1. Introduction

1.1 Background of the Study

The agricultural sector in the Republic of Kenya accounted for about 25 percent of GDP in 1996 and 70 percent of working population. Some 85 percent of the population lives in the rural areas, producing agricultural products. Production for export, particularly cut flowers and vegetables, has grown rapidly in recent years, and occupies 12 percent of the country's total exports. The amount of export of horticultural crops has increased in the last ten years, and has become the third highest export commodity following traditional exports of tea and coffee. Small-scale farmers account for 98 percent of farmers.

Smallholder farmers in the Study Area grow horticultural crops both for exporting and domestic consummations. Representative exporting vegetables in value are; French beans, okra, tomato, etc., and on the other hand, vegetables for domestic consummations are; carrots, Irish potatoes, cabbage, kale, banana, etc. These horticultural products have a tendency to fluctuate in prices, but they are promising to earn relatively high profit. However, predominant crops in the Area are maize, beans and other food crops.

The foothills of Mt. Kenya, the Study Area, are blessed with water sources for irrigation with an annual average precipitation ranging from about 800mm to 1,400mm. It is one of the areas suitable for smallholder irrigation in Kenya, which has more than 80 percent of its national land classified as arid or semi-arid zones. Since the area is located about 150 km from Nairobi, the capital of Kenya, it is also blessed with good marketing condition.

The Government of Kenya has been introducing large-scale irrigation systems in public land, and smallholder irrigation systems to smallholder farmers. Initial costs of smallholder irrigation are low, and maintenance costs are also relatively low, and it could be managed by appropriately organized farmers' groups. Therefore, horticultural development, which has high potential in the Area, can be promoted through the following;

i) Introduction of scale-scale irrigation systems,
ii) Improvement of management of sustainable horticultural farming,
iii) Organization of small farmer's group,
iv) Construction of rural infrastructure such as farm roads and marketing facilities and their operation and maintenance,
v) Improvement of agricultural extension and credit services, and
vi) Improvement of access to information on marketing and various information.

In view of such circumstances, the Government of the Republic of Kenya requested "the Study on Community-Based Smallholder Irrigation Development Project for Promotion of Horticultural Production in the Foothills of Mt. Kenya" from the Government of Japan in June, 1996.

1.2 Objectives and Scope of the Study

1.2.1 Objectives of the Study

The objectives of the Study are as follows;

- To formulated a Master Plan for promoting horticultural development. The Master Plan is formulated based on farmers' participation and introduction of smallholder irrigation systems, and composed of construction of rural infrastructure, their operation and maintenance, improvement of agricultural extension and credit services and establishment of organization for operation and maintenance.

- To select the priority area that concentrates on smallholder irrigation through the Master Plan Study. Then establish it as a Model Area in order to devise a development plan.

- To transfer technology and knowledge on various aspects of the Study to counterpart personnel in the Government of Kenya through the survey work and training in Japan.

1.2.2 Scope of the Study

The Study was carried out in the following three phases;

Phase-I Study (Formulation of Basic Development Plan)

Preparation work	: Preparation of Inception Report
Phase-I fieldwork	: Delineation of Basic Irrigated Horticultural Development Plan (Master Plan)
Phase-I home office work	: Formulation of Master Plan
	: Delineation of preliminary PDM
	: Preparation of Interim Report

Phase-II Study (Explanation of Interim Report to GOK)

Phase-II fieldwork	: Explanation of Interim Report to GOK
	: Selection of Model Area
	: Review and discussion of delineated PDM

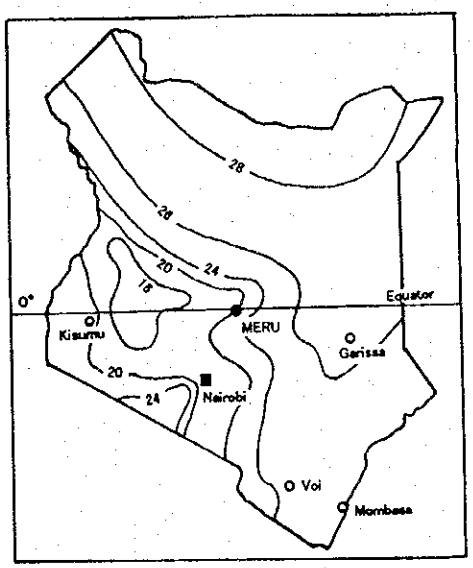
Phase-III Study (Formulation of Irrigated Horticultural Development Plan)

Phase-III fieldwork	: Delineation of Irrigated Horticultural Development Plan for Model Areas,
	: Holding of workshop seminars
Phase-III home office work	: Formulation of Irrigated Horticultural Development Plan for the Model Areas.
Explanation of Draft Final Report	: Explanation and discussion of the Draft Final Report
Submission of the Final Report	: Submission of the Final Report

2. Socio and Agro-Economic Conditions in Kenya

2.1 Climatic Conditions

Average Annual Temperature



The map shows an isotherm of the country. Depending on the location and elevation, annual temperature varies considerably. Kenya is situated on the equatorial east coast of Africa. The arid north and east of Kenya receives less than 500 mm of rain per year. This, together with its unreliability makes the growing of crops difficult. In the Highland and Plateau regions there is usually enough rain together with cool temperatures and fertile soils for farmers to grow a variety of crops. Meru, which is one of the district in the study Area, is located near the equator and isotherm of annual average temperature is 20℃.

2.2 Socio-Economy of Kenya

a) Land Area

Kenya's total land area is 582,646 sq.km. Out of this, only 9.2 million hectares are classified as of high and medium potential area for agriculture. However, two-fifths of this area is uncultivated because of soil and land form constraints. Only 3.8 million hectares are under cultivation, which is equivalent to only 6.6 percent of the total area of the country. Arid and semi-arid land constitutes four-fifths of the total land area of Kenya, in which nomadic pastoralism has been predominant.

b) Population

From 1969 to 1989, Kenya's population almost doubled. The total 1994 population of 26,423,560 is divided into 49.3 percent for male and 50.7 percent for female, with 15.6 percent urban and 84.4 percent rural. Population density is 37 persons/sq.km. Pressure of population on land has been increasing because of the limited cultivable area and the high annual increase in population of 3.42 percent.

The population of urban areas has grown with a 6.5 percent annual migration rate from rural to urban areas.

c) Gross Domestic Product

The first decade after independence from Britain in 1963, Kenya showed high economic growth at 6.5 to 6.8 percent per year. However, economic growth slowed because of a rise in oil prices, recession in the world economy and domestic drought in 1976, 1977, 1980 and 1984 and so on. Since 1988, structural reform has been implemented based on the agreement between the Kenya government and IMF and IDA. In 1993, the government reached a new agreement with the IMF and IDA on a program of action which resulted in an improvement in the macro-economy, and GDP grew at three percent in 1994. Since 1995, the Kenya economy recorded a positive growth in GDP of 4.8 percent in 1995 and 4.6 percent in 1996 pointing towards a recovery. Per capita GDP in 1996 was estimated at 309 US$.

d) Balance of Trade

Kenya's annual balance of trade shows a deficit every year which has been increasing. Exports have grown, however the amount of imports has also grown at a higher rate than exports, resulting in a trade deficit. The major imported commodities are industrial machinery, iron and steel, accounting for 36 percent of total imports. Tea and coffee accounted for 34 percent of the total exports in 1994.

e) Poverty Indices

Some 39 percent of the population and 31.3 percent of households live on the poverty line in Kenya. The poverty line is basically calculated in terms of money to purchase food necessary to meet caloric intake (2,250 calories) per day per adult plus minimum allowance for non-food consumption. Thus, the poverty line in the rural area is estimated at 703 Ksh per month per capita, equivalent to 8,440 Ksh per year, and 875 Ksh per capita per month in urban areas, equivalent to 10,500 Ksh per year .

Macro Economic Indicators

	1992	1993	1994	1995	1996
1. GDP at Current Prices(million K£)	13,224	16,681	20,036	22,785	25,896
2. GDP at Constant Prices(million K£)	4,332	4,343	4,474	4,692	4,907
3. Annual Growth of GDP(%)	0.5	0.2	3.0	4.8	4.6
4. GDP per Capita(K£)	452	546	632	698	773
5. Contribution of Agricultural Sector to GDP(%)	26.2	25.1	25.0	25.0	25.0
5.1 Growth Rate of Agricultural Sector(%)	-3.7	-4.1	2.8	4.8	-0.1
6. Gross NationalProduct at Current Prices(million K£)	10,434	12,182	14,798	18,589	22,216
7. Trade Balance(million K£)					
7.1 Exports	1,742	3,678	4,282	4,866	5,910
7.2 Imports	2,955	5,056	5,754	7,758	8,424
7.3 Balance	-1,213	-1,378	-1,472	-2,892	-2,514
8. Exports of Fresh Horticultural Products					
8.1 Volume(1,000 ton)	62.3	62.4	65.2	71.1	84.8
8.2 Value(million K£)	125.8	233.6	246.8	320.0	385.0
8.3 Major Exporting Destination Countries of the Horticultural crops	UK, France, Germany, Netherlands, Belgium, Italy, Others				
9. Major Exporting Commodities	Tea, Coffee, Horticultural crops, Petroleum Products				
10. Major Importing Commodoties	Machinery and Transport Equipment, Minerals & Fuels, Chemicals, Food and Animals				
11. Exchange Rate of US$	32.2	58.0	56.1	51.4	58.0
12. Balance of Payment(million K£)	-157	288	291	-1,031	-211

Source. Economic Survey 1996
Statistical Abstract 1995
Kenya Factbook 1997/98

f) Agriculture Contribution to The National Economy

The agricultural sector in Kenya is still the major engine for the growth of the economy and will remain so in the future. Importance of this sector can be shown by indicators such as; a) a contribution of 25 percent to GDP in 1996, b) earnings of over 60 percent of foreign currency, c) provision of employment opportunities to over 70 percent of the total population, and d) provision of raw materials for agri-based industries which account for about 70 percent of all industries. Because of its large contribution to the economy, when the agricultural sector suffers from severe drought, national economy is deeply affected.

The rural population in Kenya contributes 85.1 percent of the total population and those people is working for agricultural sector directly or indirectly. Actually about 70 percent of the total population is employed in the agricultural sector. For wage employment, there are 1.5 million employees in the whole industry, of which 280 thousand are employed in the agricultural sector, equivalent to 18.7 percent of total employees in 1994. Some 120 thousand are working in coffee and tea plantations.

g) Landholding of Smallholder Farmers

Out of an estimated 2,756,438 farm households in Kenya, 98 percent or 2,700,000 farm less than 12 ha and are thus defined as smallholders. These smaller farms are concentrated in the higher rainfall areas of Central and Eastern Province, around Mount Kenya and in the Central Rift valley. Together this farm sector produces more than 70 percent of the agricultural GDP, i.e. more than 114 billion Ksh worth of output annually. The majority of the farmland in Kenya is operated as smallholdings and at least 40 percent of these units are managed by women.

In the agricultural sector, the importance of small farmers must be noted because of their contribution to the economy despite being smallholder farms. There are about 2.7 million small farmers, of which 80 percent are estimated to have less than two hectares. Despite the small farm size, small farmers produce over 75 percent of total agricultural production, 70 percent of maize, 65 percent of coffee, 50 percent of tea, 80 percent of milk and 70 percent of beef and other meat, and all pyrethrum, cotton, and other food crops.

h) Agro-Trade Statistics

Tea and coffee earn a large amount of foreign exchange, accounting for 34 percent of the total exports in 1996, while horticultural exports show an increasing trend in recent year, increasing from 184.8 million K£ in 1991 to 681 million K£ in 1996. Kenya exports tropical vegetables, fruits and flower to the European countries, accounting for 12 percent of total exports in 1996. However, annual earnings are affected considerably by foreign exchange rates. Horticultural produce from Kenya is destined mainly to the United Kingdom, Germany, France, Netherlands and Italy but this varies from product to product. There are about 200 exporters in the country, dealing with horticultural products but the top 10 exporters share almost 90 percent of the total. The major exporting horticultural products are French beans, okra, snowpeas, karella (bitter gourd), fruits such as avocado, and cutflowers.

3. Administrative Organization

3.1 Current Conditions

The governance of the Study Area is based on Kenya's administrative framework where by the country is divided into eight provinces. Under each province, districts are in turn subdivided into divisions, locations and ultimately sub-locations. For the Study Area, these administrative arrangements and main urban centers are shown below;

Province	Districts
Central	Nyeri
	Kirinyaga
Eastern	Embu
	Mbeere
	Tharaka Nithi
	Meru
	Nyambene

For the communities in the Study Areas, the district is the most important administrative unit because it is from here that the government authority as well as support services are managed. The district commissioner, who is responsible for coordinating government development programs, is the chairman of the District Development Committee (DDC). The latter body screens and endorses major development projects whether initiated by the government, NGOs or the private sector.

3.2 Problems and Constraints

Key decision-makers (District Commissioners and District Officers) are normally based at urban centers away from rural communities. While the DDC gives some opportunity for the rural communities to be heard, in practice this opportunity is not realized because the lower planning committees (Divisional and locational) do not convene regularly. Other problems and constraints relating to the administration set-up may be summarized as follows;

- Apart from the occasional field "baraza", farmers lack well defined channels through which they can regularly communicate their priorities to administrative decision makers,
- Rural communities normally encounter considerable bureaucracy when they attempt to have an audience with administrative heads at divisional and district levels,
- Owing to its historical origin, the existing administrative structure places more emphasis on status than on the quality of services to rural communities. This is so because the administrative structure was designed during the British Colonial occupation period (1898-1963) when administrative officers (PC, DCs, DOs, and Chief) were the symbols of British power and status in Kenya. The Administrators' main objective was to maintain law and order in the country and not to improve the quality of life of rural communities. Although somewhat modified, the current administrative structure is still primarily concerned with law and order issues.

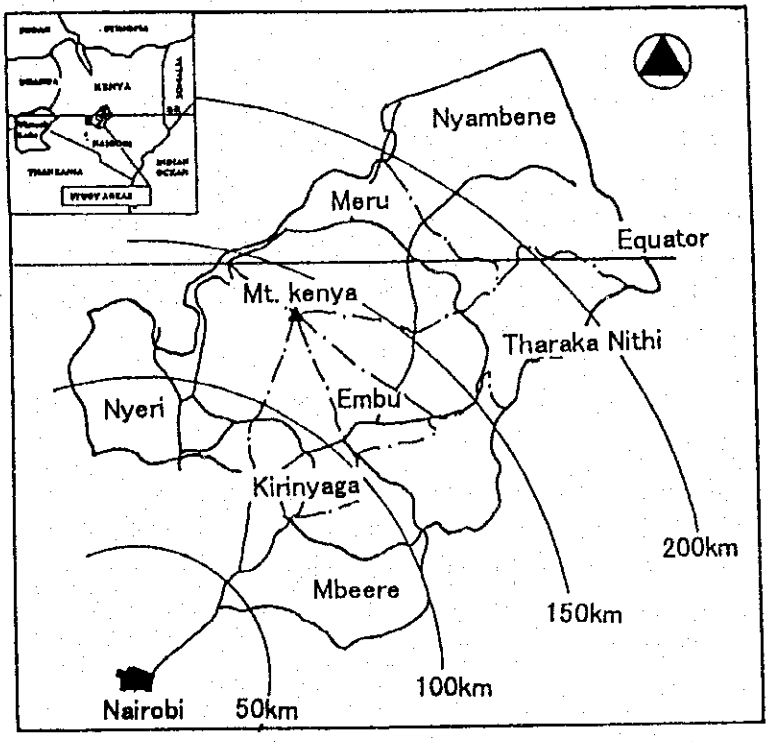
3.3 Countermeasures to be Taken

Problems/Constraints	Required Intervention	Agency Concerned	Output
- Limited opportunity for rural community's priorities to be heard	- Re-activate local level development committees	- Office of the President	- Development strategies that reflect rural community's preferences
- Undue emphasis on bureaucracy and status in existing administrative framework	- Retrain departmental officers to change attitude and place more emphasis on provision of services	- Office of the President and all Ministries	- Administrative methods and procedures that are service-oriented

4. Socio and Agro –Economic Conditions in the Study Area

4.1 Location and Topography

Figure 4.1-1 Location Map of the Study Area



The Study Area is composed of seven districts around Mt. Kenya, which is located about 150 km northeast of Nairobi, the capital of Kenya. Of these seven districts, Kirinyaga and Nyeri belong to Central province , and the rest, Embu, Meru, Tharaka Nithi, Nyambene and Mbeere belong to Eastern province. The total area of seven districts is about 17,360 sq. km. It is bounded by latitude 0° 45' N and 0° 50' S and the longitude 36° 40'E and 38° 30'E.

The main physical features of the Study Area are Mt. Kenya (5,199m) at the center, the Aberdares Range (3,999m) to the west and the Nyambeni Range (2,414 m) elongated from south-east to north-east. The altitude of the Study Area becomes lower in the eastward direction, and the altitude of lowest position is 300 m at Adamson Falls in Nyambene district. The wide range in altitude gives the Study Area a diverse climate as well as a wide range of Agro-Ecological Zones.

4.2 Regional Economy

a) Dependence on the Agricultural Sector of the Economy

Agriculture is the main economic activity in the Study Area. Both large and small-scale farming are practiced in different parts of the Area. Most of the households and economically-active population have been working in this sector, planting food crops, cash crops and keeping livestock.

In the Study Area, crop production contributes 64.8 percent of the total agricultural income and livestock farming 35.2 percent, respectively. However, the share of both sectors in the seven districts varies depending on the district condition. For example, Embu and Nyambene districts could be characterized as crop producing districts compared to the other five districts. On the contrary, the share of livestock is higher than the crop share in Nyeri district.

b) Contribution of Horticulture Farming to the Regional Economy

In Kenya, vegetables are grown in all provinces, but the Central province is known as the main vegetable producing province. Most of the vegetables are grown by smallholders with farm size of less than 0.6 ha.

According to the 1995 statistics, 4,532 ha are utilized for growing export-oriented horticultural crops, and 36,514 ha for Irish potatoes, 10,173 ha for bananas and 12,566 ha for vegetables and fruits for domestic use in the Study Area. Some 74.5 percent of a planted area of 707,771 ha is cultivated to produce food crops such as maize and beans. Export-oriented horticultural crops account for 0.6 percent of the total planted area. Considering that most farmers in the Study Area are classified as small-scale farmers, they are the major growers of the horticultural crops. Improvement of the horticultural cropping affects both the individual farm economy and the regional economy.

c) Population and Its Growth Rate

The total population in the Study Area is estimated to be about 3.15 million, which accounts for 11.9 percent of the total population of the country. However, annual population increase in the Study Area averages three percent compared to the national average of 3.42 percent. The highest rates are in Embu and Meru at 3.20, followed by Nyambene. Nyeri is the most populated district with about 730 thousand people, while the smallest is Mbeere with a population of 175 thousand.

d) Employment in the Agricultural Sector

It is estimated that more than 85 percent of people aged above 15 years are working on their own farms. The agricultural sector also provides the largest employment opportunity for wage workers in the Study Area. Some 800 thousand people have been working in this sector and most of them belong to small-scale farms. Although the large farm sectors contribution to cash crop production might be minimal, the sector contributes significantly to the regional economy through provision of employment opportunities for rural people. During coffee-picking season, a number of households subsist on income earned from picking coffee on the large farms.

e) Status of Women

According to the survey conducted in 1988/89, 87 percent of the female population lives in rural areas and works in farming activities. As males have a tendency to work away from home, the roles of females in the rural areas have become important. For example, fetching water and fuelwood, cleaning house and cooking are the major daily jobs done by females, in addition, females work in farming activities such as planting, weeding and harvesting of crops.

