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IRC International Water  
and Sanitation Centre  
Tel.: +31 70 80 889 80  
Fax: +31 70 35 899 64

*PLANNING FOR SUSTAINABLE  
HANDPUMP-BASED RURAL  
WATER SUPPLIES*

*A Partnership Approach  
to Resources Coverage*

HANS SCHOOLKATE

January 1992



IRC International Water and Sanitation Centre  
Project: Resources Coverage and Community-Based Financial Management



## *Foreword*

Experience from the International Drinking Water Supply and Sanitation Decade (1981-90) has reinforced the need for a strong focus on sustainability in the development of community water supplies in developing countries. A major challenge in the 1990s will be the pursuit of this fundamental objective in an environment where resources are likely to be more stretched. Sound project design, good planning, effective implementation, and, above all, practical and efficient approaches to community operation, maintenance, and use of water supply systems will all be of vital importance. The establishment of a partnership approach between communities and supporting agencies lies at the heart of achieving sustainable development.

This document was produced by Mr Hans Schoolkate during a study leave assignment from the Netherlands Ministry of Foreign Affairs, Directorate General of International Cooperation (DGIS). It combines some literature review work with many years of practical experience in community water supply projects in Africa. This experience is placed in the framework of an approach to sustainable development worked out in the latter years of the water decade, with IRC inputs, by the Working Group on Cost Recovery, convened by the World Health Organisation (WHO). The focus of the working group in developing the "10 key elements of sustainability" was on piped water supplies. Mr Schoolkate has taken this model and adapted it for use in handpump-based rural water supply programmes, with strong emphasis on community/agency partnership.

The document forms a part of the efforts of IRC in supporting the strengthening of community-based approaches to sustainable development through a number of ongoing projects linked to community financing and management. We hope it will provide useful guidance for project managers and professionals committed to working together with communities to implement sustainable handpump-based projects in Africa and elsewhere.

IRC International Water and Sanitation Centre,  
P.O.Box 93190,  
2509 AD, The Hague,  
The Netherlands.

Tel. 31-70-33 141 33  
Fax. 31-70-38 140 34  
Telex. 33298 irc nl.

LIBRARY IRC  
PO Box 93190, 2509 AD THE HAGUE  
Tel.: +31 70 30 689 80  
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# 1. Introduction

This document aims to contribute to improved planning of handpump-based rural water supply projects, with emphasis on elements of sustainability and cost recovery, through resources coverage and the partnership approach.

A sustainable rural water supply scheme means that provisions are made for its long term functioning. For each individual community the most suitable scheme in terms of sustainability should be determined. For many rural communities in Asia and Latin-America, but particularly in Africa, wells or boreholes with handpumps will prove to be the most appropriate option, taking into consideration on the one hand the technology level and economic situation of the communities, and on the other hand the need to provide a service level that at least enables a positive impact on the community's health situation. The World Bank estimated in 1987 that for more than half of the 1800 million people without adequate water supply, handpumps would be an appropriate technology choice (IRC/IDRC, 1988).

In the past, financial planning, particularly for the operational phase, has often received only modest attention. Lately this is changing and "cost recovery" - the users' financial contributions to construction and maintenance - is now seen as an important aspect of sustainability. Important as it is however, it is not synonymous: all inputs required for operation and maintenance need to be estimated and provision made for their timely availability.

The recently published "Water Supply and Sanitation : Handbook of Financial Principles and Methods" (WHO, 1990) by the WHO Working Group on Cost Recovery explains the principles of sustainability and cost recovery in water supply and sanitation projects, and is a practical guide for setting up a project according to these principles. The handbook deals in general with water supply and sanitation projects, but focuses -for water supply- on piped schemes. It stresses a partnership approach as essential to achieve sustainability. This approach and the other issues described are also discussed in this document but specifically focusing on handpump water supply schemes.

In the handbook ten key elements are identified which relate to the creation and maintenance of conditions for sustainable water supply and sanitation projects:

- |                        |                             |
|------------------------|-----------------------------|
| * Enabling Environment | * Expertise and Skills      |
| * Health Awareness     | * Appropriate Service Level |
| * Strong Institutions  | * Appropriate Technology    |
| * Felt Need            | * Materials and Equipment   |
| * Supportive Attitudes | * Support Services          |

For handpump-based rural water supply\*, several of these key elements are interrelated and overlap one another. In this report they are classified in four groups:

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\*) "Handpump-based rural water supply" is in this report used in the sense that handpumps are considered the "standard" rural water supply, but not excluding open wells or piped schemes for appropriate conditions.

- Group I, related to the policy environment: Enabling Environment.
- Group II, related to perceptions and attitudes: Health Awareness, Felt Need, and Supportive Attitudes.
- Group III, related to skills and institutions: Strong Institutions, Expertise and Skills, and Support Services.
- Group IV, related to the selection of appropriate options: Appropriate Service Level, Appropriate Technology and Materials and Equipment.

How each of these key elements should ensure long-term availability of the technical, social and financial resources required for handpump-based rural water supply will be described for each group in Chapters 2, 3, 4 and 5.

The various aspects vital for sustainability of handpump schemes fit easily with the key elements described by the WHO working group. In comparison to the WHO document, however, extra emphasis is placed on cash-raising systems (in group IV, under the Appropriate Service Level) and the quality of construction (in group I).

Clear agreements at an early stage (before construction starts) about who does what and when during the operational phase are essential for the long term functioning of a rural water supply scheme. The resources coverage method is a useful tool for that. In Chapter 6 the resources coverage method is applied for handpump-based water supply and is illustrated with cases from Guinea-Bissau and Mozambique.

The planning process for improvement of rural water supply is described in Chapters 7 and 8. In Chapter 7 the planning at regional/provincial level is described, resulting in the elaboration of a project proposal that can be used also to arrange funds and other required resources from government and/or donor agencies. The project proposal should enable sufficient flexibility to define the most appropriate technology, management and cash-raising options for each village during its implementation. Chapter 8 deals with the process at community level: in a sequential order the various steps are described that are required in the improvement of a community's water supply using a partnership approach between community and agency.

This study was carried out at the IRC-International Water and Sanitation Centre during a 3-month study leave funded by DGIS (Dutch Ministry of Development Co-operation), and is based on documentation available at IRC, information and ideas obtained from IRC staff and others, and personal experiences of the author in Guinea-Bissau and Mozambique. The author thanks the IRC for this opportunity, the IRC-staff for their very co-operative support, and DGIS for funding this period.



## 2. *Policy and Partnership*

The wider policy environment in which a rural water supply activity is carried out determines its success as much as the activity itself. The key element directly related to policy the Enabling Environment, is described in this chapter.

### 2.1 **Enabling environment**

Creating an enabling environment is largely the responsibility of governments. Politicians and policy-makers should provide an enabling environment through legal provisions, regulations, education, information and other incentives which influence the behaviour of the community, local politicians and the agency. This should be expressed in the national rural water supply policy, involving:

- commitment to improve rural water supply through a **partnership approach** with particular attention to women's involvement;
- a **legal framework**, with organizations and agencies having clearly defined functions and competencies, and with sufficient means to carry these out;
- clearly formulated **standards** for construction of water points;
- the recognition that **handpumps** are an adequate solution for appropriate conditions;
- a clear policy on **cost recovery**, for both the construction and operational phases;
- **monitoring and evaluation** to verify correct implementation and functioning.

At local, regional and national level political preparedness to implement the policy as agreed upon is as essential as the policy itself.

#### ***Partnership approach***

The process of consultation between the agency and community should be planned and undertaken by both parties as equal partners. The community should have a sense of ownership of the water supply project, and therefore all (future) consumers and special groups in the community should be included in the decision-making process. In many cases, women have the greater share of responsibility for water collection and for budgeting household expenditures on water supplies. They are often also more actively interested in the issue, so it is essential to ensure that women are adequately involved in the decision-making process.

Consultations should be carried out through an appropriate community organization such as a village water committee. In many cases this will not yet exist in an early stage of a project, then it is important to explore other community organizations provided they can be used to consult with the entire community. In larger villages or urban centres this could be difficult, and it may be more appropriate to consider neighbourhoods as different communities.

As a consequence of the partnership approach the planning at community level may take more time, which might lead initially to a lower production level during the construction phase. Furthermore the approach requires a supportive attitude of all agency staff and the involvement of capable extension workers, resulting in extra costs for the agency and probably in extra efforts for training. However, if successfully carried out this will be compensated by lower input at a later stage and better system's performance.

## ***Legal framework***

In many countries the role of the government is changing from provider to promoter and facilitator, enabling involvement of private and public companies in construction of wells and boreholes, installation of handpumps, distribution of spare parts, etc. As a result the role of the community in the management of its own water supply is emphasized.

The banner of the Togolese Government's maintenance programme FORMENT is "Decentralize and Privatize" (Amat and Amat, 1988): responsibilities for maintenance of handpumps are transferred from central authorities to village communities and private mechanics. The government is creating (with financial support from a donor organization) the conditions for the functioning of the system, including an extensive training programme.

Tasks and competencies of all institutions and agencies involved at the different levels should be clearly defined in the national rural water supply policy to avoid misunderstandings and unexecuted tasks.

## ***Standards***

The quality of the constructed waterpoints has an important influence on operational costs and influences the users' appreciation of them, and is therefore a crucial factor for sustainability. Establishment of and adherence to standards will help to assure the quality of waterpoints.

### ***Water Quality Standards***

In many countries the WHO standards are applied as national water quality standards for piped supply schemes. In co-ordination between the Ministry of Health and the ministry in charge of the rural water supply programme, they are often also applied for handpump water supplies. The Ministry of Health is in general responsible for surveillance and control of the quality of the delivered water. The rural water supply agency has the responsibility to supply water in conformity with the agreed standards.

Water treatment would raise considerably the operational costs of a handpump-based water supply and would require complicated technology in relation to handpumps. Therefore treatment is not a logical combination with handpumps and is seldom applied for handpump water supplies. Because the water quality cannot be improved, wells must be sited in places where bacteriological as well as chemical groundwater quality meet the standards, and must be constructed in a way that prevents surface contamination.

*Bacteriological quality* of groundwater is generally assured if no external contamination occurs. Siting of wells upstream and at sufficient distance from possible sources of pollution like latrines, septic-tanks, graves, etc. will prevent extraction of contaminated groundwater. Contamination of groundwater around shallow wells will occur when the well surroundings are dirty and muddy, and contaminated water can infiltrate from the surface. Direct contamination of well water might occur if leakage of spilled water into the well is possible. Open wells might be contaminated if dirty buckets are used to extract the water. Use of just one bucket with a windlass or a pulley will reduce this contamination. Often an agency is responsible for the functioning of hundreds or thousands of wells. Regular control of bacteriological water quality of all these wells would require the use of scarce resources like transport, skilled manpower and finance, and would therefore compete with other components of a sustainable system which might have more priority. Therefore it is seldom done on an extensive scale and avoiding contamination should receive sufficient attention in the siting of wells and their finishing.

Hygiene education aiming to avoid contamination of well surroundings and thus well water, will be more effective than bacteriological control of well water.

Salinity, iron concentration and fluoride concentration are the most important points concerning *chemical well water quality*. Although salinity and iron concentration do not influence the health of the consumers if the concentration is slightly higher than standard, they influence the taste of water and therefore often influence the degree of use of wells: the bitter taste of water with a high iron concentration discourages its use for drinking water, and brackish water reduces its applications. This will lead to less appreciation of a well and will also negatively influence willingness to pay. Even intensive awareness campaigns will seldom be able to make bacteriological quality prevail in relation to a poor taste. Excess of fluoride in drinking water may lead to mottled enamel of teeth and may cause bone diseases.

### *Water Quantity Standards*

National standards related to water quantity will include figures for the number of users of a waterpoint or the number of waterpoints for a village, and for the maximum walking distance to a waterpoint. About 200-300 consumers per waterpoint, corresponding to about 40-60 families, is a common norm in Africa, but considerable differences exist. In areas with many small villages, like in Guinea-Bissau, the average number of users of a well will be lower. In areas where an important share of the water is used for livestock, this might also be the case. In Mozambique, in a first phase, each water point has to serve 500 consumers. A daily per capita consumption of about 20 litres then means that about 10m<sup>3</sup> are required daily for domestic use.

The capacity of handpumps varies for different pump types and depends on the water depths. For a standard pump it may vary between 1500 l/h for a water depth of about 10m and 800 l/h for a water level of about 30m. Thus the maximum volume to be pumped daily from 30m depth with a handpump is about 10m<sup>3</sup>.

A per capita consumption of about 20 l/day is considered as a minimum required for consumption and personal hygiene, e.g. standards in Burkina Faso and Mali: 20 l/c/d, Cameroon: 25 l/c/d, Ivory Coast and Central African Republic: 15 l/c/d (CIEH, 1990). The maximum distance from houses to a waterpoint is often set at 500 - 1000m. If the distance exceeds 500m, the volume of water fetched daily for a household will drop, with consequences for frequency of hand-washing, bathing of children and the like.

### *Construction Standards*

Technical and other criteria for well digging and drilling, handpump installation and slab construction will help standardization and therefore reduce construction costs and improve the quality of the construction and installation work, and will ultimately result in increased reliability and reduced operation and maintenance costs.

Important technical issues to define include: minimum acceptable yield of wells and tubewells; characteristics of applied concrete; the relation between aquifer material, gravel pack material and slot-width of screens for tubewells; thickness of gravel pack; and thickness of concrete slab around (tube)wells.

The influence of poor construction on the operational costs of waterpoints is clearly evident from an example in Guinea-Bissau (DGRH/SNV, 1990): the annual costs alone of handpump spare parts for boreholes with sand intrusion was three to four times the costs for handpumps installed on correctly constructed boreholes. This was exclusive of the extra costs for cleaning the borehole and for the labour involved. Also in "Community Water Supply, The Handpump Option" (Arlosoroff et al, 1987) sand and silt intrusion in wells and boreholes is mentioned as one of the main causes of wear of handpump parts and thus of raising maintenance costs.

### *Standardization of equipment*

Standardization to one or two types of handpumps will reduce the number of different spare parts and thus will ease spare part distribution. Standardization -at least by area- will facilitate the work of local mechanics and thus will make fewer demands on their technical skills.

A well-defined standardization policy will limit importation of many different makes and types of handpumps by donor agencies. Local production of just one or two types might be agreed upon and will be an extra stimulus for standardization. India is a good example of this: hundreds of thousands of India Mark II handpumps have been installed in the country, manufactured by numerous factories but all according to equal standards. If one manufacturer gets a monopoly position, there may be an adverse effect on quality, prices and delivery conditions.

