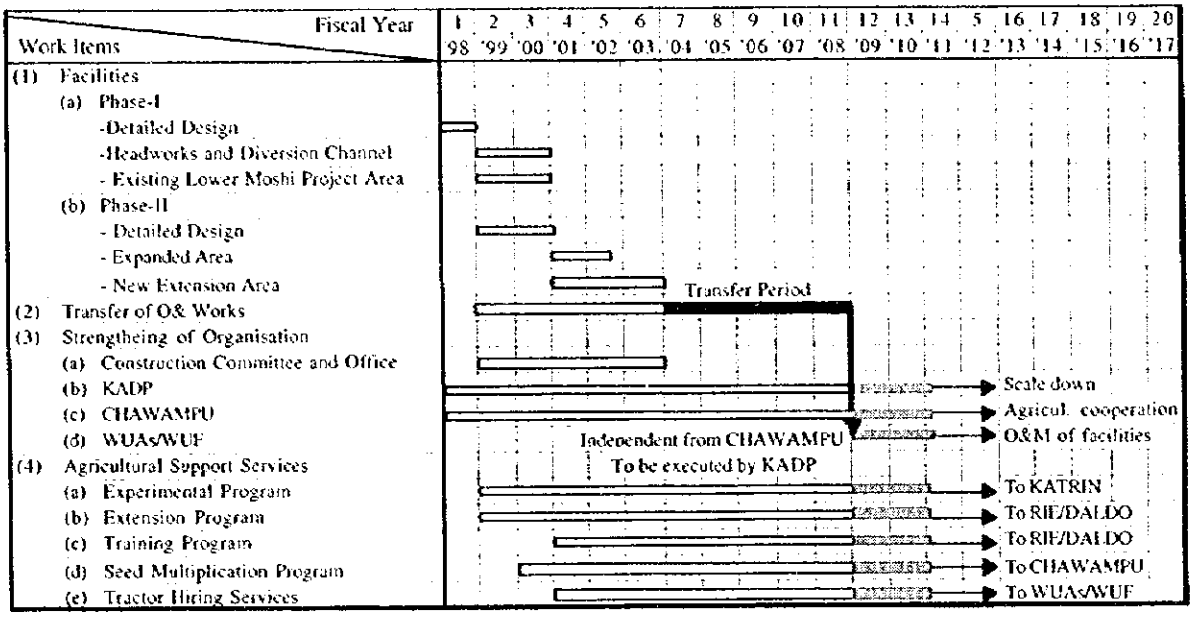
CHAPTER 5 PROJECT IMPLEMENTATION, O&M, AND WATER MANAGEMENT PLAN

5.1 Project Implementation Plan

The implementation schedule of the Project is worked out based on the stepwise strengthening plan of KADP, farmers' organisations and agricultural support services in a synchronised way with the phasewise construction of the Project facilities, and the transfer plan of O&M works to farmers' organisations. (details are given in Figure 5.1).

Project Implementation Plan



As shown in the above figure, the operation and maintenance plan for the Project is formulated focusing on the strengthening of the existing organisations, and also the organisation for operation and maintenance will be changed based on the handing-over plan of O&M work to WUAs/WUF. In this study, handing-over of O&M work is planned to be executed for 5 years after completion of all the Project facilities. Within this period, the O&M work for the Project facilities except the headworks and diversion channel, will be handed over to WUAs/WUF. The strengthening of agricultural support services is planned to be executed in line with the progress of construction works. Until completion of handing-over of O&M work to WUAs/WUF, KADP will take the initiative for strengthening of agricultural support services, and then transfer them to KATRIN, ZIE/DALDO, CHAWAMPU and WUAs/WUF as mentioned in the above figure.

5.2 Construction Plan

The construction period is estimated to be 5 years from overall viewpoints such as the work scale, impact of the Project implementation, and annual fund requirement. In addition, the works are planned to be carried out in two phases in consideration of early occurrence of benefit and urgent need of water supply to the Existing Lower Moshi Project Area. The

Phase-I works consisting of the construction of headworks and diversion channel, and rehabilitation of the Existing Lower Moshi Project Area, will require a construction period of 2 years . The Phase-II works involving the development of the Expanded Area and the New Extension Area, will need 3 years for completion.

The works to be executed in each year are as follows:

(1) Phase-I Works

Phase-I Works in each Year

Works	1st Year		2nd Year	
(a) Headworks	- Dam portion	(60%)	- Dam portion	(40%)
	- Intake portion	(30%)	- Intake portion	(70%)
(b) Diversion Channel	- Canal excavation	(80%)	- Canal excavation	(20%)
	- Canal lining in lowland area	(60%)	- Canal lining in low land area	(40%)
			in highland area	(100%)
	- Related structures	(50%)	- Related structures	(50%)
			- Rural infrastructure	(100%)
(c) Existing Lower Moshi Project Area	- Repairs of irr. & dra. facilities	(100%)	- On-farm works	(70%)
	- On-farm works	(30%)	- Rural infrastructure	(100%)

(2) Phase-II Works

Phase-II Works in each Year

Works	1st Year		2nd Year		3rd Year	
(a) Expanded Area	- Irr. & dra. facilities	(70%)	- Irr. & dra. facilities	(30%)	---	
	- On-farm works	(60%)	- On-farm works	(40%)	---	
			- Rural infrastructure	(100%)	---	
(b) New Extension Area	- On-farm works	(20%)	- On-farm works	(40%)	- On-farm works	(40%)
			- Rural infrastructure	(50%)	- Rural infrastructure	(50%)

5.2.1 Construction Quantities and Materials

The required construction quantities and materials for the Project are tabulated below.

