Chapter 6

Annex

6. Annex

6.1 Rural Water Supply in Kibungo Province (Proposal for Grant Aid Project)

6.1.1 National development plan for rural water supply

The principle governmental policies for the rural water sector are in line with VISION 2020 and the Poverty Reduction Strategy Papers (PRSP). The main objective is to improve the present water supply rate of less than 50% to 100% in the year 2020 by increasing the number of water points and building the capacity of relevant personnel in charge of water supply as well as sensibilization of water users.

Water and sanitation are a major component of the "basic economic infrastructures", the third of the 5 pillars defined in VISION 2020 and PRSP. As a commitment to the Millennium Development Goals (MDG), the objective of VISION 2020 is to reduce by half the percentage of the population that has no sustainable access to drinking water supply and sanitation by 2015.

The national investment strategy encourages studies on involvement of the private sector and implementation of water supply systems in rural and urban areas at an affordable cost to the consumers. The budget for construction and rehabilitation of water supply systems and other improvements can be allocated from the Common Development Fund (CDF) (explained in a later section).

The government is promoting a 7-year reform program for the water and sanitation sector. The activities to be pursued are the following.

- Institutional reform
- Decentralization
- Participatory approach
- Program approach
- Reinforcement of the roles of women and children
- Participation of the private sector
- Capacity building
- Integrated management by watershed
- Monitoring and assessment

The national average water supply rate in accordance with the criteria for drinking water is 54% in 2003. More specifically, the rates are 67% in urban areas and 41% in rural areas, respectively. The following are the Rwandese government's criteria for access to safe water in rural areas

- Supply rate 20 liters/capita/day
- Distance 500 m round trip between house and water point (250 m one-way)
- Quality in accordance with WHO guidelines for drinking water
- Quantity stable supply throughout the year

The table 6-1 shows the water supply rates in 2003 and 2005, and those under VISION 2020.

Table 6-1: Present and expected water supply rates under VISION 2020

Year	2003	2005	2010	2015	2020
Supply Rate	41%	46%	66%	85%	100%

The governmental program for improvement of water and sanitation in rural areas aiming for the above goals is based on the demands of the communities. The government's approach conforms to its decentralization policy through institutional strengthening, technical improvement and human resources development. The approach can thus achieve participation of beneficiaries and implementation and management of infrastructures through decentralized bodies.

6.1.2 Organizational structure for water supply

The Ministry of Lands, Environment, Forest, Water and Mines (MINITERE: Ministere des Terres, de l'Environnement, des Forets, de l'Eau et des Mines) is the main ministerial institution for the water and sanitation sector. Since water and sanitation are a cross-sectoral domain, intervention of other ministries is essential.

- MINISANTE: sanitation education related to water
- MINALOC: sensibilization on operation and maintenance of water supply systems
- MINAGRI: water resources development for irrigation
- MINECOFIN: budget for water and sanitation programs
- MINAFFET: coordination of donors

The organization chart of MINITERE, restructured this year, is shown below. The new organization is basically the same as the previous one, where Directorates have changed to Units, and former Divisions are now a pool of professionals under the Units. However, the number of staff has been reduced due to decentralization. Furthermore, the Unit of Water and Sanitation has a Director with 5 engineers and a few support staff members. The new organization emphasizes concentration on specific fields. The present professionals in charge of water supply have received some training and are requesting further training. These professionals are capable and, with adequate training and

motivation, have the potential to strengthen the organization.

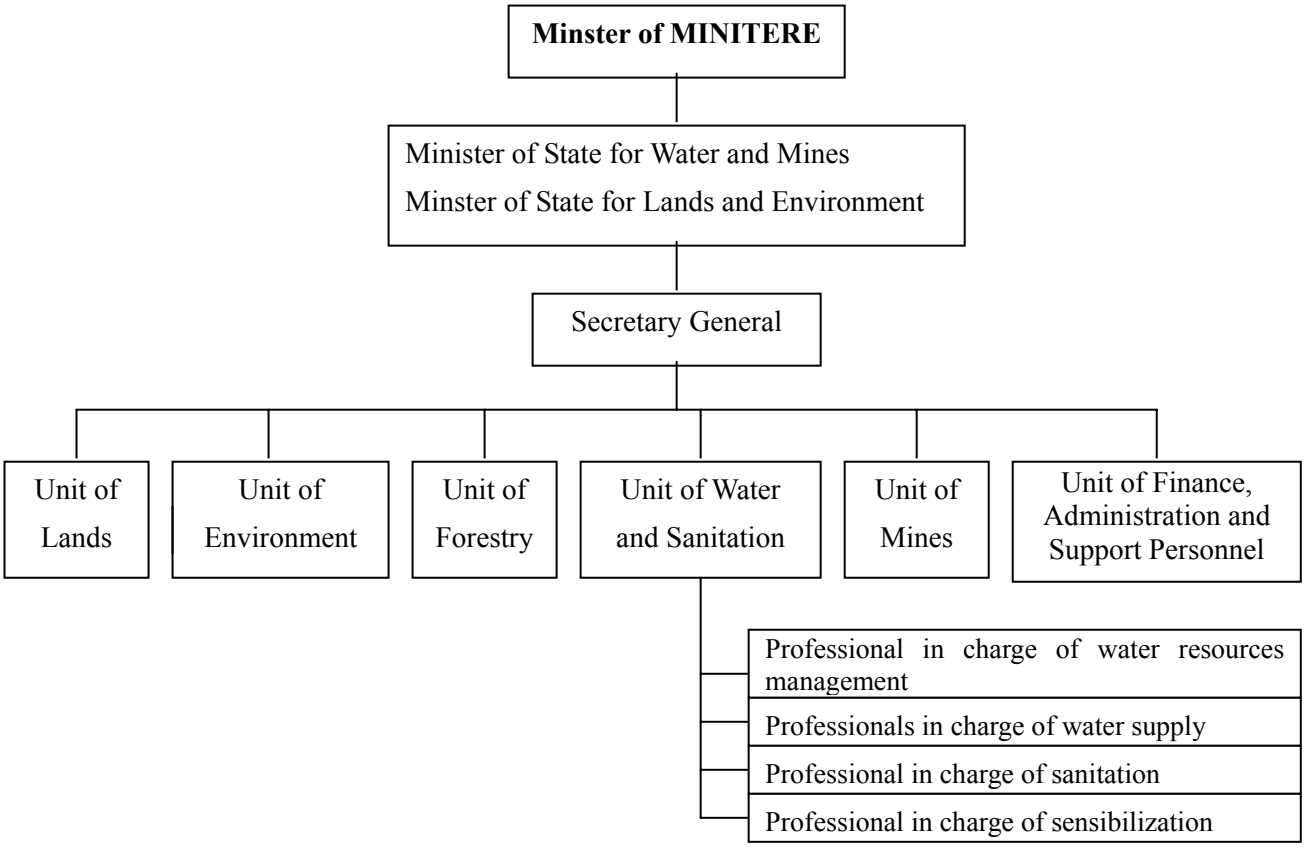


Figure 6-1: Organization chart of MINITERE

ELECTROGAZ (Société de production et de distribution d'électricité, d'eau et de gaz) is a parastatal organization in charge of urban water supply operations, as well as electric power transmission and gas supply. MINITERE formulates policies for ELECTROGAZ water supply operations, but does not supervise the activities of ELECTROGAZ.

Although the African Development Bank (BAD) is promoting the creation of a national agency for rural water and sanitation (Agence nationale d'alimentation en eau potable et assainissement en milieu rural), its realization is still in the planning stage. In line with decentralization, if this agency is created, the following functions are envisaged.

- Formulate, prepare and execute projects.
- Facilitate sensibilization programs and mobilize social activities.
- Assist districts in preparation of proper operation and maintenance systems for water and sanitation.
- Coordinate the work of donors, NGOs, and other actors.

- Conduct monitoring and evaluation.

At the regional level, the Province gives responsibility for water supply to districts and towns. Although towns and districts do not have a section specifically for water supply, most of the offices staff a technician or an officer in charge of water supply. If the town or district does not have a water technician, then a technician is posted at the Sector level. According to interviews with those in charge of water supply, the main problems are lack of repair skills, tools and logistics, especially means of transportation. The water technicians have sufficient potential. If they receive training and equipment, then the system can be strengthened.

6.1.3 Regional plans on water supply

The major development policy of the Rwandese government is based on decentralization. This involves the practice of good governance for poverty reduction and sustainable development. The policy aims to empower the Rwandese population in taking charge of its own destiny, defining its own priorities, mobilizing resources and using them effectively for a sustainable community development that involves all stakeholders. In line with this decentralization policy, towns and districts must prepare a District Development Plan (DDP) or Plan de Développement Communautaire (PDC). The PDC has the overall objective of providing a tool for planning and coordinating interventions aiming to improve the living conditions and ensure harmonious development, and has the following specific goals.

- Identify the priority problems and suggest solutions to them.
- Provide a document to facilitate interventions by various stakeholders.
- Ensure cohesion between national orientations and those of the town or district.

The Strategic Plan (Plan Stratégique) for Kibungo Province is a compilation of the PDCs of towns and districts of Kibungo Province. The strategic plan lists the following problems on access to drinking water and sanitation.

a. Water sources are insufficient and far from houses.
b. Distribution pipeline networks are deteriorated and sparsely laid, and operation and maintenance systems are inefficient.
c. Capacity for treatment of surface waters is low.
d. Techniques for rainwater harvesting are not well known.
e. Cost of drinking water is rising.
f. Sanitation is not yet at a satisfactory level.

To solve the above problems, the strategic plan identifies the priority programs with the objective of improving the living conditions of the population of Kibungo Province through equitable and sustainable access to clean drinking water, as shown below.

Table 6-2: Priority programs of strategic plan

Strategic Objective	Expected Outcome	Activity
1. Increase access rate of drinking water	• 60% of health facilities are served • 25% of group resettlements are served • 50% of secondary schools are served • 30% of primary schools are served • 100% of towns are served	• Rehabilitate existing supply facilities • Construct new water supply facilities • Improve and rehabilitate spring sources • Drill boreholes
2. Improve sanitation conditions	Plans for management of rainwater and wastewater are prepared for towns of Kibungo and Rwamagana	• Seek funds • Recruit a specialist • Prepare a management plan
	Plans for management of wastewater for hospitals, secondary schools and prisons are prepared	• Seek funds • Recruit a specialist • Prepare a management plan
	Each district has latrines in markets and public places, and each household has a private latrine	Supervise a sensibilization program to residents on hygiene and sanitation
	Rainwater harvesting is assured for 2 group resettlements as model in each district by 2007	Realize a rainwater harvesting system
	A system of collection and management of solid waste is realized by 2006	• Sensibilize and train on collection and management of solid waste • Seek funds • Facilitate an organization for collection and management of solid waste
	Each household has a compost bin	Supervise the installation of compost bins to residents
	HAMS (school hygiene and sanitation) program is introduced in all schools	Promote HAMS program
3. Strengthen capacity of water management structure	Water committees are organized and functioning in all sectors	• Sensibilize residents • Organize committee members • Train technicians
4. Promote rainwater harvesting	• 40% of health facilities are served • 25% of group resettlements are served • 50% of secondary schools are served • 70% of primary schools are served	Develop technology for rainwater harvesting
5. Prepare a master plan on water supply for Kibungo Province	A master plan for water supply is prepared by 2007	• Seek funds • Formulate a master plan on water supply for Kibungo Province

The plans for the PDC can be funded by the Common Development Fund (CDF). The CDF was conceived with the objective of financing development efforts of towns and districts. At least 10% of the annual national revenue is allotted to CDF, and the town or district must bear 10% of the total project cost in order to emphasize participation of the citizens in the project.

6.1.4 Present situation of water supply in Kibungo Province

Due to insufficient infrastructures for water supply, the residents of Kibungo Province face a severe environment where residents are consuming about 8 liters/capita/day of water on average, which is far below the objective of 20 liters/capita/day.

The average distance to water points from houses in Kibungo Province is about 3 km. Some must travel over 5 km to fetch water every day. In addition, women and children, the main water fetchers, must go down extremely steep hillsides and bring up the containers filled with water by climbing up the steep hills that have no steps. The water fetchers must spend over 3 hours to accomplish this endeavor.

Residents without access to clean water fetch unsanitary waters from surface sources such as streams and lakes, as well as stagnant water sources such as mudholes and marshes. The unsanitary water is consumed without any treatment.

The average supply rate of sanitary water in Kibungo Province is reportedly about 60%, but this figure does not take into consideration the Rwandese government's criteria for access to safe water in rural areas. If these criteria are considered, the present supply rate is estimated to be about 30%.

ELECTROGAZ supplies water to the following urban areas in Kibungo Province. Currently, there is no plan to extend the existing water supply pipelines.

- KibungoTown: Parts of Kabare 1, Kibungo and Ndamira Sectors
- Rwamagana Town: Parts of Rwikubo, Kigabiro and Nyarusange Sectors
- Muhazi District: Part of Gishali
- Kigarama District: Part of Remera Sector

6.1.5 Local private enterprises and construction materials related to water supply

(1) Construction Related Companies

In Kibungo Province, five construction companies are capable of constructing water supply systems including reservoir construction, pipe laying and electrical works. Of the five companies, three as

listed below are reliable, according to district officers. These firms have their offices in Kibungo town.

- COHYTEC
- Rwamukwaya Enterprise
- ECOHYDRA

In addition, there are three private plumbers in Kibungo Province. One private plumber was confirmed in Nyarubuye district, but the others could not be confirmed during the field survey.

FORAKY AFRICA is the only drilling company in Rwanda that is capable of drilling boreholes. There are other drilling companies in the neighboring countries of Uganda, Kenya and Tanzania, but they are at a disadvantage due to transportation and mobilization costs to Rwanda. FORAKY is reliable with sufficient experience and a reasonable cost.

(2) Local Consultants

In Rwanda and its neighboring countries such as Uganda, there are companies that can be subcontracted to conduct surveys on such topics as topography, power line extension, geosoil condition, geophysical characteristics and social situation.

(3) Construction Materials and Equipment

Construction materials such as sand and gravel are available locally, and other materials and equipment are mostly imported from neighboring countries and Europe. PVC pipes are manufactured locally by SONATUBE, a company based in Kigali.

6.1.6 Water resources of Kibungo Province

(1) Type of Water Sources

The water sources used in Kibungo Province are surface waters and groundwater. Surface waters consist of river water and lake water. Although river waters are contaminated, these are used by residents of areas where no other water sources are available. Lakes are found in Muhazi, Mirenge and Cyarubare Districts, and rural residents in these areas use lake water that is also contaminated. On the other hand, groundwater is taken from wells or from spring sources, and springs are widely used in Kibungo Province. Below is a diagram on water sources of Kibungo Province.

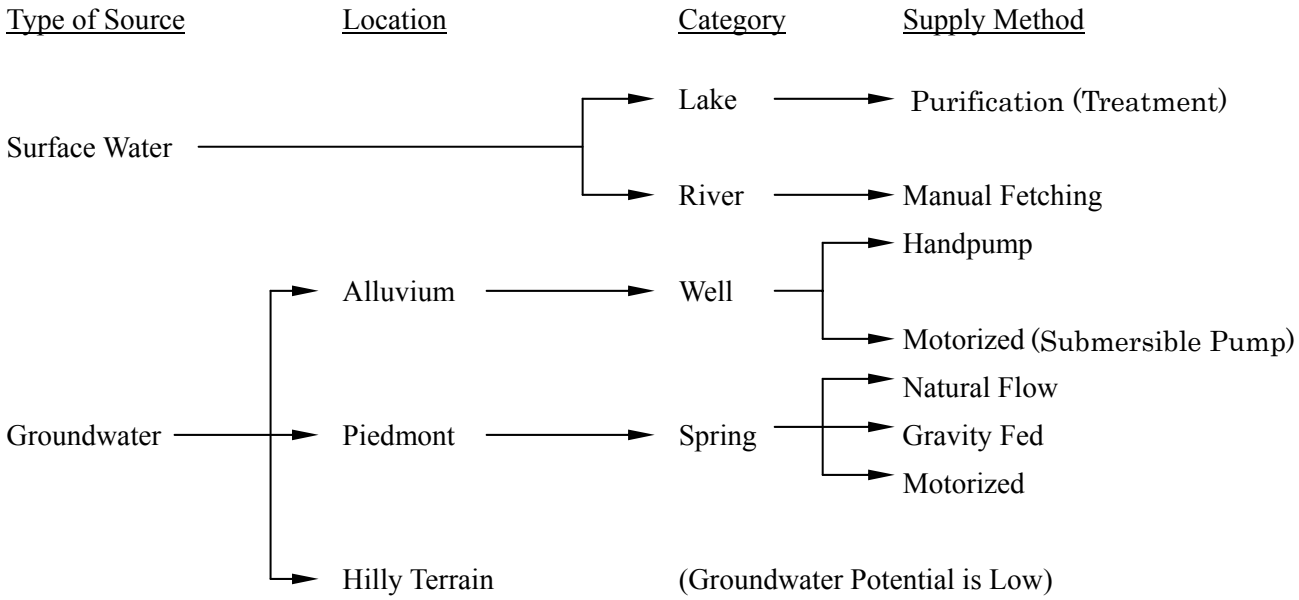


Figure 6-2: Water sources of Kibungo Province

The water source generally used in Kibungo Province is groundwater. The potential of groundwater from a hydrogeological viewpoint and conditions of spring sources are explained hereafter.

(2) Potential of Groundwater

The geology of Kibungo Province consists of layer groups that are distributed along the tectonic line running north to south. These groups are metamorphic rocks of the precambrian period, and granite intrudes into these groups. A newly formed alluvium can be found in lowlands along the tectonic line. Alluvium is also formed in the dissected valley. Groundwater potential is the highest in this alluvial area where groundwater sources in shallow aquifers or in upper weathering zones are being developed. This is where groundwater development was implemented by the previous Japanese grant aid project. In this valley, alluvial gravel and weathering zones of quartzite and schist form the aquifer and the

yield is 6-15 m^3/h according to test drilling results of the previous JICA development study. Moreover, according to results of test drillings along the edge of hillsides above the alluvial lowland, the yield in alternating layers of schist and quartzite is 1-6 m^3/h, but yield differs depending on weathering conditions and existence of faults.

According to the results of test drillings and field surveys in the present study, potential for groundwater development is expected to be low along hilltops of Cyarubare, Kabarondo, KIgarama and Rukira Districts where Rukira and Kibaya formations are distributed. Even if some potential is confirmed, pumping by handpumps would be difficult because the water level is predicted to be low. In this study, test drillings were made at 2 sites in a granite formation area, but groundwater potential was confirmed to be low at both sites (see 6-2). Granite rock distributed in Muhazi and Mirenge Districts is of a similar formation which is granite-pegmatite containing large crystalline mica and feldspar. These minerals change to clay containing kaolin upon weathering. Granite of both districts has low permeability and groundwater potential is believed to be very low and groundwater development in granite formation areas in general is presumed to be very difficult.

Therefore, groundwater development using wells in Kibungo Province is limited to alluvial zones or hillsides and terraces along alluvial zones.

