

Research Institute (IRRI) in Philippines, Mwea and Ahero schemes have played nucleus roles in rice breeding in Kenya. These schemes are also the main supplier of paddy seed of high quality to all over the country.

In the Region, about 30,000 ha of paddy fields will be developed under Kano Plain Irrigation Project and the other rice projects. It is estimated that 1,500 tons of seed will be required in every crop season. This project is expected to be the main source of paddy seed to the Kano Plain Irrigation Project.

It is proposed that Paddy Seed Multiplication Project will be executed by LBDA. By contract farmers with 300 ha selected in the irrigation area, paddy seed will be produced under the management of LBDA. For controlling purity of varieties in seed bulking, the technical assistance by these NIB schemes will be required.

(5) Tractor Hire Service Project

To realize timely seeding, land preparation has to be performed before rainy season starts. Due to labour shortage and unfavourable hard soils, however, delay in land preparation is observed as serious constraints in some districts. To overcome the problem, availability of agricultural implements as well as access to tractor hire service will have to be much improved particularly for smallholders in the Region.

It is required to install additional tractor hire services centers in several districts in Nyanza and Western Provinces. The following districts would be given the priority for phase 1 development.

- Siaya
- South Nyanza
- Kisumu
- Bungoma

In the medium to long term development strategy, the farm machinery hire service centers should be considered in connection with the Kano Plain irrigation project. It is proposed to install a tractor service center for each 500 ha block within the Kano Plain irrigation area. Since daily output of puddling per tractor is about 1.5 ha, it is estimated that one tractor can cover 75 ha during two months of land preparation period. Therefore, each center will serve 500 ha of irrigated rice fields by operating eight tractors of 65-85 Hp and workshop facilities.

(6) Grain Silo Construction Project

Out of 4,078,000 tons of the total maize production in 2005, 1,555,000 tons will be stored in on-farm storage and consumed by individual farmers in the Region. It is estimated that the total marketable amount will attain 2,523,000 tons, of which only 452,000 tons or 18% will be stored in the NCPB storage.

The storage-production balance study by district shows that the serious shortage will occur in Kericho, Nandi, Trans Nzoia and Uasin Gishu. To absorb the surplus of maize, the

further storage should be constructed in some locations of those districts. Taking account of expansion of maize fields proposed in the Master Plan, the following location will be given the priority for project siting.

- | | |
|-------------------------|-------------|
| - Kitale | Trans Nzoia |
| - Turbo | Uasin Gishu |
| - Londiani or Kipkelion | Kericho |

For determination of capacity and exact location of silo, a further study will be required.

(7) Rice Mill Complex Project

In connection with the Kano Plain irrigation project, the installation of rice mill complex should be an effective long-term measure. In view of quality control of milled rice and work efficiency, the proposed mill complex should be of sophisticated type possibly for centralized operation by LBDA. This project will produce not only milled rice but also bran for edible oil industry and broken rice for chick feed.

The total milling capacity may be 75,000 tons per year, and other specifications may be as follows:

- | | |
|----------------------------|---|
| 1) Total paddy production; | 5 tons/ha x 15,000 ha =
75,000 tons |
| 2) Annual working days; | 340 days |
| 3) Daily milling amount; | 220 tons/days |
| 4) Daily working hours; | 16 hrs by 2 shifts |
| 5) Daily milling capacity; | 5 tons/hr mill x 4 nos.
including 1 standby mill |

(8) Horticultural Crops Expansion Project

Through the sector study on Manufacturing, passion fruit is identified as one of the promising exportable crops. To encourage the agro-industry in the Region, processing and canning plant of passion fruit is proposed to be established in the phase 1 development period. By expansion and rehabilitation, production of passion fruits will be promoted.

In the mid to long term development, introduction and intensification of other horticultural crops, e.g. citrus fruits, French beans, tomatoes, etc. are also considered.

(9) Oil Crops Expansion Project

There are several edible oil crops cultivated in the Region, e.g. groundnuts, cotton seed, sunflower and sesame. In addition, by-products such as rice bran will also be a source of edible oil production.

In order to promote the expansion of these crops, firstly marketing system should be strengthened. At present, EAI is the primary purchaser and processor of sunflower, cotton

seed and sesame. However, most of groundnuts are not traded by oil processor but consumed in rural area. Secondly, farm inputs especially seeds should have to be timely supplied to the farmers.

Reference

1. Agricultural Census of Large Farms 1975, 1977, 1978, 1979, 1980.
2. CBS Economic Survey 1980, 1981, 1982, 1983, 1984, 1985.
3. CBS..Statistical Abstract 1983, 1984, 1985.
4. CBS Kenya Population Census 1979.
5. Development Estimates for the year 1986/87
6. Development plan for the period 1978 to 1982
7. Development plan for the period 1984 to 1988.
8. EcoSystems Ltd, Integrated Land Use Survey November - December 1983.
9. Farm Management Guideline, 1984, Nakuru District.
10. IBRD, 18th Annual Report, Central Bank of Kenya, 1984 Agricultural Research and Technology Flows, March 23 1983.
11. ILACO, Agricultural compendium, 1981
12. ILACO Ahero Irrigation Research Station-Kenya, Research Results 1973-1975, Vol.1 Main Report, 1975.
13. ISNAR, Kenya's National Agricultural Research System, ISNAR, 1981
14. Kenya Seed Company Ltd., Brochure.
15. Kilmer, Gary D. et al. A Strategy for the Development of Four Districts in Western Kenya May, 1982, Development Alternatives, Inc.
16. KREDP Kisii Agro-forestry/Energy Centre.
17. LBDA, Cotton Development in Western Kenya, Proceeding of the First Regional Workshop, Kisumu, April, 1984.
18. MOALD Farm Management Handbook of Kenya Vol.I, Labour Requirement Availability and Costs of Mechanization, 1980
19. MOALD Farm Management Handbook of Kenya Vol. II/A west Kenya, 1982.
20. MOALD Farm Management Handbook of Kenya Vol II/B Central Kenya, 1982.
21. MOALD Facts and Figures about Kenya's Agriculture, 1983.
22. MOALD A Workshop on Small-scale Irrigation in Kenya
23. MOERD The Integrated Rural Survey 1976-79, November 1981, CBS.
24. Natural Resources and Development of Lake Victoria Basin of Kenya, 1979
25. NIBKenya-Netherlands Joint Review and planning Mission Report on NIB-Research Project, 1986.
26. Nippon Koei Co. Ltd. Definite Development plan, Engineering Service for the Grain Silo Construction Project, Sept. 1984.
27. Zero Grazing, Farm Demonstration Extension Package, A Guideline for Extension Workers, 1984
28. Nyanza Province Provincial office of MOALD Annual Reports, 1976 - 1984.
29. PIU in Western Province Master Development Plan.
30. Rift Valley Province office of MOALD Annual Reports, 1976 - 1984.
31. Sessional Paper No.4 of 1981 on National Food Policy
32. Western Province office of MOALD Annual Reports, 1976 - 1984.
33. Nyanza Agricultural Research Station, Annual Report 1977

Table 1.1 Land and Population of LBDA Region

District		Population in 1985 (1000)	Population Density (pers./km ²)	Total Land (1000ha)	Agricultural Land	
					(1000ha)	(% in Total)
Nyanza	Kisii	1,206	548	220	144	65
	Kisumu	656	314	209	89	43
	Siaya	651	258	252	93	37
	South Nyanza	1,120	196	572	190	33
	Total	3,633	290	1,253	516	41
Western	Bungoma	658	214	307	151	49
	Busia	391	240	163	63	39
	Kakamega	1,306	371	352	183	52
	Total	2,355	286	822	397	48
Rift Valley	Kericho	699	143	489	187	38
	Nandi	434	158	275	104	38
	Narok	78	7	1,115	40	4
	Trans Nzoia	366	158	232	106	46
	Uasin Gishu	393	110	358	151	42
	Nakuru					
	Elgeyo Marakwet	159	70	227	48	21
	West Pokot					
Total	2,129	79	2,696	636	24	
LBDA Region		8,117	170	4,771	1,549	32
Kenya		20,240	36	56,914	2,761	5

Source: Ecosystems Ltd., ILUS

Table 1.2 Regional Share of Agricultural Production

Agro-product	National Production (1,000 tons)	LBDA	
		Production (1,000 tons)	Region's Share (%)
Maize	2,084	1,504	72
Sorghum & Millet	265	54	20
Beans	244	77	32
Wheat	204	156	76
Rice (dry paddy)	40	8	20
Sweet potatoes	304	195	64
Cassava	583	495	85
Sugarcane	3,542	3,488	98
Seed cotton	25	15	60
Coffee	90	5	6
Tea (green leaf)	190	125	66
Vegetable & Fruits	809	73	9
Milk	1,600	508	32
Meat	190	72	38

Sources: FAO Production Year Books 1979-1985 (National Production except milk and meat)
 SP 1 (National production of milk and meat)
 Annual Report, Provincial Offices of MOALD Nyanza, Western and Rift Valley Province
 1976-1984 (Production in LBDA region)

Table 1.3 Present Land Use

Category	Total Area (1,000 ha)	% in Total Area	% in Each Category
1. Agricultural Land	1,549	32	100
1.1 Cultivated land	1,229		79
1) Staple Crops	750		48
2) Cash Crops	327		21
3) Vegetable & Fruits	13		1
4) Others	139		9
1.2 Field Borders	19		1
1.3 Fallow Land	136		9
1.4 Managed Pasture	165		11
2. Natural Vegetation	2,950	62	100
2.1 Forest	537		18
2.2 Woodland	178		6
2.3 Bush	632		21
2.4 Grassland	1,482		50
2.5 Marshland	79		3
2.6 Other Vegetation	42		1
3. Infrastructure	234	5	100
3.1 Transport Network	82		35
3.2 Homestead Land	94		40
3.3 Hedges	58		25
4. Miscellaneous	38	1	100
4.1 Open Water	18		47
4.2 Barren Areas	14		37
4.3 Not identified	6		16
Total	4,771	100	

Source: Same as Table 1.1

Table 1.4 Land Holding Size in the Region

Holding Size (ha)	Proportional Extent of Households (%)			
	Nyanza	Western	Rift Valley	National Total
0.0	15.8	8.7	36.8	21.6
0.01-0.4	34.6	28.0	18.1	25.2
0.5-0.9	23.5	26.3	11.1	20.1
1.0-1.9	14.6	21.8	9.4	15.8
2.0-2.9	5.9	7.3	7.6	7.3
3.0-3.9	2.1	2.7	2.7	3.2
4.0-4.9	0.6	0.9	3.5	1.6
5.0-7.9	1.1	3.3	5.9	2.8
8.0<	1.8	1.0	4.9	2.4
	100.0	100.0	100.0	100.0
Mean Holding Size (ha)	0.9	1.1	1.5	1.2

Source : CBS, Integrated Rural Survey

Table 1.5 Cropping Intensity of Food Crops

District	(Unit; 1,000 ha)								
	Maize			Sorghum			Beans		
	Long R.*	Short R.**	Total	Long R.	Short R.	Total	Long R.	Short R.	Total
NYANZA									
Kisii	43	15	58	5	1	6	12	4	16
Kisumu	15	2	17	4	1	5	2	0	2
Siaya	27	0	27	16	0	16	11	0	11
South Nyanza	45	9	54	19	4	23	13	2	15
Sub-total	130	26	156	44	6	50	38	6	44
WESTERN									
Bungoma	51	10	61	1	0	1	14	3	17
Busia	7	0	7	3	0	3	4	0	4
Kakamega	44	16	60	10	3	13	23	9	32
Sub-total	102	26	128	14	3	17	41	12	53
RIFT VALLEY									
Kericho	42	15	57	0	0	0	3	1	4
Nandi	40	4	44	0	0	0	1	0	1
Narok	10	5	15	0	0	0	1	0	1
Trans Nzoia	54	3	57	0	0	0	3	0	3
Uasin Gishu	57	1	58	0	0	0	4	0	4
Others	20	2	22	0	0	0	0	0	0
Sub-total	223	30	253	0	0	0	12	1	13
Total	455	82	537	58	9	67	91	19	110
Crop. Intens.		118%			116%			121%	

Notes: * Long rainy season crop
** Short rainy season cropSources: ILUS
MOALD, Farm Management Handbook of Kenya.

Table 1.6 Present Production of Food Crops

District	(Unit; 1000 tons)						
	Maize	Sorghum & Millet	Beans	Wheat	Rice (dry paddy)	Root Crops	Other* Crops
Nyanza							
Kisii	136	5	11	0	0	38	90
Kisumu	34	4	1	0	3	38	9
Siaya	47	13	8	0	0	105	9
S. Nyanza	126	19	11	0	2	210	36
Total	343	41	31	0	5	391	144
Western							
Bungoma	228	1	12	0	0	53	45
Busia	16	2	3	0	3	158	9
Kakamega	197	10	21	0	0	83	63
Total	441	13	36	0	3	294	117
Rift Valley							
Kericho	173	0	3	3	0	0	9
Nandi	116	0	1	2	0	0	9
Narok	34	0	1	0	0	0	0
Trans Nzoia	179	0	2	20	0	0	0
Uasin Gishu	158	0	3	121	0	0	0
Others	60	0	0	10	0	0	0
Total	720	0	10	156	0	0	18
Total	1,504	54	77	156	8	685	279
Unit Yield (ton/ha)	2.8	0.8	0.7	1.7	2.5	7.5	9

Note: * mainly banana
Sources: ILUS
Provincial Offices of MOALD, Annual Reports

Table 1.7 Present Planted Area, Production and Unit Yield of Maize

District	Planted Area (1,000 ha)			Production 1,000 tons	Unit Yield ton/ha
	Long Rain Maize	Short Rain Maize	Total		
Nyanza					
Kisii	43	15	58	136	2.3
Kisumu	15	2	17	34	2.0
Siaya	27	0	27	47	1.7
South Nyanza	45	9	54	126	2.3
Total	130	26	156	343	2.2
Western					
Bungoma	51	10	61	228	3.7
Busia	7	0	7	16	2.3
Kakamega	44	16	60	197	3.3
Total	102	26	128	441	3.4
Rift Valley					
Kericho	42	15	57	173	3.0
Nandi	40	4	44	116	2.6
Narok	10	5	15	34	2.3
Trans Nzoia	54	3	57	179	3.1
Uasin Gishu	57	1	58	158	2.7
Others	20	2	22	60	2.7
Total	223	30	253	720	2.8
Total	455	82	537	1,504	2.8
Cropping Intensity			118%		

Sources: Same as Table 1.6

Table 1.8 Present Production of Cash Crops

District	(Unit; 1,000 tons)						
	Arabica Coffee	Tea (green leaf)	Sugar Cane	Cotton	Sun-flower Crops	Ground-nut	Fruits & Vegetable
Nyanza							
Kisii	2	29	64	0	0.0	0.4	10
Kisumu	0	0	1,440	2	0.0	0.7	6
Siaya	0	0	96	3	0.0	0.5	0
S. Nyanza	0	0	320	7	0.0	0.8	6
Total	2	29	1,920	12	0.0	2.4	22
Western							
Bungoma	2	0	320	2	0.5	0.1	6
Busia	0	0	32	1	5.0	1.7	0
Kakamega	0	5	1,056	0	0.0	0.0	11
Total	2	5	1,408	3	5.5	1.8	17
Rift Valley							
Kericho	1	68	64	0	0.0	0.0	10
Nandi	0	23	96	0	0.3	0.0	6
Narok	0	0	0	0	0.0	0.0	0
Trans Nzola	0	0	0	0	4.8	0.0	6
Uasin Gishu	0	0	0	0	0.8	0.0	6
Others	0	0	0	0	0.0	0.0	6
Total	1	91	160	0	5.9	0.0	34
Total	5	125	3,488	15	11.4	4.2	73
Unit Yield (ton/ha)	0.4	0.0	2.6	32.0	0.3	0.9	5.6

Source: Same as Table 1.6

Table 1.9 Present NCPB Purchasing Amount of Maize in the Region

Description	Unit	Nyanza	Western	Rift Valley	Total
1. Maize production	1000 ton	379	518	607	1,504
2. Population	1000	3,633	2,355	2,129	8,117
3. No. of household	1000	648	428	426	1,502
4. No. of maize growing household	1000	581	398	274	1,253
5. Average annual consumption per maize growing household	kg	460	690	720	590
6. Total annual consumption by maize growing household (4x5)	1000 ton	267	275	197	739
7. Marketable amount of maize (1-6)	1000 ton	112	243	410	765
8. Annual purchased amount of maize	1000 ton	45	103	292	440
	% in 7.	40%	42%	71%	58%

Source: Nippon Koei Co., Ltd., Definite Development Plan, Engineering Services for the Grain Silo Construction Project.

Table 1.10 Demand Projection of Foodstuffs

Agro-product	Per Capita Demand (kg/year)	Region	(Unit; 1,000 tons)
			Whole Kenya
2005 projected population (1,000)		16,700	41,700
Maize	133.0	2,221	5,550
Wheat	29.2	488	1,218
Sorghum & Millet	21.6	361	901
Beans	12.0	200	500
Rice (milled)	2.7	45	113
Potatoes	27.4	458	1,143
Sugar	24.7	412	1,030
Horticultural crops	57.6	962	2,402
Milk	101.2	1,690	4,220
Meat	15.5	259	646

Source: Sessional Paper No. 4 of 1981 on National Food Policy

Table 1.11 National Expansion Programme of Coffee, Tea and Horticultural Crops

Agro-product	Planted Area (1,000 ha)		Production (1,000 ton)		
	1984	2000	1984	2000	Growth Rate p.a.
Arabica Coffee					
Replanting	150	150	115	215	4.0%
New Planting	-	75	0	104	
Total	150	225	115	319	6.6%
Robusta Coffee	-	50	0	35	-
Tea					
Peplanting	83	83	117	187	3.0%
New Planting	-	41	0	75	
Total	83	124	117	262	5.2%
Horticultural Crops	-	-	809	2,180	6.0%

Source: SPI

Table 1.12 Yield and Projection of Maize(1/4)

District/ Agro-ecological Zone	Target Yield (ton/ha)		Planted Area (1,000ha)		Anticipated Production (1,000 tons)	District Average Yield (ton/ha)
	Long Rain	Short Rain	Long Rain	Short Rain		
KISII						
LH1	5.5		14	0	77	
LH2	5.5		3	0	17	
* UM1	6.0	4.8	25	25	270	
* LM1	6.0		4	0	24	
Total			46	25	388	5.5
KISUMU						
UM1	4.0	3.2	1	1	7	
LM1	4.0	3.2	1	1	7	
LM2	4.0		3	0	12	
* LM3 (irrig.)	6.0		15	0	90	
* LM4 (irrig.)	6.0		10	0	60	
Total			30	2	176	5.5
SIAYA						
* LM1	4.0		17	0	68	
* LM2	3.1		19	0	59	
LM3	2.2		8	0	18	
LM4	2.2		2	0	4	
Total			46	0	149	3.2
SOUTH NYANZA						
* UM1	6.0		6	0	36	
* UM2	6.0		6	0	36	
UM3	6.0		10	0	60	
* LM1	4.0	3.2	15	15	108	
* LM2	3.1	2.5	24	24	134	
LM3	2.2		18	0	40	
LM4	2.2		8	0	18	
LM5	2.2		5	0	11	
Total			92	39	442	3.4
Total			214	66	1,155	4.1
Cropping intensity				131%		

Note: * planted area to be expanded under Scenario 3
Sources: Same as Table 1.6

Table 1.12 Yield and Projection of Maize (2/4)

District/ Agro-ecological Zone	Target Yield (ton/ha)		Planted Area (1,000ha)		Anticipated Production (1,000 tons)	District Average Yield (ton/ha)
	Long Rain	Short Rain	Long Rain	Short Rain		
BUNGOMA						
UH0	7.0		3	0	21	
LH1	7.0		6	0	42	
LH2	7.0		3	0	21	
UM1	6.5	5.2	5	5	59	
UM2	4.5	3.6	6	6	49	
UM3	4.0		13	0	52	
* UM4	4.0		18	0	72	
LM1	4.5	3.6	1	1	8	
LM2	4.5	3.6	4	4	32	
* LM3	2.4		4	0	10	
Total			63	16	365	4.6
BUSIA						
LM1	4.0	3.2	3	3	22	
* LM2	3.2	2.6	7	7	40	
* LM3	2.3	1.8	7	7	29	
Total			17	17	91	2.7
KAKAMEGA						
LH0,UM0	7.0		1	0	7	
UM1	4.5	3.6	13	13	105	
UM3	4.0		1	0	4	
* UM4	4.0		29	0	116	
LM1	4.0	3.2	9	9	65	
LM2	4.0		5	5	20	
Total			58	27	317	3.7
Total			138	60	773	3.9
Cropping intensity				143%		

Note: * planted area to be expanded under Scenario 3

Table 1.12 Yield and Projection of Maize (3/4)

District/ Agro-ecological Zone	Target Yield (ton/ha)		Planted Area (1,000ha)		Anticipated Production (1,000 tons)	District Average Yield (ton/ha)
	Long Rain	Short Rain	Long Rain	Short Rain		
KERICHO						
UH0	6.0		1	0	6	
UH1	6.0		3	0	18	
UH2	6.0		4	0	24	
LH1	6.0		11	0	66	
* LH2	6.0		12	0	72	
* LH3	6.0	4.8	15	15	162	
UM1	5.5	4.4	5	5	50	
* UM2	6.0	4.8	8	8	86	
UM3	5.0	4.0	2	2	18	
LM1,3	5.0	4.0	1	1	9	
Total			62	31	511	5.5
NANDI						
UH1	6.0		1	0	6	
* LH1	6.0		12	0	72	
* LH2	6.0		13	0	78	
LH3	6.0		12	0	72	
UM1	5.0	4.0	7	7	63	
UM2	5.0	4.0	1	1	9	
UM3	5.0	4.0	1	1	9	
UM4	5.0	4.0	6	6	54	
LM1	5.0		1	0	5	
LM2	5.0		1	0	5	
Total			55	15	373	5.3
NAROK						
* LH1	6.0		13	0	78	
LH2	6.0	4.8	1	0	6	
UM1	5.0	4.0	2	2	18	
UM3	5.0	4.0	2	2	18	
UM4	5.0	4.0	2	2	18	
Total			20	6	138	5.3

