b) Findings

Table 3.7.1.1 shows the formulas of intake volume and intake rate and basic intake rate from the observations (see Figure A2.7.1.3).

Table 3.7.1.1 Index of Intake Rate

	Intake volume (mm)	Intake rate (mm/min)	Basic Intake rate (mm/hr)
Kizza's Farm	$Dm = 16.5114 \cdot T^{0.6382}$	$I = 10.5376 \cdot T^{-0.3618}$	90.26
Matovu's Farm(high)	$Dm = 12.2044 \cdot T^{0.6229}$	$I = 7.6021 \cdot T^{-0.3771}$	59.04
Matovu's Farm(low)	$Dm = 1.7169 \cdot T^{0.3078}$	$I = 0.5285 \cdot T^{-0.6922}$	0.49

Soils over 75 mm/hr basic intake rate is suitable for overhead irrigation, while 50 mm/hr or less for surface irrigation. Surface irrigation is feasible for upper and particularly lower Matovu's farm, although surface water erosion poses a threat in the lower region, where intake rate is extremely low. Overhead irrigation is preferable for Kizza's farm, since the unusually high basic intake rate could lead to leaching of nutrients and require greater irrigation capacity if surface irrigation were to be used.

3.7.2. Agricultural Infrastructure

In surface terms, agricultural infrastructure includes the regulation of farm parcels, work on land gradients and soil quality, while in linear terms it includes construction and repair of farm roads, irrigation and drainage canals, and ditches. Construction of new farm roads, irrigation and drainage canals, ditches, and the like within the Study Area is falling behind, and the level of maintenance is far from satisfactory.

Agricultural infrastructure has in all cases been installed manually by farmers themselves, with design differing from farm to manually by farmers themselves, with design differing from farm to farm, depending on topography. Overall the agricultural infrastructure in the Study Area has not been implemented in a coordinated or systematic way, but undertaken independently by individual farmers. There are major discrepancies in the level of development between farms, and a lack of interaction between regions. This is a major hindrance to improved farm management technology, effective land use, cooperation in farm work, mechanization, joint shipment of produce and other efforts in the area. Levels of development and some of the problems regarding agricultural infrastructures are described below.

1) Land reclamation

Farmers reclaim land as necessary when they want to expand. This has led to an unevenness in parcel size and shape. Boundaries between utilized and non-utilized land are poorly defined and there has been no work to improve land slope or soil quality. As to scale of land ownership, 90% of farmers own land of less than 5 ha, and the total area of them accounts for approximately 80% of all the privately owned land in the Study Area.

2) Farm roads

All farm roads have been built by farmers themselves, while farm roads which border on a number of farms are shared. The widths of these roads vary between 0.5 m for footpaths to 3.0 m for farm machinery roads. Land has been shared with the roads only as far as absolutely necessary. Many roads have quite steep slopes and/or bends. There has been no road surface work such as gravel surfacing or paving, and the poor surfaces on many roads can be attributed to the negligence of regular maintenance.

Thus it is common practice for farmers to walk to and from fields and for farm produce to be carried in and out. Because of restrictions on labour and transportation, fields far from homesteads tend to be neglected.

3) Contour ditches

On some farms with relatively steep slopes, ditches have been dug along contour lines for soil conservation and water harvesting. A ditch is set up with a levee immediately below, each being about 0.7 m side, 0.3 m deep and 0.3 m high.

Elephant grass and other grasses are occasionally planted on these ridges, although most farmers pay no attention to soil conservation even in crop cultivation, leading to soil deterioration in recent years.

4) Woods

Many fields still contain or border on woods. Rather than being planted, most of these are simply remnants of the original vegetation, containing various species of tree at varying densities. These woods act as windbreaks, conserve soil and preserve water resources, and have also been used for fuelwood. It cannot however be said that these woods are adequate in any of these capacities.

3.7.3. *Livestock Infrastructure*

1) Grassland

Within the Study Area some 715,000 ha is grazed by an estimated 666,000 cattle and 443,000 sheep and goats. About half of this land is untouched bush, covered in vines and scrub

and quite unsuitable as pasture. Grass yield on the remainder is only about 7 - 9 tons of dry grasses per hectare. Yields in the dry season are extremely poor compared with those in the wet season.

2) Water sources

There are 110 valley dams and tanks within the Study Area for grazing livestock. Table 3.7.3.1 shows the breakdown by district.

Table 3.7.3.1 Number of Valley Dams and Tanks

Item	Luwero	Masaka	Mpigi	Mukono	Total
Valley dam	0	35	13	4	52
Valley tank	44	13	1	0	58
Total	44	48	14	4	110

Source: Sir Alexander Gibb & Partners, 1989
Sub-Saharan Hydrological Assessment, Uganda

Since grasslands currently in use comprise a portion of the 17,000 km^2 of land which make up FFGM and SFGM, there is extremely little water resources for livestock use within these areas comprising only about one water source per each 150 km^2.

3) Condition of grasslands

Grassland conditions vary considerably according to usage for grazing. On unused land or where the density and frequency of grazing is low, soil is well-preserved and re-growth of grasses is satisfactory.

On heavily grazed grasslands, poor grass resources make grazing livestock move widely. As a result, the ground becomes hard leading to soil erosion and grassland devastation. Typical examples of such land devastation can be found in parts of the flat Buruli country of Luwero District and on a number of slopes in Masaka District.

3.8 Rural Social Infrastructure

3.8.1 Water Supplies

Hygienic drinking water is indispensable to health. In Uganda only 50% of the urban population has access to hygienic water; in rural areas this falls to 20%. Diseases such as diarrhea and bowel problems are rife. In addition, a considerable physical burden is imposed on women who are expected to bring water to the household in gerrycans from wells, springs or rivers.

The Directorate of Water Development in MNR is currently restoring drinking water facilities destroyed during the war and building new ones in seven urban areas throughout the county (Kampala, Jinja, Entebbe, Masaka, Mbarara, Tororo and Mbale) as well as in various rural areas.

Two projects, SWIP (South West Integrated Project) and RUWASA (Rural Water and Sanitation Project), are underway in rural areas to restore and develop drinking water facilities in these areas.

SWIP, funded by UNICEF as well as SIDA and CIDA, covers eight districts in south-west Uganda, including Masaka in the Study Area. RUWASA, with financial and technological assistance from DANIDA, also covers eight districts in eastern Uganda, including Mukono.

The remainder of the country is covered by a Water and Sanitation Project supported by UNICEF. However funds are insufficient for the size involved.

Within the Study Area, the only sources of hygienic drinking water in rural villages are boreholes and protected springs. According to NRWSP estimates, in 1991 only 15% of the total population had access to such water sources (see Table 3.8.1.1).

Balanced against the Population and Household census in 1991 (see Appendix 2.8.1), this ratio is fairly similar for all districts, although lower than the national average for rural areas.

Table 3.8.1.1. Population with Access to Safe Water in Rural Area, 1991

	Unit	Luwero	Masaka	Mpigi	Mukono	Total	Remarks
1.Rural Population	,000	411	759	773	723	2,666	
2.Boreholes	pls	544	60	87	178	869	
Served Pop.	,000	145	19	26	57	247	
3.Wells,Springs	pls	48	93	226	683	1,050	
Served Pop.	,000	7	14	34	102	157	
4.Population Supplied with Safe Water	,000	152	33	60	159	404	
5.Ratio (4./1.)	(%)	37	4	8	22	15	

Source : NRWP

Note : 1. average water drawing capacity for 8 hours per day = Luwero 1,000 l/h; Masaka 1,220 l/h; Mpigi 1,100 l/h; Mukono 1,200 l/h
2. requirement per capita = 30 l/day(25 + 5 l spare).
3. Average 150 People per spring
4. Boreholes well and spring numbers for Mukono taken from 1993 RUWASA documents

3.8.2 Transportation

1) Road conditions in Uganda

Uganda has "gazetted trunk roads" (national highways), under the authority of the MWTC, which link all districts with the capital, Kampala, in the center. Some gazetted trunk roads lead to neighbouring Kenya, Sudan, Zaire, and Rwanda. In rural areas most transportation is dependent on feeder roads, which form the basis for economic and social activity in all districts. These feeder road, together with urban roads come under the control of the Ministry of Local Government (MOLG).

There are currently some 7,800 km of national roads, 21,200 km of feeder roads, and 780 km of urban roads in Uganda. National roads are usually asphalt-surfaced with at least two traffic lanes, while feeder roads are either gravel or dirt roads. In view of the importance of national highways, rehabilitation has been a top priority of the present government. Due partly to the length involved, many feeder roads in the Study Area are in ruin from the period of political upheaval of the 1970's and have been poorly maintained, and this has hampered socio-economic activity in rural areas quite significantly.

The Study will focus on feeder roads, which are directly related to the socio-economic activities in rural areas.

2) Feeder roads

As mentioned above the rehabilitation of feeder roads is lagging far behind that of gazetted trunk roads. In particular road crossings and bridges are largely in ruin, with numerous blockages. Some 25% of the total road length becomes impassable in the rainy season. In addition there are major obstacles to traffic at other times including overgrown foliage and unevenness resulting from prior damage. This hinders economic and social activities in rural areas, particularly:

Economic:

i) Procurement of farm materials and equipment (transportation costs, inconvenience, time)

ii) Marketing of farm produce (transportation costs, damage sustained during transport, *timing)*

iii) Agricultural support activities (extension, access to finance, participation in cooperatives)

iv) Expansion of cultivation area, farm management

Social:

i) Transportation of drinking water

ii) Procurement of daily necessities

iii) Access to educational and health care facilities

Long feeder roads are of simple earth construction, and need constant maintenance. Prior to the period of political upheaval systematic maintenance of feeder roads was carried out in each district by the organizations shown in Figure 3.8.2.1. Under the responsibility of DA (District Administrators) actual repairs were normally carried out by porters assigned to each kilometre length of road. At present there is no such body, and as a result some roads are repaired and then simply left to deteriorate again.

Figure 3.8.2.1 District Rural Feeder Road Maintenance Institution

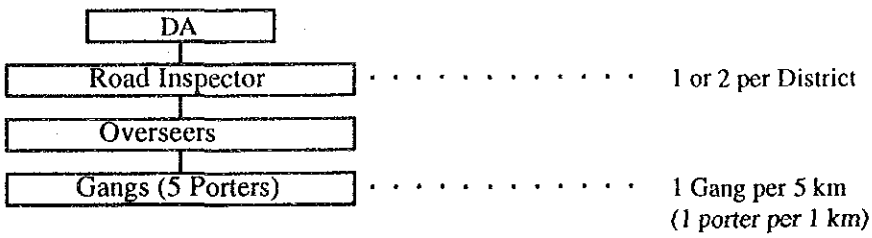


Table 3.8.2.1 Rural Feeder Road Rehabilitation & Maintenance Projects (Joint Financial Projects only)

Project Name	Finance (M.US$)		Project Coverage	Donors' Main Components	Status and Remarks
	Donor	Gov.Ug			
GTZ	9.4	1.34	Kasese, Kabarole, Bundibugyo, Hoinma, Kibale	Road Machinery, Tools, Culverts, Technical Assistance, Training, Repair of Workshops	By direct labour under the supervision of GTZ and MOLG Commenced late 1988
UNDP/UNCDF	13.9	1.5	Masaka, Rakai, Mbarara, Busheny, Rukungiri, Kabale	Equipment, Tools, Technical Assistance	By direct labour with ILO supervision Commenced in 1989
IFAD/IDA	13.3	2.7	Mbarara, Busheny, Rukungiri, Kabale, Kisoro	Contract Funds and Machinery	By contract and direct labour, Field works will commence in 1992
IDA 4th Highway	0.8	0.2	Mbale, Kapchorwa, Tororo, Pallisa	Road machinery, Tools, Materials setting up Roads Camps	By direct labour
JICA I	2.5	*1 1.2	Jinja, Kamuli, Iganga	Road Equipment	By local Consultants/Consortium, commenced
BADEA	8.2	5.6	Mukono, Mubende, Kiboga, Mpigi	Equipment, Consultant	Consultant has started work by 1992
ERC II	9.0	*1 2.0	(North, Northeast, Northwest)	Equipment	Intended to revive District Administrations' Maintenance Capacity
ADB	24.3	16.1	(West, Southwest, East)		To create Maintenance Capacities for DAs and
DANIDA	*2 3.3 10.5	*3 ny ny	Rakai Gulu, Kitgum, Lira, Apac, Kumi, Soroti, Pallisa	Rehabilitation and Maintenance strengthen the Works Department of DA Rehabilitation and Creation of Maintenance Capacities of DAs	On labour based likely to commence in 1993
IDA	*2 9.2	*3 ny	Tororo, Mbale, Luwero, Kapchorwa	Rehabilitation and Maintenance Training	On labour based expected commence in 1993
USAID	8.0	—	Mpigi, Rakai, Luwero, Masindi, Mukono, Mubende, Kiboga	Rehabilitation and Maintenance Supplement of Government Counter Funds	

Note : 1)Per year
2)tentative
3)not yet established

Rehabilitation and maintenance of rural feeder roads - TR-16 - has been adopted as part of the National Rehabilitation and Development programme by the present government. Currently rehabilitation is underway all over Uganda with the help of a number of aid organizations. As Table 3.8.2.1 shows, eleven principal projects in various districts involve the provision of heavy machinery and/or manual equipment for the rehabilitation of roads together with supervision and training.

In addition some projects emphasizing management extend over wider areas.

Feeder roads in the Study Area cover 4,192 km, or 20% of the national total. On average each square kilometre of the Study Area is served by 0.17 km of feeder road. In Luwero this falls to 0.11 km, only 65% of the overall average (see Table 3.8.2.2).

Table 3.8.2.2. Length Feeder Roads by Road Class

	Land Area	Length by Class (km)					Density
	(K㎡)	I	II	III	IV	Total	km/K㎡
Luwero	9,018	-	913.1	49.6	-	962.7	0.107
Masaka	5,865	302.5	149.0	402.0	-	853.5	0.146
Mpigi	5,167	-	-	-	-	1,735.1	0.336
Mukono	5,041	-	-	-	-	639.7	0.127
Total	25,091	302.5	1,062.1	451.6	-	4,191.0	0.167
Uganda	197,096	2,013.0	10,555.0	7,977.0	680.0	21,225.0	0.108

Source : MOLG

Note : Roads in Mpigi and Mukono District are not identified by class

3) Railways and waterways

(1) Although a railway was built to transport exports and imports via neighbouring Kenya, a fall in copper production has prompted a shift to road transport for materials and equipment distribution. Use of rail has declined and railway facilities have become antiquated.

(2) Shipping channels does exist, for instance, from Buvuma Island in Mukono District (one departure per week), but on lakes and rivers, passengers and goods are transported in wooden rowing boats.

3.8.3 Education, Health Care and Hygiene

1) Education

Uganda's education system consists of four stages: primary (seven years), secondary school (four years), high school (two years) and university. The length of time spent at university depends on the course. Primary education starts at the age of six. After secondary school, enrollment in higher education is determined on merit. Primary school education is not compulsory, and while the enrollment rate is extremely high in the early years, it drops rapidly thereafter. School enrollment figures give enrollment in the final year of primary school at 49% for boys and 29% for girls.

This is due to high tuition fees and PTA charges which parents in low income brackets are unable to bear. Costs such as meals also rise starting from secondary school education, which is usually at boarding schools.

Enrollment figures for girls are lower than boys because young men are expected to be able to support their families in the future by getting good jobs, while for girls the emphasis tends to be on raising children and helping with other housework rather than study.

In terms of educational standards in primary, secondary, and high schools, only about half the teachers have any specialized education, and many are part-time. The majority of schools suffer from shortages of textbooks, teaching materials and the like, and school buildings and classrooms suffice only to provide shelter from wind and rain. Drinking water and toilet facilities are poor, and often pupils sit on the floor for their lessons because of the lack of desks and chairs.

Emergency development of primary, secondary and high schools is already underway, using materials such as galvanized sheets for roofing, sponsored by NGOs and organizations such as IDA. This is still far from the required permanent rehabilitation, and there is an urgent need for proper development. Table 3.8.3.1 shows enrollment rates and numbers of primary and secondary schools in the Study Area based on FIS data.

Table 3.8.3.1 Number of Primary and Secondary Schools with Enrollment Rate

District / School	Luwero		Masaka		Mpigi		Mukono		Tot./Ave.	
	NO.	Enrol.	NO.	Enrol.	NO.	Enrol.	NO.	Enrol.	NO.	Enrol.
		%		%		%		%		%
Primary	341	40	410	50	559	57	360	40	1,670	8
Secondary	55	30	50	3	121	43	241	16	467	27

Source: FIS, 1993

2) Health Care and Hygiene

Health care in Uganda does not yet satisfy the minimum requirements in overall terms including facilities, equipment and doctor numbers. Together with the lack of hygienic drinking water and inadequate nutritional intake this has lead to a high infant mortality rate and low average life expectancy at birth in comparison even to other developing countries.

The mortality rate of infants under the age of five is over 10%, mainly due to malaria, diarrhea, measles and diseases of the respiratory system. In recent years the greatest cause of death amongst adults has been AIDS, followed in order by tuberculosis, malaria, meningitis, and diarrhea. Average life expectancy at birth is extremely short, barely forty-seven years.

The main diseases in the Study Area in order of incidence are AIDS, malaria, diarrhea, pneumonia, tuberculosis, whooping cough, intestinal worms, typhoid, and the common cold (FIS 1993). The inoculation rate for children in recent years has reached 79% for BCG, 48% for infantile paralysis and combined diphtheria/whooping cough/tetanus, and 50% for measles. The government hopes to boost these to 95%, 80%, and 85% respectively in the near future.

The high infant mortality rate is related to high levels of disease accompanying pregnancy and childbirth in women, and also to family planning and the educational level of women. Although more than 70% of women recognize the need for contraception only 50% actually practice it.

The health care system in Uganda incorporates private facilities and facilities managed by public bodies and NGOs, the main one being Mulaga Hospital in Kampala. The latter includes hospitals, health centres and dispensaries, classified according to scale and operation capability. The numbers of facilities throughout Uganda and in the Study Area according to FIS are shown in Table 3.8.3..2.

Although the sources of data differ, on average each facility in the Study Area serves only 5,500 people, less than one thirds the national average. Therefore rather than increasing the number of facilities, the more pressing task is to upgrade existing facilities and improve medical technology.

Since the end of civil war in 1986, health care facilities have been redeveloped and medicines provided by countries such as Denmark and Germany. Nevertheless development is seriously delayed, and there is an urgent need for the rehabilitation and expansion of buildings and the provision of proper toilets and drinking water supplies.

Table 3.8.3.2. Hospitals and Health Centres

Item		Hospitals		Health Centre		Total		Population per Facility	Remarks
Uganda	Public		50		249		299		
	NGO		36		231		267		
	Private		0		326		326		
	Total *		86		1,357		1,443	11,800	
Study Area	Luwero	(2)	4	(12)	65	(14)	69	6,500	
	Masaka	(2)	3	(20)	107	(22)	110	7,600	
	Mpigi	(9)	16	(37)	203	(46)	219	4,200	
	Mukono	(2)	4	(26)	150	(28)	154	5,400	
	Total	(15)	27	(95)	525	(110)	552	5,500	

Source: FIS

Note: Figures in parenthesis represent public facilities and Total * includes other facilities

3.8.4 Electrification and Telecommunication

1) Electricity has been developed in and around the central areas in each district, but further into the countryside the extent of electrification drops. The UEB (Uganda Electricity Board) has a branch office in each district, but construction work and maintenance suffers from chronic shortages of materials and equipment (see Figure 3.8.4.1).

2) Telecommunications is the responsibility of the Uganda Posts and Telecommunications Corporation. Telephone lines run along gazetted trunk roads and serve the main public facilities in the center of each district. Efforts are being made to provide telephone services to remote areas via microwave, but the present extent of development is low. There is a post office in each sub-county (see Figure 3.8.4.2).

