- estimation of construction cost
- project evaluation
- environmental impact
- implementation plan

1.4 UNDERTAKING OF THE STUDY

The Government of Japan, through JICA, undertook the necessary measures to dispatch the study team to Rwanda and effect a technology transfer with the GOR personnel during the course of the Study. The Study Team commenced work at the end of July 1989 and from August 1989 until March 1990, undertook surveys, discussions with GOR authorities concerned, field investigations, analyses of data collected and geological surveys in Rwanda. The results of the activities were presented in the Progress Report submitted to MINITRAPEE in October 1989.

The second on-site survey was conducted from June to October 1990. The results of the study on existing water supply systems and draft basic plans were presented in the Interim Report submitted to MINITRAPEE in September 1990.

The third on-site survey was conducted from June to August 1991. The Draft Final Report, which contained all the study items, was submitted to MINITRAPEE, for comments and further discussions held during November 1991. The Final Report was completed in January 1992, reflecting the conclusions obtained from the discussions with MINITRAPEE.

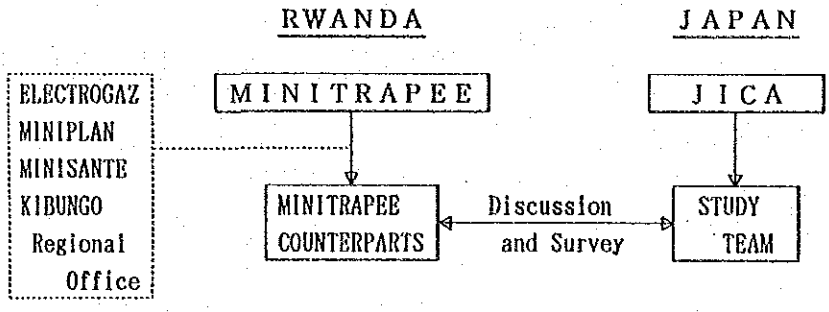
1.5 COMPONENTS OF THE REPORTS

A number of reports have been prepared and submitted to MINITRAPEE during the period of the Study, in the form of progress, interim and draft final reports, covering all the work performed under the Study. All reports culminate in the Final Report, which was composed of the following five volumes.

(1) Volume I SUMMARY REPORT in French
(2) Volume II MAIN REPORT in English and French
(3) Volume III SUPPORTING REPORT in English
(4) Volume IV DRAWINGS in English
(5) Volume V DATA BOOK in English

1.6 STUDY TEAM AND MINITRAPEE'S COUNTERPARTS

The Study was practically implemented by a joint team composed of JICA Team members and MINITRAPEE Personnel. JICA had organized a study team consisting of a team leader and 14 professionals and experts. JICA Study Team members, JICA Committee members and MINITRAPEE counterparts were as listed below.



(1) JICA Study Team and JICA Committee

(Name)	(Assignment)
1.Yukio HOSHINO	Team Leader
2.Shinichiro MATSUMOTO	Sub-Team Leader Hydrological/Water Resources
3.Hisashi KOBAYASHI	Hydrogeological/Environment Analysis
4.Hiroshi HIRAMOTO	Electrical Prospecting-A
5.Keiji TANAKA	Electrical Prospecting-B
6.Takayuki OHNO	Test Drilling/Pumping Test-A
7.Satoshi IKIMORI	Test Drilling/Pumping Test-B
8.Hiroshi MORI	Water Supply Planning
9.Osamu YAMAMOTO	Facility Engineering/Design (1989-90)
10.Keisuke TAGUCHI	Facility Engineering/Design (1991)
11.Atsushi KISHI	Topo-survey/Facility Design
12.Seishiro OGITA	Socio-Economic Analysis
13.Kazumasa FUJIMOTO	Interpretation(1989-91)
14.Wataru MAKITA	Interpretation(1991)
15.Shigeto TAKEUCHI	JICA Expert(Compressor)

(2) **MINITRAPEE Counterparts**

(Name)	(Position)
1.Leopold MUGABO	General Director of Directorate of Water (DGW), MINITRAPEE
2.Fidele KANYABUGOYI	Director of Planning Department (PD), DGW
3.Verene MUKANDEKEZI	Director of Rural Water Supply Department (RD), DGW
4.Alexis NGIRABABYEYI	Manager of Investigation Division, PD, DGW
5.Gaspard NSENGIMANA	Manager of Operation and Maintenance Division, RD, DGW
6.Charles KAYITARE	Manager of Project Inspection Division, RD, DGW
7.Boniface MUNYAGATANGA	Chief of Project Inspection Division, RD, DGW
8.Baptiste GAKWANDI	Secretary of Administration, PD, DGW
9.Chrysostome NKUNZIMANA	Secretary of Administration, RD, DGW
10.Alexandre NDAHUMBA	Secretary of Administration, PD, DGW
11.Emmanuel NZABISIGIRANDE	Mechanic in charge of Warehouse, RD, DGW
12.Phillippe MUTAZIHANA	Mechanic in charge of Warehouse, RD, DGW

CHAPTER 2

BACKGROUND OF THE PROJECT

2. BACKGROUND OF THE PROJECT

2.1 COUNTRY BACKGROUND

2.1.1 Physical Conditions

(1) General Conditions

The Republic of Rwanda, situated in central Africa, extended between latitudes of 1° and 3° South and longitudes of 29° and 31° East. Its territory covered 26,338 km2. The neighboring countries were the Republic of Uganda in the north, the Republic of Burundi in the south, the United Republic of Tanzania in the east and the Republic of Zaire in the west. Natural boundaries were formed by Lake Kivu in the west, a volcanic chain of mountains in the north and the Akagera River to the east and south.

Northern and western areas of the country were characterized by volcano ranges and huge mountains covered with lush jungles/natural forests and contained the sources of the main rivers and streams which crossed the country. There were many volcanic lakes, the biggest of which was Lake Kivu containing limpid water.

The center and southern areas consisted of hilly to rolling land with small plains containing bush/cultivated land. South-eastern and eastern areas were mainly composed of plateaus and bushy plains with numerous marshes/lakes.

The country was near to the equator, where the annual average temperature was 22°C and the mean annual rainfall in Kigali, the capital, was about 1,000 mm. The year was divided into four seasons; two rainy seasons and two dry seasons, which did not influence the temperature to a great extent.

(2) Existing Conditions of Water Resources

The following problems of surface water existed, though the country had many lakes and plentiful water sources:

- Surface water was contaminated by domestic drainage
- Residential areas were located mostly on high plateaus
- Existing drainage systems were of low technical level with insufficient funds for improvement and maintenance.

For the above reasons, springs having high quality water that could be distributed by gravity flow together with high quality groundwater had a high development potential as the source of rural water supply. Actually, most existing water supply facilities utilized developed springs.

Most of the rain fall within the western and northern regions where the annual rainfall often exceeded 1,000 mm. A sufficient yield of spring water could be provided because of the high rainfall and the large catchment areas for the springs in the region.

However, in the eastern region, due to the smaller rainfall and dissecting rolling terrain, residents used not only spring water but also surface water.

2.1.2 Social Conditions

(1) Historical Outline

On July 1, 1962, Rwanda gained its independence from Belgium. Rwanda was a nonaligned nation and had maintained friendly relations with both eastern and western powers. However, for its economic development, the country preferred to receive technical assistance and grant aid from western powers such as Belgium, France, and Germany.

In October of 1990, an armed group of refugees who had previously fled to Uganda forcibly re-entered Rwanda inciting a rebellion. The Government of Rwanda suppressed the revolt and the aftermath resulted in serious problems for the Government, such as the re-entry of refugees.

(2) Administration Organization

The Central Government of Rwanda was composed of the Office of the President and seventeen ministries.

The country was divided into ten prefectures. Each province was headed by a governor (Bourgmestre) appointed by the President. Each province was divided into Communes. Each Commune had a population ranging from 30,000 to 40,000 people. The Communes were further subdivided into "Secteurs", each having about 3,000 people. Within a "Secteur" there were from 50 to 100 household cooperative neighborhood communities called "Cellules". A "Commune" was the smallest self-governing unit having its own budgetary funds.

(3) Population

Referring to the information of MINIPLAN (1988), Rwanda had a population of 6.75 million and population density of 256 persons/km2 which had grown at an annual rate of 3.3% since 1978, one of the highest population growth in Africa. The distribution of population by age groups, of 1990, were 51.0% (0-14 years old), 45.0% (15-65 years old), and 4.0% (older than 65 years old). An economically active population (in Rwanda people older than 15 years were taken into account) was estimated to be 3.19 million in 1986.

The Government of Rwanda established the Office for National Population (ONAPO) to promote family planning and teaching contraceptive methods.

(4) Labor Force

The agricultural sector provided the greatest opportunity for employment within the country's labor market; it accounted for more than 90% of the total employment in 1986. The employment recorded 93% in the agricultural sector, 3% in the manufacturing sector and 4% in the service sector within the nation's total employment in 1980.

2.2 ECONOMIC INDICATORS

Rwanda is a typical agricultural country and cultivated mainly bananas, beans, and potatoes for self consumption. Coffee and tea were cultivated for export purposes and accounted for more than 50% of the country's total exportation.

