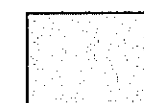


LEGEND



The Study Area

Location Map of
the Study Area



A typical scattered
type farm settlement
in Rwanda.



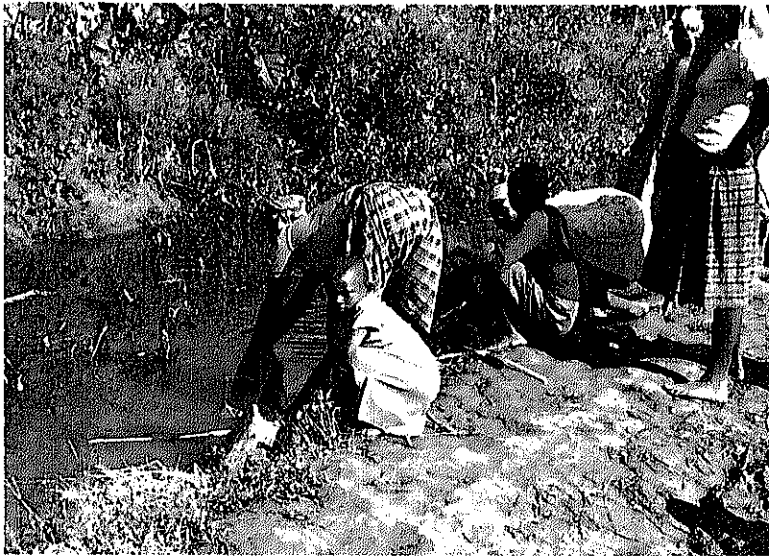
A youth carrying
water in a gourd.



Obtaining drinking
water at a natural
spring in the valley.



Obtaining
water at a
natural spring.



Obtaining water from a stream near the settlement. This stream dries up completely in the dry season.



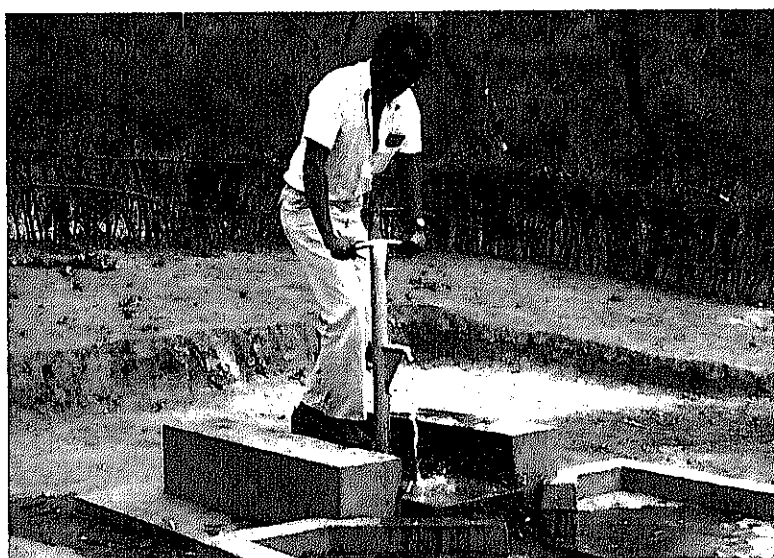
Youth obtaining drinking water from a marsh.



Rain water storage at Birenga Clinic Center.



Workers rejoicing at spring water obtained through test boring.



A well installed by test boring.



Women pumping water by a foot pedal pump.

SUMMARY

The Republic of Rwanda is a small landlocked country located in Central Africa. In comparison with other African countries, the climate is exceptionally mild with relatively ample rainfall. Approximately 95% of the population is engaged in agriculture. There are no large scale industries and the main export products are coffee and tea. The average GDP is extremely low, US\$240 per capita in 1982, but people are hard-working producing a fairly plentiful supply of agricultural food stuffs such as banana, etc. In 1983, according to a census, the population reached 5,670,000.

The landscape of the country is mountainous, comprising numerous small mountain ranges. Unlike most other African countries, Rwanda has many lakes and marshes. As water supply systems are provided only in a few urban areas, the majority of people must rely on traditional surface water such as lakes, marshes, ponds, streams and springs. However, with recent heavy contamination by parasites and bacteria, the use of surface water has resulted in serious health problems. Kibungo Prefecture, which is located in the eastern part of Rwanda and selected as the target area in the master plan for expansion of safe water supply systems, is particularly affected.

Kibungo Prefecture has a population of 383,000 (1983) and an area of 4,134km² (2,667km² excluding lakes, marshes and national parks), and is one of the less developed prefectures in Rwanda. Although some concentration of population occurs in the two cities, Kibungo and Lowamagana (both excluded from this study), the majority of people live in sparsely populated and scattered settlements on the top and side of hills. The existing water supply system covers approximately 5% of the population with facilities installed only in the two cities.

Kibungo Prefecture has protected springs which are recently developed important water supply sources, serving a population of 170,000. However, the development of protected springs has already reached its limit and further development is doubtful. Accordingly, 190,000 people who have no access to either waterworks or protected springs must still depend on surface water in spite of its poor quality.

Generally, Kibungo Prefecture's geological structure consists of interbedded permeable quartzite and impermeable schist with a dominance of quartzite. Due to the scarcity of rivers, the majority of rainfall, more than 1,000mm a year, is absorbed rapidly into the ground resulting in abundant ground water. Development of this ground water resource has not been attempted in the past and the study is thus the first step towards development in Rwanda.

Based on results of hydrographical survey of the entire study area as well as population distribution patterns, the study team selected the ideal number of water supply districts to cover as comprehensive an area as possible. Ideally, 489 water supply districts supplied by wells and 164 districts supplied by rainfall storage units were selected for a total of 653 districts (Ideal Plan).

Against the above allocation, further investigation including field survey was conducted to eliminate such infeasible districts as:

- a) Those requiring construction of long access roads for well installation;
- b) Those where the depth of available aquifers is too deep for use of manual pumps; and,
- c) Those with granite layers where probability of locating water by boring is quite low.

