Chapter 7 Pilot Study

The pilot study was one part of the feasibility study. The independent and small-scale water supply facilities were constructed in 6 villages among the 100 candidate villages during the Study program in order to:

- train villagers (water users) on autonomous management of their own water scheme, through participation in planning and facility construction,
- train villagers on facility operation/maintenance and operation of the Village Water Committee through actual use of the constructed water supply facility, in order to make the autonomous management take root in the community,
- evaluate the suitability of the type of facility constructed and/or applied management system to the communities through monitoring of the pilot sites, and
- review the established plans of facility type/scale, O/M methodology and project implementation for the future project for the 100 villages, based on the above mentioned evaluation

7.1 Review of the Pilot Study in the Former JICA Study in the Central Plateau Area

The major activities for the pilot study, such as facility construction and training of the villagers from the target sites, took place in the 2nd stage of the Study. Since there exist similar pilot schemes from a recent study program in Tanzania, the first activity of the 1st stage was to visit those pilot scheme sites to collect useful information to effectively conduct the pilot study in this study program.

The sites for pilot studies in the former JICA Study carried out in 1997-1998 are located in the Central Plateau Area. The 9 pilot scheme sites are located in 4 districts of the 2 regions, Singida and Arusha, where a new supply facility was constructed and/or rehabilitation work was carried out, as shown in Table 7-1.

7.1.1 Pilot Scheme Sites in the Central Plateau Area

Out of 9 villages where pilot facilities were constructed, the 7 villages marked with (*) in the table were visited and observed over a period of 5 days from the 16th of February by the two team's members. Interviews were also made with the chairperson or secretary of the village water committee on the issues concerning operation and maintenance conditions, especially of how to cope with the recently revised government policy on rural water supply management.

Table 7-1 Sites of pilot scheme in the Central Plateau Area

Region	District	Village	Supply Facility
Arusha	Hanang	Bassodesh	New well with hand pump
		Mara*	New well with hand pump
		Maskaroda*	New well with hand pump
Singida	Singida Rural	Choda*	New well with hand pump
		Nkuhi*	New well and Level 2 system
		Mang'onyi	Rehabilitation of Level 2 system
	Manyoni	Doroto*	Rehabilitation of Level 2 system
		Chikola*	New well and Level 2 system
		Mpapa*	New well with hand pump

7.1.2 Constructed Facility, its Condition and Suitability

- **Type of hand pump installed**

  Users complained that the rotating handles attached on both sides of the pump body were inconvenient to use, especially when operated by kids. Another complaint was that the concrete base was not big enough to place the bucket on when getting water from the spout (**Mara** and **Mpapa** villages).

  A pump was installed at the self-flowing well in **Mascorada**. It is believed that construction of a reservoir tank is preferable to the installation of a pump in the case of a self-flowing well.

  These matters seem to be a result of insufficient community participation in the stages of facility planning and construction.

  The wells are somehow too far from the clusters in some villages (2 km in **Mpapa** and 3 km in **Choda**). Locating the wells closer to the village clusters should have been considered by conducting more detailed hydrogeological surveys.

- **Motorized pump for Level-2 system**

  Only one public faucet was constructed in **Nkuhi** at the end of a pipeline extending 1km. The distribution tank was constructed in **Chikola** forcing the villagers to fetch water directly from the riser pipes of the well during pump operating hours. These facilities are not Level-2 service systems, but Level-1 systems of point source. The additional public faucets or the distribution system comprising an elevated tank and pipeline with public faucets should have been properly constructed, in order to make them proper Level-2 systems. These failures are probably due to a tight schedule or unfavorable climate conditions, or by poor supervision of the construction work. The reasons could not be obtained from the villagers. This suggests that community participation was also poor in the Level-2 schemes.

7.1.3 Operation Conditions of the Supply Facility and the Water Committee

- **Formulation of the Village Water Committee**

Water committees, formed in accordance with the National Water Policy 1991, exist in the majority of the villages. The water committee began collection of the water fund, at an amount ranging from 400 to 1000 shillings per household per year, since 1992. The amount seems too small for rehabilitation of the existing supply facility or for construction of new facility. Even so, the fund should have accumulated to over 500,000 shillings in each of the villages over the past 8 years; however, the balance of the water fund deposited was zero to several thousand, and 12,000 shillings at the most, although the fund had never been used for the water schemes at the visited villages. Where had the fund gone?

The water fund was incorporated in the village fund in all of the villages; therefore, the collected money was not used for expansion/improvement of the water scheme.

If the water supply is given priority over the various projects to improve infrastructure in the village, some of the village fund can be used for the facility in addition to the money collected for the water fund. On the other hand, however, if the water project is a low priority, improvement of the water supply will be left behind, so long as the water fund is used as part of the village fund.

In some of the villages, there is no village water committee, regardless of the district water engineers' efforts made at recommending that a water committee be formed in every village. It seems that people are not aware of the new government policy.

The following conclusions have been made based on the review of the pilot study sites:

- An amount of money sufficient to cover O/M cost should be collected.
- The water fund should be independent from the village fund, or the village council should clearly establish the policy of highest priority on the water supply.
- The district water engineers should guide the villagers more actively on how operation of the water scheme should be developed under the new government policy.

7.2 Villages Chosen for Pilot Study Sites

Eight villages were initially planned for the pilot study sites expecting that at least eight test wells out of the ten would be productive enough to be the sources of the pilot water supply facilities. Unfortunately, however, only six out of the ten test-well villages were selected, because three wells were not productive and one well had highly saline water as mentioned in section 5-2-3.

The six selected villages (3 in Lindi and 3 in Mtwara) as well as the type of constructed facilities are given in following table;

Table 7-2 Sites of pilot scheme in Lindi and Mtwara regions

Name of Village	District	Region	Type of Facility
Arusha Chini	Mtwara Rural	Mtwara	Level-2 system (Public faucets)
Ziwani	Mtwara Rural	Mtwara	Level-2 system (Public faucets)
Nanyumbu	Masasi	Mtwara	Level-1 system (Hand-pump)
Kilangala	Lindi Rural	Lindi	Level-2 system (Public faucets)
Pande Plot	Kilwa	Lindi	Level-2 system (Public faucets)
Chinongwe	Ruangwa	Lindi	Level-1 system (Hand-pump)

7.3 Supply Facilities Constructed for Pilot Study

7.3.1 Type of Facilities Constructed

The Level-2 supply systems constructed in the three villages of **Ziwani** (Mtwara R.), **Kilangala** and **Pande Plot** (Lindi R.) consist of the borehole well as the source (6-inch casing for all but different depth/productivity), a generator house, an elevated distribution tank (30 m^3 volume and 2.5m.high), 2 public faucet bases (domestic points, with 2 taps each), and a 100m long distribution pipe. Another Level-2 system constructed at **Arusha Chini** (Mtwara R.) is the same as above, except for the distribution tank, which is the rehabilitated ground-type tank with a volume of 35m^3.

The submersible motor pumps installed in the 4 wells have a pumping capability of more or less 100 liters per minute with a total head between 30 and 60 m (6 m^3/hour) regardless of the productivity of the wells. The dimension and/or capacity of the distribution systems are not in accordance with the population served of the concerned villages. Although the total population of these four villages is well over 3,000, the population to be covered by these supply systems is limited to only 2,000-3,000 (assuming the pumping hour to be 10 hours/day and the unit supply amount to be 15-25 liters/person/day) since they are temporary supply systems to be used in the pilot study. For instance, the population is 8,800 in Kilangala and 6,700 in Ziwani.

These pilot facilities should, therefore, be expanded in the implementation stage of the full-scale project.

In the villages of **Nanyumbu** (Mtwara R.) and **Chinongwe** (Lindi R.), one hand-pump each was installed at the drilled borehole wells (that is a Level-1 system), because the productivity of the drilled test wells proved to be less than 50 liters per minute. Since a well with hand-pump can supply water to 250-400 people, the following two alternatives should be taken into consideration at the stage of the full-scale project;

- An additional 2 to 4 wells with hand-pump are required to be constructed to cover the population to be served in the community
- If one of the wells constructed is productive enough to supply water to the total population of the village, the plan of Level-1 system may be converted to the Level-2 system by use of this high productive well.

7.3.2 Community Participations during Construction Stage

It was found that villagers' participations in the construction work was poor in spite of repeated suggestions made by the study team to each community. The poor participation in the

construction work suggests future difficulty in the autonomous management of the community-owned water supply facilities. It seems that the projects would not be sustainable, if implemented under the present situation of poor community participation. The water department of regional and district level must be patient in training the villagers on this matter.

The following are the findings in the concerned villages:

a. The villagers offered no active contribution. For example, they did not offer to help out in the construction work. The villagers just remained spectators. A dependant nature seems common in the regions. (All 6 sites)
b. The village chairman lacked leadership in, for example, encouraging villagers to carry water for concrete work. (Pande Plot)
c. Villagers' interest seems to be concentrated in getting wages for the labor in construction work of their own water facility, especially among the younger generation. (Ziwani, Kilangala, Pande Plot)
d. Villagers chose to wait for a tap to be installed by the contractors at the village where the facility was nearly completed, even though the Team suggested purchasing and installing the taps by themselves for earlier facility use. This is also despite the fact that the cost of the water tap is only Tsh.1,000 or less, and the town is very close to the village. (Ziwani)
e. The villagers were expecting the expenses for the opening ceremony to be paid by someone else, not by themselves. It was improved later, though. (Ziwani)

7.3.3 Performances of Local Contractors in Construction Works

The test-well construction work and the facility construction work were separately contracted out to local firms that had their principal offices at Dar es Salaam.

Since performances of both of the contractors were better than previously expected, the works were barely finalized in time, different from those in the Central Plateau Area, regardless of the very long distance between Dar es Salaam and the study area (nearly 500 km), and also between the base town and each construction site (50-250 km). However, since time was occasionally wasted during the construction period due the insufficient equipment mobilization or inexperienced workers, the work period extended to the second rainy season, when work was often suspended as it was difficult to transport material on rough muddy roads.

The following are possible reason for poor performances:

a. Not enough cars had been prepared for site-to-site transportation or communication: (Both contractors)
b. No dispatching of a permanent field representative, which resulted in insufficient

communication between the study team and contractors (Both contractors)

c. A delay of the purchasing order for the pumping equipment and generators, due to expenditure of the first payment of the contract cost for purpose other than the pilot facility construction: (Well drilling contractor)

d. Lack of experience in water works resulted in some problems as mentioned below. Most of these problems were, however, resolved under instruction from the study team. (Facility construction contractor)

- The public faucet base was constructed so that the faucet was 1-meter higher than the bottom of distribution tank. (Arusha Chini)
- There was no hole in the wall of the generator house for the cable to come through. (Arusha Chini and Ziwani)
- The valve was not installed at the domestic points. (Arusha Chini and Ziwani)
- The diameter of the pipe was smaller than specified and the valve was not insalled at the end of the pipe, indicating no consideration of future extension. (All 4 sites)
- Loose consolidated concrete due to an insufficient portion of cement and/or poor curing. (Arusha Chini)
- Backfilling of pipe-laid ditch before conducting water-through test. (Arusha Chini and Ziwani)
- The drainage was not furnished to the distribution tank. (Arusha Chini)
- Mortar facing over the surface of the existing distribution tank beforehand filling tank with water, making it impossible to check leakage from the tank: (Arusha Chini)

7.4 Educational Activities

7.4.1 General Courses

Educational activities on operation and maintenance and gender/sanitation issues were held before, during and after construction of the pilot water supply facilities in the concerned villages. The first activity in each village was the general course touching briefly on the items mentioned below. It was held at a village meeting collecting as many people as possible under precision of the village chairman.

- Awareness of the project covering the 100 villages in the Lindi and Mtwara regions, and the significance of the pilot schemes
- The introduction of an independent water supply system, which should be operated under a community-based autonomous management system, in accordance with the government's new policy on rural water supply
- The role of the water committee and operation methodologies of the committee, in collaboration with the village government, and with technical assistance from Idara ya Maji (district water department)
- Confirmation of the new committee members elected by mutual vote, and confirmation of the involvement of at least three female members, in consideration of women's concern in domestic water use and their important role in management of daily life related to water
- The role of each committee member
- Operation methodology of the facility, putting emphasis on use of supplied safe water throughout the year, and fetching water at any favorable time of the day from the domestic points without limitation of supply hours
- Collection of money for operation and maintenance of water scheme (Water Fund), putting emphasis on the maintenance cost, of which the villagers had no idea about
- Management of the water fund independently from the village fund, which means that the collected water fund should be used only for operation and maintenance of the water scheme
- Items, concerning operation and maintenance, for which money will be spent on
- The requirement of three signatories for the opening of a bank account

Questions and answers followed the explanation of the above matters. Questions centered mainly on independent management of the water fund from the village fund, since the water funds has been used as part of the village fund in the majority of the villages in the area.

The involvement of women executive members on the committee was also actively

discussed during the village meeting, in spite of the common tradition of the comparatively lower social status of women in the predominately Muslim area.

With regard to the O/M cost, the majority of the villagers in each of the concerned villages were surprised to know that replacement of worn-out pumps or generators should be included in the maintenance cost, because the autonomous operation and maintenance of the water supply scheme is a new concept to them.

7.4.2 Establishment of New Village Water Committee

(1) Election of water committee members

Each of the six pilot scheme villages had water committees, but none of them were actually functioning. Four villages had no water fund deposit. Two villages had collected 50,000-80,000 shillings in the past several years, without any concrete idea of what to do with it but expecting services from the local government or others.

The study team, in collaboration with the counterpart personnel (mostly district water engineer), persuaded the villagers to formulate a new water committee, suggesting it comprise the following 5 to 7 committee members, with an explanation of the role of each member:

- Chairperson of the committee 1 person
- Secretary to the chairperson 1 person
- Treasurer 1-2 persons
- Member in charge of technical matters 1-2 persons
- Member in charge of sanitation 1 persons

As a result, a new water committee was established in each of the six pilot scheme villages. The members were elected by mutual vote. Contrary to the expectation of the study team, women headed four out of the six committees. The member lists of newly formed committees are presented in the Supporting Report.

(2) Role of water committee and committee members

The roles of the water committee and each executive member have been described in Swahili and delivered to each of the concerned committees. This document has been displayed on the wall of the village government office accompanied by a list of the names of the committee members and their pictures, so that all of the villagers can renew their understanding on the role of the water committee whenever they visit the village office.

The description of the roles of the water committee and its members is as follows:

- **Role of water committee**

The water committee represents the water users in the community and is responsible for managing the community water supply scheme. The committee should keep the supply facility operating continuously and effectively maintain it for long-term use, which will result in improved health of the villagers by reducing water-born diseases, and more rural development activities without anxiety of a water shortage. The committee has to carry out the overall management of the water supply facilities in collaboration with the village government, and is in charge of the following specific duties:

1) Collection of the water fund from the users for the purpose of operation and maintenance of the facility (The collection method, annually, monthly or per bucket, shall be based on the users' consensus. Collection per-bucket from the users of adjacent communities may be preferable.)
2) Management of income and expenditure of the collected water fund
3) Daily operation of the pumping facility, so that users can fetch water from the domestic points at any time they like
4) Periodical inspection (daily, weekly and monthly) of the facilities and repair of minor damage, so that the users can use the facility continuously
5) Keeping in close communication with Idara ya Maji to ask for technical support or assistance when training or repair of damaged equipment is required
6) Securing the safety of the supply facility (Wage payment to the security guard shall be based on the users' consensus)
7) Mobilizing the community on the proper use of water and environmental sanitation, focusing on the constant use of supplied safe water even during the rainy season

- **Roles of water committee member**

The chairperson is in charge of overall water management in the village and has the following specific duties:

- To convene and preside at the scheduled/emergency water committee meetings to monitor committee operation
- To convene and preside at the villagers meeting on water related issues when occasion demands, in collaboration with the village chairman
- To evaluate the performance of the water committee members

The secretary to the chairperson has the following specific duties:

- To write reports and properly document all water issues in the village
- To facilitate communication between the village and Idara ya Maji
- To write the monthly report to the committee and quarterly report to the village government in collaboration with the treasurer

- To inform the villagers on the activities of the committee and the financial statement of the water fund

The treasurer is responsible in water fund related matters, and has the following specific duties:

- To keep the account book and provide the financial statement on the income and expenditure of water fund
- Banking procedure of the water fund
- Payment for purchasing of fuel/oil and spare parts, wages for guards or employed technician, and for the services of Idara ya Maji
- To prepare the draft of the monthly financial report for the committee and quarterly report for the village government

The member in charge of facility operation (Pump Attendant) is responsible for all the technical matters in operation and maintenance of the facility and has the following specific duties:

- To operate the generator everyday and control water level in the distribution tank, so that people can fetch water from the domestic point at any time they like between 6 AM and 6 PM
- Daily and/or weekly inspections on the working condition of the facilities to find out the problems. In case of the minor problems such as with the water tap or oil filter of the generator, purchasing and replacement will be done by himself/herself. If the problems are beyond his/her control, he/she shall report it to the secretary in order to receive technical assistance from Idara ya Maji
- To purchase diesel/oil to be fed to the generator and spare parts, and to keep records of the purchasing and consumption of the fuel and parts

The member in charge of sanitation is responsible for matters concerning sanitation and health related to water use, in collaboration with the social service committee of the village and has the following specific duties:

- To make sure of the usage of supplied clean water in the community, especially during the rainy season, recommending people not to use unwholesome water for drinking purpose
- To make spot checks at individual households to inspect/give guidance on the hygienic use of water
- To make a random survey on the amount of water used per person periodically (monthly or quarterly) in order to understand the actual water demand for future expansion of the supply facility, and to prepare the water use report to the committee
- To inspect whether or not the domestic points are kept clean every day. If the sanitation environment is not fairly good, he/she shall enlighten the users on how to

keep the environment clean

7.4.3 Operation and Maintenance of Water Scheme

Two major concepts in operation of the Level-2 supply system were transferred to the users through the training of the water committee members.