Although the national average of female headed households accounts for 24.5 percent, the ratio in the rural areas is generally higher at 26.2 percent. In the Study Area, Nyeri district has the highest percentage of female headed households at 27.8 percent, while lowest is in Tharaka Nithi district at only five percent.

Table 4.2-1 Socioeconomic Indicators of the Study Area

	Kenya	Study Area								Share to Nation(%)
		Embu	Nyambene	Meru	Kirinyaga	Nyeri	Mbeere	Tharaka Nithi	Total	
1. No. of Divisions	-	5	14	10	4	7	4	8	52	-
2. No. of Locations	-	15	53	27	20	34	15	28	192	-
3. No. of Sub-Locations	-	52	129	75	76	190	36	55	244	-
4. Total Land Area(sq.km)	582,646	708	3,224	3,012	1,437	3,266	2,097	2,295	16,039	2.75
5. Cultivable Area(ha)	3,826,000	49,600	184,200	216,500	102,500	260,550	161,029	156,100	1,130,479	29.55
6. Ratio of Cultivable Area(%)	0.66	70.06	57.13	71.88	71.33	79.78	76.79	68.02	70.48	-
7. Irrigated Area	82,000	68	605	4,078	6,955	1,681	1,813	239	15,439	18.83
8. Ratio of Irrigated Area(%)	2.14	0.14	0.33	1.88	6.79	0.65	1.13	0.15	1.37	-
9. Planted Area for Crops	NA	161,967	126,129	138,337	85,366	87,822	in Embu	108,150	707,771	-
9. Population										
9.1 Population in 1997	26,423,560	298,342	591,760	540,166	492,942	729,595	175,219	325,770	3,153,794	11.94
9.2 Male population(%)	49.3	48.7	49.1	49.9	49.5	48.5	48.7	48.9	49.1	99.59
9.3 Female Population(%)	50.4	51.3	50.9	50.1	50.5	51.5	51.3	51.1	50.9	-
10. Population Density(person/sq.km)	37	132	143	116	264	186	89	112	149	402.32
11. Annual Increase of Population(1979-1989,%	3.42	3.20	3.14	3.20	3.00	2.20	3.08	2.92	3.00	87.72
12. Average Family Size(1994)	5.20	6.00	5.52	6.00	5.10	5.30	5.50	6.20	5.66	108.85
13. No. of Farm Households	2,756,438	81,014	107,200	92,000	82,012	93,543	22,996	45,000	503,765	18.28
of which, Small Holders	2,700,000	59,424	105,256	91,000	81,950	93,471	22,965	43,156	497,222	18.42
Large Holders	56,438	1,590	1,944	1,000	62	72	31	1,844	6,543	11.59
14. Average Farm Size(ha)	2.5	4.44	1.78~4.78	3.97	1.86	1.80	6.00	1.6~10.5	1.95	78.00
15. Ratio of Landless Households(%)	25.8	15.7	NA	3.5	18.8	20.0	NA	0.2	-	-
16. Income and Expenditure(Ksh/month/family)										
16.1 Average Income	9,696	7,995	in Meru	9,320	5,986	6,898	in Embu	4,255	-	-
16.2 Average Expenditure	7,393	5,382	in Meru	7,020	6,324	6,624	in Embu	6,849	-	-
17. Annual Per Capita Income(Ksh)	27,403	17,997	in Meru	19,500	16,078	16,034	in Embu	9,681	-	-
18. Poverty Incidence of Household(%)	31.3	64.6	NA	46.7	28.2	29.8	NA	48.0	30.8	-
18. District Agricultural Income	-									
18.1 Crop Income(1,000 Ksh)	-	1,759,900	1,134,457	1,384,446	1,912,520	3,674,000	599,900	528,663	10,993,886	-
18.2 Livestock Income(1,000 Ksh)	-	114,633	117,116	446,772	487,615	4,459,400	232,500	130,666	5,988,702	-
18.3 Total(1,000 Ksh)	-	1,874,533	1,251,573	1,831,218	2,400,135	8,133,400	832,400	659,329	16,982,588	-
19. Access to safe Water(%)	44.9	45.6	NA	62.5	30.4	59.9	NA	32.2	-	-
20. Adult Literacy Rate, above 15 years(%)	74.8	82.0	NA	77.4	89.8	90.8	NA	90.5	-	-

Sources: Statistical Abstract 1995
District Development Plans 1997-2001
Welfare Monitoring Survey II 1996
Population Dynamics of Kenya 1996
District Annual Reports 1996
District Profile Survey 1998
Farm Management Handbook

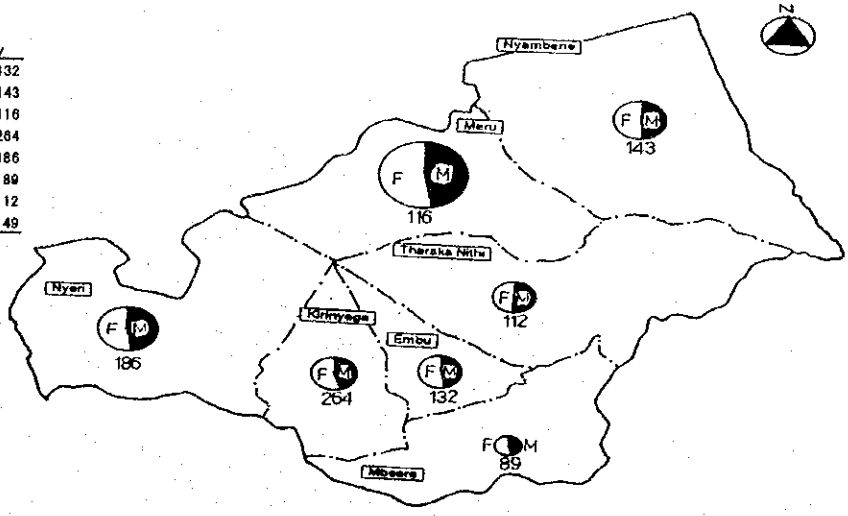
Table 4.2-2 Agricultural Characteristics of the Seven Districts

	Embu	Nyambene	Meru	Kirinyaga	Nyeri	Mbeere	Tharaka Nithi
1. Total land(km^2)	708	3,224	3,012	1,437	3,266	2,097	2,295
2. Cultivable land(ha)	49,600	184,200	216,500	102,500	260,550	161,029	156,100
3. Irrigated area(ha)	68	605	4,078	6,955	1,681	1,813	239
4. Cultivable land per capita(ha/capita)	0.17	0.31	0.40	0.21	0.36	0.92	0.48
5. Total planted area(ha)	161,967	126,129	138,337	85,366	87,822	95,492	108,150
6. Population(1997)	298,342	591,760	540,166	492,942	729,595	175,219	325,770
7. Population density(pers/km^2)	132	143	116	264	186	89	112
8. Aged 15-50 population/total population	126,411	245,246	302,614	216,883	317,111	74,243	135,025
9. Total agricultural income of district(1,000Ksh)	1,874,533	1,146,168	1,671,685	2,400,135	8,133,400	832,400	659,329
9.1 Crop income(1,000Ksh)	1,759,900	1,134,457	1,224,913	1,912,520	3,674,000	599,900	528,663
9.2 Livestock income(1,000Ksh)	114,633	11,711	446,772	487,615	4,459,400	232,500	130,666
10. Agricultural income per capita(ksh)	6,283	1,937	3,095	4,869	11,148	4,751	2,024
11. Planted area with export-oriented horti.crops	817	440	1,189	1,396	635	550	56
12. Planted area with horti.crops(ha)	9,906	5,421	17,192	6,910	22,306	0	56
13. Maize production(ton)	62,712	112,725	61,740	41,465	26,028	32,160	21,600
14. No. of farm households	61,014	107,200	92,000	82,012	93,543	22,996	45,000
15. Farm size(ha/farm household)	4.44	3.30	3.97	1.86	1.80	6.00	6.05
16. Family size(person/family)	6.00	5.52	6.00	5.10	5.30	5.50	6.20
17. Maize per capita(kg/capita/year)	210	190	114	84	36	184	66
18. Ratio of female headed households(%)	24.9	NA	16.3	23.6	27.8	NA	5.0

Note.Horticultural crops cove export-oriented crops, potatoes, bananas, and other fruits and other vegetables.
Sources:District Development Plans 1997-2001
Welfare Monitoring Survey II May 1996
District Profile Survey 1998
Population Dynamics of Kenya 1996
District Annual Reports 1996
Farm Management Handbook

Population and Population Density(1997)

	Population	Density
Embu	298,342	132
Nyambene	591,760	143
Meru	540,166	116
Kirinyaga	492,942	264
Nyeri	729,595	186
Mbeere	175,219	89
Tharaka Nithi	325,770	112
Total	3,153,794	149



Population and Density

The estimated total population of about 3.15 million in 1997 is composed of 44.7 percent male and 52.3 percent female on an average. Compared to national level female population ratio is higher by 0.5 percent.

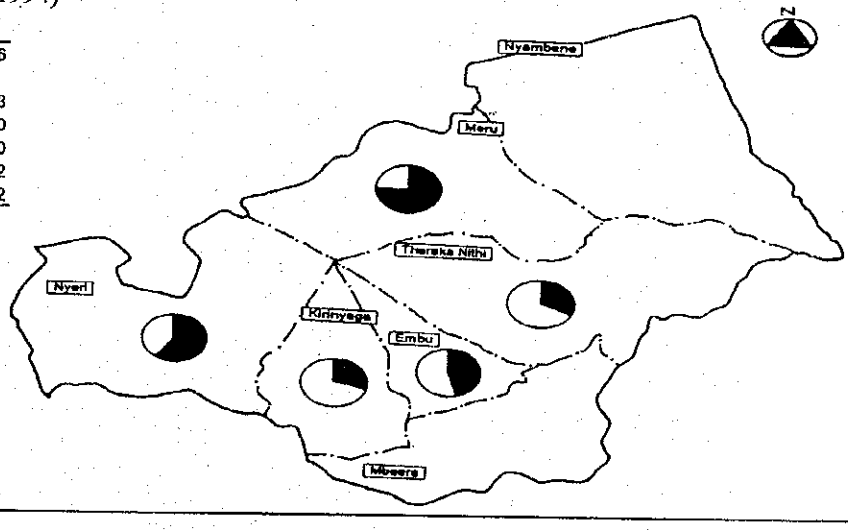
Average population density is 149 persons per sq.km, which is higher than the national average of 37. Among seven districts, the highest is Kirinyaga at 264/sq.km and the lowest is Mbeere at 89/sq.km.

Ethnic Group

Several tribes are living around Mt. Kenya, Kikuyu in the southwest, Enbu in the southeast, Meru in the northeast, respectively. Generally each ethnic group settles in their own tribal areas.

Access to safe Water(1994)

	(%)
Embu	46
Nyambene	-
Meru	63
Nirinyaga	30
Nyeri	60
Mbeere	32
Tharaka Nithi	32



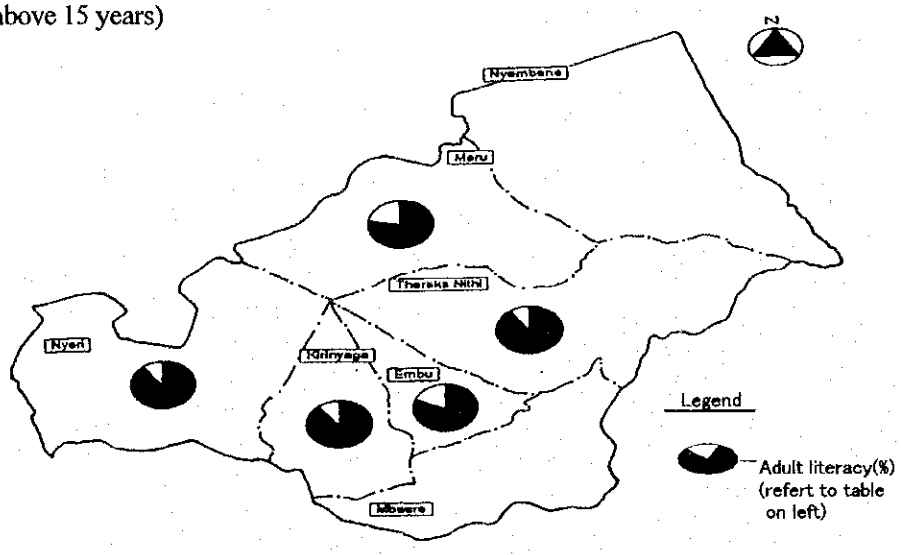
Access to Safe Water

District data on the percentage of households with access to safe water and a main water source show that 46 percent of households have access to safe water and piped water, and rivers are the main water sources of water used by the majority of the households in the Study Area. Meru is the highest at 62.5 percent, followed by Nyeri at 59.9 percent, while the lowest is Kirinyaga at 30.4 percent. The latest data for Nyambene and Mbeere are not available. The national average of access to safe water is 44.9 percent.

About 28 percent of households in the five districts take from 16 to 30 minutes to fetch water during the dry season, 29.9 percent in the wet season.

Adult Literacy (aged above 15 years)

	(%)
Embu	82
Nyambene	-
Meru	77.4
Kirinyaga	89.6
Nyeri	90.8
Mbeere	-
Tharaka Nithi	90.5



Literacy

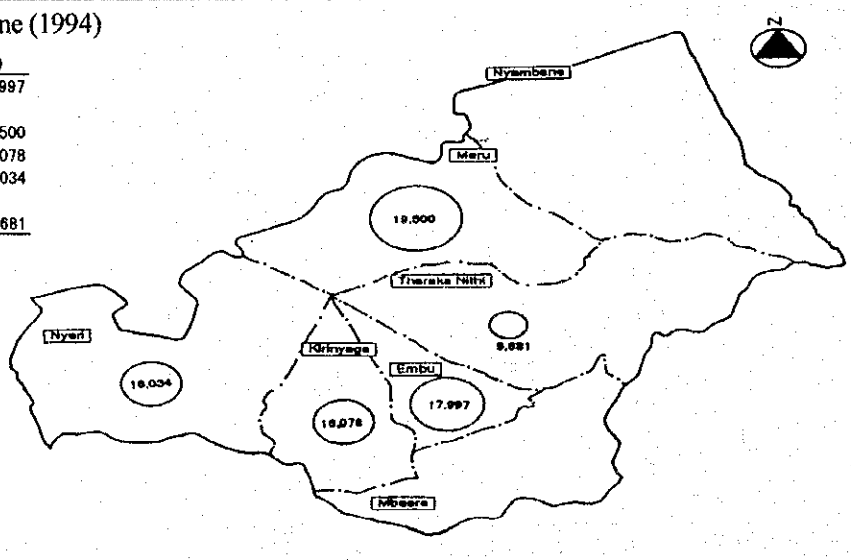
Literacy level of adults aged above 15 years shows a high rate in the Study Area. The highest rates are in Nyeri at 90.8 percent and Tharaka Nithi at 90.5 percent. Because of the administrative changes in Meru and Embu, the literacy data of Nyambene and Mbeere are not available. Compared with females, the literacy rate of males is higher.

Educational Status

It can be said that the literacy rate of household heads is generally high, ranging from 75.4 percent in Meru to 90.5 percent in Tharaka Nithi and the male heads are observed to be more literate than the female heads. However, 10.5 percent of the total population in the Study Area has never attended school for various reasons. This rate is highest in Meru at 14.8 percent and lowest in Nyeri at 6.4 percent. The national average is 18.4 percent.

Annual Per Capita Income (1994)

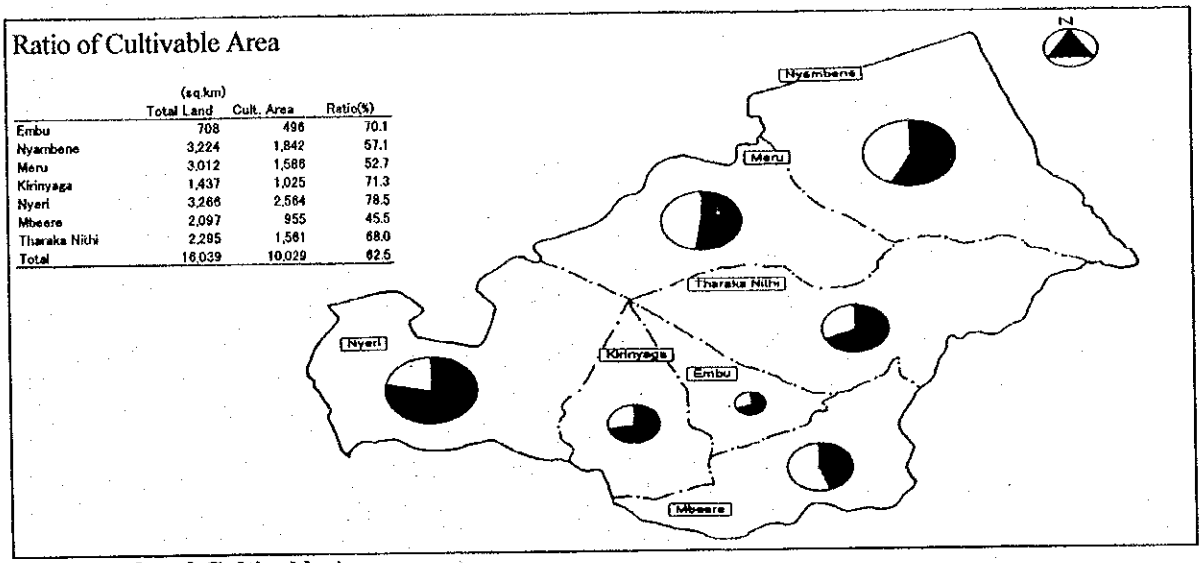
	Income (Ksh)
Embu	17,997
Nyambene	-
Meru	19,500
Kirinyaga	16,078
Nyeri	16,034
Mbeere	-
Tharaka Nithi	9,681



Per Capita Income

Income disparity exists to even in the Study Area. The highest annual per capita income is in Meru at 19,500 Ksh, followed by Embu at 17,997 Ksh, Kirinyaga at 16,078 Ksh, Nyeri at 16,035 Ksh with the lowest being in Tharaka Nithi at 9,681 Ksh. As compared with the national level 27,403 Ksh and 62,566 Ksh in Nairobi, a very large gap can be noted.

