

CHAPTER IV. DEVELOPMENT PLAN ON IRRIGATED AGRICULTURE

4.1 Development Needs

4.1.1 Political Needs in Smallholder Irrigation Development

The current national socio-economic development plan is being implemented pursuant to the second RPFB, covering the three fiscal years of 1994/95-1996/97. The fundamental principles and goals envisaged in RPFB are summarized as follows:

- To alleviate poverty so as to improve social welfare conditions of the population in Tanzania,
- To create appropriate environment for strong private sector,
- To reduce direct Government involvement in productive activities,
- To improve efficiency in the use of public resources,
- To ensure macro-economic stability, and
- To keep on an environmentally sustainable development path.

In the implementation of the national development plan, GOT has put the highest priority on the agricultural sector development with particular emphasis on attainment of self-sufficiency and food security at every level from village units to nation-wise.

Irrigation development is seen as an important strategy for achieving the policy objectives envisaged in the agricultural development plan. In fact, in Tanzania some 100,000 farm families are currently relying on themselves for obtaining agricultural production using a traditional irrigation system. These traditional irrigation schemes have been operating some for centuries, but in most cases, they require up-grading and/or rehabilitation. Fair wear and tear, increase in population pressure (necessity of more wider irrigable land), degradation of vegetation in the catchment area that causes a reduction of water discharges especially in the dry season act as constraints for an efficient use of water. Additionally, there are occasional rapid flooding in the rainy season, and perhaps, changes in the local climate, causing a drought even in the rainy season, etc. Thus, the strategic framework for implementing the irrigation development policy has been established with particular emphasis on "Rehabilitation or up-grading of the traditional irrigation schemes." It is expected that the maximum impact will have to be brought about by the irrigation beneficiaries (farmers) themselves, who will freely participate in the above mentioned irrigation development based on a participatory approach.

Based on the above rationale, GOT has selected the most promising 156 irrigation development schemes, and expected to successfully development some 174,260 ha of irrigable land.

4.1.2 Development Needs and Wishes of Irrigation Beneficiaries

The development needs and wishes of irrigation beneficiaries are identified in order to carry out the development planning on the objectives of the smallholder irrigation development projects especially putting emphasis on the Government's policy of "farmer's participatory approach to irrigation-based agricultural development." The following Table shows the actual farmers' wishes for improvement. The farmer's development needs are also all closely related to the wishes for improvement of the present constraints and problems.

Farmers' Wishes on Improvement of Constraints/Problems

Conditions Subject to Improvement/*	Response Percentage	Conditions Subject to Improvement/*	Response Percentage
- Improvement of irrigation facilities	18	- Prevention against damage by wild animal	5
- Prevention of pest and diseases problems	14	- Improvement of Weeding practices	5
- Improvement of farm inputs supply system	12	- Strengthening of Extension services	5
- Steady distribution of irrigation water	11	- Improvement of farm and access road	2
- Farm mechanization	11	- Provision of transportation facilities	2

/* Listed in descending order of importance

Development Needs of Irrigation Beneficiaries

Essential Needs/*	Response Percentage	Essential Needs/*	Response Percentage
- Consolidation of irrigation facilities	28	- Village community facilities	12
- Improvement of marketing channel (inputs)	19	- Intensive extension services	7
- Consolidation of road network	14	- Improvement of marketing channel (products)	5

/* Listed in descending order of importance

All the farmers benefited from the existing irrigation systems attach to the highest priority on "improvement of the irrigation facilities." Concerning this point, the emphasis will be put on the following assistance for future development for those farmers:

1) Irrigation Development:

- Provision of a permanent intake weir with gate structure so far as to properly manage water diversion as well as to mitigate the costs and/or burden of annual renewal of the traditional-type intake weir.
- Provision of the technical assistance for improvement of the irrigation and drainage facilities as well as guidance for improvement of the irrigation technology
- Price-subsidized provision of the materials, such as cement, steel works, etc. to be required for repair and maintenance of the irrigation facilities and related structures

2) Agricultural Development:

- Steady cum timely supply of farm inputs, i.e. qualified seeds, safety cum effective agro-chemicals, etc. In fact, many farmers pointed out the problems related to crop operations on the field.
- Adjustment farm inputs' costs as well as water agricultural production prices.
- Provision of an intensive guidance especially on improvement of farming technology, i.e. irrigated farming practices, weeding as well as pests and diseases control, soil fertilization practices, etc.
- Provision of guidance on diversification emphasizing economic crops as well as information on agricultural production markets.

3) Institutional Supporting Services:

- Activation of the agricultural extension services, including demonstration of irrigated farming technology.
- Provision of technical training courses especially those related to technology for irrigation-based agricultural production as well as O&M of irrigation facilities through rehabilitation cum reinforcement of the existing farmer's training centers.

- Provision of opportunities for easy access to credit services.

4) Supporting Infrastructure for Irrigation-based Agricultural Development:

- Consolidation of trunk roads as well as access roads to the scheme areas.
- Rehabilitation of the go-down and/or storage facilities for both marketing of crop production and properly storing of farm inputs.
- Rehabilitation or renewal of facilities to be used for community activities.

4.2 Basic Approach to the Project

In the Central Wami River Basin, a huge potential of both land and water resources in the irrigation-based agriculture development is being identified especially in Mkata Plain, which lays on central part of the Basin. It has also become apparent that an enormous investment would be required so far as to successfully materialize those development against huge flooding from Wami river and its tributaries. In fact, the present agriculture development involving either large state farms or those run by smallholders, is mainly concentrated on the piedmont plain and fan formations surrounding the Mkata Plain and/or the valley / riverine terraces in the mountainous area where the land is relatively free from seasonal floods. The land use for agricultural production in Mkata Plain is limited only to the traditional paddy cultivation extensively using flooding water.

Despite of the Government of Tanzania (GOT) continuous efforts to eliminate the constraints and problems, the present agriculture development in the Basin is still at an early stage, and accordingly, the agricultural production per farm household is still at a subsistence level in most cases, except at such villages in Lumuma, Matolo and Mgeta schemes where the traditional irrigation systems have been developed and intensively utilized under independent management by farmers, since long time ago.

The fundamental objectives and development goals in the Smallholder Participatory Irrigation-based Agricultural Development in the Study area are studied with due consideration of the present situation of the agricultural development in the Central Wami River Basin. Attention is also paid to the development policy of the Government and development needs/wishes of the irrigation beneficiaries. The fundamental objectives and conceptual development framework hereby conceived are summarized as shown in the Figure on next page.

4.3 Land Use and Agricultural Production Plan

4.3.1 Basic Concept

Prospective goal of agricultural development under this project is to increase and stabilize agricultural production to maintain sustainable development of smallholder farming, and then, contributing to the national food security program. To successfully achieve the said goal, the following approach is conceived as the basic strategy for agricultural development of each zone.

(1) Mountainous Zone

In this zone, there is no room to promote a further expansion due to topographic limitation. Accordingly, main subjects which should be considered in the development plan are to effectively develop the limited agricultural land and establish a more advanced as well as sustainable farming system. In this case, conservation plan for a fragile natural environment, facing some soil erosion, land sliding, etc., is an important issue.

Conceptual Framework for Smallholder Irrigation Development by Specific Zone in Central Wami River Basin

	Alluvial Plain Zone (Mkata Plain : Seasonal Swamp)	Piedmont Plain & Fan Zone (Surrounding Mkata & Msolwa Plain)	Valley/Riverine Terrace Zone	Mountainous Slope Zone
Major Characteristics	<ul style="list-style-type: none"> - Quaternary alluvium - Lowlying flat plain, bush-grass savanna vegetation - Seasonal waterlogging, poor drainability - Vertic Fluvisols and/or Hydromorphic Gley Soils - Clayey to sandy texture, and relatively fertile - Traditional extensive farming, inclusive of shifting cultivation - Paddy growing under seasonal flooding - Maize, cotton etc. under rainfed conditions - Large potentials for agricultural development - Scarce population - Poor infrastructure, i.e. irrigation canal, road network, water and electricity supply system 	<ul style="list-style-type: none"> - Post-Miocene deposits on Precamblian rocks - Flat to gentle slope land with grass savanna vegetation - Cambisols associated with Regosols having coarser texture, relatively fertile - Traditional crops in smallholder farming mostly under rainfed conditions - Large potential for irrigated agricultural development - Relatively good network of road & rural water supply system, while in part under rural electrification 	<ul style="list-style-type: none"> - Quaternary alluvium - Narrow penplain (fans) or riverine terraces - Gently sloped or undulating topography - Bush savanna vegetation - Fluvisols having coarser texture, while fertile - High irrigability & good drainability - Paddy, cotton maize, etc in smallholder farming under traditional irrigation system - Poor infrastructure, i.e. road network, electricity supply system, etc. - Poor accessibility to market in isolated valley area 	<ul style="list-style-type: none"> - Undifferentiated soils on Pyroxene Granulite rocks - High altitude, extremely steep slopes, narrowly dissected by eroded valleys - Serious environmental hazards, i.e. soil erosion, watershed degradation, etc. - Shallow and coarser texture soils - Production of high valued crops, i.e. fruit, vegetables, etc. in smallholder farming using traditional irrigation system - Poor infrastructure, i.e. road system - High population
Major Development Schemes	<ul style="list-style-type: none"> 1) Manvyere Scheme 2) Kiangali Scheme 	<ul style="list-style-type: none"> 1) Miali Scheme 2) Muvumi Scheme 3) Msolwa Scheme 4) Mkula Scheme 5) Sonjo Scheme 6) Mgongola Scheme 	<ul style="list-style-type: none"> 1) Migogozi Scheme 2) Nyimba Scheme 3) Chabi Scheme 4) Malolo Scheme 5) Chabima Scheme 6) Lumuma Scheme 7) Ndole Scheme 	<ul style="list-style-type: none"> 1) Mgeta Scheme
Major Development Focus	<ul style="list-style-type: none"> - Consolidation of farm land, inclusive of ridge and side-ditch formation, farm road network, etc. - Development and/or improvement of small scale irrigation system to supplement flooding water-fed irrigation and for dry-season cropping - Provision of flood control dikes and drainage system - Intensification of rice production by introduction of short growing term cum high-yielding varieties - Training of farmers on irrigated rice production technologies, including small scale mechanization - Activation of farmers' organization, i.e. furrow committee and farmers' cooperatives 	<ul style="list-style-type: none"> - Rehabilitation or improvement of the existing irrigation system - Provision of flood control dikes and drainage system in lower-reach areas - Consolidation of farm land, inclusive of ridge and side ditch formation, farm road network, etc. - Intensification cum diversification of crop production with introduction of high-valued crops - Training of farmers on irrigated crop production technology, including small scale mechanization - Activation of farmers' organization, i.e. furrow committee and cooperatives 	<ul style="list-style-type: none"> - Rehabilitation and/or improvement of small scale irrigation system especially intake facilities and water distribution structures - Consolidation of trunk road for marketing of production - Organization of farmers' cooperatives - Provision of post-harvesting service facilities, i.e. go-down, storage, etc. - Activation of farm inputs supply services - Provision of farmers' credit 	<ul style="list-style-type: none"> - Improvement of existing small scale irrigation system, especially intake facilities and water distribution structures - Land conservation against erosion hazard - Improvement of trunk road - Provision of post-harvesting service facilities, i.e. go-down, strage, etc. - Activation of farm inputs supply services - Provision of farmers' credit - Organization of farmers' cooperatives
Key Theme	<ul style="list-style-type: none"> - Consolidation of agricultural land and related infrastructure (road, flood protection dikes, etc.) 	<ul style="list-style-type: none"> - Irrigation development and intensification of crop production 	<ul style="list-style-type: none"> - Rehabilitation and/or improvement of irrigation system as well as trunk road 	<ul style="list-style-type: none"> - Consolidation of canal system (lining and drop structure) against erosion hazard
Development Focus	<ul style="list-style-type: none"> - Intensification and stabilization of rice production through efficient utilization of flood water (Formation of the farm ridge be effective for harvesting the seasonal flooding water). - Improvement of farming practices, including introduction of high yielding varieties of rice. - Activation of Farmers' organization both for irrigation water utilization and marketing of the production 	<ul style="list-style-type: none"> - Irrigation development or rehabilitation of the existing irrigation system will make possible crop intensification cum diversification. - Large increment and stabilization of crop production could be anticipated through consolidation of farm land and improvement of the farming practices. - To the above, activation of farmers cooperative societies is essentially needed. 	<ul style="list-style-type: none"> - Since an arable land is limited in this zone, intensification cum diversification of agricultural production are essentially needed. - Rehabilitation and improvement of the existing irrigation system will enable water distribution more efficiently and accordingly ensure stable crop cultivation even in the dry season. - To effectively support the above, consolidation of the trunk road is indispensable. 	<ul style="list-style-type: none"> - Consolidation of the existing irrigation system will be the basis on further subzilation of the agricultural production. It is also an essential mean for land conservation. - Afforestation with sustainable agro-forestry approach (orchard & its processing) will be effective for both protection against soil erosion hazard and rural economic development.
Sustainable development	<ul style="list-style-type: none"> - Other than the above components, improvement and reinforcement of the existing Farmers' Training Center as well as activation of Agricultural Research Center and National Seed Farm are essential. - Accordingly, the agricultural extension services shall be reinforced through further training of the extension workers. 	<ul style="list-style-type: none"> - Other than the above components, improvement and reinforcement of the existing Farmers' Training Center as well as activation of Agricultural Research Center and National Seed Farm are essential. - Accordingly, the agricultural extension services shall be reinforced through further training of the extension workers. 	<ul style="list-style-type: none"> - Other than the above components, improvement and reinforcement of the existing Farmers' Training Center as well as activation of Agricultural Research Center and National Seed Farm are essential. - Accordingly, the agricultural extension services shall be reinforced through further training of the extension workers. 	<ul style="list-style-type: none"> - Other than the above components, improvement and reinforcement of the existing Farmers' Training Center as well as activation of Agricultural Research Center and National Seed Farm are essential. - Accordingly, the agricultural extension services shall be reinforced through further training of the extension workers.

The development plan for Mgeta scheme will aim at keeping up sustainable production of food crops, i.e. maize and beans as well as such subsidiary foods as cabbage, potatoes, and other various vegetables. The following points become the basic approach to the above ends.

- Reinforcement of farm inputs supply system, especially certified seeds, fertilizer, and agro-chemicals.
- Implementation of research work in the mountainous zone using the farmers' participatory approach.
- Establishment of a seed farm for horticultural crops using the farmers' participatory approach.
- Reinforcement of extension services.

(2) Alluvial Plain Zone

Based on the irrigation development, drainage improvement, land reclamation, etc., the irrigation scheme areas in this zone will be developed aiming to increase production of rice with the following strategic approach:

- Improvement of paddy productivity by means of optimal reclamation of the present agricultural land.
- Improvement of farming practices for proper and efficient cultivation of paddy under irrigation condition.
- Implementation of seed multiplication on promising paddy varieties using farmers' participatory approach.
- Reinforcement of farm inputs supply system, especially for fertilizers, and agro-chemicals.
- Reinforcement of extension services especially for paddy cultivation and related technologies.

(3) Piedmont Plain & Fan Zone

Agricultural development in this zone aims to increase rice production in the lowlying area, while doing it for maize in an elevated fan formation. The following are the main aspects of the essential approach for achieving the said objectives.

- Improvement of paddy cultivation practices with maximum utilization of flood water.
- Establishment of rotational cropping pattern with paddy and upland crops, particularly paying attention to availability of water for irrigation.
- Reinforcement of farm inputs supply system, especially certified seeds, fertilizers, and agro-chemicals.
- Reinforcement of extension services especially in the field of rice production.

(4) Valley and Riverine Terrace Zone

Agricultural development in these areas aims to increase cum stabilize the present production of various upland crops which have been familiar to farmers certainly since long time ago. The strategic approach used to attain these goals is as follows:

- Improvement and dissemination of rotational cropping pattern.
- Improvement of the present farming practices for rotational cropping of upland crops, especially paying attention to an efficient water utilization and soil fertilization means.
- Implementation of seed production of promising cultivars of upland crops through farmers' participatory approach.
- Reinforcement of farm inputs supply system, especially certified seeds, fertilizer, and agro-chemicals.
- Reinforcement of extension services especially in the field of irrigated farming.

4.3.2 Change in Land Use

A potential net irrigable land in the Project area is estimated at 6,500 ha as shown below:

A potential net irrigable land by Schemes

Physiographical Zones	Irrigation Scheme	Rainy Season	Dry Season
(1) Zone-I Mountainous Zone	1 Mgeta	1,600 ha	1,600 ha
(2) Zone-II Alluvial Plain Zone	2 Manyenyere	1,040 ha	690 ha
	3 Kilangali	370 ha	160 ha
	4 Mgongola	660 ha	660 ha
(3) Zone-III Piedmont Plain & Fan Zone	5 Mlali	60 ha	30 ha
	6 Mvumi	260 ha	260 ha
	7 Msolwa	320 ha	240 ha
	8 Mkula	320 ha	140 ha
	9 Sonjo	480 ha	380 ha
(4) Zone-IV Valley and Riverine Terrace Zone	10 Chabima	10 ha	10 ha
	11 Lumuma	380 ha	380 ha
	12 Ndole	80 ha	80 ha
	13 Nyinga/Mgogozi	150 ha	150 ha
	14 Malolo	400 ha	400 ha
	15 Mgogozi (Kikalo)	100 ha	50 ha
	16 Chabi	270 ha	270 ha
Total		6,500 ha	5,500 ha

Mgeta scheme consists of numerous independent small irrigation systems which are scattered around Mgeta ward. The commanding area of each irrigation system is estimated at around a few hectares. Further development plan in Mgeta scheme is formulated for one unit of irrigation system which is estimated at 5 ha, as a pilot scheme in this scheme.

Thus, future land use plan for each scheme is shown below:

Land Use in Change by Scheme

(Unit: ha)

	Land Category before the Project					Land Category after the Project		
	Paddy Field	Upland Field	Sugarcane Field	Fallow Land	Total	Paddy Field	Upland Field	Total
Zone-I								
Mgeta	-	5	-	-	5	-	5	5
Zone-II								
Manyenyere	400	-	-	640	1,040	1,040	-	1,040
Kilangali	145	-	-	225	370	370	-	370
Mgongola	410	-	-	250	660	660	-	660
Zone-III								
Mtali	60	-	-	-	60	60	-	60
Mvumi	138	-	-	122	260	260	-	260
Msolwa	120	100	100	-	320	120	200	320
Mkula	120	100	100	-	320	220	100	320
Sonjo	130	100	120	130	480	260	220	480
Zone-IV								
Chabima	10	-	-	-	10	10	-	10
Lumuma	30	350	-	-	380	30	350	380
Ndole	-	80	-	-	80	-	80	80
Nyinga	10	140	-	-	150	10	140	150
Malolo	50	350	-	-	400	50	350	400
Mgogozi	-	100	-	-	100	-	100	100
Chabi	-	270	-	-	270	-	270	270
Total	1,623	1,595	320	1,367	4,905	3,090	1,815	4,905

4.3.3 Selection of Proposed Crops

The following points are considered for selection of the proposed crops for the Project, based on the agricultural development concept mentioned in Chapter IV.

- 1) To be major crops proposed in the National Agricultural Development Plan
- 2) To be relatively familiar to the farmers as well as to the extension officers concerned
- 3) To be acceptable to the farmers from the point of view of their farming practices
- 4) To consider the preferable crops of farmers in the Project area
- 5) To effectively use water resources
- 6) To provide maximum benefit to the farmers in the Project area.

The following crops are selected as major product for each scheme.

Major Crops Selected for Each Scheme

Irrigation Scheme	Rainy Season	Dry Season
1 Mgeta	Beans	Cabbage, Beans
2 Manyenyere	Paddy	Paddy
3 Kitangali	Paddy	Paddy
4 Mgongola	Paddy	Paddy
5 Mtali	Paddy	Tomato
6 Mvumi	Paddy, Maize	Paddy Beans
7 Msolwa	Paddy, Maize	Maize, Beans
8 Mkula	Paddy, Maize	Maize, Beans
9 Sonjo	Paddy, Maize	Maize, Beans
10 Chabima	Maize	Beans
11 Lumuma	Paddy, Maize, Beans	Onion, Paddy
12 Ndole	Maize, Beans	Maize, Beans
13 Nyinga, Mgogozi Mwega sub-scheme	Paddy, Maize	Onion, Beans
14 Malolo	Paddy, Maize	Onion, Beans
15 Mgogozi (Kikalo)	Maize	Onion
16 Chabi	Maize, Beans	Onion

4.3.4 Proposed Cropping Pattern and Cultivated Area

(1) Proposed Cropping Pattern

In preparing the proposed cropping pattern for the Project Area, the following points are considered, based on the concept of the agricultural development.