(3) Spring Sources and Their Conservation

Springs are widely found in Kibungo Province, but springs from faults in rock formations could not be confirmed. Many of the springs are found where mountain slopes come in contact with valley floors or from rear ends of valleys surrounded by mountains on three sides. The mechanism of a spring can be explained as follows.

Rainwater infiltrates into the surface layer and this seepage water gently flows down through the surface soil along the mountain slope. When the water reaches the valley, it percolates out as a spring source along the border between the surface soil and weathering bedrock or where clay in the surface soil forms a border. The flow rate is higher where the recharge area is widely open.

The methods of capturing spring water are the following.

a. A small pond is dug and residents fetch water that has naturally filled the pond.
b. A perforated pipe is inserted into the soil in the direction of the spring flow and a concrete structure is constructed where water can be fetched from the pipe (protected spring).
c. For large scale supplies, reticulation pits are constructed at points where springs flow out and the water is transmitted to a junction well and stored in a storage tank, then supplied by gravity or pumped up to a distribution tank and served through taps.

Most of the existing motorized water supply systems using springs are old and deteriorated, and many are damaged and not functioning.

If springs are to be used as water source, an important issue is to prevent source depletion and water contamination in the future. Consequently, measures for environmental conservation of the catchment area need to be tackled.

The conceptual drawing of spring sources of Kibungo Province is shown in the next page.

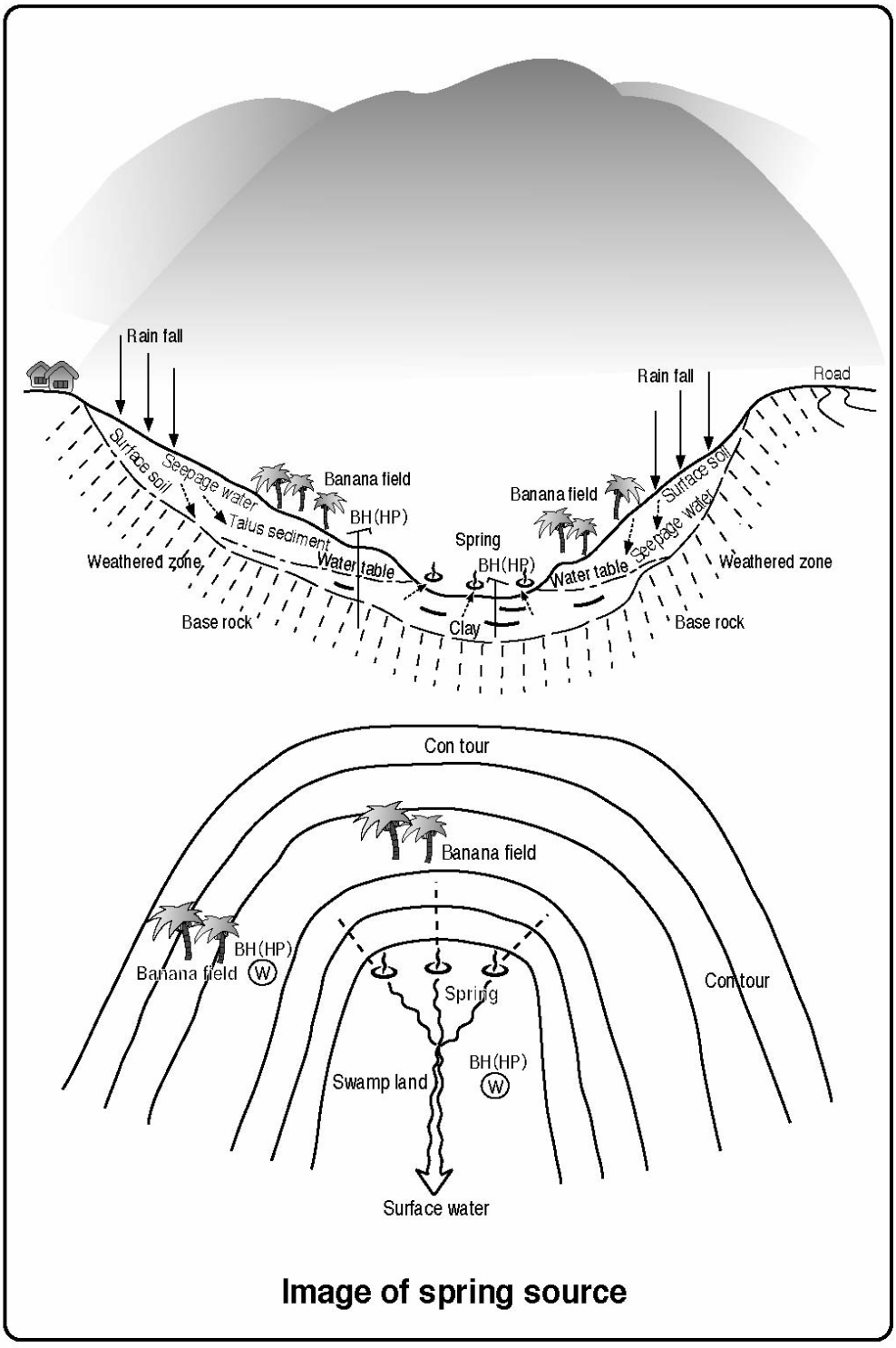


Figure 6-3: Conceptual drawing of spring sources in Kibungo Province

(4) Water Quality

Water quality analyses were made in the field using portable analysis kits on significant parameters such as pH, conductivity, iron and fluoride contents. Since Rwanda has adopted the WHO guidelines for drinking water quality, these were referred to for this study. In-situ water quality tests were made at 33 points in Kibungo Province, and their results are shown in Table 6-3. According to results of these analyses, with the exception of coliform group counts, the water sources in Kibungo Province are generally of good quality. Characteristics of parameters are explained below.

pH	Rainwater and surface waters are mostly neutral, but Muhazi lake water indicates a high pH of 8. Springs are slightly acidic because the groundwater environment of springs is in an acidic state through influence from organic plants in surface soils.
Electric Conductivity	Electric conductivity values of springs are generally low. This implies that dissolved contents are low and that the groundwater is circulatory rather than stagnant.
Ammonia, Nitrate, Nitrite	Samples from springs other than that of Karambi Cell of Muhazi District had concentrations below the WHO guideline values. Since Ammonia and Nitrite were not detected, this means that springs are presently not contaminated by fertilizers and other pollutants.
Iron, Fluoride	Samples taken from springs in the present study did not reveal any problems for the 2 parameters. However, previous studies reported that river water from Rukira District had iron contents of 0.7 to 1.0 mg/l. According to WHO reports, iron concentrations of over 1.0 mg/l is not detrimental to the health of residents. However, using water having concentrations higher than 1.0 mg/l for washing clothes can add a slight color to the clothes, and the water can have a somewhat unfavorable taste.
Hardness, Chloride	Both of these parameters are in accordance with the WHO guideline values.
Coliform Group	Coliform group counts are high in many samples. Groundwater does not usually contain these bacteria if the borehole is properly constructed. Chlorinators are not installed in existing water supply systems and installation in future plans is necessary. However, simple chlorination

such as adding bleaching tablets or powder can treat bacteria infected water, but since rural residents are usually reluctant to continuously follow this procedure, they are advised to boil water suspected of bacteria if used for drinking,

Table 6-3 Results of In-Situ Water Analyses

No.	Sampling Location			Latitude	Longitude	Altitude (m)	Type of Source	Topography, Geology	Temp. ℃	pH (-)	Appearance, Odor	Elect. Cond. (μs/cm)	Ammonia NH_4(mg/l)	Nitrate NO_3(mg/l)	Nitrite NO_2(mg/l)	T-Fe (mg/l)	F (mg/l)	Total Hardness (mg/l)	Cl (mg/l)	Coliform Count	Observation
	District	Sector	Cell																		
1	KIBUNGO	Sakara	Kukarambi				Natural spring		22.0	5.5	Brownish, Odorless	222	>0.2	10	>0.02	>0.2	0	60	75		
2	KIBUNGO	Sakara	Nyagatabe				Protected spring		22.4	5.67	Clear, Odorless	176	>0.2	10	>0.02	>0.2	0	55	100		
3	RWAMAGANA						Rainwater		21.8	7.54	Clear, Odorless	47.4	>0.2	>1	>0.02	>0.2	0	5	>25		Rainwater
4	RWAMAGANA						Tap water		27.1	7.87	Clear, Odorless	569	>0.2	>1	>0.02	>0.2	0	325	150		Tap water
5	RWAMAGANA	Mwulire	Gisanga				Spring		23.2	5.32	Clear, Odorless	290	>0.2	20	>0.02	>0.2	0	65	100		
6	RWAMAGANA	Sovu	Kabuya				Spring		23.0	5.67	Clear, Odorless	293	>0.2	20	>0.02	>0.2	0	80	100		
7	RWAMAGANA	Rutonde	Gitega				Spring		22.9	6.08	Clear, Odorless	354	>0.2	30	>0.02	>0.2	0	110	150		
8	CYARUBARE	Kadiridimba	Cyabajwa	S1°57.654′	E30°35.373′	1,370	Handpump	Alluvium	27.1	5.2	Rusty odor, Cloudy	273	>0.2	>1	>0.02	>0.2	0				
9	CYARUBARE	Bisenga	Nyakamazi	S2°05.354′	E30°35.172′	1,400	Protected spring	Valley bottom	24.3	5.61	Clear, Odorless	307	>0.2	10	>0.02	>0.2	0	95	75	High	
10	CYARUBARE	Bisenga	Ngama	S2°03.238′	E30°35.796′	1,450	Protected spring	Valley slope	26.4	5.72	Clear, Odorless	242	>0.2	2	>0.02	>0.2	0.4	80	80	Very high	
11	CYARUBARE	Shyanda	Rusave	S1°59.294′	E30°34.787′	1,380	Spring	Small valley	28.5	5.6	Slight cloudy	335	>0.2	2	>0.02	>0.2	0	120	100	Very high	Polluted
12	CYARUBARE	Mukoyoyo		S1°54.524′	E30°40.762′	1,330	Handpump	Alluvium	22.1	6.2	Clear, Odorless	232	>0.2	1	>0.02	>0.2	0	80	75	High	
13	KABARONDO	Nkungu	Murudashya	S.2°2.167′	E30°25.552′	1,350	Handpump	Terrace	21.6	5.2	Slight cloudy	380	>0.2	8	>0.02	>0.2	0	75	75	High	
14	KABARONDO	Syinzovu	Bunono	S2°00.853	E30°32.733′	1,420	Protected spring	Hill slope	23.3	5.37	Clear, Odorless	213	>0.2	10	>0.02	>0.2	0	60	50	Very high	
15	KABARONDO	Kabarondo		S1°59.524′	E30°34.154′	1,440	Handpump	Hill slope	21.9	5.6	Clear, Odorless	260	>0.2	10	>0.02	>0.2	0	105	75		
16	MIRENGE	Mabuga	Akabira	S2°12.747′	E30°23.630′	1,330	Spring	Alluvium	26.6	5.5	Cloudy	131	>0.2	2	>0.02	>0.2	0	65	75	Very high	
17	MIRENGE	Church		S2°11.887′	E30°22.846′	1,360	Protected spring		24.4	5.8	Clear, Odorless	126	>0.2	5	>0.02	>0.2	0	55	75	Low	Gravity
18	MIRENGE	Ngoma	Bukokoza	S2°11.789′	E30°25.201′	1,350	Protected spring	Marsh land	22.3	5.3	Clear, Odorless	120	>0.2	20	>0.02	>0.2	0	50	50	High	Pumped, Not function
19	MUHAZI	Kabare				1,470	Muhazi lake		26.4	8.0	Slight cloudy	553	>0.2	>1	1.0	>0.2	0	80	>25		
20	MUHAZI	Musha	Ikibuhura	S1°55.706′	E30°21.292′	1,470	Protected spring	Hill slope	27.3	5.5	Clear, Odorless	417	>0.2	1.5	>0.02	>0.2	0	165	125	Low	Pumped
21	MUHAZI	Mukarange	Cyeru				Borehole		22.3	5.67	Clear, Odorless	253	>0.2	5	>0.02	>0.2	0	90	75		Pumped, Not function
22	MUHAZI	Murambi	Karambi				Protected spring		22.0	5.48	Clear, Odorless	302	>0.2	<45	>0.02	>0.2	0	105	100		
23	NYARUBUYE			S2°09.552′	E30°48.891′	1,500	Spring	Hill slope	26.7	6.8	Clear, Odor	164									
24	NYARUBUYE			S2°12.883′	E30°45.246′	1,460	Surface water	Nyabitare river	29.2	6.94	Turbid	260									
25	RUKIRA	Rurama	Gatsi	S2°11.702′	E30°30.777′	1,460	Spring	Rwanyakagezi riv	24.0	6.84	Clear, Odorless	165	0.2	2	>0.02	>0.2	0	60	50		
26	RUKIRA	Gituku		S2°7.311′	E30°39.077′	1,680	Protected spring	Hill slope	27.0	5.2	Clear, Odorless	260	>0.2	>1	>0.02	>0.2	0	55	>25	Low	Gravity
27	RUKIRA	Rurenge	Ruzinga II	S2°15.249′	E30°32.987′	1,380	Spring	Alluvium	23.2	5.8	Clear, Odorless	190	>0.2	5	>0.02	>0.2	0	70	50		
28	RUKIRA	Rurenge	Ruzinga I				Handpump	Terrace	23.7	5.5	Clear, Odorless	195	>0.2	3	>0.02	0.2	0	60	75	High	
29	RUSUMO	Kirehe	Nyabikokova	S2°17.319′	E30°39.480′	1,410	Surface water	Sagatare river	24.1	5.67	Clear, Odorless	164	>0.2	>1	>0.02	0.5	0				
30	RUSUMO	Kirehe	Rutabagu	S2°15.853′	E30°38.101′	1,500	Spring	Valley bottom	25.5	5.61	Clear, Odorless	240	>0.2	>1	>0.02	>0.2	0				
31	RUSUMO	Gatore	Cyunuzi	S2°17.272′	E30°33.961′	1,340	Handpump	Hill slope	23.3	5.7	Clear, Odorless	413	>0.2	>1	>0.02	>0.2	0	80			
32	RUSUMO	Kigina	Mayizi				Protected spring		22.2	6	Clear, Odorless	216	>0.2	5	>0.02	>0.2	0	110	100		
33	RUSUMO	Gatore	Cyunuzi				Handpump		22.4	6.57	Clear, Odorless	365	>0.2	1	>0.02	>0.2	0	210	150		
	WHO Guideline Value									**6.5-8.5**				**50**	**3**	**0.3**	**1.5**	**500**	**250**		

6.1.7 Water supply systems appropriate for available sources

The water supply systems presently existing in Kibungo Province include natural springs, protected springs, boreholes with handpumps, gravity fed systems and pumped up systems with pipelines. Many of the systems are old, deteriorated, and thus require rehabilitation or renewal. This study carried out a survey on the existing systems to determine the necessity for new systems or rehabilitation and extension of the present systems.

Based on the survey of existing systems, the systems appropriate for supplying the water sources available in Kibungo Province are listed below along with conditions for their selection.

Table 6-4: Conditions for selection of appropriate water supply system

Water Source	Water Supply System	Location of Water Source	Population Scale	Settlement Characteristic
Spring	Protected Spring	Near settlement	Small	Scattered
	Gravity Piped Spring	Higher than settlement	Large	Clustered
	Pumped Spring	Lower than and distant to settlement	Large	Clustered
Groundwater	Well with Hand-pump	Near settlement	Small	Scattered
	Pumped Well	Lower than and distant to settlement	Large	Clustered
Surface Water (Lake, River)	Pumped System with Treatment	---	Large	Urbanized
Rainwater	Rainwater Harvester	---	Small	Scattered

Surface waters are generally contaminated due to natural and human living conditions. Residents without appropriate water sources fetch water from rivers and lakes and use it for drinking without any treatment. Consequently, they contract water-borne diseases. Surface waters require some kind of treatment for supply as drinking water, and the scope of work for construction of treatment facilities cannot be implemented within the allowed schedule for the Japanese grant aid scheme. Furthermore, difficulties can arise in operation and maintenance of treatment facilities in rural areas. Therefore, this study will not consider the use of surface waters.

Rainwater harvesting is a feasible method for supplying water to improve the shortage of water in this area. The Rwandese government is promoting the construction of these facilities especially in schools. This simple technology should be advanced by the local side and will not be included in the scope of this study.

The various supply systems listed above for spring and groundwater sources will be considered in this study. The appropriate system for each site will be determined according to the conditions listed above and requirements of actual situation at the site as well as discussions with relevant towns and districts.

6.1.8 Evolution of JICA studies and effects on assistance concept

The previous studies (development study, basic design study, preliminary study) by JICA focused on groundwater development because of the two following reasons.

- The studies were conducted before and during resettlement when the residents were living in lower areas and the houses were scattered.
- Spring sources were believed to be almost fully developed, thus development was mainly required in groundwater sources.

However, the situation has changed as follows.

- Resettlement is now almost complete, and the housing situation is clustered on higher areas for different water supply requirements.
- Spring sources are still available and require further development.

Therefore, the present situation requires a different concept in which pumped water supply systems with pipelines need to be considered.

The present rate of grouped resettlement (imidugudu) for Kibungo Province is over 90%, which implies that resettlement is almost complete. The changes due to resettlement and their effects on water supply are shown below.

Table 6-5: Effects of resettlement

Parameter	Before Resettlement	After Resettlement (Present)
Location of settlements	Mainly low areas	Higher areas
Layout of housings	Scattered	Clustered
Suitable water supply system	Point source	Piped

The feasibilities of various water supply systems on the progress of resettlement are listed in the following table.

Table 6-6: Changes in adaptability of water supply systems

Water Source	Supply Facility	Adaptability	
		Before Resettlement	After Resettlement (Present)
Groundwater	Handpump	High	Low
	Pumped up	Low	High
Spring	Protected spring	High	Low
	Gravity fed	Conditional	Conditional
	Pumped up	Low	High

As a result of changes in the actual situation, the present study will consider spring sources and groundwater sources using various methods to supply water to the residents.

6.1.9 Operation and maintenance

(1) Conditional Requirements for Operation and Maintenance

Proper management and operation and maintenance of water supply systems are essential for sustainable use of the systems. The supply systems considered for this study have requirements in operation and maintenance as listed below. Since these requirements are related to the capability and willingness of the beneficiaries, high consideration must be given to these requirements in selection of the water supply system.

Table 6-7: Requirements for Operation and Maintenance

Water Supply System	Power Source	Operation and Maintenance Requirements				
		Main Routine Cost Factor	Responsi-bilities	Frequent Repairs	Capability and Willingness to Pay	Organizational Capacity
Pumped up	Electricity	Power cost	Medium	Pipe, tap	High	High
	Diesel engine	Fuel cost	Very high	Pipe, tap	High	High
Gravity fed	Gravity	None	Low	Pipe, tap	Average	Higher than average
Handpump	Manual	None	Low	Packing	Average	Average
Protected spring	Natural	None	Very low	None	Low	Average

(2) Present State of Operation and Maintenance

The present operation and maintenance situation for boreholes equipped with handpump is mostly unmanaged. The main reasons are nonexistence of spare parts and lack of maintenance tools for handpumps as well as repair skills. However, for districts with technicians who were trained during the Japanese project implementation, repairs are possible to a certain extent. But routine maintenance needed to prevent major damages is not done.

