



REPUBLIC OF KENYA

LAKE BASIN DEVELOPMENT AUTHORITY

**THE STUDY
OF
INTEGRATED REGIONAL DEVELOPMENT
MASTER PLAN
FOR
THE LAKE BASIN DEVELOPMENT AREA**

FINAL REPORT

Volume 6

SECTOR REPORT 4

LAND USE/HUMAN RESOURCES

October 1987

JAPAN INTERNATIONAL COOPERATION AGENCY

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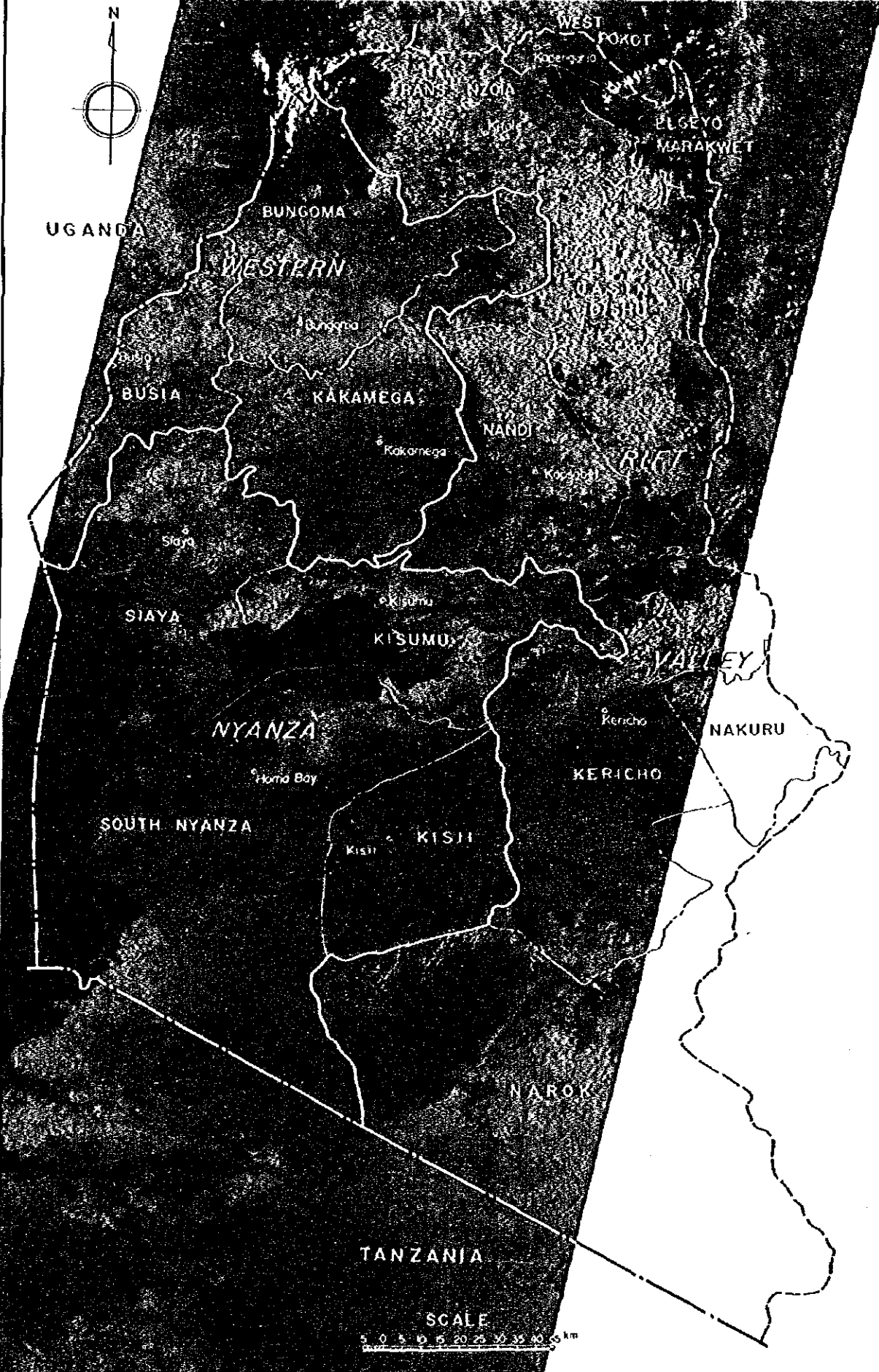
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LANDSAT IMAGE OF LAKE BASIN DEVELOPMENT AREA



UGANDA



TANZANIA

SCALE

5 0 5 10 15 20 25 30 35 40 55 km

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Abbreviations

ACFC	Agro-Chemical and Food Company	ICIPE	International Center for Insect Physiology and Ecology
ADT	Average Daily Traffic	ICOR	Incremental Capital-Output Ratio
AED	African Economic Digest	IDA	International Development Association
AESD	Agricultural Extension and Service Division	IDB	Industrial Development Bank
AFC	Agricultural Finance Corporation	IDS	Institute of Development Studies
AI	Artificial Insemination	IB	Industrial Estate
AIRS	Ahero Irrigation Research Station	IFAD	International Fund for Agricultural Development
BAT	British American Tobacco Kenya Ltd.	ILO	International Labour Organization
BOD	Biochemical Oxygen Demand	ILUS	Integrated Land Use Survey
CBK	Coffee Board of Kenya	IPA	Industrial Promotion Area
CBS	Central Bureau of Statistics	IRD	Integrated Rural Development
CL SMB	Cotton Lint and Seed Marketing Board	IRRI	International Rice Research Institute
CPCS	Cooperative Production Credit Scheme	IRS	Integrated Rural Survey
DAO	District Agricultural Officer	JICA	Japan International Cooperation Agency
DC	District Commissioner	JSCB	Japan Society of Civil Engineers
DCDC	District Community Development Committee	KCC	Kenya Cooperative Creawerdes
DDC	District Development Committee	KCPE	Kenya Certificate of Primary Education
DEC	District Executive Committee	KENAFYA	Kenya - Finland
DEO	Division Extension Officer	KENGO	Kenya Energy Non-Governmental Organizations Association
DFCK	Development Financial Company of Kenya	KETA	Kenya External Trade Authority
DME	Distance - Measuring Equipment	KFA	Kenya Farmers Association
DO	District Officer	KGGCU	Kenya Grain Growers Union
EAI	East African Industries Limited	KIB	Kenya Industrial Estates Limited
EATEC	East African Tanning Extract Company Limited	KITI	Kenya Industrial Training Institute
EEC	European Economic Community	K£	Kenya Pounds (20 Kenya shillings)
EIU	Economic Intelligence Unit	KMC	Kenya Meat Commission
ESMAP	Energy Sector Management Assistance Programme	KNAIS	Kenya National Artificial Insemination Service
FAO	Food and Agriculture Organization of the United Nations	KPCU	Kenya Planters Cooperative Union
FISS	Farm Input Supply Scheme	KPLC	Kenya Power and Lighting Company Limited
FMD	Foot and Mouth Disease	KQ	Kenya Airways
GDP	Gross Domestic Product	KRC	Kenya Railways Corporation
GRDP	Gross Regional Domestic Product	KREDP	Kenya Renewable Energy Development Programme
GTZ	German Agency for Technical Cooperation	KSA	Kenya Sugar Authority
HCDA	Horticultural Crops Development Authority	KSB	Kenya Sisal Board
HFA/2000	Health for All by the Year 2000 AD.	KSC	Kenya Seed Company
IADP	Integrated Agricultural Development Program	Kshs	Kenya Shillings
IBRD	International Bank for Reconstruction and Development	KSS	Kenya Soil Survey
ICA	International Coffee Agreement	KTDA	Kenya Tourism Development Authority
ICDC	Industrial and Commercial Development Corporation	KTDA	Kenya Tea Development Authority

KWDP	Kenya Woodfuel Development Project	SP1	Sessional Paper No.1 of 1986 on Economic Management for Renewed Growth
LBDA	Lake Basin Development Authority	SPSCP	Smallholder Production Services and Credit Scheme
LPG	Liquefied Petroleum Gas	SRRP	Smallholder Price Rehabilitation Project
LSI	Lake Shore Irrigation	SSIOP	Small Scale Irrigation Development Project
LU	Livestock Unit	SWAP	Surface Water Extraction Permit
MCH/FP	Maternal Child Health/Family Planning	T&V	Training and Visit
MOLG	Ministry of Local Government	UNDP	United Nations Development Programme
MOA	Ministry of Agriculture	UNESCO	United Nations Educational, Scientific, and Cultural Organization
MOALD	Ministry of Agriculture and Livestock Development	UNCEF	United Nations International Children's Emergency Fund
MOERD	Ministry of Energy and Regional Development	UNIDO	United Nations Industrial Development Organization
MOEST	Ministry of Education Science and Technology	USAID	United States Agency for International Development
MOH	Ministry of Health	VOR	Very High Frequency Ommidirectional Radio Range
MOLD	Ministry of Livestock Development	WHO	World Health Organization
MOPND	Ministry of Planning and National Development		
MOTC	Ministry of Transport and Communication		
MOWD	Ministry of Water Development		
MP	Member of Parliament		
MSC	Mumias Sugar Company		
MSS	Multispectral Scanner		
MSY	Maximum Sustainable Yield		
NCC	National Construction Corporation		
NCPB	National Cereals and Produce Board		
NCST	National Council for Science and Technology		
NEP	National Energy Policy		
NEP	National Extension Project		
NGO	Non-Governmental Organization		
NIB	National Irrigation Board		
NMWP	National Master Water Plan		
NSCC	New Seasonal Credit Scheme		
OD	Origin-Destination		
OECD	Organization for Economic Cooperation and Development		
PBME	Project Benefit Monitoring and Evaluation		
PC	Provincial Commissioner		
PCU	Passenger Car Unit		
PHC	Primary Health Care		
PIU	Provincial Irrigation Unit		
RAES	Rural Afforestation Extension Service		
RIDC	Rural Industrial Development Center		
ROK	Republic of Kenya		
RTPC	Rural Trade and Production Center		
RWSDP	Rural Water Supply Development Project		
SCIP	Smallholder Coffee Improvement Project		
SEFC	Small Enterprise Financial Corporation		
SEP	Special Energy Programme		

Abbreviations of Measures

Length

mm	=	millimeter
m	=	meter
km	=	kilometer

Area

ha	=	hectare
km ²	=	square kilometer

Volume

ℓ	=	lit = litre
m ³	=	cubic meter
MCM	=	million cubic meter

Weight

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

Time

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

Money

Kshs.	=	Kenya shilling
K£	=	Kenya pound
US¢	=	U.S. cent
US\$	=	U.S. dollar

Energy

kcal	=	kilocalorie
J	=	joule
MJ	=	megajoule
HP	=	horsepower
TOE	=	tons of oil equivalent
kW	=	kilowatt
MW	=	megawatt
kWh	=	kilowatt-hour
GWh	=	gigawatt-hour

Others

%	=	percent
°	=	degree
'	=	minute
°C	=	degree Celsius
cap.	=	capita
LU	=	livestock unit
md	=	man-day
mil.	=	million
no.	=	number
pers.	=	person
PCU	=	passenger car unit

CHAPTER 10 LAND USE

This chapter presents the results of sector study of land use, conducted as a part of the Integrated Regional Development Master Plan study for the Lake Basin Development Authority region. The study has been based primarily on existing study reports and maps, but some additional data and information were also obtained from interview with officials of various government agencies. Also supplemental field surveys were carried out to selected areas for on-site examination of soil, vegetation and land use.