One was the continuous use of the supplied safe water throughout the year, which means continuous operation of the pumping facility is important even in the rainy seasons when water is abundant everywhere in the vicinity of the households. This suggestion was made from the viewpoints of (1) safe water use for good health, and (2) elongating the lifespan of the water source and pumping equipment, since leaving the facilities out of operation for months causes problems such as immediate battery exhaustion, rust forming on generator and the short lifespan of the water source (well).

The other point was long lasting and constant daily operation of the facilities, from the viewpoints of (1) saving time in fetching water, and (2) saving fuel and elongating the lifespan of the equipment. If the domestic points are open for use all the day from morning to evening, people can fetch water at any time they like without having to wait in a long line for their turn. Operating the generator and motor pump continuously and at a rate a little lower than the installed capacity will result in higher efficiency in terms of fuel consumption than if run at full installed capacity for a shorter time, and will keep the equipment in better condition.

The committee member in charge of technical matters (pump attendant) should control the pumping rate by observing the water level in the distribution tank. He or she is also responsible for supplying fuel to the generator and keeping records of the purchasing and consumption of t fuel and spare parts.

The following are additional things the joint study team did as part of the training program for the villagers in relation with the autonomous management of the water scheme:

- They attached signboards to the generator house and/or elevated distribution tanks with a catchword in Swahili “All of the water users are responsible for O/M of this facility under management of the water committee” as a general notice to the water users. (Four villages of Level-2 pilot schemes)
- At the handing-over ceremonies for the completed supply facilities in the two villages of Arusha Chini and Ziwani, encouraging words were given on autonomous management by the guests of the ceremony, such as the District Commissioner of Mtwara Rural, the District Administrative Secretary of Mtwara Rural, a Representative from the Ministry of Water, the Regional Water Engineer Mtwara and the Director of the JICA Tanzania Office.

Planning of the program and execution of the ceremony by the villagers was useful in informing everyone about the pilot scheme. The song-and-dance admiring the water supply scheme, which was composed, designed and performed by the villagers at both of the villages, was the highlight of the ceremony program. This type of performance is believed to be the best way to publicize the water schemes among the people, including children.

7.4.4 Operation and Maintenance Cost and O/M fee Collection Method

(1) O/M cost estimation

With regard to the operation and maintenance cost, the following figures were given to the water committee as a standard O/M cost for the level-2 water schemes:

1) Monthly operation cost (Running cost)

- Diesel for generator	300-550 liter/month	192,000-352,000 Tsh./month
- Parts purchasing		40,000-50,000 Tsh./month
- Repair service fee	25,000 Tsh, 5 times/year	10,500 Tsh./month
- Security guard		10,000 Tsh./month
Sub-total		252,500- 422,500 Tsh./month

2) Average monthly maintenance cost for long-term maintenance (30 years):

- Well flushing	450,000 Tsh, every 5-years	7,500 Tsh./month
- Heavy repair	150,000 Tsh, every 3-years	4,000 Tsh./month
- Pump replacement	3,500,000 Tsh, every 12- years	24,300 Tsh./month
- Generator replacement	4,000,000 Tsh, every 15-years	22,200 Tsh./month
Sub-total		58,500 Tsh./month

The total of the above 1) and 2) comes in a range of 311,000-481,000 Tsh./month.

The monthly O/M cost to be covered by one household depends on the number of households. If 500 households evenly shoulder the O/M cost of the village water scheme, the burden for each household will range from 622-962 Tsh./month. If the household number is 200, the burden will increase to 1,555-2405 Tsh./month/household.

For the villages with Level-1 pilot schemes, the following estimated O/M cost was given to the water committee:

1) Operation cost: No running cost, because the pump is operated manually.
2) Average monthly maintenance cost for long-term maintenance (30 years):

- Purchasing of spare parts:	40,000 Tsh. Per year	3,330 Tsh./month

- Flushing of the well:	400,000 Tsh., every 5-year	6,670 Tsh./month
- Pump-set replacement:	570,000 Tsh., every 12-year	4,000 Tsh./month
Sub-total		14,000 Tsh./month

The above 1) and 2) total 14,000 Tsh./month. Assuming that 50 households use one well, the burden per household should be 280 Tsh./month for O/M cost. (If one person uses 20 liters a day, the O/M cost required for 1 bucket may amount only 2 Tsh./bucket. But, if the unit consumption is limited to 5-10 ℓ/c/d, the O/M cost will come to 5-6 Tsh./bucket.)

(2) O/M fee collection method

With regard to the method of O/M fee collection, the following three were suggested, mentioning that the third was the most recommendable method for both Level-1 and Level-2 schemes:

1) Collection of fee per-bucket
2) Monthly collection of fee from each household
3) Annual collection of fee from each household

The reason why 3) is considered the best method is that it will lead to

- utilization of supplied safe water throughout the year (for Level-1 and 2)
- utilization of a sufficient amount of safe water to keep healthy (for Level-1 and 2), and
- elongation of the facility lifespan (for Level-2)

If the method of 1) is taken, they will reduce the amount of water for the sake of saving money. If the water-use remains at the present situation of only 2-8 ℓ/c/d, improvement of health condition cannot be expected.

If the methods of 1) or 2) is adopted, the majority of the villagers will go back to the traditional water points during the rainy season without paying the O/M fee. In the rainy season, free water is available everywhere not only at the traditional pits but also rainwater at the vicinity of the houses. Since the villagers in the areas have not yet developed a sense of hygiene, it is obvious that many people will prefer traditional water points or rainwater to paying the O/M fee.

As for the villages with the Level-2 scheme, if the villagers do not pay the water fee, the pumping facility cannot operate, as there will be no money to buy fuel for the diesel engine generator. Moreover, suspending operation of the generator for months will result in a deterioration of its working condition.

All of the villages of the pilot scheme began collection of money by method 1), because it is the easiest method, and some of the villages had no water fund deposit to buy fuel for the present. Further recommendations should be made to encourage villagers to adopt collection method 3), taking the chances of the monitoring work for the pilot schemes.

7.4.5 Gender and Sanitation Issues

The majority of the village water committees existing in the study area have appointed at least two female members, in accordance with the regional policy of community development. However, there are no committees headed by a female chairperson in the area. After discussions with the villagers pertaining to the important role women play in water use and sanitation, the joint study team strongly recommended that a female chairperson be elected, suggesting that the social status of women would improve greatly if a women took on a managerial post in the committee. As a result, a female chairperson was elected in four out of the six pilot study villages by the mutual election, although there was much hesitation among the women and some opposition came from male executive members of the village government during the discussions.

The appointment of a female to a managerial post resulting from the establishment of the community-based management system of the water scheme is unprecedented. It is believed to be an epoch-making event in the two regions, and it is desirable that the new committee as well as the new management system takes root in these regions.

The study team should take advantage of monitoring of the pilot schemes, as an opportunity to promote the strengthening of the system and to encourage committee operation.

With regard to the issue of sanitation, keeping the living environment clean by proper preparation of latrines or by waste disposal was briefly touched on during discussions. However, the major focus was on the use of clean and safe water to maintain a healthy life. Since the provision of water, whether it was clean or not, used to be the first priority in the area, villagers were not very interested in using clean and safe water. But, upon getting a safe water supply from the pilot scheme sites, the importance of using only clean water was enhanced, especially for drinking purposes, even in the rainy season.

7.5 Monitoring of Pilot Scheme Sites

7.5.1 Short Term Monitoring

Monitoring facility operation and the operation of the newly established water committee started before and immediately after completion of the pilot facility. (Five sites were the targeted because construction work was not yet completed at Pande Plot. It was completed at the end of December 2000).

Findings of the short-term monitoring work are as follows:

1) Confirmation of Water Committee Establishment

It was confirmed that all six sites had established the new water committee.

The committees, which are in conformity with the government's guideline, comprise the members listed below. (A female chairperson has been elected in four villages.)

- Chairperson
- Secretary
- Treasurer (and assistant treasurer)
- Member in charge of sanitation (and assistant)
- Member in charge of technical matters (Pump attendant, and assistant)

2) Performance of Water Committee and Water Users

Facility use conditions were observed at the five sites from a few to several weeks after the start of its use.

(1) Facility surroundings

The condition of facility surroundings was generally good at every site. For example,

- The users constructed a fence around the intake facility under the initiative of the water committee in order to keep children from tampering with it (2 sites)
- The surroundings of the domestic points are kept clean (5 sites)
- Water taps are firmly closed so as not to waste water (2sites)

(2) Sanitation

Lack of a sense of sanitation was striking at all sites. For example,

- People were using the water drained from the tank, that was put into the tank for the purpose of cleaning the inside (1 site)
- People were using the muddy water that first passed through the pipe (3 sites)
- Many of the containers for water collection were not clean (5 sites)

- The majority of people did not come to the domestic points on rainy days. They were still collecting rainwater, or fetching muddy water from the traditional pits, because it is free of charge (2 sites)
- Self-flowing water from the well flowed into the pit through the ditch, which turned water muddy at Kilangala village. People were taking this muddy water from the pit just beside the domestic point, although clean water from the tap was already available.

(3) Water fund

Since the villagers are experiencing the autonomous management of the water scheme for the first time, it will probably take some time for them to get accustomed to it. Although it was recommended that collection of money for the water fund start earlier, two villages did not collect money until completion of the facility.

After finishing the test operation, they could not continue operation as there was neither fuel nor money to buy fuel.

With regard to the money collection method, they chose the per-bucket collection method among the three types suggested, as it is the easiest method. However, this method is the least recommended as peoplewill continue to feel as if they are buying water from a water vender (water vender = water committee), instead of paying for O/M costs. So long as the per-bucket collection method is taken, the villagers will not recognize the fact that they are the owners of the facility. Paying for O/M by the “per-bucket” method will also result in excessive saving of water on the days of no money, or going back to the traditional dug well and/or rainwater during the rainy season. These are against the concept of “A healthy life with a clean and sufficient water supply.”

The per-bucket collection method should be a temporary to cover the expenses for facility operation until the committee has secured a sufficient water fund.

In Ziwani village, however, this per-bucket collection method seemed to be successfully advancing. The treasurer of the committee sat beside the domestic point all the day, collecting 20 shillings per bucket. The amount of money collected was surprisingly big, totaling over 200,000 shillings within two weeks. They opened a bank account, and were cheerfully keeping the account book. However, it is questionable as to how the situation will be during the coming rainy season of February-April. The next monitoring in May 2001 will give the answer.

7.5.2 Methodology for Long-Term Monitoring

Based on the results of the short-term monitoring, monitoring work is planned to be conducted about half a year, nine months and one year after the completion of the pilot facilities in the similar manner. However, special attention will be paid to the following matters:

1) Team composition for monitoring work

The team for the educational activities and monitoring work on the pilot scheme sites are to be composed of one JICA study team member and one official from both the regional and district water departments, with an initiative taken by the official from district water department.

2) Points on monitoring

The monitoring of the pilot scheme and educational activities will not only focus on the village water committee and water users but also on the officials from the regional and district water engineers. Since the training activities to be taken by these officials should cover all of the 100 candidate villages, prior to implementation of the full-scale project, their performances on monitoring work during the absence of the JICA study team may become an important point for evaluation. The following items will, therefore be evaluated:

(a) Whether the monthly monitoring work was properly conducted by the district water department, and

(b) Whether the department immediately responded to requests for technical assistance from the water committees.

The monitoring and evaluation on operation of the village water committee and water use conditions by the users comprise the items mentioned below. The survey will be conducted through interviews with the members of the water committee and through observation by the survey team. The performance of the water committee members will be evaluated through an interview with the village chairman

- Operational conditions of the constructed facility
- Use of supplied water, whether continuously used during rainy season
- Problems encountered so far, and countermeasures taken against them
- Method of O/M fee collection
- Monthly variation in money collection and expenditure
- Daily generator operation hours
- Water flow from spout of hand pump or public faucets, stock of fuel, method of water level control in the reservoir tank, keeping operation records, etc.
- Sanitary condition of well and domestic points surroundings
- Performances of new water committee, especially of that of the female chairperson
- Performance of each committee member

7.5.3 Result of Long-Term Monitoring

(1) Activities taken by the District Water Department

The district water engineers patrolled the pilot schemes sites periodically, not every month but nearly every month, during teh absence of the JICA study team. They immediately extended technical assistance when a request came from the village water committee for inspection/repair of the troubled pumping equipment and other facilities. The district water engineers know about the facility conditions in detail and are aware of what is going on at the site, and the villagers seem to put their trust in the water engineers. The good performance of the district water department surely gives prospect of success in future development of the water supply in the area. However, the district water engineers appear to find it quite difficult to solve organizational problems. There were quarrels between the village committee and water committee concerning the independent operation of the water fund at four pilot scheme sites, but the water engineers could not successfully mediate the situation in some villages.

(2) Operational condition of the facilities

In all of the sites except, Pande Plot, the facilities have been in continuous operation throughout the past one-year. Suspension of operation was 3-4 days at the most, as repairs or parts replacement were quickly seen to by a committee member, sometimes assisted by the district water engineer. However, operational conditions are not ideal, especially for the Level-2 system sites. Pump operation hours have been limited to 2-4 hours a day, or one-time filling of the tank, probably with the intention of saving fuel. Only one of the two faucet bases has been used at all sites. People waited in line for their turn. This is probably due to the per-bucket water fee collection system. People should not have been allowed to fetch water from taps where the collector was absent. The team pointed out these matters and recommended that they be improved every time they visited, but little improvement has been made.

Pump operation hours during the rainy season were shorter then in dry season since number of people coming to the water point was extremely reduced in the height of rainfall. In Ziwani, for example, the pump was operating once every 4-5 days from the end of April to middle of May.

Pande Plot: The quality of water from Pande Plot well is not very good (high salinity). Therefore, there is no choice but to use it as a supplemental water source in the dry season in this village.

(3) Operation of village water committee

The facilities are working, but there is a big problem in operation of the village water committee in most of the villages, mostly in relation with the management of the water fund.

The deposited water fund, which has been unexpectedly large, has produced friction between the village council and the village water committee. The village council tried to take control of the water fund from the water committee intending to incorporate it into the village fund, under the current circumstances of an extreme shortage in the village fund. The village council dismissed all of the water committee members and appointed new members, including some councilors, at the villages where the water committee had refused to handover management of the water fund. (At the four villages of Ziwani, Nanyumbu, Kilangala, and Chinongwe. Later, the same thing occurred in Arusha Chini along with a change of the village chairman.)

Since the new water committee members have little know-how of committee operation, most of the committee's activities were discontinued (keeping of an account book, reporting to the villagers on income and expenditure, discussions on money collection method, etc.). Accordingly, the accumulated water funds are about to vanish into the night, and success of the pilot schemes is becoming hopeless, to say nothing of success of the future water project.

The district water engineer made efforts to persuade the village council that the water committee activities should be carried out by the elected committee members. The two villages of Ziwani and Nanyumbu were successfully persuaded but it was quite difficult to convince the other three villages. Therefore, the JICA team suggested that this matter be put into the hands of the regional water engineer or suitable persons like the district/regional administrative secretary.

The water committee was operating in good condition before intervention by the village council. This suggests that the only way operation of the water scheme can be successful is if the fund is managed independently from village finances. Thus, it can be said, "a guide for future development has been obtained by the pilot schemes".

(4) O/M fee (Water fee) collection method

Collection of money for operation and maintenance purposes for the pilot scheme began with the easiest method of "per-bucket" collection, because there was no working fund for opening operation (Tsh.10 per 20-liter bucket for Level-1 schemes, and Tsh.20 for Level-2 schemes).

The accountant and/or assistant accountant sat beside the water point and put collected coins into a locked wooden box. Three committee members opened a bank account, and the deposit increased day by day with amazing progress. However, the study team recommended that the collection of money be made annually or monthly from each household, so that the collectors need not attend the water point and people can fetch water at any time of the day. It was also suggested that 10 or 20 shillings per bucket was excessively high.

The two villages of Nanyumbu and Chinongwe (both with Level-1) changed to the monthly collection method according to the recommendation, collecting Tsh.500 per household per month. The actual water fee per 20 liters was reduced from 10 to 2 shillings by this change.

The villages with Level-2 systems, however, are keeping the per-bucket collection method against the team's recommendation.