Piped water supply systems are operated and maintained by autonomous water management committees with functions on the four levels of district, sector, cell and water point. Fees are collected either on a volumetric basis where a 20 liter container (called a jerrican or jerry can) is the basic unit, or a fixed rate where an annual charge is collected from beneficiary families. The collected fees are allotted to pay salaries of technicians and costs of parts when repairs are needed.

(3) Proposal for Improvement of Operation and Maintenance System

The present four-tier system seems to be working, but each district has a different organization and its own concept. The district and sector level members are either government officials or volunteers. Donors and NGOs introduce different systems of operation and maintenance. Therefore, the study team suggests that the organization be unified in order to promote effective management. In this system, responsibilities can be allocated as follows.

- The District should be in charge of coordination, water fees accounting, and saving, procurement and storage of spare parts.
- The Sector (Secteur) should post water supply technicians who will advise on technical matters, supervise repairs by the tap minders, and manage fees transferred from the Cells to the district.
- The Cell (Cellule) should conduct sensibilization activities and sanitation education to users, and manage fees collected by the tap minders to transfer to the Sector.
- The water point minders or Fontainiers should be in charge of collecting fees and making minor repairs.

The proposed organization for operation and maintenance of water supply systems for towns and districts in Kibungo Province is summarized in the following table.

Table 6-8: Proposed Four-Tier System of Operation and Maintenance

Level	Function	Responsibilities
District	In Charge of Water Supply	Coordination, procurement of parts, storage of parts, bank account
Sector (Secteur)	Water Supply Technician	Technical advise, supervision of repairs
Cell (Cellule)	Facilitator (Animateur)	Sensibilization on proper water use and water fee payments; sanitation education; cleanliness management
Water Point such as Tap (Robinet) or Handpump	Water Point Minder (Fontainier)	Fee collection, inform repair requirements, minor repairs

However, in order to realize a proper maintenance system for sustained operation of water supply systems, an organizational strengthening and capacity building program that includes the following activities is required.

- Strengthening of the management, operation and maintenance system for water supply systems to standardize the structure and program
- Preparation of manuals for proper management and effective operation and maintenance
- Capacity building of District, Secteur and Cellule staff as well as tap minders on management, operation and maintenance
- Training of trainers on procedures for sensibilization and sanitation education, including continuous monitoring and evaluation
- Sensibilization activities and sanitation education to community leaders and residents

6.1.10 Proposal for water supply to Kibungo Province

(1) Conditions and Constraints on Water Supply Method

As explained previously, this study will consider both spring and groundwater sources to supply water to the residents of Kibungo Province. The following conditions will be considered for formulating proposals for water supply to Kibungo Province.

- Groundwater development in Kibungo Province is limited only to certain areas and thus cannot be given high priority. The survey revealed that granite formation areas and along tops of hills have especially low potential for groundwater development.
- Spring sources are presently exploited in many areas of Kibungo Province, but their potential also has limits in terms of location and quantity. Careful attention is needed for their development. However, spring sources are available for further development.

- Some existing piped systems using spring sources are in need of repairs and/or extensions, and the Rwandese side is trying to remedy the situation through CDF or assistance from donors and NGOs. The study team would like to respect these efforts made by the Rwandese side and direct the Japanese assistance to areas that are unable to receive benefits from these systems.

Therefore, new piped systems will be given priority. If spring sources can be supplied by gravity, then this system will have higher priority. If gravity supply is difficult, then pumped systems will be considered. A constraint on pumped systems is that a commercial power grid is available for extension to the pump station within a reasonable distance, and diesel pumping will be considered only upon confirmation of feasibility for cost recovery from users. Furthermore, in areas where piped systems are not feasible, the following options should be considered: groundwater use through handpumps, new drillings or rehabilitation of existing facilities, or improvement of spring sources.

Other constraints on proposal for water supply systems in Kibungo Province are as follows.

a. Water source: Surface waters (rivers, lakes, etc.) and rainwater are not included in the scope of this study.
b. Water supply level: House connections (Level 3 water supply) is not included in the scope of study. Only point source supply such as handpump system and protected spring (Level 1 water supply) and piped system (Level 2 water supply) will be considered.
c. Extent of construction work: Extensions to Electrogaz pipelines will not be made, and small-scale rehabilitation and extension works will not be included in the study.

(2) Selection Criteria

The following are the selection criteria for screening of sites requested by each town and district.

a. Target site suffers from lack of drinking water.
b. Resettlement under “imidugudu” scheme has completed.
c. Should have no duplication with other donor projects.
d. Should not have any financial plans through CDF and other funds.
e. Necessary land plots are available for implementation of facilities.
f. Residents are motivated to participate in proper operation and maintenance of water supply system and pay the required water fees.
g. Is not and will not be served by an Electrogaz water supply system.
h. Can be implemented within Japan’s single fiscal year budgeting system.
i. Residents and administration can wait at least 2 years for a project to materialize.

Accessibility to water sources is also a criterion for selection of sites, but was not included in the above list due to the following reasons.

- Construction work of spring sources should be conducted on a labor intensive basis where beneficiaries should participate in carrying materials to the site and assist in digging trenches and holes. Therefore, heavy machinery and equipment are not needed at the construction site.
- Drilling for groundwater requires a drilling rig and other supporting vehicles and equipment. However, the drillings required for the proposed project are expected to be conducted in areas with existing boreholes. This means that accessibility of vehicles and equipment is already assured and is not a problem.

(3) Proposal for Water Supply Systems

Based on the above explanations and constraints, the following table lists the water supply systems proposed for Kibungo Province to meet the actual requirements of towns and districts. The systems listed below are facilities to be newly constructed or rehabilitation and extension of existing facilities.

Table 6-9: Type Classification of Water Supply Systems

<table>
<tr><th>Type</th><th>Water Source</th><th>Supply System</th><th>Power Source</th><th>Condition</th></tr>
<tr><td>A</td><td>Spring</td><td>Gravity fed</td><td>Gravity</td><td>Settlements lower than source</td></tr>
<tr><td>B</td><td>Spring</td><td rowspan="4">Pumped up supplied by pipeline network</td><td rowspan="2">Electricity</td><td rowspan="4">Residents are prepared to pay fees.</td></tr>
<tr><td>C</td><td>Groundwater</td></tr>
<tr><td>D</td><td>Spring</td><td rowspan="2">Diesel fuel</td></tr>
<tr><td>E</td><td>Groundwater</td></tr>
<tr><td>F</td><td>Groundwater</td><td>Handpump</td><td>Manual</td><td rowspan="2">Where other systems are not feasible</td></tr>
<tr><td>G</td><td>Spring</td><td>Protected spring</td><td>Natural flow</td></tr>
</table>

The next page shows the tentative proposals on water supply systems for each town and district. Table 6-11 lists the water supply systems by type.

Table 6-10 List of Proposed Water Supply Systems for Each Town/District of Kibungo Province

Town/District	Sectors to be partially covered	Water Source		Estimated Flow	Water Supply System					Population*[1]	Possible Number of Beneficiaries*[2]	Type of Construction		
		Spring	Groundwater	l/s	Gravity	Pumped/Pipe		Handpump		2003		New	Rehab	Ext
						Electricity	Diesel Gen.	New	Rehab					
Kibungo	Ndamira Sakara Kibaya	Nyamuganda		2.6		O				4,167 8,063 3,232	11,200	O		
	Rubona		O	0.3				10		8,397	5,400	10		
Rwagamana	Mwulire	Gisanza		3		O				5,650	12,900	O		
	Sovu	Kabuga		2		O				3,238	8,600	O		
	Rutonde	Gitega		2		O				3,233	8,600	O		
Cyarubare	Cyabajwa Rwinkavu		O	2.8		O				10,363 8,369	5,000	O		
	Gishanda		Nyankora	2.8		O				8,762	5,000		O	O
	Shyanda Murawa Dist. Office	Ngoma		4			O			7,552 3,846	17,200	O		
	Bisenga	Nyakanazi		3			O			5,670	12,900	O		
Kabarondo	Ruyonza Ruramira Nkamba	Gatore		2		O				2,797 3,703 4,151	8,600	O		
	Rukira Kaduha Rweru	Gitoke		3		O				2,363 4,186 4,341	12,900	O		
	Musumba	Gatare		1		O				4,932	4,300	O		
	Nkungu		O	0.3				4	6	3,291	5,400	4	6	
Kigarama	Kibimba Matongo Bare	Kagoma		2		O				4,304 6,325 5,468	8,600		O	O
	Fukwe Gashanda Kansana	Kamfonyogo		1		O				3.030 3,471 5,206	4,300	O		
	Gasetsa Rurenge Remera	Gacaca		1.8		O				5,846 7,057 4,618	7,700	O		
Mirenge	Mbuye Murwa	Murama		3		O				7,091 11,886	12,900	O		
	Ngoma Ruyema	Bukokoza		0.7+0.7		O				3,177 3,374	6,000	O		
	Karembo Zaza Kukabuye Kibare Gatare Kabirizi Shywa Nyange Kagashi	Rwarutene		4		O				5,473 5,565 4,824 4,674 4,540 7,814 3,399 4,393 5,487	17,280		O	O
Muhazi	Murambi Kitazigurwa	Karambi		2		O				4,238 2,468	8,600	O		
	Mukarange Nyagatovu		Kazabazana	2.5		O				7,700 6,384	4,500		O	O
Nyarubuye	Nyarubuye Nyabitare	Kamacumbi		0.5+0.5			O			5,550 4,652	4,300	O		
Rukira	Mushikiri	Karambi		1			O			9,456	4,300	O		
	Rurenge		O	0.3				8	2	5,536	5,400	8	2	
	Murama		O	0.3				7	1	3,207	4,300	7	1	
Rusumo	Kirehe	Gahama		1.2			O			23,496	5,100	O		
	Nyamugari	Mayizi		3	O					20,397	12,900		O	O
	Kigina	Gasenyi		1			O			10,000	4,300	O		
	Gashongora Gahara	Rwimondo		2			O			10550 19,823	8,600		O	O
	Gatore	Rugina		1.5			O			15,000	6,400	O		
				Total	**1**	**17**	**8**	**29**	**9**	*[1]From PDC	**243,480**	*[2]To supply 20 l/c/d		

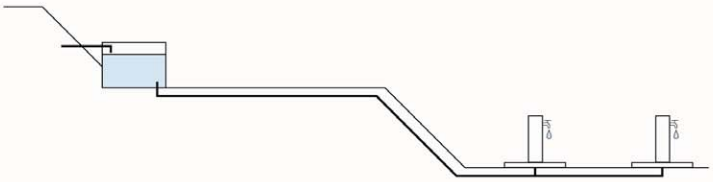
Table 6-11: Water Supply System Proposed for Each Town/District

Town/ District	Sector (Secteur)	Feasible System		District	Sector (Secteur)	Feasible System	
		Type	New or Rehab/ Ext			Type	New or Rehab/ Ext
Kibungo Town	Ndamira Sakara Kabare	B	New	Mirenge	Mbuye Murwa	B	New
					Ngoma Ruyema	B	New
	Rubona	F	New				
Rwamagana Town	Mwulire	B	New		Karembo Zaza Kukabuye Kibare Gatare Kabirizi Shywa Nyange Kagashi	B	Rehab/Ext
	Sovu	B	New				
	Rutonde	B	New				
Cyarubare	Cyabajwa Rwinkavu	C	New				
	Gishanda	C	Rehab/ Ext				
	Shyanda Murawa District Office	D	New				
	Bisenga	D	New	Muhazi	Murambi Kitazigurwa	B	New
Kabarondo	Ruyonza Ruramira Nkamba	B	New		Nyagatovu Mukarange	C	Rehab/Ext
	Rukira Kaduha Rweru	B	New	Nyarubuye	Nyarubuye Nyabitare	D	New
				Rukira	Mushikiri	D	New
	Musumba	B	New				
	Nkungu	F	New/ Rehab		Murenge	F	New/ Rehab
Kigarama	Kibimba Matongo Bare	B	Rehab/ Ext		Murama	F	New/ Rehab
	Fukwe Gashanda Kansana	B	New	Rusumo	Kirehe	D	New
					Nyamugari	A	Rehab/Ext
					Kigina	D	New
	Gasetsa Rurenge Remera	B	New		Gashongora Gahara	D	Rehab/Ext
					Gatore	D	New

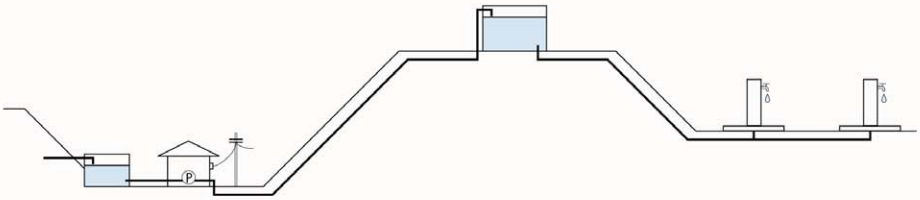
Figure 6-4 conceptualizes each system type. Figure 6-5 shows the extent of water supply coverage through the existing water supply facilities and distribution of the proposed water supply systems for towns and districts of Kibungo Province. The present conditions of the proposed water supply systems are listed in Table 6-12.

Level-2 Water Supply System

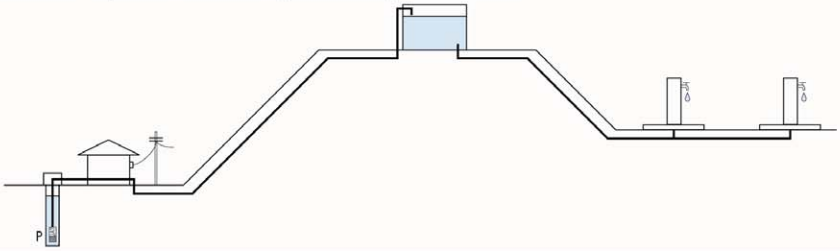
Type-A Gravity Fed Pipeline Network System using Spring



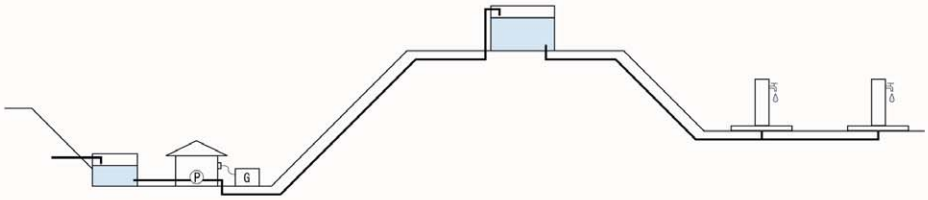
Type-B Electricity Powered Pipeline Network System using Spring



Type-C Electricity Powered Pipeline Network System using Groundwater



Type-D Diesel Powered Pipeline Network System using Spring



Level-1 Water Supply System

Type-E Borehole equipped with Handpump

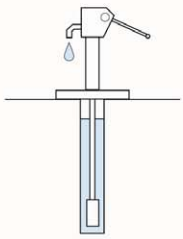


Figure 6-4. Conceptual Diagram of Proposed Water Supply Systems

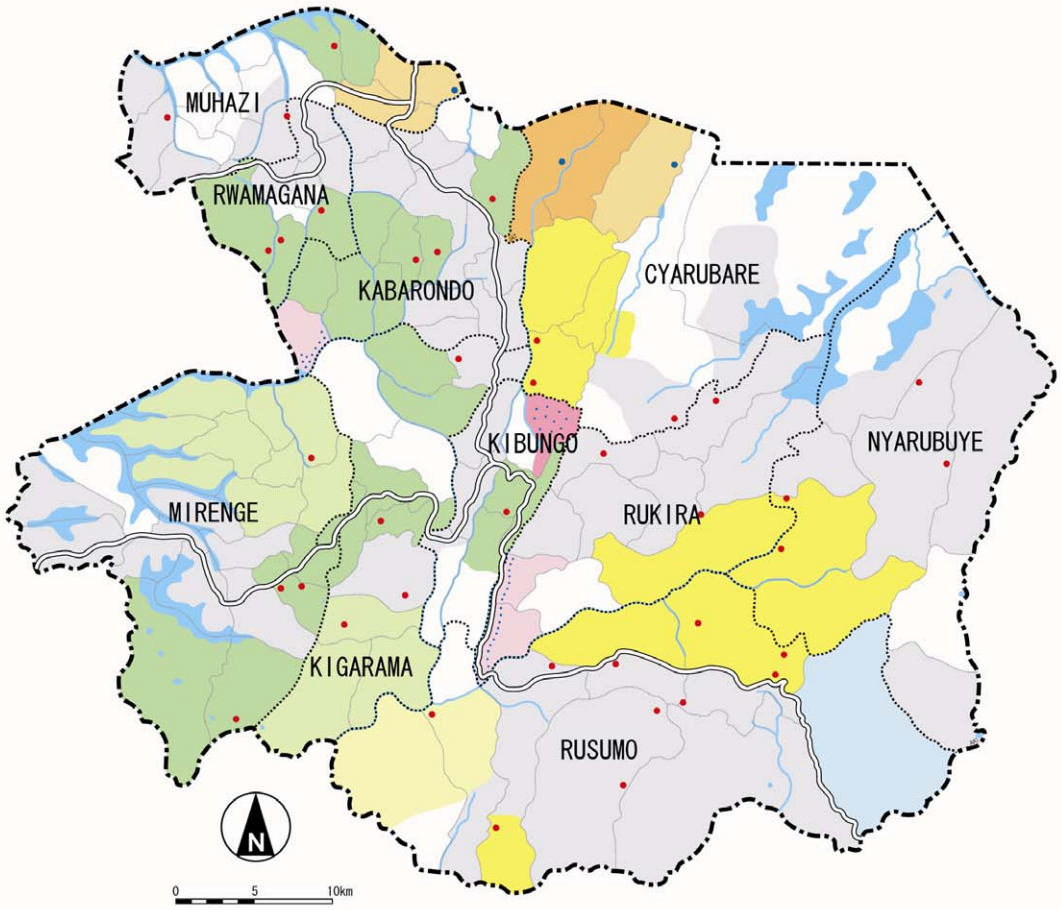


Figure 6-5. Rural Water Supply Proposal Map for KIBUNGO Province

Legend			
Province Boundary			
Town/District Boundary			
Sector Boundary			
Main Road			
Existing Water Supply Coverage			
A	Gravity Fed Pipeline Network System using Spring	Rehabilitation/Extension	
B	Elect. Powered Pipeline Network System using Spring	Rehab/Ext	New
C	Elect. Powered Pipeline Network Sys. using Groundwater	Rehab/Ext	New
D	Diesel Powered Pipeline Network System using Spring	Rehab/Ext	New
E	Borehole equipped with Handpump	Rehab/New	New
Water Source		Groundwater	Spring

