3.4.2 Facility Construction and Equipment Supply

1) Implementing and Supervising Agencies of the Project

The lead implementing agency shall be the MOA and supporting agencies be national line agencies, local governments, NGOs, JKUAT and other institutions managed by the government and financial agencies. An Executive Steering Committee (ESC) shall be established headed by National Project Coordinator (NPC) to be Permanent Secretary of MOA, with membership of representative of related national line agencies and NGOs. A Technical Working Committee (TWC) shall also be established under ESC for smooth implementation of the Project. Both ESC and TWC shall be located in Nairobi. Under TWC, and District Project Management Office (DPMO) shall be established at Meru for actual project implementation at the field level. Proposed organization chart is presented in Figure 3.4-2.

2) Implementation Framework

Prior to the construction works, implementation of social preparation and institutional strengthening as a part of community development shall be rendered by suitable agencies such as consultants and NGOs which are hired on a contract basis by ESC. In the course of implementation of social preparation, community initiative shall be fully followed.

On the other hand, facility construction shall be on contract basis with labour intensive method wherever it is feasible. Irrigation improvement including domestic water supply improvement will be undertaken by small local contractors under supervision of DPMO. Village/farm road improvement will be carried out by labour-based small contractors and supervised by consultants under direction of District Roads Engineer. These contractors are selected through local tendering.

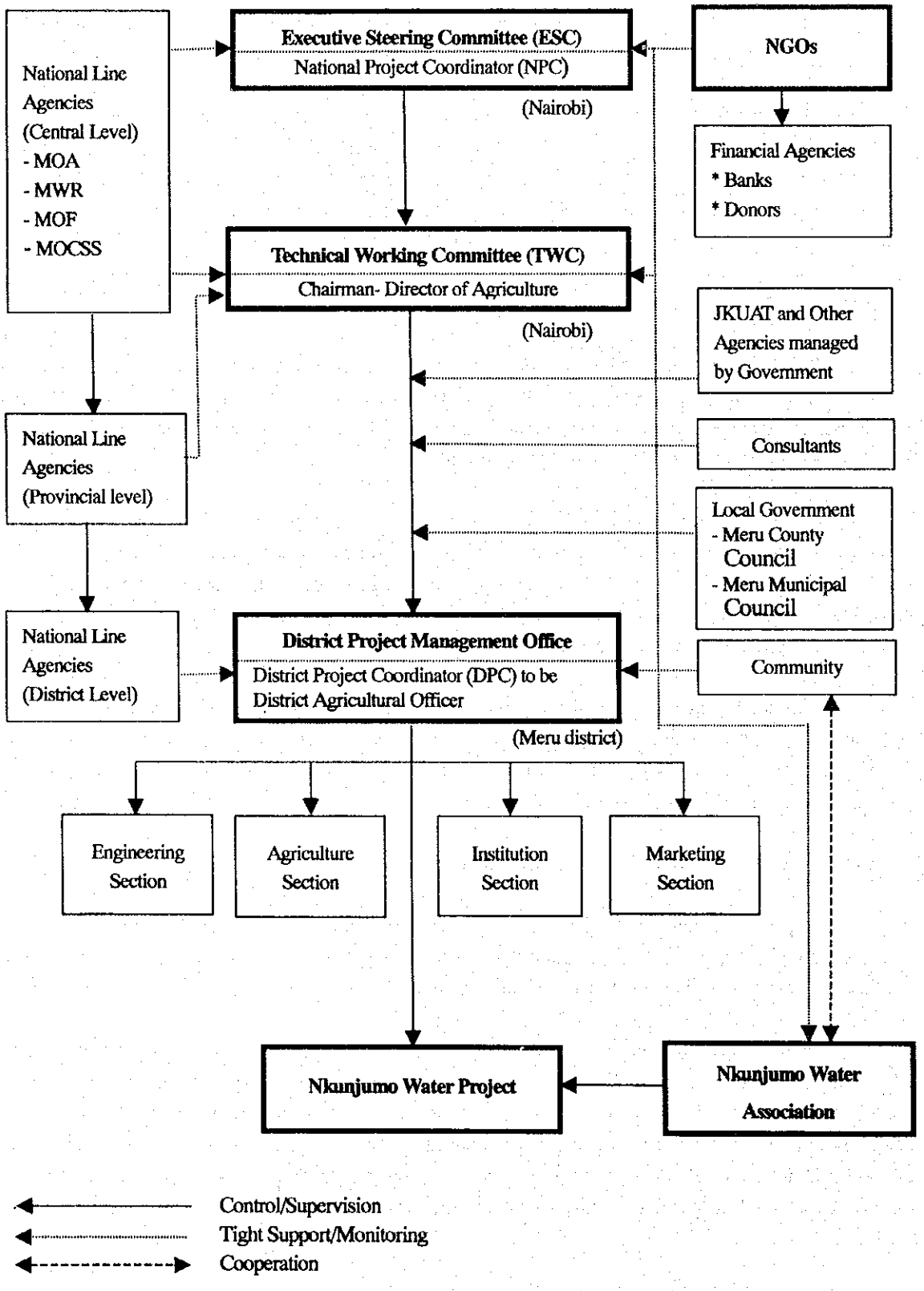
During and after the construction, community development together with support services for operation and maintenance of facilities shall be carried out by selected outside agencies with tight support of related government agencies. Well coordination among Nkunjumo Water Association, NGOs and government agencies must be provided by DPMO.

3) Implementation Process for Facility Construction

Proposed facilities under the Project are classified into two categories in terms of financial resources condition, i.e. one is self-help projects such as water supply facilities, and the other is governmental public projects like marketing facilities and village/farm roads.

Funds for self-help projects are planned to be on a cost recovery basis (in case of loan or self-contribution) or cost sharing basis (in case of partial grant or government support) or combination of those. On the other hand, governmental public projects are to be financed by the government which has to procure necessary funds from various sources such as government own budget, donor countries assistance in a form of loan/grant, international development bank loan, etc. Implementation process and period are relatively different between self-help and governmental public projects and they depend on project funds availability.

Figure 3.4-2 Proposed Organization Chart for Project Implementation for Nkunjumo Water Project



Therefore, project implementation procedure is formulated by such project category.

a) Self-help Projects

There are three major implementing bodies to be involved in the self-help projects, i.e. WUA, NGOs and ESC. Nkunjumo Water Association (WUA) is a beneficiary group who has to bear the project cost. DPMO shall be responsible for all physical works, engineering works, construction supervision and consultation of the projects. ESC shall act on overall promotion, supervision and monitoring the projects. Detailed implementation process and flowchart for self-help projects are presented in Annex R.

b) Governmental Public Projects

Two government agencies are considered to be the actual implementing body, i.e. Meru Municipal Council for marketing improvement and Meru County Council for village/farm road improvement. Consultants shall be hired to undertake all physical works from the site investigation and road identification survey up to construction supervision. Detailed implementation process and flowchart for governmental public projects are presented in Annex R.

4) Implementation Schedule

Since project funds are not immediately available by both the government and self-help groups as well as procedure of fund procurement is different depending on project type, implementation schedule shall be formulated under certain conditions. Important factors for realization and successful implementation of the Project are social preparation for community development, fund procurement for self-help projects and follow-up support services for sustainability. Although each Project is very small scale, the effort for these works would take longer time span and implementation must proceed step by step on community initiative basis.

It is assumed that the total implementation period for each Project will be seven years which consist of one and half years for social preparation, one and half years for construction and four years for follow-up support services. Proposed implementation schedule is presented in Figure 3.4-3.

3.4.3 Operation and Maintenance Plan of the Project

1) Operation and Maintenance Organization

Executing agencies/bodies for the operation and maintenance (O&M) of facilities built under the Project are classified into two categories, i.e. public and private sectors (Refer to Annex R).

- Public Sector: (1) Marketing facilities : Meru Municipal Council

- Private Sector: (1) Water supply facilities : Nkunjumo Water Association
  (2) Village/farm roads : Village community including Association

Figure 3.4-3 Implementation Schedule for the Improvement of Nkunjumo Water Project

Work Item	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year
A. Social Preparation and Institutional Strengthening							
1. Procurement of Funds (for support services)							
2. Consultation at Village Level							
3. Consultation at District Agricultural Office and Other Local Agency Level							
4. Formation of Executive Steering Committee (ESC), Technical Working Committee (TWC), and District Project Management Office (DPMO)							
5. Strengthening of Institutions a) IDB Field Office b) Other Local Agencies							
6. Selection and Contracting of NGOs							
7. Social Preparation for Community Development							
B. Facility Construction and Equipment Supply							
1. Preparation Work							
2. Survey, Detailed Design and Costing							
3. Procurement of Funds (for construction works)							
4. Consulting Services by NGOs and Consultants						Monitoring	
5. Construction Works							
C. Community Development, Support Services and O&M							
1. Community Development							
2. Agricultural Support Services							
3. Water Management Training Services							
4. Marketing Support Services							
5. Operation and Maintenance of Project Facilities							

2) Operation and Maintenance Plan of the Project

a) Agricultural Development

Demonstrations

Demonstrations are used for technology which has been tested and proved to be suitable for the Project Area, for example Copenhagen cabbage, but has not yet been widely adopted. They are intended to be convincing proof that the technology is worth adopting. Demonstrations will be carried out by project staff in conjunction with the farmers themselves. A site will be chosen dependent on the nature of the particular demonstration, and the farmers interest. Different locations will be used for individual demonstrations and will shift from season to season. To encourage participation, the inputs will be provided by the project, but the farmers will be responsible for all of the husbandry. After the demonstration has been visited, perhaps during a field day and fully assessed, all of the production will remain the property of the participating farmer.

Trials

Trials are used for technology that is believed to be an improvement on the existing crops and have potential in the Nkunjumo area, but has not been tested under the particular conditions of the Project Area, for example sugar pea and snap pea, or drip irrigation techniques. Trials will also be conducted on farmers fields, primarily to test new technology under farm conditions. Successful trials will also have a demonstration effect. These trials will be laid out by project staff, with the assistance of the land owner. The inputs will be provided by the project, and the farmers will be responsible for all of the husbandry. In the case of a crop failure, the project will reimburse the farmer for the lost production using the current crop compensation rates for wildlife damage in the district.

Livestock

No particular program is planned for the Nkunjumo livestock. Access to improved breeds is available through the private sector already.

Improved inputs

After testing and demonstrating improved inputs such as new onion varieties, suitable crop protection chemicals, sprinklers and drip irrigation etc, the project will encourage the private sector stockists in the vicinity to stock these products. If necessary, the project will facilitate the access to the improved inputs. The farmers will be responsible for all the direct costs involved.

b) Agricultural Infrastructures

- Water Supply Facilities
  O&M of water supply facilities shall be executed by existing Nkunjumo Water Association. During the O&M stage, technical support shall be extended by the Irrigation Unit of District

Agricultural Office, Meru (MOA).

Major O&M activities are water distribution management, repair of pipeline and structures and so on. Water guards shall be hired for water distribution management. Adequate membership fees shall be collected by the association committee from beneficiary members for water management and maintenance activities.

- Village/Farm Roads

Since village/farm roads belong to County Council, its improvement is planned to be undertaken by Meru County Council. However, maintenance of these roads can be conducted by village community as presently carried out due to lack of road maintenance fund in the local government. Arrangement and scheduling of maintenance activities shall be made by village community.

Major O&M activities are routine maintenance which includes repair and cleaning of roads and side ditches, spot gravelling and repair of road structures. Technical and equipment support shall be extended by County Council or District Works Office (MPWH) when required for the maintenance activities.

c) Rural Infrastructures

- Access Roads

There is no improvement activities under the Project. O&M of B6 National Trunk Road as an access of the Project Area are to be carried out by District Works Office, MPWH as presently conducted.

d) Post-Harvest and Agro-Industry

Market Facility Improvement Plan

The facilities of Gakoromone wholesale market shall be operated and maintained by Meru Municipal Council. The collection of market gate fees can be estimated as follow;

Expecting amount of market gate fees after improvement:
= 3.35 million Ksh (1997/98 records) x 1.8-2.0 (increasing collection fees by install of walls) x
1.2-1.5 (increasing trading volume by efficient trading system)
= 7.2 - 10.1 million Ksh

Recommendations for operation of the facility are i) to fund for market facility maintenance at 20-30 percent of collected market gate fees, ii) to maintain the rate of market gate fees to reduce sellers' burden and improve competitiveness in prices with other wholesale markets, iii) to employ more fee colletors from present 11 persons to 30 persons which succeeded in Embu wholesale market since April 1998 , and iv) to abolish produce cess taken at boundary of the district from the point of marketing liberalization except *miraa*.

Auction Coordination Plan

The auction at Gakoromone wholesale market shall be coordinated by HCDA. The produce will be collected on Mondays, Wednesdays and Fridays when the market is not opened. The charge for wages and fuels will be taken at the rate of 10-15 percent for Meru upper areas and Nyambene areas along tarmac roads and at 15-20 percent other areas such as Mitunguu. Recommendations for operation are i) to promote and advise to farmers' marketing groups regarding collection method, weighing of produce, marketable grading and timely prices provision traded at the market from auction results, ii) to prepare detail collection schedule, iii) to repay to bank accounts of farmers' group within 24 hours after auction and iv) not to accept cheques from buyers.

Market Information Sources Improvement Pilot Plan

The market information is collected from 16 markets in Kenya by Market Information Branch, Farm Management Division, MOA and going to expand to 40 markets including farm inputs prices with the support of USAID. However, the information show only trading prices. From the side of farmers, they want the information in terms of trading volume at near market and destination, advises of future demands or trends for crop planing and prevail timely prices at farm gate in neigbouring areas for negotiation with middlemen. It is impossible to cope with all information provision as government services, but DAO-Meru can provide through the market i) collected prices data and trading status; scare, low/high demand, glut, etc., ii) trading volume by analysis of collected market gate fees by Meru Municipal Council, and iii) destination of produce by sampling interviews to traders. Their information from market will help to make guidelines for extension services, because marketing situation always changes.

3.5 Project Evaluation and Cost Recovery

3.5.1 Economic Evaluation

1) Method of economic Evaluation

The economic viability of the small-scale irrigation project is judged by EIRR as an index. However, economic condition of smallholders obtained from the result of the farm economic survey and the comparison farm household income with poverty line show that small-scale irrigation project should be implemented as one of the poverty alleviation even if the economic viability is low.

The project life is planned to be 30 years. Benefits and cost during 30 years are discounted to get EIRR which is the discount rate at which total present value of cost and benefit become equal. The cost includes initial investment cost, annual operation and maintenance cost and replacement cost, if necessary.

