The other credit is issued by the Rural Development Bank under the rural development programme and the national maize campaign. Although this credit system was established by the Government in 1964, it has only entered the Kilimanjaro Region for two years. In the Lower-Moshi area, credit is only arranged for farmers who grow high yielding varieties of maize using tradional irrigation. In this credit, maize seeds, fertilizers and chemicals are supplied at the specific rate of 10 kg/ac for seed, 50 kg/ac for ammonium sulphate, 50 kg/ac for triple-super-phosphate, and some for insecticides. In the opening year of 1978, about TS 1,029,400 in total was issued and in the second year of 1979 TS 2,368,200 in the whole Moshi district (see ANNEX Table VI-24). In the third year, the credit to the farmers is now being arranged and as of March, 1980 the amounts had increased sharply. As far as the Lower-Moshi area is concerned, the borrowing of credit is still small covering only a few percent of the total farmers at present.

3.14 Existing Irrigation Development

(1) Irrigation developments outside the Lower-Moshi area

In the Kilimanjaro Region, tradional furrows have been used for centuries on the slopes of Mt. Kilimanjaro for irrigation and domestic purposes. The total length and number of traditional furrows are 920 km and 567 respectively on the slopes of Mt. Kilimanjaro. The total consumption of water by the furrows is estimated at 187 million m^3/year. Traditional furrows have no lawful water rights.

In Arusha Chini, about 20 km south of Moshi town, the most successful and advanced irrigation practice in the region has been conducted by Tanganyika Planting Company (TPC initiated 40 years ago) to grow sugarcane. Its gravity irrigation system from the Weru Weru river was reinforced in 1969 by large-scale sprinkler irrigation using deep wells, Presently, the total area under both the furrow and overhead irrigation is about 6,000 ha.

In Kahe, about 20 km south-east of Moshi town, a plantation has been operated by the National Agricultural and Food Corporation (NAFCO), a national institution specialized in mechanized large-scale cereal production. The irrigation area was 4,000 ha in the original plan in 1968, for which legitimate water rights of 108 cusec (3.06 m^3/sec) were granted for extraction from the Miwaleni Springs. Presently a total area of 1,400 ha is under cultivation with maize, pasture and other crops by means of border irrigation. However, the remaining 2,600 ha out of the originally planned 4,000 ha has not been developed yet because of the hazard of salinity, insufficient machinery, shortfall of fuel and other reasons. Consequently, the granted water rights have been under-utilized for the last decade. In view of the scarcity of water resources in and around the Lower-Moshi area, a proposal is made in this report to allocate some of the NAFCO's water rights to the development of the Lower-Moshi area to ensure efficient overall water utilization.

(2) Existing irrigation systems in the Lower-Moshi area

Presently, 38 irrigation systems exist in the Lower-Moshi area (see Fig. 2), of which 10 have water rights and others use traditional furrows. Based on a comparison of available reference, the total irrigable area is estimated at 4,500 ha in the rainy season excluding the NAFCO Kahe estate. In the dry season, however, the irrigable area is reduced to 570 ha due to the limited amount of available water and the defective facilities.

All facilities from the headwork to the on-farm works, constructed by either the Government or farmers themselves, are primitive and superannuated. They lack an engineering basis and technical workmanship.

More than half of the existing irrigation systems have no structure at their headwork such as weir or gate to control the intake water level; thus, extraction is possible only in the rainy season when rivers have high stages and when there is risk of inundation over lowlying areas. About one fourth of the irrigation systems have weirs made of

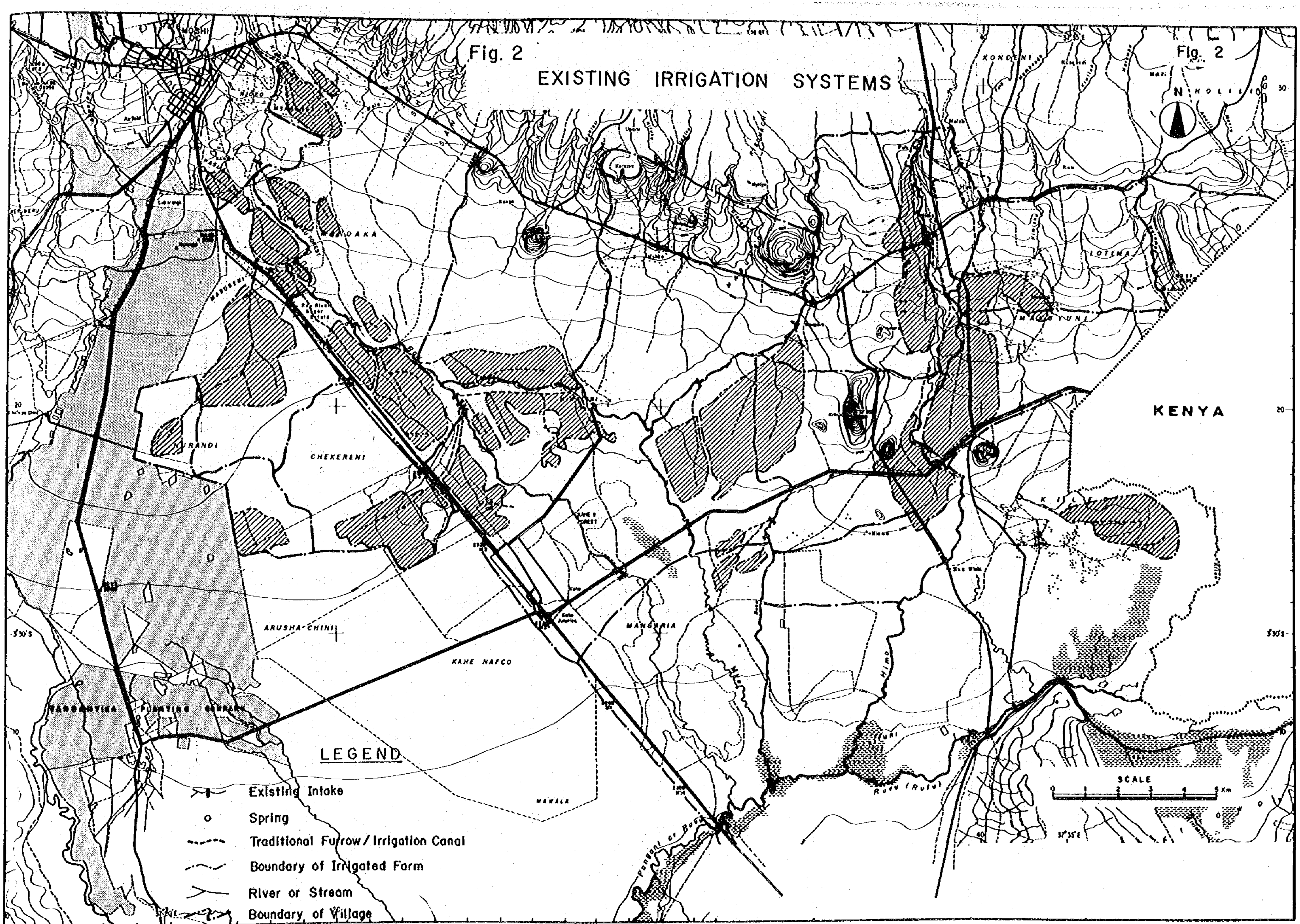
Fig. 2
EXISTING IRRIGATION SYSTEMS
Fig. 2
KENYA
CHEKERENI
ARUSHA CHINI
KAHE NAFCO
MANGERIA
LEGEND
Existing Intake
Spring
Traditional Furrow / Irrigation Canal
Boundary of Irrigated Farm
River or Stream
Boundary of Village
SCALE

banana tree trunks, which have much leakage and need frequent repairing. The remainder have concrete weirs, but some of them are defective.

The existing canal network is very sparsely laid out, in particular there are almost no tertiary canals or farm ditches at the farm level. No drainage canal can be found in the Lower-Moshi area. Most of irrigation canals in the Lower-Moshi area are unlined earth canals and thus much water is lost.

The prevailing irrigation practice at on-farm level is discouraging. It seems both inefficient and undisciplined. The reason may be attributed to the cultivation method and the topographic condition of lands since there are always small undulations on the field surface which would cause both under-irrigation in some parts of plot and water-logging in other parts. The land grading and plot realignment is therefore indispensable for effective surface irrigation. In the case of paddy fields, existing plots are of very small size and irregular shape. Land consolidation including land leveling and plot rearrangement is also of prime importance for the effective irrigation practice.

(3) Water rights

The Water Utilization (Control and Regulation) Act was enacted in 1974 and then supplemented by the subsequent legislation of the Government Notice No. 242 in October, 1975. The Notice designated the major water resources in the country as national water supply sources, including the Rau, Mue and Himo rivers and Miwaleni springs. As regards these water sources, control and regulation of water utilization are dealt with on the national level.

Granted water rights in the Lower-Moshi area total 136.9 cusec (3.88 m^3/sec) for 9 irrigation schemes, including 108 cusec for NAFCO Kahe. Other irrigation systems, called traditional furrows, have no legitimate water rights. As for the groundwater, no regulation is enforced yet.

In principle water rights in an area are granted based on the assessed minimum discharge of the water source. This is the simplest method to control and regulate the water use in a river system, but may not be the way to make the best use of the limited water resources.

The flow of rivers in the Kilimanjaro Region is fairly regular throughout the year according to the rainfall pattern. The peak occurs in April and it gradually declines towards the minimum flow in October thru December. Within certain limits, the extraction of riverflow in the rainy season has to be allowed in the water right legislation.

(4) Nyumba Ya Mungu dam and limit of water use

Water resource development of the Pangani River Basin has been investigated since 1934. Detailed surveys of the Hale Power Station and the Nyumba Ya Mungu dam were done during the 1950s. Ordinance No. 16 of 1961, referred to as the Hale Ordinance, was enacted primarily to guarantee the flow in the Pangani at Hale. This ordinance is the key problem of use of Pangani water. It envisaged the maintenance of a flow of not less than 450 cusecs (12.7 m^3/sec) at the Grand Pangani Falls at all times and the maintenance of all naturally existing flow on the basis existing in June 1961 of up to 700 cusecs (19.8 m^3/sec) at Hale 7 miles upstream. Since the flow at Hale was below 700 cusecs for 43 % of the time, the effect of the ordinance was to inhibit all new irrigation developments.

The completion of the Nyumba Ya Mungu Dam and Reservoir on the Pangani river has made it possible to guarantee a steady minimum flow of 700 cusecs at Hale and to dissolve the inhibition enforced by the ordinance. The reservoir has made available an additional 233,000 acre-feet (287 MCM) of water for the expansion of irrigation upstream of the Hale Power Station. This gives a framework for the scale of irrigation development in the Pangani valley inclusive of the Lower-Moshi area.

(5) Flood and drainage

Almost all villages in the Lower-Moshi area have suffered more or less from flood damage and poor drainage; however, no countermeasure has ever been implemented in the past.

There are twelve seasonally flooding rivers which lose their water courses at points 3 to 7 kilometers downstream from the Moshi-Himo road. In the rainy season, torrents coming down the slopes of Mt. Kilimanjaro often flood over the road because of the small capacity of culverts, thus stopping traffic for a few hours. Upon reaching the ends of the water courses, the torrents spread out over fields and flow down in the form of sheet flow toward the Rau and Mue rivers flushing away crops on the way. The Mue river's water course disappears entirely from a point 3 km downstream from the Moshi-Himo road to the confluence with the Miwaleni springs.

Low-lying areas in the villages of Rau Ya Kati, Kisangesangeni, Oria and Mangaria are subject to inundation by yearly floods. The most serious inundation occurs in Kisangesangeni village, where farmers abandon rainy season cropping and barely cultivate maize in the dry season after the recession of floods. Part of responsibility for the inundation can be attributed to NAFCO canal. At the crossing with Rau river three lanes of aqueduct were provided with an aggregate capacity of 25 m^3/sec which is far less than the flood discharge of the Rau; moreover, the canal bank acts as a dam to impound water in the low-lying area of the Village.

Flow capacity of rivers in the Lower-Moshi area is generally too small to pass flood discharge. The Rau river has a flow capacity of about 100 m^3/sec near the Moshi-Himo road; however, the flow capacity of the lower reaches decreases rapidly from about 100 m^3/sec to 10 m^3/sec or less. In the middle reaches of the Rau river, flow averages about 20 m^3/sec. According to interviews with farmers, flood runoff overflows the river bank and causes annual inundation in the fields along the Rau river. Since the Mue river course disappears in its middle reaches seasonal floods occur, forming sheet flows on the ground surface downstream of this portion. Watercourses in upstream and downstream of this portion have a flow capacity ranging from 18 to 40 m^3/sec. The Himo river has enough flow capacity in its upper reaches against flood runoff; on the other hand, lower reaches have smaller flow capacity from 210 to 4 m^3/sec.

There are two kinds of flood damage in the Lower-Moshi area: the first is mainly caused by standing water or inundation as seen in the lower reaches of the Rau, Mue and Himo rivers, and the second is caused by the wash out of the rapid sheet flows starting from the ends of water courses of the seasonally flooding rivers. The total area flooded by the 1979 flood was estimated to be 12,000 ha. The area damaged by inundation was 8,200 ha for the 1979 flood (three day rainfall probability: 1/50) and is estimated to be 4,000 ha on average over the long-term. The area damaged by wash out is estimated to be 3,800 ha with variable degrees of yearly damage, while probability of the 1979 flood was estimated to be 1/20 based on the daily maximum rainfall intensity. Annual flood damage is estimated to be TS 4.8 million as shown in Annex VI.

There are hardly any drainage canals in the Lower-Moshi area. Since about 100 mm of daily rainfall occurs once in five years, the drainage network is needed together with the irrigation network. At some part of TPC farm the raising of the groundwater table and soil salinization have recently been noticed. This calls for the provision of the drainage network for another reason.

3.15 Existing Infrastructure

Drinking water supply

In 1976, 390,000 persons or 45 % of the total population of the Kilimanjaro Region including Moshi Town were served by pipe borne water supply systems (mostly gravity supply from spring and reservoirs). In the Lower-Moshi area only a few villages have no piped water supply yet. The water supply system in the rural locality has served as a valuable utility for preventitive health service.

Transportation

The Kilimanjaro Region has well developed transportation networks. The trunk road, running the length of the Region and connecting Dar es Salaam and Tanga with Arusha, has been an axis of the transportation network in northern Tanzania. This all-weather tarmac road runs in the eastern part of the Lower-Moshi area and along the northern boundary of the area. The Moshi-TPC road, which is another tarmac road, runs in the west of the Lower-Moshi area. Within the Lower-Moshi area many branch farm roads join with these trunk roads, but they are all unpaved earth roads, not even passable by jeep in the rainy season.

