- The ministry will be approached to issue the necessary documents pertaining to water abstraction.

Ministry of Culture and Social Services
- The ministry will help in the organization of farmer into a strong registered group.
- The ministry will initiate division of duties within the farmers groups to facilitate the running of the schemes.

Ministry of Co-operative Development
- The ministry will assist the farmers on proper book-keeping.
- The ministry will advise on marketing of the produce.

The schemes will be run by an employed and paid management staff for a period long enough to recover the initial capital cost and also to thoroughly drill the farmers in irrigated agriculture. The schemes will be handed over from the direct management of LBDA to the management of farmers themselves after ensuring that the farmers management committee is well trained for running the scheme.

The management committee of each scheme will have the following management roles with assistance of LBDA and Ministries concerned:

- to establish, operate and maintain the irrigation canal network,
- to purchase and distribute the required agricultural materials (inputs) in time and to take care of the timely preparation of the fields, application of inputs, planting and harvesting,
- to keep records of purchase of agricultural material and delivered produce for the individual farmers,
- to investigate, experiment and provide adequate extension on crop husbandry and water use to achieve optimum yields and indicate optimum cropping patterns,
- to keep records of inputs and yields of the crop for each farmer,
- to improve or establish marketing channels for products of each scheme,
- to ensure proper and regular maintenance including pump maintenance for the pump schemes, and
-to make deductions for repayment of capital costs to LBDA in order to enable the Authority to open up new projects in other areas.

1.4 Conclusion and recommendation

This preparatory study has identified 16 LSI schemes of 9,600 ha in total net area. However, this preparatory study is still at reconnaissance level. To implement these LSI schemes, it is necessary to carry out a full feasibility study on the Lake shore irrigation project prior to detailed design work and construction of these schemes.

The scope of works for the feasibility study on LSI project will consist of the following.

1) Collection and review of the existing relevant data, reports and information available on the following aspects

(a) Topography
(b) Hydro-meteorology
(c) Geology
(d) Soil
(e) Agriculture
(f) Irrigation and drainage
(g) Agro-economy
(h) Socio-economy
(i) Flood damage
(j) Dams and reservoirs
(k) Power generation
(l) Others

2) Preparation of the topographic maps from aerophotograph
- Irrigation area: 1/5,000 , 0.5m contour intervals

3) Topographic survey

a) Triangulation network survey
b) Levelling survey and setting of bench marks
c) Ground control survey for photogrametric mapping
d) Detailed topographic survey for the sites of major permanent structures and construction facilities.

4) Hydrological and meteorological survey

a) Installation of river water level gauging facilities and measurement of discharge
b) Analysis of hydrological characteristics of the rivers
c) Measurement of flowing sand and sedimentation

5) Comparative study on the alternative water resources for possible irrigation sites

6) Irrigation and drainage survey including field measurement of decreasing water depth and crop consumptive use of water

7) Geological survey

- Standard penetration test at weir sites and major canal structure sites such as syphons, culverts, bridges and etc., if required

8) Soil survey including preparation of soil maps and land capability classification maps

9) Comparative study on the alternative layouts or sites of major permanent structures according to the topographic and geological survey results, and finalization thereof

10) Investigation and study of the transportation system and access road to the project site

11) Physical test and analysis for the construction materials, and physio-chemical analysis for soil and water

12) Agricultural and agro-economic survey

13) Formulation of optimum plan

a) Determination of the boundary of irrigation area, the major structures sites and the route of main irrigation and drainage canals

b) Optimization studies to determine size of the project

14) Preliminary design of all components of the project

15) Study on the layout and capacity of temporary and preparatory facilities

16) Assessment on construction inputs such as labor, materials and equipment

17) Preparation of general plan for construction and operation of the project

18) Investigation into houses, roads, land and rights to be compensated in the project area

19) Preparation of feasibility level estimates of all costs for construction, operation and maintenance of the project

20) Assessment of the economic and financial feasibility of the project

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Table 1.1 *Estimated Value Added by Sector/Subsector, 1985 and 2005*
Agriculture, Livestock, Fishery and Forestry

	1985				Master Plan (2005)			
	Cultivated Area 10^3 ha	Crop Area 10^3 ha	Pro duction 10^3 ton	Value added K£ 10^6	Cultivated Area 10^3 ha	Crop Area 10^3 ha	Pro duction 10^3 ton	Value added K£ 10^6
1. FOOD CROPS								
Maize	455	537	1,504	157	661	886	4,078	348
Sorghum & Millet	58	67	54	2	83	111	189	9
Beans	91	110	77	12	134	180	215	48
Wheat, Barley & Oat	92	92	156	6	136	136	517	40
Rice	3	3	8	1	30	30	150	21
Root Crops	92	92	693	22	92	92	1,490	48
Others	31	31	279	1	31	31	279	1
Sub-total (1)	822	932		201	1,178	1,466		515
2. CASH CROPS								
Arabica Coffee	13	13	5	9	30	30	51	79
Robusta Coffee				0	32	32	23	33
Tea	48	48	125	41	72	72	288	125
Cotton	49	49	15	3	56	56	45	9
Sugarcane	109	109	3,488	43	134	134	9,246	117
Others	16	21	25	3	16	21	38	12
Sub-total (2)	235	240		99	340	345		375
3. FRUITS & VEGETABLE								
Fruits total	10	10	56	4	20	20	402	23
Vegetable total	3	3	17	3	8	8	161	33
Sub-total (3)	13	13	73	7	28	28	563	55
TOTAL (1+2+3)	1,070	1185		307	1,551	1839		946
4. LIVESTOCK								
Milk			508	44			1,661	145
Meat								
Beef			56	2			71	4
Pork			1	0			9	1
Chicken			6	0			17	9
Sheep & Goats			9	1			9	1
Sub-total			72	3			106	15
TOTAL LIVESTOCK PRODUCTION (4)				47				160
5. FISHERY			88	10			115	37
6. ACTIVITIES IN MARA RIVER BASIN								
Crop Production			20	1			20	1
Livestock Production				8				12
Sub-total (6)				9				13
7. RURAL OFF-FARM				222				553
8. FORESTRY				15				43
TOTAL (1 to 8)					610			1,752
ANNUAL GROWTH RATE (%)								5.4%

Source: Master Plan Report (Table 3.4)

Table 1.2 Present and Target Yield of Major Crops

(Unit; ton/ha)

Crop	Kenya			LBDA Region		
	Present yield	Target yield	Growth rate (%)	Present yield ***	Target yield	Growth rate (%)
Food Crops						
Maize	1.8 *	4.5	4.7	2.8	4.6	2.5
Sorghum & Millet	1.3 **	-	-	0.8	1.7	3.8
Beans				0.7	1.2	2.7
Wheat/Barley/Oat	1.9 *	3.8	3.6	1.7	3.4	3.5
Rice (dry paddy)	4.7 **	-	-	2.5	5.0	3.5
Root crops	7.9 **	-	-	7.5	16.2	3.9
Cash Crops						
Arabica coffee	0.8 *	1.7	4.0	0.4	1.7	7.5
Robusta coffee	- *	0.7	-	-	0.7	-
Tea (black tea)	1.4 *	2.1	2.1	0.9	2.1	4.3
Cotton	0.2 **	-	-	0.3	0.8	5.0
Sugarcane	-	-	-	32.0	69.0	3.9
Horticultural crops	5.6 *	20.1	6.0	5.6	20.1	6.0

Notes: * Sessional Paper No.1 of 1986
** FAO Production Year Book 1984
*** MOALD Annual Reports 1976 - 1984

Table 1.3 Summary of Expansible Area for Agricultural Land Development

(Unit; 1000 ha)

District	Maize & Beans	Wheat	Rice	Arabica Coffee	Robusta Coffee	Tea	Cotton	Sugar -cane	Tobacco	Horti-culture
NYANZA										
Kisii	15	0	0	3	0	9	0	0	0	13
Kisumu	62	0	62	0	0	0	47	3	31	0
Siaya	96	0	3	0	33	23	79	33	33	0
South Nyanza	230	0	22	11	10	10	121	58	102	0
Total	403	0	87	14	43	42	247	94	166	13
WESTERN										
Bungoma	44	0	3	9	11	4	26	9	23	7
Busia	63	0	3	0	35	21	39	35	3	7
Kakamega	72	0	0	14	35	39	7	35	7	10
Total	179	0	6	23	81	64	72	79	33	24
RIFT VALLEY										
Kericho	87	43	3	31	0	36	0	0	1	64
Nandi	70	33	0	10	0	15	3	0	2	27
Narok	106	36	0	61	0	15	0	0	3	0
T.Nzoia	48	11	0	3	0	4	0	0	0	5
U.Gishu	92	68	0	0	0	0	0	0	0	3
Nakuru	16	16	0	0	0	0	0	0	0	0
E.Marakwet	9	8	0	0	0	0	0	0	0	0
West Pokot	4	2	0	0	0	3	0	0	0	0
Total	432	217	3	105	0	73	3	0	6	99
Total	1,014	217	96	142	124	179	322	173	205	136

Note: The expansible areas for the crops listed above are not mutually exclusive

Table 1.4 Mean Monthly Rainfall and Temperature

Mean Monthly Rain fall (mm)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
9034049	28	57	113	167	123	53	39	43	35	68	112	94	931
9034045	62	72	123	187	189	89	77	106	94	83	82	79	1,243
9034059	39	92	122	201	142	64	37	42	56	89	148	84	1,116
9134009	48	59	104	142	121	47	20	28	22	56	92	74	813
9034011	64	81	142	262	211	98	87	131	159	173	160	110	1,678
9034025	56	99	148	236	174	73	64	88	87	88	143	98	1,353
9034036	40	57	107	182	135	67	51	83	88	104	108	86	1,106
9034037	72	62	169	328	243	87	64	106	127	129	152	77	1,615
9034021	38	58	105	164	137	41	35	41	33	48	86	76	864
9034038	61	58	156	274	239	70	56	108	109	108	215	74	1,528

Mean Monthly Temperature ^{o}C

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
9034059	23.5	24.0	23.9	23.4	23.2	23.1	22.1	22.7	23.0	23.2	23.2	22.9	23.2
9034084	26.3	26.4	26.4	25.5	25.2	25.2	25.1	26.0	25.7	26.0	25.4	25.7	25.8
9034025	23.9	23.9	23.9	23.2	22.8	22.2	22.0	22.2	22.8	23.7	23.7	23.4	23.1

Note: *For location of each station see Figure 1.4*
Source: Ministry of Water Development

Table 1.5 Monthly River Discherge (m^3/sec) (Awach Tende River)

Code; 1HE1
Catchment area; 610 km^2

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1974								4.27	6.60	6.87	4.08	2.77	4.92
1975	2.18	1.72	2.44	5.35	7.41	7.95	4.97	3.08	2.62	8.00	4.56	1.58	4.33
1976							4.97	3.08	2.62	1.11	0.83	0.61	2.20
1977	0.65	0.44	0.50	7.26	16.76	5.52	5.86	5.67	6.28		8.61	4.06	5.60
1982										1.22			1.22
1983			0.91	1.03	2.33	1.14	1.01	1.91	1.30				1.38
1984			0.81	1.07									0.94
Mean	1.42	1.08	1.17	3.68	8.83	4.87	4.20	3.60	3.88	4.30	4.52	2.28	3.65

Source: Ministry of Water Development

Table 1.6 Monthly River Discharge (m^3/sec)
(Awach Kibuon River)

Code; 1HD4
Catchment area; 530 km^2

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1975	5.73	5.79	6.74	8.63	11.16	10.84		10.51	12.48	11.16	8.17	6.61	8.89
1976	5.96	5.69	5.50	6.39	9.95	10.37	10.32		9.47	8.75		6.01	7.84
1977	6.51	6.40	5.91	11.61	15.00	10.85	10.62	9.43	9.55	7.81	11.52	9.92	9.59
1978	8.56	8.33	11.85	14.31	15.38	8.96	7.93	9.13	9.91	10.77	10.75	9.26	10.43
1979	7.27	10.04	11.52	13.49	11.29	10.16	7.45	8.38	7.02	5.73	5.82	5.63	8.65
1980	5.80	4.84	5.15	7.43	10.07	9.29	8.59	7.31	7.29		6.23	6.09	7.10
1981	5.80		7.77	14.04	12.20	8.63	8.34	8.44	10.22	9.20			9.40
1982		16.60	15.65	18.69	10.84	19.61	18.69	19.32	11.15	10.10	7.74	15.39	
1983	6.68	5.85	5.34										5.96
Mean	6.54	7.94	8.38	11.82	13.24	11.09	10.28	10.36	9.61	9.22	8.77	7.32	9.55

Source: Ministry of Water Development

Table 1.7 Monthly River Discharge (m^3/sec)
(Seme Awach River)

Code; 1HB5
Catchment area; 98 km^2

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1965		0.74	0.68	0.62	0.99	1.36	0.43	0.68	0.46	0.51	0.86	1.06	
1966	0.99	0.51	0.56	0.59	1.58	1.33	0.63	0.44	0.41	0.77	0.85	1.13	0.816
1967	0.54	0.31	0.40	0.34	0.77	1.04	0.59	0.47	0.47	0.38	0.60	1.09	0.586
1968	1.57	0.39	0.42	0.94	1.22	2.37	1.74	1.26	0.71	0.65	0.69	1.47	1.119
1969	2.35	0.79	0.59	0.87	0.69	1.52	1.27	0.54	0.60	0.66	0.39	0.36	0.886
1970	0.43	0.34	0.52	0.37	2.35	1.50	1.27	0.58	0.58	0.87	0.57	0.49	0.823
1971	0.29	0.32	0.15	0.11	0.65	0.98	0.60	0.39	0.42	0.68	0.64	0.41	0.470
1972	0.23	0.38	0.36	0.36	0.16	1.07	1.16	0.76	0.93	0.54	0.96	2.00	0.743
1973	1.04	0.66	0.36	0.21	0.32	0.92	1.16	0.44	0.64	0.59	0.63	1.42	0.699
1974	0.41	1.91	0.84	0.15	1.79	1.09	0.44	0.39	0.27	1.34	1.19	0.44	0.938
1975	0.29	0.17	0.19	0.15	1.33	0.86	1.07	0.39	0.55	0.58	0.62	0.41	0.559
1976	0.25	0.14	0.06	0.14	0.25		1.19						
1977											0.31	0.55	
1978	0.44	0.45	0.44	1.99	2.28	3.66							
1979					0.70	1.10	0.81	0.50	0.39	0.55	0.35	0.43	
1980	0.35	1.80	0.32	0.13	1.08	1.30	0.75	0.42	0.58	0.68	0.63	0.43	0.706
1981	0.25	0.14	0.05	0.78	0.95	0.43	0.42	0.43	0.46	0.69			
Mean	0.674	0.603	0.396	0.523	1.132	1.369	0.902	0.549	0.534	0.678	0.664	0.835	0.738

Source: Ministry of Water Development

Table 1.8 Land Suitability Criteria for Upland Crops
(maize, beans, sugarcane, peanuts and cotton)

Land Characteristics	Land Class S1	S2	S3	NS1 and NS2
Texture(s)	Sandy loam to friable clay laom	Sandy loam to very permeable clay, non-compacted	Loamy sand to permeable clay	NS1: Includes lands which require additional investigations to determine their irrigability. N2: Includes lands which do not meet the minimum requirements for the other land classes and are not suitable for irregation. These include lands with very shallow soils, impermeable soils, excessive concentrations of salts, PH above 9.0 and more than 15% ESP etc.
Depth (s) to sand, gravel	90cm plus and greater than 150cm to impermeable horizon	60cm plus and greater than 120cm to impermeable horizon	45cm plus and greater than 100cm to impermeable horizon	
Alkalinity (reaction)	PH-H2O less than 7.5 for non-calcareous soils and less then 8.6 for calcareous soils	PH-H2O less than 9.0 unless soil is calcareous and non-sodic	PH-H2O 9.0 or less unless soil is calcareous and non-sodic	
Salinity (ECe)	Total salts not to exceed 0.2%, ECe less then 4mmhos/cm	Total salts not to exceed 0.5%, ECe less than 8mmhos/cm	Total salts not to exceed 0.5%, ECe less than 8mmhos/cm	
Slopes(t)	Flat to very gently undulating (less than 2%)	Flat to very gently undulating (less than 5% in general)	Flat to undulating (less than 8% in general)	
Surface (micro-relief)	Even enough to require only small amounts to levelling and no heavy grading	Moderate grading required but in amounts found feasible at resonable cost	Heavy and expensive grading required	
Vegetation(T)	Woody cover less than 20%, clearing cost small	Woody cover less then 40%, clearing required but at moderate cost	Woody cover less than than 80%, expensive clearing costs	
Drainage(d)	Well drained to moderately well drained. No flooding	Well drained to imperfectly drained, may have surface water for short periods	Well drained to poorly drained, may have surface water for several nionths	

Source: Compiled by JICA Study Team

Table 1.9 Land Suitability Criteria for Rice
(mainly wetland rice production)

Land Characteristics	Land Class			
	S1	S2	S3	NS1 and NS2
Texture(s)	Topsoil: Fine sandly loam to clay Subsoil: Clay but non-compacted	Topsoil: Fine sandy loam to clay loam Subsoil: Sandy clay to clay but non-compacted	Topsoil: Sandy Loam to clay loam Subsoil: Clay to clay loma but non-compacted	NS1: Includes lands which require additional investigations to determine their irrigability. NS2: Includes lands which do not meet the minimum requirements for the other land classes.
Depth(after land development) To clear sand or gravel To pisoplinthite in permeable rock To relatively impermeable zone (water)	Over 80 cm Over 80 cm less than 210 cm	Over 50 cm Over 50 cm less than 210 cm	Over 30 cm Over 30 cm less than 210 cm	
Alkalinity (reaction)	PH-H2O less than 7.5 for non-calcareous soils and less than 8.6 for calcareous soilssoils	PH-H2O less than 9.0 unless soil is calcareous and non-sodic	PH-H2O less than 9.0 unless soil is calcareous and non-sodic	
Salinity (ECe)	Total salts not to exceed 0.2%, ECe less than 4mmhos/cm	Total salts not to exceed 0.5%, ECe less than 8mmhos/cm	Total salts not to exceed 0.5%, ECe less than 8mmhos/cm	
Slope (t)	less than 1%	less than 1%	less than 2%	
Surface (micro relief, t)	Smooth except for gilgai and minor undulations	Smooth except for gilgai and minor undulations (sink holes)	Somewhat irregular but no major gulleys, sink holes or dissection	
Vegetation (T)	Woody cover less than 20%, clearing cost small	Woody cover less than 40%, clearing required but at moderate cost	Woody cover less then 80%, expensive clearing required	
Drainage (d)	Well drained to imperfectly drained may have surface water but only for short period	Well drained to poorly drained, may have surface water for several months	Well drained to poorly drained, may have surface water or be waterlogged for major parts of the year	