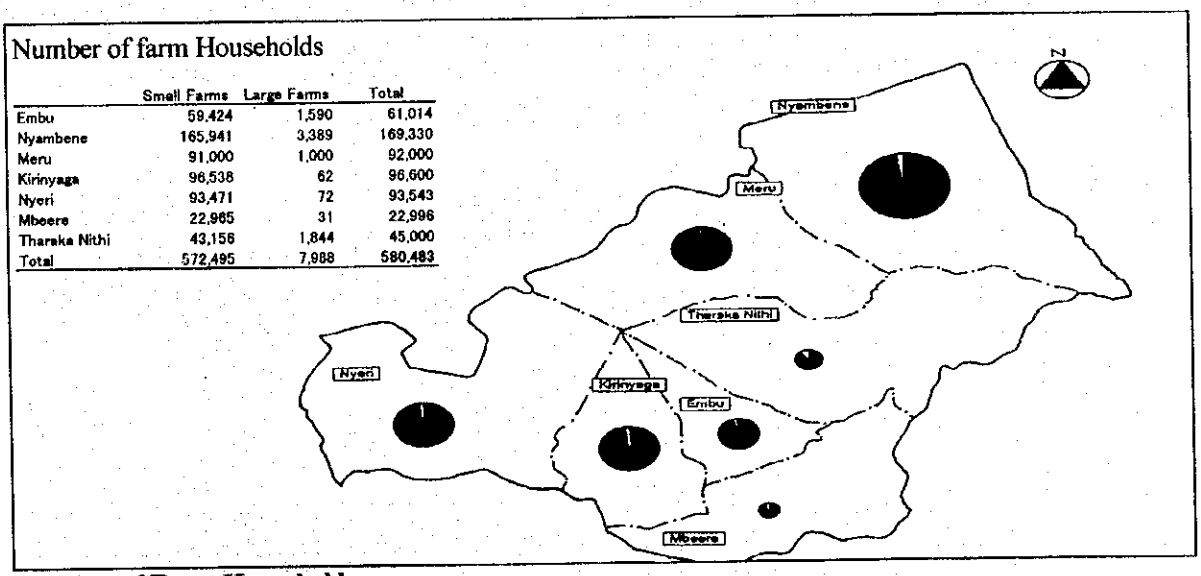
Monthly household expenditure for food accounts for 57.8 percent of the total expenditures excluding own-crop consumption.



Total Land and Cultivable Area

The total land of the Study Area is estimated at 16,039 sq.km, which is equivalent to 2.75 percent of the national land area of 582,646 sq.km. Among seven districts in the Study Area, Nyeri is the largest at 3,266 sq.km and the smallest is Embu at 708 sq.km. The total cultivable area for farming activities is also estimated at 1,130,479 ha, accounting for 70.8 percent of the total land of the Study Area. The ratio of the cultivable area is highest in Nyeri at 79.8 percent and lowest in Nyambene at 57.13 percent.

Planted area for various crops in 1995 was estimated at 707,771 ha based on DAO statistics. In comparing this figure with the total cultivable area, it could be estimated that current cropping intensity in the Study Area is low at about 63 percent.



Number of Farm Households

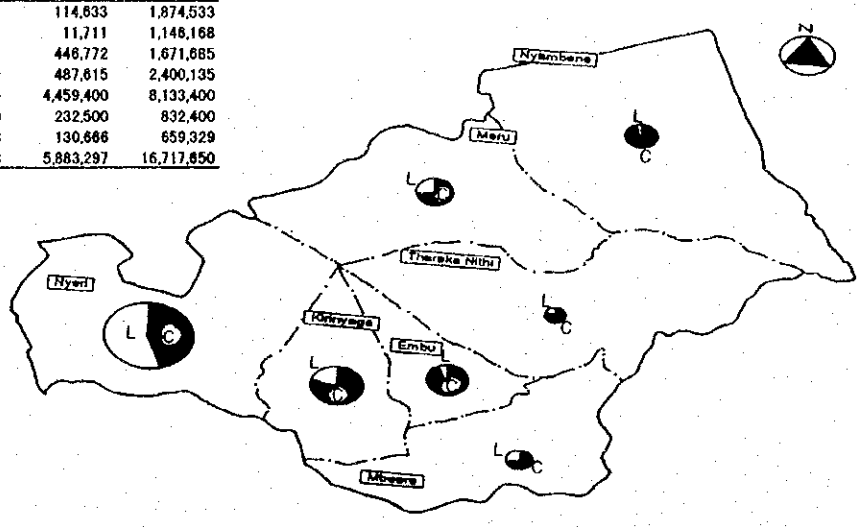
There exists 503,765 farm households in the Study Area, which is divided into 497,222(98.7%) of small-scale farms and 6,543(1.3%) of large scale farms, respectively. The averaged family size of 5.66 is bigger than the national average of 5.2. The main crops planted by large farms are wheat and coffee. Food crops such as maize, beans, potatoes and cash crops such as horticultural crops, coffee, tea, etc. are planted on the small-scale farms.

Distribution of Farm Size

The farm size is averaged at 1.95 ha per farm household which is smaller than 2.5 ha of the national average. However, there is a big difference in farm size between small-scale farms and large ones. The small-scale farm size range from 1.6 ha to 10.5 ha, while large scale farms range up to 700 ha.

District Agricultural Incomes

	Crops	Livestock	Total
Embu	1,759,900	114,633	1,874,533
Nyambene	1,134,457	11,711	1,146,168
Meru	1,224,913	446,772	1,671,685
Kirinyaga	1,912,520	487,615	2,400,135
Nyeri	3,674,000	4,459,400	8,133,400
Mbeere	599,900	232,500	832,400
Tharaka Nithi	528,663	130,666	659,329
Total	10,834,353	5,883,297	16,717,650

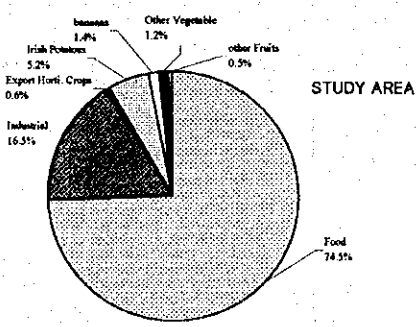


Agricultural Income

The District Development Plan for 1977-2001 shows district-wise agricultural income. By analyzing them, the agricultural character of the district can be known. The total agricultural income in the Study Area is estimated at 16.98 billion Ksh, 64.8 percent of which is crop output and 35.2 percent livestock output. Among seven districts, Nyeri produces the largest value accounting for 48.7 percent of the total, followed by Kirinyaga at 14.3 percent, and smallest is Tharaka Nithi. Nyeri district earns 54.8 percent of its income from livestock sector which is highest among seven districts, while Nyambene and Embu earn 94 percent and 99 percent from crop sector, respectively.

Area Planted (1995)

	Nyeri		Kirinyaga		Old Embu	
	Area Planted	%	Area Planted	%	Area Planted	%
Food	51,387	60.2	58,934	69.0	136,476	84.3
Industrial	14,130	16.6	19,522	22.9	15,585	9.6
Export Horti. Crops	635	0.7	1,396	1.6	817	0.5
Irish Potatoes	15,450	18.1	1,675	2.0	2,670	1.6
Bananas	1,417	1.7	1,364	1.6	4,267	2.6
Other Vegetable	4,017	4.7	2,240	2.6	615	0.4
Other Fruits	787	0.9	235	0.3	1,537	0.9
Total	87,823	102.9	85,366	100.0	161,967	100.0



	Tharaka Nithi		Meru		Nyambene		STUDY AREA	
	Area Planted	%	Area Planted	%	Area Planted	%	Area Plant	%
Food	75,701	70.0	95,090	68.7	109,544	86.9	527,132	74.5
Industrial	30,399	28.1	26,055	18.8	11,164	8.9	116,855	16.5
Export Horti. Crops	56	0.1	1,189	0.9	440	0.3	4,532	0.6
Irish Potatoes	630	0.6	13,369	9.7	2,720	2.2	36,514	5.2
Bananas	865	0.8	650	0.5	1,610	1.3	10,173	1.4
Other Vegetable	249	0.2	1,230	0.9	415	0.3	8,766	1.2
Other Fruits	251	0.2	754	0.5	236	0.2	3,800	0.5
Total	108,151	100.0	138,337	100.0	126,129	100.0	707,772	100.0

4.3 Problems and Constraints

Present problems and constraints in terms of socio and agro-econo,y are itemized as shown below;

- Poverty/low income
- Small farm size causes low income, low production of food crops for home consumption etc. Low rate of farm households holding land title deed
- Low educational status of smallholders
- High cost of farm inputs
- Limited credit facilities-only farmers dealing with cash crops such as coffee, tea, tobacco benefit from institutional credits
- High cost of irrigation facilities
- Harsh loaning conditions for cost recovery from smallholders
- Most farmers are unwilling to put up their land title as security for loans
- Farmgate prices have been noted to be low and below the production cost

4.4 Countermeasures to be Taken

Following countermeasures to solve above the problems and constraints should be taken in the project.

Problems/Constraints	Interventions	Agencies Concerned	Outputs
Poverty/low income	Increase in yield	MOALD, DAO	Improvement of living standard and decrease on infant mortality
	Construction of irrigation facilities	MOALD,DAO	Increase in yield and its stability
	Decrease in input costs	MOALD, DAO	Increase in net incomes
	Effective land use	MOALD, DAO, HCDA	Increase in crop production and incomes
	Education on credit system	MOALD, Banks, NGOs	Improvement of accessibility to credit
	Creation of employment opportunity	NGOs, MPWH, DCC	Increase in off-farm incomes
	Improvement of crop quality	HCDA, DAO, FPEAK	Improvement of farmgate prices
Low self sufficiency of food crops	Construction of irrigation facilities	MOALD, DAO	Stable supply of food crops and improvement of nutrient condition
	Use of certified seeds	DAO, HCDA	Increase in crop production
	Prevention of crop loss	DAO, HCDA	Decease in crop loss after harvest
	Provision of farming materials	DAO,HCDA	Improvement of yield and crop quality
	Soil improvement	DAO	Prevention of soil erosion and increase in yield
Land Title deed	Promotion of land survey to issue title deed for smallholders	MOL, DCC	Increase in utilization of credit by smallholders

Problems/Constraints	Interventions	Agencies Concerned	Outputs
Low educational status of farmers	Strengthening training for farmers on importance of solidarity	HCDA, FPEAK, DAO, Banks, NGOs	Empower farmer's abilities to maintain irrigation group and cooperative society etc.
	Educational training on marketing regarding crop quality and prices	DAO, HCDA, FPEAK, NGOs	Improvement of farmgate prices
High cost of irrigation facilities	Appropriate design & cost estimate agreeable with smallholders	MOALD, NGOs	Attaining full cost recovery policy and sustainability of the project
Harsh loaning condition	Relaxation of loan conditions	Banks, NGOs, MOALD	Promotion of small scale irrigation & horticulture
	Development of accessibility to group based loan	MOALD, Banks, NGOs	Encouragement of smallholders for horticulture etc.
	Discussion on current loan condition	GOK, MOALD, NGOs, Banks	Sustainable development of irrigation projects
Farmer's unwilling ness to put up title deed for security for loan	Educational training for farmers on credit system regarding interest, collateral and repayment etc.	Banks, NGOs, MOALD, DAO	More utilization of loan by smallholders and encouragement for more investment to farming and other activities. Sustainable repayment to irrigation project.
Low farmgate price of crops	Setting up marketing groups or coop. society	NGOs, HCDA, FPEAK, Banks, MOALD	Fair transaction & more benefit for farmers
	More information for farmers on markets	HCDA, DAO, NGOs, FPEAK	More income for farmers
	Provision of inputs at lower prices through coop. society	HCDA, NGOs, DAO	Decrease in cost of production and higher income

5. Agriculture

5.1 Present Conditions

1) Soil and Land Use

a) Soils

Mount Kenya dominates the area. The soils on the steeper upper mountain slopes (>30 percent) are well drained, humic Andosols derived from the volcano. On the south (Nyeri, Kirinyaga and Embu districts) and the east (Meru and Tharaka Nithi districts) these steeper slopes grade into undulating dissected footridges with mainly clay soils, first a mixture of ando-humic Nitosols and humic Andosols, and then, at lower altitudes, well drained humic Nitosols. The Nitosols (Kikuyu red loam) are important agricultural soils. Nyeri, Kirinyaga, Embu, and Meru all have large areas of this well drained, extremely deep, dusky red to dark reddish brown, friable clay with its acid humic topsoil.

Major Soil Types by District

(unit : %)

District	Andosol	Nitosol	Cambisol	Ferralsol	Vertisol
Nyeri	27	42	2.5	0	3.5
Kirinyaga	19	54	1	10	13
Old Embu	5.7	15	30	29	5
Old Meru	12	25	22	9.5	1.5

Source; Kenya Soil Survey

b) Land Use

The agricultural zone is between the forest reserve on the slopes of Mt. Kenya and Mt. Nyambene, and the lower arid plains, where rainfall is less than 750 mm and the poor soils limit rainfed agriculture. From elevation of 2,400 m upward, frosts occur and forestry is the principal land use, and from elevation of 1,000 m down, with 750-500 mm rainfall, livestock farming and limited subsistence cropping of millet, sorghum and grams are the main land uses. Between the forest and the arid plains, the main cash crops, including tea, coffee, potato, bananas, horticulture, tobacco and cotton, plus subsistence crops like sweet potatoes, beans, maize, sorghum, millet, cow pea, taro, and cassava are grown. Maize and beans occupy about 375,000 ha or more than 50 percent of the farmed area. This is an estimate based on the MOALD district reports of the area cropped annually. In the field, pure stand, as well as intercropping and multiple cropping of maize and beans are all seen.

Land and Land Use in the Study Area Districts

(unit : ha)

District	Total Area	Arable Area	Forest	Cropped
Nyeri	326,600	260,550	119,199	87,822
Kirinyaga	143,700	102,500	39,039	85,366
Embu	70,800	49,600	22,264	161,967
Mbeere	209,700	161,029	3,771	In Embu*
Tharaka Nithi	229,500	156,100	48,903	108,150
Meru	301,200	216,500	95,200	138,337
Nyambene	322,400	184,200	11,018	126,129
Total	1,603,900	1,130,479	339,394	707,771

Sources; District Development Plans (total and arable areas), District Forestry Office (gazetted forest areas), MOALD District Reports 1995 (cropped areas), District Profiles, updated 1997 (Irrigated areas).

*; Cropped area in Mbeere district is included in the area of Embu of 161,967 ha.

2) Agricultural Production

Most farmers grow perennial crops such as tea, coffee or bananas. Their annual cropping is mainly for food and always includes a grain and a pulse. Maize and beans are cultivated in the higher rainfall areas, while sorghum/millet and gram/cowpea/njahi/pigeon pea in the lower rainfall areas. A small portion of their land grows vegetables for home consumption or sale, such as potato, cabbage, or kale. Trees for fruit and forestry are usually scattered around their farm.

Most farms have a combination of crops and livestock. The relative importance varies with the climate. In the higher rainfall areas, zero-grazed dairy production is important, in the lower marginal rainfall areas, extensively grazed beef cattle may be part of the farming system.

Area Planted (1995)

(unit: ha)

	Area Planted	%
Food	527,132	74.5
Industrial	116,855	16.5
Export Horti. Crops	4,532	0.6
Irish Potatoes	36,514	5.2
Bananas	10,173	1.4
Other Vegetables	8,766	1.2
Other Fruits	3,800	0.5
Total	707,772	100.0

Source; Calculated from MOALD District Reports

The main points to note are as follows;

- The variation between the Study Area districts,
- The dominance of food crops (mainly maize and beans) in the cropping pattern, ranging from 59 percent in Nyeri to 87 percent in Nyambene,
- The importance of Irish potatoes and bananas in the wetter districts, with areas ranging from 0.6 - 17.6 percent and 0.5 - 2.6 percent,
- The comparatively small areas devoted to export horticulture, 0.1 - 1.6 percent,
- The comparatively large areas devoted to other industrial cash crops, such as coffee, tea, tobacco, cotton, 8.9 - 28.1 percent depending on the district,

3) Livestock

Livestock are found throughout the Study Area, with sheep and dairy cattle predominating in the higher and wetter elevations, beef cattle and goats in the lower and drier regions. Dairy cattle are more important closer to the towns, and beef in the more distant drier areas. At both the upper and lower elevations within the Study Area , the amount of land used for grazing is larger than in the mid elevations where zero-grazing and agriculture predominate. Throughout the area, fodder trees, forage crops, and Napier grass are seen. Crop residues are also used as feed, e.g. banana stems, sweet potato tops, maize stalks, etc. A small number of pigs and improved chickens breeds are raised in the Study Area, but nearly every farm has its flock of local chickens.

4) Organization of PAO and DAO

Agricultural services within each province are coordinated and supported by the Provincial Director of Agriculture (PDA) who is located at the Provincial Headquarters. In carrying out these coordination and support functions, the PDA is assisted by a number of specialised officers (crops, horticulture, farm-management, irrigation etc.).

The district, however, is the focal point for provision of agricultural technical services to smallholder farmers. Headed by the District Agricultural Officer (DAO), a team of subject matter specialists is based at the district headquarters and is responsible for providing technical back-up and training support to divisional and locational agricultural extension officers.

At the divisional level, a Divisional Extension officer is responsible for managing extension services in the division through locational and sub-locational extension assistants. The location and sub-

location extension assistants are the ones in daily contact with the community, hence they are often referred to as front-line extension staff.

5.2 Problems and Constraints

The overriding constraints include: an inadequate and deteriorating road infrastructure, the unavailability and a lack of access to credit, the cost of inputs, low farm gates prices, and insufficient research in horticultural problems.

The water related problems include: the availability of water; conflict between domestic and irrigated use, and with downstream users, difficult access to water permits, inadequate water basin planning and sub-catchment assessments, a lack of operating funds to assist in survey, design and follow up work, and in some areas, the topography and the depth of the river valleys.

The post-harvest related problems include: inadequate grading, storage and packing facilities, poor and expensive packaging materials, especially for pre-packs, air freight prices, a lack of sea freight capacity, and a scarcity of processing facilities, canning, drying etc.

The market related problem include: deficiency on maize supply to meet demands, the gaps between liberalization and foodstuff self-sufficiency, huge different prices among markets, huge seasonal price fluctuation, insufficient information dissemination, etc.

Constraints to expanding horticultural production include: competition for limited water resources, access to reasonably priced, high quality seeds and planting materials, pesticides and fungicides in a timely fashion, labor shortages, especially during harvest, the number of different agencies involved in irrigation, horticulture and agricultural marketing, and inadequate number of trained farmers and irrigation staff at the field level.

5.3 Countermeasures to be Taken

The following countermeasures to solve above problems and constraints should be taken in the project.

Proposed Interventions for Horticultural Development by District

District	Constraints	Activities
Nyeri	Declining soil fertility, small farm size.	Training, logistical and technical support needed in intensive crop production technology and soil management.
	Lack of marketing groups, middlemen.	Training, logistical and technical support needed in marketing for field level staff and farmers.
	High input prices, and fluctuating or thin markets.	Farm budget analysis, assessment of opportunities for processing and storage.
	Distance to grading limits time to pick snow-peas.	Farmers groups, more field grading and farm to market roads.
	Scarcity of elite planting material.	Development of crop production guidelines, and field demonstrations of improved lines to stimulate demand.
Kirinyaga	Lack of water user groups.	Development of improved water management, on-farm and by groups.
	Overuse of inefficient furrow irrigation.	Training, logistical and technical support needed in sprinkler irrigation.