### *Handpumps*

At the moment handpumps are largely considered an appropriate option for small community water supplies in rural areas in Africa. Only about 10 - 15 years ago the handpump solution was considered inferior in relation to piped schemes, and thus was often not appreciated in (donor funded) government projects. Handpumps provide a lower service level in relation to pipe supplies, but have lower construction and operation and maintenance costs and are, in general, more reliable. In several countries handpumps are still not considered an appropriate water supply in bigger villages or small urban settlements like district centres.

In the national rural water supply policy handpumps should be included as an appropriate option to be sure that qualified staff, adequate equipment and materials, and sufficient funds are made available for handpump programmes.

### *Cost recovery*

The costs of the operational phase should be shared by the government agency and the community, with possibly a donor-contribution for replacement investments. In many countries and organizations, it is felt that the community's share should, for handpump-based schemes, at least include costs of preventive maintenance and repairs (spare parts, labour and transport).

There should be a consistent policy on cost recovery in rural water supply with a more or less equal per capita government contribution for different types of supplies. This is the best way to supply the maximum number of communities with the limited funds available, but it implies that for the users the cost of a piped scheme in general will be higher than the costs of a handpump supply. Presently it is very common that piped supplies receive much larger contributions from the government than handpump schemes.

The same principle may be applied in sharing the construction costs between the agency and the community. The improvement of the water supply situation to a minimum service level might be financed with government and/or donor agency funds. Further improvements could be partially or wholly funded by the user community. For instance: the government agency may take care of the financial resources required for the construction of dug wells and a community wanting a handpump installed on it could purchase the pump with its own funds.

The policy on cost recovery should be clearly defined in the national rural water supply policy: the financial consequences should be clear for a community when choosing a certain service level. In the past this point received (little or) no attention: safe water was often promised free of charge. Introduction of cost recovery in existing schemes is therefore often difficult, also because the users' costs of the applied technology might not correspond to the community's willingness to pay. When the introduction is not carried out very carefully and in good co-ordination with the communities, the consequences could be serious as was reported from Ghana (Wood, 1988): In two northern provinces the occurrence of Guinea worm increased dramatically after introduction of payment for handpump use. As contributions were not paid, handpumps were not repaired and users were forced to return to traditional water sources. For the implementation of the cost recovery policy an appropriate cash-raising system has to be defined for each community (see 5.1).

### ***Monitoring and evaluation***

Monitoring and evaluation of the activities carried out in planning and construction phases should focus on issues related to sustainability, like: quality of the constructed waterpoints; their usage; the level of awareness (water - hygiene - health) attained in the communities; the level of community participation in decision-making; and the results of training of local mechanics.

During the operational phase monitoring and evaluation of the functioning of the system, from village level to national level, are required to identify possible weak points and to verify whether applied methods and systems are adequate. Targets concerning the functioning should be set beforehand.

Procedures and mechanisms for monitoring and evaluation should be included in the national rural water supply policy as a certain courage is required to start a consistent monitoring and evaluation programme and to implement the conclusions drawn from it. It is however essential to prevent and timely correct lack of efficiency and commitment of agency staff, in order to avoid further use of less appropriate methods and technologies, and to adapt to changing circumstances.

### 3. *Needs, Attitudes and Support*

In this chapter the three key elements are described that are related to attitudes and perceptions related to water supply and possible improvements: health awareness, felt need and supportive attitudes.

#### **3.1 Health awareness**

The awareness of the relationship between water, hygiene and health might be one of the factors which make a community decide to support the construction of new waterpoints. In the operational phase the awareness of the community members should be such that:

- only handpumps (or other safe sources) are used for collecting drinking water, water for preparation of food and for other purposes requiring good quality water;
- transport and storage of water are done in a hygienic way, avoiding contamination before consumption;
- sufficient water is used for hand-washing, for bathing, for washing clothes and for cleaning kitchen utensils; as mentioned above a daily use of 20 l/person is considered the minimum required;
- well surroundings are kept clean and tidy.

At the start of an intervention in a community the level of awareness is normally not sufficient to ensure these points, therefore a hygiene education programme is carried out. Involvement of teachers and extension workers of other ministries and particularly of local staff of the Ministry of Health will be very useful: they are well-known already by the community, are familiar with the local situation and with local health conditions, and thus have good starting-points for hygiene education. As in general women are directly involved in and make decisions about these issues, hygiene programmes should be addressed particularly to them.

During the operational phase hygiene behaviour should receive continuous attention and be improved further. In communities where during a part of the year plenty of water is available although the quality is doubtful, a strong awareness programme will be required to convince people to fetch drinking water at a more distant handpump instead of from a nearby contaminated source. Over several years an increasing number of households might decide to use the safe source also during the rainy season. The same may hold true for transport and storage of water in a hygienic way, for clean well surroundings and for the volume of water used. Whereas extension workers from the water agency have an intensive link with a community during planning and construction phases of a new water supply, health staff often have more continuous contact with communities. Involvement of health staff in hygiene education in the operational phase is therefore even more important.

Not only the community but also the staff of the water agency should have a strong awareness of the consequences of their work for the health situation. This should lead to a positive attitude towards co-operation with health staff, not just of the extension workers but also of other water agency staff. It should also lead to hygienic behaviour that serves as an example for the villagers.

## 3.2 Felt need

The community and the individual households should consider the advantages of an improved water supply as important and interesting. Positive influences on the health situation, economic benefits and/or social benefits might make the community members decide positively on improving their water supply situation, motivating them to contribute actively in planning, construction and operation.

Economic benefits may result from productive use, like cattle watering, vegetable growing and beer brewing, and from time savings. Reduced walking distance to the water source may be considered as an economic benefit if the time saved is productively used, and as a social benefit if women use this time for social events. Time savings might also be obtained from less waiting time at the water sources.

In two Mozambican provinces women were asked about their use of time savings; they could mention more than one activity (PRONAR, 1989). The following percentages indicate the number of women that mentioned the respective activity:

<i>Activity</i>	<i>Inhambane</i>	<i>Cabo Delgado</i>
Taking care of house	100%	79%
More often preparing food	78%	65%
Taking care of children	38%	37%
Political activities	5%	66%
Activities related to church	33%	0%
Visits to relatives	63%	11%
Study	0%	5%
Working at the fields	13%	65%
It takes more time now	0%	11%

- Notes:
- "More often preparing food" and extra time for "taking care of the children", will also have a positive influence on the health situation of the concerned children, women and men.
  - The political activities relate to the OMM (Mozambican Women organization) and the OJM (Mozambican Youth Organization). In Cabo Delgado they will be good entrances for mobilization campaigns, in Inhambane involving churches seems to be more appropriate.

It is mainly the existing water supply situation that determines if a community feels the improvement as an important need and as a priority. If water is scarce, even if only for a few months annually, and often linked to long walking distances and waiting times, a community will be motivated towards improvements. If water supply is really a felt need in a community, the agency's mobilization and organizational tasks are often rather easy, but finding a reliable and nearby water source might be difficult.

To measure the interest of a community in improving the water supply situation, in several countries the communities have to collect an amount of money before construction starts. This is used as a financial contribution in construction costs or as a first fund for maintenance costs: e.g. 2000 Ksh (US\$80) in the Nyanza province in Kenya (Odera et al, 1990) and amounts of 50,000 - 300,000 CFAF (US\$165-1000) in seven projects in francophone Western Africa (GREA, 1990).

An agency has the following possibilities to try to increase a community's motivation for improvement of its water supply:

- **A health awareness programme.** This option is often applied, but clean water is not largely considered by rural communities as a reason to improve their water supply situation or to use new waterpoints, as is illustrated by data obtained in Guinea-Bissau (Hermans et al, 1987). In an evaluation of a rural water supply project including hygiene education the following reasons were given by households for using the new or traditional source for drinking water:

<i>R e a s o n</i>	<i>using new well for drinking water</i>	<i>using traditional source for drinking water</i>
distance	77%	52%
safe water	12%	2%
taste	6%	38%
others	+ 5%	+ 8%
	100%	100%

Better tailor-made interventions taking into account the local socio-cultural and health practices, or more participatory approaches, may in some cases enhance the results of health awareness programmes.

- **Emphasizing the economic and social benefits of the improved water supply.** Reducing the walking distance to water sources is often the main reason for a community to decide to improve its water supply and for an individual household to use a new waterpoint. For other households the distance results to be an important reason to continue using traditional sources, as is also illustrated by the above data. Water usage for productive purposes, like for cattle watering, might be interesting for some community members. The quantity of water required, however, will often necessitate the construction of extra wells to prevent women from being hindered in fetching water for domestic use. Other productive purposes, like production of local beer and other drinks, palm oil, bricks, etc. generally do not require so much water that extra wells are needed. Partly these are typical womens' activities giving women possibilities to use the time savings for productive purposes and to increase their cash-income, but over-production due to limited markets might become a constraint. Productive use of water may ease cost recovery.
- **Co-ordination with other ministries and programmes.** To ensure the sustainability of rural water supply programmes, activities should complement those of other agencies. A rural development programme aims to improve living conditions in a certain area thus it is logical that its extension workers emphasize the importance of an improved water supply. In general such a programme also aims to raise revenues from agriculture production or other sectors, so it might ease the introduction of cost recovery. Health workers and teachers might also be involved in increasing the community's motivation for a better water supply.

All three options will take time. There must be time to enable the community members to discuss and consider the options between them and to convince the majority. If just a few households feel improvement of the water supply as an important issue, they will not be



able to realize all the required financial and in kind contributions. If they do nevertheless improve the water supply, those unable to contribute might be excluded. As a result, the less prosperous may be left with a worse situation due to a lack of concern by the more prosperous for the traditional sources.

Productive use of water might lead to extra settlement in a village. This effect and the desirability in relation to environment and well-being must be considered with the community.

The agency should allow the community to make an unpressured decision, and should be willing to co-ordinate activities with other programmes under way in the community.

### **3.3 Supportive attitudes**

#### ***Community***

The VLOM-approach ("Village Level Operation and Maintenance") has been promoted for several years as the solution for handpump maintenance. Since recently the "M" stands for "Management" to indicate that operation and maintenance alone is not sufficient and that primarily the community should be responsible for the functioning of its own water supply. Community management is considered now as the only realistic option: considering the increasing number of handpumps and their dispersal, the agencies will not be able to manage handpump schemes without spending too large a share of their budget.

Community management implies that the communities have a feeling of ownership for their waterpoints. They accept their responsibility and are willing to contribute actively in the planning, construction and operation process.

The community's formal and informal leaders will to a great extent be responsible for the positive attitude of a community. Helping the leaders to develop a positive attitude towards the improved water supply is therefore of great importance. Socio-cultural investigations of population groups living in the area, completed with community inquiries, will make clear who are the real leaders in a community. Religious leaders might have considerable influence, as well as professionals like teachers and health workers, party members or other political leaders. Special attention should be paid to formal and informal women's organizations and to key persons specially linked to the appreciation of waterpoints, e.g. elderly women.

#### ***Agency***

In the agency a supportive attitude means a genuine desire to work with the communities in a partnership approach to assist them in finding appropriate solutions for their water supply problems. The agency as a whole and each agency staff member should be willing to deal with a community on the basis of equivalence. Sufficient time should be given to the communities to make their decisions, although this might have consequences for the construction programme. The agency and its staff should be willing to co-operate and to co-ordinate interventions with other ministries and programmes. The agency's policy should motivate its staff in this sense. Higher level staff should inspire and motivate lower level staff.

Supportive attitudes from the community's formal and informal leaders and from agency staff, will be reinforced by visiting successful handpump water supplies in other communities or areas to exchange experiences.

## 4. *Institutions, Skills and Support*

In this chapter the three key elements related to the institutions responsible for implementing handpump-based rural water supply programmes are described, with emphasis on the community and agency institutions important in the operational phase.

### 4.1 Strong institutions

#### *Community*

In order to achieve sustainability, it is recommended that piped water supply schemes be managed by agencies with financial and administrative autonomy or - if they have executive responsibility - by the communities themselves (WHO, 1990). Management of handpump water supplies is in general more easily carried out by the communities. The most important conclusion of a UNDP/World Bank evaluation of seven handpump-based rural water supply projects in West-Africa (GREA, 1990), is that giving the beneficiaries / communities the means to assure the functioning of their waterpoints is the only way to improve the viability of the schemes.

In practice a group of community members will manage the scheme on behalf of the community. The community institution managing the handpump water supply will have the following main functions:

- representing the community to the agency, and - if relevant - to the area mechanics;
- organizing the users' in kind and financial contribution during construction and operational phases;
- organizing the community in correct use of the new waterpoints, including supervision of the caretakers and - if relevant - village mechanics.

For village water supply a village water committee will often be the most appropriate management structure. Representation of the interests of all the users should be assured, also of minority groups. As women are generally more directly involved in issues related to water, it is useful and rather logical that they are included in the village water committee. Besides a clear explanation of the functions of the village water committee, the agency may propose some options for its composition to the community, e.g. about the number of female members. The community and the agency should then be able to decide jointly on the composition of the village water committee and on election and nomination procedures. Next the community will elect the first committee members.

In the Togolese FORMENT programme a village water committee has minimally seven members: a chairman, a treasurer, a secretary, two members for preventive maintenance of handpumps and two members in charge of cleaning and hygiene education. As many women as possible should be in the committee. The actual number of committee members varies to reflect the size and ethnic composition of the local community (Amat and Amat, 1988).

The village water committee has a key function in a sustainable rural water supply scheme as it is the link between the users and the managers of the waterpoints on one hand, and the professionals, the providers of services (including the area mechanics) on the other hand.

A village water committee should have the capacity to negotiate with the agency whenever there is a problem with the water supply, e.g. when a well or a borehole has insufficient

water, when a handpump breaks down frequently or when the number of waterpoints becomes insufficient. The village water committee calls the area mechanic when required and pays him, and negotiates with him about his tariff when necessary. Purchasing of the pump spare parts might also be a task of the village water committee.

The village water committee should have sufficient authority to organize correct use of the waterpoints and to collect and manage the cash required for their functioning. If necessary, committee members should receive some training, but equally important will be that they receive continuing support from the agency, health staff or others.

The members of the village water committees are in general not paid. The period of their functioning and the substitution and election procedures should be well defined. The village water committee is responsible to the community: in an annual meeting with the entire community the village water committee will justify its policy and the financial management. In an extreme situation the government agency might intervene.

Depending on the actual situation of existing community institutions, the management of the village water supply might also be done by a Village Development Committee, by a women's organization or by a co-operative. Maximum use should be made of existing institutions. The village water committee might also be created as a subcommittee of the Village Development Committee, as is often done in Togo (Amat and Amat, 1988).

### ***Agency***

A "strong institution" means a functioning rural water supply agency, capable of defending the interests of rural water supply with government structures at various levels, and to negotiate with suppliers, contractors, etc., as well as with donor agencies.