- a) To minimize the crop water requirement
- b) To consider the existing cropping pattern
- c) To maximize utilization of irrigation water and the cropping intensity

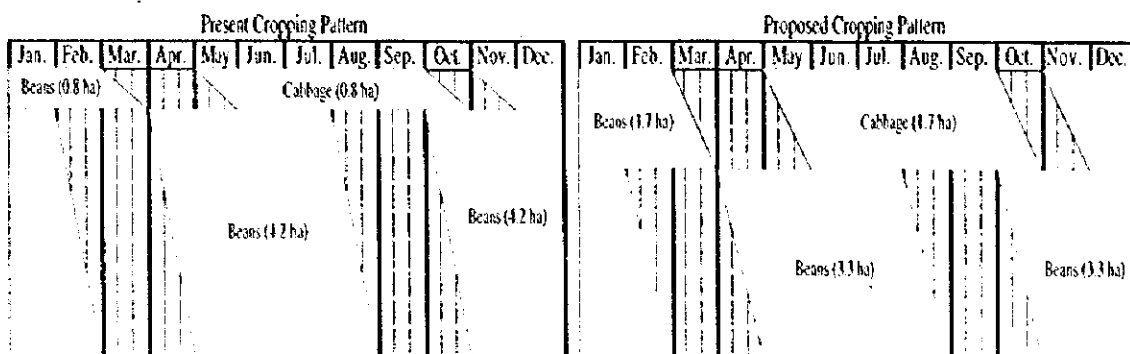
The proposed cropping patterns by scheme are summarized as follows:

1) Cool and Wet Climate, Steep Slope Mountainous Zone

a) Mgeta Scheme (Model Unit of 5 ha)

Since the existing irrigation systems are not sufficiently functioning, at present, due to structural weakness of those facilities, vegetables cultivation in the dry season is being limited to around 15% of the total irrigable land. To maintain the farm economy, farmers therefore grow beans in the remaining land using a small rainfall.

In the future when the existing irrigation systems are rehabilitated satisfactorily and successfully, it could be expected to irrigate the land entirely, and hence, to grow vegetables more than that at present. Production of beans could also be increased and stabilized under supplementary irrigation to the rainfed conditions as practiced at present.



The cropping pattern demonstrated in the preceding page is proposed as one of the model crop operation in a small unit of irrigation system covering some 5 ha, considering the labor requirement as well as a demand of vegetable market in Morogoro and Dar es Salaam.

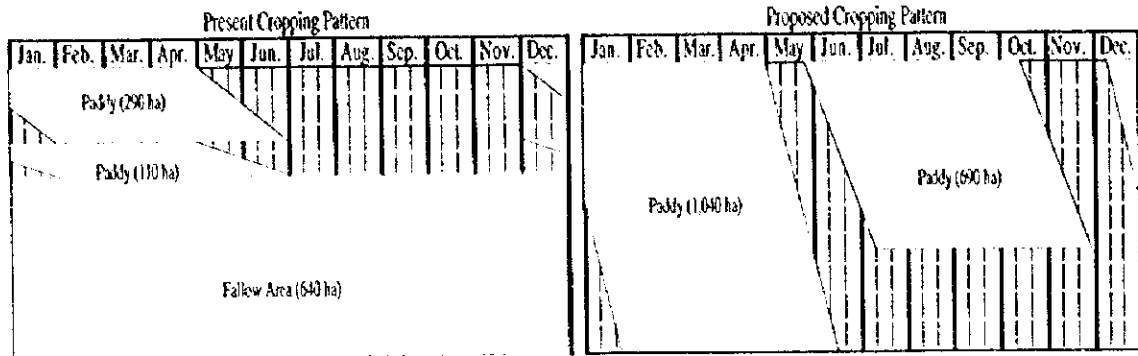
2) Savanna Climate, Alluvial Plain Zone

b) Manyenyere Scheme (1,040 ha)

In Manyenyere scheme, paddy cultivation has been extensively practiced in some area where the land is regularly inundated by the seasonal flooding but relatively shallow in depth during the rainy season, while no crops are grown in the dry season because irrigation water could not be sufficiently

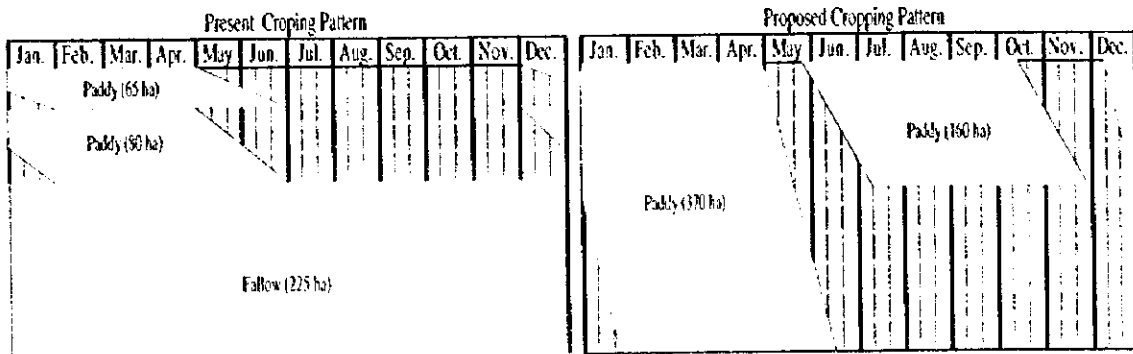
intake through the existing intake weir due to siltation problem and low water level in the river.

If the proposed irrigation development and drainage improvement including flood protection are implemented successfully, it is highly expected that paddy cultivation in the rainy season could be first extended even in lowlying land where the seasonal flooding is deeply stood at present. The dry season cropping of paddy is also possible in some 65% of the total irrigable land. An availability of the irrigation water resource during the dry season is only the limitation to the proposed cropping pattern.



c) Kilangali Scheme (370 ha)

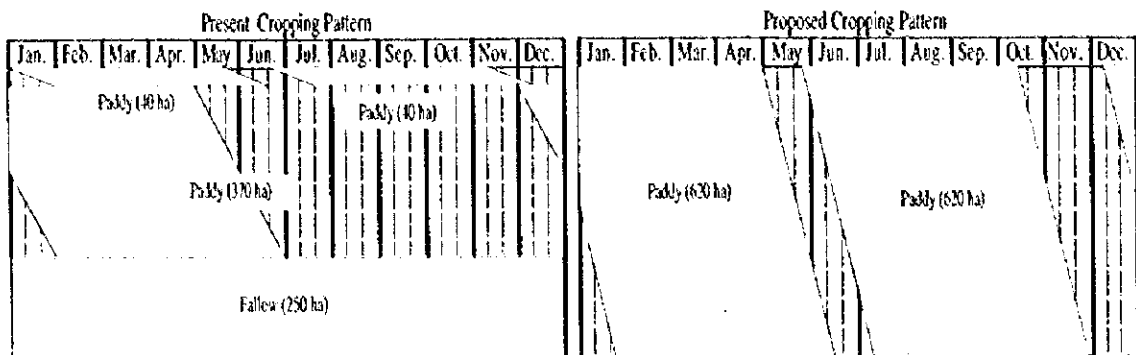
All the conditions of Kilangali scheme either physical or socio-economic aspects is quite similar to the above mentioned Manyenyere scheme. Therefore, the cropping pattern proposed for Manyenyere scheme will be applicable to Kilangali scheme as much as irrigation water is available during the dry season.



d) Mgongola Scheme (660 ha)

Mkindo irrigation scheme covering 40 ha was developed as a pilot project at the upper reach of Mgongola scheme. In this scheme, double cropping of paddy a year has been practiced under fully irrigated conditions. In the proposed Mgongola scheme area, paddy cultivation has also been performed very extensively only in the rainy season by the smallholder farmers who come from the surrounding villages. While the dry season cropping is hardly operated due to the same conditions as seen in Manyenyere and Kilangali schemes.

According to the project implementation, it is expected that paddy cultivation twice a year could be played entire irrigable area using an ample resources of irrigation water through-out the year.

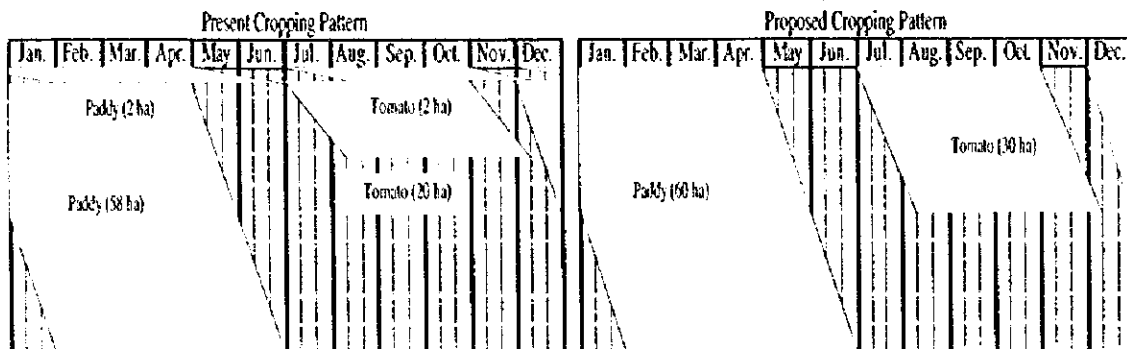


3) Savanna Climate, Piedmont Plain and Fan Zone

e) Mlali Scheme (60 ha)

In Mlali scheme, paddy cultivation is being practiced in the rainy season entirely in the area using flood water. While tomatoes are grown in the dry season in a part where soils are moistened by capillary water from the shallow groundwater. The existing irrigation facilities have not been functioned well due to degradation of intake weir and main canal by serious siltation.

Once rehabilitation of the existing irrigation system is completed, operation of the present cropping pattern could be maintained satisfactorily, and accordingly, a large increment of those paddy and tomatoes is ensured. As for the dry season cropping of tomatoes, it has no possibility to extend further cultivation area due to limitation of the available irrigation water resources.

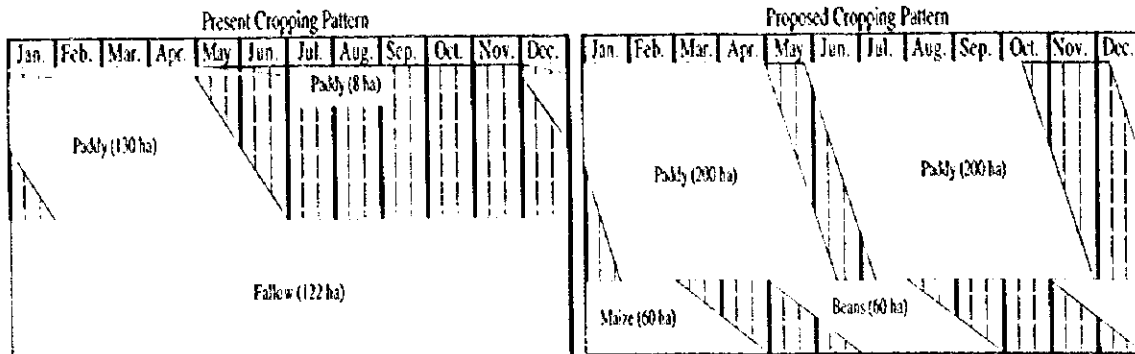


f) Mvumi Scheme (260 ha)

In this area, paddy cultivation is practiced very extensively only in the lowlying land using the seasonal flooding water, while majority of elevated upland lies at fallow, at present, since the existing irrigation facilities had been destroyed by rainy season flooding.

If the proposed project is successfully implemented, double cropping of

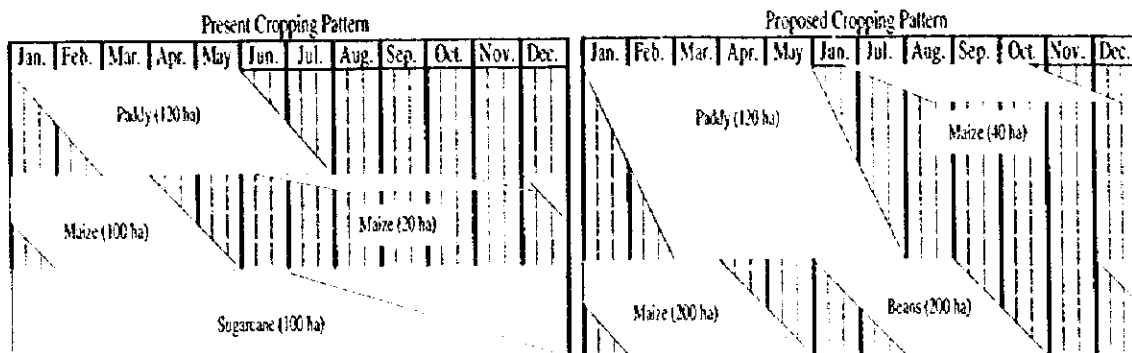
paddy a year could be settled in the lowlying area using an ample irrigation water resources. In elevated upland area, maize and beans will be grown as the main crops, respectively in the rainy and dry seasons as shown in the following Figure.



g) Msolwa Scheme (320 ha)

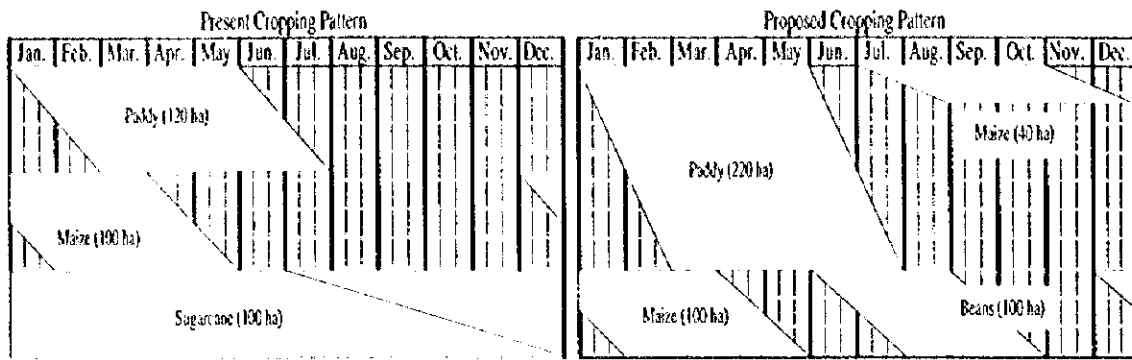
Existing irrigation facilities have not been utilized well due to disagreement on land allocation among the villagers. At present, such food crops as paddy, maize, etc. are therefore cultivated mainly in the rainy season under rainfed condition. Maize and beans are also grown in the dry season in some area where the soils are moistened by capillary water from the shallow groundwater. Besides, sugarcane is rather widely cultivated under rainfed conditions in the piedmont plain and the middle reaches of fan formation.

In the future when the proposed project is successfully implemented, it is expected that production of the present rainy season crops be possible to increase to a certain large extent under supplementary irrigation to the rainfed conditions. Drainage improvement and flood protection will much contribute to stabilization of the rainy season cropping. The dry season cropping is limited to some 75% of the total irrigable land due to shortage of irrigation water resources. In the proposed cropping pattern, the present sugarcane is replaced to food crops, i.e. beans and maize since the sugar factory has no enough processing capacity, at present, and no expansion plan for the future.



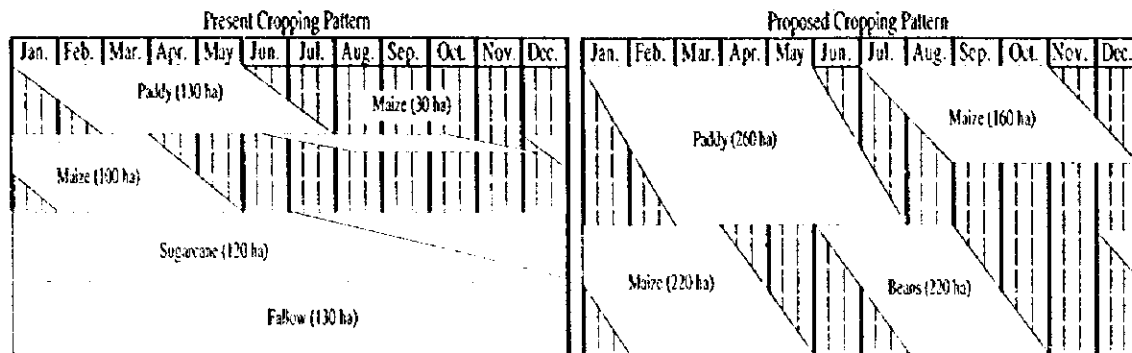
h) Mkuła Scheme (320 ha)

The proposed cropping pattern is basically the same to that for Msolwa scheme, since all of the conditions of this scheme area is considered to be similar to the said Msolwa scheme.



i) Sonjo Scheme (480 ha)

The physical as well as socio-economic conditions of this scheme is also the same to Msolwa and Mkula schemes. Thus, the same cropping pattern is proposed to this scheme. Rather than the above, a little high cropping intensity at 80% for the dry season operation is applicable owing to higher availability of irrigation water resources in that season.

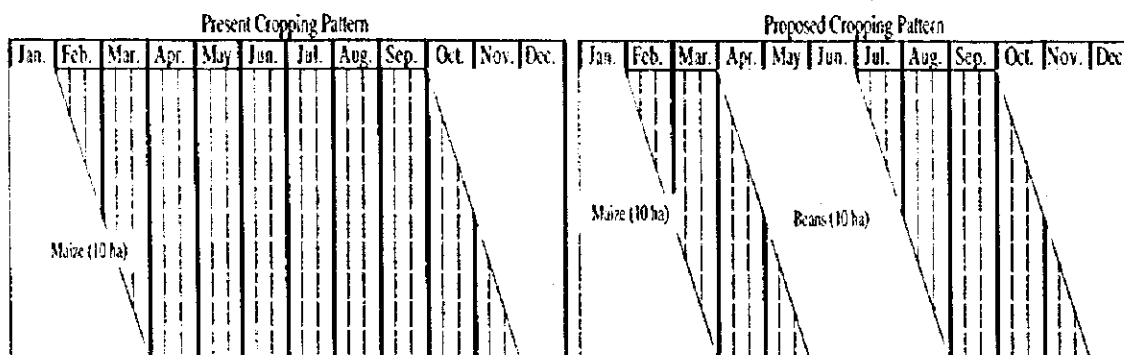


4) Semi-arid Climate, Valley and Riverine Terrace Zone

j) Chabima Scheme (10 ha)

Major crops in the scheme area are maize and beans cultivated under rainfed condition. Although the traditional irrigation furrow has also been recently developed by few farmers, the dry season cropping is practiced quite limited extent so far.

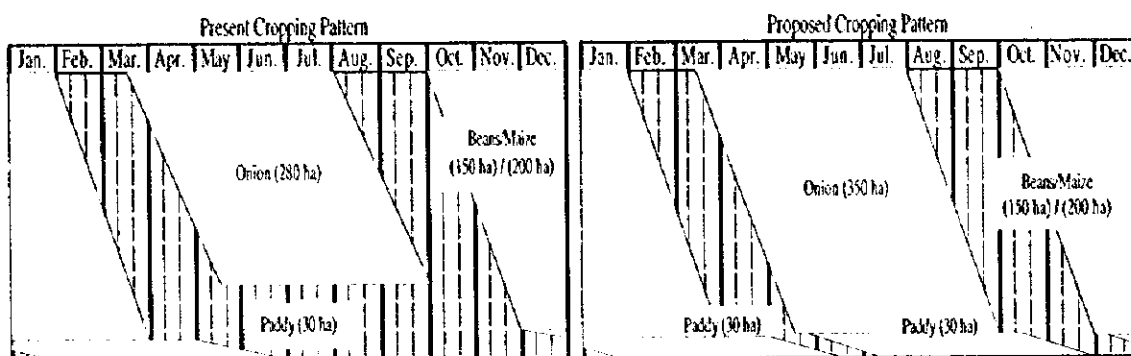
For the future cropping pattern, it is proposed to grow beans in the dry season as cash crop for maintaining the farm economy.



k) Lumuma Scheme (380 ha)

In Lumuma scheme, traditional irrigation furrow systems have been developed since long time ago, and under irrigated conditions, crop intensification cum diversification have also be progressed as well. The present major crops are of maize, beans, etc. in the rainy season. Paddy is also cultivated in some part of lowlying area. While, onion is the main crop in the dry season and its production is highly contributed to the farm economy in this scheme.

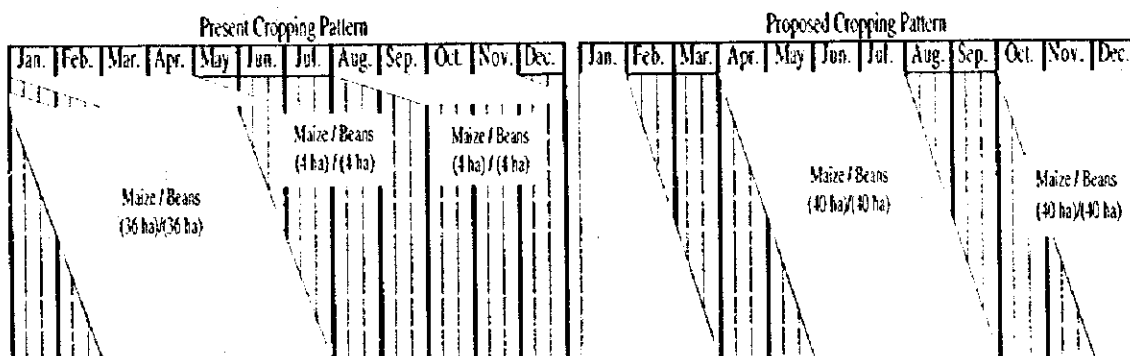
Under the project implementation, no changes on the prevailing cropping pattern is proposed except a little expansion of the onion cultivation in the dry season. But, it is to expect that production of all the crops will be increased to certain extent through improvement of the irrigated farming technology as well as water management.



l) Ndole Scheme (80 ha)

In some part of Ndole scheme, beans have been cultivated in the dry season under the small scale irrigation which has been developed recently. Majority of crops are grown in the rainy season under the rainfed conditions.

When the existing irrigation facilities is improved, it is expected to extend cash crop cultivation in the entire area using irrigation water in the dry season.

