

## 4.4 Project Implementation, Operation and Maintenance Plan

### 4.4.1 Plan for Support Services During Project Implementation

#### 1) Support Services for Capability Build-up

At various stages of the project cycle, a number of agencies will be expected to provide support services aimed at capability build-up of farmers and farmers' organizations as illustrated in Figure 4.4-1. A summary of the type of support services that will be provided at each stage by respective agencies is presented as shown below;

#### Agencies Providing Capability-build-up Services during Project Implementation

Project Stage	Agency	Type of Capability-Build-up Service
1. Project Planning	a) MOA/IDB	- Social preparation of project community - Facilitation of WUA planning sessions (activities, subactivities)
	b) MOA/DAO	- Acting as resource persons during social preparation sessions
	c) SISDO	- Acting as resource persons during social preparation sessions
2. Project Design	a) MOA/IDB	- Facilitating WUA design review sessions (availing design model, explaining design criteria and expected mode of operation of design elements) - Actively seeking women input into the design
	b) MWR	- Awarding and securing water rights for WUA
	c) SISDO	- Acting as resource persons
3. Project Funding	a) MOA/IDB	- Advising on project costing and alternative sources of project funding - Explaining funding conditions and procedures for various funding agencies
	b) SISDO	- Training WUA members on group formation for security fund contributions, banking operations; loan funds & loan servicing procedures
	c) MOCSS	- Assisting farmers on harambee organization
	d) Provincial Administration	- Facilitating harambee organization by issuing license
4. Project Construction	a) MOA/IDB	- Advising WUA on criteria for tender assessment and contractor selection, required supervision and quality control aspects of construction activities
	b) SISDO	- Training WUA committee on contractor payment procedures
5. Project (O&M)	a) MOA/IDB	- Facilitating and acting as resource persons during O & M sessions
	b) MOA/DAO	- Acting as resource persons during O&M sessions

#### 2) Agencies Providing Support Services After Project Implementation

After completing installation of the irrigation infrastructure, the farmers will require a range of post-construction support services to enable them make the best use of the harnessed irrigation water. Such services and agencies that can provide them are discussed below.

##### a) Training and Research Services

Once irrigated production begins, it is planned that MOA/DAO will request KARI's regional office at Embu to start on-farm research activities that will focus on the following issues;

- New crop introductions that are adapted to the Ruungu environment
- Soil and seed born diseases as well as general crop pests and diseases

- Irrigation production yields
- Water table and salinization problems

The planned research activities will be on-farm as well as participatory and will offer a training opportunity to both project farmers and extension staff at the divisional and locational levels. In addition, the research station will be expected to invite project farmers and associated extension staff to an annual on-station field day for training in improved crop production techniques including safe handling of farm chemicals.

#### b) Extension Services

The DAO Office, through its division field station, will be responsible for providing extension services to the Project Area. With the on-set of a re-structured extension strategy (currently under preparation), the Division centre will play the more important role of planning training programmes and overseeing performance of front-line extension workers (FEWs).

In order to provide adequate extension support to the project's irrigation community, the division extension office is expected to do the following;

- Plan, execute and monitor an extension programme that will be participatory as well as pay special attention to production/market groups and women groups
- Appoint a front-line extension worker whose coverage will be limited to the irrigation project only
- Facilitate and co-ordinate all-round farmers' training (field days, demonstration, agricultural shows, farmers training centre, visits to other irrigation schemes)
- Facilitate erection of a field office within the Project Area to be cost-shared with the farming community
- Make arrangements for the project few as well as divisional level back-stopping staff to be trained in participatory approaches, improved extension packaging and delivery methods as well as irrigated horticultural production
- Facilitate a one day annual review of irrigation project performance by the farmers and other stake holders

#### c) Community Development and Organization Services

The irrigation project is planned to address one out of many problems facing the project community. Using the irrigation project to illustrate what collective action can achieve, the project community will be encouraged to face other outstanding problems (ref. to Problem Tree).

In this regard, it is proposed to provide support services from two sources;

- From a community organizer, deployed by an NGOs or consulting firm on short-term contracts, who will support and animate the local community in taking necessary courses of action
- From staff of the district social services office (Ministry of Culture and Social Services) who will be encouraged to provide assistance from time to time on community development issues

d) Basic Skills' Development, Industrial and Entrepreneurial Training

Within the project community there are a number of artisans that include black-smiths, craftsmen. The project coordinator will make arrangements aimed at enlisting artisans within the project into the on-going World Bank/USAID training programme. Under this programme, vouchers are given to approved artisans for training in relevant technical and business skills in approved institutions (polytechnics and private firms).

Of particular interest to the project will be the training in masonry and metal works since these are the skills that will be needed during the operation and maintenance phase.

e) Credit Assistance

In the result of the farm economic survey, it was clarified that the situation of farm economy in the Ruungu/Karocho Area is classified lowest among the four Project Areas, and is under the poverty line. Therefore, it seems that the ability for cost recovery of farmers is low. However, appropriate project cost for irrigation facilities will be necessary to design properly even in the Area. Taking into consideration the harsh farm economy, it might be a matter of controversy to apply current credit system to the Areas, it might result in heavy burden on poor farmers. Banks and SISDO are required to reconsider to apply current credit system for the Area. While Ministry of Agriculture should check whether the irrigation facilities is designed properly involving check to cost estimate to avoid excess burden on the beneficial farmers. These considerations could be said for other small-scale irrigation areas.

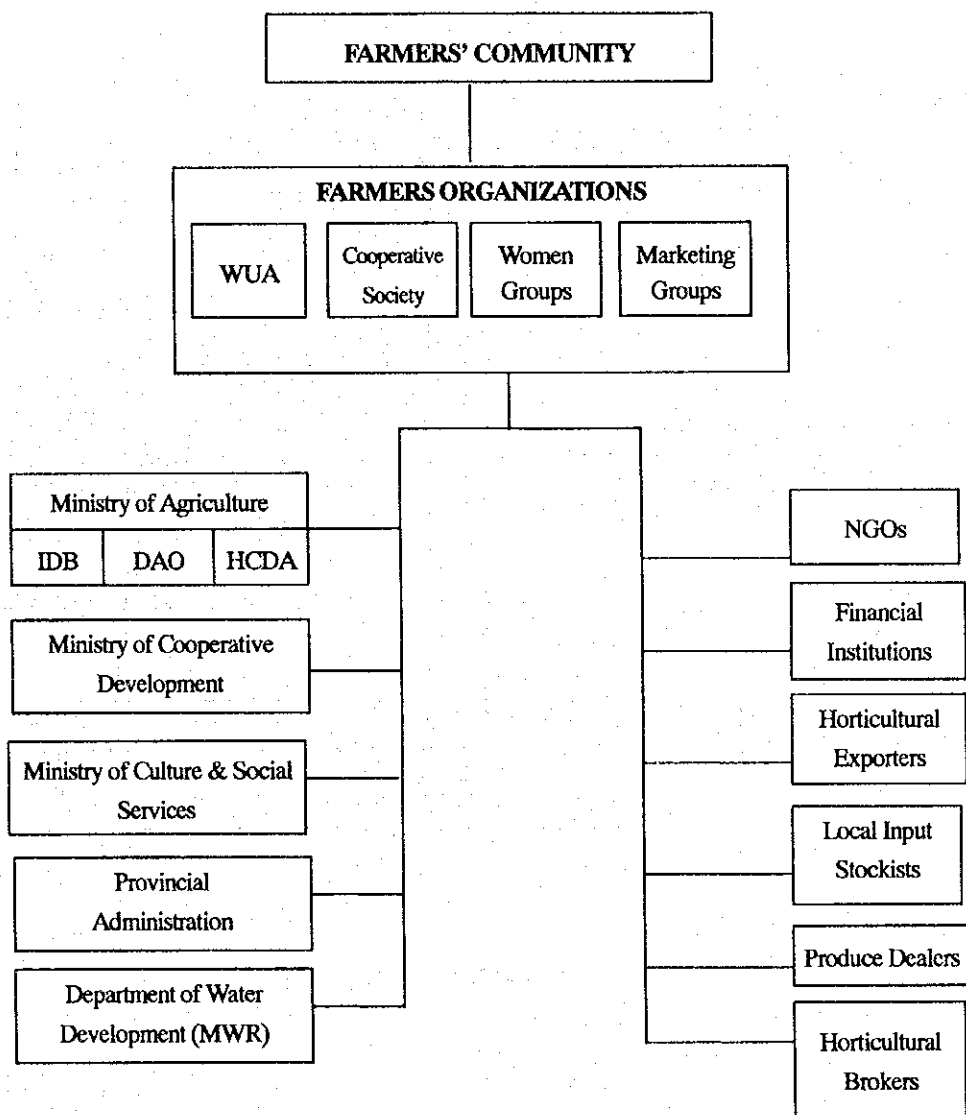
Though it is not allowed for farmers to possess private land, local County Council and the Ministry of Land and Settlement should survey farmlands and give them title deed immediately. DBK and SISDO should consider that the Area is in such a severe land condition and living environment, implying the necessity for relaxation of credit suitable for the Area. SISDO should make research and analyze the condition of socio-economy in detail instead of DBK before the implementation of the irrigation project. DBK should determine the appropriate credit conditions in consideration of the estimated project cost.