District	Constraints	Activities
Kirinyaga	Current market gluts and price fluctuation (especially in french beans and tomato).	Monitoring of farm gate prices, markets and production surpluses.
	High input prices, middlemen and lack of marketing groups.	Farm budget analysis, and assessment of opportunities for out of season production (non-competition with rainfed tomato), and establishment of improved marketing groups.
	Supply of elite planting material (banana), and seed quality.	Training in crop timing, rotation, quality and the efficient use of improved technologies. Propagation of elite lines by farmers, publicity about sources of good seed.
	Availability of intra-district transport, as the road network is poorly developed.	Development of district level strategy for horticulture, with provision for targeted road improvement.
	Large farmers in area compete with smaller farmers rather than cooperate.	Include appropriate components in district development strategy for both large and smaller farmers.
	Costs of pump irrigation, labor availability, soils crust.	Training, logistical and technical support needed in irrigation technology for field level staff and farmers. Also in crop timing, cash and water management, at both farm and group levels.
	Lack of water user groups and marketing associations.	Encourage and develop grass roots marketing and water user groups, appropriate to the district.
	Inputs comparatively scarce.	Encourage bulk buying from input suppliers in area.
Embu	Supply of elite planting material, lack of nurseries (mango budwood available), banana suckers.	Training support needed in small scale nursery establishment and management.
	Labor competition at coffee and maize and bean planting time.	Training, logistical and technical support for off season production, improved crop timing and labor efficient production.
	Limited land and high returns to coffee, importing produce from Meru, Nyeri and Kirinyaga.	Trials and demonstrations of appropriate subsidiary crops.
	Lack of marketing groups History of non-payment for horticulture in district by middlemen.	Encourage marketing groups. Training in marketing options and post harvest storage technology for field level staff and farmers.
Tharaka Nithi	Limited production results in monopoly buyers.	Focus limited resources on a few selected high potential areas.
	Lack of functional marketing groups.	Develop and encourage grass roots marketing groups. Improve selected farm to market roads in target areas.
	Transport and storage of crops. Limited tradition of horticulture, field management of hortcultural crops poor.	Training in post harvest handling. Training, logistical and technical support in crop establishment and management, timing of production and handling, cropping systems and food security, marketing and post harvest technology.
	Staff and facilities restricted, especially in field. Competition by Meru.	Increased budget allocation to target production areas. Select comparative advantage crops.
Meru	Acreage of Asian vegetables at Mitunguu in Nkuene division remains constant due to price fluctuations and variable demand.	Training, logistical and technical support needed in establishing marketing groups, and post harvest technology for field level staff and farmers, esp. use of pesticides on Asian vegetables, harvest intervals and dosages.
	Low prices for snow pea at end of season.	Crop scheduling trials for snowpea.
	Clan rivalries.	Improve collaboration between farmers groups and district level administration.
Nyambene	Restricted access to market information, lack of marketing groups and marketing channels, monopoly buyers. Roads.	Training, logistical and technical support in marketing and post harvest technology for field level staff.
	Low returns to production due to relative prices inputs and outputs, seed quality.	Targeted improvement of farm to market roads. Development of district crop production guidelines, including annually updated margin analysis, optimum planting dates and minimizing input use. Encourage bulk buying of inputs from district suppliers. Publicity for good seed sources.

6. Marketing of Agricultural Produce

6.1 Present Conditions of Marketing

1) Price Determination Factor

Factors at production stage

- Technical levels of grading in size, cleanliness, maturity and contamination of impurity
- Continuous supply of produce
- Storing methods
- Introduction of new varieties and quality of seeds and seedlings
- Acquisition of market information for farmers
- Activity of farmers' marketing groups
- Farmers' poverty which means lack of bargaining power and cheaper selling prices
- Proper chemical application and record keeping for EU markets to meet maximum residue levels for export produce

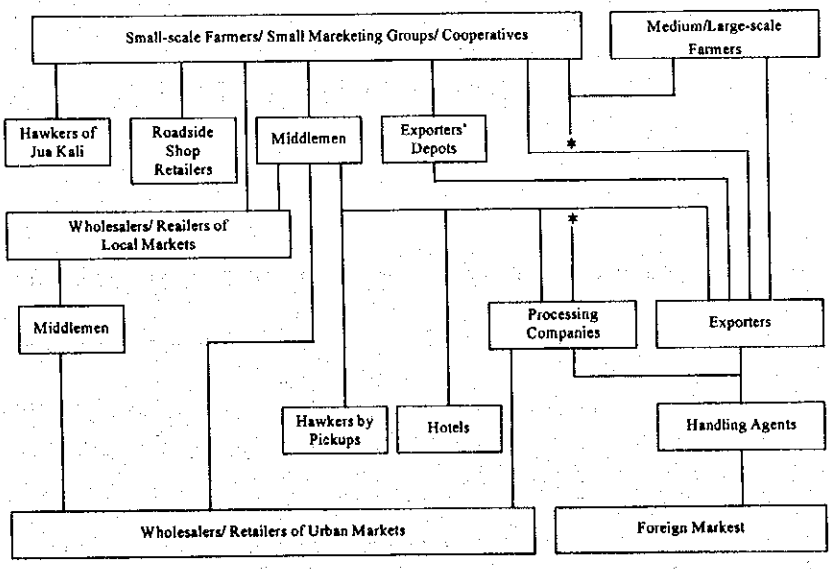
Factors at transportation stage

- Access road conditions and distance between paved roads and markets
- Price escalation of fuel reflecting on transportation costs

Factors at marketing stage

- Seasonal fluctuation in balance of demand and supply
- Market facilities, which can maintain produce quality such as cold storage, concrete floor, roof, hygienic facilities, etc.
- Production places (creation of brand), e.g. tomatoes in Karatina, red potato in Meru and miraa herb in Nyambene
- CIF prices of imported produce of neighboring countries, especially Arusha in Tanzania
- Exchange rate of local currency, charges and capacity of air cargo freight and shipping days for export produce

2) Marketing Channels for Horticultural Produce



6.2 Constraints on Marketing and Transaction Systems

1) General Constrains

- Insufficient collection and dissemination of agricultural information due to difficulty of information exchange among government agencies, budgetary limitation and low authorized position of Market Information Branch, in spite of their importance for prompt policy implementation and farmers' decision-making.
- Collapse or underdeveloped farmers' marketing organizations due to unclear handling of their funds and price fluctuation in lower side more than expected, which decreased bargaining abilities of farmers and allows the exploitation of middlemen.
- Unimproved market facilities lead to inefficient trading, lower quality of produce, difficulty to sell directly in the markets for farmers, unfairness among sellers to be charged market gate fees and difficult collection of the fees for management bodies of local authorities.
- Limited market outlets caused by poor road conditions and undeveloped road side shops.
- The gap between self-sufficiency and liberalization in maize marketing
- Unimproved seed sub-sector.

2) From Analysis of the Market Trend

- Fragile agro-economical structure by drought beyond 500-600 percent price increase depending on produce
- Deficiency on maize supply in national level achieved at about 80 percent (including import volume) of demands, which resulted by excessive demands in proportion to increasing population
- Difficult control of maize supply by weakening the function of NCPB, their exporting to maintain working capital and increase of maize import by private sector
- Disclosing of maize seed information from the parastatal of Kenya Seed Company Ltd.
- Undeveloped monitoring and investigating system to combat with fake maize seeds
- Remaining at high pricing level even after drought season which conducting to high inflation rate and consequently high interest rate
- Some produce has been occasionally traded in regional markets at higher prices than Nairobi market in spite of producing areas due to shortage in markets, interference of middlemen and poor market infrastructure, i.e. canadian wonder bean/ dolichos bean/ cassava/ cucumber/ finger millet/ red irish potato in Gakoromone Market, and banana/ canadian wonder bean/ dolichos bean/ dry bulb onion/ fresh pea in Karatina Market.
- Huge price difference among market at 300-500 percent due to high margin of traders and transportation costs, i.e. avocado/ ripe banana/ cabbage/ shelled ground nut/ kale/ lemon/ green maize/ mango/ finger millet/ orange/ pawpaw
- Huge seasonal price fluctuation for cabbage/green maize/ mango/ citrus/ fresh pea/ sorghum

3) From Viewpoints of Stakeholders

<u>On Farmer Level</u>

- Insufficient market information for decision-making in cropping and selling prices and lack of advisory services
- Inaccessibility to markets by high transporting costs using Matatu and lack of know-how in direct or consigning sale in markets
- Lack of advantageous negotiating factors in prices due to poor quality of seeds and seedlings planted and their distribution, lack of storage facilities, undeveloped irrigation system to provide produce in a period of short supply in the country
- Irregular collection by middlemen at certain times and days
- Disorganization of farmers' groups due to the presence of middlemen resulting from negotiating with individual member farmer

- Risks to cultivate export produce due to difference of demands between domestic and foreign markets
- Low purchasing power

On Middleman Level

- High transportation costs due to poor road infrastructure causing damage to older vehicles which damages produce, cess to enter other districts charged by county councils and occasionally policemen, rapid price escalation of fuel, and expensive purchasing costs of vehicles and spare parts with high custom duty and taxes
- Low quality of produce due to poor grading levels by farmers
- Risks to sell wholesalers and retailers purchased produce from farmers resulting in bargain price in evening time
- Lack of market information in produce trading volume for decision-making in the delivering destination
- Lack of farmers' information; place, kind of produce, expecting harvest volume, harvest period

On Wholesalers and Retailers Level

- Poor market infrastructure for maintaining quality and prices of produce; dusty floors, no roof, poor hygienic facilities and no alternative to storing produce for long term adaptation to seasonal fluctuation
- Inefficient facilities such as insufficient space and co-existence of wholesalers and retailers even in wholesale markets, which can cause losses in time, price, labor costs
- No cold storage warehouses for stable supply of perishable produce, though the study areas are the center of horticultural production to fulfill urban citizens in Nairobi and even Mombasa
- High cess to enter market, amounting to approximately 2.5-3.0 percent of selling price

On Exporters Level

- Difficulty to maintain reliable relationships with farmers for contract farming
- Poor harvesting and grading techniques of farmers
- Poor chemical application and lack of record keeping by farmers
- High exchange rate of local currency compared to actual economic conditions resulting in loss market share in EU
- Strict EU market export conditions regarding maximum residue levels (MRLs)
- High collection costs due to poor road infrastructure and taxes on purchase of vehicles
- High costs and limited space of air cargo freight to EU markets
- Limited space and poor sea freight facilities for mango and avocado for Gulf countries' markets
- Appearance of other competitive African countries especially in green beans

6.3 Countermeasures to be Taken

Following countermeasures to solve the above mentioned problems should be taken.

Problems/Constraints	Intervention	Agency Concerned	Outputs
Inefficient market information	Quality improvement of information sources and their timely provision	Market Information Branch, Farm Management Division, MOALD HCDA	Better crop planning
Lack of cold storage and precooling facilities	Construction of cold storage and pre-cooling facilities, which are possible to be utilized by small scale farmers	HCDA	Improvement of quality and prices of export vegetables and fruits
Low quality of produce due to lack of certified seeds	Provision of information of varieties and certified seeds/ seedlings	KARI, DAO, Seed companies	Creation of countermeasures for drought and plant diseases, better yields, quality improvement of products
Exploitation by middlemen and lack of farmers' marketing groups	Provision of information and techniques to organize farmers' marketing groups	MOALD DAO	Reduction of losses caused by unimproved transaction mode
Inefficient agricultural extension services	Support by educational institutes and agencies concerned on horticultural marketing	Agricultural universities and colleges	Food security, creation of income-generation for poor farmers
Unimproved market facilities	Development of market facilities on soft and hard approach	Municipal Council County Council	Efficient distribution, improvement of transaction modes, development of information

- Inefficient market information:
  The Information network system cooperating with the existing institutions has not been constructed yet. Market Information Branch, MOALD is required to rank the position up in the Ministry; which is proposed to set under the Director of Agriculture for collection of production status information of horticultural/ food crops and for market prediction.
- Lack of cold storage and pre-cooling facilities:
  The HCDA is going to construct including in Nkubu, Sagana and Mwea for pre-cooling facilities for export produce. For domestic produce, cold storage warehouses for the 2-3 months are desirable for very fluctuated crops of cabbage, green maize and dry bulb onion in Karatina Wholesale Market.
- Low quality of produce due to lack of certified seeds:
  More progress of privatization and strengthening of Kenya Seed Co., promotion of private sectors in exemption of duties/VAT and seed multiplication by local agents utilizing fields and public lands are required.
- Exploitation of middlemen and lack of farmers' groups:
  These negative factors are affecting on not only farmers' incomes, but also prices at consumer level. For the formation of farmers' marketing groups, the key points are financial transparency, decision-making system to absorb members' opinions and information collection. The direct selling arrangement or introduction of auction in improved markets also help to encourage the group activities.
- Inefficient agricultural extension services:

The services in terms of marketing will include knowledge on horticultural production, use and available sources of market information, formation of marketing groups through PCM workshop, auction consignment and contract farming, selection or purchasing alternatives of seed and seeding, and field trip pursuing marketing routes. They are recommended to be initiated by agricultural education institutions.

- Unimproved market facilities:
  The improvement of market facilities including hard and soft components conducts to more efficient trading. The direct selling arrangement or introduction of auction in improved markets also help to encourage the activities of farmers' marketing groups.

7. Community and Farmers' Organization

7.1 Present Conditions

1) Water users' Association and Its Activities

Within the Study Area, where a number of smallholder farmers (20-200) are sharing water for irrigation, some form of farmer organization does exist. Such groups may be loose and unregistered or registered.

The main activities of Water users' Association are;

- Mobilizing members for construction of intake and water delivery systems,
- Organizing operation of irrigation system including distribution of water , and
- Maintaining the irrigation system

2) Cooperative Society and Its Activities

In the high potential upland zones of the Study Area, farmers have established cooperative societies (number of participating arners from 20 to over 400) for carrying out the following activities;

- Processing and marketing of coffee,
- Collecting and marketing of milk, and
- Procuring farm inputs for sale to both members and non-members.

The organization structure is similar to most farmer organizations as shown in the figure of irrigation groups. The only difference is that owing to scope of its operations, a cooperative employs a relatively large number of employees.

3) Marketing Group and Its Activities

Apart from cooperative societies, there are other comparatively small marketing organizations (30-50 members) which are to be found in Nyeri and Kirinyaga districts of the Study Area. These farmers' groups are fairly recent and they are mostly concerned with horticulture marketing.

The main activities of a marketing group are;

- Installing a collection shed for receiving members' produce,
- Documenting members produce deliveries, and
- Making arrangements for farmers payments.

4) Women's Groups and Their Activities

With a membership of 20-40, women's groups exist in all the Study Area. Although they normally have a formal registration from the then Ministry of Culture and Social Services, their mode of operation is usually informal. For instance, meetings are usually held in one of the member's houses rather than in a formal setting such as a school. The organization structure is similar to the farmers' organizations.

Main activities of women groups are;

- Making financial contributions to a merry-go-round where group members take turns to share the money for buying domestic utensils, installing water tanks, buying a dairy cow or meeting unforeseen emergencies,
- Assisting each other during labor peaks (planting, weeding and harvesting)

5) Other Groups

There are other informal mutual help groups that are based on neighborhood, clan or family relations. Although such groups may have a chairman and a secretary, the structure is quite loose. Their main activities are to help each other in case of financial emergencies or in tasks requiring a lot of labor in a short time.

7.2 Problems and Constraints

Present problems and constraints encountered in the prevailing farmer's groups are summarized as shown below;

Irrigation Group

- Tendency for over-dependence on government or donors
- Farmers weak organization capability
- Leaders lacking in managerial and financial skills
- Low farmers' income level
- Inadequate farm level skill in irrigation

As a result of the above constraints, the general level of operation and maintenance for group-based irrigation schemes is usually poor.

Cooperative Society

- Low and delayed payout to farmers
- Poor management and financial skills
- Low moral standards leading to embezzlement of farmers funds
- Inappropriate stocking of coffee inputs

Marketing Group

- Insufficient information on market opportunities and prices
- Group production not matched to market opportunities
- Inadequate financial and managerial skills
- Poor bargaining capacity with produce buyers

Women's Group

- Poor management and financial skills
- Concerned mostly with short-term projects
- Group life span tends to be short (less than three years)
- Bias against women by traditional financial institutions

Other Group

- Loose and informal
- Focused on narrow short-term objectives

7.3 Countermeasures to be Taken

1) Irrigation Group

Problems/Constraints	Intervention	Agency Concerned	Out-put
- Tendency for over-dependence on government or Donors	- Social preparation through PRA sessions - Education tour to self-supporting groups	MOALD, NGOs, Ministry of Culture and Social Services	- Confident group willing and committed to address its problems
- Farmers weak organization capacity	- Training on advantages of group action - Community mobilization and education on members role, rights and obligations	MOALD, NGOs	- Members better understanding of their role
- Leaders lacking in managerial and financial skills	- Training in leadership and management skills - Training in financial skills	MOALD	- Leaders able to make sound irrigation decisions
- Low farmer income level	- Participatory extension approaches - Introduction of improved techniques	MOALD	- Increased yields, and household incomes
- Inadequate farm level skills in irrigation	- Training in improved irrigation techniques	MOALD	- Members skilled in field level water application

2) Cooperative Society

Problems/Constraints	Intervention	Agency Concerned	Out-put
- Low and delayed payout to farmers	- Training committee members in cost management methods - Training committee in members in activity and financial planing	MOALD, Ministry of Co-op Development	- Improved payout to members
- Poor management and Financial skills	- Training in management & finance	Ministry of Co-op. Development	- Improved payout to members

Problems/Constraints	Intervention	Agency Concerned	Out-put
- Low moral standards leading to embezzlement of farmers funds	- Prosecution in court of law	Ministry of Co-op. Development	- Improved farmer payouts
- Inappropriate stocking of coffee inputs	- Training in procurement criteria for farm inputs	MOALD, Ministry of Co-op. Development.	- Improved availability of right inputs to farmers

3) Marketing Group

Problems/Constraints	Intervention	Agency Concerned	Out-put
- Insufficient information on market opportunities and prices	- Training on how to access market information - Improve availability of marketing and price information	MOALD, HCDA	- Improved produce prices
- Group production not matched to market opportunities	- Training in production scheduling in relation to market prospects	MOALD, HCDA	- Improved produce prices
- Inadequate financial and managerial skills	- Training in financial and general management	MOALD	- Improved member payouts
- Poor bargaining power with produce buyers	- Training in contract making and bargaining skills	MOALD, HCDA	- Improved produce prices

4) Women's Group

Problems/Constraints	Intervention	Agency Concerned	Out-put
- Poor management and financial skills	- Training in financial and management skills	NGOs	- Improved financial records
- Concerned mostly with short term projects	- Training in long range planning	NGOs, Ministry of Culture and Social Services	- Improved planning capacity
- Group life span tends to be short (less than 3 years)	- Training in advantages of a more permanent institution	NGOs, Ministry of Culture and Social. Services	- Permanent institution able to more effectively use external support
- Bias against women by traditional financial institutions	- Educate institutions that women are creditworthy partners; Initiate women – friendly financial packages	NGOs	- Improved credit availability for women

5) Other Group

Problems/Constraints	Intervention	Agency Concerned	Out-put
- Loose and informal	- Educate groups on advantages of having a formal structure (banking facilities for example)	NGOs	- Group that can make formal contacts with support institutions

Problems/Constraints	Intervention	Agency Concerned	Out-put
- Focused on narrow short-term objectives	- Train group on benefits arising from more ambitious and long term objectives	NGOs	- Coherent group that can up-grade into production/ marketing group

8 Irrigation Water sources and Water Permits

8.1 Present Conditions

1) Available Water Sources and Irrigation Potential

River water serves as a stable and available water resources for smallholder irrigation schemes. An available river water exists in the Tana and Ewaso Ngiro river systems in the Study Area. As a result of study on the irrigation potential by dividing related drainage area in 25 sub-basins, the Study Area with a total irrigation area of 72,500 ha has an irrigation potential of 15,700 ha in total. However, as the irrigation potential includes the potential (1,100 ha) for Mwea irrigation project operated by NIB, the potential for SIS is about 14,600 ha as shown below;

Irrigation Potential in study Area

	SIS	Individual	NIB(Mwea)	RDB	Total
Irri. Area (ha)	63,982	2,010	5,800	710	72,502
Irri. Potential (ha)	14,619	-	1,085	-	15,704

The irrigation potential of about 14,600 ha for SIS includes the surplus irrigation potential of 3,400 ha in nine sub-basins where the total irrigation areas of existing and proposed projects are not exceeded the estimated irrigation potential. It is presumed that these surplus irrigation potentials are preserved for future irrigation development. Thus, the remaining irrigation potential of 11,200 ha become an area to be subjected in this study as shown below;

Irrigation Potential for SIS

	Irrigation Potential with Irrigation Scheme			Irrigation Potential	Total Irrigation
	Irrigated Area	Unirrigated Area	Sub-total	Without Irrigation Scheme	Potential
	(ha)	(ha)	(ha)		
Dist. Profile	6,919	31,133	63,982	-	-
Irri. Potential	4,741	6,480	11,221	3,398	14,619
Ratio(%)	—	—	77	23	100

2) Water Utilization for Irrigation Purpose

Under Kenya's present water law, the right to use water can only be acquired and issued by the Water Apportionment Board (WAB). Irrigation water use also require a permit from WAB.