Defending rural water supply interests with government structures will often mean competing with other agencies about scarce staff, financial resources, equipment and materials. Construction and maintenance of wells with handpumps may be financed from different government budgets: construction from investment budgets and maintenance from recurrent budgets. Budgets might be made available from government structures at national, provincial, and local level. Due to economic rehabilitation programmes and rising inflation rates, government budgets in general and for social sectors like health, education and rural water supply in particular, are being reduced in many countries.

The Ministry of Water (or more in general the ministry responsible for rural water supply) will traditionally be the principal investor in well construction and handpump installation and maintenance. Other important contributions might come from programmes like regional integrated rural development programmes, primary health care programmes and agriculture programmes.

An important contribution may come from donor agencies: in certain countries this can account for up to 70-80% of investments in well construction and handpump installation. Donor funds are traditionally applied for creation of construction capacity and for construction itself. Recently however, training, community participation and education, and institution building are receiving more attention. Often donor organizations have their own policies and ideas. For project proposals and documents the government agency and the donor in mutual consultation can try to integrate these issues with the national rural water supply policy.

A capable and strong government agency is important to prevent an overly dominant role of donor agencies in project preparation and implementation.

As mentioned in 2.1 the construction of wells and boreholes and the installation of handpumps can be carried out by private or state owned contractors. The main tasks of the government agency are to plan and control the work. In Mozambique provincial construction companies (Provincial Rural Water (supply) Workshops) with the status of parastatals were created basically for shallow well construction and handpump installation. They are authorized to do similar work for all type of clients provided that the annual community water supply construction plan for the provincial governments is realized.

In many countries some work is carried out by private contractors. Even more than shallow well construction, drilling of boreholes is an activity suitable for involvement of private or parastatal enterprises.

Contracts should be signed by both the financing agency and the contractor, with clear clauses on:

- the procedures to be applied, such as on community participation;
- the quality of the work and the way to control this (national standards on rural water supply construction work may be very useful);
- the warranty terms and conditions;
- the completion date of the work and (financial) consequences if this is not realized;
- the payment terms and the (financial) consequences if the financing agency does not realize them.

The financing agency will often be the government but it might also be a NGO, a community or a private person. Due to lack of technical knowledge by the other financing agencies, the rural water supply agency must often take responsibility for contracts and about supervision and control of the work. It is therefore crucial that the agency is sufficiently strong in relation to the contractors. The village water committee or other community members may be involved in the control of the contractors for certain aspects of the work, e.g. the mixture of concrete, the thickness of the concrete of the slab, and the water level in the well.

Establishment of new institutions for implementation of projects should be avoided. A project should be organized in a way that the best use is made of existing institutions and their resources. If a new institution must be established because existing institutions cannot carry out the project tasks, its duties and competencies should be co-ordinated with the existing institutions and, most importantly, its functioning after the project period should be assured, if relevant.

## **4.2 Expertise and skills**

Certain levels of skills should be available in the community and in the agency for planning, construction, operation and management of handpump-based water supplies. Without these skills long-term functioning of the water supplies is not assured.

### ***Community***

- The village water committee should have organizational skills for mobilizing community members and for supervision of caretakers and village mechanics. Skills related to cash-raising, financial management and hygiene issues are also necessary.
- The caretakers should have sufficient organizational skills to organize the communities and, if required, technical skills for preventive maintenance.

- The local pump mechanics should have technical skills to assure correct repair of handpumps.

### *Village Water Committee*

In small communities the authority of a village water committee will often depend on the position and authority of some of its members. Formal and informal village leaders often are in their position because they showed organizational and management skills before. As a consequence they might be involved in many functions, which may cause undesired concentration of power and overloading of the concerned people, resulting in poor realization of their tasks. Training of the village water committee may improve its performance as the training can be focused on members with less developed skills.

The importance of paying special attention to the training of women in the village water committee is underlined by a conclusion from an evaluation of seven projects in Western Africa (GREA, 1990): women are included in the village water committees but have no power in the decision making.

Training in organizational issues might include: organizing village meetings, mobilization for use and correct use of the new waterpoints and for hygienic behaviour in transport and storage of water, mobilization for cleaning of well surroundings, and supervision of caretakers and village mechanics.

The village water committee should have skills for the financial management of the handpump water supply:

- collecting the users' contributions, bookkeeping of all contributions and expenditures related to the water supply;
- proposing the level of the users' contributions according to the planned repair costs;
- management of the fund resulting from the users' contributions.

Schemes for cash-raising for other commodities in the community, like for village health programmes, may already exist. If a community fund does exist, it might be advantageous to use it for the rural water supply too, instead of creating a special fund. The continuity should however be assured, and there must be a reasonable administration. If a new fund has to be created, administration procedures must be elaborated and often training will be required for bookkeeping.

Collection of the users contributions by female members of the village water committee is often recommended: they will better know the other women and their individual possibilities and problems, and it is generally assumed that women are more honest with money than men are. Besides house to house visits by men may be less accepted.

The users' contributions will result in a fund to pay repair costs and eventually for replacement of handpumps. In several countries in Western Africa it is agreed that the village water committees should always have a fund available of about 50,000 CFAF (US\$165) per pump. From Burkina Faso (CIEH, 1990) and Niger, Tillabery (Metral, 1988) it was reported that too often the management is rather weak and there is no money available for urgent repairs when required. Consequently people are forced to return to traditional sources or must collect money on an emergency basis, maybe at an inappropriate moment.

Due to a rather high inflation rate in many countries the real value of such funds might reduce considerably when just put aside as cash or when deposited at a bank account. In the Dosso-region in Niger the money is used to buy grain when prices are low (personal communication J.Stofkoper). The grain keeps its value and may even result in profits when sold. Such speculation with funds for handpump repairs should be very safe, but requires skills, experiences and honesty of the village water committee. Additional training might be required, also for other methods with the same objective.

Besides the village water committee other committees may exist or may be established in the same community, requiring the same type of training in organizational and financial issues. Co-ordination may permit savings of costs and manpower from the agencies and may prevent overloading of some community members.

### *Caretakers*

Organizing daily and weekly cleaning of waterpoint surroundings and taking action when the waterpoint is misused or out of order, are the tasks of waterpoint caretakers. One or more people, often women, are elected by the users and nominated as caretakers for a waterpoint. It is advantageous if the caretakers live near the waterpoint. Special skills are not required but they should have sufficient authority to organize the users. Normally they are not paid for their services. They do not require special tools, unless they are also in charge of preventive maintenance of handpumps. Their functioning is controlled by the users and by the village water committee.

Training might be required in organizational aspects and possibly preventive maintenance of the handpumps.

### *Local Handpump Mechanics*

A local repair capacity is the best and only solution to repair defunct handpumps as soon as possible. It is therefore important to assure sustainability of handpump systems. Depending on the level of technical skills required, two systems may be distinguished, which may exist together in one region:

- **Village mechanics:** Two villagers are selected by the community for repair of handpumps and are trained by the agency in a short practical course. Their repair capacity is limited to VLOM-type handpumps. Agencies often recommend the selection of people with some technical skills as village mechanics, like bicycle repairmen or carpenters. In several countries women function well as village mechanics, thus making the daily users of a waterpoint independent from outside interventions. At the same time it is a good opportunity for women to get familiar with technology. As the repair of handpumps will occur only one or a few times annually, the village mechanics do not need to be paid for their services. They receive the required tools from the agency or the tools are purchased by the community.
- **Area mechanics:** An area mechanic has more tools and receives more training than a village mechanic which gives him the capacity to carry out repairs on more complicated pumps or more complicated repairs on the same type of handpumps. Somebody well "rooted" in the area, generally comprising 10 - 30 villages, is selected by the involved villages. After his training he receives a toolbox or a credit to buy the toolbox. The toolbox should be sufficient to repair the handpumps in the area. Sometimes he also receives a loan towards the purchase of a bicycle. In Guinea-Bissau the area mechanics also receive some extra tools for the repair of

other equipment like bicycles and grainmills, enabling them to earn some extra income. The tools are hardly used for anything else than handpump repairs however, mainly because of the mechanics' lack of knowledge and skills to repair other equipment (DGRH/SNV, 1990). Repairs by area mechanics should be as good as those carried out by professional repair teams. In Guinea-Bissau there was no significant difference over a three-year period between the average annual number of breakdowns of pumps under responsibility of area mechanics and those of regional installation and repair teams (DGRH/SNV, 1990).

The area mechanic has to be paid for his services. The general rule is that he is paid by the community for each repair, in cash or in kind. The tariffs might be set by the agency or by the mechanic himself. In other cases (like Niger, Tillabery (Metral, 1988)) the amount to be paid is defined by the community. The tariffs should include the costs made by the mechanic (including transport and tools) and a reasonable payment for the time spent.

Setting of the tariffs by the mechanics might be the most suitable solution. If sufficient mechanics are trained and equipped in a region, and the communities are free to make use of the services of any one of them, their tariffs will be reasonable, as reported from e.g. Togo (Amat and Amat, 1988) and Ivory Coast (CIEH, 1990). When the mechanics are appointed by the concerned villages and are well known in the area, social control will help to prevent extreme tariffs. In special cases the agency, on behalf of the government, might have to fix limits. In several countries e.g. Guinea-Bissau (DGRH/SNV, 1990) and Niger, Tillabery (Metral, 1988) the incomes of the area mechanics are reported to be too low to assure a reasonable living standard and therefore to assure that area mechanics continue to be interested in their jobs. Possibilities to raise incomes without raising tariffs are: a larger working area; involvement in installing new pumps; and involvement in selling spare parts.

If the mechanic is well known and appreciated in the area, and likes the work and feels a certain pride in it, there will be a noticeable positive effect on his functioning. A certificate and other non-material compensations might contribute to this. A good selection is essential: it is useful to select somebody with technical skills and experiences.

During his visits to the villages an area mechanic might contribute to hygiene education, such as hygiene around the waterpoint. In his training, attention should be paid to this.

The village water committee, caretakers and village mechanics are trained for their functions during the construction phase. Village mechanics should be trained as much as possible in their own village. Particularly for female village mechanics this is much more convenient. Area mechanics might be brought together in a district or regional centre to be trained. Regular refresher courses are essential, particularly to maintain their motivation.

### ***Agency***

The rural water supply agency should have sufficient skills for correct planning, construction, maintenance and management of handpump water supplies, not only the traditional technical and administrative skills, but also for management, communication, extension, training, and monitoring and evaluation.

- Qualified drillers, well-diggers, masons, handpump installation teams, as well as technicians, engineers and hydrogeologists, will result in correctly designed and constructed waterpoints, reducing the required maintenance and operational costs.
- Administrative skills are required in the agency to enable correct planning and organization of the operations as well as correct annual planning, including financial planning.
- Management skills are necessary for overall planning but also in organizing construction and maintenance operations.
- Communication skills are very important for a genuine co-operation with the community. A partnership approach requires very capable extension workers in the agency, with sufficient appropriate skills and a positive attitude towards the community, particularly towards the village women. Often female extension workers will be preferable for this job. Extension workers with sufficient skills and motivation to work daily in rural areas, are often scarce.
- Extension work also requires other special skills from the agency, like socio-cultural investigations, socio-economic investigations and thorough knowledge of the relationship between water, hygiene and health. People with such expertise should be included in the agency staff or should be contracted for short periods.
- Training skills are required in the agency for training of the village water committees, the caretakers and local mechanics, and for the training of agency staff. In both cases motivation and stimulation are often as important as transfer of technical knowledge. Regular refresher courses are therefore essential.
- Monitoring and evaluation skills are required to verify the results and the impact of the programme. Specialists might be contracted for setting up a monitoring and evaluation programme and for training of agency staff in this field.

### **4.3 Support services**

The support services are supplied by the agency and should enable the long-term functioning of the community managed water supplies: they should take responsibility for interventions that exceed local capacities, provide back-up support to village water committees and local mechanics, take care of co-ordination at national level and monitor the functioning of the rural water supply system.

#### ***Handpump installation and repair team***

The installation of new handpumps will often be the main function of the installation and repair teams: new handpumps are installed as replacements for worn out pumps, and on newly constructed or recuperated wells and boreholes. Depending on the agreements, these pumps might also be installed by the constructors of the waterpoints.

For VLOM-type handpumps repairs can be carried out by village mechanics. Area mechanics can carry out most repairs of other pumps. Particularly for pumps with installation depths of 30 - 40 meters or more, interventions of a regional team with a vehicle might be required because of the need for special tools and equipment and/or needed skills and experience.

The repair of the concrete slab around the well might be another task for the handpump installation and repair team, particularly if cement is not locally available. Handpump installation and repair teams will also be involved in training of local mechanics.



## ***Back-up support to village water committees and local mechanics***

The agency should support village water committees and local mechanics in their management of the village water supply and their continuous mobilization of the community. As mentioned in 4.2 regular refresher courses will be an appropriate method, aiming at transfer of knowledge (financial, technical, organizational), and particularly at stimulation and motivation of the village water committees and the local mechanics. The agency should have the capacity to organize training and refresher courses at regional level.

From Burkina Faso it was reported that area mechanics were losing their interest in repairing handpumps because of the low frequency of breakdowns and therefore their limited number of interventions (CIEH, 1990).

Regular visits to villages will be important for hygiene education, with emphasis on transport and storage of water and clean well surroundings, but also personal hygiene and other aspects might be touched upon. The visits serve also as stimulation and motivation of village water committees and local mechanics. Different strategies might be applied for these visits:

- Extension workers from the rural water supply agency might continue to visit the villages with a frequency of one or more times annually. Building up and maintaining the confidence of the communities will require more frequent visits than just once a year. The main advantage would be that the water supply agency would be independent of other agencies for the hygiene education and could therefore give it an appropriate amount of attention. The visits to the villages will require transport. For female extension workers (often preferable, given the tasks involved) cars will often be the only reasonable option. For a rural water supply agency however, the operational costs of such an extension service will often be too high.
- Hygiene education might be carried out through teachers, local staff of the Ministry of Health and extension workers of other ministries and programmes, which have a more or less permanent presence in the community. Special attention should be paid to women's organizations. The extension service of the rural water supply agency should promote and support and could co-ordinate the activities of the other ministries. Participation in local seminars and meetings of health-workers and teachers might be used to emphasize the importance of hygiene education and to present educational materials or methods. In co-operation with teachers lessons might be prepared for different level classes. Education methods may be developed with local staff of the Ministry of Health, based on the local situation concerning water related diseases and on local traditions. This might include the production of specific posters and leaflets.

The costs of such an extension service might be more in accordance with the agency's budget than the just mentioned strategy. The hygiene education programme will depend on the possibilities and the willingness of the involved organizations, therefore the rural water supply agency staff should have sufficient "power" and capacities to convince the other ministries' staff of its necessity.

