REPUBLIC OF KENYA

LAKE BASIN DEVELOPMENT AUTHORITY

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

FINAL REPORT

Volume 3

SECTOR REPORT 1

AGRICULTURE/LIVESTOCK/FISHERY

October 1987

JAPAN INTERNATIONAL COOPERATION AGENCY

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Abbreviations

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

KWDP	Kenya Woodfuel Development Project
LBDA	Lake Basin Development Authority
LPG	Liquefied Petroleum Gas
LSI	Lake Shore Irrigation
LU	Livestock Unit
MCH/FP	Matenal Child Health/Family Planning
MOLG	Ministry of Local Government
MOA	Ministry of Agriculture
MOALD	Ministry of Agriculture and Livestock Development
MOERD	Ministry of Energy and Regional Development
MOEST	Ministry of Education Science and Technology
MOH	Ministry of Health
MOLD	Ministry of Livestock Development
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
SP1	Sessional Paper No.1 of 1986 on Economic Management for Renewed Growth
SPSCP	Smallholder Production Services and Credit Scheme
SRRP	Smallholder Price Rehabilitation Project
SSIOP	Small Scale Irrigation Development Project
SWAP	Surface Water Extraction Permit
T&V	Training and Visit
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific, and Cultural Organization
UNICEF	United Nations International Children's Emergency Fund
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development
VOR	Very High Frequency Ommidirectional Radio Range
WHO	World Health Organization

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 1 AGRICULTURE

The study of agricultural sector has been undertaken as an important part of the Integrated Regional Development Master Plan study of the LBDA region. The study has been carried out as joint efforts of the JICA experts and their LBDA counterparts in collecting data, discussing important issues, analyzing development targets and frameworks and formulating development projects and other measures. Also much efforts have been made to exchange views with officials of all the districts in the Region as well as the central Government agencies on different occasions as outlined in the Master Plan Report.

This chapter presents the results of the sector study in four sections. In Section 1.1, the present conditions related to agriculture in the Region are examined, covering land use and tenure, crop production and marketing, and the support system. In Section 1.2, development targets are set for agricultural development in the Region in line with the national development policy, and development potential is assessed. Labour supply/demand is also examined.

The agricultural development plan for the Region is presented in Sections 1.3 and 1.4. First, development objectives, strategy and general measures are described in Section 1.3. General directions for strengthening and streamlining agricultural support system are also clarified. Along the general directions set in this way for agricultural development, specific projects are identified and associated measures formulated as described in Section 1.4.

CHAPTER 1 AGRICULTURE

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1.1 Present Agricultural Condition

1.1.1 General

The Lake Basin Development Authority region (herein called the Region) lies in the western part of Kenya in latitude between 1°30' N and 2°00'S and in longitude between 34°00'E and 35°45'E with a total area of 47,709 km^2. The Region is bordered by Uganda in the the west and by Tanzania in the south, and demarcated by the water divides in the north and the east. Administratively, Nyanza and Western Provinces, and the western parts of Rift Valley Province fall in the Region. The population and land of 15 districts constituting the Region are given in Table 1.1.

Based on the population census, the population of Nyanza and Western Provinces combined is estimated to be 6.0 million or 30% of the national total in 1985. Including parts of Rift Valley Province, it is estimated that 8.1 million of people are in the Region. This means that 40% of the Kenyan population concentrates in 8% of the nation's territory.

Within the generally arid to semi-arid tropical savanna dominant in Kenya, the Region is quite conspicuous by its ample rainfalls as shown in Figure 1.1. Under the favourable climate, the vast tracts of fertile terrain have been extensively utilized for agriculture and other related activities. Table 1.2 presents the national and regional production of major agricultural products. As can be seen, 72% of the total maize production in the nation is produced in the Region, 76% of the total for wheat and 20% for rice. Several cash crops are also extensively planted in the Region. More than 90% of sugarcane, 66% of tea and 6% of coffee are from the Region. Tea and coffee are quite important export crops of Kenya.

1.1.2 Present land use

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 as presented in Table 1.3. Agricultural land comprises cultivated land, field borders, fallow land and managed pasture. About 1,229,000 ha or 79% of the total agricultural land are being cultivated. About 136,000 ha or 9% of the total agricultural land remain as fallow land. Managed pastures have been developed in 165,000 ha mainly of Rift Valley Province, where grade cattle are broadly raised. The remainder is the field borders with 19,000 ha or 1% of the total agricultural land.

Out of 1,229,000 ha of the total cultivated land, 750,000 ha or 61% are used for producing staple crops, 327,000 ha or 27% for cash crops. Although the production of horticultural crops is promoted by the Government, their planted area is still low at 13,000 ha or 1% of the cultivated area in the Region. The remaining 139,000 ha or 12% are utilized for fodder crop production for cattle raising. The further details of present land use condition are described in Chapter 10 of Sector Report.

1.1.3 Land tenure and holding size

(1) Land title

Land title consists of Government land, County Council land, trust land and private land. Private land is further divided into freehold land and leasehold land. Through the Integrated Land Use Survey (ILUS, 1984), the land tenure system of the Region excluding the Mara river basin was clarified as below.

Land title	Extent
Government land	12%
County Council land	<1%
Trust land	20%
Private land	68%
- Freehold	(51%)
- Leasehold	(17%)

Government land consists mainly of forest and National Parks and Reserves. Districts having considerable extent of Government land are mostly in Rift Valley Province as shown in Figure 1.2.

The land in the Region is predominantly under the private ownership. High proportion of freehold land occurs in Kisii, Busia, Kakamega, Bungoma and Siaya, while leasehold land dominates in Uasin Gishu and Trans Nzoia.

(2) Land adjudication

All the land except for leasehold and Government land is now placed under the adjudication system. Except for settlement schemes, adjudication has been completed in Kisii and Kakamega and almost completed in Busia, Bungoma, Kisumu, Kericho and Nandi. At present 10% of the Region is in the process of adjudication.

Further adjudication is planned in Kisumu only to a limited extent (1%). No adjudication is planned for 11% of the Region, mainly on the Kano Plain, Yala Swamp, and parts of South Nyanza and Narok.

(3) Land holding size

According to the Integrated Rural Survey 1976-79 (1981,MOERD), the distribution of holdings by size of holding are as presented in Table 1.4. In Nyanza and Western Provinces, holding size of more than 80% of house holders falls in the classes of less than 2 ha. In Rift Valley, more farmers hold larger lands. It is noted that 36.8% of householders in Rift Valley are of zero-holding, but not operating any piece of land although they may own or graze livestock. Owing to land subdivision, proportion of smallholders has been increased in Rift Valley since IRS in 1979.

1.1.4 Crop production

(1) Cropping patterns

A variety of crops are planted in the Region. They comprise the following crops.

i)	Staple crops:	maize, sorghum, finger millet, rice, sweet-potatoes, Irish potatoes, cassava, beans, banana, etc.
ii)	Cash crops:	coffee, tea, sugarcane, cotton, sunflower, pyrethrum, groundnuts, sisal, wheat, etc.
iii)	Horticultural crops:	citrus, onion, tomatoes, passion fruits, papaya, cabbage, sukumawiki etc.

The present cropping patterns are illustrated in Figures 1.3 through 1.5 for all the districts in the Region. Generally, maize for long rainy season is sown between January and March and harvested between June and September, although the slight difference is observed in Nyanza and Western Provinces. Single cropping of maize is prevailing in Rift Valley Province, where maize is sown later than in Nyanza and Western Provinces and harvested in between October and January.

Second crops for short rainy season are planted mainly in humid to subhumid zones, i.e. LH1-2, UM1-2, LM1-2 of agro-ecological zones in Kisii, Kisumu, Siaya, South Nyanza and Kakamega. Major crops sown in the short rainy season are maize, sorghum, millet and beans. Out of 455,000 ha of the total maize fields, 82,000 ha or 18% are planted in the short rainy season. Likewise, sorghum and millet are planted in 58,000 ha for long rain season and in 9,000 ha for short rainy season giving the cropping intensity of 116%. Beans are planted in 91,000 ha for long rainy season and 19,000 ha for short rainy season giving the cropping intensity of 121%. (Table 1.5).

Planted area, unit yield and production of major crops have been analyzed, based on the annual reports (1976-1984) prepared by the provincial offices of Ministry of Agriculture and Livestock Development (MOALD). Since the annual crop production has fluctuated in the past decade mainly due to climatic changes, the average production between 1976/77 and 1984/85 is defined in this study as the present production. The results are explained below.

(2) Staple crops

About 750,000 ha or 61% of the cultivated land in the Region is used for staple crop production, of which about 600,000 ha or 80% are used for maize, sorghum, millet and beans. The present production of each crop is presented by district in Table 1.6 and summarized below.

Crop	Planted area (1000ha)	Unit yield (tons/ha)	Production (1000 tons)
Maize	537	2.8	1,504
Sorghum &millet	67	0.8	54
Beans	110	0.7	77
Rice (dry paddy)	3	2.5	8
Sweet potatoes	26	7.5	195
Cassava	66	7.5	495
Other crops (banana, etc.)	31	9.0	279

Maize, being the main diet of Kenyans, leads other food crops in both planted area and production. The total planted area is 537,000 ha and the total production amounts to 1,504,000 tons with an average yield of 2.8 tons/ha, accounting for 72% of the total production in the country. Main producing districts are Bungoma, Kakamega, Trans Nzoia, Kericho, Uasin Gishu and Kisii, where 1,070,000 tons or 70% of the regional total are produced.

Crop productivity is directly affected by local agro-climate as well as rainfall patterns. As can be seen in Table 1.7, unit yields of maize vary widely among districts, ranging from 1.7 tons/ha to 3.1 tons/ha. The yields are higher in Bungoma, Kakamega and Kericho in humid zone, whereas somewhat lower in Busia, Siaya and Kisumu in dry zone. The higher yield has been attained in Trans Nzoia under the commercial mechanized farming.

The Region has increased maize production significantly during the past eight years (1976-1983) as shown in Figure 1.6. The increased production has been obtained mainly by expansion of planted area. The average unit yield in the Region has been staying practically at the same level between 2.0 tons/ha and 3.0 tons/ha. It is noted that the maize production in the Region is highly sensitive to climatic changes. In the drought years, i.e. 1979/80 and 1983/84, maize production decreased considerably.

Beans are also important crops as a main protein source for local people. The total planted area is 110,000 ha and the total production is 77,000 tons accounting for 32% of the national total. The average unit yield is 0.7 ton/ha in the Region.

For food security in drought years or other emergency cases, such drought resistant crops as sorghum and finger millet are planted with a total area of 67,000 ha. Especially in the districts under semi-dry condition, these crops are quite important to supplement deficit of maize supply. In fact, sorghum and finger millet are broadly planted in dry zone of Busia, Siaya and South Nyanza. In Kisumu, the planted areas of these crops have steadily increased to reach 10,000 ha recently. Total production amounts to 54,000 tons giving unit yield of 0.8 ton/ha on an average.