Construction Quantities and Materials

Work Items	Unit	Phase-I	Phase-II	Total
(1) Construction Quantities				
-Rock excavation	m^3	330,000	7,000	337,000
-Soil excavation	m^3	210,000	190,000	400,000
-Embankment	m^3	128,000	750,000	878,000
-Concrete work (dam)	m^3	12,000	-	12,000
-Concrete work (structure)	m^3	14,000	6,000	20,000
-Concrete block lining	m^2	100,000	220,000	320,000
-Shoterete lining	m^3	7,000	-	7,000
-On-farm works	ha	1,050	2,550	3,600
(2) Construction Materials	m^3			
-Cement	ton	7,000	1,800	8,800
-Coarse aggregate	m^3	60,000	15,000	75,000
-Fine aggregate	m^3	30,000	7,000	37,000
-Reinforcement bar	ton	800	150	950
-Steel	ton	140	20	160
-Steel pipe (ϕ2,200mm)	ton	45	-	45

5.2.2 Construction Machinery

The required constrution machinery for the respective phases is estimated based on the construction quantities, construction period, and workable days. The number and type of required constrution machinery at the peak time are tabulated below:

Required Construction Machinery

(Unit:nos.)

Construction Machinery	Phase-I	Phase-II	Construction Machinery	Phase-I	Phase-II
(a) Bulldozer (16 ton - 32 ton)	7	14	(i) Grout pump	1	0
(b) Bulldozer (ripper 32 ton)	6	1	(j) Batching plant	2	2
(c) Backhoe (0.4 m3 - 1.0 m3)	10	24	(k) Truck mixer	8	1
(d) Dump truck	18	29	(l) Block making plant	1	1
(e) Crawled drill	4	0	(m) Shoterete machine	2	0
(f) Braker	5	1	(n) Concrete pump car	2	3
(g) Motor grader	1	0	(o) Truck crane	4	6
(h) Roller	2	5			

5.2.3 Construction Office

The Irrigation Department of MAC will become the executing agency for the Project implementation. A Project Construction Committee will be established only during the construction period, in order to execute the construction works smoothly. The Committee shall be the highest executing body for the Project construction. Figure 5.2 indicates the proposed government organisation for the Project implementation. The Committee will be chaired by the Assistant Commissioner, Irrigation. The Director of Project Construction Office will assume the post of Secretary of the Committee. The committee's membership will consist of staffs of the Zonal Office, Regional Office, and District Office. After completion of the construction works, the Committee will be dissolved.

The Project Construction Office will consist of Administration Section, Accounting Section, Supervision Section (1) and (2), Survey and Design Section, and Farmers' Participation Section. The Farmers' Participation Section will provide the farmers with technical guidance for sod facing, construction of small drains, and land levelling, in order to promote farmers' participation to the Project. The Office will be headed by a Project Director, and have 87 workers at the peak time.

5.3 O&M and Water Management Strengthening Plan

5.3.1 Basic Approach

The most important issues in O&M and water management for irrigated paddy cultivation are to secure timely and adequate water supply and also to keep the proper conditions of the canal facilities to enable such water supply at any time. In the Existing Lower Moshi Project Area, O&M and water management for the Project facilities are jointly undertaken by KADP and CHAWAMPU . The major problems envisaged as mentioned in Table 4.1, are 1) financial constrain, 2) need of strengthening of organisation and staff, 3) larger field water requirement, and 4) constant water shortage. These problems are discussed in Sections 4.5 to

4.7 of Chapter 4. The financial constrain will be coped with by establishing WUAs/WUF which have legal rights of compulsory affiliation of beneficiaries and compulsory collection of water charge. The organisations of KADP and CHAWAMPU will be strengthened stepwise stepwise. The field water requirement of paddy is re-estimated using the actual field measurement data. The constant water shortage will be settled through exploitation of new water sources. Accordingly, the strengthening plan of O&M and water management in this Project is formulated focusing on the intensification and improvement of O&M and water management activities, and also considering the handing-over of O&M and water management works to WUAs/WUF.

5.3.2 Operation and Water Management Strengthening Plans

The objectives of the operation and water management strengthening plan are to: 1) deliver water in a timely and equitable manner to all farmers in the Project Area so that they fairly share available supplies, and 2) as far as possible, adapt the irrigation schedule to the water demand. To achieve these objectives, it is necessary to make a well-established operation program particularly for the Project areas where water sources are limited.

(1) Water Distribution Method

As mentioned above, water supply for paddy is planned by combining the continuous supply and rotational supply systems in this Project. Water is supplied continuously down to tertiary canals. In the tertiary block, a rotational water supply is made. Paddy fields is to be irrigated by the basin method under which the fields will be continuously submerged with water. In principle, the water depth in paddy fields shall be maintained as shallow as possible, in order to avoid excessive percolation losses of water. The results of field investigation by KADC indicate that the percolation rate increases when the flooding depth is deeper than 60 mm as shown in the following figure. From this result, the basic application of irrigation water is proposed to be 60 mm in depth. The maximum allowable water depth should be set at 80 mm so as to utilise rainfall effectively.

Since the daily water consumption of paddy is 15 mm/day, the irrigation interval for paddy comes to 5 days at peak time (15 mm/day x 5 day = 75 mm), which is less than 80 mm.

Alfalfa as well as other upland crops will be supplied intermittently with irrigation water. The basin irrigation method is proposed for alfalfa, using a field plot for paddy although further field ridges are required for effective water use. The water supply amount at one time is calculated on the following conditions in this study:

- Effective root depth : 60 cm
- Soil moisture extraction pattern : Standard type (4 layers of 15 cm each)
- Available moisture : 10%

From these conditions, Total Readily Available Moisture (TRAM) is calculated at 56mm, which corresponds to the water amount supply at one time. Daily consumption use is computed at 6.6 mm/day at peak time. With this daily consumption use and TRAM mentioned above, the irrigation interval at peak time is calculated at 8.5 days. For easy operation of water supply and assuming that 40 % of the tertiary area is planted with alfalfa, it is proposed to apply

a 7-day irrigation interval at peak time and its multiple days at other growing stage, in the light of calendar week.

