No.

The United Republic of Tanzania

THE STUDY ON WATER SUPPLY IMPROVEMENT IN COAST REGION AND DAR ES SALAAM PERI-URBAN IN THE UNITED REPUBLIC OF TANZANIA

Final Report

SUMMARY REPORT

December 2005

JAPAN INTERNATIONAL COOPERATION AGENCY
Global Environment Department

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In this report, project costs are estimated based prices as of July 29, 2005 with an exchange rate of US$1.00 = Tanzania Shilling (Tsh) 1,137 = Japanese Yen ¥ 112.47.

PREFACE

In response to a request from the Government of the United Republic of Tanzania, the Government of Japan decided to conduct the Study on Water Supply Improvement in Coast Region and Dar es Salaam Peri-Urban in the United Republic of Tanzania and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team composed of Pacific Consultants International (PCI) and Japan Techno Co., Ltd., headed by Mr. Yasumasa YAMASAKI of PCI to Tanzania three times between August 2004 and October 2005. In addition, JICA set up an advisory committee headed by Mr. Haruo IWAHORI, Japan International Cooperation Agency, between August 2004 and December 2005, which examined the Study from specialist and technical points of view.

The team held discussions with the officials concerned of the Government of the United Republic of Tanzania, and conducted field surveys in the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the United Republic of Tanzania for their close cooperation extended to the team.

December 2005

Etsuo Kitahara
Vice-President
Japan International Cooperation Agency

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Mr. Etsuo Kitahara
Vice-President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

Dear Sir,

We are pleased to submit you the final report entitled "The Study on Water Supply Improvement in Coast Region and Dar es Salaam Peri-Urban in the United Republic of Tanzania". This report has been prepared by the Study Team in accordance with the contracts signed on 11 August 2004 and 20 May 2005 between Japan International Cooperation Agency and the Joint Study Team of Pacific Consultants International and Japan Techno Co., Ltd.

The report examines the existing conditions related to water supply, water resources potential and socio-economy in Coast Region and Dar es Salaam Peri-Urban, proposes master plan for the improvement of water supply and presents results of the feasibility study on priority projects identified in the master plan.

The report consists of the Summary, Main Report, Supporting Reports, Data Book (including drawings). The Summary summarizes the results of all studies. The Main Report contains the existing conditions, the proposed master plan, the results of the feasibility study on the priority project, and conclusions and recommendations. The Supporting Report includes technical details of the Study. The Data Book contains basic data and drawings used in the Study.

All members of the Study Team wish to express grateful acknowledgement to Japan International Cooperation Agency (JICA), JICA Advisory Committee, Ministry of Foreign Affairs, Embassy of Japan in the United Republic of Tanzania, and other donors, NGOs and also to Tanzanian officials and individuals for their assistance extended to the Study Team. The Study Team sincerely hopes that the results of the study will contribute to the improvement of water supply situation in Coast Region and Dar es Salaam Peri-Urban, and that friendly relations of both countries will be promoted further by this occasion.

Yours Faithfully,

Yasumasa Yamasaki
Team Leader

EXECUTIVE SUMMARY

1. PROJECT BACKGROUND AND EXISTING CONDITIONS

A water supply master plan for Coast Region and Dar es Salaam Peri-Urban was formulated in 1979. In the master plan, group piped water supply schemes were proposed as the main water supply scheme. However, construction of those proposed water supply scheme were not been accomplished due to financial constraints. Accordingly, 65% of inhabitants in the two regions still do not have access to safe and clean water.

In October 2001, the Government of Tanzania requested the Government of Japan to carry out the formulation of water supply plan and feasibility study of the priority projects to be formulated through the study for Coast region and Dar es Salaam Peri-Urban.

It is thought that a compact piped water supply scheme using groundwater of which service area is in and around a village, is a more suitable scheme in Coast Region and Dar es Salaam Peri-Urban area than group piped water supply scheme, considering the socio-economic situations and the view points of operation and maintenance, and water source capacities realised in this Study.

In the Study area, there are three large scale piped water supply schemes namely: Upper Ruvu Water Supply, Lower Ruvu Water Supply (under DAWASA) and Chalinze Water Supply Scheme.

The total number of existing small scale piped water supply schemes in Coast Region and Dar es Salaam Region are 20 and 73. 75% of these schemes were constructed in 1970's in Coast Region, while most of the schemes in Dar es Salaam Region were constructed in 1990's and 2000's. However, not all schemes are in good working condition and the working ratios are 35 % (Coast Region) and 77 % (Dar es Salaam Peri-Urban).

The main reason for malfunction of the schemes is trouble with intake facilities such as diesel engines, generators and pumps. Other main reason is theft of equipment and water source problem. Although damages of pipes are frequent, problem with pipelines is minor reason for malfunction.

2. WATER RESOURCES

Through the studies and investigations, development potential of both surface water and groundwater resources are evaluated.

(1) SURFACE WATER POTENTIAL

In the Study Area, it is identified that the three rivers, namely the mainstream of Wami, Ruvu, and Kizinga are perennial rivers. By the study, it is concluded that only the Wami River has the potential for surface water development, with the total amount of 5.003 m^3/s. Since the required intake amount is beyond the available river discharge, the Ruvu and Kizinga Rivers cannot be developed as new surface water sources.

Taking into account of the capability of water supply facility, potential area by distance is evaluated using the vertical drop of 100 m from the river as an index. As the result, the area within 5km from the Wami River is selected as the potential area of surface water development.

(2) GROUNDWATER POTENTIAL

In the study area, the aquifers are identified as the four types of Quaternary, Neogene, Precambrian and Cretaceous. The aquifer of Quaternary and Neogene are categorized as stratum aquifer, while the Precambrian, Cretaceous and Jurassic are categorized as fractured aquifer of the basement rocks. The results of existing well survey suggest that the Quaternary aquifer is the most promising aquifer in the area. Next to Quaternary aquifer, Neogene aquifer shows relatively higher yield. For the geological formation of Precambrian, Cretaceous and Jurassic, the yields are generally small.

The hydrogeological map and the groundwater resources evaluation map have been prepared by the Study. The evaluation map was drawn in accordance with the distribution of groundwater yield and quality (EC). *Figure 1* shows the combination of factors used in the evaluation map.

			Estimated Yield (liters/min)		
			100 <	10 - 100	< 10
Water Quality EC (μS/m)		Allotment Points	Good	Fair	Poor
			4	2	1
< 1000	Good	3	**12**	**6**	**3**
1000 - 3000	Fair	2	**8**	**4**	**2**
3000 <	Poor	0	**0**	**0**	**0**
			Weighting		

Evaluation of Groundwater Resources

12	Promising water source for the Piped Scheme to serve more than 2,500 population with single well
8	
6	Fairer water source for the Piped Scheme to serve 2,500 population with multi-well system
4	
3	Can be utilized for Hand Pump
2	
0	Not suitable for drinking water

Figure 1 Matrix of the Classification for Groundwater Evaluation

The evaluation is described as follows.

Weighting: 12 and 8 Good

Promising water source for the Piped Scheme of more than 2,500 populations by single well. EC is good or fair for drinking, and besides the yield expected is 100 liter/min and more.

Weighting: 6 and 4 Fair

Promising water source for the Piped Scheme of more than 2,500 populations by multi-well system. EC is good or fair for drinking, and the yield expected is from 10 to 100 liter/min. This volume is exploitable using a small submersible pump.

Weighting: 3 and 2 Poor

The yield is fair and exploitable for hand pump water supply scheme. EC is good for drinking or fair for drinking.

Weighting: 0 Not Applicable

– EC is poor for drinking. It may be possible to use as a source for small scale industrial water or livestock water, otherwise water treatment facility is necessary.

3. WATER SUPPLY PLAN

The water supply plan was formulated for 278 villages targeting the year 2015. The target population is about 1.4 million in 2015. Estimated water demand is 13.9 x 10^3 m^3/day in Coast Region and 20.9 x 10^3 m^3/day in Dar es Salaam Region, totaling 34.8 x 10^3 m^3/day in the whole Study area.

Alternatives of the water supply scheme and district wise number of each scheme are summarized in *Table 1*. Major water source is groundwater because surplus surface water is available only in the Wami River.

Table 1 Number of Village to be supplied by each Scheme

	Level-2	Level-1	Rehabilitation	Extension
Bagamoyo	3 schemes, 3 villages	24 schemes, 6 villages	1 scheme, 1 village	38 villages
Kibaha	2 schemes, 2 villages	45 schemes, 14 villages		8 villages
Kisarawe	4 schemes, 2 villages	236 schemes, 74 villages		
Mkuranga	5 schemes, 7 villages	237 schemes, 73 villages		
Ilala	3 schemes, 3 villages	43 schemes, 10 villages		11 villages
Kinondoni	1 scheme, 1 village	14 schemes, 2 villages		11 villages
Temeke	4 schemes, 4 villages	8 schemes, 2 villages		19 villages
	22 schemes, 22 villages	607 schemes, 181 villages	1 scheme, 1 village	87 villages

Criteria for selection of type of water supply scheme are size of population and availability of water sources in the village. Level-2 scheme is planned in villages where population in 2015 is more than 2,500 and yield of well is more than 100 liter/min. Level-1 scheme is applied in the villages

where criteria for Level-2 is not satisfied and in the areas excluded from the service area of Level-2. Rehabilitation plan is prepared only for Saadani Village, Bagamoyo District. Dar es Salaam Water Supply Sewerage Authority (DAWASA) and Chalinze Water Supply Scheme have their own extension plans. Project cost is estimated as shown in *Table 2*.

Table 2 Summary of Projects Costs

Unit: Thousand USD

Type of Scheme	Construction Cost	Engineering Service (15%)	Administration Cost (3%)	Physical Contingency (10%)	Total	Note
Level-2	13,979.3	2,516.3*	-	-	16,495.6	22 schemes
Level-1	10,561.8	1,584.3	316.9	1,056.2	13,519.2	607 schemes
Rehabilitation	181.2	27.2	5.4	18.1	231.9	1 scheme
Chalinze (Phase II)	7,546.9	754.7	226.4	754.7	9,282.7	42 villages
Total	32,269.2	4,882.5	548.7	1,829.0	39,529.4	

Note *: Approximately 3% of construction cost was added as the cost for soft component.

Implementation schedule of water supply plan is arranged as shown in *Table 3* considering the financial status of MoWLD.

Table 3 Implementation Schedule for Water Supply Plan

Project	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Priority Project (Level-2)	←	—	→							
Chalinze (Phase II)	←	—	→							
Level-1				←	—	—	—	—	—	→
Rehabilitation				←	→					
Mkuranga	←	—	—	—	→					
DAWASA	←	—	→							

Implementation of water supply plan will raise the water supply level up to 66.9 % in 2009 and 68.1 % in the target year 2015. This raising is coherent with Revised Poverty Reduction Strategy of which target is to raise the water supply level up to 65 % in 2009.

Annual disbursement for implementation of water supply plan is shown in *Table 4*.

Table 4 Annual Disbursement Schedule

Unit: thousand USD

Project No.	Project		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
1	Piped Water Supply Scheme (Level-2)	Engineering	875.9	654.4	986.0								2,516.3
		Construction	4,865.8	3,635.7	5,477.8								13,979.3
		Sub-Total	5,741.7	4,290.1	6,463.8								16,495.6
2	Hand Pump (Level-1)	Engineering				138.0	138.0	138.0	138.0	138.0	138.0	138.0	965.7
		Construction				919.7	919.7	919.7	919.7	919.7	919.7	919.7	6,438.0
		Sub-Total				1,057.7	1,057.7	1,057.7	1,057.7	1,057.7	1,057.7	1,057.7	7,403.7
3	Rehabilitation	Engineering				27.2							27.2
		Construction				204.7							204.7
		Sub-Total				231.9							231.9

As the most preferable option of management, operation and maintenance for water supply schemes, Community-Owned Water Supply Organization (COWSOs) such as Water Users Association (WUA) and Water Trust/Cooperative are proposed.

4. PRIORITY PROJECT

The Priority Project was selected considering the appropriate scale of project and proportion of population in villages. 22 Level-2 schemes in 22 villages were selected as the Priority Project. The list of the Priority Project is shown in *Table 5*. .

Preliminary design of the Priority Project was prepared based on unit water demand of 25 liter/capita/day and institution demand was also taken into consideration. Basic concept of design is to supply by gravity after exploitation of water from the intake by submersible pump. No treatment plant is planned in order to minimize the operation cost of schemes, except for the one village where source is surface water.

The cost for implementation of the Priority is estimated as 16.5 million USD including engineering cost assuming implementation by Japan's Grant Aid Project.
Implementation of the Priority Project is planned to start in 2006 and its completion in 2008 as shown in *Table 6*.

Table 5 List of Priority Project

District/Municipality Village/Mitaa	Name of Village	Serial No. of Scheme	Service Population (2002)	Service Population (2010)	Service Population (2015)	Number of Wells	Water Production (m^3/day)
BAGAMOYO							
KIBINDU	KIBINDU	BGM-1	4,904	5,746	6,344	2	173
KWAMDUMA	KWAMDUMA	BGM-2	2,545	2,982	3,292	2	86
MKANGE	MATIPWILI	BGM-3	1,948	2,283	2,518	Wami	72
KIBAHA							
RUVU	MINAZI MIKINDA (1/2)	KBH-1A	1,624	2,083	2,508	1	72
RUVU	MINAZI MIKINDA (2/2) /KITOMONDO	KBH-1B	1,627	2,102	2,513	1	72
KISARAWE							
CHOLE	CHOLE	KSW-1	2,685	3,001	3,217	2	106
MSIMBU	MSIMBU	KSW-2	2,199	2,458	2,635	2	76
MKURANGA							
LUKANGA	NJOPEKA	MKR-1	3,371	4,439	5,272	Spring	132
VIKINDU	MWANDEGE/KIPALA	MKR-2	2,100	2,370	2,815	1	79
VIKINDU	KISEMVULE	MKR-3	2,260	2,731	3,244	2	86
VIKINDU	MOROGORO MFURU MWAMBAO	MKR-4	1,945	2,036	2,635	1	72
VIKINDU	VIANZI	MKR-5	1,871	2,463	2,926	1	79
ILALA							
KITUNDA	KITUNDA-Kivuke (1/2)	ILL-4A	2,614	3,746	4,690	2	126
	KITUNDA-Kivuke (1/3)	ILL-4B	1,744	2,499	3,129	1	90
	KITUNDA-Mzinga	ILL-4C	4,114	5,895	7,382	2	198
MSONGOLA	MSONGOLA	ILL-5	1,410	2,021	2,530	1	72
PUGU	PUGU STATION	ILL-6	6,481	9,287	11,629	1	72
KINONDONI							
GOBA	MATOSA	KND-1	2,580	3,558	4,350	1	72
TEMEKE							
MJIMWEMA	KIBUGUMO	TMK-1	1,883	2,698	3,379	1	84
MJIMWEMA	MJIMWEMA	TMK-2	2,000	2,866	3,589	1	90
PEMBA MNAJI	YALEYALE PUNA	TMK-3	3,113	4,461	5,586	1	150
PEMBA MNAJI	TUNDWI SONGANI	TMK-4	1,475	2,114	2,647	1	72

Table 6 Implementation Schedule of Priority Project

District/Municipality	2006	2007	2008	2009	2010
Bagamoyo	← →				
Kibaha	← →				
Kisarawe	← →				
Mkuranga		← →			
Ilala			← →		
Kinondoni		← →			
Temeke			← →		

Implementation of the Priority Project will contribute to 5.4 % of raise in the water supply level by the target year 2015.

5. EVALUATION OF PRIORITY PROJECT

Results of the economic analysis are summarized in *Table 7*. NPV and B/C ratio indicate that the economic benefit will exceed the cost. EIRR is calculated as 13% in Coast and 16% in Dar es Salaam. The results suggest that the project is economically viable.

Table 7 Summary of Results of the Economic Analysis

Region	NPV	B/C Ratio	EIRR
Coast	722	1.07	13%
Dar es Salaam	2,123	1.27	16%

Water tariff is set at 1 Tsh/litre, which is same as the amount of Willingness to Pay (WTP) examined in the Study. The 80 % of recovery rate would assure the full operation, and maintenance cost over 10 years for the Priority Project including replacement cost. The profit-loss break-even point of revenue collection is the average recovery rate of 74 % in Coast Region and 51 % in Dar es Salaam Region. It can be concluded all the priority projects could gain operational surplus, thus financially viable.