The Gross Domestic Product (GDP) had grown at an average rate of around 4% yearly between 1982 and 1986, but from 1983 to 1984, its growth was decelerated to as low as 1.8% per annum. Nevertheless, during the subsequent period between 1984 and 1986, the Rwandan economy recovered from the said sluggish performance obtaining an annual growth rate of 8%. The 1987 GDP per capita was about US$310.

External trade with Rwanda was mainly based on agricultural and mining products for export and capital and consumer goods for import. The total export (FOB base) in 1986 was SDR 159 million against the total import (FOB) of SDR 236 million, yielding or SDR 78.06 million trade deficit. From 1982 to 1983, a trade deficit was registered due to the depressed price of coffee on the international market. Generally, a deficit in foreign trade of SDR 60 to 90 million was recorded between 1983 and 1986. The unfavorable balance of trade also continued from 1986 to 1990.

The balance of international payments (including long-term capital revenue) for 1986 accounted for a surplus of SDR 27.54 million and increased approximately SDR 31.28 million from SDR -3.74 million in the previous year.

Although the net international reserve as of 1987 was US$164.19 million, the external debt had been increasing. The 1986 foreign debt balance was US$439 million, while the foreign currency reserve was US$162 million, both on the increase. The 1986 debt service rate was 7.6%, the foreign exchange rate of 1987 for the FRW was 73.02/US$.

The exchange rate of the FRW dropped from 80 FRW/US$ to 120 FRW/US$ in November 1990 on account of the resultant aftermath of the rebellion. The exchange rate in August 1991 was 128 FRW/US$.

The money supply had been increased at the rate of 13.7% per year between 1984 and 1986. The total money supply in 1986 was FRW 26.48 billion.

The annual consumer price rate had been comparatively stable, at less than 7% between 1983 and 1987. The consumer price indicators in 1987 against 1982 (=100) was 115.2 and the annual rate of increase was estimated as an average of 3.9%.

The resultant aftermath of the rebellion brought about a sudden increase of consumer prices. The prices of import goods were raised at a rate of 1.9 times from Oct. 1990 to Jul. 1991 and that of domestic products had been increased at a rate of 1.2 to 1.5 times.

The annual revenue of Rwanda in 1987 was FRW 29,520 million (ordinary revenue). The annual expenditure in 1987 was FRW 37,320 million (ordinary expenditure: FRW 11,750 million), resulting in a deficit of FRW 7,750 million -an increase of approximately FRW 1,070 million from the previous year. The debt was supplied from both internal (40%) and external (60%) sources.

The total expenditure of ministries of the Government in 1987 was 20,702 million FRW.

2.3 HEALTH INDICATORS

2.3.1 Health and Hygiene Conditions

The index of Rwanda's public health and hygiene conditions were lower than the average of other African nations and indicated that Rwanda's public health and hygiene services were not sufficient.

The hygiene conditions were typical of those in Central Africa, however the improvement of public health conditions in Rwanda had decreased the rate of mortality and increased life expectancy.

To improve public health and hygiene conditions, MINISANTE had been exerting efforts to achieve the following objectives:

- Improvement of hospitals and health care centers
- Cultivate staff for medical care and public health
- Improvement of medical supplies and inventories
- Promotion of social education related to public health and hygiene.

2.3.2 Prominent Diseases

The most prominent diseases in Rwanda were malaria, diarrhea, pneumonia and gastritis. Thus, waterborne diseases were the more prominent.

The importance of safe drinking water must be emphasized.

2.3.3 Sewage

The rate of use of the pit-toilet was 84% in rural and small city areas. This figure was very high in comparison with those of neighboring countries. The rate of use of the pit-toilet in Rwandan rural areas was higher than in the urban areas. However, according to MINISAPASO's plan, the pit-toilet rate did not reflect the actual sanitary conditions. In spite of the high rate, reproduction related diseases and diseases contracted orally were high.

2.4 NATIONAL DEVELOPMENT PLAN

2.4.1 National Development Plan

Since the country gained its independence in 1962, the Government of Rwanda launched the following National Development Plans:

1) The First Five-year Economic, Social, and Cultural Development Plan (1966-1970)
2) The Second Five-year Economic, Social, and Cultural Development Plan (1977-1981)
3) The Third Five-year Economic, Social, and Cultural Development Plan (1982-1986)
4) The Fourth Five-year Economic, Social, and Cultural Development Plan (under preparation)

The main features of the Fourth Five-year Economic, Social, and Cultural Development Plan (1987-1991) were announced in November 1986. The details of the Plan were being prepared by MINIPLAN based on the development strategies of each ministry.

Based on the domestic water strategies of each ministry, it was expected that the domestic water supply project would be given high priority in this Plan as it was in the Third Five-year Economic, Social, and Cultural Development Plan.

2.4.2 Development Strategies for the Water Supply Sector

(1) General

The Government of Rwanda regarded the water supply project that is intended to provide all Rwandans with safe drinking water as being of utmost urgency. The implementation of the project, starting in the poorest of the eastern areas, commenced in 1981.

As its policy, the Government emphasized the development of small scale water sources and water distribution by gravity flow, and, if necessary, the installation of supplementary pumping systems and water treatment facilities. Some of the facilities had already been installed.

(2) Strategies of the Fourth National Development Program

In 1988, MINITRAPEE announced the development strategies for sectors that would become the basic data of the Fourth Five-year Economic, Social, and Cultural Development Plan. The strategies encompassed four sectors: water supply; roads; energy; and urban planning.

For projects planned to be implemented under the Fourth Five-year Development Plan (1987-1991), the cultivation of engineers and the promotion of education for residents in the water supply sector were stressed.

2.5 SECTOR ORGANIZATION

2.5.1 Institution of Water Supply Services

(1) MINITRAPEE

The Water Supply Sector was handled by the Ministry of Public Works, Energy and Water (MINITRAPEE). MINITRAPEE consisted of four Directorates and a General Secretary.

The Directorate General of Water (DGW, established in 1984), was one of the Directorates of MINITRAPEE responsible for overall planning, coordination and supervision of water resources development and water supply projects. The organization of the Directorate General of Water consisted of 4 Departments as follows:

- Secretary
- Planning Department (PD)
- Urban Water Supply and Sewage Department
- Rural Water Supply Department (RWSD)

DGW performed the following work:

- To strengthen the organization and cultivate the engineers related to domestic water supply development
- Plan, investigate and prepare technical studies for water supply projects
- Investigate water sources
- Promote education for residents

(2) Related Ministries and Agencies

Agencies related to water supply projects were as follows:

ELECTROGAZ:	Responsible for the operation and management of urban water supply facilities.
MINIPLAN:	Responsible for planning and providing financial assistance for rural water supply projects
MINIAGRI:	Responsible for the management of water source areas and hydrological data
MININART:	Responsible for the management of hydrogeological data
MINISANTE:	Responsible for the management of public health and hygiene service
MININTER:	Responsible for providing financial assistance for small-scale water supply projects to Communes

2.5.2 Water Management Organization

Presently, the management of water supply facilities was carried out by groups organized by commune administrators and facility users, private citizen groups, and committees concerned with water.

(1) Government Organizations

ELECTROGAZ was established as a public organization to produce electricity, gas and water supplies. Its activities were generally limited to urban areas, however, some activities related to complicated plants in rural areas were planned to be expanded. ELECTROGAZ came under MINITRAPEE's jurisdiction.

(2) Nongovernmental Organizations

The largest nongovernmental organizations for water management were AIDR, COFORWA and SVN. These organizations developed 93% of the water sources for the water conveyance systems in the country's rural areas until 1984.

AIDR (Association of International Rural Development, a private association of Belgium)
The construction, management, operation and maintenance of drinking water supply facilities in rural areas were entrusted to AIDR. However, in 1985, some Rwandan national nongovernmental organizations were established and AIDR's activities in Rwanda were halted.

COFORWA (Corporation for Rwanda Water)
The strongest nongovernmental organization is COFORWA which extended its activities throughout the country.

This corporation was established as a nonprofit organization in 1981. Its wide activities are supported by financial backers including the Government of Rwanda and various foreign nongovernmental organizations.

For the past several years, COFORWA had been forming facility user organizations to carry out the effective use of water supply facilities and to manage, operate and maintain facilities once they had been constructed.

SVN (Dutch Volunteer Organization)
SVN commenced its activities in Rwanda in December 1978. Since 1979 they had been engaged in rural water supply projects in Rwanda.

In 1980, under a tentative agreement with the Government of Rwanda, SVN's activities in Rwanda were placed under the jurisdiction of the Government. The agreement was formally approved in 1982.

2.5.3 International Organizations

International organizations which contributed to the Rwandan water resources and domestic water supply development were as listed below:

- United Nations Development Program (UNDP)
- United Nations Children Fund (UNICEF)
- World Health Organization (WHO)
- World Bank(IBR)
- International Development Association (IDA)
- African Development Bank(AFDB)
- European Development Fund (EDF)
- Bureau Central d'Études pour les Équipment d'Outre-Mer(BCEOM)
- Fonds d'Aide et de Coopération Française (FACF)
- Association International de Dévelopment Rural of Belgium(AIDR)
- Japan International Cooperation Agency (JICA)

UNICEF had been providing financial assistance for the development of natural spring water in Rwandan rural areas as well as cooperating in the preparation of the nationwide water resources development master plan.