## ***National co-ordination***

At national level the rural water supply agency should be responsible for:

- preparation and implementation of a national maintenance policy;
- definition of procedures, responsibilities, and authority of village water committees, local mechanics, and regional and national staff of the rural water supply agency;
- financial arrangements such as division of costs between community and government agencies, and between different sections of the agency, e.g. between regional and national level; foreign currency requirements for importation of pumps, spare parts, transport and tools;
- establishing ways of importation or manufacture of handpumps and spare parts as well as distribution systems; control of these systems and of the selling prices of spare parts;
- preparation and implementation of hygiene education programmes in consultation with the Ministry of Health, the Ministry of Education and eventually other ministries, including the preparation of training materials;
- training of agency staff, and co-ordination of training of local mechanics and village water committees;
- monitoring and evaluation.

These tasks do not require a large organization but just a few capable and experienced people, able to defend the interests of handpump-based water supplies in and outside the rural water supply agency.

## ***Monitoring***

Monitoring of the performance of the water points, their usage, the hygiene education, and the performance of the maintenance and repair organization aims to discover weak points in specific communities or in the system as a whole. Information must be collected about the water supply situation in villages, therefore visits are indispensable. These visits could be carried out by supervisors on light motorcycles, but regular visits to all villages will often be too expensive for water supply agencies. Alternative solutions for getting the required information are:

- Local health staff (or extension workers of other ministries), when visiting villages, collect information about the functioning and usage of the waterpoints. Preparation of a questionnaire by the rural water supply agency, in consultation with the health-staff, might facilitate the task and will result in more consistent information.
- The staff of the rural water supply agency might visit only selected villages, as a sample of the total area. These visits could be carried out by supervisors on motorcycles.

Simple monitoring systems should be developed for use by village water committee to provide basic information on water point performance.

The outcome of monitoring may lead to interventions at regional level in e.g. the spare parts distribution, the hygiene education or the training and refresher courses of the local mechanics. At village level it may lead to extra support to village water committees or to local mechanics.

## 5. *Technology and Service Level*

The choice of the most appropriate service level for each community and the corresponding technology are described in this chapter, as are the required materials and equipment to maintain the water supply.

### 5.1 **Appropriate service level**

The most appropriate service level of the water supply in a rural community should be jointly agreed between the users and the agency. It should be appropriate in a technical sense and should correspond to the community's willingness to pay. In the past however the last point received little if any attention, also because communities were often promised safe water free of charge.

To enable a community to decide about a service level, the agency should present several options with their advantages, disadvantages, implications and user costs. For village water supply in Africa options could include:

- an open well, with bucket and windlass;
- a well or borehole with a handpump;
- a piped scheme with diesel or electric pumping.

The main differences between the first and the second option can be summarized as follows:

<b>OPEN WELLS</b>	<b>HANDPUMPS</b>
for wells with a water level less than about 6 m, it takes less time to get a certain volume of water out	for wells with a water level deeper than about 6 m, it takes less time to get a certain volume of water out
more users can be served at the same time	just one user can be served
well water is rather often contaminated via surface	water is seldom contaminated when pumped, but might be contaminated before consumption by transport and storage
buckets and ropes will need rather frequent replacement	handpumps will need spare parts
all replacements can be carried out by villagers, without any special training	only VLOM-pumps can be repaired by villagers, and only after special training
there is no dependency from outside during operational phase	with present developments in pump design, dependency from outside will be further reduced, but certain dependencies will continue, e.g. spare parts

Some agencies do not consider an open well as an appropriate water supply as it cannot assure the bacteriological water quality. Sometimes communities do not consider the open well as a convenient solution, as the differences in relation to the traditional sources might be rather limited.

For the communities the differences between handpump supply and a piped scheme are the following:

<b>HANDPUMPS</b>	<b>PIPED SCHEMES (with motorized pumps)</b>
one well or borehole required for each pump, thus maximum of about 500 people served with 20 l/day	several public standposts can be linked to one (well or) borehole thus far more people can be served from one source, the maximum number depending on maximum yield of the borehole.
water cannot always be collected in the village	standposts can be placed at most suitable places in the village
water has to be collected at pump	yard taps and house-connections are possible
sometimes further transport of water, and thus greater possibility of pollution	sometimes shorter transport of water, and thus less possibility of pollution
human energy required for pumping	water is available by just opening the taps
construction costs and operational costs are lower	construction and operation and maintenance are more expensive
relatively simple technology	more complicated technology
no need of fuel or electricity, less need of spare parts, no qualified operators needed, thus more reliable system	fuel or electricity required, more different spares needed, trained operators needed, thus less reliable

The above mentioned differences for the three options should be clearly explained to the community by the agency. From experiences in similar villages an indication of users' costs of construction and of operation and maintenance can be given for different options. As indicated in 2.1., in the section on cost recovery, the government funds available are in principle more or less equal for the different options, thus the extra costs for a higher service level must be paid by the users themselves. This also holds true for the operational and the construction costs.

The requested community's in-kind contributions to the construction and maintenance work are also explained and discussed for the different options.

For areas where the groundwater level within a reasonable distance of the village is found deeper than about 15 - 20 meters, well digging is technically less appropriate and therefore an open well with a bucket and a windlass is not feasible. Although much more expensive, drilling of a borehole is required. These extra costs should be paid for by the agency, eventually with support from a donor organization, as it is not a free choice of the community. The "reasonable distance" depends on the felt need, and particularly on the presence of alternative sources. It should however not exceed 500 or 1000 meters, otherwise the daily fetched volume of water will be less than the for hygienic reasons minimally required 20 l/c/d.

If springs or other safe sources are found upstream of the village, a gravity scheme with standposts might be the most appropriate option for a village, as it combines the relatively high service level of piped supplies with low operational costs and high reliability.

### ***Cash-raising***

The cash-raising system itself may raise the users' costs. In "What Price Water?" (van Wijk-Sijbesma, 1987) and "The Handbook of Financial Principles and Methods" (WHO, 1990) several methods for cash-raising are presented with their advantages and disadvantages for various circumstances. In annex 3 the options relevant for handpump schemes are presented. The feasible options for cash raising should be discussed with the community: The most appropriate way to raise the cash for covering operational and eventually construction costs should be determined together with the community.

### ***Willingness to pay***

Communities should have sufficient time to consider the choice between a higher service level with higher costs involved, and a cheaper system with a lower service level but often combined with higher reliability. The costs of the selected option should correspond to the willingness to pay of the majority of the community. Estimation of willingness to pay is not as simple as asking people how much they would pay. It is based on what they pay at the moment, or their perception of the value of the effort they presently make to collect water. Willingness to pay depends on the service level: for safe water collected and carried over a long distance it will probably be much lower than for safe water collected from a source close by.

The future users should be asked how much they are willing to pay for different technologies: for open wells, for handpumps, for standposts and, if relevant, also for yard taps and house connections. It was found, particularly in Asia, that people were disposed to pay much more than expected for water supplies with a considerably higher service level, like yard taps.

Briscoe and de Ferranti (1988) report about an area in northeast Thailand where people were not supporting construction and operation of handpumps nor standposts. After introduction of yard taps, with the users paying the full costs of connection, systems were functioning reliably, were well maintained and users' contributions were covering operation and maintenance costs, major repairs and some depreciation. Many systems were extended to previously unserved areas.

If, in the view of the users, the scheme does not properly address the needs felt by them, they are unlikely to contribute in cash or in kind to the costs of construction and operation. The reliability of the water source will play an important role: community members will not

see a new well as an important improvement if it has no water during the two months at the end of the dry season. The same holds for a frequently broken down handpump.

The perception of the taste of the water is also an important factor in the perception of the value of a waterpoint. In an area where fresh water is extremely scarce a well supplying water with a salt concentration above standard might be very welcome, whereas even water with a salt-concentration slightly below standard might be judged "too salty for drinking" in other areas. The bacteriological quality of water will only be an important factor in the perception of a waterpoint in communities with sufficient awareness of the relationship between water, hygiene and health.

Willingness to pay is more relevant than the ability to pay as it reflects the value which the consumers place on their water sources. Ability to pay is based only on the income of the community and its members and is therefore an outside judgement, based for instance on some percentage of income which could be spent on water supply and sanitation. Between 3-5% was often considered as a realistic figure, but Cairncross and Kinnear (1988) and others made clear that the willingness to pay of a community depends also on so many other factors that the ability to pay alone is not a useful data.

In a special WASH publication (1988) useful guidelines for conducting willingness to pay studies are given for different circumstances.

An interesting willingness to pay study has been carried out and published by WASH for the Newala district in southern Tanzania, an area where wells or boreholes with handpumps are technically not feasible. Due to the deep groundwater levels piped schemes with diesel driven pumps had to be applied (WASH, 1989). Some results:

- 58% of the interviewed people preferred to pay by bucket (water vending) whereas 42% preferred a regular monthly charge.
- interviewed people able to read newspapers were willing to pay on average 10% more than people not reading newspapers
- interviewed women were willing to pay on average 7% more than men.

In bigger communities like district centres, the possibilities of a combination of different service levels might be considered. Shopkeepers and similar community members might prefer piped schemes with yard taps or even house connections and might be willing to pay a good price for that, whereas for the main part of the community this might be far too expensive. A mixed piped scheme with house connections, yard taps and standposts might be the solution. In other cases this might be still too expensive for many of the villagers preferring open wells or wells with handpumps. In these cases the contributions to operation and maintenance costs of a small piped scheme will be extremely high for the shopkeepers, although they still might be willing to pay for it. The same holds true for their contribution to construction costs.

For small communities a combination of options will not be practical and it will be more suitable to wait with a higher service level till the economic position of the community makes the costs affordable. For many smaller villages in Africa the handpump option will be the highest suitable service level for the time being.

Selecting the most appropriate service level is crucial for the sustainability of a village water supply:

- if the costs of a service level exceed the willingness to pay of the community, maintenance and repairs are not assured;
- if the service level of the water supply is too low according to the opinion of the community, it will not be appreciated and therefore the community's willingness to keep it operational will be small. (also the health impact might be less than it could be with a higher service level).

Giving each community the possibility to choose between different service levels, corresponding partly to different technologies, implies that a rural water supply programme based on just one technology, e.g. a handpump project, is not recommendable.

## 5.2 Appropriate technology

If handpumps are selected as the most appropriate service level for the present socio-economic situation of a community, the corresponding most appropriate technology has to be determined: the most appropriate type of water source and the most appropriate type of handpump.

### *Water source*

Handpumps can be installed on dug wells and on boreholes. Boreholes are far more expensive and require more scarce resources, thus are constructed only when hand-dug wells are not feasible. This is the case when groundwater is only found deeper than 15 - 20 m. Dug wells have the advantage that they can be opened to fetch water with a bucket and a rope when the pump is out of order. It must be kept in mind that this might easily lead to contamination of the well.

Hand-drilled boreholes might substitute hand-dug wells; they also have a maximum depth of about 20 m. They are often cheaper than hand-dug wells and do not need special inputs. They have no storage like a dug well, so they can be applied only in aquifers with sufficient permeability, e.g. in sand.

Special cylindrical buckets with a valve in the bottom, "bucket-pumps", have been designed to fetch water from a borehole in cases where handpumps are considered too sophisticated. In Mozambique and Guinea-Bissau they did not appear to be very popular with the users: supplying only small volumes of water (particularly for deeper boreholes), frequent falling of the bucket in the borehole and intrusion of fine sand by the suction caused by the cylinder in the borehole, were the main complaints. In Zimbabwe, where they are used in smaller communities of just one or a few households, their performance seems to be better.

The required number of waterpoints can be determined from the daily required volume of water and the yield of the wells, boreholes and handpumps. For dispersed settlements the maximum walking distance from a house to a waterpoint might be exceeded and additional waterpoints will be required.

In comparison to piped schemes, for point supplies future growth in demand has to be provided for only in a limited extent. Construction costs of additional wells in the future will not be much more than they are now, therefore population growth and rising of future consumption might be considered for only the first few years. However, for borehole drilling the costs of transport of the equipment might be a very considerable share of the total construction costs. In these cases it will often be advantageous to drill an extra borehole immediately, equipped or not.

## *Handpumps*

From the sustainability point of view, VLOM-type handpumps are the most appropriate. They are designed to be repaired with only a few simple tools and do not require any special technical skills. Therefore they can be repaired by village mechanics after just a short training and do not need interventions from area mechanics or repair teams. Several VLOM-pumps with a good performance are available as "direct-action" pumps, suitable for depths to 15 - 20 meters. For deeper water levels VLOM-pumps are also available; for these pumps the piston and foot-valve should be replaceable through the rising main, thus without removing the rising main. It still seems to be difficult to find a good solution for an easy removal and reinstallation of the connecting-rods. A screwthread connection requires a certain handiness with spanners, therefore hook-connections would be preferable.

Many handpumps, particularly the ones installed in boreholes, are still not VLOM; for their repairs more complete tool sets and hoisting equipment are needed. Other pumps require a level of technical skills for their repair, that cannot be achieved in each village. For these pumps area mechanics or even well equipped repair teams are required.

An area mechanic has to travel to his 10 - 30 villages; a bicycle seems to be often the most appropriate transport. In several countries the area mechanics receive their first bicycle free from the government or a donor organization, in others they receive a credit for it. Although bicycle transport is low-cost in relation to cars, the repair costs (mainly spare parts) and the depreciation are rather an important share of the costs of the functioning of an area mechanic (see also the cases of Guinea-Bissau and Mozambique, annexes 1 and 2).

In Sahel countries the area mechanic normally does not receive any support for his transport. An evaluation in the Tillabery district in Niger (Metral, 1988) revealed the following use of transport by local mechanics:

walking	- 68% of the repairs
a bicycle or a motorcycle	- 17% of the repairs
a horse or a camel	- 10% of the repairs
a taxi	- 5% of the repairs.

Particularly for pumps with installation depths of 30 - 40 meters or more, interventions by a regional team with a vehicle might be required. The dependence on a vehicle makes this type of intervention expensive and less reliable. Handpumps requiring these interventions should be avoided, although for deeper water levels this will not always be possible. In regions where such pumps already exist, for standardization purposes it might be advantageous to continue with them for the time being.

A system with only village mechanics has considerable advantages in relation to a system including area mechanics:

- village mechanics are always nearby and therefore can carry out a repair within a few hours;
- village mechanics are not dependent on any transport, thus reducing considerably the costs of a handpump repair and eliminating a potential constraint caused by broken down vehicles or bicycles;
- village mechanics do not require any payment, therefore the cash to be raised in a community for the waterpoints will be considerably less;
- women might function well as village mechanics.



From the above advantages it can be concluded that a system with village mechanics is preferable. As village mechanics can only repair VLOM pumps, the selection of the type of handpump is very important. Needless to say village mechanics are also capable of substituting components of a bucket - chain - windlass system.