In Section 10.1, the present land use is examined, focusing on uses for agricultural purposes. Section 10.2 presents the procedure and the results of land evaluation. Based on this land evaluation, the alternative agricultural land development schemes are drawn up in Section 10.3 in line with two scenarios and frameworks for the Region's development presented in the Master Plan Report. Referring to these alternative schemes, the general land use plan is prepared, consistent with the recommended development framework of the Master Plan. Section 10.4 presents the general land use plan for the Region as a whole and describes it also by district.

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10.1 Present Land Use

10.1.1 Land use pattern

Present land use conditions of the Lake Basin Development Authority region (herein called the Region) are as described in the following. Out of total land area of the Region of 4,771,000 ha, 3,924,000 ha excluding the area belonging to the Mara river basin was surveyed in 1983 under the Integrated Land Use Survey (ILUS). This area is herein called the ILUS area. The remaining part of 847,000 ha is called the Mara river basin. The present land use condition of the Mara river basin was estimated on the basis of Narok District Development Plan 1984/1988 and Landsat Multispectral Scanner (MSS) images. The location of the ILUS area and the Mara river basin are illustrated in Figure 10.1. Due to difference in availability of the existing data, the present study deals with these areas separately.

As presented in Table 10.1, out of 4,771,000 ha of the Region, agricultural land occupies 1,549,000 ha, natural vegetation land 2,950,000 ha and infrastructure and miscellaneous land 272,000 ha. The distribution of natural vegetation is presented in Table 10.2. Grass coverage of 1,219,000 ha in the ILUS area occurring in all categories of natural vegetation land except for forest are mostly utilized for cattle grazing.

The composition of agricultural land in the ILUS area is presented in Table 10.3. The agricultural land comprises cultivated land, field borders, fallow land and managed pasture. About 39% of the ILUS area is used for agricultural purposes. It is notable that 65% of the district land of Kisii is utilized for agriculture. In contrast, Narok shows the low proportion of 11%. About 1,209,000 ha or 79% of the total agricultural land are being cultivated. The spatial distribution of active cultivation areas is illustrated in Figure 10.2.

Fallow lands were identified through ILUS with a total area of 306,000 ha. However, the planted areas of cotton, beans and others recorded in the annual reports of Ministry of Agriculture and Livestock Development (MOALD) indicate that 170,000 ha out of 306,000 ha are considered as actively cultivated with these crops. It is estimated that the remaining 136,000 ha or 9% of the total agricultural land are fallow land. Western Province shows the higher proportion of fallow accounting for 17%.

Livestock production is another important activity in terms of land use pattern. The leading dairy zone is the highland of Rift Valley, where grade cattle of exotic breed have been introduced from the temperate countries. The districts concerned are Kericho, Uasin Gishu, Nandi and Trans Nzoia. In these districts, development of managed pasture has been encouraged. The total area of managed pasture amounts to 165,000 ha. In contrast, the extent of managed pasture is limited in Nyanza and Western Provinces where local cattle are prevailing. They are generally raised in natural grassland and fallow land.

A composition of cultivated land is presented in Table 10.4. Out of the total cultivated land, 730,000 ha or 60% are used for staple crop production, and 327,000 ha or 27% for cash crop production. Although the production of horticultural crops is promoted by the Government, their planted area is still low in every district. In addition, 139,000 ha are utilized for fodder crop production for cattle raising.

10.1.2 Spatial distribution of crops

(1) Land use intensity

Figure 10.3 (Figure 4.2 in Master Plan Report) shows the spatial distribution pattern and intensity of crop production. The size of each square is 5 km x 5 km (2,500 ha) and the representative crop is indicated for each square. Land use intensity is classified into four grades using an indicator of active cultivation percentage. As described in subsection 10.2.3 (1), a square containing more than 40% of active cultivation land is considered almost saturated and has no expansible area for agricultural land development.

There are some zones, which are intensively used for crop production. The south-western parts of Kisii are used for intensive maize production. Adjacent to this zone to the west is a sugarcane zone for the SONY sugar factory in South Nyanza. The northern parts of Kisumu are also covered by sugarcane. Some patches in the south Nandi and in the central Kericho, are tea estates. A large portion of Uasin Gishu is cultivated with wheat. The footslopes of Mt. Elgon, i.e. Bungoma and Kitale, are covered by maize. Kakamega can be characterized by sugarcane in the western parts and maize in the southern parts. In contrast, the Lake shore is sparsely used for crop production. The intensity of land use is lower in the south-western parts of Busia and Siaya, Kano Plain of Kisumu and the western South Nyanza. The main crops there are maize, cotton and cassava.

Associated with the grade cattle rearing, the managed pastures are widely distributed in the districts of Rift Valley Province, especially in the southern Kericho and the central Nandi.

(2) Staple crops

About 730,000 ha or 60% of the total cultivated land is used for staple crop production. Particularly maize is prevailing. Maize fields extend to every corner of the Region with a total area of 455,000 ha. Main producing districts are Uasin Gishu, Trans Nzoia, Bungoma, South Nyanza, Kakamega and Kisii occupying 65% of the total maize fields in the Region as presented in Table 10.5.

Sorghum and finger millet are characterized by their high drought resistance. Although their production level is much lower than that of maize, they are grown as supplemental diet especially in dry zones. Out of the total planted area of 58,000 ha, 35,000 ha or 60% are in South Nyanza and Siaya.

As a protein source, beans are widely planted in the Region. In many cases, they are planted under the intercropping system with maize, especially in small farms in Nyanza and Western Provinces, covering 79,000 ha or 87% of the total beans area.

Endowed with fertile soils along the shores of Lake Victoria, the wetland rice cultivation has been practiced. Three large scale rice irrigation schemes are managed under National Irrigation Board (NIB). They are Ahero Scheme (840 ha) and West Kano scheme (920 ha) in Kisumu, and Bunyala scheme (220 ha) in Busia. Besides, Provincial Irrigation Unit (PIU) also plays a nucleus role for village level irrigation. These small schemes with area

less than 100 ha are distributed along the Lake shore in Kisumu and in the valley bottoms in Busia and South Nyanza. The total planted area is 1,870 ha.

Such root crops as cassava and sweet potatoes are widely planted in the Region. They are important crops in cases of crop failures by drought. South Nyanza, Busia and Siaya are main producer districts. The total planted area is 92,000 ha. Other staple crops are represented by banana, which occupies more than 90% of other staple crop area of 31,000 ha. The main producer is Kisii district.

(3) Cash crops

In addition, 327,000 ha or 27% of the total cultivated land is used for cash crop plantations as presented in Table 10.6. Coffee production is promoted in several districts. Under the favourable climate, Arabica coffee is produced in Kisii, Bungoma and Kericho. Out of 13,000 ha of coffee area in the Region, 10,000 ha or 80% concentrate in these districts. Recently Robusta coffee was introduced in South Nyanza and Kisumu, but their planted area is still limited.

Tea production is practiced mainly in the humid highland of the Region. Large scale tea estates are managed in Kericho and Nandi with the total area of about 30,000 ha. Besides, tea production by small growers are also carried out mainly in Kisii for 18,000 ha.

Cotton production is represented by South Nyanza, Siaya, Kisumu and Busia districts. Out of the total cotton area of 49,000 ha, South Nyanza district claims 24,000 ha or 49%.

Sugarcane is one of the most important crops in the Region with a total planted area of 109,000 ha. The main producing zones are Nyanza Sugar Belt in Kisumu, Mumias in Kakamega, Nzoia in Bungoma and Awendo in South Nyanza, where 82,000 ha or 75% of sugarcane fields are maintained.

Demand for wheat, barley and oats has been increasing in Kenya at a high rate, keeping step with the urbanization. Generally these cereals are categorized into food crops, but in Kenya they are produced as cash crops or import substitute crops. Large scale mechanized wheat production is operated in Uasin Gishu, Trans Nzoia and Narok. Out of 92,000 ha of the total wheat, barley and oat area, 71,000 ha or 77% are in Uasin Gishu.

Other cash crops include pyrethrum, sunflower, groundnut and tobacco. Their total planted area is 16,000 ha or 5% of the total cash crop area.

10.1.3 Constraints

The present land use patterns reflect several constraints to the rationalized land use to be envisaged for the future under the Master Plan. The major constraints are summarized below.

(i) Agro-climate: The spatial distribution of land use types is highly coincident with rainfall distribution pattern in the Region. The high altitude areas, namely highland or high

potential area, are generally used for intensive crop production. On the other hand, the lower midland, e.g. the Lake shore, suffers from seasonal drought and has been sparsely utilized for crop production as well as cattle grazing.

(ii) Land tenure: Land tenure system restricts land use pattern in the Region. As described in subsection 1.1.3 in Chapter 1, the land tenure and land holding size in Rift Valley are different from those in Nyanza and Western Provinces. The farm land in Rift Valley is generally more productive than in the other two provinces due to larger land holding size and the favourable agro-climate. Parts of such farm land in Rift Valley are still used for large scale ranching.

(iii) Fallow land: A considerable portion i.e. 9% of agricultural land, as estimated through ILUS and the present study, still remains as fallow. As mentioned in subsection 1.3.2 in Chapter 1, the peak labour requirement occurs in March to April, when land preparation is practiced for the long rainy season crops. Due to hard consistency of soils and lack of agricultural implements, some farm land cannot be cultivated. Although fallow land supplies supplemental feed source for cattle, sheep and goats, such land is exposed to soil erosion hazard. More intensive use of land resources should be considered to achieve rationalized land use in the Region.

(iv) Natural grazing: The sector study on Livestock in Chapter 2 reveals that about 1,400,000 ha or 70% of the natural grassland are utilized for grazing purposes. Grazing of local cattle and other small stock is quite prevailing especially in Nyanza and Western Provinces, where managed pasture is limited and over-grazing is observed. To develop the livestock sector, the well-considered land use plan is essential taking account of the integration with activities in other sectors.