Note: * planted area to be expanded under Scenario 3

Table 1.12 Yield and Projection of Maize (4/4)

District/ Agro-ecological Zone	Target Yield (ton/ha)		Planted Area (1,000ha)		Anticipated Production (1,000 tons)	District Average Yield (ton/ha)
	Long Rain	Short Rain	Long Rain	Short Rain		
TRANS NZOIA						
UH0	8.0		2	0	16	
UH2	8.0		3	0	24	
LH2	8.0		8	0	64	
LH3	5.0		12	0	60	
LH4	4.0		2	0	8	
UM2	7.0		2	0	14	
UM3	5.5		1	0	6	
* UM4	5.0	4.0	34	34	306	
Total			64	34	498	5.1
UASIN GISHU						
UH1	6.0		4	0	24	
* UH2	6.0		13	0	78	
* UH3	6.0		8	0	48	
LH1	6.0		1	0	6	
LH2	6.0		3	0	18	
LH3	4.5		29	0	131	
LH4	3.5		3	0	11	
UM3	4.5		1	0	5	
UM4	3.5	2.8	11	11	69	
Total			73	11	389	4.6
OTHERS						
* UH1	5.5		15	0	83	
* UH2	5.5		11	0	61	
LH2	6.0		7	0	42	
LH4	4.5	3.6	1	1	8	
UM3	4.5	3.6	1	1	8	
Total			35	2	201	5.4
Total			309	99	2109.4	5.2
Cropping intensity				132%		
LBDA Region Total			661	225	4,038	4.6
Cropping intensity				134%		

Note: * planted area to be expanded under Scenario 3
Source: Same as Table 1.6

Table 1.13 Planted Area Production and Unit Yield of Maize in 2005

District	Planted Area (1000ha)			Production 1000 tons	Unit Yield ton/ha
	Long Rain Maize	Short Rain Maize	Total		
Nyanza					
Kisii	46	25	71	388	5.5
Kisumu	30	2	32	176	5.5
Siaya	46	0	46	149	3.2
South Nyanza	92	39	131	442	3.4
Total	214	66	280	1,155	4.1
Western					
Bungoma	63	16	79	365	4.6
Busia	17	17	34	91	2.7
Kakamega	58	27	85	317	3.7
Total	138	60	198	773	3.9
Rift Valley					
Kericho	62	31	93	511	5.5
Nandi	55	15	70	373	5.3
Narok	20	6	26	138	5.3
Trans Nzoia	64	34	98	498	5.1
Uasin Gishu	73	11	84	389	4.6
Others	35	2	37	201	5.4
Total	309	99	408	2,110	5.2
Total	661	225	886	4,038	4.6*
Cropping Intensity			134%		

Note: * The target yield of 4.6 tons/ha is obtained by dividing the anticipated production of 4,038 thousand tons with the planted area of 886 thousand ha (see Table 1.12)

Sources: Provincial Offices of MOALD, Annual Reports
MOALD, Farm Management Handbook of Kenya

Table 1.14 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	0.1*	0.7	-	-	0.7	-
Tea (black te)	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

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

Table 1.15 Agricultural Land Development Plan by Scenario

(Unit; 1000ha)

Category	Existing Land in 1985	Agricultural land to be expanded		
		Scenario 1	Scenario 2	Scenario 3
1. Food Crops				
Maize	455	235	0	206
Sorghum & Millet	58	25	0	25
Beans	91	49	0	43
Wheat	92	98	0	44
Rice	3	27	15	27
Root crops	92	24	0	0
Others	31	0	0	0
Sub-total	822	458	15	345
2. Cash Crops				
Arabica coffee	13	0	27	17
Robusta coffee	0	0	40	32
Tea	48	0	32	24
Cotton	49	0	10	7
Sugarcane	109	0	25	25
Others	16	0	30	0
Sub-total	235	0	164	105
3. Fruits & Vegetables				
Fruits	10	0	40	10
Vegetables	3	0	17	5
Sub-total	13	0	57	15
Total of 1,2 and 3	1,070	458	236	465
Fodder	139	107	107	100
Managed Pasture	165	0	0	0
Fallow	136	0	0	0
Field Border	19	0	0	0
Food crops in Mara river basin	20	0	0	0
Total	1,549	565	343	565

Source: JICA Study Team

Table 1.16 Target Agricultural Production by Scenario

Category	Present Condition		Scenario 1		Scenario 2		Scenario 3	
	Crop Area 1000ha	Produc. 1000tons	Crop Area 1000ha	Produc. 1000tons	Crop Area 1000ha	Produc. 1000tons	Crop Area 1000ha	Produc. 1000tons
Food Crops								
Maize	537	1,504	925	4,255	537	2,470	886	4,078
Sorghum & Millet	67	54	111	189	67	114	111	189
Beans	110	77	188	226	110	132	180	215
Wheat	92	156	190	646	92	313	136	517
Paddy	3	8	30	150	18	90	30	150
Root crops	92	690	116	1,879	92	1,490	92	1,490
Others	31	279	31	279	31	279	31	279
Sub-total	932		1,591		947		1,466	
Cash Crops								
Arabica coffee	13	5	13	22	40	68	30	51
Robusta coffee	0	0	0	0	40	28	32	22
Tea	48	125	48	192	80	320	72	288
Cotton	49	15	49	39	59	47	56	45
Sugarcane	109	3,488	109	7,521	134	9,246	134	9,246
Others	21	25	21	38	46	83	21	38
Sub-total	240		240		399		345	
Fruits & Vegetables								
Fruits	10	56	10	201	50	1,005	20	402
Vegetables	3	17	3	60	20	402	8	161
Sub-total	13	73	13	261	70	1,407	28	563
Livestock Production								
Milk		508		1,690		1,690		1,661
Meat		72		108		108		106

Source: JICA Study Team

Table 1.17 Present and Anticipated Value Added of Major Products

Product	Unit	Present Value Added in Kenya	LBDA Region	
			Present Value Added	Target Value Added
Food Crops				
Maize	K£/ha	190	292*	393*
Sorghum & Millet	K£/ha	60	37	78
Beans	K£/ha	190	106*	264*
Wheat, Barley & Oat	K£/ha	237	69*	292*
Paddy	K£/ha	644	342	684
Root Crop	K£/ha	254	244	524
Cash Crops				
Arabica Coffee	K£/ha	1,846	663*	2,620*
Robusta Coffee	K£/ha	-	-	1,017*
Tea	K£/ha	1,643	847*	1,741*
Cotton	K£/ha	40	60	160
Sugarcane	K£/ha	397	397	870
Sunflower	K£/ha	179	182	560
Fruits & Vegetables				
Fruit	K£/ha	367	367	1,139
Vegetable	K£/ha	1,133	1,133	4,084
Livestock Products				
Milk	K£/ton	87	87	87
Meat	K£/ton	50	50	50
Fishery				
Fish Meat	K£/ton	114	114	114

Note: * estimated on the basis of the regional data
Source: SP1 (Present value-added)

Table 1.18 Total Value Added of Agriculture, Livestock, Fishery and Forestry Sectors

Product	Present (1985)		Scenario 1		Scenario 2		Scenario 3	
	Area 10 ³ ha	Value addd K£ 10 ⁶	Area 10 ³ ha	Value addd K£ 10 ⁶	Area 10 ³ ha	Value addd K£ 10 ⁶	Area 10 ³ ha	Value addd K£ 10 ⁶
Food Crops								
Maize	537	157	945	371	537	211	886	348
Sorghum & Millet	67	2	101	8	67	5	111	9
Beans	110	12	192	51	110	29	180	48
Wheat	92	6	184	54	92	27	136	40
Rice	3	1	30	21	18	12	30	21
Root Crops	92	22	115	60	92	48	92	48
Others	31	1	31	1	31	1	31	1
Sub-total	932	201	1,598	566	947	333	1,466	515
Cash Crops								
Arabica Coffee	13	9	13	34	40	105	30	79
Robusta Coffee	0	0	0	0	40	46	32	33
Tea	48	41	48	84	80	139	72	125
Cotton	49	3	49	8	59	9	56	9
Sugarcane	109	43	109	95	134	117	134	117
Others	16	3	16	9	46	26	21	12
Sub-total	235	99	235	230	399	442	345	375
Fruits & Vegetables								
Fruits total	10	4	10	11	50	57	20	23
Vegetable total	3	3	3	12	20	82	8	33
Sub-total	13	7	13	23	70	139	28	56
Total Crop Product.	1,180	307	1,846	819	1,416	914	1,839	946
Livestock Production								
Milk (10 ³ ton)	508	44	1,690	147	1,690	147	1,661	145
Meat (10³ton)								
Beef	56	2	73	4	73	4	71	4
Pork	1	0	9	1	9	1	9	1
Chicken	6	0	17	9	17	9	17	9
Sheep & Goats	9	1	9	1	9	1	9	1
Sub-total	72	3	108	15	108	15	106	15
Total Livestock Prod		47		162		162	106	160
Fishery		10		37		37		37
Activity in Mara Basin								
Crop Production	20	1	20	1	20	1	20	1
Livestock Product.		8		12		12		12
Sub-total		9		13		13		13
Off-farm Income		222		562		608		553
Forestry		15		40		43		43
Total		610		1,633		1,777		1,752
Annual Growth Rate (%)				5.0%		5.5%		5.4%

Source: JICA Study Team

Table 1.19 Unit Labour Requirement for Maize and Sorghum

		(Unit; man-days/ha)	
District		Highland	Midland
Nyanza	Kisii	245	-
	Kisumu	-	163
	Siaya	-	161
	South Nyanza	-	170
Western	Bungoma	187	182
	Busia	-	205
	Kakamega	-	177
Rift Valley	Kericho	187	-
	Nandi	187	-
	Narok	187	-
	Trans Nzoia	65*	-
	Uasin Gishu	65*	-
	Others	65*	-

Note: * commercial maize production with machinery
 Source: MOALD, Farm Management Handbook of Kenya

Table 1.20 Monthly Labour Requirement for Maize

Crop District Agro-ecological Zone	Maize Kisii LH1-2	(Unit; man-days/month/ha)												
		Farming Practice	Total	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Ploughing														
	with draft animal	40	15	15										10
	by manpower only	120	45	45										30
	Seeding	8	4	4										
	1st Fertilizing	8	4	4										
	1st Weeding	31	10	10	11									
	2nd Fertilizing	2			1	1								
	Dusting & Spraying	4			2	2								
	2nd Weeding	25			8	10	7							
	Harvesting	27						3	12	12				
	Shelling	10							5	5				
	Packing & Transporting	10							5	5				
Total with draft animal		165	33	33	22	13	7	3	22	22	0	0	0	10
Total without draft animal		245	63	63	22	13	7	3	22	22	0	0	0	30

Source: JICA Study Team estimate based on MOALD, Farm Management Handbook of Kenya

Table 1.21 Monthly Labour Requirement for Other Products

Agro-products	Unit	Total	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Food Crops														
Beans	md/ha	213	17	12	43	42	42	57	0	0	0	0	0	0
Rice	md/ha	235	5	5	45	40	40	40	45	5	5	5	0	0
Wheat	md/ha	60	5	5	5	5	5	5	5	5	5	5	5	5
Sweet potatoes	md/ha	252	6	21	21	56	6	16	21	21	56	6	6	16
Cassava	md/ha	158	20	21	26	41	13	27	0	0	0	0	0	10
Cash Crops														
Coffee	md/ha	391	21	5	30	5	30	1	13	60	43	108	74	1
Tea	md/ha	260	17	14	16	23	23	24	24	25	24	24	24	22
Cotton	md/ha	105	7	2	13	29	31	10	4	1	8	0	0	0
Sugarcane*	md/ha	120												
Horticultural crops														
	md/ha	156	27	40	28	25	0	0	0	24	3	3	3	3
Livestock Raising														
Grazing	md/3 cows	60	5	5	5	5	5	5	5	5	5	5	5	5
Zero grazing	md/3 cows	162	7	7	7	33	7	7	33	7	7	7	7	33

Note: * Sugarcane is a crop which takes at least 18 months to mature and it has a cycle of 5 years (i.e. one plant crop and two ratoons). The labour demand is not the same during growth period but fluctuates depending on the operations being carried out at a particular stage of growth. This means that the labour requirement will spread over a period of twenty months for plant crop and 18 months for crops. Practically the crop will require 120 md/ha and labour requirement on a monthly basis will be as follows:-

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec
Year 1	3	2	26	8	18	0	18	0	2	0	0	0
Year 2	0	0	1	0	0	1	0	0	0	0	35	6

After 6 months, the crop is expected to form Canopy and the problem of weeds will be negligible. Any labour required will only concentrate on border cleaning and pests and disease control.

Source: Same as Table 1.20

Table 1.22 Monthly Farm Labour Requirement by District (1985)

(Unit; million man-days/month)

District	Avail. Labour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Nyanza													
Kisii	6.0	3.5	4.1	3.4	2.7	2.0	2.2	2.6	3.1	2.0	1.8	1.4	1.8
Kisumu	2.3	2.6	2.3	2.2	2.2	1.9	1.7	1.8	1.8	1.6	1.4	1.7	2.0
Siaya	3.4	2.4	2.7	2.7	2.9	2.1	1.7	1.0	1.2	0.7	0.4	0.8	1.2
South Nyanza	5.8	4.9	5.7	5.5	5.2	3.3	2.9	2.6	3.1	2.5	1.7	2.2	2.2
Total	17.5	13.4	14.8	13.8	13.0	9.3	8.5	8.0	9.2	6.8	5.3	6.1	7.2
Western													
Bungoma	3.1	4.3	2.8	3.3	3.2	2.2	1.9	1.5	2.2	1.1	1.2	1.1	0.8
Busia	1.9	1.2	1.3	1.3	1.6	0.8	1.1	0.4	0.5	0.4	0.2	0.3	0.6
Kakamega	6.5	5.2	3.9	5.3	4.6	3.2	3.4	3.2	3.5	3.1	2.9	2.5	2.2
Total	11.5	10.7	8.0	9.9	9.4	6.2	6.4	5.1	6.2	4.6	4.3	3.9	3.6
Rift Valley													
Kericho	3.4	1.8	3.5	4.1	4.4	2.4	1.9	3.4	2.0	1.9	2.1	2.9	4.8
Nandi	2.3	1.1	2.5	3.0	2.7	1.6	1.0	1.9	0.9	0.9	1.2	1.5	2.5
Narok	0.4	0.6	1.0	1.1	0.7	0.7	0.6	0.5	0.6	0.6	0.6	0.8	0.9
Trans Nzoia	1.7	0.7	1.0	1.1	1.7	1.0	0.8	1.2	0.7	0.7	0.4	0.4	1.0
Uasin Gishu	1.7	1.2	1.5	1.6	2.7	1.6	1.3	2.3	1.1	1.1	0.8	0.8	2.0
Others	0.8	0.3	0.4	0.4	0.6	0.4	0.3	0.5	0.3	0.3	0.2	0.2	0.4
Total	10.3	5.7	9.9	11.3	12.8	7.7	5.9	9.8	5.6	5.5	5.3	6.6	11.6
Total Req.	39.3	29.8	32.7	35.0	35.2	23.2	20.8	22.9	21.0	16.9	14.9	16.6	22.4

Source: JICA Study Team

Table 1.23 Monthly Far Labour Requirement by District (2005)

(Unit: million man-days/month)

District	Avail. Labour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Nyanza													
Kisii	13.9	4.2	4.8	4.1	3.1	2.5	2.7	3.4	4.3	2.9	2.7	2.1	2.4
Kisumu	3.4	4.2	3.4	3.4	3.1	3.0	2.3	2.5	2.8	2.0	1.9	2.7	3.0
Siaya	7.0	3.9	4.1	4.3	4.2	3.5	2.6	1.9	2.8	1.8	2.6	2.4	1.8
South Nyanza	12.1	8.2	9.4	8.4	7.4	4.7	4.0	4.9	5.8	3.8	3.4	3.8	3.4
Total	36.4	20.5	21.7	20.2	17.8	13.7	11.6	12.7	15.7	10.5	10.6	11.0	10.6
Western													
Bungoma	6.7	5.5	3.6	4.5	4.2	3.0	2.6	2.3	3.5	2.8	3.2	2.7	1.7
Busia	4.6	3.0	3.5	3.2	3.0	1.8	2.0	1.2	1.8	1.1	1.7	1.5	1.0
Kakamega	12.9	7.3	5.2	7.3	6.1	4.7	4.5	4.5	5.8	4.9	5.4	4.5	2.9
Total	24.2	15.8	12.3	15.0	13.3	9.5	9.1	8.0	11.1	8.8	10.3	8.7	5.6
Rift Valley													
Kericho	7.4	2.8	5.3	6.2	6.2	3.5	2.6	4.5	3.1	2.8	3.2	4.6	7.1
Nandi	5.4	1.8	3.8	4.5	3.8	2.3	1.4	2.6	1.8	1.6	2.1	2.7	4.0
Narok	1.0	0.7	1.6	1.8	1.1	1.0	0.7	0.6	0.7	0.7	0.7	1.1	1.3
Trans Nzoia	4.2	1.1	1.5	1.6	2.7	1.5	1.2	2.1	1.3	1.5	1.2	0.9	1.9
Uasin Gishu	3.9	1.5	1.9	2.0	3.5	1.9	1.6	2.9	1.5	1.5	1.2	1.1	2.6
Others	1.6	0.5	0.7	0.7	1.4	0.6	0.5	1.2	0.5	0.5	0.3	0.3	1.0
Total	23.5	8.4	14.8	16.8	18.7	10.8	8.0	13.9	8.9	8.6	8.7	10.7	17.9
Total	84.1	44.7	48.8	52.0	49.8	34.0	28.7	34.6	35.7	27.9	29.6	30.4	34.1

Source: JICA Study Team

Table 1.24 Fertilizer Requirement at Production Level III

Crops	Target Unit Yield ton/ha	Planted Area 1,000tons	Unit Requirement			Fertilizer Required		
			N	kg/ha P ₂ O ₅	K ₂ O	Urea*	1000ton TSP**	K ₂ O***
Food crops								
Maize	4.6	886	70	70	0	149	146	0
Sorghum & Millet	1.7	111	20	15	0	5	4	0
Beans	1.2	180	10	20	0	4	8	0
Wheat	3.8	136	80	40	0	26	13	0
Rice	5.0	30	70	30	0	5	2	0
Sweet Potatoes	16.2	50	50	70	0	6	8	0
Sub-total		1,393				195	181	0
Cash crops								
Arabica Coffee	1.8	30	40	30	80	3	2	5
Robusta Coffee	0.7	32	30	20	30	2	1	2
Tea	4.0	72	40	30	50	7	5	7
Sugarcane	69.0	134	75	60	0	24	19	0
Cotton	0.8	56	60	30	0	8	4	0
Others	1.5	21	20	20	0	1	1	0
Sub-total		345				45	32	14
Fruits & Vegetable	20.1	30	60	70	150	4	5	9
Livestock feed								
Fodder Crops	5.5 LU/ha	239	150	100	0	85	56	0
Managed Pasture	3.6 LU/ha	165	50	30	0	20	12	0
Sub-total		404				105	67	0
Total		2,172				350	285	23

Notes: * Total Nitrogen - 42%
 ** Triple Superphosphate, Available water soluble P₂O₅ - 43%.
 *** Potassium Chloride, Available K₂O - 49 %.

