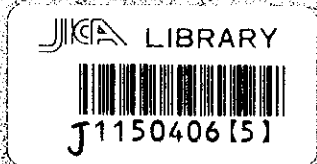


JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)  
MINISTRY OF AGRICULTURE (MOA)  
REPUBLIC OF KENYA

**THE STUDY  
ON  
COMMUNITY-BASED SMALL HOLDER IRRIGATION  
DEVELOPMENT PROJECT  
FOR  
PROMOTION OF HORTICULTURAL PRODUCTION  
IN  
THE FOOTHILLS OF MT.KENYA**

**MAIN REPORT FOR FEASIBILITY STUDY**



**MARCH, 1999**

**SANYU CONSULTANTS INC.**

AFA
JR
99-05



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1150406 [5]

## PREFACE

In response to a request from the Government of the Republic of Kenya, the Government of Japan decided to conduct the study on Community-Based Small Holder Irrigation Development Project for Promotion of Horticultural Production in the Foothills of Mt. Kenya and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Kenya a study team headed by Mr. Seiji Takeuchi, Sanyu Consultants Inc., three times between July 1997 to August 1998.

The team held discussions with the officials concerned of the Government of Kenya, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Kenya for their close cooperation extended to the Team.

March 1999



---

Mikio Fujita  
President

Japan International Cooperation Agency

Mr. Kimio Fujita  
President,  
Japan International Cooperation Agency (JICA)  
Tokyo, Japan

March 1999

**Letter of Transmittal**

Dear Sir,

We are pleased to submit herewith the Feasibility Study Report on Community-Based Small Holder Irrigation Development Project for Promotion of Horticultural Production in the Foothills of Mt. Kenya.

The Report, which describes the proposed plan for improvement of irrigated horticultural development with a participation of farmers in the area, is compiled in reflecting the advice and suggestions for the formulation of the above mentioned project by the authorities concerned of the Government of Japan and your Agency. Also comments made by the related agencies of the Government of the Republic of Kenya are incorporated in the Report.

The study had been carried out in the phasing manners, Phase-I, Phase-II and Phase-III. In the courses of the Phase-I study, Master Plan for the project was formulated, and Model Areas were preliminarily selected. During the Phase-II study followed by the Phase-I study, four Model Areas were finally selected through the discussions and field survey in collaboration with the Kenyan government staff. Furthermore, during the Phase-III study Feasibility Study on the selected Model Areas was made.

As the result of the study, the project plan involving a) introduction of small holder irrigation system, b) improving management of sustainable horticultural farming, c) organization of small farmers, d) construction of rural infrastructure such as farm roads, marketing facilities, etc., and operation and maintenance works for them, e) improvement of agricultural extension and credit services, and f) improving access to information on marketing and various information route, etc. was proposed under the participation of beneficial farmers. Through the improvement of the above-mentioned conditions, it will surely be believed that project will greatly contribute to the improvement of socio-economic well-being and sustainable regional development of the communities around Mt. Kenya.

Finally, we take this opportunity to express our sincere gratitude to Ministry of Agriculture (MOA) of the Government of the Republic of Kenya, Ministry of Foreign Affairs, Ministry of Agriculture, Forestry and Fisheries of the Government of Japan, and Japan International Cooperation Agency, especially for Advisory Committee which gave useful advice to the study team from time to time so as to smoothen the study.

