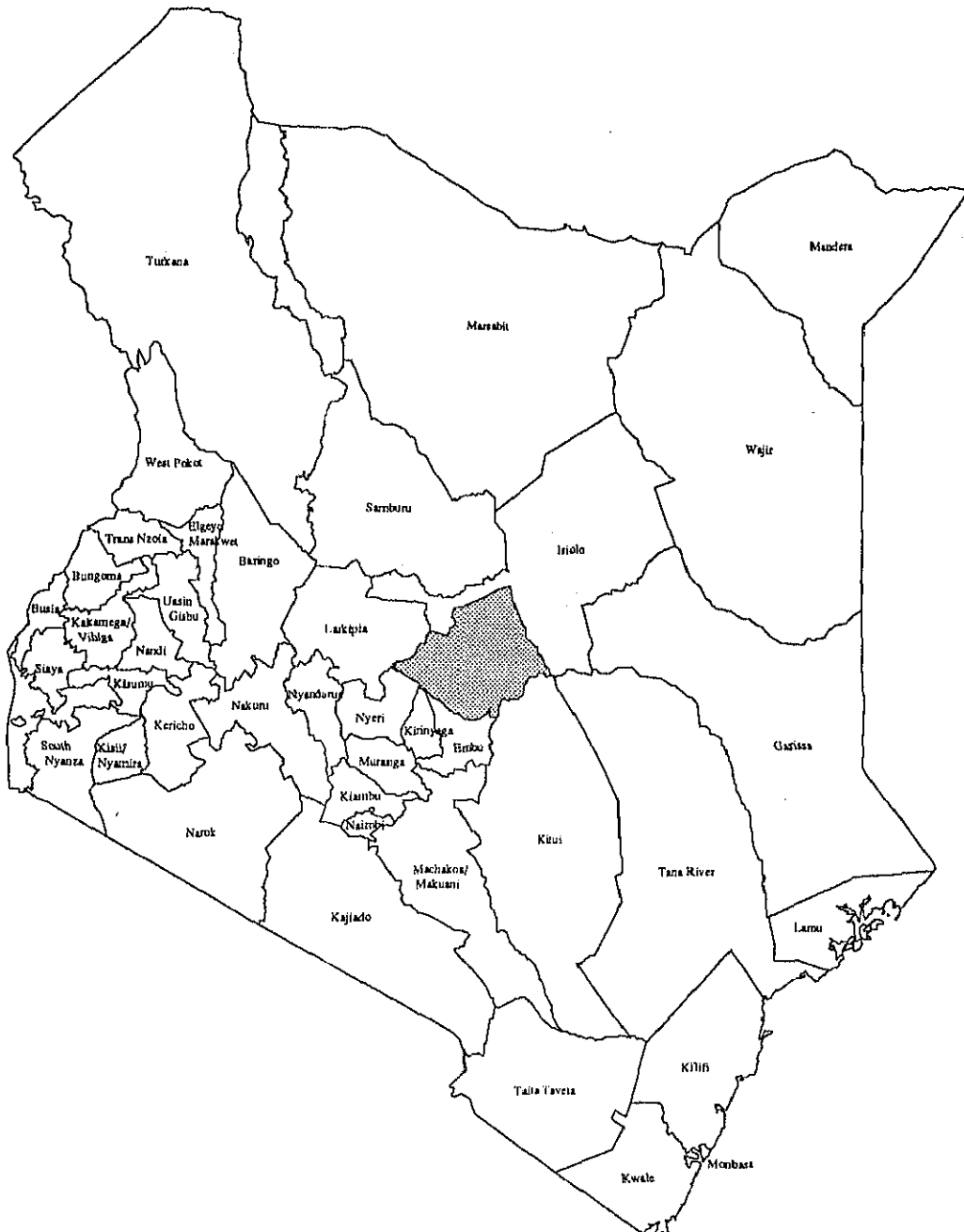
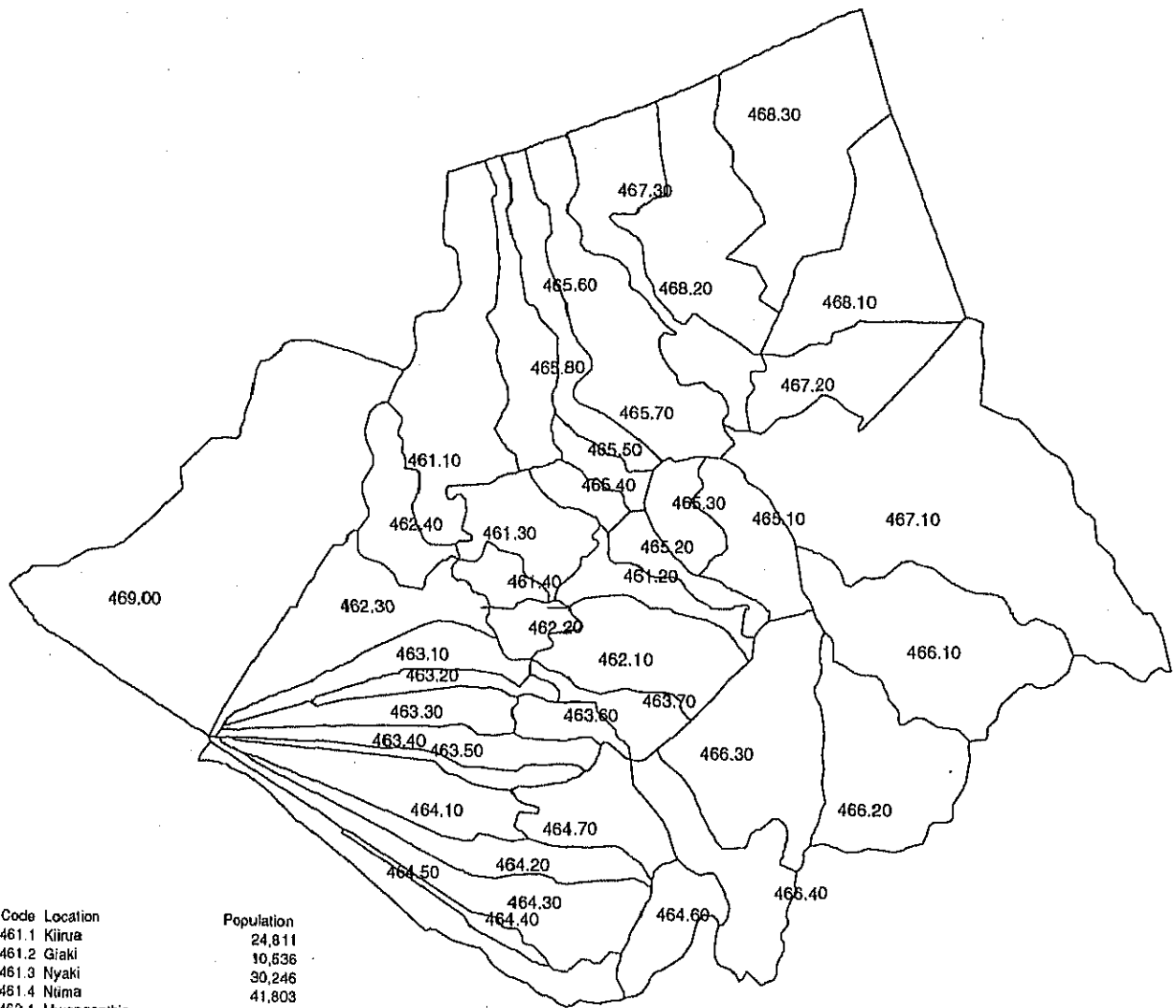


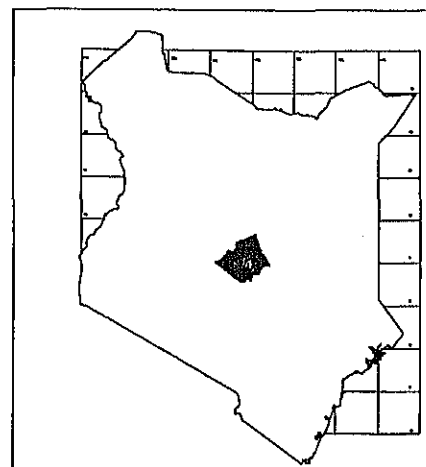
Meru District





Code	Location	Population
461.1	Kiirua	24,811
461.2	Giaki	10,636
461.3	Nyaki	30,246
461.4	Nima	41,803
462.1	Mwanganthia	27,617
462.2	Gatimbi	22,033
462.3	Abochuguchi	24,655
462.4	Kibirichia	16,733
463.1	Nkuone	27,263
463.2	Igoki	8,547
463.3	Abogola	11,236
463.4	Mitine	17,851
463.5	Igoji	12,997
463.6	Kanyakine	14,906
463.7	Mitunguu	10,743
464.1	Chogoria	21,450
464.2	Muthamba	22,376
464.3	Karingani	33,983
464.4	Mwonge	7,076
464.5	Megumoni	19,941
464.6	Kanjuki	10,308
464.7	Kiora	27,155
465.1	Thangatha	18,106
465.2	Mbeu	9,771
465.3	Mikinduri	25,509
465.4	Uringu	11,327
465.5	Kianjai	16,101
465.6	Akithi	25,015
465.7	Muthara	28,873
465.8	Mitungu	5,049
466.1	Gikingo	9,701
466.2	Gatue	7,390
466.3	Marimanti	20,291
466.4	South Tharaka	12,895
467.1	Akachiu	30,638
467.2	Mava	22,804
467.3	Njia	37,365
468.1	Uthiru/Rujine	29,069
468.2	Ithima	30,908
468.3	Mutunati	20,813
469	Timau	23,389

460 Meru



THE STUDY
ON
THE NATIONAL WATER MASTER PLAN
JAPAN INTERNATIONAL COOPERATION AGENCY

1. Socio-Economic Profile : 460 Meru 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
460	Meru District	9,927		1213.4	91.9	1121.5	1632.5	229.5	1403.0	2066.7	375.6	1691.1
461.1	Kijirua	430		36.7	-	36.7	46.0	-	46.0	55.4	-	55.4
461.2	Giaki	101		15.6	-	15.6	19.5	-	19.5	23.5	-	23.5
461.3	Nyaki	167	*->a part of Meru	34.2	33.0	1.2	82.2	80.7	1.5	135.6	133.8	1.8
461.4	Ntuma	56	Meru	47.1	45.9	1.2	113.7	112.2	1.5	187.8	186.0	1.8
462.1	Mwanganthia	251		40.9	-	40.9	51.2	-	51.2	61.7	-	61.7
462.2	Gatimbi	59		32.6	-	32.6	40.8	-	40.8	49.2	-	49.2
462.3	Abochuguchi	296		36.5	-	36.5	45.7	-	45.7	55.1	-	55.1
462.4	Kibirichia	144		24.8	-	24.8	31.0	-	31.0	37.4	-	37.4
463.1	Nkuene	142	Nkubu	41.7	5.0	36.7	58.1	12.2	45.9	75.5	20.3	55.3
463.2	Igoki	66		12.7	-	12.7	15.8	-	15.8	19.1	-	19.1
463.3	Abogeta	135		16.6	-	16.6	20.8	-	20.8	25.1	-	25.1
463.4	Mitine	140		26.4	-	26.4	33.1	-	33.1	39.9	-	39.9
463.5	Igoji	64	Igoji	19.3	-	19.3	25.0	0.9	24.1	30.2	1.2	29.0
463.6	Kanyakine	63	Kanyakine	22.1	-	22.1	28.7	1.1	27.6	34.8	1.5	33.3
463.7	Mitunguu	85		15.9	-	15.9	19.9	-	19.9	24.0	-	24.0
464.1	Chogoria	211	Chogoria	31.8	-	31.8	41.9	2.1	39.7	50.8	2.9	47.9
464.2	Muthambe	160		33.1	-	33.1	41.5	-	41.5	50.0	-	50.0
464.3	Karingani	274	Chuka	54.3	4.0	50.3	71.2	8.2	63.0	88.3	12.4	75.9
464.4	Mwonge	37		10.5	-	10.5	13.1	-	13.1	15.8	-	15.8
464.5	Magumoni	186		29.5	-	29.5	36.9	-	36.9	44.5	-	44.5
464.6	Kanjuki	126		15.3	-	15.3	19.1	-	19.1	23.0	-	23.0
464.7	Kiera	174		40.2	-	40.2	50.3	-	50.3	60.6	-	60.6
465.1	Thangatha	169		26.8	-	26.8	33.5	-	33.5	40.4	-	40.4
465.2	Mbeu	83		14.5	-	14.5	18.1	-	18.1	21.8	-	21.8
465.3	Mikinduri	96		37.8	-	37.8	47.3	-	47.3	57.0	-	57.0
465.4	Uringu	55		16.8	-	16.8	21.0	-	21.0	25.3	-	25.3
465.5	Kianjai	54		23.8	-	23.8	29.8	-	29.8	36.0	-	36.0
465.6	Akithi	168		37.1	-	37.1	46.4	-	46.4	55.9	-	55.9
465.7	Muthara	378	Miathene	42.8	-	42.8	54.5	1.0	53.5	65.8	1.3	64.5
465.8	Mituntu	184		8.8	-	8.8	11.0	-	11.0	13.3	-	13.3
466.1	Gikingo	466		14.4	-	14.4	18.0	-	18.0	21.7	-	21.7
466.2	Gatue	342		10.9	-	10.9	13.7	-	13.7	16.5	-	16.5
466.3	Marimanti	419	Marimanti	30.1	-	30.1	38.3	0.7	37.6	46.3	1.0	45.3
466.4	South Tharaka	239		19.1	-	19.1	23.9	-	23.9	28.8	-	28.8
467.1	Akachiu	1,083		45.4	-	45.4	56.8	-	56.8	68.4	-	68.4
467.2	Maua	214	Maua	37.8	4.0	33.8	50.5	8.2	42.3	63.3	12.4	50.9
467.3	Njia	287	Kangeta+Larc	55.3	-	55.3	71.4	2.2	69.2	86.4	3.0	83.4
468.1	Uthiru/Rujine	362		43.1	-	43.1	53.9	-	53.9	64.9	-	64.9
468.2	Ithima	369		45.8	-	45.8	57.3	-	57.3	69.0	-	69.0
468.3	Mutuati	493		30.8	-	30.8	38.6	-	38.6	46.5	-	46.5
469.0	Timau	1,099		34.6	-	34.6	43.3	-	43.3	52.2	-	52.2

1-2 GRDP Projection

Item	1990	2000	2010
1) GRDP (K.Pound million)	88.9	161.4	241.2
Percentage to GDP	1.1%	1.2%	1.2%
2) GRDP per Capita (K.Pound)	73.2	98.9	116.7
Ratio to GDP per capita	0.21	0.22	0.23
Urban (K.Pound)	601.6	455.6	426.3
Rural (K.Pound)	29.9	40.5	48.0

1-3 Present District Profile (1990)

1) Agricultural Production (1989)			3) Water Supply Schemes in Service Centre	
Product	Production	Unit	Piped system	18
Maize	96,453	tons	Communal water points	4
Sorghum/Millet	11,135	tons	Other sources	19
Potato	136,566	tons	4) Educational Facilities	
Rice	-	tons	Primary school	824
Wheat/Barley	23,448	tons	Secondary school	131
Coffee	-	tons	Institute	33
Tea	34,476	tons	5) Medical Facilities	
Milk	-	tons	Hospital	7
Meat	-	tons	Health Centre	8
2) Number of Manufacturing Establishments (1986)			Dispensary	87
Type of Industry	Number		Others	2
Food	23		6) Out-patient of Infective Diseases in Relation to Water Supplies (1985-89 Average)	
Textile	4		Diarrhoeal Diseases	33,175
Wood	8		Leprosy	26
Paper	1		Infectious Hepatitis	797
Chemical	0		Bilharzia	1,450
Non-metal	2		Eye Infections	34,076
Metal	0			
Machinery	0			
Others	0			
Total	38			

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
9,922	9,922	0	2,582	0	212	242	2,773	4,113

2.2 Rain fall

Unit : mm

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
33	26	74	144	50	14	8	13	10	84	168	73	704

2.3 River Flow

Unit : m³/sec

Gauge Code	Catchment Area (km ²)	Mean Flow	Low Flow Frequency			
			80%	90%	95%	Min.
4EA03	44	2.2	0.3	0.2	0.2	0.1
4EB01	120	2.9	0.7	0.6	0.6	0.5
4EB04	111	3.8	1.2	1.2	1.2	1.2
4EB06	368	4.5	1.8	1.8	1.8	1.6
4EB06A	368	4.9	1.5	1.1	0.9	0.4
4F 01	16,972	137.5	55.0	38.5	31.6	19.3
4F 02	1,642	15.2	3.2	2.4	2.1	1.5
4F 03	246	2.4	0.7	0.5	0.5	0.4
4F 04	91	2.4	1.8	1.8	1.7	1.6
4F 05	17	1.5	1.4	1.4	1.4	1.4
4F 10	878	6.3	0.6	0.4	0.3	0.2
4F 13	17,179	204.5	24.5	18.4	18.4	18.4
4F 19	1,702	17.9	3.9	3.0	2.9	1.4

2.4 Groundwater

Aquifer Characteristics

Elevation (m)	Total Depth (m)	Water Struck (m)	Level Rest (m)	Yield (m ³ /hr)	Draw Down (m)
1179	87.46	66.1	40.93	7.2	26.76

Safe Abstraction Yield

Unit : m³/year

Borehole	Shallow	Total
3,388,102	2,240,949	5,629,051

2.5 Agriculture

Suitable Area for Major Crops

Unit: km²

Maize	Wheat	Rice	Sorghum	Potato	Coffee	Tea
2,863	408	915	4,032	218	894	111

Area of Irrigation Potential

Unit : ha

Surface Water		Groundwater	
Upland	Lowland	Upland	Lowland
19,188	18,312	0	0.7

Livestock Population

Unit: 1,000

Cattle	Sheep/Goats	Camels	Donkeys
490.44	579.16	2.74	

3 Water Demand Projection

Unit: cu.m/day

Location	1990				2000				2010			
	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry
Meru District	28,962	13,289	12,751	1,637	41,332	33,815	15,796	3,024	62,124	56,374	19,739	4,346
Kiirus	771	0	409	0	1,053	0	497	0	1,481	0	613	0
Giaki	391	0	174	0	548	0	211	0	801	0	260	0
Nyaki	36	4,772	105	57	52	11,886	234	105	81	20,077	390	152
Ntina	41	6,637	141	1,523	62	16,532	320	2,814	101	27,926	534	4,042
Mwangantia	1,030	0	456	0	1,444	0	554	0	2,114	0	682	0
Gatumbi	951	0	364	0	1,378	0	442	0	2,114	0	544	0
Abochuguchi	1,238	0	407	0	1,861	0	494	0	2,999	0	609	0
Kibirichia	690	0	276	0	1,003	0	335	0	1,549	0	413	0
Nkuene	1,241	723	422	0	1,867	1,800	529	0	3,007	3,042	667	0
Igoki	435	0	141	0	657	0	171	0	1,063	0	211	0
Abogeta	584	0	185	0	885	0	225	0	1,439	0	277	0
Mitine	865	0	295	0	1,292	0	358	0	2,060	0	441	0
Igoji	633	0	214	0	944	129	263	0	1,508	180	324	0
Kanyakine	624	0	246	0	899	163	302	0	1,366	225	372	0
Mitunguu	377	0	177	0	524	0	215	0	758	0	265	0
Chogoria	1,131	0	354	0	1,719	312	436	0	2,805	431	538	0
Muthambe	1,025	0	369	0	1,515	0	448	0	2,387	0	553	0
Karingani	1,435	579	572	0	2,084	1,213	703	0	3,210	1,855	873	0
Mwonge	356	0	117	0	535	0	142	0	862	0	175	0
Magumoni	873	0	329	0	1,283	0	400	0	2,006	0	492	0
Kanjuki	303	0	170	0	407	0	207	0	559	0	255	0
Kiera	983	0	448	0	1,375	0	544	0	2,006	0	671	0
Thangatha	688	0	299	0	969	0	363	0	1,430	0	447	0
Mbeu	360	0	161	0	503	0	196	0	737	0	241	0
Mikinduri	1,079	0	421	0	1,553	0	511	0	2,365	0	630	0
Uringu	440	0	187	0	620	0	227	0	917	0	280	0
Kianjai	647	0	266	0	933	0	323	0	1,423	0	398	0
Akithi	796	0	413	0	1,094	0	501	0	1,559	0	618	0
Muthara	928	0	476	0	1,278	143	581	0	1,824	197	717	0
Mituntu	174	0	98	0	234	0	119	0	323	0	147	0
Gikingo	284	0	160	0	383	0	194	0	527	0	240	0
Gatue	217	0	122	0	292	0	148	0	401	0	182	0
Marimanti	595	0	335	57	801	104	409	105	1,101	144	504	152
South Tharaka	379	0	213	0	509	0	258	0	700	0	318	0
Akachi	943	0	506	0	1,281	0	614	0	1,791	0	757	0
Maua	782	579	387	0	1,087	1,213	479	0	1,570	1,855	597	0
Njia	1,203	0	617	0	1,659	320	755	0	2,370	443	931	0
Uthiru/Rujine	925	0	480	0	1,266	0	583	0	1,783	0	718	0
Ithima	971	0	510	0	1,331	0	619	0	1,883	0	763	0
Mutunati	638	0	343	0	867	0	417	0	1,213	0	514	0
Timau	900	0	386	0	1,285	0	469	0	1,931	0	578	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\$
Meru	319,900	Kazita R. Gatobora St	Kathita river	g	2.2	0	43,544
Nkubu	20,300	Thingithu River	Thingithu River	g	2	0	4,639
Chogoria	2,900	Mutonga River	North Mara River	p	2.8	50	1,716
Chuka	12,400	Tungu River	Tungu river	g	7	0	4,158
Maua	12,400	Mboone Stream	Ura river	p	4.1	250	3,827

g: gravity p: pump

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	Subsurface Dam	Sand Dam	Rock Catch	Existing Pipeline		Up to 2000	2001-2010
- Quantity (m3/d)	34,311	16,661	4,596	2,199	1,882	174	47	21	2,147	62,038	37.3	62.7
- No. of Facilities	0	481	923	90,443	39	21	9	5	0	91,921		
- Cost (mill.US\$)	0	60.91	4.56	54.59	2.08	0.5	0.1	0.08	0	122.82		
(mill.K£)	0	76.8	5.74	68.84	2.63	0.63	0.12	0.11	0	154.87		

4.10 Source Development Plan for Livestock Water Supply

District	Source Development Plan								Total	Implementation Program (%)	
	Surface Water	Borehole	Shallow Well	Small Dam	Subsurface Dam	Sand Dam	Existing Pipeline	Up to 2000		2001-2010	
- Quantity (m3/d)	10,891	5,417	1,622	624	61	13	2	18,630	43.6	56.4	
- No. of Facilities	0	171	331	39	11	8	0	560			
- Cost (mill.US\$)	0	19.7	1.6	0.71	0.17	0.03	0	22.21			
(mill.K£)	0	24.85	2.02	0.89	0.22	0.03	0	28.01			

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	2001-2010
3,098	5	MOWD	0.8	1.0	2	3

5 Future Water Resources Development Potential and Study Proposal

5.1 Potential Water Source for Future Development

Potential Water Source for Future Development	Purpose	Schemes		
		Water Supply	Irrigation	Hydropower
Meru W/S system High Grand Falls Dam	W P+W+I	Isiolo Rural	Small	H.Grand Falls

W:Water Supply I:Irrigation P:Power

5.2 River Basin Development 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	(WRAP completed)	MOWD	-	-																		

☆ Study

○ River Basin Study (proposed under separate programme)

North-Eastern Province

North-Eastern Province

Socio Economic Profiles

North-Eastern Province has a total area of 126.9 thousand km² or 21% of the national total. Of the total provincial area, 7.0 thousand km² or 6% is reserved area for uses such as national parks and reserved areas. The rest, 119.9 thousand km² or 94%, is habitable areas where the people carry out their daily activities. In 1990, the district population distribution was as follows:

Code District	Area (km ²)	Population in 1990 (1000)	Density (persons/km ²)
510 Garissa	43,931	127	3
520 Mandera	26,470	127	5
530 Wajir	56,501	126	2

In 1990, 381 thousand people or 1.7% of the national population were living in North-Eastern Province. Its district distribution is shown in the above table.

The urban population numbered 85 thousand or 22% of the total provincial population. It was distributed among 9 towns in three Districts as follows: three towns with 33 thousand of urban population in Garissa District; three towns with 22 thousand, in Mandera; and three towns with 30 thousand, in Wajir.

Garissa is the largest town in the Province, which functions as the provincial capital as well as the district headquarters of Garissa District. The district headquarters of the other Districts are Mandera in Mandera District; and Wajir in Wajir District.

Most of the land is of poor potential. Most of the province is devoted almost entirely to livestock keeping by pastoral tribes. Thus, livestock is very important in the province. Maize dominates the crop acreage in three districts in the province, despite the low potential of much of the area for maize. Sorghum is also important in the province.

North-Eastern Province is the least urbanized and also the least industrialized in the country. Only Garissa and Mandera have a few manufacturing establishments in the province. There were no major manufacturing industries in Wajir District, as of 1987.

North-Eastern Province recorded K£52 million at 1989 constant prices or 0.7% of GDP, according to the Study Team's estimation explained in Chapter 5 of Sectoral Report "A". Garissa District recorded the largest GRDP in the province. It was estimated at K£25 million or 0.3% of GDP. Garissa also recorded the largest GRDP per capita in the province. It was estimated at K£198 in 1990, although even Garissa accounted for only 58% the national average. GRDP per capita of the other Districts recorded as follows: K£110 or 32% in Wajir; and K£102 or 30% in Mandera.

Surface Water

North Eastern Province lies in arid land and receives an annual rainfall of about 300 mm. The only perennial river is the Daua River which forms the international boundary between Kenya and Ethiopia. Since the major catchment of the river extends to Ethiopian Highland, the rainfall-runoff relationship is not clear. The river dries up at Mandera once in a few years.

Although the off-stream reservoirs can be constructed along seasonal rivers, the high evapotranspiration rate made it impossible to ensure the water supply during drier months. The distribution of existing small dams and pans shows that the annual mean rainfall of more than 400 mm is required for the effective development of storage.

The water source for the Province depends on the development of groundwater as a major water source and water harvesting such as roof catchment, sub-surface dam and sand dam as subordinate sources.

Geology

The oldest rocks consist of Pre-cambrian metamorphic sedimentary and igneous rocks in the northwestern part of the province. The Triassic, Jurassic, and Cretaceous sediments were deposited successively in a subsiding basin lying in the northeastern corner of the province. Tertiary and Quaternary volcanic rocks consisting of basalt exist in the extreme western part of Wajir Province. Pleistocene deposits are widespread in the northern part of the province and alluvial sediments occur along many of the present drainageways.

Physiography

The province may be divided into the Northern Plainlands and Wajir Lowlands in the northern area and in the southern part, respectively.

