MINISTRY OF WATER
THE UNITED REPUBLIC OF TANZANIA

THE STUDY ON RURAL WATER SUPPLY IN TABORA REGION IN THE UNITED REPUBLIC OF TANZANIA

FINAL REPORT

SEPARATE VOLUME

(PREPARATORY SURVEY REPORT ON THE PROJECT FOR RURAL WATER SUPPLY IN TABORA REGION)

MAY 2011

JAPAN INTERNATIONAL COOPERATION AGENCY

EARTH SYSTEM SCIENCE CO., LTD
JAPAN TECHNO CO., LTD.
KOKUSAI KOGYO CO., LTD.

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SUMMARY

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1. General Description of Tanzania

The United Republic of Tanzania (hereinafter referred to as "Tanzania") is located in the eastern part of Africa covering 884,000 km^2. The total population reaches 33.58 million according to the result of census in 2002. GNP is US$330/capita in 2004 (estimation). The Study Area, Tabora Region lies in the central part of Tanzania and occupies 76,700 km^2 of area. Population is projected as 2.14 million in 2008. Annual precipitation is 952.3mm (average between 1999 and 2008). There observed a rainy season from November to April and a dry season from May to October.

Economy in Tanzania largely depends on agriculture which occupies approx. 30% of GDP. Production of mining industry is remarkable. Annual gold production in 2009 reached 41 thousand tons.

Socioeconomic system in Tanzania was socialistic economy system since independent, however, it became stuck. In 1986, Tanzania accepted social adjustment programme by World Bank and International Monetary Fund (IMF) in order to outgrow from the economic crises. However, redress of trade deficit and international account, and solution of problems of accumulated debt was not attained. Since Tanzania became one of the heavily indebted poor countries, Tanzania was approved debt reduction for heavily indebted poor countries pursuing IMF and World Bank by developing a Poverty Reduction Strategy Paper (PRSP). Recently, although Tanzanian economy has been stable increase, GDP has still remained in a low level. Therefore, reduction of poverty is the largest national issue.

2. Background of the Project

The Government of Tanzania started Rural Water Supply Project in 1971 aiming to provide safe and clean water to the entire nation within a 400m of distance. The Ministry of Water (MoW) has been continued the efforts to improve the water supply coverage formulating "Poverty Reduction Strategy Paper (PRSP)" in 2000 and "MKUKUTA (National Strategy for Growth and Reduction of Poverty (NSGRP)) " in 2005. NSGRP targets to improve water supply coverage from 53% to 65% in the rural area and from 73% to 100% in the urban area up to the year 2010. However, it is likely difficult to realize the target.

The Ministry of Water (MoW) formulated the "Water Sector Development Programme (WSDP)" in 2006 to improve the water supply coverage using the basket fund based on the Sector Wide Approach for Planning (SWAp). The WSDP intends to realize the 74% of water supply coverage of the rural area in 2015 and 90% in 2025, and 95% in 2015 and 100% in 2025 for the urban area.

There are several factors which disturb the improvement of the water supply conditions in Tabora Region, such as the difficulty of the groundwater development and the poor organization of the operation & maintenance of the water supply facilities etc.. Therefore, the effective groundwater development with proper geophysical survey method and the formulation of the sustainable operation and maintenance organization are considered as the important issue on the social infrastructure improvement.

In order to overcome these situations, Tanzania requested to Japan to implement a study in Tabora Region on groundwater potential evaluation, construction of database, formulation of rural water supply plan following the WSDP concept and feasibility study of priority projects to be formulated through the study.

In response to the request, Japan International Cooperation Agency (JICA) carried out a preparatory study in February 2009 and concluded the Scope of Work of the Study. Accordingly, "the Study on Rural Water Supply in Tabora Region" (hereinafter referred to as "the Study") was carried out during the period between August 2009 and May 2011.

The contents of the existing basic design study was combined to the Study, in the purpose to accelerate the procedures of the realization of the water supply facility construction by Grant Aid. In the first year's activities of the Study, the rural water supply plan in Tabora Region was formulated and the priority project was selected based on this plan. In July 2010, Tanzania requested Japan to implement the priority project of which the contents are the following:

1) Construction of six (6) piped water supply schemes (Level-2)
2) Construction of 174 deepwells with hand pumps (Level-1)
3) Procurement of Equipment (Geophysical Survey Equipment and GPS)
4) Soft Component

3. Study Results and contents of the Project

In the second year's activities of the Study, the detailed survey and the preliminary design of the Project were carried out. As a result, the following contents of the Project were confirmed:

1) The number of the locations of the Level-2 facilities was changed to four (4) villages, where the groundwater sources were secured by the test drilling of the Study,

2) The number of the Level-1 facilities was changed to 114 wells, based on the detailed village survey,

3) The contents of the equipment procurement were of one (1) unit of Electro-Magnetic Survey Equipment, one (1) unit of Two Dimensional Resistivity Survey Equipment and four (4) sets of GPS (Global Positioning System),

4) Soft Component activities were composed of the technical assistance for the capacity building for the operation and maintenance and for the groundwater development including the geophysical survey methods.

The target year of the project is 2020 and service population increases about 40.7 thousand populations in 2020. Unit water demand is 25 L/capita/day and the daily average water supply is about 1.0 thousand m^3. Service population and design water supply are shown in Table S-1.

Table S-1 Population in the Target Villages, Population to be Served and Water Supply Coverage

District /Municipality	Ward	Village	Population		Population served by existing WSS (2009)	Coverage by existing WSS (2009) (%)	Coverage by existing WSS (2020) (%)	To be served by the project (2020)	Number of Level-2 Sub-projects	Population served by Level-2 (2020)	Number of Level-1 Sub-projects	Population served by Level-1 (2020)	Population served by the Project (2020)	Total Population served (2020)	Coverage (by the Project: (2020) (%)	Coverage (Target Population: (2020) (%)
			2009	2020												
Igunga	Mwisi	Busomeke	3,618	5,227	250	7	5	4,977	0	0	7	1,750	1,750	2,000	34	38
	Mwisi	Kalemala	2,429	3,509	0	0	0	3,509	0	0	5	1,250	1,250	1,250	36	36
Nzega	Ijanija	Makomelo	1,005	1,319	250	25	19	1,069	0	0	6	1,069	1,069	1,319	81	100
	Lusu	Isanga	1,491	1,956	0	0	0	1,956	1	1,956	0	0	1,956	1,956	100	100
	Miguwa	Kitangili	2,664	3,496	0	0	0	3,496	0	0	10	2,500	2,500	2,500	72	72
	Wela	Wela	1,753	2,301	500	29	22	1,801	0	0	7	1,750	1,750	2,250	76	98
Sikonge	Igigwa	Kasandalala	2,282	3,332	250	11	8	3,082	0	0	7	1,750	1,750	2,000	53	60
	Kipanga	Usunga	1,894	2,766	250	13	9	2,516	0	0	5	1,250	1,250	1,500	45	54
	Pangale	Mpombwe	3,435	5,015	250	7	5	4,765	0	0	8	2,000	2,000	2,250	40	45
Tabora Rural	Kizengi	Mpumbuli	2,157	3,148	0	0	0	3,148	1	2,658	3	490	3,148	3,148	100	100
	Mabama	Mabama	4,329	6,321	500	12	8	5,821	1	5,471	2	350	5,821	6,321	92	100
	Ufuluma	Ufuluma	5,741	8,382	250	4	3	8,132	0	0	7	1,750	1,750	2,000	21	24
Tabora Urban	Kakola	Kakola	2,015	3,483	0	0	0	3,483	1	2,983	2	500	3,483	3,483	100	100
	Misha	Misha	759	1,312	0	0	0	1,312	0	0	5	1,250	1,250	1,250	95	95
	Uyui	Uyui	3,138	5,424	250	8	5	5,174	0	0	8	2,000	2,000	2,250	37	42
Urambo	Imalamakoye	Imalamakoye	2,509	4,292	1,000	40	23	3,292	0	0	4	1,000	1,000	2,000	23	47
	Kapilula	Kapilula	1,568	2,682	0	0	0	2,682	0	0	5	1,250	1,250	1,250	47	47
	Kiloleni	Kalembela	3,131	5,356	0	0	0	5,356	0	0	7	1,750	1,750	1,750	33	33
	Kiloleni	Kiloleni	1,653	2,828	250	15	9	2,578	0	0	6	1,500	1,500	1,750	53	62
	Uyowa	Nsungwa	6,911	11,821	250	4	2	11,571	0	0	10	2,500	2,500	2,750	21	23
Total			54,482	83,970	4,250	7.8	5.1	79,720	4	13,068	114	27,659	40,727	44,977	48.5	53.6

Basic concept of project is as follows.

- The target year of the Project is 2020 as agreed in the discussions of the Scope of Work of the Study between the Tanzanian side and the Japanese side.
- Water demand for the Project is estimated based on the population of the target villages in 2020 (target year). The unit water demand is 25 L/capita/day. Although water demand for the communal facilities such as schools and dispensaries is not considered, the public water points will be constructed beside such facilities for convenience. Most of the users of the communal facilities are people in the community where the facilities exist.
- Water sources are principally groundwater. Groundwater is pumped up by submersible pumps. Depth of deep wells is generally from 80 to 150m: It is determined using the geophysical survey results and relation between the aquifers and target villages.
- Four (4) piped water supply schemes with public water points (Level-2) will be constructed in four (4) villages and 115 deep wells with hand pumps will be constructed in 19 villages. Some Sub-Villages in the target villages of the Level-2 are not covered by the Level-2, such Sub-Villages will be covered by Level-1. Location of Level-1 is determined considering hydrogeological conditions.
- The type of electric sources for the intake facilities are basically diesel generators. However, commercial power supply or solar power is considered if the water tariff too much for the community people.
- Raw water pumped from water sources is transmitted to the distribution tank by the head of the submersible pump. No booster pump is planned in the transmission lines.
- Raw water is distributed by gravity from the distribution tank without chlorination
- Considering the topographic conditions, the type of the distribution tank is 15m of height of elevated one. One (1) Level-2 scheme has only one (1) distribution tank, no auxiliary tank nor booster pump is planned in the distribution lines. The service area is limited within the area where water is reachable by gravity from the distribution tank.
- One (1) public water point will supply a maximum of 250 persons. Each public water point is basically allocated within 400m from the residences of the community people. Two (2) types of public water point – Type-1: with single tap type and Type-2 with double tap type – will be adopted. Double tap type will be used for the crowed area and/or school area.
- The WHO Guideline (2008) is applied for evaluation of "Items related to health significance" except Fluoride. For the evaluation of Fluoride and other items, the Tanzania Health Standard (2008) is applied.

- The Design Manual for Water Supply and Waste Water Disposal –Third Edition (MoWI, 2009) is applied in the designing of the water supply schemes. Items not described in the Manual, are designed following the Japanese Design Standard fro Water works Facilities.

- Applicable standards for materials and equipment are those widely applied in Tanzania such as ISO, BS, SABS, DIN, ASTEM/JCS, JEC, JEM and JIS.

4. Project Period and Approximate Initial Cost

- Project Period

  The number of target villages is many (20 villages) and the type of water supply schemes are two (2), Level-2 and Level-1. The sites are widely distributed in the entire Tabora Region. The construction period will require 35 months from the conclusion of the consulting services to the completion of the construction works. Therefore, the Project will be implemented with the Government Bond Scheme throughout four (4) fiscal years.

  Software component is carried out by despatching two (2) Japanese experts during the period. One expert is in charge of the operation and maintenance of the water supply schemes and another is in charge of the groundwater development.

- Approximate Initial Cost

  Approximate initial cost for implementation to be borne by Tazanian side is estimated as 63.16 million Tanzanian Shilling (Tsh).

5. Project Evaluation

In the Project, 114 Level-1 water supply schemes and 4 Level-2 water supply schemes (118 water supply schemes in total will be constructed in 20 target villages in Tabora Region. Simultaneously, formulation of Community Owned Water Supply Organizations (COWSO) and the capacity building of District/Municipal Water and Sanitation Teams will be enhanced through the activities of soft component.

From the above inputs, the quantitative effects will be expected as shown in Table S-2.

Table S-2 Quantitative Effect of the Project

Indicator	Basic Value (2009)	Target Value (2020)
Water Supply Coverage in 20 Target Villages	7.8% (Covered Population 4,250 prs. / Population 54,482 prs.)	53.6% (Covered Population 44,977 prs. / Population 83,970 prs.)
Available Water L/capita/day	Only 20 to 25 L/capita/day of contaminated water	25L/capita/day of safe and clean water will be used.
Time for Fetching Water	56.7 % in Rainy Season 25.3 % in Dry Season (Ratio of Households who can fetch water within 30 minutes)	Most of residents will have access to safe water source within 400m and the fetching time will be within 30 minutes.

Indicator	Basic Value (2009)	Target Value (2020)
Number of COWSOs	0	For 118 water supply schemes, COWSO will be formulated and they will continuously operate and manage their schemes.

The above effects will induce the following qualitative effects:

- Cost to get water is eased in the villages where no water source is available and depends on water vendors
- Fetching water is basically task of women and children. Time for fetching water is much reduced, and then times for participating in the social activities and chance to works of women, and chance to getting education of children are increased
- Reduction of infant mortality is expected by improved drinking water quality
- Medical cost is much reduced by improved drinking water quality
- Ownership of community people is improved by organizing of community participation type of operation and maintenance system

The relevance of the implementation of the Project was examined from the view points of human security, finance, institution and organization, policy, environmental and social issues, applied technology. In all of these respects, the Project was evaluated to be relevant. The results of the evaluation are as follows:

1) Evaluation from View Point of Human Security

The implementation of the Project will produce the effect of "Provision of clean and realiable water source" and the other ripple effects such as "Relevance of women from the labour of fetching water".

Therefore, it is evaluated that the project is expected to be urgently implemented for the social stabilization and the improvement of the living conditions.

2) Financial Evaluation

Setting water user fees at 1.0 Tsh/L as a standard, and assuming their water consumption at 25l/capita/day, ratio of expenditure for water in total household income amounts to 2.5 to 3.5 percent. International organizations such as the World Bank, proposes that the ratio of water fee in total house income shall be not more than 5 %.

Therefore, it is evaluated that the affordability-to-pay of the residents in the target area is enough to operate and maintain the water supply facilities.

3) Institutional and Organizational Evaluation

In the National Water Sector Development Strategy, the following issues are mainstreamed into the principle in formulating Institutional and Organizational Plan; 1) Government's role will be limited to co-ordination, policy and guideline formulation, and regulation, 2) Regulatory and executive (i.e. service provision) functions will be separated, 3) Responsibility for executive functions will be decentralized to the lowest appropriate level, whilst balancing consumer representation/participation with economies of scale, 4) Regulatory function will be further separated from the prioritization and allocation of capital investment funds, 5) Autonomous entities will be established to manage water supply and sewerage services.

In the Project, the introduction of Community-Owned Water Supply Organization (COWSO) and the enhancement of the capacity of District/Municpal Water and Sanitation Team are planned. Such activities are evaluated to be conformed with the national strategies on water supply.

4) Evaluation from Viewpoint of Policy

MoW intends to increase water supply coverage to 74% in 2015 and 90% in 2025 in the rural area where water supply schemes are less developed. Although the Project is not a project by the basket fund under WSDP, the Project will assist WSDP to attain the target by implementation of the water supply plan formulated in the Study in the same manner of WSDP' concept.

Therefore, implementation of the Project will contribute to realize the policy of MoW.

5) Environmental and Social Evaluation

As the results of the evaluation of the report of the Preliminary Environment Assessement (PEA) for the Project, MoW evaluated the Project as "Category C".

Therefore, it is evaluated that the Project will be implemented properly in viewpoint of environmental and social issues.

6) Technical Appropriateness

The construction works of the Project are composed of drilling works, earthworks, pipe works, concrete works, mechanical/electrical works, deep well drilling and miscellaneous works. These works requires no special techniques. These will be carried out by conventional methods and machineries widely applied in Tanzania.

Therefore, the technologies which are adopted in the Project are considered to be appropriate.

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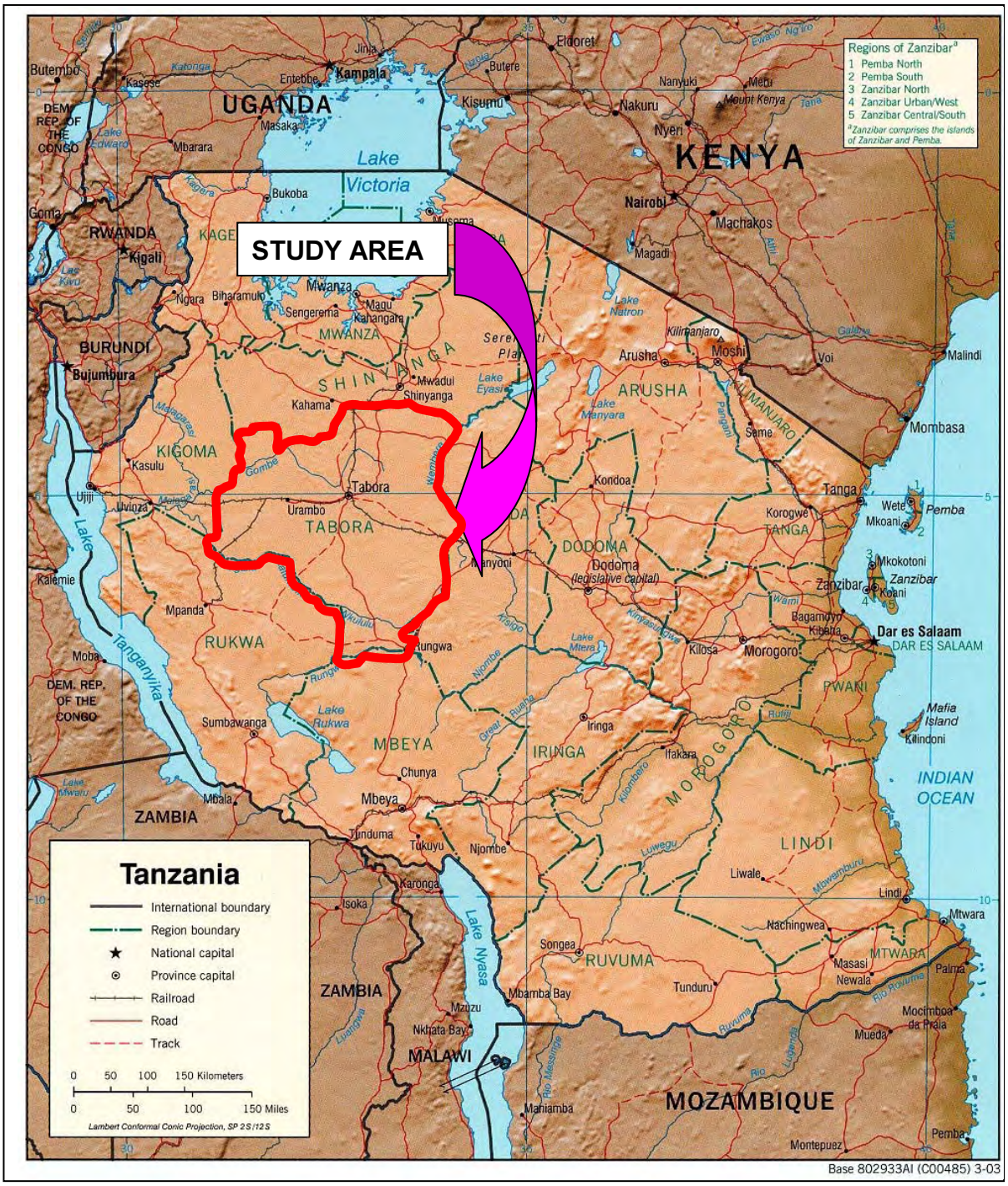
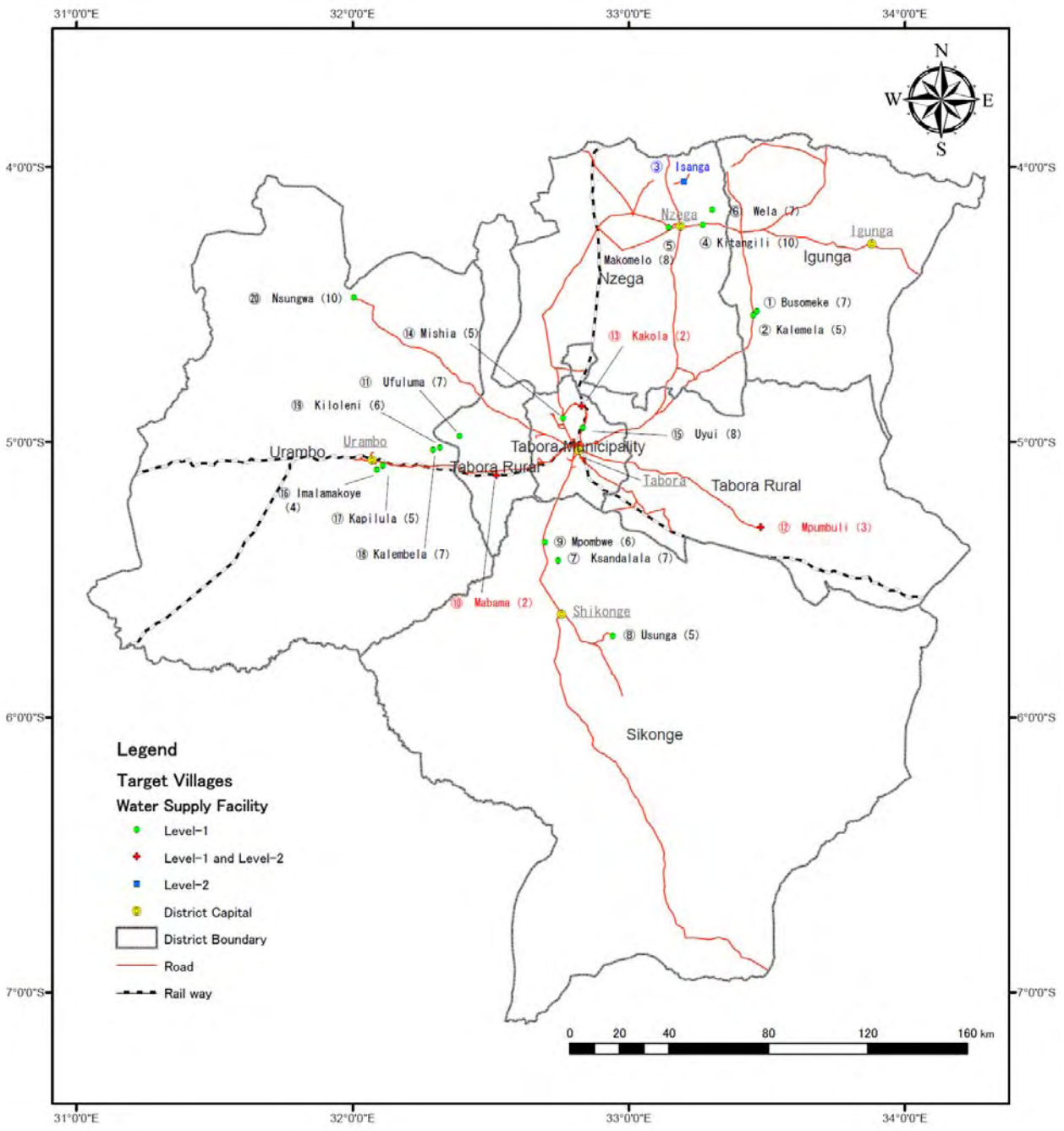


LOCATION MAP OF STUDY AREA



Construction Plan

- Level-1
- Level-2
- Level-1 and Level-2
- ( ) : No of Level-1

Igunga Distirict

① Busomeke
② Kalemela

Nzega District

③ Isanga
④ Kitangili
⑤ Makomelo
⑥ Wela

Sikonge District

⑦ Kasandalala
⑧ Usunga
⑨ Mpombwe

Tabora Rural District

⑩ Mabama
⑪ Ufuluma
⑫ Mpumbuli

Tabora Municipality

⑬ Kakola
⑭ Misha
⑮ Uyui

Urambo District

⑯ Imalamakoye
⑰ Kapilula
⑱ Kalembela
⑲ Kiloleni
⑳ Nsungwa

LOCATION MAP OF TARGET VILLAGES

PERSPECTIVE

LIST OF TABLE

LIST OF FIGURE

ABBREVIATIONS

ATP	Affordability-to-Pay
CBOs	Community-Based Organizations
CLTS	Community-Led Total Sanitation
COWSOs	Community-Owned Water Supply Organizations
CWSD	Community Water Supply Division
DDCA	Drilling & Dam Construction Agency
DSM	Dar es Salaam
DTH	Down the Hole Hammer
DWL	Dynamic Water Level
DWP	Domestic Water Points
DWST	District Water and Sanitation Team
EC	Electric Conductivity
EIA	Environmental Impact Assessment
ESAs	External Support Agencies
ESMF	Environmental and Social Management Framework
GDP	Gross Domestic Product
GIS	Geographical Information System
GNP	Gross National Product
GSP	Galvanized Steel Pipe
HDPE	High Density Polyethylene
IEE	Initial Environmental Examination
JICA	Japan International Cooperation Agency
LGRP	Local Government Reform Policy
M/M	Minutes of Meetings
MoM	Ministry of Minerals
MoW	Ministry of Water
MoWI	Ministry of Water and Irrigation
NAWAPO	National Water Policy
NEMC	National Environmental Management Council
NGOs	Non-Governmental Organizations
NAWAPO	National Water Policy
NSGRP	National Strategy for Growth and Reduction of Poverty
NWP	National Water Policy
NWSDS	National Water Sector Development Strategy
NZUWASA	Nzega Urban Water Supply Authority
O&M	Operation and Maintenance
PER	Preliminary Environmental Report
PHAST	Participatory Health and Sanitation Transformation

PRSP	Poverty Reduction Strategy Paper
PVC	Polyvinyl Chloride
RF	Registration Form
RWSD	Rural Water Supply Division
RWSSP	Rural Water Supply and Sanitation Program
SC	Specific Capacity
SR	Scoping Report
SUWASA	Sikonge Urban Water Supply Authority
SW	Scope of Work
SWAPs	Sector Wide Approach to Plannings
SWL	Static Water Level
TASAF	Tanzania Social Action Fund
TANESCO	Tanzania Electric Supply Company
TANROAD	Tanzania National Roads Agency
TDS	Total Dissolved Solid
TOR	Terms of Reference
TRC	Technical Review Committee
TRC	Tanzania Railway Company
TUWASA	Tabora Urban Water Supply and Sewage Authority
UFW	Unaccounted-for water
UWSA	Urban Water Supply Authority
UNICEF	United Nations International Children's Fund
UUWASA	Urambo Water Supply Authority
VES	Vertical Electrical Sounding
VHC	Village Health Committee
VHW	Village Health Worker
VWCs	Village Water Committees
WHO	World Health Organization
WRI	Water Resources Institute
WSS	Water Supply System
WSSAs	Water Supply and Sanitation Authorities
WSSMC	Water Supply System Management Centre
WTP	Willingness-to-Pay
WUAs	Water User Associations
WUGs	Water User Groups

L/c/day	litter/capita/day
L/min	litter/minute
masl	meter above sea level

mbgl	meter below grand level
min	Minute
sec	Second

CHAPTER 1
BACKGROUND OF THE PROJECT

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The Government of Tanzania started Rural Water Supply Project in 1971 aiming to provide safe and clean water to the entire nation within a 400m of distance. The Ministry of Water[1] (MoW) has been continued the efforts to improve the water supply coverage formulating "Poverty Reduction Strategy Paper (PRSP)" in 2000 and "MKUKUTA (National Strategy for Growth and Reduction of Poverty (NSGRP)) " in 2005. NSGRP targets to improve water supply coverage from 53% to 65% in the rural area and from 73% to 100% in the urban area up to the year 2010. However, it is likely difficult to realize the target.