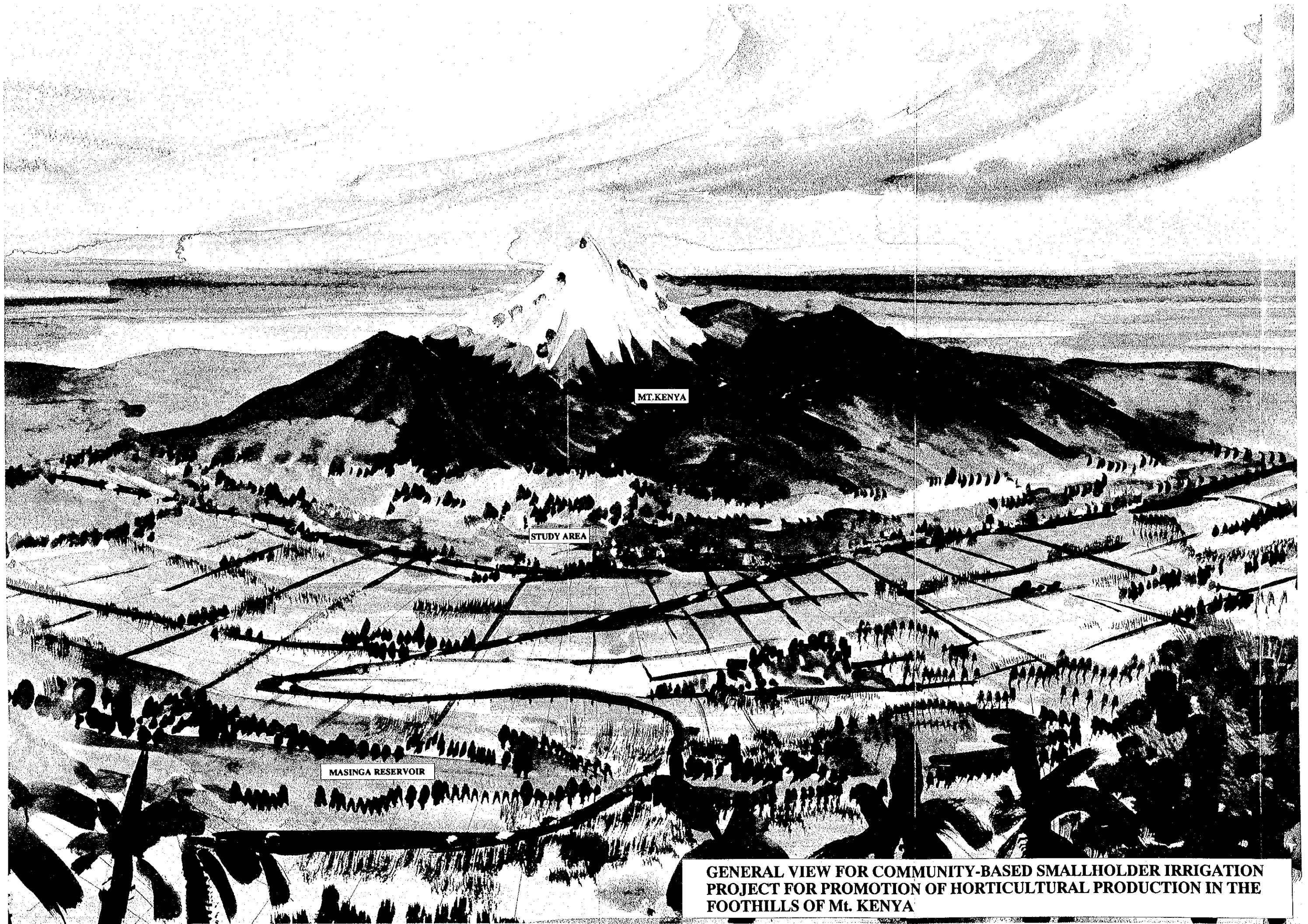
Respectfully yours,



---

Seiji Takeuchi  
Team Leader of the Study Team





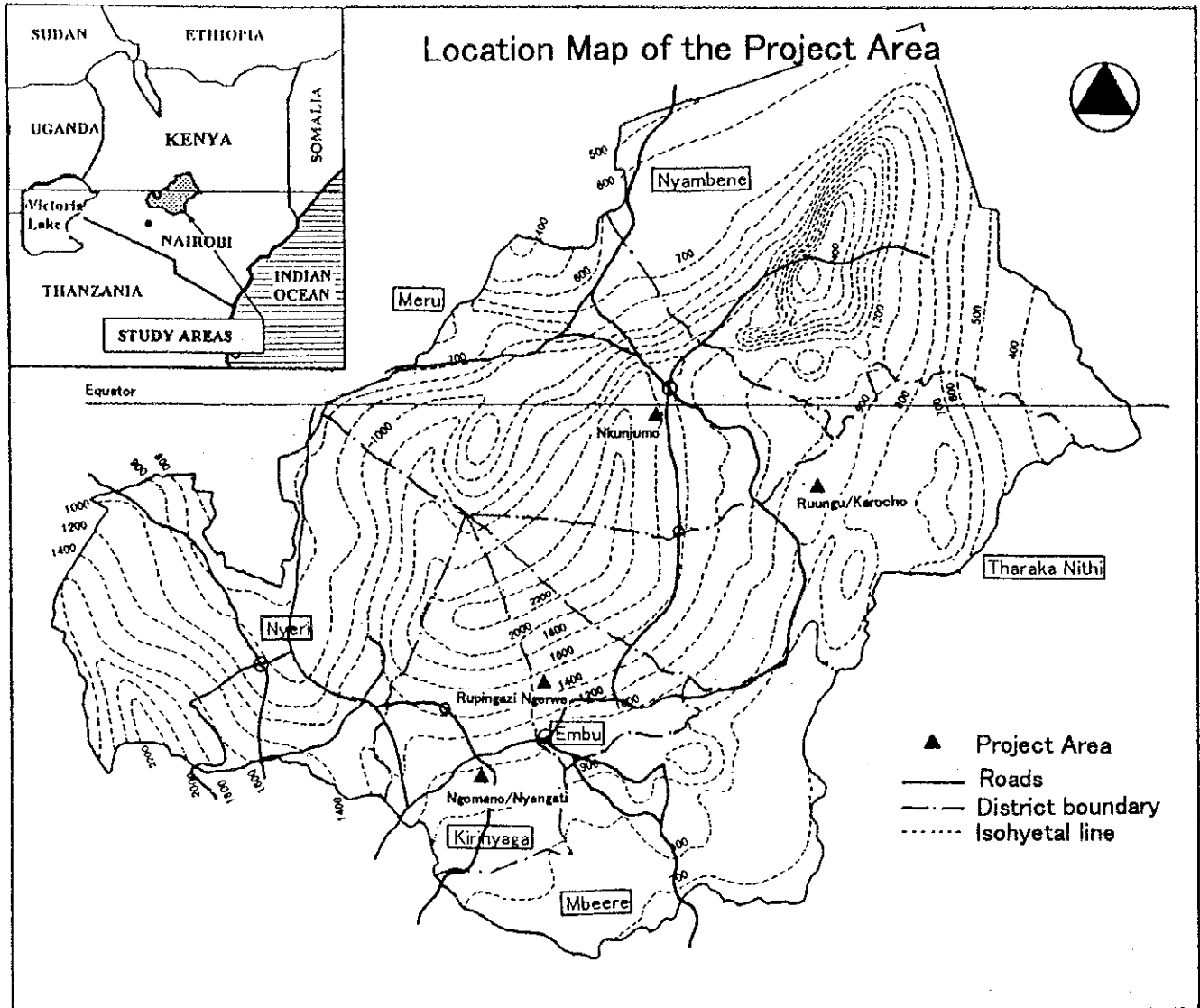
MT.KENYA

STUDY AREA

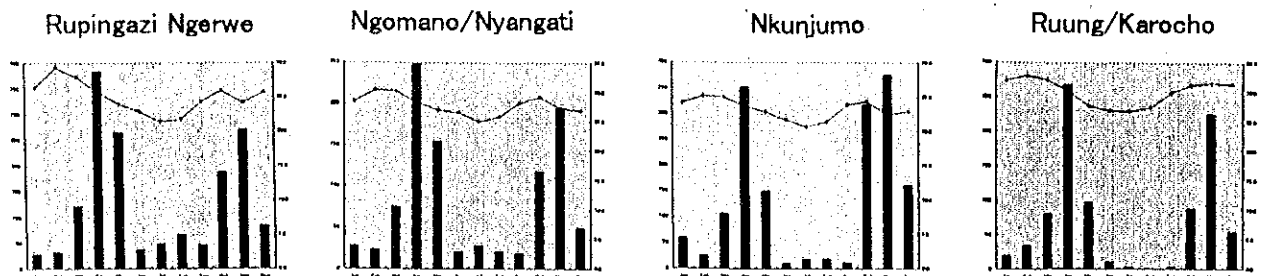
MASINGA RESERVOIR

GENERAL VIEW FOR COMMUNITY-BASED SMALLHOLDER IRRIGATION PROJECT FOR PROMOTION OF HORTICULTURAL PRODUCTION IN THE FOOTHILLS OF Mt. KENYA





Monthly Rainfall and Mean temperature



	Rupingazi Ngerwe	Ngomano/Nyangati	Nkunjumo	Ruung/Karocho
1. Province	Eastern	Central	Eastern	Eastern
2. District	Embu	Kirinyaga	Meru	Tharaka Nithi
3. Annual rainfall(mm)	1,364	1,014	1,259	847
4. Total area(ha)	166	376	160	NA
5. Elevation(m)	1,600	1,200	1,600	750
6. Present irrigable area(ha)	1	13	16	0
7. Population	2,200	1,300	2,200	2,300
8. Average family size	7.6	6.6	7.4	7.9
9. No. of farm households	300	200	300	300
Of which, member	60	68	140	164
non-member	240	132	160	136
10. Average farm size(ha)	1.33	1.50	1.10	2.80



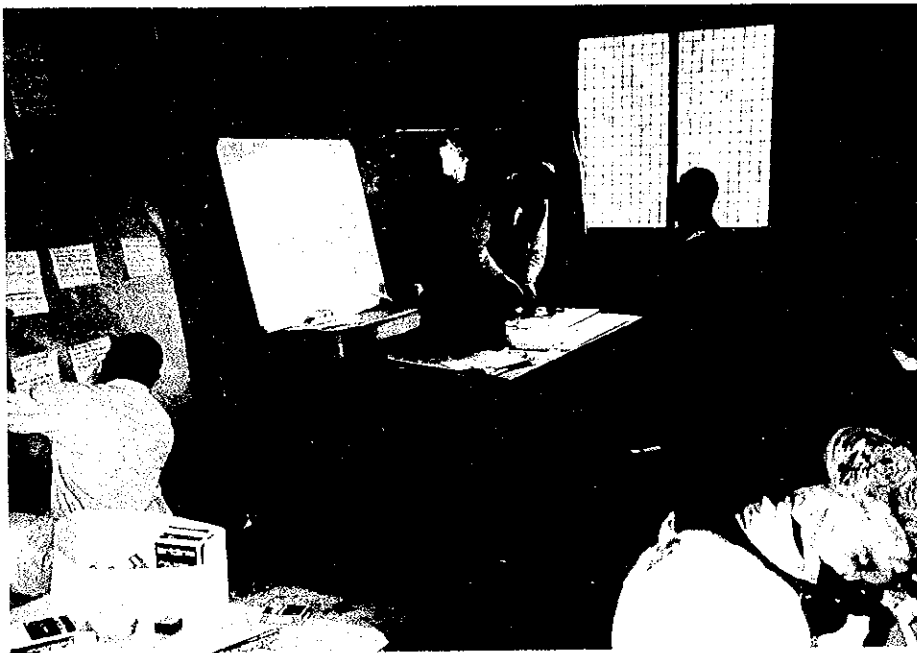
Tea plantation observed in the sloping area



Verbal information survey from farmer in the  
Rupingazi Ngerwe Irrigation Scheme



Workshop seminars held at Ruungu/Karocho Irrigation Project with participation of farmers



Workshop seminars held at Nkunjumo Water Project



Workshop seminars held at Rupingazi Ngerwe Irrigation Scheme



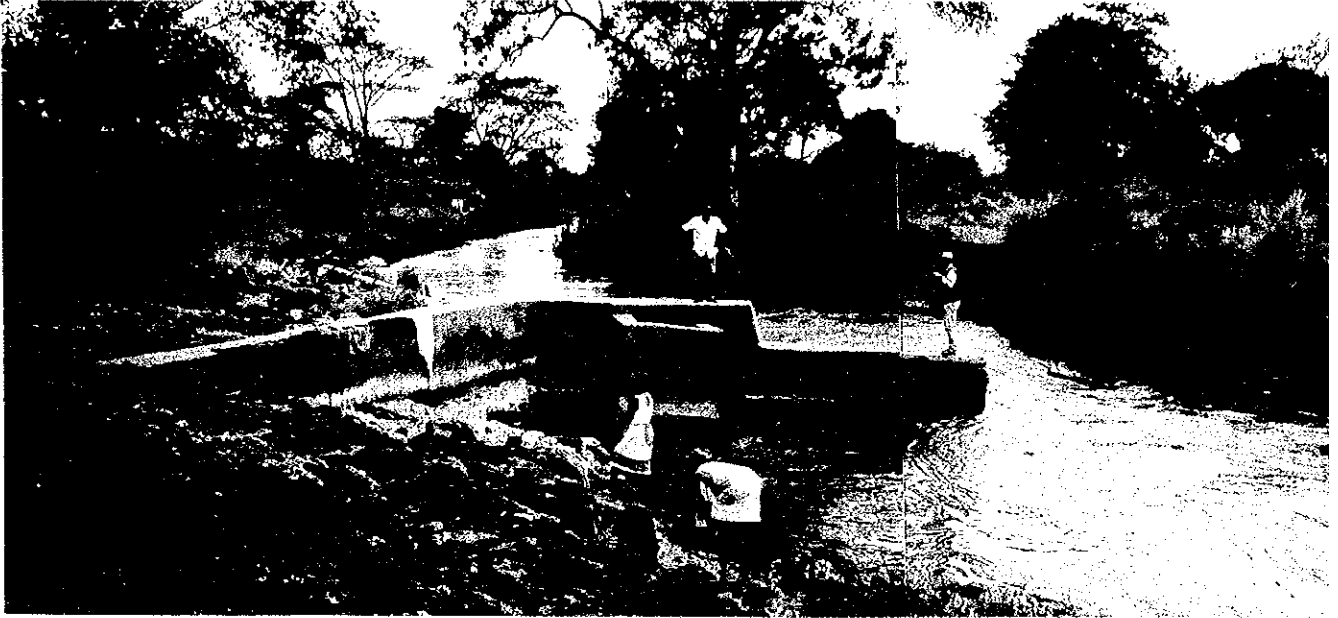
Farming by smallholder's farmers at Ciambaraga Irrigation Scheme (Type-A), under provision of sprinkler irrigation systems



Plowing works using cow in Ngomano/Nyangati Water Furrow Project, under rainfed conditions



Coffee drying works at coffee factory



Intake facilities in Ruungu/Karocho Irrigation Project,(right bank portion of intake has been washed away by the1997 flood)



Simple intake facilities provided by tree and embanked soil in Ngomano/Nyangati Water Furrow Project. Intake is washed away every year by flood.



