will be let down to draw water. This negates the very purpose for which the pump was installed, that of sealing the well against contamination from the surface in order to safequard the quality of the water.

3.4 Village-Level Maintenance

This type of maintenance system is dependent on the availability of below-ground pump components that can be maintained by pump attendants at the village-level. Eventually, the village pump caretaker using only a few tools, should be able to withdraw worn or damaged below-ground pump parts and replace them with new parts obtainable from a spare parts distribution system.

Although the present stage of handpump technology and community capabilities usually do not allow full village-level maintenance, it is simply necessary that handpump programmes should eventually move towards such a system. Maintenance at the village level needs to be made possible by modified pump designs and more intensive and specific training of the local pump caretakers.

The users of a handpump are the ultimate judges of the effectiveness and efficiency of the handpump maintenance system.

Community involvement in the maintenance of handpumps may not only result in better care and unkeep of the pump, but also may help stimulate related activities such as health education and the proper use of water for hygiene. Water can provide an entry point for a number of related activities for rural community development, if community participation is encouraged from the outset.

A certain amount of spontaneous community involvement will exist in all cases, in varying degrees. During the survey the community should have been consulted on the existing water supply situation, the acceptability of potential well sites for pump installation, and the division of maintenance responsibilities. During the well drilling stage, the community is already involved through the donation of land for the handpump site, and probably also the provision of food and lodging to the drilling crew, as well as work assistance by local labour. Drilling activity in a village will generate a natural degree of interest, and since the drilling and installation activity may require several days during which the team members stay in the village, this would provide an excellent opportunity for informal communication on the importance of safe water for health. This basis will later be useful for establishing an organised community involvement in the up-keep and maintenance of the handpump as well as for introducing health education activities.

One great advantage of a determined policy of encouraging village-level maintenance of handpumps is that it can bring out local initiative and reduce the burden of maintenance costs on the government. Government resources may then be channeled to new well construction and handpump installation. This approach completely depends on the people's attitude towards the pumps. Where the well and handpump are seen as something the government has installed without any request or consultation, the local people will normally expect the government to maintain the pump. However, where the village community does see the handpump as something that was achieved with full local cooperation, they may feel it is theirs.

The village-level handpump maintenance system in most cases includes back-up service by the government agency concerned in the carrying out of major repairs, but the routine maintenance and minor repairs would be fully at the village level.

It should be recognized that such a village-level maintenance system based entirely on local resources and only supported by a governmental backup service is very likely to fail in the early stage of development. In most developing countries it is not reasonable to expect small rural communities to fully maintain their handpump as envisaged in the maintenance system that should eventually develop. Frequently, the immediate result of such a system will be a large number of handpumps out of operation, and the resources used in well construction and handpump installation will be wasted. In the early stages when people are not yet accustomed to using well water, and do not yet appreciate the benefits of their new water supply, the first breakdown of the pump could provide a convenient excuse for the users to return to their traditional, polluted water sources.

This conclusion was illustrated and confirmed by a project in Ghana where the use of pumps on covered wells was deliberately rejected because it was felt that in practice the pumps would not be maintained. Open wells were chosen, and it was tried by various measures to reduce the health hazards associated with the use of buckets. Under these circumstances, it would probably be best to gradually upgrade the technical capabilities of the local people, urging them to accept a handpump as soon as they feel they can cope with the maintenance requirements of the pump.

In the initial stages, a mechanic from the government-organised backup service should be providing technical support to the maintenance of a given number of handpumps. His job would be to check the technical condition of the pump, to carry out repairs to the above-ground assembly, and to call in the government agency's district maintenance team for the major repairs. This technical support, in the initial years, leading up to eventual village-level handpump maintenance would fulfil an essential role.

The overall costs of a village-level handpump maintenance system will probably be no less than that under other systems. However, the cost to the government will be substantially reduced.

3.5 Private Maintenance

Quite frequently, no formal government organization exists for the maintenance of handpumps, nor is there a village-level system. Where the pumps are financed exclusively from private sources this may be acceptable.

The owners of the well and handpumps are likely to have sufficient financial resources to purchase spare parts from commercial suppliers who have a profit incentive to ensure that the needed spare parts are on sale. Furthermore, privately owned handpumps are usually not so intensively used, and the direct involvement of the owner will probably ensure greater care than is normal for a handpump used by a community.

3.6 Selecting a Maintenance System

Basically, the proper choice of system should be village-level maintenance because of feasibility, effectiveness and cost. However, at present both the equipment, the technology and the organizational structure for this type of maintenance system still need to be developed. Although field trials and research are undertaken to develop village-level maintenance of handpumps, it will still take years before it will become fully mature and effective. The variety of pumps already installed in many countries forms a serious problem and constraint which will be hard to overcome. More emphasis on standardization would greatly simplify maintenance systems.

An important factor is the scope of the handpump programme, both in terms of number of handpumps as well as the geographical area covered. In selecting a maintenance system, factors such as distance, accessibility and density of handpumps sites, and the necessary frequency of inspection and repair, are essential considerations. The importance of pump density should not be overlooked when planning the maintenance system. At some stage it may be possible to change from central, and thus, distant stockpiling of spare parts, to local stocks from which spare parts can be further distributed to the village pump caretakers.

The unit costs of maintenance are mainly dependent on the type of handpump and the density of the pump sites. When planning a maintenance system, it is important to take into account that as the system expands, economies of scale will become more significant. When the first handpumps are installed, unit maintenance costs will be relatively high. But, as the pumps increase in number, unit costs will be reduced. The travel distances between the pumps generally will become less, and spare parts may be stockpiled more near to the places where these are needed.

It makes a difference how a handpump is installed.

4. INSTALLATION AND MAINTENANCE REQUIREMENTS

4.1 Installation

The way a handpump is installed, is of great importance to its efficient operation. However, this truism is often neglected, and a pump that is not correctly installed will create major maintenance problems for the users. Often the problems will not be the fault of the pump.

Installation practice covers surveying, well drilling and the pump's installation proper. Poor surveys can give the wrong information on aquifer depth and nature, and the assessment of the potential yield of the well will be inaccurate. Poor drilling will result in a crooked well making the proper installation of the pump impossible. Inaccurate depth measurement will result in the improper positioning of the pump.

Installation problems can also lead to damage of the pump or its parts. Pumps may even be dropped down in the well, when mountings are insecure or inadequate.

Probably the area with the most pitfalls is the actual assembly, setting up and testing of the pump, and the correct installation itself. A pump installation manual is essential, and it should preferably be in the local language. However, even the best installation manual takes some standard engineering practices for granted, and these may not be apparent to the people installing the pump.

4.2 Maintenance Requirements

The common claim by manufacturers that their handpump will last for 15-20 years under "normal operating conditions" is far too simplistic a guideline to be of much value in the maintenance of pumps. Each pump has a number of components. Several of these components will probably last many years with little or no maintenance. Others have a more limited life span because of wear or vulnerability. As with any mechanical device, a handpump has wearing parts which have to be replaced periodically more or less in relation to the intensity of use. Thus, when we speak of the maintenance requirements of a pump, we are not referring only to the most rugged and longest lasting component, we are actually assessing each component of the pump separately.

Another aspect is that high-priced handpumps often have high-priced spare parts. Although the parts of these pumps may not have to be replaced often, the cost is high when it does happen. Thus, over the pump's life span the total costs of spare parts for such a pump may be considerably more than for lower-priced pumps.

The most common cause of handpump breakdowns is wear of the piston cups in the cylinder. This is much commoner than failures of the top-end parts. In deep-well pumps, it is also a more serious problem than faults in the top-end mechanism, because changing the seals in pump piston entails hauling the riser pipe, pump rod and cylinder to the surface. This is often beyond the capability of a technician working by himself. Even where villagers provide help, maintenance work on a deep-well pump remains a difficult job to undertake.

The next most significant cause of pump failure is trouble with the valves in the cylinder. Repair and maintenance again require hauling the riser pipe, pump rod and cylinder out of the well. Ball valves are normally more trouble-free than flapper valves, but they suffer from the defect that pounding of the ball may deform the metal seat on which it rests. Experience shows that poppet valves with rubber cushions are often more effective in the long run.

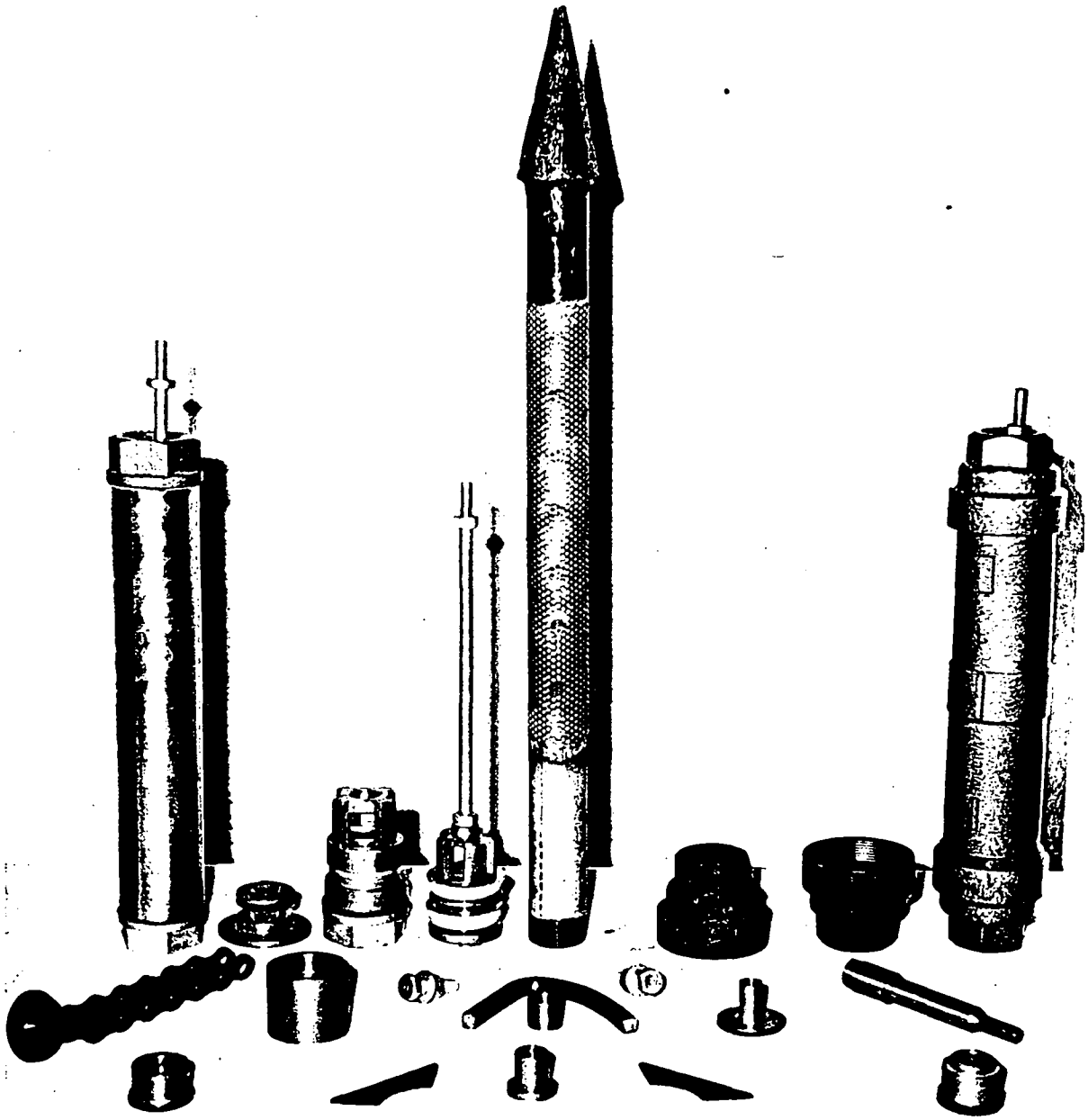
A typical handpump maintenance schedule is given in Table 1.

Village pumps are often used very intensively, and Table 1 recommends a correspondly high level of maintenance. In some instances, this would lead to pumps being over-maintained, but this is obviously preferable to the present state of total neglect of maintenance as found in many areas. The frequency of maintenance could be adjusted for lightly used pumps.

Table 1. Typical Maintenance Schedule for Handpumps

After: Pacey (1976)

daily:	-	lock and unlock the pump at hours agreed by the village.
	-	clean the well-head.
weekly:	-	thorough clean-up of pump, well-head and surroundings.
	-	oil or grease all hinge pins, bearings, and sliding parts, after checking that no rust has developed on them.
	-	record any comments from users about irregularities in working (tightness of parts, leaks from stuffing box, fall-off in water raised). Correct these when possible.
monthly:	-	if necessary, adjust the stuffing box or gland. Usually this is done by tightening the packing nut. This should not be too tight; there should be a slight leak when the adjustment is correct.
	-	check that all nuts and bolts are tight, and check that there is no evidence of loose connections on the pump rods
	-	check for symptoms of wear at the leathers, noting any comments from users about any falling off in the water raised. If the pump fails to raise water when worked slowly (e.g. at 10 strokes per minute), replace the leathers.
	-	carry out all weekly maintenance tasks.
annually:	-	paint all exposed parts to prevent development of rust.
	-	repair any cracked concrete in the well-head and surroundings.
	-	check wear at handle bearings and replace parts as necessary.
	-	check plunger valve and foot valve; replace if found leaking.
	-	check the pump rod and replace and defective lengths or connectors.
	-	replace packing at the stuffing box or gland.
	-	carry out all monthly maintenance tasks.



Maintenance costs include the costs of spare parts.

5. FINANCING HANDPUMP MAINTENANCE COSTS

5.1 General

An important factor for the viability of any maintenance system for handpump water supplies, is how the maintenance costs are to be met. The financial arrangement for meeting maintenance costs will reflect the government policies and commitment and any arrangements made under a joint plan of action with international organizations and/or bilateral aid agencies.