The prices of pump spares have an important influence on the costs of repairs. There are considerable differences for different pump types. Moulded plastic parts are cheap in relation to metal parts, which often have to be machined several times. The parts of the more recently developed types of pumps, like the direct-action pumps, are in general cheaper than the parts of older pump types.

An analysis of 3.5 years of data for several pump types in Guinea-Bissau revealed considerable differences in average annual costs of spare parts (DGRH/SNV, 1990):

<i>Pump type</i>	<i>average annual number of repairs</i>	<i>average annual costs of spare parts (US\$)</i>
India Mark II	1.2	67
Hydrovergnat	0.9	61
Buba pump	0.9	34
Open well with bucket	0.9	29
Kardia	0.7	28
Wavin *	1.1	13

\* The Wavin pump is a direct-action pump; its data only refer to rather new pumps, and over a period of less than 3 years.

This again emphasizes the importance of the selection of an appropriate pump type. The average annual costs of the components of an open well with a bucket - rope - pulley system are even higher in Guinea-Bissau than the average annual costs of the spare parts of some pumps.

The choice of a handpump type should not be made just for one community nor for one project: standardization - at least at regional level - of handpump makes and types is also very important. The type of handpump should be indicated in the rural water supply policy and changes should be made at national level only after careful consideration.

### **5.3 Materials and equipment**

For the agreed service level and technology choice there should be adequate resources, jointly provided by the agency and the community, to cover all the required inputs in planning, construction and operational phases. For the construction phase a donor organization might provide an important share of the equipment and materials.

Timely availability is the most important characteristic of this element. The availability of material and equipment during the construction phase should be relatively well assured. From the point of view of sustainability the operational phase is more important: particularly the availability of handpump spare parts is crucial. Also availability of cement for concrete repairs, handpumps for replacement, tools for local mechanics and agency staff, and spare parts for transport are essential.

## *Distribution of handpump spare parts*

To assure quick repair of handpumps, spare parts should be readily available at a short distance from the village. When the system of village mechanics is applied the latter is even more important than with area mechanics. Particularly with village mechanics it will be useful to have a stock of frequently required pump parts in the village. It is essential that the distribution point always has all the parts in stock.

Since a few years ago an increasing number of countries have introduced payment by the community for the replaced pump parts, thus also enabling distribution by commercial circuits. Traditionally in many countries the government agency was in charge of spare parts importation and distribution, often involving high costs of transport and overhead. Pumps and parts were often imported by donor-funded projects. In the scope of present policy these tasks are transferred to private or public enterprises. A UNDP/World Bank evaluation of seven projects in West-African countries revealed that all projects had changed or were changing to distribution through private local stores (GREA, 1990).

Importation and distribution might be done entirely on a commercial basis, but as a temporary solution the government agency might determine what has to be imported, involving a specialized trade enterprise in the actual importation process.

Using only one type of pump (or two types with partly the same parts) will reduce the quantity of different parts needed and thus will facilitate importation and distribution of spare parts. Complete dependency on just one supplier, however, might lead to higher prices and unfavourable terms of delivery. In some countries in the Sahel-region, handpump suppliers have already created their own distribution channel for spare parts, through commercial agents. The following options for distribution of handpump parts might be considered: (different systems may exist parallel in a region)

- **Selling by local private stores.** Rural populations visit local stores, normally in larger villages or district centres, with a certain frequency for purchasing agriculture implements and consumer goods, or for selling agriculture products. The stores will have their own system of provisioning which also can be used for spare parts. If necessary the agency may take care of the supply of the parts to the stores temporarily.

The main advantages of the system are that the spare parts are available in places relatively frequently visited by villagers, that the stores have their system of provisioning and that the continuity is reasonably assured. There are many different parts that must be kept in stock, often for two or more different pump types; ordering and administration for the many different parts can be relatively complicated and the frequency of selling them will be very low in relation to consumer goods. Therefore selling of pump spare parts might not be very lucrative for local stores, and spare parts may be expensive. This problem was reported e.g. from Niger, the Tillabery district (Metral, 1988).

It is an important government task to define the prices of the spare parts in consultation with the shopkeepers, or at least to control the prices. The spare parts should not be so expensive that communities will face serious difficulties purchasing them. In that case pumps will not be repaired for shorter or longer periods.

- **Selling by special stores of the Ministry for Rural Development, co-operative village stores and the like.** The advantages of such a distribution system are mainly the same as for selling by private local stores, although the guarantee for continuity might be less in certain cases. These stores are more oriented to selling agriculture

implements and thus will have fewer problems with the relative complexity of selling many different spare parts for different handpumps. They however do not exist in many countries and in other countries their functioning is rather poor.

- **Distribution by the agency.** When community payment for spare parts has not yet been introduced, this system will be the most suitable solution. The main advantage of such a system in relation to the above mentioned options would be that people with technical knowledge of handpumps would be involved. Disadvantages are the poor performance and high costs of running government agency selling-points (simple shops). This also holds true for the provisioning of the shops, the administrative procedures, the required regional storage, etc.

### ***Replacement of handpumps, local manufacture***

With the years the replacement of worn-out handpumps will become more important. The life of handpumps differs considerably for the various makes and types, and of course depends also on the maintenance and the way a pump is used. A life of 10 years means that annually 10% of the pumps have to be replaced. For a population of e.g. 500,000 people with 2000 handpumps, 200 handpumps have to be replaced annually. Payment by the government agency will be difficult in many countries as it will compete with construction in villages that have not received anything so far.

From the users' contributions savings might be made for the payment of these replacements, but in many countries at this stage it will be difficult enough to cover the costs of spare parts and local mechanics. A high inflation rate may make it impractical to create a fund for purchasing new pumps.

An extra constraint may be that foreign currency is required. As its availability is always limited, requirements should be reduced, particularly for the operational phase. Local manufacture of pumps and spares will considerably reduce the foreign exchange requirements of the water sector, as is illustrated in the cases of Guinea-Bissau and Mozambique. But when raw materials, tools and equipment must be imported, the net savings for the country might be limited. The economic feasibility for the local industry's manufacture of handpumps and spare parts depends on the size of the market on one side and on the necessary investments on the other. For example, plastic moulded parts are produced cheaply and very fast once the moulds are available. The moulding equipment will not be fully occupied with only pump spare parts and also other marketable products must be produced to justify the investment. For most handpumps local production of pumps or parts is only possible with authorization of the manufacturer. For pumps not commercially developed, like the India Mark II and the Afridev, these problems do not exist. The Afridev was designed to be manufactured with limited skills and equipment. The quality of locally produced pumps and spares must be assured; if not, maintenance and repair costs will increase disproportionately. Long term commitment by a donor organization might assure importation of pumps and spare parts. Arrangements should be made in time and it should be realized that it is not a permanent solution.

### ***Cement***

Every 2 - 5 years cracks in the concrete slab around the well should be repaired, otherwise more extensive and more costly repairs will be necessary. Besides, a cracked apron is not conducive to cleaning. When cement is locally available and there are masons, the communities might repair their own slab. As this is not essential to get water from the waterpoint, the community might be less interested to do so. Therefore in health education

attention should be paid to this aspect. Also area mechanics might be trained for these repairs if cement is locally available.

### ***Tools and transport***

Bicycles, bicycle spare parts and the standard tools for local mechanics are now generally available. About 5-6 years ago they were scarce or impossible to purchase in the rural areas of many African countries; donor funded imports were necessary to assure this availability. Now the materials are sold in local stores but at prices often difficult to afford for rural populations. In many cases the same holds true for cement, fuel, lubricants, etc..

Replacement of motorcycles and cars used by the agency might require donor funding for shortage of foreign currency or for general shortage of funds.

### ***Equipment, transport and tools for the construction phase***

Equipment (e.g. drilling rigs, compressors, dewatering pumps, concrete mixers), vehicles and tools used in the construction phase are generally the main share of the costs of a handpump-based rural water supply project. They are often funded by a donor organization. For the long-term functioning of the waterpoints they are less important.

## 6. Resources Coverage

Each element of sustainability has corresponding responsibilities and costs. Therefore resources have to be provided in a timely way by the development authorities (government agency and possibly a donor agency) or the community. A broad range of resources is necessary including cash, skills, labour, time and equipment and materials:

**Cash:** Funds required for purchase of materials, spare parts, fuel and equipment, payment of salaries, etc..

**Skills:** Involvement demanded for work that requires a certain training.

**Labour:** Involvement demanded for work that does not require any special training.

**Time:** Time passively spent, not involving labour or skills.

**Equipment and materials:** Goods required, including handpumps, cement, fuel, spare parts, stationery, etc; but also tools, equipment, vehicles, and the like.

The level of resources required and the corresponding responsibilities will vary from one activity to another and will be determined by the phase of the project cycle.

Some examples of required resources:

	<i>Community:</i>	<i>Agency:</i>
<b>Cash</b>	Village Water Committee purchases spare parts for handpumps Village Water Committee pays area handpump mechanic	Agency purchases cement for well construction Agency pays extension workers' salary Agency replaces tires of installation team's vehicle
<b>Skills</b>	Village handpump mechanic repairs pump Village Water Committee's bookkeeper registers users' contribution Village Water Committee's president organizes meeting	Installation team installs new handpump Mason makes slab around new well Extension worker organizes nomination of Village Water Committee
<b>Labour</b>	Handpump caretaker cleans well surroundings Community members participate in well construction	Assistant helps mason with making slab around well
<b>Time</b>	Community attends meeting about nomination Village Water Committee Community attends lessons in hygiene education	
<b>Equipment and materials</b>	Village Water Committee purchases spares for handpumps Village Water Committee purchases cement for slab-repair	Agency purchases cement for well construction Agency purchases tools for area mechanic Agency purchases fuel for handpump installation team Donor agency provides new vehicle for handpump installation team

**Schedule A : Resources required for different rural water supply technologies**

	Construction phase		Operational phase	
	<i>A g e n c y</i>	<i>C o m m u n i t y</i>	<i>A g e n c y</i>	<i>C o m m u n i t y</i>
Open Well:	l s X ee m c	tt L vv mm c	s x e m c	t l v - c
Open Well + Bucket:	l s X ee m c	tt L vv mm c	s X e m c	t l v h c
Dug Well + Handpump:	l s X ee m cc	tt L vv mm cc	ss X ee mm cc	t l v hh cc
Hand Drilled Well + Handpump:	l ss x e mm c	t ll v m c	ss X ee mm cc	t l v hh cc
Deep Borehole + Handpump:	L S X E mm C	t l v m cc	ss X ee mm cc	t l v hh cc
Deep Borehole + Windmill + Storage Tank + Taps:	LI Ss X Ee M Cc	tt L vv mm C	S Xx ee M C	T ll V H C
Deep Borehole + Solar System + Storage Tank + Taps:	LI Ss X EE M CC	tt L vv mm CC	SS Xx E M C	T ll V hh C
Gravity Scheme With Standposts:	l S Xx ee M C	T LL V mm C	ss Xx ee mm cc	tt L V hh cc
Borehole With Electric Pump + Stand Posts:	LI Ss XX EE Mm Cc	T LI Vv mm Cc	Ss XX E mm C	T ll VV hh Cc
Borehole With Diesel Pump + Standposts:	LI SS XX EE Mm CC	T LI Vv mm Cc	SS XX Ee M C	T ll VV HH Cc
Borehole With Electric Pump + Standposts + Yardtaps + Houseconnections:	LL Ss XX EE MM CC	T LI VV mm CC	Ss XX E M C	T ll VV Hh CC

T = Time

L = Labour

S = Skills, technical

X = Skills, extension service

E = Equipment

M = Materials

C = Cash

V = Skills, village water committee

H = Skills, village mechanic

More labour required from I to ll, L, LI and LL, similarly for the other resources.

Note: Community cash contribution in construction phase to be decided.

It is important that all necessary responsibilities and resources are identified, quantified, allocated, shared and agreed by all parties. This process, called "resources coverage" can only be carried out effectively in an atmosphere of confidence and trust between the agency and the community. It requires a partnership approach.

The following scheme gives examples of the resources required for different rural water supply technologies.

In annexes 1 and 2 the organizational set-ups are given for the operational phase of handpump-based rural water supply based on situations of Guinea-Bissau and Mozambique respectively, with the resources required and their providers.

Schedule B gives possible cost elements of handpump-based rural water supply.

### Schedule B Cost elements of handpump-based rural water supply scheme

COST ELEMENTS	SPECIFICATIONS	WHO PAYS?
<i>Planning phase:</i>		
<i>Staff/labour</i>	extension workers, sociologist, technicians, engineer	agency
	participation in meetings, collecting information	community
<i>Equipment</i>	vehicles, survey equipment, community education equipment	(donor) agency
<i>Operational costs of equipment</i>	fuel, lubricants, spare parts (incl. tires, batteries), insurance, drivers, operators	agency
<i>Materials</i>	education materials	(donor) agency
<i>Overhead</i>	office, management: staff, labour, equipment, materials	(donor) agency
<i>Construction phase: (well digging)</i>		
<i>Staff/labour</i>	well diggers, masons, handpump installation team, extension workers, sociologist, technicians, engineer	agency
	support to well digging	community
<i>Equipment</i>	truck/tractor, vehicle, concrete mixer, dewatering pumps, tripods, tools	(donor) agency
<i>Operational costs of equipment</i>	fuel, lubricants, spare parts (incl. tires, batteries), insurance, drivers, operators	agency
<i>Materials</i>	cement, reinforcement steel, education materials, handpumps	(donor) agency
	gravel, sand	community
<i>Overhead</i>	stores, workshops, office, management: staff, labour, equipment, materials	(donor) agency

***Operational phase:***

<b><i>Staff/labour:</i></b>	handpump installation and repair team, technicians, extension workers, sociologists, engineer	agency
	area mechanics/village mechanics	community
<b><i>Equipment</i></b>	vehicle, tools for installation/repair team bicycle and tools for area mechanic tools for village mechanic	(donor) agency community (+ agency) community
<b><i>Operational costs of equipment</i></b>	vehicle: fuel, lubricants, spare parts (incl. tires, batteries), insurance, driver	(donor) agency
	bicycle: spare parts, including tires	community
<b><i>Materials</i></b>	handpump spare parts, cement	community
	handpumps (for replacement)	community? (donor) agency?
<b><i>Overhead</i></b>	stores, workshops, office, management: staff, labour, equipment, materials agency (small in relation to construction phase)	

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## 7. *Project Planning*

In Chapters 2 to 5 the key elements of a sustainable handpump-based rural water supply programme have been described. The key method by which sustainability is achieved, is through the partnership between the agency (the government agency with possibly a donor agency) and the user community. This partnership approach plays an important role in the planning of rural water supply activities.