These constraints prevailing in the Region are further examined in the sector study of Agriculture to establish the agricultural development plan as well as the rationalized land use plan.

10.2 Land Evaluation

10.2.1 Objectives

Agriculture will continue to prevail in the Region for years to come. No structural change is expected in urban and transportation systems, which have developed rather incidentally with agricultural development in the Region. Land occupied by infrastructure is small and there is no large industrial estate existing or envisaged. With these considerations in mind, a general land use pattern is envisaged assuming that the existing agricultural land will serve for the same purpose and other land will be developed mostly for agricultural production to the extent possible.

The objective of the present land evaluation is to clarify the size and distribution of potential agricultural land or the expansible area for future agricultural development in the Region. Land evaluation is the process of collating and interpreting basic information related to land

productivity such as climate, topography, soil, present land use conditions, natural vegetation etc. in order to identify and compare the possible land use alternatives

Socio-economic features of land are also important elements for land use planning. These socio-economic features include the population distribution, location of market centers and transport network. The present land evaluation, however, deals mainly with natural land elements for the purpose of indicating physical land potentials and limitations in agricultural development of the Region.

10.2.2 Methodology

The expansible areas for agricultural land development are virgin land, which is covered by grassland and/or light bush. The constraints considered are forest, national parks and game reserves, land gradient and existing land use intensity. No agricultural land development is assumed in the land covered with forest or registered as national park or game reserve. Steep land and existing agricultural land already intensively used and land occupied by infrastructure are eliminated from expansible area.

The general procedure of the present land evaluation is illustrated in Figure 10.4 and is described below.

- i) Selection of land elements for evaluation of potential agricultural land. The following land elements are selected as mentioned above.
 - Land gradient
 - Existing land use intensity
 - Land use control
 - Agro-ecological zoning
 - Soil conditions
- ii) Construction of the grid (mesh) on the existing topographic map with a scale of 1:250,000 in order to apply the study result of ILUS to the present land evaluation.
- iii) Preparation of the following thematic maps.
 - Land gradient map using grid system of 1.25 km x 1.25 km mesh
 - Land use intensity map using grid system of 5 km x 5 km mesh
 - Land use control map using grid system of 1.25 km x 1.25 km mesh
- iv) Overlay of three thematic maps.
- v) Extraction of the expansible areas, which have no limitation with respect to steepness and land use control, and are not saturated by the existing farm land and infrastructure.

- vi) Computation of potential area for the future expansion with specific crops taking the existing agro-ecological zoning map into account.
- vii) Evaluation of soil suitability of expansible area.

10.2.3 Land elements and data availability

(1) Land gradient

Land gradient is one of the most important land elements for selection of expansion area for agriculture. In view of high erosion susceptibility and low workability, the steep lands should be eliminated from future agricultural land development.

ILUS compiled the slope classification map using the grid system of 5 km x 5 km (2,500 ha) mesh, and concluded that 19% of the ILUS area is relatively flat with slopes less than 2% and the great majority, i.e. 78%, of the ILUS area have mean slope gradients between 2 and 16%.

Since the mesh size of 2,500 ha applied in ILUS is too large to judge the agricultural suitability with respect to land gradient, more detailed analysis has been done in the present study in order to identify unsuitable sloping lands more precisely. Based on the Reconnaissance Soil Map of the Region with a scale of 1:250,000 prepared by W. Andriess et al which indicates not only soil characteristics but also slope classes, the slope classification map was prepared as presented in Figure 10.5.

Constructing the grid of 5 mm x 5mm mesh on the above soil map, which coincides with 1.25 km x 1.25 km (156 ha) on the ground, each mesh was classified into the following slope classes.

1.	0 - 2%	flat to very gently undulating
2.	2 - 5%	gently undulating
3.	5 - 8%	undulating
4.	8 - 16%	rolling
5.	16 - 30%	hilly
6.	> 30%	steep
7.	unspecified	mountain and hills

According to Kenya Soil Survey (KSS), the land with more than 8% in slope is classified into unsuitable land for irrigation farming of upland crops, e.g. maize, cotton, etc. However, there is no established land slope criteria for rainfed farming. Taking account of land gradient of the present crop fields in Kisii district, the land with slopes less than 16% (classes 1 to 4) may be regarded as suitable land for rainfed farming, but class 4 (8-16%) is probably marginal and will require soil conservation measures.

Although the slope for class 7 cannot be specified, this class was judged as unsuitable for agriculture in the present study. Results of slope classification are presented in Table 10.7 and summarized below.

Slope class		Area (1000ha)	Proportion (%)
1.	0 - 2%	415	9
2.	2 - 5%	1,317	27
3.	5 - 8%	1,308	27
4.	8 - 16%	812	17
5.	16 - 30%	275	6
6.	> 30%	39	1
7.	mountain and hill	605	13
Total		4,771	100

(2) Land use intensity

The lands actively used for agriculture or occupied by infrastructure are eliminated from the expansible area. In order to find out the land remaining for expansion, the density of actively cultivated area available for the ILUS area is converted to the density of area occupied by agriculture and infrastructure. According to the ILUS study, actively cultivated area occurs with an average density of 26.45 ha/km². It is calculated from the land use data that agricultural land and infrastructure occupy 38.96 ha/km² and 5.97 ha/km² on an average, respectively. It is assumed therefore that the agricultural land and the infrastructure occupy 44.93 ha/km², when the density of actively cultivated area is 26.45 ha/km², giving the average ratio of 1.7 to 1.

Applying this ratio, the density of active cultivation is simply converted to the total land use intensity as presented in Table 10.8. Class 5 indicates that more than 80% of the land is intensively used and no room remains for expansion. On the other hand, classes 1 to 4 have still expansible area up to the level of class 5. Table 10.9 presents the total land use intensity by district.

(3) Land use control

In selecting the expansion land, the government land use control applies mainly for forest and national parks. In the Region, there are some gazetted forests, such as Mt. Elgon forest, Mau forest, Nandi forest, Trans Mara forest and Kakamega forest under the management of Ministry of Lands, Settlement and Physical Planning. There are also three major national parks or game reserves, namely Masai Mara, Mt. Elgon and Lambwe Valley. Their location and extent are illustrated in Figure 10.7. Such government lands are not available for smallholder registration and shall remain as they are. Therefore, those lands are excluded from the expansible area.

Based on 1:250,000 topographic map, the location and extent of national parks are checked. Besides, forest coverage is delineated on the Landsat MSS images prepared by the JICA Study Team. The total coverage of forest is 537,000 ha, of which 430,000 ha are in the ILUS area. Masai Mara, the largest game reserve in the Region, has a total extent of

167,000 ha in the Mara river basin. Other two national parks exist in the ILUS area with total area of 119,000 ha.

(4) Agro-ecological zone

MOALD has introduced the agro-ecological zoning system for the purpose of assessing the climatic suitability for various land use alternatives with emphasis on the suitability for particular crops and crop varieties. The assessment is made on the basis of annual mean air temperature (T) and moisture availability (r/Eo) as follows.

Temperature (T)

Temperature belts are defined on the basis of annual mean air temperature as follows, which largely coincides with altitude:

Belt 1	TA	Tropical Alpine	2 - 10°C
Belt 2	UH	Upper Highlands	10 - 15°C
Belt 3	LH	Lower Highlands	15 - 18°C
Belt 4	UM	Upper Midlands	18 - 21°C
Belt 5	LM	Lower Midlands	21 - 24°C

Moisture Availability (r/Eo)

Moisture availability zones are defined on the basis of the precipitation / evaporation index (r/Eo) as follows:

Zone 0	Perhumid	$1.00 < r/Eo$
Zone 1	Humid	$0.80 < r/Eo < 1.00$
Zone 2	Sub-humid	$0.65 < r/Eo < 0.80$
Zone 3	Semi-humid	$0.50 < r/Eo < 0.65$
Zone 4	Transitional	$0.40 < r/Eo < 0.50$
Zone 5	Semi-arid	$0.25 < r/Eo < 0.40$
Zone 6	Arid	$0.15 < r/Eo < 0.25$

The combination diagram of temperature belts and moisture availability zones is presented in Figure 10.8. The names of crops are used only for indicating the agro-ecological zones in the diagramme. In the Region, 20 main zones are identified in the ILUS area. The distribution patterns of the zones are presented in Table 10.10. The agro-ecological features of the Region are outlined in the following paragraphs.

(i) Busia, Siaya, Kisumu and South Nyanza districts

Due to low moisture availability, the agricultural potential along the Lake shore is generally low and only drought resistant crops such as sorghum, millet and cotton can be successfully cultivated. The large portion of the Lake shore area is classified into the semi-humid to semi-dry lower midland zones (LM3, LM4 and LM5), with the total extent of 734,000 ha accounting for 56% of the total land of four districts combined. Due to much sunshine and fertile soils on the flat lowlying terrain, the area is highly suitable for rice and cotton. In

fact, the high irrigation potentials have been identified along the Lake shore, where water resources are available. At some distance from the Lake shore occur the sub-humid Marginal Sugarcane Zone (LM2) of 282,000 ha and the humid Sugarcane Zone (LM1) of 155,000 ha covering these districts.

(ii) Kakamega district

Being fed by high precipitation, an area of 228,000 ha or 62% of Kakamega district lies on a relatively high potential land, which is classified into Sugarcane Zone (LM1) and Coffee-Tea Zone (UM1). Kakamega forest reserve occupies the central part of UM1 along the Nandi escarpment. In the northern part of the district, Sunflower-Maize Zone (UM4) extends toward Trans Nzoia.

(iii) Nandi, Uasin Gishu and Trans Nzoia districts

As a result of syntectonic movement, these districts show the high complexity in topography. Up-and-down features of land coincide with patches of various agro-ecological zones.

Receiving a fairly high rainfall, the south-eastern side of Nandi district is quite suited to tea production. The lands are classified into Coffee-Tea Zone (UM1) of 47,000 ha and Tea-Dairy Zone (LH1) of 33,000 ha, but their large portion is covered by forest reserve.

The northern Nandi and the northern Uasin Gishu are the largest Wheat/Maize-Barley Zone (LH3) in Kenya with a total extent of 273,000 ha. Further, Sunflower Maize Zone (UM4) of 281,000 ha extends from northern fringes of Uasin Gishu to Trans Nzoia and penetrates into parts of Kakamega and Bungoma.

(iv) Bungoma district

The northern half of Bungoma district is characterized by the humid montane forest around Mt. Elgon. In the middle land, Sugarcane Zone (LM1) and Marginal Sugarcane Zone (LM2) are predominant with a total extent of 92,000 ha.