In many instances communities in rural areas rely, sometimes too easily on subsidies from the government or other external assistance, to finance the maintenance of their handpump water supply. It has been said that the day when people start to receive water from a handpump at no cost marks the beginning of the downfall of the pump.

4.2 Methods of Financing Maintenance Costs

The way the costs of maintenance services and spare parts are financed, greatly influences the distribution of the costs over the various sources of finance. The following arrangements exist:

(a) Government pays:

Where the government pays all costs of maintenance and spare parts, the maintenance organization must extend down to the village level. It is quite possible for a villager to be employed by the government as the pump caretaker for each pump installed, but this will further add to the financial burden on the government.

(b) Government subsidizes:

With this method, the government will be financing the costs of the central maintenance organization, and the local communities will have to pay the cost of the spare parts, and perhaps also a service charge for actual maintenance work on their pump. Or the communities may organize themselves to carry out the simple maintenance tasks and minor repairs, with the government carrying out and financing the major repairs. The government organization, in this system, will have to collect service charges and payment for spare parts, and should be able to recycle these funds for the purchase of new supplies of spare parts.

Frequently, the handling of, and accounting for, such funds will present a major administrative problem. It may even be not possible to directly recycle revenue to meet the costs of spare part supplies, in cases where revenue has to be paid into the general government account.

(c) The community pays all costs:

In this case the people may either pay the full charge for the maintenance service provided by the government organization, or the full costs of hiring local technicians to carry out maintenance and repair work. With this method, the community will be fully responsible for meeting the maintenance costs of its pump.

(d) Other options:

Other options for the financing of handpump maintenance costs may be possible such as the one that has been considered in Upper Volta. This would involve a special levy on beer and alcohol, to pay for the costs of handpump maintenance. In Upper Volta, and perhaps in many other countries, beer and alcohol are regarded as a luxury.

5.3 Maintenance Inputs

Manpower

Depending on the scope and size of the handpump programme, provision should be made to obtain staff who can deal with:

- management, supervision and training;
- general inspection;
- installation;
- preventive maintenance;
- repairs and overhauling of pumps;
- administration of stores and spare parts;
- vehicle maintenance.

Since handpump maintenance is labour intensive, and seldom a one-man job, a variety of skills is needed for running a maintenance organisation. Manpower needed includes engineers, administrators, clerks, mechanics, drivers, helpers, masons, health educators, and of course, the pump caretakers.

In a government-organised handpump maintenance system, the number of people directly employed will depend on the extent to which local communities share in the maintenance activities. Another important factor is the total number and density of pumps in an area. No firm conclusions on manpower needs are possible but the ratios found in India, Bangladesh, and Tanzania may provide some insight (Table 2).

Table 2. Typical Ratios of Staff Employed for Handpump Maintenance

Labour, Technical and Management Employees per 10,000 handpumps

	Tanzania		Bangladesh	India
	(a)	(b)		
- Executive level and above	30	5	1	1
- Middle level	60	10	9	18
- Lower level	130	75	50	160
	220	90	60	180

(a) Centralized maintenance system

(b) Decentralized maintenance system, with village communities taking responsibility for simple, daily maintenance tasks and minor repairs.

Clerical and administrative posts required in the maintenance organization are not shown in Table 2. Furthermore, other units of government may have to be strengthened in order to cope with the additional workload of the handpump maintenance programme.

Transportation

Some of the most important costs of handpump maintenance do not pertain to the handpumps themselves, but to the costs associated with the use of trucks, motorcycles and mechanics required to inspect, service and repair defective vehicles. The failure of handpump maintenance systems can often be put down to the huge transportation problems. Once the initial investment in vehicles has run out, there are frequent breakdowns, and spare parts may be hard to come by.

The number and types of vehicles required by a government maintenance organization will largely depend on the topography of the country and its transport infrastructure such as roads and railways. In many countries, the roads will be the most important. Senior staff of the maintenance organization would require vans or cars, possibly with four-wheel drive. For transport of the necessary equipment and maintenance materials, pickups or trucks may be required. In remote and difficult terrain (such as parts of Nepal) where roads do not exist, the maintenance organization may even require animals for transport purposes. All transport units themselves require maintenance, and the handpump maintenance organization will have to make provision for the upkeep of its vehicle fleet. The cost of maintaining the vehicle fleet and the write-off of vehicles quite often form a considerable part of the overall maintenance costs of handpumps.

Equipment

The maintenance organization will require equipment for routine maintenance tasks, and for making repairs. The equipment needed includes wrenches, lifting gear, screwdrivers, hammers, hack saws, and whatever other tools and equipment needed for the particular handpumps in use. The handpump caretaker may be provided with a very basic set of tools to carry out the simplest kinds of maintenance, such as bolt tightening and the replacement of the piston cups (in the case of shallow well pumps). The pump caretaker may also receive a supply of grease for regular lubrication of the pump's moving parts. Provision of tools and materials to pump caretakers obviously form part of the overall maintenance costs.

In Bangladesh, UNICEF succesfully developed a compositive tool with which all maintenance tasks on the New No.6 handpump can be carried out. The provision of this compositive tool followed a modification of the pump's design by which the sizes of nuts and bolts used in the pump, were rigidly standardised. A limited number of nut sizes is now used throughout.

Housing

In a government-organized maintenance system, staff frequently claim living accomodation and, dependent on local custom, it may be necessary to construct housing for these people. This is mentioned here because, in estimating the capital investment for a government maintenance system, it may be necessary to allow for the construction of staff housing. For the lowest level of staff who will be in the largest numbers, housing would probably not be considered the government's duty. However, if they are expected to carry out their tasks conscientiously, they must either be given sufficient income to purchase or to rent their own accomodation or else they must be provided with living quarters. In some countries, the provision of staff quarters has been found the most approriate arrangement.

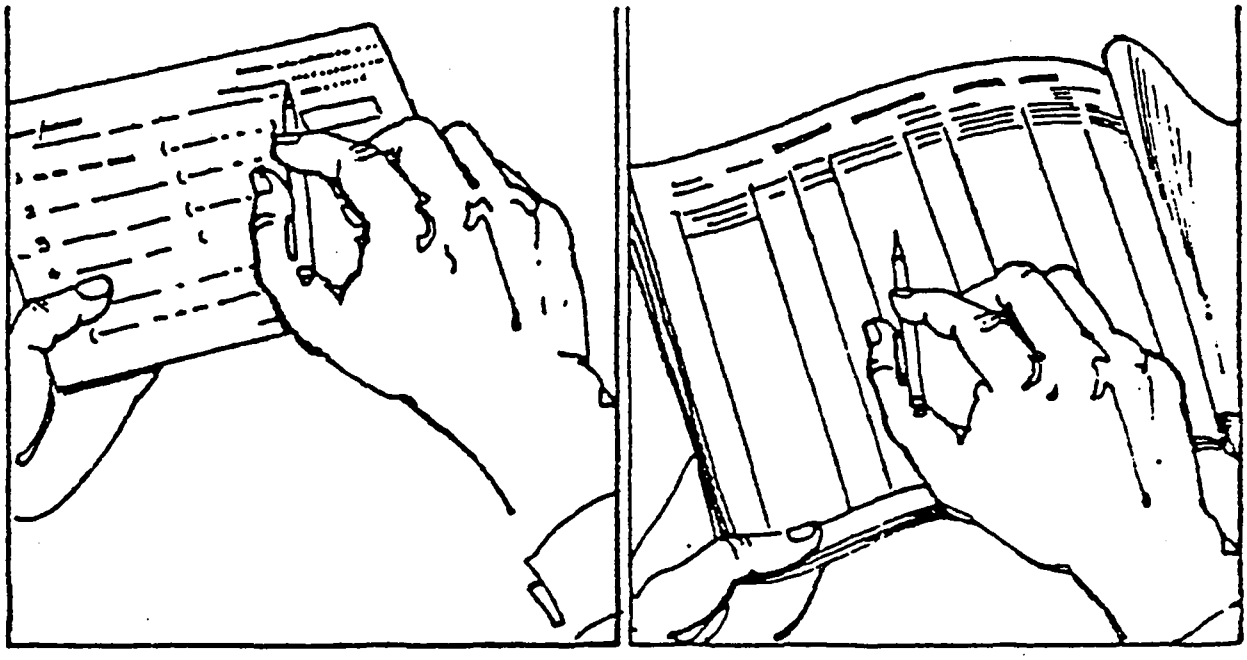
Offices, Stores, and Workshops

An essential part of any government-controlled maintenance organization is a system of offices, stores, and workshops. At these locations the government staff will have their base. Maintenance materials will be stored here and workshops for the repair of pumps, vehicles and equipment set up. Generally these offices and workshops will fit into the organizational structure of the government with a head office, and regional or district offices. Lower down the chain of operation, as work concentrates more on the actual maintenance tasks, combining offices and stores will usually be advantageous. The planning of a spare parts distribution system will be dependent on the sources of supply and areas of demand. In places where spare parts are issued, it is often economical to also collect replaced items. These can be sold as scrap or they can be reconditioned, as appropriate.

From the records as available, an analysis should be made of frequency of replacements of the different parts of the handpumps used in a handpump programme. This will provide the necessary basis for ordering (e.g. once or twice per year) the needed supply of spare parts.

5.4 Record Keeping

The need for proper record keeping as a basis for handpump maintenance cannot be over-emphasized. Only from such records, is it possible to determine the required frequency of servicing the handpumps, the time the maintenance jobs take, the actual performance and reliability of the various components of the pumps and which spare parts should be stocked in what quantities.



Maintenance requires functioning record-keeping routines.

Maintenance records are mostly kept on cards, one for each handpump. On these cards should be kept a record of regular lubrication, inspection, cleaning, replacement of worn parts and other data of importance. The data for the next regular servicing of the pump should be noted.

5.5 Maintenance Cost Data

Actual handpump maintenance costs are very much dependent on: a) number of handpump installations and the distances they are apart; b) prices of fuel, spare parts; and c) durability of the pumps. Actual cost data for maintenance of handpumps are hard to come by. This is due to a variety of reasons.

Firstly, it is a question of time before initial reports can be received. If properly installed in the first place, handpumps usually require little maintenance during the first year or so of their life.

Secondly, due to the scattered location of handpump installations in any individual country, it initially does not seem necessary to set up an organization specifically for their maintenance. Thus, when maintenance or repairs are required, these may be carried out by a government agency or private organization without any specific charges. In this situation it is not easy to analyze average maintenance costs of newly installed handpumps.

While it is true there is a dearth of actual maintenance cost data, some are available.

In a recent survey of two villages in Upper Volta, the feasibility of a financial contribution from the villagers in the costs of maintaining a new handpump water supply were investigated. The study method used was to relate the actual expenses for the ropes and buckets used to lift water from existing open wells to estimated family income (Table 3).

As the water supply situation in the village of Boare (Upper-Volta) was very inadequate, the people were found willing to pay an extra charge of 60 CFA per person. Moreover, they would be prepared to provide assistance in the installation work needed to install their handpump. Apparently, it is possible to obtain some contribution from the users for meeting maintenance costs provided the new water supply is regarded by the people as much better than their existing water sources, and is accepted as not costing more than their current expenses for water.

For the India Mark II handpump, an official source quotes maintenance costs at Rs 350 (US $ 35) per annum.

A typical cost estimate of handpump maintenance is given in Table 4.

Table 3

Expenses for Ropes and Buckets in Two Villages in Upper Volta.

(100 CFA = US $ 0.40)

Numbers of persons per family	Village of Boare* population: 1130		Village of Zizin * population: 370	
	expenditure per person	% of estimated total expenses	expenditure per person	% of estimated total expenses
less than 6	342 CFA	9.5%	162 CFA	2.9%
between 6 and 10	185 CFA	5.2%	164 CFA	3.0%
more than 10	140 CFA	3.9%	145 CFA	2.6%
average family	192 CFA	5.4%	155 CFA	2.8%

* the higher costs in Boare village are due to the greater depth of the well
** the village of Zizin is more wealthy.

Table 4

Typical Cost Estimate of Handpump Maintenance

(1 US $ = Rs 10) (Allahabad District, Uttar Pradesh, India)

Store keepers	4 x Rs 5,580 per annum	Rs 22,320
Pump Mechanics	8 x Rs 4,872 per annum	Rs 38,970
Helper to Mechanic	12 x Rs 4,632 per annum	Rs 55,580
Watchman	4 x Rs 4,032 per annum	Rs 18,530
Part-time sweeper	4 x Rs 600 per annum	Rs 2,400
Jeep Driver	1 x Rs 4,896 per annum	Rs 4,890
Travel allowance for staff at Rs 300/- per month	1x4x12x300	Rs 14,400
Running of vehicles		
a. for motor cycle average running 30 km/per day/ (one liter petrol for 30 km)	1x4x1x365 Rs 6.50/liter	Rs 9,490
b. jeep for inspection once every two weeks (approximately 200 km per trip) per trip	1x4x2x200x12x1 Rs 750/liter	Rs 20,800
Office	1x4 office Rs 750/year	Rs 3,000
Spare parts for maintenance of handpump	711 Nos. Rs 20 per HP	Rs 42,200
Total Maintenance Costs		Rs 363,680* (= US $ 36.370)

* Total Population Served 125,000
Annual Maintenance Costs: Rs 3,00 (US $ 0,30) per capita.

5.6 Budgeting for Maintenance

Per Capita

The costs of maintaining handpumps are dependent on conditions that are specific for each area. Costs may thus vary substantially, ranging from US $ 5 to US $ 250 per year per handpump. Higher pump density would normally bring costs in the $ 30 to $ 80 per year range, and for a lower density it would probably be somewhat higher but usually not more than $ 100-120 per handpump. Based on 100 persons served by a well, and in many cases this figure is double or more, per capita maintenance costs thus are usually in the range of $ 0.30 to $ 1.20 per year.