Formation of COWSO and establishment of District Water and Sanitation Team (DWST) are all in line with the national strategies and aims to assure effectiveness, efficiency, and sustainability of the water supply service. From those points of views, the plan is assessed as feasible and efficient in institutional and organizational aspects as well.

Providing facilitation package for capacity development of COWSO and DWST will enhance effectiveness, while contracting-out will increase competency and expertise in operation and maintenance of the schemes.

The results of Initial Environmental Evaluation (IEE) show that all the evaluated categories of the Priority Project fall in Category C, therefore, Environmental Impact Assessment (EIA) is not required.

The construction works for implementation of water supply plan require no special technique. Conventional methods are adequate. Thus, technique, machineries and materials necessary for the Priority Project are evaluated as technically appropriate.

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ABBREVIATIONS

ATP	Affordability-to-Pay
B/C Ratio	Benefit Cost Ratio
BTC	Belgian Technical Cooperation
CBOs	Community-Based Organizations
CIDA	Canadian International Development Agency
COWSOs	Community-Owned Water Supply Organizations
DAWASA	Dar es Salaam Water and Sewerage Agency
DD	Draw Down
DDCA	Drilling & Dam Construction Agency
DRWS	Division of Rural Water Supply
DSM	Dar es Salaam
DTH	Dawn-the-hole Hammer
DWL	Dynamic Water Level
DWSP	District Water Supply and Sanitation Team
DWST	District Water and Sanitation Team
EC	Electric Conductivity
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
ESAs	External Support Agencies
EWURA	Energy and Water Utilities Regulation Authority
FRP	Fiber Reinforced Plastic
GDP	Gross Domestic Product
GIS	Geographical Information system
GNP	Gross National Product
GPS	Global Positioning System
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
IEE	Initial Environmental Examination
JICA	Japan International Cooperation Agency
LGRP	Local Government Reform Policy
M/M	Minutes of Meetings
MOL	Ministry of Land
MoNRT	Ministry of Natural Resource and Tourism
MoWLD	Ministry of Water and Livestock Development
NEMC	National Environmental Management Council
NGOs	Non-Governmental Organizations
NPV	Net Present Value
NWP	National Water Policy
NWSDS	National Water Sector Development Strategy

O&M	Operation and Maintenance
PEDP	Primary Education Development Programme
PER	Preliminary Environmental Report
PHAST	Participatory Health and Sanitation Transformation
PRSP	Poverty Reduction Strategy Paper
PWP	Public Water Point
RF	Registration Form
RWSD	Rural Water Supply Division
RWSSP	Rural Water Supply and Sanitation Program
SC	Specific Capacity
SR	Scoping Report
SW	Scope of Work
SWAP	Sector Wide Approach
SWL	Static Water Level
TDS	Total Dissolved Solid
TOR	Terms of Reference
TRC	Technical Review Committee
UFW	Unaccounted-for water
UNICEF	United Nations International Children's Fund
VES	Vertical Electrical Sounding
VWCs	Village Water Committees
WDC	Ward Development Committee
WRI	Water Resources Institute
WSS	Water Supply System
WSSAs	Water Supply and Sanitation Authorities
WSSMC	Water Supply System Management Center
WTP	Willingness-to-Pay
WUAs	Water User Associations
WUGs	Water User Groups

<unit>	
l/min	liter/minute
masl	meter above sea level
mbgl	meter below grand level
min	minute

CHAPTER 1 INTRODUCTION

1.1 BACKGROUND OF THE STUDY

The United Republic of Tanzania is located in the eastern part of Africa covering 945 thousand km^2. The total population reached 34.57 million in 2002. GNP is low, US$270/capita in 2001. The coastal area in which Coast and Dar es Salaam Regions lie, has two rainy seasons, from March to May and from November to December. Annual precipitation ranges from 800 to 2,000mm.

The Government of Tanzania started Rural Water Supply Project in 1971 aimed to provide safe and clean water to the entire nation within a distance of 400m. A water supply master plan for Coast Region and Dar es Salaam Peri-Urban was formulated in 1979. In the master plan, the group piped water supply schemes were proposed as the main water supply scheme. They cover many villages with extensive distribution systems using the surface water. Detailed groundwater evaluation was not implemented. However, construction of those proposed water supply scheme were not been accomplished due to financial constraints. Only Chalinze Water Supply Scheme was constructed. Other factor to impede the provision of water supply schemes is thought that the scheme proposed in the master plan was not suitable for the socio-economic situations in Coast Region and Dar es Salaam Peri-Urban area. Accordingly, 65% of inhabitants in the two regions still do not have access to safe and clean water.

It is thought that a compact piped water supply scheme of which service area is limited within a village using groundwater in and around the village, is more suited for Coast Region and Dar es Salaam Peri-Urban area than group piped water supply scheme, considering the socio-economic situations and the view points of operation and maintenance, and water source capacities realised in this Study.

In October 2001, the Government of Tanzania requested the Government of Japan to carry out the formulation of the water supply plan and the feasibility study of the priority projects to be formulated through the study.

1.2 OBJECTIVES OF THE STUDY

The objectives of the Study are;

- To formulate a water supply plan for Coast Region and Dares Salaam Peri-Urban,
- To conduct a preliminary design on the priority projects,
- To develop the capacity of counterpart personnel of Ministry of Water and Livestock Development and other authorities concerned in the course of the Study, and
- Technical transfer on geophysical prospecting method to the Water Resources Institute

1.3 STUDY AREA AND STUDY TARGET MITAA/VILLAGES

1.3.1 STUDY AREA

The Study covers the following area as shown in *Figure 1.1*.

- Bagamoyo, Kibaha, Mkuranga and Kisarawe Districts in Coast Region
- Dar es Salaam Peri-Urban excluding the service area defined in Dar es Salaam City Water Supply Plan.

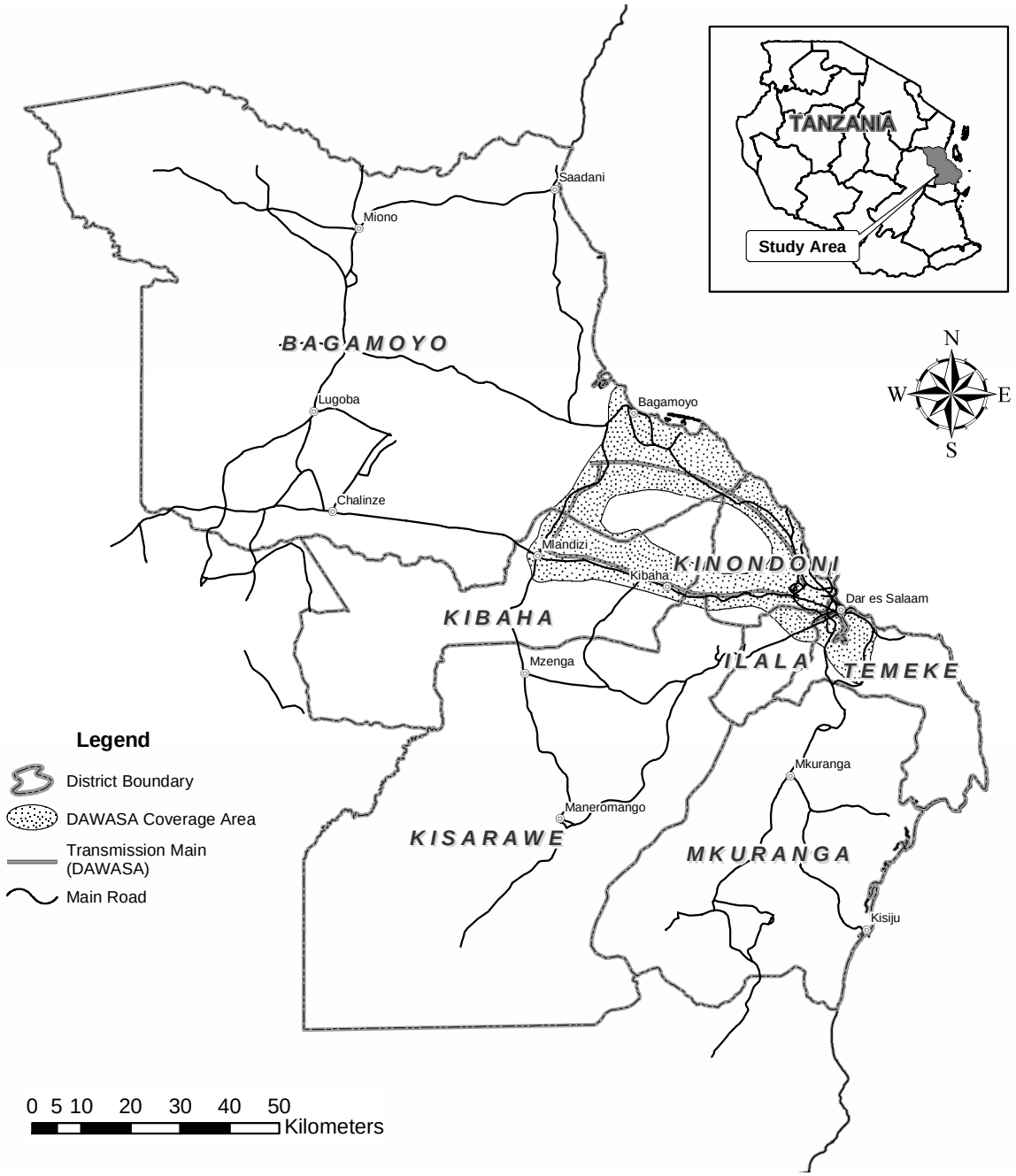

FIGURE 1.1 LOCATION MAP OF THE STUDY AREA

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1.3.2 TARGET MITAA/VILLAGES FOR THE STUDY

The number of study target Mitaa and Villages (hereinafter, referred to as "Villages") were identified as 278 Villages based on the result of the "Village Inventory Survey" (Mitaa: An administrative unit in the urban area under the Municipality, equivalent to a Village in the rural area.). In Coast Region, most villages are sub-divided into Sub Villages. In case of Dar es Salaam Peri-Urban, a few Villages are composed of Sub Villages. Total number of the Sub Villages in the Study target Villages is 884. Number of Villages and Sub Villages in each District/Municipality is shown in *Table 1.1*. Detailed list of Villages is presented in Chapter 1 of Supporting Report. Population used in this report is obtained through the Village Inventory Survey by interviewing at Ward and/or Village offices on the Census results of 2002 which was not yet officially reported. The compilation of Census results is still in process. Therefore, the population obtained through the Village Inventory Survey is provisionally used in this report as the final population.

Table 1.1 Number of Study Target Mitaas/Villages and Population

District/Municipality	Total Population (2002)	Target Villages	
		No. of Village	Population to be served (2002)
Bagamoyo	228,967	45	104,264
Kibaha	131,242	24	40,334
Kisarawe	95,323	74	85,787
Mkuranga	186,927	74	161,263
Sub Total (Coast)	642,459	217	391,648
Ilala	634,924	24	217,358
Kinondoni	1,083,913	14	113,351
Temeke	768,451	23	142,137
Sub Total (Dar es Salaam)	2,487,288	61	473,246
Total	3,129,747	278	864,494

1.4 IMPLEMENTATION OF THE STUDY

The Study was conducted by the Japanese study team, comprised of members from Pacific Consultants International and Japan Techno Co. Ltd, officially retained by JICA for the Study, and the counterpart staff provided by MoWLD.

The Study consists of the following two phases;

Phase I: Formulation of Water Supply Plan: (August, 2004 to March, 2005)

Phase II: Preliminary Design on Priority Project(s): (May to December, 2005)

CHAPTER 2 GENERAL DESCRIPTION OF STUDY AREA

2.1 GENERAL

The Study area is Coast and Dar es Salaam Regions, which lies along the Indian Ocean coast. Dar es Salaam Peri-Urban and Coast Region have acted as a receiver for demographic migration to the urban area. In these regions, shortage of domestic water has been caused by rapid expansion of population and water pollution due to inappropriate operation and management of existing water supply systems.

2.2 METEOROLOGY AND HYDROLOGY

2.2.1 METEOROLOGY

In the mainland of Tanzania, generally two rainy seasons occur in a year; one is from March to May and the other is from November to December. Annual average precipitation reaches 1,000mm.

There are 79 rainfall gauging stations in the Study Area, 57 in Coast region and 22 in Dar es Salaam region.

(1) Annual Rainfall

Figure 2.1 shows the location of meteorological stations and distribution of annual rainfall. Annual total rainfall varies greatly by the station. It ranges from 849.7 mm in Utete Bomani to 1529.9 in Kisarawe even within the Study Area.

(2) Monthly Rainfall

In the study area, rainfall patterns are similar in all stations though annual total rainfall varies by the station. Maximum rainfall occurs in the month of April in all stations, and minimum in the month of September in nine stations, July in three stations and August in one station.

(3) Monthly Temperature

Average monthly minimum and maximum temperatures are observed in the months of August (18.3°C) and February (32.5°C) at Dar es Salaam International Airport, and also in the same months of August (18.9°C) and February (32.3°C) at Kibaha Agromet. Annual average temperature at both of these locations are the same value of 26.0°C with small monthly variation.

(4) Sunshine

Annual average sunshine at Dar es Salaam International Airport and Kibaha Agromet is 7.7 and 7.3 hours, respectively.

Radiation is measured only at Dar es Salaam International Airport Station. Annual average radiation averaged over the period 1983-1993 is calculated at 551.3 Mega joule/m^2.

2.2.2 RIVER SYSTEM

(1) River System in Tanzania

Tanzania is divided into nine major river basins, namely Lake Victoria Basin, Lake Tanganyika Basin, Internal Drainage Basin, Pangani Basin, Wami and Ruvu Basin, Lake Rukwa Basin, Rufiji Basin, Lake Nyasa Basin, and Ruvuma River and the Southern coast basin. Almost the entire Study Area is included in Wami and Ruvu basin.

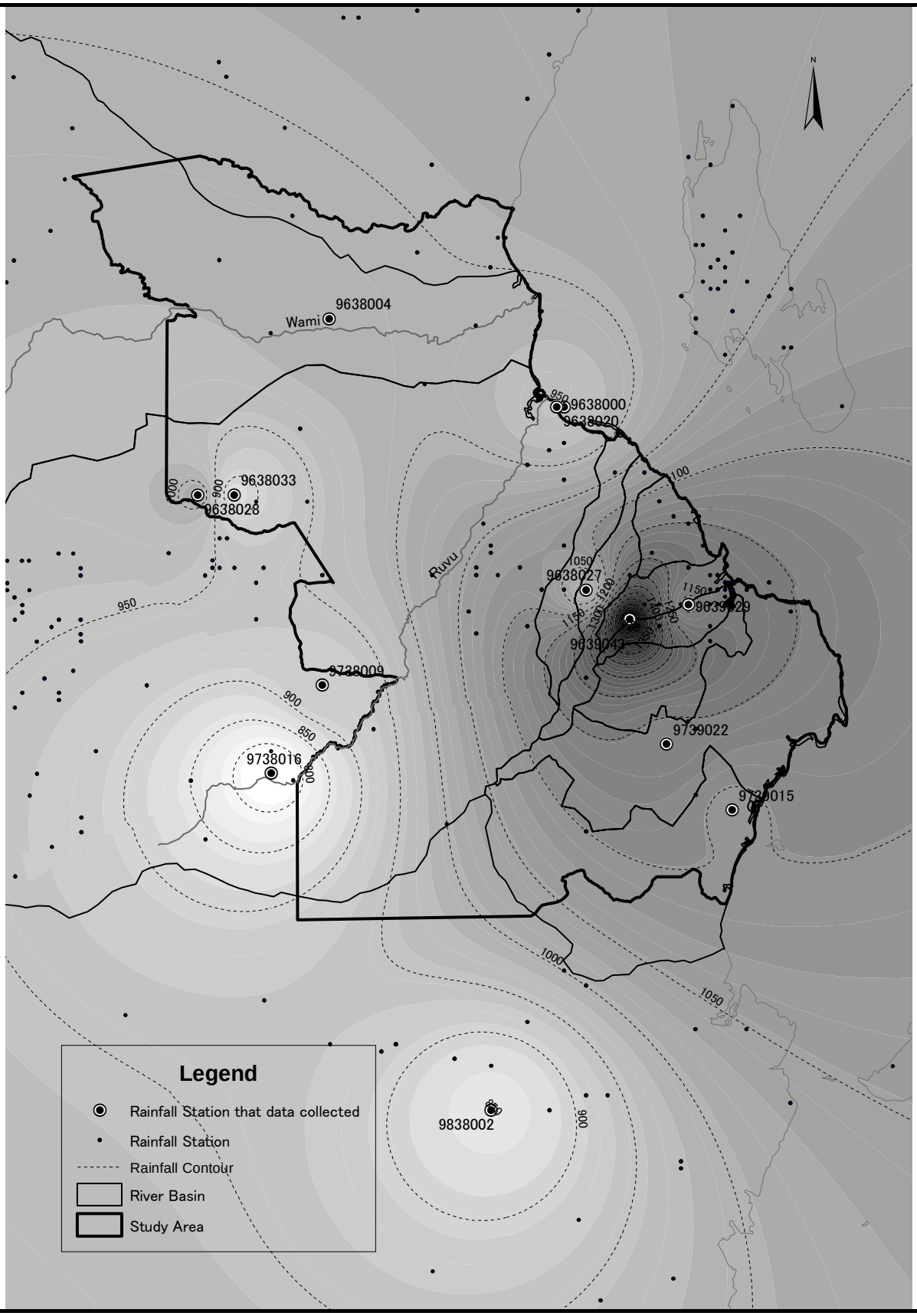

FIGURE 2.1 METEOROLOGICAL STATIONS AND ANNUAL RAINFALL DISTRIBUTION

THE STUDY ON WATER SUPPLY IMPROVEMENT IN COAST & DAR ES SALAAM | **JICA**

(2) River System in the Study Area

Study Area contains three major river basins, Pangani, Wami and Ruvu, and Rufiji basin. Wami and Ruvu basin is divided into two river basins, namely Wami, and Ruvu basin. In addition, Ruvu basin includes basin that Ruvu River itself flows, and other small river basins located east of Ruvu basin and along the ocean.

