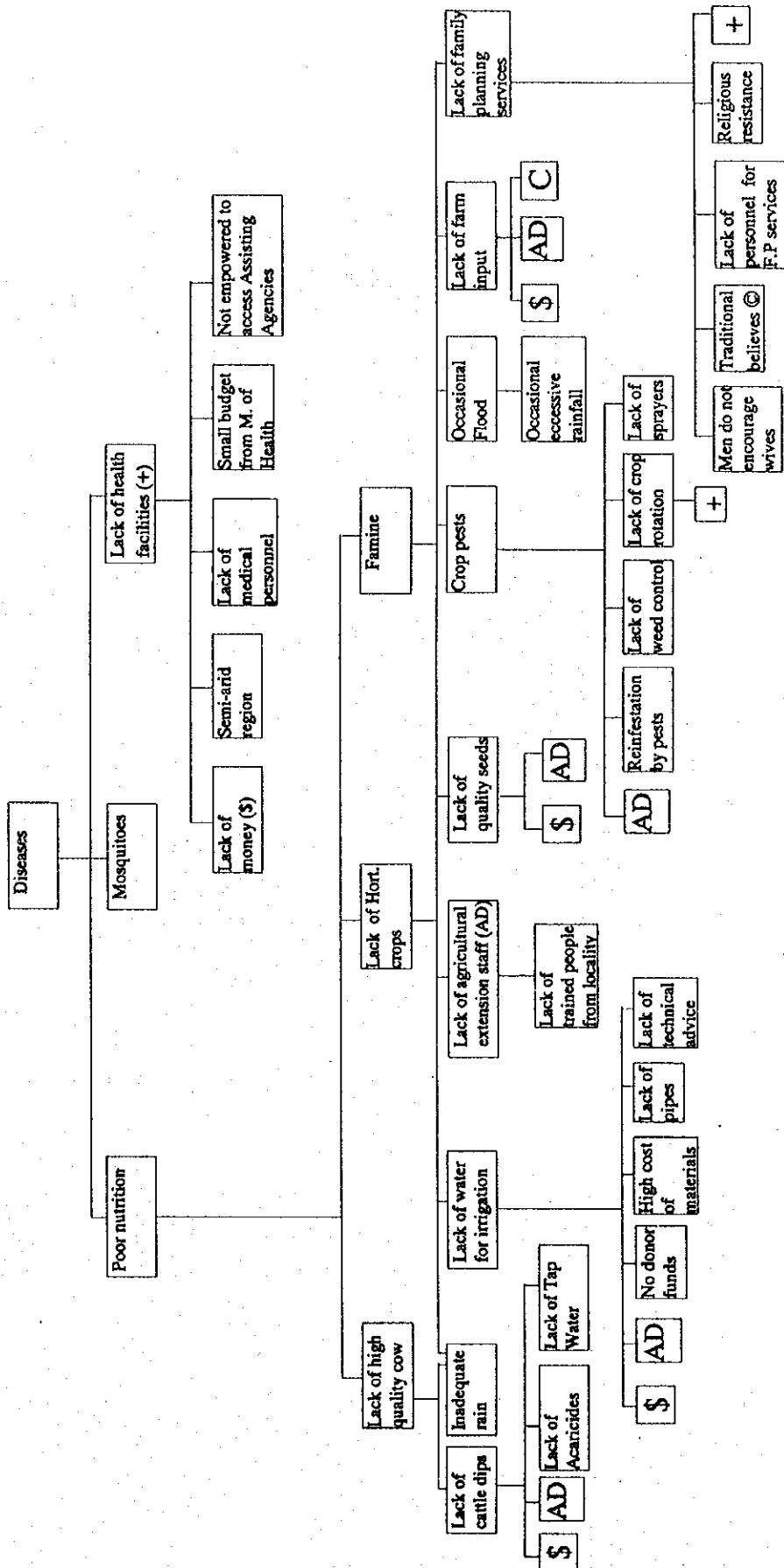


Figure 4.1-3 Problem Tree for Ruungu/Karocho Irrigation Project



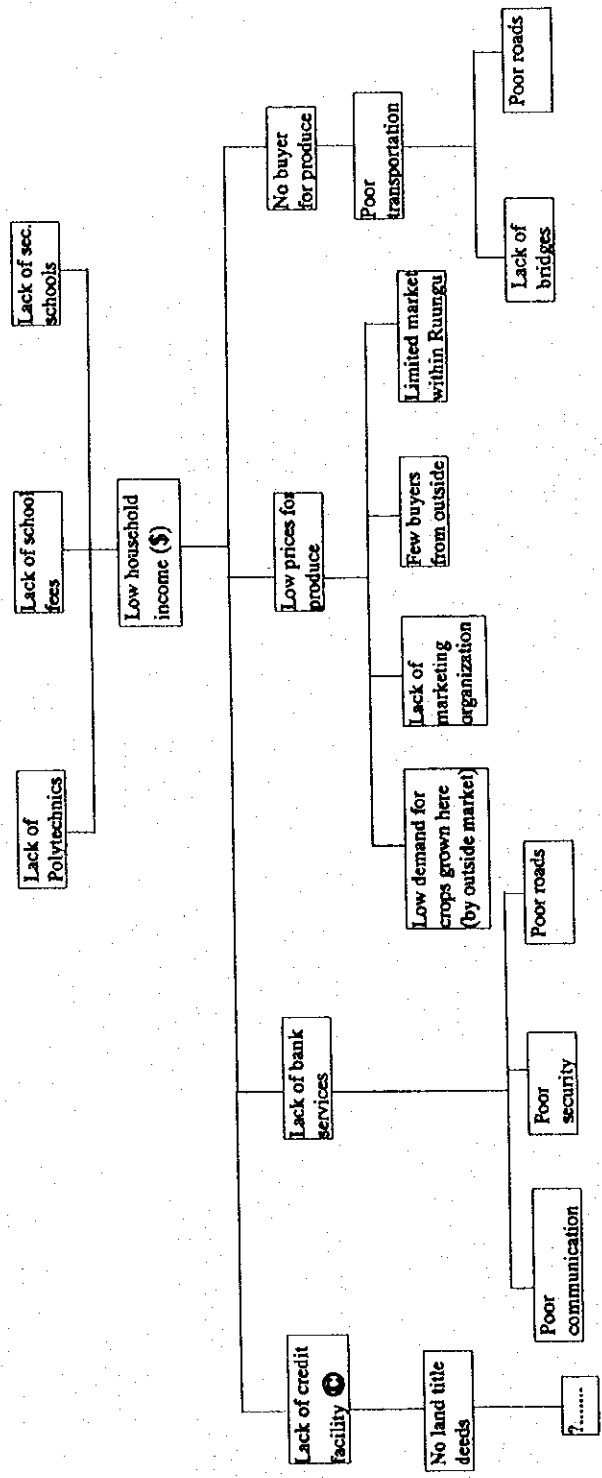
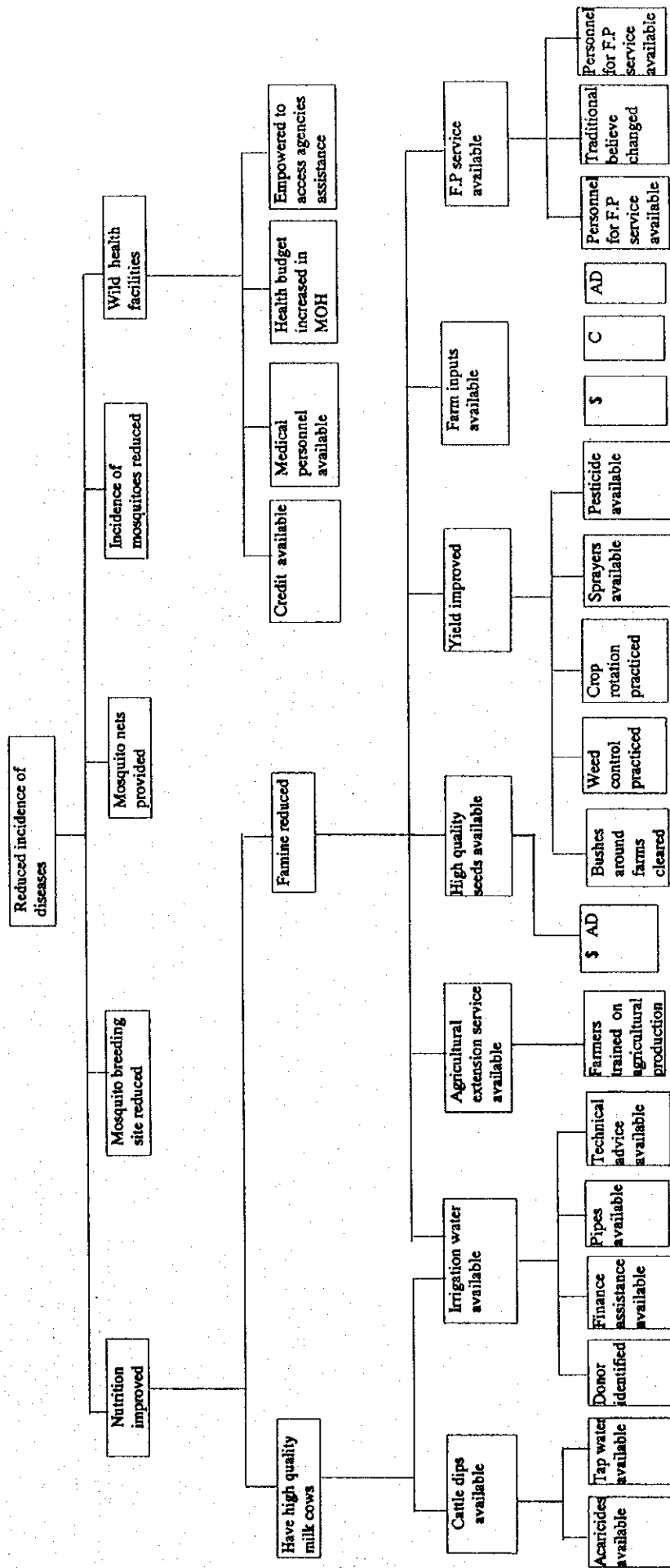
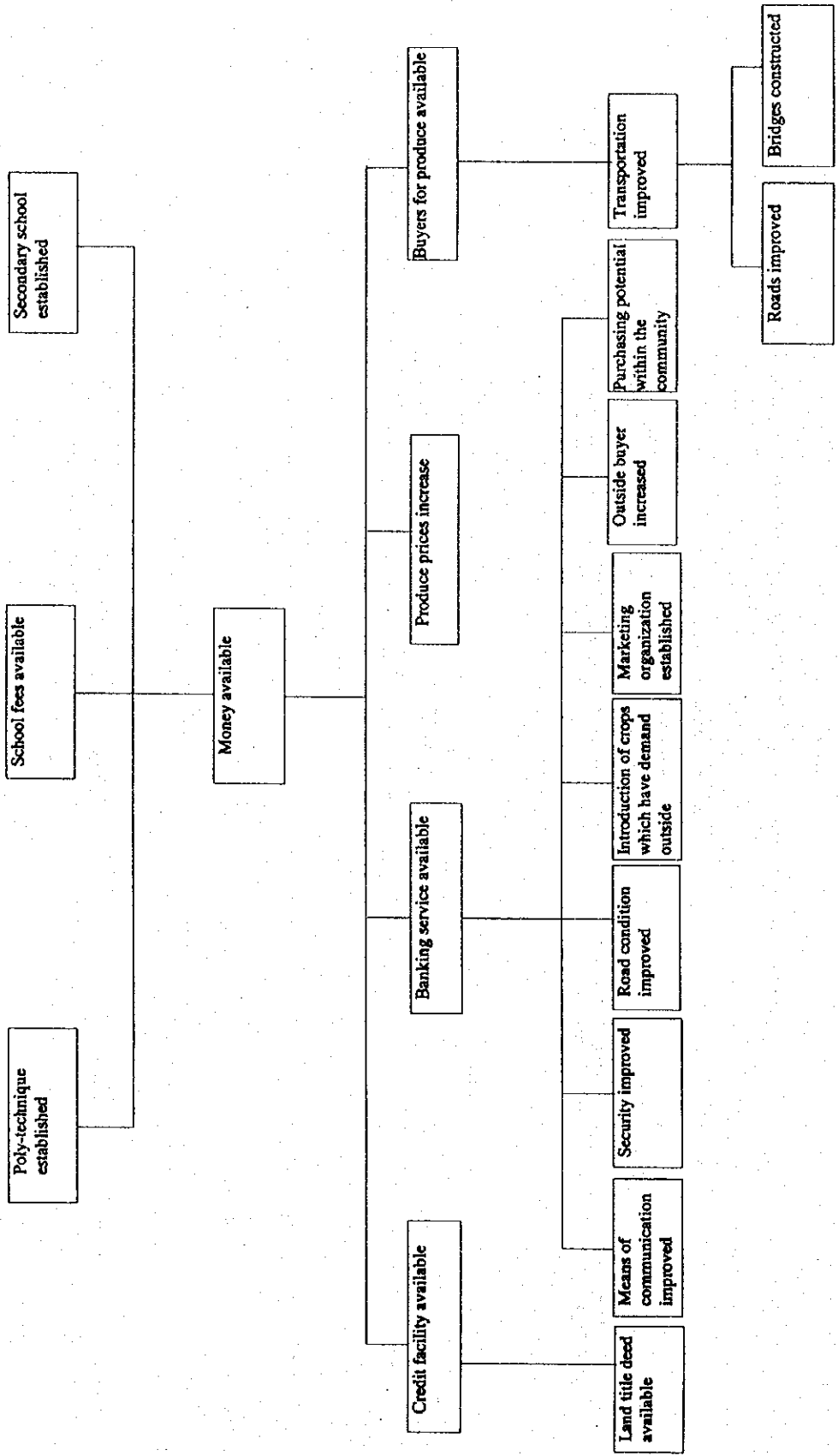


Figure 4.1-4 Objective Tree for Ruungu/Karocho Irrigation Project





- Prioritized Present Problems;

Diseases

- ├── Poor Nutrition
- ├── Mosquitoes
- └── Lack of health facilities

Low household income

- ├── Lack of credit facilities
- ├── Lack of bank services
- ├── Low price of produce
- └── No buyer for produce

- Overall Goal : Increased yields
- : Better nutrition
- : Uplifting living standards
  
- Project Purposes : Sufficient irrigation water available
- Results/Output : Organization in place
- : Prepare design with technical experts
- : Donor identified
- : Money available
- : Qualified contractor identified
- : Pipes and building material available
- : Intake installed
- : Canal system installed

**4.1.16 Present Problems, Constraints and Development Potentials**

1) Present Problems and Constraints

a) Rural Community

For the people in this Area, the burden of the cost of new irrigation facilities and the difficulties of new experience in production management of irrigated agriculture and marketing of new products are beginning to start. However, they have their many kinds of potentialities which were expressed in PCM workshop. The necessity of integrated rural development program to meet their possibility must be supported to this irrigation scheme. Public works for bridges and communal roads to market areas would be necessary. Public trial and demonstration farm for testing appropriate cropping pattern must be necessary. Jiko improvement would be helpful for the women collecting firewood. Many kinds of mini-projects would be planned so as not to waste their challenging endeavor for survival. Their success would encourage the other people who are suffering from similar situation to this Area. Appropriate integrated public support should be expected to realize.

b) Crop Production

The yields and cropping in the area are strongly influenced by the limited, unpredictable rainfall and the low soil fertility. The fertility of the soils is rather poor, due to the low organic matter content, the

low cation exchange capability, and the low base saturation. The high temperatures accelerate the breakdown of the organic matter in the soil. At this lower elevation, the lower rainfall combines with the high temperatures, the inherent low fertility and the permeability of these soils to make rainfed crop production much more precarious than in the higher elevations to the west. These soils tend to be less friable and more compact, and may seal, reducing infiltration rates and increasing runoff and erosion. Salt accumulation may be a problem under irrigation. The difficult road conditions limits access to inputs and markets. The restricted access to the area means that input prices are higher and sale prices lower. The irrigated area is also scattered around, with only limited production volumes possible at each cluster of irrigated sites.

### c) Marketing

As the result of PCM workshop, the following problem tree was (refer to Figure 4.1-3) suggested in marketing sector:

- Lack of polytechnics, Lack of school fees & Lack of secondary schools

- Low prices for produce

• Low demand for produce grown here (by outside market)

Farmers are seeking for measures to create the demands by number of buyers from outside. Current growing produce such as pigeon pea, cow pea, finger millet, bulrush millet, green maize and green gram are seasonally demanded in Gakoromone wholesale market even without introduction of new crops. Especially, finger millet can be strategic cash crop for Gakoromone wholesale market due to high trading prices. After irrigation is applied, the ripe banana of Giant Cavendish and Lactatan varieties are recommendable due to higher prices and resistance to Panama disease. Pusa Sawani variety of okra and Anaheim M or Fresno varieties of chilli for export can be grown, but it is risky without arrangement of continuous transport to Mitunguu.

