1) Community Capability Building Plan

a) General Social Preparation Plan

At the beginning of the project cycle, it is proposed to conduct a one week PRA workshop within the Project Area, where the local community (members and non-members) will be facilitated to review their living environment i.e.:

- Community's history, key events and trend observations
- Community resources (physical, social, institutional)
- Problems and prioritized needs (using pair-wise scoring matrix)
- Action plans aimed at meeting the community's priority needs

The expected outcome of the social preparation exercise is establishment, within the community, of a sense of group identity, an increased awareness about their strength and potential as well commitment for self-reliance. Thus empowered, they will be in a better position to confront the challenges of the coming irrigation project. They will be transformed from mere spectators into active participants and contributors into the irrigation drama.

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 and a private consulting firm or NGOs experienced in PRA and PDM approaches .

b) Capability Building Plan for Farmers Organization

There are four types of farmers organizations (three 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 follows;

Development and Capability-Building Plan for Farmers' Organization

Type of Farmer's Organization	Proposed Development Plan
Water Users' Association (WUA)	- Educate WUA members on requirements and implications of the intended irrigation system including the need for electing capable leaders to the management committee - Facilitate the community in reviewing and updating the PDM which they have already prepared making modifications as necessary - Train management members on organization, leadership, general and financial management
Cooperative Society	- Indirect strengthening of cooperative society through training of WUA since the two organizations have common membership - Promotion of a one day meeting attended by committee members of the Cooperative and WUA to agree on implications of increased irrigated horticultural production - Promotion of linkage with WUA and Production /Marketing groups with regard to stocking and provision of farm inputs on cash or credit
Women Groups	- Training on proposed irrigation development including review of PDM - Training in organization, general and financial management - Inviting and involving women groups in reviewing technical irrigation design (engineering and agronomic) particularly from viewpoints of labour and irrigation benefits as well as their perceived role and preferences

Type of Farmer's Organization	Proposed Development Plan
Production/Marketing Groups	- Promotion of neighborhood production/marketing groups - Training in organization, general management, agricultural marketing, accounting, and financial management - Training in souring and collation of market information - Training in production planning in relation to market opportunities

2) Development and Capability-Building of Local NGOs

Currently, there are no local NGOs undertaking development activities in Nkunjumo Water Project. However, it is recommended that the MOA/IDB approach Catholic and Methodist churches, which have a substantial following within the Project Area, to find out if they would be interested in providing some support services to the project community i.e. strengthening farmers organizations and intermediating in credit delivery. It is known that in Meru District both churches are already involved in rural water supplies as well as irrigation (e.g. Nguru/Gakirwe Irrigation Scheme by the Catholic Church).

In order to enhance the capability of the two church NGOs in providing the envisaged support services, it is planned to provide training to their staff 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 coordinated 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 goup-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 facilitation 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 Nkunjumo 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 local NGOs, relevant ministries such as MOA, Culture and Social Services, Public Works, Water Development etc
- Private sector produce buyers and local in-put stockiest

Using the existing PDM, the review will highlight achievements and failures and pin-point accountability for undertaking follow-up activities. The expected outcome of these annual reviews is to re-inforce the community's commitment and confidence to diagnose 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 and 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 these multidisciplinary support services, IDB field staff at district and divisional levels ought to possess operational skills in technical, economic, sociological and managerial fields. Hence it is proposed that staff of IDB field offices (at district and divisional levels) 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 consultants from the private sector or NGOs. Coupled 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)

In the course of project implementation, the District Agricultural Office will play a crucial role in:

- Facilitating social preparation sessions
- Coordinating 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 Coordinator at IDB Nairobi office will make necessary consultations with the District Agricultural office at Meru particularly 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

The District Agricultural Office presently accommodates 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. Currently, these skills are availed by various specialists to the project community in an uncoordinated manner.

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 specialists operational work plan.

As part of this strengthening of DAO's office, it is also proposed to:

- Deploy a suitable frontline extension worker (FEW) who will provide services to Nkunjumo Project Area 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 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
- 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 Stockiest	- 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
Cooperative Society	Farm Chemical Distributor	- Procurement of farm inputs in bulk
Marketing & Women GPs	Horticultural Exporters	- Market access through production/marketing contracts
	Banks	- Banking facilities for members contributions and sales proceeds
	Local Input Stockiest	- 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 Stockiest	- 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 capability 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 six years. The phasing of the various training events is illustrated as follows;

Implementation Schedule of Capability-Building Training Workshops

Training Event	Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7
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 (Co-operative 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)							

3.2.3 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 worked in conjunction with the team to help identify the particular physical, social and economic possibilities and constraints at this location. What follows are the horticulturists recommendations for Nkunjumo. An appropriate land use plan is very site specific, and contingent on the individual farm conditions and the current market conditions. For example, some farms in Nkunjumo have only a limited area of land available for irrigation, and this is often on a slope. The suggestions that follow will need modification to meet these particular conditions. Project staff should work with the Nkunjumo farmers to develop the most appropriate soil conservation plan and a suitably modified cropping pattern.

The overall problems at this site limiting the successful expansion of the irrigated area are likely to be; competition for labour between horticulture and coffee; market competition from growers elsewhere in Meru with better climates and land resources; the availability of suitable flat cropland; and limited irrigation water, especially in the downstream portions of the system.

1) Land Use Plan

The available land in the Nkunjumo area is fairly intensively farmed at the present time, and the original vegetation has been considerably modified. A large portion of the currently farmed area is on the steep terraced slopes of the ridges, and there is only very limited scope for opening up new land for agriculture. Rainfall is only limited for a short portion of the year, (June to September). The main restrictions to successful expansion of the irrigation area are likely to include competition for labour between the coffee and the irrigated crops, especially during the November-January and May-July harvest seasons. The availability of flat or gentle sloping land, without excsssive shade is likely to be a limitation, especially in the upper parts of the scheme. A demonstration trial of drip irrigation should be conducted, as steep slopes, especially in the lower parts of the scheme are likely to limit the expansion of irrigation. The Nkunjumo soils are acidic, with low levels of exchangeable cations. This means that non-acidifying fertilizers such as Calcium Ammonium Nitrate and the superphosphates should be used.

The current farming system is crop plus improved livestock farming using a mixture of improved and traditional technology. Introducing and expanding the use of improved inputs is likely to proceed rapidly in this scheme as they are already using pesticides and fertilizer and are used to intensive management of their coffee crop. Meru and Nkubu are close by and good sources of inputs.

2) Crop Selection and Cropping Pattern

The recommendation for Nkunjomo is to grow a mixture of domestic and export vegetables for both home use and for sale, like cabbage, French beans, maize and potato.

Proposed Cropping Areas at Nkunjumo with Project

Land Use	Land Area	Cropping Intensity	Crop	Area
(%)	(ha)	(%)		(ha)
1. Irrigated	56			
- Food Crops		53	Maize/beans	29.8
		10	Beans	5.6
		5	Kale	2.9
		5	Sweet Potato	2.8
73%			Sub-total	41.1
- Cash Crops		12	Potato	6.8
		6.9	Cabbage	3.9
		5	Maize (green)	2.8
		2.8	Tomato	1.6
		2.5	French beans	1.4
		1.4	Onion	0.8
31%			Sub-total	17.3
- Animal Feed		0.5	Napier grass	1.6
3%			Sub-total	1.6

Land Use	Land Area	Cropping Intensity	Crop	Area
- Perennials		40	Coffee	22.4
		5	Banana	2.8
45%			Sub-Total	25.2
		152%	Irrigated Total	85.2
2. Rainfed	104.3			
- Food Crops		30	Beans	32
		28	Maize/beans	29
		3	Kale	3.2
		0.2	Sweet Potato	0.3
62%			Sub-total	64.5
- Cash Crops		6.9	Potato	7.2
		3	Cabbage	3.2
		2	French beans	2.4
		1.8	Tomato	1.9
		1.5	Millet	1.6
		0.2	Onion	0.2
16%			Sub-total	16.5
- Perennials		45	Coffe	47
		6	Banana	6.4
51%			Sub-Total	53.4
		129%	Rainfed Total	134.4
Total	160.3			219.6

Source: JICA Study Team. Overall cropping intensity = 219.6 ha/160.3 x 100 = 137%

Suitable fruit trees for the site include macademia, avocado, guava, banana and pawpaw. Large plantings are not envisaged, but a few improved varieties grown around the homesteads are an easy way to improve the locals nutrition, especially of the children. Stall fed cattle are important in the area and it is recommended that irrigated napier grass be grown to increase milk yields and improve animal growth rates. The small new area planting of bananas proposed should be located and managed in such a way that the residues are available for cattle feed.

The most important crop at the moment is coffee, its total area is projected to remain unchanged, but water resources have been provisionally allocated to irrigate nearly 50 percent of the exisiting area. Combining the general high standard of management, (pruning, terracing, mulching, fertilizing) already seen in the area with irrigation should result in significant yield increases, plus a steadier production stream. Like coffee, the existing maize area will remain essentially unchanged, but more than 50 percent of this area is earmarked for increased levels of fertilizer use, and improved timing of the fertilizer application to maximize the return from growing irrigated high yielding varieties at high plant populations. The area under green maize has been increased as this is profitable crop particularly out of the main maize production season (October-January) and the urban markets of Nkubu and Meru are easy to access using the adjacent tarmac road.

The current areas under millet and onion are projected to remain unchanged. The banana area is also projected to remain unchanged, but water has been earmarked to allow 30percent of the existing area to be irrigated. The area is suitable and bananas are a productive crop, if given good management. The area under french bean is projected to remain static, and the same proportion of irrigated to rainfed production is also assumed. The existing area under french bean is small and the area available for expanding its production is limited. The cloudy conditions, slightly lower night temperatures and relatively high humidity mean that yields will not be optimum, and other areas close by, such as Mitunguu with larger areas of production are more competitive.

For kale, cabbage and potato the proportion of the current crop irrigated will increase. There is also a small increase in the area in the area of tomato, and a larger increase in the sweet potato area is projected. Given the topography, farm land areas, and existing cropping in Nkunjumo, it is not seen as ever likely to change its primary dependance on coffee as its main crop. Sweet potato and kale have the advantage of being both controlled by the women, and also tolerant of neglect. If the proposed cropping pattern is adopted, potato and cabbage are likely to be the main vegetables sold on the local markets and tomato will be a secondary crop.

3) Proposed Farming Systems

Expanded use of improved seed, new varieties, appropriate fertilizers and chemicals, combined with training in proper handling, packing and transport of crops could be conducted in conjunction with the OECF funded facilities and staff in Nkubu. Consideration should be given to testing and introducing drip irrigation techniques. Intensive horticulture, with short duration crops using improved technology and inputs would maximize the return from the limited flat land and water available in this location.

Table3.2-1 shows the proposed cropping pattern of Nkunjumo Water Project.

For the crops such as cabbage and tomato that are intolerant of the acid soils found in Nkunjumo liming is recommended. Using dolomitic limestone to increase the ph from its current level of 4.5-5 to between 5.5-6 will not only improve crop growth and reduce susceptibility to certain diseases, but will also supply calcium and magnesium which may be inadequate in these soils.