After elimination of inappropriate districts through the above selection criteria, 186 districts supplied by wells were determined as feasible for economical development. As for water supply districts to be supplied by rainfall storage units, 12 districts were selected as economically feasible for development where roofs of existing buildings can be utilized for the rainfall collecting apparatus (Working Plan).

The final number of feasible districts selected was 186 districts supplied by wells, and 12 districts supplied by rainfall storage units for a total of 198. The total population and area covered by these water supply districts is as follows:

Population Served: 67,000 (Approximately 18%
of the total population)

Area Served: 750km² (Approximately 30%
of the total area)

The proposed plan would thus supply safe water to about 35% of the 190,000 people presently relying on contaminated surface water.

Use of electric-powered pumps was considered for the wells, but because of high operation costs and lack of technical background for proper maintenance, it was decided that manually operated pumps would mainly be used. These pumps are best suited to the sparse distribution of population and the technological level of the study area.

Implementation of the project was divided into two phases. Implementation of Phase 1 (2 years) will depend entirely up on foreign grant aid. Necessary equipment will be supplied by foreign aid as well as technology transfer. In Phase 2 (3 years), implementation will be undertaken by the Government of Rwanda with partial foreign financial and technological aid. Cost is estimated as follows:

Phase 1: \$3,344,000

Phase 2: \$2,558,000

Total: \$5,902,000

With project completion, approximately 35% of the 190,000 people now dependent on contaminated surface water will be able to easily obtain clean, potable water. Substantial improvement will also be made in public sanitation and labor required in hauling water will be greatly reduced.

Implementation of the project is highly significant in that it is the first attempt at ground water development in Rwanda and will act as a model for further development, accelerating the pace of future national development. Lack of sufficient technical knowledge in Rwanda could considerably impede project implementation. Technology transfer is thus essential to ensure successful commencement as well as continuation of the project by the Rwandans themselves including maintenance of equipment and facilities.

The present development plan prepared by the study team focuses primarily on water supply through development of ground water, thus excluding those districts where ground water is unavailable. Moreover, districts designated for development were further restricted to those areas in which use of manual pumps is possible. The area covered by the plan is thus only 30% of the total area. Water supply to the remaining

70% must therefore be independently studied. A few suggestions however, can be offered on the basis of study results.

A master plan study on a comprehensive waterworks system is recommended, utilizing lake water by installing a main water supply pipe along the existing main road running north-south through the prefecture. In those areas where a considerable concentration of population occurs and aquifers are at too deep a level to be reached by manual pumps, small scale, independent waterworks, are recommended using deep wells equipped with power operated pumps. The above solutions require substantial investment in comparison to the present project which is mainly composed of small, many point water sources. A careful study is therefore required for actual application.

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CHAPTER I. INTRODUCTION

CHAPTER I

INTRODUCTION

1.1 Background of the Study

The Government of the Republic of Rwanda is presently promoting "The International Drinking Water Supply and Sanitation Decade Plan" as one aspect of their nationwide development policy for the 1980s. To realize the policy, a budget of Rfr (Rwanda franc) 15 billion (US\$ 0.16 billion) has been allotted for investment in the water supply and sanitation system under the third Five Year Development Plan (1982-86).

The Government of Rwanda requested the Government of Japan to conduct the study on the Rural Water Supply Project in Kibungo Prefecture in the eastern region of the country. The said Prefecture has an estimated population of 390,000 as of 1984, most of which lacks a safe water supply system.

In response to the above request, the Government of Japan entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as JICA). JICA conducted the preliminary study in February and June, 1983. As a result, the Scope of Works for the study was agreed upon by JICA and the Ministry of Public Works and Energy, the Government of Rwanda, in January 1984. Subsequently, JICA dispatched the third study team to the Republic of Rwanda for approximately eleven months starting in mid-October, 1984.

The Ministry of Public Works and Energy, the Government of Rwanda acted as the counterpart agency to the study team and also as the coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the study.

1.2 Purpose of the Study

The objective of the study is formulation of a feasible water supply scheme in the eastern region of Rwanda with particular emphasis on the development of ground water as a water source.

The rural areas in the region presently suffer from drinking water shortages as well as disease due to contamination of the water supply.

The study is to determine potential water resources and the most appropriate development plan for provision of safe water supply to meet rural domestic needs by the year 1990 for a projected population of 475,000.

1.3 Progress of the Study

Considering the urgency of the situation, the study team concentrated on necessary field surveys and investigation from October 1984. The actual progress of the study up to the end of February, 1985, basically followed the study work schedule described in the Inception Report, except for a deviation in execution of test boring.

The test boring work was originally scheduled to commence at the beginning of December, 1984. Unfortunately, during transport to the site the majority of equipment and material was heavily damaged except for one truck and some trailers. Despite efforts to replace the damaged equipment and material, the commencement of test boring work was delayed 5 months to the beginning of May, 1985.

The study team left Rwanda in the beginning of March, 1985 after submitting the Progress Report and returned again on May 14, 1985 to begin test boring as well as other remaining study works. The same were successfully completed in October, 1985.

Based on the results of the study, the Draft Final Report was prepared at the end of October and, after a review by all parties concerned, was finalized as the Final Report.

CHAPTER II. BACKGROUND

CHAPTER II

BACKGROUND

2.1 General Description of the Country

Rwanda, which is located in the central part of Africa (lat. 1°-3°S, long. 29°-31°E), is a small and landlocked country with an area of 26,338km². The western frontier of Rwanda is bounded by Lake Kive, a tectonic lake lying in the collapsed lowland caused by the African Rift Valley System. Volcanoes in the 4,000m class lie to the north (Kalisimbi 4,507m, Muhabura 4,127m) while there are many lakes and marshes in the southeast. The Birunga mountain range forms the watershed, the western slope of which belongs to the Zaïre River drainage system and the eastern slope of which belongs to the Nile River drainage system.

2.2 Administrative Organization

The governmental organization of the Republic of Rwanda, after reorganization in January, 1984, presently consists of the Presidential Office and 16 ministries as listed in TABLE II-1. Local administration is well organized and the country is divided into 10 prefectures.