• Lack of marketing organization

The prices of local produce such as millets are 1:2:3 times comparing to farm gate in the Project Area, Mitunguu market and Gakoromone wholesale market, in the other hand the produce of upper side of Meru District are priced at 3:2:1 times such as potato and onion. It is required to approach to upper stream of distribution route and to purchase inflow produce in a lot meeting to villagers' requirement. For this Project Area, the formulation of marketing organization can be focused on the transporting arrangement.

• Few buyers from outside

For traders, the bad road conditions hinders them to arrive in the Project Area. The area can be isolated during heavy rain seasons. But if farmers can efficiently carry produce to Mitunguu by bicycle or foot, marketing alternatives can create to retailers in Mitunguu market, traders/middlemen and retailers/wholesalers in Gakoromone wholesale market and exporters/middlemen coming Mitunguu town.

• Limited market within Ruungu

The average income counted at 19,200 Ksh/year/household equivalent to one third of Nyangati farmers, but the daily living necessities prices are on quite high level due to transport costs. In spite of apprehension of famine, the farmers give high priority to send children to primary or secondary schools and entrust future to children. In these circumstances, farmers don't have purchase power in the community.

d) Agricultural Credit

It was clarified that no farmers have title deed in this area. The reason seems that land of Ruungu/Karocho is categorized as the trust land which is under the control of county council. Although banks require collateral to avoid risks in their credit system, the farmers cannot use credit under the existing system. Ministry of Land and Settlement is required to survey individual lands in cooperation with the county council to promote publishing title deed.

While, the banks should enlighten farmers on group basis to educate them to make them understand fundamental information of financial system such as the principal, interest and repayment period etc. On the occasion, DAO staff also must participate and the important things to be considered is to pay attention to educational status of farmers.

e) Farmers' Organizations

The existing problems and potential of the three significant farmers organizations are outlined as follows;

Problems and Potential of main Farmers' Organizations

Type of Organization	Main problems	Potential
Water User's Association	<ul style="list-style-type: none"> <li>- Inability to get another funding agency after the Cooperative Bank change its mind</li> <li>- Insufficient capacity to raise finance for paying contractor owing to low member incomes</li> </ul>	<ul style="list-style-type: none"> <li>- Current organization strength provides basis for future irrigation operation and management</li> </ul>
Women Groups	<ul style="list-style-type: none"> <li>- Unable to make long term plans because groups tend to be short lived (up to 2 years)</li> </ul>	<ul style="list-style-type: none"> <li>- Offers entry point to women oriented interventions</li> </ul>
Bore-hole Groups	<ul style="list-style-type: none"> <li>- Still maintains some dependence on SIDA support</li> </ul>	<ul style="list-style-type: none"> <li>- Offers demonstration regarding advantages of group action</li> </ul>

f) Agricultural Extension Services

Provision of extension services by the Ministry of Agriculture are presently constrained by a number of problems as summarized as follows;

## Problems and Potential of Providing Extension Services to Ruungu/Karocho Project Area

Type of Problem	Assessment of Problem Severity	Potential of Existing System
- Ineffective supervision of Front-line Extension Workers (FEW) by divisional and district staff	XX	- Provide framework for channeling skills and improved technologies on irrigated horticultural production
- Lack of office space, transport and financial facilities for newly deployed district and divisional staff	XXXX	
- Inadequate relevant technical packages for use by the project community	XXXX	- Has mechanism for co-ordinating support inputs by other agencies (government, NGOs, Private) to the project community
- Insufficient work plans and performance indicators	XXXX	
- Lack of farmers confidence in extension staff	XX	- There already exists a pool of technically trained personnel whose capacities can be easily improved to provide necessary support services to the project community
- Poor motivation of field extension staff	XXX	

Note: XXXX = Very severe; XXX = Severe; XX = Substantial

### g) Water Resources

- Recommended water by District Water Office for irrigation does not meet actual requirement

### h) Irrigation and Drainage

- Construction work has been suspended
- Canal length is so long in relation to the acreage to be irrigated

### i) Agriculture and Rural Infrastructure

- Construction of irrigation facilities has been suspended in the middle of works.
- A damaged intake weir have to be repaired or re-built.
- Access roads from B6 national trunk road to the Area need rehabilitation and construction of stream crossing structures.
- Village/farm roads need rehabilitation at sections where hollows and gullies are found.
- There is no electric power supply in the Area.

### j) Farm Economy

As mentioned above, farmers in Ruungu/Karocho Area are under the severe standard of living, living on income lower than poverty line. Though there are several hand-pumps for domestic water use, no irrigation water is available at present. The poverty in this Area is caused not only by no irrigation water but also its location in arid zone. But it is clear that the most serious problem in agriculture is the lack of irrigation water. The farm economic survey ranked the projects for which people desire to implement thus; i) irrigation facilities, ii) marketing road, iii) village road, iv) school, v) agricultural credit, etc. It can be



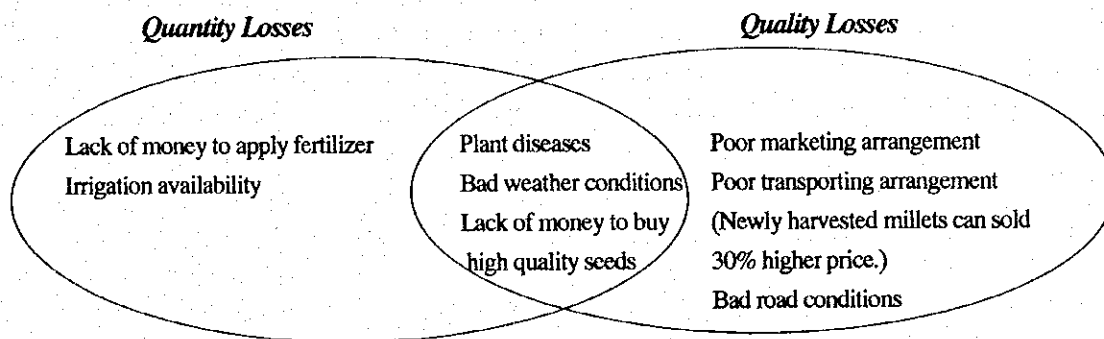
understood from this ranking that farmer give highest priority on the construction of irrigation facilities. Large impacts on farm economy could be expected by the implementation of the small-scale irrigation project in Ruungu/Karocho Area.

k) Animal Husbandry

The quality and quantity of the forage produced on the poor soils and limited rainfall found in the Project Area is poor. The nutritional status of the cattle at the end of the dry season is quite low. Tick borne diseases are prevalent in the study area, and facilities to dip cattle, or spray races are not found.

l) Post-Harvest and Agro-Industry

The post-harvest losses for horticultural produce are caused by the following issues.



The agro-industry near the Project Area is cotton ginnery, but the buying price is decreasing and it can not meet the costs of inputs.

m) Environment and Rural Life

According to the EIA Survey, there will be some negative impacts due to the project implementation including change in river flow regime, water quality deterioration and increase of water-related diseases. However, these impacts would be minor considering the small size of the scheme.

According to the Problem Analysis of PCM, the top of problems shown by farmers was famine and next, diseases, lack of health facilities and medical personnel, poor nutrition, occasional flood, lack of family planning services and lack of tap water were given.

Further, this area has the following problems:

- The cooking stoves being used in the Project Area are mainly three stones and it waste more than 30 percent of firewood compared with the improved cooking stove.

- The top disease reported in Ruungu Dispensary is Malaria and the second is intestinal worms. The reason of intestinal worms may be the drinking of unboiled water, no washing of hands before eating, etc.
- At present, farmers keep some fallow plots in their farmlands. However, the fallow plots have been changed to crop fields from year to year without shifting cultivation and this is increasing the deterioration of soil fertility as farmers can not input manure.
- Agrochemical use will increase by the development of horticulture.

## 2) Development Potentials

### a) Land Use and Crop Production

Ruungu has limited development potential for a number of reasons: it has a harsh arid climate; a poor road system, which limits access to inputs and markets; and limited soil fertility. It does have the advantages of a relatively large area of farmland and a low population density, which means that a high percentage of the existing area is available for rough grazing. One of the major restrictions to increased crop production at this site is economic. The market access severely limits the range of potentially profitable interventions at this site. Certainly improvements in crop husbandry, such as spacing, pest control, efficient irrigation application and the use of improved varieties are some potential sources of increased yields. However, using the new irrigation to increase the total food crop production for home consumption is clearly the priority here. There is also some potential for tobacco production assuming contracts can be arranged with the local factory, who will remove two of the key constraints, by supplying inputs and extension advice to their farmers, and guaranteeing a market. Onions and chillies are two potential crops that can be stored for a period until a buyer is available, or transport can be found.

### b) Marketing

#### Short-cut to Mitunguu town

Mitunguu is the most close township from the Project Area using short-cut of 8km distance. But it is impassable by vehicle presently. Marketing groups may be required to arrange transport means by labour or bicycle.

Comparison	By foot	By bicycle	By vehicle (pickup)
Required time			
(Ruungu-Mitunguu)	2 hrs	1 hr 30 min	2 hrs 30 min
(Mitunguu-Ruungu)	1 hr 45min	50 min	2 hrs 20 min
Maximum loading			
(Ruungu-Mitunguu)	30-40kg	30kg	1,500-2,000kg
(Mitunguu-Ruungu)	40-50kg	60kg	1,500-2,000kg
Cost	2Ksh/kg	2Ksh/kg	10-20Ksh/kg
Occasion	Available	Available	Rarely available

### Possibility of outflows of produce to Mitunguu market or Gakoromone wholesale market

The commodities mainly from outside are sold at Mitunguu market on marketing days, and marketing chances for local produce are comparatively lower due to same produce and harvesting season at farms around Mitunguu town. GTZ had implemented irrigation schemes projects nearby Mitunguu and many exporters and middlemen are buying Karella, Okra, Aubergine, Tindori and Avocado for export, and Kampala and Israel varieties of ripe bananas, papaya, kale, cowpea, green pigeon pea and sweet potato for local consumed produce. At Gakoromone market, finger millets are trading at high prices at 176 percent of Nairobi in 1997/98 average due to large loading to the northern ASAL areas and high demands for porridge for Meru town inhabitants. In order to link with the market foreseeing to consuming areas, the possession of antenna shop facilitated with storage function at Mitunguu can be a strategic measure for marketing groups. At the shop, marketing group can choose the outflow to retailers at Mitunguu market, wholesalers/retailers at Gokoromone markets with the transporting arrangement and other traders. They can transport produce to the antenna shop on return trip after achieving transporting arrangement, and then selling at Mitunguu market and provide purchased produce to member farmers at cheaper prices.

### Transactions of several exporters in Mitunguu area

After skillful arrangement to the Mitunguu antenna shop, the planning of export produce of Asian vegetables such as karella, okra and ravaya can be one of income generation to trade exporters.

### Road improvement plan between Meru and Mitunguu

This road C92 has been selected to be improved with high priority by assistance of World Bank. The increase of frequency of transporting opportunities and easiness of transport during rain seasons may become a reality.

### Cashewnut production

Presently producing cashewnuts have lower fat contents. It is necessary to introduce new varieties and apply fertilizers. Increasing demands of shelled nuts (unprocessed), liberalization of marketing and closer distance from Nairobi than main producing areas in Coastal Province contribute to the potential for this crop.

### Haranbee among community

The living or surviving conditions in Ruungu are comparatively hard. It makes interdependency and consensus of self-help (*haranbee*), which make it possible to construct wooden bridge by Ruungu people crossing Thingithu river.

#### c) Water Resource

- As a water source of irrigation for the scheme, the water resource of the Thungithu river is available.

d) Irrigation and Drainage

- Effective water management in the irrigation system will be possible by farmers training on irrigated agriculture and water management.

e) Rural Infrastructure

- There is an access road to the Area from classified roads network although it needs improvement.

f) Animal Husbandry

A number of beef and the occasional dairy cow are kept in the area. Increasing their stocking level substantially on the existing grazing is not realistic. The main increases in yield will come from disease control (especially of tick borne diseases) and improved nutrition. Supplying urea blocks, assuming they are available locally, especially in the dry season should improve the productivity of the local cattle. The private sector is providing no services to the Project Area currently. Irrigated forages such as napier can be grown using the irrigation water, and residue production will increase with irrigation. Increased attention to integrating cattle into the cropping system, improving their nutrition and using their manure for soil fertility management would certainly pay dividends, but will be very difficult to implement given the remote nature of the site.

## 4.2 Development Plan

### 4.2.1 Objectives and Components of the Project

#### 1) Objectives of the Project

Current dominant farming type of the Ruungu/Karocho Irrigation Project, which was classified as Type-E in Model Area selection, is consumption-oriented farming mainly planting food crops. The beneficial farmers are requesting that present farming type will be shifted to food crop planting for stable food supply accompanied with livestock grazing in the Area. The Area has no irrigated land, although irrigation facilities are under construction. These situations cause poverty with famine occurring in some frequency.

Under such situation of the Project Area, development objectives of the Project are presented below in terms of short and medium/long-term objectives;

#### Short-Term Objectives

- To stabilize and raise the rural life of beneficial farmers with introduction of small-scale irrigation system for the proposed irrigation area for 68 ha, improved farm management of sustainable food and horticultural crops, that is, along with the development programme to improve the cattle production, development of any locally tested dry-land crop varieties such as sorghums, bulrush millets, short season maize, pigeon peas, green gram and cow pea for food crops, and tobacco, Asian vegetable and sweet potato for horticultural crops, organization of small-scale farmers of 164 households, and sustainable assistance and support by related government agencies, NGOs, private sectors, etc.,

- To raise-sufficiency of food for farm household in the Area by increasing in food production,
- To establish and strengthen farmer's organization, that is, irrigation groups, marketing groups, women's groups, cooperative societies by providing educational training by related government agencies, NGOs, private sectors, etc.,
- To develop productive lands by providing small-scale irrigation and drainage facilities such as intake facilities and irrigation and drainage canals with related structures, and rural infrastructural facilities of 3.0 km of village/farm roads,
- To strengthen productive activities by developing agricultural and institutional support services, such as the provision of necessary post-harvest facilities mainly focussing on food crops, implementation of training to farmers, strengthening of extension services to farmers' group, cooperative organization, introduction of farmers' capability building programme, development of livestock raising, etc., and
- To improve the rural environmental by providing access roads (route C92 and E788) and rural road improvements, etc.

#### Medium/Long-Term Objectives

- To alleviate poverty and improve welfare conditions of smallholder beneficiaries by raising living standard and giving them opportunities to increase their incomes by means of increase in food production and stabilization of food supply to the local peoples through the improvement of rainfed agriculture and introduction of irrigated horticulture as well as improvement and/or provision of the necessary agricultural infrastructures and services, and
- To raise farmer's capability to manage rural society by providing continuous educational training.