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Tabora Region is one of the least developed Regions in Tanzania in terms of water supply. According to the "Water Sector Performance Report (September 2009)", water supply coverage in Tabora Region is 49.1%. The residents in Tabora region do not use the safe water and many of them have water-born deceases.

There are several factors which disturb the improvement of the water supply conditions in Tabora Region, such as the difficulty of the groundwater development and the poor organization of the operation & maintenance of the water supply facilities etc. Therefore, the effective groundwater development with proper geophysical survey method and the formulation of the sustainable operation and maintenance organization are considered as the important issue on the social infrastructure improvement.

In order to overcome these situations, Tanzania requested to Japan to implement a study in Tabora Region on groundwater potential evaluation, construction of database, formulation of rural water supply plan following the WSDP concept and feasibility study of priority projects to be formulated through the study.

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[1)] Ministry of Water changed its name from Ministry of Water and Irrigation (MoWI) in November 2010.

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4) Soft Component activities were composed of the technical assistance for the capacity building for the operation and maintenance and for the groundwater development including the geophysical survey methods.

1.2 NATURAL CONDITIONS

1.2.1 METEOROLOGY/HYDROGY

(1) Meteorology

The climate of Tabora Region is equatorial savannah with dry winter. There observed clear rainy season (October to May) and dry season (June to September) in Tabora Region. The average precipitation is just less than 1,000 mm, which is about the same as the national average of 1,100 mm.

The maximum temperature (32.2°C) was observed in September and October, and the minimum temperatures (14.7 to 14.8°C) were observed in the dry season, June and July.

The evapotranspiration amount is 250 mm/month in the dry season and 150 mm/month in the rainy season.

Solar radiation the highest around October, and the mean value was 5.75 kWh/m^2/day (past ten year's average). The lowest value is 4.65 kWh/m^2/day in December. The mean annual value is

about 5 kWh/m^2/day.

(2) Hydrology

There are nine (9) catchments in Tanzania and there is a Basin Water Office in each basin. Tabora Region is a part of three (3) catchments: Internal Drainage Basin (VI), Lake Rukwa Basin (VII) and Lake Tanganyika Basin (VIII). The ratio of these areas is: VI : VII : VIII=0.70 : 0.25 : 0.05

In 1970's, a total of 10 observatory stations were constructed in Tabora Region, however none of these stations are currently operating. Obvious water flow is observed from February to May and no water flow is observed in May. Maximum flow rate was observed in 1978: It was 26.6 m^3/sec (catchment area = 3,051 km^2).

(3) Water Balance

The water balance of in Tabora Region was analyzed and the groundwater recharge was calculated.

The groundwater recharge was calculated, using two methods of the arithmetical computation method and the tank model method.

1) Arithmetical Computation Method

$P = D + E + R$

P is precipitation, D is discharge, E is evapotranspiration, and R is groundwater recharge.

Calculation results using arithmetical computation method is shown in Table 1.1.

Table 1.1 Calculation Results for Groundwater Recharge

Station No	Rain(thiessen) (mm)	Evapo-transpiration (mm)	Depth of Runoff (mm)	Groundwater Recharge (mm)
	P	E	D	R
4AG2	835.8	752.5	15.2	68.1
4AG4A	842.2	752.5	22.4	67.3
4AH7	858.6	752.5	27.1	79.0
4AH13	1020.2	752.5	17.2	250.5
4AH14	1020.2	752.5	13.9	253.8
4AH20	1020.2	752.5	11.5	256.2
4AH21	1020.2	752.5	16.4	251.3
2K15	976.6	752.5	8.2	215.9

2) Tank Model Method

The groundwater recharge was calculated using the data from the 4AH7 flow rate observatory station, which had a complete set of data for monthly precipitation and flow rates. As a result, the mean value was about 85mm per year, which was approximately the same value obtained using the arithmetical computation method.

1.2.2 TOPOGRAPHY/GEOLOGY

(1) Topography of Target Area

The Tabora region is situated on a high plateau of the central part in the United Republic of Tanzania between latitude 4-7° south and longitude 31-34° east. The region shares a border with the Shinyanga region in the north, Singida region in the east, Mbeya and Rukwa region in the south and then the western border is shared with the Kigoma region. Most of the altitude in the region ranges between 1,000 and 1,300m with an approximately flat plateau. The inselbergs which the basement rock exposed and the lowlands which become marshes in the rainy season also exist in places so gently undulations are found. The hilly terrain that exceeds 1,600m altitude is located in the southeastern area.

The Tabora region is divided into three basins (Lake Tanganyika Basin, Internal Drainage Basin and Lake Rukwa Basin). The watershed which divides Lake Tanganyika Basin and the Internal Drainage Basin runs from the northern part of the Nzega district to the east in Sikonge town via south of Nzega town, and then it stretches to the region outside in a southeasterly direction. In the Lake Tanganyika Basin, the altitude declines gently from the east to the west. Beyond the watershed with about 1,200 to 1,500m altitude, the altitude falls from the west to east in the Internal Drainage Basin. The Lake Tanganyika Basin has 68% of the land area of the region, the Internal Drainage Basin has 28% and the Lake Rukwa Basin has 4%.

(2) Geology of Target Area

In the central part of Tanzania where the Tabora region is situated, Precambrian Archean plutonic rocks and metamorphic rocks are widely distributed. Overlying these rocks, sedimentary rocks in the Paleozoic era, Continental deposits of Miocene, lacustrine deposits and old alluvium in the Pleistocene, and recent alluvium of Holocene are distributed in places.

The geological stratums in the study area are described below according to the period.

1) Archean and Paleozoic

The stratum of the Archean in this area is divided into the Dodoman system, the Nyanzian system, the Kavirondian system and the Ubendian system in chronological order. The Dodoman system is composed of metamorphic rocks such as gneiss, amphibolite, migmatite, schist and so on. It is distributed in a belt shape of 100km width from the south to the west of the region. The Dodoman system is the oldest stratum in Tanzania. The Nyanzian system and the Kavirondian system are composed of metamorphic rocks such as banded ironstone, schist, quartzite, phyllite and sedimentary rocks. It is situated in the Igunga and Nzega districts in the northeast of the region. The Ubendian system is composed of metamorphic rocks such as gneiss and amphibolite, and located at the west end of the region. Additionally, the Archean intrusive rocks which are

composed of mainly granite and granodiorite are distributed in the vast area of the eastern part of the region. The intrusive rocks have developed joints and are weathered strongly. The Paleozoic Bukoban system which consists mainly of sandstone is distributed in the limited area of the west end of the region. The Mesozoic stratum is not admitted in the Tabora region.

2) Cenozoic

The stratum in the Cenozoic period in this region is composed of the continental deposits of the Miocene, lacustrine sediments and the old alluvium of the Pleistocene, and the recent alluvium of Quaternary in chronological order. The continental deposits of the Miocene consist of various materials such as silcrete which is a kind of conglomerate, duricrust and so on. It is distributed in the east of the region mainly in the eastern part of the Tabora Rural district. The lacustrine sediments of Pleistocene are mainly composed of limestone and calcareous mudstone and is found in the northern part of Igunga district which is located in the northeast of the region. The alluvial sediment in the region is divided into old alluvium of the Pleistocene and recent alluvium of the Quaternary. They are distributed mainly in the riverbeds, the marshes, the swamps and the low altitude areas of the region.

1.2.3 HYDROGEOLOGY

(1) Aquifers in the Study Area

The aquifer in the project area is divided into two main parts as the stratum aquifer and the fractured aquifer. The aquifer of Recent Alluvium and two Pleistocene Layers are categorized as a stratum aquifer. Basement rocks in those consist of the Archean rocks categorized as fractured aquifer. According to the inventory of the existing boreholes, more than 90% of the existing wells in the study area are situated in the basement rock area. Therefore, their major aquifers are thought to be fractured aquifers.

(2) Yield

A clear difference of the yield among the aquifers especially in the basement rocks of the study area can not be recognized from the existing data at present. Therefore the groundwater potential was assumed from the existing borehole data and the geological structures that is the result of satellite image analysis.

The groundwater yield is classified into three categories and the study area is divided into the following three areas. Topographical features and geological structures have effects on the groundwater potential. The classification of the area yielding groundwater was modified from the viewpoint of these features. Especially fault zones and lineaments have much effect on the groundwater yield, so these zones of the major fault of an existing borehole that has a yield $5m^3$/hour and above are classified as “Area 1”. The area of the forest reserves and the game reserves are

excluded from this evaluation.

1) Area which has a yield of 5 m^3/hour and above is assumed
   The surrounding areas of the existing borehole that have a yield of 5 m^3/hour and above.
2) Area where a yield of 1 – 5 m^3/hour is assumed
   The surrounding areas of the existing borehole that have a yield of 1 – 5 m^3/hour.
3) Area where a yield of below 1 m^3/hour is assumed
   This area is an area that is not included in Area 1 and Area-2 as referred to above.

(3) Water Quality

A high concentration of fluoride in the groundwater is the most important issue of drinking water quality in the study area. Based on the value of fluoride content from this study and the existing data, the study area is divided into the following three areas. They are shown in the hydrogeological map (Figure 1.1)

The hydrogeological map indicate that the area of fluoride contents below 1.5 mg/L distribute in a part of Iunga District. The area of fluoride contents 1.5 to 4.0 mg/L widely spreads in the Internal Drainage Basin. In most of the areas in other basins (Lake Tanganyika Basin and Lake Rukwa Basin), fluoride contetents is below 1.5mg/L. However, the test well drilling in the Study proved that the groundwater in certain areas in Lake Tanganyika Basin has high fluoride contents between 1.5 – 4.0 mg/L. Such areas are located in Sikonge District, western part of Tabora Rural District and a part of Tabora Municipality. The test well drilling points where the fluoride contents 1.5 mg/L or above were detected were located along the major faults.

(4) Test Well Drilling Results

16 test wells - 13 test wells at six (6) candidate villages for the Level-2 schemes and three (3) test wells for the evaluation of the groundwater quality in three (3) villages in Igunga Districts. The results of the test drilling

The results of the test well drilling are summarized as follows:

- ☐ Only Mabama Village in Tabora Rural District satisfied the criteria of the water sources for Level-2 scheme in both water yield and water quality (WHO Guidelines).
- ☐ At Mpumbuli Village in Tabora Rural District and Kakola Village in Tabora Municipality, the results satisfied the yield criteria. However, their fluoride contents were between the WHO Guideline value (1.5 mg/L) Tanzanian drilling water standard value (4 mg/L).
- ☐ At Isanga Village in Nzega District, two (2) wells area necessary to supply the water, if the pumping time shall not exceed 14 hours/day, because each of two test well drilling had not enough capacity to supply whole demand of the village within this pumping time.

Concerning the fluoride contents, one well satisfies the WHO Guideline value and another well exceeds the WHO Guideline value and satisfies the Tanzanian drilling water standard value.

□ At two (2) villages in Sikonge District, test well drilling failed to secure the necessary yield.

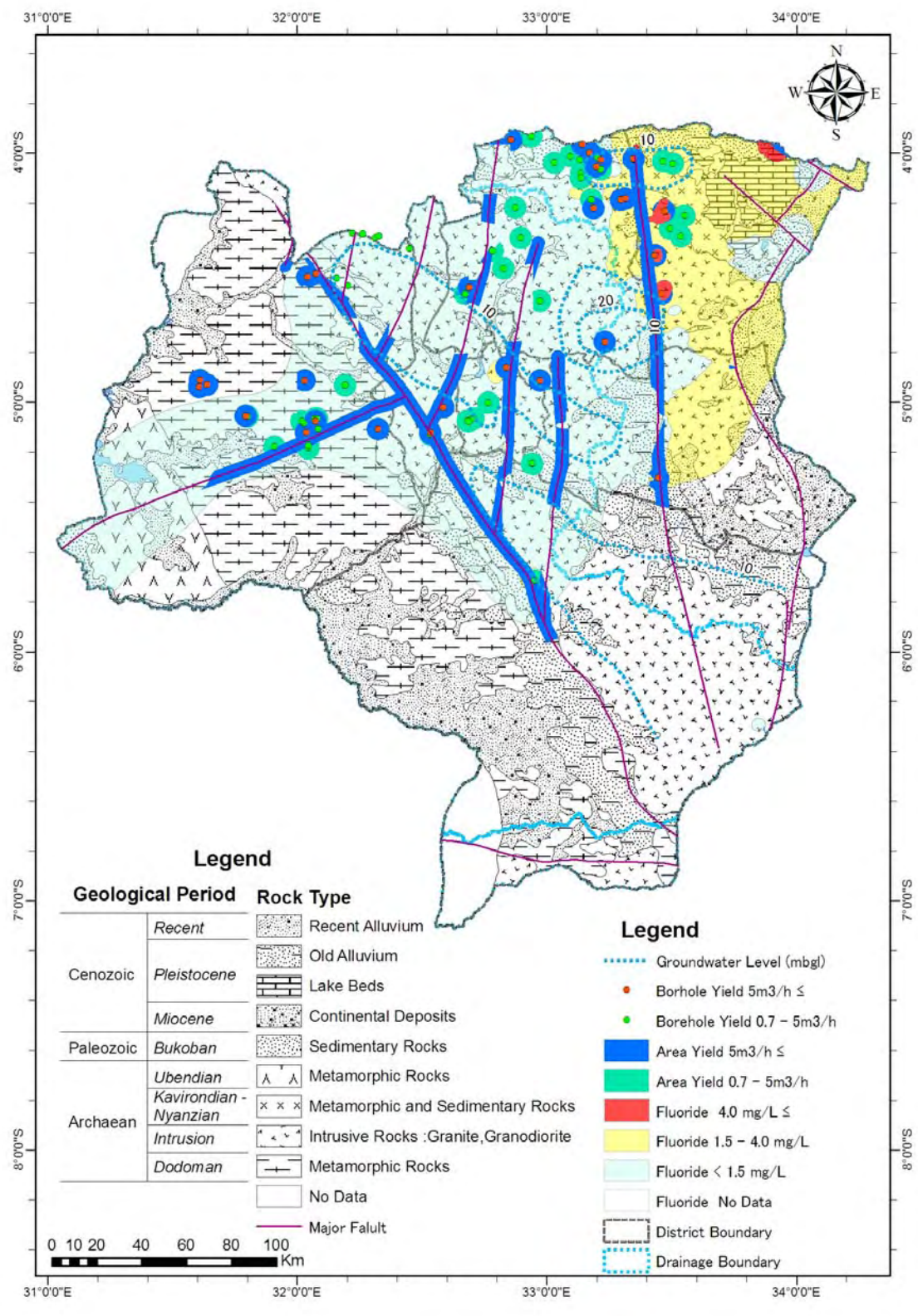


FIGURE 1.1 HYDROGEOLOGICAL MAP

RURAL WATER SUPPLY PROJECT IN TABORA REGION | **JICA**

Table 1.2 Result of Test Well Drilling

Village	Well No.	Depth (m)	Yield (m^3/h)	Fluoride (mg/L)	Evaluation
Nzega District					
Isanga	No. 1	85	3.7	2.40	Yield: suitable for Level-2 by 2 wells
	No. 2	80	3.0	1.10	Fluoride: A～B
Sikonge District					
Usunga	No. 1	98	0.2	1.46	Yield: Insufficient forLevel-2 but sufficient for Level-1, Fluoride: A
	No. 2	150	0.8	2.53	Yield: Insufficient forLevel-2 but sufficient for Level-1, Fluoride: B
Mpombwe	No. 1	79	Dry	—	Unsuccessful
	No. 2	92	0.1	1.10	Yield: Insufficient, Fluoride: A, Unsuccessful
Tabora Rural District					
Mpumbuli	No. 1	50	Dry	—	Unsuccessful
	No. 2	130	9.0	3.95	Yield: suitable for Level-2, Fluoride: B
Mabama	No. 1	79	14.0	1.50	Yield: suitable for Level-2, Fluoride: A
	No. 2	82	0.8	2.24	Yield: Insufficient forLevel-2 but sufficient for Level-1, Fluoride: B
	No. 3	86	Scarce	3.20	Yield: Insufficient for both Level-2 and Level-1, Fluoride: B
Ufuluma	No. 1	86	Scarce	—	Unsuccessful
Tabora Municipality					
Kakola	No. 1	108	6	1.61	Yield: suitable for Level-2, Fluoride: B
Igunga District（for Confirmation of Water Quality）					
Igumo		80	1.0	7.00	Yield: suitable for Level-1, Fluoride: C
Buhekela		70	Dry	-	Unsuccessful
Kagongwa		82	Dry	-	Unsuccessful

Note on Fluoride content

A： within the WHO Guideline (F＜1.5 mg/L)

B： more than the WHO Guideline but within the Tanzania Health Standard (1.5＜F＜4 mg/L)

C： more than the Tanzania Health Standard (4 mg/L＜F)

A total of 31 water quality items were analyzed for the groundwater samples from test wells. The water was sampled immediately after the completion of the continuous pumping test of each test well. The water quality analysis results are show in Table 1.3.

Table 1.3 Result of Water Quality Analysis

Aspects and Items			Unit	Tanzania Health Standard (2008)	WHO Guideline (2008)	Nzega District		Sikonge District			Tabora Rural District			Tabora Municipality	Igunga District
						Isanga 1	Isanga 2	Mpombwe	Usunga 1	Usunga 2	Mpumbuli	Mabama 1	Mabama 2	Kakola	Igumo
Microbial asptects	1	Total coliform bacteria	count/100mL	0	-	0	0	0	0	0	0	0	0	0	0
	2	Escherichia coli.	count/100mL	0	0	0	0	0	0	0	0	0	0	0	0
Chemicals that of health significance	3	Cadmium (Cd)	mg/L	0.05	0.003	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	4	Lead (Pb)	mg/L	0.1	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	5	Arsenic (As)	mg/L	0.05	0.01	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	6	Fluoride (F)	mg/L	4	1.5	2.4	1.1	1.1	1.46	2.53	3.95	1.5	2.24	1.61	7
	7	Nitrate (NO3)	mg NO_3/L	75	50	0.479	0.17	0.477	1	0.9	0.5	0.29	1.76	0.02	0.291
	8	Nitrite (NO2)	mg NO_2/L	-	3/0.2	0.01	0.01	0.02	0.6	0.01	0.01	0.01	0.02	0.01	0.01
	9	Nickel (Ni)	mg/L	-	0.07	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	10	Manganese (Mn)	mg/L	0.5	0.4	0.01	0.01	1.5	0.05	0.01	0.01	0.01	0.01	0.01	0.01
Acceptability aspects	11	Total hardness	mg/L	600	600	300	300	225	200	125	200	325	200	425	250
	12	Calcium (Ca)	mg/L	100	-	80	60	50	60	40	50	100	70	160	60
	13	Magnesium (Mg)	mg/L	100	-	24.3	36.48	24.3	12.16	6.08	18.24	18.24	6.08	6.08	24.32
	14	Iron (Fe)	mg/L	1.0	-	0.01	0.01	3.02	0.64	0.01	0.02	0.01	0.02	0.01	0.01
	15	Zinc (Zn)	mg/L	15.0	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	16	Copper (Cu)	mg/L	3.0	2	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001
	17	Chloride (Cl)	mg/L	-	-	88.6	53.1	88.6	194.97	53.17	212.7	124.07	141.8	159.5	70.9
	18	TDS	mg/L	2,000	-	475.2	377.8	459.2	468	134	685	592	590	600	570.9
	19	Ammonium (NH3-NH4)	mg/L	-	1.5	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	21	pH	-	6.5-9.2	-	7.6	7.4	7.6	7.5	7.8	7.7	7.1	7.2	7.7	7.8
	22	Taste	dilution	Not Objectionable	-	no	no	no	no	no	no	no	no	no	no
	23	Odour	dilution	Not Objectionable	-	no	no	no	no	no	no	no	no	no	no
	24	Colour	mg Pt/L	50	15	0	0	0	0	0	0	0	0	0	0
	25	Turbidity	NTU	25	5	0.99	2.53	942	1575	3.03	0.861	3.81	0.664	0.964	0.44
	26	Temperature (T)	^{0}C	-	-	28.6	28.7	28.8	26.5	26	28	26	26	25	28.7
	27	Conductivity (EC)	mS/m	-	-	86.4	68.7	83.5	93.7	268	137.5	118.3	118.1	120	103.8
Items related to characteristics of	28	Sodium (Na)	mg/L	-	-	60.2	18.8	86.9	119.37	3.22	220.5	121.9	176.41	79.81	121.4
	29	Potasium (K)	mg/L	-	-	1.5	2.4	3.3	7.7	2.2	4.9	1.7	6	2.1	4.6
	30	Biocarbonate (HCO3)	mg/L	-	-	300	300	200	200	50	200	325	200	300	250
	31	Sulphate (SO4)	mg/L	-	-	0.01	0.01	1.7	8	9.6	250	0.01	70	48	18.72

1.3 ENVIRONMENT AND SOCIAL CONSIDERATIONS

1.3.1 SCOPING OF ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

Environmental and social impacts on the specific sites of the proposed Level-1 and Level-2 facilities were assessed by the Study team together with Acting Regional Environmental Officer, Tabora Region (Table 1.4). As the result, it was confirmed that the Project would be implemented appropriately.

Table 1.4 Scoping of IEE

	S/N	Impacts	Const-ruction	Opera-tion	Description
Social Environment	1.	Involuntary Resettlement	D	D	Although the distribution pipes will be laid under land for public use in most of the area, temporary use of limited agriculture land* (w=3m) is required for construction use. However, the construction works will take place only in he dry season, in which there is no cultivation, and the land is recovered for agricultural land after the construction. Hence the impact on income means and harvesting will not be expected or negligibly small. Land acquisition will not be necessary; however, if land acquisition would be necessary due to delay of construction work, it is confirmed by village council that substitute agricultural land (with the same size and productiveness) will be provided. It is not difficult to find substitute agricultural land almost every where around the village where grassland and bush are common. *Right of cultivation is not granted from the state government, but admitted as village customary agricultural practice.
	2.	Local economy such as employment and livelihood	D	D	There would be some job opportunity provided to locals by water users' groups. They have rather positive impacts on the local economy. Water venders will receive some impact, but they are not selling drinking water only. There are always demands for their water elsewhere.
	3.	Land use and utilization of local resources	D	D	No adverse impact is expected on land use and utilization of local resources, but positive impacts by installation of water supply facility such as increasing of the land value are expected.
	4.	Local communities and decision-making institutions	D	D	No negative impact is expected on local society. Because formulation of community organizations for operation and maintenance of water supply facilities are planned, and the regulations on amount of water tariff, the collection ways of collection will be determined by the villagers.

	S/N	Impacts	Const-ruction	Opera-tion	Description
	5.	Existing infrastructures and services	D	D	Some traffic disturbances are expected when construction of burying pipes which crosses a village road; however, the impact is minimum because there is almost no paved road in the all the project sites and the works will be done in extremely short period of time.
	6.	The poor/ indigenous/ ethnic minority/ women/ children	D	D	Highly positive impacts are expected for women and children by saving their time for water fetching and spend the time for other productive work.
	7.	Misdistribution of benefit and social cost	D	D	The same with above "4".
	8.	Historical/ cultural heritage	D	D	The sizes of water supply facilities are small; and, it is movable in proximity area so it does not interfere with historical/ cultural heritage. The site is specified in Appendix III-A.
	9.	Local conflict of interests	D	D	The facility will be managed by village water committee or water users group. According to the District officials, there were no conflict over water supply facilities and therefore no impact on local interest is expected by a new facility.
	10.	Water usage, Water rights, Communal rights	D	D	Since water supply facility will provide water, there would be highly positive impact on water usage of the community. The facility will contribute to the respective village as a whole because the distribution is managed by village water committee or water users group.
	11.	Sanitation	D	D	Water quality is checked by 29 parameters in test drilling phase. The facility allows amount of water supply for sanitation use. It gives highly positive impact to the community health.
	12.	Health Hazards/Risk, Infectious Diseases such as HIV/AIDS	D	D	Public health and sanitation condition will be improved by improving accessibility to clean water. HIV/AIDS problem will not occur at water facility installation work.
Natural Environment	13.	Important/ valuable geographical and geological features/ resources	D	D	There is no such place in Tabora Region. No impact is expected.
	14.	Soil erosion	D	D	No soil erosion is expected by installation and use of water supply facility.
	15.	Amount and quality of groundwater	D	D	There would be no negative impact on quality of groundwater by installation and operation of the facility. Since the facility will be built at the site only with sufficient amount of ground water, verified by analysis by water recovery tests during test drillings, depletion of water in boreholes are not expected
	16.	Amount of natural reservoir/ flow	D	D	For ground water use, since the depth of well is about 80 meters (150m at maximum), draw down has small relationship with surface flow if the topography of Tabora is considered. Therefore extracting deep ground water has almost no impact on the flow rate of river at the surface.
	17.	Coastal zone	D	D	There is no coastal area in Tabora Region.

	S/N	Impacts	Construction	Operation	Description
	18.	Flora, Fauna, Biodiversity	D	D	Game Reserve or Forest Reserve is excluded from the project area (fringe of subject village may across the forest reserve limit in some case). A new installation of water supply facility has positive effect on forest reserve for preventing encroachment of the villagers who might come in to a forest reserve for fetching otherwise.
	19.	Meteorology/ climate	D	D	There is no plan of large scale construction or facility as to give negative impact on the climate.
	20.	Aesthetic landscape	D	D	There will be no large scale facility that may affect surrounding landscape.
	21.	Global warming	D	D	Diesel motor pumps emit CO2; however, there would be no large scale generators to be installed as to give negative impact on global warming.
Pollution	22.	Air pollution	D	D	There will be some exhaust emission from trucks and machineries during the construction work, and diesel generator emits exhaust gas, which contain SOX and NOX gases, but the size is small and operation period is short. Therefore impacts on air are negligible.
	23.	Water pollution	D	D	Water pollution during construction phase is avoidable with the proper supervision of work. There is no waste water discharge from the facilities during operation.
	24.	Soil contamination	D	D	Falling down of oil some droplets from heavy machineries is expected in during construction phase, which is negligible impact; and there is no soil contamination occurs during operation phase.
	25.	Solid waste amount increase	D	D	Although excavated soil becomes construction waste, it is properly disposed in routine manner. There is no solid waste produced by water supply facility during operation phase.
	26.	Increase of noise and vibration	D	D	Since heavy machineries will be operated during construction phase, noise and vibration will occur; however, the duration is limited. There is no complains reported by neighbors, according to the District officers.
	27.	Ground level subsidence	D	D	The capacities of pump motors are extremely smaller, compare to those causes ground subsidence. There is no case reported from all the districts.
	28.	Offensive odor	D	D	There would be no source of odor at the water supply facility.
	29.	Sedimentation	D	D	There is no sedimentation on the river bed or reservoir bed occurred by installation of the water supply facility.
	30.	Increase of Accidents	D	D	There is no circumstance to provoke accidents, by installation of the facilities according to all District officials.

Grade:

A: Serious impact(s) is (are) expected

B: Less serious impact(s) is (are) expected

C: Impact not known without further research

Note: Progress of project itself may reveal the impact (further research is not necessary, in this case)

D: Negligible impacts are expected or no impact is expected

1.3.2 CATEGORIZATION

The facilities planned in the Study are likely to have minimal or little adverse impact on the environment and society, according to our environment and social impact survey with a responsible officer of the Tabora Region to all the sites with characteristics of the project site: the Project shall be classified as “Category C”.

