CHAPTER SIX: OPERATION AND MAINTENANCE PLAN

CHAPTER SIX: OPERATION AND MAINTENANCE PLAN

6.1 Introduction

6.1.1 Background

Many of the completed rural water supply schemes in the Study area are either operating below their design capacities or not functioning at all. According to the inventory of existing water facilities, there are 186 water supply systems with boreholes; however, 88 systems are out of operation due to breakdown of engines and pumps. The major reason of malfunctioning of the completed projects is lack of periodical and preventive maintenance, particularly as the project begin to age. Lack of routine maintenance of water supply facilities, among many, results from;

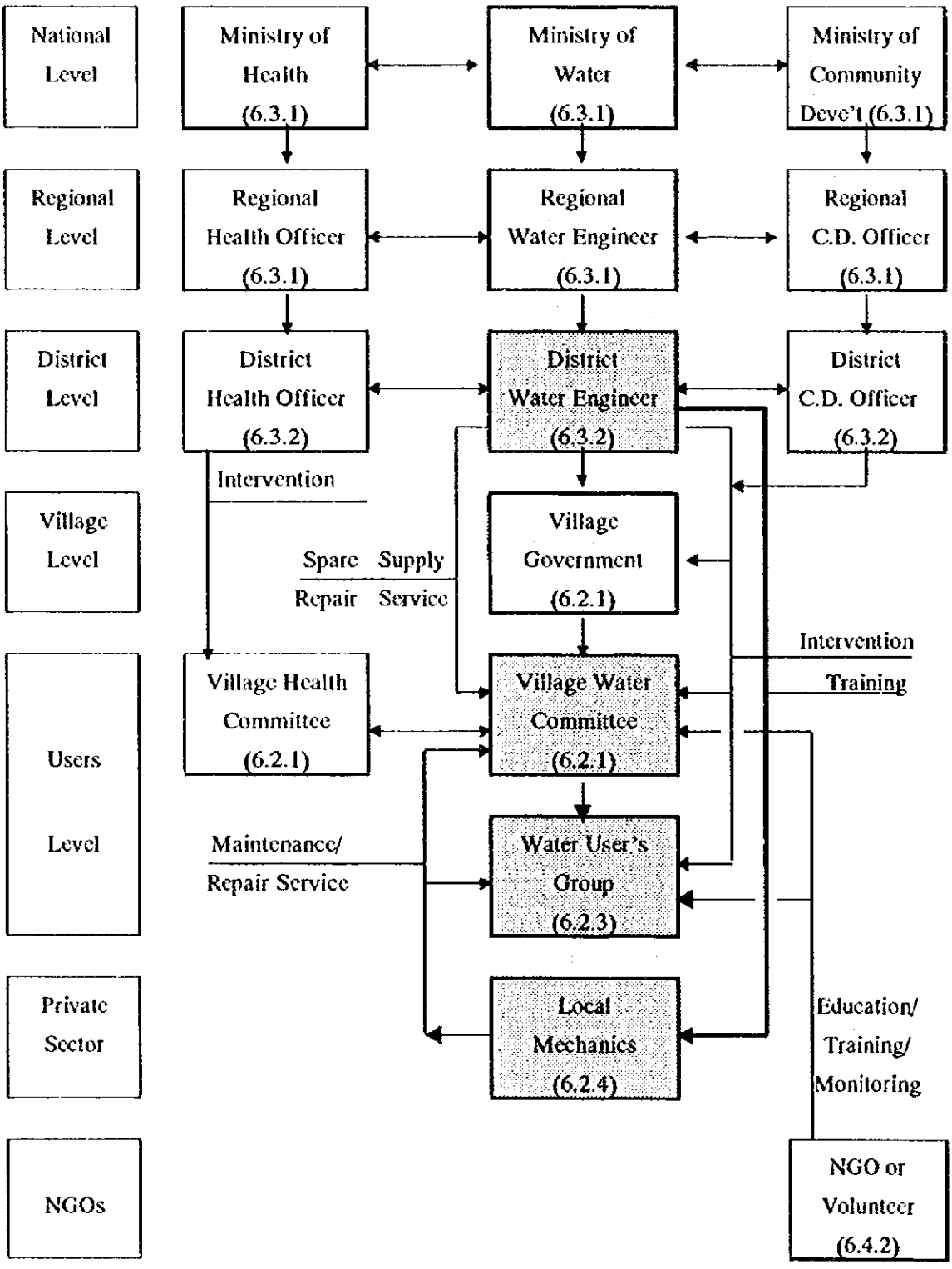
(i) irresponsible attitude of communities and organisations charged with the task of maintaining water supply projects;
(ii) reluctance to contribute or inadequate contribution by the villagers;
(iii) inadequate recurrent budget;
(iv) inadequate technical personnel with adequate qualifications and expertise; and
(v) lack of service systems for supply of equipment and spare-parts.

6.1.2 Proposed O&M System

It is impossible to establish a sustainable rural water supply scheme without full participation of the users. The most appropriate approach to be adopted should be centred on action by the end-users. The approach is that the users are responsible for planning and implementation of schemes aimed at improving their own standards of living, as well as the operation and maintenance (O&M) of their water supply project. This is important due to the fact that the ownership of the rural water supplies is in the hand of the users themselves. Genuine ownership lays the foundation for community-based management system (CBMS) and acceptance of payment for the O&M of facility, and so contributing to sustainability.

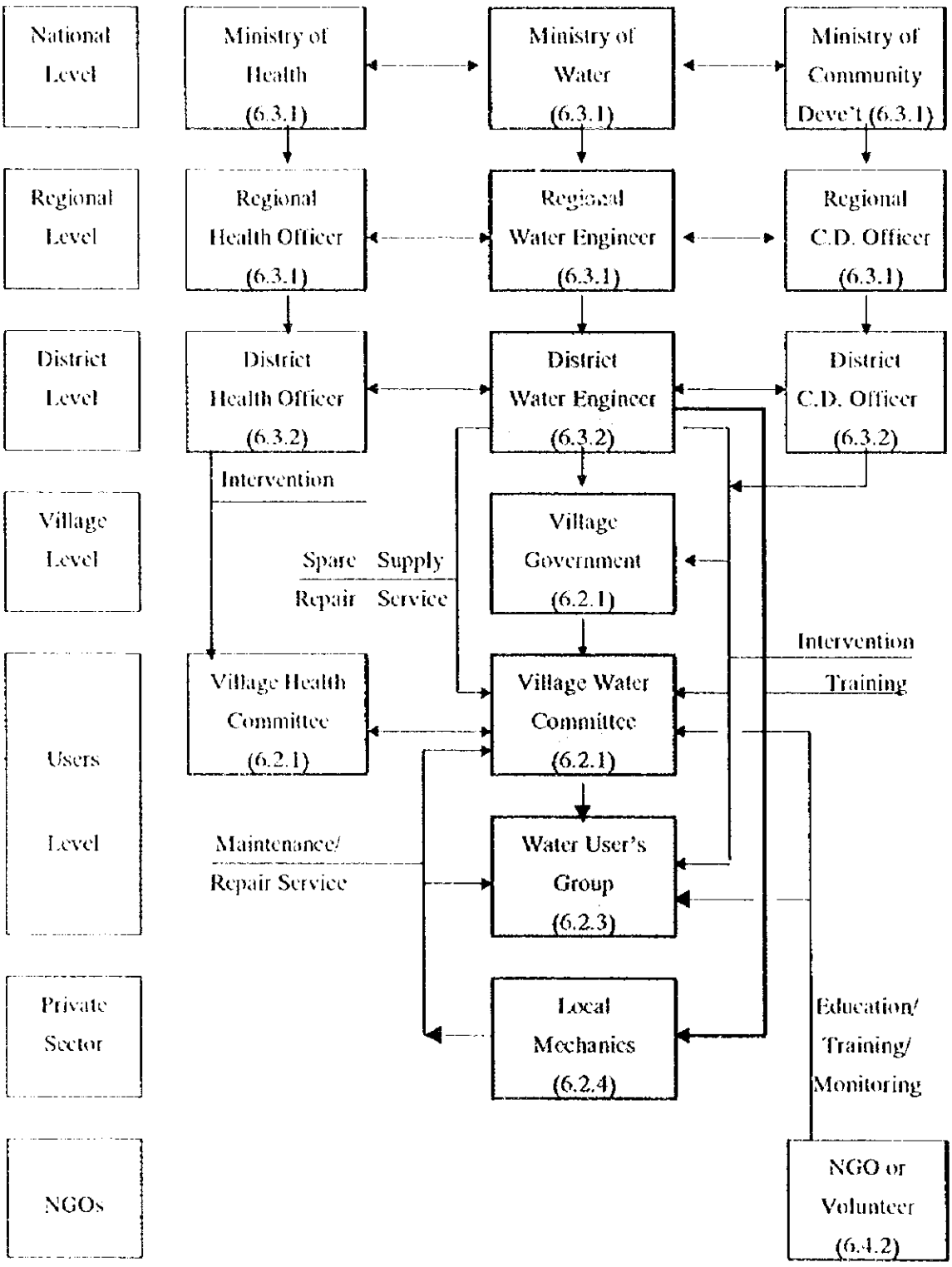
The O&M systems proposed by the Study after and during the project implementation are summarised as shown in Figures 6.1 and 6.2. The major roles and responsibilities of each levels are as stated in the following sections:

Figure 6.1 Flow of Proposed O&M System (After Project Implementation)



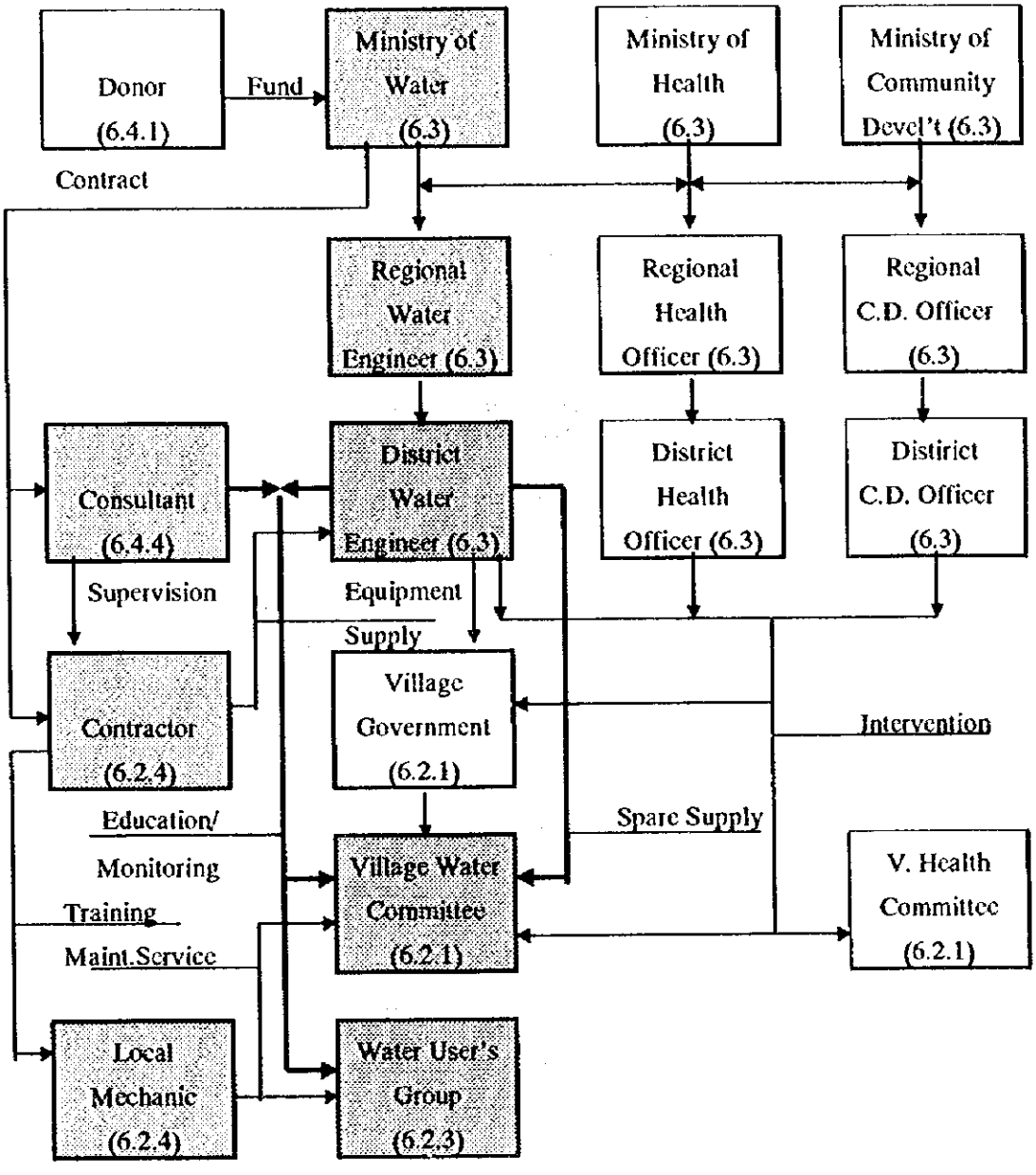
Note: Figures in the bracket are the related section numbers.

Figure 6.1 Flow of Proposed O&M System (After Project Implementation)



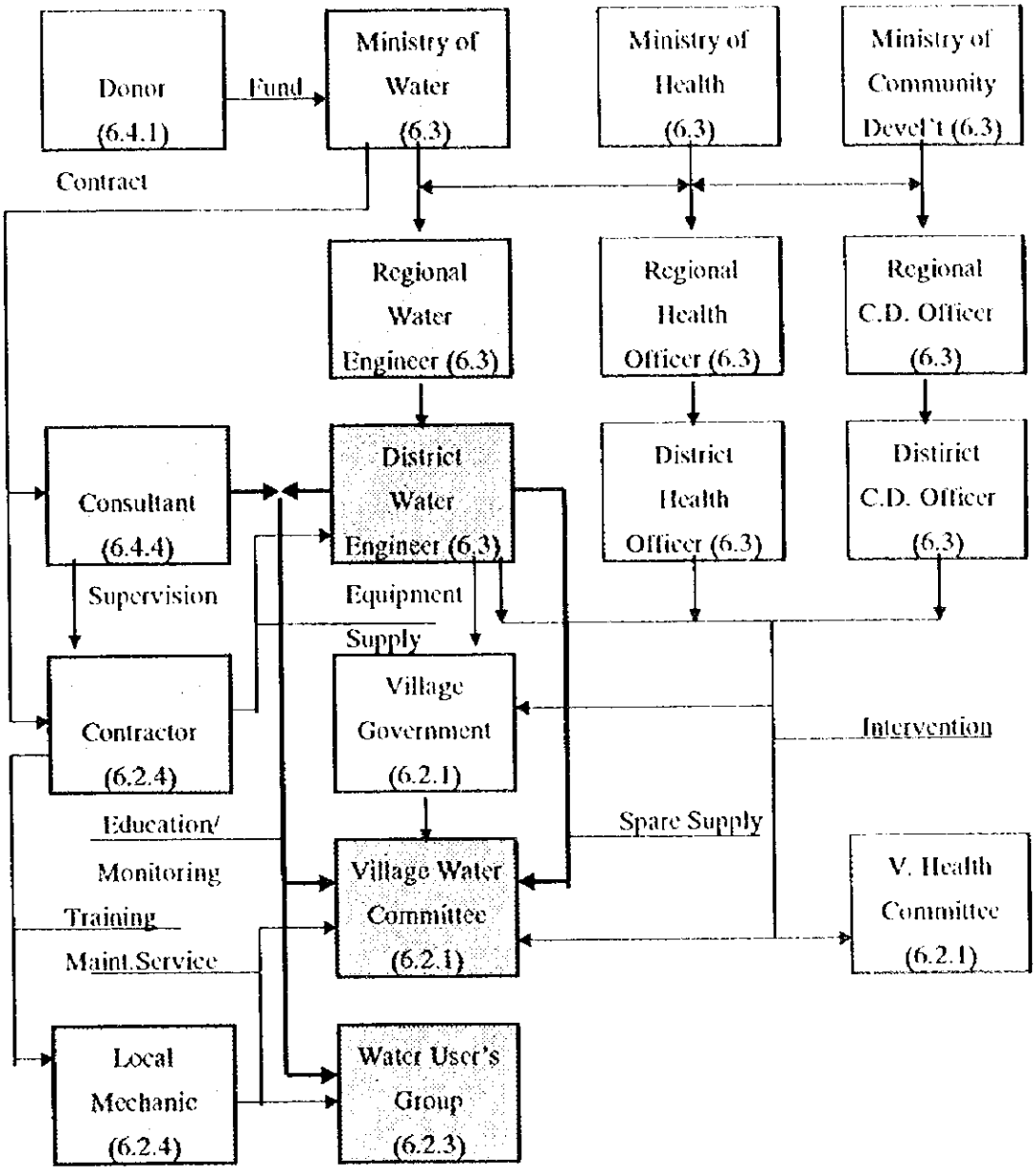
Note: Figures in the bracket are the related section numbers.

Figure 6.2 Flow of Proposed O&M System (During Project Implementation)



Note: Figures in the bracket are the related section numbers.

Figure 6.2 Flow of Proposed O&M System (During Project Implementation)



Note: Figures in the bracket are the related section numbers.

6.2 Community Involvement

6.2.1 Village Water Committees

All villages with water supply schemes or intending to have a water supply scheme shall establish a village water committee (VWC) in conformity with the provision of the National Water Policy. For sustainable O&M of the proposed rural water supply projects, the responsibilities of VWC are:

- to communicate with the related officers in the village and district governments;
- to establish and supervise the WUGs;
- to decide water fees for the member household to meet the O&M cost of water facilities;
- to establish the village water funds (VWFs);
- to make contract with a local mechanic for the maintenance and repair services for handpumps;
- to make contact with the DWE offfice for the maintenance and repair service of water facilities other than handpumps; and
- others deemed necessary.

The VWC is an administrative machinery responsible for the O&M of water facilities and management of the rural water projects. To this end, the VWC is to provide the users with full responsibilities of supervising their water supply facilities and other related services. The VWC shall be strengthened so as to assume full responsibilities with regard to the provision of water services. The leaders of the village government, the VWC and the village health committee should assume the role of guardians and linkage to district officials. All decisions related to water affairs should be left in the hands of the VWC.

The VWC shall have at least six elected members including a chairperson, a secretary, a treasurer and other three members. The chairperson and secretary are the chief executives. The VWC shall include at least three women in its members (the National Water Policy). Women are the main bearers of the burden for collecting water and are the ones affected most by the problems of shortage of water in rural areas.

Out of 284 target villages, six villages have not formed any VWC: four villages in Singida Rural district; and two villages in Igunga district. Furthermore, 77 VWCs have women members of less than three: four villages at Hanang district; 52 villages at Singida Rural district; 11 villages at Manyoni district; and 10 villages in Igunga district. Under the situation above, it is urgently required for such villages to form a VWC and establish a VWF in conformity with the provision of the National Water Policy and the guideline of the Ministry of Water.

6.2.2 Village Water Fund

All villages with water supply schemes or intending to have a water supply scheme shall establish a village water fund (VWF) which shall be kept in special and separate bank accounts (the Water Policy). The intended benefits of such a fund are:

- creation of an understanding of users that water supply is not a free service;
- to enable the users to adequately contributes materials, cash and in kind in national building activities towards construction, operation and maintenance of their water supply schemes; and
- to enable the users to own, operate and maintain water supply schemes in their respective villages.

