No.

THE IMPLEMENTATION REVIEW STUDY REPORT ON THE PROJECT FOR RURAL WATER SUPPLY IN THE REPUBLIC OF KENYA

JULY 2006

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
GRANT AID MANAGEGEMENT DEPARTMENT

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JR
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PREFACE

In response to a request from the Government of the Republic of Kenya, the Government of Japan decided to conduct an implementation review study on the Project for Rural Water Supply and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Kenya a study team from December 4, 2005 to March 25, 2006, and from June 5 to June 10, 2006.

The team held discussions with the officials concerned of the Government of Kenya, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Kenya in order to discuss a draft implementation review report, and as this result, the present report was finalized.

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

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Kenya for their close cooperation extended to the teams.

July, 2006

Masafumi Kuroki

Vice-President
Japan International Cooperation Agency

July, 2006

Letter of Transmittal

We are pleased to submit to you the implementation review study report on the Project for Rural Water Supply in the Republic of Kenya.

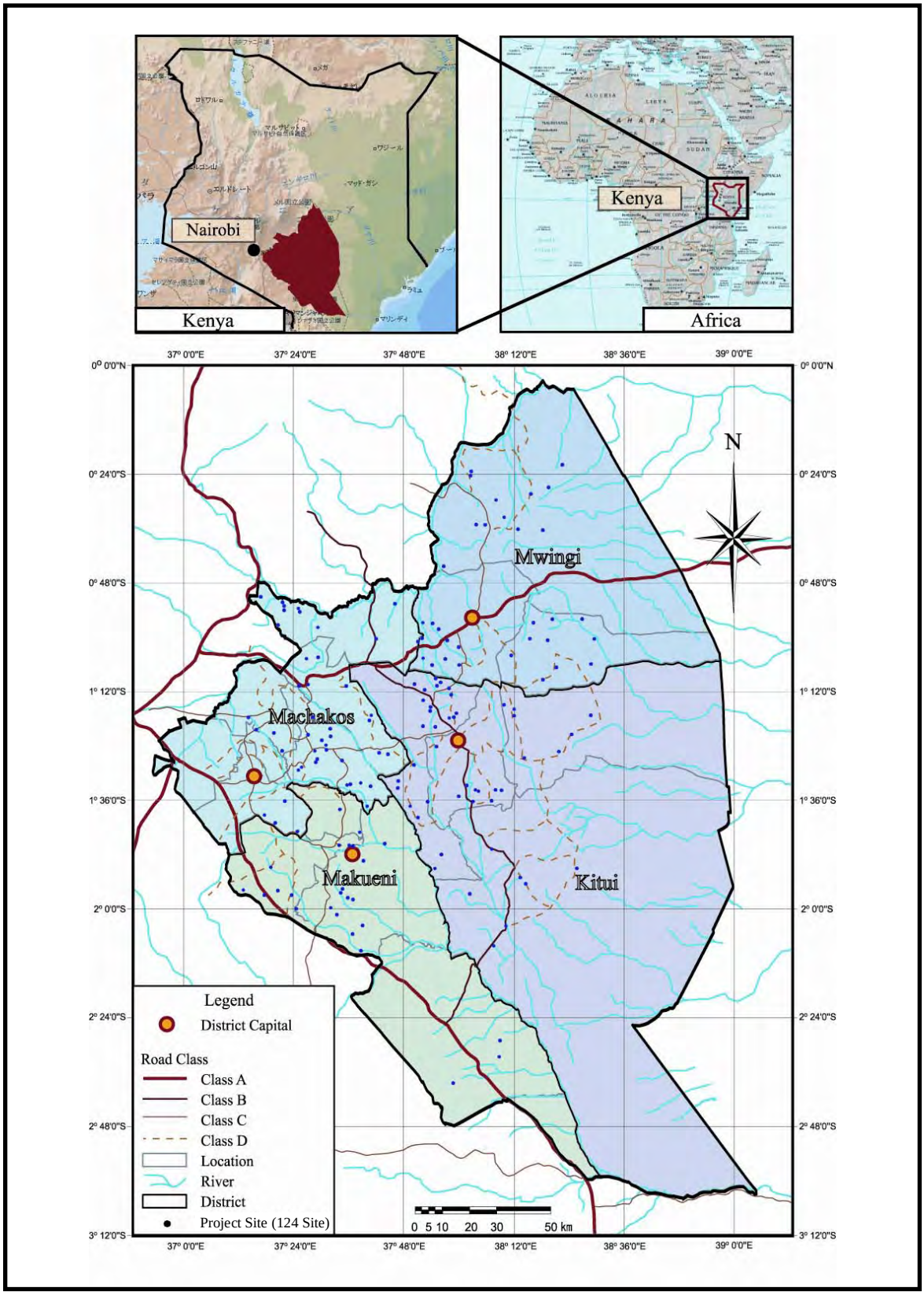
This study was conducted by the joint venture between Nippon Koei Co., Ltd., under a contract to JICA, during the period from December, 2005 to July, 2006. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Kenya and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

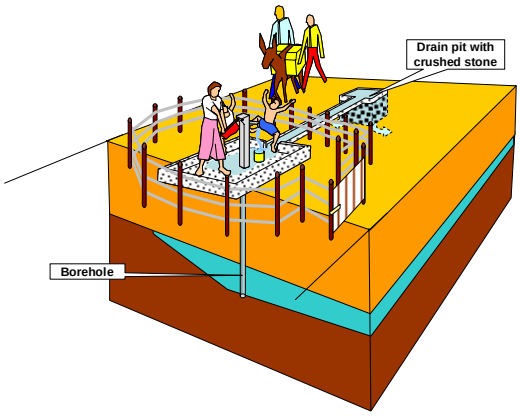
Very truly yours,

Masanobu Sakamoto

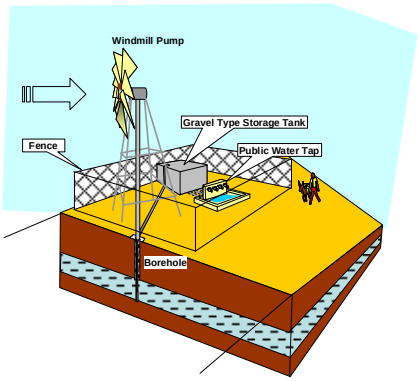
Project Manager
Basic design study team on
Groundwater Development in Rural Districts
(Machakos, Kitui, Makueni and Mwingi)
The joint venture between
Nippon Koei Co., Ltd. and Japan Techno Co., Ltd.



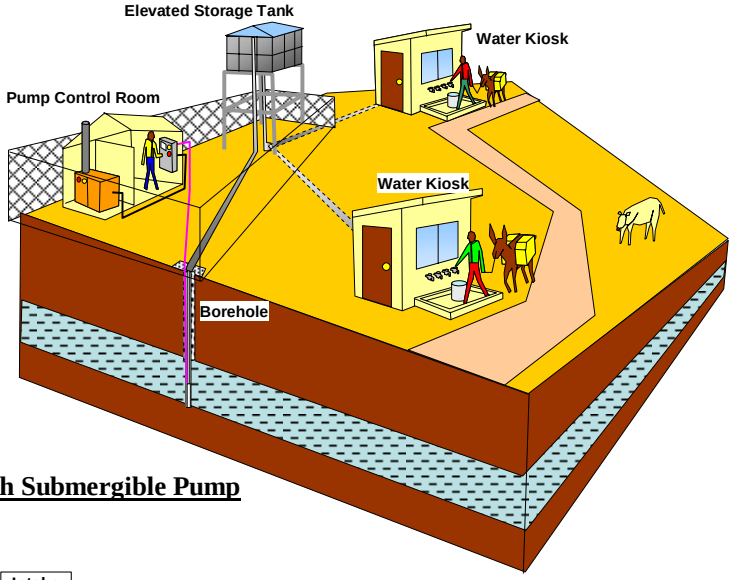
Location Map of the Project



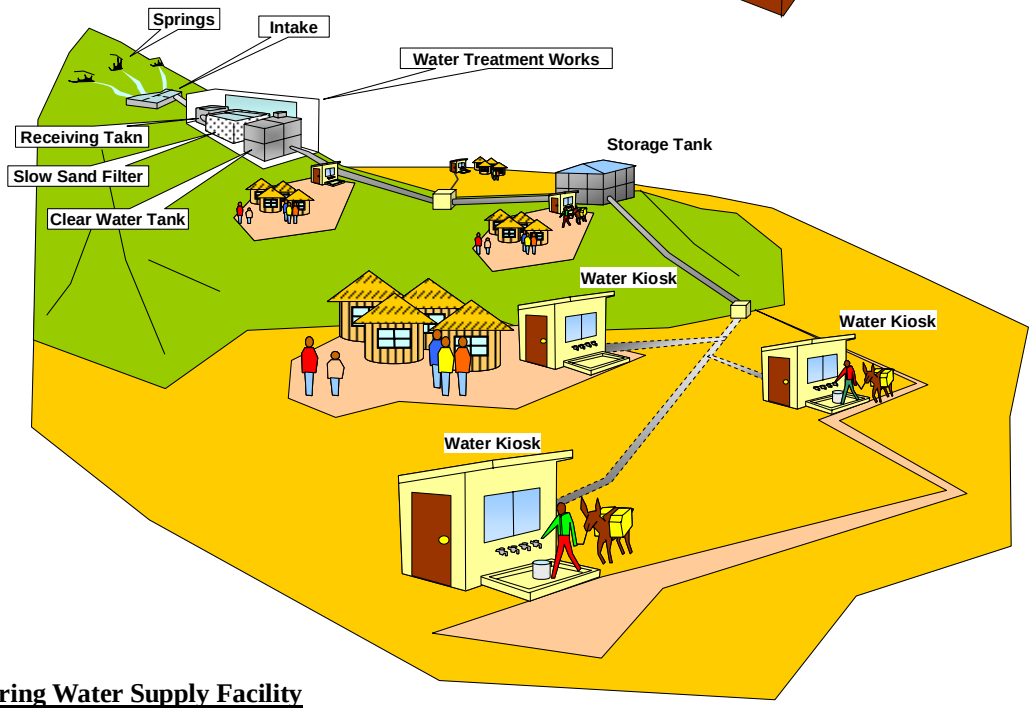
Water Supply Facility with Hand Pump



Water Supply Facility with Windmill Pump



Water Supply Facility with Submergible Pump



Spring Water Supply Facility

Perspective of Proposed Water Supply Facilities

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Abbreviations

ADRA	Adventist Development and Relief Agency
AfDB	African Development Bank
AMREF	African Medical and Research Foundation
ASAL	Arid and Semi-Arid Lands
BD	Basic Design
BTC	Belgian Technical Cooperation
CCF	Christian Children's Fund
CORP	Community Resource Person
DANIDA	Danish International Development Agency
DWO	District Water Office
EC	Electric Conductivity
E/N	Exchange of Note
GDP	Gross Domestic Product
GOK	Government of Kenya
GSP	Galvanized Steel Pipe
GTZ	German Technical Cooperation Agency
ICA	Institute of Cultural Affairs
JICA	Japan International Cooperation Agency
KAP	Kitui Agricultural Project
MoFP	Ministry of Finance and Planning
MoPND	Ministry of Planning and National Development
MoWI	Ministry of Water and Irrigation
NGO	Non-governmental Organization
NWCPC	National Water Conservation and Pipeline Cooperation
OJT	On the Job Training
PHAST	Participatory Health and Sanitation Transformation
PMU	Project Management Unit
PRSP	Poverty Reduction Strategy Paper
SIDA	Swedish International Development Agency
TDS	Total Dissolved Solid
UNDP	United Nations Development Program
UNICEF	United Nation Children's Fund
uPVC	Unplasticised Polyvinyl Chloride
VES	Vertical Electrical Sounding
WHO	World Health Organization
WRMA	Water Resources Management Authority
WSB	Water Service Board

WSP	Water Service Provider
WSRB	Water Service Regulatory Board
WSRP	Water Sector Reform Project
WUA	Water Users Association
WUASP	Water Users Association Support Program

Units

Length

mm	=	millimeter
cm	=	centimeter
m	=	meter
km	=	kilometer
ft	=	feet

Area

cm^2	=	square centimeter
m^2	=	square meter
km^2	=	square kilometer

Volume

cm^3	=	cubic centimeter
m^3	=	cubic meter
l or lit	=	liter

Weight

mg	=	milligram
g	=	gram
kg	=	kilogram

Time as denominator

/s	=	per second
/min	=	per minute
/hr.	=	per hour

Derived measures

mg/l	=	milligram per liter

Currency

Ksh	=	Kenyan Shilling

Others

%	=	percent
Ph	=	potential of hydrogen
℃	=	degrees Celsius
ppm	=	parts per million
micro S/cm	=	micro siemens per centimeter

Currency

JPY	Japanese Yen
US$	US Dollar
Ksh	Kenyan Shilling

Exchange Rate as of the end of March 2006

1 US$ = Ksh 72.93 = JPY 118.18

Summary

Summary

The Republic of Kenya locates, striding the Equator in the eastern part of Africa, surrounded by Ethiopia, Somalia, Tanzania and Uganda. It is a large country with a land area of 583,000 km2, administratively divided into 8 provinces and 68 districts. The ASAL, where is classified as arid and semi-arid regions except the coast and southern hilly areas, occupies an area of 490,000 km^2 or 83% of the overall land area of the country, and is inhabited by 25% of the overall population of 29 million (1999 census).

The economy of Kenya is largely dependent on the two major sectors of agriculture and tourism, which comprise approximately 24% and 52% of GDP. The Republic of Kenya is classified as one of the Least Developed Countries due to its low per capita Gross National Income of US$ 360 in 2002. The economic growth is presently in a state of deceleration with an annual average growth rate of 1%, and this economic situation has continued during the last decade.

In order to improve this sluggish economic situation, the Government of Kenya (GOK), in the 9th National Development Plan (2002 to 2008), clarified its intention to promote industrialization and development of commercial sectors in addition to stabilization of agriculture. Provision of stable water supplies is indispensable to promote the above objectives and appropriate development of water resources and improvement of maintenance are targets of the water supply sector. In line with this priority, the “National Water Policy” was initiated in 1999 with the policies of “importance of maintenance (of quality and quantity)”, “water development to alleviate poverty”, “entrustment to autonomous private sector entities of maintenance phase in urban areas”, “provision of maintenance costs through collection of water charges” in addition to “development of water resources to meet demand”. The Government of Kenya issued the Water Act 2002 in order to realize this poly, and the water supply sector is being re-formed in accordance with the act.

Against this background, the GOK made a request to the Government of Japan (GOJ) in August 2002 to extend grant aid assistance for development of groundwater supply facilities in the four districts of Machakos, Makueni, Kitui and Mwingi in the Eastern Province, procurement of operation and maintenance equipment and provision of technical guidance for operation and maintenance. The request was based on the “Aftercare Study on the National Water Master Plan in the Republic of Kenya”, a development program study conducted by Japan International Cooperation Agency (JICA) in 1997 to 1998.

In response to this request, the GOJ decided to conduct the preliminary study in November 2003, and the basic design study undertaken during the periods from June to October, 2004. The basic design study prepared the implementation plan of water supply for 155 target communities and population of 203,000, including construction of water supply facilities, procurement of operation and maintenance equipment and tools, and software program to develop capacity of communities for operation and maintenance.

Based on the aforesaid basic design study, the exchange of note was signed on November 2, 2004. Tendering process was done at May 16, 2005 after completion of the detailed design

works, but it did not reach to successful result. The second tendering also was done, reviewing pre-qualification criteria, construction period, and exchange rates, but the all the candidates did not submit their tenders.

The Government of Japan decided that works of the Project under the budget in 2004 fiscal year was closed at the detailed design and pre-construction works because of insufficient period for completing the scheduled construction works by the March 2006, and that the implementation of Project should be re-evaluated by the Cabinet of the Government of Japan on the basis of result of this Implementation Review Study (the Study).

This Implementation Review Study was executed for 8 months from December 2005 to July 2006 in order to confirm the present water supply condition in the target communities, to review price escalation, fluctuation of exchange rate and implementation schedule, and to execute detailed design for the revised first phase of the Project through the Study.

It is agreed between Kenyan and Japanese sides that the 28 communities have been excluded from the Project among the 155 communities proposed by the basic design study, since the these communities already have water supply system in their area by developing boreholes or piped supply from treatment plant at Masinga Dam. This Study also executed test drilling at 4 communities, i.e. 2 sites in Kitui District and 2 sites in Mwingi District, and hand-pumps water supply facilities were constructed at 3 successful borehole sites among 4 sites. These 3 communities also were agreed to be excluded from the target communities of the Project. Finally, the target communities of the Project were agreed to be revised at 124 communities from 155 communities proposed by the basic design study.

The water supply plan for the target communities was prepared by applying water consumption rate of 15 l/day/capita, which is based on criteria for ASAL area in “the design manual for water supply facilities in Kenya”. The average population of the target communities is about 1300 exceeding the 500 that is upper limit for a hand pump water supply. Therefore, the Study includes a motorized pump as water supply facilities. The windmill pump requested by the Government of Kenya has spread in Kenya during the last decade because of low operation and maintenance costs. In selecting water supply type for each target community, windmill pump and motorized submergible pump were compared from water yield, hydraulic head of borehole site, water demand, geography, and wind velocity.

Borehole is planned to be drilled once for each community. If drilling results in failed borehole at a community, an alternative community for drilling will be selected through the discussion with Kenyan side and with reference to the list of alternatives provided by the Government of Kenya.

Three types of water supply facilities were considered for the target communities: 1) hand pump, 2) windmill pump, and 3) submergible pump. The optimum type of water supply facility is proposed for each target community on the basis of the selection criteria: water demand in a target community, estimated water yield and required hydraulic head between water supply area and borehole site, and capacity of water users association for operation

and maintenance in the community.

The hand pump type is applied for communities with insufficient capacity to meet the operation and maintenance costs of submersible and/or windmill pumps based on the minimum unit revenue of Ksh 1.8 per 20 litres in Machakos and Makueni districts, and Ksh 1.2 per 20 litres in Kitui and Mwingi districts. Application of hand pump to communities requiring submergible and/or windmill pumps may induce excessive use of pump facility, so measures such as reduction of unit water consumption, restriction of water use, and so on are planned to be executed with the consensus of community residents, obtained through a soft component program.

There is no definition for successful boreholes in Kenya. Therefore, the criteria based on the guideline for basic design of groundwater development used in grant aid in 1996, coupled with the minimum engineering requirements of equipment to be used for the Project, were established for this purpose. In these criteria, the minimum requirements of water yield are 330 l/hour for hand pump and above, 600 l/hour for windmill pump and above, and 1,000 l/hour for motorized pump and above.

The water quality standard attached to this report and “Design Manual for Water Supply Facilities in Kenya” (MOWI) were principally applied for the basic design study. However, the total dissolved solid (TDS) of 2000 mg/l is adopted, taking into account the current water use situation in the study area. Design of water supply facilities are based on the aforesaid manual of MOWI.

One of the target communities, Kathanze uses Mora spring for domestic water supply. However, the supply facility can not meet water demand because of deterioration and insufficient capacity of the facilities. This spring water is available throughout the year and yields sufficient water to meet demands. Therefore, rehabilitation of the existing facility is recommended for lower operation and maintenance costs.

The water supply facilities for the 124 target communities proposed and accepted by the Government of Kenya are tabulated as follows:

Proposed Water Supply Facilities

District	No. of Target Communities	Borehole Water Supply Facility			Rehabilitation of Spring Water Supply Facility
		Hand Pump	Motor Pump	Windmill Pump	
Machakos	38	12	22	4	0
Kitui	25	9	16	0	0
Mwingi	34	18	15	0	1
Makueni	27	10	14	3	0
Total	124	49	67	7	1

The water sector reform currently being implemented in Kenya is scheduled to be completed in December 2007. The requested operation and maintenance tools and equipment are likely transferred to a new organization, responsible for operation and maintenance of rural water supply. In order to ensure smooth implementation of the Project

and create sustainable operation and maintenance, the following tools and equipment are planned to be procured:

Procurement of Operation and Maintenance Equipment

Materials and Machines	Type	Nos.
1. Vehicle	4WD Pick-Up	5
2. Motor Bike	125cc, Off-Road Type	8
3. Electric Sounding Equipment	Use for Vertical Sounding and 2-D Sounding	1
4. Water Test Equipment	Simple Kit	4
5. O&M Tool	Mega Ohm Tester	4
	Windmill Pump O&M Tools	2

The soft-component program aims “to establish the basis for a community-based operation and maintenance system”. In deciding activities of the program, consistency with activities undertaken by other donors and NGOs must be considered.

BTC (Belgian Technical Cooperation) is implementing a similar water and sanitation program, namely the Water Users Association Support Program, in Machakos and Makueni Districts. The main activity components are: 1) enhancing community awareness of ownership, 2) formation and capacity building of WUAs in community-based operation and maintenance, 3) provision of health and sanitation education through demonstration of sanitation facilities, 4) transition of WUA to WSP, and 5) monitoring and evaluation. Activities in the software component program of the current Project are established to maintain consistency with those of the BTC program. On the other hand, the water supply program being carried out by SIDA (Swedish International Development Agency) and DANIDA (Danish International Development Agency) cooperation, plans to appoint NGOs for building capacity of communities for operation and maintenance. Thus, the activities relating to capacity building of communities will be proposed by NGOs.