Each prefecture has a governor (Préfet) assigned by the President, together with vice-governors (sous-Préfet) in charge of political, administrative, economic, social and cultural affairs. There are local governments called Communes under the prefecture, governors of which are called Bourgmestre and are assigned by the President as well.

Each Commune has a population of 20,000 to 40,000, which is divided into the smallest administrative divisions called sectors. A sector consists of an average of 3,000 inhabitants and the chief councilor (Conseil) is chosen by the universal suffrage. A sector is further divided into cells (Cellule) that resemble neighborhood councils composed of 50 to 100 families each. The chief and four assistants of each Cellule are also elected by universal suffrage. Each Commune has its own budget and its legislative body which plans and executes social and economic policies inside its territory.

2.3 Population

In comparison with other African nations, Rwanda is densely populated with a population of 5.67 million in 1983 and a growth rate of 3.7% per year. The majority of the population, about 95.5% of the total, live in the rural areas. The urban population of the 12 cities and other major towns is 255,000, which is only about 4.5% of the total. A summary of population data for each prefecture is presented in TABLE II-2.

2.4 Economy

Rwanda is a typical agricultural country. GDP per capita is still very low at only US\$240 in 1982. The country has 650,000ha of cultivated land, on which almost 93% of the population is dependent.

Main exports are agricultural products such as coffee, tea, jochu-giku, etc. Coffee plays a particularly important role in the national economy with the greater part in exports. In recent years, exports have been gradually decreasing since the peak in 1979 (FRW 18,838 million), mainly due to rapid decline of the market price of coffee.

Mining also plays a significant role through export of ores such as tin and tungsten; but as it is still in an immature stage of development, its present contribution to the national economy is not marked.

In contrast to the gradual decrease in exports, imports remain at a high with a steady increase. Imports in 1982 totaled FRW 26,578 million or 2.6 times total exports in the same year and the balance of foreign trade thus leans excessively towards imports. The country has been suffering from recession since 1980.

Main exports from 1978 to 1982 are summarized in TABLE II-3 and imported articles in 1981 and 1982 are shown in TABLE II-4. Recent transitions in GDP categories and growth rate are shown in TABLE II-5.

2.5 Public Health

General health conditions in Rwanda require improvement. The average life span is estimated at 47 years and the infant mortality rate is still high (14.7% in 1983).

According to 1983 statistics, water-borne and related diseases account for a significant portion of diseases recorded by all hospital and dispensaries. Of the total diseases, 8.7% are attributable to inadequate water or sanitation. Except for a few cities, there is no potable water supply and sewage system. Moreover, water-contact diseases such as parasites and water-hygiene diseases such as trachoma are not included in the above figures as patients with these diseases rarely go to hospitals. If these unrecorded diseases are considered, the percentage of water-borne and related diseases rises remarkably.

Although recognition of the important role of safe water supply and sanitation improvement in primary health is now prevailing common sense in the country, effective countermeasures have not yet been taken, particularly in rural areas. Medical institutions include hospitals, medical centers, dispensaries, and maternity hospitals. However, as these institutions are not equally distributed in all regions, rural inhabitants have little opportunity to receive medical treatment in a hospital. Furthermore, hospitals are chronically short-staffed, lacking the doctors and nurses necessary for medical service.

Generally, medical treatment is free of charge in national hospitals, but medicine must be bought at a pharmacy with a prescription issued by a doctor. The cost of medicine seems to be a heavy burden for the average person.

2.6 Water Supply Sector

2.6.1 Governmental Agencies

In response to the United Nations'" International Decade for Water Supply and Sanitation", the National Committee for Water and Sanitation (C.N.E.A.) was created on February 27, 1981 by Presidential Decree No. 28/11 in order to coordinate and lead activities during the decade with the support of a technical team acting for the UN, through UNDP, WHO, UNICEF and the World Bank from the beginning of the same year.

Presidential Decree No. 630/06 dated October 12, 1984, declared that there would be 7 interministerial Committees for Coordination (Comités Interministériels de Coopération, CIC) in Rwanda. Among those 7 CICs, the CIC on matters of Habitat, City Planning, Regional Development, Water and Energy was established to pursue the following activities.

- a) Elaborating policies and strategies to develop habitat, city planning, regional development, water and energy.
- b) Adjustment of administrative policy on infrastructures.
- c) Exploiting evaluation of activities relevant to the sector of habitat, city planning, regional development, water and energy.

The members composing this CIC are the Ministers of Public Works and Energy, Transport and Communications, Agriculture, Stock Farming and Forests, Public Health and Social Affairs, Higher Education and Scientific Research, and Finance and Economy.

C.N.E.A. has been disbanded and matters under its jurisdiction were transferred to the said CIC. The CIC had not yet assembled for the initial meeting as of January, 1985, since it was established in October, 1984.

The Ministry of Natural Resources, the former governing authority of the water sector in Rwanda, was abolished during the reorganization of governmental agencies under Presidential Decree No. M3/06 of February 23, 1984, and therefore, the Division of Water and Energy of the former Ministry has been incorporated into the Ministry of Public Works and Energy.

The governmental agencies directly or indirectly related to water projects with foreign aid assistance are as follows:

- a) Ministry of Public Works and Energy (MINITRAPE)
Member of CIC, organizes various activities of the water sector, studies and plans water utilization plans, and works for public relations on matters relevant to water and sewerage systems.
- b) Ministry of Transport and Communication
Member of CIC, publishes annual reports on hydrometeorological data.
- c) Ministry of Agriculture, Stock Farming and Forests
Member of CIC, installs and maintains climatological and hydrological stations, and observes lakes and rivers.
- d) Ministry of Public Health and Social Affairs
Member of CIC, educates, administers and supervises matters concerning public health, particularly the quality of water.

- e) Ministry of Higher Education and Scientific Research
Member of CIC, formulates education and research programs.
- f) Ministry of Finance and Economy
Member of CIC, controls foreign grant aids.
- g) Ministry of Foreign Affairs and Cooperation
Controls foreign technical and financial cooperation.
- h) Ministry of Planning
Plans, evaluates and administers water related projects.
- i) ELECTROGAZ
A corporation under the Ministry of Public Works and Energy, administers and supervises water and sewerage projects in urban areas.