The available river water for the irrigation scheme is a "Flood Flow", which is defined as a river

flow exceeding normal flow and/or the low discharge which is obtained by subtracting the river maintenance flow and the committed water downstream of the proposed project from the base flow at the project intake site.

According to the water permit data base, the Flood Flow is used for irrigation, fishery and hydropower generation. The permitted total discharge for irrigation water use accounts for about 15.3 cu.m/sec . The quantity corresponds to 31 percent of the total permitted water of the Flood Flow.

8.2 Problems and Constraints

In spite of the occurrence of two dry seasons annually resulting from the climatological conditions, the proper consolidation of reservoir facilities has not been executed in the Study Area, thus, the available water resources are limited. Moreover, since a basin-wide water-resources development plan to be prepared by governmental organization has not so far prepared, disorganized irrigation water use and over-commitment to available river water can be found out in many sub-basins.

The disorganized water use is carried out by a number of farmers' groups. Although water intake can be conducted after securing water permits, actually, some 30 percent of SISs operated do not have water permits in any mode. It is said some groups take more river water than the discharge permitted under existing water rights.

8.3 Countermeasures to be taken

From the viewpoint of watershed conservation and effective irrigation investment, the following interventions should be taken ;

Problems/Constraints	Intervention	Agency Concerned	Outputs
Indistinct actual irrigation water abstraction	Review of existing water permit (location, permitted water, actual water abstraction, method of water intake)	MLRRWD, MOALD	-Grasp of actual irrigation water abstraction -water resources allocation between irrigation projects -Planning of improved water intake methods
Absence of water resources development plan	Study for water re-sources development in sub-basin wide	MLRRWD	-Planning of water re-sources development in sub-basin wide
Weak water control authority to water abstraction	Review of Water Law (strengthening of control power and improvement of water charge system)	MLRRWD	-Control of illegal water abstraction -Realization of saved water use

9. Irrigation and Drainage

9.1 Present Conditions

1) Climate and Hydrology

The Study Area varies from humid to semi-arid zones depending on the altitude. The humid zone with an average annual rainfall of more than 1,100 mm, extends from the eastern slope of the Aberdares Ranges and Mt. Kenya to the southern slope of the Nyambeni Range where the elevation exceeds 1,500 meters. Whereas, the lower part of the slopes and all of the northward facing slopes are a semi arid zone with an annual rainfall ranging from 400 to 850 mm.

The meteorological data at Meru indicates that the annual evaporation reaches 1,459 mm with annual rainfall of 1,259 mm and the annual average daily maximum and minimum temperatures are 24 °C and 13 °C.

The rivers in and around the Study Area originate in the Mt. Kenya and the Nyanbeni Range which run from south-west to north-east demarcating the watershed between the Ewaso Ngiro river system in the north and the Tana river system in the south. In Kenya, the major drainage areas can be classified into five groups. The Tana and Ewaso Ngiro river systems correspond to the drainage areas 4 and 5, respectively. These river systems are divided into several sub-basins. The runoff observation at Regular Gauging Stations (RGS) has been carried out by The Ministry of Land Reclamation, Regional and Water Development (MLRRWD) since 1940's. There are 200 RGS in the Study Area. The monthly low flows occur in February and September and the monthly high flows are in May and November.

2) Irrigated Area

Current irrigated agriculture has been carried out in four sectors, namely group-based smallholder irrigators (GSI), individual irrigators (II), National Irrigation Board (NIB) and River Development Authority (RDA) with a proposed irrigation area of 72,500 ha, totaling in 15,400 ha of irrigated area. However, the total irrigation potential for the Study Area estimated by this Study is only 15,700 ha. The study result implies more expansion of irrigation area has difficulty.

The district distribution ratios of irrigated areas to the irrigation areas are Nyeri (11%), Kirinyaga (45%), Embu (0%), Mbeere (12%), Tharaka Nithi (2%), Meru (26%) and Nyambene (4%). The irrigation developments in Kirinyaga and Meru Districts are advanced, while the developments of Embu and Tharaka Nithi districts are stagnated.

According to the result of District Profile Up-date Survey Work, the 463 Smallholder Irrigation Schemes (SISs) with total proposed area of 64,000 ha exist in the Study Area. Out of this, an area of 6,900 ha, which is equivalent to 11 percent of the total proposed area, is deemed to be currently irrigated. The district distribution of SIS irrigated area is shown in below table, and it becomes clear that many irrigation projects are planned in Meru district.

	Irrigated Schemes		Un-irrigated Schemes		Total		
	No. of Scheme	Area	No. of Scheme	Area*	No. of Scheme	Area	Distribution Ratio
	(nos)	(ha)	(nos)	(ha)	(nos)	(ha)	(%)
Nyeri	31	1,381	39	7,761	70	9,142	14
Kirinyaga	19	750	15	3,499	34	4,249	7
Embu	17	56	31	852	48	908	1
Mbeere	20	175	9	2,494	29	2,669	4
Tharaka Nithi	13	189	35	6,615	48	6,804	11
Meru	119	3,889	77	31,806	196	35,695	56
Nyambene	31	479	7	4,036	38	4,515	7
Total	250	6,919	213	57,063	463	63,982	100

* ; These figures include the un-irrigated area in partially irrigated schemes

3) Present Status of Irrigation Facilities

The status of irrigation facilities of the irrigated 250 irrigation schemes are characterized as follows;

- Water intake of river water operates by way of concrete and masonry weirs. The schemes accommodated by concrete weirs contribute only 45 percent of the total number of irrigated schemes. The remaining schemes have temporary weirs and have to rely upon to unstable water use.

- As for canal type, pipelines, open channel types and combined type of pipeline and open channel are used in the Study Area. The pipeline type is adopted in 102 schemes and the open channel type seems to be used in the remaining major schemes.

- As an irrigation method, sprinkler and furrow irrigation methods are adopted. The sprinkler method is popular in Nyeri and Meru districts where irrigation development is advanced.

The operation and maintenance (O&M) works for irrigation facilities are to be executed by water users' associations (WUAs) which are one of farmers organizations. However, the strength of organization of WUAs is generally poor except those of a few irrigation schemes, and the O&M works in most schemes is not properly carried out.

9.2 Problems and Constraints

Present problems and constraints for the promotion of the SIS are as follows;

- The SIS irrigation potential of the Study Area is 11,200 ha. Out of this, the irrigable area with existing irrigation facilities is 4,700 ha, the remaining areas of 6,500 ha has no irrigation facilities. The existing irrigation facilities, which were constructed by limited construction funds, and therefore have low capacity, shall be rehabilitated .
- Some data of District Irrigation Profile updated in Phase-I field work in 1997 are not accurate due to the immaturity of scheme planning. The fact was found out through Phase-II and Phase-III field works, and it prevents the MOALD from formulation of detailed plan for SIS promotion.
- All WUAs are not fully developed in the existing irrigation schemes, and in case some schemes have organizations of WUAs, the organization are generally weak, then O&M works of irrigation facilities and water distribution are not properly executed. Moreover, some existing schemes have no water permit

- Extension services for irrigated agriculture and water management are at a rather low level due to the lack of fund for travel expenses and allowance and training to front-line extension worker (FEW).

9.3 Countermeasure to be Taken

For smooth implementation and operation of the SIS, the following interventions should be executed;

Problems/Constraints	Intervention	Agency Concerned	Outputs
Unconsolidated irrigation facilities	Rehabilitation and newly construction of new irrigation facilities	Self-help groups	Consolidation of irrigation facilities
Lack of accuracy of district profile data	Review of District Irrigation Profile (location, irrigated area, water requirement, facility conditions)	IDB/MOALD	Planning of SIS promotion plan in sub-basin
Weakness of WUAs	Development and strengthening of WUAs Training of farmers	IDB/MOALD, MLRRWD, and Self-help groups	Improvement of O&M works for irrigation facilities and water management, Acquisition of water permit
Low level of extension services	Provision of fund for extension services and training of FEWs	IDB/MOALD	Provision of better extension services on irrigated agriculture and water management

10. Rural and Social Infrastructure

10.1 Present Conditions

1) Domestic Water Supply

Rural water supply facilities for domestic use can be categorized into four types by O&M agencies, i.e. government facilities, self-help facilities, public/institutions facilities and individual/private facilities. Government facilities are comparatively large scale and better equipped as they normally supply to the major towns. Most water supply systems are under self-help or the community management and are basic, without chlorinating facilities. Individual/private facilities are very small-scale, supplying to only 10-40 beneficiaries. There are around 45 government facilities, 400 self-help facilities and 30 institutional facilities in seven districts.

Water sources for domestic water are mostly rivers/streams and some dams, springs and groundwater. Beneficiary population from the rural water supply facilities are highest in Nyeri district, at 88 percent followed by Kirinyaga and Meru districts at 61-62 percent, and the lowest in Nyambene at 34 percent. The average ratio in the seven districts is 60 percent.

2) Roads Communication

In the Study Area, the classified road network amounts to 6,664 km, 13 percent bitumen, 38

percent gravel and 49 percent earth surface. The length of unclassified roads is not available. Among seven districts, Nyeri district has the biggest road network followed by Meru and Kirinyaga districts. Mbeere, Tharaka Nithi and Nyambene districts are poorly served with road network. 68 percent of the roads are with bitumen/gravel surfaces in Nyeri district, and 73 percent of the roads are with earth surface in Nyambene district.

Due to the mountainous and hilly topography, the roads traverse steep sections and therefore it is difficult to maintain them. During the rainy seasons, surface gravel is easily washed away and deep gullies due to run-off water normally cut across roads. Earth roads in the lower part of the Study Area become muddy and impassable during heavy rains, and it becomes difficult to transport agricultural products to the market in time.

As to access roads to the irrigation schemes in the seven districts of the Project, 34 percent of schemes have fair access, 44 percent need improvement/rehabilitation, and 22 percent require the reconstruction works.

3) Rural Electrification

Supply of electricity in the Study Area has been extended through the Rural Electrification Program, however the national electricity grid is limited to major urban centers and some rural market centers only. Among the seven districts, supply level of electricity is high in Nyeri, Kirinyaga and Embu districts, and low in Mbeere, Tharaka Nithi and Nyambene districts. Electricity is mainly used for commercial purposes in the urban and market areas, public institutions, administrative and trading centers, and industrial activities.

On the other hand, many individual households do not receive electricity. Therefore, in both urban and rural areas, woodfuel and charcoal are the most common sources for cooking and paraffin is widely used for lighting.

4) Public Health

Health services in the Study Area are provided by the government, the missions (NGOs) and private medical practitioners. Principal health facilities are hospitals, health centers and dispensaries. Hospitals are located in the major district centers, and health centers are in the rural market centers, and dispensaries are in the rural areas. In the seven districts, there are 25 hospitals, 45 health centers and 229 dispensaries. The government hospitals and health centers are generally over-utilized because they have better facilities and staff. On the other hand, private health facilities are generally under-utilized due to high charges.

5) Education

The formal education system in Kenya is primary school education for eight years and secondary school education for four years. Those schools are mostly run by either provincial or district governments. Other than the formal education system, there are technical training institutes, youth polytechnics, farmers training centers, teachers training college, family life training centres, and so on. Most of these institutions offer technical skills necessary for industrialization of the districts. Present conditions in formal education

are almost the same in each of the seven districts. Generally, existing school facilities are under-utilized and the rate of school drop-outs is high for both boys and girls.

10.2 Problems and Constraints

Domestic Water Supply
- Inadequate low-level facilities in the rural area,
- Lack of access to fund sources in community-based self-help projects,
- Low rate of beneficiary population,

Roads Communication
- Poor accessibility of roads in the rainy seasons,

Rural Electrification
- Limited power supply,
- Unreliable electric power supply,
- Over-utilization of woodfuel,

Public Health
- Inadequate and lack of health services and facilities,
- Shortage of health facilities in rural areas,

Education
- Lack of adequate and well-equipped education and training facilities,
- Low utilization of schools and high dropout rate,

10.3 Countermeasure to be Taken

Following table indicates the countermeasures to be taken for rural and social infrastructures Development.

Countermeasures to be taken for Rural and Social Infrastructures Development

Problems/Constraints	Intervention	Agency Concerned	Beneficiary	Implementation Method
1) Rural water supply - Inadequate low-level facilities - Lack of access to fund sources - Low beneficiary population rate	- Rural water supply improvement	Self-help groups	Self-help groups in rural area	NGOs/Contractor
2) Access roads - Poor road accessibility in rainy season	- Regraveling of access roads - Rehabilitation of access roads - Reconstruction of access roads	MPWH/DCC	Rural people	Consultant/ Contractor
3) Village/farm roads improvement - Poor communication and transportation within community	- Regraveling of village/farm roads - Rehabilitation of village/farm roads - Reconstruction of village/farm roads	District County Council (DCC)	Village people	Consultant/ Contractor

11. Rural Environment and Public Health

11.1 Present Conditions

There is a considerable risk of soil erosion as a result of farming in the steep foothills of Mt. Kenya. Therefore, soil and water conservation of catchment area is one of the important activities related to the environment and it is promoted based on the participation of farmers through the cooperation of MOALD and MENR.

The Aberdare Forest, Meru Forest, Mt. Kenya Forest, Nyambene Forest and Nyeri Forest are all in the Study Area. Especially, Aberdare Forest and Mt. Kenya Forest are important for the prevention of soil erosion and protection of catchment area and water source. All forests in the Study Area are listed in the top ten high priority forest groups ranked by biodiversity, environmental and local use values and threats, and several species are listed in the endemic trees and shrubs.

In the Study Area, there are three National Parks and one National Reserve, which cover a total area of 2,419 sq.km. Various kinds of wildlife inhabit these areas and forests in the Study Area. Some of them are listed in the endangered wildlife in Kenya such as elephant, black rhinoceros, cheetah, etc.

About 71 percent of the energy consumed annually in Kenya comes from wood, mainly as firewood for cooking and heating in the rural areas, and as charcoal in the urban areas. 100 percent of interviewed farmers in the Study Area use firewood. According to the Forestry Master Plan, fuelwood demand will increase by an average of 4.7 percent per year from 1989 to 2020 and the wood will be supplied mainly from farms. It means that the promotion of agroforestry is one of the important elements in the Forestry Master Plan.

11.2 Problems and Constraints

- Damage to crops caused by wildlife, especially elephants is a serious problem for the farmers adjacent to the forest. During the marauding season, farmers watch their farmland all night. In some areas where the damage is most serious, electric fences are constructed by KWS.
- Drinking water sources for farmers in the Study Area are rivers, springs, wells and rainwater. In some areas, piped water is connected to houses though it is not always treated and is taken directly from the river. Many of the rivers and springs including protected springs are contaminated by coliform.

- The main water-related diseases reported in the foothills of Mt. Kenya are malaria, amoebiasis, intestinal worms, etc. In 1996, the top of diseases in Nyeri were upper respiratory tract infection and the second was malaria with 4,621 cases (0.65 % of total district population). Amoebiasis was top with 4,609 cases (0.85 % of total district population) in Meru.
- Increased use of agro-chemicals resulting from the promotion of horticulture and intensive agriculture by irrigation.
- Deterioration of river water quality due to the increased use of chemical fertilizer and agro-chemicals.
- Increase of water-related diseases (malaria, amoebiasis, etc.) due to increased sources of diseases by furrows.
- Damage to crops by wildlife in irrigated farmlands in the dry season.

11.3 Countermeasures to be Taken

Environmental consideration is required even for small-scale projects and the Project should include a soil conservation plan and water source management plan, which have a direct influence upon agriculture, this applies to a public health plan and anti-malaria plan, which have an indirect relation to agriculture.

- Soil conservation plan includes technical support by MOALD to farmers for the plantation of trees, crop rotation, input of manure, promotion of improved cooking stove, etc.
- Watershed management plan includes the management of Mt. Kenya Forest Reserve by the Forestry Department.
- Public health plan includes extension services by MOALD on the use of agro-chemicals, sanitary education, etc.
- Anti-malaria plan includes the study of anti-malaria plants and promotion of their growth by MOALD and MWR.

12. Gender Issues

12.1 Present Conditions

According to the study results of Socio-Economic Survey and PRA survey conducted by the Study Team, women are responsible for providing the majority of agricultural labor in the Study Area, while in the country as whole, women are estimated to contribute about 70 percent of rural labor requirements. In addition, they are responsible for the bulk of domestic household tasks such as cooking, fetching water and firewood, attending to children and the sick. On the other hand, men are responsible for opening cultivation land, cash-crop pruning and spraying as well as managing livestock outside the homestead.

12.2 Problems and Constraints

On balance, however, the gender division of labor is unequal and female members of the household are overburdened. This over-contribution of women to agricultural labor requirements is, regrettably, not compensated by receipt of commensurate agricultural benefits. As a general rule, male members of the household tend to either control or take a bigger share of household agricultural benefits.

Of more significance is the ownership pattern of the most important household resource i.e. land, where the majority of women are excluded although they have user rights through their connection to the husband, father or male relative.

12.3 Countermeasures to be Taken

This gender issue in rural development is receiving increasingly policy attention and recently the Ministry of Agricultural inaugurated a " Gender Equity and Mobilization Unit " to be part of the Extension and Adaptive Research Division.

The above gender analysis has implications for the proposed "Community-based Smallholder

Irrigation Development Project for Promotion of Horticultural Production". In order for the project to make its contribution in addressing the existing gender imbalance, it will attempt to do the following;

- To adopt a participatory approach that will permit women's feelings and concerns to be articulated and incorporated into the planning and implementation process,
- To seek out technical packages explicitly that will be women-friendly e.g. irrigation design and cropping patterns including crops traditionally controlled by women,
- To provide for institutional mechanisms for permitting women to access relevant information and technology (e.g. marketing, extension information), and
- To encourage change of traditional attitudes towards women among communities being supported by the Project,

13. Results of Survey for Problem/Objective Analysis and Formulation of Project Design Matrix (PDM)

In order to formulate the basic irrigated horticultural development plan for the Project, participatory rural appraisal (PRA) surveys have been undertaken throughout workshop seminars during the period from the Phase-I Study to Phase-II.

The attendance of the workshop seminars are of related government staff at both central and provincial levels, the Study Team, JICA expert, NGOs, and public sectors such as Cooperative Bank of Kenya.

The results of the workshop seminars are summarized hereinafter.