Table 6-12 Present Condition of Proposed Water Supply Systems

Town/District	Sector	Cell	Name of Water Source	Type of Water Source	Flow Rate (l/s)		Supply Method	Handpmp		Facility				Power Extension Distance (km)	Construction		Served (fam)	Covered	Water Committee	Fee (FRW)		Willingness to Pay	
					Est	Selec		Tot	Func	Power	Intake Tank (m^3)	Supply Tank (m^3)	Public Stand		Year	Fund			Y/N	20 litre Jerrican	Annual (/fam)	Y/N	Cost
Kibungo	Ndamira	Kabimba	Nyamuganda	Spring	2.6	2.6	Protected Spring	-	-	-	-	-	-	5			1,600		Yes	10		Yes	
Rwamagana	Mwilire	Gisanza	-	Spring	3	3	Protected Spring	-	-	-	-	-	-	3	2003	Town	500-1,000	2 Cells	Yes		300	Yes	
	Sovu	Kabuga	-	Spring	2	2	Protected Spring	-	-	-	-	-	-	2	1987	Town	600		Yes			Yes	
Cyarubare	Gishanda		Nyankora	Groundwater	2.8	2.8	Pumped	-	-	Elect		75	12 (4 func)	-		Japan	3,000-5,000 persons	Gishanda	Yes	20		Yes	20F/20 l
	Bisenga	Ngoma	-	Spring	6	6	Pumped system const. ceased	-	-		50	100	36	-	2003	CDF			Yes		300	Yes	20F/20 l
	Bisenga	Nyakanazi	-	Spring	4	4	Protected Spring	-	-	-	-	-	-	-					No			Yes	20F/20 l
	Cyabajwa	-	-	Groundwater			Handpump	6	3	-	-	-	-	-		Japan			No				
Kabarondo	Ruyonza	Gitwe	Gatore	Spring	5	2	Protected Spring	-	-	-	-	-	-	5					No	Free		Yes	200F/yr/fam
	Ruramira	Taba	Gitoke	Spring	4.2	3	Protected Spring	-	-	-	20	-	-	6	2001	CICR			No	Free		Yes	20F/20 l
	Musumba	Kantango	Gatare	Spring	4	1	Protected Spring	-	-	-	-	-	-	5		Japan	150		No				
	Nkungu	-	-	Groundwater	0.3	0.3	Handpump	10	6	-	-	-	-	-	(Reh 2000)	Japan (GTZ)	700-1,000		No			Yes	200F/yr/fam
Kigarama	Kibimba	Kinyonzo	Kagoma	Spring	3	2	Pumped	-	-	Diesel				10 (7 to Kamfonyogo)	1985		2,000-2,400	3 Sectors	Yes			Yes	20F/20 l
	Fukwe	Umukamba	Kanfonyogo	Spring	3	1	Natural	-	-	-	-	-	-	3					No	Free		Yes	20F/20 l
	Remera		Gacaca	Spring	5	1.8	Protected Spring	-	-	-	-	120	-	3					No				
Mirenge	Mbuye	Murama	-	Spring	3	3	Protected Spring	-	-	-	-	-	-	10					No				
	Ngoma	Bukokoza	-	Spring	0.7+0.7	0.7+0.7	Natural×2	-	-	-	-	-	-	2					No	Free			
	Kabirizi	Kabonobono	Rwarutene	Spring	4	4	Pumped	-	-	Elect	40+50	170	100	-	1960 (Reh 1996)	Catholic Church	10,000	9 Sectors, 5 Secondary Schools, 2 Hospitals	Yes	10		Yes	
Muhazi	Murambi	Karambi	-	Spring	2	2	Protected Spring	-	-	-	-	-	-	6	2005	CDF			Yes		200	Yes	
	Mukarange	Cyeru	Kazabazana	Groundwater	2.5	2.5	Pumped	-	-	Diesel	100	150x2	11	3	1999	AAR	5,000-7,000	3 Sectors	Yes	20		Yes	20F/20 l
Nyarubuye	Nyarubuye	Kamacumbi	-	Spring	0.5+0.5	0.5+0.5	Natural×2	-	-	-	-	-	-	-					Yes	Free		Yes	15F/20 l
Rukira	Rugarama	Karambi	-	Spring	1	1	Protected Spring	-	-	-	-	-	-	-					Yes			Yes	20F/20 l
	Rurenge	-	-	Groundwater	0.3	0.3	Handpump	6	2	-	-	-	-	-		Japan			Yes		200	Yes	20F/20 l
	Murama	-	-	Groundwater	0.3	0.3	Handpump	2	1	-	-	-	-	-		Japan			Yes			Yes	20F/20 l
Rusumo	Kirehe	Rutabafu	Gahama	Spring	0.2+1	1.2	Protected Spring×2	-	-	-	-	-	-	-			6,000-7,000	10 Cells in Kirehe	No	Free		Yes	20F/20 l
	Kigina	Mayizi	-	Spring	3	3	Gravity Piped	-	-	-	10		30	-	1967	ADR	3,000	10 Cells in Nyamugari	Yes		600	Yes	20F/20 l
	Kigina	Gasarasi	Gasenyi	Spring	1	1	Protected Spring	-	-	-	-	-	-	-				3 Cells in Kigina	No	Free		Yes	20F/20 l
	Gashongora	Rwimondo	-	Spring	2	2	Pumped	-	-	Diesel		100	4	-	1999	UNHCR	500+Hospital	5 Cells	Yes			Yes	20F/20 l
	Gatore	Rufari	Rugina	Spring	1.5	1.5	Protected Spring	-	-	-	-	-	-	-			3,000	5 Cells in Gatore	No	Free		Yes	20F/20 l

(4) Cost Recovery

Based on interviews with district and sector level technicians, the unit costs of water are calculated as follows.

- About 0.2 FRW/liter for systems using electricity
- About 0.3 FRW/liter for systems using diesel

The average pay to the technician in charge is about 15,000 FRW/month.

The average costs for materials procured in Kibungo Province or from Kigali are as follows.

- 2,500 FRW for an ordinary tap
- 12,000 FRW for a meter
- 7,200 FRW for ϕ 2-1/2 PVC pipe

The costs of operation and maintenance of water supply systems in consideration of the above information are estimated as follows.

Table 6-13: Operation and Maintenance Cost

Item	Unit Cost (FRW/person/month)	Comment
Electricity Cost	120	20 liter/person
Diesel Fuel Cost	180	20 liter/person
Salary of Technician	5	15,000 FRW/month
Cost for Tap Repair	1.7	Repair once per year
Cost for Meter Repair	1.7	Repair every 5 years
Cost for Pipe Repair	67	Repair every 10 years
Total for Electricity	195	0.325 FRW/liter
Total for Diesel	255	0.425 FRW/liter

Presently, most of the residents of Kibungo Province are paying 10 FRW to 20 FRW for 20 liters of water, and they are consuming less than 10 liter/capita/day. The cost of water for 10 liter/capita/day is about 6 to 8% of their average income, and as they gradually increase their consumption of water, their income is expected to increase as well.

6.1.11 Project proposal for Grant Aid

To alleviate a shortage of water supply that residents of Kibungo Province face, the Rwandese government submitted a request to the Japanese government for grant assistance. In response, the Japanese government dispatched a preliminary study team of JICA in 2004 to study the feasibility of the request. The preliminary study result suggested a project focused on groundwater development, but this approach needed verification. The present project formulation study team was dispatched to formulate a program for rural development of Kibungo Province. The scope of the study included a reconfirmation of the feasibility of grant assistance for rural water supply in Kibungo Province and determination of the extent of Japan's assistance. Based on this study, the following components are proposed as possibilities for grant assistance.

Implementation of water supply systems should consist of the following construction and rehabilitation works.

a. Rehabilitation and Extension of Gravity Fed Pipe Network System using Spring 1 site
b. Construction of Electricity Powered Pipe Network System using Spring 12 sites
c. Rehabilitation and Extension of Existing Electricity Powered Pipe Network System using Spring 2 sites
d. Construction of Electricity Powered Pipe Network System using Groundwater 1 site
e. Rehabilitation and Extension of Existing Electricity Powered Pipe Network System using Groundwater 2 sites
f. Construction of Diesel Powered Pipe Network System using Spring 7 sites
g. Rehabilitation and Extension of Diesel Powered Pipe Network System using Spring 1 site
h. Construction of Borehole equipped with Handpump 29 sites
i. Rehabilitation of Existing Handpump System 9 sites

To support the rehabilitation and maintenance program promoted by the Rwandese side, the following items are required: a supply of portable flowmeters and water analysis equipment for in-situ inspections, booster pumps to supplement repair works, spare parts and maintenance tools for sustainable use of handpumps, and general mechanics and plumbing tools for proper maintenance of water supply systems.

The consultants confirmed from Rwandese government officials that an EIA (environmental impact assessment) for this project is not needed due to the scale of targeted water sources and since the project will not give a significant impact to the environment.

The proposed project components are listed below.

a. Construction of Water Supply Facilities

System Level	Type	Water Source	Supply System	Number of Sites		
				New	Rehab/Ext	Total
Level 2	A	Spring	Pipe system supplied by gravity	0	1	1
	B	Spring	Pipe system pumped by electricity	12	2	14
	C	Groundwater	Pipe system pumped by electricity	1	2	3
	D	Spring	Pipe system pumped by diesel engine	7	1	8
	Subtotal			20	6	26
Level 1	E	Groundwater	Handpump	29	9	38
Total				49	15	64

b. Procurement of Equipment

No.	Item	Quantity
1	Portable Flowmeter	10 sets
2	Portable Water Analysis Equipment (pH meter, conductivimeter, Fe meter, Mn meter)	10 sets
3	Standby booster pumps	5 sets
4	Spare parts for handpumps	1 lot
5	Maintenance tools for handpumps	3 sets
6	General mechanics/plumbing tools	10 sets

The team composition for the Basic Design Study is proposed as follows.

a. Chief Consultant/Water Supply Plan 1
b. Water Supply Plan 2/Water Supply Facilities 1
c. Hydrology/Hydrogeology
d. Water Supply Facilities 2/Topographic Survey
e. Social Survey/Management, Operation and Maintenance
f. Procurement/Cost Estimation

The required surveys to be conducted through local subcontracting are as follows.

a. Topographic survey
b. Power extension survey
c. Geosoil survey
d. Geophysical survey
e. Social survey

The implementation structure for this grant aid project should be as follows.

- Executing agency/ Responsible agency: MINITERE
- Responsible body for foreign assistance: MINECOFIN
- Other relevant bodies: Kibungo Province, MINALOC, MINAFFET

The project should be carried out as a two-phase implementation in consideration of the schedule required to implement the above components.

6.1.12 Expected outcomes

The benefits from the above proposal will be as shown in the table below. About 32% of the population of Kibungo Province can be served and about 50% of the sectors in Kibungo Province can be covered through the project.

Table 6-14: Project Benefits

Town/District	Beneficiary Population			Number of Sectors		
	Total	Project	%	Total	Project	%
Kibungo Town	44,228	16,600	37.5	7	4	57.1
Rwamagana Town	48,826	30,100	61.6	7	3	42.9
Cyarubare	78,099	40,100	51.3	8	6	75.0
Kabarondo	74,546	31,200	41.9	18	8	44.4
Kigarama	65,994	20,600	31.2	12	9	75.0
Mirenge	112,593	36,180	32.1	21	13	61.9
Muhazi	60,564	13,100	21.6	15	4	26.7
Nyarubuye	51,945	4,300	8.3	8	2	25.0
Rukira	61,878	14,000	22.6	10	3	30.0
Rusumo	162,224	37,300	23.0	9	6	66.7
Total	760,897	243,480	32.0	115	58	50.4

The ratios of beneficiary population to water sources and water supply system levels are shown in the table below. The table reveals that about 92% of the total population will benefit from level 2 supply systems, which implies that a rise in living standards of the residents of Kibungo Province can be expected.

Table 6-15: Beneficiary Population by Water Source and Supply Level

Water Source	System Level 2		System Level 1		Total	
	Population	Ratio (%)	Population	Ratio (%)	Population	Ratio (%)
Spring	212,980	87.5	0	0.0	212,980	87.5
Groundwater	10,000	4.1	20,500	8.4	30,500	12.5
Total	222,980	91.6	20,500	8.4	243,480	100.0

Improvement of the water supply situation through projects such as that proposed above can provide the following outcomes to the beneficiary residents of Kibungo Province.

(1) Short Term Outcomes

- The beneficiary residents will receive a continuous supply of safe water.
- Distance to water points will be shortened.
- Time required for fetching water will be reduced.
- Water accessibility rates for towns and districts of Kibungo Province will improve.

(2) Medium Term Outcomes

- Water supply systems will be maintained properly.
- Water-borne diseases will decrease.
- Women will have more opportunities for other household chores and constructive work.
- Children will be able to attend school more regularly.

(3) Long Term Outcomes

- Sanitary conditions will improve.
- Rural development will advance.

6.2 Results of Geophysical Surveys and Test Drillings

6.2.1 Field survey

Groundwater development in Kibungo Province is limited and especially difficult in granite formation areas and along mountaintops. Previous studies by JICA have revealed that these areas have low potential that should nevertheless be investigated. Therefore, in this study, the team made geophysical surveys and test drillings in granite formation areas and along hilltops where settlements are now grouped together due to the resettlement policy of the government. Two representative sites for each area were selected for this study. Test drillings were conducted at the granite formation areas of Kabare and Gishali Sectors in Muhzai District, as well as on mountaintops at Murama Sector in Cyarubare District. The map on the next page indicates the locations of the geophysical surveys and test drillings, and results of the surveys are explained below.

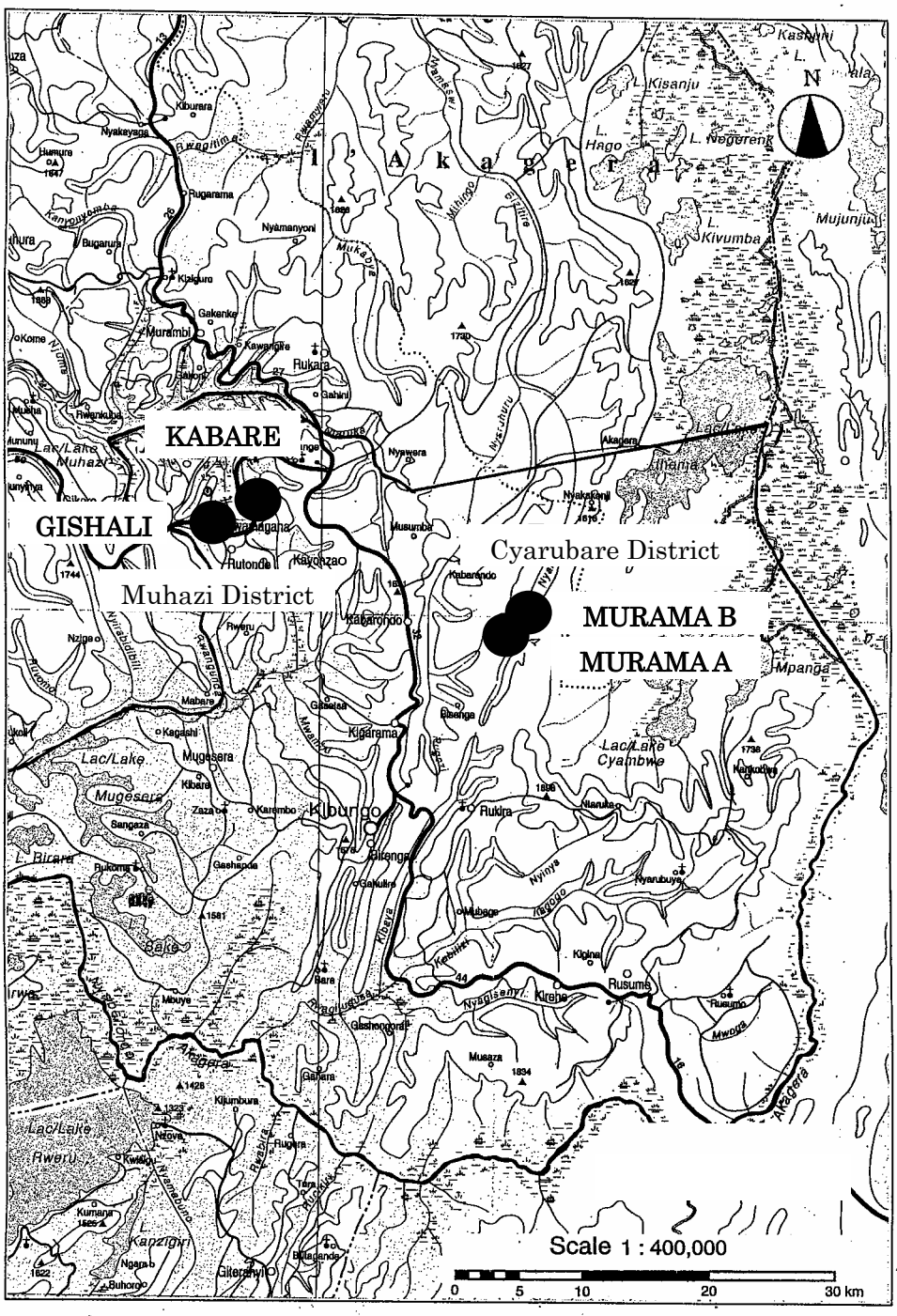


Figure 6-6: Test Drilling Location Map

6.2.2 Survey in Granite formation areas

Granite formations are located in the four Districts of Muhazi, Cyarubare, Mirenge and Rusumo. Of these areas, in Mirenge District, test drillings were made during the previously implemented development study at 2 locations. At one of these sites, as a hole was drilled down to 81 m, groundwater occurrence was confirmed in the weathering zones of granite and schist. But at another site where drilling was conducted in a completely granite formation zone, groundwater potential could not be confirmed. The granite area in Cyarubare District is located inside the National Park, and thus cannot be selected for test drilling. In Rusumo District, the granite is located near the Tanzanian border as an aggregate, but residents reside mostly in the outskirts of the granite hills, next to alluvial formations, and residences are not found on hilltops. Granite in Muhazi District encompasses Muhazi Lake. Although ELECTROGAZ is providing water to a part of the district, most of the residents must rely on lake water. Also, due to the progress of group resettlement in this area, population is increasing. Muhazi Distirct was selected for test drilling since a groundwater survey in the granite zone of this area had not been conducted yet. Upon discussions with the District office, the geophysical surveys and test drillings were held at Kabare and Gishali.

(1) Results of Geophysical Surveys

Geophysical surveys including geoelectrical prospecting and vertical electrical sounding were conducted. Based on the results of these surveys, test drilling points were selected. The results showed that resistivities of the 2 points are low at 500Ω-m and significant fluctuations in resistivity were not found. Weathering down to deep layers was presumed. Granite in this area is mainly pegmatite rocks characterized by large mica crystals assumed to be massive rocks. To determine groundwater potential in the upper layer weathering zone as well as the lower layer, test boreholes were drilled down to 50 m at Kabare and to 100 m at Gishali.

