社会開発調査部報告書

MASTER ACTION PLAN TOWARDS RURAL WATER DEVELOPMENT

PART 2

ACTION PLAN BY PROVINCE / DISTRICT

JULY 1992

JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF KENYA

MINISTRY OF WATER DEVELOPMENT

THE STUDY

ON

THE NATIONAL WATER MASTER PLAN

MAIN REPORT

VOLUME III

MASTER ACTION PLAN TOWARDS 2000

PART 2

ACTION PLAN BY PROVINCE/DISTRICT

JULY 1992

JAPAN INTERNATIONAL COOPERATION AGENCY

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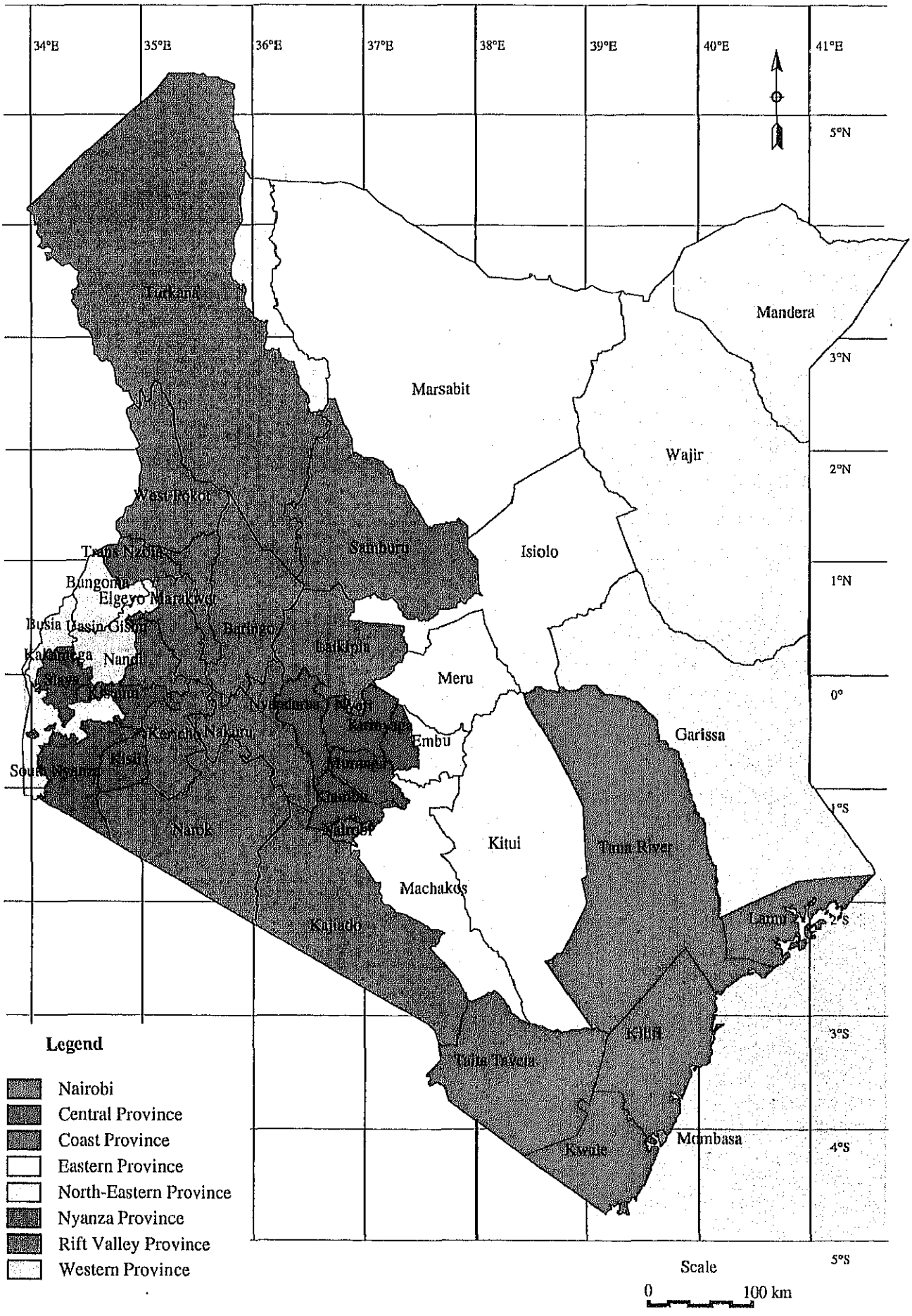

Location Map

PREFACE

Interpretation of Information in this Volume:

This volume summarizes the development potential and data by district. The action plans presented herein have been broken down into district for reference, within the framework of nationwide water resources development as defined in the original objective of the NWMP Study, but should not be regarded as the actual development plans proposed for the respective districts. The main purpose of this volume is only to provide necessary information and guidelines for formulation of specific development plans for each district in the future. Further details required for the District Water Resources Study are recommended separately in the Main Report Volume II.

Administrative Division of Districts

In this Study, the original 41 districts were considered and various statistical data, particularly socio-economic information, were collected for these districts. During the progress of the Study, six districts were detached from the original ones and established as new districts. In the report, the data on these new districts are grouped together with the corresponding original districts as shown below.

	Original Districts	New Districts	Data included in:
1.	Machakos	Makueni	Machakos/Makueni
2.	Kisii	Nyamira	Kisii/Nyamira
3.	Kakamega	Vihiga	Kakamega/Vihiga
4.	Meru	Tharaka-Nithi	Meru/Tharaka-Nithi
5.	Kericho	Bomet	Kericho/Bomet
6.	South Nyanza	Migori	South Nyanza/Migori

(Note: The last three Districts were established very recently.
The report refers only to the names of the original 41 districts.)

The administrative boundary map used in this Study is the latest complete map set covering the whole country (41 Districts, 233 Divisions and 976 Locations), prepared in 1986 by the Survey of Kenya, Ministry of Land, Housing and Physical Planning.

Data and Information

The data and information contained in the report represent those collected in the 1990-1991 period from various documents and reports made available mostly from central government offices in Nairobi and/or those analyzed in this Study based on the collected data. Some of them may be different from those kept in files at some agencies and regional offices. Such discrepancies if any should be collated and adjusted as required in further detailed studies of the relevant development projects.

Development Cost

The cost and benefit estimate was based on the 1991 price level, and expressed in US$ equivalent according to the exchange rate of US$1 = KShs25.2 prevailing at that time. The same exchange rate was used in calculating the development cost in K£/KShs currency.

MAIN REPORT Vol. III

MASTER ACTION PLAN TOWARDS 2000
PART 2 : ACTION PLAN BY PROVINCE/DISTRICT

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ABBREVIATION

CBK	Coffee Board of Kenya
CBS	Central Bureau of Statistics
CRF	Coffee Research Foundation
CSS	Computer Service Section of MOWD
DAO	District Agricultural Officer
DC	District Commissioner
DDC	District Development Committee
DO	District Officer
DRSRS	Department of Resource Surveys & Remote Sensing
EAMD	East Africa Meteorological Department
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GIS	Geographical Information System
GRDP	Gross Regional Domestic Product
GTZ	German Agency for Technical Cooperation
HCDA	Horticultural Crops Development Authority
IBRD	International Bank for Reconstruction and Development
ICDC	Industrial and Commercial Development Corporation
IDA	International Development Association
ILUS	Integrated Land Use Survey
IPC	Investment Promotion Center
IRS	Integrated Rural Survey
JICA	Japan International Cooperation Agency
KBS	Kenya Bureau of Standard
KIRDI	Kenya Industrial Research & Development Institute
KIE	Kenya Industrial Estates Limited
KMD	Kenya Meteorological Department
KPCU	Kenya Planters' Cooperative Union
KPLC	Kenya Power and Lighting Co.
KS	Kenya Standard
KSA	Kenya Sugar Authority
KSB	Kenya Sisal Board
KSS	Kenya Soil Survey
KTDA	Kenya Tea Development Authority
KVDA	Kerio Valley Development Authority
KWAHO	Kenya Water and Health Organization
LBDA	Lake Basin Development Authority
LU	Livestock Unit
MOA	Ministry of Agriculture
MOCSS	Ministry of Culture and Social Services
MOE	Ministry of Energy
MOED	Ministry of Education
MOENR	Ministry of Environment and Natural Resources
MOF	Ministry of Finance
MOH	Ministry of Health
MOHANH	Ministry of Home Affairs and National Heritage
MOI	Ministry of Industry
MOL	Ministry of Labour
MOLD	Ministry of Livestock Development
MOLG	Ministry of Local Government
MOLH	Ministry of Lands and Housing
MOMDE	Ministry of Manpower Development and Employment
MOPND	Ministry of Planning and National Development
MOPW	Ministry of Public Works
MORD	Ministry of Region Development
MORDASAW	Ministry of Reclamation and Development of Arid, Semi-arid and Wasteland
MORST	Ministry of Research, Science and Technology
MOSM	Ministry of Supplies and Marketing
MOTC	Ministry of Transport and Communication
MOTW	Ministry of Tourism and Wildlife
MOWD	Ministry of Water Development
NCC	Nairobi City Commission
NCPB	National Cereals and Produce Board
NES	National Environment Secretariat
NIB	National Irrigation Board
NMWP-I	National Master Water Plan (Stage I)
NWCPC	National Water Conservation and Pipeline Corporation
NWMP	National Water Master Plan
OECD	Organization for Economic Cooperation and Development
OECF	Overseas Economic Cooperation Fund of Japan
OP	Office of the President
PC	Provincial Commissioner
PPCSCA	Presidential Permanent Commission on Soil Conservation and Afforestation
ROK	Republic of Kenya
RTPC	Rural Trade and Production Center
RWSDP	Rural Water Supply Development Project
SEFC	Small Enterprise Financial Corporation
SOK	Survey of Kenya
SP1	Sessional Paper No.1 of 1986 on Economic Management for Renewed Growth
SWAP	Surface Water Extraction Permit
TARDA	Tana and Athi River Development Authority
UNDP	United Nations Development Programme
UNEP	United Nation Environment Programme
UNESCO	United Nations Educational, Scientific, and Cultural Organization
UNICEF	United Nations International Children's Emergency Fund
UNIDO	United Nations Industrial Development Organization
UNPEP	United Nation Population Fund Programme
UON	University of Nairobi
USAID	United States Agency for International Development
WHO	World Health Organization

ABBREVIATION OF MEASURES

Length

mm	=	millimetre
cm	=	centimetre
m	=	metre
km	=	kilometre

Area

ha	=	hectare
m^2	=	square metre
km^2	=	square kilometre

Volume

1, lit	=	liter
m^3	=	cubic metre
m^3/s, cms	=	cubic meter per second
MCM	=	million cubic metre
m^3/d, cmd	=	cubic metre per day

Weight

mg	=	milligram
g	=	gram
kg	=	kilogram
t	=	ton
MT	=	metric ton

Time

sec	=	second
hr	=	hour
d	=	day
yr	=	year

Money

Kshs.	=	Kenya shilling
K£	=	Kenya pound (Kshs.20)
US$	=	U.S. dollar
USc	=	U.S. cent

Energy

Kcal	=	Kilocalorie
KW	=	kilowatt
MW	=	megawatt
KWh	=	kilowatt-hour
GWh	=	gigawatt-hour

Others

%	=	percent
o	=	degree
'	=	minute
"	=	second
°C	=	degree Celsius
cap.	=	capital
LU	=	livestock unit
md	=	man-day
mil.	=	million
no.	=	number
pers.	=	person
mmho	=	micromho
ppm	=	parts per million
ppb	=	parts per billion

Nairobi

Nairobi

Socio-Economic Profiles

Nairobi is not only the principal urban centre of population but also the social, economic and communication's hub of the whole country, i.e., the national capital. It is inevitable that the movement of people towards urban concentrations will impinge the most heavily on Nairobi itself. In fact, the total population of Nairobi has increased from 828 thousand in the 1979 census to 1,346 thousand in the 1989 census. This is more than 6% of the national census population.

Nairobi Province has an total area of 684 km^2 or 0.12% only of the national total. Of the total land area, 95 km^2 or 14% is reserved area for uses such as national parks and reserved areas. The rest, 589 km^2 or 80%, is habitable urbanized areas where the people carry out their daily activities.

Nairobi is the most industrialized city in the country. There are some agricultural activities in the surrounding zones, but most of the lands are developed for residential and industrial uses, particularly in the central zones. According to Directory of Industries 1987, there were identified 2,527 manufacturing establishments in the country, of which 1,206 establishments or 48% were located in Nairobi City. In particular, about 70% of the following industrial type's establishments: chemical industry, machinery and paper products, were located in Nairobi City.

Nairobi recorded K£2,576 million at 1989 constant prices or one-third of GDP, according to the Study Team's estimation explained in Chapter 5 of Sectoral Report "A". Nairobi also recorded the largest GRDP per capita in the country. It was estimated at K£1,823 in 1990, which was 5.3 times the national average.

Surface Water

Nairobi municipality is located in the upstream basin of the Athi River. Annual rainfall of 988 mm is recorded at Nairobi on average. Monthly rainfall varies from 240 mm in April to 20 mm in July. Two distinctive wetter months are defined in April during Long Rains and in November during Short Rains. From June through September, the rather dry months continue with monthly rainfall of less than 50 mm.

Although the catchment of Athi River is the second largest in Kenya, almost all of the drainage area is located astride semi-arid areas. The river is therefore almost dried up in the dry months from June through September.

The present water supply system in Nairobi is organized into the following water distribution systems, a piped water distribution system supplying treated water from 3 major water sources and minor source.

	Water Sources		Treated Water (m^3/day)	(m^3/sec)
1.	Chania River		177,000	2.049
2.	Sasumua Dam		57,000	0.660
3.	Ruiru Dam	}	23,000	0.266
4.	Kikuyu Spring			
	Total		257,000	2.975

In 1988, it was estimated that about 89% of the current population was served by the water distribution system through direct house connections, communal watering points and kiosks in the shanty areas. The remaining 11% obtained their water supplies from boreholes. In addition, some industries were supplied with additional water from their own boreholes.

As increasing of population and domestic and industrial water demands rises in Nairobi, the largest surface water deficit in Kenya will occur in 2010. The deficit was estimated at 7.1 m^3/sec in 2010. However, no potential damsite with a relatively large reservoir storage which impounds surface water for domestic supply was found in the upstream reach. Therefore water transfer schemes are required from the other river basins.

At present, the water transfer of 2.6 m^3/sec from Thika dam to Nairobi is at the construction stage. The Thika dam, however, does not meet the increasing demand in Nairobi. After completion of Thika dam, Ruiru-A dam and Chania-B dam are also required to supply water at 0.30 m^3/sec and 0.76 m^3/sec respectively to Nairobi. The remaining surface water deficit is ensured by the construction of Ndarugu dam. However, the volume of inflow into Ndarugu reservoir is not fully satisfied with the required volume of water meeting the demand in 2010. The additional inflow having a monthly fluctuation with a maximum of 8.0 m^3/sec is transferred from the intake of the Chania River.

Geology

The geology consists of volcanic rocks, tuffs, and sediments of Miocene to recent. They rest directly on metamorphic basement rocks

Physiography

The province is a portion of the eastern border-zone of the Rift Valley depression filled with volcanics and sediments.

Groundwater

The average boreholes yield in the District is 7.7 m^3/hr, but the yields may actually vary from nil to over 50 m^3/hr. The average borehole depth is 152 meters. The average rest level of the water in boreholes is 56.7 meters.

The province contains many more boreholes than any other area. The Nairobi conservation area was originally defined in 1953 after long term depletion was recognized in the Ruaraka

region.

Aquifer characteristics by district

District code	name	Elevation (m)	Total depth(m)	Water struck(m)	level rest(m)	Yield (m3/hr)	Draw down(m)
110	Nairobi	1721.30	152.50	112.50	56.70	7.70	39.50

Groundwater development plan should be prohibited because of regulation in the Nairobi conservation area.

Irrigation Development Possibility

Irrigation development possibility as of 1990 was roughly checked through comparing estimated irrigation potential area and present irrigation area (existing area + future development plan) as shown in following table.

Code	110
District	Nairobi
Availability	×

note : × There is no area for irrigation development
□ There is some area for irrigation development (less than 500 ha)
○ There is more area for irrigation development (less than 5000 ha)
● There is more than enough area for irrigation development (more than 5000 ha)