Source: JICA Study Team

Table 1.25 Present NCPB Maize Storage Capacity in the Region

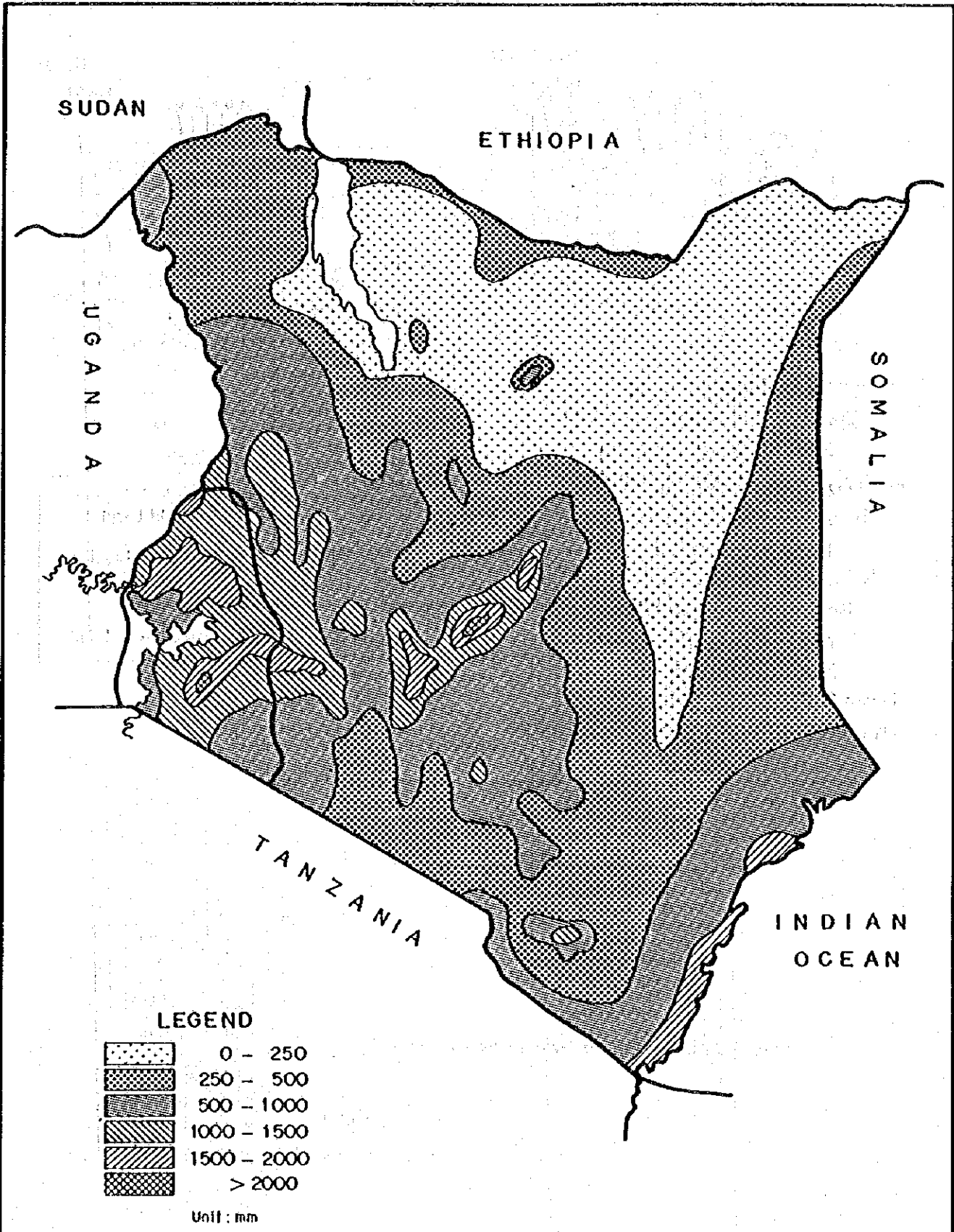
Description	Unit	Nyanza	Western	Rift Valley	Total
1. Maize production	1000 tons	379	518	607	1,504
2. Population	1000	3,633	2,355	2,129	8,117
3. No. of household	1000	648	428	426	1,502
4. No. of maize growing household	1000	581	398	274	1,253
5. Average annual disposal per maize growing household	kg	460	690	720	590
6. Total annual disposal by maize growing household	4x5 1000 tons	267	275	197	739
7. Marketable amount of maize	1-6 1000 tons	112	243	410	765
8. Present NCPB storage capacity	1000 tons	63	148	181	392
9. Maximum operational capacity of NCPB depot	8x0.9 1000 tons	57	133	163	353
10. Additional potential amount required to be stored by NCPB	7-9 1000 tons	55	110	247	412

Source: Same as Table 1.9

Table 1.26 Future Maize Storage Requirement

Description	Unit	Nyanza	Western	Rift Valley	Total
1. Maize production	1000 tons	1,155	773	2,150	4,078
2. Population	1000	6,819	4,414	4,314	15,547
3. No. of household	1000	1,364	883	863	3,109
4. No. of maize growing household	1000	1,223	821	555	2,599
5. Average annual disposal per maize growing household	kg	470	700	730	598
6. Total annual disposal by maize growing household	4x5 1000 tons	575	575	405	1,555
7. Marketable amount of maize	1-6 1000 tons	580	198	1,745	2,523
8. Present NCPB storage capacity	1000 tons	93	178	231	502
9. Maximum operational capacity of NCPB depot	8x0.9 1000 tons	84	160	208	452
10. Additional potential amount required to be stored by NCPB	7-9 1000 tons	496	38	1,537	2,072

Source: JICA Study Team



LEGEND

	0 - 250
	250 - 500
	500 - 1000
	1000 - 1500
	1500 - 2000
	> 2000

Unit: mm

Figure 1.1 Rainfall Distribution in Kenya

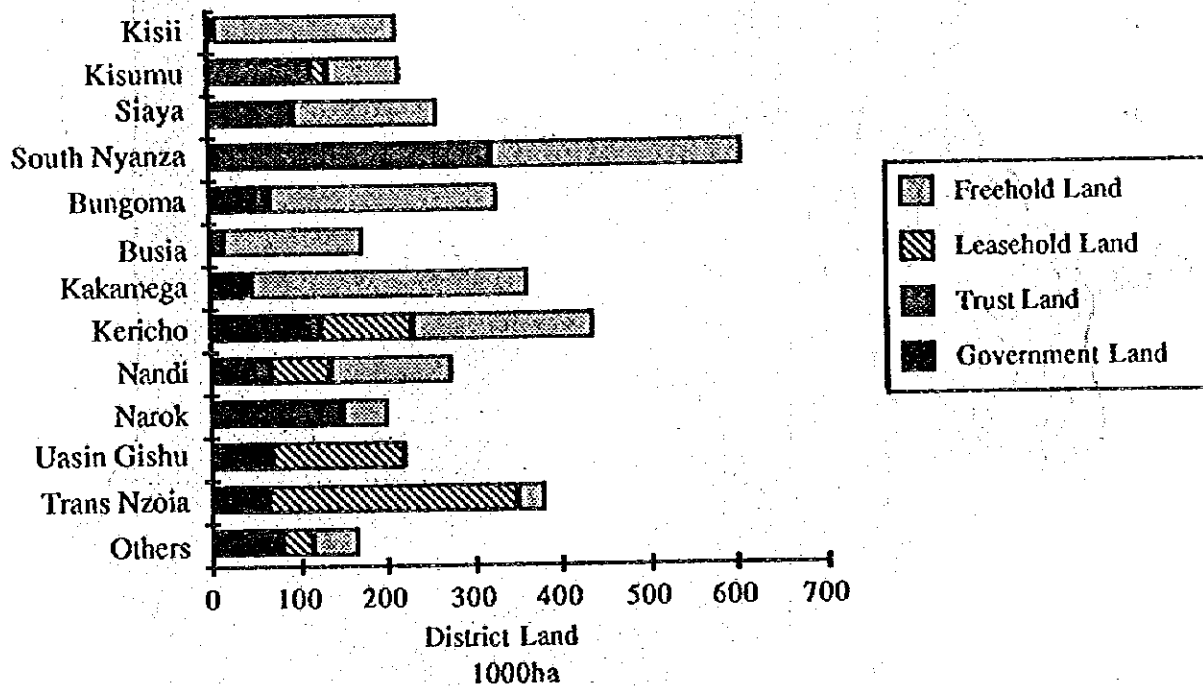
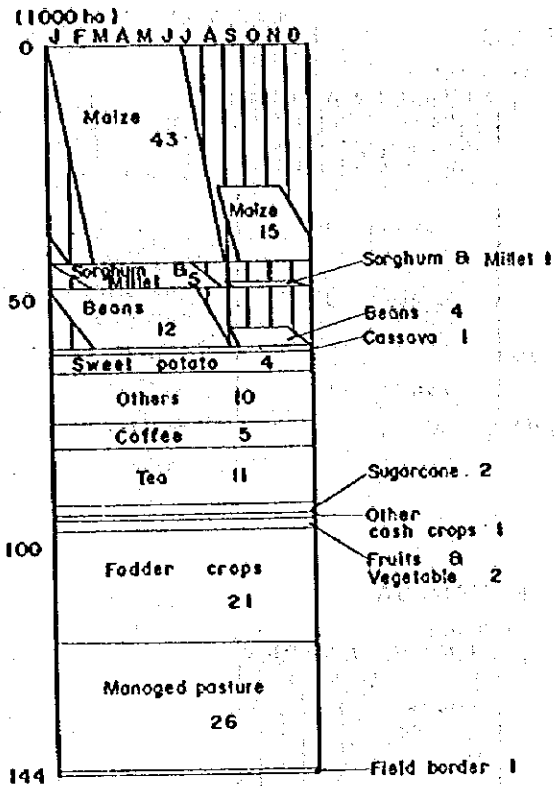
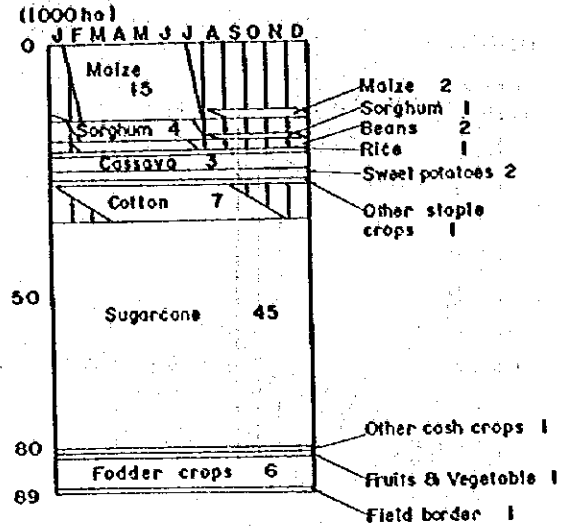


Figure 1.2 Land Tenure System by District

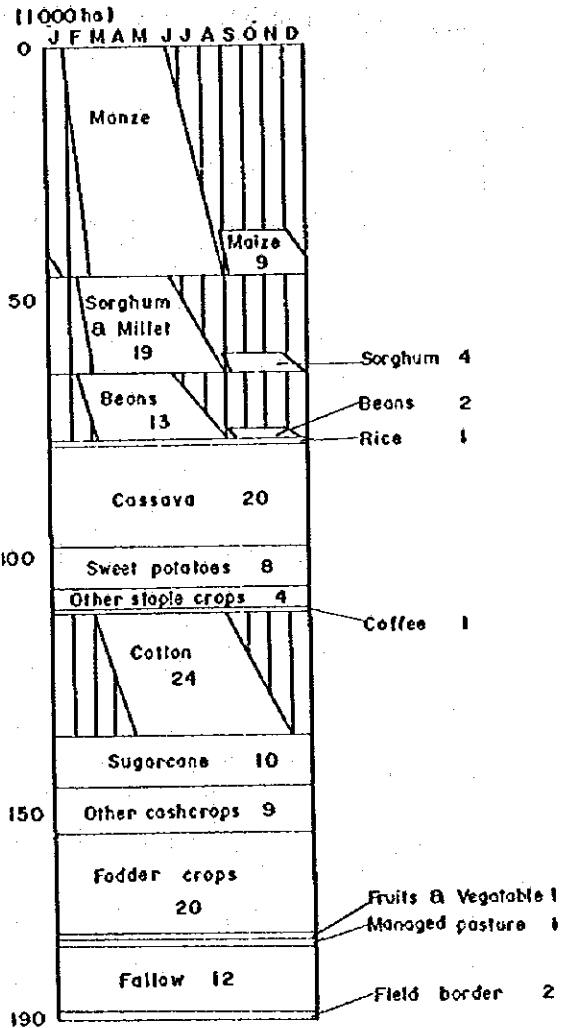
KISII



KISUMU



SOUTH NYANZA



SIAYA

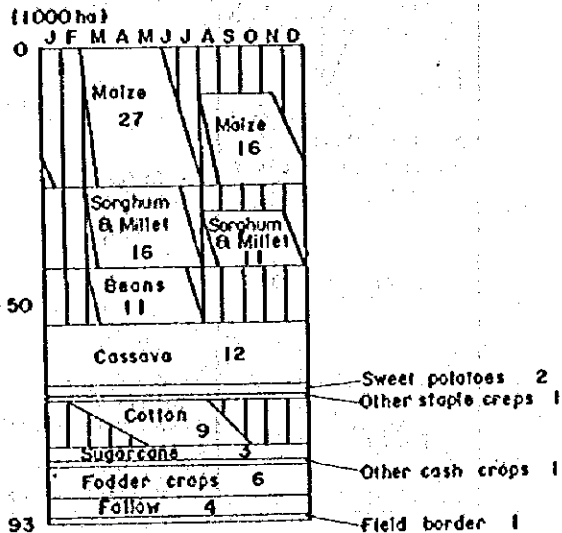
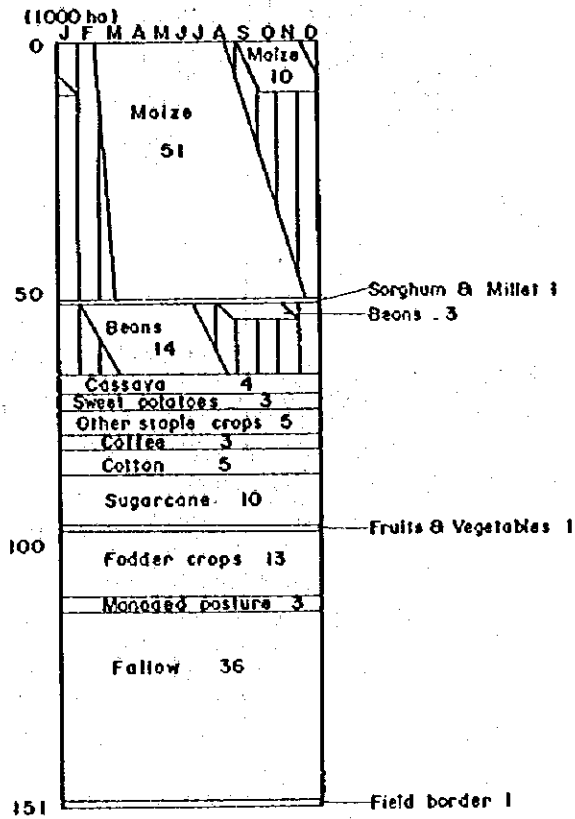
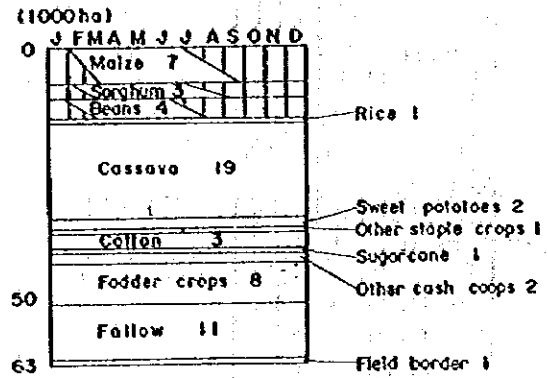


Figure 1.3 Present Cropping Patterns In Nyanza Province

BUNGOMA



BUSIA



KAKAMEGA

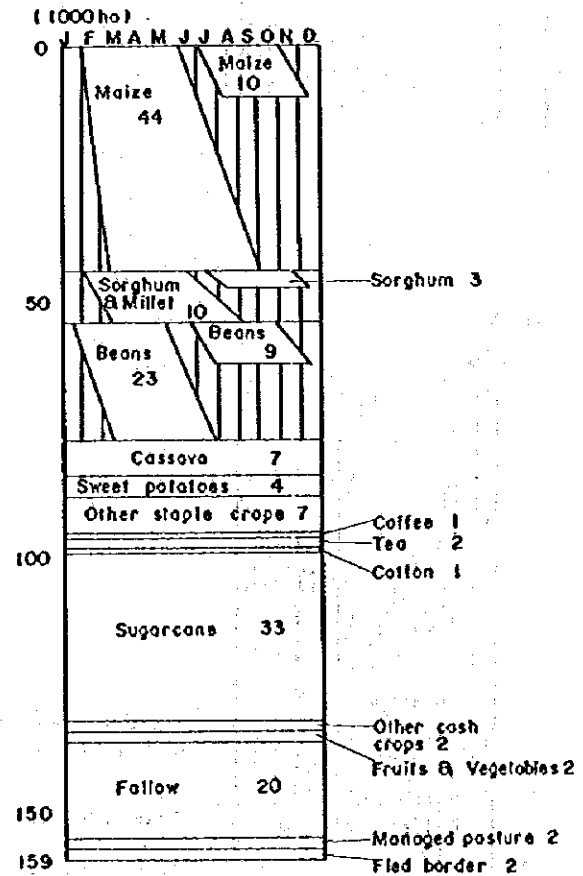
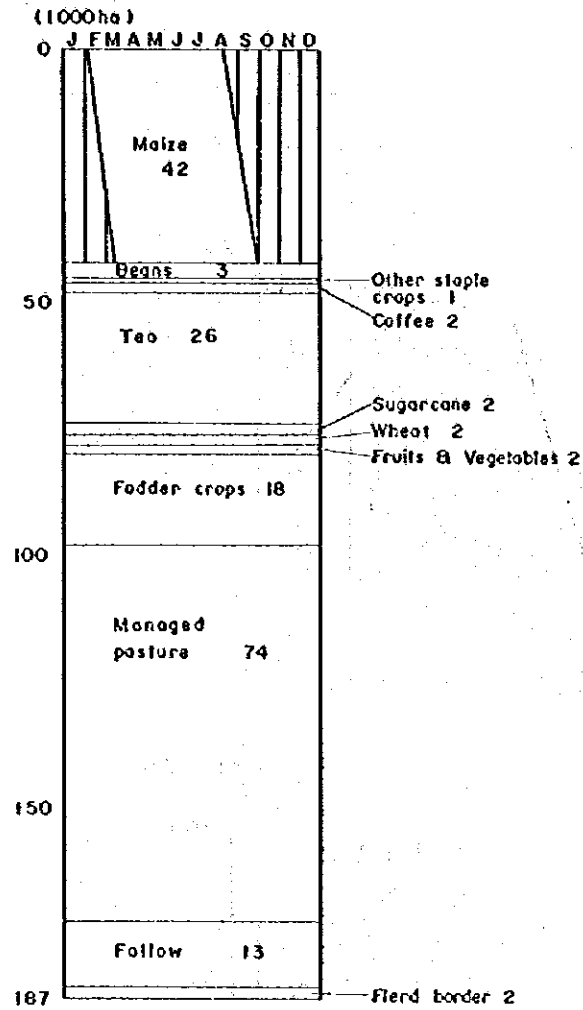
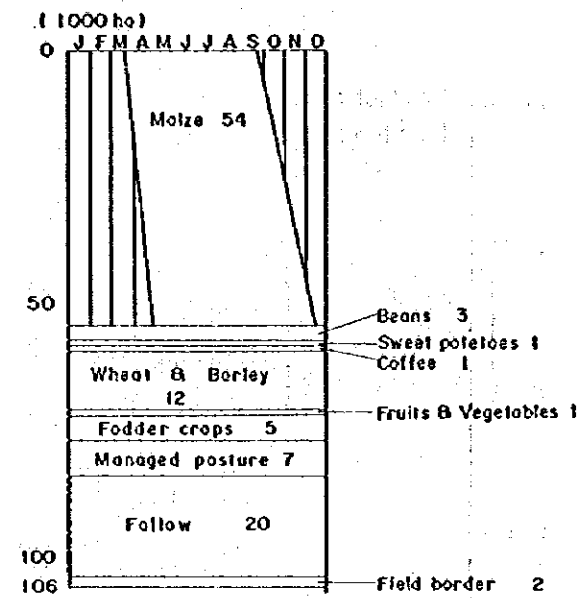