1.3.3 CONCLUSION

Facility design and their specific locations in priority villages are designated in Phase I and beginning of Phase II. Preliminary Environment Assessment (PEA) on each one of the facilities are conducted by the Tabora Regional Secretariat with support of the Study team in accord with Environmental and Social Management Frame Work (ESMF). The report of PEA was submitted to EIA division of MoW at the end of November. MoW reviewed the PEA report, and evaluated the project as “Category C”. Since “Category C” projects do not require EIA process under National Environment Management Council (NEMC), further evaluation of environmental impact assessment in Tanzania is waived

CHAPTER 2
CONTENTS OF THE PROJECT

CHAPTER2 CONTENTS OF THE PROJECT

2.1 BASIC CONCEPT OF THE PROJECT

The project plans to construct four (4) piped water supply schemes with public water points (Level-2) and 114 deep wells with hand pumps under the Japan's Grant Aid Scheme for attaining the targets described above. It is expected that 7.8% of water supply coverage in 2009 will increase to 53.6% in the target year 2020.

The total population in the target villages is about 54.5 x 10^3 persons. Among them, only 4.3 x 10^3 persons are supplied water. The water supply coverage is 7.8%, it is extremely low compared with the national average 49.1% (MoW, 2007/2008). The total population will increase to about 84x 10^3 persons in the target year 2020. Since the population served by the existing water supply schemes will not increase, the water supply coverage in 2020 will decrease to 5.1% due to increased population, should the Project not be implemented.

Contrary to this, if all the water supply schemes planned in the Project are developed, about 40.7 x 10^3 persons will be served water by the schemes. The total population served will become 45.0 x 10^3 persons adding the population served by the existing water supply schemes. Therefore, the water supply coverage in the target villages will be improved up to 53.6% in the target year 2020. Although it is less than the target of 65% set by MoW, implementation of the project will much contribute to improving water supply coverage.

The target villages and planned water supply schemes are summarized in Table 2.1, and the number of recipients is shown in Table 2.2. Table 2.3 shows the difference between the case with project and without Project.

Table 2.1 Target Village and Planned Water Supply Schemes

District/Municipality	Village	Number of Level-2	Number of Level-1
Igunga District	Busomeke	0	7
	Kalemera	0	5
Nzega District	Makomelo	0	6
	Isanga	1	0
	Kitangili	0	10
	Wella	0	7
Sikonge District	Kasandalala	0	7
	Usunga	0	5
	Mpombwe	0	8
Tabora Rural District	Mpumbuli	1	3
	Mabama	1	2
	Ufuluma	0	7
Tabora Municipality	Kakola	1	2
	Misha	0	5
	Usui	0	8
Urambo District	Imalamakoye	0	4
	Kapiula	0	5
	Kalembela	0	7
	Kiloleni	0	6
	Usungwa	0	10
Total		4	114

Table 2.2 Population in the Target Villages, Population to be Served and Water Supply Coverage

District /Municipality	Ward	Village	Population		Population served by existing WSS (2009)	Coverage by existing WSS (2009) (%)	Coverage by existing WSS (2020) (%)	To be served by the project (2020)	Number of Level-2 Sub-projects	Population served by Level-2 (2020)	Number of Level-1 Sub-projects	Population served by Level-1 (2020)	Population served by the Project (2020)	Total Population served (2020)	Coverage (by the Project: (2020) (%)	Coverage (Target Population: (2020) (%)
			2009	2020												
Igunga	Mwisi	Busomeke	3,618	5,227	250	7	5	4,977	0	0	7	1,750	1,750	2,000	34	38
	Mwisi	Kalemala	2,429	3,509	0	0	0	3,509	0	0	5	1,250	1,250	1,250	36	36
Nzega	Ijanija	Makomelo	1,005	1,319	250	25	19	1,069	0	0	6	1,069	1,069	1,319	81	100
	Lusu	Isanga	1,491	1,956	0	0	0	1,956	1	1,956	0	0	1,956	1,956	100	100
	Miguwa	Kitangili	2,664	3,496	0	0	0	3,496	0	0	10	2,500	2,500	2,500	72	72
	Wela	Wela	1,753	2,301	500	29	22	1,801	0	0	7	1,750	1,750	2,250	76	98
Sikonge	Igigwa	Kasandalala	2,282	3,332	250	11	8	3,082	0	0	7	1,750	1,750	2,000	53	60
	Kipanga	Usunga	1,894	2,766	250	13	9	2,516	0	0	5	1,250	1,250	1,500	45	54
	Pangale	Mpombwe	3,435	5,015	250	7	5	4,765	0	0	8	2,000	2,000	2,250	40	45
Tabora Rural	Kizengi	Mpumbuli	2,157	3,148	0	0	0	3,148	1	2,658	3	490	3,148	3,148	100	100
	Mabama	Mabama	4,329	6,321	500	12	8	5,821	1	5,471	2	350	5,821	6,321	92	100
	Ufuluma	Ufuluma	5,741	8,382	250	4	3	8,132	0	0	7	1,750	1,750	2,000	21	24
Tabora Urban	Kakola	Kakola	2,015	3,483	0	0	0	3,483	1	2,983	2	500	3,483	3,483	100	100
	Misha	Misha	759	1,312	0	0	0	1,312	0	0	5	1,250	1,250	1,250	95	95
	Uyui	Uyui	3,138	5,424	250	8	5	5,174	0	0	8	2,000	2,000	2,250	37	42
Urambo	Imalamakoye	Imalamakoye	2,509	4,292	1,000	40	23	3,292	0	0	4	1,000	1,000	2,000	23	47
	Kapilula	Kapilula	1,568	2,682	0	0	0	2,682	0	0	5	1,250	1,250	1,250	47	47
	Kiloleni	Kalembela	3,131	5,356	0	0	0	5,356	0	0	7	1,750	1,750	1,750	33	33
	Kiloleni	Kiloleni	1,653	2,828	250	15	9	2,578	0	0	6	1,500	1,500	1,750	53	62
	Uyowa	Nsungwa	6,911	11,821	250	4	2	11,571	0	0	10	2,500	2,500	2,750	21	23
Total			54,482	83,970	4,250	7.8	5.1	79,720	4	13,068	114	27,659	40,727	44,977	48.5	53.6

Table 2.3 Effectiveness of Implementation of the Project

Year/Item		With Project	Without Project
2009	Population	54,482	54,482
	Population served by existing water supply schemes	4,250	4,250
	Water supply coverage (%)	7.8	7.8
2020	Population	83,970	83,970
	Population served by existing water supply schemes	4,250	4,250
	Population served by th Project	40,727	0
	Water supply coverage by the Project (%)	48.5	0
	Total population served	44,977	4,250
	Water supply coverage (%)	53.6	5.1

In the Project, it is included to procure the geophysical survey equipment for improvement of the success rate of well drilling in the Project, and improvement of water supply coverage by groundwater development after the completion of the Project.

- Electro-Magnetic Survey Equipment : 1 set
- Two-Dimensional resistivity Survey Equipment : 1 set
- Global Positioning System (GPS) : 4 sets

2.2 OUTLINE DESIGN OF THE JAPANESE ASSISRTANCE

2.2.1 DESIGN POLICY

2.2.1.1 Target Villages and Selection of the type of Water Supply Schemes

The contents of the request made by the Tanzanian side are as follows:

- to construct six (6) piped water supply schemes (Level-2) and 174 deep wells with hand pumps (Level-1) in 20 target villages.
- to procure geophysical survey equipment and Global Positioning System

Since the Tabora Region is a difficult area to develop groundwater, test wells were drilled in the target villages for the Level-2 to evaluate the groundwater sources suitable for Level-2. Suitable groundwater sources were obtained at four (4) villages. The proposed sites for Level-1 were selected based on the survey results on topography, geology, hydrogeology and conditions of existing water supply schemes. Those results are summarized in Table 2.1 (page 2-1) and Table 2.2 (page 2-3).

(1) Test Well Drilling Plan

1) Criteria for successful water source

The following two (2) criteria were applied to evaluate the successful water source.

<Groundwater yield>

Capable of yielding water to satisfy the water demand of each target village planned in the Study.

<Water Quality>

To satisfy the WHO Guideline (2008) for items related to health significance except for Fluoride, and the Tanzanian Health Standard (2008) for Fluoride and other items.

2) Drilling sites

Two (2) test wells were basically allocated to each water source, therefore, a total of 14 test wells were planned to be drilled. The second test well will be drilled if the first well is not successful. In addition, three (3) test wells were drilled in Igunga District to evaluate the groundwater quality. Thus, the total number of test wells becomes 17 in maximum. Ufuluma Village in Tabora Rural District was added based on the field survey by the Study Team. The test well drilling plan is shown in Table 2.4.

The actual number of test wells drilled was 16 wells as shown in Table 2.5.

3) Alternative solution in case no suitable groundwater source is available

Results of test well drilling are evaluated applying the criteria described in (1) above. If quantity of yield of well is not enough for the Level-2 scheme, a Level-1 scheme is provided instead of Level-2. When water quality is not suitable for drinking, the village is excluded from the target village.

Table 2.4 Test Well Drilling Plan

District/Municipality	Village	Water Source (well)	Maximum Number of Test Well (well)
Nzega District	isanga	1	2
Sikonge District	Usunga	1	2
	Mpombwe	1	2
Tabora Rural District	Mpumbuli	1	2
	Mabama	2	4
	Ufuluma	1	-
Tabora Municipality	Kakola	1	2
Sub-Total		8	14
Igunga District (for evaluation of water quality)	Igumo	-	1
	Buhekela	-	1
	Kagongwa	-	1
Sub-Total		0	3
Grand Total		8	17

(2) Evaluation of Test Well Drilling

Results of the test well drilling in 10 villagesare shown in Table 2.5

Table 2.5 Result of Test Well Drilling

Village	Well No.	Depth (m)	Yield (m^3/h)	Fluoride (mg/L)	Evaluation
Nzega District					
Isanga	No. 1	85	3.7	2.40	Yield: suitable for Level-2 by 2 wells
	No. 2	80	3.0	1.10	Fluoride: A～B
Sikonge District					
Usunga	No. 1	98	0.2	1.46	Yield: Insufficient forLevel-2 but sufficient for Level-1, Fluoride: A
	No. 2	150	0.8	2.53	Yield: Insufficient forLevel-2 but sufficient for Level-1, Fluoride: B
Mpombwe	No. 1	79	Dry	—	Unsuccessful
	No. 2	92	0.1	1.10	Yield: Insufficient, Fluoride: A, Unsuccessful
Tabora Rural District					
Mpumbuli	No. 1	50	Dry	—	Unsuccessful
	No. 2	130	9.0	3.95	Yield: suitable for Level-2, Fluoride: B
Mabama	No. 1	79	14.0	1.50	Yield: suitable for Level-2, Fluoride: A
	No. 2	82	0.8	2.24	Yield: Insufficient forLevel-2 but sufficient for Level-1, Fluoride: B
	No. 3	86	Scarce	3.20	Yield: Insufficient for both Level-2 and Level-1, Fluoride: B
Ufuluma	No. 1	86	Scarce	—	Unsuccessful
Tabora Urban					
Kakola	No. 1	108	6	1.61	Yield: suitable for Level-2, Fluoride: B
Igunga District（for Confirmation of Water Quality）					
Igumo		80	15.2*1 (1.0)*2	7.00	Yield: suitable for Level-1, Fluoride: C
Buhekela		70	Dry	-	Unsuccessful
Kagongwa		82	Dry	-	Unsuccessful

Note on Fluoride content

A： within the WHO Guideline (F＜1.5 mg/L)

B： more than the WHO Guideline but within the Tanzania Health Standard (1.5＜F＜4 mg/L)

C： more than the Tanzania Health Standard (4 mg/L＜F)

*1: yield during drilling

*2: yield after well completion

1) Evaluation of groundwater yield

A suitable groundwater source for Level-2 was obtained in four (4) villages: Isanga Village in Nzega District, Mpumbuli Village and Mabama Village in the Tabora Rural District, and Kakola Village in Tabora Urban. However, no suitable groundwater source was obtained in three (3) villages: Usunga Village and Mpombwe Village in Sikonge District and Ufuluma Village in Tabora Rural District.

2) Evaluation of water quality

A total of 31 water quality items were analyzed. The results are shown in Table 2.6.

As the result of water quality analyses," Items related to Health Significance" except for Fluoride contents are lower than those of the WHO Guideline (2008) and Fluoride contents and others are lower than those of the Tanzania Health Standard (2008).

3) Selection of water supply schemes by the results of test well drilling

Among the seven (7) target villages for Level-2, a necessary groundwater source was obtained in Isanga Village in Nzega District, Mpumbuli Village and Mabama Village in Tabora Rural District, and Kakola Village in Tabora Urban. However, no suitable groundwater source was obtained in the remaining three (3) villages. Therefore, the Level-2 water supply schemes will be constructed in the villages where a suitable groundwater source was obtained. The Level-1 water supply schemes will be constructed in other villages. Although the Level-2 water supply schemes will be constructed in the four (4) villages, some Sub-Villages in those villages are excluded from the service area of the Level-2 schemes due to unsuitable dwelling types, and topographical and hydrogeological conditions. Such Sub-Villages will be supplied water by Level-1 instead of Level-2.

(3) Proposed Sites for Level-1 Water Supply Schemes

Considering the study results described above, the Level-1 schemes were planned to be constructed in 19 villages. Three (3) villages out of 19, both Level-2 and Level-1 schemes will be constructed. The field survey was carried out to select the proposed sites for the Level-1 schemes considering the population, dwelling type (dense or scarce), topographical and hydrogeological conditions and opinion of community people. Finally, 115 sites were selected as the proposed sites for the Level-1 schemes. One (1) sub-village in Kakola Village was originally excluded from the service area of the Level-2 scheme in the plan, therefore, the sub-villages was to be supplied by the Level-1 scheme. However, it was confirmed by the Study in Japan that the Level-2 scheme in Kakola was capable to cover the sub-village. Therefore, the plan was changed to supply the sub-village by the Level-2 scheme instead of the Level-1 scheme. Accordingly, one (1) Level-1 scheme in the sub-village was cancelled and the total number of the Level-1 schemes became 114.

Electro-Magnetic surveys were carried out at two (2) or three (3) sites in 16 villages where construction of the Level-1 schemes were requested. However, detailed geophysical surveys are required to decide the drilling sites of deep wells for the Level-1 schemes.

Table 2.6 Result of Water Quality Analyses

Aspects and Items			Unit	WHO Guideline (2008)	Tanzania Health Standard (2008)	Nzega District		Sikonge District			Tabora Rural District			Tabora Urban	Igunga District
						Isanga 1	Isanga 2	Mpombwe	Usunga 1	Usunga 2	Mpumbuli	Mabama 1	Mabama 2	Kakola	Igumo
Microbial asptects	1	Total coliform bacteria	count/100mL	-	0	0	0	0	0	0	0	0	0	0	0
	2	Escherichia coli.	count/100mL	0	0	0	0	0	0	0	0	0	0	0	0
Chemicals that of health significance	3	Cadmium (Cd)	mg/L	0.003	0.005	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	4	Lead (Pb)	mg/L	0.01	0.10	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	5	Arsenic (As)	mg/L	0.01	0.05	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	6	Fluoride (F)	mg/L	1.5	4	2.4	1.1	1.1	1.46	2.53	3.95	1.5	2.24	1.61	7
	7	Nitrate (NO3)	mg NO_3/L	50	100	0.479	0.17	0.477	1	0.9	0.5	0.29	1.76	0.02	0.291
	8	Nitrite (NO2)	mg NO_2/L	3/0.2	-	0.01	0.01	0.02	0.6	0.01	0.01	0.01	0.02	0.01	0.01
	9	Nickel (Ni)	mg/L	0.07	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	10	Manganese (Mn)	mg/L	0.4	0.5	0.01	0.01	1.5	0.05	0.01	0.01	0.01	0.01	0.01	0.01
Acceptability aspects	11	Total hardness	mg/L	-	600	300	300	225	200	125	200	325	200	425	250
	12	Calcium (Ca)	mg/L	-	-	80	60	50	60	40	50	100	70	160	60
	13	Magnesium (Mg)	mg/L	-	100	24.3	36.48	24.3	12.16	6.08	18.24	18.24	6.08	6.08	24.32
	14	Iron (Fe)	mg/L	-	1.0	0.01	0.01	3.02	0.64	0.01	0.02	0.01	0.02	0.01	0.01
	15	Zinc (Zn)	mg/L	-	15.0	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	16	Copper (Cu)	mg/L	2.0	3.0	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001
	17	Chloride (Cl)	mg/L	-	800	88.6	53.1	88.6	194.97	53.17	212.7	124.07	141.8	159.5	70.9
	18	TDS	mg/L	-	2,000	475.2	377.8	459.2	468	134	685	592	590	600	570.9
	19	Ammonium (NH3-NH4)	mg/L	1.5	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	21	pH	-	-	6.5-9.2	7.6	7.4	7.6	7.5	7.8	7.7	7.1	7.2	7.7	7.8
	22	Taste	dilution	-	not objectional	no	no	no	no	no	no	no	no	no	no
	23	Odour	dilution	-	not objectional	no	no	no	no	no	no	no	no	no	no
	24	Colour	mg Pt/L	15	50	0	0	0	0	0	0	0	0	0	0
	25	Turbidity	NTU	5	30	0.99	2.53	942	1575	3.03	0.861	3.81	0.664	0.964	0.44
	26	Temperature (T)	^{0}C	-	-	28.6	28.7	28.8	26.5	26	28	26	26	25	28.7
	27	Conductivity (EC)	nS/m	-	-	86.4	68.7	83.5	93.7	268	137.5	118.3	118.1	120	103.8
Items related to characteristics of	28	Sodium (Na)	mg/L	-	-	60.2	18.8	86.9	119.37	3.22	220.5	121.9	176.41	79.81	121.4
	29	Potasium (K)	mg/L	-	-	1.5	2.4	3.3	7.7	2.2	4.9	1.7	6	2.1	4.6
	30	Biocarbonate (HCO3)	mg/L	-	-	300	300	200	200	50	200	325	200	300	250
	31	Sulphate (SO4)	mg/L	-	600	0.01	0.01	1.7	8	9.6	250	0.01	70	48	18.72

2.2.1.2 Procurement of Equipment

The request by the Tanzania side includes provision of geophysical survey equipment and Global Positioning System (GPS). The contents of the request are as follows:

(1) Electro-Magnetic Survey Equipment : 1 set

(2) Two Dimensional Resistivity Survey Equipment : 1 set

(3) Global Positioning system (GPS) 4 sets

(1) Geophysical Survey Equipment

The Tabora Branch of Lake Tanganyika Basin Office is responsible for management of groundwater resources in the Tabora Region. However, equipment owned by the Tabora Branch is not suitable for a precise groundwater survey due to aging. Therefore, it is difficult to be the centre of the assistance for groundwater development.

Although the Tabora Region is a difficult area to develop groundwater, effectiveness of geophysical survey methods applied in the Study was confirmed. They are Electro-Magnetic survey and Two Dimensional Resistivity survey. Therefore, it is expected that the success rate of drilling deep wells for the Level-1 scheme will be improved by adopting the same survey method as those applied in the Study (both Electro-Magnetic survey and Two Dimensional Resistivity survey). In addition, if the Tabora Branch of Lake Tanganyika Basin Office possesses the geophysical survey equipment after the completion of the Project, the Tabora Branch will act as the assistance centre for the groundwater development in the Tabora Region and groundwater development in the Region will be much accelerated. The Two Dimensional Resistivity survey equipment can be used as the ordinary resistivity survey such as the Schlumberger method. Therefore, it is useful to provide the requested geophysical survey equipment.

Having a hydrogeologist and geophysical survey staff, the Tabora Branch has a lot of experience in groundwater survey. Furthermore, the number of staff will be increased to strengthen the ability of groundwater surveying. The Tabora Branch has enough capacity to operate and maintain the geophysical survey equipment to be provided in the Project. To provide the requested geophysical survey equipment for the Tabora Branch will much contribute to the groundwater development and to improve water supply coverage in Tabora Region.

(2) Global Positioning System (GPS)

Accurate coordinates of the survey sites are indispensable when a groundwater survey is carried out. The drilling site of the deep wells shall be found by using the coordinates. The simplest way to obtain the coordinates is to measure those by a Global Positioning System (GPS).

In the Study, an inventory of existing water supply schemes (piped schemes and hand pumps) in the

Tabora Region. The inventory includes information on deep wells, groundwater, water supply conditions together with the coordinates. A hydrogeological map was constructed using this information. It is important to update the inventory and the hydrogeological map for future groundwater development. For this purpose, information of new deep wells constructed by local governments, NGOs, etc. shall be reported together with the coordinates. Since such data are collected by the staff of Water Engineer's Office in each District and Municipality, therefore, GPS shall be equipped for each Water Engineer's Office.

Updating of hydorogeological information will enable update of the hydrogeological map. It will much contribute to the groundwater development in theTabora Region by supplying much precise hydrogeological information. Therefore, to provide a GPS in the Project is useful for improvement of the water supply coverage in the Tabora Region. A GPS will be allocated to the Tabora Branch, Regional Water Expert in the Tabora Region, Water Engineer's Office in five (5) Districts and one (1) Municipality: Eight (8) in total. Four (4) GPS were used in the Study, these GPSs will be transferred to the Tanzanian side. Therefore, four (4) other GPSs are required to allocate to the Tabora Branch of Lake Tanganyika Basin Office, the Water Office of Tabora Region, and Water Engineer's Office in five (5) Districts and one (1) Municipality.

Training on the operation of GPS and updating method of the database will be carried out in the Supervision stage for the Regional Water Expert and Water Engineers by the Consultant.

It is considered to be most effective to update the database that each Water Engineer reports the obtained data to the Regional Water Expert and the Regional Water Expert updates the database. This system will make possible to evaluate whether the updating work in each District and Municipality is properly carried out or not. If updating is not proper in a District or Municipality, the Regional Water Expert will advise the Water Engineer.

(3) Software Component on Capacity Building for Groundwater Development

On the Job Training on the operation method of the Electro-magnetic survey and the Two Dimensional Resistivity survey equipment will be done in the Detailed Design stage by the Consultant. After the equipment is provided, the Consultant will carry out the technical training as the soft component programme on the maintenance of the equipment, management and control of survey data, and analysis of the data by mobilizing an engineer. The concrete software component programme is as follows.

1) Preparation of survey plan

The actual geophysical survey plan is prepared by the Japanese consultant before starting the field survey in the Detailed Design stage for smooth implementation because the field survey period is limited. Therefore, there is no chance for the staff of the Tabora Branch of the Lake

Tanganyika Basin Office. Since the staff have to prepare the survey plan and carry out the survey by themselves after the equipment is provided, it is important to train them how to prepare the survey plan considering the topography, geology and hydrogeological conditions.

2) Review of the analysis results of the surveyed data using the test well results

The geophysical survey will not directly detect the groundwater, it detects the geophysical characteristics of geological formations. The possibility of existence of groundwater is derived from the results of the analysis of the geophysical survey data. The drilling sites will be selected based on the analysis results. Evaluation whether the analysis result is proper or not, has to wait till the drilling data is obtained. In the construction stage of the Project, the first well is drilled at the sites determined by the Consultant. The analysis result of the geophysical survey data should be reviewed comparing the drilling results in the process of the drilling programme. The staff of the Tabora Branch will learn much better analysis technique through these processes. It will contribute the groundwater development in Tabora Region. The Consultant will give such training to the staff of the Tabora Branch.

2.2.1.3 General Concept of the Design

1) The target year of the Project is 2020 as agreed in the discussions of the Scope of Work of the Study between the Tanzanian side and the Japanese side.

2) Water demand for the Project is estimated based on the population of the target villages in 2020 (target year). The unit water demand is 25 L/capita/day. Although water demand for the communal facilities such as schools and dispensaries is not considered, the public water points will be constructed beside such facilities for convenience. Most of the users of the communal facilities are people in the community where the facilities exist.

3) Water sources are principally groundwater. Groundwater is pumped up by submersible pumps. Depth of deep wells is generally from 80 to 150m: It is determined using the geophysical survey results and relation between the aquifers and target villages.

4) Four (4) piped water supply schemes with public water points (Level-2) will be constructed in four (4) villages and 114 deep wells with hand pumps will be constructed in 19 villages. Some Sub-Villages in the target villages of the Level-2 are not covered by the Level-2, such Sub-Villages will be covered by Level-1. Location of Level-1 is determined considering hydrogeological conditions.

5) The type of electric sources for the intake facilities are basically diesel generators. However, commercial power supply or solar power is considered if the water tariff too much for the community people.

6) Raw water pumped from water sources is transmitted to the distribution tank by the head of the submersible pump. No booster pump is planned in the transmission lines.

7) Raw water is distributed by gravity from the distribution tank without chlorination

8) Considering the topographic conditions, the type of the distribution tank is 15m of height of elevated one. One (1) Level-2 scheme has only one (1) distribution tank, no auxiliary tank nor booster pump is planned in the distribution lines. The service area is limited within the area where water is reachable by gravity from the distribution tank.

9) One (1) public water point will supply a maximum of 250 persons. Each public water point is basically allocated within 400m from the residences of the community people. Two (2) types of public water point – Type-1: with single tap type and Type-2 with double tap type – will be adopted. Double tap type will be used for the crowed area and/or school area.

10) The WHO Guideline (2008) is applied for evaluation of "Items related to health significance" except Fluoride. For the evaluation of Fluoride and other items, the Tanzania Health Standard (2008) is applied.

11) The Design Manual for Water Supply and Waste Water Disposal –Third Edition (MoWI, 2009) is applied in the designing of the water supply schemes. Items not described in the Manual, are designed following the Japanese Design Standard fro Water works Facilities.

12) Applicable standards for materials and equipment are those widely applied in Tanzania such as ISO, BS, SABS, DIN, ASTEM/JCS, JEC, JEM and JIS.

2.2.1.4 Concept against Natural Conditions

A rainy season (from October to May) and a dry season (from June to September) exist in the Tabora Region. Access to the sites is basically no problem in the dry season but the access is much worsened in the rainy season. Such condition shall be taken into consideration in formulating the work plan of construction of the water supply schemes.

2.2.1.5 Concept against Socio-Economic Conditions

The User-Pay-Principle (UPP) is introduced in the operation and maintenance of the water supply schemes to be constructed in the Project. The water tariff for use of the schemes shall be set to realize full cost recovery for operation and maintenance, but also, not to exceed affordability of the target communities. The tariff would be set in the careful consideration of Willingness-to-Pay (WTP) and Affordability-to Pay (ATP) of the communities.

If the calculated water tariff is an overburden to the community, alternative measures such as using commercial power supply or solar power are considered to reduce the water tariff. Even if the water tariff is still too much when solar power is introduced, the type of water supply scheme will

be changed from Level-2 to Level-1.

2.2.1.6 Concept for Construction Works and Procurement

(1) Access to the Target Villages

The roads in the Study area are not paved except within the Tabora Municipality and the section between Nzega and Igunga Towns. These are generally less than 3m in width, therefore, it is sometimes difficult for heavy vehicles to access the sites.

As mentioned in 2.2.1.4 above, much attention shall be paid to the access to the sites in the rainy season in the implementation plan.

(2) Procurement Plan

1) Materials for construction works

Sand for backfilling of pipes is supplied in the Tabora Region, therefore, sand shall be purchased in the Tabora Region. A stable supply of other materials such as cement, reinforcing steel, aggregates and wooden forms are not expected in the Tabora Region, therefore, those shall be purchased in Dar es Salaam.

2) Pipes for deep wells and water works

PVC and HDPE pipes that withstand pressure up to 1.6 MPs used in the Project are processed by two (2) major Tanzanian manufacturer using raw chips imported from Middle Eastern countries. Quality of these materials is good enough to be used in the Project. In the Tabora Region, these are sold, however, supply of a large amount of pipes and a stable supply cannot be expected. Therefore, those shall be purchased in Dar es Salaam.