There exist three pump irrigation schemes for rice in the Region, namely Ahero, West Kano and Bunyala schemes under the management of National Irrigation Board (NIB). Out of 8,000 tons of the total paddy production in the Region, some 5,000 tons or 63% are produced in these schemes. In addition, village level irrigation is assisted by Provincial Irrigation Unit (PIU) organized under MOALD. By constructing simple irrigation facilities and providing technical assistance, paddy is cultivated in about 2,000 ha of 24 locations in the Region. Besides, rainfed paddy was recently introduced to Western Province. The average unit yield is estimated at 2.5 tons of dry paddy per hectare.

Root crop production is prevailing in the Region, especially in Nyanza and Western Provinces. Major root crops are cassava and sweet potatoes. Irish potatoes are also planted, but production amount is limited. Cassava is produced mainly in dry lowlands of South Nyanza, Busia and Siaya, whereas sweet potatoes are in humid highlands of Kisii, Bungoma and Kakamega. The total production of root crops is 690,000 tons from 92,000 ha giving unit yield of 7.5 tons/ha.

Banana is another staple crop. The total planted area is 19,000 ha in Kisii alone and the total production amounts to 279,000 tons with unit yield of 9.0 tons/ha on an average. Main producer districts are Kisii, Kakamega, Bungoma and South Nyanza, where 84% of the total regional production is harvested.

(3) Cash crops

Cash crop production is an important activity in agriculture of the Region with a total extent of 327,000 ha. The production quantities by district of major cash crops are presented in Table 1.8 and summarized below.

Crop	Planted area (1000 ha)	Unit yield (tons/ha)	Production (1000 tons)
Coffee	13	0.4	5
Tea (green leaf)	48	2.6	125
Cotton	49	0.3	15
Sugarcane	109	32.0	3,488
Wheat	92	1.7	156
Sunflower	9	1.3	11
Groundnuts	16	0.9	14

Coffee production is active in several districts with a total extent of 13,000 ha. The total production is 5,000 tons giving an average yield of 0.4 ton/ha. Under the favourable climate for coffee production, the small growers in Kisii, Bungoma and Kericho produce more than 90% of the total production in the Region. Following them, South Nyanza has substantially increased its coffee fields. The necessity of quality improvement has been pointed out by MOALD. Most coffee harvested in the Region is graded as of medium quality in classes 4 to 6 of 10 classes defined by the quality criteria.

Tea production is also prevailing in the Region. Total planted area is 48,000 ha with the average unit yield of 2.6 tons/ha as green leaf equivalent. Large scale tea production is maintained by commercial plantations in humid highlands in Kericho and Nandi districts. Tea is produced also by small growers in Kisii. Kericho and Kisii produce 120,000 tons or 96% of the total green leaf in the Region.

Cotton production in the Region is represented by South Nyanza and Siaya. Two districts combined produce 10,000 tons or 67% of the total production of seed cotton. Total planted area is 49,000 ha and unit yield is presently depressed at 0.3 ton/ha.

Sugarcane is widely planted in the Region sharing 98% of the national production. Out of 3,488,000 tons of the regional production, 3,136,000 tons or 90% are produced in Kisumu, Kakamega, Bungoma and South Nyanza. There exist six large sugar factories plus two small ones in the area to produce white sugar, as of 1986. The planted area extends to 109,000 ha with the unit yield of 32.0 tons/ha on an average.

Wheat is planted as cash crop on large farms in Rift Valley Province, e.g. Trans Nzoia and Uasin Gishu, for exporting to other regions in Kenya. This area produces 156,000 tons of wheat, which correspond to 76% of the total production in the country, and is recognized as largest wheat-barley zone in Kenya. Total planted area is 92,000 ha and unit yield is 1.7 tons/ha. Although Nakuru and Narok are producing wheat, the production amount in the portion belonging to the Region is limited.

Other cash crops are represented by sunflower, groundnuts and pyrethrum. Sunflower is loosing popularity due to lack of a well organized marketing system and low prices. At present, East Africa Industries (EAI) is promoting the production of sunflower and other oil crops in Bungoma, Trans Nzoia and Uasin Gishu. Sunflower is an important rotational crop in Rift Valley Province with maize and wheat. The total production is estimated to be 11,000 tons.

Groundnuts is mainly produced in South Nyanza sharing 80% of the total production of 14,000 tons in the Region. It is categorized into cash crops, but practically all the production of groundnuts are consumed by local people. Pyrethrum is planted mainly in Kisii, producing 3,000 to 4,000 tons of dry flower. Tobacco is also produced on the contract basis with British American Tobacco Kenya Ltd. The main producer is South Nyanza with a total area of 2,000 to 4,000 ha producing 2,600 to 4,600 tons.

1.1.5 Marketing system

(1) General

Local trade of agro-products is quite active in most parts of Kenya. Several market centers are placed in each district and controlled by the respective District County Council. There are about 130 market centers in the Region, where farm products are brought in on specified days by individual farmers or private traders. Most horticultural crops are marketed there. Other foodstuffs such as maize, rice, root crops, beans, poultry and eggs are also traded

through local markets. Although their marketed quantities are not small, the most of local trade elude official statistics and agricultural census.

Major crops for both exports and domestic consumption are traded by several marketing boards. There are about 40 statutory boards, which are parastatal bodies and agencies. Most of them act as market monopolies with regulatory duties to some extent. Agricultural boards are generally responsible to MOALD, who supervises their operations with the inspector of statutory boards organized under the Office of the President.

A marketing board usually purchases the products it handles at fixed prices, processes them as necessary and sells them on wholesale basis. It is responsible also for storage, packaging and other handling, as necessary. Sales by boards are basically by competitive bidding, and in principle no favouritism should be involved. Boards are not directly concerned about retailing to individual consumers, which is left to wholesalers. Thus pricing reflecting supply/demand would be partly restored in final retailing.

The objectives of establishing a marketing board are:

(1) To improve marketing efficiency by providing facilities which increase volume sales and/or reduce marketing costs,
(2) To provide incentives to farmers and increase their incomes by establishing prices,
(3) To secure supply of food and establish national and regional reserves for consumer benefits,
(4) To eliminate excessive share of profits which may be made by private traders,
(5) To facilitate import substitution and promote export of agricultural commodities, and
(6) To create an orderly marketing system by policy pricing, quality and quantity control for the national benefits.

Common problems pointed out for marketing boards are (i) poor management, (ii) insufficient market margins, (iii) delayed payment to producers, (iv) excessive deductions for marketing costs, and (v) general favouring towards larger producers.

(2) Maize and other grains

National Cereals and Produce Board (NCPB) is the official, but not monopolistic, purchaser of maize, wheat and paddy and is also a fixed-price buyer of beans and oil crops such as sunflower, groundnuts and cashew nuts, etc. The most important role of NCPB is to ensure an even distribution of grains throughout the country, receiving from the grain surplus areas and delivering to the grain deficit areas.

The grains trade in the Region is controlled by three Area Managers for Kisumu, Bungoma and Nakuru. For smooth trade of grains, NCPB has established about 350 buying centers in the Region. These buying centers are placed at location or sub-location levels and operated during three to five months from December to April. In addition, 500 to 600 private traders, who are appointed as the agents of NCPB, are also handling purchase of grains.

The NCPB purchase of maize in the Region was recorded at 440,000 tons per annum on an average during the period of 1981 to 1983. This amount corresponds to about 77% of the total purchase by NCPB in the country. As shown in Table 1.9, 765,000 tons or 51% of maize grains are marketable out of 1,504,000 tons of the total maize produced in the Region. This means that about 58% of the total marketable amount of maize is handled by NCPB.

The grain storage capacity of NCPB amounts to 478,000 tons with 22 depots in the Region. This capacity accounts for 53% of the national total. Most of the depots are receiving maize grain from the buying centers, the private traders and the large farmers. Out of 478,000 tons, 392,000 tons are of conventional warehouse type for storing maize and 86,000 tons are for wheat. Since 440,000 tons of maize are purchased by NCPB, overall turn-over rate is estimated to be low at 1.1. In addition to the NCPB own storage with 392,000 tons for maize, the private storage with the total capacity of 97,000 tons is hired by NCPB in the Region. These are utilized to make up the seasonal shortage in storage capacity.

Besides, Kenya Grain Growers Co-operative Union (KGGCU), succeeded the former Kenya Farmers Association (KFA), has also trading activities of a range of products such as maize, wheat and beans.

(3) Cash crops

Coffee Board of Kenya (CBK) is a government parastatal responsible for the overall marketing of coffee in Kenya. It also has regulatory functions to plan and formulate the national coffee production including the coffee expansion programme. There are two types of coffee growers in Kenya. The small-scale growers organized as co-operative societies and/or unions own and manage coffee factories which process their coffee cherries harvested by individual growers. The commercial plantation growers, mainly private companies, are organized into the Kenya Coffee Growers Association.

The parched coffee from factories of societies/unions are then handled by a national body, Kenya Planters Co-operative Union (KPCU) who stores, processes and grades the coffee using advanced technology before finally handing it over to CBK for marketing.

Tea is traded by both individual commercial plantations and farmers co-operatives. Large plantations are allowed to sell their products directly to exporting companies. On the other hand, small growers are organized to form co-operatives under Kenya Tea Development Authority (KTDA). KTDA is managing 22 tea factories in the nation for collecting, processing and grading tea produced by small growers. Tea of high quality is exported through Kenya Tea Board. For domestic markets, tea is packed and sold by Kenya Tea Packers Ltd.

Cotton Lint and Seed Marketing Board (CLSMB) is dealing with cotton trade. All seed cotton is collected and processed by licensed ginneries under the supervision of CLSMB. Through brokers appointed by CLSMB, processed lint and cotton seed are sold to textile companies and EAI, respectively.

In addition to the above marketing boards and agents, Kenya Sisal Board (KSB), Kenya Sugar Authority (KSA) and Horticultural Crops Development Authority (HCDA) purchase respective crops directly from the producers or through agents for subsequent processing at their own or licensed plants.

1.1.6 Support system

(1) Extension services

Agricultural Extension and Service Division (AESD) within MOALD is the central executing agency to carry out extension services for encouraging and assisting farmers to adopt improved farming practices and farm inputs. In addition, the parastatals and private organizations such as KTDA, Kenya Breweries, British American Tobacco, EAI and other chemical companies are also carrying out their own extension services.

Field extension services are directed from the provincial level, and organized and coordinated at a district level. District Agricultural Officer (DAO) is responsible for extension activities in his district, assisted by subject matter specialists. All DAO's are graduates with degrees in agricultural science. Under DAO's are Division Extension Officers (DEO's) mostly graduates of the three year diploma courses at Egerton College. Each DEO supervises 15 to 30 frontline extension workers at location and sublocation level within his division. They are called Technical Assistants who have completed secondary school and then received a two-year certificate after training at the MOALD Agricultural Training College.