f) Fostering of Farmers' Capability

Provision of support services is aimed at enhancing the capability of individual farmers in managing her/his farm resources. Apart from financial incentives, the farmers capability should be recognized as a national asset to be cultivated and fostered.

In this connection, it is planned that MOA will every year select the best three irrigation farmers within the project for award of prizes. The annual performance review session would be an ideal time and venue for such awards which would be handed over by a distinguished guest e.g. district commissioner or director of agriculture. During this particular day, the three winning farmers should be praised as the heroes of the hour and this should serve to foster pursuit of excellence among the project community.

**Figure 4.4-1 Institution Arrangements for Providing Support Services to Farmers Organizations during Project Implementation**



g) Marketing, Post-Harvest and Other Institutional Support

The seminars for smallholders arranged by and held at Jomo Kenyatta University of Agriculture and Technology (JKUAT) and other institutions managed by the government can help very much to motivate and for decision making for farmers and beside DAO officers and HCDA expert can be important information sources

**Institutional Support on Marketing**

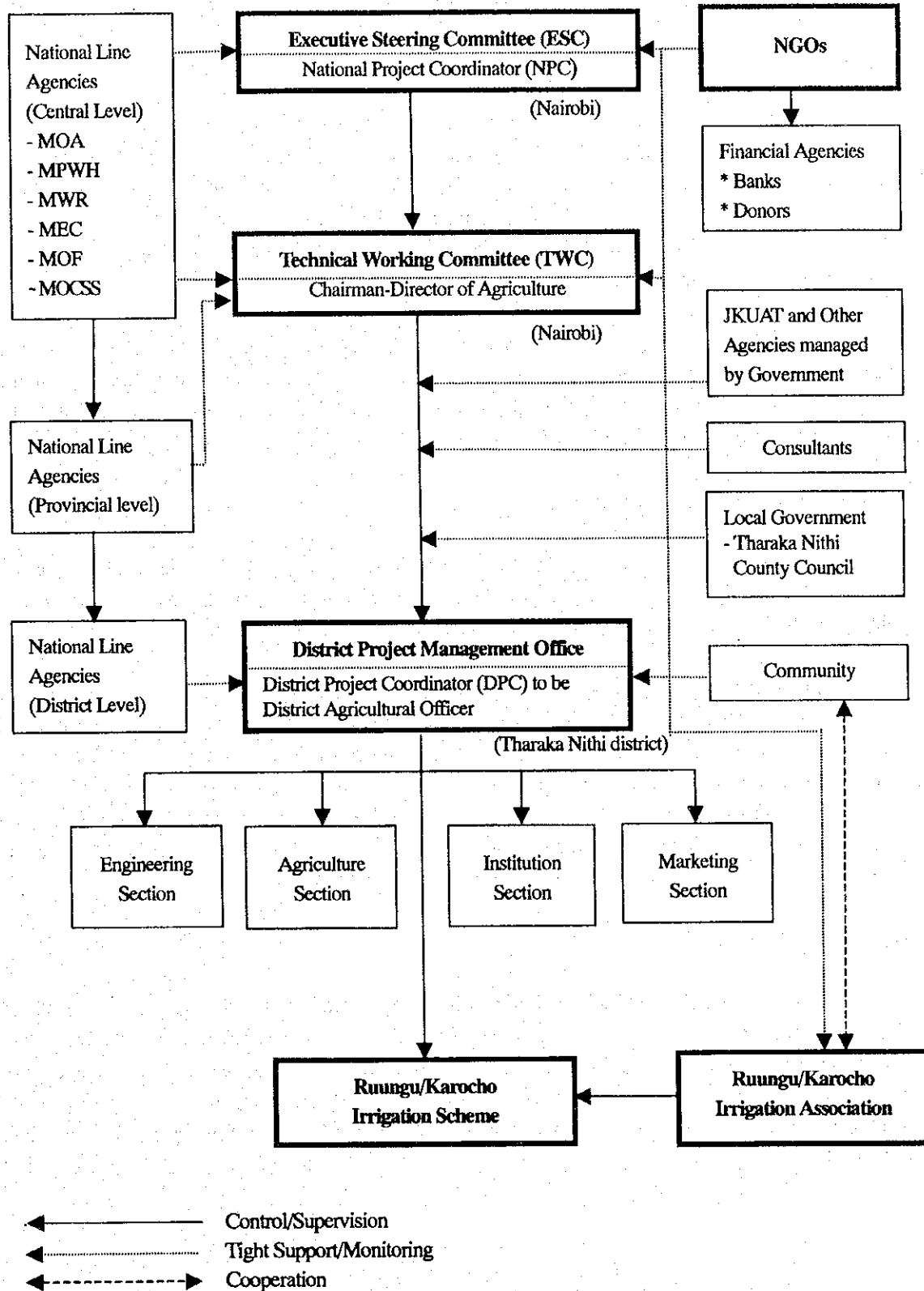
Problems/Constraints	Interventions	Agency Concerned	Outputs
<b>Seminar hold at JKUAT and other institutions managed by the government</b>			
Lack of knowledge of horticultural production	Lecturing and practice on horticultural produce	MOA staff on horticulture with lectures/technicians	Better husbandry and reducing losses caused by diseases
Lack of market information	Lecturing on market trend in key wholesale markets	Marketing officer of Marketing Information Branch of MOA	Understanding methods of price enumeration on the newspaper and analysis of data.
Lack of marketing groups	PCM workshop	MOA staff on farmers' organization	Strengthening farmers' bargaining skills
No buyers	Introduction of auction consignment	Marketing officer of HCDA	Improved transaction mode
Low quality of produce	Lecturing on selection and procurement of certified seeds / seedlings	KARI	Assurance of high rate of germination and selection of drought durable varieties
Lack of knowledge what are marketable produce/varieties or buyers' demands	Field trip pursuing marketing route	MOA staff on farmers' organization	More accessing to upper stream of marketing and proposing sites are Nairobi markets, exporters' grading & packing facilities, Nairobi Horticultural Centre for auction
<b>Local institutional support</b>			
Lack of market information	Provision of data collected (weekly base data can be referred)	Farm input/marketing officer of DAO-Meru Marketing expert of HCDA-Meru	Better crop planning and outflows to the market and traders
No. marketing alternatives	Auction consignment with HCDA	Marketing expert of HCDA-Meru	Better accessibility to outside market

**4.4.2 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 Tharaka Nithi for actual project implementation at the field level. Proposed organization chart is presented in Figure 4.4-2.

