No. 1

BASIC DESIGN STUDY
ON
THE PROJECT FOR TAVETA-LUMI WATER SUPPLY
IN
THE REPUBLIC OF KENYA

December 1987

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to the request of the Government of the Republic of Kenya, the Government of Japan has decided to conduct a basic design study on the Project for Taveta-Lumi Water Supply Project and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Kenya a study team headed by Mr. Norio Nishihata, Deputy Head of the First Basic Design Study Division, Grant Aid Planning and Survey Department of JICA from September 6 to October 11, 1987.

The team had a series of discussions on the Project with the officials concerned of the Kenyan Government and conducted a field survey in Taveta District in Coast Province. After the team returned to Japan, further studies were made, a draft report was prepared, and for the explanation and discussion of it, a mission headed by Mr. Masao Tsujioka, Deputy Head of the First Basic Design Study Division, Grant Aid Planning and Survey Department of JICA was sent to Kenya from November 21 to December 2, 1987. As a result, the present report has been completed.

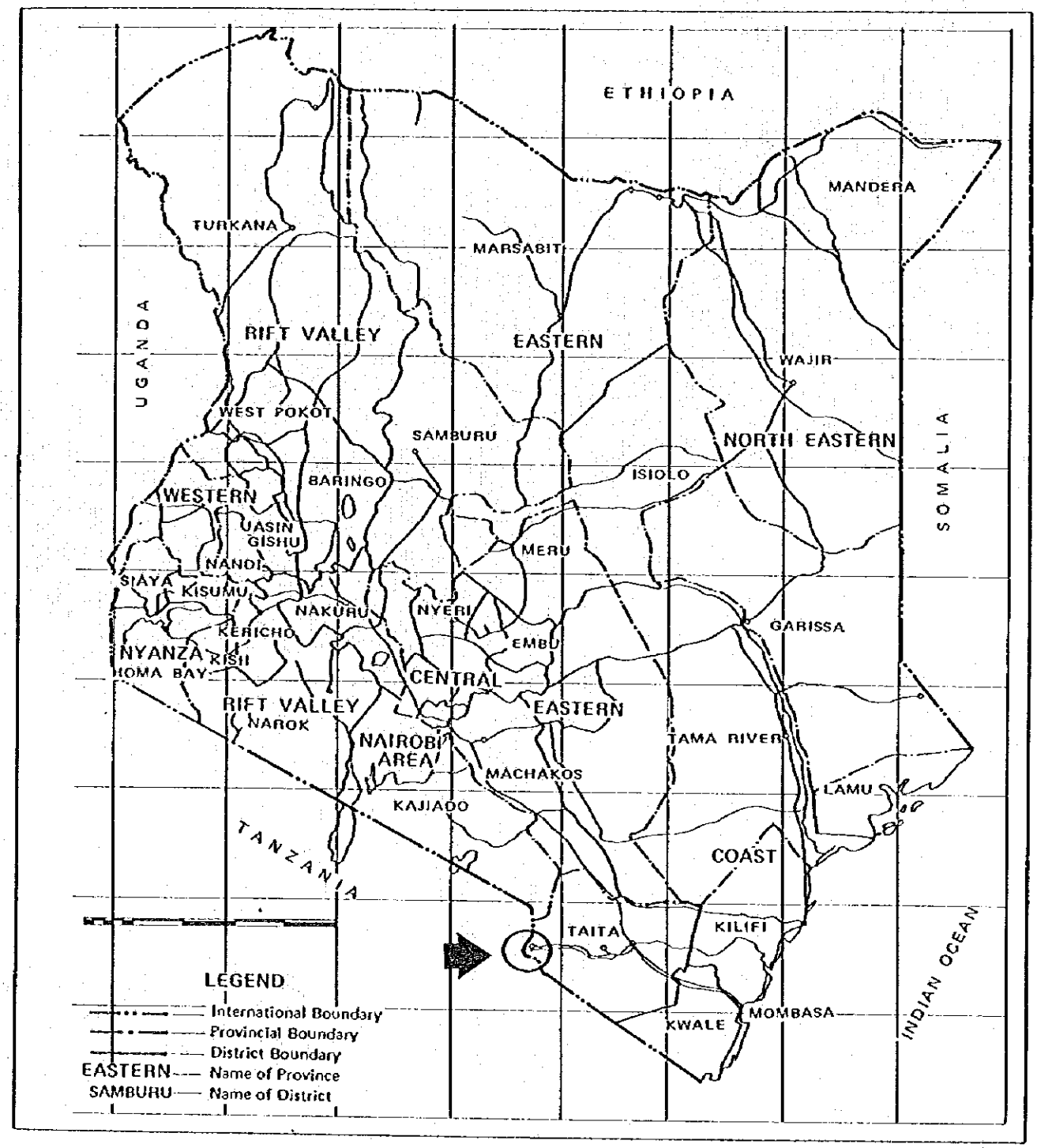
I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

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

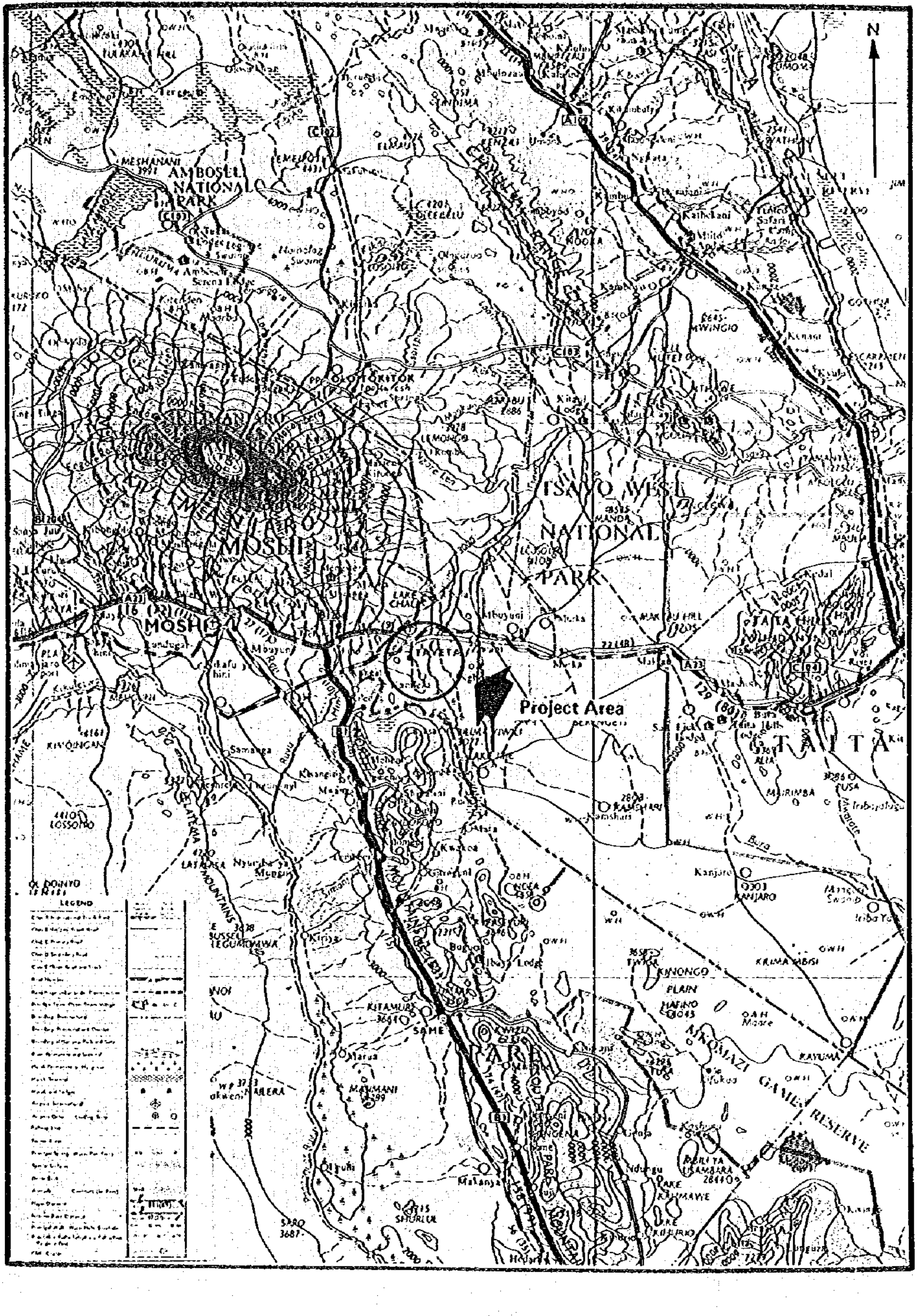
December, 1987

Keisuke Arita
President
Japan International
Cooperation Agency

LOCATION MAP



STUDY AREA



N
AMBOSELI NATIONAL PARK
KILIMANJARO
MOSHI
TSAVO WEST NATIONAL PARK
TAVETA
LAKE CHALA
Project Area
TAITA HILLS
TAITA
SAME
MKOMAZI GAME RESERVE
KIMAWE PLAIN
LEGEND

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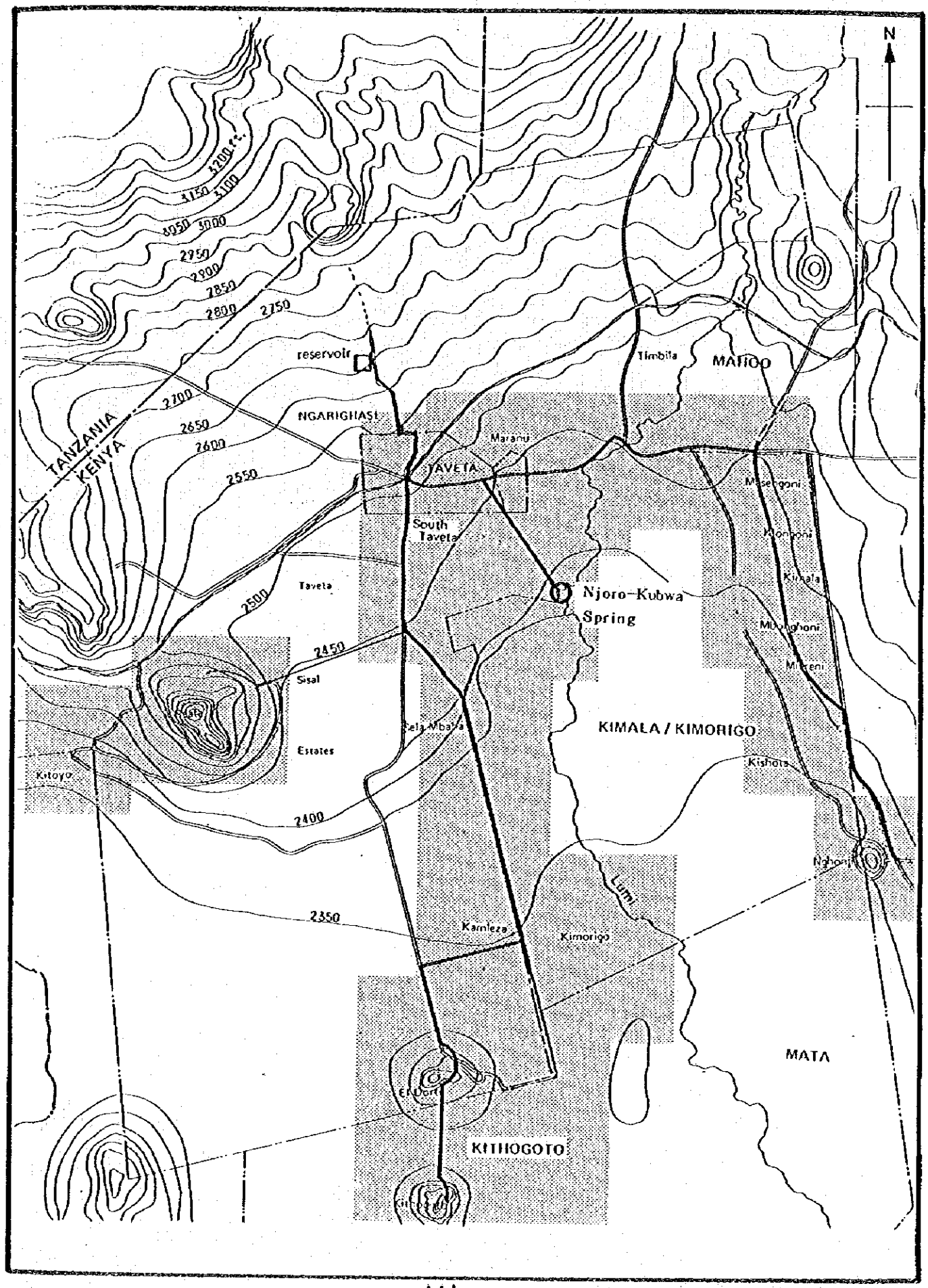
ABBREVIATION