(2) Irrigation Schedule

Taking into account the expansion of the Project area and handing-over of the O&M and water management activities to farmers' organisations, the following procedure for formulating the irrigation schedule is proposed:

Formulation Procedure of Irrigation Schedule in each Stage

Items	1st Stage	2nd Stage
(a) Estimate of available water based on river discharge	KADP	WUA/WUF
(b) Determination of irrigation area	KADP	WUA/WUF
(c)Estimate of diversion requirement at headworks sites	KADP	WUA/WUF
(d) Preparation of draft irrigation schedule	KADP	WUA/WUF
(e) Approval of draft irrigation schedule	Joint Meeting	Joint Meeting
(f) Approval of final draft irrigation schedule	Implementation Committee	Implementation Committee
(g) Announcement of final irrigation schedule	RAS	RAS

(3) Headworks and Diversion Channel

The intake discharge from the Kikuletwa river is 9 m^3/s from December to May, and 5m^3/s from June to November. On the other hand, the monthly average river discharge at the proposed headworks site ranges from 20 m^3/s to 25 m^3/s during the 3 months of April to June, but becomes about 12 m^3/s in the remaining 8 months. Judging from such river discharge, 2 intake gates will be opened at half for 8 months from April to November, and fully for the remaining 3 months. Minor adjustment of gate opening will be made by observing the water level of the Kikuletwa river. As mentioned above, the intake discharge is only either 9 m^3/s or 5 m^3/s. In order to simplify the gate operation, it is proposed to paint two red marks corresponding to water levels of 5 m^3/s and 9 m^3/s, on the side wall of the Parshall flume

In the 12 km upstream portion of the channel, there are no branched-off canals except water facilities for domestic and livestock uses, therefore special water management is not required. In the downstream portion of 12 km, there are 5 off-taking sites on the diversion channel. These are System -A, System-B and System-C for the New Extension Area, and 2 off-taking sites for the existing Mabogini main canal and Rau Ya Kati main canal. At all these sites, diversion facilities with a measuring device, such as turnouts and bifurcation structure equipped with gates will be constructed. Discharge division will be therefore made using the gate(s) and measuring device in accordance with the irrigation calendar. Even after diversion of water required for irrigation, if there remains certain water in the diversion channel, it will be released into the Rau river.

(4) Irrigation Facilities

Canal system operation down to tertiary canals is planned under the normal and unusual condition as follows:

(a) Canal system operation under normal condition

The main, secondary and supply canals shall be operated by the nominated persons only such as water masters and gate keepers. The nominated persons shall set all the gates at proper positions according to the planned discharge. In an emergency case where canal flow overtops canal banks, gates of spillways shall be opened fully so that water in the canals is drained. When water levels of canals are too low to divert the required water amount at turnouts, the check gates shall be controlled adequately so that the diversion to secondary or tertiary canals could be maintained as per the irrigation schedule.

(b) Canal system operation under unusual condition

Unusual conditions such as the discrepancy of demand and supply, droughts, floods, and bank failures may occur from time to time during the long run of the operation works. Such conditions shall therefore be given special treatment.

(5) On-Farm Facilities

In the tertiary block, a rotational use of irrigation water is proposed for the following advantages:

- It can meet peak water requirements, especially in the land preparation period for paddy when more water supply is required in a short time period.
- Equitable water distribution can be made for all farm plots.
- Rotational irrigation will maximise effective rainfalls.

The tertiary block is divided into several irrigation units, so-called quaternary blocks. The quaternary block is defined as the area commanded by a watercourse. Rotational irrigation will be made by a combination of quaternary blocks. The irrigation period of a quaternary block can be decided based on the acreage of the commanding area of the watercourse.

5.3.3 Maintenance Plan

(1) Irrigation, Drainage and Rural Infrastructure

In parallel with proper operation, suitable and continuous maintenance of the headworks, diversion channel, irrigation and drainage facilities, and rural infrastructure facilities of the Project is indispensable to secure that the facilities function properly ad constantly and to ensure that the economic life of the facilities is realised. The maintenance works broadly consist of :

(a) Regular maintenance works which are performed regularly to maintain and improve the Project facilities;

(b) Periodic maintenance works which include repair of minor damages;

(c) Emergency repair works which include repair of occasional damage of the Project facilities caused by flood, heavy rainfall or other causes; and

(d) Annual maintenance which involves a large work quantity or requires special skills.

All these works will be checked and listed up through irrigation patrol. It is necessary to make daily patrol of canals and structures. Inspection for maintenance should also be made during the patrol. These items are tabulated below:

Inspection Items for Maintenance

Facilities	Items to be inspected by O&M patrol for maintenance
(a) Lined canal	Sinking and cracking of lining
(b) Unlined canal	Sloughing of slope, settlement of bank, erosion of canal bottom, piping in canal bank, silting and grasses in canal
(c) Structures	Silting in structure, cracking of structure
(d) Gates	Greasing of spindle and hoist, leakage through gate, staff gauge
(e) Trash rack	Floating debris
(f) Farm road	Road surface

(1) Regular Maintenance

The regular maintenance refers to the day to day maintenance of irrigation and drainage facilities to be carried out by regular workers of maintenance labor groups without needing skills. It includes routine repair of embankment, clearance of silt, weeding, filling of holes on the farm roads with earth and gravel, oiling gates, etc. Satisfactory implementation requires an intensive daily inspection of the headworks, canals and appurtenant structures as well. Daily reports on regular maintenance should be prepared by the inspectors concerned and submitted to the relevant sections of KADP and WUAs.

Maintenance groups consisting of 3 to 4 labors each are to be assigned to the daily maintenance work for up 3 km to 5 km of canal per day. A weekly schedule and a reasonable length of canal can be assigned to each group referring to the hectometer stones provided in field.

(2) Periodic Maintenance

The periodic maintenance is defined as the repair of minor damage which does not cause immediate danger or malfunction to the canal system and which needs special skills to repair the damage . The periodic maintenance will be carried out by skilled workers and/or mechanics. Minor improvements to the existing facilities of the systems are also included in the periodic maintenance. The periodic maintenance report will be prepared and submitted to the relevant sections of KADP and WUAs.