Table.1.10 Present Land Use of Three Districts

(Unit :1,000ha)

Category	Kisumu	Siaya	South Nyanza	Total
1. Agricultural Land	89 (40)/1	93 (35)/1	190 (30)/1	372 (33)/1
1.1 Cultivated land	58 (65)/2	62 (67)/2	126 (67)/2	246 (66)/2
Staple crops	25 (43)/3	53 (85)/3	92 (73)/3	170 (64)/3
Cash crops	26 (45)/3	3 (5)/3	14 (11)/3	43 (17)/3
Vegetable & fruits	1 (2)/3	0	1 (1)/3	2 (1)/3
Others	6 (10)/3	6 (10)/3	19 (15)/3	31 (13)/3
1.2 Field borders	1 (1)/2	1 (1)/2	2 (1)/2	4 (1)/2
1.3 Fallow land	30 (34)/2	30 (32)/2	61 (32)/2	121 (33)/2
1.4 Managed pasture	0	0	1	1
2. Natural Vegetation	111 (50)/1	141 (54)/1	387 (62)/1	639 (57)/1
2.1 Forest	4 (3)/4	6 (4)/4	19 (5)/4	29 (5)/4
2.2 Wood land	5 (4)/4	4 (3)/4	41 (10)/4	50 (8)/4
2.3 Bush	42 (38)/4	70 (50)/4	185 (48)/4	297 (46)/4
2.4 Marsh land	13 (12)/4	13 (9)/4	6 (2)/4	32 (5)/4
2.5 Glass land	45 (41)/4	48 (34)/4	130 (33)/4	223 (35)/4
2.6 Other vegetation	2 (2)/4	0	6 (2)/4	8 (1)/4
3. Other	23 (10)/1	29 (11)/1	49 (8)/1	101 (10)/1
Total	223(100)/1	263(100)/1	626(100)/1	1,112(100)/1

Notes : /1 Percent in total land
/2 Percent in Agricultural land
/3 Percent in Cultivated land
/4 Percent in Natural vegetation

Source : Land Use Sector Report

Table 1.11 List of Lake Shore Irrigation Schemes

No.	Name	Area (ha)	Crop	Location	Remarks		
1	Alungo	100	Rice	Kisumu	Existing		
2	Anyiko	12	Rice	Siaya	Existing		
3	Awach Kano	110	Rice	Kisumu	Existing		
4	Kore	130	Rice	Kisumu	Existing		
5	Nyachoda	50	Rice	Kisumu	Existing		
6	Nyakach	150	Rice	Kisumu	Existing	Pump	
7	Obange	200	Rice	Kisumu	Existing		
8	Wasare	125	Rice	Kisumu	Existing		
9	Maugo	125	Rice	S.Nyanza	on-going		
10	Nyatini	250	Rice	Kisumu	on-going		
11	Aguko	3	Vegetable	Kisumu	Existing	Pump	
12	Gomro	?	Vegetable	Siaya	Existing		
13	Konyango	5	Vegetable	S.Nyanza	Existing	Pump	*
14	Magombe	40	Vegetable	Busia	Existing	Pump	
15	Nyandusi	5	Vegetable		Existing	Pump	
16	Seka Bondo	4	Vegetable	S.Nyanza	Existing		
17	Nyamasari-Nyalenda	60	Vegetable	Kisumu	on-going	Pump	*
18	Ombaka	?			Existing		
	Total	1,368					
19	Chiga	200	Rice	Kisumu	Proposed		
20	Kimira	2,100	Rice	S.Nyanza	Proposed		
21	Masune	250	Rice	Kisumu	Proposed		
22	Oluch	1,500	Rice	S.Nyanza	Proposed		
23	S.W.Kano	2,385	Rice	Kisumu	Proposed		
24	Sinyanya	60	Vegetable	Siaya	Proposed	Pump	*
25	Sisenye	60	Vegetable	Busia	Proposed	Pump	*
26	Ugambe	60	Vegetable	Siaya	Proposed	Pump	*
27	Wayende	60	Vegetable	Siaya	Proposed	Pump	*
28	Chianda	60			Proposed	Pump	*
29	Mudembi	60			Proposed	Pump	*
30	Siamungu	60			Proposed	Pump	*
31	Oyani	?	Rice	Kisumu	?		
32	Ugenya	?	Rice		?		
33	Bondo Shore	?	Vegetable	S.Nyanza	?		
34	Kochia shore	?	Vegetable		?		
35	Likungu	?	Vegetable		?		
36	Miruti	?	Vegetable		?		
37	Nyangera	?	Vegetable	Siaya	?		

Note: * LBDA proposed pumped schemes
Source: PIU Nyanza and LBDA

Table 1.12 Potential Area for Irrigation

(Unit: ha)

	Scheme	Area	Area limited by			Potential Area
			River Water	Lake Water	Land & Soil	
1.	Usare	300	770	-	300	300
2.	Alungo	750	530	750	750	750
3.	Manuanda	450	750	-	450	450
4.	Asembo	700	720	700	600	600
5.	Mahaya	500	270	500	500	500
6.	Wagusu	500	1,120	180	500	500
7.	Wambara	600	440	600	600	600
8.	Yimbo	300	-	300	300	300
9.	Alego	300	6,500	300	200	200
10.	Wagwe	500	-	500	400	400
11.	Oluch	1,100	2,000	-	1,100	1,100
12.	Kimira	2,100	5,000	-	2,100	2,100
13.	Ochung	750	200	200	700	350
14.	Nyagidha	850	-	850	400	400
15.	Olambwe	2,200	1,100	800	500	500
16.	Sindo	550	160	550	550	550
	Total	12,450				9,600

Source: JICA Study Team

Table 1.13 Major Features of Schemes

Scheme	Gross Area (ha)	Unsuitable Area (ha)	Development Area (ha)	Net Area (ha)	Water Source	Area Irrigated by River (ha)	Area Irrigated by Lake Water (ha)	Canal Length Main (km)	Canal Length Secondary (km)	Pump Capacity
1. Usare	300	-	300	210	Muguruk River	210	-	3.1	1.0	
2. Alungo	900	-	900	630	Luanda River Lake Water	350	280	6.0	2.5	30 kW
3. Manuanda	300	-	300	210	Seme Awach River	210	-	3.5	1.0	
4. Asembo	700	100	600	420	Rabura River Nyandiwo River	420	-	5.5	2.0	
5. Mahaya	500	-	500	350	Arese River Lake Water	175	175	6.0	1.6	2 x 11 kW
6. Wagusu	500	-	500	350	Ndate River	350	-	13.5	1.6	
7. Wambara	600	-	600	420	Alara Yenga River Lake Water	280	140	5.3	2.0	18.5 kW
8. Yimbo	300	-	300	210	Lake Water	-	210	4.5	1.0	37 kW
9. Alego	300	100	200	140	Ondago River	140	-	4.9	0.7	
10. Wagwe	500	100	400	280	Lake Water	-	280	6.0	1.3	45 kW
11. Kimira	2,100	-	2,100	1,470	Awach Kibuon River	1,470	-	23.8	6.9	
12. Oluch	1,100	-	1,100	770	Awach Terde River	770	-	11.3	3.6	
13. Ochung	750	400	350	245	Rangwena River Lake Water	140	105	6.6	1.2	45 kW
14. Nyagidha	850	450	400	280	Lake Water	-	280	7.0	1.3	2 x 18.5 kW
15. Olambwe	2,200	1,700	500	350	Olambwe River	350	-	10.0	1.6	
16. Sindo	550	-	550	385	Boosi River Lake Water	105	280	6.0	1.8	45 kW
Total	12,450	2,850	9,600	6,720		4,970	1,750	123.0	31.1	

Source: JICA Study Team

Table 1.14 Breakdown of Construction Cost (1/2)

	1) Usare Scheme	Gross Area=300 ha
	Description	COST (1,000 Kshs)
1.	Preparatory Works (10% of 2,3,4,5)	713
2.	Main & Secondary Canal Systems 3.1 km 1.0 km	3,075
3.	Tertiary and On-farm Development	3,717
4.	Pumping Facilities	-
5.	Office and Quarters (5% of 2,3,4)	340
	Sub-total 1	7,845
6.	O & M Equipment (5% of Sub-total 1)	392
7.	Administration Expenses (7% Sub-total 1)	549
	Sub-total 2	941
8.	Physical Contigency (10% Sub-total 2)	879
	Total	9,665

	2) Ahungo Scheme	Gross Area=750 ha
	Description	COST (1,000 Kshs)
1.	Preparatory Works (10% of 2,3,4,5)	1,799
2.	Main & Secondary Canal Systems 6.0 km 2.5 km	6,375
3.	Tertiary and On-farm Development	9,239
4.	Pumping Facilities 30 kW	1,470
5.	Office and Quarters (5% of 2,3,4)	857
	Sub-total 1	19,794
6.	O & M Equipment (5% of Sub-total 1)	990
7.	Administration Expenses (7% Sub-total 1)	1,386
	Sub-total 2	2,376
8.	Physical Contigency (10% Sub-total 2)	2,217
	Total	24,387

	3) Mangunda Scheme	Gross Area=450 ha
	Description	COST (1,000 Kshs)
1.	Preparatory Works (10% of 2,3,4,5)	940
2.	Main & Secondary Canal Systems 3.5 km 1.0 km	3,375
3.	Tertiary and On-farm Development	5,576
4.	Pumping Facilities	-
5.	Office and Quarters (5% of 2,3,4)	448
	Sub-total 1	10,339
6.	O & M Equipment (5% of Sub-total 1)	517
7.	Administration Expenses (7% Sub-total 1)	724
	Sub-total 2	1,241
8.	Physical Contigency (10% Sub-total 2)	1,158
	Total	12,738

	4) Asembo Scheme	Gross Area=600 ha
	Description	COST (1,000 Kshs)
1.	Preparatory Works (10% of 2,3,4,5)	1,371
2.	Main & Secondary Canal Systems 5.5 km 2.0 km	5,625
3.	Tertiary and On-farm Development	7,434
4.	Pumping Facilities	-
5.	Office and Quarters (5% of 2,3,4)	653
	Sub-total 1	15,083
6.	O & M Equipment (5% of Sub-total 1)	754
7.	Administration Expenses (7% Sub-total 1)	1,056
	Sub-total 2	1,810
8.	Physical Contigency (10% Sub-total 2)	1,689
	Total	18,582

	5) Mahaya Scheme	Gross Area=500 ha
	Description	COST (1,000 Kshs)
1.	Preparatory Works (10% of 2,3,4,5)	1,422
2.	Main & Secondary Canal Systems 6.0 km 1.6 km	5,700
3.	Tertiary and On-farm Development	6,195
4.	Pumping Facilities 2 x 11kW	1,650
5.	Office and Quarters (5% of 2,3,4)	677
	Sub-total 1	15,644
6.	O & M Equipment (5% of Sub-total 1)	782
7.	Administration Expenses (7% Sub-total 1)	1,095
	Sub-total 2	1,877
8.	Physical Contigency (10% Sub-total 2)	1,752
	Total	19,273

	6) Wagusu Scheme	Gross Area=500 ha
	Description	COST (1,000 Kshs)
1.	Preparatory Works (10% of 2,3,4,5)	1,840
2.	Main & Secondary Canal Systems 13.5 km 1.6 km	11,325
3.	Tertiary and On-farm Development	6,195
4.	Pumping Facilities	-
5.	Office and Quarters (5% of 2,3,4)	876
	Sub-total 1	20,236
6.	O & M Equipment (5% of Sub-total 1)	1,012
7.	Administration Expenses (7% Sub-total 1)	1,416
	Sub-total 2	2,428
8.	Physical Contigency (10% Sub-total 2)	2,266
	Total	24,930

	7) Wambara Scheme	Gross Area=600 ha
	Description	COST (1,000 Kshs)
1.	Preparatory Works (10% of 2,3,4,5)	1,478
2.	Main & Secondary Canal Systems 5.3 km 2.0 km	5,475
3.	Tertiary and On-farm Development	7,434
4.	Pumping Facilities 18.5 kW	1,170
5.	Office and Quarters (5% of 2,3,4)	704
	Sub-total 1	16,261
6.	O & M Equipment (5% of Sub-total 1)	813
7.	Administration Expenses (7% Sub-total 1)	1,138
	Sub-total 2	1,951
8.	Physical Contigency (10% Sub-total 2)	1,821
	Total	20,033

	8) Yimbo Scheme	Gross Area=300 ha
	Description	COST (1,000 Kshs)
1.	Preparatory Works (10% of 2,3,4,5)	1,000
2.	Main & Secondary Canal Systems 4.5 km 1.0 km	4,125
3.	Tertiary and On-farm Development	3,717
4.	Pumping Facilities 37 kw	1,680
5.	Office and Quarters (5% of 2,3,4)	476
	Sub-total 1	10,998
6.	O & M Equipment (5% of Sub-total 1)	550
7.	Administration Expenses (7% Sub-total 1)	770
	Sub-total 2	1,320
8.	Physical Contigency (10% Sub-total 2)	1,232
	Total	13,550

Table 1.14 Breakdown of Construction Cost (2/2)

	9) Alego Scheme	Gross Area=200 ha
	Description	COST (1,000 Kshs)
1.	Preparatory Works (10% of 2,3,4,5)	701
2.	Main & Secondary Canal Systems 4.9 km 0.7 km	4,200
3.	Tertiary and On-farm Development	2,478
4.	Pumping Facilities	-
5.	Office and Quarters (5% of 2,3,4)	334
	Sub-total 1	7,713
6.	O & M Equipment (5% of Sub-total 1)	386
7.	Administration Expenses (7% Sub-total 1)	540
	Sub-total 2	926
8.	Physical Contigency (10% Sub-total 2)	864
	Total	9,503

	10) Wagwe Scheme	Gross Area=400 ha
	Description	COST (1,000 Kshs)
1.	Preparatory Works (10% of 2,3,4,5)	1,306
2.	Main & Secondary Canal Systems 6.0 km 1.3 km	5,475
3.	Tertiary and On-farm Development	4,956
4.	Pumping Facilities 45 kW	2,010
5.	Office and Quarters (5% of 2,3,4)	622
	Sub-total 1	14,369
6.	O & M Equipment (5% of Sub-total 1)	718
7.	Administration Expenses (7% Sub-total 1)	1,006
	Sub-total 2	1,724
8.	Physical Contigency (10% Sub-total 2)	1,609
	Total	17,702

	11) Otuch Scheme	Gross Area=1,100 ha
	Description	COST (1,000 Kshs)
1.	Preparatory Works (10% of 2,3,4,5)	2,604
2.	Main & Secondary Canal Systems 11.3 km 3.6 km	11,175
3.	Tertiary and On-farm Development	13,629
4.	Pumping Facilities	-
5.	Office and Quarters (5% of 2,3,4)	1,240
	Sub-total 1	18,648
6.	O & M Equipment (5% of Sub-total 1)	1,432
7.	Administration Expenses (7% Sub-total 1)	2,005
	Sub-total 2	3,437
8.	Physical Contigency (10% Sub-total 2)	3,209
	Total	35,294

	12) Kimira Scheme	Gross Area=2,100 ha
	Description	COST (1,000 Kshs)
1.	Preparatory Works (10% of 2,3,4,5)	5,150
2.	Main & Secondary Canal Systems 23.8 km 6.9 km	23,025
3.	Tertiary and On-farm Development	26,019
4.	Pumping Facilities	-
5.	Office and Quarters (5% of 2,3,4)	2,452
	Sub-total 1	56,646
6.	O & M Equipment (5% of Sub-total 1)	2,832
7.	Administration Expenses (7% Sub-total 1)	3,965
	Sub-total 2	6,797
8.	Physical Contigency (10% Sub-total 2)	6,344
	Total	69,787

	13) Ochung Scheme	Gross Area=350 ha
	Description	COST (1,000 Kshs)
1.	Preparatory Works (10% of 2,3,4,5)	1,274
2.	Main & Secondary Canal Systems 6.6 km 1.2 km	5,850
3.	Tertiary and On-farm Development	4,337
4.	Pumping Facilities 45 kW	1,950
5.	Office and Quarters (5% of 2,3,4)	607
	Sub-total 1	14,018
6.	O & M Equipment (5% of Sub-total 1)	701
7.	Administration Expenses (7% Sub-total 1)	981
	Sub-total 2	1,682
8.	Physical Contigency (10% Sub-total 2)	1,570
	Total	17,270

	14) Nyagidha Scheme	Gross Area=400 ha
	Description	COST (1,000 Kshs)
1.	Preparatory Works (10% of 2,3,4,5)	1,420
2.	Main & Secondary Canal Systems 7.0 km 1.3 km	6,225
3.	Tertiary and On-farm Development	4,956
4.	Pumping Facilities 2 x 18.5 kW	2,340
5.	Office and Quarters (5% of 2,3,4)	676
	Sub-total 1	15,617
6.	O & M Equipment (5% of Sub-total 1)	781
7.	Administration Expenses (7% Sub-total 1)	1,093
	Sub-total 2	1,874
8.	Physical Contigency (10% Sub-total 2)	1,749
	Total	19,240

	15) Olambwe Scheme	Gross Area=500 ha
	Description	COST (1,000 Kshs)
1.	Preparatory Works (10% of 2,3,4,5)	1,564
2.	Main & Secondary Canal Systems 10 km 1.6 km	8,700
3.	Tertiary and On-farm Development	6,195
4.	Pumping Facilities	-
5.	Office and Quarters (5% of 2,3,4)	745
	Sub-total 1	17,204
6.	O & M Equipment (5% of Sub-total 1)	860
7.	Administration Expenses (7% Sub-total 1)	1,204
	Sub-total 2	2,064
8.	Physical Contigency (10% Sub-total 2)	1,927
	Total	21,195