GDP	: Gross Domestic Products
DDC	: District Development Committee
DC	: District Commissioner
DDP	: District Development Plan
MOWD	: Ministry of Water Development
RWS	: Rural Water Supply Programme
KPLC	: Kenya Power and Lighting Corporation
RWD	: Ranch Water Development
KWI	: Kenya Water Institute
ADB	: African Development Bank
SIDA	: Swedish International Development Authority
IBRD	: International Bank for Reconstruction and Development
DANIDA	: Danish International Development Authority
UK	: The United Kingdom
KFW	: Kreditanstalt fur Wiederlaufbau
JICA	: Japan International Cooperation Agency

FACILITY PLAN



SUMMARY

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Since gaining independence, one of the Republic of Kenya's consistent basic principles has been to provide its people with sufficient amounts of safe domestic water. Realizing that the supply of safe domestic water affects not only the health of the people, but also the country's socioeconomic conditions, the Government of Kenya established the Ministry of Water Development (MOWD) in 1974 to be the executive agency of water supply projects.

163 water supply projects have been implemented since the country gained its independence. However, the service rate (population provided with a water supply divided by the total population) still varies from province to province.

Presently, the service rate in the Central Province (Nairobi and its surrounding area) is 20%. In the Northeast Province (northeast of Mt. Kenya) the rate is only 4%.

The population served in rural areas especially is very small. In these areas, it is the daily arduous task of women and children to obtain water from remote water sources.

As a result of the MOWD's strenuous efforts, the general water supply situation has gradually been improving. In 1974, the average distance from a house to a water source was estimated to be 3.4 km. The present average distance has been reduced to 1.8 km.

Since 1963, improvements on the water supply systems in such urban areas as Kisumu, Eldoret, Kitale, Embu, Mombasa, Nakuru and Thika have been carried out. In these urban areas 75% of the people can now obtain safe domestic water.

In the Fifth Five-year National Development Plan, (1983/84/ - 1987/88), the Government of Kenya intends to promote water supply programmes in district capitals.

In rural areas having only a 20% service, Rural Water Supply programmes (RWS) are being carried out. Currently, the Fifth RWS programme that began in 1982 is in progress.

In all, 347 water supply projects have been planned as part of RWS programmes, including the ongoing Fifth RWS Programme. Of these planned projects, 163 of the said projects have been completed and, as a result, nearly 3.5 million people be able to receive water supplies.

The Fifth Five-year National Development Plan calls for providing an additional 2 million rural people with water supplies. By 1988, the year of the Plan's completion, 5.5 million out of the rural population of 16.7 million people are expected to be receiving water supplies.

During the period of the Fourth RWS Programme which began in 1978, 65 water supply projects were planned. The projects were to provide 3 million people with water supplies. However, only five projects were actually completed.

The main reason for the low project completion rate is due to insufficient budgetary funding for development; a situation brought on by the country's economic stagnation as a result of the decline in export prices for its agricultural products, especially coffee. The MOWD has been striving to prepare the necessary budgets to support RWS projects by seeking funds from within the country and by requesting foreign aid.

In light of the above background, the Government of Kenya has requested grant aid cooperation from the Government of Japan in connection with the Water Supply Project in the Taveta Division where, in the 1970's, there was remarkable agricultural development due to the increased domestic demand for cooking bananas.

Taveta Town obtains its water from borehole sources. Because of the rapid population increase and insufficient water sources, the Town is suffering from a chronic water shortage. The farming areas in Taveta Town's hinterland are also suffering from extreme water shortages -- the climate in these farming areas is classified as semi-dry.

With technical cooperation from the Danish International Development Agency (DANIDA), the construction of shallow wells began in 1985. However, field surveys indicated that a high level of salinity existed in the shallow ground strata, and the shallow well plan had to be abandoned in a large area.

The Project's objective is to provide water supply systems, via pipelines, to areas where good quality water is unobtainable from the shallow ground strata.

Since this is a project of the MOWD's water supply programme, the basic design of facilities was done referring to the MOWD's design standards. This was done with the view of providing rural areas with facilities that would retain their effectiveness over a long period of time, thereby demonstrating high investment effect. The design was also done in such a way as to keep construction, operation and maintenance costs as low as possible and to permit simple operating and maintenance procedures.

Planned population served and water demand are as follows:

		Population Served (people)	Water Demand (M_3/day)
1.	Taveta Town:	5,591	967
	House Connections:	4,473	671
	Kiosks:	1,118	22
	Public Use:	-	274

		Population Served (people)	Water Demand (M_3/day)
2.	Southern Rural Areas:	33,635	1,746
	House Connections:	13,722	767
	Kiosks:	19,913	317
	Public Use:	-	400
	Livestock:	(5,248)	262
	TOTAL	39,226	2,713

The Ministry of Water Development is the agency in the Republic of Kenya responsible for the Project in the Republic of Kenya. The Study Team's counterpart in Kenya for the Project's Basic Branch Study is the MOWD's Planning and Design Branch.

The Project will be carried out by the MOWD's Implementation Division, and Operation and Maintenance Division.

The facilities to be built under the Project are as follows:

Facility	Description	Specifications
1. Water Source & Intake Facilities		
1) Intake Pond:	Intake pumping pit (Spring intake)	Masonry Work
2) Intake Pump:	Horizontal axis, side suction, single stage, centrifugal pump. 34.5 litres/ sec capacity.	Suction: 125 mm Discharge: 100 mm 2 Units (one for standby) Total lift: 10m
3) Grit Chamber:		Reinforced concrete (1 unit)
4) Treatment Facility	Chlorination Facility	(Hypochlorite) (1 unit)

Facility	Description	Specifications
2. Transmission Facility:		
1) Pump:	Horizontal axis, side suction, multi-stage centrifugal pump. 34.5 litres/sec capacity.	Suction: 150 mm Discharge: 150 mm 2 Units (one for standby) Total Lift: 100 m Power: 75 kw/each
2) Building:	Intake Pump Room	Reinforced concrete/Masonry block
	Delivery Pump Room	Reinforced concrete/Masonry block
	STAFF House	2 units: One semi-detached and one single unit (Masonry Block)
	Warehouse	One concrete block building
3) Transmission Pipeline:	Pipe diameter: 250 mm Steel Pipe: Inside mortar lining, outside asphalt-jute two layers Valves (stop values and air-relief valves)	Length: 5,950 m
4) Electric Facilities:	Power receiving unit: Power control unit: Lighting fixtures	1 set 1 set 1 set
3. Distribution Facilities:		
1) Distribution Reservoir:	Capacity: 1,360 m^3 (12 hours per day)	Reinforced concrete 19m x 9m x 4m 2 each
	Valves, Fittings and Attendants' Shelter	1 set 1 unit
2) Distribution Pipeline (in Taveta Town)	Pipe dia: 160 mm PVC Pipe dia: 110 mm PVC Pipe dia: 90 mm PVC Hydrant	Length: 2,440 m Length: 1,740 m Length: 40 m 75 mm diameter, 5 places

Facility	Description	Specifications
3) Distribution Pipeline (Other areas than Taveta Town)	Pipe dia: 250 mm steel pipe	Length: 4,450 m
	Pipe dia: 200 mm steel pipe	Length: 6,700 m
	Pipe dia: 160 mm PVC	Length: 8,700 m
	Pipe dia: 110 mm PVC	Length: 10,650 m
	Pipe dia: 90 mm PVC	Length: 6,650 m
	Pipe dia: 63 mm PVC	Length: 5,550 m
4. Water Supply Facilities		
1) Taveta Town:	Kiosk	2 units with 4 taps 3 units with 2 taps
2) Rural Areas:	Kiosk	43 units with 2 taps

Note - : PVC pipe diameters are to conform to Kenyan standards

The Republic of Kenya will bear the expense of procuring the land required for the sites of intake facilities, transmission pipeline, distribution reservior and distribution pipelines. They will also bear the expense of installing a high voltage power cable from KPLC's line to the intake facilities, of purchasing and installing a transformer unit, and in addition be responsible for project equipment customs and clearance costs.

The major portion of the Project costs will be borne by the Government of Japan. The construction cost to be borne by the Government of Kenya is estimated to be Ksh 1.0 million.

Cost estimates were made based on the exchange rate in October 1987, which was:

1 US $ = 145.68 Yen
1 US $ = Ksh 16.21
1 Ksh = 9.02 Yen

Project facilities' operation and maintenance expenses are estimated to be Ksh 1.71 million annually. The revenues from the water tariffs are estimated to amount to Ksh 2.62 million per year.

The Project implementation is scheduled to be completed within 17 months after the signing of the Exchange of Notes: 6 months for preparing the detailed design and tender documents; 11 months for procuring and transporting materials and equipment, and for constructing Project facilities.

Judging from road conditions in the area, the construction schedule was prepared so that construction work can be performed during dry seasons (see Fig.-48 and 49).

As an index for measuring the improvement in the living environment resulting from the Project's implementation, the quantities of water supplied, both before and after the implementation, are shown as follows:

	Present Condition	Condition After Project Implementation
Taveta Town:		
Water source:	Wells	Spring
Design Capacity	83 m^3/day 30 l/cap/day	967 m^3/day House Connection: 150 l/cap/day Kiosk: 20 l/cap/day
Population served	2,760	5,591

	Present Condition	Condition After Project Implementation
Rural Areas:		
Water source:	Wells in Taveta Town	Spring
Design Capacity	145 m^3/day 20 l/cap/day	1,746 m^3/day House Connection: 50 l/cap/day Kiosk: 15 l/cap/day
Population served	7,240	33,635
Total:		
Design Capacity	228 m^3/day	2,713 m^3/day
Population served	10,000	39,226

Existing water supply facilities in Taveta Town have insufficient capacities and, due to deterioration, are not functioning properly. Accordingly, water supply tariffs are hardly being collected at all; thus, the vicious cycle of "no revenue, no maintenance" is evident.

In the rural areas, people must obtain water for daily use from irrigation channels or remote springs. Cases of bilharzia infections caused by drinking irrigation water have been reported.

The implementation of the Project together with the Taita-Taveta Development Programme will definitely alleviate the above mentioned problems and will contribute greatly to improvement of the Taveta Division's infrastructure. Therefore, grant aid cooperation from the Japanese for the Project Government is considered justifiable and extremely worthwhile.