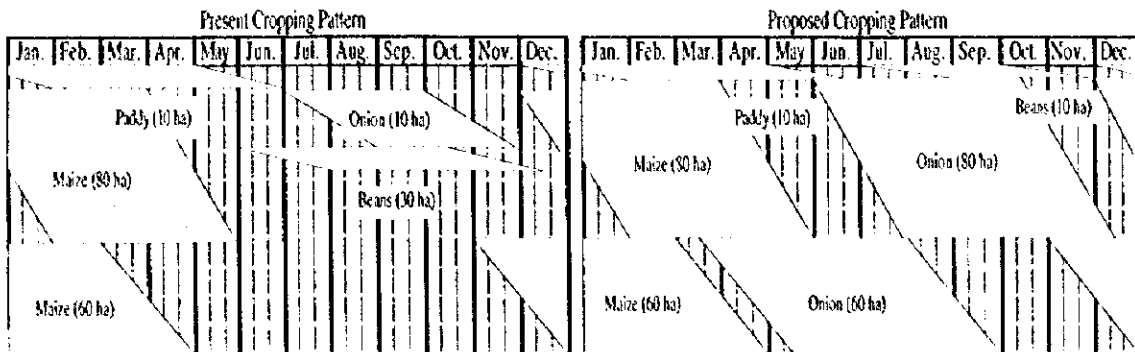


m) Nyinga and Mgogzi-Mwega Schemes (150 ha)

In Nyinga scheme, maize and paddy are rather intensively cultivated in the

rainy season, while onion as cash crop in the dry season. Productivity of onion is fluctuated year by year due to poor function of the existing irrigation facilities. Existing headworks of Mgogozi-Mwega scheme was flushed away by previous flooding, and hence, crop cultivation in this scheme is limited to maize cultivation during the rainy season, at present.

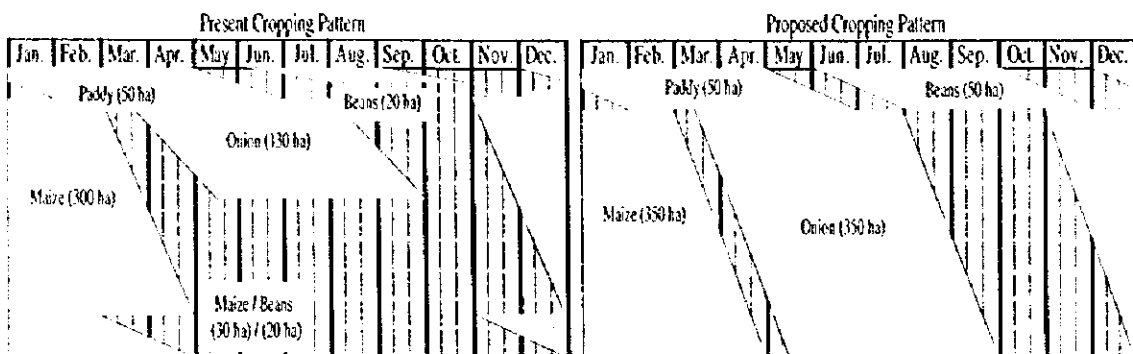
As for this scheme, the project will aim at improvement of productivity of all the crops, and hence, to maintain sustainability of farm economy through further intensification of cash crop cultivation in the dry season based on the rehabilitation effects on the irrigation facilities.



n) Malolo Scheme (400 ha)

In Malolo scheme, all the farmers grow maize in the rainy season and onion in the dry season as same to Lumuma and Nyinga schemes. However, these cropping are still unstable due to the mal-function of irrigation facilities.

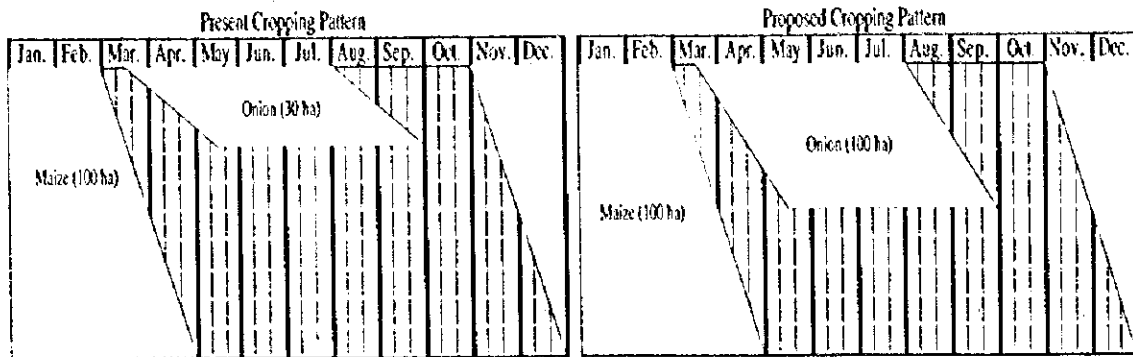
The prevailing cropping pattern in this scheme is considered to be suitable if taking into account the local climate as well as soil conditions in the scheme area. Thus, for the project implementation, no change from the present cropping pattern is proposed. Nevertheless, it can be expected that the crop production as well as those cultivated area will be expanded to a possible maximum extent of the irrigable area through rationalization of water management and the improvement of irrigation method.



o) Mgogozi-Kikalo Scheme (100 ha)

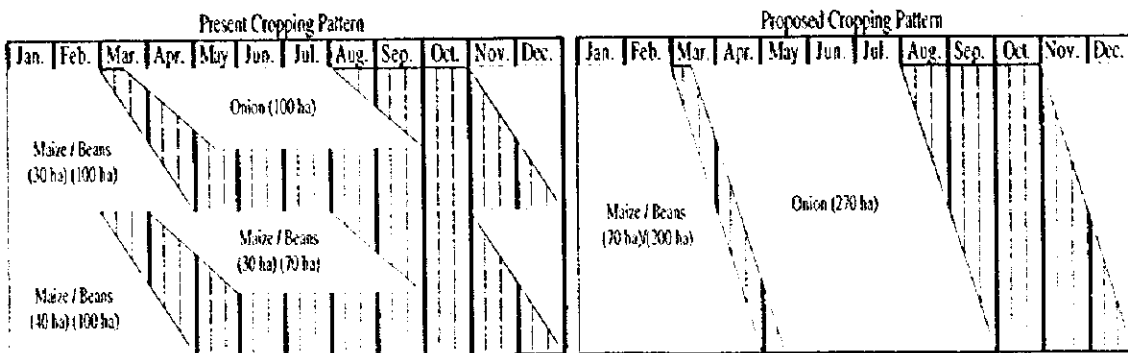
The same agronomic sense applied to Malolo scheme is also extend to Mgogozi-Kikalo scheme. An expansion of cultivated area is, however,

not expected due to limitation of available irrigation water resources in the dry season.



p) Chabi Scheme (270 ha)

Similar farming practices as well as cropping pattern to Malolo scheme is conceived for Chabi scheme. It is expected that the prevailing cropping pattern could be intensified to the potential maximum arable land through rehabilitation of irrigation facilities and rationalization of the water utilization.



(2) Cultivated Area and Cropping Intensity

After rehabilitation of irrigation facilities, supplemental irrigation in the rainy season will be ensured fully, while certain area mentioned before will be irrigated in the dry season, resulting in the drastic expansion of crop cultivation. On the other hand, it is assumed that the future situation without project is almost the same as the present situation as far as fundamental irrigation facilities will not be rehabilitated, although, in a sense, rehabilitation for irrigation facilities will be carried out by the farmers themselves.

Cultivated area and cropping intensity without and with project conditions are summarized below.

Cultivated Area and Cropping Intensity

Scheme	Project Area	Without-Project Condition				With-Project Condition			
		Cultivated Area (ha)			Intensity (%)	Cultivated Area (ha)			Intensity (%)
		RS	DS	Total		RS	DS	Total	
Zone I									
Mgeta	5	5	5	10	200	5	5	10	200
Zone II									
Manyenyeru	1,040	400	0	400	38	1,040	690	1,730	166
Kilangali	370	145	0	145	39	370	160	530	143
Mgongola	660	410	40	450	68	660	660	1,320	200
Zone III									
Mlali	60	60	22	82	137	60	30	90	150
Mvumi	260	138	0	138	53	260	260	520	200
Msolwa *1	320	320	120	440	138	320	240	560	175
Mkula *1	320	320	100	420	131	320	140	460	144
Sonjo *1	480	350	150	500	104	480	380	860	179
Zone IV									
Chabima	10	10	0	10	100	10	10	20	200
Lumuma	380	380	280	660	174	380	380	760	200
Ndole	80	80	8	88	110	80	80	160	200
Nyinga *2	150	150	40	190	127	150	150	300	200
Malolo	400	400	150	550	138	400	400	800	200
Mgogozi *3	100	100	30	130	130	100	50	150	150
Chabi	270	270	200	470	174	270	270	540	200
Total	4,905	3,538	1,145	4,683	95	4,905	3,905	8,810	180

Note)

*1 : Cultivated area of sugarcane is included for both seasons, RS and DS.

*2 : Including Mwega sub-scheme in Mgogoji Scheme.

*3 : Only Kikalo sub-scheme in Mgogoji scheme.

4.3.5 Proposed Farming Practices

As a component of farming practices, tractor operation is not adopted for the Project Area, considering some unstable conditions for supply of fuel, spare parts, etc. Fertilizers and agro-chemicals should be applied more effectively compared to the current situation. This is suggested from the viewpoint of sustainability of soil fertility and increment of crop production under irrigated conditions. Extension officers are required to give the guidance concerning the proper farming practices to farmers and spread the beneficial effects of proper application of farm inputs under irrigated conditions through the implementation of certain demonstration activities of irrigated agriculture practices.

As for paddy cultivation, weed control against such dreadful weed as wild rice (*Oriza Longistaminata*, *Oryza Glaberima*, etc.) is a most crucial work. Wild rice which is common in the Project Area is generally categorized into annual or perennial crop which has a high shattering habit and strong seed dormancy, becoming difficult to control it. Hand weeding is the most effective weed control method, although this method is laborious. In the Project, it is proposed to adopt transplanting method for paddy cultivation, in order to carry out an effective weeding and alleviate work load on weeding. Now, transplanting method has become a regular method in Mkindo Irrigation Scheme, while this method has shown good results expressed by a production increment in the Lower Moshi area of Kilimanjaro region. Further, more the transplanting method for paddy cultivation is disseminated as a prerequisite manner in the Special Program of FAO which was previously mentioned.

Unit requirement of farm inputs for the proposed farming practices for major crops

is shown below:

		Paddy	Maize	Beans	Tomatoes	Onion	Cabbage	
1	Seed	kg/ha	50	20	20	0.5	5	0.2
2	Fertilizer							
	: Urea (46 %-N)	kg/ha	180	0	0	0	0	0
	: SA (21 %-N)	kg/ha	0	190	190	380	290	380
	: TSP (46 %-P2O5)	kg/ha	125	0	0	0	100	100
3	Agro-chemical							
	: Pesticide	lit./ha	4.0	4.0	4.0	6.0	6.0	6.0
	: Herbicide	lit./ha	2.0	0.0	0.0	0.0	0.0	0.0
	: Fungicide	lit./ha	2.0	0.0	0.0	10.0	10.0	10.0
4	Packing material	No.	1S	1S	1S	1S	1S	1S
Labour Requirement								
1	Family labour	MD	160	130	120	200	180	190
2	Hired labour	MD	112	50	55	92	182	47
Sub-total (B)			272	180	175	292	362	237

The total requirement of farm inputs for the whole Project Area under with-project conditions is summarized as follows.

Total Requirement of Inputs								
Seeds	Unit	Q'ty	Fertilizers	Unit	Q'ty	Agro-chemicals	Unit	Q'ty
Paddy	ton	238	Urea	ton	858	Insecticide	lit.	37,623
Maize	ton	35	SA	ton	895	Herbicide	lit.	9,520
Beans	ton	22	TSP	ton	716	Fungicide	lit.	21,437
Tomato	kg	15						
Onion	ton	6						
Cabbage	kg	0.34						

4.3.6 Anticipated Crop Yield and Production

When the Project is implemented, it is expected that the yield of crops will be sustained at a certain higher level under a proper management of irrigation water, adoption of proposed farming practices, and enhancement of agricultural supporting services.

Based on the available information obtained from regional offices and research stations as well as actual results in some advanced area of agricultural activities, the crop yield in the without and with-project conditions are estimated as follows.

Crops	Crop Yield under Without and With-project Conditions		
	Present	Without Project	With Project
Paddy (Direct sowing)	1.6	1.6	-
Paddy (Transplanting)	3	3	5
Maize	1	1	3
Beans	0.5	0.5	1.5
Tomato	6	6	12
Onion	10	10	15
Cabbage	10	10	15

Production in each irrigation scheme under with-project conditions is summarized as follows.

Target Production of Major Crops by Scheme (ton)

Scheme	Maize	Paddy	Beans	Onions	Cabbage	Tomatoes
Zone I						
Mgeta			10		30	
Zone II						
Manyenyere		8,650				
Kilangali		2,650				
Mgongola		6,600				
Zone III						
Mtali		300				360
Mvumi	180	2,000	90			
Msolwa	720	600	300			
Mkula	420	1,100	150			
Sonjo	1,140	1,300	330			
Zone IV						
Chabima	30		15			
Lumuma	600	300	225	5,250		
Ndole	240		120			
Nyinga	420	50	15	2,100		
Malolo	1,050	250	75	5,250		
Mgogozi	300			750		
Chabi	210		300	4,050		
Total	5,310	23,800	1,630	17,400	30	360

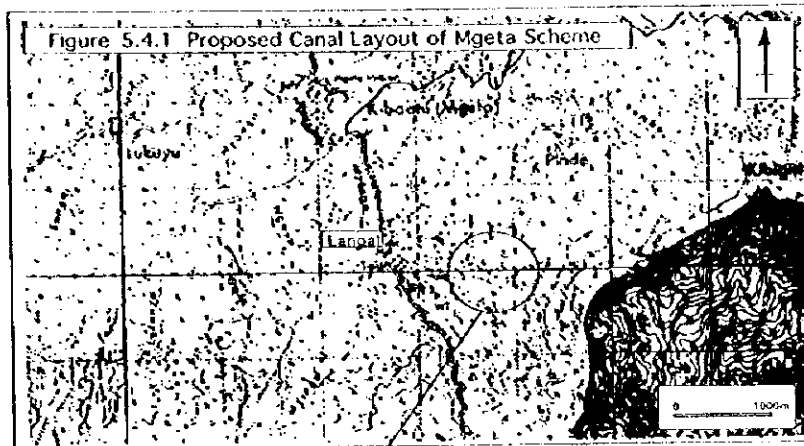
4.4 Irrigation Development and Drainage Improvement Plan

Irrigation development and drainage improvement plan on each of the 16 irrigation schemes are frameworked as follows:

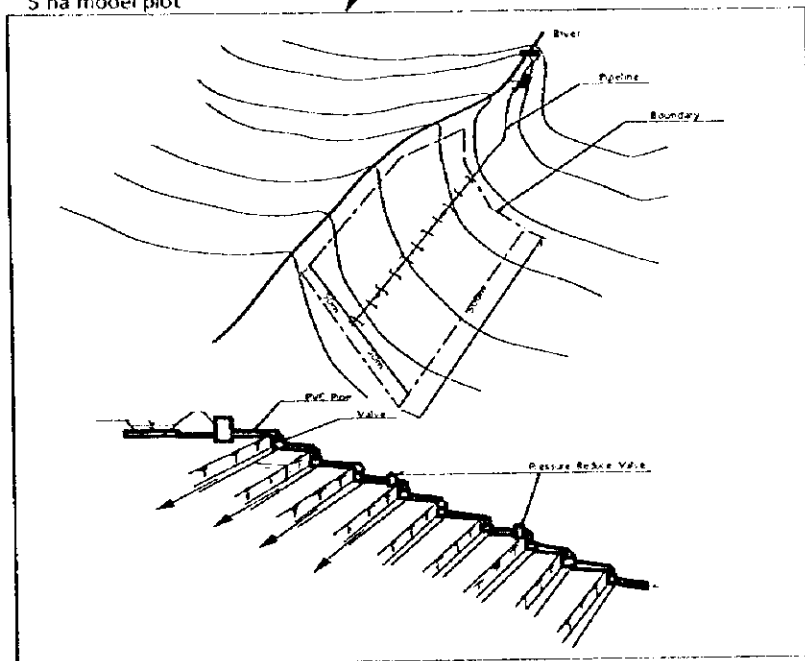
4.4.1 Mgeta scheme

Mgeta scheme is characterized as a group of numerous independent small scale irrigation systems scattered over steep mountainous slopes in Mgeta ward. In most cases, each of these irrigation systems is commanding only a few hectares of irrigable land. To improve these small scale systems, a pipe line system for conveying water by gravity will be proposed as an essential countersolution against soil erosion as well as efficient water saving. This pipeline system will also be useful to supply domestic water for farmers living in the mountainous slopes. Sample layout and basic features of the pipe line system of a typical irrigation system of 5 ha are as shown in the following page.

Cropping area	5 ha
Irrigation system	Pipeline system
Headworks (intake)	Newly provided at traditional intake sites
- Design intake discharge	About 5 litre/sec
- Type	Perforated PVC pipes covered by sand, gravel, and cobble stone, protected by concrete and rock riprap
- Pipe diameter	Around 10 to 30 cm
- Total Pipe length	10 m
Irrigation canals	Pipe line, PVC pipe buried in the ground
- Pipe diameter	50 to 100 mm.
- Length	Depending on the topography, about 600 m.
- Nos of outlets	About 20 - 30 valves
- Nos. of pressure relief valves	About 2 - 3 valves

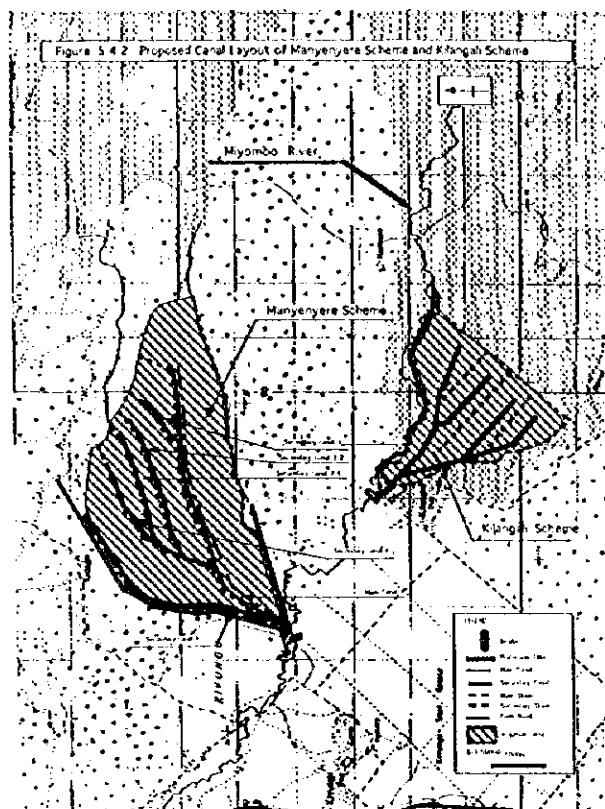


5 ha model plot



4.4.2 Manyenyere Scheme

The existing fixed overflow type weir is accelerating the seasonal flood in the upstream reaches due to a back-water effect, and moreover, the intake is not well functioning due to heavy sedimentation caught by the said weir. It is, therefore, to recommend that the existing head works shall be replaced with a new one that is "stoplog gated type." The existing canals are also required to be reshaped with provision of embankment. The drainage canals shall be newly provided along these canals so as to release an excessive water smoothly within a short time. A secondary canal is proposed to be constructed along the upstream side boundary together with the outer flood protection dike. A small natural stream, which is the southern border of this scheme area will be excavated to increase the drainage capacity. The basic features of the irrigation and drainage development are shown in Figure below and summarized in the following Table.



Gross cropping area	1,300 ha
Net cropping area	1,040 ha
Headworks	Reconstruction
- Design flood discharge	100 m ³ /sec
- Design intake discharge	2.10 m ³ /sec
- Weir type	Stoplog gated type, 22 m in total span length,
- Intake Inlet gate	Steel slide gate, 1.6m wide x 1.6m high
Irrigation canals	Rehabilitation of 7.5 km with lining, 9.5 km earthen canal
Drainage canals	Kidago stream (Natural drain) and construction of 25 km
flood protection dike	Earth type, about 1 m high, about 7.5 km long
Farm road	16 km
On-farm development	
- Paddy field	Land leveling of 1,040 ha, field ridges and field ditches

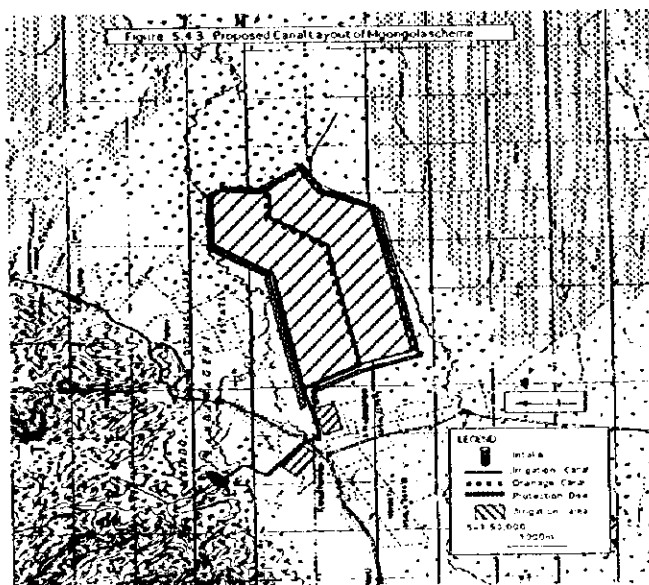
4.4.3 Kilangali Scheme

The existing fixed overflow type weir shall be replaced with a gated type weir as the same to Manyenyere scheme mentioned in the preceding section (2). It is also recommended that the existing weir for the Kilangali Seed Farm, which lies about 30 m upstream of the weir of the Kilangali scheme, shall also be removed so as to maintain the existing river course against a heavy sedimentation hazard. The canal and road layout as shown in Figure in the previous page is one of the sample layout in case using of the existing canal system. The existing canals will be reshaped with provision of an embankment. Drainage canals will be newly provided in this scheme. Flood protection dikes will be constructed along the Miyombo river. Primary features of the irrigation and drainage development are shown in the following Table.