2.2.3 HYDROLOGICAL CHARACTERISTICS

Table 2.1 shows the characteristic of the river basins in the Study area. As the result of interview survey to related persons and investigation of the past discharge data, three rivers, namely the mainstream of Wami and Ruvu, and Kizinga are confirmed as perennial river in the Study Area.

Table 2.1 Characteristics of the River Basins

Basin Name	River Name	Area (km^2)	Average Elevation (m)
Pangani	Tributary of Pangani	957	246.5
Wami	Wami	3749	285.1
Ruvu	Ruvu	8202	143.7
Coast R1	Mkuza, Kerege	518	140.7
Coast R2	Mpiji	489	168.6
Coast R3	Mbezi	312	77.7
Coast R4	Msimbo	319	115.4
Coast R5	Kizinga	249	88.9
Coast R6	Mzinga	615	109.5
Coast R7	Mbezi, Mbele, Ukooni	2128	80.5
Coast R8	Luhute, Luhule	1553	104.1
Rufiji	Tributary of Rufiji	723	150.0

2.3 TOPOGRAPHY AND GEOLOGY

2.3.1 GENERAL GEOLOGY OF TANZANIA

The geology of Tanzania comprises mainly the Precambrian (Archaean, Proterozoic) and Phanerozoic (Upper Palaeozoic, Mesozoic and Cenozoic) Formations. The Archaean rocks are characterized by a granite-greenstone terrain. The Tanzanian Craton covers the central part of the territory up to south and east part of Lake Victoria.

2.3.2 TOPOGRAPHY AND GEOMORPHOLOGY OF THE STUDY AREA

Altitudes of the Study area range from 0 m (sea level) in the coastal area along the Indian Ocean to approximately 600 m in the north-western hilly area in Bagamoyo District. The topography in general reflects the geological structure in the Study area. The north-western area, mainly in Bagamoyo District is characterized by the plateau with 200 to 600 m high. The eastern fringe of the plateau is surrounded by generally flat hills of which height is approximately 100 to 300 m. The hilly topography is widespread in the eastern half of the Study area. A pair of hills is recognized elongating in NE-SW direction. River terraces and coastal terraces are recognized along the Wami River, the Ruvu River and the Indian Ocean.

2.3.3 GEOLOGY OF THE STUDY AREA

In the Study area, a total of five major geological formations of 1) Precambrian, 2) Jurassic, 3) Cretaceous, 4) Neogene and 5) Quaternary are identified.

(1) Precambrian

The Precambrian is distributed mainly in Bagamoyo Plateau. It consists mainly of gneiss and granulite in the lower part and crystalline limestone intercalated with schists and gneiss. Many faults and lineaments are recognized in the area. Due to weathering of formation, surface of Bagamoyo Plateau is generally dense covered with soils.

(2) Jurassic

The eastern edge of Bagamoyo Plateau is occupied by the Jurassic which unconformably overlies the Precambrian and overlain by the Cretaceous. The Jurassic is unmetamorphosed and comprised mainly of sandstone intercalated sometimes with shale, siltstone and conglomerate.

(3) Cretaceous

The Cretaceous crops out in narrow areas occupying the edge of Bagamoyo Plateau. It is underlain by the Jurassic and overlain by the Neogene. Another distribution area is in the southwestern foot of the Msanga-Pugu Hills. In this area, the Cretaceous Formation is distributed in the hillside and foot of hills underlying the Neogene Formation.

(4) Neogene

The Neogene strata occur widely in the eastern half of the Study area, covering most areas in Ruvu Hill, Msanga-Pugu Hills and Mkuranga Hills.

The Neogene consists of less sorted intercalation of sandy clay and clayey sand accompanied with lenses of sand and clay.

(5) Quaternary

The Quaternary is distributed in a limited area, along the Ruvu River, near the river mouth of the Wami River and along the coast. These deposits consist of sand, gravel, silt and clay.

A fluvial deposit is distributed filling the Ruvu Graben along the Ruvu River.

2.4 SOCIO-ECONOMIC CONDITIONS

2.4.1 ADMINISTRATIVE SETTINGS

Every district/ municipalities is subdivided into divisions which are further demarcated into wards. A ward consists of a certain number of villages or Mitaas which are administratively represented by the village/Mitaa councils. Kitongoji is the smallest unit of the administrative organ to which a village is subdivided into.

Coast Region presently consists of six districts, namely Bagamoyo, Kibaha, Kisarawe, Mkuranga, Rufiji and Mafia. Dar es Salaam consists of three municipalities, namely Ilala, Kinondoni, and Temeke which were upgraded from district level in 2000.

Table 2.2 shows distribution of number of divisions, wards and villages/mitaas forming each target district in the two regions.

Table 2.2 Administrative Setup of the Study Area

District/Municipality		No. of Division	No. of Ward	No. of Village/Mitaa			
				District Total			Target Village/Mitaa of the Study
				Village	Mitaa	Total	
Coast	Bagamoyo	6	16	82	0	82	45
	Kibaha	3	9	25	0	25	24
	Kisarawe	4	15	74	0	74	74
	Mkuranga	4	15	101	0	101	74
	Sub-Total	17	55	282	0	282	217
DSM	Ilala	3	22	9	65	74	24
	Kinondoni	3	27	14	113	127	14
	Temeke	3	24	15	97	112	23
	Sub-Total	9	73	38	275	313	61
Total		26	128	320	275	595	278

2.4.2 POPULATION AND ETHNIC GROUPS

According to the population and housing census in 2002, national population of Tanzania is 34,443,603 of which 97% lives in the mainland. Coast Region has 885,017 population in total which is population-wise the second smallest region in the mainland. Meanwhile, the regional population of Dar es Salaam is 2,487,288, which is the third largest in the mainland following Mwanza and Shinyanga regions.

The population growth rate of Coast Region increased from 2.1% in the previous intercensal period (1978-1988) to 2.4% though it is below the growth rate of the national and mainland population. Regarding the population growth of Dar es Salaam Region, it has decreased from 4.8% in the last intercensal period (1978-1988) to 4.3%.

Approximately 94% of population with population density of 1,786 persons/km^2 live in urban area of Dar es Salaam Region, while nearly 80% with 27 persons/km^2 is rural population in Coast Region.

The main indigenous ethnic group in Coast Region is Wazaramo, who are dominant in all six districts of the region. Wadengereko is found mostly in Rufiji district and part of Mkuranga. Wakwere mostly reside in Bagamoyo and Wambwera and Wapokomu are found in Mafia. .

2.4.3 ECONOMIC CONDITIONS

Coast region predominantly relies on typical agricultural economy. More than 90 percent of its population is involved in agricultural sector. The agricultural sector alone contributes more than 80 percent of the regional income while other sectors such as natural resources, livestock, industries and other together share the remaining portion.

According to Socio-Economic Profile of the Coast Region (1997), it ranked as the lowest average annual regional GDP contributor to the national GDP for the period of 1980-1994 among all the regions in the mainland of Tanzania, while Dar es Salaam that accounted for 20 percent of contribution to the national GDP ranked as the highest.

Looking at the 1997 household income, Coast region has the lowest per capita income in the mainland (22,624 Tsh/capita/year). The per capita income of Dar es Salaam is recorded at approximately nine times that of Coast Region (197,107 Tsh/capita/year).

2.4.4 SOCIAL SERVICES

(1) Education

The enrolment rate in primary schools has been improved in both regions. The net enrolment rate shows improvement from 77.6 percent (1999) to 95 percent (2003) in Dar es Salaam and from 63.5 percent (1999) to 94.2 percent (2003) in Coast Region. These figures are higher than the national average of enrolment rate in primary schools.

With regard to the literacy rate of population aged 15 and above, Coast region records 54 percent which is far below the national average of 71 percent in 2001. Difference in the literacy rates between male and female is large with 61 percent for male and 48 percent for female.

(2) Health

In the both regions, major causes of illness are malaria, upper respiratory tract infection, diarrhea which shows similar trend of national situation. Common causes of infant and under-5 mortality are malaria, upper respiratory tract infections, pneumonia, diarrhea, eye infections and skin infections. Coast region is ranked at eighth highest in terms of infant mortality rate in the mainland followed by Dar es Salaam Region. Regarding under five mortality rate, Coast region has the eights highest rate while Dar es Salaam is ranked at tenth.

For the health service delivery, three government hospitals and one parastatal hospital are operational in Coast Region. On the other hand, over 20 hospitals are presently run by government, private or voluntary organizations in Dar es Salaam.

CHAPTER 3 EXISTING WATER SUPPLY CONDITION AND WATER SUPPLY SCHEMES

3.1 GENERAL

In order to comprehend the water supply condition in the Study area, current situation of existing water supply schemes was surveyed. In addition, water quality of water sources was surveyed.

3.2 EXISTING WATER SUPPLY SCHEMES

3.2.1 LARGE SCALE PIPED WATER SUPPLY SCHEMES

In the Study area there are three large scale piped water supply schemes namely: Upper Ruvu Water Supply, Lower Ruvu Water Supply (under DAWASA) and Chalinze Water Supply Scheme. Outline of these schemes are summarized below.

(1) DAWASA Water Supply Scheme

Dar es Salaam Water & Sewerage Authority (DAWASA) is currently responsible for provision of water supply and sewerage services in Dar es Salaam. The estimated service population of DAWASA is 1.25 million (about half of the total population in Dar es Salaam).

Main water source is the Ruvu River. Other sources are the Kizinga River and several wells in Dar es Salaam. Total capacity of water production (treatment capacity) of the Ruvu water treatment plants is 264 x 10^3 m^3/day.

(2) Chalinze Water Supply Scheme

The scheme has service area of 19 villages in Bagamoyo District (as of November 2005). The scheme has extension plan for up to 42 villages (38 villages in Bagamoyo and 4 villages in Kibaha). Water source is the Wami River and the capacity of water production is 9.35 x 10^3 m^3/day (Bagamoyo District, 2001).

3.2.2 SMALL SCALE PIPED WATER SUPPLY SCHEMES

The total number of small scale existing piped water suply schemes in Coast Region and Dar es Salaam Region are 20 and 73. 75% of these schemes were constructed 1970's in Coast Region, while most of the schemes in Dar es Salaam Region were constructed in 1990's and 2000's. However, not all schemes are in good working condition, and the working ratios are 35 % (Coast Region) and 77 % (Dar es Salaam Region).

The main reasons for malfunctioning of the schemes are the problem with intake facilities such as failure of diesel engines, generators and pumps. Other main reasons are theft of equipment and water source problem. Although damages of pipes are frequent, they are minor reasons for suspension.

3.3 WATER QUALITY ON EXISTING WATER SOURCE

3.3.1 OUTLINE OF WATER QUALITY SURVEY

The water quality sampling was conducted in both dry and rainy seasons for surface water and shallow wells (33 locations), but in dry season only for groundwater (tube wells) (35 locations). Samples were also collected from Test Wells (9 locations). Thus, total number of sampling locations is 77.

Water samples were collected in October 2004 as the dry season and in January 2005 as the rainy season. Samples from groundwater was taken only in dry season (October 2004).

3.3.2 WATER QUALITY STANDARDS FOR DRINKING WATER

In the evaluation of water quality, following guidelines and standards were applied.

- The Guidelines for Drinking-water Quality (WHO, 2004) for items related to the protection of human health.
- Temporary Standards of Quality of Domestic Water in Tanzania (Ministry of Water Development and Power, 1973) for items related to the Acceptability Aspects of water for drinking and domestic water use.

3.3.3 RESULTS OF WATER QUALITY ANALYSES

The number of samples that do not satisfy the Guidelines (WHO, 2004) or the Standards (Ministry of Water Development and Power, 1973) are summarized in *Table 3.1* below.

Table 3.1 Number of Samples with Items Exceeding the Guidelines and Standards

Aspects and Items		Test well	Existing well	Surface water (Dry season)		Surface water (Rainy season)	
				River and Dam	Shallow well and Spring	River and Dam	Shallow well and Spring
Total Number of Sample		9	35	17	16	16	17
Microbial aspects	Escherichia coli	6	10	17	14	16	17
Chemicals that are of health significance	Cadmium (Cd)	0	1	0	0	0	0
	Cadmium (Cd)	0	0	0	0	0	0
	Cyanide (CN)	0	0	0	0	0	0
	Lead (Pb)	1	0	0	0	0	0
	Arsenic (As)	0	0	4	4	9	11
	Mercury (Hg)	0	0	2	1	6	4
	Selenium (Se)	0	0	11	9	8	7
	Barium (Ba)	0	0	12	11	10	5
	Fluoride (F)	0	0	0	0	0	0
	Hexavalent-chromium (Cr^{6+})	0	0	0	0	0	0
	Total chromium (T-Cr)	-	-	-	-	-	-
	Nitrate (NO_3-N)	0	3	1	3	1	3
	Nitrite (NO_2-N)	0	0	0	0	0	0
	Boron (B)	0	0	1	4	0	0
	Nickel (Ni)	1	1	1	0	4	1
	Antimony (Sb)	0	0	0	0	0	0
	Molybdenum (Mo)	0	0	0	0	0	0
	Manganese (Mn)	2	0	0	3	1	2
	Organic Carbon (as carbon in Chloroform)	0	0	0	0	0	0
Acceptability aspects	Total Hardness	4	5	0	0	1	0
	Hardness	0	1	2	3	4	5
	Calcium (Ca)	-	-	-	-	-	-
	Magnesium (Mg)	-	-	-	-	-	-
	Iron (Fe)	2	0	2	3	2	1
	Zinc (Zn)	0	0	0	0	0	0
	Copper (Cu)	1	0	0	0	1	0
	Chloride (Cl)	4	5	1	1	1	0
	Residue	-	-	-	-	-	-
	Total filterable residue	4	2	1	0	1	0
	Anionic surface active agents (as ABS)	0	0	0	0	0	0
	Phenols	0	0	0	0	0	0
	Hydrogen sulfide (H_2S)	-	-	-	-	-	-
	Ammonium (NH_3+NH_4)	0	0	0	1	2	6
	Total nitrogen (Excluding NO_3)	0	0	0	0	2	6
	BOD	0	0	4	3	8	9
	Potassium permanganate consumption	0	0	2	2	4	4
	pH	0	17	3	7	3	10
	Taste	5	7	2	2	1	2
	Odour	0	8	3	5	0	0
	Colour	0	2	9	8	5	9
	Turbidity	3	2	5	6	8	10
	Temperature	-	-	-	-	-	-
	Conductivity (EC)	-	-	-	-	-	-
	Residual chlorine (Cl)	-	-	-	-	-	-
	Sulfate (Mg+Na Salts)	-	-	-	-	-	-
Water quality items related to the characteristics of groundwater	Sodium (Na)	-	-	-	-	-	-
	Potassium (K)	-	-	-	-	-	-
	Bicarbonate (HCO^{3-})	-	-	-	-	-	-
	Total alkalinity	-	-	-	-	-	-
	Sulphate (SO_4)	1	0	0	0	0	0

(1) Groundwater

Concentration of analyzed items exceeding the Standards are observed on 10 items; Microbial aspects (Escherichia coli), Nitrate Nitrogen (N-NO_3), Nickel (Ni), Chloride (Cl), Hardness, Total Dissolved Solid (TDS), pH, Taste and Odour. Among them, items related to the protection of human health are Nitrate Nitrogen (N-NO_3) and Nickel (Ni). Although contaminations of groundwater are observed for some parameters, still the results will not affect the Water Supply Plan by the Study.