(v) Kisii and Kericho districts

The humid Tea-Dairy Zone (LH1) and Coffee-Tea Zone (UM1) extensively occur in both districts. The total hectareage is estimated to be 373,000 ha. They are intensively used for tea production at present, except for Mau forest reserve in the east Kericho. The LH1 zone in Kericho district covers the watershed of Yurith and Kipsonoi Rivers, the tributaries of Sondu River.

(vi) Narok district

Except for the northern part of Narok district which extends on the east of Kericho district, the most severe constraint facing the district is a low precipitation. Most of land belongs to Ranching Zone (UM6) and Livestock-Sorghum Zone (UM5). The agricultural activities would be concentrated in the northern humid fringes, i.e. Wheat-Pyrethrum Zone (UH2).

Based on the agro-ecological zones, crop potential for main 14 crops were evaluated by ILUS. Potential lands for the crops proposed by the Master Plan as strategic or other priority crops, i.e. maize, wheat, rice, Arabica coffee, Robusta coffee, tea, cotton, sugarcane, horticultural crops and tobacco, have been extracted, applying the ILUS results. For assessing crop potential of sorghum, beans and fodder crops, the maize suitability classes were applied considering their agro-climatic requirements similar to those of maize. Figure 10.9 shows the distribution patterns of crop suitable zones. On the crop suitable zone maps, the suitability is classified into four classes. They are:

1. Very good : more than 80% of potential yield is expectable.
2. Good : 80-60% of potential yield is expectable.
3. Fair : 60-40% of potential yield is expectable.
4. Marginal : less than 40% of potential yield is expectable.

(5) Soil

There are several soil study results made mainly by KSS. The exploratory soil map of Kenya with the scale of 1:1,000,000 provides the general ideas of soil characteristics and spatial distribution pattern in the Region. The Reconnaissance Soil Map of the Lake Basin Development Authority Area with the scale of 1:250,000 prepared by W. Andriess et al gives the detail information of soil distribution pattern as well as soil characteristics in the Region. The study presents not only the taxonomic names of soil but also the important soil characteristics in terms of crop production. The soil characteristics concerned are drainability, effective soil depth, salinity, sodicity, inherent fertility, stoniness, boulders, rockiness, consistence, moisture storage capacity, infiltration capacity and excess surface water.

The soil in the Region can be broadly classified into two groups on the basis of their physiographic positions and geological origins. Most types of soil are of volcanic origin such as phonolites, granites, gneisses, basalts, rhyolites and tuffs. They occur extensively in plateaus, elevated structural plains and uplands. The major soil types identified are Ferralsols, Acrisols, Nitosols, Phaeozems and Cambisols. On the other hand, the sub-recent alluvial soil locally occurs along the Lake shore and in the lowlying bottom lands. The soil types are classified mainly into Vertisols, Planosols, Gleysols and Histosols. Their distribution pattern is illustrated in Figure 10.10.

Soil conditions are not included as a primary element in the present land evaluation. Soil in the Region is sometimes recognized to have serious limitations for crop production mainly due to shallow depth, frequent rock outcrops, and high alkalinity and salinity. However, some of the specific crops are planted even on such unfavourable soil, if farmers select the crops with special attention to crop characteristics and take soil improvement practices.

For instance, the soil in the largest Wheat-Barley Zone (Kitale-Eldoret) is generally shallow with effective depth of 60cm or less. However, mechanized agriculture enables farmers to plant maize to attain quite a high yield level. In addition, the Lake shore covered by shallow soils with high boulder content is widely used for production of groundnut and cotton.

Therefore, soil conditions are not included as a primary element for macro-zoning of potential expansible land. However, soil conditions become an important factor in selecting particular crops in expansible areas. The soil conditions of each district are outlined below.

(i) Kisii district

Soil is represented by Mollic Nitosols associated with Nito-Luvic Phaeozeme. They are well drained, deep to very deep, dark reddish brown to dark red friable clay types with topsoils of high inherent fertility rich in organic matter. Any kinds of crops, i.e. cereals, vegetables and fruits are suitable. High productivity can be expected in coffee plantation.

(ii) Kisumu district

Major soil types are Chromic and Pellic Vertisols developed in Kano Plain and Verto-Eutric Planosols occurring on piedmont plains of Nandi and Nyabondo escarpments. Chromic and Pellic Vertisols are poorly drained, deep, dark grey to black, calcareous, very firm cracking types of clay. Cotton and wetland paddy are highly suitable. In the western part of Kano Plain, they are associated with swampy soil, i.e. Gleysols and Histosols. Verto-Eutric Planosols are imperfectly drained, very deep, very dark grey to black, very firm types of clay with gravels. They are of moderate to low fertility with some drainage problems. Sugarcane and other upland crops, i.e. cotton, maize and sorghum, are suitable.

(iii) Siaya district

Major soil types are Orthic Ferralsols and Verto-Luvic Phaeozems. Association of Orthic Ferralsols and Ironstone soil covers the eastern Siaya (Rangala-Bondo-Yala). They are well drained to moderately well drained, shallow, friable sandy clay loam underlaid by petroplinthite. Sugarcane and drought resistant crops, i.e. sorghum and cassava, are suited. Verto-Luvic Phaeozems are predominant soils of the east-south Siaya. They are shallow to moderately deep, dark brown, firm clay. Along the Lake shore, lithic phase partly occurs. Cotton and drought resistant crops can grow.

(iv) South Nyanza district

Soil distribution pattern is very complicated. Major soil types are Eutric Regosols, Verto-Luvic Phaeozems, Gleyic Acrisols and Chromic Vertisols. Eutric Regosols are predominant in Gwasi Hills and in Gembe Hills. The soils are well drained, shallow, dark brown, friable, rocky and stony clay loam. Verto-Luvic Phaeozems occur in the large central area of the district. They are moderately well drained, shallow to moderately deep, dark brown to red, firm clay. They have a deep topsoil rich in organic matter. Gleyic Acrisols are extensive in the southern part of the district. They are imperfectly drained, moderately deep, brown to dark yellowish brown, mottled, friable, gravelly sandy clay loam. These three units are less suitable for cropping. Only cotton and drought resistant crops can grow. Chromic Vertisols are the major soil in Lambwe Valley. They are imperfectly drained, very deep, slightly saline and sodic cracking clay. Wetland paddy would be suitable unless salinity and alkalinity problems exist.

(v) Bungoma district

Soil is composed of Ferralo-Orthic Acrisols, Rhodic Ferralsols, Humic Nitosols, Nito-Humic Cambisols and Dystric Histosols. Ferralo-Orthic Acrisols and Rhodic Ferralsols are the most dominant units in the district covering the uplands below the foot-slopes of Mt. Elgon. They are well drained, moderately deep to very deep, brown to dark red, sandy clay to clay. Humic Nitosols cover the volcanic footslopes of Mt. Elgon. They are well drained, extremely deep, dark reddish brown to dusky red, friable clay with acid humic topsoils. These three units are suitable for coffee, maize and other upland crops. Nito-Humic Cambisols and Dystric Histosols are the major soils covering Mt. Elgon. Nito-Humic Cambisols are well drained, shallow to moderately deep, dark reddish brown, friable, humic, rocky and stony clay loam. Dystric Histosols are imperfectly drained, shallow to moderately deep, dark greyish brown, very friable, acid humic to peaty, loam to clay loam, with rock outcrops. They are mostly covered by the dense forest.

(vi) Busia district

Soil in Busia consists of Orthic and Rhodic Ferralsols, Orthic Acrisols, Humic Gleysols and Dystric Histosols. Orthic and Rhodic Ferralsols are the most predominant in the district. They are well drained, moderately deep, red, friable clays of low natural fertility. They are sometimes associated with Orthic Acrisols which have somewhat inherent natural fertility than Ferralsols. They are suitable for cotton, sorghum, millet and groundnuts. Humic Gleysols and Dystric Histosols occur in Yala Swamp. They are poorly drained, very deep, grey to black, firm clay with acid humic topsoils. Paddy and other upland crops are suitable if proper drainage is provided.

(vii) Kakamega district

Soil consists of Mollic Nitosols, Ferralo-Orthic Acrisols, Rhodic-Orthic Ferralsols and Humic Cambisols. Mollic Nitosols and Ferralo-Orthic Acrisols are predominant in middle level land mostly covering the district. They are well drained, extremely deep to very deep, dark reddish brown to yellowish red, friable to firm clay with humus topsoils. Rhodic-Orthic Ferralsols are major soil types of lower level uplands in Mumias. They are well drained, deep to very deep, dark reddish brown to strong brown, friable clay. These three units are suitable for sugarcane, maize, coffee and other crops. Humic Cambisols occur in eastern fringe of the district. They are well drained, deep, yellowish red to brown, friable clay loam with acid humus topsoils. They are suitable for coffee, maize and sunflower.

(viii) Kericho district

Soil is represented by Humic Nitosols and Humic Cambisols. Humic Nitosols are well drained, deep to extremely deep, dark reddish brown, clay loam to clay of moderate to high fertility with acid humus topsoil. They are developed on interfluves of volcanic footridges in the largest central part of the district. Associated with Nitosols, Humic Cambisols occur on valley side. They show similar soil profile to Humic Nitosols but they are shallow partly with lithic contact. Tea, coffee and other upland crops are suitable and high yield can be expected. In the southern part of the district, Eutric Planosols and Chromic Vertisols are predominant. They are imperfectly drained, deep, very dark greyish brown to very dark

grey, very firm clay of variable fertility. Chromic Vertisols are characterized by their deep cracks.

(ix) Nandi district

Soil is represented by Mollic and Humic Nitosols occupying the large central portion of the district. They are of moderate to high fertility. They are well drained, extremely deep, dark reddish brown, friable clay, with thick humus topsoils. Tea, coffee, wheat, maize and other upland crops are suitable and high yield can be expected.

(x) Trans Nzoia district

Soil is represented by Rhodic Ferralsols and Humic Nitosols. Rhodic Ferralsols occurring in the central and eastern parts of the district are well drained, very deep, red to dark red, very friable to friable clay of low fertility. Humic Nitosols are developed on the footslope of Mt. Elgon in the western part of the district. They are well drained, extremely deep, dusky red to dark reddish brown, friable clay with acid humus topsoil. Wheat, maize and other upland crops are suitable.

(xi) Uasin Gishu district

Soil is represented by Rhodic Ferralsols occurring in the northern to central parts of the district, and Humic and Mollic Nitosols in the southern parts of the district. Rhodic Ferralsols are well drained, moderately deep to deep, dark red, friable clay over petroplinthite. They occur with inclusions of small bottomlands covered by Mollic Gleysols. Humic and Mollic Nitosols are well drained, extremely deep, dusky red to dark reddish brown, friable clay with humus topsoil. Wheat, maize and other upland crops are suitable.

