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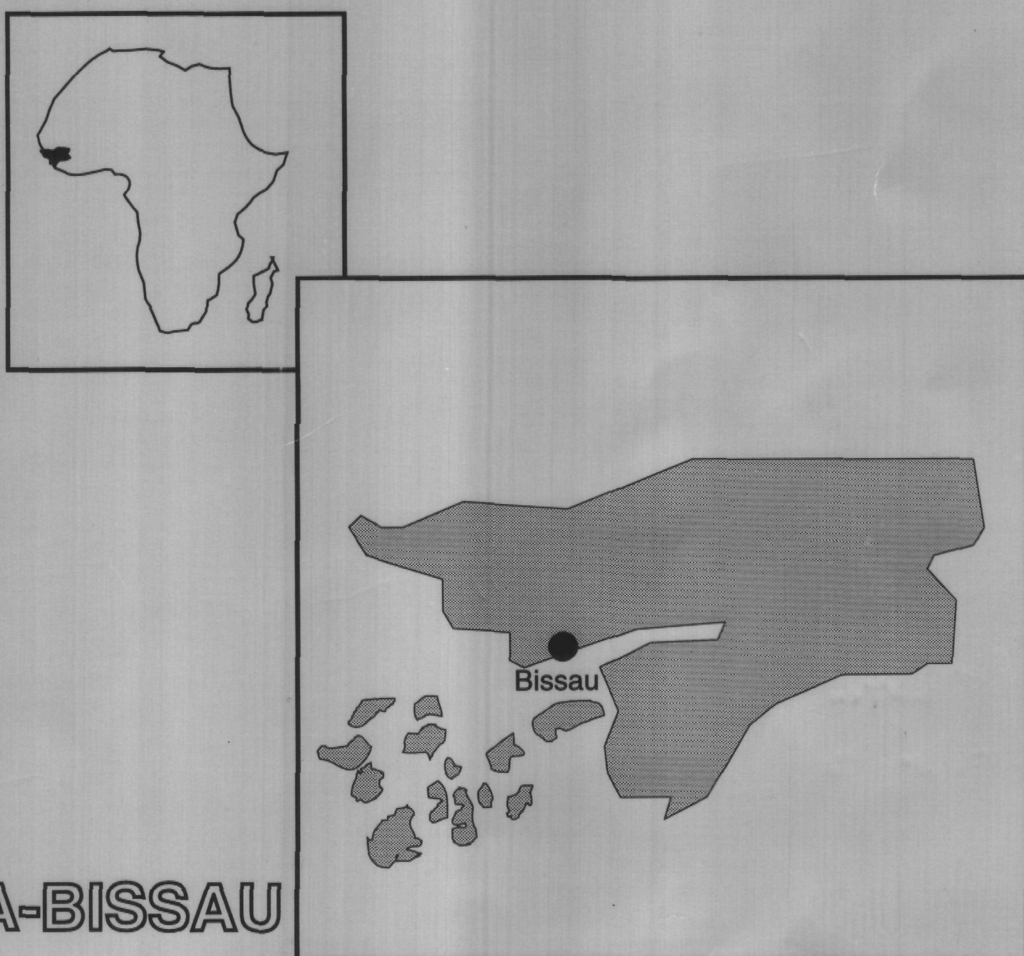
Towards Sustainable Water Supply

Eight years of experience from Guinea-Bissau



GUINEA-BISSAU

Project and Programme Papers 1-E

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The multi-disciplinary staff provides support to activities at field level through research, training and briefing, evaluation and advisory services, publications, documentation services and advocacy.

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Towards Sustainable Water Supply
Eight years of experience from Guinea-Bissau

Koen van der Werff and Jan Teun Visscher

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List of Acronyms and Abbreviations

CILSS	Comité permanent Inter-Etats de lutte contre la sècheresse dans le Sahel (Permanent Interstate Committee for Drought Control in the Sahel)
CIMA	Comité Interministerial de Agua (Inter Ministerial Committee for Water)
DAAS	Direcção de Abastecimento de Agua e Saneamento (Division of Water Supply and Sanitation)
DGE	Directorate General of Energy
DGRH	Direcção Geral de Recursos Hídricos (Directorate of Water Resources)
EAGB	Electricidade e Agua de Guiné Bissau (Public Enterprise for Electricity and Water Supply)
EC	European Community
ESA	External Support Agency
GDP	Gross Domestic Product
IMF	International Monetary Fund
lpcd	liter per capita per day
MEIRN	Ministry of Energy, Industry and Natural Resources
MRW/H14	Project Maintenance Rural Water Supply - H14
NGO	Non-Governmental Organization
PADIB	Rural Development Program in Boe
PAIGC	Partido Africano da Independência da Guinée de Cabo Verde (political party in Guinea-Bissau)
UNDP	United Nations Development Programme

Preface

This publication presents eight years of experience in planning water supply programmes and developing maintenance systems and strategies in rural areas and semi-urban centres in Guinea-Bissau.

It has been prepared by Mr. Koen van der Werff, project manager of the Netherlands-supported project Maintenance Rural Water Supply MRW/H14 between 1991 and 1994, and Mr. Jan Teun Visscher of IRC.

In the development of the document, important inputs were received from project staff, staff of the Directorate General of Water Resources (DGRH) in the Ministry of Energy, Industry and Natural Resources in Guinea-Bissau, and Ms. Christine van Wijk of IRC. We are also grateful for the comments received from the staff of the SNV Netherlands Development Organisation in Guinea-Bissau.

The preparation of the document, and its translation into Portuguese (PR 1-P), have been financially supported by the MRW/H14 project and SNV Netherlands Development Organisation.

We hope that this document will contribute to the further development of sustainable water supply systems and effective maintenance strategies in Guinea-Bissau, and may also be of use to other programmes. We would very much appreciate comments and feedback on the ideas presented in the document, which may be sent to IRC.

Summary

The Government of Guinea-Bissau has made important efforts to improve its water supply situation since its independence in 1974. Seven ESAs supported these efforts with US$ 44 million, US$ 50 per capita. The prime focus was on installation of improved wells with rope and bucket systems and handpumps in rural areas. In early 1993, over 90 percent of these handpumps were functioning. Also, 100 handpumps have been installed in semi-urban centres as well as 33 small piped supplies out of which only sixteen (59 percent) were working in 1993. Despite these efforts, overall coverage with improved systems is still only 34 percent and traditional sources remain the prime source of water supply for the vast majority of the population.

The Directorate General of Water Resources (Direcção Geral de Recursos Hídricos DGRH), the responsible organization for water supply and sanitation in Guinea-Bissau, with support from the Netherlands-financed MRW/H14 project, has, since 1987, focused on the development of a decentralized maintenance system and the standardization of handpumps. Two systems have been established, a least cost system with village mechanics and VLOM (Village Level Operation and Management of Maintenance) handpumps and a somewhat more expensive system with non-VLOM pumps and area mechanics equipped with a tool box and a bicycle. These efforts strongly contributed to improved pump performance in the country and have strongly supported the introduction of cost recovery strategies and the principle of users' involvement. In 1993 these efforts started to yield results, in that 5-10 percent of maintenance costs were financed by the users. More recently, the project also initiated assistance to the development of a maintenance strategy for semi-urban centres including the principle of cost recovery and user's participation. In some piped water supplies, payments were made for houseconnections and, recently, for the use of public standposts in two semi-urban centres. The project will continue its support in these areas and assist in consolidating the maintenance systems in rural areas and in strengthening the experiments in the semi-urban centres.

In 1991 the government published its Master Plan for the sector which includes the following policy guidelines:

- the state has to give preference to the realization of projects with a low recurrent cost component to the state
- chosen technologies are to be adapted to socio-economic and cultural conditions of the population
- local initiatives should be supported wherever they exist and executive and maintenance tasks should be progressively reduced and decentralized
- the state will take a more facilitating role, avoiding executive responsibilities and focusing on planning, promotion, training and supervision.

The government officially accepted the principle of users' payment for operation and maintenance and renewal of water supply systems. For systems providing a higher service level, users also have to pay for additional construction costs.

The Master Plan emphasizes the changing role of the government from provider to facilitator. This implies, however, that efforts have to be increased to develop the private sector. This may be encouraged by stimulation of standardization and facilitation of importation of equipment and spare parts, for example by tax reduction on standardized equipment. Private marke opportunities will also be enhanced by increasing user contributions for maintenance and spare parts, which may be strongly encouraged by better information about the hygiene risks associated with poor quality water supply.

Funding limitations make it necessary to set priorities in the selection of sustainable facilities. An analysis of the present systems in the country shows that protected wells with rope and bucket systems, or VLOM handpumps, have a high performance reliability at relatively low cost and do not contribute much to falling water tables. Also the hygiene risk involved is limited if systems are properly protected and introduced in combination with adequate hygiene promotion. Non-VLOM pumps, still about 80 percent of the pumps installed in Guinea-Bissau, involve a more complex maintenance structure and therefore a greater dependency of the users and higher cost.

Except for a few larger semi-urban centres in which piped supplies may be feasible, improved wells and handpumps are also the preferred technology choice in view of prevailing conditions, cost and problems in energy supply. Nevertheless, for these centres and the rural areas, traditional water points will remain the most important source of water supply for the population in the coming 10-15 years. This makes it very necessary to develop an approach which encourages the local population to better protect their traditional sources in order to reduce their health risk.

This is even more important as improved water systems are not always used for drinking water. This crucial aspect has received limited attention, whereas improved facilities have to compete, particularly in taste and distance, with mostly polluted traditional sources. Next to better protection of traditional sources, the use of new facilities needs to be enhanced. This can be stimulated by ensuring that:

- new or improved facilities meet a true demand and are planned and developed together with the users
- new systems provide a higher service level than traditional facilities
- users understand the importance of good quality water supply for their health and wellbeing
- traditional health beliefs are matched with health risks related to bacteriological and chemical water quality
- use of traditional systems is discouraged if new facilities are available; if this is not possible as the systems are crucial for certain population groups, they should as much as possible be improved to a minimum acceptable level
- maintenance of the facilities is guaranteed to ensure continuous functioning.

It is also important to review the possibilities of encouraging the installation and utilization of sanitary facilities and improve sanitary habits, particularly in more densely populated areas, as this may contribute considerably to the reduction of the spread of disease and the pollution of water sources.

Introduction

In 1974, Guinea-Bissau gained its independence from Portugal and inherited a weak socio-economic situation. An important part of the infrastructure was destroyed by the war and technical and managerial skills were lacking to run the state institutions. Nevertheless there was a momentum to rebuild the nation, and installing improved water supply systems was considered of prime importance. Several External Support Agencies (ESAs) were prepared to assist in this challenge.

Up to the late 1980s the National Government and most ESAs focused on construction and paid very little attention to the requirements for making the water supply systems sustainable. The official agreement was that government would take responsibility for maintenance, but in practice, projects secured spare parts and repaired the systems. Upon completion of projects, systems were handed over to the government, which did not really have the capacity and the infrastructure to organize the maintenance. As a result, most systems quickly deteriorated when the ESA stopped its project support. In some areas, over 60 percent of the systems were broken down, thus putting the impact of investments very much in jeopardy.

In 1986 two Netherlands-assisted projects drew to a close. These were: the 'Buba' water supply project, which developed some 750 water points in the South; and the project 'Structuring DGRH', which supported the institutional development of the Directorate General of Water Resources (DGRH) within the Ministry of Energy, Industry and Natural Resources (MEIRN). To safeguard the investments made under these projects, a new Netherlands-supported project, 'Maintenance of Rural Water Supply - H14' (MRW/H14) was started in 1987. Its main aim was to assist in the development of a maintenance system for the water supply systems in the rural areas and semi-urban centres, while reducing costs for the government.

In the period 1987-1990 the project realized a Pilot Phase in which activities focused on introduction of a decentralized maintenance system, regionalization and standardization of technologies, rehabilitation of some piped supply schemes in semi-urban centres, improving communication with users, and getting political clarity about cost recovery strategies. The approach towards decentralization built on experiences with local caretakers in the 'Buba' project.

An important project activity was the organization of a national seminar on maintenance of rural water supply in 1989, which showed the need for policy guidelines and urgent action to overcome the serious situation.

In 1991, the Division of Water Supply and Sanitation (DAAS) of the DGRH was made formally responsible for the maintenance of all water supply systems in the country. Furthermore, it was agreed to establish a decentralized maintenance system, delegate part of the tasks to the population, and introduce cost recovery. The Extension Department of DGRH, in particular, played an important role in making the users aware of the new policy and in developing adequate communication between DGRH and the users.

In the same period, the government, assisted by UNDP, elaborated a Master Plan for the water supply and sanitation sector, which was presented in June 1991. This Master Plan includes an inventory of the sector, an overall policy framework and an investment plan including ESA contributions. Its proposed strategy, to realize effective operation and maintenance, is based on users' participation, cost recovery and reduction of the role of the government.

New directions are chosen in the Master Plan to reduce the maintenance burden for the government, which did not have sufficient financial and human resources to cope with it. In this context, the Master plan proposes that:

- preference should be given to projects with a low recurrent cost component for the State
- technologies should be adapted to the socio-economic and cultural conditions of the population
- local initiatives should be supported and government should progressively reduce and decentralize implementation and maintenance tasks
- the State should act more as a facilitator and focus on planning, promotion, training and supervision.

The second phase of the MRW/H14 project, 1991-1993, focused on strengthening the maintenance strategy, the creation of water committees at village level, continuation of standardization of handpumps, training of staff working at village, provincial and central level, and the introduction of cost recovery through user payment of local mechanics and spare parts. Project activities related to the semi-urban centres changed from rehabilitation of infrastructure towards improving management of operation and maintenance. These efforts culminated in 1993 in the organization of a national seminar on water supply in semi-urban centres in Guinea-Bissau. This meeting clearly showed the poor performance of the systems and the need for change. It also helped to modify the rigid thinking about, for instance, technology choice, and brought out recommendations about future strategies, putting more emphasis on organizational structures and the introduction of a mix of technologies and service levels to ensure sustainable functioning.

The experience of the MRW/H14 project is reflected in this document. Chapter 1 presents a picture of Guinea-Bissau and its water and sanitation situation. Chapter 2 provides an overview of the main actors in the sector. Chapter 3 describes the water supply situation in the rural areas and Chapter 4 presents this for the semi-urban centres. Chapter 5 presents an analysis of the potential of existing water supply options and Chapter 6 gives 'food for thought' about what could be done in future to enhance sustainable development of the sector.

1. *Overview of the Situation*

1.1 The country

The Republic of Guinea-Bissau is bordered by Senegal to the north and Guinea-Conakry to the east and south. The country has an area of 36,125 square kilometres. Except for the foothills of the Fouta Djallon in the east, Guinea-Bissau mostly consists of a coastal plain, deeply indented by estuaries. The main physical characteristics are meandering rivers and wide estuaries, with the tidal influence reaching as far as 120 kilometres inland. The country is divided into three main provinces: the North, comprising the regions Oio, Cacheu and Biombo; the East, comprising Gabu and Bafata; and the South, comprising Quinara, Tombali and Bolama/Bijagos.

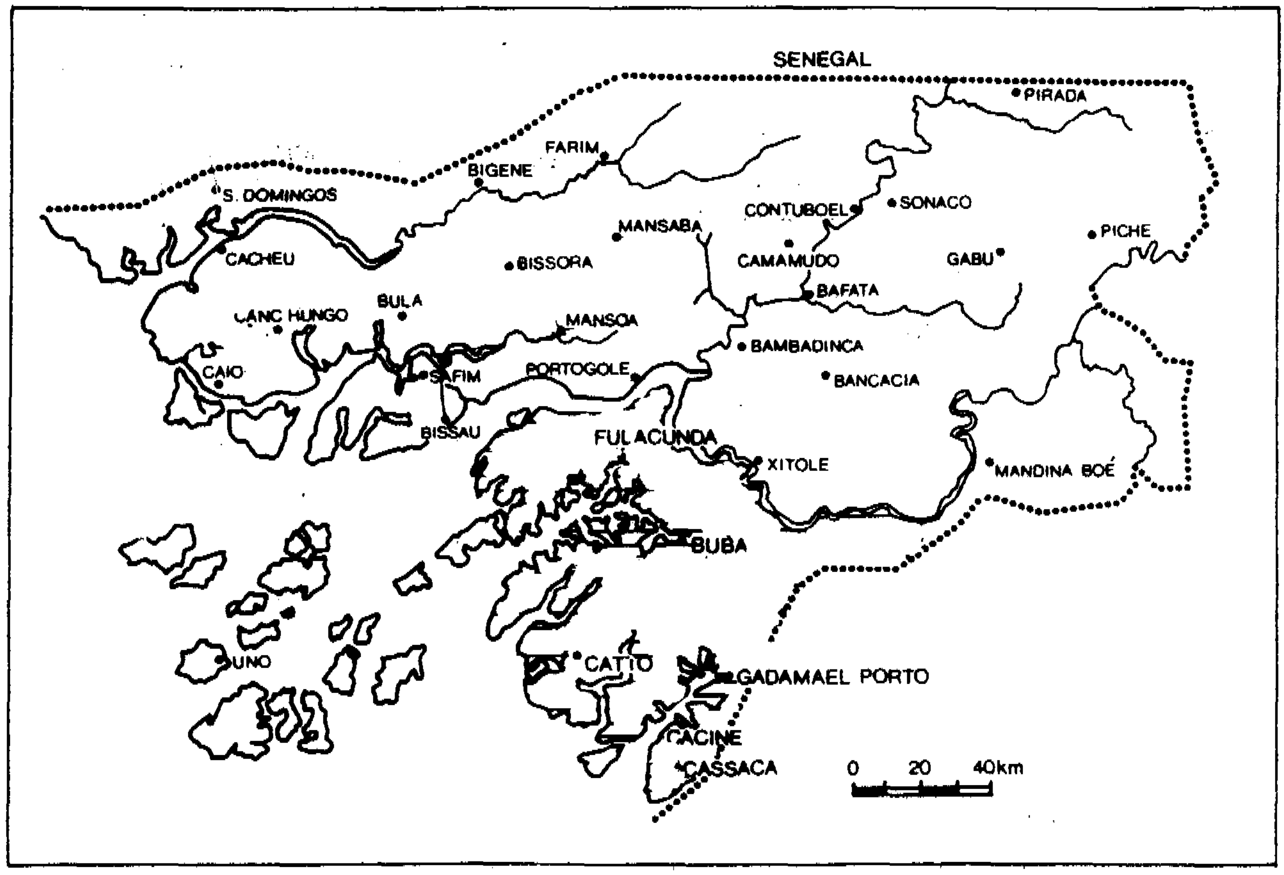


Figure 1: The Republic of Guinea-Bissau.