**Figure 4.4-2 Proposed Organization Chart for Project Implementation for Ruungu/Karocho Irrigation Project**



## 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 and marketing improvement will be undertaken by small local contractors under supervision of DPMO. Access roads improvement will be carried out by equipment-based big contractors and village/farm roads will be by labour-based small contractors. Both access roads and village/farm roads improvement works will be 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 Ruungu/Karocho Irrigation 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 irrigation facilities, and the other is governmental public projects like access roads 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. 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. Ruungu/Karocho Irrigation 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. MPWH for classified access road improvement, and Tharaka Nithi County Council for non-classified access roads and village/farm road improvement. Consultants shall be hired to undertake all physical works from the road identification survey up to construction supervision. Detailed implementation process and flowchart for governmental public projects are presented in Annex R.

## 4) Implementation Schedule

Other than the irrigation improvement which is currently on-going, 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 4.4-3.

### 4.4.3 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) Access roads : District Works Office, Tharake Nithi, (MPWH)  
(2) -do- : Tharaka Nithi County Council
- Private Sector: (1) Irrigation facilities : Ruungu/Karocho Irrigation Association  
(2) Village/farm roads : Village community including Association  
(3) Marketing facilities : Farmers group including Association

#### 2) Operation and Maintenance Plan of the Project

##### a) Agricultural Development

##### Trials

Trials are used for technology that is believed to be an improvement on the existing methods, but has not been tested under the particular conditions of the Project Area. Trials are particularly important in



Figure 4.4-3 Implementation Schedule for the Improvement of Ruungu/Karocho Irrigation Project

Work Item	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year
<b>A. Social Preparation and Institutional Strengthening</b>							
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>B. Facility Construction and Equipment Supply</b>							
1. Preparation Work	=====						
2. Survey, Detailed Design and Costing		=====					
3. Procurement of Funds (for construction works)		=====					
4. Consulting Services by NGOs and Consultants		=====					
5. Construction Works							
- Roads & Marketing Facilities							
- Irrigation Facilities	On-going	On-going	On-going	On-going	On-going	On-going	On-going
<b>C. Community Development, Support Services and O&amp;M</b>							
1. Community Development							
2. Agricultural Support Services							
3. Water Management Training Services							
4. Marketing Support Services							
5. Operation and Maintenance of Project Facilities							

Ruungu, which does not have a history of irrigated production. These trials will be conducted on farmers fields, primarily to test new technology under the 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 Tharaka Nithi district.

### Demonstrations

Demonstrations are used for technology which has been tested and proved to be suitable for the Project Area, but has not yet been widely adopted. There are a number of crops that have been successfully grown at Mitunguu, under slightly different climatic, soil and irrigation conditions, but most of the successful techniques and varieties used there are likely to be transferable. These demonstrations are intended to be convincing proof that the new 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. Opportunities will be taken for field trips to the nearby Mitunguu scheme to observe.

### Livestock

Access to improved lines of poultry will be facilitated by the project. The farmer will be responsible for the costs involved. A separate activity will be the development of a detailed review of the status of the Project Areas livestock, followed by the development of a detailed program for its improvement, if appropriate.

### Improved Inputs

After testing and demonstrating improved inputs such as new varieties, urea feeding blocks, pesticides etc, the project will encourage the private sector stockists in the vicinity to stock the products. If necessary the project will try to facilitate the access to the improved inputs. The farmers will be responsible for all the direct costs involved.

#### b) Agricultural Infrastructures

##### - Irrigation Facilities

O&M of irrigation facilities shall be executed by existing Ruungu/Karocho Irrigation Association. During the O&M stage, technical support shall be extended by the Irrigation Unit of District Agricultural Office, Embu (MOA)

Major O&M activities are water distribution management, cleaning and repair of canals, repair of 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 (Classified Roads)

C92 Primary Road and E788 Minor Road as an access road to the Project Area also functioned as an important farm-to-market road connecting between Meru town and Marimanti area. Maintenance of these sections of access roads shall be undertaken by MPWH since classified roads belong to MPWH.

Routine maintenance as a major activities includes repair and cleaning of roads and side ditches, spot gravelling and repair of road structures. Such maintenance activities shall be carried out under labour-based method (LBM) which has a direct impact on the living environment of low income communities.

- Access Roads (Non-classified Rural Roads)

A part of access road with a total length of 6.0 km from E788 junction to the Project Area is non-classified rural road which belongs to county council. Therefore, maintenance of this road section shall be carried out by Tharaka Nithi County Council. However, a community contract with length-man method, which can reduce O&M cost and create local employment, may be introduced for routine maintenance, since this road section is considered as a village access road.

In order to introduce a community contract on a maintenance of village access roads, community's awareness of road ownership shall be developed and support system by government agencies be establishes. From the beginning of the planning/design stages of the roads improvement, participation of village communities shall be attained and community initiative shall be fully taken into consideration.

Maintenance activities of routine maintenance are the same as classified access roads undertaken by MPWH. Technical and equipment support shall be extended by Tharaka Nithi County Council or MPWH.

d) Post-Harvest and Agro-Industry

The Mitunguu antenna shop with warehouse shall be operated by the manager appointed by Chairman's Executive Committee, who will have responsibility of; i) weighing, invoicing, packaging and storing of produce delivered by each marketing groups, ii) coordinating of price enumeration at Mitunguu market, auction results from marketing expert of HCDA-Meru, from marketing officer of DAO-Meru at Gakoromone wholesale market or other traders, and iii) request to each chairman for labour force of loading, packaging and askari. The information of trading date, name of the buyer, unit prices, owners' name of produce sold and selling amount must be recorded and reported to the Associated Chairman immediately. Executive Chairman's Committee shall decide the rate of wages for operation staff and funds to be deducted

from selling amount. The funds shall be used for repayment of loan, maintenance of the Mitunguu antenna shop and also newly constructing secondary school. The proposed rate of manager would be at 10,000-15,000 Ksh/month plus some incentives and 70 Ksh/day for labours, and the deducting rate for funds at 10-20 percent of selling prices.

## **4.5 Project Evaluation and Cost Recovery**

### **4.5.1 Economic Evaluation**

#### **1) Method of Economic Evaluation**

Economic internal rate of return (EIRR) is used to justify economic viability of the Project. Though eight percent of EIRR is considered to be the standard in Kenya, small-scale irrigation project in Ruungu/Karocho Area should be implemented as a measure of poverty alleviation for smallholders even if EIRR is under eight percent taking into consideration poor economic condition compared with other Project Areas.