Figure 3.8.4.1 Electrification

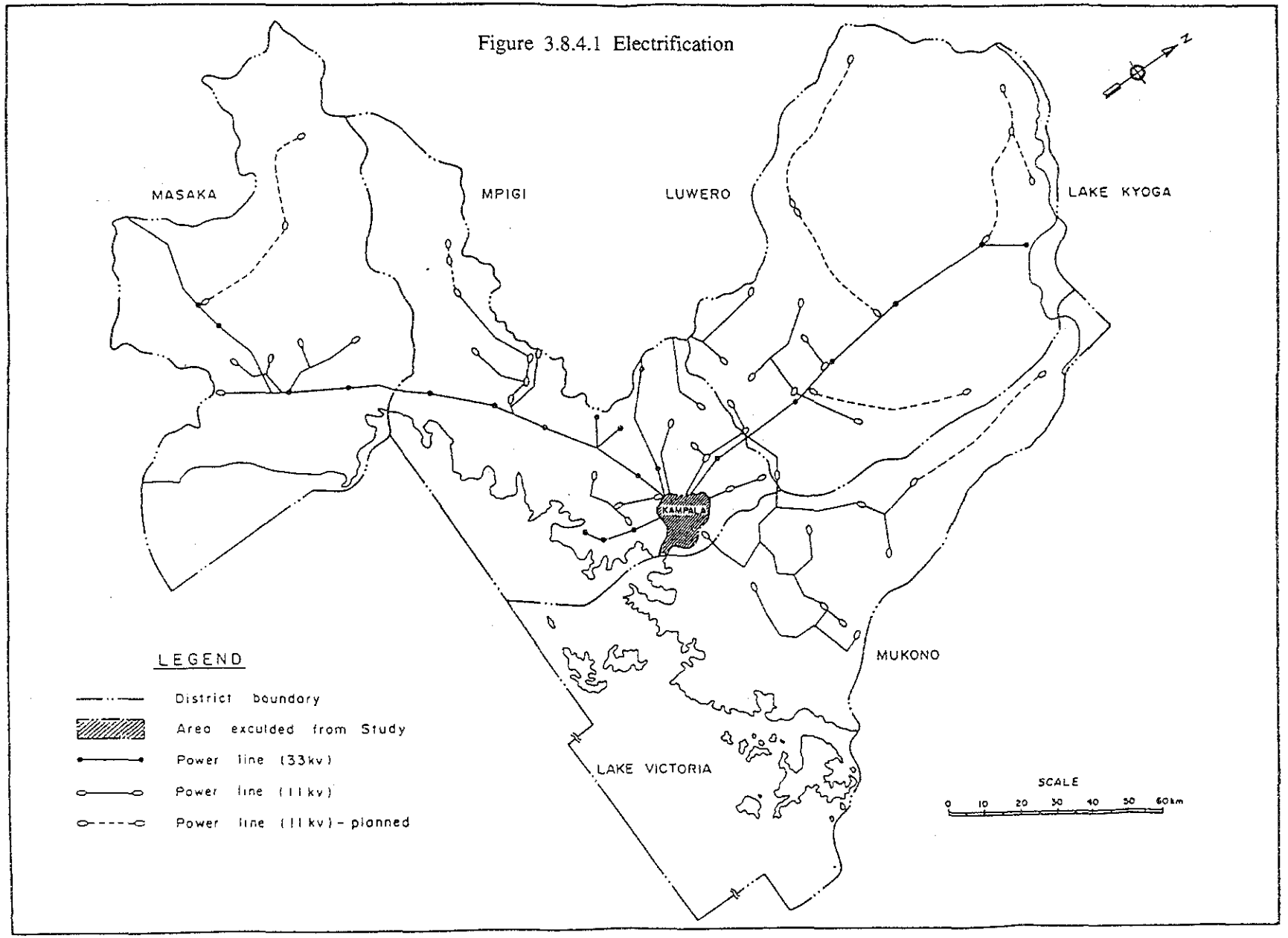
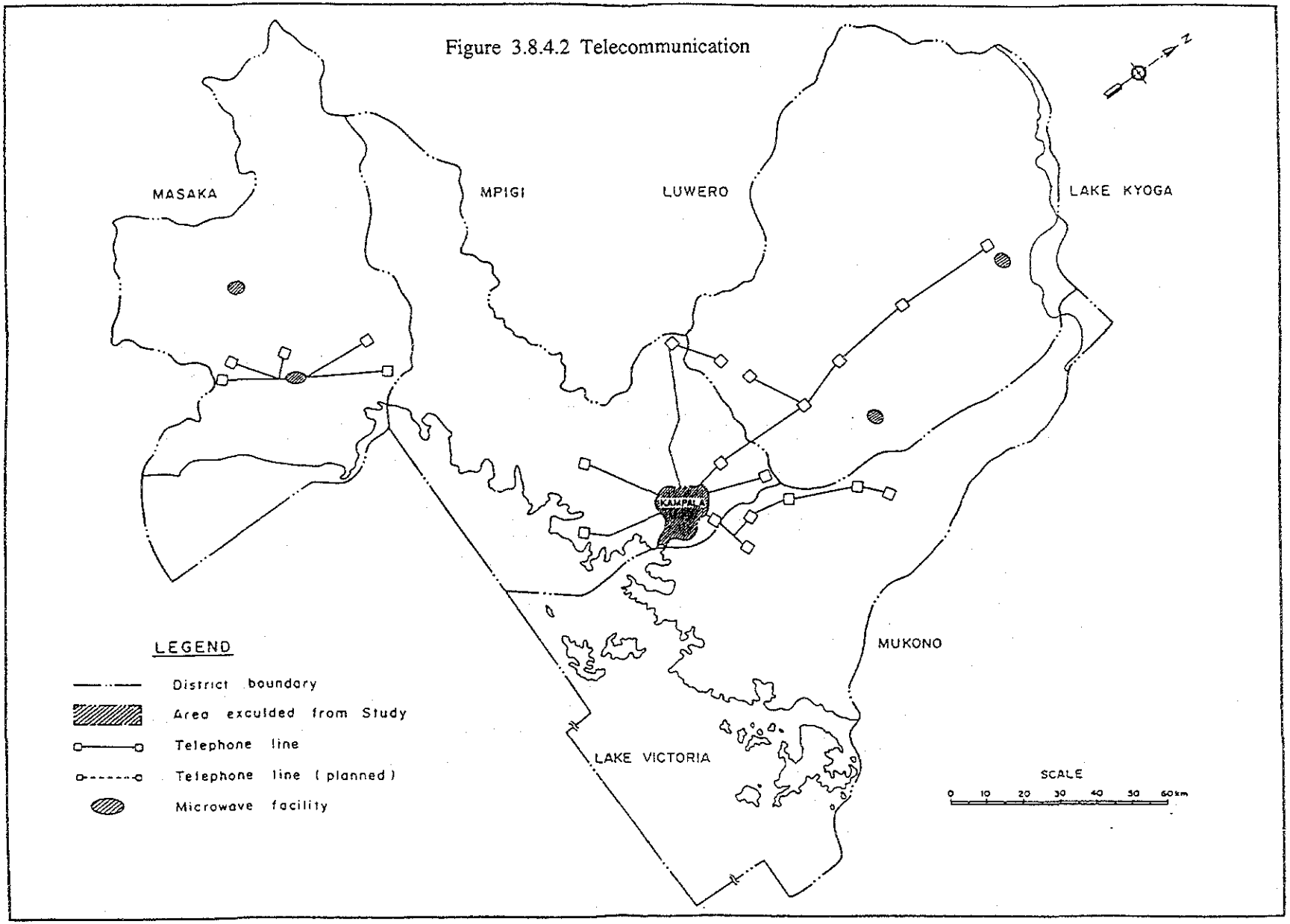


Figure 3.8.4.2 Telecommunication



3.9 Environment

3.9.1 Environmental Conservation

1) Natural Environment of Uganda and the Study Area

A graceful and affluent natural environment has nurtured the land of Uganda. Because of its geographical location in Africa, the environment is still prominent in terms of diversity and size, even though environmental destruction has worsened of late. The diversity of the natural environment in Uganda spans "seven out of eighteen bio-geographic regions of Africa" (White, 1983). It ranks third in mammalian diversity and fourth in birds among African countries.

This is largely due to its wide range of topography which ranges from rift valleys at 600 meters on the western side of the country to Mt. Rwenzori at 5,000 meters above sea level. Besides that, Uganda takes in both the eastern African savannah with its distinct ecosystem, and the deep high tropical forest of Central Africa.

However, rapid population growth since early this century (2.8 million in 1921, 5 million in 1950, 16 million in 1991), wars and other factors have caused a drastic deterioration of the environment.

Tropical high forests, the richest in number and variety of bio-diversity, covered 16 percent of the country (3.1 million hectares) at the beginning of this century. There is now only 730,000 hectares (4 percent of the land) mainly due to the expansion of farmland. On top of this, disorder in domestic policies, continuing since the beginning of the 1970's, caused the extinction of wolves, white rhinos, and bay duikers (a deer). Chimpanzees are thought to be facing extinction; and furthermore, the population of other animals that used to be poached such as elephants and crocodiles has dropped dramatically. A population of some 40,000 elephants 10 years ago is said to have been reduced to just 4,000.

The lack of research data notwithstanding, inappropriate usage of land, and agricultural land management and overgrazing of domestic animals has led to the devastation of farmland through soil erosion and degradation. Moreover, these and the devastation of water sheds have silted natural lakes and valley dams, tanks and lowered their functions. Careless waste water disposal has encouraged water eutrophication, which has deteriorated sources of drinking water and at the same time caused a mass outbreak of water hyacinth, bringing about many serious problems especially at Lake Victoria and Lake Kyoga.

The Study Area has no environmental issues other than those specified above. However, the area has a higher population than the national average, with less forest and less farmland per capita. Table 3.9.1.1 shows how the environment in the Study Area has deteriorated faster than the average for Uganda.

Table 3.9.1.1 Principal Index relating to Environment

Item	Uganda			Study Area		
	Number	Ratio	Source	Number	Ratio	Source
Population (thousand)	16,672		Pop. census (1991)	3,027		Pop. census (1991)
Land area (thousand km^2)	191.1	100	ditto	25.1	100	Land use
Farmlands	1) 40.9	21	Agr. census (1991)	6.4	25	Agr. census (1991)
Forests	35.0	18	Forest Dep.	4.3	17	Land use
Wetlands	29.6	15	Env. Dep.	3.4	14	ditto
Conservation area	2) 54.2	27	ditto	0.05	0	Env. Dep.
Others (grass land, urban area)	37.4	19	Remaining area	11.0	44	Remaining area
Population density per km^2	85			131		
Farmland per capita (ha)	0.24			0.21		

Notes: 1) Missed Districts (represent 11% of total population) were corrected by increasing.

2) Consists of National Parks, Game Reserves, Controlled Hunting Areas, Game Sanctuaries.

2) Conservation of Natural Environment

Responding to those problems, the Ugandan government, with MNR as the core administration, has been setting up various administrative measures since the advent of the current government in 1986. Nevertheless, these are still in an early stage, and they will need vast financing and efforts to cope with these environmental problems.

Since the environmental problems take various forms, corresponding governmental organizations extend over three ministries and a university, as follows:

MNR	
Department of Environment:	*Implementation of various environmental projects*
Water Development Department:	Development and conservation of water resources and water quality
Forest Department:	Rehabilitation and utilization of forest reserves, Support to private forests
MWA	
Uganda National Parks (UNP):	Maintenance and management of national parks
Game Department:	*Maintenance and management of game reserves, controlled hunting areas, and game sanctuaries*
MAAIF	
Department of Agriculture:	Soil Conservation
Makerere University:	
Biological Field Station:	Research and education on the conservation of animals and plants
Institute of Environment and National Resources:	Banking of genetic resources

One notable environmental policy is the draft of a comprehensive environmental law and related papers on eight major environmental issues prepared by the National Environment Action Plan (NEAP), which is one of the eight projects of the Department of Environment.

The law which covers the following eight issues is expected to be enacted through the parliamentary debate in the near future.

i) The National Environmental Policy, Legislation and Institutional Arrangements.
ii) Environmental Education, Research and Human Resources Development.
iii) Land Management: Agriculture, Livestock and Rangelands.
iv) Wetlands Conservation: Water Resources, Fisheries and Aquatic Bio-diversity.
v) Forest Conservation: Wild life, Tourism, Bio-diversity
vi) Mine: Mining Industry, Hazardous Materials and Toxic Chemicals
vii) Population, Health and Human Settlement
viii) Energy and Climate Change

Supported by the law it is expected to accelerate environment conservation measures as described below.

i) Raise the level of awareness of the people in the area about the environment and set up conservation measures involving them.

ii) Clarify actual environmental conditions through research and prepare inventories.

iii) Build up management, research systems and provide facilities.

3.9.2 Agricultural Development and Environmental Conservation

1) Impact on environment

Agricultural development will affect natural element such as wood, water quality, soil, plant and animal species in forests, wetlands, farmlands, grasslands and lakes. Agricultural development also has the potential to create social and economic constraints in rural communities.

Tables 3.9.2.1 and 3.9.2.2 set out the predicted impact on natural, social and economic effects of the Master Plan.

The present situation of the main environmental elements with respect to conservation are set out below.

Table 3.9.2.1 Agricultural Development and Related Natural Resources

Specific Environmental Issues	Land Resources			
	Forests	Wetlands	Farm-Grass Land	Lakes
Wood	○	–	Δ	–
Hydrology, Water Quality	–	○	–	○
Land, Soils	Δ	○	○	–
Fauna, Flora	Δ	Δ	–	Δ

Note : ○: Principal Issues

Δ : Subordinate Issues

Table 3.9.2.2 Agricultural Development and Related Environmental Issues

Agri-cultural Deve-lopment Sector	Natural Environment Issues				Sicial-Economic Environmental Issues			
	Forest Area	Wet-lands	Farm-Grass land	Lakes	Social Issues	Econo-mic Activi-ties	Insti-tution, custom	Health and Sanita-ton
Land use	Forst area	Wetland area	Farm-Grass land					
Wetland utilization plan		Irrigation and drainage facilities, Land leveling, Water use			Conflict among commu-nities	Increase in income dispar-ities	Water rights organi-zation	Out-break of endemic deseases
Irrigation plan		Water use					Water rights organi-zation	
Agr. livestock infrastruc -tural plan	Tree planting		Tree planting Soil conser-vation measures Farm road			Ogani-zation		
Farm manage-ment		Paddy culti-vation	Farm manage-ment	Farm manage-ment				
Live-stock industry			Cattle grazing	Cattle husban-dry				

2) Present environmental situation

(1) Forests

Natural forests of high tropical forests and Savannah forests vary with rainfall and to some extent altitude. Other than these, there are relatively small-sized planted forests that encompass both forest types. Forests occupied about half of Uganda (10 million ha) at the beginning of the century; however, this has fallen to a mere one third (3.5 million ha) or 18% in recent years. High tropical forests, which are the richest in terms of bio-diversity, have shrunk as shown below, principally through conversion into farmlands:

Year	Area (ha)	Sources
1900	3,090,000	Langdale and Brown, 1960
1958	1,118,000	Langdale and Brown
1987	730,000	Forest Department

The current total 3.5 million hectares of forest is made up of tropical rain forest (730,000 ha), savanna (2,746,000 ha) and planted forest (24,000 ha). Table 3.9.2.3 shows the size of forests in the Study Area, as obtained from land use maps. At 404,000 ha forests account for 16% of total land area.

Table 3.9.2.3 Forest Area in the Study Area

District	Forest Area (ha)			Land Area (ha)	Ratio occupied by forest (%)	Population (thousand)	Forest area per capita (ha)
	Forest reserves	Private forests	Total				
Luwero	68,930	17,110	86,040	901,730	9.5	450	0.19
Masaka	36,170	0	36,170	586,520	6.2	839	0.04
Mpigi	65,940	77,130	143,070	516,750	27.7	914	0.16
Mukono	72,180	66,480	138,660	504,120	27.5	825	0.17
Total	243,220	160,720	403,940	2,509,120	16.1	3,028	0.13

Source: Forest Department, MNR

Most of the wood resources in Uganda are consumed in households and public facilities for cooking and as fuel in bricks making, tea processing, and tobacco curing industries. The percentage of households using fuelwood is said to be 96 (World Bank, 1987) or 90 (Dr. A.C. Hamilton). The 1991 Population and Housing Census indicates that 89 percent of households depend on fuel wood and partly on charcoal for cooking in the Study Area (94% in Luwero, 93% in Masaka, 79% in Mpigi, and 92% in Mukono).

In addition, wood is also used as poles, building materials, and furniture, though this is negligible compared to its use as fuel for cooking, and constitutes only a small percent of total consumption (Biomass Study, 1988). To calculate wood supply and demand, it is necessary to know the volume of fuel firewood consumption and size of increase in forest resources. Reliable data however will not be available until the Biomass Study sponsored by Norway presents its final report in 1994.

As Table 3.9.2.3 suggests, timber supply still exceeds demand in Luwero, Mpigi and Mukono, while in Masaka shortages are such that household usage is being curtailed and cooking methods altered to cope with the lack of fuel.

The conservation of forests degraded during the recent civil unrest is an urgent problem for the current government. The Forest Rehabilitation Program (FRP), set up with the assistance of IDA in 1987, currently involves six sub-projects:

a) National Forest Management and Conservation Project (NFMCP)

This sub-project undertaken with aid from the EEC, tackles management and conservation of forest reserves.

b) Sorfwood Plantation Rehabilitation

This World Bank sub-project is intended to conserve the existing coniferous tree plantations and plant trees to increase the supply of lumber for building materials and other uses. This has achieved the conservation of a 15,000 ha area of the existing planted forests and the reforestation of 135 ha.

c) Peri-Urban Plantation

This is undertaken with aid from NORAD and has conserved a 900 ha area of existing planted eucalyptus forests and others in order to increase mainly the supply of poles and fuelwood, as well as to supply seedlings.

d) Farm Forestry

This is undertaken with aid from DANIDA and CARE for the purpose of promoting the recovery of private forests and reforestation of private lands. It has aided the recovery and new installation of private nurseries and supplied seedlings to the private sector.

e) Training

The purpose of this sub project is to improve the quality of the staff in the Forest Department with assistance from UNDP.

f) Forest Department Rehabilitation

This sub-project maintains equipment such as off-road vehicles used in patrolling forest areas and constructs housing for Forest Department staff.

(2) Wetlands

Wetlands are said to cover about 15 percent of Uganda. Accurate data on extent, size of each area, hydrological mechanisms, and animals and plants is very limited. Assessing the characteristics of wetlands is a prerequisite for developing concrete wetland conservation policies. However, lack of funds has prevented the compilation of an inventory. Therefore, data from field studies needed to be supplemented based on limited information such as vegetation maps (1:500,000) compiled by Langdale in 1964.

According to Langdale, Ugandan wetlands can be roughly categorized into three types by vegetation. The largest is impeded drainage wetlands. These are seasonal grasslands covered with miscanthidium and echinochloa. Next is permanent wetlands, where papyrus and miscanthidium grow thickly. Wood grown seasonal forest wetlands exist on a very small-scale.

Swamps	8,832 km^2
Swamp forests	365 km^2
Swamps with impeded drainage	20,392 km^2
Total	29,589 km^2

In this study, land use maps (scale 1:250,000) were compiled based on Landsat images taken in December 1990 and calculated each land use area. These maps identify wetlands where lush grass is distinguished in low lying areas with reference to topographic maps. The total wetlands in the Study Area in the maps amounted to 340,000 ha not distinguished by vegetation. The field study revealed that only a few areas are used for agriculture leaving most areas intact.

Wetlands in the Study Area are categorized by hydrology into four systems:

a) Lake Victoria system

This is a group of independent wetlands starting from inland to Lake Victoria, most located in Mpigi District. They join the lake with the difference of 25 to 30 metres in height at the upper most points of wetlands. Other than these, some low, flat wetlands along the lake, have a close relationship with the lake in terms of hydrology and soil.

b) Lake Kyoga system

Sezibwa wetlands and those located along Lake Kyoga belong to this system. The mainstream of Sezibwa divides Luwero District and Mukono District, and the watershed consists of the 30 thousand ha tropical high forests (Mabira forest reserve). This system is a typical permanent wetland. Many of the tributaries that pour into the trunk of Sezibwa are

located in Mukono, Luwero, and Mpigi Districts. These tributaries in southern parts of Mukono and Luwero and in Mpigi are permanent, while those in northern parts of Mukono and Luwero are seasonal, most being filled only tentatively even in rainy seasons.

c) Kafu system

This system consists of the permanent wetlands of Mayanja and Lugogo which empty into Kafu. The tributaries, many of them in Luwero and Mpigi, are categorized as either permanent or seasonal by hydrological conditions.

d) Katonga system

The Katonga river basin occupies most of Masaka and empties into Lake Victoria. The system has two major permanent wetlands, Kyoja and Nabajuzi, which join the river.

(3) Farm and Grass lands

Soil, rainfall and topographical conditions in the Study Area combine to make the soil highly vulnerable to being washed away. Slopes of gradient 6% or greater account for some 30% of the area around Lake Victoria, as opposed to the figure of 7% further inland. Rainfall, although only 1200 mm on average per year, is forceful due to tropical rainfall patterns. Some two-thirds of all the soil has over 75% sand content, making it susceptible to erosion.

The lack of soil conservation work compounds the problem. A large volume of soil is being lost. This can be seen directly in silting of artificial structures such as dams in valleys. The loss of soil from farmlands is one cause of reduced crop yields. Figure 3.9.2.1 shows the relationship between this and other factors.

Surface soil thickness was measured from the bottom to the top of both mild (4 - 9% gradient) and steep (9 - 18% gradient) valleys, in order to assess soil loss from farmlands.

Due to the considerable variation in vegetation on slope faces, including forests, cultivated areas and fallow land, it is difficult to accurately assess the relationship between top soil depth and land use. However in terms of the effect of topography and gradient on top soil depth, clearly steeper slopes are more vulnerable to soil erosion. Slopes over 9%, when converted to agricultural land, simply lose their topsoil, which accumulates in the bottom of valleys (see Figure 3.9.2.2).

Soil loss from farmlands can be controlled by slope and soil conservation work such as contour ditches. Soil loss on grazing lands in northern Luwero and Mukono and western Mpigi and Masaka, on the other hand, is linked directly to livestock farming practices such as herd size and frequency of grazing. Inappropriate grazing is particularly common on public land. The field survey found considerable evidence of soil loss even on relatively mild slopes of gradient less than 4%.