	16) Sindo Scheme	Gross Area=550 ha
	Description	COST (1,000 Kshs)
1.	Preparatory Works (10% of 2,3,4,5)	1,535
2.	Main & Secondary Canal Systems 6.0 km 1.8 km	5,850
3.	Tertiary and On-farm Development	6,815
4.	Pumping Facilities 45 kW	1,950
5.	Office and Quarters (5% of 2,3,4)	731
	Sub-total 1	16,881
6.	O & M Equipment (5% of Sub-total 1)	844
7.	Administration Expenses (7% Sub-total 1)	1,182
	Sub-total 2	2,026
8.	Physical Contigency (10% Sub-total 2)	1,891
Total		20,798

Table 1.15 Crop Production Value

Item	Unit	Maize	Beans	Rice	Cotton	G.Nuts
Without Project						
Yield	t/ha	2	0.7	2.5	0.3	0.9
Price	Kshs/kg	2.15	3.89	2.8	5.7	6.9
Production Value	Kshs/ha	4300	2,723	7,000	1,710	6,210
Production Cost	Kshs/ha	125	200	1,528	225	500
Net Production Value	Kshs/ha	4,175	2,523	5,472	1,485	5,710
With Project						
Yield	t/ha	5	1.5	5	2	2
Price	Kshs/kg	2.15	6.11	2.8	5.7	6.9
Production Value	Kshs/ha	10750	9,165	14000	11400	13,800
Production Cost	Kshs/ha	2025	2,062	3,243	3,325	3,600
Net Production Value	Kshs/ha	8,725	7,103	10,757	8,075	10,200

Sources: Ref 4
Bura Irrigation Settlement Project Mid-Term Evaluation Report
1984, World Bank, 1985

Table 1.16 Benefit Calculation(1/2)

(Unit:1,000 Kshs)

(A) With project		Scheme								
		Usare	Alungo	Manuanda	Asembo	Mahaya	Wagusu	Wambara	Yimbo	Total
a) Gross Area		300	750	450	600	500	500	600	300	4,000
b) Net area (a)*70%)		210	525	315	420	350	350	420	210	2,800
c) Crop Area (ha)										
Rice										0
Maize/Beans		105	263	158	210	175	175	210	105	1,400
Cotton		105	263	158	210	175	175	210	105	1,400
Groundnut		210	525	315	420	350	350	420	210	2,800
d) Production (ton)										0
	Yield (t/ha)									
Rice	5.0	0	0	0	0	0	0	0	0	0
Maize	5.0	525	1,313	788	1,050	875	875	1,050	525	7,000
Beans	1.5	158	394	236	315	263	263	315	158	2,100
Cotton	2.0	210	525	315	420	350	350	420	210	2,800
Groundnut	2.0	420	1,050	630	840	700	700	840	420	5,600
e) Net producton value										
	Production value (Kshs/ha)									
Rice	10,757	0	0	0	0	0	0	0	0	0
Maize	8,725	916	2,290	1,374	1,832	1,527	1,527	1,832	916	12,214
Beans	7,103	746	1,865	1,119	1,492	1,243	1,243	1,492	746	9,946
Cotton	8,075	848	2,120	1,272	1,696	1,413	1,413	1,696	848	11,306
Groundnut	10,200	2,142	5,355	3,213	4,284	3,570	3,570	4,284	2,142	28,560
Total		4,652	11,630	6,978	9,304	7,753	7,753	9,304	4,652	62,026

(B) Without project		Usare	Alungo	Manuanda	Asembo	Mahaya	Wagusu	Wambara	Yimbo	Total
f) Crop Area (ha)										
Maize/Beans		30	75	45	60	50	50	60	30	400
g) Production (ton)										0
	Yield (t/ha)									
Maize	2.0	60	150	90	120	100	100	120	60	800
Beans	0.7	21	53	32	42	35	35	42	21	280
h) Net producton value										
	Production value (Kshs/ha)									
Maize	4,175	125	313	188	251	209	209	251	125	1,671
Beans	2,523	76	189	114	151	126	126	151	76	1,009
Total		201	502	302	402	335	335	402	201	2,680
Benefit (A)-(B)		4,451	11,128	6,676	8,902	7,418	7,418	8,902	4,451	59,346

Table 1.16 Benefit Calculation (2/2)

(Unit:1,000 Kshs)

(A) With project		Scheme								
		Alego	Wagwe	Oluch	Kimira	Ochung	Nyagidha	Olambwe	Sindo	Total
a) Gross Area		200	400	1,100	2,100	350	400	500	550	5,600
b) Net area (a)*70%)		140	280	770	1,470	245	280	350	385	3,920
c) Crop Area (ha)										
Rice				770	1,470					2,240
Maize/Beans		70	140	770	1,470	123	140	175	193	3,080
Cotton		70	140			123	140	175	193	840
Groundnut		140	280			245	280	350	385	1,680
d) Production (ton)										0
	Yield (t/ha)									
Rice	5.0	0	0	3,850	7,350	0	0	0	0	11,200
Maize	5.0	350	700	3,850	7,350	613	700	875	963	15,400
Beans	1.5	105	210	1,155	2,205	184	210	263	289	4,620
Cotton	2.0	140	280	0	0	245	280	350	385	1,680
Groundnut	2.0	280	560	0	0	490	560	700	770	3,360
e) Net producton value										
	Production value (Kshs/ha)									
Rice	10,757	0	0	8,283	15,813	0	0	0	0	24,096
Maize	8,725	611	1,222	6,718	12,826	1,069	1,222	1,527	1,680	26,875
Beans	7,103	497	994	5,469	10,441	870	994	1,243	1,367	21,875
Cotton	8,075	565	1,131	0	0	989	1,131	1,413	1,554	6,783
Groundnut	10,200	1,428	2,856	0	0	2,499	2,856	3,570	3,927	17,136
Total		3,101	6,203	20,470	39,080	5,427	6,203	7,753	8,528	96,765

(B) Without project		Alego	Wagwe	Oluch	Kimira	Ochung	Nyagidha	Olambwe	Sindo	Total
f) Crop Area (ha)										
Maize/Beans		20	40	110	210	35	40	50	55	560
g) Production (ton)										0
	Yield (t/ha)									
Maize	2.0	40	80	220	420	70	80	100	110	1,120
Beans	0.7	14	28	77	147	25	28	35	39	392
h) Net producton value										
	Production value (Kshs/ha)									
Maize	4,175	84	167	459	877	146	167	209	230	2,339
Beans	2,523	50	101	278	530	88	101	126	139	1,413
Total		134	268	737	1,407	234	268	335	369	3,752
Benefit (A)-(B)		2,967	5,935	19,733	37,673	5,193	5,935	7,418	8,159	93,013

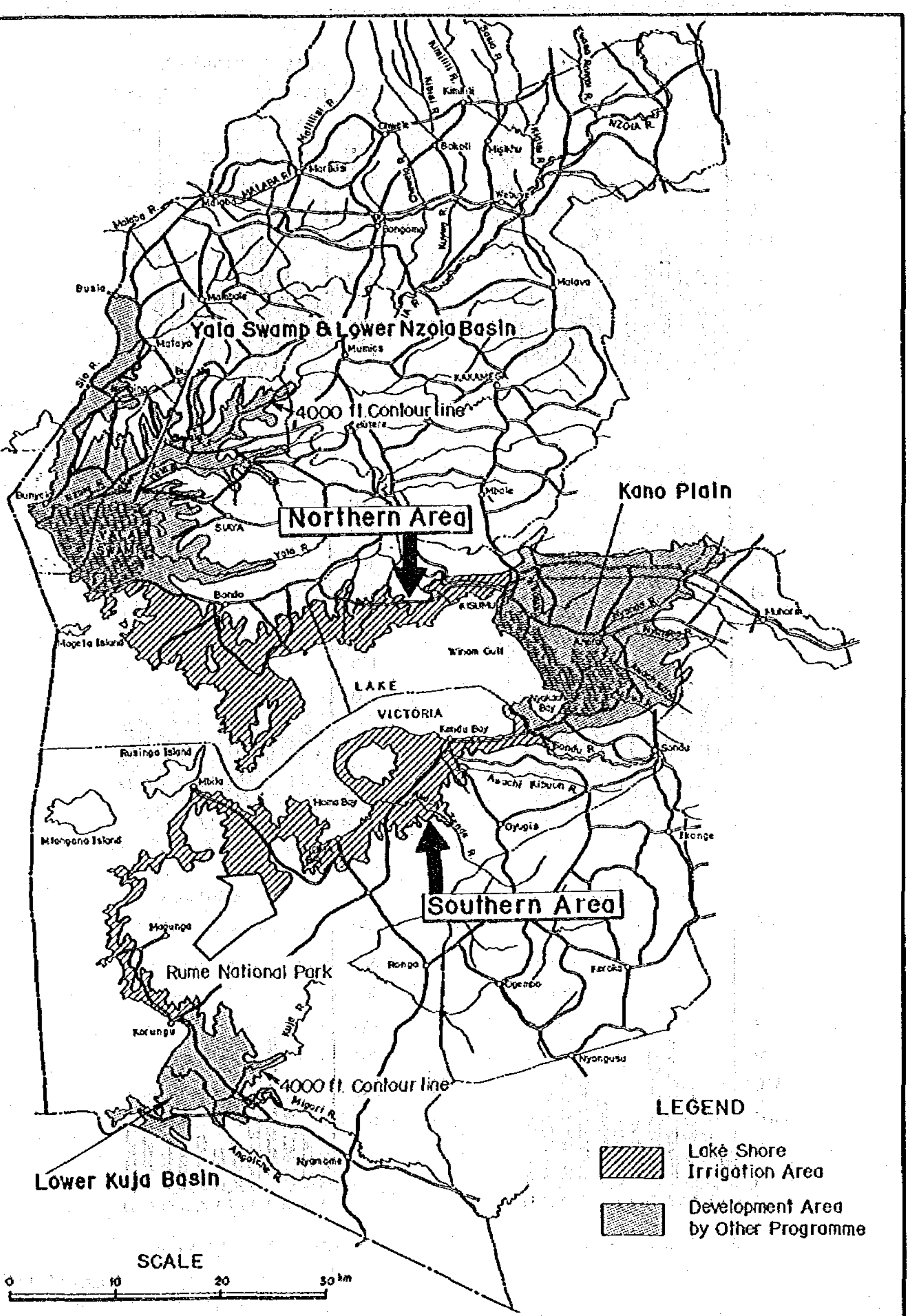
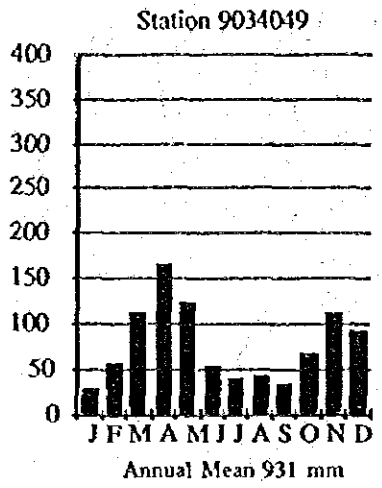
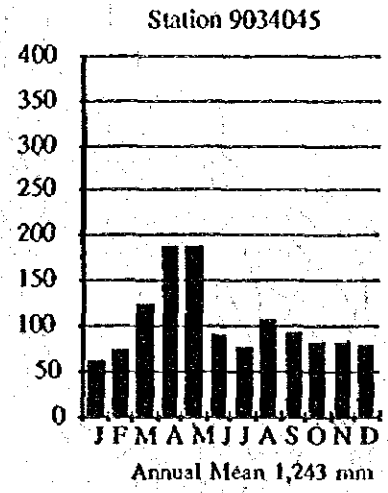
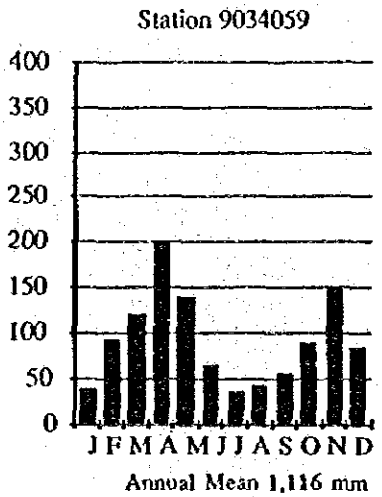


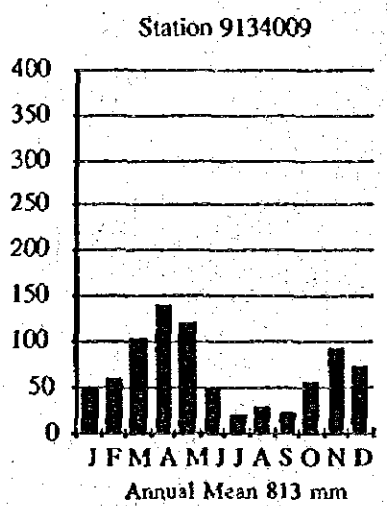
Figure 1.1 Location Map

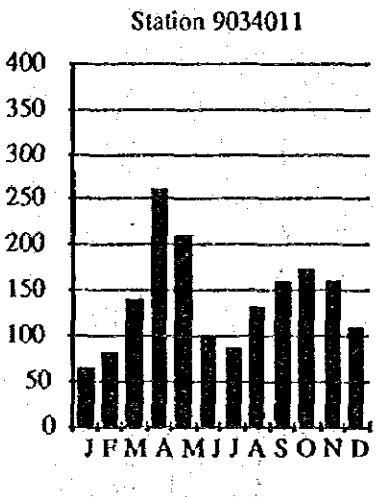
REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

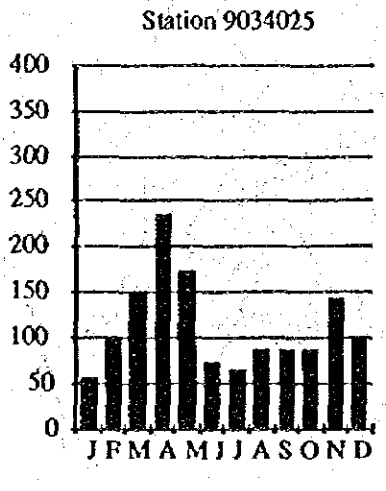






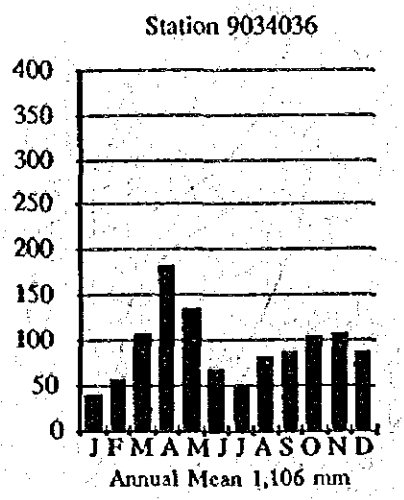


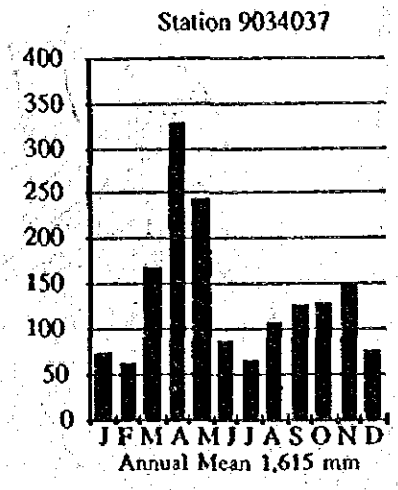


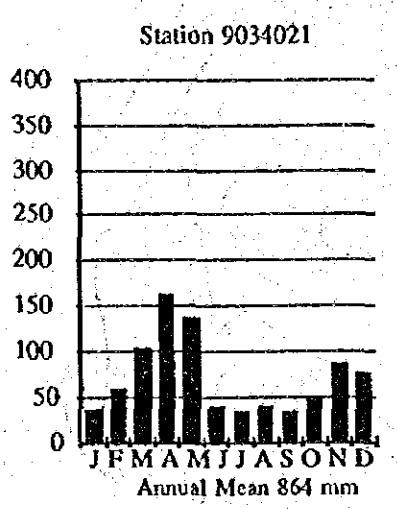


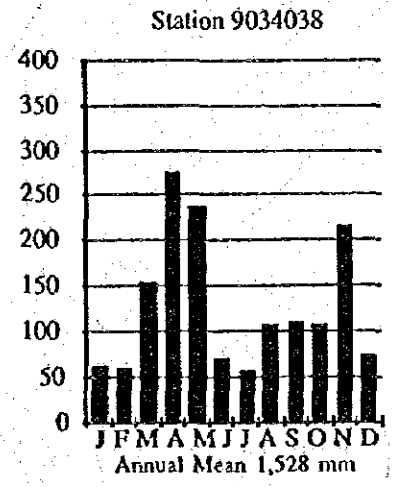
Source : Ref.6

Figure 1.2 Rainfall Distribution (1/2)