At Arusha Chini, where the largest amount of water was used, ten to twelve thousand shillings were collected per day during the dry season, and the balance of the income and expenditure increased to nearly a 2 million surplus within 10 months. (The money collection rate was reduced to one to ten or less during rainy season).

It was a matter of great disappointment that the accounts open to the public were forced one by one to become the closed ones by the intervention of the village council.

(5) Water use in relation with improvement of sanitation

The daily maximum water use in the dry season in Arusha Chini was $10m^3$ (500-bukets from the record of water fee collection). More than 200 families (over 1000 people) are using supplied water, but consumption was only 500 buckets. This means that the average consumption rate of supplied water is less than 10 liters per person a day, regardless of the fact that the capacity of the source and pump is large enough to supply over 40 m^3 a day. The consumption rate was too small even in dry season.

The seasonal variation was quite big. The water fee collection record indicates that only 40 to 50-buckets of supplied water a day were used in the village during the rainy season. This means that very few people used the public faucet, and the majority of the people returned to the traditional water points during rainy season.

It seems that improving sanitation conditions by supplying safe water will be quite difficult until people become accustomed to using only safe water in sufficient quantities throughout the year. Further public education hereafter will be necessary before implementation of the project

The method of collecting the water fees by the bucket may be the major reason for the villagers limited use of the facility in view of saving money. It may be necessary to revise the system of water fee collection to make the future project effective. Otherwise, the scale of the facility should be reduced by decreasing the planned unit supply amount from 20 to 10 liters/capita /day or less.

Chapter 8 Water Resources Development Plan

8.1 Basic Concept of the Water Resources Development Plan

8.1.1 Stable and Safe Water

The target source for the rural water supply for the 100 candidate villages in the Study Area is groundwater including spring water, in consideration of both stability and safety.

Although a variety of other water resources are available in the Study Area, such as rainwater (directly collected in vessels or storage tanks or naturally stored in ponds/lakes or farm ponds) and river water (naturally flowing streams or dammed up river water), they will hardly meet with even one of the two necessary conditions of stability (Can be supplied throughout the year) and good quality (Potable without treatment).

The reasons why the supply sources other than groundwater are not suitable are as follows:

- Rainwater is available everywhere in the area, but it is limited to the rainy seasons. (Not stable) Construction of a large-scale rainwater collection gallery utilizing a hill slope is difficult, since the land is almost flat in every village. Moreover, a small-scale collection system can be used for only one or two months after the rainy season.
- Naturally flowing river water is also available, but in very limited areas, since the majority of the rivers are seasonal (intermittent) river. (Not stable).
- Perennial streams exist at the lower reaches of major rivers such as Mavuji, Mbewmkuru, Lukuledi and Ruvuma, but treatment is required for use as a water supply source. (Problem in quality) Maintenance of water purification and other treatment facilities require huge costs, which would be difficult for the users to cover. (Villages situated closely to clean perennial streams exist, but those villages have not been selected as the candidate villages because they are not in urgent need).
- Many of the farm ponds and the dammed-up river water dry up near the end of the dry season, and stagnant water often causes the growth of bacteria and the breeding of aquatic parasites. (Occasionally not stable, and moreover, quality is not reliable)

Groundwater development is possible in and around the majority of candidate villages, although there may be difficulties in some areas regarding not only quantity but also quality, particularly in the upper reaches of the Lukuledi River Basin in the basement rock area. The drilling of wells by trial and error will be required in this area, but once the wells are successfully completed, water pumping from the wells will be in the same condition as those in other areas.

8.1.2 Independent Schemes for Easier Autonomous Management

The scheme of using groundwater as the target source has another advantage, from the viewpoint of community participation, in accordance with the new national policy on rural water supply.

A water scheme that enables the community to independently manage its own water supply requires a water source inside or in the vicinity of the village. Groundwater development makes it possible. Wells are to be drilled inside the concerned villages so it will be easy for the residents to manage the facilities on their own. If there are problems with the water source or the supply facility, the users themselves can take countermeasures immediately, with technical assistance from regional or district water departments. The users do not need to hopelessly wait for water to be transported from a source point far away from the community, like in the villages that are incorporated in large-scale water schemes that have collapsed.

8.2 Groundwater Development Plan by Villages

8.2.1 Definitions of Water Supply Sources

Three types of water sources have been planned as the supply sources for the water schemes for 100 villages in the Study Area, namely spring sources, shallow wells and deep wells. The wells are all borehole wells (tube wells). A dug well is usually called a shallow well, but here, a shallow well is defined as a well drilled to a depth less than 50m below the ground's surface, and a deep well means a drilled well deeper than 50m.

The definition of shallow or deep wells in this report is according to the drilling depth, although shallow wells will also suggest wells equipped with hand-pumps (manually operated pump) in general, and deep wells will suggest wells with motorized pumps. The pumping capability of a hand-pump is usually limited to 45-50m or less. However, hand-pumps can be installed at wells deeper than 100m if the well's water level comes up to a level higher than 40m below ground surface. (When drilling happens to hit a confined aquifer, the water level in the well rises up to the piezometric surface of that confined aquifer.) On the contrary, a motorized pump is occasionally installed at shallow wells, depending on the water demand.

Since there are many sites where confined aquifers are expected, and there are also some villages of big water demand which can be met with shallow wells, the definition of shallow and deep is made merely by drilling depth.

8.2.2 Water Scheme using Spring Sources

The use of spring water as the source of the water supply may be the best way in terms of good quality of water and low operation and maintenance costs, so long as the spring source is available in the vicinity of the village. If the mouth of the spring is too far from the village center, the maintenance cost of a long transmission line will be high, and the long distance will make daily operation of the pump inconvenient. Taking these points into consideration, only 5 villages out of the 100 have been nominated as villages to use spring sources. They are Mkwiti and Namindondi Juu in Tandahimba and Kilimahewa, Chiodya and Mandagwa in Lindi Rural. The centers of the above mentioned villages are within 3 km distance from the source. "SP"(spring) is marked in the Water Source column in **Table 5-1 (1)-(8)**.

8.2.3 Water scheme using Shallow Borehole Wells as Supply Sources

Shallow boreholes are planned as the sustainable water source in the two villages of Msimbati and Msangamkuu in the district of Mtwara Rural. Since seawater intrusion is anticipated in these two villages, wells within a depth of 20 m have been planned so that the bottoms will be above sea level. The number of wells in these two villages will be in accordance

with the water demand with a limitation of 5.

Hand-pumps will be installed at the wells of these two villages, but the installation of hand-pumps will not be limited to the wells of the two villages.

"SW" (shallow well) is marked in the Water Source column in **Table 5-1 (1)-(8)**.

8.2.4 Water Scheme using Deep Borehole Wells as Supply Source

The use of deep borehole wells as a supply source is planned at the majority of the villages (92 villages). There are 16 villages where the static water level in the well is surely estimated at shallower than 45m and hand-pumps can be installed at the wells in those villages. If a confined aquifer is hit during well drilling, resulting in a rise in the water level in the well to shallower than 45m below the ground's surface, the planned Level-2 water schemes can be converted to the Level-1 schemes. However, since it is difficult to estimate the number of such wells before execution of well drilling, the planning of Level-1 schemes may be limited to only 16 villages out of 92 villages.

Chapter 9 Plan on Water Supply Facility

9.1 Plan of Service Level

9.1.1 Water Demand

The water demand of each candidate village is to be determined based on the daily unit demand (unit supply amount) and the existing population to be served in this plan.

The serviced population should be the projected population of the target year, in general. However, since the population projection is not available at present due to a lack of exact population data and the recent rapid changes in many of the villages, the demand has to be determined on the basis of existing population data.

The water demand is calculated simply by multiplying the unit demand by the population to be served without including the factors of water loss or daily maximum, as usually done in rural water schemes, different from those in urban water schemes.

(1) Unit supply amount

The unit demand is basically set at 20 liters per person a day (20ℓ/c/d) in accordance with the revised Master Plan framework. However, the actual supply amount will be lower than 20 l/c/d in some of the villages depending on the availability of water sources for development, and also by limitations in the scale of the facility to be designed. Considering that the community-based management of the water scheme is the first of its kind in this area, a moderate one, putting emphasis on easier and lower-cost operation and maintenance, may be better than a full-scale one. It is possible to expand the scheme to a full-scale one after the autonomous operation system takes roots in this area.

(2) Planned Serviced Population

The population to be served is planned as the population of the entire area of the concerned villages as of 2000. An increase in population in the future is not considered.

The upgrading of the service level or the expansion of the service area should be duly considered, if necessary, after the updated population census data is obtained.

9.1.2 Distances to Water Points

The domestic points to be designed in this plan are limited to the most densely populated areas of the villages, especially pertaining to the Level-2 service system. Sparsely populated areas or the far away sub-villages are not considered. The distance to the water source is within a few hundred meters in the most densely populated areas, but the people dwelling in the

surrounding area or in sub-villages must walk 1 to 3 km, accordingly. Expanding the scheme will be a matter of consideration after the water users become accustomed to the managing the facilities on their own.

9.2 Supply Facility Plan

9.2.1 Types of Supply Facility

Two types of supply facilities are to be applied, namely Level-1 and Level-2. The factors for type decision are, 1) population of the concerned village, 2) water source development availability and 3) the depth to the water level in the drilled well, as detailed in Clause 3-6-3.

(1) Level-1 facility

Two or more of the point sources (Borehole well equipped with a hand-pump) are to be provided in the village and 270 to 360 of people will use one well. The number of wells in one village is determined by dividing the total population of the concerned village by 315, the average value of 270-360. The design criteria for a Level-1 facility are described in paragraph 3-6-3 (3).

Since operation and maintenance for a Level-1 system is much easier and costs less when compared with a Level-2 system, an effort was made to increase the ratio of Level-1 systems among the 100 villages. However, Level-1 facilities are planned for only 18 villages due to the inconvenient topographic and hydrogeologic conditions, as shown in Table 9-1**.**

If the elevation difference between the ground's surface and the presumed groundwater table is larger than 45m, this Level-1 system is not applicable, due to limited pumping capacity of a manual pump.

(2) Level-2 facility

Level-2 facilities supply water by public faucets. The facility comprises of a water source, (either borehole wells or a spring), a reservoir/distribution tank, a distribution pipe and domestic points (faucet-base with 2 taps), accompanied by a motorized system for pumping water from the well or spring to the distribution tank.

Water is distributed from the tank to the domestic points by natural flow, which is commonly known as the "gravity system".

The volume of the distribution tank and the number of the domestic points as well as the length of the distribution pipe will be in accordance with the population to be served and the area for service in the concerned village. The number of taps, for example, is the quotient of total serviced population divided by number of the people who are to be served by one tap (400 people is assumed). The design criteria for the Level-2 facility are given in 3-6-3 (1). Level-2 systems have been planned for 82 villages, 77 of which borehole wells is the supply source, and 5 of which a spring is the source, as shown in Table 9-1.

9.2.2 Scale of Supply Facility

The water supply facilities have been designed generally according to the water demand of each candidate village, but a small-scale scheme has been planned to meet the minimum requirement within a range of uncertain water demand, taking the easier and lower costing operation and maintenance system into consideration. A full-scale scheme to meet the maximum requirement will not be sustainable, because the scheme's community-based management system is the first of its kind in the entire project area. In other words, the beneficiaries do not yet have the required skills to operate and maintain the facilities on their own.

In addition, schemes of limited scale have been planned, especially for the quite largely populated villages, because of the following two reasons: 1) the water demand is questionable as it is based on questionable population data, and 2) uncertainties in groundwater development in terms of both quantity and quality. The limitations are as follows:

- Level-1 scheme: The number of the wells in one village will be limited to five, in view mostly of groundwater development availability.
- Level-2 scheme: The volume of the distribution tank will be limited to 50 m^3, the maximum length of the distribution pipes will be 500m and the number of public faucet-bases will be limited to five, due to both the above-mentioned reasons.

Expanding the schemes to full-scale ones, such as by increasing the domestic points and extending the distribution pipes, shall be a matter of consideration after confirming that the constructed small-scale facilities are operating smoothly.

9.2.3 Number/Specifications of Planned Facilities

The total number/specifications of the planned facilities for the 100 villages are as follows:

- The estimated total depth of the wells for 95 (93) villages: About 16,600m
  - For Level-1 scheme, 76 wells in 18 villages: 6,370m
  - For Level-2 scheme, 63 wells in 77 (75) villages: 10,200m

  As the drilling wells is carried out on a trial-and-error basis and is particularly difficult in basement rock areas, the total drilling depth including fruitless drilling is estimated at 29,500m.
- Total number and volume of the distribution tanks for 82 villages

20-50m^3 tank	80 sets	Total volume	2,240 m^3
20	49		980 m^3
30	10		300 m^3
40	9		360 m^3
50	12		600 m^3

- Total number of outlets(base with 2 taps) for 82 villages: 262 bases, 524 taps.
- Total length of distribution pipes for 82 villages: 40,000 m
- Total length of transmission pipes from spring for 5 villages: 7,500 m
- Total number of spring water pump stations: 5 places
- Total number of diesel engine generator houses: 67 sets
- Total number of solar-powered systems: 13 sets

9.2.4 Standard Design of Supply Facility

The standard design for each of the facilities and the general plans of the facility arrangements are presented in Figure 9-1 to Figure 9-7.

9.2.5 Cost Estimation for Facility Construction

The total construction cost of the supply facilities for the 100 villages is estimated at US$15,790,000, including the cost of the equipment supply required for implementation of the project.

The project cost estimation including operation and maintenance is given in the following chapter.

(1) Construction cost of the supply facilities for the 100 villages

The facility construction cost is estimated at USD11,730,000 including engineering fees.

(2) Cost for equipment supply required for execution of the project

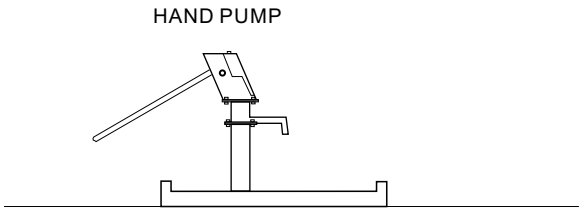
The Ministry of Water and Livestock Development owns more than 40 sets of drilling machines; the majority of them, however, are not in good working condition, due to the following reasons: a) Nearly worn-out (75%), b) A shortage of tools and spare parts and c) A lack of supporting equipment and vehicles. Accordingly, the number of drilling machines barely in use is more or less 10, and there are only 3 full-sets of the drilling equipment ready for use. The drilling capacity of these 10 machines is limited to 130m for over 8-inch diameter drilling. Some sets of drilling equipment can be mobilized to the project site to drill wells shallower than 130m, provided that drilling tools and spare parts are procured. However, the existing drilling machines cannot cope with wells deeper than 140m.

There are more than 40 boreholes of a presumed depth of over 150m in 37 villages; 20 of the villages among them require the drilling of 200-400m wells. These wells cannot be drilled by the equipment available in Tanzania. Such being the cases, at least 1 high-capacity drilling machine with a complete set of tools and spare parts as well as supporting vehicles/equipment should be procured for construction of the deep wells in the project site.

The cost of the new set of drilling equipment, 1set of tools/parts for existing equipment,

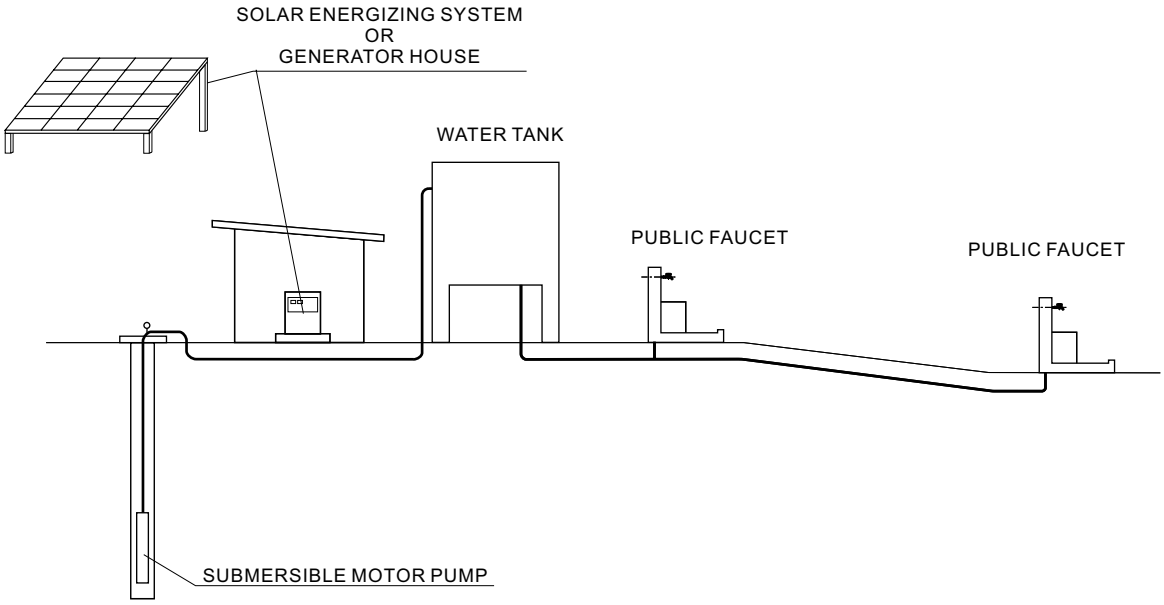
and other necessary equipment and materials for execution and maintenance of the project are estimated at US$4,060,000.