(2) Results of Test Drillings

1) Kabare Site

Kabare is approached by going northward on the national road that runs between Rwamagana Town and Kayonza, and then north from the point where the road curves to the right. The test borehole was drilled at a point about 2,850 m from the turnoff of this road. The residents of this area make 3 to 4 trips every day down to Muhazi Lake to fetch water. The test drilling was conducted to determine the groundwater potential in the granite formation of this area. In this area, a weathering zone of granite directly underlies the surface layer. The geologic structure is as follows.

0 - 26m Highly viscous brownish lateritic clay:

- No groundwater

26 -50m Highly weathering granite:

- Weathering zone contains large amounts of mica, and rock is soft showing high viscosity when moistened.
- Rock fragments could not be seen in boring samples, but feldspar and mica could have been argillized.
- Groundwater potential in this weathering zone was determined to be low.

2) Gishali Site

Gishali can be reached by traveling about 2 km from Rwamagana Town in the direction of Kigali, and going northbound towards Muhazi Lake for about 3 km. ELECTROGAZ is supplying water to a part of this area, but many of the residents are relying on Muhazi Lake water. The test drilling revealed that granite in this area is weathering formation down to deep layers similar to Kabare. The geological formation is shown below.

0 - 19m Highly viscous brownish lateritic clay:

- No groundwater

19 - 60m Secondary highly weathering granite:

- Highly weathering zone of pinkish to light brown similar to Kabare area

60 -100m Primary weathering zone:

- From 60m, color changes to grey to dark grey then to black.
- This weathering granite is soft rock and becomes highly viscous when moistened.
- Rock fragments could not be found in boring samples, and they were soft rock.
- Groundwater potential could not be confirmed at drilling down to 100 m.

3) Geologic Column

The geologic columns for Kabare and Gishali are shown in the following drawings.

DRILLING LOG

Location	District	Sector	Cell	Latitude	Longitude	Altitude(m)
	MUHAZI	Kabare	Ibyeza	S1° 52.478′	E30° 26.187′	1,550 m
Boring-No	KABARE	Well Casing Depth			Yield	
Drilling Depth	52 m	Screen			Static Water Level	m
Drilling Diameter	10″	Pump Position		m	Dynamic Water Level	m
Casing Size		Commenced on		2005/4/22	Completed on	2005/4/23

Depth (m)	Geologic log	Geological Description	Remarks
0 – 27		Overburden Brown Color Laterite Clay	
27 – 52		Completely weathered to highly weathered Zone Pegmatite Garnite Highly soft dry Formation Pinkish ~Redish Color	
52 – 60			

Figure 6-7: Geologic Column of Kabare

DRILLING LOG

Location	District	Sector	Cell	Latitude	Longitude	Altitude(m)
	MUHAZI	Gishali		S1° 52.665′	E30° 26.276′	1,530 m
Boring-No	GISHALI	Well Casing Depth			Yield	
Drilling Depth	100 m	Screen			Static Water Level	m
Drilling Diameter	10″	Pump Position		m	Dynamic Water Level	m
Casing Size		Commenced on		2005/4/25	Completed on	2005/4/27

Depth (m)	Geologic log	Geological Description	Remarks
0 – 20		Overburden Brown Color Laterite Clay	
20 – 60		Completely weathered to highly weathered 2nd Zone Pegmatite Granite Highly soft dry Formation Pinkish ~Redish Color Light Brown Color	
60 – 100		Moderately weathered to slightly weathered 1st Zone Pegmatite Granite (massive) soft dry Formation Grey·black ~dark grey Color	

Figure 6-8: Geologic Column of Gishali

6.2.3 Survey at hilltops

Hills are found everywhere in Kibungo Province. As a result of the group resettlement policy of the government, residents have moved to higher areas of the hills. Consequently, the residents who resettled on hilltops face inaccessibility to water. For Cyarubare District, in addition to this predicament, development of the district was delayed because the district was newly formed in 2001 as a result of administrative rezoning and a part of the district used to be in the premise of the Akagera National Park. Tin was mined in this district, but the mine is now closed. The mine workers lived in the valley of the mine having an altitude of 1,300 m, but after the mine closed, they have moved to hilltops in an area near the present district office at an altitude of about 1,700m. Here, since water is not available, they must travel down an altitude difference of about 200 m to a spring source located about 3 km down in the valley to fetch water. In consideration of this situation, test drilling sites were selected on hilltops of Cyarubare District.

(1) Results of Geophysical Survey

According to the results of the geophysical survey, surface soil resistivities are 500Ω-m and layer thicknesses differ by location where the thickest is 28 m. Resistivity of the basement rock is high at 5,000Ω-m and so the layer is believed to be uniform.

(2) Results of Test Drillings

1) Test Drilling Point

The survey was conducted in Bubindi Cell of Murama Sector. The test drilling points were selected at the top of the hill and midway down the hillside. The altitudes are 1,710 m at the hilltop and 1,620 m for the hillside.

2) Geologic Condition

This hill area has a distribution of Rukira and Kibaya formations of the Precambrian period. Alternating layers of schist, siltstone, quartzite and other minerals are found in both of these formations. Down in the eastern valley of this area, a fault valley running north-south can also be confirmed.

3) Test Drilling Results

a) Murama A: Hillside

Since the test drilling point is 100 m below the hilltop, layers deeper than the test drilling depth of the second point (Murama B) can be investigated.

0 - 1m	Surface soil: Brownish-red
1 - 11m	Highly weathering zone of pinkish-brown siltstone and schist

11 - 50m	Alternating layers of schist and siltstone with some quartzite: • Soft rock weathering zone • Low groundwater potential

b) Murama B: Hilltop

0 - 5m	Thin upper layer covered by brownish-red surface soil
5 - 10m	Pinkish colored hard siltstone and schist: • Highly weathering zone
10 - 60m	Alternating layers of brownish siltstone and schist: • Soft weathering zone
60 - 73m	Zone containing quartzite: Light brown
73 -100m	Alternating layers of pinkish siltstone and schist

Layers down to 100 m are weathering soft rock, and hard rock could not be found. Groundwater occurrence cannot be confirmed.

Therefore, one can conclude from this survey on geologic formations from the hilltop down to about 150 m that, since fractures also could not be found, groundwater is not present.

4) Geologic Column

The geology of Murama area is shown in the geologic columns on the following pages.

DRILLING LOG

Location	District	Sector	Cell	Latitude	Longitude	Altitude(m)
	CYARUBARE	Murama	Bubindi	S2° 00.489′	E30° 37.982′	1,600m
Boring-No	MURAMA A	Well Casing Depth		m	Yield	
Drilling Depth	76m	Screen			Static Water Level	m
Drilling Diameter	10″	Pump Position		m	Dynamic Water Level	m
Casing Size		Commenced on		2005/5/4	Completed on	2005/5/5

Depth (m)	Geologic log	Geological Description	Remarks
0 – 10 (11)		Overburden — Dark brown color	
15 – 75 (76)		Completely weathered to highly weathered Zone Highly weathered schist and hard silt stones. Quarzite intervenes as an alternating structure Pinkish ~light brown color Completely dry	
80			

Figure 6-9: Geologic Column of Murama A

DRILLING LOG

Location	District	Sector	Cell	Latitude	Longitude	Altitude(m)
	CYARUBARE	Murama	Bubindi	S2° 00.206′	E30° 37.612′	1,710m
Boring-No	MURAMA B	Well Casing Depth		m	Yield	
Drilling Depth	100m	Screen			Static Water Level	m
Drilling Diameter	10″	Pump Position		m	Dynamic Water Level	m
Casing Size		Commenced on		2005/5/2	Completed on	2005/5/3

Depth (m)		Geologic log	Geological Description	Remarks
0				
5	5		Overburden Dark brown color	
10			Completely weathered to highly weathered Zone	
15				
20				
25			Alternating bed of highly to completely weathered	
30			schist and hard siltstones	
35			Pinkish ~light brown color	
40				
45				
50				
55				
60	60			
65			Slightly weathered schist. Quarzite intervenes as an	
70			alternating structure Light brown color	
75				
80	80			
85			Alternating bed of Moderately weathered schist	
90			and hard siltstones	
95			Pinkish ~light brown color	
100	100		Soft dry formation Completely dry	

Figure 6-10: Geologic Column of Murama B

6.2.4 Conclusion

Geophysical surveys and test drillings were conducted at the following sites with results as shown.

Table 6-16: Results of test drillings

District	Sector	Target Area	Test Drilling	
			Depth	Result
Muhazi	Kabare	Granite formation area	52 m	Dry
	Gishali	Granite formation area	100 m	Dry
Cyarubare	Murama	Top of hill	100 m	Dry
	Murama	Hillside	76 m	Dry

As a result of the surveys, hilltops of granite formation zones as well as mountain tops and hillsides are areas where potential for groundwater development is low. Therefore, the team has concluded that groundwater in Kibungo Province should be developed through boreholes drilled mainly in areas where alluvial formations are found or along mountain slopes or terraces located next to alluvial zones.

6.3 Technical Note

The following technical note regarding the proposal for water supply project under Japanese Grant Aid was prepared and signed between the officials relevant to this study of the Rwandese government and consultants of the Study Team.

Project Formulation Study on Rural Development of Kibungo Province
Republic of Rwanda

Technical Note

Proposal for Water Supply Project under Japanese Grant Aid

The Consultants of the Study Team for the above-captioned project formulation study collected required data and information, and made field surveys in Kibungo Province. As a result of their study in Rwanda, the consultants explained the following points related to the water supply component to the Rwandese side, of which JICA is expected to give high priority for acceptance to conduct a Basic Design Study in the near future.

- The previous studies made by the Japanese side focused on groundwater development because they were conducted before resettlement when the residents were living in lower areas and the houses were scattered, and spring sources were believed to be almost fully developed. However, since resettlement is now almost complete, the housing situation is clustered on higher areas for different water supply requirements, and spring sources are still available for further development. Therefore, pumped water supply systems with pipelines need to be considered.
- Groundwater development in Kibungo Province is limited only to certain areas and therefore, cannot be given high priority. The survey revealed that granite formation areas and along tops of hills have especially low potential for groundwater development.
- Spring sources are presently exploited in many areas of Kibungo Province, but their potential also has limits (location and quantity-wise) and careful attention is needed for their development.
- Some existing piped systems using spring sources are in need of repairs and/or extensions, and the Rwandese side is endeavoring to remedy the situation through CDF or assistance from donors and NGOs. We would like to respect these efforts made by the Rwandese side and direct the Japanese assistance to areas not able receive benefits from these systems.
- Therefore, we would like to explain to JICA that new piped systems need to be given priority. If spring sources can be supplied by gravity, then this system will have higher priority. If gravity supply is difficult, then pumped systems will be considered. Furthermore, in areas where piped systems are not feasible, then groundwater use through handpumps, whether new drillings or rehabilitation of

existing facilities or improvement of spring sources should be considered.

- A constraint for pumped systems is that a commercial power grid is available for extension to the pump station within a reasonable distance, and diesel pumping will be considered only upon confirmation of feasibility for cost recovery from users.
- Since use of surface waters such as rivers and lakes require treatment, the scope of work cannot be implemented within the Japanese grant aid scheme and problems in operation and maintenance can arise, and therefore this alternative will not be included in this study.
- Rainwater harvesting is another feasible alternative to improve the shortage of water in this area and the Rwandese government is promoting the construction of these facilities especially in schools. This simple technology should be advanced by the local side, but we can make recommendations on their use.
- To support the rehabilitation and maintenance program being promoted by the Rwandese side, a supply of portable flowmeters and water analysis equipment for in-situ inspections, booster pumps to supplement repair works, spare parts and maintenance tools for sustainable use of handpumps, general mechanics and plumbing tools for proper maintenance of water supply systems will be suggested to JICA for inclusion in the project.
- To improve the operation and maintenance structure for water supply systems, we tentatively suggest a four-tier system similar to that being promoted by the government. In this system, responsibilities can be as follows.
  - The District can be in charge of coordination, water fees accounting and saving, procurement and storage of spare parts
  - The Secteur can post water supply technicians who will advise on technical matters and supervise repairs made by the tap minders.
  - The Cellule can conduct sensibilization activities and sanitation education to users
  - The Tap minders or Fontainiers can be in charge of collecting fees and making minor repairs.
- Another recommendation we would like to inform to JICA is that, in order to realize a proper maintenance system for sustained operation of water supply systems, the following activities should also be part of the program.
  - Capacity building of District, Secteur and Cellule staff as well as tap minders on management, operation and maintenance
  - Sensibilization activities and sanitation education to community leaders and residents

- The consultants have confirmed from responsibles of the Rwandese government that an EIA (environmental impact assessment) for this project is not needed due to the scale of targeted water sources.
- The proposed project concept to be submitted to JICA will be as shown in Annex 1.
- The selection criteria listed in Annex 2 will be considered for screening of requested sites submitted by each town/district.
- The list of proposed water supply systems for towns and districts of Kibungo Province is shown in Annex 3.

Officials relevant to this study of the Rwandese government and consultants of the study team have agreed to the study results and basic concepts listed above. These topics will be submitted to JICA by the consultants upon their return to Japan. JICA will use these results to consider the dispatch of a Basic Design Study Team.

Dated 18 May 2005.

Rwandese Side

INTARA YA KIBUNGO

Innocent NTABANA

Kibungo Provincial Government
Kibungo

Japanese Side

Chief Consultant
Project Formulation Study Team

Rwanafunzi Bruno

MINITERE
Kigali

19 MAY 2005

ANNEX-1 Proposed Project Concept

a. Construction of Water Supply Facilities

Type	Water Source	Supply System	No. of Sites	
			New	Rehab/Ext
A	Spring	Piped system supplied by gravity	0	1
B	Spring/ Groundwater	Piped system pumped by electricity	13	4
C	Spring/ Groundwater	Piped system pumped by diesel engine	7	1
D	Groundwater	Handpump	29	9

b. Procurement of Equipment

No.	Item	Quantity
1	Portable Flowmeter	10 sets
2	Portable Water Analysis Equipment ✓ pH meter ✓ Conductivimeter ✓ Fe meter ✓ Mn meter	10 sets
3	Standby booster pumps	5 sets
4	Spare parts for handpumps	1 lot
5	Maintenance tools for handpumps	3 sets
6	General mechanics/plumbing tools	10 sets

ANNEX-2 Selection Criteria for Screening of Request Sites

1. Target site is suffering from lack of drinking water.
2. Resettlement under "imidugudu" scheme has completed.
3. Should have no duplication with other donor projects.
4. Should not have any financial plans through CDF and other funds.
5. Necessary land plots are available for implementation of facilities.
6. Residents are willing to participate in proper operation and maintenance of water supply system and willing to pay the required water fees.
7. Is not or will not be served by Electrogaz water supply system.
8. Can be implemented within Japan's single fiscal year budgeting system.
9. Residents and administration can wait at least 2 years for project to be realized.

ANNEX-3 List of Proposed Water Supply Systems for Each Town/District of Kibungo Province

Town/District	Secteurs to be partially covered	Water Source		Estmated Flow Rate	Water Supply System						Population*1	Possible Number of	Type of Construction		
		Spring	Groundwater		Piped			Handpump		Protected Spring					
				l/s	Gravity	Electric Pump	Diesel Pump	New	Rehab		2003	Beneficiaries*2	New	Rehabilitation	Extension
Kibungo	Ndamira	Nyamuganda		2.6		O					4,167	11,200	O		
	Sakara										8,063				
	Kibaya										3,232				
	Rubona		O	0.3				10			8,397	5,400	10		
Rwagamana	Mwulire	Gisanza		3		O					5,650	12,900	O		
	Sovu	Kabuga		2		O					3,238	8,600	O		
	Rutonde	Gitega		2		O					3,233	8,600	O		
Cyarubare	Cyabajwa		O			O					10363	4,000	O		
	Rwinkavu										8,369				
	Gishanda		Nyankora			O					8,762	4,000		O	O
	Shyanda	Ngoma		4			O				7,552	17,200	O		
	Murawa										3,846				
	Dist. Office														
	Bisenga	Nyakanazi		3			O				5,670	12,900	O		
Kabarondo	Ruyonza	Gatore		2		O					2,797	8,600	O		
	Ruramira										3,703				
	Nkamba										4,151				
	Rukira	Gitoke		3		O					2,363	12,900	O		
	Kaduha										4,186				
	Rweru										4,341				
	Musumba	Gatare		1		O					4,932	4,300	O		
	Nkungu		O	0.3				4	6		3,291	5,400	4	6	
Kigarama	Kibimba	Kagoma		2		O					4,304	8,600		O	O
	Matongo										6,325				
	Bare										5,468				
	Fukwe	Kamfonyogo		1		O					3.030	4,300	O		
	Gashanda										3,471				
	Kansana										5,206				
	Gasetsa	Gacaca		1.8		O					5,846	7,700	O		
	Rurenge										7,057				
	Remera										4,618				
Mirenge	Mbuye	Murama		3		O					7,091	12,900	O		
	Murwa										11,886				
	Ngoma	Bukokoza		0.7+0.7		O					3,177	6,000	O		
	Ruyema										3,374				
	Karembo	Rwarutene		4		O					5,473	17,280		O	O
	Zaza										5,565				
	Kukabuye										4,824				
	Kibare										4,674				
	Gatare										4,540				
	Kabirizi										7,814				
	Shywa										3,399				
	Nyange										4,393				
	Kagashi										5,487				
Muhazi	Murambi	Karambi		2		O					4,238	8,600	O		
	Kitazigurwa										2,468				
	Mukarange		Kazabazana	2.2		O					7,700	9,500		O	O
	Nyagatovu										6,384				
Nyarubuye	Nyarubuye	Kamacumbi		0.5+0.5			O				5,550	4,300	O		
	Nyabitare										4,652				
Rukira	Mushikiri	Karambi		1			O				9,456	4,300	O		
	Rurenge		O	0.3				8	2		5,536	5,400	8	2	
	Murama		O	0.3				7	1		3,207	4,300	7	1	
Rusumo	Kirehe	Gahama		1.2			O				23,496	5,100	O		
	Nyamugari	Mayizi		3	O						20,397	12,900		O	O
	Kigina	Gasenji		1			O				10,000	4,300	O		
	Gashongora	Rwimondo		2			O				10,550	8,600		O	O
	Gatore	Rugina		1.5			O				15,000	6,400	O		
				Total	1	17	8	29	9	0	*1 From PDC	246,480	*2 To supply 20 l/c/d		

ANNEX-4 Proposed Water Supply Systems for Kibungo Province

Town/District	Sector (Secteur)	Feasible System		District	Sector (Secteur)	Feasible System	
		Type	New or Rehab/ Ext			Type	New or Rehab/ Ext
Kibungo Town	Ndamira Sakara Kabare	B	New	Mirenge	Mbuye Murwa	B	New
	Rubona	D	New		Ngoma Ruyema	B	New
Rwamagana Town	Mwulire	B	New		Karembo Zaza Kukabuye Kibare Gatare Kabirizi Shywa Nyange Kagashi	B	Rehab/ Ext
	Sovu	B	New				
	Rutonde	B	New				
Cyarubare	Cyabajwa Rwinkavu	B	New				
	Gishanda	B	Rehab/ Ext				
	Shyanda Murawa District Office	C	New				
	Bisenga	C	New	Muhazi	Murambi Kitazigurwa	B	New
Kabarondo	Ruyonza Ruramira Nkamba	B	New		Nyagatovu Mukarange	B	Rehab/ Ext
	Rukira Kaduha Rweru	B	New	Nyarubuye	Nyarubuye Nyabitare	C	New
	Musumba	B	New	Rukira	Mushikiri	C	New
	Nkungu	D	New/ Rehab				
Kigarama	Kibimba Matongo Bare	B	Rehab/ Ext		Murenge	D	New/ Rehab
					Murama	D	New/ Rehab
	Fukwe Gashanda Kansana	B	New	Rusumo	Kirehe	C	New
					Nyamugari	A	Rehab/ Ext
	Gasetsa Rurenge Remera	B	New		Kigina	C	New
					Gashongora	C	Rehab/ Ext
					Gatore	C	New

6.4 Other Rural Infrastructure Projects

The following priority projects in rural infrastructure were identified through a review of each District PDC, and opinions from the experts at District offices and residents, technical feasibility and necessity for the projects. They satisfied the cooperation conditions, e.g. there are no similar projects by other donors and land of the project implementation sites are owned by Rwandan government.