If pipes which withstand pressure of more than 1.6 MPa are required, Carbon Steel Pipes for Pressure Service (STPG) manufactured in Japan shall be used.

Submersible pumps and engine generators are not manufactured in Tanzania.

Submersible pumps shall be imported from Japan or third countries considering the supplying of spare parts and after service. Engine generators shall be Japanese in order to make it possible to discharge the exhausted gas to the outside of the control house.

Hand pumps of which installation depth is less than 45m, shall be those recommended by MoW. These hand pumps are available in Dar es Salaam. There is no type of hand pumps recommended by MoW for those with an installation depth of more than 45m. Extra deep well pumps distributed in Tanzania are not ones of Village Level Operation & Maintenance (VLOM). VLOM type hand pumps for extra deep wells (Vergnet type and Blue net pumps) made in Europe are obtainable in African countries. Therefore, if the installation depth is between 45

and 90m, pumps manufactured in Tanzania or Europe shall be used.

3) Labour

Skilled workers such as facilitators, wood workers and concrete workers are not available in Tabora. Therefore, skilled workers shall be brought in from Dar es Salaam.

2.2.1.7 Concept on Local Contractors

Construction contractors in Tanzania are all registered with the Contractor Registration Board (CRB). Approximately 6,000 contractors are registered (as of October 2010). They are ranked from Class 1 to Class 7 in descending order according to the capital, experience, machinery possessed and so on. Contractors ranked as Class 1 consist of 46 companies in the civil sector (including 28 foreign companies) and 73 in the architectural sector (including 27 foreign companies). Local major contractors have enough experience in the construction of water supply facilities like this project implemented by Donors and International Organizations. When Japanese contractors work in Tanzania, these local contractors ranked as Class 1 are available as sub-contractors.

2.2.1.8 Concept of Improved Operation and Maintenance

In implementation of the Project, the concept of Community-Owned Water Supply Organization (COWSO) is introduced, through establishment of Water User Association (WUA) and/or Water User Group (WUG) instead of conventional Village Water Committee (VWC), through capacity development in operation and management with enhancing community sense of ownership.

Although there is a variety of organizational forms in COWSO, it is assessed that, considering technical and managerial requirements for Level-2 facilities and a number of Level-1 facilities in target communities to be constructed under the Project, the WUA is a suitable management option for operation and maintenance. Thus, establishment of WUA is aimed at implementation of the Project.

It can be said the provision of institutional support by local (i.e. district) authority to the communities is indispensable for sustainable community-based management for the supply scheme facilitated by COWSO described above. It is due to the fact that lack of institutional support, such as technical guidance for the community in formation of community-based organizations, organizational management, financial management and accounting, and follow-up and monitoring, has been stated as one of major problems in operation and maintenance of rural water supply schemes, which is also regarded as one of causes for the low functional rate of the supply scheme in the Project area. In order to strengthen capacity of local authorities, a guiding model has been facilitated in the country to form and develop capacity of District/Municipal Water and Sanitation Team (DWST/MWST), which is formed under each District/Municipal Council and consists of

District/Municipal Water Engineer (DWE/MWE), District/Municipal Planning Officer, District/Municipal Health Officer, District/Municipal Community Development. However, some of the DWSTs/MWSTs in the Study area are inactive, and some of them are not functioning as expected. Thus, to improve the capacity of DWSTs/MWSTs in the Study area, basic training for improved operation and maintenance was provided under the Study. In implementation of the Project, their capacity is further enhanced through introduction of the software component program.

Considering the concept of software component production under grant aid project that primal technical support necessary for initial operation shall be provided, the program under the Project facilitate establishment and capacity development of COWSO as well as enhancement of technical guidance to be provided by local authority. However, implementation of technical cooperation project/program is expected for strengthening further capacity of COWSO and district authority in the long term.

2.2.1.9 Grade on Water Supply Facilities

Types of water supply schemes are decided considering (1) groundwater development potential, (2) suitability of water quality and (3) affordability to pay for operation and maintenance costs.

Four (4) villages out of 20 villages were evaluated to satisfy all the criteria, therefore, Level-2 schemes are planned to be constructed. However, some Sub-Villages are excluded from the service area of the Level-2 scheme in three (3) villages out of four (4) villages, such Sub-Village will be served by the Level-1 scheme instead of the Level-2 scheme.

The remaining 16 villages were evaluated suitable for construction of the Level-1 schemes. Therefore, the total number of villages where the Level-1 schemes are constructed is 19.

2.2.1.10 Construction Method, Procurement Plan and Construction Period

(1) Construction Method and Procurement Plan

Construction work of the water supply schemes consists of drilling of deep wells, earthworks, laying out water pipes, concrete works, machinery/electric works and other works. Special techniques are not required for these works. Local techniques and machinery used in Tanzania are applicable to the construction works. Materials for water supply facilities are procured in Tanzania. However, a few machines such as submersible pump and engine generator will be procured from foreign countries such as the EU, South Africa and Japan.

PVC and HDPE pipes to be used in the Project are produced in Tanzania applying the ISO Standard. Diameters of the pipes are 32, 40, 50mm of HDPE pipes and 63, 90, 110 and 160 mm of PVC pipes to adopt the gate valves of which diameters are 25, 32, 40, 50, 75, 100 and 150 mm. Three (3)

types of pressure bearing intensity of Class 10 (1.0 MPa: 100m of head), Class 12 and Class 16 are available, therefore, it will be decided after considering the results of hydraulic calculation.

Medium class GSP pipes (1.0 MPa) are used for exposed piping. However, galvanized steel pipes (GSP: 1.6 MPa) to be used in the control houses are not available in Tanzania, therefore, STPG pipes shall be purchased in Japan.

(2) Construction Period

The number of target villages is many (20 villages) and the type of water supply schemes are two (2), Level-2 and Level-1. The sites are widely distributed in the entire Tabora Region. The construction period will require 35 months from the conclusion of the consulting services to the completion of the construction works. Therefore, the Project will be implemented with the Government Bond Scheme throughout four (4) fiscal years.

2.2.1.11 Priority of the Target Villages

District/Municipality wise priority of all villages in the study area including the target villages was established in the Study (The Study on Rural Water Supply in Tabora Region (this Study, 2010). It was agreed between the Tanzanian side and the Study Team to apply the evaluation results to the priority of target villages.

2.2.1.12 Concept on the Power Supply of the Level-2 Scheme

(1) Intake and Transmission Systems

Following three (3) kinds of alternative power sources are considered for the Level-2 schemes in the Study.

- (Diesel engine generator) + (Alternative current submersible pump)
- (Commercial power supply) + (Alternative current submersible pump)
- (Solar system) + (Direct current submersible pump)

Characteristics of each system are summarized in Table 2.7.

Table 2.7 Characteristics of Intake and Transmission Facilities

Intake and Transmission System	Characteristics
(Diesel engine generator) + (Alternative current submersible pump)	－Generally used in the water supply project under the Japanese Grant Aid Project. Possible to use without consideration on yield of deep well, daily radiation and supply condition of commercial power supply. －Possible to select suitable capacity according to necessary pumping rate. －Maximun operation hour is 14 hours. －Operation cost is hgh due to using diesel oil.
(Commercial power supply) + (Alternative current submersible	－Power lines must be reached to the village for introducing commercial power supply.

pump)	－Possible to select suitable capacity according to necessary pumping rate.。 －Operation cost is much lower than that of diesel engie generator. －Cost to construct the branch line is required.
(Solar system) + (Direct current submersible pump)	－Operation hours restricted according to the sunshine duration. Operation hours are about 8 hours. －Batteries are required to expand the operation hours. Cost to replace the batteries every 2 to 4 years is an overburden on community people. －Initial construction cost is high. －Capacity of the submersible pump is limited. Head is 95 to 115m in the Project, therefore, mzximum capacity of pump is 2.7 to 2.5 m^3/hour. －Operation cost is extreamely low because electric power is generated by solar energy.

(2) Related Environment to Water Supply in the Target Villages

In order to decide the intake and transmission system, related environment is summarized in Table 2.8.

Table 2.8 Related Environment to Water Supply in the Target Villages

Village, District/Municipality	Related Environment
Isanga, Nzega Distrtict	1) Commercial power supply line reached the village, is available. 2) Constrcution of about 2.5km of the branch power line is required. 3) Yield of the deeo well is 2.24 m^3/hour/well, therefore, it is posible to pump up by solar pump. However, yield of both wells is too small to satisfy the water demand in the vilalge by 8 hours of pumping. 4) Using Commercial power supply enables 16 hours of operation of a submersible pump. In this case, 1 deep well is capable to satisfy the water demand. In addition, one set of control house and transmission pipeline (distance: about 2.0km). 5) If commercial power supply is not used, two sets of control house and transmission pipeline (distance: about 2.0km) are required.. Therefore, construction cost becames high. In case of the solar system, construction cost becames much higher because two (2) setsof solar panel are required.
Mpumbuli, Tabora Rural District	1) Commercial power supply is not available. 2) 6.09 m^3/hour of yield is required, but no solar pump has the capacity to pump up 6.09 m^3/hour.
Mabama, Tabora Rural District	1) Commercial power supply is available in the village. 2) Construction of 0.3km of branch power line is required. 3) 12.54 m^3/hour of yield is required, but no solar pump has the capacity to pump up this yield.
Kakola, Tabora Municipality	1) Commercial power supply is not available in the village 2) 5.86 m^3/hour of yield is required, but no solar pump has the capacity to pump up this yield.

(3) Construction Cost of Branch Power Line

As mentioned above, commercial power supply is available in Isanga and Mabama Villages. In order to use the commercial power supply, it is necessary to construct a branch line from the main

power line to the site, about 2.5km in Isanga and about 0.3km in Mabama. In addition, construction of an intake facility is required including a power transformer.

In general, the construction cost of the branch power line is borne by the recipient country. It is likely difficult for Nzega District and Tabora Rural district to absorb such cost. District-wise budget, total budget and water sector, is shown in Table 2.9.

Table 2.9 District-Wise Budget of Total Sector and Water Sector

District /Minicipality	Item	Fiscal Year/Annual Budget(x10^6 Tsh)			
		2007/2008	2008/2009	2009/2010	2010/2011
Igunga District	Total	10,474.2	11,032.5	15,347.1	20,027.0
	Water Sector	454.5	858.9	696.0	2,943.6
Nzega District	Total	13,172.4	13,655.7	21,757.4	23,651.2
	Water Sector	1,186.6	979.2	1,013.4	1,014.4
Sikone District	Total	4,772.9	6,034.4	8,955.3	10,294.1
	Water Sector	365.4	541.0	570.0	749.8
Tabora Rural District	Total	9,956.1	10,135.5	11,397.8	11,911.4
	Water Sector	180.0	195.6	205.4	224.5
Tabora Municipality	Total	-	4,427.0	5,335.3	6,997.4
	Water Sector	-	407.8	469.2	1,287.1
Urambo District	Total	15,315.9	15,848.9	17,130.2	23,107.2
	Water Sector	700.6	778.5	674.3	3,878.0

Isanga Village and Mabama Village, where commercial power supply is available, belong to the Nzega District and Tabora Rural District, respectively. The annual budget for the water sector in Nzega is in a range from 979.2 to 1,186.6 x 10^6 Tsh. It is about 4.3 to 9.0% of the total budget. It was 9.0% in 2007/2008 fiscal year, but it was suddenly deceased to 4%. The budget for the water sector in 2009/2010 and 2010/2011 years are 1,013.4 x 10^6 Tsh and 1,014.4 x 10^6 Tsh, respectively. The construction cost of branch power line is about 74.8 x 10^6 Tsh, it is about 7.4% of the annual budget of the water sector in 2010/2011.

The budget for the water sector in Tabora Rural is in a range between 180.0 and 224.5 x 10^6 Tsh. The amount of the budget is gradually increasing year by year and its ratio of the total budget is almost stable, 1.8 to 1.9%. The construction cost of the branch power line is about 26.3 x 10^6 Tsh, it is about 11.7% of the annual budget of water sector in 2010/2011.

Considering the situation above, it is likely difficult for both Districts to absorb the construction cost.

Comparison of the monthly operation cost for operation of diesel engine generator and commercial power supply is shown in Table 2.10. Conditions of the comparison are as follows:

- Price of diesel oil: fuel price as of November 2011
- Electric charge: price list of TANESCO

Table 2.10 Comparison of the Operation Cost

Village	Diesel Engine Generator	Commercial Power Supply

Isanga Village	Fuel consumption (2 wells, 2 generators): 2.5 L/hour x 12 hours x 30 days x 2 sites ＝1,800 L/month Monthly fuel cost: 1,760 Tsh/L x 1,800 L/month ＝**3,168,000 Tsh**	Electric consumption: 2.2kw x 16 hour x 30days＝1,056kwh Basic charge: 2,303 Tsh/month Metered rate: 129 Tsh/kwh x 1,056 kwh＝136,224 Tsh Monthly electric charge: 2,303＋136,224＝**138,527 Tsh**
Mabama Village	Fuel consumption (1 well, 1 generator): 3.6 L/hour x 12hours x 30days ＝1,296 L/month Monthly fuel cost: 1,760 Tsh/L x 1,296 L/month ＝**2,280,960 Tsh**	Electric consumption: 7.5kw x 12 hour x 30days＝2,700 kwh Basic charge: 2,303 Tsh/month Metered rate: 129 Tsh/kwh x 2,700 kwh＝348,300 Tsh Monthly electric charge: 2,303＋348,300＝**350,603 Tsh**

The monthly operation cost for commercial power supply is 3,029,473 Tsh cheaper than that of diesel engine generator in Isanga and 1,930,357 Tsh cheaper in Mabama.

In Isanga, the construction cost of the water supply scheme including construction cost of the branch power line is lower than that of the water supply scheme with diesel engine generator. However, in Mabama, construction cost of branch power line is added to that of the water supply scheme. The operation cost of the commercial power supply will save about 1.9×10^6 Tsh compared with the operation cost of the diesel engine generator. The total saved cost in 14 months is equal to the construction cost of the branch power line. Therefore, introducing the commercial power supply is quite effective to reduce the cost to be borne by the community people.

Accordingly, it seems to be reasonable that the construction cost of the branch power line in Isanga and Mabama is borne by the Japanese side.

(4) Summary of Intake and Transmission System to be Applied in Villages

Types of the intake and transmission system were selected based on the study results mentioned from (1) to (3) above, as shown in Table 2.11.

Table 2.11 Intake and Transmission System to be Applied for the Level-2

Village	Selected Intake and Transmission System	Reasons	Notes
Isanga	(Commercial power supply) + (Alternative current submersible pump)	1) In case of commercial power supply, one (1) set of intake and transmission system is necessary. Although construction of the branch power line (2.5km) is required, the total construction cost including the branch power line is lower than those of other systems. 2) In case other than commercial power supply, two (2) sets of intake and transmission system are required. Therefrore, the toal construction cost will become high.	Length of the branchpower line: about 2.5km

		3) Operation and maintenance cost to be borne by the community people will much reduced by introduing the commercial power supply.	
Mpumbuli	(Diesel engine generator) + (Alternative current submersible pump)	1) Commerecial power supply is not available in the village.。 2) Solar system is not available due to lack of capacity of submersible pump vcompared with water demand of the village.	
Mabama	(Commercial power supply) + (Alternative current submersible pump)	1) Solar system is not available due to lack of capacity of submersible pump vcompared with water demand of the village. 2) Operation and maintenance cost to be borne by the community people will much reduced by introduing the commercial power supply.	Length of the branchpower line: about 0.3km
Kakola	(Diesel engine generator) + (Alternative current submersible pump)	1) Commerecial power supply is not available in the village.。 2) Solar system is not available due to lack of capacity of submersible pump vcompared with water demand of the village.	

Specification and capacity of intake and transmission system selected in the village are shown in Table 2.12 and Table 2.13.

Table 2.12 Specification and Capacity of Diesel Engine Generator and Alternative Current Submersible Pump

Village	Population served (person)	Daily supply rate (m^3/day)	Pumping rate (m^3/hour)	Operation hour (hour)	Head (m)	Electricity (kw)	Generator (KVA)	Notes
Mpumbuli	2,658	73.1	6.09	12	113.9	3.7	20	1 well
Kakola	2,983	82.03	5.86	14	113.2	3.7	20	1 well

This system consumes diesel oil, therefore, operation and maintenance cost is expensive. Affordability of community people shall be carefully examined.

Table 2.13 Specification and Capacity of Commercial Power Supply and Alternative Current Submersible Pump

Village	Population served (person)	Daily supply rate (m^3/day)	Pumping rate (m^3/hour)	Operation hour (hour)	Head (m)	Electricity (kw)	Branch power line (km)	Notes
Isanga	1956	53.79	3.36	16	107	2.2	2.5	1 well
Mabama	5471	150.45	12.54	12	115	7.5	0.3	1 well

2.2.1.13 Concept of Success Rate of Deep wells for the Level-1 Schemes

(1) Definition of Successful Well and Success Rate

The population served by a Level-1 scheme is a maximum of 250 persons. Since the Tabora area

is difficult for groundwater development, the minimum yield of deep wells for the Level-1 scheme is set 0.4 m^3/hour. A well which yields more than 0.4 m^3/hour, is called a "successful well (yield)" in this report. After a deep well satisfies this condition, water quality is checked in the laboratory. If the water quality meets the WHO Guideline (2008) for items related to health significance except Fluoride, and the Tanzania Health Standard (2008) for other items and Fluoride, the deep well is considered as successful well.

15.6 hours of pumping is required to supply water to 250 persons by 0.4 m^3/hour of yield. When the yield is 0.5 m^3/hour, necessary operation hours of the Level-1 well is 12.5 hours. It is difficult to construct extra deep wells exceeding the planned number of deep wells, therefore, an additional Level-1 well is not constructed even if the water demand is not satisfied by the constructed Level-1.

A flow chart for construction of the Level-1 scheme is shown in Figure 2.1.

The deep wells are basically drilled by DTH (Down-the-Hole) method except for the ground surface materials. No chemicals and mud water are not used in drilling, therefore, it is possible to confirm the yield when hitting the aquifer. Checking of water quality is also possible at the same time. In this stage, if the yield is apparently not enough, or water quality is not suitable, the well is considered as unsuccessful and a casing and screen are not installed. However, geophysical logging is carried out by putting water into the well to obtain the hydrogeological information.

If yield and water quality meet the requirement at the site, a precise yield is confirmed by a pumping test and detailed water quality is analyzed in the laboratory. Then final decision is made whether the well is successful or not.

In case that it is difficult to decide success or not by air lifting, a pumping test will be carried out to determine the precise yield. A water sample will be collected at the last stage of the pumping test for water quality analysis in the laboratory will determine if the well is successful or not. In addition, when water quality (especially Fluoride and salinity) is critical to meet the requirement or not, detailed water quality will be analyzed after installing the casings and screens.

Judging from the existing data, about 80% of wells were determined successful or not by in-situ measurement. The remaining 20% of wells were required pumping tests and water quality analysis in the laboratory to determine if they were successful or not

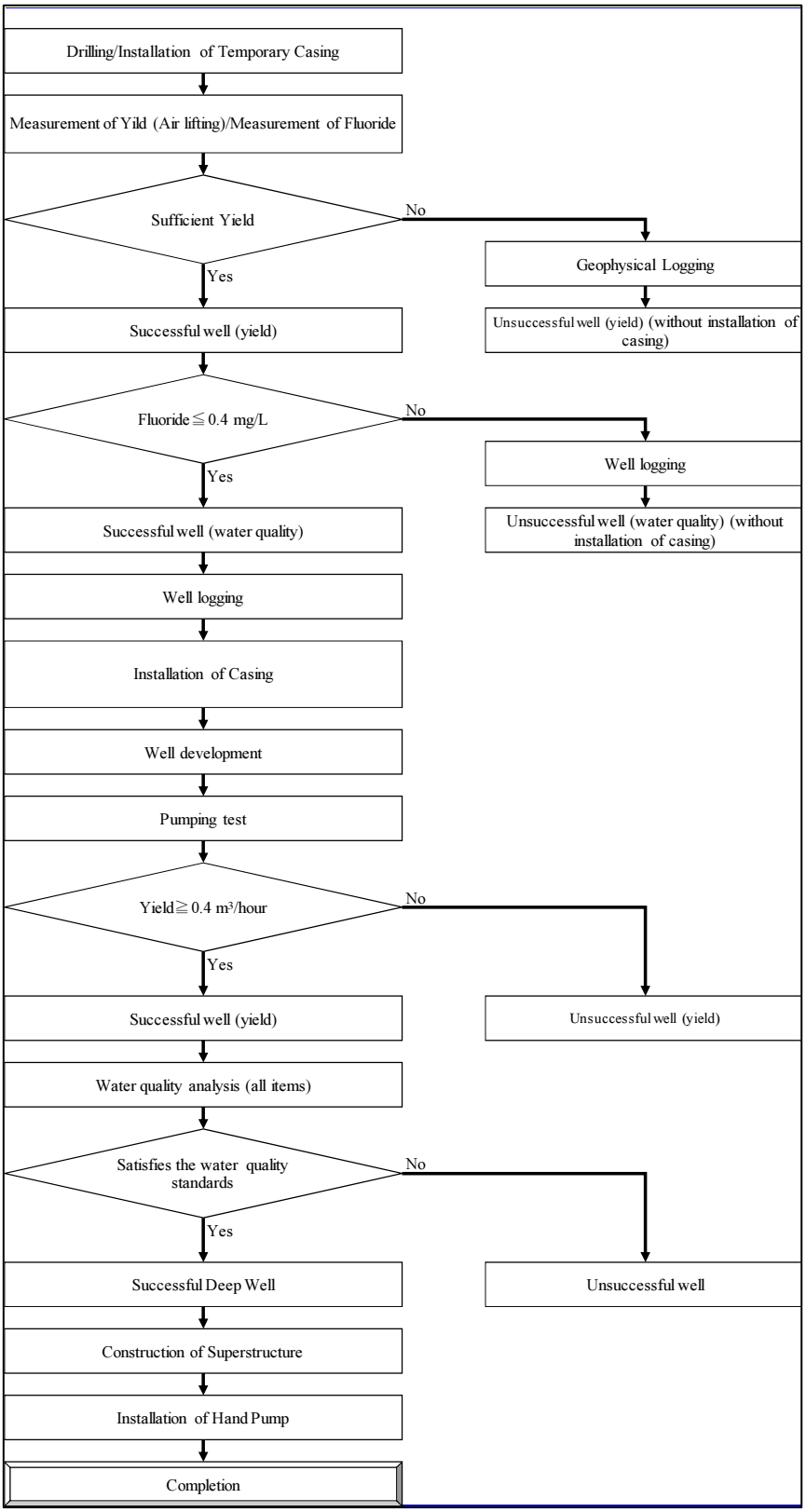


Figure 2.1 Flow Chart for Construction of the Level-1 Scheme

The total number of deep wells to be drilled is obtained by adding the number of unsuccessful wells due to lack of yield and unsuitable water quality to the target number of wells (114 wells in this

Project). Therefore, the success rate is calculated by dividing the number of successful wells by the number of total wells drilled.

(2) Characteristics of Aquifer by District and Planned Drilling Depth

The test well drilling revealed that there are regional differences in characteristics of aquifers between Sikonge District and other District/Municipality.

Table 2.14 shows a list of successful well (yield) and unsuccessful wells (yield) in the Sikonge District and other District/Municipality drilled as test wells in the Study.

No high permeable fissures were found in the test wells in the Sikonge District. Therefore, wells shall be drilled deeper (maximum depth: 150m) to get 0.4 m^3/hour of groundwater by collecting water from low permeable fissures.

On the one hand, high permeable fissures were found at a shallower depth from 30 to 100m in other District/Municipality. An average drilling depth of successful wells is 92m, therefore, it is expected that required yield of groundwater is obtained by drilling of wells up to a 90m depth.

Average depth of 90m is adopted for Districts/Municipality other than the Sikonge District and average depth of 150m for the Sikonge District.

The structure of wells for Level-1 scheme is shown in Figure 2.10 (Page 2-38).

Table 2.14 Result of Test Well Drilling (Depth and Success Rate (yield))

No.	District/Municipalit	Village	Well No.	Depth (m)	Water Strike (m):Yield (m^3/h)	Yield in drilling (m^3/h)
(Sikonge District: Successful Well (yield) (Yield ≧ 0.4 m^3/h)						
1	Sikonge District	Usunga	SK-028BH2	150	18:0.39, 53:3.5, 67:0.4, 135:0.4	0.8
			Average depth	150	m	
(Sikonge District: Unsuccessful well (yield) (Yield< 0.7m3/h)						
1	Sikonge District	Usunga	SK-028BH1	98	98:<0.2	0.18
2	Sikonge District	Mpombwe	SK-037BH1	79	0	-
3	Sikonge District	Mpombwe	SK-037BH2	92	0	0.3
	Sikonge District: Successful Well (yiled)(25.0%)					
(Districts other than Sikonge District: Successful Well (yield) (Yield ≧ 0.4 m^3/h)						
1	Igunga District	Igumo	IG-007BH1	80	62:10, 68:13.2, 73:15.7, 80:15.3	1
2	Nzega District	Isanga	NZ-047BH1	85	73:3.3, 80:3.3	3.5
3	Nzega District	Isanga	NZ-047BH2	80	80:2.8	2.7
4	Tabora Rural District	Mupumbuli	TR-054BH2	130	102.0:1.8, 120.0:7.0	7
5	Tabora Rural District	Mabama	TR-069BH1	79	61:6.6, 67:9.0, 73:11.0, 79:11.7	12
6	Tabora Rural District	Mabama	TR-069BH2	82	44:1.3, 48.5:1.8, 66:0.66, 72:0.67, 82:0.6	0.8
7	Tabora Municipality	Kakola	TU-008BH1	108	31.0:3.8, 36.0:4.6, 42.0:3.6, 45.0:4.7, 54.0:5.2, 60.0:5.4, 6	5.8
			Average depth	92	m	
(Districts other than Sikonge District: Unsuccessful well (yield) (Yield< 0.7m3/h)						
1	Igunga District	Buhekela	IG-012BH1	70	0	-
2	Igunga District	Kagongwa	IG-033BH1	82	0	-
3	Tabora Rural District	Mupumbulil	TR-054BH1	50	0	-
4	Tabora Rural District	Mabama	TR-069BH3	86	0	-
5	Tabora Rural District	Ufuluma	TR-098BH1	86	0	-
	Districts other than Sikonge: Successful well (yield)(58.3%=7/12)					

Source: This Study (2010).

As for the success rate of wells is examined in next Item together with the existing data.

(3) Success Rate of Wells for Level-1 Scheme

The existing well data were collected to examine the success rate of wells in the Study area. Data collected are as follows:

- Inventory of Drilling and Dam Construction Agency (DDCA)
- Borehole Catalogue prepared by MoW
- Well List cited in the report for "Tabora Region Water Master Plan" by International Bank for Reconstruction and Development (IBRD)
- Well List cited in the report for "The Study on Groundwater Development and Management in the Internal Drainage Basin" by JICA

The total data is 289 wells adding the data of the test well drilling to the data above. The number of wells of which yield are more than 0.4 m^3/hour is 135 wells, therefore, success rate is 46.7% (=135/289).

However, most of the data lack water quality data. The success rate will become lower if water quality (especially Fluoride) is considered.

On the one hand, the success rate judged for the test well drilling result is shown in Table 2.15.