Figure 3.9.2.1 Soil Degradation and Gradual Yield Drops

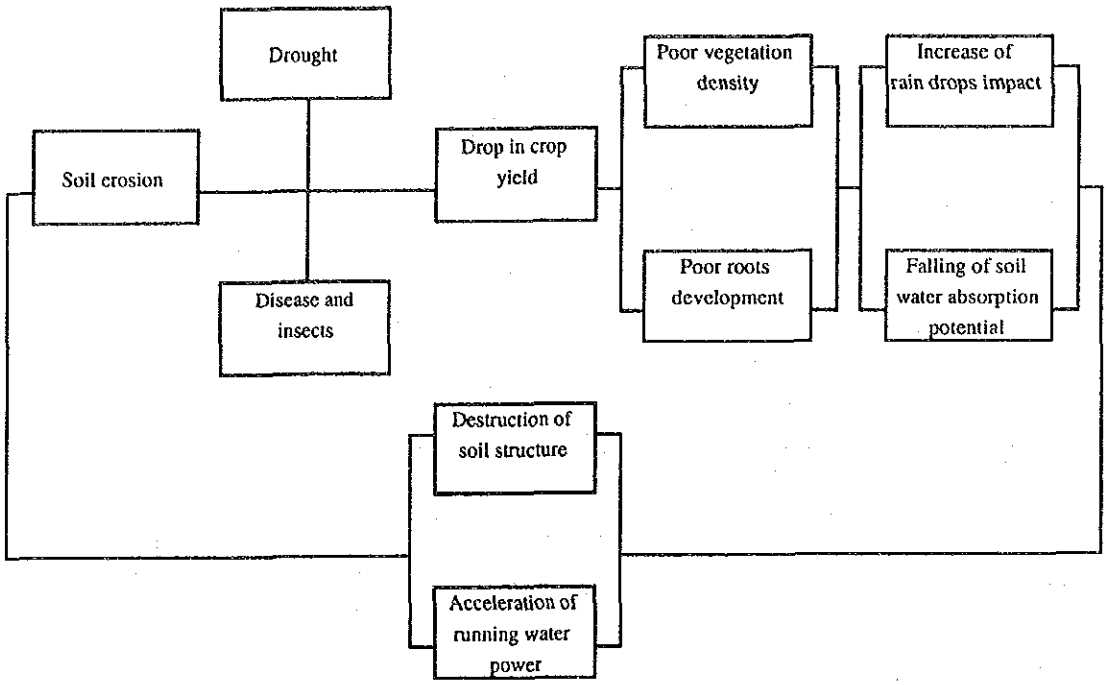
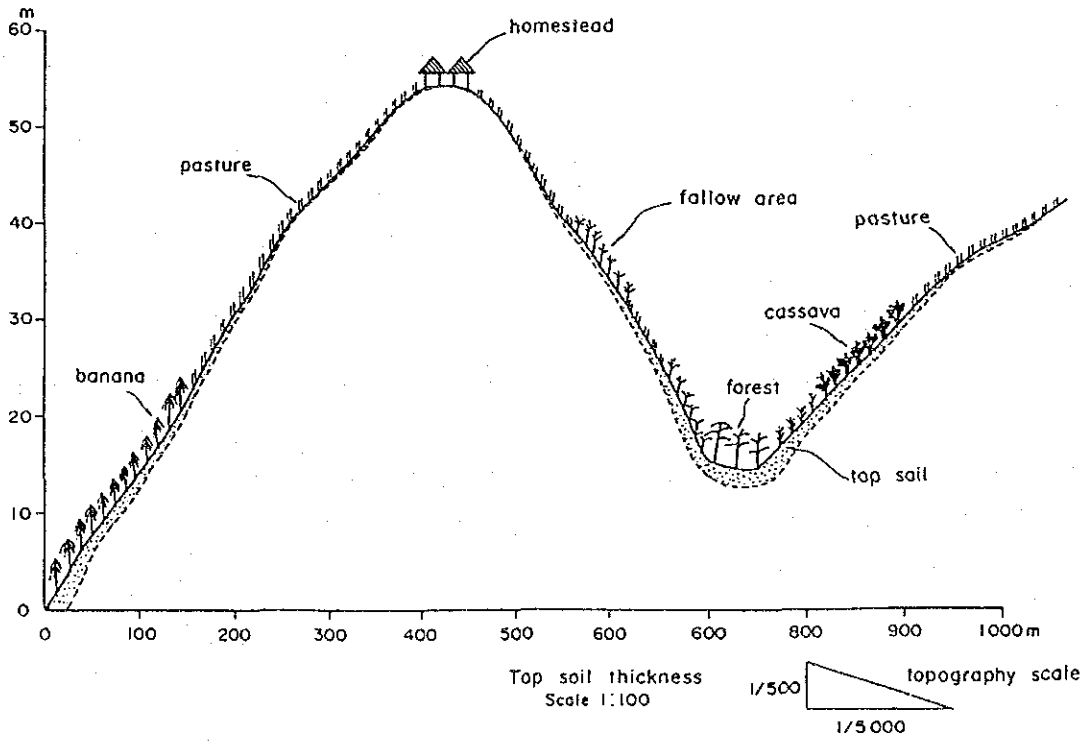


Figure 3.9.2.2 Topography and Top Soil Thickness



(4) Water Quality in Wetlands and Lakes

It is estimated that some 90% of the population in the Study Area drinks water infected with colon bacilli taken directly from lakes and wetlands. Well construction projects are underway in a number of areas to provide hygienic drinking water, but until such time as these are completed more urgent measures are required to prevent further deterioration in purity of water resources. In recent years eutrophication has progressed rapidly in lakes bordering on the Study Area, including Lakes Victoria and Kyoga, due to inflowing waste water from nearby towns. Abnormal multiplication of water hyacinth, changes in the aquatic ecological system and shrinking water resources are also major problems.

Since water contains an vast number of elements, it is necessary to develop a large number of suitable indices of water quality to indicate the quantity of these elements properly. Table 3.9.2.4 divides into four main categories the elements responsible for water pollution. Each category has a significant effect on the daily lives of the people.

Table 3.9.2.4 Classification of Constituents of Water Contamination

Category	Constituents	Index	Relation with human
1. Toxic matters	Heavy metals (Hg, Cd, Pb, As, Cr) Toxin (Cyanide, Organic phosphate, PCB)		Directly harms human health in drinking water
2. Organic matters and others	Organic matter Oxygen Suspended materials Bacteria (f. coli, others)	BOD, COD, DO SS, EC, pH, etc.	Besides harms human, impairs water sources and water environment
3. Nutritive substances	Nitrogen Phosphorous	T-N, etc. T-P, etc.	Incurs eutrophication
4. Others	Salt, Oil Radioactives		

The quality of drinking water in Uganda is required to comply with the WHO guideline set in 1984 which was revised from 1974 guideline. This guideline was set flatly for both developed and developing countries. Thus, it can be taken as target values (RUWASA, 1993). For that reason, RUWASA has been using more lenient standards than these in the guideline in order to rapidly increase the population that have access to safe water. These lenient standards seem to be accepted throughout Uganda for the time being.

Nitrogen and phosphorous are two elements which control the production of algae and influence the eutrophication of lakes based on Liebig's law of minimum.

In Japan, total-nitrogen and total-phosphorous are used as indices of water quality in lakes and wetlands, and as regulations for the required environmental level of lakes. The indices are shown in Table 3.9.2.5.

Table 3.9.2.5 Water Conservation Standard for Curbing Eutrophication in Lakes in Japan

Level of water quality	T-N (ppm)	T-P (ppm)	Remarks
I	0.1	0.005	For lakes to be most strictly conserved.
II	0.2	0.01	In descending order the standard becomes lenient according to the level required.
III	0.4	0.03	
IV	0.6	0.05	
V	1.0	0.10	

The water quality in Lake Victoria was analyzed at seven points along the bank of the lake, from Masaka through to Mukono districts.

Table 3.9.2.6 compares the findings to a 1969 - 70 WHO/Resources Group study in Murchinson bay, the 17 km^2 bay in Lake Victoria bordering on Kampala and surrounded by wetlands. The bay is the chief recipient of waste water from the capital and consequently the most badly polluted body of water in Uganda. According to the table it is safely said that the current water quality in the Lake as a whole is worse than the quality of water in Murchinson bay in 1970, which means the general water quality of the Lake now exceeds negatively the ones of worst polluted points in the Lake in 1970.

Our conclusions here are drawn from only one set of observations and with insufficient parameters. Ideally, follow-up studies should be carried out to confirm the trend and localized findings.

Table 3.9.2.6 Water Quality in Lake Victoria

		Water Along the shore of Lake Victoria in November 1993, M/P Study							Water in Murchinson bay 1969-70, FAO				WHO Stand.	Remarks
		①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪		
pH value	-	6.47	6.14	7.03	8.84	9.20	9.04	7.5	7.0-7.6	7.5	6.4-7.3	7.3-7.4	6.5-8.5	
EC	us/cm	90	95	121	130	186	129	109	80-99	80	90-120	90-100		
N-NH 3	ppm	0.18	0.23	0.15	0.09	0.26	0.06	0.22	0.0-0.26	0.0	0.0-0.9	0.0-0.04		
N-NO 2	ppm	0.013	0.050	0.007	0.005	0.015	0.007	0.013	0.0-0.02	0.0	0.0-0.001	0.0		
N-NO 3	ppm	0.060	0.050	0.055	0.900	0.800	0.110	0.105	0.0-0.11	0.23	0.0-0.5	0.0	44	
Silica	ppm	4.55	4.25	3.75	3.20	4.20	3.00	3.10	1.0-6.0	6	1.0-12.0	2.0-6.0		
Phosphate reactive	ppm	1.520	1.350	0.082	0.512	0.095	0.052	0.091	0.0-0.2	<0.05	0.0-0.3	0.05		
Total alkalinity	ppm	38	37	49	46	60	46	42	41-48	43	45-58	45-50		
Total hardness	ppm	18	23	27	26	24	28	24	24-25	25	20-45	26-30	500	
DO	ppm	13.2	13.2	>15	-	-	-	-	4.0-8.0	7.8	0.7-7.0	6.4-7.4		
Temperature	℃	28.0	26.5	26.0	-	-	-	-	-	-	-	-		

Note: The water sampling site numbers correspond to the following

① Masaka on-shore ② Masaka off-shore ③ Entebbe on-shore ④ Nytil point ⑤ Down River Nile
⑥ Bujagah point ⑦ Gava ⑧ Gava intakes - 1 ⑨ Gava intakes - 2 ⑩ Nakiyubo imlet
⑪ Kyaggwe swamp

4. Constraints on Agricultural Development

Among the countries of sub-Sahara Africa, the agriculture of Uganda is blessed with favorable weather conditions, and the comparative potential for development is high. The subject Study Area is in a location facing Lake Victoria which is particularly favored with good weather conditions. In spite of this, the Study Area is faced with the following constraining factors on its development.

1) Extensive Damage to Infrastructure and Agriculturally Related Facilities Due to Prolonged Civil War

The civil war which lasted about ten years until 1986 has affected every aspect of life in the country, and the affects of the civil war are still being strongly felt. Infrastructure including health facilities, educational facilities, drinking water facilities, and roads, amongst others, as well as cereal warehouses, cotton and coffee processing facilities have all suffered damage, while production of export oriented cash crops has declined together with a worsening of public order. The production of cotton and tea in particular have fallen dramatically. In addition, testing and research facilities along with extension facilities have become ever more dilapidated while the cultivation of such human resources as researchers and persons engaged in extension work has stagnated.

2) Increased Transport Costs of Export-Oriented Agricultural Produce Due to Being a Landlocked Country

Traditional Ugandan export products consisting of coffee, cotton, tea and tobacco are all products that are able to withstand extended periods of transport. Export shipments are sent from Mombasa Harbor and the Port of Dar Es Salaam, and the capacity for stable transport is easily affected by varying conditions set by the governments or the good will of those countries through which the products must pass on their way to port, while transport costs themselves are on rise.

3) Vulnerability of the Economic Base Due to the Extensive Dependence on Coffee Exports

Although coffee accounted for 95% of the total amount of exports for 1989, this figure dropped to 65% in 1992 due to a fall in international market values and an associated drop in production. The agricultural product with the next largest export share after coffee is cotton at 5%, resulting in great reliance having always been placed on coffee as the source of foreign exchange earnings. As a result, foreign exchange earnings are influenced every year by trends in the international value of coffee, and thus is predisposed to being vulnerable as an economic base.

4) The Low Position of Agricultural Productivity

According to the 1991 edition of Production Yearbook put out by the FAO, if the average productivity per person for 1979 - 1981 is set at 100, then 1991 values have fallen to 96.60 for cereals and 86.57 for livestock (see Table 4.1). The reason for this lies in (i) reduced productivity due to worsening public order, (ii) limitations being reached on land that can be newly developed in spite of an annual population growth rate of 2.50% (see Table 2.3.1), (iii) land utilization ratios are approaching their limits, (iv) a low level in land productivity, (v) low levels of cultivation technology, and (iv) labour productivity is low.

5) Inadequate Systems of Distribution Support

Problem areas in terms of distribution include (i) low standards of feeder roads for shipping agricultural products to nearby national roads from regions of agricultural production, (ii) inadequate agricultural product collection and distribution facilities, and (iii) insufficient support systems and means of providing information on market values as well as supply and demand of agricultural produce, amongst others.

6) Inadequacy of Support Systems for Farm Management

The following three problems may be pointed out with regard to this area.

a) It is difficult to obtain such agricultural inputs as seeds, fertilizers, agricultural chemicals and agricultural tools and machines.

b) Short-term and medium-term agricultural credit systems for buying agricultural inputs and implementing farmland development are inadequate.

c) There is a lack of extension workers who can teach technologies for controlling disease and insect damage as well as cultivation techniques, and inadequate systems or organizations to support the activities of extension workers.

Table 4.1. Index of Food Production per Capita in Uganda (1979-81=100)

Item	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1. Food production	97.81	102.19	105.05	108.80	97.00	96.19	93.50	93.71	95.16	98.67	100.00	98.40
2. Total agricultural production	98.17	101.87	105.60	109.24	97.41	96.46	93.64	93.92	95.23	98.83	99.63	98.62
3. Crops production	97.01	105.12	110.08	115.13	99.24	97.97	96.21	98.49	100.73	103.49	102.39	101.51
4. Cereals production	94.58	96.38	84.94	108.42	68.70	84.19	73.80	82.16	89.91	96.57	95.80	96.90
5. Livestock's production	101.73	92.60	91.58	90.26	89.14	87.93	81.98	77.10	76.10	81.83	87.69	86.57

Source : FAO Yearbook Production 1991

5. Basic Plan for Development

The final objectives of the development plan consist of the following five points.

5.1 Increase of Food Self-sufficiency and Improvement of Nutrition Levels

1) Increase of food self-sufficiency

The food self-sufficiency rates in the Study Area in 1990 were 97.1% for banana (staple food) and 23.8% for cereals (excluding rice). Assuming a hypothetical annual growth rate of 3.1%, the current population within the Study Area in 1990 will become 1.63 what it is now times by the year 2007 resulting in a rapid increase in demand for food.

This Plan aims to achieve 100% self-sufficiency for food in the Study Area by the target year 2007 (see Table 5.1.1) (See Chapter 6.2.1 and 6.2.2).

2) Improvement of nutrition levels

Table 5.1.2 shows average levels of nutritional supply for the World, Africa, and Uganda. While Uganda has had a caloric supply of vegetable nutrition comparable to world levels, it has consistently had lower supply levels of calorie, protein and fat from animal matter. Insufficient intake of protein by animal matter has caused malnutrition and anemia in the younger generation and has been the cause of many health problems after their reaching adulthood.

This Plan aims to improve levels of calorie, protein and fat intake from animal matter to meet increased demand accompanying the growth in population, and sets the amount of increased production of livestock for target year 2007 at 2.1 times that of the base year 1991 (see Table 5.1.3) (See 6.4.1).

Table 5.1.1 Estimated Trends of Food Crops Demand in Study Area

			RDP				Stage 1				Stage 2				Stage 3			
Item	1990	1991	1992	1993	1994	1995	1996	1997	1988	1999	2000	2001	2002	2003	2004	2005	2006	2007
Index of food production(p.o.) (1979-81=100)	100.00	98.40																
Population growth (1991=100)(p.o.)		100.00	103.10	106.30	109.60	113.00	116.50	120.11	123.83	127.67	131.63	135.71	139.92	144.26	148.73	153.34	158.09	162.99
Food crops production(1,000t)		1,908	1,967	2,028	2,091	2,156	2,223	2,292	2,363	2,436	2,512	2,589	2,670	2,752	2,838	2,926	3,016	3,110
a)Banana		810	835	861	888	915	944	973	1,003	1,034	1,066	1,099	1,133	1,169	1,205	1,242	1,281	1,320
b)Root crops		1,014	1,045	1,078	1,111	1,146	1,181	1,218	1,256	1,295	1,335	1,376	1,419	1,463	1,508	1,555	1,603	1,653
c)Cereals		84	87	89	92	95	98	101	104	107	111	114	118	121	125	129	133	137
Food crop																		
National target			(7.9)	(6.8)	(6.0)	(5.0)												
Amended target			4.0	3.5	3.0	2.5	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.5	3.5	3.5	3.5
Index(p.o.)		100.00	104.00	107.64	110.87	113.64	117.05	120.56	124.18	127.91	131.75	135.70	139.77	143.96	149.00	154.22	159.62	165.21
Study area		1,908	1,984	2,054	2,115	2,168	2,233	2,300	2,369	2,441	2,514	2,589	2,667	2,747	2,843	2,943	3,046	3,152
Luwero(1,000t)		191	199	200	212	217	224	230	237	244	252	259	267	275	285	295	305	316
Masaka(1,000t)		571	594	615	633	649	668	688	709	730	752	775	798	822	851	881	911	943
Mpigi(1,000t)		355	369	382	394	403	416	428	441	454	468	482	496	511	529	547	567	586
Mukono(1,000t)		791	822	857	876	899	925	954	982	1,013	1,042	1,073	1,106	1,139	1,178	1,220	1,263	1,307

Source : FAO Yearbook Production 1991, Production zones and targets 1992-95
Note : ( ) indicates National targes (1992-95), p.o.:per capita

Table 5.1.2 Comparative Nutrient Supply in the World, Africa and Uganda

Item / Year		1969-71	1979-81	1988-90
1. Calorie				
a) World	Vegetable	2,052	2,179	2,272
	Animal	381	400	425
	Total	2,433	2,579	2,697
b) Africa	Vegetable	2,035	2,126	2,171
	Animal	176	189	177
	Total	2,211	2,315	2,348
c) Uganda	Vegetable	2,140	1,970	2,044
	Animal	135	144	134
	Total	2,275	2,114	2,178
2. Protein				
a) World	Vegetable	43.2	44.4	46.1
	Animal	21.7	23.1	24.8
	Total	64.9	67.5	70.9
b) Africa	Vegetable	44.5	44.6	45.2
	Animal	12.1	13.2	12.5
	Total	56.6	57.8	57.7
c) Uganda	Vegetable	42.2	38.5	40.9
	Animal	11.3	11.7	9.9
	Total	53.5	50.2	50.8
3. Fat				
a) World	Vegetable	26.2	30.7	35.8
	Animal	28.5	30.0	31.9
	Total	54.7	60.7	67.7
b) Africa	Vegetable	32.5	36.1	36.9
	Animal	11.7	12.4	11.7
	Total	44.2	48.5	48.6
c) Uganda	Vegetable	24.6	15.0	17.0
	Animal	8.2	8.9	8.9
	Total	32.8	23.9	25.9

Source: FAO Production Yearbook 1992

Note: Calorie(kilo-calories), Protein(g) and Fat(g) per capita a day

Table 5.1.3 Estimated Trends of Livestock Demand in the Study Area

			RDP				Stage 1				Stage 2				Stage 3			
Item	1990	1991	1992	1993	1994	1995	1996	1997	1988	1999	2000	2001	2002	2003	2004	2005	2006	2007
Index of livestock products per capita(1979-81=100)	87.69	86.57																
Population growth (1991=100)		100.00	103.10	106.30	109.60	113.00	116.50	120.11	123.83	127.67	131.63	135.71	139.92	144.26	148.73	153.34	158.09	162.99
Amended index																		
Annual ratio		4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50
Cumulative ratio		86.57	90.47	94.54	98.79	103.23	107.88	112.73	117.80	123.10	128.64	134.43	140.48	146.80	153.41	160.31	167.52	175.06
Meat																		
Target(%)			(3.6)	(3.8)	(5.0)	(2.6)	4.0	4.0	4.0	4.0	5.0	5.0	5.0	5.0	6.0	6.0	6.0	6.0
Cumulative ratio		86.57	89.69	93.10	97.76	100.30	104.31	108.48	112.82	117.33	123.17	129.33	135.80	142.59	151.15	160.22	169.83	180.02
Products(1,000t)		14.07	14.58	15.13	15.89	16.30	16.95	17.63	18.34	19.07	20.02	21.02	22.07	23.17	24.56	26.03	27.57	29.22
Milk																		
Target(%)			(0.4)	(3.5)	(3.5)	(3.6)	4.5	4.5	4.5	4.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Cumulative ratio		86.57	86.92	89.96	93.11	96.46	100.80	105.34	110.08	115.03	121.36	128.03	135.07	142.50	150.34	158.61	167.33	176.53
Products(1,000m3)		444.3	446.1	461.7	477.9	495.1	517.4	540.7	565.0	590.4	622.9	657.1	693.2	731.3	771.5	813.9	858.6	905.8
Eggs																		
Target(%)			(5.1)	(4.9)	(5.0)	(5.1)	4.0	4.0	4.0	4.0	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Cumulative ratio		86.57	90.99	95.45	100.22	105.33	109.54	113.92	118.48	123.22	128.76	134.55	140.60	146.93	153.54	160.45	167.67	175.22
Products(1,000 eggs)		273.0	286.9	301.0	316.0	332.1	345.4	359.2	373.6	388.5	406.0	424.3	443.4	463.4	484.2	506.0	528.8	552.6