Table 6-17: Priority projects for rural infrastructures at District level

	District / Sector	Priority project	Number of Direct Beneficiaries
1	Kibungo Town (Kibungo hospital – Gahurire)	Road rehabilitation from Kibungo Hospital to Gahurire (coffee factory) (Distance = 10 km)	4,000
	Kibungo Town （Kibaya）	Marshland development for rice production (Area = 54 ha)	700
		Road rehabilitation from marshland to village including 5 bridges (Distance = 12 km)	
2	Rwamagana (Kabuya-Nawe)	Bridge construction at Cyarumenge site between Kabuya and Nawe road section (Distance = 6.0 m / Width = 2.0 m)	5,000
	Rwamagana (Kigohiro – Rutonde)	Road rehabilitation from Kigohiro to Rutonde (Distance = 9 km)	8,500
3	Cyarubare (Rwinkwavu)	Earth dam construction at Kadiridimba river for power generation, water supply and irrigation (Development Study)	8,000
4	Kabarondo (Kanyeganyege)	Marshland development for rice production (Area = 60 ha)	500
		Road rehabilitation from marshland to village (Distance = 7 km)	
5	Kigarama (Gisaya)	Marshland development for rice production (Area = 120 ha)	5,000
		Road rehabilitation from marshland to village (Distance=15 km)	
6	Mirenge (Kiranbo)	Marshland development for rice production (Area = 900 ha)	1,100
		Road rehabilitation from marshland to village (Distance = 5 km)	
7	Muhazi (Musha - Duha)	Road rehabilitation including one bridge (Distance = 18 km)	4,000
8	Nyarubuye (Kagese / Kigufi)	Road rehabilitation including one bridge (Distance = 56 km)	43,400
9	Rukira (Mushikiri / Gitwe)	Marshland development for rice production (Binoni) (Area = 60 ha)	2,000
		Road rehabilitation from marshland to village (Distance = 6.5 km)	
10	Rusumo (Kigarama / Nyamugari / Kigina)	Reforestation (Area = 345 ha)	63,000
	②Rusumo (Kigina / Kirehe / Musaza / Gatore)	Marshland development for rice production (Area = 200 ha)	2,000
		Road rehabilitation from marshland to village (Distance = 5 km)	

Source: PDC of each District, October 2004

Among the problems that the provincial population faces, environmental degradation and its countermeasures rank second after water/sanitation. Effective measures are to be taken in the areas where soil erosion and/or landslide threaten the lives and properties of villagers.

(1) Nyarubuye District

Nyarubuye District has not enough infrastructure maintenance as mentioned in the radar chart of the figure 4-7. Thus this district faces land sliding and decrease of farmland due to soil erosion. The following proposed project is to take measures to address the problems.

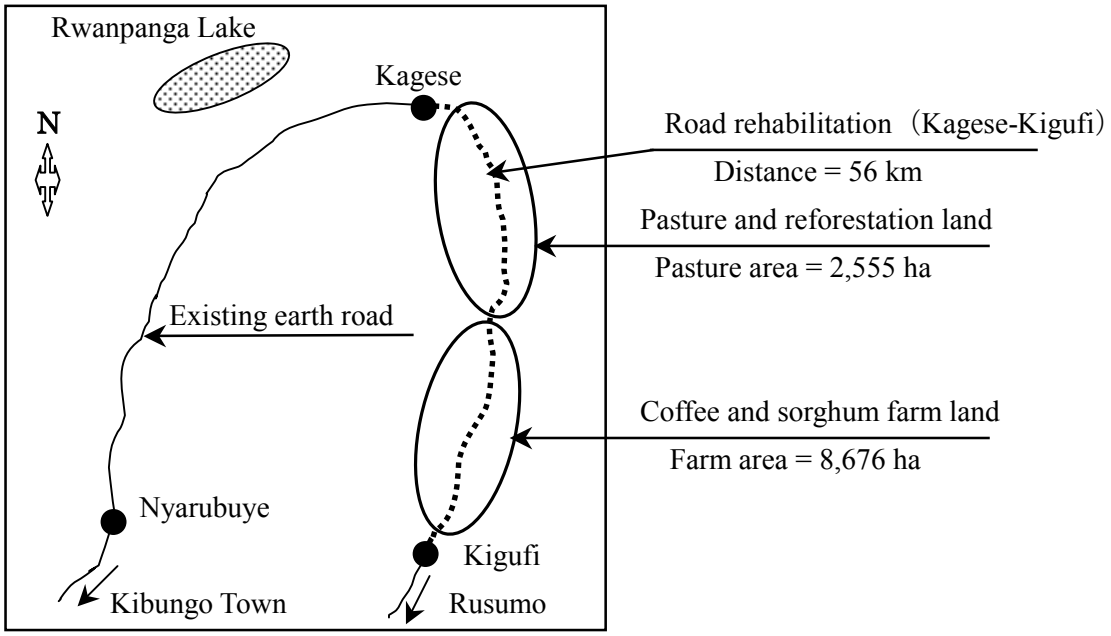


Figure 6-11: Project Location of Nyarubuye District

1) Proposed Project: Environmental Improvement in the eastern part of Nyarubuye District

2) Rationale: The infrastructure of this district has been less developed than that of others as the radar chart shows. This project in the east of the district aims to 1) protect its scarce agrarian land resource from soil erosion, mud flowing-in and landslide, and to 2) encourage emerging farming, animal raising and fishing practices near Rwampanga Lake.

83 % of residents of this region (5 sectors) grow coffee, sorghum, maize and beans on 8,676 ha of land and raise cattle on 2,555 ha of grassland. However, in the rainy season, the region is often threatened by erosion of fertile soil, flood, flowing-in of muddy soil to farmland, followed by traffic suspension and lake water contamination. Every possible countermeasure is to be taken.

Top soil flow into the farm land

Erosion on the edge of farmland

3) Relevant Data/information needed:

- Topographic and cadastral maps
- Statistical data on crop yield/ha
- Rainfall data
- Traffic data.

4) Solution: Feasibility study to assess the present situation and solutions

5) Effects: The population can exploit further the land potential, more easily sell their products including milk and fish, and stand a good chance of increasing their income. The lakeside may also be developed as a resort area.

As mentioned in Chapter 2, based on the PDCs, MINAGRI had a consultation with the local population, and identified several prospects for marshland development projects to promote food security and income-generating agriculture. Based on the MINAGRI policy guideline, the study team proposes two rural infrastructure development projects in 1) Kigarama and 2) Mirenge districts as follows.

(2) Kigarama District

More than 90% of the residents are engaged in the agriculture sector, but the cultivated land in the District is the third smallest in the Province due to geological conditions. However, the district has many untapped marshlands with high agricultural potential. Accordingly, a development plan of marshlands is needed for improvement in agriculture in the District.

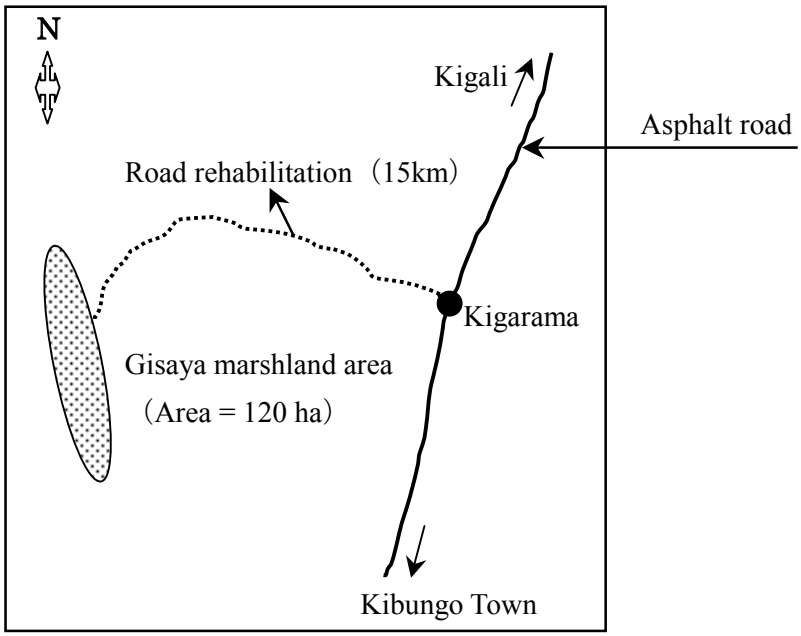


Figure 6-12: Project Location of Kigarama District

1) Proposed Project: Irrigation development of Gisaya marshland

2) Rationale: The site (120 ha) is located about 21 km west of the district office. Since the soil is fertile, villagers practice double cropping of rice culture using stream flow at the bottom of the marshland. The main canal flowing in the center of farmland runs over the bank in the rainy season. In the dry season, it doesn't irrigate the plots at the ends. Most of the products are transported to the rice mill or the market in Rwamagana town. Transport is hampered by a very poorly maintained road (15 km) during the rainy season.

Existing bridge at main channel

Existing earth road with inclined

3) Relevant Data/information needed:

- Topographic and soil maps
- Data on crop yield/ha
- Information on rice varieties
- Rainfall data
- Traffic data
- Information on agricultural cooperative/association.

4) Solution: Feasibility study to assess the present situation and solutions

5) Prospected effect: The population can utilize the water all the year round, smoothly ship their products to the market, and increase its income. A unified cooperative should be organized.

(3) Mirenge District

More than 97% of the residents are engaged in the agriculture sector. The cultivated land including 26 marshlands is the third largest in the Province. These fertile marshlands have high agricultural potential but are located in the remote areas. Accordingly, a development plan of the marshland area is needed for improvement of agriculture and transport of agricultural products.

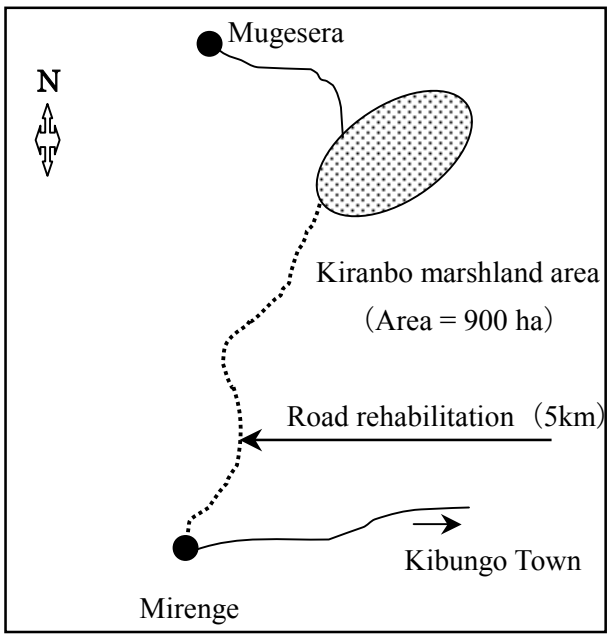


Figure 6-13: Project Location of Mirenge District

1) Proposed Project: Irrigation development of Kirando marshland

2) Rationale: The site (900 ha) is located 5 km north of the Mirenge district office. With the fertile soil, farmers practice double cropping of rice culture using stream water flow out of the marshland. Due to the lack of an irrigation system, water is not controlled and rice growing is sometimes not without problems. Besides, the farm-market road (5 km) is unpaved and not well maintained. Effective use of water and improvement of supportive infrastructure are essential.

Existing irrigation channel

Paddy field without irrigation water

3) Relevant Data/information needed:

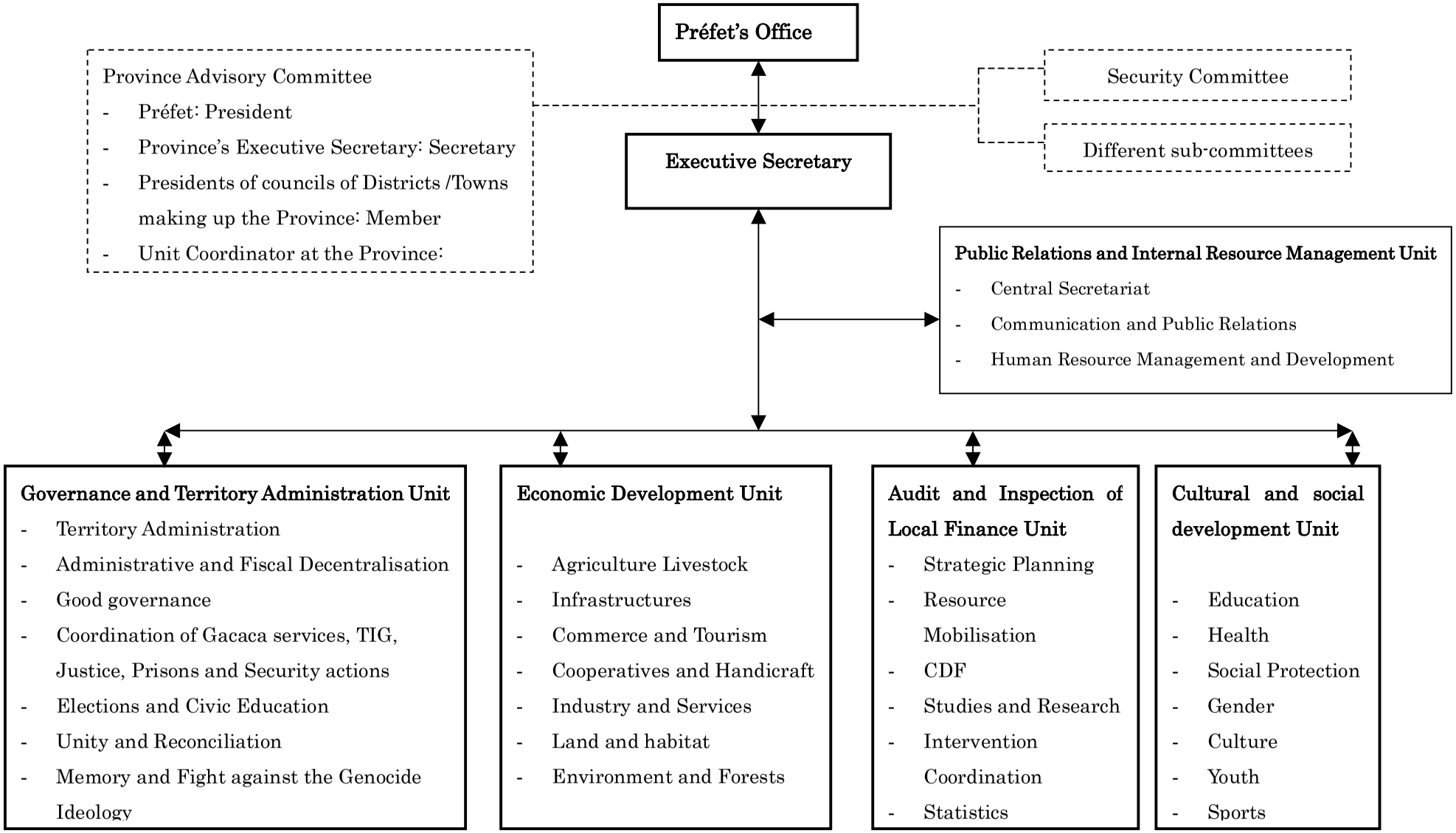
- Topographic and soil maps
- Data on crop yield/ha
- Information on rice varieties
- Rainfall data
- Traffic data
- Information on agricultural cooperative/association.

4) Solution: Feasibility study to assess the present situation and solutions

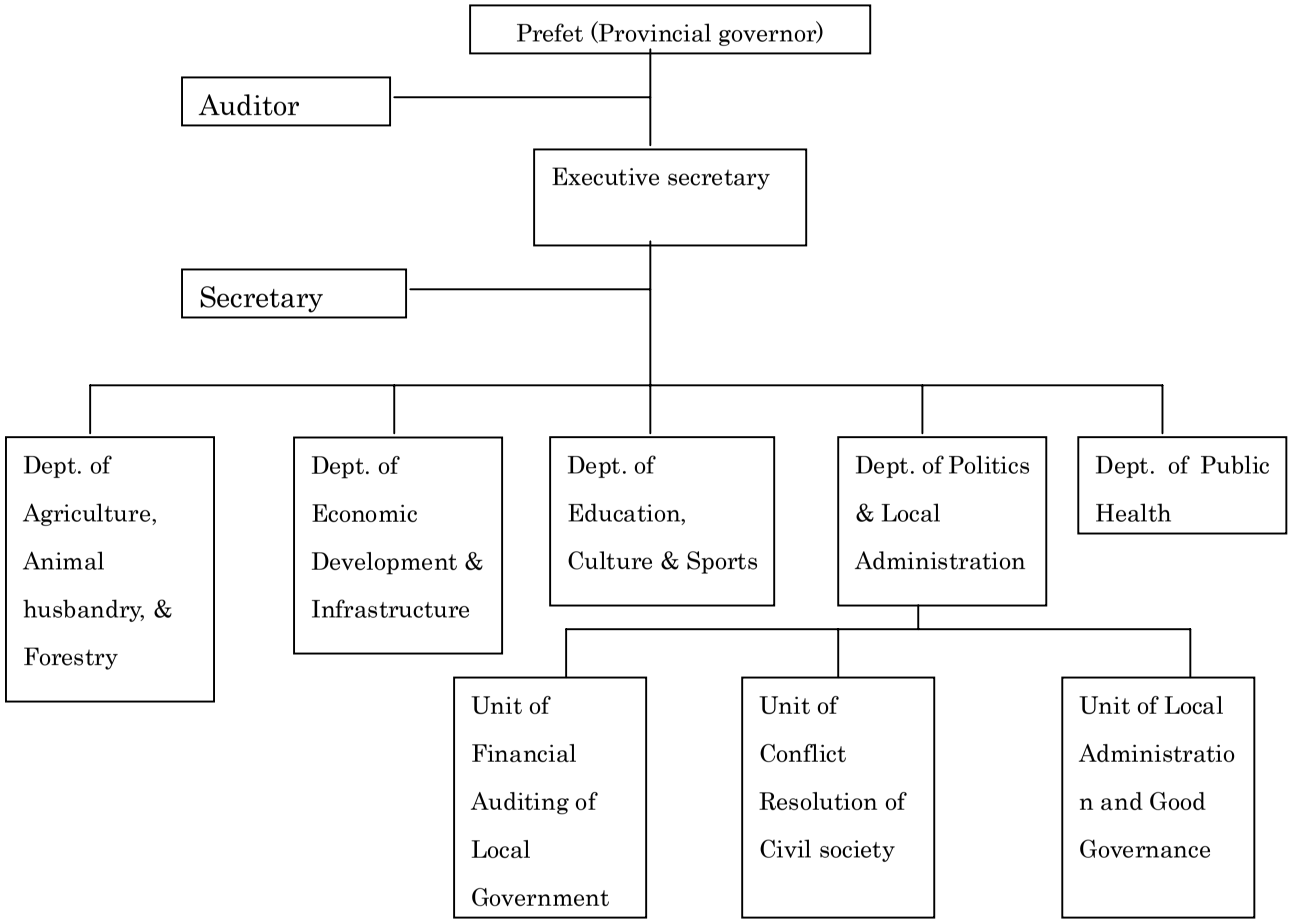
5) Prospected effect: The population can utilize the water all the year round, smoothly ship their products to the market, and increase its income. Cooperation by the existing 40 cooperative associations is needed.