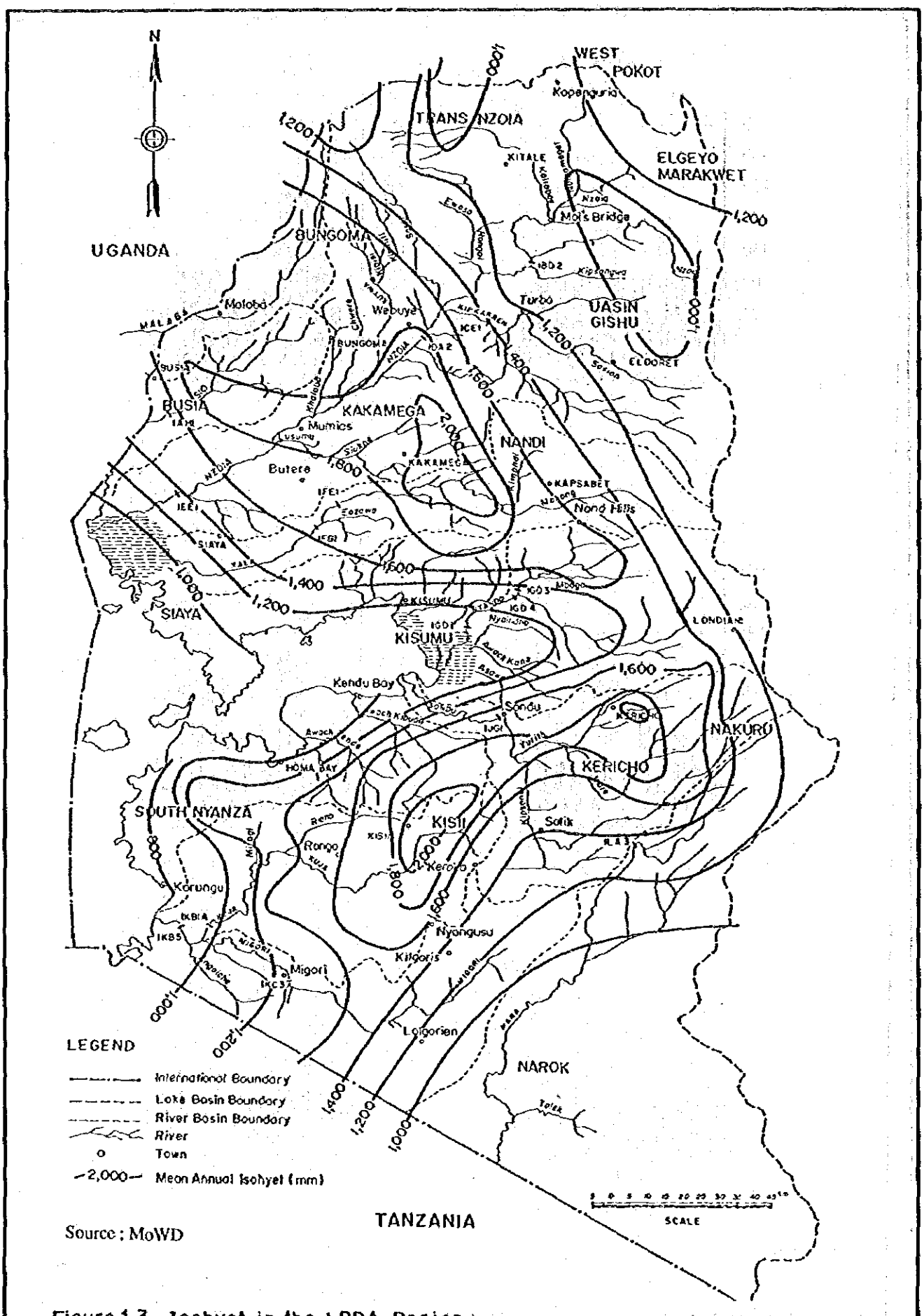






Source : Ref.6

Figure 1.2 Rainfall Distribution (2/2)



Source : MoWD

Figure 1.3 Isohyet in the LBDA Region

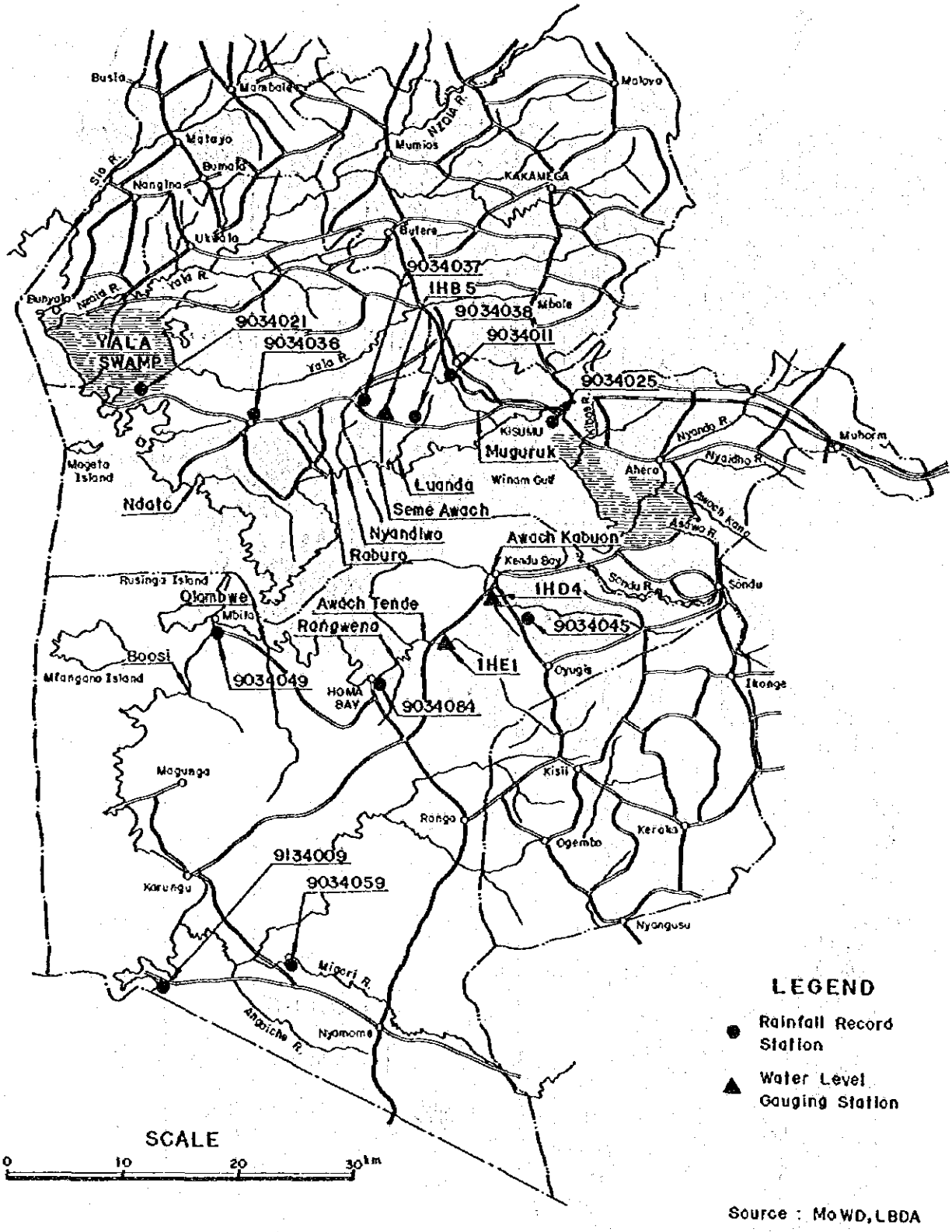
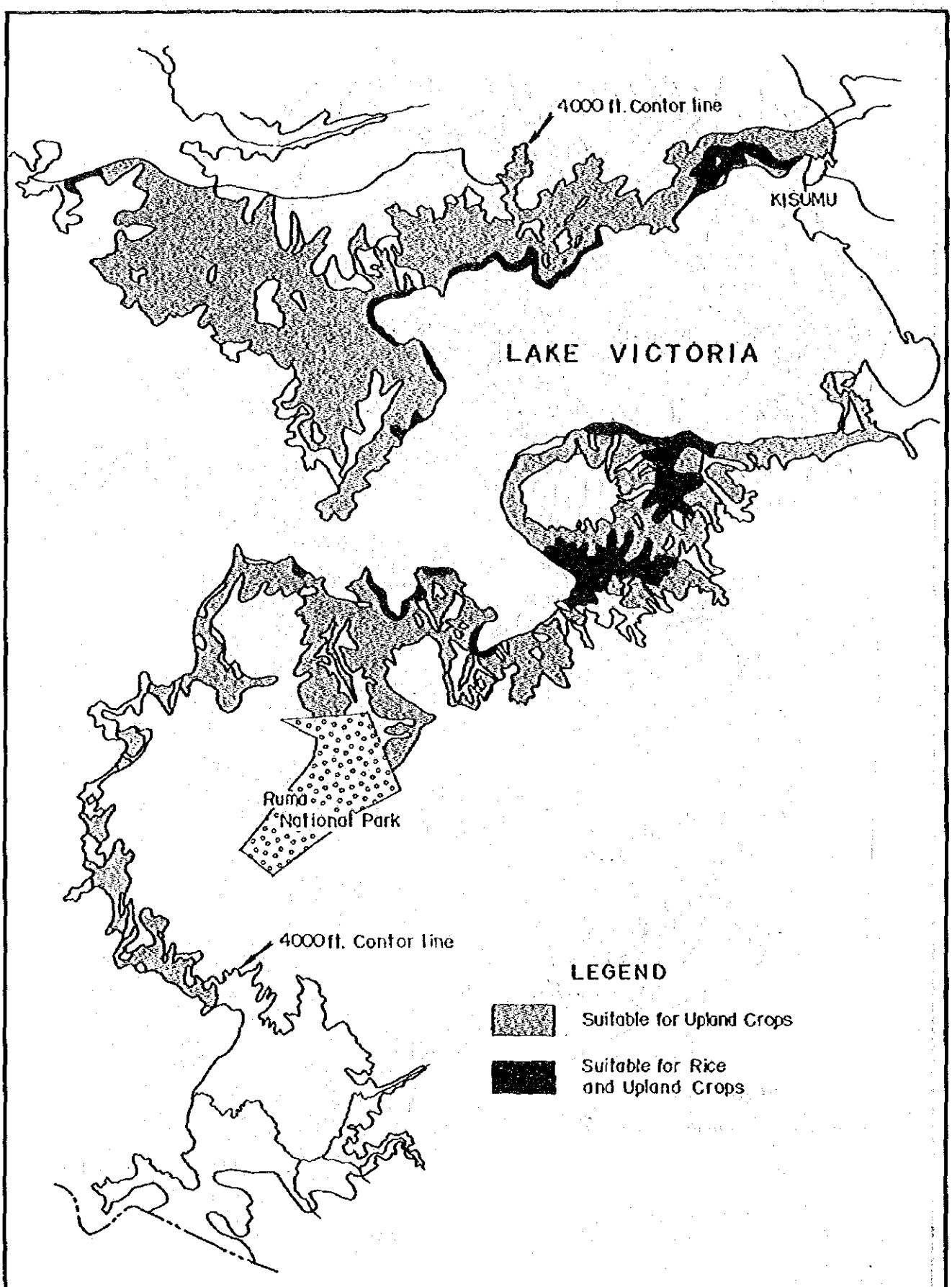


Figure 1.4 Locations of Rain, Temperature and Water Level Gauge Stations

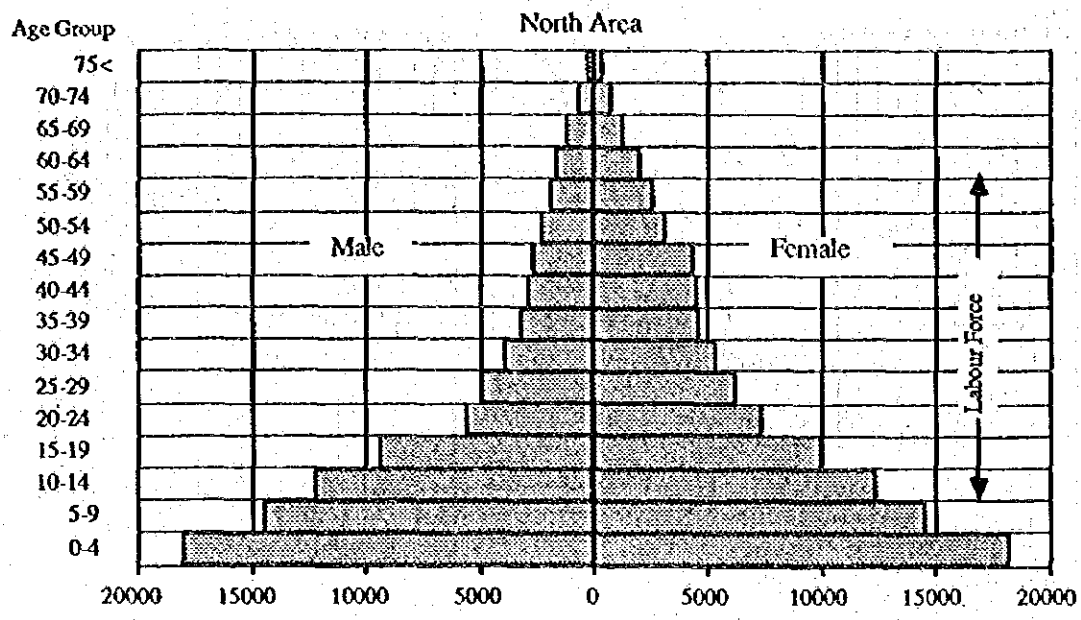
REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY



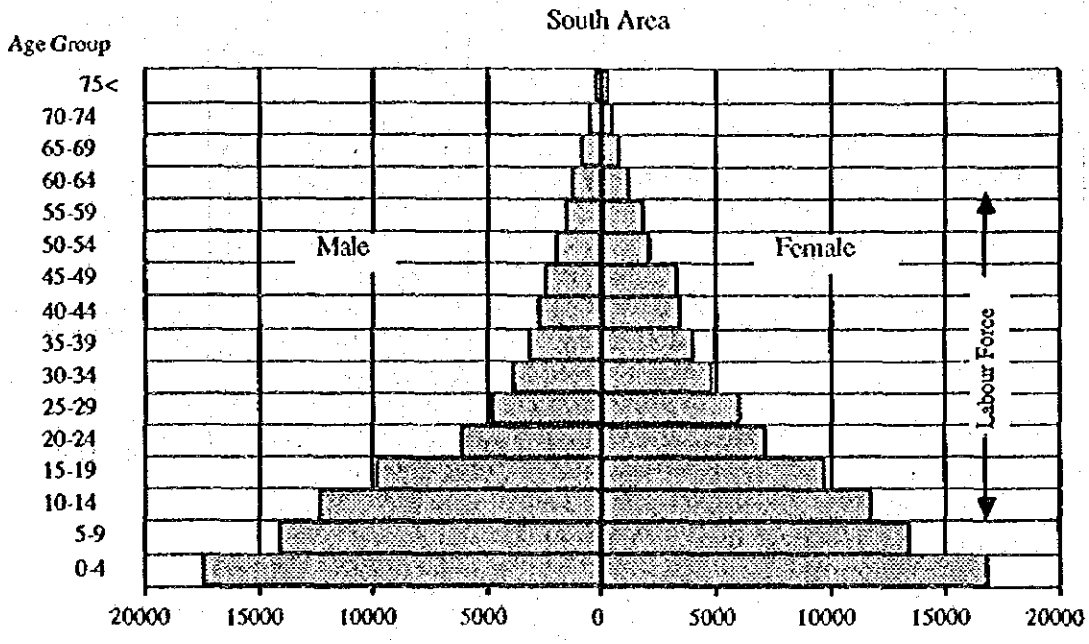
Source : Ref.5

Figure 1.5 Land Suitability Classification Map

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY



Total Population	184,000
Population in age group15-59	86,000
Labour forde (82% of age group15-59)	70,000

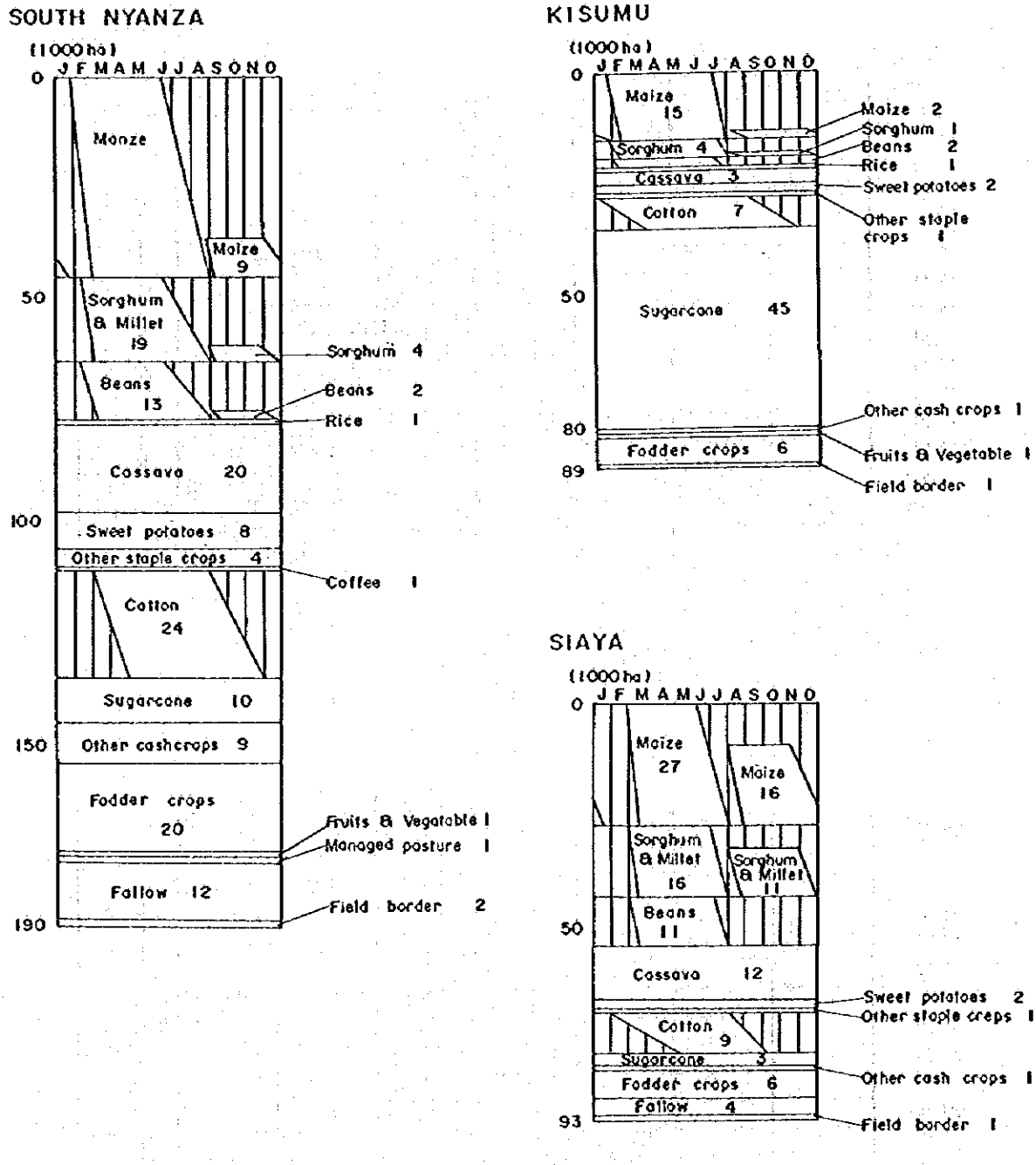


Total Population	172,000
Population in age group15-59	80,000
Labour forde (82% of age group15-59)	66,000

Source: Kenya Population Census, 1979

Figure 1.6 Estimated Population Pyramid of LSI Area in 1985

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY



Source : JICA Study team (Agriculture Sector Report)