Source : FAO Yearbook Production 1991, Production zones and targets 1992-95
Note : ( ) indicates National targes (1992-95)

Table 5.1.4 Area for New Ranch Plan

Name of District, County and Sub-county		Beef Cattle only						Beef Cattle + Goat						Total Area (ha)
		No.	NP (ha)	EP (ha)	HA (ha)	Others (ha)	Total (ha)	No.	NP (ha)	EP (ha)	HA (ha)	Others (ha)	Total (ha)	
Luwero														
Wobusana	Kikyusa	30	5,240	720	717	388	7,065	30	4,158	600	570	273	5,601	12,666
〃	Kamira	20	3,494	480	478	258	4,710	20	2,772	400	380	182	3,734	8,444
Bululi	Nabiswera	60	10,481	1,440	1,434	775	14,130	40	5,544	800	760	364	7,468	21,598
〃	Lwampanga	50	8,734	1,200	1,195	646	11,775	40	5,544	800	760	364	7,468	19,243
Katikamu	Butuntumula	60	10,481	1,440	1,434	775	14,130	40	5,544	800	760	364	7,468	21,598
Nakaseke	Ngoma	380	66,378	9,120	9,082	4,910	89,490	160	22,176	3,200	3,040	1,456	29,872	119,362
〃	Wakyato	100	17,468	2,400	2,390	1,292	23,550	60	8,316	1,200	1,140	546	11,202	34,752
Sub Total		(5,600) 700	122,276	16,800	16,730	9,044	164,850	(3,120) 390	54,054	7,800	7,410	3,549	72,813	237,663
Masaka														
Lwemiyaga	Lwemiyaga	(80) 10	1,747	240	239	129	2,355	(80) 10	1,386	200	190	91	1,867	4,222
Mpigi														
Busiro	Kakiri	(80) 10	1,747	240	239	129	2,355	(80) 10	1,386	200	190	91	1,867	4,222
Mukono														
Baale	Galiraya	30	5,240	720	717	388	7,065	30	4,158	600	570	273	5,601	12,666
〃	Baale	30	5,240	720	717	388	7,065	30	4,158	600	570	273	5,601	12,666
〃	Kayonza	20	3,494	480	478	258	4,710	20	2,772	400	380	182	3,734	8,444
〃	Kitimbwa	10	1,747	240	239	129	2,355	10	1,386	200	190	91	1,867	4,222
Sub Total		(720) 90	15,721	2,160	2,151	1,163	21,195	(720) 90	12,474	1,800	1,710	819	16,803	37,998
Total Farmer - 10,480 Group - 1,310		(6,480) 810	141,491	19,440	19,359	10,465	190,755	(4,000) 500	69,300	10,000	9,500	4,550	93,350	284,105

Note : ( ) - Number of farmers ; NP - Natural Pasture ; EP - Establish Pasture ; HA - House Area(including food crop area)

5.2 Promotion of Rural Incomes and Employment

Three major approaches can be considered for creating jobs and boosting agricultural incomes to accommodate on increasing population as shown in Fig. 5.2.1:

i) Urban policies which promote urban production

ii) Agricultural policies which stimulate agricultural production, and

iii) A new ranch plan (See Table 5.1.4) which establishes agricultural production and rural infrastructures for new settlements.

Urban policy is beyond the scope of this Study and will not be covered here. However, it should be noted that, in the light of present economic trends in cities such as Kampala, tertiary industries will continue to develop, and the ability to absorb the population in urban areas will grow.

This Plan seeks to realize increased employment combined with higher incomes in the agricultural sector. The following three measures are planned in order to realize this. However, there is a limit to much labour can be absorbed by the introduction of an agricultural processing industry only.

i) Promotion of policies for encouraging broader agricultural production (see Section 6.2.2).

ii) Development of a rural processing industry (see Section 6.5.1).

iii) Encouraging the establishment of new settlements in undeveloped lands (see Section 6.4.4). Tables 5.2.1 and 5.2.2 summarize the plans for enhancing income and employment in rural areas.

Figure 5.2.1 Policy for the Growth of Income and Employment

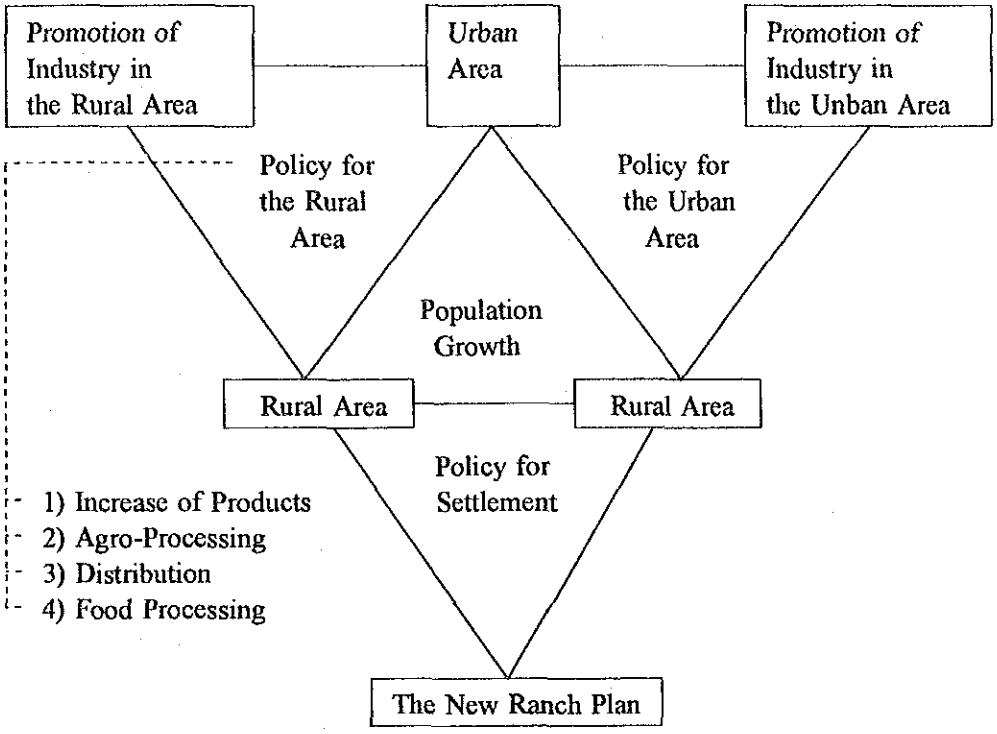


Table 5.2.1 Estimation of Net Income Increase in Rural Areas in 2007

Unit: Million USHS

Item		Luwero	Masaka	Mpigi	Mukono	Total
Agricultural Product						
Present(1991)	a	38,338	72,978	61,205	64,401	236,922
Plan (2007)	b	102,067	123,147	100,102	129,793	455,109
Balance(b-a)	c	63,729	50,169	38,897	65,392	218,187
Livestock Product						
Present(1991)	d	7,465	7,799	4,863	4,923	25,050
Plan (2007)	e	18,700	12,428	9,393	10,950	51,471
New Ranch Plan	f	6,434	117	117	1,049	7,717
Balance(e+f-d)	g	17,669	4,746	4,647	7,076	34,138
Agricultural Processing *						
Farm Product(2007)	h	16,229	10,430	8,696	19,562	54,917
Animal Product(2007)	i	5,909	2,615	1,378	1,764	11,666
Sub-total(h+i)	k	22,138	13,045	10,074	21,326	66,583
Incremental Net Income (c+g+k)		103,536	67,960	53,618	93,794	318,908

Notes: Product in plantation of sugarcane and tea are excluded.

* Income increase by the newly established facilities.

Table 5.2.2 Employment Plan In Rural Area

Unit: Persons

Item		Luwero	Masaka	Mpigi	Mukono	Total
Available labour in rural area						
in 1991	a	113,500	208,700	195,500	200,100	717,800
in 2007	b	180,100	337,300	318,700	325,900	1,162,000
Labour requirement						
in 2007	c	151,100	159,400	150,200	188,600	649,300
(of which Hired Labour)		(13,900)	(9,500)	(8,300)	(7,500)	(39,200)
Surplus labour in rural area						
in 2007(b-c)	d	29,000	177,900	168,500	137,300	512,700
Employment in Ag. Process.	e	28,960	46,230	40,832	81,765	197,787
Outflow of labour(d-e)	f	40	131,670	127,668	55,535	314,913

Notes: a) From Household and population census (1991). MFEP members 15 year of age or above

b) Estimate with the annual growth rate at 3.1%

5.3 Raising Rural Living Standards

The disturbances and ensuing civil war of the 1970s in Uganda devastated the social infrastructure, affecting roads, health and education facilities, as well as water supplies. The drop in living standards was felt nationwide, but particularly in rural areas, home to 90% of the population and responsible for 75% of the national GDP in calendar year 1992

The welfare of the nation is linked directly to the fate of the rural communities, which urgently require wide-ranging work on all aspects of their rural social infrastructure.

Within the Study Area, as in Uganda as a whole, the resolution and improvement of the following three problem areas are needed most in order to raise the standard of living of rural residents.

i) Poor health and hygiene standards, as exemplified by the high infant mortality rate
ii) Problems associated with burdens on labour, for instance on women and children required to collect and transport water and firewood
iii) Low levels of education as reflected in low enrollment rates

These three problems areas each have many offshoots and require a broad range of measures to alleviate them. Table 5.3.1 sets out some of the more significant detailed strategies adopted in the Master Plan which address the various problems associated with each of the above issues.

Table 5.3.1 Raising Rural Living Standards

Item	1. Health and hygiene	2. Family labour	3. Education and others
Problems	• Infant mortality rate • Life expectancy • Sickness in females	• Burden of labour on farmers, women and children	• Education levels • Electrification • Communication facilities
Solutions	• Health facilities • Inoculations • Family planning • Nutrition levels • Hygiene levels	• Work efficiency • Labour for transport of agricultural materials and produce • Labour involved in water and firewood collection	• Educational facilities • School enrollment rates • Electrification and communication lines
Strategies in the Master Plan	• Develop health facilities and welfare • Boost nutrition levels via food and livestock production • Expand & enhance • Water supply facilities	• Agricultural mechanization • Rural road network • Water supply facilities	• Education, electrification & communication left to other programs; Master Plan to focus on facilities needed for New Ranches

5.4 Promotion of Exports and Import Substitution

Table 5.4.1 and Appendix 1.4 show the main exports by dollar amount and weight. Major trends over the past eight years are as follows:

i) Total agricultural products accounted for more than 92% of total exports from 1984 to 1991 in Ugandan exports;

ii) Exports of cash crops (coffee + tea) ranged from 75% to 98% of total exports between 1984 and 1991;

iii) While exports of cereals, fruits and vegetables, tobacco and cotton are recently on the increase.

On the other hand, Table 5.4.2 and Appendix 1.4 show major imports, the trends of which may be outlined as follows:

i) Agricultural products accounted for 4.0% to 6.7% of total imports between 1984 to 1991;

ii) In 1991, main imports were (in descending order): agricultural machinery (US$ 8.3 mn), animal and vegetable oil (US$ 7.9 mn), cereals (US$ 4.5 mn), pesticides (US$ 3.5 mn), sugar & honey (US$ 2.6 mn).

Table 5.4.3. indicates the estimated exports and imports for the year 2007 in the Study Area. Exports are estimated to about 3.6 times 1991 levels or US$ 218 million, adding an increase in non-traditional crops. On the other hand, import substitution will be realized to the amount of US$ 5.7 million in 2007 through implementation of the Plan. The totals will be US$ 224 million or about 3.4 times the 1991 level.

From the above-mentioned results, an increase in agricultural production will also create export earnings and assist in import substitution. Increased export earnings are highly significant in Uganda in terms of improving the balance of payments.

Table 5.4.1 Main Exports of Uganda (Money Base)

Unit: Million US$

Items	1984	1985	1986	1987	1988	1989	1990	1991
Total merchandise trade (a)	416.25	470.00	406.80	333.60	285.00	277.70	177.80	171.50
Total agricultural products	(99.4) 413.89	(92.3) 433.58	(99.1) 403.23	(94.3) 314.63	(95.5) 272.11	(97.6) 271.00	(97.2) 172.76	(98.8) 169.49
Cereals	15.20	-	-	-	-	-	3.31	4.37
Fruit + Vegetables	-	-	0.30	0.30	0.20	0.35	4.84	4.61
Coffee + Tea + Cacao	(92.8) 386.48	(89.9) 422.43	(97.8) 397.75	(93.0) 310.17	(94.3) 268.79	(95.8) 265.96	(81.3) 144.53	(75.1) 128.79
Feeding stuffs	0.06	0.05	0.10	0.06	0.09	0.10	-	-
Tobacco	1.15	1.10	1.30	1.50	-	0.57	2.82	4.54
Textile Fibres	11.00	10.00	3.78	2.60	3.03	4.02	5.79	11.73
Others	-	-	-	-	-	-	11.47	15.45

Source: FAO Yearbook Trade 1989,1991

Note: ( ) indicates Ratio (%) to (a)

Table 5.4.2 Main Imports of Uganda (Money Base)

Unit: Million US$

Items	1984	1985	1986	1987	1988	1989	1990	1991
Total Merchandise Trade (a)	342.22	264.00	438.20	598.30	658.20	740.00	617.60	488.30
Total Agricultural products	(5.9) 20.19	(6.7) 17.78	(5.4) 23.67	(6.7) 39.98	(4.4) 28.85	(4.7) 34.75	(4.0) 24.93	(4.0) 19.65
Live Animals	3.00	3.00	0.18	1.98	1.18	1.98	0.98	0.48
Meat (canned)	0.80	1.00	0.50	0.15	-	0.60	0.60	0.85
Dairy Products	6.24	4.69	3.94	4.06	7.30	8.50	5.10	1.90
Cereals	7.60	4.76	3.46	4.57	4.72	5.60	2.75	4.52
Fruit + Vegetables	0.16	0.30	0.48	-	-	-	-	-
Sugar + Honey	1.05	0.25	6.60	24.00	3.45	5.90	4.60	2.60
Beverages	0.56	0.14	6.90	1.90	1.10	1.50	1.80	1.40
Animal and Vegetable Oil	0.60	0.30	1.18	2.93	10.75	10.00	9.10	7.90
Others	0.18	3.34	0.43	0.39	0.35	0.67	-	-
Agricultural Inputs	10.80	11.26	11.67	12.05	12.83	12.21	11.13	11.91
Manufactured Fertilizers	0.15	0.08	0.06	0.11	0.06	0.11	0.07	0.10
Pesticides	2.70	3.00	3.10	3.20	3.50	3.60	3.30	3.50
Agricultural Machines	7.95	8.18	8.51	8.74	9.27	8.50	7.76	8.31

Source: FAO Yearbook Trade 1986,1989,1991

Note: ( ) indicates Ratio (%) to (a)

Table 5.4.3 Estimation of Exports and Imports in the Study Area
(calculated at constant value of 1991)

Unit: Million US$

Item	1991	Ratio	Revised Ratio	2007	Balance
1. Exports			(*1)		
Coffee	48.3	2.10	2.00(5%)	96.6	48.3
Cotton	1.3	4.50	4.05(10%)	5.9	4.6
Tea	2.4	3.00	2.85(5%)	7.4	5.0
Non-traditional Crops	9.1	17.00	11.90(30%)	108.3	99.2
Sub-total	61.1			218.2	157.1
2. Imports					
Animal and Vegetable Oil	1.4	1.63	-	2.3	0.9
Cereals	0.8	1.63	-	1.3	0.5
Sugar	0.5	1.63	-	0.8	0.3
Dairy Products	0.3	1.63	-	0.5	0.2
Meat	0.2	1.63	-	0.3	0.1
Other	0.3	1.63	-	0.5	0.2
Sub-total	3.5	1.63	-	5.7	2.2
3. Total	64.6			223.9	159.3

Source: Table 2.3.1 and Appendix A4.4

Note: (*1) = (%)--Domestic consumption, (*2) = Population growth rate in 2007 (1991 = 100)
(*3) = Estimated amount of imports without this Plan

5.5 Sustainable Agriculture and Environmental Conservation

In order to conserve the natural environment, such as forests and wetlands, it is necessary to guarantee a stable livelihood for rural society through sustainable agriculture.

On-going, stable farming practices are predicated on reasonable weather conditions, proper conservation of soils and protection from chaos caused by social factors such as disease and civil war.

The farmer is not in a position to control the weather or wider social conditions. He or she is, however capable of soil conservation and of lessening the effects of the extremes of weather, through perseverance and knowledge.

Soil conservation requires two types of measures, control of topsoil runoff and preservation of soil fertility. As for measures to lessen the effects of extreme weather, the healthy cultivation via soil fertility is an indirect measure. A more direct method would be through irrigation which would reduce the adverse effects of drought.

The Master Plan addresses measures for soil conservation and irrigation in order to realize sustainable agricultural development and to alleviate the effects of greatly varying weather and climatic conditions.

Some 60% of the FFGM and SFGM areas within the Study Area would need such soil conservation measures such as contour ditches and mulching, if used as farmland for controlling soil loss within acceptable limits. Another 13% would have to be set aside as natural forests and grasslands. (Estimates taken from Table 6.10. 1.3)

Surface soil loss on grassland, unlike farm land, can be prevented by controlled livestock grazing. Grassland improvement can boost grass yields in line with herd sizes, while fences, watering pots and other devices can be used to regulate and control grazing.

Preventing the outflow of nitrogen and phosphorus from farmlands and keeping them from reaching water sources should be an integral part of ordinary farming practices.

The following three points regarding ordinary farming are considered from the viewpoints of soil conservation and water quality protection in 6.2 of the Cultivation Plan:

i) Retain soil fertility and moisture through the use of organic materials and mulching.
ii) Raise absorption levels of fertilizers by plants with making efficient management practices, e.g. through greater emphasis on second fertilization.
iii) Utilize surplus nutrients in soil through 'cleaning crop' rotation with beans and root crops which absorb more fertilizer than vegetables.

Three points to bear in mind regarding wetland farming:

i) Avoid peat and acid sulfate soils.
ii) Prevent decomposition of organic matter in soil by minimizing changes in underground water levels

iii) Plan paddy field development on small lots so as to minimize soil movement by leveling

Concerning the social environment issues, please see section 6.10.2.

6. Development Plan for Each Sector

6.1 Land Use Plan

6.1.1 Land Classification Criteria

In establishing a land use plan, firstly the area is classified in terms of productivity (based on the productivity of the land), conservation (based on the capability of land to resist erosion) and suitability for agricultural land use (based on current land use). These three aspects are used to make land suitability classifications based on natural conditions. The next step is to establish a land use plan based on the land suitability classification taking into consideration farm management plans, level of development of the agricultural infrastructure as other factors.

1) Land productivity classifications

Land productivity classification is based on both soils and topography and is taken as the lower grade of either soil fertility or topography.

(1) Soil fertility classification

Soils are divided into four categories in terms of fertility (see 3.2.2: Soils).

Table 6.1.1.1 Soil Fertility Classification Criterion

Rank	Suitability	Soil Type
I	High	Mabira C., Nakabango C., Kaku S.
II	Medium	Koki C., Buganda C., Mirambi C., Lukaya C., Buyaga C., Bukora S.
III	Low	Kabira C., Mawogora C.,Makole S.,Buruli C., Lwanpanga S., Mulembo S., Kifu S.,Sango S., Sesse S.
IV	None	Tolero S.

Note : C.:Catena , S.:Series

(2) Land productivity classifications

The grade affects the agricultural infrastructure and the work involved in farm management. In addition, the grades appropriate to paddy fields and upland fields differ. Consequently, land for paddy field and upland field is classified separately into three grades. Grade classification takes into consideration the grade classification criteria employed in this Study, design of the agricultural infrastructure, and the degree of difficulty in mechanizing farm work. Grade suitable for paddies is classified into three categories such as under 2%, under 6%, and under 12%. Grade for upland fields has also three categories: under 6%, under 12% and under 25%. Land for paddy fields with a grade of over 12%, and for upland fields with a grade of over 25% was not studied since infrastructure costs would increase sharply in these cases. Taking irrigation into account, wetlands and surrounding areas are studied to determine their suitability for paddy fields. Due to drainage, wetlands are not considered for non-paddy fields.