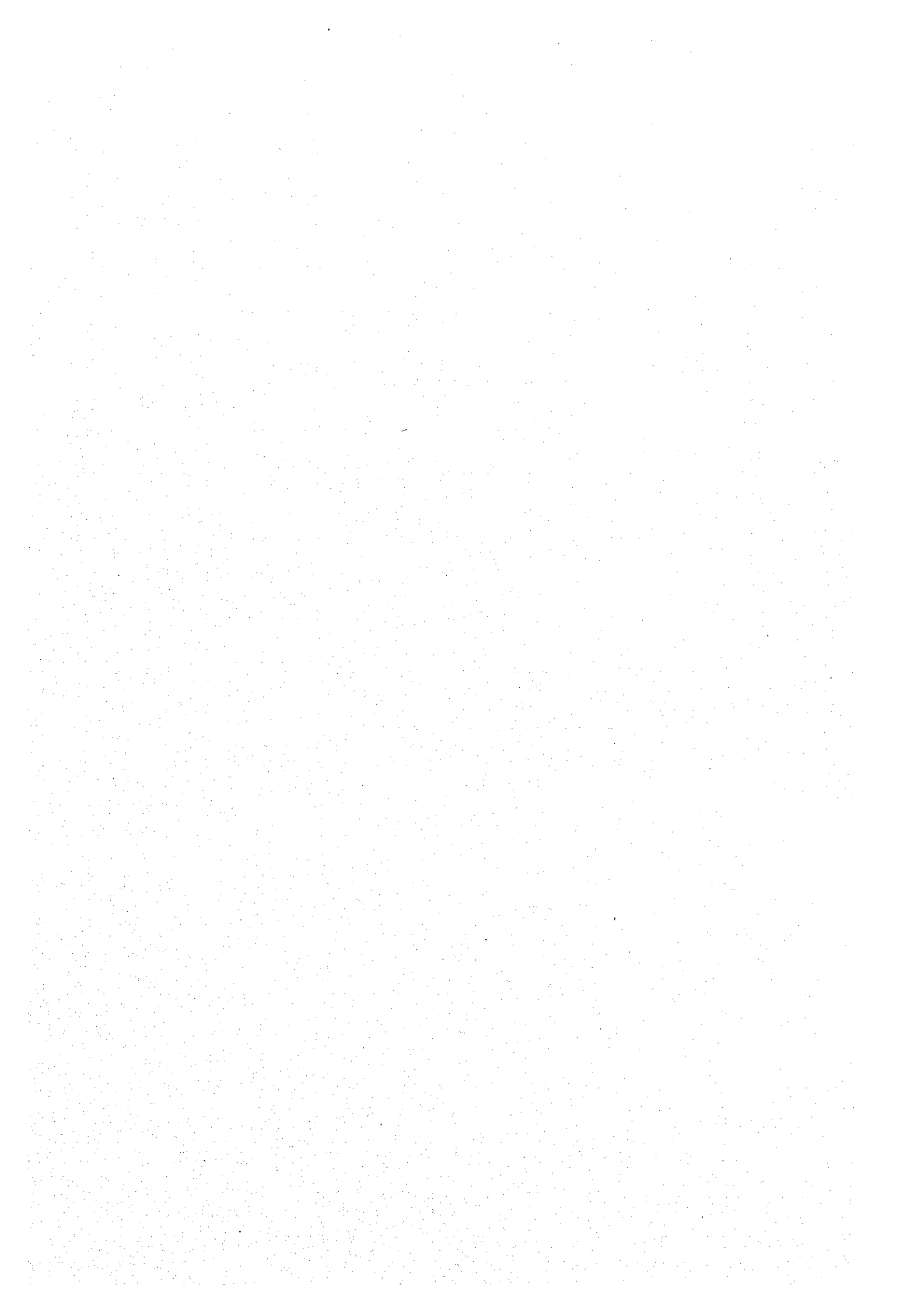
#### 2) Components of the Project

The project components for the Ruungu/Karocho Irrigation Project are planned as follows;

- Formulation of irrigated food and horticultural development plan such as land-use, crop selection, and development of animal husbandry, considering the conditions of flat topography with altitude of about 700 m above mean sea level, and semi-arid climate conditions with average annual rainfall of about 850 mm,
  - Provision of adequate extension services and trial/demonstration farms,
  - Undertaking of animal husbandry development,
  - Provision of educational training on water management, farm management, agricultural credit, marketing, processing, etc.
- Establishment/strengthening of farmers' organization and promotion of agricultural support services,
  - Establishment and strengthening of farmers' organization (irrigation groups, cooperative societies, women's groups, marketing groups, etc.)
  - Provision of educational training on group management, marketing, O&M of irrigation facilities,

- Environmental considerations,
  - Improvement of health and sanitation of local peoples inclusive of countermeasures for anti-malaria, training on appropriate utilization of agricultural chemicals including the systems of maximum residue levels (MRLs),
  - Environmental monitoring and evaluation
- Construction and improvement of access roads,
  - Construction and improvement of access roads to the Area,
- Development of agricultural and rural infrastructures,
  - Development of smallholder irrigation systems by means of improvement of intake facilities, irrigation and drainage systems and farm/village roads,
  - Development of rural roads,
- Development of post-harvest and agro-industry facilities,
  - Provision of agricultural equipment, post-harvest and agro-industry facilities focusing mainly on food crop production,
- Social capability building and institutional strengthening programme,
  - Undertaking of village, district agricultural office (DAO) and other local agencies consultations,
  - Formation of technical working committee (TWC),
  - Social preparation for the communities,
  - Strengthening of institutions of IDB and other local agencies,
- New construction of marketing facilities,
  - Construction of antenna shop/storage
- Monitoring and Evaluation of the project
  - Irrigation system operation
  - Access and village/farm roads maintenance
  - Agricultural aspect
  - Institutional aspect
  - Marketing aspect
  - Farm economic aspect
  - Control of soil erosion and watershed management

Figure 4.2-1 indicates the development concept to attain overall goals of the Project, which was formulated based on the study results so far made.



Relationship between Hard and Soft Aspects to Attain Goals  
- Ruungu/Karocho Irrigation Project -

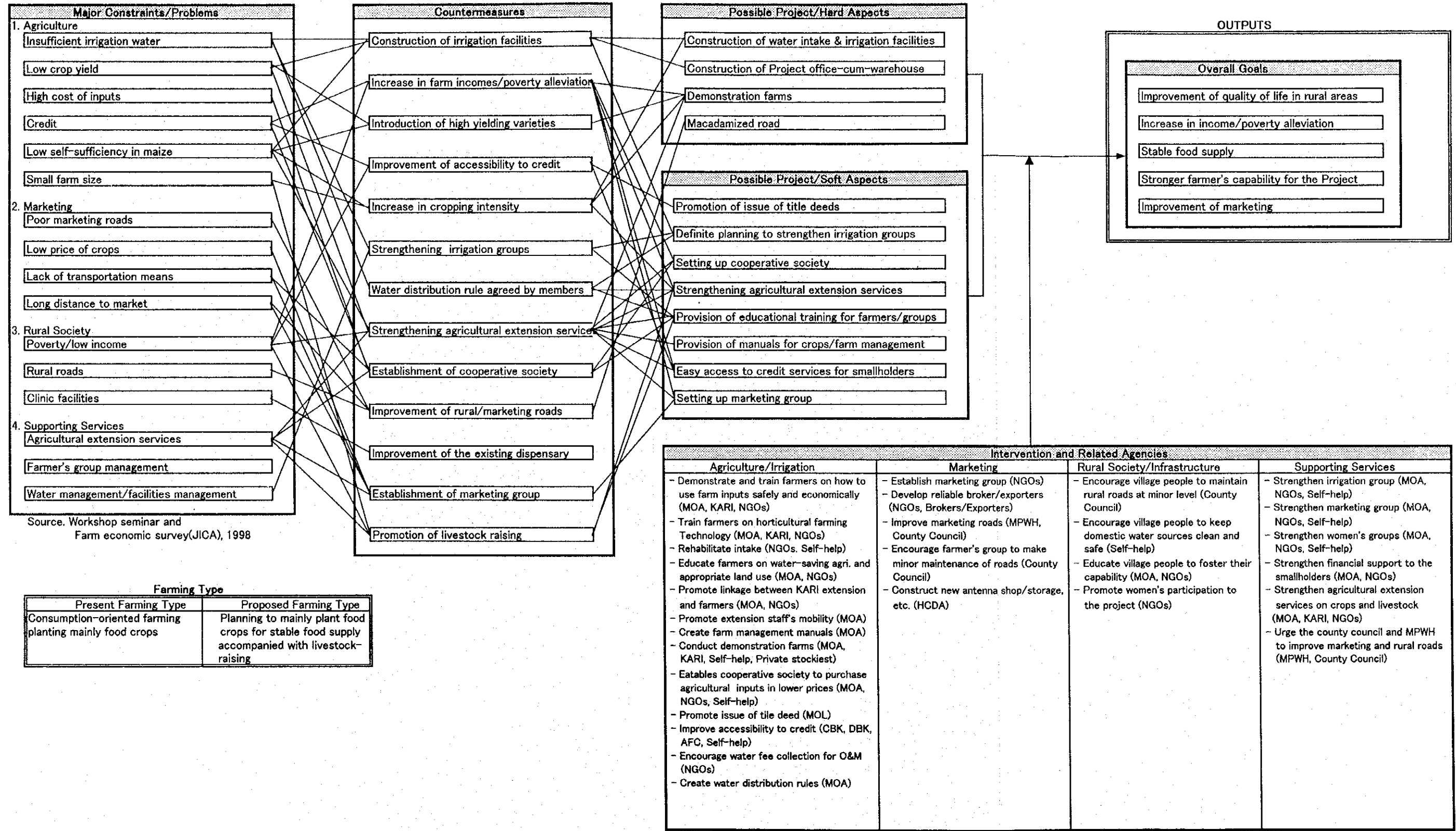
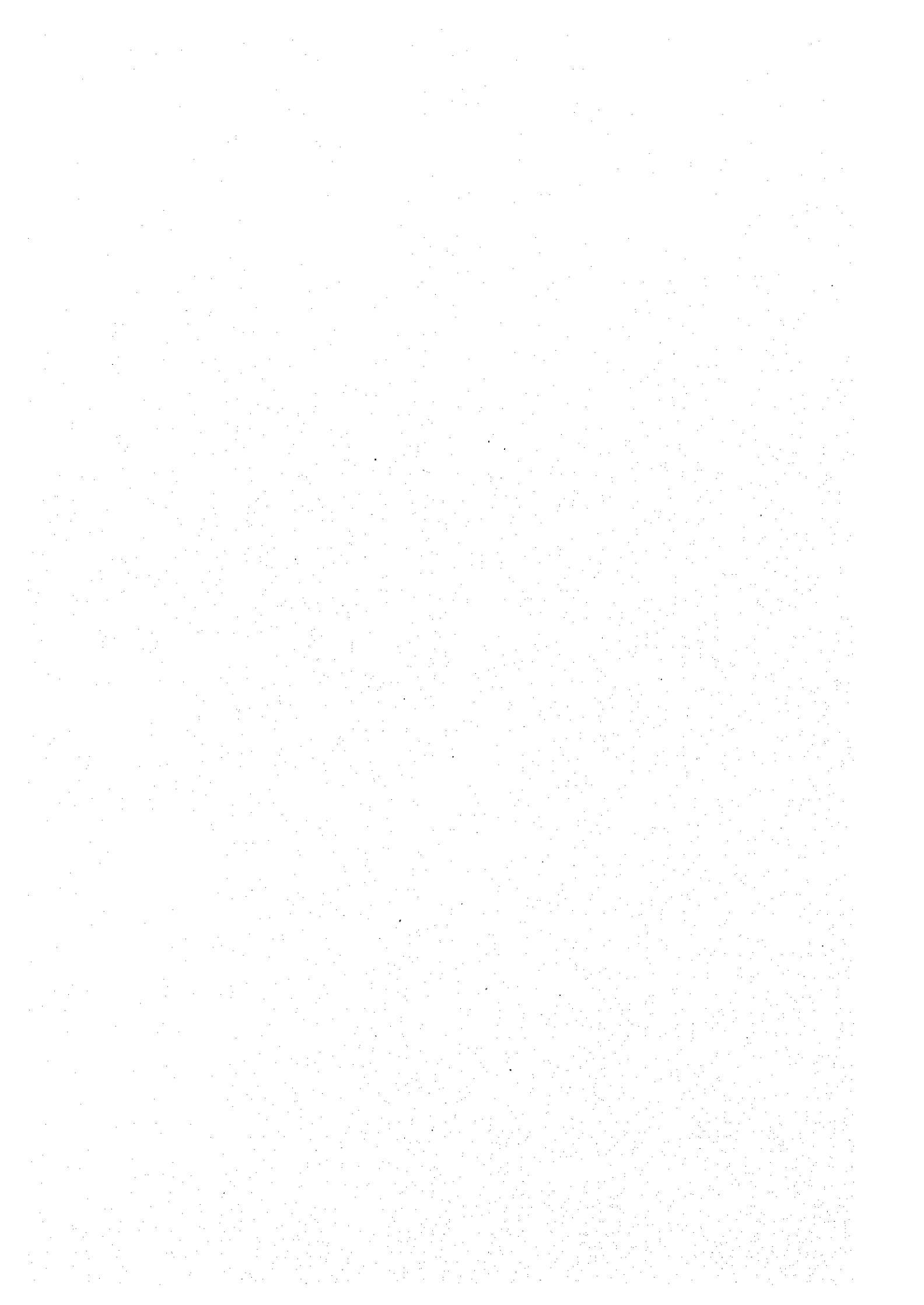


Figure 4.2-1 Relation between Hard and Soft Aspects to attain Overall Goal





#### 4.2.2 Community Capability-Building up and Institutional Development Plan

Irrigated crop production in Ruungu/Karocho Project Area can only be sustained if the project community is effectively involved in all the stages of the irrigation project cycle. Already, the project community has demonstrated its commitment to the project by contributed their 15 percent share of the project cost both (in cash and materials) and by excavating the bigger part of the main canal.

During the feasibility study, the local community participated in a one week workshop which analyzed problems as well as objectives and defined a preliminary project design for implementing their project. It is now planned to increase the capability of the local community so that they can undertake the following project tasks;

- More detailed planning of the project
- Participating in the technical re-design of the intake
- Planning and mobilizing funds for implementing the remaining elements of the project
- Implementing the project
- Operating and maintaining the resulting irrigation system
- Producing food and cash crops on a profitable and sustainable basis

For the community to acquire and up-hold the capability to carry out the above tasks, continued support services will need to be given by the MOA and relevant GOK agencies as well by NGOs and the private sector. Hence, it is planned that the capability of these institutions be built up simultaneously with that of the project community.

What follows, then, is an outline of how this capability building will be effected.

##### 1) Community-Capability Building Plan

###### a) General Social Preparation Plan

The project community has already undergone a series of social preparation session in readiness for the Cooperative Bank irrigation loan. It is therefore suggested that, at the beginning of the new project cycle, the Project Area will only require two days session to take stock of their experience and lay the ground work for the new project.

In line with the recent policy shift in extension policy, where MOA will increasingly collaborate with the private sector and NGOs, it is planned that the social preparation exercise will be facilitated by the joint effort of MOA staff, a private consulting firm or NGOs experienced in PRA and PDM approaches .

###### b) Capability-Building Plan for Farmers Organization

There are three types of farmers organizations (two existing and one to be promoted) that will make a contribution towards the irrigation project's implementation and sustenance. These farmers' organization will need to be developed and strengthened as summarized as shown below;

## Development and Capability-Building Plan for Farmers' Organization

Name of Farmer's Organization	Proposed Development Plan
WUAs	<ul style="list-style-type: none"> <li>- Educate WUA members on requirements and implications of the intended irrigation system including the need for electing capable leaders to the management committee</li> <li>- Facilitate the community in updating the PDM which they have already prepared making modifications as necessary</li> </ul>
Women's Groups	<ul style="list-style-type: none"> <li>- Train management committee on organization, leadership, general and financial management</li> <li>- Training on proposed irrigation development including review of PDM</li> <li>- Training in organization, general and financial management</li> <li>- Inviting and involving women's groups in reviewing technical irrigation design (engineering and agronomic) particularly from view points of labour and irrigation benefits as well as their perceived role and preferences</li> </ul>
Production /Marketing Groups	<ul style="list-style-type: none"> <li>- Promote formation of neighborhood production/ marketing groups and train them in organization, general management, marketing, accounting, and financial management</li> <li>- Training in sourcing and collation of market information as well as production planning in relation to market opportunities</li> </ul>

### 2) Development and Capability-Building of NGOs (SISDO)

SISDO, which is a national NGOs, is already operating in the Project Area. It is recommended that the NGOs continues giving support to the project farmers i.e. strengthening farmers organizations, intermediating in credit delivery) so long as it agrees to the following conditions;

- Identifies a specific team of field and office staff who will be responsible for providing support services to Ruungu/Karocho Irrigation Project
- Maintains a separate operational account for support services related to Ruungu
- Accepts a re-structuring of its management and financial accounting systems with the aim of reducing operational costs, making loan packages more farmer-friendly and creating a basis for long term sustainability of SISDOs lending operations
- Facilitates training of office and field staff earmarked for Ruungu in skills relevant to SISDO's as a provider of support services to the project's farmers' organizations.

In the first instance, it is proposed to provide field and credit administration staff with appropriate training in the following areas;

- Community organization techniques
- PRA approaches
- Leadership and management structures
- Credit administration methods
- Financial management and accounting procedures

### 3) Tapping Services of Other Agencies in Undertaking Social Preparation

All rural self-help activities are initially promoted and registered by the Ministry of Cultural and Social services at the district level. However, the ministry does not usually carry out after-registration follow-up. Yet at the district level, this ministry has personnel who are professionally qualified to contribute to social preparation of the local community on development matters.

It is therefore planned to encourage a co-ordinated approach between the MOA and the Ministry of Culture and Social Services during the initial social preparation workshop as well as in establishing and strengthening existing farmers' organizations.

#### 4) Establishment of Institutional Mechanism for Social Preparation

Since MOA/IDB will be promoting other group-based farmer-managed irrigation schemes elsewhere in the country, it is proposed that it assigns a serving member of its staff to be responsible for social preparation and community mobilization nationwide. In this regard, it is planned that the appointed member will acquire on-the-job skills in PRA and PDM and later attend the short PRA course offered at Egerton University.

Once deployed, it is expected that this staff member will, in future, facilitate one day annual participatory reviews of irrigation activities at Ruungu/Karocho Project Area which will be held during the off-season of the agricultural calendar. These annual reviews should include other stake-holders i.e.