Groundwater

The Merti aquifer, approximately paralleling the drainageways of the Ewaso N'giro and Lak Dera, contains groundwater of good quality and can be obtained from depths of 120 to 150 m. The Pre-cambrian metamorphic and igneous rocks, even where fracture zones are encountered, yield very little (1.5 to 6 m³/hr). The zones between basement rocks and overlying Triassic or Jurassic strata yield adequately. The Quaternary sediment's area extending southeast from Garissa to the Indian Ocean appear to be underlain predominantly by saline groundwater.

(1) Garissa District

Water is a scarce resource in the District. Sources of water include the Tana River which supplies Garissa Town and other centres along it, and also livestock and people from the hinterland, the boreholes and the water pans.

The average boreholes yield in the District is 6.7 m³/hr, but the yields may actually vary from nil to over 50 m³/hr. The average borehole depth is 118 meters. The average rest level of the water in boreholes is 92.5 meters.

The area extending southeast from Garissa to the Indian Ocean appears to be underlain predominantly by saline groundwater.

Of the 11 piped water supplies to towns along the Tana River, only 3 have treated water. There is a need to seriously consider treating the water in other facilities. This would minimize the incidence of water-related diseases in this area. The other areas further away from the Tana River are served by boreholes. It is the wish of the District to have each borehole have standby pumping sets, equip any other boreholes that may be unequipped and sink others. In this regard, the District jointly with the other two Districts in the North Eastern Province has committed to share of Appropriations-In-Aid (AIA) for the purchase of a drilling rig.

In an attempt to reduce over-grazing the District intends to raise the number of pans from 42 to about 60 during the plan period.

(2) Mandera District

Groundwater in Mandera has been developed by boreholes in the deep aquifers and wells in the shallow aquifers.

Most boreholes are concentrated along main roads and around main centres, with very few along Daua river. The boreholes have been used to supply water to administrative centres, road construction and livestock.

The chances of dry boreholes are the highest in the precambrian rocks and lowest in the cretaceous rocks.

The mean aquifer depth in the cretaceous rocks does not differ significantly from that in jurassic rocks. The only aquifer depth (50m) in the precambrian rocks is usually associated with faulting or fractures around the granitic intrusions.

The shallow aquifers are penetrated by hand dug wells.

(3) Wajir District

Borehole water facilities are unevenly distributed in the District. Habaswein Division has 6 operational boreholes and 3 that need rehabilitation.

Griftu and Wajir Bor have three operational boreholes each. Central Division and Bute have two operational boreholes. In Bute one borehole needs rehabilitation. In Central Division two boreholes need rehabilitation.

In Buna Division there is no borehole at the moment. Two are planned at Batalu and Ajawa. Other areas in the Division do not have positive hydrological survey results. Hydrological survey results in Central and Wajir Bor are also poor. The poor distribution of borehole water facilities makes national range management difficult, and this problem has to be addressed in the Five Year Development Plan.

Habaswein and Griftu Divisions have good prospects for fresh underground water supply. Development of adequate water supply for Wajir Town will have to be tackled from these two Divisions. The range water development programme have constructed roads to serve the water facilities, but the road lacks maintenance.

Aquifer characteristics by district

District code	District name	Elevation (m)	Total depth(m)	Water struck(m)	level rest(m)	Yield (m ³ /hr)	Draw down(m)
510	Garissa	248.80	117.73	101.39	92.45	6.67	11.20
520	Mandera	597.31	142.05	94.54	62.03	3.92	24.08
530	Wajir	410.99	119.07	98.27	75.72	3.67	25.42

Groundwater development plan and cost by district

District code	District 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£
510	Garissa	20	126	91	1305	45.7	58
520	Mandera	13	147	94	1875	50.5	64
530	Wajir	22	117	98	1040	36.1	46

Irrigation Development Possibility

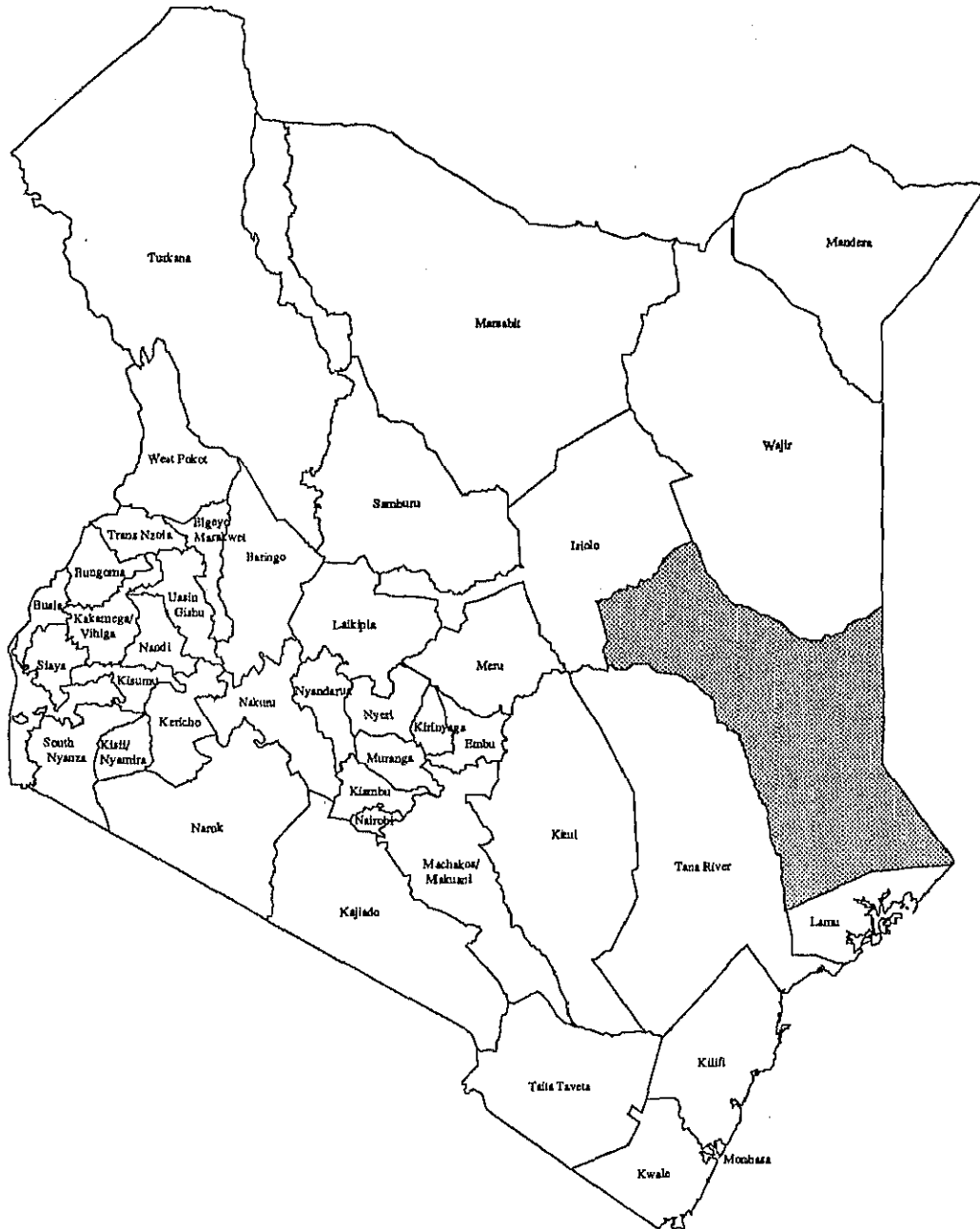
Irrigation development possibility as of 1990 was roughly checked through comparing estimated irrigation potential area and present irrigation area (existing area + future development plan) as shown in following table.

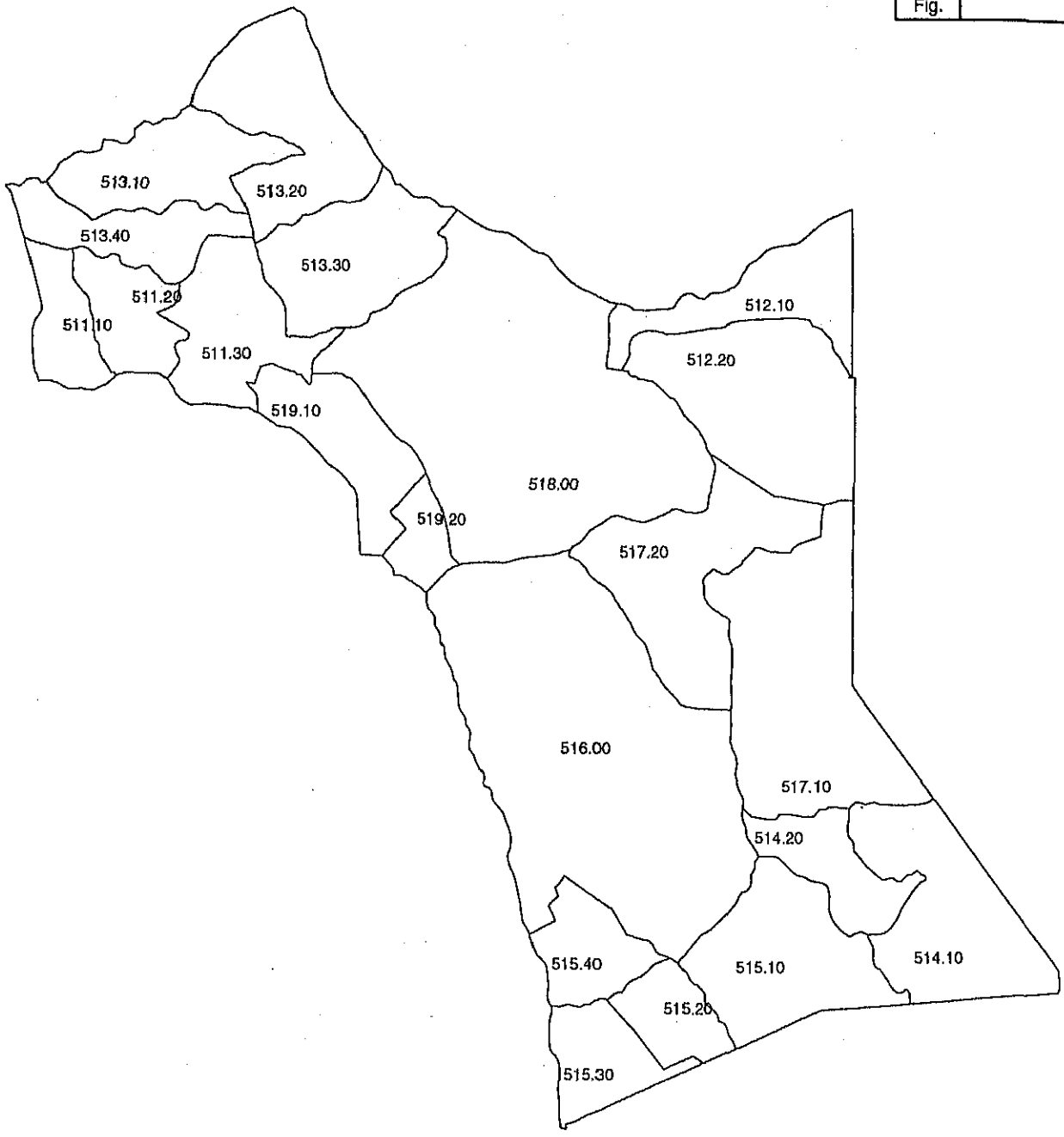
Code	510	520	530
District	Garissa	Mandera	Wajir
Availability	○	×	□

- 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)

Garissa

District

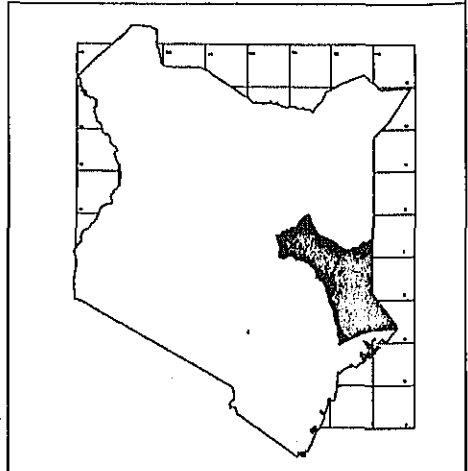




Code	Location	Population
511.1	Jara Jara Rahote	5,842
511.2	Mbalambala	4,680
511.3	Saka	9,932
512.1	Liboi	4,825
512.2	Damajare	3,009
513.1	Madogashe	6,027
513.2	Garula	5,916
513.3	Goreale	4,873
513.4	Benarie	10,681
514.1	Hulugho	8,510
514.2	Gaima Galla	5,673
515.1	Sangailu	8,005
515.2	Ijara	4,002
515.3	Kotile	4,002
515.4	Masalani	986
516	Bura	4,928
517.1	Jara Jila	2,464
517.2	Welmerer	1,478
518	Dadaab	18,653
519.1	Sankuri	18,653
519.2	Korakora	4,233



510 Garissa



THE STUDY
ON
THE NATIONAL WATER MASTER PLAN
JAPAN INTERNATIONAL COOPERATION AGENCY

1. Socio-Economic Profile : 510 Garissa 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
510	Garissa District	43,931		127.2	32.5	94.7	194.4	95.6	98.8	271.7	144.9	126.8
511.1	Jara Jara Rahole	735		5.1	-	5.1	5.3	-	5.3	6.8	-	6.8
511.2	Mbalambala	894		4.1	-	4.1	4.3	-	4.3	5.5	-	5.5
511.3	Saka	1,541		8.6	-	8.6	9.0	-	9.0	11.6	-	11.6
512.1	Liboi	1,363	Liboi	4.2	-	4.2	5.1	0.7	4.4	6.6	1.0	5.6
512.2	Damajare	2,689	Damajare	2.6	-	2.6	3.5	0.7	2.7	4.5	1.0	3.5
513.1	Madogashe	1,465	Mudo Gashe	2.2	2.2	0.0	4.7	4.7	0.0	6.7	6.7	0.0
513.2	Garufa	2,063		5.1	-	5.1	5.3	-	5.3	6.8	-	6.8
513.3	Goreale	1,814	Goreale	4.2	-	4.2	4.7	0.2	4.4	6.0	0.3	5.7
513.4	Benane	1,089	Benane	9.3	-	9.3	10.6	0.9	9.7	13.6	1.2	12.5
514.1	Hulugho	2,336	Hulugho	7.4	-	7.4	9.9	2.1	7.7	12.7	2.8	9.9
514.2	Galma Galla	951		4.9	-	4.9	5.2	-	5.2	6.6	-	6.6
515.1	Sangailu	2,109	Sangailu	7.0	-	7.0	9.4	2.1	7.3	12.1	2.8	9.3
515.2	Ijara	732	Ijara	3.5	-	3.5	6.1	2.4	3.6	7.8	3.2	4.7
515.3	Kotile	904	Kotile	3.5	-	3.5	6.1	2.4	3.6	7.8	3.2	4.7
515.4	Masalani	890	Masalani	0.9	-	0.9	3.3	2.4	0.9	4.3	3.2	1.1
516.0	Bura	7,497		4.3	-	4.3	4.5	-	4.5	5.7	-	5.7
517.1	Jara Jila	3,603		2.1	-	2.1	2.2	-	2.2	2.9	-	2.9
517.2	Welmerer	2,440		1.3	-	1.3	1.3	-	1.3	1.7	-	1.7
518.0	Dadaab	7,064	Dadaab	10.1	1.2	8.9	11.8	2.5	9.3	15.6	3.6	11.9
519.1	Sankuri	1,298	Garissa	33.1	29.1	4.0	77.8	73.7	4.2	120.6	115.2	5.3
519.2	Korakora	454	Korakora	3.7	-	3.7	4.5	0.6	3.8	5.8	0.8	4.9

1-2 GRDP Projection

Item	1990	2000	2010
1) GRDP (K.Pound million)	25.1	44.1	65.5
Percentage to GDP	0.3%	0.3%	0.3%
2) GRDP per Capita (K.Pound)	197.6	226.6	241.0
Ratio to GDP per capita	0.58	0.50	0.48
Urban (K.Pound)	505.4	324.8	328.2
Rural (K.Pound)	92.0	131.5	141.3

1-3 Present District Profile (1990)

1) Agricultural Production (1989)		3) Water Supply Schemes in Service Centre	
Product	Production Unit	Piped system	1
Maize	265 tons	Communal water points	10
Sorghum/Millet	15,919 tons	Other sources	27
Potato	- tons	4) Educational Facilities	
Rice	209 tons	Primary school	44
Wheat/Barley	- tons	Secondary school	4
Coffee	- tons	Institute	52
Tea	- tons	5) Medical Facilities	
Milk	56 tons	Hospital	1
Meat	56 tons	Health Centre	4
2) Number of Manufacturing Establishments (1986)		Dispensary	12
Type of Industry	Number	Others	2
Food	1	6) Out-patient of Infective Diseases in Relation to Water Supplies (1985-89 Average)	
Textile	2	Diarrhoeal Diseases	5,617
Wood	0	Leprosy	38
Paper	0	Infectious Hepatitis	63
Chemical	0	Bilharzia	2,164
Non-metal	0	Eye Infections	4,128
Metal	0		
Machinery	0		
Others	0		
Total	3		

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
43,931	43,931	0	3,425	56	251	0	12	40,187

2.2 Rain fall

Unit : mm

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
12	8	44	94	76	39	21	15	19	34	80	50	497

2.3 River Flow

Unit : m³/sec

Gauge Code	Catchment Area (km ²)	Mean Flow	Low Flow Frequency			
			80%	90%	95%	Min.
4G 01	32,892	152.3	86.8	79.2	73.1	65.5

2.4 Groundwater

Aquifer Characteristics

Elevation (m)	Total Depth (m)	Water Struck (m)	Level Rest (m)	Yield (m ³ /hr)	Draw Down (m)
248.8	117.73	101.39	92.45	6.67	11.2

Safe Abstraction Yield

Unit : m³/year

Borehole	Shallow	Total
14,192,737	42,800,905	56,993,642

2.5 Agriculture

Suitable Area for Major Crops

Unit: km²

Maize	Wheat	Rice	Sorghum	Potato	Coffee	Tea
51	0	0	719	0	0	0

Area of Irrigation Potential

Unit : ha

Surface Water		Groundwater	
Upland	Lowland	Upland	Lowland
1,268	1,179	0	1

Livestock Population

Unit: 1,000

Cattle	Sheep/Goats	Camels	Donkeys
445.31	415.82	57.81	3.73

3 Water Demand Projection

Unit: cu.m/day

Location	1990				2000				2010			
	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry
Garissa District	1,875	4,700	7,399	131	2,104	14,093	8,540	251	3,080	21,752	13,287	376
Jara Jara Rahole	100	0	366	0	113	0	369	0	166	0	555	0
Mbalambala	81	0	293	0	90	0	296	0	132	0	445	0
Saka	171	0	622	0	192	0	628	0	281	0	944	0
Liboi	83	0	302	0	93	107	318	0	137	143	478	0
Damajaro	52	0	189	0	59	107	203	0	85	143	305	0
Madogashe	0	319	40	0	0	687	81	0	0	1,001	136	0
Qarufa	100	0	364	0	113	0	368	0	164	0	553	0
Goreale	84	0	305	0	95	33	312	0	138	44	469	0
Benane	184	0	669	0	207	134	691	0	302	179	1,039	0
Hulugho	146	0	533	0	164	315	575	0	241	421	866	0
Galma Galla	98	0	355	0	110	0	359	0	161	0	539	0
Sangailu	138	0	502	0	155	315	543	0	226	421	818	0
Ijara	69	0	251	0	77	356	295	0	114	476	445	0
Kotile	69	0	251	0	77	356	295	0	114	476	445	0
Masalani	17	0	62	0	19	356	104	0	28	476	158	0
Bura	85	0	309	0	95	0	312	0	140	0	468	0
Jara Jila	43	0	154	0	48	0	156	0	70	0	234	0
Welmerer	26	0	93	0	28	0	93	0	42	0	140	0
Dadaab	177	174	664	0	198	375	692	0	290	546	1,048	0
Sankuri	79	4,208	810	131	89	10,856	1,571	251	129	17,297	2,783	376
Korakora	73	0	265	0	82	94	279	0	120	126	419	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\$
Mudo Gashe	6,700	Spring	Boreholes + Subsurface Dam	g	207	0	19,616
Ijara	3,200	Boreholes	Boreholes + Small dam	g	104	0	10,682
Kotile	3,200	Boreholes	Boreholes/Subsurface Dam/Tana	g	199	0	15,628
Masalani	3,200	Tana river	Tana River	p	6.3	40	2,370
Garissa	115,300	Tana river	Tana River	p	3	10	12,918

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
Khaira	10	20	?	?	Irrigation	FARMERS	0.41	?
Balambala	16	45	?	?	Irrigation	?	0.656	?
Boy'S Farm	20	0	?	?	Irrigation	?	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)		Implementation Schedule														
			US\$	K£	93	94	95	96	97	98	99	20	01	02	03	04	05	06	07

★ 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

★ Design ☆ Study ● Construction

4.6 Urban Drainage and Ad-hoc River Improvement Projects

Project	Population	Area (Km ²)	Executing Agency	Cost (million)		Implementation Schedule														
				US\$	K£	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07

★ Design ☆ Study ● Construction

4.7 Dam Development Plan

Damsites	C.A. (km ²)	Purpose	FSL (El. m)	Storage (MCM)	Yield (m ³ /s)	Height (m)	Cost (1,000US\$)
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W:Water Supply I:irrigation P: Power

4.8 Groundwater Development Projects

Proposed Numbers				Executing Agency	Cost (million)		Implementation Schedule													Remarks					
Drinking		Livestock			US\$	K£	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)																						

★ 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	

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	

4.11 Watering Points in Nomadic Pasturage Area

Assumed Nomadic Pasturage Area (km ²)	No. of Watering Points (Nos)	Executing Agency	Cost (million)		Implementaion of Watering Points (No.)	
			US\$	K£	up to 2000	2001-2010
39,187	63	MOWD	11.6	14.6	19	44

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
Dadab Dam	W	Rural	-	-
Modogashe Dam	W	Rural	-	-

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 (Uplate)	TARDA	4.0	5.0				☆	☆	☆	☆	☆										
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
	(WRAP proposed)	MOWD	-	-	☆	☆															

☆ Study

○ River Basin Study (proposed under separate programme)

Mandera District

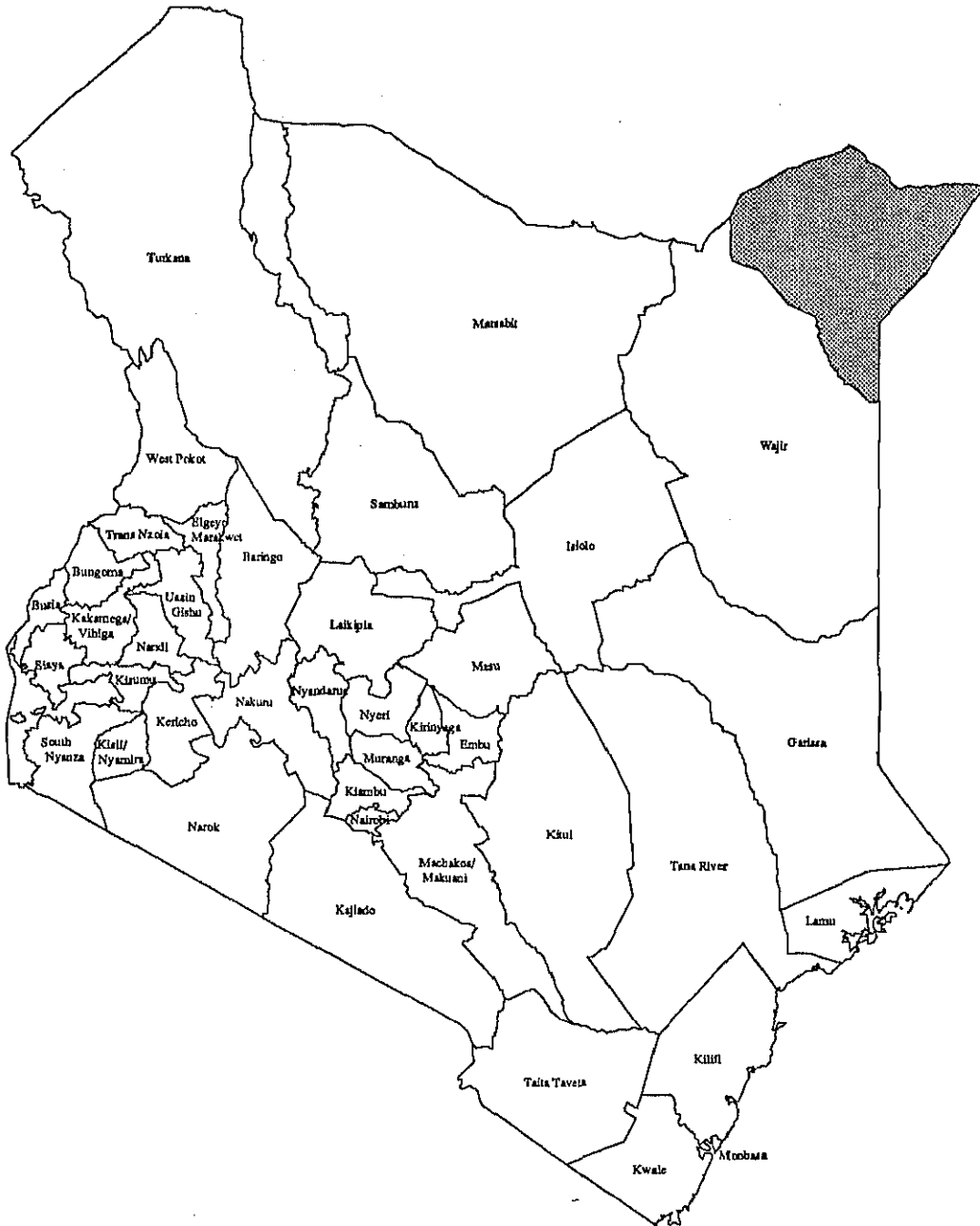
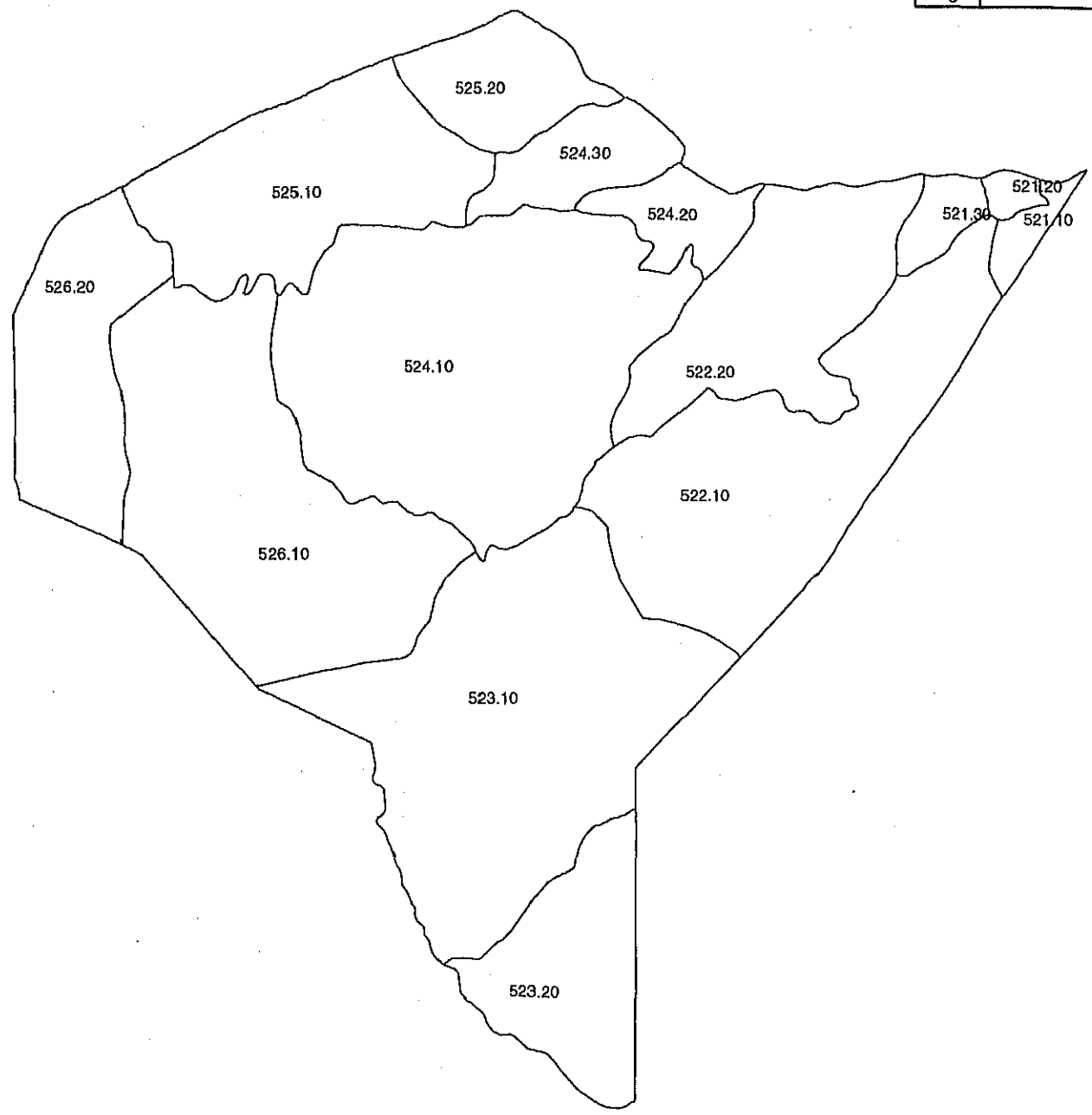
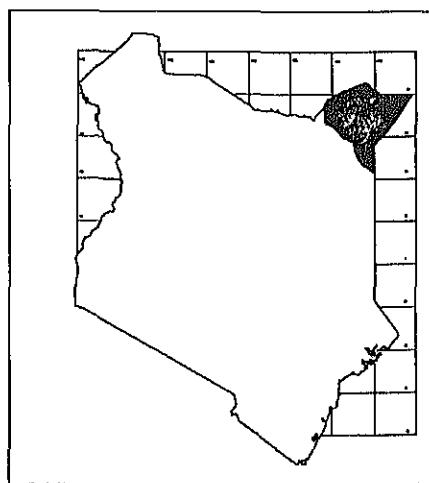


Fig.