Railways connect Moshi with Tanga and Arusha. They are used mainly for cargo transportation with only a small percentage for passenger service.

Tanga Port is the nearest port to the Region. A large proportion of the export crops of the Region pass through this port, but oil and other industrial products are imported primarily via Dar es Salaam port.

The Kilimanjaro International Airport, located on the regional boundary with Arusha and opened in 1972, is one of the most modernly equipped airports in the country. Tanzania Airways and a few international airlines render services to Dar es Salaam, Tanga, Mwanza and main world cities.

Power supply

A new electricity supply system called the "Coastal Grid System" was adopted in 1976 to ensure a steady supply of power to the Kilimanjaro and Arusha regions from large-capacity hydro-electric stations in Nare and Kidatu.

Power facilities in this region include the following:

Power Stations	:	Nyumba ya Mungu Hydro-electric Station (8 MW)
		Moshi Thermal Station (0.8 MW)
		Kikuletwa Hydro-electric Station (1.16 MW)
Substations	:	Kiyungi, Moshi Trad, School, and Same
Transmission and Distribution Lines	:	132, 66, 33, 11, 0.4 kV

IV THE PROJECT

4.1 General

The objectives of the Lower-Moshi Agricultural Development Project are:

- to increase in production of staple food crops and oil crops by means of removal of present agricultural constraints as well as crop intensification with provision of modernized irrigation and other infrastructural facilities so as to contribute to the Government policy for self sufficiency in food;

- to raise the standard living of farmers through increase in their farm products and incomes.

In order to achieve above objectives, the Project will construct nine (9) irrigation schemes covering net 6,320 ha consisting of seven (7) surface water schemes and two (2) groundwater schemes. Each irrigation area will be provided with drainage and farm-road network as well. In addition, the Project will execute other necessary works such as flood protection and improvement of existing trunk farm roads in order to ensure and enhance the benefits of the irrigation schemes. For the implementation of the Project, equipment and vehicles will be procured and such buildings as offices, laboratories, workshops and staffs houses will be constructed.

Major components of the Project are summarized as follows:

A) Construction of nine irrigation schemes

a) Rau river system : Upper Mabogini Scheme
Mabogini Scheme
Rau Ya Kati Scheme
Chekereni Scheme

b) Miwaleni springs : Miwaleni Pump Lift Scheme

c) Himo river system : Makuyuni Scheme
Ghona and Kileo Scheme

d) Groundwater : North Groundwater Scheme
East Groundwater Scheme

B) Flood protection

C) Trunk farm-road improvement

D) Procurement of equipment and vehicles

E) Construction of offices, laboratories, workshops and houses for project staff

4.2 Agricultural Development Plan

4.2.1 Proposed Land Use

According to the soil and topographic conditions, about 27,700 ha or 66% of the whole Lower-Moshi area is arable for upland crops, of which about 24,600 ha is suitable for profitable irrigated upland crop cultivation. In case of rice cultivation, about 32,500 ha is classified as arable land, of which about 15,300 ha is for profitable paddy cultivation.

Within the availability of irrigation water, the Project will provide irrigation for only 6,320 ha in net, of which 3,050 ha is paddy fields and the remaining 3,270 ha is upland fields. New reclamation of about 595 ha is to be made in Kisangesangeni and Kiomu villages.

	With Project (ha)	Without Project (ha)	Balance (ha)
Upland field			
- Irrigated by Project	3,270	-	+3,270
- Irrigated by Traditional Furrows	2,315	3,580	-1,265
- Rainfed	10,590	14,665	-4,075
Paddy field			
- Irrigated by Project	3,050	-	+3,050
- Irrigated by Traditional Furrows	270	655	- 385
Total arable land	19,495	18,900	+ 595

Note: Figures are shown in net acreage.

4.2.2 Proposed Cropping Pattern

The climate in the Lower-Moshi area is generally very favourable for cultivation of crops except for the scarcity of rainfall. The proposed cropping calendar has been made taking into account the heavy rainfall in April and comparatively low temperature in July and August.

Paddy cultivation will be introduced to the largest extent within the availability of irrigation water and suitability of soils. Oil-seeds such as soybeans, groundnut, sunflower and sesame will also be a main crop in this Project. Such food crops as maize and pulses will also be introduced to a lesser extent to meet the home consumption requirement of farm families. Cotton will remain in the irrigated fields of the Project to supply the present capacity of gin. Vegetables will be produced to meet the future demand from Moshi town.

The proposed cropping pattern for each scheme is given in Figures 3 to 6. Year-round cropping area is presented in Table 2 and summarized below:

Crop	Two Season Cropping Area (ha)	Proportion of Total (%)
Paddy	4,170	49.4
Oil seeds	1,718	20.4
Maize	738	8.7
Cotton	594	7.0
Pulses	594	7.0
Vegetables	308	3.7
Perennial crops & Others	320	3.8
Total	8,442	100.0

Total net area : 6,320 ha

Cropping intensity : 1.34

Table 2

SUMMARY OF IRRIGATION SCHEMES WITH CROPPING PATTERN

1. Rau River System	TOTAL SCHEME AREA	RAINY SEASON Paddy	DRY SEASON Paddy	PERENNIAL CROPS	OTHERS
(1) Njoro River	1,000	900	300	30	70
(i) Upper Mabogini Scheme	150	150	50	-	-
(ii) Mabogini Scheme	850	750	250	30	70 (sugar field)
(2) Rau River	1,300	1,100	350	120	80
(iii) Rau ya Kati Scheme	450	400	130	50	-
(iv) Chekereni Scheme	850	700	220	70	80 (pilot farm)
Sub-Total	2,300	2,000	650	150	150

2. Miwaleni Pump Lift Scheme		RAINY SEASON						DRY SEASON		
		Paddy	Oil Seeds	Pulses	Maize	Cotton	Vegetables	Paddy	Cotton	Vegetables
	2,000	900	320	220	280	220	60	470	220	60

3. Himo River System		RAINY SEASON						DRY SEASON			PERENNIAL CROPS
		Paddy	Oil Seeds	Pulses	Maize	Cotton	Vegetables	Oil Seeds	Cotton	Vegetables	
(i) Makuyuni Scheme	500	-	150	100	120	100	20	130	100	20	10
(ii) Ghona & Kileo Scheme	500	150	100	70	80	70	20	120	70	20	10
Sub-Total	1,000	150	250	170	200	170	40	250	170	40	20

4. Groundwater System		RAINY SEASON					DRY SEASON		
		Oil Seeds	Pulses	Maize	Cotton	Vegetables	Oil Seeds	Cotton	Vegetables
(i) North Groundwater Scheme (14 wells)	840	252	168	210	168	42	490	160	42
(ii) East Groundwater Scheme (6 wells)	180	48	36	48	36	12	108	36	12
Sub-Total	1,020	300	204	258	204	54	598	204	54
Total	6,320								