Local currency portion of the project cost is converted to economic cost by standard conversion factor (SCF) which is calculated from the past trade statistics. On the occasion, economic project cost does not include tax, the cost of land acquisition and compensation and contingency for price escalation. The cost of the road improvement and preparing topographical maps are included in the project cost.

2) Commodity Prices

The farmgate price of crops and agricultural inputs are calculated based on the farm economic survey in Nkunjumo conducted by the Study Team. The price of agricultural inputs was also collected from stockists in Embu town, which is the nearest town from the Project Area. Maize, coffee and fertilizer are subject of trade. As the World Bank releases regularly a long-term price forecast, economic price of these commodities is estimated based on it. The prices of crops mainly consumed in domestic market are estimated on the result of the farm economic survey as economic price, and vegetables such as French beans etc., which are exporting commodities, are estimated based on price investigated by HCDA. The economic prices are utilized for economic valuation, while, financial prices are for financial analysis. Both financial price and economic price in Nkunjumo Area are shown in Table 3.5-5.

3) Project Benefits

Project benefits are generated from increase of irrigation area and crop yield, which are presented in terms of money as the difference between without Project and with Project cases. Present land use was analyzed on the result of the farm economic survey and the proposed land use was prepared in consideration of actual agricultural conditions, land, soil and climate conditions, demand for crops, farmer's experience and so on. Though the Project Area has cultivated coffee for a long time, yield and quality are reported low compared with Rupingazi Ngerwe Area. Therefore, some farms have begun to switch crops from coffee to horticultural crops due to low profit of coffee. The result of the farm economic survey shows that most of the farmers intend to grow vegetables combined with maize after the implementation of the Project.

Though some areas will remain dependent on rainfed farming even after the project implementation, it is expected that crop yield can be increased by the improvement of crop management through strengthening agricultural extension service and training for farmers. The incremental agricultural benefits in Nkunjumo is estimated at 2,202 thousand Ksh (refer to Table 3.5-6).

Improvement of road is also included in the project component. As roads consist of access and farm and village roads, effects are measured with the improvement of these roads on the national economic point of views. Benefits of road improvement are calculated based on cost saving of fuel consumption with speed up of vehicles and shortening of transportation hours. Road improvement benefits in the Project Area are estimated at 1,325 Ksh (refer to Table 3.5-7).

4) Economic Project Cost

Estimated project cost in financial price in Nkunjumo is converted to economic project cost according to a principle mentioned in paragraph of 1). As materials and labours necessary for construction can be procured in Kenya, the project cost consists of only local currency portion. The economic project cost is estimated at 29,729 thousand Ksh with the annual operation and maintenance cost of 159,714 Ksh (refer to Table 3.5-8).

5) Economic Internal Rate of Return

EIRR in Nkunjumo Area is estimated at 5.9 percent. This is under the eight percent of EIRR, that is the standard for agricultural project in Kenya. Although economic viability of the project in Nkunjumo Area is considered low, the project should be implemented even if EIRR is low as small-scale irrigation project is one of the poverty alleviation for smallholders whose living standard is low. Although mapping cost is not included in the project cost because JICA Study Team made it by its own payment, if including it, EIRR will be 5.8 percent.

6) Sensitivity Analysis

Sensitivity analysis was made to verify the effect on EIRR with some assumed parameters.

		EIRR (%)
i)	10 percent increase in benefit cost	4.92
ii)	10 percent decrease of benefit	4.73
iii)	Three years delay of benefit generation	4.14
iv)	Combination of i) and ii)	3.80
v)	Combination of ii) and iii)	3.04

3.5.2 Financial Analysis of Typical Farmers

Financial analysis was made to analyze effects on farm economy with project implementation in Nkunjumo Area. Farm household's incomes in case of without Project and with Project are compared. In this analysis, household expense and off-farm income are taken into account with price escalation for four years. The result of verification is shown in the Table 3.5-10. The farm household income is estimated at five thousand Ksh including animal and off-farm incomes in the case of without Project. While, total farm household income in with Project case will be 68 thousand Ksh with a disposable income of 45 thousand Ksh, indicating farm economy will be improved with the small-scale irrigation project.

3.5.3 Cost Recovery Analysis of the Project

In this analysis, it is analyzed that beneficial farmers can bear the burden of the project cost by household income being expected to increase after the project implementation. The farmers will be required to bear the cost for road improvement and preparing topographical maps. Farmers will bear only the operation and maintenance cost for with the farm and village roads. Farmers will get disposable income of 45,117 Ksh with the implementation of the project. It will be analyzed whether farmers can bear the project cost within this disposable income.

Some alternative plans for cost recovery were studied by changing interest rate and repayment period in addition to the present credit condition to determine appropriate monthly repayment. If this is within disposable income, it is judged that farmers have ability for cost recovery.

Project cost sharing per farm household in Nkunjumo Area is estimated at 46,758 Ksh, resulting in 1,325 Ksh per month under the present credit conditions. Though farmers is judged to be able to repay project cost, case-3 or 4 will be recommendable to avoid trouble in repayment after starting irrigation service. Table3.5-11 shows monthly repayment of both cases of excluding and including mapping cost to farmer's share.

3.5.4 Study on the Proper Water Charge

The water charge is necessary to operate and maintain irrigation facilities after the implementation, which is collected from members aiming at sustainable use of irrigation facilities and irrigation benefits. Water charge will be spent on repair of irrigation facilities, salary for water guards and management cost for WUA. Eventually proper water charge in Nkunjumo Area is estimated at 3,106 Ksh/ha/year, corresponding to 259 Ksh/ha/month.

3.5.5 Social and Environmental Effects by the Project

The project benefits in Nkunjumo Area mainly comes from the increase in crop production, which are the tangible benefits. Meanwhile, some other intangible benefits, which often have important meaning, can be expected to generate.

- The implementation of small scale irrigation project in Nkunjumo become a model case of irrigation project in not only Meru district but also in other similar areas.
- It will become a good example to show necessary supporting activities in agricultural extension service, training for farmers and strengthening plan for their groups in the soft aspect.
- The operation and maintenance of irrigation facilities by farmer's groups will give a good sample for other irrigation projects in the future.
- Farm household income increase temporarily by participating in the construction work of irrigation facilities.
- Farmers will foster their harmony and recognition by participating in O&M of irrigation facilities which will become the common property of the rural society.
- Various activities in the hard and soft aspects given by many agencies will provide the ideas for activities and supports to promote the small scale irrigation projects in the future.

3.6 Project Monitoring and Evaluation

1) Necessity and Objectives of Monitoring and Evaluation

Water supply system improvement including irrigation for Kunjumo Water Project is planned to be implemented as a self-help project. Moreover, since community-based smallholder farmers in the rural areas are suffering from weak economic and technical foundation, follow-up support may be necessary to make the Project sustainable. Therefore, for certain period after commencement of the Project operation, actual benefits and impacts by the Project shall be properly obtained and evaluated through monitoring and evaluation works. Under such consideration, objectives of monitoring and evaluation of the Project are;

- To obtain and judge how many goals and targets initially formulated under the Project are attained,
- To judge whether follow-up support is required or not from viewpoint of project sustainability under self-help management, and
- To learn lessons, both positive and negative, from the Project in order to apply to other Project Areas.

2) Monitoring Works

Monitoring works shall be conducted on the following items;

a) Irrigation/water supply system operation
   - Water distribution operation including irrigation water rotation
   - Condition of irrigation facilities such as intake, pipeline, stop valves, storage tanks, etc.
   - Condition of farmers participation and maintenance costs in O&M
   - Condition of water flow through the pipeline and sprinkler irrigation

b) Access and village/farm roads maintenance
   - Road maintenance activities and conditions within the Project Area
   - Road accessibility of village/farm roads in the Project Area
   - Participation of community people in maintenance activities
   - Condition of support services to be extended by Meru County Council for O&M of village/farm roads
   - Condition of access roads maintained by MPWH

c) Agricultural aspect
   - Condition of area irrigated, crops planted and crop yield
   - Condition of farm inputs such as seeds, fertilizer, pesticide, etc
   - Activities of extension workers from MOA

d) Institutional aspect
   - Management and activities of Nkunjumo Water Association (irrigation group, women group, marketing group, cooperative society)
   - Management and activities of village community in relation to the maintenance of village/farm roads
   - Management and activities of cooperatives and women's group
   - Collection of O&M fee for water supply facilities
   - No. of days being held an education training, assembly meeting and its agenda.

e) Marketing aspect
   - Changes in marketing condition

f) Farm economy aspect
   - Changes in farm income and expenditure
   - Changes in farm gate price by crops
   - Crop budget including material cost, labour cost, etc.
   - Condition of water fee collection and repayment of loan to funding agencies/banks

3) Evaluation Works

Based on the data obtained from monitoring works, analysis and evaluation of the Project shall be conducted in consideration of goals and targets expected from the Project. Problems and constraints, if any, shall be analyzed and discussed with beneficiary groups/communities through workshop meetings. Countermeasures shall also be prepared as a follow-up support if necessary. Moreover, evaluation shall focus on the method how to apply to other Project Areas.

4) Implementation of Monitoring and Evaluation

It is essential to take community participation approach for implementation of monitoring and evaluation works. Workshop meetings will be held with association members, community members, women's groups, etc. during data collection, analysis and evaluation.

Monitoring and evaluation for the water supply system operation and village/farm roads maintenance are carried out by NGOs under supervision of ESC for two (2) years after completion of construction works. These will be the most important aspects since physical condition of facilities and its system functions of facilities are always the base of promotion of improved horticultural production.

Monitoring and evaluation of other aspects by NGOs as well can be conducted in the course of implementation of the community development and support services which are scheduled to implement up to four (4) years after the construction.

Table 3.5-1 Standard Conversion Factor

(unit:1,000 K.Pound)

	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	Average
(1)Imports	2,545,630	2,645,913	2,945,863	5,056,419	5,753,988	7,758,420	8,424,310	5,018,649
(2)Exports	1,244,010	1,629,467	1,742,268	3,678,247	4,282,132	4,866,950	5,910,000	3,336,153
(3)Import Duties	347,968	334,680	255,939	459,150	739,639	929,910	1,058,780	589,438
(4)Export Duties	729	70	740	222	130	0	0	270
(5)Subsidy on Exports	0	0	0	0	0	0	0	0
(6)=(1)+(2)	3,789,640	4,275,380	4,688,131	8,734,666	10,036,120	12,625,370	14,334,310	8,354,802
(7)=(1)+(2)+(3)-(4)+(5)	4,136,879	4,609,990	4,943,330	9,193,594	10,775,629	13,555,280	15,393,090	8,943,970
(8)SCF=(6)/(7)	0.916	0.927	0.948	0.950	0.931	0.931	0.931	0.934

Source.Economic Survey 1997
Statistical Abstract 1995

Table 3.5-2 Price Structure of Fertilizer

	Urea	TSP	Muriate of Potash
1. Projected 2010 World market price($/ton in 1990 price)	131.8	106.7	90.3
2. Projected 2010 World market price($/ton in 1998 price)	145.3	117.6	99.5
3. Freight and insurance(US$/ton)	40	40	40
4. CIF Monbasa(US$/ton)	185.3	157.6	139.5
5. Unloading and port handling(US$/ton)	9	9	9
6. Value Kenya border			
- in US$	194.3	166.6	148.5
- in Ksh(61.19Ksh/US$)	11,889	10,194	9,086
7. Domestic handling, transport, margin(Ksh/ton)	831	831	831
8. Wholesale price(Ksh/ton)	12,720	11,025	9,917
9. Transport to/from farm(Ksh/ton)	103	103	103
10. Farmgate price(Ksh/ton)	12,617	10,922	9,814
11. Farmgate price in nutrient(Ksh/kg)	27.4	24.3	16.4

Source.Commodity markets and the developing countries, February 1998, World Bank

Table 3.5-3 Price Structure of Maize

1. Projected 2010 world market price($/ton in 1990 price	94.9
2. Projected 2010 world market price($/ton in 1998 price	104.6
3. Quality adjustment(%)	90
4. World market equivalent(US$/ton)	94
5. Freight and insurance(US$/ton)	40
6. CIF Monbasa(US$/ton)	134
7. Unloading and port handling(US$/ton)	9
8. Value Kenya border	
- in US$	143
- in Ksh(61.19Ksh/US$)	8,750
9. Domestic handling, transport, margin(Ksh/ton)	831
10. Processing ratio(%)	100
11. Wholesale price(Ksh/ton)	9,581
12. Transport to/from farm(Ksh/ton)	103
13. Farmgate price(Ksh/ton)	9,478

Source.Commodity markets and the developing countries February 1998, World Bank

Table 3.5-4 Price Structure of Coffee and Tea

	Coffee	Tea
1. Projected 2010 World market price($/ton in 1990 price)	1,812	1,405
2. Projected 2010 World market price($/ton in 1998 price)	1,997	1,549
3. Adjustment for quality(%)	95	90
4. Weighted average export priceFOB price(US$/ton)	1,897	1,471
5. Port charges/handling(US$/ton)	9	9
6. Value at Kenya boder(per ton)		
- in US$	1,888	1,462
- in Ksh(61.19Ksh/US$)	115,526	89,457
7. Domestic handling, transport, margin(Ksh/ton)	766	766
8. Ex-coffee factory price(Ksh/ton)	114,760	88,691
9. Yielding recovery(%)	15	20
10. Input price at coffee factory(Ksh/ton)	17,214	17,738
11. Transport to/from farm(Ksh/ton)	20	20
12. Farmgate price(Ksh/ton)	17,194	17,718

Source.Commodity markets and the developing countries, February 1998, World Bank

Table 3.5-5 Farmgate Price at Nkunjumo

	Unit	Unit Price(Ksh) Financial	Economic
1. Crops			
Maize	kg	10.5	9.5
Maize Green	kg	10.3	10.3
Millet	kg	20.0	20.0
Sorgum	kg	15.0	15.0
Beans	kg	31.8	31.8
French Beans	kg	23.7	29.8
Irish Potatoes	kg	14.0	14.0
kale	kg	3.2	3.2
Sweet Potatoes	kg	5.2	5.2
Bulb Onions	kg	26.7	26.7
Tomatoes	kg	20.0	20.2
Cabbage	kg	10.1	10.1
Yam	kg	20.0	20.0
Banana	Bunch	150.0	150.0
Coffee	kg	14.3	17.2
Tea	kg	8.0	17.7
Milk	kg	20.2	20.2
Avocado	kg	5.0	5.0
2. Seed			
Maize	kg	91	85
French Beans	kg	165	154
Bulb onion	kg	3,420	3,194
Tomatoes	kg	5,800	5,417
Cabbage	kg	1,200	1,121
Carrot	kg	1,280	1,196
Kale	kg	1,440	1,345
3. Fertilizer			
Nitrogen	kg	26.0	27.4
Phosphate	kg	18.0	24.3
Potassium	kg	23.4	16.4
4. Agricultural Chemicals			
Dimethoate	lit.	605	565
Antracol	kg	483	451
Sancozeb	kg	465	434
Milraz	kg	1,031	963
Karate	lit.	1,462	1,366
5. Labour			
Labour	MD	75	38
Animal Labour	MAD	1,000	500
6. Nursery			
Banana	plant	50	50
Coffee	plant	50	50
Papaya	plant	40	40
Mango	plant	60	60
Avocado	plant	50	50
Tea	plant	50	50