Irrigation Area = 56ha Cropping Intencity = 152 %

Crop	Crop Area (ha)			Growing Season(days)				
	Maximum		Total					
	MAR-JUL	AUG-FEB		Initial S.	Dev.S	Mid. S.	Late S.	Total
Coffee	22.4	22.4	22.4	-	-	-	-	365
Bananas	2.8	2.8	2.8	-	-	-	-	365
Napier	1.6	1.6	1.6	-	-	-	-	365
Sweet Potato	2.8	-	2.8	20	30	40	30	120
Beans	2.8	2.8	5.6	15	20	35	25	95
Maize & Beans	16.8	13.0	29.8	25	30	45	35	135
French Beans	-	1.4	1.4	15	20	30	10	75
Irish Potato	4.0	2.8	6.8	20	35	55	40	150
Onion	-	0.8	0.8	30	35	45	30	140
Tomato	-	1.6	1.6	20	30	40	30	120
Green Maize	-	2.8	2.8	25	30	40	15	110
Cabbage/Kale	2.8	4.0	6.8	20	25	35	30	110
Total	56.0	56.0	85.2					

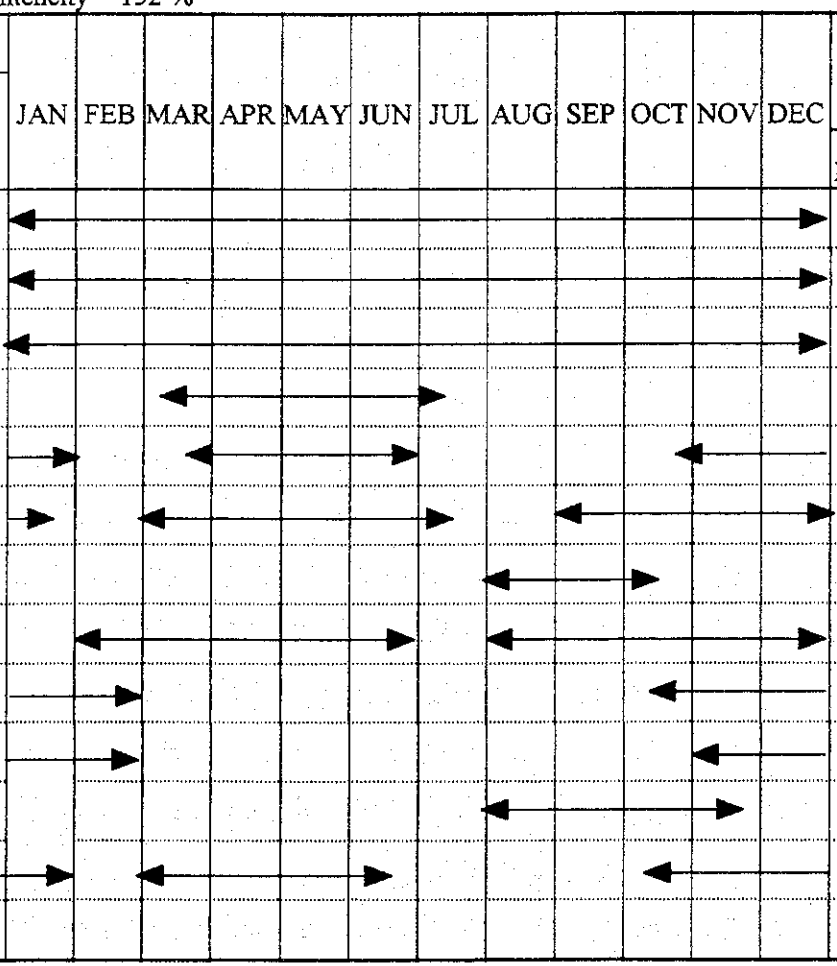


Table 3.2-1 Proposed Cropping Pattern of Nkunjumo Water Project

Projected Crop Production at Nkunjumo with Project

Crop	Area Rainfed	Area Irrigated	Unit Yields	Total Production
	(ha)	(ha)	(ton/ha)	(ton)
Maize in mixture	29	29.8	2/2.25	125
Beans in mixture	29	29.8	0.4/0.6	29
Maize (green)	0	2.8	4	11
Beans	32	5.6	0.65/0.75	25
Kale	3.2	2.9	8/12	60
Potato	7.2	6.8	8/10	126
Cabbage	3.2	3.9	15/16	110
French Beans	2.4	1.4	3.5/4	14
Sweet Potato	0.3	2.8	7/8.5	26
Tomato	1.9	1.6	7.5/10	30
Millet	1.6	0	0.8	1
Onion	0.2	0.8	6.5/7.5	7
Napier	0	1.6	15	24
Coffee	47	22.4	4.5/5.5	335
Banana	6.4	2.8	8.5/10	83

Source: JICA Study Team estimates

Trials of crops such as snow pea, and sugar snap could be conducted, but the high levels of humidity and the cool mornings plus overcast weather leading to morning mists, combined with the costs of fungicides are likely to mean that the incidence of fungal diseases will make production of quality product uneconomical.

The use of the farmyard manure on selected plots will increase their organic matter content, improve the utilization of chemical fertilizers and reduce the susceptibility to erosion due to rain drop impact. Some gully erosion on heavily grazed pasture was seen in the area.

A small area of onion is planned for Nkunjumo, the prices in October and November in the Gakoromone market are high, the problem about producing for this market at this time is that the maturing and harvest of onion needs dry weather and these are peak wet months in Nkunjumo. Production for harvest in January and February is likely to be much easier.

The design cropping pattern at full development is shown below. The peak water demand period is during June. This is the beginning of the dry season. There are two smaller water demand peaks at the beginning of January and beginning of March. Shifting crops and planting dates will change these periods of peak water use.

Although overhead piped irrigation is planned for Nkunjumo, so that transmission losses are not a major criteria, the study area soils or water have not been tested for salinity/alkalinity, or soil moisture storage capacity. It is possible that drip irrigation would work quite well under the Nkunjumo conditions, if suitable markets can be found for crops that integrate well with the existing coffee, and thus justify the capital investment. But this hypothesis will need further testing.

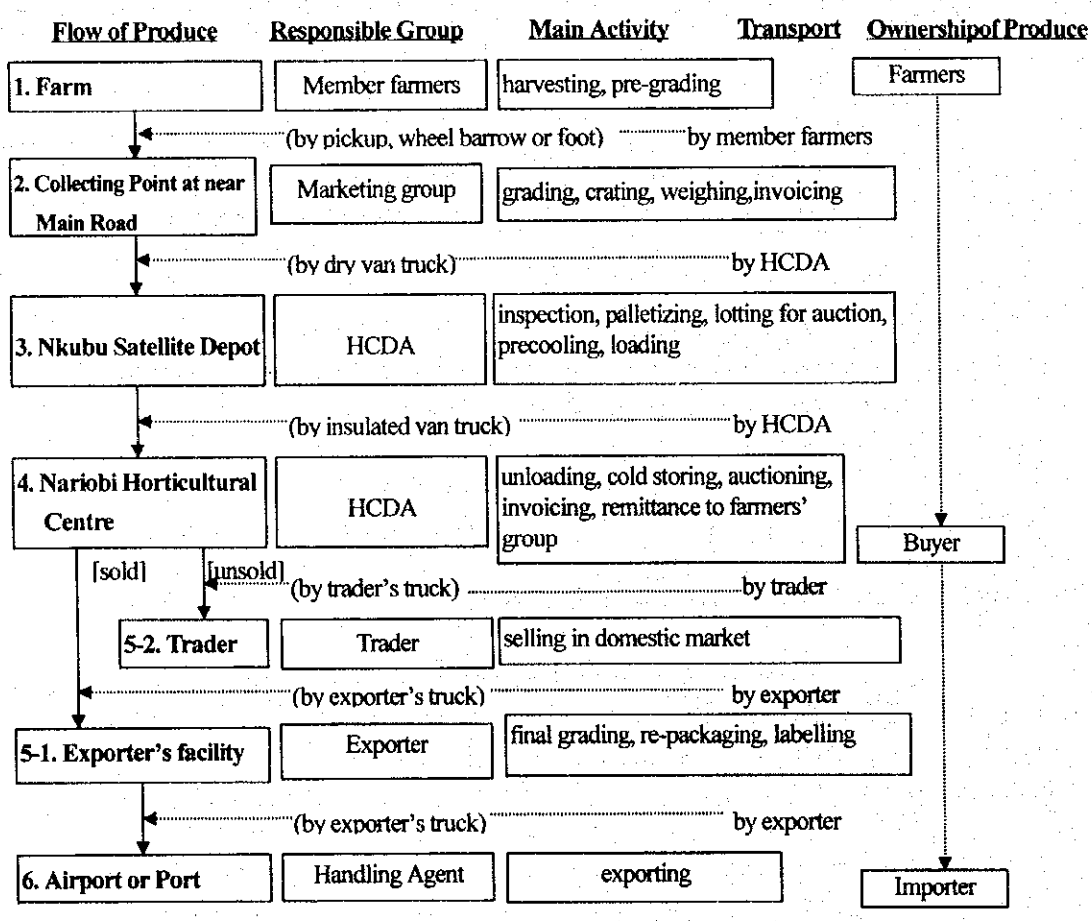
4) Animal Husbandry Plan

Although the rainfall is comparatively good and the soils are adequate, the levels of dry matter production in the area are limited somewhat by the cool night temperature during most of the year. A small area (1.6 ha) of irrigation has been allocated to irrigated napier, a larger area (29.8 ha) for maize. The expansion of the areas under sweet potato and bananas will also increase the amount of residues available for the zero grazed cattle found in the area. Given the heavily wooded nature of the nearby steep sided valleys, predators are likely to be a problem in improving and expanding the production of the local chickens. Introduction of improved local breeds can be tried, through the provision of improved breed cocks for sale.

5) Post-Harvest and Rural Industry Plan

The Project Area is close to Nkubu Satellite Depot for precooling and auction at distance of 10km. The Satellite Depot will provide various services of horticultural marketing. The flow of produce can be summarized as shown below:

Produce Flow Diagram on Horticultural Produce Handling Facilities Project



For export of green beans, the construction of grading and packing shed with charcoal temporary store is recommended. Quality assurance has become an important aspect in export trade. The shed is quite simple using timbers for frame, vinyl chloride plastic films for side cover, grading tables and safety tapped water. The washing of hands when handling produce are requisite. Before and after grading, it is better to store the produce in charcoal covered by nets. The latent heat of water in charcoal will remove the respiration heat of green beans and direct sunshine can be avoided. It is estimated that about 5-10 degree centigrade can be lowered than ambient temperature according to the test by Karen Appropriate Technology Center. Also for local consumed produce, member farmers can store before group loading or awaiting traders. These facilities can be constructed or funded by farmers themselves using local materials, and it will motivate ownership of facilities among members for sustainable operation.