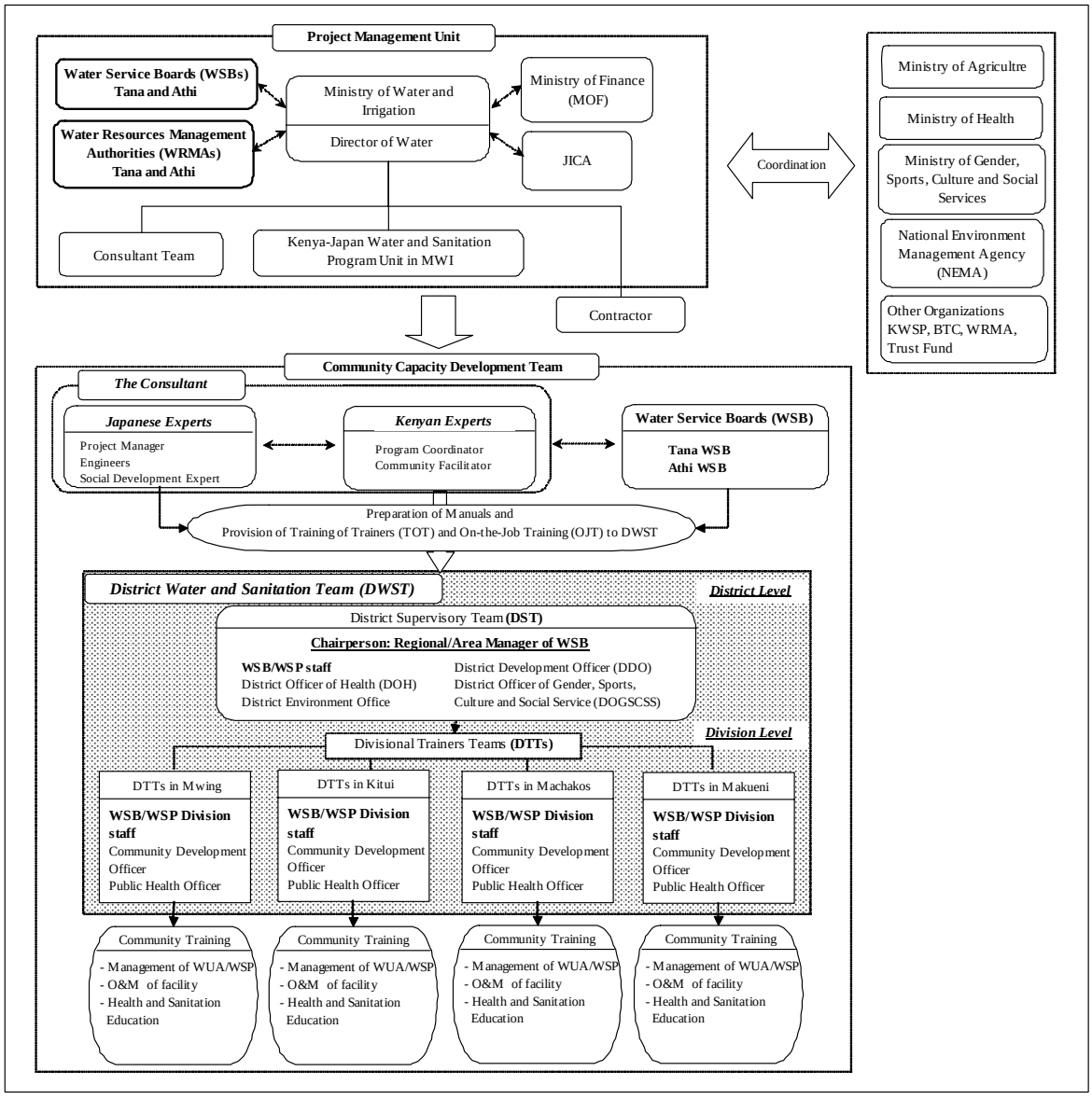
Activities planned for the software component program are based on the concept and methodology applied by NGOs active in the Project area; so that coherence with SIDA and DANIDA cooperation can also be maintained.

(1) Activities to improve community ownership and participation,
(2) Activities to enhance capacity and skills of local administration to support communities in establishment of community-based operation and maintenance system,
(3) Activities to develop capacity of target communities in operation and maintenance of improved water supply system,
(4) Activities to increase community awareness in personal health and sanitation, and understanding of correlation with safe water use, and
(5) Activities to measure the impact of the Project.

This Project is planned to be implemented in two phases. The duration of the Project is 24.5 months after the Exchange of Notes, including detailed design, tendering and preparation of contract, construction work, and software component program. The required

total project cost is estimated at JPY 1,123 million, comprised of JPY 1,014 million to be borne by Japan and JPY 109 million by Kenya. The Government of Kenya will be responsible for land acquisition and clearing of land for construction of facilities, construction of fence surrounding facilities and transmission and distribution pipelines.

The PMU shall be established for the implementation of the Project and responsible for all the management work of the Project, including coordination with the other agencies relevant to the Project:



Constitution of Project Management Unit (PMU)

The PMU comprises Ministry of Water and Irrigation (MOWI), Tana and Athi Water Service Board (WSB), MOF, and JICA. The DWD is secretariat of PMU. Under the DWD, the district level WSB executes the actual works in each district. The Kenya-Japan Water and Sanitation Program Unit provides advises and support to the district level WSB in

accordance with requirements. The district level WSB also acts as counterpart agencies for the software component program, which provides support to key staff and persons in charge of operation and maintenance of rural water supply. DWST (district water and sanitation team), provides support to WUA (water users association), and comprises district office staff of the social development office, MOF, MOH, and MOGSCSS.

The benefit of the Project is evaluated as follows:

1) Increase of served population, service ratio, and stable and safe water

The estimated incremental population with safe drinking water source is worked at 150,700 by the implementation of the Project, and the service ratio will be raised to 31.3% from the current 27.6 %.

Parameters of Existing and Planned Water Supply Condition

Parameters	Existing Condition in 2001		Planned Condition in 2008
Served Population (1000 persons)	Machakos	330.0	374.7
	Kitui	50.5	91.3
	Makueni	109.6	138.7
	Mwingi	29.8	65.9
Total of 4 Districts		519.9	670.6
Service Ratio (%)	Machakos	36.4	41.3
	Kitui	9.8	17.7
	Makueni	14.2	18.0
	Mwingi	9.8	21.7
Average of 4 Districts		27.6	31.3

2) Reduction of distance to water point/work load of women and children

The current average distance to water point is 5.2 km (District Development Plan 2002-2008), and planned to be reduced to 4.4 km, a reduction of 0.8 km.

Parameters of Existing and Planned Distance to Water Point

Parameters	Existing Condition in 2001		Planned Condition in 2008
Average Distance to Water Point (km)	Machakos	5.0	4.6
	Kitui	5.0	3.2
	Makueni	4.5	3.9
	Mwingi	10.0	5.7
Average of 4 Districts		5.2	4.4

The following issues should be fully taken into consideration for smooth implementation and effective performance of the Project:

(1) Immediate organization of water users association

To ensure smooth and sustainable operation and maintenance of the water supply facilities to be provided by the Project, the target communities require technical guidance and sensitization for water users associations (WUA). Therefore, MOWI should closely coordinate with the agencies concerned, and organize WUA at each target community

immediately after the Exchange of Notes for the Project; this will ensure smooth commencement and effective operation of these activities.

It is confirmed through the Study that the WSPs of 59 target communities in Kitui and Mwingi districts are organized by Tana WSB. The Athi WSB is preparing a plan for establishment of WSPs in Machakos and Makueni districts.

(2) Land acquisition at facility site

In order to drill boreholes and construct water supply facilities smoothly, land acquisition at each site, which is undertakings of Government of Kenya, should be completed before the completion of the detailed design.

(3) Community's undertakings for construction of fence and pipelines

The consent of the communities for the construction of water kiosk, fence and pipelines is required. This consent shall be ensured by MOWI by the completion of the detailed design of the Project, as well as organization of WUA.

(4) Preparation of business plan including operation and maintenance plan

It is clear that the WUAs will be responsible for preparing the business plans as an obligation of water service provider (WSP). This requirement is a result of the water sector reform to ensure sustainability of the water scheme. Therefore, MOWI shall provide support to WUA of the target communities during and after the implementation of the Project.

(5) Securing staff and budget for undertakings of Government of Kenya

It is requested that MoWRMD secure the necessary staff and budgets for meeting undertakings of Government of Kenya, described in section 3.5.

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Background of the Project

CHAPTER 1
BACKGROUND OF THE PROJECT

1-1 Background of the Request

The Republic of Kenya locates, striding the Equator in the eastern part of Africa. It is a large country with a land area of 583,000 km2 and a population of 32 million in the year of 2003. The ASAL, where is classified as arid and semi-arid regions except the coast and southern hilly areas, occupies an area of 490,000 km2 or 83% of the overall land area of the country, and is inhabited by 25% of the overall population and 50 % of livestock.

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In order to improve this sluggish economic situation, the Government of Kenya (GOK), in the 9th National Development Plan (2002 to 2008), clarified its intention to promote industrialization and development of commercial sectors in addition to stabilization of agriculture. Provision of stable water supplies is indispensable to promote the above objectives and appropriate development of water resources and improvement of maintenance are targets of the water supply sector. In line with this priority, the “National Water Policy” was initiated in 1999. The Government of Kenya issued the Water Act 2002 in order to realize this poly, and the water supply sector is being re-formed in accordance with the act.

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1-2 Outline of the Request

The request of Kenyan Government based on the basic design study of JICA for the Project for Groundwater Development in Rural Districts (Machakos, Kitui, Makueni and Mwingi), which was done by JICA from May to December in 2004, is listed as follows:

Table-1.1 Request of Kenyan Government Based on the Basic Design Study

Requested Issues	Contents	
1. Construction of Water Supply Facilities		
1.1 Construction of Boreholes	Machakos District	: 44 communities
	Kitui District	: 45 communities
	Mwingi District	: 35 communities
	Makueni District	: 31 communities
	Total	: 154 communities
1.2 Water Supply Facilities by Spring Water	Mwingi District	: 1communities
1.3 Type of Water Supply Facilities with Boreholes	Hand-pumps	: 56 communities
	Submergible pumps	: 88 communities
	Windmill pumps	: 10 communities
	Gravity system for spring water	: 1 communities
	Total	: 155 communities
2. Procurement of Equipment for Operation and Maintenance		
2.1 Vehicles	5 nos.	
2.2 Motor bikes	8 Nos.	
2.3 Electrical sounding equipment	1 sets	
2.4 Water quality test kits	4 sets	
2.5 O&M tools	4 sets of Mega Ohm Tester and 3 sets of Windmill Pump O&M tools	
3. Technical Guidance		
3.1 Type of Cooperation	Technical guidance for capacity building of communities for operation and maintenance	
4. Required Project Cost		
4.1 Project Cost	1.05billion Japanese Yen	

Chapter 2
Contents of the Project

CHAPTER 2
CONTENTS OF THE PROJECT

2-1 Basic Concept of the Project

The Implementation Review Study was commenced on December 2005, in order to update the project cost reflecting the price escalation after Basic Design Study, and prepare a revised implementation schedule of the Project, because of passing about 2 years since Basic Design Study.

Whilst, in order to cope with serious drought in 2005 in Kenya, the Kenyan Government has implemented construction of water supply facilities under assistance of other donors such as DANIDA, ADRA, CDF and other NGOs. This work included 26 communities for the implementation and 2 communities for planning. These communities were components of the Project.

It was agreed between Kenyan and Japanese sides that these 28 communities should be excluded from the target communities of the Project, and that the 3 communities also were excluded because successful boreholes in these communities were obtained by the test drilling of the Study and hand-pumps were provided.

The Project provides for construction of water supply facilities, procurement of operation and maintenance equipment, and execution of capacity building of trainers of MOWI for the target communities of 124 with the population of 150,700 in 2008. The latter represents a software component scheme in order to realize sustainability of the project and to strengthen operation and maintenance skills of communities:

Table-2.1 Type and No. of Water Supply Facilities to be Constructed by the Project

Districts	No. of Communities	Type of Pumps			Rehabilitation of Spring Water Supply Facilities
		Hand-pump	Submergible Pump	Windmill Pump	
Machakos	38	12	22	4	0
Kitui	27	9	16	0	0
Mwingi	34	18	15	0	1
Makueni	27	10	14	3	0
Total	124	49	67	7	1

Table-2.2 Quantities of Equipment to be Procured by the Project

O&M Equipment	Specification	Nos.
1. Vehicle	4WD Pick-up	5
2. Motor Bike	125cc, Off-road Type	8
3. Electric Sounding Equipment	Use for Vertical Sounding, 2-D Sounding	1
4. Water Test Equipment	Mobile Kit	4
5. O&M Tool	Mega Ohm Tester	4
	Windmill Pump O&M Tools	2

It is noted that the number of O&M tools for windmill pumps is reduced from 3 sets to 2 sets for Mwingi and Machakos Districts, because of exclusion of 3 communities in Kitui District, where windmill pumps were proposed to be constructed through the basic design study.

The Project Design Matrix is given as follow:

Table 2.3 Project Design Matrix

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption
Overall Goal Improve sanitation condition in Machakos, Kitui, Makueni and Mwingi Districts	a) Decrease water-bone disease in the target communities b) Operate water supply facility throughout a year by communities	a) Result of monitoring survey b) Data of Ministry of Health c) Statistical Data	Basic policy and organization framework will not be changed.
Project Purpose Increase served population with safe and stable drinking water supply	a) Served population of 203,200 increase b) Collection of water tariff and O&M cost is commenced.	a) Monitoring on O&M after implementation of the project b) Data of DWOs c) Operation records of WUA for water supply facilities d) Financial records of WUA	O&M system is not changed largely
Outputs a) Provide water supply facilities b) Organize Water Users Association for sustainable water supply c) Procure O&M Equipment	a) New water supply facilities are provided. b) Member of WUA has learnt skills required for O&M before commencement of operation of the facilities.	a) As-built Drawing b) Monitoring records of O&M	a) Supporting system for communities in O&M is not changed. b) WUA system is not changed in O&M.

Activities Japanese Side Construction of Facilities Water Supply Facilities Borehole, Hand Pump, Public Water Tap Facilities with Windmill/Submersible Pumps, Rehabilitation and Improvement of Existing Facilities with Spring Water Source Procurement of O&M Vehicles, Motor Bikes, Electrical Sounding Equipment, Portable Water Quality Equipment, O&M tool for Submersible and Windmill Pumps Kenyan Side Construction of Facilities Construction of Transmission and Distribution Pipeline, Fence surrounding Important Facilities Supporting for Communities in O&M a) Explanation of the Project and Sensitization for Communities b) Organization of Water Users Association (WUA) c) Training for WUA d) Monitoring of the Project	Input Japanese Side Experts for Construction Supervision and Guidance Japanese: Operation and Maintenance/sanitation Education (3.0M/M) Facilities Water supply facilities with hand pump (49communities), and with windmill and submersible pumps (74communities)、rehabilitation of existing water supply facilities (1 community) Procurement of O&M Equipment a) 4WD Pick-up (5 nos.) b) Motor bike (8 nos.) c) Electrical sounding Equipment (1no.) d) Water quality analysis equipment (4 sets) e) O&M equipment tools Submersible pump (4 sets) Windmill pump (2 sets)	Kenyan Side Staff of MoWI and DWO a) Project Manager (1 person) b) Project Coordinator (2 persons) c) Supervisor (8 persons) d) Experts for Soft-Component Scheme (16 persons) Construction of Facilities and Sensitization a)Construction of Transmission and Distribution Pipeline, Fence surrounding Important Facilities b) Support to communities in O&M	Trained staff of DWOs is not shifted to other organization within a short time. Pre-condition a) Economic condition is not changed largely. b) Groundwater source is not dried up.

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

The assistance requested by the Kenyan Government included construction of 155 boreholes and associated water supply facilities consisting of 56 hand pumps, 88 submergible pumps, 10 windmill pumps and rehabilitation of spring water supply facility at 155 communities in total, procurement of operation and maintenance equipment, and technical guidance for capacity building of communities in operation and maintenance of water supply facilities, based on the basic design study.

This Implementation Review Study reviewed the result of the basic design study through investigation on the current water supply condition in the target communities, and updated it based on data and information concerned, in order to smoothly implement the Project.

This Implementation Review Study was undertaken the principles outlined below:

(1) Basic Principles

1-1) Selection of Target Communities Proposed by the Basic Design Study among the Requested 200 Communities

The four districts of Machakos, Kitui, Makueni and Mwingi have suffered from extreme poverty. Many donor countries and international organizations, including the Japanese Government, have therefore worked to improve existing conditions. To improve this situation, the Ministry of Water and Irrigation (MoWI) has also made efforts to support communities in these districts in terms of rural water supply. Taking this into account, it is essential that projects of other donors and organizations are not duplicated.

There are many existing boreholes installed for the purpose of water supply. Of these, some are not operating due to a lack of capacity of communities in terms of operation and maintenance skills or inability to meet costs of operation and maintenance. In order to establish a sustainable project, the capacity of communities with regard to O&M has been evaluated from the viewpoint of cost affordability when selecting target communities for the Project.

The major groundwater source in the study area is expected to be fissure water, as a widespread aquifer is not present in this area. In order to develop fissure water, it is necessary to carefully evaluate groundwater potential in the respective communities. When borehole sites with no groundwater potential, or less than the minimum required to meet water demands, are identified during evaluation, these communities are in principle excluded from the target communities.

The groundwater source in the Project areas also indicates high level of fluoride

(F), total dissolved solid (TDS), iron (Fe) and manganese (Mn). Based on minimum water quality requirements, those communities in areas with unacceptably high level of F or TDS for drinking water have subsequently been ranked as being infeasible (in terms of water quality).

The following conditions was planned to be confirmed to assist in finally selecting the target communities at the detailed design stage, and for use in defining water supply facilities of the target communities of the Project under Grant Aid from the Japanese Government. It was confirmed by the Study for Kitui and Mwingi Districts, and will be done for Machakos and Makueni Districts in the detailed design.

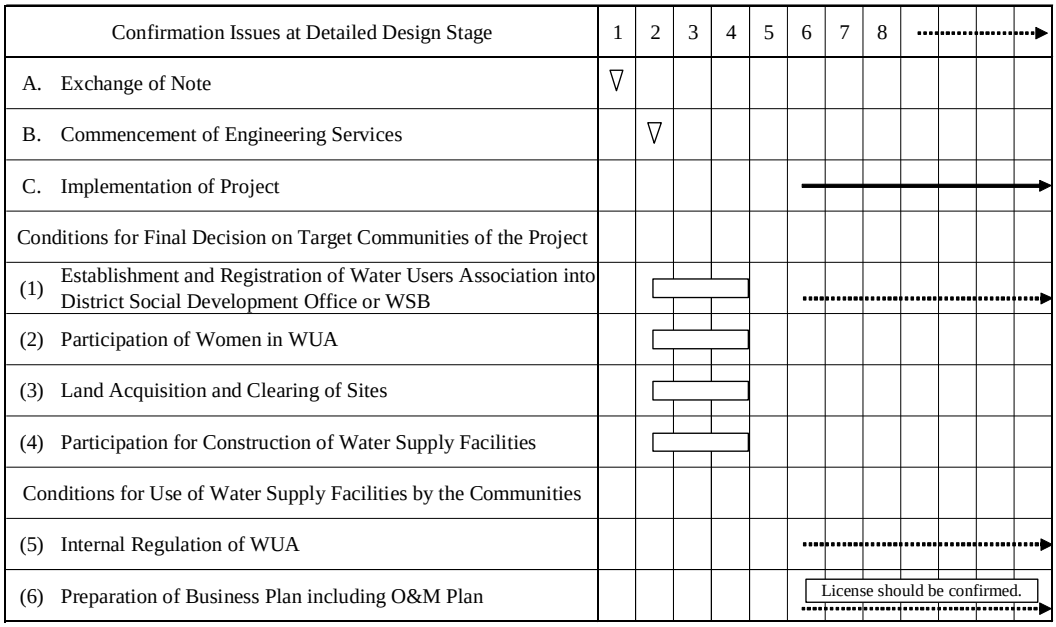


Figure 2.1 Issues to be Confirmed at Detailed Design Stage

1-2) Confirmation of Water Supply Situation in the Target Communities

After completion of the Basic Design Study, Kenyan Pipeline Corporation and NGOs have provided with the water supply facilities for several target communities of the Project and the water supply situation in these communities are considered to be improved.

Therefore, the necessity of provision of water supply facilities should be confirmed by this Study, collecting information from DWOs and investigating actual condition for the target communities. Based on this survey, the final target communities should be recommended.

1-3) Planning Principles for Groundwater Development Plan

(a) Number of Boreholes to be drilled in Communities and Failed Boreholes

A borehole is principally drilled in a community, since it is afraid that measure for trouble is neglect in case of provision of plural boreholes in a community. When this borehole fails, no further drilling is undertaken at this community as

the original location is considered as having the best potential, identified through one and two dimensional electrical sounding and test drilling, for future development in this area. Should this occur, an alternative community will be selected from the community list submitted at the Basic Design Study Team by the Government of Kenya.

It is proposed that a failed borehole in a community will be backfilled by the Project, under the acceptance of the Government of Kenya. However, when residents of the community desire to use the borehole for water supply by constructing water supply facilities themselves, the failed borehole is to be capped without backfilling and transferred to the Kenyan Government.

(b) Selection Criteria of Type of Water Supply Facility in Respective Target Communities

Unit water consumption in the target communities is based on the criteria of design manual which is prepared and applied for the existing water supply facilities by MOWI. Water supply plan is prepared by using these criteria describing the unit water consumption of 15 l/day/capita in ASAL area with an annual rainfall of 500m to 1000mm.