This chapter aims to provide a practical guide for preparing a handpump-based rural water supply project, with particular attention to sustainability issues. A handpump-based project is seldom implemented in just one community; normally several (or all) villages in a certain region are served by a particular project. Ideally the present situation and the preferred improvement should be known for all of these villages before the preparation of the project document, but generally the number of villages is such that information can be collected for only a few selected villages during project preparation. For the other villages the information is not collected until project implementation. The project document should therefore be sufficiently flexible to enable the most appropriate water supply to be defined and constructed for each village. A pilot project might be realized in a limited area, aiming to use the obtained experiences in the elaboration of the project proposal for the entire area.

Collecting information on similar projects in other areas of the country might give useful information such as problems or successes with applied participation strategy or cost recovery mechanisms.

### 7.1 **The water sector**

To justify the project, the following background information about the water sector is important and should be collected:

- occurrence of water related diseases in the country, possible regional differences;
- present and planned coverage levels for each region;
- priority areas for investments in the sector, both geographically and at the subsector level ;
- similar activities in other regions, if possible with achieved results.

Information on the water sector determining the scope of the project should be available or be collected:

- the institutional framework: government structures at national and regional level, their tasks and competencies; the executing agency;
- availability of trained staff, of equipment and materials and of funding, in local and foreign currency;
- policy on cost recovery, for construction activities as well as for the operational phase;
- standards on water quality, on number of users for each waterpoint and on maximum acceptable walking distance to a waterpoint;
- technical criteria such as for siting and construction of wells and boreholes;

- standardization of equipment and materials, particularly equipment and materials to be installed and requiring maintenance, like handpumps, but also for makes of trucks, vehicles and equipment.

A document about rural water supply policy, e.g. as a component of a national water development plan, will contain all or almost all above mentioned information. If a recent version of such a document is not available, the information has to be collected in another way from the ministry in charge.

## **7.2 The project area**

Some basic information about the project area is required as a background for planning a rural water supply project:

- demographics: population, socio-cultural aspects, socio-economic situation, health aspects;
- physical conditions: climate, geography, geohydrology.

The demographics will enable a first estimate of the number of needed waterpoints, the possible management institutions, the level of users contributions and whether water will be used for productive purposes. The information about the physical conditions of the area should allow a first impression of possible technologies. The provincial (regional/district) branch of the Ministry of Planning should be able to provide this information.

Co-ordination of planning between a rural water supply project and other organizations active in rural development in the same geographical area may ease the implementation of the project and particularly will raise its impact. Co-ordinating the development activities of the various sectors is in general the responsibility of the provincial branch of the Ministry of Planning.

The following development plans and projects (both national and donor) should be reviewed:

- priority areas for rural development as indicated by the planning agency;
- health care initiatives and their implications for rural water supply planning;
- initiatives in the education sector and their implications for rural water supply planning;
- agricultural extension plans, particularly related to livestock.

In the elaboration of the project document these plans should be taken into consideration, and the project should as much as possible complement these activities.

## **7.3 The water supply situation in the project area**

Some representative villages have to be chosen according to present water supply, geohydrological conditions and population to get information about the water supply situation in the included villages.

The information should include:

- the existing water supply situation: the percentage of users covered with good supplies, the type of water sources, the accessibility, the costs made for water supply, experiences with handpumps, whether improvement of the water supply is a felt need;

- the occurrence of water related diseases, the awareness of the relationship water - hygiene - health;
- the productive usage of water, (livestock, beer brewing, etc.);
- the users needs and expectations: service level (quantity and quality, accessibility), willingness to pay, water required for productive purposes;
- the possible options for improvement of the water supply, including technology, management and cost recovery aspects.

In section 8.2 the information required for deciding at community level about the most appropriate water supply is described more in detail. This list might in this stage be used in the selected villages. The information should be collected with the communities, as indicated also in section 8.2.

## **7.4 Project proposal**

With the collected information it should be possible now to elaborate the project proposal, including:

- background information;
- the purpose of the project;
- the service levels to be provided and technologies to be applied, strategies and methods of awareness campaigns and hygiene education;
- the institutional framework for implementation of the construction phase: contractors or government agency, planning and control of the work, eventual need for strengthening the involved institutions;
- co-ordination with other sectors;
- the possible community management institutions and cash-raising systems;
- the possible support services for the operational phase, possible need for strengthening the involved institutions;
- the budgets of the planning and construction phase and of the operational phase, for the government agency and possible donor agency; the users contributions in kind and cash for both phases;
- arrangements for monitoring and evaluation.

Particular attention might be paid to aspects like training and womens' involvement.

If a donor agency is involved in funding the project, it might have special requirements for the project document. The division of responsibilities and competencies between the government agency and the donor agency should be well defined.

In a partnership approach between communities and agencies the most appropriate service levels, technologies, management structures and cash-raising systems should be defined for each village during the implementation phase; the project proposal should be flexible enough to allow this. It means also that projects involving exclusively one technology should be avoided, e.g. projects aiming to improve the water supply situation in a region by installing handpumps, excluding other technologies. Such projects should have complementary projects or activities, allowing improvement of the water supply situation by means of other technologies in villages where this is preferred and affordable.

## 8. *Project Implementation at Community Level*

This chapter deals with the implementation of a handpump-based rural water supply project at community level. In a sequential order, following the planning and construction process, various steps to achieve a sustainable water supply are described. The community in mind is a typical rural village in Africa without safe water sources, and for which handpumps can be considered as the most appropriate improved water supply.

During the whole process the partnership approach determines the relation between the agency and the community. The community should have a sense of ownership of the water supply project. Consultation should be a continuous process to ensure that it produces acceptable and workable solutions. Sufficient time should be available for mutual consultation and for the community to come to a decision, for which a favourable, supportive attitude of agency staff is essential.

The consultation should be carried out through an appropriate community institution. This may be a village water committee but in many cases this will not yet exist in an early stage. The important requirement is that the views and needs of all consumers and special groups are fully represented. Since in many cases women are responsible for water collection and are often more actively interested in the issue, it is essential that women are adequately represented in the decision making process.

### **8.1 Introductory meeting**

The introductory meeting should be a meeting with the entire community. In this meeting the project can be introduced by project staff: project extension workers perhaps with technical staff. But it might be more effective to let people already well known by the community introduce the project, like local health workers, extension workers of rural development programmes or staff of the local government.

This first meeting aims to discuss with the community the project's objectives and methods and to inform the agency about the community's needs and expectations. The possible benefits of an improved water supply for the community and its members are explained: the walking distance may be reduced resulting in time-savings, the new water supply may be more reliable and will supply more water, it might be possible to use it for productive purposes; and the safe water supply will contribute to an improvement of the health situation of the community.

The cost recovery policy is explained and discussed for the construction phase and for the operational phase.

Village leaders and other community members will be asked about their opinions on the existing water supply situation and their feelings about an improvement, as well as about their expectations about an improved water supply. If it becomes clear that improving the water supply situation is a priority issue in the community - a felt need - the main options for improving the water supply situation can be discussed with the community.

If the community is not very interested at this stage, the agency can try to increase the community's motivation as mentioned in 3.2. This process may take several meetings and may include house to house visits. The community members should have sufficient time to think about the issue and to discuss it between them.

If a community appears to be not at all interested, the reasons should be analyzed. If only certain formal or informal leaders are not interested, it might be possible to convince them. If an entire community is not interested, for instance because of a quite reasonable existing water supply situation or because of much more urgent problems, it will be better to wait until improvement of the water supply situation has become a felt need.

The most likely technical options should be covered in an introductory fashion, explaining the benefits and the financial and other consequences of the different service levels. Discussions about the users costs may result in the community's conclusion in an early stage that piped schemes will be beyond their financial possibilities.

The benefits of additional facilities like bathing and washing facilities should be explained, as well as an indication of their costs and thus extra user charges.

Possible options for community management institutions and for cash-raising systems are also presented and discussed in a general way. During and after a geohydrological and a socio-economic survey of the village, more elaborated proposals will be presented to and discussed with the community.

At the end of this stage the following situation should have been reached (if not, the process should be stopped or certain activities must be repeated):

- Community and agency consider improvement of the community's water supply situation as an important issue, there is commitment from both sides to continue the process.
- The community has been informed about possible technical, managerial and cash-raising options, their benefits and their implications e.g. in terms of costs, in-kind contributions during construction and operational phases, dependency on external factors, etc. With this information community members and the community as a whole can think about their most appropriate water supply.
- The agency has received preliminary information about the community's expectations of an improved water supply and will consider this in the preparation of more elaborated proposals, to be discussed later on in the consultation process.

## **8.2 Collecting information and determination of the preferred options**

Socio-economic and geohydrological information about the village should be collected together with the community. It should form the basis for the technical, management and cash-raising options to be discussed between the community and the agency, aiming to select the preferred options in a partnership approach.

### ***Socio-economic information***

The socio-economic information should allow:

- estimation of the daily required volume of water, for domestic use and for productive purposes;
- identification of possible management systems;
- estimation of the willingness to pay of the community;
- addition of some specific elements to the awareness campaign and hygiene education programme, if necessary.

Schedule C gives a list of the socio-economic information that will be needed for the improvement of the water supply situation in a village.

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## **Schedule C      Information concerning the community to be served**

General data about the community:

- \* number of households and number of inhabitants
- \* presence of schools, healthposts and other similar infrastructures
- \* distribution pattern of houses, distances between houses
- \* communal funds of production co-operatives and the like, but also religious and other funds
- \* community institutions
- \* cost recovery for other programmes in the same community

Information to be collected on house-to-house visits:

- \* sources of present supply and reasons why they are used, if relevant why they are used for specific purposes; opinions about present water quality and quantity and the reliability of water sources
- \* opinions about present distance to water sources, in wet and particularly in dry season, and about ease of collection
- \* present cash expenditures on water supply (also for buckets, ropes, etc) and which and whose funds (e.g. men's or women's) are used for payment
- \* productive uses like livestock use, beer brewing, vegetable growing, etc.; estimated future use
- \* willingness to pay for one but preferable for two or three technologies (open wells, handpumps, piped schemes with standposts and eventually with yard taps and house connections)
- \* availability and use of latrines or other sanitation facilities

Information about the population, often not specific for a certain village, but, if possible, to be checked in house-to-house visits:

- \* average size of the household, number of adults, number of children
- \* projected population growth
- \* traditions related to use of water sources and to use of water, e.g. concerning transport and storage of water
- \* awareness within the community of hygiene related to water use and sanitation
- \* special local health issues and awareness within the community of these local health issues, possible impact of improved water supply on these issues
- \* socio-cultural information like about traditional and informal leadership, division of tasks and responsibilities between women and men; the relation of traditional to actual leadership
- \* socio-cultural information about traditional payment systems within the community

- \* literacy rates and the availability within the community of skills which would enhance project participation
  - \* average number of wage-earners per household
  - \* average and lowest household cash income
  - \* average household cash expenditure on food, clothes, health, education and other necessities, and these expenditures for lowest income households
- 

A part of this information may already be available from community records or from local-government records. Certain information may be collected from village health workers, teachers, (religious) leaders and the like. Not all the information has to be collected individually for each community: certain information will be relevant for an area or for a population group. More specific information and opinions can be collected by house-to-house visits, particularly about households and their present water use. This method enables special attention to be given to women as providers of information and to their opinions. It also permits a check whether general information about the area and its population is also valid for this specific community. It is important to notice the differences and exceptions. On the house-to-house visits attention can be paid to the relation water - hygiene - health, to increase the awareness of women and in general of the village population.

Any development plan for related sectors like health, education or agriculture which involve the community, should be reviewed to ensure that the rural water supply programme will complement it as much as possible.

### ***Geohydrological information***

The geohydrological information should allow the identification of the technically feasible options as well as the resources required for construction and operation and maintenance. The information to be considered in this stage is indicated in annex 4. It includes information on:

- occurrence, yield and chemical and bacteriological quality of springs;
- occurrence, depth and chemical quality of groundwater;
- occurrence and chemical and bacteriological quality of surface water;
- wind velocity and solar radiation, if appropriate.

The final siting of wells and boreholes can be done later on when they have resulted to be the preferred option.

Often the technically feasible options for a village can be determined with a relatively simple survey, making use of:

- data about the existing water sources:
  - \* measurements of water quality, yield of springs, depth and water level of existing wells;
  - \* information from users about reliability and changes in water quality of existing sources (see also schedule C);
- experiences gained in similar villages in the same area;
- topographical and geological maps, aerial photographs;
- information collected from the community on possible new water sources.

The local availability of construction materials like gravel, stones, bricks and sand should also be verified at this stage.

### *Selection of preferred options*

Based on the collected information, at this stage the agency prepares some realistic proposals for alternative options, with the provided service levels, benefits, and required resources in construction and operational phases (users share, agency's share and eventually a donor-organizations share) in terms of labour, skills, time, cash and equipment and materials. The agency presents these proposals in a form which enables the community and the agency to select jointly the preferred technical, management and cash-raising options. The preferred siting of the waterpoints should also be discussed and agreed upon.

For the preferred technical option the community's share of the costs during the operational phase and eventually also of the construction phase, can be compared to their willingness to pay, which might be different for the various options. Furthermore, different groups of users may prefer different solutions and might be willing to pay different levels of contributions. In larger villages a combination of options might be considered, while for smaller villages just one option has to be determined. It should be assured that the new water supply can be used by all community members. If some cannot afford the users contribution, special solutions must be arranged.

If there is no option for which the community's willingness to pay corresponds to the users costs:

- Programmes as mentioned in 3.2 might be organized to increase the willingness to pay. In a poor community where households have nothing extra to spend, this will make no sense.
- Subsidies may be asked e.g. from donor agencies. This might be a good solution if funds for the construction phase are lacking, for the operational phase it is a dangerous solution, as long term functioning will not be assured. Subsidies from nearby enterprises or richer villagers might better assure continuity.
- The minimum improvement is carried out with government funds.

At the end of this stage the preferred options - technical, management and cash-raising - should have been defined in consultation between the agency and the community. The preferred siting of the waterpoints should have been agreed upon. On the part of the community there should be an appreciation of the convenience, health and other benefits, and of the cost implications. The community should still have the possibility to decide whether they judge the benefits sufficient in relation to their expected efforts and contributions in cash and kind.

If the decision about project implementation is positive, a procedure should be agreed for further project implementation. The establishment of a management structure, e.g. a village water committee, is an important step now.

Before the final decision on implementation can be made, a detailed survey should be carried out to check if the preferred technical option can be realized at the preferred place.



### **8.3 Election and nomination of a village water committee**

In 8.2 the most appropriate management structure for the new waterpoints was defined. Often this will be a village water committee, but other management institutions might be possible. The composition and election procedures were already defined as well. A strong community management structure is of vital importance for the sustainability of a handpump-based rural water supply, as mentioned in 4.1. At this stage the members of the committee should be elected. Participation of all community members should be assured; special attention may be required to assure women's participation.