3.2.4 Marketing Plan of Agricultural Products

1) Strategies on Marketing Development

The main strategies for this Project Areas are, i) horticultural production planning to meet market demands at Gakoromone wholesale market with price information collection in order to shift from heavy depending upon coffee production, ii) Direct sale at the Gakoromone wholesale market with transporting arrangement or auction consignment planned at the market, iii) expansion of marketing alternatives for export produce by auction consignment with HCDA, iv) 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
Indicated problems on PCM workshop			
- Poor marketing arrangement for crops - Lack of market for produce - Low prices for produce	Included in the ways below		
- Inadequate market information	- 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 local consumed produce	- Marketing expert from HCDA-Meru	
	- Seminar on trends in foreign markets	- Representative of exporters or FPEAK staff	

Problems/Constraints	Interventions/Activities	Agency/Operation Body Concerned	Outputs
- Low quality of agricultural produce	- Seminar on varieties and certified seeds at JKUAT and other institutions managed by the government - Provision of certified seed procurement information	- KARI - Farm inputs/ marketing officer in DAO-Meru - Marketing expert of HCDA-Nkubu	- Better yields and plant protection - Assurance of germination rate
	- Seminar on maximum residue levels (MRLs), crop assurance and grading using Export Crop Bulletin at JKUAT and other institutions managed by the government	- Marketing expert of HCDA	- Attaining information of for export green beans, crop assurance and grading - Increasing materials for decision-making in selection of crop
- Lack of alternative buyers of the agricultural produce - Exploitation by middlemen	- Seminar on auction consignment at JKUAT and other institutions managed by the government - Auctioning services at Nairobi Horticultural Centre for export produce	- Marketing expert of HCDA - HCDA Nkubu Satellite Depot	- Introduction of auction consignment with HCDA - Organizing small scale marketing groups
	- Auction services at Gakoromone wholesale market for local consumed produce - Following up the marketing groups with provision of information		
- 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 small scale marketing groups
- High transport costs to the market	- Auction consigning to Nairobi Horticultural Centre for export produce - Auction consigning to Gakoromone wholesale market for local consumed produce	- Marketing expert of HCDA-Meru & Nkubu	- Better trading prices than middlemen. - Cheaper costs than *Matatu*
	- Group loading and transport arrangement for local consumed produce	- Marketing groups	- Creating options of market alternatives to consign or sell directly at Gakoromone wholesale market
Identified problems by Study Team			
Heavy dependence upon coffee cherry production for income generating Frequent buying of pulses and vegetables from outside	- Shifting to horticultural production - Lecturing and practice on horticultural production at JKUAT and other institutions managed by the government	- Farmers themselves - MOA staff on horticulture with lectures/technicians	- More Stable income than current situation - Saving on food expenses

Problems/Constraints	Interventions/Activities	Agency/Operation Body Concerned	Outputs
High losses due to bad weather conditions	- Weather forecasting	- Kenya broadcasting (KBC) - DAO-Meru - Member farmers	- Crop planning to select fluctuating produce such as green maize, beans, cabbage, kale, fresh peas when expecting drought, and red bulb dry onion, carrot and red irish potato when heavy rain
Lack of knowledge on consumers' or buyers' demands	- Field trip pursuing marketing route; Nairobi markets, exporters' grading & packing facilities, Nairobi Horticultural Centre, Nairobi coffee auction	- MOA staff	- Better understanding of consumers' or buyers' demands and how produce are handled

2) Structure of Functional Marketing Group

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

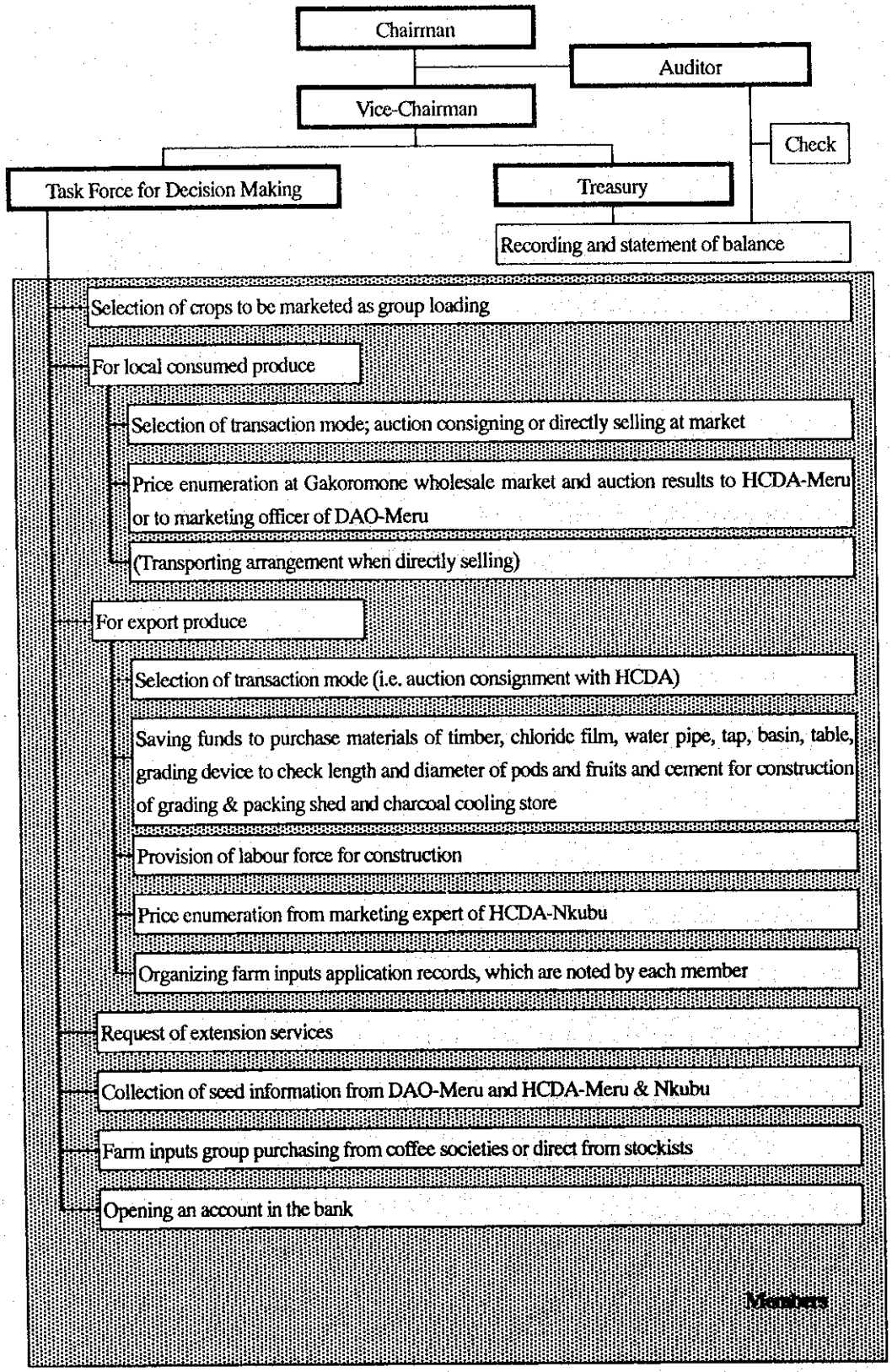
3) Strategic Marketable Horticultural Crops

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

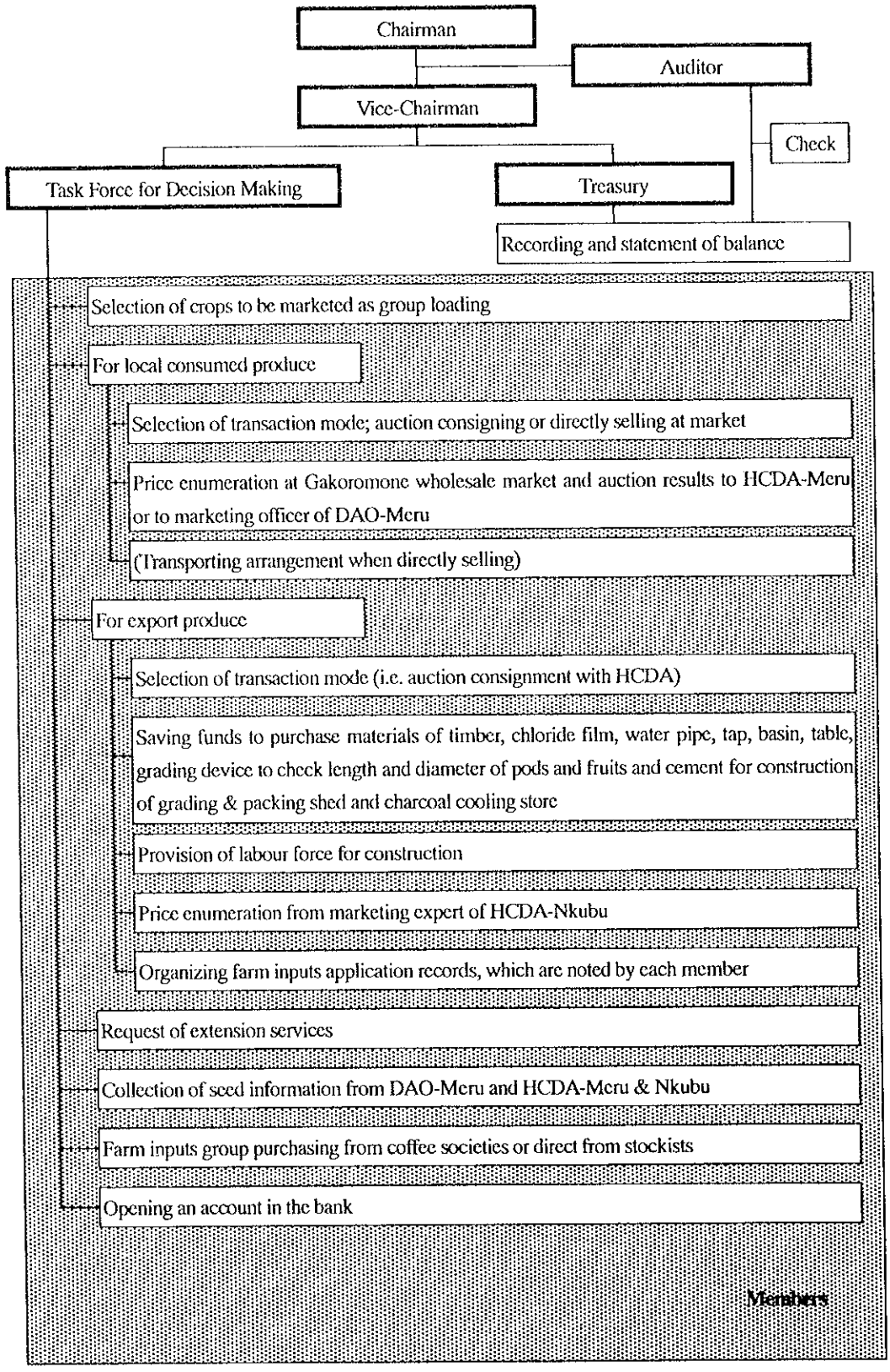
Strategic Horticultural Crops in the Project Area

Category	Strategic Crop
Home consumed produce	dry maize (Pioneer Hybrid H3253, Cargill Hybrid), beans (Canadian Wonder, Rose Coco, Dolichos, Wairimu when expecting drought), kale
Local consumed produce	ripe banana (Apple, Giant Cavendish), green maize, cabbage (Copenhagen), spring onion, fresh pea, sweet potato, spinach, tomato (Cal J)
Export produce	French bean (Monel, Caudia, Gloria, Morgan, Espada), macadamia nut, avocado (Fuerte, Hass), mango (Tommy Atkins, Van Dyke, Keitt, Kent, Apple, and in future Matthias, Kensington, Azacus, Zill, Nimrod, Irwin Sabine after observation), baby corn, snowpea (Carouby, Mommoth Melting Sugar, Drwart Grey Sugar, Oregon Sugar Pod, Suger-Snap, Tolendo), runner bean

Recommended Organization Chart and the Functions



Recommended Organization Chart and the Functions



3.2.5 Environmental Management Plan

1) Soil and Water Conservation Plan

Farmers of this area are comparatively practicing soil conservation activities. However, in case that horticulture is practiced instead of coffee growing, soil conservation activities should be strengthened. Therefore, encouragement of farmers for the soil and water conservation shall be included in the extension service and farmers' training by DAO. MOA has the capability of these activities as they have the Soil and Water Conservation Manual published by Soil and Water Conservation Branch and a soil conservation officer is assigned in each district office.