The village inventory survey revealed that 241 villages have established a VWF; however, 43 villages have not established a VWF so far: two villages in Hanang district; eight villages in Singida Rural district; 10 villages in Manyoni district; and 23 village in Igunga district. Total amount of VWF provided by 241 villages comes out at Tsh 31,732 thousand, ranging from Tsh 9,000 at a village in Manyoni district to Tsh 1,685,000 at a village in Singida Rural district with an average of Tsh 131,700 (US$ 211) per village.

In many villages, the VWFs are provided by the villagers through collection of money on a flat rate basis. An average VWF of Tsh 131,700 above seems to be too small to sustain a rural water supply project. The above low level of VWFs may be attributed to malfunctioning of their water supply facilities and or irresponsible attitudes of VWCs.

As estimated in the Study (refer to Section 6.4.5), the annual O&M costs by facility type, inclusive of costs for personnel, fuel in case L-2 facility, repairing, depreciation and so forth, are:

L-1-1 facility : Tsh 732,000 or US$ 1,172
L-1-4 facility : Tsh 1,758,000 or US$ 2,812
L-2 facility : Tsh 9,788,000 or US$15,664

The VWC shall collect such fund from the users as the water fee. The water fees for a typical household by facility type are estimated as follows:

L-1-1 facility : Tsh 11,000 per year or Tsh 917 per month or Tsh 5.2 per bucket
L-1-4 facility : Tsh 12,700 per year or Tsh 1,058 per month or Tsh 6.0 per bucket
L-2 facility : Tsh 14,000 per year or Tsh 1,167 per month or Tsh 6.6 per bucket

The VWF collected is to be spent for the daily allowances of pump-attendants, caretakers and others; the repairing services inclusive of used spare-parts rendered by the

designated local handpump mechanic in case of facility with handpump or the DWE office in case of facility with powered pump; and for the replacement of pumping equipment when it is aged.

The number of water facilities under the project will reach 361 by the year 2001, 1,073 by the year 2006 and 3,651 by the year 2016. The O&M cost estimated by the Study (refer to Table 6.6) includes costs for the maintenance, repair and replacement of pumping equipment (pump, engine, wind-mill, solar-panel and others). The estimated annual costs for the maintenance and repair are US$ 173 for the facilities with handpump and US$ 590 to 850 for the facilities with power-pump.

An annual maintenance and repair cost for 3,651 facilities by the year 2016 is estimated at a total of US$ 670,000. Out of the amount, a sum of US$ 606,000 for the handpump facilities could be an annual resource for the services provided by the local mechanics and spare-parts. A sum of US$ 64,000 for the power-pump facilities would be an annual resource for the services and spare-parts provided by the DWE Offices.

Under the situation, the District Water Engineer (DWE) should embark on a programme to revitalise the VWCs in their respective districts to motivate villagers on making contribution to the VWFs through the collection of water fees.

6.2.3 Establishment of Water Users' Groups

For sustainable management of the rural water supply schemes, the Study proposes to establish water users' groups (WUG) for their own water supply system in order to be closer to the water facilities and also able to mount the maximum security. Nevertheless, these WUGs will be directly accountable to the VWCs which in turn will operate as an umbrella organisation.

The proposed WUGs will be formed on the basis of sub-village, since the sub-village has factual information on local condition and is well informed of desire of the users relative to specific problems. The decision-making will be effectively made by the WUGs which have knowledge of local culture and customs such as existing informal forms of cooperation and organisations. The WUGs will perform functions which allow the members of the groups to fully utilise water by providing the following services:

- daily O&M of the water facilities under the authority to be vested;
- appointment of pump-attendants, caretakers and others;
- collection of designated water fees from the users;
- providing a mean whereby the members of WUG make decisions concerning problems of water supplies; and
- others deemed necessary.

The WUG will have a chairperson, a secretary and an accountant to be elected by the members of the group. The responsibilities are to fulfil the above services effectively. The chairperson will appoint caretakers among the members of the groups to undertake the daily activities for the O&M of the water facilities. Depending on the types of water supply facilities, the caretakers will consist, but not limited, of the following:

- borehole with handpump or solar-pump (L-1 system): pump attendants
- borehole with engine-pump and public taps (L-2 system):
  pump attendants, domestic-point keepers and an accountant.

The duty of the pump attendant involves daily operation and other prescribed maintenance work that covers all the work necessary to ensure that the water pump continues to function in a satisfactory manner. In case that special maintenance including repairs of damage caused by major disasters is required, the pump attendant shall inform to the chairperson of WUG for repairs by technicians from the DWE office or local mechanics. To keep cleanliness is of primary importance in preventive maintenance to do not allow dust, moisture, oil or other substances to remain in or on the equipment.

6.2.4 Local Mechanic Services Programme

(1) Plan of Programme

In the Study area, neither systematic services for repairing of water pumps nor provision of spare-parts are available at present, thus resulting in failure to maintain the rural water schemes in many villages as mentioned earlier. The DWEs are responsible for such services in order to maintain the rural water supply schemes. However, their services are not active at present though the DWE and his staff are in charge of technical services to the VWCs. This is mainly due to lack of vehicles, equipment and tools as well as financial constraints involved in the DWE offices and insufficient provision of VWFs.

The optimum system of private local (handpump) mechanic services and its management depends on the tasks it has to perform and the environment in which it operates. With the implementation of this proposed project in the Study area, more than three thousands of boreholes with handpump are scheduled to be constructed. The government is carrying out structural reforms aiming at reducing and gradually removing the dependence of communities to run their water supply schemes.

Under the such environment, the Study proposes to implement a local mechanic services programme under the control of the DWE. The purpose of this services programme is to provide the periodical preventative maintenance and repair, when necessary, of handpumps on a private and commercial basis by local mechanics qualified by the DWE and appointed by and contracted with the VWCs.

The assignment of the local mechanic and his assistants (four persons) is to perform periodical visits to the rural water supply facilities for preventative maintenance services. The services include the following:

- minor maintenance : three times a year; and
- major maintenance : one time a year for overhaul of handpumps.

For successful implementation of the programme, the DWE concerned will select several enterprising and knowledgeable persons among people residing in the Study area. The DWE will provide for the technical training courses to the mechanic and his assistants. The technical courses will consist of two sessions. The first session with five-day length includes lectures on the mechanism of rural water scheme, the theory of groundwater development, structure of borehole and handpump and practical techniques for inspection and repair of handpumps. In the second session with another five-day length, on-the-site training will be carried out at several sites of the existing water schemes. For implementation of the programme, the DWE will recruit a group of experts in the fields of rural water supply management, groundwater development and pump mechanics.

After they have finished the training courses including theory and practice, they are registered as the local mechanics charged with technical services to maintain and repair the handpumps on a commercial basis. The VWC shall make a contract with one of local mechanics certified by the DWE; and pay to him for his periodical services and spare-parts used for repairing. A local mechanic may cover around 40 villages on an average together with four assistant mechanics, thus being able to secure his livelihood. The project area could be covered by a total of 10 local mechanics, four for Singida Rural, two each for other districts.

At the initial stage of the implementation of the programme, the DWE will supply the local mechanics with transportation equipment (bicycles) and tools required for maintenance and repair of handpumps on a rental basis in order to encourage the programme in early fixation.

(2) Financial Balance of Local Mechanics

(i) Financial Resource for Service Charge of Local Mechanic

In Section 6.7.1, the annual repairing cost per L-1-1 facility (Tsh 107,990 or US$ 173) is estimated at about 8% of procurement cost of handpump (Tsh 1,350,000 or US$ 2,160). The cost includes 5% (Tsh 71,190) for spare-parts and 3% (Tsh 36,800) for repairing service. This cost for repairing service is to be the financial resource for the local mechanical service.

(ii) Required Service Charge per Local Mechanic Team

Typical local mechanic team is composed of a chief mechanic and four assistants. An annual service charge required by a typical team is estimated at Tsh 4,416,000 as shown in the following table:

Items	Q'ty	Amount (Tsh)	Remarks
Remuneration			
- Chief mechanic	1 x 12	780,000	Technician level
- Assistant mechanics	4 x 12	2,400,000	Driver level
Sub-total		3,180,000	
Maintenance Cost	Lump Sum	500,000	For 5 bicycles, tools, etc.
Total		3,680,000	
Overhead		736,000	For handling of spare-parts, etc. 20 % of above sub-total
Ground Total		4,416,000	(US$ 7,066)

(iii) Number of Facilities to be maintained by a Local Mechanic Team

In consideration of the available resource and required service charge, a local mechanic team is to render its service to 120 facilities (Tsh 4,416,000 ÷ Tsh 36,800) or some 40 villages (3 facilities/village). In case that the maintenance service of a handpump takes one day and four times a year, a local mechanic team, dividing into two sub-teams, will work for 240 days a year to cover 120 facilities (120 facilities x 1 day x 4 times/year ÷ 2 sub-teams).

6.3 Governmental Intervention

In order to enhance a sustainable O&M of the completed rural water projects, the intervention of governments at all levels is indispensable. One of major causes in failure of water schemes are deemed to be lack of appropriate governmental interventions.

6.3.1 National and Regional Government

The ministries in the central government related to the water and environmental sanitation (WES) sector such as the Ministry of Water (MOW), the Ministry of Health (MOH) and the Ministry of Community Development, Women and Children (MCDWC) as well as the related officers responsible for the water, health and community development of the regional government should play the role to secure the qualified officers and the recurrent budget enough for daily activities of them, to guide and support the district government.

6.3.2 District Government

(1) Related Officers

The principal supporting services to be provided by the district government include the technical services of O&M of water facilities beyond the village level, training programmes for village pump attendants, caretakers and local mechanics, the implementation of community health and gender education programmes; and the project monitoring and evaluation in conjunction with the other authorities involved. The officers in charge of water, health, community development and others in the district government play important roles in the sustainable O&M of rural water scheme.

(2) District Water Engineer

The district water engineer (DWE) plays a key role in the governmental intervention in collaboration with other officers concerned. The DWE is responsible for:

- all maintenance and repairing services beyond the rural technical capabilities such as boreholes, powered pumps and plumbing;
- marketing (procurement, stock and sale) of spare-parts and stand-by pumping equipment;
- ensuring easy availability of diesel fuel, particularly in rainy season;
- education of users regarding hygiene, sanitation and gender in collaboration with the district health and community development officers;
- training of village technical persons and local mechanics;
- periodical monitoring of water quality of facilities;
- monitoring and evaluation of project in collaboration with the district health and community development officers;
- guidance for the establishment and management of the VWC and VWF; and
- others deemed necessary.

The DWE offices of Hanang, Singida Rural, Manyoni and Igunga are the key governmental organisations responsible for implementation of the proposed project. The DWEs shall embark on a programme to revitalise the VWCs. The DWEs should provide professional advice to the VWCs on the O&M of the water facilities, effective use of the local mechanic services programme and financial management of the project.

The DWE shall, applying his existing staff, reorganise the maintenance team(s) which is (are) composed of an assistant engineer and each of pump/engine mechanics. Considering the number of facilities in each district, it is necessary to organise three maintenance teams for Singida Rural, two teams for Manyoni and one team for each other two districts. The maintenance teams shall make periodical visits to the target villages twice a year in order to

render the VWC's preventative maintenance and repairing, if necessary, of engine-, wind- and solar-pumps, pipelines and other structures. Actual expenses for such services inclusive of spare-parts and replaced equipment will be collected from the VWFs. The necessary equipment and tools for the said services will be provided by the project fund.

The DWE shall appoint and supervise fuel supplier to secure the diesel supply to the VWCs with L-2 facility. The DWE shall stock spare-parts and stand-by pumping equipment in his office and distribute them upon the request of his maintenance team(s) and the local mechanics. The DWE appoint and supervise a stock manager to secure those parts and equipment good enough for a year running. The first lot of parts and equipment may be provided by the project fund. And the second lot and beyond will be supplied by the fund collected from the VWCs.

(3) Required Annual Budget for the Intervention Activities of DWE's Offices

Annual budget required during the project implementation period (and also after the completion of project) for the intervention and O&M activities of District Water Engineer's (DWE's) Offices are estimated as shown in Table 6.1. The Government of Tanzania is to secure and allocate such much annual budget to each DWE's Office concerned.

Table 6.1 Required Annual Budget for Intervention Activities by DWE's Office

(Unit: Tsh '000)

Items/ District	Hanang	Singida	Manyoni	Igunga	Total
(1) Personnel Cost [Note (1)]	-	-	-	-	-
(2) Office Running Cost [Note (2)]	-	-	-	-	-
(3) Communication Cost [Note (3)]	-	-	-	-	-
(4) Vehicle Running Cost [Note (4)]	2,272	9,885	7,242	2,722	22,121
(5) Workshop Running Cost [Note (5)]	960	1,920	960	960	4,800
(6) Warehouse Running Cost [Note (6)]	-	-	-	-	-
(7) Run'g Cost of Water Lab. [Note (7)]	1,870	3,740	1,870	1,870	9,350
Sub-total	5,102	15,545	10,072	5,552	36,271
(8) Contingencies (10% of Sub-total)	510	1,555	1,007	555	3,627
Total	5,612	17,100	11,079	6,107	39,898

Note (1) : The cost stays within the present budget allocation as no additional staff is required.

Note (2) : The cost stays also within the present budget allocation.

Note (3) : The cost stays also within the present budget allocation.

Note (4) : Refer to the following tables;

Table 6.2 Annual O&M Cost of Vehicles (Unit: Tsh '000)

	Hanang	Singida	Manyoni	Igunga	Total
Fuel & Lubricant Cost *	649	4,216	3,351	994	9,210
Maintenance Cost **	1,630	5,702	3,973	1,749	13,054
Total	2,272	9,885	7,242	2,722	22,121

Notes: * refer to Table 6.3; ** refer to Table 6.4

Table 6.3 Fuel and Lubricant Cost per Year (Unit: Tsh '000)

	Hanang	Singida	Manyoni	Igunga	Remarks
(a) Av. Driv'g Distance (km)	30 x 2	50 x 2	70 x 2	30 x 2	
(b) No. of Village	33	129	72	50	
(c) No. of Annual Visits	3	3	3	3	
(d) Total Distance (km)	6,000	39,000	31,000	9,000	(1)x(2)x(3)
(e) Fuel Consumption(lit/year)	1,200	7,800	6,200	1,800	5 km/lit
(f) Fuel	564	3,666	2,914	864	Tsh 470/lit
Lubricant	85	550	437	130	0.15 above
Total	649	4,216	3,351	994	

Table 6.4 Annual Maintenance Cost of Vehicle (Unit: Tsh '000)

	Hanang	Singida	Manyoni	Igunga	Remarks
No. of Vehicles	1	3	2	1	
Repair Cost *	1,400	4,200	2,800	1,400	
Tyre Consumption **	1.2	7.7	6.0	1.8	
Tyre Cost ***	230	1,502	1,173	349	
Total	1,630	5,702	3,973	1,749	13,054

Notes: * Repair Cost: Tsh 1,400,000/year
[7% of procurement cost (US$ 32,000/unit)]
** Tyre consumption: 4 tyres/20,000 km
*** Unit cost Tsh 194,000/tyre

Note (5) : Refer to the following Table 6.3.1 (4):

Table 6.5 Annual Running Cost of Workshop (Unit: Tsh'000)

	Hanang	Singida	Manyoni	Igunga	Total
Electricity Cost *	241	482	241	241	1,205
Maintenance Cost **	719	1,438	719	719	3,595
Total	960	1,920	960	960	4,800

Notes: * Electricity Cost/unit:

Electricity supply by diesel generator (12 HP):

Fuel requirement: 444 lit/year

(12 HP x 0.037 lit/hr x 5 hr/day x 200 day/year)

Fuel cost : Tsh 209,000 (444 lit/year x Tsh 470/lit)

Lubricant cost : Tsh 32,000 (15% of above)

Total : Tsh 241,000

** Maintenance Cost: Tsh 719,000/year/unit

[Tsh 14,375,000/unit (US$ 23,000/unit) x 0.05

(5% of procurement cost of workshop equipment)]

Note (6) : Warehouse running cost is to be inclusive of the office running cost.

Note (7) : Annual Running Cost of Water Laboratory:

Supply of Reagents: Tsh 1,563,000 (US$ 2,500)

(for 700 water samples/year)

Maintenance cost of kit: Tsh 307,000

[Tsh 4,375,000/kit (US$ 7,000/kit) x 0.07

(7% of procurement cost of analysis kit)]

Total: Tsh 1,870,000/kit

6.4 Donor, NGO and Others

6.4.1 Donor

In case that the project is implemented with the fund provided by a donor, the fund may cover not only the facility construction but also the related activities necessary for O&M such as provision of equipment for DWE, training of local mechanics, education and training of users, monitoring and evaluation of project and so forth. Those activities will be conducted only during the project implementation period by the consultant and the contractor to be employed under the fund programme.

6.4.2 NGOs or Volunteer

After the project has been implemented, the said O&M related activities such as the follow-up education of users, training of pump-attendants and local mechanics, monitoring and evaluation of project and others may be conducted with the cooperation of NGOs or volunteers.

6.4.3 Consultant

In case that the project is implemented under the fund provided by a donor, the project executing body, the MOW, will employ a consultant firm to prepare the detailed

design and tender documents, to supervise the construction contractor and others. In this case, during the project implementation period, the MOW may render to the consultant a part of activities of government interventions such as the education of users, the monitoring and evaluation of the project and others.

6.4.4 Contractor

In case that the project is implemented with the fund provided by a donor, the MOW will employ a construction contractor for the facility construction. The supply of equipment for the O&M, training of pump attendants and local mechanics for the maintenance and repair of pumping equipment and others may be rendered to the contractor.

6.5 Education and Training

6.5.1 Introduction

In order to manage the village water schemes effectively and efficiently, the villagers must be equipped with the necessary knowledge and skills.

The hygiene education will give the villagers the understanding on the linkage of water, environmental sanitation and health. And the understanding will motivate the users in the necessity of safe water, environmental sanitation and proper hygiene habit of individual, household and community.

All training activities will focus on the empowerment of the individuals users, especially women, in the community. The communities will be enable to plan for improved environmental health and better operation and maintenance of their water schemes. The main training methodology will be gender sensitive participatory approaches with a view of enabling the participants to apply their own experiences and knowledge in discussing different subjects. The training materials for villagers have been prepared at the final stage of the Study after the education and training have been conducted at the pilot villages.

6.5.2 Basic Principles

(1) Community Participation

Most of activities to be done should strongly be guided by the principles of community participant and bottom-up planning and decision making process. Promoting villagers based on participatory methodologies is the most important tools for achieving true participation.

(2) Hygiene Education

The hygiene education will focus the formation of understanding of the linkage between water, environmental sanitation and health and the creation of proper hygiene habit in individual, household and community. The linkage of human excreta disposal; colon bacillus; role of fly in propagation of colon bacillus and diseases; the contamination of water and food by colon bacillus, other bacteria and diseases; and human health is to be taught to all levels of village population. The proper and preventive hygiene habit is also taught and trained in practical cases. "Wash hand by soap" and "drink boiled water" campaign become very important as preventive measures for water-related diseases.

(3) Gender Issues

There is a need to actively promote the participation of both women and men in all activities in order to succeed in mobilising all available human resources for development activities. Since women are responsible for house keeping activity inclusive of procurement of water, cooking, child care and sanitation in house, enhancing their proper awareness on hygiene can accelerate the improvement of the family health. Most health and sanitation activities should therefore be targeted towards women, particularly house-wives.

Whenever villagers are invited to discuss issues related to water or health, the role of women will inevitably arise. It is therefore essential that women be invited to these meetings and be encouraged to actively participate in discussions of issues. It is also an opportunity to promote the modifications of roles within a family and community, and also create understanding for more equal distribution of responsibilities between women and men.