Figure 1.4 Present Cropping Patterns in Western Province

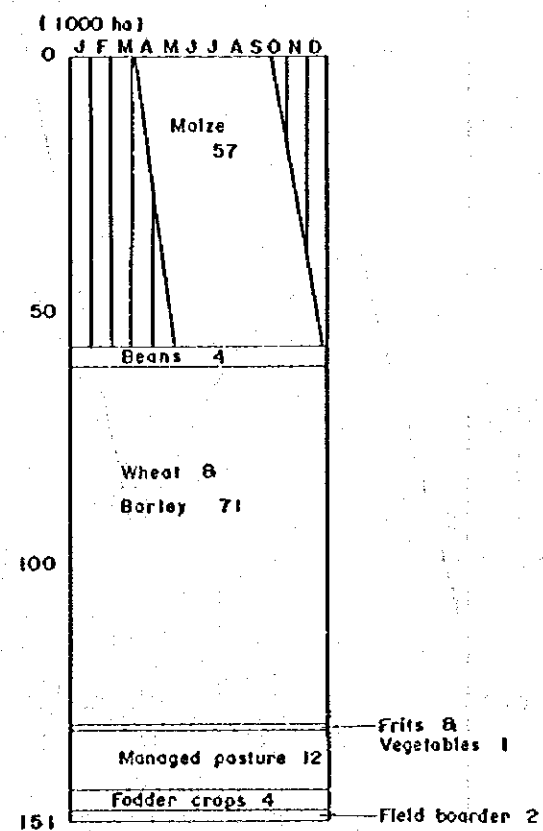
KERICHO



TRANS NZOIA



UASIN GISHU



NANDI

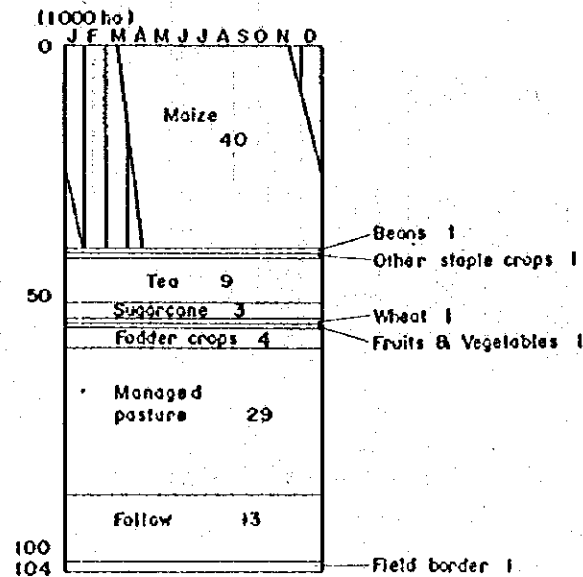


Figure 1.5 Present Cropping Patterns in Rift Valley Province

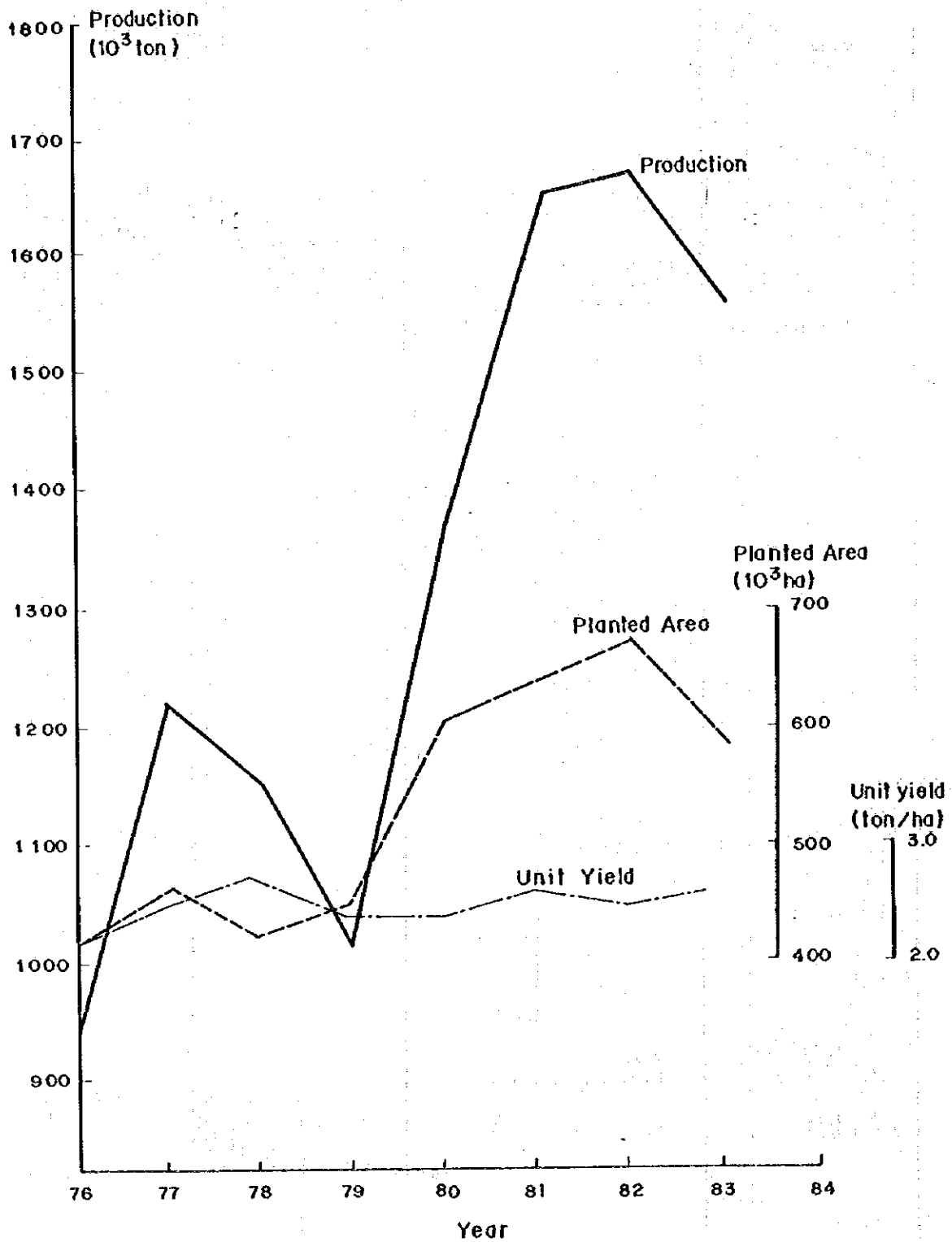


Figure 1.6 Planted Area, Production and Unit Yield of Maize

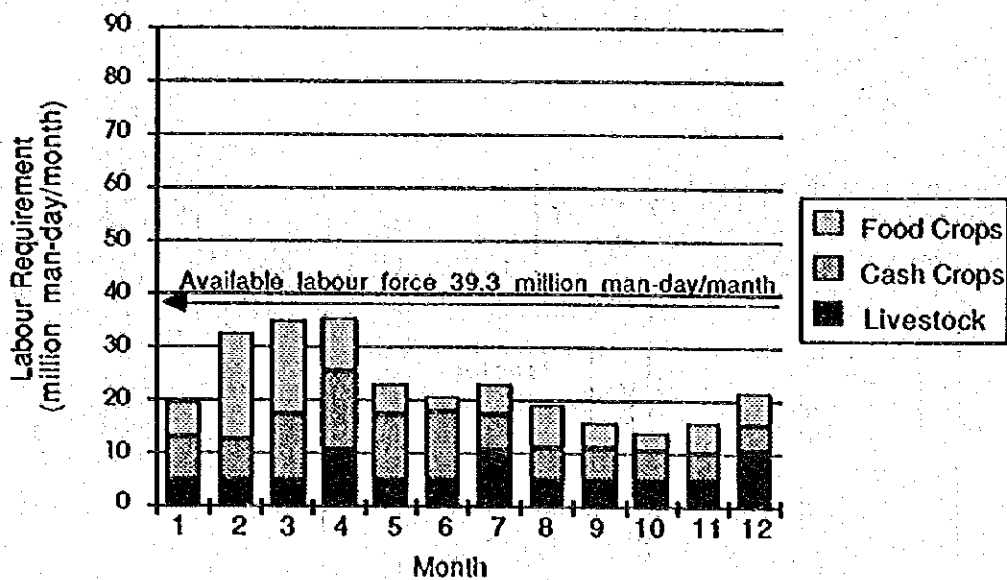


Figure 1.7 Monthly Labour Requirement of Agricultural Sector (1985)

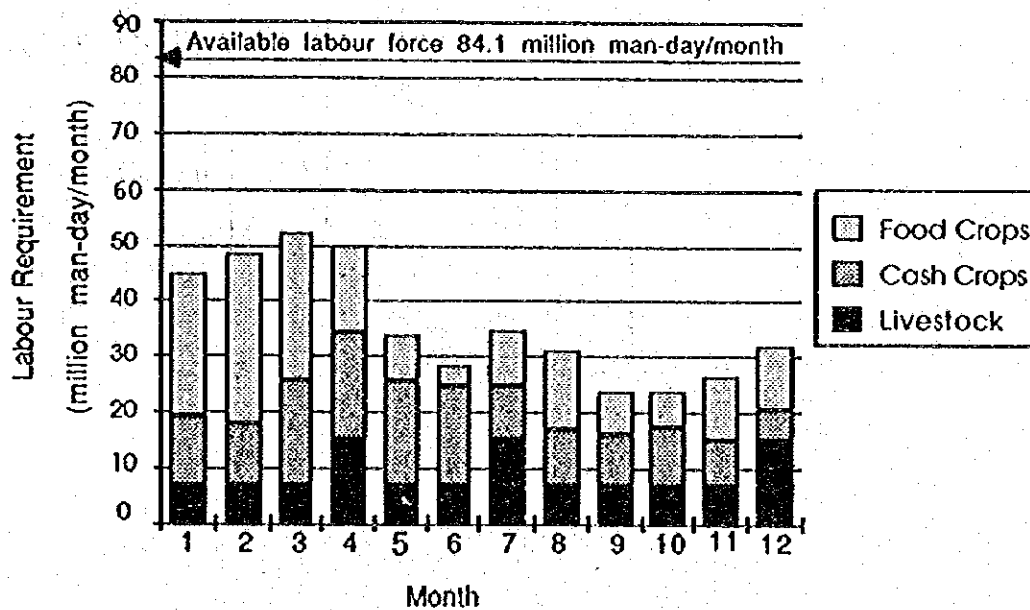


Figure 1.8 Monthly Labour Requirement of Agricultural Sector (2005)

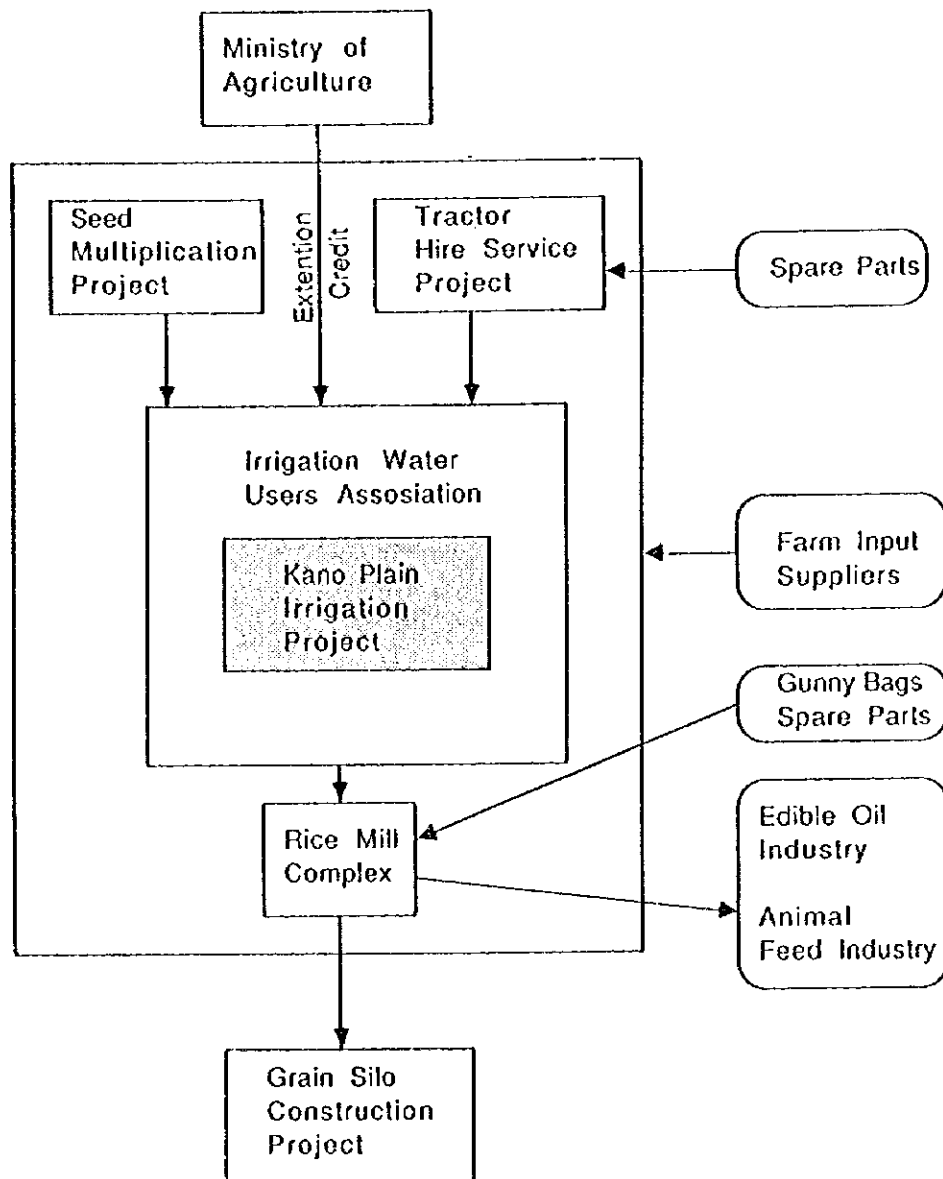


Figure 1.9 Kano Plain Irrigation Project and Its Related Projects

Chapter 2 LIVESTOCK

As a part of the Integrated Regional Development Master Plan study for the LBDA region, a sector study of the livestock sector has been conducted. The study has been based firstly on existing data and reports, but secondly field reconnaissances have been extensively carried out to examine existing conditions of livestock activities, pasture, vegetation and other natural conditions which affect livestock development. Surveys were made also of potential project sites.

All the study results are compiled into this chapter consisting of three sections. Section 2.1 describes the present conditions of livestock development, including various stock raising activities, supporting activities, marketing of livestock products and other aspects. Section 2.2 clarifies the strategy for livestock development in the Region. Finally in Section 2.3, the livestock development plan is presented, consisting of development targets, strategy, projects and other measures..

Chapter 2 LIVESTOCK

Contents

	Page
2.1 Present Situation-----	2-1
2.1.1 General-----	2-1
2.1.2 Livestock farming in the Region-----	2-1
(1) Population-----	2-1
(2) Farming system-----	2-2
2.1.3 Milk and meat production-----	2-4
(1) Unit rates-----	2-4
(2) Milk production-----	2-4
(3) Meat production-----	2-5
2.1.4 Marketing and pricing-----	2-5
(1) Milk-----	2-5
(2) Meat-----	2-6
2.1.5 Support system-----	2-6
(1) Livestock development projects and programmes-----	2-6
(2) Artificial insemination (AI)-----	2-7
(3) Disease control-----	2-7
(4) Commercial feed production-----	2-8
(5) Training and extension services-----	2-8
2.2 Strategy for Livestock Development-----	2-9
2.2.1 Development policy-----	2-9
(1) National Policy-----	2-9
(2) Regional policy-----	2-9
2.2.2 Constraints and prospects-----	2-10
(1) Constraints-----	2-10
(2) Prospects-----	2-11
2.2.3 Development strategy-----	2-11
2.3 Livestock Development Plan-----	2-12
2.3.1 Development frameworks-----	2-12
(1) Overall framework-----	2-12
(2) Development target-----	2-13
2.3.2 Forage production-----	2-15
(1) Basic concept-----	2-15
(2) Estimation of carrying capacity-----	2-15
(3) Feed availability-----	2-16
(4) Demand and supply balance of forage-----	2-16
(5) Future forage production and natural grazing-----	2-17
2.3.3 Recommended development framework-----	2-17
(1) Fodder crop expansion-----	2-17
(2) Anticipated production of milk and meat-----	2-18

2.3.4 Specific measures.....	2-18
(1) Measures for cattle.....	2-18
(2) Feeding programmes.....	2-20
(3) Measures for goats and sheep.....	2-20
(4) Measures for poultry.....	2-20
(5) Pig industry complex project.....	2-21
(6) Animal feed mill plant.....	2-22
(7) Extension and training facilities.....	2-22
References.....	2-23

Tables

Tables 2.1 Livestock Population in Kenya
Tables 2.2 Livestock Population and Total Livestock Unit in 1985 in the Region
Tables 2.3 Herd Composition and Live-Weight of Cattle
Tables 2.4 Productivity of Milk and Meat in the Region
Tables 2.5 Milk Production in 1985
Tables 2.6 Meat Production in 1985
Tables 2.7 Prices of Livestock Products in the Region
Tables 2.8 National Livestock Development Expenditure
Tables 2.9 Main Commercial Feed and Prices
Tables 2.10 Milk Production in 2005 under Scenarios 1 and 2
Tables 2.11 Meat Production in 2005 under Scenario 1 and 2
Tables 2.12 Common Species of Pasture Grasses
Tables 2.13 Stocking Rate of Natural Grassland and Managed Pasture
Tables 2.14 District Average Rate of Carrying Capacity and Forage Productivity
Tables 2.15 Total Availability of Feed Sources for Livestock in 1985
Tables 2.16 Total Availability of Feed Sources for Livestock under Scenarios 1 and 2
Tables 2.17 Livestock Population and Total Livestock Unit under Scenarios 1 and 2
Tables 2.18 Feed Availability and Grassland to be Reserved for Grazing
Tables 2.19 Total Availability of Feed Sources for Livestock under Scenario 3
Tables 2.20 Milk Production in 2005 under Scenario 3
Tables 2.21 Meat Production in 2005 under Scenario 3

Figures

Figure 2.1 Dairy Milk Distribution Channel in the Region
Figure 2.2 Livestock Products (Meat) Marketing Channel in the Region
Figure 2.3 Livestock Industry Supporting Stations and Milk Plants in the Region
Figure 2.4 Inter-relationships of Pig Industry Components

2.1 Present Situation

2.1.1 General

The livestock industry in Kenya has played an important role in the agricultural sector of the national economy. In 1985, it produced K£118.99 million of marketed livestock products, which account for 15.8% of the total marketed agro-products of K£ 752.66 million. The major products are milk, meat, eggs, hides, skins and wool, of which milk and meat are leading products fetching 90% of the total income from livestock products.

In Kenya, cattle is reared in various ecological zones ranging from low to high agricultural potential areas. In low potential area especially under semi-arid condition, traditional raising of indigenous cattle breeds are managed under pastoral and nomadic systems. In these areas, the livestock production is depressed due to lack of adequate water, insufficient availability of pasture due to often prolonged droughts, epidemic disease outbreaks and lack of breeding systems for better productivity.

Pastoral systems and large scale ranching are also practised with both indigenous and exotic beef breeds. Livestock Development Division of Ministry of Agriculture and Livestock Development (MOALD) made efforts of providing better water reticulation system through range management, organized herd health programmes through veterinary services and to lesser extent improvement of breed qualities through introduction of high quality exotic breeds. These efforts have been overtaken by the Ministry of Livestock Development (MOLD).

In medium and high potential areas, indigenous breeds, cross breeds and exotic breeds are reared with a more or less modern systematic techniques of varying degrees. The major activity undertaken by the farmers in these areas is dairy production. The Government as well as District Development Committees (DDC) backed by institutional support has endeavored to promote the systematic cattle raising and marketing system with encouraging success. Still, some sections in these areas have lagged behind due to various factors, such as insufficiency of better breeding stock, inadequate pasture and fodder development, absence of modern feeding and management techniques, ineffective disease control programmes, inefficient breeding and upgrading programmes and poor marketing systems for livestock products. In those less privileged areas, livestock products are either locally consumed or otherwise wasted.

2.1.2 Livestock farming in the Region

(1) Population

According to Annual Report 1984 of Livestock Development Division, it is recorded that there were 10.9 million heads of cattle in Kenya in 1983 and 9.7 million in 1984. The population records of different kinds of livestock are presented in Table 2.1.

On the basis of the annual reports prepared by the provincial offices of MOALD, District Development Plan 1984-1988 of Narok district and the study results of Eco-System (ILUS

1983), the population of livestock in 1985 in the Region was estimated by district as shown in Table 2.2. It is estimated that 3,044,000 heads of cattle are reared in the Region corresponding to 28% of the total cattle in Kenya. Rift Valley Province has the highest number of cattle compared with Nyanza and Western Provinces. The total livestock units (LU; 300 kg of live-weight) of cattle amounts to 1.89 million, of which 1.34 million or 67% are derived from local cattle.

(2) Farming systems

Cattle

In the Region, various types of cattle farming systems are practiced by small farmers, large farmers, the government organizations and private enterprises.

Relatively modern livestock farming with grade cattle is prevailing in Rift Valley Province. Rift Valley Province is composed of the highlands, in which white farmers settled and improved basic cattle rearing systems including livestock facilities. Supported by modern techniques of cattle farming thus obtained, Rift Valley Province is now the leading dairy zone and the techniques and breeds prevailing in Rift Valley are gradually being introduced into the other two provinces in the Region.

Recently, the intensive cattle raising techniques, namely zero-grazing, have been effectively introduced into some areas of the Region. Zero grazing is one of dairy cattle feedlot systems promoted originally by MOALD, Livestock Development Division and now by Ministry of Livestock Development (MOLD). Zero grazing systems require high labour and capital inputs but do have the advantage that more cattle can be kept per land unit because low yielding natural grazing areas are replaced by high yielding fodder crops. Hence, zero grazing is the ideal form of dairying for small holders who keep up to five high yielding dairy animals. It is becoming increasingly popular especially in mixed farming smallholder areas. The main features of zero grazing are as follows:

- Cattle are permanently confined in a cattle shed or boma.
- Cattle feed like Napier or Bana grasses are cut and carried to a cattle shed or boma (Cut and Carry System).
- Forage is chopped and offered to cattle in a feed trough.
- Cattle are watered inside a shed or boma so that water has to be piped in or collected and carried to the animals by the farmers.
- Cattle are milked in a dairy and calves are reared in calf pens which in most cases are inside the shed or boma.

Zero-grazing system has gained popularity particularly in areas with high population densities, e.g. Kisii and Kakamega. In the most districts in Nyanza and Western Provinces, however, this system, together with pasture and fodder development, disease control

programme, systematic breeding through artificial insemination (AI) and concentrate feed supplementation has been applied to a very limited extent.

The cattle breeds prevailing in the Region are characterized as follows.

- Local cattle are composed of East African Zebu and Boran. They produce very little milk, but they constitute the main source of livestock products. They are preferred mostly by small farmers because of resistance to adverse conditions such as droughts and disease.
- Grade cattle are Friesians, Jersey, Ayrshire and Guenseys. There are also exotic beef breeds in the Region such as Hereford breeds and Brown Swiss breed. Most of these exotic breeds have been introduced from Europe.
- There are dual purpose breeds, namely Sahiwal of Pakistan origin and Red Poll, which are reared for obtaining both milk and beef.

In Rift Valley, most of the pastures are well managed and intensively utilized. In addition, silage and hay are produced for feed preservation. In Nyanza and Western Provinces, managed pasture has been less developed, but fodder crops such as Napier grass, Bana grass and Kikuyu grass are produced mostly for grade cattle. However, local cattle which is majority of cattle reared in both provinces, and small stock are grazed in natural grassland.

Sheep and goats

Sheep and goats are also important source of meat for Kenyans. They are raised mainly in low and marginal potential areas. In high potential areas, farmers keep sheep and goats only for home consumption.

Poultry

There are no large scale hatchers in the Region. Large scale egg layers and broilers are found in the Rift Valley Province. Broilers farming is unpopular among small farmers in the Region. The local indigenous birds are still predominant due to their high disease resistance even to new castle disease.

The eggs produced in rural areas are normally consumed by farmers and very limited numbers reach local markets. Eggs from the exotic breeds are marketed in most urban centres of the Region. Poultry meat is well consumed in the Region and benefits local farmers. Every local farm family keeps a few chickens.

Pigs

Pig industry is least developed compared with the other livestock sectors in Kenya. In the Region, pig industry is still at the initial phase and they are mainly found in the farms under the management of farmers training centers, colleges and some schools for the purpose of training farmers and students. It is noted, however, that the demand for pork related products has recently increased in Kenya.

2.1.3 Milk and meat production

(1) Unit rates

Milk and meat produced in the Region are consumed mainly by local farmers or partly traded through private market channels. Official statistical data are limited only to marketed amount. In order to reveal the total production amount in the Region, the estimation was made according to the following procedures.

In order to estimate the average milk and meat yields of the prevailing cattle herds and the other basic information about live-weight of cattle and small stock, slaughter rate, carcass dressing percentage, etc., a farm interview was carried out by the livestock expert of JICA and his counterpart. The towns visited are Kitale, Eldoret, Bungoma, Kisii, Kakamega, Migori, Homa Bay, and Kisumu.