WHO had been providing guidance in the preparation of the country's water quality and for public health and hygiene standards. The World Bank had been financing water supply development projects in the urban areas and had also financed the Comprehensive Study of Existing Water Supply Facilities in Rural Areas.

AFDB is cooperating in establishing a chemical manufacturing factory for water treatment and was planning to finance the Pumping Station Construction Project in the Lava Region.

2.6 PRESENT SITUATION AND DEVELOPMENT PLAN OF THE WATER SUPPLY SECTOR

2.6.1 Existing Conditions

The safe drinking water supply rate throughout the entire country was 37% in 1981. In 1986, when the Third National Development Plan was completed, the rate improved to 64%; 48% of the people within Rwanda were able to obtain water from improved springs. 16% of the people were able to receive water via piped supply systems.

In 1985, there were 292 simple water supply systems for rural areas. 243 of these systems were gravity flow types and six of them included water purification facilities. There was a total of 3,939 km of piping and 2,459 supply connections by which 44,000 m3 of water was supplied daily. By assuming that one household consumed an average of 80 liters a day, approximately 550,000 households benefitted from these facilities.

2.6.2 Strategies and Activities of the Third National Development Program

In Rwanda, water supply system improvements were conducted by MINITRAPEE. Providing a supply of fresh water to the people of Rwanda was the country's highest priority objective. During the period of the Third Five-year Economic, Social, and Cultural Development Plan, more money was invested in the water supply sector than originally planned.

Major projects and activities under the Third Five-year Development Plan were as follows:

1) Development projects in urban areas	:	9
2) Development projects in rural areas	:	16
3) Nationwide projects	:	5

The progress of the development projects in rural areas was as follows:

Completed projects	8
Still continuing but close to completion	1
Study project with guaranteed funds	1
Projects awaiting financing	3
Project under study stage	1
Projects under planning stage	2

Table 2.1 Comparison of Amounts Planned and Actually Spent During the 3rd Five-year Development Plan Period

(unit: million FRW)

Category	Planned	Actual Amount Spent					
	Amount	1982	1983	1984	1985	1986	Total
Urban	1,930	147.2	176.0	292.0	684.8	690.2	1,990.3
Rural	1,200	341.5	256.3	554.0	339.2	664.6	2,155.6
Total	3,130	488.7	432.3	846.0	1,024.0	1,354.9	4,145.9

Source: Evaluation Report for the Third Five-year Economic, Social, and Cultural Development Plan (1982-1986), by MINIPLAN, 1988

2.7 FINANCIAL IMPLICATIONS OF THE SECTOR

2.7.1 Budgetary Conditions of MINITRAPEE

The Government's 1984 budgetary fund amounted to 18.65 billion FRW (192 million US dollars). MINITRAPEE's portion was 6.8% (1.25 billion FRW which was equivalent to 13 million US dollars). The General Direction of Water's budgetary fund was only 70 million FRW (720,000 US dollars) and represented only 5.6% of MINITRAPEE's budgetary fund. Of the 70 million FRW, 30 million FRW (310,000 US dollars) was allotted to rural water supply projects. However, it was believed that this amount would be insufficient to solve the domestic water supply problems now faced in the rural areas.

To improve the domestic water supply facilities in rural areas, therefore, it would be necessary to rely on aid from foreign governments and international organizations.

The annual budgetary funds for the two organizations are listed below:

Table 2.2 Annual Budgetary Funds of MINITRAPEE and DGW

(unit: million FRW)

Fiscal Year	Government's Budgetary Fund	MINITRAPEE	General Direction of Water
1986	25,340	1,543	159
1987	26,922	1,405	85
1988	39,909	1,464	104
1989	36,455	-	-

2.8 FOREIGN AID

2.8.1 Development Assisting Countries

From 1977 to 1986, Rwanda received 1.535 billion US dollars in aid from Development Assisting Countries (DAC) and international organizations. 78% of the amount was in grant aid (34% of which was for technical cooperation) and the remaining 22% was in loans.

The most aid given by a foreign government was provided by Belgium; they gave 277 million US dollars (28.5% of the total aid). West Germany giving 190 million US dollars (19.5% of the total foreign aid), and France giving 131 million US$ (13.5%) were the second and third highest contributors, respectively. Japan gave 19.82 million US dollars. Of the international organizations providing aid, the European Community gave the most (171 million US dollars, 30.1% of the total aid). The World Bank was the second highest contributor (164 million US dollars, 29.1% of the total aid).

During the two-year period of 1985 and 1986, the countries, in order of providing aid were Belgium, West Germany, the United States of America, and France. During the same period, the World Bank was the main contributing international organization.

2.8.2 Japanese Grant Aid and The Rural Water Supply Project

Japanese Grant Aid during the period from 1983 to 1987 was 5,367 million J.Yen. The Rural Water Supply Project in the Eastern Region commenced in 1986 and 568 million J.Yen was provided during the period from 1986 to 1988.

From 1984 to 1985, JICA carried out the "Study on Rural Water Supply Project in the Eastern Region". Based on the study results, the Phase I Project commenced in 1986.

Seventy-two wells were bored under the Phase I Project. One of the wells was provided with a simple piped water distribution system and the remaining seventy-one wells were equipped with hand pumps. A rainwater storage facility was also constructed under the Project.

CHAPTER 3

THE STUDY AREA

3. THE STUDY AREA

3.1 GENERAL

The Study Area covered the entire Kibungo Prefecture, excluding the Akagera National Park and districts which were served by existing water supply system.

Location and Settlement Units
The Study Area, the Kibungo Prefecture, was located at about 50 km south-east of Kigali, the Capital of Rwanda. The Kibungo Prefecture lay between latitudes 1°40' and 2°25'S and longitudes 30°15' and 30°55'E. The Prefecture extended over approximately 4,130 km2.

In 1988 the Area consisted of eleven (11) communes (120 secteurs) with a total population of 433,000.

Accessibility
The main access to the Kibungo Prefecture was through the arterial National Road. This road connected the Area to Kigali. Within the Study Area, there were several local roads which served as branches of the main artery. Only a few boats were provided on main rivers for transportation purpose and there rarely operated.

3.2 PHYSICAL ENVIRONMENT

3.2.1 Topography

The Study Area consisted of mountains and hills ranging in altitude from 1,300 to 1,800 m. In most of the Study Area, wide and deep dissecting valleys were observed and the relative heights of mountains or hills to valleys generally exceeded 200 m. As many valleys occurred, the plateau-like hills and mountains were progressively eroded, leaving only a series of peaks and ridges of approximately the same height.

Using the geographical features and the drainage system, seven (7) land classification units had been formed. On the basis of distribution of the land classification units, the Study Area would be conveniently divided into three (3) geographical regions as below:

Gentle Lowland:
This land was found around main lakes and the Akagera River. Though the elevations ranged from 1,300 m to 1,450 m, relative heights were less than 50 m.

Rolling Land:
This land widely occurred in the area. The elevations ranged from 1,350 m to 1,700 m and relative heights were generally 200 m to 300 m.

Hilly Land:
This land was found in the south-eastern portion of the Study Area. The elevations ranged from 1,350 m to 1,800 m and relative heights were more than 250 m.

3.2.2 Geology

The Study Area in Kibungo Prefecture was composed of Pre-cambrian rock formations (pelitic schist, sericite, phylite quartzite), granitic rocks intruded into the Pre-cambrian formations and unconsolidated Quaternary deposits (talus sediments, alluvial river/lacustrine deposits).

In the western half of the Study Area, mainly schist with thin sandstone and quartzite beds occurred and Rolling Land was dominant; in the eastern half, a large quartzite extrusion and Hilly Land were evident together with massive granitic outcrops found on some marginal Gentle Lowlands in the Area.

Pre-cambrian formations were divided into three (3) stratigraphical classifications; i.e. Miyove Series of upper, Byumba Series of middle, Inferieure Series of lower.

Granitic rocks were also divided into two (2) types of massive, less altered granite, in the southeastern part and gneissose granite around the main lakes. A few basic intrusive rocks of diorite were scattered in the southern to eastern margins of the Area.

The surface of the Precambrian formations were overlaid by weathered zones. Below these, strong fissured sections were developed up to 50 m deep. Further weak fissured sections were assumed to exist for depths of up to 200 m.

Since precambrian formations were formed in the oldest geological age, its original textures were very hard and impesneable bedrock. But the coarse beds in these weathered zones and fissured sections were considered to be good aquifers.

Quaternary formations in some valleys were deposited for depths of almost 30 m, and good aquifers were formed in sand and gravel beds contained within.

Pre-cambrian formations were generally laid NS and mostly dipped straight. Many folds with axes of a NNE-SSW trend and faults of a mainly NNE-SSW trend occurred. A few conjugate faults also ran in the EW direction.

Hydrogeological descriptions of the Study Area were also given in Chapter 4 "WATER RESOURCES EVALUATION".