These may not seem large amounts but as handpumps are mostly used in (very) poor areas, it may be quite difficult to raise such sums locally. The amounts must be viewed in the context of the local incomes from which a contribution towards the maintenance costs of a handpump would be charged. The costs may seem negligible but, in fact, may represent a considerable portion of family income in a rural area.

According to a publication of the World Bank*, any charges for water should not exceed five percent of family cash income. However, even where considerably less than this amount is required for pump maintenance, the mechanism to collect the money does not normally exist except for funds raised through the general taxation process. There may be a case for government funds to cover all or part of the cost of handpump maintenance, but it should not be unreasonable to expect the village community to pay for spare parts, if the government already pays for the distribution of spare parts and major repairs.

Maintenance Costs as a Proportion of Capital Cost

The maintenance costs expressed as a proportion of the capital cost of new handpump installations will vary considerably depending on the type of maintenance system used, density of handpump installations, the country's infrastructure, prices of fuel and spare parts, wage level and a host of

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* Village Water Supply: Economics and Policy in the Developing World. World Bank Research Publication. Johns Hopkins University Press, Baltimore, 1976.

other factors, such as the quality and durability of the pumps. As a rough guide, maintenance costs may be estimated in the range of 6 to 20% of the initial cost of the pump, per year.

Replacement Costs

The pumps must be replaced eventually so the initial cost of installation is not the end of the financial commitment. It is necessary to consider the eventual cost of replacement or rehabilitation of the pump. The well usually costs several times as much as the pump, and replacement of the well also has to be considered. New well construction or rehabilitation is almost always a matter that has to be handled by the government. The technical skills and capital requirements will be much greater than what the village community can normally provide. In most cases, the replacement of a well has to be financed by the government from general revenue, if possible with some contribution by the village. Attempts to get the village to repay the full cost of the well over a number of years are likely to fail because once the government has installed the well, any threatening that it will be removed or closed is both unreasonable and not very realistic.

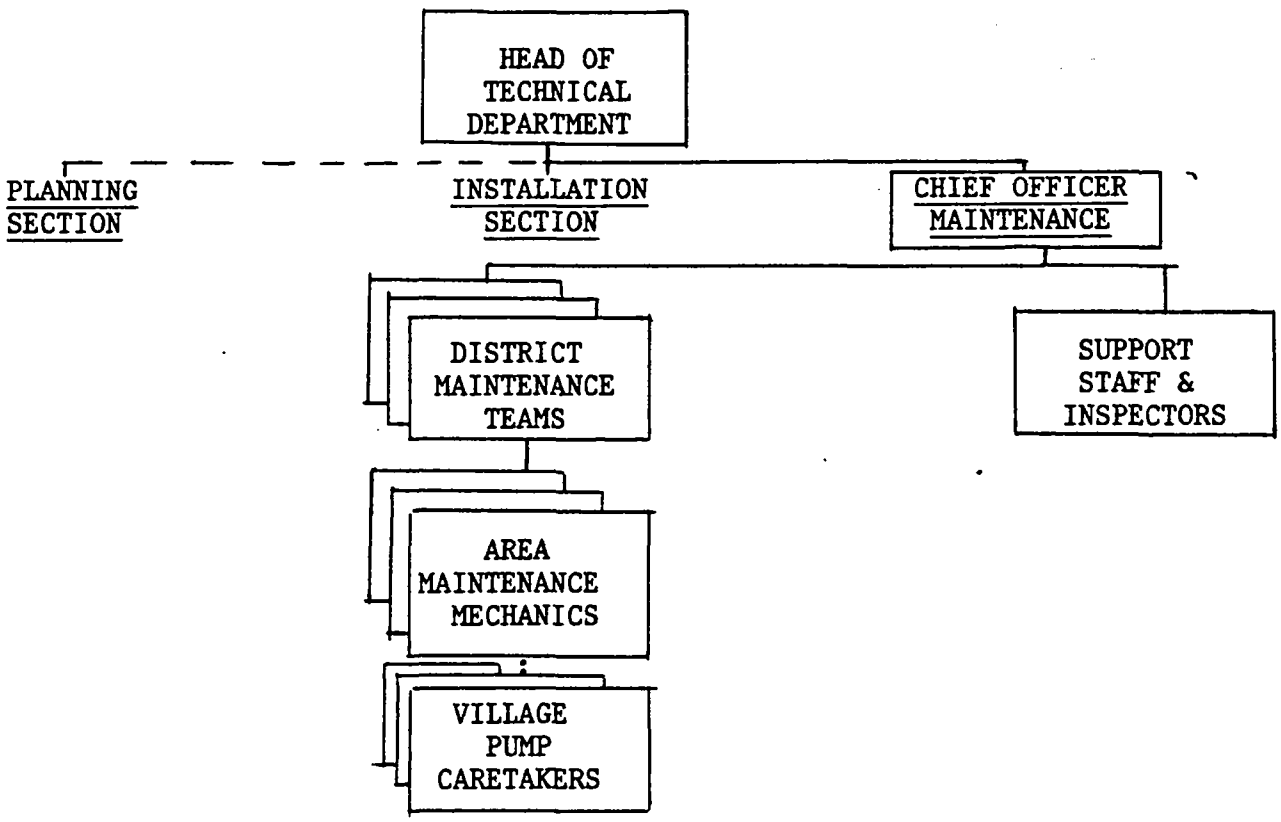
6. HANDPUMP MAINTENANCE ORGANISATION

6.1 Organisational Structure

It is recommended not to place the maintenance function under the line authority of the handpump installation section of the water supply agency. Maintenance has its own set of requirements, so that the maintenance section does have its own responsibility. This should cover:

- the regular programme of maintenance and repairs.
- training the maintenance force.
- maintenance procedures and records.

A typical organization structure for handpump maintenance is shown in the figure below.



Organization Structure for Handpump Maintenance.

6.2 Job Descriptions

The following is a set of typical job descriptions used in a handpump maintenance organisation in India.

Job Desciption of District Maintenance Team

- Maintain the handpumps in the assigned area (covering about 500 handpumps). This concerns both preventive maintenance and repairs on any broken down handpump.
- Provide technical assistance, as required, to the Block Maintenance Mechanic, to repair any handpump in his area.
- Respond without delay to complaint cards received from the village-level handpump caretaker (i.e. within one week of receiving the request).
- Explain to villagers why the handpump is installed, and that the handpump is a safe drinking water source, which will improve the villagers' health.
- Demonstrate to villagers how to use the pump correctly. Explain that, when the pump is used in this way, it will give long service.
- Recondition at the district-level workshop the various handpump components, e.g. by re-threading/cutting of pipes and rods. Particularly, recondition the cylinder. This material will be reused as exchange items.
- Maintain in perfect condition their vehicle, i.e.:
  - change oil regularly
  - clean air and oil filters every week
  - attend to any vehicle repair required.

Job Description of Maintenance Mechanic

- Visit each and every handpump in his area once a month on a regular schedule.
- Carry out a routine check on every pump by operating it. Ensure that all nuts and bolts are tight, that the inside of the pump head assembly is clean, that the handle is not shaky, etc.
- Carry out the necessary repairs to the pump assembly above the ground, including minor masonry repairs to cracks in the platform and remove rusty patches on the pump body and apply some anti-rust paint coating.
- Ensure that the area around the handpump is clean and free from refuse.
- Ensure that the excess water is channelled to a soak-pit or garden, and that the drainage channel allows the free flow of water.
- To maintain a log on each pump in which condition of the pump and repairs carried out are recorded.
- Maintain a daily movement register to record his schedule of visits.
- Report the need for major repairs to the District Maintenance Team without delay.
- Submit monthly report to District Engineer about movements/visits and repairs carried out, spare parts used, and condition of tools.

Job Description of Village Pump Caretaker

Daily

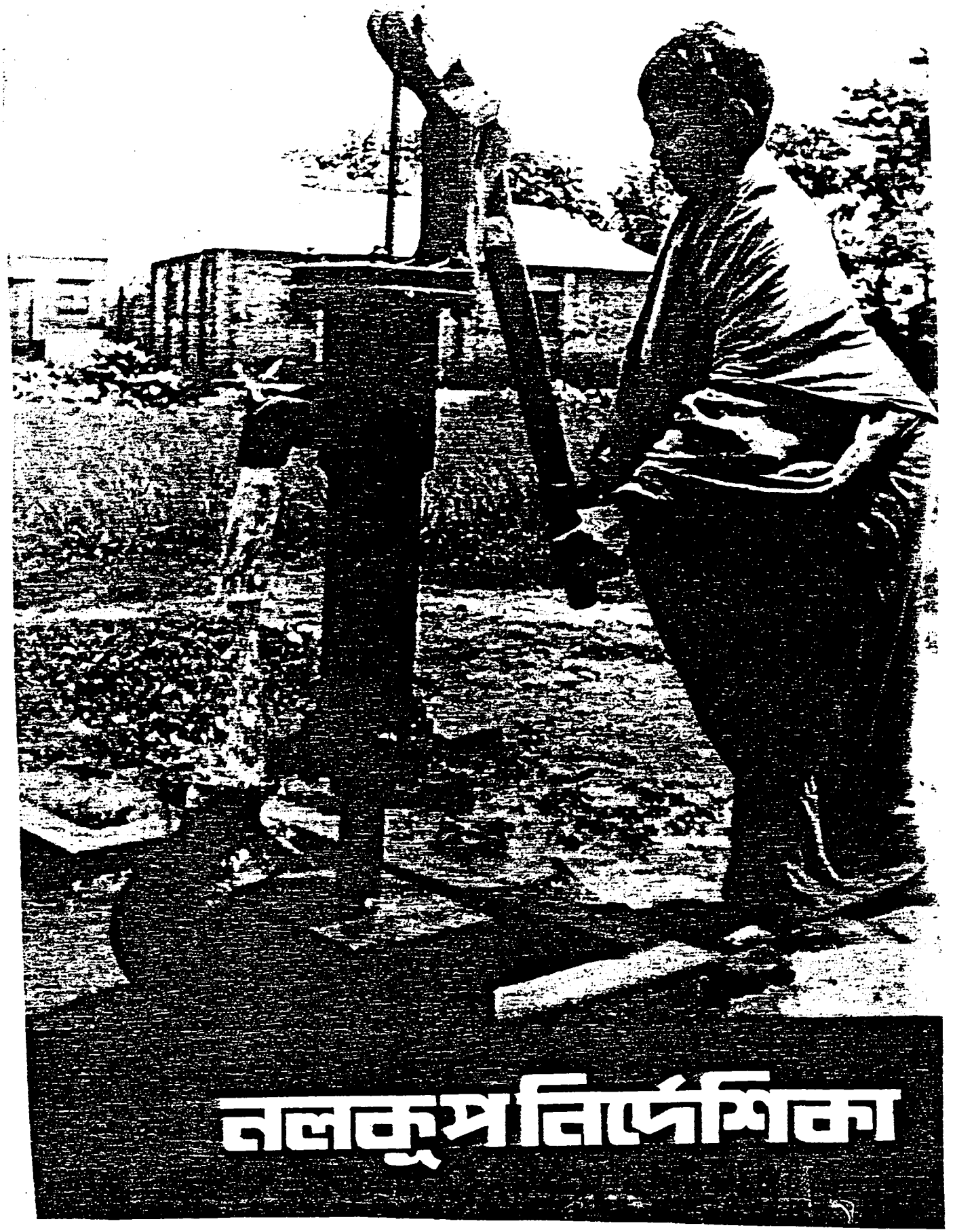
- See that the villagers operate the handpump properly so that it will have a long life.
- See that excess water is channelled into a garden or soakage pit.
- Keep the area around the handpump clean and free of refuse.
- If the handpump breaks down, report it to the District Maintenance Officer.
- Maintain the handpump log book.
- Explain to villagers that water from a handpump is better for their health than water from a pond, river, or open-well.

Weekly

- Check axle bolt. Make sure lock-nut is tight.
- Check flange bolts fastening water chamber to pedestal and make sure they are tight.
- Make sure handpump is firm on its base.
- Clean out trash from drain hole below inspection cover.

Criteria for Selection of Village Pump Caretakers

- Preferably someone with technical ability e.g. motor mechanic, cycle shop technician, flour mill operator.
- Should be literate.
- Should be user of the pump.
- Permanent residency (socio-economic ties to village).
- Willingness to do tasks such as site cleaning and user education, next to technical maintenance duties.
- Proof of technical and communicative skills during training.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6. CASE STUDIES

6.1 Bangladesh

Characteristic	Summary Description
Type of Maintenance system	Government-organised Decentralised Three-tier
Pump used	New No.6 pump (Shallow Well)
Annual Costs per pump	US $ 6 - 10
Method of Financing	Villager contribution to costs of spare parts Government bears costs of maintenance mechanic and other costs of maintenance organisation
Village level	Pump caretaker
Staffing	Maintenance Mechanic Technical Officer
Management	Government Dept. Public Health Engineering
Equipment & materials	Special composite tool spare parts
Transportation	bicycle

6.1. BANGLADESH

Previous System of Maintenance

Previously, in Bangladesh a government-organised handpump maintenance system existed that operated as follows. The government purchased spare parts in bulk and collected them into central stores. Spares were then distributed according to allocation, to stores at the district and subdivisional level. At the next lower level, the thana (or "police district"), maintenance mechanics were employed each having responsibility for maintaining about 200 hand pumps. They obtained spare parts from the subdivisional stores and bicycled out to the villages to maintain and repair hand pumps. In this system there was no payment by the people for the spare parts.

The maintenance mechanics were, in theory, responsible for routine preventive maintenance. However, their role frequently reducedto that of repair men, traveling to a broken handpump when informed by the local people. The handpump used was one that required frequent maintenance, and the maintenance costs were paid by the government. Thus, there was one maintenance organization for the whole country. Involvement of the people was minimal, except in the initial selection of the well site and the appointment of a caretaker who was nominally responsible for the well.