6.5 Organizational chart of local governments

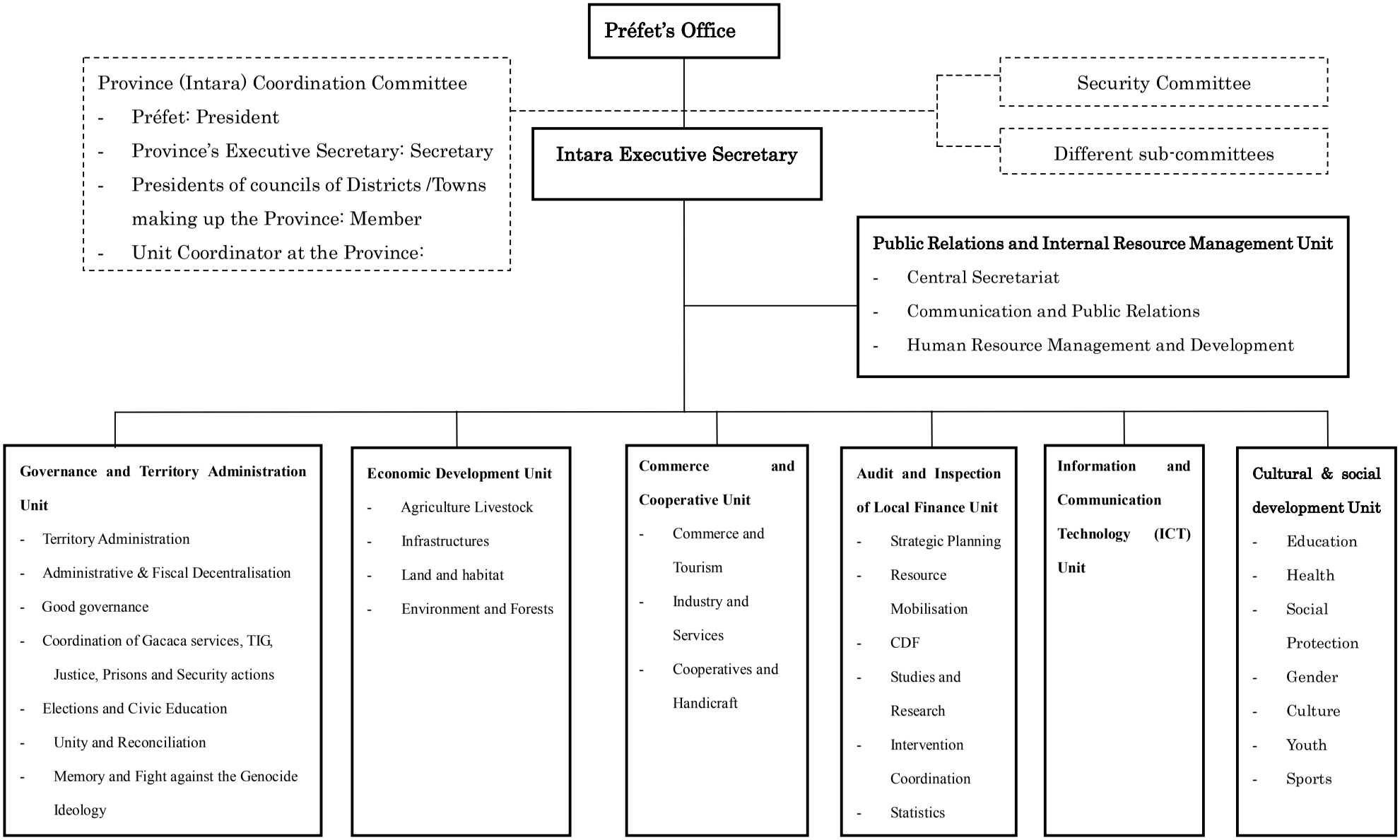
6.5.1 Organizational Chart of Kibungo Provincial Office (as of April 05): After decentralization and organizational restructuring program



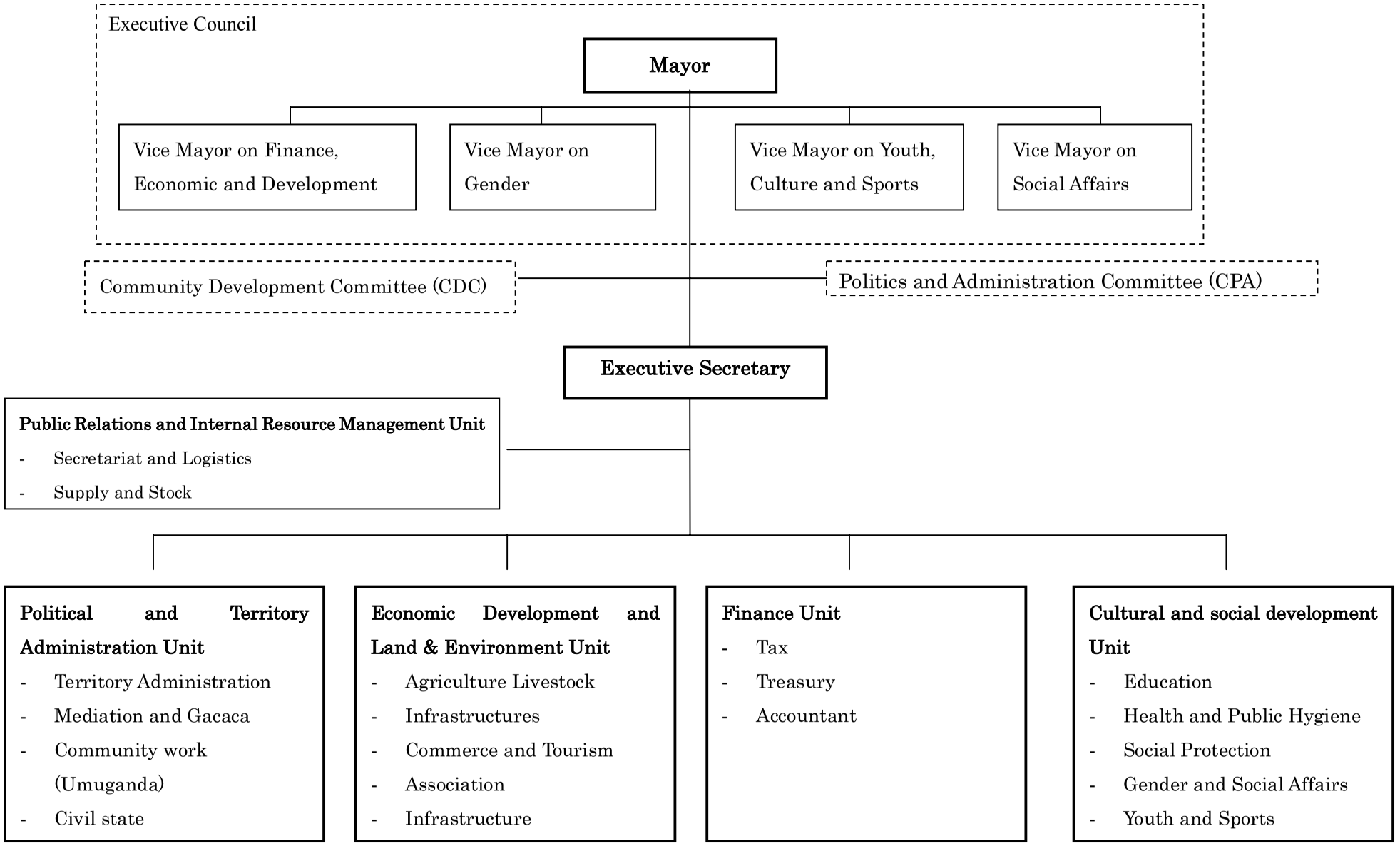
6.5.2 Organizational Chart of Kibungo Provincial Office: Before decentralization and organizational restructuring program



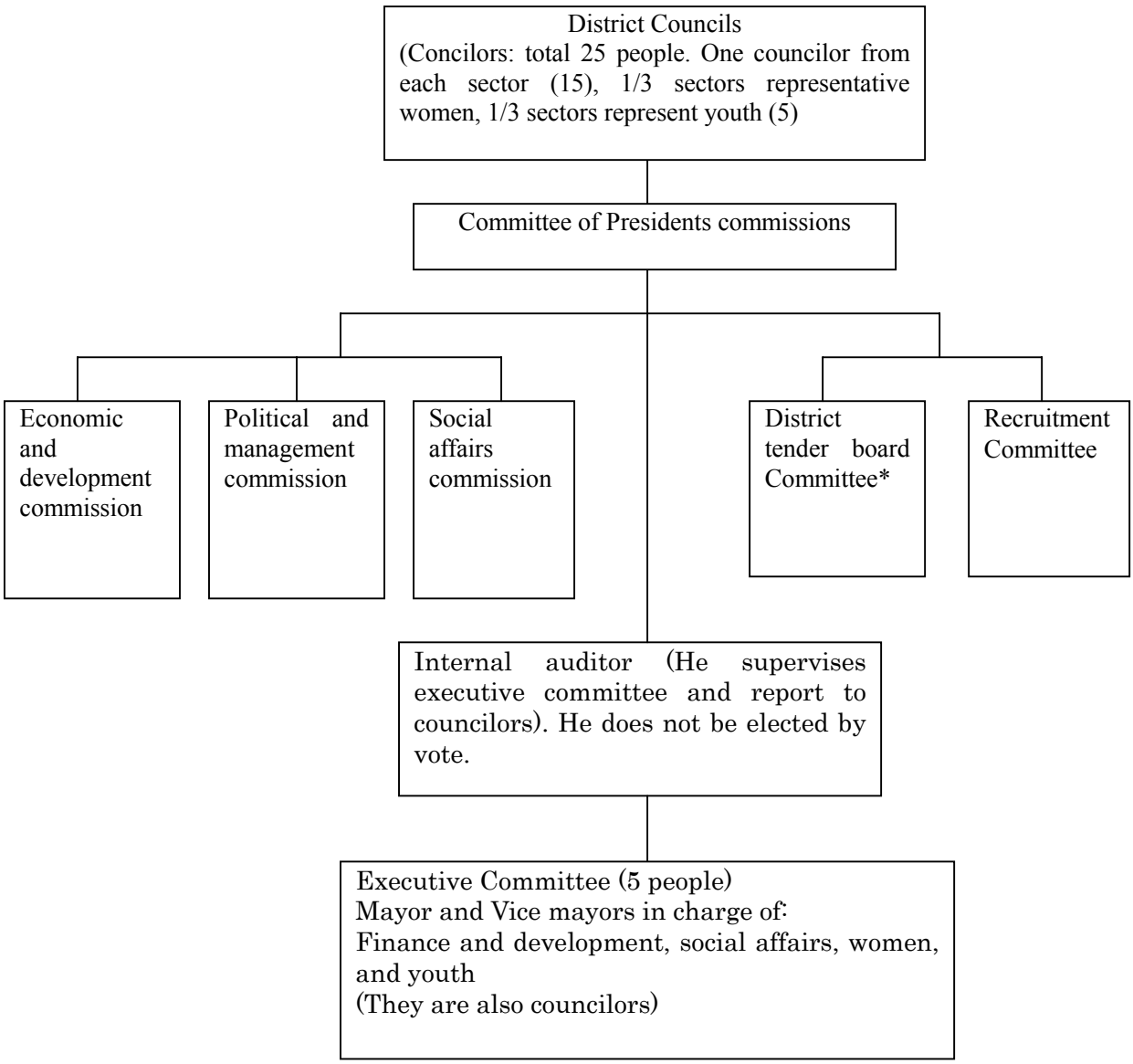
6.5.3 Organizational Chart of Kibungo Provincial Office: After May 05



6.5.4 Current Organizational Chart of District Office

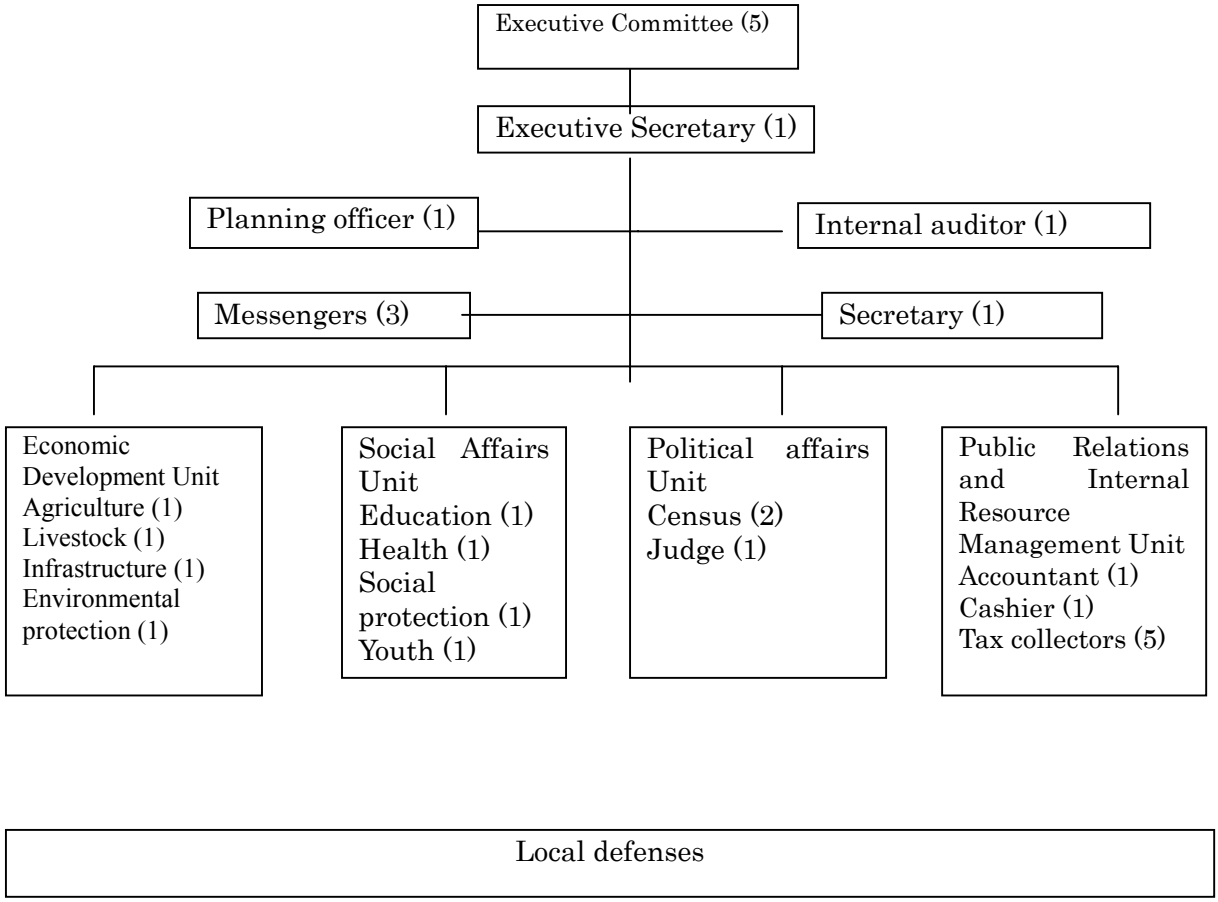


6.5.5 Decision makers of a district office: Example of Muhazi District



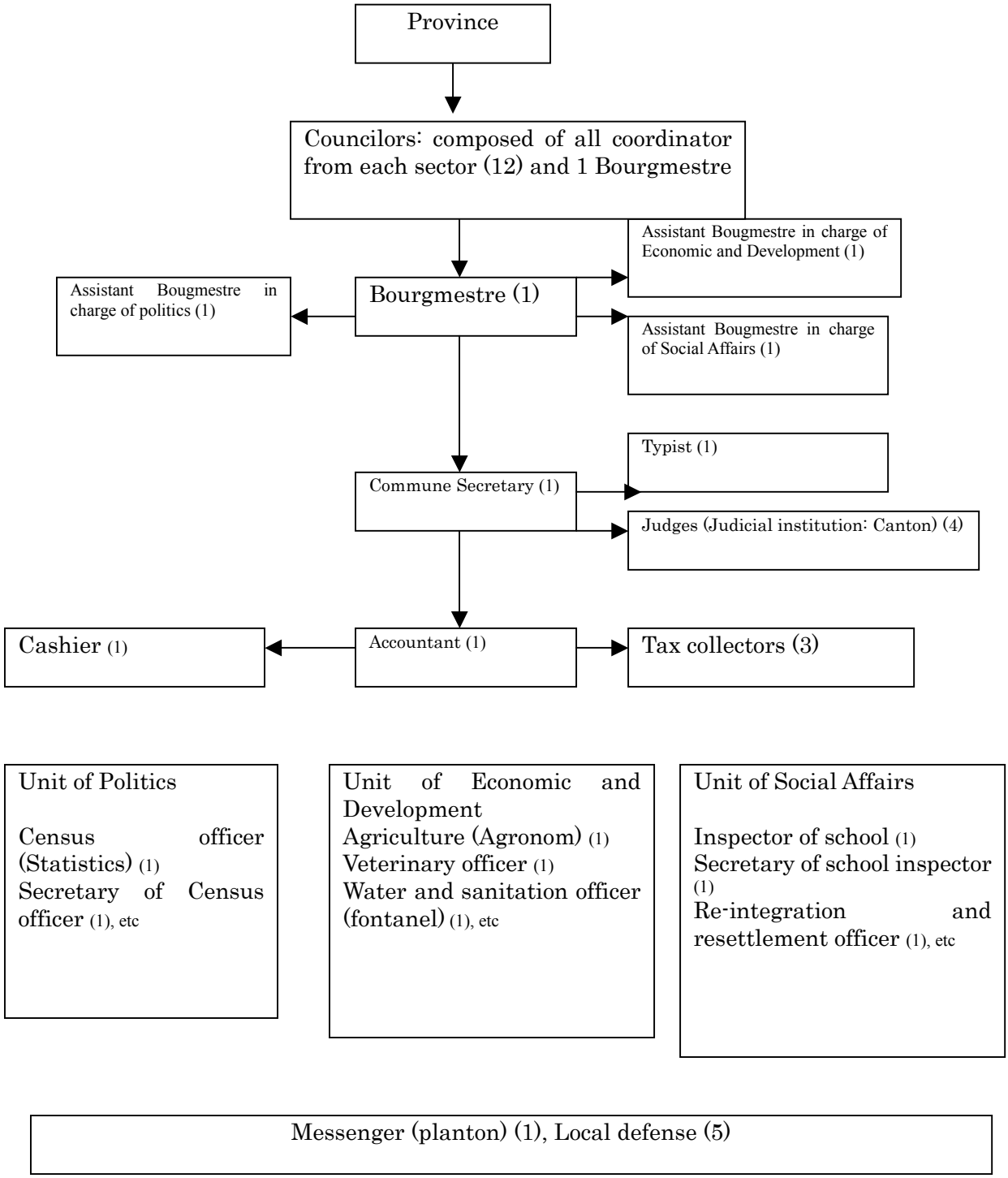
Note:
Muhazi District consists of 15 sectors. 25 members of district councils are divided to 3 commisions and 2 comittees. Member of District tender board commission consists of the members of other commissions. Councilors meet every 3 months.