(4) Self Reliance and Ownership

The issues of ownership should be explained, discussed, understood and agreed upon by the community. The users own the facilities and will eventually take full responsibility for the management, financing, O&M after completion. The financial management issues must be cleared and agreed upon within the community.

(5) Credibility

Credibility requires that what has been chosen and that the choice was based on sufficient information. Genuine creditability requires communication of full information and its assimilation, dissemination, acceptance and internalisation. This takes times. In absence of full information, villagers respond rationally to available information by opportunistic behaviour (when it produces immediate benefits) and reluctance (when action would incur costs).

(6) Sustainability

An installation may last long because it was built simply and strongly, and the users have maintained it well through their own efforts and resources. The villagers should discuss the cost involved. They should also discuss the community's ability and willingness to pay for the services over a longer period of time. From the very beginning the villagers need to understand the financial implications of operating and maintaining their scheme.

The availability of spare-parts must also be discussed with the end users so that they know what to expect when there is a breakdown.

(7) Affordability

To get the maximum benefit from the water scheme, the technologies used must be the ones that the villagers can easily understand, can afford and can maintain. Thus, the means of acquiring clean water and improving environmental sanitation must be financially affordable by individual households or villagers. Similarly, the maintenance costs of installations must be made clear to all and must be feasible.

(8) Cost Effectiveness

In all discussions with the villagers it is important to discuss cost efficiency and effectiveness of various activities. This should include choice of appropriate technology, methods to be used, as well as operation and financial management.

6.5.3 Implementation Programme

(1) Participatory Rural Appraisal (PRA)

During the early stage in the project implementation, the consultant in cooperation with the district water engineer will conduct the PRA at all target villages in the project. The principal objectives of PRA are to inform the villagers of the proposed water scheme and implementation procedures of the project, as well as to elaborate on their responsibilities as regards the water scheme.

The PRA will be carried out by a group of facilitators qualified in the fields of water supplies; health and environmental sanitation; and gender issues. PRA activities in a village include meeting with village government; hearing of village history and preparation of village maps; focus group discussions; site visits; village meeting to brief villagers on the findings of PRA; identification, analysis, ranking of problem; and preparation of village action plans.

(2) Education and Training of Villagers

Just after the completion of the water facilities, the education and training of villagers will be conducted in the manner mentioned previously. The programme will be implemented by a group of facilitators in cooperation with the DWE and other related district officers.

(3) Training of Village Caretakers

The daily O&M of water facilities are under the responsibility of caretakers and/or pump attendants selected by the VWC or WUG. First training of village caretakers is to be made when the water facilities have been completed by the construction contractor. The contractor is to carry out a training programme for village caretakers prior to the hand-over of the completed facilities to the DWE in accordance with the provision of contract agreement between the MOW and the contractor.

6.6 Project Monitoring and Evaluation Plan

6.6.1 Monitoring

The monitoring seeks to ensure that input, plan, budget, target and other necessary actions are proceeding according to expectation. The monitoring exercise consists of (i) physical and financial monitoring, (ii) process monitoring, (iii) effect monitoring and (iv) follow-up monitoring. The physical and financial monitoring entails measuring project activities and production of outputs against targets. The process monitoring concentrates on an identification of factors hindering expected progress of the project. The effect monitoring is the measuring of the initial response and reaction to project activities and their immediate and short term effects to the environment and beneficiaries. On the other hand, the follow-up monitoring is subject to (i), (ii) and (iii) above and mainly focuses on an identification of remedial solutions to constraints and bottlenecks.

6.6.2 Evaluation

All development management is concerned with four other critical issues. These are (i) efficiency of the project, (ii) effectiveness of project activities, (iii) impact of the project, (iv) sustainability of the project. The first two are perhaps the most important ones. This is because while the efficiency is doing things right, the effectiveness is doing right things right. These two determine the impact and sustainability of the project and its related activities. The main purpose of evaluation is to provide a basis for any or all of the following information;

- corrective and remedial measures to improve the effectiveness of the on-going project activities;
- decisions as to whether or not to continue with, revise, extend or even terminate some project activities; and
- solid response to the concerns and demands of donors, policy makers, project managers and beneficiaries.

6.7 Users' Affordability to Water Fees

6.7.1 O&M Costs

The initial costs of water facilities will be entirely granted by the government or external agencies. The replacement cost of equipment is basically to be born by the users. The O&M costs will be shouldered by the villagers themselves according to the provision of the national water policy.

The annual costs of three types of water supply facilities are estimated: L-1-1 system (handpump borehole; service population of 430), L-1-4 system (solar-pump borehole; service population of 900) and L-2 system (engine-pump borehole; service population of 4,500). The O&M cost consists of expenditures for personnel (pump attendants, caretakers, watchman etc.); fuel and lubricants; repairing and maintenance; contingencies and depreciation costs of equipment. Summary of the estimated annual O&M cost is as follows:

Table 6.6 Annual Operation and Maintenance Cost in Tsh

Cost Items	L-1-1	L-1-4	L-2
Personnel	391,071	391,071	3,390,762
Fuel and lubricant	-	-	4,317,400
Repairing	107,990	368,750	531,043
Contingencies	14,972	22,795	247,176
Depreciation	217,908	975,000	1,301,688
Total in Tsh	731,941	1,757,616	9,788,069
Total in US$	1,172	2,812	15,664

6.7.2 Estimated Water Fees

Annual water quantity to be lifted is determined by the service population and water consumption rates of 20 lcd as : 3,139,000 lit. for L-1-1 system; 6,570,000 lit. for L-1-4 system; and 32,850,000 lit. for L-2 system. Standard water fees have been estimated on the condition that the average household size is 5.8 persons and the collection efficiency of water fee is 90%, as given below:

L-1-1 system: Tsh 0.26/lit or Tsh 5.2 /bucket: (Tsh 731,941 ÷ 3,139,000 lit ÷ 0.9)

L-1-4 system: Tsh 0.30/lit or Tsh 6.0 /bucket: (Tsh 1,757,616 ÷ 6,570,000 lit ÷ 0.9)

L-2 system : Tsh 0.33/lit or Tsh 6.6 /bucket: (Tsh 9,788,069 ÷ 32,850,000 lit ÷ 0.9)

6.7.3 Household Income and Payment for Water

Detail surveys on annual household income were carried out at 10 pilot villages in order to supplement date collected through the sample household surveys (4,489 samples). The values of two representative average indicator of the annual household income are given below:

Mean : Tsh 410,000 ($656)
Median : Tsh 245,000 ($392)

Annual income of about 77% households is lower than the mean value of Tsh 410,000, whereas annual income of 50% households is lower or higher than the median value of Tsh 245,000. Regarding representative annual household income to be used for evaluation of villagers' affordability to water fees, it has been agreed by between the Ministry of Water and the JICA Study team that the income level covering 80% of households should be used for evaluation of affordability considering the distortion effects created by the few high income earners. Accordingly, such annual household income is worked out at Tsh 145,000 ($232) as the representative annual household income.

Annual water consumption of an average household with a family size of 5.8 persons is 42,340 lit. The water fees to be paid by the average household are estimated at:

L-1-1 system : Tsh 11,000/year, or Tsh 917/month
L-1-4 system : Tsh 12,700/year, or Tsh 1,058/month
L-2 system : Tsh 14,000/year, or Tsh 1,167/month

6.7.4 Affordability

The percentage of the annual water fees to the representative annual household income (Tsh 145,000) ranges from 7.6% to 9.7% as under:

L-1-1 system : 7.6%
L-1-4 system : 8.8%
L-2 system : 9.7%

Above figures may imply that the estimated water fees are not affordable to the lowest 20% income group. The households are classified into five income groups with equal number of households: the lower 20% income group, second 20% income group, third income group, fourth income group and the upper 20% income group in order to evaluate affordability of each income group. The results are as follows:

Income Group	Income (Tsh)	Water Fee Ratio (%)		
		L-1-1	L-1-4	L-2
Lower 20%	145,000	7.6	8.8	9.7
Second 20%	215,000	5.1	5.9	6.5
Third 20%	280,000	3.9	4.5	5.0
Fourth 20%	460,000	2.4	2.8	3.0
Upper 20%	1,000,000	1.1	1.3	1.4

As indicated above, the water fees are payable by 60% of the households in the Study area. However, some difficulties in water fee payment might be arisen for the lower 20% income group to use L-1-4 (solar-pump borehole) system or L-2 (engine-pump borehole) system. The VWCs shall take measures to relief the lower-income households by such a way to appoint those households to caretakers or pump-attendants and to pay their water fees by the daily allowances.

Another indicators related to evaluation of water fees are current prices of water sold by water vendors and willingness to pay for water. According to the results of the village inventory and sample household surveys, at about 60 villages, people buy water from the water vendors at prices of Tsh 50 to 100 per 20 litre-can; and the villagers responded to the questionnaire "How much will you pay for water if clean and safe water is supplied throughout the year?"; the value of willingness to pay for water averaged to Tsh 82 per 20 litre-bucket.

6.7.5 Collection of Water Fee

Regarding the collection of water fee from the villagers who receive water from public taps, two methods are applicable in a general way including a flat rate system and a simple metering system that charges for each bucket of water drawn at the public tap.

(Flat Rate System)

The flat rate may be justified for the villages where water for domestic consumption is relatively small. The flat rate is determined by a fixed household fee regardless of family size, or head taxes, or assessment on property.

(Simple Metering System)

Charging for each bucket of water clearly has advantages in controlling water use; however, it has encountered administrative difficulties, and the cost of having an attendant permanently present at each public tap is necessary.

There is no easy answer to the problem of water fee collection from public taps. The choice between charging methods is largely dictated by local condition, and should normally be made on the basis of administrative simplicity, acceptability and effectiveness.

To attain high efficiency of water fee collection, thus resulting in sustainability of rural water supply projects, it is effective to raise awareness of the villagers in respect of benefits of the projects. The villagers should be given basic health education so that they appreciate the benefits of improved water supply.

CHAPTER SEVEN: PLOJECT COST

CHAPTER SEVEN: PROJECT COST

7.1 Introduction

The project cost consists of the following seven items:

(1) facility construction cost,

(2) procurement cost of equipment necessary for the implementation of the project,

(3) cost for education and training of users, local mechanics and others,

(4) project monitoring cost,

(5) fee for engineering services,

(6) fee for administration; and

(7) the physical contingencies.

The costs necessary for land acquisition, compensation and environmental measure are not applicable to the project; and excluded from the project cost.

7.2 Facility Construction Cost

The facility construction costs are estimated based on the work quantity, current unit rates employed in Singida RWED projects and similar projects. The construction costs are divided into two portions of foreign and local currencies. The foreign currency portion covers the amount of costs required for procurement of machinery, equipment, spare parts and materials to be imported, and cost of parts. The local currency portion covers the costs required for personnel and materials locally available. The estimated unit costs by facility construction are summarised as shown in the following table:

Table 7.1 Unit Costs by Facility (Unit: US$)

Facility	Local Currency	Foreign Currency	Total
L-1-1	7,621	19,908	27,529
L-1-2	2,845	970	3,815
L-1-3	11,506	52,203	63,709
L-1-4	27,064	124,413	151,477
L-2 (SP: 4,320)	35,042	106,732	141,774
L-2 (SP: 5,040)	35,570	109,405	144,975
L-2 (SP: 6,000)	38,306	128,970	167,276
Charco Dam	38,340	21,860	60,200

Note: (1)Unit cost of L-2 facility varies by the proposed service population (SP).
(2)As per the unit costs of rehabilitation by facility type, refer to Appendix-6, Volume Three Report.

The summary of facility construction costs in each target years is given in Table 7.2.

Table 7.2 Summary of Facility Construction Cost

(Unit: US$ '000)

Project Stage	Year 2001 Project			Year 2006 Project			Year 2016 Project		
Cost Items	Q'ty	LC	FC	Q'ty	LC	FC	Q'ty	LC	FC
A. Domestic Water Facility									
L-1-1	264	2,012	5,256	693	5,281	13,796	2,557	19,487	50,905
L-1-2	-	-	-	78	222	76	39	111	38
L-1-3	-	-	-	-	-	-	29	334	1,514
L-1-4	7	189	871	11	298	1,369	24	650	2,986
L-2	9	321	1,013	2	72	229	1	38	129
Rehabilitation	36	4	85	375	88	1,813	970	69	3,235
Total		2,526	7,225		5,961	17,283		20,689	58,807
B. Charco	64	2,454	1,399	127	4,869	2,776	272	10,428	5,946

7.3 Equipment Procurement Costs

The procurement cost of equipment for preventative maintenance and repairing of the water facilities is estimated as listed in the table below: The total cost is to be US$ 434,000.

Equipment	Quantity	Amount (US$)	Remarks
Pickup trucks	7	224,000	4WD
Workshop equipment	5	115,000	
Water quality kits	5	35,000	
Office equipment	4	48,000	
Tools	10	12,000	for local mechanics
Total		434,000	

The procurement cost is allocated to four distincts as given in Table 7.3.

7.4 Training and Education Cost

The training costs include all necessary expenditures for training of the technicians from the district water engineer's offices, proposed local mechanics to be assigned by the district water engineers and village technicians (pump-attendant and caretakers). The training of local

mechanics inclusive of 10 chief mechanics and 40 assistant mechanics will be carried out for 10 days; five days for theory and experimental training; and another five days for practical experience at sites. The training will be conducted by the contractor and/or the equipment suppliers during the construction stage. The project cost shall include such costs required for this purpose.

The education programme consists of PRA and education/sensitisation of the users. The PRA will be carried out by a group of facilitators for three days for each village before the construction stage; and education/sensitisation will be conducted for three days for each village during the construction stage.

The cost required for the said training and education is estimated as shown below:

Cost Item	Cost (US$)	Remarks
Training		
- Local mechanics	14,000	10 days for 50 persons
Education		
- PRA	392,000	3 days for 280 villages
- Sensitisation	308,000	3 days for 220 villages
Total	714,000	

7.5 Monitoring Cost

The monitoring will be conducted by groups of qualified surveyors for a three-day period for the villages covered by the project; one day for interview with the village government and representatives of VWC and WUGs; one day for interview with selected users; and one day for evaluation. The monitoring programme is scheduled to be implemented at an interval of once a year for a period of five years after completion of the construction works.

Thus, the total cost amounts to US$ 1,100,000 (220 villages × 5 years × $ 1,000/village/time).

7.6 Other Costs

7.6.1 Engineering Services Fee

The fee for engineering services is estimated at 10 % of the total cost of facility construction, equipment procurement, education and training; and monitoring. However, the fee on the charco dam construction is estimated only from the facility construction cost.

7.6.2 Administration Cost

The administration cost of domestic water projects is estimated at five(5) % of the total cost of facility construction, equipment procurement, education & training, monitoring and engineering services, whereas the administration cost of charco dam projects is estimated at five(5) % of the total cost of facility construction and engineering services.

The estimated administration cost in terms of US$1,000 amounts to 580 in the year 2001, 1,305 in the year 2006 and 4,426 in the year 2016. The breakdown of administration cost in the year 2001 is given on the basis of the district as follows (US$1,000):

	LC	FC	Total
Hanang	24.9	58.4	83.3
Singida	69.9	177.6	247.5
Manyoni	39.3	103.1	142.4
Igunga	31.9	74.9	106.8
Total	166.0	414.0	580.0

7.6.3 Physical Contingencies

In provision for unknown factors regarding cost estimate, the physical contingencies is added to the project cost. The physical contingencies are estimated at 10 % of the total cost of facility construction, equipment procurement, education and training, monitoring, engineering services and administration. The physical contingencies for charco dam is estimated based on the total cost of facility construction, engineering services and administration.

7.7 Total Project Cost

The total project cost amounts to US$ 181,624,000. Summary of the project cost by target year is given in Table 7.4.

Project	Domestic Water Facility (US$'000)	Charco Dam (US$'000)	Total (US$'000)
Year-2001 Project	13,400	4,895	18,295
Year-2006 Project	30,565	9,714	40,279
Year-2016 Project	102,245	20,805	123,050
Total	146,210	35,414	181,624

Table 7.3 Equipment Procurrement Cost by District

District	Item	Pickup Trucks	Workshop Equipment	Water Kits	Office Equipment	Handpump Tools
Hanang	Q'ty	1	1	1	L.S	2
	($1,000)	32	23	7	12	2.4
Singida	Q'ty	3	2	2	L.S	4
	($1,000)	96	46	14	12	4.8
Manyoni	Q'ty	2	1	1	L.S	2
	($1,000)	64	23	7	12	2.4
Igunga	Q'ty	1	1	1	L.S	2
	($1,000)	32	23	7	12	2.4
Total	Q'ty	7	5	5	L.S	10
	($1,000)	224	115	35	48	12

Table 7.4 Summary of Project Costs by Target Year

(Unit: US$ '000)

Project Stage	Year 2001		Year 2006		Year 2016	
Cost Items	LC	FC	LC	FC	LC	FC
A. Domestic Water Facility						
1. Facility Construction	2,526	7,225	5,961	17,283	20,689	58,807
2. Equip't Procure't	125	309	125	309	-	-
3. Educat'n & Training	143	-	186	-	386	-
4. Monitoring	220	-	286	-	594	-
5. Engineer'g Service	301	753	643	1,728	2,167	5,881
6. Administration	166	414	354	951	1,192	3,234
7. Contingencies	348	870	743	1,996	2,503	6,792
Sub-total	3,829	9,571	8,298	22,267	27,531	74,714
Total	13,400		30,565		102,245	
B. Charco Dam						
1. Facility Construction	2,454	1,399	4,869	2,776	10,428	5,946
2. Engineer'g Service	245	140	487	278	1,043	595
3. Administration	135	77	268	153	574	327
4. Contingencies	283	162	562	321	1,205	687
Sub- total	3,117	1,778	6,186	3,528	13,250	7,555
Total	4,895		9,714		20,805	
Grand-total	18,295		40,279		123,050	
Total Project Cost	181,624					

CHAPTER EIGHT: PROJECT IMPLEMENTATION PLAN

CHAPTER EIGHT: PROJECT IMPLEMENTATION PLAN

8.1 Implementation Programme

8.1.1 Implementing Organisation

The Ministry of Water will be the executing agency responsible for implementation of the proposed rural water supply project with the project area extending over three regions of Arusha, Singida and Tabora. The Ministry of Water will appoint a project manager who has responsibilities for promoting the project and coordinating and directing the local organisations at all levels of region, district, ward and village.

For effective implementation of the project, four project offices will be established, one office for each district. The district water engineer will be the representative who is responsible for organising and directing the village organisations inclusive of the water users' groups, coordinating the district organisations related to rural water supply, and supervising consulting services and construction work.

The construction work will be carried out on the contract basis, under the supervision of the district water engineer, by employing an engineering consulting firm and a construction contractor. The assignment of the consulting firm is to assist the Ministry of Water in preparing the detail design and tender documents, bidding and contracting with a construction contractor, and supervising the construction work as well as conducting the programmes of education and training of the users.

8.1.2 Implementation Schedule of Facility Construction

The proposed project will be implemented as a package project composed of three stage projects: Year 2001, Year 2006 and Year 2016 projects. The implementation schedule has been prepared on the basis of the following condition:

(1) Boreholes Construction

Major works of this project is the construction of borehole facilities due to its large numbers. The construction of boreholes becomes a critical path in the construction planning. Construction plans for boreholes in each stage project are formulated as follows:

(a) Annual Working Days

Sunday	:	51 days
Holiday	:	15 days
Shutdown days in the rainy season	:	74 days
Sub-Total	:	140 days

Therefore, the annual working days are 225 days.