- Community members from within the Project Area
- Personnel from SISDO as well locally based NGOs, relevant ministries such as MOA, Culture and Social Services, Public Works, Water Development etc.
- Private sector produce buyers and local in-put stockists

Using the existing PDM, the review will highlight achievements and failures and pin-point accountability for undertaking various follow-up activities. The expected outcome of these annual reviews is to re-inforce the community's confidence and commitment in their capacity to diagnose and confront their problems while at the same time expecting mutually agreed support services from other stake-holders.

#### 5) Strengthening of IDB Field Offices

During the entire project cycle, IDB field offices will be expected to render support services as summarized below;

- Facilitation of social preparation & capacity building for farmers' organizations
- Technical advisory services on irrigation design, tendering, construction, operation and maintenance
- Agricultural extension services on horticultural production and marketing

For them to effectively render the above support services, IDB field staff will need to have a number of operational skills (technical, economic, sociological and managerial). Hence it is proposed that staff of IDB field offices (at district and divisional level) will be strengthened by exposing them to a training regime that will include;

- Communication and social marketing
- PDM and PRA techniques
- Participatory extension approaches
- Organization and leadership training

This training will be in the form of one week workshops facilitated by IDB headquarters staff in collaboration with consultant from the private sector or NGOs. Together with availing of office and field equipment, this training should enhance the capacity of IDB field staff in providing expected support services.

6) Institutional Strengthening of District Agricultural Offices

a) Consultation with District Agricultural Office (DAO)

The District Agricultural Office will play a crucial role in;

- Facilitating social preparation sessions
- Co-ordinating in-puts of other local level agencies (government, private sector and NGOs)
- Providing technical advisory services to the farming community during various stages of the project cycle (design, construction, operation & maintenance, production and marketing)

In this regard, the Project Co-ordinator at IDB Nairobi office will make the necessary consultations with the District Agricultural Office with regard to the project plan and its implication on staff time and technical inputs.

b) Incorporation of Project Support Requirements into DAO's Work Plans

Once fully established, the the Tharaka District Agricultural Office is likely to accommodate a number of subject matter specialists (SMS) whose skills will be required during implementation, operation and management phases of the project. Such skills include irrigation engineering, horticulture, soil conservation, farm-management, pesticide handling and marketing.

With a view to institutionalizing contribution of these specialists, it is planned that once a year, the relevant specialists make a joint technical visit to the project, diagnose operational problems and submit a report to the DAO on required intervention measures. The recommended interventions will then form the basis for support follow-up which will be incorporated into an individual specialist's operational work plan.

As part of this strengthening of DAO's Office, it is also proposed to;

- Deploy a suitable front-line extension worker (FEW) who will provide services to Ruungu/Karocho Scheme on an exclusive basis
- Install a modest field office (semi-permanent) within the Project Area, where farmers can make technical consultations with the extension worker, and whose cost will be shared with the farming community

## 7) Equipment and Facility Support

To facilitate the work of IDB field staff in providing support services to the project, it is proposed that the following equipment be availed;

- Two computers : one each to the district and divisional levels
- Two sets of soil augurs: one each to district and divisional levels
- One pH meter for divisional office
- One tensiometre for divisional office
- Three motor cycles: one for district office and two for divisional office

Availing of the above equipment will address transport and office facilities constraints currently facing extension services

## 8) Partnership with the Business Community

On the basis of the government commitment to promote increased role of the private sector in agriculture, it is planned to encourage linkages between project level institutions and the business community. The Ministry of Agriculture (IDB, DAO) will take the initiative in this respect by;

- Inviting private sector stakeholders to project level workshops or meetings
- Advising and training farmers and farmers organizations on how to develop beneficial partnerships with different elements of the business community.

### Planned Partnership between Various Institutions and the Business Community

Institution	Type of Business Partner	Nature of Partnership
MOA/DAO	Horticultural Exporters	- Common approach in farm chemicals application in order to comply with "minimum residue level" requirements (MRL) - Drawing of production/marketing contracts
	Farm Input Distributors	- Collaboration in staging field demonstrations and field days - Collaboration in holding local agricultural shows
	Local Input Stockists	- Specification of farm chemical types - Farm chemical stocking levels
WUA	Banks	- Banking facilities for members contributions
	Credit/Loan Institutions	- Availability of project implementation funds
	Contractor	- Installation of irrigation infrastructure
Production/ Market Gp. & Women Gp.	Horticultural Exporters	- Market access through production/marketing contracts
	Banks	- Banking facilities for members contributions and sales proceeds
	Local Input Stockists	- Group acquisition of farm inputs - Probable access to in-put credit or price discount
Individual Farmers	Horticultural Exporters	- Individual market outlet for produce with or without contract
	Banks	- Saving and withdraw facilities
	Local input Stockists	- Supply of farm inputs
	Broker/buyer	- Purchase of farm produce

9) Implementation of Capability Building Training Workshops

As part of a strategy aimed at building up the capacity of the farmer community as well as that of supporting institutions, it is planned to implement a series of training workshops over a period of 6 years. The phasing of the various training events is illustrated as shown below;

**Implementation Schedule of Capability-Building Training Workshops**

Training Event	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7
1. Social Preparation (Project Community)	■						
2. Internal Organization & Management (WUA Members)	■						
3. Project Planning & Implementation (WUA Members)	■	■	■	■			
4. Irrigation Operation & Maintenance (WUA Members)			■	■			
5. Organization & Management (Women Groups Members)		■	■	■			
6. Initiation, Internal Organization & Management (Production/Marketing Groups)			■	■	■	■	■
7. Farm Inputs & Credit facilities for Irrigation Farmers (Kibugu Cooperative Committee)			■				
8. Community Organization, Management & Credit Administration (Local NGOs Staff)	■	■	■	■			
9. Community Organization & Irrigation technology (IDB Field Staff)	■	■	■				
10. Community Organization, Extension Packaging & Delivery (DAO Extension Staff)	■	■	■	■	■		

**4.2.3 Land Use and Agricultural Development Plan**

The development potential and land use at a site is determined by a number of factors including; the soils, the topography, the climatic conditions, the present land use and the relative factor prices. During the PDM, the land users working in conjunction with the team helped identify the particular physical, social and economic possibilities and constraints at each location. What follows are the horticulturists recommendations for Ruungu based on his field survey of the overall situation at this site. An appropriate land use plan is very site specific, and contingent on the individual farm conditions and the current market conditions. The key factor for Ruungu farmers is likely to be the market conditions. The suggestions that follow will need modification to meet these particular conditions. Project staff should work closely with the Ruungu farmers to develop the most appropriate livestock development plan and a suitably modified cropping pattern.

The main overall problems on this scheme are likely to be the access to inputs and markets; the soil fertility; and irrigation management given the layout of the scheme.

#### 1) Land Use Plan

The land resources in the Ruungu/Karocho area are somewhat limiting. There is restricted access to both inputs and markets. The small areas of land to be irrigated are scattered over a large area. The soils are low in inherent fertility. Unreliable and insufficient rainfall will always continue to limit the rainfed agriculture. The climate is less of a limitation to irrigated agriculture, as the high sunshine hours and generally high temperatures are conducive to crop production, but the permeability and fertility of the soils will limit the impact of surface irrigation, and the economics of inputs and markets will limit the return to any investment. There is a large area of gently sloping land available, plus the current use of much of the crop land is a semi-permanent system with rotating furrows and shifting cultivation, this combined with moderately low population densities allows the possibility of opening up new land for irrigated agriculture if the economic constraints and the issue of access can be resolved.

Irrigation in the area is going to have a limited use for market production until the current road conditions are improved. Therefore, at least in the short run, the most probable use of any irrigation is likely to increase crop production for home consumption and some limited local marketing. Other influence of the poor road conditions is that providing technical training and supervision to the farmers, most of whom are not used to irrigation, is likely to be difficult. Government staff do not have the mobility or the incentives to visit remote sites like Ruungu. Introduction of intensive techniques and new technology has a high probability of failure. Therefore, the existing crops and land use has been changed only slightly. Many of the same grain and pulse crops that are grown now under rainfed conditions will still be grown, the main difference is that now they will receive irrigation water.

#### 2) Crop Selection and Cropping Pattern

The recommendations for Ruungu are to consider developing a program to improve the cattle production in the area, along with the wider distribution of seeds of any locally tested dryland crop varieties such as sorghums, bulrush millets, short season maize, pigeon peas, green gram, and cow pea that may be available from KARI and elsewhere. These crops are familiar to local farmers. A few new crops such as tobacco, Asian vegetables (such as ravaya) and sweet potato are also proposed.

Suitable fruit trees for the Ruungu area are cashew, guava, mango and tamarind. Farm forestry is another possibility. Suitable mixed use woodlot species include *Eucalyptus camaldulensis*, *Terminalia brownii* and *Melia volkensii*.

The main crop at the moment is maize, even though it is not suited to the climate and crop failures frequently occur. The area under rainfed maize is projected to remain the same, while a large new area of irrigated maize is proposed. Using irrigation on the maize crop is likely to go a long way to ensuring the food security of this area. Currently maize yields are unpredictable and low due to the constraints of rainfall. Even a small amount of supplemental irrigation could stabilize the yields of this preferred food grain and reduce the cropping risk. This expansion should be using the local composite varieties rather than hybrids,



and trials should be conducted to determine the best lines. Hybrids are not recommended for Ruungu for a variety of reasons; seeds are going to be difficult to acquire in the quantities needed; the soil fertility is likely to be limiting; and the irrigation management is likely to not allow the optimum plant populations. Millet is another important rainfed grain crop in the existing cropping pattern. This will continue to be grown. A small area of irrigated finger millet is likely to find a good market in Meru.

Green gram, pigeon pea and sorghum would continue their important role in the cropping system, with sorghum and pigeon pea as a solely rainfed crops as they are not particularly responsive to irrigation. Trials should be conducted of the dwarf lines of sorghum and the new varieties of dryland pulses from Kari to see how they perform under Ruungu conditions, compared to the existing lines, and how acceptable they are to farmers. Green gram is a lucrative cash crop and irrigation on at least part of the existing area is likely to give reasonable yields, it is also easy to store until transport is available to the markets of Mitunguu, Marimanti and Meru.

However, these existing rainfed crops do not justify the irrigation investment and some new crops are required. The new crops proposed for trial in Ruungu are tobacco, bananas, sweet potato, Asian vegetables, onions and tomatoes.

Tobacco is currently produced in the area, is reasonably profitably to farmers who give it the attention to good husbandry it requires, and the market is guaranteed once a contract has been written. A further major advantage of tobacco is that the tobacco companies will provide inputs such as seed, as well as extension services.

Banana production is not proposed for everyone, rather it is envisaged that a few of the new irrigators will wish to grow intensive banana stands. There is likely to be some local demand for the small volumes produced and with irrigation bananas are likely to produce well in the Ruungu climate.

A large area of sweet potato is projected, this is a crop that while it responds to management is tolerant of neglect, the tops make good fodder, and the harvests can be timed to provide an input of food to the local families at a time when other crops are scarce. It is also a crop that can be controlled and managed by the women.

The final three new irrigated crops are only proposed for a total of a little over 13 ha. This reflects the difficult conditions that producers for the market are likely to meet. Tomato are popular locally and the small area projected can probably be sold on the local area markets. Onions are suited to the climatic conditions in Ruungu, and can be stored. It remains to be seen whether soil crusting causes problems with stand establishment. Finally, there is a consistent demand for Asian vegetables at Mitunguu and some types are amenable to the transport hazards they will have to face from Ruungu.

Crop residue management and limited use of chemical fertilizer in appropriate levels and split applications will increase yields and can help reduce the inevitable decline in soil fertility. At present, wood fuel is available, but as the population increases fuel may become limiting, if farm fuel lots were encouraged now they could be in production by the time the natural woody vegetation had been depleted.

Proposed Cropping Areas at Ruungu with Project

Land Use	Land Area	Cropping Intensity	Crop	Area
(%)	(ha)	(%)		(ha)
1. Irrigated	68			
- Food Crops		83	Maize/beans	57.1
		21	Cowpea	14.3
		17.5	Sweet Potato	11.9
		4.4	Other Vegetables	3
		3	Green gram	2.1
130%			Sub-total	88.3
- Cash Crops		12	Tobacco	8.4
		9	Onions	6.4
		8.8	Millet (finger)	6
		7.6	Asian Vegetable	5.2
		3.8	Other Vegetables	2.6
		3	Green gram	2.1
		2.5	Tomatoes	1.7
48%			Sub-total	32.4
- Perennials		5	Banana	3.4
5%			Sub-Total	3.4
		183%	Irrigated Total	124.2
2. Rainfed	332			
- Food Crops		61	Maize/beans	220
		42	Millet	140
		8.5	Green gram	28
		5.4	Pigeon Pea	18
		4.5	Cowpea	15
127%			Sub-total	421
- Cash Crops		8	Green gram	28
		1.5	Cowpea	5
		6	Sorghum	20
16%			Sub-total	53
		143%	Rainfed Total	474
Total	400			598.2

Source: JICA Study Team Overall cropping intensity =  $598.2 \text{ ha} / 400 \text{ ha} \times 100 = 150 \%$

### 3) Proposed Farming Systems

Poor access, and thus the inability of farmers to reach markets for inputs and for the sale of surpluses is likely to depress returns, and may limit the ability of participants to participate in repayment of loans for an irrigation scheme based on full cost recovery. Continued diversification of the existing dryland cropping patterns, with selection and distribution of improved drought resistant varieties is needed.

Table 4.2-1 indicates the proposed cropping pattern of Ruungu/Karocho Irrigation Furrow Project.

Table 4.2-1 Proposed Cropping Pattern of Ruungu/Karocho Irrigation Project

Irrigation Area = 68ha Cropping Intensity = 183%

Crop	Crop Area (ha)		Growing Season(days)																	
	Maximum		Initial S.	Dev.S	Mid. S.	Late S.	Total	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
	MAR-JUL	AUG-FEB																		
Bananas	3.4	3.4	3.4																	365
Tomato	1.7	-	1.7	20	30	40														120
Sweet Poteto	5.1	6.8	11.9	20	30	40														120/130
Maize & Beans	27.2	29.9	57.1	25	30	40														125
Cowpeas	6.8	7.5	14.3	15	20	35														95
Green Gram	4.2	-	4.2	20	30	35														105
Millet	3.0	3.0	6.0	20	30	40														120
Asian Veggies	2.6	2.6	5.2	30	35	80														180
Onion(dry)	-	6.4	6.4	30	35	45														140
Other veg.	5.6	-	5.6	20	25	35														105
Tabacco	8.4	8.4	8.4	45	45	60														195
Total	68.0	68.0	124.2																	

Table 4.2-1 Proposed Cropping Pattern of Ruungu/Karocho Irrigation Project

Supplemental irrigation for the existing maize, green gram and millet crops will increase their reliability.

This site needs a good cash crop to replace cotton, which appears to have lost its market in Kenya. If the demand for cotton revives, supplemental irrigation in the January-February dry period will increase lint yields, but frequent insecticide spraying will also be required. Tobacco is probably a more lucrative alternative. Cashew production is already occurring in the region, but the erratic market and long establishment period is limiting its expansion. The yields here are generally lower than at the Coast. Tobacco is grown and processed within the region, and assuming sufficient water (particularly for the nursery) and other resources are available after food crop security is ensured, this may be one potential cash crop. Specialization in production of onions, some kinds of Asian vegetables or dried chillies also seems to be worth exploring.

#### Projected Crop Production at Ruungu with Project

Crop	Area Rainfed	Area Irrigated	Unit Yields	Total Production
	(ha)	(ha)	(Rainfed/Irr.)	(ton)
Maize	220	57.1	1.25/2.5	418
Green gram	56	4.2	0.45/0.8	29
Pigeon pea	18	0	0.5	9
Millet	140	6	0.45/0.75	68
Cow pea	20	14.3	0.45/0.7	19
Sorghum	20	0	0.85	17
Sweet Potatoes	0	11.9	3.5/8.5	101
Asian Veggies	0	5.2	4	21
Onions	0	6.4	7	48
Tomatoes	0	1.7	12	20
Tobacco	0	8.4	0.75	6
Other Veggies	0	5.6	4	24
Bananas	0	3.4	7.5	26
Mango	8	0	3.5	28

Source: JICA Study Team estimates

Currently, many of these crops are grown extensively on the flat under rainfed conditions. Initially the main improvement in the farming system is likely encouraging the use of increased plant populations, improved fertility and laying out the land in small basins to facilitate the irrigation. Basin irrigation is simple, and does not demand a lot of labour. Erosion is likely to be limited on the level land in the area.