(2) Surface Water

The results indicate that many of samples of the surface water including the shallow wells (unprotected wells) are contaminated with respect to many parameters.

As shown in *Table 3.1*, contamination is identified on all of the parameters related to the human health and on many other parameters. For the investigation into the cause of such contaminations, pollutant sources must be identified. However, in most case, such pollutant sources do not exist in the Study area.

The contamination by Microbial aspects and organic pollutions were confirmed in most of the samples. Degree of colour and turbidity shows unsuitability for drinking water use without treatment in many samples. These characteristics seem to be caused by organic pollutions.

High concentration of Boron (B) is confirmed at the water source of Maneromango Water Supply Scheme in dry season. It is 1.0 mg/l against the Guidelines value of 0.5 mg/l. Since the seasonal variation in contamination level is not confirmed, periodical monitoring of water quality is highly recommended.

Although contaminations of surface water are observed with respect to many parameters, the results will not affect to the Water Supply Plan by the Study, except for the Wami River water for Matipwili village water supply scheme.

3.4 CURRENT STATUS OF OPERATION AND MAINTENANCE OF EXISTING SCHEME

3.4.1 OVERVIEWS OF CURRENT INSTITUTIONAL FRAMEWORK

In the current institutional framework in rural and peri-urban water supply services, the ultimate responsibility for the provision of those services rests largely with the Ministry of Water and Livestock Development (MoWLD). In rural and peri-urban water supply sector, the Government has also been the owner and operator of number of water supply installations.

The situation has led to a lack of commitment by the users to safeguard the facilities, and reluctance to contribute to the cost of operation and maintenance. Furthermore, Draft National Water Sector Development Strategy 2005-2015 (NWSDS) points out that the lack of participation of beneficiaries in the execution of water scheme in rural areas, has led to poor performance of the schemes, lack of proper management of the schemes, lack of ownership and poor delivery of the service.

Those consequences for inadequate participation and ineffective institutional framework are widely observed and well recognized in the Study Area.

3.4.2 CURRENT COMMUNITY ORGANIZATION OPTIONS

In the reorganized current institutional framework, executing functions in rural/peri-urban water supply sector development are considerably decentralized to Municipal/District Councils, while autonomous entities, such as Water Supply and Sanitation Authorities (WSSAs) and Community-Owned Water Supply Organizations (COWSOs) are responsible for service provision. COWSOs currently take various organizational forms.

(1) Village Water Committees (VWCs)

Village Water Committees (VWCs) are the most common and conventional arrangement used among the communities in the Study Area.

Committee members are appointed by the Village Government in most cases, and the VWCs are placed under the Village Councils. Thus, they are considerably less autonomous, without any legal status being provided. The efficiency of VWC is often hindered by Village Council interference and sometimes also by misappropriation of water funds.

(2) Water Users Groups (WUGs)

It is an arrangement similar to the Village Water Committee, but only a single WUG is formed

by the community at each and every Domestic Water Point (DWP). In the formation of WUGs, gender balance in membership is often emphasized. WUGs are responsible for daily operation and maintenance of designated DWPs and user fee collection.

(3) Water Users Associations (WUAs)

Water Users Associations (WUAs) are a currently evolving arrangement in rural and peri-urban water supply services. WUAs are given autonomy and legal status, by registering itself either under Ministry of Water and Livestock (MoWLD) or local government framework. Executive members of WUA are elected among the registered users. Its regulations and by-laws are often developed in a participatory manner with users and other stakeholders such as District staff, Ward and Village officers. Through this process, risks of negative intervention by the Village Council are reduced and their relationship becomes rather mutually interactive.

(4) Water User Trust / Co-operative

A Water User Trust is constituted by deed and should be approved by the Attorney General according to the Tanzanian Trustee Incorporation Ordinance. In a trust, specified properties are legally placed under the custody, management and care of specified persons for the benefits of the beneficiaries. In this arrangement, a few specified persons hold on trust the property on behalf of the users who have little say in management.

(5) Water Company by Guarantee

This is a unique arrangement emerged in Morogoro Region, that the water users themselves organize and manage Water Company by guarantee. Water Company is registered under Company Acts (Cap. 381), with submission of its articles and memorandum of association, and managed in an autonomous manner by a Board made of elected representatives of users from Domestic Water Points (DWPs).

(6) Water Company by Share

This is an arrangement similar to the usual commercial company where members buy shares from their company. In such arrangement, water users are shareholders and a team of executive manages the company. Kilimanjaro Water Supply Company Ltd (KILIWATER) in Northern Tanzania is a typical example of such arrangement.

Reviewing the characteristics of those current COWSO management options, competency, effectiveness and degree of expertise and guarantee in the scheme management, operation and maintenance are further assessed in the later chapter (Refer to Chapter 8).

CHAPTER 4 WATER RESOURCES

4.1 GENERAL

This chapter describes the evaluated development potential of water resources of both surface water and groundwater.

4.2 SURFACE WATER POTENTIAL EVALUATION

4.2.1 SELECTION OF THE RIVER

As the result of interview survey to related persons and investigation of the past discharge data, three rivers, namely the mainstream of Wami and Ruvu, and Kizinga are confirmed as perennial river in the Study Area.

4.2.2 POTENTIAL AMOUNT OF SURFACE WATER DEVELOPMENT

The Potential amount of surface water development is calculated as shown in *Table 4.1*.

Table 4.1 Potential Amount of Surface Water Development

Unit: m^3/s

River	Station Code	Available Discharge (Average Droughty-Water Discharge) A	Droughty-Water Discharge of 10-year Return Period B	Actual Total Intake Amount in Downstream of the Station C	Maintenance Flow Discharge D=B+C	Potential Amount of Surface Water Development E=A-D
Ruvu	1H8	7.073	3.260	4.866	8.126	-1.053
Wami	1G2	6.781	1.611	0.167	1.778	5.003
Kizinga	1J5	0.074	0.015	0.104	0.119	-0.045

It is concluded that only the Wami River has potential for development. Total amount of about 5 m^3/s is considered as the potential amount of surface water development.

Since the required actual intake amount is beyond the available discharge, the Ruvu and Kizinga rivers are not suited for new surface water development.

4.2.3 POTENTIAL AREA FOR SURFACE WATER DEVELOPMENT

As the result of above investigation, river with surplus surface water is only the mainstream of Wami River. Taking into account the capacity of water supply facility, potential area of intake location by distance is evaluated using the vertical drop of 100 m from the river as an index. As the result, the area within 5km from the Wami River is selected as a potential area of surface water intake development.

4.3 GROUNDWATER OF STUDY AREA

4.3.1 AQUIFER CATEGORY

In the study area, the aquifers are identified as four types of Quaternary, Neogene, Precambrian and Cretaceous. The aquifers of Quaternary and Neogene are categorized as stratum aquifer, while the Precambrian, Cretaceous and Jurassic are categorized as fractured aquifers of the basement rocks. Most of the well drilled in the study area are tapped from Quaternary and Neogene aquifers. Wells drilled in the aquifers of Precambrian, Cretaceous and Jurassic are very few.

4.3.2 WELL YIELD AND WATER QUALITY

The well yields and water qualities by the geological formation is graphically shown in *Figure 4.1*.

Quaternary aquifer shows very high yield of more than 100 liter/min in median value. Next to Quaternary aquifer, Neogene aquifer shows relatively higher yield. In Neogene aquifer, median yield is only 24.5 liter/min.

For the geological formations of Precambrian, Cretaceous and Jurassic, the yields are generally low of about 10 liter/min in average, which is almost 0 liter/min as median yield.

For the water quality, electric conductivity (EC) shows relatively low value in Neogene and Quaternary aquifers. It is 1150 μ S/cm in Neogene aquifer, and 1088 μ S/cm in Quaternary aquifer.

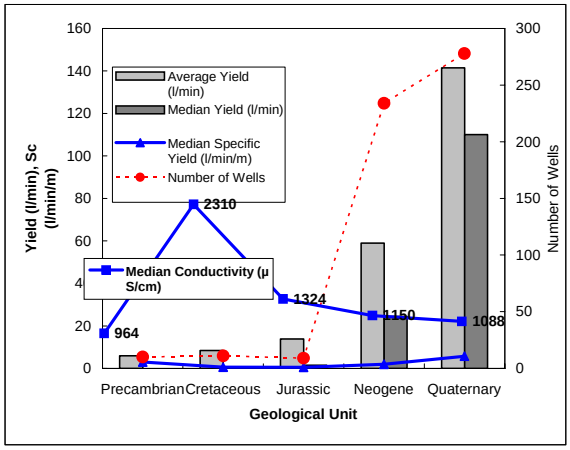

Figure 4.1 Yield and Water Quality by Geological Formation

4.3.3 AQUIFER EVALUATION

The *Table 4.2* shows the overall ranges of hydraulic conductivity for soils and rocks. The foremost range of the obtained values by the pumping test for each aquifer was also shown in the table.

The results suggested that for the two major aquifers of Quaternary and Neogene in the study area, hydraulic conductivity varies widely from “Very Low” to “High”. The Quaternary still has slightly higher range of Hydraulic Conductivity than that of Neogene aquifer. For the Cretaceous, Jurassic and Precambrian aquifers, since the number of sample is very low, scattered result is observed.

Table 4.2 Evaluation of Hydraulic Conductivity of Aquifers

(m/day)

	10^4	10^3	10^2	10^1	1	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}
Quaternary	4.07×10^{2} ◄					●	2.05×10^{-1} ►				1.80×10^{-5}
Neogene		2.30×10^{1} ◄					● 3.00×10^{-2} ►				3.67×10^{-6}
Cretaceous				1.27 ◄			7.00×10^{-2} ►				
Jurassic										▲	6.21×10^{-6}
Precambrian						2.20×10^{-1} ◄			5.48×10^{-4} ►		

Relative permeability

Very high	**High**	**Moderate**	**Low**	**Very low**
Clean gravel	Clean sand and sand and gravel	Fine sand	Silt, clay and mixture of sand, silt and clay	Massive clay
Vesicular and scorioceous basalt and covernous limestone and dolomite	Clean sandstone and fractured igneous and metam orphic rocks		Laminated sandstone shale, and mudstone	Massive igneous and meramorphic rocks

Remarks : ● *Median Value*
: ▲ *Only one sampls*

After Kashef, A.I GROUNDWATER ENGINEERING, 1987

U.S. Bureau of Reclamation, Groundwater Manual, U.S. Department of Interior, Washington, 1977.

4.4 GROUNDWATER POTENTIAL EVALUATION

4.4.1 PREPARATION OF HYDROGEOLOGICAL AND GROUNDWATER EVALUATION MAPS

The hydrogeological map has been prepared as shown in *Figure 4.2*. The map contains the information on groundwater yield, quality (EC), depth to groundwater, existing well location, geological structure and physiographic information such as surface water and contour lines. Naturally, groundwater yield, or productivity, is one of the most important factors for groundwater exploitation. The quality of groundwater is another essential factor. Pumping and maintenance costs depend on the depth to water. The analyses using GIS show the regional characteristics in the area.

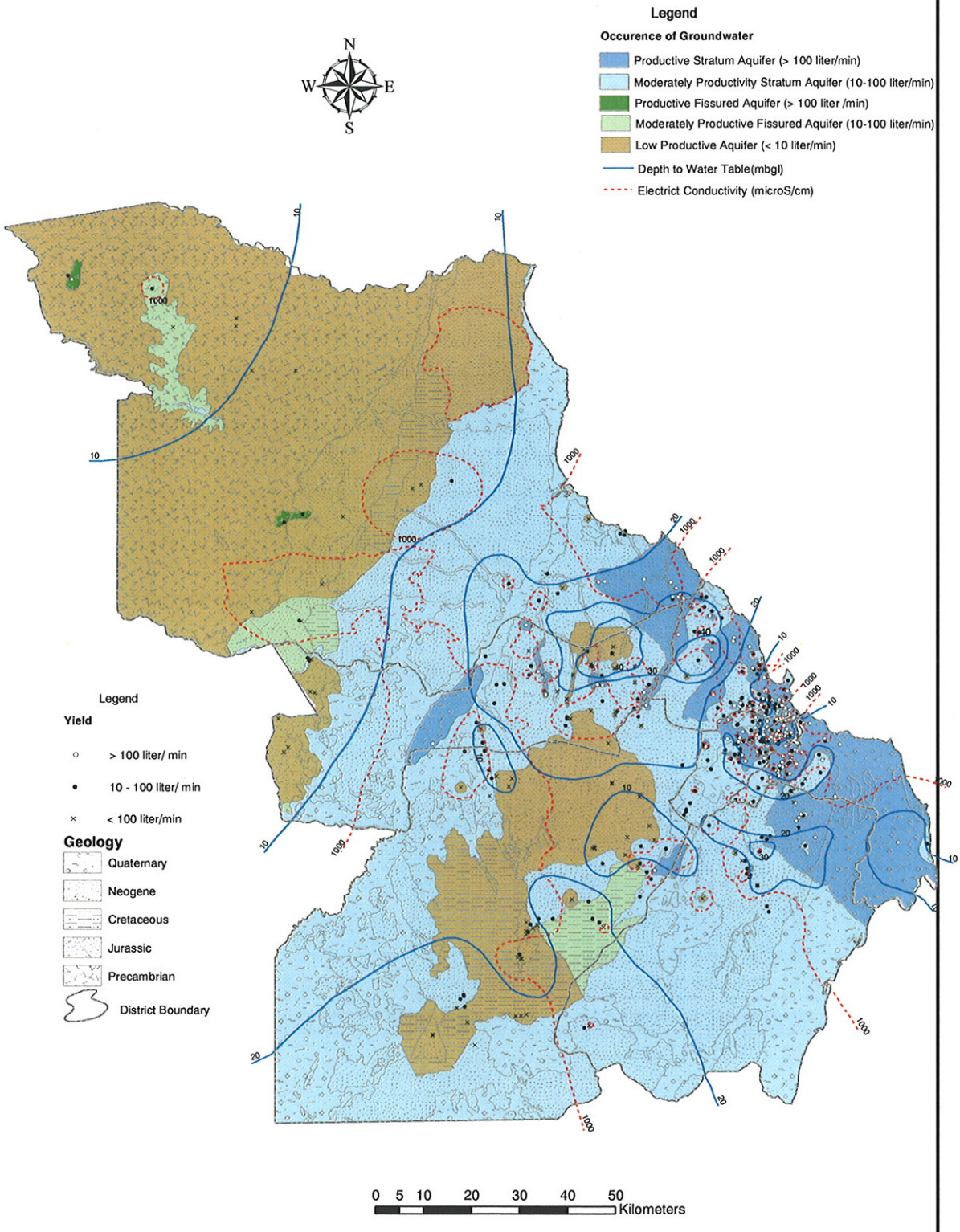

FIGURE 4.2 HYDROGEOLOGICAL MAP

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4.4.2 PROMISING AREA FOR GROUNDWATER DEVELOPMENT

After the preparation of the hydrogeological map, the groundwater resources evaluation map was prepared. *Figure 4.3* shows the combination of factors used in the evaluation map. The evaluation map (*Figure 4.4*) was drawn in accordance with the distribution of groundwater yield and quality (EC).

			Estimated Yield (liters/min)		
			100 <	10 - 100	< 10
Water Quality EC (μS/m)		Allotment Points	Good	Fair	Poor
			4	2	1
< 1000	Good	3	**12**	**6**	**3**
1000 - 3000	Fair	2	**8**	**4**	**2**
3000 <	Poor	0	**0**	**0**	**0**
			Weighting		

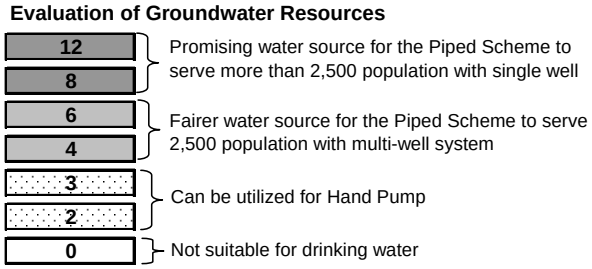

Figure 4.3 Matrix of the Classification for Groundwater Evaluation

The evaluation is described as follows.