(b) Required Number of Days for Borehole Drilling

successful borehole	:	6 days
dry borehole	:	5 days

(c) Year 2001 project:

Borehole (successful)	:	1,680 days (280 × 6 days)
Borehole (dry)	:	350 days (280 × 0.25 × 5 days)
Total	:	2,030 days

When three (3) drilling parties are mobilized for the works, it takes 3.1 years (2,080 ÷ 3 ÷ 225days/annum) for drilling.

(d) Year 2006 project:

Borehole (successful)	:	4,224 days (704 × 6 days)
Borehole (dry)	:	880 days (704 × 0.25 × 5 days)
Total	:	5,104 days

When six (6) drilling parties are mobilized for the works, it takes 3.8 years (5,104 ÷ 6 ÷ 225days/annum) for drilling.

(e) Year 2016 project:

Borehole (successful)	:	15,186 days (2,531 × 6 days)
Borehole (dry)	:	3,164 days (2,531 × 0.25 × 5 days)
Total	:	18,350 days

When nine (9) drilling parties are mobilized for the works, it takes 9.1 years (18,350 ÷ 9 ÷ 225days/annum) for drilling.

(2) Reconstruction of Dug Wells

As the number of proposed dug-wells is not so many, the reconstruction works will be carried out in the last year of each stage project.

(3) Rehabilitation of L-1-1 System

The number of L-1-1 (handpump-borehole) facilities to be rehabilitated is 326 in the Year 2006 project and 1,008 in the Year 2016 project. The rehabilitation works will be implemented over the construction period of each stage project.

(4) Rehabilitation of Other Facilities

As the number of other facilities is not so large, the rehabilitation of other facilities is implemented in the last year of each stage project.

8.2 Education and Training

8.2.1 PRA

During the early stage of the project implementation, the consultant in cooperation with the district water engineer and related district officers will conduct the participatory rural appraisal (PRA) at all target villages. The principal objectives of PRA are to inform the villagers of the proposed project and implementing procedures of the project, as well as to elaborate on their responsibilities as regards the project.

The PRA will be carried out by a group of facilitators qualified in the sectors of water facilities, health and environmental sanitation and gender issues. The activities in PRA in any village include a meeting with village government staff for hearing of outlines of the village and preparation of village map; the group discussions with villagers by sector; the site inspection of proposed site of water facilities; and the briefing meeting with villagers on the findings of PRA, the identification, analysis and ranking of problems, and preparation of village action plans.

8.2.2 Education and Training

Just after the completion of the construction of water facilities, the education and training programme mentioned in Section 6.4 will be conducted by a group of facilitators as same as PRA in cooperation with the district officers concerned. The programme will be administered by focusing on groups such as the members of VWC and WUG, the pump attendant and caretakers, the primary school teachers and the users.

8.3 Project Monitoring and Evaluation

8.3.1 Task Forces

The district water engineer will be charged with implementation of the monitoring programme. The task forces shall be organised under the control of the district water engineer in conjunction with other district officers concerned.

The monitoring and evaluation are the process that attempts to determine the extent of four issues mentioned in Section 5.5 and to provide effective information necessary for formulation of development plans of the overall project through generalising findings from the on-going/completed village water schemes to other target villages. In this context, task forces shall consist of qualified facilitators covering the field of water supply, health and environmental sanitation and gender issue.

8.3.2 Methodology

The monitoring and evaluation take place at defined and critical intervals of the project cycle namely, during (on-going), towards (at the end of construction), and after (on completion). The first monitoring and evaluation will be conducted during the detailed design period as a part of the participatory rural appraisal, and the second one will be during the construction period together with the implementation of education and training programme. It is proposed to implement the monitoring and evaluation programmes once a year for a five-year period after completion of the construction works.

The monitoring will be administered to two target groups including village government officials, other related officials and representatives of committees and organisations concerned with rural water schemes; and villagers.

8.4 Project Implementation Schedule

The components of proposed project are (i) project preparation inclusive of detailed design, preparation of tender documents, tendering and contracting of construction contractor; (ii) procurement of equipment required for the project implementation; (iii) PRA; (iv) borehole siting by means of geophysical sounding and others; (v) facility construction; (vi) education and training of users; and (vii) project monitoring.

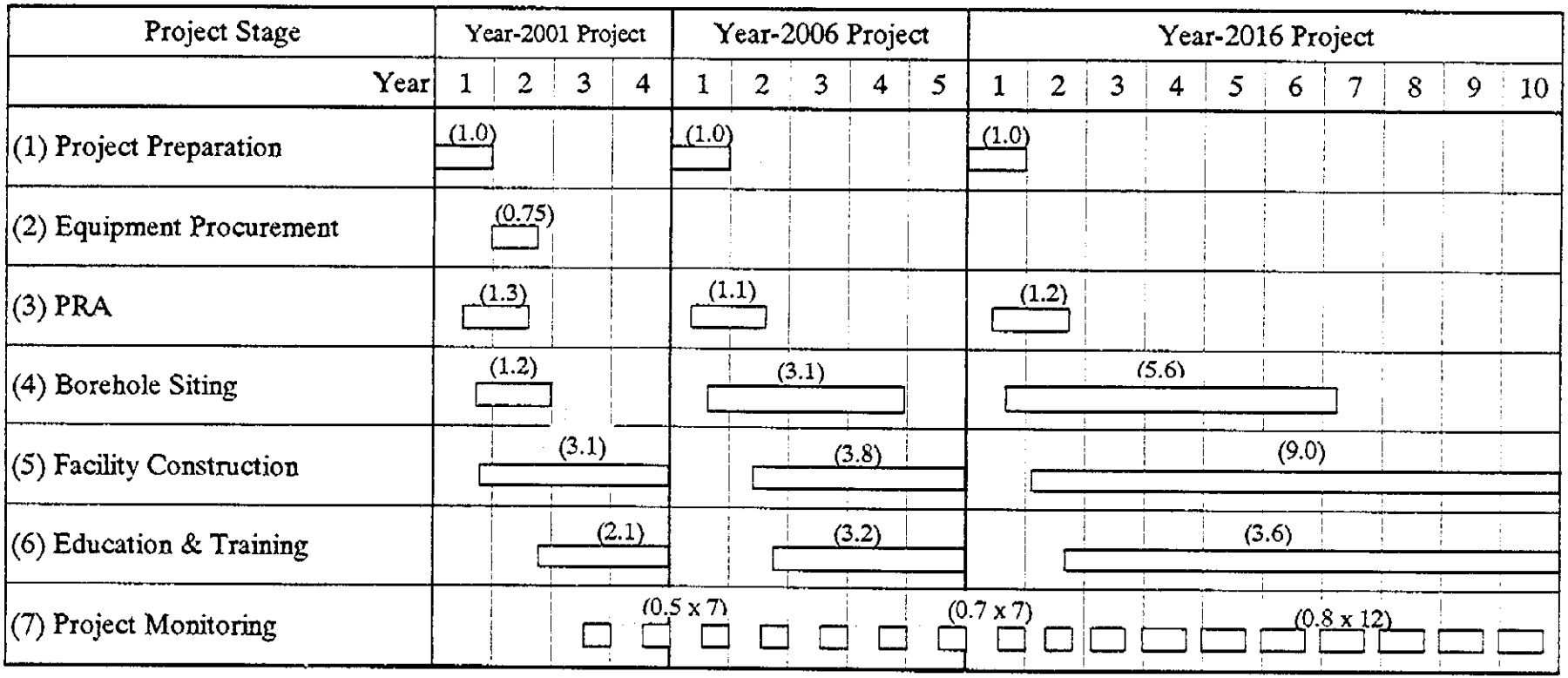
The required period of time (number of year) for each component are estimated as follows:

Table 8.1 Required Period by Project Component

Project Component	Year 2001	Year 2006	Year 2016	Remarks
Number of Village	157	243	270	
Number of Borehole	280	704	2,531	
(i) Project Preparation	1.0	1.0	1.0	
(ii) Equip't Procurement	0.75	-	-	
(iii) PRA	1.3	1.1	1.2	3 days/village;3 parties
(iv) Borehole Siting	1.2 (2 parties)	3.1 (2 parties)	5.6 (4 parties)	2 days/site
(v)Facility Construction	3.1	3.8	9.0	refer to Sect. 8.2.2
(vi) Educat'n & Train'g	2.1	3.2	3.6	3 days/village;1 party
(vii) Project Monitoring	0.5	0.7	0.8	2 days/village;3 parties; per year

Based on above, an implementation schedule of the proposed project was planned as shown in Figure 8.1.

Figure 8.1 Project Implementation Schedule



Notes : (1) Project preparation includes the detailed design and tendering of construction contractor.
(2) Figures on bars mean required numbers of year during a period shown by the bar.

CHAPTER NINE: PROJECT EVALUATION

CHAPTER NINE : PROJECT EVALUATION

9.1 Environmental Evaluation

9.1.1 Environmental Setups

(1) Legislative and Institutional Setups

The laws and regulations concerning the environment are not enacted in Tanzania. Especially, those related to the environmental impact assessment (EIA) are also not included in any regulations administrated by any regional government and sectorial agency. The regulations pertaining to environment in the Study are Wildlife Conservation Act No. 12, 1974; Forest Ordinance 384, 1954; Fisheries Act No 16, 1970; Grassfire Ordinance; and Range Development and Management Ordinance.

Responsible agencies for the environmental management are the National Environment Management Council under the National Environmental Management Act, 1983, for purposes of acting as an advisory body to the Government on all matters relating to the environment and the Division of Environment created in 1991 in the Ministry of Tourism, Natural Resources and Environment.

The Government intends to enact law and regulations to enforce environmental management including the environmental impact assessment.

(2) National Conventions

The international conventions on environment to which the Government is a party are the Convention on Biological Diversity; Basel Convention and the Convention on International Trade in Endangered Species.

(3) Game Reserve and Forest Reserve

There are three forest reserves, one game and forest reserve and three game reserves in the Study area. Out of 284 target villages, nine villages are located in the above reserve areas: three villages in Duamghanga game and forest reserve, three villages in Minyuge proposed forest reserve and three villages in Rungwa game reserve.

9.1.2 Initial Environmental Examination (IEE)

An initial environmental examination (IEE) was made in the Study on 23 items of social, natural and pollution environmental impacts related to the implementation of groundwater development project according to the guideline of JICA. As a result of screening and scoping in IEE, the following two items was clarified;

- unknown impact factor on vested water right of dug wells due to drawing down of water level and/or decreasing by drilling of new boreholes; and

- change of quantity and quality of groundwater of the existing boreholes due to drilling of new boreholes.

9.1.3 Environmental Impact Assessment

The EIA was made on the following two items clarified by IEE: (1) vested water right of existing dug-wells and (2) the change of groundwater quantity and quality of the existing boreholes.

(1) Vested Water Right

Some 474 dug-wells are distributed over the Study area. The dug-wells are usually sunk manually into the superficial soft layers. The maximum depth of well does not, in general, exceed 20 m, and the well wall is protected with concrete rings. Some of them are dry during dry season. A borehole extracts water normally from deep aquifer and not from shallow aquifer. However, a borehole, which is constructed nearby a dug well and not properly designed or constructed, might give water level influence to the existing dug-well.

The following measures are recommended to be taken in order to avoid water level affection to the dug-well:

- to confirm location and aquifer of dug wells; and
- to design appropriate borehole structure to avoid extract water from aquifer of the dug-well, including installation of blank casing more than 30 m long and sealing by grout to six m depth below the ground.

(2) Influence to the Existing Borehole

In case that a new borehole is proposed to be constructed in a village where a borehole(s) is already existing, the influence of the construction works on the existing borehole(s) should be eliminated in terms of water quantity and water quality of the existing borehole(s).

At some 39 target villages, additional boreholes will be constructed. The extent of influence on the existing boreholes was evaluated based on the number of new boreholes and hydrogeological condition. At 16 villages, influence on the existing boreholes will be nil or very small because the number of new boreholes is small in comparison with the potential water yield and drawdown of groundwater level. At 14 villages in which three to five boreholes will be newly constructed, influence may be avoided by keeping enough distance between the existing and new boreholes. At 9 villages in which large number of borehole (6 to 12) are required, some existing boreholes may be influenced in case of over-pumping of new boreholes, resulting in rapid drawdown of water level and change of water quality.

The following measures are recommended to be taken in order to avoid such influence:

- to investigate in detail hydrogeological condition around the existing boreholes such as drawdown of water level and pumping discharge, and the possible change of water quality by pumping test;
- to estimate enough interval between the existing and new boreholes based on hydrogeological investigation;
- to unify the existing and new boreholes adopting L-2 systems; and
- to make periodical monitoring on water level and water quality after the construction of borehole.

9.2 Institutional Evaluation

9.2.1 Governmental Setup in WES Sector

The governmental setups of the WES sector in Tanzania is, in general, formed on the practical basis under the leadership of the related ministries of the national government. The ministries dispatch their staff to regional governments as the regional officers responsible for the WES sector such as the water engineer, the officers for community development, health, women and children affairs; and so forth. The WES related officers in the district government are water, community development, health, school teacher and others.

Those WES related officers in both national and local governments devote their duties. The WES officers at the district level play important role in daily support services to villagers. Their daily activities is, however, very limited due to financial constraint not sufficient to perform their duties properly. Their activities would be more functioned, particularly at the district level, when enough number of staff and fund for their daily activities are secured. The capacity building effort for them is also required on a periodical basis.

In order to maintain a sustainable community based management system in the WES sector, the governmental intervention is indispensable not only for education and training at the initial stage of the project but also at the O&M stage in a long term. Although the external assistance for intervention activities may be available during the implementation stage of WES project, any recurrent assistance for the governmental intervention may not be expected. It is important to seek a self-reliance measure through development of own resources so as to enable a long term intervention.

9.2.2 VWC

The village water committees (VWCs) have been established in most of the target villages in the Study area. It is found through the Study that some active and vital VWCs are operating well their water schemes. However, many VWCs are not so active, thus causing malfunction of

their water schemes, one of the reasons for which, among many, is lack of proper guide and services to the VWCs to be provided by the government organisations

Water shortage is a major problem in all the target villages and they have been seeking to provide village water facilities. On completion of the proposed project, VWCs with the proposed water users' groups may manage their water schemes sharing their responsibilities as designed in the Study when intervention and support services by the governments are properly implemented..

9.3 Technical and Engineering Evaluation

9.3.1 Drilling and Construction Contractor

In consideration of the size and nature of the proposed project, the Study recommends to employ a private contractor(s) (an expatriate prime contractor with local sub-contractors) to undertake the construction works of borehole drilling inclusive of facility construction for the implementation of project.

Some ten (10) number of drilling contractors are operating in Tanzania. They are running under small size in terms of capital, finance, staff and outfit. Most of them hold non or one or two drilling rig(s) and very limited number of vehicles and other supporting equipment. Many of them hold no drilling rig and they borrow the rig from the MOW when necessary.

A number of technical issues are observed regarding the technologies of Tanzanian drilling contractors through the implementation of the pilot project of the Study which involved the drilling works.

The contractors used to exclusively apply the DTH (air-hammer) drilling even to very collapsible layers; the mud-circulating drilling was not used. And drilling through those layers at a village, unexpected time were lost and the proposed borehole could not be finally completed. This is supposed to be attributed to lack of mud-pumps and mud materials; and lack of mud-drilling technology which is common to drillers in Tanzania.

To import the equipment and materials for the drilling and facility construction into Tanzania, it took three to four months after the order has been given by the Study team due to low financial and administrative capabilities of contractors and the prevailing custom system.

The biggest drilling firm in Tanzania is the Drilling and Dam Construction Agency of the MOW which is semi-autonomous body and holds a number of staff and old but enough outfits inclusive of 30 drilling rigs.

9.3.2 Climate and Road Conditions

The rainy season in the Study area lasts for some five-month starting from November to end in March in a normal year. During three-month period from the end of December to the end of March, the local dirt roads are hardly passable for vehicles, even in a part of the trunk gravel-top

roads. In the year 1997/98, the supply of petrol and commodities was interrupted due to the wash-out of many bridges on the trunk roads.

A three month period is, therefore, taken for the shutdown of construction works in the project implementation plan in the Study.

9.3.3 Geophysical Sounding for Borehole Siting

The resistivity and double-loop EM soundings were applied to borehole siting in the Study. An application of both the above soundings were effective to a 100 m depth; and in case that the superficial formation is thin and the bed-rock formation is at shallow depth, soundings were effective.

The Study identified that most of productive aquifer was in fracture zone within the bed-rock formation at a 100 m to 150 m depth. In some wide area the bed-rock formation and fracture zone within it are overtopped by a lake-bed deposits. Both the above soundings are not so effective in the said situation.

The Study recommends to introduce the time-domain electromagnetic (TDEM) sounding for the borehole siting at the project implementation stage. The TDEM sounding may be more effective to sound to a several-hundred-metre depth in terms of precision and site-work performance.

9.4 Project Benefits

9.4.1 Financial Benefits

Financial benefits mean revenues from water charge. Three model cases are put forward for financial and economic evaluation: L-1-1 system (borehole with handpump; service population: 430); L-1-4 system (borehole with solar-pump; service population: 900) and L-2 system (piped domestic-point; service population: 4,500).

As already described in Section 6.5, the system type-wise annual revenues are:

- L-1-1 System : Tsh 816,000 or US$ 1,306
- L-1-4 System : Tsh 1,902,000 or US$ 3,043
- L-2 System : Tsh 10,841,000 or US$ 17,345.

The above values are as of 1997. Actually, household income will go up in future in parallel with economic growth. It is assumed that household income in the Study area will increase at the average annual rate of 2% in future.

9.4.2 Economic Benefits

The two major benefits are expected to accrue from project implementation. One is the time saving benefit and another is the benefit of medical cost reduction.

(1) Time Saving Benefit

If the project is not implemented, the users have to continue to walk far away to sources to collect water. The problem is that not only does it require much physical exertions to women and children but also it accompanies the daily spending of considerable portions of their precious daytime hours.

Based on the per capita per day spending of time for water collection and the economic value of unit length of time, the annual per capita economic loss of water collection is estimated at Tsh 9,319. From this value, the assumed time saving rate of 70% in the with-project case and the number of users covered by a water system, the annual benefits by system are:

L-1-1 : Tsh 2,805 thousand or US$ 4,488,

L-1-4 : Tsh 5,871 thousand or US$ 9,394,

L-2 : Tsh 29,355 thousand or US$ 46,972.

(2) Benefit from Medical Cost Reduction

According to the results of the household survey conducted by the Study Team, an average medical expenditure for water-related diseases per person per year is deemed to be Tsh 4,022 or US$ 6.4. From this value, the assumed disease reduction rate of 25% in the with-project case and the number of service population of a water system, the annual benefits by system type are estimated as follows;

L-1-1 : Tsh 432 thousand or US$ 692,

L-1-4 : Tsh 905 thousand or US$ 1,448

L-2 : Tsh 4,525 thousand or US$ 7,240.

(3) Total Benefits

From the above, the total annual benefits are:

L-1-1 : Tsh 3,237 thousand or US$ 5,180,

L-1-4 : Tsh 6,776 thousand or US$ 10,842,

L-2 : Tsh 33,880 thousand or US$ 54,212.

The above values are as of 1997. Actually, the time saving benefit will go up in future in parallel with economic growth. It is assumed that the time saving benefit in the Study area will increase at an average annual rate of 2% in future. The benefit of whole project in 20-year period from 1999 to 2018 are estimated as US$ 2,069 thousand by 2003, US$ 7,181 thousand by 2008, US$ 13,285 thousand by 2013 and US$ 27,496 thousand by 2018.

9.5 Economic and Financial Evaluation

9.5.1 Project Cost

(1) Financial Cost

The project cost consists of the capital cost and the O&M cost. The capital cost consists of the initial and replacement costs. The initial cost is the cost related to the new construction of water supply facilities, while the replacement cost is the cost related to the replacement of such facilities when their depreciation periods are completed.