3.2.3 Land Use

The landuse pattern in the Study Area was characterized by the geographical location in the area because of the relief and distribution of rainfall. The land in the Study Area was classified into four categories as follows:

A1: Savanna with Agricultural Lands
Rainfed croplands under annual cultivation were mainly found in the relatively higher lands together with a scattering of savanna grasslands.

A2: Low-lying Savanna with Agricultural Lands
Landuse patterns in this area are similar to those of "A1" but many irregularly irrigated croplands were broadly scattered in the lower parts.

F: Savanna with Forests
The area was mainly covered with sparse forest of steep topography and some stone surfaces.

S: Swamp/Swampy Lands
Broad swampy lands occurred along the Akagera river and its tributaries with widths of 1 to 5 km.

The coverage in uplifted dry-land are given in the Table below.

- Agricultural Lands	:	1,455 km2	(55%)
- Pasture	:	88 km2	(3%)
- Forest/woods	:	1,124 km2	(42%)
		2,667 km2	(100%)

3.2.4 Meteorology

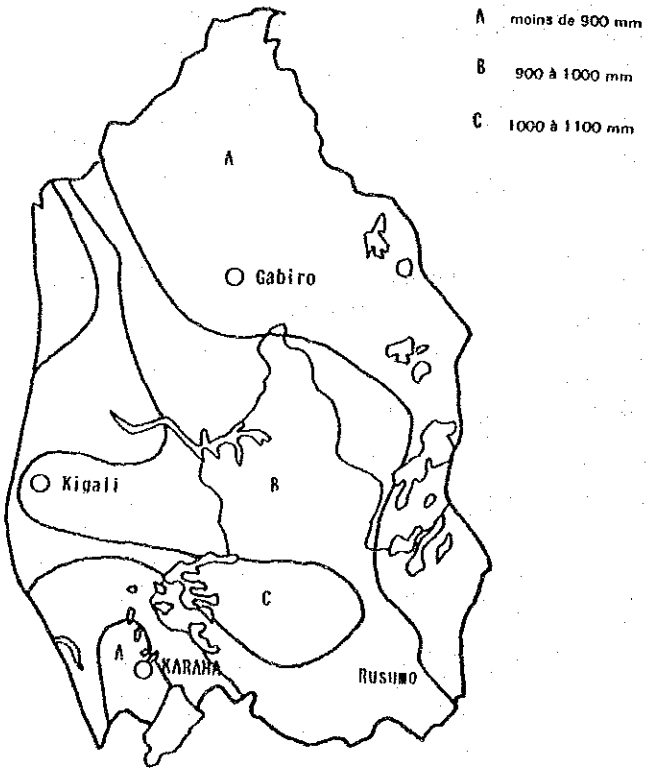
No systematic observations were carried out in the Study Area, though Kibungo and Zaza Meteorological Stations and some rain gauges existed (see Appendix C).

Meteorological Characteristics

Although situated near the equator, the Study Area had a rather mild climate. Since the rainfall in the Study Area was sporadic, no correlation between each area and its daily rainfall was seen. Also, each area's monthly rainfall deviated. The 10 year record shows that the highest rainfall occurred in March. North-eastern and eastern regions had less rainfall.

The year is divided into 4 seasons, as outlined below, which do not significantly affect temperature variation.

- Rainy season : Mid Mar.- Mid May, Mid Sep.- Mid Dec.
- Dry season : Mid May - Mid Sep., Mid-Dec.- Mid Mar.



Annual Rainfall Class

The climate in the Study Area was divided into three categories based on rainfall amount and length of dry period:

"Ia" in southern and eastern parts:
annual rainfall of less than 900 mm with a longer dry season,

"Ib" in center:
annual rainfall of around 1,000 mm with a shorter dry season, and

"Ic" in the northern parts:
annual rainfall of around 1,000 mm with a long dry season and rainfall concentrated in the rainy season.

Rainfall

A maximum rainfall of 1,351 mm p.a. was recorded at Zaza (1982) in the center of the Area and a minimum precipitation of 640 mm p.a. was recorded at Ruhanda (1984) in the northern portion of the Area.

At Kibungo station, around 1,000 mm was an in average and around 800 mm p.a. was the precipitation of a 5 year return probability. Generally, more than 70 mm p.m. of rainfall was recorded during the rainy season (Mar. to Apr.) and less than 20 mm p.m. during a long dry season (Jun. to Aug.).

The monthly mean rainfall was 7.3 mm (Jul.) minimum and 161 mm (Mar.) maximum. Consequently, the rainfall in March was more than ten times of that in the dry period.

Temperature

The annual mean temperature was 20°C to 19°C, and the fluctuation during the months was as small as 1°C. The daily temperature was around 30°C maximum and 11°C minimum.

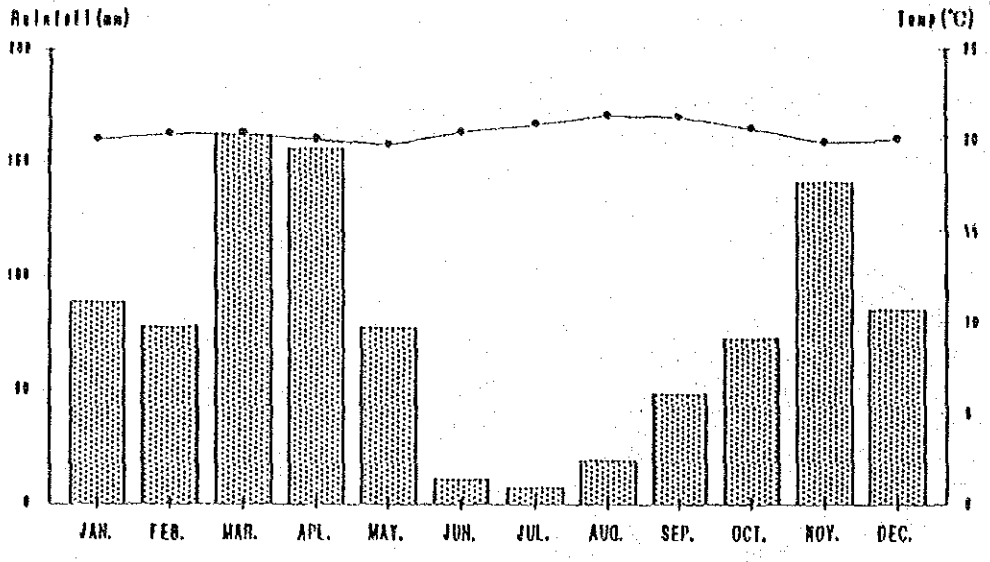


Fig. 3.1 Mean Monthly Climatological Data

Evaporation

According to the data in Kigali, the monthly mean evaporation was around 95 mm; the maximum was 5.82 mm/day in August and the minimum was 1.92 mm/day in April.

3.2.5 Hydrology

The Study Area was divided into eleven (11) drainage basins as follows:

Table 3.1 Drainage Basins in the Study Area

Catch-ment	Name of Basin	Catchment Area (km2)
A	Ngungu River Basin	349
B	Lake Muhazi Basin	346
C	Nyakora River Basin	502
D	Lake Nasho Basin	267
E	Lake Mugesera Basin	432
F	Lake Sake Basin	420
G	Lake Kabavubyi Basin	167
H	Rwagitugusa River Basin	658
I	Akagera River Southern Basin	226
J	Akagera River South-Eastern Basin	161
K	Akagera River Eastern Basin	152
	Total	3,680

Regarding the time of concentration of the runoff discharge, a short time concentration was observed at the stream area connected to the river channel, because of the steep slopes, but the time in the river channel was relatively long due to the flat topography.

It was estimated that the characteristics of river discharge in the Study Area were:

Direct runoff:
Quickly occurred, after rainfall of more than 20 mm/day.

Sub-surface runoff:
Small peaks of discharge continued for more than one week.

Basic runoff:
1.4 m3/sec (587 m3/day/km2 = 0.6 mm/day) was estimated.

Specific discharge:
19.2 lit./sec/km2 to 5.3 lit./sec/km2. The annual runoff coefficient was 26%.

Flood discharge:
30 lit./sec/km2 to 60 lit./sec/km2.