The Ministry of Public Works and Energy is responsible for overall planning, coordination and supervision of water resource development and water supply projects. The Ministry has 4 Directions Générales. Figure II-1 illustrates the organization of the Directions.

2.6.2 International Organizations

International organizations which extend financial as well as technical aid to Rwanda include the following:

- UNDP (United Nations Development Program)
- UNICEF (United Nations Childrens' Fund)
- WHO (World Health Organization)
- IDA (International Development Association)
- AFDB (African Development Bank)
- EDF (European Development Fund)
- FAC (Founds d'Aides et de Coopération)
- AIDR (Association Internationale de Développement Rural)

2.6.3 Sector Objectives and Strategies

For improvement of domestic water supply in the country, the main goals of the decade have been determined as outlined below.

(1) Up to 1985

- In urban centers: 75% of the population will be supplied with drinking water; 40% by private installation and 35% by public faucets.

- In rural areas: 70% of inhabitants will be supplied with drinking water.

(2) Up to 1990

- In urban centers: 90% of the population will be supplied; 45% by private installation and 45% by public faucets.
- In rural areas: 80% of the population will be supplied with drinking water.

The served population versus the total population when the goals are attained is estimated as in the table below.

TABLE II-6 SERVED POPULATION VERSUS TOTAL POPULATION

Area		Intermediate Objectives (end of 1985)	Objectives of Decade (end of 1990)
Urban centers	S.P	(233,000)	(370,000)
	T.P	310,000	411,000
Rural areas	S.P	(2,888,000	(4,797,000)
	T.P	5,776,000	6,852,000
Total	S.P	(3,121,000)	(5,167,000)
	T.P	6,086,000	7,263,000

S.P: (Served population)

T.P: (Total population)

Intermediate progress achieved by December of 1983 is as follows:

- Urban centers
55% of the population (127,000 inhabitants) were furnished with drinking water, 35% from private installation with a consumption average of 70ℓ/day/person while 20% were supplied with water from public faucets with an average of 20ℓ/day/person.
- Rural districts
95.5% (5,415,850 inhabitants) of the total population live in rural areas. 60% of this population draw water from small springs and some are connected to rare water collecting channels, with a consumption average of 10ℓ-20ℓ/day/person.

2.6.4 Financial aspects

The total budget invested in water projects in Rwanda over a 3-year period (1981-1983) was US\$25,050,000 of which financial aid extended by foreign governments and international organizations accounted for US\$21,291,000 or 85% of the total budget.

These figures are summarized in TABLE II-7, and TABLE II-8.

TABLE II-7 TOTAL BUDGET INVESTED IN WATER PROJECTS IN RWANDA

Location	Number of Projects	Beneficiaries	Total Cost	(US\$) External Cooperation
Water projects in urban centers	4	152,000	8,377,000	7,120,000
Water projects in rural areas	126	535,000	16,673,000	14,171,000
Total	130	687,000	25,050,000	21,291,000

2.6.5 Budget for Ministry of Public Works and Energy (1984)

The budget for the Ministry of Public Works and Energy in 1984 is as shown in the following table.

TABLE II-9 BUDGET FOR MINISTRY OF PUBLIC WORKS AND ENERGY (1984)

a. General Secretary	221,859,181 FRW	18%
b. Civil Structures, Town- planning and Habitat	434,260,285 FRW	35%
c. Bridges and Roads	506,377,523 FRW	40%
d. Energy	22,034,408 FRW	2%
e. Water	69,711,180 FRW	5%
Total	1,254,242,577 FRW (13,016,216, USD)	100%
Total Government Budget	18,650,122,000 FRW (193,546,000 USD)	

2.6.6 Water Resources

Rwanda has two rainy seasons, i.e., a long rainy season (February-May) and a short rainy season (October-December), which bring plenty of precipitation with an average of more than 1,150mm per year. Annual precipitation is more than 1,600mm in the western region of Rwanda, whereas it decreases to 900mm in the eastern region. Water resources are constantly replenished by the heavy precipitation.

Water sources utilized for drinking in the rural area are mainly lakes and springs; wells are extremely rare. As electrification in Rwanda does not yet cover the entire country, most rural regions remain without sufficient water supply facilities, especially in the eastern region.

The government of Rwanda has endeavored to obtain drinking water from springs since 1976 on small water-source development projects (Aménagement de PETITES SOURCES dans le milieu rural au Rwanda) with financial aid from UNICEF. As a result, a total of 5,556 springs have been developed throughout the country to date.

The number of springs in each prefecture are as follows:

BUTARE	1,088
BYUMBA	515
CYANGUGU	357
GITARAMA	856
GIKONGORO	691
GISENYI	467
KIGALI	390
KIBUYE	392
KIBUNGO	273
RUHENGARI	527
<hr/>	
TOTAL	5,556

2.7 Local Construction Work Conditions

Local conditions with regards to construction work for the project are somewhat unfavorable. Construction material available through the local market is of inadequate quality and quantity and cement, reinforcing bars and other fabricated steel material which are all imported, are expensive in spite of the poor quality.

However, brick and aggregate such as gravel and sand, which are locally produced and widely used in building work, are available at

moderate prices. Plastic pipe and sheets are also fabricated exclusively by a local manufacturer but stock is usually limited and production orders require considerable time to complete. Although there are car rental services, rental businesses for construction machinery and equipment have not yet been developed. It may, however, be possible to utilize machines and equipment owned by MINITRAPE.

Capital strength and technical experience of the few local contractors is insufficient for execution of the project construction and well-drilling works in particular, as no ground water development project has previously been implemented in the country. Unskilled laborers can be easily mobilized at low cost from the surrounding area; however, semi-skilled and skilled laborers are very difficult to find as the majority are already employed in the civil service.

It is possible to utilize people through the "Umuganda" system but as this system may only be applied on a simple piece work basis for manual labor due to the 4 hour/week limitation on continuous working hours it has little value for actual construction work under the proposed project.