Table 2

Fig. 3

CROPPING PATTERN FOR RAU RIVER SYSTEM

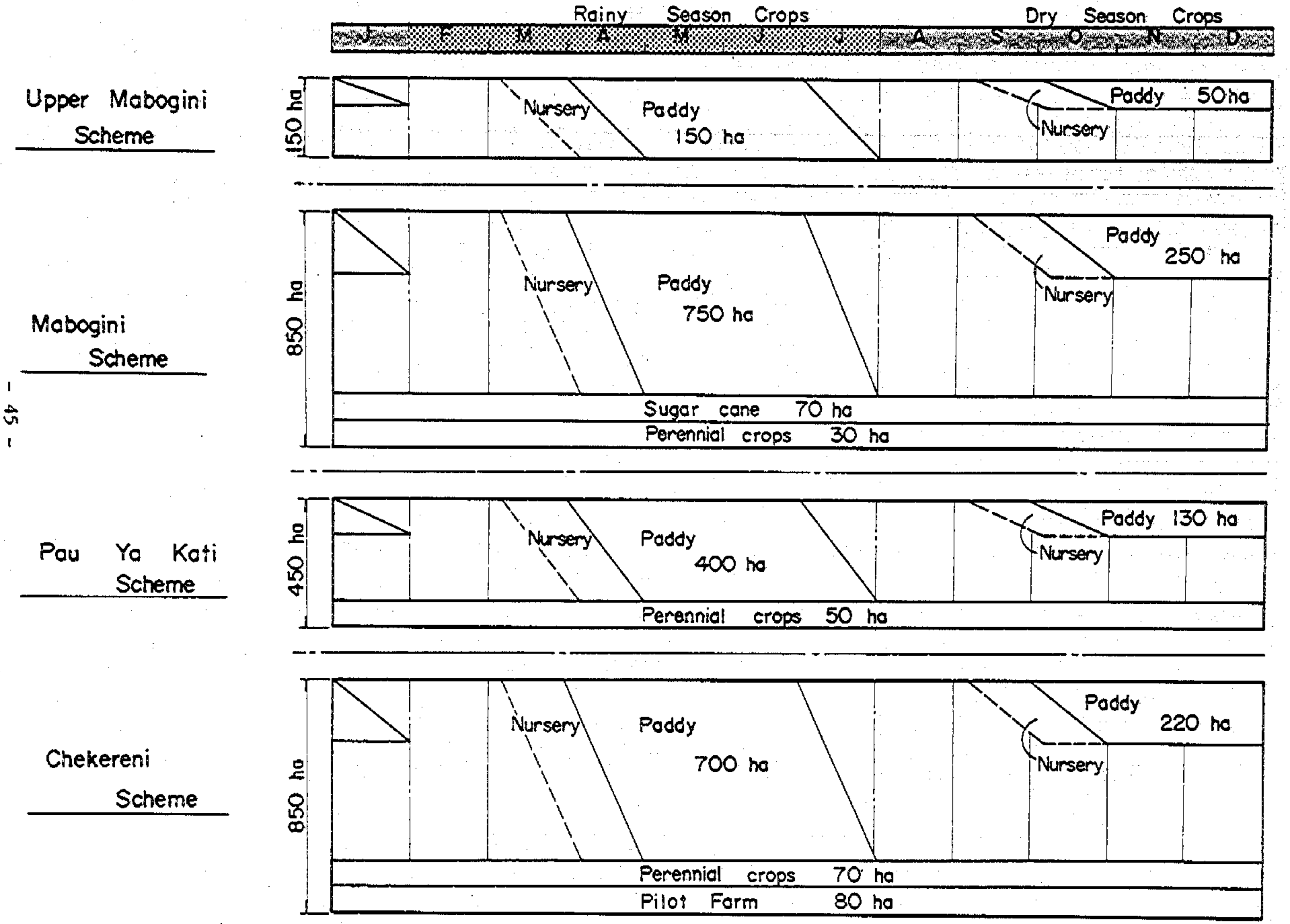

Fig. 4 CROPPING PATTERN FOR MIWALENI SPRING SYSTEM

Miwaleni Pump Lift Scheme

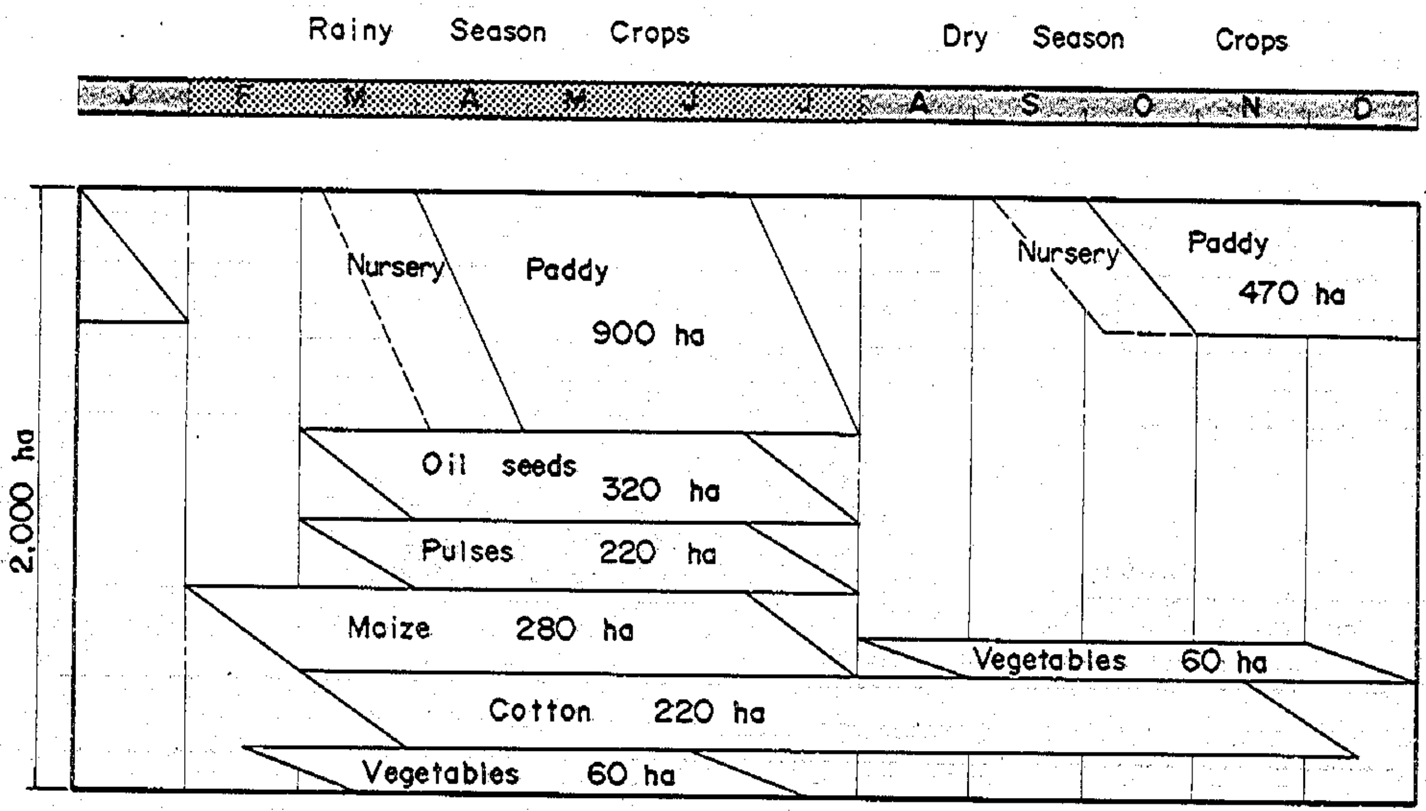

Fig. 4

Fig. 5

CROPPING PATTERN FOR HIMO RIVER SYSTEM

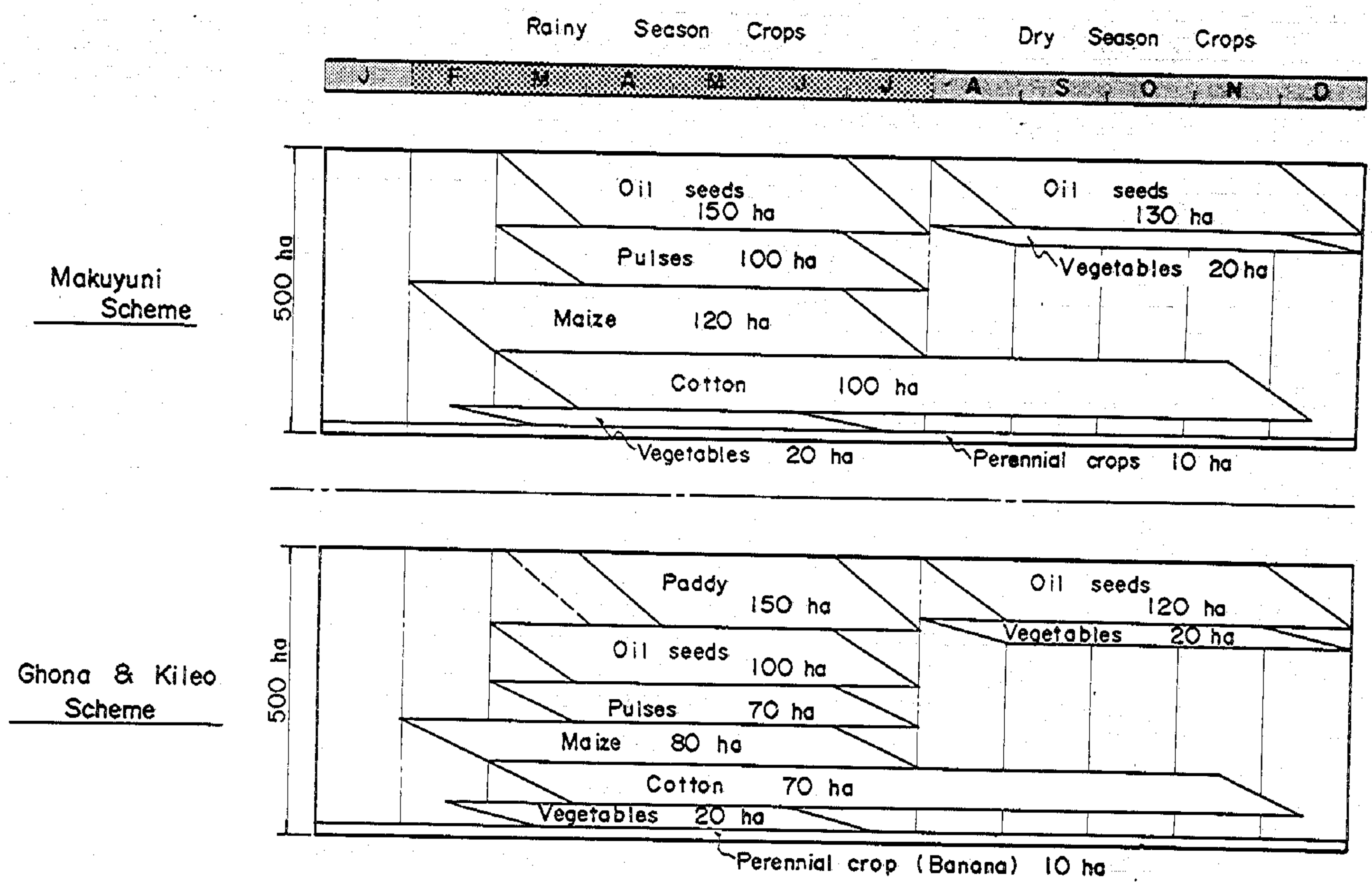

Fig. 6 CROPPING PATTERN FOR GROUNDWATER SCHEME

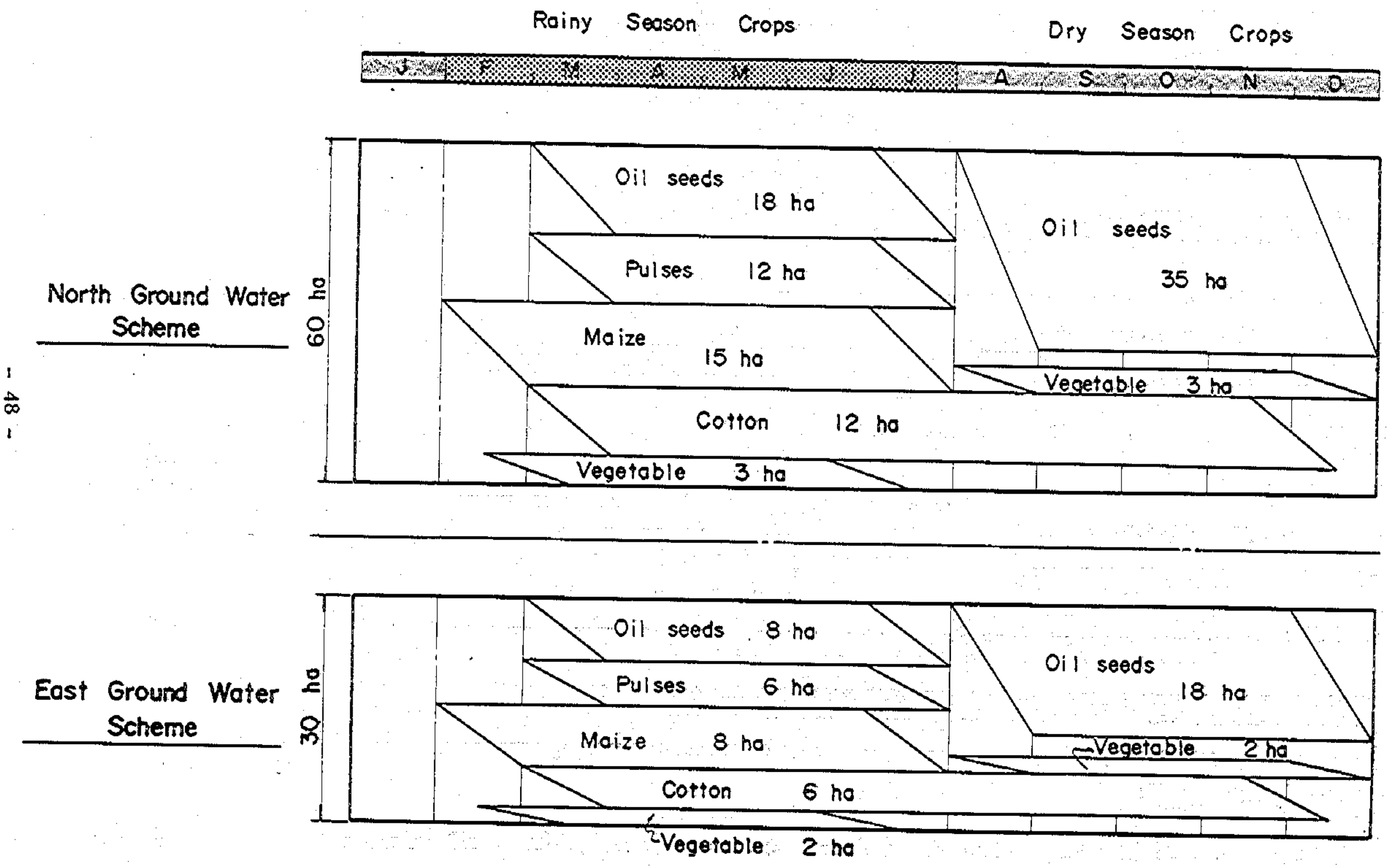

Fig. 6

4.2.3 Proposed Farming Practice

In order to expect possible higher return with the irrigation development, improved farming techniques should be introduced. The proposed farming practices and farm inputs have been based on the following assumptions:

i) The land productivity will be greatly improved by the introduction of irrigation and drainage and control of seasonal flooding;

ii) Land holdings will decrease slightly from 1.2 ha at present to 1.0 ha in the future. However, average family labour will increase from 2.4 to 3 persons;

iii) Most farmers have experience in irrigated farming through operation of traditional furrows. In addition, farmers have a strong desire to introduce improved farming according to field interviews with them; and

iv) As to farm mechanization, the present machinery use for soil preparation will be continued. In addition, a small scale power dust/sprayer, auto-thresher and sheller will be introduced, although basically, the proposed farming will be practiced by manual operation.

Soil preparation

In the proposed practices, both disc plowing plus one to two harrowings are recommended for upland farming to stabilize the seedling establishment and to effectively operate irrigation. For paddy cultivation, harrowing cum puddling is required after plowing. Prior to the harrowing for both cases, basic fertilizers will be applied at the rate of one third of the total requirements of urea and triple-superphosphate.

Seeding

In case of paddy rice, about 60 kg of seeds are to be sown on about 250 m^2 of nursery bed and grown for 25 days. The proposed seeding rate of 60 kg/ha is rather high because no certified seed is available in Tanzania. A seed multiplication programme should be started. Transplanting to the main field will be practiced with 15 cm x 30 cm spacing and 2 to 3 seedlings per hill.

In case of vegetables, kinder seedlings will be first grown in small beds under roof shading and then transplanted to the nursery bed. Transplanting to the main field will be made about 30 days after the seeding.

Fertilization

The soils are quite deficient in plant nutrients especially in organic carbon, nitrogen and phosphate. Suitable kinds of chemical fertilizers are urea for paddy fields and ammonium sulphate and triple-super-phosphate (TSP) for upland fields. For use of urea and ammonium sulphate, the split application method is recommended.

Plant protection

Intensive application of insecticides and fungicides is required for control of insects, pests and diseases, when the high yielding varieties are introduced. For application of chemicals, the knapsack type of motor driven mist cum duster will be used. The capacity of this equipment will be 3 to 5 ha per hour. It is strongly recommended to organize a systematic plant protection programme through farmers' cooperative or association to avoid reinfection from neighboring farmers.

Weed control

It is not recommended to use so-called herbicides because they are still considered harmful not only to human beings and livestock but also to the natural environment. The proposed practice for weed control will, therefore, be by use of the traditional instruments.

Only for the paddy rice cultivation is use of small amount of herbicides planned to control not only weeds but also Bilharzia which is now spreading slightly in the lowland areas.

Harvesting and threshing

Considering a large capacity of labour force in and around the Lower-Moshi area, manual harvesting is proposed. It is proposed to introduce the treadle thresher or sheller for pulses, oilseeds and maize and the auto-thresher for paddy rice.

4.2.4 Anticipated Crop Production

Target yields have been conservatively estimated as shown below on the basis of the crop experiments of the Miwaleni Experimental Sub-station, the results of actual operation at NAFCO Kahe and the accomplishment or rice products in Tanzania:

ANTICIPATED CROP YIELD COMPARISON
(WITHOUT AND WITH PROJECT)

(Unit: tons/ha)

Major Crops	Crop Yield without Project (Traditional)	Crop Yield with Project (Advanced)	Incremental Crop Yield
Maize	2.0	2.5	+ 0.5
Paddy	1.5	4.5	+ 3.0
Oil seeds	-	2.0	+ 2.0
Cotton	0.95	1.5	+ 0.55
Pulses	0.5	1.0	+ 0.5

Annual crop production for the whole Lower-Moshi area with and without the increment of production from the project are summarized as below.

Annual Crop Production and Incremental Production

(Unit: tons)

Major Products	Without Project	With Project	Incremental Production
Maize	20,740	16,340	- 4,400*
Paddy	980	19,170	+ 18,190
Pulses	490	850	+ 360
Oil-seeds	Some	3,430	+ 3,430
Cotton	610	900	+ 290
Vegetable	1,000	1,650	+ 650

* The reason for a decline in maize production is the use of a certain amount of maize fields for paddy production.

4.2.5 Market prospect

Up to now in Tanzania, the productive conditions of staple foods such as maize, wheat, sorghum, millet and beans, have not meet the target yield which was set down in the Third Five Year Development Plan, although their total production have gradually increased through government efforts. In addition, production of oil-seeds is rather small mainly due to placing major attention on attaining self-sufficiency in food crops. As a result, a large amount of capital is being spent to supplement food and oil-seed crops with foreign imports. The importation of maize amounted at 230,000 to 250,000 tons until 1975 although it has sharply declined to 25,000 - 50,000 tons in the recent years. By contrast, import of rice have increased sharply from about 3,000 tons before 1975 to 25,000 - 50,000 tons in the last 3 years. In addition, imports of cereals such as wheat, sorghum, millet, etc. (about 100,000 to 170,000 tons are imported annually) also increased sharply from that imported in the years before 1975.

As far as the external trade of oil-seeds is concerned, almost all of the raw production is exported to the European countries and some processed oil is imported, although its amount falls short of meeting the domestic demand.

In the Kilimanjaro Region, production of food grains except finger-millet has recently attained a surplus above regional rural demand, although partial shortage is found in Rombo, Mwanga and Same Districts. On the other hand, regional importation of rice for amounted to 4,000 tons. In the future, it is considered that the demand for rice will increase particularly from the expected population increase in Moshi township which is expanding under urban development. The vegetable oil production in the region is very small at present, at only 60 tons of raw seeds per year. Therefore, the rural demand for vegetable oil is mostly supplemented by the importation.

In the future when the proposed irrigation development is completed in the Lower-Moshi area, considerable amounts of crop production will be incremented: about 18,200 tons of paddy rice, 3,430 tons of oil-seeds, 300 tons of seed cotton, and 650 tons of fresh vegetables and so on. These crop productions will cover the present shortage of rural demand and provide a certain amount of marketable surplus for the rural economy. Actually, however, on a small contribution is anticipated to the national economy due to the limited availability of irrigation water in the area.

4.2.6 Price prospect

Nonetheless, it is anticipated that the national demand for food will still surpass the domestic supply, and continuous supplementation will be needed with the importation for the time being.

Based on the production/marketing situation foreseen above, the future costs and prices were estimated.

In estimating the future costs and prices of agricultural commodities, shadow price factor (SPF) was evaluated to assess the realistic economic viability of the proposed agricultural development. Based on the current external trade in Tanzania, the shadow price factor is estimated at 1.09. In addition, conversion between the international market prices and the farm gate prices was made based on "The Price Prospects for Primary Commodities" prepared by IBRD, January, 1980. The current exchange rate of US$1.0 equal to TS 8.18 (as of the end of March, 1980) in terms of financial prices was converted to a rate of US$1.0 equal to TS 8.92 in terms of economic prices.

As for the local commodities, costs/prices were estimated based on the current market price making reference to the inflation prospects ranging from 10% in the short term for the 1980s to 7.5% for the long term for the 1990s.