1.2 The population

Guinea-Bissau has some 983,000 inhabitants, of which 17.5 percent live in the capital Bissau, while the remainder live in the rural areas and small semi-urban centres (Table 1). The average population density is approximately 30 persons per square kilometre. By far the majority of the population still lives in one of the 3,600 small villages of between 50 and 2,000 population. The urban and semi-urban centres are growing rapidly, holding 4 percent of the population in 1970, 8 percent in 1980 and 32.5 percent in 1991. It is estimated that the rural population will increase from 739,000 in 1991 to almost one million in the year 2001. Almost two-thirds of this population will live in villages with less than 500 inhabitants.

Table 1: Overview of the population distribution (1991)

Location	*Definition*	*% of population*
Bissau	capital	17.5
semi-urban centres	centres between 2,000 and 20,000 or with piped supply	15.0
rural areas	less than 2,000	67.5
total population	983,000	100.0

1.3 The political and socio-economic situation

After eleven years of war, Guinea-Bissau gained its independence in 1974. The socialist government which came into power arranged a centralized economy in which the State assumed the main responsibility for economic development and private enterprise was marginalized. In 1980 the military took over and nominated João Bernardo Vieira as President. Gradually the economy was modified, and in 1987 the government, in collaboration with the World Bank and the International Monetary Fund (IMF), initiated a structural adjustment programme to improve the deteriorating economic situation. This reform process is being continued through strengthening public sector management, stimulating the private sector and developing a programme for the social sector (health and education). However, the public administration is still confronted with lack of operational capacity and financial and human resources. The foreign debt of Guinea-Bissau increased from US$ 473 million in 1987 to US$ 631 million in 1993, and in the period 1988-1993 the rate of inflation averaged around 55 percent per year (van Manen, 1994). This indicates the limited financial capacity of the government and the low purchasing power of the population.

In 1991 a process of democratization started, as in many African countries, which resulted in the introduction of a multi-party system. The elections for Parliament and President were delayed, but took place in July 1994. The ruling political party, Partido Africano da Independência da Guine e do Cabo Verde (PAIGC), got the majority in Parliament and João Bernardo Vieira continued his presidency.

The economy has a large rural sector, in which agriculture, fisheries and forestry account for about 90 percent of employment and 50 percent of GDP. The social indicators for health and education are among the world's worst (Table 2).

Table 2: Key socio-economic indicators of Guinea-Bissau

Population size (1991)	983.000		
Gross Domestic Product (1990)	180 US$ per capita		
Religion	animist	:	61 %
	Muslim	:	35 %
	Christian	:	4 %
Ethnic groups	Balanta	:	28 %
	Fula	:	23 %
	Mandinga	:	12 %
	Manjaco	:	12 %
	Papel	:	10 %
	Others	:	15 %
Literacy rate (15 years)	male	:	53 %
	female	:	25 %
Life expectancy	male	:	41 years
	female	:	44.5 years
Mortality	infant	:	141/1000
	under 5	:	240/1000

Sources: Human Development Report (1994); Master Plan WS&S sector (1991)

1.4 Climate and water resources

The climate of Guinea-Bissau is tropical with a wet season (June-October) and a dry season (November-May). In the north-east the climate is hot with sahelian influences and low rainfall (1200 mm). In the south temperature is lower and rainfall considerably higher (2500 mm). In recent years, average annual rainfall has been declining, and together with increasing deforestation this poses a threat to the replenishment of groundwater resources.

A first estimate of the groundwater resources has been made by MEIRN with support from UNDP. Five main aquifers have been established with their respective annual recharge (Table 3). The availability of these resources is not uniform throughout the country. Shallow groundwater is widely available and used, but shows strong variations throughout the year. Furthermore this water table was falling by up to 0.7 metres per year between 1979 and 1986. Deeper confined groundwater is available at different depths and to a different extent in the north and south (sedimentary basin). Some of these aquifers, however, do present problems because of a high mineral content, and particularly iron, which makes its taste less attractive for the population. The best aquifer (Maestrichtian), is presently being used for the water supply of the capital Bissau and some surrounding settlements. It showed an average fall of 0.17 metres per year over the period 1978 to 1990 (unpublished geo-hydrological data of the Master Plan DGRH/UNDP, 1991).

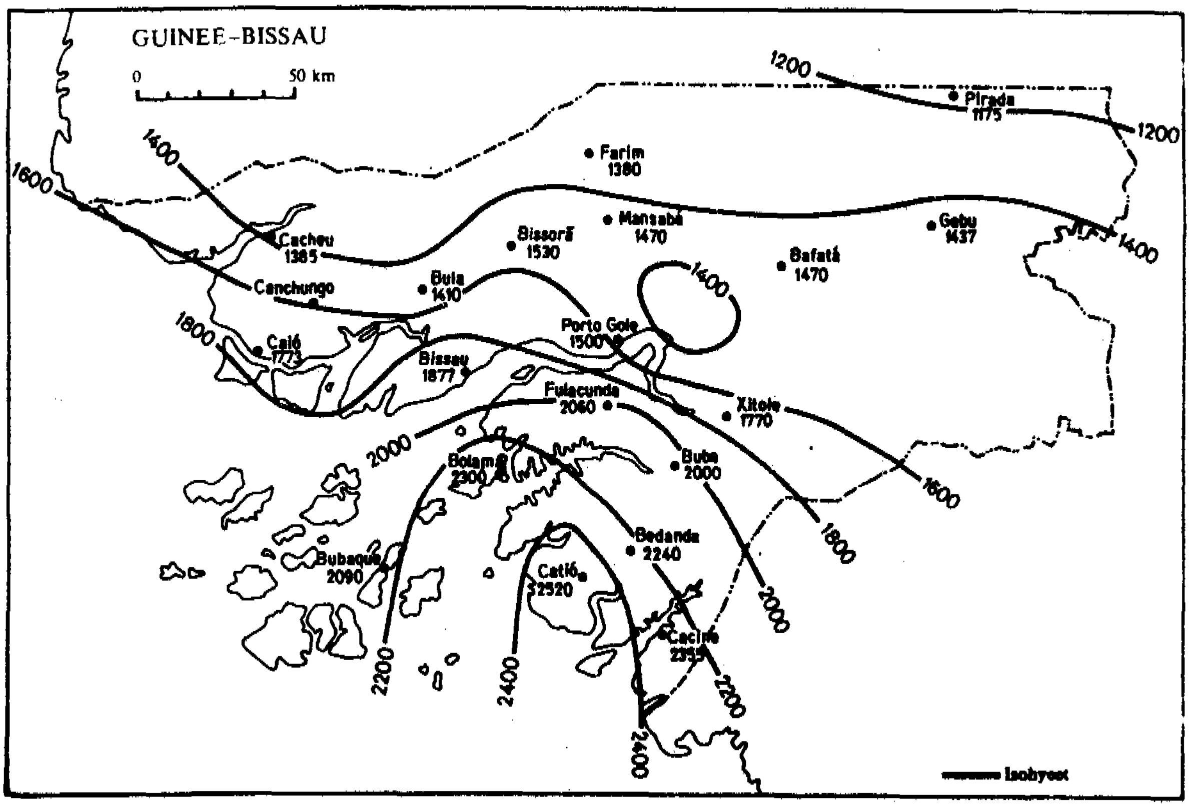


Figure 2: Rainfall data (1977)

Table 3: Overview of groundwater resources

Aquifer	***Annual recharge mm³/year***
Paleozoic basement/Quartenaire (East GB) Neogene/Quartenaire (Wesr GB)	several hundreds
Miocene	probably below 5
Oligocene	3 to 9
Paleocene/Eocene	no data (probably low)
Maestrichtian	5 to 15

Source: Master Plan 1991

The physical availability of fresh water differs by region and by season. During the rainy season, generally speaking, water is available in sufficient quantities all over the country through shallow and deep wells. As soon as the dry season starts, this changes drastically. In most areas of the South, sufficient water sources remain available, although walking distances may rise and quality deteriorates when traditional wells dry up and people have to rely on pools and holes in riverbeds. In the North, and especially in the East, significant problems exist to get access to fresh water during the dry season. Many traditional wells dry up and only a limited number of new wells exist to cater for the demand.

1.5 Water supply

In Guinea-Bissau a distinction can be made between traditional and new water supply systems. Traditional systems include:

- dug wells, sometimes protected by old oil drums with or without a cover
- water holes in low areas (*bolanhas*)
- artesian springs.

New systems include:

- improved dug wells, often equipped with a rope and bucket system
- improved dug and drilled wells equipped with a handpump
- wells with wind pumps
- wells with solar pumps.

Furthermore, some pumped and piped supplies are available, providing water to a relatively small part of the population in semi-urban centres and Bissau. A more detailed discussion of these systems is presented in Chapter 5.

In 1991, some 34 percent of the population had access to safe water supply from new systems. The water supply coverage was distributed as follows:

- 42 percent for the rural areas
- 18 percent for the semi-urban centres
- 20 percent for the city of Bissau
- 34 percent for the total population.

The coverage in rural areas is largely the result of the installation of some 2,000 modern water points, comprising 850 dug wells with rope and bucket systems or pumps, and 1,150 drilled wells with pumps. The Master Plan indicates that future water points in rural areas should be designed to deliver 25-30 lpcd for a maximum of 200 persons. For semi-urban centres the norm is 50 lpcd and for Bissau 100 lpcd. This norm would result in the construction of some 3,950 water points in the rural areas, which was considered too ambitious. Therefore it was decided to exclude rural settlements with less than 100 inhabitants, bringing the number down to 2,800. Even this boundary is under discussion within the ministry and may rise to possibly 300, given the high investment levels needed, versus the available resources. Current practice seems to be to take 150 inhabitants as a minimum. A broader discussion is needed, however, which also takes into account the existence of traditional waterpoints and prioritizes larger communities which do not have secured traditional or new water points throughout the year.

Traditional waterpoints are numerous and really are the main water supply source for over 66 percent of the population (Figure 3). These traditional waterpoints may have a significant impact on rural water supply programmes. When available throughout the year they are in direct competition with new water points. But even when they have water only in the wet season, people may prefer them for reasons of taste or distance and may not be willing to pay for a new waterpoint and related maintenance cost.

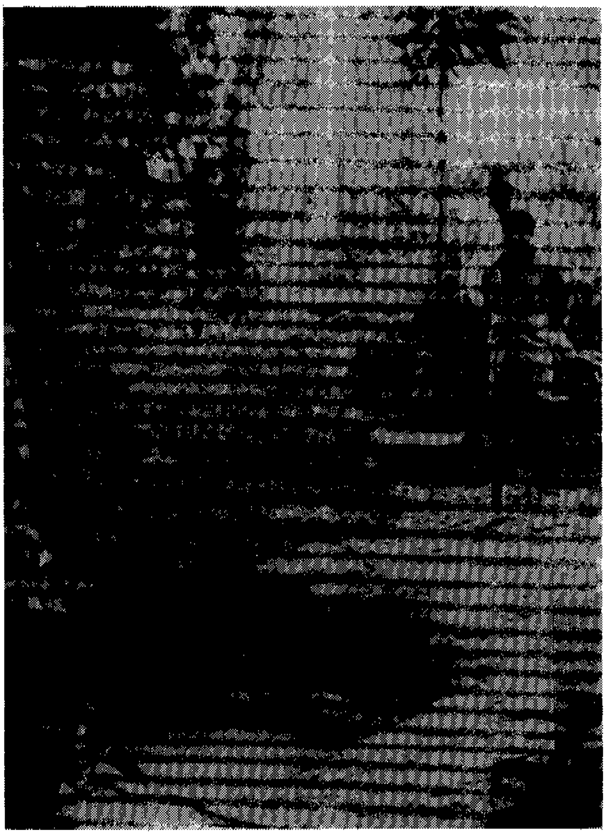


Figure 3: Traditional water sources are crucial for over 66 percent of the population.

1.6 The water culture

Water was, and sometimes still is, considered a free gift of Nature. Furthermore, most people felt it to be government responsibility to take care of the water systems. This way of thinking was reinforced after Independence, when the government stated that they would provide modern water points for the population. Government policy has changed only recently and it is now accepted that users should contribute towards operation and maintenance and related costs.

Water use practices

Different ethnic groups in rural and semi-urban areas have their own water use habits but specific data are only available on two groups. Traditional wells of the Balantas, the largest ethnic group, are usually not protected. Often surface run-off can freely enter the wells, which are surrounded by pools of spilt water and wash water. The presence of dirt and frogs in the wells is not exceptional. The second main ethnic group, the Fulas, have a concern for cleanliness of water and some of them even use a water filter. They have a practical understanding of the relationship between polluted water and disease. Most of their traditional wells have an upper part consisting of an old oil drum with a cover against contamination (Visscher and Hofkes, 1982).

Factors which influence water use practices and upkeep of facilities include:

- ***Availability***
  In the South, traditional water sources remain available throughout the year, whereas in the North and East they dry up.

- ***Walking distance***
  This proved to be a decisive factor for people to choose between an existing well or a new well. A survey in the 'Buba' project revealed that out of 581 households, 363 mentioned use of the new well for reasons of distance, and only 56 households mentioned the reason of clean water.

- ***Religion***
  The Muslim culture, to which the Fulas belong, gives a historic importance to water use and cleanliness. The animistic culture, to which the Balantas belong, puts less emphasis on water handling and quality.

- ***Economic value***
  In the East, having a reliable water source for watering cattle is of great importance.

- ***Water quality***
  This concerns particularly the taste and suitability for clothes washing, whereas bacteriological quality seems of limited or no concern. A high iron content, for example, may easily lead to rejection of a water point. Considerable walking distances are accepted to fetch water with a better taste, even where an improved well is situated close to the house (Hermans et al., 1987).

Sometimes different sources are used for different purposes based on the following characteristics:

- drinking water should be visibly clean and tasty
- kitchen water should be available at short distance

- water for clothes washing should be available in sufficient quantity and preferably be flowing
- water for bathing should be available at a sheltered place to give privacy (Visscher and Hofkes, 1982).

Gender aspects

Women are responsible for most of the tasks related to water supply and water management - in fact, for everything except watering cattle and fetching water for preparing clay blocks. Women decide from where the water is fetched and for what purpose, and take certain responsibilities related to operation and maintenance.

In semi-urban centres women are willing to pay for water closer to the homestead areas, to reduce the amount of labour involved fetching water for domestic purposes. In rural areas, where cattle are an important economic factor, men are ready to contribute to water supplies to guarantee water supply to their cattle. In a survey concerning payment systems for handpump maintenance, it was seen that the decision and realization of financial payments is mainly a male activity (Hüsken et al., 1994). It should also be realized that, when people have been used to free water for many years, getting the idea of payment accepted is quite a process, involving changes in deep-rooted traditional habits.

1.7 Sanitation

Improvement of sanitation is not getting priority at all, and information on sanitation is hardly available. The statistical coverage is 18 percent for rural and 30 percent for urban and semi-urban areas. Most of the sanitary facilities are traditional latrines, many of them poorly built and hardly maintained. Only a few flush toilets are available, mostly in Bissau. In reality the coverage is even lower than indicated because of the inadequate functioning of the latrines. The low coverage represents a considerable health risk, particularly for areas with a higher population density. This may partly explain the high incidence of water- and sanitation-related disease in Guinea-Bissau.