FIG. II-1

ORGANIZATION CHART OF THE WATER DEPARTMENT

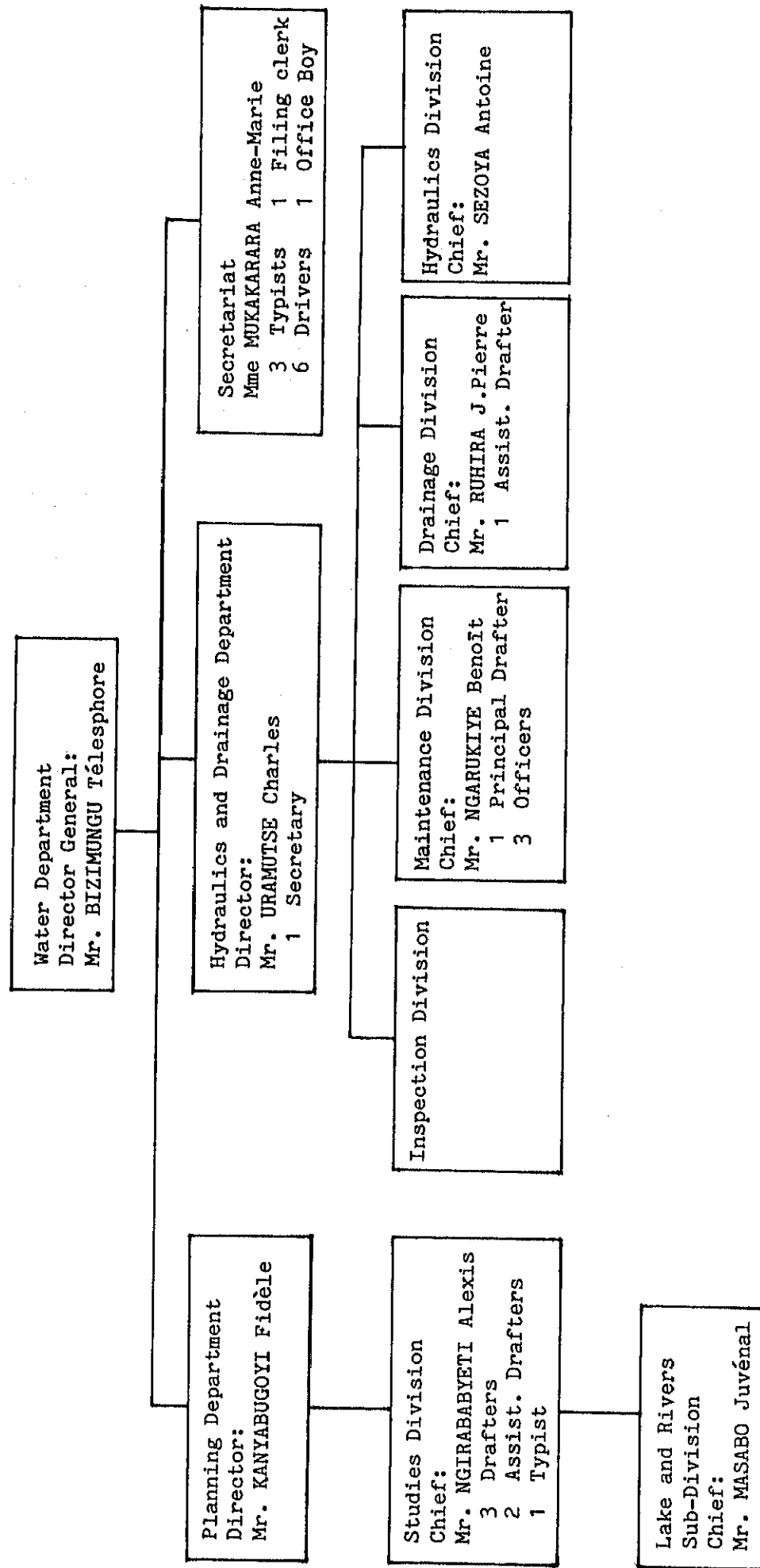


TABLE II-1
LIST OF MINISTRIES

1. Présidence de la République (Presidency of the Republic)	PRESIREP
2. Ministère de la Défense Nationale (Ministry of National Defense)	MINADEF
3. Ministère Chargé des Relations Institutionnelles (Ministry in Charge of Institutional Relations)	MINIREI
4. Ministère de l'Intérieur et du Développement Communal (Ministry of the Interior and Communal Development)	MININTER
5. Ministère de la Justice (Ministry of Justice)	MINIJUST
6. Ministère de la Fonction Publique et de la Formation Professionnelle (Ministry of Public Function and Professional Formation)	MINIFOP
7. Ministère des Finances et de l'Economie (Ministry of Finance and Economy)	MINIFINECO
8. Ministère de l'Industrie, des Mines et de l'Artisanat (Ministry of Industry, Mines and Artisans)	MINIMART
9. Ministère de l'Agriculture, de l'Elevage et des forêts (Ministry of Agriculture, Stock Farming and Forests)	MINAGRI
10. Ministère du Plan (Ministry of Planning)	MINIPLAN
11. Ministère des Travaux Publics et de l'Energie (Ministry of Public Works and Energy)	MINITRAPE
12. Ministère des Transports et des Communications (Ministry of Transport and Communications)	MINITRANSCO
13. Ministère de l'Enseignement Primaire et Secondaire (Ministry of Primary and Secondary Education)	MINIPRISEC
14. Ministère de l'Enseignement Supérieur et de la Recherche Scientifique (Ministry of Higher Education and Scientific Research)	MINISUPRES
15. Ministère de la Jeunesse et du Mouvement Coopératif (Ministry of Youth and Cooperative Movement)	MIJEUCOOPE
16. Ministère des Affaires Etrangères et de la Coopération (Ministry of Foreign Affairs and Cooperation)	MINAFFET
17. Ministère de la Santé Publique et des Affaires Sociales (Ministry of Public Health and Social Affairs)	MINISAPASO