(3) Emergency Repair

Damage to the Project facilities will hamper the normal practices of irrigation. Therefore, repair of damaged facilities should be quickly and effectively carried out under the category of the emergency repair. The damage to the Project facilities may result from flood, heavy rainfall, violation acts, and destruction by animals and vehicles.

(4) Annual Maintenance

Maintenance works which involve a large work quantity or require special skills should be carried out under the category of annual maintenance. These works are executed based on the annual maintenance program which will be prepared by the O&M Sub-section using reports submitted.

5.3.4 O&M Equipment

An internal network will support the management and operation of the commissioned canal system. For this purpose, an internal radio-communication network will be installed connecting the O&M Office with control house of the Kikuletwa headworks and the Water Users' Association Office. In addition, for the regular maintenance, periodic maintenance and annual maintenance, a certain number of construction equipment will be required and kept at the O&M Office. In addition to this construction equipment, vehicles, motorcycles and bicycles will be required for the staff movement for the operation and maintenance purposes.

Required O&M Equipment

O&M Equipment	Specifications	Quantity (no./nos.)
(a) Backhoe	0.4 m3	1
(b) Bulldozer	12-ton, Swampy type	1
(c) Motor grader	3.1 m	1
(d) Tire roller	8 - 20-ton	1
(e) Dump truck	6-ton	2
(f) Pickup truck	2-ton	2
(g) Cargo truck	6-ton	1
(h) Truck with crane	4-ton/2-ton	1
(i) Vehicles (4 wheel drive)	4WD/3000cc	4
(j) Motorcycle	125 cc	15
(k) Bicycle	-	50
(l) Repairing tools	-	One set
(m) Radio-communication system		One set
(n) Computer system	-	One set
(o) Spare parts	-	One set

5.3.5 Monitoring and Data Collection

For ensuring the effective use of the limited water sources and for maintaining the Project facilities in the maximum workable condition, an elaborated O&M manual is of a paramount importance. In the Existing Lower Moshi Project, there is an Operation and Maintenance Manual for Project Facilities prepared in April 1985. However, this Manual will require revision and updating because the Project scale is totally different and also circumstances around the Project have largely changed. For the revision and updating of the Manual, various data should be monitored and collected through the actual operation and maintenance work. In order to cope with a huge volume of data collected, it is essential to establish computer files in the O&M Office. Such data will be not only stored systematically, but also can be retrieved easily and conveniently . Studies, evaluation and improvement plans will greatly be benefited by the use of computer files.

IDC5 and IDC35 are old discharge measurement stations installed on the Rau and Njoro rivers, respectively. The discharge observation at IDC5 and IDC35 was discontinued in 1960 and 1980. As these data are very important for discharge analysis, it is proposed to re-start the discharge observation urgently.

CHAPTER 6 PROJECT COST ESTIMATE

6.1 Basic Conditions and Assumption for Cost Estimate

The following basic conditions and assumptions are used for estimating the Project cost taking into consideration the construction method, productivity of labour and construction machinery.

(1) The Project cost comprises direct construction cost, procurement cost of O&M equipment, administration expenses, engineering services, physical contingency, and price contingency.

(2) The unit prices are estimated based on the 1997 prices, and the exchange rate used is US$1.00 = Tsh.620 = ¥125.

(3) Construction works will be executed on a full contract basis through international competitive bidding.

(4) The unit prices comprise foreign currency and local currency portions. The local currency portion is estimated on the basis of the current prices in 1997 in the Kilimanjaro Region (Moshi city). The foreign currency portion is estimated based on CIF (cost, insurance and freight) prices at Tanga, making reference to FOB (free on board) prices of materials and equipment in Japan in 1997.

(5) Compensation is not considered for land acquisition and right-of-way for the Project facilities.

(6) The engineering services cost is estimated based on the Project implementation schedule.

(7) Physical contingency for the variation of work quantities is assumed to be 10% of the direct construction cost, procurement cost of O&M equipment, administration cost, and engineering services cost.

(8) Price contingency is estimated based on the annual escalation rate of 3% for the foreign currency portion and 17% for the local currency portion.

6.2 Cost Estimate

The total Project cost is estimated at US$ 53.6 million as summarised below. The breakdown of the total Project cost is given in Table 6.1.

Summary of Project Cost

Work Description	Foreign Currency (US$1,000)	Local Currency (Tsh million)	Total (US$1,000)
(a) Phase-I Works			
- Headworks	2,597	429	3,289
- Diversion Channel	8,454	1,485	10,850
- Existing Lower Moshi Area	3,434	892	4,874
Sub-total of (a)	14,485	2,806	19,013
(b) Phase-II Works			
- Extension Area and Expanded Area	11,388	2,616	15,606
Sub-total of (b)	11,388	2,616	15,606
(c) O&M Equipment	1,000	–	1,000
(d) Administration Expenses	–	521	841
(e) Engineering Services	3,629	562	4,536
Sub-total of (a) to (e)	30,502	6,505	40,996
(f) Physical Contingency	3,050	651	4,100
(g) Price Contingency	2,506	3,736	8,533
(h) Total	36,058	10,892	53,629

6.3 Annual Disbursement Schedule

The annual disbursement schedule is worked out on the basis of the construction schedule as summarised below:

Annual Disbursement Schedule

(Unit: US$1,000)

Description	FY1998	FY1999	FY2000	FY2001	FY2002	FY2003
(a) Construction Works	0	10,055	8,958	6,531	5,018	4,058
(b) O&M Equipment	0	0	500	0	0	500
(c) Administration Expenses	140	140	140	140	140	141
(d) Engineering Services	570	1,140	1,140	562	562	562
(e) Physical Contingency	71	1,134	1,074	723	572	526
(f) Price Contingency	0	812	1,645	1,946	2,061	2,069
Total	781	13,281	13,457	9,902	8,353	7,855

6.4 O&M Cost

As mentioned previously, the O&M works will be jointly executed by KADP and farmers' organisations. At first, KADP will conduct the O&M works for all the Project facilities except the tertiary canal system and on-farm works (1st stage). And then, the O&M works except the headworks, diversion channel and related structures, will be handed over to the farmers' organisations (2nd stage). The O&M cost is therefore estimated based on such handing-over schedule, say about 5 years after completion of all the Project facilities.