Bangladesh's record for hand pump maintenance is not worse than for many other countries. However, 30-40% of the pumps usually were out of order at any one time, and this must be considered too high a failure rate. Moreover, the government was required to pay for the entire cost of hand pump maintenance. For 500,000 hand pumps installed and an annual maintenance cost per hand-pump of US$ 5 (US$ 3 in spare parts, and US$ 2 in operating costs), the total annual expenditure on handpump maintenance would rise to US$ 2.5 million. To pay only US $ 2.5 million for handpumps serving almost 40 million people may not look excessive, but in a country with a gross national product of only US$ 2,000 million (1978), it is very difficult to make this amount available. Recognizing that the maintenance costs would certainly increase further as more pumps would be installed, it was found necessary to transfer at least part of the cost of handpump maintenance from the government to the people.

The Modified System

The following modifications were made to the maintenance system to make it possible to charge the people for part of the costs. The government would continue to purchase from local sources (and, where necessary, to import) all spare parts. These would be stored centrally by the government's public health engineering department. From the central stores, spare parts would be distributed to government stores at the subdivisional level. The government would further establish small new stores at the "thana" level, an additional 350 stores throughout the country. For each store at the "thana" level there would be a government sub-assistant engineer supervising a group of government-employed maintenance men. At the next lower level, the district level, each district would appoint a maintenance man who would be paid a small salary by the district and would have the duty of maintaining all hand pumps in the district area. The cost of the spare parts required in the district, would be paid from the district budget. The necessary funds could be raised by local taxation or by directly charging for the spare parts.

The district maintenance man would service the hand pumps in the district, installing any necessary spare parts. He would purchase spare parts from the "thana" stores. Each handpump is placed under the direct charge of a pump caretaker. The caretaker is generally a responsible person living close to the pump. He or she will receive some training with regard to the proper care of the handpump and some health education training. Part of his duties is to keep the area around the handpump clean, and to carry out the minor routine maintenance. He is also expected to keep a record of the visits of the district maintenance man, and in the event of pump break down, he has to inform the district mechanic. The government-employed maintenance men at "thana" level are expected to carry out the major repairs. To give the pump caretaker an incentive to carry out his duties properly is not easy, and there have been cases where a caretaker was not prevented from exploiting his position.

WELLS INSPECTION AND EVALUATION REPORT

Form RWS/05

1. IDENTIFICATION

Village :
Union :
Thana :
Sub-Division :
District :

3. CARETAKER

Name :
Profession :

2. PUMP

Date of Installation :
Water Discharge Rate
Depth (Well)

4 QUALITY OF SITE

(a) Distance of UNICEF/DPHE Well from :
- Caretaker's house _____ ft.
- a Cluster of houses _____ ft.
- a Tubewell (excl. private) _____ ft.
- a Latrine _____ ft.
- Standing water around _____ ft.

(b) Platform.
Completed ? Yes [ ] No. [ ]
Intact ? [ ] Broken ? [ ]

(c) Well-
—subject to flooding (1) ? Yes [ ] No. [ ]
—installed on low ground ? Yes [ ] No. [ ]

(d) Slope-
—Sufficient slope to drain away water from
Platform- Yes [ ] No. [ ] and around
well- Yes [ ] No. [ ]

5. USE AND USERS

(a) Population of the Village _____
(b) Population of a cluster of houses where well installed _____
(c) Population using this well _____
(d) Population uses this well for
Drinking [ ] Bathing [ ] Washing [ ]
Other [ ]
(e) Population uses (3)
_____ for Drinking
_____ for Bathing
_____ for Washing
_____ for other need

6. WATER QUALITY

Iron content : _____
Chloride content : _____
Water Taste : _____
Odor : _____

7. MAINTENANCE

a Pump (2) Lubricated ? Yes [ ] No. [ ]
b. Spare readily available ? Yes [ ] No. [ ]
c. PHE Mechanic last attended the pump : Month _____
d No. of time pump repaired _____

e. Pump ever repaired by
Caretaker ? Yes [ ] No. [ ]
Villager ? Yes [ ] No. [ ]

f. Platform maintenance
Satisfactory ? [ ] Poor ? [ ] None ? [ ]

g.
Well accepted ? Yes [ ] No [ ]
If not, give reason _____

WES Field Technician
Name : _____
Signature : _____
Date : _____

(1) Situation which will warrant pouring floodwater into the well (pipe).
2) Piston, pins, nuts, and bolts.
(3) Tubewell water, ring well water, pond water, or any other type of water for mentioned purposes.

Contractor :
Work Order No :
Date :

SEA pst
7.4.1c

Wells Inspection and Evaluation Report
Used in Bangladesh

6.2 India (Tamil Nadu)

Characteristic	Summary Description
Type of Maintenance system	Government-organised Decentralised Three-tier
Pump used	India Mk-II (Deepwell)
Annual Costs per pump	US $ 35 (equivalent)
Method of Financing	Government funds
At Village level	Pump caretaker
Staffing	Mechanic (at Subdistrict); Mobile team (at District level)
Management	Water Supply & Drainage Board
Equipment & materials	various
Transportation	bicycle; truck

6.2. INDIA (State of Tamil Nadu)

Previous System of Maintenance

Previously, in India the government used to construct wells and install handpumps, without any special arrangements for maintenance and repair of the pumps. The advantage of this approach is that the government can standardize equipment and ensure a satisfactory well construction and the use of suitable handpumps. The great disadvantage was that the government did not develop an organization to carry out the routine maintenance. Thus, the government did not have the opportunity to promote health education through an established pump maintenance network. This maintenance system or rather the lack of it generally produced poor results. With pump maintenance completely left to the local communities, as many as 80% of the pumps were inoperative within two years after installation.

Considerable efforts have been made to develop a better handpump which has resulted in the India Mark II deepwell pump, and to provide for its proper functioning through improved maintenance. A new maintenance system has been developed (the "Three-tier" system), which was first used in the State of Tamil Nadu*. This system generally has been successful in reducing the number of inoperative handpumps.

Three-tier Maintenance System

At Village level

A responsible person, who usually resides close to the handpump, is approached with the general consent of the village residents. He or she may either be an artisan, a literate farmer, or a social worker. He is given a two-day orientation course on the importance of a safe drinking water

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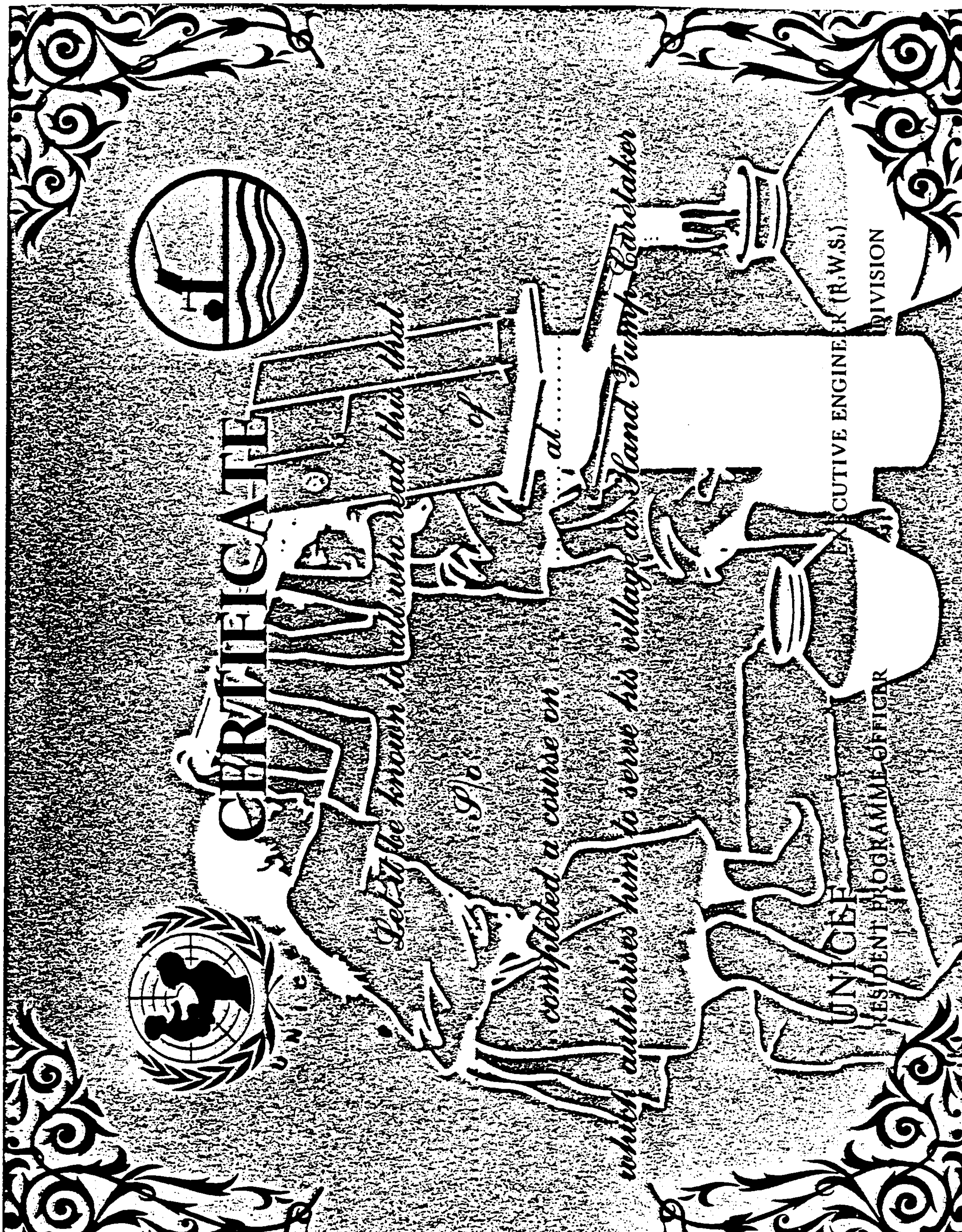
* Until August 1976, all handpumps whether installed by the state government or by the panchayat unions, were formally under the maintenance of the village panchayat concerned. Due to the limited financial resources of the village panchayats and the non-availability of skilled mechanics in the rural areas, there was no proper maintenance of the pumps. A very high portion was, in fact, out of order. The government, by order dated 3 August 1976, entrusted the responsibility for the maintenance of the handpumps to the Tamil Nadu Water Supply and Drainage Board.



CERTIFICATE

Let it be known to all who read this that

S/o

of

completed a course on

at

which authorises him to serve his village as Hand Pump Caretaker

UNICEF
RESIDENT PROGRAMME OFFICER

EXECUTIVE ENGINEER (R.W.S.)
DIVISION

Handpump Caretaker's Certificate used in State of Tamil Nadu (India).

supply, the mechanism of the handpump, and the failures that might occur to the pump. He is trained to attend to minor repairs, and is supplied with the basic tools necessary. He is also provided with pre-stamped and -addressed postcards, which list, in the regional language, the possible problems that might arise. When such a breakdown occurs, the caretaker will indicate on two postcards the type of repairs needed, and will post one to the block-level fitter and the other to the District mobile team.

The function of the village caretaker includes:

- attending to minor handpump repairs;
- educating the community on how to protect the water supply;
- informing to the block-level fitter and district mobile team whenever there is a breakdown of the handpump.

At Sub-District ("Block") level

One fitter is appointed at the Block level for every 100 handpumps, under the administrative control of the Block Development Officer and the technical supervision of the District engineer. The fitter usually operates from the Sub-district headquarters. If the Block has 100 or more pumps, his base is situated in the area which has the largest number of handpumps to be attended to. Upon receipt of a request from a caretaker, the fitter will go to the village and attend to repairs, if the problem is located in the top-end mechanism.

At District level

In the case of a major repair, it is the district-level team which will go to the village immediately upon receipt of a request. If there is a large number of repairs to be carried out, the help of the District Engineer of the Tamil Nadu Water Board is sought.

Experience has shown that one District mobile team cannot effectively cover 1,000 handpumps as was first planned. The Tamil Nadu Water Supply and Drainage Board has, therefore, recommended one mobile team for every 500 handpumps.

The objective of the maintenance system for the handpump is to attend to any repair within a week. Any expenditures incurred are shared by the government and the local bodies concerned.

TAMILNADU WATER SUPPY & DRAINAGE BOARD

Hand pump Maintenance Record

VILLAGE .....
PANCHAYAT .....
UNION .....
DISTRICT.....

PUMP No:
DEPTH OF BORE :
WATER LEVEL :
DATE OF INSTALLATION :

DETAILS OF REPAIRS	DATE OF REPAIR	DATE OF INTI-MATI-ON	NAME OF MACHANIC	REPAIR ATTEN-DED DATE	DETAILS OF REPAIRS ATTENDED	DETAILS OF SPARES USED	REMARKS

Handpump Maintenance Record Card used in State of Tamil Nadu (India).

TAMIL NADU WATER SUPPLY AND DRAINAGE BOARD.

HAND PUMP FITTERS ACTIVITIES REPORT.

VILLAGE . . . . . .

PANCHAYAT . . . . . .

UNION . . . .

DISTRICT . . . .

HAND PUMP NO.. . . . . .

TYPE OF HAND PUMP . . . . .

NAME OF AGENCY SUPPLIED THE PUMP . . . . . .

DATE OF INSTALLATION . . . .

NAME OF FITTER . . . . . .

Sl.No.	Date of receipt of Information Card/ Date of Inspection.	Date of repairs attended to.	Repairs attended by whom.	Nature of Repairs.	Details of spare parts changed if any

6.3. Indonesia

Characteristic	Summary Description
Type of Maintenance system	Government-organised Decentralised Three-tier
Pump(s) used	Dragon "Jetmatic" (Shallow Well) "Bandung"; "S.B.", etc
Annual Costs per pump	n.a.
Method of Financing	Government funds
At Village level	Sanitarian
Staffing	Staff of: Rural Public Health Centre Subdistrict District
Management	Provincial Health Service (Ministry of Health)
Equipment & materials	n.a.
Transportation	n.a.