TABLE II-2
SUMMARY OF POPULATION DATA FOR EACH PREFECTURE

Prefecture	1971 Estimate	1978 Census			1981 Estimate	Mean Annual Rate of Increase	
		Male population	Female population	Total population		1970-1978	1978-1981
					Density per usable km ² (1)		
BUTARE	507,568	290,798	311,752	602,550	343	2.2%	2.8%
BYUMBA	354,521	254,435	266,916	521,351	200	5.0%	3.7%
CYANGUGU	272,213	165,084	168,103	333,187	298	2.6%	4.5%
GIKONGORO	315,676	178,130	192,466	370,596	237	2.1%	1.3%
GISENYI	368,618	227,019	241,863	468,882	358	3.1%	4.2%
GITARAMA	466,532	295,299	310,913	606,212	281	3.4%	2.9%
KIBUNGO	236,760	176,032	185,217	361,249	136	5.5%	5.7%
KIBUYE	225,520	164,198	172,390	336,588	260	5.2%	2.7%
KIGALI	373,417	353,195	345,247	698,442	249	8.2%	5.8%
RUHENGERRI	456,985	258,722	273,205	531,927	369	1.9%	2.9%
RWANDA	3,579,810	2,362,912	2,468,072	4,830,984	258	3.8%	3.7%

TABLE II-3
MAIN EXPORT PRODUCTS

Year		1978	1979	1980	1981	1982	
Export Products							
Coffee	s	4,533	12,820	5,813	6,342	6,344	
	q	19,319	39,113	22,418	30,044	25,082	27,195
Tin	s	1,547	1,817	1,785	1,403	794	
	q	2,123	1,882	2,062	1,869	853	1,758
Tea	s	826	986	1,040	1,025	1,053	
	q	5,307	4,778	7,062	6,749	6,769	6,133
Tungsten	s	560	611	510	388	290	
	q	665	759	712	535	595	653
Jyochugiku	s	106	191	150	42	21	
	q	34	33	23	5	3	20
Cinchona	s	230	126	279	73	66	
	q	671	299	960	420	499	570
Hide Skins	s	155	227	280	306	353	
	q	623	577	620	701	884	681
Others	s	2,393	2,060	2,545	1,001	1,148	
	q	1,175	1,598	1,889	4,102	5,703	2,893
Total	s	10,530	18,838	12,402	10,520	10,069	
	q	29,917	49,039	35,746	44,425	40,388	

TABLE II-4
MAIN IMPORT PRODUCTS

Import Products	Price: Million FWR	
	1981	1982
1. Consumer Goods	<u>13,395.4</u>	<u>15,155.2</u>
Food	2,508.0	3,203.8
Tobacco & Drink	513.9	731.1
Clothes	2,886.5	2,714.3
Health & Sanitary Goods	412.7	489.0
Energy & Lube Oil	3,941.6	4,261.7
Sundry Goods	139.9	189.3
Others	2,992.8	3,566.0
2. Material & Equipment	<u>5,389.6</u>	<u>5,994.1</u>
Transportation Equipment	1,544.3	2,103.0
Machinery & Tools	2,980.9	2,712.2
Others	864.4	1,178.9
3. Necessities	<u>4,990.6</u>	<u>4,517.3</u>
Construction Material	2,768.2	2,423.0
Fertilizer	33.9	85.1
Other Chemical Products	640.1	578.9
Plastic & Rubber	373.2	404.4
Fiber	39.9	52.4
Fatty Acid	242.8	418.9
Others	892.5	554.6
4. Extra Imports	2,489.7	912.1
Total	26,265.3	26,578.7

TABLE II-5
TRANSITIONS IN GDP AND GROWTH RATE

Item	1980		1986		Average Annual Growth
	GDP	%	GDP	%	
Food & Agricultural Products	38,923	36.0	42,290	32.3	2.9
Livestock, Forest & Fishery Products	5,051	4.7	5,620	3.9	1.8
Exported Agricultural Products	5,532	5.1	6,231	4.3	2.0
Industry	1,841	1.7	2,602	1.8	5.9
Exported Agro-Industry Products	999	0.9	1,935	1.4	11.6
Household Industry Products	4,257	3.9	6,270	4.4	6.7
Food Industry Products	11,226	10.4	13,461	9.4	3.1
Electric Power	126	0.1	670	0.5	32.1
Construction & Public Works	4,818	4.5	7,480	5.2	7.6
Tourism, Hotels & Restaurants	290	0.3	590	0.4	12.6
Commerce	15,595	14.4	23,400	16.3	7.0
Transportation & Communication	2,292	2.1	3,130	2.2	5.3
Bank, Insurance & Service	4,113	3.8	6,230	4.4	7.2
Administration	9,176	8.6	13,950	9.7	7.1
Import Tax	3,752	3.5	5,470	3.8	6.5
Gross Domestic Products	107,991	100.0	139,329	100.0	4.8

TABLE II-8
EXTERNAL COOPERATION FOR
THE WATER SUPPLY SECTOR (1981-1983)

Main External Cooperation	US\$
African Development Bank (AFDB)	4,685,000
International Bank for Reconstruction and Development (IBRD-World Bank)	870,000
UN Children's Fund (UNICEF)	1,262,000
Arab Bank for Economic Development in Africa (ABEDA)	1,190,000
Caisse Centrales de Coopération Economique (CCCE-France)	480,000
East Flandre, SOS, FAIM (Belgium)	970,000
Netherland Volunteer Organisation	461,000
KFW (West Germany)	376,000
UN Development Program (UNDP)	415,000
European Economic Community (EEC)	2,013,000
Canadian International Development Agency (CIDA)	70,000
Others	8,499,000
Total	21,291,000

CHAPTER III. THE STUDY AREA

CHAPTER III

THE STUDY AREA

3.1 Location of the Study Area

The study area is located in the eastern region of Rwanda, covering the entire Kibungo Prefecture, but excluding the Akarage National Park and districts which are served by existing water supply systems (Kibungo city and Rwamagana city).