The extension service and farmers' training include the field trip of model farm and the technical support for the following items:

- Plantation of trees along the river for feed, firewood and soil conservation.
- Plantation of grass as terrace banks.
- Sanitary management of livestock and production of manure.
- Thoroughness of crop rotation for horticulture.

Farmers' training should be held at least for group leaders including women's groups. Some farms of participants can be used as practical training places so that farmers understand clearly how to conserve soil and water in their farm.

It is considered to choose several species of trees and grass for plantation to avoid the risk of diseases and insect damage. It may be better that MOA will support some active farmers groups for the production of seedlings and group members will visit the farm of each member with seedlings in turn to advice each other how to improve the farm and work together.

2) Public Health Plan

The extension service and farmers' training shall include the encouragement of farmers' awareness about the risk and appropriate use of agrochemical including the system of MRL. HCDA has the extension manual.

3) Watershed Management Plan

As the source of Mariara River is in Mt. Kenya Forest, the management of Mt. Kenya Forest is important for the stable water supply for drinking and irrigation in the Project Area. This area is managed by Forestry Department and the management shall be strengthened against illegal logging.

3.2.6 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 mentioned above, 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 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 continue fulfilling its members' expectations of reliable water supply, it will need to maintain close linkages with other organizations and agencies. It is therefore planned to encourage linkages with external organizations as summarized in table.

WUA Linkages with Other Institutions

Institution	Linkage Purpose/Advantage
Ministry of Agriculture	- Advisory services on design, implementation, operation and maintenance of irrigation system - Coordination of other support services to the project community - Organization and management support
Ministry of Land Reclamation, Regional and Water Development	- Security of irrigation water rights
Cooperative Society	- Possible input credit facilities for members
Local NGOs	- Availability of loans on affordable terms - Organization and management support
Private Sector	- Construction of irrigation infrastructure - Source of farm in-puts for members

2) Cooperative Development Plan

a) Education and Training

The education and training of the Cooperative Society will be effected indirectly through the WUA. This is so because the cooperative shares the same membership with the Water Users' Association. Hence, members whose social and community awareness is enhanced through WUA training, will in turn contribute towards strengthening of the cooperative society.

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.

b) Financial and General Management Training

Financial Management Training

The Cooperative Society has an established financial management system already put in place by the Ministry of Cooperative Development. However, on the basis of problems indicated by the members (ref. problem tree), the society's performance could be improved if the management committee were exposed to a short training session on:

- Operational cost management
- Improved budget control procedures

General Management Training

The quality of management in coffee cooperative societies is generally low throughout the country. Hence the Project Area coffee cooperative society is likely to benefit from 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

The Coffee 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	- Advisory services on coffee husbandry - Coordination of other support services to the cooperative
Ministry of Land Reclamation, Regional and Water Development	- Security of water rights for coffee processing
WUA Production/Marketing Groups	- Purchase of farm inputs by WUA members - Purchase of farm inputs by group members
Private Sector	- Bulk supply of farm in-puts - Training in improved coffee handling and processing

3) Marketing Group Development Plan

a) Education and Training

Establishment of production/marketing groups is aimed at addressing major problems currently facing smallholder horticultural production (Ref. Problem Tree). The groups are expected to put in place a mechanism for co-ordinating production and marketing opportunities. More specifically each group will identify its own marketing outlets and then schedule the members production to match market requirements. The alternative of organizing marketing for the entire project community was considered but was found unattractive because of its excessive management requirements. The relatively smaller neighbourhood marketing group (30-50 members) consists of members who know each other well and is 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

An education visit to "Baricho Marketing Group" in Kirinyaga District would serve to demonstrate advantages and mode of operation of such a group.

b) Financial and general Management Training

As part of project implementation, it is expected that production/marketing groups will be formed. For such groups to function effectively, they will need training in financial and general management skills as outlined below (see Annex J for details).

Financial Management Training

- Members transaction records; delivery and receipt procedures
- Mode of payment by exporters to group and by group to individual members
- Banking procedures ; cash deposit and withdrawal procedures; operating a check 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 members
- Sourcing and processing of marketing information
- Accessing production technology; production planning in relation to market opportunities
- Production/purchase contract and implied legal issues
- Communication skills; sharpening negotiation and bargaining capabilities

c) Linkages with Other Institutions

Each production/marketing group will be encouraged to forge linkages with a number of institutions with a view to sourcing technical or physical benefits. The suggested pattern of linkages with other institutions is shown below;

Production /Marketing Group Linkages with Other Institutions

Institution	Linkage Purpose
Ministry of Agriculture/HCDA	- Souring marketing information &production technology - Organization and management support - Coordination of other support services to the group
Horticultural Export Companies Produce Brokers	- Purchase contract & market out-let for horticultural produce - Farm-input credit & production advice for contract crop - 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
Local Farm input Stockiest	- Availability of farm inputs - Possibility of short-term input credit
Banks	- Banking facilities for members contributions - Clearance of checks issued by exporter - Processing of checks issued by group to individual member

4) Women's Group Development Plan

The four women groups within the Project Areas offer an entry point for getting women's perspective in irrigation and irrigated horticultural production. In this regard, it is planned to conduct a training programmme targeted to these women groups with the aim of enhancing their capacity to effectively contribute to the design and implementation of the irrigation infrastructure. In addition, the training will stimulate the women to identify how the installed irrigation system can be adapted to meet their needs and concerns. A proposed training for women groups is outlined below while further details are given in Annex J.

a) Education and Training

A general education and training session will be conducted and 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-centered 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
- Negotiation/bargaining skills,

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 training in general management under the following topics:

- Present strengths, weaknesses, opportunities and threats to the women group
- Group organization; management principles; leadership; negotiation/bargaining skills
- Review of current activities and exploration of irrigation-related opportunities
- Forward-planning procedures; performance monitoring
- 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 are likely be the actual producers of most horticultural produce at Nkunjumo Project Area. For this reason, women groups could act as independent production/marketing groups and form similar institutional linkages. Hence the linkages are anticipated to be as shown below;

Women Group Linkages with other Institutions

Institution	Linkage Purpose/Advantage
Ministry of Agriculture/HCDA	- Souring women-specific production technology and market information - Coordination of other support services to the group
Horticultural Export Companies	- Purchase contract & market out-let for horticultural produce - Farm-input credit & production advice for contract crop
Produce Brokers	- Market outlet for farm produce - Indication (though distorted) of market information
WUA	- Reliable supply of irrigation water

Institution	Linkage Purpose/Advantage
Local NGOs Local Farm input Stockiest	- Organization and management support - Input credit facilities - Availability of farm inputs - Possibility of short-term input credit
Banks	- Banking facilities for members contributions - Clearance of checks issued by exporter - Processing of checks issued by group to individual member

3.2.7 Institutional Supporting System Development Plan

1) Agricultural Extension Services

Technology development, field trials, demonstration and extension in the model areas 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 Nyweri, Mariene and Meru.

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 Nairobi.

The implementation of the agricultural development plan for Nkunjump 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 in Meru. They will be asked to comment on the plan, as well as provide their input when specific technical problems arise in their field.

The Nkunjumo farmers themselves have the primary responsibility for managing the irrigation scheme, and implementing the irrigation development. 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, for example of drip irrigation 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 areas. Any involved NGOs staff will also be expected to participate on an ongoing basis.

2) Agricultural Credit Services

The possession rate of title deed in the Project Area is 55 percent based on the farm economic survey. Bank requires land as collateral on the occasion of financing, implying that possession of land title decides possibility for credit at present condition. Therefore, Ministry of Land and Settlement must promote to survey individual farmlands and publish the title deed immediately. At the same time, farmers must be enlightened about credit system. Through the educational training, farmers will understand how to apply credit, the meaning of principal, interest and how to repay. These educational training are to be

cooperated with main banks dealing with agricultural credit such as CBK, AFC, DBK, and DAO and cooperative society to facilitate smallholders access to agricultural credit. Fortunately, as irrigation group exists in Nkunjumo Area, assembly meeting will provide a good opportunity for their training to make them recognize and understand the credit system.

The other measure to improve accessibility is a relaxation of current credit conditions. Banks are required to reduce interest and expand repayment period taking into consideration economic condition of smallholders and their contribution to the regional economy. Not only credit for individuals but also for group must be studied by banks. Especially, land title should be published immediately for farmers who does not have it as well as promotion of organizing group for credit.

3) Agricultural Input Supply

The material of improved seeds and planting materials will be provided on a purchase basis. The private sector suppliers in Nkubu and Meru will be actively encouraged to develop new or existing outlets in the Model Areas, and to stock the required inputs for the proposed agricultural development.

4) Training to Strengthen Farmers' Organization

With the installation of the irrigation system, there will be need for strengthening farmers organizations, so that they can more effectively undertake system operation & maintenance as well as optimize on horticultural production. For such strengthening to be in place, institutions that provide support services to the project community must possess appropriate skills and approaches.