The study area locates at vicinity of the capital of Kenya, Nairobi. Since an average population per target community, therefore, is 1300 persons over the population of 500 applicable for hand pump facility, water supply facility with motorized pump is included in planning.

The requested windmill pump has popularized in Kenya after 1990's because of cheaper operation and maintenance cost. Therefore, windmill and submersible pumps are proposed as alternatives of motorized pumps in the basic design study.

This Study executes the detailed design based on the number of population in the target communities obtained through the social survey by the basic design study. During the implementation of the Project, type of water supply facilities and detailed design will be reviewed and finalized by applying the actual yield of borehole in a target community, based on the capability of community for operation and maintenance.

Measures for excessive use of facilities will be examined and executed under sanitation education program for residents of communities in the software program of the Project, when actual water yield is significantly less than water demand. Possible measures such as "Control of Water Consumption", "Restriction of Water Use by Water Kiosk Keeper", and so on will be discussed with the residents and applied to communities.

1-4) Spring Water Supply Facility

Twelve communities, which were requested during the basic design study, use spring water for domestic water supply. Of these, only the Mora spring of

Kathanze community in Mwingi district is available throughout the year and is also sufficient to meet water demands. However, raw spring water needs treatment as it contains bacteria and colon bacillus.

Taking into account the population of 4,400 in this community, borehole development with a submersible pump water supply facility might be appropriate. However, rehabilitation of the existing facility is recommended from the viewpoint of lower operation and maintenance costs.

(2) Natural Conditions (Criteria for Successful Borehole)

There is no definition for successful boreholes in Kenya. Therefore, the following criteria based on the guideline for basic design of groundwater development under grant aid in 1996, coupled with minimum engineering requirements of equipment to be used for the Project, are established for this purpose:

Water yield : 330 l/hour for hand pump and above,
600 l/hour for windmill pump and above, and
1,000 l/hour for motorized pump and above.

Based on these criteria and results of a hydro-geological assessment by the Study Team, the groundwater potential at the respective communities will be evaluated.

The groundwater source in the Project areas also indicates high level of fluoride (F), total dissolved solid (TDS), iron (Fe) and manganese (Mn). The following principles therefore are applied for the basic design study:

- Boreholes with F and As exceeding guideline values are defined as having failed and are backfilled under acceptance of Kenyan Government.
- The permissible TDS level is proposed as 2000 mg/l.
- A borehole with levels of Fe and Mn higher than permissible ones will be equipped with a sand filter for removal of these components by the Japanese side.
- A borehole with levels of other chemical components above permissible ones, which are not able to be removed by equipment cheaply and which also have other associated O&M costs, will be backfilled by the Project under acceptance of Kenyan Government.

The field survey during the basic design study executed test drilling at three communities in three districts of Machakos, Makueni and Mwingi. Out of these sites, a borehole in Mwingi district satisfies the aforesaid criteria and is defined as successful borehole. Therefore, it is planned to construct the water supply facilities for this community. Other two boreholes meet criteria on water yield or water quality and are classified into the failed boreholes.

The implementation review study also carried out test drilling at 2 sites in Kitui District and 2 sites in Mwingi District, where the target communities for the first phase are involved, in order to confirm hydro-geological condition in the Study area. Two boreholes in Kitui District and one in Mwingi District are successful in terms of water quality and quantity, but the other one in Mwingi District is dry.

(3) Social Conditions

Water supply facilities to be constructed will be operated and maintained by the WUA of the target communities. The four districts are classified into extremely poverty areas in Kenya, and therefore, it is essential to support communities in training of WUA for operation and maintenance and to create their ownership for the facilities, in order to realize sustainable Project.

In order to perform these issues, construction of fence and transmission and distribution pipelines needs to be undertaken by the target communities. It is noted that Japanese Government provides pipe material for the pipeline construction and Kenyan Government is responsible for supervision of work by trained district WSB staff.

(4) Construction Method and Period

The Project recommended by the basic design study was proposed to be executed by dividing three phases for the purpose of provision of optimum water supply facilities meeting actual water yield and hydraulic head, in order not to minimize design revision and amendment of contract for contractor. The first and second phases mainly deal drilling of boreholes with submergible and windmill pumps to confirm actual water yield and hydraulic head. Based on these conditions, detailed design finalizes the design of water supply facilities in the second and third phases.

Among the 155 target communities proposed by the basic design study, 31 communities are excluded because of provision of water supply facilities by other donors and/or NGOs, and, therefore, work volume was decreased. In addition, it is expected to start the construction works within the fiscal year of 2006, if the Project is accepted by the Japanese Government. Taking into account these issues, two phase implementation is proposed; namely, the first phase includes construction of water supply facilities in Kitui and Mwingi Districts, where the water supply condition is more serious than other districts; the second phase in Machakos and Mwingi Districts.

In order to cope with the failed borehole and re-design of water supply facilities with piped water supply, and with submergible and windmill pumps, drilling works will be commenced from the initial stage of each phase and the yield and water quality will be confirmed for earlier decision of borehole, prior to the borehole for hand-pump type water supply.

(5) Procurement of Construction Material

MOWI has prepared the Design Manual that has guided the design procedure and methods for water supply facilities since 1982. This Study in general uses this manual. Type and specification of facilities and equipment such as pumps, generators and so on to be applied in the Project are prepared from the viewpoints of ease of operation and maintenance and lower costs, including procurement of spare parts locally available in the Kenyan market.

Construction material and equipment for the Project available in Kenya will be procured and used for construction of water supply facilities. These include hand pumps, windmill pumps, casing pipes for boreholes, uPVC pipe and galvanized steel pipe for transmission and distribution pipelines, structural steel material, reinforcement bars, cement, timber, fuel, and painting materials.

Submersible pumps and diesel generators are not, however, manufactured in Kenya. This equipment will therefore need to be imported. It is also planned that imported pumps and generators from other countries will be used for construction of water supply facilities. Procurement of contractors in Kenya is basically assumed for construction works.

(6) Procurement of Operation and Maintenance Equipment

The Kenyan Government is in the process of reforming the water supply and sewerage sector. This is scheduled for completion in December 2007. Under the reforming, DWOs has been being transferred to Water Service Board (WSB) in the organization. But the function of this DWO will not be changed even after the completion of re-form of water sector. Therefore, the procured equipment will be used by the DWO.

From the above, the Study reviews the necessity and requirement of the operation and maintenance equipment to define the number and specification of equipment.

(7) Operation and Maintenance

There are several issues pertaining to inadequate operation and maintenance in the Project area including: 1) a less mature sense of ownership and willingness to participate in operation and maintenance based on the user-pay-principles, 2) lack of knowledge and skills for community-based operation and maintenance, 3) lack of awareness in health and sanitation, and poorer understanding of the correlation between personal health and use of safe water, and 4) inadequate support to the communities by the local administration for establishment of community-based operation and maintenance systems.

In undertaking countermeasures for these problems and issues, the software component program aims “to establish the basis for a community-based operation and maintenance system”.

2-2-2 Basic Plan (Construction Plan/Equipment Plan)

2-2-2-1 Selection of Target Communities

The flow diagram for selection of target communities for the Project follows:

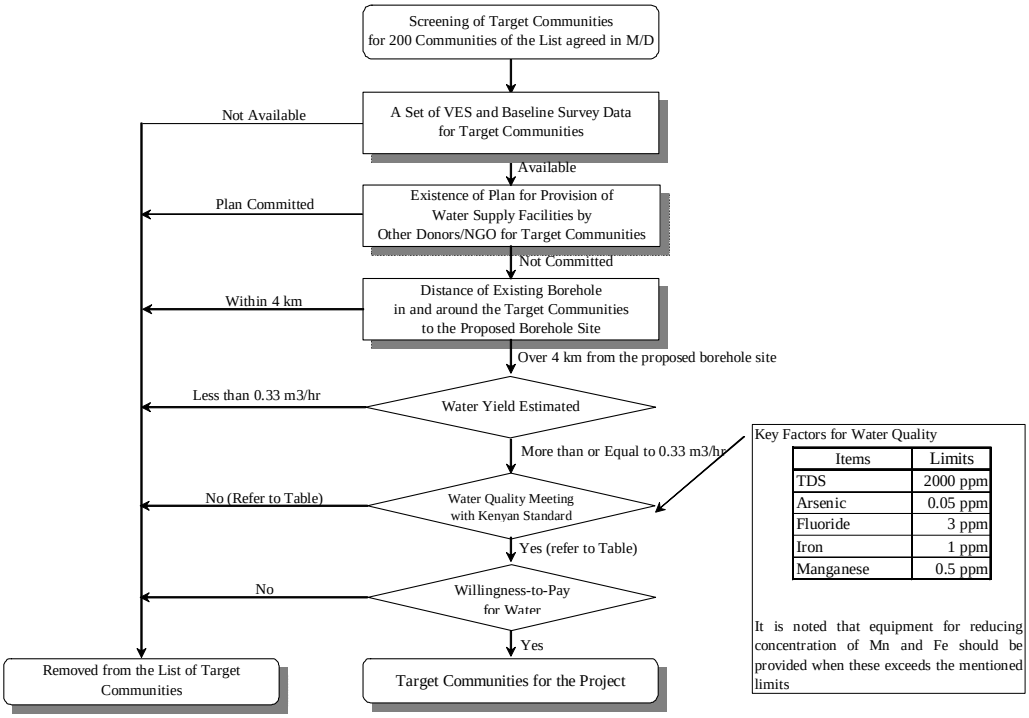


Figure 2.2 Flow Diagram for Selection of Target Communities

The requested 200 communities were screened by the basic design study, based on issues in this flow diagram, including availability of data on vertical electrical sounding and social conditions, 2) duplication of water supply plan with other donors, 3) water supply conditions of existing boreholes, 4) estimated water yield, 5) water quality, and 6) willingness to pay for water.

It is noted that issues related to availability of data for vertical electrical sounding and socio-economic surveys were included on condition that these surveys were undertaken by Kenyan authorities. Although the actual water yield is unknown at this stage, it is assumed boreholes with estimated water yields less than 0.33 m3/hr will be discarded.

The selection results of the target communities by the basic design study are outlined as follows:

Table 2.4 Number of Target Communities Selected for the Project

Issues	Machakos	Kitui	Mwingi	Makueni
	Request：54	Request：53	Request：41/1	Request：51
Availability of Basic Data	54（0）	52（1）	41（0）	50（1）
Duplication with Other Donors	53（1）	52（0）	41（0）	50（0）
Existing Water Supply Facilities	51（2）	52（0）	40（1）	49（1）
Estimated Water Yield	45（6）	46（6）	40（0）	31（18）
Water Quality	44（1）	45（1）	34（6）	31（0）
Willingness to Pay	44（0）	45（0）	34（0）	31（0）
Proposed Communities	44（10）	45（8）	34（7）	31（20）

Note: Values are shown as selected communities for each issue. /1：Excluding spring water supply

As given in the Table, 154 communities were selected as target communities for the Project and basic design was undertaken for each. There are no communities discarded from willingness to pay for water.

2-2-2-2 Confirmation of the Target Communities

Information on water supply conditions in 155 target communities has been collected through the DWO and investigation of the Team was done in order to supplement this information. Among the 155 communities proposed by the basic design study, the 26 communities already have water supply system in their area by developing boreholes or piped supply from treatment plant at Masinga Dam and the 2 communities have a plan for similar project. Therefore, these communities have been excluded from the Project.

This Study has executed test drilling at 2 communities in Kitui District and 2 communities in Mwingi District. Two in Kitui District and one in Mwingi District is successful in terms of water quality and quantity, and these communities were agreed to be excluded during the survey.

Based on the result of these survey and investigation, the following communities are the target ones for the Project:

Table 2.5 Target Communities for the Project

Districts	No. of Communities	Type of Pumps			Spring Water Supply Facilities
		Hand-pump	Submergible Pump	Windmill Pump	
Machakos	38	12	22	4	0
Kitui	25	9	16	0	0
Mwingi	35	18	15	0	1
Makueni	27	10	14	3	0
Total	124	49	67	7	1

2-2-2-3 Groundwater Development Plan

(1) Groundwater Potential

Based on the result of vertical electrical sounding (VES) and specific resistance values, the groundwater development potential has been classified into four categories:

Table 2.6 Category of Groundwater Potential

Categories	Description	Developing or Not
Good	Aquifer is clearly identified.	Developing
Fair	Aquifer is identified.	Developing
Poor	Aquifer is possible to be identified, including slightly blackish water.	Developing
Very Poor	Aquifer is not identified at all, including salty water	Not

It is noted that some boreholes categorized as “very poor” were re-evaluated and categorized into other definitions based on the results of two-dimensional vertical sounding.

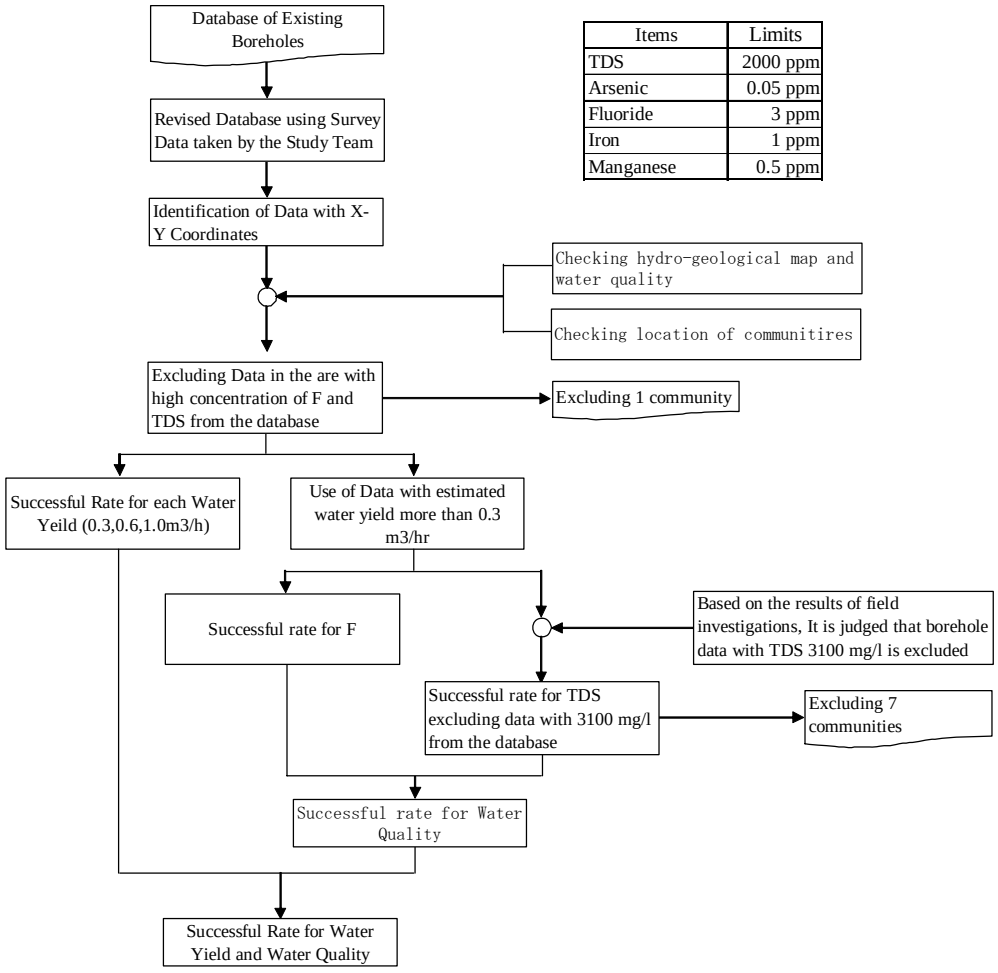
Table 2.7 Results of Groundwater Potential Analysis

	Kitui	Mwingi	Machakos	Makueni
Good, Fair, Poor	46	42	46	28
Very Poor	6	0	8	22
VES (1) is not available	1	0	0	1
Total	53	42	54	51

Note: VES Vertical electrical sounding

(2) Success Rate of Groundwater Development

Success rates were assessed by applying the following flow diagram and were based on a database of the existing wells and boreholes.



Items	Limits
TDS	2000 ppm
Arsenic	0.05 ppm
Fluoride	3 ppm
Iron	1 ppm
Manganese	0.5 ppm

Figure 2.3 Flow Diagram of Success Rate Estimation

Existing boreholes excluded from the analysis were located in Neocene sedimentary rock in the western part of Machakos district and Neocene volcanics in Makueni district, where the groundwater contains high fluoride. Also, the borehole data in the north-western part of Mwingi district were excluded because of high TDS contamination (refer to Attachment-4).

The estimated success rates are given as follows:

Table 2.8 Success Rate of Boreholes

Water Yield	Comprehensive Success Rates (%)			
	Machakos	Kitui	Mwingi	Makueni
0.3 m^3/hr and above	95.4	77.5	75.1	73.4
0.6 m^3/hr and above	92.3	71.4	69.1	69.8
1.0 m^3/hr and above	86.3	68.9	61.6	66.1

(3) Water Quality

Groundwater in the study area indicates groundwater in the four districts is expected to contain high levels of F, TDS, Fe and Mn. In this study, these

parameters and also arsenic (Ar) were selected as key items.

The standard values for these five items were as defined in the design manual of MOWI and actual water use conditions in the districts, as outlined below:

Table 2.9 Proposed Parameters and Standard Values of Water Quality

Parameters		Proposed Standard Value (mg/l)
Arsenic	(Ar)	0.05
Fluoride	(F)	3
Total Dissolved Solids	(TDS)	2000
Iron	(Fe)	1
Manganese	(Mn)	0.5

3-1) Fluoride and Arsenic

The permissible level for F of 3 mg/l in the design manual was applied as the proposed standard value in the Project. For Ar, a standard value of 0.05 mg/l was adopted, taking into account its toxicity.

3-2) Total Dissolved Solids（TDS)

There are many existing boreholes with concentrations exceeding 1500 mg/l, the defined permissible level in the design manual. It is expected that the number of failed boreholes would increase when this value is applied.

During the field survey, it was identified that residents often use groundwater with TDS of 2200 mg/l to 2600 mg/l for drinking. Kenyan authorities therefore desired a modification to the standard value to define a successful borehole and it was proposed 2000 mg/l be adopted for the Project.

3-3) Iron and Manganese

Iron and manganese are easily removed by using a sand filter facility. When this does not function well, continuous operation and maintenance is necessary as taste of water deteriorates. Consequently, it is planned that sand filters be installed at borehole sites with high concentrations of Fe or Mn.

(4) Borehole Depth and Number of Boreholes

The number of planned boreholes and those required based on the likely success rates are given as follows:

Table 2.10 No. of Proposed Boreholes : Water Yield of 0.3m^3/hr and above (Hand pump)

District	Average Borehole Depth (m)	Range of Borehole Depth (m)	No. of Planned Boreholes	Success Rate	Total No. of Boreholes
Machakos	99.6	47-136	12	95.4	13
Kitui	101.2	45-168	9	77.5	12
Mwingi	105.0	40-173	18	75.1	24
Makueni	117.2	75-150	10	73.4	14
Total	-	-	49	-	63

Table2.11 No. of Proposed Boreholes : Water Yield of 0.6m^3/hr and above (Windmill pump)

District	Average Borehole Depth (m)	Range of Borehole Depth (m)	No. of Planned Boreholes	Success Rate	Total No. of Boreholes
Machakos	124.6	93-151	4	92.3	5
Kitui	-	-	0	71.4	0
Mwingi	-	-	0	69.1	0
Makueni	156.3	132-166	3	69.6	5
Total	-	-	7	-	10

Table 2.12 No. of Proposed Boreholes : Water Yield of 1.0m^3/hr and above (Submersible pump)

District	Average Borehole Depth (m)	Range of Borehole Depth (m)	No. of Planned Boreholes	Success Rate	Total No. of Boreholes
Machakos	106.6	49-141	22	86.3	26
Kitui	115.5	35-182	16	68.9	24
Mwingi	112.2	51-188	15	61.6	25
Makueni	127.9	79-172	14	66.1	22
Total	-	-	67	-	97

Borehole depth in these tables is estimated by adding 10% of the depth based on the results of analysis of vertical sounding data and rounded up to the next 5 m.

It is noted that the drilled boreholes during the basic design study and this Study are not included.

(5) Design of Boreholes

5-1) Borehole Design

The geology in the study area mainly consists of volcanic rocks represented by Precambrian gneisses and volcanic rocks. Of 154 communities, 139 are located in Precambrian gneissic rocks where the geology can be considered as similar. Therefore, a standard borehole structural design has been prepared and is attached to this report.

5-2) Diameter of Casings and Screens

Casing with DN 150 mm (6 inches) has been adopted to the base of the boreholes in order to ensure their long-term stability. No engineering problems should be raised, since this diameter is generally used in Kenya (for around 54%

of existing boreholes).

5-3) Drilling Diameter

Drilling diameter with sufficient clearance for casing work is designed at 220 mm, assuming the above casing diameter.

The adopted material for casing screen pipe is uPVC. This has been used previously in Kenya and its long-term stability has been proven in the existing boreholes. This material also has an advantage in terms of rust prevention in saline groundwater.

The screen is designed to be a slot-type, common in Kenya. Aquifers in the study area exist in the weathered rock layers, cracks of massive rock, or sedimentary deposits where layers are thin and grain size of soil material is rather fine. Therefore, it is planned to adopt a continuous slit screen with wider openings in order to reduce flow velocity and hydraulic loss. This will also prevent large draw-downs in groundwater levels.