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

#### **2) Commodity Prices**

The economic price is utilized for economic evaluation, while, financial price for financial analysis. Agricultural crops are divided into crops for export and for domestic consumption. The World Bank releases long-term forecast on commodity prices regularly. Therefore, economic price for maize and fertilizers is estimated based on this. Economic prices of French bean and other exporting vegetables are based on data of HCDA. Financial prices of crops which are consumed in domestic market are regarded as the economic prices. Financial and economic prices in the Ruungu/Karocho Area are shown in Table 4.5-5.

#### **3) Project Benefits**

The project benefits were estimated based on the present land use and proposed land use. The present land use is prepared on the result of the farm economic survey and proposed land use is based on the present agricultural conditions, the condition of land, soil and climate, demand for crops and farmer's experience and so on.

The incremental benefit means the difference of crop production between without Project and with Project cases, which is presented in terms of money. Benefits are generated by the increase of irrigated areas and crops yield with the construction of irrigation facilities. Though some area will remain dependent on rainfed farming even after the project implementation, increase in crop yield can be expected through strengthening of agricultural extension service and training for farmers. Incremental agricultural benefits in Ruungu/Karocho Area was estimated at 4,211 thousand Ksh under the assumption (refer to Table 4.5-6).

Road improvement is also included in the project. Effect on road improvement is evaluated for national economic point of views. Road improvement benefit would be presented as cost saving of fuel consumption with speed up of vehicles, which can be estimated in terms of money. As the result, road improvement benefit is estimated at 133 thousand Ksh (refer to Table 4.5-7).

#### 4) Economic Project Cost

Project cost is composed of local currency portion because all the construction materials and labour can be procured in Kenya. Financial project cost is converted to the economic project cost by using standard conversion factor (SCF). On the occasion, tax, subsidy, cost for land acquisition and compensation, contingency of price escalation are not included in economic project cost. Costs for road improvement and topographic map preparation are included in the project cost. The economic project cost for Ruungu/Karocho Area was estimated at 58,431 thousand Ksh with 1,085 thousand Ksh of annual O & M cost (refer to Table 4.5-8).

#### 5) Economic Internal Rate of Return

EIRR Ruungu/Karocho Area is calculated at 3.6 percent (refer to Table 4.5-9), which is lower than eight percent of the standard EIRR in Kenyan agricultural project. Therefore, the irrigation project in this Area might be judged economically not feasible if applied on this standard EIRR. However, small-scale irrigation project should be implemented considering that Ruungu/Karocho is located in arid zone and farmers have been in harsh living standard to be improved as one of poverty alleviation measures. Mapping cost is not including in the project cost because JICA Study Team made it. If including it, EIRR will be estimated at 3.5 percent.

#### 6) Sensitivity Analysis

Sensitivity analysis was made to verify the effect on EIRR under some parameters assumed;

	<b>EIRR(%)</b>
i) 10 percent increase in project cost	2.78
ii) 10 percent decrease of benefit	2.33
iii) Three years delay of benefit generation	1.89
iv) Combination of i) and ii)	1.54
v) Combination of ii) and iii)	0.86

#### **4.5.2 Financial Analysis of Typical Farmers**

Financial analysis for the standard farm household was made to compare income in without Project and with Project cases. Household expense and off-farm income are included in the analysis taking into account price escalation for four years. All the data used is based on the result of the farm economic survey carried out by the Study Team. Table 4.5-10 shows the result of the financial analysis. The total farm household income in case of without Project is estimated at 20,360 Ksh including off-farm income. While, living expense taking into account price escalation is estimated at 23,420 Ksh, resulting in deficit of 2,881 Ksh. However, farm household income in with Project case will be 57,306 Ksh with 34,065 Ksh of disposable income, indicating that farm economy will be improved by the small scale irrigation project. Difference between Ruungu/Karocho Area and other Project Areas is lack of technology and experience of farmers for growing vegetables and horticultural crops. Therefore, dense agricultural extension service must be given until farm management will be stable. As to marketing, HCDA and FPEAK should support them in developing market and selling prices etc., which is the most important matter influencing on farmer's ability for cost recovery, in other words, on success of this project.

#### **4.5.3 Cost Recovery Analysis of the Project**

It is clarified through the analysis of the farm economic survey that household economy in Ruungu/Karocho Area is below the poverty line. Under the conditions, cost recovery was analyzed whether farmers can repay project cost or not. Costs for the road improvement and topographical map preparation are the subject of cost recovery. The analysis is aimed at whether beneficial farmers can repay project cost within 34,065 Ksh of disposable income.

In addition to current credit conditions, some alternative plans were studied by changing interest, repayment period to compare monthly repayment and farmer's ability for cost recovery within the estimated disposable income. As the result, project cost to be paid by individual farmers is estimated at 37,795 Ksh, which corresponds to 1,071 Ksh per month under the current credit condition. This amount is considered very harsh for farmers and might cause some constraints in cost recovery after starting irrigation service. The case-3 or case-4 will be recommendable for Ruungu/Karocho area. Table 4.5-11 also shows the monthly repayment in both cases of excluding and including mapping cost to farmer's burden. As the result, effect on involving mapping cost is considered small.

#### **4.5.4 Study on the Proper Water Charge**

The beneficial farmers must pay the cost for O & M as the water charge, which will be spent for water guard's salary, repair cost, administration cost for WUA etc. to maintain irrigation facilities and irrigation benefits with sustainability. The water charge in Ruungu/Karocho project is estimated at 1,773 Ksh/ha/year, that is 231 Ksh/ha/month.

#### 4.5.5 Social and Environmental Effects by the Project

The effect of the irrigation project in Ruungu/Karocho Area mainly occurs from the increase of agricultural production. Other than these tangible benefits, small-scale irrigation project effects indirectly, though it is difficult to present in terms of money, and some these indirect benefits often have important meaning.

- The implementation of small-scale irrigation project in Ruungu/Karocho become a model case of irrigation project in other arid or semi-arid areas not only in Tharaka Nithi.
- It will provide a good example for other areas about financial supporting services and credit conditions.
- It could become an example for supporting activities in agricultural extension service, educational training for farmers, strengthening farmers groups taken into consideration the farmers educational status.
- The operation and maintenance of irrigation facilities by farmer's group will give a good sample for other areas in which irrigation project will be implemented.
- Farmer's income will increase temporarily by working in the construction of irrigation facilities.
- Harmony in the rural community will be strengthened by maintaining irrigation facilities as a common property of the rural society.
- The project will show the appropriate direction for the promotion of small-scale irrigation project in hard and soft-aspects to be supported by many agencies concerned and linkage in their actions between them.

#### 4.6 Project Monitoring and Evaluation

##### 1) Necessity and Objectives of Monitoring and Evaluation

Irrigation improvement for Ruungu/Karocho Irrigation 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 system operation
  - Water distribution operation including irrigation water rotation
  - Condition of irrigation facilities such as intake, canals, division boxes, etc.
  - Condition of farmers participation and maintenance costs in O&M
  - Condition of water flow through the canals
  
- b) Access and village/farm roads maintenance
  - Road maintenance activities and conditions within the Project Area and access roads
  - Road accessibility of village/farm roads in the Project Area and access roads
  - Participation of community people in maintenance activities
  - Condition of community contract operation for rural roads
  - Condition of support services to be extended by Tharaka Nithi 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 Ruungu/Karocho Irrigation 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 irrigation facilities
  - No. of days being held an education training, assembly meeting and its agenda
  
- e) Marketing aspect
  - Changes in marketing condition
  - Condition of marketing facilities in the Project Area
  
- 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 irrigation system, village/farm roads and marketing facilities are carried out by NGOs under supervision of ESC for two 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 years after the construction.