"Three Stone Jico" of coking stove provided in homestead in Kirinyaga district



Soil conservation works by Perspalum Grass planted at edge of terrace in steep sloping coffee area(Menu district)



Land sliding site observed at main roads at about 1.0km far from Chuka town, No pasable of vehicles(Tharaka Nithi district)



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## **ABBREVIATIONS AND GLOSSARIES**

(as of August 1997)

### **1. Related Agencies**

ADB	: African Development Bank
AED	: Agricultural Engineering Division
AFC	: Agricultural Finance Corporation
ASK	: Agricultural Society of Kenya
BADC	: Belgian Administration for Development Cooperation
BAT	: British-American-Tabacco Co.
CBK	: Cooperative Bank of Kenya
CBOK	: Coffee Board of Kenya
CBS	: Central Bureau of Statistic
CBOs	: Community-Based Organizations
CC	: County Council
CRF	: Coffee Research Foundation
DANIDA	: Danish International Development Agency
DBK	: Development Bank of Kenya
DDC	: District Development Committee
DDP	: District Development Plan
DEAR	: Department of Extension and Adaptive Research
DFID	: Department for International Development(UK)
DIU	: District Irrigation Unit
DPIS	: Department of Planning and Information Services
DPD	: Development Planning Division
DvDC	: Divisional Development Committee
DWDP	: District Water Development Plan
DWDS	: District Water Development Study
EC	: European Commission
EDF	: European Development Fund
EEC	: European Economic Commission
EPC	: Export Promotion Council
EU	: European Union
FAO	: Food and Agricultural Organization of the United Nations
FINNIDA	: Finnish International Development Agency
FPEAK	: Fresh Produce Exporters Association of Kenya
FRG	: Federal Republic of Germany
GOK	: Government of Kenya
GTZ	: Deutsche Gesellschaft fur Technische Zusammenarbeit (German Agency for Technical Cooperation)
HCDA	: Horticultural Crops Development Authority
IBRD	: International Bank for Reconstruction and Development
ICDC	: Industrial and Commercial Development Corporation
IDA	: International Development Association
IDB	: Irrigation and Drainage Branch

IFAD	: International Fund for Agricultural Development
ILO/ASIST	: International Labour Organization, Advisory Support, Information Services and Training
IMF	: International Monetary Fund
IPC	: Investment Promotion Center
ITC	: International Trade Center
JETRO	: Japan External Trade Organization
JICA	: Japan International Cooperation Agency
JKUAT	: Jomo Kenyatta University of Agriculture and Technology
KARI	: Kenya Agricultural Research Institute
KBC	: Kenya Broadcasting Corporation
KBS	: Kenya Bureau of Standards
KCC	: Kenya Co-operative Creameries
KDB	: Kenya Dairy Board
KEPHIS	: Kenya Plant Health Inspectorate Services
KETA	: Kenya External Trade Authority
KEWI	: Kenya Water Institute
KfW	: Kreditanstalt für Wiederaufbau (German Agency for Technical Assistance)
KMD	: Kenya Meteorological Department
KPCU	: Kenya Planters' Cooperative Union
KSA	: Kenya Sugar Authority
KSS	: Kenya Soil Survey
KTDA	: Kenya Tea Development Authority
KWAHO	: Kenya Water for Health Organization
KWS	: Kenya Wildlife Service
LDD	: Land Development Division
MEC(MENR)	: Ministry of Environmental Conservation (Ministry of Environment and Natural Resources)
MGD	: Mines and Geology Department
MOA(MOALD)	: Ministry of Agriculture (Ministry of Agriculture and Livestock Development)
MOCD	: Ministry of Co-operative Development
MOCI	: Ministry of Commerce and Industry
MOCSS	: Ministry of Culture and Social Services
MOE	: Ministry of Energy
MOF	: Ministry of Finance
MOH	: Ministry of Health
MOL	: Ministry of Land
MOLG	: Ministry of Local Government
MOLMD	: Ministry of Labour and Manpower Development
MOPND	: Ministry of Planning and National Development
MORTTT	: Ministry of Research Technical Training and Technology
MOTC	: Ministry of Transport and Communication
MPWH	: Ministry of Public Works and Housing
MWR(MLRRWD)	: Ministry of Water Resources (Ministry of Land Reclamation, Regional and Water Development)
NCPB	: National Cereals and Produce Board
KEDS	: Kenya Export Development Support
NES	: National Environmental Secretariat
NGOs	: Non Governmental Organizations
NIB	: National Irrigation Board

NRI	: National Resources Institute
NSQCS	: National Seed Quality Control Services
NWC&PC	: National Water Conservation and Pipeline Cooperation
OECD	: Organization for Economic Cooperation and Development
OECF	: Overseas Economic Cooperation Fund
OP	: Office of the President
OVP&MPND	: Office of the Vice-President and Ministry of Planning and National Development
PC	: Project Committee
PDA	: Provincial Director of Agriculture
PDMED	: Project Development Monitoring and Evaluation Division
PIO	: Project Implementation Office
PIU	: Provincial Irrigation Unit
RBDA	: River Basin Development Authority
SIDA	: Swedish International Development Agency
SISDO	: Smallholder Irrigation Scheme Development Organization
SISO	: Smallholder Irrigation Support Organization
SOK	: Survey of Kenya
SSIDP	: Small Scale Irrigation Development Project
TARDA	: Tana and Athi River Development Authority
TBK	: Tea Board of Kenya
UNESCO	: United Nations Educational, Scientific, and Cultural Organization
UNIDO	: United Nations Industrial Development Organization
UON	: University of Nairobi
USAID	: United States Agency for International Development
WAB	: Water Appointment Board
WB	: World Bank
WDD	: Water Development Department
WHO	: World Health Organization
WQPCC	: Water Quality and Pollution Control Laboratory
WTO	: World Trade Organization

## **2. Glossaries**

AA	: Agricultural Assistant
AI	: Artificial Insemination
AO	: Agricultural Officer
AAO	: Assistant Agricultural Officer
ADA	: Assistant Director of Agriculture
ADF	: African Development Fund
AE	: Agricultural Engineer
AEZ	: Agro.- Ecological Zone
AO	: Agricultural Officer
AGDP	: Agricultural Gross Domestic Product
AIDS	: Acquired Immuno Deficiency Syndrome
ASAL	: Arid and Semi Arid Land
ASIP	: Agricultural Sector Investment Programme

B/C Ratio	: Benefit Cost Ratio
COC	: Community Organizers Consultants
CAAO	: Chief Agricultural Assistant Officer
DAE	: District Agricultural Engineer
DAO	: District Agricultural Officer
DC	: District Commissioner
DCC	: District Coordinating Committee
DDA	: Deputy Director of Agriculture
DDO	: District Development Officer
DFRD	: District Focus for Rural Development
DHO	: District Horticultural Officer
DIE	: District Irrigation Engineer
DIO	: District Irrigation Officer
DIU	: District Irrigation Unit
DO	: District Officer
DWE	: District Water Engineer
DWO	: District Water Office
ECF	: East Coast Fever
EIA	: Environmental Impact Assessment
EIRR	: Economic Internal Rate of Return
FIRR	: Financial Internal Rate of Return
FY	: Financial Year
GDP	: Gross Domestic Product
GRDP	: Gross Regional Domestic Product
HIV	: Human Immuno-Deficiency Virus
HMP	: High to Medium Potential
IE	: Irrigation Engineer
IEE	: Initial Environmental Examination
IRS	: Integrated Rural Survey
ISH	: Individual Smallholder
JAA	: Junior Agricultural Assistant
KBS	: Kenya Bureau of Standard
KS	: Kenya Standard
LBM	: Labour Based Method
LU	: Livestock Unit
MIDAS	: Minor Irrigation Design Aid Software
M/M	: Minutes of Meeting
MRL	: Maximum Residue Level
MRP	: Minor Roads Programme
M/P	: Master Plan
NEAP	: National Environmental Action Plan
NEP	: National Extension Project
NWMP	: National Water Master Plan
NORAD	: Norwegian Rural Access Road Development