Source.Farm Economic Survey(JICA) 1998
and interview survey to stockists

Table 3.5-6 Estimation of the Agricultural Benefits

(A) Rainfed Areas

	Maize/ Beans	Maize Green	Beans	Kale	Potato	Cabbage	French Beans	Sweet Potato	Tomato	Millet	Onion	Napier	Coffee	Banana	Total
I. Without Project															
Unit price(Ksh/kg)	9.5/31.8	0.0	31.8	3.2	14.0	10.1	29.8	5.2	20.2	20.0	26.7		17.2	7.5	
Yield(kg/ha)		0	600	6,000	7,500	10,000	3,000	7,000	7,500	800	6,500	0	4,500	8,500	
Gross Income(Ksh/ha)	26,165	0	19,080	19,200	105,000	101,000	89,400	36,400	151,500	16,000	173,550	0	77,400	63,750	
Cost of Production(Ksh/ha)	15,743	0	10,904	6,825	67,414	9,162	19,537	9,762	19,976	4,111	28,681		12,238	7,771	
Net Return(Ksh/ha)	10,422	0	8,176	12,375	37,586	91,838	69,863	26,638	131,524	11,889	144,869		65,164	55,979	
Planted Area(ha)	62.02	0.00	33.35	3.06	7.09	3.49	2.18	0.25	1.89	1.45	0.18	0.00	69.51	9.17	
Total Net Return(1,000 Ksh)	646	0	273	38	266	321	152	7	249	17	26	0	4,530	513	7,038
II. With Project															
Unit price(Ksh/kg)	9.5/31.8	0.0	31.8	3.2	14.0	10.1	29.8	5.2	20.2	20.0	26.7		17.2	7.5	
Yield(kg/ha)		0	650	8,000	8,000	15,000	3,500	7,000	7,500	800	6,500	12,000	4,500	8,500	
Gross Income(Ksh/ha)	31,720	0	20,670	25,600	112,000	151,500	104,300	36,400	151,500	16,000	173,550	0	77,400	63,750	
Cost of Production(Ksh/ha)	16,407	0	11,144	7,218	68,824	10,376	19,657	10,557	21,258	4,255	29,807		13,306	7,931	
Net Return(Ksh/ha)	15,313	0	9,526	18,382	43,176	141,124	84,643	25,843	130,242	11,745	143,943		64,094	55,819	
Planted Area(ha)	28.92	0.00	32.06	3.21	7.21	3.21	2.40	0.32	1.92	1.60	0.16	0.00	47.11	6.41	
Total Net Return(1,000 Ksh)	443	0	305	59	311	453	203	8	250	19	23	0	3,019	358	5,452
III. Incremental Benefit(1,000 Ksh)	-204	0	33	21	45	132	51	2	1	2	-3	0	-1,510	-156	-1,586

(B) Irrigated Areas

	Maize/ Beans	Maize Green	Beans	Kale	Potato	Cabbage	French Beans	Sweet Potato	Tomato	Millet	Onion	Napier	Coffee	Banana	
I. Without Project															
Unit price(Ksh/kg)	0.0	10.3	31.8	3.2	14.0	10.1	29.8	0.0	20.2	0.0	26.7		0.0	0.0	
Yield(kg/ha)	0	3,000	700	8,000	8,500	14,000	3,500	0	8,500	0	7,000	13,000	0	0	
Gross Income(Ksh/ha)	0	30,900	22,260	25,600	119,000	141,400	104,300	0	171,700	0	186,900	0	0	0	
Cost of Production(Ksh/ha)	0	8,486	11,144	7,488	74,112	10,376	19,737	0	22,541	0	30,839		0	0	
Net Return(Ksh/ha)	0	22,414	11,116	18,112	44,888	131,024	84,563	0	149,159	0	156,061		0	0	
Planted Area(ha)	0.00	0.55	0.00	1.45	1.64	0.55	1.45	0.00	0.91	0.00	0.73	1.67	0.00	0.00	
Total Net Return(1,000 Ksh)	0	12	0	26	74	72	123	0	136	0	114	0	0	0	557
II. With Project															
Unit price(Ksh/kg)	9.5/31.8	10.3	31.8	3.2	14.0	10.1	29.8	5.2	20.2	0.0	26.7		17.2	7.5	
Yield(kg/ha)		4,000	750	12,000	10,000	16,000	4,000	8,500	10,000	0	7,500	15,000	5,500	10,000	
Gross Income(Ksh/ha)	40,455	41,200	23,850	38,400	140,000	161,600	119,200	44,200	202,000	0	200,250	0	94,600	75,000	
Cost of Production(Ksh/ha)	17,075	9,880	11,507	10,939	86,773	11,959	20,123	14,459	32,273	0	36,365		20,357	11,491	
Net Return(Ksh/ha)	23,380	31,320	12,343	27,461	53,227	149,641	99,077	29,741	169,727	0	163,885		74,243	63,509	
Planted Area(ha)	29.80	2.80	5.60	2.90	6.80	3.90	1.40	2.80	1.60	0.00	0.80	1.80	22.40	2.80	
Total Net Return(1,000 Ksh)	697	88	69	80	362	584	139	83	272	0	131	0	1,683	178	4,344
III. Incremental Benefit(1,000 Ksh)	697	75	69	53	288	512	16	83	136	0	17	0	1,683	178	3,788
(C) Incremental Benefit(1,000 Ksh)	493	75	102	75	333	644	67	85	137	2	14	0	153	22	2,202

Table 3.5-7 Estimation of Benefits on the Farm and Village Roads Improvement

①Fuel Consumption(2 ton truck)

15km/hour	0.180 lit./km
20	0.160
30	0.135
40	0.116
50	0.105

②Speed(Km/hr)	without Project	with Project
Rupingazi Ngerwe	20	40
Ngomano/Nyangati	40	50
Nkunjumo	30	40
Ruungu/Karocho	15	40

Note.Figures in parenthesis are fuel consumption(lit./km)

③Road Length to be Improved(km)	without Project	with Project
Rupingazi Ngerwe	7.5	7.5
Ngomano/Nyangati	3.2	3.2
Nkunjumo	2.5	2.5
Ruungu/Karocho	40.5	40.5

④Fuel Consumption per Unit(lit.)	without Project	with Project
Rupingazi Ngerwe	2.4	1.7
Ngomano/Nyangati	0.7	0.7
Nkunjumo	0.7	0.6
Ruungu/Karocho	14.6	9.4

⑤Amount of Fuel Consumption(Ksh)	without Project	with Project	Diffrence
	23,167	16,796	6,371
	21,932	19,852	2,080
	9,417	8,092	1,325
	373,357	240,608	132,749

Table 3.5-8 Project Cost and O&M Cost

Project Cost(Nkunjumo)

	Financial Cost(Ksh)		Economic Cost(Ksh)
	Total Cost	Of Which, Private Sector	Total Cost
1. Construction cost			
1) Irrigation & drainage improvement	5,455,106	5,455,106	5,095,069
2) Marketing improvement	286,600,000	0	0
3) Access roads improvement	0	0	0
4) Village/farm roads improvement	1,425,000	0	1,330,950
5) Rural water supply improvement	0	0	0
Sub-Total	293,480,106	5,455,106	6,426,019
2. Community Development & Supporting Services			
1) Agricultural support services	10,640,000	0	9,937,760
2) Community development	7,086,000	0	6,618,324
3) Water management services	1,960,000	0	1,830,640
4) Marketing support services	21,280,000	0	354,920
5) Public health services	0	0	0
Sub-Total	40,966,000	0	18,741,644
3. Associated Cost			
1) Pre-engineering cost	8,697,750	0	0
2) Administration cost	10,484,226	0	1,668,569
3) Consulting services	11,292,610	545,510	2,383,671
Sub-Total	30,474,586	545,510	4,052,239
4. Physical Contingency	15,018,010	545,510	509,506
Total	379,938,702	6,546,126	29,729,409

Note.Construction cost and associated cost for the marketing improvement are excluded.

Operation and Maintenance Cost(Nkunjumo)

Financial Cost		Economic Cost
Annual Operation and Maintenence Cost		
1) Irrigation & drainage facilities	109,000	101,806
2) Marketing facilities	0	0
3) Access roads	0	0
4) Village/farm roads	62,000	57,908
5) Rural water supply facilities	0	0
Total	171,000	159,714

Table 3.5-9 Calculation of EIRR

-Nkunjumo-

(Unit:1,000 Ksh)

Year	Capital Cost	O & M Cost	Total	Benefit	Return	Present Value by Discount Rate					
						Interest= 0.16		Interest= 0.10		Interest= 0.12	
						Cost	Benefit	Cost	Benefit	Cost	Benefit
1	238	160	398	1,102	704	398	1,102	398	1,102	398	1,102
2	13,735	160	13,895	1,322	-12,573	10,326	982	11,483	1,092	11,077	1,054
3	13,140	160	13,300	1,322	-11,978	8,521	847	9,993	993	9,467	941
4	713	160	873	1,762	889	482	973	597	1,204	555	1,120
5	624	160	784	2,203	1,419	373	1,049	487	1,368	445	1,250
6	624	160	784	2,203	1,419	322	904	443	1,244	397	1,116
7	654	160	814	2,203	1,389	288	779	418	1,130	368	997
8	0	160	160	2,203	2,043	49	672	75	1,028	65	890
9	0	160	160	2,203	2,043	42	579	68	934	58	794
10	0	160	160	2,203	2,043	36	499	62	849	52	709
11	0	160	160	2,203	2,043	31	431	56	772	46	633
12	0	160	160	2,203	2,043	27	371	51	702	41	565
13	0	160	160	2,203	2,043	23	320	46	638	37	505
14	0	160	160	2,203	2,043	20	276	42	580	33	451
15	0	160	160	2,203	2,043	17	238	38	527	29	402
16	0	160	160	2,203	2,043	15	205	35	479	26	359
17	0	160	160	2,203	2,043	13	177	32	436	23	321
18	0	160	160	2,203	2,043	11	152	29	396	21	286
19	0	160	160	2,203	2,043	10	131	26	360	19	256
20	0	160	160	2,203	2,043	8	113	24	327	17	228
21	0	160	160	2,203	2,043	7	98	22	298	15	204
22	0	160	160	2,203	2,043	6	84	20	271	13	182
23	0	160	160	2,203	2,043	5	73	18	246	12	163
24	0	160	160	2,203	2,043	5	63	16	224	11	145
25	0	160	160	2,203	2,043	4	54	15	203	9	130
26	0	160	160	2,203	2,043	3	46	13	185	8	116
27	0	160	160	2,203	2,043	3	40	12	168	8	103
28	0	160	160	2,203	2,043	3	35	11	153	7	92
29	0	160	160	2,203	2,043	2	30	10	139	6	82
30	0	160	160	2,203	2,043	2	26	9	126	5	74
Total	29,729	4,800	34,529	62,766	28,257	21,053	11,348	24,547	18,175	23,266	15,270
								EIRR=	5.92 %		
						B/C Ratio=		16 %	0.54		
						B/C Ratio=		10 %	0.74		
						B/C Ratio=		12 %	0.66		

Table 3.5-10 Financial analysis for Standard Farm

1. Small Farm size: 1.10 ha

Without Project

	Planted Area(ha)	Yield (kg/ha)	Production (kg)	Unit Price (Ksh/kg)	Gross Income(Ksh)	Cost of Production (Ksh)	Net Return (Ksh)
Maize/Beans	0.45	1,750	788	10.5	8,274		
Beans/Maize	0.45	300	135	31.8	4,293	9,685	2,882
Beans	0.24	600	144	31.8	4,579	3,149	1,430
Cabbage	0.03	10,000	300	10.1	3,030	403	2,627
Potatoes	0.05	7,500	375	14.0	5,250	3,900	1,350
Other Vegetables	0.07	3,000	210	23.7	4,977	1,828	3,149
Coffee	0.51	4,500	2,295	14.3	32,819	9,990	22,829
Banana	0.06	8,500	510	7.5	3,825	625	3,200
Total	1.41						37,467
1. Crop Income(Ksh/year)							37,467
2. Animal Income(Ksh/year)							3,890
3. Off-Farm Income(Ksh/year)							15,315
4. Living Expense(Ksh/year)-family size 7.4persons/family							42,020
5. Disposable Income(Ksh/year)							14,652

With Project

I. Rainfed Area

	Planted Area(ha)	Yield (kg/ha)	Production (kg/ha)	Unit Price (Ksh/kg)	Gross Income(Ksh)	Cost of Production (Ksh)	Net Return (Ksh)
Maize/Beans	0.30	2,000	600	10.5	6,300		
Beans/Maize	0.30	400	120	31.8	3,816	6,698	3,418
Beans	0.34	650	221	31.8	7,028	4,623	2,405
Potatoes	0.08	8,000	640	14.0	8,960	6,429	2,531
Cabbage	0.03	15,000	450	10.1	4,545	447	4,098
Other Vegetables	0.10	3,500	350	23.7	8,295	2,636	5,659
Coffee	0.50	4,500	2,250	14.3	32,175	10,520	21,655
Banana	0.07	8,500	595	7.5	4,463	751	3,712
Sub-Total	1.42						43,478
II. Irrigated Area							
Maize/Beans	0.21	2,250	473	10.5	4,967		
Beans/Maize	0.21	600	126	31.8	4,007	4,868	4,105
Beans	0.04	750	30	31.8	954	561	393
Potatoes	0.05	10,000	500	14.0	7,000	4,977	2,023
Other Vegetables	0.13	4,000	520	23.7	12,324	3,518	8,806
Coffee	0.16	5,500	880	14.3	12,584	4,672	7,912
Banana	0.02	10,000	200	7.5	1,500	285	1,215
Sub-Total	0.61						24,454
1. Total Crop Income(Ksh/year)							67,932
2. Animal Income(Ksh/year)							3,890
3. Off-Farm Income(Ksh/year)							15,315
4. Living Expense(Ksh/year)-family size 7.4persons/family							42,020
5. Disposable Income(Ksh/year)							45,117