ESA support for sanitation and hygiene promotion has been very low and strongly reflects the bias towards water supply improvement of the ESAs and the government as well as the population. Nevertheless, much higher priority will be needed for sanitation to break the transmission cycle of water- and sanitation-related diseases.

2. *Organization of the Sector*

2.1 Legal framework

Although a new 'Water Code' has been developed, the legal framework for the water sector is still very weak and comprises outdated juridical texts from the colonial period. The new 'Water Code' was prepared as part of the Master Plan, to cater for the need of a more comprehensive framework. This Code was approved in 1993, but still has no legal status as it has not been officially published. The main subjects covered are the administration and management of water resources, protection of the environment and regulations concerning rights to water use and water systems in which traditional water rights will continue to have a strong bearing on new legislation. The actual function and power of the Code has yet to be clarified and operationalized.

2.2 Directorate General of Water Resources

The Ministry of Energy, Industry and Natural Resources (MEIRN) has the prime responsibility for policy development and planning of sector activities, including putting into effect the Water Code. The executive agency of MEIRN is the Directorate General of Water Resources (DGRH). The objectives of DGRH have been defined as follows:

- to assure implementation of the national policy concerning water supply and basic sanitation in the rural and urban setting, through collaboration with relevant projects and organizations
- to manage water resources in such a way that conflicts between users are avoided and conservation is assured
- to guarantee protection of the population against negative effects of available water resources
- to develop the sector through promotion of investments, assuring finance, training of needed staff, reinforcement of the structure, participation of the population in water resources management, introduction of adapted technologies and coordination between the different institutes
- to realize legislative and normative actions and implementation of the 'Water Code'.

DGRH comprises three divisions: the Division of Planning, the Division of Water Resources Management and the Division of Water Supply and Sanitation. To enhance decentralization, DGRH has one Delegate in every province (Figure 4). In 1991, some 400 people were working within the DGRH, including sixteen engineers and fifteen higher level technicians. Most of the staff joined DGRH in the 1970s and 1980s and have experience primarily in project implementation. In response to the changing role of DGRH and under pressure of the Structural Adjustment Programme, over 120 staff members with implementation experience left the organization since 1991. The new role of facilitator requires further staff adjustments and a fundamental change in thinking within the ministry. Still today, for example, performance is valued in terms of investments and numbers of waterpoints constructed. Also, jobs related to construction have a higher status and better perspectives in terms of financial reward and career development within DGRH. Gradually, however, appreciation for long term planning is growing, as well as understanding of the importance of sustained functioning of water supply facilities. To facilitate the changes, a proposal is under discussion to restructure the different sections according to responsibilities and importance. The implementation of this proposal will need to include the development of job descriptions and training of staff.

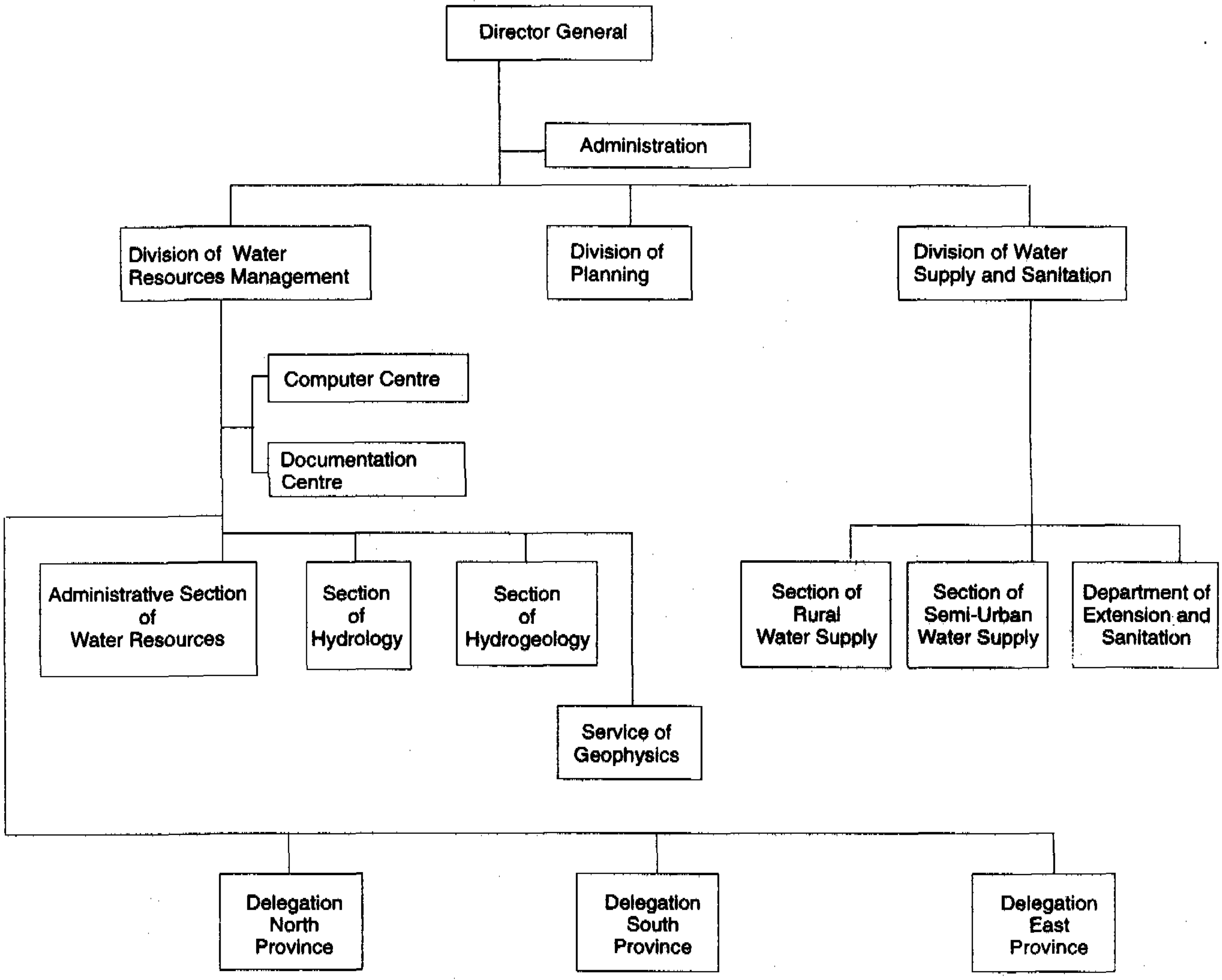


Figure 4: Structure of the Directorate General of Water Resources (DGRH) (based on Master Plan 1991).

The ***Division of Planning*** has the following main tasks:

- prepare decisions and projects concerning actions and programmes as foreseen in the Master Plan
- update inventory of water demand
- update the Master Plan
- evaluate the sector situation and the impact of programmes of DGRH
- identify funding support and maintain relations with supporting agencies
- maintain links with CIMA
- establish and monitor the annual plan of the DGRH.

The ***Division of Water Resources Management*** has the following main tasks:

- maintain and update the database on water resources allocation and exploitation
- realize technical, economic and legal studies to define and improve exploitation of water resources
- increase knowledge about the hydrological basin
- manage water resources and water rights administration

- authorize water resources allocation and exploitation
- control of waste water
- develop the Water Code and control its application
- ensure environmental protection of water resources
- supervise the provincial delegations
- collaborate with the Division of Planning for revision and implementation of the Master Plan.

The ***Division of Water Supply and Sanitation (DAAS)*** has been established to develop the water and sanitation sector and has the following main tasks:

- conceptualize water projects for village and semi-urban water supply and sanitation
- realize and supervise investments in the sector, including the preparation of specifications and criteria of equipment according to the conditions in Guinea-Bissau and preparation of tendering procedures
- take necessary action to guarantee proper functioning of the water supply and sanitation infrastructure, construction of bore holes, maintenance of pumps, distribution of spares and communication with users
- realize studies and stimulate research to establish low cost technology for different service levels
- evaluate the impact of projects, monitor the actual utilization of infrastructure and its performance
- collaborate with the Division of Planning for revision and management of the Master Plan.

DAAS comprises the Section of Rural Water Supply (SAAR), the Section of Semi-Urban Water Supply (SAAS), the Section of Sanitation and the Extension Department. The last two were functionally combined early in 1994, and operate presently as one Department of Extension and Sanitation.

The ***Extension Department*** was established in 1987 at the start of the MRW/H14 project. Its aim was to institutionalize the communication between the users of water supply and sanitation facilities and the Ministry. The operationalization and long term sustainability of this important department, which now also covers sanitation, still needs considerable attention, as it remains difficult for DGRH to attract specialized staff with a background in communication and participation methodologies.

2.3 Other governmental institutions

Several other governmental institutions play a role in the sector, including:

- Ministry of Public Health, working at the link between water, hygiene and sanitation.
- Public Enterprise for Electricity and Water Supply (EAGB), managing the water supply utilities of the capital, Bissau.
- Directorate General of Energy (DGE), managing the water supply in several semi-urban centres.

A private market is surely developing for national firms capable of making improved wells and boreholes. The UNDP is supporting the creation of an independent parastatal drilling company. Also, services are becoming available for carrying out socio-economic surveys and consultancies.

The NGO sector in Guinea-Bissau has been hardly visible until recent years. Some NGOs are now developing their activities, but these are not yet very much related to the water and sanitation sector.

2.6 Sector financing and ESA support

Over the period 1977-1990, the water sector received US$ 44 million, (US$ 50 per inhabitant), from different ESAs (Table 4). Some 70 percent of this funding was spent on water projects in rural areas, where the majority of the population is living. Relatively small amounts of money have been spent on the construction of sanitation facilities. At the start of the 1990s, ESA investments reduced significantly, mainly because of the uncertain political situation. Recently, however, the level of ESA investments, particularly from UNDP, UNICEF, the EC, France, the Netherlands and Japan, is increasing again.

Government contributions to the sector have been very small, reaching perhaps a level of some 5 to 10 percent of ESA funding. They covered, for example, part of the staff cost, but at low salary levels and through irregular payments.

Table 4: Principal ESA contributions to the sector, 1977-1990

ESA	*Funding in US$*	*Funding share %*
The Netherlands	13.7 million	31
United Nations	10.1 million	23
Saudi Arabia	9.2 million	21
USSR	4.7 million	11
Denmark	2.1 million	5
European Community	1.9 million	4
France	1.4 million	3
Sweden	0.7 million	2
TOTAL	43.8 million	100

ESAs have had a strong influence on sector developments, and have contributed not only to solving, but also to creating, problems. They often implemented their projects in isolation and introduced different technologies and different ways of communicating with the beneficiaries. They trained staff to different degrees and had their own views about institutional development.

Initially, ESA funds were spent on construction, under the assumption that the government would take responsibility for maintenance and repairs. As the government was not able to keep up the systems, the ESAs gradually also started to pay for repairs and spare parts. Users contributions were limited to financial contributions from owners of house connections in a very few piped water systems in semi-urban centres.

This changed in 1991, when the principle of user payment was accepted, adopting the following criteria:

- Water in rivers, aquifers or springs, directly available to people can be used at no cost for household purposes.
- Commercial use of water will be taxed by the government who will use this money for management of water resources.
- The State, in accordance with its actual financial capacity, will guarantee a minimum service level which will be equally distributed in return for some user contribution. Emphasis will be placed on assisting less privileged user groups.
- The beneficiaries should pay for maintenance, use and renewal of drinking water supply installations. Initial construction costs are the responsibility of the State, but users have to pay for the construction of systems above minimum service level.
- Beneficiaries will be fully charged when installations are used for other purposes than drinking water.

The introduction of the principle of payment by users has been very much stimulated by the MRW/H14 project, which trained and financed provincial extension teams to discuss these issues at village level. A gradual programme of handing over responsibilities from the government to the users was realized in the three provinces, and early in 1994 the full introduction of cost recovery and user management was completed for handpump water supplies. Communities also take full responsibility for the upkeep of traditional and improved wells, although still in some small areas buckets are being sold at subsidized prices.

In piped schemes, payment routines did exist for house connections and these are being expanded. Recently a start was also made with users' contributions for public standpost water supply in Mansoa and Catio. So far, this has met with limited success, as only some 10 percent of the users actually pay. This may be partly attributed to the fact that it is a new principle and that users have not been involved in the planning and implementation of the schemes.

3. *Water Supply in Rural Areas*

3.1 Water supply situation

Despite the important efforts the government has made, with support from ESAs, the majority (66 percent) of people in rural communities in Guinea-Bissau still depend for their water supply on traditional wells. Progress has been made, however, and over the period 1977 to 1989, a total of 1,991 new water points were constructed, comprising improved wells and handpump systems (Table 5).

Table 5: Water points constructed 1977-1989

Region	*Improved wells*	*Handpumps on drilled wells*	*Total*
Bafata	0	205	205
Gabu	180	329	509
Total East	180	534	714
Biombo	0	11	11
Cacheu	222	53	275
Oio	13	147	160
Total North	235	211	446
Quinara	132	158	290
Tombali	230	207	437
Bolama/Bijagos	66	38	104
Total South	428	403	831
TOTAL	843	1148	1991

Source: Master Plan, 1991

In 1989 a national seminar was organized on rural water supply with support from the MRW/H14 project and the IRC International Water and Sanitation Centre. Information on the existing situation was presented and it was found that the following nine different handpumps were installed: Briau Royal, Nepta, Buba, Volanta Holandês, Hydro vergnet, Volanta Português, India Mark II, Wavin and Kardia. The seminar clearly recognized the need to reduce the number of pump types. A gradual strategy was proposed, starting with regional standardization and limiting the purchase of new pumps to three types. The project gave strong follow-up to this recommendation, with positive results as can be seen from Table 6. There are now only two pump types in the North (Wavin and India Mark II) and in the South (Wavin and Buba), and four in the East.

The Volanta Holandês included in the table is the pump type DGRH promotes for use at local health centres, as it is able to act as a pressure pump to pump water into a small overhead storage tank.

Table 6: Regional distribution of handpump types

Handpumps	*North*		*East*		*South*		*Total*	
	1991	1994	1991	1994	1991	1994	1991	1994
Kardia	1	-	289	290	-	-	290	290
Hydrovergnet	1	-	78	72	2	-	81	72
Buba	31	-	5	-	332	315	368	315
Wavin	53	111	55	58	53	73	161	242
India Mark II	100	152	135	129	-	-	235	281
Volanta Holandês	-	16	-	-	-	3	-	19
other pump	27	-	-	-	13	-	40	-
TOTALS							1175	1219

Source: MRW/H14

In the North some fifteen wind pumps have been installed at wells for agricultural purposes (irrigation of vegetable gardens) with the help of an Italian NGO. Most of these water points are located outside the villages.

In 1994, some ten handpumps were replaced by solar pumps in the East, under the programme of the Comité permanent Inter-Etats de lutte contre la sècheresse dans le Sahel (CILSS) with finance from the European Community. The aim is to analyze the performance of these pumps under rural Guinean conditions. The pumps will be managed by the existing pump committees, which are expected to establish a fund to pay for breakdowns. Technical assistance will come during the first years from the European manufacturer, who is looking for a local representative capable of doing repairs of solar technology. The wind and solar pump technology do not yet form part of the rural standardization policy as defined by DGRH.

3.2 Performance of rural water supply systems

The performance of the rural water supply systems should be analyzed in terms of reliability, quantity, quality and accessibility. However, limited systematic data are available to make a proper judgement.

Traditional systems

Springs are often of good quality provided sufficient protection is given, but many reduce in flow towards the end of the dry season (April-May). Water holes are dug in low lying areas and are likely to be polluted. They often contain water also in the dry season, but may be situated several kilometres away from the villages.

Not much is known about the number and performance of traditional hand dug wells, but they seem to have an advantage in terms of local management and clearly defined ownership. Some are well-protected and provide good quality water throughout the year, whereas others are polluted or dry up. They basically draw water from shallow aquifers. The degree of pollution depends on the protection against infiltration of surface run-off, the way of water lifting (dirty rope/bucket), the intensity of use and the hydrogeological situation (depth and natural protection of the aquifer in use, distance of latrines).

In the South some traditional wells have been rehabilitated. This included deepening of the well and lining it with concrete rings. Yet this proved not very successful, as recharge problems continued and people did not benefit from an increased number of wells as would have been the case if new wells had been built. In some cases the water quality deteriorated as deepening resulted in the intrusion of saline groundwater. Also, access to rehabilitated wells was restricted because of private ownership. Therefore, rehabilitation of existing wells was no longer promoted in the Buba project.

New water supply systems

Protected dug wells. Some 450 wells have been constructed in the South, of which half need rehabilitation (Figure 5). Problems include drying up of wells and disintegration of porous concrete filter rings, due to low pH and low calcium content of the ground water. This leads to sand intrusion and ultimately collapse of the wells. This type of problem is not reported from wells constructed in the North and East.