3.2 Aministration

Kibungo Prefecture consists of 11 Communes which are subdivided into 120 administrative sectors and 694 Cellules of the Revolutionary Movement for National Development (M.R.N.D.). Each Commune is ruled under a Bourgmestre assisted by a Communal Council, a technical commission and councilors. The administrative units are summarized in TABLE III-1. As Kibungo Prefecture is too large an area for effective administration and communication, the same is divided into two sub-Prefectural offices, one in Rwamagana, the second largest town, and the other in Kirehe, the south eastern depopulated area. The administrative organization chart of Kibungo Prefecture is shown in FIG. III-1.

3.3 Agriculture, Stockbreeding and Industry

The total area of Kibungo Prefecture is 266,660.0ha, of which 54.6% is cultivated as delineated below.

Agricultural lands	145,526.63ha	55%
Pasture	8,777.65ha	3%
Wood and forests	112,355.72ha	42%
Total	266,660ha	(100%)

3.3.1 Agriculture

Main crops in Kibungo Prefecture are coffee, banana, cassava and beans. Coffee is the main cash crop and an important source of income for producers. Flood crop plantations have been promoted by the BGM Project (Project for development of Bugesera-Gisaka Migongo region), and the

KIBUNGO II Project since 1977. These projects also distribute selected seeds among farmers. Although the production of food crops is gradually increasing, organized markets for food products are still insufficient.

3.3.2 Stockbreeding

According to estimations as of 31 December 1982, 65,000 sheep, 7,526 rabbits, 204,699 hens and 5,850 pigs were raised in Kibungo Prefecture on a pasture area of 8,777.65ha. As livestock raising requires a large amount of fodder, it is directly associated with agriculture.

3.3.3 Industries and Mines

Industries and mines in Kibungo Prefecture are as follows:

- 1) The Rwanda Paper Factory: located in Zaza
- 2) Rice Factory: located in Rwamagana
- 3) Society of Mines of Rwanda (SOMIRWA): exploiting cassiterite deposits
- 4) Kibungo Mines Union (UMK): In some sites, minerals are no longer exploited because they have no economic value such as the wolfram (tungsten) deposit in Kigarama Commune at Gasetza. A groundnut oil factory was in operation; however, production came to a halt after only a short time.

3.4 Population

The population of Kibungo Prefecture is 382,915 and population density is 144 inhabitants per usable km² as of 1984. In comparison with other prefectures, Kibungo Prefecture, especially such districts as Gisaka, Kigarama, Mugesera and Sake, is less populated. This results in frequent and uncontrolled emigrations from other areas which is creating serious regional problems.

In some Communes like Birenga and Rutonde, urbanization is proceeding but the majority of people prefer to stay in the rural areas with their own cultivated fields. The population of the Prefecture is summarized in TABLE III-2 and the distribution of the population is shown in FIG. III-2.

3.5 Geomorphology

FIG. III-3 and FIG. III-4 show the relief of the eastern region of Rwanda and Kibungo Prefecture, respectively. Kibungo Prefecture has an area of 4,114km² and is bordered by Kigali Prefecture in the west, Byumba Prefecture in the north, Tanzania in the east and Burundi in the south. The study area consists of mountains and hills ranging in altitude from 1,300 to 1900m.

In most of the study area, widely and deeply dissected valleys are observed and the relative height of mountains or hills to valleys generally exceeds 200m. As the valleys widen, the plateau-like hills and mountains are progressively eroded, leaving only a series of peaks and ridges of approximately the same height.

3.6 Geology

FIG. III-5 shows the lithology of the study area. The study area is underlain chiefly by a complex of Precambrian metamorphic rocks intruded by granitic rocks. Precambrian rocks consist mostly of interbedded schist and quartzite which are complexly folded and faulted. The quartzite beds in the study area are generally well joined and permeable; thus they are capable of yielding sufficient ground water. In addition, many springs exist in the area where dominant quartzite is exposed.

The granitic rocks contribute to ground water development in the study area, as the positively developed extensive joint system in the same forms a good aquifer. However, only a limited number of springs and their daily yield could be determined where granitic rocks occur. Accordingly, further investigation by means of drilling and electric sounding is required in this area.

3.7 Climate

3.7.1 Rainy and Dry Seasons

Although situated near the Equator, this region has a rather mild climate. The year is divided into seasons as outlined below, which do not significantly affect temperature variation.

Long rainy season	: February-May
Long dry season	: June-September
Short rainy season	: October-December
Short dry season	: January-February

3.7.2 Precipitation

TABLE III-3 shows the monthly rainfall observed at the Kibungo meteorological station from 1973 through 1983. The average monthly rainfall obtained from the data in TABLE III-3 is shown in FIG. III-5 and according to the same, average annual precipitation at the Kibungo meteorological station is 956.8mm.

TABLE III-4 shows annual precipitation data observed at each meteorological station located in Kibungo Prefecture from 1974 through 1983. The average annual precipitation in Kibungo Prefecture is summarized in FIG. III-6.