Nairobi District

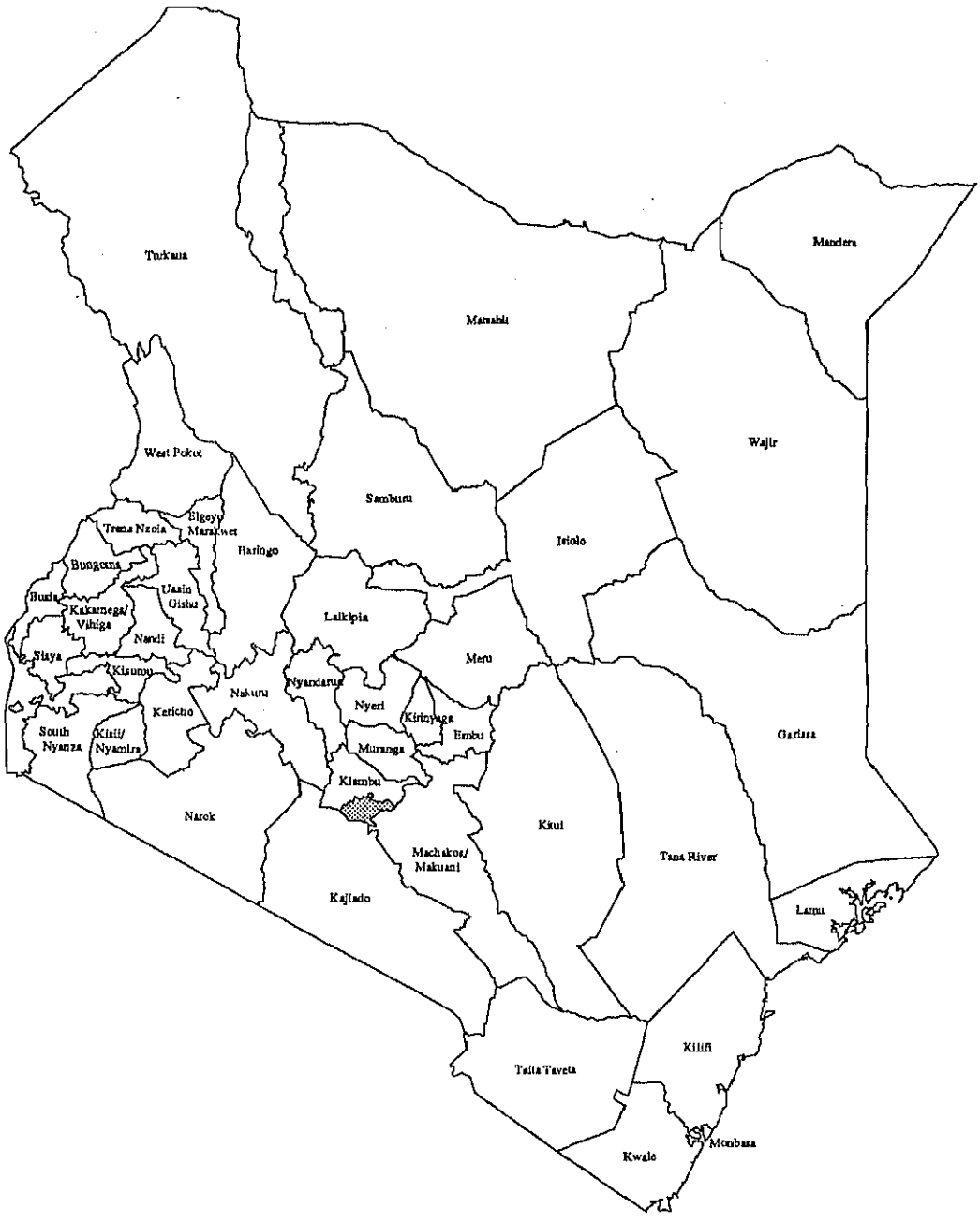
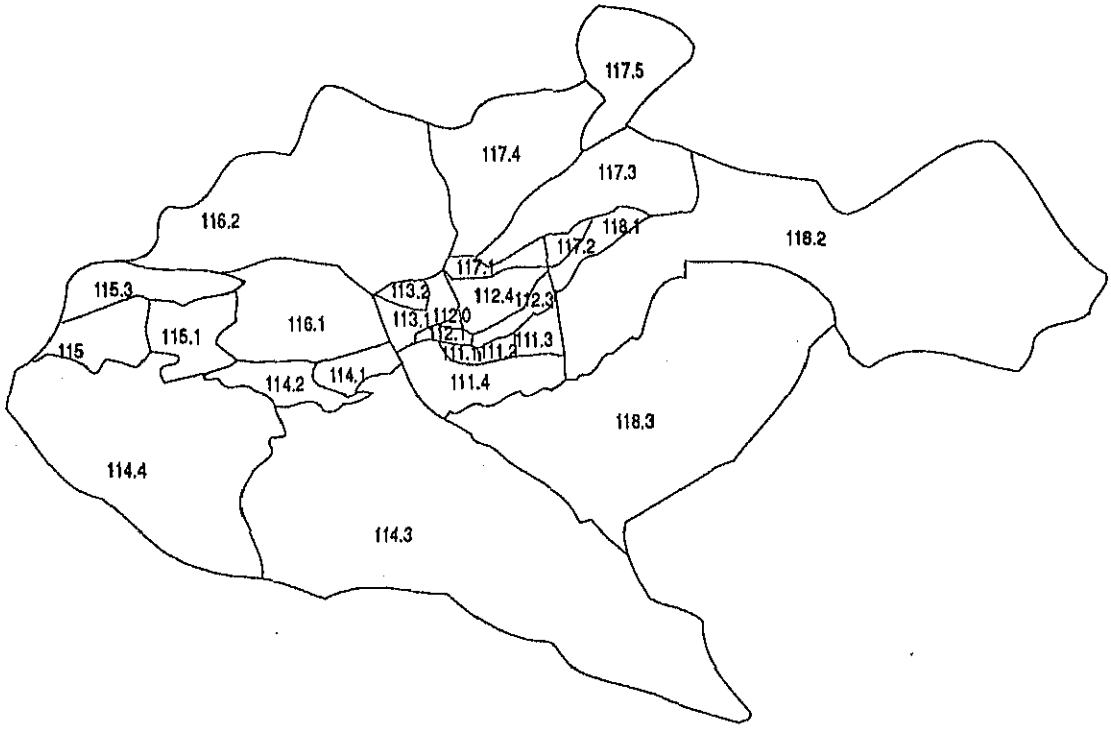
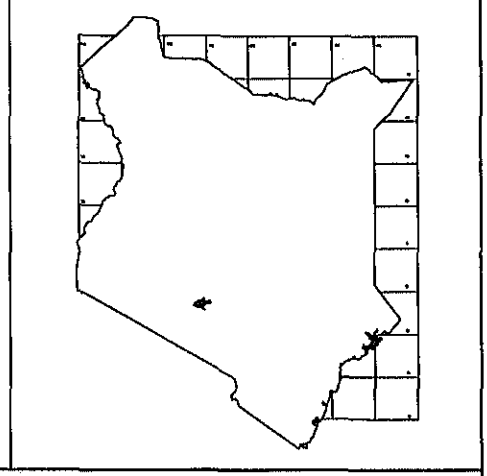


Fig.



Code	Location	Population
111.1	Makongeni	21,726
111.2	Maringo	27,156
111.3	Makadara	41,732
111.4	Viwanda	18,013
112.1	Kamukunji	18,858
112.2	Pumwani	14,403
112.3	Bahati	34,483
112.4	Eastleigh	53,562
113.1	Starehe	53,005
113.2	Ngara	26,379
114.1	Kenyatta Hospital	16,670
114.2	Kibera	63,353
114.3	Mugumoini	32,048
114.4	*Langata*	*13,112*
115.1	Riruta	41,578
115.2	Waithaka	14,992
115.3	Kangemi	29,221
116.1	Kilimani	45,111
116.2	Parklands	53,555
117.1	Mathare	68,456
117.2	*Kariobangi*	*13,005*
117.3	Ruaraka	38,551
117.4	Roysambu	18,575
117.5	Kahawa	12,383
118.1	Dandora	21,675
118.2	Njiru	18,138
118.3	Embakasi	18,036



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110 Nairobi

THE STUDY
ON
THE NATIONAL WATER MASTER PLAN

JAPAN INTERNATIONAL COOPERATION AGENCY

1. Socio-Economic Profile : 110 Nairobi District

1-1 Population Projection (Unit:1000)

Code	Location	Land Area (sq.km)	Town Name	1990 Total	1990 Urban	1990 Rural	2000 Total	2000 Urban	2000 Rural	2010 Total	2010 Urban	2010 Rural
110	Nairobi	684	Nairobi	1413.1	1413.1	0.0	2260.5	2260.5	0.0	3465.3	3465.3	0.0

1-2 GRDP Projection

Item	1990	2000	2010
1) GRDP (K.Pound million)	2575.7	4803.7	7287.9
Percentage to GDP	33.2%	34.7%	35.7%
2) GRDP per Capita (K.Pound)	1822.8	2125.1	2103.1
Ratio to GDP per capita	5.34	4.72	4.15
Urban (K.Pound)	1822.8	2125.1	2103.1
Rural (K.Pound)	-	-	-

1-3 Present District Profile (1990)

1) Agricultural Production (1989)

Product	Production in tons
Maize	0
Sorghum/Millet	1
Potato	0
Rice	0
Wheat/Barley	0
Coffee	0
Tea	0
Milk	0
Meat	0

2) Number of Manufacturing Establishments (1986)

Type of Industry	Number
Food	153
Textile	208
Wood	149
Paper	194
Chemical	159
Non-metal	52
Metal	11
Machinery	212
Others	68
Total	1206

3) Water Supply Schemes in Service Centre

Piped system	1
Communal water points	0
Other sources	0

4) Educational Facilities

Primary school	-
Secondary school	-
Institute	-

5) Medical Facilities

Hospital	-
Health Centre	-
Dispensary	-
Others	-

6) Out-patient of Infective Diseases in Relation to Water Supplies (1985-89 Average)

Diarrhoeal Diseases	8,850
Leprosy	72
Infectious Hepatitis	76
Bilharzia	268
Eye Infections	4,983

2. Land and resources

2.1 Present Land Use

Unit : km2

Total Area	Land Area	Water Area	Forest & Park	Swamp	Town	Barrenland	Agriculture Land	Other Land
684	684	0	215	0	93	0	53	323

2.2 Rain fall

Unit : mm

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
51	47	92	235	154	35	16	22	26	61	151	93	988

2.3 River Flow

Unit : m3/sec

Gauge Code	Catchment Area (km2)	Mean Flow	Low Flow Frequency			
			80%	90%	95%	Min.
3AA04	272	0.7	0.2	0.1	0.1	0.1
3BA29	75	0.3	0.1	0.0	0.0	0.0

2.4 Groundwater

Aquifer Characteristics

Elevation (m)	Total Depth (m)	Water Struck (m)	Level Rest (m)	Yield (m3/hr)	Draw Down (m)

Safe Abstruction Yield

Unit : m3/year

Borehole	Shallow	Total
0	16,510	16,510

2.5 Agriculture

Suitable Area for Major Crops

Unit: km2

Maize	Wheat	Rice	Sorghum	Potato	Coffee	Tea
284	2	0	304	2	53	0

Area of Irrigation Potential

Unit : ha

Surfce Water		Groundwater	
Upland	Lowland	Upland	Lowland
943	0	0.1	0

Livestock Population

Unit: 1,000

Cattle	Sheep/Goats	Camels	Donkeys
6.57	7.72		

3 Water Demand Projection

Unit: cu.m/day

Location	1990				2000				2010			
	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry
Nairobi District	0	204,334	192	128,300	0	333,080	257	218,953	0	520,147	345	281,668

4 Action Plan

4.1 Urban Water Supply

Urban Name	Population	Present Raw Water Source	Future Raw Water Source	G/P	Pipe line (km)	Pump lift (m)	Cost 1000 US$
Nairobi	3,465,400	Chaania R.+Sasumua Dam+Ruiru Dam +Kikuyu spring	Thika Dam, Ndarugu, Ruiru-A, Chania-B	p	165	150	1,061,640

g: gravity p: pump

4.2 Small Scale Irrigation Scheme

Scheme Name	Area (ha)	Farmers No (Nos)	Division	Location	Type of Project	Imp. Agency	Cost million Kshs	Basin
-	-	-	-	-	-	-	-	-

4.3 Large Scale Irrigation Project

Project	Area (ha)	Water Source	Water Demand (MCM)	Cost (million)		Major Crops
				US$	K£	
-	-	-	-	-	-	-

4.4 Hydropower Development

Project	Description	Executing Agency	Cost(million)		Implementation Schedule																
			US$	K£	93	94	95	96	97	98	99	20	01	02	03	04	05	06	07	08	09	10
–	–	–	–	–																		

★ Design ☆ Study ● Construction

4.5 Flood Mitigation Project

Project	Description	Executing Agency	Cost (million)		Implementation Schedule																
			US$	K£	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10
Nairobi City (Nairobi river, etc)	– Enlargment of existing channels/culverts (13 sites) – Channel improvement (11 sites)	MOLG	10.8	13.6			☆	☆	☆	●	●	●										

★ Design ☆ Study ● Construction

4.6 Urban Drainage and Ad-hoc River Improvement Projects

Project	Population	Area (Km2)	Executing Agency	Cost (million)		Implementation Schedule																
				US$	K£	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10
Nairobi	1,413,100	90.0	MOLG	360.0	453.6	☆	☆	●	●	●	●												

★ Design ☆ Study ● Construction

4.7 Dam Development Plan

Damsites	C.A. (km2)	Purpose	FSL (El. m)	Storage (MCM)	Yield (m3/s)	Height (m)	Cost (1,000US$)
Upper Athi	400	W	1552	10.3	0.30	26	6,519

W:Water Supply I:Irrigation P: Power

4.8 Groundwater Development Projects

Proposed Numbers				Executing Agency	Cost (million)		Implementation Schedule																Remarks
Drinking		Livestock																					
(B/H+D)	(S/W+H)	(B/H+D)	(S/W+H)		US$	K£	93	94	95	96	97	98	99	20	01	02	03	04	05	06	07	08	09	10	
–	–	–	–	–	–	–																			

★ Design ☆ Study ● Construction

4.9 Source Development Plan for Rural Water Supply

District	Source Development Plan									Total	Implementation Program (%)	
	Surface Water	Borehole	Shallow Well	Roof Catch	Small Dam	Subsur-face Dam	Sand Dam	Rock Catch	Existing Pipeline		Up to 2000	2001-2010
- Quantity (m3/d)	0	0	0	0	0	0	0	0	0	0	0	0
- No. of Facilities	0	0	0	0	0	0	0	0	0	0		
- Cost (mill.US$)	0	0	0	0	0	0	0	0	0	0		
(mill.K£)	0	0	0	0	0	0	0	0	0	0		

4.10 Source Development Plan for Livestock Water Supply

District	Source Development Plan							Total	Implementation Program (%)	
	Surface Water	Borehole	Shallow Well	Small Dam	Subsur-face Dam	Sand Dam	Existing Pipeline		Up to 2000	2001-2010
- Quantity (m3/d)	0	0	0	0	0	0	0	0	0	0
- No. of Facilities	0	0	0	0	0	0	0	0		
- Cost (mill.US$)	0	0	0	0	0	0	0	0		
(mill.K£)	0	0	0	0	0	0	0	0		

4.11 Watering Points in Nomadic Pasturage Area

Assumed Nomadic Pasturage Area (km2)	No. of Watering Points (Nos.)	Executing Agency	Cost (million)		Implementation of Watering Points (No.)	
			US$	K£	Up to 2000	2000-2010
-	-	-	-	-	-	-

5 Future Water Resources Developmet Potential and Study Proposal

5.1 Potential Water Source for Future Development

Potential Water Source for Future Development	Purpose	Schemes		
		Water Supply	Irrigation	Hydropower
-	-	-	-	-

W:Water Supply I:Irrigation P: Power

5.2 River Basin Developmetn Study

Description	Executing Agency	Cost (million)		Implementation Schedule																	
		US$	K£	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10
Athi River Basin Study (Update)	TARDA	4.0	5.0		☆	☆	☆	☆	☆												

★ Design ☆ Study ● Construction

5.3 District Water Resource Study

Related Basin Study Proposed	Remarks	Executing Agency	Cost (million)		Implementation Schedule																
			US$	K£	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10
Athi	(To be coveredby separate studies)	NCC	--	--																		

☆ Study

o River Basin Study (proposed under separate programme)

Central Province

Central Province

Socio Economic profiles

Central Province has total area of 13.2 thousand km^2 or 2.2% of the national total. Most of the land is of high and medium potential. Of the total provincial area, 4.2 thousand km^2 or 32% is reserved area for uses such as national parks and reserved areas. The rest, 9.0 thousand km^2 or 68%, is habitable area where the people carry out their daily activities. The district population distribution was as follows:

Code District	Area (km^2)	Population in 1990 (1000)	Density (persons/km^2)
210 Kiambu	2,451	972	397
220 Kirinyaga	1,437	413	287
230 Murang'a	2,476	899	363
240 Nyandarua	3,528	378	107
250 Nyeri	3,284	647	197

In 1990, 3,309 thousand people or 15% of the national population were living in Central Province. Its district distribution is shown in the above table.

The urban population numbered 309 thousand or 9.3% of the total provincial population in 1990. It was distributed into 24 towns in five Districts as follows: seven towns with 106 thousand of urban population in Kiambu District; five towns, 19 thousand, in Kirinyaga; six towns, 65 thousand, in Murang'a; three towns, 12 thousand, in Nyandarua; and three towns, 107 thousand, in Nyeri. Among these towns, the top 10 towns in terms of urban population were Nyeri, Thika, Maragwa, Murang'a, Karuri, Ruiru, Ol Kalou, Kerugoya, Kutus and Kikuyu in order.

Nyeri is the largest town in the Province, which functions as the provincial capital as well as the district headquarters of Nyeri District. Besides, district headquarters of the other Districts are Kiambu town in Kiambu District; Kerugoya in Kirinyaga; Murang'a in Murang'a; and Ol Kalou in Nyandarua.

Maize dominates the crop acreage in the five Districts in the province. Succeedingly, potatoes and beans are significant features of the cultivated area. Coffee and tea are well developed in the four Districts, i.e., Kiambu, Kirinyaga, Murang'a and Nyeri. The relatively high level of agricultural and cash crop development is matched by a comparatively high level of urbanization in the province.

Thika ranks as the most industrialized town in the province. It also functions as a satellite town attracting overspill industries from Nairobi. Besides, Nyeri, Limuru, Kikuyu and Kiambu are also listed as industrialized towns in the province. Their industrial potential is comparable to that of Kisumu. However, taking the water resources availability into consideration, their potential might be better than that of Kisumu.

Central Province recorded K£1,050 million at 1989 constant prices or 14% of GDP,

according to the Study Team's estimation explained in Chapter 5 of Sectoral Report "A". Kiambu recorded the largest GRDP in the province. It was estimated at K£439 million or 5.7% of GDP. Kiambu also recorded the largest GRDP per capita in the province. It was estimated at K£452 in 1990, which was 1.32 times of the national average. GRDP per capita of the other Districts recorded as follows: K£362 or 1.06 times in Nyandarua; K£297 or 0.87 in Murang'a; K£240 or 0.70 in Nyeri; and K£126 or 0.37 in Kirinyaga.

Surface Water

Central province is located astride 4 drainage areas around Mt.Kenya and Aberdare Range, they are, Drainage Areas 2 to 4. Annual rainfall was estimated at 1,055 mm at Kiambu, 1,345 mm at Kirinyaga, 1,121 mm at Muranga, 886 mm at Nyandarua and 1,105 mm at Nyeri. Two distinctive wetter months are defined in April during the Long Rains and in November during the Short Rains. Among 5 Districts, 4 Districts receive less than 50 mm from June through September. While, Nyandarua District receives more than 50 mm even in the drier months.

(1) Kiambu District

Kiambu District is located in the upstream reach of Athi river basin. Although several tributaries of the Athi River flow through the District, the lower water level with small runoff in distinctive drier months made the intake structures mal-function. The increasing population and water demand, has meant that the exploitable flow of tributaries has already been utilized for domestic and industrial water. Raw water source depends on boreholes at present. To supply domestic and industrial water sufficiently in 2010, the construction of Ndarugu dam at the downstream end of the Ndarugu River (alternatively Munyu Dam) ensures the water supply to urban centers in the District.

(2) Nyeri, Muranga and Kirinyaga Districts

Nyeri, Muranga and Kirinyaga Districts are located in the upstream reach of the Tana river basin. Both annual rainfall and annual runoff are relatively high compared with the other Districts in Kenya. Forest area which is cultivated during high rainfall in the uppermost basin forms a groundwater reservoir for the District which causes a relatively large river flow even in the drier months. A number of small springs are also identified at the fringe of forest areas. The surface water source is sufficient for the demand by 2010.

(3) Nyandarua District

Nyandarua District extends from Lake Naivasha basin in the Rift Valley (Drainage Area 2) in the south to the town of Nyahururu (Drainage Area 5) in the north. The southern part of the District which has a perennial surface water sources is located westwards of the Aberdare Range. The surface water of the Turasha River is the major perennial water source for the internal drainage systems of Lakes Naivasha,

Elementaita and Nakuru. In the southern part of the District, two potential damsites were identified, i.e., Turasha Dam, Greater Nakuru Water Transfer Project, which supplies the domestic water to Gilgil and Nakuru and Malewa Dam which is proposed to augment the water supply volume.

While, in the northern part of the District where the Ewaso Ngiro River originates, a number of swamps cause much evaporation and seepage losses along main river course and the increasing demand accelerates the reduction of annual mean discharge of the upstream of the Ewaso Ngiro River.

Storage dams supplying water to Nyahururu and Rumuruti towns will be required.

Geology

The geology consists of Tertiary and Quaternary volcanic rocks, and metamorphic basement rocks in the eastern part. The volcanic accumulations originated from the Rift Valley and Mt. Kenya. Soils emanating from volcanic activity are rich in humus and generally fertile.

Physiography

The province lies within the Eastern Kenya Highlands. Soil erosion is a serious problem, and landslides and other earth movements are common in steep slope zones.

Groundwater

Most of the boreholes are sited in the volcanic rocks (phonolites, basalts, and trachytes) and the yields of between 5 and 25 m^3/hr are common. On the other hand, boreholes sunk in the gneiss of the metamorphic basement rocks give relatively low yields.

(1) Kiambu District

Based on the geological conditions, ground water occurrence in the District may be classified under five headings:

- Ground water in the major faults. These are the shattered rocks of the Ondiri, Lari, Tigoni and other main faults running roughly north and south and in the areas to the west of these faults. They provide storage for large quantities of water.
- Springs derived from the major faults: Such springs are : the Tusoga and discharging from Tigoni fault, Kikuyu, Gitathuru and Mweteta from the Ondiri fault.
- Shallow groundwater
- Groundwater in old land surfaces and
- Groundwater in the lake beds (Ruaraka area) where boreholes penetrating the beds have varying yields generally between 100 to 324 m^3/day.

According to available information, ground water is pumped from some 1000 boreholes. Much irrigation of this water is used for single family domestic and irrigation water supplies. Out of these, only some 30 boreholes are used for public water supplies. However, there are still others that have been drilled by the Ministry of Water Development but have not been developed. These boreholes and other water supplies in the District need to be developed and improved to meet the growing water demand in the District. These should be implemented in response to priority areas now and during the plan period.