Table 3.5-11 Cost Recovery Analysis

	Excluding Map Preparation	Including Map Prep.
Case-1 Present condition		
1) Number of beneficiaries	140 farm households	
2) Total project cost to be paid by the beneficiaries	379,938,702 Ksh	
of which, irrigation facilities	6,546,126 Ksh	7,309,839
3) Loan per farm household	46,758 Ksh	52,213
4) Repayment Period(years)	4 48 (months)	
5) Annual interest rate(%)	16 per year	
6) Monthy interest ratre(%)	1.33 (16/12)	
7) Monthly repayment(Ksh)	1,325 Ksh/month	1,480

Alternative Plans for Loan Repayment

Case-2		
1) Loan per farm household(Ksh)	46,758	52,213
2) Repayment Period(years)	6 72 (months)	
3) Annual interest rate(%)	12 per year	
4) Monthy interest ratre(%)	1.00 (12/12)	
5) Monthly repayment(Ksh)	914 Ksh/month	1,021
Case-3		
1) Loan per farm household(Ksh)	46,758	52,213
2) Repayment Period(years)	8 96 (months)	
3) Annual interest rate(%)	10 per year	
4) Monthy interest ratre(%)	0.83 (10/12)	
5) Monthly repayment(Ksh)	710 Ksh/month	792
Case-4		
1) Loan per farm household(Ksh)	46,758	52,213
2) Repayment Period(years)	10 120 (months)	
3) Annual interest rate(%)	5 per year	
4) Monthy interest ratre(%)	0.42 (5/12)	
5) Monthly repayment(Ksh)	496 Ksh/month	554
Case-5		
1) Loan per farm household(Ksh)	46,758	52,213
2) Repayment Period(years)	4 48 (months)	
3) Annual interest rate(%)	30 per year	
4) Monthy interest ratre(%)	2.50 (30/12)	
5) Monthly repayment(Ksh)	1,684 Ksh/month	1,880

Repayment under the Current Situation(Nkunjumo)

Case-6	
1) Loan per farm household	46,758 Ksh
2) Repayment Period(years)	4 (48 months)
3) Annual interest rate(%)	16 (% per year)
4) Monthy interest ratre(%)	1.33 (16/12)
5) Monthly repayment(Ksh)	1,325 (Ksh/month)

6) Monthly repayment and disposable income(Ksh)

	Repayment	Disposable Income	
1st year	1,325	350	(farm economic survey 1998)
2nd year	1,325	1,880	
3rd year	1,325	2,600	
4th year	1,325	3,760	

Table 3.5-12 Estimation of Water Charge

(Unit:Ksh)

Year	Initial Cost	O & M Cost	Replacement Cost	Total	Present Value by Discount Rate Int.= 0.16 Initial Cost	O&M Cost	Replacement	Total	Int.= 0.15 Initial Cost	O&M Cost	Replacement	Total	Int.= 0.20 Initial Cost	O&M Cost	Replacement	Total
1	0	109,000	0	109,000	0	109,000	0	109,000	0	109,000	0	109,000	0	109,000	0	109,000
2	3,273,063	109,000	0	3,382,063	2,432,418	81,005	0	2,513,424	2,474,906	82,420	0	2,557,326	2,272,980	75,694	0	2,348,655
3	3,273,063	109,000	0	3,382,063	2,066,913	69,832	0	2,136,745	2,152,092	71,669	0	2,223,761	1,894,134	63,079	0	1,957,212
4	0	109,000	0	109,000	0	80,200	0	80,200	0	82,321	0	82,321	0	52,566	0	52,566
5	0	109,000	0	109,000	0	51,896	0	51,896	0	54,192	0	54,192	0	43,805	0	43,805
6	0	109,000	0	109,000	0	44,738	0	44,738	0	47,124	0	47,124	0	36,504	0	36,504
7	0	109,000	0	109,000	0	38,567	0	38,567	0	40,977	0	40,977	0	30,420	0	30,420
8	0	109,000	0	109,000	0	33,248	0	33,248	0	35,632	0	35,632	0	25,350	0	25,350
9	0	109,000	0	109,000	0	28,662	0	28,662	0	30,985	0	30,985	0	21,125	0	21,125
10	0	109,000	0	109,000	0	24,709	0	24,709	0	26,943	0	26,943	0	17,604	0	17,604
11	0	109,000	0	109,000	0	21,300	0	21,300	0	23,429	0	23,429	0	14,670	0	14,670
12	0	109,000	0	109,000	0	18,362	0	18,362	0	20,373	0	20,373	0	12,225	0	12,225
13	0	109,000	0	109,000	0	15,830	0	15,830	0	17,716	0	17,716	0	10,188	0	10,188
14	0	109,000	0	109,000	0	13,646	0	13,646	0	15,405	0	15,405	0	8,490	0	8,490
15	0	109,000	0	109,000	0	11,764	0	11,764	0	13,395	0	13,395	0	7,075	0	7,075
16	0	109,000	0	109,000	0	10,141	0	10,141	0	11,648	0	11,648	0	5,896	0	5,896
17	0	109,000	0	109,000	0	8,743	0	8,743	0	10,129	0	10,129	0	4,913	0	4,913
18	0	109,000	0	109,000	0	7,537	0	7,537	0	8,808	0	8,808	0	4,094	0	4,094
19	0	109,000	0	109,000	0	6,497	0	6,497	0	7,659	0	7,659	0	3,412	0	3,412
20	0	109,000	0	109,000	0	5,601	0	5,601	0	6,660	0	6,660	0	2,843	0	2,843
21	0	109,000	0	109,000	0	4,828	0	4,828	0	5,791	0	5,791	0	2,369	0	2,369
22	0	109,000	0	109,000	0	4,162	0	4,162	0	5,036	0	5,036	0	1,974	0	1,974
23	0	109,000	0	109,000	0	3,588	0	3,588	0	4,379	0	4,379	0	1,645	0	1,645
24	0	109,000	0	109,000	0	3,093	0	3,093	0	3,808	0	3,808	0	1,371	0	1,371
25	0	109,000	0	109,000	0	2,667	0	2,667	0	3,311	0	3,311	0	1,143	0	1,143
26	0	109,000	0	109,000	0	2,299	0	2,299	0	2,879	0	2,879	0	952	0	952
27	0	109,000	0	109,000	0	1,982	0	1,982	0	2,504	0	2,504	0	793	0	793
28	0	109,000	0	109,000	0	1,706	0	1,706	0	2,177	0	2,177	0	661	0	661
29	0	109,000	0	109,000	0	1,473	0	1,473	0	1,893	0	1,893	0	551	0	551
30	0	109,000	0	109,000	0	1,270	0	1,270	0	1,646	0	1,646	0	459	0	459
Total	6,546,126	3,270,000	0	9,816,126	4,529,332	988,349	0	5,217,681	4,626,998	729,909	0	5,356,907	4,167,094	560,871	0	4,727,965
Annua	218,204	109,000	0	327,204	150,978	22,945	0	173,923	154,233	24,330	0	178,564	138,903	18,696	0	157,599

Water Charge

	Interest 0.16	Interest 0.15	Interest 0.20
a. Annual Water Intake	589,100 m3/year		
b. Cost	Present Value	Present Value	Present Value
b.1 Cost per year at financial price	150,978	154,233	138,903
b.2 Annual OM cost at financial price	22,945	24,330	18,696
b.3 Replacement cost at financial price	0	0	0
Total	173,923	178,564	157,599
c. Water Charge			
c.1 per cubic meter	0.295235 Ksh	0.303112 Ksh	0.267525 Ksh
c.2 per ha/year	3,106 Ksh	3,189 Ksh	2,814 Ksh
c.3 ha/month	259 Ksh	266 Ksh	235 Ksh

3.7 Recommendations

Agriculture

a) The current dominant farming type of the Nkunjumo Water Project, which was classified as Type-D in Model Area selection, is the production-oriented commercial-based coffee farming with small-scale horticultural crops. Beneficial farmers have such strong willingness that the present farming type should be shifted to commercial-based coffee farming with planning of expansion of horticultural agriculture. Therefore, plan of agricultural farming in the Area should be formulated in the direction mentioned above.,

b) The trials and demonstrations will be conducted by the GOK staff in Agricultural Extension and Irrigation Development Department. The recipients will be the smallholders. The trials and demonstrations will be conducted on farmer's fields. The actual timing will be determined by the nature of the trial, and preparations will have to be made in advance of the planting season. The frequency will be as shown below. The method will be collabouration between individual farmers and the project.

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Demonstrations	2	2	1	1	1	7
Trials	2	2	2	1	1	8

c) The training programs on crop cultivation will be conducted by GOK staff and hired professionals from private sectors. They will be given to interested farmers, and will be held in the field, near to the irrigation scheme, in churches, meeting halls etc. for periods of approximately every six months for the first two to two and a half years. These training programs will be linked to the trials and demonstration farms.

The programs will include topics such as selection of new varieties (e.g. maize hybrids) and how their production differs from traditional varieties, water management and irrigation techniques, animal nutrition including the use of urea supplement blocks, etc.

d) Others

- Testing of drip irrigation technology on coffee and other crops,
- Ensuring access to improved breeds of local chicken,
- Introduction of suitable improved maize varieties,
- Implementation of trials of urea supplement blocks,

Institutional Supporting Services

a) The District Irrigation Unit at Meru should liaise with IDB, Nairobi in devising a training programme specfic to Nkunjumo Water Project for social preparation of the community and capability-building of relevant agencies such as department of social services and local private sectors.

b) Project Coordinator (DPMO) should draw a training timetable for social preparation and capability-building of relevant agencies.

Irrigation and Drainage

a) The pipeline systems provided for the Project Area will be facilitated for the purpose of domestic water supply, institutional water supply as well as irrigation water supply. As all beneficiaries take domestic water through their own outlet taps every day, it is recommended that irrigation water shall be irrigated through plural rotation blocks. The WUA shall decide the area and location of proposed farmland to determine the design capacity of the irrigation canal before the commencement of detailed design study.

b) In order to realize effective water management, a water management manual shall be prepared by employing consultants. As a content of the manual, the following items as well as general techniques of water management shall be included, and the training of the members of the WUA shall be provided before the commencement of actual irrigation.

- Adaptive organization for water management (general water management method for total system, organization of irrigation group)
- Water operation rule (method of distribution of domestic and irrigation water, observance of standard cropping pattern, operating rules of control valves, formulation of penalty)
- Water distribution method within the irrigation group (irrigation turn, irrigable area)
- Irrigation method (performance of commonly used sprinklers, unit irrigation area and water application time)
- Irrigation schedule

c) It is recommended to renew existing water permit.

Marketing

a) Discussion and formulation of farmers' marketing groups,

b) Diversification of Planting crops from coffee monoculture,

c) Auction participation at Gakoromone wholesale market for local consumed produce and auction participation in connection with Nkubu satellite depot for export produce as one of marketing alternatives,

d) Practical utilization on social and natural resources for marketing advantages of; i) close distance to Gakoromone wholesale market and Nkubu market, ii) geographical advance of Gakoromone wholesale market, iii) Motivation of horticultural farming for income generation of farmers, iv) close proximity to Nkubu satellite depot,

e) Participation to related seminars for smallholders held at Jomo Kenyatta University of Agriculture and Technology (JKUAT) and other institutions managed by the government,

Agricultural and Social Infrastructure

a) Main implementation agency of the Project is MOA, however, close cooperation and adjustment of work demarcation should be made among related government agencies such as MPWH, MWR, MEC, etc., since the Project involves many project components being related each other.

b) Basic plan for the water-supply system improvement shall be finalized based on feasibility study result through workshop meetings to be held with association members before commencement of the detailed design.

Project Implementation

a) Main implementation agency of the Project is MOA, however, close cooperation and adjustment of work demarcation should be made among related government agencies such as MPWH, MWR, MEC, etc., since the Project involves many project components which are related to each other.

b) For the construction work of the self-help projects, detailed work allocation and responsibilities as shown below among Contractors, WUA and NGOs, which are directly related to the construction costs, shall be clearly presented to WUA in the detailed design stage;

- Contents of work to be contributed by WUA in the form of labour,
- Responsibility of procurement and management of materials, equipment and skilled labours, and
- Responsibility of work quality and schedule.

c) In the course of project implementation, farmers/farmers representatives should make reference to the on-going activities of classified Type-A smallholder irrigation schemes such as Ciambarage Irrigation Scheme in Tharaka Nithi and Muguna Water Project in Meru district for their horticultural development.

d) For the planning of irrigated horticultural development for each Model Area, the Study Team prepared a topographical maps with a scale of 1:5,000 utilizing aerial photographs and ground survey methods. Its costs were about 669 thousand Ksh per site (average size is 276 ha). These topographical maps are deemed to be essential and useful not only for carrying out physical planning of irrigation and drainage facilities in the Area, but also encouragement of farmers' participation in the project with their awareness of common ownership for community resources.

In the project evaluation, the required costs for preparation of the topographical maps mentioned above were not counted because the Study Team shoulders the burden of the costs. However, when other projects are planned, such topographical maps with scales of 1:5,000 should be prepared and these required costs should be assumed by beneficiary groups themselves.

Environment

a) It is necessary to avoid the use of herbicides as far as possible, as their use will have a negaative influence on soil and rivers, and will destroy valuable resource for manure. MOA should prohibit the sale of

herbicide that are prohibited for use in the EU and collect them for disposal from agencies and coffee societies.

b) Promotion of horticulture crops should be limited to the gentle slopes of farmland. On the other hand, improvement of coffee growing techniques and the management of coffee societies, and the possibility of fruit-tree growing, etc. should be examined in the steep slopes of the Area.

c) From view point of rural environment, MOA should support horticulture as well as livestock raising, production of feed and manure synthetically. Extension officers of the MOA should improve the know-how of agriculture and livestock raising. Further, it is important to approach the plan in combination with other projects executed or being executed by other donors.

Project Economy and Farm Budget

a) Preparation is recommended for detailed project plans of the proposed small-scale irrigation schemes that MOA should undertake as well as careful appraisal of project plans to be proposed by the community's concerned, placing emphasis on the appropriateness of the technology designed for irrigation systems and the accuracy of the cost estimate to be based on least-cost approaches.

In almost all the small-scale irrigation projects, many farmers are being confronted with difficulty in loan repayment. This holds true even for the farmers of Ciambaraga Irrigation Schemes in Tharaka Nithi district, one of the well managed projects among the 463 reviewed. Accurate cost estimates are important, since the cost is a crucial element in determining the financial and economic viability of the project and also for planning its funding.

b) It is recommended that prior to the implementation of the projects, a farm budget analysis of the representative farms should be conducted, through detailed farm surveys, with the primary objective of providing a basis for an assessment of the investment plans and debt repayment capacities of the farmers.