AESD has the function to plan and implement agricultural extension strategies and to facilitate the supply of farm credit and inputs to the local farmers. AESD consists of the following five branches.

1. National Extension Programme Branch,
2. Agriculture Information Service Branch,
3. Home Economics and Rural Youth Branch,
4. Agricultural Credit and Farm Management Branch, and
5. Farm Input Supply Branch.

National Extension Programme Branch formulates extension methods, arranges the training of extension staff and maintains close linkage with agricultural research. This branch is the central body to execute the on-going National Extension Project (NEP).

In 1982, NEP was commenced in Kericho and Nandi as a part of nationwide extension services with the financial assistance of the World Bank and International Fund for Agricultural Development (IFAD). At present, all other districts in the Region are covered by NEP. The main objectives of NEP are:

(a) provision of sufficient extension staff members,
(b) investment in transportation, office equipment, audio-visual aids and the construction of offices at the district and location levels,

(c) provision of sufficient finance for covering vehicle operation cost and extension materials,
(d) provision of funds for training,
(e) support to adaptive research and improvement of research extension linkage, and
(f) technical assistance, monitoring and evaluation.

A significant feature of NEP is the introduction of the Training and Visit (T&V) system in order to convey technological advice to farmers and to serve as an efficient channel between the farmers and the agricultural research.

(2) Farm input supply

The major farm inputs are seeds, seedlings, fertilizer and agro-chemicals. The main distributors of these inputs are KGGCU, marketing boards and co-operative societies assisted by the Farm Input Supply Scheme and the Smallholder Improvement Coffee Project of MOALD.

Such commercial seeds as maize, wheat, barley, sunflower and pasture are produced and released by Kenya Seed Company (KSC) based in Kitale town, Trans Nzoia district. KSC was formed in 1956 by a group of farmers to produce and market the improved pasture seeds. All varieties of seeds produced are selected from indigenous materials. At present, KSC contracts annually with farmers in Kitale area with 1,500 to 2,000 ha for producing pasture seeds, e.g. Rhodes Grass (Chloris Gayana). About 40% of the seeds thus produced are sold in the domestic market and the surplus is exported to other countries.

In 1962, the governmental plant breeders released the first hybrid maize and KSC undertook the multiplication of the seeds in the following years. The maize seeds prevailing in the Region are hybrids of H632, H613, H614, H612 and H511, and composite type of Katumani. All the seeds are produced by the contract farmers in 6,000 ha within 15 km distance from the KSC office. In addition, about 1,000 to 1,500 tons of sunflower seeds, 8,000 tons of wheat and 4,000 tons of barley are annually released for local farmers.

The activities of LBDA cover the seed multiplication and marketing in the Region. Serena sorghum treated with fungicides are released to the local farmers. The seedlings of fruit trees and coffee, which are multiplied in Yala Swamp under the management of LBDA, are also available in the Region.

All the fertilizer and agro-chemicals are imported either under donor-funded schemes or through private companies that receive foreign exchange allocations. The large portion of fertilizer is applied to cash crops such as tea, coffee and tobacco and the very limited amount is used for food crop production, except for hybrid maize. In 1978, 89,300 tons of fertilizer were marketed in the nation, of which 15,800 tons or 18% were applied in the Region.

Fungicides and insecticides are also available to farmers through the same sources as fertilizer, but application amount is still low. Out of 7,400 tons of the total agro-chemicals used in the whole of Kenya in 1978, only 300 tons or 4% were used in the Region.

(3) Farmer's credit

Agricultural credit is available through a number of channels. The main formal sources are agricultural credit institutions, commercial banks, marketing boards and input suppliers.

Agricultural credit institutions

Agricultural Finance Corporation (AFC) and Co-operative Bank of Kenya Ltd. are the principal agricultural lending institutions in Kenya. They are the on-lending vehicles for a number of projects, which are financed by the Government as well as international agencies such as IBRD.

AFC was established in 1969 under the Agricultural Finance Corporation Act to develop the domestic agriculture and agro-industries by offering loans to farmers, cooperative societies, private companies and public bodies engaging in agricultural activities. AFC loans are given for short term (2 years), medium term (3-8 years) and long term (over 8 years).

AFC operates the New Seasonal Credit Scheme (NSCS) of MOALD as the most important governmental credit facility offered to the smallholders. The following is a brief outline of this scheme.

a) Objective crops are maize and wheat.
b) Funds are used for land preparation, purchase of seed, fertilizer, agro-chemicals and agricultural implements.
c) Loans are Kshs.1000 per acre at maximum.
d) Other conditions are as follows.
   - Land must be suitable for crop production.
   - Farm must be legally owned by the applicant.
   - Minimum acreage for each crop must be five acres.
   - Interest is 14% per annum.
   - Repayment is completed within 12 months from the date of loan approval.

Because the loan condition requires that an applicant must own five acres or more, most smallholders in the Region are not eligible. The total loan applied in Western and Nyanza Provinces in 1982 were Kshs.14.2 million and Kshs.1.1 million, respectively.

Co-operative Bank of Kenya was established in 1965 under the Co-operative Societies Act, and confirmed under the Banking Act in 1968, to provide central banking services to the cooperative sector. Co-operative Bank of Kenya has channelled funds under various donor-funded projects through five branches in Nairobi, Kisumu, Mombasa, Meru and Nakuru. Loans are offered to the specific projects, with loan conditions varying from one project to another. In general, the interest rate is 16% per annum regardless of maturity period of loans: short term (2 years), medium term (5 years) and long term (over 5 years). The loans are divided into four types; i.e. production loan, farm land acquisition loan, hire purchase of vehicles and tractors, and construction loans. The production loans are most accessible by smallholders. Smallholders have benefitted from the following.

- Co-operative Production Credit Scheme (CPCS),

- Smallholder Production Services and Credit Scheme(SPSCP),
- Farm Input Supply Scheme (FISS),
- Smallholder Coffee Improvement Project (SCIP), and
- Integrated Agricultural Development Program (IADP).

Commercial banks

There are 18 commercial banks currently operating in Kenya. Kenya Commercial Bank Ltd., Barclays Bank Ltd. and Standard Bank Ltd. dominate the banking system and account for some 90% of total deposits and commercial banking credit amounts. These banks have over 250 branches, sub-branches and agencies in the country, and also several mobile bank units, which visit a number of smaller towns and villages at regular intervals.

Commercial bank credit is generally of short term with annual interest rate of 16%. As of December 1983, the distribution of credit to the agricultural sector was Kshs. 3,812 million in the nation, of which Kshs. 3,218 million or 84% were directed to large farmers, co-operative societies and agricultural boards.

Marketing boards

The smallholders growing coffee, tea, pyrethrum and cotton can obtain seasonal or medium-term credit from the respective monopolistic marketing boards. Farmers growing only subsistence crops have little access to this type of credit. Farmers are not required to deposit in advance, whereas repayment is made by deduction from their products at the time of harvesting.

Input suppliers

KGGCU provides credit to its members for purchases of farm inputs. Generally, this credit is lent only to those farmers who sell their produce to KGGCU. Farmer's title deeds and credit standing are verified prior to loan approval. Recovery is enforced through deduction at the time of sales. Loans are given without interest for the first 90 days, and thereafter repaid under the condition with an interest charge of 16% per annum. KGGCU works closely with Agricultural Finance Corporation (AFC) in its credit and marketing activities.

The British American Tobacco Ltd. and Kenya Breweries Ltd. also provide credit to farmers under their crop production schemes. Input and extension advice are provided by these companies, too. Farmers' products are purchased by the companies at guaranteed minimum prices.

(4) Agricultural research

MOALD is responsible for executing the agricultural research being supplemented by University of Nairobi, KSC and other governmental organizations. National Council for Science and Technology establishes research strategies and coordinates the agricultural research activities at the national level. In addition to the national research stations, MOALD also runs several regional research stations for specific experiments in respective regions.

There are four national research stations in the Region. National Agricultural Research Station (912 ha) in Kitale is carrying out maize and pasture breeding. National Sugar Research Station in Kibos (212 ha) and in South Nyanza (14 ha) are doing selection of sugarcane varieties and establishing the appropriate farming operation for sugar. Tea Research Foundation (390 ha) in Kericho is carrying out tea breeding. A branch of Coffee Research Foundation located in Kisii (10 ha) is executing the experiments of coffee breeding and plant protection, and has responsibility as an extension liaison.

Four regional stations are operated in the Region. Western Agricultural Research Station (324 ha) having farms in Kakamega and Alupe is breeding sorghum and millet and also dealing with agronomic study for horticulture, maize, groundnuts and animal production. Nyanza Agricultural Research Station (115 ha) with farms in Kisii, Homa bay, Oyani and Kilgoris is operating the research work for maize, sorghum, millet, legume and horticulture. The other two stations are Cotton Research Station (20 ha) in Kibos and Ahero Irrigation Research Station (AIRS) in Kisumu. In addition, the International Center for Insect Physiology and Ecology (ICIPE) has a station at Mbita point in the Region which carries out research an insect pests and several crop species. The accomplishments of the researches on the major crops in the Region are outlined below.

The first hybrid maize was released in 1962 for highlands in the Region. Following it, various hybrids and other high-yielding varieties have been released. They are H500 and H600 series of hybrid maize and Katumani of early maturing variety for semi-dry zones. The nationwide variety test and fertilizer trial for maize have been performed applying these varieties. In the Region, such experiments were initiated in the National Agricultural Research Station in Kitale, Nyanza Agricultural Research Station in Kisii and Western Agricultural Research Station in Kakamega. Through the experiments, these stations have achieved the high yield records exceeding 8 tons/ha.

Wheat and barley production in the Region has been largely enhanced as a result of the research work performed in National Plant Breeding Station in Njoro of Nakuru district. This station is carrying out the fertilizer trial for wheat, barley, and triticale in several locations of the highlands in Rift Valley Province, e.g. Eldoret. Based on these experimental data, recommendations on variety choice and proper husbandry have been given to the Region.

Research for sorghum and millet is still in its initial phase. The regional Agricultural Research Stations in Nyanza and Western Provinces are performing fertilizer trial with new varieties of those crops in the several locations. The research efforts for beans have established a good basis for the development of proper husbandry. The considerable amount of information and experiences have already been translated into simple technical messages for the smallholders and transferred through NEP.

Rice research is centralized in NIB schemes in the Region. AIRS is carrying out the experiments on several aspects of irrigated rice, especially for irrigation water management, pest control and variety choice.

Coffee research was started as early as in 1908 and have been controlled by Coffee Research Foundation since 1964. A major research work has concentrated on improvement

of planting density and fertilizer application. Research stations have contributed to better productivity by extending guidelines for replanting and new planting with new varieties, by training proper pruning technique, and by encouraging research/extension cooperation.