In this connection, a training programme for staff of these support institutions is proposed. In the first instance, it is planned that MOA, as the irrigation project promoter, convene a meeting in Meru where staff from these institutions will be:

- Briefed on the planned irrigation activities at Nkunjumo
- Discuss and agree on a common approach to 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 strengthening farmers' organizations is given as follows;

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

Institution	Training Aimed at Enhancing ability to Strengthen Farmers Organizations	Farmers' Organization to be Strengthened
Front-line Extension Worker (FEW)	- Community organization and PRA approaches - Hands-on irrigation technology	- WUA - Production/Marketing Group - Women Group

Institution	Training Aimed at Enhancing ability to Strengthen Farmers Organizations	Farmers' Organization to be Strengthened
District Subject Matter Specialist	- Community organization and PRA approaches - Irrigated horticultural production technology - Participatory extension needs assessment methods - Social marketing skills - Improved extension planning, packaging and delivery	- Production/Marketing Group - Women Group
District Cooperative Office at Meru	- Factory level cost management - Coffee processing for quality improvement	- Cooperative Society
Diocese of Meru (Catholic Church)	- Community organization and PRA approaches - Financial management skills - Loan administration skills	- WUA - Women Group - Production/Marketing Group
Methodist Church of Kenya	- Community organization and PRA approaches - Financial management skills - Loan administration skills	- WUA - Women Group - Production/Marketing Group
Ministry of Culture & Social Services District Offiice, Meru	- Community needs assessment - Procedures for group formation, organization and follow-up - Work planning and scheduling	- Women Group - Production/marketing Group - WUA

3.2.8 Water Sources Development Plan

1) Available Water Sources

The available water sources for the Area is river water. There are two ways to use river water; one is stored water in a reservoir, other is run-off water. As the smallholder irrigation scheme is planned to be implemented by poor farmer themselves, it is required to make project cost as low as possible. Therefore, plan of storage construction was excluded from the project component. Thus, available water resources is only run-off water in the related river.

2) Methodology of Assessment of Water Availability

According to Water Act published by the 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;

$$Qd = Qb - Qm - Qcd$$

Where;

Qd: Dependable flow

Qb: 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.

Qm: River maintenance flow equivalent to 30 percent of the base flow

Qcd: 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 and total committed water in immediate down stream of a proposed intake site. The probability flow is analyzed by Iwai Method.

3) Assessment of Water Availability at Project Site

Since no gauging station exists at Nkunjumo intake site, the dependable flow at the intake site is estimated based on the discharge data at RGS-4F5 of the Mariara river. The minimum monthly discharge has a record length of 26 years from 1970 to 1996 as shown in Table G.2.3-2, Annex G.2. The estimated monthly probability flow is shown in Table 3.2-2 and the estimated minimum monthly flow with 80 percent probability of exceedance is 0.43 cu.m/sec which occurs in October.

The base flow at Nkunjumo intake site is estimated by multiplying the yield of base flow at RGS-4F5 and catchment area above Nkunjumo intake. Thus obtained base flow at Nkunjumo intake site is 0.328 cu.m/sec. Since there exists 21 water permits with total amount of 0.05cu.m/sec in the immediate down stream, the minimum dependable flow is estimated to be 0.179 cu.m/sec. The estimated monthly dependable water ranges from 0.179 to 0.636 cu.m/sec are shown in Table 3.2-2.

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 (0.179 cu.m/sec) and requested irrigation area (56 ha) by the WUA.

The dependable water source amount in the driest month at the intake site is 0.179 cu.m/sec, while, the maximum unit water requirement in the driest month is estimated at 1.3 lit/sec/ha as below. Thus, the maximum water requirement for the irrigation area of 56 ha is 0.073 cu.m/sec.

Maximum unit water requirement in the driest month is calculated as follow;

$$q = (ETo*Kc-Pe)/IE*10,000/(h*3,600)*7/v = 1.3 \text{ lit/sec/ha}$$

where;

Maximum reference crop evapotranspration (ETo)	:	4.0 mm/day (refer to subsequent Clause of 3.2.9)
Crop factor (Kc)	:	0.9 (average)
Effective rainfall (Pe)	:	0.5 mm/day
Irrigation efficiency(IE)	:	0.65 (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 positive value (0.106 cu.m/sec), the proposed irrigation area of 56 ha could be irrigable. Thus, it is proposed that the required water for the Project is taken by the existing intake weir.

Table 3.2-2 Dependable Water for Nkunjumo Water Project

1) Probability Analysis of River Flow at 4F5 Regular Gauging Stations

Station Code	4F5	
River	Mariara	
Drainage Area	42 sq.km	
Location	Latitude	00-01-30 S
	Longitude	37-39-30 E
Period of Record	1970-1996	

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	1.26	0.99	0.71	0.93	1.52	1.12	0.96	0.80	0.58	0.54	1.23	1.57	1.02
80	0.89	0.76	0.58	0.65	1.03	0.85	0.75	0.63	0.46	0.43	0.79	1.02	0.74
90	0.76	0.65	0.53	0.56	0.80	0.71	0.64	0.54	0.40	0.40	0.61	0.81	0.62

2) Probable River Flow at Intake Site

Water Source	Mariara River
Drainage Area at Intake Site	32.0 sq.km
Code of Adopted Station for Estimation	4F5 (Mariara River)
Drainage Area of Adopted Station	42.0 sq.km
Conversion Factor	0.762

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	0.960	0.754	0.541	0.709	1.158	0.853	0.731	0.610	0.442	0.411	0.937	1.196	0.775
80	0.678	0.579	0.442	0.495	0.785	0.648	0.571	0.480	0.350	0.328	0.602	0.777	0.561
90	0.579	0.495	0.404	0.427	0.610	0.541	0.488	0.411	0.305	0.305	0.465	0.617	0.470

3) Dependable River Flow at Intake Site

Base Flow(Qb):	0.328 cu.m/sec
River maintenance flow (30% of Qb=):	0.098 cu.m/sec
Committed water amount in upper basin of intake site:	0.639 cu.m/sec
Committed water amount below the intake of scheme:	0.050 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	0.530	0.431	0.294	0.347	0.636	0.499	0.423	0.332	0.202	0.179	0.454	0.629	0.413

3.2.9 Irrigation, Domestic and Institutional Water Supply Plan and Drainage Plan

1) Irrigation, Domestic and Institutional Water Supply Plan

The water supply plan for irrigation and domestic water use is established for the Project. The irrigation water demand is estimated for the proposed irrigation area of 56 ha and the institutional water for secondary school and polytechnics are estimated on the base target year of 2018.

a) Irrigation Plan

The area to be irrigated is discussed in previous paragraph of 3.2.8, based on the available water amount at the project intake site and the requested area by the WUAs. The 140 farmers that participate to the Project and each farmer is allocated the irrigation area of 0.4 ha each, and the total acreage of proposed irrigation area is 56 ha.

(1) Irrigation Water Requirement

(a) 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 and grain maize as a staple crop and coffee, bananas, cabbage, French beans, onion etc. as cash crops are selected. The proposed cropping pattern is shown in Table 3.2-1.

(b) Reference Crop Evapotranspiration

Reference crop evapotranspiration (ETo) is estimated by Penman Method on monthly basis. For the calculation of ETo value, meteorological data at Meru station, which is nearest one from the Project Area is adopted.

The calculation of ETo was carried out by using computer program "CROPWAT" owned by IDB. The estimated ETo rauged from 2.9 mm/day in July to 4.0 mm/day in March. The monthly ETo is tabulated in Table 3.2-3.

(c) Crop Evapotranspiration

The crop evapotranspiration (ETcrop) will be determined as;

Table 3.2-3 Reference Evapotranspiration (ETo) of Nkunjumo Water Project

	Temperature		Humidity	Wind	Sunshine	Radiation	ETo-
	maximum (degree)	minimum (degree)	mean (%)	Speed (km/day)	hours (hrs/day)	Mj/m2/day (km)	Penman (mm)
Jan	23.4	11.4	73	66.8	8.1	21.2	3.5
Feb	24.7	11.9	64	67.7	8.6	22.8	3.9
Mar	25.7	13.0	67	63.5	8.3	22.6	4.0
Apr	24.1	14.3	74	53.6	7.5	20.7	3.5
May	22.8	13.7	74	62.9	8.1	20.4	3.4
Jun	22.1	12.0	72	58.1	7.5	18.8	3.1
Jul	21.5	11.9	73	62.1	6.1	17.1	2.9
Aug	22.1	12.0	70	75.2	6.5	18.6	3.2
Sep	24.4	12.3	64	82.7	7.7	21.3	3.8
Oct	25.1	13.5	64	75.3	7.9	21.6	3.9
Nov	22.8	13.1	77	50.9	6.4	18.8	3.2
Dec	22.7	12.0	77	50.8	7.0	19.3	3.2
Ave/Total	23.5	12.6	70.8	64.1	7.5	20.3	1,264

Table 3.2-4 Crop Factors of Major Crops

	Initial Stage	Crop Dev. Stage	Mid-season. Stage	Late season Stage
Coffee	1.05	1.05	1.05	1.05
Bananas	0.90	0.90	0.90	0.90
Napier	1.00	1.00	1.00	1.00
Potatos	0.45	0.75	1.15	0.85
Maize & Beans	0.40	0.80	1.15	0.70
French bean	0.35	0.70	1.10	0.90
Green Maize	0.40	0.80	1.15	0.70
Onion	0.50	0.75	1.05	0.85
Tomato	0.50	0.75	1.05	0.85
Cabbage	0.45	0.75	1.05	0.90

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

Table 3.2-5 TRAM and Irrigation Interval of Nkunjumo Water Project

Crop	Depth of Effe. Root Zone(m)	Half-storage Capa.* (mm/m)	TRAM (mm)	ETo(max) (mm/day)	Kc(max)	ETcrop (mm/day)	Irrigation Interval (day)
Coffee	1.2	90	108	4.0	1.05	4.2	25.7
Bananas	1.2	90	108	4.0	0.90	3.6	30.0
Napier	0.8	90	72	4.0	1.00	4.0	18.0
Potatos	0.5	90	45	4.0	1.15	4.6	9.8
Maize & Beans	0.6	90	54	4.0	1.15	4.6	11.7
French beans	0.4	90	36	4.0	1.10	4.4	8.2
Green Maize	0.8	90	72	4.0	1.15	4.6	15.7
Onion	0.5	90	45	4.0	1.05	4.2	10.7
Tomato	0.5	90	45	4.0	1.05	4.2	10.7
Cabbage	0.4	90	36	4.0	1.05	4.2	8.6

*) Soil Type: Clay loam

ETcrop = ETo x Kc

Where;

ETcrop	: Crop evapotranspiration (mm/day)
ETo	: Reference crop evapotranspiration (mm/day)
Kc	: Crop factor (see Table3.2-4)

(d) 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;

NIR = ETcrop-Pe

Where;

NIR	: Net irrigation requirement (mm/day)
ETcrop	: Crop evapotranspiration (mm/day)
Pe	: Effective rainfall (mm/day)

The monthly effective rainfall can be estimated the following formula developed by Kalder in 1987 .