5-4) Electrical Logging

After drilling of boreholes, electrical logging is designed to identify the aquifer depth for provision of screen pipe at appropriate locations. This is expected to increase the success rate of the boreholes.

5-5) Gravel Packing, Slime Packing and Cementing

Gravel packing is provided for gaps between the casing and inside of the drilled hole from the bottom to 10 m above static water level. The section to within 10 m of the ground surface will be packed with slime produced by the drilling, and the upper part to the ground surface will be filled by cement mortal. This cementing aims to prevent intrusion of rainwater and wastewater near the borehole. A bottom plug and temporary top cover will be provided.

5-6) Pumping Test

A pumping test will be undertaken after completion of borehole construction in order to identify the water yield:

- Trial test : by identification of clean water, maximum 12 hours
- Step draw down test : more than 3 steps, more than 2 hours for each step
- Constant discharge test : more than 24 hours
- Recovery test : more than 8 hours

5-7) Water Quality Analysis

Water sampling will be done during the pumping test and water quality analysis undertaken by public laboratories in Kenya. Parameters to be defined include: 1) pH, 2) TDS, 3) turbidity, 4) color, 5) total hardness, 6) chloride, 7) copper, 8)

iron, 9) manganese, 10) sodium, 11) sulfate, 12) zinc, 13) water temperature, 14) arsenic, 15) lead, 16) fluoride, 17) nitrate, and 18) nitrous acid.

2-2-2-4 Water Supply Facilities Plan with Groundwater and Spring Water Source

(1) Target Year

The current national development plan and district development plan have a target year of 2008. This Project also adopts the same target year.

(2) Unit Water Consumption Rate

Unit water consumption for public taps in rural areas in the Design Manual has been applied for the basic design of water supply facilities.

2-1) Unit Water Consumption Rate for Domestic Use

The following rates for public taps in rural areas are described in the Design Manual, on the basis of potential of land and mean annual rainfall.

Table 2.13 Unit Water Consumption for Public Taps in Rural Areas

Potential of Land	Unit Rate	Mean Annual Rainfall
High	20 l/capita/day	more than 1,000mm
Middle	15 l/capita/day	500mm to 1,000mm
Low	10 l/capita/day	less than 500mm

The mean annual rainfall of the four districts is ranging from 500 mm to 1000 mm. Therefore, a value of 15 l/capita/day is applied for the basic design.

2-2) Water Consumption in Schools and Medical Centers

According to the Design Manual, water consumption in boarding schools is defined as 50 l/capita/day. This includes water flushing toilets using 20 l/capita/day. However, there are no schools with flushing toilets in the four districts and a unit rate of 30 l/capita/day has been applied.

Table 2.14 Unit Rates for Boarding Schools and Other Public Facilities

Categories	Unit Rates (lit/capita/day)
Boarding School	30
Public School	5
Medical Centre	5,000
Public Facility	25

(3) Livestock Water Demand

Water demand for livestock was not included for the basic design of the Project. However, a standard design will be undertaken and provided to Kenyan authorities. When sufficient water yield for livestock is identified after borehole construction, communities can plan the construction of livestock troughs based

on this standard design.

(4) Design Water Demand

Design water demand is estimated by multiplying the population and unit water consumptions.

Operation hours of hand pump and submersible pump facilities are defined as 8 hours. In the case of windmill pumps, operation hours are dependant on actual wind velocity and are therefore not specified in the design. However, the average effective operation time was estimated at 12.3 hours based on the wind measurement survey undertaken during the field survey period of the study.

(5) Population to be Served by the Proposed Water Supply Facilities

Water supply capacity is dependant on the actual water yield as is the actual population to be supplied by the facilities to be constructed during the Project since a borehole is provided for a community by the Project. Therefore, at present, the population surveyed is tentatively applied and these shall be reviewed in the detailed design stage based on the actual water yield, as follows:

Table 2.15 Population in the Target Communities

Districts	Population in Target Communities				
	Hand Pump	Windmill Pump	Submersible Pump	Spring Water	Total
No. Communities	49	7	67	1	127
Machakos	9.3	2.9	32.5	-	44.7
Kitui	4.4	-	36.4	-	40.8
Mwingi	9.3	-	22.3	4.5	36.1
Makueni	3.8	2.5	22.8	-	29.1
Total	26.8	5.4	114.0	4.5	150.7

(6) Distance to Hand Pump and Public Water Tap

Public taps or water kiosk types were generally applied for design purposes. The maximum distance from residents to a water supply point was 1 km for water kiosks and 2 km for public taps. This took into account the limited water sources in the ASAL area including the four districts, recommendations in the design manual, and so on.

(7) Selection of Type of Water Supply Facilities

The type of water supply facilities was selected by applying the following work flow diagram:

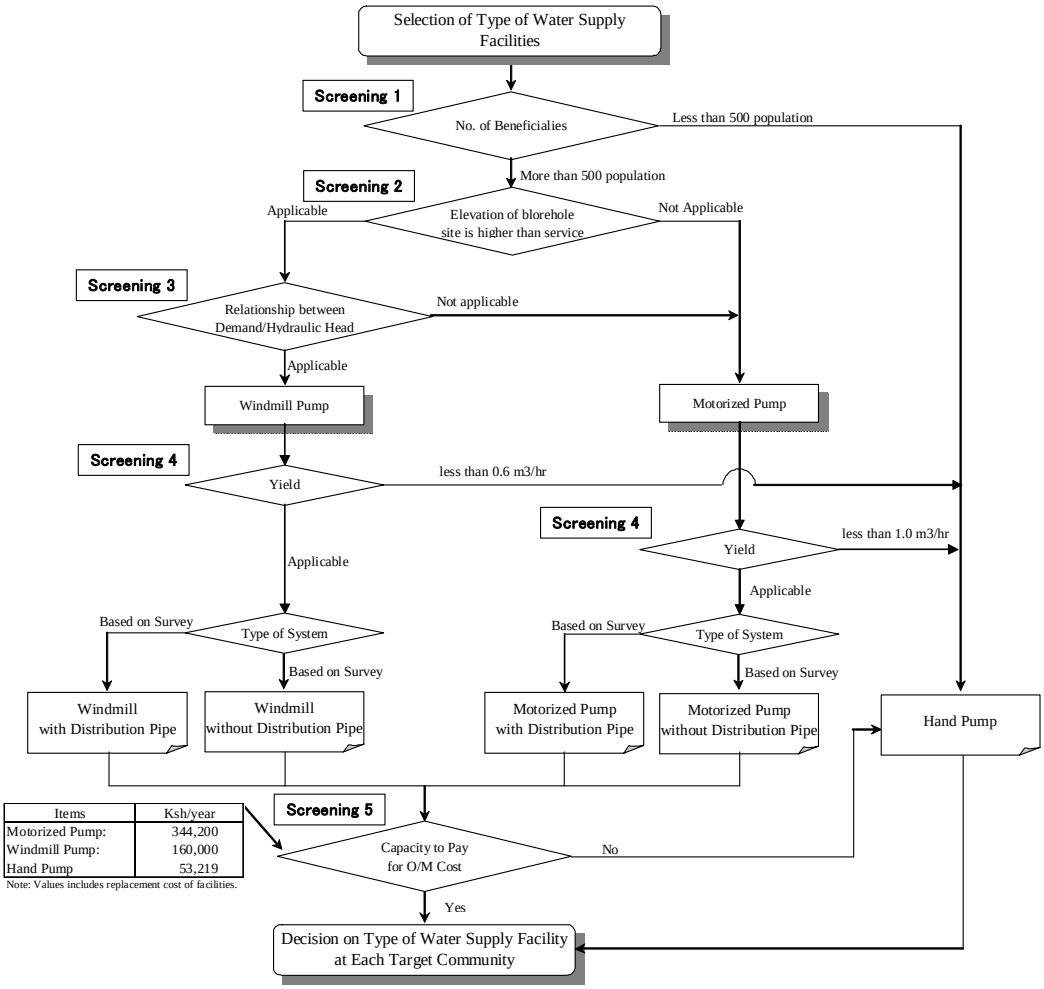


Figure 2.4 Flow Diagram for Selection of Type of Water Supply Facilities

Three types of water supply facilities, namely hand pumps, windmill pumps and submersible pumps, were adopted for the basic design study.

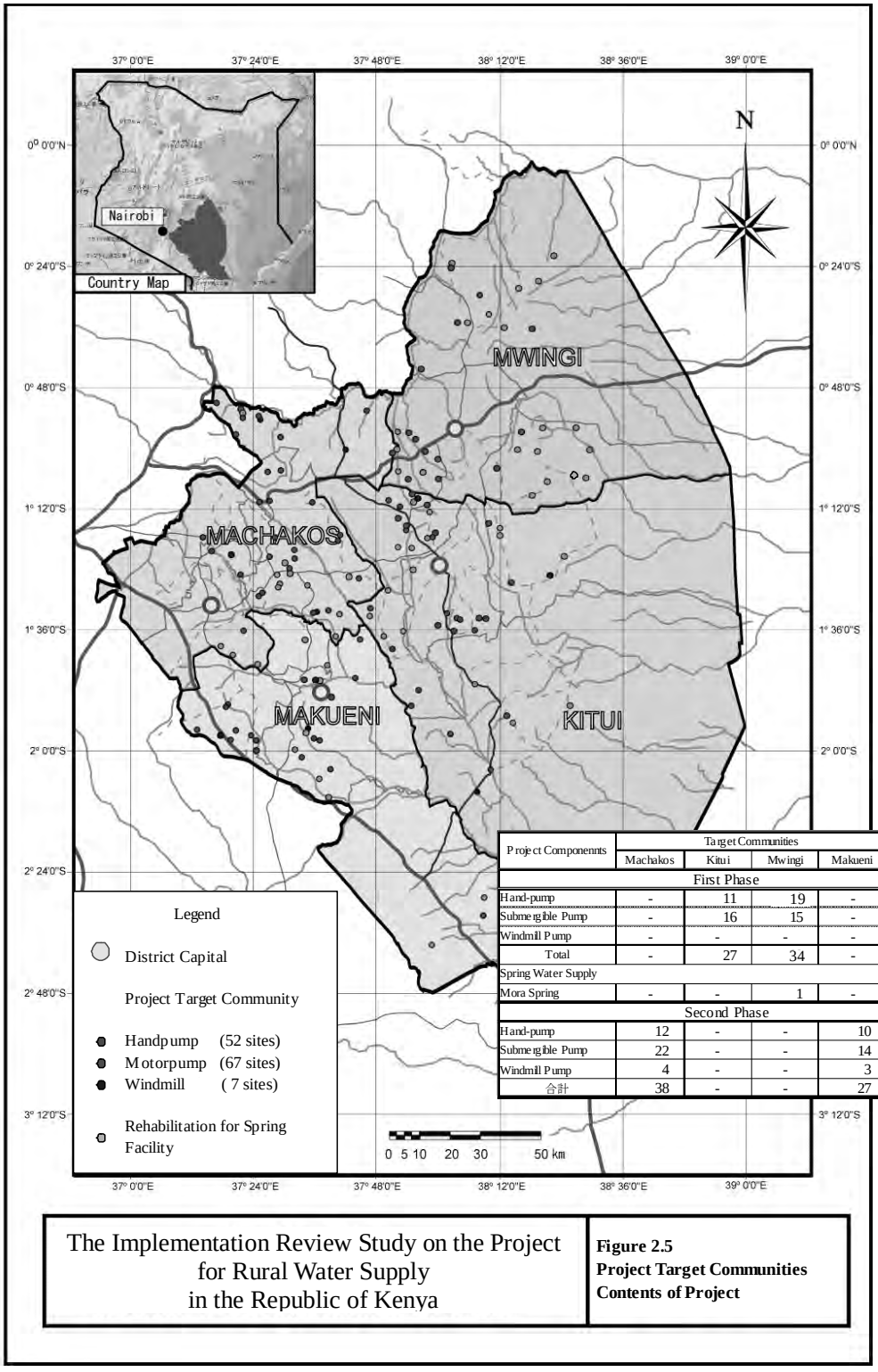
Hand pump water supply facility was applied for communities with a population of less than 500, taking into account the recommendation of the Design Manual and capacity-covering operation cost of other types.

Communities with a population of more than 500 were assessed based on both windmill and submersible pumps and the natural conditions and geography, population distribution in community area, and capacity for operation and maintenance as given in the flow diagram. In particular, elevations of the proposed borehole sites and service areas were compared using available survey data. Where the elevation of the borehole site was lower than the served area and there were many sheltering facilities around the borehole site, a windmill

pump was not appropriate.

A windmill pump was designed on the basis of wind velocity measurements and hydraulic head. When the geographic and borehole conditions at a community were not suitable for a windmill pump, a submersible pump type was assumed for the site.

The capacity of the community to cover operation and maintenance costs was evaluated by comparing affordability to pay for water with required O&M cost. Affordability of community was estimated based on the socio-economic survey and population and unit water cost in each community. As a result, the affordability of communities was adopted as Ksh 1.8 per 20 l in Machakos and Makueni districts, and Ksh 1.2 per 20 l in Kitui and Mwingi districts. It is noted that hand pumps are planned to be installed at communities with insufficient capacity to cover the O&M cost. The selected communities of 127 and their type of water supply facilities are shown in the following figure:



Project Componennts	Target Communities				Total
	Machakos	Kitui	Mwingi	Makueni	
First Phase					
Hand-pump	-	11	19	-	30
Submergible Pump	-	16	15	-	31
Windmill Pump	-	-	-	-	-
Total	-	27	34	-	61
Spring Water Supply					
Mora Spring	-	-	1	-	1
Second Phase					
Hand-pump	12	-	-	10	22
Submergible Pump	22	-	-	14	36
Windmill Pump	4	-	-	3	7
合計	38	-	-	27	65

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Figure 2.5
Project Target Communities
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Figure 2.5 Target Communities and Type of Water Supply Facilities

Components of water supply facilities with windmill or submersible pumps are designed to have the borehole, storage tank or elevated storage tank, public tap or water kiosk, transmission main, distribution pipeline, as well as pump facilities, based on the facility survey for the target communities and investigation of this Study. The major types of water supply facilities are outlined as follows:

Table 2.16 Type and No. of Water Supply Facilities with Windmill or Submersible Pump

Districts	Type A Borehole Storage Tank Public Water Tap	Type B Borehole Transmission Main Storage Tank Water Kiosk	Type C Borehole Storage Tank Distribution Pipeline Water Kiosk	Type D Borehole Transmission Main Storage Tank Distribution Pipeline Water Kiosk	Type E Borehole Transmission Main Storage Tanks at more than 2 sites Distribution Pipeline Water Kiosk	Other Type Type is not categorized into Type A to E due to topography and location of population center
Machakos	9/3	4/0	0/1	8/0	1/0	-
Kitui	2/0	6/0	0/0	0/0	0/0	8/0
Mwingi	4/0	3/0	0/0	4/0	0/0	4/0
Makueni	9/1	1/1	0/1	3/0	1/0	-
Total	24/4	14/1	0/2	15/0	2/0	12/0

Note: "24/4" : No. of submersible pumps/No. of windmill pumps

(8) Basic Design of Water Supply Facilities

8-1) Hand Pump

The served population is less than 500 people and the following conditions are applied for the basic design:

- Water consumption : 15 l/capita/day
- Operation time : 8 hours per day

In order to design hand pump facilities, it is necessary to consider hydraulic head and water yield. The water abstracted by one stroke is the same under different hydraulic heads, but the higher the hydraulic head the greater the power required for a stroke. Therefore, for larger hydraulic heads the water amount taken during a certain time reduces because of the reduced number of strokes.

A hand pump was designed to have a maximum hydraulic head equivalent to abstracting 330 l/hour, which is the minimum water requirement.

Afridev-type hand pumps have been designed based on theoretical curves showing the relationship between hydraulic head and water to be pumped. These were based on site tests. This was also confirmed in the groundwater development project in Kenya executed by the Japanese Grant Aid Scheme. In that project, it was furthermore identified that taking water by hand pump becomes difficult for ladies or children when the hydraulic head exceeds 45 m.

Taking into account the above and draw-down water levels of 10%, the design static level was adopted as 40 m. Specification of hand pump facilities are given below:

Table 2.17 No. of Hand Pumps and Specifications

No. of Pumps			Specification		
Target Communities	:	49	Minimum water yield	:	330 l/hr
No. of Pumps to be installed	:	49	Maximum hydraulic head	:	45 m
			Diameter of Casing pipe	:	150 mm
			Internal diameter of cylinder	:	50 mm
			Water amount taken by one stroke	:	0.44 litters

8-2) Submersible Pump

Submersible pumps available in Kenya are designed to have a minimum water intake of 1.0 m3/hr under continuous operation and this 1.0 m3/hr is applied for the minimum water yield. Generator is designed in this basic design stage, but during the detailed design stage, it is necessary to survey availability of commercial power source and to confirm cheaper price of power and acceptance of community for use of this power. If commercial power source satisfies these conditions, commercial power is used for submersible pump.

Capacity of submersible pumps was designed by assuming water demand of communities and hydraulic head based on results of vertical sounding and facility surveys, as outlined as follows:

Table 2.18 No. of Submersible Pumps and Specifications

Discharge Rate	Hydraulic Head (m)	No. of Pumps	Power (kW)	Diameter of Discharge Pipe (mm)
1.7 m^3hour	100	1	1.1	32
	75	13	0.75	32
	50	3	0.37	32
2.5 m^3/ hour	170	1	2.2	32
	120	2	1.5	32
	80	3	1.1	32
	60	15	0.75	32
3.5 m^3/ hour	170	2	3.0	32
	130	3	2.2	32
	75	5	2.2	32
	60	8	1.1	32
	50	5	0.75	32
7.5 m^3/ hour	220	2	7.5	50
	110	1	4.0	50
	60	3	2.2	50
Total	-	67	-	-

8-3) Windmill Pump

The minimum water yield was estimated by assuming a population of 500 people, a unit water consumption of 15 l/capita/day, and average effective operation time of 12.3 hours. As a result, a minimum water yield of 0.6 m3/hour is recommended. Hydraulic heads were based on the existing borehole data. Specifications are as follows:

Table 2.19 No. of Windmill Pump

Hydraulic Head (m)	No.	Discharge Rate (m^3/day)	Diameter of Windmill (m)	Diameter of Discharge Pipe (mm)
20	-	-	3.7	DN 100
20-40	1	16	4.9	DN 100
40-60	-	-	6.1	DN 100
60-80	5	10 to 18.5	7.4	DN 100
80-100	1	26	7.9	DN 100

8-4) Other Components of Water Supply Facilities

(a) Storage Tanks

Storage tanks are designed to be steel with galvanized coating for prevention of rust. The structure of the tank is based on panels for easier construction. A water level meter is to be installed and connected to a submersible pump in order to control pump operation for effective use of groundwater source. The type and number of storage tanks are outlined as follows:

Table 2.20 No. of Storage Tanks

Type/Height		Storage Volume (m^3)									
		4	8	10	15	24	50	75	100	125	Total
Ground Tank		0	2	4	13	21	26	1	0	0	67
Elevated Tank	5 m	0	1	0	3	2	4	1	0	0	14
	10 m	0	0	0	0	1	2	0	0	0	3
Sub-total		0	1	0	3	3	6	1	0	0	14
Total		81									

(b) Transmission Mains and Distribution Pipelines

These pipelines comprise galvanized steel or uPVC pipes, which are available in Kenya. The surface soil depth in the study area averages around 2 m and consists of late-rite with fine to medium sand. Therefore, excavated material can be utilized for backfilling after pipe laying. Concrete thrust blocks will be applied at elbows and tees of pipelines in order not to take off pipes. The minimum covering depth for pipes is 0.6 m. It is noted that the transmission main and distribution pipelines are defined as the pipelines between the pump and storage tank, and between storage tank and water kiosk or public taps.

The total length of these pipelines is given in Table 2.2.17. Steel pipe is assumed for pipeline in open air or between the borehole and pump control room, and uPVC for underground sections.

Table 2.21 Total Length of Pipeline

Pipelines	Material	Diameter (mm)	Length (m)
Pump Control Room including discharge pipe of borehole	GSP	32	2,155
	GSP	50	264
	GSP	65	0
Transmission or Distribution Pipelines	uPVC between Facility Site	40	609
	uPVC within Facilities	40	22,368
	uPVC between Facility Site	50	621
	uPVC within Facilities	50	30,410
	uPVC between Facility Site	80	69
	uPVC within Facilities	80	5,015

Total length of transmission and distribution pipelines between facilities is 80.7 km. This pipe laying is proposed to be undertaken through community participation in order to create ownership of communities. Therefore, the pipe material is planned to be provided by the Japanese side, and pipe laying be undertaken by local communities under the supervision of DWST, consisting of staff DWO and related agencies. These also proposed to be completed within the construction period of the Project.

A water flow meter is provided on the transmission pipeline at the discharge side of the pump and a water meter is installed at the water kiosk in order to measure water consumption. For public taps, water flow meters are also used.

The total number of water flow meters and water meters to be installed by the Project is listed below:

Table 2.22 Water Flow Meters to be Installed

Diameter of Pipeline (mm)	40 mm	50 mm	100 mm
No. of Flow Meters	46	64	10

(c) Water Kiosk

A standard design for this facility as outlined in the Design Manual was applied. A water kiosk with two water taps (water user by less than 500 people) or four water taps (for greater than or equal to 500 people) with a diameter of 20 mm will be constructed at 99 sites. Infiltration-type drain pits will be constructed at water kiosks.