All of the costs and prices were studied in terms of economic and financial prices. The economic prices are the prices for the economic evaluation of the Project for the national economy, and hence, such transfer payments as taxes, duties, indirect overhead cost related to the market price, etc. are excluded from the estimation. The financial prices are the prices for appraising the financial viability of the Project, thus all price factors are included into the estimation. At present, all agriculture prices are subsidized to a certain extent, but this condition is precluded from the estimation.

4.2.7 Gross and Net Returns of the Crop Production in the Future Conditions

Based on the price prospects studied above, the gross return, production cost and net return per ha. for each crop is estimated for both economic and financial bases. In addition, to evaluate the incremental profit attributable to the Project, productive conditions in the future with and without the Project are also estimated for each crop production.

On the basis of the foregoing estimates of the crop production in the whole Lower-Moshi area, total gross and net return for each crop were estimated with and without the project (See table below). The gross production value based on economic prices is estimated with the project at TS 189.9 million (eqv. US$21.3 million) per annum in the whole Lower-Moshi area, versus TS 94.0 million (eqv. US$10.5 million) per annum without the Project; hence, TS 95.9 million (eqv. US$10.8 million) is obtained as the incremental gross value attributed to the Project.

Deducting the annual total production cost from the gross value, the net production value or primary profit with the project is obtained at TS 137.0 million (eqv. US$15.3 million) versus TS 66.9 million. (eqv. US$7.5 million) without the project. Thus, the annual incremental net value attributable to the Project is TS 70.1 million (eqv. US$7.8 million). The primary income level per farm household is estimated at TS 11,800 on average with the Project which is more than double what could be expected without the Project.

Annual Production Values
(in economic prices)

(Unit: 10^3 TS)

Description	Without Project	With Project	Increment
Gross Production Value	94,065	189,945	+95,880
Less Total Production Cost	27,150	52,900	+25,750
Net Production Value	66,915	137,045	+70,130

In terms of financial prices the gross production value is estimated at TS 65.4 million (eqv. US$8.0 million) per annum in the whole Lower-Moshi area with the Project and the net production value at TS 34.5 million (eqv. US$4.2 million). The primary income level per farm household is estimated at TS 3,320 (eqv. US$406) on average.

As far as the farms in the irrigation schemes are concerned, the primary income per farm household varies from TS 4,275 (eqv. US$525) for the typical paddy grower to TS 4,320 (eqv. US$528) for the typical oil-seeds growers.

4.3 Irrigation and Drainage Plan

4.3.1 Water requirements

The water requirements for the Project are estimated on a monthly basis. Potential evapotranspiration is calculated by the modified Penman method using climatic data. Monthly consumption of water by crop is estimated from the potential evapotranspiration multiplied by crop coefficients minus effective rainfall. For the consumption of water in paddy, percolation rates of 1.0 and 2.0 mm/day in the rainy and dry seasons, respectively, and puddling water requirements of 180 mm are added. Taking into account the irrigation efficiencies of 61% and 50% for paddy and upland irrigations respectively, the gross water requirements for each crop are estimated as follows:

	total water requirements		Maximum water requirements
	rainy season	dry season	
	mm	mm	ℓ/s/ha
Paddy	1,106	1,704	1.85
Pulses	686	1,190	1.43
Maize	996	1,562	1.53
Cotton	1,228	-	1.22
Vegetables	712	1,270	1.46
Soybeans	724	1,238	1.44
Banana	3,512		1.96

4.3.2 Available water resources

Irrigation water sources in the Lower-Moshi area are the surface waters and the groundwaters. The surface waters consist of the Rau river, the Hino river and the Miwaleni springs. The available water for the Project has been estimated based on the discharge data at gauging stations and the simulation analysis by the tank model as presented in Annex I.

Available water of the Miwaleni springs for the Miwaleni Pump Lift scheme is estimated on the following grounds: a) the NAFCO Kahe scheme will not expand its area larger than the present cultivation area of 1,400 ha; b) certain amount of water will be used by Oria village in the future to irrigate about 600 ha in their village from the NAFCO main canal; c) the water requirements for NAFCO and Oria are calculated based on the FAO report the "Engineering Aspects and Technical Soundness of the Proposed Kahe Irrigation Scheme"; and d) the irrigation water to NAFCO will be supplied on the basis of 16 hours a day. The water balance of the Miwaleni springs between the available discharge and the above consumption is presented in Table-4.

The groundwater schemes have been formulated more conservatively than the development potential in each groundwater area as presented in Annex II. In the Miwaleni upland area, 14 deep wells will be dug with 60 ℓ/sec of discharge and 60 ha of commanding area each. In the Kiomu area, 6 deep wells will be dug covering 30 ha each with 30 ℓ/sec of expected discharge. Before the production wells are constructed, a few test wells should be dug to examine the geo-hydraulic characteristics of the aquifer.

4.3.3 Scale of irrigation area

The irrigation area by the surface water has been assessed by means of the monthly water balance between the available water and the irrigation water requirements based on the cropping pattern of each scheme. The dependability level of irrigation is taken to be 80% both in the rainy season and dry season. The location of irrigation area has been determined by placing priority on existing irrigation areas which have water rights either lawfully sanctioned or based on custom. The groundwater irrigation scheme area and most of the Miwaleni Pump Lift scheme area are virgin areas for irrigation.

As a result of the water balance study, the irrigable area for each water source has been estimated as follows:

Schemes	Command Area (ha) Rainy Season	Dry Season	Maximum Water Requirements Rainy Season (m^3/sec)	Dry Season (m^3/sec)
1. Surface Water System				
(i) Rau River System	2,300	950		
Upper Mabogini Scheme	150	50	0.20	0.09
Mabogini Scheme	850	350	1.08	0.56
Rau Ya Kati Scheme	450	180	0.58	0.30
Chekereni Scheme	850	370	1.11	0.60
(ii) Miwaleni Springs	2,000	750		
Miwaleni Pump Lift Scheme	2,000	750	2.00	0.91
(iii) Himo River System	1,000	480		
Makuyuni Scheme	500	260	0.44	0.21
Ghona and Kileo Scheme	500	220	0.48	0.20
Sub-Total	5,300	2,180		
2. Groundwater System	1,020	856		
North Groundwater Scheme (for each of 14 wells)	60 x 14	50 x 14	0.053	0.054
East Groundwater Scheme (for each of 6 wells)	30 x 6	26 x 6	0.027	0.029
Total	6,320	3,036		

Table 3 WATER REQUIREMENT FOR KAHE NAFCO SCHEME

	EVAPO-TRANSPIRATION[1/] (110% mean) (mm)	EFFECTIVE RAINFALL[1/] (90% exceedence) (mm)	WATER DEFICIT (mm)	UNIT[2/] WATER REQUIREMENT (ℓ/s/ha)	DIVERSION[3/] REQUIREMENT FOR 2,000 HA (m^3/s)
Jan	160	0	160	0.95	1.90
Feb	147	0	147	0.96	1.92
Mar	147	8	139	0.82	1.64
Apr	124	41	83	0.51	1.02
May	102	10	92	0.55	1.10
Jun	94	0	94	0.58	1.16
Jul	91	0	91	0.54	1.08
Aug	107	0	107	0.63	1.26
Sep	124	0	124	0.76	1.52
Oct	147	0	147	0.87	1.74
Nov	147	0	147	0.90	1.80
Dec	152	0	152	0.90	1.80

Note: 1/: Referring to Appendix C, Hydrological Aspects, A Report on The Engineering Aspects and Technical Soundness of the Proposed Kahe Irrigation Scheme, FAO

2/: Based on overall irrigation efficiency of 0.63, which is referred to Chapter IV, Irrigation and Power Development, Survey and Plan for Irrigation Development in the Pangani and Wani River Basins.

3/: Including drawn-up extension areas of about 600 ha in Oria village in addition to the present cultivated area of 1,400 ha in NAFCO field.

Table 4 WATER BALANCE OF MIWALENI SPRINGS

MONTH	MIWALENI[1/] SPRING FLOW (m³/s)	DIVERSION WATER REQUIREMENT FOR NAFCO AREA 24 hrs[2/] Supply (m³/s)	16 hrs Supply (m³/s)	DIVERSION REQUIREMENT OF MIWALENI PUMP LIFT SCHEME (m³/sec)	WATER BALANCE (m³/sec)
Jan	3.57	1.90	2.85	0.41	0.31
Feb	3.54	1.92	2.88	0.24	0.42
Mar	3.59	1.64	2.46	0.94	0.19
Apr	3.72	1.02	1.53	1.44	0.75
May	3.97	1.10	1.65	1.56	0.76
Jun	3.83	1.16	1.74	2.00	0.09
Jul	3.59	1.08	1.62	0.92	1.05
Aug	3.54	1.26	1.89	0.31	1.34
Sep	3.51	1.52	2.28	0.34	0.89
Oct	3.59	1.74	2.61	0.90	0.08
Nov	3.60	1.80	2.70	0.88	0.02
Dec	3.61	1.80	2.70	0.91	0

Note: 1/: Using recorded minimum flow during 5 years from 1966 to 1970

2/: See Table 3, Diversion requirement for 2,000 ha

4.3.4 Total water consumption

As mentioned in Section 3.14, (4), the Hale Ordinance, 1961, has effectively prohibited all new irrigation developments in the Pangani valley. The completion of the Nyumba ya Mung Dam and Reservoir in 1968 made available an additional 233,000 acre-feet (287 MCM) of water for the expansion of surface water irrigation upstream of the Hale Power Station. As shown in Table 5, the Lower Moshi Project will consume a volume of irrigation water (surface) of 74 and 79 MCM in an average and a drought year respectively. NAFCO Kahe will consume an additional 33 MCM. Therefore, the total consumption would amount to 112 MCM which is well below the ceiling volume of 287 MCM set forth by the Nyumba ya Mungu Dam Project. The Project is viable in the light of the overall water-use plan of the Pangani valley.

4.3.5 Irrigation practice

For paddy cultivation, the flooding irrigation method will be applied with rotation irrigation only in the land preparation and puddling period, and a continuous irrigation thereafter. One rotation block would be 20 ha commanded by a tertiary canal.

For upland crops, the furrow irrigation method is recommended for economic reasons and farmer familiarity with it. Systematic and disciplined rotational irrigation should be undertaken throughout the year.

The irrigation hour for paddy fields is to be 24 hours a day, while upland fields will be irrigated 18 hours a day during months when maximum water requirements occur. A farm pond will be provided to regulate the difference between the supply hours of the main system and the irrigation hours in the fields. By the function of farm pond, the irrigation hours will be shortened in months other than the peak water requirement months.

From the irrigation point of view, soils in the scheme area are classified into two types: fine soil (alluvium) and medium soil (colluvium). The proposed upland irrigation practice is summarized as follows:

Table 5

WATER CONSUMPTION BY PROJECT

(Unit: MCM)

1. Lower-Moshi Area

	Rau River		Miwaleni Spring		Himo River		Groundwater		Total		Year
	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	
1968	19.0	14.1	12.0	8.9	6.9	4.4	4.3	8.8	42.2	36.2	78.4
1969	24.3	14.6	17.6	9.2	9.5	4.3	7.8	8.3	59.2	36.4	95.6
1970	23.6	14.7	15.5	9.3	7.3	4.1	6.0	7.9	52.4	36.0	88.4
1971	22.4	14.1	14.0	9.0	5.4	4.2	5.1	7.9	47.2	35.2	82.4
1972	21.7	13.4	13.8	8.5	6.1	3.1	5.3	5.8	46.9	30.8	77.7
1973	25.9	13.8	17.9	9.0	8.0	4.7	7.6	8.7	59.4	36.2	95.6
1974	23.4	15.4	15.6	9.7	6.6	4.8	6.3	9.0	51.9	38.9	90.8
1975	26.4	15.0	18.7	9.5	9.2	4.1	8.1	7.9	62.4	36.5	98.9
1976	23.1	15.4	14.9	9.8	6.1	3.7	5.8	7.3	49.9	36.2	86.1
1977	24.7	13.2	16.8	8.3	6.5	3.5	6.9	6.7	54.9	31.7	86.6
1978	24.4	14.1	16.2	9.1	7.2	4.6	6.4	8.5	54.2	36.3	90.5
1979	23.2	14.4	14.9	9.3	6.5	4.1	5.6	8.3	50.2	36.1	86.3
Average	23.5	14.4	15.7	9.1	7.1	4.1	6.3	7.9	52.6	35.5	88.1 (73.9)
80% dependable supply	25.9	15.4	17.9	9.7	9.2	4.7	7.8	8.8	59.4	36.5	95.6 (79.0)

2. Other Schemes

	Wet Season	Dry Season	Year
(i) Kabe NAFCO (1,400 ha, from Miwaleni Springs)	14.4	18.2	32.6
(ii) Existing deep wells including TPC (from groundwater abstruction)			20.4

Crops	Soil Moisture Fine Soil (mm/M)	Soil Moisture Medium Soil (mm/M)	Rooting Depth at Full Growth (m)	Net Depth of Irrigation Application Fine Soil (mm)	Net Depth of Irrigation Application Medium Soil (mm)	Irrigation Interval (day)
Maize	120	80	1.0	120	80	10
Cotton	130	90	1.0	130	90	10
Pulses	90	65	0.6	54	39	5
Soybeans	100	70	0.6	60	42	5
Onions	50	35	0.25	25	18	5
Tomatoes	80	60	0.40	56	42	5
Cabbages	90	65	0.45	36	26	5

These figures have been derived from a limited number of field tests as well as from the past experience gained in other parts of the world. Therefore, additional field tests are necessary prior to commencement of actual irrigation practices to confirm erodibility of soils, adequate stream size, steepness of slope, and proper length of irrigation run.

4.3.6 Field layout, land levelling and grading

A proper layout of the farm plots, farm roads and irrigation and drainage canals is essential for well management of irrigated farming. The size, shape and location of fields should be suited for the farming practices to be adopted.

For upland fields, furrow lengths of 100 m and 150 m are adopted. Land grading will be conducted by the Project over all the upland fields. The direction of irrigation slope will be set to be milder than 1%. In principle, the tertiary irrigation canals, drainage canals and farm roads will be provided at an interval of 400 m.

For paddy fields, the size of a plot will be about 0.3 ha consisting of three sub-plots of 0.1 ha. The tertiary block will consist of two blocks of 20 ha each. The land levelling will be implemented by the Project.

Where the existing plots are small and irregular, boundary realignment program is needed. As there is no cadastral map at present, a cadastral survey would be needed to prepare the boundary realignment program. About 15% of the land will be used by the Project facilities such as the right of ways of canals and roads. This loss of land can be shared equitably among farmers concerned, if a boundary realignment program is executed. Where plots are large enough, no boundary realignment is needed. Implementation of a boundary realignment program requires the prior agreement of the majority of farmers concerned.