**Table 4.5-1 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 4.5-2 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 4.5-3 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 4.5-4 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 price FOB price(US\$/ton)	1,897	1,471
5. Port charges/handling(US\$/ton)	9	9
6. Value at Kenya border(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 4.5-5 Farmgate Price at Ruungu/Karocho

	Unit	Unit Price(Ksh)	
		Financial	Economic
<b>1. Crops</b>			
Maize	kg	15.0	9.5
Millet	kg	10.0	10.0
Sorgum	kg	6.9	6.9
Beans	kg	27.1	27.1
French Beans	kg	24.0	29.8
Cowpeas	kg	16.5	16.5
Pigeon Peas	kg	23.5	23.5
Irish Potatoes	kg	20.0	20.0
Cotton	kg	10.0	10.0
Sweet Potatoes	kg	5.0	5.0
Bulb Onions	kg	25.0	25.0
Tomatoes	kg	25.0	20.2
Okra	kg	23.0	22.4
Banana	Bunch	150.0	150.0
Green grams	kg	21.5	21.5
Milk	kg	17.7	17.7
Macadamia nut	kg	30.0	30.0
Avocado	kg	10.0	10.0
Mangoes	kg	15.0	15.0
<b>2. Seed</b>			
Maize	kg	85	80
French Beans	kg	500	467
Okra	kg	300	280
Tomatoes	kg	6,400	5,978
Kale	kg	1,000	934
<b>3. Fertilizer</b>			
Nitrogen	kg	28.0	27.4
Phosphate	kg	20.0	24.3
Potassium	kg	24.0	16.4
<b>4. Agricultural Chemicals</b>			
Dimethoate	lit.	800	747
Sancozeb	kg	950	887
Karate	lit.	1,300	1,214
<b>5. Labour</b>			
Labour	MD	60	30
Animal Labour	MAD	1,500	750
<b>6. Nursery</b>			
Banana	plant	50	50
Papaya	plant	40	40
Passion fruit	plant	50	50
Macadamia nut	plant	60	60
Cashew nut	plant	60	60

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

Table 4.5-6 Estimation of the Agricultural Benefits

	Green		Sweet Asian		Onion	Tomato	Tobacco	Banana	Mango	Total
	Maize	Gram	Millet	Sorghum						
<b>(A) Rainfed Areas</b>										
I. Without Project										
Unit price(Ksh/kg)	9.5	21.5	10.0	6.9	10.0	0.0	0.0	0.0	0.0	15.0
Yield(kg/ha)	1,000	300	400	750	1,000	0	0	0	0	3,500
Gross Income(Ksh/ha)	9,500	6,450	4,000	5,175	10,000	0	0	0	0	52,500
Cost of Production(Ksh/ha)	11,211	2,605	2,000	2,611	5,857	0	0	0	0	2,526
Net Return(Ksh/ha)	-1,711	3,845	2,000	2,564	4,343	0	0	0	0	49,974
Planted Area(ha)	228.44	85.36	140.41	17.15	5.72	0.00	0.00	0.00	0.00	0.00
Total Net Return(1,000 Ksh)	-391	328.2	280.8	43,973	24.94	0	0	0	0	392.8
										679.78
II. With Project										
Unit price(Ksh/kg)	9.5	21.5	10.0	6.9	0.0	0.0	0.0	0.0	0.0	15.0
Yield(kg/ha)	1,250	450	450	850	0	0	0	0	0	3,500
Gross Income(Ksh/ha)	11,875	9,675	4,500	5,865	0	0	0	0	0	52,500
Cost of Production(Ksh/ha)	11,495	3,721	2,095	2,863	0	0	0	0	0	2,526
Net Return(Ksh/ha)	380	5,954	2,405	3,002	0	0	0	0	0	49,974
Planted Area(ha)	220	94	140	20	0	0.00	0.00	0.00	0.00	0.00
Total Net Return(1,000 Ksh)	84	580	337	80	0	0	0	0	0	400
III. Incremental Benefit(1,000 Ksh)	474	231	56	16	-25	0	0	0	0	760
										1,440
										760
<b>(B) Irrigated Areas</b>										
I. Without Project										
Unit price(Ksh/kg)	0.0	21.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yield(kg/ha)	0	600	0	0	0	0	0	0	0	0
Gross Income(Ksh/ha)	0	12,900	0	0	0	0	0	0	0	0
Cost of Production(Ksh/ha)	0	3,816	0	0	0	0	0	0	0	0
Net Return(Ksh/ha)	0	9,084	0	0	0	0	0	0	0	0
Planted Area(ha)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Net Return(1,000 Ksh)	0	0	0	0	0	0	0	0	0	0
II. With Project										
Unit price(Ksh/kg)	9.5	21.5	10.0	0.0	0.0	5.0	22.4	25.0	20.2	50.0
Yield(kg/ha)	2,500	800	750	0	0	8,500	4,000	7,000	12,000	750
Gross Income(Ksh/ha)	23,750	17,200	7,500	0	0	42,500	89,600	175,000	242,400	37,500
Cost of Production(Ksh/ha)	14,739	6,736	3,248	0	0	14,878	10,475	41,484	33,214	15,378
Net Return(Ksh/ha)	9,011	10,464	4,254	0	0	27,622	79,125	133,516	209,186	22,122
Planted Area(ha)	57.10	18.50	6.00	0.00	0.00	11.90	10.80	6.40	1.70	8.40
Total Net Return(1,000 Ksh)	515	194	28	0	0	331	855	855	356	186
III. Incremental Benefit(1,000 Ksh)	515	194	28	0	0	331	855	855	356	186
										3,451
										3,451
										0
<b>(C) Incremental Benefit(1,000 Ksh)</b>										
	989	425	81	16	-25	331	855	855	356	186
										4,211
										7

**Table 4.5-7 Estimation of Benefits on the Farm and Village Roads Improvement**

① Fuel Consumption( 2 ton truck)

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

② Speed(Km/hr)

	<u>without Project</u>	<u>with Project</u>
Rupingazi Ngerwe	20	40
Ngomano/Nyangati	40	50
Nkunjumo	30	40
Ruungu/Karocho	15	40

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

③ Road Length to be Improved(km)

	<u>without Project</u>	<u>with Project</u>
Rupingazi Ngerwe	7.5	7.5
Ngomano/Nyangati	3.2	3.2
Nkunjumo	2.5	2.5
Ruungu/Karocho	40.5	40.5

④ Fuel Consumption per Unit(lit.)