LEVEL-1



LEVEL-2

Water Schemes Using Deep Borehole Well



LEVEL-2

Water Schemes Using Spring Source

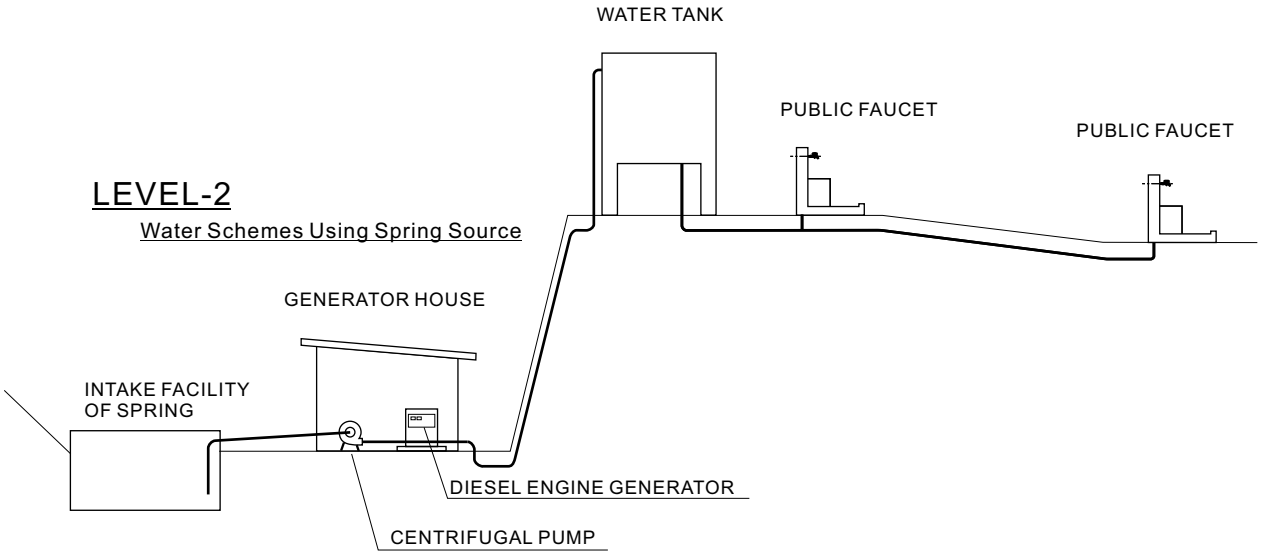
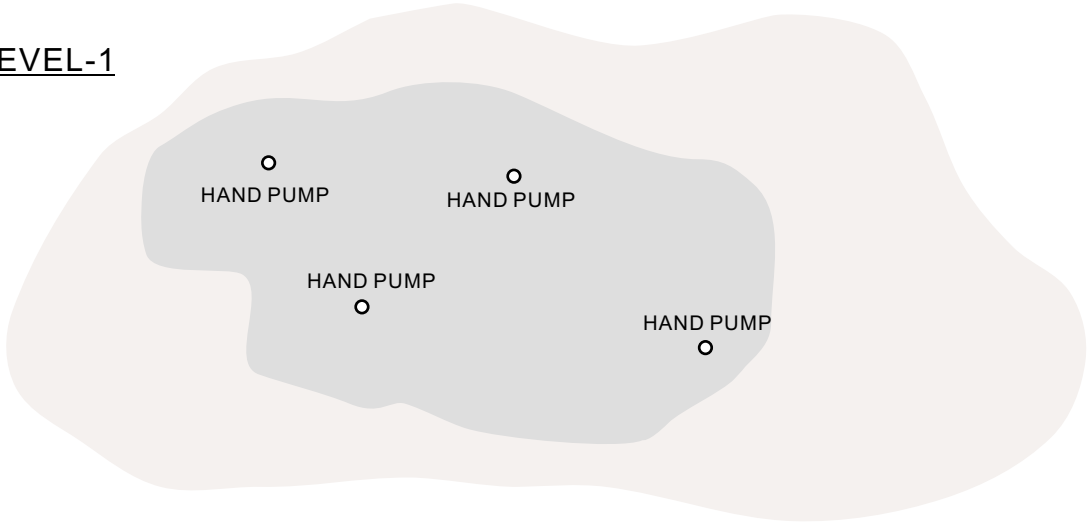


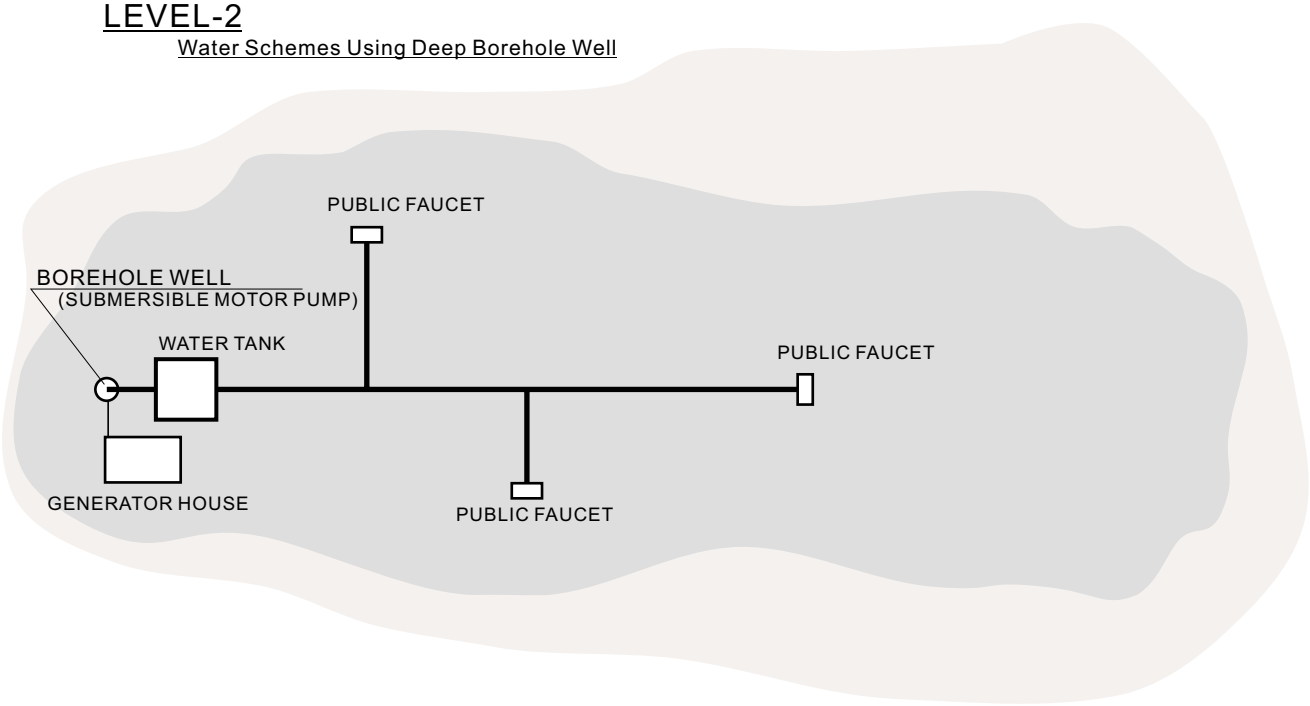
Figure 9-1 FACILITY TYPE

LEVEL-1



LEVEL-2

Water Schemes Using Deep Borehole Well



LEVEL-2

Water Schemes Using Spring Source

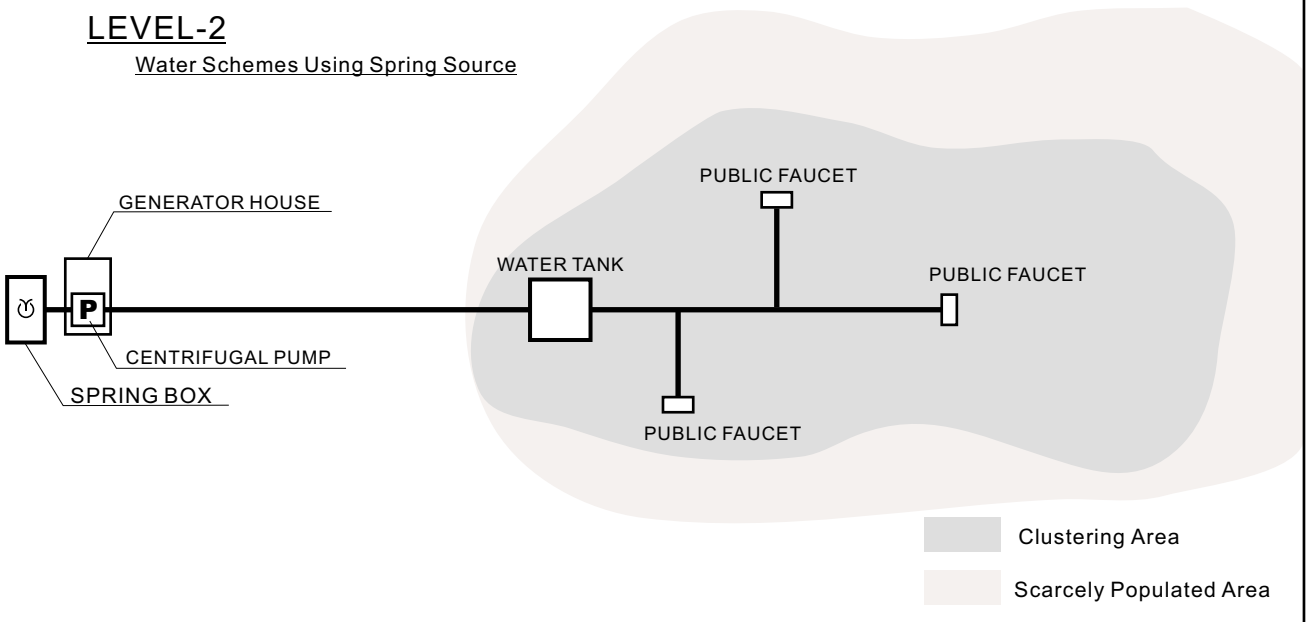


Figure 9-2 FACILITY PLAN

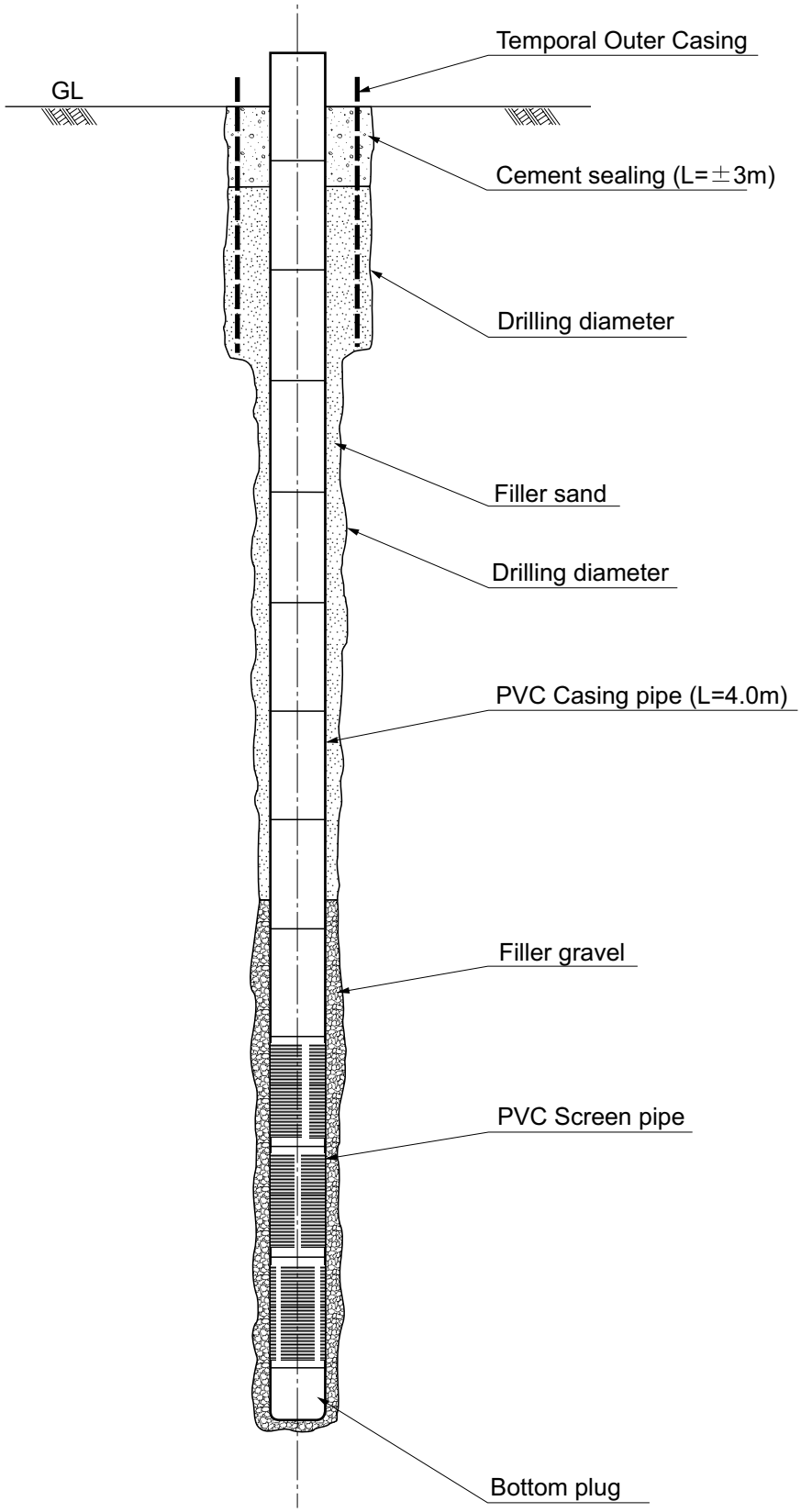


Figure 9-3 Deep Well Construction Plan

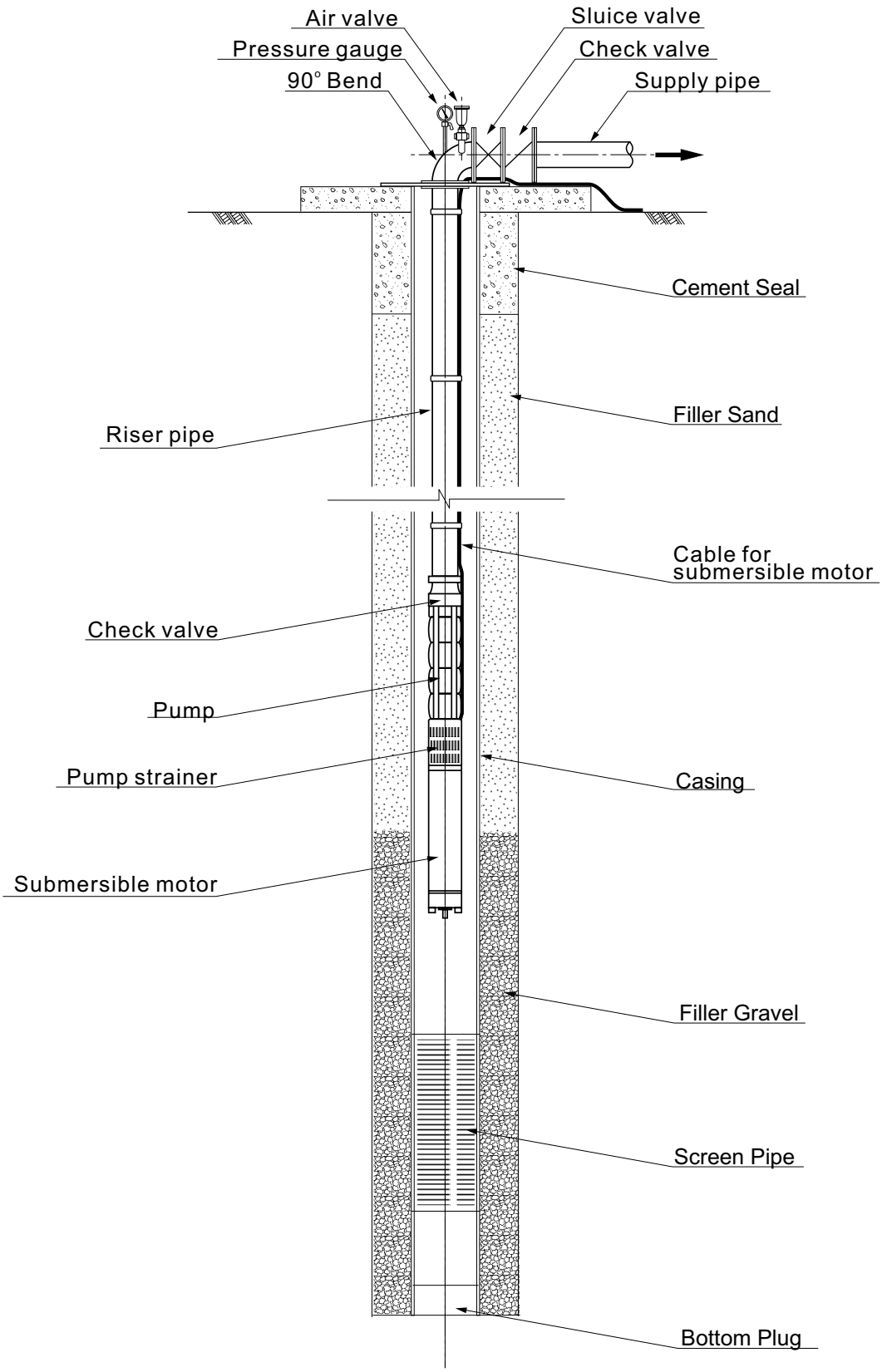
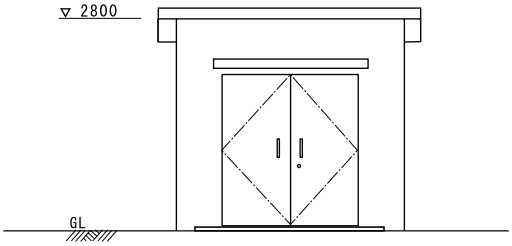
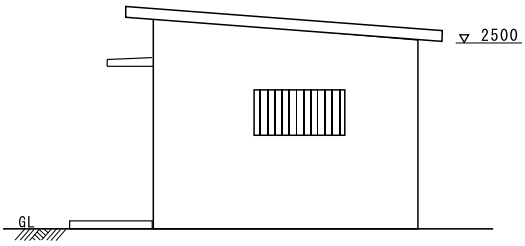