ODA	: Official Development Assistance(Japan)
O&M	: Operation and Maintenance
OOIP	: Objectives Oriented Intervention Planning
PDA	: Provincial Director of Agriculture
PDM	: Project Design Matrix
PMC	: Project Management Committee
PRA	: Participatory Rural Approach
PSC	: Project Steering Committee
RARP	: Rural Access Roads Programme
RDF	: Rural Development Fund
RMI	: Road Maintenance Initiative
RTF	: Research Trust Fund
RWSDP	: Rural Water Supply Development Project
SAAO	: Senior Assistant Agricultural Officer
SAE	: Senior Agricultural Engineer
SAO	: Senior Agricultural Officer
SDDA	: Senior Deputy Director of Agriculture
SDR	: Special Drawing Right
SIDP	: Smallholder Irrigation and Drainage Project
SIS	: Smallholder Irrigation Scheme
SOK	: Survey of Kenya
SPR	: Special Purpose Road
SSIDP	: Small Scale Irrigation Development Project
SSATP	: Sub-Saharan African Transport Programme
SSIU	: Small Scale Irrigation Unit
S/W	: Scope of Work
SWEP	: Surface Water Extraction Permit
TA	: Technical Assistance
TO	: Technical Officer
T&V	: Training and Visiting
UNDP	: United Nations Development Programme
UNEP	: United Nation Environment Programme
UNICEF	: United Nations International Childrens Emergency Fund
UNFPF	: United Nation Population Fund Programme
UPOV	: Union for the Protection of New Plant Varieties
WID	: Women in Development
WRAP	: Water Resources Assessment Project
WTP	: Water Treatment Plant
WUAs	: Water Users Associations

### **3. Unit of Measurements**

mm	: millimeter
cm	: centimeter
m	: meter
km	: kilometer
sq.m	: square meter

sq.km	: square kilometer
ha	: hectare
l, lit	: liter
cu.m	: cubic meter
MCM	: million cubic meter
cu.m/day	: cubic meter per day
lit/sec	: liter per second
cu.m/sec	: cubic meter per second
ppm	: parts per million
pH	: potential of hydrogen
EC	: electric conductivity
g	: gram
kg	: kilogram
t, ton	: metric ton
sec.	: second
min.	: minute
hr.	: hour
yr.	: year
ave.	: average
min.	: minimum
max.	: maximum
kcal	: kilocalories
kw	: kilowatt
kwh	: kilowatt-hour
%	: percent
No.	: number
°C	: degree centigrade
cap.	: capita
md	: man-day
mil.	: millimho
pers.	: person
mmho	: micromho
msl	: meters above mean sea level
vpd	: vehicle per day
ET	: evapo-transpiration
N	: nitrogen
P	: phosphorus
K	: potassium
Kenya shilling (Ksh)	: Kenya shilling
K £	: Kenya Pound (20 Kenya Shillings)
US\$	: US Dollar = 60 shillings (August 1998)

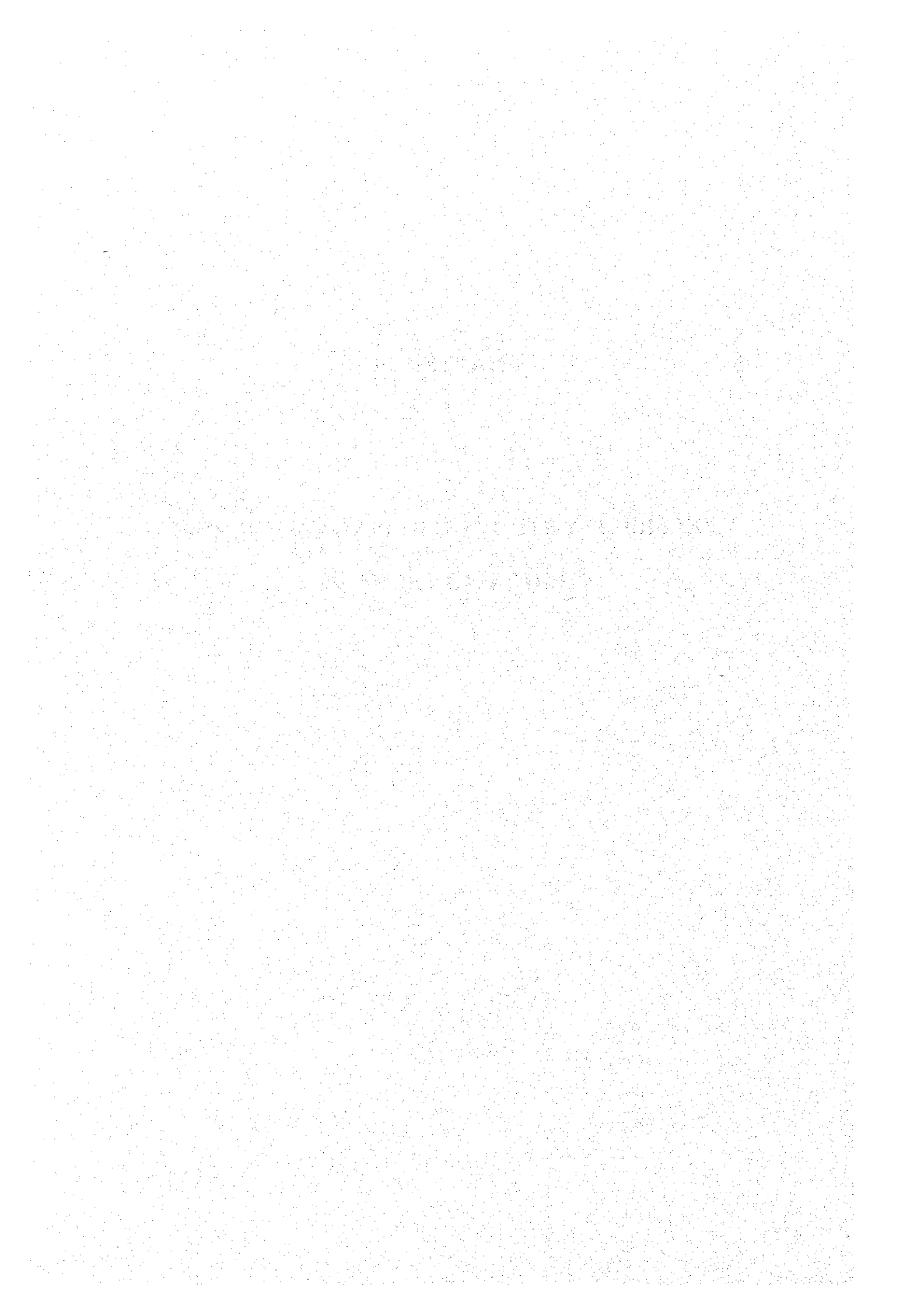
1/ The organization names of the Government of the Republic of Kenya in the Master Plan Report are used as of August 1997, while those in the Feasibility Study are based on the latest Government organization. Major differences in organization names used in both Reports are as follows;

Ministry of Agriculture and Livestock Development (MOALD)→Ministry of Agriculture (MOA)  
Ministry of Land Reclamation, Regional and Water Development (MLRRWD)→Ministry of Water Resources (MWR)  
Ministry of Environment and Natural Resources (MENR)→Ministry of Environmental Conservation (MEC)

## **CHAPTER I.**

# **FEASIBILITY STUDY ON RUPINGAZI NGERWE IRRIGATION SCHEME**





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## CHAPTER I. FEASIBILITY STUDY OF RUPINGAZI NGERWE IRRIGATION SCHEME

### 1.1 Present Situation of the Area

#### 1.1.1 Introduction

Rupingazi Ngerwe Irrigation Scheme is Type-B Model Area. This Area is existing irrigation scheme provided with necessary irrigation and drainage facilities. However, community activities in the Area such as irrigation, crop farming, marketing activities, etc. are not well-managed due to ineffective function of irrigation facilities and weak farmers' organization.

#### 1.1.2 Physical Condition

##### 1) Location, Meteorological and Hydrological Conditions

Rupingazi Ngerwe Irrigation Scheme is situated in Ngida location, Manyatta Division of Embu District, Eastern Province. It is about 12 km north north-east of Embu town. The scheme extends 6.2 km along the right bank of the Rupingazi river and is up to 0.3 km wide. The gross area of scheme is 161 ha.

The scheme is in Agro-ecological zone UM2, the main coffee zone. The mean annual rainfall of 1,364 mm is only slightly exceeded by the evaporation of 1,550 mm with the long rains from March to May and the short rains from October to November. The temperature are moderately warm ranging from a daily minimum of 12.1°C in January to a daily maximum of 26.3°C in March. The details of data observed at Embu Meteorological Station are shown in Table G.2.1-1, Annex G.2.

The irrigation water source is the Rupingazi river, which is a tributary of the Thiba river, one of major rivers in Embu district. The catchment area for the scheme is partly located in the nearby Njukiini Forest. As the catchment area above the intake site is about 130 sq.km, and upstream use is limited, the water is available year round. The location of meteo-hydrological stations and the intake of project is shown in Figure 1.1-1.

##### 2) Topography

The Project lies between 1,440 m to 1,560 m in elevation in a hill and valley region, part of the south-eastern foothills of Mount Kenya. The longitudinal gradient along the Rupingazi river is about two percent and the sectional gradient is so steep such as more than 30 percent partly. The currently non-functioning permanent weir and gravity intake structure is located on the upstream portion of the Rupingazi river in a narrow and steep sided valley. The distribution canal runs along the bottom edge of the steep sided valley slope. The potential irrigation area is located on a gently sloping river terrace of variable width, with an undulating slope of between 0-8 percent.