The design cropping pattern at full development is shown in the overleaf. The peak water demand periods are during June, October and early January. October and early January are at the end of the dry seasons, and June is at the end of the first rainy season and a number of crops are either being started early or extended past their usual harvest date by growing them using irrigation. This is because of the shortness of the rainy seasons at Ruungu. Shifting crops and planting dates will obviously change these periods of peak water use.

An important proviso to these provisional recommendations, especially for Ruungu, where overhead piped irrigation is not economically feasible, is that the study area soils or water have not been tested for salinity/alkalinity, percolation rates, (a determinant of transmission losses in surface systems), or soil moisture storage capacity. A final recommendation is that not only should any future implementation activities at Ruungu be coordinated with other donors working in dryland agriculture such as IFAD, but that comparable lending terms and implementation modalities be established for any new lines of credit established under this project.

#### 4) Animal Husbandry Plan

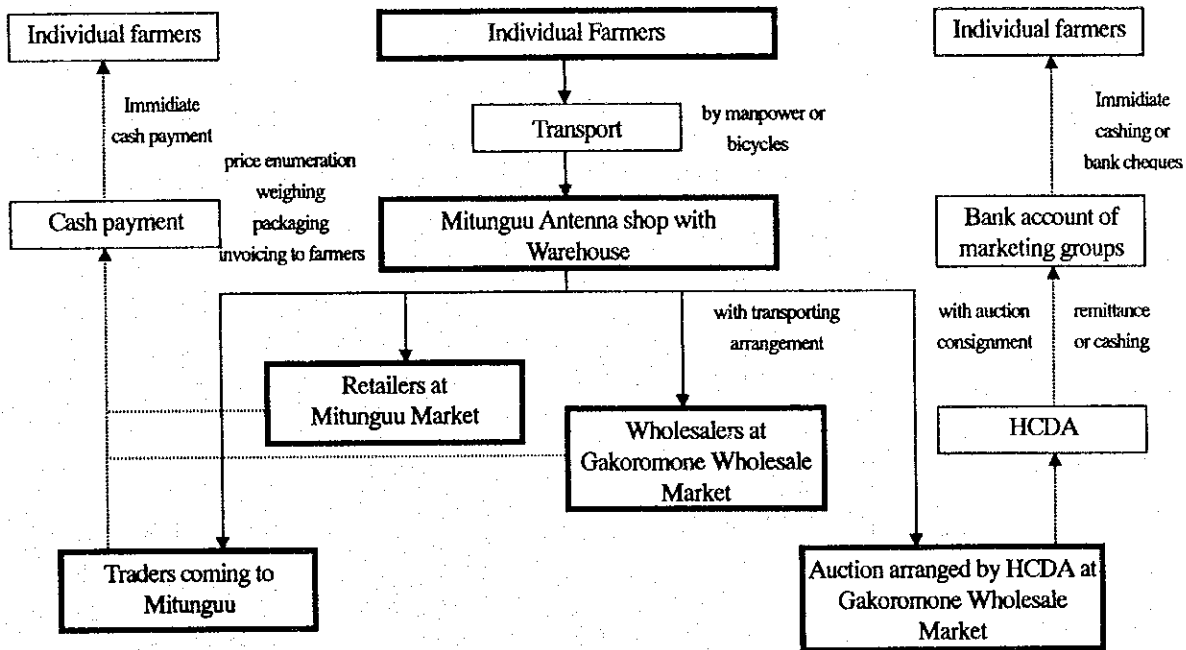
This is the only site studied that retains any major areas of its original vegetation, although wood-cutting and grazing are rapidly modifying the original dry land shrub. Extensive grazing is currently practiced and permanent water is available on both sides of the Project Area from the enclosing rivers. The availability of surplus production of animal products buffers the farmers from the erratic rainfed crop production.

The recommendation for Ruungu is to improve the cattle production in the area. Cattle are the likely to be the most economical use of much of the non-crop land in the area, but any expansion of cattle rearing must be accompanied by improved disease control, management of the grazing and possibly irrigated forage production. The current carrying capacity of the area is around four hectare per Animal Unit.

#### 5) Post-Harvest and Rural Industry Plan

The strategic produce are locally consumed produce for the Project Area. In order to access upper stream of marketing route, the farmers in Ruungu needs their antenna shop with warehouse at Mitunguu town. The transport means to Mitunguu by pickups using detour roads are not economical and realistic, and the means by manpower or bicycles will be feasible. After sacking produce into standardized bags, the manager of the antenna shop will decide to sell in the ways of the following marketing alternatives:

### Flow of Produce and Payment



#### 4.2.4 Marketing Plan of Agricultural Products

##### 1) Strategies on Marketing Development

The main strategies for this Project Areas are, i) creation of marketing alternatives by mean of owning antenna shop with warehouse at Mitunguu, ii) Direct sale at the Gakoromone wholesale market with transporting arrangement or auction consignment planned at the market, iii) participation in smallholders seminar holding at JKUAT and other institutions managed by the government including marketing sector. The necessary interventions as government services or activities to be done by farmers' marketing groups are categorized by the problems indicated on PCM workshop and identified in field survey as follows:

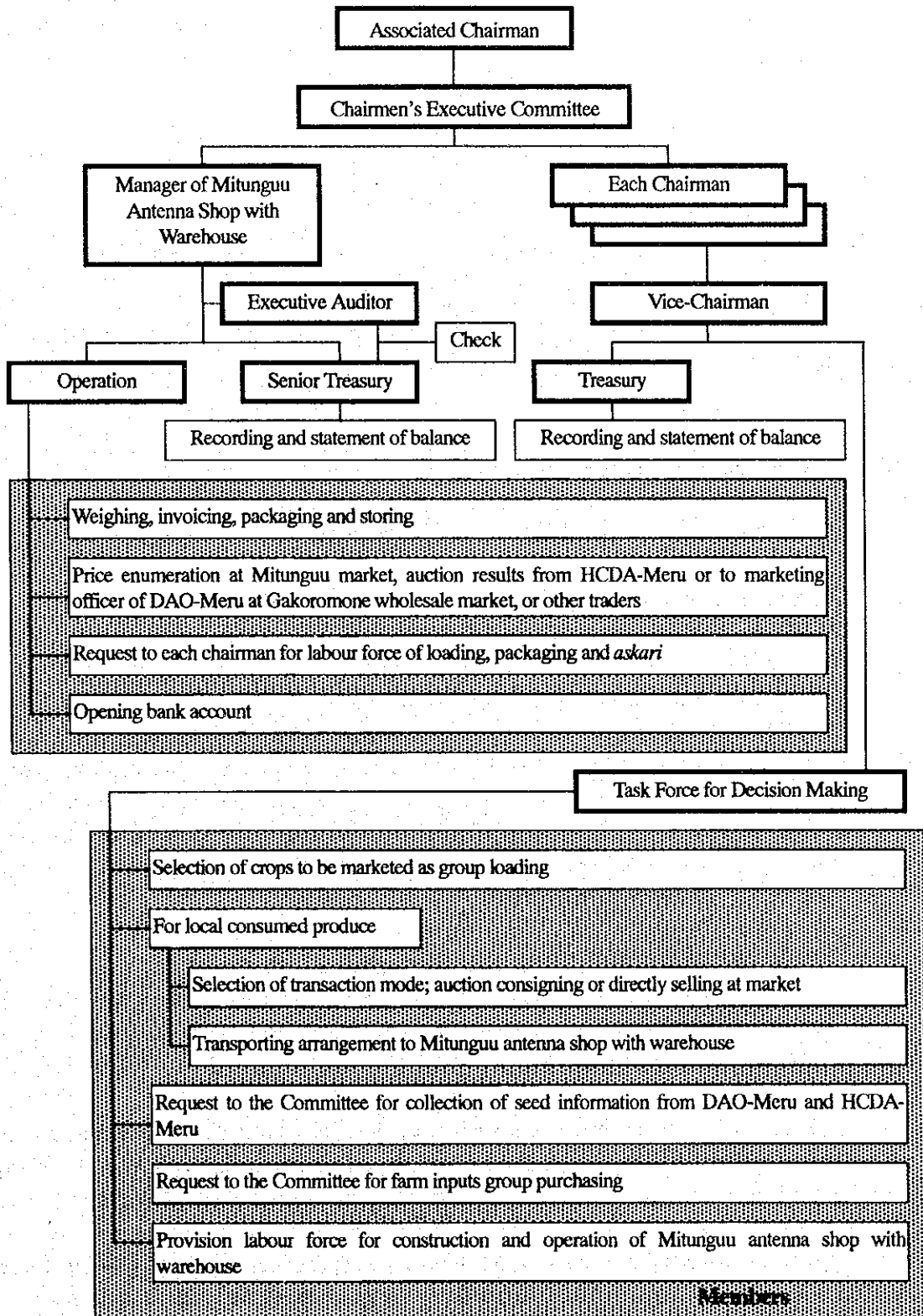
### Interventions and Outputs Categorized by Problem

Problems/Constraints	Interventions/Activities	Agency/Operation Body Concerned	Outputs
<b>Indicated problems on PCM workshop</b>			
<ul style="list-style-type: none"> <li>- Low prices for produce</li> <li>- Low demand for grown here (by outside market)</li> </ul>	- Operation of antenna shop with warehouse at Mitunguu	- Farmers group	- Creation of marketing alternatives
	- Provision of market price information at Gakoromone wholesale market for local consumed produce	- Farm inputs/ marketing officer of DAO-Meru	- Better crop planning - Attaining prevailing information - Reducing post-harvest losses - Increasing bargaining power
	- Provision of market price information of auction at Gakoromone wholesale market for locally consumed produce	- Marketing expert of HCDA-Meru	
	- Seminar on varieties and certified seeds procurement at JKUAT and other institutions managed by the government - Provision of certified seed information	- KARI - Farm inputs/ marketing officer in DAO-Meru - Marketing expert of HCDA-Meru	- Better yields and plant protection - Assurance of germination rate
	- Lecturing and practice on horticultural production	- MOA staff on horticulture with lectures/technicians	- More stable income than current situation - Saving on food expenses
- Lack of marketing organization	- Seminar on marketing organization though PCM workshop at JKUAT and other institutions managed by the government	- MOA staff on farmers' organization	- Organizing and associating marketing groups
- Few buyers from outside	- Auction consigning to Gakoromone wholesale market for local consumed produce	- Marketing expert of HCDA-Meru	- Better trading prices than middlemen. - Cheaper costs than <i>Matatu</i> - Increasing transaction opportunities
- Limited demands in Ruungu	- Transport arrangement to Mitunguu antenna shop with warehouse for local consumed produce	- Marketing groups	- Creating options of market alternatives to consign or sell directly at Gakoromone wholesale market, retailers at Mitunguu market or other traders
<b>Identified problems by Study Team</b>			
Lack of countermeasures for drought	- Weather forecasting	- Kenya broadcasting (KBC) - DAO-Meru - Member farmers	- Crop planning to select drought durable produce such as millets, pigeon pea, dolichos bean, green gram and sorghum
Lack of knowledge on consumers' or buyers' demands (After well arranging to Mitunguu, it is possible to plan export produce such as Asian vegetables.)	- Field trip pursuing marketing route; Nairobi markets, exporters' grading & packing facilities, Nairobi Horticultural Centre	-MOA staff	- Better understanding of consumers' or buyers' demands and how handled produce

#### 2) Structure of Functional Marketing Group

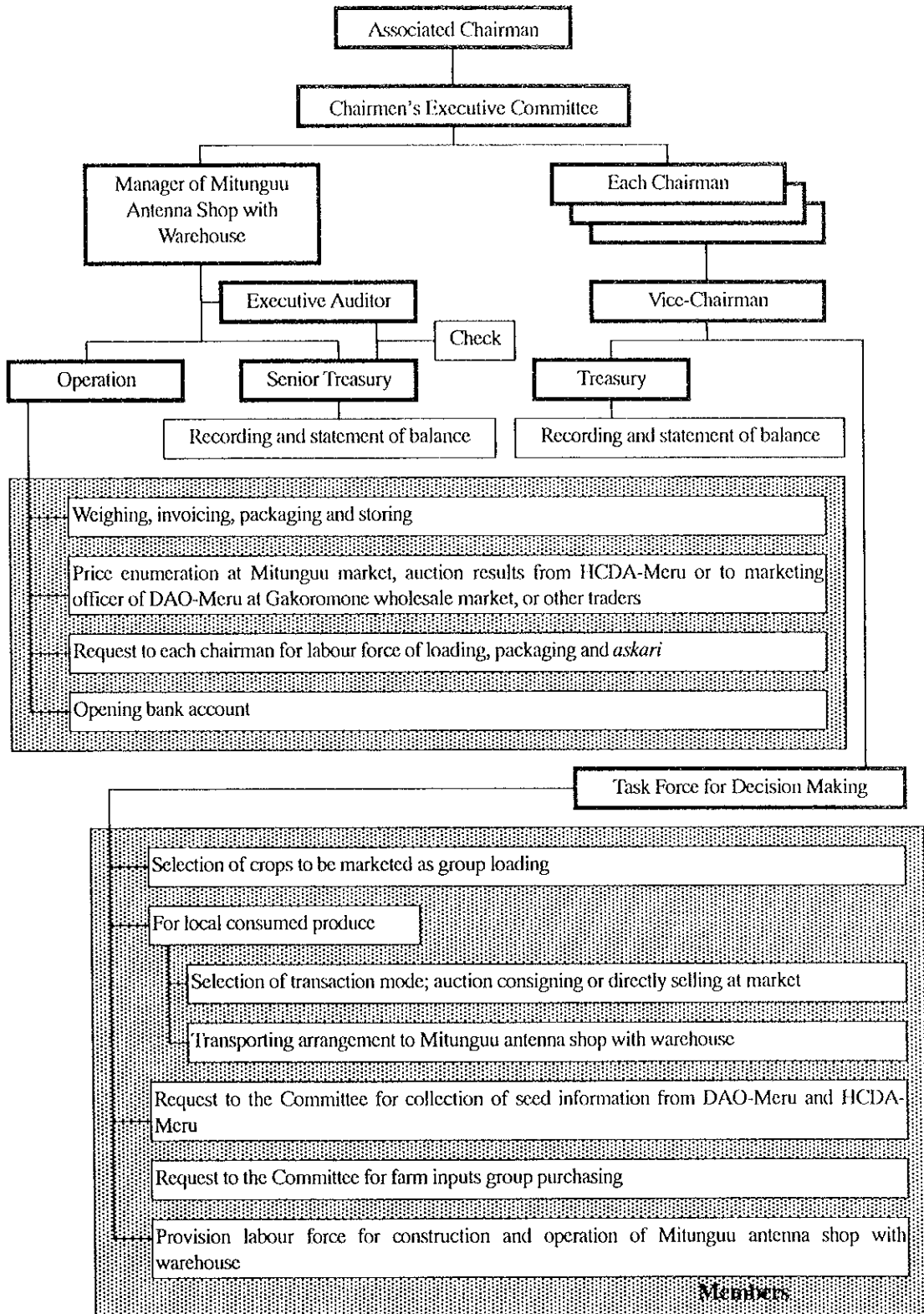
Farmers understand the importance and benefits of establishment of marketing groups, which was confirmed on PCM workshop. For efficient marketing, it is necessary to associate small scale marketing groups. The recommended formation of the groups are shown in the next page, but it is necessary to discuss among all members before the formation.

Recommended Organization Chart and the Functions





Recommended Organization Chart and the Functions



### 3) Strategic Marketable Horticultural Crops

Utilizing the resources of market demands, food security, agro-climatic aspect and current production, the following crops are recommended to be selected through discussion among members of marketing groups:

#### Strategic Horticultural Crops in the Project Area

Category	Strategic Crop
Home consumed produce	dry maize, beans (Rose Coco, Dolichos when expecting drought), kale, tomato, pumpkin, cassava, cooking banana
Local consumed produce	finger millet, bulrush millet, pigeon pea, cow pea, green gram, green maize, ripe banana (Apple, Giant Cavendish), water melon, sweet melon, arrow root, sweet potato, passion fruit (banana, purple), lemon, lime
Export produce (in future)	cashew nut, okra, ravaya, karella, turia, mooli and other Asian vegetables

#### 4.2.5 Environmental Management Plan

The extension service and farmers' training shall include the encouragement of following items:

- Risk and appropriate use of agrochemical including the system of MRL.  
HCDA has the extension manual.
- Promotion of improved cooking stove for women's groups.  
It will save 30 - 50 percent of firewood and contribute to keep boiled water. Home Economic Branch of Extension Service Division in MOA has the knowhow as they worked for the promotion project of GTZ. The project of ENZARO JIKO (promotion of improved cooking stove) by JICA was also a great success and it must be effective to invite some women's group leaders from Enzaro, where the community has become very active, to Ruungu or to hold a study tour to Enzaro in order to exchange information among farmers.
- Promotion of tree growing for fodder and soil conservation.  
MOA shall study the appropriate tree species in the Project Area and tree nursery by farmers shall be promoted. MOA has the manual of useful trees for Kenya established by ICRAF that has a good explanation with clear illustration and it is useful for the selection of trees.