Table 2.15 Summary of Yield and Water Quality of Test Wells

Yield	Fluoride Content	No. of Well	Ratio (%)	Ratio (%)
More than 0.4 m^3/hour	Less than WHO Guideline	2	12.5	87.5
	More than WHOGuidelinebut less than Tanzania Helth Standard	5	31.3	
	More than Tanzania Helth Standard	1	6.3	12.5
	Sub-Ttotal	8	50.0	100
Less than 0.4 m^3/hour	Less than WHO Guideline	2	12.5	
	More than WHOGuidelinebut less than Tanzania Helth Standard	1	6.3	
	More than Tanzania Helth Standard	0	0	
	Data, not available	5	31.3	
	Sub-Ttotal	8	50.0	
Total		16	100.0	

Source: This Study (2010)

A shown in Table 2.15, water quality of one (1) well exceeds the Tanzania Health Standard.

The Fluoride content was measured at 334 deep wells in the inventory survey carried out in the Study. The number of data exceeding the Tanzania Health Standard is shown in Table 2.16.

Table 2.16 Number of Data exceeding the Tanzania Health Standard

District/Municipality	No. of sample	Fluoride content, more than 4.0 mg/L	Ratio (%)
Igunga District	28	8	28.6
Nzega District	116	3	2.6
Sikonge District	18	0	0
Tabora Rural District	25	0	0
Tabora Municipality	25	0	0
Urambo District	122	0	0
合計	334	11	3.3

Source: This Study (2009).

Among eight (8) wells having yield more than 0.4 m^3/hour One (1) test well of which Fluoride contents is more than the Tanzania Health Standard is located in Igunga District. Other seven (7) wells are located in other District/Municipality and Fluoride content is less than 0.4 m^3/hour. As shown in Table 2.15, Fluoride content of 30% of the total wells exceeds the Tanzania Health Standard in Igunga District. In other District/Municipality, no or a few data are more than the Tanzania Health Standard. This tendency is almost same as that derived from the existing data (Table 2.16).

Considering above situation, success rates (water quality) of wells are set 71.4% in Igunga, 97.3% in Nzega, and 100% in other Districts and Municipality.

As shown in Table 2.15, success rate (yield) of wells is 50%, however, it is 43.8% if water quality is considered. Using all the existing data, District/Municipality-wise success rates are summarized in Table 2.17. The average success rate of the total area is 46.7%. It is the highest in Urambo (62.9%) and is the lowest in Sikonge (22.2%). The average success rate of the area except Sikonge is 54.1%.

Table 2.17 District/Municipality-Wise Success Rates

District/Municipality	Total No. of well	No. of wells (yield>0.4 m^3/hour	Ratio (%)
Sikonge District	9	2	22.2
(Area except Sikonge)			
Igunga District	58	13	22.4
Nzega District	106	57	53.8
Tabora Rural District	22	12	54.5
Tabora Municipality	24	7	29.2
Urambo District	70	44	62.9
Sub-total (Area except Sikonge)	280	133	54.1
Total	289	135	46.7

Source: This Study (2009)

As shown in Table 2.18, the success rate of the test is higher than that of all the existing data. It means that the Electro-Magnetic Survey and Two-dimensional Resistivity Survey method applied in the Study are effective for detecting fissures in the hard rock formation.

In the implementation of the Project, it is expected that it is possible to increase the success rate 5% more than that of the test wells by applying the Electro-Magnetic Survey and Two-dimensional Resistivity Survey method. Therefore, success rates are set 30.0% in Sikonge and 63.3% in other Districts and Municipality for the Project.

Table 2.18 Comparison of Success Rates of Total Data and Test Wells

Area	Existing Data and Test Wells			Test Wells only		
	Total No. of Wells	No. of Successful Well	Ratio (%)	Total No. of Wells	No. of Successful Well	Ratio (%)
Sikonge	9	2	22.2	4	1	25.0
Area except Sikonge	280	133	54.1	12	7	58.3
Total	289	135	46.7	16	8	50.0

Source: This Study (2010)

(4) Total Number of Wells to be Drilled

Based on the discussion above, the total number of wells to be drilled in the Project is calculated as shown in Table 2.19.

Table 2.19 Total Number of Wells to be Drilled

District/Municipality	Planned Well	Type	Success Rate	Unsuccessful Well	Number of Well to be Drilled
Igunga District	12	A	45.1%	15	27
Nzega District	23	A	61.3%	15	38
Tabora Rural District	12	A	63.2%	7	19
Tabora Municipality	15	A	63.3%	9	24
Sikonge District	20	B	30.0%	47	67
Urambo District	32	A	63.2%	19	51
Total	114		50.4%	112	226

Source: This Study (2010)

Finally, the total number of wells to be drilled is 226 wells.

2.2.1.14 Concept of Alternative Village

Successful wells for the Level-1 schemes are very low in Sikonge (22.2%) and relatively high in Urambo (62.9%). Although it is 22.4% in Igunga, located in the Internal Drainage Basin, it is a concern that wells meet groundwater with high content of Fluoride in the drilling In such case, it seems to be difficult to get a successful well in the site even if several wells are drilled.

A total of 114 successful wells are planned to be obtained for the sources of the Level-1 schemes. In order to get the planned number of wells, it is more reasonable to change the location to the alternative village from the target village than to continue the drilling of wells in the target village.

Therefore, alternative villages will be provided in the Project. In case the site moves to the alternative village, there two (2) options, to shift the entire drilling sites or some portion of the drilling sites. This concept is summarized in Table 2.20.

Table 2.20 Conditions and Contents to Shift the Sites to Alternative Village

Conditiosto Shift		Contents of Shifting
I. Two (2) consecutive wells are unsuccessful in a target village.		The site is shifted to the alternative village if it is considered to be difficult to get successful well by continuing drilling at the same site, judgeing from the drilling data and the hydrogeological situation.
II. Two (2) consecutive wells at more than two (2) sites in a same village are unsuccessful.		Drilling sites remained undrilled are shifted to the alternative village, if it is considered to be difficult to get successful well by continuing drilling at the same site, judgeing from the drilling data and the hydrogeological situation.
	A Successful well was not consecutively obtained at the first drilling site and the second drilling site.	All the sites are shifted ot the akternative village.
	B Two (2) wells are failed at the plural sites inconsecutively	Drilling site to be drilled the secoond unsuccessful site is shited to the alternative village.

Following procedure is taken to select the alternative village if a target village is shift to the alternative village.

The 20 target villages of the Project consist of 16 villages evaluated as priority-1 and four (4) villages evaluated as priority-2. Therefore, the alternative villages shall be selected from the same District/Municipality as the target village

The alternative villages shall be basically selected from the villages evaluated priority-2. If no village evaluated as priority-2 exists in a District/Municipality, the alternative village(s) will be selected from those evaluated as priority-3. The alternative village(s) will be sequentially from those with a higher priority.

The factors, which caused the wells to be unsuccessful, were either yield or water quality. Considering the situation of an unsuccessful well, it is decided which factor is important in selection of the alternative villages. Factors to be considered are water quality, groundwater potential and water supply coverage used in evaluation of the priority of the villages in the Study.

2.2.2 BASIC PLAN (CONSTRUCTION PLAN/PROCUREMENT PLAN)

2.2.2.1 The Target Year of the Project and Population to be Served

The target year of the Project is set 2020 as agreed in the discussion of the Scope of the Works of the Project.

Population in 2020 was projected by using the population surveyed by the Study Team in October

2010 and population growth rates estimated by National Bureau of Statistics, because no census data was available after the census in 2002. Population growth rates applied are shown in Table 2.18. The projected population in each District/Municipality is shown in Table 2.21. The population growth rate is high in Tabora Municipality and Urambo District, and low in Nzega District. The average growth rate of the Tabora Region is 3.6%. Population will be increased to 79,720 in 2020.

Table 2.21 Population Growth Rate of Each District/Municipality

District/MUnicipality	Growth Rate (%)	District/MUnicipality	Growth Rate (%)
Igunga District	3.4	Tabora Rural District	3.5
Nzega District	2.5	Tabora Municipality	5.1
Sikonge District	3.5	Urambo District	5.0

Source：The 2002 Population and Housing Census (National bureau of Statistics, 2003)

2.2.2.2 Water Demand

Unit water demand in Tanzania is 25 L/capita/day. Water demand of the Project was estimated by the following formula.

(unit water demand) x (population) = (water demand)

There are some schools and medical facilities (mainly dispensaries) and most of the users are the community people in the same village. If water demand of such facilities is considered, the target population will be duplicated. It will put too much pressure on the water supply schemes and overburden the water tariff by the community people. Therefore, the water demand of such facilities was not considered in the Project.

Considering the situation above, water demand and withdrawal plan of intake were set as shown in Table 2.22.

Table 2.22 Water Demand and Withdrawal Plan of Intake of the Target Villages of Level-2

District /Municipality	Village	Population to be Served	Water Demand (m^3/day)	Pumping Rate (m^3/hour))	Operation Hour (hour)
Nzega District	Isanga	1,956	48.90	3.36	16
Tabora Rural District	Mupumbuli	3,148	66.45	6.09	12
	Mabama	6,321	136.78	12.54	12
Tabora Rural District	Kakola	3,483	74.58	5.86	14

2.2.2.3 Design Flow and Hydraulic Calculation

The daily average flow is set in the Design Manual (MoW, 2009) considering 20% of leakage from the system. However, 10% of leakage was considered in the Study because the water supply schemes would be constructed by the Japanese contractor under the supervision by the consultant. The following concept was agreed with the Tanzanian side in the meeting held in November in

Tabora and Dar es Salaam. The next formula was applied to obtain the daily average flow.

Daily average flow (m^3/day) = Design daily water demand (m^3/day) x (100% + leakage (10%))

Daily maximum flow is from 20 to 30% in general, however, it is not considered in the Study in order to avoid over capacity of water supply schemes which will require too much overburden of operation and maintenance cost to the community people.

Daily maximum flow (m^3/day) = Daily average flow (m^3/day) x 100%

Hourly maximum flow was set at the peak time three (3) hours in the morning and three (3) hours in the evening.

Hourly maximum flow (m^3/day) = Daily maximum flow (m^3/day) / 6 (hours)

Operation hours of the intake are basically 12 hours, and 14 hours in maximum considering operation and maintenance. In case of the commercial power supply, the operation hours were set at 16 hours.

Hazen-William's Formula was applied for hydraulic calculation.

$H = 10.666 \times C^{-1.85} \times D^{-4.87} \times Q^{1.85} \times L$

H: Friction loss head (m)

C: Coefficient of velocity (110) including loss of bend (Design Standard for Water Works in Japan)

D: Inner diameter (m)

Q: Flow rate (m^3/sec)

L: Distance (m)

The diameter of the pipes was decided considering the result of hydraulic calculation assuming the velocity in pipes as less than 0.6 m/sec.

The water hammer was taken into consideration in designing transmission pipelines.

The water head at the public water points should be 5m or more and less than 25m as specified in the Design Manual. However, if it is difficult to keep the above conditions due to topographical or economical reasons at a public water point, 3m of water head in minimum and 50m of the same will be allowed. Any public water point in the locations where water head is less than 3m will not be constructed.

2.2.2.4 Facility Plan for Level-2 Water Supply Scheme

(1) Facility Plan

The Level-2 water supply scheme pumps up groundwater by a deep well and distributes water at the public water points through the elevated distribution tank by gravity. Each water supply scheme has one (1) distribution tank and no additional pump or tank is constructed in the transmission and distribution lines. Treatment system is not constructed. The facility plan is shown in Figure 2.2.

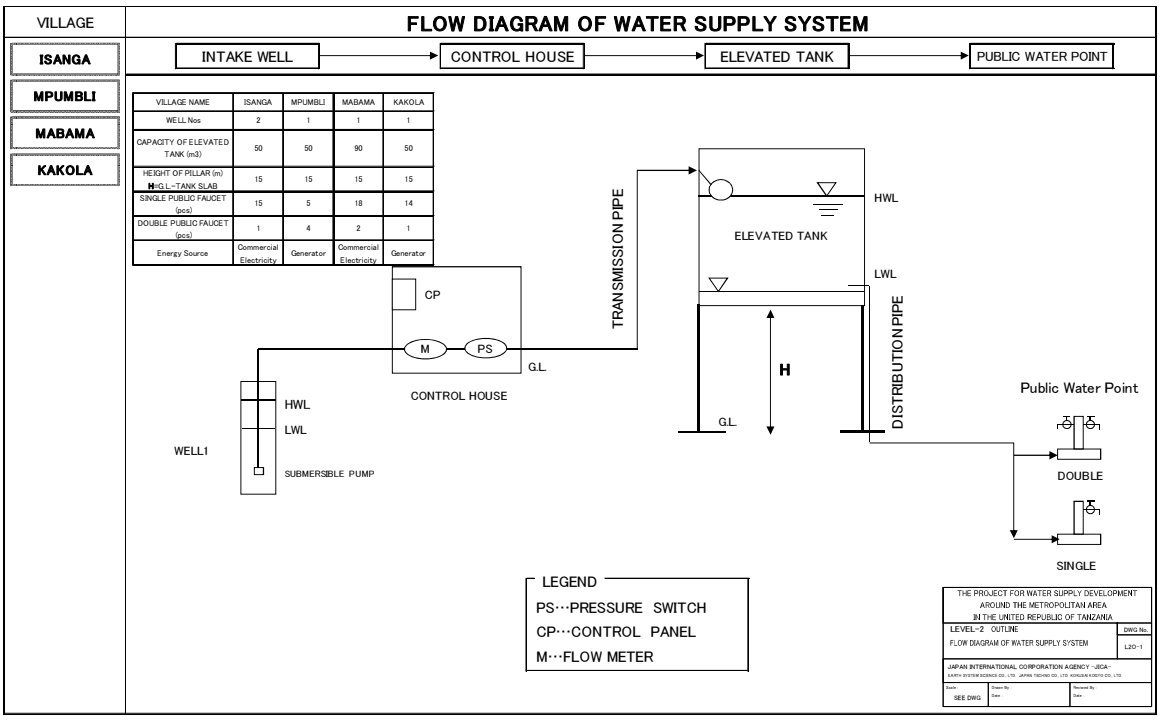


Figure 2.2 Framework of Level-2 Water Supply Scheme

Deep wells will be drilled and hand pumps will be installed for Level-1 schemes. Reinforced concrete pads will be constructed around wells/hand pumps. The drained water will be introduced to the soak-a-way pit. The facility plan is shown in Figure 2.3.

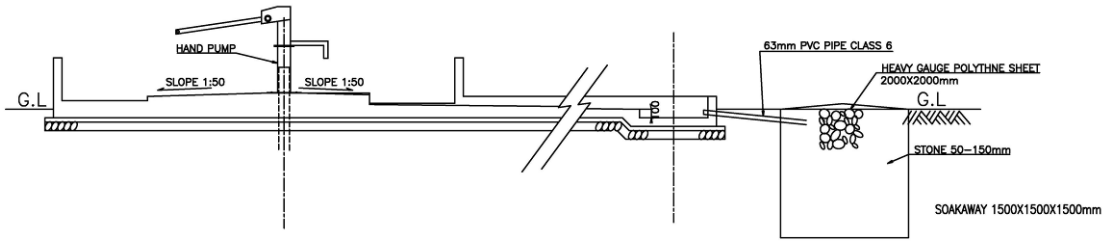


Figure 2.3 Framework of Level-1 Water Supply Scheme

(2) Water Source

1) Intake Facility

(i) Deep well

The water source is groundwater, and it is pumped up by a deep well. The water sources for the Level-2 schemes were already drilled in the test well drilling. Those wells are now properly protected up to the commencement of the implementation. The specifications of the deep wells are shown in Table 2.23.

Table 2.23 Specification of Deep Wells

	Level-2	Level-1	
Type	-	Type-A	Type-B
Target area	-	District other than Sikonge	Sikonge District
Drilling method			
- Sediments	(already drilled)	Mud-rotary method	
- Granite, Gneiss (hard rock)		Down-the-Hole method	
Drilling depth	75～125m	90m in average	150 m in average
Drilling diameter	8 inches	7-5/8 inches	
Diameter of casing	6 inches	4 inches	
Material of casing/screen pipe	PVC	PVC	
Opening ratio of screen pipe	4%	4%	
Pumping method	Submesible pump	Hand pump	

The annular space between the wall of the borehole and casing/screen pipe is packed by gravel. The space on the gravel packing is filled by cement milk to prevent deterioration by surface water. The structure of the deep wells is shown in Figure 2.8（page 2-34）.

(ii) Pumping rate

The discharge rate of each well for the Level-2 scheme is shown in Table 2.19 (page 2-25).

(iii)Water quality

The water quality of the water source is evaluated applying the WHO Guidelines (2008) for the items related to health significance except for Fluoride, and the Tanzania Health Standard (2008) for other items and Fluoride.

Fluoride content was initially planned to be evaluated applying the WHO Guidelines. However, the Fluoride contents of many test wells were more than the WHO Guidelines and within the Tanzania Health Standard. The community people will be obliged to continue using deteriorated traditional water sources if that groundwater is not used as the water source due to high contents of Fluoride. Therefore, MoW requested JICA to change the standard for evaluation of Fluoride content from the WHO Guidelines to the Tanzania Health Standard in the Project. JICA accepted this request providing that the community people in such villages were

informed of the possibility to cause fluorosis, mitigation measures should be taken to reduce exposure of Fluoride and proper standard for Fluoride content would be set in the future.

(3) Control House

A control house is constructed next to the water source (deep well), in which a control panel for the diesel engine generator and submersible pump is stored. The structure of the control house is block masonry considering the local construction conditions and easier construction methods. The pump will be is automatically stopped by setting a float valve in the distribution and a pressure sensor in the control house. It will be restarted manually. Concerning the water level in the well, the pump will be automatically controlled by high and low water level sensors in the well.

A ventilating duct is provided to evacuate exhaust gas from the diesel engine.

As shown in Table 2.11, a commercial power supply is introduced in Isanga village, Nzega District and Mabama Village, Tabora Rural District. The diesel engine generator is used in Mpumbuli Village, the Tabora Rural district and Kakola Village, Tabora Municipality. One (1) diesel engine generator is provided in Isanga and Mabama villages respectively for the auxiliary power source in case of electric power failure.

(4) Distribution Tank

1) Capacity and Type

Height of the distribution tank was set a 15m considering the topographical condition of the project sites. Capacity of each tank is basically half of the daily maximum flow, but it was set as $50m^3$ at Isanga, Mpumbuli and Kakola, and $90m^3$ at Mabama for effective construction works.

2) Excavation Work

The open-cut method is used for ground leveling work and excavation of foundation of structures. Backhoe (035 m^3) is used considering the condition of the site and the access road. Backhoe is used for excavation work and loading work. Surplus soil is carried out by a dump truck.

3) Construction of Concrete Structures

Type of reinforcement is deformed reinforcement procured in Tanzania. Frame work is carried out using locally procured wooden or steel frame. Concrete is mixed by mixer at the site and placed by manpower or crane.

(5) Pipeline

The HDPE pipe was used for small diameter pipes (outer diameter less than 50mm) and the PVC

pipe for larger diameter from 63 to 160mm. Pipes are laid manually along the road with 1 to 3m distance from the both side of the road. However, if it is difficult due to natural or artificial conditions, pipes may be laid under the roads. Laying depth (from ground surface to the top of the pipes) is at least 90m. Pipes are laid in the sand bed for protection: the sand bed covers up to 10cm above the top of pipes. In crossing the roads or laying under the roads, the pipes are laid in the depth more than 1.2m.

GSP pipes are used for crossing of small water flow of stream or channels and pipes are protected by concrete.

In case of crossing of the railway, pipes are laid in the sleeve pipes installed by pipe jacking method (horizontal drilling) under the railway. Material of the sleeve pipe is HDPE. Diameter is 300mm (2 sites) at Mabama) and 200m (1 site) at Kakola.

Valves such as gate valve, air valve and blowoff valve are properly installed following the Design Manual or the Japanese Design Standard for Waterworks Facilities. T-tube and bend pipes are properly protected by concrete blocks. In the probable flood areas during rainy season, pipelines are protected by concrete.

(6) Public Water Point

Public water points are provided basically within 400m from the residences for 150 to 250 persons taking surrounding environment (school, dispensary, etc.) into technical consideration. Intension of the community people was also considered. One (1) (type 1) or two (2) (type 2) taps are installed at each public water point. The type 1 supplies to 250 persons in maximum and type 2 to more than 250 persons. Table 2.24 shows the number of public water points in each village.

Table 2.24 Number of Public Water Point in each Village

Village	Type 1	Type 2
Isanga	15	1
Mpumbuli	5	4
Mabama	18	2
Kakola	14	1
Total	52	8

A water flow meter is installed before each public water point considering the collection of water tariff. Drain is constructed at each public water point.

2.2.2.5 Facility Plan for Level-1 Water Supply Scheme

The Level-1 water supply schemes of which water source is groundwater distributes water at the point water source installed on the deep well. Structure of the Level-1 is shown in Figure 2.3(Page 2-29).

The number of Level-1 water supply schemes to be constructed in the Project is 114 as shown in Table 2.1 (page 2-1).

Criteria for successful wells for the Level-1 schemes are as follows:

The maximum population served by a Level-1 scheme is 250 persons. As the Tabora area is a difficult area in development of groundwater, a deep well with the yield of 0.4 m^3/hour is considered a sucessful well, because the minimum yield to pump by a hand pump is 0.4 m^3/hour. The well satisfies this criteria, water quality of such a well is analyzed in the laboratory. If water quality satisfies the standards, the well is evaluated as a successful well. Standards to be applied are the same as those for Level-2 schemes.

About 15.6 hours of pumping is required to supply water to 250 persons if the yield is 0.4 m^3/hour. If the yield is 0.5 m^3/hour, the pumping hours are reduced to 12.5 hours. Since it is difficult to construct additional wells exceeding the planned number of wells in the village, no additional well is constructed even if the water demand of the village is not satisfied.

2.2.2.6 Procurement Plan for Equipment

Specifications of the electro-Magnetic Survey Equipment and the Two-Dimensional Resistivity Survey Equipment were decided considering the hydrogeological conditions in the Project sites.

(1) Electro-Magnetic Survey Equipment

- Measurements method : Electro-magnetic method (slingram system)
- Depth of penetration : More than 200m (length of cable: 100m and 200m)
- Measurement function : Maximum depth of penetration is automatically detected by the connected cable.
- Power requirement : 12 volts, 3 batteries

(2) Two Dimensional Resistivity Survey Equipment

- Measurements method : Multichannel, automatic measurement mode
- Measurement depth : 200m
- Electrode array : Pole-pole, pole-dipole and dipole-dipole

  Depth of penetration is manually changeable in measurement.
- Power requirement : Internal NiMh battery (rechargeable)

(3) Global Positioning System (GPS)

- Type : Touch screen portable GPS

- Receiver performance : More than 12 channels
- Accuracy : Less than 10m 95% typical
- Memory : Built in memory
- Interface : USB mass storage device

Power source : Two AA batteries

2.2.2.7 Waste Disposal

Waste generated in the construction works such as asphalt concrete, residual clay, etc. are carried to a waste disposal area appointed by Districts and Municipality. The average distance to the waste disposal area is about 4 km.

2.2.3 OUTLINE DESIGN DRAWING

The outline drawings to be constructed in the Project are as follows:

(1) Location of Target Villages (shown at the top of the report)

(2) Layout Plan of Level-2 Water Supply Schemes in each Village (Figure 2.4 to Figure 2.7)

(3) Deep Well Structure for Level-2 and Level-1 Water Supply Schemes (Figure 2.8)

(4) Cross Section of Transmission and Distribution Pipelines (Figure 2.9)

(5) Structure of Distribution Tank (Figure 2.10)

(6) Structure of Public Water Point (Figure 2.11)

(7) Structure of Level-1 Water Supply Schemes (Figure 2.12)