	<u>without Project</u>	<u>with Project</u>
Rupingazi Ngerwe	2.4	1.7
Ngomano/Nyangati	0.7	0.7
Nkunjumo	0.7	0.6
Ruungu/Karocho	14.6	9.4

⑤ Amount of Fuel Consumption(Ksh)

	<u>without Project</u>	<u>with Project</u>	<u>Difference</u>
	23,167	16,796	6,371
	21,932	19,852	2,080
	9,417	8,092	1,325
	<u>373,357</u>	<u>240,608</u>	<u>132,749</u>

**Table 4.5-8 Project Cost and O&M Cost**  
Project Cost(Ruungu/Karocho)

	Financial Cost(Ksh)		Economic Cost(Ksh)	
	Total Cost	Of Which, Private Sector	Total Cost	Total Cost
1. Construction cost				
1) Irrigation & drainage improvement	4,520,200	4,520,200	4,221,867	
2) Marketing improvement	1,500,000	1,500,000	1,401,000	
3) Access roads improvement	19,660,000	0	18,362,440	
4) Village/farm roads improvement	1,710,000	0	1,597,140	
5) Rural water supply improvement	0	0	0	
Sub-Total	27,390,200	6,020,200	25,582,447	
2. Community Development & Supporting Services				
1) Agricultural support services	14,050,000	0	13,122,700	
2) Community development	7,120,000	0	6,650,080	
3) Water management services	1,810,000	0	1,690,540	
4) Marketing support services	284,000	0	265,256	
5) Public health services	150,000	0	140,100	
Sub-Total	23,414,000	0	21,868,676	
3. Associated Cost				
1) Pre-engineering cost	1,600,900	105,000	1,495,241	
2) Administration cost	3,239,880	0	3,026,048	
3) Consulting services	4,628,400	150,000	4,322,926	
Sub-Total	9,469,180	255,000	8,844,214	
4. Physical Contingency	2,287,000	150,000	2,136,058	
Total	62,560,380	6,425,200	58,431,395	

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

**Operation and Maintenance Cost(Ruungu/Karocho)**

	Financial Cost	Economic Cost
Annual Operation and Maintenance Cost		
1) Irrigation & drainage facilities	62,300	58,188
2) Marketing facilities	30,000	28,020
3) Access roads	994,000	928,396
4) Village/farm roads	75,000	70,050
5) Rural water supply facilities	0	0
Total	1,161,300	1,084,654

Table 4.5-9 Calculation of EIRR  
-Ruungu/Karocho-

(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	4,908	1,084	5,992	1,303	-4,689	5,992	1,303	5,992	1,303	5,992	1,303
2	20,509	1,084	21,593	2,172	-19,422	16,047	1,814	17,846	1,795	17,214	1,731
3	18,639	1,084	19,723	3,040	-16,683	12,636	1,948	14,819	2,284	14,039	2,164
4	4,382	1,084	5,466	3,909	-1,558	3,019	2,159	3,734	2,870	3,474	2,484
5	3,447	1,084	4,531	4,343	-188	2,157	2,068	2,814	2,697	2,571	2,464
6	3,447	1,084	4,531	4,343	-188	1,860	1,783	2,558	2,452	2,298	2,200
7	3,097	1,084	4,181	4,343	162	1,479	1,537	2,145	2,229	1,891	1,965
8	0	1,084	1,084	4,343	3,259	331	1,325	508	2,026	438	1,754
9	0	1,084	1,084	4,343	3,259	285	1,142	460	1,842	391	1,566
10	0	1,084	1,084	4,343	3,259	246	984	418	1,674	349	1,398
11	0	1,084	1,084	4,343	3,259	212	849	380	1,522	312	1,249
12	0	1,084	1,084	4,343	3,259	183	732	345	1,384	278	1,115
13	0	1,084	1,084	4,343	3,259	157	631	314	1,258	248	995
14	0	1,084	1,084	4,343	3,259	136	544	285	1,144	222	889
15	0	1,084	1,084	4,343	3,259	117	469	260	1,040	198	793
16	0	1,084	1,084	4,343	3,259	101	404	236	945	177	708
17	0	1,084	1,084	4,343	3,259	87	348	214	859	158	633
18	0	1,084	1,084	4,343	3,259	75	300	195	781	141	565
19	0	1,084	1,084	4,343	3,259	65	259	177	710	126	504
20	0	1,084	1,084	4,343	3,259	56	223	161	646	112	450
21	0	1,084	1,084	4,343	3,259	48	192	146	587	100	402
22	0	1,084	1,084	4,343	3,259	41	166	133	534	90	359
23	0	1,084	1,084	4,343	3,259	36	143	121	485	80	320
24	0	1,084	1,084	4,343	3,259	31	123	110	441	71	286
25	0	1,084	1,084	4,343	3,259	27	106	100	401	64	255
26	0	1,084	1,084	4,343	3,259	23	92	91	364	57	228
27	0	1,084	1,084	4,343	3,259	20	79	83	331	51	204
28	0	1,084	1,084	4,343	3,259	17	68	75	301	45	182
29	0	1,084	1,084	4,343	3,259	15	59	68	274	41	162
30	0	1,084	1,084	4,343	3,259	13	51	62	249	36	145
<b>Total</b>	<b>58,431</b>	<b>32,520</b>	<b>90,951</b>	<b>123,341</b>	<b>32,390</b>	<b>45,509</b>	<b>21,898</b>	<b>54,848</b>	<b>35,226</b>	<b>51,262</b>	<b>29,474</b>

EIRR= 3.63 %

B/C Ratio= 16 % 0.48  
 B/C Ratio= 10 % 0.64  
 B/C Ratio= 12 % 0.57



**Table 4.5-10 Financial analysis for Standard Farm**

Farm size: 2.80 ha

**Without Project**

1st Rain Season	Planted Area(ha)	Yield (kg/ha)	Production (kg)	Unit Price (Ksh/kg)	Gross Income(Ksh)	Cost of		
						Production (Ksh)	Net Return (Ksh)	
Maize	1.60	1,000	1,600	15.0	24,000	23,074	926	
Pulses	0.72	300	216	21.5	4,644	3,240	1,404	
Millet	0.98	400	392	10.0	3,920	3,507	413	
Cotton	0.04	1,000	40	10.0	400	349	51	
Mango	0.05	3,500	175	15.0	2,625	253	2,372	
<b>Total</b>	<b>3.39</b>						<b>5,166</b>	
1. Crop Income(Ksh/year)								<b>5166</b>
2. Animal Income(Ksh/year)								<b>1,823</b>
3. Off-Farm Income(Ksh/year)								<b>13,371</b>
4. Living Expense(Ksh/year)-family size 7.9 persons/family								<b>23,240</b>
5. Disposable Income(Ksh/year)								<b>-2,881</b>

**With Project**

**I. Reinfed**

	Planted Area(ha)	Yield (kg/ha)	Production (kg)	Unit Price (Ksh/kg)	Gross Income(Ksh)	Cost of	
						Production (Ksh)	Net Return (Ksh)
Maize	1.83	1,250	2,288	15.0	34,320	26,853	7,467
Pulses	0.79	450	356	21.5	7,654	1,393	6,261
Millet	1.16	450	522	10.0	5,220	4,262	958
Sorghum	0.17	850	145	6.9	1,001	889	112
Mango	0.06	3,500	210	15.0	3,150	304	2,846
<b>Sub-Total</b>	<b>4.00</b>						<b>17,644</b>

**II. Irrigated**

	Planted Area(ha)	Yield (kg/ha)	Production (kg)	Unit Price (Ksh/kg)	Gross Income(Ksh)	Cost of		
						Production (Ksh)	Net Return (Ksh)	
Maize	0.33	2,500	825	15.0	12,375	6,217	6,158	
Pulses	0.08	800	64	21.5	1,376	706	670	
Sweet Potatoes	0.07	8,500	595	5.0	2,975	1,059	1,916	
Tobacco	0.05	750	38	50.0	1,900	1,193	707	
Asian Vegetables	0.20	4,000	800	23.0	18,400	3,383	15,017	
<b>Sub-Total</b>	<b>0.73</b>						<b>24,468</b>	
1. Total Crop income(Ksh/year)								<b>42,112</b>
2. Animal Income(Ksh/year)								<b>1,823</b>
3. Off-Farm Income(Ksh/year)								<b>13,371</b>
4. Living Expense(Ksh/year)-family size 7.9 persons/family								<b>23,240</b>
5. Disposable Income(Ksh/year)								<b>34,065</b>