Sanitary education for children at primary school is required not to drink the water from river and furrow without boiling and to wash their hand before eating and after using the latrine. DAO shall request the primary school to warn the children and their parents frequently. First of all, the primary school has to set a water tank to wash hands near the latrine and next, it should be introduced into home life. Water quality analysis of Thingithu River and the boreholes is required periodically by the Ministry of Health and the result shall be informed to the inhabitants so that they can learn which water source is more safe.

#### 4.2.6 Institutional Development Plan for Farmers Organizations

##### 1) Water Users Association Plan

An institutional development plan for WUA will aim at achieving the following objectives:

- A better organized, cohesive and self reliant irrigation community
- Enhanced awareness of individual members rights and obligations
- Improved decision making capability by the management committee on implementation, operation and maintenance issues
- Increased capability to effectively deal with external agencies

In order to achieve the four objectives, it is planned to undertake a range of training activities targeted at both WUA members and the management committee. These training activities are summarized below while detailed training modules, showing content and approach, are presented in Annex J.

##### a) Education and Training

Using PRA approaches, WUA members will be educated on implications and responsibilities associated with a group-based smallholder irrigation scheme. In particular the following issues will be covered;

- Expected roles, conduct and performance of ordinary members and management committee members
- Suitability for election as management committee member
- Irrigation by-laws, water allocation and distribution rules as well as disciplinary measures and procedures in executing penalties to non-compliant farmers
- Irrigation design and its relation to operation and maintenance issues
- Procedures for raising funds for irrigation implementation
- Financial implications for operation and maintenance

##### b) Financial and General Management

The management committee of WUA will participate in training sessions aimed at improving their financial and management skills. The contents of this training is summarized below while full details are given in Annex J.

##### Financial Management Training for WUA Committee

- Determination of irrigation water charges and collection procedures
- Financial records, book-keeping procedures, banking and accounting reports
- Planning for operation and maintenance including provision for maintenance fund
- Budget preparation and budget control

##### General Management Training for WUA Committee

- Roles, conduct and performance of management committee members

- Elementary principles of management
- Community organization
- Conduct of meetings (committee and general meetings)
- Management of external relations (supporting agencies : GOK, NGOs, private sector)

c) Linkages with Other Institutions

For the WUA to fulfill members' expectations of reliable irrigation water supply on a sustainable basis, it will need to maintain close linkages with other organizations and agencies. It is therefore planned to encourage linkages with external organizations as follows;

WUA Linkages with Other Institutions

Institution	Linkage Purpose/Advantage
Ministry of Agriculture	<ul style="list-style-type: none"> <li>- Advisory services on design, implementation, operation and maintenance of irrigation system</li> <li>- Coordination of other support services to the project community</li> <li>- Organization and management support</li> </ul>
Ministry of Land Reclamation, Regional and Water Development	<ul style="list-style-type: none"> <li>- Security of irrigation water rights</li> </ul>
Local NGOs	<ul style="list-style-type: none"> <li>- Availability of irrigation development loan on affordable terms</li> <li>- Organization and management support</li> </ul>
Private Sector	<ul style="list-style-type: none"> <li>- Construction of irrigation infrastructure</li> <li>- Source of farm in-puts for members</li> </ul>

2) Cooperative Development Plan

a) Education and Training

Currently, there is no cooperative society at Ruungu/Karocho Project Area. However, with initiation of irrigated production, it is likely that farmers will need a cooperative society to assist in mobilizing members savings and marketing some of their produce (grains, onions, cow-peas). More specifically, the cooperative society will initially perform the following activities;

- Receive saving from and offer credit facilities to members
- Construct a storage facility for dry and semi-dry farm produce before selling to outside dealers and for stocking farm-inputs required in irrigated production
- Collect, grade, pack and document cooperative members produce intended for sale to out-side dealers
- Arrange for marketing of members produce at remunerative prices
- Purchase and stock farm-inputs for re-sale to members and non-members at affordable prices
- Process members payment for produce marketed on their behalf

As it gains experience, the cooperative could venture into marketing of horticultural crops. However, it needs emphasizing that in the past cooperatives have not been successful in horticultural marketing (ref. to Loitokitok experience and the defunct Horticultural Cooperative Union). Empirical evidence, so far, suggests that marketing of perishable horticultural produce is better handled by marketing

groups where quick and discretionary action have to be taken by persons intimately known and trusted by the members.

In the course of the cooperative's establishment, the members will need to be educated on the nature and operational mode of a cooperative society. Since the cooperative members will be almost identical with those of WUA, they will have already learnt about advantages of group action. Their general education should therefore be brief. In addition, a formal workshop will be conducted with the aim of bringing together management committees of the cooperative and WUA in order to explore areas of cooperation for the benefit of their members. The temptation to encourage WUA to convert to or assume the roles of a cooperative society should, however, be resisted as this has been demonstrated not to work in Kenya (Ref. Mitunguu before restructuring; or Kibirigwe currently). Project farmers would be better off with WUA exclusively focusing on operation and maintenance of the irrigation system while a cooperative on any other farmers' organization handling marketing.

#### b) Financial and General Management Training

##### Financial Management Training

It is expected that the District Cooperative Officer will take the lead in promoting formation of the Ruungu Cooperative Society and will train the members on preparing their cooperative constitution, process cooperative registration and establish financial and accounting norms. In particular, it is expected that the management committee will be trained in;

- Operational cost management
- Internal accounting procedures
- Budget preparation and control
- Accounts and financial reports

##### General Management Training

With a view to strengthening the managerial capacity of the cooperative society, it is proposed that the Committee participates in a training workshop covering the following topics;

- Roles, conduct and performance of management committee members
- Elementary principles of management
- Containment of coffee factory processing costs
- Management geared to improved green coffee quality
- Options for improved cherry payment to members
- Conduct of meetings (committee and general meetings)
- Management of external relations (supporting agencies : GOK, consultants, private sector)

### c) Linkages with Other Institutions

Ruungu Cooperative Society will be encouraged to develop linkages with a number of institutions as summarized below;

#### Cooperative Linkages with Other Institutions

Institution	Linkage Purpose/Advantage
Ministry of Agriculture	<ul style="list-style-type: none"><li>- Advisory services on produce handling &amp; storage</li><li>- Market information on crops marketed by cooperative</li><li>- Advice on type and level of farm-input stocks</li><li>- Coordination of other support services to the project community</li></ul>
Ministry of Cooperative Development	<ul style="list-style-type: none"><li>- Initial training on nature of a cooperative society</li><li>- Registration processing</li><li>- Follow-up training of management committee</li></ul>
WUA	<ul style="list-style-type: none"><li>- Purchase of farm-inputs by WUA members</li><li>- Sourcing of savings from WUA members</li></ul>
Production/Marketing & Women Groups	<ul style="list-style-type: none"><li>- Purchase of farm-inputs by group members</li><li>- Sourcing of saving from marketing/women group members</li></ul>
Private Sector	<ul style="list-style-type: none"><li>- Bulk supply of farm in-puts</li><li>- Possibility of credit facilities for farm-input procurement</li></ul>
Produce Brokers	<ul style="list-style-type: none"><li>- Purchase of produce</li><li>- Information on produce markets (though distorted)</li></ul>
Banks	<ul style="list-style-type: none"><li>- Banking facilities</li></ul>

### 3) Marketing Group Development Plan

#### a) Education and Training

Promoting production/marketing groups are aimed at addressing a likely problem when production becomes stabilized as a result of irrigation. The groups are expected to establish a mechanism for coordinating production and marketing opportunities. More specifically, each group will identify its own marketing outlets (to private buyers or to the cooperative society) and then schedule the members production to match market requirements. The relatively smaller neighborhood marketing group (30-50 m) will consist of members who know each other well and will be comparatively easier to co-ordinate and manage. As part of promoting the formation of marketing groups, prospective members will be given general education and training on;

- Advantages of group marketing as opposed to individual marketing
- Criteria for membership recruitment and procedures for member mobilization and organization
- Group by-laws and registration requirements and procedures

Group members will be facilitated to visit marketing groups elsewhere in the Mount Kenya region where advantages and mode of operation of marketing groups will be demonstrated.

b) Financial and general Management Training

For the marketing groups to function effectively, they will need to acquire financial and general management capabilities as outlined below. More details on proposed training modules are given in Annex J.

Financial Management Training

- Members transaction records; delivery and receipt procedures
- Mode of payment by buyers to group and by group to individual members
- Banking procedures ; cash deposit and withdrawal procedures; operating a cheque account; bank reconciliation
- Books of accounts and accounts reports
- Budget preparation and budget control

General Management Training

- Management principles; role, conduct and performance of management committee
- Sourcing and processing of marketing information & production technology
- Production planning : production/purchase contract and implied legal issues
- Communication skills; sharpening negotiation and bargaining capabilities

c) Linkages with Other Institutions

Each production/marketing group, however, will need to forge links with several organizations as summarized below;

Production /Marketing Group Linkages with Other Institutions

Institution	Linkage Purpose/Advantage
Ministry of Agriculture/HCDA	- Sourcing marketing information & production technology - Organization and management support - Coordination of other support services to the group
Buying companies	- Purchase contract & market out-let for produce - Farm-input credit & production advice for contract crop
Produce Brokers	- Market outlet for farm produce - Indication (though distorted) of market information
Local NGOs	- Organization and management support - Input credit facilities
WUA	- Reliable supply of irrigation water
Cooperative	- Availability of farm inputs - Marketing outlet for dry produce - Availability of credit
Local Farm input Stockists	- Availability of farm inputs & short-term input credit
Banks	- Banking facilities for group members contributions

#### 4) Women Group Development Plan

The 20 women groups within the Project Areas offer an entry point for getting women's perspective in irrigation and irrigated production. In this regard, it is planned to conduct a training programme targeted to these women groups with the aim of enhancing their capacity to effectively contribute to the design of the irrigation system as well obtain maximum benefits from resulting production opportunities. The proposed training is outlined below while further details are given in Annex J.

##### a) Education and Training

A general education and training session will cover the following topics;

- Identification of women concerns and prioritized needs
- Review of proposed irrigation project plan in relation to women concerns and needs
- Review of the engineering design where women contributions will be sought and incorporated
- Implications of increased irrigated horticultural production not only in terms of increased workload for women but also in terms of new opportunities for women-specific benefits

##### b) Financial and General Management

###### Financial Management Training

One of the problems associated with women groups is their weak financial management capability. In order to remedy this constraint, women groups will be given an elementary course in financial management which will include the following;

- Procedures for keeping members financial records (contributions and disbursements)
- Banking procedures; types of bank accounts; cash deposit and withdrawal procedures
- Maintenance of simple accounting records
- Identifying income generating activities and associated expense and revenues streams
- Identifying agencies that can provide loans to women groups
- Procedures for applying and negotiating for loans
- Annual report of group activities including statement on expenditure and revenue as well as benefits to individual members

###### General Management Training

Presently women groups adopt short-term horizons and engage in a fairly narrow range of low turn-over activities. It is therefore proposed to broaden the scope and depth of women development perceptions by giving them a training course in general management covering the following areas;

- Group organization; management principles; leadership
- Strengths, weaknesses, opportunities and threats to the women group
- Review of current activities and exploration of other opportunities when irrigation becomes available e.g. production/marketing of horticultural produce
- Forward-planning procedures
- Monitoring performance



- Accessing support agencies in government, NGOs and private sector
- Negotiation/bargaining skills

c) Linkages with Outside Support Organizations

Since women account for the bulk of farm labour, they will likely be the actual producers of most horticultural produce at Ruungu/Karocho Project Area. For this reason, women groups could act as independent production/marketing groups and form similar institutional linkages. Hence the linkages are likely to be as shown below;

Women Group Linkages with Other Institutions

Institution	Linkage Purpose/Advantage
Ministry of Agriculture/HCDA	<ul style="list-style-type: none"> <li>- Sourcing women-specific production technology and market information</li> <li>- Coordination of other support services to the group</li> </ul>
Horticultural Export Companies	<ul style="list-style-type: none"> <li>- Purchase contract for horticultural produce</li> <li>- Market outlet for horticultural produce</li> <li>- Farm-input credit</li> <li>- Advice on how to produce contract crop</li> </ul>
Produce Brokers	<ul style="list-style-type: none"> <li>- Market outlet for farm produce</li> <li>- Indication (though distorted) of market information</li> </ul>
WUA	<ul style="list-style-type: none"> <li>- Reliable supply of irrigation water</li> </ul>
Cooperative Society	<ul style="list-style-type: none"> <li>- Market outlet for produce</li> <li>- Source of credit</li> </ul>
Local NGOs	<ul style="list-style-type: none"> <li>- Organization and management support</li> <li>- Input credit facilities</li> </ul>
Local Farm input Stockists	<ul style="list-style-type: none"> <li>- Availability of farm inputs</li> <li>- Possibility of short-term input credit</li> </ul>
Banks	<ul style="list-style-type: none"> <li>- Banking facilities</li> </ul>

**4.2.7 Institutional Supporting System Development Plan**

1) Agricultural Extension Services

Technology development, field trials, demonstration and extension in the model area should be carried out in close cooperation with the MOA staff, the front line agricultural extension workers, and any involved NGOs staff.

The overall responsibility for developing the demonstration program, and supervising the layout and management of the trials at each site will be with the MOA staff at Marimanti and/or any NGOs groups involved.

The development and responsibility for the training program for farmers, extension workers and NGOs staff will be under the overall supervision of the relevant MOA staff in Kenya.

The implementation of the agricultural development plan and any modifications to the proposed cropping patterns will be decided jointly by farmers, extension staff, and any involved NGOs staff. An advisory role will be played by the district level Subject Matter Specialists and the Extension staff at Mitunguu, who are very familiar with irrigated horticulture. They will be asked to comment on the final plan, as well as provide their technical input when specific technical problems arise in their field.

The Ruungu farmers themselves have the primary responsibility for managing the irrigation scheme, and implementing any development plan. The extension workers and NGOs staff have the responsibility of acting as a liaison between the farm level and the district administration, as well as the Nairobi based project staff.

Training of all of the concerned players to assist them in their roles will be conducted under the project. Facilities for the trials and demonstrations will be provided by the project. The Government of Kenya will facilitate the involvement of their officials in the development and supply of the extension services to the model area. Any involved NGOs staff will also be expected to participate on an ongoing basis.

## 2) Agricultural Credit Services

Personal possession of land has not been allowed in Ruungu/Karocho Area because of trust land. Therefore, farmers don't hold title deed as collateral being required by banks when crediting. At first, County Council must survey lands in cooperation with the Ministry of Land and Settlement and publish authorized title deed immediately.

Since farmers don't have enough knowledge and recognition about agricultural credit system, educational training about credit taken into consideration their educational status should be given to farmers. On the occasion, group basis training should be planned to make them understand with common recognition.

## 3) Agricultural Input Supply

The supply of improved seeds and planting will be provided on a purchase basis. The private sector suppliers will be actively encouraged to develop new or existing outlets in the model areas, and to stock the required inputs for their agricultural development. Contact will be made with the tobacco company regarding tobacco production.

## 4) Training to Strengthen Farmers' Organization

There are five main institutions which are likely to render support services to the project community of Ruungu/Karocho. In this connection, it is proposed that staff of these institutions participate in specific training workshops where they can acquire operational skills necessary for strengthening farmer's organizations.

In the first instance, it is planned that MOA as the irrigation project promoter will convene a meeting in Tharaka where staff from these institutions will be:

- Briefed on the planned irrigation activities at Ruungu/Karocho
- Discuss and agree on a common approach for establishing or strengthening relevant farmers organizations.
- Identify specific training needs for staff of various institutions who are or will be involved in strengthening farmers' organizations

In the meantime a likely training programme, aimed at imparting skills needed in strengthening farmers' organizations, is outlined as shown below;

#### Out-line of Training Programme for Enhancing Capability to Strengthen Farmers Organizations

Institution	Training Aimed at Enhancing ability to Strengthen Farmers Organizations	Farmers' Organization to be Strengthened
Front-line Extension Worker (FEW)	<ul style="list-style-type: none"> <li>- Community organization and PRA approaches</li> <li>- Hands-on irrigation technology</li> </ul>	<ul style="list-style-type: none"> <li>- WUA</li> <li>- Production/Marketing Group</li> <li>- Women Group</li> </ul>
District Subject Mater Specialist	<ul style="list-style-type: none"> <li>- Community organization and PRA approaches</li> <li>- Irrigated horticultural production technology</li> <li>- Participatory extension needs assessment methods</li> <li>- Social marketing skills</li> <li>- Improved extension planning, packaging and delivery</li> </ul>	<ul style="list-style-type: none"> <li>- Production/Marketing Group</li> <li>- Women Group</li> </ul>
Cooperative Employees	<ul style="list-style-type: none"> <li>- Factory level cost management</li> <li>- Procurement procedures</li> </ul>	<ul style="list-style-type: none"> <li>- Proposed Ruungu Cooperative Society</li> </ul>
SISDO Staff	<ul style="list-style-type: none"> <li>- Community organization and PRA approaches</li> <li>- Skills in financial and loan administration s</li> </ul>	<ul style="list-style-type: none"> <li>- WUA; Women Group &amp; Production/Marketing Group</li> </ul>
Ministry of Culture & Social Services Office Staff	<ul style="list-style-type: none"> <li>- Community needs assessment</li> <li>- Procedures for group formation, organization and follow-up</li> </ul>	<ul style="list-style-type: none"> <li>- Production/marketing Group.</li> <li>- Women Groups</li> <li>- WUA</li> </ul>

#### **4.2.8 Water Sources Development Plan**

##### **1) Mode of Water Abstraction**

As a method of water intake in the Project, direct abstraction from river through intake weir works is adopted to implement the project by low cost. Therefore, available water resources is only run-off water in related rivers.