Weighting: 12 and 8 Good

- Promising water source for the Piped Scheme of more than 2,500 population with single well. EC is good or fair for drinking, and besides the yield expected is 100 liter/min and more.

Weighting: 6 and 4 Fair

- Promising water source for the Piped Scheme of more than 2,500 population with multi-well system. EC is good or fair for drinking, and the yield expected is from 10 to 100 liter/min. This volume is exploitable using small submersible pumps.

Weighting: 3 and 2 Poor

- The yield is fair to exploit for hand pump water supply scheme. EC is good for drinking or fair for drinking.

Weighting: 0 Not Applicable

- EC is poor for drinking. It may be possible to use as a source for small scale industrial water or livestock water, otherwise elaborate water treatment facility is necessary for drinking water use.

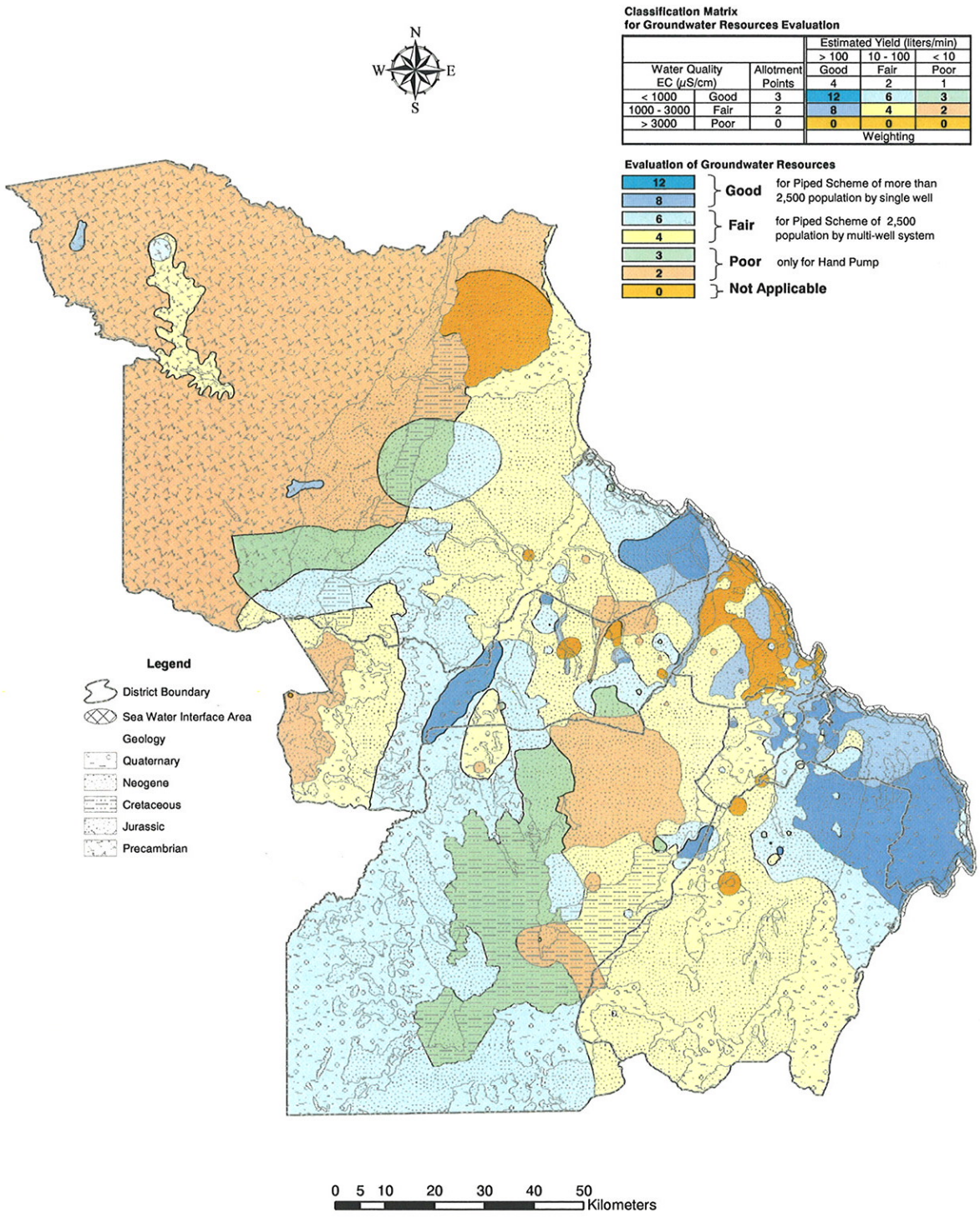

FIGURE 4.4 GROUNDWATER RESOURCES EVALUATION MAP

THE STUDY ON WATER SUPPLY IMPROVEMENT IN COAST & DAR ES SALAAM | **JICA**

CHAPTER 5 WATER SUPPLY PLAN

5.1 TARGET VILLAGE, POPULATION AND WATER DEMAND

The Water Supply Plan was formulated for 278 villages; 217 villages in Coast Region and 61 in Dar es Salaam Peri-Urban. Project target year was set as 2015 while the implementation of the Priority Project was to be completed by 2010. Population to be covered by the Water Supply Plan is 864.5 x 10^3 in the year 2010 and 1,386.3 x 10^3 in 2015. District wise breakdown of service population is shown in *Table 1.1* of Chapter 1.

Water demand, including institutional demand, is estimated applying the Design Manual (MoWLD, 1997). It is 13.9 x 10^3 m^3/day in Coast Region and 20.9 x 10^3 m^3/day in Dar es Salaam Region, totalling 34.8 x 10^3 m^3/day in the whole Study area.

5.2 ALTERNATIVES OF WATER SUPPLY SCHEME

Four types of water supply schemes are provided for the Water Supply Plan: Piped scheme (Level-2), Hand pump scheme (Level-1), Rehabilitation of existing scheme and extension of existing schemes (Chalinze Water Supply Scheme and DAWASA). Type of scheme was selected considering the two criteria, availability of water source and service population. Criteria on water source is mentioned in Section 5.3 of below. Service population should be more than 2,500 for Level-2 considering the recovery of operation and maintenance cost. Therefore, condition for the provision of Level-2 service is the availability of water source along with service population of more than 2,500 in the village.

5.3 WATER SOURCE

Both surface water and groundwater are considered as the potential source of water supply. Groundwater is main source, while surface water of the Wami River is available only for Matipwili in Bagamoyo.

In order to select the type of water supply scheme, water sources were evaluated applying the two criteria, yield and quality (EC). As for the yield, groundwater potential is classified into three categories, less than 10 litre/min, between 10 and 100 litre/min, and more than 100 litre/min. The yield of more than 100 litre/min meets the water demand for 2,500 populations under 10 hours of operation per day in average (maximum 12 hours of operation). The yield of more than 100 litre/min is suitable for the piped scheme (Level-2) and the yield less than 10 litre/min is not suitable even for hand pump. An EC value less than 1000 micro-S/cm is the most suitable for drinking water. The EC value more than 3,000 micro-S/cm is not at all suitable for drinking.

5.4 SELECTION OF TYPE OF WATER SUPPLY SCHEME

Type of water supply scheme was selected applying the criteria mentioned in Section 5.2. Then, it was confirmed by the field survey carried out by the Study Team. As the result, some parts of the target villages are excluded from the service area if the area falls under the following conditions. Such an area was planned to be supplied by Level-1 scheme.

(1) Elevation is much higher than other major part of the village and requires a booster pump to supply the area.
(2) An area, which is isolated from the major part of the village and population is too low.
(3) A village, population of which becomes less than 2,500 after exclusion mentioned above (1) and (2).

Then, the Water Supply Plan was finalized as shown in *Table 5.1*. A total of 22 Level-2 schemes were proposed in 22 villages. In case of Level-1, a total of 607 schemes were planned in the Study area. Service population in 2015 is 78,352 by Level-2 scheme and 145,850 by Level-1 scheme

5.5 PRELIMINARY DESIGN OF WATER SUPPLY SCHEME

The entire Level-2 schemes (22 schemes) are selected as the priority project as described in Chapter 6. Designs of each scheme are presented in Chapter 6. Accordingly, only preliminary design for Level-1 is presented in this Chapter. Level-1 water supply scheme is composed of deep tube well and hand pump, which supplies typically 250 persons/scheme. Depth of deep tube wells is 50 m in average.

5.6 WATER SUPPLY DEVELOPMENT PLAN

5.6.1 IMPLEMENTATION PLAN

Cost for proposed projects is estimated as shown in *Table 5.2.*

Table 5.2 Summary of Projects Costs

Unit: million USD

Type of Scheme	Construction Cost	Engineering Service (15%)	Administration Cost (3%)	Physical Contingency (10%)	Total	Note
Level-2 (Priority Project)	13,979.3	2,516.3	-	-	16,495.6	22 schemes (Priority Project)
Level-1	10,561.8	1,584.3	316.9	1,056.2	13,519.2	607 schemes
Rehabilitation	181.2	27.2	5.4	18.1	231.9	1 scheme
Chalinze (Phase II)	7,546.9	754.7	226.4	754.7	9,282.7	42 villages
Total	32,269.2	4,882.5	548.7	1,829.0	39,529.4	

Note: (1) Administration cost and physical contingency are not included in Level-2 project because its implementation is expected as Japanese Grant Aid Project.
(2) About 3% of construction cost was added to Engineering Service cost for Level-2 as the cost for soft component.
(3) Engineering Service cost for Chalinze Water Supply Project Phase II is 10 % of the construction cost.

External supports for the project implementation are expected in the Study area. Level-2 project is supposed to be implemented with the Japan's Grant Aid. Chalinze Water Supply Project Phase II is planned to be implemented by MoWLD. DAWASA has its own extension plans of its service area and Community Water Supply and Sanitation Project (CWSSP). AMREF has a plan to provide Level-1 schemes in Mkuranga District. Level-1 projects in other areas have no such plans. Implementation schedule is planned as shown in *Table 5.3*. In case the projects are implemented as planned, service population will increase up to 66.9 % in 2009 and 68.1 % in the target year 2015. This would meet the Revised Poverty Reduction Strategy target of which is to raise the water supply level up to 65 % in 2009.

Table 5.3 Implementation Schedule for Water Supply Plan

Project	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Priority Project (Level-2)	←	—	→							
Chalinze (Phase II)	←	—	→							
Level-1				←	—	—	—	—	—	→
Rehabilitation				←	→					
Mkuranga	←	—	—	—	→					
DAWASA	←	—	→							

5.6.2 FINANCIAL PLAN

The budget of MoWLD shows steep rise in total amount from the fiscal year 2002/03 to 2005/06. It is mainly due to sharp increase of the budget for Urban Water Supply and Sewerage sub-sector, of which internal amount is between 91 % and 63 % in fiscal year of 2003/04, 2004/05 and 2005/06. Budget of Rural Water Supply sub-sector suddenly increased up to 3.16 million USD in 2005/06, which is a 248 % of increase against that of previous year, while it was rather stable in a range from 1.04 to 1.43 million USD from 2002/03 to 2004/05. Financial capability of MoWLD

for the implementation of proposed Water Supply Plan is rather lacking. Thus, the implementation of the Plan requires additional grants from External Supporting Agencies.

The annual disbursement schedule for the implementation of plan is shown in *Table 5.4* considering the financial status of MoWLD.

Table 5.4 Annual Disbursement Schedule

Project No.	Project		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
1	Piped Water Supply Scheme (Level-2)	Engineering	875.9	654.4	986.0								2,516.3
		Construction	4,865.8	3,635.7	5,477.8								13,979.3
		Sub-Total	5,741.7	4,290.1	6,463.8								16,495.6
2	Hand Pump (Level-1)	Engineering				138.0	138.0	138.0	138.0	138.0	138.0	138.0	965.7
		Construction				919.7	919.7	919.7	919.7	919.7	919.7	919.7	6,438.0
		Sub-Total				1,057.7	1,057.7	1,057.7	1,057.7	1,057.7	1,057.7	1,057.7	7,403.7
3	Rehabilitation	Engineering				27.2							27.2
		Construction				204.7							204.7
		Sub-Total				231.9							231.9

5.7 EVALUATION OF WATER SUPPLY PLAN

5.7.1 ECONOMICAL AND FINANCIAL EVALUATION

In case of Level-2 schemes, NPV and B/C ratio show the economic benefit will exceed the cost. EIRR is calculated as 13 % in Coast Region and 16 % in Dar es Salaam Region. These rates are higher than the opportunity cost of investment, therefore, Level-2 scheme is evaluated as economically viable. Level-1 scheme will generate same economical benefit as Level-2. Therefore, proposed projects are considered to be economically feasible.

Water tariff is set at 1 Tsh/litre, which is same as the amount of Willingness to Pay (WTP) examined in the Study. Applying this tariff, more than 80 % of revenue collection rate would ensure the full operation and maintenance cost over 10 years for Level-2 scheme including replacement cost. It means that amount of water tariff to be collected largely exceed the cost necessary for management, operation and maintenance of Level-2 scheme. In order to make realistic, the profit-loss break even point of revenue collection rate was estimated for the full cost recovery. It is 74 % in average ranging from 53 to 84% in Coast Region and is 51 % in average ranging from 32 to 70 percent in Dar es Salaam Region. Average recovery rates are expected 74 % in Coast Region and 51 % in Dar es Salaam Region. The cost for management, operation and maintenance for Level-1 scheme is lower than that of Level-2. Financial situation of Level-1 is much improved under the same tariff structure as Level-2, 1 Tsh/litre.

It is concluded that both Level-2 and Level-1 schemes could gain surplus, thus the projects proposed were evaluated as financially viable.

5.7.2 INSTITUTIONAL AND ORGANIZATIONAL EVALUATION

Institutional and organizational setup is developed by taking consideration the following key issues; (1) current and future institutional setup formulated under National Water Policy (2002) and Draft National Water Sector Development Strategy (2004), (2) decentralized functional responsibilities of each stakeholders in the water supply service delivery, (3) transition of the role of MoWLD from service delivery to the one of policy making, monitoring and regulation, (4) strategy to enhance Community-Owned Water Supply Organizations (COWSOs) and (5) current approach to increase private sector participation and contracting-out in the service delivery. Among those issues, COWSO management options with contracting-out with Service Providers for part or all of management, operation and maintenance, is assessed as favourable to enhance competency and efficiency in the scheme management particularly for the piped supply scheme (Level-2) with significant deficiency in management at present.

From these points of view, the plan is assessed as feasible and efficient in institutional and organizational aspects.

5.7.3 EVALUATION OF ENVIRONMENTAL AND SOCIAL ASPECTS

Environmental assessment revealed that water resource analysis evaluated groundwater balance to avoid negative impacts such as overexploitation, land subsidence, groundwater depletion, interference of wells and seawater intrusion. Based on these evaluation results, appropriate water source was selected for water supply schemes.

Proposed water supply facilities do not cause any adverse impacts on important fauna and flora in the reserves distributed in the Study area.

The water supply plan provides sufficient amount of safe water within short distance from households, and saves time. This gives women and children spare time. Therefore, the plan definitely provides positive impact on gender issues, which will very much improve women and children's predicament condition.

Regarding water vendors, if the project is implemented, it might affect water vender's socio-economic condition. However, the water supply plan proposes mitigation measures to such situation as described in Institutional Plan

The construction of proposed water supply schemes dose not cause any significant adverse impact on environmental and social elements in the Study area. However, appropriate technical and social monitoring is required.

As the result, Categories evaluated B in the preliminary study as per the JICA Guidelines fall in category C. Therefore, EIA is not required in this Study, as also agreed by NEMC.

5.7.4 TECHNICAL APPROPRIATENESS

Construction works of the Water Supply Plan are composed of drilling works, earthworks, pipe works, concrete works, mechanical/electrical works, and miscellaneous works. These works require no special techniques. These are carried out by conventional methods and machineries widely applied in Tanzania. Equipment and materials required for the Water Supply Plan are generally procured in Tanzania, although some items need to be imported from abroad such as EU countries, South Africa and Japan. Accordingly, the project is evaluated as technically appropriate.