Most of the Kiambu streams and rivers have in their upper reaches good sites for construction of storage and check weirs and small dams for flow regulation. These would serve to conserve water and also provide water that would be of economic significance. Sites are also available which could be developed to provide water for irrigation. River flow would then be regulated to provide a constant water supply for the District throughout the year.

(2) Kirinyaga District

The average boreholes yield in the District is 6 m^3/hr, but the yields may actually vary from nil to over 16 m^3/hr. The average borehole depth is 81 meters. The average rest level of the water in boreholes is 21.6 meters.

(3) Muranga District

The average boreholes yield in the District is 6 m^3/hr, but the yields may actually vary from nil to over 50 m^3/hr. The average borehole depth is 102 meters but water is commonly found at a depth of about 4 meters, although this varies. The average rest level of the water in boreholes is 20.78 meters.

Most of the boreholes are sited in the Kapiti phonolite or in basaltic agglomerate and trachytic turfs, and they are numerous between Makuyu and Thika, where yields of between 4.55 and 22.7 m^3/hr are common from aquifers and from the base of volcanic formations. On the other hand boreholes sunk in the gneiss of the basement system give relatively low yields, rarely exceeding 2.3 m^3/hr. Rest levels of boreholes in the area show a westward rise of water table towards the Makuyu area.

Chemical quality of the underground water is fair except for the high iron, manganese, and flouride content. The high flouride content is of concern as there are numerous cases of dental flourosis in residents. Methods to deflouridate the water are researched, but no economical and efficient method has yet been developed.

(4) Nyandarua District

The average boreholes yield in the District is 5 m^3/hr, but the yields may actually vary from nil to over 27 m^3/hr. The average borehole depth is 126 meters. The average rest level of the water in boreholes is 68 meters.

(5) Nyeri District

The average boreholes yield in the District is 6 m^3/hr, but the yields may actually vary from nil to over 20 m^3/hr. The average borehole depth is 122 meters. The average rest level of the water in boreholes is 50 meters.

Exploitation of this potential, particularly in the arid parts of Kieni is still in its infancy. There are high possibilities for developing this potential based on the evidence of some scattered boreholes owned by the former colonial settlers in the same region. There is a great need for exploring ground water resources due to the high rate in which surface water is being exploited.

Aquifer characteristics by district

District code	name	Elevation (m)	Total depth(m)	Water struck(m)	level rest(m)	Yield (m3/hr)	Draw down(m)
210	Kiambu	1785.44	133.98	100.13	45.85	8.49	41.51
220	Kirinyaga	1199.00	81.40	49.67	21.64	6.13	36.15
230	Muranga	1437.90	102.53	67.15	20.78	6.02	57.83
240	Nyandarua	2420.77	126.15	107.11	67.83	5.12	33.21
250	Nyeri	1925.41	121.98	84.93	49.80	5.94	40.34

Groundwater development plan and cost by district

District code	name	Proposed Drinking (B/H+D)	number (S/W+H)	Proposed Livestock (B/H+D)	number (S/W+W)	Proposed (million) US$	cost (million) K£
210	Kiambu	88	17	13	2	15.4	19
220	Kirinyaga	16	14	2	3	4.0	5
230	Murang'a	28	81	1	16	6.3	8
240	Nyandarua	231	27	71	7	45.4	57
250	Nyeri	6	12	0	0	1.3	2

Irrigation Development Possibility

Irrigation development possibility as of 1990 was roughly checked through comparing estimated irrigation potential area and present irrigation area (existing area + future development plan) as shown in following table.

Code	210	220	230	240	250
District	Kiambu	Kirinyaga	Muranga	Nyandarua	Nyeri
Availability	×	×	●	●	●

note : × There is no area for irrigation development
❑ There is some area for irrigation development (less than 500 ha)
○ There is more area for irrigation development (less than 5000 ha)
● There is more than enough area for irrigation development (more than 5000 ha)

Kiambu District

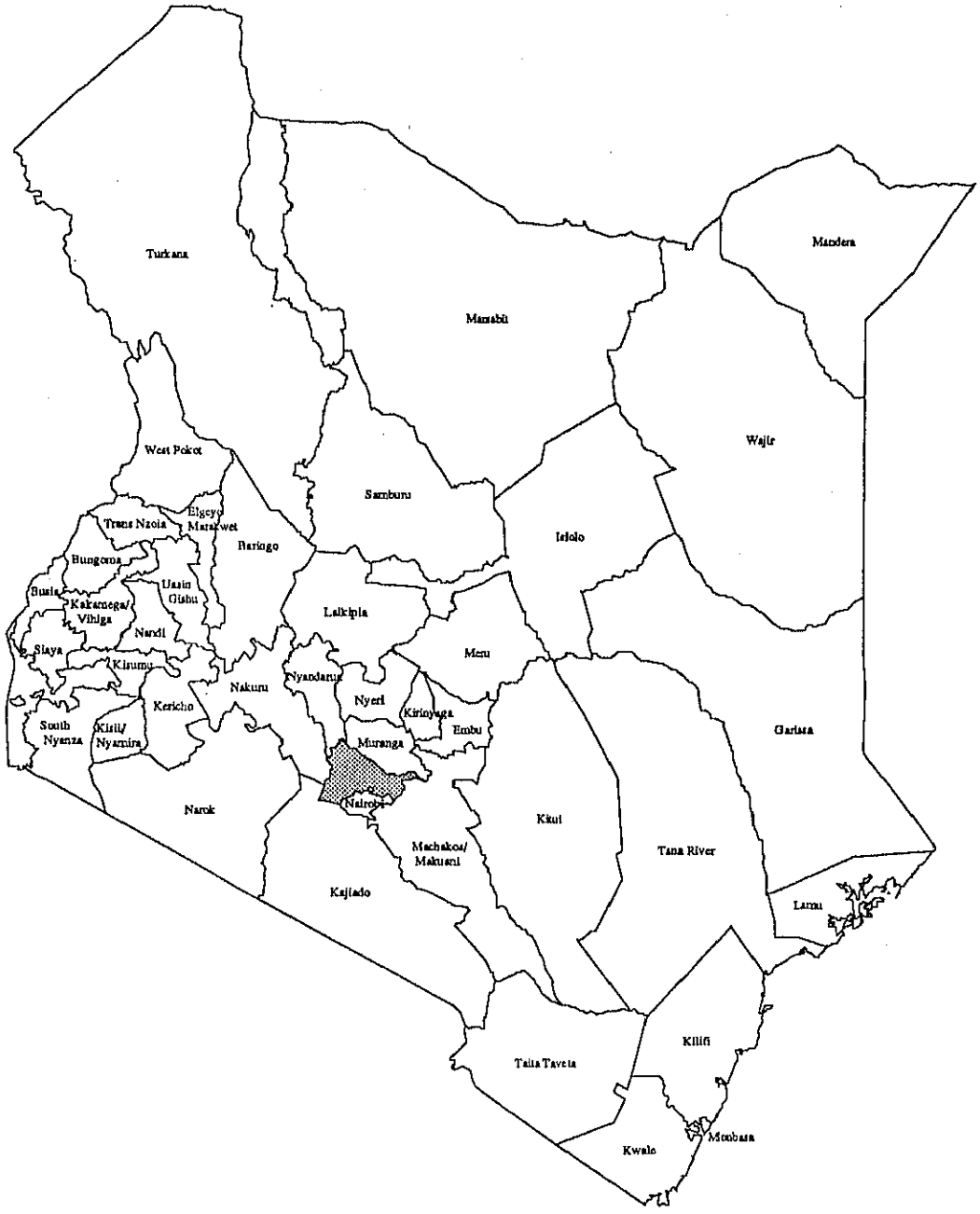
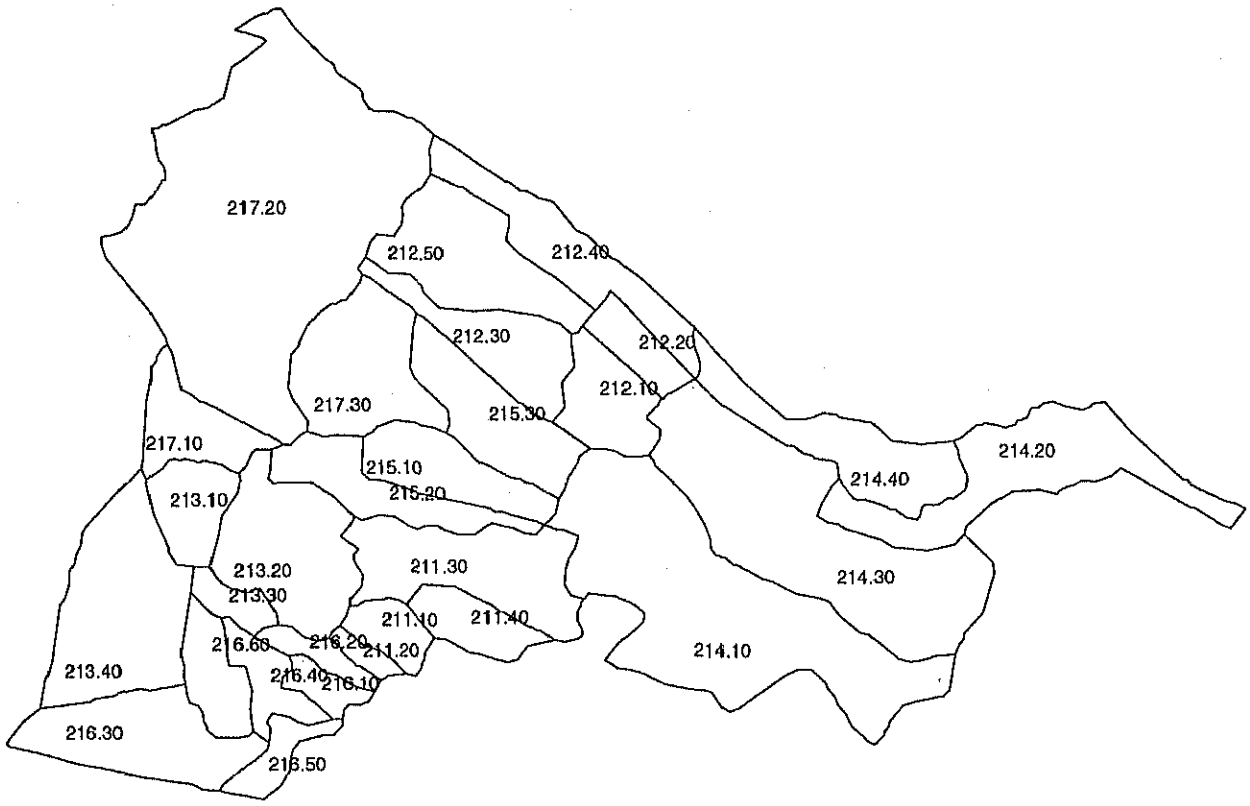
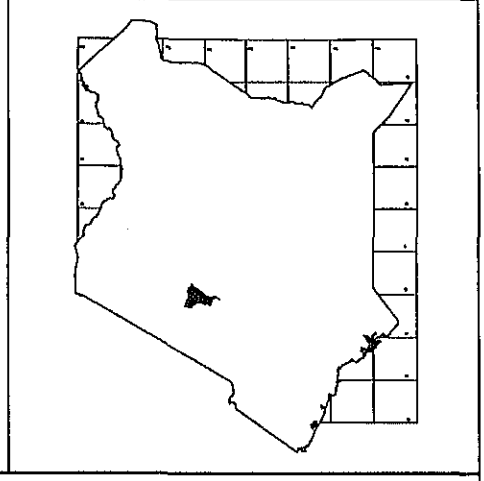


Fig.



Code	Location	Population
211.1	Kiambaa	28,623
211.2	Kihara	19,577
211.3	Tinganga	20,265
211.4	Kiambu Municipality	35,594
212.1	Ngenda	31,804
212.2	Mangu	22,358
212.3	Kiganjo	38,670
212.4	Chania	32,530
212.5	Ndarugu	27,009
213.1	Limuru	23,205
213.2	Tigoni	19,699
213.3	Ngecha	13,347
213.4	Ndeiya	14,886
214.1	Rulru	22,459
214.2	Gatuanyaga	12,922
214.3	Juja	14,248
214.4	Thika Municipality	41,324
215.1	Githunguri	35,571
215.2	Ikinu	34,689
215.3	Komothai	25,835
216.1	Kabete	15,434
216.2	Nyathuna	15,434
216.3	Karai	18,794
216.4	Muguga	21,102
216.5	Kinoo	21,092
216.6	Kikuyu	17,290
217.1	Lari	20,608
217.2	Kijabe	18,468
217.3	Gatamayu	23,453



210 Kiambu

THE STUDY
ON
THE NATIONAL WATER MASTER PLAN

JAPAN INTERNATIONAL COOPERATION AGENCY

1. Socio-Economic Profile : 210 Kiambu District

1-1 Population Projection

(Unit:1000)

Code	Location	Land Area (sq.km)	Town Name	1990 Total	1990 Urban	1990 Rural	2000 Total	2000 Urban	2000 Rural	2010 Total	2010 Urban	2010 Rural
210	Kiambu District	2,449		971.9	105.5	866.4	1248.5	241.5	1007.0	1582.7	376.1	1206.6
211.1	Kiambaa	25	Karuri	55.3	16.2	39.1	77.1	31.7	45.4	100.7	46.3	54.4
211.2	Kihara	9		26.7	-	26.7	31.1	-	31.1	37.2	-	37.2
211.3	Tinganga	104		27.7	-	27.7	32.1	-	32.1	38.5	-	38.5
211.4	Kiambu Munici.	35	Kiambu	48.1	4.5	43.6	61.0	10.3	50.6	77.3	16.6	60.7
212.1	Ngenda	49	Gatundu+Ngenda	43.4	-	43.4	51.9	1.5	50.5	62.4	2.0	60.5
212.2	Mangu	27	Mangu	30.5	-	30.5	36.0	0.5	35.5	43.2	0.7	42.5
212.3	Kiganjo	63	Kiganjo	52.8	-	52.8	61.8	0.5	61.3	74.1	0.6	73.5
212.4	Chania	78		44.4	-	44.4	51.6	-	51.6	61.8	-	61.8
212.5	Ndarugu	98		36.9	-	36.9	42.8	-	42.8	51.3	-	51.3
213.1	Limuru	39	Limuru	33.3	1.6	31.7	39.9	3.1	36.8	48.7	4.6	44.1
213.2	Tigoni	102	Tigoni	26.9	-	26.9	33.0	1.8	31.2	39.8	2.3	37.4
213.3	Ngecha	16		18.2	-	18.2	21.2	-	21.2	25.4	-	25.4
213.4	Ndeiya	131		20.3	-	20.3	23.6	-	23.6	28.3	-	28.3
214.1	Ruiru	274	Ruiru	45.0	14.3	30.7	63.6	27.9	35.6	83.6	40.9	42.7
214.2	Gatuanyaga	124		17.6	-	17.6	20.5	-	20.5	24.6	-	24.6
214.3	Juja	228	Ndarugu	19.4	-	19.4	24.5	1.9	22.6	29.7	2.6	27.1
214.4	Thika Munici.	80	Thika	59.0	59.0	0.0	135.4	135.4	0.0	217.4	217.4	0.0
215.1	Githunguri	58	Githunguri	48.9	3.8	45.1	61.2	8.7	52.4	76.8	14.0	62.8
215.2	Ikinu	58		47.3	-	47.3	55.0	-	55.0	65.9	-	65.9
215.3	Komothai	73		35.3	-	35.3	41.0	-	41.0	49.1	-	49.1
216.1	Kabete	16	Wangige	21.1	-	21.1	25.3	0.9	24.5	30.5	1.1	29.3
216.2	Nyathuna	16		21.1	-	21.1	24.5	-	24.5	29.3	-	29.3
216.3	Karai	90		25.7	-	25.7	29.8	-	29.8	35.7	-	35.7
216.4	Muguga	29		28.8	-	28.8	33.5	-	33.5	40.1	-	40.1
216.5	Kinoo	21		28.8	-	28.8	33.5	-	33.5	40.1	-	40.1
216.6	Kikuyu	36	Kikuyu	24.3	6.1	18.2	35.1	14.0	21.1	47.8	22.5	25.3
217.1	Lari	46		28.1	-	28.1	32.7	-	32.7	39.2	-	39.2
217.2	Kijabe	428	Kimende	25.2	-	25.2	29.7	0.4	29.3	35.7	0.6	35.1
217.3	Gatamayu	96	Kagwe	32.0	-	32.0	40.1	2.9	37.2	48.4	3.8	44.6

1-2 GRDP Projection

Item	1990	2000	2010
1) GRDP (K.Pound million)	439.2	813.0	1193.6
Percentage to GDP	5.7%	5.9%	5.8%
2) GRDP per Capita (K.Pound)	451.9	651.1	754.1
Ratio to GDP per capita	1.32	1.45	1.49
Urban (K.Pound)	1040.9	859.7	845.5
Rural (K.Pound)	380.2	601.1	725.7

1-3 Present District Profile (1990)

1) Agricultural Production (1989)

Product	Production	Unit
Maize	29,784	tons
Sorghum/Millet	262	tons
Potato	119,427	tons
Rice	31,375	tons
Wheat/Barley	-	tons
Coffee	33,492	tons
Tea	42,729	tons
Milk	-	tons
Meat	-	tons

2) Number of Manufacturing Establishments (1986)

Type of Industry	Number
Food	32
Textile	29
Wood	36
Paper	11
Chemical	7
Non-metal	2
Metal	1
Machinery	7
Others	1
Total	*126*

3) Water Supply Schemes in Service Centre

Piped system	72
Communal water points	0
Other sources	8

4) Educational Facilities

Primary school	321
Secondary school	139
Institute	26

5) Medical Facilities

Hospital	5
Health Centre	28
Dispensary	51
Others	10

6) Out-patient of Infective Diseases in Relation to Water Supplies (1985-89 Average)

Diarrhoeal Diseases	31,214
Leprosy	16
Infectious Hepatitis	2,590
Bilharzia	2,090
Eye Infections	17,774

2. Land and resources

2.1 Present Land Use

Unit : km2

Total Area	Land Area	Water Area	Forest & Park	Swamp	Town	Barrenland	Agriculture Land	Other Land
2,451	2,448	3	513	0	155	0	1,409	371

2.2 Rain fall

Unit : mm

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
48	45	100	244	160	40	26	28	31	74	164	88	1,055

2.3 River Flow

Unit : m3/sec

Gauge Code	Catchment Area (km2)	Mean Flow	Low Flow Frequency			
			80%	90%	95%	Min.
3BA32	1,942	10.1	4.1	3.4	3.3	2.9
3BD05	283	2.0	1.3	1.1	1.0	0.9
3CB05	312	4.7	0.8	0.5	0.4	0.3

2.4 Groundwater

Aquifer Characteristics

Elevation (m)	Total Depth (m)	Water Struck (m)	Level Rest (m)	Yield (m3/hr)	Draw Down (m)
1785.44	133.98	100.13	45.85	8.49	41.51