Gross cropping area	460 ha
Net cropping area	370 ha
Headworks	Reconstruction
- Design flood discharge	100 m ³ /sec
- Design intake discharge	0.74 m ³ /sec
- Weir type	Stoplog gated type, 22 m in total span length,
- Intake	steel slide gate, 0.8m wide x 0.8m high
Irrigation canals	Rehabilitation,
- Main canal	Trapezoidal shape, stone or brick masonry lining, about 3.5 km long
- Secondary canals	Earthen canal, 4 nos. about 4 km in total length
Drainage canals	New construction
- Main drains	Trapezoidal, earthen type, about 3,900 m long
- Secondary drain	Earthen canal, about 12 km in total length
Flood protection dike	New construction for about 5.5 km long
Farm road	8.5 km
On-farm development	Paddy field, land leveling of 370 ha, field ridges and field ditches

4.4.4 Mgongola Scheme

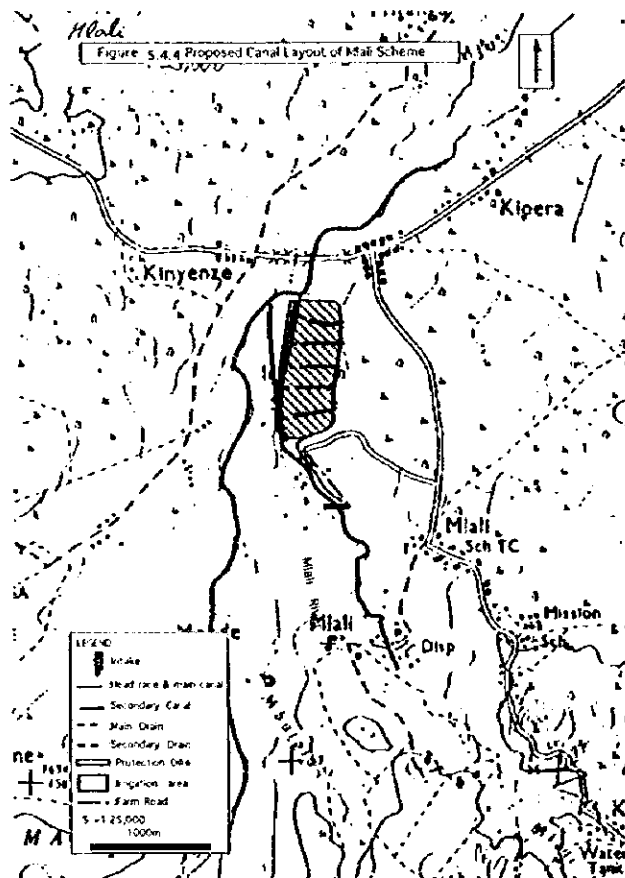
In 1990, a preliminary study on Mgongola scheme was carried out by the Zonal Irrigation Office, Morogoro as one of the development scheme under the Institutional Support for Irrigation Development Project assisted by FAO/UNDP, and demarcated about 660 ha of potential irrigable area including the present Mkindo Pilot Irrigation Scheme (40 ha). The study revealed that the Mkindo river has a sufficient river discharges even in the dry season and useful as a main water source for irrigation to the Mgongola scheme. To develop 660 ha of Mgongola scheme, it is required that the existing intake facilities shall be enlarged through rehabilitation and renewal of the whole



intake and spillway gates. In order to accommodate enough water for the scheme, the head race also needs enlargement of its canal section. The new head race will be concrete-lined having a smooth surface in the wetted perimeter. At the diversion point to the Mkindo system, the head race will be followed by a main canal to the proposed Mgongola area. The main canal will run through a lowlying plain and cross the Dizingwi river by a siphon and the trunk road B127 by a culvert. Water conveyed by the proposed main canal will be divided into two proposed secondary canals and then distributed to paddy fields through tertiary canals. Excess water in the fields will be drained through field drains, then secondary and main drains to the Mgongola river. Flood protection ridges will be provided around the project area. The basic features of the irrigation and drainage development are shown in Table below.

Gross cropping area	830 ha including existing Mkindo area
Net cropping area	660 ha including existing Mkindo area
Headworks	Minor repairing with replacement of 4 steel gates
- Design flood discharge	112 m ³ /sec in 50 year return period
- Design intake discharge	1.4 m ³ /sec
- Type	Fixed weir on the top of natural fall
- Intake inlet gate	Steel slide gate, 1 m wide x 1 m high x 2 sets
- scouring gate	Steel slide gate, 1 m wide x 1 m high x 2 sets
Irrigation canals	all newly constructed
- Head race	replaced, stone or brick masonry lining, about 1 km long
- Main canal	lining canal type, about 2.5 km long
- Secondary canals	earthen canal, 2 canals, about 9 km in total
- Tertiary canals	earthen canal, commanding about 24 ha each, about 700 - 1,000 m long each
Drainage canals	all newly constructed
- Main drains	trapezoidal, earthen type, about 250 m long
- Secondary drains	earthen type, 2 drains, about 8 km long
- Tertiary canals	earthen canal, commanding about 24 ha each, about 700 - 1,000 m long each
Flood protection dike	15 km long
Farm road	two way road 2.3 km and one way road 17 km
On-farm development	land leveling of 620 ha, and field ditches

4.4.5 Mlali Scheme



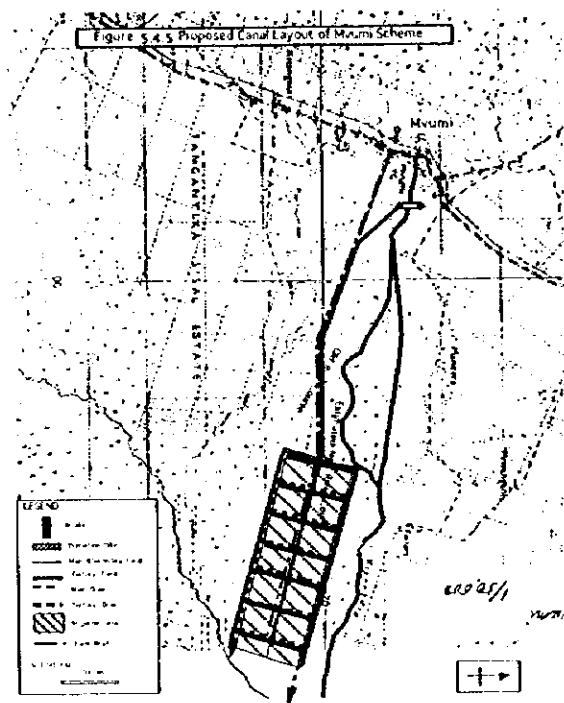
Instead of the existing buried head works, new head works are proposed to construct in the upstream about 240 m from the existing head works where the river is slightly meandering to the left and water route is biased to the right. The proposed head works will be only an intake without weir, because the water level is kept by the existing weir located at about 240 m downstream point of the proposed intake site. The intake will be followed by a head race to connect the existing main canal. The head race will have a trapezoidal cross section with lining. The existing main canal having a trapezoidal cross section will be rehabilitated with provision of lining. All the secondary canals will be constructed on the former routes as an earthen canal type. The basic features of the irrigation and drainage development are shown in the following Table.

Gross cropping area	80 ha
Net cropping area	60 ha
Headworks	only an intake be constructed in the upstream 240 m or 600 m
- Design flood discharge	64 m ³ /sec in 50 year return period
- Design intake discharge	0.12 m ³ /sec
- Type	Intake without weir
- Intake	Stoplog type, 2 m wide x 0.6 m high
Irrigation canals	
- Head race	Newly provided, stone or brick lining, 250 m
- Main canal	Rehabilitated with masonry lining, about 1,400 m long
- Secondary canals	Newly constructed, earthen canal, about 1.2 km in total
Drainage canals	Main 2.1 km, secondary 1.2 km
Flood protection dike	Earth type, about 1.5 m high, 1.3 km long
Farm road	Improvement from Mgeta road to present weir and then newly constructed. to new intake, total 1.5 km

4.4.6 Mvumi Scheme

A Pre-Feasibility study conducted in 1985 identified about 300 ha as a prospective land for irrigated agriculture. Water source of the project is the Kisangata river of which provides enough water to irrigate all the planned paddy and upland crop fields (260 ha in total); however the river flow is very unstable. Site for headworks have to be carefully decided giving due consideration to sand sedimentation conditions and stability of the river course.

Head works are tentatively proposed at about 1.5 km upstream of the buried head-works, where the river depth is about 3 m and water do not overflows in accordance to the information from the farmers. From this diversion point to the Project Area, a 4 km long head race will be planned to be constructed along the existing road. A main canal will convey water, distributing it to the secondary canals, and then, serve fields via tertiary canals. Flood protection dikes will be provided so as to surround the scheme area.

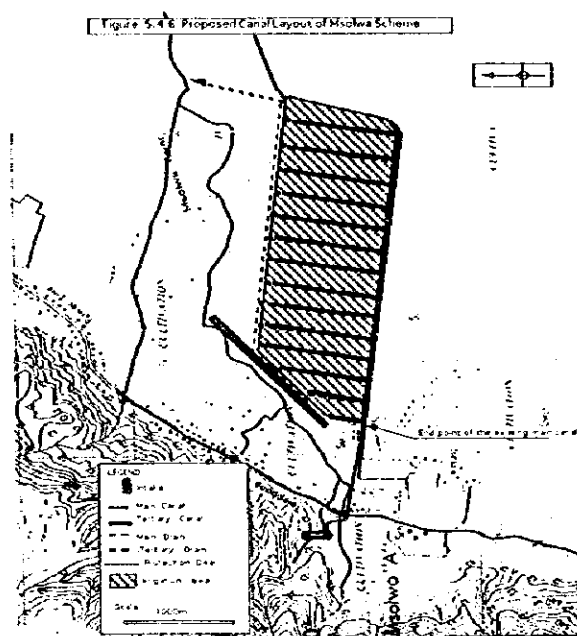


The basic features of the proposed facilities are shown in the following Table.

Gross cropping area	330 ha
Net cropping area	260 ha
Headworks	New construction at 1.5 km upstream of present buried intake
- Design flood discharge	244 m ³ /sec in 50 year return period
- Design intake discharge	0.5 m ³ /sec
- Weir type	Stoplog gated type
- Intake	Steel gate, 0.8 m wide x 0.8 m high
Irrigation canals	New construction
- Head race	lining, about 4 km long
- Main canal	lining, about 3 km long
- Secondary canals	Earthen canal, 6 km in total, about 500 m ² /25 ha each
Drainage canals	New construction
- Main drains	Trapezoidal, earthen type, along right & left boundary, about 3.3 km long each
- Secondary drain	Earthen canal; 6 km, commanding about 25 ha each, about 8.5 km long
Flood protection dike	about 8.5 km long
Farm road	Improvement; 5 km, new road in area; 3 km
On-farm development	
- Paddy field	Land leveling of 200 ha, field ridges and field ditches
- Upland	Field ditches for 60 ha

4.4.7 Msolwa Scheme

The Zonal Irrigation Office, Morogoro has planned on this scheme to enlarge more irrigable area through rehabilitation of the existing intake weir and extend irrigation and drainage facilities to lower reaches of the fan formation. In this plan, it has been emphasized on expansion of the main canal by 3.8 km along the existing village road branching off from the route B127 (Ifakara - Mikumi road) to the east in a straight line. An irrigable area was estimated about 400 ha in gross or 320 ha in net (4 km along the village road and 1 km perpendicular to the road) in the north side of the road as shown Figure in the right. The head works will be repaired and reinforced with cement mortar plaster. The existing two ruined gates will be replaced with more sizable gates. The existing main canal and the related structures will also be repaired mainly at the leakage points including the level-crossing structure. The canal walls will be heightened to a certain extent to increase the flow capacity. The main canal to be newly extended will be lined as the same to the existing reaches. The secondary canals will run in parallel with the contour line.



It is noted that an adjustment of water allocation upon between beneficiaries of this scheme and the existing water right holders is essential subject so far as to implement this scheme. The basic features of the irrigation infrastructure development in the Msolwa scheme are shown in the following Table.

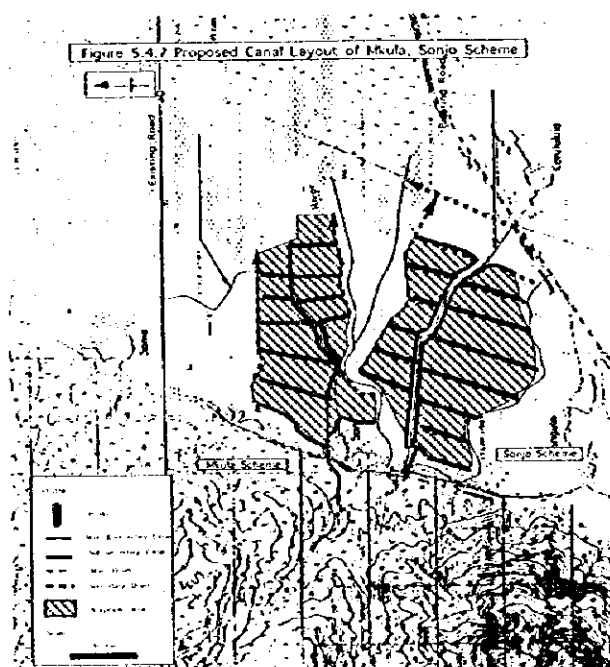
Gross cropping area	400 ha
Net cropping area	320 ha
Headworks	Rehabilitation of existing weir and intake with gates' replacement
- Design flood discharge	97 m ³ /sec in 50 year return period
- Design intake discharge	0.3 m ³ /sec
- Weir type	Fixed overflow type
length	about 17 m
- Intake type	A gated inlet followed by a sand trap pond
inlet gate	Steel slide gate existing, 0.9 m wide x 1.2 m high
sand flush gate	Steel slide gate existing, 0.9 m wide x 1.3 m high
Irrigation canals	
- Head race	Rehabilitated at leakage points and increasing capacity, 1.3 km long
- Main canal	Newly constructed, lining 3.8 km long
- Secondary canals	Newly constructed, earthen canal, about 13 km in total
- Major related structures	Culverts for crossing farm road and division structures
Drainage canals	
- Main drains	newly constructed, earthen type, about 5 km long
- Secondary drains	newly constructed, earthen type, about 13 km long in total
Flood protection dike	Earth type, about 1 m high, 1.2 km long
On-farm development	Land leveling of 100 ha, and field ditches for paddy fields Field ditches for 220 ha of upland crop fields

4.4.8 Mkula Scheme

Prospective irrigable land of the scheme is estimated to be 320 ha in gross. Most of the land has been reclaimed and extensively cultivated with upland crops as well as paddy under rain-fed conditions. As stated in the preceding Chapter III, a water discharges of the Mkula river largely fluctuate seasonally, and accordingly, irrigation in the dry season is limited to only 150 ha or around.

The proposed canal layout is as shown in Figure in the right. The existing head works will have to be rehabilitated entirely. A concrete membrane will e provided in front of the existing weir in order to reduce the water leakage hazard. The

existing head race will be replaced at the upper-most reaches of 175 m. Enlargement of a conveyance capacity is required on this replacement of this head race canal. The walls of the rectangular flume will be heightened for increasing water conveyance capacity through out the reaches of main canal. Repairing of the rectangular flume especially after crossing the trunk road B127 (Ifakara - Mikumi road) be also made so as to eliminate water leakage hazard. Then the main canal will be extended along the existing village road. The basic features of the proposed irrigation and drainage facilities are as shown in the following Table.



Gross cropping area	400 ha
Net cropping area	320 ha
Headworks	Rehabilitation of existing head works, intake and apron
- Design flood discharge	59 m ³ /sec in 50 year return period
- Design intake discharge	0.3 m ³ /sec
- Weir type	Fixed overflow type
length	about 11 m
- Intake inlet gate	steel slide gate, 0.6 m wide x 0.6 m high
Irrigation canals	
- Head race	Replaced with new one, lining about 175 m
- Main canal	Raising walls height by 30 cm for total 450 m length and repair leak-age points
	Newly constructed, lining, 3 km long
- Secondary canals	Newly constructed, earthen canal, about 11 km in total
Drainage canals	
- Main drains	Newly constructed, earthen type, about 5 km long
- Secondary drains	Newly constructed, earthen type, about 11 km long in total
Flood protection dike	Earth type, 2.5 km long
On-farm development	Land leveling of 220 ha, and field ditches for paddy fields Field ditches for 100 ha of upland crop fields

4.4.9 Sonjo Scheme

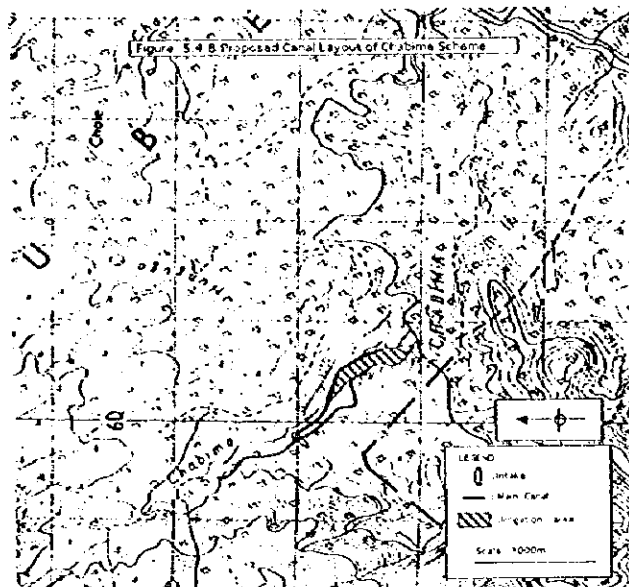
The Sonjo scheme is one of the new irrigation development program. The proposed canal system planned is as shown in Figure attached to the preceding page same to Mkula scheme. Head works will be provided on the Sonjo river at about 100 m upstream from the existing bridge of the trunk road B127 (Ifakara - Mikumi road). The proposed head work site has been out cropped and founded with firm rock, and the water head is sufficiently high to distribute water to all the irrigable area by gravity. A main canal will be laid along an existing earthen road running in the center of the scheme area from the route B127. The secondary canals will be located on the opposite side of the main canal along the existing road. The basic features of the proposed facilities are shown in the following Table.

Gross cropping area	600 ha
Net cropping area	480 ha
Headworks	Newly provided
- Design flood discharge	154 m ³ /sec in 50 year return period
- Design intake discharge	0.5 m ³ /sec
- Weir type	Fixed overflow type
length	about 15 m
- Intake inlet gate	Steel slide gate, 0.9 m wide x 0.9 m high
Irrigation canals	
- Main canal	Stone or brick masonry lining, 3.5 km long
- Secondary canals	Stone or brick masonry lining, 3 km long
- Other secondary canals	Mainly earthen canal, about 12 km in total
Drainage canals	
- Main drains	New construction in both sides, earthen type, about 4 km long
- Secondary drains	New construction, earthen type, about 12 km long in total
Flood protection dike	2.4 km long
On-farm development	Land leveling of 260 ha, and field ditches for paddy fields Field ditches for 220 ha of upland crop fields

4.4.10 Chabima Scheme

Prospective irrigable area is estimated about 10 ha that is extending along the left

bank of the Chabima river. The scheme itself is very small and does not require any heavy infrastructure for irrigation and drainage except the head works. As for the head works, it is required to repair the existing intake weir. To this, the left-side portion where the weir body has been damaged by the previous floods and cracked seriously shall be reconstructed with provision of a safety measure for the foundation and abutment. The right-side portion of the weir, where the backfill earth has been eroded out to a serious extent, shall be repaired with provision of wingwalls and then refilled with suitable embankment material. The basic features of the development scheme are as shown in the following Table.