As well as rice, paddy fields can be used for the cultivation of vegetables that require a lot of water.

Table 6.1.1.2 Land Gradient Classification Criterion (Paddy fields)

Rank	Suitability	Land Slope	Present Land Use
I	High	I < 2%	Swamps , around Swamps or around Water areas
II	Medium	2% <= I< 6%	ditto
III	Low	2% <= I < 12%	ditto
IV	None	I >= 12%	Others

Note: "around swamps" means the next meshes of swamps or water areas.

Table 6.1.1.3 Land Gradient Classification Criterion (Upland fields)

Rank	Suitability	Land Slope	Present Land Use
I	High	I < 6%	Except swamps
II	Medium	6% <= I< 12%	ditto
III	Low	12% <= I< 25%	ditto
IV	None	I >= 25%	Swamps

2) Soil conservation classification

This classification refers to the ability of land to resist soil erosion from rain. Two factors—land slope and soils—are used to classify soil conservation ability into three classes.

Table 6.1.1.4 Soil Conservation Classification Criterion

Rank	Suitability	Land Slope	Soil Type
I	High	I < 6%	Mabira C.,Nakabango C.,Kifu S., Kaku S.,Sesse S.
II	Medium	6%<=I<12%	Koki C.,Buganda C.,Kabira C., Mirambi C.,Mawogora C.,Makole S., Lukaya C.,Buyaga C.,Mulembo S., Bukora S.
III	Low	I >= 12%	Tolero S.,Buruli C.,Lwanpanga S., Sango S.

Note: This rank be taken which is worse between land slope and soil.

3) Land suitability classification for farmland

Current land use cannot be ignored when classifying land, suitability, since land use reorganization for forests, plantations, and urban areas is not considered in Land Use Plans.

Lands considered suitable for paddy fields are limited to wetlands and FFGM and SFGM areas surrounding wetlands, while land suitable for upland fields are existent in FFGM and SFGM areas.

Table 6.1.1.5 Present Land Use Classification Criterion (Paddy fields)

Rank	Suitability	Present Land Use
I	Exist	Swamps , Forest/Farm-grassland and Savanna/Farm-grassland around Swamps
II	None	Forest/Farm-grassland and Savanna/Farm-grassland except around Swamps,Forests, Plantations,Urban areas,Water areas

Table 6.1.1.6 Present Land Use Classification Criterion (Upland fields)

Rank	Suitability	Present land use
I	Exist	Forest/Farm-grassland , Savanna/Farm-grassland
II	None	Forests,Plantations,Swamps, Urban areas, Water areas

4) Overall land suitability classifications based on natural conditions

The overall land suitability classifications for the Study Area based on natural conditions are the product of synthesis of the results of the classifications made from 1), 2) and 3) above mentioned.

Table 6.1.1.7 Land Suitability Classification Criterion (Paddy fields)

Rank	Suitability	Land Productivity Classification	Soil Conservation Classification	Land Suitability Classification
I	High	I	I	I
II	Medium	I ····· II ·····	····· II ···· I 、 II	I
III	Low	I ····· II ····· III ·····	····· III ····· III ·· I 、 II 、 III	I
IV	None	IV	—	II

Table 6.1.1.8 Land Suitability Classification Criterion (Farm fields)

Rank	Suitability	Land Productivity Classification	Soil Conservation Classification	Land Suitability Classification
I	High	I	I	I
II	Medium	I ・・・・・・ II ・・・・・・	・・・・・・II ・・・・I 、 II	I
III	Low	I ・・・・・・ II ・・・・・・ III ・・・・・・	・・・・・・III ・・・・・・III ・・I 、 II 、 III	I
IV	None	IV	—	II

Table 6.1.1.9 Synthesized Overall Land Suitability Classification

Rank	Suitability	Land Suitability Classification	
		Paddy	Farm
I	for Paddy : above Medium for Farm : above Medium	I 、 II	I 、 II
II	for Paddy : above Medium for Farm : Low	I 、 II	III
III	for Paddy : Low for Farm : above Medium	III	I 、 II
IV	for Paddy : Low for Farm : Low	III	III
V	for Paddy : above Medium for Farm : None	I 、 II	IV
VI	for Paddy : None for Farm : above Medium	IV	I 、 II
VII	for Paddy : Low for Farm : None	III	IV
VIII	for Paddy : None for Farm : Low	IV	III
IX	for Paddy : None for Farm : None	IV	IV

Note : The rank II cannot be in the combination of these classifications.

6.1.2 Land Classification

Areas were classified in accordance with the land classification criteria mentioned in the previous section. The land was ranked with data codes such as land grade, soil, land use and wetlands given to each mesh. Mesh diagrams and tables of classifications by county are presented in Annex. The classifications are summarized as below.

1) Paddy fields
   i) Lands highly suitable as paddy fields are mainly found in the Sezibwa Swamp and account for approximately 2% of the total Study Area. Mukono has much highly suitable paddy field land, while Masaka has none.
   ii) Lands with medium suitability as paddy fields are mainly found to the south of the Sezibwa Swamp and Luwero, the east of Mpigi, and around the wetlands of central Masaka, accounting for approximately 6% of the total area.
   iii) Lands with low suitability as paddy fields are found in the wetlands and surrounding areas other than those above, accounting for approximately 22% of the total area. Nearly half of these are located in Masaka.
   iv) Soil is a major factor in determining the degree of suitability for paddy field use. Much of the land with Kaku soil Series is highly suitable.
   v) In contrast, lands unsuitable for paddy field account for some 70% of the entire region. Much of this land is in Luwero.
2) Upland fields
   i) Lands considered highly suitable for upland fields are, as in the case of paddy fields, almost all found around the Sezibwa Swamp, accounting for approximately 2% of the total area. By district, Mukono and Luwero have much highly suitable land, while Masaka has none.
   ii) Lands with medium suitability as upland fields are concentrated in an area extending from southern Luwero to northeastern Mpigi and in central Mukono and central Masaka, and account for approximately 20% of the total area.
   iii) Lands with low suitability as upland fields are concentrated in northern Luwero and Mukono and western Masaka, accounting for a large 44% of the Study Area.
   iv) Soil fertility is a major factor in determining the degree of suitability for upland fields also.
   v) In contrast, lands unsuitable for upland fields extend mainly over Mgipi and Mukono on either side of Kampala. The lands in this area are currently classified as forests, plantations, and wetlands. The forests and wetlands of Luwero and Masaka are also unsuitable. Land unsuitable for upland fields accounts for about 33% of the total area.

3) General

Lands suitable for paddy and upland fields (which overlap) are summarized in Figure 6.1.2.1.

Land suitability is generalized as follows by District.

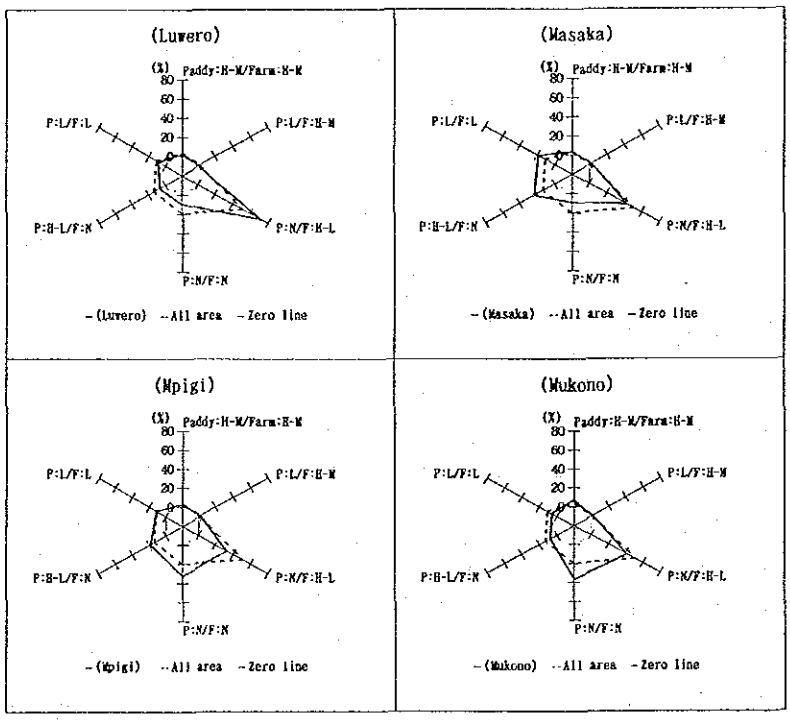
i) Luwero District has a very high rate of land suitable only for upland field compared to the entire Study Area. The land is highly suitable for upland field. This is attributed to the abundance of flat SFGM and the scarcity of wetlands.

ii) Masaka District has a high rate of land suitable for both paddy and upland field. Lands suitable for paddy only are large due to well distributed wetlands in the District.

iii) Mpigi District has a high rate of land unsuitable both for paddy and upland field as compared to the whole Study Area. This is understood by land slope classification and land use classification.

iv) Mukono District shows relatively low rate of land suitable for both paddy and upland field except the area along Sezibwa Swamp. This is due to little land available for cultivation and grazing out of the existing forests and plantations.

Figure 6.1.2.1. Synthesized Overall Land Suitability



Source: Mesh Database in This Study

Note: P: Paddy, F: Farm, H: High Suitability, M: Medium, L: Low, N: None

6.1.3 Land Use Plan

The Land Use Plan has been established through the analysis of the present land use, land classification and land requirements in farm management and livestock sectors.
The land reclamation plan within the Land Use Plan has been formulated on the basis of the following concepts:

i) Land reclamation in counties which have unused lands suitable for paddy and/or upland field.
ii) Land reclamation according to the needs taking into consideration rural population and crop production plan.
iii) Grassland reclamation in the remaining areas of land reclamation.

Tree planting is to be encouraged especially in such areas as steep sloped areas, tops of hills and lower strips of hills adjacent to wetlands where cultivation and grazing are not suitable. Tree planting saves soils from erosion, protects environment and supplies fuel woods. Paddy field development has been planned in wetlands and their peripheries based on plan of irrigation sector.

Some existing farmland and grassland in mosaic areas will also be improved to enhance productivity.

The land use plan as shown in Table 6.1.3.1 and Figure 6.1.3.1 which includes auxiliary areas such as roads and canals is formulated.

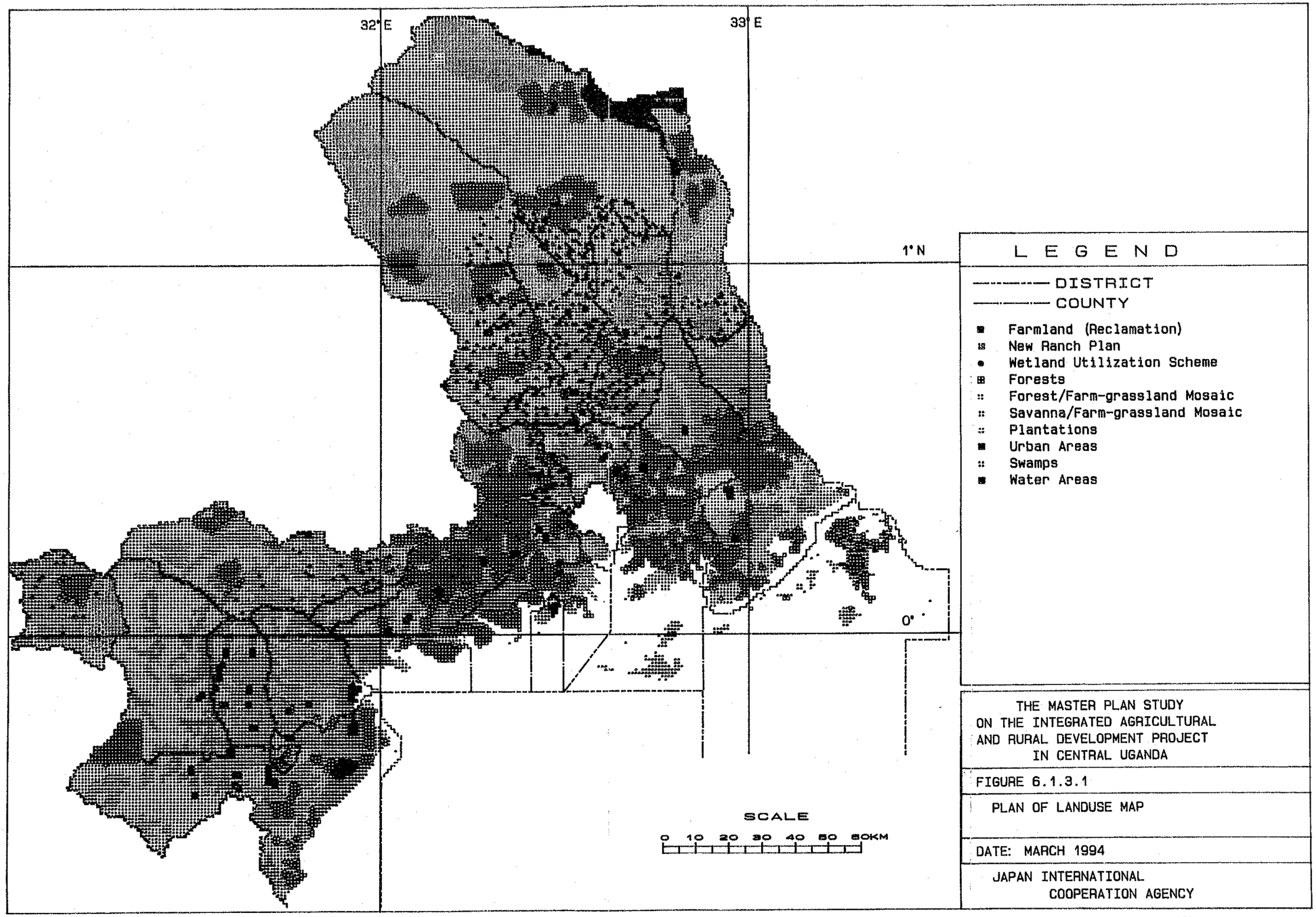
表 6.1.3.1 County別土地利用計画

(ha)

District County	Land Reclamation						Land Improvement	
	Forest/Farm-Grassland and Savanna/Farm-Grassland					Swamps	Forest/Farm-Grassland and Savanna/Farm-Grassland	
	Unused Areas ①	Proportion of Suitable Land for Reclamation ②	Suitable Land Area for Reclamation ③=①*②	Farmland Reclamation *1	New Ranch Plan *2	Wetland Utilization Scheme	Farmland Improvement *3	Grassland Improvement
Luwero								
Buruli	74,360	99.8	74,210	18,000	40,841		310	10,870
Katikamu	43,120	99.9	43,080	18,000	21,598	240	2,990	1,400
Nakaseke	191,860	99.9	191,670	17,000	154,114	280	1,540	3,080
Wabusaana	40,950	99.8	40,870	17,000	21,110	80	3,030	2,090
Total	350,290		349,830	70,000	237,663	600	7,870	17,440
Masaka								
Bukomansimbi		100.0				710	2,650	1,430
Bukoto		87.8				910	6,200	4,520
Kalungu		99.8				210	1,960	4,300
Lwemiyaga	8,970	100.0	8,970	2,000	4,222		290	2,690
Masaka Mun.		100.0						60
Mawoggola		99.9				140	1,620	5,590
Total	8,970		8,970	2,000	4,222	1,970	12,720	18,590
Mpigi								
Busiro	13,050	99.4	12,970	8,000	4,222	750	2,340	930
Butambala		99.5				210	1,200	690
Entebbe Town		100.0						300
Gomba	12,200	99.0	12,080	4,000			1,100	1,760
Kyadondo	3,210	100.0	3,210	3,000		480	2,060	880
Mawokota		99.2				1,170	2,250	870
Total	28,460		28,260	15,000	4,222	2,610	8,950	5,430
Mukono								
Bbale	43,410	100.0	43,410	5,000	37,998		1,160	2,150
Buikwe		97.8				270	2,000	1,390
Buvuma	8,510	100.0	8,510	2,000				150
Mukono		98.9				370	5,100	1,200
Nakifuma		100.0				80	2,250	400
Ntenjeru		100.0					4,950	350
Total	51,920	100.0	51,920	7,000	37,998	720	15,460	5,640
Grand Total	439,640	99.8	438,980	94,000	284,105	5,900	45,000	47,100

Source :Mesh Database in This Study
Note :Each plan areas are including attendant area such as farm roads,canals and etc.
*1 : Grand total(94,000ha) is including the Small Scale Irrigation Schem Area(700ha).
*2 : Grand total(284,000ha) is including the Glassland Develoment Area(29,400ha).
*3 : Grand total(45,000ha) is including the Small Scale Irrigation Schem Area(1,800ha).

Table 6.1.3.1 Land Use Plan by County



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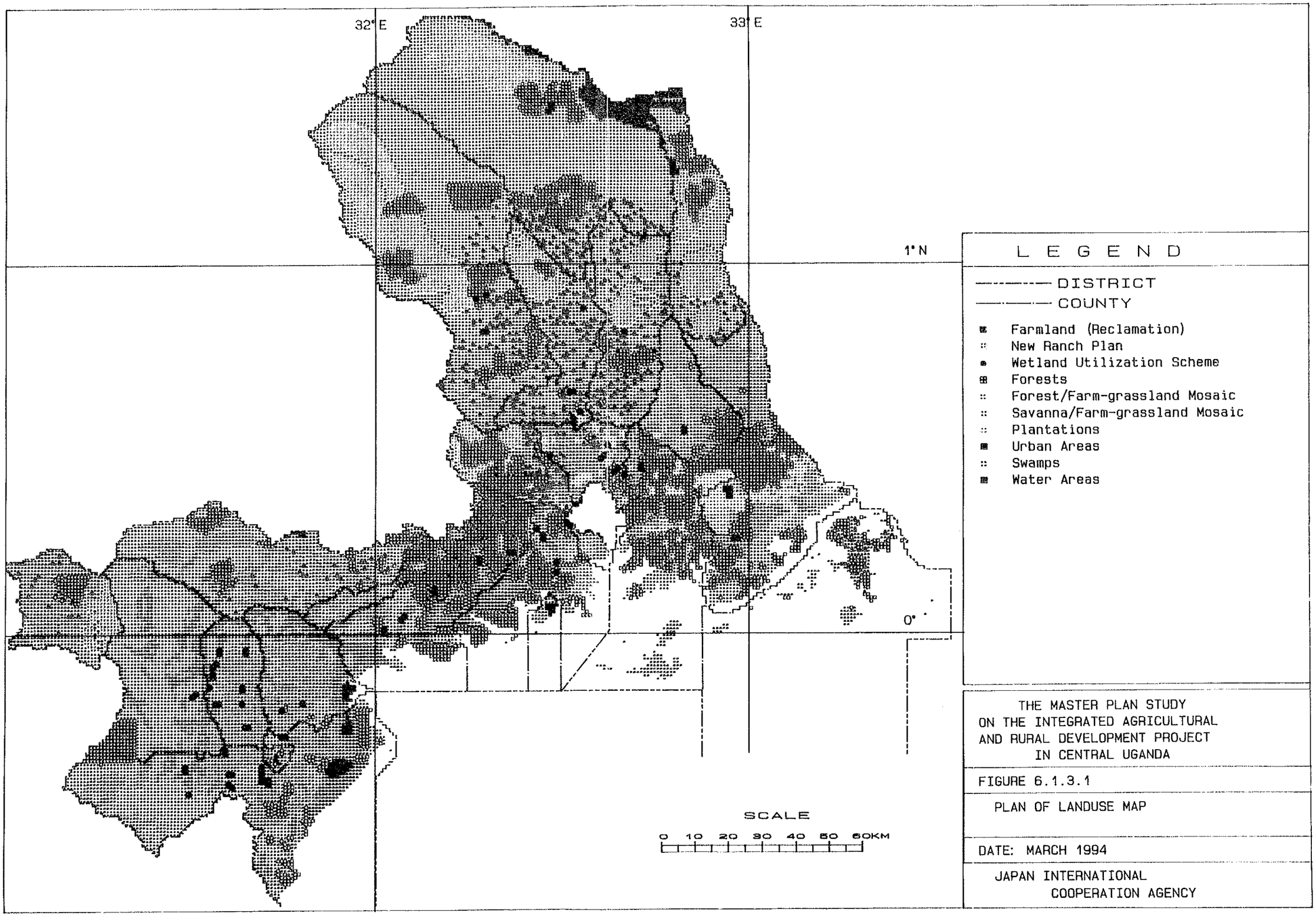
AND RURAL DEVELOPMENT PROJECT
IN CENTRAL UGANDA

FIGURE 6.1.3.1

PLAN OF LANDUSE MAP

DATE: MARCH 1994

JAPAN INTERNATIONAL
COOPERATION AGENCY


32° E
33° E
1° N
0°
SCALE
0 10 20 30 40 50 60KM
L E G E N D
DISTRICT
COUNTY
Farmland (Reclamation)
New Ranch Plan
Wetland Utilization Scheme
Forests
Forest/Farm-grassland Mosaic
Savanna/Farm-grassland Mosaic
Plantations
Urban Areas
Swamps
Water Areas
THE MASTER PLAN STUDY
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AND RURAL DEVELOPMENT PROJECT
IN CENTRAL UGANDA
FIGURE 6.1.3.1
PLAN OF LANDUSE MAP
DATE: MARCH 1994
JAPAN INTERNATIONAL
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6.2 Cultivation Plan

6.2.1 Study of Strategic Crops

The basic idea in the study of strategic crops in regional planning is how farmers should introduce which crops and in what manner, and what methods they should use to expand production in order to meet food supply targets, and to boost exports and thus income. Together with strategic crops, agricultural policies such as extension of agricultural technology and processing and distribution system development plans have been studied, as well as development of farm land where necessary.