Since the on-farm works mentioned above are costly and time consuming, farmer collaboration in the Project work is indispensable. The land grading and land levelling will be conducted by the Project only roughly. The final finishing will be left to farm labour. The Project expects the grading and levelling works to be completed over a rather long term.

4.3.7 Drainage water requirements

Surface drains from upland field will be provided to remove the excess runoff caused by a 5-year, 1-hour storm rainfall. While drains for paddy field are planned so that 5-year, 24 hour storm rainfall is drained within 48 hours.

Drainage requirements for upland field are estimated by using the McMath formula. Design rainfall is determined scheme by scheme according to the rainfall-altitude relation as discussed in Annex I and IV.

4.4 Flood Protection and Roads

4.4.1 General

The Project will provide low flood protection dikes (polder type) along the Rau river and floodways from the seasonal rivers. The buried portion of the Mue river will be rehabilitated and the crossing of the Rau and NAFCO canal will be improved by provision of a syphon.

The Project will provide a farm road network in and around the irrigation schemes. Two trunk farm roads, the Mabogini-Chekereni-Kahe road and the Miwaleni-Uchira road, will be improved with gravel metalling to be passable in the rainy season.

4.4.2 Flood Protection Plan

For design of flood protection facilities, flood discharge with a recurrence interval of 20 years is employed.

Floodways will be constructed along the natural ground slope ranging from 1/20 to 1/600. To introduce excess water to and from outside area and to give accessibility across the floodway, open dike will be provided at about 2 km intervals, where canal base is to be paved by wet rubble masonry and gabion. After several years erosion and sedimentation, the canal bed will reach an equilibrium and permanent structures will be installed thereafter. The main features of each floodway are listed below and shown in the following schematic plan and flood protection plan.

Name of Floodway	Relevant Rivers	Design Discharge (m^3/sec)	Total Length (km)	Junction
(1) Mandaka FW	Kishiringo, Msaranga, Msangaji, Mola, and Mlalo.	17 - 132	11.55	Rau river
(2) Nanga FW	Nanga.	46	4.55	Rau river
(3) Miwaleni FW	Cholo and its tributary.	40	6.30	Mue river
(4) Mue FW	Kandalu, Urenga, and Mue.	160	3.0	Mue river
(5) Uchira FW	Uchira.	56	2.75	Mue river

Fig. 7 SCHEMATIC PLAN FOR FLOOD PROTECTION FACILITIES

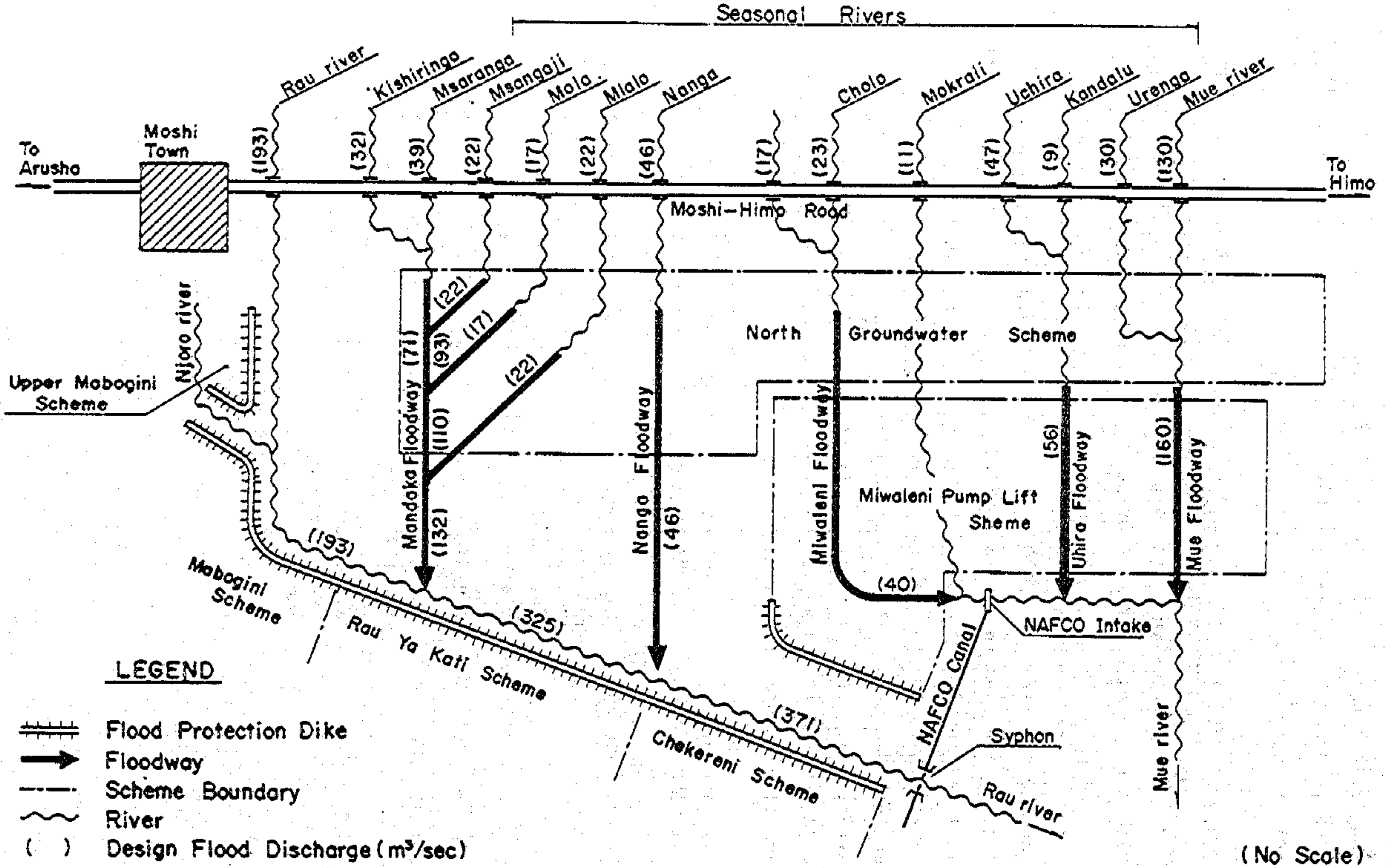

Fig. 7

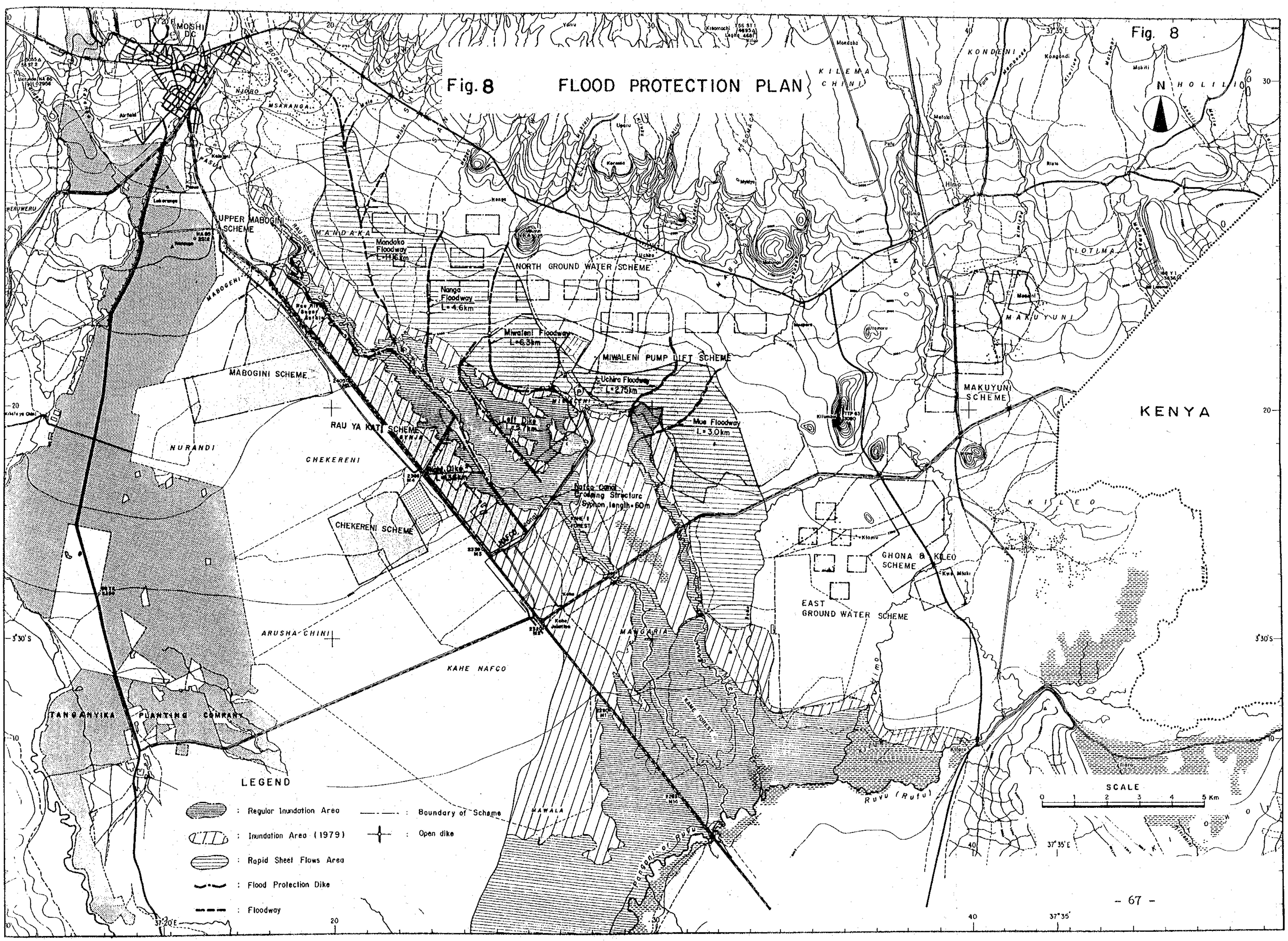

Fig. 8 FLOOD PROTECTION PLAN
Fig. 8
MOSHI
KENYA
UPPER MABOGINI SCHEME
MABOGINI SCHEME
RAU YA KATI SCHEME
CHEKERENI SCHEME
NORTH GROUND WATER SCHEME
MIWALENI PUMP LIFT SCHEME
MAKUYUNI SCHEME
GHONA & KILEO SCHEME
EAST GROUND WATER SCHEME
TANGANYIKA PLANTING COMPANY
Mondoka Floodway
Nanga Floodway L=4.6km
Mwaleni Floodway L=6.3km
Uchira Floodway L=2.75km
Mue Floodway L=3.0km
Left Dike
Nafco Canal Crossing Structure Syphon, length=60m
NURANDI
CHEKERENI
ARUSHA CHINI
KAHE NAFCO
MANGARIA
MAWALA
KILEO
MAKUYUNI
LOTIMA
KONDENI
KILEMA CHINI
Ruvu (Rufu)
SCALE
0 1 2 3 4 5 Km
LEGEND
: Regular Inundation Area
: Inundation Area (1979)
: Rapid Sheet Flows Area
: Flood Protection Dike
: Floodway
: Boundary of Scheme
: Open dike

Flood protection dike will have an average height of 1.5 m above the ground surface, top width of 3 m and side slope of 1:2.0. The length of dike for each scheme is shown below.

Location	Name of Scheme	Length of Dike (km)
Right Bank	Upper Mabogini	2.7
"	Mabogini	1.3
"	Rau Ya Kati	5.2
"	Chekereni	4.4
	Sub-total	13.6
Left Bank	Miwaleni Pump Lift	5.7
	Total	19.3

The total length of the floodways and flood protection dikes will be 30.2 km and 19.3 km, respectively. The NAFCO syphon will be a box culvert of 60 m long and 2 m x 2 m cross section.

4.4.3 Farm Road

The Chekereni trunk farm road leading from Mabogini to Kahe via Chekereni will be 19.0 km, while the Miwaleni trunk farm road from Uchira to Miwaleni would be 5.8 km in length. They would be gravel-metalled with total width of 7.0 m and thickness of 0.10 m.

In addition to the trunk farm roads, the main, secondary, tertiary and field farm roads would be constructed alongside the corresponding irrigation canals. All farm roads are earthen with following widths:

Main farm road	7.0 m
Secondary farm road	5.0 m
Tertiary farm road	4.0 m

4.5 Project Works

Each irrigation scheme will include following main works in common:

i) head work either a concrete weir or pumping station or deep well;

ii) concrete lined main and secondary canals and related structures;

iii) unlined tertiary and quarternary canals and related structures;

iv) on-farm works including land levelling for paddy fields and land grading for upland fields together with boundary realignment where necessary;

v) drainage system; and

vi) farm road network.

General features of each scheme are given hereunder, while those of flood protection works are shown distributed to the relevant irrigation scheme.