Gross cropping area	15 ha
Net cropping area	10 ha
Headworks	Rehabilitation of cracked portion, reinforcement of apron & right wing, intake is newly provided
- Design flood discharge	16 m ³ /sec in 50 year return period
- Design intake discharge	0.01 m ³ /sec
- Weir Type	Fixed type weir
- Intake Type	A stoplog gated inlet, 0.5m wide x 0.8m high
Irrigation canals	New construction
- Main canal	earthen canal, about 1 km long
- On-farm development	10 ha

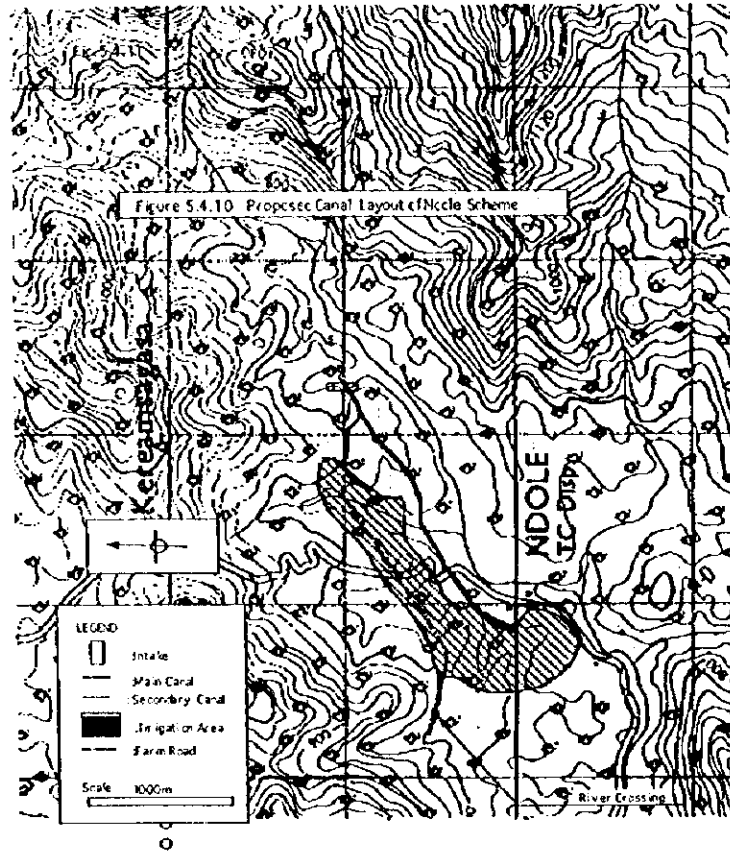
4.4.11 Ndole Scheme

The basic features of the development scheme are as shown in the following Table.

Gross cropping area	100 ha
Net cropping area	80 ha
Irrigation canals	Rehabilitation of existing canal & extension of main canal
- Head race	Increasing canal height, about 250 m long
- Main canal	Flume type, lining, about 2.5 km long
- Secondary canal	Provision of lining, about 0.3 km long
- Major related structures	Construction of stepped chute and division box on main canal
Farm road	2 km with a bridge for river crossing
On-farm development	Field ditches for 80 ha

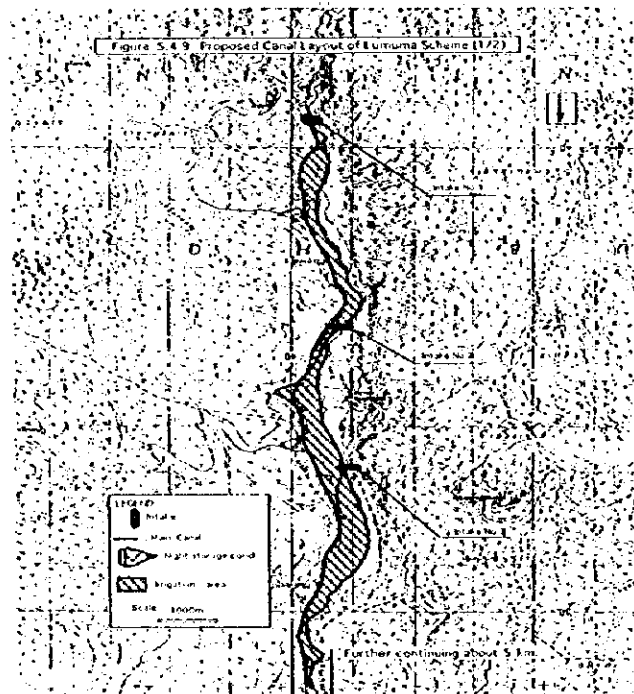
The scheme does not require any heavy infrastructure pertaining to irrigation and drainage works. The main tasks are to be:

- 1) Canal lining of about 3 km to increase flow capacity and to prevent earth erosion generated by the canal flow and
- 2) provision of some control structures at appropriate points.



4.4.12 Lumuma Scheme

Total net cropped area served by the Lumuma river is about 1,100 ha in the Lumuma river basin including Mpwapwa district of Dodoma region, out of which 380 ha belong to the Lumuma scheme. Water resources are not sufficient to irrigate all the cropped area of the Lumuma river basin especially in the mid-dry season. In case of Lumuma scheme, however, majority of farmers could enjoy irrigation practices throughout the year since the area is located at the upstream reaches of the Lumuma river basin and blessed with good water distribution. Thus, for irrigation development in this scheme, it has been emphasized on improvement of irrigation efficiency with provision of a water saving measures, and then, to bear surplus of irrigation water as much as possible for contributing to farmers in the lower reaches. To this, it is recommended to unify various number of the existing traditional intakes into few permanent intakes, line the main canals, and provide night storage ponds, etc.



To implement the proposed development plan, an adjustment of the water right on the basis of mutual understanding with Mpwawa district, Dodoma region is essential and crucial subject. The basic features of the development scheme are as followings:

Gross cropping area	480 ha		
Net cropping area	380 ha		
Headworks	First System	Second System	Third System
- Design flood discharge	Traditional intakes are released with permanent head works. 161 m ³ /sec in 50 year return period		
- Design intake discharge	0.13 m ³ /sec	0.10 m ³ /sec	0.15 m ³ /sec
- Weir type	Fixed overflow type	Stoplog gated type	Stoplog gated type
- Intake inlet gate	Steel slide gate, gate leaf size: 0.6 m wide x 0.6 m high x 1 set		
Irrigation canals			
- Main canal	Lining 4.5 km	5 km	11 km
- Night storage pond, capa.	2,800 m ³	2,200 m ³	3,200 m ³

4.4.13 Nyinga and Mgogozi Mwega Scheme

New head works will be provided at the upper most reach of the Nyinga area in stead of the existing three traditional intakes in the Nyinga scheme. In case of Mgogozi-Mwega scheme, no suitable site for diverting the river water to an irrigable area. Therefore, a canal coming from the above proposed head works will be extended to the Mgogozi area and connect with the existing canal system. As for the canal layout from the proposed head works, two alternatives are conceivable:

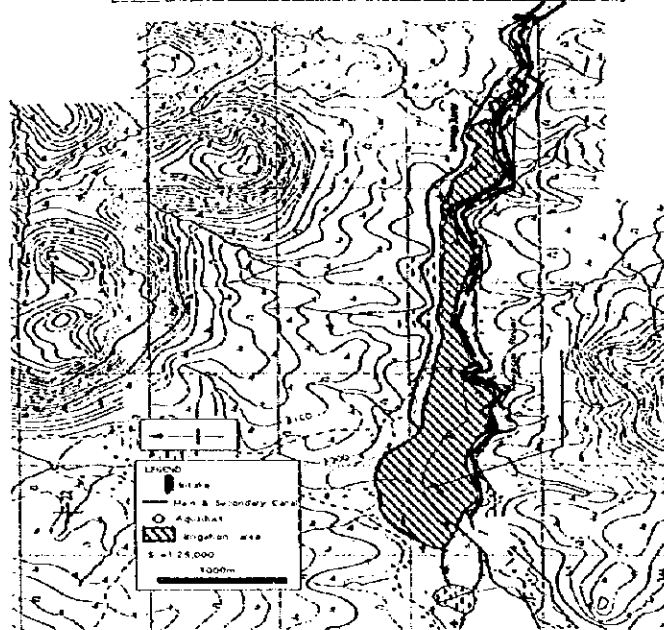
- 1) Alternative-1: Direct water diversion for both banks by two canal systems:
The proposed main canals are branched off directly from the proposed headworks to both banks of the Mwega river.

Gross cropping area	180 ha
Net cropping area	150 ha
Headworks	Newly constructed for unification of traditional intakes
- Design flood discharge	99 m ³ /sec
- Design intake discharge	0.15 m ³ /sec
- Weir type	stoplog gated type
- Intake inlet gate	Steel slide gate, gate leaf size: 0.5 m wide x 0.5 m high x 1 set
Irrigation canals	
- Proposed main canal	3.2 km, lining
- Proposed secondary canal to Mgogozi area	4.4 km, lining

- 2) Alternative-2: Water diversion to right bank area through aqueduct:
The proposed main canal be branched off from the headworks only to the left bank area, and on the way, a secondary canal be branched off and runs to the right bank across the Mwega river by aqueduct.

The alternative-1 might be technically feasible, but hardly justified its financial viability due to a large cost to be required for excavation of base rock portion to longer extent especially in the right bank area. Therefore, in this study, the proposed irrigation development plan is primary formulated based on the idea represented in the alternative-2. Major features of the development scheme are as summarized in the above Table, and its layout is shown in Figure below:

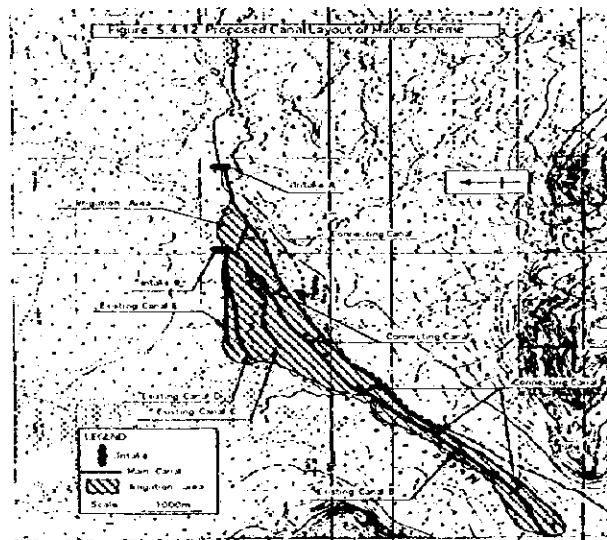
Figure 5.4.11 Proposed Canal Layout of Nyinga Mnyigizi Mvonga Scheme



4.4.14 Malolo Scheme

The existing canal-A and canal-B are running in parallel with each other at intervals of 100 m to 250 m and commanding very long-cum-narrow strips extended on the left bank of river terrace. In this plan, it is proposed to utilize the canal-A as a main canal for commanding all the irrigable area of the left bank of river terrace, while the canal-B be used as secondary canal of the canal-A system as shown in the following Figure.

The existing intake-A lacks flow capacity to release the seasonal flood water and worsens flooding conditions causing back-water effect. The weir is also accelerating hazardous sedimentation at the upstream reaches, and making the river unstable.



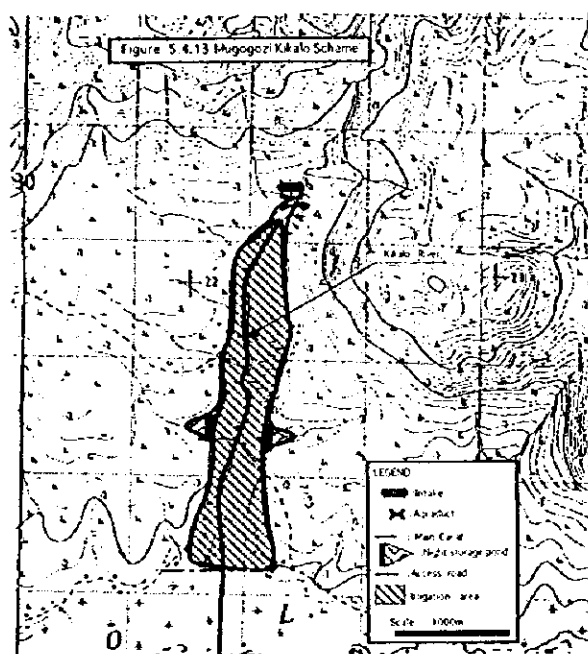
Thus, it is proposed to replace the existing intake-A and provide a new one with stoplog gated type to a upper reach position. The intake-B has also the same problem as the intake-A, but the foundation of the weir is expected to be firm on the right side portion. Thus, it is planned that the weir section should be widened to the right side, so certain increment of flow capacity could be expected. The weir type should be all a stoplog type. The sill elevation will be set a little lower than the present river bed at downstream of the weir in order to mitigate the sedimentation at the upstream reaches. A new lined canal will be constructed from the new intake-A, and connected to the existing canal-A. The

existing canal-A shall also be lined in most of the reaches and provided with diversion structures. The basic features of the development scheme are as shown in the following Table.

Gross cropping area	500 ha	
Net cropping area	400 ha	
Net irrigation area	Intake A system (Left bank area) 350 ha	Intake B system (Right bank area) 50 ha
Headworks	Replaced with new one	Improvement
- Design flood discharge	117 m ³ /sec	
- Design intake discharge	0.35 m ³ /sec	0.05 m ³ /sec
- Weir type	stoplog gated type	stoplog gated type
- Intake type	an inlet and a sand trap pond	pond with slide gates
gate (leaf size)	0.9 m x 0.9 m	0.5 m x 0.5 m
Irrigation canals		
- Main canal	Main canal A, 10.5 km	
- Proposed connecting canal from canal-A to existing canal-B	6 canals, 2.2 km in total	

4.4.15 Mgogozi-Kikalo Scheme

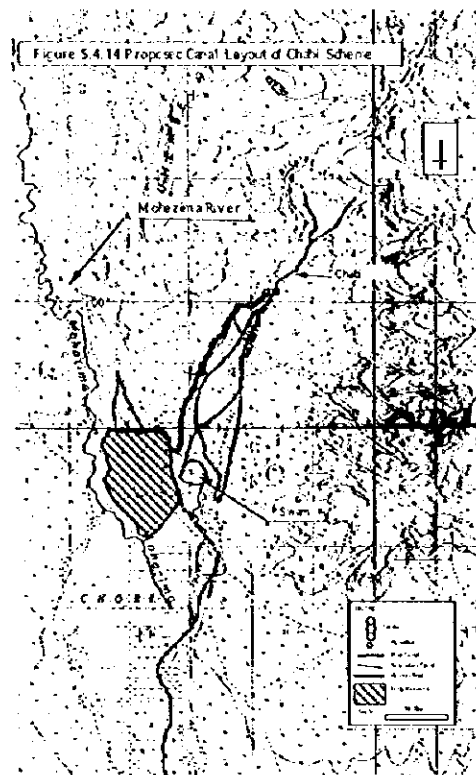
The cropped area of about 100 ha served by the Kikalo river suffers from a shortage of water resources. It is estimated that only half of the cropped area be irrigable in case of drought specified under the conditions of the five year return period, while almost all the area could be irrigated in the case of the drought conditions of the two year return period. Thus, the irrigation development should put an emphasis on the improvement of irrigation efficiency in order to save water and to extend irrigation area as much as possible. For this purpose, unification of existing traditional intakes by a permanent intake, lining of main canals, and provision of night storage ponds are proposed. Primary features of the infrastructure development are shown in the following Table.



Gross cropping area	130 ha
Net cropping area	100 ha
Headworks	Improvement of weir and newly construction of intake
- Design flood discharge	8 m ³ /sec in 50 year return period
- Design intake discharge	0.10 m ³ /sec
- Weir	Existing, fixed overflow type, repairing leakage point
- Intake	Steel slide gate, gate leaf size: 0.5 m wide x 0.5 m high x 1 set
Irrigation canals	
- Main canal, Left and right	Lining, 2 km long each
- Major related structures	A night storage pond for each of left and right main canal Effective storage volume: 900 m ³ to 1,300 m ³ for each
River improvement	Enlargement, about 1 km in the downstream reaches
On-farm development	Small earthen canals, about 3 km in total

4.4.16 Chabi Scheme

The Chabi scheme consists of Chabi sub-scheme and Mohazima sub-scheme. In case of the Mohazima sub-scheme, water rights on the Mohazima river are granted only to the beneficiaries of Mpwapwa district, Dodoma region. Its granted amount is 0.53 m³/sec, which is larger than the Mohazima river discharge in mid-dry season. Thus, there is no room, from the granted water right point of view, for allocation to the Mohazima scheme in the mid dry season, although by mutual understanding, river water is fairly taken by both Chabi scheme and the Mpwapwa side at present. However, the Mohazima sub-scheme will continuously suffer from a water shortage in the dry season due to absolute insufficiency of water resources. Meanwhile, even in the dry season the water resources of the Chabi river still remain without utilization even when all the area of the Chabi sub-scheme is irrigated. About 240 ha can be irrigated by the water resources of the Chabi river in mid-dry season. Thus, in addition to the Chabi sub-scheme area of 100 ha, the Mohazima sub-scheme area of 140 ha out of 170 ha should be covered by the Chabi river. Water of the Chabi river can be conveyed to the Mohazima area by gravity.



The canal under construction from the upper Chabi intake is proposed to be extended to the Mohazima area along the foot of hills; another proposal is branching off a canal from the existing canal originating from the lower Chabi intake to provide the Mohazima area across the Chabi river with a new canal. In either case, the current two traditional intakes of the Chabi river should be replaced with only one permanent intake. Primary features of the project facilities are shown in the following Table.

Gross cropping area	340 ha
Net cropping area	270 ha, only 240 ha be irrigated by proposed Chabi system
Headworks	Construction of permanent head works on the Chabi river
- Design flood discharge	33 m ³ /sec in 50 year return period
- Design intake discharge	0.27 m ³ /sec
- Weir Type	Fixed type weir
- Intake Inlet gate size	Steel gate, 0.6m wide x 0.6m high
Irrigation canals	New construction & rehabilitation of existing canal
- Main canal	Lining, about 5 km long
- Secondary canals	New construction. of 0.5 km & improvement of about 3 km by lining
On-farm development	Small earthen canals, 11 km in total

4.5 Access Road Improvement Plan

The present condition and improvement plan for these access roads are summarized in the following Table.

Name of Scheme	Name of Trunk Road	Distance from Trunk R. to Scheme	Access Road Condition	Improvement Work Items
Mgeta	A-7	35 km	First 25 km: -Laterite road in flat area -Relatively well maintained Last 10 km: -Mountain road -Appearance of Rock due to soil erosion	-Road surface improvement about 0.5 km -Rock cutting & filling
Manyenyere	B-127	20 km -13 km up to Tindiga village -7 km up to intake	-Earth road without embankment -Difficult to pass during the rainy season	-Embankment & side ditches about 4.5 km -Provision of some cross drains
Kilangali	B-127	15 km	-Earth road without embankment -Difficult to pass during the rainy season, especially in last half portion	-Embankment & side ditches -About 5.0 km -Provision of some cross drains
Chabima	B-127	21 km	First several km :Difficult to pass during the rainy season Last half: Appearance of rock due to soil erosion	-Embankment about 2 km -Rock cutting & filling about 0.5 km
Lumuma	Railway connected to Dar es Salaam	10 km from Kidate railway station	-Earth road -Relatively well maintained -Passing some depressions -Few longitudinal steep portions	-Provision of some cross drains -Improvement of alignment & embankment about 0.5 km
Ndole	B-127	37 km from Mvomero	First 10 km: -Laterite road in flat area -Relatively well maintained Last 27 km: -Mountain road -Appearance of Rock due to soil erosion -No superstructure of one bridge -Big gully portion at one road side	-Surface improvement about 3km -Provision of 7 cross drains -Construction of 10m superstructure for one bridge -Provision of gabion
Malolo	A-7	25 km up to Malolo village	-Flat road without any embankment -Relatively good surface condition -Passing some depressions	-Provision of some cross drains
	Chabi road	4 km up to Malolo intake B	-Very bad surface condition near canal B -Wash away superstructure of bridge on Mwega river -Soil erosion of one road side	-Embankment about 1.2 km -Construction of 13m superstructure for one bridge -Provision of gabion
Nyinga	Malolo village	9 km from Malolo to Nyinga	-Earth road -Insufficient drainability -Few longitudinal steep portions	-Provision of some cross drains -Provision of side ditches -Improvement of alignment & embankment about 0.5 km

The access road is the one of the most important facilities for rural development, and for which its improvement, villagers and farmers have a strong desire. Access roads to Mgeta, Manyenyere, Kilangali, Chabima, Lumuma, Ndole, Malolo, Nyinga, Mgogozi, and Chabi schemes, are commonly serving as a public road for many beneficiaries belonging not only to the Project irrigation schemes.

4.6 Plan of Community Development and Reinforcement of Farmers' Organization

4.6.1 Basic Concept

Reinforcement of the present farmers' organization is one of the essential subject so as to properly perform O&M work on the rural-cum-agricultural infrastructure as well as to successfully maintain sustainable crop production. An activation of the village community society is the primary basis of this approach.

1) Strengthening of Water Users' Group (WUG)

GOF has worked out as a basic policy that the irrigation system should be maintained through the beneficiaries participatory approach. After completion of the Project, it can be expected that the irrigation systems in each scheme will be improved and expanded its function to a considerable extent. To successfully undertake O&M work by farmers themselves in each scheme, it is, therefore, essentially needed in advance to strengthen and/or further improve the existing water user's groups through re-structuring or newly organizing into WUG.

2) Strengthening of Supporting Services to O&M Work of Farmers

Majority of the beneficiary farmers in each scheme has been experienced to do O&M work through operation of the existing irrigation facilities. In reality however, those farmers are all in small holders, and consequently, still lie at poverty level. Accordingly, provision of an opportunity for access to the agricultural credit as well as technically skilled-based training is essential and crucial program so as to activate the participatory approach to the O&M work. To extend such supporting services, efficiently and properly, strengthening of the technical staff and hence supporting function of the concerned local government authorities or agencies is one of the important subject in implementation of the Project.

3) Encouragement of Participation of Women into Irrigation Development

Women in the Project area play an important role in not only household keeping but also various economic activities in agriculture, forestry and other production sectors as well as social activities, i.e. health and welfare, cultural sectors, etc. However, actual involvement in agricultural development is not up to the mark mainly due to their social and cultural background and lack of access to new technology, despite their ample contribution to farm product and consequently farm income.