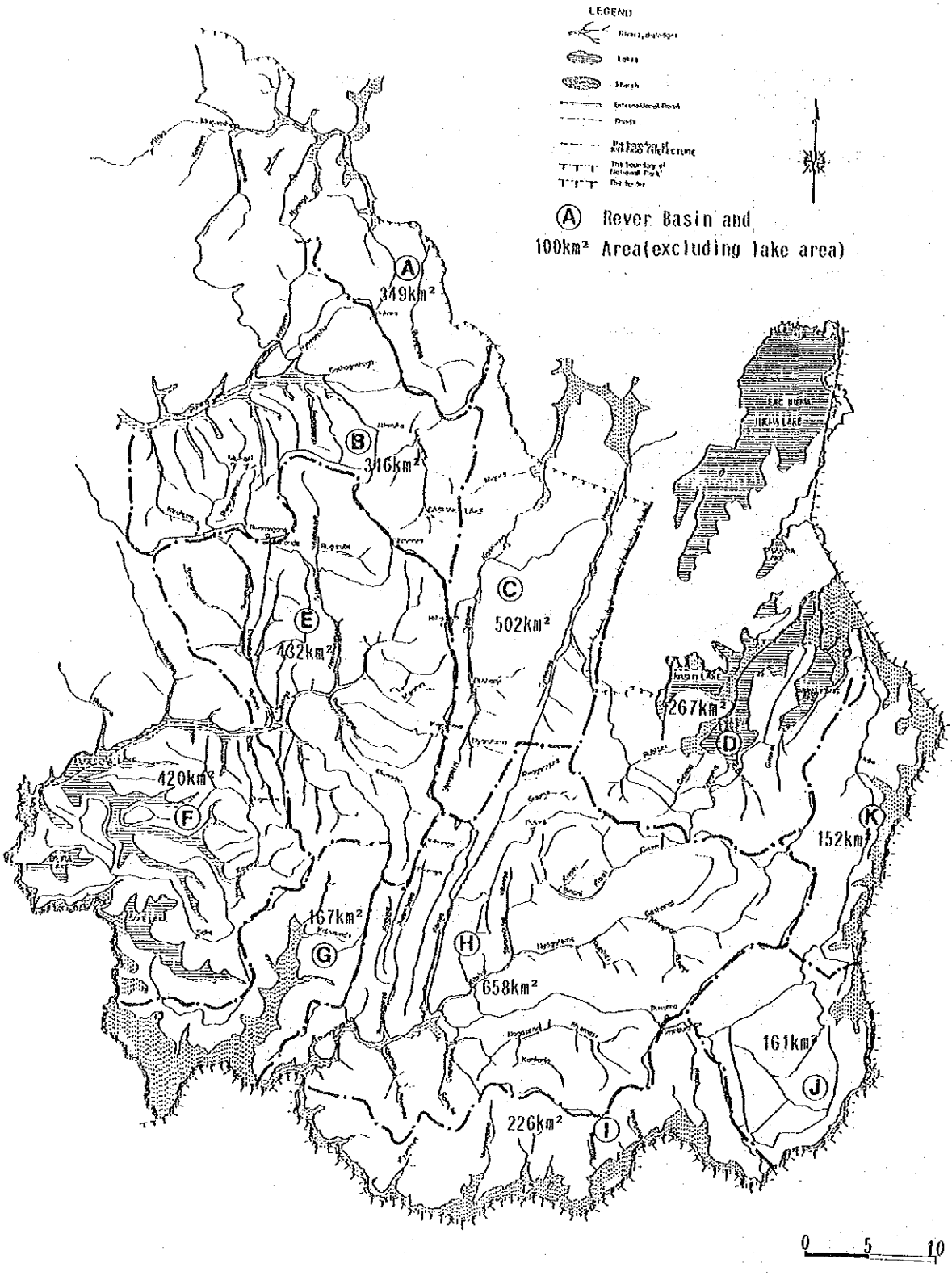
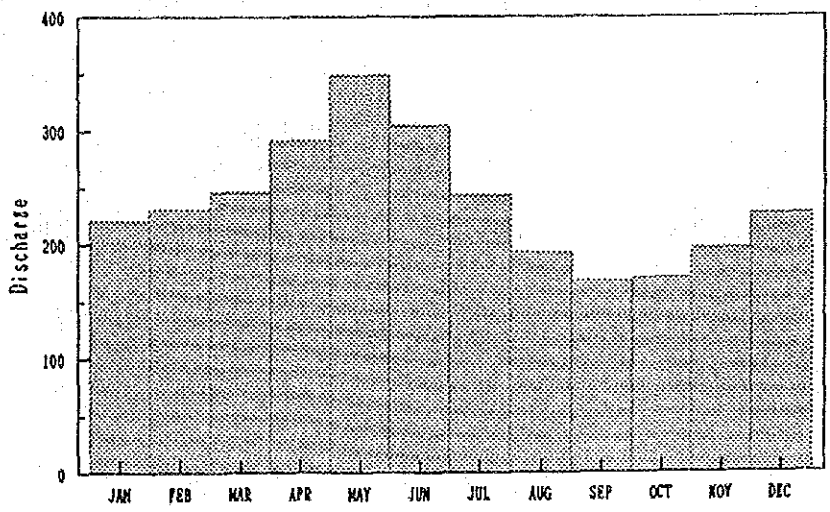


Fig. 3.2 River System and River Basin

The monthly discharge of the Akagera River were as given below.

Monthly Discharge at the AKAGERA Hydrological Station (1978-1987)



The relation between rainfall, discharge, lake water level and river system/river basin were presented in Appendix C.

In addition, sizable lake water surfaces were found in the Study Area. The total area of water surface within the Study Area was 87 km2, except for lakes on the eastern margin, and the total storage amount of water was estimated to be 690 million m3.

3.3 POPULATION

3.3.1 Population Pattern

Kibungo Prefecture consisted mostly of rural areas and only Kibungo, Rwamagana, Sake and Zaza were the major town areas. Less than 10% of the whole population were living in the town areas. The rest were generally living in small settlements and/or farm-houses scattered on hilly lands. The town of Rwamagana has the biggest population with some 10,000 inhabitants, also, the town of Kibungo had a population of some 5,000 inhabitants as of 1988.

The population of younger age-groups (under 15 years old) was dominant in the Study Area reflecting the population pattern at a National level.

3.3.2 Actual Population

The population of each commune in Kibungo prefecture, as of 1984 and 1987, was as listed below:

Table 3.2 Population in the Study Area

Commune	Area (km2)	Population 1983	Population 1988	Increase	Density 1983	Density 1988
1 BIRENGA	263.6	33,307	43,413	10,106	126.4	164.7
2 RUKIRA	253.2	30,344	35,970	5,626	119.8	142.1
3 RUSUMO	788.8	46,972	64,103	17,131	59.5	81.3
4 SAKE	146.1	34,118	40,841	6,723	233.5	279.5
5 MUGESERA	144.1	41,509	46,128	4,619	288.1	320.1
6 KIGARAMA	273.3	35,597	39,559	3,962	130.2	144.7
7 KABARONDO	160.3	27,531	31,975	4,444	171.7	199.5
8 KAYONZA	190.0	23,760	25,953	2,193	125.1	136.6
9 RUTONDE	93.7	27,726	31,024	3,298	295.9	331.1
10 MUHAZI	91.6	33,499	38,478	4,979	365.7	420.1
11 RUKARA	261.6	31,542	35,541	3,999	120.6	135.9
TOTAL	2,666.6	365,905	432,985	67,080		

Source : Monographie dela Prefecture de Kibungo 1988

The population density of Muhazi Commune, the highest within the Prefecture, was 420 persons per km2 and that of Rusumo Commune was the lowest of 81 persons per km2. The population density of secteurs ranged from 100 to 1,000 persons per km2. The areas of high population density were Muhazi, Rutonde, Mugesera and Sake communes, and the density in each secteur ranged from 300 to 1,000 inhabitants per km2.

3.3.3 Population Growth Rate and Pattern

The average population growth rate in Kibungo Prefecture from 1982 to 1988 was estimated to be 3.3 percent per year.

The population growth rate of Rusumo Commune was highest in Kibungo Prefecture with 6.5 percent on account of an inflow of many immigrants from other prefectures. The immigrants had been entering the communes of low population such as Rusumo, Rukira, Birenga, Kayonza and Kigarama as settlers.

The population of each secteur in the year 2000 were projected on the basis of the population in 1988 and the calculated growth rate of each commune. The projected population of the year 2000 which would be applied to the water supply plan was 653,500 persons.