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

$Pem = 18.54 + 0.52 \times Pm$: for Pm > 100 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	10	7	14	173	46	2	4	3	4	78	204	34
mm/5day	1.7	1.2	2.3	28.8	7.7	0.3	0.7	0.5	0.7	13	34	5.7

The monthly rainfall data observed at Meru meteorological station are used for the analysis of effective rainfall. The data are shown in Table L.2.3-1, Annex L.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. Since the present water application of on-farm level is executed by sprinkler system, sprinkler irrigation is proposed for the Project. The E values for sprinkler irrigation is assumed to be 0.65. The GIR is estimated by the following equation;

GIR= NIR/E

Where;

GIR	: Gross irrigation requirement (mm/day)
NIR	: Net irrigation requirement (mm/day)
E	: Overall irrigation efficiency

E= Ea x Ec x Eo

Ea	: Field application efficiency (sprinkler irrigation 0.6-0.85)
Ec	: Conveyance efficiency (0.8-0.9)
Eo	: Operational efficiency (0.95)

Irrigation Water Requirement

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

IWR = GWR x A x 10,000 /(h x 3,600) x 7/v

where,

IWR	: Irrigation water requirement (lit/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 6 working days per week are generally adopted by farmers. Thus, the same values will be adopted for the estimation of IWR.

Based on the above mentioned procedure, the water requirement of 5-days basis is estimated at 67.5 lit/sec of the maximum irrigation water requirement. The variations of water requirement are illustrated in Figure 3.2-2. The detail are shown in Table L.2.1-2, Annex L.2.

(2) Time Interval of Irrigation Application

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

(a) Determination of depth of effective root zone
(b) Determination of half-storage capacity of soil
(c) Calculation of total ready available moisture (TRAM)
(d) 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;

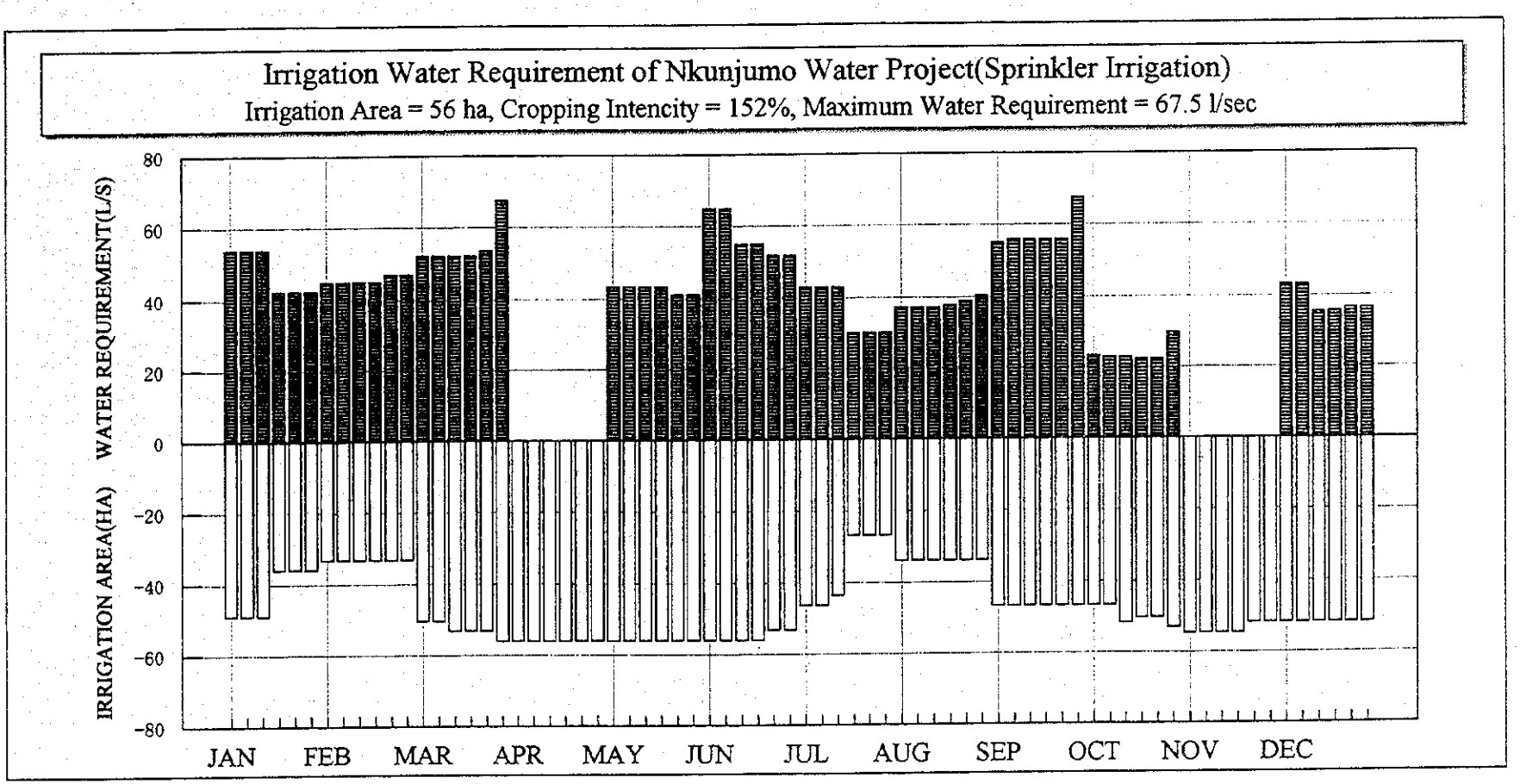


Figure 3.2-2 **Irrigation Water Requirement of Nkunjumo Water Project (Sprinkler Irrigation)**

Coffee	:	120 cm
Bananas	:	120 cm
Maize	:	80 cm
Potatoes	:	40 cm
Beans	:	60 cm
French beans	:	40 cm
Onion	:	50 cm
Tomato	:	50 cm
Cabbage	:	40 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 bellow;

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

The predominant soil type in the Project Area is clay loam.

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

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

TRAM = (depth of effective root zone) x (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 3.2-5. The estimated irrigation intervals for various crops ranged from eight to 30 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.

b) Domestic and Institutional Water Supply Plan

Water demands for domestic and institutional use are estimated by the following conditions;

- As a service population of water supply, the estimated population in 2018 is given.
- A rate of annual increase of population is 3.2 percent which is resent mean increase rate of Meru district.

- As a unit water demand per person, standard figures in the "Guidelines of implementation of the water act and the policies of the water apportionment board" published by WAB in 1983 are adopted.

The estimated demand for domestic and institutional water are shown below table.

Estimated Demands for Domestic and Institutional Water Supply

	Present Population (1998)	Service Population (2018)	Unit Water Demand (lit/day/person)	Total Demand (m3/day)	Operation hour (hr/day)	Design Discharge (lit/sec)
Domestic	2,200	4,130	45	186	12	4.3
Secondary Sch.	540	1,020	25	26	6	1.2
Polytechnics	34	60	25	1.5	6	0.1
Total	-	-	-	-	-	5.6

c) Water Management Plan

The plots to be irrigated are spread over the Project Area of 160 ha. Therefore, the area to be irrigated along proposed irrigation system is allocated according to the present command area along the existing pipeline.

As the proposed irrigation area of 56 ha is irrigated in six days, the irrigation area per day is 9.3 ha. As described above, irrigation operation time per day is 12 hours, then a night storage can be introduced to the system theoretically. However there is no adequate place for the facilitation of night storage because the proposed irrigation area extends in few distance from the intake facility. Thus, night storage is not introduced in the irrigation system.

The proposed domestic water is allocated according to the distribution of proposed irrigation area and the estimated institutional water for schools is allocated to actual demand points.

Since the existing water supply system is pipeline system with sprinkler, the pipeline system is proposed as an adaptable one. As a water application method, continuous system and rotational system are considered. The result of comparison to these systems on easiness of water management and construction cost of facilities is shown below, and the rotational system with much advantage than the continuous system is adopted.

Comparison of Irrigation System

Irrigation system	Water Management	Construction Cost
Continuous System	Difficult	High
Rotational System	Easy	Relative low

Irrigation water distribution by single rotation block will be unrealistic, because all beneficiaries take domestic water through their own outlet tabs every day. Therefore, the water management with plural rotation blocks is proposed.

Considering the alignment of existing pipeline and the geographical feature of the Project Area, seven rotation blocks are proposed. The daily irrigation water application is separately executed at seven places at the same time. Therefore, seven water guard will be required to control the system. The irrigation network is illustrated in Figure 3.2-3.

2) Drainage Plan

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

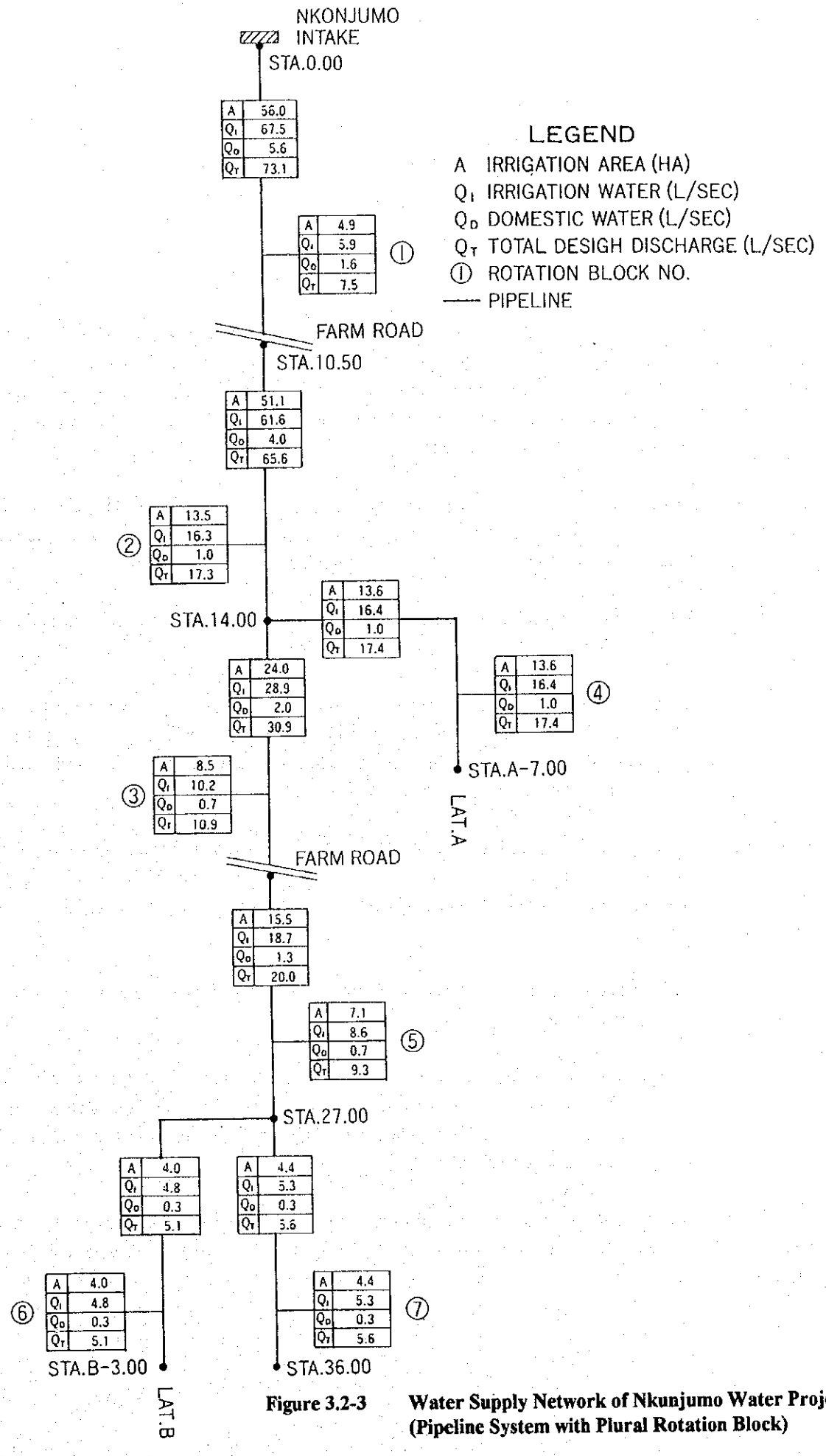


Figure 3.2-3 **Water Supply Network of Nkunjumo Water Project (Pipeline System with Plural Rotation Block)**

3.3 Physical Plan and Cost Estimate

3.3.1 Agriculture and Rural Infrastructure Plan

1) Agriculture Infrastructure Plan

a) Irrigation and Drainage Facilities

Improved water supply system of Nkunjumo Water Project shall be used for both irrigation and domestic water as presently utilized. Major purpose of the improvement is to supply sufficient water for both irrigation and domestic use, to provide more water pressure for sprinkler irrigation at the upper part of the system, and to supply safe water for domestic use. Alternative study is made to meet the most effective and realistic water supply system based on farmers needs and field conditions.