Tea research services were commenced in 1951 by the major tea companies. Even after it was placed under the responsibility of the MOALD in 1980, it has been funded by the tea companies. As a result of efforts made in tea research, yields of green leaf were roughly doubled from 1962 to 1972. However, such increased productivity has been made mainly in commercial estates. The productivity in small farms is generally still low due to lack of farm inputs and adequate pruning technique. Average smallholder productivity is about one-third of the yield in commercial plantations.

Cotton Research Stations were established in the 1950's at Kibos of Kisumu district and Msabaha of Coast Province. Following rapid expansion of cotton in central Kenya, another research station was opened at Tebere, which was designed as a national center of cotton research in Kenya. The past research work has concentrated on variety testing and insect control. The recommended variety is BPA 75, which is a long fibre rainfed cotton resistant against bacterial blight. Since 1978, higher producing American varieties have been imported and tested. Further researches to be required are fertilizing techniques and mixed cropping method with sorghum and millet.

A sugar research programme is being carried out in order to upgrade the techniques for sugar production on small farms. The programme focuses on introduction of high yielding varieties and improvement of irrigation and drainage techniques. The research station at Kibos is being strengthened with World Bank's assistance.

(5) Irrigation water supply

Out of four national irrigation schemes managed by NIB, three are located in the Region, i.e. Ahero, West Kano and Bunyala. The total service area amounts to 1,440 ha accounting for 20 % of the total NIB area of 7,200 ha. Ahero scheme covers about 840 ha extending in the central part of the Kano Plain along the Nyando River. The area is fully used for irrigated rice cultivation. West Kano scheme was established with the total area of 920 ha along the lakeside on the Kano Plain, where about 440 ha are used for rice production and remainder for sugarcane. Both schemes are located in Kisumu district. Bunyala scheme has a service area of 220 ha on the right bank of lower reaches of the Yala River in Busia district, where a single cropping of rice is performed.

The farmers are selected and resettled by NIB as tenants of the organization, being allotted around 3 to 4 acres of irrigated land area at a rent. They can get services in advance for land preparation, irrigation water supply, farm input supply and transportation of products and repay by their products.

By introducing the semi-dwarf high yielding varieties such as IR 1561, BG 90-2, BW 196 and IR 54, average yields are now at a very high level reaching 5 to 6 tons. At present, farmers can obtain the revenue ranging from Kshs. 4,750/ha to Kshs. 7,380/ha, which are considerably higher than revenues of farmers outside the schemes.

Encouraged by the demonstration effects of the NIB schemes and the availability of seeds of high qualities, a number of farmers in the Region started to plant rice in swampy areas of the Lake shore and river valley bottoms. The Provincial Irrigation Unit (PIU) has stimulated such farmers activities and assisted their organizations. To enhance their productivity, PIU is undertaking two particular projects, namely Small Scale Irrigation Development Project (SSIDP) and Smallholder Rice Rehabilitation Project (SRRP). Under these projects, 1,870 ha of 24 schemes are irrigated, with concomitant drainage improvement. This hectarage corresponds to about 60% of the national total of 3,000 ha at present.

(6) Tractor hire services

Land preparation in the Region is still done predominantly by hoeing, especially on small farms of Nyanza and Western Provinces. Ox-ploughing is also applied in some areas, where seasonal labour shortage occurs during the period of land preparation, or where soils are too hard to plough by hands. The hiring charges range from Kshs.180/ha to Kshs.520/ha according to kinds of practices.

There are some agricultural mechanization stations managed at provincial level under Land Development Division of MOALD. The agricultural mechanization stations in the Region have been established in Bumala of Busia district, Migori of South Nyanza, Kitale of Trans Nzoia, Eldoret of Uasin Gishu and Kipkelion of Kericho. Service charges range from Kshs.250/ha to Kshs.800/ha for ploughing and Kshs.150/ha to Kshs.300/ha for harrowing. The service coverage is from 1,000 ha to 2,000 ha in total.

Bumala agricultural mechanization station has its service coverage of southern Busia and the northern Siaya. The station has 5 crawlers, 21 wheeled tractors and other equipment such as disc-harrow and cultivators. The past performance of land preparation varied year by year, e.g 1,230 ha in 1982 and 110 ha in 1983, mainly due to inadequate funds for repair. In addition to services for land preparation, the station provides machinery services for civil works such as levelling of school ground, construction of earth dams and water holes.

Migori agricultural mechanization station was set up to serve South Nyanza district. Its services have tended to concentrate in the sugarcane zone of Awendo. The station had 4 crawlers and 18 wheeled tractors in 1982 for land preparation of 810 ha. Besides, civil work such as bush clearing, terracing and cut-off-drain construction were also carried out in Nyakach.

To supplement Migori and Bumala stations, machinery testing centers are placed in Homa Bay and Siaya to carry out the test for the adaptability of machinery and agricultural implements and introduce them to the local farmers. Their test results are presented at the agricultural shows held in the Region.

Farm mechanization or tractor hiring services in Rift Valley are more prevailing than in Nyanza and Western Provinces. There are three agricultural mechanization stations in the LBDA portion of Rift Valley, i.e. Eldoret, Kitale and Kipkelion. Eldoret station had 13 crawlers and 10 wheeled tractors, and carried out ploughing and harrowing for 350 ha in 1982 and 130 ha in 1983. Kitale station had 7 tractors and performed 210 ha of land

levelling in 1982. Kipkelion station owned 9 crawler and 11 wheeled tractors and performed land preparation for 80 ha in 1982.

1.2 Development Targets and Potential

1.2.1 National development policy

The agricultural policy in Kenya is formally defined in a series of sterling documents, including Sessional Paper No.4 of 1981 on National Food Policy, Development Plan for 1984-1988, Sessional Paper No.1 of 1986 on Economic Management for Renewed Growth (SP1).

National Food Policy was established in 1981 after severe food shortage in 1980 and 1981. The policy paper provided the guideline for decision making on all issues related to production and distribution of agricultural products by 1989. The overall objectives of this policy are:

- To maintain a position of broad self-sufficiency in the main foodstuffs in order to satisfy the majority of national food requirements without using limited foreign exchange on food imports,
- To achieve a satisfactory degree of security of food supply for each area of the country, and
- To ensure that these foodstuffs are distributed in such a manner that every member of the population has a nutritionally adequate diet.

The policy paper estimated that maize production would have to increase from 2,598,000 tons in 1983 to 3,514,000 tons in 1989 with a growth rate of 3.4% per annum in order to achieve self-sufficiency of maize. It also examines the entire food production system including input supply and extension services necessary for facilitating production increase.

Development Plan for 1984-1988 set up the following development objectives for agricultural sector.

- Increased food production to achieve or maintain self-sufficiency in major foodstuffs as well as to reduce dependency on imported edible fats and oils, and rice,
- Growth in agricultural employment to absorb the increasing labour force,
- Expansion of agricultural exports by increasing the production of coffee and tea and by diversifying into horticultural crops,
- Resource conservation, and
- Poverty alleviation.

In the Development Plan, the overall growth for the agricultural sector is set at 4.6% per annum during 1984-88 period. In order to achieve such a high performance, the Development Plan set up six major strategies, consisting of (i) small farm focus, (ii) more

intensive resource use, (iii) acceleration of development of appropriate technologies, (iv) provision for market incentives via pricing policies, improved marketing efficiency, etc., (v) the development in arid and semi-arid zones and (vi) the improvement of administrative management and procedure.

SP1 has set out the goals and targets toward the year 2000. The overall national economic growth is set at 5.6% per annum, and the agricultural sector should grow at over 5% per annum to contribute to the following.

a) To provide food security for a population of almost 35 million in 2000,

b) To generate farm family incomes that will grow at least at 5% a year for the next 15 years,

c) To absorb new farm workers at the rate of over 3% a year with raising productivity,

d) To supply export crops sufficient for a 150% increase in agricultural export earnings by 2000, and

e) To stimulate the growth of productive off-farm activities in the rural areas, so that off-farm jobs can grow at 3.5% to 5.0% a year.

To achieve these goals, three broad strategies are presented. First, farmers will be encouraged to obtain higher crop yields by improving their farming technique and inputs assisted by extension services. Pricing and marketing policy will also be properly set up. Second, research, especially of breeding of maize and other grains, will be reorganized and accelerated to generate the new high-yielding varieties. Third, crop diversification into cash crops of high value such as tea, coffee and vegetables will be emphasized in order not only to produce higher incomes but also to create employment opportunities.

Increased production of seven kinds of agro-products is emphasized in SP1. Coffee and tea are expected to contribute to the growth of both farm family incomes and improvement of balance of payment. Maize, wheat, milk and meat production must be adequate for food security. Horticultural crops will serve both goals. Programmes to expand production of these seven products are outlined below.

Within the context of the International Coffee Agreement (ICA), expansion and replanting of Arabica coffee will be achieved using the new Ruiru II variety. Breeding, extension and input supply will be enhanced by activities of Coffee Research Foundation and CBK. In addition, production of Robusta coffee will be encouraged in western Kenya and Coast Province.

Expansion of tea fields will be encouraged for both estates and smallholders with the support of Kenya Tea Development Authority (KTDA). Government-owned tea estates will be established on the perimeters of indigenous forests. Market incentives will be enhanced by setting up proper producer prices of tea.

Maize research will be accelerated to identify high potential research areas and to achieve quick results. Proper maize prices should be set up at such levels that would balance domestic supply and demand within the range between export and import parity prices. To promote food security, on-farm storage will be encouraged by extension service advice and credit allocation.

Wheat and flour prices will also be set up properly at projected long-term import parity levels. To reduce import amount of wheat flour, domestically produced wheat substitutes, such as triticale and sorghum, will be encouraged. Research will concentrate on disease control by appropriate variety selection.

Successful programme of artificial insemination (AI) will be required as an essential component of increasing milk production. First of all, governmental AI service agencies will be improved and expanded. The Government will also encourage private distributors to emerge outside the market under Kenya Cooperative Creameries (KCC).

For increase in meat production, the breeding stock will be evenly distributed to pastoral areas. Water supplies will be developed and maintained properly by charging water fees. To make up the future meat shortage, production of such small stock as sheep and goats will be developed under national breeding policy.

For horticultural crops, expansion of market in the major urban areas will be encouraged by improving market infrastructure and more effectively utilizing co-operatives supported by Horticultural Crops Development Authority (HCDA). The Government will pursue export of fresh products to the Middle East.

SP1 will serve as a basis for the next development plan (1989-1993) and those to follow. The paper directs that the Ministry of Planning and National Development (MOPND) shall prepare guideline for all Ministries based on this strategy and Ministries will then prepare comprehensive plans to achieve their own goals.

1.2.2 National development targets

(1) Demand and supply of foodstuffs

In order to set up the target production of agro-products for 2005, the demand for each of major foodstuffs has been projected on the basis of National Food Policy and SP1.