CHAPTER I INTRODUCTION

CHAPTER 1
INTRODUCTION

The Republic of Kenya lies on the equator in east central Africa on the coast of the Indian Ocean. Sixty percent of the country consists of semi-dry areas, while forty percent of the country is suitable for farming and raising stock.

Agriculture is a very important sector for supporting the country's economy; however, the infrastructure for supporting farmers' activities and standard of living still needs to be improved.

Since its independence, water supply projects have been carried out as one of the country's high priority development objectives. However, due to the "oil shock" and the falling prices agricultural products prices in international markets, the country's foreign trade balance is worse than expected. For this reason, the funds for water supply development projects are insufficient. Faced with this situation, the Government of Kenya is carrying out water supply projects with a limited budget and with the assistance of international organizations and foreign countries.

The water supply rate in urban areas is presently about 75%, but, in rural areas, the rate is still very low. During the Fifth Five-year National Development Plan (1983/84 - 1987/88), the aim is to raise the rate of the population served by an improved water supply in rural areas to 30%.

Since 1978, out of the 170 water supply projects planned, only 11 of the said projects were completed.

In view of the above background, the Government of Kenya requested grant aid cooperation from the Government of Japan for the Taveta-Lumi Water Supply Project that is scheduled in the Fifth Five-year National Development Plan with high priority for implementation.

In response to the request, the Government of Japan, through the Japan International Cooperation Agency (JICA), sent to Kenya a preliminary study team headed by Mr. Yukiya Saika, an official of the Grant Aid Division, Economic Cooperation Bureau, the Ministry of Foreign Affairs, from May 18 to June 2, 1987.

The preliminary study team confirmed the contents, background, and appropriateness of the Government of Kenya's request for grant aid cooperation. The Government of Japan then dispatched a basic design study team headed by Mr. Norio Nishihata, Deputy Head of the First Basic Design Study Division, Grant Aid Cooperation Planning and Study Department, JICA, from September 6 to October 11, 1987. The study team confirmed the contents and scope of the cooperation.

The results of the field surveys and the basic agreement -- made after discussions pertaining to the Project were held with the concerned officials of the Government of Kenya -- were written up as the Minutes of Discussions and were signed by both parties (see Appendix 1).

Upon returning to Japan, further studies were made relevant to the Project. The Draft Final Report was submitted to the Ministry of Water Development in November, 1987 by the JICA team led by Mr. Masao Tsujioka, Deputy Head of the First Basic Design Study Division, Grant Aid Planning and Survey Department of JICA and discussions were made as shown in Appendix I. As a result, this report (the BASIC DESIGN STUDY REPORT ON THE TAVETA-LUMI WATER SUPPLY PROJECT IN TAITA-TAVETA DISTRICT) has been prepared.

CHAPTER 2 BACKGROUND OF THE PROJECT

CHAPTER 2
BACKGROUND OF THE PROJECT

2-1 General Description of Kenya and National Development Plan

2-1-1 Natural Environment

The Republic of Kenya, located in the eastern part of the African Continent, lies astride the equator from 4° North to 4° South latitude. The country faces the Indian Ocean to the east, Somalia, Ethiopia, and sudan to the north, Uganda to the west, and Tanzania to the south. The country has an area of about 580,367 km^2.

A distinguishing Kenyan landmark is the Rift Valley which separates the country into two parts. The Valley is 50 km to 80 km wide and its precipitous cliffs rise 600 m to 1,500 m from the valley floor. In the vicinity of the Rift Valley, between Ethiopia and Tanzania, there are nine large lakes. Among them the northern-most is Lake Turkana, and Lake Victroia, forming the southwestern border with Uganda, are the centers of Kenya's inland fishing industry.

The high inland area of the country rises 1,000 m to 2,000 m above sea level (ASL). In the middle of the country, and located on the equator, is Mount Kenya which is over 5,000 m ASL.

Kenya has 5.3 million ha of forests, 80,000 ha of bare mountains, and 10.6 million ha of arable land. There are almost 30 million ha of grassland and might possible be utilized for pasturage. Proportionately, about 18% of the area is suitable for cultivation, 9% is marginally suitable for cultivation, 52% is grassland (possible for pasturage use only), and 21% is barren.

The climate in the northeastern border region is dry, while along the coastal zone of the Indian Ocean it is tropical. The western plateau area (west of Mt. Kenya) has a mild climate. In the coastal zone, the annual average temperature is 32.7°C, and the average low temperature is 20°C. In the inland area, the climate is cool due to its high altitude.

Climatic characteristics are classified in correlation with the location, altitude, and precipitation, and also relate directly to the productivity of the land.

It can be seen from the country's climatic characteristics that the 1,000 to 2,000 m high western plateau zone is suitable for farming, while the northern and northeastern areas that occupy 60% of Kenya are semi-desert and are not suitable for agricultural use. Table-1 shows the country's average air temperatures.

Table-1 Monthly Highest and Lowest Temperatures in Major Cities

City	1	2	3	4	5	6	7	8	9	10	11	12
Nairobi	25.3 (11.3)	26.6 (12.6)	25.6 (14.3)	24.8 (15.0)	23.8 (12.5)	23.4 (11.4)	22.5 (11.0)	23.7 (11.2)	26.7 (11.5)	26.4 (13.2)	25.1 (13.2)	24.3 (14.1)
Nakuru	25.6 (8.5)	27.0 (9.7)	29.4 (12.3)	24.3 (11.3)	24.4 (10.3)	24.3 (10.2)	23.1 (10.6)	24.3 (10.5)	24.6 (8.6)	24.1 (9.5)	24.2 (9.1)	24.9 (10.9
Mombasa	32.9 (24.1)	32.3 (23.4)	32.2 (23.8)	30.2 (23.2)	29.5 (22.0)	28.3 (21.4)	27.9 (20.5)	29.8 (20.5)	29.8 (21.1)	30.3 (22.4)	30.4 (23.3)	31.3 (23.3)
Eldoret	22.5 (9.8)	24.5 (10.8)	23.1 (12.0)	23.4 (11.8)	23.3 (10.0)	22.2 (9.6)	20.8 (9.9)	22.4 (10.0)	22.4 (9.0)	22.4 (10.9)	23.0 (10.7)	23.2 (11.2)
Kisumu	29.8 (16.2)	30.3 (17.4)	28.1 (17.6)	28.5 (17.3)	28.3 (16.7)	27.7 (16.1)	27.4 (15.9)	29.1 (16.5)	29.1 (15.7)	30.4 (16.9)	29.0 (16.3)	28.8 (17.6)

Note: Figures within parenthese indicate monthly lowest temperatures

Source: Statistical Abstract

Most areas in Kenya receive an annual rainfall of about 500 mm; the semi-dry climate zone in the northeast have less than 250 mm, whereas the western part along Lake Victroria and the southern slope of Mt. Kenya receives 2,000 mm.

The country can be divided into four separate annual rainfall zones:

Zone I: The area between Kitale and Nairobi that receives about 1,300 mm of annual rainfall.

Zone II: Areas along Lake Victoria having about 2,000 mm of annual rainfall.

Zone III: The areas between Nairobi and the Tanzanian Border have an average rainfall of 600 mm.

Zone IV: Areas in the vicinity of Mombasa, along the Indiation Ocean, receive about 800 mm of annual rainfall.

The dry and rainy season cycles, although having little annual deviation, controls crop planting (sowing seasons) in the different areas. There is rainfall thorughout the year in Kenya viz; there are two definite rainy seasons: one brings moderate rain and the other brings light rain. The sowing season corresponds to the rainy seasons and harvesting corresponds to the dry season.

Maize, a staple in Kenya, is sown during the first rainy season and is harvested during the second. A good example of this cropping pattern can be seen in the Kikuyu tribe's farmland in the highland area neighboring on Nairobi. This area has 900 to 1,000 mm of annual rainfall. Cultivation work is accomplished during the mild dry season which precedes the moderate rainy season when crops are sown.

2-1-2 The Economic Trend After Achieving Independence

In 1963, Kenya, following Tanzania, achieved its independence from a British colony.

After gaining its independence, the guidelines of the country's economic policy were outlined in the 1965 Sessional Paper No. 10, "African Socialism and its Applications to Planning in Kenya."

The definite objectives of the policy were shown in the First Five-year national Development Plan (1963/64-1966/67). This plan called for the increase of per capita income based on the rules of political equality, socialism, respect for humanity and equal opportunities. After that, Kenya chose a free economic system.

The Government's development policy may be summarized as one calling for an increase of per capital income, Kenyalization of the economy, and for fairness in the distribution of wealth. Under the free economic system, firness in the distribution of wealth is being pursued by public corporations and cooperative associations.

From 1964 to 1972, according to statistics, the country's GDP (combining both monetary and traditional economic units) increased by 6.6 percent annually; the monetary unit increased by 7.5 percent while the traditional economic unit increased by 3.6 percent. In the agricultural sector, the increase was 6.0 percent and 3.6 percent, respectively. During that period, the First Five-year Development Plan gave precedence to the economic advancement made by Kenyans in commerce and industry while measures for promoting agriculture was deferred. The second Five-year National Development Plan (1968/68 -1972/73), therefore, emphasized promoting development in the rural areas. Investments in the agricultural sector were used to obtain agricultural equipment and domestic animals however, no allocations were provided for land improvement or plantation development.

The Third Five-year National Development Plan (1973/74 - 1977/78) saw a continuation of the previous two development plan policies; its first priority was for increasing the nation's production and to distribute wealth fairly. For this reason, the development plan emphasized the development of rural areas and the increase of employment opportunities. However, Kenya, being a non-oil producing country, received a great impact from the "Oil Shock" and the GDP during the Third Five-year National Development Plan that increased 14.4% annually in nominal terms (12.5% in 1978) was only 1.9%, after subtracting the inflation rate.

Before making the Fourth Five-year National Development Plan, the Government of Kenya reaffirmed the fundamentals of the country's previous development process. Those fundamentals were: (1) participation of the people from all social strata, (2) diversification of development methodolgy, (3) positive participation by the Government, and (4) Harambee (self-help cooperation).

In the Fourth Five-year National Development Plan, the Government's primary objective was to eliminate poverty. However, with an annual population increase rate of 3.4%, the effects of the country's economic development were absrobed and did not contribute to raising the living standards.

The trend of the country's GDP up to 1981 is shown in Table-2.

Table-2 Growth Rates in Sectoral GDP (*Per cent per annum*)

Sector	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
Agriculture	3·3	0·6	3·4	1·9	9·1	4·8	−0·9	−1·3	6·3
Industry	9·6	0·6	0·2	−0·8	13·4	13·0	7·1	4·7	5·7
Government Services	6·3	6·8	8·6	5·1	5·1	6·4	7·1	5·6	5·3
Others	2·1	4·0	0·7	3·3	7·9	5·7	6·8	5·2	5·2
TOTAL GDP	4·3	2·5	2·6	2·4	8·8	6·7	4·2	3·0	5·5

Source: National Development Plan (1983/84 - 1987/88)

2-1-3 Population

According to the national census of 1979, the country's population was 15,327,061. The average annual population increase rate since the previous census taken in 1969 was 3.8%. This rate is slightly larger than the average rate of 3.4% for the 1962-1969 period.

The Government estimates that the country's population in the year 2,000 will be 38.5 million assuming that the present birth rate is maintained, or 34.8 million if the birth rate decreases from present figures (see Table-3).