6.3. INDONESIA

General

In Indonesia, the "Dragon (Jetmatic)" shallow well handpump of Japanese design is very popular. Most of these pumps are locally manufactured, and spare parts are readily available on the local market. The "Dragon" pump is of fairly complex construction. The quality of "Dragon" pumps imported from Japan is better than the local pumps, but their price is much higher. Another shallow well pump used in Indonesia, is the "Bandung" pump which was developed for the West Java Rural Water Supply Project. The pump is manufactured in Bandung and a few other places.

Deepwell handpumps are, to date, not widespread in Indonesia. These pumps are mostly imported models (i.e. Dempster (USA), Climax (U.K.), Korat (Thailand).

The Ministry of Health which has general responsibility for rural water supply, will be developing a handpump maintenance system. The district health officers will be responsible for the handpumps after their installation, and sanitarians belonging to the district health officer's staff will carry out the maintenance of handpumps. This is just one of the many tasks they have, and pump maintenance is actually carried out only on a very limited basis. The condition of many handpumps is poor.

Planned Maintenance System

At the Central and Provincial level, the Ministry of Health plans to take charge of:

- purchase, supply and installation of handpumps;
- purchase and distribution of spare parts;
- training of the sanitarians in handpump maintenance.

POMPA TANGAN PADA SUMURGALI

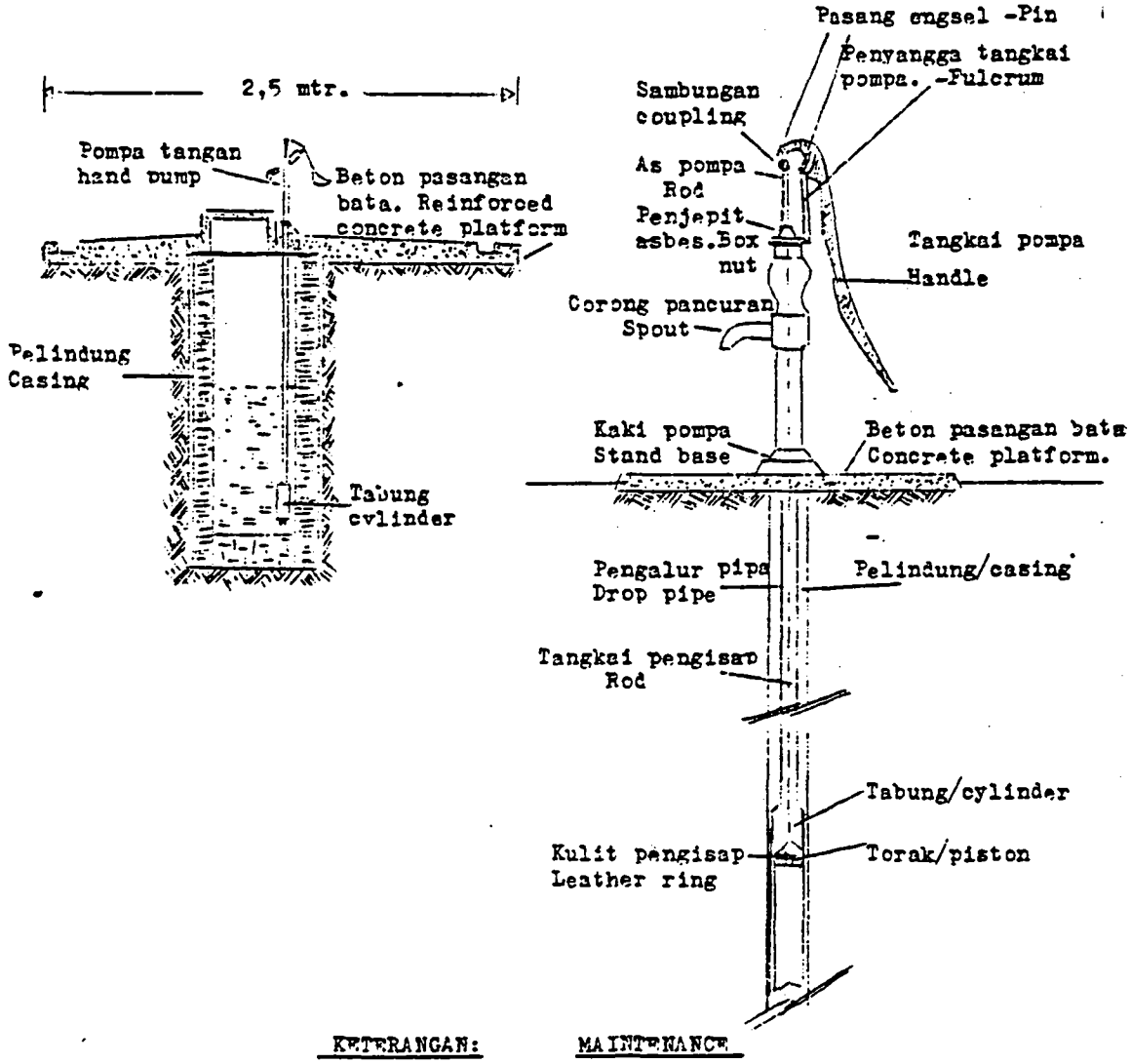
IMPROVEMENT OF THE WELL AND HAND PUMP INSTALLATION-

KETERANGAN POMPA TANGAN

Lubrication and spare parts replacement of the pump on the spot.

Instruksi teknis untuk penilik kesehatan. -

Technical instructions for the maintenance for the field sanitarian.



KETERANGAN:

-Tangkai pengisap= Oli per minggu.
-Pasak engsel= Oli per minggu, periksa per tahun.
-Besi= Cat per tahun.
-Beton pasangan bata=Bersih setiap hari, kalau ada kerusakan.
-Tabung valve= Periksa setiap per tahun
-Kulit pengisap= Periksa setiap per bulan perhatikan bila ada kelainan.

MAINTENANCE

-Rod: Lubricate weekly.
-Hinge pins: Lubricate weekly, check annually.
-Exposed ironworks: Paint annually.
-Concrete platform: Clean daily, repair as necessary after any damage.
-Plunger valve: Check annually.
-Leather ring: Constant look-out on symptoms. Monthly check.

Handpump Maintenance Instruction Sheet for Sanitarians

(Indonesia)

At the Kabupaten (district, part of province) level.

- the Kabupaten will store the parts of the pumps which normally are not replaced very often such as:
  - the pump body;
  - the handle;
  - the head cover;

- the Kabupaten will take care of the distribution of small spare parts to the Kecematans and Puskesmases.

At the Kacematan (subdistrict) level:

- The Kacematan will store the spare parts which are more frequently replaced, such as:
  - the pivot pins;
  - plunger rods;
  - cylinder linings.

The Puskesmas (rural public health centre) will store the tools and very frequently needed spare parts such as:,
- valves;
- plunger cups;
- bolts and nuts.

The sanitarians on Puskesmas level are very important in the handpump maintenance organization. They will be carrying out maintenance duties on the pumps, and also will be transfering "know-how" to people who live near the pump. The goal is that, eventually, the people can themselves do the maintenance work for their pump with technical support of a sanitarian.

6.4 Tanzania

Characteristic	Summary Description
Type of Maintenance system	Government-organised (with external assistance) Decentralised Two-tier
Pump used	"Shinyanga" "Kangeroo" "Nira", "SWN", and various other pump models
Annual Costs per pump	TAS 700 (approx US $ 95)
Method of Financing	Government funds (Contribution from village communities for spare parts and minor repairs planned.
Village level	Pump Caretaker (male) Pump Attendant (female)
Staffing	Maintenance teams District Maintenance Officer
Management	Regional Water Engineer
Equipment & materials	Tools, spare parts
Transportation	Motorcycle, (Trucks)

6.4. TANZANIA

Introduction

Initially, two alternative systems of handpumps maintenance were considered:
(1) centralized maintenance, with two complete check-ups anually per well.
(2) decentralized maintenance with responsibilities delegated to the villagers, and decentralized maintenance and repair teams.

Under the early, centralized system, the pump maintenance organization would consist of three sections: a maintenance section, comprising a number of maintenance teams, each operating in a specific area; a laboratory section; and a repair section.

The work of each maintenance team would include:
- inspection of the pump head mechanism (above ground), and carrying out any necessary repairs.
- dismantling the lower parts of the pump if these are not operating effectively. If the pump cylinder is out of order, it is replaced by a spare one and the defective unit is returned to the central workshop for repair.

The work of the laboratory section would comprise the examination of all relevant constituents in the water samples taken by the inspection groups.

The work of the repair section would involve the repair of the concrete platform and the surroundings of pumps.

Every six months, each hand pump would be overhauled and completely serviced.

Planned Maintenance System

After careful study, it was decided to develop a decentralised handpump maintenance system in order to achieve a considerable reduction of the maintenance costs. In the decentralised system, the first responsibility for pump maintenance rests with the village communities themselves. In practice, the candidates for pump caretaker training are recruited from the voluntary labour that assisted in the installation of the pump. Usually, one man and one women are appointed, and receive a basic training on pump maintenance.

The duties of the pump caretakers would include:

1. daily

- check operation of the pump
- control bolts and nuts to be tightened
- clean the slab
- clean the drainage gutter
- surround the well with minyara or thorns to prevent cattle from entering the area of the well
- prevent the pump platform from being used as a working area
- prevent the pump surrounds from becoming a children's playing ground.

2. monthly

- check damage, rotting of wood, insects in wooden handle etc.
- grease or oil all pivot points and oil the wooden handle and upright
- inform if capacity or quality of the water has diminished
- check concrete slab and repair the cracks with some mud or stones.

District Level

To support the village pump caretakers, maintenance services have been established at the district level. A District Maintenance Officer supervises all pump maintenance and is in charge of the maintenance teams in his district. Major repairs are carried out by a repair section as in the earlier, centralized system.

The District Maintenance Officer's task is to check the village pump caretaker's maintenance work, to help with the major repairs and to ensure the provision of spare parts. He is required to keep records on all handpumps in his district. In several regions, the District Maintenance Officers each have a motorcycle on which a large box is mounted for tools and spare parts. Experience in the Shinyanga Region shows that one maintenance team can carry out about 300 pump checks per year. A frequency of two checks annually per pump has proved to be adequate. The number of pumps that can be maintained by one team, is thus fixed at 150. The distance between the pumps plays an important role, and for wells and pumps in less sparsely populated areas than Shinyanga Region the capacity per maintenance team may be considerably higher.

Cost Reduction

In the centralized maintenance system the annual maintenance costs per pump in a situation comparable with Shinyanga Region (about 800 wells spread over an area of 50,000 square kilometers) were in the range of TAS 1,000 to 1,500 (approx US $ 130-200!). In the decentralized maintenance system the costs were considerably reduced to about TAS 700 (approx US $ 95) per pump per year.

Costs may be further reduced by introducing a system whereby the villages are charged for the maintenance of their pump. Village committees may be able to finance the maintenance costs from a levy they are entitled to impose for village development activities. The pump and well would become the property of the villages, which would have to buy any spare parts needed from the District Maintenance Officer. The costs of spare parts may be estimated at TAS 300 (approx US $ 40) per pump per year. For an average 300 villagers using a pump, the direct costs of pump maintenance would thus amount to TAS 1 per person per year.

Health education, sofar, consisted only of the provision of instructional materials (posters). However, it is planned that health education will become an integral part of the handpump maintenance activities.

Experience

An evaluation of the handpump maintenance system in Shinyanga Region was carried out in January 1982. The survey indicated that about 70% of all pumps were out of order at any given time. This was due to technical reasons for about 30% of the total number of pumps, the other pumps being out of order for other reasons. The period of time the pump had already been inoperative could be established accurately in only 10 cases; the average period was 4 months.

A selected sample of maintenance record cards of handpumps was analysed for frequency and length of breakdown. However, the maintenance card records were rather incomplete, and the findings were indicative only. The analysis produced the following results;

(i) Intervals between major repairs on the pump cylinder assembly were, on average, 15 months; the range was 6-26 months. The most common repair was replacement of a worn foot valve, the second most common frequent repair was on the piston assembly.

(ii) Repairs on the pumpstand (above-ground) were reported in a few cases only; the interval of such repair ranged from 9-29 month, on average about 18 months.

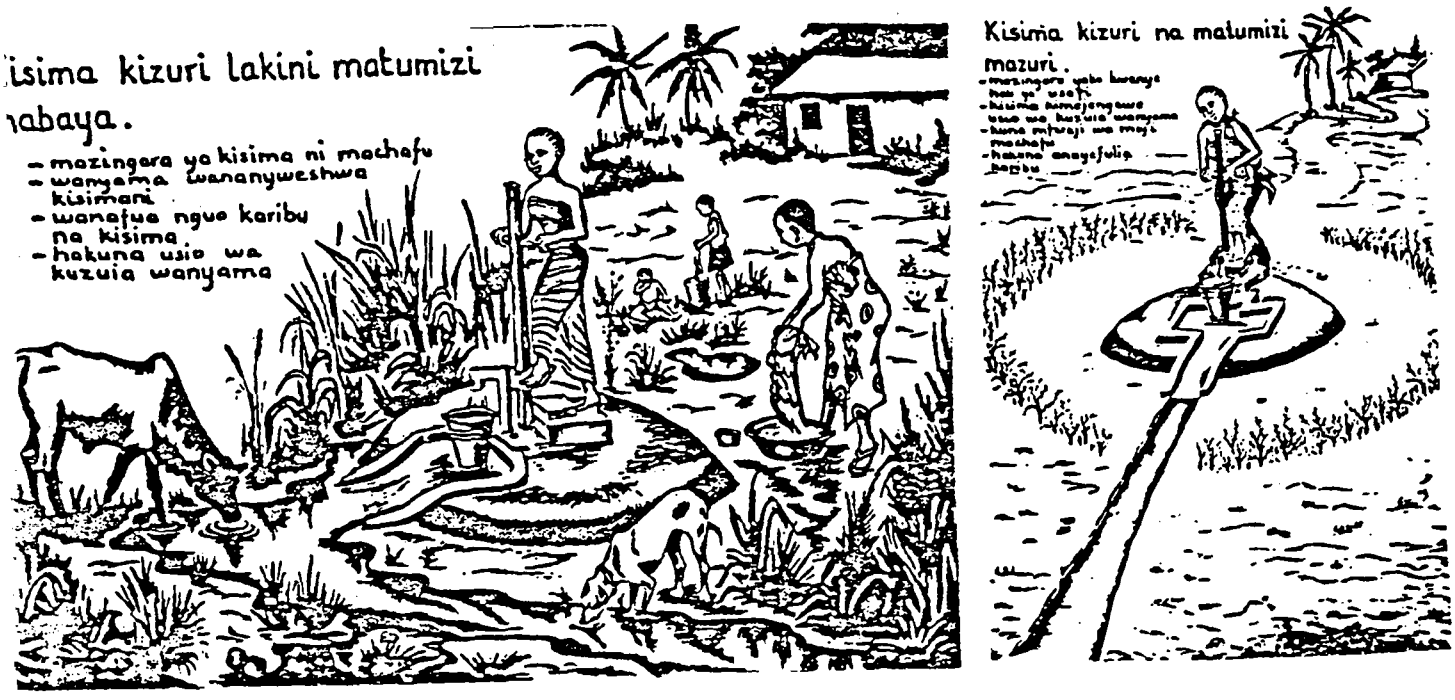
(iii) It was found that spare parts were not available, and the maintenance system suffered from enormous logistical problems i.e. transport, communications, and failure reporting.