Code	Location	Population
521.1	Mandera	9,188
521.2	Nebot	4,344
521.3	Kalaliyo	2,843
522.1	Arabia	9,730
522.2	Libehia	9,330
523.1	Elwak	18,595
523.2	Kotulo	1,442
524.1	Ashabito	9,138
524.2	Rhamu	2,976
524.3	Rhamu Dimtu	1,865
525.1	Banisa	11,250
526.2	Malka Mari	1,957
526.1	lakaba	12,850
526.2	Dandu	10,093

520 Mandera



THE STUDY
ON
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JAPAN INTERNATIONAL COOPERATION AGENCY

1. Socio-Economic Profile : 520 Mandera 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
520	Mandera District	26,469		127.3	21.6	105.7	154.6	37.2	117.4	195.8	54.0	141.8
521.1	Mandera	193	Mandera	6.7	6.5	0.2	12.0	11.7	0.3	18.4	18.1	0.3
521.2	Neboi	105		0.3	-	0.3	0.3	-	0.3	0.4	-	0.4
521.3	Kalaliyo	264		3.7	-	3.7	4.1	-	4.1	5.0	-	5.0
522.1	Arabia	3,388		12.7	-	12.7	14.1	-	14.1	17.0	-	17.0
522.2	Libehia	1,976	*->a part of Rhamu	12.2	1.3	10.9	14.2	2.1	12.1	17.6	3.0	14.6
523.1	Elwak	4,596	El Wak	24.4	10.7	13.8	32.5	17.2	15.3	42.8	24.3	18.5
523.2	Kotulo	1,452		1.9	-	1.9	2.1	-	2.1	2.5	-	2.5
524.1	Ashabito	4,728		11.9	-	11.9	13.2	-	13.2	16.0	-	16.0
524.2	Rhamu	508	Rhamu	3.9	3.1	0.8	5.9	5.0	0.9	8.2	7.1	1.1
524.3	Rhamu Dimtu	673		2.4	-	2.4	2.7	-	2.7	3.3	-	3.3
525.1	Banisa	2,290		14.7	-	14.7	16.3	-	16.3	19.7	-	19.7
525.2	Malka Mari	863		2.6	-	2.6	2.8	-	2.8	3.4	-	3.4
526.1	takaba	3,773	Takaba	16.8	-	16.8	19.7	1.1	18.6	23.9	1.5	22.5
526.2	Dandu	1,660		13.2	-	13.2	14.6	-	14.6	17.7	-	17.7

1-2 GRDP Projection

Item	1990	2000	2010
1) GRDP (K.Pound million)	13.0	23.9	36.0
Percentage to GDP	0.0	0.0	0.0
2) GRDP per Capita (K.Pound)	101.9	154.4	184.0
Ratio to GDP per capita	0.3	0.3	0.4
Urban (K.Pound)	423.7	466.4	492.3
Rural (K.Pound)	35.9	55.5	66.7

1-3 Present District Profile (1990)

1) Agricultural Production (1989)			3) Water Supply Schemes in Service Centre	
Product	Production	Unit	Piped system	5.0
-	-	-	Communal water points	0.0
Maize	-	tons	Other sources	17.0
Sorghum/Millet	80,651.00	tons	4) Educational Facilities	
Potato	-	tons	Primary school	36.0
Rice	-	tons	Secondary school	4.0
Wheat/Barley	-	tons	Institute	3.0
Coffee	-	tons	5) Medical Facilities	
Tea	-	tons	Hospital	1.0
Milk	-	tons	Health Centre	3.0
Meat	-	tons	Dispensary	2.0
2) Number of Manufacturing Establishments (1986)			Others	0.0
Type of Industry	Number		6) Out-patient of Infective Diseases in Relation to Water Supplies (1985-89 Average)	
-	-		Diarrhoeal Diseases	3894.4
Food	3.0		Leprosy	2.6
Textile	0.0		Infectious Hepatitis	14.4
Wood	0.0		Bilharzia	45.0
Paper	0.0		Eye Infections	2149.8
Chemical	0.0			
Non-metal	0.0			
Metal	0.0			
Machinery	0.0			
Others	0.0			
Total	3.0			

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
26,470	26,470	0	51	0	251	1,512	55	24,601

2.2 Rain fall

Unit : mm

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
5	5	36	106	45	3	4	3	6	51	58	16	343

2.3 River Flow

Unit : m³/sec

Gauge Code	Catchment Area (km ²)	Mean Flow	Low Flow Frequency			
			80%	90%	95%	Min.
-	-	-	-	-	-	-

2.4 Groundwater

Aquifer Characteristics

Elevation (m)	Total Depth (m)	Water Struck (m)	Level Rest (m)	Yield (m ³ /hr)	Draw Down (m)
597.31	142.05	94.54	62.03	3.92	24.08

Safe Abstraction Yield

Unit : m³/year

Borehole	Shallow	Total
5,260,371	23,295,791	28,556,162

2.5 Agriculture

Suitable Area for Major Crops

Unit: km²

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

Area of Irrigation Potential

Unit : ha

Surface Water		Groundwater	
Upland	Lowland	Upland	Lowland
0	0	0	0.7

Livestock Population

Unit: 1,000

Cattle	Sheep/Goats	Camels	Donkeys
106.04	375.74	104.74	3.47

3 Water Demand Projection

Unit: cu.m/day

Location	1990				2000				2010			
	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry
Mandera District	2,093	3,132	7,603	171	2,501	5,480	10,074	316	3,447	8,098	14,852	455
Mandera	5	940	128	171	6	1,727	255	316	8	2,709	463	455
Neboi	5	0	19	0	7	0	25	0	9	0	37	0
Kalaliyo	74	0	254	0	87	0	327	0	121	0	475	0
Arabia	251	0	868	0	300	0	1,120	0	413	0	1,628	0
Libehia	215	192	766	0	257	314	1,002	0	354	453	1,466	0
Elwak	272	1,547	1,124	0	326	2,532	1,556	0	448	3,649	2,346	0
Koulo	38	0	129	0	44	0	166	0	61	0	241	0
Ashabito	236	0	815	0	282	0	1,052	0	389	0	1,528	0
Rhamu	16	452	109	0	20	741	172	0	27	1,067	275	0
Rhamu Dimtu	48	0	166	0	57	0	215	0	79	0	312	0
Banisa	291	0	1,004	0	347	0	1,295	0	478	0	1,882	0
Malka Mari	50	0	175	0	61	0	225	0	83	0	327	0
takaba	332	0	1,146	0	396	166	1,502	0	547	219	2,184	0
Dandu	260	0	900	0	311	0	1,162	0	430	0	1,688	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\$
Mandera	18,100	Boreholes/Daua river	Daua River	p	2.2	40	3,136
Elwak	24,400	Borehole	Boreholes	g	750	0	75,481
Rhamu	10,200	River (Local)	Daua River	p	2.2	40	2,866

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

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

★ 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

★ 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

★ 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\$)
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W: Water Supply I: Irrigation P: Power

4.8 Groundwater Development Projects

Proposed Numbers				Executing Agency	Cost (million)		Implementation Schedule															Remarks			
Drinking		Livestock			US\$	K£	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)																						

★ 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	Subs-face Dam	Sand Dam	Rock Catch	Existing Pipeline	Up to 2000		2001-2010	

4.10 Source Development Plan for Livestock Water Supply

District	Source Development Plan								Total	Implementation Program (%)	
	Surface Water	Borehole	Shallow Well	Small Dam	Subs-face Dam	Sand Dam	Existing Pipeline	Up to 2000		2001-2010	

4.11 Watering Points in Nomadic Pasturage Area

Assumed Nomadic Pasturage Area (km ²)	No. of Watering Points (Nos)	Executing Agency	Cost (million)		Implementaion of Watering Points (No.)	
			US\$	K£	up to 2000	2001-2010
23,946	38	MOWD	5.3	6.6	11	27

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
Kutulo-Elwak Dam	W	Rural	-	-
Neboi-Mandera Dam	W	Rural	-	-
Kalatiyo Dam	W	Rural	-	-
Takaba Dam	W	Rural	-	-
Markamari Dam	W	Rural	-	-
Mandera Dam	W	Mandera	-	-
Rham Mandera Dam	W	Rural	-	-
Arabia Dam	W	Rural	-	-
Fino Dam	W	Rural	-	-

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

★ Design ☆ Study ● Construction

5.3 District Water Resource Study

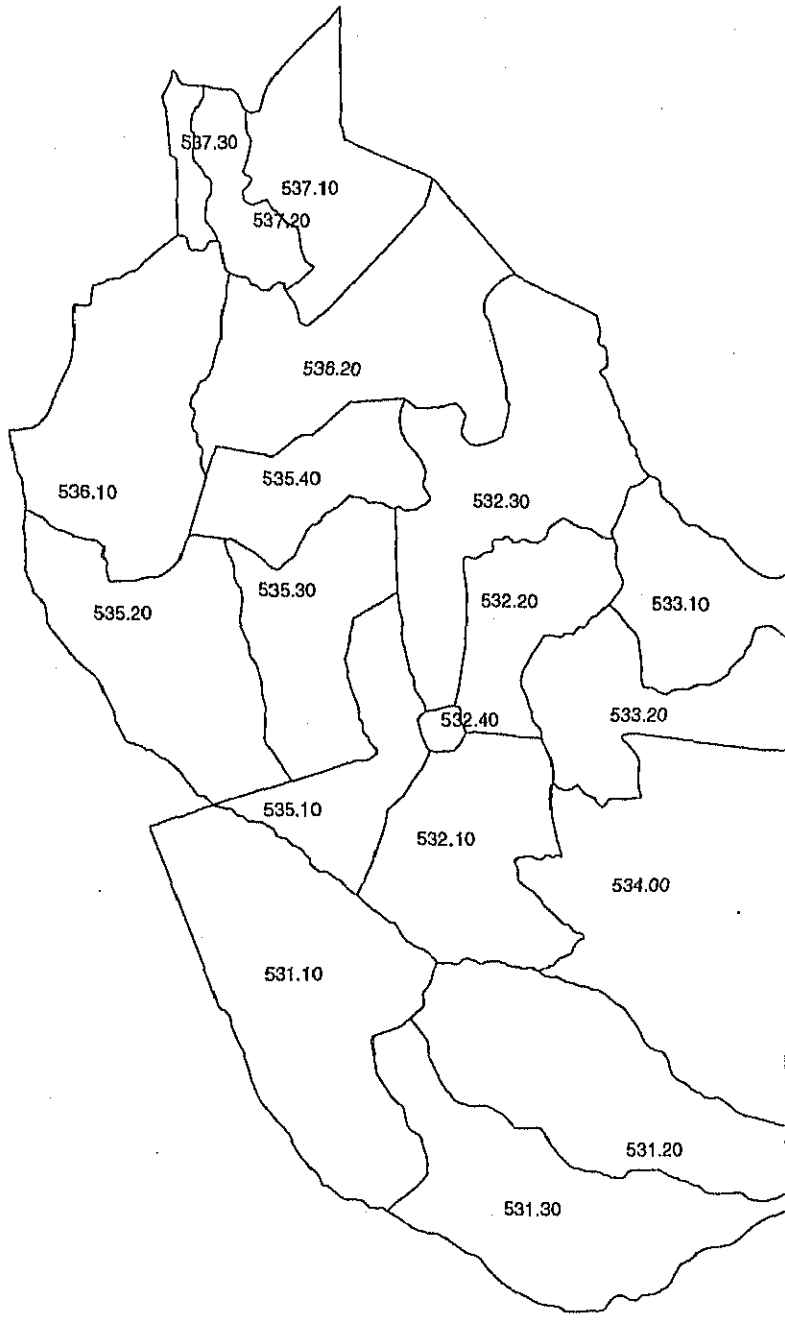
Related Basin Study Proposed	Remarks	Executing Agency	Cost (million)		Implementation Schedule																
			US\$	K£	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09
		MOWD	3.0	3.8	☆	☆	☆														

☆ Study

○ River Basin Study (proposed under separate programme)

Wajir District

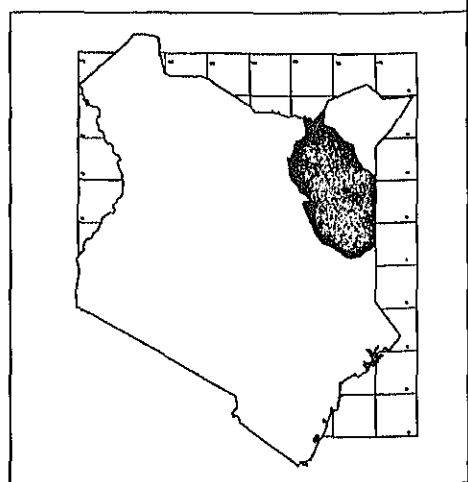




Code	Location	Population
531.1	Habaswein	14,656
531.2	Banane	1,075
531.3	Sabule	1,387
532.1	Kulaley	14,016
532.2	Wargadud	6,171
532.3	Tarhaj	13,247
532.4	Wajir Township	20,002
533.1	Khorol/Harar	3,192
533.2	Wajir Bor	3,667
534	Dif	3,029
535.1	Wagala	5,802
535.2	Arbajahan	2,070
535.3	Griftu	3,104
535.4	Eldas	4,625
536.1	Korondile	6,120
536.2	Buna	9,323
537.1	Gurar	9,594
537.2	Bute	14,822
537.3	Godoma	3,418



530 Wajir



THE STUDY
ON
THE NATIONAL WATER MASTER PLAN
JAPAN INTERNATIONAL COOPERATION AGENCY

1. Socio-Economic Profile : 530 Wajir 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
530	Wajir District	56,500		126.0	30.4	95.6	164.8	63.0	101.8	228.7	100.6	128.1
531.1	Habaswein	5,434	Habaswein	11.6	-	11.6	12.7	0.3	12.4	16.0	0.4	15.6
531.2	Banane	4,278		0.9	-	0.9	0.9	-	0.9	1.1	-	1.1
531.3	Sabule	4,234		1.1	-	1.1	1.2	-	1.2	1.5	-	1.5
532.1	Kulaley	3,129		11.1	-	11.1	11.8	-	11.8	14.9	-	14.9
532.2	Wargadud	1,891		4.9	-	4.9	5.2	-	5.2	6.6	-	6.6
532.3	Tarhaj	4,421		10.5	-	10.5	11.2	-	11.2	14.1	-	14.1
532.4	Wajir Township	144	Wajir	32.2	21.4	10.8	57.5	46.0	11.5	89.9	75.4	14.5
533.1	Khorof/Harar	2,023		2.5	-	2.5	2.7	-	2.7	3.4	-	3.4
533.2	Wajir Bor	2,512		2.9	-	2.9	3.1	-	3.1	3.9	-	3.9
534.0	Dif	6,234		2.4	-	2.4	2.6	-	2.6	3.2	-	3.2
535.1	Wagala	1,927		4.6	-	4.6	4.9	-	4.9	6.2	-	6.2
535.2	Arbajahan	3,592		1.6	-	1.6	1.7	-	1.7	2.2	-	2.2
535.3	Griftu	2,546		2.5	-	2.5	2.6	-	2.6	3.3	-	3.3
535.4	Eldas	1,903		3.7	-	3.7	3.9	-	3.9	4.9	-	4.9
536.1	Korondile	4,101		4.9	-	4.9	5.2	-	5.2	6.5	-	6.5
536.2	Buna	4,270	Buna	11.1	6.8	4.4	17.2	12.6	4.6	24.5	18.7	5.8
537.1	Gurar	2,380		7.6	-	7.6	8.1	-	8.1	10.2	-	10.2
537.2	Bute	1,053	Bute	7.1	2.2	4.9	9.3	4.1	5.2	12.6	6.1	6.6
537.3	Godoma	428		2.7	-	2.7	2.9	-	2.9	3.6	-	3.6

1-2 GRDP Projection

Item	1990	2000	2010
1) GRDP (K.Pound million)	13.9	22.5	32.4
Percentage to GDP	0.0	0.0	0.0
2) GRDP per Capita (K.Pound)	110.0	136.8	141.5
Ratio to GDP per capita	0.3	0.3	0.3
Urban (K.Pound)	176.1	160.5	153.9
Rural (K.Pound)	89.0	122.1	131.8

1-3 Present District Profile (1990)

1) Agricultural Production (1989)			3) Water Supply Schemes in Service Centre	
Product	Production	Unit	Piped system	2.0
-	-	-	Communal water points	6.0
Maize	946.0	tons	Other sources	12.0
Sorghum/Millet	7374.0	tons	4) Educational Facilities	
Potato	-	tons	Primary school	37.0
Rice	-	tons	Secondary school	4.0
Wheat/Barley	-	tons	Institute	3.0
Coffee	-	tons	5) Medical Facilities	
Tea	-	tons	Hospital	2.0
Milk	25.0	tons	Health Centre	2.0
Meat	2713.0	tons	Dispensary	10.0
2) Number of Manufacturing Establishments (1986)			6) Out-patient of Infective Diseases in Relation to Water Supplies (1985-89 Average)	
Type of Industry	Number		Diarrhoeal Diseases	1,938
-	-	-	Leprosy	2
Food	0.0		Infectious Hepatitis	10
Textile	0.0		Bilharzia	29
Wood	0.0		Eye Infections	1,245
Paper	0.0			
Chemical	0.0			
Non-metal	0.0			
Metal	0.0			
Machinery	0.0			
Others	0.0			
Total	0.0			

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
56,501	56,501	0	291	388	565.01	679	25	54,552.99

2.2 Rain fall

Unit : mm

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
9	8	39	104	41	3	3	3	5	45	69	27	362

2.3 River Flow

Unit : m³/sec

Gauge Code	Catchment Area (km ²)	Mean Flow	Low Flow Frequency			
			80%	90%	95%	Min.
-	-	-	-	-	-	-

2.4 Groundwater

Aquifer Characteristics

Elevation (m)	Total Depth (m)	Water Struck (m)	Level Rest (m)	Yield (m ³ /hr)	Draw Down (m)
410.99	119.07	98.27	75.72	3.67	25.42

Safe Abstraction Yield

Unit : m³/year

Borehole	Shallow	Total
13,621,366	56,759,870	70,381,236

2.5 Agriculture

Suitable Area for Major Crops

Unit: km²

Maize	Wheat	Rice	Sorghum	Potato	Coffee	Tea
0	0	0	101	0	0	0

Area of Irrigation Potential

Unit : ha

Surface Water		Groundwater	
Upland	Lowland	Upland	Lowland
0	0	0	0.8

Livestock Population

Unit: 1,000

Cattle	Sheep/Goats	Camels	Donkeys
214.91	527.30	159.79	5.14

3 Water Demand Projection

Unit: cu.m/day

Location	1990				2000				2010			
	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry
Wajir District	1,892	4,393	6,424	0	2,169	9,282	6,920	0	3,109	15,102	9,441	0
Habaswein	231	0	724	0	264	45	734	0	378	63	967	0
Banane	17	0	53	0	20	0	53	0	27	0	70	0
Sabale	22	0	69	0	25	0	69	0	36	0	91	0
Kulaley	220	0	692	0	252	0	697	0	362	0	918	0
Wargadud	97	0	305	0	111	0	307	0	159	0	404	0
Tarbaj	208	0	654	0	239	0	659	0	342	0	868	0
Wajir Township	214	3,095	1,006	0	246	6,784	1,355	0	352	11,323	2,054	0
Khorof/Harar	50	0	158	0	57	0	159	0	82	0	209	0
Wajir Bor	57	0	181	0	66	0	182	0	94	0	240	0
Dif	48	0	150	0	54	0	151	0	79	0	198	0
Wagala	91	0	287	0	105	0	289	0	150	0	380	0
Arbajahan	33	0	102	0	38	0	103	0	53	0	136	0
Grifu	48	0	153	0	56	0	155	0	80	0	203	0
Eldas	72	0	229	0	83	0	230	0	120	0	303	0
Korondile	96	0	302	0	110	0	305	0	158	0	401	0
Buna	86	980	377	0	98	1,852	458	0	141	2,806	648	0
Guzar	151	0	474	0	172	0	477	0	248	0	629	0
Bute	97	319	339	0	111	602	367	0	160	911	498	0
Godoma	54	0	169	0	62	0	170	0	88	0	224	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\$
Wajir	75,500	Borehole (CS267)	Boreholes + Ewaso Ngiro River	p	1456	20	172,266
Buna	18,700	Boreholes	Boreholes(Lago Bor river)	g	1197	0	94,774
Bute	6,100	Boreholes	Boreholes + Small Dams	g	176	0	18,378

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	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
Wajir	21,400	0.2	MOLG	1.5	1.9													☆	☆	☆	●	●	●

★ 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				Executing Agency	Cost (million)		Implementation Schedule															Remarks			
Drinking		Livestock			US\$	K£	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)																						
22	117	98	1040	MORDASA	35.2	44.4				☆	●	●	●	●											Rural water 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)	0	744	1,899	318	0	28	75	0	0	0	3,064	22.8	77.2
- No. of Facilities	0	40	369	16,739	0	10	20	0	0	0	17,178		
- Cost (mill.US\$)	0	3.12	1.75	10.1	0	0.08	0.15	0	0	0	15.19		
(mill.K£)	0	3.94	2.2	12.73	0	0.09	0.19	0	0	0	19.16		

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	2,138	5,427	0	87	205	0	0	7,857	16.4	83.6
- No. of Facilities	0	98	1,040	0	19	31	0	0	1,188		
- Cost (mill.US\$)	0	8.99	5.01	0	0.24	0.43	0	0	14.67		
(mill.K£)	0	11.34	6.32	0	0.31	0.54	0	0	18.5		

4.11 Watering Points in Nomadic Pasturage Area

Assumed Nomadic Pasturage Area (km ²)	No. of Watering Points (Nos)	Executing Agency	Cost (million)		Implementaion of Watering Points (No.)	
			US\$	K£	up to 2000	2001-2010
53,124	85	MOWD	11.1	14.0	26	59

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
Buna Dam	W	Bona	-	-
Lag-Bor Dam	W	Wajir	-	-

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	20	01	02	03	04	05	06	07	08	09	10
-	-	-	-																		

★ 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
	(WRAP proposed)	MOWD	-	-	☆	☆															

☆ Study

○ River Basin Study (proposed under separate programme)

Nyanza Province

Nyanza Province

Socio Economic Profiles

Nyanza Province has a total area of 16.2 thousand km² or 2.7% of the national total. Most of the land is of high and medium potential. Of the total provincial area, 3.6 thousand km² or 22% of the provincial area is occupied by water areas such as Victoria lake, marshes and rivers. Of the total provincial land area of 12.5 km², 0.9 thousand km² or 6.8% is reserved area for uses such as national parks and reserved areas. The rest, 11.7 thousand km² or 93.2%, is habitable areas 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)
610 Kisii/Nyamira	2,196	1,202	547
620 Kisumu	2,660	708	266
630 Siaya	3,528	677	192
640 South Nyanza	7,778	1,155	148

In 1990, 3,742 thousand people or 16% of the national population were living in Nyanza Province. Its district distribution is shown in the above table.

The urban population numbered 347 thousand or 9.3% of the total provincial population. It was distributed among 20 towns in four districts as follows: four towns with 60 thousand of urban population in Kisii/Nyamira District; four towns, 210 thousand, in Kisumu; four towns, 27 thousand, in Siaya; and eight towns, 50 thousand, in South Nyanza. Among these towns, the top 10 towns in terms of urban population were Kisumu, Kisii, Homa Bay, Siaya, Nyamira, Ahero, Muhoroni, Migori, Awendo, Kehancha and Oyugis in that order.