Figure 6.2.1.1 shows the relationship between three key points connected to strategic crops, farmers and the nation. The nation is responsible for providing a stable supply of food to its people and for ensuring suitable conditions for farmers to cultivate crops (Triangle A). At the same time, besides farm products for food, the nation also makes plans to enhance the production of farm products for export in order to acquire foreign currency for economic development (Triangle B). Farmers strive to improve their standard of living and to increase their income by selecting crops which are highly profitable (Triangle C).

Although there is more to be studied in addition to the three triangles, basically speaking crops should be profitable for both farmers and the nation in general. The following three points proposed in the Scope of Work were also taken into consideration.

i) Agricultural development that will contribute to the diversification of export crops
ii) Agricultural development that will utilize both the market and private sector forces
iii) Selective expansion of crops to substitute for imported foods

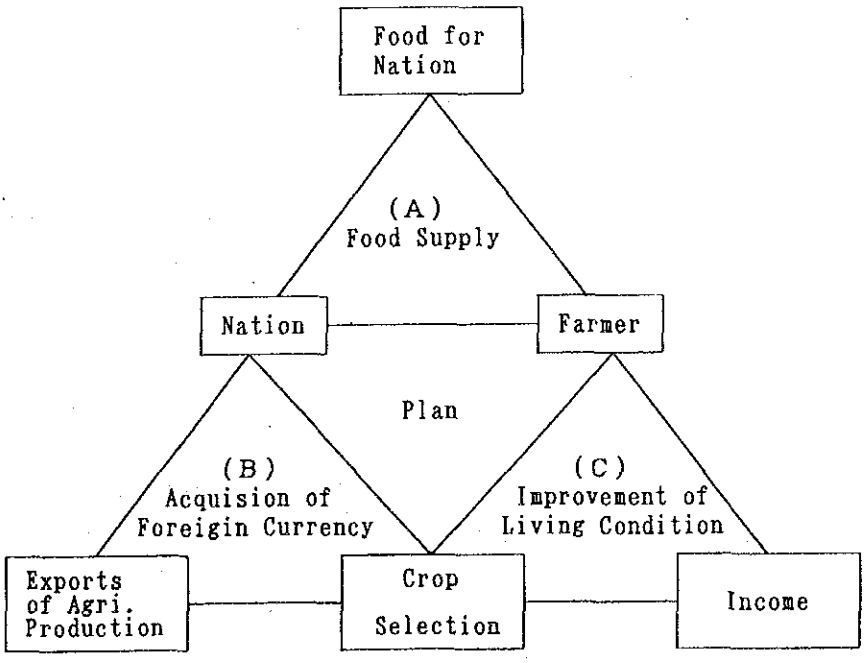


Figure 6.2.1.1 Principles of Stratagic Crops Plan

Uganda requires a stable and sufficient food supply for its rising population as well as greater production of export-earning crops with which to obtain foreign currency. Thus, staple food crops include banana, cassava, sweet potato, maize and beans, oil crops, peanuts and soybeans, horticultural crops, and export oriented crops such as coffee, cotton, tea and cacao. Potentially lucrative exports include passion fruit, vanilla and cocoons, as well as dried tomatoes, pineapples and other fruits. Demand for grains is rising, while rice is enjoying a dramatic surge in popularity.

Table 6.2.1.1 shows planned crops by agricultural zones, assuming future improvements in distribution systems and production technology. As a rule, most crops are selected according to the characteristics of the area, such as natural and economic conditions, and are produced continuously as strategic crops. However, it is conceivable that farmers will shift to more highly profitable crops in the future.

Seen by zone, Zones Ia and Ib have similar natural and geographic conditions, and are suitable for private sector-led market and distribution systems with crops requiring processing.

Although Zone Ic has a slight disadvantage in natural conditions, it does have an agricultural college, which provides thorough services for the improvement and extension of cultivation technology. Farmers will be begun to introduce the same strategic crops here as in Zones Ia and Ib.

The three sub-zones in Zone II differ in both land use and land holding size, so a policy of promoting homogeneity for all districts, as in Zone I, would be inappropriate. However cotton, which is an important strategic product in terms of Ugandan national policy and a key cash crop for small-scale farmers in Zone II, should be restored to the production levels of the 1960s.

Cotton-based farming will be supplemented with peanuts, and *citrus* fruits under combined cropping in Zones IIa and IIc, to offset the vulnerability of the main crop to price fluctuations and weather conditions. Zone IIb will be devoted largely to livestock farming.

1) Cash crops:

   i) Foreign currency acquisition has been badly affected by the worldwide slump in coffee prices in recent years, and the present coffee-dependent cash crop production system must shift to more diversified production. Other products where primary processing could be easily carried out in rural communities (tea, cacao, vanilla, and sugar cane) are promising for coffee producing areas.

   ii) Cotton is the second most important export crop after coffee, and Ugandan seed cotton, along with Egyptian cotton, is highly regarded in the world market. Therefore, if Ugandan cotton production volume were to be stabilized, cotton could become competitive in the world market. This requires guidance at the farm level in

conjunction with the rehabilitation of processing and distribution systems through various projects.

iii) Fruits such as passion fruit and pineapple are now-considered suitable as export items. Demand for processed products such as juices and dried produce is growing in the developed countries. Production areas should be consolidated and processing industries nurtured.

2) Food crops:

i) Cereal production, which currently supplies only about 20% of local demand, will be *boosted to 100%.*

ii) Of the structural changes in food demand in recent years, besides cereals, the demand for pulses, oil crops, vegetable, fruits, and livestock has increased, and the demand for tubers and bananas has declined in urban areas. Although products such as cereals and vegetables readily affected by the weather and prices are unstable, it is nevertheless considered important to boost production of these strategic crops to meet demand.

iii) The demand for rice has been growing in recent years, and 60% of domestic consumption (40,000 tons) is imported using precious foreign currency. There are many wetlands suited to paddy field development in the Study Area. Rice is considered as a promising crop for curbing imports and saving foreign currency.

Table 6.2.1.1 Strategic Crops by Farming Zone

++ Plenty, + Some, * Introduce/Increase

Item	ZONE I			ZONE II		
	I a	I b	I c	II a	II b	II c
Banana	++	++	++	+	+	++
Maize+Sorghum	++	++	++	+	++	++
Cassava+Potato	++	++	++	++	+	++
Beans+S.beans	++	++	++	+	+	++
Vegetable	++	++	++			+
Pineapple	++	++	++			+
Passion Fruit	++	++	++			
Rice	+	*				
Cacao	++	+*	+*			
Vanilla	+*	+*	+*			
Sunflower	+*	+*	+*			
Coffee	++	++	+			+
Sugar Cane	++	+	++			+
G/Nut+simsim	++	+	++	++	*	++
Local Fruit	++	++	++	++		
F/Millet				++	+	+
Orange				+	*	*
Cotton				*	*	++
Cattle(milk)	+	+	++	++	++	
Cattle(beef)	+	+	++	++	++	
Goat&Sheep	+	+	+	+	+	
Poultry(meat)	++	+	++	++	+	
- do - (egg)	+	+	+	+	+	
Pig	++	++	++	+	+	+

6.2.2 Agricultural Production Targets

Table 6.2.2.1 presents the agricultural production targets and planting areas required in order to cope with increased export volumes and predicted demand within the Study Area by target year 2007. Further details are given in Appendix 3.3.

With respect to cash crops, the Production Plan gives due attention to the introduction of crops aimed at export and domestic urban markets, introduction of processing facilities in rural villages, and the need to promote the inflow and curb outflow of foreign currency.

Table 6.2.2.1 Target of Agricultural Production and Cultivation Area

Item	Production			Consumption		Cultivation area*	
	Present	Plan	Balance	Present	Plan	Plan	Increase (Balance)
	ton	ton	ton	ton	ton	ha	ha
Cash crops							
Coffee(Robusta)	101,681	207,022	105,341	-	-	118,297	0
Sugar Cane	2,180,450	4,360,900	2,180,450	-	-	87,218	43,609
Tea	5,099	15,805	10,707	-	-	4,856	1,456
Cacao	3,444	10,332	6,888	-	-	13,307	7,078
Cotton	940	4,270	3,330	-	-	5,386	3,781
Vanilla	55	2,957	2,902	-	-	11,830	11,808
Food Crops							
Banana	1,016,998	1,600,624	583,626	1,047,222	1,600,624	197,630	33,549
Roots & Tubers	973,649	1,231,701	258,052	503,886	761,938	101,092	-60,204
Cereals	69,177	469,133	399,956	289,977	469,133	227,195	174,601
Rice	3	26,413	26,410	7,124	26,413	5,389	5,388
Pulses/Legumes	81,758	161,470	79,712	99,457	161,470	117,212	52,059
Oil Seed	24,837	74,646	49,809	45,910	74,646	45,510	26,327
Vegetables	127,065	176,527	49,462	78,850	128,312	23,399	2,793
Fruits	120,322	336,618	216,296	125,404	310,636	11,006	6,914
Mulberry						1,000	950
			Total of Incremental Cultivation				310,109

Note: * See Appendix Table A3.3.1.2

Medium-term export levels have been calculated with reference to government target figures for 1995. Long-term government targets are only available for coffee and cotton; the remaining figures represent estimates by the Study team.

The targets of agricultural production by each crop are described below.

1) Coffee

Planting area to be maintained at current level. Production levels to be boosted under the current Farming System Support Programme (FSSP). Target production level = twice current production volume.

2) Sugar cane

Major increase in planting area to reverse present situation (limited imports) and work towards exporting by the target year. Primary processing in rural towns by village cooperative; increase export volume.

3) Tea

Export volume of tea has risen 2.5 times in the last five years. Encourage plantings by smaller farmers. Primary drying in rural towns by village cooperatives; more produce shipped to privately owned factories. Target production level = three times current volume.

4) Cacao

Export volume of cacao has doubled over the last five years. Increase planting area. Primary processing in rural towns by village cooperatives; increase export volume. Target production level = three times current volume.

5) Cotton

Export volume of cotton has doubled over the last five years. A nationwide Cotton Sub-sector Development Project (CSDP) is expected to start within the Study Area. Production volume in target year corresponding to CSDP = 6,000 bales.

6) Vanilla

Grow via mixed cropping on 5% of coffee plantations; primary processing in rural towns by village cooperatives; increase export volume. Target production level = nine time current volume.

7) Passion fruit and pineapple

Increase planting area; primary processing in rural towns by village cooperatives; increase export volume. Target production level = twice current volume.

8) Banana, tubers

Raise production levels to meet local demand. Annual consumption per capita set at 263 kg for bananas and 126 kg for tubers (Table 6.2.2.2); these two seen as being interchangeable. Predicted demand level takes Kampala population into account (same applies below except for grains).

9) Grains

Raise self-sufficiency level in rural areas from current 24% to 100% by target year. Increase by 1.6 times the volume shipped to Kampala and other cities, in line with the increase of the population.

The government views grain as an important cash crop to be boosted, in the light of current exports to neighboring countries. However, grains need more land per revenue dollar than horticultural crops and crops for processing. The target volume takes into account the limit to potential farm land expansion.

10) *Beans and oil crops*

Raise self-sufficiency level in rural areas from current 50% to 100%.

11) Fruits and vegetables

Consumption per capita, currently less than half that of nearby countries, is to be doubled by the target year. Increased demand and the expected rise in population have both been taken into account, and the volume at present being shipped outside the area will be retained. (Although shipments outside the area will also increase by the target year, accurate estimates cannot be made as it is impossible to designate specific areas.)

The current population of 3.8 million in the Study Area and Kampala is expected to rise to 6.2 million by the target year. Table 6.2.2.2 shows predicted consumption per year per person for each food type. These estimates were used in formulating annual production targets. Although dietary patterns clearly differ significantly between rural and urban areas, accurate data is not available. The Study team has therefore used its own estimates.

Table 6.2.2.2. Consumption per Capita by Agricultural Production

Item	Current		Plan	
	Rural kg	Town kg	Rural kg	Town kg
Staple food	415	389	389	364
Banana	280	263	263	247
Tubers	135	126	126	117
Cereals	96	123	123	157
Rice(Paddy)	2	3	3	8
Pulses & Legume	29	17	29	17
Oil seed	12	11	12	11
Vegitables	20	23	20	23
Fruits	30	46	46	69

Source: Estimation from data of MAAIF & MPED

Assuming the above annual targets were to be met by agricultural production within the Study Area, the shortfall in land for planting would be approximately 310,000 hectares. This can be overcome by reducing the planting area for potatoes (maintaining production levels in line with future demand, through greater efficiency) to be replaced by fruit, vegetables and other crops instead. Furthermore as shown in Table 6.2.2.3, an increase in area under cultivation is needed, as well as more intensive land use. Farm management plans for individual farmers take into account new crops and greater planting area.

Table 6.2.2.3 Expansion of Crop Planting Area

Item	Area (ha)	Remarks
Incremental farm land	310,109	
Increase of land use intensity	219,719	From 1.34 to 1.68
Farm land reclamation	85,000	0.33 ha/farmer
Paddy field development	5,390	

6.2.3 Cultivation Plan

1) Boost of the agricultural production

There are three effective methods of raising agricultural production levels.

i) Boosting land productivity

Land productivity is raised through soil management which includes particularly the use of chemicals and fertilizers, and introducing advanced techniques supported by extension services. Irrigation is required for introducing lucrative new crops, while farmland improvement is necessary for maintaining soil fertility, introducing irrigation and farm mechanization.

ii) Raising land use ratio

The land use ratio can be increased through more intensive double cropping, intercropping and the use of fallow land. As these techniques accelerate the loss of nutrients from the soil and have a significant effect on productivity, they must be accompanied by careful soil management. This will not be achieved through better extension services alone. Research is needed to establish suitable crop rotation systems where crops complement one another.

iii) Increasing available land area

Farm land can be effectively created by converting suitable areas which are unused. Care must be taken however to investigate the environmental impact beforehand.

2) Cultivation techniques improvement

(1) Crop yield targets

Table 6.2.3.1 lists yield targets for major crops which could be cultivated under improved techniques (use of fertilizers and organic material, disease and pest control). The yield targets are based on experiments by Ugandan research bodies and also world crop yield standards. The targets do not presuppose irrigation, except in the case of rice plants. Targets for onion, tomato and similar vegetables are 20% higher if irrigation is used.

(2) Increasing yields

To increase yields, it is especially important to introduce superior varieties, improve soil, fertilize, and control diseases and insect damage. All of these items will be discussed here except for breeding.

a) Soil Improvement

As discussed in the section on soil, almost all soils in the Study Area have medium to low soil fertility. These soils need improvements such as acidity correction, phosphoric acid treatment, and use of organic matter. Appendix 3.2 gives recommended application rates of lime (to correct acidity) and of phosphorus by soil type in representative soil catena/series. (Quantities are given as rough estimates only.)

For development projects in specific areas or soil management in fields at the farm level, further soil diagnosis for the area and detailed measures for soil improvement will be necessary.

b) Fertilization

Fertilizer improves crop growth and boosts yield. Appendix 3.2 gives standard application rates and techniques determined from research at KARI and NAARI and recommendations of individual experts.

This is only a yardstick however. In order to gain optimum benefit from fertilizers, it is essential to consider crop nutrient absorption, characteristics soil fertility, and climate corresponding to crop growth stapes to determine how much of which one to use and when. Given the financial costs of farm management, a specific application plan should also be drawn up.

Application of organic matter is also important, since it has a number of benefits such as supplying nutrients and improving physical properties of the soil. Some examples of organic matter are: manure from domestic animals like cows, poultry, and pigs, coffee husks, rice hulls, crop residue like stems and leaves, and cotton seed meal. It is best to apply small quantities of organic matter all year round rather than all at once.

Table 6.2.3.1 Unit Yield of Main Crops

(t/ha)

Crops	Present Yields	Maximum Yield in Ugand	Yield Goals	Yield of Other Countries			Rem.
				World	East Africa	South East Asia	
Banana	6.3	10-20	10	-	-	-	
Cassava	8～9	35	15	9.9	8.9	12.2	
Sweet Potatoes	6.5	-	15	13.6	7.0	7.9	
Irish Potatoes	8.1	25-30	20	14.7	6.5	11.6	
Maize	1.2	3～4	2.5	3.7	1.4	1.7	
Finger Millet	0.7	3	2.0	0.8	1.1	0.7	
Sorghum	1.8	3	2.0	1.3	1.0	1.1	
Rice	1.3	-	3.5	3.5	2.2	2.8	
Beans	1.4	2	1.5	0.7	0.8	0.8	
Groundnuts	1.3	2.5	2.0	1.1	0.9	1.4	
Soya Bean	1.7	-	2.0	1.9	1.6	0.9	
SimSim	0.7	-	1.0	0.7	0.4	0.8	
Sunflower	0.5	-	1.0	1.4	0.7	0.7	
Cotton	0.6	1.0<	1.0	1.8	0.7	1.4	
Mulberry (fresh leaves)	50	-	100	-	-	-	
Coffee	0.4～0.6	2～3.5	2.0	0.5	0.6	1.3	
Tea (Processed)	1.4～1.6	5～12	5.0	1.0	1.0	1.7	
Cocoa	0.3～0.5	1.5	0.7～1.0	0.4	0.3	0.9	
Sugarcane	11	-	50	60	63	59	
Onions	4.5	-	10	15	6.3	7.2	
Tomato	5.8	-	15	24	8.9	9.3	

Notes:

1 Current crop yield refers to the following:
   a) Cassava, rice, and onions: from the 1986-1989 crop statistics of Statistic Department, MPED.
   b) Sunflowers, sugar cane, and tomatoes: from the 1991 FAO Production Year Book.
   c) Mulberry and coffee: according to the Kawanda Agricultural Research Institute.
   d) Tea and cacao: according to the Agricultural Committee, 1991.
   e) Others: from the Uganda National Census of Agriculture and Livestock in 1990/1991.
2. The highest yields recorded in Uganda are taken from the National Agricultural Research Strategy and Plan, Agricultural Policy Committee, 1991.
3. Crop yields of other countries are from the FAO Production Yearbook, 1991.
4. Uganda is included in the crop yields of the world and Eastern Africa.
5. Eastern Africa comprises Burundi, Ethiopia, Kenya, Rwanda, Somalia, Sudan, Tanzania, Uganda, and Zaire.
6. Southeast Asia comprises India, Indonesia, Laos, Malaysia, Myammar, the Philippines, Thailand, and Vietnam.

c) Disease and pest control

Disease and pest control techniques are classified as either chemical or biological. Agricultural chemicals are simple to use and highly effective providing they are applied at the correct time. Accurate forecasting of occurrence is thus critical. Measures must be taken however to prevent build-up of chemicals, which can effect people, livestock and aquatic life, and pollute the water.

Biological control, or the improvement of the cultivation environment, involves the use of healthy seeds and seedlings, changing cultivation times, employing crop rotation and preventing excess moisture in the soil. More effective and economic however is the use of disease and pest-resistant varieties. Uganda is racing to make up for its slow pace in developing and introducing resistant varieties.

In some cases it may be necessary to bury damaged crops in the soil, or even to burn or remove them. Pathogens and insects must be prevented from entering Uganda from other countries at all cost. Appendix 3.2 summarizes pest and disease control techniques recommended by KARI and NAARI.

(3) Establishing cropping systems

A technologically ideal crop system maintains soil fertility, conserves soil, and produces crops stably through crop rotation, mixed cropping and intercropping. It is also important to consider profitability when establishing a crop system. This point is discussed in Section 6.3.1.