The country's average population density in 1979 was 27 people/km^2. The population densities in provincial areas are as follows:

Province	Population Density (People/km^2)
Nairobi	1,210
Western	222
Nyanza	211
Central	178
Coast	16
Eastern	17
Rift Valley	19
North Eastern	2

As only 18% of the country's total area is arable, the population increase results in sizeable increases of urban population. In 1979, 2.3 million people lived in ninety-one city areas. The population increase rate, combining natural and social increases, in the city areas was estimated to be 7.6% annually from 1969 to 1979. By the end of 1983 the population in the city areas climbed to 2.8 million.

Table-3 Projected Population in Kenya 1988 and 2000

	Base Year 1980		Constant Birth Rate 1988		Constant Birth Rate 2000		Declining Birth Rate 1988		Declining Birth Rate 200	
	Number	%	Number	%	Number	%	Number	%	Number	%
Total Population	16,667	100·0	23,032	100·0	38,499	100·0	22,657	100·0	34,792	100·0
Children (0–14)	8,579	51·5	11,826	51·3	20,039	52·2	11,451	50·5	16,538	47·5
Productive age (15–59) ..	7,495	45·0	10,431	45·3	17,176	44·7	10,431	46·0	17,065	49·0
Persons aged 60 + ...	593	3·5	775	3·4	1,194	3·1	775	3·5	1,189	3·5
Pre-school age (0–5)	4,140	24·8	5,719	24·8	9,602	25·0	5,359	23·7	8,141	23·4
Primary School age (6–12) ..	3,607	21·8	4,921	21·4	8,181	21·3	4,907	21·7	7,480	21·5
Secondary school age (13–16)..	1,567	9·4	2,266	9·8	3,764	9·8	2,266	10·0	2,505	7·2
Potential Labour force ..	6,371	38·2	8,866	38·5	14,560	38·0	8,866	38·5	14,505	41·7
Dependency ratio	1·22:1		1·21:1		1·24:1		1·17:1		1·04:1	

Source:—Central Bureau of Statistics.

Note:—1. In the two alternatives a decline in mortality from a crude death rate of 12 per thousand in 1980 to 9 in the year 2000 is assumed

2. In the alternative 'constant birth rate', it is further assumed that TFR will remain constant throughout at 7.9.

3. In the alternative 'Declining Birth rate', it is further assumed that TFR will decline from 7.9 in 1980 to 5.6 in the year 2000.

4. Potential labour force is defined as 85 per cent of population aged 15–59 years.

5. Dependency ratio is defined as: $\frac{\text{Population aged 0-14 years} + \text{Population aged 60+ years}}{\text{Population aged 15-59 years}}$

2-1-4 General Description of the National Development Plan

1) Basic Development Policy

After gaining its independence, the Government's development principles were to increase per capital income, encourage the Kenyanization of the economy, and ensure fairness in the distribution of wealth. The Fourth Five-year National Development Plan held to similar principles, especially by emphasizing those concerned with increasing per capita income and for ensuring fairness in the distribution of wealth. Such being the background, the Statistics Bureau has been carrying out comprehensive surveys in urban areas to obtain the country's social indices. Various surveys concerned with social economics and agriculture have been conducted by universities with subsidies received from the Government.

Average incomes from district to district vary distinctly. One of the objectives of the Government's development plan was to moderate these differences. Exceptionally low income districts are in the dry and semi-dry areas. However, all other areas have various types of low-income groups. Common factors causing low-income groups are the lack of access to employment opportunities, land, water, markets, finances, modern science and technology, energy, education, medical care, etc.; therefore, one of the Government's development principles was to equalize the opportunities for gaining access into these areas in all districts.

In view of the above mentioned background, the Fifth Five-year National Development Plan (1983/84 - 1987/88) emphasized the importance of the "District Focus for Rural Development" as its development policy. For this purpose, each District Development Committee (DDC) was charged with planning and implementing development projects; the District Commissioner was empowered to develop rural areas.

Each DDC, in coordination with related ministries, prepares the District Development Plan (DDP) based on the district's long term development policy, and implements rural development projects in accordance with each fiscal year's Annual Works Programme.

In order for the District Commissioner (DC) to commence planning and implementation of rural development projects, related ministries first pay particular attention to the projects from the view point of the country's development policy and then allocates a budget for each DDP and provides the DC with technical assistance.

The budgets necessary for implementing projects are provided by the related ministries and the local government.

2) Development Objectives

As set forth in the previous Five-year plans, the most urgent basic principles of the Fifth Five-year national Development Plan (1983/84 - 1987/88) call for developing infrastructures and eliminating the income disparity found in various districts. The major objectives of the infrastructure development are as follows:

- Communication and Transporation:
  . Improvement of railway and road operational and maintenance systems, and the improvement of associated facilities.
- Civil Engineering and Architecture:
  . Improvement of organizational structure
  . Standardization of construction materials and methods
  . Training of technicians
- Energy:
  . Electrification of rural areas
- Environment:
  . Creating harmony in the development in the fields of agriculture, stock-raising, industries, and public health and hygiene, and apply suitable techniques
- Education:
  . Educate technicians to meet the needs of society for economic development and to provide this education on an equal opportunity basis and with respect for traditional culture.
- Public Health and Hygiene:
  . Improvement of medical services and preventive measures in rural areas.

- Housing
  . Construction of low-priced houses
- Social Development
  . Improvement of adult education, social services, modern libraries, and museums
- Strengthening of Local Autonomy:
  . To strengthen the 20 cities, 7 town, 39 provinces and 17 self-governing urban cities under the Ministry of local government.

Development objectives in the economic sector were set up as shown in Table-4.

In order to achieve the above mentioned plans, development and working budgets were planned as shown in Tables-5 and 6.

Table 4 GDP Growth Targets (1982 prices)

Year	1982	1983		1984		1985		1986		1987		1988	
Sector	Provisional	Expected		Targets									
	Level (K£m)	Growth Rate %	Level (K£m)	Growth Rate %	Level (K£m)	Growth Rate %	Level (K£m)	Growth Rate %	Level (K£m)	Growth Rate %	Level (K£m)	Growth Rate %	Level (K£m)
Non Monetary	164·5	3·3	169·9	3·5	175·8	3·5	182·0	3·5	188·4	3·5	195·0	3·5	201·8
Monetary: Enterprises													
Agriculture	876·1	4·5	915·5	4·5	956·7	4·5	999·7	4·5	1,044·7	4·5	1,091·8	5·0	1,146·3
Forestry	20·4	4·7	21·4	5·0	22·5	5·0	23·6	5·0	24·8	5·0	26·0	5·0	27·3
Fishing	7·2	6·0	7·6	6·0	8·1	6·0	8·5	6·0	9·1	6·0	9·6	6·0	10·2
Mining and Quarrying	5·6	0·0	5·6	2·0	5·7	2·7	5·9	3·0	6·0	3·0	6·2	3·0	6·4
Manufacturing	371·3	2·0	378·7	3·0	390·1	5·4	411·1	6·5	437·8	7·0	468·5	7·5	503·6
Building and Construction ..	118·2	3·0	114·7	0·0	114·7	1·5	116·4	4·0	121·1	4·5	126·5	5·0	132·9
Electricity and Water	45·4	4·0	47·2	6·0	50·0	6·0	53·0	6·0	56·2	6·0	59·6	6·0	63·2
Transport, Storage, Communication	158·5	4·0	164·8	4·5	172·2	4·5	180·0	5·0	189·8	5·2	198·8	5·5	209·7
Trade, Restaurants and Hotels ..	299·2	0·0	299·2	2·0	305·2	3·6	316·2	4·0	328·8	4·5	343·6	5·0	360·8
Finance, Insurance, Real Estate and Business Services	194·9	8·0	210·5	5·0	221·0	5·4	233·0	6·0	246·9	7·0	264·2	7·0	282·7
Ownership of Dwellings	140·9	6·5	150·1	6·0	159·1	6·0	168·7	6·0	178·8	6·0	189·5	6·0	200·9
Other Services	62·3	4·8	65·3	6·0	69·2	6·0	73·4	6·5	78·1	7·0	83·6	7·0	89·5
Total Enterprises	2,299·9	3·5	2,380·6	3·9	2,474·5	4·7	2,589·5	5·1	2,721·3	5·4	2,867·9	5·8	3,033·5
Domestic Services	37·0	6·5	39·4	8·0	42·6	8·0	46·0	8·0	49·6	9·0	54·1	9·0	59·0
Government Services	449·2	3·0	462·7	3·5	478·9	4·1	498·5	4·7	622·0	5·0	548·1	5·1	576·0
TOTAL MONETARY	2,786·1	3·5	2,882·7	3·9	2,996·0	4·6	3,134·0	5·1	3,292·9	5·4	3,470·1	5·7	3,668·5
TOTAL GDP AT FACTOR COST ..	2,950·6	3·5	3,052·6	3·9	3,171·8	4·5	3,316·0	5·0	3,481·3	5·3	3,665·1	5·6	3,870·3
Indirect Taxes *less* Subsidies ..	469·7		495·7		515·1		538·6		565·4		595·2		628·6
TOTAL GDP AT MARKET PRICES ..	3,420·3		3,548·3		3,686·9		3,854·6		4,046·7		4,260·3		4,498·9
GDP Deflator 1982 = 1·000 ..	1·000		1·1583		1·866		1·2403		1·3092		1·3818		1·4590
Total GDP at Current Market Prices	3,420·3		4,110·1		4,374·9		4,780·6		5,298·0		5,886·7		6,563·8

Source: Development Plan 1983/84-1987/88

Table 5 Forward Development Budget Expenditure Ceilings (1983/84 - 1987/88)

(K£000's in 1983/84 Prices)

Vote		1983/84	1984/85	1985/86	1986/87	1987/88	Total	% Share
D1. Office of the President		11,855	20,797	19,973	16,034	17,578	86,235	5·1
D2. The State House		323	266	276	262	172	1,299	0·1
D3. The Directorate of Personnel Management		1,219	1,396	969	1,269	1,244	6,097	0·4
D4. Ministry of Foreign Affairs		839	1,798	475	2,105	2,205	7,422	0·4
D5. Office of the Vice-President and Ministry of Home Affairs		3,023	2,970	2,811	2,711	3,109	14,624	0·9
D7. Ministry of Finance and Planning		12,808	11,225	9,988	12,701	14,356	61,078	3·6
D8. Department of Defence		9,402	9,701	9,339	10,780	11,298	50,520	3·0
D10. Ministry of Agriculture and Livestock Development		33,303	40,937	42,132	39,036	38,857	194,265	11·5
D11. Ministry of Health		14,280	17,743	18,153	16,466	16,094	82,736	4·9
D12. Ministry of Local Government		4,390	4,600	5,600	5,385	6,400	26,375	1·6
D13. Ministry of Works, Housing and Physical Planning		11,694	12,697	13,060	14,743	14,992	67,186	4·0
D14. Ministry of Transport and Communications		76,383	82,016	73,905	74,014	76,257	382,575	22·6
D15. Ministry of Labour		814	1,247	1,110	840	1,240	5,251	0·3
D16. Ministry of Tourism and Wildlife		3,666	2,932	2,553	2,135	1,978	13,264	0·8
D17. Ministry of Lands and Settlement		3,589	3,098	1,493	1,138	1,244	10,562	0·6
D18. Ministry of Culture and Social Services		7,626	12,712	14,634	15,326	18,261	68,559	4·0
D19. Ministry of Information and Broadcasting		2,762	2,719	2,027	3,177	4,356	15,041	0·9
D20. Ministry of Water Development		26,561	33,368	34,468	34,447	35,770	164,614	9·7
D21. Ministry of Environment and Natural Resources		9,709	10,543	11,160	11,736	12,177	55,325	3·3
D22. Ministry of Co-operative Development		3,948	4,344	4,905	5,295	5,280	23,772	1·4
D23. Ministry of Commerce and Industry		3,421	3,096	3,061	2,986	2,986	15,550	0·9
D24. Ministry of Education, Science and Technology		10,800	11,896	10,851	12,536	13,735	59,818	3·5
D25. Office of the Attorney-General		35	51	27	2	2	117	0·0
D26. Judicial Department		500	479	500	600	700	2,779	0·2
D30. Ministry of Energy and Regional Development		13,412	37,123	54,245	72,774	84,503	262,057	15·5
Contingency		16,638	—	—	—	—	16,638	1·0
TOTAL GROSS DEVELOPMENT EXPENDITURE	K£	283,000	329,752	337,715	358,498	384,794	1,693,759	100·0