13.1 Stakeholder Analysis

The identified stakeholders are summarized as follows;

Government Agencies

- District Irrigation Office
- MOPWH
- MOALD
- IDB, MOALD
- Agricultural Extension Officers
- Market Information Branch
- MOALD Land Development Division
- Division Irrigation Unit
- District Office
- Provincial Agricultural Office
- Provincial Government
- District Agricultural Office
- District County Council
- District Water Office
- District Work Office
- National Environmental Secretariat

Farming Community

- Farmers
- Farmers' Marketing Group
- Water Users' Association
- Irrigated Smallholders
- Women's Groups

Private Sector

- Farmers
- Local Consumer
- Households
- Local Private Credit Providers
- Input Stockists
- Middlemen
- Wholesalers/Retailers

NGO's
- SISDO and Others

Public Groups
- Markets
- Cooperative Bank of Kenya
- Kenya Broadcasting Corporation

13.2 Problem Analysis

The outline of the formulated problem tree is presented below (details of problem tree are given in Figure C.1-1, Annex C);

Insufficient Level of Welfare in Household/Community

- Low Household Income
  - Low Financial Return from Farming
    - Poor Farm-gate prices
      - Lack of access to finance (credit)
  - Low farmer's Return
    - Poor marketing systems
      - Lack of information on production elsewhere
      - Weak bargaining power of farmers
      - Lack of access to markets
      - High margin by middlemen
      - Seasonal gluts
      - Failure of contract farming
      - Limited and expensive air freight costs
      - Strong competition with other African countries in exporting produce.
  - Low Yield of Marketable and Self-sufficient Produce
    - Insufficient volume of horticultural production
      - Insufficient water for crops
      - Poor farming management
      - Low irrigated area
      - Failure to meet standards
      - Sub-optimal farm size

13.3 Objective Analysis

The formulated objective tree is summarized below (details of objective tree are given in Figure C.1-2, Annex C);

Increased Level of Welfare in Rural Household/Community

- Increased Household Income
  - Increased Production Output
    - Increased farm-gate prices
      - Provision of access to finance (credit)
  - Increased Farmer's Return
    - Improved Marketing Systems
      - Improved access to external production information
      - Strengthened power of farmers
      - Improved access to markets
      - Reasonable margin by middlemen
      - Better linkage with demand and supply
      - Successful contracting farming
      - Sufficient and reasonable air freight costs
      - Cooperation with other African countries in exporting produce
  - High Crop Yield of Marketable and Self-Sufficient Produce
    - Improved Production Systems
      - Sufficient water for crops
      - Improved farming management
      - Improved development of new irrigation
      - Increased compliance with standards
      - Minimize the rate of soil fertility deterioration
      - Optimal farm size

13.4 Formulation of Project Design Matrix

Through the above mentioned studies, project design matrix (PDM) for the Study was formulated.

14. Identification of Present Core Problem Areas in the Study Area

The problems and constraints in the Study Area were identified in relation to the smallholder irrigation schemes located around Mt. Kenya. These identifications were made during the field survey, data collection, and results of socio-economic survey, participatory rural appraisal (PRA) survey, and project cycle management (PCM) survey conducted during the fieldwork in phase-I to phase-III, and they can be largely categorized into the following six core areas;

Table 14.1-1 Core Problem Areas and Their Diagnosis and Countermeasure for Implementation of SIS

Core Problem Areas	Diagnosis and Countermeasures
A. Institutional Aspects	
1) Policy of MOALD's Future Direction	MOALD's new structure was approved by the Cabinet in March 1997. Under the new structure, the vision of the Ministry is to facilitate the production of sufficient food and other commodities in an ecologically sustainable way with specific goals of poverty alleviation and employment creation. Emphasis is put on effectively facilitating the private sector initiatives, liberalization of marketing, and participation of farmers to project implementation, especially in case of smallholder irrigation schemes with cost sharing concept. The following key initiatives will be required to be undertaken; - To provide the necessary socio-economic enabling environment to facilitate widespread and free participation by the private sector, - To prioritize and rationalize public sector involvement in agriculture for greater efficiency in resource allocation, which calls for acceleration of the parastatal reform programme to reduce budgetary constraints and to facilitate increased private sector participation in agricultural production, marketing and processing, - Stimulate private sector investment in agriculture through improved rationalization and increased investment including rural access roads, rural water supply, rural electrification, marketing facilities and information, agricultural credit, research and extension, - To put in place support mechanisms and policies that will enhance the development of a strong and vibrant sector in agriculture, - To maintain effective and efficient coordination systems within the government, and between the various agencies of the government, farmer/farmers' organizations, women/women's organizations, private sectors, donors and NGOs through intensive and regular consultation.
2) Policy of SIS Development	Farmers' participation is essentials to proceed SIS development, and its concepts are of cost sharing and cost recovery of the project costs with high interest rate (30 %) and short repayment period of 48 months. These conditions are very severe for farmers. Therefore in the study, some alternative plans for amortization should be studied taking into consideration the existing credit system and its conditions. As the results of the alternative studies on credit conditions in each Model Area, followings are recommendable; - Rupingazi Ngerwe: Interest(%) 12, Repayment Year (year) 6 - Ngomano/Nyangati: Interest(%) 12, Repayment Year (year) 6 - Nkunjumo: Interest(%) 8-10, Repayment Year (year) 10-5 - Ruungu/Karocho: Interest(%) 8-10, Repayment Year (year) 10-5
3) Policy of Basin Water Management	The MLRRWD has a role of proper water management in each sub-basin. Water users are requested to apply water permits as per the Water Act. However, the activity for strict enforcement

Core Problem Areas	Diagnosis and Countermeasures
	of the law on users is poor which results in many illegal abstractions, ineffective water use and usage conflicts. An assessment study of available water resources in sub-drainage basin should be examined.
4) Agricultural support services by MOALD	Farmers are strongly requesting horticultural farming, water management, and marketing techniques to be carried out by MOALD. However, due to shortages of both the necessary budget and staff, effective supporting services for these purposes have not been given to farmers. Consequently, MOALD should make effort to increase recurrent and development budgets by means of appropriate ways. And also, it will be essential to increase the numbers of technical staff to implement the smallholder irrigation schemes, especially front-line extension workers (FEW) (basically one FEW per one scheme).
B. Financial Aspects	
1) Allocation of Government Budget	MOALD's annual budget for the last three years (1994/95-1996/97) has increased from 213 million Kenyan Pound to 341 million Kenyan Pounds. Out of these annual budgets, about 47 percent of the budget is utilized for development expenditure on an average and the rest is for recurrent expenditure with 150 million Kenyan Pound, equivalent to 53 percent of the total budget. The rate of annual budget allocated for irrigation development work is so low with about a few percent of the total budget, which amounts at 3.1 million Kenyan Pound. Of the budget for irrigation development, about 47 percent is occupied by the fund obtained through an aid assistance (AiA) from the related donors. Therefore, necessary procedures to allocate more budgets to the irrigation sector should be recommended for the request to the Ministry.
2) Increase of Farm Input Costs	Recently, price of farm inputs has been increasing, resulting in no profits to farmers. Therefore, establishment and strengthening of cooperative society should be proposed to procure inputs in lower prices by purchasing them in bulk by group basis.
3) Accessibility to Credit for smallholders	80 percent of horticultural crops for export and domestic market is from small farmers. However, only farmers dealing with cash crops such as coffee, tea, and tobacco benefit from institutional credit services. Smallholders who are the major producer of horticultural crops should be covered by those institutional credit service to encourage them in farming activities. Banks request land as a collateral for loan. However, most of smallholders have not certificate for land holding. In order to improve current condition, therefore, the Study Team proposed to promote land survey in earlier stage by the Ministry of Land and Settlement in cooperation with a local government to issue a certificate by identifying area and owner of the individual land. Another proposal is to study possibility for financing for the group basis on the basis of collective responsibility. The government and bank are required to have initiative in this matter. Similarly to the current full cost recovery policy on the small scale irrigation project, government has enough responsibility to study and improve current credit system for the smallholders.

Core Problem Areas	Diagnosis and Countermeasures
C. Community Aspects	
1) Capability of Farmers and Lack of Harmony in Community	The main constraints facing farmers organization are; a) inadequate farmers capability to organize themselves with a view to harnessing available irrigation resources and potential support services from external agencies, b) poor leadership resulting in cohesive groups, lack of common purpose as well as discipline, c) lack of general and financial management skills on the part of the management committee. In order to enhance success of a community-based irrigated horticultural programme, it will be important to raise participatory willingness of beneficial farmers through social preparation works for rural community, which should be undertaken by hired consultants and NGOs, at the beginning stage of project implementation.
2) Poverty	Smallholders are predominant and live on lower income in the Study Area, so that to alleviate the poverty, financial analysis should be made taking into consideration promising crops, its profitability and security of the staple foods.
3) Famine and poor health of farmers	Famines are occurring in some areas, especially Nyambene and Tharaka Nithi districts, which are located in isolated areas far from main roads, and these situations cause the poor health of rural people. In these areas with shortage of food crops, supply of food crops such as maize, beans, etc. should be stabilized by increasing the production, and self-sufficiency for food crops should be raised, in addition to the introduction of irrigated horticultural crops in the areas.
4) Agricultural & Rural Infrastructure	The agricultural and rural infrastructure in the Area, that is, rural water supply, access and farm roads, rural electrification, public health and school, etc. have already been provided. However, due to lack of related services such as construction equipment and budgets for operation and maintenance, etc., current rural life faces a under severe situation. Especially, access roads utilized for connecting villages and also for marketing of agricultural production are very hard to pass during the rainy season. Therefore, improvement of these access roads is essential to encourage marketing and rural communication.
5) Gender	All the communities in the Study Area have a patri-lineal system which has a strong influence on the status of women. Traditionally, land ownership is inherited from father to son, but women (wives and daughters) only have right to use agricultural land, not own it. Women are presently responsible for providing about 70 percent of agricultural labor. In addition they are responsible for the bulk of domestic tasks, e.g. cooking, fetching water and firewood, child care etc. In order to improve women's status in the community, they should have an opportunity to join the rural society activities.
D. Organizational Aspects	
1) Lack of Training of Farmers/ Farmer Leader	Organizing farmers is the core issue of the community-based irrigation projects. Therefore, training programme should be studied to organize beneficiaries.
2) Lack of Training of WUA and Cooperative Society	Training programme and procedure to organize WUA and cooperative society should be studied.
3) Inadequate Extension Services	Extension programme covering on-farm water management and crop management and marketing of crops, etc. should be studied with some alternative programme.

Core Problem Areas	Diagnosis and Countermeasures
E. Technical Aspects	
1) Training of Staff and Farmers	The technologies on irrigation and water management are extended by agriculture staff such as DIE, DIO, DAO, etc. However, the knowledge of most front-line staff is inadequate with regard to providing proper solutions to farmers' problems relating to farmers participation procedures, e.g. project identification/ planning/design /implementation and O&M work. Training programs covering O&M of small-scale irrigation facilities, water management, crop management, environment management and so on should be proposed for both farmers and district staff.
2) Farming Management	Intensive farm management should be proposed to produce horticultural crops and staple food crops in the current small farm sizes.
3) Marketing and Quality Control	Awareness of crop quality to earn higher income should be fully understood through the proposed marketing plans.
F. Environmental Aspects	
1) Soil Conservation	There is a considerable risk of soil erosion on farmland in the foothills of Mt. Kenya. Many farmers have knowledge on soil and water conservation methods through the training by MOALD. Planting of Napier grass and trees (mainly Grevellia rubusta) around the farm, and along the contour and roads should be promoted.
2) Pollution of Drinking Water	Resources of domestic water for farmers in the Study Area are rivers, springs, wells and rain water. River water in particular is also used for irrigation purposes. In some areas, piped water is connected in the house though it is not sterilized. Many rivers and springs including protected springs are contaminated by coliform. Water borne diseases are Malaria and Amoebiasis. Therefore, plan of irrigation facilities considering the improvement of water quality such as construction of drinking places for livestock should be made in order to prohibit their being close to water sources. Furthermore, minimum water treatment applying chemicals such as chloride should be examined.
3) Chemical Residue on Horticultural Produce	Suitable use of fertilizer and agro-chemicals (timing, quantity, number of times etc.) should be studied in the proposed extension programme to avoid chemical residue on horticultural crops to be exported and consumed in local markets.

15. Expected Overall Development Target /Strategy and Intervention

15.1 Development Targets for National and Regional Economy

National Economy

As the development target from the view point of national economy, following factors are set up;

- Earning of foreign currency by expanding horticultural exports
- Food security by increasing horticultural production
- Position of agricultural sector for the national economy

Regional Economy

- Position of agricultural sector in the regional economy
- Increased number of harm households, population and farm labor

- Expanded irrigable area
- Increased production of horticultural and major crops
- Improvement of farm economy
- Development needs of farm households in the Area

15.2 Development Strategy and Necessary Intervention

Through the review of the formulated development strategy mentioned above and also based on the results of additional workshop seminars held at the selected four Model Areas during Phase-III fieldwork with the participation beneficiary farmers in each Area, the following overall development strategy for a Master Plan is expected.

Overall Goal

- Improvement of socio-economic well-being of community around Mt. Kenya
- Sustainable regional development of community around Mt. Kenya

Project Purposes

- Small farmer development in the rural communities around Mt. Kenya through the promotion of irrigated horticultural development

Expected Results and Outputs

As a development strategy to realize the project purposes mentioned above, following results and outputs will be essential and prerequisites for the project (refer to Table 15.2-1);

- Strengthening of related government agencies in terms of technical and financial viewpoints,
- Training of related government staff and farmers' representatives,
- Development and strengthening present community organization,
- Planning, designing, construction and operation for improved irrigation systems,
- Establishment of water resources allocation in the basin,
- Effective water management at the farm level with equitable water distribution among farmers,
- Efficient supporting services to farmers, including credit system and loan repayment condition,
- Increased crop production for small farmers for both home consumption and income generation,
- Improvement of farm-to-market roads in the vicinity of Project Areas,
- Improvement of gender issues in rural community,
- Improvement of marketing system and supply of marketing information to farmers,
- Improvement of rural infrastructure in village water supply health, education, rural electricity,
- Improvement of environmental situations, and
- Population control in rural community.

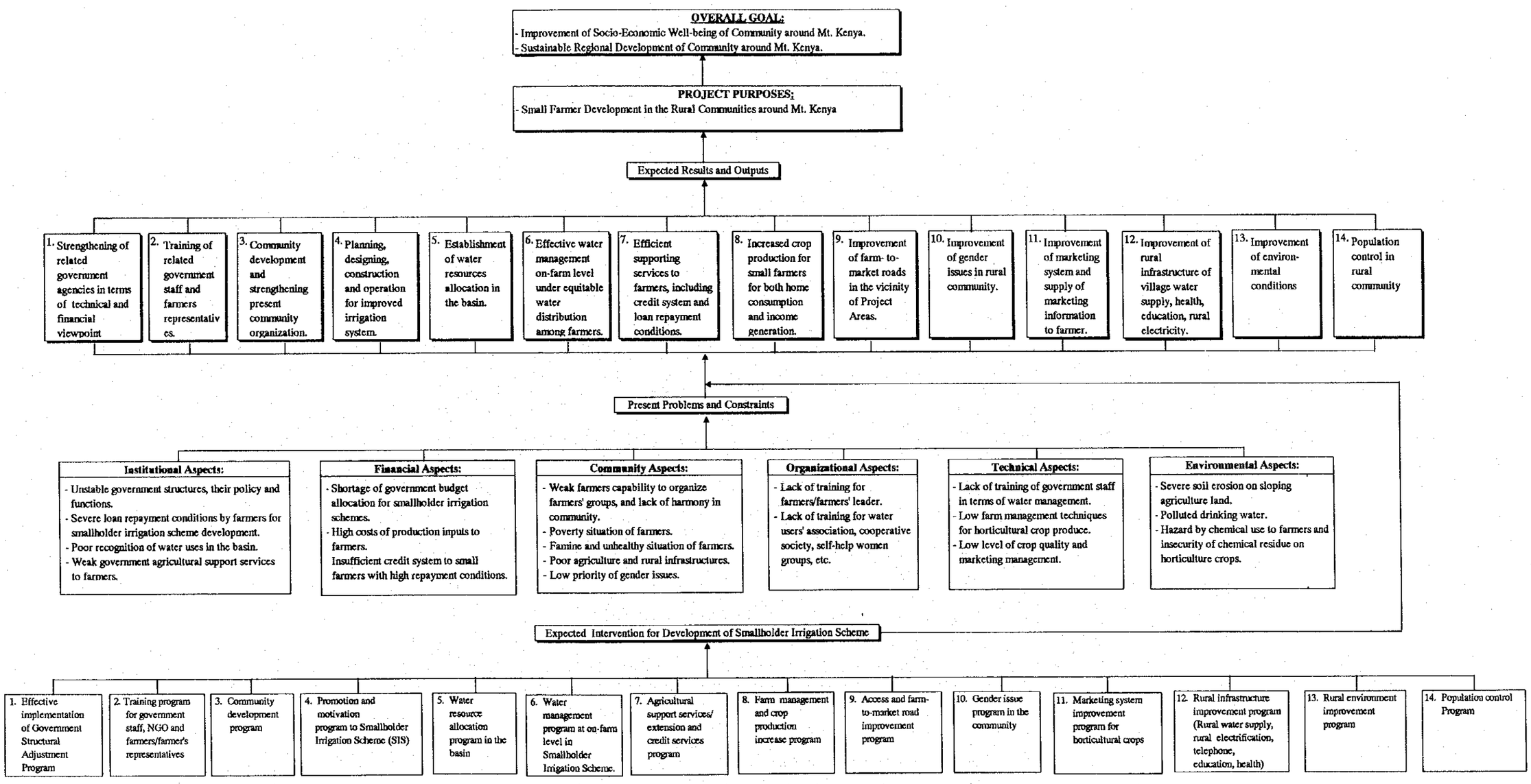


Figure 15.2-1 Expected Overall Development Strategy and Intervention

Expected Intervention for the Project

The expected intervention for the development of smallholder irrigation schemes, which will be consistent with the above mentioned results and outputs are as follows;

1. Effective implementation of Government Structural Adjustment Program
   - Implementation and monitoring of Agricultural Sector Investment Program (ASIP) by relevant government agencies and other agencies
   - Strengthening of government budgets with support by donor's countries

2. Training program for government staff, NGOs, farmers/farmer's representatives
   - Training need assessment and formulation of training strategies for GOK staff
   - Training for production technologies, e.g., irrigation and water management, use of fertilizer as well as pesticides, marketing, farm budgeting, and post-harvest handling for local government field level staff, NGOs, and farmer's group/farmer's representatives by related agencies of MOALD, Egerton University, Jomo Kenyatta University of Agriculture and Technology
   - Training for farmers/farmer's representative on maximum residue levels (MRLs) and pesticide use by Horticultural Crops Development Authority (HCDA), KEPHIS, MOALD, NGOs

3. Community development program
   - Establishment of institutional mechanism and program for social preparation, and undertaking of social preparation of community by means of PRA workshop with participation of beneficiary farmers by Irrigation and Drainage Branch (IDB), Department of Culture and Social Services (DSSS) and the private sectors
   - Undertaking of capability building for farmers' organizations, e.g., water users' association, cooperative society, women's group, production/marketing group by MOALD, DCSS, MLRRWD and NGOs/private sectors
   - Undertaking of development and capacity-building of relevant agencies at district level government staff and NGOs by MOALD and other agencies

4. Motivation program to smallholder irrigation schemes (SIS)
   - Effective implementation, demonstration and monitoring of "Community-Based Smallholder Irrigation Development Project for Promotion of Horticultural Production in the Foothills of Mt. Kenya" by IDB staff and JICA
   - Effective adjustment and coordination with related similar smallholder irrigation projects such as "Eastern Province Horticulture and Traditional Food Crops Project (EHTCP)" by MOALD
   - Promotion of land survey for smallholder's land holdings by District Land Office (DLO), Ministry of Land (MOL)
   - Lowering and easing of loan conditions for development of smallholder irrigation schemes through the discussion with MOALD and financial agencies such as Cooperative Bank of Kenya (CBK), Development Bank of Kenya (DBK)

5. Water resource allocation program in the basin
   - Review of existing water permits (location, permitted water, actual water abstraction, and method of water intake) by District Water Office (DWO), MLRRWD and MOALD.
   - Study for water resources development in sub-basin mode by DWO.
   - Review of Water Act (strengthening of control power and improvement of water charge systems) by MLRRWD
   - Coordination of water use within sub-basin schemes by DWO.