Figure 1.7 Indicative Cropping Patterns

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

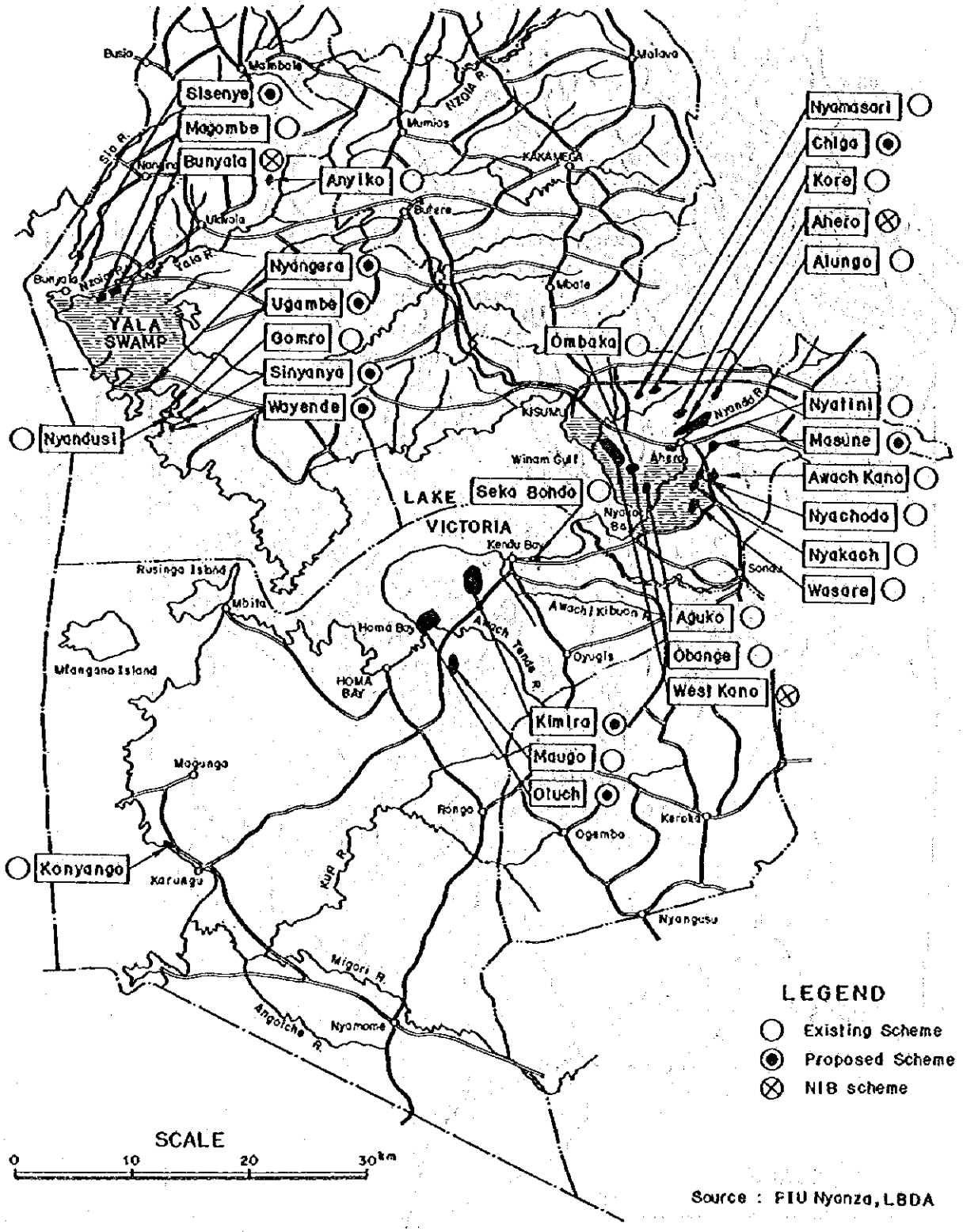


Figure 1.8 Irrigation Schemes in the Area

REPUBLIC OF KENYA - LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

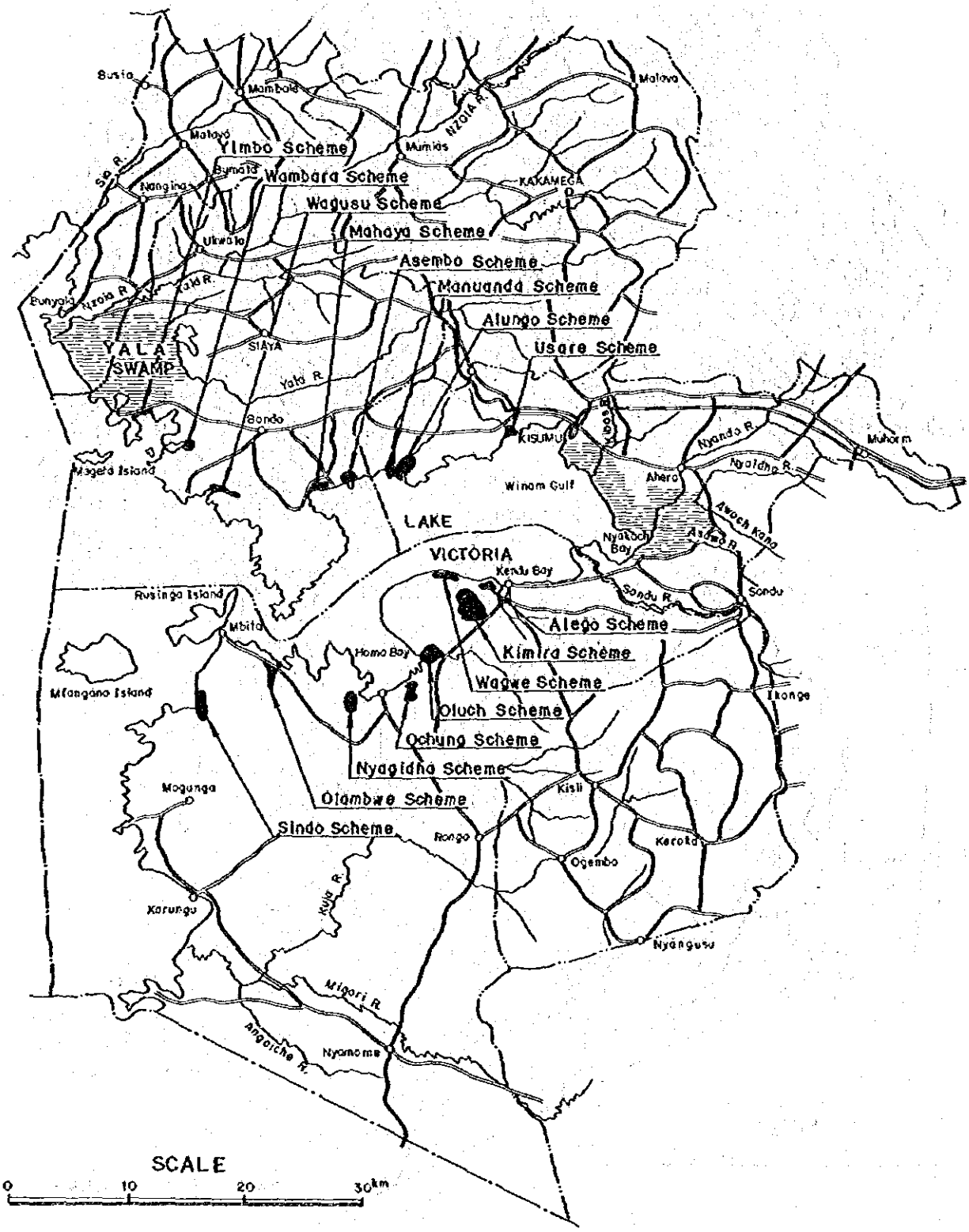


Figure 1.9 Locations of Lake Shore Irrigation Schemes

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

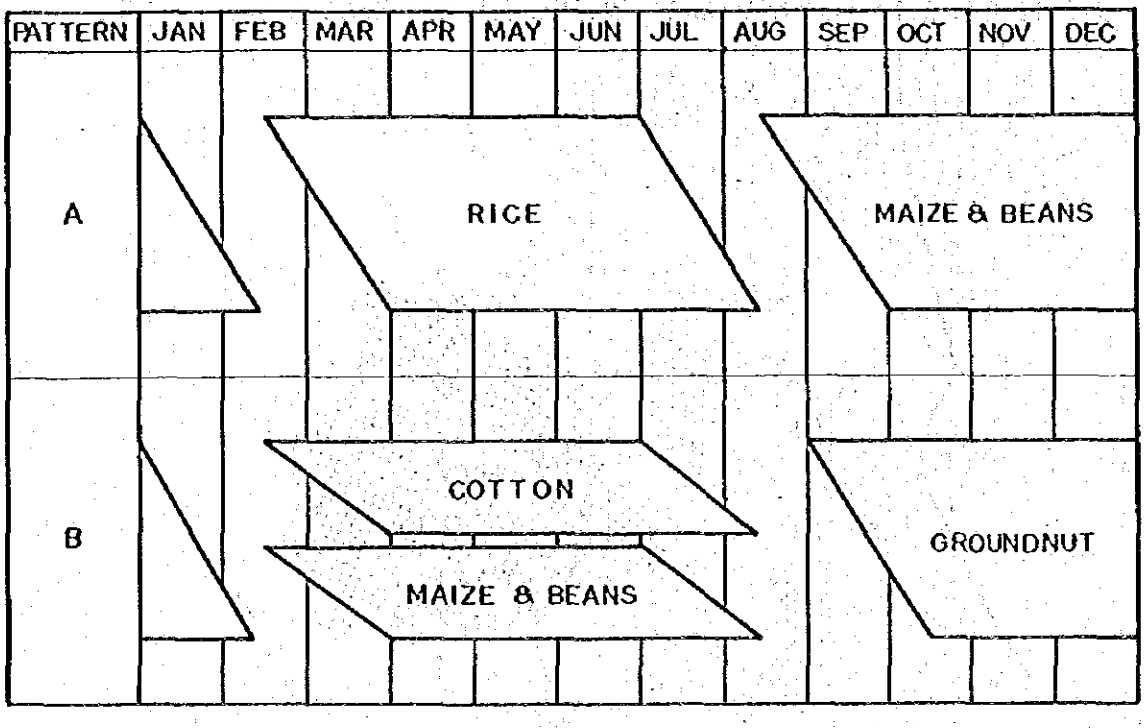


Figure 1.10 Indicative Cropping Patterns

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

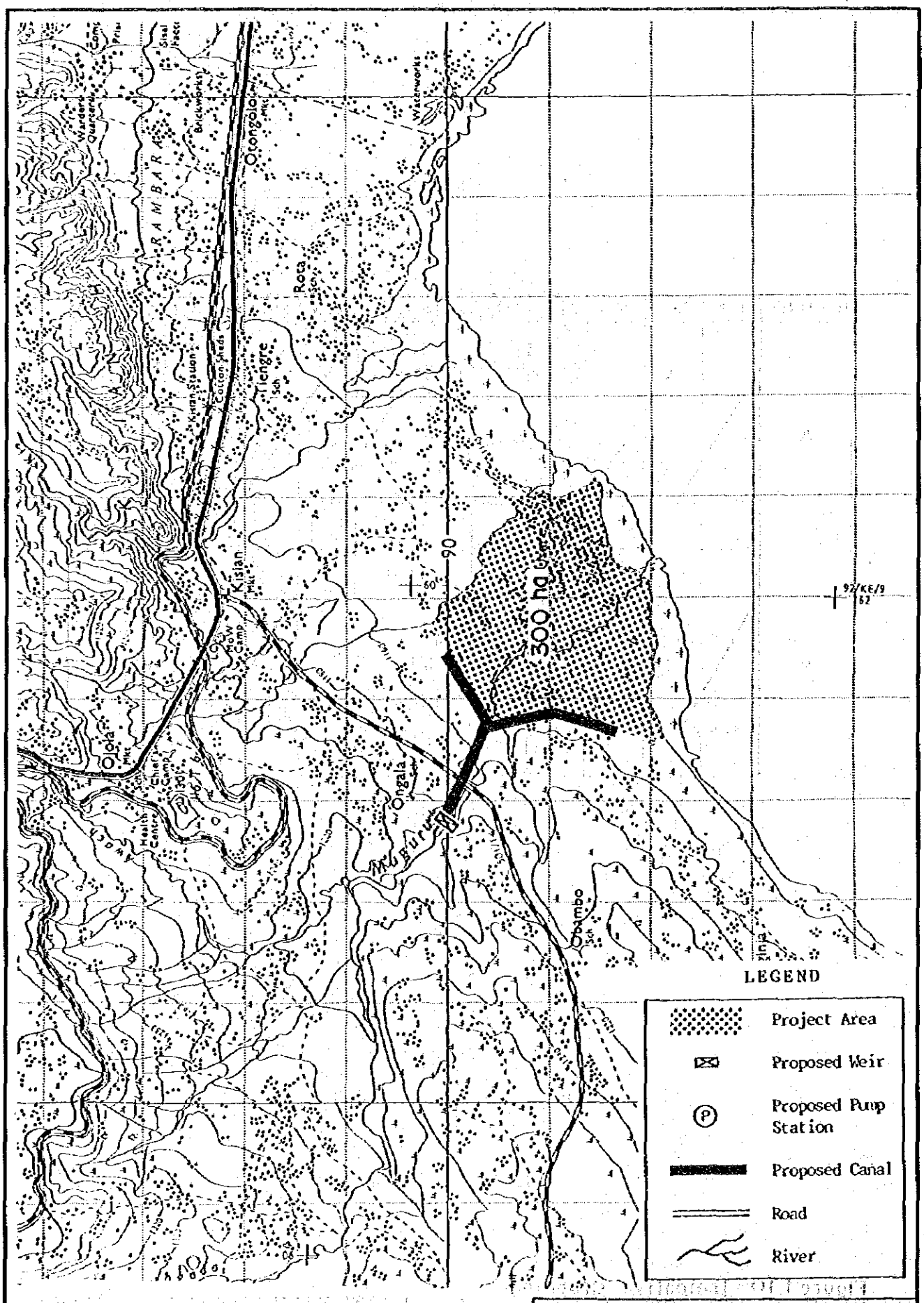


Figure 1.11 Preliminary Layout of Usare Scheme

REPUBLIC OF KENYA / LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 1.12 Preliminary Layout of Alungo, Manuanda Schemes

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 1.13 Preliminary Layout of Asembo, Mahaya Schemes