Herein the Project, women in development (WID) would thus aim at enforcing women's social status through promotion of diversifying the income sources for financial self-reliance of women as well as en-rolling their community activities, more efficiently and satisfactorily. WID also aims at improving the labour productivity by providing skill-based training and extension in respective aspects of irrigated farming to women.

4.6.2 Water Users' Group

(1) Objectives of WUG

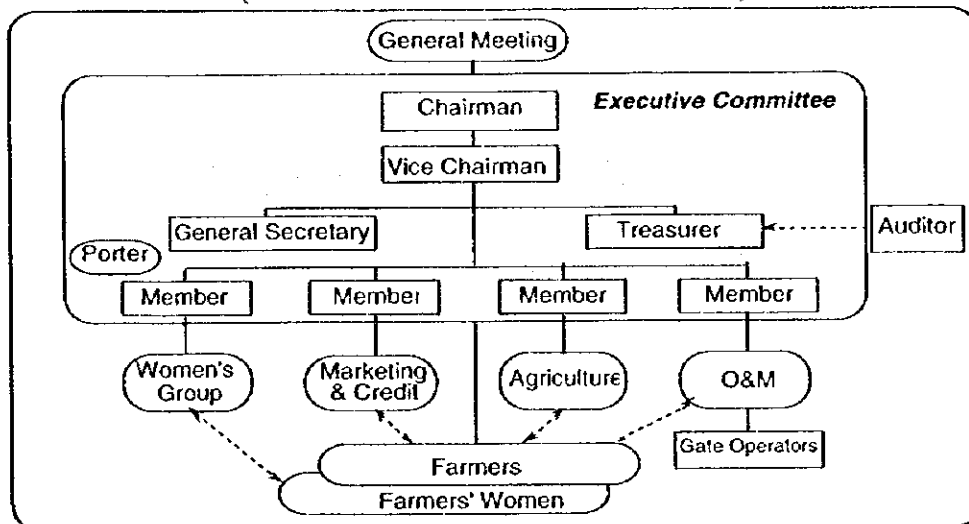
The WUG shall be independently established for each scheme. The essential objectives conceived in organization of WUG are to perform O&M work on the irrigation and drainage facilities as well as access road, etc. at the post-construction stage. Access to marketing and credit services is also one of the elemental function of WUG. All the beneficiary farmers in the scheme shall be participated into WUG organization, and accordingly, its membership shall be permitted to all the beneficiaries, irrespective of their gender as well as social-cum-cultural background.

(2) Proposed Organization and Prospective Activities

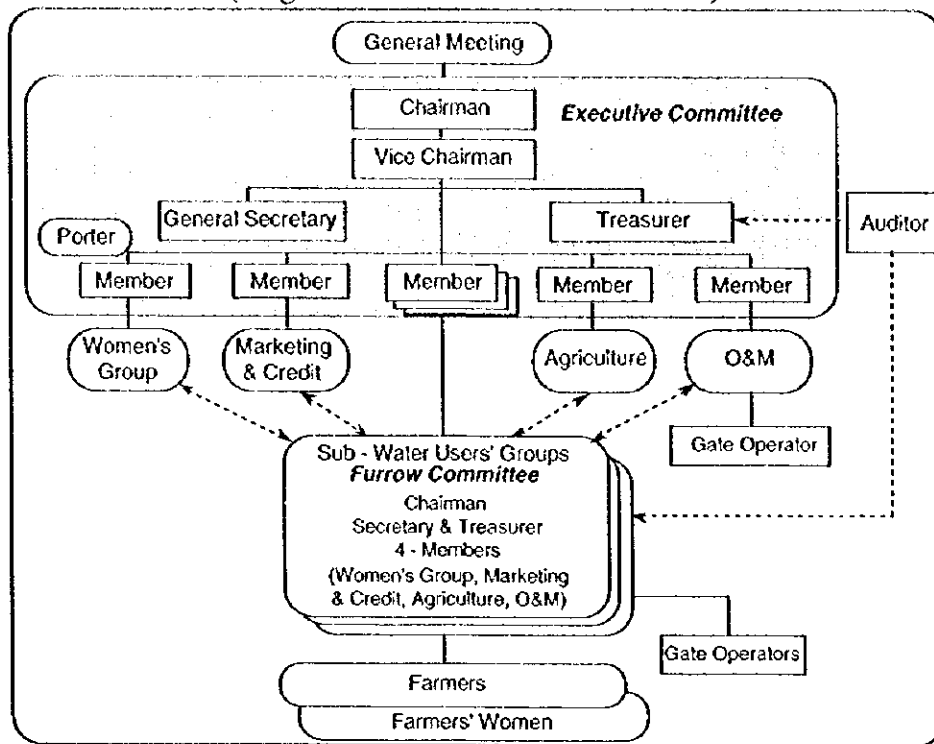
The proposed organization structure of WUG is as shown below. The proposed WUG will consist of Type-A and -B.

The Type-A is applicable for the small scheme having less than 100 farm households. In this organization, the member farmers will be directly coordinating with the executive committee and perform necessary activities any one time. While, the Type-B is recommendable for the larger scheme over 100 farm households. In the Type-B organization, the member farmers will be grouped into several units of sub-water users' groups (sub-WUG) by each irrigation block or each village unit. Each group will be functioning separately under management of the executive committee. To organize farmers into WUG, it is to recommend that members of a unit group shall be limited to less than 100 farm households, so that a face to face communication among the members could be maintained, satisfactorily.

Proposed Water Users' Group Type-A
(Small Scale WUG below 100 Members)

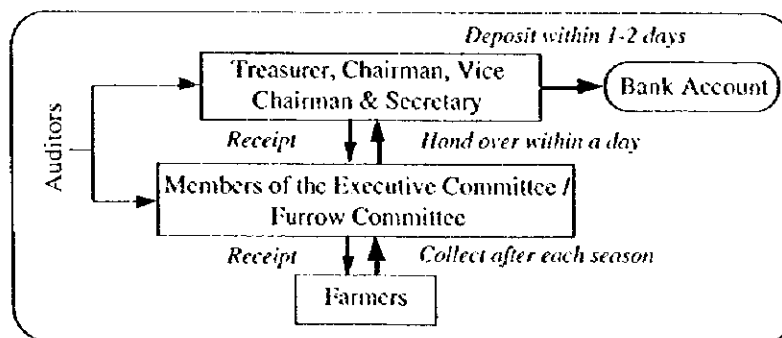


**Proposed Water Users' Group - Type-B
(Large Scale WUG over 100 Members)**



(3) Irrigation Service Charges

All the O&M costs to be required for operation and management of the irrigation facilities will be covered by the irrigation service charges (ISC) collected from the beneficiary farmers. The proposed procedure for collecting ISC is as follows.



ISC could be collected immediately after each cropping season. All members of the executive committee will collect ISC directly from the beneficiary farmers. ISC collected will deposit in the respective bank account of WUG. For collection of ISC, the members of executive committee shall make a small group consisting of 2-3 members, and take a collection schedule together for keeping security. The treasurer shall manage all these transactions, and auditors should check all the financial statements and balance sheet periodically.

To achieve a good progress of ISC collection, it is recommended to adopt the following punishment rule as well as give incentive issue in the respective articles and/or by-laws of WUG:

- a) To farmers who are not able to pay ISC on time, WUG fines them a certain percent of the due ISC for the months to be payment delayed; and in contrast,
- b) When farmers pay full charges on time, a certain percent of the due ISC be reimbursed to them as a given incentive.

(4) **By-laws, Water Right and Registration of WUG**

The articles or by-laws should be enacted by WUG in accordance with the Co-operative Act. 15. In this articles or by-laws, following items should be included:

- 1) WUG has the right to collect ISC from the beneficiaries, and the beneficiaries have the duty to pay its ISC to WUG.
- 2) WUG inflicts a punishment on the beneficiaries who use irrigation water and facilities illegally and are not able to pay ISC.
- 3) The beneficiaries have the duty to participate in the communal works on O&M.
- 4) The tenant beneficiaries have a right to join WUG with the election to the executive members, and are in duty bound to pay ISC and membership fees .

All WUG established in each scheme shall be registered under administration of MAC before commencement of the project implementation, and then, acquire the water right. DALDO office shall extend necessary supporting services to WUG for those registration and acquisition of the water rights.

(5) **Irrigation Meeting**

The production activities of crops are closely linked with various agricultural support activities including extension services, machinery services, supply of farm inputs, credit services, etc., which are extended either by the government authorities or private agencies. In order to coordinate the functions between farming sector and these supporting service sector, it is proposed to hold an irrigation meeting under the presidency of WUG. The meeting could be held before starting each cropping season, and would consist of the following members: (i) all farmer beneficiaries, (ii) executive committee members of WUG, (iii) officers of DALDO office, (iv) VEO and the irrigation technician, (v) members of village government, (vi) representatives of the private sectors, i.e. banks, NGO, owner of farm machinery, dealer of farm inputs, etc. VEO and the irrigation technician will provide necessary support to hold this meeting by WUG. In the meeting, farmers shall clarify the schedule of crop operation, and request necessary supporting services to the respective members attended. WUG will later request to all the concerned agencies in writing for extending those necessary supporting services, timely-cum-efficiently.

(6) **Office and Facilities of WUG**

WUG could share a floor space in the office of the village government or establish a new office in the village. The officers of DALDO office or Division Extension Officer (DIVEO) shall support the necessary administrative works, i.e. typing, printing, photo copying, communication, etc.

4.6.3 Women's Participation to Development

Limitation of women's access to economic resources and their lower social status are perhaps a consequence of each other. Farm women have, in most cases, been neglected by the technical extension service system despite their ample contribution to farm

product and accordingly farm income. In case of the project area, participation of women is to extent of 60% in crop plantation, while in house-keeping work, it increases to 70%. Role of women quite evident in determining and development of technology in almost all aspects of farming practices, more so in up-keepingwork on crop plantation. Seeding and /or transplantation are done by women, while the works to be required physical power, i.e. soil preparation, O&M work on irrigation facilities, etc. are undertaken entirely by men. The post-harvest activities also find a shoulder to shoulder support from women. However, actual involvement is not up to the mark mainly due to their illiteracy, social and cultural background and lack of access to new technology.

Implementation of the project will induce further activation of the crop production, post harvest activities, marketing and transportation of farm inputs, crop products, etc., social or culture-based community services, etc. Thus, women in each scheme area will also have greater opportunities to participate into those economic and social activities. To encourage women's participation to the project work, it is emphasized on:

- i) To stablish the women's group and encourage in their promotion-cum-activation of income generation, i.e. value-added processing of crops, livestock farmin, etc.
- ii) To appoint women's leaders in the executive committee of WUG especially for activation of the social welfare and cultural aspect.

The objectives of women development has been rightly defined in giving recognition to their work enabling them to develop their skills and confidence in decision making and not merely increasing their income and employment levels. Thus, herein the proposed irrigation schemes, it is very essential to implement WID program to extent knowledge on improvement of irrigation-based crop cultivation technology and skills thereby increasing crop productivity and also enhancing the status of women by giving their recognition. An important component of the program is induction of women extension officers in DALDO office, ensuring that intensive extension-cum-training services will reach farm women so smoothly and effectively.

4.6.4 Training Program for WUG and Agricultural Supporting Agencies

In the current implementation of irrigation development project, MAC has planned to organize irrigation beneficiaries into the scheme-based primary WUG for doing O&M works through communal activities of the co-operatives at the self-reliance basis, efficiently and satisfactorily. However, as far as operation and management of WUG are concerned, it feels rather anxious that members of the existing co-operatives have the following difficulties and demand technical-cum-financial assistance from the Government:

- Difference in opinion among the members due to vested interest
- Financial limitation to extend further host tree plantation as well as construction of the rearing houses and those related facilities
- Limitation to accessibility in the present credit support service especially at the initial stage of co-operative work
- Lack of education/ technical skill in operation and management of the co-operative society
- Shortage of guidance to the members in respect of technical matters, accounting and auditing system.

To eliminate the above constraints and then improve the background of co-operative activities, it is crucial to reinforce the extension and training services especially at

the on-farm level to a maximum extent. To this, training of the front-line staff of DALDO office is essentially required at the initial stage of the project implementation as their experiences are also short as far as technology on operation and management of WUG is concerned.

The training program hereby proposed is as follows. The program consists of four courses which are set up taking into consideration of the technical demand and trainee's educational background.

Proposed Training Courses by Technical Level		
Training Courses	Period (day)	Trainees
Course-A	2	- District Commissioner, District Executive Director, District Administrative Officer. - Senior officials of the offices of RALDO and DALDO and the Zonal Irrigation Office. - Senior officials of the offices involved in WUA's activities (District Water Engineer, District Community Development Officer, District Cooperative Officer, etc.).
Course-B	5	- Officials involved in O&M (Zonal Irrigation Office, RALDO and DALDO's offices, Division Extension Officer, DCO). - Village extension officer and irrigation technician to be attached to the project.
Course-C	10	Farmer's level training to leaders of WUA, gate keepers and key farmers.
Course-D	2	Village chairman, village executive office, chairman of ward council, ward executive office, elder people, informal rural leaders in the village, leaders of women's group, etc.

The training curriculum covers how to perform O&M and management technology on WUG. Promotion of WID is also included in the program, since WUG shall be one of the basic structure for activation of women's activities. DALDO office will have to be responsible for conducting the above training program.

In addition to the above program, it is also proposed to schedule on the following special training program:

1) Special Training to VEO and Irrigation Technicians:

Before the implementation of the project, VEO and Irrigation Technicians to be attached to each scheme shall be dispatched to KATC (Kilimanjaro Agricultural Training Center) for upgrading their basic technology on irrigation development and its management.

2) Follow-Up Training to WUG:

DALDO office shall provide an occasional follow-up training course for WUG according to the demand to be necessary for improving their management system. DALDO office shall undertake monitoring of all the activities of WUG through periodical observation of VEO and Irrigation Technicians, and prepare necessary training program for them.

4.7 Implementation Plan

4.7.1 Project Executing Agencies

Under the administrative supervision of MAC, the Zonal Irrigation Office in collaboration with the respective regional and district offices concerned will implement the Project.

The implementation schedule of the project is basically divided into three stages, i.e. (i) preparatory works including finalization of the development plan and basic design of the schemes through holding the explanation meeting and discussion with the farmer beneficiaries, (ii) execution of the project including detailed design, establishing WUG and then construction of all the facilities and related structures, and (iii) O&M works at the post construction stage.

Agencies related to the Project Implementation

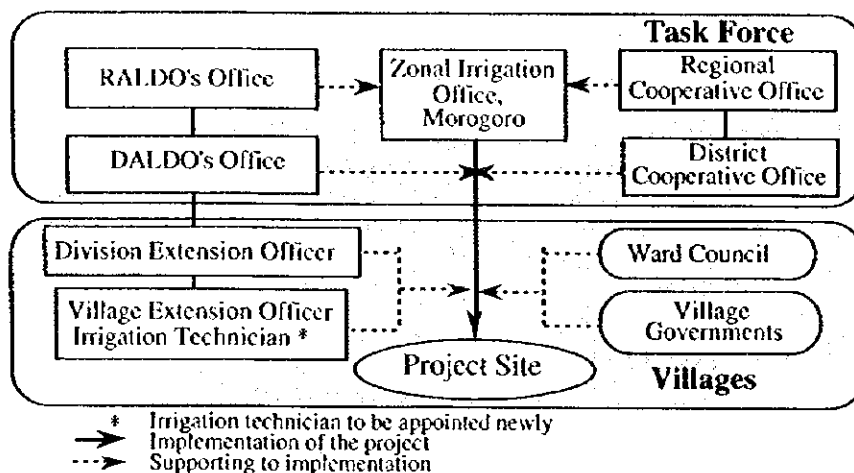
Development Stage	Implementing Agencies	Main Supporting Agencies
1) Preparatory Work	Zonal Irrigation Office	Office of RALDO/DALDO, DCO, Village Government & Ward Council
2) Project Implementation & Strengthening of WUA	Zonal Irrigation Office	Office of RALDO/DALDO, DCO
3) O&M of Irrigation Facilities	WUG	Office of DALDO

(1) Project Organization

MAC as the supervisory ministry is responsible for implementation of the proposed Project. The Department of Irrigation (DOI) of MAC will be coordinating amongst the relevant Government agencies and regional administrative authorities.

The Zonal Irrigation Office, Morogoro will have direct responsibility for implementing the project, and undertake the basic design, detailed design and then supervision of all the construction works as well as technical guidance to WUG for doing O&M work at the post construction stage. For execution of O&M work, WUG will require technical-cum administrative supporting services from the regional and district authorities and/or agencies concerned, i.e. RCO, RALDO, DCO, DALDO, etc. It is therefore recommended to establish a "Task Force" which will have a function for coordinating amongst the Zonal Irrigation Office and the regional and district agencies concerned. The organization structure to be necessary for implementing the Project is proposed as shown in Figure attached hereto the next page, and the conceptual coordinating flow chart for extending supporting activities are as summarized below:

Activities of Task Force and Offices Concerned



MINISTRY OF AGRICULTURAL & COOPERATIVES

COMMISSIONER
AGRICULTURAL & LIVESTOCK DEVELOPMENT

ASSISTANT COMMISSIONER
IRRIGATION

**MOROGORO ZONAL
IRRIGATION OFFICE**

ZONAL IRRIGATION ENGINEER

ASSIST. ZONAL IRRIGATION ENGINEER

PROJECT PREPARATION &
DESIGN SECTION
Section Head

DESIGN SUB-SECTION
Civil Engineer
1 - Agricultural Engineer
1 - Irrigation Engineer

SOIL SURVEY SUB-SECTION
Soil Scientist
2 - Agric. Field Officers

TOPOGRAPHIC SURVEY
SUB-SECTION
Assist. Land Survey
3 - Irrigation Technicians

AGRONOMY SUB-SECTION
Agric. Field Officer
1 - Agric. Field Officer

ECONOMIC & SOCIAL SURVEY
SUB-SECTION
1 - Agro-economist
1 - Sociologist

OPERATION OF PROJECT &
SUPPORTING SERVICE SECTION
Section Head

RESEARCH SUB-SUBSECTION
EXTENSION & TRAINING
SUB-SECTION
3 - Agric. Field Officers
1 - Irrigation Technician

PRODUCTION UNIT SUB-SECTION
1 - Agric. Field Officer

ADMINISTRATION
SECTION
Section Head

ADMINISTRATION SUB-SECTION
Registry Assistant
1 - Registry Assistant
1 - Office Attendant
1 - Office Attendant/Typist
1 - Tele-communication Operator
1 - Driver

ACCOUNTING SUB-SECTION
1 - Accountant Assistant

STORE & TRANSPORTATION
SUB-SECTION
1 - Store Assistant

4 - Watchmen (Guard)

1 - Agro-economist : Officers to be appointed newly to the office

**Proposed Organizational Structure and Staffing of
the Morogoro Zonal Irrigation Office (As of August 1996)**

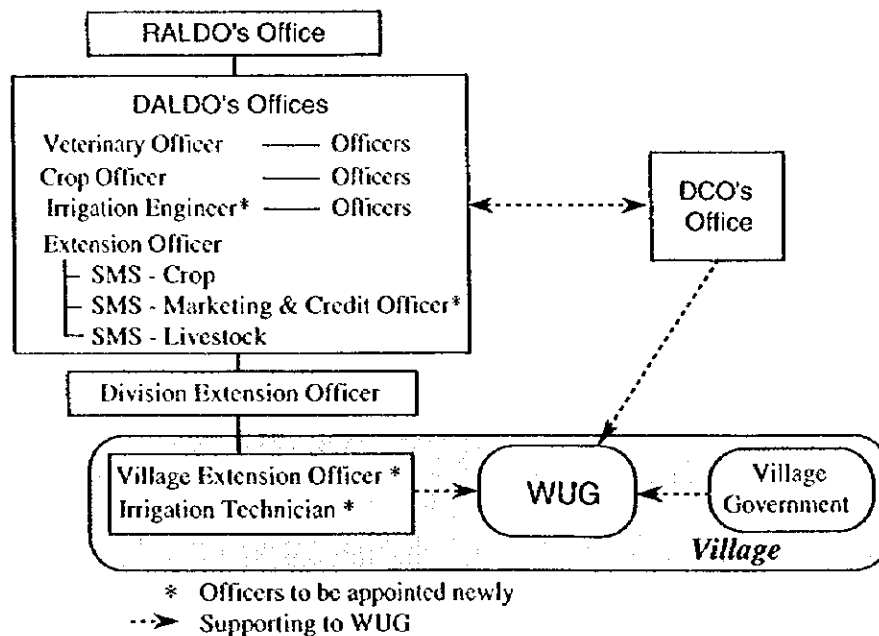
Prior to commencement of the proposed project implementation, strengthening of the technical staffing shall be made in the Zonal Irrigation Office as well as RALDO and DALDO offices of the respective districts so as to support WUG, efficiently and satisfactorily. A supplementary staffing to be required for each office is estimated as follows.