6.5.6 Implementing bodies at District/town office



Note: Muhazi District has 30 officers.

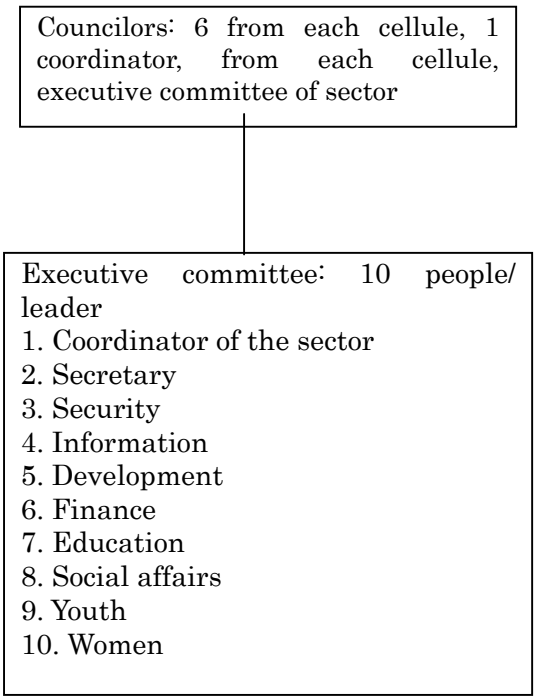
6.5.7 Organizational chart before decentralization: Example of Muhazi Commune



Note: There were 12 sectors at Muhazi Commune

6.5.8 Decision makers of Sector office: Example of A sector with 10 cellules

6 from each cellule (6x10)
1 coordinator from each cellule (1x10)
10 people of executive committee (10)
Total: 80

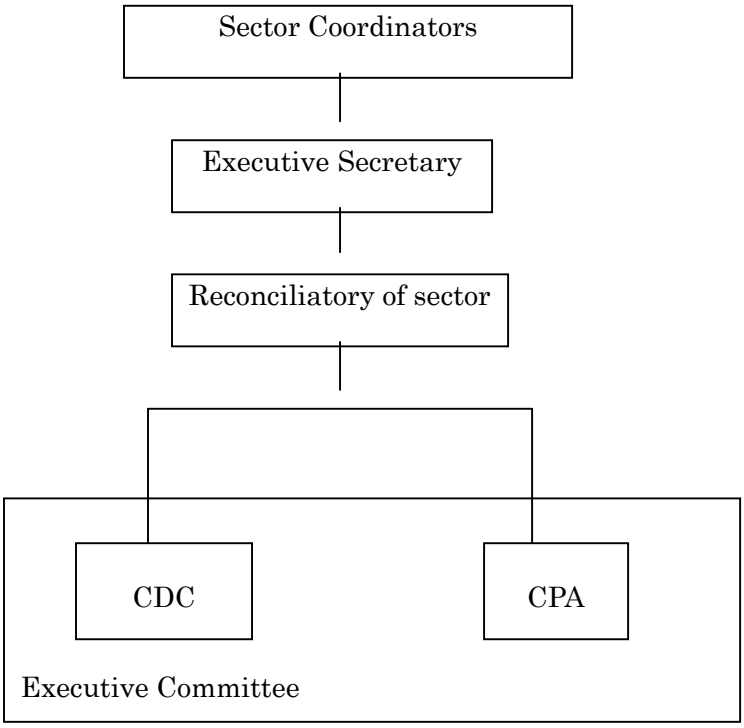


CPA: members of 1.-4.
CDC: members of 5.-10

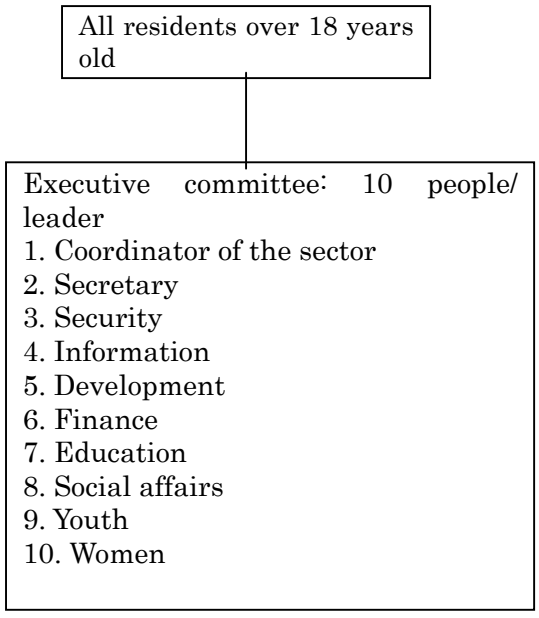
Other committee/councils are:
Reconciliation committee: 12 leaders
Gacaca: 9 leaders
Women: 10 leaders
Youth: 12 leaders
Local defense force: no specific number

There are 2 types of executive committee that is CDC and CPA. CDC means Community Development Committee and CPA means Political Administrative Committee.

6.5.9 Implementing bodies at sector office



6.5.10 Organizational Chart of Cellule office



Other council/committees
Gacaca: 9 leaders
Women: 10 leaders
Youth: 12 leaders

6.6 SWOT analysis

6.6.1 Results of the SWOT analysis (Kibungo Provice: 10 interviewees)

(1) Strength

N	Sterngth	No of answer
1	Staff are motivated and hard working	8
2	There is a system of planning activities and monitoring them	4
3	Staff members are qualified and trained	3
4	Staff members know each other and cooperate together	2
5	Staff training opportunity is available	1
6	Good structure of organization	1
7	Good leaders and management	1
8	Leaders are highly committed for development of Kibungo Province	1
9	Staff members work in their specialised fields.	1
10	Good working environment at office	1
11	Staff have good knowledge and skill on the computer	1

(2) Weakness

N	Weakness	No of answer
1	Insufficient amount of equipment	6
2	A lot of works per person	5
3	Communication means is insufficient	3
4	Staff members' skill is insufficient	2
6	Number of staff member is not enough	2
7	Not enough communication between province and sectors	1
8	Non respect of job description among some staff members	1
9	Limited budget from the Ministry of Finance	1
10	Low knowledge in computer	1
11	Few employees are hard working, because of low salary.	1
12	Budget retards very much	1

(3) Opportunity

N	Opportunity	No of answer
1	The population follows direction of authorities and collaborate with them	3
2	Skilled employees are available for recruitment in Kibungo province (Kibungo has university)	2
3	Kibungo with its fertile soil	2
4	Road and communication system are improved	2
5	Decentralization process is progressing	1
6	Promise of increase of salaries and equipment provision	1
7	It is easy to borrow money from neighbours to supplement salary	1
8	Good government policies	1
9	Existence of MTEF planning	1
10	Good relations with neighboring countries	1
11	All sectors are interested in development work	1
12	Collaboration with District/Town level is good	1
13	Central government supports the provincial government.	1

(4) Threat

N	English	No of answer
1	Low educational and understanding level of people	5
2	Lack of transportation means	3
3	lack of trainings	2
4	New organisational reform created some confusion in job demarcation of staff members	2
5	There are many people who need public service support (ex. Many homeless and refugees in neighboring countries)	3
6	Some areas face drought conditions	2
7	The poverty of the population	2
8	Insufficient capacity of sectors retards reporting to district and provincial government	2
9	Unskilled technicians at the districts	1
10	Technicians at district level lack transport means, other basic materials and with low salary.	1
11	Insufficient entrepreneurship among local population and they wait for the Government help	1
12	Insufficient statistics report at sectors	1

6.6.2 Results of the SWOT analysis (District level: 11 interviewees)

(1) Strength

N	English	No of answer
1	Some staff are trained and with good knowledge and experience	8
2	Staff members are motivated to work hard.	4
3	Existence of a work plan of the year	2
4	Regular meeting with local leaders and associations	2
5	Staff members share experience in daily work with colleagues	1
6	Regular meeting with other District staff	1
7	Regular meeting with the population	1
8	Good implementation and monitoring system	1
9	Cooperation with the central government and province is well	1

(2) Weakness

N	English	No of answer
1	No or insufficient equipment (ex. computer)	6
2	Insufficient qualification of staff members	3
3	A lot of work	2
4	Insufficient amount of salary	2
5	No or insufficient amount of allowance	1
6	Inappropriate coordination of all staffs	1
7	Poor communication means	1
8	Poor management (i.e. do not have training and good knowledge in management)	1

(3) Opportunity

N	English	No of answer
1	Donor and NGO assist in development work	5
2	Training by national and provincial governments is available	4
3	Local leaders and the existing committee of the sector are cooperative	4
4	Various committee from cellule level to the country level	2
5	Monetary contribution and tax from people is available	2
6	Local population voluntary work	2
7	Training based on finance and local administration is available	2
8	NGO and donors provide trainings	2
9	Support from other districts	1
10	Province does allocate funds to finance programs	1
11	Basics materials are available	1
12	Free election of staff	1
13	Support from central government	1
14	Marshland is available for agricultural projects	1
15	Health insurance is available	1

(4) Threat

N	English	No of answer
1	Shortage of transportation means	8
2	No electricity	4
3	Small number of donors	3
4	Local leaders and associations do not have enough qualifications	2
5	Knowledge level of people is low	2
6	People's misunderstanding and low level of perception on health, education, etc.	2
7	There are many poor people and vulnerable people	2
8	Insufficient training opportunity	2
9	Assistance from Ministries is delayed	2
10	Women do not have sufficient amount of experience and educational background	1

6.6.2 Results of the SWOT analysis (Sector level: 10 interviewees)

(1) Strength

N	English	No of answer
1	Staff are hard working and motivated	7
2	Through regular meeting, collaboration with local population is good	4
3	Through regular meeting, coordination with other staff at this sector is good	4
4	Staff meeting is regularly conducted and well organized.	2
5	We plan together for activities of the year and plan for implementation manner.	1
6	Coordination of all sector activities is good	1
7	Monitoring and evaluation of activities are well done.	1
7	Salary does not delay	1

(2) Weakness

N	English	No of answer
1	No sector office or not rehabilitated	7
2	No materials/equipment	7
3	Salary is low	8
4	Allowance is not enough or no allowance	5
5	Heavy workload	2
6	Some staff are not active in their work (i.e. not participating in development activities)	2
7	Shortage of funds to implement programs	1
8	Salary is not paid on time	1
9	Not being confident for terms of employment	1
10	Working on the issues not regarding public administration	1
11	Staff does not have enough training	1

(3) Opportunity

N	English	No of answer
1	Cell Coordinators and other committees are cooperative	3
2	The local population and local leader have freedom to share idea and plan projects	2
3	The local population are motivated to work hard even without payment to support the Develop activities	2
4	Some donors and NGOs are ready to cope with	2
5	The population is motivated to be associated into groups	2
6	Decentralization is welcomed by local population	2
7	No problem to meet people because most of them live in Imidugudu.	1
8	Local population respect to pay contribution to support vulnerable people (Umusanzu), attend Gacaca, work for Umuganda	1
9	Reasonable healthy insurances	1
10	Easy to receive loans from banks in order to supplement salaries	1

(4) Threat

N	**English**	**No of answer**
1	No means of transportation to work in far places	9
2	Local leaders and other Committees of cells not having enough qualification. Not trained enough	3
3	Receiving information later (communication problem)	2
4	Illiteracy and poverty of population	2
5	No freedom for sector to use money as required	1
6	Some people are not participating in development activities	1
7	Few visit from district to the sector	1
8	Capacity of the district is still poor	1
9	Variation of seasons leads the starvation	1
10	Local leaders and other Committees of cells are not paid to be motivated	1
11	There are no technicians to support water project.	1

6.8 Documents Collected

(1) MINITERE

REVUE DU SECTEUR EAU & ASSAINISSEMENT, MINITERE, Ministere des Terres, de l'Environnement des Forets, de l'Eau et de Mines (Minister of Lands, Environment, Forestry, Water and Mines), Avril 2005

SECTEUR EAU ET ASSAINISSEMENT, Rapport des Realisation du PRS-PR 2004, MINITERE, Ministere des Terres, de l'Environnement des Forets, de l'Eau et de Mines, Direction de l'Eau et Assaainissement, Avril 2005

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Rwanda National Environment Policy 2, Minister of Lands, Environment, Forestry, Water and Mines, Kigali 2002

Rwanda National Environment Policy 3, Minister of Lands, Environment, Forestry, Water and Mines, Kigali 2002

Politique Nationale de Forets, Minister of Lands, Environment, Forestry, Water and Mines, Direction des forets, 2004

Rain Water Harvesting, Intermediate Technology Development Group

(2) MINALOC

Sectoral Strategies, MINALOC, 2004

National Decentralization Policy, MINALOC, May 2001

HIMO PROCEDURES MANUAL, LABOUR INTENSIVE LOCAL DEVELOPMENT PROGRAMME, PDL-HIMO, MINISTRY OF LOCAL GOVERNMENT, COMMUNITY DEVELOPMENT AND SOCIAL AFFAIRS (MINALOC), REPUBLIC OF RWANDA, 31st December 2003

HIMO Programme Document, LABOUR INTENSIVE LOCAL DEVELOPMENT PROGRAMME, PDL-HIMO, MINISTRY OF LOCAL GOVERNMENT, COMMUNITY DEVELOPMENT AND SOCIAL AFFAIRS (MINALOC), REPUBLIC OF RWANDA, 31st December 2003

(3) PDC

PLAN STRATEGIQUE DE LA PROVINCE DE KIBUNGO 2005-2007 REPUBLIQUE DU RWANDA

PLAN DE DEVELOPPEMENT COMMUNAUTAIRE DU DISTRICT, PROVINCE DE KIBUNGO, *DISTRICT de Cyarubare, DISTRICT de Nyarubuye, DISTRICT de Rukira, DISTRICT de Rusumo, DISTRICT de Muhazi, DISTRICT de Mirenge, DISTRICT de Kabarondo, DISTRICT de Kigarama, Ville de Rwamagana, Ville de Kibungo*, October 2004

(4) CDF

Rapport Annuel 2004, FONDS COMMMUN DEVELOPPEMENT (CDF), Republique du Rwanda, Janvier 2005

(5) MINICOFIN

VISION 2020 draft 3 English Version, Ministry of Finance and Economic Planning, Kigali, November 2002.

Repertoire de l'Aide Exterieure au Rwanda, volume2, Repartition des Interventions par Bailleur, Ministere des Finances et de la Planification Economique, CEPEX, Republique du Rwanda, Avril 2004

(6) MINAGRI

STRATEGIC PLAN FOR AGRICULTURAL TRANSFORMATION IN RWANDA, Main Document, MINISTRY OF AGRICULTURE AND ANIMAL RESOURCES, REPUBLIC OF RWANDA Kigali, October 2004

MISSION D'APPUI AU MINISTERE DE L'AGRICULTURE ET DE L'ELEVAGE EN VUE DE L'OPERATIONNALISATION DE LA POLITIQUE AGRICOLE NATIONALE, Synthèse des résultats des consultations à la base dans la Province de Kibungo, Kigali, 15 octobre 2004

Opérationnalisation de la Politique agricole nationale: Résultats des consultations à la base: *District de Cyarubare*, MISSION D'APPUI AU MINISTERE DE L'AGRICULTURE ET DE L'ELEVAGE (MINAGRI) EN VUE DE L'OPERATIONNALISATION DE LA POLITIQUE AGRICOLE NATIONALE RAPPORT DE DISTRICT, Kigali, Septembre 2004

Opérationnalisation de la Politique agricole nationale: Résultats des consultations à la base: *District de Nyarubuye*, MISSION D'APPUI AU MINISTERE DE L'AGRICULTURE ET DE L'ELEVAGE (MINAGRI) EN VUE DE L'OPERATIONNALISATION DE LA POLITIQUE AGRICOLE NATIONALE RAPPORT DE DISTRICT Kigali, Septembre 2004

Opérationnalisation de la Politique agricole nationale: Résultats des consultations à la base: *District de Muhazi*, MISSION D'APPUI AU MINISTERE DE L'AGRICULTURE ET DE L'ELEVAGE (MINAGRI) EN VUE DE L'OPERATIONNALISATION DE LA POLITIQUE AGRICOLE NATIONALE RAPPORT DE DISTRICT Kigali, Septembre 2004

Opérationnalisation de la Politique agricole nationale: Résultats des consultations à la base: *District de Rukira*, MISSION D'APPUI AU MINISTERE DE L'AGRICULTURE ET DE L'ELEVAGE (MINAGRI) EN VUE DE L'OPERATIONNALISATION DE LA POLITIQUE AGRICOLE NATIONALE RAPPORT DE DISTRICT Kigali, Septembre 2004

Opérationnalisation de la Politique agricole nationale: Résultats des consultations à la base: *Ville de Rwamagana*, MISSION D'APPUI AU MINISTERE DE L'AGRICULTURE ET DE L'ELEVAGE

(MINAGRI) EN VUE DE L'OPERATIONNALISATION DE LA POLITIQUE AGRICOLE NATIONALE RAPPORT DE DISTRICT　Kigali, Septembre 2004

(7) MINISANTE

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