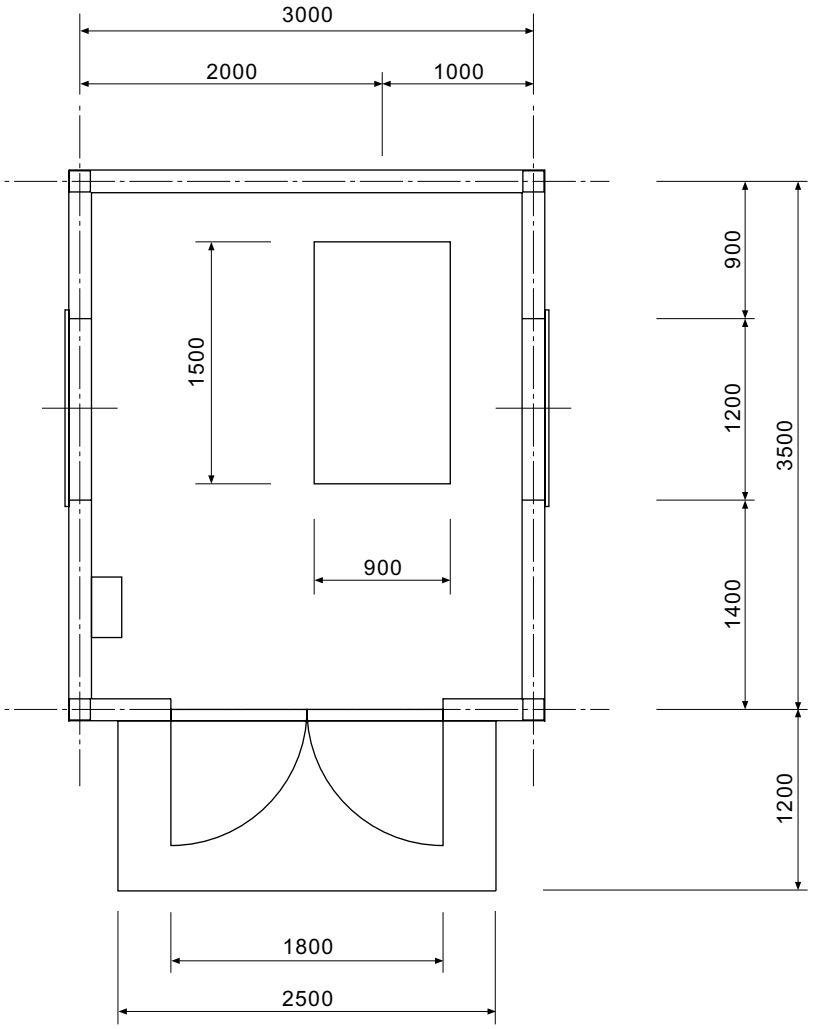
Figure 9-4 Submersible Pump Structure



FRONT VIEW

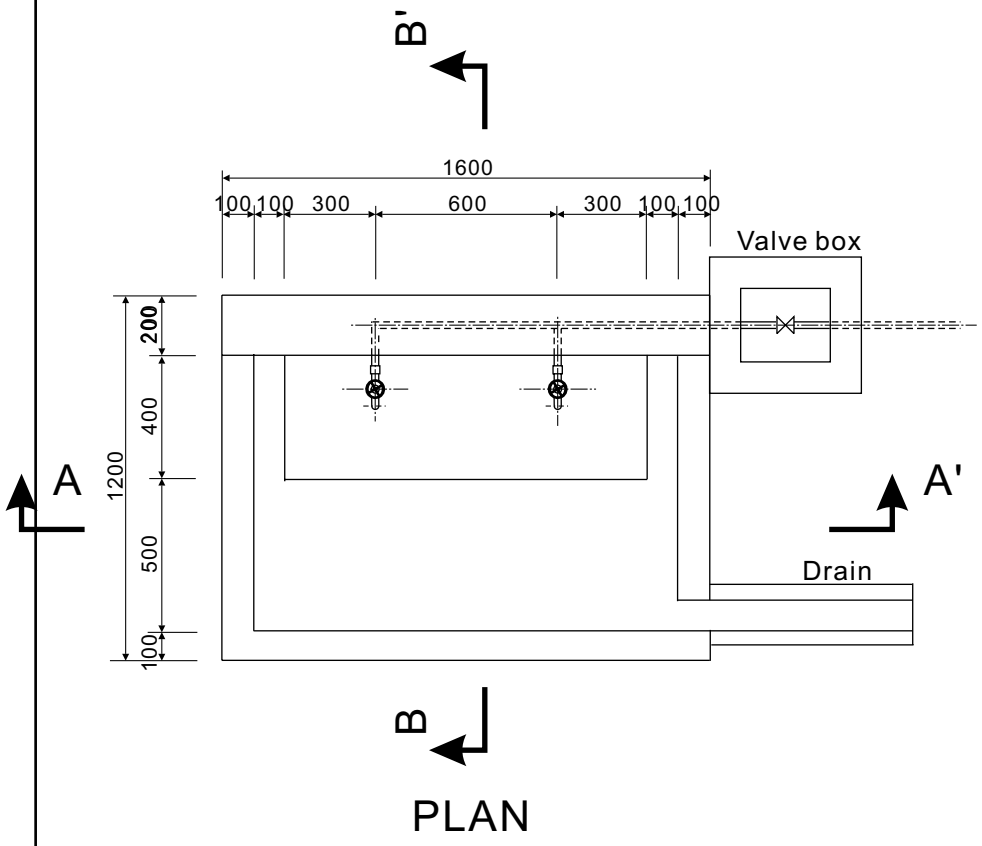


SIDE VIEW

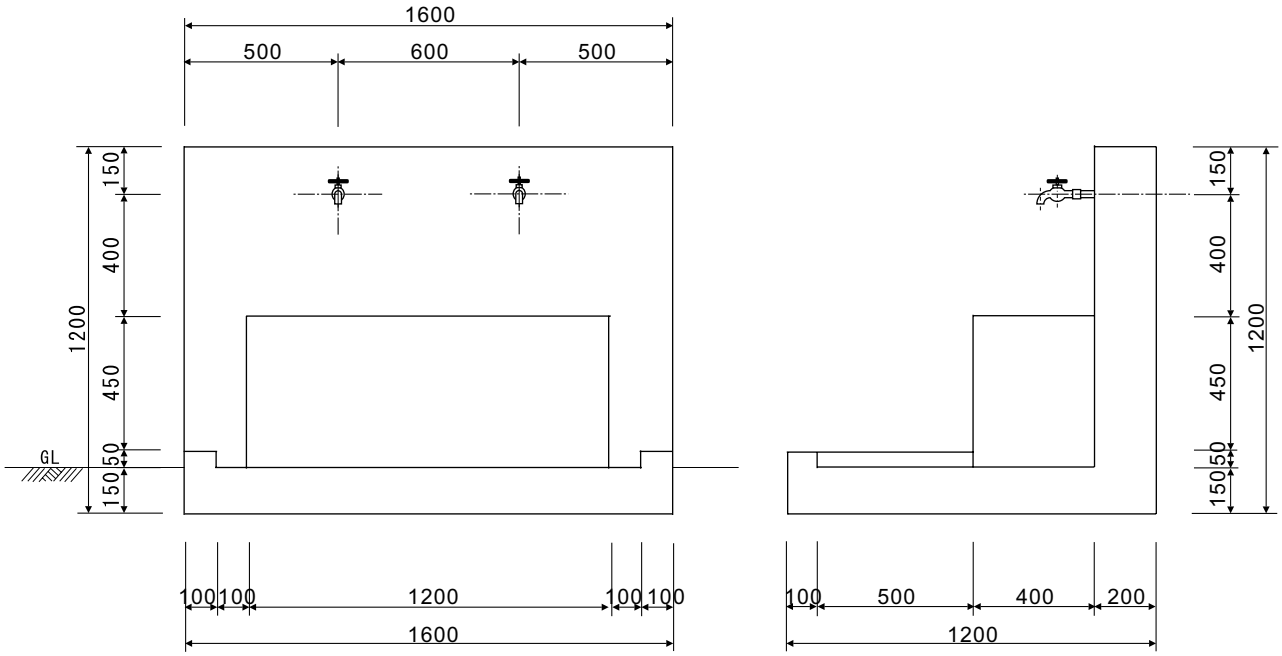


PLAN

Figure 9-5 Generator House



PLAN



SECTION A-A' SECTION B-B'

Figure 9-6 Public Faucet

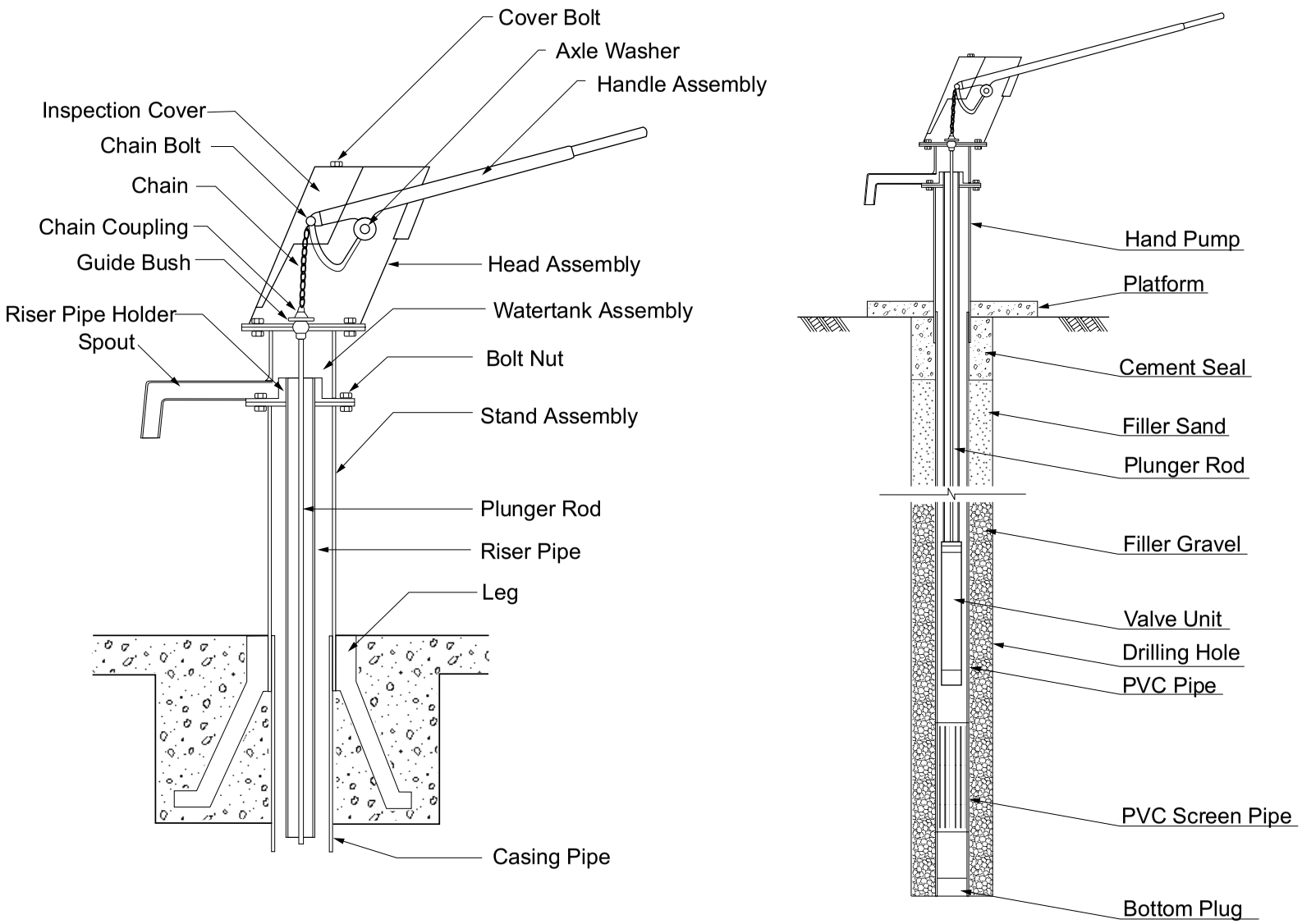
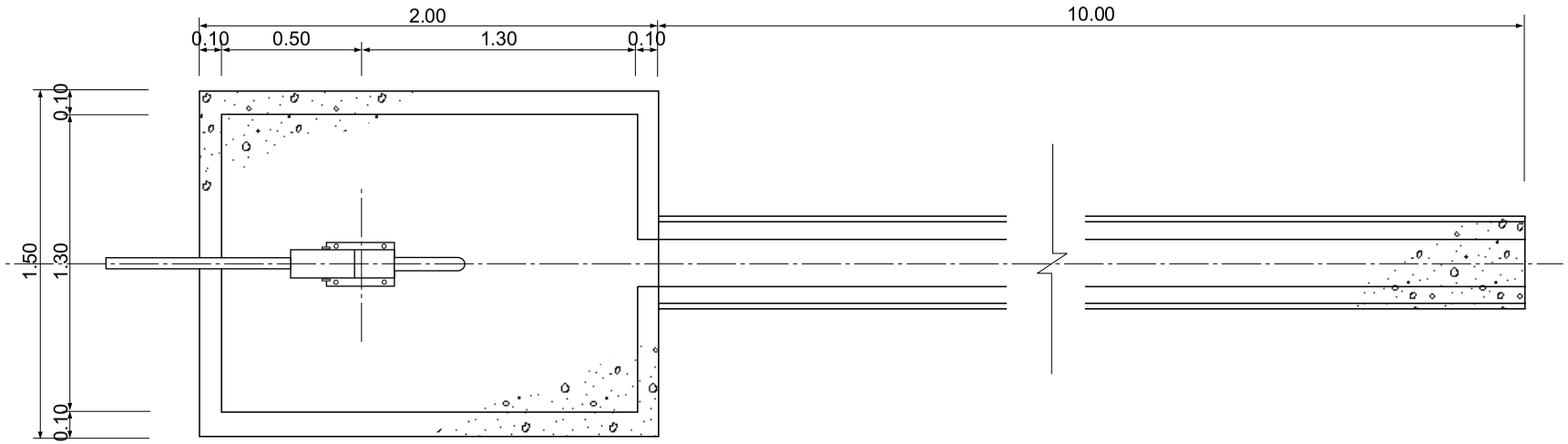