GENERAL FEATURES OF RAU RIVER SYSTEM (1)

	Upper Mabogini Irrigation Scheme	Mabogini Irrigation Scheme
1 Source of Irrigation water	Njoro river	Njoro river
2 Net Irrigation Area	150 ha	850 ha
3 Maximum Diversion Water Required	0.20 m^3/sec	1.08 m^3/sec
4 Irrigation Facilities		
(1) Intake structure		
Location	3.5 km upstream of confluence of the Rau and Njoro rivers	2.0 km upstream of confluence of the Rau and Njoro rivers
Weir type	Floating type concrete weir	Floating type concrete weir
Crest length	8.4 m	8.4 m

- continued -

	Upper Mabogini Irrigation Scheme	Mabogini Irrigation Scheme
Scouring sluice	1.0 m width x 1 no.	1.0 m width x 1 no.
Intake gate	Circular slide gate ∅ 800 mm x 1 no.	Slide gate 1,000mm x 1,500mm x 1 no.
(2) Main irrigation canal	0.60 km	3.53 km
(3) Secondary irrigation canal	0.45 km	7.98 km
5 Drainage Canal	0.65 km	17.0 km
6 Farm Road	4.8 km	13.1 km
7 On-farm Development Works		
(1) Tertiary irrigation canal	7.0 km	28.7 km
(2) Tertiary drainage canal	2.3 km	24.3 km
(3) Tertiary farm road	3.7 km	33.6 km
(4) Farm ditch, drain & road	for 150 ha	for 780 ha
8 Land Levelling	150 ha	780 ha
9 Flood Protection Dike		
(1) Top width	3.0 m	3.0 m
(2) Length	2.7 km	1.3 km

GENERAL FEATURES OF RAU RIVER SYSTEM (2)

	Rau Ya Kati Irrigation Scheme	Chekereni Irrigation Scheme
1 Source of Irrigation Water	Rau River	Rau River
2 Net Irrigation Area	450 ha	850 ha
3 Maximum Diversion Water Requirement	0.58 m^3/sec	1.11 m^3/sec
4 Irrigation Facilities		
(1) Intake structure Location	1.2 km downstream of confluence of the Rau & the Njoro river	0.5 km upstream of the existing Chekereni Weir

- continued -

	Rau Ya Kati Irrigation Scheme	Chekereni Irrigation Scheme
Weir type	Floating type concrete weir	Floating type concrete weir
Crest length	13.4 m	13.4 m
Scouring sluice	1.0 m width x 1 no.	1.0 m width x 1 no.
Intake gate	Slide gate 1,000mmx1,000mmx 1 no.	Slide gate 1,500mmx1,500x1 no
(2) Main irrigation canal	3.5 km	3.4 km
(3) Secondary irrigation canal	3.2 km	7.5 km
5. Drainage Canal	8.9 km	17.2 km
6. Farm Road	8.7 km	13.3 km
7. On-farm Development Works		
(1) Tertiary irrigation canal	14.4 km	23.0 km
(2) Tertiary drainage canal	13.7 km	21.0 km
(3) Tertiary farm road	24.3 km	32.2 km
(4) Farm ditch, drain & road	for 450 ha	for 780 ha
8. Land Levelling	450 ha	780 ha
9. Flood Protection Dike		
(1) Top width	3.0 m	3.0 m
(2) Length	5.2 km	4.4 km

GENERAL FEATURES OF MIWALENI PUMP LIFT SCHEME

1. Source of Irrigation Water	Miwaleni Springs
2. Net Irrigation Area	2,000 ha
3. Maximum Diversion Water Requirement	2.00 m^3/sec

- continued -

4. Irrigation Facilities

(1) Pump station

Pump, Type	Horizontal shaft double section volute type
Number of unit	4 sets including 1 spare
Pump capacity	40 m^3/min.
Rated head	24.0 m
Motors output of each motor	230 kW each
Discharge pipe line,	
Internal diameter	1,100 m
Length	1,850 m
Pump house,	336 m^2
(2) Main irrigation canal	11.9 km
(3) Secondary irrigation canal	19.2 km
(4) Farm Pond	5 Nos.
5. Drainage Canal	18.2 km
6. Farm Road (including Trunk Farm Road)	33.5 km
7. On-farm Development Works	
(1) Tertiary irrigation canal	66.0 km
(2) Tertiary drainage canal	53.2 km
(3) Tertiary farm road	32.2 km
(4) Farm ditch, drain & road	for 2,000 ha
8. Land Levelling and Grading	2,000 ha
9. Flood Protection Dike	5.7 km
10. Floodway	12.1 km
11. Power Distribution Line and Sub-station	
(1) Voltage	11 kV
(2) Length	5.5 km
(3) Transformer	one bank of 2,000 kVA

GENERAL FEATURES OF HIMO RIVER SYSTEM

	Makuyuni Irrigation Scheme	Ghona & Kileo Irrigation Scheme
1. Source of Irrigation Water	Himo river	Himo river
2. Net Irrigation Area	500 ha	500 ha
3. Maximum Diversion Water Requirement	0.44 m^3/sec	0.48 m^3/sec
4. Irrigation Facilities		
(1) Intake structure Location	Just downstream of Moshi-Himo road crossing (existing Marangu/ Siding intake)	4 km downstream of Moshi-Himo road crossing (Existing Ghona intake)
Scouring sluice	1.0 m width x 1 no.	1.0 m width x 1 no.
Intake gate	1.0 m width x 1 no.	1.0 m width x 1 no.
(2) Main irrigation canal	5.17 km	4.10 km
(3) Secondary irrigation canal	5.4 km	7.2 km
5. Drainage Canal	4.6 km	4.2 km
6. Farm Road	11.3 km	8.7 km
7. On-farm Development Works		
(1) Tertiary irrigation canal	21.5 km	18.4 km
(2) Tertiary drainage canal	25.6 km	17.1 km
(3) Tertiary farm road	22.7 km	13.2 km
(4) Farm ditch, drain & road	for 500 ha	for 500 ha
8. Land Levelling	500 ha	500 ha
9. Farm pond	2 Nos.	1 No.

GENERAL FEATURES OF GROUNDWATER SCHEMES

	North Groundwater Scheme	East Groundwater Scheme
1. Number of Wells	14	6
2. Total Irrigation Area	840 ha	180
	Typical Layout of One Tubewell Area	
3. Net Irrigation Area	60 ha	30 ha
4. Maximum Diversion Water Requirement	54 ℓ/sec	29 ℓ/sec
5. Irrigation Facilities		
(1) Tubewell pump station		
Pump		
Type	Submersible type	Submersible type
Pump capacity	60 ℓ/sec	30 ℓ/sec
Rated head	35 m	25 m
Pump diameter	200 mm	125 mm
Motor		
Output of motor	37 kW	15 kW
Pumphouse	12 m^2	12 m^2
(2) Irrigation canal		
Lead canal	50 m	50 m
Secondary canal	1,100 m	420 m
Tertiary canal	2,750 m	1,350 m
Regulation pond	1 No. Storage capacity, 1,300 m^3	1 No. storage capacity, 650 m^3
(3) Tubewell		
Diameter	∅300 mm	∅300 mm
Depth	100 m	100 m
6. Drainage Canal	4,500 m	2,250 m
7. Farm Road	4,800 m	2,300 m
8. Land Grading	60 ha	30 ha

- continued -

	North Groundwater Scheme	East Groundwater Scheme
9. Power Distribution Line		
(1) Transformer	11 kV/400-230 V	11 kV/400-230 V
(2) Length of power line	18km/14 Nos. of wells	12km/6 Nos. of well
10. Floodway		
Mandaka Floodway	11.55 km	--
Nanga Floodway	4.55 km	--

The irrigation system capacity for all schemes is summarized in the table below.

SUMMARY OF IRRIGATION SYSTEM CAPACITY

Scheme	Intake	Main Canal	Secondary Canal	Tertiary Canal
	(m^3/s)	(ℓ/s/ha)	(ℓ/s/ha)	(ℓ/s)
1. Rau River System				
(1) Upper Mabogini Scheme	0.20	1.34	1.34	37
(2) Mabogini Scheme	1.08	1.27	1.34	37
(3) Rau Ya Kati Scheme	0.58	1.29	1.34	37
(4) Chekereni Scheme	1.11	1.31	1.40	37
2. Himo River System				
(1) Makuyuni Scheme	0.44	0.88	0.88(1.17) 1/	38
(2) Ghona & Kileo Scheme	0.48	0.96	0.96(1.28) 1/	38
3. Miwaleni Scheme (Pump Station: 2.00 m^3/s)				
(1) East Area	1.07	0.91	0.91(1.21) 1/	37
(2) West Area	1.06	1.34	1.34	37
4. Groundwater Scheme				
(1) North Groundwater Scheme	0.054	-	46 ℓ/s	23
(2) East Groundwater Scheme	0.029	-	38 ℓ/s	19

Note: 1/: for canals downstream of farm ponds.

4.6 Environmental Effects of the Project

The introduction of irrigation to the project area will tend to increase groundwater levels. Since this might cause problems of water logging or salinity in lowlying area towards the Nyumba ya Mungu Reservoir, the Project will provide certain drainage systems in these area. Periodical monitoring is required during the project operation.

Irrigation can sometimes lead to the spread of disease vectors. The most serious of these diseases, schistosomiasis (bilharzia) reportedly exists in TPC canals, therefore, the situation should be carefully monitored in the complete canal systems of the Project. Malaria has mostly been eliminated from the area and does not seem to present a serious problem. Water borne diseases, such as cholera, typhoid and dysentry, are not likely to the exacerbated by the project as most villages rely on the piped water supply systems for drinking.

V IMPLEMENTATION OF THE PROJECT

5.1 Construction of Project Works

The civil works to be constructed by the Project are broadly divided into two categories: the main civil works and the on-farm development works.

The main civil works consist of main project facilities such as intake structures, pump stations, main and secondary irrigation canals, main and secondary drains, trunk farm roads, main and secondary farm roads, and flood protection facilities.

The on-farm development works include all facilities below the tertiary outlets such as tertiary irrigation canals and related structures, tertiary drains, tertiary farm roads, farm ditches and drains, farm roads, land levelling or grading, and land consolidation.

The Project will construct both the main civil works and the on-farm development works simultaneously, so that upon completion of construction works immediate benefits can be envisaged.

Since the ownership of all lands in Tanzania belongs to the Government, no compensation will be required for the land acquisition for the right of way of the Project facilities.

As mentioned in 4.3.6, the Project will undertake the land levelling for paddy fields and the land grading for upland fields, together with the boundary realignment of the existing farm plots. The land levelling and grading will be done only roughly, leaving the precise finishing to farmers. In executing the boundary realignment, the Project has the power to change the existing farm boundaries to more rational ones without any legal procedure nor negotiation with the farmers, which will much ease the difficulty normally encountered by the planner and executor of on-farm works.

As the civil works of the Project include a large volume of earth work, the mechanized construction method will be introduced. The required kind and number of equipment and machinery are shown in Table VIII-12 of Annex VIII.

Since there are few local contractors in Tanzania who have sufficient experience or enough equipment for this kind of work, it is proposed that both the main civil works and the on-farm development works be undertaken by a qualified international contractor/contractors selected through competitive bidding. The scale of the work for which a tender is called should be large enough to attract the interest of international contractors. Construction equipment and machinery needed for the Project works will be imported by the contractor and re-exported when the construction is completed. The Project office will procure equipment and vehicles necessary for supervising contractors works and for operating and maintaining the Project facilities.

5.2 Implementation Schedule

The project implementation schedule is shown in Figure 9. It includes the project preparatory works and the construction works. The project preparatory works will last 18 months including the time necessary for survey works, detailed design works, project mobilization and procurement of operation and maintenance equipment. The construction works will last 62 months for the main construction works and the on-farm development works. The project mobilization includes financing and organizational legalization. Establishment of the project organization will have to be completed by the middle of 1982.

5.3 Operation and Maintenance

All facilities constructed by the Project will be owned, operated and maintained by the Government. The farm plots, which are re-shaped and equipped with irrigation facilities by the Project, will be allocated to farmers by the Government either on individual or communal bases.

The operation and maintenance (O & M) of the main facilities will be the responsibility of the Project office, whereas the O & M of on-farm facilities will be entrusted to the farmers concerned.

As will be mentioned in Chapter VIII, the farmers will be capable of bearing the O & M cost of the Project including both for the main and on-farm facilities, when the Project reaches the full development stage of agriculture.

Fig. 9 PROJECT IMPLEMENTATION SCHEDULE

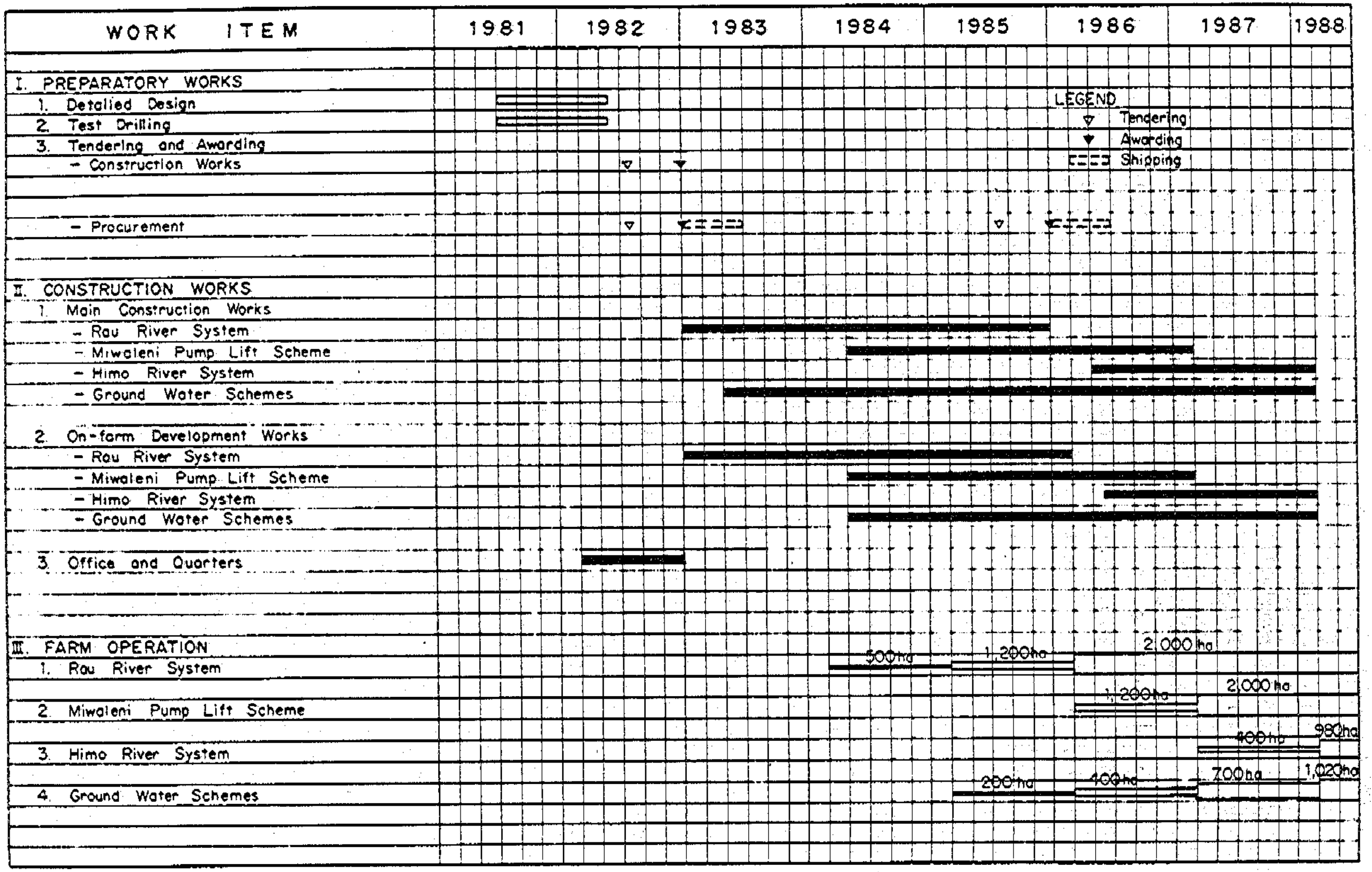

Fig. 9

VI ORGANIZATION AND MANAGEMENT

6.1 Project Implementation Organization

For the construction and management of the Lower-Moshi Agricultural Development Project, it is proposed to establish an executing organization tentatively called the Project Office under the jurisdiction of the Regional Development Director (RDD). To properly coordinate, guide and assist the Project Office in the Project implementation and its operation and management, the Executive Committee will also be organized under the RDD. The Committee will consist of representatives concerned, such as Regional Planning Officer, Regional Manpower Management Officer, Regional Accountant, Regional Irrigation Engineer, Regional Agricultural Development Officer, Regional Officer of Tanzanian Rural Development Bank, District Development Director, Village chiefs, etc.