The farm budget analysis also provides a basis for setting repayment terms and conditions for credit that will be enough to encourage the farmers to participate in the project and make sure that they would have sufficient cash to repay the loans. The ability of the farmers to pay is an instrument for promoting sustainability.

c) It is recommended that intensive support should be given to the farmers participating in the project untill they have attained the full production target ,since it may take several years to reach. To this end, the district governments should establish the District Project Management Office (DPMO), responsible for providing supporting services to the farmers, as proposed in this study.

The proposed DPMO shall formulate support services programs in close coordination with HCDA, FPEAK, DAO and NGOs as agricultural development could be realized only with the full cooperation of the agricultural services agencies, as well as the cooperation of the private entities concerned.

Monitoring of the Project

a) Monitoring work for the progress of project implementation should be carried out by external agencies under the supervision of Executive Steering Committee (ECS), to cope with the following purposes;

- To obtain and judge how many goals and targets initially formulated under the Project are attained,
- To judge whether or not follow-up support is required from the viewpoint of project sustainability under self-help management, and
- To learn lessons, both positive and negative, from the Project in order to apply them to other Project Areas.

b) Monitoring work shall be conducted on the following items;

- Irrigation system operation
- Access and village/farm roads maintenance
- Agricultural aspect
- Institutional aspect
- Marketing aspect
- Farm economy aspect
- Control of soil erosion and watershed management

Table 3.7-1 indicated the required training items for implementation of smallholder irrigation schemes in Nkunjumo Water Project.

Table 3.7-1 Required Training Items for Nkunjumo Water Project

	Training Items	Farmers/ Farmers' Group	Implementing Staff
1. Agriculture/Irrigation	- Land use in combination with coffee plantation	●	●
	- Irrigated and rainfed crop farming for both horticulture and food crops	●	
	- Establishment of cooperative society to purchasing agricultural inputs	●	
	- Application of farm input	●	
	- Water saving farming	●	
	- Water management in pipe-line system	●	
	- O&M works for pipe-line irrigation facilities	●	
	- Management of trial and demonstration farms	●	●
	- Monitoring of the project		●
	- Development of farm and water management manuals		●
	- Maximum residue levels (MRLs) and crop assurance for export crops	●	●
	- Soil erosion control at sloping farms	●	
2. Marketing	- Establishment/strengthening of marketing group	●	●
	- Marketing techniques for both horticulture and food crops to brokers/exporters	●	
	- Promotion of contract farming	●	●
	- Collection/compilation of market information	●	●
3. Rural Society/Infrastructure	- Capability-building for farmers/farmers' group and implementing staff	●	●
	- Promotion of women's participation to the project	●	
	- O&M for water source facilities for rural water supply	●	
	- Construction and O&M of village and farm roads	●	●
4. Support Services	- WUAs' roles and performance	●	
	- Financial management for cooperative societies	●	●
	- Processing techniques for coffee produce	●	
	- Access to agricultural credit	●	●
	- Linkages with other institution		●
5. Environment	- Soil erosion control at sloping farms	●	●
	- Watershed Management and water conservation	●	●
	- Promotion of improved cooking stove	●	

CHAPTER IV.

FEASIBILITY STUDY ON RUUNGU/KAROCHO IRRIGATION PROJECT

CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER IV. FEASIBILITY STUDY ON RUUNGU/KAROCHO IRRIGATION PROJECT

4.1 Present Situation of the Area

4.1.1 Introduction

Ruungu/Karocho Irrigation project is Type-E Model Area. This Area is the proposed irrigation scheme situated in both districts of Nyambene and Tharaka Nithi, far from all weather roads (more than 7.0 km), under the poverty conditions with frequent occurrence of famine due to shortage of food crops.

4.1.2 Physical Conditions

1) Location, Meteorological and Hydrological Conditions

Ruungu/Karocho Irrigation Project is situated in Turima location, Tharaka Central division of Tharaka Nithi district, Eastern province. It is about 34 km east of Nkubu town of Meru district. The scheme extends seven kilometers along the left bank of the Thingithu river and is two kilometers wide. The gross area of scheme is 400 ha.

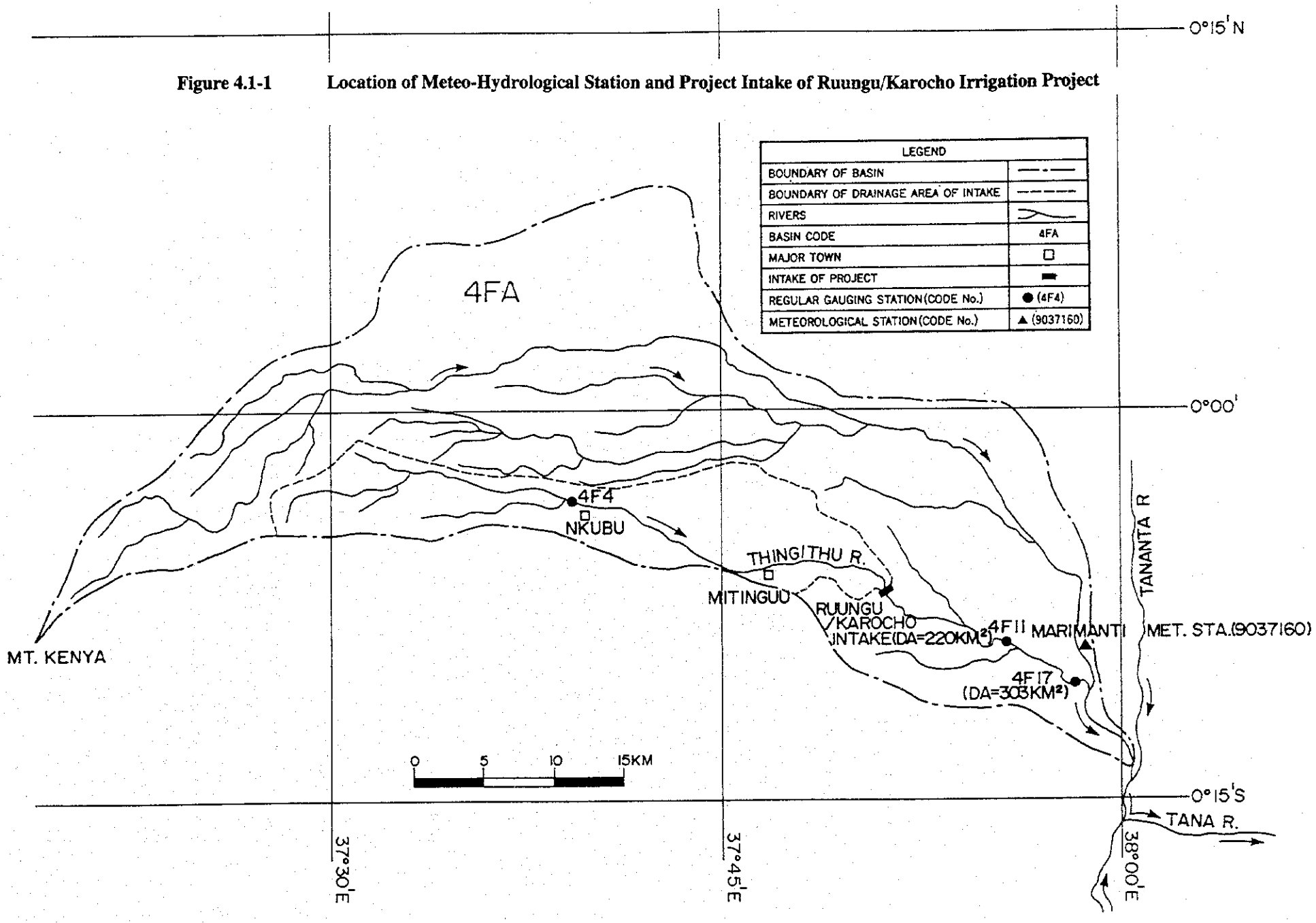
The scheme is in Agro-ecological zone Lower Midland 4, the Marginal Cotton zone. Ruungu is the driest of the four Project Areas with a potential evaporation of over 2,200 mm per year, and an average rainfall of about 850 mm with the long rains from March to May and the short rains from October to November. The mean temperature ranges from a daily minimum of 18.4℃ in January to a daily maximum of 34.6℃ in March. The details of data observed at Marimante Meteorological Station are shown in Table G.2.4-1, Annex G-2.

The water source for the project is Thingithu river which is a tributary of the Kathita river and one of main rivers in Tharaka Nithi district. The catchment area above the proposed intake site is 220 sq.km, and includes the Mount Kenya Forest, so the water is available year round as long as upstream use is controlled. The location of meteo-hydrological stations and the intake of project is shown in Figure 4.1-1.

2) Topography

The Project is located to the east of Mount Kenya, on a flat interfluvial plain between two rivers, on the very edge of the eastern foothills of Mount Kenya, just before the Tana River Plain. The Project Area is between 670 m to 780 m in elevation, from the south bank of a medium sized tributary stream of the Thinguthu river and the Thinguthu river itself, which is the southern boundary of the Project. The proposed area for irrigation is a gently east sloping flat topped ridge between the two river valleys with slopes of zero to two percent.

Figure 4.1-1 **Location of Meteo-Hydrological Station and Project Intake of Ruungu/Karocho Irrigation Project**



3) Soil and Land Use

The study area soils are moderately deep clay to sandy loams derived from the basic and intermediate rocks and Gneisses of the underlying basement complex. The flat topped ridge which dominates the area is covered with well drained Ferrasols. These Ferrasols are red to yellowish brown, sands, silts and clays with a tendency to be generally low in humus. Soil samples were taken and the soil profiles describedv (see Annex H).

The current farm sizes are larger than in the well watered areas and the households are scattered in small settlements throughout the Project Area. Pigeon pea, sorghum, maize and grazing are the main land use. The main cash crop in the past has been cotton. Currently no significant irrigation is occurring, the proposal is that 164 households would irrigate a total of 68 ha. Extensive stands of pigeon pea are common, and the main annual grain crop is maize. Even though for some years the yields are very low, maize is preferred over sorghum and millet. Most of the maize fields are planted with boundary rows of sorghum and/or millet. Green grams and cow peas are also commonly grown. Much of the land in the area is under bush, grazed by cattle, with the farm being planted to maize, bulrush millet and sorghum, plus green gram, pigeon pea and cow pea. The main perennials grown are cashew and mango. Charcoal burning is also occurring in the area.

4.1.3 Administration, Socio and Farm Economic Conditions

1) Administration and Rural Organization

The administration of the Project Area may be described within the context of existing administrative units of the country as shown below:

Administration of Project Area

Province	District	Division	Location	Sub-Location
Eastern	Tharaka (Ex-Meru)	Central Tharaka	Turima	Karocho

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 from the district to the sub-location level. Tharaka, however, is a new district which was created from the former Tharaka-Nithi District in November1997 and the district head-quarters, which is likely to be at Marimanti, has not yet been installed. Hence most district staff, including those of MOA, are still based at Chuka town.

Once office infrastructure are installed, the new district establishment is likely to include the district commissioner, district agricultural officer, district medical officer of health, district water engineer and others. In turn, these ministries and departments will be represented at lower administrative units from the division level down to the sub-location level.

The political leadership pattern will most probably coincide with immediately planned administrative framework. For instance, the member of parliament (national legislative organ) represents a constituency whose boundary will coincide with that of the division administrative unit. Similarly, the councilor who represents the local community in the new Tharaka District County council (local government) is elected from an area which is the same as the location administrative unit.

Typically, the district commissioner, who is the head of the "provincial administration," is responsible for co-ordinating government promoted development activities in the new district. He is the chairman of the District Development Committee, 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

Farming people in Ruungu/Karocho Area is the Tharaka. The Tharaka seems to be similar to the Meru ethnic group in character, way of life and language. The Area is quite different from other three Project Areas, because of its location in arid zone. They have experienced famine several times in their history since 1950s and have received food support due to drought.

3) Population and Farm Household

Since there are no statistics on socio-economy in the area, the Study Team conducted the farm economic survey to collect data on socio-economy and agriculture. In the survey, farmers were chosen at random and interviewed to fill the prepared form. As the result, the total number of farm households in the Area is estimated at about 300,. 164, which are the member of the existing irrigation group. Average family size of 7.9 persons is the largest among four Project Areas, and eventually the total population is estimated at about 2,300. It is difficult to calculate annual growth of population because of lack of precise data. The rate of women population accounts for 49.4 percent.

4) Farm Economy and Living Conditions

a) Farm Size and Self-Sufficiency of Food

The area is not irrigated at present. Though irrigation facilities were once constructed in 1997, it was destroyed by the flood before starting irrigation service. The average farm size of 2.8 ha is the largest among four Project Areas, which is also larger than 2.5 ha of the national average of Kenya, and categorized as smallholders as well as other three Project Areas. Marketing group and cooperative society are not established in the Ruungu/Karocho Area at present.

The farmers interviewed in the farm-economic survey do not have title deed. The local county council holds their lands as the trust land respecting to the custom of their tribes.

b) Farm Household Income

As the result of the farm economic survey, averaged farm household income in the Project Area is estimated at 19,200 Ksh/year, which is the lowest among the four Project Areas, and lower than national and district averages. Total income of 19,200 Ksh is composed of crop income of 6,700 Ksh and 11,000 Ksh of animal income, respectively. It is remarkable that off-farm income accounts for 57 percent in the total income. As the area is in arid zone, agricultural production has been dependent on the climate and affected by the poor soil, resulting in the limited cultivation of cereals and pulses and low household income. They cannot cultivate cash crops because of no irrigation water, long distance to the market and worst road. Other than crops, farmers raised goats which is suitable for arid and poor feeding. Average number of goats per household is about 2.2 head, which is the largest among the four Project Areas.

c) Farm Labour Available

Average family in Ruungu/Karocho Area has 7.9 members, which is the largest of the four Project Areas through the result of the farm economic survey. Some 3.4 of which are farm labours and 1.6 persons are full-time farm labours. The full-time farm labour of 1.6 persons is the smallest of the four Project Areas. The female farm labour accounts 50.5 percent.

d) Living Standard compared with Poverty Line

It is obvious that the farm household income in the Project Area is the lowest among four Project Area, because of the harsh agricultural environment, that is, arid zone, and no irrigation water. The average farm household income of 19,200 Ksh which corresponds to 2,430 Ksh/capita/year, which is lower than poverty line of 8,440 Ksh/capita of Kenyan rural areas, implying that most of the farmers in the Area live on the income under the poverty line.

e) Educational Status

The educational status of the head of family in Ruungu/Karocho are is generally low. The ratio of heads graduated from elementary school, junior high school are 67 percent and 10 percent, respectively. Therefore, various supporting activities after the implementation of this project must be taken into consideration such a educational status when preparing training materials and programs.

f) Bylaw of the WUA

The existing irrigation group has their own bylaws. It mentioned the duty for repayment, duty for participation to meetings, penalty to illegal water use and so on. However, it does not describe the water change for repayment.