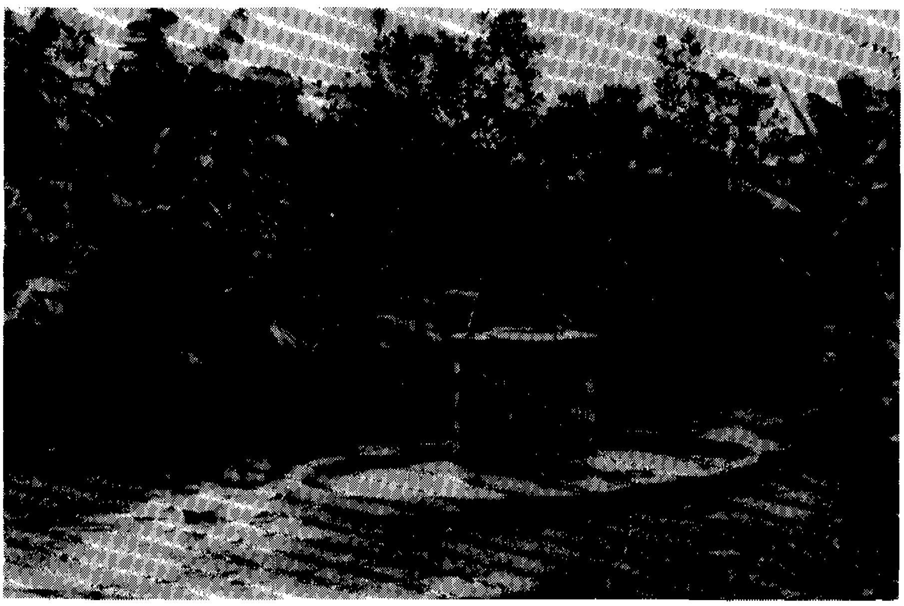


Figure 5: Protected well equipped with a rope and bucket system.

Throughout the country, bacteriological contamination of protected wells is lower than that of traditional wells.

A study by Rural Development Program in Boe (PADIB) showed that, out of 65 improved wells, water quality in 26 wells (40 percent) was fully acceptable, in 28 wells (43 percent) reasonable, requiring some curative and preventive action, and in six wells (9 percent) poor, calling for immediate curative action. In five wells (8 percent) the samples indicated a varying water quality. Out of thirteen traditional wells, 70 percent needed immediate curative action while the other 30 percent had a reasonable, though not fully acceptable, quality.

Management of new wells is normally organized through a well committee, differing in size and often initiated with the assistance of the organization which established the well. Some organizations continue their support after construction, such as the PADIB project in Boe, which is still importing and selling subsidized buckets; but elsewhere, spare parts are bought by the users on the local market.

Dug or drilled wells with handpumps. Different types of handpumps are installed, many of which showed unreliable performance and frequent breakdowns. An inventory in the North found that in 1987:

- 9 percent of the handpumps functioned normally
- 33 percent of the pumps functioned with deficiencies
- 58 percent of the pumps were out of order.

No performance data are available for the other two provinces, but verbal communication within DGRH revealed that the situation in the East and South was less critical.

Problems related to operation and maintenance found in 1988 included:

- costs of maintenance almost completely covered by project budgets, with government unable to support the high costs of the existing centralized maintenance system
- difficulties with transport and communication
- problems with spare part supply
- quality of water points not always up to standard; well drilling, in particular, has sometimes been poor, resulting in sand intrusion
- the conviction of the population that water is for free
- peoples' participation absent or limited to site selection.

In April 1989 a national seminar was organized to discuss the problems of maintenance of rural water supply. The main recommendations of this meeting were to:

- establish a decentralized maintenance system
- arrange for users' contribution
- reduce the number of pump types
- ensure an adequate supply and distribution of spare parts
- guarantee high quality of installations.

In follow up of this meeting a decentralized maintenance system was introduced which ensured spare part supply, trained local mechanics, and organized village water committees and user payment. A survey in 1993 of 217 handpumps (18 percent of the total number of handpumps) showed a marked improvement over the earlier findings in 1988, with 89 to 97 percent of pumps operating (Table 7). However, in the decentralized system, many essential services, including import and distribution of spare parts, tools and transport, are still supported by the externally-financed MRW/H14 project. Decentralized handpump maintenance may thus provide a high quality water supply at acceptable distance, but involves dependency on repair capacity and spare parts.

Table 7: Handpump performance, early 1993

Pump	Type	Visited	Functioning	Performance %
Wavin	VLOM	135	122	90
Kardia	non VLOM	28	25	89
India Mark II	non VLOM	19	17	89
Buba	non VLOM	35	34	97

Source: MRW/H14

Wind pumps. No data are available on the performance of the fifteen wind pumps. Spare parts are imported from a work shop in Dakar, Senegal, with the help of an Italian NGO. This pump type requires a somewhat higher level of mechanical skills for maintenance than handpumps.

3.3 Maintenance organization for rural water supply

In 1993 the Section for Rural Water Supply (SAAR) was established to stimulate regionalization, standardization and privatization. This Section is not only responsible for overall coordination, but presently also has the important tasks of estimating the total demand for spare parts and equipment and ensuring distribution to private selling points and the provincial stores from DGRH. For this they receive financial and organizational support from the MRW/H14 project.

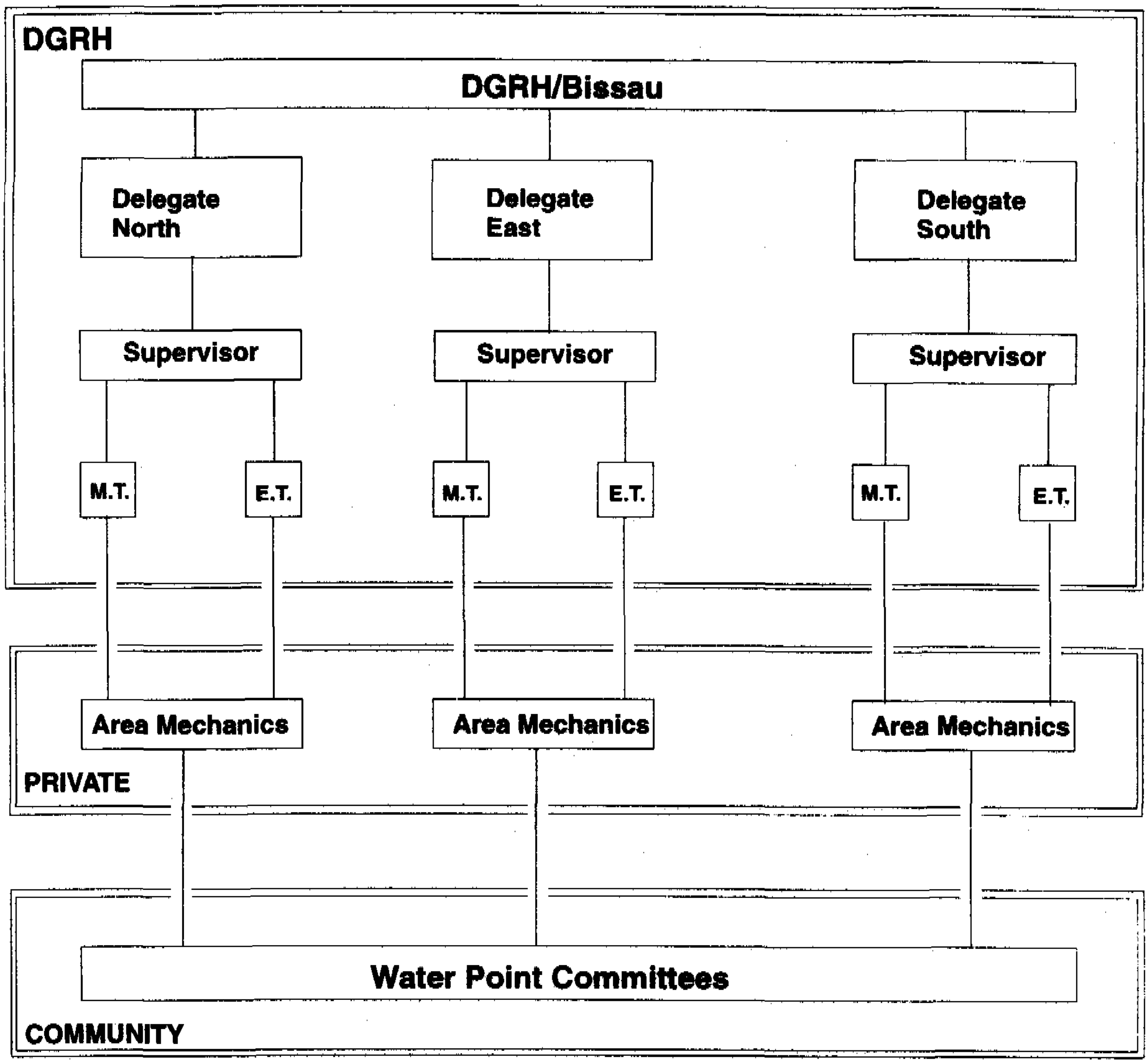
In each of the three provinces, North, East and South, a DGRH-nominated Delegate is in charge of all activities. Under their command, a Supervisor oversees maintenance activities, provides guidance to the provincial maintenance team and the promotion team, and also supports SAAR in data collection and monitoring.

Initially, there were eight regional maintenance teams of six persons each, which played an important role in standardization and pump replacement. The number has now been reduced to three provincial teams of four persons and action is underway to reduce this to two-person teams. These teams have now much more a backstopping role, as most of the maintenance has been handed over to the area or village level. An important problem is that the present set-up is not yet sustainable, as the teams are not financed by DGRH but work under the umbrella of the MRW/H14 project.

Both teams have a four-wheel drive car and the supervisor has access to a motor cycle. The provincial maintenance teams train area and village mechanics and provide support in case of complicated repairs.

The decentralized maintenance set-up which is in place involves two main models: a system with area mechanics (Figure 6) and a system with village mechanics.

Each province also has a project-financed extension team consisting of four persons, normally three female and one male, who are responsible for communication between the villages and DGRH. The extension teams play a vital role in the introduction of the maintenance system, working through community meetings and support visits in which they give special emphasis to the involvement of women.



M.T. = Provincial Maintenance Team
E.T. = Provincial Extension Team

Figure 6: Maintenance organization with area mechanics.

Maintenance through area mechanics

In a large part of the country, area mechanics are maintaining the pumps. This concerns the India Mark II, Kardia, Hydrovergnet and Buba pumps, which are not suitable to be maintained at village level. In the East, two area mechanics also maintain Wavin pumps. Each area mechanic is responsible for maintaining the pumps between fifteen and 30 villages.

Candidates for the position of area mechanic are selected in village meetings, which are facilitated by the provincial extension team. The final candidate is selected in a general meeting by representatives of the villages from the selected area. Villages still have a strong preference for male mechanics and presently all area mechanics are male. Important arguments mentioned by the villagers in favour of male mechanics include the travelling by bicycle to visit the villages and the physical labour involved in pump repair.

The mechanics receive a two-week training course organized by the provincial maintenance team and the Supervisor, and a yearly refresher course. The course includes technical training and elements of hygiene education and promotion.

The mechanics get a toolbox, an initial stock of spare parts and a bicycle. They receive payments for the repair of the pump, the amount depending on the complexity of the repair, e.g. repair of the upper part or also the below-ground parts.

The area mechanics have to comply with the following:

- Keep a register of the pumps in their area.
- Ensure proper functioning of the handpumps in their area, which implies monitoring and repair visits.
- Repair the pump, upon request and against payment. If the repair is unsatisfactory because the pump shows the same problem within a week, the pump should be repaired again, but free of cost.
- Maintain the bicycle and tools in good working condition. They remain the property of the provincial office of DGRH, but costs for maintenance and replacement, if lost, are the responsibility of the area mechanic.
- Keep a stock of spare parts and purchase new ones when required.

In early 1994, a total of 77 area mechanics had been trained and were at work in the provinces (North 12, East 32, South 33). Most of them visit the pumps regularly. They like the job and feel a moral obligation to perform well. The financial revenues, however, are limited and not sufficient to maintain their bicycle. Unless fees go up or other income is being generated the system will not be sustainable. An attempt to generate income by using the tools for bicycle repair proved not very feasible because of lack of demand. A potential solution may be the installation of a larger number of handpumps in their area, and in slowly deregulating price levels by reducing DGRH influence and leaving it more to the free market to adjust prices to regional economic capacities. If the new pumps are of a type which can be maintained at village level, this may contribute to a perhaps more feasible solution of phasing out the more complicated pumps as well as the need for area mechanics.

Village level maintenance

The concept of Village Level Operation and Management of Maintenance (VLOM) has been extensively promoted at international level as a reaction to the poor performance of many handpump programmes (IRC and IDRC, 1988). In Guinea-Bissau this resulted in the introduction of VLOM handpumps in all three provinces. The first pumps were installed in the South in areas with very low accessibility, particularly during the rainy season. These were Wavin handpumps with a capacity to draw water from a maximum of 20 metres depth. Most of these pumps replaced earlier installed pumps of a non-VLOM type. Installation was accompanied by a process of communication with the concerned villages.

The organization of maintenance of these pumps is in the hands of a village mechanic, who is a member of the Water Point Committee. The village mechanic is responsible for the proper functioning of the handpump and receives tools and some spare parts. The tasks are similar to those of the area mechanic, even though usually only one pump is maintained. Selection of the village mechanic is done in a village meeting in which the provincial promotion team strongly encourage the villagers to select women for this job, as they have a direct interest and are less likely to leave the village. In the North, for example, several male village mechanics travel frequently to Senegal to generate income, thus leaving their pumps unattended.

So far, the performance of the village mechanics has been promising, even though they do not receive remuneration for their activities. In mid 1993, a total of 177 village mechanics, including 98 females, were trained and maintaining their pumps.

Water Point Committees

Since 1988 Water Point Committees for every new water point have been established by the DGRH teams, with support from the MRW/H14 project. The committees should consist of two male and two female persons. In the case of VLOM pumps, one of these persons is trained as village mechanic. In the South, this implied an extension of the existing 403 two-person committees introduced earlier by the 'Buba' project (Visscher and Hofkes, 1982). In the North, 211 new committees were formed. In the East, 534 committees have been established, of which 58 deal with a VLOM pump. For these 58 VLOM pumps only seven committees include a village mechanic, whereas for the other 51 VLOM pumps, maintenance became the responsibility of two area mechanics.

The Water Point Committee needs to:

- control the proper use of the water pump
- realize opening hours for the pump
- keep the pump surroundings clean
- maintain the fence around the pump
- maintain the concrete apron
- keep a small stock of spares for repair
- raise money for maintenance
- purchase spare parts
- grease the pump
- repair the pump or inform the area mechanic
- help the village or area mechanic
- pay the area mechanic.

3.4 Performance of Water Point Committees

Early in 1994 a survey was made in 46 villages with handpump water supply to review the management performance of the Water Point Committees (WPCs). The results are presented in Table 8 and discussed below.

Although the initiative to create the committees came from outside, in only one of the 46 villages had the committee ceased to exist. In three villages the committee had only one member. In thirteen villages (30 percent), of which eleven are located in the South, the actual committee consisted of two members. This reflects the earlier approach of the Buba project which promoted two-person committees. In ten villages (20 percent) the committee consisted of three members, in sixteen villages (35 percent), four members, and in three villages, five members.

Some 53 percent of the committee members are female, with 20 percent of them having management type of functions which are outside their traditional task of cleaning pump surroundings. The majority of the female members are ordinary village women, while 40 percent of them are performing some kind of communal task within the village.

Women thus play a visible role in the committees and perform responsibilities which surpass their traditional role. The impact of these new roles of women needs further attention in relation to their work load and the possible reinforcement of their authority within the village.

Most of the committees actually manage the maintenance and use of the pumps. In several villages also, Village Committees are making a substantial contribution towards the organization of management tasks. These Village Committees were installed shortly after Independence to replace the traditional village structures. How far the activities of these two committees are complementary or overlapping is not clear. Some argue that the Village Committees are presently losing their influence and traditional leadership is becoming stronger again, but this can only be confirmed through a longer term monitoring process. This should provide the data for tuning the organizational structure in a flexible way to local possibilities.

Table 8: Performance of 46 Water Point Committees

	Activity performed in % of villages				***Activity organized by (%)***		***Activity implemented by (%)***	
ACTIVITY	**Total rural**	**North**	**East**	**South**	**WPC**	**female member**	**WPC**	**women**
1. control of handpump use	90	85	100	95	80	40	70	40
2. fixing pumping hours	40	45	75	20	80	20	95	25
3. cleaning pump surroundings	80	60	100	90	90	80	60	95
4. maintaining fence	50	45	75	45	80	0	35	0
5. repair of apron	2	-	-	6	2	-	-	-
6. control of VLOM pump repair	75	70	na	100	90	30	100	30
7. stock keeping in village	70	60	na	100	100	0	100	0
8. fund raising for repairs	80	80	na	100	65	0	55	20
9. purchase of spare parts	80	80	na	100	65	0	80	0
10. greasing of pump	70	100	65	50	70	0	15	0
11. notifying area mechanic	90	75	90	95	85	0	70	0
12. supporting area mechanic	75	65	80	80	80	10	20	30
13. paying area mechanic	70	65	80	70	80	10	?	?