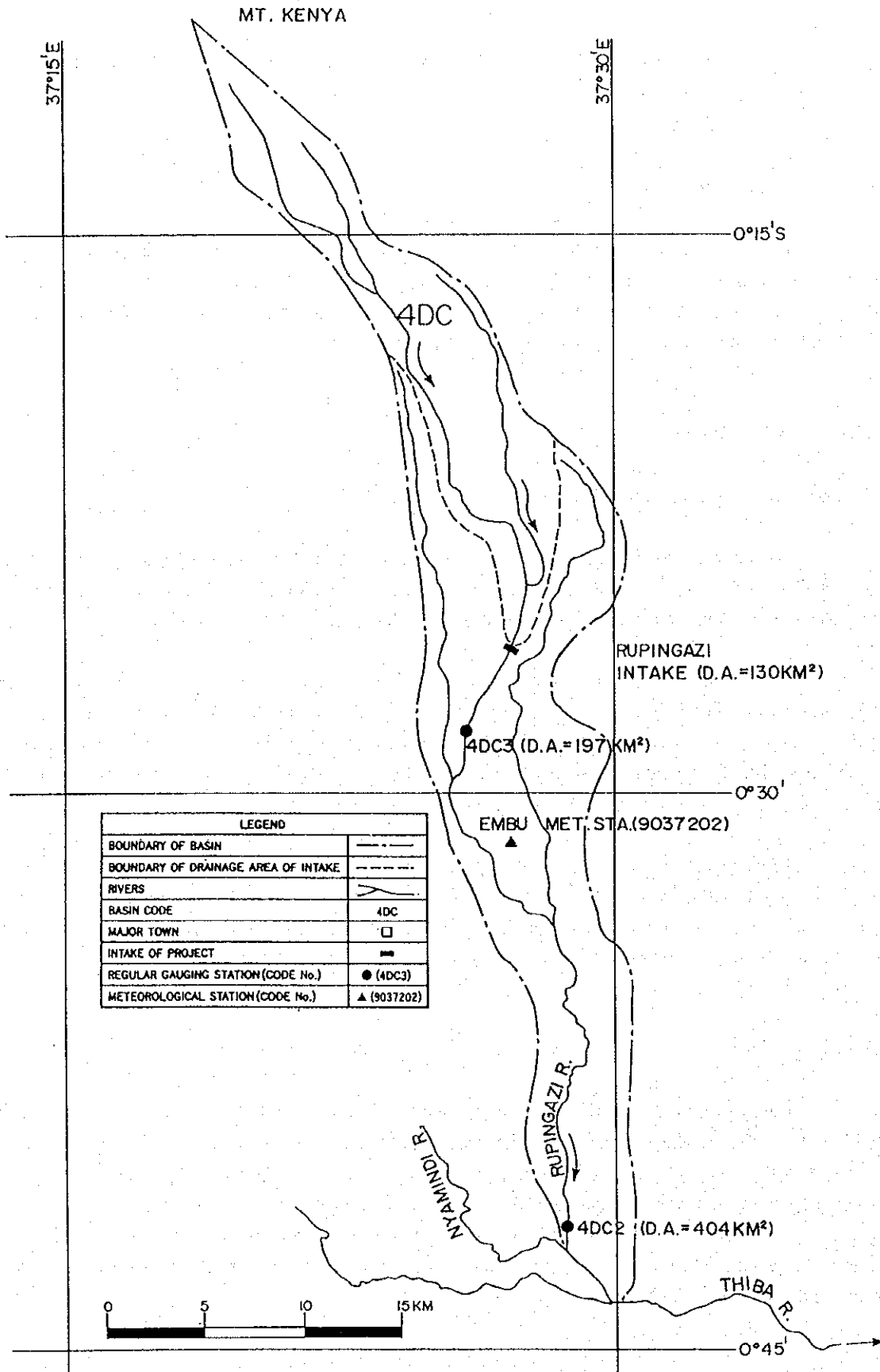


Figure 1.1-1 Location of Meteo-Hydrological Station and Project Intake of Rupingazi Ngerwe Irrigation Scheme

### 3) Soil and Land Use

The soils are deep, clay loams derived from the olivine rich basalt volcanic flows of Mount Kenya. The undulating dissected footridges of the Rupingazi area are covered with ando-humic Nitosols. These nitosols (Kikuyu red loams) are well drained, extremely deep, dusky red to dark reddish brown, friable clays with an acid humic topsoil. At this site, the rainfall combined with the good water storage capacity of these nitosols usually makes crop production much less precarious than in the drier lowlands. At Rupingazi a plough pan at 40-70 cm may be causing restricted drainage. Soil samples were taken, and the soil profiles described (see Annex H).

Much of the steeper sloping farm land on the valley slopes has already been terraced and planted to perennials (coffee, banana, and occasionally tea). The main field crop on the gently undulating river terrace is maize. The proposed irrigation area is 40 ha. Some piped low pressure sprinkler irrigation is already occurring from a smaller functional furrow, located upslope from the non-functional silted channel. These irrigators are producing green maize, kale and cabbages. The main cash crop is coffee, with small areas of tea. Stands of bananas are common, and the main rainfed crops are maize and beans.

#### 1.1.3 Administration, Socio and Farm Economic Conditions

##### 1) Administration and Rural Organization

The administration context of the Project Area may be specified using the standard Kenyan administrative units as shown below;

##### Administration of Project Area

Province	District	Division	Location	Sub-Location
Eastern	Embu	Manyatta	Nginda	Kibugu

At the district level, governance of the Project Area, including provision of government support services, is structured along the last four administrative units i.e district, division, location and sub-location.

At the district headquarters, are located the heads of government ministries and departments which include the district commissioner, district agricultural officer, district medical officer of health, district water engineer etc. In turn, most of these ministries and departments are represented at lower administrative units from the division level down to the location or sub-location level.

The political leadership pattern also generally follows the existing administrative framework. For instance the member of parliament (national legislative organ) represents a constituency whose boundary approximately coincides with that of the division administrative unit. Similarly, the councilor who represents the local community in the district county council (local government) is elected from an area which is almost identical with the location administrative unit.

The district commissioner, who is the head of the "provincial administration," acts as the coordinator of all government supported development activities in the rural areas within the district. He is also the chairman of the District Development Committee (DDC), the body responsible for reviewing major development projects (whether promoted by government, NGOs or the private sector) so long as such projects have an impact on the public at large. The authority of the provincial administration is projected downwards by the district officer at the divisional level, by the chief at the location level and the sub/assistant chief at the sub-location level.

## 2) Ethnic Group

Ethnic Group living in Rupingazi Ngerwe Area is the Embu. The Embu mainly lives in eastern part of Kenya and is the ethnic group of Bantu origin, and so is the Mbeere. The Mbeere is the third largest ethnic group in the Embu district. The languages spoken by these two ethnic group are almost same but a little different.

## 3) Population and Farm Household

As there are no reliable statistics in Rupingazi Ngerwe, it is difficult to grasp both exact number of farm households and population. Therefore, the farm economic survey was carried out in the Project Area in June 1998, and images of agriculture, rural community and farm household were known. There are about 300 farm households in the Area, with a population of about 2,200, accounting for 51.6 percent of female.

Out of the total number of farm household of 300, 240 of them are not members of irrigation group, while 60 are members at present.

## 4) Farm Economy and Living Conditions

### a) Farm Size and Self-Sufficiency of Food

Average farm size is 1.33 ha per farm household according to the result of the farm economic survey. This size is much smaller than Kenyan average of 2.5 ha and 4.4 ha of Embu district.

Farm household possessing the title deed, which indicates the authorized land title, is about 70 percent, which is the highest compared to other Project Areas. The reason for this is that the main crop grown in the Project Area is coffee, and the coffee cooperative society has already been organized. The marketing groups dealing with other crops have not get been formed at present.

Some 45 percent of the farms households interviewed in the farm economic survey cannot produce enough maize for home consumption on their farms. They buy maize from local market to supplement shortage. The reasons are that their farm size is too small, farm management type is concentrated to coffee farming, resulting in limited area for maize production.

b) Farm Household Income

Averaged annual farm household income in the Area is estimated at about 50 thousand Ksh based on the result of farm economic survey. Crop income of which is 37 thousand Ksh, six thousand Ksh of animal income and six thousand Ksh of off-farm income, respectively. The ratio of animal income is the highest among the four Project Areas. Animal income is mainly earned by milk selling, which is mainly consumed in Embu town. Though the level of farm household income is the second out of the four Project Areas, it is still lower than 116 thousand Ksh of the Kenyan average and 96 thousand Ksh of Embu district average.

c) Farm Labour Available

Average family size is 7.6 persons, 4.9 of which is farm labour available. Mean while, 4.9 is divided into 3.4 of full-time farm labour and 1.5 of part-time farm labours. The rate of female farm labour is the highest among the four Project Area accounting for 51.1 percent.

d) Living Standard Compared with Poverty Line

As mentioned above, it is clarified that average household income is lower than that of Kenyan and Embu district averages. Poverty incidence of household in Embu district is 65 percent, that is high rate among the seven districts of Study Area. The poverty line in Kenyan rural area is estimated at 8,440 Ksh/person/year, corresponding to about 80 percent of urban poverty line of 10,500 Ksh/person/year.