Supplementary Staffing to be Required

1) Zonal Irrigation Office	Agro-economist and Sociologist
2) RALDO office	Officer attached to the Project (To make close coordination with the Zonal Irrigation Office, an officer attached to the project is appointed as a representative of RALDO Office)
3) DALDO offices	Irrigation Engineer and Marketing and Credit Officer
4) At the field level	VEO in each village and Irrigation Technician in each scheme

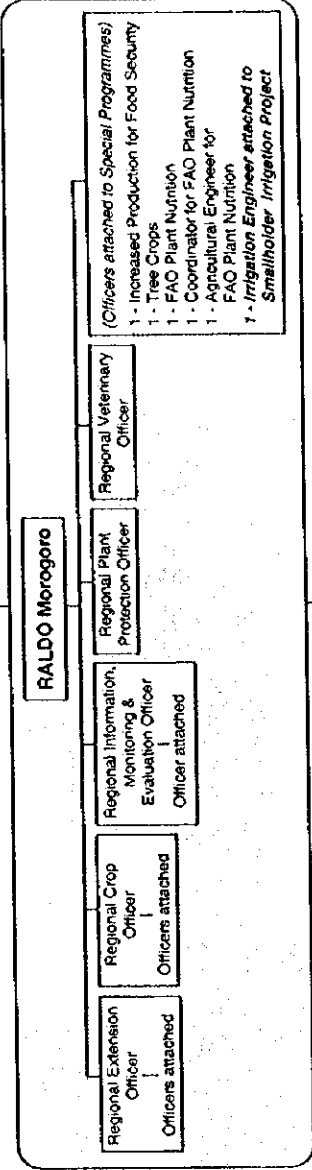
(2) Supporting Services to WUG

In implementation of the Project, DALDO be in charge of the agricultural-cum-institutional supporting services to each of WUG. DALDO will also have the responsibility for undertake monitoring, evaluation of the project effects, and then, extend the follow-up services for maintaining sustainable agricultural production as well as O&M work, satisfactorily and successfully. RALDO as the regional supervisory agency provides the technical guidance and administrative supervision for all the activities of DALDO mentioned above. The organizational structure and staffing of RALDO and DALDO are as shown in the following page. The schematic flow of the supporting services hereby conceived is as follow:



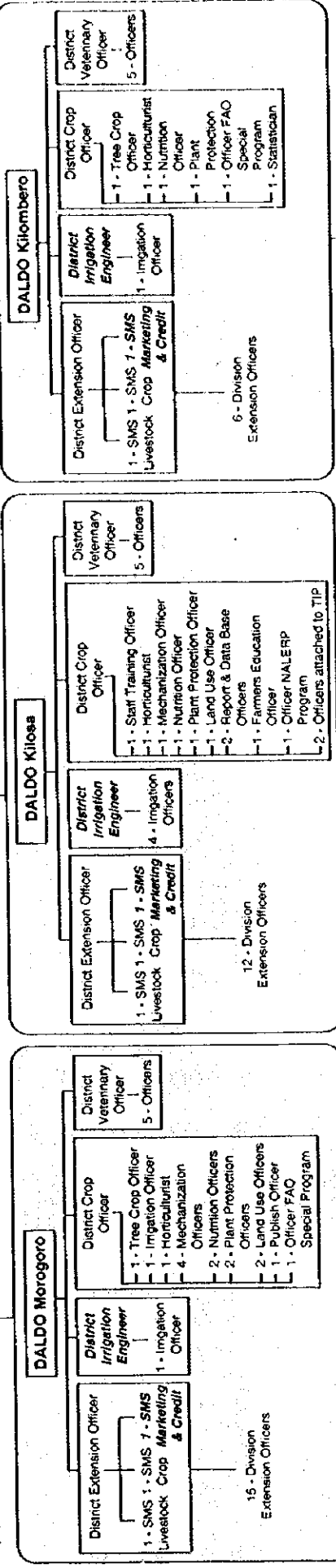
DALDO office will provide overall services to WUG directly or through supervisory services for field extension activities of VEO and Irrigation Technician to be attached to each scheme. The engineering services include the technical and administrative guidance on O&M work of the project facilities, follow-up training to WUG, monitoring and evaluation of the project effects, etc. At the project site, VEO and Irrigation Technician will carry out all necessary supporting services, i.e. extension for farming as well as O&M technology, supporting to marketing and credit activities, etc.

Ministry of Agriculture and Cooperatives
 Commissioner
 Agricultural & Livestock Development



Regional Level

District Level



Irrigation Schemes

	Villages	VEO	IT
Migota	15	7 + 8	4 + 1
Mgongola	3	3	1
Mlali	2	2	1
Ndole	1	1	1

Supporting Services

	Villages	VEO	IT
Manyeyere	3	1 + 2	1
Kiangali	1	1	1
Mvumi	1	1	1
Chabima	1	1	1
Lumuma	3	3	1

Supporting Services

	Villages	VEO	IT
Msolwa	1	1	1
Mkula	1	1	1
Sonjo	1	1	1

* District Irrigation Engineer or IT : Officers to be appointed newly to the offices of RALDO and DALDO
 VEO : Village Extension Officer
 IT : Irrigation Technician

Proposed Organizational Structure of the Offices of RALDO and DALDO (Master Plan Study)

In addition to the staff strengthening programs stated above, it is proposed to establish an "agricultural coordinating committee" and "project monitoring system" so far as to perform sustainable O&M work through communal activities of WUGs.

1) Agricultural Coordinating Committee:

In case of Lunuma and Malolo schemes, several WUGs had been organized and functioning up to present. These WUGs have own irrigation furrow system individually within each scheme, while use irrigation water from the same water resource. Thus, establishment of an "agricultural coordinating committee" amongst all respective WUGs is essential and crucial so as to avoid an unbalanced distribution or sharing of water for each WUG as it is arison in common up to present,.

2) Monitoring System:

To maintain sustainable O&M work and step forward its further efficient management, it is essentially needed to establish a monitoring system on the project effects as well as performance progress of O&M work. Major items to be necessary to monitor include (i) meteorological observation aspect in each scheme area, (ii) hydrological aspect on the water resources, i.e. seasonal water discharge in the respective rivers, seasonal water diversion in each scheme, etc., (iii) performance progress of O&M work on the project facilities, (iv) operation and management of WUG, (v) agricultural economy, i.e. crop production, application of farm inputs, farm economy, etc.

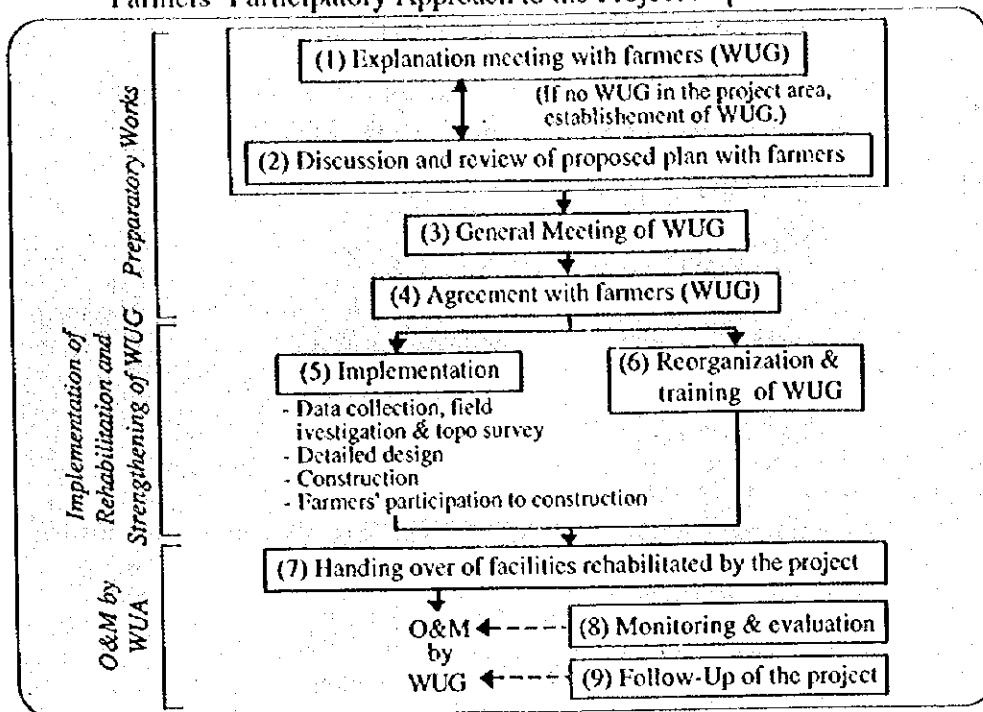
Monitoring work shall be undertaken by DALDO office under supervision of RALDO. Field observation shall be made by VEO in collaboration with Irrigation Technician to be attached to each scheme, while the primary compilation and analysis of the field data be made by DALDO office. All the data and the results of primary analysis compiled by DALDO will finally be assessed by RALDO fully using the data-base system in computers. All the results obtainable through this monitoring work will be fed back to the on-farm level for improvement of the work performance of such O&M work, crop production by means of irrigated farming, institutional and organization function of WUG, etc.

4.7.2 Farmers' Participatory Approach to the Development

All the irrigation facilities, which will be rehabilitated and improved through implementation of the project, shall, in principle, be operated and maintained by the beneficiary farmers themselves in accordance with the principle of "participatory approach to development" issued as the development policy of GOT.

The following Figure demonstrates a schematic flow for implementing the proposed project based on the "farmers' participatory approach to the development."

Farmers' Participatory Approach to the Project Implementation



For implementation of the Project by means of the farmers' participatory approach, the Project Executing Agency (PEA) has first to hold the "Explanation Meeting". At this meeting, PEA shall precisely explain the basic concept as well as proposed rehabilitation plan of the Project to the beneficiary farmers, and discuss about the specific conditions how farmers are expected to participate to the project implementation, i.e. direct involvement to construction work, supply of local materials, etc. and confirm farmers' opinion and/or wishes for implementing the Project. PEA has then to amend the development plan as required. The amended plan be explained to the farmers again immediately after compilation. Then, WUG shall hold the "General Meeting" for review and appreciation of the final plan. PEA and WUG have to exchange an agreement in respect to implementation of the project thereafter the general meeting. The specific conditions relating to farmers' participation and/or farmers' responsibility for both construction work and O&M work at the post-construction stage should be mentioned fully in this agreement.

PEA will later commence the project works including field investigation, detailed design and construction. While WUG will make necessary arrangements for supplying laborers and local materials in accordance with the agreement. In parallel with this project implementation, WUG will be strengthened in accordance with the proposed plan. After the construction, joint inspection will be carried out by both parties, then all facilities rehabilitated by the project will be handed over to WUG.

PEA has to perform periodical monitoring and evaluation of the project. The results of the said monitoring and evaluation shall be fed back to the original design for improvement of O&M system as well as any other matters related to the project implementation. PEA shall also make necessary advice WUG how to settle problems and/or conflicts if observed during the field monitoring. The follow-up training of WUG shall be provided so as to maintain efficient-cum successful operation and management of WUG.

4.7.3 Implementation Plan

The Project should be executed on the basis of farmers' participatory approach in

principle. Major canals and facilities in all the schemes, which farmers can hardly design, construct or rehabilitate, should be planned, designed and constructed or rehabilitated by the Government Executing Agency (GEA) taking the farmers' desire and ideas in the planning and design into account, while all the minor canals and field ditches, which are constructed or rehabilitated by locally available materials should be constructed or repaired by beneficiaries themselves under the technical assistance of GEA as well as minor land leveling in prospective paddy fields.

Except for Mgeta, Lumuma, Nyinga, and Malolo, on-farm development and/or land leveling for paddy cultivation are required through out the whole scheme area or for some sections of the scheme area. Considering that the construction of on-farm works need a rather longer period than the construction or rehabilitation of major canals and structures, since most of the on-farm works will be carried out by man power of beneficiaries themselves, the implementation of on-farm development is scheduled to be commenced prior to the works of major facilities. In the works of major facilities, farmers are expected to participate in the works according to their abilities in order to get knowledge for operation and maintenance of the major facilities. Through these works, farmers are expected to clearly recognize the significance of group works as well as the importance of their position in the development works.

The proposed implementation schedule is as shown in the next page. The schedule is arranged in accordance with the evaluation results for selecting priority development schemes discussed in Chapter 5. Total period of the implementation is supposed to be 10 years in this schedule for 14 schemes except Manyenyere and Mgeta schemes, which are very large, thus supposed to need a longer period.

4.8 Cost Estimate

Total construction cost of each scheme is shown in the following page and summarized below.

Name of scheme	Irri. & Drainage Develop.			Access Road Improvement			Total Construction Cost		
	(M.Tsh.)	(T.US\$)	(M.Yen)	(M.Tsh.)	(T.US\$)	(M.Yen)	(M.Tsh.)	(T.US\$)	(M.Yen)
1 Mgeta *1	17	28	3	6	10	1	22	38	4
2 Manyenyere	6,059	10,183	1,120	187	314	34	6,246	10,497	1,155
3 Kilangali	2,376	3,994	439	212	356	39	2,588	4,350	479
4 Mgongola	3,585	6,025	663	-	-	-	3,585	6,025	663
5 Mlali	222	373	41	-	-	-	222	373	41
6 Mvumi	1,597	2,684	295	-	-	-	1,597	2,684	295
7 Msolwa	953	1,601	176	-	-	-	953	1,601	176
8 Mkula	943	1,585	174	-	-	-	943	1,585	174
9 Sonjo	1,551	2,608	287	-	-	-	1,551	2,608	287
10 Chabima	38	65	7	61	103	11	100	167	18
11 Lumuma	1,472	2,474	272	41	70	8	1,513	2,544	280
12 Ndole	234	394	43	169	284	31	403	678	75
13 Nyinga Mgogozi*2	513	862	95	21	35	4	534	897	99
14 Malolo	1,136	1,909	210	-	-	-	1,136	1,909	210
15 Mgogozi Kikalo	335	563	62	-	-	-	335	563	62
16 Chabi	705	1,185	130	-	-	-	705	1,185	130
Access road for above three schemes*3	-	-	-	111	187	21	111	187	21
Total	21,736	36,532	4,018	808	1,358	149	22,544	37,890	4,168

Conversion rate: 595 Tsh. = 1 US\$ = 110 Yen

*1: The cost of Mgeta scheme is estimated on the basis of 5 ha model plot.

*2: Improvement cost of access road is counted only for the road from Malolo to Nyinga.

*3: Improvement cost of road includes for the road from highway A7 to Malolo and bridge crossing Mgeta river and 1.2 km section of road from Malolo to Mgogozi and Chabi.

4.9 Preliminary Evaluation of the Development Schemes

Feasibility of the respective development schemes is evaluated based on both "economic and financial internal rate returns" estimated at the preliminary bases. To this evaluation, it is also taken into account the "capacity to annual O&M cost as well as amortization cost on the development fund" in the farm economy of the typical farm household as well as the "contribution capacity to the regional economy and the national food security program" from the macro-economic viewpoint.

As stated in Chapter II, both GOT and village community in each scheme have the basic function to implement the Project though structural reinforcement is required. Thus, the development capability of each scheme is considered to be generally acceptable from the institutional and organization viewpoints. It is also appreciated that the traditional village community being organized in each scheme area is well functioning to manage farmers' activities. In most scheme area, the local farmers have, more or less, experienced in the irrigated farming since certain long time ago, and accordingly, acknowledge whether irrigation development is required or not. Therefore, from the technical viewpoint, the farmers' participatory approach to the project implementation could be maintained without serious problems.

The initial environmental examination pointed out that the Project would bring such misgivings as "influence of water-borne diseases", "water contamination by use of chemical fertilizers and agro-chemicals", "degradation of vegetation due to increment of fuel wood consumption" and "social conflicts on utilization of the land and water resources". However, it could be satisfactorily managed and minimize these negative impacts since all of the proposed schemes are small in development scale.

4.9.1 Economic and Financial Evaluation of Each Scheme

(I) Incremental Benefits and Project Costs

The Table below shows the incremental benefits which are brought by the implementation of the Project. These benefits are estimated only on the essential crop production to be obtainable under the irrigated conditions with and without the Project.

Name of scheme	Incremental Benefit (Million Tsh.)
1 Mgeta	1.88
2 Manyeyere	649.15
3 Kilangali	195.34
4 Mgongola	468.09
5 Mlali	22.09
6 Mvumi	174.21
7 Msolwa	133.71
8 Mkula	125.15
9 Sonjo	239.19
10 Chabima	4.01
11 Lumuma	212.98
12 Ndole	33.69
13 Nyinga Mgogozzi-Mwega	150.98
14 Malolo	301.66
15 Mgogozzi-Kikalo	45.61
16 Chabi	190.01

Table below shows the development costs of main and on-farm facilities and O&M costs estimated at the financial bases for each scheme.

Project Cost at Financial Bases

(Unit : Million TSh)

Scheme	Development Costs			O/M Costs
	Main facilities	On-farm Dev.	Total	
Mgeta	11.84	0.00	11.84	0.18
Manyenyere	3,337.42	990.48	4,327.90	50.57
Kilangali	1,345.02	352.39	1,697.41	20.38
Mgongola	1,970.15	590.48	2,560.63	29.85
Mlali	158.31	0.00	158.31	2.40
Mvumi	1,075.21	65.45	1,140.66	16.29
Msolwa	608.12	72.48	680.60	9.21
Mkula	605.39	68.29	673.68	9.17
Sonjo	1,006.39	101.82	1,108.21	15.26
Chabima	25.50	1.99	27.49	0.39
Lumuna	1,051.39	0.00	1,051.39	15.93
Ndole	151.29	15.96	167.25	2.29
Nyinga/Mgogozi-Mwega	366.44	0.00	366.44	5.55
Malolo	811.20	0.00	811.20	12.29
Mgogozi-Kikalo	232.75	6.36	239.11	4.61
Chabi	489.12	14.46	503.58	7.63

- 1) Above costs do not include contingencies (physical and prices)
- 2) On-farm dev. costs include works to be carried out exclusively by farmers.
Other on-farm works which are not carried out by farmers themselves are already included in the development costs of main facilities.

(2) Financial and Economic Internal Rate of Return (IRR)

Based on the direct net benefits and Project costs shown above, a financial IRR has been calculated for each scheme. After converting the financial direct net benefits and Project costs into economic ones, corresponding IRR are also calculated. The results are as follows:

Financial and Economic IRR per Scheme

Scheme	Financial IRR	Economic IRR
Mgeta	10.3%	10.4%
Manyenyere	12.0%	12.2%
Kilangali	9.2%	10.0%
Mgongola	15.9%	16.2%
Mlali	10.2%	15.3%
Mvumi	10.6%	13.6%
Msolwa	14.7%	15.0%
Mkula	13.9%	14.1%
Sonjo	15.9%	16.4%
Chabima	10.2%	11.6%
Lumuna	13.6%	17.3%
Ndole	14.9%	15.9%
Nyinga/Mgogozi-Mwega	25.8%	31.9%
Malolo	23.7%	29.1%
Mgogozi-Kikalo	12.7%	15.9%
Chabi	24.5%	28.7%

Note)

For the financial evaluation, the on-farm dev. costs will not be included. On the other, for the economic evaluation, the costs are included.

If an IRR of 15% is considered to be the minimum level for acceptance of a project, the following 5 schemes which have both financial and economic IRR above the required level could be appreciated as viable project: Mgongola, Sonjo, Nyinga, Malolo, and Chabi. The following 5 schemes which have economic IRR above 15% but their financial IRR are below that level are to be marginally acceptable: Mlali, Msolwa, Lumuma, Ndole, and Mgogozi. One scheme which its rate of return barely misses the minimum acceptance level is Mkula.

(3) Financial Capacity to Pay of Typical Farm Household

Concerning the financial capacity to pay of the farmers, an analysis has been carried out to determine whether a typical farm household can cover the amortization costs for the development fund (or replacement cost for the project facilities) and O&M costs. The following table shows the calculation of the capacity to pay of a typical farm household by comparing the financial incremental net value ("net income with project" minus "net income at present") obtained by implementing the project against the amortization costs on the development fund and O&M costs.

Scheme	Income at Present (TSh)	Income with Project (TSh)	Net Value (TSh/ha)	Financial Burden			Proportion of Burden *1 (%)
				Const. Cost (Tsh./ha)	O/M (Tsh./ha)	Total Cost (Tsh./ha)	
Mgeta	55,483	157,446	127,455	2,195	24	2,219	2
Manyenyere	33,070	374,592	421,633	9,158	99	9,257	2
Kifangali	51,967	502,201	349,019	45,269	490	45,759	13
Mgongola	40,944	321,079	172,923	9,590	104	9,694	6
Mlali	11,913	31,869	27,337	12,507	135	12,642	46
Mvumi	11,023	106,203	109,402	12,080	131	12,211	11
Msolwa	66,738	334,162	148,569	20,684	224	20,908	14
Mkula	61,914	316,323	197,216	21,011	227	21,238	11
Sonjo	143,025	1,088,686	685,262	4,510	49	4,559	1
Chabima	8,442	36,499	16,408	99,121	1,073	100,194	-
Lumuma	208,898	492,621	333,792	19,378	210	19,588	6
Ndole	30,987	128,466	216,621	39,583	90	39,673	18
Nyinga/Mgogozi-Mwega	206,981	1,338,148	890,682	112,662	1,219	113,881	13
Malolo	225,114	868,158	502,378	23,235	251	23,486	5
Mgogozi-Kikalo	177,476	496,760	207,327	88,576	1,252	89,828	43
Chabi	408,199	1,461,450	675,161	54,769	610	55,379	8

Note) Mgogozi scheme is divided into two sub-schemes, that is Mgogozi-Mwega and Mgogozi-Kikalo, based on river sources.

Mgogozi-Mwega sub-scheme is joined into Nyinga scheme, in order to promote water resources development and rational rehabilitation of water management facilities.

*1: Proportion of the total cost of financial burden to the net value

From the Table above, if the financial capacity to pay is taken as a proportion (%) of the net value for each typical farm household, in the case of Chabima, the household may be able to cover the O&M costs but not the amortization costs for development fund. The main reason is that the total area to be benefited by irrigation is too small if compared to the investment development cost. The typical farm families in Mlali and Mgogozi-Kikalo schemes can cover both the amortization of development fund and O&M costs, while their income may have to bear a heavy burden to cover those costs. For the other schemes, the households may not face problems in covering the subjected costs as the proportion of the costs relative to their income is less than 20%.