Activity 1-5 concern all 46 visited pumps (North 18, East 11, South 17)
Activity 6-9 concern 13 VLOM pumps (North 10, South 3)
Activity 10-13 concern the 33 non VLOM pumps (North 8, East 11, South 14)

Source: Survey results Hüsken et al., 1994.

1. Control of handpump use. In 42 out of 46 villages, handpump use is currently controlled. In 34 of them, the WPC organizes this control and in 30, implements it. In thirteen villages, women had the main responsibility. In the remaining cases, active community members organized control (20 percent) and sometimes realized this themselves (30 percent). The main problems felt by community members included lack of discipline of users and too heavy use of the pump, probably indicating that too few pumps are available to them.

2. ***Fixing of pumping hours.*** In nineteen out of 46 villages, the use of the pump is limited to certain fixed hours, whereby the WPC plays the major role in fixing and keeping the hours. In five villages, women have the responsibility for this activity within the committee. Fixing pumping hours is not prescribed, but discussed at village meetings by the extension team as option to avoid misuse.

3. ***Cleaning of pump surrounding.*** In 37 out of 46 villages, this activity is organized by the WPC and in 33 they also realize the actual work. If not, then often leading village women take this responsibility. In 80 percent of the villages, the female WPC members organize the cleaning, whereby almost always (95 percent) women do the real job. In the North, only eleven out of eighteen villages clean the pump surroundings, whereas in the East this is done in all villages and in the South, in fifteen out of seventeen. The last figure is particularly interesting, since common thinking in the sector is that communities in the South are less interested in a clean water supply.

4. ***Maintaining a fence around the water point.*** In 24 out of 46 villages, a fence is maintained. In nineteen this work is organized by the WPC, but in only nine do they also carry it out themselves. The work is a male activity (cattle are owned and kept by men) and a considerable share (40 percent) is carried out by youths. In some areas, interest is clearly lacking, whereas in others no fence is needed as there are hardly any animals present.

5. ***Repair of the apron.*** In almost all villages, the population did not know who was responsible for repair of the concrete apron. Only in one case had an actual repair been made. It is unclear whether the WPCs are sufficiently aware of their responsibility in this respect. They may have problems in carrying out repairs, or may not see the urgency of repairing the apron, although it may result in pollution of the well.

6. ***Controlling repair of VLOM pump.*** In ten out of thirteen villages with a VLOM pump and a village mechanic, pump repair is carried out and controlled by the WPC. Yet only in three cases is the organization and execution of the work in the hands of female WPC members. An important problem is the frequent breakdown of the Wavin pump, and particularly pipe failures due to joint problems. In some cases in the North, the population has been so discouraged that they do not arrange the repairs any more, even if the lost parts are replaced free of cost.

7. ***Stock keeping at village level.*** In nine out of thirteen villages with a VLOM pump, a stock of spare parts was kept by the WPC. Yet although female village mechanics are responsible for maintenance and repair in several communities, they are not involved when it comes to purchasing spare parts.

8. ***Fund raising for repairs.*** In eleven out of thirteen villages with a VLOM pump, funds are collected when repair is due. In seven of them this is organized and implemented by the WPC and in four by the Village Committee. The organization is a male activity and only in two of the cases is the actual work done by women.

9. ***Purchase of spare parts.*** The buying of spare parts for VLOM pumps is a male activity and is mostly done (eleven out of thirteen villages) by the WPC and otherwise by the Village Committee.

10. ***Greasing of the pump.*** This was done in 22 out of 33 villages with a conventional pump, while in three of them a pump is installed which does not need lubrication. Although in every village the WPC is responsible for the greasing, in nineteen out of 22 the area mechanic did the job. The organization and realization was always in the hands of male villagers. The greasing activity was done in all of the villages visited in the North, but only in 50 percent and 65 percent respectively in the South and the East, possibly because of differences in the training of area mechanics.

11. ***Notifying the area mechanic.*** In 29 out of 33 villages depending on an area mechanic, there was a system to warn him in case of a breakdown. In the other four, the area mechanic was living close

by, the pump had never broken down, or the responsibility for pump maintenance had only been handed over to the population recently. Informing the area mechanic is almost always done by men, as it involves travel.

12. Supporting the area mechanic. A system to help the area mechanic exists in 25 out of 33 villages. In 20 of them, this is organized by the WPC; in the other five by the Village Committee or senior community members. In only five villages does the WPC actually assist in repairs, and in fifteen of the villages, the support is provided by village youth (male and female). In only two is the organization done by female villagers and in eight the actual support is provided by them.

13. Payment for area mechanics. In 24 of the 33 surveyed villages, a system existed for fund raising and paying the area mechanics and spare parts, and in nineteen of these this is organized by the WPC. Reasons for not having a proper system of payments were related to absence or incompetence of the mechanic and the absence of breakdowns. Organizing the payment of the area mechanic was done in only 10 percent of the cases by women.

3.5 Maintenance financing of rural water supply

Maintenance financing is still very much subsidized by ESA-funded projects. Users are increasingly contributing and the organization of users' payment is often done by the Water Point Committees. The cost items involved concern:

- the central team and the three regional teams, for training, supervision and backstopping and including salaries, transportation and equipment
- the area mechanic or the village mechanic, including fee and transportation by bicycle or public transport
- importation and distribution of spare parts.

Cost of the regional teams are fully covered by MRW/H14 project and DGRH.

Payment of area mechanics was introduced in 1990[1]. The initial financial compensation was fully determined by DGRH, and was kept low to facilitate introduction and acceptance of the principle of cost recovery. The levels were put at PG 5,000 for repairs of the upper part of the pump and PG 10,000 for below-ground repairs. In 1991 these levels were raised to PG 10,000 and PG 25,000 and again in 1993 to PG 25,000 and PG 50,000 respectively, after discussions between the regional delegates/supervisors, villages and area mechanics. The 1993 costs represent respectively 17 percent and 33 percent of the minimum wage level for civil servants (US$15 per month). The willingness and ability to pay these amounts differs from one region to another. In the discussions with DGRH, the communities in the East proposed payment levels for area mechanics which were twice as high as in the South. This led to a discussion about the regionalization of tariffs, but uniform tariffs still apply, which are communicated by radio to villagers and mechanics. Initiating tariff differentiation or leaving the tariffs to free market mechanisms seems worth studying in more detail. Village mechanics do not receive payment for their work.

1) exchange rates:

1990:	1 US$ = 2300 PG	1993:	1 US$ = 9800 PG
1991:	1 US$ = 4800 PG	1994:	1 US$ = 12.700 PG
1992:	1 US$ = 7300 PG		

The costs of transport and tools for the area mechanics, as derived from data provided by them in 1991, are shown in Table 9. Since then, the income from repairs has risen, but it is very clear that expenditure on depreciation and maintenance is not at all covered by the income received. This implies that the mechanic can hardly keep the bicycle running and can definitely not replace it every four years, unless more income is received from repairs or other sources.

Table 9: Cost balance for the area mechanic (1991)

Item	Investment PG	Annual Cost PG	Annual Income PG
bicycle	1,350,000	depreciation 200,000	
		maintenance 80,000	
tools	2,900,000	depreciation 300,000	
repairs			85,000

Adapted from: MRW/H14, Report First Phase, 1991. (1 US$ = 4800 PG)

Another important cost component is spare parts. Payment for spares was initiated in 1991 and is now the rule in all regions. Initial data on performance show that users still only pay part of the cost. Spare parts are being imported with financial support from the MRW/H14 project and sold in ten private shops and three government or project provincial stores to the mechanics or users, at subsidized rates (30 percent of CIF Bissau costs). Apart from handling charges, importation is free of tax. In 1993, a total of US$ 22,000 was spent on spare parts, of which users paid only 5-10 percent. The other part was subsidized by the project. Furthermore, the project spent about US$ 69,000 for renovation and substitution of pumps before they were handed over to users. This is already less than in previous years as the project spent some US$ 900,000 in pump substitution and renovation and spare parts supply over the period 1986-1994. Yet it is clear that user contributions still have to increase considerably before the systems can be self-sustained.

Revenue collection systems

In a survey covering 46 villages (Hüskes et al., 1994) four main types of revenue collection systems for communal activities were identified:

- collection, in cash or kind, at the time of need
- creation of funds through revenue collection at regular intervals
- collective work at the time of need, to raise money
- raising money from entrance fees for dancing parties or other events.

Only the first two options, however, are used for pump maintenance. In eight villages, revenues are collected regularly, whereas in 33 they are collected at the time of need. Twenty-two of these villages use this system also for other purposes, whereas the other eleven only use it for pump maintenance. In three villages, payment systems are not yet established or foreseen, while in two villages individuals volunteer to pay for the repairs.

In 20 percent of the villages, the whole population seems to be contributing towards paying for pump repair, without major difficulties. In another 40 percent the system has been initiated on the same footing, but serious problems seem to exist, as part of the population is not contributing (stopped paying, tired of paying, thinking of paying in future). In the remaining 40 percent of the villages, only a part of the total population is contributing towards maintenance since not everybody is using the pump because of distance, ethnic division, access to alternative water sources and capacity of the pump. The survey also established a distribution of the persons or groups mainly contributing to meeting maintenance cost (Table 10).

Table 10: Persons or groups paying for maintenance

Person or group paying the cost	***no villages***	***share %***
only women	1	2
only men	2	4
adult men and women; in four villages women pay less	27	59
cooking unit (both men and women)	11	24
payment system not yet established	5	11

4. *Water Supply in Semi-urban Centres*

4.1 The semi-urban centres

The Master Plan identifies 35 semi-urban centres, applying the following criteria:

- communities above 2,000 population except Bissau
- communities below 2,000 population with existing piped supply.

The MRW/H14 project proposed in 1993 to add another six centres to the list as these will have a population over 2,000 by the year 2000, bringing the total to 41 semi-urban centres. They are spread over the country and often give the impression of an expanded village with scattered housing. Most of the centres have less than 5,000 population and all are below 25,000 (Table 11). The three centres above 10,000 inhabitants are Gabu, Bafata and the conglomerate Biombo.

Table 11: Size of semi-urban centres in Guinea-Bissau

Number of inhabitants	*Number of semi-urban centres*
< 2000	8 (19.5%)
2001 - 3000	15 (36.6%)
3001 - 5000	9 (22.0%)
5001 - 10000	6 (14.6%)
> 10000	3 (7.3%)
Total	41

Source: MRW/H14, base report SUC 1993.

4.2 The water supply situation

In 1993, 33 of the 41 centres had a system for piped water supply drawing water from confined aquifers. Sufficient water is available in these aquifers also for the future, but quality is not always in line with the requirements of the population. The capacity of the existing wells is 985 m^3/h which is sufficient to provide between 50 and 100 lpcd to the population in the different centres. Available pumping capacity, however, is only 446 m^3/h.

In six of the 33 centres, a Prakla Seismos system exists which comprises a well, a pump, a generator and a ground level reservoir ($20m^3$) with eight taps. In the other 27 centres the systems have an overhead storage reservoir and a distribution network, but not always of good quality and not well-maintained. These systems were initially constructed during the colonial period. In thirteen centres, new systems and distribution networks have been built since independence. In nine centres, systems have been rehabilitated partially and in five rehabilitation is still due.

In most cases, the piped water supply only serves a small part of the population and functions with great difficulties or not at all. The larger part of the population still relies on traditional and new water points which are similar to those in the rural communities, although the well density is usually higher (Table 12). In 21 centres surveyed, seven improved wells were found, of which none fell dry. In total, 100 handpumps are installed in these 21 semi-urban centres, the distribution being as follows: Wavin (28), Buba (28), Kardia (18), India Mark II (16), Volanta Holandês (6), Hydro Vergnet (3) and Aquadev (1). An overview of the non-piped systems in the semi-urban centres is given in Annex 1.

Piped water supply involves basically two service levels: house connections and public standposts. Furthermore, a few yard connections exist. Table 12 gives the coverage distribution for the different systems. True coverage for the piped supplies, however, is lower than indicated, as often schemes are not functioning. In the centres over 5,000 population, coverage for both service levels is five times higher than in the smaller centres.

Table 12 clearly shows that traditional water points are also the most important system in semi-urban centres. The vulnerability to pollution of these traditional sources is known to be high, and drying up of these wells strongly influences the actual coverage.

Table 12: Water supply coverage in semi-urban centres

Type of water supply systems	*Population % with access*
traditional water points	68
improved water points	12
piped supply / house connections	9
piped supply / public standposts	11

Source: MRW/H14

4.3 Performance of semi-urban water supply systems

Traditional Water Points

The general performance of traditional water points in semi-urban centres differs over the country and is very much comparable with the situation in rural areas. Water availability in the dry season is, for example, much more serious in Mansoa than in Catio (Table 13). In Mansoa, out of the 66 traditional wells, only six can be used in the dry season, the others run dry for periods of one to three months.The water quality differs also considerably and depends very much on the type of system and its use. Very little has been done so far to encourage people to better protect the traditional sources.

Improved Water Points

Improved wells and handpumps are common in most semi-urban centres and often of similar quality to the systems in rural communities, although the environmental conditions may involve a somewhat higher hygiene risk because of a larger number of users and poor drainage.

Table 13: Traditional wells in three semi-urban centres

	No of traditional wells		
	drying up	*don't dry*	*total*
Bissora	75	22	97
Catio	7	60	67
Mansoa	60	6	66

Source: MRW/H14, 1993

Piped systems without distribution network

The Prakla Seismos system shows a mixed performance and provides water of good bacteriological quality. Although pumping is intermittent, the absence of a distribution system reduces the risk of contamination. Users have a lower service level, however, as they have to collect the water from the taps and may contaminate the water during transport. The technical viability of the system depends on the functioning of the generator, electric pump and the availability of fuel. The system has been constructed in central locations in six smaller centres in the East. In June 1993, three out of six systems were out of order for a long period of time because of a broken pump or generator.

Piped systems with distribution network

Out of the 27 systems, five, dating from the colonial period, are completely abandoned. Thirteen systems have been fully renovated and nine only partially renovated, excluding the distribution network. The initial quality of the installations is not always adequate and is not formally guaranteed by DGRH. Eleven of the thirteen fully-renovated systems, and five of the nine partly-renovated ones, are actually operating. Preventive maintenance is not practised and repairs are often not very effective and are sometimes made by cannibalising similar equipment in stock. As a result, systems are in a bad state and present high water losses.

In total sixteen out of 27 schemes (59 percent) are functioning, but often for only a few hours per day or per week, with frequent breakdowns due to operational and managerial weaknesses and unclear institutional arrangements. This includes: lack of fuel, lack of spare parts, technical problems, lack of funds and irregular electricity supply. Thus, where a high level of service could be provided, the technical and organizational complexity of the systems demand high levels of management skills, which are normally absent. Nevertheless, a survey showed that, with a few exceptions, no problems of water quality were encountered, although there is always a risk of polluted water entering when systems are not under pressure.

Systems depending on the electricity supply of the centre often can only pump during the evening. This implies that reservoirs are not recharged during daytime, thus causing irregular water supply. By the end of the month the situation is often worse, as electricity is even more rationed because of lack of fuel. Although the government has been providing semi-urban centres with a free monthly quantity of fuel, this was in most cases not sufficient to run the city electricity supply in such a way that the water supply was guaranteed. In early 1994, these fuel supplies also stopped, meaning, for example, that Bafata, the second city in the country, was without piped water supply for more than six months.

4.4 Maintenance organization for semi-urban water supply

Management and maintenance of the water supply of the semi-urban centres is complex as it concerns a range of systems which includes traditional water points, improved water points and piped schemes.

Traditional water points have private management and improved wells normally have a Water Point Committee. Decentralized maintenance of handpumps, as applied in rural areas, has been introduced by SAAR in about 50 percent of the semi-urban centres. The remaining pumps are managed by individuals and by (semi)public institutions.

The Section for Semi-Urban Water Supply (SAAS), within the Division of Water Supply and Sanitation, assumed overall responsibility for maintenance of semi-urban water systems in 1991. They focus, however, only on the piped systems, which are often also dependent on electricity supply which is the responsibility of the Directorate of Energy (DGE) of MEIRN. Even the management organization for piped systems is not fully clear and is quite complicated, as several other institutions are involved, often having inadequate means to keep the systems functioning at an acceptable level.