(d) Public Water Tap

Public taps are designed to be directly connected with a storage tank via a gravity system. A public tap facility is equipped with four taps with a diameter of 20 mm and infiltration-type drain pit. This public tap facility is constructed within an area together with pump control house and storage tank. Therefore, a pump operator will collect revenue directly from water users and a water kiosk house is not required. This facility is planned at 39 sites.

(e) Sand Filter for Removal of Iron and Manganese

Communities requiring this facility were determined based on existing groundwater data and their geographic coordinates. Borehole locations with high levels of Fe and Mn were plotted on maps and target communities close to existing boreholes were identified. The selected communities are outlined as follows:

Table 2.23 No. of Sand Filters for Removal of Iron and Manganese

Type of Filters	Kitui	Mwingi	Makueni	Machakos	Total
Discharge less than 1 m^3/hr	0	0	3	3	6
Discharge 1-2 m^3hr	0	0	2	5	7
Discharge 2-3 m^3/hr	0	4	1	2	7
Discharge 3-4 m^3/hr	0	3	1	1	5
Discharge 4-6 m^3/hr	2	1	0	0	3
Total	2	8	7	11	28

(9) Spring Water Supply Facilities

Water supply facilities using the Mora spring were developed in the 1960's. Later, an El-Nino Project financed by AfDB rehabilitated the water supply facilities. However, the rehabilitated pipelines do not meet the water demand of Kathanze community. Leakage from the pipeline occurs and water does not reach the end of pipes. As a result, rotation of water supply is ongoing during the dry season.

The Mora spring has a discharge capacity of 186 m3/day. This is sufficient to meet net water demands of 66 m3/day for two communities with a population of 4415. However, provision of further rehabilitation and improvement of facilities is necessary to make effective use of water resources and to improve water quality of drinking water. In addition, the existing facility has also provided livestock water. The new facility is therefore designed to separate drinking water and livestock watering by branching off the existing conduction main to the existing facilities and to the proposed treatment plant.

The proposed facilities are as follows:

9-1) Rehabilitation of Intake Facilities

The existing intake structure is well maintained but the screen has been damaged and needs rehabilitation. This work consists of a concrete foundation with 40 cm x 40 cm steel screen.

9-2) Conduction Pipeline

The conduction main is defined as the pipeline between the existing intake structure and proposed slow sand filter. The construction work comprises rehabilitation of the damaged pipe and replacement of the existing pipe for improvement of hydraulic head. The replacement pipe will be galvanized steel

with a diameter of 100 mm and length of 300 m. An air valve (1 no. with a diameter of 25 mm) and blow-off valve (1 location with dimension of 100 mm x 40 mm) will also be provided.

9-3) Receiving Tank/Sedimentation Tank

A combined-type concrete tank has been selected to reduce the required area. This facility is designed to have a retention time of 1.5 minutes and treatment capacity of 87 m^3/day, including plant loss of 5% and transmission losses of 20%. The designed facility has a storage volume of 12 m^3 with dimensions of 1.0 m wide x 4.0 m long x 2.0 m high and two tanks, taking into account operation and maintenance requirements.

9-4) Slow Sand Filter and Sand Washing Basin

The slow sand filter is designed based on a treatment capacity of 87 m^3/day, filtration velocity of 4 m/day, and turbidity of 10 NTU. As a result, the required area is estimated to be 22.5 m^2. The depth of filter is 1.0 m with filtering material comprising a sand layer with a grain size of 0.15-0.35 mm, and sand and gravel layer with grain size of 3-60 mm. The tank structure has a dimension of 2.5 m x 9.0 m x 3.0 m (WxLxH).

9-5) Clear Water Tank

A clear water tank of galvanized steel panelling and storage volume of 83 m^3, corresponding to 24 hour water demand, will be provided (based on the Design Manual of MoWI). Taking into account cleaning of the tank, its structure is separated into two parts.

9-6) Storage Tank

Mora spring water supply scheme has two demand areas at Kathanze and Mangeni. Kathanze community is supplied by the clear water tank at the treatment plant and Mangeni community by the new storage tank with a storage capacity corresponding to a water demand of 55 m^3. This will also act as a break pressure tank.

9-7) Transmission and Distribution Pipeline

Total length of transmission and distribution pipelines is 25.9 km. It is afraid that high design pressure and long pipe length may induce less quality of pipeline and delay of construction works if applying undertakings of the community due to limited labour force. Therefore, construction of these pipelines is proposed to be done by Japanese side.

Table 2.24 Transmission and Distribution Pipelines

Pipelines	Material	Diameter (mm)	Length (m)
Conduction Main	GSP	50	429
Transmission and Distribution Pipeline	uPVC	63	17,853
	uPVC	90	4,437
Total	-	-	22,719

9-8) Water Kiosk

Water kiosks are designed at 11 sites taking into account the location of the existing public taps.

2-2-3 Basic Design Drawings

The following drawings were prepared by the Study and are attached to this report.

Table 2.22 List of Basic Design Drawings

Drawing no	Title	Drawing no	Title
GE-001	LOCATION MAP	WSF-022	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (9/40)
GE-002	PLAN OF MORA SPRING WATER SUPPLY FACILITY	WSF-023	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (10/40)
BW-001	DETAILS OF BOREHOLE STRUCTURE	WSF-024	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (11/40)
BW-002	HAND PUMP	WSF-025	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (12/40)
BW-003	REINFORCEMENT BAR ARRANGEMENT OF HAND PUMP	WSF-026	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (13/40)
BW-004	HAND PUMP WITH IRON FILTER	WSF-027	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (14/40)
BW-005	REIFORCEMENT BAR ARRANGEMENT OF IRON FILTER	WSF-028	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (15/40)
SP-001	LAYOUT PLAN OF TYPE A	WSF-029	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (16/40)
SP-002	LAYOUT PLAN OF TYPE B	WSF-030	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (17/40)
SP-003	LAYOUT PLAN OF TYPE D	WSF-031	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (18/40)
SP-004	LAYOUT PLAN OF LOCATION No. 4	WSF-032	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (19/40)
SP-005	LAYOUT PLAN OF LOCATION No. 10	WSF-033	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (20/40)
SP-006	LAYOUT PLAN OF LOCATION No. 11	WSF-034	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (21/40)
SP-007	LAYOUT PLAN OF LOCATION No. 15	WSF-035	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (22/40)
SP-008	LAYOUT PLAN OF LOCATION No. 18	WSF-036	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (23/40)
SP-009	LAYOUT PLAN OF LOCATION No. 33	WSF-037	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (24/40)
SP-010	LAYOUT PLAN OF LOCATION No. 39	WSF-038	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (25/40)
SP-011	LAYOUT PLAN OF LOCATION No. 41	WSF-039	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (26/40)
SP-012	LAYOUT PLAN OF LOCATION No. 54	WSF-040	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (27/40)
SP-013	LAYOUT PLAN OF LOCATION No. 55	WSF-041	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (28/40)
SP-014	LAYOUT PLAN OF LOCATION No. 62	WSF-042	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (29/40)
SP-015	LAYOUT PLAN OF LOCATION No. 69	WSF-043	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (30/40)
SP-066	PIPEWORK OF PUMP CONTROL ROOM	WSF-044	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (31/40)
SP-068	LAYOUT OF CABLES	WSF-045	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (32/40)
SP-069	CONTROL PANEL	WSF-046	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (33/40)
SP-070	CONTROL CIRCUIT	WSF-047	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (34/40)
SP-071	GANTRY CRANE DETAILS	WSF-048	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (35/40)
SP-076	IRON FILTER TYPE III (1/2)	WSF-049	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (36/40)
SP-077	IRON FILTER TYPE III (2/2)	WSF-050	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (37/40)
SP-080	IRON FILTER TYPE IV (1/2)	WSF-051	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (38/40)
SP-081	IRON FILTER TYPE IV (2/2)	WSF-052	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (39/40)
SP-084	IRON FILTER TYPE VI (1/2)	WSF-053	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (40/40)
SP-085	IRON FILTER TYPE VI (2/2)	WSF-054	BRANCH VALVE CHAMBER
SP-087	STORAGE TANK (1/2)	WSF-055	AIR VALVE, SLUICE VALVE & FLOW METER CHAMBERS
SP-088	STORAGE TANK (2/2)	WSF-056	PIPE INSTALLATION, LINE MARKER AND THRUST BLOCK
SP-089	ELEVATED STORAGE TANK	WSF-057	RIVER AND ROAD CROSSING OF PIPE
SP-090	ELEVATED STORAGE TANK - TYPE I (10M)	WSF-058	LAYOUT PLAN OF WATER TREATMENT PLANT
SP-091	ELEVATED STORAGE TANK - TYPE III (5M)	WSF-059	CROSS SECTIONAL VIEW OF WATER TREATMENT PLANT
SP-092	ELEVATED STORAGE TANK - TYPE V (5M)	WSF-060	FLOW CHART OF WATER TREATMENT PLANT
SP-093	ELEVATED STORAGE TANK - TOWER CONNECTION DETAILS AND RAILING (1/2)	WSF-061	RECEIVING TANK DETAILS (1/3)
SP-094	ELEVATED STORAGE TANK - TOWER CONNECTION DETAILS AND RAILING (2/2)	WSF-062	RECEIVING TANK DETAILS (2/3)
SP-097	PUBLIC TAP	WSF-063	RECEIVING TANK DETAILS (3/3)
WSF-001	GENERAL FLOW DIAGRAM FOR WATER SUPPLY FACILITIES	WSF-064	REINFORCEMENT BAR ARRANGEMENT OF RECEIVING TANK (1/2)
WSF-002	PLAN & PROFILE OF RAW WATER MAIN	WSF-065	REINFORCEMENT BAR ARRANGEMENT OF RECEIVING TANK (2/2)
WSF-003	INTAKE STRUCTURE DETAILS (1/2)	WSF-066	SLOW SAND FILTER DETAILS (1/3)
WSF-004	INTAKE STRUCTURE DETAILS (2/2)	WSF-067	SLOW SAND FILTER DETAILS (2/3)
WSF-005	PLAN OF TRANSMISSION AND DISTRIBUTION PIPE LINE(1/9)	WSF-068	SLOW SAND FILTER DETAILS (3/3)
WSF-006	PLAN OF TRANSMISSION AND DISTRIBUTION PIPE LINE(2/9)	WSF-069	REINFORCEMENT BAR ARRANGEMENT OF SLOW SAND FILTER (1/2)
WSF-007	PLAN OF TRANSMISSION AND DISTRIBUTION PIPE LINE(3/9)	WSF-070	REINFORCEMENT BAR ARRANGEMENT OF SLOW SAND FILTER (2/2)
WSF-008	PLAN OF TRANSMISSION AND DISTRIBUTION PIPE LINE(4/9)	WSF-071	SAND WASH DETAILS
WSF-009	PLAN OF TRANSMISSION AND DISTRIBUTION PIPE LINE(5/9)	WSF-072	REINFORCEMENT BAR ARRANGEMENT OF SAND WASH BASIN
WSF-010	PLAN OF TRANSMISSION AND DISTRIBUTION PIPE LINE(6/9)	WSF-073	CLEAR WATER TANK DETAILS (1/2)
WSF-011	PLAN OF TRANSMISSION AND DISTRIBUTION PIPE LINE(7/9)	WSF-074	CLEAR WATER TANK DETAILS (2/2)
WSF-012	PLAN OF TRANSMISSION AND DISTRIBUTION PIPE LINE(8/9)	WSF-075	STORAGE TANK DETAILS (1/2)
WSF-013	PLAN OF TRANSMISSION AND DISTRIBUTION PIPE LINE(9/9)	WSF-076	STORAGE TANK DETAILS (2/2)
WSF-014	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (1/40)	WSF-077	WATER KIOSK DETAILS (TYPE A)
WSF-015	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (2/40)	WSF-078	WATER KIOSK DETAILS (TYPE B)
WSF-016	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (3/40)	WSF-079	MAINTENACE OFFICE
WSF-017	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (4/40)	WSF-080	DETAILS OF STAIRCASE AND HANDRAIL
WSF-018	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (5/40)	WSF-081	DETAILS OF FENCE
WSF-019	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (6/40)	WSF-082	DETAILS OF GATE AND DRAIN
WSF-020	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (7/40)	WSF-083	CONSUMER CONNECTION DETAILS
WSF-021	PROFILE OF TRANSMISSION AND DISTRIBUTION PIPE LINE (8/40)		

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

(1) Principles

Assuming that the Project is implemented under the Japanese Grant Aid Scheme, the following principles should be applied for implementation:

1) The executing agency of Kenyan Government is MoWI.

2) At signing of Exchange of Notes between Japanese and Kenyan Governments, MOWI should commence the preparation works in the Department of Water Development and DWOs and proceed with necessary actions for implementation of the Project.

3) After signing of Exchange of Notes for the implementation of the Project between Japanese and Kenyan Governments, a Japanese consulting firm will sign a contract with MoWI, and the consultant will prepare detailed design and tender documents, and then commence the tendering procedure.

4) Japanese contractor will sign a contract with MOWI and execute construction works under supervision of the consultant.

5) Japanese contractor will establish site management office for construction works.

6) The Project should be implemented for 124 communities, comprising construction of 122 boreholes and water supply facilities in 123 communities, and rehabilitation of the existing water supply facilities with spring water source for 1 community. It is noted that one borehole drilled by the basic design study in Mwingi District are available for the Project.

7) Construction method for boreholes is mud circulation drilling method for surface layers and DTH/Air Hammer for basement rock.

8) Failed boreholes should be completely backfilled to ensure safety.

9) Water supply facilities with submersible and windmill pumps should be constructed after confirmation of the actual water yield and design of facilities in accordance with this actual water yield in order to minimize revision of design during construction stage. Therefore, the construction schedule of these facilities should be separated.

10) During construction of water supply facilities, laying of transmission and distribution pipelines, building of water kiosk houses and fences should be undertaken by community participation in order to create community's ownership. However, pipe material should be procured and delivered by the Japanese side.

11) At the completion of construction works, responsibility for the constructed facilities is handed over to MoWI.

12) Construction material for the Project should be procured in Kenya. This includes hand pumps, windmill pumps, galvanized steel pipe, uPVC pipe, steel plates, structural steel, reinforcement, cement, timber, fuel, oils, painting materials, and so on.

(2) Principles for Procurement of Operation and Maintenance Equipment

Operation and maintenance equipment such as vehicles, motor bikes, electrical sounding equipment, portable water analysis equipment and operation and maintenance tools, which are available in the market of Kenya, should be procured in Kenya taking into account procurement of spare parts. These should be procured by the contractor.

2-2-4-2 Implementation Conditions

(1) Tax Exemption

Necessary procedures for tax exemptions are concerned with many organizations including MOWI. Therefore, it is assumed that these will take a significant period because of the complicated application and approval system.

Responsibility for the tax exemption procedure is taken by MOWI, although the consultant and contractor should understand laws and regulations, prepare required documents, and apply/proceed them.

(2) Emvironmental Protection

Environmental impacts due to construction works are related to: 1) noise, 2), dust, 3) vibration by heavy construction equipment, and 4) traffic accidents in general. Since schools and health centers are located in 124 communities, impacts due to noise and vibration shall be considered. There are many habitat areas of wild animals in the study area and it is essential to prevent traffic accident caused by these animals. This could be achieved by strict management of traffic rules and driving speed, application of a registration system of drivers, restriction of private vehicle use, education of drivers, creation of awareness by periodic meetings, control of traffic, and so on.

2-2-4-3 Scope of Works

(1) Scope of Works to be executed by Japanese Side

1) Execution of detailed design

2) Preparation of tender documents, evaluation and support for tendering process on behalf of MOWI

3) Undertaking construction of boreholes and water supply facilities based on the terms of reference stipulated in the Basic Design Study Report

(2) Undertaking by Government of Kenya and/or Communities

1) Provision and arrangement of land necessary for implementation of the Project
2) Construction of access roads, including cutting of bushes
3) Explanation of works to inhabitants, and requesting their cooperation in the construction of the water kiosks, pipelines and fencing
4) Budget arrangement and payment of import tax, internal tax, and other levies
5) Support for establishment and training of WUA
6) Arrangement of necessary counterpart personnel

2-2-4-4 Construction Supervision

(1) Detailed Design and Tendering

1-1) Detailed Design

Based on the result of the basic design study, detailed design and tender documents will be prepared:

- Detailed design for water supply facilities
- Preparation of design report and drawings
- Calculation of work quantities and cost estimate
- Preparation of construction plan and tender documents

1-2) Tender assistance

Prior to the tender, a pre-qualification of applicants will be done. This announcement will appear in the name of MOWI in major Japanese construction-related newspapers. The pre-qualification documents will be prepared and distributed by the consultant. Tender documents will then be distributed to the qualified contractors. The proposals of the contractors will be received by the consultant and opened by the consultant with staff of MoWI.

The proposals will be evaluated by the consultant and staff of MOWI immediately after opening of the proposals. The contract document will be drafted and finalized by discussion with the selected contractor. The consultant will assist MoWI in the following works:

- Tender announcement
- Preparation, distribution, and evaluation of pre-qualification documents
- Distribution and evaluation of tender documents and contract negotiation

(2) Construction Supervision

After verification of the contract by the Japanese Government, the consultant will publish notification of the commencement of the works. After this commencement, a resident engineer will reside at the site. The resident engineer will supervise construction works and report work progress to the Embassy of Japan, JICA Kenya office, and MoWI. The resident engineer will take a role in facilitating communication among the concerned agencies including the contractor.

The following are the major items of the supervision works:

1)	Approval of construction drawings	:	Evaluation and approval of construction and shop drawings, permission of construction works, material, specification of equipment and machinery, and so on
2)	Supervision of construction works	:	Instruction for construction schedule, overseeing progress of works, shop inspection for materials, and other required works
3)	Approval for payment	:	Issuance of certificate for payment and completion of works
4)	Inspection at the end of defect liability period	:	Inspection of constructed facilities

2-2-4-5 Quality Control Plan

Quality control plan for the Project applies to drilling work, concrete work, pipe laying and manufacturing of equipment such as pipes, steel storage tanks, pump and generators., and so on. The quality control items are given as follows:

Table 2.25 Quality Control Items

Items	Tests	Method
1. Drilling of boreholes	Shop inspection Electrical logging Preliminary pumping test	Witness of inspection Check and review of test records ditto
2. Concrete works	Slump test Compression test	Once per 50m3 ditto（7-day/28-day strength）
3. Pipe laying	Hydraulic pressure test	1.5 times of design pressure for pipe
4. Equipment	Shop inspection	Witness of inspection Check and review of test records

2-2-4-6 Procurement Plan

(1) Construction Material, Local Contractor and Construction Equipment

1-1) Construction Material

Most of the material required for the Project such as motorized pumps, galvanized steel pipe, uPVC pipe, steel plate, structural steel, reinforcement, cement, timber, fuel, oil, and paint can be procured in Kenya. The required quantity will not be so large as to affect local demand conditions.

(a) Hand Pumps

Afridev-type hand pumps are most popular in Kenya and also surrounding countries. There are several Afridev hand pump manufacturers in Nairobi. Most of the spare parts are produced by local manufacturers.

(b) Submersible Pumps

Submersible pumps can be procured through the Kenyan agencies of European manufacturers because of small size and common specification of adopted pumps. Spare parts indispensable for operation and maintenance of pumps can also be procured through these agents. Therefore, submersible pumps is planned to be procured in Kenyan agencies.

(c) Windmill Pump

Windmill pumps in Kenya have been manufactured only by Kenyan Company, Kijito having headquarter in Nairobi. Advantage of windmill of this company is simple structural mechanism of windmill and cheaper operation and maintenance thereby. Associated spare parts can be procured from this company. They also have training

courses suitable for operation and maintenance.

Taking into account these advantages of windmill pumps manufactured in Kenya, the mentioned windmill is planned to be procured.

(d) Storage Tanks

Storage tanks made of steel, masonry and concrete are commonly used in Kenya. In this Project, it is proposed to use steel tanks because of low cost, wide range of the project sites, limitations of the implementation period and common quality.

Thus, both elevated and ground storage tanks use steel. However, in consideration of water quality requirements, it recommended that galvanizing of the steel panels be undertaken.

(e) Galvanized Steel Pipe and uPVC Pipe

Galvanized steel pipe and uPVC pipe and their fittings are manufactured in Kenya and can be procured locally.

(f) Galvanized Steel Plate and Iron Material

Galvanized steel plate and iron material are imported from South Africa and the Middle East. Thus, those materials will be procured through Kenyan agencies.

(g) Valves

Valves are procured from Europe and South Africa through Kenyan agencies.

(h) Reinforcement Bar and Form Work

Reinforcement bar is manufactured in Kenya and easy to procure from Kenyan agencies. Domestic products shall be procured for formwork.

(i) Concrete Blocks

Concrete blocks for the building of walls are manufactured by small or medium scale manufacturers in Kenya.

(j) Sand and Aggregate

There are small quarries for fine and course aggregate and stone in target districts. These materials can therefore be obtained locally.

(k) Cement

Cement shall be procured from Kenya.

(l) Fuel

Fuel can be procured through the Kenyan agency of a major international oil company in target districts.

(m) Fittings for Doors, etc.

Fittings for pump houses and water kiosks can be procured at a market in Nairobi.

(n) Paints

Paints can be procured in Kenya.