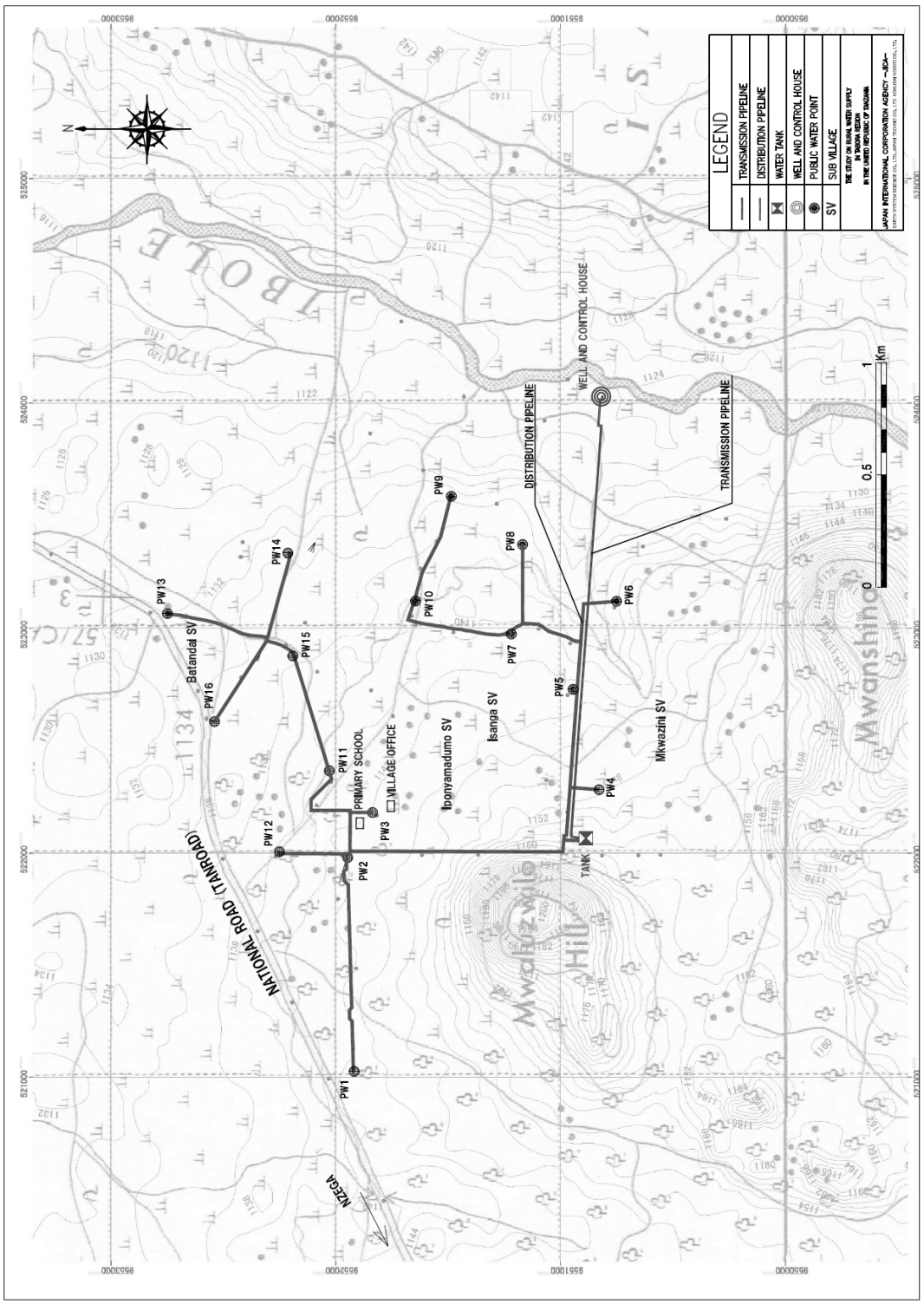


Figure 2.4 Layout Plan of Isanga Village, Nzega District

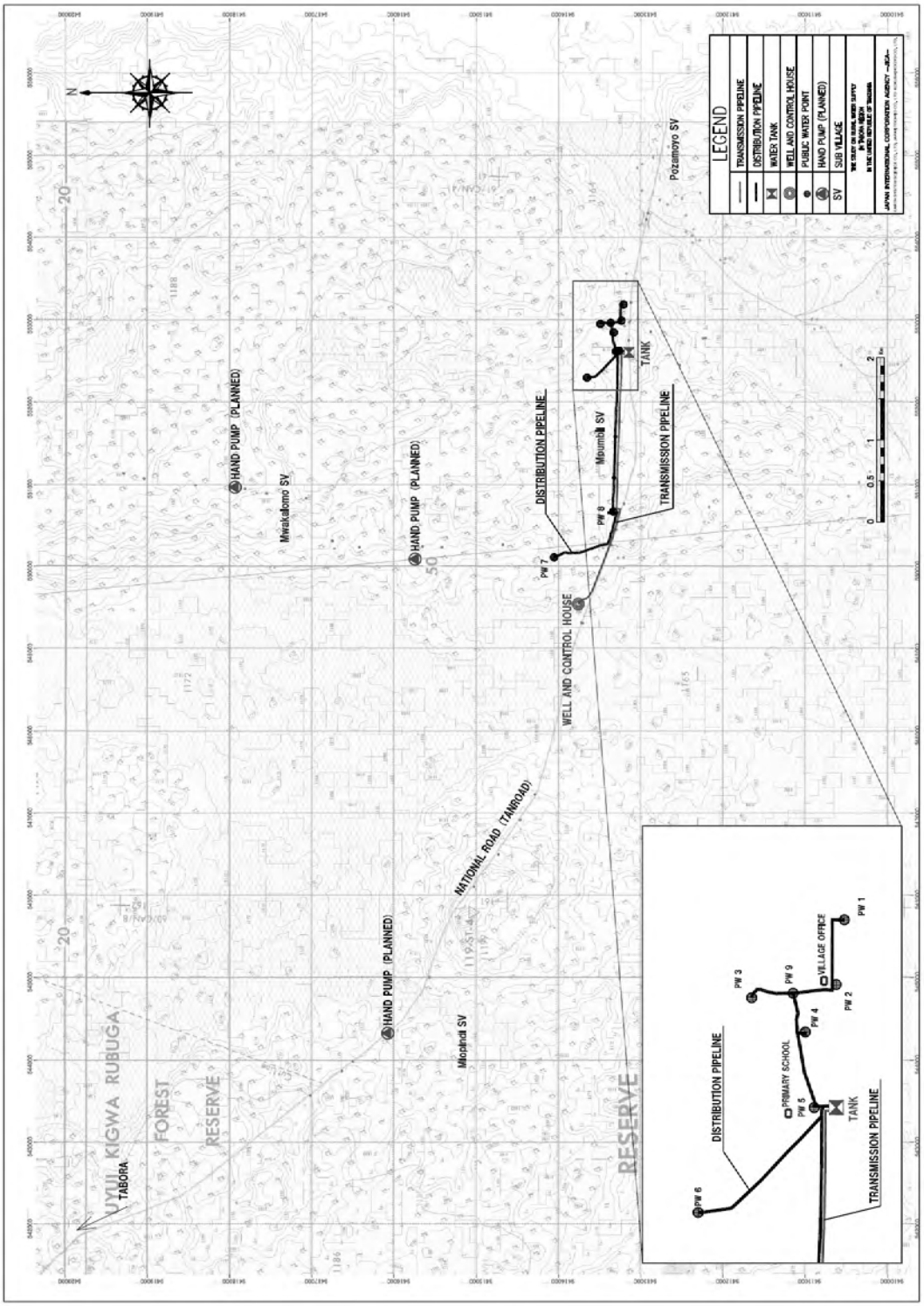


Figure 2.5 Layout Plan of Mpumbuli Village, Tabora Rural District

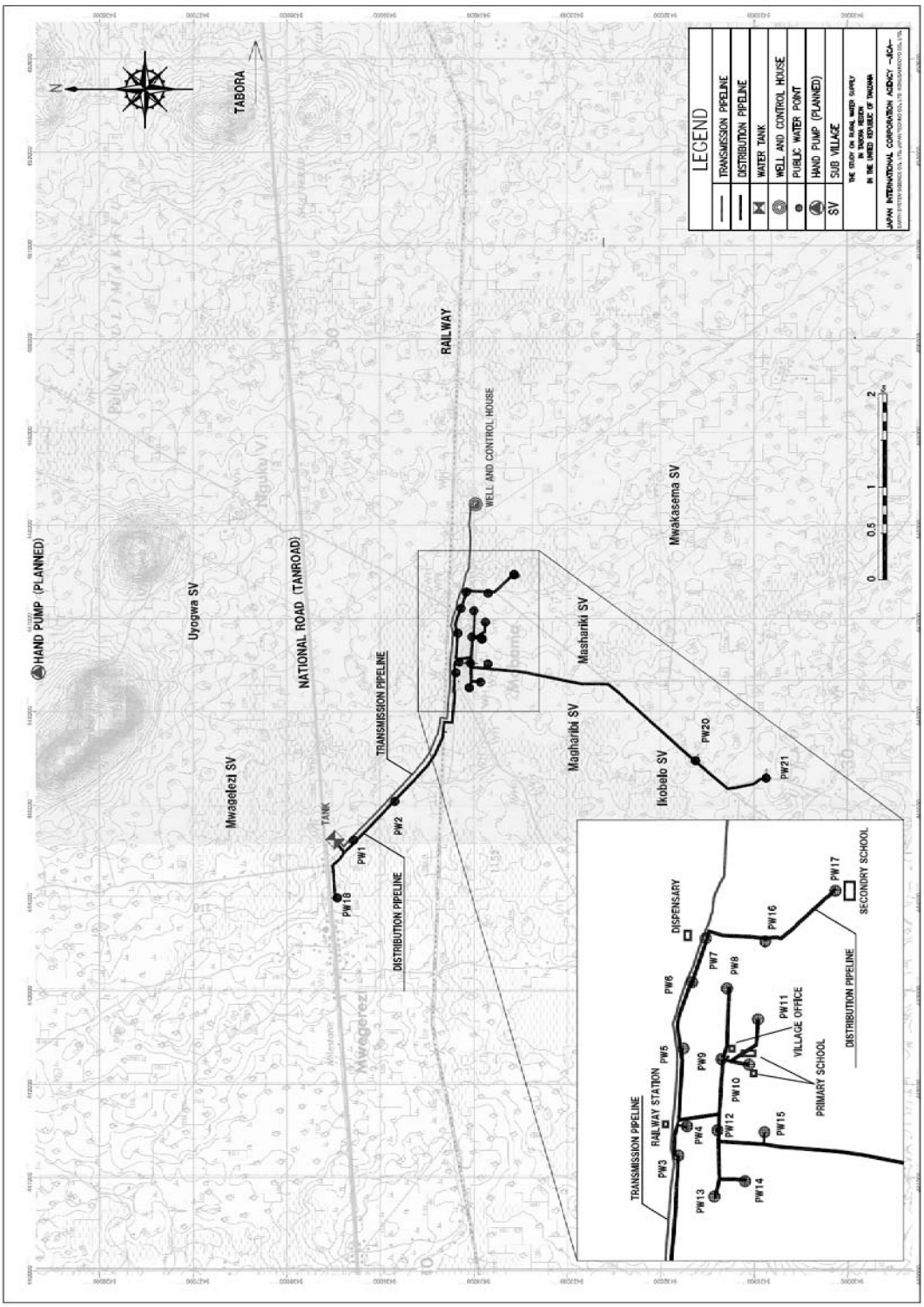


Figure 2.6 Layout Plan of Mabama Village, Tabora Rural District

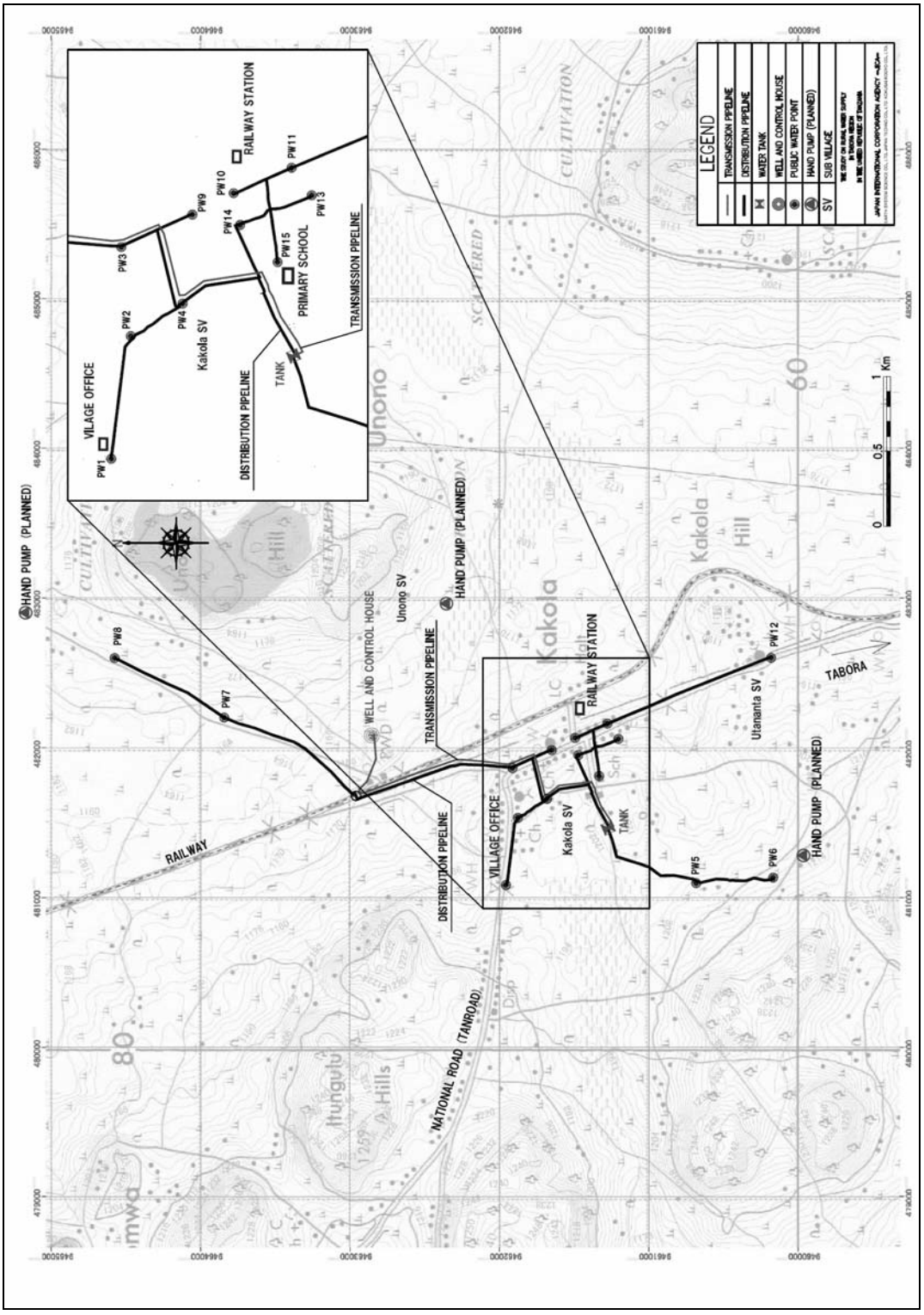


Figure 2.7 Layout Plan of Kakola Village, Tabora Municipality

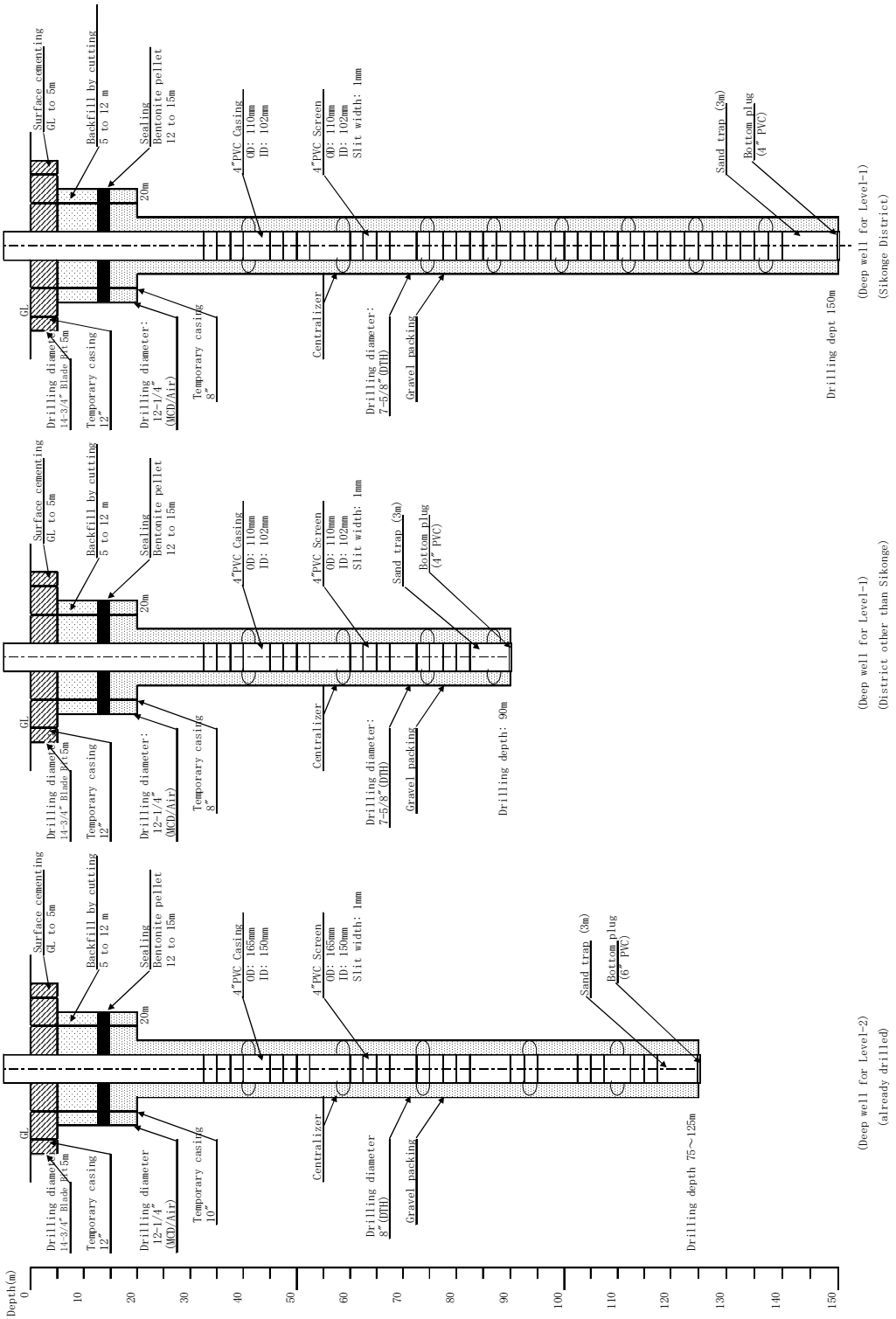
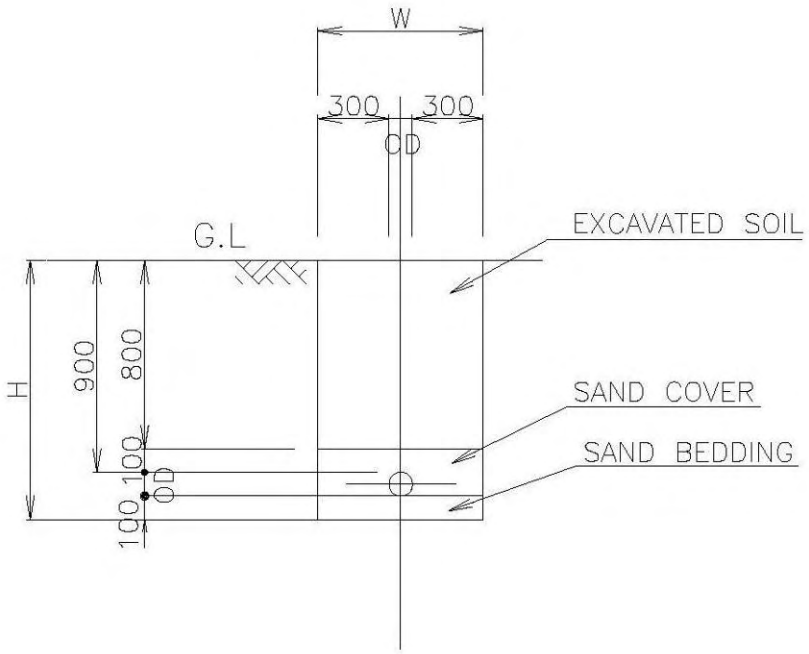


Figure 2.8 Well Structure of Deep Well for Level-2 and Level-1 Schemes



DIMENSIONS TABLE OF STANDRD PIPE LAYING

OUTSIDE DIA(mm)	W (mm)	H (mm)
32	650	1050
40	650	1050
50	650	1050
63	700	1100
90	700	1150
110	750	1200
160	800	1200
200	800	1200

FIGURE 2.9 Cross Section of Transmission and Distribution Pipelines

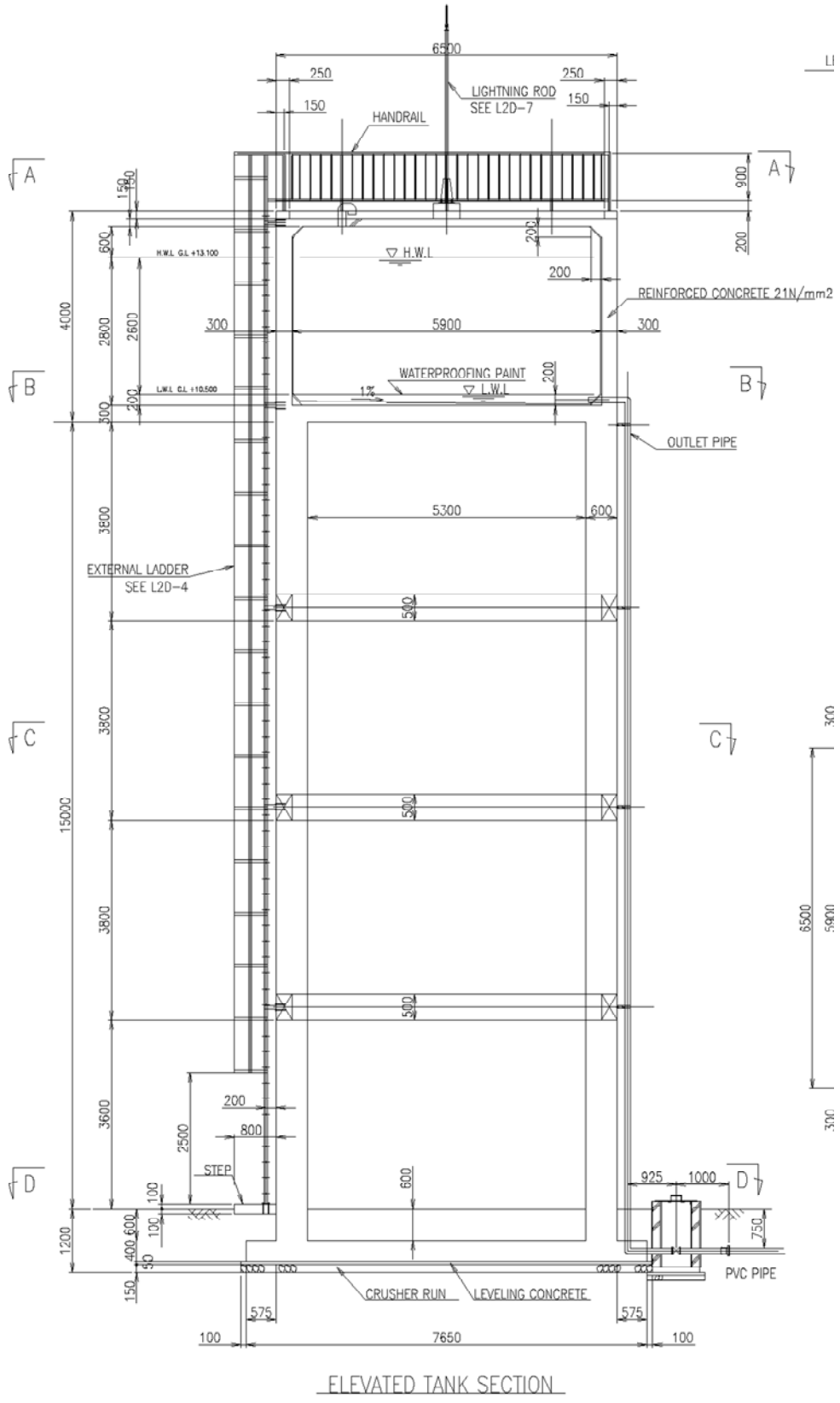


FIGURE 2.10 Structure of Distribution Tank

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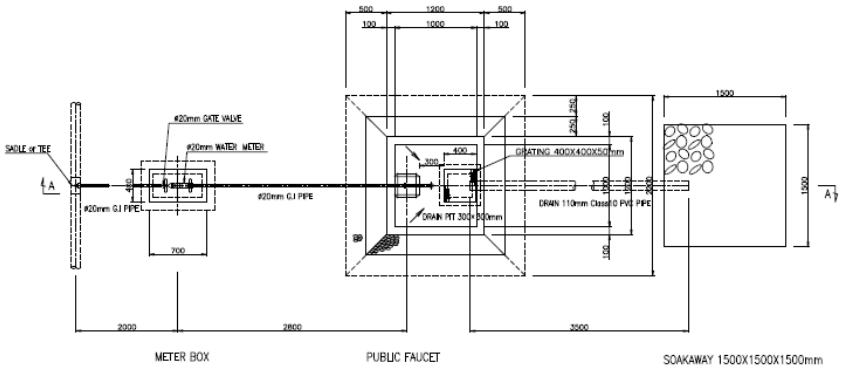
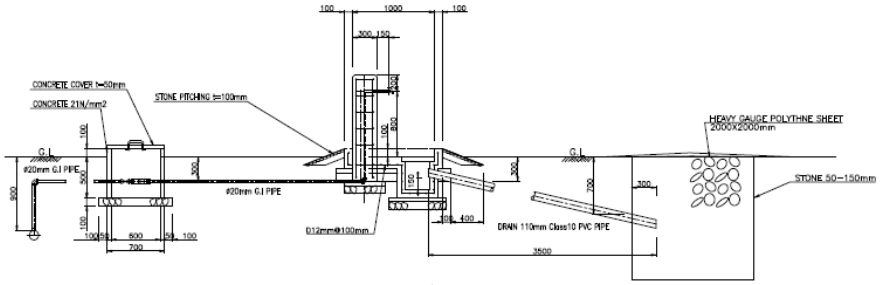
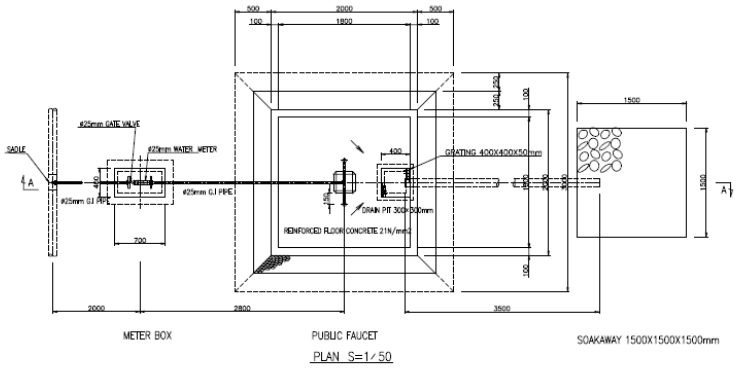


PLAN S=1/50

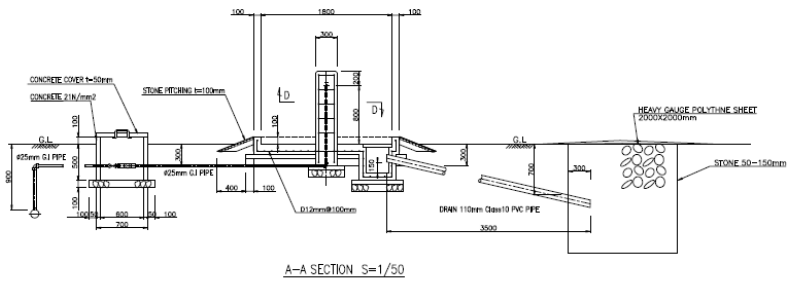


A-A SECTION S=1/50

Type 1 (1 tap)



PLAN S=1/50



A-A SECTION S=1/50

Type 2 (2 taps)

FIGURE 2.11 Structure of Public Water Point

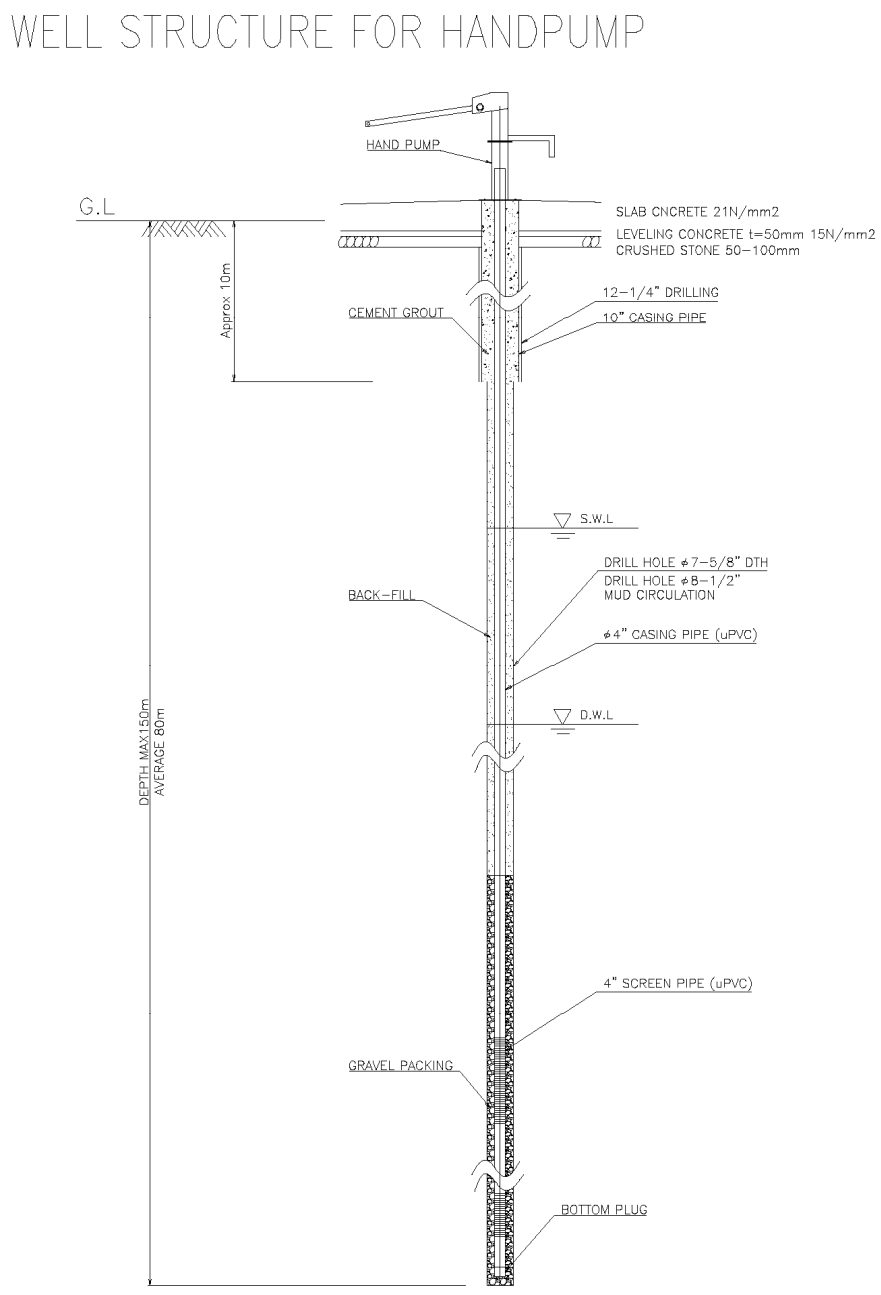


FIGURE 2.12 Structure of Deep Well with Hand Pump (Level-1)

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2.2.4 IMPLEMENTATION AND PROCUREMENT PLAN

2.2.4.1 Implementation and Procurement Policy

The main contractor of construction of water supply facilities designed in the Study shall be a Japanese contractor.