Kisumu is the largest town in the Province, which functions as the provincial capital as well as the district headquarters of Nyanza. The district headquarters of the other Districts are Kisii in Kisii District; Siaya in Siaya; and Homa Bay in South Nyanza. In addition, Nyamira town is functioning as district headquarters of Nyamira District at present.

Nyanza Province is one of the most highly developed provinces in the country both in terms of cash crop development and the standards of husbandry. Maize dominates the crop acreage in five Districts in the province. Succeedingly, beans and sorghum are significant features of the cultivated area. In Kisii/Nyamira District, coffee and tea are produced substantially. In addition, cotton is also produced as a cash crop in Kisumu, Siaya and South Nyanza.

Kisumu ranks as the most industrialized town in the province. Besides, Kisii, Homa Bay, Siaya, Yala, Ahero, Kendu Bay, Keroka, Migori and Muhoroni are also listed up as industrialized towns in the province. However, Kisumu functions as the administrative and commercial centre for the whole of the Lake Victoria basin. Thus, if the high potential

hinterland of Kisumu is developed to create sufficient demand for the establishment of industries serving the entire region, Kisumu could become a reception centre for the overspill population from other provinces.

Nyanza Province recorded K£1,122 million at 1989 constant prices or 14% of GDP, according to the Study Team's estimation explained in Chapter 5 of Sectoral Report "A". South Nyanza District recorded the largest GRDP in the province. It was estimated at K£581 million or 7.5% of GDP. South Nyanza also recorded the largest GRDP per capita in the province. It was estimated at K£503 in 1990, which was 1.48 times of the national average. GRDP per capita of the other Districts recorded was as follows: K£347 or 1.02 times in Siaya; K£297 or 0.87 in Kisumu; and K£180 or 0.23 in Kisii/Nyamira.

Surface Water

The Province which is located at the shore of the Lake Victoria receives annual mean rainfall ranging from 1,217 mm in Siaya to 1,536 mm for Kisii.

(1) Kisii District

The district receives an annual rainfall of 1,536 mm on average has a number of small rivers, wells, and boreholes. Although a number of water supply systems have been constructed, a large proportion of the total population do not have access to clean water. As well as the rehabilitation of existing water supply systems, the water transfer scheme from the Bunyunyu Dam will be required for urban water supply.

(2) Kisumu District

The District receives an annual rainfall of 1,300 mm on average. At present, about 28 piped water supply systems which depend on the water output of boreholes are under operation. Most of the systems, however, are irregular, with the result that about 40% of the consumers also depend on alternative water sources. The present water sources are organized into boreholes (36.7%), shallow well (19.3%), river flow (23.6%), springs (2.9%), lake water (16.4%), and others (0.3%).

For the future water demand, as well as the development of boreholes and shallow wells, the development of Kibos Dam will be required for Kisumu water supply.

(3) Siaya District

The average annual rainfall increases from 800 mm at the shore of Lake Victoria to 1,500 mm near the border with Kakamega District. Surface water sources include the Lake Victoria, the Nzoia River and the Yala River. Several other small rivers have perennial flow, but their discharges are generally too meagre to be used for the water source of a water supply system.

Both the effective use of surface water from the main water sources and the development of boreholes/shallow wells are inevitable in order to meet the future demand.

(4) South Nyanza District

The average annual rainfall increases from 800 mm at the shore of Lake Victoria to 1,400 mm near the border with Kisii District.

At present, the water sources in the dry season are organized into springs (32%), river water (20%), shallow wells (10%), small dams (8%), lake water (13%), and water harvesting (17%). The ratio of water harvesting increases slightly in wet season.

Both the effective use of surface water from the main water sources including spring protection and the development of borehole/shallow wells are inevitable for the future demand.

Geology

The rocks in the area can be grouped into: Pre-cambrian metamorphic rocks (55 %), intrusive rocks (15%), Tertiary volcanic rocks (10 %), and Quaternary sediment rocks (20 %). The area has undergone severe faulting and rifting since late Tertiary.

Physiography

Nyanza Province forms part of the Kenya Highland. The area can be subdivided into four physiographic units: the Nyanza Low Plateau, Kavirondo Rift Valley, Kisii Highlands, and Nyanza Lowlands.

Groundwater

The groundwater potential is generally considered to be low to extremely low, except in alluvial sediments. In faults and fracture zones, the ideal locations for wells are preferably overlain by saturated weathered zones. The depths of shallow wells vary from 2 to 30 m and 9 m on average. Water from the wells was drawn by rope and bucket, before Lake Basin Shallow Wells Pilot Project started.

(1) Kisii District

Apart from the rivers, and the many streams which drain into them, there are springs and boreholes which supply clean water to the human and livestock population.

Though surface and ground water is abundant in the District there is evidence that most of the surface water is being polluted by effluents from coffee factories and

the herbicides and fertilizers used on tea and coffee farms.

The average boreholes yield in the District is 4.8 m³/hr, but the yields may actually vary from nil to over 14 m³/hr. The average borehole depth is 83 meters. The average rest level of the water in boreholes is 16 meters.

(2) Kisumu District

Aquifers are found at various depth levels.

The first aquifer is found between 10 and 25 m depth. This shallow aquifer is relatively thin and its yield low. Most existing dug wells in the Kano Plain are in this aquifer.

A second and third aquifer level usually is found between depths of 30 to 80 m. these aquifers are sufficiently productive for hand pump and limited capacity motorized pumping. Most boreholes constructed by the RDWSSP draw water from these aquifers. Between 80 and 150 m depth other ground water bearing levels are found with characteristics similar to the second and third aquifers. Below 150 m depth progressively thicker and better developed aquifers are expected to occur.

With the present knowledge of the geology of the Kano Plain sediments, it is not necessary to carry out geophysical surveys to indicate borehole locations.

(3) Siaya District

Ground water can be present in (1) the weathered layer, (2) fault and fracture zones, (3) sedimentary deposits, and Ground water within the weathered layer

(a) Groundwater in the weathered layer

The relatively high amount of annual rainfall in the north and the northeastern part of the District causes a reliable and steady recharge into the weathered layer. The ground water level varies between 5 - 15 meters, which makes the ground water easily accessible through hand dug wells.

In the southern part however, little or no ground water is found within the weathered layer due to a very low recharge in this apart of the District.

Because of the rather clayer weathering of the volcanic rocks, the well yields generally are low, but are sufficient for hand pump use (1-2 m³/hr).

(b) Ground water in fault and fracture aquifers

From the results of the ground water survey and the on-going borehole drilling

programme in Nyanza Province it appears that relatively high yield wells (10-50 m³/hr.) can be constructed in major fault zones while the surrounding areas have only a moderate or no ground water potential at all.

Well constructed in this type of aquifer can only be done through machine drilling or boreholes. For successful borehole location in this aquifer type special exploration techniques are warranted.

The programme has developed a combination of survey techniques based on remote sensing, aerial photograph interpretation and ground geophysical survey.

(c) Ground water in sedimentary deposits

About 10% of Siaya District is covered by sediments, mainly Pleistocene to Recent in age, and consisting of lacustrine and fluvial deposits. Relatively thick deposits of sediments are found near the mouth of the Yala and Nzoia Rivers (Yala Swamp area).

Ground water generally is present in the coarse layers at a relatively shallow depth (5-8 meters).

Ground water presence and quality in these sedimentary deposits are explored by means of the drilling of hand auger survey holes.

(4) South Nyanza

The zone with a high potential for the exploitation of ground water through hand dug wells. Within the possibilities for reliable wells are limited in general to topographically lower areas. Concentrations of inhabitation, institutes, missions and schools are usually found in topographically elevated areas and consequently it is in those areas where wells are often preferred and at the same time impossible to construct successfully.

The depth of hand dug wells depends on local conditions but generally will be between 10 and 20 m, although some wells as deep as 30 m have been constructed as well. Statistics on existing wells and wells constructed under the RDWSSP show that on an average wells are relatively shallow (12 m) in the south-east and east of the District, particularly in the Kihancha Division, the eastern part of Migori Division, and Rangwe Division. Elsewhere, the average depth is 14-17 m.

Although within the high potential zone it is not really necessary to site the wells by means of geophysics, it is commended to do so if financial resources are available because this will allow the selection of the best possible well locations and will reduce the number of dry or low yield wells.

Outside the indicated high potential zone, the construction of hand dug wells is

possible as well. Here however, well siting by means of geophysical surveys is commendable. Well may exceed 20 m and still have only low yields.

The yield of hand dug wells depends on the type of aquifer, on the depth of the well and the seasonal ground water table fluctuations which may amount to 1-5 m. Low yields and seasonal wells can be avoided by bringing the wells to a depth of 3 m below the lowest dry season water table. If this can be accomplished than mosyt hand dug wells will be able to provide the required 7.5 m³/day.

Boreholes can be constructed successfully almost everywhere in South Nyanza District, provided thsat a thorough geophysical survey has been carried out to determine the precise location. It has been proven that in South Nyanza District the chances for productive boreholes are increased from less than 50% to over 80% by geophysical siting.

Additional advantages obtained through geophydical survey are higher well yields and less cost for drilling unnecessary deep boreholes.

The required borehole depth in most parts of the District is between 50 and 80 m. For planning purposes an overall average depths of 75 m can be used.

Areas where boreholes as deep as 125-150 m have to be constructed occur only in Lambwe Valley in Mbita Division and around Mount Homa in Kendu Division.

Average yields vary form 0.1 m³/hr in the driest areas underlain by granite, to 19 m³/hr in higher rainfall areas underlain by volcanic rock.

Aquifer characteristics by district

District code	District name	Elevation (m)	Total depth(m)	Water struck(m)	level rest(m)	Yield (m ³ /hr)	Draw down(m)
610	Kisii	1801.62	83.30	44.05	15.73	4.79	42.89
620	Kisumu	1268.88	95.61	67.33	21.24	11.10	34.55
630	Siaya	1232.95	59.08	40.67	17.95	4.19	17.08
640	South Nyanza	1346.30	75.63	54.41	19.07	4.49	29.98

Groundwater development plan and cost by district

District code	District name	Proposed Drinking (B/H+D)	number (S/W+H)	Proposed Livestock (B/H+D)	number (S/W+W)	Proposed (million) US\$	cost (million) Kf
610	Kisii /Nyamira	137	1525	10	63	39.5	50
620	Kisumu	95	825	41	384	37.5	47
630	Siaya	187	2582	62	623	63.7	80
640	South Nyanza	263	2436	68	366	77.0	97

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

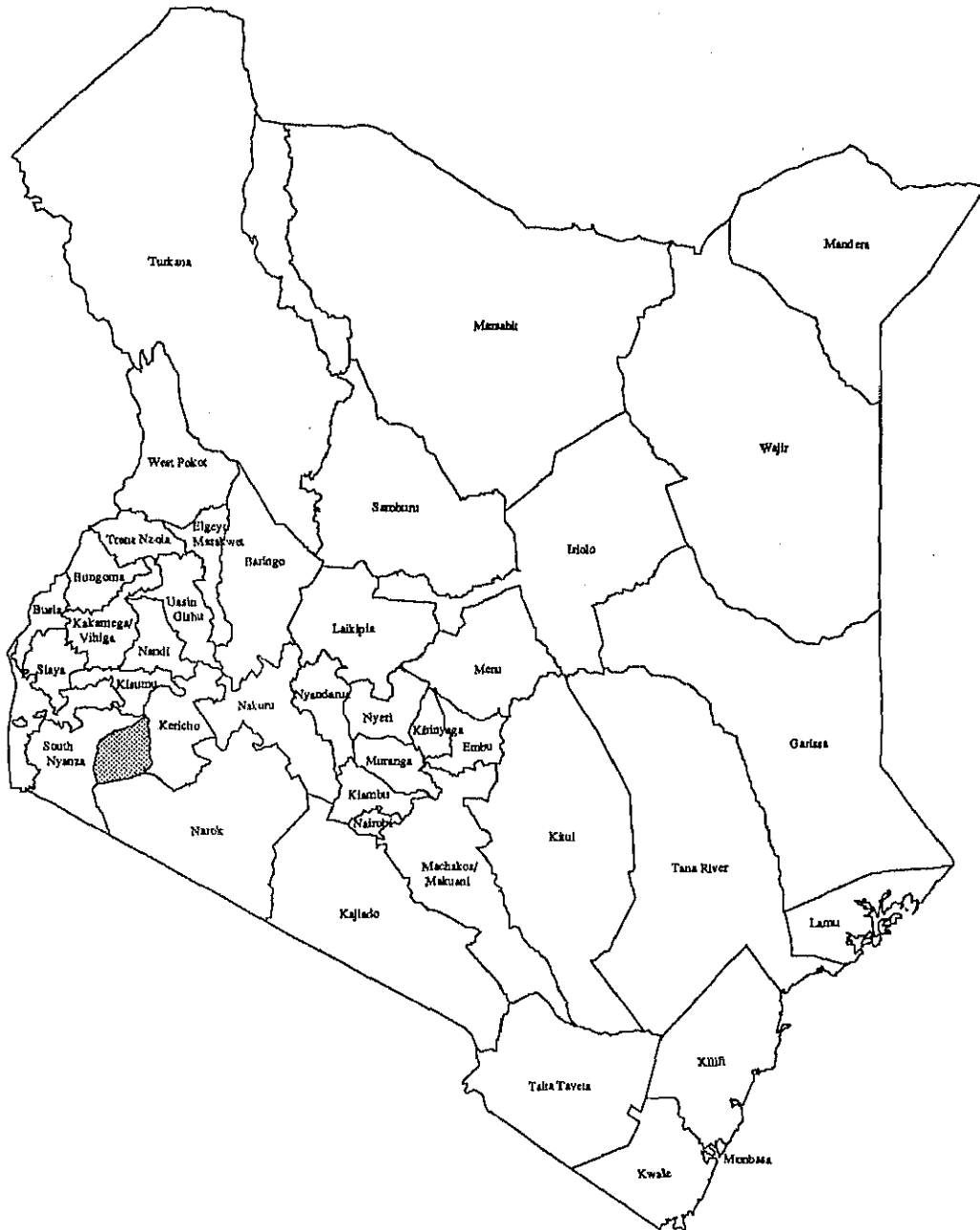
development plan) as shown in following table.

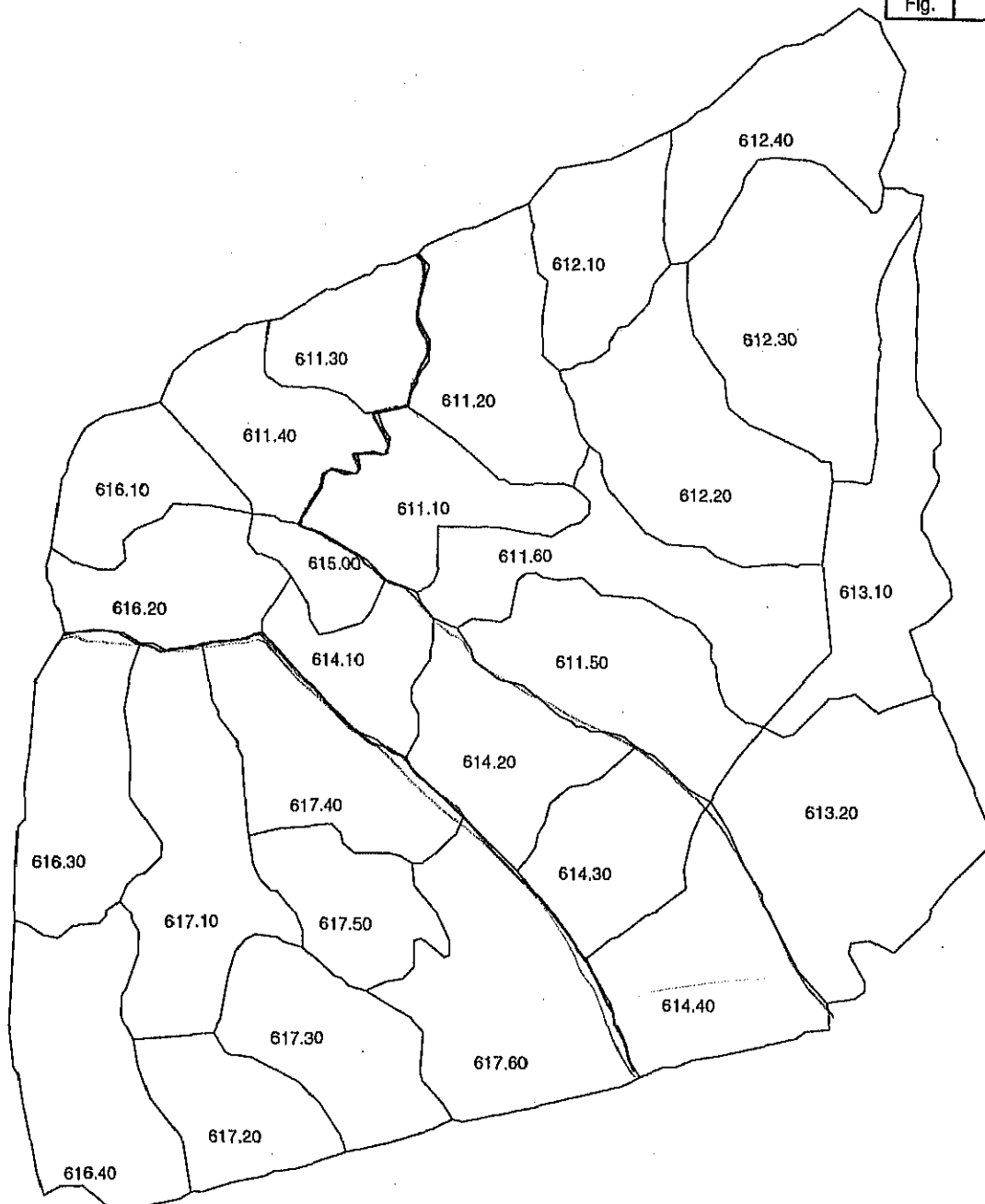
Code	610	620	630	640
District	Kisii	Kisumu	Siaya	South Nyanza
Availability	●	×	●	●

- 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)

Kisii/Nyamira

District

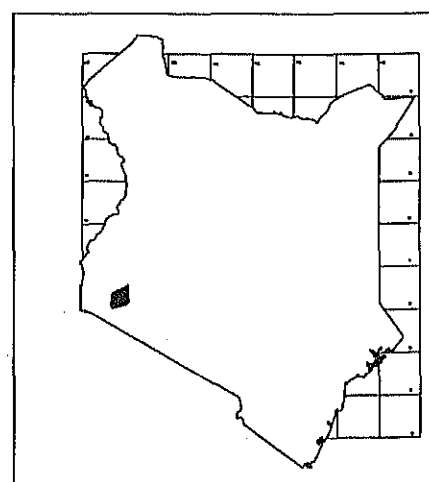




Code	Location	Population
611.1	Central Kitutu	33,645
611.2	Eronge	43,485
611.3	Marani	25,795
611.4	Nyakoe	26,479
611.5	East Kitutu	39,515
611.6	North Kitutu	45,899
612.1	West Mugirango	37,558
612.2	East Mugirango	54,148
612.3	North Mugirango	42,600
612.4	North Mugirango Ch:	32,515
613.1	North Borabu	13,634
613.2	Borabu	17,953
614.1	Nyaribari Chache We	20,871
614.2	Nyaribari Chache Ea:	29,906
614.3	Nyaribari Central	26,792
614.4	Nyaribari Masaba	40,189
615	Kisii Municipality	29,661
616.1	North Wanjare	16,806
616.2	South Wanjare	32,370
616.3	South Mugirango Ch:	36,166
616.4	South Mugirango Bo:	32,816
617.1	Majoge Chache	44,767
617.2	Majoge Masaba	18,356
617.3	Majoge Borabu	31,958
617.4	Bassi Chache	30,892
617.5	Kionyo	20,224
617.6	Bassi borabu	44,722



610 Kisii/Nyamira



THE STUDY
ON
THE NATIONAL WATER MASTER PLAN
JAPAN INTERNATIONAL COOPERATION AGENCY

1. Socio-Economic Profile : 610 Kisii/Nyamira 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
610	Kisii/Nyamira	2,198		1,201.9	59.7	1,142.2	1,401.0	126.1	1,274.8	1,662.4	189.4	1,473.0
611.1	Central Kitutu	66		45.6	-	45.6	50.9	-	50.9	58.8	-	58.8
611.2	Bronge	87	Manga	59.1	-	59.1	67.6	1.6	66.0	78.3	2.1	76.3
611.3	Marani	47	Marani	35.1	-	35.1	39.2	-	39.2	45.2	-	45.2
611.4	Nyakoe	64		36.0	-	36.0	40.2	-	40.2	46.4	-	46.4
611.5	East Kitutu	92	Keroka	56.2	2.5	53.7	64.3	4.3	60.0	75.4	6.1	69.3
611.6	North Kitutu	104		62.4	-	62.4	69.7	-	69.7	80.5	-	80.5
612.1	West Mugirango	64		51.1	-	51.1	57.0	-	57.0	65.9	-	65.9
612.2	East Mugirango	117	Nyamira+Kebirigo	83.9	10.3	73.6	103.6	21.4	82.2	127.3	32.3	95.0
612.3	North Mugirango	132		57.8	-	57.8	64.5	-	64.5	74.5	-	74.5
612.4	North Mugirango Chache	85		44.2	-	44.2	49.4	-	49.4	57.0	-	57.0
613.1	North Borabu	100		18.5	-	18.5	20.7	-	20.7	23.9	-	23.9
613.2	Borabu	147		24.4	-	24.4	27.3	-	27.3	31.5	-	31.5
614.1	Nyaribari Chache West	45		28.4	-	28.4	31.7	-	31.7	36.6	-	36.6
614.2	Nyaribari Chache East	72	Kcumbu	40.7	-	40.7	46.7	1.3	45.4	54.1	1.7	52.5
614.3	Nyaribari Central	64		36.4	-	36.4	40.7	-	40.7	47.0	-	47.0
614.4	Nyaribari Masaba	92		54.7	-	54.7	61.0	-	61.0	70.5	-	70.5
615.0	Kisii Municipality	23	Kisii	45.8	45.8	0.0	90.9	90.9	0.0	138.5	138.5	0.0
616.1	North Wanjare	50		22.9	-	22.9	25.5	-	25.5	29.5	-	29.5
616.2	South Wanjare	63	Suneka	44.0	-	44.0	49.1	-	49.1	56.8	-	56.8
616.3	South Mugirango Chache	86	Nyamarambe	49.2	-	49.2	56.4	1.5	54.9	65.4	1.9	63.4
616.4	South Mugirango Borabu	98		44.6	-	44.6	49.8	-	49.8	57.6	-	57.6
617.1	Majoge Chache	113		60.9	-	60.9	68.0	-	68.0	78.5	-	78.5
617.2	Majoge Masaba	56		25.0	-	25.0	27.9	-	27.9	32.2	-	32.2
617.3	Majoge Borabu	77	Kenyenya	43.5	-	43.5	50.4	1.9	48.5	58.5	2.5	56.0
617.4	Bassi Chache	82		42.0	-	42.0	46.9	-	46.9	54.2	-	54.2
617.5	Kionyo	54	Ogembo	28.6	1.1	27.5	32.6	1.9	30.7	38.1	2.7	35.5
617.6	Bassi Borabu	118	Nyamache	60.8	-	60.8	69.2	1.3	67.9	80.1	1.6	78.4

1-2 GRDP Projection

Item	1990	2000	2010
1) GRDP (K.Pound million)	95.8	160.2	231.8
Percentage to GDP	1.2%	1.2%	1.1%
2) GRDP per Capita (K.Pound)	79.7	114.4	139.4
Ratio to GDP per capita	0.23	0.25	0.28
Urban (K.Pound)	639.9	572.7	584.0
Rural (K.Pound)	50.5	69.0	82.3

1-3 Present District Profile (1990)

1) Agricultural Production (1989)			3) Water Supply Schemes in Service Centre		
Product	Production	Unit	Piped system	18	
Maize	119,545	tons	Communal water points	0	
Sorghum/Millet	33	tons	Other sources	62	
Potato	25,819	tons	4) Educational Facilities		
Rice	-	tons	Primary school	923	
Wheat/Barley	-	tons	Secondary school	212	
Coffee	1,708	tons	Institute	7	
Tea	24,797	tons	5) Medical Facilities		
Milk	-	tons	Hospital	7	
Meat	-	tons	Health Centre	21	
2) Number of Manufacturing Establishments (1986)			Dispensary	33	
Type of Industry	Number		Others	8	
Food	20		6) Out-patient of Infective Diseases in Relation to Water Supplies (1985-89 Average)		
Textile	3		Diarrhoeal Diseases	19,558	
Wood	2		Leprosy	83	
Paper	2		Infectious Hepatitis	731	
Chemical	0		Bilharzia	3,016	
Non-metal	1		Eye Infections	41,219	
Metal	0				
Machinery	2				
Others	1				
Total	31				

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
2,196	2,196	0	1	0	29	0	585	1,581

2.2 Rain fall

Unit : mm

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
78	92	160	230	178	102	80	99	121	128	158	106	1,536

2.3 River Flow

Unit : m³/sec

Gauge Code	Catchment Area (km ²)	Mean Flow	Low Flow Frequency			
			80%	90%	95%	Min.
1KA09	398	6.0	1.7	1.5	1.3	1.1

2.4 Groundwater

Aquifer Characteristics

Elevation (m)	Total Depth (m)	Water Struck (m)	Level Rest (m)	Yield (m ³ /hr)	Draw Down (m)
1801.62	83.3	44.05	15.73	4.79	42.89