4.9.2 Macro-economic Evaluation

(1) Contribution to the Regional Economy

Once the project has fully accomplished its production target, it is expected that, at 1996 prices, the gross production value from all the schemes will attain to TSh. 5,589 million per year. This represents 5% of the regional agricultural GDP for the year 1994. Contribution to the regional economy can be expected at TSh. 4,566 million to be born from the incremental crop production, annually.

(2) Contribution To National Food Security

After the project has accomplished its full production target, the contribution of cereals from the respective 16 schemes will be 25,190 ton, annually. This represents 6% of total present production of cereals of the Morogoro Region. Now, concerning rice production, the Rolling Plan and Forward Budget contemplates a target of 800,000 ton for the year 2000; the rice contribution by the Project, 23,800 ton, will represent 3% of such target.

4.9.3 Initial Environmental Impact Assessment

(1) General

The development plans mentioned above aim at attainment of food crop production increase for the national self-sufficiency and promotion of crop diversification cum intensification for stabilization and up-grading of the farm economy through consolidation of the agricultural land particularly with emphasis on rehabilitation and/or improvement of the traditional smallholder irrigation furrow systems. Herein, in the initial environmental examination, preliminary clarification and identification of the negative development impacts are carried out to grasp how the environmentally susceptible elements would be affected by implementation of this Project.

(2) Potential Environmental Impacts

In the Study Area, it is identified that the environmentally susceptible elements have been, more or less, affected even under the present conditions with the negative impacts due to "high annual increment of both human and livestock population", "high energy consumption chiefly of the forest resources", "unconsolidated rural sanitation facilities", etc. Generally, the negative impacts to be brought by the project implementation could be classified into "direct impacts" and "indirect impacts." Among those negative impacts, the following environmental aspects shall be carefully taken into consideration when the proposed Project will be implemented hereafter.

1) Direct Environmental Impacts

Noticeable impacts to be directly caused by the proposed irrigation development are as follows:

a) Increment of Water-borne Epidemic Diseases

It is foreseeable that the hydrological regime in the scheme areas would be changed to a certain extent, i.e. appearance of wide impounding area, wet land as well as raising of ground water level, etc. through consoli-

dation of irrigation facilities and its operation, and a new ecological conditions be established accordingly. With such conditions, the negative impacts would increase its potential for expansion of an influence of the water-borne epidemic diseases, such as Protozoan, Malaria, Helminths, Schistosomiasis, Filariasis, Onchocerciasis, etc., and water contamination. Thus, in the implementation of the proposed project, particular attention shall be paid to this concern.

b) **Agro-chemical Impacts and Water Contamination**

Utilization of chemical fertilizers and agro-chemicals for maintaining the agricultural production at a high level would cause water contamination as well as accumulation of toxic elements into the water in the scheme areas. Accordingly, those chemical elements bring a risk to human health as well as the natural eco-system especially for the aquatic species in the area. In case of the implementation of this project, however, it is foreseeable that the said negative impacts might not so be seriously extended to the surrounding area because each of the proposed schemes are at a small scale development level. However, special attention should be paid to the fact that the toxic chemical elements will surely be accumulated to a certain extent within the scheme areas.

2) **Indirect Environmental Impacts**

The following two environmental impacts are pointed out as indirect impacts of the proposed development.

a) **Deforestation and/or Degradation of Vegetation**

When the development target is successfully achieved and accomplished activation of the agricultural production, the present living conditions could be up-graded, and consequently, energy consumption per household will largely be increased to a high level. This means that deforestation and/or degradation of vegetation will be accelerated due to increment of the fuel wood collection from the present poorest area.

b) **Misgivings of Social Conflict**

Although it shall be studied more in detail, a social conflict on water rights, land tenure system, right of irrigable land occupancy, etc. is one of the misgivings in this Project since the land and water resources in each scheme area have been mostly used to a maximum extent up to present.

(4) **Mitigation Measures and Required Further Environmental Studies**

The negative impacts mentioned above are identified on a very preliminary basis according to the results of the initial environmental examination. Thus, in order to eliminate such above problems in a satisfactory and successful way, further detailed study shall be made during the feasibility study at the forthcoming Phase-III stage. The followings points are considered within the basic approach to mitigation measures and required further environmental studies to be required.

1) Measures for Mitigation of Direct Negative Impacts

a) Influence of Water-borne Diseases

The following is generally accepted as the most practical approach to eliminate and/or mitigate of the Influence of Water-borne Diseases in the irrigable area as a countermeasure for decreasing the habitat available for the vectors and intermediate hosts of diseases such as malaria, schistosomiasis, onchocerciasis, which harbor or spread the causative agents of diseases.

- Periodic cleaning of the irrigation and drainage canals and drying the canals during the agricultural off-season
- Consolidation of the sanitation facilities in the village area
- Utilization of the agro-chemicals for controlling the habitat available for the vectors and intermediate hosts of diseases

Among the above items, diseases influenced through the habitat for the vectors and/or intermediate hosts shall be investigated more precisely. As far as consolidation of the sanitation facilities is concerned, it shall be based on a national and/or regional health service program, and all the design conditions which might be applied to the proposed sanitation facilities should comply with that program.

b) Agro-chemical Impacts and Water Contamination

As for the water contamination problems due to utilization of chemical fertilizers and agro-chemicals, it is essential to prepare a standard guideline and advise the introduction of a safe chemicals as much as possible depending on availability. In order to eliminate and/or improve the accumulation hazard of toxic chemical elements in the drainage canal system, it is recommended that the irrigation beneficiaries shall be organized into water users' association, and establish the functions for a precise management of such chemical utilization as well as waste and drainage water from the house yard.

2) Measures for Indirect Impacts

a) Deforestation and Degradation of Vegetation

To properly maintain the present forest and vegetation against the negative of impacts of predatory fuel wood collection, a detailed investigation and assessment of the available resources shall be performed, and accordingly, demarcation of the open forest for collection of fuel wood, limitation of the development area, etc. shall be made through this study. Afforestation program is the most essential cum practical way for conservation of the vegetation, therefore, it must be incorporated into the implementation schedule. In planning of the afforestation program, it is also crucial to pay attention to such aspects as soil conservation, watershed conservation, protection measure to siltation in the river bottom, etc.

b) Social Conflict in Land and Water Utilization

To establish an appropriate program for elimination of the social conflict in land and water utilization, social environmental aspects shall be studied in more detail for each development scheme, and grasp such the ac-

tual situations of the institutions to be related to the community development, farmers' organization, etc. It is also essential to precisely refer to the national and/or regional program whether the local government has enough power to control the disputes.

(5) Essential Items for Further Environmental Study

The essential items to be studied for further clarification of the environmental impacts are as follows.

1) Direct Environmental Impacts

- Present conditions of the water-borne diseases influence, area by area for each river basin,
- Present situations of the public health control activities and inventory of the sanitation facilities in the each villages in the respective schemes, including those for major diseases; performing qualitative analysis on appearance of the water-borne diseases
- Water contamination at present and institutional regulations to be specified by the Government

2) Indirect Environmental Impacts

- Program on afforestation and re-planting of fuel wood
- Present conditions of vegetation and forest, including distribution of types of vegetation, major constitution of vegetation species, etc.
- Present conditions of forest resources utilization, including consumption of fuel wood, major consumption of forest resources by purpose, demand of woods, potential resources, etc.
- Present situation of social conflicts, such as illegal use of land and water resources, disagreement of the land allocation among the villagers, etc.
- Social aspects, including demographic characteristics, population growth, age composition and settlement pattern, types of existing water rights and amount, coordination system in the community and organization activities, etc.

CHAPTER V. SELECTION OF PRIORITY DEVELOPMENT SCHEMES

5.1 Priority Schemes in National Irrigation Development Plan

GOT is now under process of implementing irrigation development projects with particular emphasis on improvement and/or rehabilitation of the smallholder irrigation schemes according to the National Irrigation Development Plan (NIDP) which was prepared and issued on October, 1994 by the Irrigation Department of the Ministry of Agriculture and Co-operatives. Prior to compilation of NIDP, the primary selection and priority evaluation of promising irrigation projects were made at the Zonal Irrigation Units bases under the joint technical assistance provided by UNDP and FAO on September, 1990. The schemes, which would have no chance to be developed successfully in the foreseeable future, were screened according to the following four critical conditions:

- Motivation of the farmers in the proposed irrigation schemes is poor and there is strong evidence of their lack of interest and capacity to undertake irrigated agriculture.
- Several physical constraints and/or hazards, which might cause high investment costs for those improvement or require high technology for those management, are observed.
- The proposed water resources are considered to be severely saline.
- There is no water readily available for irrigation.

To the above end, low priority schemes were also identified according to the following criteria.

- The net pumping head is more than 10 m in case of the pump irrigation schemes.
- The predominant slope of the land proposed for irrigation development is over 4 %.
- The regional and district authorities have clearly stated that the farmers are not interested in the implementation of the scheme.

The total 156 irrigation schemes selected through the above screening process were then evaluated using the Irrigation Project Evaluation Form with the supporting information obtained by a quick appraisal questionnaires to the respective schemes. The priority ranking of each scheme was then finalized making reference to the irrigation development policy of GOT as follows:

- Improvement and/or rehabilitation of the existing smallholder irrigation schemes shall have the highest priority over construction of the new smallholder irrigation schemes.
- Both of the above schemes shall take priority over the commercial or parastatal projects
- Growing of crops for subsistence purposes as well as food security shall be considered more important than those for marketing.
- The crops for domestic market shall be considered more important than those for export.

In Morogoro region, the total 16 smallholder irrigation schemes were taken up as the promising irrigation development schemes, and put the high priority for those implementation in NIDP.

5.2 Basic Criteria for Selection of Priority Development Schemes

To confirm the priority ranking given to the proposed schemes by the previous

screening and evaluation, and then, to select the priority development schemes for initiating the objective smallholder irrigation development in Morogoro region, the priority evaluation on the proposed 16 schemes are hereby made since the agricultural setting as well as socio-economic situations in each proposed scheme area have been greatly changed through recent implementation of structural adjustment of the national economy. To prepare the specific criteria for priority evaluation, the following Irrigation Development Policy set forth in NIDP is taken into consideration.

- Improvement and/or rehabilitation of the existing smallholder irrigation schemes be given the first priority.
- The farmers shall have the initiatives for implementation of the schemes (farmer's participatory approach to the irrigation development).
- The schemes shall contribute to the national food security program especially through production increase of maize and rice.

With due consideration of the conditions mentioned above and also the present situations of the agricultural and socio-economic setting in each proposed scheme area, the priority evaluation criteria is prepared with particular emphasis on the following six aspects including 54 check items. To assess the priority ranking, four rated scoring points but without policy weighting have been given.

Criteria for Selection of Priority Development Schemes		
Aspects Subject to Evaluation	No. of Items Subject to Evaluation	Points
I. <u>Technical aspect</u>	20	60
I.1 <u>Physical nature</u>	3	9
1) Topographic conditions	1	3
2) River system	2	6
I.2 <u>Agricultural resources & development potential</u>	17	51
1) Accessibility	3	9
2) Land resources	8	24
3) Water resources	2	6
4) Conditions of the existing irrigation system	4	12
II. <u>Social aspects</u>	10	30
1) Human resources	7	21
2) Land tenure and owner-ship	1	3
3) Infrastructure development	2	6
III. <u>Institutional and Organization aspects</u>	9	27
1) Community Development	2	6
2) Farmer's organization	2	6
3) Leader-ship in farmer's society	3	9
4) Regularization of duties and collection	1	3
5) Extension service activities	1	3
IV. <u>Financial aspects</u>	3	9
1) Present situations	1	3
2) Prospective future situations	2	6
V. <u>Economic aspects</u>	5	15
1) Present situations	2	6
2) Prospective future situations	3	9
VI. <u>Environmental aspects</u>	7	21
1) Socio-economic impacts	3	9
2) Impacts to natural environment	4	12
Total	54	162

5.3 Evaluation of Priority Development Schemes

Based on the priority evaluation criteria mentioned above, the scoring by items is made on each scheme. Under consideration to this, all the field observation as well as relevant information on the sociological and institutional cum organization aspects obtained from the concerned villages are fully incorporated into this evaluation.

The results of priority evaluation (scoring) are summarized as follows:

Score Ranking on Proposed Irrigation Development Schemes

Schemes	Technical Aspect	Social Aspect	Institut/ Organiz.	Financial Aspect	Economic Aspect	Environ. Aspect	Total Score
Zone-I: Mountainous Zone							
Mgeta	34	21	26	5	2	14	102/69
Zone-II: Alluvial Plain Zone							
Mgongola	39	15	20	6	3	18	103/70
Kilangali	35	17	19	4	2	15	92/63
Manyenyere	36	17	17	5	2	15	92/63
Zone-III: Piedmont Plain & Fan Zone							
Mlali	43	24	23	3	3	18	114/78
Mkula	47	21	20	5	2	17	111/76
Sonjo	45	20	19	6	3	15	109/74
Mvumi	44	16	18	4	2	16	100/68
Msolwa	44	19	15	5	3	15	100/68
Zone-IV: Valley/Riverine Terrace Zone							
Nyinga	46	25	22	4	3	17	117/79
Malolo	46	25	22	6	3	16	118/80
Mgogozi	46	25	21	5	3	16	116/79
Lumuma	45	25	21	5	3	16	115/78
Chabi	42	21	19	6	3	17	112/76
Ndole	42	20	22	3	3	15	106/72
Chabima	39	16	14	3	2	16	90/61

Note: Figures are the scored points. In total score, the first figures show total points from all the items evaluated, while later figures are the adjusted percentage point. The financial and economic aspects will be assessed in due time when the relevant information from the farm economic survey is completed.

Mgogozi scheme is divided into Mwega and Kikalo sub-schemes by river source. Mgogozi-Mwega sub-scheme is joined with Nyinga scheme for effective water resources development and rational rehabilitation of water management facilities.

In the proposed scheme areas, no serious limiting factors are observed for environmental aspects except soil erosion hazard in Mgeta scheme and cautious apprehension about ecological change in Manyenyere, Kilangali and Mgongola schemes.

From the technical viewpoints, it is recognized that all the proposed schemes have a considerably large potential for irrigated agricultural development, except Chabima scheme. However, habitual flooding and poor drainability are one of the largest constraints in Manyenyere, Kilangali and Mgongola schemes. To intensify the agricultural land use and increase rice production to escape from the subsistence level at present, a flood control by means of protection dikes is the essential measure in these schemes. Instability of the river channel due to heavy sediment load is the main problem for sustainable development of the irrigated agriculture in Malolo, Nyinga and Chabi schemes. Since the arable land has been reclaimed almost to a potential maximum, and in contrast, the population is being increased significantly in these scheme areas, the land fragmentation will continue within a foreseeable future. Thus, to maintain sustainable agricultural development in these areas, improvement of the existing furrow irrigation system with paying attention to stabilization measures to the river system is essentially needed. In case of Lumuma and Mlali schemes, a shortage of irrigation water resources is a limiting factor to further development of agriculture. Thus, improvement of the existing furrow irrigation system and then rationalization of the water utilization is essential and crucial.

As far as the sociological aspects are concerned, two major constraints lie in the present irrigation development. One is the disagreement on land allocation in the irrigable area among farmers in case of Msolwa scheme, while on demarcation of the area for cattle grazing between Massai and villagers in case of Mvumi and Kilangali schemes. The other constraint is found in Manyenyere scheme that might be caused by a low motivation of the leading farmers or the representative of village community. In fact, poor activities of farmers' societies is observed in the same schemes. For eliminating the

above constraints and promoting successful implementation of the proposed schemes, an education and training of the farmers are indispensable, however either of them will certainly take a long time. To this end, it is also essentially needed to reinforce the institutional supporting services, i.e. extension of agricultural as well as irrigation technology, operation and management of such farmer's organization as cooperative society, water use's association (furrow committee), etc.

5.4 Selection of Priority Development Schemes

Apart from the above evaluation as well as taking sincerity into account the strong intention of GOF to implement these schemes as a pilot project for NIDP, the priority development schemes are selected from each physiographical zones with particular attention to the following conditions.

- The selected priority schemes shall act as a model or pilot project for implementation of the smallholder irrigation development which could lead the development of other schemes to be followed in a later period.
- The leading farmers or representatives of the village community shall be motivated to take initiative on farmer's participatory approach to the irrigation development. If they adopt a positive attitude concerning motivation, it shall also be taken into consideration.
- Technical and financial requirement for irrigation development shall not exceed farmers' capacity to properly operate and manage of the scheme.

It is to understand that requirement of irrigation based agricultural development in the specific four zones, which has been physiographically classified in the Study area, would be almost same to those in the entire Tanzanian territory. Accordingly, all the schemes in each specific zone is considered to be a capable candidate for selection of the most priority scheme.

To select the priority schemes, special attention has been paid to each subject mentioned above, namely:

The priority schemes, which will be suitable for implementing the "model or pilot project" for leading the other irrigation development program, must have (i) the highest ranking in each zone in the priority evaluation, (ii) relatively good access to the scheme area, namely the scheme could be implemented without heavy investment to such construction and/or rehabilitation of the access road and (iii) almost none negative development impacts to the natural environment.

As for the second subject, the following two essential factors shall be taken into account; (i) farmers are sufficiently motivated in irrigation based agricultural development, and (ii) the farmers' organization is being established and taking respective activities.

Selection of the priority schemes based on the third subject be made with particular attention to (i) majority of farmers have already experiences in irrigated farming, and (ii) large capacity to pay is expected in a farm household after the conditions with the project.

Making reference to all the above conditions, the priority schemes to be subject to the feasibility study are selected as follows:

Priority Schemes Selected

Schemes	Existing Irrigated Area (ha)	Proposed Irrigable Area (ha)	Proposed Crops	
			Rainy Season	Dry Season
Zone-I: Mountainous Steep Slope				
Mgeta Scheme	1,600	30 ^{/1}	Maize	Vegetables
Zone-II: Alluvial Plain				
Mgongola Scheme	60 ^{/2}	620	Paddy	Paddy
Zone-III: Piedmont Plain/Fans				
Mkula Scheme	few	149	Paddy	Maize & Paddy
Zone-IV: Valley/Riverine Terraces				
Nyinga Scheme	110	130	Paddy & Maize	Onion
Mgongozi-Mwega Scheme	60	70	Paddy & Maize	Onion
Maloto Scheme	380	380	Paddy & Maize	Onion
Total	2,210	1,379		

Note: /1: The proposed irrigable area for Mgeta Scheme is demarcated only for model development.
/2: The existing irrigated area in Mgongola Scheme is from Mkindo pilot scheme which is located at the upper most reach of the Scheme area.

Mgeta scheme is an unusual case in the irrigated agriculture development, not only for the Wami River Basin but also for Morogoro region. The traditional furrow system was developed in the extremely steep-sloped land since long time ago with production of maize as the subsistence staple food crop and high-valued economic crops, i.e., vegetables and fruits in the smallholder farming. Consolidation of the existing irrigation system is the basis for further stabilization of the agricultural production, and hence, maintaining sustainable development of such smallholder farming. It is also acceptable as an essential mean for the land conservation in this area.

Mgeta scheme constitutes more than 300 of the micro- to small scale traditional furrow systems, and is feeding the irrigation water to approximated total of 1,600 ha within the respective four (4) wards, i.e., Langali, Tchenzema, Kikeo and Bunduki according to the information obtained from the concerned village representatives. In this study on the priority schemes, the representative three furrow systems commanding about 50 ha in Langali village, Langali ward are primarily selected as the development model for this scheme. The remaining large area is still subject to clarification and identification.

Mgongola scheme is selected as the model scheme for development of the lowlying alluvial plain against frequent seasonal flooding hazard and poor drainage conditions. To develop this scheme, a certain large investment will be required for flood protection and drainage control measures. Although a financial viability shall be analyzed in due time, it is expected that the said investment would be amortized if rice production is to be obtained higher than eight tons/ha. by twice a year cultivation. The double cropping of paddy is being carried out at Mkindo pilot scheme which is located near this scheme. In addition, the farmers' groups in Mkindo and Hembeti villages have been recently incorporated in the National Food Crop Production Increase Program. Thus, if the Program is integrated with the implementation of this scheme, a multiplier effect from the irrigation development and institutional supporting services will bring about high incentives to the farmers, and accordingly, successful achievement of the policy objectives envisaged in both NIDP and NFSP.

The Mkula scheme is selected as one of the typical scheme models in the piedmont Plain and Pan zone in the Central Wami River Basin. Rehabilitation and improvement of the existing irrigation system will make possible crop intensification cum diversification. A large increment and stabilization of the crop production will ensure sustainable agricultural development in the Mkula village. It is also expected that development impact of this scheme will directly extend to the surroundings, i.e. Msolwa and Sonjo schemes where the farmers are not yet motivated on irrigation development in conflict with irrigation requirement particularly for the dry season cropping.

The Nyinga, Malolo scheme and downstream half of Mgogozi scheme (Mgogozi Mwega sub-scheme), where the irrigation water source is the same to Mwega river, are selected as a package from the technical view point. Since an arable land is limited in these scheme areas, it is essentially needed to extend further intensification cum diversification of the crop production together with rationalization of the irrigation water utilization. To provide an appropriate function of the irrigation system, it is suggested to combine three schemes and make unification of the existing irrigation furrow systems.