Construction work is composed of deep well drilling, construction of distribution tank, laying out of transmission/distribution lines, construction of public water points and installation of the handpump. These works are carried out by local contractor(s) under the supervision by the Japanese contractor.

The implementation agency of the Project is Ministry of Water (MoW), Tanzania. Keeping a close relationship with MoW is required in the construction period. In addition, District/Municipal Water Engineer's Office should be involved in order for smooth implementation during the construction work. Materials and machinery to be applied in the construction work should be those possible to be procured in Tanzania considering proper maintenance of the water supply facilities.

(1) Temporary Works of the Sites

A 20m x 20m area of land is required adjacent to the control house and the distribution tank site as a storage site for materials, installation site of a concrete mixer, panel processing site. A 20m x 30m area as a storage site for pipes and site cabin should be prepared along the main road.

The site for the field office should be also provided.

(2) Inland Transportation of Materials

In the construction works of the level-1 schemes, heavy vehicles such as drilling rigs and long body trucks will pass to the drilling sites. Therefore, clearing of bush and maintenance of access roads are required.

In case of the construction works of the Level-2 schemes, it is difficult to pass heavy vehicles (10 tons) to the sites. Materials will be carried by heavy vehicles to the field office and to the sites by 4 tons of trucks. Therefore, 4 ton trucks with a crane and 4 ton dump trucks should be allocated to each field office.

(3) Installation Work of Pipelines

A 5m width of land for installation of pipelines is required along the pipeline routes considering the width of the trench to be drilled and temporary storage of excavated materials. Excavation work will be done by manually if the access roads will not allow heavy duty trucks to pass to the sites due to their width.

(4) Construction Work of Distribution Tanks

Concrete will be gestated by mixer at the site because it is impossible to use freshly mixed concrete. Placement of concrete will be done manually or by crane.

(5) Drilling Work of Deep Wells for Level-1 Scheme

A 30mx 30m area of land is required close to the drilling site for a storage site of drilling rig, compressor, water tank lorry, trucks, drilling pipes, drilling tools, casing pipes, cement and aggregates in the drilling work of deep wells for the Level-1 scheme.

2.2.4.2 Implementation/Procurement Conditions

(1) Access to the Sites

Roads in the Tabora Region are not paved except for the section between Tabora Municipality and Nzega Town and the city area of Tabora Municipality. The width of access roads to the sites is sometimes narrow, about 3m in width, so that it is difficult for heavy vehicles to pass through the roads.

Access in the dry season is not a problem, however, it becomes very bad in the rainy season (October to May) in many villages. Therefore, construction work in such villages should be done in the dry season.

(2) Safety of the Site

Since installation work of pipelines will be done along the roads in service, signboards and security facilities will be provided at the working site. In addition, a person for traffic control will be allocated to each site.

2.2.4.3 Scope of Work

Scope of works is divided by both Government, Tanzania and Japan, as shown in Table 2.25.

Table 2.25 Scope of Work for the Tanzanian and Japanese Government

Construction Works	Japanese side	Tanzanian side
1. Construction of Intake		
1.1 Acquisition of land		○
1.2 Provision of land for temporary works		○
1.3 Provision of access road		○
1.4 Construction of intake structure	○	
1.5 Road construction in the site	○	
1.6 Construction of fence and gate	○	
1.7 Construction of branch power line to the site	○	
2. Pipe Laying Work for Transmission and Distribution Lines	○	

Construction Works	Japanese side	Tanzanian side
2.1 Land acquisition		○
2.2 Provision of access road		○
2-3 Pipe laying work	○	
3. Construction of Distribution Tank		
3.1 Land acquisition		○
3.2 Provision of access road		○
3.3 Construction of distribution tank	○	
3.4 Road construction in the site	○	
3.5 Placing fence and gate	○	
3.6 Construction of drainage canal	○	
4. Construction of public water point		
4.1 Land acquisition		○
4.2 Construction of public water point	○	
4.3 Construction of drainage canal	○	

2.2.4.4 Consultant Supervision

(1) Implementation System of construction Works

The project is implemented under the Japan's Grant Aid Assistance scheme based on the conditions described in the Exchange of Note (E/N) which will be concluded between the Tanzanian Government and the Japanese Government. The implementation agency in Tanzania is the Ministry of Water (MoW). Division of Community Water Supply (CRWS) is responsible organization for technical issues in MoW. Supervision and inspection of the construction works are carried out by CRWS.

A Japanese consultant will be employed by MoW for services of the detailed design study, preparation of tender documents, assistance in the tendering process and construction supervision. In the construction stage, the Japanese consultant supervises the construction works as well as reports to and discusses with the Embassy of Japan and the JICA Office.

Conceptual structure for the project implementation is shown in Figure 2.13.

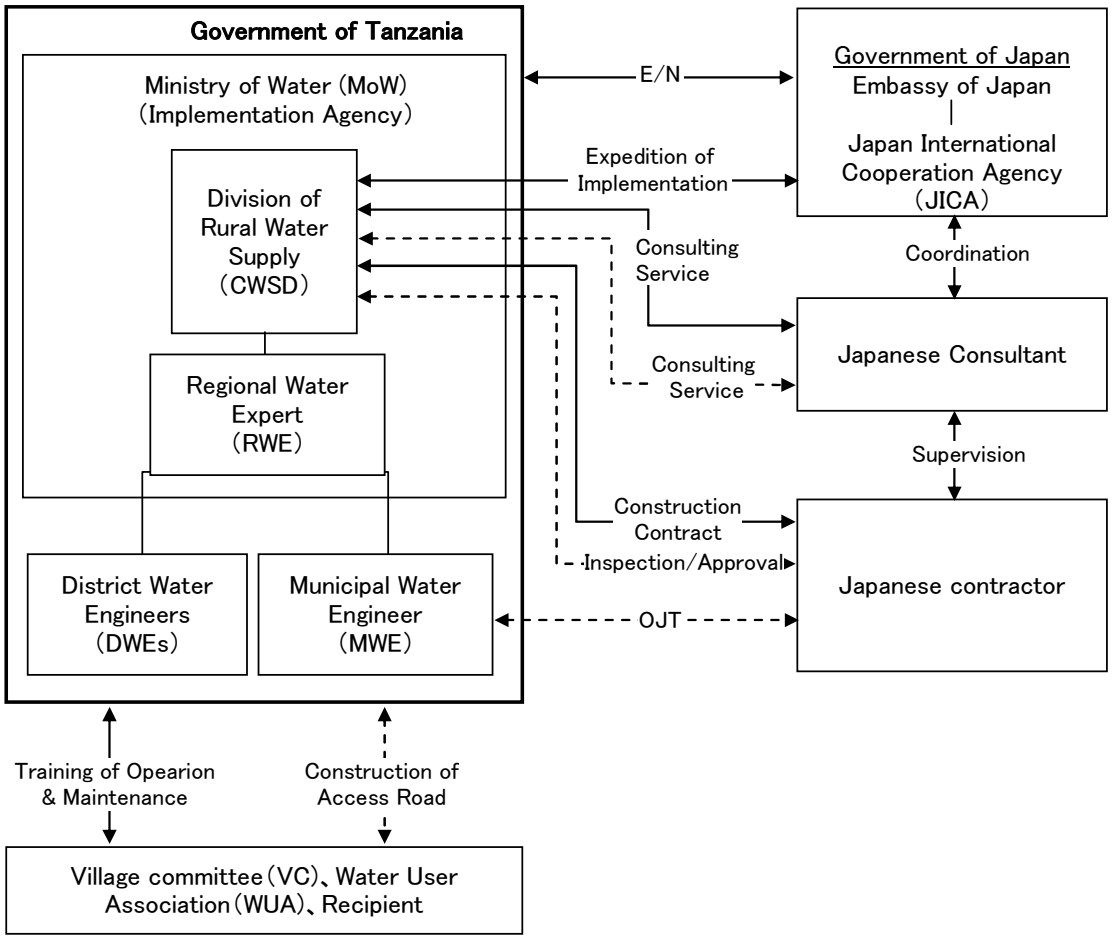


Figure 2.13 Conceptual Structure for the Project Implementation

(2) Basic Concept during the Detailed Design Stage

In the detailed design study stage, following works will be conducted.

- In the field work, the following works are carried out:

  Site reconnaissance of pipeline routes, investigation of underground structures and other obstacles (electric poles, aerial cables, etc.)

- Geophysical prospecting and test well drilling for water sources
- Reviewing of basic design based on the field survey including test well drilling
- Comparison on construction methods, structural and temporary planning for decision of implementation plans
- Structural calculation and calculation for temporary works
- Preparation of location map, plans, longitudinal sections, detailed drawings and structural drawings

- Preparation of calculation sheets on all that necessary items for construction
- Confirmation on basic conditions, comparison examination, validity of design, consistency of drawings and calculation sheets
- Reviewing of cost estimation in the basic design stage, based on the decided scale of facilities and quantities
- Preparation of tender documents along the line of the guideline of Japan's Grant Aid Assistance scheme
- Assistance to MoW in the selection of a contractor in line with the tendering procedure stipulated in the guideline above.

(3) Basic Concept during Construction Supervision Stage

Major issues of the construction supervision stage are summarized as follows:

- Close coordination with parties concerned for completing the construction work as scheduled in the implementation program of the Project
- Precise and timely advice to the contractor and the executing agency to construct the facilities consistent with design drawing / contract document
- Proper transfer of knowledge to the staff of MoW and DWEs'/MWEs' office on construction methods and techniques to maximize the expected effects of the Grant Aid Project in the form of on-the-job training (OJT)
- Adequate advice and guidance on operation and maintenance of the constructed facilities to facilitate the proper operation of the Project
- To minimize interference to traffic of National Highways in the pipe laying works by cooperation with MoW and DWEs'/MWE's offices
- In order to achieve project objectives from the early stages, the consultants would pay attention to the progress of construction of distribution pipelines, from the preparatory to construction stages. The consultants will assist its designing and planning to coordinate the complete progress of the Project.
- Preparation of Operation and Maintenance (O&M) manual for equipment and pipelines.

  Each manual for equipment or facilities would be made by the manufactures. And the consultants will combine the manuals into a comprehensive O&M manual. It will be used for training in commissioning. Necessary modifications shall be made, if any.

The above supervision works include the following duties and responsibilities:

- Supervision of construction program and quality control, such as approval and inspection of construction materials and works at each step of the construction work.
- Inspection and approval of dimensions, and numbers of the constructed works and facilities.
- Change order of the contract as required.
- Preparation of reports and papers required as specified by JICA

The above consulting services will be required from the commencement to the completion of all construction works. Throughout the construction period, a resident engineer will be assigned who coordinates the construction works. In addition, experts in several disciplines will be dispatched to the site in addition to the resident engineers for smooth implementation of the work.

2.2.4.5 Quality Control Plan

Quality control plan for the project is summarized in Table 2.26.

Table 2.26 Quality Control Plan for Major Type of Works

Type of Works	Quality Control Items	Test Method
Placement of concrete (for major structures)	Strength of concrete	Compression stress: 3 test pieces/placement
	Salt contents of concrete	Salt contents test: each placement
	Viscosity of concrete	Slump test: each placement
	Granularity of coarse aggregate	Sieve analysis: each supplier
	Granularity of fine aggregate	Sieve analysis: each supplier
Process and assembling of reinforcement	Strength of reinforcement	Tensile test of reinforcement: each supplier
Pipe laying work	Condition of pipe connection	Water pressure test: Every distribution lines

2.2.4.6 Operational Guidance Plan

Among the water supply facilities, facilities and machinery necessary to guide the operation and maintenance at the initial stage are summarized in Table 2.27.

Table 2.27 Operational Guidance Plan for Water Supply Facilities and Machineries

Type of Facility	Target facility	Contents of Guidance	Method of Guidance
Level-2	Intake	Operation of generator	Will be done by the contractor using manuals prepared by makers during the test operation and delivery of facilities.
		Operation of submersible pump and control box	
		Maintenance of pipes in the control house	Will be done by the consultant during the test operation and delivery of facilities.
	Distribution Tank	Check and maintenance of ball taps	Will be done by the consultant when delivery of facilities.
	Pipelines	Operation of valve	
		Leakage control	
	Public Water Points	Maintenance of flow meter	

		Wearing of packing	
Level-1	Hand pump	Exchange of valve	
		Cleaning of well site	

2.2.4.7 Procurement Plan

(1) Labour

Local staff will be allocated as the personnel administrator under the Japanese engineer. Under him, a local facilitator will be allocated. Technical transfer from the Japanese contractor is done to them through the construction period in order to strengthen the improvement of technical level. Other labour including administrative staff will be employed in Tabora.

(2) Construction Materials

1) General Construction Materials

Cement is produced in Tanzania by three (3) major manufacturers. Reinforcement is made from basic steel imported from South Africa. Since materials such as sand, aggregates, wooden forms, etc. are widely circulated in the local market, it is possible to procure them through local contractors and dealers.

2) Pipes for Deep Well and Pipeline

PVC and HDPE pipes to be used in the Project are manufactured by two (2) makers and widely distributed in Tanzania and it is possible to purchase them through local dealers. The quality of these is good enough to be used in the project. They are widely used and are obtainable through local agents. As for GPS pipes to be used for road crossing, those locally processed and/or imported from South Arica are available.

Submersible pumps and engine generators should be imported from Japan or third countries considering the supplying of spare parts and after service.

Table 2.28 Procurement Plan for Major Materials

Material	Tanzania	Japan/Third Country
Cement	◎	
Reinforcement	◎	
Aggregate	◎	
Wooden Form	◎	
PVC Pipe	◎	
HDPE	◎	
Deformed pipe, Valve	◎	○
Submersible pump		◎
Engine generator		◎

Note) ◎: First priority ○: Second priority

3) Construction Machineries

Construction machineries for civil works are possessed by major contractors in Tanzania. Since no special machineries are required for the construction work of the Project, it is possible to lease these machineries from the contractors.

4) Inland Transportation

Among the materials and equipment, those to be imported from Japan are transported to the stock yard in Tabora and then separately transported to each site. Part of the transportation route to each site are paved main roads, therefore, road conditions are no problem. Although the routes from the main roads are not paved, no problem is found in transportation. However, some sections of the route require maintenance in the rainy season. Time for transportation to each site from Dar es Salaam is shown in Table 2.26.

Table 2.29 Time for Transportation to Each Site from Tabora

Site	Time for Transportation
Igunga District	3 hours
Nzega District	2.5 to 3 hours
Sikonge District	1.5 to 2 hours
Tabora Rural District	1 to 1.5 hours
Tabora Municipality	0.5 to 1 hours
Urambo District	1.5 to 2 hours

2.2.4.8 Soft Component (Technical Assistance) Plan

(1) Operation and Maintenance of Water Supply Schemes

In the implementation of the Project, software component program is introduced to assure the operation and maintenance plan described in 2.4. The Project requests from the Tanzanian side included capacity building of community-based organization and establishment of community-based management for operation and maintenance of rural water facilities, and enhancement of local authorities in provision of community support, as well as construction of supply facilities. In the Study, assessing national policy and strategy in the rural water sector and current operation and maintenance of rural water supply facilities in the Project area, the following development issues are identified for improved operation and maintenance.

- Low functionality rate of rural water supply facilities
- Lack and weak capacity of community-based organization
- Less awareness and willingness on water fee payment
- Uncreated awareness on “water and Hygiene”
- Lack of capacity of DWST/MWST (District/Municipal Water and Sanitation Team)

In order to cope with these development issues, the software component program under the Project has been prepared, aiming at; 1) establishment and development of community-based organization for management of rural water supply schemes, 2) capacity development of community in operation and maintenance of supply facilities, 3) creation of awareness and willingness to pay water fees through introduction of user-pay principle for operation and maintenance, 4) enhancement of community awareness in "water and health", and 5) development capacity of DWST/MWST for establishment of community-based operation and maintenance. Activities necessary for achievement of objectives and outputs set above are described as follows:

1) Activities related to establishment of community-based operation and maintenance mechanisms

   - ☐ Prepare field guide for community
   - ☐ Conduct general community meeting
   - ☐ Carry out participatory community assessment and prepare CAP (Community Action Plan)
   - ☐ Implement activities to facilitate community participation in the target communities
   - ☐ Form General Assembly of WUA and conduct community election to select Directive Board of WUA
   - ☐ Prepare WUA constitution regarding operation and maintenance, and organization management
   - ☐ Register WUA under Ministry of Water or local authority
   - ☐ Provide capacity development training for WUA in operation and maintenance of the supply scheme

2) Activities related to the capacity building of health education organization concerning "Water and Sanitation"

   - ☐ Prepare "Water and Sanitation Manual" for VHWs, VHCs and Health Teachers.
   - ☐ Provide the training to VHWs, VHCs and Health Teachers, based on the above manual.

3) Activities related to capacity building of DWST/MWST in provision of technical guidance for the communities

   - ☐ Prepare field manual for DWST/MWST
   - ☐ Form DWST/MWST (District/Municipal Water and Sanitation Team)
   - ☐ Provide TOT (Training of Trainers) for DWST/MWST, and prepare action plan of DWST/MWST

- ☐ Provide OJT (On-the-Job Training) for DWST/MWST to carry out activities at field level, utilizing field manual prepared.
- ☐ Prepare action plan of DWST/MWST for monitoring and evaluation.

4) Activities to measure the impact brought by the Project

- ☐ Carry out monitoring and follow-up activities by DWST/MWST
- ☐ Implement post baseline survey

(2) Groundwater Development

Software component program to support the capacity building for the groundwater development in Tabora Region is introduced. The purpose of these activities is to improve the water supply situation in Tabora Region by facilitating the progress of the water schemes construction with improved capacity of the groundwater development.

In order that the staff of the Tabora Branch of the Lake Tanganyika Basin Office (hereinafter referred to as "the staff of the Tabora Branch") can proceed smoothly their works for the groundwater development, 1) The staff of the Tabora Brach obtain the knowledge and skills to formulate the survey (well siting) plan for themselves in consideration of the topographical, geological and hydrogeological conditions, 2) The staff of the Tabora Branch acquire the proper use of the geophysical equipment to be used in the Project, and 3) The staff of the Tabora Branch acquire the knowledge and skills to analyze the survey data to formulate the groundwater development plan in the target areas.

1) Activities related to the formulation of the survey (well siting) plan in the target areas

- ☐ Classroom Study using the existing plan and survey results from the Study on Rural Water Supply in Tabora Region (2010)
- ☐ Classroom Study of the planning exercises for the target villages for Level-1 schemes in the Project

2) Activities related to the improvement of the knowledge and skills of geophysical survey techniques

- ☐ On site training of survey line setting, equipment manipulation, measurement works etc
- ☐ On site training of the evaluation of the quality of the acquired data

3) Activities related to the analysis of the survey data and the formulation of groundwater development plan

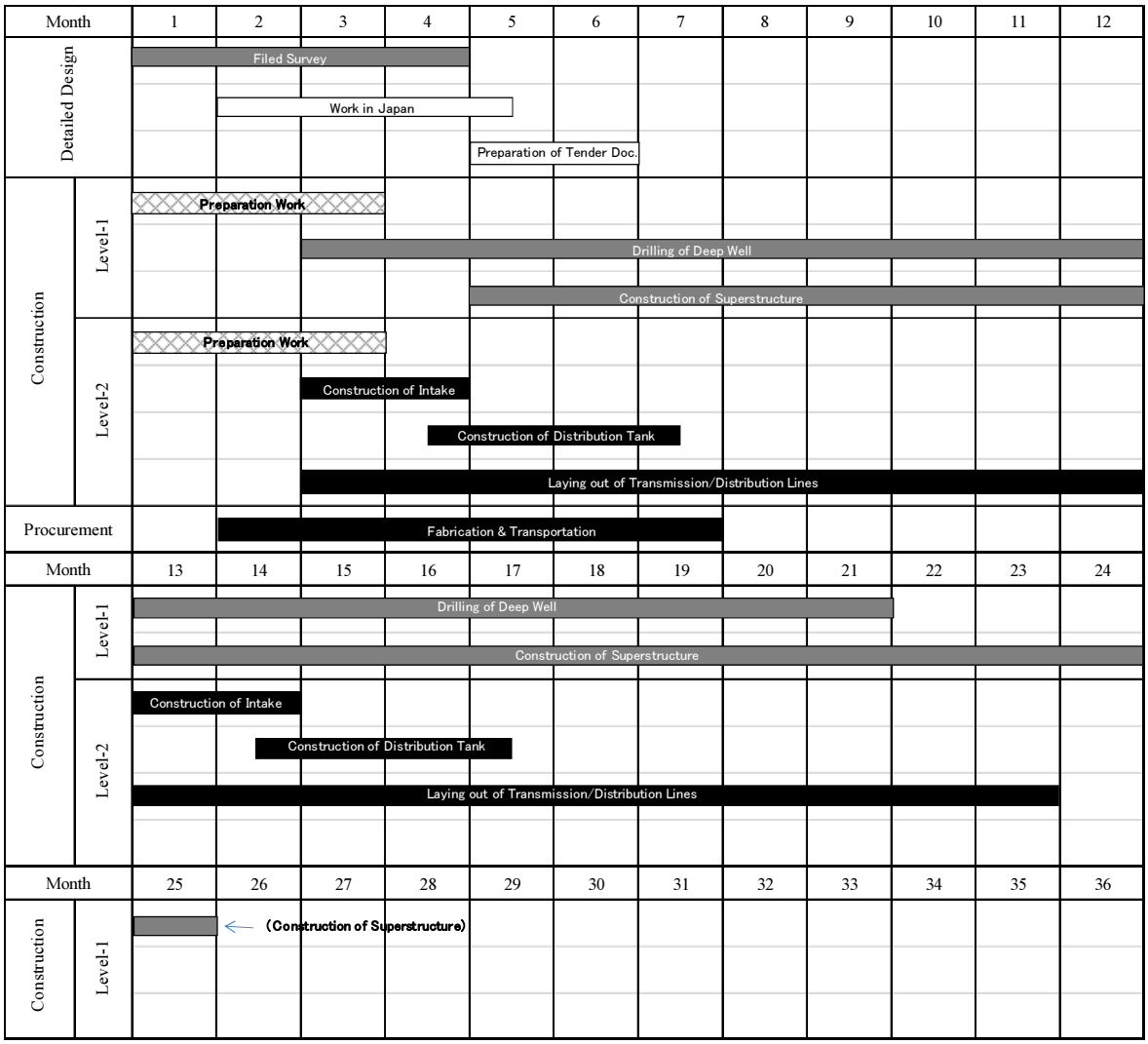
- ☐ Training of the survey data analysis

- ☐ Training of the groundwater development plan formulation (siting of the drilling points, decision of the probable drilling depth etc.)
- ☐ Training of the evaluation of the survey data analysis by comparing survey data analysis results and drilling results
- ☐ Training of the re-analysis of the survey data and the revision of the groundwater development plan

2.2.4.9 Implementation Schedule

The schedule of implementation of the project is shown in Table 2.30. Soft component programme will start before commencement of construction work and continue up to the completion of the construction work.

Table 2.30 Implementation Schedule of the Project



The period of the Project from the detailed design until the completion of all the water supply facilities will be 35 months.

2.3 OBLIGATION OF RECIPIENT COUNTRY

In implementation of the Project, the obligation of the Tanzania side beside the items described in 2.2.4.3 is as follows.

2.3.1 GENERAL ISSUES

- To provide land necessary for the construction of the intake and distribution tank, and access to the site
- To provide the storage site for equipment and materials, and for temporary works during the construction period.
- To provide and transfer the data and information necessary for the detailed design study.
- To facilitate the assistance and cooperation to the Project by the community people and to take necessary measure for traffic control.

. To provide a storage area for the residual clay and a place for discharge.

- To carry out ancillary works of the construction of drainage channel
- To ensure all the expense and prompt execution for unloading, custom clearance at the port of disembarkation of the equipment and materials necessary for the Project.
- To open Banking Arrangement (B/A) and issuance of an Authorization to Pay (A/P), and to bear an advising commission of the Authorization to Pay (A/P) and payment commission to the Bank.
- To accord a facility to Japanese nationals whose services may be required for implementation of the Project, for their entry into Tanzania and their stay therein for the performance of the Project.
- Proper use and maintenance of the facilities/equipment constructed/purchased under the Japanese Grant Aid Project.
- Cost burden for items not included in the Japanese Grant Aid Scheme but necessary for the Project.

2.3.2 SPECIFIC ISSUES IN THE PROJECT

(1) Arrangement of water use permit for water source

Water source of the water supply schemes to be constructed in the Project is entirely groundwater. As required yield of water source was decided in the Study, a water use permit shall be given by MoW before the commencement of the Project.

(2) Arrangement of permission necessary for the Project (especially pipe laying work

crossing the railway).

Pipelines will be installed crossing the railway in Mabama Village in Tabora Rural District and Kakola Village in Tabora Municipality. In the pipe laying work, inspection by the Tanzania Railway Company (TRC) is required. The Tanzanian side is requested to take the necessary procedures and to bear the necessary cost. Such cost is shown in 2.3.3.

(3) Arrangement of necessary procedures to lay pipe line in or along the main roads

Construction work will be carried out along the main roads (District/Municipal roads and TANROAD) and sometimes in the road reserve area. If inspection or permission is required from these authorities, the Tanzanian side should take necessary procedures.

(4) Announcement to community people prior to the commencement of the Project.

It is desirous to inform of the community people about the contents and implementation schedule of the Project prior to the commencement of the Project, in order to ask cooperation of the community people and to keep safety during the construction works.

(5) To bear the cost of daily allowance and travel expenses in the geophysical survey in the detailed design study

In the detailed design study stage, the consultant will carry out a geophysical survey to decide the drilling location of the deep wells for the level-1 schemes. The Electro-Magnetic survey method and the Two-Dimensional Resistivity survey method will be applied. Equipment to be used in the survey are the same as those to be procured in the Project. Therefore, on-the-job-training will be carried out to the Tanzanian personnel in order to familiarize the operation of the equipment before purchasing of the equipment. The Tanzanian side is required to bear the cost for the personnel to attend the training, such as travel allowance and daily allowance. The necessary cost expected is shown in 2.3.3.

(6) To bear the cost for attending the soft component programme for the operation and maintenance of the water supply schemes

Two (2) soft component programmers below are planned in the Project to develop the capacity of the Tanzanian side.

1) Operation and maintenance of the water supply schemes

2) Ability to develop groundwater for the water supply schemes

Members of DWST/MWST will attend the programme Item 1). The actual programme is held in both Tabora Municipality and each District/Municipality. The cost to attend the programme is borne by the Tanzanian side. The expected cost is shown in 2.3.3.

2.3.3 COST TO BE BORNE BY THE TANZANIAN SIDE

The approximate cost mentioned in 2.3.2 above is summarized in Table 2.31.