O&M Cost

(Unit: Tsh. million)

Item	1st Stage		2nd Stage	
	KADP	Farmers' Organisations	KADP	Farmers' organisation
Salary of Project Staff	40.7	-	9.6	12.1
Office Running Cost	22.3	-	11.1	3.7
O&M Equipment	29.0	-	2.9	26.1
Labour Cost	2.9	4.1	0.2	5.0
Materials Cost	1.4	1.5	0.4	1.9
Total	96.3	5.6	24.2	48.8
Total for each stage	101.9 (US$164,400)=US$35/ha		73.0 (US$117,700)=US$25/ha	

6.5 Replacement Cost

Some of the facilities such as gates and screens of headworks and irrigation related structures have a shorter life than civil works and have to be replaced periodically. The useful life and costs of replacement of such facilities are estimated as follows:

Useful Life and Replacement Cost

Description	Useful Life (year)	Replacement Cost (US$ 1000)	Remarks
(1) O&M Equipment			
- Existing Lower Moshi Project Area	10	500	O&M equipment
- Expanded and New Extension Areas	10	500	O&M equipment
(2) Gates and Other Metal Works			
- Headworks	25	210	Gates and screens
- Diversion Channel	25	1,000	Gates and steel pipes
- Existing Lower Moshi Project Area	*20	500	Gates and screens
- Expanded and New Extension Areas	25	500	Gates and screens

**: The first replacement only will be made after 20 years, but subsequent ones after 25 years.*

6.6 Water Charge

The O&M cost and replacement cost of O&M equipment will be collected from the beneficial farmers as a water charge, which will be used for operation, maintenance and management of the Project. The replacement cost of O&M equipment is estimated at US$ 40 /ha. Thus, the water charge comes to US$ 75 /ha at the 1st stage and US$ 65 /ha at the 2nd stage.

CHAPTER 7 PROJECT EVALUATION

7.1 Economic and Financial Evaluations

7.1.1 Basic Conditions for Evaluation

Basic conditions for economic evaluation are as follows:

(1) The economic life of the Project is 50 years.

(2) All prices are expressed in 1997 constant prices.

(3) The exchange rate of US$ 1.00 = Tsh. 620 =¥ 125 is applied.

(4) The construction period is 6 years including one year for the preparatory works, detailed design, and tendering and tender evaluation.

(5) Only the economic benefit from crop production is taken into account in the economic evaluation, and that generated by livestock production, etc.are not included in the evaluation.

(6) The construction cost conversion factor is 0.8.

(7) The shadow price of labour work used for evaluation is 75% of the market price.

(8) The O&M cost is estimated at US$ 35/ha for the first 5 years and US$ 25/ha thereafter. The water charge to be collected from the beneficial farmers is estimated at US$ 75/ha for the first 5 years and US$ 65/ha thereafter.

7.1.2 Economic Benefit

The direct benefit expected to be generated in the Project Area is derived from the increased crop production as a result of stable irrigation water supply. The balance of total amount of economic net return obtained from crop production between the future "With Project" and "Without Project" conditions represents the direct benefit. The benefit is expected to increase year by year after the completion of the irrigation project. The anticipated incremental benefits for the Existing Lower Moshi Project Area, New Extension Area and Expanded Area are summarised below.

Incremental Benefits for Each Area

(Unit: US$1000)

Area	Without Project Condition	With Project Condition	Incremental Benefit
(a) Whole Project Area (4,700 ha)	1,065	7,654	6,589
(b) Existing Lower Moshi Project Area (2,150 ha)	819	3,537	2,718
(c) New Extension Area and Expanded Area (2,550 ha)	246	4,117	3,871

7.1.3 Economic Cost

The Project cost consists of direct construction cost, procurement cost of O & M equipment, engineering services cost, administration expenses, and physical contingency. The financial construction costs are converted into economic construction costs by applying a construction conversion factor (CCF) of 0.8. For the economic evaluation purpose, the costs

for the head works, diversion channel, and trunk road, are allocated to the Existing Lower Moshi Project Area and the New extension Area on an areal basis, because these areas will be directly supplied with water from the Kikuletwa river. The economic capital cost is summarised as follows, details of which are given in Table 7.1.

Economic Capital Cost

(Unit: US$ 1,000)

Area/Items	Direct Const-ruction Cost	O & M Equipment	Engineering Services	Administration Expense	Physical Contingency	Total
(a) Whole Project Area	27,695	1,000	4,536	841	3,407	37,479
(b) Existing Lower Moshi Project Area	9,027	500	2,075	385	1,199	13,186
(c) New Extension Area and Expanded Area	18,668	500	2,461	456	2,208	24,293

7.1.4 Economic Evaluation

The economic internal rate of return (EIRR) is calculated on the basis of the flows of economic benefits and costs individually for the whole Project, Existing Lower Moshi Project Area, and New Extension Area combined with the Expanded Area. The results are summarised below:

Estimated EIRR

Case	Description	EIRR (%)
(a) Case -1:	Whole Project Area (4,700 ha)	13.4
(b) Case -2:	Existing Lower Moshi Project Area (2,150 ha)	17.2
(c) Case -3:	New Extension Area and Expanded Area(2,550 ha)	11.2

The evaluation results show that the whole Project is judged to be economically feasible with an EIRR of 13.4 %. The Existing Lower Moshi Project Area has the highest EIRR of 17.2 % followed by the whole Project Area. Even EIRR for the New Extension Area combined with the Expanded Area is still within the feasible range.