Safe Abstraction Yield

Unit : m³/year

Borehole	Shallow	Total
768,095	1,991,473	2,759,568

2.5 Agriculture

Suitable Area for Major Crops

Unit: km²

Maize	Wheat	Rice	Sorghum	Potato	Coffee	Tea
2,045	239	18	1,067	929	984	1,460

Area of Irrigation Potential

Unit : ha

Surface Water		Groundwater	
Upland	Lowland	Upland	Lowland
10,516	9,003	45.4	18.8

Livestock Population

Unit: 1,000

Cattle	Sheep/Goats	Camels	Donkeys
583.00	197.89	-	-

3 Water Demand Projection

Unit: cu.m/day

Location	1990				2000				2010			
	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry
Kisii/Nyamira District	40,573	8,632	11,536	1,547	55,016	18,585	12,712	2,855	86,050	28,429	15,071	4,100
Central Kitutu	1,656	0	455	0	2,256	0	496	0	3,547	0	583	0
Erongo	2,147	0	590	0	2,924	237	646	0	4,599	312	761	0
Marani	1,273	0	350	0	1,735	0	381	0	2,729	0	448	0
Nyakoe	1,307	0	359	0	1,781	0	391	0	2,800	0	460	0
East Kitutu	1,951	362	542	228	2,657	640	594	421	4,179	914	702	607
North Kitutu	2,265	0	622	0	3,086	0	678	0	4,853	0	798	0
West Mugirango	1,829	0	509	0	2,484	0	555	0	3,894	0	653	0
East Mugirango	2,671	1,489	760	69	3,639	3,148	852	117	5,722	4,852	1,022	148
North Mugirango	1,707	0	576	0	2,214	0	628	0	3,274	0	739	0
North Mugirango Chache	1,269	0	441	0	1,634	0	480	0	2,390	0	565	0
North Borabu	558	0	185	0	728	0	201	0	1,083	0	237	0
Borabu	868	0	243	0	1,177	0	265	0	1,841	0	312	0
Nyaribari Chache West	1,031	0	283	0	1,404	0	308	0	2,207	0	363	0
Nyaribari Chache East	1,477	0	406	0	2,011	190	445	0	3,162	249	524	0
Nyaribari Central	1,322	0	363	57	1,802	0	396	105	2,833	0	466	152
Nyaribari Masaba	1,984	0	545	0	2,702	0	594	0	4,250	0	699	0
Kisii Municipality	0	6,622	114	1,079	0	13,395	221	2,002	0	20,787	343	2,889
North Wanjare	830	0	228	0	1,130	0	248	0	1,778	0	292	0
South Wanjare	1,598	0	439	57	2,177	0	478	105	3,423	0	563	152
South Mugirango Chache	1,785	0	490	0	2,432	222	538	0	3,824	291	634	0
South Mugirango Borabu	1,620	0	445	57	2,206	0	485	105	3,471	0	571	152
Majoge Chache	2,210	0	607	0	3,010	0	661	0	4,735	0	778	0
Majoge Masaba	906	0	249	0	1,234	0	271	0	1,941	0	319	0
Majoge Borabu	1,578	0	433	0	2,149	285	477	0	3,380	375	562	0
Bassi Chache	1,525	0	419	0	2,077	0	456	0	3,267	0	537	0
Kionyo	998	159	277	0	1,360	282	303	0	2,138	403	358	0
Bassi borabu	2,208	0	606	0	3,007	187	664	0	4,730	246	782	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\$
Manga	2,100	Gucha river	Bunyonyu Dam	p	23.9	90	3,601
Keroka	6,100	Chirichiri river	Bunyonyu Dam	p	13.8	320	5,228
Nyamira + Kebirigo	32,400	River (Local)	Kuja river	p	22	220	11,590
Kisii	138,500	Nyakobisaro	Bunyonyu Dam	g	10.9	0	27,548
Ogembo	2,700	Spring	Kuja river	g	4.1	0	1,734

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£	

4.11 Watering Points in Nomadic Pasturage Area

Assumed Nomadic Pasturage Area (km ²)	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	20	01	02	03	04	05	06	07	08	09	10
-	-	-	-																		

★ Design ☆ Study ● Construction

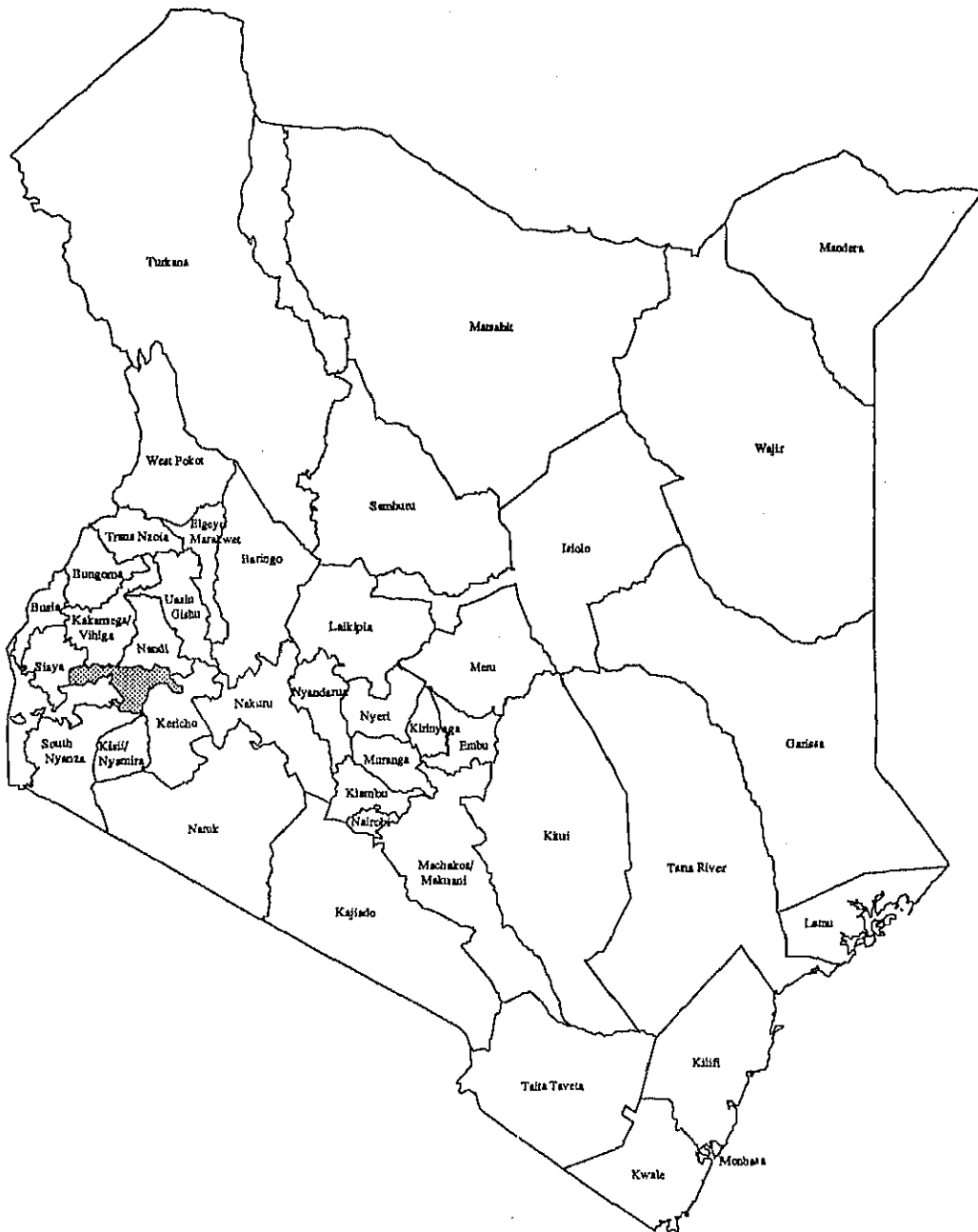
5.3 District Water Resource Study

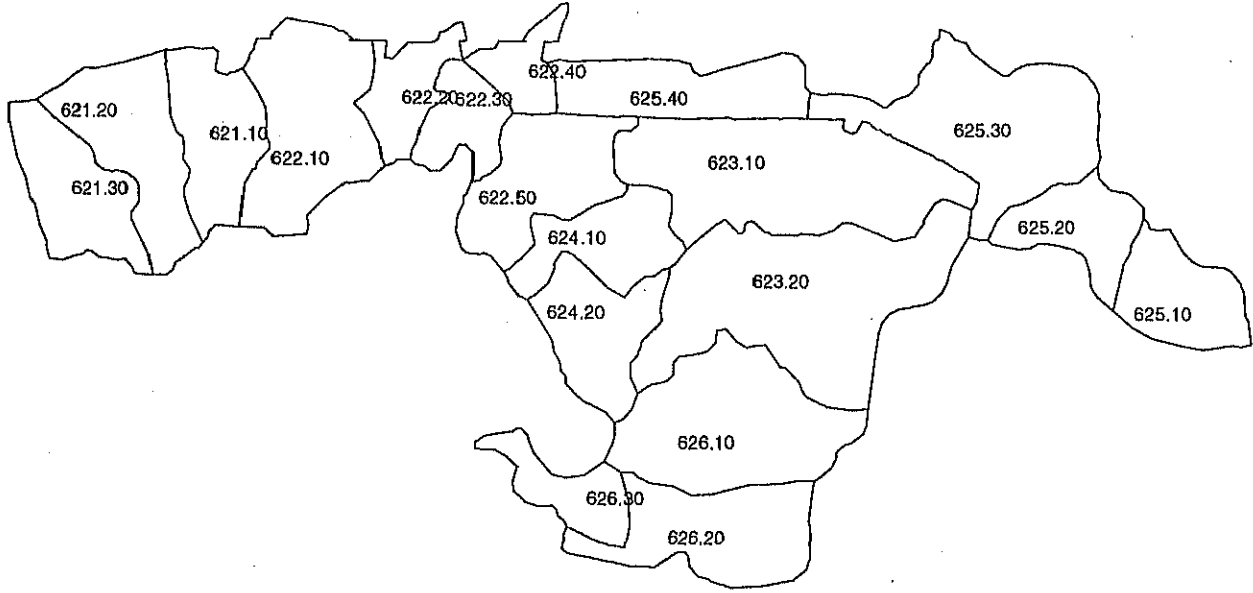
Related Basin Study Proposed	Remarks	Executing Agency	Cost (million)		Implementation Schedule																
			US\$	K£	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09
		MOWD	2.0	2.5			☆	☆	☆												

☆ Study

○ River Basin Study (proposed under separate programme)

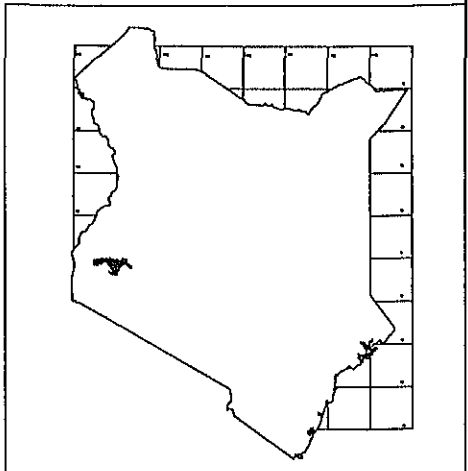
Kisumu District





Code	Location	Population
621.1	East Seme	19,662
621.2	Central Seme	22,135
621.3	West seme	17,770
622.1	West Kisumu	34,510
622.2	Central Kisumu	17,352
622.3	East Kisumu	55,753
622.4	Kajulu	14,725
622.5	Koiwa	63,924
623.1	North East Kano	41,693
623.2	South East Kano	36,853
624.1	North West Kano	18,719
624.2	South West Kano	13,586
625.1	Koru	7,565
625.2	Muhoroni	10,293
625.3	Chemelil	21,162
625.4	Miwani	9,500
626.1	North Nyakach	34,129
626.2	South Nyakach	30,781
626.3	West Nyakach	12,215

620 Kisumu



THE STUDY
ON
THE NATIONAL WATER MASTER PLAN
JAPAN INTERNATIONAL COOPERATION AGENCY

1. Socio-Economic Profile : 620 Kisumu 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
620	Kisumu District	2,092		708.2	210.1	498.1	970.9	434.4	536.5	1381.5	689.4	692.1
621.1	East Seme	87		30.2	-	30.2	32.5	-	32.5	42.0	0.0	42.0
621.2	Central Seme	105	Kombewa	34.0	-	34.0	37.2	0.5	36.6	48.0	0.7	47.3
621.3	West Seme	92		27.3	-	27.3	29.4	-	29.4	37.9	-	37.9
622.1	West Kisumu	134	Kisumu+Maseno	52.9	16.0	36.9	71.9	32.1	39.7	101.8	50.6	51.3
622.2	Central Kisumu	53	*<---Kisumu	24.4	9.6	14.8	35.7	19.8	15.9	52.1	31.6	20.5
622.3	East Kisumu	57	Kiboswa +Kisumu	68.9	68.9	0.0	142.5	142.5	0.0	227.5	227.5	0.0
622.4	Kajulu	36	*<---Kisumu	18.2	18.2	0.0	37.5	37.5	0.0	59.9	59.9	0.0
622.5	Kolwa	111	*<---Kisumu	79.0	79.0	0.0	162.6	162.6	0.0	259.9	259.9	0.0
623.1	North East Kano	228		64.1	-	64.1	69.0	-	69.0	89.0	-	89.0
623.2	South East Kano	256	Ahero	66.9	10.3	56.6	79.4	18.4	61.0	105.5	26.9	78.7
624.1	North West Kano	77		28.8	-	28.8	31.0	-	31.0	40.0	-	40.0
624.2	South West Kano	84		20.9	-	20.9	22.5	-	22.5	29.0	-	29.0
625.1	Koru	78		11.6	-	11.6	12.5	-	12.5	16.1	-	16.1
625.2	Muhoroni	69	Muhoroni	15.5	8.1	7.4	24.7	16.7	8.0	37.0	26.6	10.3
625.3	Chemelil	182		32.5	-	32.5	35.0	-	35.0	45.2	-	45.2
625.4	Miwani	96	Miwani+Chemelil	14.6	-	14.6	18.9	3.2	15.7	24.5	4.3	20.3
626.1	North Nyakach	178		52.4	-	52.4	56.5	-	56.5	72.9	-	72.9
626.2	South Nyakach	120	Sondu	47.3	-	47.3	52.0	1.1	50.9	67.2	1.4	65.7
626.3	West Nyakach	49		18.8	-	18.8	20.2	-	20.2	26.1	-	26.1

1-2 GRDP Projection

Item	1990	2000	2010
1) GRDP (K.Pound million)	210.1	392.0	591.6
Percentage to GDP	2.7%	2.8%	2.9%
2) GRDP per Capita (K.Pound)	296.7	403.8	428.2
Ratio to GDP per capita	0.87	0.90	0.84
Urban (K.Pound)	712.4	651.5	628.7
Rural (K.Pound)	121.4	203.2	228.5

1-3 Present District Profile (1990)

1) Agricultural Production (1989)			3) Water Supply Schemes in Service Centre	
Product	Production	Unit	Piped system	37
Maize	31,284	tons	Communal water points	2
Sorghum/Millet	9,086	tons	Other sources	16
Potato	24,616	tons	4) Educational Facilities	
Rice	7,624	tons	Primary school	519
Wheat/Barley	-	tons	Secondary school	114
Coffee	566	tons	Institute	24
Tea	-	tons	5) Medical Facilities	
Milk	-	tons	Hospital	3
Meat	-	tons	Health Centre	11
2) Number of Manufacturing Establishments (1986)			Dispensary	19
Type of Industry	Number		Others	0
Food	37		6) Out-patient of Infective Diseases in Relation to Water Supplies (1985-89 Average)	
Textile	12		Diarrhoeal Diseases	49,285
Wood	8		Leprosy	99
Paper	10		Infectious Hepatitis	371
Chemical	5		Bilharzia	1,756
Non-metal	4		Eye Infections	20,305
Metal	0			
Machinery	19			
Others	1			
Total	96			

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
2,660	2,093	567	28	160	475	0	790	640

2.2 Rain fall

Unit : mm

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
71	86	146	215	146	83	75	91	84	89	129	83	1,302

2.3 River Flow

Unit : m³/sec

Gauge Code	Catchment Area (km ²)	Mean Flow	Low Flow Frequency			
			80%	90%	95%	Min.
IGD02	1375	6.3	2.2	1.8	1.5	1.2
1HA04	117	1.6	0.5	0.4	0.4	0.3
1HA14	104	1.8	0.6	0.5	0.4	0.3
1HB05	101	0.6	0.2	0.2	0.2	0.1

2.4 Groundwater

Aquifer Characteristics

Elevation (m)	Total Depth (m)	Water Struck (m)	Level Rest (m)	Yield (m ³ /hr)	Draw Down (m)
1268.88	95.61	67.33	21.24	11.1	34.55

Safe Abstraction Yield

Unit : m³/year

Borehole	Shallow	Total
847,199	2,629,877	3,477,076

2.5 Agriculture

Suitable Area for Major Crops

Unit: km²

Maize	Wheat	Rice	Sorghum	Potato	Coffee	Tea
1,307	13	1,057	1,335	15	46	71

Area of Irrigation Potential

Unit : ha

Surface Water		Groundwater	
Upland	Lowland	Upland	Lowland
10,722	12,880	34.7	19.2

Livestock Population

Unit: 1,000

Cattle	Sheep/Goats	Camels	Donkeys
255.70	287.16	-	-

3 Water Demand Projection

Unit: cu.m/day

Location	1990				2000				2010			
	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry
Kisumu District	14,673	30,380	6,351	5,880	18,487	64,010	8,454	10,472	30,768	103,480	13,886	14,329
East Seme	1,022	0	348	0	1,323	0	426	0	2,279	0	674	0
Central Seme	1,141	0	392	0	1,474	78	482	0	2,535	106	762	0
West seme	843	0	315	0	1,067	0	385	0	1,789	0	609	0
West Kisumu	1,203	2,314	472	5,053	1,545	4,734	626	8,946	2,633	7,594	1,026	12,136
Central Kisumu	535	1,388	198	0	703	2,912	273	0	1,233	4,741	456	0
East Kisumu	0	9,963	199	57	0	20,994	467	105	0	34,151	914	152
Kajulu	0	2,632	52	0	0	5,521	123	0	0	8,988	240	0
Kolwa	0	11,423	228	0	0	23,964	533	0	0	39,013	1,044	0
North East Kano	2,089	0	739	0	2,682	0	904	0	4,572	0	1,430	0
South East Kano	1,499	1,489	683	265	1,843	2,716	859	494	2,964	4,032	1,372	719
North West Kano	709	0	332	0	853	0	406	0	1,332	0	642	0
South West Kano	413	0	241	0	479	0	295	0	705	0	466	0
Koru	329	0	134	69	416	0	164	117	693	0	259	148
Muhoroni	212	1,171	109	228	267	2,457	160	421	448	4,000	273	607
Chemdili	1,108	0	375	114	1,443	0	459	211	2,506	0	726	303
Miwani	530	0	168	94	696	472	216	178	1,223	639	343	264
North Nyakach	1,202	0	605	0	1,432	0	740	0	2,202	0	1,170	0
South Nyakach	1,342	0	545	0	1,662	161	671	0	2,702	217	1,061	0
West Nyakach	496	0	216	0	602	0	265	0	952	0	419	0

4 Action Plan

4.1 Urban Water Supply

Urban Name	Population	Present Raw Water Source	Future Raw Water Source	G/P	Pipe	Pump	Cost 1000 US\$
					line (km)	lift (m)	
Maseno	50,600	Kima river	Edzawa Dam	p	13.2	160	15,551
Kisumu & + Kiboswa	578,700	Lake Victoria	Kibos dam	g	13.8	0	104,840
Ahero	26,900	Boreholes	Nyando river	p	0.7	20	5,869
Muhoroni	26,700	Nyando river	Nyando River	g	8.4	0	7,633

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
Minuti	0	0	?	?	Irrigation	IDB	10	?
South Kano	0	0	?	?	Irrigation	LBDA	50	?

4.3 Large Scale Irrigation Project

Project	Area (ha)	Water Source	Water Demand (MCM)	Cost (million)		Major Crops
				US\$	K£	
Kano Plain	25,640	Sondu, Nyando River	540.4	232.5	293.0	Rice, Maize

4.10 Source Development Plan for Livestock Water Supply

District	Source Development Plan							Total	Implementation Program (%)	
	Surface Water	Borehole	Shallow Well	Small Dam	Subsurface Dam	Sand Dam	Existing Pipeline		Up to 2000	2001-2010
	- Quantity (m3/d)	6,489	1,377	2,940	287	0	0		0	11,093
- No. of Facilities	0	41	384	16	0	0	0	441		
- Cost (mill.US\$)	0	5.09	1.83	0.15	0	0	0	7.07		
(mill.K£)	0	6.42	2.3	0.19	0	0	0	8.92		

4.11 Watering Points in Nomadic Pasturage Area

Assumed Nomadic Pasturage Area (km ²)	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 Development Potential and Study Proposal

5.1 Potential Water Source for Future Development

Potential Water Source for Future Development	Purpose	Schemes		
		Water Supply	Irrigation	Hydropower
Nyando Dam	W+I+F	Greater Nakuru	Kano Plain	-

W:Water Supply I: Irrigation P: Power

5.2 River Basin Development 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
Nyando River Basin Study	LBDA	2.5	3.2	☆	☆	☆															

★ Design ☆ Study ● Construction

5.3 District Water Resource Study

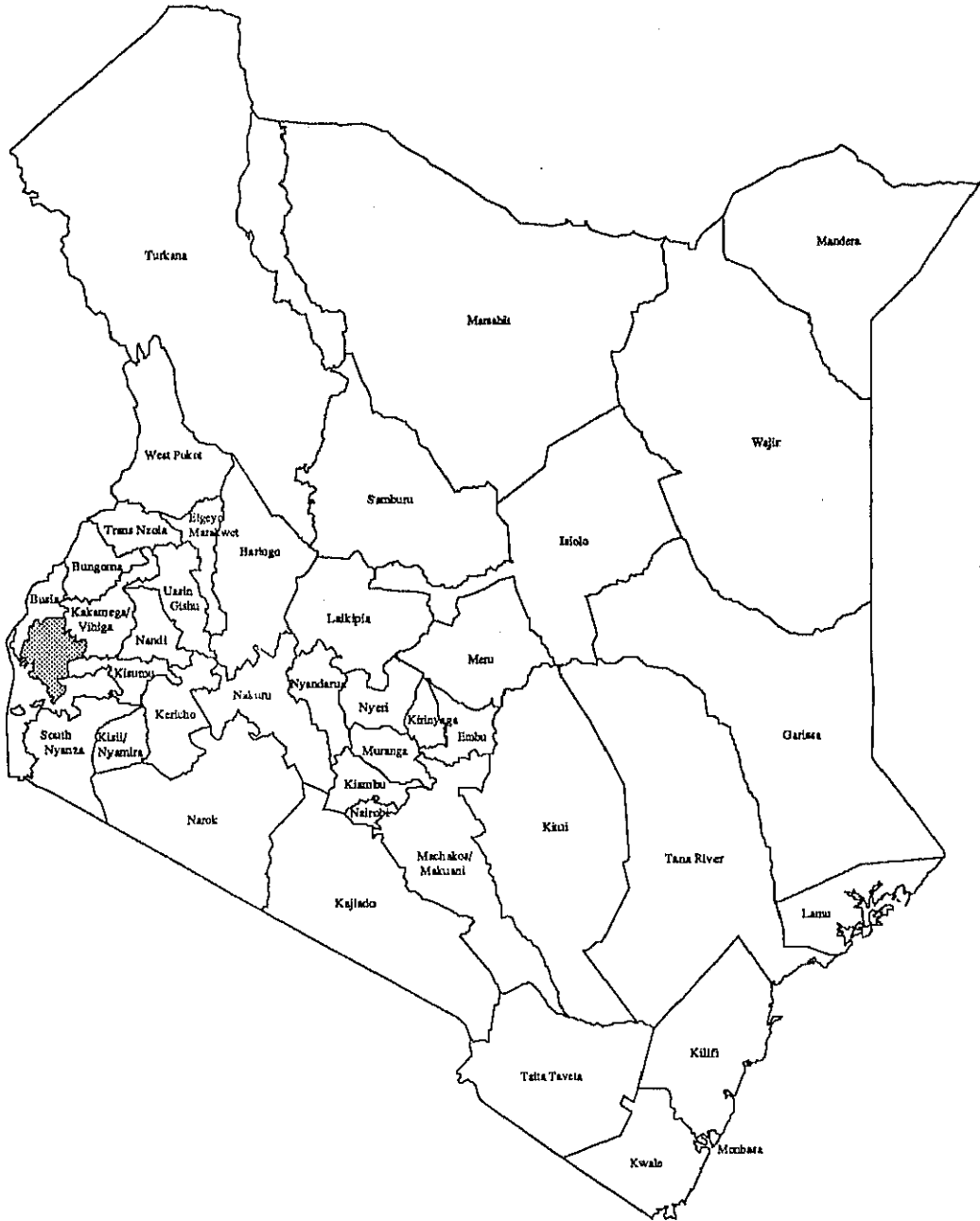
Related Basin Study Proposed	Remarks	Executing Agency	Cost (million)		Implementation Schedule																	
			US\$	K£	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10
Nyando		MOWD	2.5	3.2	○	○	○	☆	☆													

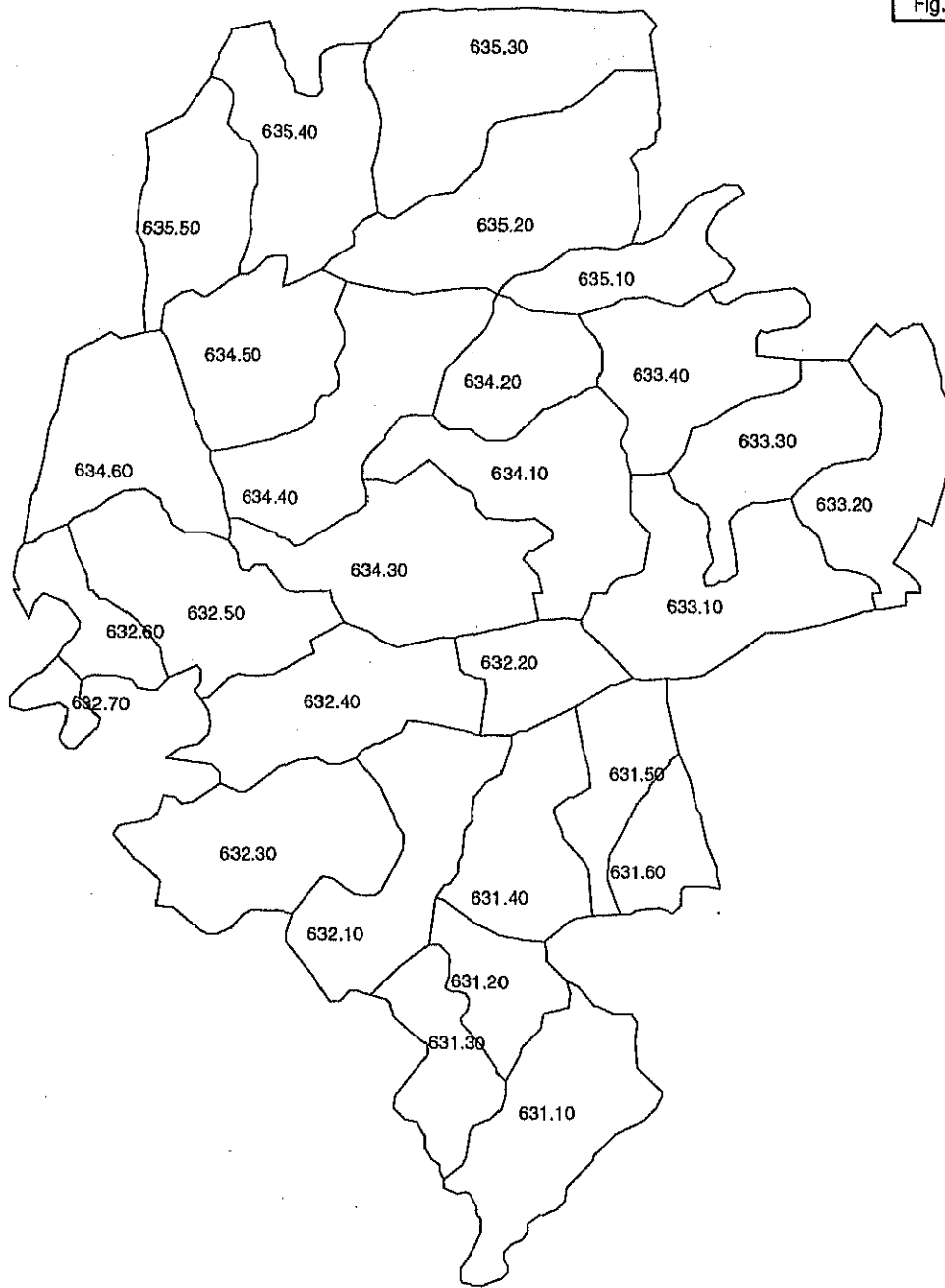
☆ Study

○ River Basin Study (proposed under separate programme)