Table 5.1 Summary of Water Supply Plan (1/4)

No.	District /Municipality Ward	Villages/Mitaa		Population to be served		Water Demand (m3/day)(2015)	Neessary Number of Well (Level-2)	Exploitable Number of Well (Level-2)	Neessary Number of Well (Level-1)	Exploitable Number of Well (Level-1)	Serial No. (Level-2)	Served Population (2015) by Level-2	Served Population (2015) by Level-1	Served Population (2015) by Others(*)	Total Served Population (2015)	Coverage of Water Supply (%)	Alternative Water Supply
		Name of Village	Target Area	2002	2015												
Bagamoyo																	
1	Chalinze	Chamakweza	All	2,152	2,784	70	Chalinze-2							2,784	2,784	100.0	
2	Chalinze	Mdaula	Part	2,982	3,858	96	Chalinze-2							3,858	3,858	100.0	
3	Chalinze	Msolwa	All	2,672	3,457	86	Chalinze-2							3,457	3,457	100.0	
4	Dunda	Kaole	Part	292	378	9	DAWASA							378	378	100.0	
5	Kibindu	Kibindu	All	5,605	7,251	126	3	2	4	4	BGM-1	6,344	907		7,251	100.0	
6	Kibindu	Kwamduma	All	3,677	4,757	119	2	2	6	6	BGM-2	3,292	1,465		4,757	100.0	
7	Kibindu	Kwamsanja	All	1,001	1,295	32			6	6			1,295		1,295	100.0	
8	Kiwangwa	Fukayosi	All	3,700	4,786	120	Chalinze-2							4,786	4,786	100.0	
9	Kiwangwa	Kidomole	All	586	758	19	Chalinze-2							758	758	100.0	
10	Kiwangwa	Kiwangwa	All	12,762	16,509	413	Chalinze-2							16,509	16,509	100.0	
11	Kiwangwa	Masuguru	All	1,768	2,287	57	Chalinze-2							2,287	2,287	100.0	
12	Kiwangwa	Mkenge	All	2,050	2,652	66	Chalinze-2							2,652	2,652	100.0	
13	Kiwangwa	Msinune	All	1,927	2,493	62	Chalinze-2							2,493	2,493	100.0	
14	Lugoba	Diozile	All	1,631	2,110	53	Chalinze-2							2,110	2,110	100.0	
15	Magomeni	Magomeni	Part	645	834	21			4	2			500		500	59.9	
16	Magomeni	Makurunge	All	1,636	2,116	53	Chalinze-2							2,116	2,116	100.0	
17	Mbwewe	Kifuleta	All	3,523	4,557	114	Chalinze-2							4,557	4,557	100.0	
18	Mbwewe	Kwang'Andu	All	2,016	2,608	65	Chalinze-2							2,608	2,608	100.0	
19	Mbwewe	Kwaruhombo	All	2,068	2,675	67	Chalinze-2							2,675	2,675	100.0	
20	Mbwewe	Pongwekiona	All	3,135	4,055	101	Chalinze-2							4,055	4,055	100.0	
21	Miono	Kweikonje	All	1,124	1,454	36	Chalinze-2							1,454	1,454	100.0	
22	Miono	Masimbani	All	1,181	1,528	38	Chalinze-2							1,528	1,528	100.0	
23	Miono	Mihuga	All	1,417	1,833	46	Chalinze-2							1,833	1,833	100.0	
24	Mkange	Manda Mazingara	All	3,122	4,039	101	Chalinze-2							4,039	4,039	100.0	
25	Mkange	Matipwili*	All	2,698	3,490	87	Wami River		4	4	BGM-3	2,518	972		3,490	100.0	
26	Mkange	Mkange	All	2,396	3,099	77	Chalinze-2							3,099	3,099	100.0	
27	Mkange	Saadani	All	1,344	1,739	43	Protected Well				BGM-4	1,739			1,739	100.0	
28	Msata	Pongwe Msungura	All	1,005	1,300	33	Chalinze-2							1,300	1,300	100.0	
29	Talawanda	Kisanga	All	855	1,106	28	Chalinze-2							1,106	1,106	100.0	
30	Talawanda	Malivundo	All	1,166	1,508	38	Chalinze-2							1,508	1,508	100.0	
31	Talawanda	Mindukeni	All	1,438	1,860	47	Chalinze-2							1,860	1,860	100.0	
32	Talawanda	Msigi	All	1,124	1,454	36	Chalinze-2							1,454	1,454	100.0	
33	Talawanda	Talawanda	All	4,124	5,335	133	Chalinze-2							5,335	5,335	100.0	
34	Ubenazomozi	Kaloleni	All	3,210	4,152	104	Chalinze-2							4,152	4,152	100.0	
35	Ubenazomozi	Matuli	All	1,349	1,745	64	Chalinze-2							1,745	1,745	100.0	
36	Ubenazomozi	Mwidu	All	1,977	2,557	64	Chalinze-2							2,557	2,557	100.0	
37	Ubenazomozi	Tukamisasa	All	3,051	3,947	99	Chalinze-2							3,947	3,947	100.0	
38	Ubenazomozi	Ubenazomozi	All	2,490	3,221	81	Chalinze-2							3,221	3,221	100.0	
39	Ubenazomozi	Visakazi	All	4,893	6,330	158	Chalinze-2							6,330	6,330	100.0	
40	Vigwaza	Buyuni	All	1,759	2,275	57	Chalinze-2							2,275	2,275	100.0	
41	Vigwaza	Kidogozero	Part	1,077	1,393	35			6	2			500		500	35.9	
42	Vigwaza	Vigwaza	All	4,039	5,225	131	Chalinze-2							5,225	5,225	100.0	
43	Vigwaza	Visezi	All	1,281	1,657	41	Chalinze-2							1,657	1,657	100.0	
44	Yombo	Yombo	Part	121	157	4	DAWASA							157	157	100.0	
45	Zinga	Mapinga	Part	195	252	6	DAWASA							252	252	100.0	
Total (with Chalinze-2 & DAWASA)				104,264	134,876	3,336	5	4	30	24		13,893	5,639	114,117	133,649	99.1	
Total (without Chalinze-2 & DAWASA)				16,047	20,759	463									19,532	94.1	
Kibaha																	
1	Kibaha	Kongowe	Part	362	559	14			3	3			559		559	100.0	
2	Kibaha	Msangani		3,025	4,671	*117*	DAWASA							500	500	10.7	
3	Kibaha	Mwendapole	Part	854	1,319	33	DAWASA							4,671	4,671	354.1	
4	Kibaha	Tangani	All	2,800	4,325	*108*	DAWASA							500	500	11.6	
5	Kibaha	Viziwaziwa	All	2,124	3,280	82			14	2			500		500	15.2	DAWASA
6	Kwala	Dutumi	All	1,300	2,008	50			9	9			2,008		2,008	100.0	
7	Kwala	Mpelamumbi	All	346	534	13			3	3			534		534	100.0	
8	Magindu	Gumba	All	5,000	7,722	193	Chalinze-2							7,722	7,722	100.0	
9	Magindu	Gwata	All	2,136	3,299	82	Chalinze-2							3,299	3,299	100.0	
10	Magindu	Lukenge	All	1,050	1,622	41	Chalinze-2							1,622	1,622	100.0	
11	Magindu	Magindu	All	2,041	3,152	79	Chalinze-2							3,152	3,152	100.0	
12	Mlandizi	Mlandizi 'B'	Part	4,040	6,239	156	DAWASA							6,239	6,239	100.0	
13	Ruvu	Kikongo	All	710	1,097	27			5	2			500		500	45.6	
14	Ruvu	Kitomondo	All	627	968	24	1	1			KBH-2	968			968	100.0	
15	Ruvu	Lupunga	All	1,128	1,742	44			7	2			500		500	28.7	
16	Ruvu	Minazi Mikinda	All	2,624	4,053	101	1	1			KBH-1	4,053			4,053	100.0	
17	Ruvu	Mwanabwito	All	1,540	2,378	59			10	4			1,000		1,000	42.1	DAWASA
18	Ruvu	Ngeta	All	1,616	2,496	62			10	2			500		500	20.0	DAWASA
19	Soga	Bokomnemela	All	2,831	4,372	109			18	4			1,000		1,000	22.9	DAWASA
20	Soga	Kipangege	All	347	536	13			3	3			536		536	100.0	
21	Soga	Misufini	All	337	520	13			3	3			520		520	100.0	
22	Soga	Mpiji	All	1,774	2,740	69			11	4			1,000		1,000	36.5	DAWASA
23	Tumbi	Bokotimiza	All	623	962	24			4	2			500		500	52.0	
24	Visiga	Zogowale	All	1,099	1,697	42			7	2			500		500	29.5	DAWASA
Total (Kibaha) (with Chalinze-2 & DAWASA)				40,334	62,291	1,555	2	2	107	45		5,021	10,157	27,705	42,883	68.8	
Total (Kibaha) (without Chalinze-2 & DAWASA)				23,428	36,181	902									15,178	42.0	

Table 5.1 Summary of Water Supply Plan (2/4)

No.	District /Municipality Ward	Villages/Mitaa		Population to be served		Water Demand (m3/day)(2015)	Neessary Number of Well (Level-2)	Exploitable Number of Well (Level-2)	Neessary Number of Well (Level-1)	Exploitable Number of Well (Level-1)	Serial No. (Level-2)	Served Population (2015) by Level-2	Served Population (2015) by Level-1	Served Population (2015) by Others(*)	Total Served Population (2015)	Coverage of Water Supply (%)	Alternative Water Supply
		Name of Village	Target Area	2002	2015												
Kisarawe																	
1	Chole	Chole	All	2,685	3,217	80	2	2			KSW-1	3,217			3,217	100.0	
2	Chole	Kurui-Chole	All	1,032	1,236	31			5	4			1,000		1,000	80.9	
3	Chole	Kwala-Chole	All	2,245	2,690	67			11	4			1,000		1,000	37.2	
4	Chole	Mafumbi	All	664	796	20			4	4			796		796	100.0	
5	Chole	Sofu	All	142	170	4			1	1			170		170	100.0	
6	Chole	Yombo Lukinga	All	862	1,033	26			5	4			1,000		1,000	96.8	
7	Kibuta	Bwama	All	1,332	1,596	40			7	6			1,500		1,500	94.0	
8	Kibuta	Chang'ombe 'B'	All	989	1,185	30			5	2			500		500	42.2	
9	Kibuta	Kauzeni	All	1,685	2,019	50			9	4			1,000		1,000	49.5	
10	Kibuta	Kibuta	All	2,050	2,456	61			10	2			500		500	20.4	
11	Kibuta	Masanganya	All	2,289	2,742	69			11	2			500		500	18.2	
12	Kibuta	Mtamba	All	840	1,006	25			5	4			1,000		1,000	99.4	
13	Kibuta	Muhaga	All	911	1,091	27			5	4			1,000		1,000	91.7	
14	Kiluvya	Kiluvya 'A'	Part	1,287	1,542	39			7	2			500		500	32.4	
15	Kiluvya	Mloganzila	All	1,250	1,498	37			6	2			500		500	33.4	
16	Kiluvya	Tondoroni	All	4,233	5,072	127			21	4			1,000		1,000	19.7	
17	Kisarawe	Kazimzumbwi	All	1,678	2,010	50			9	6			1,500		1,500	74.6	
18	Kisarawe	Kifuru	All	544	652	16			3	2			500		500	76.7	
19	Kisarawe	Kisarawe	Part	900	1,078	27			5	4			1,000		1,000	92.8	
20	Kisarawe	Visegese	All	1,182	1,416	35			6	4			1,000		1,000	70.6	
21	Kurui	Kidugalo	All	532	637	16			3	3			637		637	100.0	
22	Kurui	Kurui	All	584	700	18			3	3			700		700	100.0	
23	Kurui	Mtakayo	All	998	1,196	30			5	5			1,196		1,196	100.0	
24	Kurui	Zegero	All	738	884	22			4	5			1,250		1,250	141.4	
25	Mafizi	Gwata	Part	1,956	2,343	59			10	10			2,343		2,343	100.0	
26	Mafizi	Kimala Misale	All	720	863	22			4	4			863		863	100.0	
27	Mafizi	Mafizi	All	1,436	1,720	43			7	6			1,500		1,500	87.2	
28	Mafizi	Nyani	All	861	1,032	26			5	5			1,032		1,032	100.0	
29	Mafizi	Ving'Andi	All	780	935	23			4	4			935		935	100.0	
30	Maneromango	Boga	All	2,038	2,442	61			10	2			500		500	20.5	
31	Maneromango	Chale	All	516	618	15			3	3			618		618	100.0	
32	Maneromango	Kidugalo-Kanga	All	857	1,027	26			5	2			500		500	48.7	
33	Maneromango	Mengwa	All	996	1,193	30			5	2			500		500	41.9	
34	Maneromango	Msegamo	All	777	931	23			4	2			500		500	53.7	
35	Maneromango	Ngongele	All	710	851	21			4	2			500		500	58.8	
36	Marui	Kihare	All	720	863	22			4	4			863		863	100.0	
37	Marui	Kisangire	All	300	359	9			2	2			359		359	100.0	
38	Marui	Marui-Mipera	All	1,034	1,239	31			5	2			500		500	40.4	
39	Marui	Marui-Ngwata	All	1,443	1,729	43			7	2			500		500	28.9	
40	Marui	Titu	All	427	512	13			3	3			512		512	100.0	
41	Marumbo	Chang'ombe 'A'	All	548	657	16			3	2			500		500	76.1	
42	Marumbo	Kitonga	All	734	879	22			4	2			500		500	56.9	
43	Marumbo	Kivukoni	All	1,770	2,121	53			9	2			500		500	23.6	
44	Marumbo	Marumbo	All	1,115	1,336	33			6	6			1,336		1,336	100.0	
45	Marumbo	Mfuru Kikwete*	All	3,686	4,416	110			18	2			500		500	11.3	
46	Marumbo	Palaka	All	963	1,154	29			5	2			500		500	43.3	
47	Masaki	Kisanga	All	2,125	2,546	64			11	8			2,000		2,000	78.6	
48	Masaki	Masaki	All	2,786	3,338	83			14	4			1,000		1,000	30.0	
49	Masaki	Sungwi	All	1,573	1,885	47			8	2			500		500	26.5	
50	Msanga	Bembeza*	All	1,259	1,508	38			7	6			1,500		1,500	99.5	
51	Msanga	Mianzi	All	747	895	22			4	2			500		500	55.9	
52	Msanga	Msanga	All	1,998	2,394	60			10	4			1,000		1,000	41.8	
53	Msanga	Visiga	All	1,188	1,423	36			6	4			1,000		1,000	70.3	
54	Msimbu	Gumba	All	1,385	1,659	41			7	2			500		500	30.1	
55	Msimbu	Homboza	All	1,458	1,747	44			7	2			500		500	28.6	
56	Msimbu	Kitanga	All	486	582	15			3	2			500		500	85.9	
57	Msimbu	Luhangai	All	769	921	23			4	2			500		500	54.3	
58	Msimbu	Maguruwe	All	497	595	15			3	2			500		500	84.0	
59	Msimbu	Msimbu	All	2,967	3,555	89	2	2	4	4	KSW-2	2,635	920		3,555	100.0	
60	Mzenga	Chakenge	All	1,356	1,625	41			7	6			1,500		1,500	92.3	
61	Mzenga	Mitengwe	All	408	489	12			2	2			489		489	100.0	
62	Mzenga	Mzenga 'A'	All	1,163	1,393	35			6	2			500		500	35.9	
63	Mzenga	Vilabwa	All	197	236	6			1	1			236		236	100.0	
64	Vihingo	Chamalale	All	149	179	4			1	1			179		179	100.0	
65	Vihingo	Kibwemwenda	All	740	887	22			4	4			887		887	100.0	
66	Vihingo	Mihugwe	All	310	371	9			2	2			371		371	100.0	
67	Vihingo	Mzenga 'B'	All	1,231	1,475	37			6	2			500		500	33.9	
68	Vihingo	Sangwe	All	741	888	22			4	2			500		500	56.3	
69	Vihingo	Vihingo	All	340	407	10			2	2			407		407	100.0	
70	Vikumburu	Kitonga	All	420	503	13			3	3			503		503	100.0	
71	Vikumburu	Koresa	All	689	825	21			4	2			500		500	60.6	
72	Vikumburu	Mtunani	All	504	604	15			3	3			604		604	100.0	
73	Vikumburu	Pangala Mwingereza	All	778	932	23			4	2			500		500	53.6	
74	Vikumburu	Vikumburu	All	1,484	1,778	44			8	6			1,500		1,500	84.4	
	Total (Kisarawe)			85,787	102,782	2,568	4	4	422	236		5,852	56,206	0	62,058	60.4	

Table 5.1 Summary of Water Supply Plan (3/4)