5) Condition of Social Capability

a) Present Conditions of Social Capability

The community at Ruungu/Karocho Project Area has to contend with two major challenges. The first is the harsh environment which makes agriculture very risky and famine a constant threat. As a result the community operates a largely subsistence economy. The second challenge is lack of social infrastructure i.e education, health, roads etc. A possible explanation for lack of these facilities is the area's relatively remote location, far away from major towns where government and other sources of development influence are sited.

The project community has, therefore, devised mechanisms in an attempt to cope with both challenges. In facing up to the scarce and unreliable rainfall, the community grows short maturing drought tolerant crops (millets, cow peas, green gramsetc). The existence of mutual self-help among women and men also ensure land preparation and planting is done quickly and in time to make use of the available rainfall.

In coping with the second challenge, again the community has utilized its traditional practice of mutual help. The road leading to Ruungu centre is usually cleared by the community while there is a standing group of young men responsible for re-construction and maintenance of the foot/bicycle bridge across the Thananto River leading to Mitunguu town. They have used the same collective action to build schools, churches and more recently the main canal of the proposed irrigation project.

b) Assessment and consideration of Present Conditions of Social Capability

The community at Ruungu/Karocho Project Area has adopted collective action as a survival reflex. During the field workshops, this collective response was demonstrated by a high community turn up as well as the quantity and quality of workshop contributions.

The community was considerably disappointed by the failure of the Cooperative Bank and SISDO to honor an earlier agreement to implement the irrigation project. Given another opportunity, the Ruungu people have the social capability to implement and operate the project to meet their greatest need i.e. food self sufficiency at the household and community level.

4.1.4 Agricultural Conditions: Ruungu/Karocho Irrigation Project

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 Ruungu is estimated at 485 ha.

Estimate of Present Crop Production

(unit : ha)

Crop	Area Rainfed	Area Irrigated	Yield Rainfed	Yield Irrigated	Production Rainfed (ton)	Production Irrigated (ton)
Maize	228	0	1.0	-	228	0
Millet	140	0	0.4	-	56	0
Green Gram	55	0	0.3	-	17	0
Pigeon Pea	18	0	0.4	-	7	0
Sorghum	17	0	0.7	-	13	0
Cowpea	12	0	0.3	-	4	0
Mango	8	0	3.5	-	28	0
Cotton	6	0	1	-	6	0
Total	485	0				

Source: Farm Economic Survey and Phase III field work

The current cropping intensity is about 121percent of the gross area, and is all rainfed. The average farm size is around 2.8 ha. Ruungu is the driest of the four Project Areas, with a potential excess of evaporation over rainfall of over 1,350 mm per year. The temperatures are generally high. The maize is interplanted with sorghum and millet to reduce the risk of crop failure. The cowpeas are used as both green vegetable and as a pulse. The green grams are the main cash crop. Occasionally mango or cashew trees are planted near the farmhouses.

2) Farming Practices and Input Supply

Much of the land around the proposed irrigation area is secondary bush. The cultivation methods used are traditional, and shifting cultivation is still practiced to some extent. The plant spacing of the crops are usually very wide. Land preparation is with the use of a jembe. The seed is usually saved by the farmer or acquired from neighbors. Little or no fertilizer or pesticides are used. Because the animals are allowed to range free to find grazing, little or no manure is available. Because of the flourishing irrigation scheme at Mitunguu, most purchased inputs are available there, but few are used. Visits by government extension staff are infrequent.

3) Animal Husbandry

Livestocks are an important part of the agriculture in the area and are grazed on the grazing land, the fallow areas and crop residues. Both cattle and goats are kept. The slow growing, but disease resistant native cattle are sold mainly as beef, to middlemen in the neighboring towns. Most farms have a few local hens around the house, kept penned at night, because of predators.

4.1.5 Marketing of Agricultural Product

1) Crops for Local and Export Markets

The crops for cash earning are very limited in volume of produce such as pigeon pea, cowpea and its leaf, finger and bulrush millets and cotton only for local markets. Most farmers in this Project Area produce grains, pulses, vegetables and fruits for home consumption or barter trade among communities or families.

Pigeon Pea and Cowpea

These produce are traded either green or dry, and leaf also for cowpea; called 'Patra'. After harvesting, the green beans are peeled off pods at selling points at Runngu and Karocho markets or Mitunguu market. In Ruungu and Karocho markets located in this Project Area, trading produce are usually inflow produce from Gakoromone or Nkubu markets.

Finger and Bulrush Millets

Most of the farmers are planting these crops with maize as main stable foods in this Project Area. These produce are consumed at home and sold their surplus. These produce are very marketable at Gakoromone wholesale market, which were traded at 40Ksh/kg for finger millet and 29Ksh/kg for bulrush millet in 1998. The prices are higher than Nairobi at 176 percent. Finger and bulrush millets are consumed as morning porridge in Meru town and brewery in local area. The prices are comparatively stable due to resistance to drought.

Cotton

The production of cotton in Kenya has drastically decreased in recent years. Kenya's annual production of cotton lint currently averages about 20,000 bales, against a domestic demand level estimated at 120,000 bales per year according to Economic Review of Agriculture issued by Division of Planning & Information Services, MOA. The 83 percent of gap is covered by import mainly from Tanzania, Egypt and Uganda. Beside the importing cheaper prices of synthetic fibres can defeat cotton production. With advent of liberalization of cotton marketing, the Board of Cotton had been sold cotton ginneries to private sectors. These streamlines affected to the Project Area. Many farmers stated non-benefit on cotton production due to high volume and costs of fertilizer and insecticide, and abandon the cotton fields, where recovery of soil fertility and rotation of crops make difficult.

Other minor produce

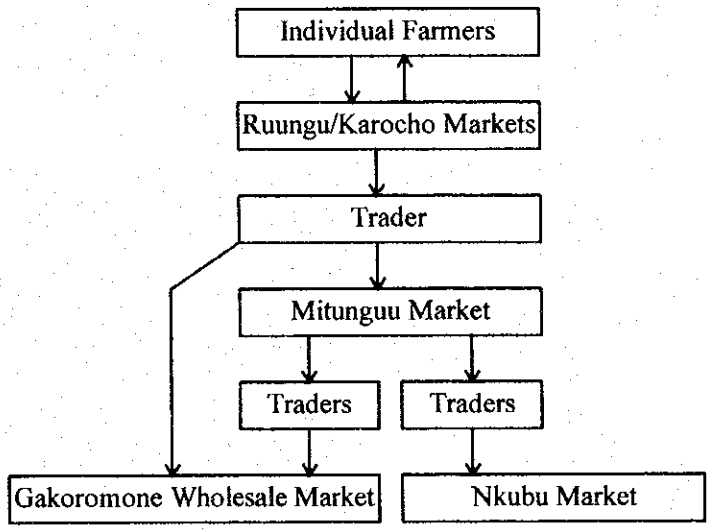
Cashewnut production is found in the Project Area. The trend of cahsewnut production in Kenya declines at 17,920 tonnes (1993), 25,503 tonnes (1994), 12,800 tonnes (1995) and 10,000 tonnes (1996). The low production and discouragement by farmers are caused by low price offered from Kenya Cashewnuts Ltd. (KCL) and low yielding germ plasm, pest infestation and disease. The marketing had been liberalized from the monopoly of KCL and unprocessed form export has been demanded, which

provide the chance of marketing for middle or small scale traders. Since the content of fat in nuts are low, the application of fertilizer may be required with loading at least to Mitunguu town. A limited number of farmers are planting green gram, pumpkin, sweet potato, local variety of mango, Hass variety of avocado, pawpaw, tamarind and banana passion fruit are planted. They are mostly consumed by farmers themselves, exchanged among farmers or sold at Runngu/Karocho markets. Outlet to outside are rare.

2) Post-Harvest Handling and Marketing Alternatives

Pigeon Pea and Cowpea

The trader in village who own the pickup truck collects these produce and sell them at Mitunguu or Gakoromone wholesale markets. The prices are three times more compared with the farm gate and prices at Gakoromone wholesale market, which shows the huge transporting costs and middlemen/retailers' charges.



Finger and Bulrush Millets

These produce are also sold to the trader like pigeon pea.

Horticultural Crops as Local Consumed Produce

Farmers who plan other minor produce such as cashewnut, mango, avocado, pumpkin and green gram carry their produce by foot or bicycle using short cut (8km) to Mitunguu market.

3) Regional Market Aspects and Produce Trading Status

Tharaka Nithi District has two economical zones considering flows of substances and people; gathering to the capital Chuka and Mitunguu-Meru/Nkubu of Meru District. The Project Area belongs to

Mitunguu - Meru or Nkubu. Probably Thraka Nithi district was split into Meru South District and Tharaka District. Prices at Mitunngu market is not collected by Meru DAO, therefore the Study Team surveyed prices and produce distribution status.

Crop	Origin	Price at Mitunguu Mkt.	Availability in Ruungu/Karocho Mkts.
Arrow Root	local	3Ksh/kg	5Ksh/kg
Avocado	local	3-5Ksh/pc	5Ksh/pc
Banana, Cooking	local	1Ksh/1pc	seasonal
Banana, Ripe	local	0.5Ksh/pc	1Ksh/pc
Bean, Dolichos	local	30Ksh/kg	none
Bean, Mwitemania	local	35Ksh/kg	none
Bean, Rose Coco	local	35Ksh/kg	none
Cabbage	Meru	7-10Ksh/kg	none
Carrot	local	30-40Ksh/kg	none
Cowpea, Dry	local	30Ksh/kg	seasonal
Cowpea, Leaf	local	2Ksh/bundle	seasonal
Green Gram	local	35Ksh/kg	none
Kale	local	1Ksh/leaf	none
Maize, Dry	local	10Ksh/kg	12Ksh/kg
Maize, Green	local	10Ksh/3cobs	seasonal
Millet, Finger	local	45Ksh/kg	25Ksh/kg
Millet, Bulrush	local	25Ksh/kg	seasonal
Orange	local	65Ksh/kg	none
Onion, Red Dry Bulb	Meru	80Ksh/kg	none
Onion, Spring	Meru	5Ksh/bundle	none
Pigeon Pea, Dry	local	30Ksh/kg	seasonal
Pigeon Pea, Green	local	40Ksh/kg	28Ksh/kg
Potato, Irish Red	Meru	40Ksh/kg	80Ksh/kg
Potato, Sweet	local	10Ksh/kg	10Ksh/kg
Tamarind	local	not found	20Ksh/kg
Tomato	local	80Ksh/kg	none

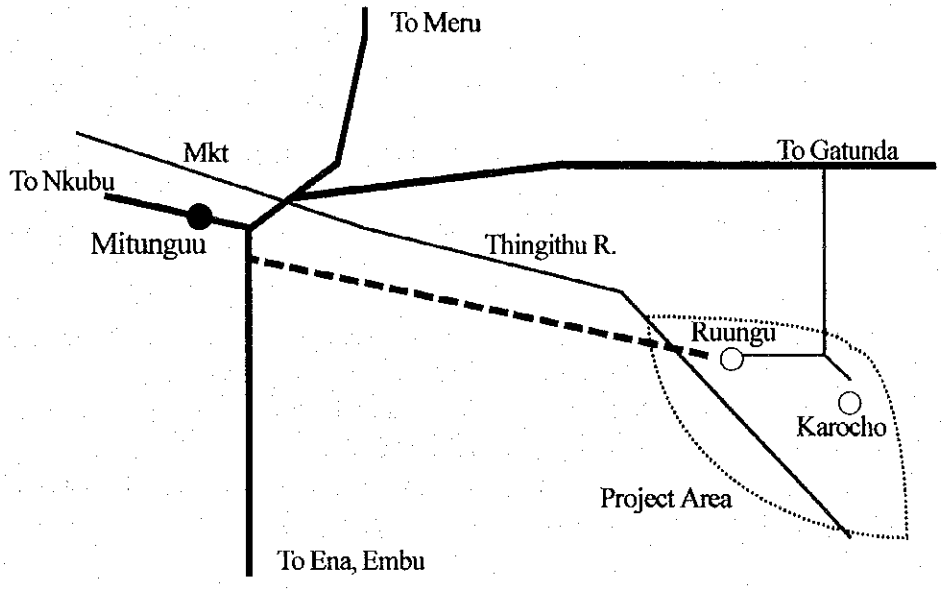
Source: JICA Study Team, prices as of end of July, 1998

The inflow produce such as cabbage, irish potato and red dry bulb onion are traded in higher prices than Gokoromone wholesale market. At the markets in the Project Areas, quite limited number of crops and volume are traded because the inflow produce such as irish potato costs double price and purchasing power in the communities are quite low.

4) Farm-to-Market Roads

The people of Ruungu use the short-cut road to Mitunguu town or its market. The road, showing the figure in dot line, is not passable by vehicles, so narrow and steep with 200m height difference. Crossing the Thingithu River, there is the wooden bridge constructed by the community members. The relatively richer men in the community use bicycles for transportation of their produce from Ruungu and

miscellaneous goods from Mitunguu. Therefore, group loading using the resources of youth power might be effective if community owns warehouse in Mitunguu. Other small markets in Ruungu and Karocho are not active due to low purchasing power in the communities, but traders of millets and pigeon pea come to collect in those markets detouring the road.



4.1.6 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. Once arrangements for establishing the new district are complete, MOA agricultural staff will be deployed at various administrative levels as shown below:

Provision of Agricultural Extension Services at the District Level

District Level (Marimanti)	Division Level (Central Tharaka)	Location Level (Turima)	Sub-location Level (Karocho)
- 1 x District Agricultural Officer - Unknown x Subject matter but likely to reflect the ASAL condition of the district (eg food crops, irrigation)	- 1 x Divisional Agricultural Extension Officer - Unknown x subject matter specialists	- 1 xLocation Agricultural Extension Officer	- 1 x Agricultural Extension Assistant

Note: 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

It is at the location and sub-location level where "front-line 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 Prorgamme (NEP) II", the mobility of extension staff has been severely constrained owing to lack of operational finance and transport facilities. Consequently, individual and group farmer contacts as well as skills upgrading of front-line extension workers have become irregular.