**Table 4.5-11 Cost Recovery Analysis**

Case-1 Present condition	Excluding Map Preparation	Including Map Prep.
1) Number of beneficiaries	170 farm households	
2) Total project cost to be paid by the beneficiaries of which, irrigation facilities	62,560,380 Ksh 6,425,200 Ksh	6,925,200
3) Loan per farm household	37,795 Ksh	40,736
4) Repayment Period(years)	4 48 (months)	
5) Annual interest rate(%)	16 per year	
6) Monthly interest rate(%)	1.33 (16/12)	
7) Monthly repayment(Ksh)	<u>1,071 Ksh/month</u>	<u>1,154</u>

Alternative Plans for Loan Repayment

Case-2		
1) Loan per farm household(Ksh)	37,795	40,736
2) Repayment Period(years):	6 72 (months)	
3) Annual interest rate(%)	12 per year	
4) Monthly interest rate(%)	1.00 (12/12)	
5) Monthly repayment(Ksh)	<u>739 Ksh/month</u>	<u>796</u>

Case-3		
1) Loan per farm household(Ksh)	37,795	40,736
2) Repayment Period(years)	8 96 (months)	
3) Annual interest rate(%)	10 per year	
4) Monthly interest rate(%)	0.83 (10/12)	
5) Monthly repayment(Ksh)	<u>574 Ksh/month</u>	<u>618</u>

Case-4		
1) Loan per farm household(Ksh)	37,795	40,736
2) Repayment Period(years)	10 120 (months)	
3) Annual interest rate(%)	5 per year	
4) Monthly interest rate(%)	0.42 (5/12)	
5) Monthly repayment(Ksh)	<u>401 Ksh/month</u>	<u>432</u>

Case-5		
1) Loan per farm household(Ksh)	37,795	40,736
2) Repayment Period(years)	4 48 (months)	
3) Annual interest rate(%)	30 per year	
4) Monthly interest rate(%)	2.50 (30/12)	
5) Monthly repayment(Ksh)	<u>1,361 Ksh/month</u>	<u>1,467</u>

Repayment under the Current Situation(Ruungu/Karocho)

Case-6	
1) Loan per farm household	37,795 Ksh
2) Repayment Period(years)	4 (48 months)
3) Annual interest rate(%)	16 (% per year)
4) Monthly interest rate(%)	1.33 (16/12)
5) Monthly repayment(Ksh)	1,071 (Ksh/month)
6) Monthly repayment and disposable income(Ksh)	

	Repayment	Disposable Income
1st year	1,071	100 (farm economic survey 1998)
2nd year	1,071	1,420
3rd year	1,071	1,990
4th year	1,071	2,839

Table 4.5-12 Estimation of Water Charge

(Unit:Ksh)

Year	Initial Cost	O & M Cost	Replac- ment Cost	Total	Present Value by Discount Rate											
					Int= 0.16				Int= 0.15				Int= 0.20			
					Initial Cost	O&M Cost	Replac- ment	Total	Initial Cost	O&M Cost	Replac- ment	Total	Initial Cost	O&M Cost	Replac- ment	Total
1	2,260,100	62,300	0	2,322,400	2,260,100	62,300	0	2,322,400	2,260,100	62,300	0	2,322,400	2,260,100	62,300	0	2,322,400
2	3,265,100	62,300	0	3,327,400	2,428,501	46,299	0	2,472,800	2,468,885	47,108	0	2,515,992	2,267,431	43,264	0	2,310,694
3	900,000	62,300	0	962,300	578,592	39,913	0	618,505	591,765	40,963	0	632,728	520,833	36,053	0	556,887
4	0	62,300	0	62,300	34,408	0	34,408	0	35,620	0	35,620	0	30,044	0	30,044	
5	0	62,300	0	62,300	29,662	0	29,662	0	30,974	0	30,974	0	25,037	0	25,037	
6	0	62,300	0	62,300	25,571	0	25,571	0	26,934	0	26,934	0	20,884	0	20,884	
7	0	62,300	0	62,300	22,044	0	22,044	0	23,421	0	23,421	0	17,387	0	17,387	
8	0	62,300	0	62,300	19,003	0	19,003	0	20,386	0	20,386	0	14,489	0	14,489	
9	0	62,300	0	62,300	16,382	0	16,382	0	17,710	0	17,710	0	12,074	0	12,074	
10	0	62,300	0	62,300	14,122	0	14,122	0	15,400	0	15,400	0	10,062	0	10,062	
11	0	62,300	0	62,300	12,174	0	12,174	0	13,391	0	13,391	0	8,385	0	8,385	
12	0	62,300	0	62,300	10,485	0	10,485	0	11,644	0	11,644	0	6,967	0	6,967	
13	0	62,300	0	62,300	9,048	0	9,048	0	10,125	0	10,125	0	5,823	0	5,823	
14	0	62,300	0	62,300	7,800	0	7,800	0	8,805	0	8,805	0	4,852	0	4,852	
15	0	62,300	0	62,300	6,724	0	6,724	0	7,656	0	7,656	0	4,044	0	4,044	
16	0	62,300	0	62,300	5,799	0	5,799	0	6,658	0	6,658	0	3,370	0	3,370	
17	0	62,300	0	62,300	4,997	0	4,997	0	5,789	0	5,789	0	2,808	0	2,808	
18	0	62,300	0	62,300	4,308	0	4,308	0	5,034	0	5,034	0	2,340	0	2,340	
19	0	62,300	0	62,300	3,714	0	3,714	0	4,378	0	4,378	0	1,950	0	1,950	
20	0	62,300	0	62,300	3,201	0	3,201	0	3,807	0	3,807	0	1,625	0	1,625	
21	0	62,300	0	62,300	2,760	0	2,760	0	3,310	0	3,310	0	1,354	0	1,354	
22	0	62,300	0	62,300	2,379	0	2,379	0	2,878	0	2,878	0	1,128	0	1,128	
23	0	62,300	0	62,300	2,051	0	2,051	0	2,503	0	2,503	0	940	0	940	
24	0	62,300	0	62,300	1,768	0	1,768	0	2,176	0	2,176	0	784	0	784	
25	0	62,300	0	62,300	1,524	0	1,524	0	1,893	0	1,893	0	653	0	653	
26	0	62,300	0	62,300	1,314	0	1,314	0	1,646	0	1,646	0	544	0	544	
27	0	62,300	0	62,300	1,133	0	1,133	0	1,431	0	1,431	0	454	0	454	
28	0	62,300	0	62,300	976	0	976	0	1,244	0	1,244	0	378	0	378	
29	0	62,300	0	62,300	842	0	842	0	1,082	0	1,082	0	315	0	315	
30	0	62,300	0	62,300	726	0	726	0	941	0	941	0	262	0	262	
Total	6,425,200	1,869,000	0	8,294,200	5,263,193	393,433	0	5,656,626	5,320,749	417,187	0	5,737,936	5,048,384	320,571	0	5,368,935

Annual 214,173 62,300 0 276,473 175,440 13,114 0 188,554 177,358 13,906 0 191,265 166,279 10,886 0 178,964

Water Charge

	Interest 0.16	Interest 0.15	Interest 0.20
a. Annual Water Intake	889,700	889,700	889,700
b. Cost			
b.1 Cost per year at financial price	175,440	177,358	166,279
b.2 Annual O&M cost at financial price	13,114	13,906	10,886
b.3 Replacement cost at financial price	0	0	0
Total	188,554	191,265	178,964
c. Water Charge			
c.1 per cubic meter	0.21193 Ksh	0.214976 Ksh	0.201152 Ksh
c.2 per ha/year	2,773 Ksh	2,813 Ksh	2,832 Ksh
c.3 ha/month	231 Ksh	234 Ksh	219 Ksh

## 4.7 Recommendations

### Agriculture

- a) The current dominant farming type of the Ruungu/Karocho Irrigation Project, which was classified as Type-E in Model Area selection, is the consumption-oriented farming mainly planting food crops. And, beneficial farmers have such strong willingness that present farming type should be shifted to food crop planting for stable food supply accompanied with livestock grazing in the Area. Therefore, plan of agricultural farming 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 collaboration between individual farmers and the project.