7.1.5 Sensitivity Analysis

A sensitivity analysis for each area individually and for the whole area is conducted to evaluate the soundness of the Project against unexpected adverse changes in the future in the following cases:

(1) The Project cost runs over the price and physical contingencies by 10%

(2) The market prices of crops decrease by 10%

(3) Combination of (1) and (2)

The analysis results indicate that the effects of these changes on EIRR are as follows:

Results of Sensitivity Analysis

Case	Existing Lower Moshi Project Area	New Extension Area and Expanded Area	Whole Project Area
(a) 10% increase of cost	15.7 %	10.3 %	12.0 %
(b) 10% decrease of benefit	15.5 %	10.2 %	12.2 %
(c) Combination of (a) and (b)	14.6 %	9.4 %	11.2 %

The above results indicate that the Project even under the most severe case of cost increase and benefit decrease, presents an EIRR of 11.2 %, and is thus proved to be rather insensitive to the adverse changes .

7.1.6 Financial Evaluation

(1) Cash Flow Statement Analysis

The financial sustainability of the Project was assessed using a cash flow statement analysis which presents the financial soundness of the Project by comparing all revenues collected from the benificial farmers with the fund requiement for the project operation. For the assessment, the following assumptions have been applied:

(a) The capital funds of the project works and tractor hiring services will be arranged by the Government of Tanzania.

(b) The cash flow statement analysis was prepared from the viewpoint of CHAWAMPU.

(c) Revenue sources for the project operation are:1) annual water charge of Tsh.46,500/ha (US$ 75) in the 1st stage and Tsh.40,300/ha (US$ 65), and 2) tractor hiring services fees of Tsh.50,000/ha for paddy cultivation and Tsh.12,500/ha for alfalfal cultivation. The water charge consists of replacement cost and O & M cost of the project facilities including O & M equipment, administration cost, etc. as shown in Clause 6.4. The tractor hiring service fees includes the O & M cost and replacement cost of tractors.

On the basis of these assumptions, the cash flow statement of the project implementation and operation stages was tabulated as shown in Table 7.2. The results of the analysis indicated that the anticipated revenues collected from the beneficial farmers would be able to provide sufficient funds for O & M cost and replacement cost of O & M equipment and tractors for the Project, and thus the financial sustainability of the Project for CHWAMPU.

(2) Farm Budget Analysis and Capacity to Pay

The payment capacity is defined as the ability of the beneficiary farmers to bear the expenses required for operation and maintenance of the Project facilities. The analysis results for respective cases are summarised in the following table.

Results of Farm Budget Analysis

(Unit:Tsh.)

Description	Ex Lower Moshi Project Area			Expanded Area			New Extension Area		
	Marginal 0.5 ha	Small 1.5 ha	Medium 3.0 ha	Marginal 0.5 ha	Small 1.5 ha	Medium 3.0 ha	Marginal 0.5 ha	Small 1.5 ha	Medium 3.0 ha
(1) Income Structure									
(a) Net farm crop income									
- Gross farm income	885,500	2,656,500	5,313,000	819,900	2,459,600	4,919,300	885,500	2,656,500	5,313,000
- Production cost*	237,600	712,800	1,425,500	231,200	693,600	1,387,300	237,600	712,800	1,425,500
- Net farm crop income	647,900	1,943,700	3,887,500	588,700	1,766,000	3,532,000	647,900	1,943,700	3,887,500
(b) Livestock income	99,600	83,000	66,400	213,600	178,000	142,400	51,600	43,000	34,400
(c) Homestead income	12,500	12,500	12,500	61,000	61,000	61,000	35,000	35,000	35,000
(d) Non-farm income	290,000	130,000	0	250,000	221,000	0	290,000	153,600	0
(e) Household income	1,050,000	2,169,200	3,966,400	1,113,300	2,226,000	3,735,400	1,024,500	2,174,700	3,956,900
(2) Living Expenditure	854,000	915,800	1,089,900	950,000	1,078,000	1,293,600	872,000	1,003,000	1,203,600
(3) Net Reserve	196,000	1,253,400	2,876,500	163,600	1,148,000	2,441,800	152,500	1,171,700	2,753,300
- in US$	316	2,022	4,640	263	1,852	3,938	246	1,890	4,441
(4) Water Charge	23,250	69,750	139,500	23,250	69,750	139,500	23,250	69,750	139,500
- in US$	38	113	225	38	113	225	38	113	225
(5) Payment Ratio(4/5)	12 %	6 %	5 %	14 %	6 %	6 %	15 %	6 %	5 %
(6) Balance	172,750	1,183,650	2,737,000	140,050	1,078,250	2,302,300	129,250	1,101,950	2,613,800
- in US$	279	1,909	4,415	226	1,739	3,713	208	1,777	4,216

*: *Production cost consists of farm inputs cost, chemicals cost, labour cost, O&M costs of tractors.*

The analysis result shows that even the marginal farmers with land holding of 0.5 ha in the New Extension Area will have a substantial amount of reserve to pay O&M costs. The estimated per farm household income is US$ 1,650 (Tsh one million) for farmers with land holding of 0.5 ha which is largely higher than US$ 310 of the averaged income mentioned in Section 3.6. Deducting the living expenditure, the capacity to pay is estimated at US$ 246 to US$ 316 for marginal farmers, US$ 1,852 to US$ 2,022 for small farmers, and more than US$ 3,938 for medium farmers. The payment ratio ranges from 4 % to 15% of net reserve, and comes to about 6 % in average as a whole since the average farm size in the whole Project Area is about 1.5 ha. From this analysis, it is clear that the water charge including O & M cost could be covered even by the marginal farmers and would not represent a heavy financial burden.

7.2 Indirect Benefits and Impacts of the Project

There are various intangible benefits expected from the implementation of the Project. Major impacts expected after the implementation of the Project are described below.

(1) Technical Impacts

(a) Improvement of farm roads and village roads in the Project Area

Local transportation will be improved by the construction of the farm roads along the canals and improvement of village roads. In particular, the inspection road along the diversion channel will play an important role to connect the presently isolated western part of the Project Area with the Moshi urban area. Besides, the social and economic activities in the eastern part of the Project Area will be much improved by the construction of bridges on the Rau and Njoro rivers.

(b) Improvement of the domestic water supply condition

It is planned under the Project to provide canal water supply facilities for domestic and livestock uses. After completion of these facilities, the farmers in the Project Area will obtain stable water supply, which will lead to improvement of the rural sanitary situation and prevention of sickness for farmers and livestock.