Nine major foodstuffs were selected in the analysis of National Food Policy. They include maize, wheat, sorghum and millet, rice, beans, potatoes, sugar, beef and milk. On the basis of daily nutritional intake requirement, i.e. 2,460 calories and 64.0 grams of protein, annual demand was specified in the form of mixture of foodstuffs. They consist of 120.0kg of maize, 21.6 kg of sorghum and millet, 2.7 kg of rice, 11.5 kg of wheat, 27.4 kg of potatoes, 12.0 kg of beans, 24.7 kg of sugar, 9.0 kg of beef and 52.4 kg of milk.

The recent analysis on the future food requirement is found in SP1, in which five major foodstuffs were selected. SP1 estimated the domestic food demand in 2000 consisting of

4,400,000 tons of maize, 1,000,000 tons of wheat, 3,600,000 tons of milk and 540,000 tons of meat and 1,830,000 tons of horticultural crops. This corresponds to 133.0 kg of maize, 29.2 kg of wheat, 101.2 kg of milk, 15.5 kg of meat and 57.6 kg of horticultural crops on per capita basis. Applying these unit rates and the 2005 projected population of 41.7 million in the whole of Kenya and 16.7 million in the Region, the total food demands have been calculated as presented in Table 1.10.

To maintain the national self-sufficiency of maize, it is required to increase its production from 2,100,000 tons at present to 5,550,000 tons by 2005. Likewise, the national demand of the other agro-products will have to increase to several times the current production level.

(2) Expansion programmes of coffee and tea

Coffee exports of Kenya are restricted by a very small share of the world coffee market, i.e. only 2.3% under the current ICA. The Government has been working to increase its quota. To improve its position in the coffee market by the late 1990's, the Government set the national targets in its production programme of coffee as presented in Table 1.11.

Annual production of Arabica coffee will be increased from 115,000 tons in 1984 to 319,000 tons by 2000 at a rate of 6.6% per annum. Planned for this increased production are to replant about 150,000 ha of the existing coffee fields and to newly expand 75,000 ha of planting area. In addition, Robusta coffee production will be promoted by establishing 50,000 ha in western Kenya and Coast Province. The total production of Robusta coffee is expected to achieve 35,000 tons by 2000.

The Government has set up the target for tea production in 2000 at 262,000 tons per annum in order to export 255,000 tons by 2000, which correspond to three times the amount exported in 1984 of 90,000 tons. For realizing the production target, 83,000 ha of the existing tea fields will be replanted and 41,200 ha of land suitable for tea will be opened and newly planted.

(3) Expansion of horticultural crops

Horticultural crop production is expected to increase both to meet the increasing domestic demand and to provide a surplus for exports. It is recorded that the total national production of horticultural crops in 1983 was 809,000 tons, of which 724,000 tons or 89% were consumed in domestic markets and 85,000 tons or 11% exported.

SP1 proposes to increase the domestic production from 809,000 tons at present level to 2,180,000 tons by 2000 at a growth rate of 6.0% per annum. By applying this growth rate, the 2005 target production is estimated to attain 2,917,000 tons. On the other hand, the consumption will grow from 724,000 tons to 2,402,000 tons by 2005. This means that per capita demand will increase from 37.1 kg to 57.6 kg during the same period. Exportable amount will also increase from 85,000 tons to 545,000 tons.

1.2.3 Development potential in the Region

(1) Yields

The crop yields in the Region are strongly influenced by agro-ecological conditions, soil and fertilizer application. The detail information about yield response to these factors is presented in Farm Management Handbook Vol.II produced by MOALD. To exploit the maximum yield potential by 2000, MOALD set up the idea of a stepwise development by improvement of farming practices and farm input dosages as follows.

Production Level I reflects traditional production techniques. Farmers use their own seed except for maize seed, of which 75% are hybrid, without the application of fertilizer and agro-chemicals. Cultivation is done mostly by hand, and in some cases with draft animals. At Production Level II, farmers apply the recommended farming practices, use fertilizer, new seed and plant protection methods. For first ploughing, the large farmers hire tractors. Production Level III reflects the yield level to be achievable under optimum conditions of farm inputs and farming practices. According to the estimation of MOALD, about 75 to 85% of farmers were at Production Level I and only 2% of farmers achieved the yields at Production Level III in 1981/82.

The present study applies the anticipated yields under the conditions of Production Level III as target yields to be attained by 2005. The potential maize yields by district and by agro-ecological zone are taken from Farm Management Handbook and summarized in Table 1.12.

Maize fields of 455,000 ha extend in the Region, which are fully planted in the long rainy season. In the short rainy season, 82,000 ha or 18% of the total maize area are planted, under agro-ecological zones of UM 1-3 and LM 1-3. Under the Master Plan, the maize fields will be increased to 661,000 ha by 2005, and the planted area in short rainy season will be maximized at 225,000 ha, increasing the crop intensity to 134%.

By using the yield data in Table 1.12, where the anticipated yields of short rainy season maize are assumed to be 80% of yields for long rainy season maize, the average maize yield has been computed by district as given also in Table 1.12. Overall average yield of the Region will increase from 2.8 tons/ha to 4.6 tons/ha as summarized in Table 1.13.

Target yields of the other major crops have also been determined taking account of target yields presented in SP1 and yields at Production Level III as presented in Table 1.14. The target yield of rice has been determined based on the prevailing yields in three NIB irrigation schemes in the Region, which are presented in the report prepared by the Kenya-Netherlands Joint Review and Planning Mission for support to NIB-Research Project (1986).

(2) Potential agricultural land

There exist 1,311,000 ha of the area expansible for agricultural development in the Region (Section 10.2, Chapter 10: Land Use). The expansible area is defined as low gradient land covered by grasses or bush at present and can be used for agricultural development. This

expansible area is further divided into three potential yield classes: namely very good, good and fair, according to agro-climatic conditions. The study on land use has identified the size and spatial distribution of the potential areas for different crops as follows. To avoid any confusion, it should be noted that the potential areas listed below are not mutually exclusive. For instance, the large portion of potential area for rice, which is extending along the Lake shore, is also suitable for cotton production. Wheat potential area spreading in the highland of Rift Valley Province is also highly suitable for maize production.

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

1.2.4 Development targets of the Region

(1) Aims for agricultural development in the Region

Aims for agricultural development in the Region are clarified for each of the alternative development scenarios. Each development scenario emphasizes different aspects of development objectives as follows.

Under Scenario 1, the Region is expected to increase food production as much as possible. As a granary of Kenya, the Region will supply the foodstuffs to the whole nation or even to parts of East Africa. Among various foodstuffs, maize and rice are selected as strategic crops under Scenario 1 for the following reasons.

The Region has supplied the large amount of maize, 1,504,000 tons or 72% of the national production in recent years. Considering the importance of stable supply of this crop as the main staple food, the Region is expected at least to maintain the current share in the national production. Thus about 4,000,000 tons or 72% of the national production of 5,550,000 tons in 2005 have to be produced in the Region.

Demand for rice has substantially increased recently as mentioned in National Food Policy. In view of the past performance of irrigated rice schemes in the Region and the potential areas along the Lake shore for further expansion, rice production in the Region should be

increased to make up a significant portion of rice shortage envisioned in Kenya. Through implementation of irrigation projects along the Lake shore as well as the rainfed rice project, it is estimated that paddy fields can be expanded from 3,000 ha to 30,000 ha. As a result, dry paddy production will increase from 8,000 tons to 150,000 tons, which account for 85% of the national demand in 2005.

Wheat is another food crop, for which the national demand has been rapidly increasing. Also the Region is a major producer of wheat with large mechanized farms, and has potential for expansion. Due to the importance attached by this Master Plan to smallholders, however, wheat is not selected as a strategic crop, although its expansion is planned by the Master Plan. The production of other food crops will also be increased in future, but their contribution to the economic growth in the agricultural sector will be quite small. Therefore such crops as sorghum, millet, beans, cassava, etc. are excluded from strategic crops under Scenario 1.

Under Scenario 2, the Region is expected to make maximum contribution to foreign exchange earnings/savings through diversifying, expanding and intensifying cash crop production and then also by promoting agro-industries. The crops concerned are Arabica coffee, Robusta coffee, tea, cotton, sugarcane, horticultural crops and oil crops in consideration of the endowed natural conditions and the past experience for these crops in the Region. Among the crops mentioned above, Robusta coffee, cotton and horticultural crops are selected as strategic crops, for which every development efforts will be made.

As pointed out in SP1, Robusta coffee can be grown in large areas of western Kenya and Coast Province. In fact, the potential area for Robusta coffee extends in Busia, Siaya, South Nyanza, Kisumu and the western part of Kakamega with a total coverage of 124,000 ha, where no valuable cash crops are currently planted and maize production is also depressed at present. To improve the economic situation of these areas, the Master Plan proposes to introduce Robusta coffee as much as possible within the regulation of the national coffee expansion programme. Out of 35,000 tons of Robusta to be produced under the coffee expansion programme, about 28,000 tons or 80% are to be produced in the Region and the remainder in Coast Province.

Cotton is an important crop for smallholders in the Region. Recently the domestic demand for seed cotton has increased along with the development of textile industries in Kenya. However, the weakness of the current market system tends to make cotton production stagnant. Since the natural conditions are very suitable and the availability of manpower is generally high, cotton production should be strengthened in the Region. Cotton will benefit the smallholders especially in the Lake shore area, where no other cash crops of high value can be introduced. Under Scenario 2, the 2005 production is expected to increase to 50,000 tons from the current production level of 15,000 tons. Since the potential cotton production in the Region is estimated to be 123,000 tons of seed cotton (200,000 bales of lint), this target production accounts for about 40% of the maximum potential. In addition to textile industry, cotton growers are expected to become good supplier of cotton seed to edible oil industry.

The production of horticultural crops of high value will be encouraged to enhance the regional economy and farmers' incomes. Out of 2,917,000 tons of the national production

by 2005, the regional production aims at about a half of them. Under the present conditions of the international market, the Master Plan proposes to expand passion fruits production in the Region. Provided with fresh passion fruit in large quantities, the agro-industry should be strategically encouraged to produce passion juice for export to Europe and other countries.

In addition to the above three strategic crops, the production of Arabica coffee, tea, sugarcane and oil crops will be promoted to a certain extent. Replanting and new planting of Arabica coffee will be carried out to realize a part of the national target. The Master Plan proposes that the regional share will be increased from 6% at present to 20% by 2005.

Tea has been more or less traditionally produced in the Region. The regional share reached 66% of the national production. To maintain such a position, the Region will increase the green leaf production to 320,000 tons, which correspond to about 160,000 tons of black tea and 60% of the national target set under the tea expansion programme.