Siaya

District

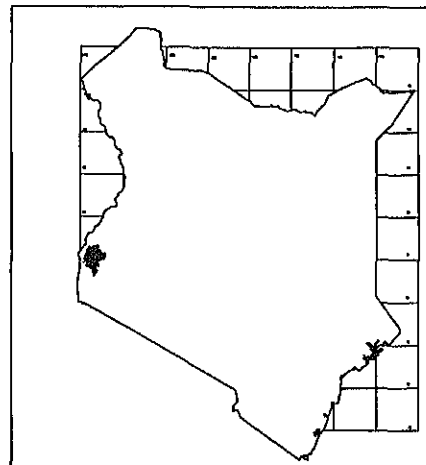




Code	Location	Population
631.1	east Uyoma	19,461
631.2	Central Uyoma	8,332
631.3	West Uyoma	10,660
631.4	West Asembo	13,987
631.5	Central Asembo	11,067
631.6	East Asembo	11,411
632.1	South Sakwa	13,457
632.2	North Sakwa	8,913
632.3	Central Sakwa	12,304
632.4	West Sakwa	10,588
632.5	East Yimbo	8,578
632.6	Central Yimbo	4,122
632.7	West Yimbo	7,373
633.1	South Gem	25,405
633.2	East Gem	27,904
633.3	Central Gem	14,995
633.4	North Gem	25,726
634.1	East Alego	29,853
634.2	North Alego	14,059
634.3	South Alego	18,116
634.4	Central Alego	22,354
634.5	West Alego	24,265
634.6	Usonga	9,169
635.1	South Ugenya	26,562
635.2	Uholo	25,235
635.3	East Ugenya	27,993
635.4	North Ugenya	27,577
635.5	West Ugenya	15,050



630 Siaya



THE STUDY
ON
THE NATIONAL WATER MASTER PLAN
JAPAN INTERNATIONAL COOPERATION AGENCY

1. Socio-Economic Profile : 630 Siaya District

1-1 Population Projection

(Unit:1000)

Code	Location	Land		1990			2000			2010		
		Area (sq.km)	Town Name	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural
630	Siaya District	2,520		676.8	26.8	650.0	789.0	50.1	738.5	929.7	76.0	853.7
631.1	east Uyoma	89		26.9	-	26.9	30.5	-	30.5	35.3	-	35.3
631.2	Central Uyoma	49		11.5	-	11.5	13.1	-	13.1	15.1	-	15.1
631.3	West Uyoma	58		14.7	-	14.7	16.7	-	16.7	19.3	-	19.3
631.4	West Asembo	86		19.3	-	19.3	22.0	-	22.0	25.4	-	25.4
631.5	Central Asembo	57		15.3	-	15.3	17.4	-	17.4	20.1	-	20.1
631.6	East Asembo	41	Asembo Bay	15.8	-	15.8	18.3	0.4	17.9	21.2	0.5	20.7
632.1	South Sakwa	106		18.6	-	18.6	21.1	-	21.1	24.4	-	24.4
632.2	North Sakwa	51		12.3	-	12.3	14.0	-	14.0	16.2	-	16.2
632.3	Central Sakwa	124		17.0	-	17.0	19.3	-	19.3	22.3	-	22.3
632.4	West Sakwa	109	Bondo	18.2	3.6	14.6	22.7	6.1	16.6	27.8	8.6	19.2
632.5	East Yimbo	113		11.9	-	11.9	13.5	-	13.5	15.6	-	15.6
632.6	Central Yimbo	45		5.7	-	5.7	6.5	-	6.5	7.5	-	7.5
632.7	West Yimbo	9		10.2	-	10.2	11.6	-	11.6	13.4	-	13.4
633.1	South Gem	130	Ng'iya	35.1	-	35.1	40.1	0.2	39.9	46.4	0.3	46.1
633.2	East Gem	95	Yala	41.2	2.7	38.5	48.3	4.5	43.8	57.1	6.4	50.6
633.3	Central Gem	84		20.7	-	20.7	23.5	-	23.5	27.2	-	27.2
633.4	North Gem	99		35.5	-	35.5	40.4	-	40.4	46.7	-	46.7
634.1	East Alego	122	Siaya	55.1	19.4	35.7	77.6	37.1	40.5	104.0	57.1	46.9
634.2	North Alego	60		19.4	-	19.4	22.1	-	22.1	25.5	-	25.5
634.3	South Alego	131		25.0	-	25.0	28.4	-	28.4	32.9	-	32.9
634.4	Central Alego	124		30.9	-	30.9	35.1	-	35.1	40.6	-	40.6
634.5	West Alego	100		33.5	-	33.5	38.1	-	38.1	44.0	-	44.0
634.6	Usonga	104		12.7	-	12.7	14.4	-	14.4	16.6	-	16.6
635.1	South Ugenya	55	Ugunja	36.7	-	36.7	42.0	-	41.7	48.7	0.5	48.2
635.2	Uholo	152		34.9	-	34.9	39.6	-	39.6	45.8	-	45.8
635.3	East Ugenya	140		38.7	-	38.7	43.9	-	43.9	50.8	-	50.8
635.4	North Ugenya	110	Ukwala	39.2	1.1	38.1	45.1	1.9	43.3	52.7	2.6	50.0
635.5	West Ugenya	77		20.8	-	20.8	23.6	-	23.6	27.3	-	27.3

1-2 GRDP Projection

Item	1990	2000	2010
1) GRDP (K.Pound million)	234.5	464.5	689.6
Percentage to GDP	3.0%	3.4%	3.4%
2) GRDP per Capita (K.Pound)	346.6	588.8	741.7
Ratio to GDP per capita	1.02	1.31	1.46
Urban (K.Pound)	556.6	713.5	898.8
Rural (K.Pound)	337.9	582.3	733.5

1-3 Present District Profile (1990)

1) Agricultural Production (1989)		3) Water Supply Schemes in Service Centre	
Product	Production Unit	Piped system	54
Maize	66,013 tons	Communal water points	0
Sorghum/Millet	894 tons	Other sources	0
Potato	13,070 tons	4) Educational Facilities	
Rice	38 tons	Primary school	551
Wheat/Barley	- tons	Secondary school	70
Coffee	1,903 tons	Institute	22
Tea	- tons	5) Medical Facilities	
Milk	- tons	Hospital	3
Meat	- tons	Health Centre	26
2) Number of Manufacturing Establishments (1986)		Dispensary	14
Type of Industry	Number	Others	0
Food	17	6) Out-patient of Infective Diseases in Relation to Water Supplies (1985-89 Average)	
Textile	2	Diarrhoeal Diseases	46,867
Wood	3	Leprosy	234
Paper	0	Infectious Hepatitis	502
Chemical	0	Bilharzia	1,090
Non-metal	1	Eye Infections	19,421
Metal	0		
Machinery	1		
Others	0		
Total	24		

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	2,523	1,005	0	96	1,002	0	800	625

2.2 Rain fall

Unit : mm

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
60	64	130	217	154	72	56	77	83	95	133	70	1,217

2.3 River Flow

Unit : m³/sec

Gauge Code	Catchment Area (km ²)	Mean Flow	Low Flow Frequency			
			80%	90%	95%	Min.
1FG01	2388	25.0	15.3	13.3	12.8	10.5
1FG02	2864	29.6	13.6	11.5	9.5	7.7

2.4 Groundwater

Aquifer Characteristics

Elevation (m)	Total Depth (m)	Water Struck (m)	Level Rest (m)	Yield (m ³ /hr)	Draw Down (m)
1232.95	59.08	40.67	17.95	4.19	17.08

Safe Abstraction Yield

Unit : m³/year

Borehole	Shallow	Total
639,352	2,227,428	2,866,780

2.5 Agriculture

Suitable Area for Major Crops

Unit: km²

Maize	Wheat	Rice	Sorghum	Potato	Coffee	Tea
2,034	0	1,967	2,041	0	15	168

Area of Irrigation Potential

Unit : ha

Surface Water		Groundwater	
Upland	Lowland	Upland	Lowland
20,884	32,819	23.8	18.4

Livestock Population

Unit: 1,000

Cattle	Sheep/Goats	Camels	Donkeys
404.40	325.78	-	-

3 Water Demand Projection

Unit: cu.m/day

Location	1990				2000				2010			
	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry
Siaya District	21,124	3,876	7,925	1,134	28,681	7,439	8,660	2,091	43,960	11,414	10,034	2,998
east Uyoma	532	0	324	0	651	0	352	0	858	0	406	0
Central Uyoma	254	0	139	0	318	0	151	0	431	0	174	0
West Uyoma	321	0	178	0	400	0	193	0	543	0	222	0
West Asembo	525	0	233	0	678	0	253	0	973	0	292	0
Central Asembo	493	0	184	114	665	0	200	211	1,013	0	231	303
East Asembo	435	0	190	0	564	54	208	0	812	71	239	0
South Sakwa	492	0	224	0	632	0	244	0	899	0	281	0
North Sakwa	424	0	149	0	581	0	161	0	902	0	186	0
Central Sakwa	418	0	205	0	531	0	223	0	742	0	257	0
East Sakwa	392	521	187	171	504	894	209	316	716	1,289	246	455
West Yimbo	317	0	143	0	408	0	155	0	580	0	179	0
Central Yimbo	147	0	69	0	188	0	75	0	266	0	86	0
West Yimbo	202	0	123	0	246	0	133	0	325	0	154	0
South Gem	1,274	0	424	0	1,767	36	460	0	2,780	48	531	0
East Gem	1,399	390	473	285	1,941	670	518	527	3,053	966	601	758
Central Gem	752	0	250	0	1,042	0	271	0	1,641	0	313	0
North Gem	1,290	0	429	0	1,789	0	466	0	2,814	0	537	0
East Alego	1,295	2,805	489	381	1,797	5,461	574	710	2,826	8,577	703	1,030
North Alego	705	0	234	0	977	0	254	0	1,539	0	293	0
South Alego	805	0	302	0	1,087	0	328	0	1,654	0	378	0
Central Alego	1,032	0	373	0	1,406	0	405	0	2,164	0	466	0
West Alego	1,154	0	405	0	1,582	0	439	0	2,455	0	506	0
Usonga	339	0	153	0	436	0	166	0	620	0	191	0
South Ugenya	1,332	0	443	126	1,847	52	482	222	2,906	70	555	300
Uhoho	1,265	0	421	57	1,755	0	457	105	2,761	0	526	152
East Ugenya	1,404	0	467	0	1,947	0	507	0	3,063	0	584	0
North Ugenya	1,383	159	463	0	1,917	273	504	0	3,017	394	583	0
West Ugenya	743	0	251	0	1,025	0	272	0	1,607	0	314	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\$
Bondo	8,600	Yala River	Yala river	p	8	100	4,172
Yala	6,500	Yala River	Yala river	p	1.2	20	2,526
Siaya	57,200	Nyamawin River	Yala River	p	22	200	15,975
Ukwala	2,700	Borholus	Nzoia River	p	5.4	100	1,914

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
Uthga Bay	-	-	Bondo	West Sakwa	Irrigation	M.O.A./KFFH	-	-
Aram/Asembo	-	-	Rarieda	West Asembo	"	KFFH	-	-
Ugambo Valley	24	-	Bondo	East Yimbo	"	CARE (K)	-	-
Wagusu	7	-	Bondo	South Sakwa	"	M.O.A.	-	-
Anyiko	25	-	Ugunja	West Uhoho	"	MOAA	-	-

4.3 Large Scale Irrigation Project

Project	Area (ha)	Water Source	Water Demand (MCM)	Cost (million)		Major Crops
				US\$	K£	
Lower Nzoia/ Bunyala Extension	10,480	Nzoia River	240.8	12.4	15.6	Rice, Cotton, Maize

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
Yala Swamp (Yala/Nzoia river)	- Rehabilitation of existing dykes (25 km) - Construction of new dykes (16 km)	MOWD/ LBDA	17.7	22.3																		

★ 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
Siaya	19,400	0.1	MOLG	1.0	1.2																	

★ 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				Executing Agency	Cost (million)		Implementation Schedule												Remarks					
Drinking		Livestock			US\$	K£	93	94	95	96	97	98	99	20	01	02	03	04		05	06	07	08	09
(B/H+D)	(S/W+H)	(B/H+D)	(S/W+H)	MOWD	62.6	78.1																		

★ 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)	18,041	6,380	15,369	1,827	1,134	0	0	98	1,041	43,890	33.1	66.9	
- No. of Facilities	0	220	2,983	30,004	27	0	0	7	0	33,241			
- Cost (mill.US\$)	0	23.95	14.32	18.11	0.46	0	0	0.12	0	56.96			
(mill.K£)	0	30.2	18.06	22.83	0.58	0	0	0.16	0	71.83			

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)	4,776	1,484	3,221	263	0	0	13	9,757	34.9	65.1	
- No. of Facilities	0	62	623	28	0	0	0	713			
- Cost (mill.US\$)	0	5.55	2.94	0.1	0	0	0	8.59			
(mill.K£)	0	6.99	3.71	0.13	0	0	0	10.83			

4.11 Watering Points in Nomadic Pasturage Area

Assumed Nomadic Pasturage Area (km ²)	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 Development 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 Development 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
Nzoia/Yala River Basin Study	LBDA	3.0	3.8		☆	☆	☆														

☆ Design ☆ Study ● Construction

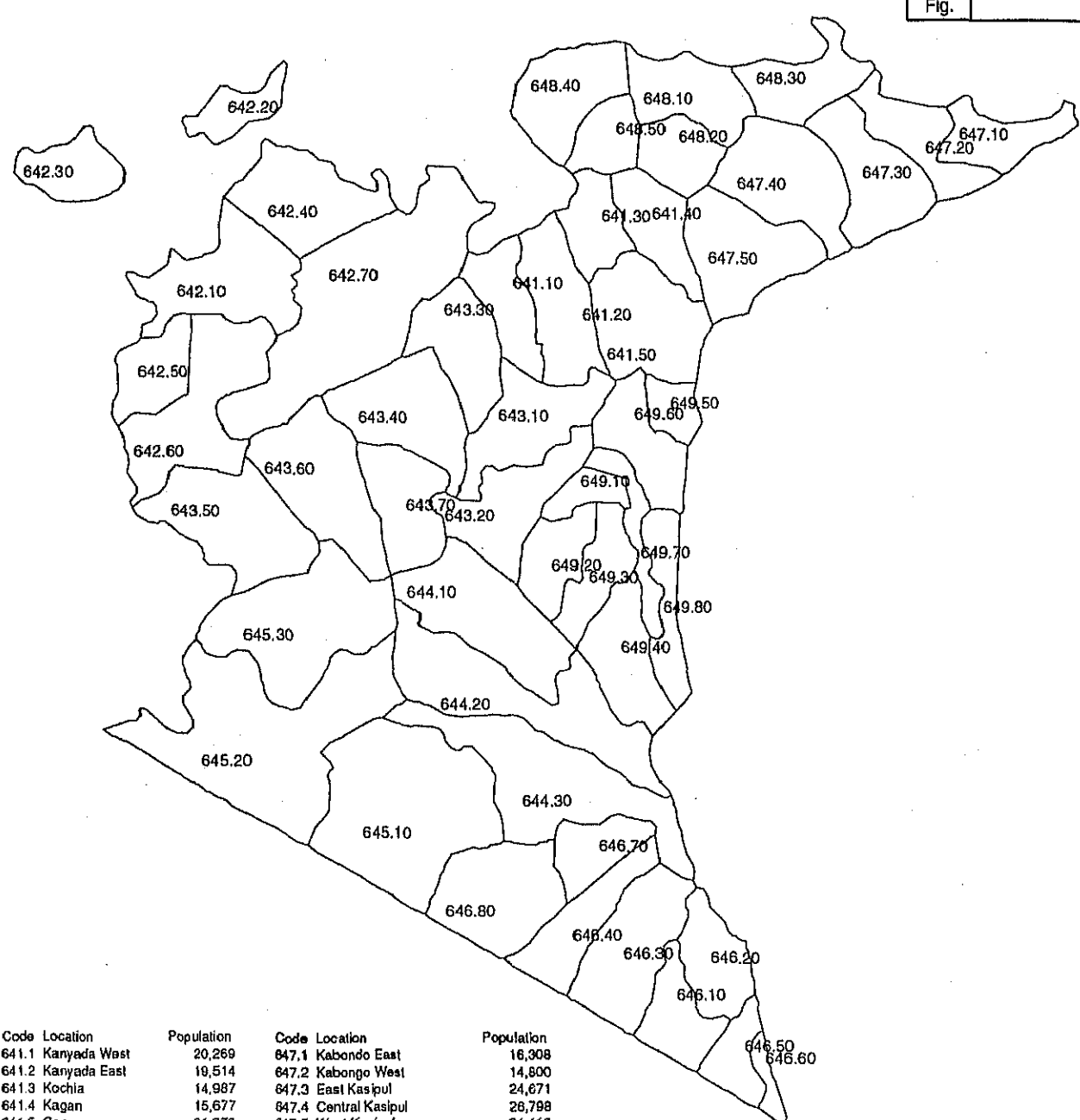
5.3 District Water Resource Study

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
Yala		MOWD	2.0	2.5		o	o	o	☆	☆												

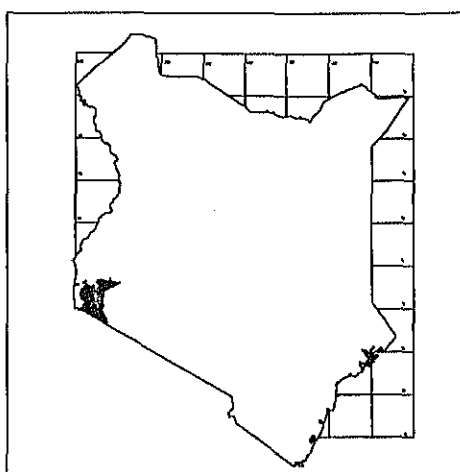
☆ Study

o River Basin Study (proposed under separate programme)

Fig.



Code	Location	Population	Code	Location	Population
641.1	Kanyada West	20,269	647.1	Kabondo East	16,308
641.2	Kanyada East	19,514	647.2	Kabongo West	14,800
641.3	Kochia	14,987	647.3	East Kasipul	24,671
641.4	Kagan	15,677	647.4	Central Kasipul	28,798
641.5	Gem	21,878	647.5	West Kasipul	24,418
642.1	Kaksingri	12,341	648.1	Central Karachuonyo	25,707
642.2	Rusinga	9,905	648.2	Kanyaluo	13,880
642.3	Mfangano	6,876	648.3	Wang Chieng	19,953
642.4	Gembe	17,705	648.4	West Karachuonyo	29,501
642.5	Gwasi North	10,126	648.5	Kibiri	17,867
642.6	Gwasi South	13,276	649.1	North Sakwa	5,352
642.7	Olambe	14,459	649.2	West Sakwa	9,208
643.1	Kabuoch North	15,703	649.3	Central Sakwa	14,915
643.2	Kabuoch South	13,907	649.4	South Sakwa	15,675
643.3	Kanyamwa Kologi	11,390	649.5	North Kamagambo	6,839
643.4	Kanyamwa Kosewe	14,495	649.6	Central Kamagambo	18,028
643.5	Kanungu	14,629	649.7	West Kamagambo	8,110
643.6	Kwabwai	12,517	649.8	South Kamagambo	9,866
643.7	Kanyidoto	13,126			
644.1	North Kanyamkago	18,468			
644.2	South Kanyamkago	27,601			
644.3	Suna East	39,285			
645.1	Suna West	27,379			
645.2	Muhuru/South Kadem	33,217			
645.3	North Kadem	14,773			
646.1	Nyabasi West	8,693			
646.2	Nyabasi East	13,810			
646.3	Bukira East	14,505			
646.4	Bukira West	10,155			
646.5	Bwirege West	7,304			
646.6	Bwirege East	5,234			
646.7	Bugembe East	6,738			
646.8	Bugembe West	18,643			



640 South Nyanza

THE STUDY
ON
THE NATIONAL WATER MASTER PLAN
JAPAN INTERNATIONAL COOPERATION AGENCY

1. Socio-Economic Profile : 640 South Nyanza 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
640	South Nyanza	5,720		1,154.9	50.1	1,104.8	1,357.0	106.1	1,251.0	1,603.8	156.3	1,447.5
641.1	Kanyada West	71	Homa Bay	40.6	23.0	17.6	68.5	48.6	19.9	96.9	73.8	23.1
641.2	Kanyada East	106		26.9	-	26.9	30.5	-	30.5	35.2	-	35.2
641.3	Kochia	60		20.7	-	20.7	23.4	-	23.4	27.1	-	27.1
641.4	Kagan	73		21.6	-	21.6	24.5	-	24.5	28.3	-	28.3
641.5	Gem	138	Rangwe	30.2	-	30.2	34.4	0.2	34.1	39.8	0.3	39.5
642.1	Kaksingri	151	Sindo	17.0	-	17.0	20.2	0.9	19.3	23.4	1.2	22.3
642.2	Rusinga	37		13.7	-	13.7	15.5	-	15.5	17.9	-	17.9
642.3	Mfangano	67		9.5	-	9.5	10.7	-	10.7	12.4	-	12.4
642.4	Gembe	128	Mbita	24.4	-	24.4	28.7	1.1	27.6	33.4	1.4	32.0
642.5	Gwasi North	70		14.0	-	14.0	15.8	-	15.8	18.3	-	18.3
642.6	Gwasi South	166		18.3	-	18.3	20.7	-	20.7	24.0	-	24.0
642.7	Olambe	338		19.9	-	19.9	22.6	-	22.6	26.1	-	26.1
643.1	Kabuoch North	115		21.6	-	21.6	24.5	-	24.5	28.4	-	28.4
643.2	Kabuoch South	113		19.2	-	19.2	21.7	-	21.7	25.1	-	25.1
643.3	Kanyamwa Kologi	99		15.7	-	15.7	17.8	-	17.8	20.6	-	20.6
643.4	Kanyamwa Kosowe	132	Ndhiwa	20.0	-	20.0	23.4	0.8	22.6	27.2	1.0	26.2
643.5	Karungu	148	Sori+Karungu	20.2	-	20.2	24.0	1.1	22.8	27.9	1.5	26.4
643.6	Kwabwai	154		17.3	-	17.3	19.5	-	19.5	22.6	-	22.6
643.7	Kanyidoto	97		18.1	-	18.1	20.5	-	20.5	23.7	-	23.7
644.1	North Kanyamkago	159		25.5	-	25.5	28.8	-	28.8	33.3	-	33.3
644.2	South Kanyamkago	203		38.0	-	38.0	43.1	-	43.1	49.8	-	49.8
644.3	Suna East	210	Migori	53.1	7.5	45.6	67.4	15.8	51.6	83.8	24.1	59.7
645.1	Suna West	294		37.7	-	37.7	42.7	-	42.7	49.4	-	49.4
645.2	Muhuru/South Kadem	355	Macalder	45.8	-	45.8	52.4	0.6	51.8	60.7	0.7	60.0
645.3	North Kadem	207		20.4	-	20.4	23.1	-	23.1	26.7	-	26.7
646.1	Nyabasi West	69		12.0	-	12.0	13.6	-	13.6	15.7	-	15.7
646.2	Nyabasi East	78		19.0	-	19.0	21.6	-	21.6	24.9	-	24.9
646.3	Bukira East	135	Kehancha+Tarang'anya	23.8	3.8	20.0	29.6	6.9	22.6	35.9	9.7	26.2
646.4	Bukira West	85		14.0	-	14.0	15.8	-	15.8	18.3	-	18.3
646.5	Bwirege West	47		10.1	-	10.1	11.4	-	11.4	13.2	-	13.2
646.6	Bwirege East	17		7.2	-	7.2	8.2	-	8.2	9.5	-	9.5
646.7	Bugembe East	59		9.3	-	9.3	10.5	-	10.5	12.2	-	12.2
646.8	Bugembe West	137	Nyabikaya	29.3	3.6	25.7	35.7	6.6	29.1	42.9	9.2	33.7
647.1	Kabondo East	67		22.5	-	22.5	25.4	-	25.4	29.4	-	29.4
647.2	Kabondo West	79		20.4	-	20.4	23.1	-	23.1	26.7	-	26.7
647.3	East Kasipul	111		34.0	-	34.0	38.5	-	38.5	44.5	-	44.5
647.4	Central Kasipul	136	Oyugis	40.7	3.8	36.9	48.8	6.9	41.8	58.1	9.7	48.4
647.5	West Kasipul	133		33.7	-	33.7	38.1	-	38.1	44.1	-	44.1
648.1	Central Karachuonyo	95	Kendu Bay	35.0	2.7	32.3	42.3	5.7	36.6	51.0	8.7	42.4
648.2	Kanyaluo	61		19.1	-	19.1	21.7	-	21.7	25.1	-	25.1
648.3	Wang Chieng	84		27.5	-	27.5	31.1	-	31.1	36.0	-	36.0
648.4	West Karachuonyo	103		39.3	-	39.3	44.5	-	44.5	51.5	-	51.5
648.5	Kibiri	51	Nyangweso	24.6	-	24.6	28.2	0.3	27.9	32.6	0.4	32.3
649.1	North Sakwa	32		7.4	-	7.4	8.4	-	8.4	9.7	-	9.7
649.2	West Sakwa	65		12.7	-	12.7	14.4	-	14.4	16.6	-	16.6
649.3	Central Sakwa	65		20.6	-	20.6	23.3	-	23.3	26.9	-	26.9
649.4	South Sakwa	96	Awendo	25.9	4.3	21.6	32.3	7.9	24.5	39.3	11.0	28.3
649.5	North Kamagambo	34		9.4	-	9.4	10.7	-	10.7	12.4	-	12.4
649.6	Central Kamagambo	83	Rongo	23.5	1.4	22.1	27.6	2.6	25.0	32.5	3.6	28.9
649.7	West Kamagambo	44		11.2	-	11.2	12.7	-	12.7	14.6	-	14.6
649.8	South Kamagambo	63		13.8	-	13.8	15.6	-	15.6	18.0	-	18.0