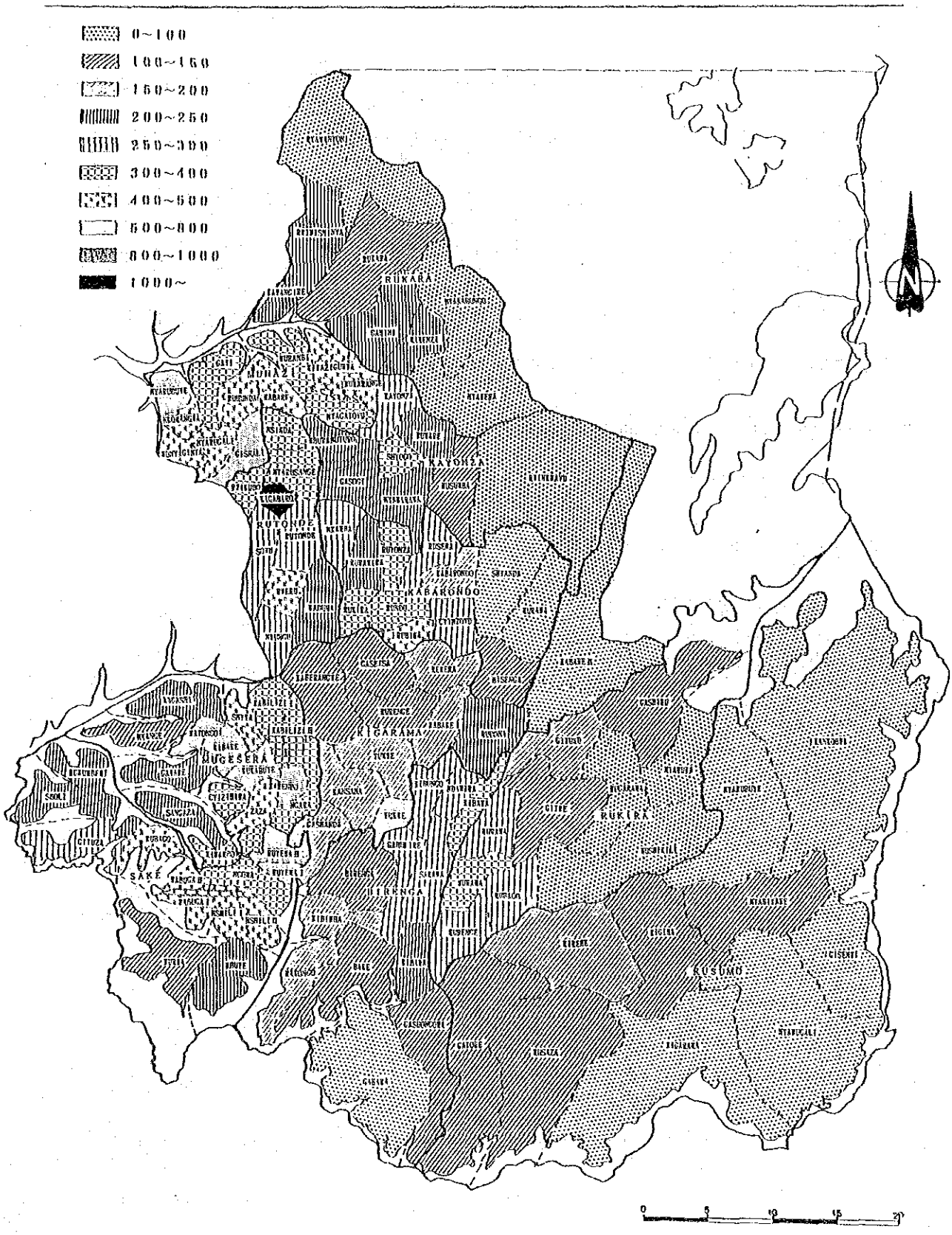


Fig. 3.3 Population Density of Each Secteur

3.4 ECONOMIC AND SOCIAL CONDITIONS

3.4.1 Administration (refer to Appendix D)

The Study Area was administratively located in the jurisdiction of Kibungo Prefecture. Kibungo Prefecture consisted of 11 Communes subdivided into 120 administrative Secteurs and 695 Cellules of the Revelational Movement for National Development (M.R.N.D.).

Each Commune was ruled under a Bourgmestre nominated by the President and assisted by a Communal Council, a technical commission and councilors.

3.4.2 Economic Aspects (refer to Appendix E)

(1) Economic Structure and Activities

The economy of Kibungo Prefecture, dominated by agriculture, presumably employed around 67% of the labor force.

Other industries including the home industry, local manufacturing, transportation services, building and commerce and public services still remained at their initial stage of development playing a rather minor role in the overall economic operations of the Prefecture. These sectors of the industry employed less than 3% of the total labor force within the Prefecture. Around 31% of the labor force was presumed to be unemployed (see Table E.1 of Appendix).

Financial activities had been conducted mainly by commercial banks. The management fee of the existing water supply systems was usually collected by communal organizations and was also deposited to commercial banks such as "La Banque Commerciale du Rwanda (BCR)" and "La Banque de Kigali".

Household-economy was surveyed by the Study Team in 1989 and 1990, by the direct interviewing of inhabitants.

According to the interview survey results, the income of salaried persons in the Prefecture ranged from about 5,000 to 12,000 FRW a month. The income of farmers ranged from of 1,000 to 5,000 FRW (2,500 FRW in average) a month.

In 1988, the labor wage was 200 to 500 FRW (3 - 7 US$) per day and, in general, wages were lower in the rural areas than in the urban suburban areas.

(2) Financial and Marketing Characteristics

The transactions were mainly carried out in "Marches", a traditional market-system in the rural areas of Rwanda. 43 Marches (markets) were operated to trade goods and each marketing area covered two or three secteurs. Most of the Marches were operated on a weekly basis, except densely populated areas such as Kibungo, Murindi, Kabarondo and Rwamagana areas where the markets were open to the public more frequently.

The marketing structure and organization was still at an initial level of development and the transportation/communication facilities for the market were quite inadequate.

3.4.3 Social Aspects (refer to Appendix E)

(1) Education

In the Study Area, most of the primary schools were located in each Secteur and managed by the commune or the catholic church. The approximate number of pupil was 80,000.

Secondary schools were located only in Birenga, Kigarama, Muhazi, Mugesera, Rukara, Rukira and Rutonde Communes. Another educational facility was the vocational training school, also located in each commune.

(2) Health

There were 34 medical institutions in Kibungo Prefecture. These institutions consisted of four (4) hospitals, 11 public health centers, six (6) dispensaries, 12 service nutrition centers and one (1) sanatorium.

The said four prefectural hospitals with a total of 549 beds were located in Kibungo, Rwamagana, Rwinkuwabu and Gahini.

The main causes of morbidity and mortality in Kibungo Prefecture were malaria, diarrhea and pneumonia. In addition, many water-borne diseases such as typhoid, amoebic dysentery, bacillary dysentery and schistosomiasis occurred.

(3) Infrastructure

Roads

The total length of main roads in the Study Area was 431.3 km in 1989 and were classified into three types; international road, national road and communal road. The international road included an asphalt pavement, whilst other roads, not paved, had traffic suspended during the rainy season.

These main roads were maintained by the Road Division in MINITRAPEE. Other local roads were maintained by each commune.

Electrification

Rwanda contained four hydroelectric power plants and one thermal power plant in GATSATA. The total capacity of these plants was 28.69 MW.

There were two transformer substations in Kibungo Prefecture: one in Kabarondo and the other in Rwinkwavu. The operation/management of these substations was conducted by ELECTROGAZ.

Power transmission lines in the Study Area were insufficient. Most of the areas were not electrified, especially, RUKIRA, RUKARA and RUSUMO Communes.

The transmission line network for electric power in the Study Area was presented in Fig. E.4 of Appendix E.

Transportation and Telecommunication

The main transportation means were bus and taxi for the National/Communal roads. Bus transportation was operated by ONATRACOM and taxi-transportation by commercial groups.

Telecommunications were scarcely available in the Prefecture except for telephone services amongst Kibungo, Rwamagana and Kigali.

3.5 EXISTING WATER SUPPLY SYSTEM AND POPULATION SERVED

3.5.1 Conditions of the Existing Facilities

The residents in the Study Area were concentrated on the mid-slopes or hill tops which made it difficult to adopt a centralized water supply method. Thus, most residents would fetch water from sources which were located at a long distance (2 to 3 km).

Springs, lakes, swamps and rivers were the main sources of existing water supply systems in Kibungo Prefecture.

However, many water-related diseases broke out in the areas where residents used surface water taken from lakes, rivers and swamps.

The existing water-supply facilities in the Study Area were classified into the following groups.

i) Non-piped supply system:
Spring/Hand-pump/Rainwater harvesting

ii) Piped supply system
Urban water/Rural water supply systems

(1) Non-piped Water Supply Systems

1) Springs

257 protected springs were in use in Kibungo Prefecture. Over 30 main springs were found within Birenga, Kigarama, Mugesera, Rusumo and Rutonde Communes.

Springs having some water yields provided good quality domestic water to a portion of residents with un-piped and piped water supply systems, mainly developed by NGO, such as AIDR etc. However, many small springs occurred which were not suitable for domestic use because of the small yield and were considered suitable for auxiliary water sources.

2) Handpump

Seventy one hand-pump wells were installed with grant aid from Japan (Rural Water Supply Project, Phase I) as a water supply project using groundwater as the source.

3) Rainwater harvesting

In the communes of Rukara, Kabarondo, Birenga and Rusumo, rainwater harvesting facilities using the roofs of such public facilities as hospitals could be seen. But, these facilities were for supplementary use and the communes relied on other water sources during the dry season.

(2) Piped Supply Systems

The service level of the existing systems was mostly the public standpipe method with distribution pipes. Only the water supply systems in Kibungo and Rwamagana cities were managed and operated by ELECTROGAZ.

1) Urban water supply system

Kibungo City's water source was a spring and the water treated with chlorine. Rwamagana City's water source was Muhazi Lake and after treating the lake water it was conveyed to the city. These two water supply systems were designed to meet 1995 demands.

2) Rural water supply system

The water supply system constructed with an assistance of AIDR; water was taken from a spring and distributed through pipes by gravity flow. During the dry season the quantity of water in the spring reduced and some of the system's public standpipes dried up. Furthermore, due to inadequate management and maintenance work, together with damage or deterioration caused by aging, some facilities were not fully functional.

3.5.2 Service Coverage and Population Served

According to the existing data/information, the total beneficiaries were estimated to be more than 150,000 persons (35.0% in Kibungo Prefecture). However, the population served drinking water of good-quality and of sufficient amount, was considered to be around 105,000 persons (24.2% in the Prefecture) based on the results of the field survey and the evaluation of existing facilities.