Herd composition was estimated with some modifications of the standard herd composition of the prevailing breeds. Live-weight is estimated based on the results of field reconnaissance and information obtained at public and private slaughterhouses. These results are presented in Table 2.3. For an average cattle herd, milking cows constitute about 25% of the total for grade cattle and 15% for local cattle. Their live-weight is 320 kg for grade cattle and 220 kg for local cattle on an average.

Taking account of the information obtained through the farm interview, milk and meat yields by breed were estimated as presented in Table 2.4. The meat yields of sheep and goat were also estimated based on the information obtained at Kisumu slaughterhouse. Referring to these unit rates, the regional production of milk and meat was computed.

(2) Milk production

The milk yield of cow varies widely by breed. One milking cow of local cattle produces only 100 to 250 litres of milk per year, while grade cattle produce 2,500 to 4,000 litres per year. From the cattle population of each breed, percentage of milking cow in cattle herd and average milk yields, the total regional milk production was estimated to be 508,000 tons/year consisting of 507,000 tons of cow milk and less than 1,000 tons of goat milk as presented in Table 2.5 and summarized below.

	Grade cattle	Local cattle	Goats
1. Population (1000)	647	2,397	440
2. Milking cow or goat in herd (%)	25	15	10
3. Average yield (kg/year)	2,800	150	30
4. Total production (1x2x3)	453	54	1

The regional milk production thus estimated corresponds to about 32% of the national total of 1.6 million tons in 1984. Since there are about 10 millions of cattle in Kenya and 3 millions in the Region, this regional share estimated at 32% seems to be realistic.

(3) Meat production

Based on slaughter liveweight and carcass dressing percentage, the average meat yield per slaughtering was estimated. Taking account of cattle population and slaughter rate, the regional meat production was estimated to be 72,000 tons consisting of 56,000 tons of beef and 16,000 tons of small stock and poultry meat. The results are presented in Table 2.6 and summarized below.

Items	Grade cattle	Local cattle	Sheep and Goats	Poultry	Pig
1. Population (1000)	647	2,397	870	4,301	15
2. Slaughter weight (kg/head)	400	250	40	1.5	80
3. Carcass. dress. rate(%)	50	50	40	60	70
4. Slaughter rate(%)	25	8	65	150	90
5. Total(1000 tons)	32	24	9	6	1

2.1.4 Marketing and pricing

(1) Milk

The marketing channels of milk in the Region are illustrated in Figure 2.1. Due to the lack of cooling and transport facilities, milk marketing in Nyanza Province and some parts of Western Province is poorly organized. Milk produced in Rift Valley Province is collected by co-operative societies and delivered to milk processing plants. Kenya Co-operative Creameries (KCC) is the main purchaser of milk and is allowed to sell processed milk in every urban center of Kenya. Out of the total milk of 1,600,000 tons produced in Kenya, 275,000 tons or 17% were traded by KCC in 1983. The prices of milk are surveyed at this time and presented in Table 2.7.

(2) Meat

Inter-regional marketing of meat in Kenya is handled by Kenya Meat Commission (KMC), which purchases cattle in rural areas and sells beef mainly in Nairobi and Mombasa. The commission produced 10,700 tons of carcass beef in 1983, which correspond to about 6% of the national meat production of 190,000 tons.

Meat trade in the Region is mostly through private channels as shown in Figure 2.1. Licensed traders and butchers purchase animals from farmers either at farm gate or at

livestock auction. The animals purchased are slaughtered in both public and private slaughterhouses in the Region.

The facilities for livestock holding ground once existed in the Region, and were used by the livestock marketing division for holding livestock on transit to the ranches for fattening and consequently for slaughter in KMC and other slaughter houses in Nairobi and Mombasa. The increased land value due to changes in land tenure, increased cultivation and other agricultural activities and increased demand for beef in the Region have resulted in a number of local beef cattle markets disseminated all over the Region.

Prices of live animals at the auction markets are always negotiated and thus tend to result in exploitation of small scale farmers. Prices of meat are controlled under the Government price policy. The prices of beef and other meat are listed in Table 2.7. The lack of quality control has made producers fail to pay attention to quality of the animals. Introduction of quality standard and controlling agency will benefit producers.

2.1.5 Support system

(1) Livestock development projects and programmes

MOALD has established strategies of implementing and monitoring development projects aimed at increased livestock production particularly for medium and high potential areas, with more emphasis on dairy production. The main national livestock projects and programmes are as follows.

- 1) National Dairy Cattle Improvement Programmes financed by the Netherlands
- 2) Rural Milk Collection and Cooling Programmes sponsored by Finland
- 3) Integrated Agricultural Development Programme (IADP) financed by World Bank
- 4) National Dairy Cattle Breeding Programmes controlled by the Government
- 5) Sheep and Goat Farming Projects sponsored by the Netherlands
- 6) Bee Keeping Project sponsored by Canada
- 7) Rabbit Production Programme sponsored by IADP and GAT

Table 2.8 presents the approved recurrent and development expenditures for Livestock Development Division for 1983 and 1984 fiscal years.

(2) Artificial insemination (AI)

Artificial insemination is a major means for improving livestock production. However, cases of insemination provided by Kenya National Artificial Insemination Service (KNAIS) have been decreasing in recent years. This is attributed mainly to the deterioration of

KNAIS's vehicle conditions due to breakdowns and lack of funds to repair and service such vehicles. The table below shows the cases of insemination by Province in the past few years.

Cases of Insemination

Province	1983	1984	1985
Rift Valley	65,161	54,037	61,848
Nyanza	7,315	13,507	10,028
Western	12,794	13,667	11,382

(3) Disease control

There are a variety of livestock diseases in Kenya. The prevailing diseases are tick borne diseases, internal parasitisms, epidemic disease such as foot and mouth disease (FMD), anthrax and black leg, which are the causes of low livestock production in the Region. MOALD has laid strategies of effective herd health programmes. Infectious pig diseases are rare in this country; parasitism is experienced but always put under control.

Some of the disease control measures practised in Kenya are annual vaccination against FMD, runderpast and contagious bovine pleuropneumonia vaccination and anthrax and black leg inoculations. Tick control programmes are taken seriously in Kenya. Other measures are quarantine and livestock movement restriction. Other minor diseases are dealt with through clinical identification and institution of curative treatment measures.

Existing facilities in the Region for disease control are summarized below.

Province	Dips	Spray races
Rift Valley	2,889	119
Nyanza	387	2
Western	304	

Lack of sufficient facilities in Nyanza and Western Provinces is quite evident. Besides most dips in these provinces are not operational due to a variety of reasons, the main ones being:

- 1) lack of frequent supply of Acaricides,
- 2) ineffective dip management standard and testing services, and
- 3) high costs of Acaricides.

(4) Commercial feed production

In Rift Valley Province, commercial feeds are supplied for all types of livestock animals. In Nyanza and Western Provinces, there is insufficient supply of these feeds. There is only one commercial feed plant in Kisumu town with very low output capacity.

There is acute shortage of these feeds in most rural towns particularly in Nyanza and Western Provinces. The availability of these feeds is quite limited for most small scale farmers and it is expensive to transport them from main towns.

The commercial feeds are normally used for concentrate supplementary feeding especially for milking cows. Market prices of commercial feed available in the Region are listed in Table 2.9.

(5) Training and extension services

The training and extension services are provided now by MOLD to the farmers. The services are extended up to location level, and their major activities include AI and technical advice to farmers on animal husbandry and on disease control. Due to lack of sufficient facilities and equipments, the objectives of these extension services have not been properly accomplished.

2.2 Strategy for Livestock Development

2.2.1 Development policy

(1) National policy

In view of long-term development objectives of the Nation and the renewed emphasis on more important ones placed by SP1 (Section 2.2 of Master Plan Report), the objectives of livestock development in Kenya may be summarized as follows:

- 1) To increase meat and milk production to contribute to self-sufficiency in food supply;
- 2) To alleviate poverty by creating income generating employment at all stages of development;
- 3) To improve nutritive status of people;
- 4) To contribute to foreign exchange earnings/savings; and
- 5) To provide raw materials for processing industries

The recent emphasis for livestock development may be revealed by the current five year development plan, which includes the following projects.

- i) Dairy development to be attained by timely availability of quality fodder and feed, breed improvement through AI and bull schemes, proper and efficient use of multiplication centers, improvement in milk collection, cooling and marketing;
- ii) Beef development through rehabilitation and improved management of ranches, better marketing, strengthening of supporting services such as credit, extension and fodder conservation;
- iii) Small stock development for poultry, pigs, sheep, goats and rabbits through improved extension, research, credit, consumption promotion and better availability of input supplies; and
- iv) Other projects, including the integration of camel into the national livestock development efforts, improvement of slaughtering facilities, creation of market information services and promotion of processing industries and by-product utilization.

(2) Regional policy

LBDA, as a statutory organization responsible for planning and co-ordinating development activities in the Lake Victoria catchment, is in a position to draw up the policy for livestock development in the Region. Its activities are viewed as complementary efforts to the Ministry of Livestock Development programmes, and meant also to liaise and collaborate with DDC's of all the districts in its jurisdiction.

Objectives for livestock development in the Region are naturally in line with the national policy outlined above, but emphasis is different due to conditions specific to the Region. At present, LBDA places more emphasis on dairy farming especially for helping small farmers, in view of present frustrating conditions in Nyanza and Western Provinces. Increased milk production will help first to alleviate malnutrition problems in rural areas and second to meet growing demand in urban areas.

Four dairy multiplication centers have already been established, one each in Kisumu, South Nyanza, Busia and Bungoma districts, and three more are under implementation at Chemasi in Nandi, Lugari in Kakamega and Kokwanyo in South Nyanza (see Figure 2.2).

2.2.2 Constraints and prospect

(1) Constraints

Constraints to the livestock development in the Region may be summarized as follows.

- 1) There is lack of sufficient improved breeds for breeding stock for areas like Nyanza and Western Provinces.

- 2) Overgrazing is observed especially in Nyanza and Western Provinces due to inadequate pasture management.
- 3) There is very low utilization of high energy feeds such as by-products of cereals, root crops and miscellaneous concentrates such as molasses, which are abundant in the Region. The commercial feeds are used mainly in large scale farms and poultry industry.
- 4) Ticks and other external parasites cause deadly diseases such as east coast fever, hubesiosis anaplasmosis and heart water which causes high losses in cattle, especially exotic breeds.
- 5) Intensive systems of raising livestock have not sufficiently picked up. Extensive rearing systems are practised which do not utilize available resources effectively for optimum production.
- 6) The management of livestock feeding varies widely due to divergent climatic conditions in the Region. There is great need to develop and popularize particular systems for different agro-ecological zones in the Region.
- 7) There is a great need to establish a quality control for livestock products. This will create an incentive for the farmers to raise quality livestock products.
- 8) Marketing and transporting systems of various livestock products is not well organized.

(2) Prospects

The following advantages are recognized for the future livestock development in the Region.

- i) High marketability of livestock products in the whole of Kenya as well as neighboring countries;
- ii) Good climate for grade cattle and other improved livestock breeds to be introduced;
- iii) High familiarity of farmers with livestock farming;
- iv) High yield potential in pasture production, if proper management is practiced; and
- v) High availability of raw materials for livestock feed such as molasses, grain brans, cotton seed and brewer's wastes.

2.2.3 Development strategy

Based on the analysis of present situation described in the previous section and in line with the National policy and the present LBDA emphasis outlined in subsection 2.2.1, the strategy for livestock development in the Region is drawn up in order to overcome the constraints by effectively capitalizing on the advantages summarized above. It consists of the following:

- 1) To improve the overall productivity of livestock by making available sufficient number of high quality breeding stock;
- 2) To organize and improve stock raising activities of small scale farmers through demonstration effects of pilot farms as well as provision of training and technical extension services;
- 3) To promote livestock feeding systems through the improvement of fodder crop production and pasture grasses, the production of supplementary feed and the encouragement of home-grown energy crops; and
- 4) To establish more widely, intensive systems of stock raising, especially in high population density areas.

In view of present situation in the Region and the recent policy emphasis, the strategy presented above should aim firstly at increasing milk production and secondly at increasing meat production. Other objectives are expected to be attained to a certain extent in the course of attaining these more important objectives.

2.3 Livestock Development Plan

2.3.1 Development frameworks

(1) Overall framework

Under the basic strategy presented above, a framework and targets for livestock development are presented in this subsection, which will determine the attainment levels of the development objectives. The national targets set by SP1 naturally provide the guidelines for setting regional framework and targets.

SP1 places the great emphasis on the development of milk and meat production by 2000 as described in the sector report on Agriculture in Chapter 1. The national targets of livestock production are as follows.

Product	Production		Consumption	
	1984	2000	Total	Unmet Demand
Milk (1000 tons)	1,600	3,600	3,600	0
Meat (1,000 tons)	190	420	540	120

The domestic demand of milk and meat will reach 3,600,000 tons and 540,000 tons respectively. These target amounts are expected to achieve the self-sufficiency of milk and to cover 78% of the domestic meat demand.

In line with the national demand projection, the 2005 regional demands of milk and meat were estimated. Since per capita consumption of milk and meat will increase to 101.2 litres

and 15.5 kg, the regional demand of these products will reach 1,690,000 tons and 259,000 tons as shown below.

(Unit; 1000 tons)

<u>1985 (Production)</u>		<u>2005 (Demand)</u>	
Milk	Meat	Milk	Meat
508 (100)	69 (100)	1,690 (333)	259 (375)

Reflecting the national policy of milk self-sufficiency, the Master Plan has set up the target of milk self-sufficiency in the Region. Besides every efforts will be made to produce meat to maintain the current regional shares, i.e. 38%, of the national production as much as possible.

(2) Development targets

Milk

Under Scenarios 1 and 2, it is aimed at achieving the regional self-sufficiency of milk with the total production of 1,690,000 tons (see Chapter 3 of Master Plan Report for descriptions of Scenarios). For this purpose, it is required to promote the multiplication of grade cattle in the Region. In view of low milk productivity and limited land resources, population of local cattle should not be increased. However, local cattle in the Region have benefitted the small farmers especially in Nyanza and Western Provinces due to their high resistant characteristics against adverse conditions. Therefore, improvement of local cattle will be envisaged to increase their milk productivity, maintaining their inherent favourable characteristics.

For improving milk yield of local cattle, some of indigenous breeds should be replaced by cross-bred (F1). As presented in Table 2.4, milk productivity of crossbred is lower than that of grade cattle, but much higher than local cattle e.g. Boran and Zebu.

In order to produce 1,690,000 tons of milk, 330,000 heads of grade cattle will be further required in addition to the existing 647,000 heads. Besides, 2,397,000 heads of local cattle will also be required, of which 1,250,000 heads or 52% will be replaced by cross-bred. The milk produced by goats is negligible and is not taken into account. The milk production plan under both Scenarios 1 and 2 can be summarized in the following table.

Item (Unit)	Grade Cattle	Cross-bred	Local Cattle
Population (1000)	977	1,250	1,147
Milking cow (%)	30	30	15
Milk yield (kg/yr)	3,500	1,700	150
Production (1000tons)	1,026	638	26

The cattle population and the anticipated milk production under Scenarios 1 and 2 are presented by district in Table 2.10.

Meat

In view of the rationalization of land use and small farmer focus policy, the large scale ranching would not be the way of livestock development in the Region. The intensification of both crop and livestock production should be emphasized to exploit the limited land resources to the maximum level. In this context, the beef cattle raising would not be expanded under the future livestock development plan.

By encouraging milk production under Scenarios 1 and 2, population of cattle herd will increase from 3,044,000 heads in 1985 to 3,374,000 heads by 2005. The live-weight of the cattle will be increased as a result of favourable feed supply. Thus the increased beef production will also be attained. However, the per capita availability of beef alone will be just 4.4 kg, far short of meat requirement of 15.5 kg expected to be attained in the country according to SPI. Therefore, the development of smaller animals would also be required.

Small stock raising is generally suited to small farmers. Of all the different kinds of small stock, the development of goats and sheep aims only at meeting social requirements of local people, as extensive rearing of these animals will have negative effects on land productivity. Smaller animals such as rabbit will have negligible effects on Region's economy. Therefore, the emphasis will be placed on poultry and pigs.

Pigs have an additional advantage especially in highly populated areas, as they require very small land. Also they can most effectively take advantage of the abundance of agricultural residues and other wastes in the Region, as they can feed on practically anything and have excellent food conversion efficiency (see Chapter 2; Report on Preparatory Study for more details).

Thus, pigs will be increased from 15,000 heads at present to 160,000 heads in 2005, and poultry from 4,300 thousand to 12,700 thousand heads. The number of sheep and goats to be reared in the Region will be 870,000 in 2005. Including 977,000 heads of grade cattle and 2,397,000 heads of local cattle, the meat production in the Region will look like the table below. As seen from the table, the total meat production will be 113,000 tons in 2005,

consisting of 73,000 tons beef and 40,000 tons of other kinds of meat. The per capita availability of meat will be 6.8 kg. If the projected fish consumption of some 68,000 tons is added, the per capita availability of animal protein source is calculated to be 10.8 kg, representing 70% attainment of the requirement (Chapter 3, Sector Report). It is estimated that total LU's will also increase from 1.98 million in 1985 to 2.8 million in 2005.

Items	Grade cattle	Local cattle	Sheep and Goats	Poultry	Pig
1. Population (1000)	977	2,397	870	12,700	160
2. Slaughter weight (kg/head)	400	250	40	1.5	80
3. Carcass. dress. rate (%)	50	50	40	60	70
4. Slaughter rate (%)	25	8	65	150	90
5. Total (1000 tons)	49	24	9	17	9

The details of meat production are presented by district in Table 2.11.

2.3.2 Forage production

There are many conditions which have to be satisfied as prerequisites for attaining the development targets set above. Most crucial of them is the availability of livestock feed. Thus fodder crop production, managed pasture and natural grazing are examined here. Availability of agricultural residues and high quality feed supplements are discussed elsewhere (Chapter 3, Report on Preparatory Study).

(1) Basic concept

Even though the Government places the great emphasis on zero-grazing policy in its livestock development strategy, most of cattle and other small stock in the Region are still raised in the natural grassland. In view of maximum exploitation of land resources, the rationalized land utilization should be realized through the future agricultural land development. In this context, agricultural development of the natural land, which is presently used for cattle grazing, is one of the most important aspects for increasing livestock production and harmonizing it with crop production.

With this consideration, the minimum requirement of natural grassland was calculated and the intensive fodder production plan has been formulated. The study results are taken as specific conditions in the formulation of the general land use plan discussed in the sector study of Land Use in Chapter 10, which examined the expansion of crop area in the future without causing conflicts with the land use plan for livestock development.

There are several types of feed sources prevailing in the Region. They are natural grassland, managed pasture and fodder crops (Table 2.12). In addition, crop residue and grasses sparsely vegetated in fallow land also provide the supplemental feed. The results of analyses on the current feed availability as well as the future feed production in the Region are described below.

(2) Estimation of carrying capacity

The carrying capacity is the sustainable number of LU's per hectare of either grasslands or pastures. The carrying capacities of natural grassland and managed pastures in the Region are analyzed in order to clarify the availability of animal feed and to estimate the future requirement of fodder production.

On the basis of the existing data for stocking rates and spatial distribution of natural grasslands, the carrying capacities are calculated by agro-ecological zone and by district. The stocking rate is reciprocal number of carrying capacity, which is the area requirement of grasslands and pastures that can sustain one livestock unit (LU) expressed in the unit of hectare per LU (ha/LU). The Farm Management Handbook (1982, 1983 MOALD) provide the stocking rates for each agro-ecological zone and for each district as listed in Table 2.13.

Stocking rates of natural grassland and managed pasture are varied widely from 0.5 ha/LU to 3.3 ha/LU according to agro-ecological conditions. The average carrying capacity in each district is computed based on hectareage of grass coverage under each agro-ecological zone revealed through ILUS and stocking rates as presented in Table 2.14. Since no difference in forage productivity between managed pasture and fodder crop field is recognized under present condition, the feed productivity of fodder crop fields is represented by carrying capacity of managed pasture under the same agro-ecological conditions.

(3) Feed availability

At present, feed of 2,568,000 LU's equivalent is available in the Region. The feed availability by each source is presented in Table 2.15 and described below.

Natural grassland is a widely distributed feed source with a total extent of 2,750,000 ha accounting for 42% the total area of the Region, of which total carrying capacity is estimated to be 1,544,000 LU's equivalent.

Managed pasture in the Region has been developed mainly in Rift Valley Province and Kisii district, where the modern dairy farming is prevailing. Major grasses planted are Napier, Bana, Rhodes, White clover, Nandi Setaria, Kikuyu, etc. Each managed pasture is simply fenced with wire and used for grazing. The total extent is 165,000 ha providing the feed of 462,000 LU's equivalent.

Fodder crop production is promoted particularly in Kakamega, Kisii, South Nyanza and Kericho. The kinds of grasses prevailing are Napier and Bana. They are chopped and supplied directly to animals. The total extent is 139,000 ha with the total feed availability of 401,000 LU's equivalent.

Crop residues remained in harvested areas can be counted as main supplemental feed sources. The useful crop residues are derived from maize, sorghum, beans and sweet potatoes. Referring to ILUS data, the feed value per land unit of their harvested area is assumed to be 0.3 LU/ha. The total planted areas of these crops were referred to in the sector study results of Land Use (Chapter 10). It is estimated at 255,000 LU's equivalent in the Region.

(4) Demand and supply balance of forage

As presented in Table 2.2, 647,000 heads of grade cattle, 2,397,000 heads of local cattle and 870,000 heads of sheep and goats are raised in the Region. It is estimated that average liveweight is 254kg or 0.85 LU/head for grade cattle, 167 kg or 0.53 LU for local cattle and 30kg or 0.10 LU for sheep and goats (Table 2.3).

As shown in Table 2.2, the total LU's are 1,980,000 consisting of 550,000 of grade cattle, 1,343,000 of local cattle and 87,000 of sheep and goats. Since the forage of 2,568,000 LU's equivalent is available in the Region, the forage availability is calculated at 130%. However, some feed shortage districts are recognized when Tables 2.2 and 2.15 are compared. In Kisumu, the forage of 98,000 LU's equivalent is required, whereas only 82,000 LU's of forage are available. Likewise, Narok is also forage shortage district. In other words, the animals in these districts are overgrazed and their live-weight would be smaller than the animals reared in other high potential zones. Siaya and South Nyanza are marginal in feed availability, and Kisii, Bungoma, Kakamega and Uasin Gishu have good forage sources.