6. Water management program at farm level in smallholder irrigation schemes
   - Rehabilitation and construction of new irrigation facilities by the community under technical assistance of IDB staff and private sectors
   - Review of District Irrigation Profile (location, irrigated area, water requirement, and facilities' conditions) by IDB, MLRRWD and other relevant agencies as well as local communities
   - Promoting the establishment of WUAs by MOALD, NGOs and the private sector
   - Strengthening of existing WUAs by MOALD, NGOs and the private sector
   - Preparation of guidelines for water management by IDB staff, NGOs/private sector

7. Agricultural support services/extension and credit service program
   - Supporting and encouragement of private sector involvement in smallholder irrigation by IDB staff
   - Provision of NGO/private sector with access to technical and market data for distribution to smallholders by IDB and Marketing Information Branch (MIB) staff in MOALD
   - Strengthening of credit operation procedures of financial institutions by MOALD
   - Initiation of on-farm demonstration by MOALD
   - Improvement of horticultural information through the use of KBC by MIB
   - Improvement of mobility of field staff by MOALD

8. Farm management and crop production program
   - Identification of key constraints by crop and development and dissemination for solution by MOALD
   - Development of irrigation crop production guidelines by MOALD
   - Review of opportunities for agricultural processing by MOALD and the private sector
   - Provision of profitable models of farming suitable for young farmers by MOALD
   - Production scheduling in relation to market prospects by MOALD

9. Access and village/farm improvement program
   - Regravelling, rehabilitation and reconstruction of access roads and village/farm roads by MPWH, District County Council and local community

10. Gender Issue program in the community
   - Adoption of participatory approach in respect of gender issues by MOALD
   - Formulation of explicit technical packages that will be gender-friendly, e.g. irrigation design and cropping patterns including crops controlled by women by MOALD
   - Provision of institutional mechanisms for permitting women to access relevant information and technology by MOALD
   - Encouragement of change of negative traditional attitudes towards women among communities by DCSS and other relevant agencies

11. Marketing systems improvement program
   - Training on how to access market information by MOALD/HCDA for local and export markets
   - Improvement of availability of marketing and price information by Market Information Branch (MIB) and DAO
   - Training of market groups on financial and general management by MOALD in collaboration with NGOs and the private sector
   - Training in contract-making and bargaining skills by MOALD/HCDA and others
   - Development of storage for key crops by farmer's group with the assistance of MOALD
   - Training and encouragement of processing and utilization of market surplus by MOALD, NGOs/private sector

12. Rural infrastructure improvement program
    - Rural water supply improvement by self-help groups with the assistance of NGOs
    - Effective coordination with related rural water supply projects such as "Rural Water Supply Program in Tharaka Nithi and Meru District" by SIDA and self-help group
    - Development of other supporting infrastructure, e.g., roads and electricity by related agencies

13. Rural environment improvement program
    - Development of afforestation program by Forestry Department, MOALD and others
    - Reduction of chemical hazards by farmers' groups with the assistance of Department of Environment, MOALD, KARI, KEPHIS, etc.

14. Population control program
    - Encouragement of family planning in rural communities by District Health Office (DHO), MOH

15.3 Establishment of Development Strategies for Horticultural Development

The direct objectives of the Study are to improve the farm economy of smallholders who mostly produce horticultural crops and account for 98.7 percent of the number of farm households in the Study Area. However, there exist many problems and constraints surrounding smallholders irrigation schemes, as stated in the problem analysis.

These problems and constraints could be largely divided into four groups, that is, a) agriculture, b) marketing, c) rural society and d) supporting services. The possible project interventions (components) are proposed to solve the problems and constraints, taking into consideration both soft and hard-aspects to attain the expected project benefits and targets, as shown in Figure 15.3-1.

15.4 Formulation of Basic Development Plan for Master Plan

Basic development plan for the "Irrigated Horticultural Development" in and around the Study Area was formulated based on the development goals and strategies mentioned in the above, and its content includes the following contents;

- Examination of project justification
- Horticultural development plan
- Marketing development plan
- Institutional development plan
- Community development and farmers organization plan
- Irrigation and drainage plan
- Road development plan
- Rural water supply development plan
- Environmental conservation plan
- Operation and maintenance plan
- Project implementation plan
- Improvement of socio-cultural situation

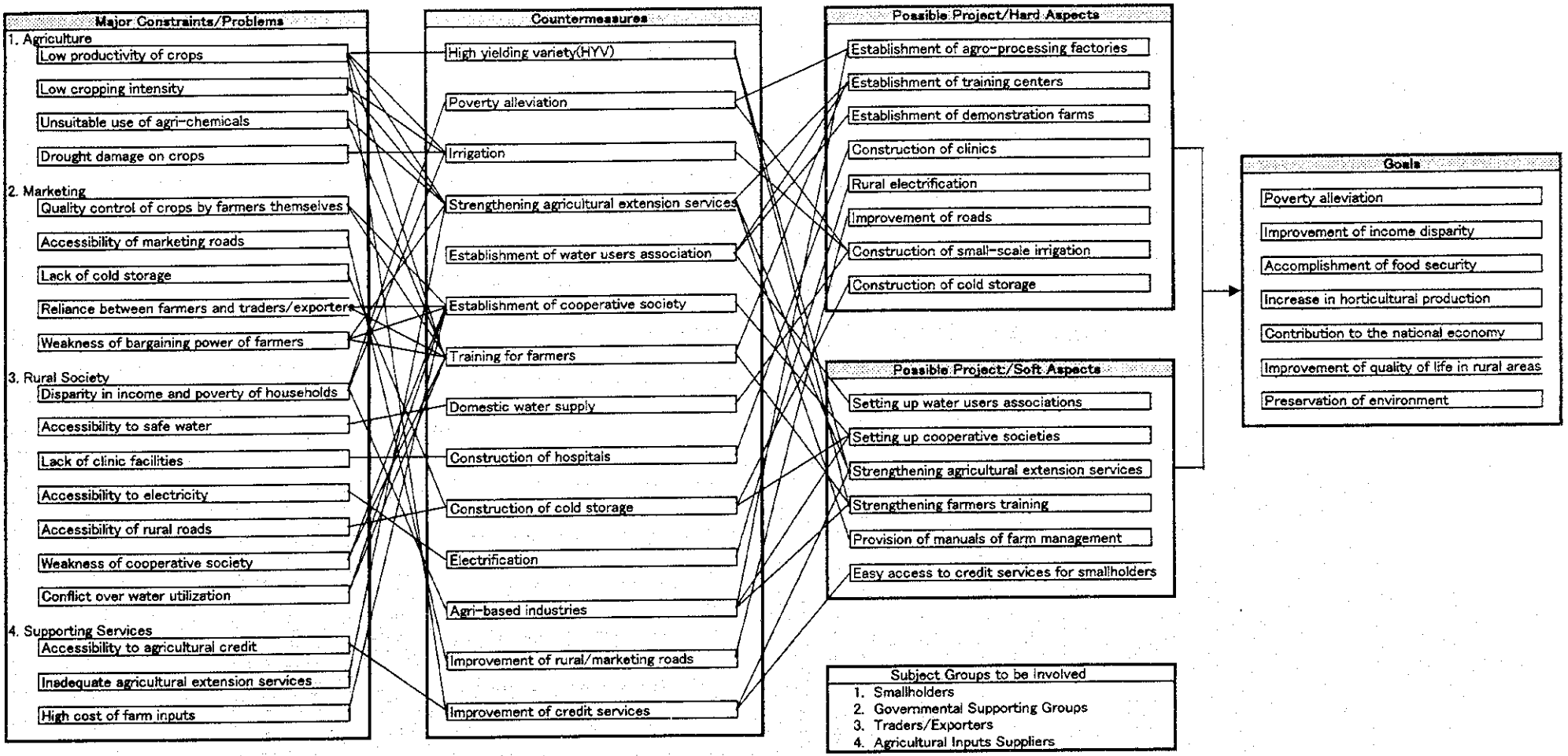


Figure 15-3-1 Relation between Soft and Hard Aspects to be planned

16. Operation and Maintenance Plan

Executing agencies/bodies for the operation and maintenance (O&M) of facilities are divided into two categories, i.e. public sector and private sector.

O&M of irrigation and drainage facilities shall be executed by a WUA. Establishment of a WUA shall be supported by MOALD and NGOs through the implementation of community development and support services. During the O&M stage, technical support shall be extended by MOALD. O&M of village/farm roads shall be executed by village communities, since they are located within the Project Area.

Access roads are maintained by either District Works Office of MPWH or District County Council according to the road classification. However, a part of access roads which functions as a village access shall be planned to hand over to village communities for O&M under the community contracting.

Major market facilities such as cold storage and wholesale/retail marketing shall be operated and maintained by either HCDA or local government such as District County Councils and Municipal/Town Councils. On the other hand, O&M of the post-harvest and processing facilities shall be undertaken by farmers' marketing groups. Since the rural water supply facilities are planned in the category of self-help and community initiated projects, O&M shall be executed by a Project Committee (PC) formed by beneficiaries.

17. Project Implementation Plan

17.1 Project Implementation Organization

The lead implementing agency shall be the MOALD. An Executive Steering Committee (ESC) shall be established under the chairmanship of MOALD Permanent Secretary. A Technical Working Committee (TWC) shall also be established under ESC for smooth implementation. In the district level, a District Project Management Office (DPMO) shall be established.

Implementation mode for facility construction shall be on a contract basis, and community development and support services shall be implemented by consultants and NGOs which are hired on a contract basis. Community initiative shall be fully followed in the implementation of each project.

17.2 Implementation Schedule

1) Implementation Schedule for Model Areas

In formulating the implementation schedule for the selected Model Areas, the followings considerations were taken into account;

- Implementation capability of Irrigation and Drainage Branch (IDB) in MOALD, specially focusing on allocated budgets and staff capability,
- Implementation capability of NGOs, which are main supporting organization for the implementation of the smallholder irrigation schemes,

- Scale and items of construction works for agricultural and rural infrastructual facilities
- Farmer's capability for project implementation, and
- Improvement of credit conditions for farmers to implement the smallholder irrigation schemes

After due consideration of above mentioned matters, it was concluded that the implementation period of each Model Area would be seven years consisting of one and half year for social preparation, one and half year for construction of project facilities, and four years for demonstration of Model Area, follow-up support service, etc.

2) Implementation Schedule for Smallholder Irrigation Schemes in Seven Districts

Since the current Kenyan economy is situated in severe economical and financial conditions as mentioned previously, it will be recommendable to formulated the implementation schedule for the smallholder irrigation schemes from view point of short-term implementation schedule.

Under such considerations, implementation schedule for smallholder irrigation schemes in the Study Area was examined for the following two cases; Case-1: under the same situations of IBD budgets even in future, and Case-2: under the increased IDB budget as same level of budget in 1994/95. In the study, following assumptions are taken into considerations;

- Average project costs per area (average about 270 ha) is about 5,500 thousand Ksh, which is derived from the cost estimation in Model Areas. Beneficial farmers will repay this amount.
- 50 percent of the development budgets allocated to IDB could be used for this project.
- Necessary IDB expenditures for carrying out the project implementation are assumed to be the same amounts of project cost of the scheme.
- The project costs necessary for improvement of rural infrastructural facilities such as road improvement, marketing facilities improvement, etc. will be procured by the related government agencies.

In the Case-1, annual development areas will become two schemes with project area of about 540 ha, under the allocated IDB budget of 1,220 thousand Kenyan Pound. On the other hand, in the Case-2 annual development areas will be of seven schemes under the allocated IDB budget of about 4,030 thousand Kenyan Pound, on the basis of above mentioned assumption.

The commencement of project implementation for these schemes is planned at the stage of three years in the implementation schedule of the Model Area, so as to expect the effective demonstration effects of the Model Area so far implemented. This stage corresponds to the completed year of social preparation works for rural community (1.5 year) and construction works of project facilities (1.5year).

Selection of the schemes to be implemented should be undertaken considering equal distribution of scheme in the Study Area, development priority in the district, demonstration effects by the implementation in the vicinity of the scheme.

18. Conditions of Farm Households in Small-Scale Irrigation Schemes

18.1 Natural Conditions

Existing small-scale irrigation schemes around Mt. Kenya are located in wide varieties of Agro-Ecological Zones, ranging from high to medium potential slopes of Mt. Kenya to low potential, which extends from the lower part of Mt. Kenya into adjacent plateaus (elevation is about 1,100 to 1,800 m above mean sea level).

Climatic conditions around the schemes vary from humid to semi-arid, and remarkable locality of rainfall is observed with about 850 mm at semi-arid zone and about 1,100 mm at humid zone, respectively. Rainy seasons occur two times a year; long rain from middle of March to May and short-rain from early October to November. In accordance with these rainfall patterns, agricultural farming concentrates mostly in these rainy seasons.

18.2 Social Conditions

Present social problems encountered in rural communities were identified through the field survey, participatory rural appraisal (PRA) survey, farm economic survey, workshop seminars with the participation of beneficial farmers, etc, and they are summarized as follows;

- Low crop yield due to lack of irrigation and farming techniques, lack of production inputs, shortage of labor, soil erosion of farm fields, etc.
- Low price of agricultural products due to weak farmers' organization, oppressive crop handling of middlemen, exploitation of exporters, poor access and marketing roads, no provision of storage facilities for produced crops, etc.
- Shortage of farm households' funds and resulting poverty due to low price of agricultural products, no opportunity to access to farm credits, no existence of middlemen, etc.
- Occurrence of diseases for local people due to inadequate nutrition, no provision of public health facilities, etc.

18.3 Agricultural Support Services by Government and Private Sectors

Agricultural support services for the small-scale farmers are programmed to be conducted by government and private sectors in the following fields. However, effective services are not implemented at present due to a shortage of government budgets and staff, expensive input materials, poor quality of seeds, poor access roads, low farmers' capability, etc.

Support Services for Agricultural Inputs

MOALD	: Technical advice on available agricultural inputs, recommended application rates and staging of on-farm demonstration,
Kenya Seed Company	: Production of ranges of seeds including maize, beans, horticultural seeds,
Private Sectors	: Bulk importation of agricultural chemical inputs such as fertilizer, insecticides and fungicides, and re-packing them into conveniently sized

containers for distribution to rural retail shop and stockists by large-scale private sector, and setting up of inputs stores and shops in rural areas by small-scale private sector.

Cooperative Society (coffee, dairy) :Selling and maintenance of input stocks in cooperative stores.

Support Services to Agricultural Extension

MOALD : Technical advice on agriculture plastics, livestock, horticultural crops, marketing, etc. Technical advice and training at field level by District Agricultural Office and District Irrigation Unit

HCDA : Organization of field days to train farmers on post-harvest horticultural crop-handling and packing particularly for export, organization for demonstrations of pesticide application with a view to meeting maximum residue level (MRL) standards, collection and analysis of price information on export crops.

NGOs : Implementation for establishing and strengthening farmers' organization, credit arrangement, irrigation and farming techniques, design and construction of irrigation facilities, etc.

Private Sectors : Demonstration of inputs' use and application techniques

MOCSS : Assistance for local communities on the possibilities and benefits of forming self-help groups, and registration for self-help groups

Support Services to Agricultural Research

KARI : Conducting on-station and on-farm trials for crop spacing, fertilizer use and crop protection applications, soil fertilizer tests, soil surveillance on crop pests and outbreaks of disease, introduction of new crop varieties and screening them for adaptability in the various Agro-Ecological Zones (except for coffee, tobacco, and tea)

British-American-Tobacco Co.
: Research and trials on tobacco planting

18.4 Samples of Small-Scale Irrigation Schemes

As the samples of small-scale irrigation schemes so far implemented, the following two projects could be listed, that is, "Smallholder Irrigation Schemes (SIS) Project" implemented by IDB with assistance from the Netherlands and "Eastern Province Horticultural and Traditional Food Crops" under progress by the International Fund for Agricultural Development (IFAD). The numbers of small-scale irrigation schemes with fully irrigated conditions in the Study Area are 250 schemes (irrigation area is 6,920 ha), out of, a total of 463 small-scale irrigation schemes.

The following section describes the Ciambaraga Irrigation Scheme in Tharaka Nithi district,

which is categorized into Type-A in the classification of existing irrigation schemes. The Ciambaraga Irrigation Scheme is evaluated as a successful small-scale irrigation scheme among the schemes in terms of project implementation and its management.

1) History and Outline of Ciambaraga Irrigation Scheme

Ciambaraga Irrigation Scheme was started with a view to solving the problem of domestic water for the area in 1992, and after holding the first general meeting of those who were willing to join the group, they decided to get both domestic and irrigation water. The group registered with the Ministry of Culture and Social Services (MOCSS) in April 1993 and applied for a water permit in May 1993.

Major features of the scheme are as follows;

Outline of the Scheme

- Scheme gross area	:	600 ha
- Total number of farm households	:	700 households
- Households with irrigation facilities	:	122 households
- Irrigated area	:	52 ha (1.0 acre)
- Farmers' group	:	10-25 households/group
- Total project costs	:	12 million Ksh (98,000 Ksh/house)
- Repayment costs per month	:	2,500-3,000 Ksh/house (four year)
- Starting of repayments	:	August 1997
- Assistance by NGOs	:	SISDO

2) Main Horticultural Crops

Main horticultural crops are French beans, Asian vegetables such as chills, okra, kallera, dudhi, local vegetables such as tomatoes, kale and green maize.

After the implementation of the scheme a marketing committee was established to look for an exporter or whoever was willing to buy the produce from the farmers. Presently, Fresh Produce Exporters' Association of Kenya (FPEAK) is assisting the market activities for the scheme.

3) Farmer's Group and Community Organization

All the scheme members belong to Ciambaraga water users' association (WUA). They contribute 200 Ksh/month, which is banked in the operation and maintenance account in a local bank. This money also pays the water attendant who monitors the project on a day-to-day basis.

After forming WUA in 1992, the members selected a steering committee consisting of chairman, secretary and treasurer. Under the steering committee, 20 sub-group leaders (a man and a woman), maintenance committee, marketing committee, and excavation committee (disbanded after implementation), etc. are organized. The steering committee then approached the Ministry of Agriculture (MOALD) for advice. They were advised to register with Ministry of Culture and Social Services (MOCSS) and apply for a water permit from Ministry of Water Resources (MLRRWD). After fulfilling the requirements, they were introduced to SISDO for loaning.