Before discussing crop systems from a technological standpoint, some terms must be defined:

Continuous cropping:	cultivating the same crop on the same plot at all times according to cultivation order.
Crop rotation:	cultivating different crops on the same plot in a given order.
Mixed cropping:	simultaneously cultivating two or more crops on the same plot without delineating the two.
Intercropping:	cultivating a second crop in the spaces between rows of the original crop.

a) Crop systems centered on coffee

At present coffee is usually grown together with banana, Arbizzia Spp., Ficus Spp. and other trees with wide crowns for shade. A more lucrative arrangement would be to replace trees such as Arbizzia with cash crops such as mango, jackfruit and papaya, which provide fruit as well as shade. Since these would all be grown together however, tolerance to shade of different crops would need to be given careful attention.

b) Cropping system with banana as main crop

i) Intercropping of bananas and green manure crops

When banana is cultivated in the same place for many years and the fruit taken away for consumption, soil fertility gradually declines. This problem can be remedied by intercropping leguminous green manure crops with banana, cutting off the stems and leaves of the manure crops, and then mulching them back into the banana plots. Some examples of green manure crops are Mucuna Spp., Centrosema pubescens, Crotalaria Spp., and Stylosanthes Spp.

ii) Mixed cropping of banana and leguminous crops

In this system banana trees are planted sparsely, with about three metres between canopies, and mixed-crop leguminous plants like beans, groundnuts, and French beans are planted between the trees. These broad leaf legume crops repress weeds quite effectively, and also fertilize soil by shedding leaves, pods and stalks.

c) Mixed cropping of banana, coffee and vanilla

This mixed cropping provides shade which protects the vanilla from sunburn, lessens the effect of wind and keeps the humidity high. Mulching for vanilla is done by fallen banana and coffee leaves. Cacao beans is also grown together with other trees to be sheltered from wind.

d) Crop rotation system with annual food crops as main crops

The crop rotation system is suitable for comparatively large fields cultivated by machinery or animal plowing. It supplies the soil with organic matter, maintains the balance of soil nutrients, and prevents damage from continuous cropping. Some examples of crop rotation systems with annual food crops are:

i) maize—sweet potatoes (or Irish potatoes)—beans (or soybeans, field peas, and French beans);

ii) groundnuts—vegetables—maize;

iii) maize—green manure crops—vegetables;

iv) cotton—sorghum (or finger millet, gram, beans, maize, sweet potatoes).

Cassava should be planted at about ten metres intervals and cultivated via crop rotation with annual food crops in between.

e) Intercropping with perennial crops as main crops

For instance passion fruit is cultivated via intercropping with pineapple and banana.

f) Crop rotation with pasture plants

i) Crop rotation with pasture plants for cut grass

Mixed sowing of Elephant grass (Pennisetum purpuretum) [or Guinea grass (Panicum maximum)] and Lablab purpureus—maize—sweet potatoes.

Pasture plants should be cultivated continuously for five to six years.

ii) Crop rotation with pasture plants for grazing

Mixed sowing of graminae pasture plants like Kikuyu grass (Pennisetum clandestinum) and leguminous pasture plants like Glycine (Glycine wightii)—annual food crops.

(Pasture plants used for grazing should be cultivated for about ten years. Growers should plow lands previously used for pasturing and cultivate annual food crops for one to two years, and then sow pasture plants again.)

g) Cropping system with alley cropping

Alley cropping is a contour tillage method on slopes, whereby woody plants or herbaceous plants (green manure crops) are cultivated in rows, usually with annual food crops in between. Leucaena Spp. and Flemigia congesta are two examples of green manure crops planted in rows. Growers should prune the plants, and mulch the branches and leaves back into the soil. This enhances soil fertility and soil conservation. In addition, growers can use green manure crops as firewood.

h) Cultivation of paddy rice

Paddy rice should be grown twice a year in continuous cropping.

3) Farmland improvement and reclamation

Table 6.2.3.2 sets out the agricultural infrastructure required in order to achieve the target levels of crop production in Table 6.2.2.1. In addition to improvements in cultivation techniques and land productivity, an extra 310,000 hectares of land is required. Some 220,000 ha could be obtained by boosting current annual land use levels, 134% to 168%. But this still leaves 85,000 ha of farmland reclamation.

Table 6.2.3.2 Requirement of Farmland Improvement and Reclamation

Unit:ha

Item	Total	Luwero	Masaka	Mpigi	Mukono
	(43,200)				
Farm Improvement area	43,000	7,518	12,157	8,550	14,775
By Farmers	38,700	6,766	10,941	7,695	13,298
By Groups	4,300	751	1,215	855	1,478
	(93,300)				
Land Reclamation	85,000	63,298	1,809	13,564	6,330
By Farmers	76,500	56,968	1,628	12,207	5,697
By Groups	8,500	6,330	181	1,356	633
	(5,900)				
Paddy field development	5,390	551	1,799	2,380	659
By Groups	5,390	551	1,799	2,380	659
	(2,500)				
Irrigation by Groups	2,500	560	961	828	151
In Improved area	1,800	274	947	439	140
In Reclamed area	700	286	14	389	11

Note:( )is based on development area

The first step towards more efficient land use is to improve infrastructure so as to increase labour efficiency. This must be complemented with the development of roads to facilitate transport within rural areas and in turn stimulate export-oriented production.

Land productivity is raised by soil improvement and irrigation works in addition to better cultivation techniques.

The Study Area is particularly short on spare land. There will be little land left for development after 2007. For this purpose, irrigation and paddy field development are included in the Master Plan.

i) Farmland improvement

Work on farm roads and soil improvement will be carried out on one-fourth of the coffee farms and on one-half of the vegetable, pineapple and passion fruit farms within the Study Area. Farmland improvement of about 43,000 ha (planting area) will be uniformly implemented at a rate of 10% per year during the first ten years of the twelve year implementation period with due consideration being given to the construction capacity on the Ugandan side. (Items ii), iii), and iv) will also be uniformly implemented over ten years.)

ii) Farmland reclamation

Some 85,000 hectares of new land is needed as part of the expansion of planting area. Lucrative new crops are needed on the new land to cover the cost of reclamation.

iii) Construction of small irrigation facilities

Small irrigation facilities will be built in groups in vegetable fields around wetland areas with good access to cities, to facilitate planting of cucumber, broccoli, eggplant and other high-grade vegetables. The species of passion fruit developed by KARI are vulnerable to drought and also need irrigation.

iv) Paddy field development

Some 5,900 ha of wetlands will be converted to paddy fields to meet rice demand in the Study Area. Experimental farms will be set up in DFIs as a means of assessing and minimizing the environmental impact of wetland development.

4) Other aspects

(1) Reforming rural transportation

Uganda must be able to provide a steady supply of exports if it is to compete successfully on international markets. This in turn requires better organization of shipping at the rural village level.

As mentioned in section 3.3.2, farmers must be given proper means of transport so that they can negotiate with traders at town markets along with other farmers, instead at their own farms.

This will require the systematic organization of production and shipping to enable a stable supply of goods for purchasers.

The first step is to form farmers' associations in villages, to draw up shipping and collection schedules at designated collection centres together with traders. Animal-driven carts should be phased in to replace bicycles as the main form of transport between farms and villages. The introduction of bulk transportation is one step towards a coherent distribution network. In the long-term, trailers could be used to transport.

(2) New agricultural systems in rural areas

In order to carry out smooth distribution with the capital, it is necessary to establish such facilities as Agricultural Produce Collection Centres, information systems which can provide accurate production data and other information on each agricultural area to purchasing wholesalers and middlemen, as well as associations which can offer guidance on techniques for cultivating different types of crops. Furthermore, it will be necessary to establish farmer associations and community centres as well as related offices to manage the construction of production and processing facilities for various crops.

(3) Restoring the rural finance system

Financial institutions should be set up at collection centres and other appropriate locations. Funding will encourage more efficient farm management. Capital circulating in the markets can gradually be drawn to farming regions and used for new crop expansion loans to farmers.

Such institutions could have a host of other benefits: for instance, repayments could be taken out of sales and the surplus put towards savings.

(4) Extension service on production techniques

Extension services are a prerequisite to boosting productivity and improving the quality of crops. Group training is more preferable than individual training by research institutes and extension organizations. The training is to be given to some 20,000 farm households per year. A single year is not considered sufficient: some two thirds of farmers will require more training the following year, and another one third for a further year after that. Each extension worker is responsible for about 100 new households and 100 carried over from the previous year. Extension activities should be organized according to farm type in order to help extension staff cope with all crops.

The projections of farmers who will have received instruction at each stage are: one sixth by 1998, one third by 2003, and fully half by the target year 2007 (see Appendix 3.3).

(5) Farm input

Below is shown estimates of farm input requirements taking into account training projections. Detailed figures for separate regions are given in Appendix 3.3.2.

Item	Content	Cost & Quantity
i) Expenses	Chemicals	US$ 22 million/year
	Chemicals	29 - do -
	Other	199 - do -
ii) Labour and Machines	Workers for Farming	655,000 persons
	Cows/bulls	250,000 head
	Tractors	1,000 units

Note: Other expenses include wages and depreciation of equipment. Tractors are to be used by newly formed farmer's associations.

6.3 Farm Management Plan

6.3.1 Farm Management Type

The production targets set in 6.2.2 are related to the planed management types shown in Table 6.3.1.1.

As mentioned in 3.3.2, the usual farm management type of small-scale farmers is to grow food for self-consumption, and also grow cash crops such as coffee to earn cash income for necessities. It is necessary to improve the management of standards of living and the self-sufficiency of small farm holdings, which account for 75% of all farm households in Uganda. For this purpose, a management plan has been prepared for increasing the current income of small farms from 458,000 USHS to more than 900,000 USHS, model farms are being developed by farm management type in rural communities and villages, and conduct education and extension activities for farm households in the surrounding area. Table A3.3.2 in the Annex shows a conceptual outline of the management and extension plans for the area by farm management type.

Agricultural productivity is low by world standards and there is considerable scope for improvement. Management plans by farm type thus emphasize (See also 6.2.3 Cultivation plan.) the:

i) adoption of appropriate fertilization and pest control techniques;
ii) use of green manure and organic material;
iii) establishment of proper planting systems to maintain soil fertility; and
iv) introduction of superior varieties.

The main features of each type are as follows.

i) Type 1 is the basic pattern in central Uganda generally called the coffee-banana system. All of Zone I and Zone IIa are suitable for this type.
ii) In type 2, in order to diversify into export products besides coffee, commercial cash crops such as cacao, tea, sugarcane, and vanilla are introduced. Type 2 is suited to the same Zones as Type 1.
iii) In type 3, farmers who currently produce mainly subsistence food crops will move into sericulture and rice production. Suitable districts are the same as type 2.
iv) Type 4 is a combination management pattern in which vegetables (demand for which has been growing in recent years) are the main crop, together with hogs and chickens. This type is suitable for all areas in Zone I.

Table 6.3.1.1 Plan of Farm Management Type

Item		Number of Worker	Size of Farm	Gross Income	Production Cost	Net Income	Number of Farmer
Type 1	Coffee Coffee	3.3 hired 0.3	ha 2.74	000USHS 1,911	000USHS 797	000USHS 1,113	000 86.7
	Vanilla	3.0 1.0	1.30	2,023	397	1,626	59.2
Type 2	Cash Crop Cacao	4.5 1.3	3.00	2,583	1,270	1,313	10.5
Type 3	New Crop Sericulture	4.5 1.5	1.55	2,182	904	1,278	1.0
	Rice	4.5 1.5	1.55	1,874	546	1,328	10.8
Type 4	Vegetable	5.2 1.9	1.38	2,085	662	1,423	21.8
Type 5	Fruit	5.2 1.9	0.99	1,629	355	1,274	17.1
Type 6	Oil Seed	5.2 1.4	3.13	2,051	1,135	916	38.7
Type 7	Cotton	5.2 1.1	2.73	2,007	1,085	922	10.8
Type 8	Livestock Dairy Cattle	4.4 1.2	D.Cattle 0.70	4,397	3,008	1,389	4.0
	Beef Cattle	4.4 1.2	B.Cattle 3.00	2,942	1,470	1,472	6.5
	Beef + Goat	4.4 1.2	B.Catlle 2.80	3,048	1,608	1,440	4.0
	Poultry	3.3 0.3	Poultry 1.13	4,679	3,368	1,311	1.0
	Free Range (Large Lovestock Holder)						5.5
	Subsistent Farmers			865	291	574	242.6
	Total Farmers						520.0

Note : From Appendix 3.3.2, 3.3.3

v) In type 5, fruits are the main product. Although all of the Study Area is suitable for fruit, Zone I is best for passion fruit and pineapples, and Zone II for local fruits such as avocado and oranges. This is a combined management pattern in which livestock is also raised.

vi) Type 6 is for large farms. The main crops are cereals and pulses. Farm mechanization is actively promoted. This is a combined management pattern in which livestock is also raised. All areas have potential for this type.

vii) In type 7 cotton is the main crop. Cotton is given the most attention in the agricultural policy after coffee. Cotton cultivation must be boosted, supported by sophisticated production techniques in line with the development of processing and distribution industries.

viii) Type 8 is a livestock farm management type. This type includes dairy farms and beef cattle farms, and may include medium-sized livestock such as goats and sheep. Since these types of farms are often located in Zone II, far from cities, it is important to establish processing and distribution systems linked to urban markets.

Table 6.3.1.2 shows the standard farm management plan in type 1. Other types of individual plans are shown in Appendix 3.3.2.

It should be noted that average farm size has been used for each type in this Study. Since in reality farms vary greatly in size, there is a need to study different farm management types. The standard data used to facilitate the preparation of the individual plans by each extension worker by scale are also given in Appendix 3.3.2.

Table 6.3.1.2. Plan of Standard Farm Management (Type 1)

Kind of Crops/ Livestocks	Cultivated Area (ha)	Production (ton)	Farm gate Price (USHS/kg)	Gross Income (000USHS)	Production Cost (000USHS)	Net Income (000USHS)	Hired Cost (000USHS)
Coffee	1.16	2.03	232	406	310.7	95.3	6.8
Banana	0.9	7.29	90	729	141	588	14.1
Beans-1	0.15	0.207	28.5	39.3	9.9	29.5	3.4
Beans-2	0.15	0.207	28.5	39.3	9.9	29.5	3.4
Sweet Potato-1	0.015	0.1662	1.32	14.6	1.9	12.8	0.2
Sweet Potato-2	0.015	0.1662	1.32	14.6	1.9	12.8	0.2
Cassava	0.1	1.016	9.2	93.5	7.6	85.9	2
Sugar Cane	0.2	10	4.4	220	123.6	96.4	0.6
Onion-1	0.025	0.22775	3.75	34.2	5.5	28.6	0.8
Onion-2	0.025	0.22775	3.75	34.2	5.5	28.6	0.8
Beef	(1head)	0.25	704	176	100	76	
Poultry	(10head)	0.026	4230	110	80	30	
Total:	2.74			1,910.7	797.5	1,113.4	32.3

6.3.2 Labour Plan

A switch from labour-saving crops (e.g. grains) to labour-intensive crops such as horticultural crops, along with larger planting areas, would boost incomes and utilize human labour more efficiently. This may not suffice, however, since both arable land area and market size are limited. These workers can then be gainfully employed by processing industries in rural villages, to be developed under the Plan (see 6.5.1).

The production targets set in 6.2.2 take into account the need for raw materials for the new processing industries.

Table 6.3.2.1 gives estimated labour balance. Required labour for cultivation was calculated by multiplying the monthly unit labour requirement by planting area. The size of the surplus labour force is obtained by subtracting labour requirements from available supply.

Appendix 3.3.3 gives required farm labour and surplus labour by County. Processing factory numbers and other estimates are given in 6.5.1 Processing.

Table 6.3.2.1 Monthly Farm Labour Balance by District

District Name	Item	Labours (Unit: Man-Days)											
		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Luwero													
	Required Labours	124,390	115,802	118,159	116,144	117,766	119,363	136,927	122,681	102,999	81,926	96,973	123,565
	Estimated Labours	180,060	180,060	180,060	180,060	180,060	180,060	180,060	180,060	180,060	180,060	180,060	180,060
	Balance of Labours	55,670	64,258	61,901	63,916	62,294	60,697	43,133	57,379	77,061	98,134	83,087	56,495
Masaka													
	Required Labours	138,635	136,807	145,683	138,595	135,998	128,120	132,430	133,744	117,673	98,420	116,402	137,768
	Estimated Labours	337,316	337,316	337,316	337,316	337,316	337,316	337,316	337,316	337,316	337,316	337,316	337,316
	Balance of Labours	198,681	200,509	191,633	198,721	201,318	209,196	204,886	203,572	219,643	238,896	220,914	199,548
Mpigi													
	Required Labours	130,858	112,678	120,713	115,348	118,936	123,058	129,020	118,513	106,644	78,740	92,129	121,299
	Estimated Labours	318,750	318,750	318,750	318,750	318,750	318,750	318,750	318,750	318,750	318,750	318,750	318,750
	Balance of Labours	187,892	206,072	198,037	203,402	199,814	195,692	189,730	200,237	212,106	240,010	226,621	197,451
Mukono													
	Required Labours	134,656	120,955	128,346	115,857	122,092	114,294	157,958	125,254	101,080	80,196	108,139	128,989
	Estimated Labours	325,941	325,941	325,941	325,941	325,941	325,941	325,941	325,941	325,941	325,941	325,941	325,941
	Balance of Labours	191,285	204,986	197,595	210,084	203,849	211,647	167,983	200,687	224,861	245,745	217,802	196,952
Total													
	Required Labours	528,539	486,242	512,901	485,944	494,792	484,835	556,335	500,192	428,396	339,282	413,643	511,621
	Estimated Labours	1,162,067	1,162,067	1,162,067	1,162,067	1,162,067	1,162,067	1,162,067	1,162,067	1,162,067	1,162,067	1,162,067	1,162,067
	Balance of Labours	633,528	675,825	649,166	676,123	667,275	677,232	605,732	661,875	733,671	822,785	748,424	650,446

6.4 Livestock Plan

6.4.1 Livestock Production

1) Livestock production targets

Livestock production must be boosted significantly because of the high population growth rate and current low levels of animal protein consumption. The population within the Study Area is expected to grow at 3.1% per annum. Taking this into consideration, livestock products must grow at a higher rate. The plan sets the annual average growth at 4.7%, based on the target figure in the FAO Yearbook for 1991. The livestock production growth index was set at 2.1 for the target year (2001) against the base year (1991).

The production and consumption balance of livestock production within the Study Area differs according to produce type. There are surpluses of beef, pork, and milk, and it is believed that these are shipped to Kampala. On the other hand, there are also shortages of goat meat, mutton, chicken, and eggs, and it is believed that the per capita consumption of these is lower than the national average.

Consequently, production volume targets are high for goat meat, mutton, and chicken (currently in short supply) and low for pork (in surplus), thus, balancing the production volume for all meats, as well as establishing beef and milk production volumes that maintain current supply levels for Kampala's consumption needs (see Table 6.4.1.1).

According to the Table, the annual per capita livestock product consumption volume will be 11.3 kg for meats as a whole, a 17% increase over the current level, 28.9 kg for milk (29%) increase, and 1.0 kg for eggs (29%).

2) Achieving production targets

The production targets for livestock products will be achieved by: (1) increasing the number of head of livestock, (2) improving the productivity of livestock units, and (3) reducing the livestock mortality rate. In particular, for cattle, the targets will be realized by using the plans and strategies indicated in Table 6.4.1.2.

In addition, the production targets of these livestock products in the Study Area have been established by livestock product type for each county, taking into consideration: (1) current production volumes, (2) available pasture resources, and (3) the distances from the regions of consumption.

Table 6.4.1.1 Livestock Production Plan

Item	Beef		Goat and Sheep Meat		Pork		Chicken Meat		Total (Meat)		Milk		Eggs	
	Qua'ty	Ratio	Qua'ty	Ratio	Qua'ty	Ratio	Qua'ty	Ratio	Qua'ty	Ratio	Qua'ty	Ratio	Qua'ty	Ratio
Study Area														
Demand(ton)	25,750	2.1	8,142	2.1	12,382	2.1	9,473	2.1	55,747	2.1	142,415	2.1	4,982	2.1
Production(ton)	31,740	2.0	8,231	4.2	12,426	1.5	9,478	3.5	61,875	2.1	157,327	2.1	4,953	3.5
Balance(ton)	5,990		89		44		5		6,128	2.7	14,911	1.7	-29	
Consumption per Capita(Kg)	5.22	1.05	1.65	1.29	2.51	1.00	1.92	1.29	11.30	1.17	28.87	1.29	1.01	1.29
(Reference) Kampala														
Demand(ton)	9,919	2.1	2,183	2.1	1,107	2.1	2,005	2.1	15,214	2.1	73,482	2.1	1,796	2.1
Consumption per Capita(Kg)	7.86	1.29	2.82	1.29	1.43	1.29	2.59	1.29	14.70	1.29	58.23	1.29	2.32	1.29

Note : Ratio is planned production / present production

Table 6.4.1.2 Plan and Strategy for Livestock Production Increase(Cattle)

Item	Dairy Cattle		Beef Cattle	
	Plan	Strategy	Plan	Strategy
1. Increase Cattle Number	· from 12,000 to 37,000 head	· Increase grazing area · Improve grassland	· from 655,000 to 1,052,000 head (new ranch: 258,000 head) (others : 794,000 head)	· Increase grazing area · Improve grassland
2. Improve Cattle Productivity	· Increase number of Inproved	· Purchase high-yielding cattle · Crossbreed especially by artificial insemination	· Reduce first calving age from 39 to 30 months · Reduce shipment age from 36 to 30 months	· Purchase fast growing breed (Esp. Boran) · Improve breeding and management
3. Reduce Mortality and Maintain Productivity	· Keep livestock healthy	· Strengthen veterinary service	· Reduce calf motality rate from 15%to 6%(0~2 months) from 6%to 3%(3~4 months)	· Strengthen veterinary service · Provide water and tick controll facilities

6.4.2 Livestock Husbandry

1) Livestock numbers

The numbers of livestock necessary in order to achieve production targets for the entire Study Area are: cattle, 1,092,000; goats and sheep, 1,655,000; pigs, 300,000; and chickens, 6,192,000.