The O&M cost is the annual recurrent cost related to personnel, oil, repairing and others. The initial cost will be entirely granted by the external agency or subsidised by the government, while the O&M cost and the replacement cost will be basically shouldered by the users.

(a) Initial Cost

The estimated initial cost by facility are:

- L-1-1 system : US$ 37,012,
- L-1-4 system : US$ 196,194,
- L-2 system : US$ 212,163.

The costs required for the procurement of equipment and the education & training are worked out from the total project cost, and the ratio of the service population for L-1-1, L-1-4 or L-2 system to the total service population. Thus, the initial cost required for whole project is estimated at US$ 162,721 thousand.

(b) Replacement Cost

The lifetimes per facility is to be 7 years for the handpump, 10 years for the engine and pump for L-1-4 and L-2 system, and 20 to 30 years for trunk facilities. During the project life of 20 years from 1999 to 2018, the following replacement cost will be required:

- L-1-1 : US$ 2,441 (by 7th year after installation, that are, in 2006 and 2013),
- L-1-4 : US$ 15,600 (by 10th year after installation, that is in 2009),
- L-2 : US$ 20,829 (by 10th year after installation, that is, in 2009)

(c) O&M Cost

The O&M costs by facility are estimated as:

- L-1-1 : US$ 1,172,
- L-1-4 : US$ 2,812,
- L-2 : US$ 15,664.

The above figures are as of 1997, and the personnel cost included is assumed to go up in future in parallel with the economic growth at and averaged annual rate of 2%.

(2) **Economic Cost**

The economic cost is driven from the said financial cost. To convert a financial cost to an economic cost the standard conversion factor (SCF) in the country is to be applied to local components (LC) of the former. SCF worked out to 0.9287.

(a) Economic Cost by System Type

Applying SCF to LC, the economic cost by facility is estimated as:

- L-1-1 : US$ 754,
- L-1-4 : US$ 1,163,
- L-2 : US$ 12,613.

(b) Economic and Financial Costs for Whole Project

In accordance with the implementation schedule, the project costs in economic and financial terms were distributed over 20 years from 1999 to 2018. Total financial and economic costs of the project in the said period are estimated at US$ 175 million and US$ 170 million respectively.

9.5.2 Economic and Financial Evaluation

(1) Projection of Financial Statements

It is quite important to prepare projected financial statements to assure whether or not the user's organisation manages the water supply facilities in financially stable and successful manner. In preparing those statements it was assumed that no governmental tax would be imposed on the surpluses to be generated in the water operations.

Based on all the above described assumptions regarding revenues and cost, the financial statements were projected by district and by facility type for the project life of 20 years. The following table highlights what those statements convey:

(Unit: %)

Facility	Revenues/ Expenditures	Net Profits/ Revenues	Working Capital/ Revenues	Net Profits/ Total Assets
L-1-1	118.3	18.6	24.0	6.2
L-1-4	125.1	22.9	40.5	3.8
L-2	120.1	19.6	23.9	7.9

As an alternative, supposing the governmental corporate tax is imposed on the surpluses with the maximum tax rate of 30%, then the representative financial indicators will take the following values. It shows that the water operations are expected to be financially smoothly performed in any case with tax or without tax.

(Unit: %)

Facility	Revenues/ Expenditures	Net Profits/ Revenues	Working Capital/ Revenues	Net Profits/ Total Assets
L-1-1	118.3	13.0	18.4	5.1
L-1-4	125.1	19.9	33.8	2.9
L-2	120.1	13.7	18.1	6.6

The above table shows that the user's organisation may manage financially successful any of L-1 or L-2 systems.

(2) Financial Analysis

Using cost benefit (revenue) streams in the project life of 20 years, a financial analysis was performed on conditions that the discount rate is 10%. The resultant financial criteria are shown below:

Facility	NPV (US$)	B/C	FIRR (%)
L-1-1	1,005	1.08	16.2
L-1-4	- 1,964	0.94	8.1
L-2	20,626	1.14	21.9

From the above results the project in terms of the construction of L-1-1, L-1-4 and L-2 systems is judged to be financially highly feasible in all the four districts. Although the FIRR value for L-1-4 system is below 10%, the financial feasibility of system is amply attested by the high value of projected representative indicators of the system.

(3) Economic Analysis

Based on the foregoing assumptions concerning benefits and economic cost, the cost benefit streams were prepared for L-1-1, L-1-4 and L-2 systems in the project life of 20 years. Also, the cost benefit streams were prepared for the whole project in the project life of 37 years. Using those streams, an economic analysis was performed on the conditions that the opportunity cost of capital is 10%. The resultant economic criteria of whole project are shown below:

- NPV (US$ thousand) : 27,595
- B/C : 1.38
- EIRR (%) : 15.0

The sensitivity in EIRR of whole project was analysed as below:

- Case 1 (Benefits: -20%) : 11.5
- Case 2 (Cost: +20%) : 12.1
- Base Case : 15.0

From the above results the project in term of whole project is judged to be economically feasible.

9.6 Synthetic Evaluation

Water is not only one of basic human needs but humanitarian issue in terms of the minimum wages, security from physical danger, protection from diseases and primary health care. Without it, one can hardly survive as a human being. In this mean the water supply has an aspect of a social undertaking.

However, the current world-wide consensus revolves around the financial self-help at the grass-root level. This is the irreversible great tide of today, which provides the surest and permanent solution to such project as rural water supply. It was made amply clear as a result of institutional and financial analysis that the rural population in the Study area can by themselves manage water facilities to be constructed under the project in a financially stable and successful manner. At the same time, it was revealed that this project is economically feasible in saving time for water collection as well as reducing medical cost. Together with the above described quantitative evaluation, a more mention must be made of the qualitative benefits of this project. In short, it will work as a saviour for those who suffer and for women.

The rural population in the Study area now mostly use unsafe water from sources like rivers, springs, ponds and water holes or shallow dug wells for domestic purposes. Virtually all the water from such sources has been found to be biologically contaminated. This state of affairs gives rise to a high incidence of water-related diseases. The project is expected to contribute to reducing sufferings from such illnesses. Usually patients are tended by the female sex. Accompanying the reduction of the diseases concerned, therefore, the project will also lessen women's and children's burden in patient caring.

It was found as a result of the sample household survey that a household on an average spends 10 hours in total per day for water collection. Such a practice is not only a great economic loss to the household itself as well as to the nation, but also forces heavy physical exertions and mental stresses to women and children. This is a typical case of female discrimination. The project is expected to contribute to the alleviation of such gender sufferings.

The Study formulates the charco dam scheme for livestock watering in view from the economic importance of livestock raising in the Study area. The cost required for the scheme to construct 463 charco dams, however, reaches to some US$ 21 million or some 11% of the total project cost of US$ 181 million.

In consideration of the more importance and effectiveness of the water supply for human being, an option could be selected that the available resource for investment is weighted to cover

domestic water supply scheme; and a self-reliance measure of users may be taken to realise the charco dam scheme since the required technology is met to the rural level.

CHAPTER TEN: CONCLUSION AND RECOMMENDATION

CHAPTER TEN: CONCLUSION AND RECOMMENDATION

10.1 Conclusion

The Study identified that the water supply coverage over the Study area as of 1997 was only 40% (7.3% in Hanang, 54.9% in Singida Rural, 46.0% in Manyoni and 10.9 % in Igunga). Out of total population of 696,000 in 284 target villages, the daily lives of 420,000 population depend on the water collected from water-holes, lakes and other distant, unsafe and unstable sources. Such population is obliged to endure heavy workload to collect water (10 hours/day/household) and medical expenses for water-related diseases (Tsh 23,000 or US$ 37).

Through a series of survey and study on hydrogeology and groundwater, the Study revealed that a sufficient groundwater resource is available in terms of quantity and quality in general to meet the requirement of the proposed project.

As the outcome of the Study, it is necessary to construct some 3,500 water source facilities to exploit the groundwater in order to provide safe water for a estimated population of 1,148,000 by the target year of 2016. In addition, some 460 charco dams shall be constructed for the use of livestock keeping which is an important income source for the people in the Study area.

In consideration of the available resources envisaged in the project implementation planning, the proposed project will be implemented under the stage-wise programme with the three target years of 2001, 2006 and 2016.

By the year 2001, in addition to the rehabilitation of 36 existing water facilities, 280 of new water facilities will be constructed to cover some 60 % of 789,000 populations, and furthermore 64 of charco dams for livestock purposes. By the year 2006, construction of 704 water facilities and rehabilitation of 375 water facilities will be carried out for water supplies to cover some 80 % of 895,000 populations. 127 of charco dams will be constructed. By the year 2016, the target year of the project, 2,531 of new water facilities will be constructed together with the rehabilitation of 970 of existing facilities so as to meet the water demand of a population of 1,148,000.

The policy of the Government of Tanzania is that the rural water supply system is to be operated, maintained and managed by the user's organisation, the village water committee (VWC). Most of target villages in the Study area established their VWCs and reserve the village water fund (VWF). Some of VWCs which are operating their water facilities are active and well-

functioned; however, the remaing VWCs are dispirited because their water facilities remain malfunctioning.

Women are the major bearers as well as beneficiaries in the water and environmental sanitation (WES) sector. They play important roles in the management, supplemental finance and child-cares in their household. Simultaneously they have to participate themselves more into the decision-making process in their villages as well as VWCs as the major bearers and beneficiaries.

The Study estimated the O&M costs by type of water facilities, and concluded that annual water fee per household comes to Tsh 11,000 or US$ 18 for a handpump equipped borehole and Tsh 14,000 or US$ 22 for L-2 (piped domestic-point) system. The water fee shares some 6% of the median value of annual household income (Tsh 245,000 or US$ 392).

The governmental intervention is indispensable to lead any community based management system (CBMS) to sustainable and success. The existing system in Tanzania of the WES sector has distributed responsibilities at each level ranging from village, district, region to national. WES officers at district level play an important role in daily support service to village level. Their daily activities, however, are very limited due to financial and other constraints to conduct their proper duties. The Study concluded that a sustainable CBMS could be realised if certain interventions in the education, training and support services are properly extended to VWCs.

The total project cost is estimated at US$ 182 million as given below:

Year-2001 project	: US$ 18.3 million
Year-2006 project	: US$ 40.3 million
Year-2016 project	: US$ 123.1 million
Total	:US$ 181.7 million

A distinguished socio-economic effects of the proposed project are evaluated in terms of the stabilisation of daily life of water users in the security of stable and safe water source, revitalisation of economic activities, child-cares, generation of opportunity in income generation and education, decrease of water-related diseases and so forth. Even in the economic and financial evaluation of project within an extent of tangible benefits, the internal rates of return are significant (FIRR: 16% and EIRR: 15%).

10.2 Recommendation

(1) Urgent Commencement of the Project

The current water supply coverage of the Study area ranks the lowest in Tanzania. Therefore, in order to improve the situation of water supplies for the rural people, the rural water supply schemes should be urgently implemented. In this context, it is recommended to commence the proposed project which will generate significant project benefits as closely as possible to the proposed implementation schedule.

(2) Phasing of the Project

The project has been proposed to be implemented in three stages with the different target years of 2001, 2006 and 2016. In case that further phasing regarding the implementation of the project is necessitated, it is recommended to strictly follow "some for all" principle; not giving priority to any district(s) or villages but covering all the target villages at any implementation stage.

(3) Self-reliance Measure to Charco Dam Scheme

In consideration of the more importance and effectiveness of water supplies for human being, an option may be available that the resources for investment is more weighted in favour of domestic water schemes; and the self-reliance measure be taken to promote the implementation of charco dam schemes as one of the rural development projects.

(4) Revision of Water Supply Plan

It is recommended to revise in 2006 the water supply plan with the target year of 2016 proposed under this overall water supply plan, basing on the outcomes of the implementation of the previous project and the socio-economic situation of the Study area..

(5) Strengthening of District Water Engineer's Office

In order to assure sustainable management of the community based system of rural water supply schemes, the district water engineer's office shall play a leading role in the implementation of the project and O&M after the completion of the construction work. It is recommended that the Government shall make more efforts to earmark the appropriate recurrent budget and provide the training programme regarding the capability building of the district water engineer's offices.

(6) "Drink Boiled Water" Campaign

The groundwater collected from boreholes is the most favourable safe water. The water facilities other than boreholes, however, also remain important water sources in the rural area. It is recommended to extend a more extensive campaign in "Drink Boiled Water" and "Wash Your Hand by Soap" to all rural population.

(7) Introduction of TDEM in Borehole Siting

The Study identified the effectiveness of resistivity and simplified electro-magnetic soundings. In view of the depth and situation of productive aquifers, the time-domain electro-magnetic (TDEM) sounding is recommended to be introduced for the borehole siting during the project implementation stage.

APPENDICES

Appendix-1(1) : List of Study Team, Counterpart Personnel and Project Working Committee

JICA Study Team

1. Mr. YOSHIKAWA Mitsuru	Team Leader / Groundwater Development
2. Mr. OHTA Kunio	O&M / User's Organisation
3. Mr. KAWASAKI Satoshi	Hydrogeology / Environment
4. Mr. OKAMOTO Sumitada	Rural Water Supply
5. Ms. Mercy J. MANDAWA	Social Analysis / WID
6. Dr. James BUGENGO	Hygiene Education
7. Mr. IBARAKI Hisayuki	Geophysics
8. Mr. OHCHI Minoru	Drilling Superintendent
9. Mr. ISHIBASHI Naomichi	Economy / Finance
10. Mr. OHTA Kazuhisa	Team Coordination

Counterpart Personnel

1. Mr. M. A. MACHA	Senior Design Engineer, Ministry of Water, Dar es Salaam
2. Mr. L. R. E. KONGOLA	Head of Hydrology Section, Ministry of Water, Dodoma
3. Mr. A. J. MCHARO	Planning Engineer, Arusha Region
4. Mr. A. F. SANGIJA	Regional Hydrogiologist, Tabora Region
5. Mr. P. H. KILLEWO	Regional Planning Engineer, Singida Region
6. Mr. A. KASONTA	Senior Geologist (Geophysist), Miistry of water, Dodoma
7. Mr. N. M. SHATTA	Chief Drilling Inspector, Ministry of Water, Dodoma

Project Working Committee

1. Mr. Gabriel LWAKABARE	Ag. Director of Rural Water Supply, Ministry of Water, Dar es Salaam
2. Dr. MOHAMED A. H.	Head of Drilling and Dam Construction Section, Ministry of Water, Dar es Salaam
3. Mr. Ryubba MAGESA	Rural Water Supply Section, Ministry of Water, Dar es Salaam
4. Mr. M, R. RUGAIMUKAMU	Assistant Drilling Superintendent, Ministry of Water, Ubungo
5. Mr. M. B. LOISENGER	Representing Regional Water Engineer, Arusha Region
6. Mr. George C. MFUKO	District Water Engineer, Hanang District
7. Mr. D. K. KAMARA	Regional Water Engineer, Singida Region
8. Mr. Joel C. MWAIHOJO	District Water Engineer, Singida Rural District
9. Mr. A. Ara KUSENHA	District Water Engineer, Manyoni District
10. Mr. T. M. BUZARE	Regional Water Engineer, Tabora Region
11. Mr. Rutta MERCHADES	District Water Engineer, Igunga district
12. Mr. R. M. Kukula	Principal Health Officer, Ministry of Health, Dar es Salaam

Appendix-1(2):
List of Persons Contacted

1. The Embassy of Japan:

H.E. Mr. Shintaro SASAKI	Ambassador
Mr. Kazuhiko KITAGAWA	Second Secretary

2. JICA Tanzania Office:

Mr. Shinya NAKAI	Resident Representative
Mr. Takashi MIZUNO	Deputy Resident Representative
Mr. Masahiko URYU	Deputy Resident Representative
Mr. Tadanobu ONO	Assistant Resident Representative
Mr. Jackson M. BISWARO	Assistant Director
Ms. Deborah SUNGUSIA	Assistant Director

3. The Government of Tanzania:

Mr. Frederick Sumaye	Prime Minister

4. The Ministry of Water:

Prof. Idris A. MTULIA	Principal Secretary
Mr. B. E. NJAU	Commissioner, Water Affairs
Mr. Laurent M. SECHU	Head of Design Section
Mr. M. A. MACHA	Design Engineer
Mr. L. R. E. KONGOLA	Head of Hydrology Section, Dodoma Office
Mr. M. R. RUGAIMUKAMU	Assistant Drilling Superintendent, Ubungo Office
Mr. Gabriel LWAKABARE	Ag. Director of Rural Water Supply
Dr. A. H. MOHAMED	Head of Drilling and Dam Construction Section
Mr. A. KASONTA	Senior Geologist (Geophysist), Dodoma Office
Mr. N. M. SHATTA	Chief Drilling Inspector, Dodoma Office

5. Tabora Region:

Mr. T. M. BUZARE	Regional Water Engineer
Mr. P. A. M. CHIKIRA	Regional Administrative Secretary
Mr. Y. E. C. MASATU	Ag. Regional Planning Officer
Ms. NZURI	Ag. Regional Community Development Officer
Mr. A. F. SANGIJA	Regional Hydrogiologist

Iguuga District:

Mr. Rutta MERCHADES	District Water Engineer
Mr. M. S. MAGOLINYA	In-charge of Rural Water Supply
Mr. S. M. S. JUMANNE	Ag. Planning Officer

6.Arusha Region:

Mr. Jeremiah T. AKONAAY	Regional Water Engineer
Mr. M. B. LOISENGER	Representing Regional Water Engineer
Mr. A. J. MCHARO	Planning Engineer

Hanang District:

Mr. George C. MFUKO	District Water Engineer
Mr. N. J. NYAKI	Ag. District Water Engineer
Mr. Njovu	Ag. District Planning Officer

7.Singida Region:

Col. A. TARIMO	Regional Commissioner
Mr. Martin MGONGOLWA	Regional Administrative Secretary
Mr. S. M. CHIMA	Deputy Private Secretary to Regional Commissioner
Mr. A. S. MSHAMA	Ag. Regional Planning Officer
Mr. Richard M. C. MSENGI	Regional Water Engineer
Mr. Peter H. KILLEWO	Regional Planning Engineer
Mr. Vasenan MAKUSARO	Regional Hydrogeologist
Mr. Saidi CHUME	Regional Drilling Officer
Mr. Deocres KAMARA	Regional Hydrologist
Mr. M.S. Shimba	Regional Hydrogeologist

Singida Rural District:

Mr. Abbas H. KANDORO	District Commissioner
Mr. L. J. R. CHILEWA	Ag. District Executive Director
Mr. Joel C. MWAIHOJO	District Water Engineer
Mr. Geofrey Mrisho	District Hydrogeology Technician

Manyoni District:

Mr. A. OMBORI	District Executive Director
Mr. A. Ara KUSENHA	District Water Engineer
Mr. Yange MAKAJULA	Assistant District Water Engineer

Appendix-1(3) : Data & Information Collected

Classification of Data	Title	Year	Writer	Publishing Organization
O&M, Management	Water Policy	1993	-	Project Implementation Coordination Unit
	Implementation of National Water Policy towards Community Based Self Management of Water Supplyin Tanzania	1993	-	MWEM, MCDWAC, Ministry of Helth
	Water and Sanitation Monitoring System	1991	-	MWEM, Ministry of Helth
	Water Supply and Sanitation Project Preparation Handbook	1983	-	World Bank
	Handpumps : Toward a Sustainable Technology	1992	-	IBRD / World Bank
	UNICEF Strategies in WES	1995	-	United Nations
Statistics	Statistical Abstract :1994	1996	-	Bureau of Statistics, Planning Commission
	Statistical Abstract :1995	1997	-	Bureau of Statistics, Planning Commission
	The Rolling Plan and Forward Budget	1994	-	Planning Commission
	Tabora Resional Statistics Abstract 1993	1994	-	Bureau of Statistics, Planning Commission
WID	Woman and Children in Tanzania	1990	-	Government of United Republic of Tanzania & UNICEF
	Situation of Women in Tanzania	1988	-	Ministry of Community Development, Culture, Youth & Sports
	Analysis of African women & men	1995	-	Ministry of community Development & Bureau of Statistics
	Gender Key to sustainability & Food Security	1996	-	FAO
	Baseline study on the proposed involvement in Singida Resion	1992	-	Community Development Department, Singida

WID	Policy on Women in Development in Tanzania	1992	-	Ministry of community Development, Women affairs & Children
	Report of the Workshop on Gender Mainstreaming in the Planning process	1996	-	Ministry of community Development, Women affairs & Children
Helth Sanitation	HESAWA Promotion Strategy	1992	-	Helth Sanitation and Water Program
	Health Statistics Abstract,1996	1996	-	Planning Dep., Ministry of Health
Forms of Community	Community Participation in Water and Sanitation	1992	A. White	IRC International Water and Sanitation Centre - The Hague, Netherland-
Environment	Checklist of CITES Faund and Flora	1992	-	Kees Schouten
	Environmentally related legistlation in Tanzania	1994	L,Hickock	Division of Environment Ministry of Tourism, Natural Resources & Environment
	An overview on existng legistlation pertaining to environment	1995	C.J.Gondwe	Paper to environmental law workshop 1995 Dar Es Salaam organized by Ministry of Tourism, Natural Resources & Environment
	Intterntionational environmental convention and implementation	1995	C.M.Peter	Paper to environmental law workshop 1995 Dar Es Salaam organized by Ministry of Tourism, Natural Resources & Environment
	National environmental policy	1996	The united republic of Tanzania	Vice president's office
Geology & Hydrogeology	Summary of the geology of Tanganyika part 1 Introduction and stratigraphy	1986	A.M.Quennel, A.C.Mckinlay, W.G.Aiken	Department of land and mines, geological division
	1/50,000 Topographic Map (82sheet)		-	Survey and Mapping Division
	Aerial Photograph (about 2300 sheet) 1/30,000 - 1/50,000		-	Service and Mapping Division of Ministry of Land
	Geological Map of tanzania (Output data by Aut-Cad)		-	Mineral resources division Ministry of Commerce and Industries.
	Quarter degree sheet 28 Nzeca N.W. quater	1956	-	Geological survey department Ministry of Commerce and Industries.