Alternative-1: Present intake site is retained, therefore existing intake box is to be replaced by adequate size of new intake box. In this case, however, need of more water pressure is not attained. Alternative-1 is further divided into two sub-alternatives.

A-1-a: Additional pipeline is planned to supplement existing pipeline, therefore size of pipes is minimized.

A-1-b: Additional pipeline is planned separately for irrigation use only, therefore existing one is used for domestic water only, and size of additional pipes becomes large. Safe domestic water can be supplied providing simple water treatment works which include filtration tank and pot chlorination.

Alternative-2: Intake site is relocated at 150m upstream of existing site, therefore existing intake box will be demolished because two intake boxes are not permitted under one water permit. In this case, need of more water pressure can be attained. Alternative-2 is also further divided into two cases.

A-2-a: Additional pipeline is planned to supplement existing pipeline, therefore size of pipes is minimized.

A-2-b: Additional pipeline is planned separately for irrigation use only, therefore existing one is used for domestic water only and size of additional pipes becomes large. Safe domestic water can be supplied providing simple water works which include filtration tank and pot chlorination.

Furthermore, in all alternatives, structural improvement on existing pipeline is planned such as supply of valve boxes at division points and building of water tanks for secondary school and youth polytechnics.

Alternative Study for Improvement of Nkunjumo Water Supply System

Conditions			Objectives/Needs for Improvement			Direct Cost
Alternatives	Intake location	Pipeline system for irrigation & domestic use	To increase water supply capacity	To provide more water pressure	To supply safe domestic water	('000 Ksh)
A – 1 – a	Existing site	Common use	Attained	Not attained	Not attained	3,278
A – 1 – b	- do -	Separated	Attained	Not attained	Attained	4,882
A – 2 – a	Upstream	Common use	Attained	Attained	Not attained	3,953
A – 2 – b	- do -	Separated	Attained	Attained	Attained	5,656

As a result of Alternative study, Alternative 2-a is recommended for the improvement of Nkunjumo Water Supply System. From view point of attainment of objectives/needs of improvement, Alternative 2-b is preferable to other alternatives, but its costs seem to be too high. Need for safe domestic water supply would be less priority among above three objectives/ needs according to the interview survey, therefore Alternative 2-a which cost is 2nd lowest among alternatives can provide more water pressure for irrigation purpose is recommended. However, final decision shall be made by association members who have to bear the construction cost (Refer to Annex M and P).

b) Village/Farm Roads

Village/farm roads shall be rehabilitated as a spot improvement method which requires road grading and regravelling. Side drains shall be properly built with steps at steep sections to protect road surface from heavy rain water which will easily develop deep gullies on the road. A total length of the village/farm road improvement shall be 2.5 km (Refer to Annex P).

2) Rural Infrastructure Plan

a) Domestic Water Supply

Improvement of domestic water supply is included in the improvement plan of the irrigation water supply system as mentioned above. Major facility improvement related to the domestic water supply is water storage tanks for schools and stop valves at division points.

b) Access Roads

Access roads are not included in the improvement plans.

c) Post-Harvest and Agro-Industry Plan

The grading and packing shed must be funded and constructed by farmers marketing groups in order to create motivation of self-help, strengthen relationship among members, ownership and also lower the construction costs by using local materials and labour force of members.

3.3.2 Regional Marketing Improvement Plan for Transaction Modes and Information Flows of Horticultural Produce in Gakoromone Wholesale Market

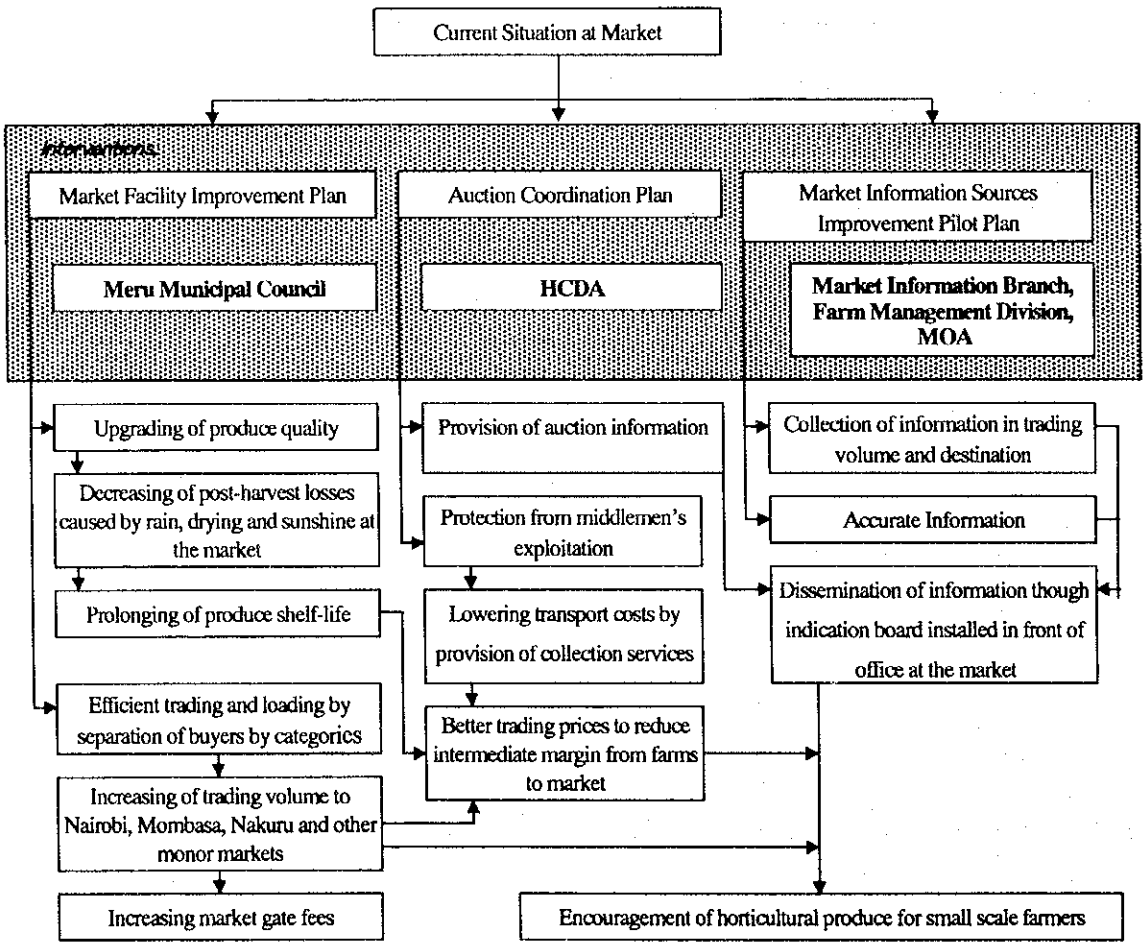
1) Proposed Strategies

The plan has strategies to promote trading activities of horticultural crops, grains and pulses of Meru produce through market facility improvement, improve current exploiting transaction modes between small-scale farmers and middlemen, and to create collection/dissemination system of timely market information in trading volume by crop and trading prices.

2) Interventions and Possible Vision on Plans

Gakoromone wholesale market is located at transporting centre for produce from Meru District, Nyambene District, lower part of Tharaka Nithi District and to northern districts of Isioro, Samburu, Marsabit and even Wajir. Therefore, improvement of this market is urgently required than the other wholesale markets in the hills of Mt. Kenya. By means of interventions of market facility improvement, auction coordination and market information sources improvement, the small scale farmers will make easy to access marketing streams.

Logical Diagram of Interventions through Market Facility Improvement with Supporting Services



3) Design Concept

Construction

The market is located in slope topographical conditions. As alternatives, the designs were planned in two cases in flat ground and two grounds. For estimation, one ground type is proposed due to moving convenience and utilization of limited space at 1.5ha. In both cases, the sellers will be separated by transaction mode into retailers in daily base rental, shop retailers in monthly base, wholesalers with warehouse in monthly bases, wholesaler in daily base, hawkers of farmers in daily bases and important auction space for small scale farmers' produce. All facilities will be covered by roof and paved on all grounds. The building plans are shown in Figure N.2-1 to Figure N.2-23, Annex N.

Equipment

The equipment to be procured will be concentrated in collection and immediate provision of information and auction of produce, and used for operation of services at the market.

Equipment	Q'ty	Specifications	Usage
Computer Set	3 sets	2.1GB or better with Printer and software	Aggregation of market gate fees for Meru Municipal Council, price analysis for Marketing officer of DOA-Meru, and issuance of invoice /receipt for HCDA
Copying machines	3 units	AC240V, 50Hz	Tickets, bills and documentation of data for each stakeholder
Facsimile	2 units	AC240V, 50Hz	Information delivering to head offices for DOA-Meru and HCDA
Dry van truck	5 units	5 tonnes loading 150KW or better	Collection from Nyambene(1), Mitunguu(2) and upper side of Meru(2) along B6 road
Weighing scale	5 units	100kg	Sampling test for auction for HCDA
Motorcycle	1 unit	125cc	Collection of data at neigbouring Nkubu and Timau markets in Meru District for marketing officer of DOA-Meru

4) Possible Evaluation of Plans

The indicators to evaluate the plan will be the sum of marketing gate fees, trading volume calculated by the fees and its rate, numbers of hawkers coming, numbers/amount of auction participants/produce and acreage of horticultural production estimated by DAO-Meru.