(5) Future forage production and natural grazing

The future forage production is planned by the following procedure.

- i) In view of high productivity, the fodder crop fields will be developed to stabilize forage supply to grade cattle under zero-grazing policy. Intensification of management of the existing managed pasture will also be envisaged.
- ii) Local cattle, and sheep and goats will be supplied with the surplus of the forage to be produced in fodder areas or managed pastures, as well as crop residue.
- iii) Further deficit of forage will be made up with by the natural grazing.

Although the existing fallow land would serve as a supplemental feed source, it was not taken into account in the future forage production plan. Based on the feed productivity as well as the carrying capacity presented in Table 2.14, the future feed production under Scenarios 1 and 2 has been calculated as presented in Table 2.16. The feed of 2,461,000 LU's equivalent are expected to be produced by intensified use of the existing feed source and the expansion of 107,000 ha for fodder production. As shown in Table 2.17, 977,000 heads of grade cattle will require the feed of 1,036,000 LU's equivalent, which can be fully supplied by these feed sources.

According to the calculation shown in Table 2.18, the hectarage of natural grassland to be reserved for grazing purposes is obtained. As can be seen, the feed of 1,425,000 LU's equivalent (2,461,000 LU's - 1,036,000 LU's) will be required by local cattle, sheep and goats, which amounts to 1,765,000 LU's. To make up the balance of 340,000 LU's equivalent, 1,009,000 ha of natural grassland should be reserved. In this calculation, the efficiency of utilization of grassland was assumed to be 70%. Since there are 1,939,000 ha of natural grassland in the Region, 52% of grassland will be reserved for future grazing purpose and 930,000 ha or 48% will be devoted to crop expansion. These study results are further discussed in the sector study of Land Use in order to judge the optimum land expansion for fodder production.

2.3.3 Recommended development framework

(1) Fodder crop expansion

To ensure the livestock development plan proposed under Scenarios 1 and 2, the sufficient and stabilized feed supply is essential. It has been clarified through the present sector study of livestock that it is necessary to intensify the utilization of the existing managed pasture of 165,000 ha and to increase productivity of existing fodder crop field of 139,000 ha. In addition, 107,000 ha of the expansible area have to be opened to produce fodder crops.

Through the sector study of Land Use in Chapter 10, possibility of such expansion of fodder crops was examined and confirmed under the conditions of Scenarios 1 and 2. The further exercises have determined 100,000 ha of the expansion of fodder crop fields as the optimum, taking account of the expansion of the food crops and cash crops under Scenario 3. The feed production of fodder crops fields under Scenario 3 is reduced to 1,289,000 LU's equivalent instead of 1,324,000 LU's equivalent under Scenarios 1 and 2. The forage production plan under Scenario 3 is presented in Table 2.19.

(2) Anticipated production of milk and meat.

Due to this reduction, sustainable population of grade cattle becomes 950,000 heads as presented in Table 2.20. As a result, the future milk production amounts to 1,661,000 tons or 98% of self-sufficiency. Besides meat production will attain 106,000 tons consisting of 71,000 tons of beef and 35,000 tons of other meat as shown in Table 2.21.

2.3.4 Specific measures

(1) Measures for cattle

Multiplication centers

In order to increase the availability of quality breeds in the Region, cattle multiplication centers should be expanded. In addition to the existing and on-going LBDA multiplication centers, several more should be established aiming at the service coverage of the entire

Region by 2005. Some of the former livestock holding grounds mentioned above should be used for this purpose. The major means for quality improvement are AI and introduction of high quality stud bulls from other regions or abroad.

Static AI systems should be introduced associated with the centers, where portable semen preserving equipment is installed and personnel for insemination are maintained under LBDA supervision.

Each center should also be equipped with disease control functions. Dips should be constructed at each center for controlling tick borne diseases. There will be annual vaccinations against foot and mouth disease, rinderpest and contagious bovine pleuropneumonia and biannual inoculation against black quarter and anthrax.

Bull camps

In order to supplement the functions of LBDA multiplication centers for improving stock breeds, bull camps should be established in inaccessible areas for the purpose of upgrading local breeds. Bull calves to be produced at the multiplication centers should be carefully selected and used to stock the camps. Dips should also be provided at each camp.

Auction markets

Each market should be equipped with weighing instruments and a corral to drive animals in. An inspector in charge of sanitation and a judge to control standards must be available in order for auctions to be conducted fairly. Quality standards should also be established and grades and standards be used to determine the right value of each animal. It is recommended that such auction markets must be run by producers' cooperatives or LBDA. In the long run, these markets can expand to include slaughtering and possibly processing. A realistic standards for slaughter and feeder animals will encourage farmers to produce better quality animals to be marketed.

Extension services

Technical advice will be extended from the LBDA multiplication farms and the bull camps to avoid reproductive diseases associated with natural breeding and also inbreeding as well as to control other diseases.

Other technical packages may also be provided at the farms or camps for proper feeding systems, organized forage improvement systems and feed supplementation. Especially, intensive feeding systems such as zero-grazing or stall feeding should be encouraged in densely populated areas.

Moreover, the existing research centres should be increased in the Region to serve at least every district. This includes more facilities such as research equipment, vehicles and staff. A higher level educational research centre needs to be set up to train staff of the extension services since such a centre does not exist in the Region. This centre shall cover epidemic diseases and livestock feeding control together with the installation of experimental research

equipment. The use of some of the existing LBDA farms or other requisites can be slightly altered to serve such purposes.

Disease and herd health control programmes by the Ministry of Livestock Development should be continued and thoroughly followed.

Marketing and processing

Milk marketing systems should be further consolidated through better organizing dairy cooperative societies. Geographic distribution of milk production and transport conditions should be well captured by each cooperative, and milk cooling facilities should be provided at those farms where timely collection of milk is difficult especially in evenings.

Production of dairy products should be encouraged in areas where excess production is expected. Dairy processing is relatively simple and can be successfully operated even in a small scale and will contribute to income and employment generation in rural areas. This possibility should be further investigated.

Feed mills

A large stock feed plant should be established to produce high quality feed supplements for dairy production. This plant will serve a range of animals and is described later.

In addition, small scale feed mills should be established in every larger secondary towns. These mills should utilize locally available raw materials so that the production cost and thus prices will be low enough for small farmers. Another important function of mills would be to blend the high quality feed produced from the stock feed plant with locally available raw materials to make products which would best suit the local demand.

(2) Feeding programmes

In order to sustain much increased livestock production, more efforts should be placed on feeding programmes. As mentioned in preceding sections, this will consist of three components: i.e. increased fodder crop production for zero-grazing or stall grazing, expansion of area under managed pasture, and high quality feed supplementation. The third one has already been described (see also below).

Fodder and pasture development will form the major part of the feeding programmes for cattle. Farmers should be encouraged to grow grasses suited to the Region such as Bana grass, Boma Rhode grass, Nandi setaria, Kikuyu grass, Guinea grass and Sudan grass. Mixing of clovers in pasture should be recommended. Also planting of legumes such as soybeans, leucaena trees and lucerne should be encouraged to enhance nutritive status of feed. Leucaena trees are particularly desirable, as they are fast growing, has fuelwood and timber value, provides wind breaks and fencing posts as well as serving as a fodder crop and nitrogen source.

Extension services of the Ministry of Livestock Development should put more emphasis on teaching farmers for the selection of grasses and the management of pasture as well as proper feeding practices.

(3) Measures for goats and sheep

Goats and sheep should be encouraged in areas where cultivation is not favourable, especially in low potential areas of the Region. However, the goats have browsing habit, which can be a great disadvantage, because if allowed to browse uncontrolled they will often kill bushes and young trees by eating off all the leaves and the young shoots. In this way, plantation can easily be destroyed and soil erosion made inevitable. Therefore, goats farming should be introduced to intensive feeding systems such as zero-grazing.

(4) Measures for poultry

The most effective approach to further developing poultry in the Region is to encourage the establishment/enhancement of commercial enterprises for poultry meat and eggs whose operation would be based on small scale farming systems for poultry practiced by the majority in rural areas. However, in order to eliminate unfavourable price and marketing effects of middlemen, rural cooperative societies should be consolidated so that small scale poultry farmers can market their products through the societies. Also, the provision of cheaper feed and the establishment of hatcheries and slaughtering facilities are also recommended. Cheap feed can be provided through the channels already mentioned above for milk production.

(5) Pig industry complex project

All the measure to encourage the development of pig industry can be most effectively taken within the package of activities under what may be called the pig industry complex project. This represents a very deliberate and thorough effort to establish a subsector of the livestock sector which at present is practically non-existent in the Region.

Background

Meat consumption in Kenya is characterized by the predominance of meat from ruminant animals. More than 80% of meat consumption comes from cattle, goats and sheep as compared with some 50% from cattle and sheep in developed countries and slightly over one-third in the centrally planned economies.

The future demand for pork will be influenced by prices of both pork and beef. Prices of pork and its products are at present higher than prices of beef and chicken (Table 2.7). Beef prices are expected to increase, as the demand for beef generally increases as the economy develops. Thus the demand for pork will also increase, subject only to the expansion of supply capacity.

Project description

The pig industry complex project is planned to establish breeding centers for distributing pigs to contract farmers with the concomitant provision of extension services. Meat processing and blood and bone meals factories will also be included in this complex to process pigs to be purchased from the farmers. Tannery, hides and skins, and leather goods industries will be subsequently introduced. These processing industries will constitute an integrated slaughtering and processing center for effective utilization of all the raw materials, which in turn will contribute to minimizing adverse environmental effects due to discharge of organic materials. Feed production may also be combined to serve both livestock and fishery production (Chapter 3, Report on Preparatory Study). Production of animal feeds and manure may be induced at individual farm level as informal sector activities.

More detailed descriptions are given in the Report on Preparatory Study (Chapter 2).

Associated measures

For more effective implementation of this project, a scheme for integrated contract farming systems should be introduced for small-scale farmers. With this scheme, farmers would raise combinations of small animals including hogs or also fish with home-grown or locally available feeds. Extension and other services would be provided to them through farmers' cooperative societies, covering the following:

- Extension services for farming practices most suited to each scale of operations,
- Supply of rearing stock, e.g. feeder pigs and chicks,
- Arrangement of credits,
- Supply of construction materials for stalls, fish ponds etc,
- Veterinary services and other technical activities,
- Purchase of animals ready for marketing at uniform and standard prices, and
- Research on locally available feed resources such as cowpeas, soybeans, rice bran, cassava, sweet potatoes, bananas and others.

(6) Animal feed mill plant

Pressure on land due to increasing population will necessitate more intensive livestock production with commercial (mixed) feed. Animal feed in the Region, however, is too expensive for most small scale farmers or simply not available sometimes.

With the new development into alternative feed sources such as cassava, sweet potatoes, peanuts and cowpeas as well as the utilization of agricultural by-products currently wasted, the feed production industry can diversify both energy and protein sources of feed for the livestock industry. It is therefore highly recommended that a livestock feed plant be established in Nyanza or Western Province in the nearest future.

This possibility is pursued in more detail in the Report on Preparatory Study (Chapter 3), along the more general line of animal feed industry project.

(7) Extension and training facilities

In addition to the facilitative measures described above, basic research and training should be intensified. The research activities related to disease, feeding and management, and breeding of livestock should be intensified. Research centers should be increased to cover all the districts. The research should be conducted along with clinical identification of diseases, proper diagnosis, treatment and advice to farmers.

A training institution to the level of extension staff equivalent to Animal Health Assistant should be introduced in the Region. The LBDA farms such as the one at Lugari may be turned into the training institution to produce the extension staff to serve the Region.

References

- 1) Akinsanmi, O., Certificate Agricultural Science, Longman Group Ltd, London.
- 2) A Pocket Directory of Trees and Seed in Kenya,
- 3) Barber, J. and D.J. Wood, Edward Arnold, Livestock Management for East Africa, London, 1977.
- 4) Eusebio, J.A., Pig Production in the Tropics, Longman Group Ltd, London, 1980.
- 5) Hall, H.T.B., Disease and Parasites of Livestock in the Tropics, Longman Group Ltd., London.
- 6) Kenya Institute of Education, Agriculture, Animal Husbandry for Secondary School and Teachers Colleges, 1981.
- 7) Kenya Government Development Plan for the Period, 1984-1988.
- 8) Kenya Government Sessional Paper No. 1 - 1986.
- 9) Lake Basin Development Authority, Livestock Plan 1983-1988.
- 10) Ministry of Livestock Development, National Livestock Policy, 1980
- 11) Ministry of Agriculture and Livestock Development, Annual Report, 1983, 1984
- 12) Musnagi, R.S., and Longman Kenya, Dairy Husbandry in East Africa, 1975.
- 13) Pig Industry Study Group, Ministry of Agriculture Report and Recommendation on the Future Prospects on the Pig Industry in Kenya, 1973.

Table 2.1 Livestock Population in Kenya

Livestock	1983	1984
Dairy Cattle	2,220	2,040
Beef Cattle	8,676	7,682
Sheep and Goats	14,363	19,638
Pigs	95	85
Poultry	19,638	15,372

Source: Livestock Development Division, MOALD, Annual Report 1984

Table 2.2 Livestock Population and Total Livestock Units in 1985 in the Region

District	Grade Cattle		Local Cattle		Sheep & Goats		Total 1000LU's
	1000 heads	1000LU's	1000 heads	1000LU's	1000 heads	1000LU's	
NYANZA							
Kisii	29	25	133	74	28	3	102
Kisumu	1	1	161	90	69	7	98
Siaya	0	0	179	100	47	5	105
South Nyanza	1	1	432	242	105	11	253
Sub-total	31	26	905	507	249	25	558
WESTERN							
Bungoma	8	7	194	109	23	2	118
Busia	0	0	89	50	14	1	51
Kakamega	25	21	207	116	36	4	141
Sub-total	33	28	490	274	73	7	310
RIFT VALLEY							
Kericho	217	184	164	92	79	8	284
Nandi	133	113	75	42	29	3	158
Narok	1	1	275	154	47	5	160
Trans Nzoia	74	63	36	20	34	3	86
Uasin Gishu	133	113	89	50	80	8	171
Others	25	21	46	26	39	4	51
Sub-total	583	496	685	384	308	31	910
ILUS Area	647	550	2,080	1,165	630	63	1,778
MARA R. BASIN	0	0	317	178	240	24	202
TOTAL	647	550	2,397	1,343	870	87	1,980

Sources: Provincial Offices, MOALD, Annual Reports
 District Development Plans, 1984-88
 Ecosystem, Integrated Land Use Survey (ILUS), 1983

Table 2.3 Herd Composition and Live Weight of Cattle

(1) Present condition

Herd Composition	Grade Cattle		Local Cattle		Sheep & Goats
	Proportion (%)	Live-weight (kg)	Proportion (%)	Live-weight (kg)	Live-weight (kg)
Bull	2	400	2	280	
Milking Cow	25	320	15	220	
Dry Cow	20	320	13	220	
Heifers	17	240	25	160	
Heifer Calves	14	140	10	100	
Bull Calves	11	140	10	100	
Steers	11	240	25	160	
Average live-weight		254		167	30
LU/head		0.85		0.56	0.10

(2) Future condition (2005)

Herd Composition	Grade Cattle		Local Cattle		Sheep & Goats
	Proportion (%)	Live-weight (kg)	Proportion (%)	Live-weight (kg)	Live-weight (kg)
Bull	2	500	2	350	
Milking Cow	30	400	15	280	
Dry Cow	15	400	13	280	
Heifers	17	300	25	200	
Heifer Calves	14	180	10	130	
Bull Calves	11	180	10	130	
Steers	11	300	25	200	
Average live-weight		319		211	30
LU/head		1.06		0.70	0.10

Source: Surveys by JICA Study Team

Table 2.4 Productivities of Milk and Meat in the Region

Livestock	Milk Yield		Slaughter Live-weight (kg/animal)	Carcass Dressing (%)
	Daily yield (lit/day/animal)	Annual yield (lit/year/animal)		
Cattle				
Local	1-2	100-250	200-300	45-50
Grade	8-10	2,500-4,000	350-500	50-55
Cross-bred	4-6	1,000-2,000	300-400	45-50
Sheep	-	-	25-45	40-50
Goats	0.5	30-50	25-45	40-50
Pigs	-	-	80-85	70-75
Poultry	-	-	1-2	60-65

Source: Surveys by JICA Study Team

Table 2.5 Milk Production in 1985

District	Population (1000 heads)			Milk Production (1000 tons)			
	Grade Cattle	Local Cattle	Sheep & Goats	Grade Cattle	Local Cattle	Goats	Total
Nyanza							
Kisii	29	133	14	20	3	0.0	23
Kisumu	1	161	35	1	4	0.1	4
Siaya	0	179	24	0	4	0.1	4
South Nyanza	1	432	53	1	10	0.2	11
Sub-total	31	905	126	22	20	0.4	42
Western							
Bungoma	8	194	12	6	4	0.0	10
Busia	0	89	7	0	2	0.0	2
Kakamega	25	207	18	18	5	0.1	22
Sub-total	33	490	37	23	11	0.1	34
Rift Valley							
Kericho	217	164	40	152	4	0.1	156
Nandi	133	75	15	93	2	0.0	95
Narok	1	275	24	1	6	0.1	7
Trans Nzoia	74	36	17	52	1	0.1	53
Uasin Gishu	133	89	41	93	2	0.1	95
Others	25	46	20	18	1	0.1	19
Sub-total	583	685	157	408	15	0.5	424
ILUS Total	647	2,080	320	453	47	1.0	501
Mara River Basin	0	317	120	0	7	0.4	7
Total	647	2,397	440	453	54	1.3	508

Source: Surveys by JICA Study Team

Table 2.6 Meat Production in 1985

District	Population (1000 heads)					Meat Production (1000 tons)						
	Grade Cattle	Local Cattle	Sheep & Goats	Poultry	Pigs	Grade Cattle	Local Cattle & Goats	Sheep	Poultry	Pigs	Total Beef	Other Total
Nyanza												
Kisii	29	133	28			1	1	0			3	0
Kisumu	1	161	69			0	2	1			2	1
Siaya	0	179	47			0	2	0			2	0
South Nyanza	1	432	105			0	4	1			4	1
Sub-total	31	905	249			2	9	3			11	3
Western												
Bungoma	8	194	23			0	2	0			2	0
Busia	0	89	14			0	1	0			1	0
Kakamega	25	207	36			1	2	0			3	0
Sub-total	33	490	73			2	5	1			7	1
Rift Valley												
Kericho	217	164	79			11	2	1			12	1
Nandi	133	75	29			7	1	0			7	0
Narok	1	275	47			0	3	0			3	0
Trans Nzoia	74	36	34			4	0	0			4	0
Uasin Gishu	133	89	80			7	1	1			8	1
Others	25	46	39			1	0	0			2	0
Sub-total	583	685	308			29	7	3			36	3
ILUS Total	647	2,080	630	4,301	15	32	21	7	6	1	53	14
Mara River Basin	0	317	240	0	0	0	3	2	0	0	3	2
Total	647	2,397	870	4,301	15	32	24	9	6	1	56	16

Source: Surveys by JICA Study Team

Table 2.7 Prices of Livestock Products in the Region

Livestock Product	Unit	Producer Price	Consumer Price
Fresh milk	Kshs./lit	3.4	
Treated milk (UHT)	Kshs./lit		5
Beef cattle (live)	Kshs./kg	10-20	
Beef without bone	Kshs./kg		25
Beef with bone	Kshs./kg		21
Hog (live)	Kshs./kg	10	
Pork with bone	Kshs./kg		30
Sheep and goats (live)	Kshs./kg	10	
Mutton with bone	Kshs./kg		25
Ram with bone	Kshs./kg		35
Goats meat with bone	Kshs./kg		25
Chicken (live)	Kshs./bird	30-40	
Chicken meat	Kshs./bird		35-45
Chicken egg	Kshs./pcs	1.0-1.5	1.5

Source: Surveys by JICA Study Team

Table 2.8 National Livestock Development Expenditure

Project/Programme	Unit: K£	
	1983/84	1984/85
Approved Recurrent Estimate	1,135,025	1,449,853
Approved Development Estimate	830,717	1,478,077
Bee keeping	139,300	160,231
Sheep and Goats Projects	224,300	292,620
National Dairy Cattle Improvement	45,200	217,200
Improvement of Pig Husbandary	26,100	271,000
Poultry Development Projects	41,156	35,800
Livestock Recording Projects	52,211	
Rural milk collection and cooling centers	159,030	640,724
Data processing	10,100	
IADP II	133,320	104,400

Source: Kenya Government, Development Expenditure 1983/84 and 1984/85

Table 2.9 Main Commercial Feed and Prices

	Food	Unit; Kshs/kg Price
Layer	Chicken grower	2
	Layer	3
Broiler	Starter	5
	Grower/Finisher	4
Cattle	Dairy Feed	2
Pigs	Pig Feed	

Source: KGGCU Kisumu and Uni Feed, 1986

Table 2.10 Milk Production in 2005 under Scenarios 1&2

District	Population (1000 heads)				Milk Prod. (1000 tons)			
	Grade Cattle	Cross-bred	Local Cattle	Total	Grade Cattle	Cross-bred	Local Cattle	Total
NYANZA								
Kisii	96	80	53	229	101	41	1	143
Kisumu	1	97	64	162	1	49	1	52
Siaya	0	107	72	179	0	55	2	56
South Nyanza	10	262	170	442	11	134	4	148
Sub-total	107	546	359	1,012	113	278	8	399
WESTERN								
Bungoma	15	116	78	209	16	59	2	77
Busia	10	53	36	99	11	27	1	38
Kakamega	40	124	83	247	42	63	2	107
Sub-total	65	293	197	555	68	149	4	222
RIFT VALLEY								
Kericho	290	98	66	454	305	50	1	356
Nandi	150	45	30	225	158	23	1	181
Narok	5	165	110	280	5	84	2	92
Trans Nzoia	120	22	14	156	126	11	0	138
Uasin Gishu	170	53	36	259	179	27	1	206
Others	70	28	18	116	74	14	0	88
Sub-total	805	411	274	1,490	845	210	6	1,061
ILUS Area	977	1,250	830	3,057	1,027	638	19	1,683
MARA R. BASIN	0	0	317	317	0	0	7	7
TOTAL	977	1,250	1,147	3,374	1,027	638	26	1,690