Geology & Hydrogeology	Quarter degree sheet 28 Nzeca N.E. quater	1956	-	Geological survey department Ministry of Commerce and Industries.
	Quarter degree sheet 124 Kelema	1960	-	Geological survey division Ministry of Commerce and Industries.
	Quarter degree sheet 123 Kwa Mtoro	1961	-	Geological survey division Ministry of Commerce and Industries.
	Quarter degree sheet 142 Bahi	1961	-	Mineral resources division Ministry of Commerce and Industries.
	Quarter degree sheet 177 Mansoka	1962	-	Geological survey division Ministry of Commerce and Industries.
	Quarter degree sheet 143 Meia Meia	1963	-	Geological survey division Ministry of Commerce and Industries.
	Quarter degree sheet 103 Balangida Lelu	1964	-	Department of land and mines, geological division Ministry of Industries. Mimeral Resources and Power
	Quarter degree sheet 104 Kondoa	1965	-	Geological survey division Ministry of Commerce and Industries.
	Explanation of the geology of degree sheet No.29 (Singida)	1966	N.W.Eares, W.H.Reeve	Department of land and mines, Geological division
	Quarter degree sheet 85 Babati	1966	-	Department of land and mines, geological division Ministry of Industries. Mimeral Resources and
	Quarter degree sheet 84 Hanang	1966	-	Department of land and mines, geological division Ministry of Industries. Mimeral Resources and
	Quarter degree sheet 61 Manyoni (Drawing only-blue print)	1972	-	Mineral resources division Ministry of Commerce and Industries.
	Quarter degree sheet 122 Ikungi (Drawing only)	1973	-	Mineral resources division Ministry of Commerce and Industries.
	Quarter degree sheet 160 Iluma (Drawing oniy)	1973	-	Mineral resources division Ministry of Commerce and Industries.
	Provisional geological map of the lake Victoria goldfields Tanzania 1/500,000	1990	H. Barth	Federal Institute for Geosciences and Natural Resources Hnnover (for Geology divisionMinistry of Energy and Minerals Dodoma)

Geology & Hydrogeology	Tabora region water master plan	1978	-	Ministry of Water Development, Energy and Minerals
	Singida region water resources survey	1978	Australian development assistance bureau	Ministry of Water, Energy and Minerals
	Arusha region water master plan Hanang district	1993	-	Ausha Regional Water Engineer's Office
	Borehole inventotry	1996	-	Ministry of Water, Energy and Minerals Groundwater assessment and exploration sectionGroundwater data management unit
Design Criteria	Water Supply Design Manual, Chapter 1:Planning	1986	-	Ministry of Lands, Water, Housing and Urban Development
	Water Supply Design Manual, Chapter 5:Design of Piped Water Supply System	1988	-	Ministry of Water
	Technical Note on the Design and Construction of Small Earth Dams	-	C. A. F. Lucas	Ministry of Agriculture, Water Development and Irrigation Division
Rural Development	Planning and Monitoring System Phase IV, 1996-1999	1996	-	Tanganyika Christian Refugee service
Economic Condition	Economic Bulletin for the quarter Ended 30th June 1997	1997	-	Bank of Tanzania
	Agriculture 1994/95, Tanzania Mainland	1996	-	Statistics Unit, Ministry of Agriculture
	Household Budget Survey 1991/92	1996	-	Bureau of Statistics, Planning Commission
Socioeconomic Condition	Singida Region, Socio-Economic Profile and Development Perspective Planning to the year 2000	1994	-	Regional Administrative Secretary's Office
	The Regional Development Strategy, Tabora Region	1994	-	Regional Commissioner's Office, Tabora

Appendix-2 Summary of Groundwater Potential

Hydrogeological Unit			Area	Village No.	Borehole depth	Standerd Yield	Static water level	Water quality		Successful Rate of borehole	Remarks
District	Aquifer system	Unit				(m3/hr)	(m)	Ec	pH		
Hanang	Volcanics	A-1	Foot of Mt. Hanang	--	150	1-10	30			70	
	Volcanics, Gneiss	A-2	Katesh, Murero	13,14,17	100	2-10	20			75	
	Bubu Cataclasite (rift valley)	B-1	Masqaroda, Mara	21-25,28-33	80	5-20	0-15	140	8.3	80	
	Cataclasite, granite(plateau)	B-2	Gissanberg,Sirop	15,16,18,26, 27	100	1-5	15			70	
	Granite, Nyanzian(plateau)	C-1	Mingenyi	19	100	1-2	25			70	
		C-2	Mulbadaw, Ishponga	1,3,4,5,20	100	1-2	25			70	
		C-3	Gahata, Hibadaw	2,6,8-12	100	1-5	25			70	
	Granite, Nyanzian (rift valley)	C-4	Basodesh	7	100	2-10	20	350	7.5	80	
	Granite	D	Balangidalelu	--							
Singida	Granite, Nyanzian (plateau)	A-1	Ntinko, Makuro	51-65	80	2-5	20	125	8	75	
		A-2	Ugandi,Irisya, Sepuka	66-72, 37-41,49,50	100	1-2	30	200	8	70	
	Granite (fault)	A-3		--	90	3-10	10	160	7	75	
	Granite (rift valley)	B-1	Ikuhanoda, Maghojoa	88, 92-102	80	1-5	5-35	120	8	75	
		B-2	Ilongero, Kinyeto, Merya, Iknanado	73-79, 80-85, 87-91, 92-97	80	2-7	5-15	100	7	80	
		B-3	Singida Town		80	5-15	10	120	7	80	
	Granite (plateau)	B-4	Maghojoa, Kinyeto	86, 99,111	130	2-5	50	100	8	70	
	Granite, Nyanzian (rift valley)	C	Mgori,Misughaa, Siuyu	103-105, 118-122, 125	100	2-10	5-40	100	7	75	
	Granite (plateau)	D	Mgori	106-109,112	100	1-3	20			70	

Hydrogeological Unit			Area	Village No.	Borehole depth	Standerd Yield (m3/hr)	Static water level (m)	Water quality		Successful Rate of borehole	Remarks
District	Aquifer system	Unit						Ec	pH		
	Granite (rift valley & plateau)	E-1	Ikungi,Dung'unyi, Puma,Siuyu, Mungaa	1-3, 5,7,12, 14, 15, 30-33, 35, 36, 113-117, 123,124	80	3-7	5-15	80	7	70	
	Granite, Nyanzian (fault)	E-2	Mang'onyi	6, 13,16-18	80	2-10	30	250	7	75	
	Kilimatinde/Granite, Nyanzian (rift valley)	E-3	Nkuhi,Ihanja	4,11,20,21,23,24,34	100	5-10	40	80	7	80	
	Kilimatinde/Granite (plateau)	E-4	Ntuntu	126-130	100	1-5	30	100	7	70	
		F-1	Issuna, Muhintiri	8, 22,27-29	90	1-5	20			70	
	(fault)	F-2	Choda, Mkiwa	9,10	90	2-10	30	60	7	80	
	Granite (plateau)	G	Mwaru, Igombwe	42-45	90	1-2	30	160	6.5	70	
	Wenbere Basin	H	Mgungira	46-48	100	1-5	35			70	
Manyoni	Kilimatinde/Granite (rift valley)	A-1	Kilimatinda, Sasajira	37,67,68,71 72	100	3-15	35-45	125	8	80	
	Kilimatinde/Granite (Bahi basin)	A-2	Chikuyu, Majiri	36,39,70	80	1-5	25		7	70	
		A-3	Kintinku, Makanda	33-35,40-45	80	1-5	10-30	100	8	70	
	Granite (rift valley)	A-4	Sanza	59-62	80	5-10	10	300	8	80	
	Kilimatinde/Granite (rift valley)	B-1	Muhalala	4-5	110	3-10	55	100	7.5	80	
		B-2	Soleva	64,69	110	2-7	35	100	7	75	
		C-1	Manyoni	1-3,6,7	90	2-7	15-30	200	7	80	
	Kilmatinde/Granite (plateau)	C-2	Njiri, Makuru	11,12,63,65,66	100	1-3	30	80	7	70	
	Kilimatinde/Granite (fault)	C-3	Itigi,Aghondi, Saniaranda, Kitaraka	9,10,13,14,16, 18-20	100	2-10	20	150	7	75	

Hydrogeological Unit			Area	Village No.	Borehole depth	Standerd Yield	Static water level	Water quality		Successful Rate of borehole	Remarks
District	Aquifer system	Unit				(m3/hr)	(m)	Ec	pH		
	Kilimatinde/Granite (platea	C-4	Kashangu, Doroto, Ipande	15,17,22-24	100	1-3	30	200	7	70	
	Granite (fault)	D-1	Chikola, Mpola	47,49,50,52, 54	100	1-5	25			75	
	Granite (plateau)	D-2	Nkonko, Issoke	46,48,51,53, 55-58	100	1-3	30	180	7	70	
		D-3	Mgandu	25-29	100	1-3	10	70	6	70	
	Granite, Gneiss	E	Rungwa, Kitanula	30-32	100	2-5	10-30	100	8	70	
Igunga	Granite (plateau)	A-1	Ziba, Nkinga, Nyandekuwa	11-22,38-40, 49,50	90	1-8	20	150	7.5	70	
		A-2		--	80	1-2	30				
		A-3	Itunduru, Moyufuko	7,24,32,34,35	100	1-3	30			70	
	Granite (riift valley)	A-4	Ipande	22	100	1-3	30			75	
	Nyanzian (plateau & fault)	B-1	Matinje, Ngulu, Chomachankola, Ntobo	1,5,6,8,10,28,31,33,36,41,43	100	1-4	30	70	7.5	70	
	Nyanzian (plateau)	B-2	Mwashinku, Kinungu	2-4, 9, 26-27	100	1-3	30			70	
	Nyanzian (terrace)	B-3	Igunga, Bukoko	30,37, 44-46	120	1-2	30	130	7	70	
	Manonga Lake Beds, Nyanzian (fault)	C-1	Igurubi	23,25,29	150	24	24	283	8.2	80	
	Manonga Lake Beds, Granite(fault)	C-2	Itumba	47,48	120	3-10	20			70	
	Manonga Lake Beds, Nyanzian	C-3		--	100	1-3	20				

Appendix-3(1) : Allocation of Water Supply Facilities by Village (Hanang District)

Village No.	Village Name	Population				Existing Facilities								Exist. Total Pop.	Yr. 2001						Yr. 2006						Yr. 2016						Village No.	Remarks
						Types									Rehabilitation				Req. Service Pop.	Req. BH No.	Exist. Total Pop.	New Const.		Req. Service Pop.	Req. BH No.	Exist. Total Pop.	New Const.		Req. Service Pop.	Req. BH No.			
						Borehole		Well		Water Hole		Dam/Lake			Borehole		Dugwell					Borehole					Borehole						
		1997	2001	2006	2016	Yld	Pop.	Yld	Pop.	Yld	Pop.	Yld	Pop.		Yld	Pop.	Yld	Pop.				Yld.	Pop.				Yld.	Pop.					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	
1	Mulbadaw	3,696	4,360	5,133	7,061						2,640			2,640					1,720	4	924			3,157	7				7,061	24	1		
2	Dang'ata	580	684	806	1,108						414			414				860	(590)	-1	145			(150)	0				248	0	2		
3	Dayamet	774	913	1,075	1,479						553			553					360	1	198			661	2				1,479	5	3		
4	Laghanga	1,818	2,145	2,525	3,473						1,299			1,299					846	2	455			1,553	4				3,473	12	4		
5	Gawidu	1,801	2,125	2,503	3,441						1,286			1,286					838	2	450			1,538	4				3,441	12	5		
6	Gurawia	4,438	5,235	6,164	8,479						1,110			1,110	6,00	4,320			(195)	0	1,110			551	1				4,159	14	6	L-2 System (2001)	
7	Basodesh	1,992	2,350	2,767	3,806						1,423			1,423				860	67	0	498			1,057	2				2,946	10	7		
8	Hirbadaw	3,007	3,547	4,177	5,745				580		1,734			2,314					1,234	3	1,187			2,242	5	580			5,165	18	8		
9	Mwange	3,229	3,809	4,485	6,169						2,306			2,306					1,503	3	807			2,758	6				6,169	21	9		
10	Wandela	420	495	583	802						300			300					195	0	105			359	1				802	3	10		
11	Gatamuwas	1,471	1,735	2,043	2,810						1,051			1,051					685	2	368			1,257	3				2,810	10	11		
12	Gidika	1,348	1,590	1,872	2,575						963			963					627	1	337			1,151	3				2,575	9	12		
13	Dumbeta	1,370	1,616	1,903	2,617						979			979					638	1	343			1,170	3				2,617	9	13		
14	Dirma	2,190	2,583	3,042	4,184						1,564			1,564					1,019	2	548			1,871	4				4,184	14	14		
15	Gisambalang	1,626	1,918	2,258	3,107						1,161			1,161					757	2	407			1,389	3				3,107	11	15		
16	Warangu	1,021	1,204	1,418	1,951						729			729					475	1	255			872	2				1,951	7	16		
17	Murere	1,388	1,637	1,928	2,652						991			991					646	2	347			1,186	3				2,652	9	17		
18	Dideda	1,385	1,634	1,924	2,646						989			989					645	1	346			1,183	3				2,646	9	18		
19	Mogonyo	2,424	2,860	3,367	4,631						1,731			1,731					1,128	3	606			2,071	5				4,631	16	19		
20	Ishpanga	1,494	1,762	2,075	2,854						1,067			1,067					695	2	374			1,276	3				2,854	10	20		
21	Mara	1,976	2,331	2,745	3,775						1,411			1,411				860	60	0	494			1,043	2				2,915	10	21		
22	Gidahahameg	2,290	2,701	3,181	4,375			2.50	2,000		207			2,207				430	64	0	2,073			509	1	2,000			1,945	7	22		
23	Endasahoghechem	2,290	2,701	3,181	4,375						1,636			1,636					1,066	2	573			1,956	5				4,375	15	23		
24	Hatet	2,000	2,359	2,778	3,821						1,429			1,429				860	71	0	500			1,063	2				2,961	10	24		
25	Basotughang	1,480	1,746	2,056	2,828						1,057			1,057					689	2	370			1,264	3				2,828	10	25		
26	Sirop	1,870	2,206	2,597	3,573	1.20	720				821			1,541					665	2	1,008			1,192	3	720			2,953	10	26		
27	Matetgunnu	2,280	2,690	3,167	4,356			1.60	1,280		714			1,994					695	2	1,530			1,228	3	1,280			3,076	11	27		
28	Simbay	621	733	863	1,186						444			444					289	1	155			530	1				1,186	4	28		
29	Gidagharabuk	618	729	858	1,181						441			441					288	1	155			528	1				1,181	4	29		
30	Masakta	3,584	4,228	4,978	6,847						2,560			2,560				860	808	2	896			2,416	6		12.5	6,000	(13)	0	30	L-2 System (2016)	
31	Lambo	2,390	2,819	3,320	4,566						1,707			1,707		430			682	2	598			1,719	4				4,136	14	31		
32	Masqaroda	2,504	2,954	3,478	4,784						1,789			1,789				860	305	1	626			1,498	3				3,924	14	32		
33	Getasum	1,126	1,328	1,564	2,151						804			804					524	1	262			962	2				2,151	7	33		
	Total	62,501	73,731	86,810	119,412		720		3,860		39,312			43,892		4,750		5,590	19,498	45	19,060		0	43,057	100	4,580		6,000	98,492	339			

Appendix-3(2) : Allocation of Water Supply Facilities by Village (Singida Rural District)