4) SISDO's Loan Conditions

SISDO's loan conditions are as follows;

- The group must be registered with MOCSS,
- The group must get authority to extract water from MLRRWD,
- Farmers to contribute 15 percent of the estimated project costs. This was meant to show the farmers' commitment towards the project.

After fulfilling the first two conditions, SISDO in conjunction with MOALD started training the leaders on group organization and project management. By-laws were formulated by the members with assistance from MOALD and SISDO.

5) Current Situation and Problems

Current situation and major problems of the scheme, although the scheme is operated by farmers, are summarized as shown below;

- The farmers are well organized with a strong committee, and also project's steering committee is very strong as they have managed to lead the project from its inception to this day.
- Once implemented, the members expected benefit from increased agricultural production and more high value horticultural crops, which will lead to higher incomes and increased employment opportunities in the locality. It will also play a roll in generating much-needed foreign exchange because some of the vegetable will be for the export market.
- Monthly repayment amounts for farmers (repayment period is four years) are presently requested to be about 2,500 to 3,000 Ksh. However, all farmers are not allowed to pay such high repayment amounts, that is, only the amounts of about 2,000 Ksh/month are limited, due to insufficient farm incomes even after the project. These situations cause the shortage of SISDO's budgets. Major reasons of these low farm incomes are mainly due to low productivity of crops, low marketing price of products, high price of inputs, unreasonably high project costs, etc.
- No undertaking of agricultural extension services to farmers in terms of farm and water managements have been undertaken by MOALD.

19. Selection of Model Areas and Classification of Smallholder Irrigation Schemes

19.1 Selection of Model Areas

1) Current Smallholder Irrigation Schemes

There currently exist 463 smallholder irrigation schemes (SISs) (total areas of 63,982 ha) in the Study Area. Out of these SISs, 250 (areas of 6,919 ha) are irrigated with irrigation facilities provided, and however the schemes fully irrigated with 100 percent of the proposed irrigation area are only 22 schemes (areas of 1,449 ha). The annual development of irrigation area over the last 20 years was about 350 ha on average with slow development progress. The reasons for such slow progress are that SISs development have the following constraints resulting from the defects and immaturity of the SISs supporting system, farmers organization and transportation system.

Poor Marketing System

- Lack of information on production elsewhere
- Weak bargaining power of farmers
- Lack of access to market
- High margins by middleman
- Seasonal gluts of production
- Failure of contract farming

Poor Production System

- Insufficient water for crops
- Poor farm management
- Defective strategy and tactics on irrigation development
- Low adaptability of farmers to meet selling standards
- Soil fertility deteriorating
- Sub-optimal farm size

2) Definition and Function of Model Areas

The above-mentioned constraints are commonly observed in all irrigation schemes in the Study Area. In this situation, in order to analyze these problems and constraints to be solved, and also to expect demonstration effects as a model area in terms of smallholder irrigation schemes, the proposed Model Areas will be defined with the following functions;

- Monitoring of actual implementation process in the smallholder irrigation scheme development, especially emphasizing on effects and efficiency obtained through improved horticultural farming under irrigation condition,
- Application of resulting effects and experiences to other smallholder irrigation schemes facing similar problems and constraints at present, so that Model Areas will play an important "pilot area" in developing smallholder irrigation schemes.

3) Selection of Model Areas

a) Category of Existing Smallholder Irrigation Schemes

The existing 463 smallholder irrigation schemes mentioned in the above could be categorized into following five types (Type-A, B, C, D, and E) taking into account the prevailing situation of these schemes such as implementation stage, operation conditions of the scheme, etc. The characteristics of each Type are presented below;

Implemented Schemes

Type-A : This type is the existing scheme with irrigation and farming activities well managed and with provision of irrigation facilities and establishment of farmer's organization,

Type-B : This type is also an existing scheme, but with irrigation and farming activities not well-managed due to ineffective functions of irrigation facilities and weak farmers' organization ,

Proposed Schemes (Expansion and New Development Schemes)

Type-C : This type is a proposed scheme, and in categorized into favorable situations with easy accessibility to area by all-weather roads, low construction costs per hectare, and a high percentage of horticultural cropping,

Type-D : This type is a proposed scheme, and is categorized into a moderate to severe area with relative hard accessibility to area, relative high construction costs per hectare, and a fairly low percentage of horticultural cropping.

Type-E : This type is also a proposed scheme situated in poverty conditions, especially in those districts of Nyambene and Tharaka Nithi.

b) Selection of Representative Model Areas

As a first step for selecting Model Areas, analyses of representative candidates for four types of Model Areas except for Type-A were made applying auto-filter methods using computer, based on the database analysis using the results of District Profile Survey conducted during the Phase-I field works (The reason why Type-A is excluded from the Model Area is that it presently well managed in both hardware of irrigation water supply and software of farmers' organization, marketing, etc.).

And then, in order to select one representative Model Areas in each type, field surveys for nine schemes mentioned above were made to confirm the present situation in each site. Through these field surveys and evaluation meetings with MOALD staff, the following four areas were finally selected as representative Model Areas in each type of classification.

Selected Representative Model Area

Type	Irrigation Scheme	District
Type-B	:Rupingazi Ngerwe Irrigation Schemes (EMB-34)	Embu
Type-C	:Ngomano/Nyangati Water Furrow Project (KIR-22)	Meru
Type-D	:Nkunjumo Water Project (MER-10)	Kirinyaga
Type-E	:Ruungu/Karocho Irrigation Project (THA-40)	Tharaka Nithi

Note; Location of selected Model Areas is shown in Figure19.3-1.

19.2 Classification of Smallholder Irrigation Schemes

The proposed smallholder irrigation schemes of 463 areas were classified in accordance with five clusters of the formulated Model Areas (two types for the implemented irrigation schemes and three types for the expansion and new development irrigation schemes). The objectives of the classification are to judge the similar characteristics of the scheme to the selected model type.

Following table indicates the classified scheme numbers of model types by each district.

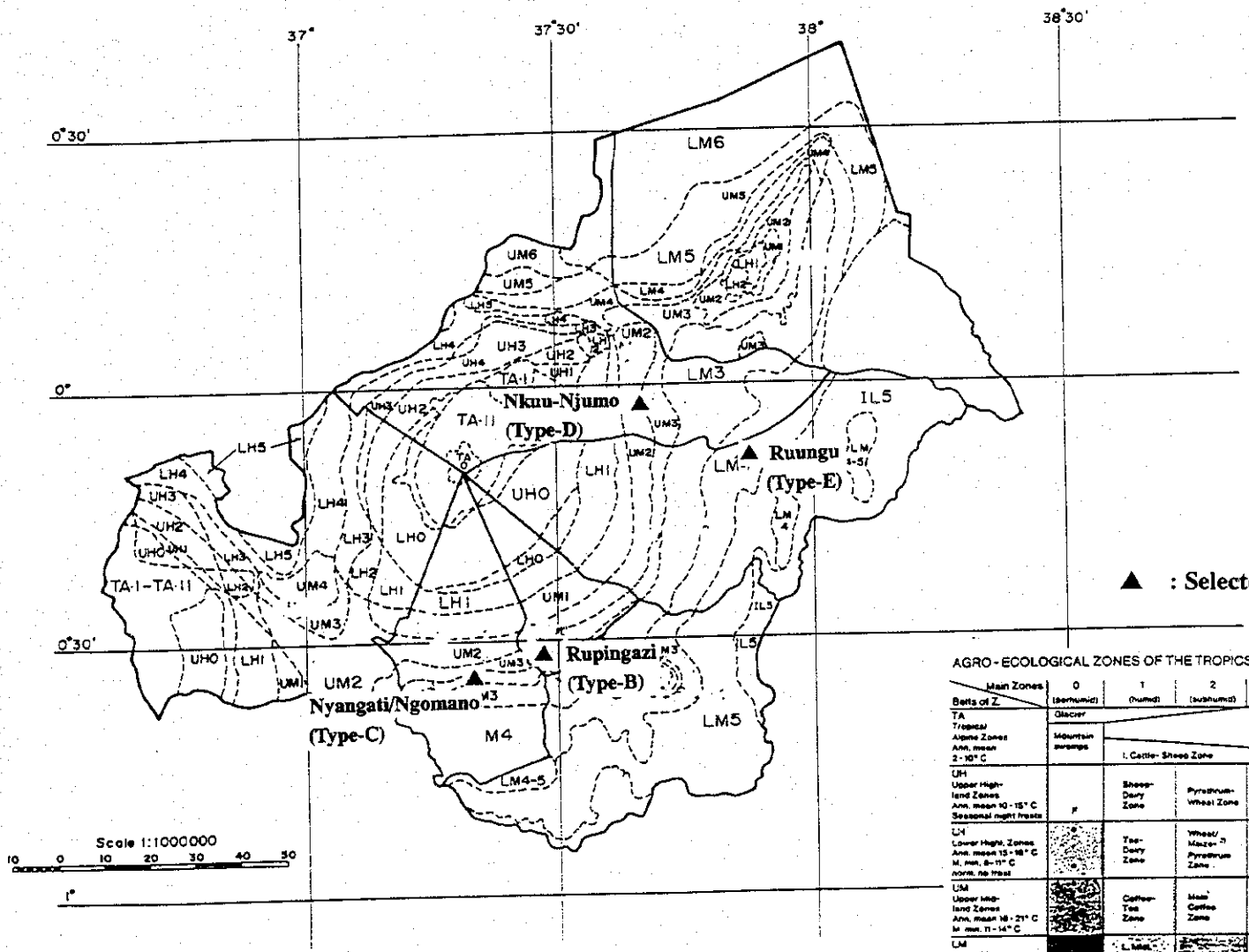


Figure 19.3-1 Location Map of the Selected Model Areas

Analyzed Scheme Numbers of Model Types

District	Types: Existing Schemes		Types: Expansion and New Development Scheme								Total
	Type-A	Type-B	Type-C(1)	Type-C(2)	Type-D(1)	Type-D(2)	Type-D(3)	Type-E(1)	Type-E(2)	Type-X	
Nyeri	6	1	6	19	7	12	6	12		1	70
Kirinyaga		2	8	10	3	5		5			33
Embu		2	6	20	9	6		5	1		49
Mbeere			6	2	6	1	1	12		1	29
Tharaka Nithi	1	1	5	4	8	3			26		48
Meru	5	6	29	22	33	33	9	54		5	196
Nyambene		1	5	2	5				25		38
Total	12	13	65	79	71	60	16	88	52	7	463

Note; Schemes classified into Type-X indicate the area being not available to be classified, because of insufficient data in the District Profile Survey.

20. Recommendations

20.1 Aspects of Administration and developments Policy in Agriculture

a) Under the prevailing Kenya's economic and financial situations, the project is important and should be implemented to support one of ASIP's goals of increased role for the private sector in Kenya's agriculture inclusive of smallholder irrigation schemes and a reduced dependence on government.

b) Basic development policy of the smallholder irrigation schemes is participation of beneficial farmers under the jurisdiction of MOALD, specially Irrigation and Drainage Branch (IDB) in Land Development Division (LDD). Therefore, self-awareness and responsibility for the project implementation by IDB staff in MOALD are strongly requested in the project.

c) The most critical constraint for development of smallholder irrigation projects in Kenya is the inadequate budgetary provision by government for recurrent and development expenditure. Therefore, the government should take necessary actions and arrangements to secure the required funds for irrigation development including sourcing from foreign donors.

d) At the relevant provincial and district-office level and in collaboration with the local community, the administration should be actively involved in better utilization and conservation of river resources including protection of river banks and prevention of illegal abstraction of irrigation water.

e) The provincial administration should facilitate local community initiatives aimed at mobilizing community financial resources for installation of irrigation infrastructure.

f) For the development of smallholder irrigation schemes located in the foothills of Mt. Kenya, existing policy guidelines on smallholder irrigation development should be strictly adhered to by all agencies involved in irrigation (Government and NGOs). In particular, consideration; i) participation of

farmers' groups on a cost sharing basis, ii) full cost recovery of the project costs by farmers, and iii) operation and maintenance of their own project facilities.

g) Current loan conditions applied for development of smallholder irrigation schemes are extremely high and severe not only for farmers but also for horticulture development in the Areas. Consequently, government should take necessary arrangements and adjustment of loan conditions to be applicable to farmers and horticultural crop development in the area.

20.2 Aspects of Project Implementation

a) Training and encouragement of projects implementation agencies such as central and regional government officers at provincial and district level and NGOs will be essential prerequisites in the following fields, in order to implement the project effectively and smoothly. Training subjects are social preparation and community capability-building, establishment and strengthening of farmer's groups, water and farm management, operation and maintenance of project facilities, etc.
IDB staff members will be deployed and trained in PRA and PDM techniques and later attend the short PRA course at Egerton University or Jomo Kenyatta University of Agriculture and Technology, for coordinating social preparation of the community and capability of relevant agencies such as GOK agencies and NGOs within the Study Area.

b) During the course of the project implementation, NGOs playing important functions in the aspects of loan arrangement, supporting services to farmers for organization, agricultural extension services, operation and maintenance of facilities, etc. under the jurisdiction of MOALD. One of the NGOs is SISDO. However, more specified NGOs should be involved for the development of smallholder irrigation schemes, considering the schemes' characteristics such as location, main features of the scheme, scale of schemes, farmer's group situation, etc., in order to expect more effective implementation of the schemes.

c) As the demonstration and pilot farms for promotion of horticultural production in the vicinity of foothills of Mt. Kenya, the following four Model Areas will be implemented as prioritized schemes in the area.

- Rupingazi Ngerwe Irrigation Scheme in Embu district (Type-B)
- Ngomamo/Nyangati Water Furrow Project in Kirinyaga district (Type-C)
- Nkunjumo Water Project in Meru district (Type-D)
- Ruungu/Karocho Irrigation Project in Tharaka Nithi (Type-E)

The testing and monitoring of data obtained through the implementation and monitoring stages of the demonstration farms should be effectively applied to similar types of other schemes falling under different classes (Type-B to Type-E). In addition, farmers/farmers representatives should be supported to make study visits to relatively successful schemes classified as Type-A such as Ciambaraga Irrigation scheme in Tharaka Nithi and Muguna Water Project in Meru district.

d) The Project implementation period in the Feasibility Study was planned to be seven years from the commencement of project implementation in view of the current economic and financial conditions in the country. In this connection, the implementation plan of the master plan should be formulated

more concretely on the basis of the country's future economic and financial situation as well as on outputs obtained from the implemented Model Areas.

e) The limited implementing capacity of MOALD and other supporting agencies will be concentrated in the implementation of the four Model Areas. However, it is recommended that parallel implementation of the remaining 459 schemes be encouraged using any available support capacity of MOALD and other agencies and incorporating approaches specified in this report as well as the existing guidelines on smallholder irrigation.

20.3 Technical Aspects

Agricultural Production

In order to realize the targeted objectives of crop farming in the Area, the following countermeasures as agricultural interventions should be taken.

a) A wide variety of training programs in new technologies and approaches to irrigated horticulture.

b) Listening to, and working closely with the Model Area farmers to empower them,

c) Development and testing of new irrigation methods suitable for smallholder irrigation,

d) Measuring and monitoring water use by farmers in the Model Areas,

e) Field training of farmers in the use of improved/constructed irrigation facilities,

f) Support to, and training of, irrigated horticultural extension agents in both MOALD and selected NGOs,

g) Application of obtained results of field trials and demonstrations of new varieties and techniques at established Model areas,

h) Encouragement of gender-friendly crops such as sweet potatoes, kale and introduction of training programs aimed specifically at women,

i) Monitoring of farm-gate prices and production surpluses in the Model Areas

j) MOALD should assist the scheme in the way that farm planning will be undertaken to come up with appropriate cop mix.

Irrigation Water Resources and Water Permit

a) MLRRWD shall undertake a study on actual irrigation water abstraction in the river basin with cooperation of MOALD with a view to grasping the present situation of available water resources in the basin.

b) MLRRWD shall establish a water resources development plan on the basis of sub-drainage area based on the above study.

c) MLRRWD shall undertake a review of the present Water Act as part of counter measures to attain reasonable water abstraction and utilization

d) WUAs having no water permit at present shall take actions for water applications to MLRRWD to get the permit.

Irrigation and Drainage

a) MOALD shall undertake a detailed review of District Profiles for smallholder irrigation schemes (including individual smallholder schemes) located in the Study Area and formulate a promotion plan of such schemes on a priority basis.

b) MOALD shall train and strengthen WUAs of smallholder irrigation schemes through periodical training of WUA leaders in order to improve O&M works for irrigation facilities and water management and to obtain water permit.

c) MOALD shall undertake training programs for front-line extension workers to upgrade their techniques and knowledge on irrigated agriculture and water management.

d) Members of WUAs shall have mature discussion on the methodology of water management and O&M work for irrigation facilities and determine the basic plan for the rehabilitation scheme before the commencement of actual implementation.

Farmers' Organization

a) Since the proposed project will mainly be community-based and farmer-managed, MOALD should assign a qualified staff member with the task of strengthening and coordinating farmers' organization within the project sites.

b) In drawing on the findings of the feasibility study, MOALD should formulate a detailed plan aimed at strengthening farmers' organization throughout all the stages of the project cycle.

c) There are several agencies (government and NGOs) involved in the promotion of smallholder irrigation within the Project Area. MOALD should therefore take the initiative in ensuring a common approach in strengthening farmers' organization including training of leaders and ordinary farmers.

Marketing

a) In close collaboration with other stakeholders, Marketing Information Branch (MIB) of MOALD should collect comprehensive marketing information of trading volume, trend, and destination of produce and up-date prices. Dissemination of this information should be propagated through detailed descriptions in newspapers, longer broadcasting time on radio programs and extension services through

marketing offices in DAOs. MB should exchange export produce information in close coordination with HCDA and other relevant stakeholders.

b) Provision of cold storage facilities is essential for maintaining the quality of horticultural produce and emphasis should therefore be placed on prompt implementation of the on-going HCDA cold storage programme within the Study Area.

c) Improvement of existing marketing facilities should be implemented to meet the requirements of maintaining crop quality and shelf life, equal allocation for retailers and hawkers, collection of marketing information and provision of services.

d) Promotion of small-scale market groups should be undertaken by relevant stakeholders.

e) Necessary countermeasures for seed improvement are needed to increase expected of yields and durability against drought and diseases.

f) In collaboration with local authorities, MOALD should explore the possibility of installing roadside marketing facilities near production centers in order to enhance domestic marketing outlets for horticultural produce

g) Contract farming should be extensively promoted as a part of marketing strategy for horticultural crops and mechanisms for contract enforcement should be put in place by the relevant stakeholders (farmers, MOALD, HCDA, FPEAK, private sector)

Environment

a) From the viewpoint of rural environment, the project plan should include soil conservation and water source management, which will have an influence on the agricultural plan as well as public health and water-borne diseases.

b) Soil conservation plan should include technical support from MOALD to farmers for planting of trees, crop rotation, in-put of manure, promotion of improved cooking stoves, etc. On the other hand, watershed management plan should include the management of Mt. Kenya Forest Reserve by the Forest Department. Public health should include extension services by MOALD on the use of agro-chemicals, sanitary education etc. anti-malaria plan should includes the study of anti-malaria plants and promotion of their growing by MOALD.

c) At areas adjacent to forest areas, it is important to pay due consideration that the irrigated crop farming during the dry season has the possibility to be damaged by elephants judging by severe living conditions in the forest during the dry season. Therefore, necessary countermeasures should be provided.