The Project Office will have the following functions:

- Construction of irrigation and drainage facilities and farm road networks for the Project with engagement of contractors;

- Operation and maintenance of the irrigation and drainage facilities and farm road networks; and

- Accounting and administration of construction operation and maintenance of the Project.

At the implementation stage of the project, the Project Office will organize four working sections, such as (1) Design Section, (2) Implementation Section, (3) Mechanical Section and (4) Administrative Section under the management of the Project Manager to be appointed by the RDD. The organization chart of the above is given in Figure 10.

Fig. 10 ORGANIZATION CHART AT IMPLEMENTATION STAGE

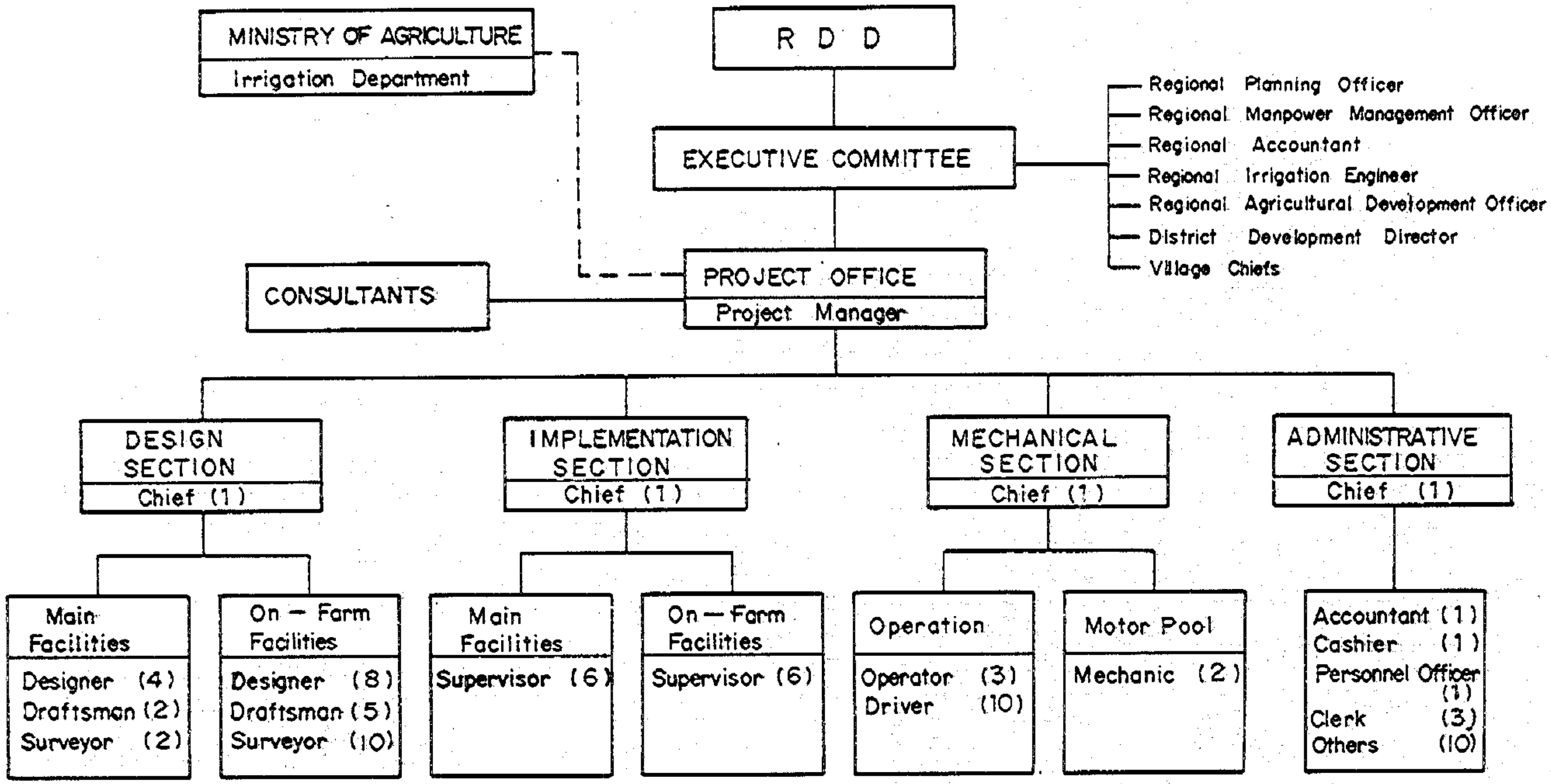

Fig. 10

After the completion of the Project construction works, the Project Office will be re-organized into three working sections, i.e., Operation Section, Maintenance Section and Administrative Section as shown in Figure 11.

The Kilimanjaro Agricultural Development Center (KADC), which is now under construction in the Chekereni village under the technical and financial assistance of the Japanese Government, will directly coordinate and assist the Project Office in operation and maintenance of the Project.

At farmers' level, Irrigation Association should be organized in each scheme to operate and maintain the on-farm facilities with assistance and guidance of the Project Office. The Irrigation Association is to be a farmers' group like the present communal working group organized in each village. The Irrigation Association will have to coordinate and to maintain good communication with the Project Office for water supply management and maintenance of facilities. The Irrigation Association will establish the rotation blocks each comprising about 20 ha of fields and about 20 members of farmer in every tertiary command area. Rotational irrigation will be conducted by farmers themselves in the rotation block.

Total number of staff at the implementation stage of the Project is estimated to be 85 and mainly consist of administrative staff, specialists, engineers and field attendants.

The required number of staff at the full operation stage of the Project will be 36. In addition, a considerable number of seasonal employees will be required for the field operation, although the farmers' association will provide the manpower to a certain extent.

6.2 Consultants' Services

Severe shortage in experienced personnel in the country will require the participation of foreign expertise in the Project. Throughout the preparatory and construction stages of the Project, a qualified engineering consultanting firm will be employed by the Project Office.

Fig. 11

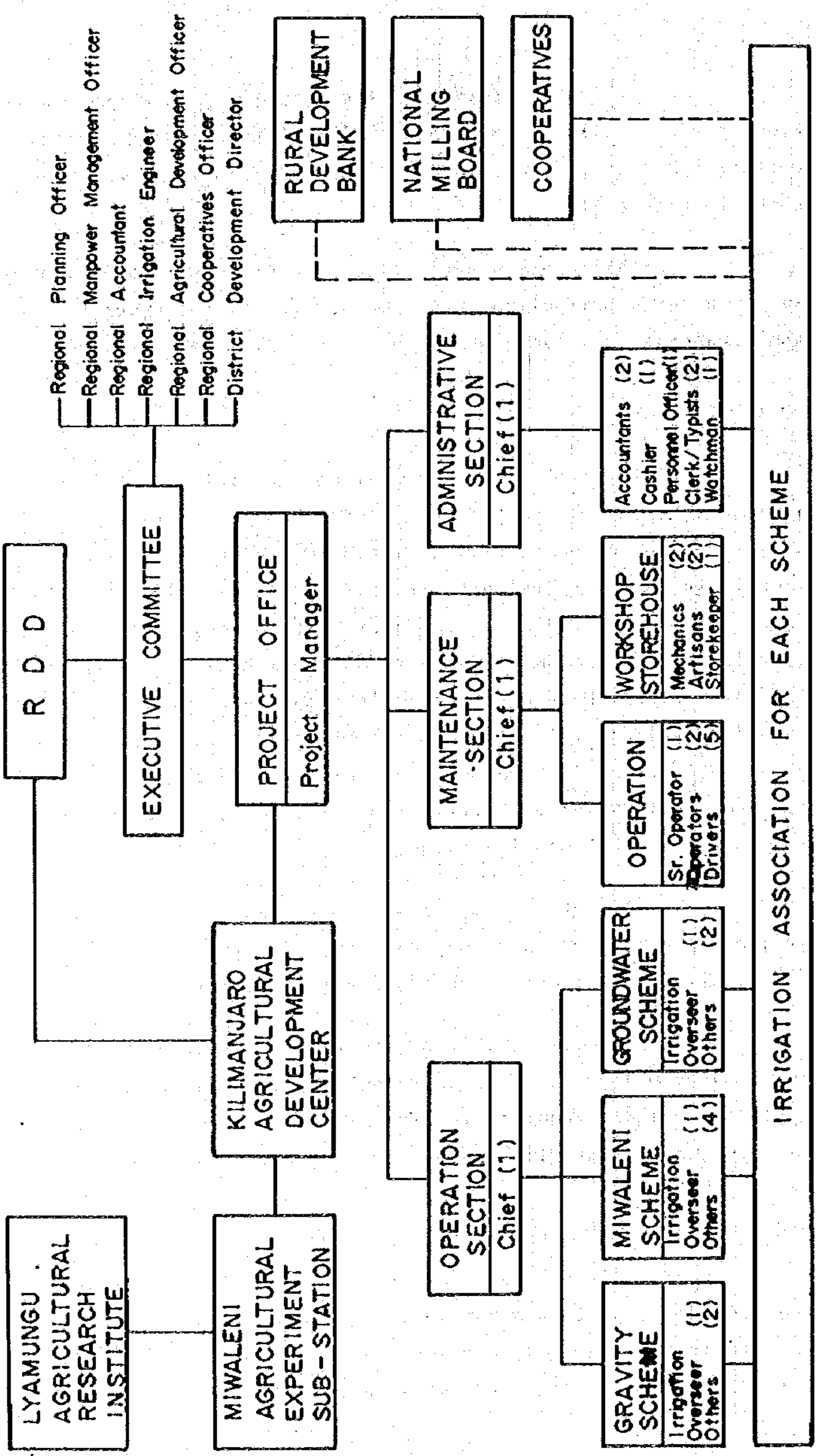

Fig. 11 ORGANIZATION CHART AT O & M STAGE

The consultants will be engaged in the project implementation such as for preparation of the design and the tender documents, and supervision of the construction works. Total man-months of consulting services required will be about 405, for which the cost will amount to approximately US$ 4.1 million as shown in Table VIII-14 of Annex VIII.

VII PROJECT COSTS

7.1 General

The costs for the implementation of the Project are estimated on the basis of the preliminary design of the Project works taking into account the construction method to be applied, productivity of labour and machinery and based on the following assumptions:

(1) The exchange rate used is:

US$ 1.00 = TS 8.18 = ¥ 250

(2) The civil work construction will be carried out by Contractor(s) selected through international tendering. Construction machinery and equipment needed for the Project works will be imported by the contractor and re-exported when the construction is completed.

(3) Taxes and duties on the construction materials, machinery and equipment to be imported from abroad and on the incomes of international contractors are excluded from estimate of construction cost.

(4) The unit prices are divided into foreign and local currency portions. Local currency portion is estimated based on the current prices in early 1980 in Kilimanjaro Region, and on the cost data of on-going civil works obtained from the Government authorities concerned. Foreign currency portion is estimated based on the CIF prices at Dar es Salaam, with reference to FOB prices of materials and equipment in Japan in 1980. The classification of local and foreign currency portions is defined as follows:

Local Currency Portion

- Local labour
- Wooden materials
- Inland transportation cost
- Administration expenses

Foreign Currency Portion

- Reinforcing bar
- Depreciation of construction equipment and machinery
- Pumping plant and electrical facilities
- Steel gates for intakes and canal related structures
- Structural steel
- Contractor's general expenses and porfits for foreign contractors
- Expenses and fees of engineering services by foreign consultants

Besides the above estimate, the foreign currency portion includes part of procurement costs of materials which are imported or deemed as semi-imported goods, such as fuel and cement, to the extent of the border prices.

(5) Physical contingency is 10% of the construction cost.

(6) Price contingency applied in the estimate is: 7.5% per annum for the foreign currency portion and 10% per annum for the local currency portion.

7.2 Cost estimate

(1) Investment cost and annual disbursement schedule

The investment cost for the Project is estimated at US$ 77 million equivalent, comprising US$ 46 million of foreign currency and TS 257 million of local currency as summarized in Table 6. The annual disbursement schedule based on the implementation schedule is shown in Table 7.

The detailed breakdowns of the construction cost, procurement cost of O & M equipment, and other related expenses are shown in Table VIII-8 to Table VIII-15 in Annex VIII.

(2) Operation and maintenance costs

Operation and maintenance costs at the full operation stage of the Project are estimated at TS 4.17 million at the 1980 price level, consisting of the costs for: (1) operation and maintenance of project offices including personnel cost, (2) operation and maintenance of the Project facilities. These costs are shown in Table VIII-21 of Annex VIII.

(3) Cost for replacement of project facilities

Pumping equipment and electrical facilities, and steel gates for intakes and canal related structures have to be periodically replaced. The economic life of each facility and costs for replacement are given in Table VIII-23 of Annex VIII.