Figure 9-7 Hand Pump Structure



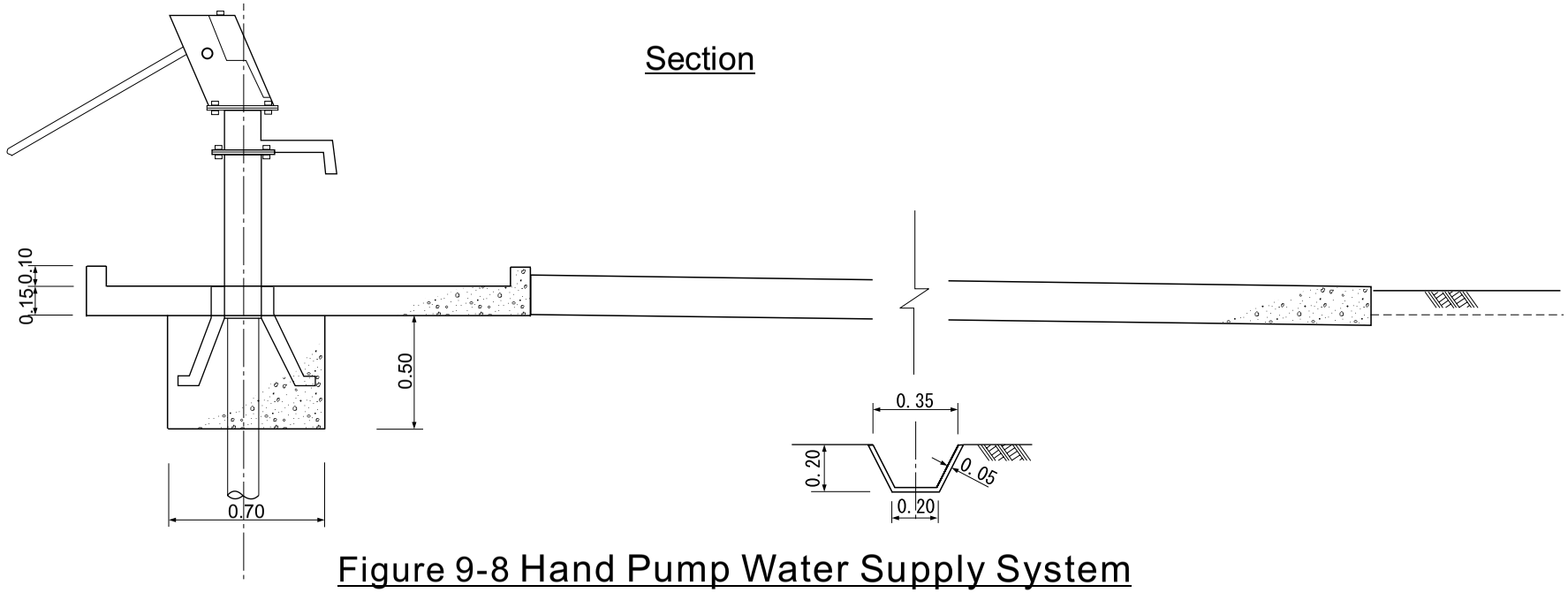


Figure 9-8 Hand Pump Water Supply System

Table 9-1 (1) Water Supply Facility Plan of 100 Villages
Mtwara Rural District, Mtwara Region

Division	Ward	Village	Design Population Served	Amount of Planned Water Supply	Facility Plan													Remarks
					Water Source	Facility Type	Well		Submersible Motor Pump			Engin Generator	Pipeline	Reservor Tank	Public Faucet	Hand Pump		
							Diameter	Depth	Capacity × Head		KW	Operation Time						
				m^3/day								Hr.	KVA	m	m^3	Place	Place	
Nanyamba	Nanyamba	Mbembaleo	5,600	112	BH	Level 2	φ 6 "	200 m	160 ℓ/min×	120 m	7.5 KW	12	55	500	50	5	—	
	Mtiniko	Maranje	2,346	46	BH	Level 2	φ 6 "	160 m	80 ℓ/min×	120 m	3.7 KW	10	20	500	20	3	—	
		Mtiniko	1,166	23	BH	Level 2	φ 4 "	150 m	50 ℓ/min×	130 m	2.2 KW	8	15	500	20	2	—	
		Malamba	1,557	31	BH	Level 2	φ 4 "	120 m	70 ℓ/min×	100 m	2.2 KW	8	15	500	20	2	—	
Ziwani	Ziwani	Ziwani	6,700	134	BH	Level 2	Existing Well		380 ℓ/min×	70 m	7.5 KW	6	55	500	60	5	—	
	Nalingu	Msimbati	5,320	106	SW	Level 1	φ 4 "	30 m	20 ℓ/min×	30 m	—	—	—	—	—	—	5	
		Msangamkuu	4,980	99	SW	Level 1	φ 4 "	30 m	20 ℓ/min×	30 m	—	—	—	—	—	—	5	
	Nanguruwe	Nanguruwe	4,482	89	BH	Level 2	φ 6 "	180 m	130 ℓ/min×	130 m	5.5 KW	12	35	500	40	5	—	
		Mbawala	2,050	41	BH	Level 2	φ 6 "	200 m	120 ℓ/min×	190 m	7.5 KW	6	55	500	20	3	—	
Mayanga	Mayanga	Kawawa	3,530	70	BH	Level 1	φ 4 "	140 m	20 ℓ/min×	40 m	—	—	—	—	—	—	5	
Kitaya	Kitaya	Kitaya	2,767	55	BH	Level 2	φ 6 "	60 m	160 ℓ/min×	70 m	3.7 KW	6	20	500	30	4	—	
		Arusha Chini	1,654	33	BH	Level 2	Existing Well		100 ℓ/min×	80 m	2.2 KW	6	15	500	20	3	—	
	Kiromba	Mayambe Juu	887	17	BH	Level 2	φ 4 "	150 m	50 ℓ/min×	140 m	2.2 KW	6	15	500	20	2	—	
	Mahurunga	Kitunguli	4,530	183	BH	Level 2	φ 6 "	100 m	390 ℓ/min×	60 m	7.5 KW	8	55	3,000	50	5	—	
		Mahurunga	4,628													5		
Dihimba	Dihimba	Dihimba	1,587	82	BH	Level 2	φ 6 "	100 m	140 ℓ/min×	80 m	3.7 KW	10	20	2,000	40	2	—	
		Mpondomo	2,556													4		

Table 9-1 (2) Water Supply Facility Plan of 100 Villages
Tandahimba District, Mtwara Region

Division	Ward	Village	Design Population Served	Amount of Planned Water Supply	Facility Plan												Remarks
					Water Source	Facility Type	Well		Submersible Motor Pump			Engin Generator	Pipeline	Reservor Tank	Public Faucet	Hand Pump	
							Diameter	Depth	Capacity × Head	KW	Operation Time						
				m^3/day							Hr.	KVA	m	m^3	Place	Place	
Namikupa	Mihambwe	Mihambwe	3,279	65	BH	Level 2	φ 6 "	180 m	100 ℓ/min× 130 m	5.5 KW	12	35	500	30	5	—	
	Kitama	Kitama	6,198	123	BH	Level 2	φ 6 "	180 m	180 ℓ/min× 190 m	5.5 KW	12	35	500	50	5	—	
		Mitondi A	1,333	26	BH	Level 2	φ 4 "	180 m	50 ℓ/min× 120 m	2.2 KW	10	15	50	20	2	—	Public Faucet built to tank side.
	Mkoreha	Misufini	883	17	BH	Level 2	φ 4 "	180 m	40 ℓ/min× 120 m	2.2 KW	8	15	50	20	1	—	Public Faucet built to tank side.
Litehu	Luagala	Litehu	840	16	BH	Level 2	φ 4 "	200 m	50 ℓ/min× 120 m	2.2 KW	6	15	50	20	1	—	Public Faucet built to tank side.
		Mmeda	823	16	BH	Level 2	φ 4 "	200 m	50 ℓ/min× 180 m	3.7 KW	6	20	50	20	1	—	Public Faucet built to tank side.
		Mabeti	850	17	BH	Level 2	φ 4 "	250 m	50 ℓ/min× 240 m	5.5 KW	6	35	50	20	1	—	Public Faucet built to tank side.
	Mkwiti	Mkwiti Chini	1,034	20	SP	Level 2	—	—	50 ℓ/min× 100 m	5.5 KW	8	35	500	20	2	—	Volute Pump
	Ngunja	Namindondi Juu	1,550	31	SP	Level 2	—	—	90 ℓ/min× 100 m	5.5 KW	6	35	500	20	2	—	Volute Pump
		Nanjanga	1,525	30	BH	Level 2	φ 4 "	400 m	50 ℓ/min× 240 m	2.2 KW	10	15	50	20	2	—	
		Mkuti	1,620	32	BH	Level 2	φ 4 "	400 m	30 ℓ/min× 240 m	3.7 KW	24	20	500	20	3	—	

Table 9-1 (3) Water Supply Facility Plan of 100 Villages

Newala District, Mtwara Region

Division	Ward	Village	Design Population Served	Amount of Planned Water Supply	Facility Plan												Remarks
					Water Source	Facility Type	Well		Submersible Motor Pump			Engin Generator	Pipeline	Reservor Tank	Public Faucet	Hand Pump	
							Diameter	Depth	Capacity × Head	KW	Operation Time						
				m^3/day							Hr.	KVA	m	m^3	Place	Place	
Newala	Nanguruwe	Mnanje	780	15	BH	Level 2	φ 4 ”	350 m	50 ℓ/min× 280 m	5.5 KW	6	35	500	20	1	—	
	Mnekachi	Kilidu	1,780	35	BH	Level 2	φ 4 ”	250 m	50 ℓ/min× 190 m	3.7 KW	12	20	500	20	3	—	
Chilangala	Mnyambe	Mnima	1,162	23	BH	Level 2	φ 4 ”	300 m	50 ℓ/min× 280 m	5.5 KW	8	35	500	20	2	—	
	Chilangala	Miyuyu	850	17	BH	Level 2	φ 4 ”	400 m	30 ℓ/min× 390 m	3.7 KW	12	20	500	20	1	—	
		Namangudu	722	14	BH	Level 2	φ 4 ”	400 m	20 ℓ/min× 390 m	3.7 KW	12	20	50	20	1	—	Public Faucet built to tank side.
Kitangari	Kitangari	Mitanga	1,271	25	BH	Level 2	φ 4 ”	250 m	50 ℓ/min× 190 m	3.7 KW	10	20	50	20	2	—	Public Faucet built to tank side.
		Likwaya	507	10	BH	Level 2	φ 4 ”	300 m	30 ℓ/min× 240 m	2.2 KW	6	15	50	20	1	—	Public Faucet built to tank side.
	Malatu	Malatu juu	2,230	44	BH	Level 2	φ 6 ”	250 m	70 ℓ/min× 190 m	5.5 KW	12	35	500	20	3	—	
	Mchemo	Mdimba	1,362	27	BH	Level 2	φ 4 ”	250 m	50 ℓ/min× 220 m	3.7 KW	10	20	500	20	2	—	
	Chiwonga	Chiwonga	1,558	31	BH	Level 2	φ 4 ”	250 m	50 ℓ/min× 220 m	3.7 KW	12	20	500	20	2	—	
		Mmulunga	1,593	31	BH	Level 2	φ 4 ”	250 m	50 ℓ/min× 220 m	3.7 KW	12	20	500	20	2	—	

Table 9-1 (4) Water Supply Facility Plan of 100 Villages

Masasi District, Mtwara Region

Division	Ward	Village	Design Population Served	Amount of Planned Water Supply	Facility Plan												Remarks
					Water Source	Facility Type	Well		Submersible Motor Pump			Engin Generator	Pipeline	Reservor Tank	Public Faucet	Hand Pump	
							Diameter	Depth	Capacity × Head	KW	Operation Time						
				m^3/day							Hr.	KVA	m	m^3	Place	Place	
Chikundi	Nanganga	Nanganga	2,385	47	BH	Level 2	φ 6 ”	50 m	140 ℓ/min× 50 m	2.2 KW	6	15	500	20	3	—	
Lisekese	Lisekese	Namkungwi	1,339	26	BH	Level 2	φ 4 ”	100 m	50 ℓ/min× 50 m	1.5 KW	10	10	500	20	2	—	
	Mikangaula	Kilosa	2,001	40	BH	Level 2	φ 4 ”	80 m	90 ℓ/min× 50 m	1.5 KW	8	10	500	20	3	—	
	Namatutwe	Chikoweti	3,273	65	BH	Level 2	φ 6 ”	30 m	100 ℓ/min× 45 m	1.5 KW	12	10	500	30	5	—	
		Mlingula	3,321	66	BH	Level 2	φ 6 ”	80 m	100 ℓ/min× 50 m	1.5 KW	12	10	500	30	5	—	
	Lukuledi	Chiwale	9,567	191	BH	Level 2	φ 6 ”	100 m	270 ℓ/min× 50 m	3.7 KW	12	20	500	80	5	—	
Nanyumbu	Nanyumbu	Nanyumbu	1,205	24	(BH)	Level 1	φ 4 ”	80 m	20 ℓ/min× 45 m	—	—	—	—	—	—	4	
		Namasogo	1,304	26	BH	Level 2	φ 4 ”	100 m	80 ℓ/min× 50 m	1.5 KW	6	—	500	20	2	—	Solar System
Lulindi	Namalenga	Msanga	954	19	BH	Level 2	φ 4 ”	200 m	40 ℓ/min× 120 m	2.2 KW	8	15	500	20	2	—	
Chiungutwa	Chiungutwa	Mpeta	2,117	42	BH	Level 2	φ 6 ”	80 m	90 ℓ/min× 60 m	1.5 KW	8	10	500	20	3	—	
	Mbuyuni	Mitonji	2,500	50	BH	Level 2	φ 6 ”	80 m	70 ℓ/min× 80 m	2.2 KW	12	15	500	30	4	—	

Table 9-1 (5) Water Supply Facility Plan of 100 Villages
Kilwa District, Lindi Region

Division	Ward	Village	Design Population Served	Amount of Planned Water Supply	Facility Plan												Remarks
					Water Source	Facility Type	Well		Submersible Motor Pump			Engin Generator	Pipeline	Reservor Tank	Public Faucet	Hand Pump	
							Diameter	Depth	Capacity × Head	KW	Operation Time						
				m^3/day							Hr.	KVA	m	m^3	Place	Place	
Pwani	Kikole	Migeregere	1,400	28	BH	Level 2	φ 4 "	150 m	80 ℓ/min× 140 m	2.2 KW	6	15	500	20	2	—	
Miteja	Tingi	Mtandango	909	18	BH	Level 1	φ 4 "	50 m	20 ℓ/min× 40 m	—	—	—	—	—	—	3	
	Kinjumbi	Somanga Ndumbo	3,800	76	BH	Level 2	φ 6 "	80 m	160 ℓ/min× 45 m	2.2 KW	8	15	500	40	5	—	
Pande	Pande Mikoma	Pande Plot	3,600	72	BH	Level 2	φ 6 "	75 m	150 ℓ/min× 70 m	3.7 KW	8	20	500	30	5	—	
		Mtitimira	1,034	20	BH	Level 1	φ 4 "	100 m	20 ℓ/min× 50 m	—	—	—	—	—	—	3	
	Lihimalyoao	Lihimalyoao	4,686	93	BH	Level 2	φ 6 "	80 m	130 ℓ/min× 50 m	2.2 KW	12	—	500	40	5	—	Solar System
		Namakongoro	1,500	30	BH	Level 1	φ 4 "	80 m	20 ℓ/min× 30 m	—	—	—	—	—	—	5	
	Mandawa	Mandawa	7,070	141	BH	Level 2	φ 6 "	100 m	200 ℓ/min× 50 m	3.7 KW	12	20	500	60	5	—	
		Kiwawa	1,800	36	BH	Level 2	φ 4 "	150 m	100 ℓ/min× 60 m	2.2 KW	6	15	500	20	3	—	

Table 9-1 (6) Water Supply Facility Plan of 100 Villages

Lindi Rural District, Lindi Region

Division	Ward	Village	Design Population Served	Amount of Planned Water Supply	Facility Plan													Remarks
					Water Source	Facility Type	Well		Submersible Motor Pump			Engin Generator	Pipeline	Reservor Tank	Public Faucet	Hand Pump		
							Diameter	Depth	Capacity × Head	KW	Operation Time							
				m^3/day							Hr.	KVA	m	m^3	Place	Place		
Mtama	Nyangao	Chiwerere	1,438	28	BH	Level 1	φ 4 "	80 m	20 ℓ/min× 40 m	—	—	—	—	—	—	5		
	Nyengedi	Nyengedi	3,812	76	BH	Level 2	φ 6 "	80 m	160 ℓ/min× 50 m	2.2 KW	8	15	1,000	40	5	—		
		Mtumbya	1,250	25	BH	Level 2	φ 4 "	180 m	50 ℓ/min× 100 m	1.5 KW	10	10	500	20	2	—		
	Mtua	Kilimahewa (Muta)	4,400	88	SP	Level 2	—	—	150 ℓ/min× 100 m	5.5 KW	10	35	500	40	5	—		Volute Pump
Sudi	Sudi	Madangwa	5,603	112	SP	Level 2	—	—	160 ℓ/min× 100 m	5.5 KW	12	35	500	50	5	—		Volute Pump
		Hingawali	3,960	79	BH	Level 2	φ 6 "	180 m	110 ℓ/min× 100 m	3.7 KW	12	20	500	40	5	—		
Nyangamara	Nyangamara	Madingo	1,611	32	BH	Level 2	φ 4 "	180 m	90 ℓ/min× 90 m	3.7 KW	6	20	500	20	3	—		
	Mandwanga	Chiuta	2,098	41	BH	Level 2	φ 6 "	180 m	90 ℓ/min× 120 m	3.7 KW	8	20	500	20	3	—		
		Malungo	1,566	31	BH	Level 1	φ 4 "	160 m	20 ℓ/min× 40 m	—	—	—	—	—	—	5		
Mingoyo	Kiwalala	Kiwalala	9,471	189	BH	Level 2	φ 6 "	60 m	400 ℓ/min× 70 m	7.5 KW	8	55	500	80	5	—		
	Mnolela	Mnolela	7,367	147	BH	Level 2	φ 6 "	200 m	210 ℓ/min× 90 m	5.5 KW	12	35	500	70	5	—		
Rondo	Chiponda	Chiodya	3,425	68	SP	Level 2	—	—	100 ℓ/min× 100 m	5.5 KW	12	35	500	30	5	—		Volute Pump
Ngapa	Ngapa	Kinengene	9,020	180	BH	Level 2	φ 6 "	60 m	250 ℓ/min× 70 m	5.5 KW	12	35	500	80	5	—		
Mchinga	Mchinga	Kilangala	8,773	175	(BH)	Level 2	φ 6 "	140 m	250 ℓ/min× 40 m	3.7 KW	12	20	500	80	5	—		
	Kilolombwani	Kilolombwani	1,160	23	BH	Level 1	φ 4 "	80 m	20 ℓ/min× 30 m	—	—	—	—	—	—	4		
Mipingo	Mipingo	Lihimilo	1,058	21	BH	Level 2	φ 4 "	180 m	50 ℓ/min× 90 m	1.5 KW	8	—	50	20	2	—		Solar System
Nangaru	Chikonji	Chikonji	2,391	47	BH	Level 2	φ 6 "	90 m	140 ℓ/min× 40 m	1.5 KW	6	10	500	20	3	—		