10.2.4 Results of land evaluation

As a result of the land evaluation, 1,311,000 ha of the expansible area have been identified in the Region, accounting for 27.5% of the total area. Out of 1,311,000 ha, 1,014,000 ha distribute in the ILUS area and 297,000 ha in the Mara river basin.

Due to high adaptability to a wide range of agro-climatic conditions of different varieties, maize, sorghum, beans and fodder crops can be introduced anywhere in the said 1,014,000 ha belonging to the ILUS area if varieties are properly selected. Since agro-ecological zones in the Mara river basin are semi-arid to arid, these crops can not be successfully cultivated in the expansible area of 297,000 ha. Only drought resistant crops can be planted there.

Table 10.11 presents the potential agricultural lands for the proposed crops in the Region. They are not mutually exclusive. For instance, the large portions of the potential land for rice, cotton and tobacco are overlapped one another. The results are summarized below.

Crops	Potential land (1000 ha)
Maize, sorghum, beans and fodder crops	1,014
Wheat	217
Rice	96
Arabica coffee	142
Robusta coffee	124
Tea	179
Cotton	322
Sugarcane	173
Tobacco	205
Fruits and vegetables	136
Net	1,311

The detailed results of the potential agricultural land by district are presented in Table 10.12. The size and spatial distribution of expansible area are illustrated in Figure 10.10.

10.3 Alternative Agricultural Land Development Schemes

10.3.1 Development strategy

Objectives stipulated in SP1 related to agriculture are to provide food security, to increase incomes of farm families, to create sufficient employment in rural areas, and to expand exports. More emphasis is placed on coffee and tea as cash crops, maize and wheat as food crops, and milk and meat production. In line with these national policies as well as the Region's potential outlined in subsection 10.2.4, the land development strategy for the Region is drawn up as follows.

The intensification of land use in existing agricultural land should be attempted to the maximum possible, given the present cropping patterns. This will cover an area of some 1,549,000 ha cultivated under a variety of crops. With the intensification alone, however, the development targets set for agriculture could not be attained and the valued-added in agriculture would increase only at the annual average rate of 3% (Section 1.2.2, Chapter 1, Sector Report).

According to the alternative development scenarios, i.e Scenario 1: Granary and Scenario 2: Agro-industrial base, the future agricultural land development plans are set up under the following conditions (Master Plan Report).

- i) The existing cropping patterns will be maintained on the existing cultivated land.
- ii) Potential agricultural lands will be reclaimed for food crop production under Scenario 1, and mainly for cash crop production under Scenario 2.

- iii) To stabilize fodder supply to grade cattle, sufficient area of fodder crop field will be developed on potential agricultural land so as to achieve the level of the regional self-sufficiency in milk.

10.3.2 Specific conditions

(1) Pasture requirement

The natural grasses play an important role as a feed resource for livestock raised in the Region. On the basis of livestock unit (LU; 1 LU = 300kg of live-weight) and carrying capacity of natural grassland, the total pasture requirement of grassland to be reserved by 2005 is calculated through the sector study of Livestock reported in Chapter 2.

The future feed requirement is estimated to reach 2,797,000 LU's, i.e. 2,550,000 LU's in the ILUS area and 246,000 LU's in the Mara river basin. The requirement of grassland has been calculated under the following conditions and assumptions.

- i) Under "zero-grazing" programme, all grade cattle in the Region will be raised in managed pasture or fed by fodder crops in order to stabilize feed supply throughout the year. Crop residue of maize, beans, sweet potatoes, rice and wheat will also be supplied to grade cattle.
- ii) Local cattle, sheep and goats will be fed by surplus forage of the above sources as much as possible, or otherwise they will be raised on the natural grassland as they are.
- iii) Although fallow land is providing supplemental feed to local cattle, it is not taken into account in this calculation.

The regional milk self-sufficiency amounting to 1.68 million tons/year shall be achieved under Scenarios 1 and 2. As presented in subsection 2.2.4 of Livestock sector report, the total requirement of grade cattle is 977,000 heads or 1,036,000 LU's equivalent, for which 246,000 ha of fodder fields and the existing 165,000 ha of managed pasture will be required. These feed source will supply 2,461,000 LU's including 538,000 LU's of crop residue. For this purposes, 107,000 ha of fodder fields will be newly developed in addition to 139,000 ha of existing field.

The surplus of feed with 1,425,000 LU's equivalent (2,461,000 minus 1,036,000) will be supplied to 2,397,000 heads (1,678,000 LU's) of local cattle and 870,000 heads (87,000 LU's) of sheep and goats. To make up the feed shortage of 340,000 LU's, 1,009,000 ha or 52% of the total grassland with 1,939,000 ha will be reserved for natural grazing purpose. The remaining 930,000 ha will be developed for the future expansion of agriculture and infrastructure. (Table 10.13).

(2) National expansion programmes of coffee and tea

In SPI, the national expansion programmes of both coffee and tea are presented. Since the ceiling amount of coffee production is based on the exportable amount regulated by International Coffee Agreement (ICA), the regional production has to be planned paying much attention to the national expansion programme. The national expansion programmes aim to attain the following by 2000:

Arabica coffee	75,000 ha
Robusta coffee	50,000 ha
Tea	41,200 ha

SPI emphasizes the development of Robusta coffee especially in the western and coastal areas in Kenya. In view of the high potential in the Region, the Master Plan gives the high priority to this crop. As described in subsection 1.2.2 of the agricultural sector report (Chapter 1), 40,000 ha or 80% of the Robusta expansion is envisaged under Scenario 2. Besides Arabica coffee will be expanded to increase the current regional share of 6 to 20% by 2005. To keep the regional share of tea, i.e. 66%, 60% of the national tea expansion will be allocated to the Region.

(3) Possible irrigation projects

The irrigation projects are taken into account for preparation of agricultural land development. The major projects are listed in Table 10.14.

Kano Plain Irrigation Project consists of two schemes i.e. the south and the north schemes, with the total irrigation area of 20,540 ha. Maize, rice and cotton are the main crops to be planted under irrigation. In addition, the intensive production of fodder crops such as Napier and Bana grasses are also expanded for cattle raising.

Yala Swamp Reclamation and Development Project is on-going and consists of three areas with a total extent of 17,500 ha in Siaya and Busia districts. Area I with 2,300 ha has already been reclaimed and is under cultivation for seed and seedling production.

Kuja Irrigation Project will comprise a number of small schemes with area of 200 to 300 ha. Each scheme will be irrigated by an individual diesel pumping system. Total irrigation area is 1,900 ha. Maize, groundnuts, pulses, cotton and vegetables are proposed.

Upper Nzoia Irrigation Project is proposed to cover 5,030 ha along the upper reaches of Nzoia River and its tributaries. The sprinkler irrigation is proposed due to rather rolling topography with slope gradient between 5 and 10%. Fruit, vegetable and maize are proposed. Lower Nzoia Irrigation Project will be located along the lower reaches of Nzoia River near Bunyala Irrigation Scheme covering 6,420 ha for maize, rice, and cotton.

The master plan study for PIU of Western Province is being carried out. The study proposes to supply irrigation water to the existing crop fields of 2,100 ha located from Mumias to Bunyala. As a model scheme of the Lake Shore Irrigation Project, two irrigation schemes, namely Oluch and Kimira, have been selected. By abstracting from

small streams, i.e. Awach Tende and Awach Kibuon, the lowlying flat terrains along the Lake shore will be irrigated. The total irrigation area is estimated to be 3,200 ha

(4) Fallow land

There are 136,000 ha of fallow lands in the Region, which provide supplemental feed equivalent to 137,000 LU's. At the same time, organic manure of livestock is naturally applied to fallow lands. It is generally known that fallowing prevents crop field from soil degradation process. However, the maximum utilization of farm land should be realized by introducing the proper soil management, e.g. application of farm yard manure and compost, etc. from the viewpoint of rationalized land use plan.

(5) Expansion of infrastructure

Infrastructure consists of transport network, homestead land and hedges. As presented in Table 10.1, the total area occupied by infrastructure is 234,000 ha accounting for 6.0% of the ILUS area.

It is assumed that homestead land and hedges will proportionally increase according to the population growth in the Region. About 600,000 ha will be utilized for these purposes in 2005. Thus further land expansion of 366,000 ha will be carried out for infrastructural development.

(6) Mara river basin

The total coverage of Mara river basin is 847,000 ha. Narok, Kericho and Nakuru districts are concerned. Due to the lack of sufficient data, there are some difficulties in preparing the land development plan for this area.

Since Masai Mara game reserve is located in this basin, special attention should be paid for possible adverse effects to wildlife caused as a result of the agricultural land development. Taking also the unfavourable climatic conditions into account, it is assumed that large scale agricultural development will not be carried out in the Mara river basin and the land use pattern will basically be maintained through 2005.

10.3.3 Land development under alternative scenarios

(1) Land development under Scenario 1

Table 10.15 presents the summary of the alternative land use plans under both development scenarios.

Expansion area under Scenario 1 is presented in Table 10.16. Under Scenario 1, 565,000 ha will be developed for food crop cultivation and milk production. Out of the total expansion area, 309,000 ha or 55% will be allocated to maize, sorghum and beans. These crops are expected to be expanded in the whole Region. Wheat, barley and oat production

will be encouraged in Rift Valley Province. For these crops, 98,000 ha will be newly reclaimed.

The expansion of paddy fields takes into consideration the proposed Kano Plain Irrigation Project. About 15,000 ha will be irrigated for paddy under this project alone. Additional 12,000 ha of the paddy cultivation are also counted by Lower Nzoia Irrigation Projects as well as PIU projects. Upland rice programme will also be included. For root crops, 24,000 ha will be expanded mainly in dry-zone in South Nyanza, Busia and Siaya districts, taking account of drought resistant characteristics of these crops and dietary habit of local people.

As mentioned in subsection 10.3.2, pasture requirement will increase in the future. Considering the future livestock development with a large number of grade cattle, 70,000 ha of fodder crops field will be expanded in the districts in Rift Valley. In order to overcome the present feed shortage, fodder field will be expanded also in Nyanza Province with a total area of 37,000 ha. In Kisumu, the fodder crops will be planted under irrigated conditions. In Western Province, no expansion of fodder field will be required, but productivity of fodder crops should be improved in the existing field.

(2) Land development under Scenario 2

Expansion area under Scenario 2 is summarized in Table 10.17. Under Scenario 2, 343,000 ha will be developed for cash crops and milk production. Under the national expansion programme, 67,000 ha will be newly cultivated for Arabica coffee, 32,000 ha for Robusta coffee and 32,000 ha for tea.