##### **2) Methodology of Assessment of Water Availability**

According to Water Act published by government, if a proposed scheme includes accommodation of storage facility in the project component, flood flow can be used for irrigation purpose and if the scheme

does not include storage facility, monthly dependable flow (Qd) for irrigation is defined by the following equation;

$$Q_d = Q_b - Q_m - Q_{cd}$$

Where;

Q<sub>b</sub> : Base flow is a flow with 80 percent probability of exceedance in the driest month on the minimum monthly flow basis. The base flow at specific point is converted proportionally based on the acreage of catchment area from the base flow at RGS which is located in lower reach of related river or near location from the related project site.

Q<sub>m</sub> : River maintenance flow equivalent to 30 percent of the base flow

Q<sub>cd</sub> : Total committed water in the immediate down stream of proposed intake site

Thus, the dependable flow can be estimated through the probability analysis of minimum monthly flow by Iwai Method, and total committed water in the immediate down stream of a proposed intake site.

### 3) Assessment of Water Availability at Project Site

Since no gauging station exists at Ruungu intake site, the discharge data at RGS-4F17 of the Thingithu river are analyzed to estimate dependable flow at the intake site. Based on the minimum monthly discharge record of 25 years from 1970 to 1995 as shown in Table G.2.4-2, Annex G.2, the 80 percent low flow of exceedance is estimated to be 0.44 cu.m/sec which occurs in October as shown in Table 4.2-2.

The base flow at Ruungu intake site is estimated by multiplying the yield of base flow at RGS-4F17 and the catchment area above Ruungu intake. Thus obtained base flow at Ruungu intake site is 0.319 cu.m/sec. Since there exists one water permit with amount of 0.002 cu.m/sec in the immediate down-stream, the minimum dependable flow is estimated to be 0.222 cu.m/sec. The estimated monthly dependable water ranges from 0.222 to 0.708 cu.m/sec as shown in Table 4.2-2.

**Table 4.2-2 Dependable Water for Ruungu/Karocho Irrigation Project**

**1) Probability Analysis of River Flow at 4F17 Regular Gauging Stations**

Station Code	4F17
River	Thingithu
Drainage Area	303 sq.km
Location	Latitude 00-29-90 S
	Longitude 37-57-35 E
Period of Record	1970-1995

Exceeding Probability (%)	Probable Discharge of Monthly Minimum Flow (cu.m/sec)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
50	1.96	1.34	1.08	1.53	2.51	1.67	1.26	0.98	0.79	0.72	1.57	2.83	1.52
80	1.28	0.76	0.67	0.89	1.11	1.01	0.77	0.64	0.54	0.44	0.59	1.56	0.86
90	1.06	0.59	0.54	0.70	0.64	0.77	0.57	0.49	0.42	0.34	0.35	1.16	0.64

**2) Probable River Flow at Intake Site**

Water Source	Thingishi River
Drainage Area at Intake Site	220.0 sq.km
Code of Adopted Station for Estimation	4F17 (Thingishi River)
Drainage Area of Adopted Station	303.0 sq.km
Conversion Factor	0.726

Exceeding Probability (%)	Probable Discharge of Monthly Minimum Flow (cu.m/sec)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
50	1.423	0.973	0.784	1.111	1.822	1.213	0.915	0.712	0.574	0.523	1.140	2.055	1.104
80	0.929	0.552	0.486	0.646	0.806	0.733	0.559	0.465	0.392	0.319	0.428	1.133	0.621
90	0.770	0.428	0.392	0.508	0.465	0.559	0.414	0.356	0.305	0.247	0.254	0.842	0.462

**3) Dependable River Flow at Intake Site**

Base Flow(Qb):	0.319 cu.m/sec
River maintenance flow ( 30% of Qb= ):	0.096 cu.m/sec
Committed water amount in upper basin of intake site:	0.186 cu.m/sec
Committed water amount below the intake of scheme:	0.002 cu.m/sec

Exceeding Probability (%)	Dependable River Flow (cu.m/sec)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
80	0.832	0.454	0.389	0.548	0.708	0.635	0.461	0.367	0.294	0.222	0.331	1.035	0.523

#### 4) Water Source Development Plan

The irrigation area of the Project is determined in consideration of the following concept;

- Full irrigation in the dry season as well as supplemental irrigation in the rainy season will be planned from the view point of marketability of irrigated crops
- The irrigation area of the Project is allowed within the amount of available water source (0.222 cu.m/sec) and requested irrigation area (68 ha) by the WUA.

The dependable water source amount in the driest month at the intake site is 0.222 cu.m/sec, while the maximum unit water requirement in the driest month is estimated at 2.5 lit/sec/ha as below. Therefore, the maximum water requirement for the irrigation area of 68 ha is 0.170 cu.m/sec.

Maximum unit water requirement in the driest month (q l/sec/ha) is calculated as follow:

$$q = (E_{To} * K_c - P_e) / IE * 10,000 / (h * 3,600) * 7 / v = 2.5 \text{ lit/sec/ha}$$

where;

Reference crop evapotranspiration (E <sub>To</sub> )	: 5.1 mm/day (refer to subsequent Clause of 4.2.9)
Crop factor (K <sub>c</sub> )	: 0.9 (average)
Effective rainfall (P <sub>e</sub> )	: 0.0 mm/day
Irrigation efficiency (IE)	: 0.50 (surface irrigation)
Operation hours per day (h)	: 12 hours
Irrigation days per week (v)	: 6 days

As the balanced water amount at the intake site after the abstraction of required water for the Project, is to be 0.052 cu.m/sec, Thingithu river can supply the required water for the project. The existing intake facility is used as the water source facility of the Project.

#### 4.2.9 Irrigation and Drainage Plan

The irrigation and drainage plan for the Project had been established by SISDO 1994. The construction work for irrigation system started since 1994. While, the JICA Study Team also studied the proposed cropping pattern during the study period. Therefore, irrigation water requirement for the proposed cropping pattern is estimated to check the adaptability to the canal system designed by SISDO.

##### 1) Irrigation Plan

The area to be irrigated is based on the available water amount at the project intake site and the requested area by the WUA. The 170 farmers participate to the Project and each farmer is allocated the irrigation area of 0.4 ha, and the acreage of proposed irrigation area is 68 ha.

a) Irrigation Water Requirement

(1) Proposed Cropping Pattern

Introduced crops shall be examined considering the following factors;

- Natural condition (climate, soil, topographic condition)
- Social condition (local demand, available labour, access to market)
- Technical condition (present crop grown, farmers experience to irrigation)
- Economical condition (profitability and marketability of crop)

Consequently, maize, beans and cowpeas as staple crops, and banana, tomato, Asian vegetables, onion, tabasco etc. as a cash crops are selected. The proposed cropping pattern is shown in Table 4.2-1.

(2) Reference Crop Evaporation

Reference crop evapotranspiration (ET<sub>o</sub>) is estimated by Penman Method on monthly basis. For the calculation of ET<sub>o</sub> value, meteorological data at Embu station, which is nearest one from the Project, is adopted.

The calculation of ET<sub>o</sub> was carried out by using computer program "CROPWAT" owned by IDB. The estimated ET<sub>o</sub> are ranging from 3.9 mm/day in December to 5.1 mm/day in September and October. The monthly ET<sub>o</sub> is tabulated in Table 4.2-3.

(3) Crop Evapotranspiration

The crop evapotranspiration (ET<sub>crop</sub>) will be determined as:

$$ET_{crop} = ET_o \times K_c$$

Where;

- ET<sub>crop</sub> : Crop evapotranspiration (mm/day)
- ET<sub>o</sub> : Reference crop evaporation (mm/day)
- K<sub>c</sub> : Crop factor (see Table 4.2-4)

(4) Irrigation Water Requirement

Net Irrigation Requirement

The net irrigation requirement (NIR) is determined by deducting the corresponding effective rainfall estimated on monthly basis by following equation:

**Table 4.2-3 Reference Evapotranspiration (ET<sub>o</sub>) of Ruungu/Karocho Irrigation Project**

	Temperature		Humidity mean (%)	Wind Speed (km/day)	Sunshine hours (hrs/day)	Radiation Mj/m <sup>2</sup> /day (km)	ET <sub>o</sub> - Penman (mm)
	maximum (degree)	minimum (degree)					
Jan	31.9	18.4	64.0	53.3	8.1	21.2	4.3
Feb	33.8	19.8	61.0	68.0	8.6	22.7	4.8
Mar	34.6	20.9	59.0	69.8	8.3	22.6	5.0
Apr	33.1	21.4	67.0	55.5	7.5	20.7	4.4
May	32.2	20.8	64.0	56.4	8.1	20.4	4.3
Jun	31.7	19.2	55.0	67.1	7.5	18.9	4.0
Jul	31.0	19.4	54.0	84.9	6.1	17.1	4.0
Aug	31.3	19.5	50.0	100.6	6.5	18.6	4.4
Sep	33.2	20.0	49.0	111.3	7.7	21.3	5.1
Oct	34.2	21.1	5.0	103.1	7.9	21.6	5.1
Nov	30.0	20.3	70.0	55.0	6.4	18.7	4.0
Dec	30.9	18.9	71.0	50.8	7.0	19.2	3.9
Ave/Total	32.3	20.0	55.8	73.0	7.5	20.3	1,620

**Table 4.2-4 Crop Factors of Major Crops**

	Initial Stage	Crop Dev. Stage	Mid-season. Stage	Late season Stage
Bananas	0.90	0.90	0.90	0.90
Tomato	0.45	0.75	1.15	0.80
Potatos	0.45	0.75	1.15	0.85
Maize & Bean:	0.40	0.80	1.15	0.70
Cowpeas	0.35	0.75	1.10	0.70
Green Gram	0.35	0.75	1.10	0.70
Millet	0.35	0.70	1.05	0.75
Asian veg.	0.35	0.75	1.10	0.70
Onion	0.50	0.75	1.05	0.85
Other crops	0.35	0.75	1.10	0.70
Tabacco	0.45	0.75	1.10	0.95

Source) Irrigation water management training manual no.3 FAO 1986

**Table 4.2-5 TRAM and Irrigation Interval of Ruungu/Karocho Irrigation Project**

Crop	Depth of Effe. Root Zone(m)	Half-storage Capa.* (mm/m)	TRAM (mm)	ET <sub>o</sub> (max) (mm/day)	Kc(max)	ET <sub>crop</sub> (mm/day)	Irrigation Interval (day)
Bananas	1.2	80	96	5.1	0.90	4.6	20.9
Tomato	0.5	80	40	5.1	1.15	5.9	6.8
Potatos	0.5	80	40	5.1	1.15	5.9	6.8
Maize & Bean:	0.8	80	64	5.1	1.15	5.9	10.9
Cowpeas	0.6	80	48	5.1	1.10	5.6	8.6
Green Gram	0.6	80	48	5.1	1.10	5.6	8.6
Millet	0.8	80	64	5.1	1.05	5.4	12.0
Asian veg.	0.6	80	48	5.1	1.10	5.6	8.6
Onion	0.5	80	40	5.1	1.05	5.4	7.5
Other crops	0.6	80	48	5.1	1.10	5.6	8.6
Tabacco	0.6	80	48	5.1	0.95	4.8	9.9



$$\text{NIR} = \text{ET}_{\text{crop}} - \text{Pe}$$

Where;

NIR : Net irrigation requirement (mm)

ET<sub>crop</sub> : Crop evapotranspiration (mm)

Pe : Effective rainfall (mm)

The USDA soil conservation method has been used to determine the effective rainfall. The monthly effective rainfall can be estimated applying following formula developed by Kalder in 1987.

$$\text{Pem} = 0.81 \times \text{Pm}^{0.975} \quad : \text{for Pm} < 100 \text{ mm}$$

$$\text{Pem} = 18.54 + 0.52 \times \text{Pm} \quad : \text{for Pm} > 100 \text{ mm}$$

Where : Pem : Monthly effective rainfall

Pm : Monthly rainfall with 80 percent probability of exceedance

The estimated effective rainfall is shown in below table;

Monthly and 5-days Effective Rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
mm/month	0	0	28	138	138	0	0	0	0	9	56	39
mm/5day	0	0	4.7	23	23	0	0	0	0	1.5	9.3	6.5

The monthly rainfall data used for the analysis are shown in Annex G.2.

### Gross Irrigation Requirement

Gross irrigation requirement (GIR) is determined by taking into consideration the irrigation efficiency (E) which is composed of field application efficiency, conveyance efficiency and operational efficiency. In this study, the E values for surface irrigation is assumed to be 0.5. The GIR is estimated by the following equation.

$$\text{GIR} = \text{NIR}/\text{E}$$

Where; E : Overall irrigation efficiency

E : E<sub>a</sub> x E<sub>c</sub> x E<sub>o</sub>

E<sub>a</sub> : Field application efficiency (surface irrigation: 0.55- 0.75)

E<sub>c</sub> : Conveyance efficiency (0.8-0.9)

E<sub>o</sub> : Operational efficiency (0.95)

## Irrigation Water Requirement

Irrigation water requirement (IWR) for the determination of system capacity is analyzed by taking into consideration the number of irrigation hours per day and working day per week. The following equation is used;

$$IWR = GWR \times A \times 10,000 / (h \times 3,600) \times 7/v$$

where,

- IWR : Irrigation water requirement ( l/sec)
- GWR : Gross water requirement ( mm/day)
- A : Irrigation area (ha)
- H : Operation hours per day (hrs)
- V : Working days per week (days)

In the Project Area, 12 hours operation per day and six working days per week are generally adopted by farmers. Thus, the same values will be adopted for the estimation of IWR.

The maximum irrigation water requirements for the proposed cropping pattern is estimated to be 150.3 lit/sec, while the maximum capacity of main canal designed by SISDO is 214.3 lit/sec. The difference between above two estimated values arises from the difference in estimated ETo, adopted Kc values and conveyance losses. Although more discussion about water requirement is necessary, the irrigation water required for the proposed cropping pattern can distribute through the designed irrigation system .

The monthly variations of water requirement for the proposed cropping pattern are illustrated in Figure 4.2-2. The details are shown in Table L.2.4-2, Annex L.2.