The Region has produced the large amount of sugarcane equivalent to 380,000 tons of refined sugar per annum during the last decade and shared 98% of the national production. The amount corresponds to 20.0kg of per capita consumption and ensures almost 80% self-sufficiency. The Region is expected to continue the sugar production in future. However, sugar is now a less profitable agro-product due to unfavourable prices in the international market. Considering such situation, sugar production is not given high priority in agricultural sector of the Region. Since the sugar demand in the domestic market will reach 1,030,000 tons (9,400,000 tons of sugarcane) by 2005, the maximum production should be kept within this amount and no export is considered. Under Scenario 2, sugarcane production will reach 9,246,000 tons.

For edible oil industry, various raw materials are available in the Region, consisting of cotton seed, sunflower, maize, groundnuts, etc. It is highly expected that the production amount of cotton seed will rapidly grow under Scenario 2, which promotes the cotton production. Sunflower will be the good second crop after maize in Rift Valley. Groundnuts will be broadly planted by smallholders in Nyanza Province, as they are. Besides, there is a possibility to supply the surplus maize to corn oil industry.

As mentioned in Chapter 4 of Sector Report on Manufacturing, 70,000 tons of edible oil, corresponding to 70% of the national consumption, are imported by Kenya every year. In international market, the demand for edible oil is growing at 11% per annum. These conditions make oil crop production quite promising. Under Scenario 2, therefore, the production of oil crops will also be promoted.

(2) Targets for agricultural development

Scenarios 1 and 2

In order to attain the aims for agricultural production in the Region, the intensification of land use in existing agricultural land should be attempted to the maximum extent. If such a vertical expansion is realized on the existing agricultural land of some 1,549,000 ha, maintaining the present cropping patterns, the value-added of subsistence and modern

agriculture sector would grow at a rate of about 3% per annum. This is still significantly lower than the expected national average of 5% stipulated in SP1. Therefore, horizontal expansion should also be attempted for higher growth with the view to rationalizing the land use. Through the sector study of land use reported in Chapter 10, the agricultural land development plan has been worked out and the results are summarized in Table 1.15. It is planned to open 565,000 ha under Scenario 1, of which 458,000 ha (81%) will be used for food crop production. No expansion is considered for cash crop production. Under Scenario 2, 343,000 ha will be expanded, of which 164,000 ha (48%) will be devoted to cash crops and 57,000 ha (18%) to horticultural crops. For both scenarios, 107,000 ha will be expanded as fodder crop area to ensure the regional self-sufficiency of milk.

Table 1.16 presents the summary of anticipated production under the alternative scenarios. Under Scenario 1, regional maize production will meet 77% of the total national demand of 5,550,000 tons. Rice will increase its regional share to 83%. Under Scenario 2, maize produced will be able to cover the regional demand of 2,195,000 tons, but the surplus will be very limited. However, cash crop production will be substantially increased.

Value-added of agricultural sector under each development scenario is computed by using the per hectare value-added of major crops given in Table 1.17 and per ton value-added of livestock and fishery products. The results are presented in Table 1.18. As can be seen, value-added of the sector will increase from K£ 610 million in 1985 to K£ 1,633 million in 2005 at an annual growth rate of 5.0% under Scenario 1 and to K£ 1,777 million at 5.5% under Scenario 2.

Based on the results of the examination of Scenarios 1 and 2, the sector development framework for Scenario 3 has been examined as the one which is most realistic and yet attaining highest growth possible.

Scenario 3

Under Scenario 3, the Region will be developed by making use of complementary aspects of Scenarios 1 and 2. Some of districts will increase their food crop production to meet a considerable portion of the domestic demand for foodstuffs. Some other districts will be specialized more with strategic cash crops.

Under Scenario 3, the expansible area is 565,000 ha comprising 345,000 ha for food crops, 120,000 ha for cash crops and 100,000 ha for fodder crops (Table 1.15). The value-added of the agricultural sector will increase to K£ 1,752 million by 2005 at an annual growth rate of 5.4% (Table 1.18).

The regional maize production will reach 4,078,000 tons accounting for 73% of the national demand. Deducting 2,195,000 tons to be consumed in the Region, 1,883,000 tons will be exported to other regions. The production of sorghum and millet will remain at 189,000 tons accounting for 53% of the regional demand, wheat production will fully cover the regional demand of 482,000 tons. The Region will produce 150,000 tons of dry paddy, i.e 96,000 tons of milled rice. This means that about 51,000 tons of rice grains can be exported to other regions.

As a strategic crop, Robusta coffee will be promoted. About 22,000 tons or 65% of the national target production will be produced in the Region. Arabica coffee production in the Region will increase to 51,000 tons and provide 16% of the national production in 2005. Tea production in the Region will account for 55% of the national production.

Cotton of 45,000 tons will be ginned to produce 13,500 tons (73,000 bales) of lint and supply 31,500 tons of cotton seed to edible oil industry. Sugarcane production in the Region will be increased to 9,246,000 tons, from which 1,006,000 tons of refined sugar can be processed. With this amount 98% of the domestic demand for sugar can be satisfied in 2005. Horticultural crop production in the Region will be at the level of 26% of the national target.

Through livestock development, 1,661,000 tons of milk and 107,000 tons of meat will be produced. As a result, 98% of the regional milk self-sufficiency will be achieved and 38% of meat demand in the Region will be covered under the Master Plan.

(3) Employment opportunities

The labour demand and supply balance in the rural areas has been analyzed on the basis of projected population and the future job opportunities to be created by the agricultural sector. The labour demand for agricultural sector is derived from crop production, livestock raising and fishery. In addition, off-farm activities are also large supplier of employment opportunities.

The unit labour requirements of maize and sorghum by district are summarized in Table 1.19. In Nyanza and Western Provinces, these crops are cultivated manually by small farmers. The labour input for maize ranges from 161 man-days/crop/ha to 245 man-days/crop/ha in these Provinces. On the other hand, maize in Trans Nzoia, Uasin Gishu, Nakuru, Elgeyo Marakwet and West Pokot is produced under mechanized farming by large farmers or other enterprises. The commercial maize production with machinery reduces the labour input to 65 man-days/crop/ha. The typical monthly labour requirements for maize are presented in Table 1.20. Table 1.21 presents the unit labour requirements for the other major crops in the Region. Labour requirements for livestock raising are also estimated as presented in Table 1.21.

Present conditions

Based on the monthly labour requirements and the planted area by crop and livestock population, the monthly farm labour demand has been calculated by district under the present conditions as summarized in Table 1.22. In most districts, the peak labour demand is observed between January and April, when land preparation for long rainy season crops is carried out. Relatively high requirements occur also during harvesting period in July and August. As a whole, 35.2 million man-days/month are required at the peak month of April in the Region as shown in Figure 1.7. Based on the current population of fishermen in the Region, the total labour demand for fishery is estimated at 0.4 million man-days/month.

Labour availability is calculated on the basis of active population falling in the ages between 15 and 59 years old and their working days. In 1985, active population in rural area was

2.8 million or 37.5% of the total rural population of 7.5 million. Farmers work on their land for 120 hours per month, i.e. 6 hours per day for 20 days per month. Since farmers spend a few hours for housework, work efficiency is set at 0.7 in order to obtain a net working hour for crop production and livestock raising. It is estimated that the total labour force in rural area amounts to 39.3 million man-days/month. Thus 90% of the total active population can be absorbed by the agricultural sector.

Labour shortage is observed in Kisumu, Bungoma, Kericho, Nandi and Uasin Gishu. The shortage in Kisumu occurs in January due to land preparation and maintenance of sugarcane. In Bungoma, the labour shortage occurs due much to land preparation for maize and other food crops. Milk producing districts such as Kericho, Nandi and Uasin Gishu show high labour demand in April, July and December, when large labour force is required for weeding in pasture and other maintenance work of managed pasture. In contrast, labour surplus is observed in Kisii and Kakamega resulting from high population and shortage of farm land.

Future conditions

In 2005, the peak labour demand for the agricultural sector including fishery will appear in March with the total labour demand of 52.0 million man-days/month as presented in Table 1.23 and Figure 1.8. Active population in rural areas will increase from 2.8 million to 6.0 million by 2005 corresponding to 84.0 million man-days/month of labour force. This means that 3.8 million or 63% of the rural active population can be engaged in the crop production, livestock raising and fishery.

Substantial manpower will be required during the period of land preparation for paddy, which will be expanded in Kisumu under irrigation. The period coincides with the maintenance of sugar field. Thus labour shortage will occur from January to March. In this district, the use of farm machinery will be quite effective in reducing the seasonal labour shortage. This will apply also to Bungoma and Busia districts. Kisii and Kakamega districts will face more serious shortage of employment opportunities. For these areas, labour intensive practices such as pig industry and poultry farming will be preferentially introduced. Moreover, crop diversification should be examined.

Modern cattle raising will require a large amount of labour. Based on the past experience in livestock development, it is expected that the further effort will be made for improving pasture management in Rift Valley Province. This is also effective to create employment opportunities.

1.3 Objectives, Strategy and General Measures for Agricultural Development

1.3.1 Objectives and basic strategy

(1) Objectives

In line with the national agricultural development policy and targets (subsections 1.2.1 and 1.2.2) and based on the analysis of agricultural development potential (subsection 1.2.3) and envisaged development scenarios(subsection 1.2.4), the objectives of agricultural development in the Region are summarized as follows:

1) To contribute to the Nation's food self-sufficiency; and

2) To enhance Region's economy and farmers' income levels by promoting cash crop production.

(2) Basic strategy

Corresponding to each of the objectives, the basic strategy for vertical and horizontal expansion of agriculture may be spelled out as follows:

1) To intensify land use in existing agricultural land, maintaining in principle the present cropping patterns in order to capitalize on experiences gained in different areas with various crops; and

2) To emphasize cash crops and national strategic crops in horizontal expansion of agricultural land, while maintaining the present shares in national production of food crops and coordinating with the conservation of upper catchment areas of major rivers as much as possible.

1.3.2 Specific development strategies

(1) Strategic crops

In order to focus the development efforts on selected and more promising crops, strategic crops have been selected for agricultural development in the Region (subsection 1.2.2). Maize and rice have been selected from among all the food crops, and Robusta coffee, cotton and horticultural crops from among all the cash crops. Other crops also emphasized in the Master Plan are wheat, Arabica coffee, tea, sugarcane and oil crops.

(2) Strategies for vertical expansion

Under the basic strategy, the following more specific strategies may be taken for vertical expansion:

1) to apply better seed varieties and farming practices including land preparation,

2) to provide irrigation where it is found effective in semi-arid areas,
3) to increase application of fertilizer and agro-chemicals, and
4) to improve pricing and marketing to give incentives for farmers to increase production.

(3) Strategies for horizontal expansion

Specific measures for horizontal expansion may be taken under the basic strategy as follows:

1) to distribute, timely and in sufficient quality and quantity, seed and seedlings for crops to be expanded;
2) to control pests and diseases,
3) to consolidate credit and other financial schemes to encourage farmers to expand their farmlands, and
4) to improve pricing and marketing for those crops to be promoted.