Safe Abstruction Yield

Unit : m3/year

Borehole	Shallow	Total
907,805	44,544	952,349

2.5 Agriculture

Suitable Area for Major Crops

Unit: km2

Maize	Wheat	Rice	Sorghum	Potato	Coffee	Tea
1,076	331	0	838	301	601	0

Area of Irrigation Potential

Unit : ha

Surfce Water		*Groundwater*	
Upland	Lowland	Upland	Lowland
6,519	1,118	6.7	0.3

Livestock Population

Unit: 1,000

Cattle	Sheep/Goats	Camels	Donkeys
174.20	136.47		

3 Water Demand Projection

Unit: cu.m/day

Location	1990				2000				2010			
	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry
Kiambu District	27,737	15,255	4,827	9,405	38,367	35,590	5,669	16,362	60,667	56,450	7,144	21,649
Kiambaa	1,200	2,343	233	189	1,638	4,665	283	358	2,546	6,953	362	530
Kihara	716	0	144	0	941	0	165	0	1,388	0	204	0
Tinganga	882	0	150	0	1,215	0	171	0	1,914	0	212	0
Kiambu Municipality	1,241	650	242	933	1,659	1,522	283	1,667	2,509	2,490	356	2,288
Ngenda	1,515	0	235	59	2,131	220	270	109	3,441	298	335	157
Mangu	1,060	0	165	57	1,490	78	189	105	2,404	106	234	152
Kiganjo	1,916	0	285	173	2,717	70	326	321	4,432	95	405	463
Chania	1,566	0	240	0	2,206	0	274	0	3,571	0	340	0
Ndarugu	1,338	0	199	0	1,898	0	228	0	3,095	0	282	0
Limuru	1,150	231	173	698	1,631	461	200	1,225	2,660	687	249	1,641
Tigoni	895	0	145	0	1,246	259	168	0	1,987	353	209	0
Ngecha	661	0	98	0	938	0	112	0	1,529	0	139	0
Ndeiya	502	0	110	0	658	0	125	0	967	0	155	0
Ruiru	667	2,067	185	580	850	4,118	226	1,019	1,197	6,137	291	1,365
Gatuanyaga	349	0	95	0	436	0	109	0	597	0	135	0
Juja	419	0	105	0	534	285	123	0	749	386	152	0
Thika Municipality	0	8,532	80	2,522	0	19,952	180	4,593	0	32,637	299	6,472
Githunguri	1,631	550	249	116	2,311	1,285	290	216	3,766	2,102	364	311
Ikinu	1,711	0	256	0	2,425	0	292	0	3,950	0	362	0
Komothai	1,280	0	191	0	1,815	0	218	0	2,962	0	270	0
Kabete	565	0	114	0	742	126	131	0	1,094	171	163	0
Nyathuna	579	0	114	0	766	0	130	0	1,141	0	161	0
Karai	599	0	139	0	771	0	158	0	1,103	0	196	0
Muguga	837	0	156	0	1,127	0	178	0	1,717	0	220	0
Kinoo	772	0	156	0	1,014	0	178	0	1,496	0	220	0
Kikuyu	589	882	107	3,671	815	2,063	131	5,987	1,288	3,375	170	7,159
Lari	1,021	0	152	94	1,448	0	174	178	2,362	0	215	264
Kijabe	914	0	136	313	1,297	64	156	584	2,114	87	194	847
Gatamayu	1,162	0	173	0	1,648	421	201	0	2,688	572	250	0

4 Action Plan

4.1 Urban Water Supply

Urban Name	Population	Present Raw Water Source	Future Raw Water Source	G/P	Pipe line (km)	Pump lift (m)	Cost 1000 US$
Karuri	46,400	Boreholes	Kiambaa Dam (Rui Ruaka R.)	p	2.2	170	11,970
Kiambu	16,600	Bore holes + NCC P/L	Kiambaa Dam (Rui Ruaka r.)	g	12.1	0	9,087
Gatundu & Ngenda	2,000	Boreholes	Thiririka River	p	3.2	70	314
Limuru	4,600	Boreholes	Chania P/L	p	59.7	360	14,167
Ruiru	40,900	Ruiru River	Ruiru River	g	7.5	0	9,678
Thika	217,500	Chania River	Chania River (Lower)	g	5.5	0	21,339
Githunguri	14,100	Boreholes	Ruiru river	p	7.2	120	4,968
Kikuyu	22,500	Boreholes	Kikuyu Dam	g	0.44	0	14,866

g: gravity p: pump

4.2 Small Scale Irrigation Scheme

Scheme Name	Area (ha)	Farmers No (Nos)	Division	Location	Type of Project	Imp. Agency	Cost million Kshs	Basin
Kerwa	0	30	?	?	Drainage	?	?	3AA
Komo	50	45	?	?	Irrigaiton	FAR	2.05	3BC
Juja Farm	15	40	?	?	Irrigaiton	FAR	0.615	3BD
Munyu	50	40	?	?	Irrigaiton	MOA	2.05	3CB
Gathaiti	0	25	?	?	Irrigaiton	FAR	?	3CB
Gachororo	0	220	?	?	Drainage	FAR	?	3CB
Gatuanyaga E	0	42	?	?	Drainage	?	?	3CB
Ruiru Centre	10	10	?	?	Drainage	?	0.41	?
Gatuanyaga W	0	30	?	?	Drainage	?	?	?
Thita	0	60	?	?	Drainage	?	?	?

4.3 Large Scale Irrigation Project

Project	Area (ha)	Water Source	Water Demand (MCM)	Cost (million)		Major Crops
				US$	K£	
-	-	-	-	-	-	-

4.4 Hydropower Development

Project	Description	Executing Agency	Cost(million)		Implementation Schedule																
			US$	K£	93	94	95	96	97	98	99	20	01	02	03	04	05	06	07	08	09	10
–	–	–	–	–																		

★ Design ☆ Study ● Construction

4.5 Flood Mitigation Project

Project	Description	Executing Agency	Cost(million)		Implementation Schedule																
			US$	K£	93	94	95	96	97	98	99	20	01	02	03	04	05	06	07	08	09	10
–	–	–	–	–																		

★ Design ☆ Study ● Construction

4.6 Urban Drainage and Ad-hoc River Improvement Projects

Project	Population	Area (Km2)	Executing Agency	Cost (million)		Implementation Schedule																
				US$	K£	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10
Kiambu	4,500	1.6	MOLG	12.9	16.3													☆	☆	☆	●	●	●
Thika	59,000	1.9	MOLG	14.8	18.6													☆	☆	☆	●	●	●

★ Design ☆ Study ● Construction

4.7 Dam Development Plan

Damsites	C.A. (km2)	Purpose	FSL (El. m)	Storage (MCM)	Yield (m3/s)	Height (m)	Cost (1,000US$)
Kiambaa	100	W	1756	2.7	0.12	18	4,708
Kikuyu	81	W	2007	11.0	0.25	25	8,250
Ndarugu	360	W+I	1451	224.2	6.10	36	42,227
Ruiru-A	202	W	1899	19.0	0.35	69	48,920

W:Water Supply I:Irrigation P: Power

4.8 Groundwater Development Projects

Proposed Numbers				Executing Agency	Cost (million)		Implementation Schedule																Remarks
Drinking		Livestock																					
(B/H+D)	(S/W+H)	(B/H+D)	(S/W+H)		US$	K£	93	94	95	96	97	98	99	20	01	02	03	04	05	06	07	08	09	10	
88	17	13	2	MOCSS	15.0	18.9	☆	●	●																Small communication supply

★ Design ☆ Study ● Construction

4.9 Source Development Plan for Rural Water Supply

District	Source Development Plan									Total	Implementation Program (%)	
	Surface Water	Borehole	Shallow Well	Roof Catch	Small Dam	Subsur-face Dam	Sand Dam	Rock Catch	Existing Pipeline		Up to 2000	2001-2010
- Quantity (m3/d)	39,127	2,726	83	135	2,169	0	0	30	16,360	60,630	32.3	67.7
- No. of Facilities	0	93	17	3,718	25	0	0	3	0	3,856		
- Cost (mill.US$)	0	10.54	0.08	2.24	1.87	0	0	0.05	0	14.77		
(mill.K£)	0	13.28	0.1	2.82	2.35	0	0	0.06	0	18.63		

4.10 Source Development Plan for Livestock Water Supply

District	Source Development Plan							Total	Implementation Program (%)	
	Surface Water	Borehole	Shallow Well	Small Dam	Subsur-face Dam	Sand Dam	Existing Pipeline		Up to 2000	2001-2010
- Quantity (m3/d)	5,949	286	8	333	0	0	21	6,597	36.3	63.7
- No. of Facilities	0	13	2	28	0	0	0	43		
- Cost (mill.US$)	0	1.07	0.01	0.3	0	0	0	1.37		
(mill.K£)	0	1.35	0.01	0.37	0	0	0	1.73		

4.11 Watering Points in Nomadic Pasturage Area

Assumed Nomadic Pasturage Area (km2)	No. of Watering Points (Nos.)	Executing Agency	Cost (million)		Implementation of Watering Points (No.)	
			US$	K£	Up to 2000	2000-2010
-	-	-			-	-

5 Future Water Resources Developmet Potential and Study Proposal

5.1 Potential Water Source for Future Development

Potential Water Source for Future Development	Purpose	Schemes		
		Water Supply	Irrigation	Hydropower
Munyu Dam	W+I+P	Nairobi	-	Munyu

W:Water Supply I:Irrigation P: Power

5.2 River Basin Developmetn Study

Description	Executing Agency	Cost (million)		Implementation Schedule																
		US$	K£	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10
Athi River Basin Study (Update)	TARDA	4.0	5.0		☆	☆	☆	☆	☆												

★ Design ☆ Study ● Construction

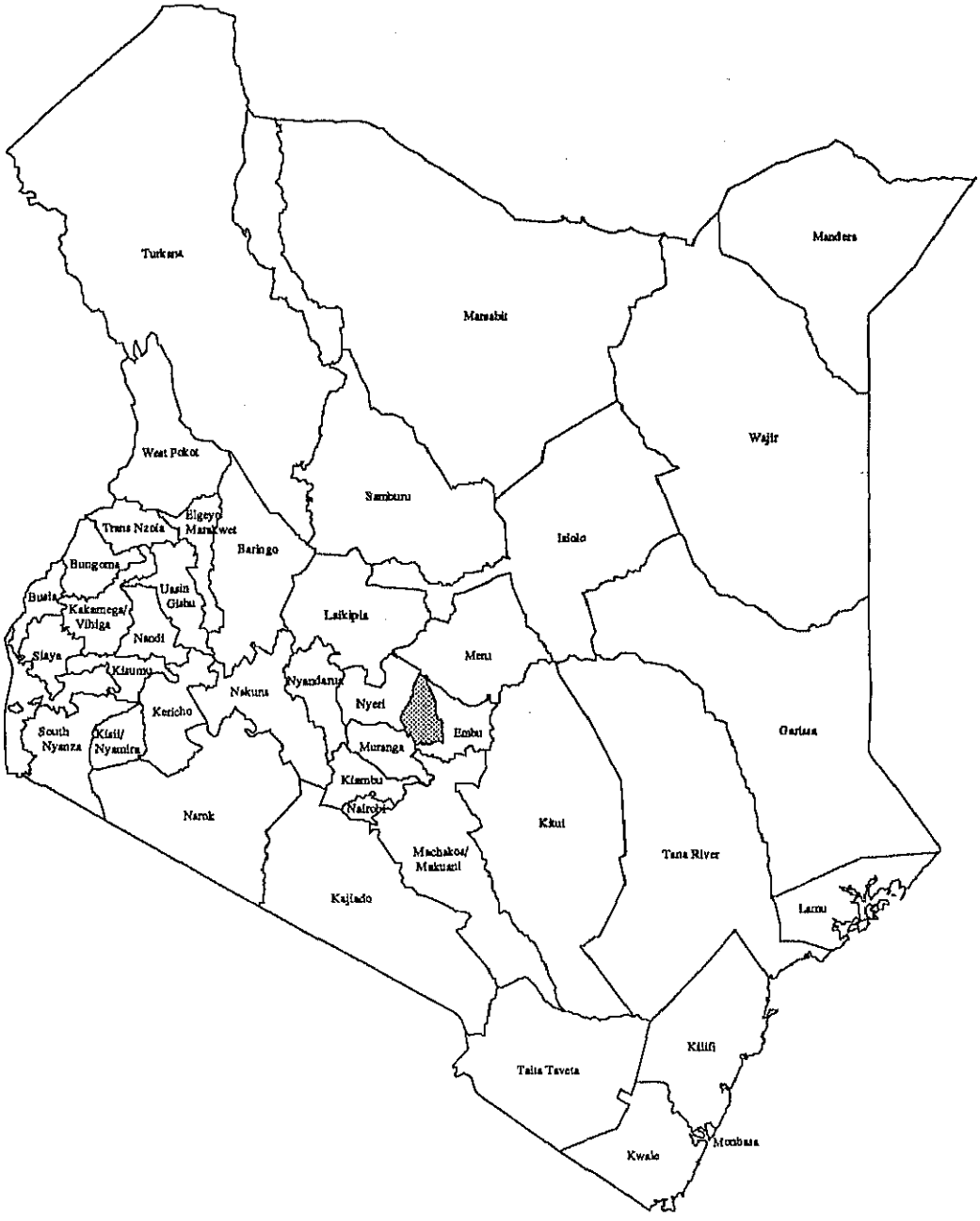
5.3 District Water Resource Study

Related Basin Study Proposed	Remarks	Executing Agency	Cost (million)		Implementation Schedule																
			US$	K£	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10
Athi		MOWD	2.0	2.5		o	o	o	o	o	☆	☆										

☆ Study

o River Basin Study (proposed under separate programme)

Kirinyaga District



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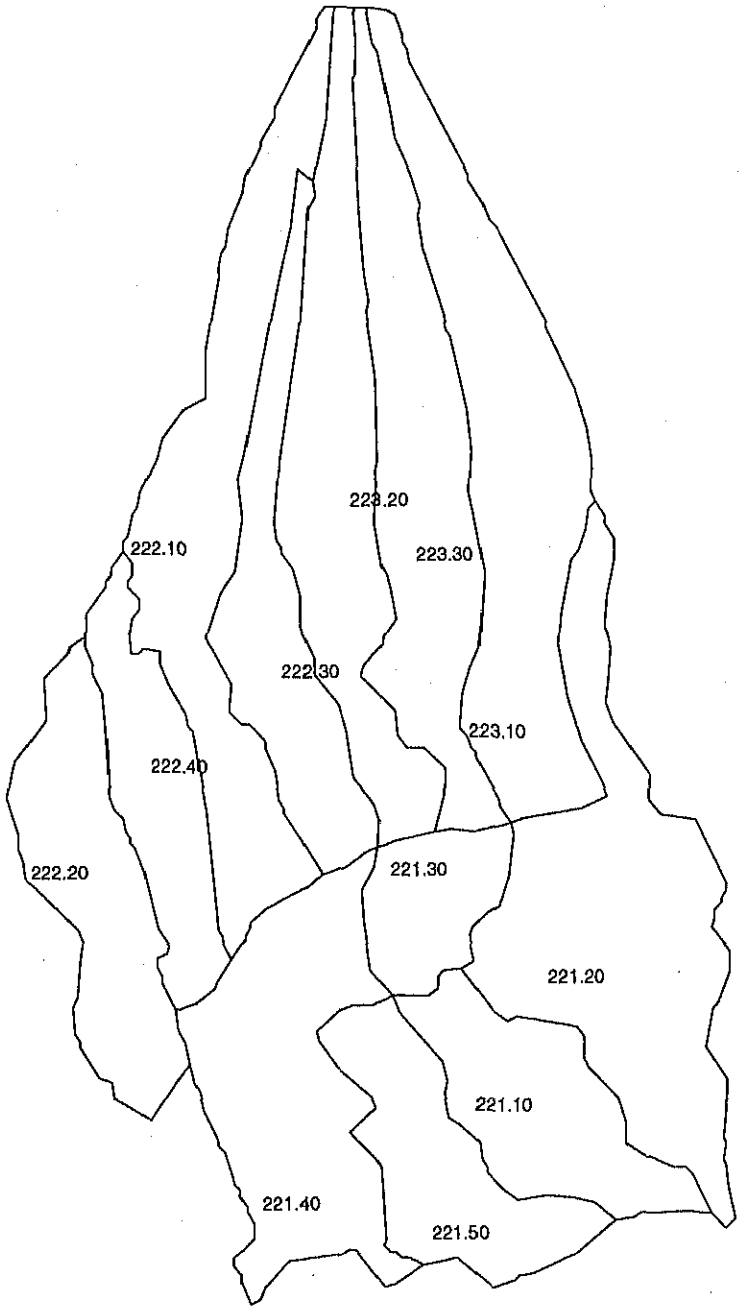
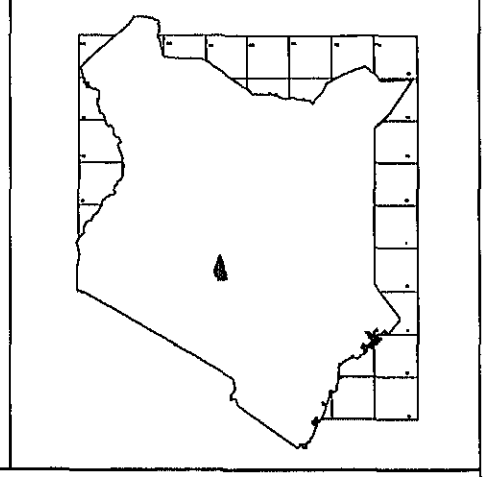


Code	Location	Population
221.1	Tebere	16,646
221.2	Murinduko	11,844
221.3	Nyagati	8,759
221.4	Mutithi	22,172
221.5	Thiba	21,633
222.1	Mutira	27,493
222.2	Kiine	31,820
222.3	Inoi	36,829
222.4	Mwerua	24,242
223.1	Ngariama	31,721
223.2	Kabare	27,862
223.3	Baragwi	30,410



220 Kirinyaga

THE STUDY
ON
THE NATIONAL WATER MASTER PLAN

JAPAN INTERNATIONAL COOPERATION AGENCY

1. Socio-Economic Profile : 220 Kirinyaga District

1-1 Population Projection (Unit:1000)

Code	Location	Land Area (sq.km)	Town Name	1990 Total	1990 Urban	1990 Rural	2000 Total	2000 Urban	2000 Rural	2010 Total	2010 Urban	2010 Rural
220	Kirinyaga	####		412.9	19.4	393.5	519.4	45.3	474.0	633.2	73.8	559.4
221.1	Tebere	87	Wanguru	23.1	-	23.1	28.9	1.0	27.8	34.3	1.4	32.8
221.2	Murinduko	195		16.4	-	16.4	19.8	-	19.8	23.4	-	23.4
221.3	Nyagati	47		12.2	-	12.2	14.6	-	14.6	17.3	-	17.3
221.4	Mutithi	140		30.8	-	30.8	37.1	-	37.1	43.7	-	43.7
221.5	Thiba	85		30.0	-	30.0	36.2	-	36.2	42.7	-	42.7
222.1	Mutira	161		38.2	-	38.2	46.0	-	46.0	54.2	-	54.2
222.2	Kiine	100	Sagana	44.1	2.9	41.2	56.4	6.7	49.7	69.7	11.1	58.6
222.3	Inoi	94	Kerugoya	60.0	8.9	51.1	82.2	20.7	61.6	106.7	34.1	72.7
222.4	Mwerua	74	Baricho	34.5	0.9	33.6	42.3	1.8	40.5	50.5	2.7	47.8
223.1	Ngariama	177	*-->Embu	39.1	-	39.1	47.1	-	47.1	55.6	-	55.6
223.2	Kabare	135	Kutus+Kimunye	41.9	6.3	35.6	57.2	14.3	42.9	74.0	23.4	50.6
223.3	Baragwi	144	Kianyaga	42.6	0.4	42.2	51.6	0.8	50.8	61.2	1.2	60.0

1-2 GRDP Projection

Item	1990	2000	2010
1) GRDP (K.Pound million)	52.0	82.7	116.8
Percentage to GDP	0.7%	0.6%	0.6%
2) GRDP per Capita (K.Pound)	125.9	159.2	184.4
Ratio to GDP per capita	0.37	0.35	0.36
Urban (K.Pound)	724.7	586.3	551.6
Rural (K.Pound)	96.4	118.4	136.0

1-3 Present District Profile (1990)

1) Agricultural Production (1989)