Procurement sources of the materials are summarized as follows:

Table 2.26 Procurement Source of the Main Construction Materials

Item	Kenya	Japan	Third Country	Reason
Hand Pump	○			Available from Domestic Product
Windmill Pump	○			Available from Domestic Product
Motorized Pump			○	Reliability of Quality and Supply
Storage Tank	○			Available from Domestic Product
Galvanized Steel Pipe	○			Available from Domestic Product
uPVC Pipe	○			Available from Domestic Product
Iron Materials	○			Available from Domestic Product
Reinforcement Bar	○			Available from Domestic Product
Sand, Gravel	○			Available from Domestic Product
Cement	○			Available from Domestic Product
Formwork	○			Available from Domestic Product
Wood	○			Available from Domestic Product
Fuel	○			Available from Domestic Product
Oil	○			Available from Domestic Product
Paint	○			Available from Domestic Product

1-2) Local Contractors and Construction Machinery

(a) Local Contractor

In Kenya, local contractors are registered in each category of their main works by the Ministries. Contractors in Kenya have accumulated experience and technology through domestic projects conducted by joint venture with foreign firms, mainly from European countries, for many years since the independence in 1963.

Therefore, local engineers and labors for the Project will be procured from Kenyan contractors with experience of similar projects with MoWI or with similar levels of engineering skill and experience.

(b) Construction Equipment

Major local contactors have their own drilling rigs and supporting equipment. Most construction equipment, excluding drilling and large-scale equipment, can be procured from Kenyan companies under a lease contract.

(2) Procurement Plan for Operation and Maintenance Tools

The following equipment was requested by the Government of Kenya based on the result of the basic design study:

a) Vehicle (4WD Pick-up Track) : 5 nos. for the headquarter and 4 DWOs
b) Motorbikes : 8 nos. for 4 DWOs (2 nos. per each DWO)
c) Electrical Sounding Equipment : 1 sets for Eastern PWO and Machakos DWO
d) Portable Water Quality Testing Equipment : 4 sets for 4 DWOs
e) Operation and Maintenance Tool : 4 sets of Mega-Ohrm Tester for each DWO
3 sets of Windmill Pump O&M Tools for 3 DWOs

Necessity of the equipment for the Project was investigated by information and data and result is described as follows:

2-1) Vehicles

The road network is not well developed and is of poor quality. Therefore, 4 WD vehicles are indispensable for driving in the study area.

MoWI has DWO in each district for development of water supply facilities and their operation and maintenance. In the study area, DWOs of Machakos, Kitui, Mwingi and Makueni districts deal with these works. The present conditions of mobiles owned by these DWOs are described as follows:

Table 2.27 No. and Conditions of Vehicles Owned by DWOs (unit: No.)

District	Total No.	Available Mobiles	Requiring Repair	Not Working
Machakos	3	1	-	-
Kitui	4	1	-	3
Mwingi	2	1	-	1
Makueni	2	1	0	1

Source: District Water Office

These vehicles are procured from 1990 to 1995 and have deteriorated due to the extremely poor road conditions. Currently available vehicles are used for administration works or revenue collection/pipeline patrol. Therefore, they are unavailable for supporting work for operation and maintenance of communities. There are no vehicles for the Project during the implementation stage.

The DWO has provided technical support for communities after construction of

water supply facilities, but efficient support is not possible due to lack of transportation.

Taking into account these conditions of vehicles owned by MOWI and DWO, widely spread Project Area, and necessity of technical support to communities, it is proposed to procure four vehicles (one for each DWO) in order to strengthen the capacity of DWOs in terms of support to communities, provided that these vehicles should be used within the Project Area.

During the implementation stage of the Project, coordination and management works between relevant agencies are required for the Kenya-Japan Water Supply Project. In order to smoothly execute work for the Project, one vehicle is procured for this unit. Requests for two vehicles for WSBs are at present not acceptable because these organizations are still being established and operation and maintenance systems for vehicles are not yet prepared.

The proposed vehicles are 4WD double cabin-type pick-up trucks.

2-2) Motorbikes

The present conditions of motorbikes owned by these DWOs are described as follows:

Table 2.28 Present Conditions of Motorbikes Owned by DWOs

Districts	Available Nos.	Present Conditions
Machakos	3	These were procured by WUASP (BTC) and have been used in divisions of Ito and Wamyunu. These also are occupied by works of WUASP and not available for this Project.
Kitui	7	KAP (DANIDA, 4 nos. and off-road type) and MoWI (3 nos.) procured these motorbikes, and those owned by KAP is scheduled to be sold in Dec. 2004. Others owned by MoWI has been executively used for the town water supply in Kitui.
Mwingi	4	GTZ (2 nos.) and SIDA（2 nos.) procured and have used executively in the districts of Nuu, Tslikuru, Nguni and Migwani.
Makueni	-	-

Source: DWOs of MoWI

The DWOs have no own motorbikes and all the existing ones are executively used by the projects of other donors or town water supply in divisions in the study area. These motorbikes are indispensable as transportation tools for supporting works to communities widely spreading in the Project Area.

Consequently, it is proposed to procure 8 motorbikes (two for each DWO) with off-road type and displacement of 125 cc, in order to implement the Project smoothly and to strengthen the capacity of DWOs in terms of support to communities.

2-3) Electrical Sounding Equipment

Through the field survey, the effectiveness of two-dimensional electrical

sounding equipment was confirmed by its ability to identify the most appropriate position of test drilling in Mwingi district. On-the-job training was also given to engineers of MoWI during the field survey and they now understand how to use this equipment. Out of the four DWOs, only Machakos DWO does not have electrical sounding equipment. The other three DWOs have functioning equipment but the PWO has no direct relationship with this Project.

Taking into account the above issues and transfer of technology to engineers of MoWI, it is proposed that two-dimensional electrical sounding equipment be procured for Machakos DWO.

2-4) Portable Water Quality Analysis Equipment

At present, DWOs do not have this equipment even though sand filter facilities for removal of iron and manganese are planned for construction in the four districts. As a result, periodic monitoring of water quality required to define operating condition of these facilities, could not be undertaken.

It is therefore proposed that four sets of equipment (one for each DWO) will be procured by the Project. It is noted that equipment including material is available and able to be procured in Kenya.

2-5) Operation and Maintenance Tools

Mega ohm testers, which are required for checking the condition of submersible pumps, are not kept by any DWO. It therefore is proposed that one tester for each DWO be procured by the Project.

Windmill pumps proposed by the Project need operation and maintenance tools for their periodic checking. However, DWOs in the two districts, in which the windmill pumps are proposed, have no suitable tools. Therefore, three sets of O&M tools are proposed for Machakos and Makueni DWOs.

2-2-4-7 Basic Plan for Soft-component Scheme

(1) Background of Soft-component Scheme

Rural water supply facilities in the Project Area are; 1) groundwater supply with wells, hand pump, submergible pump, windmill pump, stone-masonry tank, and public tap; 2) spring water supply with intake, stone-masonry tank, or public taps; 3) small scale impounding using river water; 4) sand dam storing sub-surface flow and taking water by hand-pump; 5) rock catchments constructed using massive rock surface; 6) roof catchments and storage tank; 7) piped water supply with intake, treatment plant, storage tank, transmission and distribution pipelines, and public taps.

Out of the groundwater use by wells, communities with population of more than 1000 persons construct borehole, submergible pump, storage tank and public

taps. Also, they establish water users association (WUA) or a mutual-aid association which are comprised of residents and manage the constructed facilities. This WUA collect water tariff of Ksh 1 to 2 per 20 lit, or monthly fee for covering operation and maintenance costs. MOWI has supported WUA in execution of electrical sounding, design of water supply facilities, and so on. During 1990s, windmill pump water supply facilities, which is made in Kenya, were constructed by support of other donors or NGOs. In the Project Area, windmill pumps are identified at 13 communities, and is being developed in Kenya because of low operation and maintenance costs.

Problems in operation and maintenance, which is identified by the social survey done by the basic design study, are; 1) financial arrangement for replacement of facilities; 2) lack of training for operation and maintenance; 3) selection of member of committee for WUA, their term, and so on; and 4) accounting issue relevant to transparency. Their measures are for these problems are; 1) support of school management; 2) support of NGOs for training; 3) appropriate setting of member's term and selection of female members; 4) preparation of financial plan; and 5) employment of female as accountant. Especially, it is often identified that water supply facilities such as pumps or generators are breakdown and that lack of maintenance technology and/or fund for replacement induced the abandonment of these facilities.

In order to improve this situation, it is required to provide the communities with support in capacity building for operation and maintenance and financial planning.

The plan for operation and maintenance under the software component program of the Project, which includes 49 communities with hand-pump water supply facilities and 75 communities with piped system in the four districts of Machakos, Kitui, Mwingi and Makueni, aims at strengthening community-based operation and maintenance systems, and capacity building of local administration in supporting target communities. However, in planning the software component program of the Project, the capacity of the implementing agency to take necessary steps in future to cope with newly established institutional frameworks after completion of sector reform is considered, as outlined below:

1-1) Local Administration

A training package is provided for the staff of District/Divisional Water Office and other related local administrations in the basic design study, to improve their capacity and skills in administrative support for the communities to establish community-based operation and maintenance systems.

However, provision of those support services for the communities (e.g. provision of training for communities in operation and maintenance, health and sanitation education, monitoring), which is currently provided by the local administration, is transferred to and undertaken by WSB and WSP in the newly established institutional framework under the sector reform to be completed on

December 2007.

Therefore, training for staff of District/Divisional Water Office is provided on the condition that those staff is transferred/recruited to WSBs after the sector reform.

1-2) Target Communities

The main duties of WSBs under the new institutional framework are: 1) to prepare a development plan on water supply and sewerage services and to set up performance target, 2) to examine application by potential WSPs (Water Service Providers), 3) to enforce regulation and tariffs on water services. WSPs shall obtain a business license from WSBs on service provision, with preparation of a business plan. In the rural water supply service, NGOs, community-based organizations, and private sector organizations could become WSPs.

The water supply facilities to be constructed by the Project will be transferred to WSB with their ownership in the same manner with other water supply facilities owned by the Government of Kenya. Then, WSP, which concluded contract with WSB, will operate and maintain these water supply facilities and water supply services. However, for rural water supply facilities, it may be difficult to be operated and maintained by private sector, taking account of their low profitability and public undertakings of water supply services. Therefore, cooperation between WSB, WSP licensed by WSB and WUA will be necessary to realize sustainable operation and maintenance of the facilities.

Therefore, although Soft Component Program at community level focuses on capacity building of WUA, cooperation between aforementioned WSB, WSP and WUA, and transition of WUA to WSP will also be examined, in order to facilitate adjustment to the new institutional framework under the sector reform.

1-3) Willingness and Ability of Communities to Participate in Operation and Maintenance

Although relatively high willingness of target communities for participation in operation and maintenance was confirmed by the socio-economic survey in the basic design study, it was observed that some community members lacking a willingness to pay for water, understand user-pay-principles, and lack a willingness to participate in operation and maintenance. In addition, the majority of target communities have no supply facilities, and therefore they have little experience on operation and maintenance of water supply facilities in a systematic or organized manner. It is recognized that intervention to increase participation and capacity in operation and maintenance through implementation of Soft Component Program is indispensable to enhance sustainability of the Project.

Lack of awareness among target communities on water quality of existing water sources was revealed in the socio-economic survey. Moreover, there were a considerable number of respondents preferring the existing/traditional water

sources in the rainy season, even provided improved water supply facilities under the Project.

For achieving expected output on health and sanitation improvement by the Project, enhancement of community awareness on water quality is necessary. In addition, the number of users for the improved water supply facilities would be decreased in rainy season, which results in decrease in fee collection and affects sustainable operation of the facilities. Therefore, from the viewpoint of sustainability of the Project, implementation of activities to increase awareness of communities on health and sanitation aspects shall be essential.

(2) Target of Soft Component Program

There are several issues pertaining to inadequate operation and maintenance in the Project area including: 1) a less mature sense of ownership and willingness to participate in operation and maintenance based on the user-pay-principles, 2) lack of knowledge and skills for community-based operation and maintenance, 3) lack of awareness in health and sanitation, and poorer understanding of the correlation between personal health and use of safe water, and 4) inadequate support to the communities by the local administration for establishment of community-based operation and maintenance systems.

In undertaking countermeasures for these problems and issues, Soft Component Program aims “to establish the basis for a community-based operation and maintenance system”.

(3) Expected Output of Soft Component Program

Outputs expected through the implementation of the program are as follows:

1) Improved sense of ownership and participation

2) Enhanced capacity and skills of local administration to support communities for establishment of community-based operation and maintenance and retention of these skills at the concerned organizations

3) Enhanced capacity of the target communities in operation and maintenance of the improved water supply system

4) Increased awareness in personal health and sanitation, and understanding of correlation between personal health and use of safe water

(4) Means of Verification to Assess the Achievement set as Output

The means of verification to assess the achievement set as expected output are outlined below:

Output 1) Sense of ownership and participation is improved.

Participatory community assessment is undertaken in each target community

prior to the construction of facilities under the Project. This will employ participatory methods such as PRA (Participatory Rapid Appraisal) to identify and analyze the problem of communities in health and sanitation aspects, and future operation and maintenance.

This community assessment results in preparation of a Community Action Plan (CAP), which determines required actions and input, time framework, and indicators to verify achievements. Degree of improved community awareness can be confirmed by achievement of CAP through quarterly reports prepared by DWST (District Water and Sanitation Team).

In addition, the project plans that the construction of fences surrounding hand pump facilities, water kiosks, and installation of pipelines is to be undertaken by the user communities in order to increase the sense of ownership and participation. Due attention shall also be paid to the progress and achievement of construction works carried out by user communities to assess the issue.

Output 2) Capacity and skills of local administration to support communities to establish community-based operation and maintenance and to facilitate sanitation education are enhanced and retained by the concerned organization.

District Water and Sanitation Team (DWST), which is composed of the district level staffs of WSB and other district officers in concerned agencies involved in the water and sanitation sector, is formed to apply multi-sector approach on implementation of operation and maintenance plan of the Project.

On initial stage of Soft Component Program, a field implementation manual for DWST will be prepared for the establishment of community-based operation and maintenance, and implementation of health and sanitation education. Training of Trainers (TOT) is provided to DWST utilizing the field manual. DWST, which is trained as the trainer, will undertake activities to establish community-based operation and maintenance systems at community level, in collaboration with a NGO sub-contracted under the Japanese consultant. On-the-Job-Training (OJT) is also provided to DWST by NGOs during the implementation of field activities. Degree of acquisition of skills through both TOT and OJT can be confirmed in the workshop reports and quarterly reports prepared by NGO.

Output 3) Capacity of the target communities in operation and maintenance of the improved water supply system is enhanced.

It is a prerequisite for the construction of improved water supply facilities that a Water Users Association (WUA), which is the community-based organization taking the leading role and responsibility in operation and maintenance, is formed in each target community and registered with a prepared constitution. In the formation and provision of training to a WUA, participation of women in numbers and the decision-making process shall be enhanced, which can be assessed by quarterly reports prepared by NGO/DWST, and minutes of village

meetings.

Capacity and skills, that WUA shall acquire and enhance, can be categorized as follows: 1) leadership skills, 2) organization management skills, 3) financial management skills including tariff setting, collection, budgeting, accounting, 4) technical skills such as operation, maintenance, and trouble shooting of supply facilities, and 5) monitoring and evaluation skills. These skills are monitored and assessed by DWST with applying uniformed monitoring sheets. In addition, operation and accounting records by WUA shall be checked for assessment.

In case that WSP is established in the target community, operation and accounting records will be checked based on the framework of cooperation between WSP and WUA.

Output 4) Awareness in individual health and sanitation and correlation with use of safe water is increased.

Soft Component Program includes activities to improve community awareness on health and sanitation in relation with use of safe water, through which communities are expected to change their attitude towards more improved hygiene practices. In the implementation of health and sanitation education, PHAST (Participatory Health and Sanitation Transformation), a tool for participatory health education adopted by many NGO in Kenya, is introduced.

This is an efficient and effective means of enhancing understandings of communities on correlation between unhygienic practices and water-borne diseases, and improving personal hygiene practices. Community Resource Persons (CORPs) shall be trained under the program in PHAST concept and skills. These CORPs are expected to provide health and sanitation education to their community. Frequency and contents of health and sanitation education provided by CORPs shall be confirmed for assessment purposes through quarterly reports prepared by NGOs/DWST.

Moreover, the achievement of the issues shall be evaluated through a post-baseline survey at the completion of the Project. This will measure and compare the results of the baseline survey conducted in the Basic Design Study and focus on the degree of understanding on causes of water-borne diseases, incidence of water-related diseases, improvement in personal hygiene practices, and degree of satisfaction/dissatisfaction on the water quality and quantity.

(5) Activity of Soft Component Program

Activities planned for Soft Component Program are based on the concept and methodology applied by NGOs active in the Project area, so that consistency with SIDA/DANIDA cooperation can also be maintained.

5-1） Activities to improve community ownership and participation:

- Community consultative meetings

- Participatory community assessment, preparation of and consensus building on community action plan
- Activities to facilitate community participation
- Supervision of community construction of fences surrounding hand pumps, kiosks, and installation of pipelines

5-2) Activities to enhance capacity and skills of local administration to support communities in establishment of community-based operation and maintenance system:

- Development of field implementation manual
- Formation of DWST (District Water and Sanitation Team)
- Provision of TOT (Training of Trainers) for DWST, and development of DWST action plan
- Provision of OJT (On-the-Job-Training) through the implementation of field-level activities
- Preparation of monitoring/follow-up check list

5-3) Activities to develop capacity of target communities in operation and maintenance of improved water supply system:

- Review and revision of WUA constitution, and consultation meeting to introduce WSS (water supply and sanitation) management option under the sector reform
- Implementation of activities to develop capacity of communities in operation and maintenance, and health and sanitation education
- Provision of follow-up training for WUAs to strengthen the capacity in operation and maintenance
- Preparation of WUA to be transformed to WSP, development of guidelines for transition
- Monitoring and follow-up
- Support for the activities on strengthening water supply services with adopting a concept of WSP

5-4) Activities to increase community awareness in personal health and sanitation, and understanding of correlation with safe water use:

- Community human resource development for health and sanitation education
- Provision of training for CORPs (Community Resource Persons) in PHAST (Participatory Health and Sanitation Transformation) methods
- Implementation of health and sanitation education by CORPs

5-5) Activities to measure the impact of the Project:

- Monitoring and follow-up by DWST
- Post-Baseline survey

Details of activities are described in the following table, indicating the contents of activities and their output, target of activities, means and period of implementation, human resources for implementation, and output of submission:

Table 2.29 Contents of Soft Component Activities (1/4)

Activity	Output	Target	Means of Implementation	Period	Implementer 【Responsibility】	Output of Submission
Stage 1: Pre-Planning Stage						
☐ Development of Field Manual 【Contents】 ➢ Leadership Skill ➢ Organization Management Skill ➢ Financial Management ➢ Technical Operation and Maintenance ➢ PHAST (Participatory Health and Sanitation Transformation) ➢ Participatory Monitoring and Evaluation	Field implementation manual for trainers, which is utilized in the implementation of field activities, is developed. (Draft was prepared during the 1st stage in the previous Grant Aid scheme. The draft should be modified in accordance with the progress of Sector Reform.)	All 4 District	Consultation and needs assessment with implementing agency, preparation and development	10 days/project	Japanese Consultant NGO 【Japanese Side】	Field Manual
☐ Formation of DWST (District Water and Sanitation Team)	DWST, which composed with WSB staffs and district staffs from the ministries involved in water and sanitation sector, is formed in each district, and sector-wide approaches can be introduced.	All 4 District	Request to each District by implementing agency	0.5 month/District	MWI, WSB 【Kenyan Side】	Member list of DWST
☐ Provision of TOT (Training of Trainers) for DWST, and Preparation of DWST Action Plan 【Contents】 ➢ Leadership Skill ➢ Organization Management Skill ➢ Financial Management ➢ Technical Operation and Maintenance ➢ PHAST (Participatory Health and Sanitation Transformation) ➢ Participatory Monitoring and Evaluation	Utilizing field manual, facilitation skills of DWST are improved, and DWST Action Plan for the implementation of Soft Component Program is prepared.	All 4 DWST	Workshop seminar	10 day/District (5 days training was carried out in Mwingi and Kitui Districts during the 1st stage in the previous Grant Aid scheme)	Japanese Consultant NGO 【Japanese Side】 DWST 【Kenyan Side】	Workshop Report DWST Action Plan

Table 2.29 Contents of Soft Component Activities (2/4)

Activity	Output	Target	Means of Implementation	Period	Implementer 【Responsibility】	Output of Submission
Stage 2: Participatory Planning						
☐ Community Consultative Meeting, and Confirmation of Pre-Conditions for Construction	Communities understand project purpose, expected output, and detail activities and willingness to collaborate the project is enhanced. In particular, User-Pay-Principle is understood. Pre-conditions, including community undertakings, for the construction of improved water supply system is confirmed.	All of Target Communities	Meetings	0.5 day/Community	Japanese Consultant NGO 【Japanese Side】 DWST 【Kenyan Side】	Minutes of Meeting
☐ Participatory Community Assessment, and Preparation of Community Action Plan (CAP)	Problems and concerns in operation and maintenance of improved water supply system are identified and analysed, and community action plan (CAP), which indicates community task and means of implementation, is developed in participatory manners	All of Target Communities	Participatory field workshop	1.0 day/Community	NGO 【Japanese Side】 DWST 【Kenyan Side】	Workshop Report Community Action Plan (CAP)
☐ Community Consultative Meeting (Consensus Building for Community Action Plan)	Community consensus on CAP is made.	All of Target Communities	Meeting	0.5 day/Community	NGO 【Japanese Side】 DWST 【Kenyan Side】	Agreed CAP
Stage 3: Construction/Implementation						
☐ Review on Constitution of WUA (Water Users Association), and orientation on the WSS (Water Supply and Sanitation) Management Option under the Sector Reform	Constitution of WUA, which is prepared by community prior to the implementation of the program, is reviewed and revised in the viewpoints of feasibility and efficiency. Various WSS management option is introduced to the community, and the community is prepared for the sector reform.	All of Target Communities	Participatory field workshop	0.5 day/Community	NGO 【Japanese Side】 DWST 【Kenyan Side】	Revised WUA Constitution Workshop Report
☐ Capacity Building of Communities in Operation and Maintenance, Implementation of Health and Sanitation Education, and OJT (On-the-Job-Training) for DWST	Capacity of community in management, operation and maintenance of improved water scheme and awareness in health and sanitation is improved.	All of Target Communities DWST CORPs	Participatory field workshop	4.0 days/Community (Level-1 Site) 6.0 days/Community	NGO 【Japanese Side】 DWST	Training Report