Village No.	Village	Population				Existing Facilities								Yr. 2001						Yr. 2006						Yr. 2016						Village No.	Remarks
						Types							Exist. Total	Rehabilitation				Req. Service	Req. BH	Exist. Total	New Const.		Req. Service	Req. BH	Exist. Total	New Const.		Req. Service	Req. BH				
						Borehole		Well		Water Hole		Dam/Lake		Borehole		Dugwell					Borehole					Borehole						
		1997	2001	2006	2016	Yld	Pop.	Yld	Pop.	Yld	Pop.	Yld	Pop.	Yld	Pop.	Yld	Pop.	Pop.	No.	Pop.	Yld.	Pop.	Pop.	No.	Pop.	Yld	Pop.	Pop.	No.				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	
1	Kungu	2,666	3,063	3,539	4,627				1,160		1,061		2,221					842	2	1,532			1,505	4	1,160			3,527	12	1		
2	Ighuka	3,256	3,769	4,355	5,708				3,480				3,480		430			(141)	0	3,424			375	1	3,480			1,856	6	2		
3	Ulyampiti	2,103	2,434	2,813	3,725				2,320				2,320					114	0	2,266			410	1	2,320			1,405	5	3		
4	Msongo	2,897	3,354	3,874	5,132				2,320		412		2,732					621	1	2,466			1,058	2	2,320			2,812	10	4		
5	Mwangano	2,444	1,672	1,931	2,558				2,610				2,610					(938)	-2	2,319			(290)	-1	2,610			(52)	0	5		
6	Matare	3,196	3,702	4,277	5,665				580		1,970		2,550					1,252	3	1,235			2,282	5	580			5,095	18	6		
7	Mahamba	1,360	1,574	1,819	2,409				2,030				2,030					(456)	-1	1,963			(33)	0	2,030			379	1	7		
8	Isuria	3,303	3,824	4,417	5,851						2,359		2,359					1,464	3	826			2,694	6				5,051	20	8		
9	Chala	1,325	1,534	1,772	2,347						946		946					547	1	331			1,081	3				2,047	8	9		
10	Mkiwa	1,827	2,115	2,443	3,236	0.33	198		870		542		1,610					505	1	1,258			869	2	1,068			2,168	7	10		
11	Ntuntu	2,199	2,546	2,941	3,895						1,571		1,571					975	2	550			1,793	4				3,895	13	11		
12	Sepuka	5,502	6,354	6,664	6,203				6,960				6,960					(2,906)	-7	6,066			(1,059)	-2	6,960			(757)	-3	12		
13	Ujaire	1,631	1,888	2,181	2,889				3,480				3,480					(1,592)	-4	3,018			(627)	-1	3,480			(591)	-2	13		
14	Kipumbuta	2,698	3,556	2,955	3,911				4,350				4,350					(1,794)	-4	3,815			(646)	-2	4,350			(439)	-2	14		
15	Mkunya	1,662	1,924	2,223	2,944				4,060				4,060					(2,136)	-5	3,461			(928)	-2	4,060			(1,116)	-4	15		
16	Mang'oswi	2,102	2,433	2,811	3,722						1,501		1,501	7.00	5,040			4,108	-10	526			(2,066)	-5				(1,217)	-5	16	L-2 System (2001)	
17	Tupendane	1,570	1,817	2,100	2,781						1,121		1,121					686	2	393			1,260	3				2,781	10	17		
18	Mwasi	4,039	4,676	5,405	7,155				290		2,678		2,968	8.00	4,320			2,612	-6	1,227			(109)	0	290			2,545	9	18	L-2 System (2001)	
19	Sambaru	1,273	1,474	1,703	2,255	3.00	1,800						1,800					(326)	-1	1,668			26	0	1,800			455	2	19		
20	Ihanja	3,814	4,415	5,101	6,756						2,724		2,724					1,691	4	954	7.50	5,400	(939)	-2				1,356	5	20	L-2 System (2006)	
21	Isseke	1,797	2,080	2,403	3,183				4,060				4,060				430	(2,410)	-6	3,496			(1,141)	-3	4,060			(1,307)	-5	21		
22	Nkonee	3,006	3,480	4,020	5,325				4,350				4,350					(670)	-2	4,014			5	0	4,350			975	3	22		
23	Unyangwe	2,234	2,586	2,988	3,957				2,320				2,320					266	1	2,299			517	1	2,320			1,637	6	23		
24	Gwagu	2,906	3,468	4,007	5,307				3,480				3,480					(12)	0	3,359			466	1	3,480			1,827	6	24		
25	Mtitaghe	2,225	2,576	2,976	3,941				2,320				2,320					256	1	2,299			510	1	2,320			1,621	6	25		
26	Msake	3,810	3,253	3,758	4,979				290		1,800		2,090					1,163	3	920			2,129	5	290			4,688	16	26		
27	Muhunin	2,929	3,391	3,917	5,188						2,092		2,092					1,298	3	732			2,369	6				5,188	18	27		
28	Mnyenge	1,838	2,128	2,458	3,256						1,313		1,313					815	2	460			1,499	3				3,256	11	28		
29	Mpetu	1,320	1,528	1,765	2,338				290		736		1,026					502	1	548			913	2	290			2,068	7	29		
30	Matyuku	1,691	1,957	2,262	2,995	2.16	1,296		290		78		1,664					596	1	1,612			487	1	1,596			1,409	5	30		
31	Utaho	2,932	3,394	3,788	5,016				2,030		573		2,603					675	2	2,231			1,166	3	2,030			2,996	10	31		
32	Isalenda	838	970	1,121	1,484				580		184		764					206	0	665			357	1	580			904	3	32		
33	Kituntu	2,453	2,840	3,281	4,345				2,320		95		2,415					425	1	2,353			696	2	2,320			2,055	7	33		
34	Msamina	1,827	2,115	2,443	3,236				2,030				2,030					85	0	1,979			348	1	2,030			1,206	4	34		
35	Mkuminkano	2,044	2,424	2,801	3,709				3,770				3,770					(1,046)	-3	3,351			(413)	-1	3,770			(61)	0	35		
36	Wibe	2,258	2,591	2,993	3,964				2,320				2,320					271	1	2,300			520	1	2,320			1,644	6	36		
37	Msmii	5,680	6,459	7,463	9,884				1,740		2,743		4,483					1,976	5	2,700			3,572	8	1,740			8,144	28	37		
38	Msangwa	3,379	3,911	4,519	5,985				2,900		342		3,242					669	2	3,020			1,125	3	2,900			3,095	11	38		
39	Kinandas	3,704	4,392	5,074	6,721				2,900		639		3,539					853	2	3,124			1,465	3	2,900			3,621	13	39		
40	Mnang'ana	2,972	3,440	3,975	5,264				3,480				3,480					(460)	0	3,353			466	1	3,480			1,784	6	40		
41	Mtunduru	4,481	5,187	5,993	7,937				4,930				4,930					257	1	4,818			881	2	4,930			3,007	10	41		
42	Mwaru	2,368	2,741	3,167	4,195	2.00	1,200				834		2,034					707	2	1,402			1,256	3	1,200			2,595	10	42		
43	Mtandala	2,516	2,912	3,365	4,457						1,797		1,797					1,115	3	629			2,052	5				4,457	15	43		
44	Igombwe	2,049	2,372	2,740	3,630						1,466		1,466					908	2	512			1,671	4				3,630	13	44		
45	Msosa	1,421	1,645	1,900	2,517						1,015		1,015					630	1	355			1,159	3				2,517	9	45		
46	Mgungira	2,180	2,527	2,920	3,867						1,559		1,559					966	2	546			1,780	4				3,867	13	46		
47	Ufana	1,390	1,609	1,859	2,462						993		993					616	1	348			1,134	3				2,462	8	47		
48	Iyumbu	2,724	3,153	3,643	4,825						1,946		1,946					1,206	3	681			2,222	5				4,825	17	48		
49	Inyia	2,608	3,019	3,488	4,620	3.00	1,800				577		2,377		1,220			1,078	3	2,002			176	0	1,800			1,100	4	49		
50	Mwasutunga	1,357	1,571	1,815	2,404				1,450				1,450					121	0	1,427			291	1	1,450			954	3	50		
51	Mtinko	3,910	4,526	5,229	6,926				3,480		307		3,787					739	2	3,588			1,231	3	3,480			3,446	12	51		
52	Malolo	3,044	3,524	4,076	5,399				290		1,970		2,260					1,268	3	980			2,323	5	290			5,109	18	52		
53	Mughanga	2,318	2,683	3,100	4,106						1,656		1,656					1,028	2	560			1,890	4				4,106	14	53		
54	Mpambwa	2,756	3,190	3,686	4,882				2,610		104		2,714					476	1	2,947			780	2	2,610			2,272	8	54		
55	Kyesa	1,716	1,986	2,295	3,040				580		811		1,391				430	165	0	866			751	2	580			2,030	7	55		
56	Ndau	1,502	1,806	2,064	2,529						1,423		1,423					885	2	408			1,625	4				3,529	12	56		

Village No.	Village	Population				Existing Facilities								Exist. Total Pop.	Yr 2001						Yr 2006						Yr 2016						Village No.	Remarks
						Types									Rehabilitation				Req. Service	Req. BH	Exist. Total	New Const.		Req. Service	Req. BH	Exist. Total	New Const.		Req. Service	Req. BH			
						Borehole		Well		Water Hole		Dam/Lake			Borehole		Dugwell					Borehole					Borehole					
		1997	2001	2006	2016	Yld	Pop.	Yld	Pop.	Yld	Pop.	Yld	Pop.		Yld	Pop.	Yld	Pop.	Pop.	No.	Pop.	Yld.	Pop.	Pop.	No.	Pop.	Yld.	Pop.	Pop.	No.		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	
57	Muvenye	4,034	4,670	5,395	7,146				3,440		396			3,676					794	2	3,619			1,332	3	3,480			3,666	13	57		
58	Ikuvu	3,803	4,402	5,086	6,736						2,716			2,716					1,686	4	951			3,102	7				6,736	25	58		
59	Makuvi	2,568	2,973	3,434	4,549						1,434			1,434					1,138	3	642			2,094	5				4,549	16	59		
60	Ghalunyangu	2,454	2,841	3,282	4,347						1,753			1,753					1,088	3	614			2,001	5				4,347	15	60		
61	Mpuyu	4,063	4,680	5,407	7,162				1,740		1,645			3,385				430	865	2	2,316			1,996	5	1,740			4,992	17	61		
62	Mpuku	3,216	3,723	4,301	5,697				3,440					3,440					243	1	3,414			665	2	3,480			5,217	8	62		
63	Matumbo	3,060	3,577	4,133	5,474				870		1,566			2,436					1,121	3	1,425			2,031	5	870			4,604	16	63		
64	Mkenge	2,389	2,765	3,195	4,232				580		1,292			1,872					893	2	1,032			1,622	4	580			3,652	13	64		
65	Mugugu	2,437	2,821	3,259	4,317				1,740		498			2,238					563	1	1,914			1,069	2	1,740			2,577	9	65		
66	Ughandi 'B'	2,501	2,895	3,345	4,430	2.16	1,296				861			2,157					738	2	1,597			1,311	3	1,296			3,134	11	66		
67	Ngase	1,009	2,168	2,540	3,364						1,356			1,356					862	2	475			1,549	4				2,301	8	67		
68	Lughenda	2,849	3,298	3,810	5,047	2.16	1,296		1,450		74			2,820					478	1	2,772			779	2	2,766			4,896	17	69		
69	Mwenko	3,658	4,234	4,892	6,480	1.44	864		290		1,789			2,943		430			862	2	1,780			2,012	5	1,154			4,896	17	69		
70	Ntondo	1,473	1,705	1,970	2,609	2.16	1,296		290					1,586					119	0	1,558			309	1	1,586			1,023	4	70		
71	Mwai	3,513	4,067	4,698	6,225	2.88	1,728		580		861			3,169					898	2	2,609			1,567	4	2,306			3,915	13	71		
72	Senene Mtuvu	1,071	1,240	1,432	1,897				290		558			848		860			(468)	-1	695			65	0	290			747	3	72		
73	Mademujhe	3,679	4,259	4,920	6,517				1,450		1,592			3,042	7.00	5,040			(3,823)	-9	2,007			(1,595)	-4	1,450			27	0	73	L-2 System (2001)	
74	Mtamu	4,302	5,072	5,861	7,762				1,160		2,301			3,461					1,611	4	1,466			2,921	7	1,160			6,602	22	74		
75	Mwahengo	1,851	2,143	2,476	3,279						1,322			1,322					823	2	463			1,516	4				3,279	11	75		
76	Ilongero																															76	Blank	
77	Mwakili	2,307	2,671	3,085	4,087				290		962		670	1,922					748	2	1,297			1,341	3	960			3,127	11	77		
78	Ilanka	2,265	2,620	3,027	4,009				3,480					3,480					(660)	-2	3,176			(112)	0	3,480			529	2	78		
79	Selonguure	2,290	2,639	3,049	4,039				870		1,007			1,877					762	2	1,223			1,370	3	870			3,169	11	79		
80	Kinyelo	3,991	4,620	5,336	7,069				5,510					5,510					(890)	-2	5,130			156	0	5,510			1,559	5	80		
81	Ntundua	2,367	2,740	3,166	4,193				2,900					2,900					(160)	0	2,767			289	1	2,900			1,293	4	81		
82	Mkombi	1,893	2,180	2,518	3,335				4,350					4,350					(2,170)	-5	3,755			(911)	-2	4,350			(1,015)	-3	82		
83	Mmyua	2,158	2,498	2,886	3,823				2,900					2,900					(402)	-1	2,715			129	0	2,900			923	3	83		
84	Igeun	1,799	2,078	2,401	3,180				2,320					2,320					(242)	-1	2,189			159	0	2,320			860	3	84		
85	Stonge	2,340	2,755	3,183	4,216				2,610					2,610					145	0	2,553			473	1	2,610			1,606	6	85		
86	Mghemo	4,392	5,084	5,874	7,780				3,190		859			4,049					1,036	0	3,491			1,788	0	3,190			4,590	0	86	Solar System	
87	Merya	4,290	5,113	6,139	8,131				580		1,907		1,340	3,827					1,686	5	2,598			2,663	6	1,920			6,211	21	87		
88	Mvae	4,033	4,669	5,394	7,144						2,881			2,881					1,788	4	1,008			3,289	8				7,144	25	88		
89	Makhemi	3,125	3,617	4,179	5,535						2,235			2,235					1,385	3	791			2,549	6				5,535	19	89		
90	Kinyagio	2,514	2,910	3,362	4,453				580		1,381			1,961					949	2	1,064			1,724	4	580			3,493	13	90		
91	Mwanaaye	3,060	3,542	4,092	5,420				2,320		529			2,849					698	2	2,605			1,191	3	2,320			3,100	11	91		
92	Ukanda	2,409	2,789	3,222	4,267						1,149		900	1,949		430			409	1	1,202			1,192	3	860			3,037	10	92		
93	Mughole	3,934	4,554	5,261	6,969				1,740		1,567			3,307					1,247	3	2,209			2,230	5	1,740			5,579	18	93		
94	Mumbi	3,549	4,108	4,746	6,287				2,320		878			3,198					910	2	2,627			1,589	4	2,320			3,967	14	94		
95	Mdilu	2,819	3,263	3,770	4,993						2,014			2,014					1,250	3	705			2,299	5				4,993	17	95		
96	Mwasauya	3,463	4,009	4,631	6,134						2,474			2,474					1,535	4	866			2,824	7				6,134	21	96		
97	Migamu	4,093	4,738	5,474	7,250						2,926			2,926					1,814	4	1,023			3,338	8				7,250	25	97		
98	Mipilo	3,221	4,866	5,645	7,477	0.27	162				2,899			3,061					1,825	4	1,177			3,351	8	162			7,315	25	98		
99	Mangola	3,351	3,879	4,482	5,936						2,394			2,394					1,486	0	838			2,933	0				5,936	0	99	Solar System	
100	Selunga	2,705	3,133	3,618	4,792						1,932			1,932					1,199	0	676			2,206	0				4,792	0	100	Solar System	
101	Ghele	3,638	4,211	4,865	6,444						2,599			2,599					1,615	4	910			2,967	7				6,444	22	101		
102	Msange	4,180	4,839	5,590	7,406						1,993		1,390	3,383					1,456	3	2,088			2,627	6	1,390			6,014	21	102		
103	Mgeni	1,680	1,898	2,193	2,905				1,160		343			1,503					596	1	1,290			695	2	1,160			1,345	6	103		
104	Mshola	2,379	2,754	3,182	4,214	2.16	1,296				774			2,070		860			(176)	0	1,567			566	1	1,296			2,058	7	104		
105	Sughene	2,093	3,117	3,602	4,770						1,924			1,924					1,194	3	673			2,196	5				4,770	16	105		
106	Unyampanda	1,270	1,470	1,699	2,250						907			907					563	1	318			1,036	2				2,250	8	106		
107	Muyhunga	1,195	1,383	1,598	2,117						854			854					530	1	299			975	2				2,117	7	107		
108	Nkuamughanga	1,356	1,570	1,814	2,402						969			969					601	1	339			1,106	3				2,402	8	108		
109	Ngamu	3,905	4,625	5,343	7,077						2,454			2,454					1,771	4	999	6.00	4,320	18	0				2,757	10	109	L-2 System (2006)	
110	Mwighabi	2,938	3,481	3,929	5,204				1,740		856			2,596					805	2	2,040			1,417	3	1,740			3,464	12	110		
111	Itaja	5,249	6,076	7,020	9,208						2,499		1,750	4,249	6.00	4,320			(2,493)	-9	2,625			56	0	1,750			3,224	11	111	L-2 System (2001)	
112	Pohama	3,175	3,675	4,246	5,624				1,740		1,025			2,765					910	2	2,099			1,611	4	1,740			4,455	15	112		
113	Mungea	2,552	2,931	3,386	4,485						1,809			1,809					1,122	3	633			2,066	5				1,511	5	113		
114	Minyaga	2,163	2,506	2,893	3,831				2,320					2,320					184	0	2,281			459	1	2,320			2,919	9	114		
115	Kinku	2,517	2,914	3,366	4,459				1,740		555			2,295					619	1	1,904			1,074	2	1,740					115		

Village No.	Village	Population				Existing Facilities									Yr. 2001						Yr. 2006					Yr. 2016					Village No.	Remarks
						Types									Rehabilitation																	
						Borehole		Well		Water Hole		Dam/Lake		Exist. Total	Borehole		Dugwell		Req. Service	Req. BH	Exist. Total	New Const. Borehole		Req. Service	Req. BH	Exist. Total	New Const. Borehole		Req. Service	Req. BH		
		1997	2001	2006	2016	Yld	Pop.	Yld	Pop.	Yld	Pop.	Yld	Pop.	Pop.	Yld	Pop.	Yld	Pop.	Pop.	No.	Pop.	Yld.	Pop.	Pop.	No.	Pop.	Yld.	Pop.	Pop.	No.		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)
116	Kumbwa	2,318	2,680	3,100	4,106				1,746		377		180	2,207					476	1	2,027			805	2	1,950			2,176	8	116	
117	Unyamyghumbi	2,809	3,252	3,757	4,976	0.66	396				1,724			2,120					1,132	3	999			2,068	5	396			4,580	16	117	
118	Mnyghua	1,427	1,652	1,908	2,528						1,019			1,019					633	1	357			1,164	3				2,528	9	118	
119	Mnule	1,218	1,410	1,629	2,158						870			870					540	1	305			993	2				2,158	7	119	
120	Sakat	1,410	1,632	1,886	2,498						1,007			1,007					625	1	353			1,150	3				2,498	9	120	
121	Mnane	1,960	2,153	2,488	3,295				1,160		500			1,660					493	1	1,335			664	2	1,160			2,135	7	121	
122	Nkundi	2,092	2,422	2,798	3,706				290		1,287			1,577					765	2	741			1,543	4	290			3,416	12	122	
123	Siuyu	2,530	2,929	3,384	4,482				290		1,600			1,890					1,039	2	850			1,900	4	290			4,292	14	123	
124	Unyankanya	2,466	2,855	3,298	4,368				2,900					2,900					(85)	0	2,792			380	1	2,900			1,468	5	124	
125	Mkungaakihendo	2,299	2,660	3,073	4,071						1,641			1,641					1,019	2	575			1,874	4				4,071	14	125	
126	Ntuntu	2,245	2,599	3,002	3,977	3.00	1,800				318			2,118					481	1	1,911			938	2	1,800			2,177	8	126	
127	Nnewa	3,437	3,979	4,597	6,088				3,480					3,480					499	1	3,499			946	2	3,480			2,608	9	127	
128	Mampando	2,824	3,269	3,777	5,002	2.88	1,728		1,740					3,468					(399)	0	3,307			352	1	3,468			1,534	5	128	
129	Lighwa	2,568	2,614	3,020	4,000	1.44	864		2,320					3,184					(570)	-1	2,953			51	0	3,184			816	3	129	
130	Mwisi	2,008	2,359	2,726	3,610	0.72	432		1,740					2,172					187	0	2,159			440	1	2,172			1,438	5	130	
		339,791	393,339	454,440	601,892		19,452		167,040		126,458		6,140	319,090		23,459		1,290	49,509	106	229,622		9,720	142,919	317	192,632		0	374,800	1,240		