Source: Development Plan 1983/84-1987/88

Table 6 Forward Recurrent Budget Expentigure Ceiling (1983/84 - 1987/88)

(*K£000's in 1983/84 Prices*)

Vote		1983/84	1984/85	1985/86	1986/87	1987/88	Total	Average Annual Percentage Growth
R1. Office of the President		67,970	64,733	67,758	72,535	76,722	349,718	3·1
R2. The State House		916	949	1,032	1,017	1,089	5,003	4·4
R3. Directorate of Personnel Management		3,781	4,092	4,366	4,539	4,655	21,433	5·3
R4. Ministry of Foreign Affairs		13,855	16,214	16,502	16,836	17,382	80,789	5·8
R5. Office of the Vice-President and Ministry of Home Affairs		15,718	17,304	18,341	19,450	20,506	91,319	6·9
R7. Ministry of Finance and Planning		13,486	13,986	14,702	15,476	16,349	73,999	4·9
R8. Department of Defence		131,247	101,583	104,797	111,162	117,576	566,365	-2·7
R10. Ministry of Agriculture and Livestock Development		44,379	49,652	52,359	55,332	58,639	260,361	7·2
R11. Ministry of Health		59,877	65,231	68,442	72,047	75,662	341,259	6·0
R12. Ministry of Local Government		6,836	13,018	13,502	13,986	14,501	61,843	20·7
R13. Ministry of Works, Housing and Physical Planning		14,893	21,553	24,048	25,000	26,102	111,601	15·0
R14. Ministry of Transport and Communications		31,296	38,907	41,805	45,314	49,376	206,698	12·1
R15. Ministry of Labour		4,102	4,737	5,102	5,418	5,753	25,112	8·8
R16. Ministry of Tourism and Wildlife		9,545	11,316	11,714	12,142	12,510	57,227	7·0
R17. Ministry of Lands and Settlement		9,774	10,060	10,260	11,370	10,575	52,039	2·0
R18. Ministry of Culture and Social Services		8,068	9,434	9,897	11,167	10,472	49,038	6·7
R19. Ministry of Information and Broadcasting		6,062	6,633	6,815	7,116	7,554	34,180	1·1
R20. Ministry of Water Development		12,985	14,279	15,513	16,515	18,278	77,570	8·9
R21. Ministry of Environment and Natural Resources		2,637	2,765	2,841	2,868	2,937	14,048	2·7
R22. Ministry of Co-operative Development		3,049	3,267	3,411	3,537	3,672	16,936	4·8
R23. Ministry of Commerce and Industry		4,420	4,659	4,873	5,169	5,387	24,508	5·1
R24. Ministry of Education, Science and Technology		172,589	205,291	219,656	239,737	256,302	1,093,575	10·4
R25. Office of the Attorney-General		2,247	1,731	1,694	1,782	2,252	9,706	0·1
R26. Judicial Department		2,409	2,709	2,891	3,048	3,197	14,254	7·3
R27. Public Service Commission		200	228	247	262	264	1,201	7·2
R28. Office of the Controller and Auditor-General		1,105	1,550	1,739	1,819	1,907	8,120	14·6
R29. National Assembly		2,087	2,165	2,203	2,281	2,249	10,985	1·9
R30. Ministry of Energy and Regional Development		1,912	2,391	2,400	2,711	2,866	12,280	10·6
Contingency less Prior Year Adjustments		-2,450	—	—	—	—	-2,450	
TOTAL GROSS RECURRENT EXPENDITURE	K£	645,000	690,437	728,910	779,636	824,734	3,668,717	6·3

Source: Development Plan 1983/84-1987/88

2-2 Water Supply Project

2-2-1 General

Since gaining its independence, one of the consistent basic policies of the Government of the Republic of Kenya was to supply sufficient amounts of clean water to housing areas. Because the water supply effects not only public health, but also the social economy, the Government established the Ministry of Water Development (MOWD) in 1974 as the executive organization for water supply projects.

A total of 163 water supply projects were carried out since the country gained its independence. However, ther service rate varies greatly from province to province. The present service rate in the Central Province is 20% of the total population, however, in the Northeastern province it is only 4%. The service rate is very low in rural areas especially. In those areas it is an everyday task for women and children to obtain water for domestic use from remote water sources.

Since the implementation of service projects has been made by the MOWD, the country's water supply rate has improved. In 1974 the average distance from a house in the rural area to a water source was estimated to be 3.4 km. This distance has been shortened and presently it is estimated to be 1.8 km to a water source.

In the urban areas of Kisumu, Eldoret, Kitale, Embu, Mombasa, Nakura, and Thika, the water supply system is capable of serving 75% of the population. Safe water for domestic use is supplied to houses and kiosks in these areas.

2-2-2 Water Supply Development Plan

1) Development Objectives

Similar to the Fourth Five-year National Development Plan, the Fifth Five-year National Development Plan (1983/84 - 1987/88) established the following objectives:

(1) To provide a balanced supply of safe water for domestic, livestock and industrial use.

(2) To develop water sources for multipurpose dams, irrigation, and recreational purposes, and to pay attention to the preservation of the natural environment.

(3) To develop waste-water treatment techniques, to keep watch on water source contamination by sewerage, and to enlighten people about the importance of water quality preservation.

(4) To educate the people concerning the supply of water and its cost.

(5) To conduct a national educational programme to prevent the wasteful use of water, the conservation of water, and the prevention of environmental damage through the misuse of water.

(6) To make it generally know to the people of the concept that beneficiaries will have pecuniary responsibilities for the supply of water based on the fundamental national economic development principle "the efficient use of domestic resources for well balanced development."

2) Development Principles

Development principles for urban areas are to provide a water supply to each house wherein a water meter is to be installed, and to improve sewerage treatment facilities.

Water supply projects in rural areas are to be carried out in accordance with the following principles:

(1) The distance from a water source to a house is to be as follows:

Area	Distance
High Potential Area	1 km
Medium Potential Area	1 km
Low Potential Area	5 km

The priority ranking of self-help effort water supply projects is to be decided upon by the MOWD in accordance with each DDC's recommendations.

(2) The operation and maintenance costs of water supply facilities are to be paid for by the beneficiaries.

(3) Water charges are to be lowered reexaminating of the present design standards for the MOWD's water works facilities.

(4) Water charges are to be determined based on the operating and maintenance costs for the rural water supply, and on the operation and maintenance costs plus facilities' depreciation costs for the urban water supply.

Based on the above development principles, nine action programmes were established. The major action programmes are described in the following chapter.

3) Action Programmes

The major action programmes are as follows:

(1) Rural Water Supply Programme (RWS)
This programme is aimed at supplying water to rural areas that are inhabited by 87% of the total population. This programme includes the planning, design, construction, and operation and maintenance of the rural water supply systems.

During the period of the Fifth Five-year national Development Plan, service rates in urban areas are expected to increase thereby providing 30%. Beneficiaries of the rural water supply in 1983 numbered 3.5 million; in 1988 this figure is expected to increase to 5.5 million.

The First Plan of RWS began in 1970. Presently, the Fifth Plan of RWS has been carried out. The RWS through First to Fifth Plans has included 347 water supply projects throughout the country.

The Government of Kenya has allocated kshs. 1,240 million for water supply projects during the period of the Fifth Five-year national Development Plan.

2) Urban Water Supply Programme

Due to the sudden urbanization, water shortages became serious in urban areas. For this reason, the Government made special efforts to expand water supply facilities in the large cities up until the Fourth Five-year National Development Plan. A total of fifteen large cities, such as Kisumu, Eldoret, Kitale, Embu, Mombasa, Nakuru, Thika, and Nyahuru benefited from this expansion of water supply facilities.

The Fifth Five-year National Development Plan calls for expanding water supply facilities in twenty-four capital cities of districts. Kshs. 646 million were appropriated in the budget for this plan.

After the implementation of the plan, beneficiaries of the water supply are expected to increase from the 1983 total of 2.8 million to 4.5 million in 1990.

(3) Sewerage Development Programme

The quantity of waste water increases in proportion to progress made by water supply projects. Because waste water tends to contaminate water sources and damage environmental conditions, the MOWD has been putting forth great effort for the treatment of waste water. Since 1974, sewerage disposal and treatment plans have been made for 41 cities; however, as yet, the plans have not been implemented. Thus, in the Fifth Five-year National Development Plan, the implementation of sewerage plans is scheduled for 17 minicipalities; kshs. 156 million has been appropriated for this in the budget.

(4) Water Quality and Pollution Control Programme

Water quality observation stations have been established since 1984. Presently, 120 rivers are under surveilance by these stations.

In the Fifth Five-year National Development Plan, in order to develop the water quality observation system, it is scheduled to expand Pollution Control Division facilities and to increase the number of staff members. The establishment of a Water Quality Research Centre in Nairobi is also scheduled.

(5) Minor Irrigation, Drainage, and Flood Protection Programme. In this programme it is planned to expand the Yatta Furrow in Macharos and the Njoro Kuwa Furrow in Taveta. Kshs 120 million has been appropriated in the budget for this programme.

(6) Livestock Water Supply programme
Livestock raising is one of the most important industries in the Republic of Kenya. This industry is under the jurisdiction of the Ministry of Agriculture and Livestock Development. The supply of livestock water, however, is being carried out as the Ranch Water Development (RWD) by the MOWD.

During the period of the Fifth Five-year National Development Plan, the Third RWD is scheduled to continue present livestock water supply projects in the Northeastern and Rift Valley states and to start new projects in Marsabit and Tana River Districts. Kshs.144 million has been allocated for the Third RWD.

2-3 Relationship of This Study with Action Programme

This is the basic design study of Taveta-Lumi Water Supply Project included in the 5th RWA which has been listed as a high priority project requested to MOWD for immediate implementation by DDC of Taita-Taveta District.

2-4 Present Condition of Water Supply

Upon establishing the MOWD in 1974, the Government set the year 2000 as the target year for providing people and livestock with safe drinking water. Since that time, great efforts have been made towards attaining that goal.

In 1984, the country's estimated population was 19.5 million; 2.8 million lived in urban areas, while the remaining 16.7 million inhabited rural areas. After 1984, the concentration of the population in urban areas has been increasing steadily.

Presently, in one way or the other, water for domestic use is being supplied (in some cases lacking in quantity) to entire urban areas of large cities. The rate of the population served by improved water supply in large cities are estimated to be about 75% of the cities' population. In rural areas, however, only 20% of the population is being supplied with water that meets Government standards.

The Fifth Five-year National Development Plan calls for increasing the service rate in rural areas upto 30% of the population. Thus, it is estimated that about 5 million people in rural areas will receive water supplies by the end of the National Development Plan in 1988.

2-5 Improvement of Water Supply

2-5-1 Water Supply Projects

The Water Supply Department of Nairobi City Council has been conducting the planning, implementation, and operation and maintenance of the Nairobi Municipal water supply projects. After the establishment of the MOWD it became their custom to provide technical cooperation to the Water Supply Bureau of Nairobi City.