(1) Non-piped Water Supply Systems

The service coverage and population served by a non-piped water supply system were:

. Spring	257 points	-
. Hand-pump	21 wells	46,300 beneficiaries
. Rainwater harvesting	6 facilities	-

(2) Piped Water Supply Systems

The total production of the facilities was 4,227 m3/day and the beneficiaries were 77,170 persons (18% of total population in Kibungo Prefecture), as shown in Table 3.3 and Fig. 3.4.

Table 3.3 Existing Rural Water Supply Systems (Piped Systems)

Urban/ Rural	No.	Name of System	Water Sources	Production m3/day	Popuration	Organization of Assistance
Urban	1	KIBUNGO		250	7300	
	2	RWAMAGANA		500	17,100	
		Sub-Total		750	24,400	
Rural	1	FUKUWE-RWINTARE	Spring	75	2,050	IDA
	2	GAHINI	L. Muhazi	86	480	IDA
	3	NASHO I	Spring	172	2,520	AIDR
	4	NASHO II	Spring	121	2,420	AIDR
	5	RUKIRA	Spring	182	10,320	AIDR
	6	RUSUMO I (Nyakiziba)	Spring	190	1,980	AIDR
	7	RUSUMO I (Nyakagezi)	Spring	217	2,820	AIDR
	8	RUSUMO II (Kamombo I)	Spring	217	600	AIDR
	9	RUSUMO II (Kamombo II)	Spring	86	1,760	AIDR
	10	AKAGERA A	Spring	43	1,120	AIDR
	11	AKAGERA B	Spring	145	2,750	AIDR
	12	AKAGERA C (Nyokibatika)	Spring	432	240	AIDR
	13	KIREHE	Spring	216	2,640	-
	14	RUSUMO-BGM	Spring	345	6,180	AIDR
	15	MUSAZA BAS	Spring	207	3,840	AIDR
	16	RUKARA	Spring	278	3,570	HYDROBAT
	17	ZAZA	Spring	250	2,500	AIDR
	18	KAMUSHIKUZI	Spring	51	2,100	HYDROBAT
	19	SAKE	Spring	111	720	AIDR
	20	NYANKORA	Groundwater	80	2,160	Japanese Grant
		Sub-Total		3,477	52,770	
		Total		4,227	77,170	

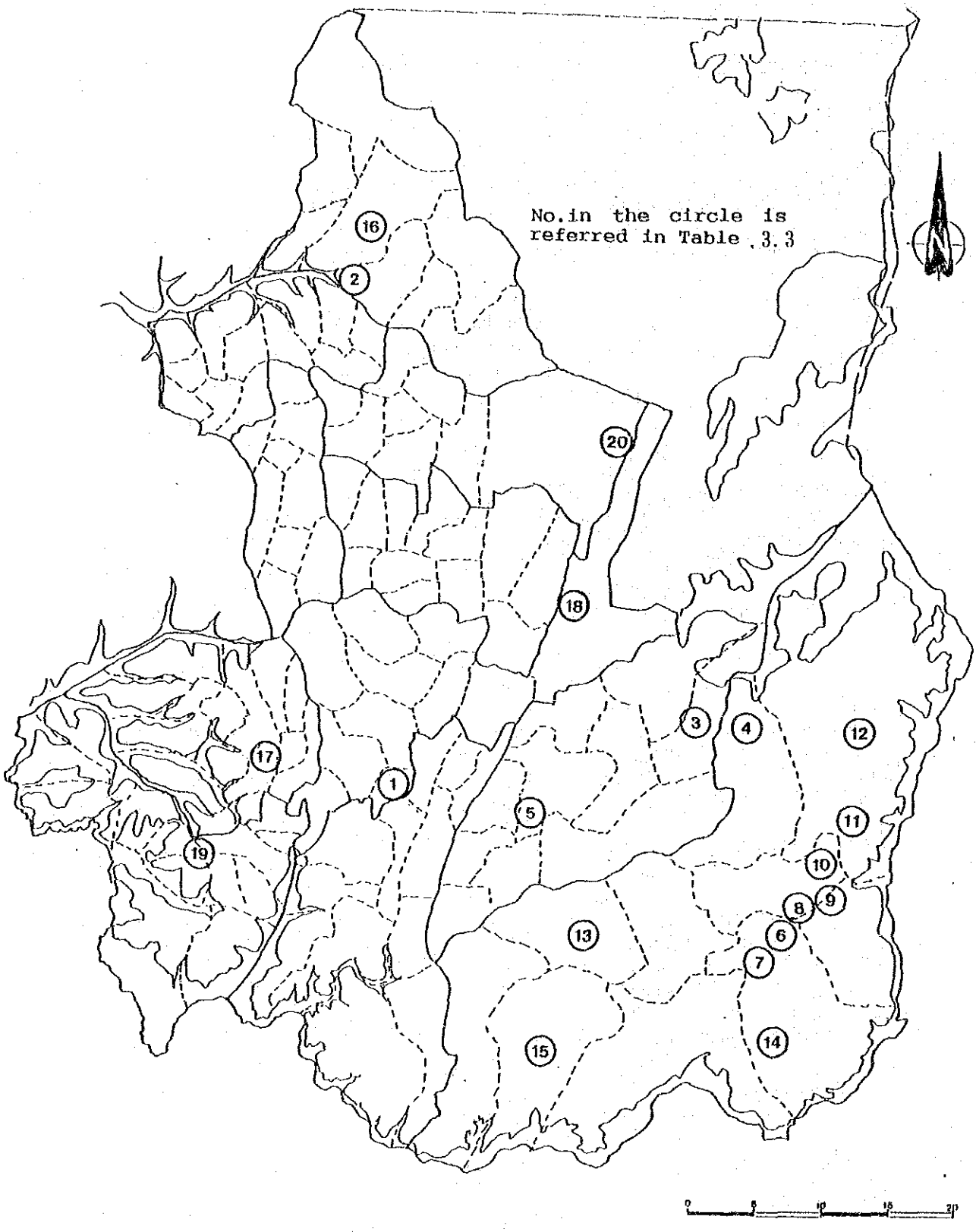


Fig. 3.4 Existing Rural Water Supply Systems
(Piped System)

3.5.3 Development Plan and Activities

The following projects in the Study Area were either in the planning or construction stages.

Phase III Basic Plan would be formulated by considering the projects in terms of service coverage.

Table 3.4 Water Supply Projects at Planning/Construction Stage

No.	Project	Planning/ Construction	Organization
1.	Phase II Project	planning	MINITRAPEE
2.	IDA's Rehabilitation Project	planning	MINITRAPEE/ IDA
3.	Extension Project of Kibungo Water Supply System	under-construction	ELECTROGAZ
4.	Rural Water Supply Development Project in KABARONDO	under-construction	KABARONDO Commune/ MINIPLAN
5.	UNICEF's Rural Water Development Project	survey/ planning	MINITRAPEE/ UNICEF
6.	Extension Project of Rwamagana Water Supply System in Muhazi Area	planning	MINITRAPEE/ MINIPLAN
7.	Rural Water Supply System Expansion Project in RUKARA	planning	MINITRAPEE

3.5.4 Types of Water Supply Systems and Service Levels

(1) Types of Water Supply Systems

1) Spring

The form of spring used varied widely: use of springs without man-made structures, with water collection chambers, with reservoir tanks, etc.

2) Handpump

All existing hand-pumps in Kibungo Prefecture were provided by grant aid cooperation from the Government of Japan. These bellows-type hand-pumps were installed in tube-wells that were an average of 60 m deep.

3) Rainwater Harvesting

All rainwater harvesting facilities in Kibungo Prefecture were the roof catchment type. Most of the water tanks were made of F.R.P. or corrugated metal.

4) Piped Water Supply Systems

The piped water supply systems in Kibungo Prefecture were classified into six types as shown in the following Table. The majority of the systems were Type F, a piped system with gravity flow of spring water.

Table 3.5 Type of Piped Water Supply System

Type	Water Source	Treatment	Pump/ Gravity	Type of Service	Remarks
A	Lake	with	Pump	House Connection of Kiosk	Rwamagana
B	Spring	with	Pump	House Connection of Kiosk	Kibungo
C	Lake	non	Pump	Public Standpipe	Gahini
D	Groundwater	non	Pump	Public Standpipe	Nyankora
E	Spring	non	Pump	Public Standpipe	Kirehe, Rukara Zaza, Sake
F	Spring	non	Gravity	Public Standpipe	14 Facilities

3.5.5 Domestic Water Use Conditions

To make a diagnosis on water supply conditions in the Study Area, a questionnaire and water use surveys were conducted:

The survey results and their analysis were compiled as listed below:

(1) Results of the Questionnaire Survey

- The water supply source most preferred by residents was the public standpipe connected to a pipeline. Conversely, the residents were supposed to be dissatisfied with the use of surface water (lakes and rivers) and direct spring water use.
- Of the surveyed water supply sources, 28% were public standpipes, 9% were wells, 7% were improved springs, and 56% were direct intake of surface water.

- For some periods of the year, certain residents depended on water sources other than spring water or surface water.