Product	Production	Unit
Maize	45,624	tons
Sorghum/Millet	19	tons
Potato	11,960	tons
Rice	-	tons
Wheat/Barley	-	tons
Coffee	7,000	tons
Tea	45,312	tons
Milk	23,414	tons
Meat	346	tons

2) Number of Manufacturing Establishments (1986)

Type of Industry	Number
Food	6
Textile	3
Wood	4
Paper	0
Chemical	0
Non-metal	0
Metal	0
Machinery	0
Others	0
Total	13

3) Water Supply Schemes in Service Centre

Piped system	38
Communal water points	0
Other sources	5

4) Educational Facilities

Primary school	177
Secondary school	52
Institute	28

5) Medical Facilities

Hospital	1
Health Centre	14
Dispensary	27
Others	2

6) Out-patient of Infective Diseases in Relation to Water Supplies (1985-89 Average)

Diarrhoeal Diseases	38,796
Leprosy	98
Infectious Hepatitis	2,934
Bilharzia	5,198
Eye Infections	21,588

2. Land and resources

2.1 Present Land Use

Unit : km2

Total Area	Land Area	Water Area	Forest & Park	Swamp	Town	Barrenland	Agriculture Land	Other Land
1,437	1,437	0	513	0	86	14	815	9

2.2 Rain fall

Unit : mm

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
43	48	106	296	219	45	34	40	33	158	227	89	1,345

2.3 River Flow

Unit : m3/sec

Gauge Code	Catchment Area (km2)	Mean Flow	Low Flow Frequency			
			80%	90%	95%	Min.
4BC02	2365	29.0	12.5	10.4	9.3	7.5
4BC04	158	6.3	2.4	1.9	1.6	1.3
4BC05	86	1.6	0.4	0.3	0.2	0.1
4DA02	31	1.8	0.6	0.5	0.4	0.3
4DA07	658	6.6	1.7	1.3	1.1	0.8
4DA10	353	10.1	5.1	3.5	3.1	2.5
4DA11	180	8.2	4.1	3.4	2.6	2.1
4DB01	215	12.0	4.5	3.5	3.0	2.0

2.4 Groundwater

Aquifer Characteristics

Elevation (m)	Total Depth (m)	Water Struck (m)	Level Rest (m)	Yield (m3/hr)	Draw Down (m)
1199	81.4	49.67	21.64	6.13	36.15

Safe Abstruction Yield

Unit : m3/year

Borehole	Shallow	Total
528,750	34,372	563,122

2.5 Agriculture

Suitable Area for Major Crops

Unit: km2

Maize	Wheat	Rice	Sorghum	Potato	Coffee	Tea
901	0	153	780	123	387	268

Area of Irrigation Potential

Unit : ha

Surfce Water		Groundwater	
Upland	Lowland	Upland	Lowland
7,962	7,555	0	0

Livestock Population

Unit: 1,000

Cattle	Sheep/Goats	Camels	Donkeys
99.44	86.63	Not Null	Not Null

3 Water Demand Projection

Unit: cu.m/day

Location	1990				2000				2010			
	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry
Kirinyaga District	11,835	2,805	2,764	457	16,816	6,682	3,355	857	25,875	11,078	4,152	1,258
Tebere	466	0	160	94	605	154	194	178	820	212	239	264
Murinduko	409	0	114	0	556	0	137	0	805	0	168	0
Nyagati	288	0	84	0	387	0	101	0	545	0	124	0
Mutithi	674	0	214	0	891	0	256	0	1,235	0	314	0
Thiba	601	0	208	0	780	0	250	0	1,054	0	307	0
Mutira	1,271	0	265	0	1,836	0	318	0	2,890	0	390	0
Kiine	1,155	419	291	94	1,608	993	355	178	2,411	1,666	441	264
Inoi	1,806	1,286	370	94	2,642	3,044	461	178	4,216	5,112	583	264
Mweria	1,070	130	235	0	1,532	262	283	0	2,383	398	348	0
Ngariama	1,362	0	271	172	1,986	0	326	318	3,155	0	399	458
Kabare	1,253	911	258	3	1,832	2,114	321	5	2,920	3,513	406	8
Baragwi	1,480	58	294	0	2,161	116	353	0	3,441	176	433	0

4 Action Plan

4.1 Urban Water Supply

Urban Name	Population	Present Raw Water Source	Future Raw Water Source	G/P	Pipe line (km)	Pump lift (m)	Cost 1000 US$
Wanguru	1,500	N.I.B canal	Thiba River	g	5	0	1,179
Sagana	11,100	Ragati River	Ragati River	g	4.1	0	3,562
Kerugoya	34,100	Rutu River	Kiringa River	g	10	0	8,350
Kutus	23,500	Thiba River	Thiba River	g	3.3	0	4,891

g: gravity p; pump

4.2 Small Scale Irrigation Scheme

Scheme Name	Area (ha)	Farmers No (Nos)	Division	Location	Type of Project	Imp. Agency	Cost million Kshs	Basin
Kathiga	30	?	?	?	Irrigaiton	?	1.23	4DA
Kiangwaci	0	0	?	?	Irrigation	MOA	?	?

4.3 Large Scale Irrigation Project

Project	Area (ha)	Water Source	Water Demand (MCM)	Cost (million)		Major Crops
				US$	K£	
Mwea extension	2,900	Tana & Thiba	118.9	63.7	80.3	Rice, upland crops

4.4 Hydropower Development

Project	Description	Executing Agency	Cost(million)		Implementation Schedule																
			US$	K£	93	94	95	96	97	98	99	20	01	02	03	04	05	06	07	08	09	10
–	–	–	–	–																		

★ Design ☆ Study ● Construction

4.5 Flood Mitigation Project

Project	Description	Executing Agency	Cost(million)		Implementation Schedule																
			US$	K£	93	94	95	96	97	98	99	20	01	02	03	04	05	06	07	08	09	10
–	–	–	–	–																		

★ Design ☆ Study ● Construction

4.6 Urban Drainage and Ad-hoc River Improvement Projects

Project	Population	Area (Km2)	Executing Agency	Cost (million)		Implementation Schedule																
				US$	K£	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10
Kerugoya	8,900	1.0	MOLG	7.7	9.7													☆	☆	☆	●	●	●

★ Design ☆ Study ● Construction

4.7 Dam Development Plan

Damsites	C.A. (km2)	Purpose	FSL (El. m)	Storage (MCM)	Yield (m3/s)	Height (m)	Cost (1,000US$)
Thiba	173	I	1380	18.0	-	35	22,208

W: Water Supply I: Irrigation P: Power

4.8 Groundwater Development Projects

Proposed Numbers				Executing Agency	Cost (million)		Implementation Schedule																Remarks
Drinking		Livestock																					
(B/H+D)	(S/W+H)	(B/H+D)	(S/W+H)		US$	K£	93	94	95	96	97	98	99	20	01	02	03	04	05	06	07	08	09	10	
–	–	–	–	–	–	-																			

★ Design ☆ Study ● Construction

4.9 Source Development Plan for Rural Water Supply

District	Source Development Plan									Total	Implementation Program (%)	
	Surface Water	Borehole	Shallow Well	Roof Catch	Small Dam	Subsur-face Dam	Sand Dam	Rock Catch	Existing Pipeline		Up to 2000	2001-2010
- Quantity (m3/d)	23,036	758	76	40	973	0	0	0	977	25,860	35.5	64.5
- No. of Facilities	0	17	16	889	12	0	0	0	0	934		
- Cost (mill.US$)	0	2.64	0.08	0.53	0.58	0	0	0	0	3.82		
(mill.K£)	0	3.33	0.09	0.67	0.73	0	0	0	0	4.82		

4.10 Source Development Plan for Livestock Water Supply

District	Source Development Plan							Total	Implementation Program (%)	
	Surface Water	Borehole	Shallow Well	Small Dam	Subsur-face Dam	Sand Dam	Existing Pipeline		Up to 2000	2001-2010
- Quantity (m3/d)	3,779	58	14	154	0	0	0	4,005	42.6	57.4
- No. of Facilities	0	2	3	12	0	0	0	17		
- Cost (mill.US$)	0	0.22	0.01	0.08	0	0	0	0.32		
(mill.K£)	0	0.28	0.02	0.11	0	0	0	0.4		

4.11 Watering Points in Nomadic Pasturage Area

Assumed Nomadic Pasturage Area (km2)	No. of Watering Points (Nos.)	Executing Agency	Cost (million)		Implementation of Watering Points (No.)	
			US$	K£	Up to 2000	2000-2010
-	-	-			-	-

5 Future Water Resources Developmet Potential and Study Proposal

5.1 Potential Water Source for Future Development

Potential Water Source for Future Development	Purpose	Schemes		
		Water Supply	Irrigation	Hydropower
-	-	-	-	-

W:Water Supply I:Irrigation P: Power

5.2 River Basin Developmetn Study

Description	Executing Agency	Cost (million)		Implementation Schedule																
		US$	K£	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10
Tana River Basin Study (Update)	TARDA	4.0	5.0				☆	☆	☆	☆	☆										

★ Design ☆ Study ● Construction

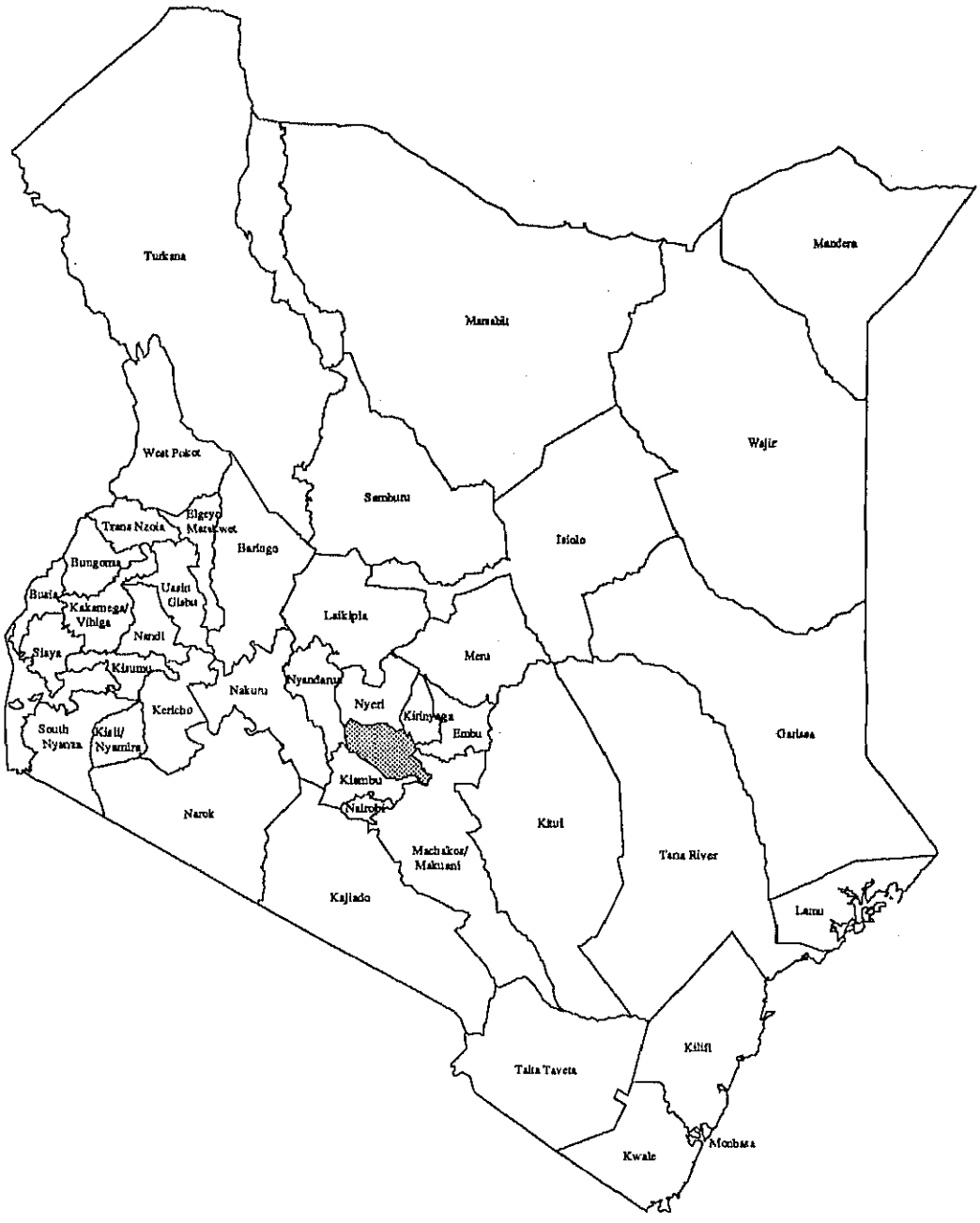
5.3 District Water Resource Study

Related Basin Study Proposed	Remarks	Executing Agency	Cost (million)		Implementation Schedule																
			US$	K£	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10
Tana		MOWD	2.0	2.5				o	o	o	o	o	☆									

☆ Study

o River Basin Study (proposed under separate programme)

Muranga District



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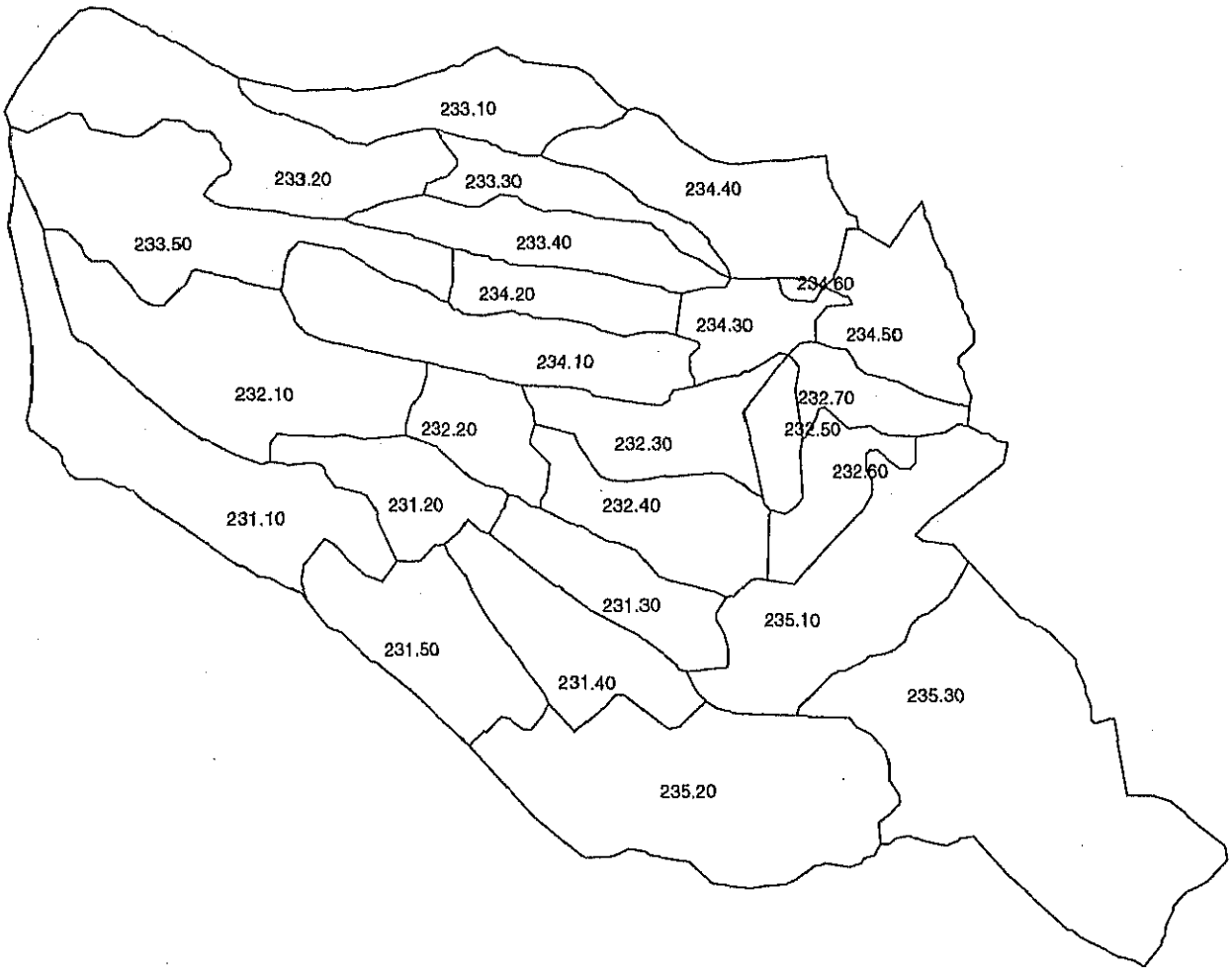
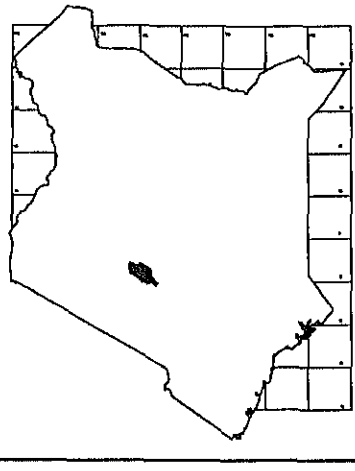


Code	Location	Population
231.1	Kariara	20,798
231.2	Ruchu	26,792
231.3	Gaichanjiru	37,087
231.4	Muruka	51,658
231.5	Gatanga	45,386
232.1	Kinyona	24,705
232.2	Kigumo	27,176
232.3	Nginda	31,722
232.4	Muthithi	32,054
232.5	Samar	1,053
232.6	Kamahuha	15,758
232.7	Maragua Ridge	2,648
233.1	Kiru	36,685
233.2	Kiriti	26,945
233.3	Gitugi	21,243
233.4	Iyego	29,790
233.5	Kanyenyaini	18,249
234.1	Mugoiri	51,507
234.2	Weithaga	36,204
234.3	Mbiri	13,764
234.4	Gaturi	26,158
234.5	Gikindu	9,023
234.6	Murang'a Old Town	1,526
235.1	Makuyu	15,676
235.2	Mitubiri	16,977
235.3	Kakuzi/Ithanga	27,749



230 Muranga

THE STUDY
ON
THE NATIONAL WATER MASTER PLAN

JAPAN INTERNATIONAL COOPERATION AGENCY

1. Socio-Economic Profile : 230 Murang'a District

1-1 Population Projection

(Unit:1000)