In other large cities and district capitals, water supply projects are planned by the Planning and Design Division of the MOWD and are constructed by the Implementation Division.

The operation and maintenance of water supply facilities are basically the responsibilities of beneficiaries. however, the Operation and Maintenance Division of the MOWD presently operates and maintains many water supply facilities at its own cost.

In accordance with request made by a District Development Committee, the MOWD conducts water source surveys and project planning. Based on the basic principles for providing water supplies equally throughout the entire country, a higher project priority is given to an area having a lower rate of the population served.

As 75% of the population in large cities is benefiting from the supply of water, it is scheduled to drive forward to establish water supply projects in district capitals during the Fifth Five-year National Development Plan.

In rural areas, having a service rate of only 20%, water supply projects are implemented under the Rural

Water Supply Programme (RWS). The Fifth RWS, presently, is being carried out.

The RWS started in 1970. Since that time, which includes the Fifth RWS, a total of 347 water supply plans were set up; of them, 163 plans were implemented. The construction of these 163 projects meant that about 3.5 million people in rural areas could receive water supplies.

In the Fifth Five-year National Development Plan, further rural area water supply projects are scheduled, and, by 1988, 5.5 million people are expected to receive water supplies. However, due to the lack of finances, the construction of water supply projects has been substantially delayed since the Fourth RWS. Under the Fifth RWS only about 5% of the total projects were completed.

	Year Started	Design Population x 1,000	Construction Costs Kshs Million	No. of Projects	Completed Projects	Completion Rate
The First RWS	1970	-	43	72	72	100%
The Second RWS	1972	-	57	29	29	100%
The Third RWS	1974	2,035	1,788	70	51	73%
The Fourth RWS	1978	3,058	1,043	65	5	8%
The Fifth RWS	1982	4,242	12,205	111	6	5%
TOTAL			15,136	347	163	

2-5-2 Project Implementation Organization

As mentioned in the previous section, water supply projects in Nairobi are carried out by the city's Water Supply Bureau. In other cities they are under the jurisdiction of the MOWD. The MOWD conducts water source surveys, project planning, selection of contractors, and supervision of construction work in medium and small size cities. The MOWD also conducts

the operation and maintenance of existing water supply facilities.

For this purpose, Provincial Water Engineer is assigned in each province, and branch offices of Provincial Water Office are established in each district or division of each province. Under this organizational structure, about 300 water supply facilities are presently being operated in medium and small size cities and in rural areas by the MOWD.

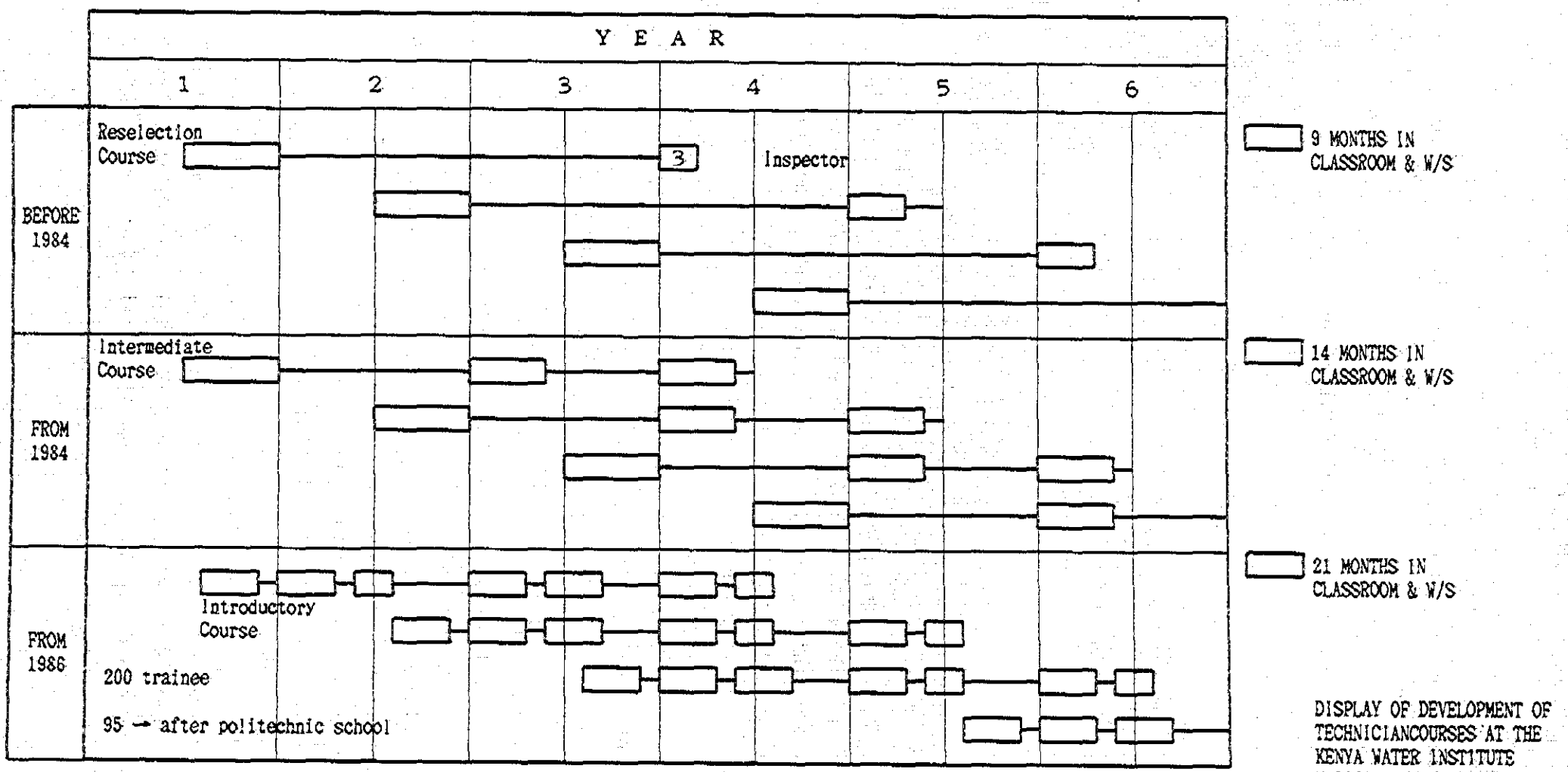
A large staff is required to operate and maintain those facilities. For this reason, the Kenya Water Institute (KWI) was established to educate young people for the purpose of filling necessary staff positions.

The KWI was established in 1970 and was placed under the jurisdiction of the MOWD immediately after its establishment in 1974. The method of education at KWI is through the combination of lectures, practice, and practical training. By 1984, approximately 2,000 students received their education at KWI. Education was limited, however, due to the lack of follow-up during practical training periods, and the insufficient amount of time allowed for practicing lecture subjects.

In order to improve the quality of education, in 1986 the KWI revised its system to provide six months of lectures and practice followed by five months of practical training, then another six months of lectures and practice followed by five months of practical training, and then winding up with six months of lectures (see Fig.-1).

It is reported that, due to the revised educational system together with the cooperation of KWI and MOWD to conduct follow-up during practical training periods, remarkable improvement to the quality of education has been made.

Fig - 1 Staff Training School '86 Kenya Water Inst.
320 students



THREE - YEARS COURSES FOR WATER TECHNICIANS
REVISED 2/9/87

Since 1986, 105 students enter KWI annually. There are 35 students in each of three classes.

The organizational structure of MOWD is summarized in Fig.-2.

2-5-3 Financial Aspects and Foreign Assistance of Water Supply Project

A large number of man power and significant amount of financial source are required for the 13 years old MOWD to improve water supply in Kenya. MOWD's annual budgets for the past six years are shown in Table-7.

Table-7 Development Expenditures for Water Supplies and Related Services (1981/82 - 1986-87)

K£'000

	1931/82	1982/83	1983/84	1984/85**	1985/86*	1986/87
Water Devlopment	246	553	638	1,050	505	5,089
Trainig of Water Development Staff	67	56	44	270	65	619
Rural Water Supplies	9,235	5,252	7,470	8,782	10,819	14,096
Self-Help Water Supplies*	5,586	2,900	5,924	5,169	6,358	5,045
County Council and Urban Water Supplies	11,672	5,591	9,350	8,756	10,503	10,593
Miscellaneous and Special Water Programmes	4,259	2,698	4,651	5,592	5,025	3,768
Total	31,065	17,054	28,077	29,619	33,280	39,212

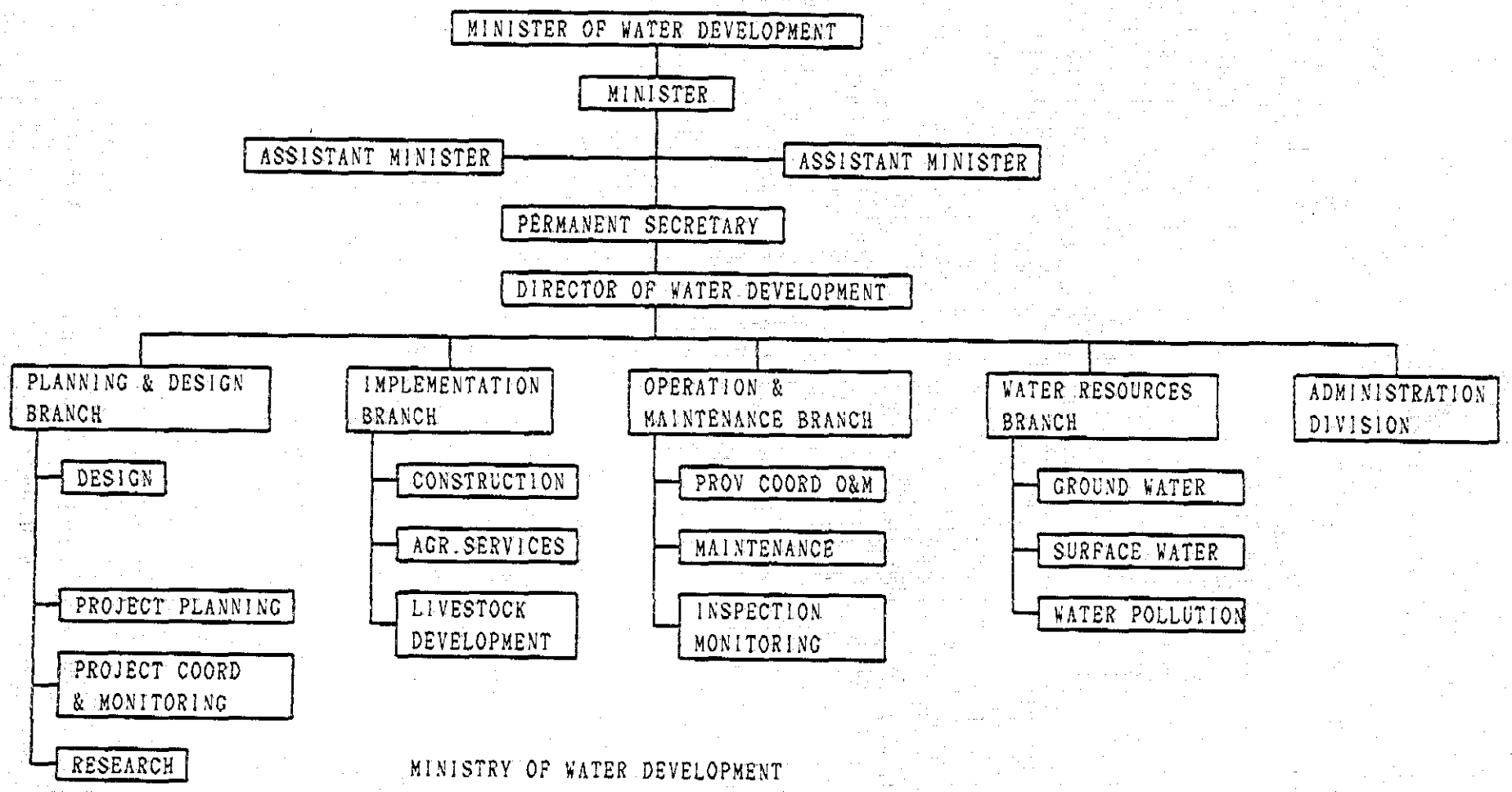
* Provisional.