Table 9-1 (7) Water Supply Facility Plan of 100 Villages
Ruangwa District, Lindi Region

Division	Ward	Village	Design Population Served	Amount of Planned Water Supply	Facility Plan												Remarks
					Water Source	Facility Type	Well		Submersible Motor Pump			Engin Generator	Pipeline	Reservor Tank	Public Faucet	Hand Pump	
							Diameter	Depth	Capacity × Head	KW	Operation Time						
				m^3/day							Hr.	KVA	m	m^3	Place	Place	
Ruangwa	Malolo	Nanganga	1,150	23	BH	Level 2	φ 4 ”	80 m	70 ℓ/min× 50 m	1.5 KW	6	10	500	20	2	—	
	Likunja	Chilangalile	966	19	BH	Level 1	φ 4 ”	80 m	20 ℓ/min× 40 m	—	—	—	—	—	—	3	
	Narun'gombe	Machanganja	1,905	38	BH	Level 2	φ 4 ”	80 m	110 ℓ/min× 50 m	2.2 KW	6	—	500	20	3	—	Solar System
		Liuguru	3,736	74	BH	Level 2	φ 6 ”	80 m	110 ℓ/min× 70 m	2.2 KW	12	15	500	40	5	—	
	Namichiga	Mihewe	1,017	20	BH	Level 1	φ 4 ”	80 m	20 ℓ/min× 30 m	—	—	—	—	—	—	3	
Mnacho	Luchelegwa	Chinongwe	3,395	67	(BH)	Level 2	φ 6 ”	80 m	100 ℓ/min× 50 m	1.5 KW	12	10	500	30	5	—	
		Litama	1,546	30	BH	Level 2	φ 4 ”	80 m	90 ℓ/min× 50 m	1.5 KW	6	10	500	20	2	—	
		Likwachu	1,824	36	BH	Level 2	φ 4 ”	80 m	50 ℓ/min× 60 m	2.2 KW	12	15	500	20	3	—	
		Ipingo	981	19	BH	Level 1	φ 4 ”	80 m	20 ℓ/min× 40 m	—	—	—	—	—	—	3	
Mandawa	Mandawa	Chibula	1,192	23	BH	Level 2	φ 4 ”	80 m	70 ℓ/min× 80 m	2.2 KW	6	—	500	20	2	—	Solar System

Table 9-1 (8) Water Supply Facility Plan of 100 Villages

Nachingwea District, Lindi Region

Division	Ward	Village	Design Population Served	Amount of Planned Water Supply	Facility Plan													Remarks
					Water Source	Facility Type	Well		Submersible Motor Pump			Engin Generator	Pipeline	Reservor Tank	Public Faucet	Hand Pump		
							Diameter	Depth	Capacity × Head		KW	Operation Time						
				m^3/day								Hr.	KVA	m	m^3	Place	Place	
Mnero	Mnero Miembeni	Mkonjela	3,665	73	BH	Level 2	φ 6 ”	80 m	110 ℓ/min×	80 m	3.7 KW	12	20	500	40	3	—	
Ruponda	Marambo	Litula	1,793	35	BH	Level 1	φ 4 ”	100 m	20 ℓ/min×	40 m	—	—	—	—	—	—	5	
	Mkoka	Rweje	1,352	27	BH	Level 1	φ 4 ”	100 m	20 ℓ/min×	40 m	—	—	—	—	—	—	5	
Nambambo	Naipanga	Naipanga	17,939	358	BH	Level 2	φ 6 ”	80 m	500 ℓ/min×	50 m	7.5 KW	12	55	500	50	5	—	
	Naipanga	Chiumbati Miembeni	1,369	27	BH	Level 2	φ 4 ”	80 m	40 ℓ/min×	70 m	1.5 KW	12	10	500	20	2	—	
	Mkotokuyama	Mandai	1,628	32	BH	Level 2	φ 4 ”	80 m	90 ℓ/min×	60 m	1.5 KW	6	10	500	20	3	—	
	Ndomoni	Ndomoni	1,230	24	BH	Level 2	φ 4 ”	80 m	40 ℓ/min×	60 m	1.5 KW	10	10	500	20	2	—	
	Mtua	Kipara Mtua	2,573	51	BH	Level 2	φ 6 ”	160 m	80 ℓ/min×	70 m	1.5 KW	12	10	500	30	4	—	
	Mpiruka	Mpiruka	2,621	52	BH	Level 2	φ 6 ”	150 m	80 ℓ/min×	80 m	2.2 KW	12	15	500	30	4	—	

Liwale District, Lindi Region

Division	Ward	Village	Design Population Served	Amount of Planned Water Supply	Facility Plan													Remarks
					Water Source	Facility Type	Well		Submersible Motor Pump			Engin Generator	Pipeline	Reservor Tank	Public Faucet	Hand Pump		
							Diameter	Depth	Capacity × Head		KW	Operation Time						
				m^3/day								Hr.	KVA	m	m^3	Place	Place	
Barikiwa	Mlembwe	Mlembwe	1,586	31	BH	Level 1	φ 4 ”	80 m	20 ℓ/min×	40 m	—	—	—	—	—	—	5	
Liwale	Liwale B	Mikunya	1,100	22	BH	Level 1	φ 4 ”	60 m	20 ℓ/min×	40 m	—	—	—	—	—	—	4	
	Mihumo	Mihumo	1,771	35	BH	Level 2	φ 4 ”	50 m	100 ℓ/min×	60 m	2.2 KW	6	15	500	20	3	—	
	Mbaya	Mbaya	1,442	28	BH	Level 2	φ 4 ”	60 m	80 ℓ/min×	70 m	1.5 KW	6	10	500	20	2	—	
	Ngongowele	Ngongowele	1,291	25	BH	Level 1	φ 4 ”	80 m	20 ℓ/min×	20 m	—	—	—	—	—	—	4	

Chapter 10 Operation and Maintenance

10.1 Responsible Bodies for Operation and Maintenance

All of the water users are responsible for operation and management of the water scheme of their own communities. The village water committee represents the users on management of the scheme in collaboration of the village council.

The role of the village water committee is as follows;

- Daily operation of the supply facility
- Inspection of the facility and minor repair of troubled portions
- Water charge collection and management of it for operation and maintenance purposes
- Keeping in close contact with the district water department and making requests for technical assistances for major repair or replacement and redevelopment of the well

The district water department is responsible for technical assistance in operation and maintenance of the community's water supply facility in compliance with the requests from the village water committee. The district water department is also responsible for training the villagers and village water committee on proper usage of supply facility and monitoring the water committee by conducting periodical patrol services.

The regional water department is responsible for training the staff from the district water departments, and for giving technical assistance to the district water departments on the matters that the district level cannot cope with, such as water resource management, repair of pumping equipment, re-development of wells, etc.

The regional and district administrations are responsible in taking necessary budgetary measure to the water departments, which enables the departments take satisfactory activities in the technical assistances.

The rural water supply department of the Ministry is responsible in monitoring of the water scheme operation and condition of the collaboration between above mentioned bodies, and in giving technical advices to the regional and district water departments.

10.2 COST ESTIMATION FOR OPERATION AND MAINTENANCE

The majority of the operation and maintenance cost is to be shouldered by the water users. The village water committee collects O/M fees from the users and manages it as the village water fund. The O/M cost varies according to the type (Level-1 or Level-2) and scale of the facility and, concerning the Level-2 system, by the power source of the facility.

The operation and maintenance cost to be shouldered by the district water department comprises of personnel expenses, allowances and the vehicle management cost necessary for periodical patrol services.

The estimated annual O/M cost for 100 villages totals Tsh.360 million. This amount is to be paid by about 54,700 households in 100 villages. The breakdown of costs for each type of facility, and the average charge per household are shown below;

- Village water fund

1) For Level-1 facility: (76 wells in18 villages with 6540 households)

Tsh.170,000/well/year, totaling Tsh.12,920,000/year for 76 wells

Pump parts purchasing:	Tsh.40,000/well/year
Well flashing (every 5-year)	Tsh.80,000/well/year
Pump replacement (every 12-year)	Tsh.50,000/well/year

The O/M fee to be paid per household ranges from Tsh.1, 810 to Tsh.2, 830, averaging Tsh.2,000/household/year (about 170 shillings monthly per household).

2) For Level-2 facility: with diesel engine power source: (69 villages with 44,800 hhs)

The O/M cost for 69 villages totals Tsh.322 million/year, ranging from Tsh.3.5 to 5.8 million per village, and from 5000 to 24,000 shillings per household. The average charge per household is Tsh.7, 200/year (420-2000 shillings /month)

The O/M cost for a Level-2 facility is divided into 2. One is the operation cost including fuel for the diesel engine generator, small parts, minor repairs and personnel (security guard). (Tsh.2,670,000-5,070,000/year). The other is the maintenance cost including heavy repairs, well flashing, equipment replacement and renewal of pipes (about Tsh.790,000).

3) For a Level-2 facility using a solar-powered system: (13 villages with 3,300 households), the O/M cost is nearly half of that in 2), because the operation cost is negligible. (350-800 shillings monthly per household)

- The operation and maintenance cost covered by district water departments

In addition to the annual budget allocated to each of the district water departments, Tsh.3,600,000/year should be distributed, to cover the cost of hiring one additional staff member and expenses for periodical patrol services.

Chapter 11 Project Evaluation

11.1 Economic Evaluation

(1) Introduction

The Project has been designed to satisfy the basic human needs of the people residing in rural areas of the Lindi and Mtwara regions. Out of 913 communities (excluding urban areas) in the Study Area, a total of 100 rural communities have been selected as the target villages for the implementation of the first-step of the Project.

The objectives of the Project are: i) to provide and distribute sufficient and safe potable water to meet the needs of domestic water users in 100 villages by the year 2005 and ii) to establish an improved operation and maintenance system in prioritized villages through the participation of the villagers.

Based on the phased project implementation concept, the Project will be implemented in two phases, each phase covering 50 villages. Phase-1 project works will be implemented by the year 2003 and Phase-2 by the year 2005.

(2) Evaluation of the Economic Benefits of the Project

1) Overall benefits

The implementation of the Project is expected to yield various kinds of benefits including direct as well as indirect ones. These benefits include not only quantifiable ones such as increased number of beneficiaries, improvements in health and time saving, but also non-quantifiable ones such as consumer satisfaction and improved quality of life of the people in general. The Project is also expected to yield indirect benefits as a result of time saving such as employment generation, a reduction in morbidity and mortality among children as a result of an increase in time women spend on childcare, and an increase in community activities for rural development.

2) Increased Beneficiaries

One of the significant effects of the Project is the increased number of beneficiaries as a result of an increased supply of safe water.

Project works will cover 100 villages in the Lindi and Mtwara regions covering an actual population of 157,688 persons in the Lindi region and 112,515 persons in the

Mtwara region.

There are currently no public water supply systems in these villages except those of the 6 pilot sites, and it is assumed that the coverage rate in the target villages is zero percent. The number of beneficiaries is 155,271 persons in the Lindi region and 122,056 persons in the Mtwara region with a total population of 277,327 persons.

Number of Beneficiaries in Lindi Region

	No. of Target Villages	Beneficiaries (Actual Population in 2000)
Kilwa	9	25,799
Lindi Rural	17	68,403
Ruangwa	10	17,712
Nachingwea	9	34,167
Liwale	5	7,190
Total	50	155,271

Note: Population in 2000 is based on the actual figure in each village.

Number of Beneficiaries in Mtwara Region

	No. of Target Villages	Beneficiaries (Actual Population in 2000)
Mtwara Rural	17	56,340
Newala	11	13,815
Tandahimba	11	19,935
Masasi	11	29,966
Total	50	122,056

Note: Population in 2000 is based on the actual figure in each village.

3) Improvement in Health Conditions

One of the main objectives of rural water supply programs is to improve health conditions in rural areas. The proposed Project has also been designed to reduce the incidence of waterborne diseases through provision of improved water quality and increased water use.

Having better access to water may change personal hygiene habits, promoting an increase in bathing and clothes washing. Increased water use for bathing, washing and food preparation can lead to a reduction in water-washed diseases (e.g. skin diseases). Improved water quality can be expected to reduce the incidence of waterborne diseases (e.g. diarrhea). In addition, spending more time on childcare and food preparation may

lead to a reduction in child mortality and morbidity.

The extent of the effects that the provision of clean water will have on users' health conditions can be estimated from the results of analyses conducted by USAID and WHO. (Refer to World Development Report, 1992). It is estimated that out of the total reduction in the incidence of diarrhea due to the provision of clean water and improvements in sanitation, 78% is attributable to clean water and the remaining is attributable to improvements in sanitation. It is also reported that the incidence of diarrhea has been reduced by 22% due to the provision of clean water and improvements in sanitation. It can be concluded from these analyses that the provision of clean water alone can reduce the incidence of diarrhea by at least 17%. It should be noted, however, that improving water quality alone is not sufficient to have an impact on human health. Furthermore, water supply programs should incorporate educational activities on hygiene practice, sanitation, health and so on.

4) Time Saving Effect of Water Collection

One of the main objectives of the water supply project is to reduce the workload of the residents, particularly women and children, for water collection. The time needed for water collection consists of travel time, queuing time and filling time. By providing a stable supply of water through the improved facilities, water users will have better access to water sources. As a result, time required for water collection will be significantly decreased. The saved time may be used for social, educational, agricultural or commercial activities.

11.2 Financial Analysis

11.2.1 Project Costs

Project costs have been estimated on the basis of market prices as of April 2000. The Project costs comprise the costs for drilling works, construction of water supply systems (including water storage facilities, distribution lines, service pipes, public faucets, hand-pumps and platforms), operation and maintenance equipment, and engineering services.

Base costs of the Project amount to 15.79 million US dollars as summarized in the following table (refer to Table 11-1).

Table 11-1 Summary of Project Costs

Unit: USD

Cost Items	Foreign Portion	Local Portion	Total
1. Construction	6,976,000	3,757,000	10,733,000
2. Equipment	3,819,000	0	3,819,000
3. Engineering Services *	937,500	300,500	1,238,000
Total	11,732,,500	4,057,000	15,790,000

11.2.2 Financial Sources

(1) Financial Sources

Financial resources for the Project will be derived from the government budget and financial assistance from foreign countries and/or international lending institutions. Although the funds from the government and water charges collected from beneficiaries will not be enough to cover the major part of investment costs, they are expected to contribute significantly to the recovery of operation and maintenance costs.

1) Financing of Investment Costs

The total investment costs of the Project comprise a foreign currency portion of 1,404,951 thousand Yen (76.7 %) and a local currency portion of 427,750 thousand Yen (23.3 %). It is the policy of the Government of Tanzania that the Government shall finance the capital costs of water supply programs under the condition that each local community will be responsible for operation and maintenance costs of the water supply facilities.

In consideration of the size of the investment costs and the current financial status of the government of Tanzania, financial assistance from foreign sources will be indispensable. External assistance in terms of grant aid will be necessary to cover the entire foreign currency portion and a part of the local currency portion of the Project costs.

2) Government and Community Contributions

(a) Financing of Capital Costs

The Government will be responsible for financing a part of capital costs for the implementation of the Project. The budget allocation for the Project will be arranged by Regional Water Departments in Lindi and Mtwara through MWLD.