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

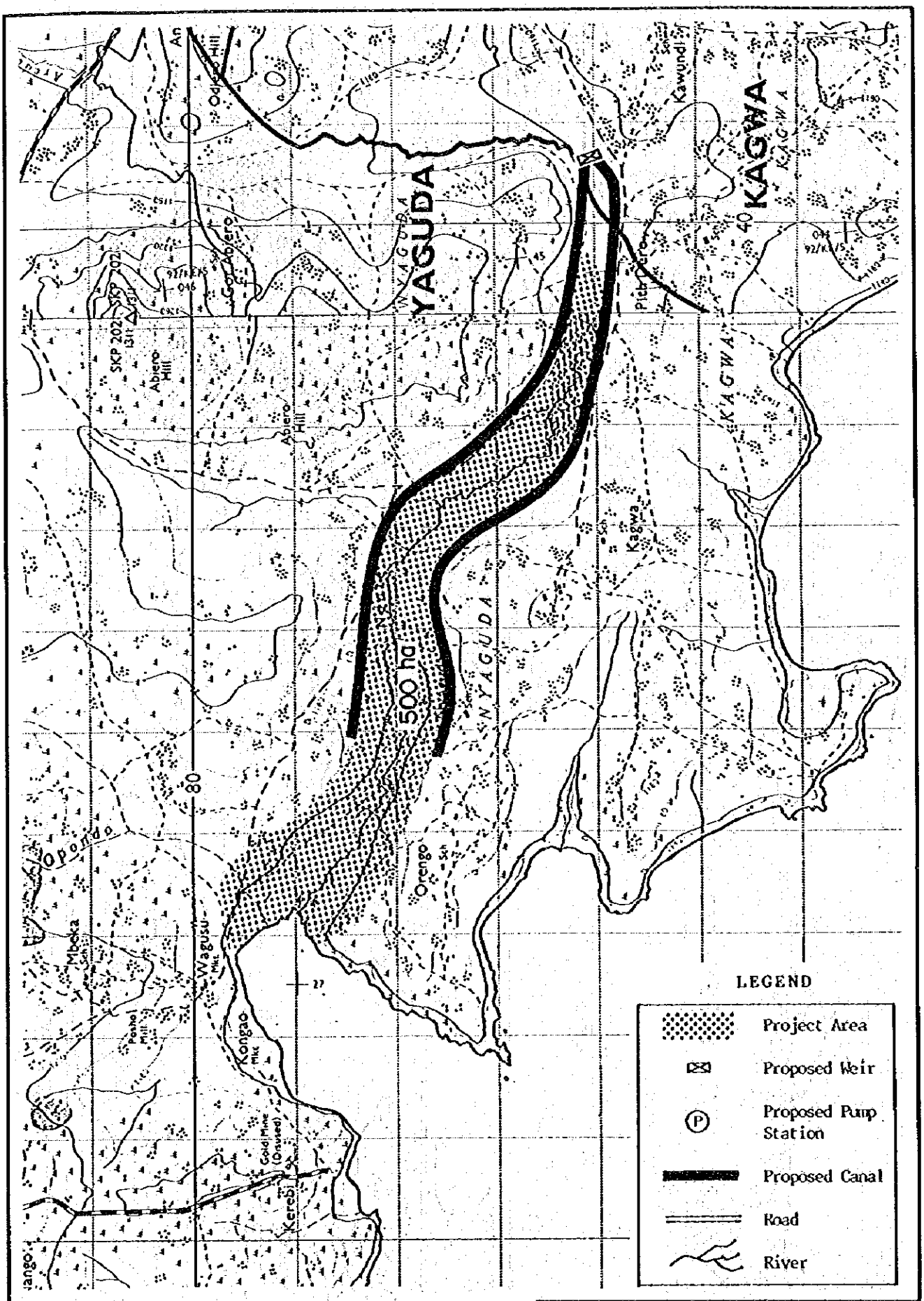


Figure 1.14 Preliminary Layout of Wagusu Scheme

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

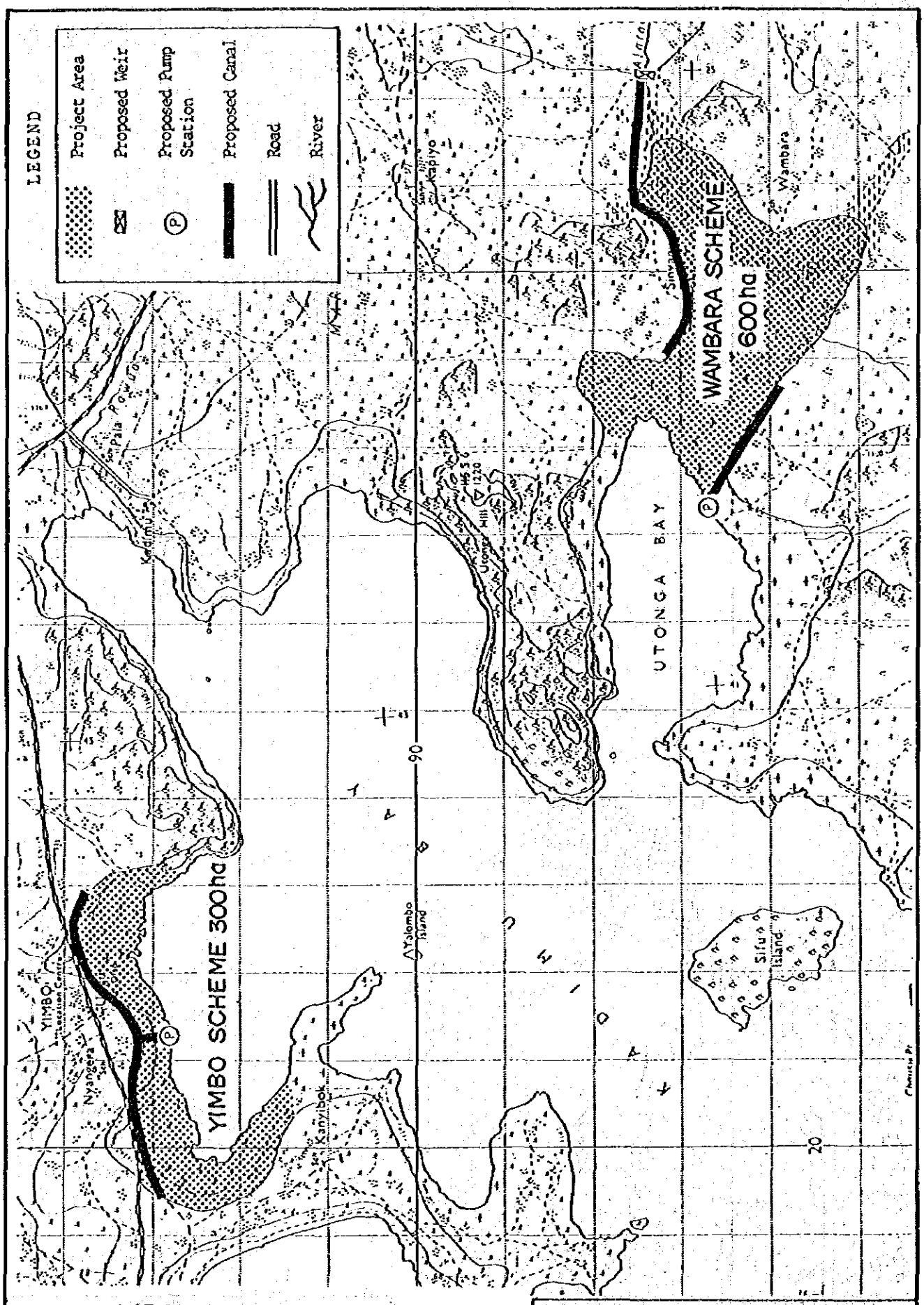


Figure 1.15 Preliminary Layout of Wambara, Yimbo Schemes

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

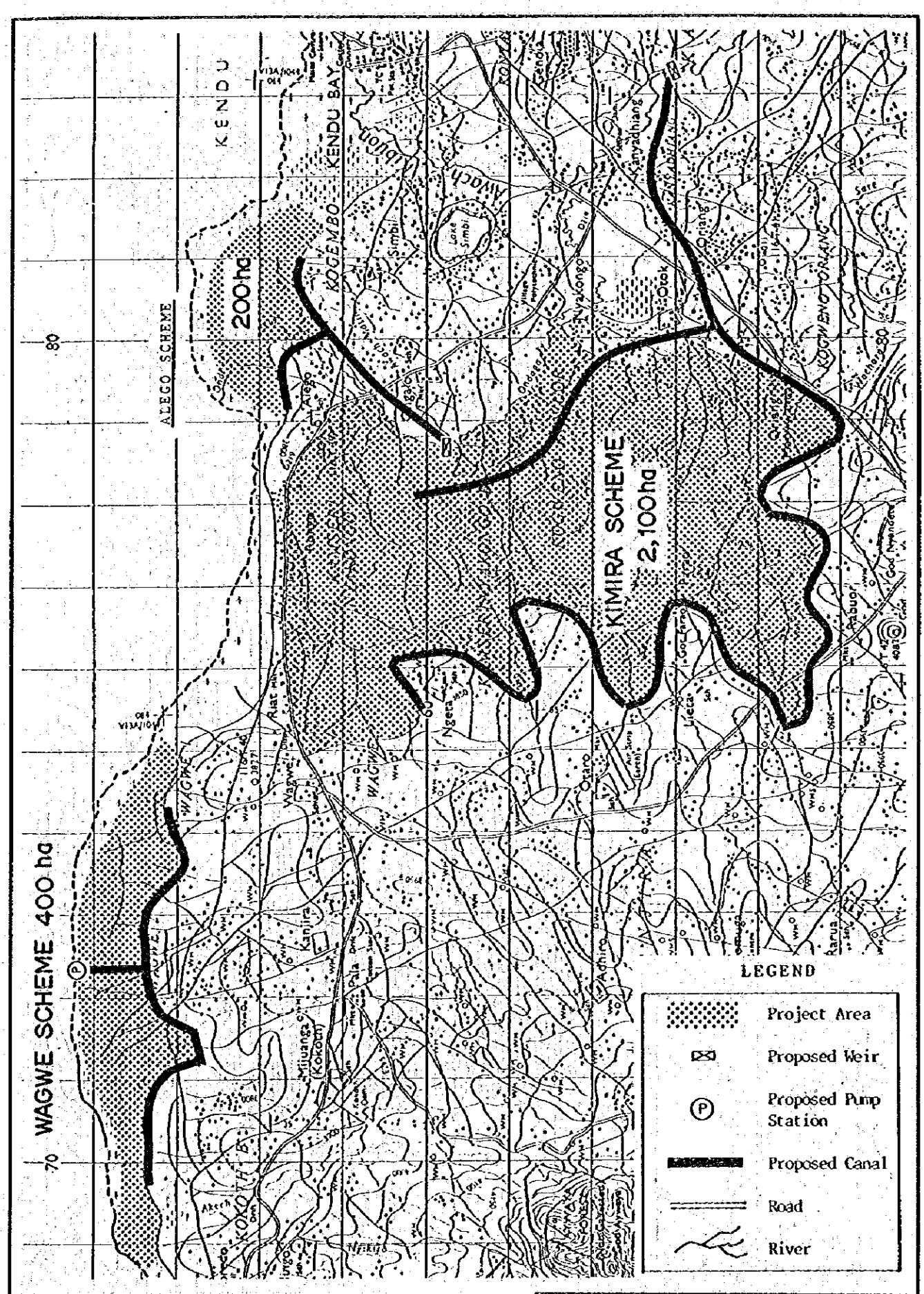


Figure 1.16 Preliminary Layout of Alego, Wagwe, Kimira Schemes

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

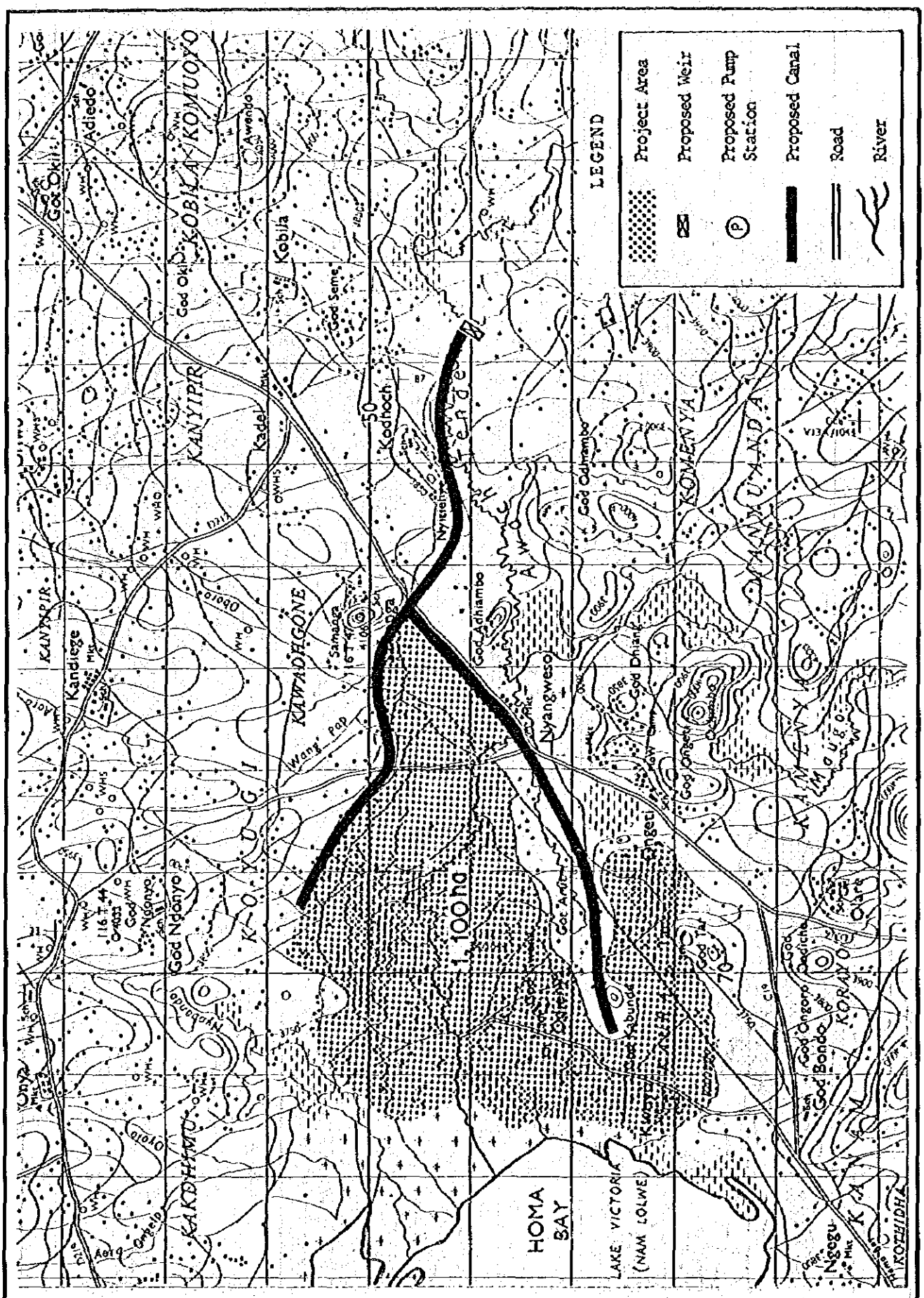


Figure 1.17 Preliminary Layout of Oluch Scheme

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

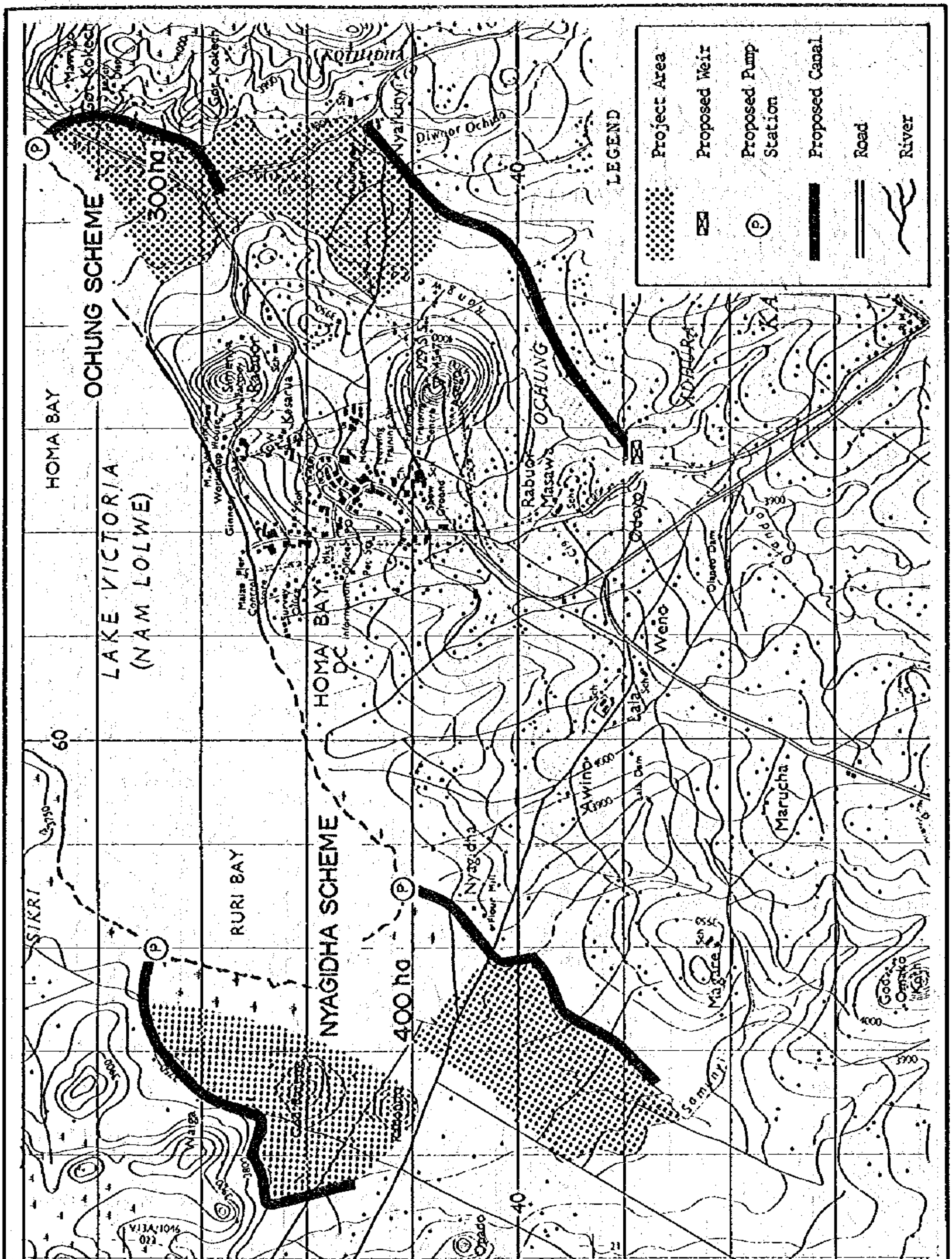


Figure 1.18 Preliminary Layout of Ochung, Nyagidha Schemes

REPUBLIC OF KENYA · LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

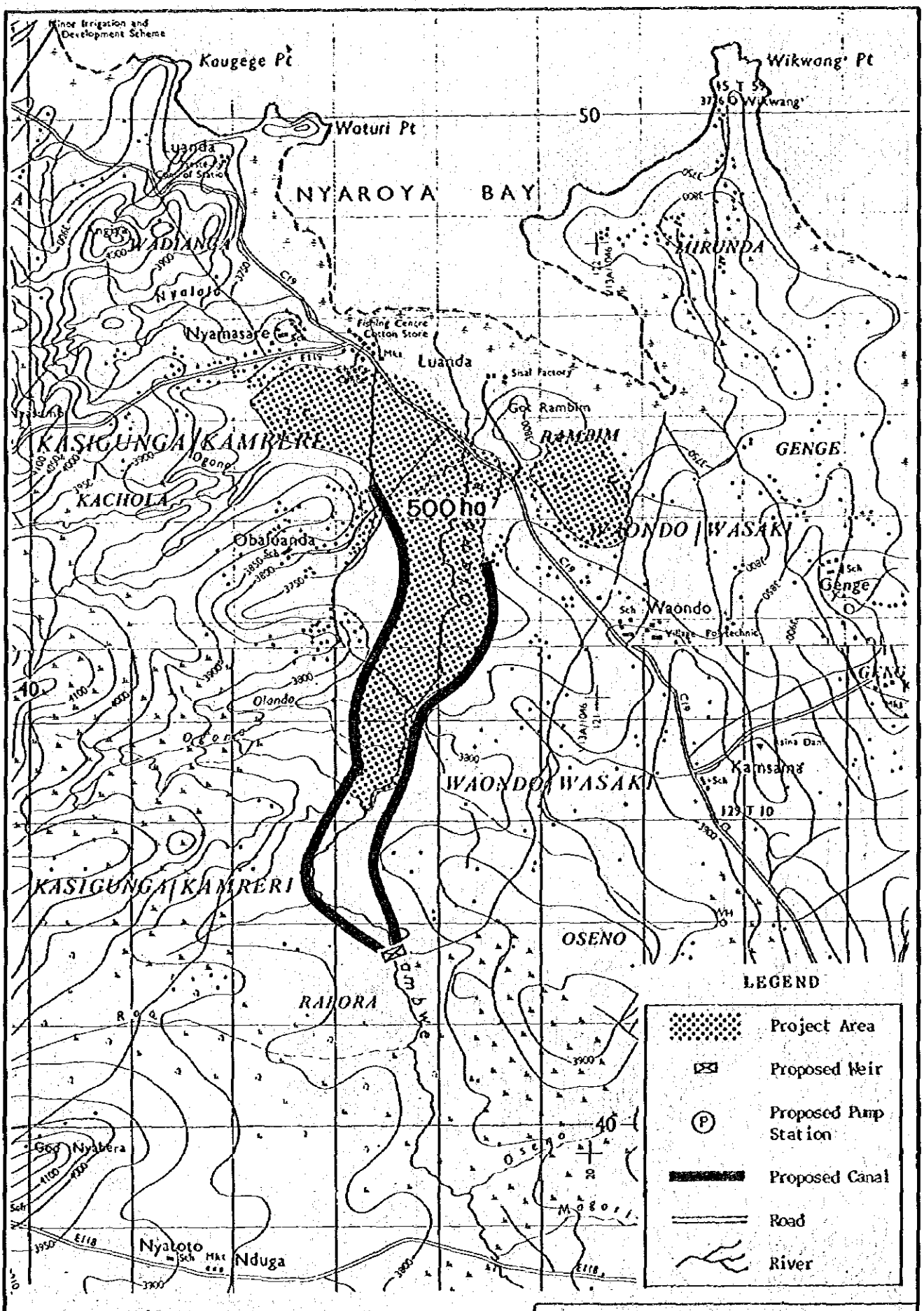


Figure 1.19 Preliminary Layout of Olambwe Scheme

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

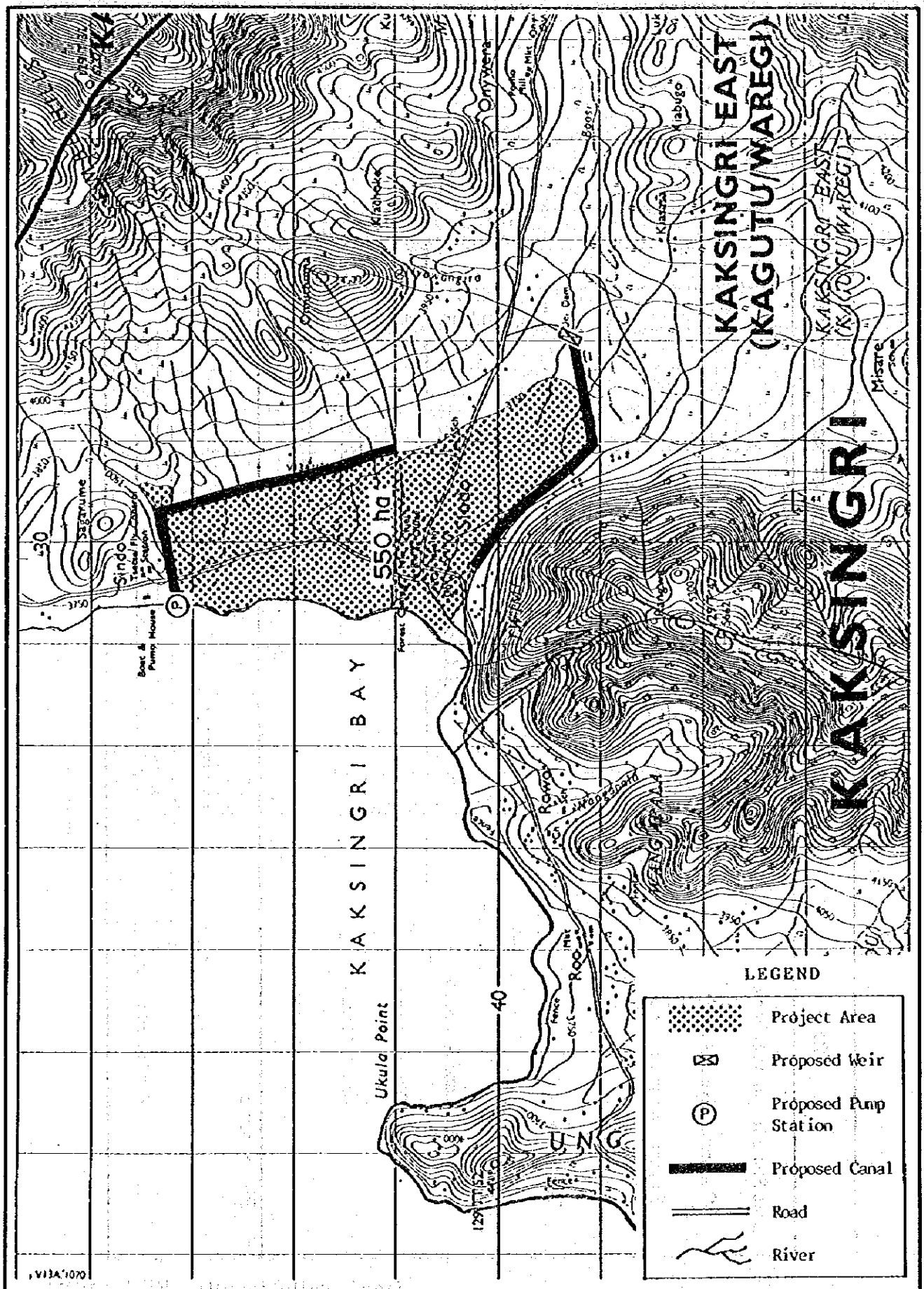
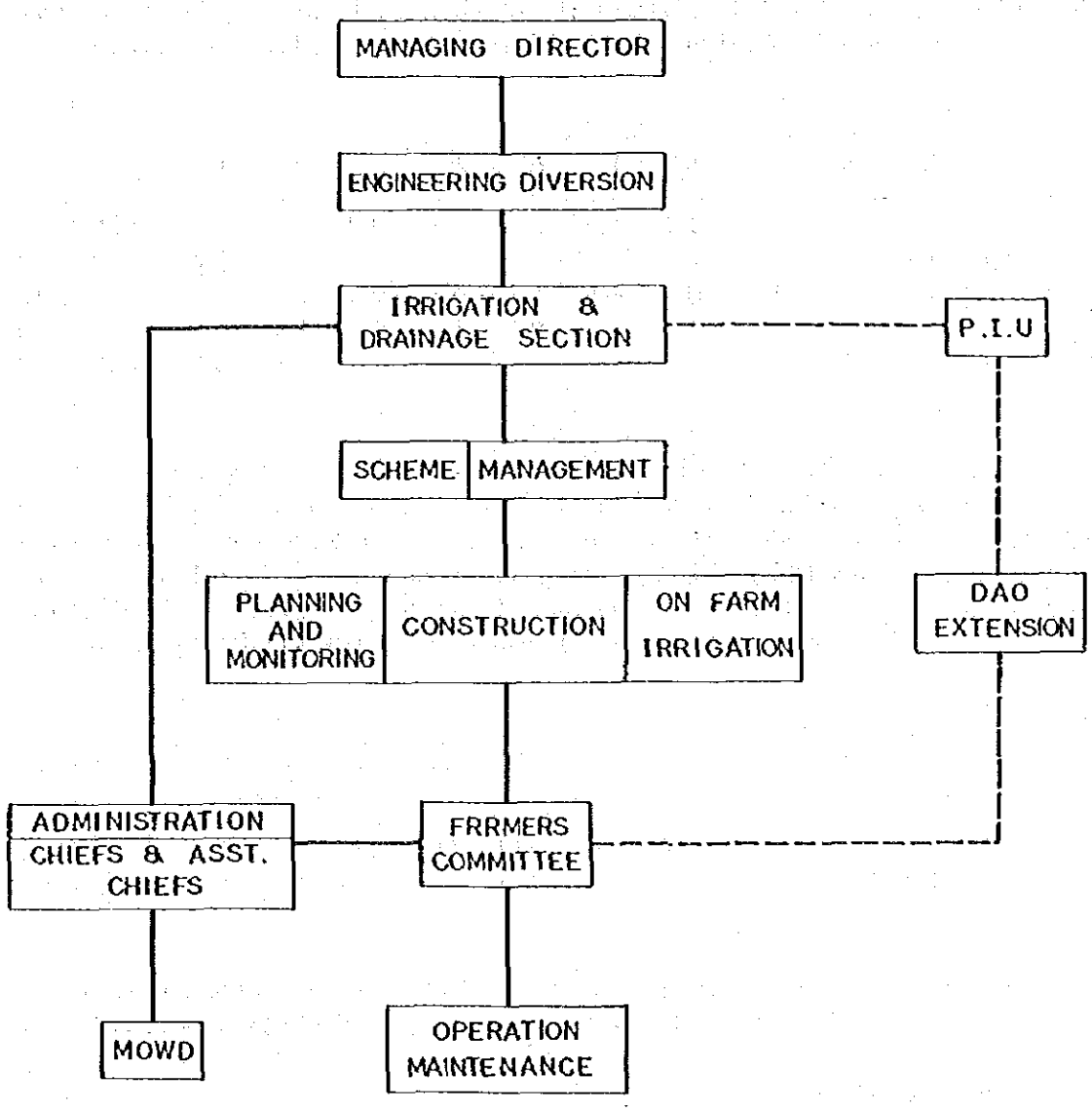


Figure 1.20 Preliminary Layout of Sindo Scheme

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 1.21 Tentative Implementation Schedule

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY



Source ; LBDA

Figure 1.22 Organization Chart

Attachment to Chapter 1: Water Requirement

Monthly water requirements for two indicative cropping patterns have been calculated by using the result of a previous study (ref.4) and rainfall data in the area. Monthly consumptive water use by each crop is cited from the same source shown below.

(Unit: mm/days)

	J	F	M	A	M	J	J	A	S	O	N	D
LR Paddy	-	-	5.9	5.3	4.8	4.4	4.1	-	-	-	-	-
SR Paddy	5.6	-	-	-	-	-	-	-	5.3	5.8	5.4	5.5
Maize	-	2.4	2.9	3.6	4.4	4.3	4.0	3.7	-	-	-	-
Cotton	-	2.1	2.5	3.1	3.9	4.1	4.1	-	-	-	-	-
Groundnut	4.0	3.1	-	-	-	-	-	-	2.7	3.9	4.7	4.3

Effective rainfall was deducted from consumptive use. To estimate the effective rainfall, the method of U.S. Department of Agriculture's Soil Conservation Service is applied, using monthly rainfall equalled or exceeded in 80% of years. Data at two rain gauge stations are used. Data of No. 9034045 station (Table A-1) is applied for Oluch/Kimira area and data of No.9034038 (Table A-2) for areas of the northern LSI area. The following table shows applied 80% probability rainfall data of these two stations (see Figure A-1).

(Unit: mm)

Station	J	F	M	A	M	J	J	A	S	O	N	D	Total
9034045	41	47	81	122	123	58	50	69	61	54	53	51	810
9034038	42	40	107	188	164	48	39	74	75	74	148	50	1,050

Other water requirements such as for land preparation, topping up and re-flooding are considered for both paddy and upland crops as shown below (ref. 2).

(Unit: mm)

Crop	Land preparation	Topping up	Re-flooding
Paddy	200	90	150
Upland	100	-	-

Water requirements at river diversion were calculated from the net water requirements by using an overall irrigation efficiency of 40% including allowance for conveyance, operation and on-farm application losses. The following table shows diversion water requirements for two indicative cropping patterns.

(Unit: ℓ/sec/ha)

	J	F	M	A	M	J	J	A	S	O	N	D
Pattern A	0.87	1.12	1.12	1.60	0.55	0.78	0.28	0.10	0.31	0.77	1.06	1.19
Pattern B	0.59	0.23	0.10	0.00	0.22	0.83	0.45	0.27	0.09	0.56	0.34	0.89

Table A-1 Monthly Rainfall at Station No. 9034045

Unit:mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1943	0	94.5	148.8	115.3	106.7	111.8	87.9	164.6	34.3	59.7	9.7	3.8	937.1
1944	7.9	39.4	153.4	350.3	154.7	51.3	157	115.3	70.1	66.5	82.8	110.5	1,359.2
1945	33.3	85.3	8.1	88.6	146.6	129.5	71.6	79.5	160.5	64	74.7	47	988.7
1946	6.9	0	116.6	143	142.5	156	67.8	167.1	87.9	61.5	70.9	84.8	1,105.0
1947	50.8	107.7	221.5	220.7	200.9	122.4	29.5	57.7	158	8.9	13	124	1,315.1
1948	7.9	10.7	63	222.5	99.1	198.1	37.1	32.8	103.1	56.1	32.8	42.2	905.4
1949	0	20.3	0	142.2	172.7	71.9	78.2	56.1	241	80.8	15.7	305.3	1,184.2
1950	94.2	15	246.1	100.3	203.5	92.7	63.8	0	345.4	95.3	63.8	77.5	1,397.6
1951	27.9	23.4	119.1	370.6	325.4	0	31.2	58.2	24.4	63	94.5	212.3	1,350.0