Arabica coffee will be expanded in high potential area surrounding the existing Arabica coffee fields in Kisii, South Nyanza, Bungoma, Kakamega, Kericho and Nandi districts. The expansion of Robusta coffee in the western Kenya is emphasized in SP1. In view of crop potential, a large portion of expansion will be carried out in Busia, Siaya, South Nyanza, Bungoma, Kakamega and Kisumu districts. The tea expansion will be performed in and around the existing tea planting zone, i.e. Kericho, Nandi, Bungoma and Kisii districts.

Cotton will be expanded for 10,000 ha mainly in Busia, Siaya and South Nyanza districts. A part of Kano Plain will also be planted with cotton under irrigated condition. Sugarcane will be expanded in and around the existing sugarcane areas with a total extent of 25,000 ha in South Nyanza, Bungoma and Kakamega districts. Other cash crops, i.e. sunflower, sesame, soyabean, groundnuts, tobacco, etc, will also be expanded for 30,000 ha in total throughout the Region.

Fruits and vegetable production is emphasized in SP1. In line with the government policy, Horticultural Extension Projects are presently being studied for Nyanza and Western Provinces. For fruits and vegetables, 57,000 ha will be expanded. Passion fruit is one of the most promising crops. For paddy, 15,000 ha of expansion will also be carried out under the Kano Plain Irrigation Project as mentioned. Livestock development will be carried out under the same condition as Scenario 1.

10.4 General Land Use Plan

10.4.1 Land development under Scenario 3

Based on the alternative development scenarios presented in subsection 10.3.3, the agricultural land development plan has been worked out under the conditions of recommended framework, i.e. Scenario 3. For the preparation of land development plan, the following conditions were set.

- i) High potential areas should be allocated to each of the national strategic crops listed above to attain the highest possible yields.
- ii) Cash crops should be given a priority in view of their greater contributions to value-added on per hectare basis, employment generation and export expansion in line with the national policies.
- iii) The present shares in national production of food crops should be maintained in view of nation's food security.
- iv) Expansion of fodder crop production should also be considered aiming at the regional self-sufficiency of milk.

In addition, proper allocation of land should be considered for those crops for which specific areas in the Region are already major producers or have comparative advantage. The crops include maize, sorghum and millet, beans, wheat and paddy as food crops, and coffee, tea, cotton, sugarcane and horticultural crops as cash crops.

Table 10.18 presents the total expansion area of major food crops, i.e. maize, sorghum and beans. Out of the selected 274,000 ha, 197,000 ha or 72% are classified into very good and good potential areas for maize. Based on the present cropping pattern, 274,000 ha have been allocated to these food crops i.e. 206,000 ha or 75% for maize, 25,000 ha or 9% for sorghum and 43,000 ha or 16% for beans, respectively.

Table 10.19 presents the expansion of other food crops, i.e. wheat and rice. In the districts of Rift Valley, 98,000 ha will be newly developed for wheat, barley and oat. For rice, 27,000 ha will be developed in Nyanza and Western Provinces. Out of the total expansion of rice, 15,000 ha or 56% will be newly planted under the Kano Plain Irrigation Project in Kisumu district.

Table 10.20 presents the expansion of Arabica coffee, Robusta coffee and tea. For Arabica coffee, 17,000 ha of good potential area are selected in Kisii, Kakamega, Kericho and Nandi districts. These expansions correspond to 23% of the national expansion programme with a target area of 75,000 ha by 2000. For Robusta coffee, 32,000 ha of good potential area are selected in Nyanza and Western Provinces accounting for 64% of the national programme target with 50,000 ha. For tea, 24,000 ha of very good and good potential areas are selected in Kisii, Kakamega, Kericho and Nandi districts accounting for 58% of the national programme target with 41,200 ha.

Table 10.21 gives the expansion of sugarcane, cotton and horticultural crops. Sugarcane will be expanded in the total area of 25,000 ha in and around the existing sugarcane field in South Nyanza, Bungoma and Kakamega districts. Cotton will be newly planted in Kisumu, Siaya, South Nyanza and Busia districts for 7,000 ha. Horticultural crops will be expanded in Kisii, Bungoma, Busia, Kericho and Nandi districts for 17,000 ha.

The agricultural land development under the Master Plan is summarized in Table 10.22. In addition to 465,000 ha of crop expansion, 100,000 ha of fodder fields will also be expanded in Nyanza and Rift Valley Provinces. The future land use pattern of the Region is schematically illustrated in Figure 10.11 (Figure 4.3 in Master Plan Report).

10.4.2 Land use plan by district

(1) Kisii district

Under the favourable climate and the fertile soil conditions, the district land is intensively utilized for agriculture. Out of 212,000 ha of the district land, 144,000 ha are used for agriculture, of which 117,000 ha are presently under cultivation.

For food production, 75,000 ha or 64% of the cultivated land are used as presented in Table 10.5. Major crops are maize (45,000 ha), beans (12,000 ha) and banana (10,000 ha), followed by sorghum and millet (5,000 ha) and sweet potatoes (4,000 ha). The planted areas are widely distributed in the district.

Cash crop production is represented by tea (11,000 ha) and Arabica coffee (5,000 ha). Tea fields cultivated by smallholders extend over the whole district, while the tea estates are located in the south of Ikonge along the district boundary with Kericho. Arabica coffee fields are scattered in the northern and western portions of the district.

In the agricultural land development, the priority should be given to cash crops of high value, as the expansible area in the district is limited. The Master Plan proposes the further expansion of tea, Arabica coffee and horticultural crops. By 2005, 6,000 ha of tea fields will be newly established in the south of the existing tea fields near Keroka under Tea-Dairy Zone (LH1) and Wheat/Maize-Pyrethrum Zone (LH2). This expansion accounts for 15% of the national tea expansion programme aiming at 41,200 ha by 2000. Arabica coffee will be expanded in the north of Nyamira division. The total expansion is 3,000 ha under Coffee-Tea Zone (UM1). Horticultural crops will be expanded for 2,000 ha in the north and the east of Kisii town. Passion fruit is one of the promising crops for this expansion.

Food crops will also be expanded. Total expansion is 4,000 ha along the district boundary with Narok district, i.e. Nyangusu and Monianku, under Coffee-Tea Zone (UH1). Maize, sorghum and beans are the main crops to be introduced.

Livestock production is also prevailing in the district. In order to feed 29,000 heads of grade cattle, which account for 94% of the total grade cattle in Nyanza Province, 26,000 ha of managed pasture and 21,000 ha of fodders have already been developed. The present study has clarified that the potential feed productivity of the managed pasture and the fodder

fields is high enough to sustain all the existing cattle in the district, i.e. 29,000 heads of grade cattle and 133,000 heads of local cattle. In addition, 84,000 heads of grade cattle can also be sustained if the maximum productivity of feed is realized. Thus no expansion of pasture and fodder fields is planned.

(2) Kisumu district

Out of 209,000 ha of the district land, 89,000 ha are used for agriculture. Agriculture of the district is characterized by large sugarcane estates and food production of smallholders. Sugarcane is represented by Nyanza Sugar Belt extending on the piedmont plain adjacent to the Nandi escarpment. The total planted area amounts to 53,000 ha or 60% of the total agricultural land.

Food production is carried out mainly in Kano Plain which is the vast flat terrain occupying the central part of the district. Crop production by smallholders covers a total extent of 36,000 ha, of which 21,000 ha of farm land are used for maize, sorghum and beans production. Root crop production is also prevailing with a total area of 5,000 ha. Rice is planted in the low-lying land of 1,000 ha under both irrigated and rainfed conditions. Ahero Scheme plays a nucleus role for rice cultivation in the district. Rainfed or swamp rice is cultivated along the Lake shore, i.e. Wasare, although the planted area is limited to less than 1,000 ha.

Cotton is an important cash crop in the district. Some 7,000 ha are used for this crop at present.

A large scale irrigation project is one of the central measures to enhance the land productivity in Kano Plain. It is proposed that about 20,000 ha, of which more than 90% falls in the district, will be irrigated by using the river water of Sondu and Nyando. Under the year-round irrigated condition, double cropping of maize, rice and other crops will be carried out.

The Master Plan fully takes this irrigation development into consideration. Under the proposed irrigation project, the agriculture in the district will be drastically improved with significant increase in crop yields and cropping intensification. The yield of maize can be increased from 2.0 tons/ha to 5.5 tons/ha not only through intensification, but also as a result of expansion of maize field which would allow better farm management and farming practices. The total expansion is to be 15,000 ha within the irrigation scheme. Besides, sorghum and beans are expanded with 4,000 ha and 2,000 ha respectively. Irrigated paddy will be established with 15,000 ha, capitalizing on the experience gained through the past operation of Ahero Scheme.

The major constraint to livestock development is the low productivity of fodder crops and pasture shortage. There are 1,000 heads of grade cattle, 161,000 heads of local cattle and 69,000 heads of sheep and goats in the district amounting to 126,000 LU's in total. In contrast, the total feed availability remains at 82,000 LU's equivalent even under the assumption that natural grass coverage is fully utilized for grazing. In order to overcome such feed shortage, 11,000 ha of fodder crops will be expanded in and around the proposed irrigation scheme. The total feed availability will increase to 155,000 LU's equivalent by 2005.

(3) Siaya district

District's agriculture is constrained at present by limited rainfall and soil of low fertility. Out of 252,000 ha of the district land, 93,000 ha are used for agriculture. Food production is the main activity in the whole district. Major crops are maize (27,000 ha), sorghum (16,000 ha), cassava (12,000 ha) and beans (11,000 ha).

Cash crop production is less developed. The north-eastern portions of Siaya town, i.e. Ukwala and Yala divisions, are suitable for sugarcane. The total planted area is 3,000 ha along the boundary with Kakamega district. Cotton production is quite prevailing in the district. The southern part of Bondo division and the Busia border at Ukwala are main producing zones with a total area of 9,000 ha

The Master Plan places the priority on the food production. Under Sugarcane Zone (LM1) and Marginal Sugarcane Zone (LM2), 30,000 ha will be reclaimed for food crops. Besides, the current efforts for rainfed rice will be further intensified in the low-lying swampy land of 3,000 ha.

As mentioned in SP1, 50,000 ha of new planting of Robusta coffee are scheduled by 2000 under the national coffee expansion programme. SP1 recognizes the high potentiality for Robusta in both western and coastal areas of Kenya, and the Master Plan endorses such a position. The total area allocated to the district is 10,000 ha accounting for 20% of the national target. The proposed area is to be selected in Ukwala and Yala divisions along the boundary with Kakamega district. In addition, 1,000 ha of cotton are also expanded mainly in Bondo division.