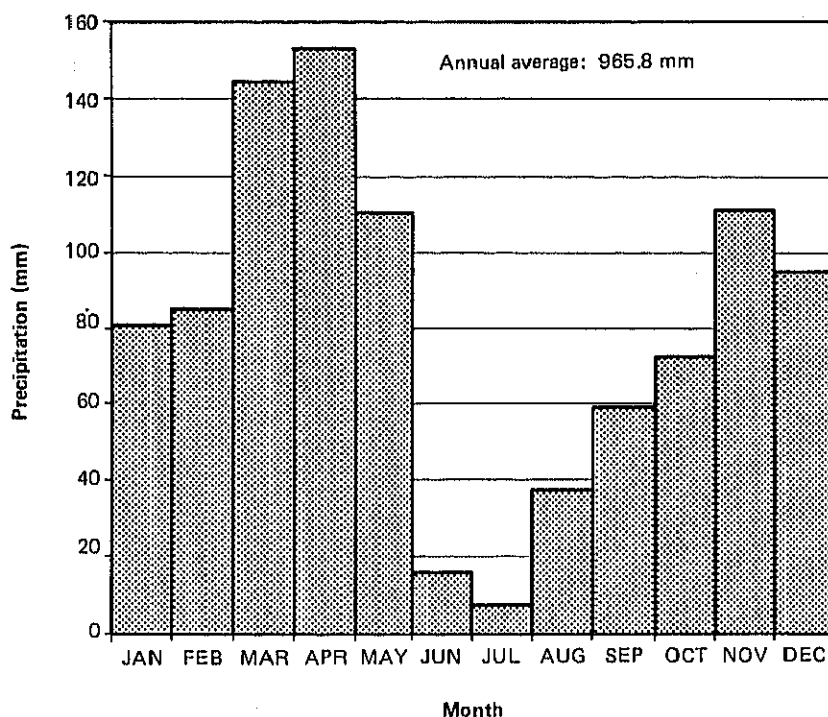


FIG III-6 **AVERAGE MONTHLY PRECIPITATION
AT THE KIBUNGO METEOROLOGICAL STATION**

3.7.3 Temperature

TABLE III-5 shows the temperature observed at the Kibungo meteorological station from 1974 through 1983. Although the daily fluctuation in temperature ranges from approximately 10 to 30°C in general, the average temperature is almost constant (18-19°C) throughout the year.

3.7.4 Humidity

TABLE III-6 shows monthly average humidity observed at the Kibungo meteorological station from 1974 through 1983. Humidity ranges from approximately 70 to 90%, reaching a maximum of approximately 90% in April and May (long rainy season) and a minimum of about 70% in July and August. According to the data, the study area is rather humid even in the long dry season.

3.8 Water Resources of the Study Area

3.8.1 Drainage Basins and Precipitation

The study area consists of ten (10) drainage basins (catchments) as shown in TABLE III-7 and FIG. III-7.

3.8.2 Rivers and Lakes

As the study area is mainly composed of alternating layers of dominant permeable quartzite and impermeable schist, the greater part of rainwater infiltrates rapidly into the ground. Consequently, river discharge is generally scarce, except that of Akagera, Nyabarongo, and Rwagitugusa rivers.

Although there are many lakes and ponds in Kibungo Prefecture, their locations are localized in the peripheral region of the study area, such as Lake Muhazi located in the northwest and Lake Nasho in the northeast. Use of water from lakes and ponds is therefore restricted to the minority who live in the vicinity, which is less than 30% of the total population of Kibungo Prefecture.

Since the water of these rivers and lakes is highly polluted with coliform bacilli and other unsanitary materials, a water purification plant, as well as an electric pumping station, is required for full-scale use of water resources.

3.8.3 Springs

There are 273 spring in Kibungo Prefecture, all of which were newly developed or improved with financial aid from UNICEF from 1976 through 1982. The springs are mainly caused by seepage of ground water through permeable beds and/or rock joints, and the quality of water is generally fit for drinking; however, yield largely depends on the season. The supply particularly decreases and sometimes disappears during the dry season, representing a serious problem in the use of spring water in the study area.

At present, almost all exploitable springs in the study area have been developed by the efforts of the Government of Rwanda, UNICEF, and AIDR.

TABLE III-8 (1)-(2) shows the water demand and availability of spring water for each sector of the study area. According to the table, 35.4% ($3,799\text{m}^3/\text{day}$) of the total water demand in the study area was estimated to be fulfilled with spring water in 1983, and 41.6% ($4,446\text{m}^3/\text{day}$) in 1990.

3.8.4 Precipitation

Average annual precipitation in the study area is approximately 1,000mm.

Supposing rain water were captured with a 100m^2 saucer ($10\text{m} \times 10\text{m}$) laid horizontally on the ground, the total amount of water collected would come to $100\text{m}^3/\text{year}$, which would meet the water demand of 50 persons for 3 months. Hence, precipitation should also be considered as an important water source as a temporary expedient especially in mountain top areas where ground water is unobtainable. Total precipitation in the study area is estimated at approximately $2.89 \times 10^9\text{m}^3/\text{y}$ ($= 7.93 \times 10^6\text{m}^3/\text{d}$) on the average.

As statistical hydrometeorological data on river discharge in the study area are not available, it is difficult to perform a water balance study. However, the total amount of water infiltrating into the ground and river discharges can be estimated as described in Section 3.8.3. Total precipitation in the study area is estimated at approximately $2.89 \times 10^9\text{m}^3/\text{y}$ ($= 7.93 \times 10^6\text{m}^3/\text{d}$) on the average.

As statistical hydrometeorological data on river discharge in the study area are not available, it is difficult to perform a water balance study. However, the total amount of water infiltrating into the ground and river discharges can be estimated if the value of evapotranspiration is given as a constant.

Supposing 60% of the precipitation would evapotranspire (average value of worldwide evapotranspiration), $1.16 \times 10^9 \text{ m}^3/\text{y}$ ($3.17 \times 10^6 \text{ m}^3/\text{d}$) of water would remain on the ground of the study area. Considering the fact that the study area has a rather high annual average humidity of about 80%, the percentage of actual evapotranspiration may be less than 60%, or perhaps 50%.

If we adopt the availability factor of 30%, the total amount of water exploitable in the study area comes to $9.51 \times 10^5 \text{ m}^3/\text{d}$ ($3.47 \times 10^8 \text{ m}^3/\text{y}$). Water demand in 1990 in the study area is estimated to be $10,700 \text{ m}^3/\text{d}$ ($22.5 \text{ l.c.d.} \times 475,000$, estimated population in 1990); which is less than 1.2% of the total amount of available water. The water demand in 1990 in the study area is estimated to be $10,700 \text{ m}^3/\text{d}$ ($22.5 \text{ l.c.d.} \times 475,000$, estimated population in 1990); which is less than 1.2% of the total amount of available water.

3.9 Roads and Electrification

3.9.1 Roads

A national paved road, 186km long (KIGALI-RUSUMO), crossing Kibungo Prefecture is in very good condition. Each Commune has local roads which ensure traffic between administrative districts; however, they are impassable during the rainy season.

Some roads which require maintenance, especially in the rainy season, are under the jurisdiction of the Bridge and Road Department (Ministry of Public Works and Energy). However, due to insufficient mechanical equipment, roads are constantly in need of repair despite maintenance efforts.

Main roads include:

- Kayonza-Kagitumba road: 123km long (from Kibungo to Byumba), slippery in rain.