1952	1	122.2	49.8	275.1	244.9	78.7	70.6	90.7	35.8	103.4	15.7	8.1	1,096.0
1953	42.4	0	74.4	226.6	89.4	42.4	43.9	46.2	101.3	85.1	46.7	5.8	804.2
1954	7.9	0	11.2	112.8	125.5	86.6	10.9	0	3.3	7.6	10.9	51.6	428.3
1955	4.6	51.8	20.3	56.6	186.2	30.5	25.4	148.6	190.8	33.5	34	111.5	893.8
1956	205.7	86.9	71.6	279.4	171.5	91.4	68.6	122.4	110.5	45.7	16	139.2	1,408.9
1957	81.8	11.4	210.6	162.8	133.9	47.5	15.2	53.1	6.6	38.1	48.8	77.5	887.3
1958	0	73.7	143.3	140	232.2	95	115.8	122.4	46.2	59.9	27.9	54.6	1,111.0
1959	48.3	91.2	227.1	159.8	84.8	3.8	13.2	53.3	104.1	134.9	109	16.5	1,046.0
1960	3.3	16.5	41.9	62.7	80	42.2	0	66.5	80.8	55.1	27.9	0	476.9
1961	2.5	17.3	23.6	55.4									98.8
1962						79.2	81.8	106.9	140	171.2	133.4		712.5
1963	111	201.7	127.5	110	339.6	152.4	82.6	48.8	6.1	10.2	133.4	10.2	1,333.5
1964	61.5	134.9	133.9	329.7	393.2	32	184.2	148.1	115.1	83.8	12.4	147.6	1,776.4
1965	14.2	87.4	68.1	221.5	78.2	9.1	6.3	21.8	87.6	69.8	87.8	17.2	769.0
1966	93.8	123.5	237.4	258.6	36.3	57.7	82.3	140.3	131.1	58.2			1,219.2
1967	5.6	33	80.4	243	280.1	170.9	86.1	100.2	22.9	119.5	199.7	118.6	1,460.0
1968	0	177.6	156.5	314.3	120.6	136.2	26.9	81.8	42.1	85.3	143.5	187.3	1,472.1
1969	165.4	157	60.4	92.6	184.2	84.8	53.2	140.9	62.2	192.3	133.1	76.2	1,402.3
1970	102.4	53.4	223.3	167.9	221.6	97.2	26.4	212.1	97.2	85.7	67.6	62.7	1,417.5
1971	12.2	14.7	4.8	288.1	383.8								703.6
1972	70.6	86.6	99.2	93.3	189.8	109.8	114.7	65.4	0	114.3	0	40.8	984.5
1973	133.3	70.8	62	175.8	10	12.8	74.2	165.4	89	131.1	81.1	39	1,044.5
1974	74	47.2	184	183	191	154.1	116.1	37	108	56.1	75.1	40.1	1,265.7
1975	5.1	37	211	194.2	263.3	91	84	243	149	151	74	47	1,549.6
1976	59	43	55	121	223	53	162	126	66	88	120	132	1,248.0
1977	105	57	52	235	321	132	93	121	48	162	208	48.6	1,582.6
1978	111	164	278	258	304	132	380	70	94.3	92.9	81.4	46	2,011.6
1979	98	109	157	230.5	86	89	31	132	41	29	70	81	1,153.5
1980	109	54.6	68.5	118.2	246	72	57	102	89	70	108	32	1,126.3
1981	39	47	247	195	141	37	102	126.6	140	57	60.9	72.6	1,265.1
1982	105.7	39.7	143.8	133.8	235.1	166.5	86.6	199.6	57.6	201.4	358.5	101.2	1,829.5
1983	128.2	94.6	192.7	168.9	203.9	162.3	4.2	199.6					1,154.4
Mean	55.76	67.53	119.8	185.4	188.5	89.3	74.93	103.2	91.85	82.84	79.53	77.01	1,153.0

Source: LBDA Data base

Table A-2 Monthly Rainfall at Station No.9034038

Unit:mm

YEAR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1961	31.5		211.7	254.8	165.4	49.3	82.7	86.3	182.2	235.3	342.8	166.9	
1962	101.1	0	126.6	402	247	84.2	66.9	88.3	74.7		149.9	159.5	
1963	71	134.7	115.2	308.4	278.4	78.9	45.7	30.4	69.9	185.4	283.2	0	1601.2
1964	0	12.3	287	319.9	86.1	63.3	86.3	61	113	53.3	107.1	53.9	1243.2
1965	66.5	30.5	62.7	265.3	136.3	5.8	90.4	30.2	60	269.8	168	57.7	1243.2
1966	33.2	69.6	298.6	209.5	147.6	36.5	96.8	85.6	165.5	229.3	164.4	6.1	1542.7
1967	23.6	7.4	121.9	213	267.3	70.4	11.9	82	108.4	237.1	297.1	99	1539.1
1968	0	189.7	133	317.5	137.6	90.2	107.5	101.5	174.5	100.8	180.3	265.3	1797.9
1969	8.3	108.5	145.8	137.3	259.6	39.2	33.4	84.3	89.4	86.5	122.9	121.5	1236.7
1970	371.4	115.1	373.3	564.9	286.7	122.7	6.2	486.5	7.6	15	15.7	4.1	2369.2
1971	7.4	0	23.4	288	546.8	3.1	2.8	32.3	7.5	145.5	12.4	73	1142.2
1972	13.9	50.9	12.3	14.3	276.4	12.5	203.4	14.8	10	13.6	524.4		
1973	186.5	7.8	99.8	438.2	430	128.7	9.7	157.5	358.3	10.2	973.9	5	2805.6
1974	30	2.8	17.5	262.8	236.4	88.4	17.6	2.4	24.3	11.2	7	52.1	752.5
1975	1.6	11.2	410.1	761.7	562.6	238.6	5.1	237.4	213.7	15.4	199.3	67.3	2724
1976	130.8	149	65	259.4	187.9	65	105	129.4	84.8	81.3	138.3	23	1418.9
1977	103.8	25.2	203.1	277.2	219.6	94.7	37.7		155.2	87.2	170.1	68.1	
1978	64.7	144.7	221.1		214	76.6	6.1	89.8	51.6	79.3	132.2	138.1	
1979	99.5	84.3	188.4	141.9	203.2	66.5	56.2	90.8	91.3	48	129.8	72.5	1272.4
1980	10.2	0	160.1	152	209.9	70.7	25.5	169.3	143.6	39.7		0	
1981	23.8	10.5	180.8	102.3	65.5	20.4	127.2	66.9	109.2	77.9	72.3	42.1	898.9
1982	0	48.7	90	119.4	196.5	104.1	72.4	112.4	138.9	228.5	427.8	78.1	1616.8
1983	20.9	71	39.3	213.7	135.6	9.1	0	130.9	70.8	129	102.6	60.6	983.5
Mean	60.9	57.9	155.9	273.8	239.0	70.4	56.4	107.7	108.9	108.2	214.6	73.4	1540.5