Appendix-3(3) : Allocation of Water Supply Facilities by Village (Manyoni District)

Village No.	Village Name	Population				Existing Facilities								Exist. Total Pop.	Yr. 2001				Yr. 2006						Yr. 2016						Village No.	Remarks
						Types									Rehabilitation				Req. Service Pop.	Req. BH No.	Exist. Total Pop.	New Const.		Req. Service Pop.	Req. BH No.	Exist. Total Pop.	New Const.		Req. Service Pop.	Req. BH No.		
						Borehole		Well		Water Hole		Dam/Lake			Borehole		Dugwell					Borehole					Borehole					
		1997	2001	2006	2016	Yld	Pop.	Yld	Pop.	Yld	Pop.	Yld	Pop.		Yld	Pop.	Yld	Pop.				Yld.	Pop.				Yld.	Pop.				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)
1	Manyoni	5,209	5,995	6,886	9,014	6.00	3,600				3,149			6,749		1,604			(358)	-1	4,002		1,218	47	0	3,600		596	2,297	8	1	
2	Kipondoda	5,210	5,996	6,887	9,016	0.40	240		580		3,136			3,956					2,040	5	1,918	7.00	5,040	(53)	0	820			3,156	11	2	L-2 System (2001)
3	Mwanzi	1,333	1,534	1,762	2,307	3.00	1,800							1,800					(266)	-1	1,683			59	0	1,800			507	2	3	
4	Muhalala	2,256	2,596	2,982	3,904	7.00	4,200							4,200					(1,604)	-4	2,982				0	3,904			-	0	4	
5	Mdunundu	1,703	1,960	2,251	2,947						1,216			1,216					743	0	426			1,369	0				2,947	0	5	Solar System
6	Mnoo	893	1,028	1,180	1,545	0.50	300				424			724					304	1	448			549	1	300			1,245	4	6	
7	Mkwese	2,630	3,027	3,477	4,551				1,740		636			2,376					651	2	1,963			1,136	3	1,740			2,811	10	7	
8	(Blank)																								0						8	(Blank)
9	Agbondi	1,027	1,182	1,358	1,777	0.95	570				326			896					286	1	684			505	1	570			1,207	4	9	
10	Mahondeni	599	689	792	1,037				580		14			594					96	0	585			155	0	580			457	2	10	
11	Ngiti	751	864	993	1,300						536			536					328	1	188			604	1				1,300	4	11	
12	Kumenyanga	1,449	1,666	1,915	2,507				2,030					2,030					(362)	-1	1,885			23	0	2,030			477	2	12	
13	Idoovwandole	2,250	2,589	2,974	3,894	0.65	390				1,329			1,719					871	2	855			1,589	4	390			3,504	12	13	
14	Mbugani	2,172	2,500	2,871	3,759	0.65	390				1,273			1,663					837	2	836			1,527	4	390			3,304	12	14	
15	Kashangu	862	992	1,139	1,492						616			616					376	1	216			693	2				1,492	5	15	
16	Itigi Mjini	8,258	9,504	10,916	14,290				2,030		4,449			6,479	7.00	5,040			(2,015)	-5	3,587			1,717	4	2,030			7,220	25	16	L-2 System (2001)
17	Domo	1,410	1,623	1,864	2,440	0.80	480				664			1,144					478	1	713			864	2	480			1,960	7	17	
18	Kitaraka	1,574	1,811	2,081	2,724				580		710			1,290					521	1	829			939	2	580			2,144	7	18	
19	Sanjaranda	2,183	2,512	2,886	3,778	0.08	48		290		1,318			1,656					856	2	799			1,565	4	338			3,440	12	19	
20	Gurungu	1,471	1,693	1,945	2,546				580		636			1,216					476	1	803			856	2	580			1,966	7	20	
21	Kiopeni	2,032	2,339	2,686	3,516	1.10	660				773		290	1,723					616	1	1,221			1,099	3	950			2,566	9	21	
22	Ipande	2,488	2,863	3,289	4,305	3.00	1,800				491			2,291					572	1	1,972			988	2	1,800			2,505	9	22	
23	Muhanga	1,660	1,910	2,194	2,873	2.04	1,224		290		104			1,618					292	1	1,551			483	1	1,514			1,359	5	23	
24	Dumweku	1,350	1,554	1,785	2,336	0.65	390				686			1,076					478	1	630			866	2	390			1,946	7	24	
25	Mgandu	4,998	5,749	6,594	8,632	5.04	3,024				1,403			4,427				2,150	(836)	-2	3,515			696	2	3,024			3,458	12	25	
26	Kalangali	699	801	920	1,204						497			497					304	1	174			560	1				1,204	4	26	
27	Bagala	1,479	1,702	1,955	2,559	2.88	1,728		580					2,308					(606)	-1	2,101			(109)	0	2,308			251	0	27	
28	Kuyui	2,899	3,336	3,832	5,017	3.00	1,800		1,160					2,960				430	(54)	0	2,945			343	1	2,960			1,627	6	28	
29	Makale	2,074	2,387	2,742	3,589	1.44	864		1,740					2,604					(217)	-1	2,472			203	0	2,604			985	3	29	
30	Rungwa	1,857	2,137	2,455	3,214						1,326			1,326					811	2	464			1,493	3				3,214	11	30	
31	Mwamagembe	1,793	2,063	2,370	3,103						1,281			1,281					783	2	448			1,441	3				3,103	11	31	
32	Kintanula	410	472	542	710						293			293					179	0	103			330	1				710	2	32	
33	Mawemi	1,741	2,004	2,301	3,013						1,244			1,244					760	2	435			1,400	3				3,013	10	33	
34	Myumi	1,298	1,494	1,716	2,246				1,740					1,740					(246)	-1	1,630			65	0	1,740			506	2	34	
35	Ngaiti	2,347	2,701	3,103	4,061				4,060					4,060					(1,359)	-3	3,632			(397)	-1	4,060			1	0	35	
36	Chikuyu	2,762	3,179	3,651	4,780	1.90	1,140		2,320					3,460					(281)	-1	3,286			274	1	3,460			1,320	5	36	
37	Mbwasa	1,866	2,148	2,467	3,229	1.60	960				647			1,607					540	1	1,187			960	2	960			2,269	8	37	
38	Mwihoo	2,934	3,377	3,878	5,077				1,160		1,267			2,427					949	2	1,604			1,706	4	1,160			3,917	14	38	
39	Makutupora	1,365	1,571	1,804	2,362						975			975					596	1	341			1,097	3				2,362	8	39	
40	Makanda	1,422	1,637	1,880	2,461						1,016			1,016					621	1	356			1,143	3				2,461	8	40	
41	Mangesa	1,421	1,635	1,878	2,459						1,015			1,015					620	1	355			1,142	3				2,459	8	41	
42	Kitalalo	1,425	1,640	1,884	2,466						1,018			1,018					622	1	356			1,146	3				2,466	9	42	
43	Kintinku	1,430	1,646	1,890	2,475				2,320					2,320					(674)	-2	2,098			(155)	0	2,320			155	0	43	
44	Lusilile	3,130	3,602	4,138	5,416				2,320		579			2,899					204	2	2,525			1,211	3	2,320			3,096	11	44	
45	Udimaa	1,710	1,968	2,260	2,959				2,320					2,320					(352)	-1	2,168			70	0	2,320			639	2	45	
46	Nkonko	2,655	3,056	3,510	4,594	3.00	1,800				611			2,411					645	1	2,014			1,122	3	1,800			2,794	10	46	
47	Mpola	1,489	1,714	1,968	2,577	3.00	1,800							1,800					(86)	0	1,722			185	0	1,800			777	3	47	
48	Ntumbi	2,224	2,560	2,940	3,849						1,589			1,589					971	2	556			1,788	4				3,844	13	48	
49	Chikola	2,152	2,477	2,845	3,724						1,537			1,537					940	2	538			1,730	4				3,724	13	49	
50	Chidamsulu	1,081	1,244	1,429	1,871						772			772					472	1	270			869	2				1,871	6	50	
51	Winamila	889	1,023	1,175	1,538						635			635					388	1	222			715	2				1,538	5	51	

Village No.	Village Name	Population				Existing Facilities								Exist. Total Pop.	Yr. 2001						Yr. 2006						Yr. 2016						Village No.	Remarks
						Types									Rehabilitation				Req. Service Pop.	Req. BH No.	Exist. Total Pop.	New Const.		Req. Service Pop.	Req. BH No.	Exist. Total Pop.	New Const.		Req. Service Pop.	Req. BH No.				
						Borehole		Well		Water Hole		Dam/Lake			Borehole		Dugwell					Borehole						Borehole							
		1997	2001	2006	2016	Yld	Pop.	Yld	Pop.	Yld	Pop.	Yld	Pop.		Yld	Pop.	Yld	Pop.				Yld.	Pop.					Yld.	Pop.					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	
52	Heka	3,425	3,942	4,528	5,927	1.50	900				1,275		740	2,915					1,027	2	2,086			1,831	4	1,640			4,287	15	52		
53	Sasile	3,734	4,297	4,936	6,462						1,774		1,250	3,024					1,273	3	1,871			2,299	5	3,250			5,212	18	53		
54	Chikombo	3,751	4,317	4,958	6,491	0.50	300				2,465			2,765					1,552	4	1,163			2,847	7	300			6,191	21	54		
55	Iweke	971	1,117	1,284	1,680						465		320	785					332	1	483			601	1	320			1,360	5	55		
56	Simbanguru	1,164	1,340	1,539	2,014						831			831					508	1	291			936	2				2,014	7	56		
57	Igwamadete	2,048	2,357	2,707	3,544						1,663			1,663					894	2	512			1,646	4				3,544	12	57		
58	Mpepo	1,837	2,114	2,428	3,179						1,312			1,312					802	2	459			1,477	3				3,179	11	58		
59	Sanza	2,604	3,031	3,482	4,558	1.30	780				1,324			2,104					927	2	1,244			1,679	4	780			3,778	13	59		
60	Nkope	2,545	2,929	3,364	4,404						1,818			1,818					1,111	3	636			2,046	5				4,404	15	60		
61	Chicheho	1,327	1,527	1,754	2,296						948			948					579	1	332			1,067	2				2,296	8	61		
62	Ilassi	1,118	1,287	1,478	1,935						799			799					488	1	280			899	2				1,935	7	62		
63	Msememba	2,658	3,059	3,514	4,600	0.50	300				1,644			1,944					1,075	2	890			1,908	5	300			4,300	15	63		
64	Saranda	2,768	3,186	3,659	4,790						1,977			1,977					1,208	3	692			2,225	5				4,790	17	64		
65	Londoni	1,205	1,387	1,593	2,085	3.00	1,800							1,800					(413)	-1	1,651			(44)	0	1,800			285	0	65		
66	Hoka	467	537	617	808						219		160	379					158	0	237			285	-1	160			688	2	66		
67	Kalmalinde	1,247	1,435	1,648	2,158						891			891					544	1	312			1,002	2				2,158	7	67		
68	Nolya	1,709	1,967	2,259	2,957	3.00	1,800							1,800					167	0	1,777			361	1	1,800			1,157	4	68		
69	Sukamahela	3,169	3,647	4,189	5,486	1.90	1,140		3,190					4,330					(683)	-2	4,040			112	0	4,330			1,154	4	69		
70	Mapiri	2,514	2,663	3,059	4,004						1,103		770	1,873					790	2	1,156			1,427	3	770			3,234	11	70		
73	Kinangali	2,912	3,351	3,849	5,039						2,080			2,080					1,271	3	728			2,341	5				5,039	17	73		
71	Sasanila	1,017	1,170	1,344	1,760						726			726					444	0	254			818	0				1,760	6	71	Solar System	
72	Makasuku	1,031	1,187	1,363	1,784						736			736					450	0	258			829	0				1,784	6	72	Solar System	
		147,358	169,588	194,793	255,003		36,228		131,610		62,081		3,530	133,449		6,644		2,580	26,916	59	69,634		6,258	67,258	149	71,072		296	166,156	555			

Appendix-3(4) : Allocation of Water Supply Facilities by Village (Iguniga District)

Village No.	Village Name	Population				Existing Facilities								Yr. 2001						Yr. 2006						Yr. 2016						Village No.	Remarks
						Types								Rehabilitation				Req. Service	Req. BH	Exist. Total	New Const.		Req. Service	Req. BH	Exist. Total	New Const.		Req. Service	Req. BH				
						Borehole		Well		Water Hole		Dam/Lake		Borehole		Dugwell					Borehole					Borehole							
		1997	2001	2006	2016	Yld.	Pop.	Yld.	Pop.	Yld.	Pop.	Yld.	Pop.	Yld.	Pop.	Yld.	Pop.	Pop.	No.	Pop.	Yld.	Pop.	Pop.	No.	Pop.	Yld.	Pop.	Pop.	No.	Pop.		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)		
1	Matinje	4,536	4,699	4,869	5,225								4,536					163	0	4,536			249	1	4,536			689	2	1		
2	Buchenjegele	3,962	3,980	4,124	4,426						1,316		2,000					665	2	2,461			1,247	3	2,000			2,426	8	2		
3	Mondo	2,517	2,608	2,702	2,900						1,334		650					624	1	1,117			1,189	3	650			2,050	8	3		
4	Mwashiku	2,279	2,361	2,446	2,625						1,428		280					653	2	780			1,250	3	280			2,345	8	4		
5	Ngelu	2,025	2,096	2,171	2,330				580		1,031							435	1	961			923	2	580			1,750	6	5		
6	Imalilo	2,554	2,439	2,527	2,712						1,117		790					532	1	1,181			1,009	2	790			1,922	7	6		
7	Mwansugho	1,543	1,599	1,656	1,778						1,102							496	1	386			953	2	-			1,778	6	7		
8	Chomachankola	6,460	6,695	6,934	7,442	3.00	1,800				3,329			6.00	4,320			(2,756)	-6	2,965			(264)	-1	1,800			1,322	5	8		L-2 System (2001)
9	Chibeso	2,499	2,589	2,682	2,879						1,785							804	2	625			1,543	4	-			2,879	10	9		
10	Bulangamitwa	4,061	4,207	4,359	4,676						2,622		390					1,195	3	1,308			2,288	5	390			4,208	15	10		
11	Zitu	4,923	5,100	5,284	5,671	0.93	558		1,450		2,092							1,010	2	2,737			1,910	4	2,008			3,665	13	11		
12	Ibologero	4,643	4,810	4,983	5,349	1.80	1,080		580		2,151							1,019	2	2,406			1,933	4	1,660			3,649	13	12		
13	Bulumbela	2,274	2,356	2,441	2,620						1,153		660					543	1	1,064			1,033	2	660			1,950	7	13		
14	Ndembezi	5,293	5,484	5,681	6,097				870		3,159			6.00	4,320			(2,866)	-7	1,976			(461)	-1	870			907	3	14		L-2 System (2001)
15	Ntigu	1,496	1,550	1,606	1,723				290		861							308	1	592			761	2	290			1,433	5	15		
16	Kitangili	3,176	3,290	3,409	3,659						1,719		770					802	2	1,372			1,528	4	770			2,889	10	16		
17	Moyofuke	1,812	1,882	1,950	2,093						1,041		360					482	1	724			919	2	360			1,733	6	17		
18	Nkinga	6,321	6,549	6,784	7,282	3.00	1,800		580		2,615							1,354	3	3,365			2,564	6	2,380			4,902	17	18		
19	Utaya	2,453	2,541	2,633	2,826						1,752							789	2	613			1,515	4	-			2,826	10	19		
20	Ugaka	2,495	2,585	2,678	2,874				580		1,308							637	1	1,059			1,214	3	580			2,294	8	20		
21	Mwakabuta	1,855	1,922	1,991	2,137						1,325							597	1	464			1,145	3	-			2,137	7	21		
22	Ikunguigina	1,392	1,442	1,494	1,604						994							448	1	348			860	2	-			1,604	6	22		
23	Iguruhi	4,425	4,584	4,749	5,098						2,107		1,475					1,002	2	2,213			1,903	4	1,475			3,623	12	23		
24	Mwagala	1,933	2,003	2,075	2,227						1,266		160					576	1	605			1,104	3	160			2,067	7	24		
25	Kalangale	1,618	1,676	1,737	1,864						1,156							521	1	405			990	2	-			1,864	6	25		
26	Kinungu	2,555	2,647	2,742	2,943						1,825							822	2	909			1,578	4	-			2,943	10	26		
27	Mwandihimuji	2,827	2,929	3,034	3,257						1,348		960					641	1	1,412			1,217	3	960			2,317	8	27		
28	Mwamapuji	2,331	2,415	2,502	2,685								2,331					86	0	2,331			128	0	2,331			354	1	28		
29	Mwajilunga	1,375	1,425	1,476	1,584						982							442	1	344			889	2	-			1,584	5	29		
30	Mugongwa	2,092	2,167	2,245	2,410						1,066		600					502	1	973			954	2	600			1,810	6	30		
31	Ntobo	2,720	2,818	2,919	3,133						1,293		910					615	1	1,365			1,168	3	910			2,223	8	31		
32	Mwamloli	2,031	2,104	2,180	2,340						446		1,350					268	1	1,520			495	1	1,350			990	3	32		
33	Mwahubete	1,885	1,953	2,023	2,171						896		630					426	1	984			810	2	630			1,541	5	33		
34	Ilunduru	3,557	3,685	3,818	4,098						848		2,370					467	1	2,667			863	2	2,370			1,728	6	34		
35	Kagongwa	1,397	1,354	1,403	1,506						934							420	1	327			807	2	-			1,506	5	35		
36	Mungheraturu	4,768	4,940	5,118	5,493								4,768					172	0	4,768			262	1	4,768			725	2	36		
37	Mwayunga	3,112	3,224	3,340	3,585						1,551		960					733	2	1,483			1,393	3	960			2,645	9	37		
38	Nyandekuwa	3,199	3,290	3,398	3,647				580		1,847							853	2	1,227			1,629	4	580			3,067	11	38		
39	Ussongo	2,663	2,555	2,644	2,837	1.80	1,080				968							484	1	1,426			913	2	1,080			1,757	6	39		
40	Iiele	2,170	2,248	2,329	2,500	1.80	1,080				779							390	1	1,355			732	2	1,080			1,420	5	40		
41	Nanga	2,424	2,511	2,602	2,792						1,731							780	2	606			1,497	3	-			2,792	10	41		
42	Kaumbu	3,181	3,296	3,414	3,664						1,515		1,060					721	2	1,590			1,368	3	1,060			2,604	9	42		
43	Hulyangombe	3,327	3,447	3,571	3,833						2,376							1,020	2	832			2,034	5	-			3,853	13	43		
44	Ijogo	1,951	2,021	2,094	2,248							30.0	1,951					70	0	1,951			107	0	1,951			297	1	44		
45	Bukoko	2,445	2,533	2,624	2,817						1,746							787	2	611			1,510	4	-			2,817	10	45		
46	Imumulya	2,932	3,038	3,147	3,378						2,044							983	2	733			1,810	4	-			3,378	12	46		
47	Itumbe	1,239	1,284	1,330	1,427				580				1,100					(396)	-1	1,520			(180)	0	1,080			(253)	-1	47		
48	Lugulu	1,231	1,275	1,321	1,418				580		465							230	1	743			434	1	580			835	3	48		
49	Sungwa	2,692	2,789	2,889	3,101				1,450		659		320					360	1	2,001			667	2	1,770			1,333	5	49		
50	Ngunju	4,689	4,858	5,033	5,402						2,666		1,040					1,211	3	1,952			2,310	5	1,040			4,362	15	50		
		142,608	147,836	153,190	164,366		7,398		8,120		68,029		32,381		8,640			23,269	56	71,599			58,693	127	47,899			107,847	372