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Demonstrations	3	3	2	2	1	11
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 demonstrations farm. 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

- Introduction of adapted improved dryland crops
- Working with farmers to get tobacco contracts
- Testing of onion, chilies and some Asian vegetables
- Development of livestock improvement program

### Institutional Supporting Services

- a) The District Irrigation Unit at Marimanti should liaises with IDB, Nairobi in drawing up a training programme specific to Ruungu/Karocho Irrigation 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 up a training timetable for social preparation and the capability-building in relevant agencies.

## Irrigation and Drainage

- a) The proposed cropping pattern of irrigated crops is established by putting focus on food consumption in the Area, marketability and storage life of crops, then, these cropping patterns are slightly different from the proposed ones by SISDO. Therefore, it is necessary to review the proposed cropping pattern in order to determine irrigation water requirement.
- b) The members of WUA have only land occupation right to their land and do not have land ownership. It is recommended to execute a cadastral survey for the Project Area to define land ownership.
- c) The water management method proposed by SISDO having 12 rotation blocks with group feeder canals will be adequate for the Project. The WUA shall decide the area and location of proposed farmland to determine dimensions of group feeder canals before the commencement of detailed design study.
- d) 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 training for 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, 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.
- e) It is recommended to review current water permits applied for.

## Marketing

- a) Discussion and formulation of farmers' marketing groups,
- b) Construction of an antenna shop with a warehouse in Mitungu and transporting arrangements to Mitungu by the marketing groups,
- c) Auction participation at Gakoromone wholesale market for local consumed produces as one of marketing alternatives,
- d) Practical utilization of social and natural resources for marketing advantages of ; i) short-cut to Mitunguu town, ii) possibility of outflows of produce to Mitunguu market or Gakoromone wholesale market, iii) transactions of several exporters in Mitunguu area, iv) road improvement plan between Meru and Mitunguu, v) Haranbee among community,

- 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) Repair of damaged diversion weir shall be carefully carried out considering the following points;
- Re-design of weir may be considered,
  - Condition of riverbed rock needs to be investigated,
  - Relocation of weir site to upstream depending on availability of funds, and
  - Capable contractor for river works is required to undertake the works.

#### 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 each other.
- b) For the construction works of the self-help projects, detailed work allocation and responsibilities as indicated below among Contractors, WUA and NGOs, which are directly related to the construction costs, shall be clearly presented to WUA during the detailed design stage;
- Contents of works 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, Study Team prepared the topographical maps with scale of 1:5,000 applying aerial photography and ground survey methods. Its costs were about 669 thousand Ksh per site (average size is 276 ha). These topographical maps are deemed essential and useful not only for carrying out physical planning of irrigation and drainage facilities in the Area, but also for the encouragement of farmers' participation to 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 shouldered the costs. However, when other projects are planned, such topographical maps with scale of 1:5,000 should be prepared and the necessary costs should be shouldered by beneficiary group themselves.

## Environment

- a) In relation to agro-chemical use, it is important to refrain from their use in preventing pest and diseases by use of proper crop husbandry practices such as crop rotation, inter-cropping and improvement of soil fertility. As concerns the training of safe use of agro-chemicals, it may be effective to include the matter about endocrine disruptors which are contained in many pesticides. For example, the endocrine-disrupting effects may give an impact to farmers.
- b) MOA should support horticulture as well as livestock raising, production of feed and manure synthetically. Extension offices should improve the know-how of agriculture and livestock raising, and visit farmlands periodically though road conditions are very bad. Further, it is important to approach the plan in combination with other projects being executed or being executed by other donors.
- c) The incentive to soil and water conservation activities by farmers is to show them that these activities are connecting with increase of soil fertility and crop production. It is supposed that there are several farmers who are active for soil and water conservation in each village, therefore, MOA should survey the difference of crop productivity including input and output between these farmers and others to find a model farm for the field trip in farmers training. Farmers training should also include to develop the sense of river bank protection that flows along farm lands.
- d) Forestry Department is responsible to watershed management in forest reserves and illegal logging must be exposed and punished fairly. National awareness for the importance of forest also should be encouraged. To hold eco-tours to forest intended for children with their parents who live in towns may give them a positive impact for the importance of watershed management.
- e) Monitoring of the Project shall include the environmental impact survey. When the quality of some water sources was analyzed in EIA survey, the unit of agrochemical content was microgram order. Though the agrochemical content should be analyzed by picogram order in monitoring works as the risk of agrochemical is discussed by picogram order internationally. Coliform should be analyzed by count in monitoring works though it was analyzed by positive and negative in EIA survey.
- f) It is reported that ENZARO JIKO Project (promotion of improved cooking stove) by JICA achieved a magnificent effect in the community. The JICA expert promoted to make water jar with a metal tap as same as to make improved cooking stoves. Metal tap was at present from the expert and the improved cooking stove was spread rapidly because people were pleased to fix a metal tap on water jar. The marvelous secondary effects are the increase in scholarship of children and decline in birth rate. Children became more healthy and the active community seemed to give a positive impact on children. This kind of indirect approach is also very important for the agricultural development as the future success of rural area rests on children.

## Project Economy and Farm Budget

- a) It is recommended for the preparation of the detailed project plans of the proposed small-scale irrigation schemes that MOA should undertake a careful appraisal to examine project plans to be proposed by the communities 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 confronted with difficulties in loan repayments. 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 the farmers 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 backing should be given to the farmers participating in the project till they have attained the full production targets, since it may take several years to reach these targets. To this end, the district governments should establish the District Project Management Office (DPMO), responsible for providing support 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 of the progress of project and implementation should be carried out by external agencies under the supervision of an Executive Steering Committee (ECS), to cope with the following objectives;

- 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 to other Project Areas.

- b) Monitoring 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
- Environmental impact of irrigation (river water quality, kinds and use of agro-chemical, condition of soil and water conservation activities, etc.)

Table 4.7-1 indicated the required training items for implementation of smallholder irrigation schemes in Ruungu/Karocho Water Project.



Table 4.7-1 Required Training Items for Ruungu/Karocho Irrigation Project

	Training Items	Farmers/ Farmers' Group	Implementing Staff	
1. Agriculture/Irrigation	- Land use and crop selection in relative dry area	●	●	
	- 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 open canal system	●		
	- O&M works for 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	●	●	
	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		●	●	
- Rehabilitation of access roads		●	●	
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	●	●	
	- WUAs' roles and performance	●		
4. Support Services	- Financial management for cooperative societies	●	●	
	- Access to agricultural credit	●	●	
	- Linkages with other institution	●	●	
	- Soil erosion control at sloping farms	●	●	
5. Environment	- Watershed Management and water conservation	●	●	
	- Promotion of improved cooking stove	●	●	
	- Promotion of rural health	●	●	



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