No.	District /Municipality Ward	Villages/Mitaa		Population to be served		Water Demand (m3/day)(2015)	Neessary Number of Well (Level-2)	Exploitable Number of Well (Level-2)	Neessary Number of Well (Level-1)	Exploitable Number of Well (Level-1)	Serial No. (Level-2)	Served Population (2015) by Level-2	Served Population (2015) by Level-1	Served Population (2015) by Others(*)	Total Served Population (2015)	Coverage of Water Supply (%)	Alternative Water Supply
		Name of Village	Target Area	2002	2015												
Mkuranga																	
1	Bupu	Bupu	All	1,435	2,244	56			9	4			1,000		1,000	44.6	
2	Bupu	Mamndikongo	All	1,421	2,222	56			9	4			1,000		1,000	45.0	
3	Bupu	Mandimpela	All	1,820	2,846	71			12	2			500		500	17.6	
4	Bupu	Tundu	All	1,416	2,215	55			9	8			2,000		2,000	90.3	
5	Kimanzichana	Kilimahewa Kaskazini	All	3,256	5,092	127			21	2			500		500	9.8	
6	Kimanzichana	Kimanzichana Kaskazin	All	1,006	1,573	39			7	2			500		500	31.8	
7	Kimanzichana	Kimanzichana Kusini	All	13,700	21,426	536			86	2			500		500	2.3	
8	Kimanzichana	Kimbwinindi	All	3,250	5,083	127			21	4			1,000		1,000	19.7	
9	Kimanzichana	Mkenge	All	2,393	3,743	94			15	2			500		500	13.4	
10	Kisiju	Binga	All	1,832	2,865	72			12	2			500		500	17.5	
11	Kisiju	Dondo	All	1,189	1,860	47			8	4			1,000		1,000	53.8	
12	Kisiju	Kalole	Part	1,198	1,874	47			8	2			500		500	26.7	
13	Kisiju	Kerekese	All	2,800	4,379	109			18	2			500		500	11.4	
14	Kisiju	Mpafu	All	665	1,040	26			5	4			1,000		1,000	96.2	
15	Kisiju	Sotele	All	1,917	2,998	75			12	2			500		500	16.7	
16	Kitomondo	Kikoo	All	2,395	3,746	94			15	2			500		500	13.3	
17	Kitomondo	Kitomondo	All	1,799	2,814	70			12	2			500		500	17.8	
18	Kitomondo	Kiwambo	All	1,969	3,079	77			13	2			500		500	16.2	
19	Kitomondo	Mingombe	All	992	1,551	39			7	2			500		500	32.2	
20	Kitomondo	Mitaranda	All	1,552	2,427	61			10	2			500		500	20.6	
21	Kitomondo	Miteza	All	1,819	2,845	71			12	2			500		500	17.6	
22	Kitomondo	Njia Nne	All	6,788	10,616	265			43	4			1,000		1,000	9.4	
23	Lukanga	Lukanga	All	1,983	3,101	78			13	4			1,000		1,000	32.2	
24	Lukanga	Misasa	All	2,196	3,434	86			14	2			500		500	14.6	
25	Lukanga	Mkola	All	1,107	1,731	43			7	2			500		500	28.9	
26	Lukanga	Njopeka	All	6,611	10,339	258	Spring		21	6	MKR-1	5,272	1,500		6,772	65.5	
27	Lukanga	Sangalani	All	1,678	2,624	66			11	2			500		500	19.1	
28	Magawa	Kifumangao	All	681	1,065	27			5	4			1,000		1,000	93.9	
29	Magawa	Magawa	All	4,524	7,075	177			29	4			1,000		1,000	14.1	
30	Magawa	Mdini	All	1,648	2,577	64			11	2			500		500	19.4	
31	Magawa	Msonga	All	1,197	1,872	47			8	2			500		500	26.7	
32	Magawa	Mtongani	All	591	924	23			4	2			500		500	54.1	
33	Magawa	Nasibugani	Part	97	152	4			1	1			152		152	100.0	
34	Magawa	Nyamihimbo	All	889	1,390	35			6	2			500		500	36.0	
35	Magawa	Sangasanga	All	1,006	1,573	39			7	2			500		500	31.8	
36	Mkuranga	Dundani	All	1,577	2,466	62			10	2			500		500	20.3	
37	Mkuranga	Hoyoyo	All	3,320	5,192	130			21	2			500		500	9.6	
38	Mkuranga	Kibululu	All	1,005	1,572	39			7	2			500		500	31.8	
39	Mkuranga	Kiparang'anda'A'	All	4,321	6,758	169			28	2			500		500	7.4	
40	Mkuranga	Kiparang'anda'B'	All	2,065	3,230	81			13	2			500		500	15.5	
41	Mkuranga	Kise*	All	674	1,054	26			5	2			500		500	47.4	
42	Mkuranga	Kolangwa	All	500	782	20			4	2			500		500	63.9	
43	Mkuranga	Magoza	All	2,220	3,472	87			14	2			500		500	14.4	
44	Mkuranga	Mkuranga	Part	2,823	4,415	110			18	4			1,000		1,000	22.6	
45	Mkuranga	Mkwalia	Part	1,072	1,677	42			7	2			500		500	29.8	
46	Mkuranga	Sunguvuni	All	989	1,547	39			7	2			500		500	32.3	
47	Mkuranga	Tengelea	All	2,845	4,449	111			18	2			500		500	11.2	
48	Mwalusembe	Bigwa	All	2,098	3,281	82			14	2			500		500	15.2	
49	Mwalusembe	Kitonga	All	1,500	2,346	59			10	2			500		500	21.3	
50	Mwalusembe	Kiziko	All	1,286	2,011	50			9	4			1,000		1,000	49.7	
51	Mwalusembe	Mwalusembe	All	5,886	9,205	230			37	2			500		500	5.4	
52	Nyamato	Kilmba	All	1,280	2,002	50			9	4			1,000		1,000	50.0	
53	Nyamato	Kilimahewa Kusini	All	1,920	3,003	75			13	2			500		500	16.7	
54	Nyamato	Mkiu	All	3,742	5,852	146			24	4			1,000		1,000	17.1	
55	Nyamato	Mvuleni	All	1,886	2,950	74			12	2			500		500	16.9	
56	Nyamato	Nyanduturu	All	1,668	2,609	65			11	2			500		500	19.2	
57	Nyamato	Tipo	All	1,997	3,123	78			13	8			2,000		2,000	64.0	
58	Tambani	Dondwe	All	1,951	3,051	76			13	2			500		500	16.4	
59	Tambani	Kibamba	All	1,095	1,713	43			7	2			500		500	29.2	
60	Tambani	Mipeko	All	1,418	2,218	55			9	2			500		500	22.5	
61	Tambani	Mlamleni	All	2,318	3,625	91			15	2			500		500	13.8	
62	Tambani	Mwanadilatu	All	1,560	2,440	61			10	4			1,000		1,000	41.0	
63	Tambani	Mwanambaya	All	2,466	3,857	96			16	4			1,000		1,000	25.9	
64	Tambani	Tambani	All	1,538	2,405	60			10	2			500		500	20.8	
65	Vikindu	Kipala	All	2,029	3,173	79	-	-			MKR-2	782		2,391	3,173	100.0	Own Scheme
66	Vikindu	Kisemvule	All	2,260	3,535	88	2	2	2	2	MKR-3	3,244	291		3,535	100.0	
67	Vikindu	Malela	All	1,250	1,955	49			8	8			1,955		1,955	100.0	
68	Vikindu	Morogoro	All	1,500	2,346	59	1	1	2	2	MKR-4	1,939	407		2,346	100.0	
69	Vikindu	Mfurumwambao	All	1,435	2,244	56	1	-	7	7	MKR-4	696	1,548		2,244	100.0	
70	Vikindu	Mkokozi	All	1,769	2,767	69			12	12			2,767		2,767	100.0	
71	Vikindu	Mwandege	All	1,600	2,502	63	1	1	2	3	MKR-2	1,905	597		2,502	100.0	
72	Vikindu	Vianzi	All	2,625	4,105	103	2	1	5	5	MKR-5	2,926	1,179		4,105	100.0	
73	Vikindu	Vikindu	All	5,125	8,015	200			20	13			3,206	4,809	8,015	100.0	Private schemes
74	Vikindu	Yavayava	All	1,830	2,862	72			12	12			2,862		2,862	100.0	
Total (Mkuranga)				161,263	252,203	6,306	7	5	955	237		16,764	57,964	7,200	81,928	32.5	
Total (Coast: with Cahalinze-2 & DAWASA)				391,648	552,152	13,765	18	15	1,514	542		41,530	129,966	149,022	320,518	58.0	
Total (Coast: without Cahalinze-3 & DAWASA)				286,525	411,926	10,239									171,496	41.6	

Table 5.1 Summary of Water Supply Plan (4/4)

No.	District /Municipality Ward	Villages/Mitaa: Name of Village	Target Area	Population to be served: 2002	Population to be served: 2015	Water Demand (m3/day)(2015)	Neessary Number of Well (Level-2)	Exploitable Number of Well (Level-2)	Neessary Number of Well (Level-1)	Exploitable Number of Well (Level-1)	Serial No. (Level-2)	Served Population (2015) by Level-2	Served Population (2015) by Level-1	Served Population (2015) by Others(*)	Total Served Population (2015)	Coverage of Water Supply (%)	Alternative Water Supply
Ilala																	
1	Chanika	Buyuni	All	6,544	11,742	294			47	6			1,500		1,500	12.8	
2	Chanika	Chanika	All	13,906	24,953	624			100	4			1,000		1,000	4.0	
3	Chanika	Majohe	All	3,122	5,602	140			23	6			1,500		1,500	26.8	
4	Ilala	Shariff Shamba	All	6,708	12,037	301	DAWASA							12,037	12,037	100.0	
5	Kinyerezi	Kinyerezi	All	5,811	10,427	261	DAWASA							10,427	10,427	100.0	
6	Kipawa	Kipunguni	All	19,275	34,586	865	DAWASA							34,586	34,586	100.0	
7	Kitunda	Kitunda	All	23,424	42,031	1,051	10	5			ILL-1	15,201		26,829	42,030	100.0	DAWASA
8	Msongola	Msongola	All	3,668	6,582	165	3	1			ILL-2	2,530		4,052	6,582	100.0	
9	Msongola	Mvuti	All	4,108	7,371	184			30	4			1,000		1,000	13.6	DAWASA
10	Pugu	Pugu Kajiungeni	Part	3,850	6,908	173			28	4			1,000		1,000	14.5	DAWASA
11	Pugu	Pugu Station	Part	1,998	3,585	90	2	1	3	3	ILL-3	2,882	703		3,585	100.0	
12	Segerea	Amani	All	4,238	7,605	190	DAWASA							7,605	7,605	100.0	
13	Segerea	Kimanga Darajani	All	19,270	34,578	864	DAWASA							34,578	34,578	100.0	
14	Segerea	Kisukulu	All	4,151	7,448	186	DAWASA							7,448	7,448	100.0	
15	Segerea	Tembomgwaza	All	6,239	11,195	280	DAWASA							11,195	11,195	100.0	
16	Tabata	Matumbi	All	4,304	7,723	193	DAWASA							7,723	7,723	100.0	
17	Tabata	Tabata	All	9,239	16,578	414	DAWASA							16,578	16,578	100.0	
18	Tabata	Tenge	All	4,750	8,523	213	DAWASA							8,523	8,523	100.0	
19	Ukonga	Gongo La Mboto	All	20,470	36,731	918	DAWASA							36,731	36,731	100.0	
20	Ukonga	Guluka Kwalala	All	12,978	23,287	582			94	4			1,000		1,000	4.3	DAWASA
21	Ukonga	Markaz	All	4,279	7,678	192			31	2			500		500	6.5	DAWASA
22	Ukonga	Mongo La Ndege	All	3,698	6,636	166			27	2			500		500	7.5	DAWASA
23	Ukonga	Mwembemadafu	All	27,648	49,611	1,240			199	4			1,000		1,000	2.0	DAWASA
24	Ukonga	Ulongoni	All	3,680	6,603	165			27	4			1,000		1,000	15.1	DAWASA
Total (Ilala) (with DAWASA)				217,358	390,020	9,751	15	7	609	43		20,613	10,703	218,312	249,628	64.0	
Total (Ilala) (without DAWASA)				156,552	280,911	7,023									31,316		
Kinondoni																	
1	Bunju	Mabwepande	All	3,100	5,227	131	DAWASA							5,227	5,227	100.0	
2	Bunju	Mbopo	All	1,868	3,149	79	DAWASA							3,149	3,149	100.0	
3	Goba	Kulangwa	All	1,220	2,057	51	DAWASA							2,057	2,057	100.0	
4	Goba	Matosa	All	25,144	42,393	1,060	16	1			KND-1	2,747			2,747	6.5	DAWASA
5	Kawe	Changanyikeni	All	17,000	28,662	717	DAWASA							28,662	28,662	100.0	
6	Kibamba	Kibwegere	All	3,000	5,058	126	DAWASA							5,058	5,058	100.0	
7	Kibamba	Kwembe	All	7,600	12,814	320				10			2,500		2,500	19.5	DAWASA
8	Kimara	Kimara Baruti	All	14,584	24,589	615	DAWASA							24,589	24,589	100.0	
9	Kimara	Mavurunza	All	3,974	6,700	168	DAWASA							6,700	6,700	100.0	
10	Kunduchi	Madala	All	8,932	15,059	376	DAWASA							15,059	15,059	100.0	
11	Mbezi	Mbezi-Luis	All	20,079	33,853	846	DAWASA							33,853	33,853	100.0	
12	Mbezi	Mpiji Magohe	All	2,723	4,591	115	DAWASA							4,591	4,591	100.0	
13	Mbezi	Msakuzi	All	2,797	4,716	118	DAWASA							4,716	4,716	100.0	
14	Mbezi	Msumi	All	1,330	2,242	56			9	4			1,000		1,000	44.6	DAWASA
Total (with DAWASA)				113,351	191,110	4,778	16	1	9	14		2,747	3,500	133,661	139,908	73.2	
Total (without DAWASA)				34,074	57,449	1,436									6,247	10.9	
Temeke																	
1	Chamazi	Msufini	All	6,427	11,532	288	DAWASA							11,532	11,532	100.0	
2	Charambe	Kimbangulile	All	12,500	22,430	561	DAWASA(CWSSP)							22,430	22,430	100.0	
3	Kimbiji	Kizito Huonjwa	All	1,096	1,967	49	DAWASA							1,967	1,967	100.0	
4	Makangarawe	Makangarawe	All	10,400	18,661	467	DAWASA							18,661	18,661	100.0	
5	Makangarawe	Yombo Dovya	All	15,881	28,496	712	DAWASA							28,496	28,496	100.0	
6	Mbagala	Kingugi	All	4,663	8,367	209	DAWASA							8,367	8,367	100.0	
7	Mbagala Kuu	Mbagala Kuu	All	11,540	20,707	518	DAWASA							20,707	20,707	100.0	
8	Mbagala Kuu	Mgeni Nani	All	7,020	12,596	315	DAWASA							12,596	12,596	100.0	
9	Mjimwema	Kibugumo	All	1,883	3,379	84	1	1			TMK-1	3,379			3,379	100.0	
10	Mjimwema	Mjimwema	All	5,670	10,174	254	3	1			TMK-2	3,589		6,585	10,174	100.0	Municipality
11	Pemba Mnazi	Yale Yale Puna	All	3,321	5,959	149	1	1	2	2	TMK-3	5,586	373		5,959	100.0	
12	Pembamnazi	Tundwi Songani	All	2,204	3,955	99	2	2	6	6	TMK-4	2,647	1,308		3,955	100.0	
13	Tandika	Maguruwe	All	6,599	11,841	296	DAWASA							11,841	11,841	100.0	
14	Tandika	Nyambwela	All	4,402	7,899	197	DAWASA							7,899	7,899	100.0	
15	Tandika	Tamla	All	5,814	10,432	261	DAWASA							10,432	10,432	100.0	
16	Tuangoma	Kongowe	All	3,165	5,679	142	DAWASA							5,679	5,679	100.0	
17	Vijibweni	Kibene	All	751	1,348	34	DAWASA							1,348	1,348	100.0	
18	Vijibweni	Kisiwani	All	1,060	1,902	48	DAWASA							1,902	1,902	100.0	
19	Vijibweni	Mkwajuni	All	997	1,789	45	DAWASA							1,789	1,789	100.0	
20	Vijibweni	Vijibweni	All	1,800	3,230	81	DAWASA							3,230	3,230	100.0	
21	Yombo Vituka	Machimbo	All	15,421	27,671	692	DAWASA							27,671	27,671	100.0	
22	Yombo Vituka	Sigara	All	8,024	14,398	360	DAWASA							14,398	14,398	100.0	
23	Yombo Vituka	Vituka	All	11,499	20,633	516	DAWASA							20,633	20,633	100.0	
Total (with DAWASA)				142,137	255,045	6,377	7	5	8	8		15,201	1,681	238,163	255,045	100.0	
Total (without DAWASA)				13,078	23,467	586									23,467	100.0	
Total (DSM: with DAWASA)				472,846	836,175	20,906	38	13	626	65		38,561	15,884	590,136	644,581	77.1	
Total (DSM: without DAWASA)				203,704	361,827	9,045									54,445	15.0	
Total (Total Area: with Chalinze-2 and DAWASA)				864,494	1,388,327	34,671	56	28	2,140	607		80,091	145,850	739,158	965,099	69.5	
otal (Total Area: without Chalinze-2 and DAWASA				490,229	773,753	19,284									225,941	29.2	

lote: Following Village and Mitaa are excluded in this list.