### b) Time Interval of Irrigation Application

The time interval of irrigation application is determined in the following procedures;

- (1) Determination of depth of root zone
- (2) Determination of half-storage capacity of soil
- (3) Calculation of total ready available moisture (TRAM)
- (4) Determination of time interval of irrigation application

### Depth of Effective Root Zone

The depth of effective root zone is determined on the basis of field survey and collected data on the root zone and is shown below;

Bananas	:	120 cm
Maize & beans	:	80 cm

Irrigation Water Requirement of Ruungu/Karocho Irrigation Project(Surface Irrigation)  
 Irrigation Area = 68 ha, Cropping Intensity = 183%, Maximum Water Requirement = 150.3 l/sec

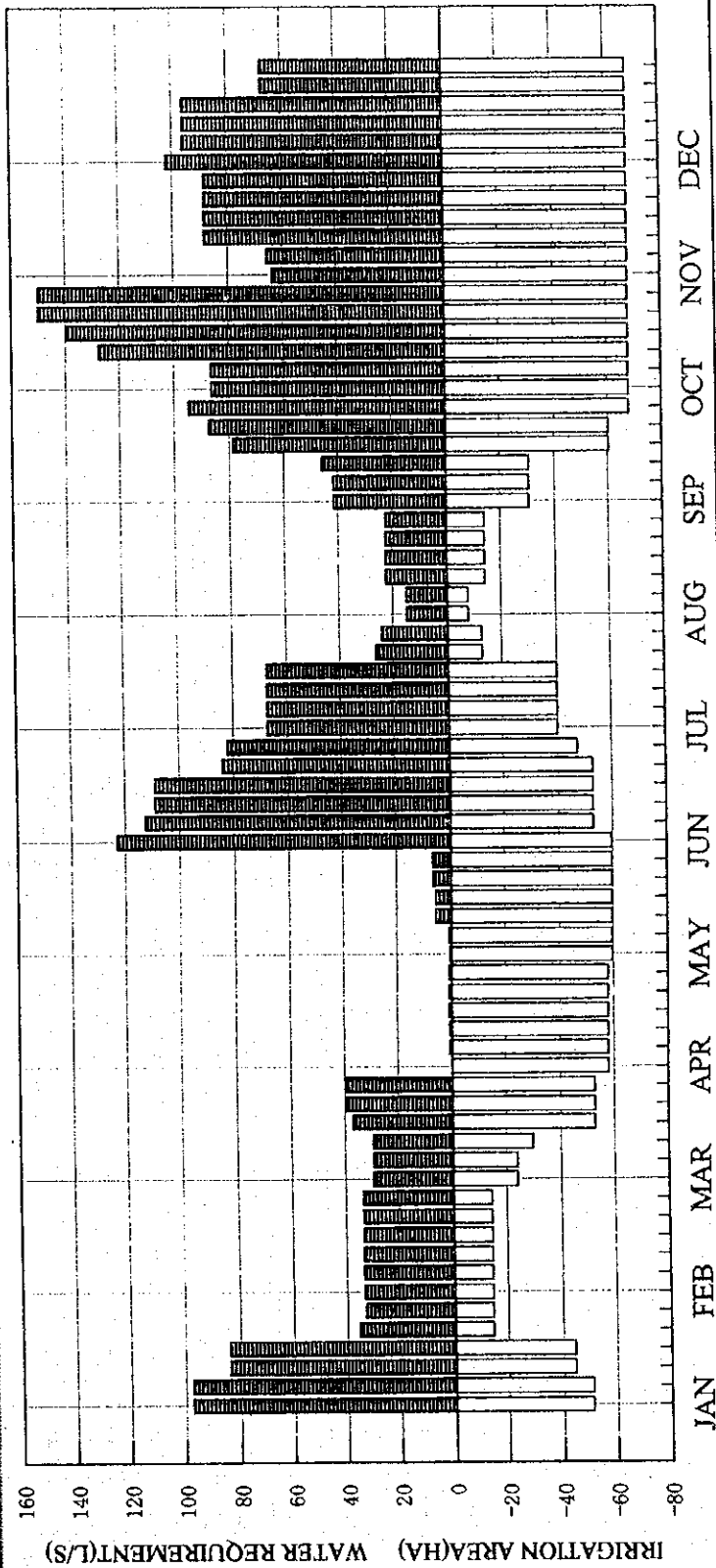


Figure 4.2-2 Irrigation Water Requirement of Ruungu/Karocho Irrigation Project (Surface Irrigation)

Potatoes	:	50 cm
Cowpeas	:	60 cm
Green gram	:	60 cm
Millet	:	80 cm
Asian vegetable	:	60 cm
Onion	:	50 cm
Tabasco	:	60 cm

#### Half-Storage Capacity of Soil (Ready Available Moisture)

Half- Storage capacity is defined as the quantity of water which is acceptable to the crop without loss of yield and is classified by soil type as below. The predominant soil type in the Project Area is loam to sandy loam.

Soil Type	Half-Storage Capacity (mm/m)
Clay	70-100
Clay loam	80-100
Loam	70-100
Sandy loam	40-80
Sand	30-50

#### Total Ready Available Moisture (TRAM) and Interval of Irrigation Application

Total Ready Available Moisture (TRAM) is obtained from the following equation;

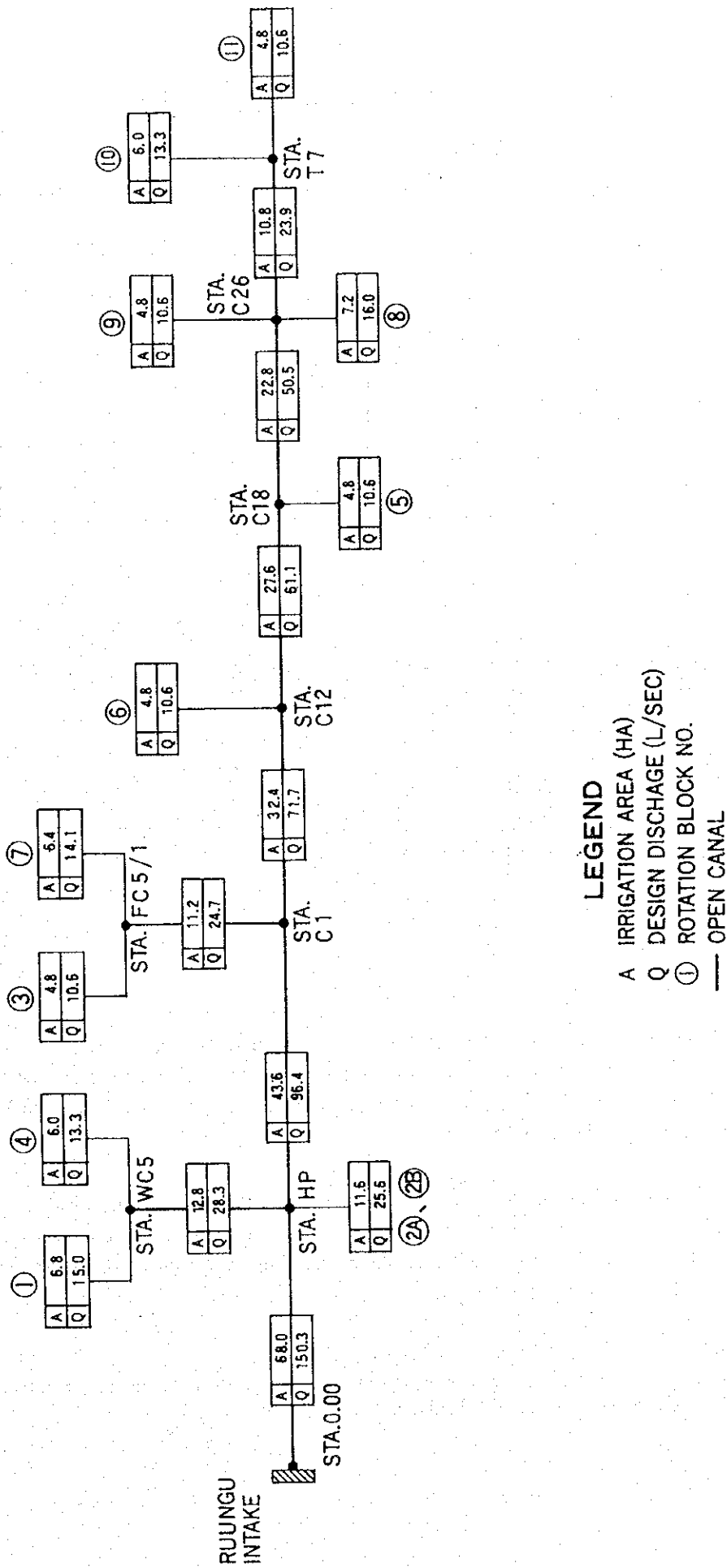
$$\text{TRAM} = (\text{depth of effective root zone}) \times (\text{half-storage capacity})$$

The time of interval of irrigation application is obtained by dividing the TRAM values by maximum crop evaporation as shown in Table 4.2-5. The estimated irrigation intervals for various crops ranged from 7 to 21 days.

From the view point of water management, the irrigation on same day in a week is desirable, therefore, seven days of irrigation interval is planned for the Project Area.

#### c) Water Management Plan

The plot to be irrigated is spread over the Project Area of 400 ha. As the proposed irrigation area of 68 ha is irrigated in six days, the irrigation area per day is 11.3 ha. As a water application method, furrow irrigation method is adopted. According to the design report by SISDO, the irrigation area is divided 13 rotation blocks with an area of 5 to 7 ha, and each block is irrigated through individual group feeder canal. This concept of water management is basically followed in this study. The water application time of each irrigator to its own irrigation area of 0.4 ha is 4.0 to 6.0 hr. and the shifting of irrigation area per day is two to three times. The dimensions of water management at each block are shown below table, and the proposed irrigation network is shown in Figure 4.2-3.



- LEGEND**
- A IRRIGATION AREA (HA)
  - Q DESIGN DISCHARGE (L/SEC)
  - ① ROTATION BLOCK NO.
  - OPEN CANAL

**Figure 4.2-3** Irrigation Water Requirement of Ruungu/Karocho Irrigation Project (Surface Irrigation)

### Dimension of Water Management in Each Rotation Block

Rotation Block	No. of Farmers	Rotation Block Area (ha)	Application Time/Farmer (hr/0.4ha)	Operation Time/day (hr)	No. of Irrigator /day	Irrigation Day per Week (day)	Design Dis. of G.F.Canal (lit/sec)
1. Umoja	17	6.8	4	12	3	6	15.0
2A. Nyange	17	6.8	4	12	3	6	15.0
2B. Maendeleo	12	4.8	6	12	2	6	10.6
3. Karimi	12	4.8	6	12	2	6	10.6
4. Mukuria	15	6.0	4.8	12	2.5	6	13.3
5. Kajoa	12	4.8	6	12	2	6	10.6
6. Riongo	12	4.8	6	12	2	6	10.6
7. Majengo	16	6.4	4	12	3	6	14.1
8. Kamatuduru	18	7.2	4	12	3	6	16.0
9. Keoria	12	4.8	6	12	2	6	10.6
10. Koraka	15	6.0	4.8	12	2.5	6	13.3
11. Mutethia	12	4.8	6	12	2	6	10.6
Total	170	68.0	-	-	-	-	150.3

#### 2) Drainage Plan

Since the Project Area is located in sloping area, there is no severe drainage problem. Thus, no drainage plan is established for the project.

### 4.3 Physical Plan and Cost Estimate

#### 4.3.1 Agriculture and Rural Infrastructure Plan

##### 1) Agriculture Infrastructure Plan

##### a) Irrigation Facilities

For irrigation facilities, since the construction of irrigation facilities is on going under the management of SISDO after obtaining a loan from Cooperative Bank of Kenya, present facility design conducted by SISDO is studied in this section. Its design both for irrigation system and facilities was made based on the Scheme Design Manual of MOA.

Major facilities of the on-going irrigation system are classified into four categories, i.e. diversion weir on Thingithu river, water conveyance system, water distribution system and water application system. Comments on facility design and existing facilities being built will focus particularly on the diversion weir which was damaged by floods in late 1997, as presented below:

- (1) Stability analysis of intake weir has been made in the low river flow condition ( $Q = 0.552$  cu.m/sec). However, it is necessary to conduct in the flood flow condition ( $Q = 100$  cu.m/sec) which produce relatively large hydraulic pressure and overturning forces.

- (2) Condition of riverbed foundation particularly at the right bank side is neither clearly stated in the report nor observed at the site. It seems to be rock foundation but riverbed cross section is not presented in the drawings, therefore it is unclear if the weir was firmly touched to the base rock or not. Even if concrete key into the rock foundation is shown in the drawings, actual condition observed during construction works is not known.
- (3) Possible causes of the damage of the weir might be either overturning by excess hydraulic pressure, or sliding due to weak friction between concrete weir and foundation, or insufficient concrete strength of weir body, or combination of those.
- (4) Existing weir site is immediately downstream of small water falls. There is another good site for diversion weir at around 30 m upstream from the existing site, and upstream site could provide some more water head.
- (5) GI pipeline with a length of 85 m connecting between intake box and main canal has been partially built in the dry riverbed. Its alignment is too close to water course and therefore needs to be relocated toward the river bank so as not to be damaged by flowing trashes such as big trees in the floods.
- (6) It is noted that an appraisal report was prepared by IDB, MOA in September 1996.

b) Village/Farm Roads

Village/farm roads shall also be rehabilitated under spot improvement method with grading and regravelling. A total length of the village/farm road improvement shall be three kilometers (Refer to Annex P).

2) Rural Infrastructure Plan

a) Domestic Water Supply

Domestic water supply is not included in the improvement plan as it is presently supplied with boreholes under SIDA assistant.

b) Access Roads

For access roads, rehabilitation of C92 primary road, E788 minor road and unclassified rural road shall be planned to secure access to major market Meru even in the rainy seasons. Rehabilitation shall be carried out through either partial rehabilitation or spot improvement methods. Partial rehabilitation with spot gravelling applies to road sections slightly damaged, and spot improvement which consists of grading and regravelling applies to road sections severely damaged. A total length of partial rehabilitation is 20.0 km for C92 road, and spot improvement is 11.5 km for E788 road and 6.0 km for unclassified rural road. Spillway type bridges are also planned at five places of stream crossing on the unclassified rural road.

c) Post-Harvest and Agro-Industry Plan

The proposed Mitunguu antenna shop with warehouse will have or start from small house to avoid huge initial investment. Farmers shall provide labour force in order to create their ownership.

Dimensions	:10mW x 30mL x 4mH
Wall	:concrete block
Floor	:concrete slab
Roof	:galvanized iron sheet
Ceiling	:ply wood
Electricity and water supply	:not necessary in initial stage
Cost	:approximately 1,500,000 Ksh

#### 4.3.2 Cost Estimate and Disbursement Schedule

##### 1) Conditions of Cost Estimate

Unit costs are determined based on similar work items used in the recent and on-going projects in Kenya, and material costs are taken from the Annual Tender 1997/98 conducted by district offices. Base price year of the project cost is August 1998 and exchange rate is 1.0 US\$ = 60.0 Ksh.

Construction costs of the facilities are estimated on a contract basis with labour intensive method for all projects. For self-help projects, costs for casual labours for the works such as canal excavation, structure excavation and backfilling and so on are not included in this estimate since they are planned to be provided by Ruungu/Karocho Irrigation Association in order to reduce the construction costs. Construction cost for irrigation facilities which are currently under construction under supervision of SISDO is taken from SISDO's estimate. On the other hand, community development and support services costs are estimated as it is implemented by the related government agencies, mainly MOA, through NGOs which are hired on a contract basis.

Associated costs necessary for project implementation are determined as seven percent of the construction cost for pre-engineering works, seven percent for administration activities and ten percent for consulting services. These percentages were based on the past experience in similar irrigation project. Pre-engineering cost means the cost for field investigation and survey for roads improvement. Administration cost, which is necessary for administrative works undertaken by governmental implementing agencies, contains salaries and wages of office staff, miscellaneous cost for administration, fuel and light expenses, etc. during implementation period. Consulting services to be undertaken by consultants and NGOs are necessary for the detailed design, preparation of the tender documents, supervision of the construction works, and community development & support services. Such consultants or NGOs shall be selected either through national or local tenders. Further ten percent of the construction cost is assumed as a physical contingency.

##### 2) Project Costs and Disbursement Schedule

###### a) Project Costs

Project cost consists of major two categories, i.e. construction cost and community development & support services cost. Summary of project costs is as shown below, and detailed cost and cost sharing by sector and by agency are shown in Annex Q.



**Summary of Project Cost for Ruungu/ Karocho Irrigation Project**

(Ksh)

1. Construction Cost	
1) Irrigation & Drainage Improvement	4,520,000
2) Marketing Improvement	1,500,000
3) Access Roads Improvement	19,660,000
4) Village/Farm Roads Improvement	1,710,000
5) Domestic Water Supply Improvement	0
Sub-total	27,390,000
2. Community Development & Support Services	
1) Agricultural Support Services	14,050,000
2) Community Development	7,120,000
3) Water Management Services	1,810,000
4) Marketing Support Services	284,000
5) Public Health Services	150,000
Sub-total	23,414,000
3. Associated Cost	
1) Pre-engineering Cost	1,601,000
2) Administration Cost	3,240,000
3) Consulting Services	4,628,000
Sub-total	9,469,000
4. Physical Contingency	2,287,000
<b>Total</b>	<b>62,560,000</b>

b) Disbursement Schedule

Disbursement schedule of the project cost by sector and by agency is prepared based on the planned implementation period of seven years, as presented in Annex Q. Procurement of funds will be the most critical factor particularly for self-help projects.

3) Operation and Maintenance Costs

Annual operation and maintenance costs are composed of salaries and wages of O&M staff, administration and general expenditures, depreciation and repair costs, maintenance cost of the facilities. It is assumed that annual operation and maintenance costs are estimated at two percent of the initial construction cost unless obtained specifically from each project or facility. Summary of annual operation and maintenance costs are as presented below and details by sector and by agency are shown in Annex R.

**Annual Operation and Maintenance Cost for Ruungu/ Karocho Irrigation Project**

(Ksh/year)

1) Irrigation & Drainage Facilities	62,000
2) Marketing Facilities	30,000
3) Access Roads	994,000
4) Village/Farm Roads	75,000
5) Domestic Water Supply Facilities	0
<b>Total</b>	<b>1,161,000</b>