1.3.3 General measures

Under the strategies presented above, a set of measures should be taken to attain the development targets set in subsection 1.2.4. Such measures take the form either of development projects or of institutional measures related to the agricultural support system.

For each of the strategies for vertical and horizontal expansion, principal measures would be as follows.

Vertical expansion strategy	Principal measures
1) Better seed varieties	Seed multiplication projects
	Research for better varieties
	Extension/information service to encourage adoption
Better farming practices	Demonstration projects
	Tractor hire service
	Research for inter-cropping etc.
	Extension/information service
2) Irrigation	Credit scheme (medium term)
	Irrigation projects
	Extension service
	Proper land tenure system
3) Fertilizer and agro-chemicals	Distribution depots for agricultural inputs
	Extension service for proper application
	Credit scheme (short to medium terms)

4) Pricing and marketing	Market information service Storage for timely purchase
Horizontal expansion strategy	Principal measures
1) Seed and seedlings	Multiplication projects Research for better varieties Extension/information service to encourage adoption
2) Pests and disease	Research for pests and disease tolerant varieties, proper application etc.
3) Finance	Credit scheme (medium to long term) Crop insurance scheme
4) Pricing and marketing	Market information service Processing industries Establishment of marketing channels with boards, cooperatives and informal sector activities

In addition, for those crops newly established or much expanded, demonstration projects would be effective, for which direct involvement of public organizations such as LBDA will be required.

Development projects/programmes may be identified, making the general measures listed above more substantial by specifying crops and formulating demonstration schemes through which combinations of measures can be effectively taken. They are described in the next section. General directions for strengthening the support system are described in the next subsection.

1.3.4 Support system

A comprehensive package of supporting service will be required to achieve the production targets envisaged by the Master Plan, consisting of agricultural research, extension service, farm input supply, farmer's credit and others. Proper pricing and marketing constitute another important factor to motivate producers. These services and measures should be organized in the following way.

(1) Extension programme

Since its commencement in 1982, NEP has shown a remarkable success in the Region. For instance, yield sampling tests carried out in Kisumu, Bungoma and Busia showed that unit yield of maize in the NEP plot was significantly higher than that in non-NEP areas. Improved plant density by the line-planting newly introduced has increased the cotton yield in the NEP plot in Kisumu. The T&V system is well organized to disclose constraints specific to each area and to provide adequate measures for farmers. Agricultural production in the Region should be promoted by continued effort along the line initiated under NEP.

The NBP extension team in each agro-climatic zone should maintain small demonstration/training farms to conduct the simple fertilizer application tests under the guidelines given by the regional agricultural research stations. The Farmer's Training Centres can be used as the main demonstration/training farms. The test results will clarify the optimum dosage of fertilizer and confirm the target yields at Production Level III.

To transfer the appropriate fertilization method to local farmers, lead farmers should be selected in each sublocation (village). They will provide their farm land for demonstration to other farmers in their village.

For executing the demonstration successfully, a number of frontline extension workers will be required in the Region under District Extension Officers. They should learn at the District Farmer's Training Centers the proper husbandry in modern agriculture and how to transfer the technical messages to each farmer. A major constraint of NEP so far pointed out is the lack of extension workers. In order to ensure frequent contact with farmers, the ratio of extension workers to farmers should be increased to 1:200 from the present level of 1:600-800.

Since maize and rice in the Region suffer from weeds, intensive weeding is an essential practice. The necessity and proper practices in manual weeding should be transferred to farmers through NEP, in order to minimize the application of herbicides to protect the environment of the Lake basin.

In addition, soil conservation measures have to be transferred to farmers in the Region. At present about 20% of existing farmland extends on the sloping land having more than 8% gradient. These lands occur mainly in cash crop fields in Kisii, Kakamega, Nandi and Kericho. Soil in these districts is derived from basic igneous rocks, and can be characterized by high fertility and high erodibility. To maintain the high productivity of cash crops, soil conservation measures are essential. Simple but effective cropping practices for soil conservation such as buffer strip cropping and mulching should be introduced to farmers. Buffer strip cropping is a way of alternate strips with annual crops and grasses along contours. Even in the absence of annual crops, permanent grass strips can trap the eroded materials and reduce the surface erosion. Mulching is also an effective practice for surface erosion. The chopped stubbles will be spread in the fields to cover land surface. In this way, soil can be protected from splash erosion and wind erosion.

(2) Farm input supply

Seed and seedlings

The use of good quality seed of suitable varieties is one of the most important factors for increasing crop yield. To produce sufficient amount of seed, while maintaining their purity and uniformity, the established line of seed multiplication programme should be organized under the control of the Government.

As for hybrid maize, new seed is needed for every crop season so that it has to be produced continuously. The total requirement of hybrid maize seed in 2005 is estimated to be 13,000 tons consisting of 10,000 tons for long rainy season maize and 3,000 tons for short

rainy season maize. This will be produced in seed multiplication fields with a total area of 5,000 ha.

Since KSC in Kitale has the limitation in their production capacity of seed, seed bulking has to be performed in the seed multiplication fields under the management of the Government. In order to maintain the quality of seed, certified seed should be released by KSC. Using the certified seed thus obtained, the subsequent multiplication will be carried out by large farmers or commercial enterprises.

Paddy seed will be multiplied in Mwea and Ahero Irrigation Schemes. Importing the breeder seeds of high yielding varieties mainly from International Rice 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 by 2005. It is estimated that 1,500 tons of seed will be required in every crop season. Ahero scheme is expected to be the main source of paddy seed used in the Region. AIRS should assist such seed bulking for controlling purity of varieties.

Seed varieties of wheat, oat, barley, sunflower and pasture will continue to be multiplied and released by KSC. Cotton seed will be multiplied and released to the contract farmers under the control of CSLMB.

The activities of LBDA to multiply seed and seedlings should be further promoted for grains, fruit trees and coffee. In connection with Coffee Expansion Project, MOA should continue to make its efforts to distribute Robusta coffee seedlings.

Chemical fertilizer

Timely distribution of farm inputs is considered as a prerequisite for obtaining the target yields at Production Level III. As presented in Table 1.24, the tremendous amount of fertilizer will be required in 2005. Since the soil in the Region is rich in potassium (K), application of other two primary plant nutrients, i.e. nitrogen (N) and phosphorus (P), will be primarily required.

Cash crops should be given priority for fertilization considering high returns, and the fertilization of coffee, tea and cotton should be done in Phase 1 by 1993. Fertilization of maize, rice and wheat should follow. Fodder crops and managed pasture should also be applied with fertilizer to realize high feed production. Farm yard manure can supplement chemical fertilizer for smallholders.

For selection of the most suitable types of fertilizer, the regional agricultural research stations should give necessary advice to farm input suppliers such as marketing boards and farmers co-operatives. Technical suggestions will be made on chemical composition of fertilizer materials and on fertilizer types, e.g. single or complete mixture, taking account of climatic and soil conditions of the Region.

As pointed out through NEP, large packs of fertilizer are not suitable for use by smallholders, who have farmland less than 2 ha. Due to high cost, these smallholders tend

to apply fertilizer only for high-value crops. For easy purchasing, size of pack should be reduced by farm input suppliers. Alternatively, rural cooperatives may purchase the fertilizer for further distribution to respective member farmers at cost. Advice on its application may be more effectively transferred to the farmers with the coordination between the cooperatives and the regional agricultural research stations.

Agro-chemicals

Frequent and unorderly application of agro-chemicals will cause serious contamination of the Lake water. In principle, the execution of preventive measures for pest control should be preferred to frequent application of agro-chemicals. First, efforts should be made on selection of disease tolerant varieties. Also the optimum cropping patterns should be established with particular attention to life cycle of hosts of disease.

As mentioned in Section 1.2.4, quality of coffee in the Region is graded into lower classes. This is due to the prevailing coffee berry disease, which causes a brown or black colouring by fungus. In addition, cash crops such as tea and cotton in the Region often suffer from diseases and pests. Well-timed selective spraying will be one possible control method for cash crops. Research into environmentally sound application methods would be necessary.

(3) Credit

The Master Plan proposes to introduce some strategic crops such as Robusta coffee, cotton and passion fruits to the expansion area. Since the crop selection is basically made by individual farmers, it is essential to motivate them to produce these crops. For this purpose, a new credit scheme will be established for the contract farmers to reduce their initial investment. It takes about five years to obtain coffee berries after planting. Therefore, the new credit scheme should be of medium to long terms (5 to 8 years). The coffee farmers will obtain a service in the form of package of seedlings and farm inputs supplied by CBK. Coffee Research Foundation will conduct advisory services.

Of several credit schemes available, NSCS is the most accessible to the farmers in the Region. However, its loan conditions have to be improved; for instance, a sort of package credit programme will be effective. With this credit scheme, a package of farm inputs, e.g. seed, fertilizer and chemicals, of high quality should be provided instead of cash, in proper amount and timing, following technical guidance by extension workers of NEP. Coverage of the scheme should be extended to crops other than just maize and wheat. The scheme should also cover the provision of hire services, when and where the land preparation by machinery or ox-plough is required.

For maize producers, the credit for installation of on-farm storage should be established in addition to credit for purchasing farm inputs. In view of food security, the good storage facility with a capacity of 600 to 700 kg per family will help to make up the shortage of the NCPB storage capacity.

Crop production often suffers from prolonged drought, floods, plant disease, pests and other adverse conditions. A crop insurance system should be established to stabilize farmers' income. It will also be effective in enhancing the overall land productivity by

encouraging farmers to plant more during short rainy seasons. A portion of their products will be used to pay the insurance, which will be repaid in failure seasons. Management of the insurance may be entrusted to cooperative societies. Specific terms should be established by further examination.

(4) Research

The agricultural research in Kenya has been conducted mainly for monocropping of maize, and studies on intercropping have been insufficient. In the Region, intercropping is widely applied by smallholders such as maize and beans and maize and cotton. In order to obtain higher yields in intercropping, proper farming practices for smallholders have to be established through research. Research on striga weed, which depresses yields of maize and sorghum, will also be required

Development of new crop varieties should be strengthened. As experienced during the last decade, the introduction of hybrid maize has contributed to increased production of this staple crop in Kenya. Climatic adaptability of several varieties has also been studied. As a result, Katumani, which is an early maturing composite variety, has been selected as a variety suitable for low potential areas in the Region. Selection or breeding of high disease tolerant varieties should also be emphasized in research activities.

For smooth introduction of Robusta coffee, a coffee research station should be established in the western part of the Region, e.g. Busia or Bungoma. Under the management of Coffee Research Foundation, proper farming practices for Robusta will be experimented. Results and information obtained will be immediately translated into technical messages to the coffee growers in the Region.

As for Arabica coffee, the research using the new Ruiru II variety should be commenced in the Region. The coffee research station in Kisii is expected to perform this experiment. Replanting schedule including multiplication of seedlings will also be prepared, along with the experiment.