Source: JICA Study Team

Table 2.11 Meat Production in 2005 under Scenarios 1 and 2

District	Population (1000 heads)				Meat Production (1000 tons)							
	Grade Cattle	Local Cattle	Sheep & Goats	Pig Chick.	Grade Cattle	Local Cattle	Sheep & Goats	Pork Chick.	Chick.	Total Beef	Other Meat	
NYANZA												
Kisii	96	133	28	30	1,500	5	1	0	2	2	6	4
Kisumu	1	161	69	20	1,500	0	2	1	1	2	2	4
Siaya	0	179	47	20	1,500	0	2	0	1	2	2	4
S. Nyanza	10	432	105	20	2,500	1	4	1	1	3	5	5
Sub-total	107	905	249	90	7,000	5	9	3	5	9	14	17
WESTERN												
Bungoma	15	194	23	20	1,000	1	2	0	1	1	3	3
Busia	10	89	14	15	1,500	1	1	0	1	2	1	3
Kakamega	40	207	36	23	1,000	2	2	0	1	1	4	3
Sub-total	65	490	73	58	3,500	3	5	1	3	5	8	8
RIFT VALLEY												
Kericho	290	164	79	2	400	15	2	1	0	1	16	1
Nandi	150	75	29	2	400	8	1	0	0	1	8	1
Narok	5	275	47	2	500	0	3	0	0	1	3	1
T. Nzoia	120	36	34	3	450	6	0	0	0	1	6	1
U. Gishu	170	89	80	3	450	9	1	1	0	1	9	2
Others	70	46	39	0	0	4	0	0	0	0	4	0
Sub-total	805	685	308	12	2,200	40	7	3	1	3	47	7
ILUS Area	977	2,080	630	160	12,700	49	21	7	9	17	70	33
MARA BASIN	0	317	240	0	0	0	3	2	0	0	3	2
TOTAL	977	2,397	870	160	12,700	49	24	9	9	17	73	35

Source: JICA Study Team

Table 2.12 Common Species of Pasture Grasses

Category	Local Name	Scientific Name
Graminosa Grass	Rhodes grass	Chloris agayana Kunth
	Guinea grass	Panicum maximum Jacq.
	Kikuyu grass	Pennisetum clandestinum Hochst, ex Chiov
	Napier grass	Pennisetum purpureum Schumahr
	Bana grass	Pennisetum purpureum xp. typhoides
Leguminosa Grass	Lucerne	Medicago sativa African
	Desmo	Desmodium ovalifolium (Prain) Wall ex. Ridley
	Leucaena	Leucaena leucocephala

Source: Compiled by JICA Study Team

Table 2.13 (1/2) Stocking Rate of Natural Grassland and Managed Pasture
in Nyanza and Western Provinces

District/AEZ	Natural Grassland		Managed Pasture		Major Grasses
	Range	Average	Range	Average	
(Unit: ha/LU)					
KISII					
LH1	0.5 - 0.7	0.6			
LH2	0.8 - 1.0	0.9	0.60	0.60	Setaria, Rhodes, W. clover
UM1	0.6	0.6	0.15	0.15	Napier, Bana
KISUMU					
UM1	0.6	0.6			
UM3	0.7 - 1.2	1.0	0.15	0.15	Napier, Bana
LM3	1.0 - 2.0	1.5	0.25	0.25	Bana, Townsville leuceme
LM4	1.0 - 2.0	1.5			
SIAYA					
LM1	0.5	0.5	0.13	0.13	Napier, Bana
LM3	0.9 - 1.2	1.1	0.25	0.25	Bana, Stylosanthes
LM4	1.0 - 2.0	1.5	0.80	0.80	Horse tamarind (Leucaena)
LM5	1.0 - 2.0	1.5			
SOUTH NYANZA					
UM1	0.6 - 0.8	0.7	0.15	0.15	Napier, Bana
UM2	0.6 - 1.1	0.9	0.15 - 0.50	0.33	Rhodes, Napier, Bana
UM3	1.0 - 1.2	1.1	0.25 - 0.60	0.43	Rhodes, Napier, Bana
LM1-3	0.5 - 1.2	0.9	0.13 - 0.25	0.19	Rhod., Napier, Bana, Silv. leaf
LM4	1.3 - 2.0	1.7	0.30	0.30	Rhodes, Napier, Bana, Sitalro
LM5	2.5 - 4.0	3.3			
BUNGOMA					
LH1	0.6	0.6			
LH2	1.0	1.0	0.30 - 0.60	0.45	Nandi Setaria, Rhodes
UM1	0.6	0.6			
UM2	0.6 - 1.0	0.8	0.15 - 0.50	0.33	Rhodes, Napier, Bana
UM3	1.0 - 1.2	1.1	0.18 - 0.60	0.39	Rhodes, Napier, Bana, Sitalro
UM4	1.2	1.2	0.20 - 0.60	0.40	Napier, Bana
LM1	0.5	0.5	0.12	0.12	Napier, Bana
LM3	0.7 - 1.0	0.9	0.18	0.18	Napier, Bana, Stylosanthes
BUSIA					
LM1	0.5	0.5	0.13	0.13	Napier, Bana
LM2	0.5 - 0.7	0.6	0.15	0.15	Napier, Bana
LM3	0.7 - 1.2	1.0	0.18 - 0.25	0.22	Napier, Bana
LM4	1.0 - 2.0	1.5			
KAKAMEGA					
UM1	0.6	0.6	0.12	0.12	Napier, Bana
UM3	1.2	1.2	0.30 - 0.60	0.45	Rhodes, Napier, Bana, Sitalro
LM1(3)	0.5 - 0.6	0.6	0.13	0.12	Napier, Bana

Note: LU : Livestock Unit, 300 kg of liveweight

Table 2.13 (2/2) Stocking Rate of Natural Grassland and Managed Pasture
in Nyanza and Western Provinces

(Unit: ha/LU)

District/AEZ	Natural Grassland		Managed Pasture		
	Range	Average	Range	Average	Major Grasses
KERICHO					
UH1	0.5 - 1.2	0.9			
UH2	0.8	0.8	0.50	0.50	Lucerne
LH1	0.4 - 0.8	0.6			
LH2	1.0	1.0	0.60	0.60	Napier, Red oat
LH3	1.2	1.2	0.70	0.70	Napier, Setaria, Rhodes
UM1	0.6	0.6	0.12	0.12	Napier, Bana
UM2	0.6 - 1.0	0.8	0.50	0.50	Rhodes
UM3	1.0 - 1.2	1.1	0.18 - 0.60	0.39	Napier, Bana
NANDI					
LH1	0.4 - 0.8	0.6			
LH2	1.0	1.0	0.30 - 0.60	0.45	Rhodes, Setaria, Lotononis
LH3	1.2	1.2	0.70	0.70	Nandi, Rhodes, Setaria
UM1	0.6	0.6	0.12	0.12	Napier, Bana
UM2	0.6 - 1.0	0.8			Napier, Bana
UM4	1.2	1.2	0.20 - 0.60	0.40	Rhodes, Napier, Bana
LM1	0.5 - 0.6	0.6	0.13	0.13	Napier, Bana
LM2	0.6 - 1.2	0.9	0.15	0.15	Napier, Bana
NAROK					
UH1	0.6 - 1.2	0.9			
UH2	0.8	0.8	0.50	0.50	Lucerne
LH1	0.5 - 0.7	0.6			
LH2	0.8 - 1.0	0.9	0.60	0.60	Setaria, Rhodes, W. clover
LH3	1.2 - 2.0	1.6	0.70 - 0.80	0.75	Setaria, Rhodes, W. clover
LH4	1.3 - 2.5	1.9	0.80	0.80	Rhodes
UM3	1.0 - 1.2	1.1	0.22 - 0.60	0.41	Rhodes, Napier, Bana
UM4	1.0 - 1.5	1.3			
TRANS NZOIA					
UH1	0.6 - 1.3	1.0			
UH2	0.9	0.9			
LH2	1.0	1.0	0.30 - 0.60	0.45	Nandi Setaria
LH3	1.2 - 1.5	1.4	0.60 - 0.70	0.65	Rhodes, Napier, Bana
LH4	2.0	2.0			
UM2	0.7 - 1.0	0.9	0.16 - 0.50	0.33	Napier, Bana, Rhodes
UM3	1.2	1.2	0.25 - 0.70	0.48	Napier, Bana
UM4	1.0 - 1.2	1.1	0.20 - 0.60	0.40	Napier, Bana, Rhodes
UASIN GISHU					
UH1	0.6 - 1.3	1.0			
UH2	0.9	0.9			
LH1	0.5 - 0.8	0.7			
LH2	1.0	0.5	0.30 - 0.60	0.45	Napier, Bana
LH3	1.5 - 3.0	2.3			
LH4	3.0	3.0			
UM3	1.2	1.2	0.25 - 0.70	0.48	Nap., B., Silv. Leaf Desmodium
UM4	1.4 - 2.0	1.7	0.28 - 0.70	0.49	Napier, Bana, Rhodes

Note: MoALD, Farm Management Handbook, 1982, 1983

Table 2.14 District Average Rate of Carrying Capacity and Forage Productivity

(Unit: LU/ha)

District	Present		UNDER MASTER PLAN (2005)		
	Man. Pasture & Fodder Crops	Grassland	Managed Pasture	Fodder Crop Field	Grassland
NYANZA					
Kisii	3.6	1.5	4.6	6.6	1.5
Kisumu	2.9	0.9	3.7	5.3	0.9
Siaya	2.9	0.9	3.7	5.4	0.9
South Nyanza	2.9	0.9	3.7	4.8	0.9
WESTERN					
Bungoma	3.7	1.2	4.8	5.8	1.2
Busia	2.9	1.0	3.7	5.6	1.0
Kakamega	2.9	1.4	3.7	7.0	1.4
RIFT VALLEY					
Kericho	2.7	1.2	3.5	6.6	1.2
Nandi	2.8	1.1	3.6	6.4	1.1
Narok	2.4	1.0	3.1	5.9	1.0
Trans Nzoia	2.3	1.0	2.9	4.7	1.0
Uasin Gishu	2.5	1.6	3.2	3.9	0.6
Others	2.2	1.2	2.8	4.5	1.2
MARA R. BASIN		0.4			0.4

Source: JICA Study Team

Table 2.15 Total Availability of Feed Source for Livestock in 1985

District	Managed Pasture		Fodder Crops		Grassland		Crop* Residue 1000 LU's	Total Availability 1000 LU's
	1000 ha	1000 LU's	1000 ha	1000 LU's	1000 ha	1000 LU's		
NYANZA								
Kisii	26	94	21	76	27	41	25	235
Kisumu	0	0	6	17	81	57	8	82
Siaya	0	0	6	17	91	82	27	126
South Nyanza	1	3	20	58	259	233	30	324
Sub-total	27	97	53	168	458	412	90	767
WESTERN								
Bungoma	3	8	13	35	77	92	25	161
Busia	0	0	8	23	76	76	5	104
Kakamega	2	6	23	67	76	106	30	209
Sub-total	5	14	44	125	229	275	60	474
RIFT VALLEY								
Kericho	74	200	18	49	84	101	19	368
Nandi	29	81	4	11	81	89	14	196
Narok	2	5	9	22	105	105	5	136
Trans Nzoia	7	16	5	12	67	54	22	103
Uasin Gishu	12	30	4	10	146	234	40	314
Others	9	20	2	4	49	59	12	95
Sub-total	133	352	42	107	532	641	112	1,212
ILUS Area	165	462	139	401	1,219	1,328	262	2,453
MARA R. BASIN					720	216	7	115
TOTAL	165	462	139	401	1,939	1,544	269	2,568

Note: Crop residue remained in harvested areas of maize, sorghum, beans and sweet potatoes can be counted as supplemental feed sources with carrying capacity of 0.3 LU/ha.

Source: JICA Study Team

Table 2.16 Total Availability of Feed Source for Livestock under Scenarios 1 and 2

District	Managed Pasture		Fodder Crops		Crop Residue 1000 LU's	Total Availability 1000 LU's
	1000 ha	1000 LU's	1000 ha	1000 LU's		
NYANZA						
Kisii	26	120	21	139	50	308
Kisumu	0	0	19	101	16	117
Siaya	0	0	14	76	54	130
South Nyanza	1	4	36	173	60	237
Sub-total	27	123	90	488	180	791
WESTERN						
Bungoma	3	14	13	75	50	140
Busia	0	0	8	45	10	55
Kakamega	2	7	23	161	60	228
Sub-total	5	22	44	281	120	423
RIFT VALLEY						
Kericho	74	259	18	119	38	416
Nandi	29	104	11	70	28	203
Narok	2	6	41	185	10	201
Trans Nzoia	7	20	15	71	44	135
Uasin Gishu	12	38	17	66	80	185
Others	9	25	10	45	24	94
Sub-total	133	454	112	556	224	1,233
ILUS Area	165	599	246	1,324	524	2,447
MARA R. BASIN	0	0	0	0	14	14
TOTAL	165	599	246	1,324	538	2,461

Note: *: Crop residue remained in harvested areas of maize, sorghum, beans and sweet potatoes can be counted as supplemental feed sources with carrying capacity of 0.6 LU/ha.

Source: JICA Study Team

Table 2.17 Livestock Population and Total Livestock Units under Scenarios 1 and 2

District	Grade Cattle		Local Cattle		Sheep & Goats		Total LU's 1000LU's
	1000 heads	1000LU's	1000 heads	1000LU's	1000 heads	1000LU's	
NYANZA							
Kisii	96	102	133	93	28	3	198
Kisumu	1	1	161	113	69	7	121
Siaya	0	0	179	125	47	5	130
South Nyanza	10	11	432	302	105	11	324
Sub-total	107	113	905	634	249	25	772
WESTERN							
Bungoma	15	16	194	136	23	2	154
Busia	10	11	89	62	14	1	74
Kakamega	40	42	207	145	36	4	191
Sub-total	65	69	490	343	73	7	419
RIFT VALLEY							
Kericho	290	307	164	115	79	8	430
Nandi	150	159	75	53	29	3	214
Narok	5	5	275	193	47	5	203
Trans Nzoia	120	127	36	25	34	3	156
Uasin Gishu	170	180	89	62	80	8	251
Others	70	74	46	32	39	4	110
Sub-total	805	853	685	480	308	31	1,359
ILUS Area	977	1,036	2,080	1,456	630	63	2,550
MARA R. BASIN	0	0	317	222	240	24	246
TOTAL	977	1,036	2,397	1,678	870	87	2,797

Source: JICA Study Team

Table 2.18 Feed Availability and Grassland to be Reserved for Grazing

District	Feed Avail. in MP&FC 1000LU's	Total LU of Grade Cat. 1000LU's	Feed Avail. for Local C. 1000LU's	Feed Req. LC&Sheep 1000LU's	Feed Req. in Grass. 1000LU's	Carry. Capa. LU/ha	Grassland Required 1000ha	Grass Cover 1000ha	Utilized Grass. %
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
NYANZA									
Kisii	308	102	206	96	110	1.5	0	27	0
Kisumu	117	1	116	120	-4	0.9	6	81	8
Siaya	130	0	130	130	0	0.9	0	91	0
S. Nyanza	237	11	226	313	-87	0.9	138	259	53
Sub-total	791	113	678	659			144	458	32
WESTERN									
Bungoma	140	16	124	138	-14	1.2	17	77	22
Busia	55	11	44	63	-19	1.0	27	76	36
Kakamega	228	42	186	149	37	1.4	0	76	0
Sub-total	423	69	354	350			44	229	19
RIFT VALLEY									
Kericho	416	307	109	123	-14	1.4	14	84	17
Nandi	203	159	44	56	-12	1.1	16	81	19
Narok	201	5	196	198	-2	1.0	3	105	3
Trans Nzoia	135	127	8	28	-20	1.0	29	67	43
Uasin Gishu	185	180	5	70	-65	1.6	58	146	40
Others	94	74	20	36	-16	1.2	19	49	39
Sub-total	1,233	853	380	511	-131		138	532	26
IRUS Area	2,447	1,036	1,411	1,519			327	1,219	27
MARA R. BASIN	14	0	14	246	-232	0.4	682	720	95
TOTAL	2,461	1,036	1,425	1,765			1,009	1,939	52

- Notes:
- (1) Forage to be produced in managed pasture and fodder crop area (Table 2.16)
 - (2) Total LU's of grade cattle (Table 2.17)
 - (3) Surplus feed available for local cattle (3)=(1)-(2)
 - (4) Feed requirement of local cattle, sheep and goats (Table 2.17)
 - (5) Feed to be obtained by natural grazing (5)=(3)-(4)
 - (6) District average of carrying capacity of natural grassland (Table 2.14)
 - (7) Natural grassland to be reserved for grazing local cattle, sheep and goats (7)=(5)/(6)/70%
Efficiency of grazing=70%
 - (8) Total grass coverage
 - (9) Utilization ratio of natural grassland for grazing (9)=(7)/(8)*100

Source: JICA Study Team

Table 2.19 Total Availability of Feed Source for Livestock under Scenario 3

District	Managed Pasture		Fodder Crops		Crop Residue 1000 LU's	Total Availability 1000 LU's
	1000 ha	1000 LU's	1000 ha	1000 LU's		
NYANZA						
Kisii	26	120	21	139	50	308
Kisumu	0	0	17	90	16	106
Siaya	0	0	13	70	54	124
South Nyanza	1	4	32	154	60	217
Sub-total	27	123	83	453	180	756
WESTERN						
Bungoma	3	14	13	75	50	140
Busia	0	0	8	45	10	55
Kakamega	2	7	23	161	60	228
Sub-total	5	22	44	281	120	423
RIFT VALLEY						
Kericho	74	259	18	119	38	416
Nandi	29	104	11	70	28	203
Narok	2	6	41	185	10	201
Trans Nzoia	7	20	15	71	44	135
Uasin Gishu	12	38	17	66	80	185
Others	9	25	10	45	24	94
Sub-total	133	454	112	556	224	1,233
ILUS Area	165	599	239	1,289	524	2,412
MARA R. BASIN	0	0	0	0	14	14
TOTAL	165	599	239	1,289	538	2,426

Notes: Crop residue remained in harvested areas of maize, sorghum, beans and sweet potatoes can be counted as supplemental feed sources with carrying capacity of 0.6 LU/ha.