(c) Demonstration effect to other similar projects

The successful implementation of the Project including operation, maintenance and water management, will have a demonstration effect to other similar irrigation projects. Especially, technical knowledge on operation, maintenance and water management for irrigated paddy cultivation can be transferred to other relevant staff.

(2) Social Impacts

(a) Improvement of living conditions

The development of irrigation, drainage, farm roads and rural infrastructure under the Project will contribute to increase farmers' income and ultimately to improve their living conditions.

(b) Increase of employment opportunities

The Project will generate employment opportunities during the construction period. Farmers will gain more experience, technical know-how, and skills in various working fields. Those know-how and skills could be applied effectively to the future development in the region as well as to O&M activities under the Project. In addition the Project will create a demand for farm labour due to increased farming activities with double cropping of paddy and intensification of land use.

(c) Contribution to National Food Security

The Project will increase paddy production from about 7,700 tons at present to 46,700 tons after its compleiton, which will contribute to regional as well as national food security. In addition, since GOT imported about 50,000 tons of rice in 1994 and still continues to import rice at a similar level, the large increase in rice production by the Project will be conducive to saving of foreign currency, and contribute to the national economy.

(d) Enpowerment of Women

The Project will improve the agricultural production condition and consequently increase farmers' income. Such income increase will enable women to have time to participate in activities related to education, culture, leisure, etc, which will elevate their social standing.

CHAPTER 8 ENVIRONMENTAL CONSERVATION PLAN

8.1 General

The environmental conservation plan for the Project aims first at prevention and mitigation of the negative impacts on environment predicted under the EIA study, in order to preserve at least social welfare levels without the Project in and around the Project Area. Secondary, it intends to conserve in mid- and long-terms the existing environmental resources which have contributed to living of local people. Thus, the final goal of the plan is to establish an environmental framework for sustainable development of the Project.

The plan for environmental conservation of the Project consists of preventive/mitigative measures and monitoring works, which were proposed in the EIA Report formulated in December 1997 as described in Section 3.12. Technical and institutional aspects of the conservation plan are briefly summarised in this section.

Preventive/mitigative measures and monitoring are to be taken for 5 and 13 environmental items respectively. The items subject to monitoring include those, on which significant adverse impacts had not been identified during the EIA study although their future situation is to be regularly checked for long-term environmental sustainability and conservation of the sites in and out of the Project Area i.e. six ecological regions.

8.2 Preventive/Mitigative Measures against Environmental Impacts

8.2.1 Social Environment

(1) Involuntary Resettlement (Ecological Region 3 during construction)

The Project is to assist in locating technically suitable places for building houses. Secondly, it should give technical assistance in demolishing, transporting new and old building materials required for erecting the new structures.

(2) Population Increase and Drastic Change in Population Composition (Ecological Region 1 during construction and operation, and Ecological Region 3 during construction)

The mitigation measures to cope with the increase in the population are adequate if implemented as specified. They are detailed in the rural infrastructure development plan, water management plan, operation and maintenance plan, and the strengthening plan of executing agencies and farmers organisations, even through the planning stage as well.

(3) Outbreak of Endemic Diseases and Prevalence of Epidemic Diseases (Ecological Region 1 during operation)

One of the important measures to eradicate or reduce the prevalence of diseases in irrigation schemes, is to diagnose and to treat the already sick people. This situation will minimise or curtail the transmission route of diseases. It is only recently that safe, effective and low-cost drugs have become available for treatment of all types of schistosomiasis like

oxamniquine, praziquantel, and metrifonate. These drugs can be given to endemic communities with medical supervision by paramedical personnel. The following measures are not only for schistosomiasis and malaria, but also for diarrhoea diseases, intestinal worms, etc.

(4) Increase in Domestic and Other Human Wastes (Ecological Region 1 during operation)

Prior to the Project operation, a study on proper and cheap waste handling and disposal should be conducted. The best solution for solid waste disposal could be through waste recycling in the form of composting of husks to obtain organic manure which can be used in the farms. Similarly recycling of rice husks can be done by making briquettes which might be used as a source of fuel for domestic use.

8.2.2 Natural Environment

(1) Proliferation of Hazardous Species (Ecological Region 2 during construction)

Prior to the construction stage, technical measures to avoid crocodile proliferation should be taken into consideration. Construction of the diversion channel should be in such a way that there is a physical barrier to prevent crocodiles from coming into the channel. Dissemination of information on risks from crocodiles will be necessary.

8.3 Environmental Monitoring

Environmental monitoring is intended to provide constant feedback on the effectiveness of the mitigation measures instituted, to identify and define any problems encountered, and to provide the opportunity to adjust the approach to mitigation in a timely fashion. This will lead to an enhanced understanding of the impact of the Project on the environment and allow more effective planning and implementation of future projects. Outlined frameworks for monitoring of the different environmental items are presented below.

8.3.1 Social Environment

(1) Involuntary Resettlement (Ecological Region 3 during operation)

During the operation stage, the affected people should be monitored for the early years of the implementation to see whether there is no undue suffering because of the Project, compared with other Project beneficiaries.

(2) Conflict among Communities and People (Ecological Regions 1, 3 and 4 during operation)

The Project should monitor that the farmers who will be allocated the paddy field are the ones who were the original owners of the farms and their names were included in the list of traditional farm owners. Second, the efficiency of institutions vested with operation and management of the Project should be monitored regularly. Any deficiencies should be corrected at once to avoid conflicts among farmers.

(3) Population Increase and Drastic Change in Population Composition (Ecological Regions 1 and 3 during construction and operation)

The impact of population change in number and composition should be carefully monitored, and it will be checked whether the proposed mitigation measures are properly implemented.

(4) Adjustment of Water/Fishing Rights (Ecological Regions 1, 2,4 and 6 during operation)

Monitoring should be done to make sure that there is an adherence to water rights requirement, and that there is enough water downstream so as not to invade formerly existing water/fishing rights. If there are deficiencies, adjustment of these rights should be made, possibly by reducing the amount of water taken for the Project area.