As averaged annual household income in Rupingazi Ngerwe area is estimated at 50,000 Ksh per capita, per income will be 6,578 Ksh/year, if based on average family size of 7.6 persons, which is lower than poverty line in Kenyan rural areas, indicating the living standard of farm household in this area is generally low.

e) Educational Status

The educational status of head of family cannot be considered high. The rate of person graduated from elementary school, junior high school and vocational school are 45 percent, 38 percent and 10 percent, respectively. This low educational status would be an important factor when promoting the irrigated horticultural farming in the future. That is to say, educational training for farmers on farm management, O & M of irrigation facilities and WUA should be done taking into consideration farmer's educational status in preparing training materials etc.

f) Bylaw of the WUA

The existing irrigation group is officially called Rupingazi Ngerwe Irrigation Scheme Group. The group has the bylaw agreed by members, in which qualification of members, duty, penalty, management method of group are described. But it does not touch on the water distribution rules.

## 5) Condition of Social Capability

### a) Present Conditions of Social Capability

The project community is presently involved in a wide range of agricultural activities that include cash and food crops. In doing so, they have accumulated useful resource management skills such as soil and water conservation as well as improved crop husbandry practices. They therefore perceive irrigation as offering yet an additional opportunity for improving on what they already have.

Traditionally, community members have had a history of pooling resources to assist each other on the basis of neighborhood, family or clan groups. Such mutual assistance was for building a house, weeding or harvesting or any other labour intensive activity. More recently, they have engaged in non-traditional form of collective action as exemplified by;

- Co-operative society through which they collectively process and market their coffee.
- Construction of schools, village poly-techniques as well as churches

In the upper section of the Project Area, members are also participating in another water project where they have installed gravity piped water for domestic use and limited sprinkler irrigation. Hence, this section has some skills in the use and handling of irrigation sprinklers. This is useful experience in the event that the proposed project design is based on pipes and sprinklers.

### b) Assessment of Social Capability for Proposed Irrigation Project

As related by the farmers during the field workshop, one of the reasons for the failure of the original irrigation scheme was lack of active participation by the local community. Arrangements should therefore be made to ensure that the farmers are consulted and involved during all the stages of the proposed project. They still have a high dependency inclination and this should be reduced from the start.

Irrigated horticultural production requires considerable adaptability as well as willingness to seek and acquire innovations and the youth have advantage in both. It was not surprising that during the field workshop, they were the most active in raising questions relating to technological options for the Rupingazi Ngerwe Irrigation Project. They also indicated reluctance, by the old people, to release land to them as a likely constraint to irrigation. If the community is to get maximum benefits from irrigation, it must address and resolve the issue of youth and access to land.

## 1.1.4 Agricultural Conditions

### 1) Crop Production

Based on the results of the field survey by the JICA Study Team, and the Farm Survey the total gross cropped area per year in Rupingazi is estimated at around 240 ha.

### Estimate of Present Crop Production

Crop	Area Rainfed	Area Irrigated	Yield Rainfed	Yield Irrigated	(unit : ha)	
					Production Rainfed (ton)	Production Irrigated (ton)
Maize/beans	95	0	1.75	2	168	0
Beans/maize	95	0	0.3	0.45	29	0
Maize green	0	4.5	-	2.5	0	14
Beans	54	0.3	0.6	0.7	32	0.5
Coffee	57	0	4.5	-	258	0
Banana	0.6	0	8.5	-	5	0
S. Potato	1	0	6.5	-	7	0
Cabbage	1.7	1.3	10	14.5	17	19
Kale	6.4	1.1	6	8	38	9
French Beans	0.6	0	3	-	2	0
Potato	5	0	7.5	-	38	0
Napier	0.3	0	12	-	4	0
Millet	0.3	1.2	0.85	0.90	0	1
Tea	4.2	0	10	-	43	0
Others	2.7	1	4	5	11	5
<b>Total</b>	<b>230</b>	<b>9.5</b>				

Source: Estimated from Farm Economic Survey and Phase III field work

The current cropping intensity is about 149 percent of the gross area. The average farm size is around 1.33 ha. The rainfall and soils in this area are both good. The annual rainfall of 1,364 mm is only slightly exceeded by the evaporation of 1,550 mm, and the temperatures are always moderately warm. The site has a high potential for rainfed plant growth.

Rupingazi is one of the wettest of the four Project Areas, with the main restrictions on crop agriculture being small farm size, diminishing soil fertility, and lack of irrigation water for out of season cropping. The fields are of two types, the steeper hill slope terraces, and the large, comparatively flat riverain land. The main cash crop is coffee, which is grown on the terraces. The main food crop, maize, is grown alone or interplanted with beans on the riverside land. An existing furrow irrigation system in the central portion of the valley is being used to grow a small amount of a range of vegetables, including kale, green maize, cabbage and tomato. The fruit trees found include bananas near the houses and the occasional macadamia and avocado tree.

#### 2) Farming Practices and Input Supply

The land in the proposed irrigation area is being currently used mainly to grow maize and beans. The beans are usually intercropped with the maize. Almost every house has some wet season kale plants. Sweet potato is also grown and some sugar cane and cassava. Occasional plots of tomato were seen, and in the wetter areas along the riverside taro occurs. Pumpkin and pigeon pea also occur sporadically.

Because of the location close to the market town of Embu, and because of the importance of coffee in the area, fertilizer, seed and other inputs are likely to be available nearby. Both fertilizer and pesticides are being used already on the coffee and the small area of vegetables. Access to government extension staff and services at the provincial headquarters of Embu is comparatively easy.

### 3) Animal Husbandry

There are no extensive areas of fallow and rough grazing, so field weeds and residues are collected and used as forage. Dairy cattle and goats are kept. The cattle are mainly improved breeds or crosses. Napier grass for the dairy cows is grown on the waste areas and along the edge of the roads. The zero grazed cattle are also fed maize and banana stalks. Children are responsible for collecting forage for the animals, and removing manure. Women do the milking. Most farms have a few local hens around the house.

#### 1.1.5 Marketing of Agricultural Product

##### 1) Crops for Local and Export Markets

The crops for cash earning are mainly coffee cherry, macadamia nut and local consuming vegetables in this Project Area.

##### Coffee

Most of the farmers depend their main cash income from the production of coffee cherry in the Project Area. The auction prices in Nairobi Coffee Auction located at 1st floor of Kenya Planters Cooperative House, Hailselassie Ave. are closely influenced by the international prices at New York market or Bremen/Hambrug markets, and fluctuated in the range of 3-4 times in decade. Most of Kenya coffee beans are classified as Colombian mild arabica, or brand of Blue Mountain, which prices are about 10 percent higher than the average prices including other mild Arabica, Brazilian Arabica and Robusta beans. Normally, the coffee cherries at Rupingazi are evaluated as TT or better classes out of 14 grades.

##### **Coffee Auction Prices Comparison by Grade:**

AA (US\$205.29/bag), PB (US\$204.44/bag) AB (US\$191.43/bag), E (US\$182.60/bag), C (US\$159.96/bag), TT (US\$158.67/bag), UG1 (US\$119.29/bag), HE (US\$118.33/bag), UG (US\$116.50/bag), T (US\$114.33/bag), MH (US\$94.83/bag), UG2 (US\$77.73/bag), ML (US\$60.82/bag), SB (US\$35.00/bag)  
as of the average of Nairobi auctioned prices per 50kg bag in July, 1998.

##### Macadamia Nut

The second source of cash is shelled Macadamia nuts. The Macadamia nuts can be stored about ten days and its post-harvest losses caused by transport are relatively lower. The nuts had been researched and selected the recommended varieties by Thika Horticultural Research Centre annexed KARI-Thika under JICA technical assistance program.

##### Banana

Kampala variety is planted widely in the Project Area for local market and self-consumption. This is an important produce for the farmers even to keep food security due to relatively lower price fluctuation by drought.

### Chilli

Fresh chilli has stable demand for export market, relatively lower inputs and labour force but farmers sell the produce to middlemen at lower prices.

### Cabbage

The demands at Embu Market are high especially in May. The cabbage are very glut by season because of production in Nyeri District in November to December. The farmers understand it is necessary to obtain the price information at the market and to bring early morning (around 6:00am) to the market, because the prices of the produce become down by afternoon at 10-30 percent.

### Tomato

This produce are also demanded at Embu market. The marketable variety of tomato is "Cal J" instead of "Money maker" and others due to longer shelf life and also lower post-harvest losses in the field management practice. Harvest in July should be avoided due to the glut from Kirinyaga District. The prices can be triple depending on the season and grade.

### Kale

Kale is required its freshness in moisture content and difficult to transport in long distance. At Embu wholesale market, this produce has high demand whole a year. From this Project Area to the market, it requires only 20 minutes by *Matatu* or 1 hour by ox wheelbarrow, therefore kale is still marketable produce for this Project Area.