Table 2.29 Contents of Soft Component Activities (3/4)

Activity	Output	Target	Means of Implementation	Period	Implementer 【Responsibility】	Output of Submission
➢ Facilitation of Community Participation ➢ Improvement of Leadership Skill of WUA ➢ Enhancement of Financial Management for WUA Accountant ➢ Technical Training for WUA Artisan in Operation and Maintenance ➢ Training for CORPs (Community Resource Persons) in PHAST (Participatory Health and Sanitation Transformation), and Health and Sanitation Education	Facilitation skill of DWST is enhanced through OJT.			(Level-2 Site)	【Kenyan Side】	
☐ Follow-up Activities for Capacity Building, and Health and Sanitation Education	Sense of community ownership, capacity of community in operation and maintenance, and awareness in health and sanitation is firmed.	All of Target Communities	Participatory Field Workshop	3.0 days/Community	DWST 【Kenyan Side】	Minutes of Meeting
Supervision on Community for Construction of Fence, Kiosk, and Installation of Pipeline	Fence, kiosk, and pipeline is constructed and installed by communities, and sense of community ownership is enhanced.	All of Target Communities	Supervision	2.0 days/Community (Level-1 Site) 5.0 days/Community (Level-2 Site)	DWST 【Kenyan Side】	Constructed facilities
Stage 4: Operation and Maintenance						
☐ Follow-up Training for WUA (Strengthening Community Capacity in Operation and Maintenance)	Through the actual operation and maintenance of improved water supply scheme, training needs are identified, and training package to strengthen community capacity is provided.	All of Target Communities	Participatory Field Workshop	2.0 days/Community	DWST 【Kenyan Side】	Training Report
☐ Support on strengthening water supply services with the concept of WSP (Water Service Provider) ➢ Support for constructing cooperating	Transition to the new organization framework on water supply service under the Sector Reform is facilitated.	All 4 District	Consultation and needs assessment	1.0 Month	Japanese Consultant NGO 【Japanese Side】	Guideline, Manual, Format

Table 2.29 Contents of Soft Component Activities (4/4)

Activity	Output	Target	Means of Implementation	Period	Implementer 【Responsibility】	Output of Submission
structure with WSB, WSP and WUA. ➢ Preparation of transition plan from WUA to WSP.			with implementing agency, preparation and development of policy and plan		MWI, WSB 【Kenyan Side】	
Stage 5: Monitoring and Follow-Up						
☐ Preparation of Monitoring and Follow-up Check List	Issues to monitor and follow-up are identified, and monitoring and follow-up check list, which include indicators and means of verification, is developed.	All 4 DWST	Workshop	1.5 days/DWST	Japanese Consultant NGO 【Japanese Side】 DWST 【Kenyan Side】	Monitoring and Follow-up Check List
☐ Monitoring and Follow-up	Monitoring and follow-up activities are conducted by DWST	All of Target Communities	Field Investigation	2 days / each 3 month / Community	DWST 【Kenyan Side】	Monitoring Report
☐ Post-Baseline Survey	Impact by the Project is assessed	36 Communities	Socio-Economic Survey with interviews	0.5 Month	Japanese Consultant NGO 【Japanese Side】 DWST 【Kenyan Side】	Post-Baseline Survey Report
☐ Strengthening water supply services with adoption of the concept of WSP ➢ Orientation on WSS management option under the sector reform, and selection of option by community ➢ Development of business plan of WSPs, registration and approval as provider ➢ Contracting with WSB for service provision	New management structure on water supply services is constructed at community level with the concept of WSP.	All of Target Communities	Workshop Training	3.0 Month	MWI, WSB, DWST 【Kenyan Side】	

In addition, responsibilities and duties to undertake each activity either by the Japanese or Kenyan authorities are determined and indicated in the chart, which means the realization of output set in the program depends on the efforts undertaken by both.

Since knowledge and skills required for the target community could differ between facility levels, communities with a piped water scheme (level-2) shall be provided with a more intensive and lengthy training package in organization management, financial management, and technical operation and maintenance, than communities with hand pump water supply schemes (level-1).

(6) Assignment of Personnel

Personnel to be assigned to implement Soft Component Program are as follows:

6-1） Japanese consultant (Operation and Maintenance/Health and Sanitation Education)

One Japanese consultant is responsible for: 1) formulation and supervision of Soft Component Program, 2) reporting to the implementing agency and Japanese concerns, and coordinating parties concerned in the program, and 3) coordination in implementation of the program with construction schedule. Also, technical advice and capacity building will be given to local staff from the implementing agency.

6-2） Counterpart from implementing agency

One staff from MoWI will participate as a counterpart to the Japanese consultant to cooperate in supervisory activities. During the course of program implementation, the counterpart will also coordinate administrative matters with the Kenyan authorities when necessary.

6-3） Local NGO

Involvement of NGO in establishment of a community-based operation and maintenance system is promoted in Kenya as national policy and strategy. Thus, in the implementation of Soft Component Program, NGO with knowledge and experience on capacity building of communities in similar programs is employed.

NGO will implement activities of the Japanese side described above, under the supervision of the Japanese consultant. Also, NGO will collaborate with the Japanese consultant in preparation of a field implementation manual, provision of TOT and OJT to DWST, and implementation of field level activities.

NGO staffs shall be deployed are as follows, considering the scale and schedule of activities involved in the program. Each staff member shall be experienced in a similar program and be fluent in the local language.

(a) Program Coordinator

Under the supervision of the Japanese consultant, one program coordinator will take the leading role in implementation of field-level activities and manage the schedule, methodology and output in the implementation of the program, as well as reporting to the Japanese consultant. The program coordinator shall be experienced as a team leader in similar programs.

(b) Community Facilitator

Under the supervision of the program coordinator, one community facilitator will conduct field-level activities to support the program coordinator. The community facilitator shall be experienced in establishment of community-based operation and maintenance, participatory planning, monitoring and evaluation, capacity building, and health and sanitation education in the water and sanitation sector.

6-4） DWST: District Water and Sanitation Team

The DWST (District Water and Sanitation Team) will be formed in each target district of the Project. This will be composed of WSB staffs and other district staffs from Ministries involved in development of the water and sanitation sector. Prior to the implementation of Soft Component Program, MoWI will take a leading role to coordinate with each District Executive Officer for formation of DWST. The DWST will be provided with TOT (Training of Trainers) and OJT (On-the-Job-Training) through the implementation of field activities to establish community-based operation and maintenance systems and health and sanitation education, so that the knowledge and skills are improved and retained in the institutions.

(7) Implementation Schedule

The implementation schedule is given in Figure 2.7.

(8) Output of Submission

Output of submission will be a field implementation manual for DWST, DWST action plan, community action plan, training reports, monitoring checklists, post-baseline report, etc. In addition, the Japanese consultant will prepare the activity progress report on a quarterly basis (Quarterly progress report), and submit to the implementing agency and those Japanese authorities concerned. On completion of each phase of the program, a completion report will be prepared and submitted to the institution concerned.

Year	2006												2007												2008												2009					
Fisical Year	2006												2007												2008												2009					
Item	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6			
Agreement: Cabinet Approval				▲										▲																												
Agreement: E/N					▼										▼																												
Agreement: Consultant Agreement					■										■																												
Detail Design: Detail Design Study																																									
Detail Design: Preparation of Tender Document																																									
Detail Design: Confirmation on Tender Document																																									
Detail Design: PQ						▲	□																																		
Detail Design: Explanation of Tender																																									
Detail Design: Tender								▲																																	
Detail Design: Contractor Contract									■																																
Detail Design: Approval of Contract									▲																																
Construction: Construction																																									
Construction: Construction of Hand Pump Facilities	Machakos																																								
	Makueni																																								
	Mwingi																																								
	Kitui																																								
Construction: Construction of Level 2 Facilities	Machakos																																								
	Makueni																																								
	Mwingi																																								
	Kitui																																								
Construction: Construction of Gravity-Fed System	Machakos																																								
	Makueni																																								
	Mwingi																																								
	Kitui																																								

Software Component Program	Days Required	Target Phase 1	Target Phase 2	Total Days Phase 1	Total Days Phase 2
Stage 1) Pre-Planning					
Development of Field Implementation Manual	10 day /proj	1 proj		10	0
【Undertakings by Kenyan Side】 Formation of DWST (District Water and Sanitation Team)	15		1	0	15
	15 day /dist	dist	dist	0	15
	5	1		5	0
	5	1		5	0
Provision of TOT (Training of Trainers) for DWST, and Preparation of DWST Action Plan	10		1	0	10
	10 day /dist	dist	dist	0	10
	5	1		5	0
	5	1		5	0
Stage 2) Participatory Planning					
Community Consultative Meeting, and Confirmation of Pre-Conditions for Construction	0.5 day /village	59 village	65 village	29.5	32.5
Participatory Community Assessment, and Preparation of Community Action Plan (CAP)	1.0 day /village	59 village	65 village	59	65
Community Consultative Meeting, and Consent of Communities for Action Plan	0.5 day /village	59 village	65 village	29.5	32.5
Stage 3) Construction/Implementation					
Review on Constitution of WUA (Water Users Association), and Orientation on the WSS Management Option under the Sector Reform	0.5 day /village	59 village	65 village	29.5	32.5
Capacity Building of Communities in Operation and Maintenance, Implementation of Health and Sanitation Education, and OJT for DWST (Level-1 Package)	4.0 day /village	27 village	22 village	108	88
Ditto (Level-2 Package)	6.0 day /village	32 village	43 village	192	258
【Undertakings by Kenyan Side】 Follow-up Activities for Capacity Building, and Health and Sanitation Education	3.0 day /village	59 village	65 village	0	0
【Undertakings by Kenyan Side】 Supervision on Community for Construction of Fence (Level-1 Sites)	2.0 day /village	27 village	22 village	0	0
【Undertakings by Kenyan Side】 Supervision on Community for Construction of Kiosk, Installation of Pipeline (Level-2 Sites)	5.0 day /village	32 village	43 village	0	0
Stage 4) Operation and Maintenance					
【Undertakings by Kenyan Side】 Follow-up Training for WUA (Strengthening Community Capacity in Operation and Maintenance)	2.0 day /village	59 village	65 village	0	0
Preparation to Transit WUA to WSP, Development of Guideline for Transition	30.0 day /proj	1 proj		30	0
Preparation of Monitoring and Follow-up Check List	1.5 day /dist	2 dist	2 dist	3	3
【Undertakings by Kenyan Side】 Monitoring and Follow-up (3 months/community)	2.0 day /month			0	0
Post-Baseline Survey	15.0 day /proj		1 proj	0	15

Assignment Schedule

1. Japanese Consultant	1staff	M/M			Frequency		
(Operation and Maintenance, Health Education)		P1	P2	Total	P1	P2	Total
(grade 4)		1.0	2.0	3.0	1	2	3

2. Local NGO/Consultant		M/M		
		P1	P2	Total
Program Coordinator	1staff	13.0	11.5	24.5
Community Facilitator 1	1staff	5.5	7.0	12.5

Figure-2.6 Implementation Schedule for Software Component Program

(9) Undertakings by Kenyan Authorities

On the implementation of Soft Component Program, the following activities shall be undertaken by Kenyan side:

- Formation of DWST (District Water and Sanitation Team)
- Field-level follow-up activities (capacity building of community in operation and maintenance, improvement of health and sanitation awareness and practice)【During construction stage】
- Supervision of community construction of fences, kiosks, and installation of pipelines
- Provision of follow-up training for WUAs【During operation and maintenance stage】
- Monitoring activities【After completion of construction】

Technical cooperation under Soft Component Program covers only establishment and capacity building of WUA as well as preparation of WUA to be transformed to WSP. However, transformation from WUA to WSP will be realized under direction of MoWI and WSB on completion of the sector reform.

2-2-4-8 Implementation Schedule

The Project shall be divided into two phases. The first phase includes construction of water supply facilities in Kitui and Mwingi Districts from the view point of serious condition in water supply. The second phase consists of those in Machakos and Makueni Districts.

Table 2.30 Implementation Schedule

Item	Phase-1	Phase-2
Detailed Design・Tendering	―	7.0
Construction and Inspection	13.5	11.5
Soft Component	13.0	11.5

This three phase implementation schedule is summarized below:

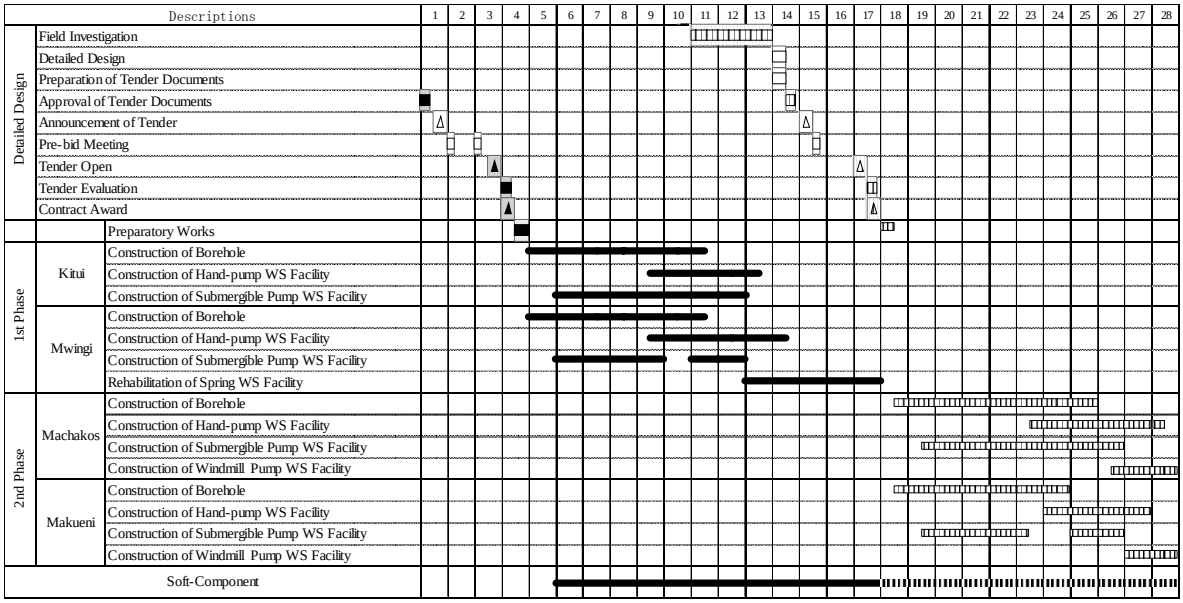

Figure 2.7 Implementation Schedule

2-3 Obligation of Recipient Country

Undertakings of the Government of Kenya are drafted as follows:

(1) To secure the site for proposed water supply facilities.

(2) To clear, level and reclaim the site prior to commencement of construction.

(3) To provide data and information necessary for the Project.

(4) To provide the land for access road, a temporary site office, warehouse and stock yard during implementation of the Project.

(5) To provide warehouse for storing of spare parts and other equipment procured by the Project, at DWO for four target districts and headquarters of MoWI.

(6) To undertake incidental outdoor works such as security of the sites, fencing, gates, and exterior lighting in and surrounding the borehole sites if necessary.

(7) To construct access road to the site prior to commencement of construction if necessary.

(8) To bear the commissions of the Japan bank for banking services based upon Banking Arrangement.

(9) To exempt taxes and to take necessary measures for customs clearance of materials and equipment procured by the Project at the port of disembarkation.

(10) To ensure the prompt unloading and customs clearance at a port of disembarkation in Kenya and facilitate internal transportation therein of the products purchased under the Grant.

(11) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in Kenya with respect to the supply of the products and services under the Verified Contracts.

(12) To accord Japanese nationals whose services may be required in connection with supply of the products and services under the verified contracts, such facilities as may be necessary for their entry into Kenya and stay therein for the performance of their work.

(13) To assign the necessary staff and secure the necessary budget for operation and maintenance of the equipment purchased under the Grant Aid.

(14) To maintain and use properly and effectively the equipment procured

under the Grant Aid.

(15) To bear all the expenses other than those to be borne by the Grant Aid necessary for construction of the facilities as well as for the transportation and installation of the equipment.

(16) To maintain the control of tools and spare parts purchased under the Grant Aid.

(17) To support the establishment of Water Users Association and for target communities.

(18) To establish and manage the Project Management Unit, and to corporate with relevant Ministries.

(19) To bear all the expenses and staff for establishment of the trainer's team.

MoWI conducted above-mentioned works properly through the Project for Groundwater Development in Rural Districts previously funded by the Japan Grant Aid. Therefore, it is expected that MoWI is again able to conduct the above-mentioned works.

2-4 Project Operation Plan

2-4-1 Organization for Operation and Maintenance

The framework of operation and maintenance plan is composed of: 1) promotion of the active participation of the community-based organizations in operation and maintenance, and 2) the support service provided by the administration agencies. The concept of the operation and maintenance system in this plan is shown as follows:

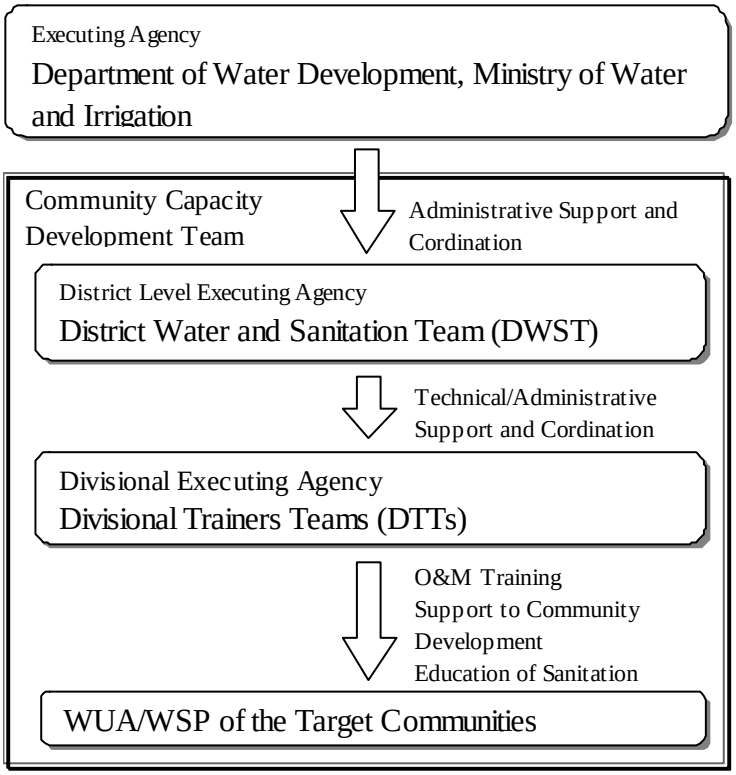

Figure 2.8 Organization of Operation and Maintenance Plan

2-4-2 Operation and Maintenance Plan

Based on the issues raised by the review on the current operation and maintenance situation of the existing water supply facilities in the target areas as well as by the socio-economic survey, the main approach in the operation and maintenance plan is explained in this section.

(1) Basic Policy Relevant to Operation and Maintenance at Administration Level

A participatory model for a community-based operation and maintenance system has been adopted to carry out water supply and sanitation projects in rural areas of Kenya. Through this approach, community-based organizations have been encouraged to participate actively in operation and maintenance, and

have been provided support services by administrative agencies.

In this plan, on the one hand, community members are required to form self-governing organizations as well as to acquire and apply knowledge, skills and capability to independently operate and maintain the water supply facilities to be constructed. On the other hand, the implementing agency of the Project, MoWI, is expected to provide administrative support services to local communities through District/Divisional Water Officers designated in each District/Division, so that the participatory operation and maintenance system can be established smoothly. The administrative support service is planned to include training for capacity building of community-based organizations, monitoring, and technical support for matters beyond the current community capability.

The support service to communities, however, is now in the process of transferring its control from District/Divisional Water Offices of the MoWI, to the Water Service Boards (WSBs). This is due to the sector reform followed by the enforcement of the Water Act 2002.

The WSBs are organized as an autonomous institution, to play a role of executing and supervisory agency for operation and management. Nairobi WSB and Central WSB were established respectively in April and June, 2004, and transformed to Athi WSB and Tana WSB in 2005. Furthermore, the Water Service Provider (WSP) is an agency to provide water supply services, and is authorized as service provider by concluding commission contracts with WSBs regarding operation and maintenance. In rural areas, WSPs can be NGOs, community-based organizations, and private sector organizations such as enterprises and entrepreneurs.