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). Among other factors, NALEP will be based on the following;

- Extension to be demand-driven taking due recognition of GOK's policy commitment to liberalization, privatization, and commercialization of the agricultural sector
- Increased involvement of the private sector in providing extension services
- Sharing of extension delivery costs by beneficiary farmers
- Use of participatory approaches in extension (involving main stakeholders in problem diagnosis, planning, appraisal and implementation of agricultural projects)

b) Other Government Agricultural Support Services

Across the river, some eight kilometers away from the Project Area, there is a government-run irrigation demonstration farm which is likely to be accessible to Ruungu irrigation farmers.

2) Agricultural Extension Services by the Private Sector

In Tharaka Nithi the number of private sector agricultural services and NGOs are limited. The private sector comes only infrequently to Ruungu, and farmers in Ruungu that want inputs, fertilizer, animal medicines etc. have to travel to Mitunguu or Marimanti. British American Tobacco is working in Mitunguu and provides a range of extension services to its tobacco growers. A cotton gin exists in Marimanti. There are no NGOs currently active in the Ruungu Project Area. In the past SIDA has provided boreholes and SISDO was involved in some of the preliminary work on the Ruungu irrigation scheme design. Various church groups, such as the Catholics, are involved in irrigation development in other parts of Tharaka Nithi district.

4.1.7 Agricultural Credit

1) Institutional Credit

Ruungu/Karocho Area is located far from Meru town and Chuka in which banks exist. These situation results in difficulty for farmers in accessing to the institutional credit service. Actually 80 percent of farmers interviewed in the farm economic survey are not given both institutional credit and informal credit services. The main reasons are; i) no title deed, ii) never tried to access to credit service.

2) Informal Credit

As mentioned above, Ruungu/Karocho is so distant from banking services that most of farmers use informal credit from relatives and neighbors.

4.1.8 Farmers' Organizations and Their Activities

1) Cooperative Society

There are no cooperative societies within the Project Area.

2) Water User's Association

A Water Users Association (WUA) of 164 members has been formed and registered with the Ministry of Culture and Social Services in the name of Ruungu/Karocho Irrigation Project with the aim of procuring irrigation water. At present, and the main activities of the Water Users' Association are;

- Bringing together members in order to plan and implement an irrigation project
- Mobilizing members to contribute towards security fund and labour contribution required in installing an intake and main canal.

The WUA has delegated the above functions to a management committee consisting of a chairman, vice-chairman, secretary, treasurer.

Members of the association have a strong sense of commitment and have pooled resources under difficult conditions to excavate the bigger part of the main canal. During the field workshops, the members showed the highest incidence of participation and enthusiasm.

3) Marketing Groups

Farm produce is sold individually to Mitunguu market or at Ruungu market centre to visiting produce brokers buyers. No organized marketing groups exist within the Project Area.

4) Women's Groups

There were a total of 20 women groups which were identified as active within the Project Area during the field workshop (ref. to participation/stakeholder analysis). These women groups are engaged in mutual self-help activities that include;

- Procurement of domestic utensils
- Purchase of milk cows and goats
- Installation of water storage tanks
- Assistance with cash in case of emergencies e.g. deaths, sickness, school fees
- Mutual help during labour peaks that coincide with weeding and harvesting

5) Other Community Associations/Organizations

Other significant associations within the Project Area are shown in the following table;

Types of Associations and Respective Activities

Type of Association	No. of Associations	Main Activities
Men group (clan-based)	10	- Construction and maintenance of bridge across the River Thananto - Pooling labour for difficult tasks: opening new fields, making beehives - Buying farm tools and livestock
Youth Group	18-35	- Mutual help in opening new fields & construction of houses - Sports & preparation of community ceremonies
Bore Hole Group	20	- Supervising operation of bore-holes dug with SIDA support - Carrying out bore-hole maintenance work

6) Non-Government Organizations (NGOs)

Presently following NGOs are operating within the Project Area summarized as follows;

Type and Respective Activities of NGOs in Ruungu/Karocho

Name of NGOs	Main Activities
SISDO	- Community organization support WUA - Procuring loan funds for WUA - Supporting WUA in dealings with a contractor
CARE (Kenya)	- Famine relief - Promotion of school attendance by paying school fees on behalf of needy families

A number of church organizations (Kenyan and foreign) also operate within or near the Project Area and combine missionary activities with poverty/famine alleviation programmes.

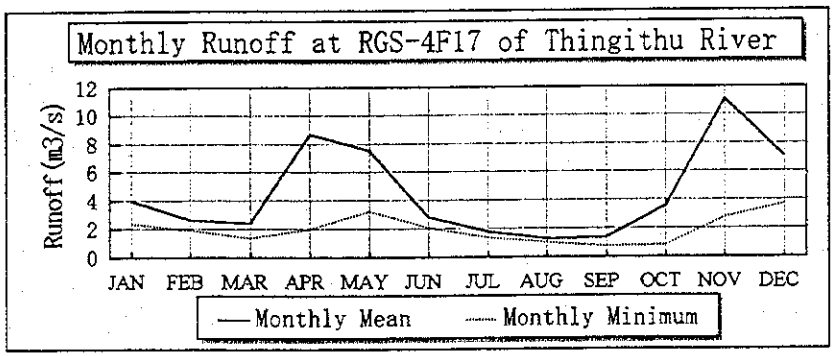
4.1.9 Irrigation Water Sources and Water Permit

The water source of the Project is Thingithu river which is a tributary of the Kathita river and one of major rivers in Tharaka Nithi district. The Thingithu river starts the origin from the mid part of Mt. Kenya and flows down towards east with a steep slope. The river length from the origin to the intake site of scheme is 43 km and the river slope around intake site is 1/60. Since the catchment area above the proposed intake site is large with 220 sq.km, the river water is available year round.

The river is gauged at RGS-4F17 with a catchment area of 303 sq.km which is situated at immediate upstream of junction to the Kathita river as shown in Figure 4.1-1. The station has discharge record of 25 years from 1970 to 1995. The high occurs two times in November and April and the lowest flow occurs in September. The annual mean and low flow are 4.51 and 1.95 cu.m/sec, respectively. The variation of monthly runoff is shown in Table 4.1-1.

Table 4.1-1 Monthly River Runoff at RGS-4F17 of Thingithu River

RGS	YEAR	ITEM	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Thingithu River(C.A = 303 km2)															
4F17	1970-'95	MEAN	3.96	2.61	2.39	8.69	7.50	2.81	1.77	1.27	1.37	3.56	11.10	7.09	4.51
4F17	1970-'95	MINI	2.37	1.92	1.38	2.00	3.23	2.09	1.36	1.04	0.77	0.83	2.77	3.70	1.96



The authorization of water permit belongs to MWR. The WUA of the scheme applied the water permit for irrigation to District Water Office of Tharaka Nithi in March of 1996 and the authorization is under processing. However, the water recommended by the Water Office for this scheme with a proposed irrigation area of 68 ha is only 17.2 lit/sec. There exist 30 projects holding water permit in the upper basin of the scheme. The total amount of authorized water is 0.186 cu.m/sec. While, one water permit exists in the downstream and the amount is 0.002 cu.m/sec.

4.1.10 Irrigation and Drainage

Ruungu/Karocho Irrigation Project is on-going project. The project was initiated by farmers in 1982 for irrigation purpose, but did not progressed until 1995 when discussion with MOA and SISDO (NGOs) was started. The construction of intake and canal was started in 1995. However, the construction works have been interrupted since April 1997, when the concrete intake weir was washed away by flood .

The existing non-functional concrete weir and gravity intake structure is located on the Thingutha river in a valley surrounded by river terraces. The proposed area for irrigation extends over a gently east sloping flat topped ridge with slope of about two percent between the two river valleys. The weir is broken and the distribution furrow remains to be completed. The proposed canal system with long length extends to the scattered irrigation areas as shown in Figure 4.1-2.

This scheme has a gross area of about 400 ha with 170 farm household. The major crops are maize, pigeon pea, sorgam and millet. Currently there is no significant irrigation occurring in the area.

Irrigation plan was established by SISDO in 1995, and it seems to be fairly designed especially in the point of water management method applying group feeder canal. According to the design document, the outline of irrigation plan is as follows;

- Open canal system getting water from the Thingithu river is adopted. The maximum canal length from intake to tail end (C26) is 7.3 km. The major part of canal consist of earth canal.

- The scheme has 170 members and each member has an irrigation area of 0.4 ha. Thus a total area to be irrigated is 68 ha. The proposed irrigation area is scattered in the a gross area of 400 ha.

- The scheme is divided into 12 rotation block, and a group feeder canal to each block is facilitated. Irrigation water to a farm plot is supplied through the group feeder canal with a design capacity of 10 and 20 lit/sec.

- The members of one groups is between 12 and 18. The proposed irrigation crops are karela, okra, tomatoes, onion, garlic, French beans, etc. and furrow irrigation is adopted with 12 hours operation time per day and seven days irrigation interval.

- The overall irrigation efficiency of the system is assumed to be 50 percent and seepage loss of 2.5 lit/sec per km is allowed in the canal sections based on their length due to the excessive length of the main and secondary canals from the head of the scheme to the last division box.

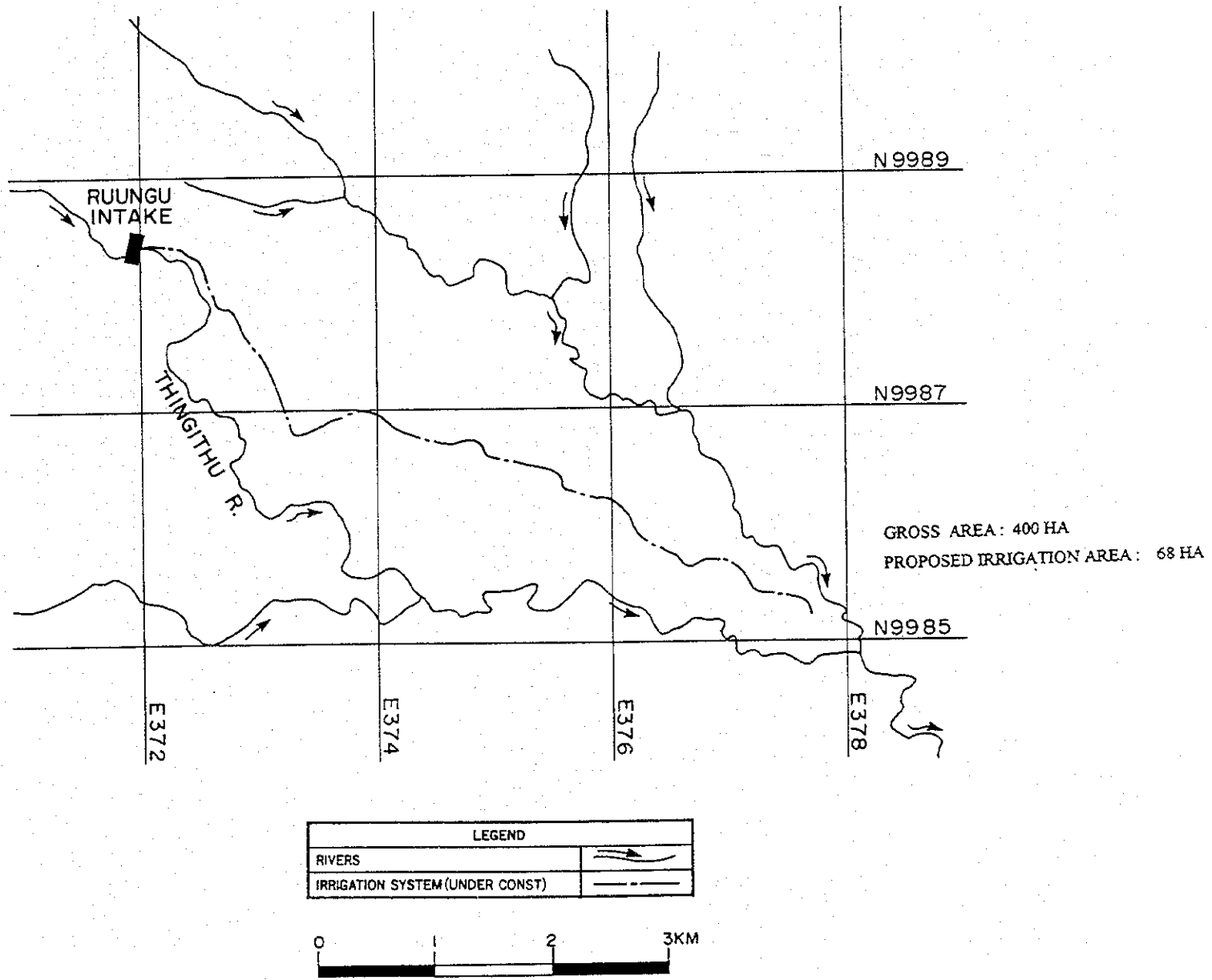


Figure 4.1-2 **Irrigation Area of Ruungu/Karocho Irrigation Project**

4.1.11 Agriculture and Rural Infrastructure Conditions

1) Irrigation and Drainage

Irrigation water supply system tapping water from Thingithu river for open canal system is presently under construction with some interruption. The construction was commenced in August 1996 as a self-help project supported by SISDO (NGOs) with a loan from Cooperative Bank of Kenya. During the construction, however, a half part of the concrete intake weir was washed away by floods in late 1997. Since then the construction work has been suspended but it will start again after all issues raised from the damaged intake are settled.

Irrigation facilities being built to date are an intake weir which requires major repair or re-construction, a part of pipe culvert from intake box, and some parts of main (conveyance) canal. Sub-main and secondary canals have not been excavated. A total length of canals in the design is one kilometer for main canal and 6.4 km for sub-main canal.

There is a water users association named Ruungu/Karocho Irrigation Association with 164 members for O&M of the water supply system. Since irrigation system has not been complated yet O&M has not started.

2) Domestic Water Supply

Rural water supply in this semi-arid lowland area has been recently covered by boreholes which were built through SIDA assisted Tharaka Water and Sanitation Project (TWASP) from 1988 to1997. There are eight boreholes with handpumps in Ruungu and Karocho areas. The depth of boreholes is around 40 m. Water quality is fair except a little salty at some boreholes. The maintenance of boreholes will be carried out by users group starting this year.

3) Rural Roads

There are two access roads linking from B6 tarmac road (national trunk road) to the Project Area. One is from Meru town through C92 road (primary road) and E788 road (minor road), and the other one is from Nkubu through D475 (secondary road), C92 and E788. The distance to the entrance of Ruungu area is 43.7 km from Meru and 32.5 km from Nkubu. Both access roads are generally in poor condition with earth surface but the former access is better than the latter one. The latter is very rough and steep with many deep gullies and hollows particularly at whole D475 section and the section from Mitungu town to E788 junction where the road crosses Thingithu river. Both of them become impassable except by four wheel vehicles during the rainy seasons from March to May and from October to November. E788 road passes in the lower area with flat gradient but becomes muddy and impassable in the rainy seasons. These roads are classified road owned and maintained by MPWH, and its improvement has not been included in the first stage of EC Roads 2000 Project commenced in March 1998.