### Sweet Potato

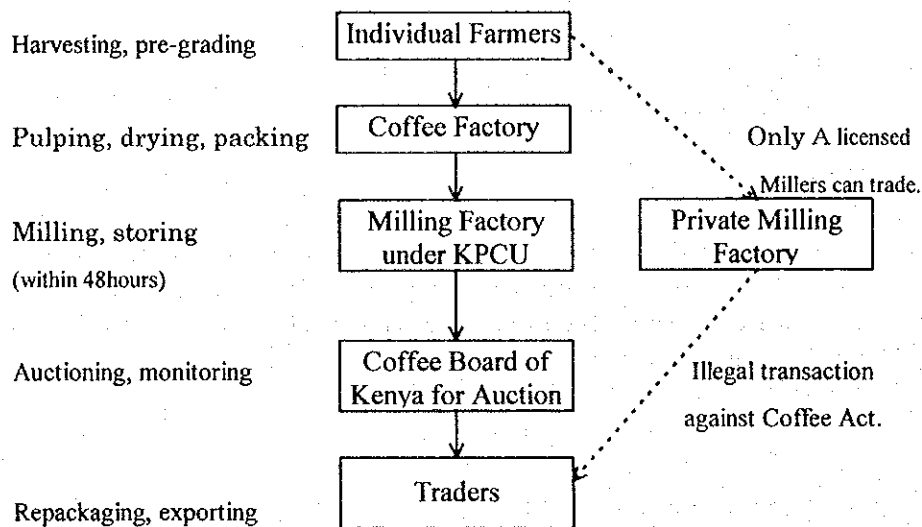
Sweet potato is relatively strong against drought comparing with other root crops, so the prices are stable. From the viewpoints of food security and utilization of leaves as by-product for feeding cows (zero-grazing), this produce is very important but not so profitable at Embu market comparing other root crops such as arrow root.

## 2) Post-Harvest Handling and Marketing Alternatives

### Coffee

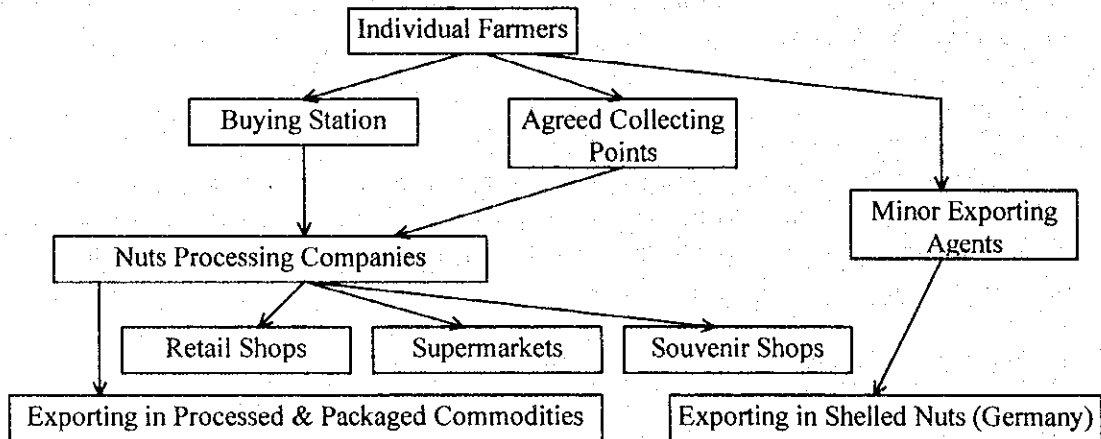
After harvesting coffee cherries, farmers bring them to coffee factories for pre-grading, pulping, solar drying and packing to 50kg sacks. The limited farmers sell the cherries by cash to middlemen of private milling factories, but this is illegal transaction mode according to Coffee Act, which mentioned the obligation to supply all beans to Coffee Board of Kenya through Kenya Planters Cooperative Union (KPCU).





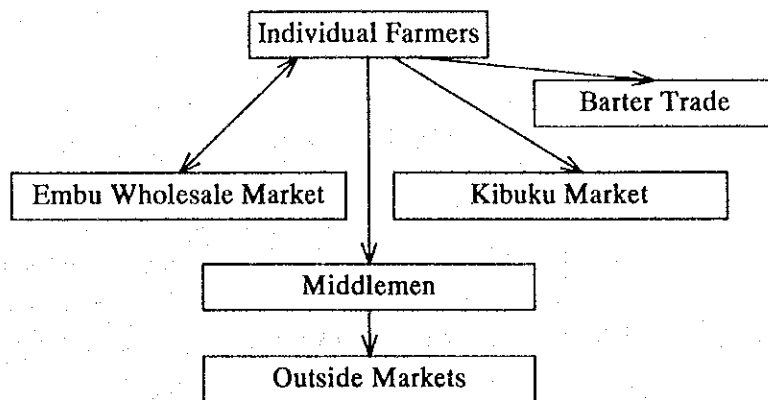
### Macadamia Nut

Farmers bring to the Coffee Factory as agreed collecting point or buying stations of two nuts companies in shelled nuts and sell in normally cash to transporters of each companies in the Project Area. There is no governmental intervention in this marketing route. The prices are stable at 50Ksh/kg.



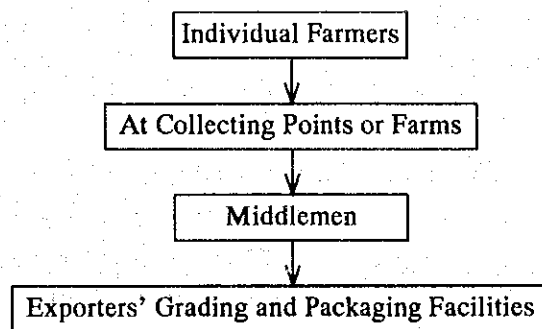
### Horticultural Crops as Local Consumed Produce

The farmers consume themselves vegetables and fruits; ripe banana, kale, cabbage, tomato and sweet potato, and bring the surplus of the produce to Embu Wholesale Market (6 km) for town consumers or very small scale Kibuku Market (2 km) for the community. In particular seasons (niche in markets), middlemen visits farmers individually. In planting season, farmers buy vegetables and dry beans from outside markets. The cash income from these produce are very important for farmers until paid money from coffee cherries, which can take three to six months later after harvesting would be available.



### Horticultural Crops as Export Produce

The main export produce are chilli, avocado and French bean in this Project Area. Farmers pre-grade and packaging into carton boxes in the fields or collecting points. Exporters do not purchase directly to farmers here, but purchase through middlemen. Farmers do not have the way to know the price at exporters grading houses located at Nairobi, therefore are forced to accept the offered prices from middlemen.



### 3) Regional Market Aspects and Produce Trading Status

In Embu District, large amount of produce are loaded into the markets; Embu, Runyenjes, Mayatta, Ena, etc. The facility of Embu wholesale market was improved in 1996 by the financial support of NGOs Plan International. The operation and maintenance is undertaken by the Embu Municipal Council. The market has large trading volume accounted at about 18,000 tons per year or 175 tons per day, for which figures, there is no any data to state the trading volume, so the Study Team estimated from the Market Gate Fees in the fiscal year 1997/98 collected by the Council.

Estimation of Trading Volume at Embu Wholesale Market:  
 Annual Trading Volume  
 =  $\Sigma \{ \text{Monthly Collected Fees} (2.40 \text{ million Ksh} \times \text{Collected Ratio} (70\% \text{ by Feb } 1998 \text{ and } 90\% \text{ from March } 1998) \times \text{Market Fee Rates} (15\text{Ksh}/90\text{kg bag}) = 18,000 \text{ ton/year}$   
 From March 1998, the fee enumerators were increased from 13 to 31 persons.  
 Average Daily Trading Volume  
 =  $18,000 \text{ ton} \div 52 \text{ weeks/year} \div 2 \text{ times/week (on Wednesdays and Saturdays)} = 175 \text{ ton/day}$

During the year of 1997, the food production was better than 1996. The long rains set in the last week of March and continued, although very unevenly distributed to June. The poor distribution of rainfall amounts led to poor performance of majority of the food crops, as they faced moisture stress in their critical stages, which led to targeted yields not being achieved. The months of July and August did not receive the normal 'Gathamo Rain', and this condition continued to September. Maize, that is usually planted in the higher zones during these months, dried up while still very young. The short rains started earlier than normal in the beginning of October and continued quite heavily. The rains were too heavy, especially when the crop was young, and this resulted to adverse conditions of water-logging and leaching of mineral nutrients in most farms in poorly drained and infertile soils. This resulted stunted growth in crops such as maize, yellowing and rotting of the beans and potatoes. Despite the main season, most of the food crops were performed poorly and the market prices were high throughout the year.

Embu market is importer of most of produce from other districts, and the adverse weather conditions led continuous high prices. Majority of the farmers having insufficient foodstuffs and depended fully on markets to purchase any required food for most of the year. The monthly prices are shown in Table N.2-5, Annex-N.