Table 6 SUMMARY OF INVESTMENT COSTS

ITEM	FC	LC	TOTAL	FC	LC	TOTAL
	(10^3 US$)			(10^3 TS)		
1. Preparatory works	810	355	1,165	6,630	2,900	9,530
2. Main construction works						
- Rau river system	3,590	2,694	6,284	29,360	22,040	51,400
- Miwaleni pump lift scheme	6,092	3,329	9,421	49,830	27,230	77,060
- Himo river system	1,759	1,308	3,067	14,390	10,700	25,090
- Groundwater system	3,343	2,046	5,389	27,340	16,740	44,080
3. On-farm development works						
- Rau river system	2,778	1,831	4,609	22,720	14,980	37,700
- Miwaleni pump lift scheme	2,941	2,089	5,030	24,060	17,090	41,150
- Himo river system	1,255	944	2,199	10,270	7,720	17,990
- Groundwater system	1,770	1,275	3,045	14,480	10,430	24,910
4. Office and quarters	400	1,193	1,593	3,270	9,760	13,030
Sub-total	24,738	17,064	41,802	202,350	139,590	341,940
5. O & M equipment	734	37	771	6,000	300	6,300
6. Engineering services and administration expenses	4,110	917	5,027	33,620	7,500	41,120
7. Contingencies						
- Physical contingency	2,958	1,802	4,760	24,200	14,740	38,940
- Price contingency	13,370	11,616	24,986	109,370	95,020	204,390
Total	45,910	31,436	77,346	375,540	257,150	632,690

Table 7 ANNUAL DISBURSEMENT SCHEDULE OF FINANCIAL COST

Unit: FC: 10^3US\$
LC: 10^3TS

DESCRIPTION	TOTAL		1981		1982		1983		1984		1985		1986		1987		1988	
	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC
1. Preparatory Works	810	2,900	-	-	400	1,450	410	1,450	-	-	-	-	-	-	-	-	-	-
2. Main Construction Works																		
- Rau river system	3,590	22,040	-	-	-	-	1,475	9,040	1,430	9,040	685	3,960	-	-	-	-	-	-
- Mivaleni pump lift scheme	6,092	27,230	-	-	-	-	-	-	3,465	15,470	2,250	10,110	300	1,360	77	290	-	-
- Himo river system	1,759	10,700	-	-	-	-	-	-	-	-	-	-	740	4,500	870	5,240	149	960
- Groundwater system	3,343	16,740	-	-	-	-	240	1,170	770	3,850	935	4,690	830	4,180	500	2,120	68	730
3. On-farm Development Works																		
- Rau river system	2,778	14,980	-	-	-	-	700	3,750	970	5,240	1,108	5,990	-	-	-	-	-	-
- Mivaleni pump lift scheme	2,941	17,090	-	-	-	-	-	-	440	2,560	1,120	6,490	1,120	6,490	261	1,550	-	-
- Himo river system	1,255	7,720	-	-	-	-	-	-	-	-	-	-	320	2,010	750	4,550	185	1,160
- Groundwater system	1,770	10,430	-	-	-	-	130	730	250	1,460	420	2,500	420	2,500	420	2,500	130	740
4. Office and Quarters	400	9,760	-	-	400	9,760	-	-	-	-	-	-	-	-	-	-	-	-
Sub-total (Item 1 to 4)	24,738	139,590	-	-	800	11,210	2,955	16,140	7,325	37,620	6,518	33,740	3,730	21,040	2,878	16,250	532	3,590
5. O & M Equipment	734	300	-	-	172	80	-	-	-	-	562	220	-	-	-	-	-	-
6. Engineering Services and Administration Expenses	4,110	7,500	640	200	615	200	595	1,200	635	1,400	555	1,400	495	1,400	495	1,400	80	300
7. Physical Contingency	2,958	14,740	65	20	160	1,150	355	1,730	795	3,900	764	3,540	423	2,240	335	1,770	61	390
Sub-total (Item 1 to 7)	32,540	162,130	705	220	1,747	12,640	3,905	19,070	8,755	42,920	8,399	38,900	4,648	24,680	3,708	19,420	673	4,280
8. Price Contingency	13,370	95,020	53	22	272	2,658	946	6,310	2,940	19,920	3,660	23,750	2,528	19,040	2,444	18,420	527	4,900
TOTAL	45,910	257,150	758	242	2,019	15,298	4,851	25,380	11,695	62,840	12,059	62,650	7,176	43,720	6,152	37,840	1,200	9,180

VIII PROJECT EVALUATION

8.1 General

The economic viability of the proposed agricultural development is found by estimating the internal rate of return (IRR) for four irrigation systems individually and also for the whole project. In this evaluation, the sensitivity analysis is also made, aiming to assess the elasticity range of the project under changed conditions due to various causes, such as over-running the project cost, delaying the attainment of production target, drop in the market prices of crops etc. In addition, the financial evaluation of the proposed development is made by analysing the capacity to pay for the water charges at the farm level.

The indirect benefits from this agricultural development which will benefit regional development are also studied briefly.

8.2 Economic Cost

The economic project cost covers the costs for (1) preparatory works, (2) civil works on major facilities and on-farm development, (3) general administrative management, (4) procurement of O/M machinery and equipment, (5) engineering services and (6) physical contingencies (10%). The economic costs used in the analysis are adjusted to 1980 price levels. The economic costs exclude both the provision for expected price increases and the transfer payments such as taxes and duties. The foreign currency portion, which is estimated based on border prices of goods, is converted into the economic cost by multiplying by 1.09, which is the shadow price factor.

The economic costs for the proposed component schemes are summarized below:

Economic Cost

Major Irrigation Systems & Schemes	Total Cost (TS x 10^3)
Rau River System	93,780
Miwaleni Pump Lift Scheme	124,860
Himo River System	45,300
Groundwater Schemes	72,750
(Sub-total)	336,690
Total Related Costs	115,560
Total	452,250

8.3 Project Benefits

The project benefits consist of the direct benefits and the indirect benefits. The direct benefits will come from the increment of crop production with irrigation development, flood protection and drainage improvement. The indirect benefits are anticipated from the contribution to (1) saving foreign exchange particularly for the importation of food crops, (2) rural and regional economy and other sociological benefits with particular emphasis on the labour opportunity, and (3) greatly enhancing the land value particularly in the lowlying area. However to be conservative, only the direct benefits are incorporated in the calculation of the internal rate of return.

The direct economic benefits are evaluated applying the same principles as in the economic cost evaluation. They are the difference of net income from the crop production in the future with and without the project, as summarized in the following Table. The direct benefits will start in 1984 and increase year by year. It should attain its maximum level of TS 70.1 million in and after the 10th year after commencement of the construction works.

Annual Net Incremental Values

(Values in economic prices)

(unit: $Ts10^3$)

Description	Future-without Project	Future-with Project	Incremental Values
Gross Production Values	94,065	189,945	95,880
Total Production Cost	27,150	52,900	25,750
Net Production Value	66,915	137,045	70,130

8.4 Economic Evaluation

8.4.1 Internal Rate of Return

On the basis of the economic costs and benefits estimated in the preceding Tables, the internal rate of return (IRR) of the Lower-Moshi Agricultural Development Project is calculated individually for four irrigation systems and for the whole project. The benefits derived from the livestock production, which will also be increased to a certain extent with the proposed project implementation, are excluded from this evaluation, conceptionally. The calculation is made based on 50 years of project life starting from 1981 which will be the starting year of project implementation and assuming that attainment of the project target production is reached 5 years after completion of the construction works. The results are summarized below.

Internal Rate of Return

Irrigation Systems	Internal Rate of Return (%)
Rau River System	15.3
Miwaleni Pump Scheme	12.4
Himo River System	9.8
Groundwater Schemes	8.1
Total Project	12.1

As seen above, the Rau River System shows the highest economic viability and is followed by the Mivaleni Pump Schemes. The total project also shows a high IRR, proving the project feasible economically.

8.4.2 Sensitivity Analysis

In the evaluation on the internal rate of return of the project, sensitivity analysis is also made with respect to the following critical conditions, to test the elasticity range of the project.

(1) if the project cost runs over the price and physical contingencies.

(2) if the market prices decline.

(3) if the attainment of the Project target is delayed.

Paying attention to the critical conditions above, the sensitivity analysis is made as shown in the following table. As seen in the table, the elasticity of the Project for the most adverse conditions caused by a 20% of price decline and 20% cost over-run lowers the IRR to 7.9%.

COST OVER-RUN	INTERNAL RATE OF RETURN (%)			
	Production or Price Decline			Target Attainment Delay
	0	-10%	-20%	3 years
0	12.1	10.9	9.7	11.7
+10%	11.0	9.9	8.7	10.7
+20%	10.1	9.0	7.9	9.8

8.5 Financial Evaluation

The financial viability of the Project is evaluated from the viewpoint of farm economy. In this context, the repayment capability for the capital investment is studied by analyging the capacity to pay for the water charges at the farmers' level.

8.5.1 Capacity to Pay

The net production returns estimated in terms of the financial price are at TS 34.5 million in the whole Lower-Moshi area and these returns correspond to about TS 3,320 per farm household on average.

As far as the forecast farm economy in the irrigation schemes is concerned, the primary income per farm household is estimated at TS 4,275 for the typical paddy grower, and TS 4,320 for the typical oil-seed grower. These are respectively about 3.3 times and 5.5 times more than under present conditions.

The home consumption of major crop production is estimated at about Ts 1,900 based on the food requirement. Thus, deducting the values of home consumption from the primary income of farm household, the forecast capacity to pay is obtained at Ts 2,375 per annum for the typical paddy growers and Ts 2,420 for the typical oil-seeds growers.

8.5.2 Repayment capability

For the repayment capability analysis, it is assumed that the investment requirement would be arranged under the following conditions:

(1) Foreign currency portion: This is financed under bilateral finance agreement or by international finance organizations at an interest rate of 3% per annum. Repayment period is 30 years including 10 years of grace period.

(2) Local currency portion: This is financed by the budget allocation of the Government. For this, no repayment is expected.

Based on the above assumption, the full charges to Water users for repayment are estimated as high as Ts 4,790/ha/years (see ANNEX IX Table IX-9). Generally, the charges to be collected from the water users should be within a reasonable range in the capacity to pay that can still give sufficient incentive to the farmers for agricultural production increases. In this view, it is anticipated that the Government will have to subsidize a certain proportion of the charges.

Financial cash flow at the Project level is calculated throughout the project life as shown in Table-8, in which, temporarily, only the O & M costs and replacement costs are assumed to be borne by beneficiary farmers and all other costs including amortization of the loan are by the Government as subsidy to the Project.

8.6 Socio-economic Impacts

The increase of crop production will bring a considerable amount of the net profits to the farmers. These profits will not only improve the farmer's living standard but also stabilize the rural economic aspects through overall effects on the economic activities.

Improvement of local transportation and communication systems will also be anticipated by the project implementation particularly of farm road network. This will also contribute to the improvement of rural economic activities including the agricultural activities.

The increase of employment opportunities will be expected by the project implementation, and the operation/maintenance works on the project facilities. Besides, the employment opportunities will also increase in the agro-business particularly of oil-milling which might be induced in the Region by a large quantity of oil seeds production in the Project area.

Through the project implementation and the operation/maintenance works, the people will gain more experience, technical know-how, skillfulness in the various working fields. These accumulation will provide motive-power for further development in the Kilimanjaro Region.

Table 8 CASH FLOW STATEMENT

Unit: 10^3 TS

Year	CASH OUTFLOW: PROJECT INVESTMENT F.C.	L.C.	REPLACEMENT COST	O & M COST	LOAN REPAYMENT	TOTAL	CASH INFLOW: PROJECT REVENUE LOAN	GOVERNMENT BUDGET ARRANGEMENT	WATER CHARGE /5	GOVERNMENT SUBSIDY LOAN REPAYMENT	PART OF REPLACEMENT COST	TOTAL	BALANCE OF CASH FLOW
1981	6,200	242	-	-	-	6,422	6,200	242	-	-	-	6,442	0
82	16,520	15,298	-	-	-	31,818	16,520	15,298	-	-	-	31,818	0
83	39,680	25,380	-	-	-	65,060	39,680	25,380	-	-	-	65,060	0
84	95,660	62,840	-	203	-	158,703	95,660	62,840	203	-	-	158,703	0
85	98,640	62,650	1,348 (238)/2	736	-	163,374	98,640	62,650	974	-	1,110	163,374	0
86	58,700	43,720	1,348 (754)/2	2,334	-	106,102	58,700	43,720	3,088	-	594	106,102	0
87	50,320	37,840	1,348(1,146)/2	3,545	-	93,053	50,320	37,840	4,691	-	202	93,053	0
88	9,820	9,180	1,348	4,170	-	24,518	9,820	9,180	5,518	-	-	24,518	0
89	-	-	1,348	4,170	-	5,518	-	-	5,518	-	-	5,518	0
			(5,154)/3										
1990	(451,030)/1		1,348	4,170	-	5,518	-	-	5,518	-	-	5,518	0
91			1,348	4,170	30,320	35,838			5,518	30,320		35,838	0
92			1,348	4,170	30,320	35,838			5,518	30,320		35,838	0
93			1,348	4,170	30,320	35,838			5,518	30,320		35,838	0
94			1,348	4,170	30,320	35,838			5,518	30,320		35,838	0
			(5,154)/3										
95			1,348	4,170	30,320	35,838			5,518	30,320		35,838	0
96			1,348	4,170	30,320	35,838			5,518	30,320		35,838	0
97			1,348	4,170	30,320	35,838			5,518	30,320		35,838	0
98			1,348	4,170	30,320	35,838			5,518	30,320		35,838	0
99			1,348	4,170	30,320	35,838			5,518	30,320		35,838	0
			(5,154)/3										
2000			1,348	4,170	30,320	35,838			5,518	30,320		35,838	0
01			1,348	4,170	30,320	35,838			5,518	30,320		35,838	0
02			1,348	4,170	30,320	35,838			5,518	30,320		35,838	0
03			1,348	4,170	30,320	35,838			5,518	30,320		35,838	0
04			1,348	4,170	30,320	35,838			5,518	30,320		35,838	0
			(5,154)/3										
05			1,348	4,170	30,320	35,838			5,518	30,320		35,838	0
06			1,348	4,170	30,320	35,838			5,518	30,320		35,838	0
07			1,348	4,170	30,320	35,838			5,518	30,320		35,838	0
08			1,348	4,170	30,320	35,838			5,518	30,320		35,838	0
09			1,348	4,170	30,320	35,838			5,518	30,320		35,838	0
			(36,483)/4										
2010			1,348	4,170	30,320				5,518	30,320		35,838	0

/1. Compound amount of investment for foreign currency.

/2. Annual replacement cost collected from farmers.

/3. Replacement cost or compound amount of annual replacement cost for O & M equipment.

/4. Replacement cost or compound amount of annual replacement cost for O & M and other project equipment.

/5. Inclusive of replacement cost and O & M cost to be collected from farmers.

IX CONCLUSION AND RECOMMENDATIONS

Conclusion

The present feasibility study concludes that the Lower-Moshi Agricultural Development Project herein proposed in technically sound and economically feasible.

Recommendations

It is recommended that the Government of Tanzania should:

1) urgently proceed financing arrangement for the Project implementation and execute the Project in accordance with the time schedule proposed in this report in order to avoid any cost overrun;

2) establish the Project Executing Organization under the RDD with mobilization of project staff and recruitment of engineers and technicians;

3) employ a qualified consultants firm to perform the implementation design and construction supervision of the Project;

4) employ an eligible contractor or contractors qualified to carry out the construction works of the Project;

5) make administrative arrangements to transfer part of NAFCO Kahe's water rights to the Miwaleni Pump Lift scheme;

6) expedite KADC's activities and strengthen all agricultural supporting services; and

7) start four schemes in the Rau river system as the first stage development, because the four schemes are superior to other schemes in terms of IRR, construction cost per hectare and operation cost.

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