Source: LBDA Data base

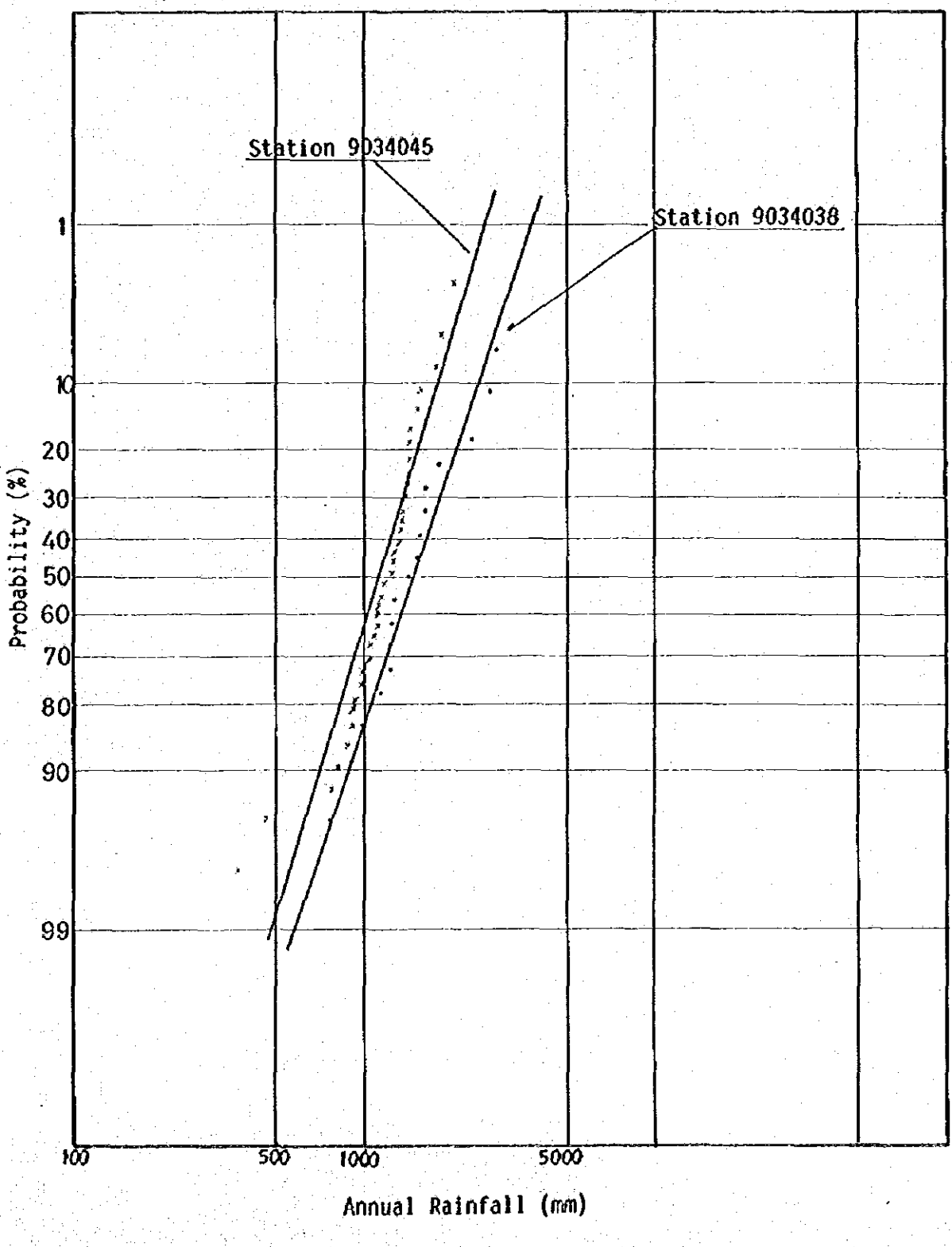


Figure A-1 Probability of Annual Rainfall

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

Chapter 2 PIG INDUSTRY COMPLEX PROJECT

Chapter 2 PIG INDUSTRY COMPLEX PROJECT

Contents

Tables

Figures

2.1. Introduction

(1) Livestock development in Kenya

The livestock industry in Kenya has been playing an important role in the national economy of Kenya. In 1985, it produced K£119.0 million of marketed livestock products, accounting for 15.8% of the total marketed agro-products (Chapter 2, Sector Report). The Government of Kenya views livestock development as one of the most important and promising means of economic diversification particularly for mixed farming sector.

Food and nutrition are undoubtedly the most fundamental of all basic needs. Since Independence, production of major food stuffs in this country has grown considerably, although in some cases it failed to keep pace with population growth. The table below shows changes in per capita availability of major livestock products over the period from 1965 to 1980.

(Unit: kg per year)

Product	1965-70	1971-75	1976-80
Milk	74.8	56.0	62.5
Beef	-	12.0	13.5
Mutton	-	2.5	3.6
Pork	-	0.5	0.3
Eggs	-	1.4	1.6
Poultry	-	-	1.9
Fish	3.1	2.5	2.0

(Source: Development Plan 1984 - 1988)

National meat production is currently at 0.2 million tons while the demand is 0.3 million tons. According to the Sessional Paper No.1 of 1986, the demand will increase to 0.5 million tons by the year 2005, while the production is estimated to be 0.42 million tons. This indicates a deficit in meat supply which may force this country to import meat and meat products.

One of the major features of meat consumption in Kenya is the predominance of meat from ruminant animals as compared to consumption from pigs and poultry. This reflects the fact that Kenya has developed its livestock sector mainly with cattle farming. More than 80% of the meat intake comes from cattle, goat and sheep as compared to 50% from cattle and sheep in developed countries, and somewhat over one-third in the centrally planned economies.

Livestock meat production varies depending on the incidence of ruminant infectious diseases and the yield of pasture grasses. For stable supply of livestock meat to Kenyans, the diversification of livestock meat production should be regarded as most important, as well as enhancement and stabilization of pasture yield. Modernized poultry industries have already been introduced by the private sectors in Rift Valley and Central Provinces. Pig industry, however, is least developed of all the livestock subsectors in Kenya.

(2) Constraints to pig industry development

The pig industry in Kenya has been stagnant in recent years (Table 2.1). This is attributable to a variety of factors, main-ones being the following:

1) Irregularity of feed grain supply due to droughts, which is probably the main cause of the decline in recent years;

2) Difficulty in obtaining protein supplements due to high prices and competing uses;

3) Lack of proper marketing channel;

4) Lack of good quality breeding stock;

5) Lack of modern farming techniques;

6) Lack of controlled and hygienic slaughter houses which prevents many pigs from being inspected and discourages potential customers from buying the pork;

7) Lack of attractive profit margins for producers;

8) Local tribal traditions and lack of education about preparing and eating pork; and

9) Lack of chilling facilities enabling butchers to keep pork over night.

In addition, it should be noted that other livestock sectors have received foreign grant in aids and technical assistance for development, while pig industry has not.

2.2 Present Situation in the Region

(1) Pig farming

In the Region as well as in the Country, the pig breeds most commonly used are Large White, Landrace and Saddle-back breeds. Present domesticated pigs have been developed by crossing and selecting from these breeds.

Although many of the present pig farmers in the Region are relatively small and new to the field, and inexperienced in modern pig farming techniques, their performance is likely to improve as evidenced by the increasing number of pigs weaned per year, improving feed conversion rate and other signs of improving efficiency. According to the information obtained through the site investigation in Chavakali, Maragoli in South Nyanza district, an example of performance of pig industry managed by small farmers in the Region is as presented below.

i)	Conception rate	80%
ii)	No. of pigs weaned per sow per year	14 heads
iii)	Maturity period for slaughter age at 85kg	200 days

Weaning rate, however, is still very low because more piglets are crushed than usually expected due to lack of farrowing crates. Moreover, decrease in reproductivity has occurred due to excessive inbreeding, as local small scale farmers are in short supply of good quality breeding stock at present.

(2) Climate

The climate of the Region is varied but most parts of the Nyanza and Western Provinces have climate suitable for raising pigs. Natural conditions with average temperature of 16 - 25°C and humidity of about 65 - 85% are suited for farrowing/wearing and finishing of pigs, as illustrated in Figure 2.1.

(3) Feed sources

As for pig feed, almost all pig farmers are using home grown grains, agricultural by-products, supplemented partly by commercial feed. If commercial pig feed could be produced locally, it would benefit farmers, increase employment opportunities and reduce the dependence on high cost commercial feed.

The agro-ecological conditions of the Region are generally suitable for growing grain crops and also for fruits and root crops. In the Region, dried banana meal, dried cassava meal, maize grains, maize bran, rice bran, sunflower oil meal, and cotton oil meal are available as main sources of energy and protein for pigs.

The feasibility of using these raw materials depends on the relative cost of the final products compared to the currently marketed commercial pig feed which sells at Kshs. 2.0 per kg to wholesalers.

In this study, a model plant is considered to determine the total cost of locally produced pig feed. Examples of the feed formulation are shown in Table 2.2. A preliminary calculation shows that locally produced pig feed would cost on average about Kshs. 1.3-1.8 per kg of feed.

Options considered to achieve self dependency in pig feed production are (a) establishment of feed production plant, (b) provision of price subsidy to farmers, (c) organization of farmers for producing new materials for feed, (d) promotion of farm by-products to increase feed output, and (e) establishment of fish meal processing plant and livestock by-products rendering plant.

(4) Pig diseases

At present, there is no incidence of serious pig diseases such as African Swine Fever, FMD (Foot and Mouth Disease), Pseudorabies, Swine Fever and Swine Pox etc., while mange, diarrhea and internal parasites are commonly seen in the Region.

(5) Meat processing and grading

At present, meat processing plants are mostly concentrated near Nairobi. They are the KMC plant at Athi River, Haral at Ngong, at the bacon factory of Uplands and at the ADC/BAT broiler plant near Tigoni. Small-scale slaughterhouses enjoy a competitive advantage over large ones such as the KMC plant since the production costs by the latter cover facilities of high hygienic standard.

The Ministry of Livestock Development wishes to see wholesome meat to reach the consumers with equal standard. Therefore, in future, all meat processed in the country will be inspected and graded with the same rigour and thoroughness.

(6) Uplands bacon factory

At present, this important statutory body of pork processing plant faces serious financial, management and marketing problems. As such, they are unable to fulfill the function for which this plant was established.

The pork marketing will thus be reorganized on a national basis with a view to encouraging fair competition in the industry. In particular, the Ministry of Livestock Development intends to remove the monopoly now enjoyed by the Uplands bacon factory by licensing other pig slaughterhouses in those areas which cannot be efficiently served by this factory, subject to the relevant meat hygiene regulations being observed.

2.3 Project Description

(1) Justification

The pig industry complex project will contribute significantly to the country's national food policy, farmers income, employment generation and nutritional conditions of the people in the Region and the country as a whole.

Despite the constraints on pig industry already mentioned, there are some favourable conditions for pig development particularly in Nyanza and Western Provinces. They are as follows.

1) There are abundant agricultural by-products in the Region which could be utilized as raw materials for pig feeds. Some of these by-products are rice-bran, broken rice, corn (maize) bran, wheat bran, waste bananas, oil crop residues,

cassava, sweet potatoes, cane molasses, brewer's and distiller's grain wastes, papaya, pineapple and pumpkins.

2) Nyanza and Western Provinces have high population densities, the majority of them being small scale farmers who could adopt pig farming relatively easily.

3) Pigs are highly prolific in their reproductive natures and could be used in the Region to boost meat production faster than through beef production. For instance, one sow may produce up to one ton of meat in a year, whereas one beef cow may produce 300-400 kg of meat in two to two and a half years.

4) The national policy of promoting mixed farming systems among small scale farmers will be enhanced by incorporating pig farming because pigs could provide high quality animal manure for crop farming.

5) Potential demand for pork products is high as reflected in their high prices at present, higher than those of beef products (Table 2.7, Chapter 2, Sector Report).

Other potential advantages in regard to pig industry as means of improving livestock production are as follows:

1) Pigs are efficient in the conversion of the animal feed to human food;

2) Pigs could be financially rewarding;

3) Pigs are tolerant to a wide variety of feeds;

4) Pigs live in small areas;

5) Pigs improve soil fertility through pig mature which could also be used for production of biogas and aquaculture for fish farming; and

6) Pigs can be raised by small scale farmers with relatively simple techniques and management.

(2) Objective and strategy

The objective of the pig industry complex project is to contribute to increasing farmers' income and employment opportunities, and improving nutritional conditions by expanding the pork production satisfying a large part of the growing demand for animal protein sources. The strategy for the project consists of the following:

a) To upgrade productivity of pig farming through introduction of excellent pig breeds from overseas countries;

b) To encourage the utilization of locally available feed sources for raising pigs; and

c) To establish a system for extension of modern pig farming techniques for local farmers with mixed farming practices.

(3) Main components

The pig industry complex project will be composed of units of breeding center, packing plant (slaughter house), feed mill plant, training and extension center, and marketing organization network.

In addition to these main functions, the experiment of methane gas (biogas) production from pig manure may also be carried out for effective utilization of pig manure. Utilization of methane as domestic fuel will be effective for conservation of the country's limited forest resources, partly substituting woodfuel and petroleum used in rural areas for cooking, lighting or even fueling internal combustion engines (Chapter 9, Sector Report). The residue yield from methane production process can be utilized as fertilizer for agriculture crops.

(4) Contract farmers scheme

The project will be effectively carried out under a contract farmers scheme. Each farmer registered to the project will be given at least 20 pigs at a time after one month weaning age (liveweight is approximately 15-20 kg), with principal pig feed. He will raise them for period not exceeding four months to reach slaughter weight of 80 - 85 kg on an average and bring them back for slaughter upon which he will be paid rearing charges and housing depreciation cost.

Reasons for adopting this scheme are the following.

1) This type of production is of low cost: pig pens can be made out of local materials such as banana leaf thatch, and feed can be prepared with own swill, vegetables, and possibly agro-byproducts.

2) Pig raising does not require hard management so that even old people, women and children can easily take care, and does not require much capital investment.

3) Economic advantage of pig production over beef production are well known among small farmers.

4) Pig contract farmers can get manure for fertilizing their farms and producing biogas, and the aquaculture can also be promoted in the inland areas.

The number of contract farmers scheme will be determined by the stage of the project. In one year of contract, each farmer may have cropping of slaughter hogs three or more times.

(5) Pig breeding center

The center will be involved mainly in the rearing of the breeding stock, which will produce commercial pigs for slaughter and replacement stock for both independent farmers and further expansion of the pig industry complex. The physical production data are given in Table 2.3. The center will have an initial capacity of 500 sows and 50 boars and annual output of 7,000 market hogs.

Table 2.4 shows the stage-wise development of breeding center and its complex for the twenty years period. A pig breeding centre is illustrated in Figures 2.2 and 2.3.

(6) Training and extension

Training and extension services related to the project will directly deal with farmers either individually or through co-operative societies. They will compose of the following:

1) Registering farmers who will be under contract scheme;

2) Identifying independent farmers to fall under project area;

3) Training farmers on modern pig production techniques;

4) Extending on-farm supervision and training visits;

5) Supplying contract farmers with principal feed, feeder pigs, raising equipment on credit scheme and pertinent drugs; and

6) Co-ordinating all project activities in relation to pig farming technology.

(7) Feed mill plant

The production capacity of a feed plant is determined so as to produce enough feed for the planned production of pigs. It is therefore envisaged that the output from the plant should be 3,000 tons per year (about 10 tons per day) in order to supply sufficient quantities for the pig industry complex.

It is also recommended that this type of feed mill should be installed within the pig breeding center. Such type of small scale feed mill plant is shown in Figures 2.4, 2.5 and 2.6.

(8) Slaughterhouse

With the constraints outlined before still prevailing, no significant development of rural butchering can be seen. Therefore the plant for slaughter should also be provided within this complex, processing and marketing with the capacity of at least 200 pigs per week. In the subsequent years, the capacity will increase, and the project in Phases 2 and 3 will see more slaughter plants to be established. One of the examples of small scale but modernized

slaughterhouse is shown in Figure 2.7. The inter-relationships of this component with other components are illustrated in Figure 2.8.

Two alternative styles of dressing hogs should be tried at the packing plant: viz. scalding with skin and skin-off. Advantages and disadvantages of the alternatives should be carefully examined with the view to establishing standard procedure that can be applied to carcass evaluation in pork trade throughout the country.

(9) Future expansion

The pig industry complex project is envisaged that at maturity, it will have a capacity of 10,000 heads of breeding sow level. It will be developed in stages over 20 years with 500 sow level annual stockings. Projections of production are shown in Tables 2.4 and 2.5. The first pilot project breeding center will serve as a nucleous breeding farm for subsequent establishments in the Region as well as for demonstration purposes.

2.4 Conditions for Project Implementation

(1) Location

As a pilot stage development of the pig industry complex project, it is recommended that Kisii district should be selected for project location for several reasons. First, the climatic conditions are suitable with the temperature ranging in 14-23 ^{o}C throughout a year and the rainfall over 2,500 mm well distributed over a year. Second, water can be relatively easily obtained from rivers and streams nearby. Third, the population density is so high that intensive stock raising with small land area is particularly sought. Fourth, the income level is relatively high so that the demand for pork is expected to be higher. Fifth, the communication to this area is comparatively good from both Kisumu and outer regions, which would make it easier to procure production inputs, to distribute products and to obtain market information.

To increase the local consumption of pork to an average of 1 kg per person per year, some 25,000 heads per year of market hogs would be required by the year 2005 in this district alone.

(2) Costs

The investment costs required in the initial year to establish the complex have been roughly estimated at K£ 1,115,000. The cost estimates include farm machinery, plant and transport equipment. The detail of initial costs is shown in Table 2.6. Estimated production costs of baby pigs and of fattening hogs are shown in Tables 2.7, 2.8, and 2.9.

(3) Viability

The viability of the project has been assessed on the basis that the pork carcass will be sold to a baconer. As shown in Table 9, the total production cost is estimated to be Kshs.586