**Maize:** In the rainy season in March to April, the maize production was affected by the inadequate rains during the critical tasselling and milking stages. This resulted to only 40 percent of the production target set by DAO and maize prices increased at 1,600 Ksh/90kg-bag. The price of maize did not lower as expected at the end of the season; says lower than 1,000 Ksh/bag. It was required for supplementary food supplies to be distributed to the most affected families in the month of October as famine relief.

**Beans:** Beans production in the long rains was below average because the crops were affected during the critical stage of flowering and pod-filling with inadequate rainfall amounts. This led to a low supply of especially the Rosecoco beans and the prices increased from 2,780Ksh/90kg-bag in 1996 average to 5,800 Ksh/bag in April. The short rains were so heavy for this crop that the flowers were falling and the mature crops were rotting. The bean crops in the upper areas UM2 and above suffered heavy losses, while in lower areas there was a lot of rotting and germinating of the seed in the pods.

**Irish Potato:** The crop during the long rains was also affected by the inadequate rainfall, which lowered its expected production of 12 ton/ha to 6 tons/ha. This low production led to high prices of the produce at from 1,025 Ksh/100kg-bag in 1996 average to 1,900 Ksh/bag in April and the produce had to come from outside the districts of Meru, Nyeri and Nyandarua. During the short rain season, the crop was afflicted with a lot of blights and rots, again due to the heavy rains. In the higher areas of UM2 and above, most of the crop were affected, while did well on average in lower areas UM3 and UM4. The rains continued much in December and thus hardening of the crop was not possible. Therefore, expected yields at the end of the harvesting is still on the lower side.

**Cowpea:** The crop had average harvest in the first season of about 4 bags/ha, while the crop planted during the short rains is expected to reach 4-6 bags/ha as target. The rains in the short rains allowed for very heavy vegetative growth and thus allowed for a longer supply of green cowpea. But the increased prices of other beans affected the prices of this crop.

Millet/Sorghum: During the long rains limited planted areas of sorghum and the millets are grown. Less than half the expected target was achieved, although the crops were not adversely affected by the inadequate rains. The annual average prices of millets were decreased from 1,713 Ksh/90kg-bag in 1996 to 1,404 Ksh/bag in 1997 for bulrush variety and from 3,099 Ksh/90kg-bag in 1996 to 2,040 Ksh/bag in 1997 for finger variety, while sorghum prices were increased. It proved millets can alleviate famine situation by drought.

Cooking Banana: The crop had poor production during the first season, where on many farms the crop had started drying due to the prolonged drought, that continued during this season. Other factors that contributed to the poor performance were pest infestation and poor management aspects i.e. fertility and feeding to cows. With the increased rainfall amounts in the short rains season, this has been a big advantage to bananas and more than 80 percent of previously affected bananas, therefore the supply of bananas increased in the market.

Cassava, Sweet Potato, Arrowroot and Yam: With the poor performance of the food crops in 1996, there was a general trend by the farmers to increase their planting areas of the above drought-resistant crops. The planted areas increased by twice during the short rains, so the prices of sweet potato and yam were stabilized.

Mango: The interest of farmers in improved mango varieties are growing in the district. Promotion campaigns were done among the groups in Runyenjes and Kyeni divisions. Good harvests were realized from the 1996. However, little flowering was realized in 1997 which can adversely affect mango drying activities. Farmers were advised to plant mango seeds direct in their farms for top working/grafting in 1998.

Avocado: The crop continued to very low popularity from farmers due to previous problems of marketing. Some farmers phased out their avocado orchards for alternative crops. In the domestic market, the demands are comparatively low.

Cabbage: A total of 76 ha was planted yielding about 15 tons/ha. More potential exists and the district is a net importer of cabbages. But this crop is glut in Embu market in June to July due to high supply from Kirinyaga and Nyeri districts.

Kale: The crop is more popular in the district than cabbages especially in kitchen gardens. But shortage of rainfalls led to high fluctuation and the prices were increase from 312 Ksh/60kg-bag in 1996 average to 450 Ksh/bag in 1997.

Tomato: The crop is mainly produced under irrigation. According to supply volume from Kirinyaga district, the prices are very fluctuated; 1,800 Ksh/60kg-crate in November to December in 1996 as highest and 360Ksh/60kg-crate in July in 1997 as lowest. Supply in July are very risky for Embu farmers.

Dry Bulb Onion: The crop is grown in kitchen gardens and a few commercial farms, but farmers were discouraged in the prices due to over-supply from Tanzania and lower prices. The prices were at 3,099 Ksh/100kg-bag in average with the range of 2,500 Ksh/100kg-bag to 4,000 Ksh/bag in 1996, and at 2,040 Ksh/bag in average with the range of 1,500 Ksh/100kg-bag to 4,500 Ksh/bag in 1997.

**Carrot:** The crop is mainly imported from Kirinyaga, Nyeri and Meru districts. The prices were comparatively stable except April to July in 1997, because the heavy rains damaged rural roads in production areas in that period.

#### 4) Farm-to-Market Roads

The slippery road conditions from the Project Area to B6 tarmac road cause to the difficulty of transport especially in *Gathano* rain season. *Matatus* and lorries are needed to fix tyre chains to the Project Area except 4WD cars, and loading volume becomes quite limited. The transportation costs are normally charged at 10Ksh/bag weighted at 60-90kg.

### 1.1.6 Agricultural Extension Services

#### 1) Institutional Extension Services

##### a) Ministry of Agriculture (MOA)

Presently the Ministry of Agriculture (MOA) is the main provider of agricultural support services to the Project Area and has deployed technical staff at various administrative levels as illustrated below;

District Level (Embu Town)	Division Level (Manyata)	Location Level (Nginda)	Sub-location Level (Kibugu)
- 1 x District Agricultural Officer	- 1 x Divisional Agricultural Extension Officer	- 1 x Location Agricultural Extension Officer	- 1 x Agricultural Extension Assistant
- 12 x Subject matter specialists(extension, irrigation, crops, horticulture, coffee, farm-management, marketing etc)	- 5 x subject matter specialists (crops, horticulture, farm-management, irrigation, soil conservation)		

Note: 1) The above staffing situation refers to the Department of Agriculture and does not include personnel belonging to the Departments of Livestock Development and Veterinary Services  
2) Number of staff is not constant and fluctuates from time to time owing to transfers

It is at the location and sub-location level where "frontline extension workers" (FEWs) are supposed to make regular contacts with the farming community and transfer improved agricultural technologies. Extension officers located at division and district levels are normally expected to provide back-up support to FEWs in such areas as strategic planning, skills upgrading and performance supervision.

With the completion of the World Bank supported "National Extension Programme (NEP) II", the mobility of extension staff has been severely curtailed. Individual and group contacts are no longer regular while training of front-line extension workers by subject matter specialists is not taking place.

The extension services are, however, currently being drastically re-structured as part of the on-going ASIP (Ref. to proposal on the National Agricultural Livestock Extension Programme , NALEP, "Draft No 3", Ministry of Agriculture April 6, 1998 ). The thrust of the proposed extension strategy is based on the following key considerations;

- Extension to be demand-oriented taking due recognition of GOK's policy commitment to liberalization, privatization, and commercialization of the agricultural sector
- Need to encourage private sector involvement in provision of extension services
- Participatory approaches, involving main stakeholders in problem diagnosis, planning,
- Appraisal and implementation of agricultural projects
- Bottom-up ownership of project and project activities including cost sharing and cost recovery
- Strategy for encouraging self reliance through capacity building (entrepreneurship, knowledge, technical as well as managerial skills) among the farming community and extension staff

#### b) Other Government Agricultural Support Services

Apart from MOA extension services, the Rupingazi Ngerwe community receives limited agricultural support from the regional station of Kenya Agricultural Research Institute (KARI), located at Embu town, with regard to on-farm adaptive research for fodder crops, potatoes and beans.

#### 2) Agricultural Extension Services by the Private Sector

In Embu a number of private sector agricultural services and NGOs are currently operating. The private sector is working mainly in the provision of inputs and fertilizer to coffee cooperatives and growers, and the supply of artificial insemination services. There are a number of NGOs active in Embu district, for example, Plan International which has been involved in irrigation development has an office there. Various church groups, such as the Catholics and the Anglicans have been working on encouraging dairy production and organic farming in the Project Area.

### 1.1.7 Agricultural Credit

#### 1) Institutional Credit

Institutional credit service is available in Embu town. In the case of Rupingazi Ngerwe Area, it is said that relationship between farmers and banks is stronger compared to other Project Areas, because of the credit services for farm inputs etc. through the cooperatives. However only 40 percent of the farm households interviewed in the farm economic survey are given credit services. The reasons are, no title deed, intricate application procedure, never tried, high interest, rising interest without a prior notice and these reasons would be attributed both to farmer themselves as a user and reliance on bank. Especially, 70 percent of farms answered that it is difficult to access credit of AFC and CBK, which are the representatives of agricultural credit services.

#### 2) Informal Credit

A few farmers utilize informal credit which are given from relatives and neighbors in the same area.