Code	Location	Land Area (sq.km)	Town Name	1990			2000			2010		
				Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural
230	Murang'a	2,478		898.8	65.0	833.8	1,087.2	128.6	958.6	1,315.6	189.3	1,126.3
231.1	Kariara	163		27.5	-	27.5	31.6	-	31.6	37.1	-	37.1
231.2	Ruchu	59		35.4	-	35.4	40.7	-	40.7	47.8	-	47.8
231.3	Gaichanjiru	65	Kabati	49.0	-	49.0	57.2	0.8	56.4	67.3	1.1	66.2
231.4	Muruka	82	Kandara	69.0	0.7	68.3	79.8	1.3	78.5	94.0	1.8	92.2
231.5	Gatanga	98	Karwara(Gatanga)	60.0	-	60.0	69.7	0.7	69.0	81.9	0.9	81.0
232.1	Kinyona	166		32.6	-	32.6	37.5	-	37.5	44.1	-	44.1
232.2	Kigumo	49	Kigumo	35.9	-	35.9	42.0	0.7	41.3	49.4	0.9	48.5
232.3	Nginda	69		41.9	-	41.9	48.2	-	48.2	56.6	-	56.6
232.4	Muthithi	80		42.4	-	42.4	48.7	-	48.7	57.2	-	57.2
232.5	Samar	25		1.4	-	1.4	1.6	-	1.6	1.9	-	1.9
232.6	Kamahuha	44	Saba Saba	20.8	-	20.8	24.4	0.4	23.9	28.7	0.6	28.1
232.7	Maragua Ridge	37	Maragwa	39.0	35.5	3.5	68.2	64.2	4.0	95.9	91.1	4.7
233.1	Kiru	83		48.5	-	48.5	55.7	-	55.7	65.5	-	65.5
233.2	Kiriti	149		35.6	-	35.6	40.9	-	40.9	48.1	-	48.1
233.3	Gitugi	47		28.1	-	28.1	32.3	-	32.3	37.9	-	37.9
233.4	Iyego	69	Kangema	40.9	1.5	39.4	48.0	2.7	45.3	57.0	3.9	53.2
233.5	Kanyenyaini	153		24.1	-	24.1	27.7	-	27.7	32.6	-	32.6
234.1	Mugoiri	115	Kahuro(Muriranjas)+Ka	68.6	0.5	68.1	80.1	1.9	78.3	94.5	2.5	91.9
234.2	Weithaga	47		47.8	-	47.8	55.0	-	55.0	64.6	-	64.6
234.3	Mbiri	43	Murang'a	19.5	19.5	0.0	40.7	40.7	0.0	62.9	62.9	0.0
234.4	Gaturi	101		34.6	-	34.6	39.7	-	39.7	46.7	-	46.7
234.5	Gikindu	75		11.9	-	11.9	13.7	-	13.7	16.1	-	16.1
234.6	Murang'a Old- Town	3	*-->Murang'a	2.2	2.2	0.0	4.6	4.6	0.0	7.1	7.1	0.0
235.1	Makuyu Town	147	Makuyu	23.0	5.1	17.9	31.2	10.6	20.6	40.6	16.5	24.2
235.2	Mitubiri	218		22.4	-	22.4	25.8	-	25.8	30.3	-	30.3
235.3	Kakuzi/Ithanga	291		36.7	-	36.7	42.2	-	42.2	49.5	-	49.5

1-2 GRDP Projection

Item	1990	2000	2010
1) GRDP (K.Pound million)	267.0	436.6	614.8
Percentage to GDP	3.4%	3.2%	3.0%
2) GRDP per Capita (K.Pound)	297.1	401.6	467.3
Ratio to GDP per capita	0.87	0.89	0.92
Urban (K.Pound)	442.7	423.2	492.5
Rural (K.Pound)	285.8	398.7	463.1

1-3 Present District Profile (1990)

1) Agricultural Production (1989)

Product	Production	Unit
Maize	78,880	tons
Sorghum/Millet	252	tons
Potato	34,163	tons
Rice	-	tons
Wheat/Barley	-	tons
Coffee	18,610	tons
Tea	87,319	tons
Milk	45,503	tons
Meat	3,555	tons

2) Number of Manufacturing Establishments (1986)

Type of Industry	Number
Food	5
Textile	3
Wood	4
Paper	3
Chemical	0
Non-metal	0
Metal	0
Machinery	0
Others	0
Total	15

3) Water Supply Schemes in Service Centre

Piped system	83
Communal water points	0
Other sources	0

4) Educational Facilities

Primary school	388
Secondary school	146
Institute	39

5) Medical Facilities

Hospital	8
Health Centre	11
Dispensary	64
Others	2

6) Out-patient of Infective Diseases in Relation to Water Supplies (1985-89 Average)

Diarrhoeal Diseases	30,720
Leprosy	16
Infectious Hepatitis	149
Bilharzia	316
Eye Infections	30,721

2. Land and resources

2.1 Present Land Use

Unit : km2

Total Area	Land Area	Water Area	Forest & Park	Swamp	Town	Barrenland	Agriculture Land	Other Land
2,476	2,476	0	366	0	161.46	0	1,200	748.54

2.2 Rain fall

Unit : mm

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
39	42	98	264	170	40	26	30	32	120	186	70	1,121

2.3 River Flow

Unit : m3/sec

Gauge Code	Catchment Area (km2)	Mean Flow	Low Flow Frequency			
			80%	90%	95%	Min.
4BD06	6	2.6	1.1	0.8	0.7	0.4
4BE02	3,672	112.7	55.2	40.6	36.1	24.8
4BE09	43	3.0	1.3	1.0	0.8	0.5
4BF01	352	16.5	8.1	6.4	5.8	4.3
4CA02	518	9.4	1.8	1.4	1.1	0.7
4CA03	73	7.0	2.7	2.1	1.7	1.0
4CA16	28	1.3	0.3	0.2	0.2	0.1
4CB04	316	6.4	2.4	1.9	1.8	1.5
4CC03	1,321	0.8	0.2	0.1	0.1	0.1
4CC03A	1,321	103.9	34.3	24.9	20.8	13.5
4CC05	1,567	19.4	7.8	6.6	6.6	4.1

2.4 Groundwater

Aquifer Characteristics

Elevation (m)	Total Depth (m)	Water Struck (m)	Level Rest (m)	Yield (m3/hr)	Draw Down (m)
1437.9	102.53	67.15	20.78	6.02	57.83

Safe Abstruction Yield

Unit : m3/year

Borehole	Shallow	Total
1,031,007	344,593	1,375,600

2.5 Agriculture

Suitable Area for Major Crops

Unit: km2

Maize	Wheat	Rice	Sorghum	Potato	Coffee	Tea
1,229	43	61	1,239	43	659	0

Area of Irrigation Potential

Unit : ha

Surfce Water		Groundwater	
Upland	Lowland	Upland	Lowland
32,295	26,299	0	0

Livestock Population

Unit: 1,000

Cattle	Sheep/Goats	Camels	Donkeys
181.79	82.60		

3 Water Demand Projection

Unit: cu.m/day

Location	1990				2000				2010			
	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry
Murang'a District	26,788	9,400	4,709	673	36,739	18,946	5,334	1,257	57,134	28,413	6,424	1,833
Kariara	998	0	152	0	1,400	0	170	0	2,239	0	203	0
Ruchu	1,285	0	196	0	1,803	0	219	0	2,884	0	262	0
Gaichanjiru	1,458	0	272	0	1,956	123	305	0	2,955	164	364	0
Muruka	2,119	102	379	0	2,870	186	424	0	4,393	269	507	0
Gatanga	2,158	0	332	0	3,021	105	372	0	4,821	139	445	0
Kinyona	1,185	0	181	0	1,663	0	202	0	2,659	0	241	0
Kigumo	1,304	0	199	0	1,829	100	223	0	2,926	133	267	0
Nginda	1,217	0	232	0	1,624	0	260	0	2,438	0	310	0
Muthithi	1,201	0	235	0	1,593	0	262	0	2,373	0	313	0
Samar	31	0	8	0	37	0	9	0	52	0	10	0
Kamahuha	446	0	115	0	560	65	130	0	768	87	155	0
Maragua Ridge	81	5,134	69	0	102	9,457	108	0	144	13,681	151	0
Kiru	1,759	0	269	0	2,470	0	300	0	3,949	0	358	0
Kiriti	1,293	0	197	0	1,814	0	220	0	2,900	0	263	0
Gitugi	1,015	0	156	0	1,423	0	174	0	2,274	0	208	0
Iyego	1,421	217	220	0	1,992	399	247	0	3,180	578	296	0
Kanyenyaini	875	0	134	0	1,228	0	149	0	1,964	0	178	0
Mugoiri	2,318	72	378	0	3,208	276	424	0	5,044	382	507	0
Weithaga	1,734	0	265	0	2,433	0	296	0	3,889	0	354	0
Mbiri	0	2,820	27	228	0	5,992	55	421	0	9,444	86	607
Gaturi	1,048	0	191	0	1,415	0	214	0	2,156	0	256	0
Gikindu	258	0	66	0	324	0	74	0	447	0	88	0
Murang'a Old Town	0	319	3	445	0	676	6	836	0	1,065	10	1,226
Makuyu	365	738	106	0	454	1,567	125	0	614	2,470	155	0
Mitubiri	493	0	124	0	622	0	139	0	861	0	166	0
Kakuzi/Ithanga	726	0	203	0	898	0	227	0	1,204	0	271	0

4 Action Plan

4.1 Urban Water Supply

Urban Name	Population	Present Raw Water Source	Future Raw Water Source	G/P	Pipe line (km)	Pump lift (m)	Cost 1000 US$
Kandara	1,800	Thika River	Thika River	g	4.7	0	482
Maragua	91,200	Boreholes	Githanji river	g	3.3	0	15,066
Kangema	3,900	River (Local)	Mathioya River	p	4.5	80	1,208
Murang'a	70,100	River (Local)	Maragua river	p	1.8	70	11,378
Makuyu	16,500	River (Local)	Motoho river	p	4.7	80	4,792

g: gravity p: pump

4.2 Small Scale Irrigation Scheme

Scheme Name	Area (ha)	Farmers No (Nos)	Division	Location	Type of Project	Imp. Agency	Cost million Kshs	Basin
Nginda	0	0	Kigumo	Nginda	Irrigation	farmers	?	4BA
Kimathi	100	0	Kihuru	Gaturi	Drainage	farmers	4.1	4BD
Kambirwa/Mirira	150	?	?	?	Irrigaiton	?	6.15	4BD
Itiitu-Ikundu	150	2400	Kigumo	Gakoigo	Irrigation	MOA	6.15	4BE
Maragua	200	0	Kigumo	Maragua	Irrigation	farmers	8.2	4BF
Muthithi	0	0	Kigumo	Muthithi	Irrigation	farmers	?	4BF
Kabati	100	40	Makuyu	Kabati	Drainage	FARMERS	4.1	4CC
Thika F.T.C.	0	?	?	?	Irrigaiton	?	?	4CC
Mgararia	40	28	Kandara	Muruka	Drainage	farmers	1.64	?
Mugecha	42	8	?	?	Drainage	?	1.722	?
Waitua	48	9	Kihuru	Gaturi	Drainage	?	1.968	?
Muranga	0	?	Kigumo	Gakoigo	Irrigation	farmers	?	?
Kaharo	0	0	Makuyu	Makuyu	Irrigation	farmers	?	?
Kahutha	0	0	?	?	Irrigation	?	?	?

4.3 Large Scale Irrigation Project

Project	Area (ha)	Water Source	Water Demand (MCM)	Cost (million)		Major Crops
				US$	K£	
-	-	-	-	-	-	-

4.4 Hydropower Development

Project	Description	Executing Agency	Cost(million)		Implementation Schedule																
			US$	K£	93	94	95	96	97	98	99	20	01	02	03	04	05	06	07	08	09	10
–	–	–	–	–																		

★ Design ☆ Study ● Construction

4.5 Flood Mitigation Project

Project	Description	Executing Agency	Cost(million)		Implementation Schedule																
			US$	K£	93	94	95	96	97	98	99	20	01	02	03	04	05	06	07	08	09	10
–	–	–	–	–																		

★ Design ☆ Study ● Construction

4.6 Urban Drainage and Ad-hoc River Improvement Projects

Project	Population	Area (Km2)	Executing Agency	Cost (million)		Implementation Schedule																
				US$	K£	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10
Murang'a	21,700	5.3	MOLG	31.5	39.7											☆	☆	☆	●	●	●		

★ Design ☆ Study ● Construction

4.7 Dam Development Plan

Damsites	C.A. (km2)	Purpose	FSL (El. m)	Storage (MCM)	Yield (m3/s)	Height (m)	Cost (1,000US$)
Chania-B	338	W+I	1791	51.0	1.30	101	113,527

W:Water Supply I:Irrigation P: Power

4.8 Groundwater Development Projects

Proposed Numbers				Executing Agency	Cost (million)		Implementation Schedule																Remarks
Drinking		Livestock																					
(B/H+D)	(S/W+H)	(B/H+D)	(S/W+H)		US$	K£	93	94	95	96	97	98	99	20	01	02	03	04	05	06	07	08	09	10	
28	81	1	16	MOCSS	6.2	7.8			☆	●	●														Small communication supply

★ Design ☆ Study ● Construction

4.9 Source Development Plan for Rural Water Supply

District	Source Development Plan									Total	Implementation Program (%)	
	Surface Water	Borehole	Shallow Well	Roof Catch	Small Dam	Subsur-face Dam	Sand Dam	Rock Catch	Existing Pipeline		Up to 2000	2001-2010
- Quantity (m3/d)	52,242	1,031	474	82	2,819	0	0	0	458	57,106	32.8	67.2
- No. of Facilities	0	28	96	2,828	24	0	0	0	0	2,976		
- Cost (mill.US$)	0	3.91	0.47	1.68	0.99	0	0	0	0	7.05		
(mill.K£)	0	4.93	0.59	2.12	1.25	0	0	0	0	8.89		

4.10 Source Development Plan for Livestock Water Supply

District	Source Development Plan							Total	Implementation Program (%)	
	Surface Water	Borehole	Shallow Well	Small Dam	Subsur-face Dam	Sand Dam	Existing Pipeline		Up to 2000	2001-2010
- Quantity (m3/d)	5,734	19	79	305	0	0	0	6,137	36.4	63.6
- No. of Facilities	0	1	16	23	0	0	0	40		
- Cost (mill.US$)	0	0.07	0.08	0.11	0	0	0	0.26		
(mill.K£)	0	0.09	0.1	0.14	0	0	0	0.33		

4.11 Watering Points in Nomadic Pasturage Area

Assumed Nomadic Pasturage Area (km2)	No. of Watering Points (Nos.)	Executing Agency	Cost (million)		Implementation of Watering Points (No.)	
			US$	K£	Up to 2000	2000-2010
-	-	-			-	-

5 Future Water Resources Developmet Potential and Study Proposal

5.1 Potential Water Source for Future Development

Potential Water Source for Future Development	Purpose	Schemes		
		Water Supply	Irrigation	Hydropower
Maragua-8 Dam	W	Maragua	-	-

W:Water Supply I:Irrigation P: Power

5.2 River Basin Developmetn Study

Description	Executing Agency	Cost (million)		Implementation Schedule																	
		US$	K£	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10
Tana River Basin Study (Update)	TARDA	4.0	5.0				☆	☆	☆	☆	☆										

★ Design ☆ Study ● Construction

5.3 District Water Resource Study

Related Basin Study Proposed	Remarks	Executing Agency	Cost (million)		Implementation Schedule																
			US$	K£	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10
Tana		MOWD	2.0	2.5				o	o	o	o	o	☆								

☆ Study

o River Basin Study (proposed under separate programme)

Nyandarua District

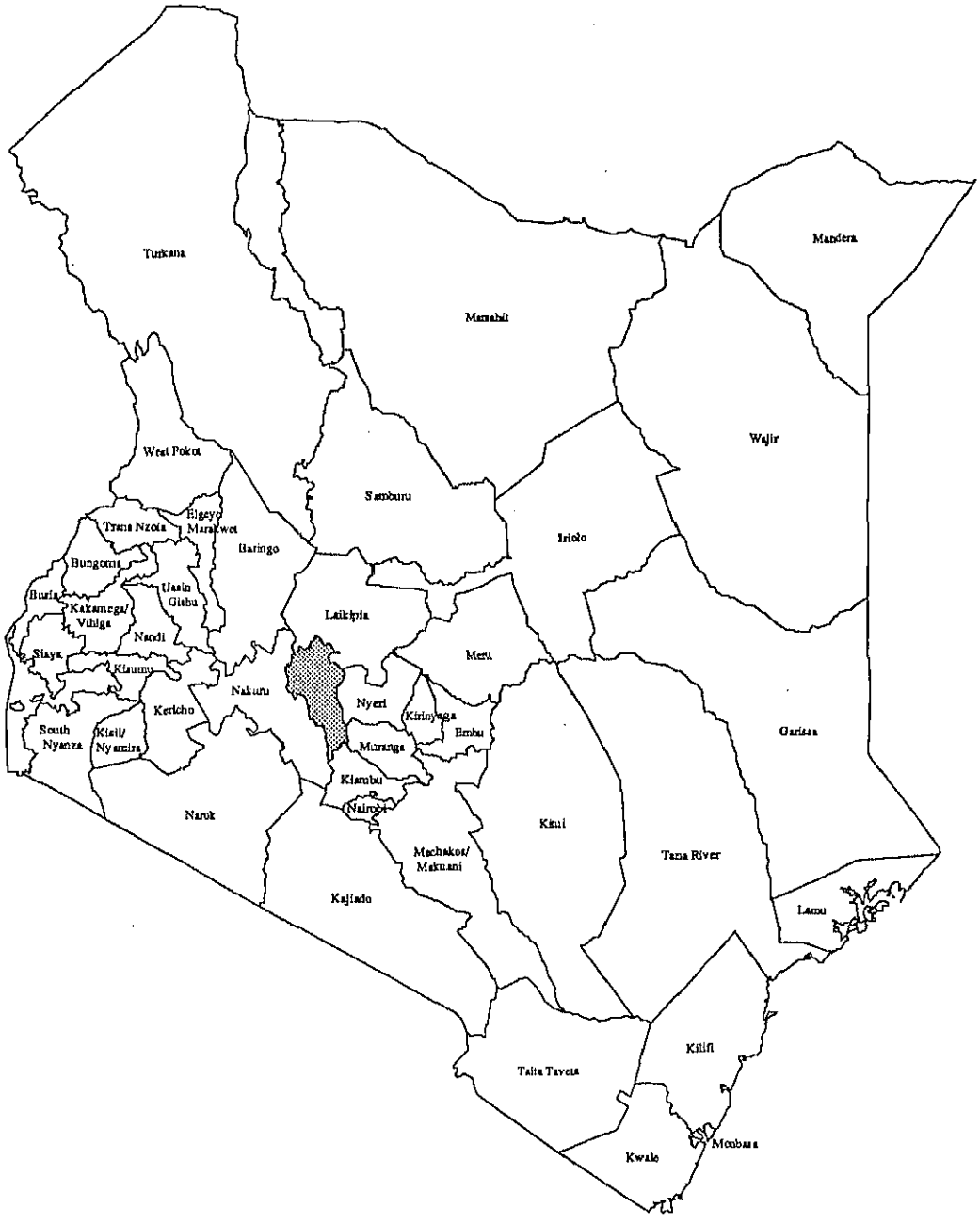
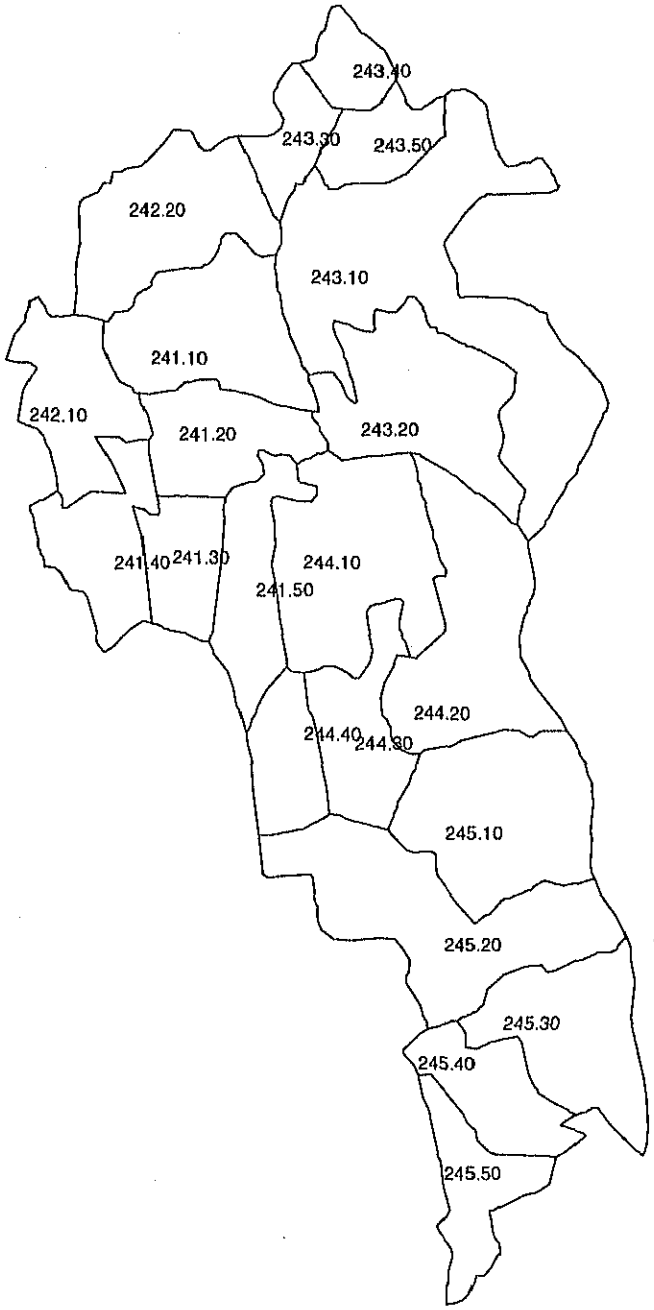
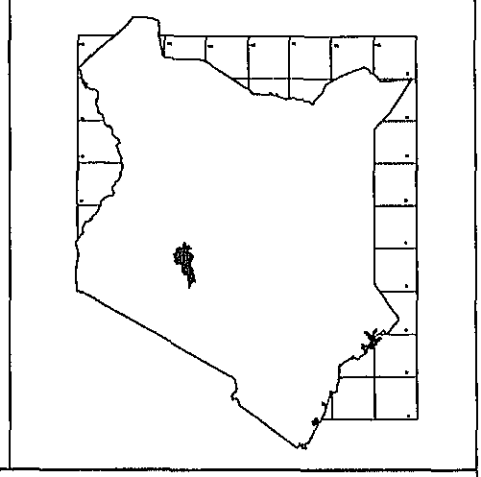


Fig.