(2) **Results of the Water Use Surveys**

The surveyed water use patterns are shown in Fig. F.4, Appendix F. The peak demand fell during the following two time zones:

First peak : 6:00 - 10:00
Second peak: 14:00 - 18:00

By comparing the designed water supply amount to the actual water use conditions, the following conclusions were drawn:

- About 60 - 70% of the designed water supply amount is obtained from public standpipes that were charged for supply.
- 100%, or more, of the designed water supply amount was obtained from wells or public standpipes. This water was good in quality and free of charge.
- The use rate of wells -- wells constructed under the Phase I Project -- having poor water qualities was low. However, the wells reported as being abandoned were still being used at a rate of about 15% of the designed water supply amount.

(3) **Results of the Hearing Survey to Water Supply Administration**

The hearing survey disclosed problems related to each commune's sanitation and water supply conditions in the following manner:

Rukira, Muhazi, Mugesera, Sake, Rutonde and Kabarondo Communes were considered to be the worst in terms of sanitation and water supply conditions. The following areas called for urgent improvements in connection with water supply conditions:

Table 3.6 High Priority Areas to Improve

RUKARA	GAHINI, KWANGIRE, KIYENZI, RUKARA, RWIMISHINYA, RYAMANYONI
MUHAZI	GATI, KITAZIGURWA, MUKARANGE, MURANBI, NKOMANGWA, NYAGATOVU, NYARUBUYE
MUGESERA	GATARE, KAGASHI, KIRAMBO, MATONGO, NYANGE, SANGAZA
SAKE	GITUZA, MBYE, MURWA, NSHILI-2, RUBAGO, RUKUMBERI, RUYEMA-2, SHOLI
KAYOUZA	NYANIRAMA, RUTARE, SHYOGO
RUTONDE	KADUHA, NKUNGU, RUTONDE, RWERU, SOVU
KABARONDO	BISENGA, MURAMA, RUBIRA, RUNDU, RURAMIRA, RUSERA, RUYOUZA, SHUANDA

3.5.6 Evaluation of the Existing Systems

Taking the basic policies of the Phase III Project into consideration, the existing water supply systems could be divided into the following three categories (Table 3.6), according to the conditions of the facilities and their operation and maintenance system. The evaluation results are presented in Table 3.7.

Table 3.7 Evaluation of Existing Water Supply Systems

Class	Facility Condition	Operation and Maintenance System
A	No problem existed in water quality and yield amount. Present facilities could be used beyond after the year 2000.	Owing to an appropriate system, the existing facilities were operated and maintained adequately.
B	Some problems existed in water quality and yield amount. Present facilities could be used subject to conducting rehabilitation work.	Water management committee and water fee collection system were already established, but management was not adequately carried out.
C	Due to the lack of water yield and/or facility deterioration, rehabilitation or reconstruction of the facilities were considered prerequisite.	No water management committee existed and the entire facility operation and maintenance work was carried out by the Government.

3.5.7 Development Organization

The following development organizations were mainly responsible for the water supply facilities in the Study Area:

(1) **MINITRAPEE**

MINITRAPEE was an organization responsible for the country's rural water supply. A branch of the Directorate General of Water was located in the Kibungo Prefectural Government Office. One officer was stationed at the branch office.

(2) **ELECTROGAZ**

ELECTROGAZ was a public corporation under the jurisdiction of MINITRAPEE.

Table 3.8 Classification of Existing Systems

		Facilities					O/M				Total Evaluation	Facility of Improvement under Phase III	Remarks
		Water Quality	Water Quantity	Approach	Condition of Adjust.	classifi -cation	O/M Agency	Fee Collect. System	Condition of O/M Facility	Classifi -cation			
Un-piped	Protected Spring	B	B	C	B	B	C	C	C	C	BC		Supporting Water Source
Water	Handpump	B	A	A	B	A	C	C	C	C	AC		
Supply System	Rain Harvest	A	C	A	B	B	-	-	B	B	BB		
Urban Water	Kibungo	A	A	A	A	A	A	A	A	A	AA		
Supply System	Rwamagana	A	A	A	A	A	A	A	A	A	AA		
Rural piped	IDA Rehabilitation												
Water	Facility (11Areas)	A	B	A	C	B	B/C	B/C	C	C	BC		IDA Rehabilitation Project
Supply System	AKAGERA C	A	A	B	B	A	C	C	C	C	AC		
	KIREHE	A	A	A	B	A	B	C	B	B	AB		
	RUSUMO BGM	A	B	A	B	B	B	C	C	C	BC	yes	
	MUSAZA BAS	A	C	B	C	C	B	C	C	C	CC	yes	
	RUKARA	A	A	A	B	A	B	C	C	C	AC		
	ZAZA	A	A	A	B	A	B	B	B	B	AB		
	KAMUSHIKUZI	A	C	B	C	C	C	C	C	C	CC	yes	
	SAKE	A	A	B	C	B	B	C	C	C	BC	yes	
	NYANKORA	A	A	A	B	A	C	C	C	C	AC		

Note :

Water Quality
- A : Good
- B : There is a few problem
- C : Bad

Water Quantity
- A : Good
- B : A few lack
- C : Lack

Approach
- A : Good
- B : Average
- C : Bad

Condition of Adjustment
- A : Good
- B : Partially Repair Need
- C : All Repair Need

O/M Agency
- A : ELECTROGAS
- B : Water Committee
- C : None

Fee Collecting System
- A : Good
- B : There is system but Collecting is not smooth
- C : None system

Condition of O/M Facility
- A : Good
- B : There is a few problem
- C : No good

(3) A.I.D.R.

A.I.D.R. was a Belgian non-governmental organization which had contributed greatly to the development of rural water supply in Rwanda. Until 1985 when the organization was dissolved, it carried out many rural water supply development projects.

3.5.8 Conditions of Existing Operation/Maintenance Systems

The existing water fee collecting systems that were confirmed during the field study period were classified into either the fixed rate system or the meter system as follows:

Table 3.9 Fee Collecting System

Name	Management Agency	Collecting System	
Rwamagana/ Kibungo	ELECTROGAZ	House connection is fee by amount by meter. Kiosk is 2FRW/jerrican (20lit)	By Amount System
Rukara	Commune	2FRW/jerrican (20lit) Other account of commune not General	By Amount System
Rukira	Commune	100FRW/year/Family General Account of Commune	Fixed Amount System
Kigarama	Commune	100FRW/Month/Family General Account of Commune	Fixed Amount System
Rusumo	Commune	50FRW/Month/Family General Account of Commune	Fixed Amount System
Zaza	Water Committee	45FRW/m3, 2FRW/jerrican (20lit)	By Amount System
Sake	Commune	3FRW/jerrican (20lit)	By Amount System

The operation and maintenance systems of the existing water supply facilities were classified into four patterns, as follows:

Pattern "A" ELECTROGAZ's direct operation and maintenance system for the urban water supply facilities.

Example: Urban water supply systems in Rwamagana and Kibungo.

Pattern "B" Operation and management system of the water management committee whose representatives were water supply recipients.

Example: Water supply systems in Zaza, Kigarama, Rukira, etc.

Pattern "C" A commune's operation and maintenance system known as Fountainie. Members of this group inspected and maintained the improved springs and piped water supply systems in the commune.

Example: Improved springs and piped systems in each commune.

Pattern "D" MINITRAPEE's operation and maintenance system of the water supply facilities. Residents did not participate in the operation and maintenance of the facilities.

Example: Hand-pumps installed under the Phase I Project.

Except for the urban water supply systems in Rwamagana and Kibungo, water fee collecting systems were not fully established. Most of the residents were still of the opinion that they should obtain water free of charge.

Thus, MINITRAPEE had been making a great effort to change the residents' concept and proposed a policy whereby recipients would pay facility O/M costs. The policy of future water supply administration was discussed in Appendix F of Volume III (Supporting Report).

CHAPTER 4

WATER RESOURCES EVALUATION

4. WATER RESOURCES EVALUATION

4.1 OUTLINE OF THE CONDITIONS OF WATER RESOURCES

4.1.1 General Condition

The water resources in the Study Area were groundwater and surface water. The maximum development potential of surface water was estimated to be around 100,000 m3/km2 (100 mm p.a.), approx. 30 percent of total discharge, while mean annual rainfall was 900 mm.

The yield for a sustainable groundwater development in the Area was estimated as (around 30 mm p.a.), though a rough estimation of the development potential of groundwater was calculated as 177 mm p.a. (45.79 million m3 p.a.) based on the recession curve of river discharge.

The maximum development capacity of surface water and groundwater in the Area, therefore, was estimated to be 130 mm p.a.

As the topography of the area consisted of plateau-like hills, the catchment areas of streams and springs were relatively small. Consequently, the quantities of spring water were considered to be smaller and more unsettled, as compared with other prefectures in Rwanda.

From the above conditions of water resources, priority for development of groundwater and the surface water of lakes/rivers would be considered.

4.1.2 Existing Water Resources

(1) Groundwater

1) Spring Water

Springs were located at higher elevations than other types of water sources and the water could be distributed by gravity flow. Thus, most of the potential springs in the Study Area had already been developed by AIDR and only a few potential springs remained.