(b) Financing of Operation and Maintenance Costs

DWEs in the Lindi and Mtwara regions and VWCs in the target villages will be responsible for operation and maintenance costs of water supply facilities including borehole wells, water storage facilities, pipelines and pumps. VWCs at the target villages will be responsible for operation and maintenance of water supply facilities in the forms of water charge and voluntary labor.

(c) Provision of Project Staff

RWEs and DWEs will be responsible for arranging technical and administrative staff necessary for the implementation of the Project. DWEs will take action to recruit some technical staff (e.g. hygiene education experts) from other government agencies when necessary.

(2) Recovery of Capital Cost and Recurrent Cost

1) Basic Concept

It is the policy of the government of Tanzania that beneficiaries are responsible for covering a part of the investment costs in water supply projects. Under the proposed Project, all the construction work including the drilling of boreholes, the construction of water supply systems including water storage facilities and pipelines, the installation of hand pumps, and the construction of platforms will be conducted by the implementing agency. After the completion of the Project facilities, the residents in the beneficiary villages will organize VWCs to collect water charges and to perform periodical tasks for operation and maintenance of the facilities.

In consideration of the present income level of the residents in the Study Area, it is suggested that water charges should be maintained at levels to ensure recovery of the

full cost of operation and maintenance.

2) Recovery of Operation and Maintenance Costs

Annual operation and maintenance costs of the Project will consist of the costs for annual operation and maintenance (including replacement costs) of the water supply facilities. It is the policy of the government of Tanzania that these costs will be borne by the beneficiaries.

Annual operation and maintenance costs for Level-2 water supply facilities are estimated at Tsh. 3,732,000 to 5,772,000. The cost varies depending on the size of the village population. For villages with 500 households, the burden for each household will be Tsh. 622 to 962 per month. For villages with 200 households, the burden for the same facility will be Tsh. 1,555 to 2,405 per month.

Annual operation and maintenance costs for Level-1 water supply facilities are estimated at Tsh. 168,000. For villages with 50 households, the burden for each household will be Tsh. 280 per month.

11.3 Institutional Evaluation

11.3.1 Role of Water Department

RWE offices in Lindi and Mtwara will be the executing agencies for the proposed Project. For smooth and effective implementation of the Project, it is recommended that a Project Management Unit (hereinafter referred to as "PMU") be established at each RWE office. A team of technical staff comprising a water supply engineer, a water quality specialist, and an administrative staff will be stationed at the PMU under a Project Director who is responsible for overall management activities of the Project. During the construction stage, PMU shall play an intermediary role between the agencies concerned and the beneficiary villages. After the completion of construction work, PMU shall function as the Monitoring Unit for periodical monitoring of rural water supply facilities in the Project area.

The activities of RWEs should be concentrated on planning, training and monitoring of the water supply program and will act as facilitators of overall project activities.

With regard to operation and maintenance (O&M) activities, RWEs shall be responsible for monitoring water quality, manpower training in operation and maintenance, and providing technical assistance to each DWE office on heavy repairs of the existing facilities.

11.3.2 District Level

With regard to operation and maintenance activities, each DWE office will be responsible for monitoring the existing facilities in the communities, training VWC members, and providing technical assistance for heavy repairs on the existing facilities in the communities.

11.3.3 Establishment of VWCs in Target Villages

The Government of Tanzania is promoting rural development activities through village development committees (VDC) and village water committees (VWC). VWCs are responsible for water resource development programs in all sectors, including water supply projects.

There exist VWCs in most of the target villages, but these VWCs are not properly functioning. Therefore, reorganization of the existing VWCs was attempted in 6 pilot project sites. Through a series of discussions with representatives of villagers, water committee members including chairpersons, secretaries, treasurers, and pump attendants were elected. The role of VWC and its members was also clarified.

VWCs in the target villages other than the 6 pilot project sites should be reorganized in

parallel with construction of the water supply facilities. Such activities should be conducted by DWE offices in collaboration with other agencies such as the Health Department in each district.

A distinct difference between the conventional and proposed O&M systems is that preventive maintenance and minor repairs of hand pumps will be conducted by each VWC through VWC members in charge of technical matters (e.g. pump attendant) elected by the water users. DWEs will be responsible for providing spare parts to VWCs, training caretakers, and giving assistance in the case of serious repairs based on requests from the VWCs.

The establishment of new VWCs is expected to give the water users a full sense of ownership concerning the water supply facilities. It is also expected that the water users will be encouraged to make substantial contributions in the form of cash or participation in operation and maintenance works for their own hand pump system.

11.4 Technical Evaluation

11.4.1 Concepts for Improvement in Water Supply Service

The proposed Project has been designed on the basis of the following concepts.

(1) Improvement of the water supply service to a unit daily supply of 20 liters per person on average through the provision of new public water supply facilities

(2) Improvement of the operation and maintenance system through the establishment of VWCs in each target village

The Project design will not involve any further technical knowledge compared to the present level, and therefore the Project works will be conducted without any difficulty from the construction stage to the operation and maintenance stage.

11.4.2 Improved Operation and Maintenance System

A distinct difference between the conventional and proposed O&M systems is that preventive maintenance and minor repairs of water supply facilities will be conducted by the VWC members to be established in each village. DWE office at each district will be responsible for monitoring the existing facilities in the communities, training VWC members, and giving assistance in case of serious repairs.

11.5 Environmental Evaluation

In general the implementation of the proposed rural water supply project has significant positive socio- environmental impacts on the area. However, the following adverse natural and socio-environmental impacts, although they are not so significant in magnitude, could occur during and after the implementation of the project:

1) Water level drawdown or a depletion of shallow wells and a reduction of spring yield in the vicinity of the area where new wells will be drilled;
2) An acceleration of shallow well water contamination by an increase in wastewater as a consequence of increased use of domestic water;
3) Opposition from private water vendors who make a living by transporting and selling water to remote rural areas, for fear that they might lose their businesses;
4) Confusion in the water management system, especially in water fee collection, due to the adoption of a new charging system developed by each VWC; and
5) Damage to plantations when construction equipment and materials are brought in.

11.6 Overall Evaluation

The proposed Project has been evaluated from various aspects including social, economic, financial, institutional, and WID aspects. Project evaluation is summarized as follows.

Table 11-2 Overall Project Evaluation

Evaluation Items	Benefits Identification and Evaluation
Economic	1) Water supply coverage will be increased from 0 % to 100 %. 2) The number of beneficiaries will be increased by 128,676 persons. 3) Time saving in domestic water collection 4) Time saving in agricultural water collection 5) Time saving in terms of going to the clinic and buying medicine as a result of health improvements. 6) Increased farming opportunities as a result of an increased supply of water 7) Satisfaction of BHN 8) Improved quality of life in general
Financial	1) Internal financial resources and water charge collected from the beneficiaries are not sufficient to cover the Project cost. Financial assistance from external sources will be required. 2) A water charge will be collected from the beneficiaries to cover a part of operation and maintenance cost. 3) The water charge will be set at 11,340 Tsh. (US$ 3) per year per household.
Institutional	1) Smooth and effective implementation of the Project by PMU 2) Training of VWCs members by DWE offices 3) Sustainable management of Project facilities through formation of VWCs and Training Program for villagers.
Technical	1) The level of technology adopted in the Project design will not involve any special technical knowledge compared to the present level 2) Project works will be conducted without any difficulty from the construction stage to the operation and maintenance stage. 3) Preventive maintenance and minor repairs of water supply facilities will be conducted by VWCs to be established in each village under technical assistance from each DWE office.
Environmental	1) The Project will have significant positive socio-environmental impacts on the area 2) Some adverse natural and socio-environmental impacts may occur (e.g. water level drawdown or a depletion of shallow wells and a reduction of spring yield in the vicinity of the area where new wells will be drilled)

Chapter 12 Conclusions and Recommendations

12.1 Conclusions

One of the most important conclusions of this study program is the urgent need to implement the water supply projects for the prioritized 100 villages in the area. The prioritized 100 villages are only a small part of the two regions where over 900 villages are distributed. There are another 200 villages or more that are under similarly poor supply service conditions.

The projects for the first 100 villages may be, so to speak, a case study of the proposed community-based O&M methodology, as it is quite new to the water users. It will take time for the autonomous management system to take root among the users, and a lot of trial and error will be required to determine the most suitable O/M system in the area.

The second and third groups of prioritized villages cannot wait such a long time without a supply of potable water, which is why immediate implementation of the projects for the first 100 villages is essential.

Generally speaking, the following two points will be good indicators for evaluating the success or failure of the rural water supply projects:

1) Whether or not the time saved on water fetching is practically used for rural development through an increase in social, educational, agricultural or commercial activities.
2) Whether or not the use of clean water supplied in sufficient amounts throughout the year results in the improved health of the inhabitants leading to prosperous rural development.

It seems quite difficult, however, to initiate with a full-scale project, as it would be hindered by many geographical, social and economic constraints. Improving water supply conditions in steps is preferable for this area, such as by first aiming at securing water sources near the houses (within the villages) even in dry season, and then focusing on utilization of the supplied clean water throughout the year.

The difficulties that have been made clear through the study are as follows;

From the viewpoint of natural conditions:

Many of the candidate villages are located on the plateau area where the groundwater level is low resulting in a high pumping cost. Moreover, the quality of the groundwater in some of the plateau area is not good for drinking purposes, as it has a high content of sulfates and other dissolved ions. The investment cost required to drill deep wells and to hit water of good quality is also high. Small-scale facilities with a reduced unit supply amount (from 25 to 20 ℓ/c/d) have been planned in order to reduce the investment cost and the O/M cost. However, the O/M cost

for some of the villages still seems too high for autonomous management. Solar energized pumping systems are to be introduced for low cost operation, although this system may not pump a sufficient amount of water, especially in rainy season.

From an economic point of view:

The responsibility of management of the water schemes in the rural areas was transferred from the central government to the cooperative bodies of the local government and the water users in 1992. This policy change was done in accordance with the decentralization policy, and was also directly motivated by the financial constraints of the central government. However, the financial situation of the local government and the local communities is also tight. The regional and district administrations have not distributed enough budget to the water departments that have been directly involved in water supply schemes in the regions. Moreover, the beneficiaries of the community water schemes, who suddenly became responsible for shouldering most of the operation and maintenance cost under the new policy of the government, are barely managing their lives, with very low annual cash incomes averaging Tsh.240, 000. About 10% of the households in each of the villages have a cash income lower than Tsh.50, 000. Such financial constraints as in each of the bodies give anxieties as to whether the schemes are sustainable or not.

From a social point of view:

The underdeveloped social background of the area also gives uncertainty as to whether or not the community-based water schemes will be long-lasting. For example, due to a shortage of social services in the areas, the level of education is low and this has led to poor operation of the organizations concerned. In addition, there is no concept of using time effectively to allow for productive activities so the villagers may not be motivated to use the supply facilities continuously (As fetching water from far-away water points is a long accustomed habit, they do not realize the urgent need for a supply facility.) There is also a lack of education in hygiene and sanitation, and as a result, people may return to the nearby traditional water points, especially in the rainy seasons, in spite of their unsanitary conditions. Finally, there was not much village participation in operation of the Level-2 supply system in the previous water supply schemes, and consequently, they lack the necessary technical skills, etc.

However, an encouraging factor was found during the study period making good operation and maintenance of the water schemes possible; that is the serious and obedient nature of the people in the area. Preparing the villagers will require patience, but if motivated and properly trained, they are likely to perform their duties well and the autonomous water schemes will surely take root in the communities.

The pilot schemes operated mainly by the village water committees also have given a bright outlook for autonomous management of the rural water schemes. The village water committees' performance in operating the pilot schemes was fairly good, especially, that of the committees headed by a female chairperson. Such committees did better than expected, suggesting that management of water related affairs should be undertaken mainly by women who generally engage in almost all aspects of water collection and its use. It is expected that the social status and voice of women in the community will be strengthened through their participation in the management of water related matters.

Although many difficulties are anticipated in realizing the aims of the projects in the area as mentioned above, the urgent need to implement the project is an undeniable fact when taking into consideration the basic human needs of the villagers and the poor conditions of the existing water supply. The total investment cost required for construction of the water supply facilities in 100 villages is estimated at about 15.79 million US dollars. In consideration of the considerable size of the investment cost and also the current financial status of the government of Tanzania, the introduction of financial assistance, especially of grant aid from foreign sources is indispensable.

12.2 Recommendations

The following four major items related to policy on rural water supply and water scheme operation methodology are recommended based on the findings of the study.

(1) Water policy and the design manual for water supply facilities

The draft of the national policy on water supply and sanitation revised in 1999 mentions that the water schemes must be implemented side by side with the scheme to provide sewer systems. However, neither sewer systems nor sewerage treatment facilities are urgently required in the scarcely populated rural areas, especially in small villages with populations of a few thousand. A further revision on the draft seems necessary differentiating the small rural communities from the densely populated areas.

There is a similar problem with the design manual of the water supply facilities. Although the existing manual has been prepared for the supply systems of both urban and rural areas, the rural areas mentioned in the manual are limited to large-scale villages with populations of more or less ten thousand. A design manual for facilities of small-scale villages should be prepared with a more simple design and a lower construction cost, because inhabitants of the small-scale villages cannot afford sophisticated facilities.

(2) Positive participation of women in water scheme management

The national and regional policies encourage women's participation in the water schemes by requiring two to three women to be appointed to the village water committees. Going a step further, it is recommended that women's leadership in water scheme management be institutionalized. Although women alone take part in water-related activities, their participation in water management organizations such as the village council or the village water committee is limited to mere assistants or supporting staff, and generally they have little or no say in decision-making. As seen in the pilot study sites, women are more suitable for managing the schemes as they are directly involved in water related matters.

Allowing women to play a major role in water management is an effective way of strengthening the voice of women, which will in turn raise their social status in the area.

(3) Participation of the private sector in O/M of water schemes

The new national water policy suggests that operation of the water schemes by experienced private firms should be taken into consideration in order to solve the technical problems, especially in maintenance work in the water schemes.

Since the private sector is motivated by profit, however, the objective sites may be limited to largely populated villages (10 thousand or more) and areas abundant in water resources.

There are few villages among the 100 candidate villages that fulfill those conditions; therefore, it would be worthwhile to establish the private firm's intention prior to implementing the project. The choice of autonomous management by the users themselves or paying for the services of a private firm should be left to the inhabitants, though.

Some of the large-scale piped schemes that cover several villages with a total served population of over 10 thousand are still in operation in the area under O/M services of the district water departments. However, because of a shortage in water resources, water distribution is insufficient and the water charge collection rate is very low. As a result, none of the private bodies are interested in taking over the services from the district water department.

(4) Methodologies for sustainable and effective operation

The staffs from the district water departments should be in charge of training the water users in the technical skills and institutional matters required for the schemes to be successful. In regard to this, the following are strongly recommended:

1) Increasing the effectiveness of the projects by utilizing clean water throughout the year
   A hygiene campaign should be held in cooperation with the district hygiene committee members, concentrating on the use of the supplied safe water even in the rainy seasons. The district government should take budgetary measures for this type of campaign.
2) Villagers' participation, maintenance, water fund, etc., for sustainable Projects:
   The three major elements essential for making the projects sustainable are users' participation, maintenance technology and the fund. The persons that have what it takes to train the water users in technical and institutional matters are the staffs of the district water departments. In addition to training activities, they should take periodical patrols and put emphasis on the following matters.
   - Making sure the villagers understand that the facilities to be constructed under the Project are the property of the communities, and encouraging people to participate in the planning, construction work and maintenance of their own facilities.
   - Making sure a village water committee is established in all the candidate villages. It is preferable that the committee members be elected by mutual election, rather than be appointed by the village council, as one type of villager's participation.
   - Having frequent contact with the committee members for technology transfer
   - Making sure the villagers understand that the water fund shall not only be used to cover the running cost of the facility but also the maintenance cost, including the replacement of pumping equipment, etc., in future.
   - Not fixing the water charge in consideration that some families live in extreme poverty.
   - Establishing a system of pay that will encourage use of the facility throughout the

year. The method of paying per-bucket, which will be most likely adopted in the majority of the villages, will discourage villagers from using supplied water in the rainy season.

- Ensuring that the water fund is used solely for O/M of the water scheme. The district governments shall be responsible for strengthening administrative guidance to the village councils on the expenditure of the water fund.

When the government of Tanzania makes a request for financial assistance from foreign sources, it is recommended that they include the procurement of equipment and materials for maintenance service to be done by the district water departments. Incorporating a soft component, which will give motivation to the water users, is also recommended.

The implementation of the water schemes for the 100-community must be understood as one part of the project to improve the water supply situation in the project area. More than 200 villages out of the 913 villages in the two regions are in a similarly critical condition, due mainly to the rapid deterioration of the previous water schemes, resulting from the poor maintenance services over the past 15 years.

One of the reasons for poor maintenance was probably due to the fact that it was unclear where the responsibility of maintenance lay, aside from the financial constraints of the concerned bodies.

Once it is confirmed that the autonomous management system is firmly established in the first 100-communities, the system should be popularized in the two regions by carrying out the second and third stages of the project.

In consideration of the above, it is recommended that the water supply projects of the prioritized 100-communities commence as soon as possible.