Source: JICA Study Team

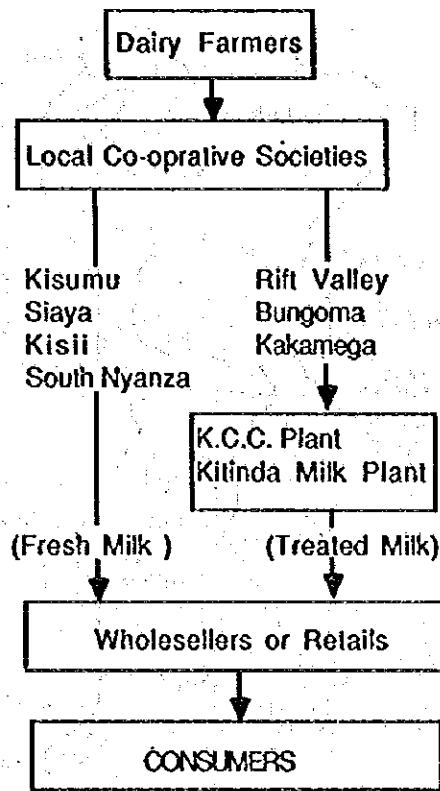


Figure 2.1 Dairy Milk Distribution Channel in the Region

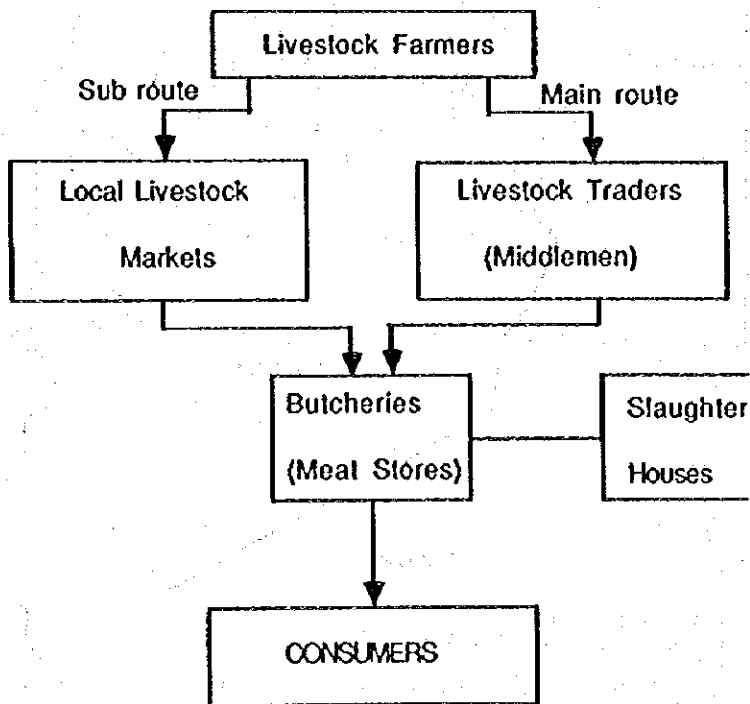
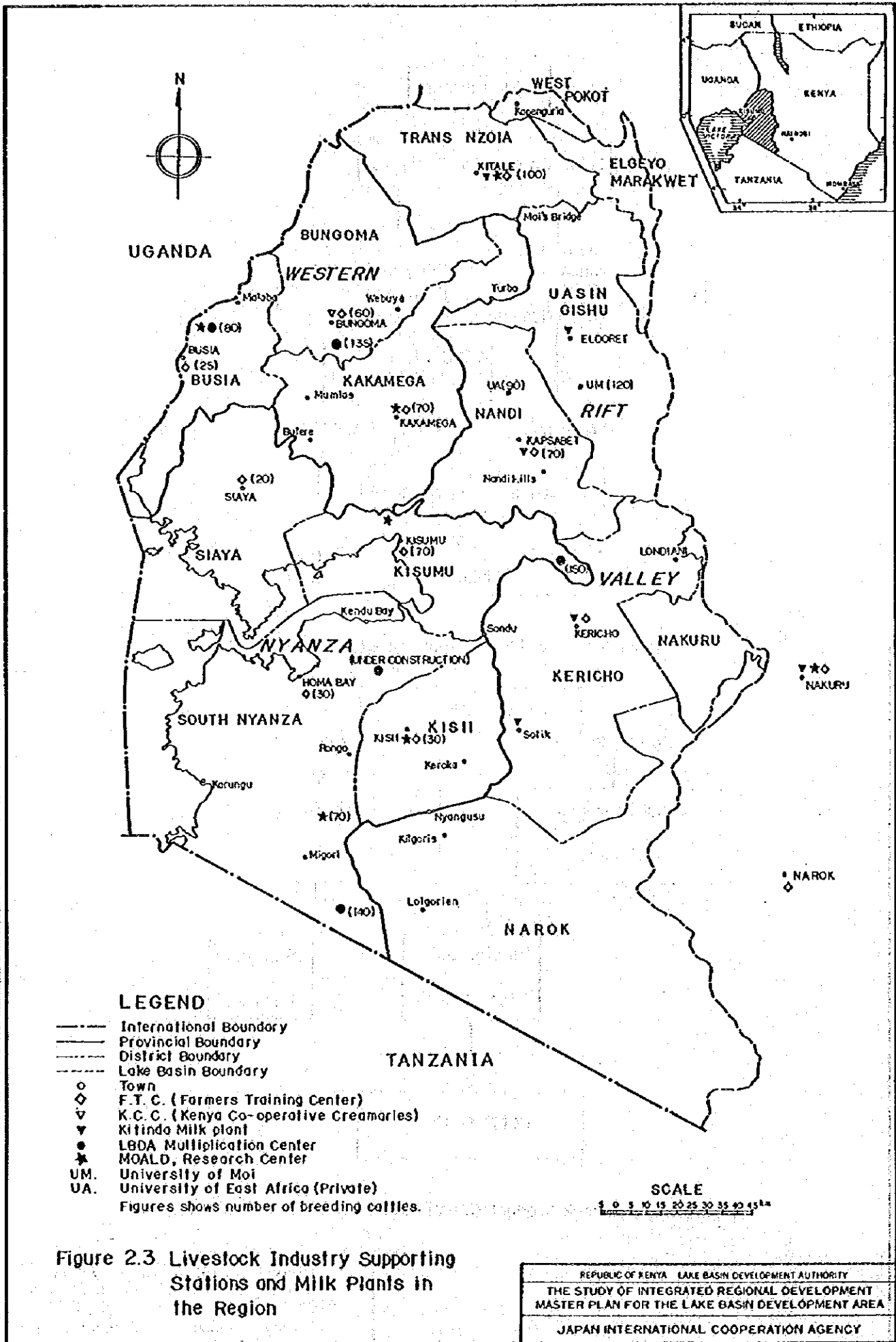


Figure 2.2 Livestock Products(Meat) Marketing Channel in the Region



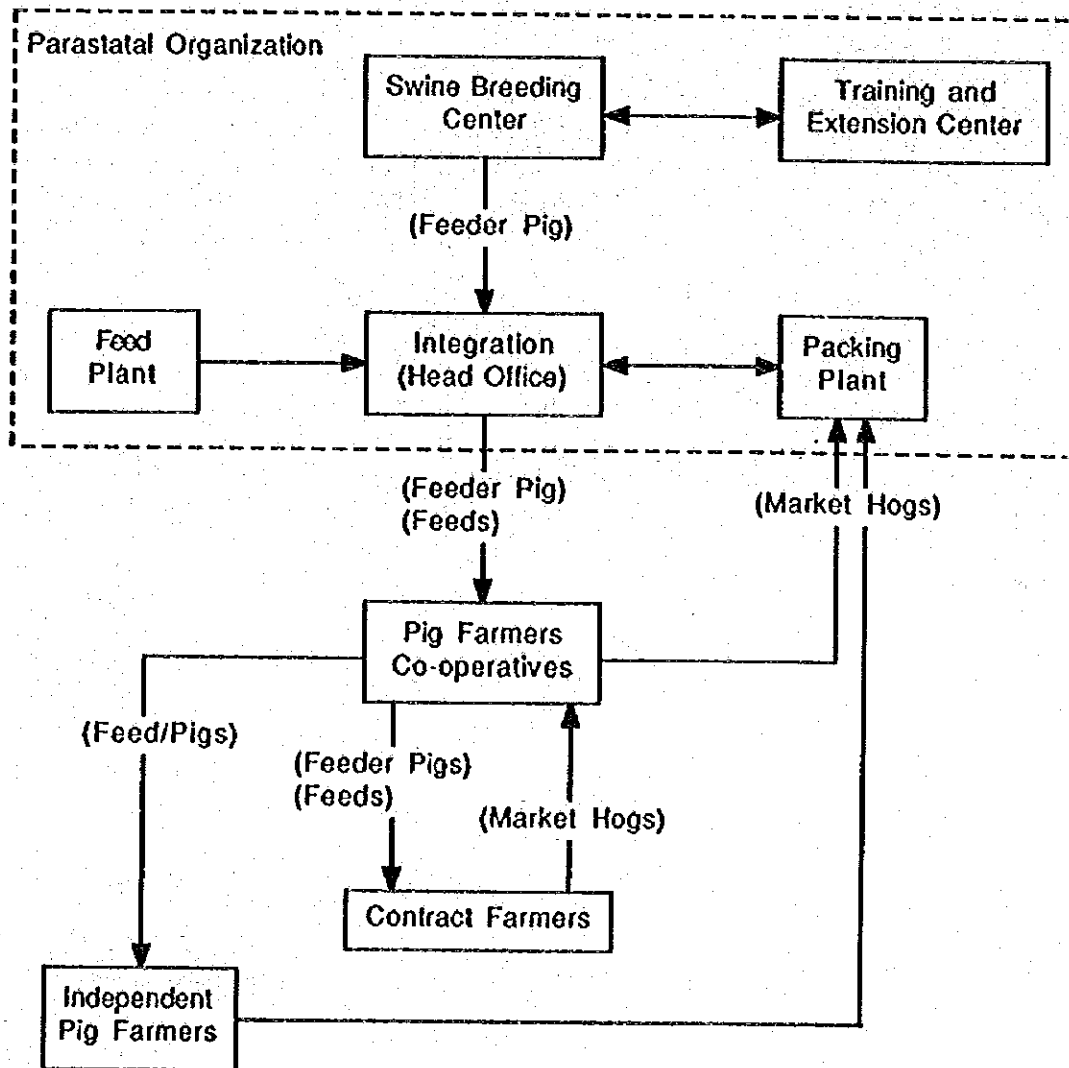


Figure 2.4 Inter-relationship of Pig Industry Components (Pig Integration Systems)

Chapter 3 FISHERY

This chapter presents the results of the fishery sector study, associated with the Integrated Regional Development Master Plan study for the LBDA region. In Section 3.1, existing conditions of the fishery sector are examined, including fish production, fishery activities, marketing and prices, and aquaculture. Section 3.2 presents the demand and supply prospects, covering the yield from Lake Victoria, fish protein requirements and regional/export demand for fish, and fish culture.

Section 3.3 is devoted to the fisheries development plan, which has been formulated and made consistent with the integrated regional development master plan for the entire Region. First, the objectives and basic strategy for fisheries development in the Region are clarified, and second, the development plan is presented, consisting of development projects and associated institutional measures, which together will satisfy the development needs identified.

Chapter 3 FISHERY

Contents

3.1 Present Situation	3-1
(1) Fish production	3-1
(2) Fishery activities	3-1
(3) Marketing and prices	3-2
(4) Aquaculture	3-3
3.2 Demand and Supply Pro spects	3-3
(1) Future yield from the Lake	3-3
(2) Demand	3-4
(3) Prospect of fish culture	3-5
(4) Demand/supply balance	3-6
3.3 Fisheries Development Plan	3-7
3.3.1 Objectives and strategy	3-7
(1) Objectives	3-7
(2) Basic strategy	3-7
3.3.2 Measures	3-7
(1) General	3-7
(2) Projects	3-8
(3) Institutional measures	3-9
References	3-11

Tables

Table 3.1	Fish Catch by Year in Kenya
Table 3.2	Annual Catch by Species from Lake Victoria and Percentage Composition
Table 3.3	Beach Value and Consumer Prices of Fish by Main Species
Table 3.4	Status of Fish Ponds in LBDA Region
Table 3.5	Fish Catch per Canoe and per Fisherman
Table 3.6	Exotic Fish Species Introduced in Kenya
Table 3.7	Agricultural By-Products and Food Ingredients which can be used in a Tilapia Diet

Figures

Figure 3.1	Locations of Fishermen's Cooperatives and Main Marketing Channels of Fish
Figure 3.2	Changes in Average Value of Fresh and Processed Fish on the Beach
Figure 3.3	Change of Catches by Species and shares of Predators and Non-Predators
Figure 3.4	Change in Annual Catches by Species
Figure 3.5	Change in Annual Catches by Non-Predators
Figure 3.6	Classification of Fresh Water Fish Culture
Figure 3.7	Flow of Fish in 2005

3.1 Present Situation

(1) Fish production

The fish production from inland fisheries has been covering 80-90% of total fish production in Kenya in recent years. The production of inland fisheries has been increasing rapidly, especially in the past decade; the production in 1985 was three times that of 1974. This has been achieved primarily by the dramatic increase of fish catch in Lake Victoria (Table 3.1).

The unit yield from the Lake increased from 40-80 kg/ha/year in 1970's to 234 kg/ha in 1985, one of the highest among lakes in Africa. Composition of fish species has drastically changed, following the artificial introduction of Nile perch (*Lates niloticus*) in 1960's. Nile perch, Dagaa (*Engraulicypris*), Tilapia spp (especially *T. nilotica*) and other mixed small fish have increased, while *Haplochromis* has decreased sharply (Table 3.2).

(2) Fishery activities

It is estimated by Fisheries Department of Ministry of Tourism and Wildlife that there are some 25,000 fishermen and 5,000 fishing boats along the Kenyan Lake shore. Estimates by a Nordic survey team give slightly different results with about 31,000 fishermen and 8,500 fishing boats in 1982.

There exist over 200 landing beaches along the Kenyan Lake shore. A sampling survey by Fisheries Department in 1985 shows that AESD Naya recorded the highest landings of the twelve sampling beaches with 2,778 tons, followed by Uhanya with 1,226 tons, while Kusa recorded the lowest catch of 101 tons. The district breakdown of the total catch of 88,585 tons in 1985 was 57.7% for Siaya, 20.3% for South Nyanza, 5.3% for Busia and 7.7% for Kisumu (Fisheries Statistics 1986).

Fishing gears currently used for fishing in Lake Victoria include gill net, beach seine net (gogo net), mosquito net, long line and others. Additionally, the Fisheries Department and Kenya Marine Fisheries possess four trawlers having tonnage from 7 to 20 tons, which are mainly used for survey and for research works. Gill nets are the most popular fishing gear used for catching Nile perch, Tilapia spp, etc. in Lake Victoria. Mosquito net which is normally mended with 1cm mesh net is used for Dagaa fishing. The lighting method for Dagaa fishing was introduced in recent years in Lake Victoria, and the increase in the catch of Dagaa is attributed to the introduction of mending and lighting method. However, the other fishing gears have not been changed much since 1960's.

The Nordic survey shows that there are 35 fisheries cooperatives along the Lake shore with 8,480 member fishermen. Some cooperatives provide valuable services to their members, the most useful one being to offer stable buying prices of fish on the beach. The cooperatives sell them on to traders, both local and from other regions. They usually charge admission fees. For instance at Mbita, they charge Kshs.20/= for a share, Kshs.5/= for administration and 10% of the catch which is credited to an account held in their name. Traders buying fish through cooperatives pay service charges to them.

However, there exists strong criticism on the activities of fishermen's cooperatives, saying that they do little more than providing a clerical service in return for the admission fees. There is no cooperative which has its own cold storage. It is estimated that the cooperatives deal only with less than 15% of the total catch (Poulter, 1981), and fishermen prefer to sell directly to traders to obtain better prices (Balarin, 1984).

(3) Marketing and prices

Of the total catch of 88,600 tons in 1985, 35,800 tons or about 40% were sold in fresh form, while 52,800 tons or about 60% in processed form. Most fish (over 97% of the total) was marketed. The fresh fish dominated the market until 1982, and thereafter the processed fish claims over 50% share at beaches (Lake Victoria Annual Fisheries Statistics Report, 1986).

Most fish locally processed takes the forms of sun-dried and smoked fish, although small quantity of frozen fillets is also produced at a filleting plant in Kisumu. All the fillet fish are made from Nile perch and Tilapia.

The fish landed in southern parts of Winam Gulf is either locally marketed or sent to Nairobi and Mombasa without passing through Kisumu city, while the fish landed in the northern parts is collected once in Kisumu for further distribution. Fish trades are handled by fishermen themselves, wholesalers or fish mongers who buy small quantities of fish and distribute to local markets. In addition, some fish companies in Nairobi and Mombasa buy the fish at beaches through fishermen's cooperatives, as mentioned earlier. Some cooperatives offer stable prices of fish to fishermen and sell to traders, both local and from outside. Main marketing routes and locations of fishermen's cooperatives are illustrated in Figure 3.1.

Since the dominance in the shares of fresh and processed fish in the total marketed fish was reversed in 1982, the value of processed fish at beaches has been comparatively more reduced than the value of fresh fish (Figure 3.2). The value of fresh fish is now almost twice as much as the value of processed fish. Average value of processed fish was Kshs.1.6 per kg in 1985 on the converted fresh fish basis, while that of fresh fish was Kshs.3.0 per kg.

At beaches, *Tilapia spp* (*Tilapia esculenta* and *Tilapia nilotica*) have the highest value at about Kshs.6.5 per kg. *Haplochromis*, Nile perch and *Engraulicypris* (Dagaa) are valued very low: Kshs.1.8 per kg for the first two species and Kshs.1.4 per kg for Dagaa.

Consumer prices of fish in markets of major cities are almost the same as the prices of beef. Fish preserved with ice and frozen fillets made from Nile perch and Tilapia fetch much higher prices than the beach prices (see Table 3.3).

Fish prices in Kenya are not Government controlled, and threefold disparity between wholesale and retail prices is not uncommon. The disparity is more serious with Nile perch, which is less popular among the people around the Lake. The fish is sometimes sold at throw-away prices. The value of smoked and dried fish produced around the Lake has been reduced recently as mentioned above. This implies that the current fish production is much

higher than what can be locally consumed or otherwise transported effectively to outer areas. These conditions indicate that there exist much needs for improving marketing systems for fish as well as for processing and cold storage facilities to expand the markets.

(4) Aquaculture

Fish culture is not indigenous in Africa. Some cold-water fish culture developed between the wars, but the introduction of warm water fish culture, mainly with Tilapia, took place principally between 1953 and 1960 (Meschkat 1960).

In Kenya rural fish pond culture started in the late 1940's but received greater impetus in 1960's when the Department of Fisheries launched an "East more fish campaign" and fish culture spread to various parts of Kenya including non-fish eating communities in the Central Province (UNDP/FAO/Norway, Aquaculture Thematic Evaluation Mission, 1985). Due to the campaign, the number of fish ponds had increased to some 32,000 ponds by 1965 (Balarin, 1985). The size of most ponds was very small being about 100 m². The main purpose of this campaign was to improve the nutrition of the farmers by producing fish from the ponds for their consumption.

Most of the small-scale Tilapia ponds that were established in Western and Nyanza Provinces up to 1965 following the campaign by the Department of Fisheries have been abandoned (FAO/World Bank, 1978). A recent report on the status of ponds, stocking and harvesting in the LBDA region indicates the presence of 4,842 fish ponds having the total of 59 hectares (see Table 3.4). The average size of ponds is 121m² with an average production of 1.2 tons/ha.

LBDA has a plan to rehabilitate existing fish ponds and to establish commercial fish farms and fish fry production centers. Production targets by 1990 set in its current five-year plan are 3,000 tons by rehabilitated fish ponds, 25,000 tons by commercial fish farms and 8,500 tons by the fish fry production centers. Implementation, however, is far behind the schedule.

3.2 Demand and Supply Prospects

(1) Future yield from the Lake

Possible production of fish from Lake Victoria constitutes a basis for drawing up the development plan including both Lake fishery and fish culture. Several studies in the past estimated the maximum sustainable yield in the Kenya portion of Lake Victoria as summarized below, but all of them have been surpassed by the actual catches since 1981. The total catches reached 88,600 tons in 1985.

Estimated Maximum Sustainable Yields in the Kenya Portion of Lake Victoria

Estimated Yield (tons/year)	Source
28,000 - 40,000	Rhodes (1966)
25,000 (8% of Total Lake)	Butcher and Colaris (1975)
20,000 (approximate)	Kongere (1979)
46,000 (approximate)	Coche and Balarin (1982)
26,000 (approximate)	Zonneveld (1983)

(Source: Zonneveld 1985)

Recently many arguments have been made not only in Kenya but also in Europe, America and Japan, regarding the yield from the Lake and ecological aspects of increasing production. The arguments are complicated by the fact that the Winam Gulf, which is responsible for the major portion of fish catches, is not a closed and stable water body, as its water is turned over every few years by the inflow from rivers, and the introduction of Nile perch in 1960's has drastically changed its ecosystem.

Although the sufficient data for estimating future yields from the Lake are not available at this time, the following points may be noted as related to possible yields.

- 1) The catches of both predator and non-predator species have increased (Figures 3.3 - 3.5).
- 2) Nile perch has ousted other predators (Figure 3.4).
- 3) Fishing efficiency has much increased, as represented by increased catch per canoe (Table 3.5).
- 4) The yield per hectare in the Kenya portion of Lake Victoria has reached one of the highest among lakes in Africa (234 kg/ha in 1985).

These points seem to suggest that the catch from the Lake may be sustained at least for some years, but higher yields cannot be expected. The total annual catch from the Lake would vary between 40,000 tons (100 tons/ha) and 95,000 tons (250 tons/ha) in the future. For the planning purpose, the annual catch from the Lake is set at 70,000 tons to be sustained through the year 2005.

(2) Demand

The total consumption of fish in the LBDA region was estimated at 24,500 tons in 1981 (Balarin, 1985). This corresponds to about 55% of the fish protein requirement in the Region, based on the FAO guideline of 9.5 kg per capita annual requirement. It is assumed that this ratio will be sustained in the future, since some people in the Region do not much relish fish and other sources of animal proteins will become increasingly more available. Thus the total demand for fish in the Region is calculated to be about 85,000 tons in 2005.

At present, some fish companies located in Nairobi and Mombasa send their own insulated trucks to the main fishing beaches such as Karungu, Homa Bay, Kendu Bay and Usenge Beach and buy fish through fishermen's cooperatives. Some portion of the fish is

processed into fillets and exported to Europe, Middle East and other places. The rest is sold in Nairobi or in Mombasa as fresh fish. The total processing capacity may be about 32.5 tons/day or about 10,000 tons/year in weight of whole fresh fish, but less than 5,000 tons are supplied annually by the Lake fish, for the processing facilities are shared by sea fish, too. The total consumption outside the Region is estimated at about 10,000 tons per year.

The demand for Lake fish outside the Region is expected to increase significantly, and it is estimated to reach 25,000 tons per year by 2005, if proper production and marketing channels are warranted.

(3) Prospect of fish culture

The fish species which are used for fish farming in Kenya are mainly *Tilapia* spp, trout spp, common carp and mirror carp. Some of them are exotic species (Table 3.6). Those species are cultured in many other countries in the World and the culture methods have already been established. Present methods of fresh water fish culture can be classified into two categories: namely feeding and non-feeding (manuring) cultures (Figure 3.6).

Although the polyculture method using Chinese carp and Indian major carp is still keeping in with their ideal productivity, it requires a larger fish pond together with empirical culture methods and a hormone inducement method for the production of fingerlings.

Feeding culture has some advantages in the Region. First, it would fit better to farmers having smaller ponds. Second, the Region is rich in raw materials for feed including various brans, oil crop cakes, pollards, livestock wastes and brewery wastes. Third, this method would involve the least conflict in land and water use, as it can be practiced in various water bodies such as lakes, rivers, irrigation canals, and dams by adopting cage net culture, running water culture and others. The productivity of 5 tons per ha or even more can be achieved by this method.

Non-feeding (manure) culture cannot be ignored in the Region. Although the productivity is generally low (2 tons/ha at best), it can be relatively easily practiced by small farmers primarily for home consumption. Such activities may be combined with small stock raising of pigs and poultry (Chapter 2, Sector Report).

There exist two main livestock feed industries located in Nakuru and Mombasa, with the production capacity of 3 tons per hour of 3 mm pellet. There is another factory in Kisumu, but the production capacity is only 5 tons of pelleted feed per day.

A variety of by-products are available for the production of fish feeds in Kenya and in the Region, such as various brans, cakes, pollard and brewer wastes. Zonneveld (1985) carried out a survey of agricultural by-products which can be used as feed ingredients in a *Tilapia* diet (Table 3.7). The quality of stockfeeds is also important to increase productivity in aquaculture. Protein content of some 30% would generally be required. Crude protein contents vary widely among potential feed materials from some 8% for maize bran to over 50% for blood and bone meal and fish meal. Most oil seeds and cakes have contents in the range of 30-45%.