### **8.4 Final survey**

In a final survey the preferred sites for the waterpoints are checked: whether wells or boreholes constructed there will supply sufficient water, also at the end of the dry season, and whether the chemical quality of the water will be acceptable. National standards may exist for quantity and quality as mentioned in 2.1. The final checks will reduce construction costs, as no "failures" will be constructed anymore. Only in areas where the geohydrological situation is well known and very favourable, might the siting surveys not be justified.

For dug wells and hand-drilled boreholes the most appropriate survey is hand drilling with light survey equipment. Such a drilling gives rather accurate information on the occurrence of possible aquifers (sand mainly, or other material with sufficient permeability) and on the groundwater level. The thickness of the aquifer can also be determined, taking in consideration seasonal water level fluctuations. Knowledge of these fluctuations is essential but difficult, particularly when starting in an area. Information provided by the community, as on existing wells, will be very helpful. The drilling also allows a simple capacity test and a check of the electrical conductivity and, if necessary, other characteristics of the chemical water quality. Detailed information about this type of survey is given in "Shallow Wells" (DHV, 1979) and in "Hand-drilled Wells" (Blankwaardt, 1984).

The costs and the accuracy of this type of survey are such that geophysical surveys generally cannot compete with it. The equipment used is very simple and sturdy, and the surveyors do not require technical skills and can be easily trained.

For deeper boreholes geophysical surveys are the most appropriate. It is a specialized job, requiring skilled operators for the measurements on the sides and skilled staff for the interpretations, involving computers.

If from the survey it appears that a preferred site is not feasible, an alternative site has to be selected and checked together with the community.

### **8.5 Decision on project implementation**

If this stage of the consultation is complete, there should be an agreement on the project to be undertaken, its technical characteristics, the siting of the waterpoints and the responsibilities of community, government and an eventual donor-organization in supplying inputs to the construction and operational phases.

The allocation of responsibilities should be agreed upon, and formally set down in a written document. If appropriate, this can take the form of a contract between the community and the government agency. It is essential that there is no misunderstanding of respective responsibilities at this stage.

## **8.6 Construction**

As mentioned in 4.1 the construction of wells and boreholes and the installation of handpumps can be carried out by private or state owned enterprises. The main tasks of the government agency will be to prepare and control the work. Contracts should be signed to define the procedures and payment terms. Community participation in the construction work should be assured, also when this is carried out by contractors, unless in consultation with the community another arrangement has been agreed upon.

Shallow wells and boreholes should be constructed according to standardized designs, which may be available as national standards. Depth and location of filters or screens should have resulted from the survey. They might be adapted according to the conditions found in the actual well digging or drilling, but particularly for digging it is essential that the minimum required depth is reached.

The quality of the constructed wells and boreholes is essential for the sustainability of the system as mentioned in 2.1. Clear arrangements about this have to be made with the implementing agency. Adequate control is equally important. For certain aspects of control the community might be involved. If, for whatever reason it might be, the waterpoint is poorly constructed, resulting in higher maintenance costs, the community must have the right not to accept such a waterpoint for community management.

The waterpoint caretakers are elected by the users' community during the construction phase. The village water committee, caretakers and village mechanics are trained for their functions.

## **8.7 Handing over**

When the well or borehole has been finished and the waterpoint has been completed by the installation of a handpump, or a bucket with a pulley or a windlass, the waterpoint should be handed over formally by the agency to the community. From then on the village water committee will be responsible on behalf of the community for its management.

The waterpoint is handed over to the village water committee by project extension workers, preferably accompanied by the project's technical or management staff. The opportunity might be used to explain again the correct usage of the waterpoint and the importance of this to the future users, as well as the importance of correct transport and storage of water and in general the relationship water - hygiene - health. Local representatives of the Ministry of Health might be asked to emphasize the importance of this relationship. Also representatives of the local government and other ministries and entities working at village level might be present at the handing over ceremony.

The waterpoint caretakers, the village pump mechanic(s) and/or an area mechanic are officially installed as responsible for correct functioning of the waterpoints.

## **8.8 Operational phase**

The positive impact of the improved water supply on a community, like a better health situation and time savings for women, should result during the operational phase. But therefore it is essential that the waterpoints are always correctly functioning and correctly used, or, in short, that the scheme is sustainable.

Presuming the most appropriate service level has been installed in a partnership approach between community and agency, making use of an appropriate technology, certain provisions are required in the operational phase at community level, but also in the area, at provincial/regional level and at national level. They have been described under the key elements for sustainability:

- A strong community management institution, often a village water committee, to organize and motivate the beneficiaries in correct use of the waterpoint and of the supplied water, for collecting the users' financial contributions (cash-raising), and for the management of the created fund (sections 4.1 and 4.2).
- Local repair capacity for handpumps: operational village and/or area mechanics (sections 4.1 and 4.2).
- A functioning distribution system for spare parts: handpump spare parts can be obtained at a reasonable distance from the villages and at a reasonable prices (5.3).
- Functioning back-up support for local mechanics, village water committees and caretakers (4.3):
  - \* a system of regular visits to villages established for support and motivation, and a continuous hygiene awareness programme;
  - \* provisions made to organize training and refresher courses.
- A team available at provincial/regional level for installing new pumps and for more complicated repairs if necessary (4.3).
- Policy-making and control functioning at national level (4.3).
- Operational and accepted monitoring and evaluation system (4.3 and 2.1).
- Sufficient funds available at various levels within government agency, possibly with support from donor organizations for investments (4.1).
- Provisions made for replacement of worn out handpumps (5.3).
- Equipment, tools, transport and spare parts available at appropriate levels: area, provincial and national (5.3).

These are the minimum conditions and provisions which have to be maintained. Often it will be possible to improve them further gradually, as will be the case with the functioning of the local mechanics and the village water committees. Also the hygiene awareness of the villagers should gradually increase. The monitoring and evaluations system should be a helpful tool to achieve this.



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## *Resources Coverage for a Handpump Maintenance Organization*

*(based on a proposal for Mozambique)*

### **1. Numbers and Quantities**

- Local currency: Meticaís (Mt). 1000 Mt = US\$ 1.00
- A Province with about 1,000,000 inhabitants, living in 450 villages.
- Each handpump serves 500 people, thus about 2000 handpumps required.
- An area mechanic can serve about 8 to 14 villages, depending mainly on distances, so there are about 40 village mechanics required.
- Two different options are presented: using NIRA pumps (imported direct-action handpumps) or RURAL pumps (locally manufactured India Mark II handpumps). The direct-action pumps are applicable in about 70 - 80% of the cases, but where the groundwater level is deeper than 12 - 15m they cannot be used. RURAL pumps can be used in all the villages.
- An installation and repair team works about 2 - 3 days in a village replace worn-out handpumps and repair concrete slabs and washing facilities.

#### **NIRA-pump** (imported direct-action pump):

Replacement every 10 years: 200 installations annually;

Spare parts costs: annually 5% of pump price;

Installation: 3-5 pumps daily;

Repairs all by village and area mechanics.

#### **RURAL-pump** (locally manufactured India Mark II pump):

Replacement every 5 years: 400 installations annually;

Spare parts costs: annually 25% of pump price;

Installation: 1-2 pumps daily;

Repairs by village mechanics, area mechanics and workshop teams (annually about 5% of pumps have to be repaired by teams).

#### **Concrete slabs and washing facilities:**

Repairs are required every 2-3 years, resulting in 800 repairs annually. In an average village with 4 waterpoints the slabs and washing facilities can be repaired in 3 days: 1.33 waterpoint daily.

#### **Volume of work for installation and repair teams:**

Slabs and washing facilities: 800 repairs annually and 1,33 repairs daily, thus 600 days required;

NIRA-pumps: the replacements can be carried out at the same time when repairing slabs and washing facilities;

RURAL pumps: the replacements can be carried out at the same time when repairing slabs and washing facilities;

Repairs: annually 5% of pumps means 100 repairs annually, thus 100 days extra are required.

**Number of teams required** (based on approximately 250 working days annually):  
 With NIRA-pumps: 600 days required, thus  $600/250 = 2.4$  teams, meaning 3 teams;  
 With RURAL-pumps:  $600 + 100 = 700$  days required, thus  $700/250 = 2.8$  teams, meaning 3 teams.

## 2. Organization

<i>Level of organization</i>	<i>Staff</i>	<i>Transport and Tools</i>
Provincial level	1 coordinator 1 assistant	1 light vehicle, 4x4, pick-up
Workshop level	3 handpump installation and repair teams	3 light vehicles, 4x4, pick-up 3 complete tool sets
Area level	40 area mechanics	40 bicycles 40 tool sets
Village level	450 x 2 village mechanics 450 village water committees	450 basic tool sets
Waterpoint level	2000 x 2 caretakers	--

## 3. Annual salaries, prices

- Provincial
 

coordinator:	Mt	900,000
assistant:	Mt	420,000
  
- Installation and maintenance teams:
 

handpump mechanic	:	Mt	600,000
mason	:	Mt	456,000
assistant	:	Mt	336,000
driver	:	Mt	468,000
<b>Team total</b>		<b>Mt</b>	<b>1860,000</b>
  
- Area mechanics:
 

	Mt	330,000
--	----	---------
  
- Vehicles, 4x4, pick up type:
  - Price: US\$ 20,000
  - Replacement: every 6 years
  - Spare parts: 10% annually
  - Annual milage: 25,000 km
  - Fuel: 20 litres/100 km, 200 Mt/litre
  - Costs of lubricants: 10% of fuel costs.



- Tools and equipment:  
Each installation and repair team: US\$ 1000  
Each area mechanic: US\$ 350  
Each village mechanic: US\$ 50  
Annual depreciation: 20%; 60% of which in local currency, rest in hard currency.
- Bicycle for area mechanics:  
Price: Mt 250,000  
Replacement: every 2 years (local production, less appropriate type for rough conditions)  
Spare parts costs: annually 20% of price
- Slabs and washing facilities:  
Each repair requires 0.5 bag of cement  
Price of 1 bag of cement: Mt 7500
- Handpumps:  
NIRA: US\$ 500  
RURAL: Mt 400,000  
Cement required for installation: 0.25 bag  
Cement required for installation: 0.5 bag

#### 4. Annual costs

	<i>local currency (Mt)</i>	<i>paid by</i>	<i>hard currency (US\$)</i>	<i>paid by</i>
• Caretakers:		no costs involved		
• Village mechanics: No salaries Tools: 20% of US\$ 50 <b>Total for 450 villages:</b>	  6,000 <b>2,700,000</b>	  community	  4 <b>1800</b>	  donor
• Area mechanics: Salary: Tools: 20% of US\$ 350 Bicycle: depreciation spare parts <b>Total for an area mechanic:</b> <b>For 40 area mechanics:</b>	 330,000 42,000 125,000 50,000 547,000 <b>21,880,000</b>	 community community community community <b>community</b>	  28  28 <b>1120</b>	  donor  <b>donor</b>
• Installation and repair teams: Salary: Tools: 20% of US\$ 1000 Vehicle, depreciation spares Fuel: Lubricants: <b>Total for each team:</b> <b>For 3 teams:</b>	 1,860,000 120,000   1,000,000 100,000 3,080,000 <b>9,240,000</b>	 agency agency   agency agency <b>agency</b>	  80 3350 2000   5430 <b>16,290</b>	  donor donor donor   <b>donor</b>

- Handpumps (for 2000 handpumps):
  - I. NIRA-pumps:
 

Replacement: 200 pumps	100,000	donor
Spares:	50,000	donor
<i>Total NIRA:</i>	<i>150,000</i>	<i>donor</i>
  - II. RURAL-pumps:
 

Replacement: 400 pumps	160,000,000	agency
Spares:	200,000,000	community
<i>Total RURAL:</i>	<i>360,000,000</i>	<i>comm./agency</i>
- Cement:
  - Repair of slabs and washing facilities: 400 bags: 3,000,000 agency
  - I. With NIRA: 50 bags: 375,000 agency
  - II. With RURAL: 200 bags: 1,500,000 agency

## 5. Annual requirements in cash for operation of 2000 handpumps

	<i>NIRA</i>	<i>RURAL</i>
Communities (1000 Mt)	33,820	233,820
Agency (1000 Mt)	12,615	173,740
Donor (US\$)	169,210	19,210

Note: In these figures the costs of provincial and national coordination, hygiene education and monitoring and evaluation are not included.

## 6. Purchase of tools and materials

	<i>NIRA</i>	<i>RURAL</i>
Communities	Tools for village mechanics	Tools for village mechanics Pump spare parts
Area mechanic	Tools Bicycle and spare parts	Tools Bicycle and spare parts
Agency	Tools for installation and repair teams Cement Fuel, lubricants	Tools for installation and repair teams Cement Fuel, lubricants Replacement pumps
Donor	Tools for village mechanics, area mechanic, and installation and repair teams Vehicles and spare parts Replacement pumps and spare parts	Tools for village mechanics area mechani, and installation and repair teams Vehicles and spare parts

## 7. Comparison of annual costs of NIRA and RURAL pumps

	<i>NIRA</i>		<i>RURAL</i>	
Real costs in Mt	Mt	46,435,000	Mt	407,560,000
Real costs in US\$	US\$	69,210	US\$	19,210
Total costs (Mt and US\$)	US\$	215,645	US\$	426,770
% in hard currency		78%		5%
Real charges for a community:	Mt	103,000	Mt	906,000
Real charges per user:	Mt	206	Mt	1812
Real charges per family:	Mt	1030	Mt	9060
Costs in Mt per pump	Mt	23,000	Mt	204,000
Costs in US\$ per pump	US\$	85	US\$	10
Total costs (Mt and US\$) per pump	US\$	108	US\$	214
Total costs per user	US\$	0.22	US\$	0.43

- Notes:
- Total cost of operation of 2000 RURAL pumps is almost twice the cost of operation of 2000 NIRA pumps
  - Foreign currency input for imported NIRA pumps is almost nine times foreign currency input for locally manufactured RURAL pumps (excluding foreign currency requirements for raw material, etc.)
  - It will be difficult to assure an annual donor input of about US\$ 170,000, required for operation of 2000 imported NIRA-pumps
  - Local manufacture of direct-action pumps similar to NIRA-pumps is possible
  - Seen the geohydrological conditions, water supply cannot be ensured solely with direct-action pumps. A mixture of the two types of pumps will be the most appropriate option.
  - The real user charges for a family with RURAL pumps are about 3% of minimum salary; there are no data available about cash-income of peasants
  - Skills, labour and time are other resources required from the community, the area mechanics, installation and repair teams and provincial and national coordination.