Code	Location	Population
241.1	Dundori	14,247
241.2	Rurii	10,493
241.3	Ol Kalou	3,625
241.4	Tumaini	9,814
241.5	Kaimbaga	16,906
242.1	Ol'Joro Orok	10,797
242.2	Gathanji	15,114
243.1	Ndaragwa	14,594
243.2	Shamata	9,390
243.3	Kiriita	6,323
243.4	Mathingira	5,252
243.5	Leshau	8,339
244.1	Wanjohi	12,000
244.2	Geta	12,220
244.3	Kipipiri	4,164
244.4	Lereshwa	3,534
245.1	North Kinangop	13,486
245.2	Engineer	11,829
245.3	South Kinangop	16,479
245.4	Nyakio	12,039
245.5	Magumu	8,379



240 Nyandarua

THE STUDY
ON
THE NATIONAL WATER MASTER PLAN

JAPAN INTERNATIONAL COOPERATION AGENCY

1. Socio-Economic Profile : 240 Nyandarua District

1-1 Population Projection (Unit:1000)

Code	Location	Land Area (sq.km)	Town Name	1990			2000			2010		
				Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural
240	Nyandarua	3,529		378.0	11.9	366.1	517.6	32.0	485.6	634.9	50.2	584.7
241.1	Dundori	202		23.5	-	23.5	31.2	-	31.2	37.5	-	37.5
241.2	Rurii	129		17.3	-	17.3	22.9	-	22.9	27.6	-	27.6
241.3	Ol Kalou	90	Ol Kalou	20.6	9.7	10.9	39.3	24.8	14.5	55.3	37.8	17.4
241.4	Tumaini	128		16.2	-	16.2	21.5	-	21.5	25.8	-	25.8
241.5	Kaimbaga	123		27.9	-	27.9	37.0	-	37.0	44.5	-	44.5
242.1	Ol'Joro Orok	139	Ol'Joro Orok	18.4	0.6	17.8	24.9	1.3	23.6	30.2	1.8	28.4
242.2	Gathanji	201	*<===Nyahururu	24.9	-	24.9	33.1	-	33.1	42.3	2.5	39.8
243.1	Ndaragwa	460		24.1	-	24.1	31.9	-	31.9	38.4	-	38.4
243.2	Shamata	226		15.5	-	15.5	20.5	-	20.5	24.7	-	24.7
243.3	Kiriita	62	Mairo Inya	12.0	1.6	10.4	17.2	3.4	13.8	21.4	4.8	16.7
243.4	Mathingira	52		8.7	-	8.7	11.5	-	11.5	13.8	-	13.8
243.5	Leshau	71		13.8	-	13.8	18.2	-	18.2	22.0	-	22.0
244.1	Wanjohi	257		19.8	-	19.8	26.2	-	26.2	31.6	-	31.6
244.2	Geta	251		20.2	-	20.2	26.7	-	26.7	32.2	-	32.2
244.3	Kipipiri	120	Kipipiri	6.9	-	6.9	9.7	0.6	9.1	11.7	0.7	11.0
244.4	Lereshwa	85		5.8	-	5.8	7.7	-	7.7	9.3	-	9.3
245.1	North Kinangop	245	North Kinangop	22.2	-	22.2	30.5	1.0	29.5	36.8	1.2	35.5
245.2	Engineer	290		19.5	-	19.5	25.9	-	25.9	31.1	-	31.1
245.3	South Kinangop	185	Njabini	27.2	-	27.2	37.1	1.0	36.0	44.7	1.3	43.4
245.4	Nyakio	110		19.9	-	19.9	26.3	-	26.3	31.7	-	31.7
245.5	Magumu	103		13.8	-	13.8	18.3	-	18.3	22.1	-	22.1

1-2 GRDP Projection

Item	1990	2000	2010
1) GRDP (K.Pound million)	136.7	276.6	412.3
Percentage to GDP	1.8%	2.0%	2.0%
2) GRDP per Capita (K.Pound)	361.7	534.4	652.1
Ratio to GDP per capita	1.06	1.19	1.29
Urban (K.Pound)	549.3	572.2	698.2
Rural (K.Pound)	355.6	531.9	648.3

1-3 Present District Profile (1990)

1) Agricultural Production (1989)

Product	Production	Unit
Maize	52,704	tons
Sorghum/Millet	66	tons
Potato	56,000	tons
Rice	-	tons
Wheat/Barley	8,412	tons
Coffee	-	tons
Tea	-	tons
Milk	135,865	tons
Meat	1,206	tons

2) Number of Manufacturing Establishments (1986)

Type of Industry	Number
Food	6.0
Textile	1.0
Wood	8.0
Paper	0.0
Chemical	0.0
Non-metal	0.0
Metal	0.0
Machinery	0.0
Others	0.0
Total	15.0

3) Water Supply Schemes in Service Centre

Piped system	13
Communal water points	5
Other sources	18

4) Educational Facilities

Primary school	209
Secondary school	64
Institute	24

5) Medical Facilities

Hospital	3
Health Centre	6
Dispensary	25
Others	0

6) Out-patient of Infective Diseases in Relation to Water Supplies (1985-89 Average)

Diarrhoeal Diseases	13,576
Leprosy	2
Infectious Hepatitis	43
Bilharzia	10
Eye Infections	10,304

2. Land and resources

2.1 Present Land Use

Unit : km2

Total Area	Land Area	Water Area	Forest & Park	Swamp	Town	Barrenland	Agriculture Land	Other Land
3,528	3,508	20	850	22	266	31	1,487	852

2.2 Rain fall

Unit : mm

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
36	40	68	138	111	62	62	77	66	72	96	52	886

2.3 River Flow

Unit : m3/sec

Gauge Code	Catchment Area (km2)	Mean Flow	Low Flow Frequency			
			80%	90%	95%	Min.
2GB01	1,430	3.9	1.5	1.0	0.9	0.5
2GC04	695	3.5	0.9	0.7	0.6	0.4
2GC07	18	0.4	0.2	0.1	0.1	0.0
5AA01	577	5.8	1.4	0.9	0.8	0.4
5AA02	251	12.0	2.9	2.0	1.6	1.1
5AA04	60	0.3	0.1	0.1	0.0	0.0
5AA05	157	0.7	0.2	0.1	0.1	0.1

2.4 Groundwater

Aquifer Characteristics

Elevation (m)	Total Depth (m)	Water Struck (m)	Level Rest (m)	Yield (m3/hr)	Draw Down (m)
2420.77	126.15	107.11	67.83	5.12	33.21

Safe Abstruction Yield

Unit : m3/year

Borehole	Shallow	Total
921,987	92,954	1,014,941

2.5 Agriculture

Suitable Area for Major Crops

Unit: km2

Maize	Wheat	Rice	Sorghum	Potato	Coffee	Tea
73	0	0	0	983	0	0

Area of Irrigation Potential

Unit : ha

Surfce Water		Groundwater	
Upland	Lowland	Upland	Lowland
6,135	0	2.6	0

Livestock Population

Unit: 1,000

Cattle	Sheep/Goats	Camels	Donkeys
213.75	239.47	-	8.79

3 Water Demand Projection

Unit: cu.m/day

Location	1990				2000				2010			
	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry
Nyandarua District	10,904	2,039	7,785	831	16,827	5,400	10,556	1,556	26,061	8,602	13,436	2,271
Dundori	605	0	491	1	909	0	661	2	1,352	0	838	3
Rurii	431	0	362	0	640	0	487	0	935	0	617	0
Ol Kalou	269	1,403	279	286	398	3,653	439	530	580	5,676	601	764
Tumaini	511	0	338	0	801	0	456	0	1,263	0	577	0
Kaimbaga	576	0	583	0	828	0	785	0	1,153	0	994	0
Ol'Joro Orok	646	86	375	59	1,044	189	508	109	1,711	269	645	157
Gathanji	752	0	521	0	1,173	0	702	0	1,832	375	903	0
Ndaragwa	584	0	503	0	867	0	677	0	1,270	0	858	0
Shamata	503	0	324	0	793	0	436	0	1,263	0	552	0
Kiriita	232	231	226	0	338	503	312	0	480	719	399	0
Mathingira	172	0	181	0	244	0	244	0	336	0	309	0
Leshau	272	0	287	0	388	0	387	0	533	0	490	0
Wanjohi	604	0	414	0	943	0	557	0	1,471	0	706	0
Geta	731	0	421	38	1,184	0	567	75	1,940	0	719	115
Kipipiri	221	0	144	0	348	83	196	0	551	109	249	0
Lereshwa	121	0	122	1	175	0	164	2	242	0	208	3
North Kinangop	791	0	465	1	1,274	142	631	2	2,077	187	800	3
Engineer	565	0	408	0	871	0	549	0	1,342	0	696	0
South Kinangop	986	0	568	0	1,596	154	770	0	2,615	202	976	0
Nyakio	630	0	415	0	989	0	559	0	1,559	0	708	0
Magumu	444	0	289	0	700	0	389	0	1,109	0	493	0

4 Action Plan

4.1 Urban Water Supply

Urban Name	Population	Present Raw Water Source	Future Raw Water Source	G/P	Pipe line (km)	Pump lift (m)	Cost 1000 US$
Ol Kalou	37,900	Boreholes	Malewa River	g	16	0	10,714

g: gravity p: pump

4.2 Small Scale Irrigation Scheme

Scheme Name	Area (ha)	Farmers No (Nos)	Division	Location	Type of Project	Imp. Agency	Cost million Kshs	Basin
Gathanji	0	0	?	?	Irrigation	MOA	?	?

4.3 Large Scale Irrigation Project

Project	Area (ha)	Water Source	Water Demand (MCM)	Cost (million)		Major Crops
				US$	K£	
-	-	-	-	-	-	-

4.4 Hydropower Development

Project	Description	Executing Agency	Cost(million)		Implementation Schedule																
			US$	K£	93	94	95	96	97	98	99	20	01	02	03	04	05	06	07	08	09	10
–	–	–	–	–																		

★ Design ☆ Study ● Construction

4.5 Flood Mitigation Project

Project	Description	Executing Agency	Cost(million)		Implementation Schedule																
			US$	K£	93	94	95	96	97	98	99	20	01	02	03	04	05	06	07	08	09	10
–	–	–	–	–																		

★ Design ☆ Study ● Construction

4.6 Urban Drainage and Ad-hoc River Improvement Projects

Project	Population	Area (Km2)	Executing Agency	Cost (million)		Implementation Schedule																
				US$	K£	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10
Olkalou	9,700	0.8	MOLG	6.0	7.5													☆	☆	☆	●	●	●

★ Design ☆ Study ● Construction

4.7 Dam Development Plan

Damsites	C.A. (km2)	Purpose	FSL (El. m)	Storage (MCM)	Yield (m3/s)	Height (m)	Cost (1,000US$)
Malewa	635	W	2149	71.7	1.37	80	47,628

W:Water Supply I:Irrigation P: Power

4.8 Groundwater Development Projects

Proposed Numbers				Executing Agency	Cost (million)		Implementation Schedule																Remarks
Drinking		Livestock					93	94	95	96	97	98	99	20	01	02	03	04	05	06	07	08	09	10	
(B/H+D)	(S/W+H)	(B/H+D)	(S/W+H)		US$	K£																			
231	27	71	7	MOCSS	44.2	55.7	☆	●	●	●	●	●	●												Small communication supply

★ Design ☆ Study ● Construction

4.9 Source Development Plan for Rural Water Supply

District	Source Development Plan									Total	Implementation Program (%)	
	Surface Water	Borehole	Shallow Well	Roof Catch	Small Dam	Subsur-face Dam	Sand Dam	Rock Catch	Existing Pipeline		Up to 2000	2001-2010
- Quantity (m3/d)	16,155	6,917	255	545	1,160	0	0	164	380	25,576	39.1	60.9
- No. of Facilities	0	250	27	11,081	20	0	0	13	0	11,391		
- Cost (mill.US$)	0	28.17	0.12	6.65	1.09	0	0	0.23	0	36.26		
(mill.K£)	0	35.53	0.16	8.39	1.37	0	0	0.28	0	45.73		

4.10 Source Development Plan for Livestock Water Supply

District	Source Development Plan							Total	Implementation Program (%)	
	Surface Water	Borehole	Shallow Well	Small Dam	Subsur-face Dam	Sand Dam	Existing Pipeline		Up to 2000	2001-2010
- Quantity (m3/d)	10,186	1,855	49	881	0	0	51	13,022	49.1	50.9
- No. of Facilities	0	71	7	21	0	0	0	99		
- Cost (mill.US$)	0	7.43	0.02	0.86	0	0	0	8.31		
(mill.K£)	0	9.36	0.03	1.09	0	0	0	10.48		

4.11 Watering Points in Nomadic Pasturage Area

Assumed Nomadic Pasturage Area (km2)	No. of Watering Points (Nos.)	Executing Agency	Cost (million)		Implementation of Watering Points (No.)	
			US$	K£	Up to 2000	2000-2010
-	-	-			-	-

5 Future Water Resources Developmet Potential and Study Proposal

5.1 Potential Water Source for Future Development

Potential Water *Source for* Future Development	Purpose	Schemes		
		Water Supply	Irrigation	Hydropower

W: Water Supply I: Irrigation P: Power

5.2 River Basin Developmetn Study

Description	Executing Agency	Cost (million)		Implementation Schedule																
		US$	K£	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10
Nakuru and Environs Integrated Water Use Study	NWCPC	3.0	3.8	☆	☆	☆															
Ewaso Ngiro North River Basin Study	ENNRDA	2.5	3.2		☆	☆	☆														

★ Design ☆ Study ● Construction

5.3 District Water Resource Study

Related Basin Study Proposed	Remarks	Executing Agency	Cost (million)		Implementation Schedule																
			US$	K£	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10
Nakuru		MOWD	2.0	2.5	o	o	o	☆	☆													

☆ Study

o River Basin Study (proposed under separate programme)

Nyeri District

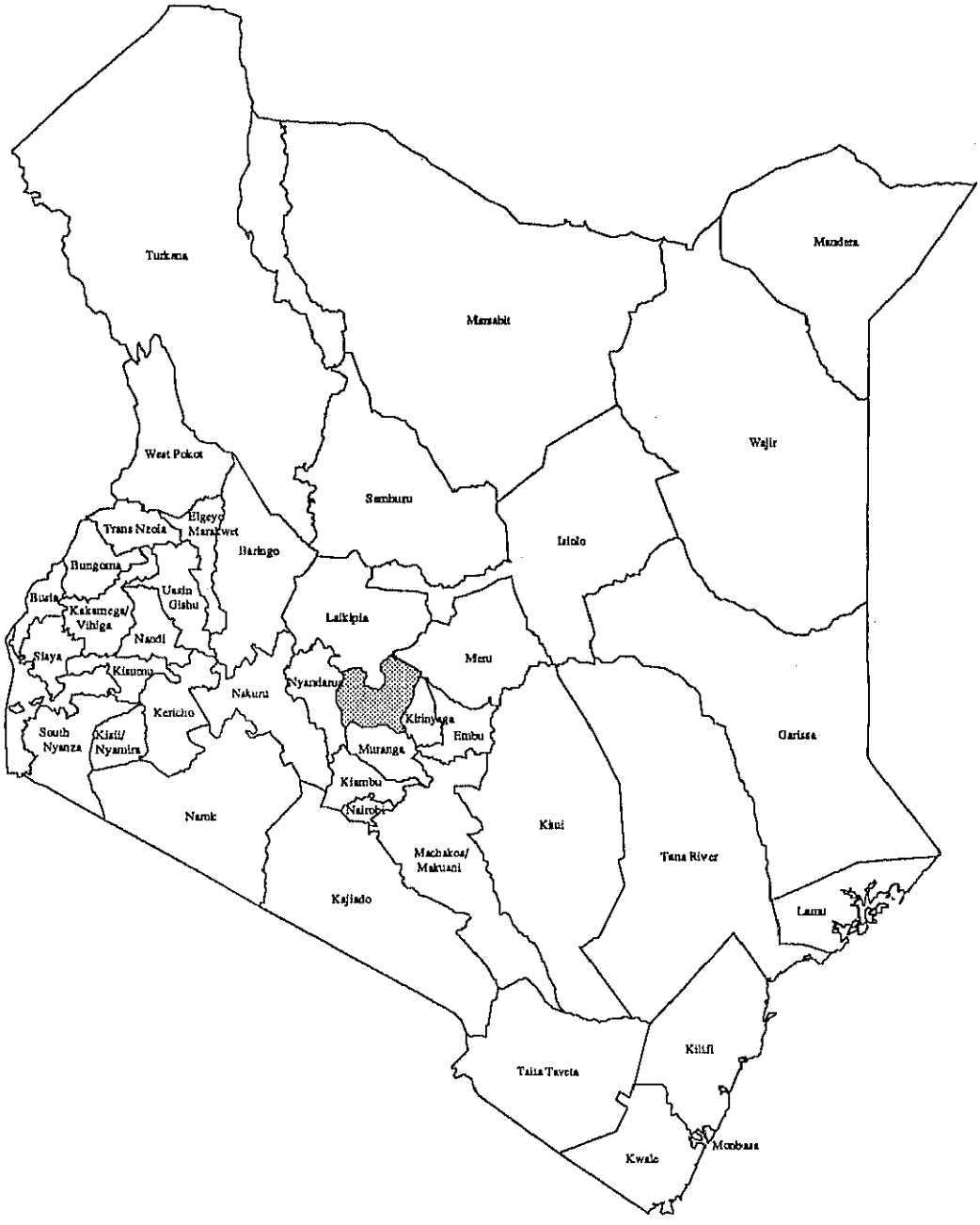
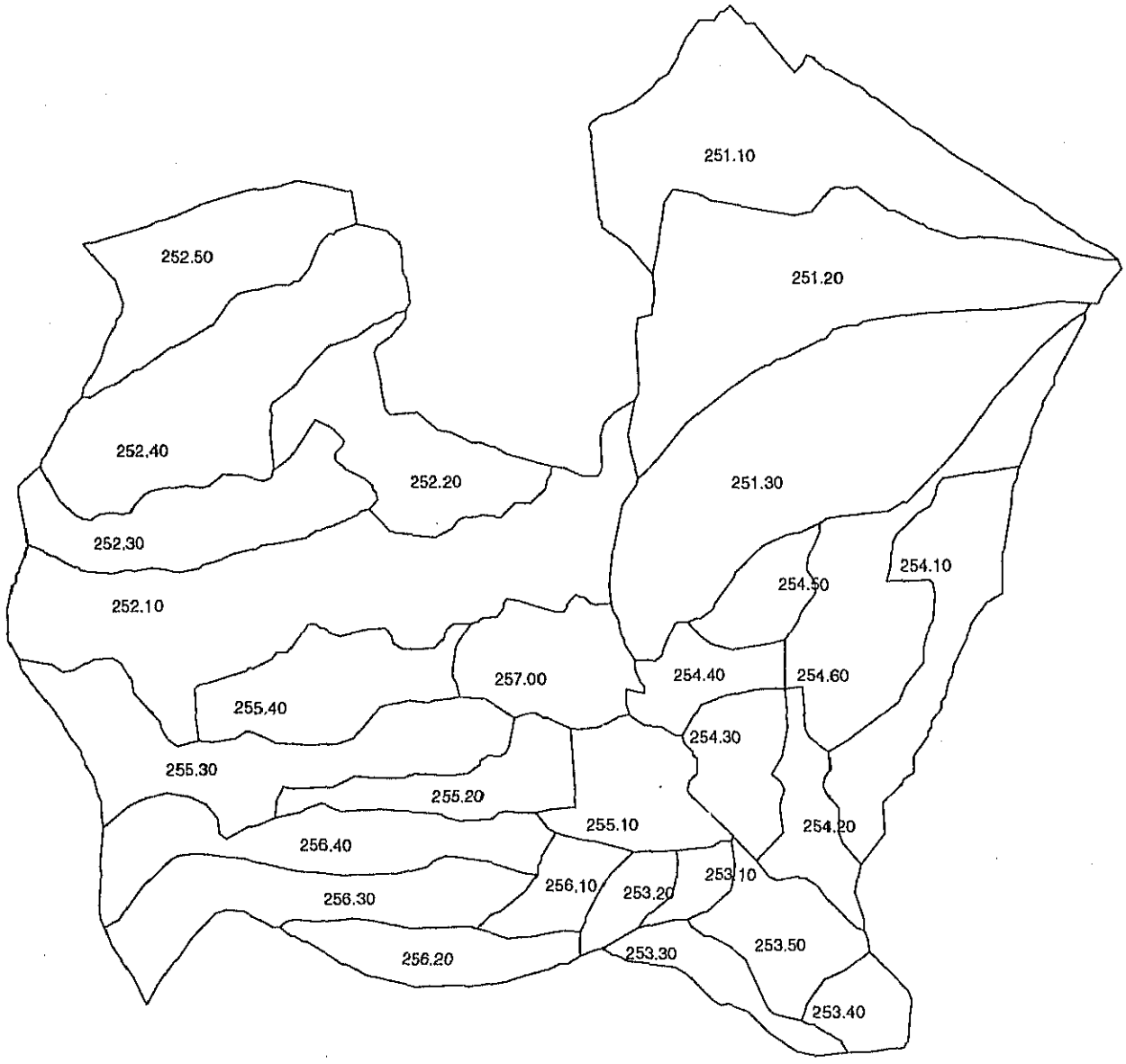
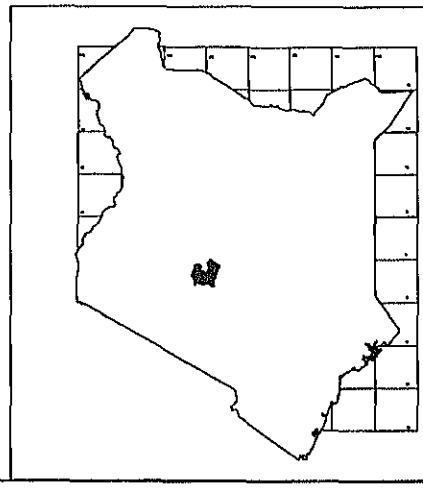