These are allocated by county (Appendix 3.4) and summarized by district in Table 6.4.2.1. Regarding cattle, an improved breed of dairy cows will be increased by 10% a year in all districts, and by the target year, will increase to 3.1 times the current number. Beef cattle numbers will be increased mainly in Luwero District, which has surplus pasture resources, by 1.6 times overall.

Goats and sheep will increase by 3.7 times with differences, between counties depending on available grasslands. Pigs and chickens, since they can be raised mainly on the residue of farm produce, will rise 1.5 and 3.5 times respectively, uniformly for all districts, in accordance with production plans.

Table 6.4.2.1 Heads of Livestock and Increase Ratio

		Luwero	Masaka	Mpigi	Mukono	Total
Dairy	Head	5,348	2,827	9,815	18,560	36,550
Cattle	Ratio	3.1	3.1	3.1	3.1	3.1
Beef	Head	535,153	263,456	129,085	128,022	1,055,716
Cattle	Ratio	2.3	1.1	1.2	1.7	1.6
Goat and	Head	347,060	750,480	216,380	338,640	1,652,560
Sheep	Ratio	7.4	5.9	3.1	1.7	3.7
Pigs	Head	56,550	61,274	66,300	115,650	299,774
	Ratio	1.5	1.5	1.5	1.5	1.5
Chickens	Head	1,209,950	1,362,200	2,352,700	1,267,350	6,192,200
	Ratio	3.5	3.5	3.5	3.5	3.5

Note: Ratio is to the present head of livestock

2) Livestock productivity improvement

Regarding beef cattle, goats, and sheep, their productivity per head will be improved by reducing the age at first calving and age of shipment, along with lowering the mortality rate, by improving nutrition, breeds, and livestock hygiene. The livestock product improvement plan and its comparison with the current situation are indicated in Table 6.4.2.2.

However, in the case of dairy cattle, it is assumed that all are of improved breed (Fresian). For this reason, the present high productivity rate has left no further improvement to be

achieved. Therefore, the effort must be put to realize the present rate be applied entirely to the increased dairy cows.

Regarding pigs and chickens, as is currently so, productivity will follow the existing agricultural situation, since increases in the numbers of these animals are being planned based on small-scale farmers who mainly engage in agriculture.

3) Feed supply

The production of grass differs greatly between the wet and dry seasons. During the dry season, it drops to below half of the wet season. Consequently, during the dry season, cattle and goats put out to graze travel longer distances seeking grass, and as a result they become exhausted which this in turn hinders livestock growth.

Table 6.4.2.3 summarizes the volumes of nutrition consumed during the wet and dry seasons by adult beef cattle (weighing 360 kg).

This kind of cow requires approximately 400g of DCP (Digestible Crude Protein) per day. This required nutrient volume is equivalent to 36 kg of grass (wet season green grass), and this is satisfied in wet season. However, since the grass production volume drops greatly during the dry season, even assuming the volume of green grass consumed is half that of the wet season, this would only amount to a half of the required volume of DCP.

The dry season nutrition deficiency is causing the delayed development of calves and kids. For example, for beef cattle, the age at first calving is 39 months and the bullock age of shipment 36 months.

This dry season nutritional deficiency will be resolved by converting 10% of current natural grass land to established grass land for making hay. The hay will be used as supplementary feed during the dry season.

Table 6.4.2.2 Livestock Product Improvement Plan.

Item	Beef Cattle		Dairy Cattle	
	Present	Plan	Present	Plan
1.Propagation				
Adult Liveweight (Bull)	423kg	423kg	1,000kg	1,000kg
〃 (Cow)	360kg	360kg	510kg	510kg
Age at First Service (months)	23-34	20	20	16
Weight at First Service	280kg	265kg	370kg	332kg
Calving Rates	75%	85%	75%	85%
Calving Interval (months)	13	13	12.6	12
Age at First Calving (months)	33-45	30	30	24
Age at First Calving Liveweight	336kg	336kg	468kg	445kg
Milk yield /Lactation	1,100kg	1,100kg	4,050kg	4,050kg
Milk Fat Percentage	5.4%	5.4%	3.4%	3.4%
Milking Period (day)	200	200	300	300
Bull Calf Birth Weight (kg)	30kg	30kg	40kg	40kg
Cow Calf Birth Weight (kg)	30kg	30kg	40kg	40kg
Age at Weaning (months)	7.5	6	5	5
Weight at Weaning (kg)	115kg	124kg	140kg	140kg
Economic Lactations Year (year)	6	6	8	8
Cow Replacement Ratio	16.9%	19.1%	12.2%	13.7%
Mating Way	Free Breeding on Pasture	AI and Free Breeding on Pasture	Artificial Insemination	Artificial Insemination
Mortality rates (0～2 months)	15%	6%	3.8%	3%
〃 (3～4 months)	6%	3%	2.5%	2%
Other Cattle Mortality Rates (1 month)	0.4%	0.2%	0.2%	0.1%
2.Bullock Cattle				
Shipment Bullock (months)	36	30	18	18
Shipment Bullock Weight	280kg	280kg	360kg	360kg
Killing percentage (meat weight ratio%)	48%	48%	50%	50%
Culled Cow weight	360kg	360kg	510kg	510kg
Killing Percentage (meat weight ratio%)	50%	50%	50%	50%

Source : MAAIF

Table 6.4.2.3 Feeding Improvement Plan (Beef Cow)

Item		Unit (kg/day)	Water (g)	DM (g)	DCP (g)	TDN (g)	Remarks
Beef Cow: Weight 360 kg Nutrient Requirement (per day)				7,500	396	3,953	
Composition and Nutritive value							
Wet Season	Grass (1 kg)		792	208	16	110	
Dry Season	Grass (1 kg)		692	308	8	142	
	Hay(1 kg)		200	800	66	459	
Feeding							
Present	Wet Season						
	Feeding Grass	36		7,488	576	3,960	Feeding Grass/year
	Nutritive Balance			-12	180	7	10,829 kg
	Dry Season						Wet(36 kg x 164 days)
	Feeding Grass	24.5		7,546	196	3,479	5,904 kg
	Nutritive Balance			46	-200	-474	Dry(24.5 kg x 201
	Sufficient Ratio (%)			101	49	88	days)
							4,925 kg
Plan	Wet Season						Feeding Grass/Year
	Feeding Grass	36		7,488	576	3,960	9,723 kg
	Nutritive Balance			-12	180	7	Wet(36 kg x 164 days)
	Dry Season						5,904 kg
	Feeding Grass	19		5,852	152	2,698	Dry(19 kg x 201 days)
	Feeding Hay	2.5		2,000	165	1,148	3,819 kg
	Formula Feed	0.38		342	81	250	Hay/year
	Total			8,194	398	4,096	Dry(2.5 kg x 201
	Nutritive Balance			694	2	143	days)
							503 kg
							Formula Feed/day
							Dry(0.38 kg x 201
							days)
							76 kg

Note: DM: Dry Matter, DCP: Digestible Crude Protein, and TDN: Total Digestible Nutrient

6.4.3 Livestock Breeding and Sanitation

1) Livestock breeding

Further, with regards to cattle, the Artificial Insemination Centre (ABC) and Artificial Insemination Sub-centres in livestock areas will be upgraded and/or newly built, and artificial insemination will be expanded using the semen produced at the Artificial Insemination Centre. Moreover, valley dams will be constructed in suitable locations in savanna areas in order to ensure water for livestock.

2) Livestock sanitation

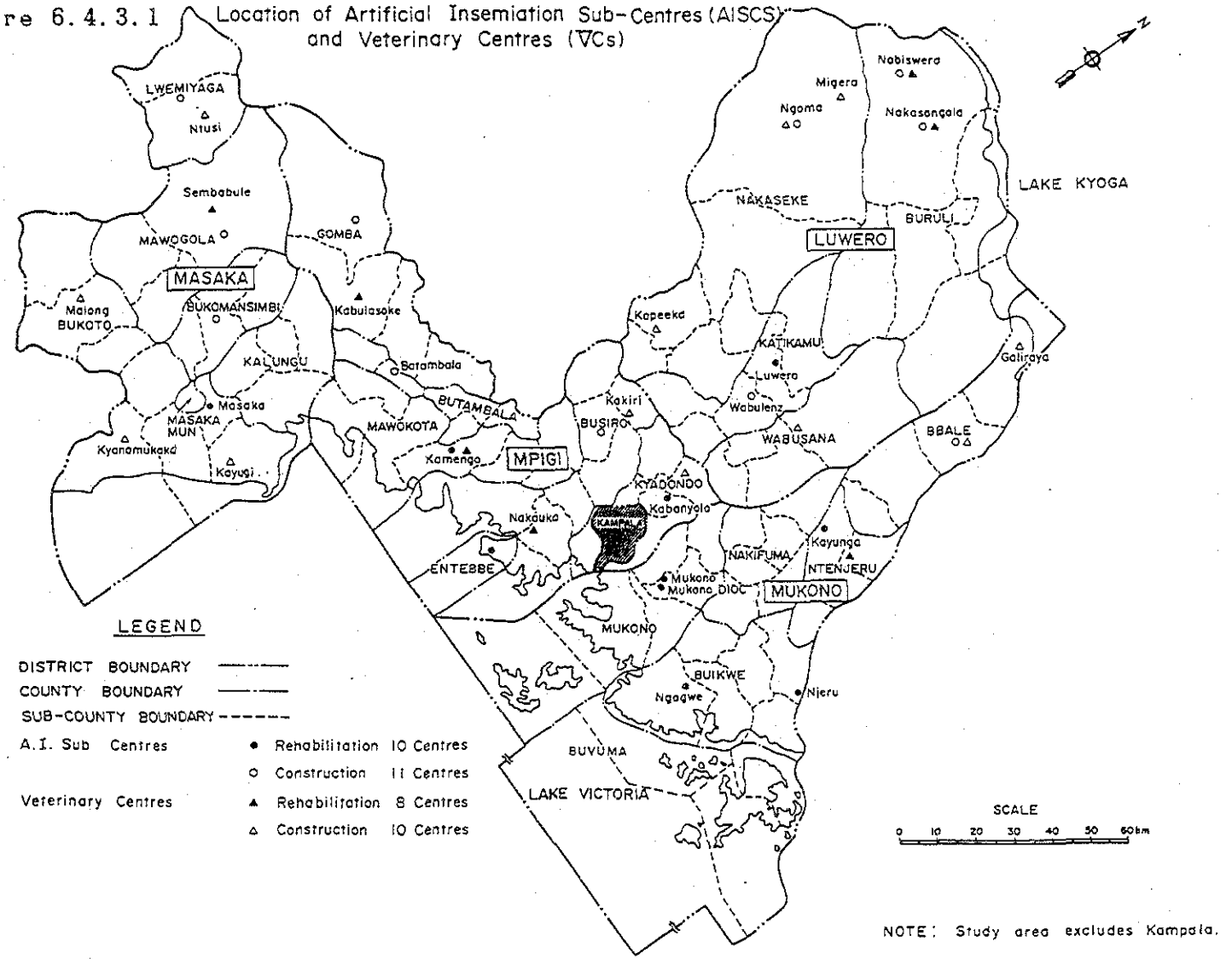
The mortality rate of animal offspring will be reduced by upgrading and/or building veterinary centres (VC) and establishing a system to improve inoculation against diseases and detect infectious diseases early and treat them properly.

At present, the only domestically produced vaccine for inoculation against diseases is the vaccine for New Castle Disease in chickens. Since Uganda is dependent on imports for all other vaccines, a vaccine production laboratory will be constructed in order to domestically produce vaccines whose necessity is high, such as those for Pleuropneumonia and Brucellosis in cows.

Figure 6.4.3.1 shows the location of the existing AISC and VC to be improved and new construction sites.

In addition, dips with Valley Dam will be established in the appropriate sites in order to protect grazing livestock from diseases borne by ticks.

Figure 6.4.3.1 Location of Artificial Insemiation Sub-Centres (AISCS) and Veterinary Centres (VCs)



NOTE: Study area excludes Kampala.

6.4.4. New Ranch Plan (NRP)

As mentioned in Table 8.1.1.2, by the year 2007 (target year), the number of farmers is estimated to be 520,000. Of which 10,480 will be engaged in livestock operations to improve animal nutrition and maintain the balanced regional development, for instance through efficient land use in Savannah areas (public land) as provided under land transfer procedures. Of the 10,480 farmers 6,480 will be engaged in beef cattle only while 4,000 will concentrate on mixed farming operations, incorporating beef cattle and goat husbandry (see Table 5.1.4).

The NRP has five main tenets:

1) Acquisition of land

Land will be obtained via the land tenure system and also from vast publicly-owned land reserves, via IDC (Integrated Development Centre) on the land transfer procedures. Under this system, public land is loaned to applicants who pass a screening test. Individual recipients who fail to develop their land within five years may have it confiscated and relent to other applicants. Land could be obtained in this way especially for the NRP and similar projects. Interviews with sub-county chiefs established that public land (available for grazing) accounts for 691,445 ha, of which 529,570 ha is dry land and 161,875 ha wetland (see Appendix 1.3).

2) Size of transfer farms (see Table 6.4.4.1, Figure 6.4.4.1 and Figure 6.4.4.2)

Beef cattle only will be about 25 ha and mixed farming about 20 ha. About 12% of the area will be artificially converted to established pasture. A group of eight farmers will use this area for grazing up to 222 beef cattle (beef cattle only) and 154 beef cattle 269 goats (mixed farming). Approximately about 2.5 ha per farmer will be set aside as a food production area for self-sufficiency, including residential area. Each group will also have a common use area with a reservoir and group facilities.

3) Preparatory work

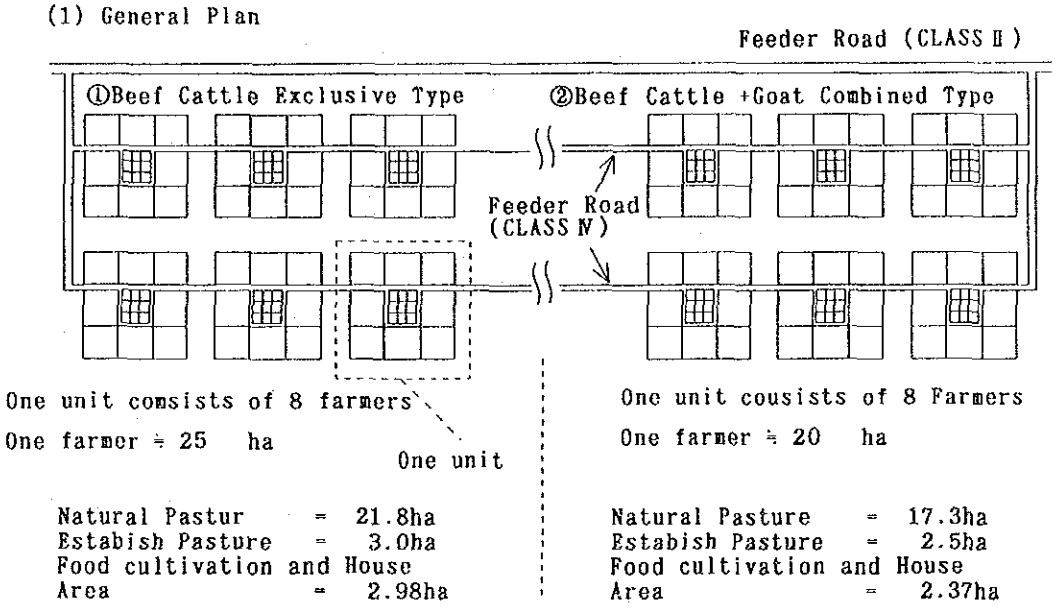
Besides improved grass land, fence around pasture and water supply will be provided for use of livestock husbandry. Agricultural machinery (e.g. for grass production) will be available for collective use. Feeder roads and social infrastructure will be provided to a minimum (see Figure 6.4.4.1 and Figure 6.4.4.2).

Table 6.4.4.1 Contents of One Group at NRP

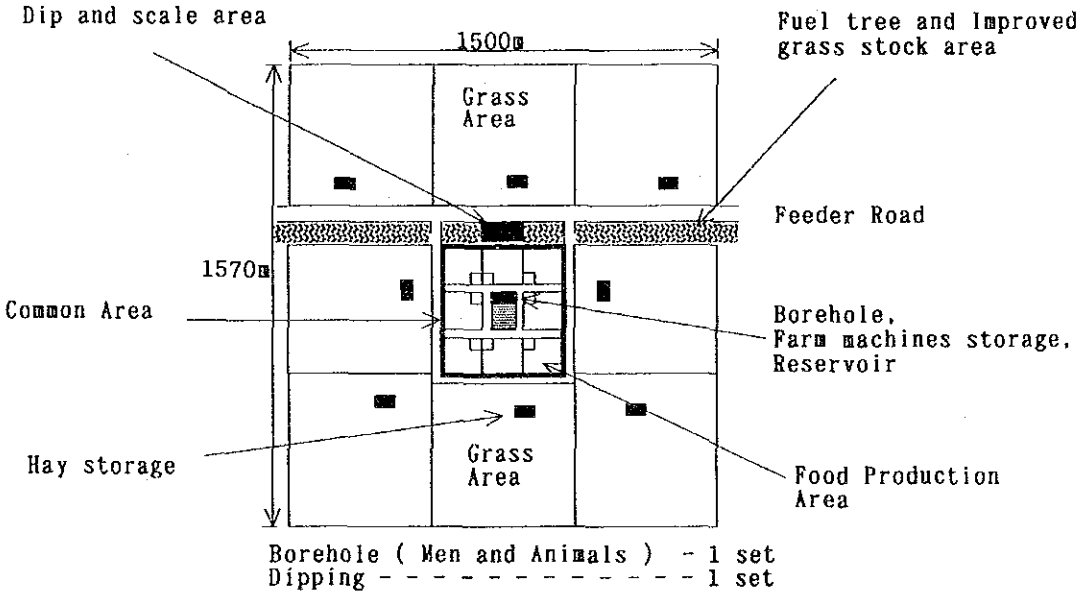
Item	Unit	Beef Cattle only	Beef Cattle + Goat (Mixed Farming)
1. Group by Farmers	Nos.	8	8
2. Area			
Total Area	ha.	235.5	186.7
Natural Pasture	ha.	174.6	138.6
Established Pasture	ha.	24.0	20.0
Improve Grass Stock	ha.	1.5	1.2
Fuel Tree (Legume Tree)	ha.	8.1	4.8
House Area (for food Supply)	ha.	23.9	19.0
Common Area, etc.	ha.	3.4	3.1
3. Animal			
Beef Cattle (Cow)	Nos.	80.0	56.0
Beef Cattle (Cow Calf, Bull Calf)	Nos.	110.4	76.0
Beef (Kid)	Nos.	31.2	21.6
Goat (Female and Buck)	Nos.	-	134.4
Goat (Buckling, Goatling)	Nos.	-	108.8
Goat (Kid)	Nos.	-	25.6
4. Infrastructure			
Fence (3 Wires)	km.	6.0	-
Fence (4 Wires)	km.	-	5.4
Dipping and Scale Facility	Pls.	1	1
Hay Storage	Pls.	8	8
Feeding Pen	Pls.	8	8
Reservoir	Pls.	1	1
Feeder Road (iv)	km.	1.8	1.8
Electricity (433V, 240V)	km.	8	8
House	No.	8	8
Primary School	ScS.	0.07	0.07
Secondary School	ScS.	0.03	0.03
5. Machinery			
Tractor (80 HP)	SeS.	0.35	0.35
Disk Plow (3 Disks)	SeS.	0.05	0.05
Disc Harrow	SeS.	0.05	0.05
Packer	SeS.	0.05	0.05
Rotary Mower	SeS.	0.05	0.05
Tedder	SeS.	0.05	0.05
Rake	SeS.	0.05	0.05
Trailer	SeS.	0.05	0.05
Truck (2,000 kg)	SeS.	0.05	0.05
6. Livestock Association (20 groups/LA)	Grs.	0.05	0.05
7. Income and Cost per Farmer			
Income	1,000 USHS	2,942	3,048
Cost	1,000 USHS	1,472	1,610
Balance	1,000 USHS	1,470	1,438

Figure 6.4.4.1 New Ranch Plan (NRP)

(1) General Plan



(2) One unit (Beef Cattle Exclusive Type)



4) Establishment of Livestock Association (LA)

Livestock association consisting of twenty groups (160 farmers) will be set up to administer and maintain new agricultural machinery. Maintenance and upkeep of all facilities will also be carried out by LA, under the supervision of IDC.

5) Screening of farmers for NRP

At least one reliable and conscientious farmer will be selected to form the nucleus of each group. Farmers will be screened according to four criteria:

i) In order of Sub-county, Sub-district, District, Districts other than the four in the Study Area.

ii) Preferably married with at least two (one male and one female) working members per household.

iii) Owns at least 1.5 mn USHS of transportable assets or ten head of beef cattle only (for mixed farming, 5 beef cattle and 20 goats).

iv) Belongs to livestock association (LA), is working through the IDC and IDC is keen to be involved in management.

Farmers who wish to be considered as candidates for NRP must apply through their Sub-county. Districts should apply to the IDC which will determine eligibility together with the MAAIF.

Figure 6.4.4.2 Area used in Cooperation of NRP