The main problem clearly is to keep the pumps working, that is to maintain them. Either the performance of the maintenance system must be greatly improved, or other means of drawing water from the well must be accepted that are more reliable or easier to repair. The bucket-and-rope system using a windlass would have to be considered as an alternative to the handpump. The shallow well design as developed in Shinyanga would be suitable for mounting a rope-and-bucket with windlass, if this type of open well were to be the choice of technology.

Periodical Check-up

Date of check/	Controlled/ repaired by	Well dry?	General impression of well cover	well surrounds	pump	Pump repaired	Water sample	Remarks/ action taken
30.2.76	maintenance	no	ok	mess	ok	-	yes	drain cleared out

Maintenance Report Sheet used in Shinyanga Shallow Well Project (Tanzania).



Health Education Material used in Tanzania

6.5 Malawi

Characteristic	Summary Description
Type of Maintenance Organisation	Government-organised Three-tier
Pump used	"MALDEV", and other pump models (medium & deepwell)
Annual Costs per pump	US $ 20-30 target (equivalent)
Method of Financing	Government funds (contribution of labour by village communities)
At Village level	Pump Attendents
Staffing	Pump mechanics (Sub-district) Technicians (District)
Management	Dept. of Lands, Valuation and Water (Office of the President)
Equipment & materials	n.a.
Transportation	Pump mechanic: bicycle Technician : pick-up

6.5. MALAWI

Previous Situation

In Malawi where 90% of the country's population lives in the rural areas, up to 1975, tubewells of 35 - 45 m depth were drilled on which handpumps were fitted. About 4,500 of such tubewells with handpumps are spread across the country. To maintain the pumps, some 20 special teams existed who inspected the pumps and made urgent repairs on request. The system worked fairly well, but it had the major disadvantage of high costs. The annual maintenance costs had risen to as high as US $ 200 for each pump serving an average of 130 people! At this price, Malawi which has a per capita income of US $ 250 simply could not afford to provide tubewells for the entire population. Moreover, because of the technical level of the well drilling and pump maintenance techniques used, it was difficult for the villagers to contribute any labour to bring costs down.

New Maintenance System

A new system of maintaining handpumps is being developed and field tested in the Upper Livulezi Water Supply Project. This is a project of 5 years duration being implemented by the Department of Lands, Valuation and Water (Office of the President and Cabinet), with foreign assistance. The main work of drilling wells and installing pumps has been carried out in the first 2 years and currently, over a 3 year period, a low-cost maintenance system is being established. The goal is to reduce the annual maintenance costs to about US $ 20-30 per pump. To achieve this, a pump having suitable characteristic was needed, and for this purpose the MALDEV pump has been developed. The pump is further developed through extensive field testing in collaboration with the UNDP/World Bank Project for Testing and Technological Development of Handpumps.

The new handpump maintenance system is being set up as a three-tier organisation which will involve a maximum of community participation at the village level. It will comprise:

Central Government/Departmental Level:

(a) Planning and strategy (handpump policy)
(b) Research and development in handpump design, with the major target to minimise and simplify maintenance
(c) Training of district pump technicians
(d) Procument of pumps, spares, tools and equipment
(e) Monitoring of the maintenance programme
(f) Distribution of equipment to district stores

District Level

(a) Supervision of about 1000 pumps by a trained technician (District Pump Technician) with support driver and one vehicle (1 ton pick-up)
(b) Store for spares
(c) Maintenance records for all water points within district
(d) Training of area pump mechanics
(e) Liaison with District Development Committee
(f) Periodic inspection of area water points
(g) Repair or replacement beyond capabilities of area mechanics
(h) Estimate of annual maintenance requirements for spares etc.

Sub-district Level

(a) In each sub-district, Pump Mechanics chosen on the basis of skills shown during the pump installation work. Further training is provided by District Pump Technician or through DLVW training courses. Each Pump Mechanic is responsible for about 50 pumps.
(b) Visits to each pump/village at least once every four months (bycicle)
(c) Recording all repair work and reporting to District Pump Technician.

Village Level

(a) Village Pump Attendants chosen by the village Development Committee responsible for all pumps in one village (could be men or women).
(b) Attendants ensure that the pumps are properly used, pump surroundings are kept clean and acts of vandalism are prevented.

(c) Minor replacement, preventive maintenance and all simple repairs will be effected at this level. When major repairs or replacement parts are required the attendants will notify the Area Pump Mechanic.

(d) The attendants will be trained on site by Project Assistants at the time of installation.

An essential element of the new maintenance system is that each community has to appoint a pump attendant, to assume responsibility for the regular maintenance and minor repairs of the pump. Training of the pump attendants is provided by the government, through a training course of five days duration. The course programme includes the following items:

- Strip down in the workshop a handpump of each model representative of those installed in the area.
- Describe the general layout of the pump, indicating all fittings and explaining their respective functions.
- Ensure that each trainee becomes familiar with all the working parts, and understands the operation of the pump.
- Demonstrate and thoroughly practise the fitting of replaceable parts, i.e. for maintenance and repair. Reassemble each model of handpump.
- Carry out practical demonstration on cutting and threading G.I. pipes and mild steel rods.
- Ensure that each trainee practises this exercise thoroughly.
- Demonstrate points for lubrication to reduce wear on moving parts.
- Explain in detail the technique of identifying pump troubles at an early stage!
- Demonstrate the correct procedure to be adopted when extracting a handpump from a borehole.
- Demonstrate the correct procedure to be adopted when inserting a handpump into a borehole.
- Stress the need for cleanliness, both of the pump and the surrounding area, and the simple rules which should be observed to avoid contamination of the pump and well.
- Explain the procedures for reporting breakdowns to have repairs carried out.

6.6 Ivory Coast

Characteristic	Summary Description
Type of Maintenance organisation	Government-organised Centralised One-tier
Pump used	n.a.
Annual Costs per pump	n.a.
Method of Financing	special surtax on the water tariff in the urban areas (cross-subsidy); contribution from village communities covering part of maintenance and repair costs, is being introduced
At Village level	
Staffing	Maintenance teams
Management	SODECI (Urban Water Supply Agency)
Equipment & materials	n.a.
Transportation	Trucks (with workshop equipment)

6.6. IVORY COAST

Existing Situation

Ivory Coast has been using , since 1975, in its well drilling programme, covered wells equipped with various types of handpumps.

The maintenance of the pumps is the responsibility of the urban water supply organization (SODECI). The maintenance costs were financed from a special surtax on the water tariff in the urban areas. An evaluation report of the European Development Fund (EDF) stressed the point that this system has been possible due to "several, particularly favourable conditions allowing it to function: an (urban) group of consumers sufficiently wealthy to permit a cross-subsidy, through the tariff system, towards the maintenance costs of rural water supply handpumps, and feasible because of the relatively low cost price of the water in the capital and the substantial total volume of water sold".

The maintenance service for the rural village handpumps uses trucks with workshop equipment. This is possible in Ivory Coast because the necessary all-weather road infrastructure exists. Repair of broken down pumps could be effected within 48 hours after a pump breakdown is reported. However, the maintenance system, although technically satisfactory, has a very high cost. This means that this system is not possible in countries where the urban water users do not have the economic capacity to subsidize the rural sector.

Experience and Problems

The increasing costs of spare parts, fuel and personnel has made the financing of this maintenance system more and more difficult, in spite of the favourable conditions existing in Ivory Coast. In 1982, a change had to be introduced under which the communities are now charged for part of the maintenance and repair costs of their handpumps.

6.7. Ghana

Characteristic	Summary Description
Type of Maintenance organisation	Government-organised On a regional basis One-tier
Pump used	Various pump models
Annual Costs per pump	US $ 75 - 90
Method of Financing	Government water supply agency funds
At Village level	
Staffing	Maintenance Inspectors Mobile teams (District) District Officer
Management	Ghana Water & Sewerage Corporation
Equipment & materials	Standard set of tools; spare parts; hoisting gear
Transportation	Maintenance Inspectors: Motorcycles Mobile team: trucks

6.7. GHANA

Existing Situation

In the Upper Region of Ghana, a regional handpump maintenance system was set up between 1974 and 1978 to cope with the maintenance and repair of the 2,400 handpumps installed in the Region. This formed part of the Upper Region Water Supply Project, jointly financed by the Ghana Water and Sewerage Corporation (GWSC) and the Canadian International Development Agency (CIDA).

Considerable efforts were made to ensure that handpumps would be selected requiring a practical amount of maintenance. It was evident that the ultimate success of the entire project would depend upon the effectiveness of the handpump maintenance system.

The requirements of regularly maintaining and servicing the handpumps, was the most important factor determining the organizational set up. The handpump maintenance system was established within the existing GWSC organization, with control at the regional GWSC offices.

The handpump maintenance system was operated from five district centres. Maintenance of handpumps was conducted as two separate activities:

(a) inspection and minor repairs every 2 or 3 months
(b) complete pump servicing on a "as required" basis.

The GWSC Regional Manager was responsible for the maintenance scheme and provided general direction. He was assisted by the Maintenance Engineer and the Field Supervisor who were responsible for the proper functioning of the system. A total of 250 field and workshop staff comprising a core of trained technicians and mechanics were assigned. Most of the staff were newly-hired, but existing staff was used to fulfil some of the new maintenance functions.

The vehicles, and the mechanical and electrical equipment for the districts and workshops were carefully selected, after consideration of the levels of service to be provided at each district. A large proportion of the handpump sites required that vehicles would be used in difficult terrain, following trials and footpaths, or even crossing cultivated fields. Thus transportation, especially during the rains and the growing season, was of particular concern.

Due to the poor access to the pumps, because of the limited road network, and due to the ever increasing cost of fuel, it was decided to utilize lightweight trail motorcycles [1]) for routine inspection of the handpumps.

Each mechanic with motorcycle would visit about 50-110 handpumps each month, for inspection and minor repairs, and to report the need for major repairs to the mobile maintenance service. Complete field servicing of a handpump required the availability of at least two men having a service vehicle, equipped to remove and replace the handpump, drop-pipes and cylinder.

Service trucks[2]) were allocated to the districts on the basis of the number of wells to be serviced and the distances to be covered. These trucks were equipped with front-mounted winches, rear-mounted derrick facilities; compartments on both sides of the truck for storing spare parts, and tool boxes containing accessory tools and equipment.

In establishing the workshops, consideration was given to the level of service to be provided at the regional headquarters and in the districts. Five workshops were established.

At the Regional Stores Depot, a complete stock of spares of pumps, vehicles and equipment was maintained. At the district depots, only stocks of fast moving parts and consumables for pumps and vehicles were kept.

The Regional Stores had responsibility for the procurement of supplies of petrol, gas-oil, lubricants, cement and disinfectants required for well maintenance. Supplies were distributed to the districts and maintenance staff under a controlled stores ledger system.

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[1]) Honda CT 90 motorcycle equipped with special box to carry maintenance tools and spare parts.

[2]) Eight GMC one-ton trucks were distributed over the five maintenance districts.

Experience

The operation was first established on a pilot stage in one district (Bawku) and then expanded on a successive district-by-district basis, until the entire Region was fully covered. Five maintenance districts were established at Bawku, Bolgatanga, Tumu, Lawra and Wa. In each district, an organisation comprising motorcycle inspectors, service truck crews and workshop facilities was formed. Each of the district organizations operated independently under the general direction of the Regional Headquarters. The District Officer was responsible for the repair, servicing and maintenance of handpumps and wells in his district.

Maintenance Inspectors used lightweight motorcycles for routine inspections of the handpumps, following designated routes within the districts. Each pump was visited every 2 or 3 months.

The Inspectors also carried out lubrication of pumps as well as other preventive maintenance tasks and minor repairs. They reported major pump failures to the district officer. On the average, 80% of all handpumps in the region were so inspected on a regular basis. A major problem was that the motorcycles themselves were out of operation for almost 50% of the time. The useful life of the motorcycles proved to be only 1-2 years. The short useful life of the motorcycles resulted in exessive costs under the budget post "Equipment and Material".

Eight specially equipped service trucks operating from the district centres carried out repairs on handpumps which were beyond the means of the Maintenance Inspectors. These units did not make routine inspections, but responded only to pump failures reported by the Inspectors. The trucks were out of operation, due to breakdown and repair, for about 40% of the time. The estimated service life of the vehicles was 3-4 years.

Each reported breakdown of pumps was scheduled into the work programme of the service vehicles. The normal response time for a pump repair was 3-4 days and more after a failure was reported. As each community usually has more than one well, the adjacent pumps were available during the breakdown response period.