Fig.



Code	Location	Population
251.1	Gakawa	10,567
251.2	Kamburaini	13,378
251.3	Kabaru	14,947
252.1	Mweiga	9,442
252.2	Mwiyogo	7,779
252.3	Endarasha	9,510
252.4	Gatarakwa	7,448
252.5	Mugunda	7,232
253.1	Muhito	14,563
253.2	Gakindu	13,088
253.3	Gikondi	16,967
253.4	Rutune	6,189
253.5	Gethi	21,481
254.1	Iria-Ini	21,022
254.2	Konyu	32,181
254.3	Kirimukuyu	26,939
254.4	Ngorano	14,043
254.5	Ruguru	10,400
254.6	Magutu	20,809
255.1	Aguthi	32,622
255.2	Thigingi	34,149
255.3	Tetu	21,305
255.4	Muhoya	14,197
256.1	Karima	20,184
256.2	Chinga	16,691
256.3	Iria-Ini	13,102
256.4	Mahiga	18,523
257	Nyeri Municipality	37,718



250 Nyeri

THE STUDY
ON
THE NATIONAL WATER MASTER PLAN

JAPAN INTERNATIONAL COOPERATION AGENCY

1. Socio-Economic Profile : 250 Nyeri District

1-1 Population Projection

(Unit:1000)

District/Town Code	Location	Land Area (sq.km	Area (sq.km.) Town Name	3284.0	1990 Total	1990 Urban	1990 Rural	2000 Total	2000 Urban	2000 Rural	2010 Total	2010 Urban	2010 Rural
250	Nyeri District	3285			647.3	107.2	540.1	803.6	242.9	560.7	1084.4	411.5	672.8
251.1	Gakawa	263			12.8	-	12.8	13.3	-	13.3	16.0	-	16.0
251.2	Kamburaini	277	Naro Moru		16.2	-	16.2	17.5	0.6	16.8	21.1	0.9	20.2
251.3	Kabaru	338			18.1	-	18.1	18.8	-	18.8	22.6	-	22.6
252.1	Mweiga	333	Mweiga		11.4	-	11.4	12.3	0.4	11.9	14.8	0.6	14.3
252.2	Mwiyogo	121			9.4	-	9.4	9.8	-	9.8	11.7	-	11.7
252.3	Endarasha	118			11.5	-	11.5	12.0	-	12.0	14.4	-	14.4
252.4	Gatarakwa	211			9.0	-	9.0	9.4	-	9.4	11.2	-	11.2
252.5	Mugunda	126			8.8	-	8.8	9.1	-	9.1	10.9	-	10.9
253.1	Muhito	19			17.7	-	17.7	18.3	-	18.3	22.0	-	22.0
253.2	Gakindu	28			15.9	-	15.9	16.5	-	16.5	19.8	-	19.8
253.3	Gikondi	42			20.6	-	20.6	21.3	-	21.3	25.6	-	25.6
253.4	Rutune	35			7.5	-	7.5	7.8	-	7.8	9.3	-	9.3
253.5	Gethi	71			26.0	-	26.0	27.0	-	27.0	32.4	-	32.4
254.1	Iria-Ini	119			25.5	-	25.5	26.5	-	26.5	31.7	-	31.7
254.2	Konyu	51			39.0	-	39.0	40.5	-	40.5	48.6	-	48.6
254.3	Kirimukuyu	60	Karatina		34.4	5.4	29.0	42.3	12.2	30.1	56.8	20.6	36.2
254.4	Ngorano	46			17.0	-	17.0	17.7	-	17.7	21.2	-	21.2
254.5	Ruguru	42			12.6	-	12.6	13.1	-	13.1	15.7	-	15.7
254.6	Magutu	150			25.2	-	25.2	26.2	-	26.2	31.4	-	31.4
255.1	Aguthi	77			39.5	-	39.5	41.0	-	41.0	49.3	-	49.3
255.2	Thigingi	67			41.4	-	41.4	43.0	-	43.0	51.6	-	51.6
255.3	Tetu	164			25.8	-	25.8	26.8	-	26.8	32.2	-	32.2
255.4	Muhoya	98	Ihururu		17.2	-	17.2	18.2	0.3	17.9	21.9	0.4	21.4
256.1	Karima	37	Othaya		29.3	4.8	24.5	36.2	10.8	25.4	48.8	18.3	30.5
256.2	Chinga	62			20.2	-	20.2	21.0	-	21.0	25.2	-	25.2
256.3	Iria-Ini	122			15.9	-	15.9	16.5	-	16.5	19.8	-	19.8
256.4	Mahiga	122			19.8	-	19.8	20.6	-	20.6	24.7	-	24.7
257.0	Nyeri Municipality	86	Nyeri		99.4	97.0	2.4	221.0	218.6	2.5	373.6	370.7	3.0

1-2 GRDP Projection

Item	1990	2000	2010
1) GRDP (K.Pound million)	155.1	279.4	414.7
Percentage to GDP	2.0%	2.0%	2.0%
2) GRDP per Capita (K.Pound)	239.6	347.7	382.4
Ratio to GDP per capita	0.70	0.77	0.75
Urban (K.Pound)	762.8	636.6	575.4
Rural (K.Pound)	135.8	222.5	264.4

1-3 Present District Profile (1990)

1) Agricultural Production (1989)

Product	Production	Unit
Maize	27,397	tons
Sorghum/Millet	157	tons
Potato	124,030	tons
Rice	-	tons
Wheat/Barley	2,274	tons
Coffee	8,231	tons
Tea	53,006	tons
Milk	20,755	tons
Meat	2,277	tons

2) Number of Manufacturing Establishments (1986)

Type of Industry	Number
Food	32.0
Textile	1.0
Wood	14.0
Paper	1.0
Chemical	1.0
Non-metal	3.0
Metal	0.0
Machinery	0.0
Others	0.0
Total	52.0

3) Water Supply Schemes in Service Centre

Piped system	62
Communal water points	2
Other sources	2

4) Educational Facilities

Primary school	339
Secondary school	128
Institute	31

5) Medical Facilities

Hospital	7
Health Centre	6
Dispensary	29
Others	0

6) Out-patient of Infective Diseases in Relation to Water Supplies (1985-89 Average)

Diarrhoeal Diseases	32211
Leprosy	49
Infectious Hepatitis	911
Bilharzia	593
Eye Infections	21785

2. Land and resources

2.1 Present Land Use

Unit : km2

Total Area	Land Area	Water Area	Forest & Park	Swamp	Town	Barrenland	Agriculture Land	Other Land
3,284	3,284	0	1,526	0	60	5	1,104	589

2.2 Rain fall

Unit : mm

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
50	52	87	198	168	48	46	50	45	114	157	84	1,105

2.3 River Flow

Unit : m3/sec

Gauge Code	Catchment Area (km2)	Mean Flow	Low Flow Frequency			
			80%	90%	95%	Min.
4AA01	96	1.0	0.2	0.2	0.2	0.1
4AA07	41	1.2	0.2	0.2	0.2	0.1
4AB05	420	2.0	0.6	0.4	0.4	0.2
4AC03	282	12.6	3.9	2.9	2.5	1.9
4AC04	210	6.2	1.4	1.0	0.8	0.4
4AD01	430	12.7	4.4	3.3	2.8	2.0
4AD03	37	1.5	0.1	0.1	0.0	0.0
4BB01	254	9.9	2.3	1.2	0.9	0.5

2.4 Groundwater

Aquifer Characteristics

Elevation (m)	Total Depth (m)	Water Struck (m)	Level Rest (m)	Yield (m3/hr)	Draw Down (m)
1925.41	121.98	84.93	49.8	5.94	40.34

Safe Abstruction Yield

Unit : m3/year

Borehole	Shallow	Total
1,089,109	66,746	1,155,855

2.5 Agriculture

Suitable Area for Major Crops

Unit: km2

Maize	Wheat	Rice	Sorghum	Potato	Coffee	Tea
907	639	2	626	586	505	130

Area of Irrigation Potential

Unit : ha

Surfce Water		Groundwater	
Upland	Lowland	Upland	Lowland
15,567	244	0	0

Livestock Population

Unit: 1,000

Cattle	Sheep/Goats	Camels	Donkeys
142.52	118.26	-	-

3 Water Demand Projection

Unit: cu.m/day

Location	1990				2000				2010			
	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry
Nyeri District	18,024	15,500	3,916	2,521	22,488	35,792	4,427	4,570	36,041	61,771	5,989	6,407
Gakawa	342	0	88	0	407	0	95	0	616	0	123	0
Kamburaini	453	0	112	0	546	94	121	0	835	133	158	0
Kabaru	508	0	125	0	613	0	134	0	937	0	174	0
Mweiga	341	0	79	1	418	62	85	2	654	87	111	3
Mwiyogo	191	0	65	0	215	0	70	0	295	0	91	0
Endarasha	380	0	80	0	471	0	85	0	754	0	111	0
Gatarakwa	251	0	62	0	303	0	67	0	463	0	87	0
Mugunda	190	0	61	0	217	0	65	0	306	0	84	0
Muhito	641	0	122	228	812	0	131	421	1,326	0	170	607
Gakindu	576	0	110	0	730	0	117	0	1,192	0	153	0
Gikondi	715	0	142	0	897	0	152	0	1,449	0	198	0
Rutune	197	0	52	57	231	0	55	105	339	0	72	152
Gethi	892	0	180	398	1,116	0	193	738	1,796	0	250	1,062
Iria-Ini	924	0	176	0	1,172	0	188	0	1,914	0	245	0
Konyu	1,416	0	269	0	1,794	0	289	0	2,930	0	375	0
Kirimukuyu	1,014	781	210	185	1,275	1,793	236	333	2,061	3,098	319	460
Ngorano	458	0	118	0	546	0	126	0	827	0	164	0
Ruguru	437	0	87	0	548	0	93	0	884	0	121	0
Magutu	899	0	174	0	1,134	0	187	0	1,845	0	243	0
Aguthi	1,254	0	273	0	1,541	0	292	0	2,424	0	380	0
Thigingi	1,420	0	286	0	1,777	0	306	0	2,859	0	398	0
Tetu	937	0	178	0	1,188	0	191	0	1,940	0	248	0
Muhoya	616	0	119	114	779	44	128	211	1,268	63	166	303
Karima	888	694	177	0	1,125	1,593	200	0	1,838	2,753	271	0
Chinga	734	0	140	57	930	0	150	105	1,520	0	195	152
Iria-Ini	577	0	110	0	730	0	117	0	1,193	0	153	0
Mahiga	720	0	137	115	912	0	147	212	1,490	0	191	306
Nyeri Municipality	53	14,026	184	1,366	61	32,205	407	2,443	86	55,638	738	3,362

4 Action Plan

4.1 Urban Water Supply

Urban Name	Population	Present Raw Water Source	Future Raw Water Source	G/P	Pipe line (km)	Pump lift (m)	Cost 1000 US$
Karatina	20,700	Ragati River	Ragati River	g	6.9	0	3,883
Othaya	18,400	Gikira River	Tuthi river	g	5	0	5,000
Nyeri	370,700	Chania River	Chania River	g	4.1	0	50,344

g: gravity p; pump

4.2 Small Scale Irrigation Scheme

Scheme Name	Area (ha)	Farmers No (Nos)	Division	Location	Type of Project	Imp. Agency	Cost million Kshs	Basin
Kamburaini	8	?	?	?	Irrigaiton	?	0.328	4AA
Ruhotie	0	?	?	?	Irrigaiton	?	?	4AB
Kihuru	29	?	?	?	Irrigaiton	?	1.189	4BB
Riakiumu	0	?	?	?	Irrigaiton	?	?	4BB
Kanjuri	20	200	Mathira	Magumu	Irrigation	FARMERS	0.82	?
Kamoko	20	?	?	?	Irrigaiton	?	0.82	?

4.3 Large Scale Irrigation Project

Project	Area (ha)	Water Source	Water Demand (MCM)	Cost (million)		Major Crops
				US$	K£	
-	-	-	-	-	-	-

4.4 Hydropower Development

Project	Description	Executing Agency	Cost(million) US$	Cost(million) K£	Implementation Schedule 93	94	95	96	97	98	99	20	01	02	03	04	05	06	07	08	09	10
-	-	-	-	-																		

★ Design ☆ Study ● Construction

4.5 Flood Mitigation Project

Project	Description	Executing Agency	Cost(million) US$	Cost(million) K£	Implementation Schedule 93	94	95	96	97	98	99	20	01	02	03	04	05	06	07	08	09	10
-	-	-	-	-																		

★ Design ☆ Study ● Construction

4.6 Urban Drainage and Ad-hoc River Improvement Projects

Project	Population	Area (Km2)	Executing Agency	Cost (million) US$	Cost (million) K£	Implementation Schedule 93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10
Nyeri	97,000	1.6	MOLG	13.1	16.5							☆	☆	☆	●	●	●						

★ Design ☆ Study ● Construction

4.7 Dam Development Plan

Damsites	C.A. (km2)	Purpose	FSL (El. m)	Storage (MCM)	Yield (m3/s)	Height (m)	Cost (1,000US$)
-	-	-	-	-	-	-	-

W:Water Supply I:Irrigation P: Power

4.8 Groundwater Development Projects

Proposed Numbers Drinking (B/H+D)	Proposed Numbers Drinking (S/W+H)	Proposed Numbers Livestock (B/H+D)	Proposed Numbers Livestock (S/W+H)	Executing Agency	Cost (million) US$	Cost (million) K£	Implementation Schedule 93	94	95	96	97	98	99	20	01	02	03	04	05	06	07	08	09	10	Remarks
-	-	-	-	-																					-

★ Design ☆ Study ● Construction

4.9 Source Development Plan for Rural Water Supply

District	Source Development Plan: Surface Water	Borehole	Shallow Well	Roof Catch	Small Dam	Subsur-face Dam	Sand Dam	Rock Catch	Existing Pipeline	Total	Implementation Program (%): Up to 2000	2001-2010
- Quantity (m3/d)	34,264	163	58	0	1,473	0	0	0	51	36,009	24.8	75.2
- No. of Facilities	0	6	12	0	28	0	0	0	0	46		
- Cost (mill.US$)	0	0.58	0.06	0	0.87	0	0	0	0	1.5		
(mill.K£)	0	0.73	0.07	0	1.09	0	0	0	0	1.89		

4.10 Source Development Plan for Livestock Water Supply

District	Source Development Plan: Surface Water	Borehole	Shallow Well	Small Dam	Subsur-face Dam	Sand Dam	Existing Pipeline	Total	Implementation Program (%): Up to 2000	2001-2010
- Quantity (m3/d)	4,969	0	0	200	0	0	0	5,169	24.7	75.3
- No. of Facilities	0	0	0	27	0	0	0	27		
- Cost (mill.US$)	0	0	0	0.11	0	0	0	0.11		
(mill.K£)	0	0	0	0.14	0	0	0	0.14		

4.11 Watering Points in Nomadic Pasturage Area

Assumed Nomadic Pasturage Area (km2)	No. of Watering Points (Nos.)	Executing Agency	Cost (million)		Implementation of Watering Points (No.)	
			US$	K£	Up to 2000	2000-2010
-	-	-			-	-

5 Future Water Resources Developmet Potential and Study Proposal

5.1 Potential Water Source for Future Development

Potential Water Source for Future Development	Purpose	Schemes		
		Water Supply	Irrigation	Hydropower
-	-	-	-	-

W:Water Supply I:Irrigation P: Power

5.2 River Basin Developmetn Study

Description	Executing Agency	Cost (million)		Implementation Schedule																	
		US$	K£	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10
Tana River Basin Study (Update)	TARDA	4.0	5.0				☆	☆	☆	☆	☆										

★ Design ☆ Study ● Construction

5.3 District Water Resource Study

Related Basin Study Proposed	Remarks	Executing Agency	Cost (million)		Implementation Schedule																
			US$	K£	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10
Tana		MOWD	2.0	2.5				o	o	o	o	o	☆									

☆ Study

o River Basin Study (proposed under separate programme)