1-2 GRDP Projection

Item	1990	2000	2010
1) GRDP (K.Pound million)	581.4	685.3	850.3
Percentage to GDP	7.5%	5.0%	4.2%
2) GRDP per Capita (K.Pound)	503.4	505.0	530.2
Ratio to GDP per capita	1.48	1.12	1.05
Urban (K.Pound)	703.0	628.0	652.5
Rural (K.Pound)	494.3	494.6	516.9

1-3 Present District Profile (1990)

1) Agricultural Production (1989)			3) Water Supply Schemes in Service Centre	
Product	Production	Unit	Piped system	24
Maize	145,810	tons	Community water points	0
Sorghum/Millet	3,204	tons	Other sources	0
Potato	47,624	tons	4) Educational Facilities	
Rice	750	tons	Primary school	823
Wheat/Barley	-	tons	Secondary school	109
Coffee	-	tons	Instituts	94
Tea	-	tons	5) Medical Facilities	
Milk	-	tons	Hospital	1
Meat	-	tons	Health Centre	23
2) Number of Manufacturing Establishments (1986)			Dispensary	29
Type of Industry	Number		Others	0
Food	31		6) Out-patient of Infective Diseases in Relation to Water Supplies (1985-89 Average)	
Textile	4		Diarhoeal Diseases	47,319
Wood	2		Leprosy	126
Paper	1		Infectious Hepatitis	717
Chemical	0		Bilharzia	4,884
Non-metal	1		Eye Infections	25,305
Metal	0			
Machinery	2			
Others	0			
Total	41			

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
7,778	5,714	2,064	119	52	715	0	1,500	3,328

2.2 Rain fall

Unit : mm

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
75	89	154	226	174	92	69	90	116	126	157	105	1,480

2.3 River Flow

Unit : m³/sec

Gauge Code	Catchment Area (km ²)	Mean Flow	Low Flow Frequency			
			80%	90%	95%	Min.
1HD01	508	6.7	2.2	1.9	1.5	1.3
1HD02	119	2.0	0.7	0.6	0.5	0.4
1HD03	119	1.8	0.8	0.7	0.6	0.5
1KB01	3103	24.4	10.7	9.3	8.8	7.1
1KB01A	3115	28.4	12.2	9.9	8.5	6.8
1KB03	1114	14.9	7.2	6.3	5.8	4.6
1KB05	6600	48.3	22.2	19.3	17.9	12.5
1KB07	342	6.8	2.5	2.1	1.8	1.4
1KC03	3046	18.2	8.4	7.1	6.5	5.6

2.4 Groundwater

Aquifer Characteristics

Elevation (m)	Total Depth (m)	Water Struck (m)	Level Rest (m)	Yield (m ³ /hr)	Draw Down (m)
1346.3	75.63	54.41	19.07	4.49	29.98

Safe Abstraction Yield

Unit : m³/year

Borehole	Shallow	Total
2,102,380	4,427,174	6,529,554

2.5 Agriculture

Suitable Area for Major Crops

Unit: km²

Maize	Wheat	Rice	Sorghum	Potato	Coffee	Tea
3,965	0	2,978	4,103	0	123	87

Area of Irrigation Potential

Unit : ha

Surface Water		Groundwater	
Upland	Lowland	Upland	Lowland
22,365	22,123	106.6	46.9

Livestock Population

Unit: 1,000

Cattle	Sheep/Goats	Camels	Donkeys
550.73	408.54		

3 Water Demand Projection

Unit: cu.m/day

Location	1990				2000				2010			
	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry
South Nyanza District	32,034	7,245	5,542	2,114	42,254	15,628	6,115	3,910	62,728	23,461	7,134	5,625
Kanyada West	496	3,326	116	590	646	7,157	154	1,089	939	11,081	199	1,561
Kanyada East	820	0	133	94	1,088	0	146	178	1,628	0	169	264
Kochia	553	0	102	57	709	0	112	105	1,010	0	130	152
Kagan	617	0	107	0	804	0	117	0	1,176	0	136	0
Gen	1,047	0	150	0	1,434	35	164	0	2,234	45	190	0
Kakasingri	337	0	84	0	410	132	93	0	542	173	108	0
Rusinga	270	0	68	0	329	0	74	0	434	0	86	0
Mfangano	188	0	47	0	229	0	51	0	302	0	60	0
Genbe	484	0	121	0	588	164	134	0	777	216	155	0
Gwasi North	308	0	69	0	383	0	76	0	522	0	88	0
Gwasi South	365	0	91	0	445	0	99	0	588	0	115	0
Olabwe	425	0	99	0	526	0	108	0	711	0	125	0
Kabuoch North	785	0	107	0	1,084	0	117	0	1,708	0	136	0
Kabuoch South	696	0	95	0	961	0	104	0	1,514	0	121	0
Kanyamwa Kologi	451	0	78	0	590	0	85	0	863	0	99	0
Kanyamwa Kosewe	583	0	99	114	766	120	109	211	1,128	157	127	303
Karungu	422	0	100	0	519	169	111	0	698	222	129	0
Kwabwai	442	0	86	37	563	0	93	73	795	0	109	112
Kanyidoto	575	0	90	0	771	0	98	0	1,170	0	114	0
North Kanyamkago	889	0	126	0	1,218	0	138	0	1,900	0	160	0
South Kanyamkago	1,181	0	189	0	1,574	0	206	0	2,371	0	239	0
Suna East	1,332	1,084	235	228	1,748	2,334	266	421	2,578	3,613	315	607
Suna West	1,039	0	187	0	1,341	0	204	0	1,932	0	237	0
Muhuru/South Kadem	1,062	0	227	0	1,331	84	249	0	1,836	110	289	0
North Kadem	465	0	101	0	581	0	110	0	799	0	128	0
Nyabasi West	287	0	59	0	362	0	65	0	503	0	75	0
Nyabasi East	557	0	94	0	744	0	103	0	1,123	0	120	0
Bukira East	534	550	104	0	700	1,023	117	0	1,029	1,458	137	0
Bukira West	421	0	69	0	565	0	76	0	856	0	88	0
Bwirege West	254	0	50	0	322	0	55	0	453	0	63	0
Bwirege East	171	0	36	0	215	0	39	0	298	0	45	0
Bugembe East	301	0	46	0	406	0	50	0	620	0	58	0
Bugembe West	807	521	132	0	1,083	969	147	0	1,643	1,382	173	0
Kabondo East	649	0	112	0	849	0	122	0	1,246	0	141	0
Kabongo West	642	0	101	0	859	0	111	0	1,299	0	128	0
East Kasipul	1,179	0	169	0	1,614	0	184	0	2,511	0	214	0
Central Kasipul	1,148	550	188	69	1,530	1,023	208	117	2,305	1,458	244	148
West Kasipul	1,152	0	167	0	1,573	0	182	0	2,440	0	212	0
Central Karachuonyo	866	390	164	242	1,109	840	182	452	1,580	1,301	214	658
Kanyaluo	513	0	95	0	657	0	104	0	935	0	120	0
Wang Chieng	737	0	136	0	943	0	149	0	1,344	0	173	0
West Karachuonyo	1,049	0	195	0	1,343	0	213	0	1,911	0	247	0
Kibiri	660	0	122	57	844	43	134	105	1,204	57	155	152
North Sakwa	268	0	37	0	370	0	40	0	583	0	46	0
West Sakwa	460	0	63	0	636	0	69	0	1,003	0	80	0
Central Sakwa	747	0	102	0	1,031	0	111	0	1,624	0	129	0
South Sakwa	751	622	113	455	1,029	1,158	126	843	1,602	1,650	149	1,213
North Kamagambo	342	0	47	0	473	0	51	0	745	0	59	0
Central Kamagambo	802	202	111	171	1,108	377	123	316	1,745	537	143	455
West Kamagambo	406	0	55	0	561	0	61	0	883	0	70	0
South Kamagambo	499	0	68	0	690	0	75	0	1,088	0	87	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\$
Homa Bay	73,900	L. Victoria	Lake Victoria	p	2	110	12,521
Migori	24,100	Boreholes	Migori river	p	1.1	110	5,446
Kehancha + Tarang'anya	9,800	Orawe Dam	Migori river	p	10.8	120	4,757
Nyabikaye	9,300	Stream	Boreholes	g	267	0	27,046
Oyugis	9,800	Awachi River	Isanta river(Awach Tonde)	g	11.3	0	4,938
Kendu Bay	8,700	Awachi River	Lake Victoria	p	1.5	40	2,970
Awendo/Sare	11,000	Sare River	Sare river	g	8.3	0	5,263

g: gravity p: pump

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	Subsurface Dam	Sand Dam	Rock Catch	Existing Pipeline		Up to 2000	2001-2010
- Quantity (m3/d)	24,460	11,171	17,346	7,043	1,924	176	176	0	292	62,588	33.3	66.7
- No. of Facilities	0	342	3,050	92,293	51	27	27	0	0	95,790		
- Cost (mill.US\$)	0	42.01	15.24	55.54	1.05	0.5	0.36	0	0	114.69		
(mill.K£)	0	52.97	19.22	70.03	1.32	0.63	0.46	0	0	144.62		

4.10 Source Development Plan for Livestock Water Supply

District	Source Development Plan								Total	Implementation Program (%)	
	Surface Water	Borehole	Shallow Well	Small Dam	Subsurface Dam	Sand Dam	Existing Pipeline	Up to 2000		2001-2010	
- Quantity (m3/d)	3,025	1,428	2,148	209	8	8	0	6,826	36.0	64.0	
- No. of Facilities	0	68	366	47	8	8	0	497			
- Cost (mill.US\$)	0	5.38	1.77	0.1	0.02	0.02	0	7.28			
(mill.K£)	0	6.79	2.23	0.13	0.02	0.02	0	9.18			

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 Development Potential and Study Proposal

5.1 Potential Water Source for Future Development

Potential Water Source for Future Development	Purpose	Schemes		
		Water Supply	Irrigation	Hydropower
Katieno Dam	W	Kisii	-	-
Namba Kodero Dam	W+P	-	-	Namba Kodero

W:Water Supply I:Irrigation P:Power

5.2 River Basin Development 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
-	-	-	-																		

★ 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
		MOWD	2.0	2.5					☆	☆	☆										

☆ Study

○ River Basin Study (proposed under separate programme)

Rift Valley Province

Rift Valley Province

Socio Economic Profiles

Rift Valley Province has a total area of 183.5 thousand km² or 31% of the national total and is the largest province in the country. The high potential land is mainly on the highlands west of the rift valley. Most of the land is of medium to poor potential and mainly of range potential. Of the total provincial area, 2.8 thousand km² or 1.5% of the provincial area is occupied by water areas such as lakes and rivers. Of the rest of the land area of 180.7 thousand km², 29.4 thousand km² or 16% is reserved area for uses such as national parks and reserved areas. The rest, 151.4 thousand km² or 82.5%, is habitable areas 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)
710 Kajiado	21,105	286	14
720 Kericho	4,890	916	187
730 Laikipia	9,718	228	23
740 Nakuru	7,200	933	130
750 Narok	18,513	425	23
760 Trans Nzoia	2,468	424	172
770 Uasin Gishu	3,784	470	124
810 Baringo	10,790	306	28
820 Elgeyo Marakwet	2,722	227	83
830 Nandi	2,745	473	172
840 Samburu	20,809	122	6
850 Turkana	69,684	189	3
860 West Pokot	9,056	248	27

In 1990, 5,248 thousand people or 23.1% of the national population were living in Rift Valley Province. Its district distribution is shown in the above table.

The urban population numbered 677 thousand or 13% of the total provincial population. It was distributed among 42 towns in 13 Districts as follows: five towns with 34 thousand of urban population in Kajiado District; four towns, 53 thousand, in Kericho; three towns, 42 thousand, in Laikipia; seven towns, 258 thousand, in Nakuru; four towns, 18 thousand, in Narok; and one town, 56 thousand, in Trans Nzoia; five towns, 124 thousand, in Uasin Gishu; five towns, 26 thousand, in Baringo; one town, 6 thousand, in Elgeyo Marakwet; two towns, 15 thousand, in Nandi; one town, 9 thousand, in Turkana; and two towns, 13 thousand, in West Pokot. Among these towns, the top 15 towns in terms of urban population were Nakuru, Eldoret, Kitale, Kericho, Naivasha, Nanyuki, Maralal, Ngong, Gilgil, Nyahururu, Kapsabet, El Burgon, Kapenguria, Narok and Molo in that order. Every one of these towns had more than 10 thousand population in 1990.

Nakuru functions as the provincial capital as well as the district headquarters of Nakuru District. The district headquarters of the other Districts are Kajiado in Kajiado District; Kericho in Kericho; Nanyuki in Laikipia; Narok in Narok; Kitale in Trans Nzoia; Eldoret in Uasin Gishu; Kabarnet in Baringo; Iten in Elgeyo Marakwet; Kapsabet in Nandi; Maralal in

Samburu; Lodwar in Turkana; and Kapenguria in West Pokot.

Most of Kenya's wheat and barley is produced in Nakuru and Uasin Gishu Districts. Maize is also important in most of the districts as well as these two districts. Trans Nzoia functions as the centre of commercial maize production. The most important plantation agriculture in the province is tea. There are several tea estates in Kericho and Nandi Districts. Large-scale commercial ranching occupies most of Laikipia and parts of Kajiado. The northern sections of Rift Valley Province are occupied by the over populated pastoral areas of Turkana, Samburu and parts of West Pokot and Baringo Districts.

Nakuru ranks as the most industrialized and commercial centre in the province. It is the chief town for the processing of agricultural products from a wide area. Eldoret, Kericho and Kitale, being the following industrialized and commercial centres, perform similar functions but serve more localized hinterland areas. Besides them, Molo, Nyahururu, Nanyuki, Njoro, El Burgon, Nandi Hills, Londiani, Naivasha, Kabarnet, Sotik and Lodwar are also listed up as industrialized towns in the province.

Rift Valley Province recorded K£1,161 million at 1989 constant prices or 15% of GDP, according to the Study Team's estimation explained in Chapter 5 of Sectoral Report "A". Nakuru District recorded the largest GRDP in the province. It was estimated at K£355 million or 4.6% of GDP. Nakuru also recorded the largest GRDP per capita in the province. It was estimated at K£381 in 1990, which was 1.12 times of the national average. GRDP per capita of the other Districts recorded as follows: K£310 or 0.90 in Uasin Gishu; K£291 or 0.85 in Samburu; K£257 or 0.75 in Trans Nzoia; K£250 or 0.73 in Laikipia; K£249 or 0.73 in Kajiado; K£186 or 0.55 in Kericho; K£168 or 0.49 in Elgeyo Marakwet; K£157 or 0.46 in Nandi; K£126 or 0.37 in West Pokot; K£103 or 0.30 in Baringo; K£70 or 0.70 in Narok; and K£61 or 0.18 in Turkana.

Surface Water

(1) Kajiado District

About 300 boreholes are concentrated in the northern part of the District and sparsely distributed in the remaining parts. However, less than 50% of boreholes are operational. At present, water harvesting such as small dam/pan, roof catchment and sub-surface/sand dam provides the water for rural water supply as major water source.

Kajiado town is presently served by the piped water from the Kiserian River and Nol-Tresh pipeline. However, their capacities do not meet the demand in 2010. At present, the Kiserian Dam is under construction to augment water supply volume of the existing dam.

Magadi town is presently served by the water pipeline from the Oloibortoto River. An additional water pipeline from the river (alternatively from the Ewaso Ngiro River) will be required.

(2) Kericho District

The District receives enough annual rainfall of 1,400 mm without a distinctive dry month and the perennial rivers originate from the Mau Forest. At present, about 40 pumped water supply systems are in operation. As the growth of the population uses, the development of small dams and desilting of existing small dams will be required as the major water sources.

(3) Laikipia District

The District receiving an annual mean rainfall of 696 mm on an average does not have enough surface water resources. At present, 7 water supply systems mainly with boreholes have been developed as the major water source.

As the growth of population of Rumuruti town, the Rumuruti Dam will be required for urban water supply. The rural water supply will be provided by the development of boreholes as the major water source.

(4) Nakuru District

The District is located in the basin of internal drainage system. The annual rainfall of 949 mm was recorded on an average. A few perennial rivers flow through the District, but their discharges are small. The potential water sources have already been developed and used. At present, the Nakuru water supply via Gilgil is being constructed. However, the system does not meet the water demand of Nakuru in 2010. Malewa Dam for augmentation of the system and large water transfer scheme from Itare Dam will be required for Nakuru, Gilgil and Naivasha towns.

(5) Narok District

The District receives mean annual rainfall of 972 mm. Two major perennial rivers, the Ewaso Ngiro River and the Mara River, flow through the District and discharge into Tanzania. The Mara River flowing through in the Masai Mara National Park is the major water source for wildlife and the Ewaso Ngiro River is the major inflow to the Lake Natron. Both rivers need to conserve their flow keeping river ecosystem.

At present, 9 water supply systems are under operation for domestic water supply. Narok town, however, suffered from serious water shortage in 1990. The Upper Narok Dam will be required for water supply to Narok. Groundwater development in combination with water harvesting are the major water sources for rural water supply.

(6) Trans Nzoia District

The District is located at the eastern foot of Mt. Elgon and extends eastwards. The mean annual rainfall is 1,281 mm. About 20 water supply systems utilizing water of the tributaries of the Nzoia River are in operation for the purpose of domestic, livestock and irrigation water uses.

(7) Uasin Gishu District

The District receives an annual rainfall of 1,231 mm on average. The wetter months with rainfall of more than 100 mm are from April to August. At present, 9 water supply systems which border Eldoret town are in operation utilizing the relatively large amount of surface water from the tributaries of the Nzoia River. In the rural areas, many people manage their own shallow wells near their homes. However, due to the increase of population, it was reported that the overutilized shallow wells were subject to pollution resulting from poor sanitation of the factories within Eldoret town.

The clean water supply from the Moiben Dam is required for the purpose of domestic and industrial water supply to Eldoret town. At the same time, a sewerage system with standard treatment will be required to avoid the water pollution of the Sosiani River.

(8) Baringo District

The District which receives annual rainfall of 851 mm on an average is located in the internal drainage system of Lakes Baringo and Bogoria. Both available surface water and groundwater are quite limited so that water harvesting has been carried out traditionally. However, potential water sources have already been utilized at urban and rural centers of major demand.

As increase of urbanization of the demand centers, such as, Eldama Ravine, Mogotio and Kabarnet continues, the capacity of existing 50 small scale water supply system will be overburdened. As well as the water supply from the Chemususu Dam, the additional water transfer scheme from Itare Dam will be required for Eldama Ravine and Mogotio water supplies. As for Kabarnet town, the Kirandich Dam is in the process of construction for domestic water supply.

(9) Elgeyo Marakwet District

The District which is located in the Kerio Valley receives an annual rainfall of 1,039 mm on average. Generally, enough surface water is available, especially in the highlands. At present, about 22 systems are in operation for communal water supply with 15 surface water sources, 3 springs, 3 small dams and 2 boreholes.

The water pipeline from Moiben Dam to Iten town will be required in order to cope

with the increase of water demand in 2010. The remaining area needs to develop small dams and boreholes as major water sources.

(10) Nandi District

The District receives an annual rainfall of 1,524 mm on average. There is no distinctive dry month throughout the year. At present, 7 water supply systems are under operation utilizing surface water from the tributaries of the Nzoia River. In the rural areas, the water sources are piped water supply, protected springs and boreholes. However, due to the increase in population, it was reported that the coverage of existing water supply system was estimated at 6% for urban areas and less than 10% for rural areas.

Piped water supply with sewerage system may become top priority for urban domestic water supply. As for rural water supply, the combination of shallow wells and water harvesting will be required.

(11) Samburu District

The District receives an annual rainfall of 540 mm on average. The only wetter month with more than 100 mm is April. There is no perennial river in the District, except small streams around Maralal town. To meet the increase in demand in 2010, small dams will be required as major water sources for Maralal town. For the remaining areas, the development of groundwater resources, boreholes and shallow wells, will be enhanced as the major water sources for the District as well as the development of water harvesting as subordinate measure.

(12) Turkana District

The District receives an annual average rainfall of 442 mm which is the least amount for any district in Kenya. Although the Turkwel River flows through the District and discharges into Lake Turkana, its flow is quite small during the dry period and its course is far from the rural centers which are scattered in the District.

At present, about 200 shallow wells supply domestic water for a population of 19,000. The saline water from shallow wells and the difficulty of maintenance works made the implementation of development of shallow wells difficult.

The future development of water resources may include the development of sub-surface/sand dam as major water sources as well as shallow wells.

(13) West Pokot District

The District receives an annual rainfall of 772 mm on average. The wetter months with more than 100 mm are April and May. The water demand in the District is mainly in the rural areas, except Kapenguria town. At present, 13 major water

supply systems are in operation and the population which is served by piped water supply was estimated at less than 20%. The growth of urban centers such as Kapenguria may involve relatively high construction cost with pumping because of their higher altitude. The water harvesting involving small dams and/or sub-surface/sand dams, therefore, will be required as major water sources for the urban centers which are located at relatively high elevation. The District is located at the western foot of Mt.Elgon and extends northwards. The potential of groundwater and springs still remains. The development of groundwater and spring protection may result in major water sources for rural water supply.

Geology

The geology is diversified, consisting of rocks whose age range from Pre-cambrian to recent. Four divisions can be recognized: the Tertiary and Quaternary volcanic rocks along the Rift Valley, Quaternary sedimentary rocks in the northern part and around the lakes in the Rift Valley, and Pre-cambrian metamorphic basement rocks to the east and western sides.

Physiography

Northern Plainlands spread in the northern part, Rift Valley in the central belts, and Highlands in the east and western sides.

Groundwater

Most of the boreholes are sited in the volcanic rocks (phonolites, basalts, and trachytes) and the yields of between 5 and 25 m³/hr are common. The Pre-cambrian metamorphic and igneous rocks, even where fracture zones are encountered, yield very little water (1.5 to 6 m³/hr). Quaternary sedimentary rocks around the lakes in the Rift Valley yield fair amounts of water but the sedimentary rocks in the northern part yield little water.

(1) Kajiado District

The occurrence of groundwater in Kajiado District is mainly influenced by climate and topography, as well as origin of underlying parent rock. According to TARDA's report on Kajiado District; groundwater occurrence may therefore be based on four hydrogeologic formations which include:

The volcanic areas of Ngong and Loitokitok account for 81 boreholes out of the 153 boreholes drilled in Kajiado. Most of the boreholes are located within the Ngong area and indicate yields ranging from 0 to 864 m³/day, while total depths vary from 61 to 292m. Boreholes sunk through volcanic lavas of Mt.Kilimanjaro in the Loitokitok area indicate yields ranging from 60 to 327 m³/day, with depths varying from 46 to 292m. The most notable feature of boreholes sunk through volcanic rocks in both areas is that all of them struck water of good quality, though in varying quantities.

Available information obtained from 18 boreholes drills through volcanic over basement indicate that yields ranging from 4 to 1,166 m³/day have been obtained at various depths, ranging from 46 to 227m.

Available information from 32 of the drilled in the basement system indicate that yields ranging from 0 to 719m³/day have been obtained from various depths, ranging from 66 to 183 m. Of the 32 boreholes, 22 produced water of good quality while 3 had slightly mineralized water. Five boreholes failed to strike water.

Available information on 25 boreholes drilled through sediment over basement shows that, of the 25 boreholes, only one failed to strike water, while 24 boreholes indicate yields ranging from 57 to 433m³/day with depths varying from 24 to 152m. Based on available information on the range of yields and quality of water from boreholes drilled through the sediments over basement rock type, it may be concluded that there are good prospects of developing aquifer for both livestock and domestic water supplies.

All of the boreholes surveyed by TARDA were utilized for supply of water to the trading centers, domestic use for livestock use. There was no evidence of any irrigation being carried out using borehole water.

(2) Kericho District

The average boreholes yield in the District is 7.2 m³/hr, but the yields may actually vary from nil to over 36 m³/hr. The average borehole depth is 146 meters. The average rest level of the water in boreholes is 40 meters.

There are 40 water supply schemes in the District. Belgut Division has 13 followed by Kipkelion with 8, Bomet 6, Buret 5, Londiani 4, Chpalungu 3, and Konoin 1.

The relatively easy access to water in Belgut Division has forested a lot of development. Dairy farming (especially zero grazing), and health centers are well served. Market centers also have adequate water supply, as have hotels and secondary schools.

Bomet and Chepalungu Divisions, though quite large, have only 9 water schemes between them. The schemes are quite far apart and to make it worse, the Divisions are quite dry during some months. This makes development of other infrastructure quite difficult. For example milk cooperatives cannot at times process their produce due to lack of water, which also makes it impossible to expand health facilities and schools especially boarding schools.

In Buret nearly 60% of the Division is covered by the Litein Water Project. The Division has 4 other water projects. Kiplelion and Londiani Divisions have large farms with no reliable water supply although there are number of boreholes which needs rehabilitation to supplement the existing water supply. Being newly settled

areas, a lot of development is going on but at a slow pace in some areas due to lack of water. Health and education facilities are some aspects of development that would do better if water supplies were adequate.

(3) Laikipia District

The average boreholes yield in the District is 5.1 m³/hr, but the yields may actually vary from nil to over 41 m³/hr. The average borehole depth is 126 meters. The average rest level of the water in boreholes is 44 meters.

The number of existing water supplies in the District are limited. The majority of them are in Rumuruti Division. These supplies are mainly using surface water sources. In addition, there are about 120 operating boreholes mainly in the ranches which supply water for both domestic and livestock uses. The operating boreholes are concentrated in the Central Division, between Nanyuki and Pesi swamp. Furthermore, water is also obtained from springs in Central, Rumuruti and Nargua Divisions. In Mukogodo, it is obtained from handdug wells in the river beds during the dry seasons.

Mukogodo is least endowed in the water facilities having only three boreholes. This is so because the divisions happens to have only one river (Uwaso Nyiro) passing through it. Considering that not all water projects can draw water from these rivers, especially projects for areas to the east of the Division, the rest of the areas have to depend on boreholes, many of which dry up during the dry season. Thus the people living in this Division are at times forced to travel for long distances in search of water. Fortunately for the inhabitants of Mukogodo, Laikipia Rural Development Programme (ASAL) has embarked on helping construct a number of boreholes. This action has helped many people.

(4) Nakuru District

All the lakes are presently at very low levels because of drought and interference with catchment areas. Because of shortage of surface water for domestic use more reliance has been put on the use of ground water sources. However, the lack of aquifers and the porous volcanic rocks limits the availability of ground water. Many boreholes were drilled in the area specially during the colonial period and most have become disused during the sub-division of farms. These constraints and the large influx of people into the settlement areas in the District has seriously strained both surface and ground water sources and supplies.