Piped systems without distribution network. In six centres, Prakla Seismos systems are installed. In four cases these are managed by the local State Committees, and in two cases by the Village Committee. Daily operation is in the hands of a person chosen by the neighbourhood in which the system is located, with the assistance of an operator for the pump and generator. Technical assistance for major repairs is to some extent given by the provincial Delegate of DGRH and realized by the Prakla company. No spare parts are kept in stock, and three out of six systems have broken down. Users apparently have to pay for the water by volume, but no firm data exist on the performance of this system. Revenues are used to purchase fuel from the nearest gas station. The operator and manager of the systems are normally not paid.

Piped systems with distribution network. Out of the 27 systems, seventeen have been visited, including five with a non-functioning system, to analyze the management situation (Annex 2). In six centres, the local State committee is responsible and in another five, the Directorate of Energy. DGRH is directly operating systems in two centres. Two centres have private management. In one centre (Mansoa) the local management is under the responsibility of the users' association, with the assistance of DGRH. Only one system is managed by the Empresa de Água da Guiné-Bissau (EAGB), which is also responsible for the systems in Bissau.

The survey also showed that:

- Responsibilities are not clearly defined between the different actors within the management system (DGE, state committee and DGRH), concerning operation, maintenance and repair.
- Activities related to operation and maintenance are mostly limited to switching on pumps and management of energy supply. For (major) repairs the local management calls on the DGRH, which decides about the intervention and realizes the work. Thereafter, DGRH sends the bill to the local management organization. No independent control is realized as this would imply that DGRH would be controlling itself.
- Local operators often have very little knowledge about the system and their tasks, and do not receive supervision or backstopping.
- Preventive maintenance is not realized.
- Where pumps are connected to the electricity network, energy supply is always intermittent, and no continuous water supply is provided.
- Water production and quality are not measured and registered.

To gain experience with decentralized maintenance systems, a water users' association was established in Mansoa. A contract was signed between DGRH and the association with a description of the mutual responsibilities. Representatives of users with a house connection and representatives of public standposts elected a board which is responsible for daily management and contact with DGRH at central level. A standpost committee has been elected by the users of each standpost to administer its use. Although it is still too early to draw firm conclusions, it can be said that the association has internal difficulties and the final organizational structure has not yet been found. Lack of available and capable staff, pursuit of personal benefits, and problems in realizing financial contributions for the use of standposts are main issues. DGRH, with support from the MRW/H14 project, is trying to facilitate the internal strengthening of the local association through administrative and technical training and support.

Another experience is realized in the city of Catio, where a local DGRH staff member is made responsible for the functioning of the piped system. He is assisted by a technician and an administrator. Technical and administrative support is given by DGRH, with assistance from the MRW/H14 project, to realize 24 hours supply and recover running costs from the users. Presently the system is working, but it is too early to draw major conclusions.

4.5 Maintenance financing

In nine out of the seventeen centres visited in the survey, no payment system exists, implying 100 percent subsidy by the State. In eight centres, fixed tariffs to the users are set, including five where DGE is responsible and implements a combined tariff for electricity and water supply. Also in these eight centres supply is partially subsidized by the State, as the local DGE representatives and the State Committees receive a fixed monthly fuel quota, which depends on the size of the centre. The DGE representatives do not pay for the fuel whereas the State Committees pay 50 percent of the rates the DGE has to pay to the national oil company.

No clear data exist concerning cost and revenues of the systems, as no books are kept on expenditures for the water supply system and the electricity supply where one combined tariff is applied.

In some DGE managed systems, payments were only requested from house connections, and did not have a relation with water consumption. Collected funds were transferred to central level, and not used to maintain the existing infrastructure or realize needed investments.

The poor performance data show a vicious circle of bad service and poor payment. This possibly can only be overcome by making the systems more reliable and realizing a service which is demanded by users. With the existing systems it is unsure that potential users are willing to pay the required tariff, the more so as systems have previously functioned, albeit irregularly, free of cost, and people do have access to alternative water sources. Involving users in the organization, mainly women, will be crucial to be able to respond to felt needs and arrive at a viable system. On the other hand, much better insight is required into the costs of the system, particularly as, in the near future, it may only be economically feasible in most centres to better protect traditional water sources and construct some new wells.

5. *Potential of Existing Water Supply Options*

The sustained functioning and expansion of water supply systems in Guinea-Bissau is a matter of choice. In the next sections key aspects of the existing water supply options will be reviewed and their sustainability assessed.

5.1 Open wells

Two types of open wells exist, traditional wells and lined dug wells with head walls and well cover. These wells are widely spread over the country and are very important for community water supply.

Environmental aspects

Open wells use shallow aquifers and many have recharge problems towards the end of the dry season, thus not providing a year-round sustainable water supply. Improved lined wells are often deeper and show better performance, particularly in the East and North, but in the South many still run dry. The limited quantity of water drawn from these wells does not pose a threat of over-abstraction of groundwater. The groundwater fluctuation over the year is a natural phenomenon, although due to reduced rainfall, groundwater levels are tending to fall, which may make shallow groundwater a less feasible option.

Technological aspects

Traditional open wells are built with locally available materials. The wells are not lined and are usually not protected against inflow of surface runoff. Some, however, have a protection consisting of an old oil drum. Cement is rarely used. The construction is simple and done by local traditional well diggers, having access to all needed materials.

The construction of improved wells is simple, using technologies which can easily be mastered through local training. Well diggers are trained in a school for improved well construction in São Domingos. Recently, national private companies have started construction of improved wells of satisfactory quality. The only external dependency is therefore the use of imported cement. In the South, problems have occurred with porous filter rings, but these can most likely be overcome by the use of perforated rings.

Organizational aspects

Management, use and maintenance of traditional wells is decided and organized by the owner. Women of the household have direct access, but often no control over management.

The improved wells are mostly for public use but the ownership is not well defined. Official handing over was foreseen in the South, but delayed because of poor performance of the wells. In the North and the East this is being planned after a review of the actual status of the wells. These wells are managed by a committee of up to four male and female members. The tasks involved are limited to keeping the well clean and carrying out some minor repairs. Major maintenance activities including deepening of the well and repairing the headwall or the lining are not arranged. In the North, capacity is available to carry out these repairs, but not in the South and East.

Socio-economic aspects

Traditional wells are often used by a small group of people who share the cost. The investment costs for traditional hand dug wells range between US$ 6 and US$ 13 per user for a 15-metre deep well with fifteen users. Actual maintenance cost, including yearly cleaning of the well, may amount to between US$ 1.5 and US$ 1.9 per user per year, which is relatively high because of the low number of users. No information is available about the cost sharing for maintenance and the contribution of female members of households.

Construction of new community wells is normally financed by ESAs. The investment cost for dug wells range between US$ 30 and US$ 40 per user for a 20-metre deep well with 100 users and built by a local contractor. Maintenance costs are mainly related to the wear and tear of the rope and bucket system, and may amount to some US$ 0.30 per user per year.

In the absence of national guidelines, participation of future male and female users in planning and managing the wells is largely dependent on the views of the financing agency. Common practice is to request a contribution through supplying food and lodging for the well diggers' team and cleaning the future well site.

Health risk

Access to the water is secured through a rope and bucket system or private buckets, implying hardly any dependency on outside support. Only towards the end of the dry season may problems occur with drying up of wells.

The sanitary condition of traditional wells often is not very good, thus involving a high sanitary risk. This concerns direct pollution through contaminated buckets and seepage from latrines and spilled water.

Compared with traditional wells, improved wells give an increased availability of water in terms of quantity. Quality, however, is not ensured and depends on the way water is drawn and the well is protected. So the improved wells still provide a health risk, but may contribute to health improvements as water availability is often of greater importance than quality (Esrey, 1994).

5.2 VLOM handpumps on dug or drilled wells

In Guinea-Bissau, almost 250 handpumps have been installed which qualify as Village Level Operation and Management of Maintenance (VLOM) pumps. This is some 20 percent of the total number of handpumps and most of them are being maintained by a village mechanic. They are placed on dug, hand drilled or machine drilled wells.

Environmental aspects

Pumps drawing water from shallow aquifers show similar problems to the improved wells, with some wells running dry towards the end of the dry season. Pumps on deep wells do not have this problem as the fall of the water table is still limited. Only the increase of irrigation schemes carries the risk of drawing down the water levels considerably, which may pose a threat to long-term sustainability. The handpumps themselves draw very little water, only 8-10 m^3/day, which is causing no risk of depletion to aquifers.

Technological aspects

The principles of VLOM pumps seem to match very well with the conditions in Guinea-Bissau. Although VLOM pumps are imported, they can be installed and maintained without heavy equipment or high level expertise. A considerable number of Wavin pumps have been installed. Some presented technical problems due to breaking pipe joints because of poor glueing, but these now seem to have been solved. Several other VLOM pumps are presently being tested as well.

Two important aspects have to be guaranteed to ensure the technical sustainability of VLOM pumps. Spare parts need to be available in the market and need to be imported. Local production of spare parts and pumps is not feasible for the next few years, but local or regional assembly of pumps may be an option. Furthermore, equipment and expertise needs to be available for cleaning of wells. This is a bigger problem in the East, where a considerable number of wells exist which gradually are filling up with sand because of construction problems, and therefore need frequent cleaning.

Organizational aspects

A Water Point Committee organizes the maintenance of the pump and includes one trained village mechanic. So far, repairs are done satisfactorily even though no payment is received. Both male and female mechanics exist and are well equipped to do the job, but female mechanics have a preference as they leave the village far less frequently than men. Nevertheless, most pumps continue functioning even if the village mechanics are absent. Then, relatively untrained villagers manage repairs.

Although the external dependency on spare parts remains, the VLOM pump option is very reliable as village mechanics are directly accessible and in close contact with the pump users.

Socio-economic aspects

The investment costs have been largely met by ESAs and range between US$ 60 and US$ 120 per user for deep wells with 150 users, depending on the depth of the well and the method of drilling. Machine drilling is particularly costly in Africa and leaves room for high cost savings through adequate planning and management. Hand drilled wells of some 20 metres are much cheaper and may cost US$ 30 per user.

VLOM pumps cost between US$ 750 and US$ 2,000 and so costs range between US$ 5 and US$ 15 per user for 150 users.

Costs involved in maintenance primarily concern the purchase of spare parts, including importation and transport. These costs amount to some US$ 0.3 per user per year. These costs are still being subsidized to a considerable extent from MRW/H14 project funds. This will have to change through asking larger users' contributions, which seems possible particularly in the North and the East. Privatization of the import and selling of spare parts needs attention to reach a sustainable situation. Costs for central support services can be limited to training and monitoring. At this moment the village mechanic is not paid, but in future they may ask for some renumeration in cash or kind.

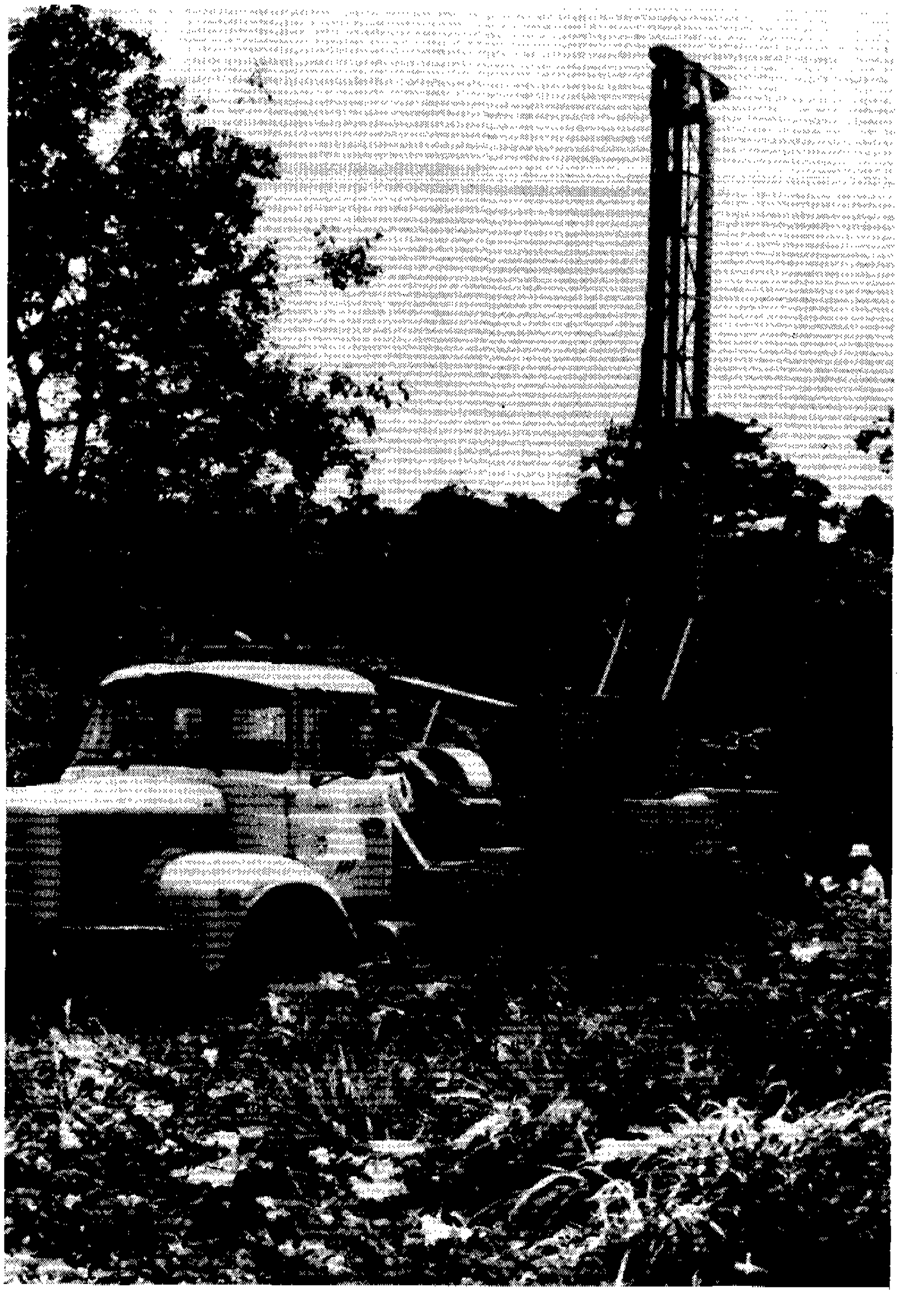


Figure 7: Well drilling involves considerable cost.

Health risk

VLOM pumps deliver clean drinking water, as long as the aquifer is not polluted and repairs are made in a clean way. To limit the risk of pollution, the location of the pump should be away from latrines, soakaways, graveyards or refuse dumps. The aquifers in Guinea-Bissau are still of good quality as population density is low and agro-industry and small scale industry has not much developed. Car repair workshops and small-scale leather industries may, however, create problems in some locations.

Direct pollution by seepage water should be avoided by proper installation and sealing of the connection between the handpump and the apron and by repairing possible cracks in the apron. Furthermore, proper drainage needs to be maintained, to avoid spill water becoming a nuisance and a health risk.

The most important health risk is the possibility of polluting the water during transport to the house and during storage. This requires hygiene education programmes in which modern education and learning techniques such as games and role plays are used to help men, women and children to draw their own conclusions and change their own behaviour.

5.3 Conventional handpumps on dug or drilled wells

Some 80 percent of the 1,200 handpumps in Guinea-Bissau are conventional pumps. Four main trademarks are available, having rather similar maintenance requirements.

Environmental aspects

These aspects are similar to those described in section 5.2 and do not pose a major problem except for hand drilled wells in locations where fluctuation in ground water level is high.

Technological aspects

The installation and repair of conventional handpumps is more complicated than of VLOM pumps. It requires more skill and knowledge and better tools and equipment. Therefore more training is also required to ensure that repairs are being made properly. So in this case, not only spare parts and well maintenance need to be guaranteed as described in 5.2, but also the availability of regional repair capacity.

Organizational aspects

At present a three-tier maintenance system exists which comprises a Water Point Committee, an area mechanic and a provincial technical support team. This system has the advantage that communication lines between pump users and area mechanics are not too long and long periods between breakdown and repair can be avoided. Nevertheless the organization is much more complex than with VLOM pumps, because the area mechanic cannot do all repairs without support from the provincial team. This implies that it is much more difficult for the users and the Water Point Committee to ensure the continuous functioning of the conventional pump.

Socio-economic aspects

Cost of the wells are similar to those indicated in section 5.2, but most conventional pumps are more expensive than VLOM pumps and spare parts tend to be more costly as well. Investment costs for conventional pumps may range between US$ 10 to US$ 20 per user. Also, pump installation requires more manpower and material.

Whereas for VLOM pump maintenance at present the spare parts are the main cost item, the costs involved in maintaining conventional pumps are higher and may be estimated at US$ 0.5 to US$ 0.7 per user per year. This includes payment and transport of the area mechanic as well as the provincial team. Presently, these costs are almost fully born by the MRW/H14 project, and it remains to be seen if they can indeed be fully transferred to the users. The present policy of making area mechanics totally responsible for the maintenance of their bicycles needs close monitoring. The situation has improved somewhat in that bicycles are no longer imported from the Netherlands, but from Senegal or purchased on the local market. This implies a larger availability of spare parts, but still the tariffs set by DGRH do not sufficiently cover the cost, and do not permit the mechanic to properly maintain his bicycle.