** Estimate.

* Includes only contributions by the Ministry of Water Development

Under the circumstance, various international cooperation has been offered to MOWD's activities by dispatched experts from many donor countries and international organizations.

Fig - 2 ORGANIZATIONAL STRUCTURE OF MOWD



MINISTRY OF WATER DEVELOPMENT

Table-8 shows the amount of foreign aid furnished to the Fourth RWS up until the year 1981.

Table-8 Foreign Aid to the Fourth RWS

Offering Organization	Number of Projects	Total Costs (Grand Aid) Ksh million
ADB	4	41.5
SIDA	7	515.0
DANIDA	2	77.5
IBRD	33	1,098.2
Japan	1	15.1
NETHERLANDS	16	329.0
U.K.	2	38.0
TOTAL	65	2,168.5

For the Fifth RWS, which began in 1982, it is expected that Khs 1,772 million in foreign aid will be forthcoming (see Table-9).

Table-9 Foreign Aid Expected for the Fifth RWS

Offering Organization	Number of Projects	Population Served	Amount of Aid Ksh million
NORWAY	3	45,000	151
SIDA	3	384,000	214
ADB	3	116,000	178
KFW	5	791,000	398
IBRD	1	196,000	120
FRANCE	1	113,000	244
ITALY	1	240,000	280
U.K.	1	202,000	90
JICA	1	69,000	97
TOTAL	9	2,156,000	1,772

Of those projects, only four (supported by aid from ADB and KFW) are being carried out. The MOWD is asserting great effort to start other projects as soon as possible.

2-5-4 Development Plan in the Study Area

1) General

The budget for development projects in the Taveta Division for fiscal year 1986-87 was Ksh 5.6 million. The budgeted money was spent on some of the district's priority development projects that were listed in the Fifth Five-year National Development Plan.

Projects scheduled to be implemented during the National Development Plan period 1983/84 - 1987/88 in the Taveta Division are as follows:

1. Extension of Lessesia Village
2. Taveta - Lumi Water Supply
3. Shallow Well Programme
4. Kimorigo water Supply
5. Mata Water Supply
6. Cattle Dip at Kimorigo
7. Kimorigo Irrigation Scheme
8. Kimala A & B Small Scale Irrigation
9. Cattle Throught at Kivalwa
10. Upgrading Mata & Kitovo Dispensaries
11. Proposed Dispensaries: Timbila, Kimala, Malukiloriti, Jipe
12. Taveta Township Development
13. Njoro Primary School Building
14. Kimorigo Social Hall
15. Taveta Stadium
16. Marketing Centers: Riyata, Njoro, Kimorigo, EL Dolo, Kithogoto, Rekeke, Luduvai, Kivalwa, Bura Njoro

Of the above listed projects, the Taveta-Lumi and Kimorigo water supply studies are to be made during this Basic Design Study. And the shellow well programme is covered by the Taita-Taveta District Development Programme which is presently being carried out with the technical cooperation of Denmark.

2) Taita-Taveta District Development Programme

The Taita-Taveta District Development presently is being carried out with the technical cooperation of the Danish International Development Agency (DANIDA). The major items of this programme are as follows:

1. To increase the people's understanding concerning the need for water and soil-resources conservation.
2. To improve farming.
3. To promote tree planting for watershed conservation and to provide a source for firewood.
4. To improve the quality of drinking water by selfhelp effort.
5. By a self-help effort to conserve water and soil-resources utilized in farming.

In the Taveta Division, plans have been made to dig shallow wells, introduce hand pumps and make improvements to toilet facilities. For the shallow well development, presently, aerial photographs in a 1/10,000 scale are being taken, electric conductivity surveys of ground water in the shallow strata are being made, and water quality and quantity surveys are being conducted.

For the shallow well development project, six experts of DANIDA have been dispatched from Denmark.

Up-to-date, 36 sites have been surveyed. As a result, high salinity water that is unfit for drinking purposes was found in many sites. In some other sites ground water could not be found in the shallow strata. For this reason, in the wide area of the Taveta Division, it will be necessary to obtained drinking water from a source other than from ground water in the shallow strata.

2-6 Background of the Request

One of the Government of Kenya's development objectives is to provide safe drinking water to all its people by the year 2000. To accomplish this objective, the Government must increase the population served during the Fifth Five-year National Development Plan by an additional 2 million people.

In the Fourth RWS, which began in 1978, 65 projects were planned to supply water to approximately 3 million people; only 5 of the said projects were actually implemented.

111 projects to provide water supplies to 4 million people were planned for in the Fifth RWS that started in 1982; only six of these projects were completed. The main reason for the project completion rate was due to insufficient project funds. The drop in export prices of agricultural products, especially coffee, hurt the country's economy and the Government's budget was unable to provide sufficient funds to water supply projects.

In view of the above, the MOWD has been striving to obtain funds for the RWS from within the country, and by requesting grant aid from foreign countries.

In light of this background, the Government of Kenya requested grant aid cooperation from the Japanese Government for the water supply project in the Taveta Division where, during the 1970's, remarkable agricultural growth was achieved.

The Taveta Division with Taveta Town at its center is surrounded by farming areas that mainly produce cooking bananas.

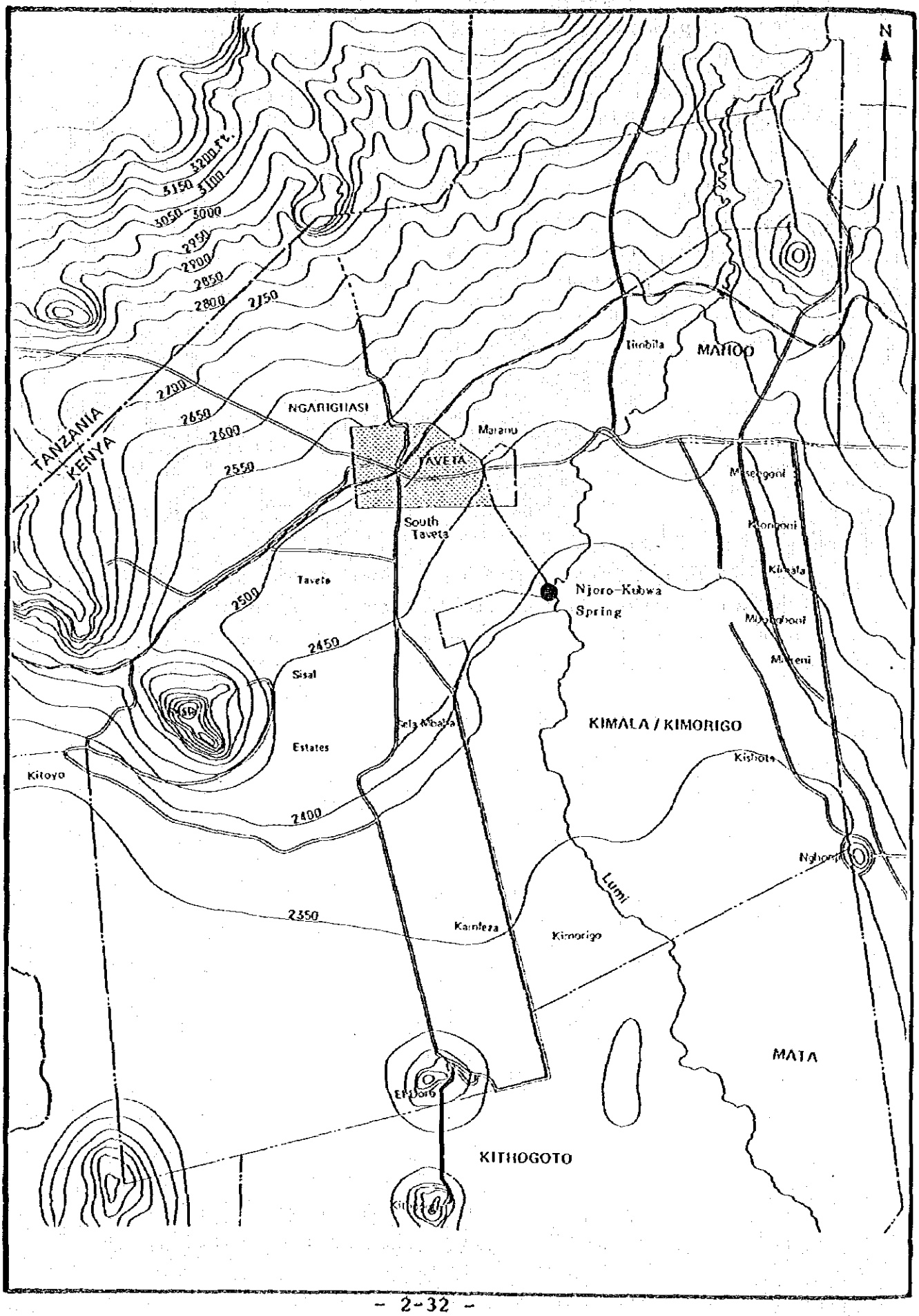
In Taveta Town, water is supplied from wells. However, these wells have limited capacities and, what with the

sudden population increase, there is a chronic water shortage. Being situated in a semi-dry climate zone, safe drinking water in the surrounding rural areas is very scarce. Therefore, from 1985, with technical assistance from the Danish International Development Agency (DANIDA), the construction of shallow wells began. However, as a result of ground water surveys in this area, it was found that the salinity of the ground water in the shallow strata was found in a wide coverage of the project area, and the shallow well plan had to be abandoned in such sites.

The request by the Government of Kenya is for improving the water supply system in Taveta Town and for providing the water supply systems to the farming areas that are unable to obtain potable water from shallow wells.

Njoro Kubwa Spring, having a large quantity of clean water, is expected to be the Project's suitable water source (see Fig.-3 and Section 4-3-3 Water Source).

Fig.–3 SPRING MAP



CHAPTER 3 GENERAL DESCRIPTION OF THE PROJECT AREA

CHAPTER 3 GENERAL DESCRIPTION OF THE PROJECT AREA

3-1 General Description

3-1-1 Location and Topography

The Project Area is the southern half of the Taveta Division that is in the Taita-Taveta District of the Coast Province. The Area is a part of the Kimorigo Location. The Kimorigo Location covers an area of 600 km^2 and consists of the following four sublocations:

Kimorigo Location:
1. Kimorigo Sublocation
2. Kitobo Sublocation
3. Mboghani Sublocation
4. Kimala Sublocation

The Taita-Taveta District is situated in the southeastern part of the Republic of Kenya. The Kimorigo Location, south of Mt. Kilimanjaro, faces the national border with Tanzania.

The administrative center of the district is in Wundani of the Taita Division. A branch of the district office is in Taveta Town and it controls the Taveta Division.

The Area stretches along the flat land at the foot of Mt. Kilimanjaro. There are many springs in the Area that derive their origin from the infiltrated stream water of Mt. Kilimanjaro. These springs are used for domestic and irrigation purposes, and especially for raising the new cash crop of bananas.