Livestock development in the district is facing feed shortage. For 179,000 heads of local cattle and 47,000 heads of sheep and goats equivalent to 136,000 LU's, only 120,000 LU's equivalent of feed are available. To stabilize feed supply as much as possible, 7,000 ha will be expanded for fodder crops. The feed availability is expected to increase from 120,000 LU's equivalent to 168,000 LU's equivalent to cover 74% of the total feed requirement in 2005.

(4) South Nyanza district

Out of 571,000 ha of the district land, 190,000 ha are used for agriculture. Crop fields are widely but sparsely distributed in the district. Exceptions to such a general land use pattern are the lands intensively used for agriculture in and around Rongo and Migori along the boundary with Kisii district.

The major crops are maize (45,000 ha), cassava (20,000 ha), sorghum (19,000 ha), beans (13,000 ha) and sweet potatoes (8,000 ha). Cotton and sugarcane are representative cash crops in the district. The planted area of cotton amounts to 24,000 ha or 49% of the total cotton fields of the Region. Sugarcane is produced to supply South Nyanza Sugar Factory in Awendo. The total planted area is 10,000 ha in the south of Rongo under Sugarcane Zone (LM1) and Marginal Sugarcane Zone (LM2). Following both crops, groundnut is broadly produced in the district. The total planted area is 9,000 ha, producing 11,000 tons or 76% of the total groundnut production in the Region.

The Master Plan proposes the expansion of food crops in the area surrounding the intensively cultivated Rongó and Migori areas. In addition, the flat patches of lowlands located on the Lake shore i.e. Homa Bay, Mbita and Karungu will be newly cultivated. The total expansion is 62,000 ha consisting of 47,000 ha of maize, 8,000 ha of beans and 7,000 ha of sorghum under Marginal Sugarcane Zone (LM2).

The small scale rice irrigation projects in Oluch and Kimila valleys are expected to be implemented in the near future. In total, 3,200 ha of irrigated paddy will be newly established.

Cash crops will also be expanded. In the south of Migori, i.e. Nyamome, 5,000 ha of sugarcane will be introduced along C13 road. In addition, 3,000 ha of cotton will be expanded in the central part of district along C18 road under Cotton Zone (LM3). Besides, 5,000 ha in Rongó and Migori will be developed for Robusta coffee.

Although 432,000 heads of local cattle and 105,000 heads of sheep and goats are broadly raised, population of grade cattle is limited at 1,000 heads. Under the Master Plan, dairy cattle raising is emphasized. Through multiplication of grade cattle from 1,000 heads to 5,000 heads and improvement of milking yield of local cattle by introduction of crossbred with grade cattle, milk production will be increased from 10,000 tons to 146,000 tons. The main dairy zone will be situated in Rongó and Migori. For stabilizing feed supply, 12,000 ha of fodder crops will be developed.

(5) Bungoma district

Bungoma district is one of high potential areas for agricultural development in the Region. At present 151,000 ha, out of 307,000 ha of the district land, are used for agriculture. Among them, 78,000 ha are cultivated for food production and 18,000 ha for cash crop production.

The district can be divided into three zones from north to south in terms of the present land use patterns. The northern part is covered by dense montane forest of Mt. Elgon. The central part is intensively used for food production. The southern part is represented by sugarcane plantation for Nzoia Sugar Factory. Total maize fields are 51,000 ha accounting for 50% of the total maize fields in Western Province. Beans and root crops cover 14,000 ha and 7,000 ha, respectively. Arabica coffee is also a predominant crop in this area under Main Coffee Zone (UM2). The total planted area of Arabica coffee is 3,000 ha in Kimilili and its west. Cotton is the main cash crop in the western part of the district i.e. Malikisi. The total planted area is 5,000 ha under Cotton Zone (LM3). Total planted area of sugarcane in the south is 10,000 ha.

The Master Plan proposes the expansion of 17,000 ha for food crops which consists of 12,000 ha for maize, 3,000 ha for beans and 2,000 ha for rice. Main expansion of maize and beans will be performed in the south-west of Chwele along the existing maize fields. Rainfed rice will be expanded for 2,000 ha in the southern part of Sirisia division, i.e. Malikisi.

Expansion for cash crops will be promoted primarily with Arabica coffee, Robusta coffee and sugarcane. About 4,000 ha will be developed for Arabica coffee on the footslopes of Mt. Elgon. Besides, 3,000 ha will also be developed for Robusta coffee along the borders with Kakamega and Busia districts. Sugarcane will be expanded for 10,000 ha in the area surrounding the existing fields for Nzoia Sugar Factory.

Dairy farming is prevailing in the district for producing 10,000 tons of milk, and some 3,000 ha of managed pasture and 13,000 ha of fodder crops are maintained. Under the Master Plan, dairy production will be encouraged. In view of the high potential productivity of feed, no expansion of pasture is planned. Through intensification of pasture maintenance, its carrying capacity can be improved from 3.7 LU's/ha to 4.8 LU's/ha. Fodder production will also be enhanced from 3.7 LU's/ha to 5.8 LU's/ha. This would enable to increase the total feed availability from 43,000 LU's to 89,000 LU's equivalent in the existing managed pasture and fodder fields. Supported also by the LBDA dairy cattle multiplication center at Sangalo, milk production will be increased from 10,000 tons at present to 71,000 tons by 2005.

(6) Busia district

Busia district is constrained by its limited rainfall and soil of low fertility. Out of 163,000 ha of the district land, 63,000 ha are used for agriculture. Main crops are cassava (19,000 ha), maize (7,000 ha), beans (4,000 ha) and sorghum (3,000 ha). Cotton is the important cash crop with a total area of 5,000 ha. Due to low carrying capacity of grassland, livestock production is less developed.

The district's agriculture, however, has been undergoing substantial changes due to implementation of national projects such as the irrigated rice scheme of Bunyala managed by NIB and Yala Swamp Reclamation Project conducted by LBDA. These projects contribute not only to increasing crop production but also to improving farming technology and farm inputs in the Region. The provision of seeds of cereals and seedlings of coffee is a typical example.

The Master Plan proposes the further food production and the introduction of Robusta coffee in the district. The total expansion will be 33,000 ha. About 20,000 ha of food crops will be expanded in Malaba and Matayo under Marginal Sugarcane Zone (LM2). The central part of the district, which is highly suitable for agriculture under Sugarcane Zone (LM1), will be developed with Robusta coffee. The proposed expansion amounts to 18,000 ha. Moreover, cotton will be further expanded along the district boundary with Bungoma, i.e Malaba-Malakisi zone. The total expansion is 1,000 ha under Cotton Zone (LM3). Upland rice will also be expanded for 2,000 ha.

(7) Kakamega district

Kakamega district is characterized by its wide-spread distribution of agricultural land with a total area of 183,000 ha. Out of actively cultivated land of 159,000 ha, 95,000 ha or 60% are used for food production. Maize (44,000 ha), beans (23,000 ha) and sorghum (10,000 ha) are major food crops. They are intensively cultivated in the southern part of the district, namely Vihiga and Hamisi divisions, under the favourable climate of Tea-Coffee Zone

(UM1). Besides, the north-eastern corner extending to Uasin Gishu and Trans Nzoia i.e, Lugari division, is also main producing zone of food crops in the district.

Cash crop production is also an important activity in the district covering 39,000 ha of the agricultural land. Sugarcane is the leading crop with a total area of 33,000 ha in Mumias. Arabica coffee (1,000 ha), tea (2,000 ha) and horticultural crops (2,000 ha) are also planted in Tea-Coffee Zone (UM1) in the west to south of Kakamega forest.

Under the Master Plan, 49,000 ha of agricultural land development are proposed in the district. Maize of 14,000 ha and beans of 8,000 ha will be expanded surrounding the existing maize and beans field in Malaba under Marginal Sugarcane Zone (LM2) and in Lugari under Sunflower Maize Zone (UM4). By attaining the target yield of 4.0 tons/ha, maize production in the district is expected to increase from 197,000 tons at present to 317,000 tons by 2005.

Sugarcane area of 11,000 ha will be expanded along the eastern fringe of the existing sugarcane fields. Arabica coffee and tea will also be expanded for 2,000 ha and 7,000 ha respectively near the existing fields surrounding Kakamega Forest. The new plantation of Robusta coffee will be introduced in the eastern district with a total area of 1,000 ha. Horticultural crops will also be expanded as a part of Horticultural Extension Project. Total expansion will be 3,000 ha.

Kakamega is a large dairy zone in Western Province. With 25,000 heads of grade cattle and 207,000 heads of cattle, 22,000 tons of milk and 3,000 tons of beef are produced accounting for 65% and 50% of the total production respectively in Western Province. Through intensification of feed production in the existing managed pasture (2,000 ha) and fodder fields (23,000 ha), livestock production will be further promoted in the district. Although no expansion of feed producing fields is planned under the Master Plan, the district has a capacity to increase the milk production from 22,000 tons to 91,000 tons.

(8) Kericho district

Kericho district is one of the districts best endowed with favourable climate and fertile soil. Out of 443,000 ha of the district land, 187,000 ha are used for agriculture, of which 98,000 ha or 52% are under cultivation.

The main maize zone is the northern part of the district, i.e. Londiani, Kipkelion and Kericho, with a total area of 42,000 ha under Wheat/Maize-Pyrethrum Zone (LH2) to Tea-Dairy Zone (LH1). In these areas, 173,000 tons or 12% of the total maize production in the Region are harvested. Tea plantations extend along the western fringe of Mau forest i.e. Kericho, Litein and Bomet with a total area of 26,000 ha. The total tea production amounts to 68,000 ton or 54% of the regional production. Arabica coffee is planted in the north of Kipkelion with 2,000 ha under Coffee Zone (UM2). This zone is also utilized for sugarcane production with a total area of 2,000 ha. Fruits and vegetables are widely planted in the district with 2,000 ha.

The Master Plan proposes the expansion of maize, sorghum and beans production. It is planned with 25,000 ha of expansion to increase these food crops from 176,000 tons to

564,000 tons by 2005. About 5,000 ha of wheat will be introduced in the south of Bomet under Wheat-Barley Zone (LH3).

On the basis of the long experience of tea industry, new plantations of tea will be established around the existing tea plantations. About 7,000 ha of Kabianga, Litein and Kapkatet will be developed for this. This expansion corresponds to 16% of the target under the national tea expansion programme by 2000.

Arabica coffee will be newly introduced in Roret and its north under Tea-Coffee Zone (UM1). The total expansion is to be 4,000 ha.

Expansion of horticultural crops will be encouraged in the district. Several kinds of vegetables will be newly planted, considering the marketability of each. Passion fruit is one of the promising crops.