Proper communication among the maintenance staff themselves on one hand and between them and the rural villagers on the other proved particularly important in the early stage of the maintenance system implementation. In fact, part of the reason for the needed frequent inspections of handpumps was because there was a lack of adequate communication facilities. Therefore, the routine inspections, in actual fact, provided the reporting system for needed repairs of handpumps.

A record system was incorporated into the maintenance system so that a history of repairs for each handpump could be accumulated. The records were used as a basis of organising the routine servicing of each pump. Other uses were for stocking of spares, upgrading maintenance procedures and for programming future maintenance activities throughout the Region.

As the handpump maintenance system was established as an integral part of the GWSC regional maintenance organization, it was difficult to assess the operating costs of it, precisely.. Although efforts were made at the initial stage to keep separate accounts of the maintenance operations, reliable data was not obtained.

The nature and scope of operating costs involved:

(i) operating cost of service vehicles;
(ii) operating cost of workshop and repair facilities; and
(iii) manpower costs.

Being part of the regional maintenance structure, facilities such as personnel, buildings, equipment and vehicles were shared with other units. For example, some of the headquarters management, accounting and records personnel had regional responsibility. Also, in order to avoid duplication of functions in the district centres some of the staff such as accounting, general services and security personnel were shared.

Actual Results

A survey was conducted at the end of the third year's operation of the maintenance system to assess its performance. The findings were as follows:

Some 83% of all the pumps in the region were found in operation. The relative performance by districts varied between 68% and 90%. Of the pumps out of service about 11% had to do with above-ground parts which the Motorcycle Inspector was able to repair. The remaining 89% needed service trucks to hoist below-grade components to carry out repair. A visual inspection of all the pumps which were operating revealed that:

(a) 63% were in good condition
(b) 28% were in fair condition
(c) 5% were in poor condition
(d) 4% were in very poor condition.

It was observed that at 56% of all handpump/wells some site improvements had been carried out by the users. Of the inspected wells, 38% had back-fill placed around the concrete platform, and an additional 18% had been provided with concrete slabs constructed by the villagers. Well site sanitary conditions were as follows:

(a) 52% in good condition
(b) 35% in fair condition
(c) 13% in poor condition

Certain parts of the record system such as measurement of static water levels proved useful to future hydrogeological investigations. The personnel involved in the maintenance programme coped very well with the new work procedures and tasks. They acquired a much higher social status at the village-level than was originally envisaged. Their visits to the well site proved useful in communicating with the villagers and educating them regarding pump usage, water conservation, hygiene and sanitation.

Modification in the Handpump Maintenance System

Due to the ever-increasing cost of fuel and the problems of supply, it was decided to change from using petrol trucks to diesel trucks. This proved to be economical in terms of lower operating costs and more reliability.

DISTRICT MONTHLY REPORT

District ..... Month ending ..... 19..

1. From Motorcycle Inspection Log

a. No. of hand pumps inspected .....
b. No. working on arrival .....
c. No. working but repaired by motorist .....
d. No. not working and repaired by motorist .....
e. No. working but requiring service truck .....
f. No not working and requiring service truck .....

2. a. No of hand pumps reported not working by villagers but not reported by motorist .....
   b. No. of hand pumps reported not working by villagers and also reported by motorist .....

3. a. No. of hand pumps serviced .....
   b. No of pumps requiring service at month end .....
   c. No of mechanical pumps serviced .....

4. Hand Pump Inventory

	TYPES OF PUMPS			
a. Hand pumps on wells in District at end of last month				
b. Hand pumps removed from old wells				
c. Hand pumps installed on old wells				
d. Hand pumps installed on new wells				
e. Total hand pumps on wells in District at end of month				
f. Hand pumps in stock requiring repairs				
g. Hand pumps in stock ready for installation				

5. Vehicle usage

	miles travelled	gallons of fuel	m.p.g.
a. Motor Cycle No			
b. Motor Cycle No			
c. Service Truck No.			
d. Service Truck No.			

SERVICE TRUCK REPORT

Date .....

District ..... Service Unit .....

Travelling time ..... Time spent on site .....

Well number ..... Village .....

Type of pump ..... Static water level taken (from top of concrete base) Yes / No

Pump operating on arrival Yes ... No ...

Work done	Parts replaced	
	Number	Name

Comments: .....

3 Copies

1. *White to Region Officer*
2. *Canary to District Office*
3. *Pink remains in Report Book*

..... Serviceman's signature

..... Serviceman's name

VEHICLE DOWN TIME

NOTE: RECORD ONLY WORKING DAYS VEHICLE WAS NOT USED

District ..... Month ending .....

Vehicle No ..... No of working days .....

No of days worked .....

Date	No work to do	No Operator	No petrol	Mech problem	weather	other

WELL SERVICE RECORD

Well No .....

District ..... Village .....

Well Location .....

Type of pump .....

Date well drilled ..... Depth of well .....

Diameter of casing ..... Recommended yield ..... Igpm

Date serviced	Pump operating on arrival		Work done	Parts replaced		Static water level
	Yes	No		Number	Name	

RECORD OF BROKEN-DOWN HAND PUMPS

District ..... Month ending .....

Well No	Type	AG	BG	Date down	Date repaired	Remarks

RURAL WELL INSPECTION LOG

Well No.	Date	Village	Odometer reading	Well operating on arrival		Work done	Parts replaced	Service Truck required	
				Yes	No			Yes	No

Examples of Maintenance Reports and Records as used in Ghana.

6.8 Togo

Characteristic	Summary Description
Type of Maintenance organisation	Decentralised One-tier
Pump used	"Vergnet" Foot-operated Pump; other pump models (on a limited scale)
Annual Costs per pump	n.a.
Method of Financing	Project funds (foreign assistance)
At Village level	Villagers trained in handpump maintenance
Staffing	(Two teams of mechanics for training villagers in handpump maintenance; externally funded
Management	--
Equipment & materials	--
Transportation	--

6.8. TOGO

Existing Situation

Most parts of Togo in the dry season are depleted of surface water and only a few areas have phreatic groundwater. Cisterns storing rainwater have been in use for a very long time, but this type of water supply can provide only limited quantities of water. In recent years, well drilling and handpump installation have become of greater importance.

Experience in Handpump Maintenance

In several rural water supply projects financed by the European Development Fund the "Hydropompe Vergnet" foot-operated pump was used. Efforts were made to train the villagers in the maintenance of the pump, and the replacement of parts. This specialised training of villagers is the responsibility of two teams of Togolese mechanics who have been trained in France by the manufacturer of the "Vergnet" pump. Since 1978, the training courses provided by these teams of mechanics have resulted in the development of a methodology and the preparation of special documents as training aids. The training is also provided to the teams that are responsible for promoting community participation and health education for the rural population. The training of the village pump caretakers and of the women responsible for daily cleaning of the pump platform is integrated with the health education effort.

The first results show that trained villagers (often bicycle repair men) are perfectly capable of replacing pump parts and connecting rods, and are also able to repair the pump. In contrast, the results of the health education leave much to be desired. It appears to be difficult for the mechanics to give, under the existing constraints of time, sufficient attention to the questions of community participation and hygiene as these are matters for which a generous amount of time is needed.

6.9 Upper Volta

Characteristic	Summary Description
Type of Maintenance organisation	Organised by executing agencies of regional projects; Government policy being formulated
Pump used	"Vergnet" Foot-operated Pump; "Volanta"; several other handpump models
Annual Costs per pump	n.a.
Sources of Financing	Project funds (foreign assistance); contribution from village communities through various systems of revenue collection
At Village level	
Staffing	Maintenance teams (District) Regional offices of government Water Supply Agency (being established)
Management	Direction de l'Hydraulique (Government Water Supply Agency)
Equipment & materials	--
Transportation	--

6.9. UPPER VOLTA

Existing Situation

In Upper Volta, well drilling and handpump installation are used extensively for rural water supply. The envisaged coverage is to have, by 1985, about one water well for each village. By 1990, there should be 12,000 water points, about one for every 250 inhabitants.

Rural water supply projects are being implemented in various regions of the country, by the European Development Fund (EDF), UNICEF, Communauté Economique de l'Afrique Occidentale (West African Economic Community), FAC/France, GTZ/West Germany, Netherlands, USAID, and the Islamic Fund. Other organizations involved in the rural water supply sector are the l'Autorité des Valées des Voltas (Volta River Valleys Authority) and various non-governmental organisations.

By 1985, the Government, through the Department of Water Affairs, (Direction de l'Hydraulique, HER) will be responsible for the maintenance of the 3,000 existing handpumps as well as 7,000 new pumps, thus 10,000 in total. In the past the record of maintenance has been very poor. HER being a centralized organization, all maintenance teams and equipment were located in the capital. There was no provision made for training of community members or local artisans to carry out village-level maintenance on the handpumps. When a pump breakdown did occur and was reported by the village (which often did not happen), a maintenance team of HER would need to travel long distances along poor roads to reach the pump for repair. Moreover, the necessary handpump spare parts were often unavailable from the commercial suppliers.

In addition to these logistic problems, there are great financial limitations. The costs of maintaining handpumps and the replacement of defective pumps would amount to double the total annual budget of HER! The present situation is not satisfactory, and there is an urgent need to develop an adequate maintenance system for the village handpumps.

Development of Handpump Maintenance Organization

To overcome the serious problems, the policy for developing a handpump maintenance system is as follows.

HER will be decentralised, and an HER regional office is to be set up in each of the eleven regions. A maintenance service will be established at each of the regional offices. These will be responsible for carrying out heavy-duty repairs, as well as for providing support in village-level maintenance work. A spare part distribution system will be developed to ensure the availability of spare parts for about six of the models of handpumps used in the country. The necessary legal framework will be established to permit the control of a revolving fund at each of the districts (sous-préfecture) from which the operating costs of the handpump maintenance service will be paid.

In the rural water supply project financed by the European Development Fund in the Yatenga and Comoë regions the project executing agency (BURGEAP) has established, on a trail basis, a three-tier maintenance system which is presently under consideration by HER for implementation in more regions.

District maintenance teams will carry out the major repairs on handpumps. Trained local artisans (e.g. bicycle repairmen) will have to be paid by the villagers to do the simpler pump repairs. A pump attendant will be appointed by the village water committee to carry out preventive maintenance and minor repairs. The village water committee will be responsible for the collecting the money needed to pay for the pump maintenance and repair by the district teams.

The economic feasibility studies conducted to determine whether it is within the villagers' means to pay for handpump maintenance have, found that this is the case. Using water from a traditional well, a family spends about 900 CFA on the rubber "container" and the ropes with which the water is drawn. In comparison, the contribution of each family to a village fund for maintaining a handpump would be about 1,000 CFA a year. With an average 50 families in a village, this would provide 50,000 CFA being the required village contribution for handpump maintenance.

This amount would cover the fee of the village pump attendant for his workand travel costs, as well as the cost of any spare parts needed. For certain types of handpump (i.e. the Vergnet and the Volanta pump), the 50,000 CFA would probably also cover the payment of the regional maintenance service costs for the major repairs. Because of the design and nature of these pumps, the regional maintenance teams would need neither heavy equipment nor vehicles so that the overhead costs would be low.

A survey was carried out in a number of villages. It showed that the villagers generally would accept bearing the costs of pump maintenance and repair, at the proposed level of CFA 50,000 annually per pump.

The situation as regards the ABI and the India Mark II handpump is different. The repairs for these pumps are much more costly so that the village fund would probably only cover the pump attendant's fee and the costs of spare parts. Therefore, in those regions where these two types of handpump are used, a separate provision will have to be made to finance the costs of any major repairs.

An arrangement for revenue collection, which has been proposed in the Volta Noire rural water supply project, is as follows. Seventy-five percent of what the village committee collects, would be used to pay the pump attendant, spare parts and any repairs done by the HER regional maintenance service. The remaining 25% of revenue collected would be paid to the HER regional district to cover overhead costs.

Another possibility under consideration is that the committee would only be responsible for collecting the fund, passing it on to the regional district who would, in turn, pay the bills presented to it by both the village pump attendants and the district maintenance teams.

In the proposed three-tier maintenance system, HER will have responsibility for ensuring that there will be a supply of spare parts for all the various handpumps in use.

In the EDF-financed project, the spare parts would be available from two commercial dealers. The problem with this type of arrangement is that the manufacturer of the Vergnet pump can only be obligated to guarantee that the spare parts are available to the dealers during the life of the project.

Although it is in the Vergnet pump manufacturer's own interest to continue supplying and selling the spare parts afterwards, it is a fact that in the past when spare parts were needed in areas with boreholes equipped with Vergnet pumps, they were often unavailable at commercial dealers. It is therefore, questionable whether an maintenance system involving a commercial supply of spare parts would be the best to be applied on a country-wide scale.

The plan developed by HER for the national rural water supply programme also includes a provision for creating an on-going training programme for the handpump maintenance mechanics. HER has arranged with each of the aid agencies involved in rural water supply projects that either the handpump manufacturer or the project itself will train two instructors at the National Training Centre for Professional Rural Artisans (CNAPR) in the maintenance of handpumps used. The instructor will, in turn, train the handpump maintenance mechanics.

In the rural water supply project under implementation by the Authorité des Aménagements des Vallees des Voltas (AVV), the villages that are provided with a handpump are required to pay for any spare parts needed. However, there are as yet no village committee funds to cover the cost of the spare parts. Instead money for buying spare parts is taken from the funds generated from the profit made by selling grain and cotton. When spare parts are needed, the village pump attendant has to travel to Ouagadougou and purchase them from a commercial dealer.

The pump used in the AVV project requires the use of heavy equipment in dismantling the pump. With the AVV maintenance service located in Ouagadougou, the villages concerned that are located in various parts of the country, cannot really be served. In practice, this maintenance system has not been succesful.