Health risk

The health risks involved are very similar to those of VLOM pumps, although the risk of pollution from repairs may be slightly less if mechanics are well trained.

5.4 Piped systems

Piped systems are available in 33 semi-urban centres, and basically serve only a small part of the population living there. Six systems comprise only a pump and a storage tank, but no distribution network.

Environmental aspects

Water resources are sufficient to cover the needs of the population in the rural areas and semi-urban centres in the foreseeable future. Recharge capacity of the wells, however, may not always match the pump capacity, as sometimes pumps are replaced without paying much attention to pumping capacity.

Some environmental problems relate to the very old generators which supply energy for the electrical pumps. Many of these generators have a high fuel consumption and also oil spillage is very common, entailing a risk of aquifer pollution.

Technological aspects

Piped pumped schemes require much higher knowledge and skills than handpump systems. Advanced knowledge is needed to design the system and calculate pump capacity. Furthermore, all system elements need to be imported. For adequate maintenance of the pumps and generators trained caretakers are needed, who should receive sufficient payment to take full responsibility for maintenance. Also, the piped system itself needs to be maintained to avoid leakages and reduce the risk of infiltration of polluted water. These types of skills are presently not available in the semi-urban centres, making the systems non-sustainable under present conditions.

Organizational aspects

Piped water supply demands organizational inputs at different levels. Locally people are needed to operate the system, check its performance and maintain it in all its aspects, including preventive maintenance. The complexity of the system makes it necessary that the operators have access to a wide range of resources, including spare parts, fuel or electricity and tools.

As the costs of operation and maintenance are considerable, the administrative tasks are also quite demanding: collection of revenues, administration of expenditures and management of fuel and spare parts. Also, user consultation is an important task which is often overlooked.

Presently some pilot projects are being realized in centres with existing piped schemes, to get a better insight into their requirements and feasibility for application in Guinea-Bissau. Although no firm conclusions can be drawn yet, it is felt that piped supplies may not be the most sustainable solution for many of the semi-urban centres. It is crucial to first establish properly functioning systems in a few locations before continuing with the rehabilitation of systems in new centres in order not to build a new series of non-functioning monuments. Improved wells and VLOM handpumps may be a much better choice at this moment, particularly for the smaller centres.

Socio-economic aspects

Investment cost for piped systems in Guinea-Bissau are not very well known, but may be estimated to range from US$ 60 to US$ 100 per user for centres of 5,000 population. The lowest figure is for the Prakla Seismos system, which comprises only a pump and a ground storage tank, thus having a lower service level as people still have to fetch the water and carry it home. Running costs for pumped schemes are considerable and may be in the order of US$ 2 to US$ 4 per year per user. In addition, maintenance cost have to be paid, which brings the cost to US$ 3 to US$ 5 per user per year. Almost all these costs will have to be met in foreign currency as they mostly concern fuel and imported spares.

Piped supply with house connections and public standposts implies a higher service level than handpumps, provided the schemes operate for sufficiently long periods of the day. This can only be achieved if the tariff covers the running costs or if high subsidies are being given. Presently the latter is very much the case, and only a small number of people with house connections, and an even smaller number of users of public standposts, pay their tariffs - which are too low to cover the costs anyway. On the other hand, only a relatively small part of the population in the semi-urban centres benefits from piped supplies. The larger part still rely on traditional wells or improved water points, also because they prefer the taste of this water over the water from the piped scheme, which sometimes has a high mineral content.

An experiment in one centre, in which tariffs for public standpost water supply were fixed after a survey on willingness to pay, is not yet completed, but some resistance against payment has been detected and definitely the costs of operation and maintenance are not covered. Unless cost recovery is increased, these systems are not feasible, since the subsidy level they involve cannot be sustained.

Health risk

The current piped supply schemes operate intermittently and therefore still involve a health risk. Water availability is not secured at the time of demand, thus requiring water storage at home, which is more prone to pollution. People may also continue using their traditional facilities alongside the piped scheme. At times of low pressure, pollution may enter the distribution network, particularly in the rainy season. The challenge thus is to provide 24 hours supply, or provide people with access to point water sources without distribution network.

5.5 Solar and wind pumps

Guinea-Bissau is beginning with the application of solar pumps, which may have considerable potential. Ten pumps have been installed and are being monitored. Furthermore, fifteen windpumps have been installed.

Environmental aspects

The use of solar and wind energy is very positive for the environment and the only small risk associated with these pumps is local overpumping of the aquifer. The radiation level in Guinea-Bissau is sufficient to ensure a continuous water supply, although it needs further experiment to see if, for rainy days, a backup system, such as a connection to the electricity grid or a handpump, is needed. Wind pumps have a very low potential as the wind regime seems to be only sufficiently reliable in the North and even that needs to be confirmed through further study.

Technological aspects

Solar technology is sophisticated but does not need frequent repairs. Current experience is, however, that when breakdowns occur, these may last for a very long period of time, up to several months. So only if the repair capacity in the country is increased and spare part supply is guaranteed may this option be considered. A pilot project financed by the EC does try to overcome these kind of problems by realizing a maintenance contract with the supplier of the pumps, for the initial years of installation.

The wind pump which is presently installed in the North West is made in Dakar, Senegal. Local mechanics are trained and master the technology which is relatively simple.

Organizational aspects

The management of a solar pumped system is not much different and probably easier than systems driven by electrical or diesel pumps. It has a major advantage that fuel supply does not have to be secured, which is one of the very big bottlenecks in the country. Experiments with solar pumps, however, have only just started, and need further review to really establish their potential.

Wind pumps are presently used as point water supplies and maintained by a mechanic with backup of an NGO. The mechanic is part of a committee of six persons which manages the pump. The organizational set up required for this is similar to the systems with conventional handpumps indicated in 6.3.

Socio-economic aspects

Solar pumps in use in Guinea-Bissau have a capacity of 1-2 m^3/h. The investment cost of the ten pumps installed on existing wells ranges between US$ 150 and US$ 240, including a reservoir and distribution system but excluding the cost of the well, which is of the same order as a well for a handpump. Despite the high investment cost, which may reduce in future, solar pumps are interesting as they do not imply high running costs, just the cost of a local caretaker to do minimum preventive maintenance. Furthermore, the cost of repairs needs to be catered for, but it is not yet clear what these costs will be in the context of Guinea-Bissau. An experiment is being implemented to establish a maintenance fund for solar pumps in the bank. It is not yet clear how the community will have access to and control over this fund. The contribution is net at US$ 2.4 per capita per year.

Wind pumps are used primarily for horticulture and may be maintained from the derived revenue. The continuity of supply depends very much on the wind regime, thus making a backup service, for example, in the form of a handpump, necessary. This makes the system rather costly to be used for drinking water alone.

Health risk

Solar pumps are installed on boreholes or wells in a similar way as handpumps or electrical pumps. The health risk is therefore low, as explained for those types of systems, and may be even lower if, through proper overhead storage, a 24-hour supply can be safeguarded. Present wind pumps are installed on open wells, thus representing a health risk.

5.6 Comparing the options

The different options which are available are being compared in this section. Table 14 summarizes the four different well types which are available and Table 15 the five water supply systems.

Environmental aspects

From an environmental point of view only the use of electrical or diesel pumps, particularly for irrigation, may pose problems of drawing down water tables. This appears more a local problem which can be assessed and reasonably controlled on a case by case basis.

Reduced recharge levels because of lower rainfall, reduced forest cover, and insufficient river basin management do pose a risk to all technology options. These are, however, of a lower magnitude for deep ground water than for shallow ground water, which shows considerable seasonal changes. Through proper siting of wells and planning the desired depth, taking into account a possible fall of the water table, no true restriction on choice is being posed, except possibly in specific areas throughout the country where only deep wells can guarantee a year-round supply, thus making it less feasible to use protected dug wells.

Technological aspects

Traditional water sources, new wells and VLOM handpumps are suitable for operation and maintenance at village level and offer a good opportunity for sustained local access and control by female users. These options, and particularly the VLOM pump, only need the ensured availability of spare parts. The conventional pump is more complex and needs spare parts and a back-up service for larger repairs, thus creating a greater dependency on a system which cannot be fully secured in the present situation in Guinea-Bissau. Pumped piped supply is even more complex and implies a much greater dependency on external resources, including repair capacity and fuel, unless solar pumps are used.

Sufficient construction capacity is locally available for traditional and new wells. The country has also reasonable experience with well drilling and design and implementation of piped schemes, be it only with ESA support. Limited assembling capacity is available for handpump technology. For most materials and pumps, importation against foreign currency will remain necessary. The ongoing standardization of systems providing a basic service level needs to be pursued strongly, as it very much facilitates operation and maintenance activities.

From a technology perspective, preference should be given to installing new dug wells or drilled wells with VLOM handpumps, as these seem to best match the prevailing conditions in the country.

Organizational aspects

While traditional systems are owned and organized at household level, all other systems require organizational capacity at community level. Functioning of traditional and new wells can be sustained by communities, purchasing spare parts, such as rope and buckets, from the existing commercial market. Management of VLOM pumps requires a higher organizational level in the community, as funds need to be raised to purchase spare parts. In comparison, the cost level for VLOM pump repair is lower than of conventional pumps. Management of conventional pumps is also more complicated and vulnerable as it requires an area mechanic and a provincial back-up repair service, which are at present largely subsidized. Thus it is very useful to proceed with the trend to replace conventional pumps with VLOM pumps.

Table 14: Sustainability aspects of different water source options

Technology parameters	*Traditional open well*	*Improved lined dug well with head wall and cover*	*Hand drilled well*	*Machine drilled well*
environment	* quite some dry-up for part of the year * drawing shallow groundwater * open system prone to direct pollution * supply in danger if water table falls	* some dry-up for part of the year * using shallow groundwater * partly open system with a risk of direct pollution * supply in danger if water table falls	* some dry-up for part of the year * use shallow groundwater * closed system with low risk of pollution * supply in danger if water table falls	* do not dry-up * use deep groundwater * closed system with low risk of pollution * limited fall of water table
technology	* uses local material * local building capacity available * repair simple and locally possible	* uses mostly local material available at local markets * local building capacity available * repair simple and locally possible	* uses imported drilling set and lining * regional building capacity available * repair hardly needed and usually means replacement	* uses imported machinery and fuel * uses imported lining * some regional building and cleaning capacity * few repairs/cleanings
organisation	* simple management * direct access and control by users	* simple community management * direct access and control by users	* more complicated management as it requires a pumping device	* more complicated management as it requires a pumping device
socio-economic	* investment cost not well known but may amount to some US $ 10/cap, covered by users * maintenance cost fully covered by users	* investment cost US$ 30 to US$ 40/cap mostly covered by ESAs * maintenance cost not known but low and covered by users	* investment cost US$ 30 to US$ 40/cap covered by ESAs * maintenance cost neglectable, some apron repair can be covered by users	* investment cost US$ 60 - US$ 120/cap covered by ESAs * maintenance cost not known, comprise occasional cleaning covered by ESAs
health risk	* good water availability except in dry season * low quality if not protected * drainage may cause problem	* good water availability but sometimes a problem in dry season * reasonable quality if properly managed * drainage mostly organized	* good water availability but sometimes a problem in dry season * good bacteriological quality but sometimes taste problems * drainage mostly organized	* good water availability * good bacteriological quality but sometimes taste problems * drainage mostly organized

Table 15: Sustainability for different water supply systems

Technology parameters	*Rope and bucket system*	*VLOM handpump*	*Non VLOM handpump*	*Pumped piped supply*	*Solar pump*
environment	* no danger of over-drawing	* no danger of over-drawing	* no danger of over-drawing	* danger of over-drawing * high energy consumption	* some danger of over-drawing * good radiation levels available
technology	* imported materials * local assembly possible * repair locally	* imported materials * local assembly possible * no local construction capacity * repair locally	* imported materials * no local assembly capacity * repair needs skills and knowledge	* imported materials * no local production capacity * repair needs high skills and knowledge	* imported materials * no local production capacity * repair needs high skills and knowledge
organisation	* control at community level * simple local management	* control at community level * simple local management	* management at community level * maintenance through area mechanics with support from provincial level	* complicated management * national level support needed * dependency of fuel/electricity	* management at community level * maintenance support at national level
socio-economic	* investment cost US$ 2 - 4/cap made by ESAs * maintenance cost US$ 0.3/cap/yr are subsidized by ESAs	* investment cost US$ 5 - 15/cap made by ESAs * maintenance cost US$ 0.3/cap/yr subsidized by ESAs	* investment cost US$ 10 - 20/cap made by ESAs * maintenance cost US$ 0.5 - 0.7 /cap/yr heavily subsidized	* investment cost US$ 60 - 100/cap made by ESAs * maintenance cost US$ 3 - 5 /cap/yr almost fully subsidized by ESAs	* investment/cap US$150 - 240 made by ESAs * maintenance cost/cap/yr not yet known
health risk	* availability of water depends on well type, but is often good * quality may range from poor to good and depends on water fetching * need for hygiene promotion	* availability of water depends on well type, but is often good * good quality * need for hygiene promotion	* availability of water depends on well type, but is often good * good quality * need for hygiene promotion	* availability of water is less secured due to problems with fuel and repairs * intermittent supply endangers water quality and availability	* availability of water is good but still risk of long breakdown period * good quality

Piped systems involve the most complicated management and the present organizational set-up has not yet resulted in systems which are properly functioning. It seems most opportune to restrict such systems for the moment to a few densely-populated centres with an effective demand of users, willing to pay an adequate tariff.

For all systems which include a pump, spare part supply is crucial and involves purchase, importation and distribution. No sustainable commercial network is yet existing to take this in hand. Standardization to one or a very few types of pumps is of major importance to stimulate the development of such a network.

Socio-economic aspect

For traditional water points, investment and maintenance costs are borne by the owners. For all other options, the costs of construction are mainly paid by ESAs. For new dug wells maintenance costs are born by the users and cement and ropes and buckets are available in the local market.

The other options are less promising. Even maintenance of VLOM handpumps is subsidized, be it at a lower level than of conventional handpumps. Although the actual cost recovery level is only 10 percent, the VLOM handpump still appears to have potential to become self-sustained, particularly in the East and the North. Nevertheless, this needs further review as increasing cost levels may make people return to their polluted traditional sources. So it is obvious that a close link with the community is needed to make sure that they get the service level they really want to pay for.

The costs involved in maintenance and repair of solar pumps and piped supply systems are higher than those of handpump systems, but can be shared with a large number of users. This aspect needs further study on the basis of the current experiments which are taking place in a few centres.

Health risk

In terms of health risk, traditional systems are often not able to provide a year-round water supply and do not provide water of an acceptable quality unless they are properly protected. New wells have a much better record in terms of quantity and availability of water throughout the year. Water quality problems do exist, and may pose a hygiene risk depending on the way the well is used, thus requiring strong hygiene promotion to minimize the risk.

Most handpumps do offer a year round water supply in sufficient quality and quantity, but still pose a risk in water pollution between collection and use. This requires a strong hygiene promotion effort to minimize this risk. When deep groundwater is tapped, people may not like its taste and therefore continue to use their traditional sources, at least during part of the year, for drinking water. Piped systems with solar or electrical pumps sometimes also have this taste problem. The systems without a distribution network can be quite reliable, but systems with a network and not operated 24 hours a day hold a risk of pollution of the water in the distribution system.

6. *Setting the Trend*

6.1 The changing roles in the sector

Government changing from provider to facilitator

With the publication of the Master Plan in 1991, the government defined its sector policy up to the year 2001. This policy clearly meant a new approach in which the role of DGRH was changed from implementing agency into a facilitator. They became responsible for overall sector planning, training, communication and monitoring and evaluation. Their role in implementation and maintenance was to be privatized. This policy is now gaining momentum, but needs to be further operationalized. Projects are still largely in the hands of the government, but consultants and contractors gradually become responsible for implementation.

The changing role of the government requires new thinking and a new culture. The users, the NGOs and the private sector have to get used to the fact that they have to take things in hand and have new opportunities and responsibilities. Issues to be taken in hand to establish the new sector policy include:

- Development of a discussion platform within DGRH.
- Stimulation of the activities of CIMA to enhance the discussion with other government agencies, NGOs and community representatives.
- Operationalization of the increased involvement of communities in planning and implementation to ensure that appropriate service levels are selected, which respond to the felt needs of the users and not so much to what engineers and planners consider to be the best option.
- Creation of a higher demand for paid water supply and sanitation facilities through gender specific hygiene promotion which clarifies the importance of good quality water and sanitation services.
- Development and implementation of monitoring and evaluation activities to review sector progress. This should include the performance and use of traditional and new systems.
- Phasing out government's role in construction, and developing instead guidelines and criteria for the sector to guide privatization of construction and operation and maintenance. Technical support to maintenance presently given by the regional teams should be gradually taken over by private sector. The provincial teams could then be reduced and their activities be focussed on water quality monitoring.
- Enhancing of standardization of VLOM handpumps.
- Development of a parastatal umbrella organization for piped water supply to support the few semi-urban centres where such a system is feasible in the near future.