From the junction on E788 road, access still continues for another six kilometers to Ruungu village. This is unclassified rural road which belongs to county council. The road is 3.7 to 4.0 m in width and its condition is also very poor with earth or rocky surface. Some deep gullies are observed at sloped sections and the road crosses streams at five places without any crossing structures.

Village/farm roads in the Project Areas are also in poor condition at many sections. The road width is around 2.5 m with earth or rocky surface. These roads belong to Tharaka Nithi County Council which is responsible for O&M. However actual road maintenance has been carried out by communities as organized by Assistant Chief of Karocho Sub-Location.

4) Rural Electrification

There is no electric power supply in the Project Area. Nearest existing power line under operation of Kenya Power & Lighting Company has extended to Tunyai village, 7.0 to 9.0 km from the Project Area.

5) Public Health

Marimante health centre, 15 km from the Project Area, is the nearest public medical facility where a clinic officer and nurses are stationed. When further medical treatment is required, inhabitants have to go to Meru district hospital (49.7 km) or Nkubu mission hospital (38.5 km).

6) Education

There are two primary schools in the Project Area. Ruungu primary school and Karocho primary school with 120 pupils and seven teachers. School attendance rate is around 70 percent. For secondary school, around 30 percent of children go to vicinity secondary school either at Kiriria secondary school (14 km) or Tharaka boys secondary school (17 km).

4.1.12 Post-Harvest and Rural -Agro-Industry

1) Post-Harvest

The outlet produce of pigeon pea, cow pea and finger millet have lower post-harvest losses.

2) Rural Agro-Industry

In Mitunguu, the ginnery factory of cotton is operating. They used to collect from smallholders but now concentrate to collect from large-scale farmers due to low prevailing prices of cotton in Kenya and high transport costs.

4.1.13 Rural Environment and Public Health

1) Natural Conditions

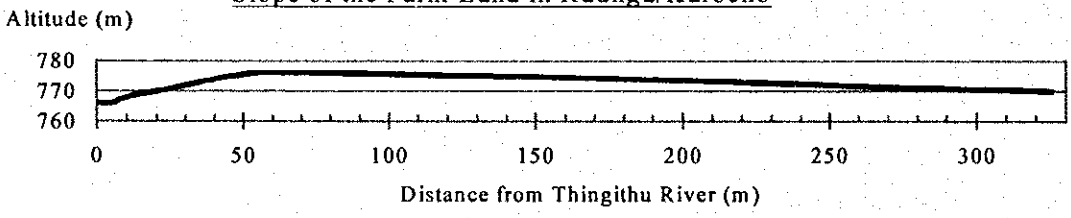
This area is dry zone and sometimes droughts caused terrible famines as shown in the following history.

1937	:	Terrible famine.
1960	:	Terrible famine and the Government supported the community by relief of food.
1961	:	Great rainfall and good crop production.
1963	:	Famine reduced the number of domestic animals.
1980	:	Terrible famine reduced people to beggars.
1984	:	Terrible famine and the Government supported the community by relief of food.
Late 1984	:	Good rain.

The water source of the Project Area is Thingithu River and the catchment area covers nearly all the agro-ecological zones. There is not any forest around the Project Area and farmers are collecting firewood in their farmlands. Fishery is not important in the Project Area though it is practiced in the upper region of Tharaka Nithi, approximately 20 km from the Project Area, because there are numerous springs and rivers there.

The land slope is gentle, e.g. 2.4 percent (1.4°) at the 900 m downstream from the intake of Thingithu River as shown below.

Slope of the Farm Land in Ruungu/Karocho



There are no game reserves near the Project Area and damages of crops by wildlife is not serious though damages by baboons, monkeys and rodents were reported.

2) Health and Sanitary Conditions

This area suffered from famines for some times. Therefore the top of farmers' anxiety is famine, and even in the normal year, there is a shortage of vegetables and meat in their food life.

As for the drinking water, 96 percent of households use the deep wells, depth of approximately 40 m at an average distance of 417 m, and four percent use Thingithu River at an average distance of 120 m. Details are shown below.

Sources of Drinking Water in Ruungu and Karocho

Source of Water	Households (%)		
	July 1998	Dry Season	Rainy Season
Borehole	96	96	96
River	4	4	4

Source: EIA Survey, July 1998

The water quality of Thingithu River and two deep wells in the Project Area are over the standard for drinking water on some parameters as summarized below. It is supposed that the cause of low quality of deep wells are due to inappropriate construction method and characteristics of soil. Details of the water quality analysis are shown in Table T.2-3, Annex T.

Summary of the Water Quality Analysis

		Standard	Thingithu River		Deep well 1	Deep well 2
			Intake	5.3 km downstream		
BOD	(mg/l)	< 1	10.0	5.0	2.5	5.0
NO_3^-	(mg/l)	< 10	5.8	6.2	14.8	1.6
HCO_3	(mg/l)	< 25	0.0	76.3	332.5	79.3
E. Coli.	/250 ml	-	+	+	+	+

Source: EIA Survey, July 1998

As for the construction material for house, 47 percent of houses have corrugated iron sheet roof while 53 percent have thatched roofs and most of households rely on mud as the common material for the wall (73 %) and floors (77 %). 87 percent of households have a pit latrine which depth is four to five meter and 13 percent use nearby bush as a method of excreta disposal.

The cooking stoves being used in the Project Area are mainly three stones. Though the Special Energy Project (1983 - 1994) was implemented by GTZ for the promotion of improved cooking stove (one-pot ceramic liner-stove without a chimney) with the target of whole country, and it was made in 733 households in Tharaka Nithi District by the training of women's groups, it is supposed that this area was not included. One of farmers groups, Kithanje Mixed Group, contributed money to buy solar system cooking stoves and all 15 members (10 men and 5 women) got it now. It is a black wooden box with a stainless sheet to collect solar heat and costs 2,000 Ksh. The enthusiasm for the solar system cooking stove is due to lack of firewood.

Malaria ranks as the top diseases in Ruungu Dispensary as shown right. Ruungu Dispensary was closed in 1997 due to lack of fund and after that, the medical staff of Ruungu Dispensary opened a private clinic.

Medical facilities are underutilized partly due to lack of drugs which are heavily subsidized and hence the Government find it difficult to sustain the supply. However, all women in the Project Area attend ante-natal clinic and 70 percent deliver their babies in health facilities, while 30 percent at home.

Common Diseases Reported in Ruungu Dispensary

(unitt: case)

Diseases	Year 1996
Malaria	2,311
Intestinal Worms	1,117
Respiratory Diseases	1,102
Diarrhea	692
Rheumatism	546
Skin Diseases	472

Source: EIA Survey, July 1998

3) Soil and Water Conservation Conditions

A part of the road in Karocho is eroded severely because of flood and a vehicle or a cart can not pass there though the land slope is gentle.

Commonly, the farm size in Ruungu is big and the measurement has not yet been carried out by the government and they do not have the land certificate. The characteristics of farmlands in this area is that a certain plots are kept as fallow for grazing. However, the fallow plots have been changed to crop fields from year to year without practice of shifting cultivation that is effective for the recovery of soil fertility. They input neither chemical fertilizer nor manure in the farm because their breeding method does not produce manure. Even the feed for cows is not enough in the fallow. The examples of land use are shown in Figure T.2-9 and T.2-10, Annex T.

The farmers' awareness for soil and water conservation is shown in the next table. Many farmers practice Napier grass plantation though the area is very small and the growth is not good due to lack of water.

Farmers' Awareness for the Soil and Water Conservation

Soil and Water Conservation Activities	Farmers' Answer (%)	
	I know.	I practice.
Planting trees	87	52
Planting of Napier grass	100	78
Contour cultivation	78	52
Stone wall along contour line	35	17
Others	48	35

Source: EIA Survey, July 1998

4) Use of Agrochemical

77 percent of farmers use agrochemical, mainly insecticide for cotton as follows. All of them are approved for agricultural use in Kenya.

Crop	Agrochemical
Cotton	: Karate EC, Ripcord five percent EC, Ambush cy
Cow peas	: Karate EC, Ambush cy, Dimethoate 400 G/L EC
Green grams	: Marshall

According to the EIA Survey, all farmers answered to have the knowledge of agrochemical use, though 33 percent of farmers answered that they followed the recommended dilution and 34 percent answered that they followed the recommended application interval. Actually, 63 percent of agrochemicals were used within the recommended dilution including 50 percent less than recommended dilution. 20 percent of agrochemicals were used in the interval shorter than the recommendation, mainly for cotton. All farmers know that they must use gloves and mask when they use agrochemical, though most of them do not practice as shown below.

Farmers' Awareness for the Agrochemical Use

Questions	Farmers' Answer (%)	
	I know it.	I practice it.
Dilution of Agrochemical	100	33
Frequency of Agrochemical Application	100	34
Use of gloves and mask	96	28
Maximum Pesticide Residue Levels	68	0

Source: EIA Survey, July 1998

Actual Agrochemical Dosage by Farmers

Agrochemical Use	% of Agrochemical
Within the Recommended Dilution	63 %
Less than the Recommended Dilution	(50 %)
Equivalent to the Recommended Dilution	(13 %)
Over the Recommended Dilution	0 %
Unknown	37 %
Recommended Application Interval was followed	80 %
Recommended Application Interval was not followed	20 %

Source: EIA Survey, July 1998

5) Related Projects on Environment and Public Health

The following projects were/are implemented widely in the district including the Project Area.

Name of Project	Donor	Duration	Method	Results
Tharaka Water and Sanitation Project	SIDA	1995	Provision of boreholes	Success
National Agricultural Extension Program	World Bank	On-going	Training of farmers including soil conservation	
Soil and Water Conservation Project	SIDA	On-going	Training of farmers	
Ruungu Community Dispensary	EAPA	-1997	Construction of dispensary	Lack of fund
Karocho Community Dispensary	SDA	On-going	Construction of dispensary	Lack of fund

EAPA : East African Pentecostal Assembly
Source : EIA Survey, July 1998 SDA:Seventh Day Adventist Church

Ruungu Dispensary was constructed and operated until 1997, though it was closed due to lack of fund to purchase drugs and necessary equipment and to employ qualified medical staff. When the EAPA pulled out, the local community could not sustain the operation of the dispensary. It is in the process of soliciting fund from the donor to reopen the dispensary.

As for Karocho Dispensary, the construction work is at a stand still due to inadequate fund. It is expected that the donor may provide additional fund to complete the construction and probably initial running cost.

4.1.14 Gender Issues

1) Women's Status in Rural Society

On account of its remote location, the community in Ruungu/Karocho Project Area is relatively more tradition-bound. Expectedly, women status is highly influenced by traditional attitude and cultural value systems which may have slackened in other parts of the Mount Kenya communities. Consequently, women are more likely to undergo cultural rites of passage which underpin their rather low traditional status in the society in comparison with men.

2) Women's Roles in Farm Households

The community of the Project Area operates a predominantly subsistence economy based on drought tolerant crops and limited keeping of livestock (ref. to Workshop List of Members). Distribution of household tasks, between female and male adults tend, therefore, to underline the role of women as food providers and care-takers of the entire household unit.

Rainfall in Ruungu is low and unreliable and incidence of famine high. Given the harsh environment in which women have to fulfill their traditional roles, they have designed coping mechanisms that include;

- Forming women groups for mutual assistance during labour peaks and emergencies
- Making craft articles (baskets, mats, trays) for sale to Mitunguu market some eight kilometers away
- Selling their labour to the nearby Mitunguu irrigation scheme
- Rearing indigenous free-ranging chicken for sale at Ruungu or at Mitunguu
- Engaging in petty trade at Ruungu market

The current distribution of household tasks between female and male adults is summarized as follows;

Task Distribution Between Female and Male Adults

Household task	Female	Male
1. Land Opening		XX
2. Buying inputs	X	XX
3. Planting	XX	X
4. Weeding	XX	X
5. Harvesting	XX	X
6. Open market selling	XX	
7. Fetching groceries	X	X
8. Livestock grazing	X	XX
9. Bee keeping		XX
10. Stall feeding	X	
11. Milking	XX	X
12. Milk delivery	X	X
13. Firewood collection	XX	
14. Water collection	XX	
15. Cooking	XX	
16. House cleaning	XX	
17. Caring for young children, sick and the old	XX	

Note: X = Sometimes; XX = Main responsibility

It is obvious from the table that the work load is heavily weighted against women members of the household. Hence in the design of the irrigation system relevant gender issues will have to be considered and incorporated. Given the prevailing environmental conditions, women may wish to pose the following questions:

- What are the labour implications of the irrigated production system?
- How will increased irrigation labour relate to our current commitments, preferences, and capabilities as women members ?
- Will irrigation reduce present food uncertainties facing our households ?
- Will irrigation mean we will not have to travel far to fetch domestic water?
- Will there be new irrigation-induced opportunities for us to make some money and uplift overtraining standard?

3) Women's Rights to Land Inheritance

Although land in Ruungu/Karocho Project Area has been demarcated, title deeds have not been issued yet. Hence, up to now, land inheritance has been based on tradition and custom. However, since the community is patrilinear, land ownership and inheritance is from male/father to son or closest male relative. While female members of the household have user rights to land owned by husband, father, or any other male relative, they are according to tradition not able to own or inherit it.

Once title deeds are issued, however, a market for land is likely to emerge and a woman who is financially empowered will no doubt be able to purchase and own land in her own account.

4) Women's Rights to Selling of Agricultural Products

Field discussions, indicated that women can market subsistence crops (millet, maize, green gram etc) but with the due consultation of the husband. If an irrigated production is in place, she will be in a position to sell such other crops as kale, sweet potatoes and bananas.

4.1.15 Findings through Workshop Seminars held at Ruungu/Karocho Irrigation Project

Workshop seminar at Ruungu/Karocho Irrigation Project categorized into Type-E was held at project site during the period from July 21, 1998 to July 24, 1998 with a participation of beneficiary farmers of the scheme, and through the seminar under eager discussion among farmers, the studies on i) members and relevant information, ii) participatory/stakeholder, iii) problem analysis, iv) objective analysis, and v) project design matrix (PDM) were analyzed.

Followings indicate the outlines of problem analysis and PDM, and Figure 4.1-3 and Figure 4.1-4 indicate the problem and objective trees for the Area. The details are referred to Table C.2-10 to Table C.2-12 and Figure C.2-10 to Figure C.2-11, Annex C.