The district is the most developed zone of dairy farming in the Region. The total milk production of the district is 156,000 tons accounting for 31% of the regional production. It is expected that the carrying capacity of the managed pasture will be increased from 2.7 LU's/ha to 3.5 LU's/ha and the productivity of fodder crop from 2.7 LU's/ha to 6.6 LU's/ha. With this improvement of the existing feed sources, the grade cattle will be increased from 217,000 heads to 290,000 heads to increase milk production to 337,000 tons. No expansion of managed pasture and fodder crops area is planned.

(9) Nandi district

Although the present land use in Nandi district is restricted to an extent by its rolling topography, the agro-climate of the district is highly suitable for production of various crops. Out of 275,000 ha of the district land, 104,000 ha are used for agriculture. The agricultural land extends mainly in the southern part of the district.

Maize is widely planted in the district with a total extent of 40,000 ha. In contrast, the planted area of sorghum and beans are limited at 1,000 ha. Tea plantation in Nandi Hills with the total area of 9,000 ha under Tea-Dairy Zone (UH1) produces 23,000 tons or 18% of the total tea production in the Region, the second largest only next to Kericho. Constituting the northern fringe of Nyanza Sugar Belt in Kisumu, 3,000 ha of sugarcane are cultivated in the south of Nandi Hills in Aldai division under Marginal Sugarcane Zone (LM2).

Dairy farming in the district is another important activity. About 29,000 ha of managed pasture and 4,000 ha of fodder crops are developed for 133,000 heads of grade cattle and 75,000 heads of local ones. Producing 95,000 tons of milk, the district is a net supplier of milk in the Region.

The Master Plan proposes, first of all, the further promotion of milk production in the district. Through expansion of 7,000 ha for fodder crops, 37,000 heads of grade cattle will be added. For such expansion, Tea-Dairy Zone (LM1) around Kapsabet will be devoted. Raising 170,000 heads of grade cattle and 45,000 heads of improved local cattle i.e.

crossbred with grade cattle, milk production will be increased from 75,000 tons at present to 245,000 tons by 2005.

The Master Plan also proposes an increase in food and cash crop production. For maize and beans, 15,000 ha and 2,000 ha respectively of the district land will be newly reclaimed. The main expansion area is planned to be located along the eastern side of Tinderet Forest extending from Kaiboi to Kapsabet, and the northern portion of Nandi Hills. This area falls in Wheat/Maize-Pyrethrum Zone (LH2). In addition, 10,000 ha of wheat are planned to be expanded on the flat terrain in the north-eastern portion of the district, i.e. Masop division.

In Tea-Coffee Zone (UM1) and Tea-Dairy Zone (LH1) around Southern Tinderet Forest, 4,000 ha will be selected for tea plantation. Moreover, Arabica coffee will be expanded in the south of Southern Tinderet Forest with a total area of 4,000 ha under Tea-Coffee Zone (UM1). About 5,000 ha of horticultural crops will be expanded within maize expansion area. The increased production of fruits and vegetables seems very promising, as Nandi district is located between Kisumu and Eldoret, two major markets.

(10) Narok district

Out of 1,851,000 ha of the district land, 1,049,000 ha or 57% are within the LBDA region.

Narok district can be divided into two zones on the basis of agro-climatic conditions and present land use. One is north-western portion of Esoit-Oloolo escarpment (ILUS area) with a total extent of 202,000 ha, i.e. Kilgoris division, bordered in the north and in the west by the district boundaries with Kisii, Kericho and South Nyanza. The other is a portion of Mara river basin with 847,000 ha.

Agricultural activities in the district are less developed compared with other districts. At present, only 42,000 ha are used for food production. This corresponds to 4% of the LBDA portion of the district. Maize and sorghum are the major crops.

Local cattle raising is a more important activity than crop production. In total, 592,000 heads of local cattle and 282,000 heads of sheep and goats are grazing within the LBDA portion.

The Master Plan proposes further food and milk production in the district. Taking into account the possible adverse effects to wildlife in Masai Mara, however, the intensive agricultural development is not considered in the Mara river basin. Therefore, Kilgoris division will be central for the future agricultural development in the district.

Along the district boundaries with Kisii and South Nyanza, 12,000 ha will be newly reclaimed for maize, sorghum and beans. Although Arabica coffee and tea can be developed in this area, the expansion will be limited for the next 20 years. A part of perimeters of Mau forest will be developed for Arabica coffee expansion.

Since the carrying capacity of natural grassland is low at 0.3 LU/ha, only 136,000 LU's equivalent of feed are available for the total feed requirement of 207,000 LU's. For making up with the pasture shortage, fodder crop production will be encouraged. Semi-zero

grazing will be promoted by developing 32,000 ha of fodder crops for 185,000 LU's equivalent.

(11) Trans Nzoia district

Agriculture of the district is represented by commercial and seed maize production by large farmers and enterprises. Mechanized wheat production is also prevailing. Out of 232,000 ha of the district land, 106,000 ha are used for agriculture, of which 66,000 ha are cultivated with maize and wheat under Sunflower-Maize Zone (UM4) and Cattle/Sheep-Barley Zone (LM4-UM4).

Arabica coffee is the major cash crop in the district. The coffee plantation is managed in the east of Endebess of Kwanza division with a total area of 1,000 ha. Horticultural crops are planted in the district with 1,000 ha.

The Master Plan proposes the further production of maize, wheat and milk. For maize, 10,000 ha will be expanded in and around Kitale town. Wheat production prevailing on the footslopes of Mt. Elgon will be further expanded with a total area of 10,000 ha around the existing fields in Kwanza division. Arabica coffee will also be expanded in Kwanza division with a total area of 1,000 ha under Main Coffee Zone (UM2).

Dairy farming is also the mainstay of the agriculture in the district. The district raises 74,000 heads of grade cattle and 36,000 heads of local cattle to produce 53,000 tons of milk and 3,000 tons of beef accounting for about 10% and 5% of the total production respectively in the Region. To stabilize the feed supply to grade cattle, 10,000 ha of fodder crop field will be developed. This would enable to increase population of grade cattle from 74,000 to 120,000. As a result, milk production will increase to 129,000 tons by 2005.

(12) Uasin Gishu district

Out of 358,000 ha of the district land, 151,000 ha are used for agriculture. In 57,000 ha of maize fields and 71,000 ha of wheat fields under the largest Wheat-Barley Zone (LH3) in Kenya, 158,000 tons of maize and 121,000 tons of wheat are produced, corresponding to 11% and 78% of the total produced in the Region, respectively.

The Master Plan proposes to promote maize, wheat and milk production in the district. About 16,000 ha of maize will be expanded in and around Kipkabus under Pyrethrum-Wheat Zone (UH2) and in the southwest of Turbo under Sunflower-Maize Zone (UM4). Wheat will be expanded from the north to the south of the district with a total area of 19,000 ha. The anticipated annual production of wheat will attain 342,000 tons. This amount corresponds to 86% of the target national production in 2000. Since SP1 projects that the national wheat demand in 2000 will reach one million tons, the proposed wheat expansion would contribute substantially to food self-sufficiency in Kenya.

Feeding 133,000 heads of grade cattle and 89,000 heads of local cattle, the district produces 95,000 tons of milk and 5,000 tons of beef accounting for 19% and 9% of the total amounts respectively in the Region. The present production is supported by 12,000 ha of managed pasture and 4,000 ha of fodder fields.

Milk production will be encouraged through both intensification and expansion of fodder crop production. In order to perform multiplication of grade cattle from 133,000 heads to 170,000 heads by 2005, the additional 13,000 ha of fodder are to be expanded in the whole district. Under such a condition, milk production will be increased from 95,000 tons to 195,000 tons.

(13) Nakuru district

About 67,000 ha or 7% of the western portion of the district is included in the LBDA region. Out of the total, 27,000 ha or 40% are covered by South Western Mau forest, constituting the uppermost portion of the watershed of Sondu River. Presently about 8,000 ha are used for maize and 4,000 ha for wheat.

The Master Plan gives the highest priority to the conservation of natural forests for watershed management. However, to take advantage of the good potential under Pyrethrum-Wheat Zone (UH2), a maximum of 10,000 ha is planned for maize expansion.

Dairy cattle raising is prevailing in the district. It is estimated that approximately 15,000 heads of grade cattle and 28,000 heads of local cattle distribute in the LBDA portion. Some 11,000 tons of milk and 2,000 tons of meat are produced.

Through the promotion of zero-grazing, intensive dairy farming will be encouraged. Grade cattle will be multiplied from 15,000 heads to 49,000 heads to attain the milk production of 56,000 tons by 2005. For this purpose, 5,000 ha of fodder crops will also be expanded.

(14) West Pokot district

Out of 898,000 ha of the district land, 25,000 ha or 3% in the south of the district, i.e. Kapenguria division, are in the LBDA region. The area falls in Sheep-Dairy Zone (UH1-2), Tea-Dairy Zone (LM1), Wheat/Maize-Pyrethrum Zone (LH2) and Marginal Coffee Zone (UM3) from east to west. The eastern half portion, i.e. UH1-2 and LH1, is covered by Kapkanyar forest extending to Kiptaber forest of Elgeyo Marakwet. This forest zone forms the uppermost portion of the watershed of Nzoia River.

Agricultural activities are concentrated mainly in the eastern portion under LH2 and UM3. Dairy farming is the most important activity there. It is estimated that about 5,000 heads of grade cattle and 9,000 heads of local cattle are raised in 3,000 ha of managed pasture and 11,000 ha of natural grassland.

The Master Plan proposes the multiplication of grade cattle from 5,000 heads to 16,000 heads in order to increase the milk production from 4,000 tons to 19,000 tons. Planned for this purpose are the improvement of carrying capacity of existing managed pasture and expansion of fodder crops with 3,000 ha.

It is estimated that 8,000 ha of the agricultural land are used for crop production, i.e. maize and wheat. The expansion of 3,000 ha for food crops is proposed by the Master Plan.

(15) Elgeyo Marakwet district

Out of 281,000 ha of the district land, the western 87,000 ha or 31% fall in the LBDA region. The land is characterized by rolling to hilly topography. Especially, almost the entire land areas in Tot and Northern divisions have the steepness of over 16%. These lands are also characterized by dense forest coverage i.e. Kiptaber forest. About 6,000 ha are used mainly for maize production. The main producing zone is the flat terrain extending in the west of Iten. Dairy production is also prevailing in the district, with about 5,000 heads of grade cattle and 9,000 heads of local cattle grazing in 3,000 ha of managed pasture and 2,000 ha of natural grassland.

The Master Plan proposes, first of all, the establishment of the well-planned forest conservation programme and second the further increase in food and milk production. In total, 2,000 ha of maize fields and 2,000 ha of fodder crops will be expanded, mainly in Central division, i.e. Iten to Tambach.