3.3.3 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 pipe laying, structure excavation and backfilling and so on are not included in this estimate since they are planned to be provided by Nkunjumo Water Association in order to lower the construction costs. 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 three to seven percent of the construction cost for pre-engineering works, three to seven percent for administration activities and three to ten percent for consulting services. These percentages are based on the past experience in similar irrigation projects. 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 five to 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 Nkunjumo Water Project

(Ksh)

1. Construction Cost		
1) Irrigation & Drainage Improvement	5,455,000	
2) Marketing Improvement	286,600,000	※
3) Access Roads Improvement	0	
4) Village/Farm Roads Improvement	1,425,000	
5) Domestic Water Supply Improvement	0	
Sub-total	293,480,000	
2. Community Development & Support Services		
1) Agricultural Support Services	10,640,000	
2) Community Development	7,086,000	
3) Water Management Services	1,960,000	
4) Marketing Support Services	21,280,000	
5) Public Health Services	0	
Sub-total	40,966,000	
3. Associated Cost		
1) Pre-engineering Cost	8,698,000	
2) Administration Cost	10,484,000	
3) Consulting Services	11,293,000	
Sub-total	30,475,000	
4. Physical Contingency	15,018,000	
Total	379,939,000	

※ Marketing improvement costs include the required rehabilitation/expansion costs of Gakoromone market in Meru town.

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 one to 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 Nkunjumo Water Project

	(Ksh/year)
1) Water Supply Facilities	109,000
2) Marketing Facilities	2,866,000
3) Access Roads	0
4) Village/Farm Roads	62,000
Total	3,037,000

3.4 Project Implementation, Operation and Maintenance Plan

3.4.1 Plan for Support Services during Project Implementation

1) Support Services for Capability Build-up

At various stages of the project cycle, a number of agencies will provide support services aimed at capability build-up of farmers and farmers' organizations as illustrated in Figure 3.4-1. The type of support services that will be expected from various agencies are summarized as shown below;

Agencies Providing Capability-buildup Services during Project Implementation

Project Stage	Agency	Type of Capability-Build-up Service
1. Project Planning	a) MOA/IDB	- Social preparation of project community - Facilitation of WUA planning sessions (activities, subactivities)
	b) MOA/DAO	- Acting as resource persons during social preparation sessions
	c) Local NGOs	- Acting as resource persons during social preparation sessions
2. Project Design	a) MOA/IDB	- Facilitating WUA design review sessions (availing design model, explaining design criteria and expected mode of operation of design elements) - Actively seeking women's input into the design
	b) MWR	- Awarding and securing water rights for WUA
	c) Local NGOs	- Acting as resource persons

Project Stage	Agency	Type of Capability-Build-up Service
3. Project Funding	a) MOA/IDB	- Advising on project costing and alternative sources of project funding - Explaining funding conditions and procedures for various funding agencies
	b) Local NGOs	- Training WUA members on group formation for security fund contributions, banking operations, loan funds & loan servicing procedures
	c) MOCSS	- Assisting farmers on harambee organization
	d) Provincial Administration	- Facilitating harambee organization by issuing licenses
4. Project Construction	a) MOA/IDB	- Advising WUA on criteria for tender assessment and contractor selection, required supervision and quality control aspects of construction activities
	b) Local NGOs	- Training WUA committee on contractor payment procedures
5. Project (O&M)	a) MOA/IDB	- Facilitating and acting as resource persons during O&M sessions
	b) MOA/DAO	- Acting as resource persons during O&M sessions

2) Agencies Providing Support Services After Project Implementation

Farmers will need a range of post-construction support services to enable them make the best use of the harnessed irrigation water. Such services and agencies that can provide them are discussed below.

a) Training and Research Services

With the onset of irrigated production, farmers will need to know what, when and how to grow horticultural crops. Some of these problems will not be readily answerable by the extension staff since they are research problems. For this reason, it is suggested that MOA/DAO request KARI (through the regional office at Embu) to initiate on-farm research and training activities at Nkunjumo so as to address such problems as :

- Soil and seed born diseases as well as general pests and diseases
- Low crop yields
- Limited diversity of cropping pattern

Furthermore, KARI will be expected to invite project farmers and associated extension staff to an annual on-station field day for training in new horticultural production techniques such as use of drip irrigation, recommended sprinkler handling methods, crop management as well safe handling of farm chemicals.

b) Extension Services

The DAO office, through its division field station, is responsible for providing extension services to the Project Area. According to the re-structured extension strategy (currently under preparation), the Division will play the more important role of planning training programmes and overseeing performance of frontline extension workers (FEWs).

In order to provide adequate extension support to the project's irrigation community, the division extension office will therefore be expected to do the following:

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

c) Community Development and Organization Services

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

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

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

d) Basic Skills' Development, Industrial and Entrepreneurial Training

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

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

e) Credit Assistance

Financial supports to the small-scale irrigation project are dealt with DBK instead of CBK as of 1998. Though interest rate for irrigation project is lowered to 16 percent, other conditions haven't been changed. Despite the lowering annual interest, the repayment is still harsh for smallholders who are living

on low incomes as mentioned above. It is reported that the monthly water charge to be collected for O & M is lowered from fixed water charge agreed before starting irrigation service because of economic reasons in Ciambaraga in Tharaka Nithi. Small-scale Irrigation Project must be considered as one of the poverty alleviation measure like other Project Area, and further convenient credit should be carried out taking into consideration existence of many smallholders who lack funds despite of their contribution to the regional economy.

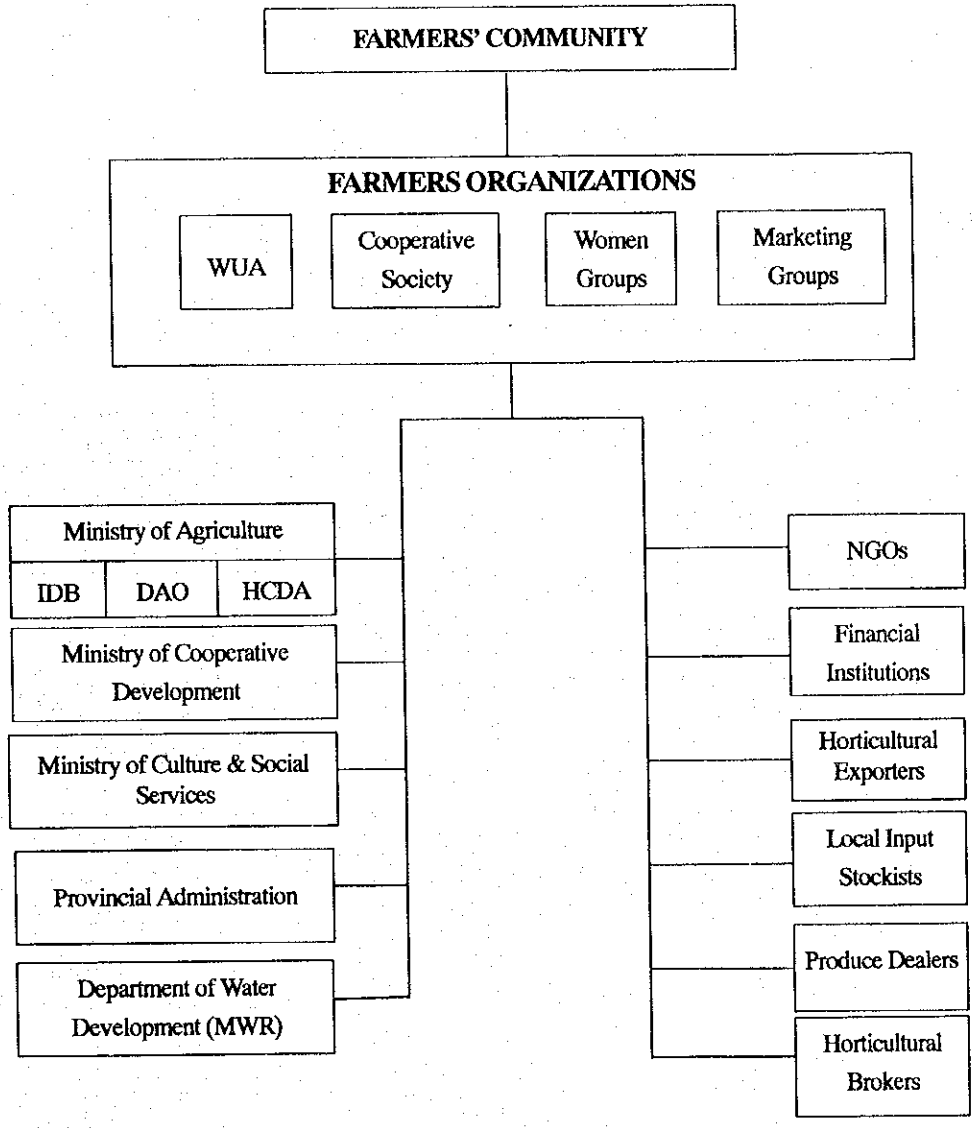
Further convenient credit system will be possible because DBK has changed interest from 30 percent to 16 percent at present. It could be understood that banks as lender counts for risk, however, above example implies that more research and discussion involving government, Ministry of Agriculture, banks, NGOs, representatives of farms, HCDA and so on are necessary to provide credit wit proper conditions.

f) Fostering of Farmers' Capability

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

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

Figure 3.4-1 **Institution Arrangements for Providing Support Services to Farmers Organizations during Project Implementation**



g) Marketing, Post-Harvest and Other Institutional Support

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

Institutional Support on Marketing

Problems/Constraints	Interventions	Agency Concerned	Outputs
Seminar hold at JKUAT and other institutions managed by the government			
Heavy depending upon coffee production and lack of knowledge of horticultural production	Lecturing and practice on horticultural produce	MOA staff on horticulture with lectures/technicians	Better husbandry and reducing losses caused by diseases
Lack of market information	Lecturing on market trend in key wholesale markets	Marketing officer of Marketing Information Branch of MOA	Understanding methods of price enumeration on the newspaper and analysis of data.
Lack of marketing groups	PCM workshop	MOA staff on farmers' organization	Strengthening farmers' bargaining skills
Exploitation of middlemen	Introduction of auction consignment	Marketing officer of HCDA	Improved transaction mode
Lack of knowledge of market demands for export produce	Lecturing on grading technique and measures for MRLs	Technical staff of FPEAK or exporter	Reducing post-harvest losses caused by reject and understanding EU market demands in MRLs
Low quality of produce	Lecturing on selection and procurement of certified seeds / seedlings	KARI	Assurance of high rate of germination and section of marketable varieties
Lack of knowledge what are marketable produce/varieties or buyers' demands	Field trip pursing marketing route	MOA staff on farmers' organization	More accessing to upper stream of marketing and proposing sites are Nairobi markets, exporters' grading & packing facilities, Nairobi Horticultural Centre for auction, Nairobi coffee auction
Local institutional support			
Lack of market information	Provision of data collected (weekly base data can be referred)	Marketing officer of DAO-Meru Marketing expert of HCDA-Meru & Nkubu	Better crop planning and outflows to the market and traders
Exploitation of middlemen	Auction consignment with HCDA	Marketing expert of HCDA-Nkubu	Better access to market