Here, it is uncertain if the above institutional framework introduced by the sector reform can be applicable in operation and maintenance of the water supply facilities in rural areas, as the sector reform was originally aimed at improving the water supply projects in urban/peri-urban areas. In particular, it is debatable if shifting the role and responsibility of the current District/Divisional Water Offices of the MoWI to the WSBs is feasible, and if the capabilities of WSBs are sufficient to play their role.

Therefore, currently the WSBs are required to declare operation and maintenance plans not only for urban areas but also for rural areas, in the Business Strategy & Plan each WSB is obliged to set. The Business Strategy & Plan will be set in December, 2004.

Basically, the framework of the present participatory operation and management system is adopted in this plan, under the agreement with the executing agency. This is because the sector reform is only at an early stage and is anticipated the transfer of operation and management control of District/Divisional Water Offices to WSBs will occur slowly. In addition, PMUs (Project Management Units) composed of stakeholders who implement this plan are expected to ensure information sharing with WSBs and participation in decision making, so

that the operation and maintenance system can be transformed smoothly after the sector reform.

Furthermore, a part of the software-component program, such as TOT (Training of Trainers) to improve the participatory facilitation skills towards community-based operation and management systems targets the District/Divisional officers of MoWI. However, this needs to be carried out on condition that the officers be employed again by WSBs and assume the same responsibilities.

(2) Basic Policy Relevant to Operation and Maintenance at Community Level

In the current operation and maintenance system at community level, each community is obligated to form community-based organizations before starting construction work with the guidance and support from District/Divisional Water Offices of MoWI. Communities are in charge of making constitutions as well as application and registration at District Social Program Offices. Furthermore, they are required to carry out operation and maintenance activities, such as operation of water supply facilities, daily maintenance, collection of user charges and fund control, and small-scale repairs.

The operation and maintenance system at the community level can follow the three patterns:

1) Water Users Associations (WUAs), as a community-based organization, play a role of WSP written in the Water Act 2002, providing services as an enterprise to community members based on the commission contracts with WSBs.

2) Private sector organization such as private enterprises/entrepreneurs, churches, and NGOs, plays a role of WSPs to provide services to local residents.

3) The present participatory operation and maintenance system is preserved with support from WSBs (MoWI at the present).

The plan adopts the framework of the participatory operation and maintenance system at the community level based on support from MoWI, referred the above as 3), as it is now at the beginning transition stage of the sector reform.

Reflecting the results of socio-economic survey as well as learning from the operation and maintenance situation of the existing water supply facilities, the plan examines the training package for the participatory operation and maintenance system, and is carried out as a part of the software-component program. Also, NGOs with experience in the same area are planned to be in charge of training.

The operation and maintenance at the community level is aimed principally at establishing the participatory operation and maintenance system for “water

supply and sanitation", within which the scope of the software-component program is limited. An integrated approach is required, however, for effective and sustainable operation and maintenance in this plan. Fields such as income generation, expansion of educational opportunity, food security, and education to improve nutrition, reproductive and health HIV/AIDS, need to be included and integrated in this plan. Local NGOs have possibly accumulated relevant methods and experiences in introducing the integrated approach in the above fields. Therefore, the activities can be developed through partnerships between the local NGOs and the local JICA office.

From a middle- or long-term viewpoint, capacity building to ensure community-based organizations, WUAs, play a role of WSPs, is important for reconstruction of operation and maintenance systems in rural areas (in line with the sector reform). Therefore, capacity building is essential as a project model that will be further implemented in the future by the Kenyan authorities. Local NGOs are expected to play a key role in water supply by establishing the partnership with the public sector and introducing the integrated approach mentioned above, as well as to provide the middle- or long-term training for capacity building so that WUAs can transit smoothly to WSPs with enough capability.

(3) Operation and Maintenance Plan

3-1) Strengthening Community Support by Rural Administrative Agencies

The present participatory operation and maintenance system essentially requires the target communities to improve their capability for operation and maintenance. The system cannot work without support services to the communities from administrative agencies, such as training, monitoring and guidance aimed at capacity building. It is District/Divisional Water Offices, local branches of MoWI, that provide administrative support services to the communities.

The District/Divisional Water Offices are required to play their roles: 1) support for organizing Water Users Associations (WUAs) that primarily operate and maintain the newly constructed water supply facilities as community-based organizations, 2) guidance and advice to formulate regulations of WUAs, and support for registering them as WUAs, 3) technical guidance regarding operation of water supply facilities and daily maintenance, 4) guidance and advice for setting the use fee amount and methods for its collection, 5) guidance regarding accounting, and fund employment and control, and 6) follow-up and monitoring.

Moreover, a multi-sectoral approach is adopted in establishing a participatory operation and maintenance system in this plan. This approach is based on organizing District Water and Sanitation Teams (DWST) mainly composed of officers at Government departments related to the Water and Sanitation sector, as each District and Division has a branch of Government departments apart from the MoWI. With this approach, technical transfer is carried out by DWSTs

in the software-component program.

For the formation of DWSTs, whose chairperson is a District Executive Officer, the MoWI is required to coordinate the various Government departments such as Ministry of Health and Ministry of Gender, Sports, Culture and Social Services. The District/Divisional offices of these Government departments have carried out the direct traveling guidance at the community level, and experienced various activities in the fields of health and sanitation, community development and organizing support, etc. Therefore, these experiences and know-how of the District/Divisional offices of government departments are expected to be applied practically.

3-2) Improving Awareness of Local Communities for Participation

The participatory operation and maintenance system basically requires the target communities to foster awareness and willingness to participate in operation and maintenance, based on their ownership and the principle of user-pays fees by community members themselves. Therefore, the plan initiates an expanding of the scope of activities and is aimed at fostering their ownership mentality and willingness to participate in operation and maintenance at the target communities. This involves organizing the above-mentioned DWSTs, centering around the District/Divisional Water Offices.

3-3) Capacity Building of Communities

The target communities have the higher-level need for capacity building towards establishing participatory operation and maintenance systems. These needs are found particularly in terms of the following, and it is planned to provide training to them and to establish self-reliance operation system thereby:

- Improvement of leadership skills,
- Improvement of management skills to be used in community-based organizations,
- Decision-making on the amount of user fee and method for its collection,
- Establishing a budget, accounts, and fund control,
- Operation of facilities, maintenance and repair, and trouble shooting,
- Establishing monitoring check lists, and participatory monitoring activities, and
- Review meetings.

3-4) Hygiene Education on “Water”

The sustainable use of water supply facilities cannot improve the living environment without community members’ ownership as well as their practice based on understanding of appropriate use and management of safe water. Therefore, the concept of sanitation and custom, which users of the water sources and facilities apply, need to be carefully taken into account in operation and maintenance of water supply facilities. In order to ensure self-sustaining of the Project, the District/Divisional Water Offices and the DWST members need

to facilitate the local communities to positively transform their awareness and behavior on water use.

3-5) Measures towards Sector Reform

The operation and maintenance plan mainly aims at establishing a self-governing system by local communities, and build a participatory system based on the support services to the communities from rural administrative agencies. At the same time, this plan needs to build a foundation to accommodate the operation and maintenance system and institutional framework due to the expected changes resulting from sector reform now being implemented as part of the national policy. Otherwise, the executing agency cannot appropriately function and provide the services after implementation of this plan, as the reform will be completed after this Project.

Therefore, the plan includes strategies in operation and maintenance, so that it can adapt the future institutional framework to be established by the sector reform. Specifically this plan prepares a guideline for WUAs to be transformed to Water Service Providers (WSPs). Thus, after its implementation, the executing agency and related organizations can be accommodated properly in the enterprise system of the water supply services in the new institutional framework.

3-6) Institutional Strengthening and Capacity Building of Stakeholders in Operation and Maintenance

In order to realize sustainable water supply from the newly constructed facilities, as well as to quicken the expected effects, the activities for institutional strengthening and capacity building of stakeholders in operation and maintenance need to be implemented in the software-component program. These activities are also needed based on the principle that Kenya is primarily responsible for this international cooperation project between Kenya and Japan, in line with the general rules of Japanese grant aid assistance.

2-5 Project Cost

2-5-1 Project Cost

Under Japan's Grant Aid Scheme, the Project cost is estimated at JPY1,123million, comprised of JPY 1,014 million of Japanese Government and JPY 109 million of the Kenyan Government in accordance with the work demarcation between the Japanese and Kenyan sides and based on the conditions outlined below. This cost estimate is provisional and would be further examined by the Government of Japan for the approval of the Grant.

(1) Japanese Side

Estimated Project Cost : 1,014 Million Japanese Yen

Machakos District, 38 communities（38 boreholes）

Item		Project Cost （Million JPY）	
Facilities	Water supply facilities equipped with hand pumps (Construction of boreholes, installation of hand pumps, construction of aprons, and iron and manganese removal filters)	35	252
	Water supply facilities equipped with windmill pumps (Construction of boreholes, installation of windmills, construction of storage tanks and iron and manganese removal filters, laying of distribution pipes, and public taps)	65	
	Water supply facilities equipped with motorized pumps (Construction of boreholes, installation of windmills, construction of storage tanks and iron and manganese removal filters, laying of distribution pipes and water kiosks)	152	
Procurement of Equipment	Vehicles, Motor Bikes, Electrical Sounding Equipment, Portable Water Quality Testing Equipment, Equipment for O&M	8	8
Detailed Design, Construction Supervision, Institutional Development		54	54
Estimated Project Cost for Machakos District			314

Kitui District, 25 communities（25 boreholes）

Item		Project Cost（Million JPY）	
Facilities	Water supply facilities equipped with hand pumps (Construction of boreholes, installation of hand pump, construction of aprons, and iron and manganese removal filters)	28	167
	Water supply facilities equipped with windmill pumps (Construction of boreholes, installation of windmills, construction of storage tanks and iron and manganese removal filters, laying of distribution pipes, and public taps)	0	
	Water supply facility equipped with motorized pumps (Construction of boreholes, installation of windmills, construction of storage tanks and iron and manganese removal filters, laying of distribution pipes and water kiosks)	139	
Procurement of Equipment	Vehicles, Electrical Sounding Equipment, Portable Water Quality Testing Equipment, Equipment for O&M	7	7
Detailed Design, Construction Supervision, Institutional Development		28	28
Estimated Project Cost for Kitui District			202

Makueni District　27 communities（27 boreholes）

Item		Project Cost（Million JPY）	
Facilities	Water supply facilities equipped with hand pumps (Construction of boreholes, installation of hand pumps, construction of aprons, and iron and manganese removal filters）	29	172
	Water supply facilities equipped with windmill pumps (Construction of boreholes, installation of windmills, construction of storage tanks and iron and manganese removal filters, laying of distribution pipes, and public taps)	45	
	Water supply facilities equipped with motorized pumps (Construction of boreholes, installation of windmills, construction of storage tanks and iron and manganese removal filter, laying of distribution pipes and water kiosks)	98	
Procurement of Equipment	Vehicles, Electrical Sounding Equipment, Portable Water Quality Testing Equipment, Equipment for O/M	8	8
Detailed Design, Construction Supervision, Institutional Development		37	37
Estimated Project Cost for Makueni District			217

Mwingi District　35 communities
(33 boreholes, 34 upper structures, 1 spring water supply facility)

Item		Project Cost (Million JPY)	
Facility	Water supply facilities equipped with hand pumps (Construction of the boreholes, installation of the hand pumps, construction of aprons, and iron and manganese removal filters)	49	235
	Water supply facilities equipped with windmill pumps (Construction of boreholes, installation of windmills, construction of storage tanks and iron and manganese removal filters, laying of distribution pipes, and public taps)	0	
	Water supply facility equipped with motorized pumps (Construction of boreholes, installation of windmills, construction of storage tanks and iron and manganese removal filters, laying of distribution pipes and water kiosks)	134	
	Mora spring water supply facilities (Rehabilitation of intake, rehabilitation of raw water main, construction of water treatment plant, laying of distribution pipe, and water kiosks)	52	
Equipment	Vehicles, Electrical Sounding Equipment, Portable Water Quality Testing Equipment, Equipment for O/M	7	7
Detailed Design, Construction Supervision, Institutional Development		39	39
Estimated Project Cost for Mwingi District			281

(2) Kenyan Side

The Government of Kenya has executed the projects under the grant aid of Japanese Government such as “Groundwater Development in Rural Area”, “Meru Water Supply”, and so on , by managing their staff and budget appropriately, and therefore, they could perform these arrangement of staff and budget in order not to induce any delay of the Project. The following are the proposed undertakings of the Government of Kenya:

1) Undertakings of Community

Item	Description	Project Cost	
		Thousand Ksh	Million JPY
1. Land Acquisition	Land acquisition/compensation (for private land) Drilling site, pipe installation, storage tank, water kiosk, spring water supply facilities, etc.	-	-
2. Tree	Cutting/compensation	-	-
3. Community Participation	Fences (107 nos.) Drain Ditch (107 nos.) Distribution pipes (81 km)	34,257	55.50
4. Organization of WUA	Organization of 126 WUA	-	-
Total Cost for Community Side		34,257	55.50

1) Undertakings of MoWI

Item	Description	Project Cost	
		Thousand Ksh	Million JPY
1. Site	Land acquisition/compensation (for public land) Drilling site, pipe installation, storage tank, water kiosk, spring water supply facilities, etc.	-	-
	Holding Temporary yard, storehouse, office	-	-
	Acquiring permission for road use and drilling from local police/Government	-	-
2. Tree	Cutting permission, supporting for communities	-	-
3. Construction	Quality and progress control for construction of fences（107 nos.） Quality and progress control for construction of drain ditch（107 nos.） Quality and progress control for construction of distribution pipeline（81 km）	3,617	5.86
4. Storage house/Place	Storage place for O&M material	-	-
5. Project Manager /Coordinator	Staffing of project manager and project coordinator	2,425	3.93
6. Establishment of WUA	WUA organization for 126 communities Staff regarding training for O&M method and sanitary education	8,619	13.96
7. Supervisory Team	Staffing for supervisory team on the construction of boreholes and civil works（each 4 people）	3,564	5.77
8. Operation Cost	Arrangement for allowance for above-mentioned staff	14,711	23.83
Total Cost for MOWI Side		32,936	53.35

(3) Condition of Cost Estimate

1) Time of Cost Estimate March, 2006

2) Exchange of Rate 1 US$ = ¥118.18

1 Ksh = ¥1.62

3) Schedule Two phases

4) Others The Project shall be implemented in accordance with the regulations and system of Japan's Grant Aid Scheme.

2-5-2 Operation and Maintenance Cost

In accordance with the Water Act 2002, Water Users Association shall carry out the operation and maintenance for the facilities. Therefore, WUA shall collect the water fee from respective members to cover all necessary costs for operation, maintenance and replacement of water supply facilities.

As a result of the social-economic survey, 84% of the beneficiaries are willing to pay for water, however, 15% are not. The latter also lack an understanding of the user-pays principle and a willingness to participate in operation and maintenance. Furthermore, the survey indicated beneficiaries' willingness to pay for each facility-type were 1.98 Ksh. for hand pump, 3.18 Ksh. for motorized pump and 2.09 Ksh for windmill pump.

In view of affordability to pay, Machakos and Makueni District are able to pay 1.8 Ksh. per 20 liter. On the other hand, Kitui and Makueni District are able to pay 1.2 Ksh. per 20 liter based on the results of income/expense levels in each district.

From the above, operation and maintenance cost could be estimated. In addition, a revenue collection ratio of 65% was applied based on experience of the previous groundwater project.

(1) Water Supply Facility Equipped with Hand Pump

The maintenance period for hand pumps is expressed in terms of MTBF (Mean Time Before Failure). In the case of an Afridev hand pump, MTFB is 6 months. Thus, the maintenance period at the community level is fixed at 6 months. In addition, regular maintenance will be executed every 6 months by a serviceman dispatched by the manufacturer or agents.

According to the interview with pump manufacturers/agents in Kenya, the operational life for hand pumps is 8 years if proper maintenance is executed. As a result, the Afridev hand pump would require maintenance eight times at community level and 16 times by a regular serviceman in 8 years. Using these study results, the operation and maintenance costs including replacement cost for the Afridev hand pump, are estimated as follows:

Table 2.31 Operation and Maintenance Cost for Hand Pump

Item		Hand pump	
		Contents	O&M Cost (Ksh/Year)
Pump Cost		65,000 Ksh/8 years	8,125
O&M by WUA	Spare Parts	1,190 Ksh x twice/year	2,380
O&M by Technician	Spare Parts	10,514 Ksh/year	10,514
	Commission Cost	1,000 Ksh/year	1,000
Pump Operator		2,000 Ksh x 12 month	24,000
Transportation Cost		600 Ksh x twice/year	1,200
Incidentals（Stationery etc.）		500 Ksh x 12 months	6,000
Total		-	53,219

Regarding the operation and maintenance costs, based on a 65% collection efficiency ratio it is possible to operate and manage the hand pump facilities with revenue collection for the four districts.

(2) Water Supply Facility Equipped with Submersible Pumps

Motorized pumps are depreciated within 12 years. Therefore, the period of

operation and maintenance is also defined as this duration. On the other hand, diesel generators are depreciated within 9 years with a comparable period for operation and maintenance. Community level maintenance should be undertaken every six months and the overhaul of equipment every 8,000 hours. Therefore regular maintenance by a serviceman should occur once a year.

Based on these conditions, operation and maintenance costs are estimated as follows:

Table 2.32 Operation and Maintenance Cost for Submersible Pump

Item		Contents	O&M Cost (Ksh/year)
Pump Cost		80,000 Ksh/12 years	7,000
Generator (9 years)		250,000 Ksh/9 years	28,000
Fuel		350 Ksh/day x 365 days	128,000
O&M by WUA	Spare Parts	Lump-sum	50,000
O&M by Technician	Spare Parts	Lump-sum	50,000
	Commission Cost	1 time/year	2,000
Pump Operator		1 person x 2,000 Ksh x12 months	24,000
Water Kiosk Keeper		2 persons x 2,000 Ksh x12 months	48,000
Transportation Cost		1 Unit	1,200
Incidentals（Stationery etc）		1 Unit	6,000
Total		-	344,200

Regarding the operation and maintenance costs, based on a 65% collection efficiency ratio, affordability-to-pay and population of communities, it is possible for 88 communities to operate and manage submersible pump facilities with revenue collection for the four districts.

(3) Water Supply Facility equipped with Windmill Pumps

According to interviews and studies with windmill pump manufacturers in Kenya, regular maintenance for windmill pump only requires greasing of rotors and gear box every 6 months. From the site survey, it was also confirmed that there were no report of damage to blades, rotor and gear, apart from deterioration of cylinders and rubber. These were replaced every 3 years to 10 years.

According to wind pump manufacturers in Kenya, overhauls are recommended once every ten years even if there is no damage. This overhaul is generally carried out as part of the pumping system to extend the life span. The period of depreciation for windmill pumps in Japan is 10 to 15 years. However wind pump manufacturers in Kenya do not fix time periods for overhaul, with most windmill pumps having run for more than 20 years.

Based on this, the period of operation and maintenance for windmill pump was fixed at 15 years, and the maintenance period at the community level at 6 months. The estimated operation and maintenance cost are as follows:

Table 2.33 Operation and Maintenance Cost for Windmill Pump

Item		Windmill Pump	
		Contents	O&M Cost (Ksh/Year)
Pump Cost		2,000,000 Ksh/15 years	133,333
O&M by WUA	Oil/Grease	500 Ksh x twice/year	1,000
O&M by Technician	Spare Parts	3,000 Ksh/3 years	1,000
	Commission Cost	1,000 Ksh/3 years	333
	Overhaul	100,000 Ksh/15 years	6,667
Water Kiosk Keeper		1,500 Ksh x 12 months	18,000
Incidentals（Stationery etc）		500 Ksh x 12 months	6,000
Total		-	166,333

Regarding the operation and maintenance costs, based on a 65% collection efficiency ratio, affordability-to-pay and population of communities, it is possible for 10 communities to operate and manage windmill pump facilities with revenue collection for the four districts.

(4) Mora Spring Water Supply Facility

The principal operation and maintenance cost of Mora spring water supply facility is personal expenses for the operators of the eleven water kiosks and two water treatment plant operators and watchmen.

Based on this, operation and maintenance cost are as follows:

Table 2.34 Operation and Maintenance Cost for Spring Water Supply Facility

Item	Contents	O&M Cost (Ksh/Year)
Water Kiosk operator	11 Persons x 2,000 Ksh x 12 months	264,000
Operator of WTP	2 Person x 8,000 Ksh x12 months	192,000
Watchman in WTP	2 Person x 2,000 Ksh x12 months	48,000
O&M by WUA		
Spare Parts	Filter Sand, Pipes etc	100,000
Transportation Cost	Lump-sum	1,200
Incidentals（Stationery etc）	Lump-sum	6,000
Total		611,200

The operation and maintenance cost for the Mora spring water supply facilities is estimated at 611,200 Ksh. Based on 65% of the water revenue collected from 4,400 people, the annual revenue is estimated as 940,000 Ksh. Therefore, it possible for the Mora spring WUA to suitably conduct regular operation and maintenance of the water supply facility on a self-payment basis if a minimum water unit cost of 1.2 Ksh per 20 l and revenue collection ratio of 65% is secured.

2-6 Key Points for Project Implementation

In order to facilitate the undertakings of Government of Kenya, the following issues, which directly affect to the implementation of the Project, shall be taken into consideration:

(1) Establishment of organization for implementation and operation and maintenance of the Project, and preparation of necessary staff and budget for the Project,

(2) Coordination with the agencies concerned for organizing the district water and sanitation team,

(3) Organization of water users association of 124 target communities, and

(4) Land acquisition for construction of water supply facilities.