3-1-2 Socio-economic Conditions

The Taveta area was previously an extremely low populated area because of its remote location from the country's capital, Nairobi, and its dry climate (annual

rainfall: 500 to 700 mm). Sisal from three large plantations used to be the main product of the area.

At the time of the census in 1969, the present Taveta Division was called the Taveta Location. At that time the population in the present Taveta, the Chala, and the Kimorigo Locations totalled 15,000. In 1979, however, this area's population grew to 25,862 which is attributed to the fact that an efficient utilization of irrigation canals from natural springs was achieved by the local people. Records indicate that there has been an annual population increase of 5.4% since 1969.

Presently, the population in the Kimorigo Location (the Project Area) is 15,180.

Attributable to the development of irrigation farming in the Kimorigo Location, the population of Taveta Town increased from 1,070 in 1969 to 1,812 in 1979.

In the Kimorigo Location, the hinterlands of Taveta Town, the expansion of farmlands was considerable during the 1970's; most of the arable land was developed. Uncultivated land only remains in remote areas away from irrigation channels or in the marshy area having saline soil. It is expected, therefore, that future agricultural development will be carried out not with extension of farmland, but by the intensive use of existing farmland. Thus, there is a possibility that the population increase rate in the area might drop below the 5.4% current rate.

Some time ago, Taveta Town was a small village along the national highway. Now it is the growing economic center of the surrounding farming areas. Its relatively high population increase rate is expected to continue in the future.

3-2 Natural Conditions

3-2-1 Climatic Conditions

The Taveta Division is located in an extremely dry climate zone. The annual average air temperature in the area is 20°C. The monthly highest air temperature is 30° while the lowest is 15°. Daytimes temperatures are relatively high.

The average rainfall in the area varies from 500 to 700 mm.

The dry and rainy seasons are very distinct. 40 to 50 percent of the annual rainfall occurs from March through May. June through October is the dry season; it is followed by another rainy season lasting until December.

The MOWD categorized the Taveta Division as a "low potential area" based on temperature and rainfall amount.

Monthly rainfall amounts for the area are shown in Table-10.

Table-10 Monthly Rainfall (mm)

MONTHS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
DRY 1 IN 5	3	7	27	82	32	0	0	0	0	3	27	17	441
MEAN 1 IN 2	26	26	95	110	61	4	2	2	1	12	67	42	536
WET 1 IN 5	67	64	141	202	99	20	15	10	7	32	119	79	686
AVERAGE	39	38	93	139	67	8	8	5	8	21	87	51	563

Source: MOWD

3-2-2 Topographic Conditions

The Project Area is located near the Tanzanian border at the eastern foot of Mt. Kilimanjaro on the flat land that slopes gently southward. The Lumi River, having its watershed on the eastern slope of Mt. Kilimanjaro, meanders through the Project Area.

Due to the direction of the seasonal wind, the rainfall on the eastern slope of Mt. Kilimanjaro is less than on the southern slope.

As Mt. Kilimanjaro itself is formed of highly permeable volcanic rock, river water on the mountainslope infiltrates into the riverbed; therefore, the discharge of the Lumi River is extremely small. however, over a long span of time, the Lumi River -- because of repeated flooding -- created flat marshy land along the river course in the southern part of the Project Area. As a alkaline salts are deposited in these marshy areas, they are not suitable for farming.

Even though the Lumi River only has a small discharge, the water that infiltrates the slope of Mt. Kilimanjaro develops into a subsurface flow that reappears in the form of springs in many places. Njoro Kubwa, the probable Project water source, is one of those springs. It has a discharge rate of 4 to 6 m^3/sec.

Water from springs in the Project area is of good quality and is being used not only for drinking purposes, but also for irrigating lands having suitable topographic and soil conditions in the Project Area.

Land located some distance away from irrigation canals from the springs, however, are being used only for sisal plantations or grazing because of the small amount of rainfall and the relatively high temperature.

3-2-3 Groundwater

Since the 1930s some bore holes have been utilized in sisal estates in the area. According to the records, 12 bore holes were constructed in the depth varying 30m to 70m deep. Many of them however, are already abandonned due to lack of water. At present only 5 bore holes are under operation. Yields of these bore holes are in a range between 10 m^3/hr and 30 m^3/hr. (see Table-11.)

This is partly due to the semi-arid conditions receiving only small amount of annual rainfall (500 mm/year - 700 mm/year) while the potential evapotranspiration is estimated to be more than 2,000 mm/year. In addition, hydrogeological conditions in the area is unfavourable for development of aquifers since prevailing geology in the area is tertiary volcanic rocks and precambrian metamorphologic rocks.

Existing bore holes giving yield to a certain extent are all distributed in the volcanic rock area near by Taveta Town. (C3197, C4130, C545, C76, C140) (Fig.-4)

The eastern part of the study area is covered by metamorphic rocks of precambrian basement, where ground water aquifers rarely develops and even when certain amount of ground water is stored in faults or fracture zones, it would not be regarded as reliable water source because of the limited storage of water under the prevailing dry climate. Accordingly ground water is not recognized as the permanent source of water supply.

3-3 Conditions of Existing Infrastructures

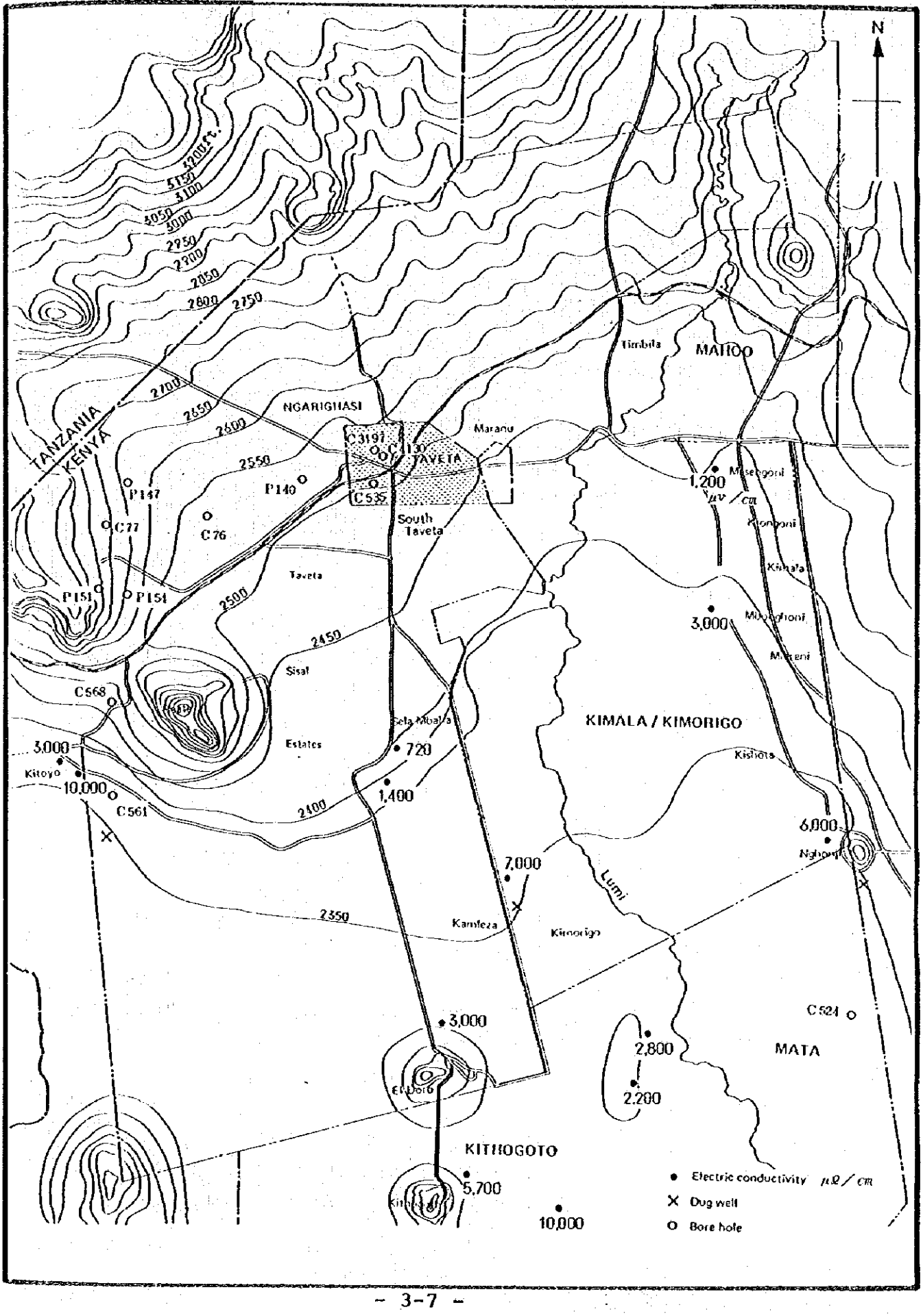
Infrastructures in the Project Area, are summarized as follows:

Table 11: Ledger of Existing Wells in Taveta Area

Name of Well	Borehole No.	Total Depth (m)	Depth to Aquifer (m)	Static Water Level	Yield (m^3/hr)	Completed (day/mon/yr)	Location	Status
'Garden' borehole Tabeta Sisal Estate	P140	33.6	29.9	14.6	13.7	25/3/31	512248	abandoned
'Garden' borehole Taveta Sisal Estate	P147	33.6	29.9	14.6	13.7	16/4/31	485248	- do -
'Reate Taveta Sisal Estate	P154	51.8	48.8	30.5	7.6	7/7/31	485231	- do -
Taveta Sisal Estate	C 76	30.5	15.2	13.1	Unlimited	8/6/35	497241	working
Girigan Borehole, Jipe Sisal Estate	C524	53.3	44.0	13.1	10.0	1/5/47	599166	abandoned
Railway Station Taveta	C535	36.6	29.9	29.6	19.0	28/6/47	525248	working
Reata Taveta Sisal Estate	C561	66.8	36.0	29.6	13.7	5/7/47	484198	abandoned
Kitobo, Taveta Sisal Estate	C568	51.8	46.0	34.7	19.0	6/8/47	485214	working
Taveta Town Water Supply	C3197	55.5	34.4	32.6	12.3	1075	524253	working
Taveta Town Water Supply	C4130	64.0	61.0	31.0	23.8	14/7/76	524253	working
Reata Tabeta Sisal Estate	P151	57.9	-	-	DRY	1931	482231	abandoned
Reata Taveta Sisal Estate	C 77	15.2	-	-	Abandoned	3/7/35	481241	- do -

Source: MOWD

Fig.-4 LOCATION OF BOREHOLES AND DISTRIBUTION OF ELECTRIC CONDUCTIVITY



3-3-1 Power Supply

Transmission lines are being extended from Voi. Electricity is already supplied to a part of Taveta Town. Completion of the transmission extension work is expected by October 1987.

3-3-2 Telephone

The project area is included in the country's telephone network. It is possible to communicate to Nairobi through the Taveta Telephone Station's operator.

3-3-3 Transportation

From Nairobi and Monbassa the railway and the national highway that lead to Tanzania pass through Taveta Town.

3-3-4 Education

There exist 12 primary schools and 2 secondary schools. Total number of primary school pupil is 5,112 and secondary school students is 1,560.

Number of teachers are 127 and 39 for the primary and the secondary schools respectively.

3-3-5 Medical Facilities

The Divisional Hospital Locates in the center of Taveta Town. There are 206 beds in this hospital to admit patients. In addition, there are 2 medical centers and 5 clinics in the study area.

3-3-6 Water Supply

Taveta Town's water source is obtained from two deep wells bored in 1963 and 1975. One of the wells yields