1) Village and Mitaa located in the DAWASA Supply Area difined in Dar es Salaam City water supply plan.
2) Village and Mitaa served by existing water supply schemes such as Chalinze Water Supply Schme..
3) Village and Mitaa where other intervention related to water supply is planned (as of June 2004).

CHAPTER 6 PRIORITY PROJECT

6.1 GENERAL

The Priority Project for implementation was selected from the Water Supply Plan assuming the implementation with the Japan's Grant Aid.

6.2 EVALUATION OF VILLAGES FOR PRIORITY

6.2.1 CRITERIA AND THEIR WEIGHTING FOR EVALUATION

High priority for selection of villages for the project was given to the villages where water resource is available along with high degree of unprovision of water.

(1) Evaluation of Urgency to provide Water Supply Schemes

Factors for evaluation of urgency are (1) average time required for fetching water, (2) duration of months when water source is available and (3) daily water consumption amount per household per day. Each factor was given score from 1 to 3 considering the urgency with respect to each factor. Those factors were compared and evaluated using the "Pair-Wise Ranking" method, and then weighting was given to each factor.

(2) Evaluation of Water Resources

Groundwater evaluated as the major water source since surface water would be used only in one village. The evaluation criteria and its weighting are shown in *Figure 4.4* of Chapter 4. If groundwater is not available due to high salinity and/or low yield, surface water is evaluated from its availability.

6.2.2 EVALUATION OF VILLAGES

All the Villages were given ranking of priority based on the evaluation results applying following concept. Weighting of urgency and water resource is considered as same. The maximum score of water sources is 12: it is half of that of urgency. Therefore, score of water source was multiplied by two. The results are shown at the end of this Chapter as *Table 6.1*.

6.3 SELECTION OF PRIORITY PROJECT

6.3.1 CRITERIA FOR SELECTION OF PRIORITY PROJECT

In the selection of candidate villages for Priority Project, appropriate scale of project was considered. Then, proportion of village was determined based on the population of each District/Municipality.

6.3.2 SELECTION OF PRIORITY PROJECT

Applying the criteria mentioned above, alternatives for the Priority Project were proposed. Through the discussion with MoWLD and District/Municipal Water Engineers, the project composed of 17 Level-2 schemes in 19 villages were evaluated as technically reasonable and selected as the Priority Project. The candidate villages are further evaluated on these technical suitability and socio-economic aspects. As the result of comprehensive evaluation, some villages were excluded from the service area of the Level-2 piped water supply scheme, if such area is technically not suitable. When a village was evaluated as not suitable for Level-2 water supply, a village standing next on the list of priority village was newly selected as a candidate of the Priority Project. Finally, 22 schemes in 22 villages were selected as the Priority Projects. Their list and location are shown in *Table 6.2* and *Figure 6.1*, respectively.

Table 6.2 List of Priority Project

District/Municipality Village/Mitaa	Name of Village	Serial No. of Scheme	Service Population (2002)	Service Population (2010)	Service Population (2015)	Number of Wells	Water Production (m^3/day)
BAGAMOYO							
KIBINDU	KIBINDU	BGM-1	4,904	5,746	6,344	2	173
KWAMDUMA	KWAMDUMA	BGM-2	2,545	2,982	3,292	2	86
MKANGE	MATIPWILI	BGM-3	1,948	2,283	2,518	Wami	72
KIBAHA							
RUVU	MINAZI MIKINDA (1/2)	KBH-1A	1,624	2,083	2,508	1	72
RUVU	MINAZI MIKINDA (2/2) /KITOMONDO	KBH-1B	1,627	2,102	2,513	1	72
KISARAWE							
CHOLE	CHOLE	KSW-1	2,685	3,001	3,217	2	106
MSIMBU	MSIMBU	KSW-2	2,199	2,458	2,635	2	76
MKURANGA							
LUKANGA	NJOPEKA	MKR-1	3,371	4,439	5,272	Spring	132
VIKINDU	MWANDEGE/KIPALA	MKR-2	2,100	2,370	2,815	1	79
VIKINDU	KISEMVULE	MKR-3	2,260	2,731	3,244	2	86
VIKINDU	MOROGORO MFURU MWAMBAO	MKR-4	1,945	2,036	2,635	1	72
VIKINDU	VIANZI	MKR-5	1,871	2,463	2,926	1	79
ILALA							
KITUNDA	KITUNDA-Kivuke (1/2)	ILL-4A	2,614	3,746	4,690	2	126
	KITUNDA-Kivuke (1/3)	ILL-4B	1,744	2,499	3,129	1	90
	KITUNDA-Mzinga	ILL-4C	4,114	5,895	7,382	2	198
MSONGOLA	MSONGOLA	ILL-5	1,410	2,021	2,530	1	72
PUGU	PUGU STATION	ILL-6	6,481	9,287	11,629	1	72
KINONDONI							
GOBA	MATOSA	KND-1	2,580	3,558	4,350	1	72
TEMEKE							
MJIMWEMA	KIBUGUMO	TMK-1	1,883	2,698	3,379	1	84
MJIMWEMA	MJIMWEMA	TMK-2	2,000	2,866	3,589	1	90
PEMBA MNAJI	YALEYALE PUNA	TMK-3	3,113	4,461	5,586	1	150
PEMBA MNAJI	TUNDWI SONGANI	TMK-4	1,475	2,114	2,647	1	72

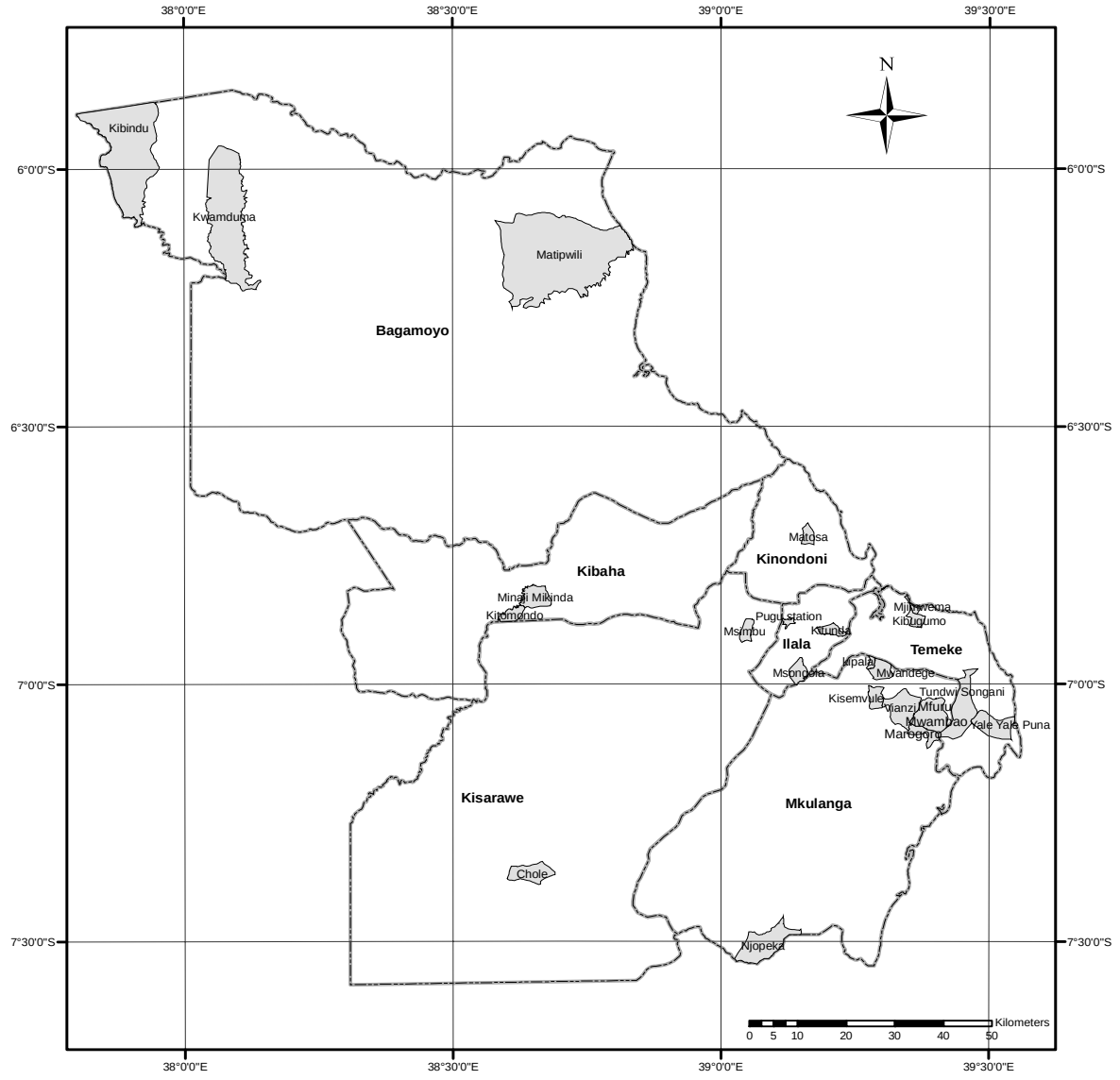

FIGURE 6.1 LOCATION OF TARGET VILLAGES OF PRIORITY PROJECT

THE STUDY ON WATER SUPPLY IMPROVEMENT IN COAST & DAR ES SALAAM | **JICA**

6.4 PRELIMINARY DESIGN OF WATER SUPPLY FACILITIES FOR PRIORITY PROJECT

6.4.1 GENERAL CONCEPT OF PRELIMINARY DESIGN

Water source is basically groundwater. Surface water is exceptionally used in Matipwili, Bagamoyo District. In order to minimize the construction cost and operation cost, water is supplied by gravity to the service area through public water points.

6.4.2 WATER DEMAND

Water demand is estimated considering the domestic water use and institutional use as discussed in Chapter 5. Unit water demand for domestic use is 25 litre/capita/day.

6.4.3 MANUAL AND GUIDELINE APPLIED IN THE PRELIMINARY DESIGN

Design Manual (Ministry of Water, 1997) was basically adopted. Guideline for Design of Water Supply Facilities in Japan (2000) was also applied for laying depth of pipelines.

6.4.4 DESIGN CONDITIONS

Design conditions for the water supply facilities are summarized in *Table 6.3*.

Table 6.3 Design Conditions of Water Supply Scheme

1. Time period of water consumption: 6 hours (from 6:00 to 9:00a.m. and from 3:00 to 6:00 p.m.)		
2. Design Flow		
Daily average flow	Daily average flow = Daily water demand + Distribution losses	
Daily maximum flow	Daily maximum flow = Daily average flow	
Hourly maximum flow	Hourly maximum flow = Daily maximum flow / 6 hours[1)]	
3. Distribution Losses	20 % of Daily average flow	
4. Facilities	Specification	
Intake facilities	Daily operation hour	Average: 10 hours (=600 min.) Maximum: 12 hours (=720 min.)
	Capacity (m^3/min.)	Daily maximum flow (m^3/day) / 600 (min/day)
	Type of pump	Submersible pump (Centrifugal pump)
	Power source	Generator (diesel engine with generator)
Disinfection facility*	Chlorine feeder	Dropping type, Sodium hypochlorite
Transmission Line	Design Flow	Daily maximum flow (m^3/day) / 600 (min/day)
	Method of water supply	Pressure flow
	Material of pipes	P.V.C. pipe
	Earth covering depth	0.75 m (minimum)
Storage tank (Distribution tank)	Capacity (m^3)	Daily maximum flow (m^3/day) x 50% (40-120 m3)
	Type of tank	Ground tank or Elevated tank (12 m in maximum)
	Low Water Level	Ground tank (G.L+0.2 m) Elevated Tank (G.L+8.95 m in maximum)
	No. of tank	1 tank /scheme
	Material of tank	Reinforced concrete
Distribution Line	Design Flow	Hourly maximum flow
	Material of pipes	P.V.C. pipe (Galvanized pipe)
	Earth covering depth	0.75 m (minimum)
	Method of water supply	Gravity flow
Public water point (PWP)	Number of tap /PWP	One or two taps/PWP according to the population
	Number of PWP	One tap/250 persons against the population in 2010
	Maximum number of user	250 persons / tap
	Maximum distance of access	400 m from household

* : Disinfection facility is installed in Matipwili only.

6.4.5 FACILITY PLAN

Water supply facilities are composed of intake, transmission line, storage tank, distribution lines and public water points. Design parameters of each scheme are summarized in *Table 6.4*.

Table 6.4 Summary of Design Parameter for Water Supply Facilities of Priority Project

District	Village /Mitaa	Water Sources (Well)		Transmission Pipe Line		Storage Tank		Total Length of Distribution Line (m)	Maximum Length from Water Source to the end of PWP (m)	No. of PWP	
		No. of Well	Well Depth (m)	Diameter (mm)	Total Length (m)	Capacity (m^3)	Type of Tank [1)]			PWP with Single Tap	PWP with Double Taps
Bagamoyo	Kibindu	2	100	75	2,060	100	Ground tank	6,820	5,557	13	5
	Kwanduma	2	100	50	1,500	50	Ground tank	2,590	2,930	2	5
	Matipwili	Wami River	-	63	510	40	Elevated tank (A)	1,330	1,100	10	0
Kibaha	Minazi Mikinda	1	50	50	100	40	Elevated tank (A)	1,280	1,030	0	5
	Kitomondo/Minazi Mikinda	1	50	50	100	40	Elevated tank (A)	6,900	5,090	9	0
Kisarawe	Msimbu	2	120	90	4,700	50	Ground tank	18,400	8,450	11	0
	Chole	2	80	110	3,960	60	Ground tank	10,550	8,110	18	0
Mkuranga	Mwandege /Kipala	1	80	63	100	50	Elevated tank (A)	10,660	4,220	22	0
	Kisemvule	2	80	63	940	60	Ground tank	9,560	5,750	12	0
	Marogoro /Mfuru Mwambao	1	50	50	100	40	Elevated tank (B)	11,370	5,230	14	0
	Vianzi	1	100	75	100	50	Elevated tank (A)	7,420	2,640	13	0
	Njopeka	Spring	-	110	2,480	80	Ground tank	13,830	8,070	12	3
Ilala	Kitunda-1	2	80	50	400	80	Elevated tank (A)	7,930	3,980	0	8
	Kitunda-2	1	80	63	100	50	Elevated tank (A)	8,900	4,830	0	5
	Mzinga	2	80	63	400	120	Elevated tank (A)	8,440	4,800	0	12
	Msongala	1	80	75	100	40	Elevated tank (A)	6,620	3,170	9	0
	Pugu Station	1	90	75	1,420	50	Ground tank	2,230	2,870	0	5
Kinondoni	Matosa	1	120	75	2,180	50	Elevated tank (A)	5,070	5,640	4	3
Temeke	Yaleyale Puna	1	80	125	4,430	90	Elevated tank (A)	9,990	9,170	6	6
	Tundwi Songani	2	80	63	3,920	40	Elevated tank (A)	8,550	5,410	16	0
	Mjimwema	1	50	50	100	60	Elevated tank (B)	4,980	3,220	6	3
	Kibugumo	1	50	75	100	50	Elevated tank (B)	3,590	2,470	7	2
Total		28	-	-	29,800	1,290	-	167,010	-	184	62

Note: 1) Ground tank : Low water level = GL + 0.20 m
Elevated tank (A): Low water level = GL + 6.05 m
Elevated tank (B): Low water level = GL + 8.95 m