## *Resources Coverage for a Handpump Maintenance Organization*

*(based on a proposal for Guinea-Bissau)*

### **1. Numbers and Quantities**

- 1000 pG (Guinean pesos) = US\$ 0.40
- Calculations based on present number of 1200 handpumps of different types; on average one repair annually.
- Repairs by area mechanics and occasionally by an installation and repair team of 5 people equipped with a 4x4 vehicle. There is one team in the country.
- Annual costs of pump spare parts are based on 3.5 years of data. Average annual costs of spare parts for present mixture of various pump types are about pG 100,000; for WAVIN-pumps (direct-action VLOM pump) they cost about pG 33,000.
- 70 area mechanics are required, equipped with a bicycle (depreciation in 5 years) and a tool set (depreciation in 15 years).
- The area mechanic's tariff is pG 10,000 for each repair.
- In three bases (North, South and East) substituted pumps and pump components are repaired by a pump mechanic. Each base has a warehouse of pumps and spare parts.
- Supervision by 3 supervisors equipped with motorcycles.
- At national level there is a coordinator equipped with a vehicle.

## 2. Annual costs of the maintenance organization (in 1000 pG)

<i>Type of costs</i>	<i>investment</i>	<i>depreciation*</i>		<i>operational costs*</i>	
Pump spare parts	--	--		120,000	C
Payments of repairs by area mechanics	--	--		12,000	C
Area mechanics:					
Tools	90,000	6,000	C	--	--
Bicycle	50,000	10,000	C/A/D	5,000	C
3 Regional bases:					
Salaries	--	--		3,600	A
Tools and equip.	90,000	4,500	A/D	--	--
Materials	--	--		6,000	A
3 Regional supervisors:					
Salaries	--	--		2,700	A
3 Motorcycles	30,000	7,500	D	4,500	A
Installation and repair team:					
Salaries	--	--		3,000	A
Vehicle	54,000	13,500	D	11,500	A
Tools and equip.	4,000	400	A/D	--	
National coordination:					
Salaries	--	--		1,200	A
Vehicle	47,500	9,500	D	10,000	A
Materials	--	--		2,000	A
	<u>365,500</u>	<u>51,400</u>		<u>181,500</u>	

- \* C = To be paid by Community  
A = To be paid by Agency  
D = To be paid by Donor-organization

## 3. Annually required funds

	<i>Investments</i>	<i>Operational costs</i>
Community	10*	137
Agency	14.9*	40 - 44.5
Donor	30.5 - 45.4	--

- \* No decision has been made so far about several investment:  
• The depreciation of area mechanics' bicycles are foreseen to be included in the area mechanics' tariffs, but the feasibility has to be investigated. Investment by the agency is most probably not feasible, therefore long-term arrangements with donor organizations

- have to be considered.
- The major portion of the tools and equipment required for the installation and repair team and for the three regional bases can be purchased locally by the agency, but others must be imported, which requires hard currency. Donor support has to be considered.
- Costs of hygiene education and monitoring and evaluation are not included.

#### 4. User charges

The user charges include pump spare parts and payments of the repairs by the area mechanics, which include a salary for the area mechanic (pG 10,000 per repair), the maintenance of his bicycle, the depreciation of his tools and perhaps the depreciation of his bicycle.

	<i>User charges for present mix of pumps</i>		<i>User charges for WAVIN-puimp</i>	
Pump spare parts	pG 100,000	82%	pG 33.000	55%
Area mechanic's salary	" 10,000	7%	" 10.000	16%
Bicycle maintenance	" 4,000	3%	" 4,000	7%
Tools depreciation	" 5,000	3%	" 5,000	8%
Bicycle depreciation	" 8.000	5%	" 8,000	14%
	<b>" 127,000</b>	<b>100%</b>	<b>" 60,000</b>	<b>100%</b>

It is clear that the costs of required spare parts have a considerable influence: for the WAVIN pump (direct-action VLOM pump) the total annual user charges are less than half of those for the present mixture of handpumps.

If only WAVIN pumps (or similar types) would be applied, the costs of the bicycle would be about 20% of the user charges. If users do not pay for pump spare parts (present situation) the costs of maintenance and replacement of bicycles is almost half of the users' charges.

	<i>Present mix of pumps</i>	<i>WAVIN pump</i>
User charges per pump	pG 27,000	pG 60,000
User charges per family	" 4,200	" 2,000
User charges per person	" 850	" 400
	(= US\$ .34)	(+ US\$ ..16)

These figures are rather similar to the user charges found in the example based on Mozambique (Annex 1).

## *Cash Raising For Handpump-based Schemes*

### **1. Community Fund Raising**

Under community fund raising, the users do not pay a regular contribution for the water supply system, but instead finance water supply and sanitation projects through contributions to community funds. A special water supply fund might be created, but if one or more community funds already exist, it might be more suitable to make use of these. If the local conditions permit, the money can be placed in a bank to earn interest.

Community fund raising is a rather appropriate method for cash raising in handpump-based schemes because:

- normally users benefit more or less equally from the provision of the service; where users have different service levels, user charges which reflect these differences in service are usually more appropriate
- contributions are not directly linked to use of the supply, this makes administration easier, particularly in villages with more waterpoints where it is difficult to regist all the users of a particular pump
- administration is less complicated than for regular charges

#### *1.1 AD-HOC CONTRIBUTIONS*

The use of ad-hoc contributions is appropriate in communities with a tradition of this kind of fund raising, particularly when household incomes exhibit a high degree of seasonality. Ad-hoc contributions can be used for financial contributions to construction activities like well construction or handpump installation, or for handpump repairs when the pump is out of order. Regular payments to finance the costs of the preventive maintenance of handpumps can be made from a fund replenished with these ad-hoc contributions.

Fund raising by ad-hoc contributions can be organized by the management structure - often the village water committee -, possibly in collaboration with the traditional leadership or with a voluntary organization such as a women's group. The process involves the soliciting of contributions, either in advance or when required. This can be done through public meetings, by house-to-house collections or by less conventional methods such as lotteries and festivals.

Ad-hoc contributions are a rather flexible way of fund raising and therefore quite appropriate when introducing cost recovery.

#### *1.2 REVOLVING FUNDS*

A more sophisticated form of fund raising involves the creation of a community revolving fund. A revolving fund is a credit facility which is earmarked for a specific purpose, for instance water supply and sanitation. Initial capital may be supplied by government or by a donor agency, possibly through the government agency. Another possibility is the sale of shares to members of the community.

The fund will be used for maintenance and repairs of handpumps, as well as for their replacement when required. The construction of more waterpoints can also be financed. The fund can also be used to provide loans to households for latrine construction or repair. The principle throughout is that the fund is earmarked for water supply and sanitation services and any money invested, once recovered, should be spent on water supply and sanitation services, at least until all members of the community are served with both safe water supply and sanitation facilities.

The revolving fund should be managed by a specially constituted body such as the village water committee. For communities with a handpump-based water supply this form of cash raising will often be too sophisticated.

### *1.3 COMMUNAL REVENUE LEVIES*

Communal revenue levies may be appropriate for communities with a source of community income such as community fields, a flour mill or other agro-processing and small-scale community industry.

The dependency of the village water supply on another community activity is a certain risk: if the community is not well motivated for the communal income-generating activity, the maintenance of the water supply also might become impossible.

### *1.4 COOPERATIVE UNIONS*

Water supply projects can also be financed by local cooperative unions. These can be oriented towards production (agriculture, artisans), agricultural marketing or savings. The cooperative union may finance - or contribute to the financing of - construction of the water points, as well as their operation and maintenance. The cooperative's contribution would be managed by its executive committee, or by a specially set up water sub-committee, which would reserve funds on the basis of the cooperative's expected net income and the estimated project costs. The use of the water point by non-members of the cooperative could be arranged for through separate contributions.

As for the previous option, maintenance of water supplies will depend on other communal activities: if revenues decrease, the maintenance of waterpoints is in danger. Therefore, considering this option, the sustainability of the cooperative also should be taken in consideration.

## **2. Indirect taxes**

Indirect taxation is another way to raise the community's contribution to project costs, particularly for the operational costs of a handpump-based water supply scheme, but also for construction. This may prove appropriate for communities with an adequate taxation base and effective tax collection. The level of taxation should be related to the water use and the service level (if different for different users). To relate the taxation to water use there are two main options:

- charges based on houses and other forms of property: for instance higher rates for larger houses
- charges based on a flat rate per capita, which effectively assumes even per capita use of water in a given group. A household of five people would pay five times the consumption of a single occupant.



Billing and collection of indirect taxes are usually best managed by the relevant government institution, among others because administration costs can be saved by combining water taxes with charges for other services.

The transfer of funds from the taxation agency to the relevant water agency or even to the village water committee should be assured. In case of real community-managed village water supply, this system is not very appropriate: the village water committee would have to receive the water taxes from the government agency.

### **3. Regular user charges**

Regular user charges for water supply can be applied for operation and maintenance costs.

In the case of "fixed charges" each household pays the same rate. This will be suitable in communities where incomes are rather homogeneous and where all benefit more or less equally from the water supply. For rural communities with handpump-based water supplies this will quite often be the case. As fixed charges are also simple to administer, they may be a suitable cash raising option for many communities with water supply through wells and handpumps.

However, if there are appreciable variations in household incomes or in water usage between households, different fixed charges for different users have to be applied. Members of the community will usually agree that in these cases equal charges would not be fair.

Criteria for allocating different fixed charges to households include:

the number of people in a household

- whether water consumption is for household use only or also for other (productive) purposes
- the distance from the household to the nearest waterpoint
- indications of the household income, such as area of cultivated land, number of cattle, type of house (thatched or zinc roof, etc.)
- different backgrounds resulting in different economic positions, like refugees in relation to autochthonous population

Based on the above mentioned and other relevant criteria, the community itself should set the tariffs for the different classes of users. Specialist advice from the water agency will be required, among others about the classification.

The main disadvantage of the fixed charges is the lack of a link between payment and actual water use, therefore they do not encourage care in use of water. On the other hand this means that users are not tempted to reduce water use below the minimum required level merely for financial savings.

### **4. Water vending**

Water vending is often applied to supplement or substitute piped distribution systems, particularly in cities with a fast growing population in poor urban areas.

For point supplies water vending is the only option for cash raising based on the actual water use. Two possibilities for organizing this water vending are:

- a) selling the water under direct responsibility of the village water committee, which receives the money and takes care of its management

- b) licensing one or more persons to manage the well or handpump, and therefore charging them with its maintenance and repair

Water can be sold at a well or a handpump by the litre or by type of container, the last option being more practical. Wastage and vandalism may be minimized, and user payment can be assured. The water vendors can be selected according to socio-economic policy criteria; for instance women head of households who are likely to need the additional income could be chosen. However, if they are also in charge of maintenance and repair (option b), their capabilities to organize this should be carefully considered.

Water vending has a number of potential drawbacks which should be considered by the community as part of the evaluation of different cost recovery options. The most important is that users will usually face much higher costs than under other options because the salary or profit of the vendors should also be covered. Particularly for wells and handpumps, with relatively low operational costs, the increase might be very substantial.

A firm reduction in costs of water vending might be obtained by involving all (or a group of) women users in the selling. If women are scheduled just one or two days per month, they might be willing to do the work for just a small compensation or even for nothing, knowing that this reduces the price of water. Obviously this works only for option a: if the management of the waterpoints is completely handed over to a concession holder, she/he will normally depend on the waterpoint for her/his income. This dependency means also that there should be sufficient clients to justify a waterpoint being open during the whole day (or another agreed period). This may, however, result in long waiting times at peak hours and thus reduced willingness to pay and even continued use of contaminated alternative sources.

Locking wells and pumps at night might cause a certain inconvenience, but more serious might be the problems due to temporary absence of the concession holder. Users are also vulnerable to exploitation in times of water shortage. Clear agreements must be made about all these points between the concession holder and the community through the village water committee.

Water vending, particularly when involving many people, will easily cause fraud, hence adequate control should exist. A practical problem may be that a bucket or other container of water might be cheaper than even the smallest coin in a country. Using special tickets is an option but will again raise the costs.

Water vending means a direct relation between the amount paid and actual water use, thus reducing wastage and encouraging wise use of water. It may however also lead to a reduction of water use -even for essential purposes- by poorer families, merely for reasons of saving cash. This would create an adverse situation: poorer families would not be able to benefit from (the health effects of) the improved water supply. It may be possible to elaborate a system with different tariffs for different user groups, based on the same criteria as indicated for the fixed charges.

## *Information Required for Selecting Technically Feasible Options in Handpump-based Projects*

### **Groundwater or surface water**

- Choosing the type of water source depends mainly on the geohydrological conditions: if appropriate springs are available upstream of the village, they might be used as sources for a gravity system. The occurrence of fresh groundwater determines if wells or boreholes are possible sources or if surface water has to be used. As the quantities of groundwater extracted with handpump supplies are limited in relation to schemes based on engine driven pumps, even very local and relatively thin aquifers may provide sufficient water. This however has to be thoroughly verified by detailed surveys at a later stage.

### **Groundwater depth**

- The depth of the fresh groundwater determines the feasibility of hand dug wells and hand drilled boreholes: groundwater levels deeper than 15 to 20 metres require mechanical drilling of boreholes. The fluctuations in the groundwater levels that will occur with the seasons have to be studied and must be counted for. Also the danger of intrusion of saline or brackish water in wells or boreholes may rise during the dry season.

### **Open wells or handpumps**

- Abstracting water from boreholes requires that they are equipped with handpumps or with other means demanding even more resources for operation and maintenance. Dug wells can be equipped with handpumps or with a bucket, a rope or a chain and a pulley or a windlass, but also may be left open (every user brings her/his bucket).

### **Handpump types**

- There are many different types of handpumps. A global distinction can be made between direct-action pumps, suitable for water levels less than 12 to 15 metres depth, and other handpump types like lever pumps and wheel pump suitable for deeper water levels. Lever pumps are generally spoken not suitable for water levels deeper than 50 to 60m. Wheel pumps are also suitable for water levels somewhat deeper. The resources required for installation and particularly for maintenance and repair differ considerably for the various types of handpumps; generally spoken they increase with increasing installation depth.

### **Wind- and solar energy**

- Dug wells and boreholes can be equipped with handpumps, but pumps driven by wind- or solar energy may be other options. Appropriate data on wind velocity and/or radiation should be available to decide about the feasibility of these systems. Water distribution is possible through just one standpost near the water source or through a real distribution network with house connections and standposts. The maximum possible yield of the water source and the availability of energy may be limiting factors to the number of users to be served.

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**Diesel- or electric pumps**

- Diesel- or electric driven pumps are other options to abstract water from wells or boreholes. Distribution might be through just a single standpost or through a network with house connections and/or standposts. The maximum yield of the water source might be limiting for the number of people to be served and thus for the reasonable number of standposts and connections.

**Distant water source**

- If sufficient fresh groundwater is not available within a reasonable distance from a village, water has to be brought in through a pipeline. This means diesel or electric pumping, a transport main, and a standpost or a network with house connections and/or standposts. If use has to be made of surface water, treatment is also required.