But also within the ministry, it is an enormous challenge to leave implementation and focus on facilitation and regulation. To stimulate this new role, it is urgently necessary to:

- prepare detailed task descriptions for government staff
- increase the status of jobs which are not directly related to construction activities
- provide adequate training and guidance to staff for their new responsibilities
- complete the process of staff reduction in a transparent way

- secure remuneration of core staff and to bring it in line with the importance of the new responsibilities.

NGOs strengthening their support role

The role of NGOs as intermediaries between government and communities is still limited but can increase. The government can promote this by including them as partners in sector discussions. NGOs may be particularly helpful in identifying the actual needs of the communities. Their role, however, should not be overestimated, as they often have limited administrative and managerial capacities and their own specific social mission. Another option would be to strengthen the role of the provincial extension teams and involve them in identification of needs and in provision of information and assistance to communities.

Communities taking up a larger management role

The community is the main party who is interested in a sustainable service. They should have the final say in getting the appropriate and affordable service level, after being well informed about the different possibilities. Options which enable upgrading to a higher service level are to be preferred. This allows greater flexibility when user groups expand and capacity and willingness to pay increases. Service level selection should match the investment policy which guarantees minimum service levels but also allows higher levels provided the additional costs are fully borne by the users. To make this effective, government, and possibly NGOs, should play a guiding role to help users make an informed choice about service levels and technology.

Increased private sector involvement

The role of the private sector is gradually increasing, particularly in construction and in spare parts supply. The high expectations, however, should be tempered, as Guinea-Bissau is a small market in terms of population and economic capacity. There is a potential market for technical support and maintenance services and spare part supply. This however will only materialize if government pulls out of construction and users' payment for services increase. ESAs are able to support the private sector, in particular, to increase its share in construction activities. The chances that the private sector will also continue support the financing of operation and maintenance of water supply systems, however, is far more limited. This requires a more market-driven importation of spare parts, which also creates private sector opportunities.

The government can strongly support the development of this market by:

- Strengthening the standardization policy for water supply schemes and, for example, promote the installation of only one or two types of VLOM handpumps. This will increase the market volume of a limited number of spare parts, thus increasing commercial possibilities.
- Facilitating the importation of standardized equipment, including reduction of import tax.
- Opening up discussions with neighbouring countries on the development of common markets and regional production of pumps and equipment. Some pump manufacturers already have regional representatives, which shows the viability of regional markets.

6.2 Making sector financing more self-sustained

Obtaining a larger contribution from the users

The government is gradually shifting the responsibilities for operation and maintenance to the users. This includes asking them to cover (part) of the recurrent cost to reduce the financial burden for the government. The responsibility for investment cost and support services such as sector planning and training still lies with the government. These cost are largely met from financial support provided by ESA projects.

It is quite clear that the present situation of sector financing is not sustainable. So when we look at the future a combination of approaches is needed.

- Priorities have to be set and a minimum acceptable service level has to be defined otherwise the government will not be able to finance the required investments and support activities. This may imply that many communities will have to continue using their traditional water sources, albeit after some improvement and in a better way through hygiene promotion.
- Considerable ESA funding will have to be attracted to complement the investments of the government and for some time to support operation and maintenance costs.
- Sustainable service levels have to be provided which can be financed by the users, including (part of) the construction and depreciation costs.

Priority setting

A policy discussion is needed to establish the level of investment by the government in water supply and sanitation systems and to define the minimum acceptable service level and possible subsidies the government is prepared to provide.

Whereas the government plans to continue subsidizing construction costs for a minimum service level, they plan to phase out their support to spare parts supply before the year 2000. This seems a realistic approach for spare parts related to new wells and VLOM pumps, provided the market will be sufficiently established, users are paying the full price and foreign currency requirements are met. For conventional pumps and piped supplies the situation may be more complicated, thus requiring further analysis.

If the market does not develop sufficiently, a serious situation will arise. Some of the existing systems will start to function very poorly and gradually will be abandoned. The population which was depending on these systems will have to return to the traditional water sources or new dug wells or migrate to other areas. This implies a tremendous loss of investment and possibly increased population pressure in the larger settlements, including Bissau. Against this background the government should, on the one hand, strongly support the development of the market for spare parts, but also consider to continue subsidizing spare parts, particularly of VLOM pumps, to sustain a minimum service level for a longer period of time. Eventually, however, this subsidy should be phased out, and the sooner the better, the more so as subsidized spare parts can possibly be sold at a profit in neighbouring countries.

Minimum acceptable service level

Protected wells or VLOM handpumps could be selected as the minimum acceptable service level. Both offer an acceptable service in terms of water quality and quantity. For these systems construction will be financed by the government, but it may be considered also to request some user contribution for construction. It should be very clear to the users that the full costs need to be borne by them if they would like a higher service level. In view of the required priority setting, it may even be required for the time being to also accept traditional water sources of acceptable quality as minimum service level, provided they are at a reasonable distance, can be protected and provide year round supply. This can only be done if adequate hygiene promotion and support is being provided.

Attracting ESA funding

It should still be possible to attract ESA funding to meet some of the operational costs as Guinea-Bissau is amongst the poorest countries in the world. Nevertheless, it will become more difficult as ESA funding is reducing and being more directed towards emergency situations. Also, funding conditions will increasingly ask for more efficiency, more sustainable systems and larger contributions from government, and particularly from users.

Users' contributions to sustainable services

The contributions from users can be increased provided they get a larger share in decision making and get an acceptable service level at a price they can pay. At present, investments and service levels are decided by the ESAs and the government with very little input from the users. At first, users received these services almost free of charge, and now they have to start paying for them. Whereas it is legitimate to increase the contribution from the user, it seems less reasonable to ask them to pay the full price for an existing conventional pump, if VLOM pumps with lower maintenance costs are available. So it is not a matter of shifting the whole burden of maintenance and renovation to the users, but to devise realistic strategies for using new investments to reduce costs and hand over good quality systems to the users which they want and are willing to pay for. It is particularly important to select systems with low operation, maintenance and replacement costs, and to assess the risk of cost increases for spare parts as a result of modifications in the exchange rate for foreign currency.

6.3 Towards sustainable service levels

Protected wells and VLOM handpumps are suggested as minimum acceptable service levels in section 6.2. A higher service level is usually more costly and more complicated to manage and maintain. In densely-populated areas, or areas which can be supplied by gravity supply, this may differ in that the per capita cost of higher service levels would actually be lower. This needs to be reviewed on a case by case basis. Whether the system with the lowest cost per capita is a good choice will very much depend on the *effective demand*. The users may be willing to pay more for a higher service level and sometimes not at all for the minimum service level, which they feel to be too close to their traditional wells. Helping the users to make an informed choice often requires an external input, which possibly could be provided by an NGO, but preferably by DGRH's provincial extension teams. This support needs to include gender- specific activities, as the interests of men and women are often different when it comes to water supply systems. Before finally deciding, it is also necessary to check that investments for higher service levels are not made at the expense of the provision of services to other communities.

ESAs can very much support the development of sustainable systems, as they may be willing to provide loans in addition to their current grants to meet requests for higher service levels. Furthermore, they can support users' involvement in planning and decision-making. In practice, however, they still seem to stick more to their routine of annual spending targets, which does not match very well the need to work with relatively inexperienced users' groups.

Other aspects also need to be reviewed, including the support requirements, the management demands and the health implications. The management problems encountered in systems with conventional pumps and small piped schemes in Guinea-Bissau are an important reason for system failures. In many countries, the trend is to install VLOM handpumps in rural areas and focus on piped supply for more densely-populated centres. Increasing service levels, however, imply more complex management, and in view of the organizational problems, installing piped schemes does not yet seem a viable approach for most of the centres in Guinea-Bissau. The best choice will often also be a protected well or a VLOM handpump to have a guaranteed water supply of acceptable quality.

Improving traditional wells in these centres could also be considered, but this needs further study, as earlier results with this in the South province were not continued because of ownership problems and the limited effects of the technical improvements.

The capacity to construct good quality dug wells is available in Guinea-Bissau, particularly in the North. The privatized teams of the well diggers' school in São Domingos, those working in the Boe project and in Cacheu, as well as private firms, have mastered the technology. Well drilling is also done by private firms, but with support from outside the country. In both cases, but surely in the case of well drilling, good quality supervision is needed and could be taken up either by the private sector or by DGRH.

6.4 Management of maintenance at the lowest possible level

Traditional wells are maintained at local level using locally available materials. In this way sustainability is ensured without external assistance, but the wells are unreliable and unprotected.

New dug wells are mostly maintained by well committees, receiving very limited or no support from outside the community. Local expertise is available for repairs or a well-digger team is brought in. Even without external support, this system will be maintained and will provide water to the users.

For VLOM pumps, the maintenance set-up is still relatively simple and the operational part is within control of the users. The system comprises: a Water Point Committee including a local mechanic, and a provincial technical team which is gradually phasing out its role, reducing it to occasional monitoring and backstopping. The supply of spare parts presently appears the weakest link in the chain.

It seems much better to move away from the conventional pumps which need a more comprehensive maintenance system, which includes area mechanics with bicycles and a technical team at provincial level with heavy equipment and a car. This system creates a greater dependency on external support and its present cost are higher than for maintaining VLOM pumps.

The maintenance record for piped systems in semi-urban centres is poor. Local maintenance leaves much to be desired and is not able to secure continuous running of the systems. Electric pump repairs depend on a central team from Bissau, and take a long time, thus forcing the users to go to other sources during breakdowns. Payments for operating the system and repairs are rarely effectuated. The current experiments in three pilot centres will have to generate the necessary information and experience to improve local management and improve cost recovery. Yet the systems will remain rather dependent on outside support. For most centres, it will therefore be better to focus for the time being on other alternatives, such as VLOM pumps.

For a few densely-populated semi-urban centres, piped supply may be feasible, provided this is the preferred option for the users. To keep these systems in operation it seems very important to establish a local organization which takes full management responsibilities. Users should have adequate representation in this organization to enhance the possibility that they are satisfied, take co-responsibility, provide regular payments and file complaints whenever problems exist.

6.5 Gender-specific approach for task sharing

An important aspect to take into account when trying to improve existing systems or construct new ones is a more gender-specific strategy. The introduction of new systems and new tasks in a community is complicated, and in the past often resulted, for women, in changing the burden of fetching water over long distances to that of cleaning the new system and paying for it. Often, they were not really consulted and had no decision-making power in these developments. When new systems have created paid jobs such as that of area mechanic, these were almost always for men. A better sharing of responsibilities and burdens can be reached by:

- Creating understanding amongst regional teams and the male and female user groups about the need for a gender-specific approach.
- Ensuring that information about the project and the potential choices reaches both male and female groups and is understood by them. Female groups may need specific information as they often have a lower literacy rate and a different understanding of technology.
- Arranging meetings at times when both men and women can participate and make sure that they are informed in advance about timing, venue, content and importance.
- Applying participatory techniques in meetings in such a way that both men and women have equal opportunities to speak up or make their point in a different way, as women sometimes do not speak up in public meetings.
- Guaranteeing that decision-making about paid and unpaid activities is fair and does not result in paid jobs for men and unpaid tasks for women. Guidelines can be established to create equity in job distribution, and men and women groups can be asked to select their own candidates.
- Ensuring that training activities are accessible to both men and women.
- Jointly with the male and female users' groups, monitoring and evaluating the tasks related to system management, the gender distribution and the performance.

6.6 Towards water resources management

Whereas the rainfall reduction over the last decades cannot be directly influenced by the people in Guinea-Bissau, other factors which involve the risk of lowering ground water tables can be affected.

This particularly concerns problems related to deforestation and increased erosion of top soil. It is very important to better assess the carrying capacity of the different regions for specific activities. Uncontrolled cutting of forest, bush fires and over-grazing because of high cattle density are quickly resulting in deterioration of the environment and reduction of recharge capacity. This damage is often irreversible, and therefore activities which pose a risk to the environment need much more control. Promotion of sound environmental behaviour needs to be stimulated also by clarifying the linkages which exist between environmental care and water supply systems.

Overdrawing of ground water through pumping also needs attention. This risk is not related to handpumps, as the total quantity of water which is pumped is very small. Pumping for irrigation, however, is of a much higher magnitude and may cause problems of lowering groundwater tables. This point is particularly important for the deepest groundwater layer, the Maestrichtien, which should be strictly kept for the water supply of the capital, and no permission granted for irrigation. This implies that adequate water legislation and water rights allocation and good management tools, including groundwater models, have to be established.

Irrigation, mechanised agriculture and industrial development may also cause a risk of groundwater pollution and need to be kept away from the main aquifers which are used for drinking water supply.

A positive trend towards safeguarding the environment is observed in Guinea-Bissau, in which it strives towards an integrated management of available natural resources. Part of this involves actions at the West African regional level, coordinating the use of river basins and available water resources. It is important to strongly pursue coordination both at national and international level. Developing a river basin management programme under the guidance of MEIRN, with the involvement of relevant ministries and national and international NGOs, could be a good starting point. The specific responsibility of DGRH on a range of issues, such as, coordination, user involvement and monitoring of main hydrological systems including border-crossing rivers, is described in the Master Plan. Their financial means to implement these tasks, however, are quite insufficient. This is even endangering basic activities such as monitoring of groundwater and river water levels.

6.7 Towards a broader based approach

Over the last fifteen years, over 2,000 new water supply systems have been built in Guinea-Bissau, but traditional water points are still the most important source of water supply for the population. Many of these sources are polluted and involve considerable health risks. Even if the rate of implementation of new facilities were increased, traditional sources will still remain of great importance in the next ten to fifteen years. This makes it very necessary to develop an approach which encourages the local population to better protect their traditional sources in order to reduce the health risk.

This is even more important because improved water systems are not always used for drinking water. This crucial aspect is receiving limited attention, whereas the improved facilities have to compete, particularly in taste and distance, with mostly polluted traditional water points. So it is not only important to improve traditional sources, but also to enhance the use of new facilities. This can be stimulated by ensuring that:

Annex 1: Presence of non-piped water supply systems in 21 semi-urban centres in Guinea-Bissau

	No. of traditional wells	***Percentage which falls dry***	***improved wells***	***handpumps***	***springs***	***Bolanha available***
Bafatá	unknown	unknown	0	0	2	no
Bambadinca	unknown	90%	1	0	1	yes
Biombo	unknown	unknown	0	2	0	yes
Bissorã	97	90%	0	2	0	no
Bolama	unknown	90%	3	18	1	no
Bula	unknown	90%	0	0	2	no
Cacheu	unknown	75%	1	1	0	no
Canchungo	unknown	unknown	0	4	1	no
Catió	67	10%	0	3	0	no
Contuboel	70	70%	0	5	0	no
Cumeré	12	100%	3	0	0	no
Farim	unknown	30%	0	0	0	no
Gabú	500	1%	0	4	0	yes
Jabicunda	unknown	0%	0	5	0	yes
Mansabá	unknown	0%	0	1	0	yes
Mansoa	66	91%	0	3	0	yes
Morés	30	7%	0	3	0	yes
Pelundo	unknown	unknown	0	1	1	no
Quinhamel	unknown	unknown	0	1	0	yes
Safim	40	unknown	0	0	0	yes
Sonaco	unknown	unknown	0	1	0	no

Source: MRW/H14, 1993

Responsible agency for water supply	Centre	System functioning	System payment	No. of staff for water supply	Energy source	Responsible for energy
State Committee (SC)	Bula	yes	no	no info	city supply	DGE
	Cacheu	yes	fixed tariff	2	city + generator	DGE
	Mansabá	yes	no	1	city supply	SC
	Sonaco	yes	fixed tariff	3	generator	SC
	Quinhamel	yes	no	3	generator	SC
	Safim	yes	fixed tariff	2	city + generator	SC
Directorate General of Energy (DGE)	Bafatá	yes	" "	3 + 1 (DGRH)	city + generator	DGE/SC
	Gabú	yes	" "	3	city + generator	DGE
	Canchungo	yes	" "	3	city + motor pump	DGE
	Farim	no	" "	2 + 1 (DGRH)	city + generator	DGE
	Bissorã	yes	fixed tariff	3	city supply	DGE
User association	Mansoa	yes	no	1 + 1 (DGRH)	city supply	DGE
Directorate General of Natural Resources (DGRH)	Bolama	no	no	4	city supply	DGE
	Catió	yes	no	7	city + generator	DGE/.DGRH
EAGB	Cumeré	yes	no	1	city supply	EAGB
Private	Morés	no	no	1	generator	private
	Pelundo	no	no	1	generator	private

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