(5) Farm machinery service station

The machinery hire services were initiated in the Region by the Land Development Division of MOALD. However, the most of service stations do not function adequately due to lack of finance.

Farm machinery services will become essential in the Region to ensure the execution of the timely seeding. Although the optimum seeding period has been clarified in the research stations, lack of tractors and agricultural implements does not allow timely land preparation and seeding. More tractor hiring services and other institutional supports will be required. As clarified through the labour balance study in subsection 1.2.4, the labour shortage will be observed in some districts during land preparation. Such services will be quite effective for these districts.

(6) Storage, marketing and pricing

NCPB possesses at present 478,000 tons capacity of grain storage facilities, of which 392,000 tons are for maize. The average annual purchase of maize by NCPB is about 440,000 tons in recent years, or 58% of the total marketable maize. The storage capacity is clearly inadequate, and NCPB hires private warehouses with a total capacity of 97,000 tons. Even with this additional capacity, shortage of storage occurs in the years of good harvest. Moreover, additional storage is required for tiding over lean years. Of the national minimum strategic reserves of four million bags or 360,000 tons of maize, about 270,000 tons should be allocated to the Region, considering the present production share.

The shortage of storage capacity will become an even more serious problem in the future. Recognizing such a situation, the Government launched in 1981 the National Food Production and Storage Programme. Under the programme, the construction of silo systems is going on at Nakuru, Kisumu and Bungoma with a total storage capacity of 110,000 tons, with the technical and financial cooperation of the Japanese Government.

The future storage requirement is calculated as presented in Table 1.26. Out of 4,078,000 tons of the total maize production, 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% can be stored in the existing 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. Besides, it is also required to expand the storage capacity in the vicinity of the large markets, e.g. Nairobi and Mombasa.

For essential food crops such as maize, the Government is responsible for ensuring effective production and marketing, and prices can not be entirely left to be determined by demand/supply balance in markets. Even in the case that sales of such essential crops through boards are not dominant, lower prices set by boards would certainly affect prices of those crops in informal markets.

For less essential crops, marketing boards should make observations and forecasts of their demand/supply and reflect them in pricing. In either case, production costs have to be properly reflected in purchase prices by marketing boards so that incentives to farmers are maintained. Timely purchase and prompt payment are also essential for maintaining market incentives, and the provision of sufficient storage facilities and financial supports by the Government are conditions for these.

Strengthening of marketing systems will be needed for some agricultural products, especially for grains, cotton, oil crops and horticultural crops. Not only the streamlining of the national marketing boards, marketing functions of cooperatives and private dealers should also be strengthened.

(7) Institutional supports for Kano Plain irrigation project

Irrigation water users association

In order to obtain higher yield and better quality of cash crops, irrigation and drainage are emphasized in long-term development strategy. The Kano Plain irrigation project is the most promising one in the Region. Covering 26,000 ha of low-lying terrain by gravity irrigation system, the project will enable the local farmers to carry out double cropping under year-round irrigated conditions. Although the capital investment of the gravity irrigation scheme needs loans from external sources as well as the governmental investment fund, the operation and maintenance costs are low compared with the existing pumping irrigation schemes. Farmers can obtain irrigation services with low water charges.

The situation of farmers under the project will be different from that of tenants under the NIB rice estates. In NIB schemes no tenants are allowed to plant other crops of their choice. Partly supported by machinery services, all the farming practices are performed by tenants under the supervision of NIB. Therefore, the farmer's technical level has been considerably improved and the productivity has been increased up to the level of 5 tons/ha.

In contrast, the farmers under the Kano plain irrigation project will be able to select and maintain their crops individually. For smooth operation and maintenance of the project, it is proposed to organize each farmer into irrigation water users association under LBDA. The association will function to distribute irrigation water timely and evenly to each plot and to collect water charge for operation and maintenance of irrigation and drainage facilities. In addition, the association will handle the purchasing of farm inputs and trading of the products.

Project Benefit Monitoring and Evaluation (PBME) unit

As experienced through many irrigation projects, the result and effectiveness of those projects often differ from expectations originally considered and targeted in project planning stage. It is not only because of the difficult and unforeseen conditions in project implementation but also of the lack of farmers' experience.

In order to reveal the major constraints at an early time, it is proposed that the Project Benefit Monitoring and Evaluation (PBME) unit will be organized under LBDA. To the average households selected as benchmark in and around the project area, the PBME unit will carry out the monitoring survey by means of periodical interviews in terms of important indicators about socio-economic aspects and specific aspects of the project. It will enable LBDA to find out the chronological changes in the socio-economic situation of the farmers and to identify the constraints against the project.

1.4 Development Projects and Associated Measures

1.4.1 Formulation of projects

Development projects have been identified, making general measures listed in subsection 1.3.3 more substantial by specifying crops and formulating demonstration schemes through which combinations of measures can be effectively taken along the general directions clarified in subsection 1.3.4. The core projects are the following.

(1) Lake Shore Irrigation Project
(2) Robusta Coffee Expansion Project
(3) Cotton Expansion Project
(4) Seed Multiplication Project
(5) Tractor Hire Services Project
(6) Grain Silo Construction Project
(7) Rice Mill Complex Project
(8) Horticultural Crops Expansion Project
(9) Oil Crops Expansion Project

Project (1) aims at intensifying food and cash crop production in the semi-arid Lake shore areas through small scale irrigation development. Projects (2) and (3) are meant to serve for the expansion of areas for two strategic crops by providing essential inputs for the expansion and demonstrating better farming practices. Outputs of these projects will be used for establishing new manufacturing industries (Section 4.5, Sector Report). Project (4) is for increasing the seed bulking capacity in the Region to serve both horizontal and vertical expansion of grains. Project (5) has been identified to make up the serious shortage of tractor hire service especially for smallholders in the Region. Project (6) will extend the present efforts by NCPB to expand the grain storage capacity to meet the increasing requirements as described in subsection 1.3.4. Project (7) aims at processing a large amount of dry paddy to be produced under the Kano Plain Irrigation Project. Projects (8) and (9) are another set of demonstration projects for crops to be much promoted by the Master Plan and will provide inputs to the agro-industries to be established in the Region (Section 4.5, Sector Report). Projects (4), (5), (6), (7) and (9) are mutually inter-related, centering around the Kano Plain irrigation project as illustrated in Figure 1.9. More details of these projects are given in the next subsection.

1.4.2 Project descriptions

(1) Lake Shore Irrigation Project

Many small scale irrigation schemes have been envisaged along the Lake shore. Schemes in Oluch and Kimira valleys in South Nyanza district seem most promising.

At present, the both areas are used for rainfed rice and maize. The Kimira scheme is located in Kendu Bay. Diverting the flow of Awach Kibwon, about 2,100 ha can be irrigated for

rice production. The Oluch scheme is located in the south of Mt. Homa. Awach Tende is the proposed water source to irrigate 1,100 ha of low-lying land for rice production.

The both schemes are located on the favourable topographic position close to the Lake. The Lake water is also a possible water source which can be made available through pumping. Other possible schemes are examined in more detail elsewhere (Chapter 1, Report on Preparatory Study). Utilization of the Lake water would deserve special attention.

(2) Robusta Coffee Expansion Project

Robusta coffee fields will be established in Busia, Siaya and Kakamega according to the following land development schedule.

Phase 1 (-1993)	5,200ha
Phase 2 (1993-2000)	13,500ha
Phase 3 (2000-2005)	13,300ha
Total	32,000ha

Although a further consideration on the project organization is needed, the Master Plan proposes that LBDA will take part in this project. For selection of the suitable land, the detailed soil survey should be conducted by Ministry of Agriculture (MOA) in association with Kenya Soil Survey (KSS) and Coffee Research Foundation.

Land preparation for the selected area and preparation of coffee seedlings will also be carried out through this project. Since 1,500 trees/ha will be planted on an average, about 8 million of seedlings will be required in the phase 1 period. The Yala Swamp Reclamation Project will contribute to supplying the seedlings under the management of LBDA.

Maintenance of coffee fields requires 2.4 labours/ha/day on an average. Assuming that each farm family maintains 0.5 ha of Robusta coffee fields, about 64,000 families will be involved in this project. To achieve the target of this project, the following measures will be required.

i) For smooth introduction of Robusta coffee, a coffee research station should be established in the western part of the Region, e.g. Busia or Bungoma. Under the management of Coffee Research Foundation, the proper farming practices for Robusta will be analyzed. The experimental results and information obtained will be immediately translated into technical messages to coffee growers in the Region.

ii) It takes about five years to obtain coffee berries after planting. Therefore, new medium to long term credit scheme should be considered, under which the coffee farmers will obtain a service in a form of package of seedlings and farm inputs. Besides, Coffee Research Foundation will be required to conduct the extension services.

(3) Cotton Expansion Project

With the cooperation of Cotton Lint and Seed Marketing Board (CLSMB), cotton will be expanded from 49,000 ha in 1985 to 56,000 ha by 2005 under the Master Plan. The proposed expansion areas of 7,000 ha are distributed in the districts along the Lake shore, i.e. South Nyanza, Kisumu, Siaya and Busia.

South Nyanza	3,000 ha
Kisumu	2,000 ha
Siaya	1,000 ha
Busia	1,000 ha
	7,000 ha

Land preparation of the first 3,500 ha in phase 1 period (-1993) will be carried out under the management of LBDA. The project areas are 1,500 ha in the north of Lambwe Valley in South Nyanza, 1,000 ha of Bondo in Siaya and 1,000 ha of Malakisi in Busia. The soil in the project area is generally hard due to high content of ironstones. Therefore, heavy machinery will be required.

For this project, the following institutional measures will be required.

i) Timely purchasing and prompt payment should be made to motivate cotton producers in the Region.

ii) Farming practices in cotton production have to be improved through National Extension Programme (NEP).

iii) Cotton research should be encouraged to select the suitable varieties, which are highly resistant against bacteria blight such as BPA 75

(4) Seed Multiplication Project

New seed of hybrid maize is needed for every crop season so that it has to be produced continuously. The total requirement of hybrid maize seed in 2005 is estimated to be 13,000 tons, which will be produced in seed multiplication fields with a total area of 5,000 ha.

Since Kenya Seed Company (KSC) in Kitale has the limitation in their production capacity of seeds, maize seed bulking has to be performed under the management of the Government. In order to keep the quality of seed, certified seed should be released by KSC. Using the certified seeds thus obtained, the subsequent multiplication will be carried out by large farmers or commercial enterprises through this project. The further consideration will be required to select executing agency and project organization.

In connection with the Kano Plain Irrigation Project, multiplication of paddy seed will also be carried out as a part of Seed Multiplication Project.

Paddy seed is being multiplied in Mwea and Ahero Irrigation Schemes at present. Importing the breeder seeds of high yielding varieties mainly from International Rice