Table 2.31 Cost to be Borne by the Tanzanian Side

Item	Cost (Tsh)
1) Cost to attend the on-the-job training on the geophysical survey	3,840,000 Tsh
2) Inspection cost for pipe laying works the railwaycrossing	3,260,000Tsh/site x 2 = 6,520,000 Tsh
3) Cost for attending the soft component programme on the operation and maintenance of the water supply schemes	1,920,000 Tsh
4) Cost for attending the soft component programme on the geophysical survey for groundwater development	50,880,000 Tsh

2.4 PROJECT OPERATION PLAN

2.4.1 GENERAL

In Tanzania, improvement of operation and maintenance for the rural water supply facilities has been one of the major development issues in the rural water supply sector. The National Water Policy 2002 (NAWAPO) is the national basic policy for water resource management and water supply, of which principles in operation and maintenance for rural water supply system are to promote 1) decentralization in implementation of water supply and sanitation projects to the lowest appropriate institutions, 2) introduction of user-pay principle to recover the cost for operation and maintenance, and 3) enhancement of community-based management (CBM) to sustain the supply system. On the other hand, in National Water Sector development Strategy (NWSDS) that is a basic strategy of the sector development and Water Sector Development Program (WSDP) that illustrates the national sector investment program, emphasis is placed on capacity development of local authority in planning and implementation of district water supply and sanitation plans, as well as improvement of community-based operation and maintenance. For improvement of operation and maintenance for the rural water supply faculties, introduction of user-pay and participation principles and provision of technical support to the communities by local authorities such as District/Municipal Water Engineer Office has been adopted. In such approaches, beneficiary communities are required not only to establish community-based organizations, but also to develop their capacity for operation and maintenance of rural water supply facilities. On the other hand, local authorities represented by the DWE are responsible for provision of technical guidance and monitoring to the communities to develop their capacity in operation and maintenance. Along with such strategy and approaches, this software component plan also applied the principles as such; 1) promotion of community-based operation and maintenance, and 2) enhancement of capacity of local authorities in provision of technical guidance to the communities.

Reviewing development issues in current operation and maintenance for the rural water supply

facilities in the Project area, the following approaches are emphasised for improved operation and maintenance.

2.4.2 FORMATION OF COMMUNITY-BASED ORGANIZATION WITH ENHANCED AWARENESS ON OWNERSHIP

In the target area of the Project, conventional Village Water Committee (VWC), which is appointed by and formed under the Village Council, has been expected to handle operation and maintenance of the rural water supply scheme. However, the organizational nature of VWC can be regarded as "consumer group", which has less awareness and expertise for the scheme management as a "service provider". Thus, in most cases in the Project area, VWCs are not performing their expected roles and responsibilities in the scheme management.

While the limited capacity of VWCs in operation and management of the supply scheme has been pointed out, various forms of community-based water supply organization have been developed and introduced, among which certain organizations have become established in the country, such as Water User Group (WUG), Water User Association (WUA), Water Trust/Cooperative, Water Company by Guarantee, and Water Company by Share. Those community-based water supply organizations are established by the beneficiary group and legal ownership of the scheme is vested with, facilitating their awareness and capacity in the scheme management through processes such as community consensus building on management options, election of executive members, preparation of a constitutions, registration of organization under appropriate authority, training provided by local authority or NGOs/local consultant for capacity development of the community-based organization in the scheme management. Through those processes of formation, community awareness and capacity in the scheme management and sense of ownership is enhanced, which can be regarded as a feature of those community-based water supply organizations. The final draft of the National Water Sector Development Strategy 2005-2015 advocates establishment of community-based operation and maintenance in rural water supply development, facilitating legalization of community ownership through a registration process of the community-based organizations, which are defined as "Community-Owned Water Supply Organization (COWSO)". The concept of COWSO, defined in the National Water Sector Development Strategy, is introduced in the operation and maintenance plan of the Project.

2.4.3 CAPACITY BUILDING OF COMMUNITY IN OPERATION AND MAINTENANCE

While establishment of COWSO is expected to take initiative in operation and maintenance of the supply scheme, capacity development of the organization in the scheme management is also desirable. However, most of the target communities are less experienced in organizational management of the supply scheme. Survey results and findings, gained through the Study and the

development study conducted prior to the Study, identify the training needs for the target communities and suggest provision of training for improvement of their capacity in the following concerns to assure sustainability in the community-based operation and management;

- Leadership skills
- Community communication skills
- Organizational/Institutional management skills
- Tariff setting and collection methods
- Financial management skills such as budget preparation, accounting, and fund management
- Technical operation and maintenance, and trouble shooting
- Participatory monitoring and evaluation with preparation of monitoring check list

2.4.4 INTERFACING COWSO WITH LOCAL ADMINISTRATIONS

Lack of institutional support, such as technical guidance for the community in formation of community-based organization, organizational management, financial management and accounting, and follow-up and monitoring, have been regarded as some of the major problems in operation and maintenance of the rural water supply scheme, which is also regarded as one of causes for the low functional rate of the supply scheme in the Project area. Although MoW is the implementing agency responsible for the Project, in the operation and maintenance stage, District/Municipal Water Engineer office (DWE/MWE) under District/Municipal Council is responsible for provision of technical guidance to the communities. Thus, capacity development of DWE/MWE in provision of technical guidance to the community is indispensable for the sustainability of the Project. Under the Project, capacity development of District/Municipal Council is facilitated, through formation of and provision of training packages to the District/Municipal Water and Sanitation Team (DWST/MWST). In general, DWST/MWST is formed under each District/Municipal Council and consists of District/Municipal Water Engineer (DWE/MWE), District/Municipal Planning Officer, District/Municipal Health Officer, District/Municipal Community Development, which enables an integrated approach for the sub-sector development. In the operation and maintenance plan of the Project, capacity of DWST/MWST is improved to form community-based operation and maintenance structures, and functional roles and responsibilities of the organization to provide technical guidance and monitoring for the communities in the subsequent stages are also enhanced. Capacity development of DWST/MWST is intended through On-the-Job training provided by local consultant/NGO employed for the project implementation. Figure 2.14 illustrates the operation and maintenance

structure in the Project plan.

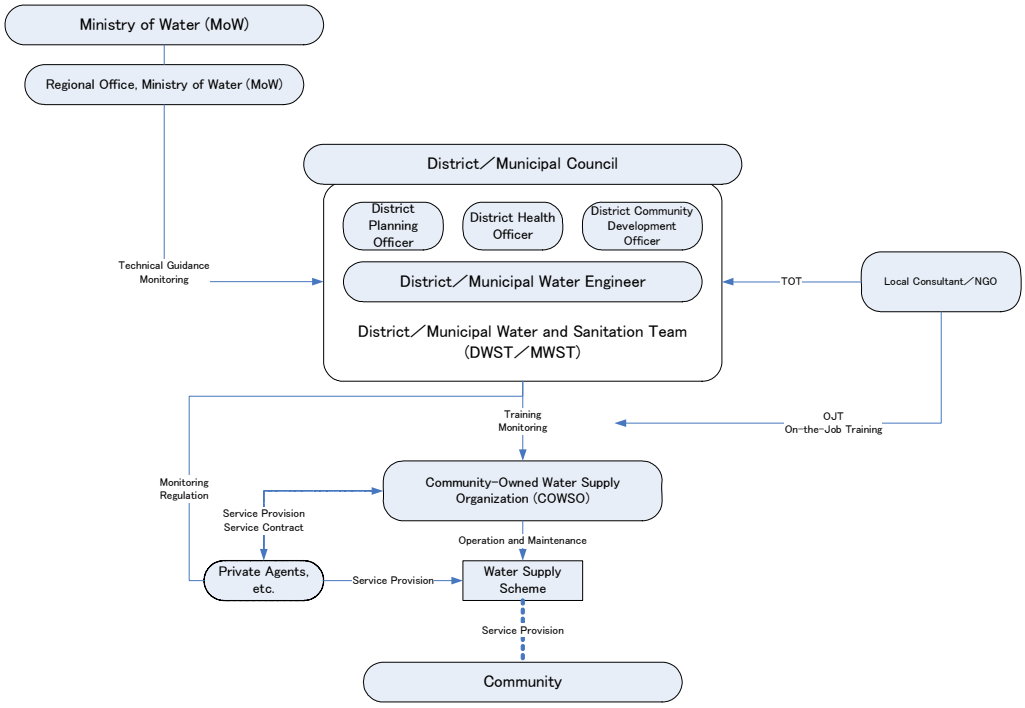


Figure 2.14 Operation and Maintenance Structure in the Project Plan

2.4.5 USER-PAY PRINCIPLE IN OPERATION AND MAINTENANCE

The User-Pay Principle (UPP) is introduced in the country for operation and maintenance of rural water supply facilities. An inventory survey (JICA, 2009) revealed that only one-third of the communities owning their rural water supply facilities carry out water user fee collection. In circumstances that most cases where periodical or regular fee collections are practiced in the communities managing Level-1 schemes, and considerably less communities operating and maintaining the facilities in a sustainable manner through fee collection are found. The JICA inventory survey found that their willingness to pay (WTP) amounted only to 0.66 Tsh/l and 0.41 Tsh/l respectively for Level-2 and Level-1, which is less than 1.0 Tsh/l of de-facto standards in the country. The detailed socio-economic survey (JICA, 2010) also confirmed that the mean monthly household income in the target communities amounted to 150,000 – 200,000 Tsh. Setting water user fees at 1.0 Tsh/l as a standard, and assuming their water consumption at 25l/capita/day by average of 7 household members, ratio of expenditure for water in total household income amounts to 2.5 to 3.5 percent, which is less than the limit of 5 percent to assure their affordability to pay (ATP) for water. Thus, it became obvious that 1.0 Tsh/l is the water user fee affordable for the communities. Thus, considering there is less community and customary collecting of water fees and the ATP is higher while WTP is lower, component activities to increase their awareness and

willingness in user-pay principle is indispensable.

Operation and maintenance cost for Level-1 (boreholes fitted with hand pumps) is estimated by using experiences from similar projects, dividing into maintenance cost, remuneration for accountants as management cost, replacement cost, and risks and inflation (refer to Table 2.3.2).

Table 2.32 Basis of Operation and Maintenance Cost Estimation for Level-1

Cost	Item	Value（USD）/year
Maintenance Cost	Wage (Caretaker)	150
	Tools	10
	Material	40
	Spare parts	100
	Regular Maintenance of Hand Pump	50
Management Cost	Commission (Treasurer)	100
Replacement Cost		130
Inflation and Risks		6.6
		586.5

Source：Brikke, F (2001), Key factors for sustainable cost recovery, IRC, Netherlands

Setting served population per level-1 supply facilities at 250 persons, from indicated figure of 586.5 USD/year as entire operation and maintenance cost in the above table, it can be converted to 2.34 USD as operation and maintenance cost per person. Assuming the average household size at 6.3 persons based on a detailed socio-economic survey (this Study, 2010), operation and maintenance cost per household becomes 1.23 USD/month, or 1,761 Tsh/month (1 USD = 1,435 Tsh). Based on the mean monthly household income obtained through the socio-economic survey, the ratio of household expense for water in the total household income is estimated at 0.9% to 1.2%, which is far less than the maximum rate of 5% recommended by international institutions such as he world bank. The table below shows analysis on affordability to pay (ATP) for each community that own Level-1 facilities under the Project.

Table 2.33 Analysis on the ATP in Each Community (Level-1)

District / Municiparity	Ward	Community	Mean Monthly Household Incom (Tsh)	Ratio of O&M Cost in Mean Monthly Household Income
Igunga	Mwisi	Busomeke	150,000-200,000	0.9% - 1.2%
	Mwisi	Kaloma	150,000-200,000	0.9% - 1.2%
Nzega	Ijanija	Makomelo	60,000-100,000	1.7% - 2.9%
	Lusu	Isanga	（Level-2）	
	Miguwa	Kitangili	60,000-100,000	1.7% - 2.9%
	Wela	Wela	150,000-200,000	0.9% - 1.2%
Sikonge	Igigwa	Kasandalala	60,000-100,000	1.7% - 2.9%
	Kipanga	Usanga	60,000-100,000	1.7% - 2.9%
	Pangale	Mpomwe	10,000-20,000	1.2% - 1.8%
Tabora Rural	Kizengi	Mpumbuli	60,000-100,000	1.7% - 2.9%
	Mabama	Mabama	60,000-100,000	1.7% - 2.9%
	Ufuluma	Ufuluma	150,000-200,000	0.9% - 1.2%
Tabora Urban	Kakola	Kakola	150,000-200,000	0.9% - 1.2%
	Misha	Misha	150,000-200,000	0.9% - 1.2%
	Uyui	Uyui	60,000-100,000	1.7% - 2.9%
Urambo	Imalamakoye	Imalamakoye	300,000-500,000	0.6% - 0.4%
	Kapilula	Kapilula	150,000-200,000	0.9% - 1.2%
	Kiloleni	Kalembela	200,000-300,000	0.6% - 0.9%
	Kiloleni	Kiloleni	100,000-150,000	1.2% - 1.8%
	Uyowa	Nsungwa	200,000-300,000	0.6% - 0.9%

In the estimation of operation and maintenance costs for Level-2 facilities (small-scale piped water scheme with domestic water points), in addition to the operation costs such as fuel and labor costs, remuneration for formed COWSO members and costs for overhaul of motor pumps are included as maintenance costs, as well as office costs for COWSO and replacement of the facility. The basis of estimation for operation and maintenance costs are shown in the following table.

Table 2.34 Basis of Cost Estimation for Operation and Maintenance (Level-2)

Cost	Item	Approximation/Year
Operation Cost	Fuel/Electricity	Consumption in each scheme is estimated, market price (*1) is applied
	Wage and Allowance	
	Operator	100% of mean annual income / person in Tanzania (*2)
	Kiosk Attendant	25% of mean annual income / person in Tanzania (*2)
	Guards	80% of mean annual income / person in Tanzania (*2)
Management Cost	Commission for COWSO	
	Manager	100% of mean annual income / person in Tanzania (*2)
	Treasurer	100% of mean annual income / person in Tanzania (*2)
	Overhaul of Pump	3% of cost for pump
Maintenance Cost	Tools, Supply	10% of construction cost
	Spare parts	
	Regular Pump Maintenance	
Replacement		Construction cost ÷15 years
Risks and Inflation		5% of replacement cost

*1：Unit price of diesel: 1,760Tsh/litre, Unit price of electricity Tsh/Unit

*2：Mean Monthly Income 620,136 Tsh/person（Household Budget Survey 2007, National Bureau of Statistics, Tanzania, 2009)

Based on the table above, analysis of each target community on affordability to pay (ATP) and sustainability of operation and maintenance is made, estimating operation and maintenance cost for Level-2 supply facilities. The results are indicated in the following table. It shall be noted that replacement cost for the facilities are estimated per year, assuming the durability of the facility lasts for 15 years and setting construction cost at local level.

Table 2.35 Analysis on the ATP in Each Community (Level-2)

District /Municipality	Village	Served Population (2020)	Served House-hold (2020)	O&M Cost/year	O&M Cost/capita/month (Tsh)	Ratio of O&M cost in Household
Nzega District	Isanga	1,956	310	24,208,515	6,498	3.2%
Tabora Rural District	Mpumbuli	2,658	422	43,452,069	8,583	4.3%
	Mabama	5,471	868	40,494,581	3,886	1.9%
Tabora Municipality	Kakola	2,733	434	48,030,389	9,226	4.6%

As the above table indicates, ratio of operation and maintenance cost per households in total household income is also estimated less than 5%. Thus, considering there are less community in the Project area that regularly and customary collects water fee and ATP is higher while WTP is lower, measures, such as advocacy, to increase their awareness and willingness in user-pay principle is incorporated in the operation and maintenance plan.

2.4.6 SENSE OF COMMUNITY IN WATER AND SANITATION

People living in rural areas of the Tabora Region do not have sufficient knowledge on health, sanitation and hygiene including safe water. The results of the socio-economic survey by the Study (2010) Team reveal that the respondents know access to safe water can prevent them from diarrhoeal diseases but few know proper hand washing can also do so. The socio-economic survey also revealed that while 70 percent of the community rely on its domestic water source in traditional and unprotected sources (i.e. charco dam, shallow well, pond/river), 30 percent of community members responded they “are very satisfied” and/or “satisfied” for water quality from those traditional sources, and including those who responded “fair) the figure increases to 60 percent. It is inferred that people do not know what safe water is. In order to maximize the impact on health and hygiene aspects brought by improved water supply facilities and increase awareness in payment of water user fees and participation in operation and maintenance, measures to enhance awareness in “water and sanitation” shall be included in the operation and maintenance.

Villages and schools are the forefront of health education. Village Health Workers (VHW) and Village Health Committees (VHC) perform health education in the village/community level, while Health Teachers play the role of health-related instruction. The operation and maintenance plan advocates preparation and provision of manual/teaching guides and teaching aids to VHW, VHC, and health teachers for promotion of “water and sanitation” in order to strengthen the structure to

promote participatory health and sanitation education. The plan also applies the approach of Community-Led Total Sanitation (CLTS) as guideline prepared by Ministry of Water advocates.

In addition, since Tanzanian water quality standards are applied for fluoride as the Tanzanian government requested, in the community which owns the water supply facilities of which contamination of fluoride exceeds WHO standards, guidance for the community about its anxiety on health and its countermeasures is provided.

2. 5 PROJECT COST ESTIMATION

2.5.1 INITIAL COST ESTIMATION

The approximate cost to be borne by the Tanzanian side is summarized in Table 2.36.

Table 2.36 Cost to be Borne by the Tanzanian Side

Item	Cost (Tsh)
1) Cost to attend the on-the-job training on the geophysical survey	3,840,000
2) Inspection cost for pipe lyaing works the railwaycrossing	6,520,000
3) Cost for attending the soft component programme on the operation and maintenance of the water supply schemes	50,880,000
4) Cost for attending the soft component programme on the geophysical survey for groundwater development	1,920,000

2.5.2 OPERATION AND MAINTENANCE COST

Operation and maintenance costs for the Level-2 and Level-1 water supply schemes were estimated in Chapter 4 as shown in Table 2.37.

Table 2.37 Operation and Maintenance Costs for Level-2 and Level-1

Type	Village	O&M Cost/Year ($x10^3$ Tsh)	O&M Cost /capita/household (Tsh)
Level-2	Isanga	24,208	6,498
	Mpumbuli	43,452	8,583
	Mabama	40,404	3,886
	Kakola	48,030	9,226
Level-1	Each scheme	841	1,765

2.6 OTHER RELEVANT ISSUES

For smooth implementation of the Project, the Tanzanian side is requested to pay consideration to following issues.

(1) Arrangement of water right for water source

(2) Announcement of the implementation of the Project to concerned organizations

(3) Obtaining of acceptance for crossing of railway and road of transmission/distribution pipelines

(4) Obtaining of acceptance for pipe laying along the roads which are managed by Districts/Municipality and/or Tanzanian National Road Agency (TANROAD).

CHAPTER 3
PROJECT EVALUATION

CHAPTER 3 PROJECT EVALUATION

3.1 RECOMMENDATIONS

3.1.1 PRECONDITIONS OF PROJECT IMPLEMENTATION

It was confirmed that the following items are the obligation of the Tanzanian side for the implementation of the Project.

(1) General Issues

- To provide land necessary for the construction of the intake and distribution tank, and access to the site
- To provide the storage site for equipment and materials, and for temporary works during the construction period.
- To provide and transfer the data and information necessary for the detailed design study.
- To facilitate the assistance and cooperation to the Project by the community people and to take necessary measure for traffic control.

. To provide a storage area for the residual clay and a place for discharge.

- To carry out ancillary works of the construction of drainage channel/
- To ensure all the expense and prompt execution for unloading, custom clearance at the port of disembarkation of the equipment and materials necessary for the Project.
- To open Banking Arrangement (B/A) and issuance of an Authorization to Pay (A/P), and to bear an advising commission of the Authorization to Pay (A/P) and payment commission to the Bank.
- To accord a facility to Japanese nationals whose services may be required for implementation of the Project, for their entry into Tanzania and their stay therein for the performance of the Project.
- Proper use and maintenance of the facilities/equipment constructed/purchased under the Japanese Grant Aid Project.
- Cost burden for items not included in the Japanese Grant Aid Scheme but necessary for the Project.

(2) Specific Issues in the Project

- Arrangement of water use permit for water source
- Arrangement of permission necessary for the Project (especially pipe laying work crossing the

railway)

- Arrangement of necessary procedures to lay pipe line in or along the main roads
- Announcement to community people prior to the commencement of the Project
- To bear the cost of daily allowance and travel expenses in the geophysical survey in the detailed design study
- To bear the cost for attending the soft component programme for the operation and maintenance of the water supply schemes

3.1.2 PRECONDITIONS FOR THE ACHIEVEMENT OF PROJECT PURPOSE

The purpose of the Project is to supply safe and clean water to 20 target villages in the rural areas in Tabora Region and to improve the water supply coverage in the these villages from 7.8 % in 2009 to 53.6 % in the target year of 2020.

The inputs of the Project will be the construction of water supply schemes, the procurement of the geophysical survey equipment and the activities of soft component programme. The Tanzanian side is requested to continuously consider the following issues in order to extract the output from the above input and sustain them.

1) Success of operation and maintenance of water supply scheme depends on the participation of communities. It is indispensable to improve living environment that community people uses safe water supplied by water supply schemes constructed by the project. DWST and MWST are requested to continue the instruction and the monitoring of the operation and maintenance activities by each Community Owned Water Supply Organization (COWSO), based on the manuals which will be prepared through the activities of soft component programme.

2) It is important to continue periodical monitoring of groundwater level and water quality. As for groundwater level, proper operation of water supply scheme so as not to cause groundwater recession due to over pumping. Checking of water quality is necessary to confirm the deterioration of water due to aging.

Concerning the improvement of the water supply coverage of whole Tabora Region, which will be the overall goal of the Project, The following issues will be needed to be realized.

1) Each District/Municipality will complete District/Municipality rural water supply plan and proceed the water supply facility construction by using the schemes such as WSDP.
2) The Tabora Branch of the Lake Tanganyika Basin Office will continuously implement and improve their groundwater development activities, of which the knowledge, skills and the geophysical survey equipment they will acquire through the Project.

3) In order to sustain the capacity of the Community Owned Water Supply Organizations which will be formulated and start the activities during the Project, the monitoring and technical support from Districts/Municipality will be indispensable. The continuous reinforcement of the DWST/MWST with the collaboration with the other schemes such as JICA's technical cooperation projects will be expected.

3.2 PROJECT EVALUATION

3.2.1 RELEVANCE

(1) Evaluation from View Point of Human Security

The Tabora Region is one of the least developed Regions in Tanzania in terms of water supply.

By implementing the Project, 40,727 persons in 20 target villages will directly benefit from the Project's effect. Currently, the population who are supplied with water by existing water supply facilities is only 4,250 persons (2009). Other residents use the contaminated water from traditional dug well and/or small streams. The implementation of the Project will produce the effect of "Provision of clean and realiable water source" and the other ripple effects such as "Relevance of women from the labour of fetching water".

Therefore, it is evaluated that the project is expected to be urgently implemented for the social stabilization and the improvement of the living conditions.

(2) Financial Evaluation

The cost of the operation and maintenance of the water supply facilities to be constructed in the Project will be born by the water tariff to be collected from the user community. The affordability-to-pay (ATP) and the willingness-to-pay (WTP) of the residents were analyzed based on the results of the detailed socio-economic survey in this Study (2010). Setting water user fees at 1.0 Tsh/L as a standard, and assuming their water consumption at 25l/capita/day by average of 7 household members, ratio of expenditure for water in total household income amounts to 2.5 to 3.5 percent. International organizations such as the World Bank, proposes that the ratio of water fee in total house income shall be not more than 5 %.

Therefore, it is evaluated that the affordability-to-pay of the residents in the target area is enough to operate and maintain the water supply facilities.

(3) Institutional and Organizational Evaluation

In the Project, Community-Owned Water Supply Organization (COWSO), which is autonomous legal entity and vested with ownership of the scheme management, will be introduced and the enhancement of the capacity of District/Municpal Water and Sanitation Team on their activities such as the technical support, instruction for the organization management and the monitoring etc.

In the National Water Sector Development Strategy, the following issues are mainstreamed into the principle in formulating Institutional and Organizational Plan; 1) Government's role will be limited to co-ordination, policy and guideline formulation, and regulation, 2) Regulatory and executive (i.e. service provision) functions will be separated, 3) Responsibility for executive functions will be decentralized to the lowest appropriate level, whilst balancing consumer representation/participation with economies of scale, 4) Regulatory function will be further separated from the prioritization and allocation of capital investment funds, 5) Autonomous entities will be established to manage water supply and sewerage services.

Therefore, it is evaluated that the institutions and organizations which are planned in the Project are conformed with the national strategies on water supply.

(4) Evaluation from Viewpoint of Policy

MoW intends to increase water supply coverage to 74% in 2015 and 90% in 2025 in the rural area where water supply schemes are less developed. Although the Project is not a project by the basket fund under WSDP, the Project will assist WSDP to attain the target by implementation of the water supply plan formulated in the Study in the same manner of WSDP' concept.

Therefore, implementation of the Project will contribute to realize the policy of MoW.

(5) Environmental and Social Evaluation

PEA on each one of the facilities is conducted by the Tabora Regional Secretariat with support of the Study team in accord with ESMF. The report of PEA was submitted to EIA division of MoW at the end of November. MoW reviewed the PEA report, and evaluated the project as "Category C". Since EIA process under NEMC is not required for "Category C" projects, further evaluation of environmental impact assessment in Tanzania is waived.

Therefore, it is evaluated that the Project will be implemented properly in viewpoint of environmental and social issues.

(6) Technical Appropriateness

The construction works of the Project are composed of drilling works, earthworks, pipe works, concrete works, mechanical/electrical works, deep well drilling and miscellaneous works. These works requires no special techniques. These will be carried out by conventional methods and machineries widely applied in Tanzania.

Therefore, the technologies which are adopted in the Project are considered to be appropriate.

3.2.2 EFFECTIVENESS

In the Project, 114 Level-1 water supply schemes and 4 Level-2 water supply schemes (118 water

supply schemes in total will be constructed in 20 target villages in Tabora Region. Simultaneously, formulation of Community Owned Water Supply Organizations (COWSO) and the capacity building of District/Municipal Water and Sanitation Teams will be enhanced through the activities of soft component.

From the above inputs, the quantitative effects will be expected as shown in Table 4.1.

Table 3.1 Quantitative Effect of the Project

Indicator	Basic Value (2009)	Target Value (2020)
Water Supply Coverage in 20 Target Villages	7.8% (Covered Population 4,250 prs. / Population 54,482 prs.)	53.6% (Covered Population 44,977 prs. / Population 83,970 prs.)
Available Water L/capita/day	Only 20 to 25 L/capita/day of contaminated water	25L/capita/day of safe and clean water will be used.
Time for Fetching Water	56.7 % in Rainy Season 25.3 % in Dry Season (Ratio of Households who can fetch water within 30 minutes)	Most of residents will have access to safe water source within 400m and the fetching time will be within 30 minutes.
Number of COWSOs	0	For 118 water supply schemes, COWSO will be formulated and they will continuously operate and manage their schemes.

The above effects will induce the following qualitative effects:

- Cost to get water is eased in the villages where no water source is available and depends on water vendors
- Fetching water is basically task of women and children. Time for fetching water is much reduced, and then times for participating in the social activities and chance to works of women, and chance to getting education of children are increased
- Reduction of infant mortality is expected by improved drinking water quality
- Medical cost is much reduced by improved drinking water quality
- Ownership of community people is improved by organizing of community participation type of operation and maintenance system