The district relies almost equally on surface and ground water for its water supplies. Most of the operating water supplies are over-utilized because of the phenomenal growth in population as a result of immigration into both the rural areas and the towns. Because of lack of sufficient surface water sources there has been great reliance on ground water sources. There are many boreholes that were drilled and are now disused and now need rehabilitation.

There are about 770 boreholes both private and public scattered in the District. The distribution of water supplies in the District is no even.

(5) Narok District

The average boreholes yield in the District is 4.4 m³/hr, but the yields may actually vary from nil to over 11 m³/hr. The average borehole depth is 147 meters. The average rest level of the water in boreholes is 56 meters.

In addition to the water supply systems operated by the Ministry of Water Development, there are 17 operating boreholes in different parts of the District and 9 dams and ponds which serve both the population and livestock. There are also several permanent rivers which are utilized by the people, livestock and wild animals.

There are several individual water supply systems in the District. These are mainly found in the lodges. Most of the cattle dips have tanks for collecting water.

(6) Trans Nzoia District

The average boreholes yield in the District is 2.4 m³/hr, but the yields may actually vary from nil to over 11 m³/hr. The average borehole depth is 66 meters. The average rest level of the water in boreholes is 18 meters.

Trans Nzoia District is well endowed with water resources from Mt. Elgon slopes and the Cherengani Hills. There are also a number of springs and boreholes in the District. In many parts boreholes have been sunk at a depth of only 18-76 m to provide water for domestic use.

(7) Uasin Gishu

The average boreholes yield in the District is 3.7 m³/hr, but the yields may actually vary from nil to over 30 m³/hr. The average borehole depth is 78 meters. The average rest level of the water in boreholes is 16 meters.

The district receives 98% of its water supply from rivers and streams and lies in the Lake Victoria catchment area.

There is also sufficient groundwater, both in quantity and quality. However, since surface water has been available, only few public water supplies use boreholes. Although water shortages will continue to be problem, especially in the dry season, better utilization of the water resources available will provide adequate water for human, livestock and agriculture use.

(8) Baringo District

The average boreholes yield in the District is 8 m³/hr, but the yields may actually vary from nil to over 30 m³/hr. The average borehole depth is 139 meters. The average rest level of the water in boreholes is 69 meters.

Sub-surface water resources are tapped by shallow wells and drilled boreholes. These are mainly found in the elevated parts of southern, Western and south-eastern Baringo. In the latter area, it is estimated that over 100 yielding boreholes exist. However, due to high flouride concentration in the ground water the prospects for viable development of these sources are poor.

There are about 50 water supply schemes in the District. Out of these, only 13 are officially gazetted for purposes of regular maintenance. The water facilities are distributed throughout the District. However, the major water supplies are concentrated within the high and medium-potential areas while the low-lands are served mainly with wells, boreholes, pans and dams due to the absence of surface water sources.

(9) Elgeyo Marakwet District

The average boreholes yield in the District is 4.9 m³/hr, but the yields may actually vary from nil to over 9.9 m³/hr. The average borehole depth is 112 meters. The average rest level of the water in boreholes is 38 meters.

Generally, enough surface water is available, especially in the highlands but also in those parts of the Kerio Valley where surface water is carried by streams flowing down the Elgeyo Escarpment.

Most of the water supplies in the Valley are gravity supplies and the ones in the highlands use pumps. The remaining water supplies are various springs, dams of boreholes.

(10) Samburu District

Surface water is scarce in Samburu District except for along the the banks of the Ewaso Ngiro. Groundwater is the only permanent source of water in most of the district and the safest source.

The average boreholes yield in the District is 4.2 m³/hr, but the yields may actually vary from nil to over 22 m³/hr. The average borehole depth is 97 meters. The average rest level of the water in boreholes is 31 meters.

Drinking water of acceptable quality is available in most of the rural areas. In alluvial deposits of most laggas, shallow wells can be dug which usually tap groundwater at depths of less than 2 meters below the river bed. In weathered or fractured volcanic and basement rocks, groundwater occurs.

(11) Turkana District

The include boreholes and wells and is increasingly becoming the most sought after source of fresh water, There is a close association between boreholes and settlements in addition to the correspondence between the best supplied areas and the major roads and reflects the active drilling undertaken in relation to the construction of the Nairobi to Juba road.

High yielding boreholes are proportionally less common in northern Turkana which hold almost all the District's least productive boreholes. This could be attributable to a more intensive search for water in the north rather than any hydrological factor.

Despite the above biases with respect to the roads, settlements and the north, borehole distribution is essentially random within different geological formations, the proportion of boreholes in each closely matching their proportion in the District as a whole.

The abundance of wells dug in sand rivers over Turkana during the dry season highlights the importance of river bed aquifers to the local pastoral ecology. Furthermore, while rock aquifers are difficult and costly to exploit, requiring the drilling, equipment and maintenance of boreholes, riverbed aquifers can be tapped relatively easily and cheaply from wells dug by hand. Currently there are estimated 23,640 wells district-wide.

(12) West Pokot District

The average boreholes yield in the District is 2.6 m³/hr, but the yields may actually vary from nil to over 16 m³/hr. The average borehole depth is 78 meters. The average rest level of the water in boreholes is 22 meters.

The District being a semi-arid area, there is lot of emphasis on water supply. Surface water supply is only serving some 15% of the total District population. Groundwater supply (boreholes) serve about 50% of the District's population. Thus about 35% of the people have no reliable supply of water. The current thrust will be put on building shallow wells and roof catchments which are rain-fed. They are more economical than boreholes and can serve both the livestock and human population at lower maintenance cost. Drilling of boreholes is being discouraged as the maintenance cost is high.

Over 80% of the boreholes in the semi-arid and arid areas of Kachliba and Alale divisions.

Aquifer characteristics by district

District code	District name	Elevation (m)	Total depth(m)	Water struck(m)	level rest(m)	Yield (m3/hr)	Draw down(m)
710	Kajiado	1548.08	125.88	80.20	39.71	7.56	40.59
720	Kericho	2036.90	146.41	105.87	40.33	7.19	55.41
730	Laikipia	1909.10	126.10	105.18	43.63	5.14	65.41
740	Nakuru	2087.91	135.29	106.58	69.55	8.56	27.20
750	Narok	3037.92	147.39	82.36	56.43	4.44	38.22
760	Trans Nzoia	1367.00	66.40	39.23	18.30	2.38	34.69
770	Uasin Gishu	1294.27	78.45	54.01	15.97	3.74	48.58
810	Baringo	1531.52	139.02	108.11	69.31	8.05	26.18
820	Elgeyo Marakwet	1320.30	111.86	67.07	38.36	4.87	32.03
830	Nandi	1523.50	95.10	45.75	15.67	6.04	39.80
840	Samburu	1261.37	96.83	64.10	30.88	4.21	57.18
850	Turkana	671.76	63.64	37.06	18.29	5.10	15.86
860	West Pokot	1510.80	77.79	45.57	22.38	2.56	21.46

Groundwater development plan and cost by district

District code	District 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£
710	Kajiado	73	203	328	1311	84.1	106
720	Kericho	68	324	10	50	18.4	23
730	Laikipia	113	105	279	360	69.6	88
740	Nakuru	292	34	470	277	123.7	156
750	Narok	199	818	392	2326	134.8	170
760	Trans Nzoia	31	205	0	0	4.5	6
770	Uasin Gishu	4	21	0	0	1.3	2
810	Baringo	90	114	97	172	36.4	46
820	Elgeyo Marakwet	65	490	63	675	35.4	45
830	Nandi	25	340	0	0	6.2	8
840	Samburu	38	139	242	1287	55.7	70
850	Turkana	33	178	796	5765	219.1	276
860	West Pokot	60	584	38	417	23.7	30

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	710	720	730	740	750
District	Kajiado	Kericho	Laikipia	Nakuru	Narok
Availability	×	●	●	●	●

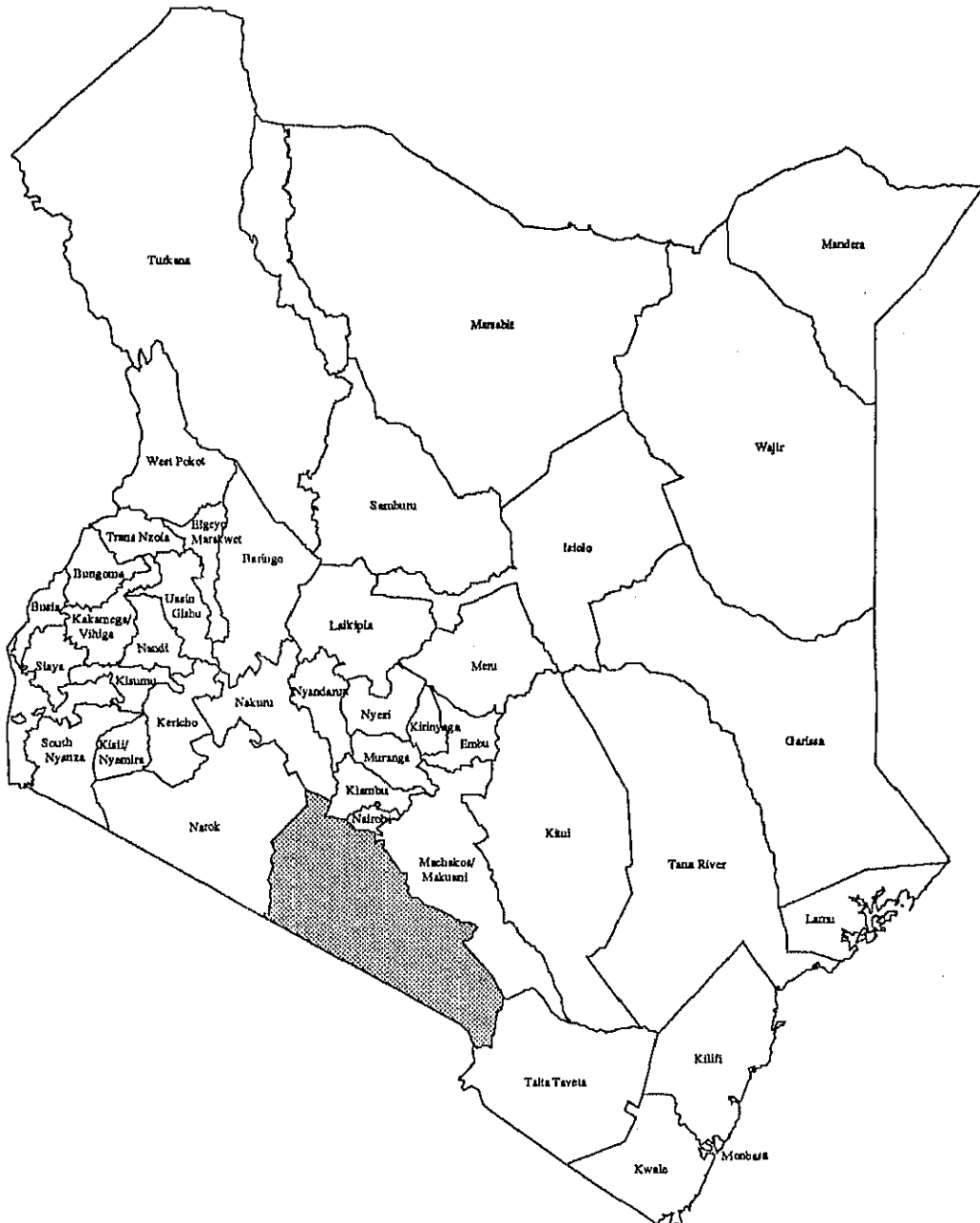
Code	760	770
District	Trans Nzoia	Uasin Gishu
Availability	●	●

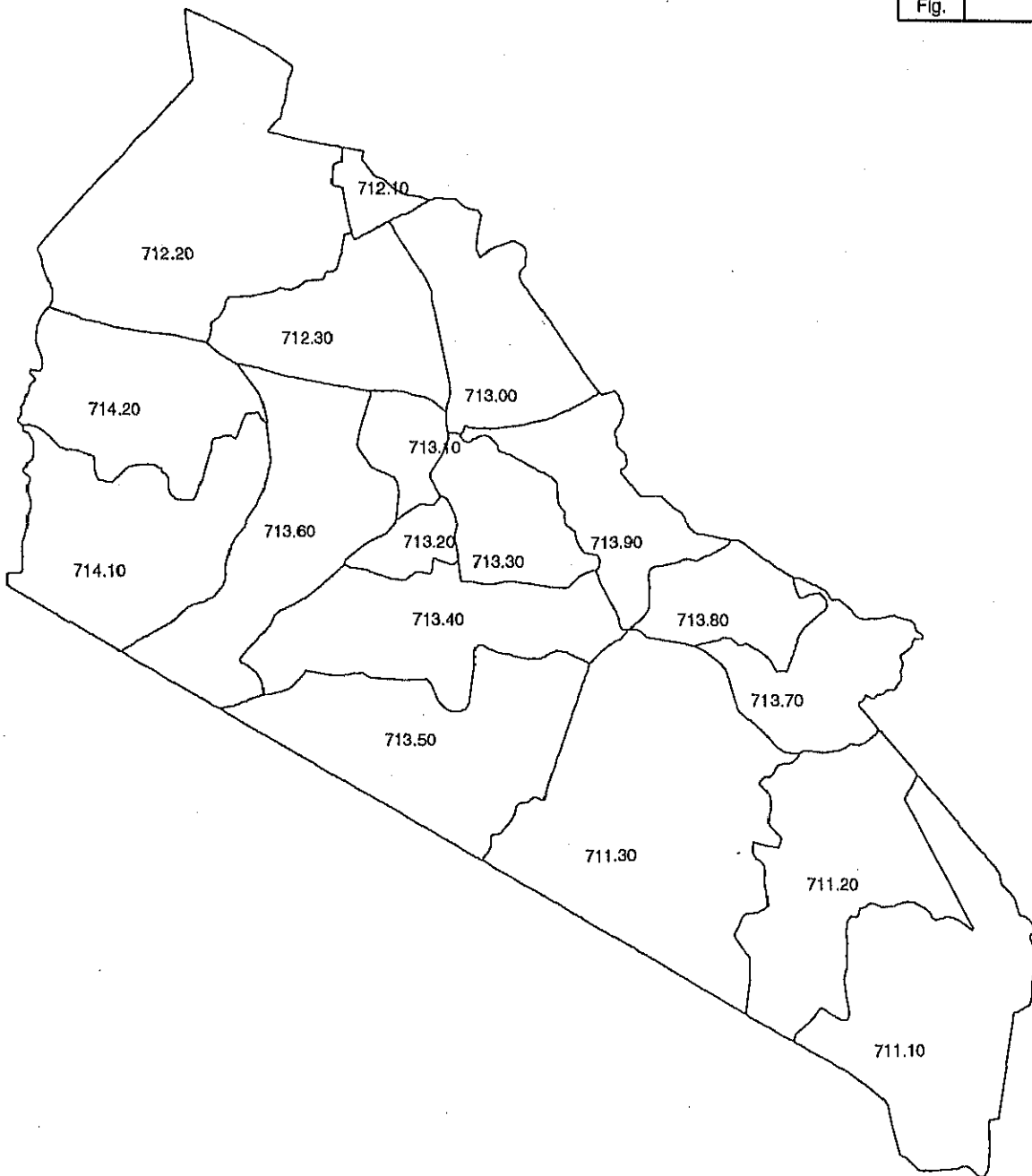
Code	810	820	830	840	850	860
District	Baringo	Elg. Marakwet	Nandi	Samburu	Turkana	West Pokot
Availability	●	○	●	●	●	●

- 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)

Kajiado

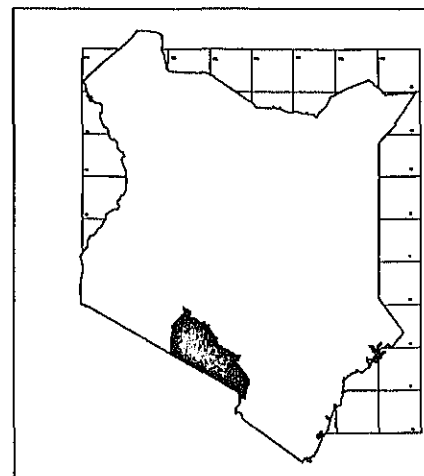
District





Code	Location	Population
711.1	Odomongi	23,272
711.2	Orok Kiteng	8,588
711.3	Entonet	10,923
712.1	Ngong	30,044
712.2	Keekonyokie North	8,666
712.3	Keekonyokie South	7,339
713.1	Ildamat	4,840
713.2	Puriko	1,808
713.3	Dalalekutuk	5,601
713.4	Malapalo	7,535
713.5	Namanga	9,079
713.6	Loodokilani	5,407
713.7	Kenyawa	2,913
713.8	Nkama	2,913
713.9	Central Kaputel	4,597
713.A	North Kaputel	5,618
714.1	Magadi	4,791
714.2	Olkiramatian	5,073

710 Kajiado



THE STUDY
ON
THE NATIONAL WATER MASTER PLAN
JAPAN INTERNATIONAL COOPERATION AGENCY

1. Socio-Economic Profile : 710 Kajiado 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
710	Kajiado District	20,966		286.4	34.0	252.4	461.0	98.1	363.0	651.9	183.4	468.5
711.1	Odomongi	1,934	Oloitokitok	44.0	4.3	39.7	69.9	12.8	57.1	98.1	24.4	73.7
711.2	Orok Kiteng	1,511		16.1	-	16.1	23.1	-	23.1	29.8	-	29.8
711.3	Entonet	2,703		20.4	-	20.4	29.4	-	29.4	38.0	-	38.0
712.1	Ngong	159	Ngong+Ongata Rongai	64.8	16.1	48.7	114.8	44.6	70.1	172.2	81.7	90.5
712.2	Keekonyokie North	2,333		16.2	-	16.2	23.3	-	23.3	30.1	-	30.1
712.3	Keekonyokie South	1,033		13.7	-	13.7	19.8	-	19.8	25.5	-	25.5
713.1	Ildamat	308	Kajiado	8.5	6.0	2.5	21.4	17.9	3.5	38.6	34.1	4.6
713.2	Purko	220		3.4	-	3.4	4.9	-	4.9	6.3	-	6.3
713.3	Dalalekutuk	648		10.5	-	10.5	15.1	-	15.1	19.5	-	19.5
713.4	Matapato	1,307		14.1	-	14.1	20.3	-	20.3	26.2	-	26.2
713.5	Namanga	1,603	Namanga	18.0	4.8	13.2	33.3	14.3	19.0	51.8	27.3	24.5
713.6	Loodokilani	1,457		10.1	-	10.1	14.6	-	14.6	18.8	-	18.8
713.7	Kenyawa	756		5.5	-	5.5	7.8	-	7.8	10.1	-	10.1
713.8	Nkama	574		5.5	-	5.5	7.8	-	7.8	10.1	-	10.1
713.9	Central Kaputei	819		8.6	-	8.6	12.4	-	12.4	16.0	-	16.0
713.A	North Kaputei	998		10.5	-	10.5	15.1	-	15.1	19.5	-	19.5
714.1	Magadi	1,463	Magadi	7.0	2.8	4.2	14.4	8.4	6.0	23.6	15.9	7.7
714.2	Olkiramatian	1,140		9.5	-	9.5	13.7	-	13.7	17.6	-	17.6

1-2 GRDP Projection

Item	1990	2000	2010
1) GRDP (K.Pound million)	71.3	106.9	148.1
Percentage to GDP	0.9%	0.8%	0.7%
2) GRDP per Capita (K.Pound)	249.0	231.8	227.2
Ratio to GDP per capita	0.73	0.51	0.45
Urban (K.Pound)	366.4	240.3	235.4
Rural (K.Pound)	233.2	229.6	224.9

1-3 Present District Profile (1990)

1) Agricultural Production (1989)		3) Water Supply Schemes in Service Centre	
Product	Production Unit	Piped system	19
Maize	63,856 tons	Communal water points	6
Sorghum/Millet	576 tons	Other sources	0
Potato	4,630 tons	4) Educational Facilities	
Rice	- tons	Primary school	138
Wheat/Barley	- tons	Secondary school	26
Coffee	- tons	Institute	8
Tea	- tons	5) Medical Facilities	
Milk	2,075 tons	Hospital	3
Meat	10,117 tons	Health Centre	10
2) Number of Manufacturing Establishments (1986)		Dispensary	28
Type of Industry	Number	Others	0
Food	0	6) Out-patient of Infective Diseases in Relation to Water Supplies (1985-89 Average)	
Textile	0	Diarrhoeal Diseases	5,980
Wood	0	Leprosy	2
Paper	0	Infectious Hepatitis	62
Chemical	0	Bilharzia	359
Non-metal	1	Eye Infections	3,391
Metal	0		
Machinery	0		
Others	0		
Total	1		

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
21,105	20,963	142	3,300	1,233	16	192	1,757	14,465

2.2 Rain fall

Unit : mm

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
51	39	78	135	60	12	7	8	11	33	116	89	644

2.3 River Flow

Unit : m³/sec

Gauge Code	Catchment Area (km ²)	Mean Flow	Low Flow Frequency			
			80%	90%	95%	Min.
-	-	-	-	-	-	-

2.4 Groundwater

Aquifer Characteristics

Elevation (m)	Total Depth (m)	Water Struck (m)	Level Rest (m)	Yield (m ³ /hr)	Draw Down (m)
1548.08	125.88	80.2	39.71	7.56	40.59

Safe Abstraction Yield

Unit : m³/year

Borehole	Shallow	Total
6,647,623	12,271,226	18,918,849

2.5 Agriculture

Suitable Area for Major Crops

Unit: km²

Maize	Wheat	Rice	Sorghum	Potato	Coffee	Tea
694	210	0	3,506	119	1	0

Area of Irrigation Potential

Unit : ha

Surface Water		Groundwater	
Upland	Lowland	Upland	Lowland
4,175	4,759	146.1	70

Livestock Population

Unit: 1,000

Cattle	Sheep/Goats	Camels	Donkeys
602.74	961.41	-	12.23

3 Water Demand Projection

Unit: cu.m/day

Location	1990				2000				2010			
	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry	Rural	Urban	Livestock	Industry
Kajiado District	5,140	4,916	18,521	69	8,002	14,448	24,061	117	11,888	27,525	30,142	148
Odongoi	799	622	2,894	0	1,242	1,890	3,743	0	1,841	3,665	4,675	0
Orok Kiteng	322	0	1,141	0	500	0	1,435	0	740	0	1,749	0
Entonet	406	0	1,452	0	627	0	1,826	0	924	0	2,224	0
Ngong	1,084	2,328	3,746	0	1,713	6,579	5,046	0	2,607	12,268	6,500	0
Keekonyokie North	324	0	1,152	0	504	0	1,449	0	744	0	1,765	0
Keekonyokie South	272	0	975	0	422	0	1,227	0	621	0	1,495	0
Ildamat	48	867	281	0	75	2,638	498	0	111	5,114	767	0
Purko	67	0	240	0	103	0	302	0	152	0	368	0
Dalalekutuk	208	0	744	0	321	0	936	0	473	0	1,141	0
Matapato	279	0	1,001	0	432	0	1,260	0	636	0	1,534	0
Namanga	266	694	1,024	0	413	2,110	1,403	0	611	4,091	1,837	0
Loodokilani	200	0	719	0	310	0	904	0	457	0	1,101	0
Kenya	108	0	387	0	167	0	487	0	246	0	593	0
Nkama	108	0	387	0	167	0	487	0	246	0	593	0
Central Kaputei	170	0	611	0	264	0	769	0	339	0	936	0
North Kaputei	208	0	747	0	323	0	939	0	474	0	1,144	0
Magadi	83	405	346	69	128	1,231	502	117	188	2,387	687	148
Olkiramatian	188	0	674	0	291	0	848	0	428	0	1,033	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\$
Oloitokitok	24,500	Nol-Turesh Spring	Nol-Turesh Spring	p	8.3	340	7,032
Ngong	81,800	Boreholes	Kerarapon Spring	p	5.3	120	14,608
Kajiado	34,100	Boreholes & Nol-Turesh	Kiserian P/L	g	53	0	19,742
Namanga	27,300	Namanga Spring	Namanga Spring	g	0.8	0	5,666
Magadi	16,000	Oloiboroto river	Oloiboroto river	g	34	0	10,688

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
Ngurumani Pi.	0	0	Magadi	Olkiramatian	Irrigation	TRD	-	2KC
Ewaso Ngiro	0	0	Magadi	Olkiramatian	Irrigation	TRD	-	-

4.3 Large Scale Irrigation Project

Project	Area (ha)	Water Source	Water Demand (MCM)	Cost (million)		Major Crops
				US\$	K£	
Lower Ewaso N'giro	10,000	Ewaso Ngiro South	-	57.0	71.8	-

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
-	-	-	-	-																		

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4.6 Urban Drainage and Ad-hoc River Improvement Projects

Project	Population	Area (Km ²)	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
Kajiado	6,000	1.2	MOLG	9.2	11.6															★	★	●	●

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4.7 Dam Development Plan

Damsites	C.A. (km ²)	Purpose	FSL (El. m)	Storage (MCM)	Yield (m ³ /s)	Height (m)	Cost (1,000US\$)
Oldorko	5696	P+I	1300	956.4	18.00	55	121,620

W: Water Supply Irrigation P: Power

4.8 Groundwater Development Projects

Proposed Numbers				Executing Agency	Cost (million)		Implementation Schedule															Remarks		
Drinking		Livestock			US\$	K£	93	94	95	96	97	98	99	20	01	02	03	04	05	06	07		08	09
(B/H+D)	(S/W+H)	(B/H+D)	(S/W+H)																					
73	203	328	1311	MORDASA	81.8	103.1	★	●	●	●	●	●	●	●	●									

★ 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 (m ³ /d)	2,381	3,312	2,501	995	125	56	58	43	2,357	11,828	42.4	57.6	
- No. of Facilities	0	123	431	38,954	9	16	15	9	0	39,557			
- Cost (mill.US\$)	0	12.99	2.15	23.39	0.17	0.16	0.12	0.14	0	39.1			
(mill.K£)	0	16.39	2.71	29.49	0.21	0.2	0.15	0.17	0	49.31			

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 (m ³ /d)	9,193	9,559	7,539	593	160	190	174	27,408	47.7	52.3	
- No. of Facilities	0	328	1,311	11	25	30	0	1,705			
- Cost (mill.US\$)	0	37.2	6.52	0.8	0.46	0.4	0	45.37			
(mill.K£)	0	46.91	8.22	1.01	0.57	0.5	0	57.21			

4.11 Watering Points in Nomadic Pasturage Area

Assumed Nomadic Pasturage Area (km ²)	No. of Watering Points (Nos)	Executing Agency	Cost (million)		Implementaion of Watering Points (No.)	
			US\$	K£	up to 2000	2001-2010
13,830	22	MOWD	3.2	4.0	7	15

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
Ewaso Ngiro South River Basin Study	ENSRDA	2.5	3.2			☆	☆	☆													
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
Athi	(WRAP underway)	MOWD	-	-	☆	☆															

☆ Study

○ River Basin Study (proposed under separate programme)