Plans exists to decentralize AVV's maintenance service as well as making changes in the organization of the village-level maintenance. It is proposed that the village committee should collect a contribution from every family to cover pump maintenance costs and spare parts. However, the costs of ABI pump spare parts are very high and further studies are needed to ascertain whether it is feasible to expect the community to bear the full costs. Furthermore, the ABI pump is not very well suited for village-level maintenance. Given the present strategy of AVV to maximize the villages' self-reliance, the ABI pump appears to be not suitable. In fact, its characteristics are in contradiction with the project's basic strategy.

A great problem in the AVV project is that the village pump attendants are not maintaining the hygiene around the pump area, nor cleaning the drinking through for the cattle. This raises a question whether the health education has been effective. At present the health education related to water use and pump area hygiene is directed towards the women of the village. It appears that the village water committee which is entirely composed of men, does not receive any health education.

6.10 Sri Lanka

Characteristic	Summary Description
Type of Maintenance organisation	Government-organised Decentralised Three-tier
Pump used	"Diasson" (AID-type) India Mk II; "Wasp" and many other pump models
Annual Costs per pump	n.a.
Sources of Finance	Funds from various levels of government; small contribution by village Communities
At Village level	Pump caretakers (appointed by community Centre)
Staffing	Technical Officers of Local Authorities Technical Staff of District Authorities Technical Staff of National Water Supply Organiaztion
Management	Assistant Commisioner of Local Government
Equipment & materials	--
Transportation	--

6.10 SRI LANKA

Development of Handpump Maintenance Organisation

In Sri Lanka, an organisational structure for maintaining handpumps is being set up in the responsibilities are defined as follows:

A Pump Caretaker will be assigned by the Community Centre for each well and its pump(s). He will be responsible for the following tasks:

- Lubricating the pump(s) on a weekly basis as shown in the maintenance manual.
- Replacing the plunger cups and connecting pins as shown in the maintenance manual.
- Keeping a stock of necessary spare parts.
- Contacting the Technical Officer of the Local Authority concerned when the pump(s) need major repairs, when additional plunger cups or pins are needed, or when general advice about the pump is required. (All repairs other then the routine replacement of connecting pins and plunger cups are considered major).
- Being reponsible for the security of the well and the pump(s).
- Keeping records of pump maintenance and repairs, and the utilisation of the pump.
- Ensuring that regular bacteriological tests are sent to the Community Centre.
- Ensuring that corrective steps are taken where the bacteriological tests show the quality of water to be unsatisfactory.
- Providing any other assistance necessary for the Community Centre to maintain and operate the well and to promote its use by the Community.

The Community Centre will have overall responsibility for the management of the well and its pump(s). For this purpose, it will appoint a Caretaker and if necessary an assistant, to attend to the maintenance duties assigned. Among the main responsibilities of the Community Centre are the following:

- Ensuring that the Pump Caretaker performs his/her duties properly.
- Ensuring that the pump is not abused in any way.
- Ensuring that the water from the well is available to all residents in the surrounding area of the well. In dry seasons, steps should be taken to conserve water.

- Ensuring that water quality test are done regularly and corrective action taken.
- Promoting use of safe drinking water in the community.
- Making necessary arrangements to collect any fees or subscription from the community in order to pay the maintenance of the pump and well.

The Local Authority will have overall responsibility for the work of all the Community Centres in its area of authority in respect of the management of these wells. Among its main responsibilities are the following:

- Making the necessary institutional arrangements for the Community Centres to properly manage these wells.
- Arranging for provision and accounting of funds required by Community Centre for this purpose.
- Providing the services of its Technical Officer when required by the Community Centres.
- Passing any by-laws required and implementing them.

The Technical Officer of the Local Authority will carry out the following duties:

- Periodically check the condition of all pumps in his area of authority, and provide any assistance required by Pump Caretakers.
- Ensure that all pumps in his area of authority are operating properly. Necessary instructions for this purpose will be issued by him to the Caretakers, with copies to the Community Centres.
- Perform all major repairs such as replacement of foot valve. Where he has a difficulty in doing this, he will obtain assistance of the Regional Office of the National Water Supply and Drainage Board.
- Ensure that sufficient stocks of plunger cups and connecting pins are available with each Caretaker.
- Ensure that sufficient stocks of spare parts and major components are kept at the Local Authority.
- Coordinate work in respect of quality control of the water from the wells.

The Assistant Commisiones of Local Government will be responsible for supervising the work of all Local Authorities in his area of authorities, in connection with the proper maintenance and operation of handpumps and wells. In addition, the Technical Officers of the Assistant Commisioner of Local Government will monitor the work of the Technical Officers of the Local Authorities, and will check their work regularly.

The Regional Office of the National Water Supply and Drainage Board will provide technical assistance as requested by the Local Authority or the Assistant Commisioner of Local Government, for the proper maintenance of the well and the pumps. It will also undertake repairs of pumps where a Technical Officer of the Local Authority requires such assistance. It will also make arrangements for water samples to be tested regularly. Where needed, advice will be given to Local Authorities and their Community Centres on measures to be taken on wells and pumps that are in a unsatisfactory condition.

6.11 Thailand

Characteristic	Summary Description
Type of Maintenance organisation	Organised by various Government Departments involved; on a provincial (regional) basis; two-tier
Pump used	A considerable number of pump models are used
Annual Costs per pump	US $ 60 (equivalent)
At Village level	Village Health Volunteers trained in handpump maintenance
Staffing	Various; mobile maintenance teams; or technicians supervisors/inspectors
Management	Government department concerned (differs by area)
Equipment & materials	Tools, spare parts, (hoisting gear)
Transportation	trucks (in certain areas)

6.11 THAILAND

Existing Situation

To date, the main approach to handpump maintenance in Thailand, is for the water supply agencies concerned to have their own maintenance units.

For instance, the Groundwater Division of the Department of Mineral Resources has separate maintenance units based in Khon Khaen and Saraburi for maintaining handpumps in the North-East Region of Thailand.

The unit has three mobile maintenance teams each equipped with a medium-size truck and repair equipment, and responsible for maintaining 250 pumps. Each month they serve about 125 pumps. Thus, in two months all pumps are covered. Supervisors check whether the scheduled maintenance visits are properly carried out, and they undertake inspection visits to randomly selected pump sites.

The costs of each mobile crew operating in the Groundwater Division's handpump maintenance systems, are as follows:

Costs of Mobile Maintenance Crews
(responsible for 250 pumps)

Category		Costs per year
Material and spare parts for vehicles		7,200 Baht
Fuel		30,000 Baht
Repairs		6,000 Baht
Transportation		3,600 Baht
Personnel (3 No)		54,000 Baht
Travel allowance		60,000 Baht
Handpump spare parts		9,200 Baht
Depreciation of vehicles and equipment		20,000 Baht
Overhead (20%)		37,900 Baht
	Total	227,300 Baht
		(US $ 14,160)
Maintenance Costs per Handpump		US $ 57

A handpump is used by about 40 households, with an average of 5.6 persons per household. Thus the maintenance cost per person served, works out at US $ 57 : (40 x 5,6) = US $ 0,25.

A similar set-up for maintaining handpumps is being used by the Accelerated Rural Development Office (ARD) of the Department of Interior. ARD does not employ mobile teams, but technicians from the ARD Provincial Office visit pumps that are reported as broken down.

Each province has about 100 handpump water supplies, and the number of visits made by ARD technicians per month is 20.

Experiences

The performance of the handpumps concerned shows no evidence that the present system of maintenance is effective. Experience shows that the available technical personnel and equipment are unable to cope with the requirements.

The Public Health Department has adopted another handpump maintenance system in its water wells drilling and pump installation projects. They provide village-level training for village health volunteers in routine maintenance, such as lubrication, changing of worn parts, etc. The Department assists in obtaining the necessary tools and spare parts. The Sanitation Section of the Provincial Public Health Unit provides technical assistance to the village health volunteers. Its technicians are equipped with vehicles and equipment, and they undertake repair and maintenance work on request.

It is hoped that involving local authorities in the repair and maintenance of handpumps will create a spirit of participation at the village or provincial level, and will help reduce maintenance costs. However, this type of maintenance organisation requires effective coordination among the various levels. Although the type of maintenance system which delegates responsibility for maintenance work to the local authority at the village level should be supported in principle, it cannot as yet be regarded as feasible. In view of the need for maintenance, special efforts are needed in the initial stage to create a maintenance system which can effectively carry out the work, even if this involves higher costs in the first years. Thus, water supply agencies need to employ mobile maintenance teams operating from their operational centres, in the initial stage.

By the year 1990, there would be 250,000 handpump water supplies to be maintained. This would require some 500 mobile maintenance teams. Even if each team consist of only two technicians, some 1,000 maintenance mechanics would be needed. The total costs would be substantial. In the envisaged maintenance system, the following favourable characteristics could help reduce the costs:

(1) The shorter distances to be travelled due to increased number of operational centres.

(2) Local participation in the maintenance of handpumps.

(4) The utilization of standardized pumps and equipment so taht these can be procured in bulk.

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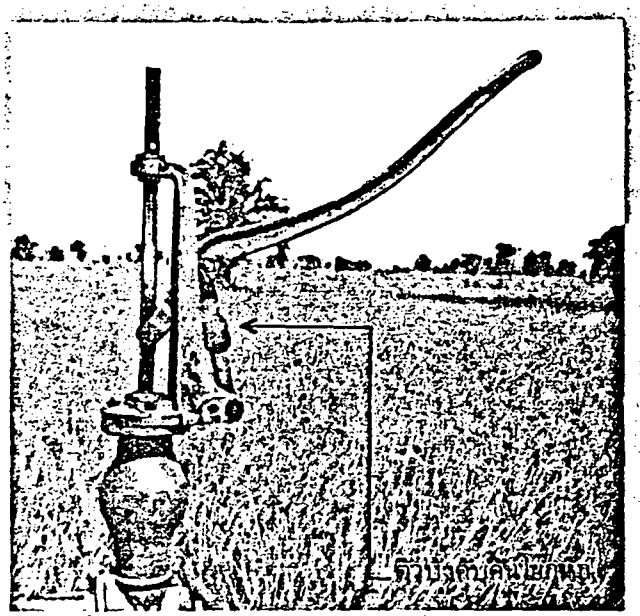

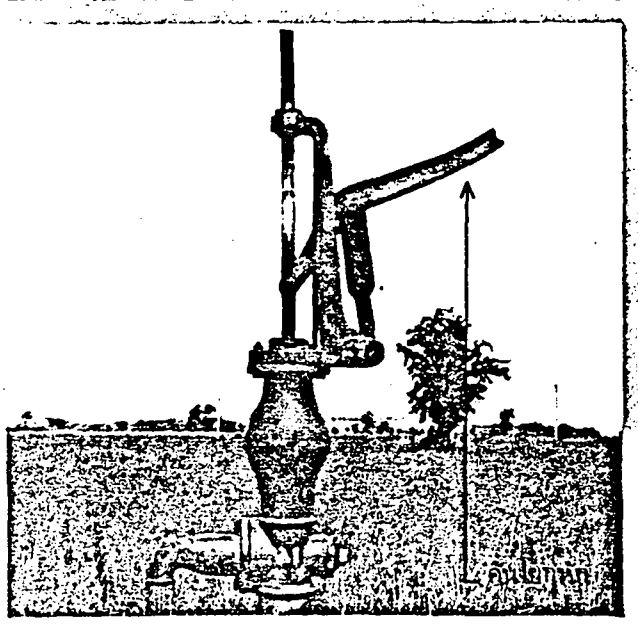

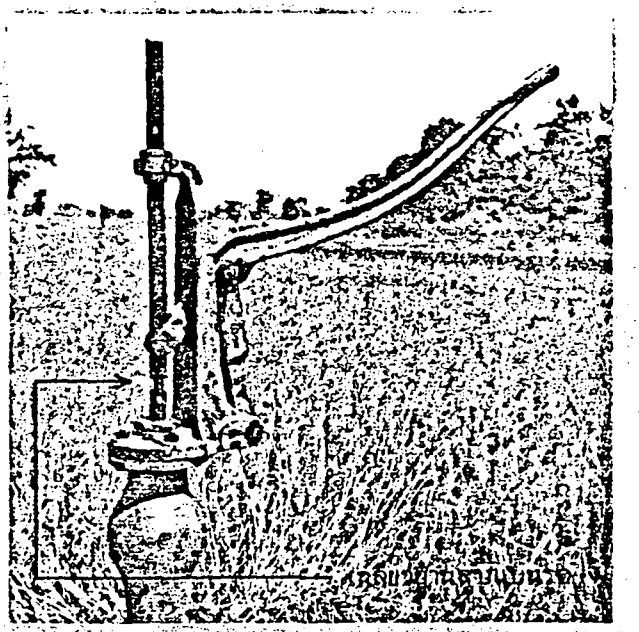

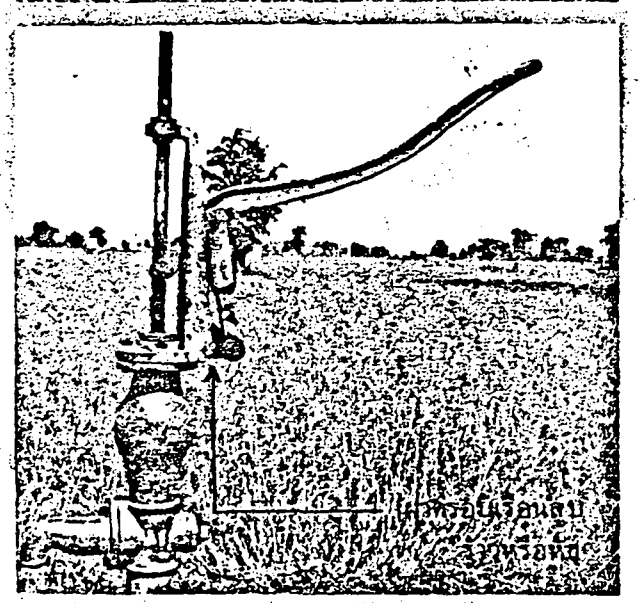

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