(5) Increased Use and Residual Toxicity of Agro-chemicals (Ecological Regions 5 and 6 during operation)

The agro-chemicals to be applied are to be tested to check their biological degradation in the environment and the properties imparted in the soil, e.g. acidity/alkalinity properties, etc. The levels of agro-chemical elements in rivers, drainage channels and the Nyumba ya Mungu reservoir are to be monitored

(6) Outbreak of Endemic Diseases and Prevalence of Epidemic Diseases (Ecological Regions 1 and 3 during operation)

Monitoring of the designed parameters such as affected snails should be done continuously in order to avoid any malfunctioning which could result in health jeopardy. It should be noted that complex drainage of low-lying areas may be required for effective control even though it may not be necessary for agricultural purposes. Monitoring of this aspect should be done. Moreover, it is proposed to monitor the impact of diseases on school children and farmers continuously at chosen times.

(7) Increase in Domestic and Other Human Wastes (Ecological Regions 1 and 3 during operation)

The Project executing agency, in collaboration with the health authorities, should be responsible for following up the sanitation condition of the Project area. Specific issues to follow up are reuse or disposal of rice husks, other crop residuals, and waste in a sanitary manner, and construction of excreta disposal facilities.

8.3.2 Natural Environment

(1) Impact on Important Fauna and Flora, and Degradation of Ecosystem (Ecological Region 3 during construction, and Ecological Region 6 during operation)

With regard to fishery in Nyumba ya Mungu reservoir, the migration pattern of three species of fish, namely *Barbus sp.*, *Labeo sp.* and *Clarias mossambicus*, whose breeding is

known to be probably associated with flow regimes in the affluent rivers and streams, will be monitored. The fish population in the reservoir is also to be monitored.

(2) Proliferation of Hazardous Species (Ecological Regions 3 and 4 during operation)

The trend of change in crocodile population and attack on people and livestock will be monitored. Also the intrusion of crocodiles into the channel from the new headworks will be monitored.

(3) Soil Erosion (Ecological Region 3 during operation)

Soil erosion should be carefully monitored along hilly parts of the diversion channel route during the operation stage. Then if there are some problems, appropriate actions should be taken to control soil erosion. Some areas which are more sensitive to erosion can be completely restricted.

(4) Soil Salinisation (Ecological Region 1 during operation)

The applied agro-chemicals are to be tested to check their biological degradation in the environment and the properties imparted in the soil, e.g. acidity/alkalinity properties, salinity, etc. The salinity levels in soils in and around the Project area should be monitored.

(5) Changes in Surface Water Hydrology (Ecological Region 4 during operation)

Although no environmental impacts are anticipated from abstraction of water from the Kikuletwa river, there is still a need to monitor flows in rivers in the Project sites and levels of water in the Nyumba Ya Mungu reservoir. Most stress must go to the downstream reaches of the Kikuletwa river up to the reservoir. But it should be taken into account that there are possibilities of changes in surface hydrology as a result of natural factors, especially weather conditions.

(6) Water Pollution and Eutrophication (Ecological Region 6 during operation)

The results of water quality laboratory analysis and of the prediction by Streeter-Phelps model during the EIA study have ruled out the possibility of significant impact on water quality downstream of the Project area including the Nyumba Ya Mange reservoir. However, there is still a need to monitor water quality changes to accommodate any unforeseen anthropogenic and natural changes that may affect the water quality and fishery activities.

8.4 Institutional Aspect for Planning and Implementation

The Environmental Management and Monitoring Plan (EMMP) is required to realise the countermeasures described above in an integrated way for ensuring environmental sustainability of the Project. It is proposed to incorporate a section called "Environmental Management Unit" (EMU), into the organisation set-up of the Project executing agency. The responsibilities of the proposed Unit will be to formulate and implement an environmental management and monitoring plan, based on the EIA report for this Project (refer to ANNEX-I). Its proposals and recommendations for countermeasures and monitoring will be a blue print for the preparation of the EMMP.

EMU should work in close collaboration with all stakeholders in environmental issues pertaining to the Project including government agencies. The Unit should therefore liaise with government authorities related to its activities. These are :

(1) National Environment Management Council (NEMC),

(2) Environment Division, Vice President's Office,

(3) Environment Unit, Irrigation Department, Ministry of Agriculture and Co-operatives, and

(4) Natural Resources Regional Office of Kilimanjaro

8.5 Environmental Conservation Measures Proposed in the Development Plan

The following are plans or measures friendly to environmental conservation which are already built in the other plans except for the environmental conservation plan, under the current JICA Feasibility Study.

(1) To Prevent Negative Social Impacts on Local Communities

(a) The proposed institutional development plan shall take a stagewise approach. The first stage is a preparatory period for handing over the responsibility for the management of the Project to farmers' organisations. In the second stage, the water management, O&M activities, and agricultural machinery service, etc. shall be handed over to farmers' organisations after full completion of the preparatory period. A stagewise introduction of such new organisations is proposed because of the limitation of manpower resources for the immediate organisation and in order to avoid confusion among farmers.

(b) KADP shall take more progressive and substantial activities during the first stage for managing and operating the Project, particularly in terms of O&M of irrigation facilities, agricultural supporting activities and strengthening of farmers' organisations including CHAWAMPU. In order to undertake the above, the existing KADP's organisation shall be strengthened in terms of its organisational structure and staffing.

(c) The financial, organisational and human structures of CHAWAMPU shall be strengthened/developed so as it can take over the management of the Project through solving the problems it is faced now.

(d) To ensure equal distribution of project benefit to all the Project Area, the same cropping pattern will be introduced to the Existing Lower Moshi Project Area, Expanded Area, and New Extension Area.

(e) Over 90% of the areas categorised as grassland/grazing land and utilised for grazing purpose in the southern part of the Study Area will be excluded from the Project Area.

(2) To Minimise Adverse Impacts of Application of Agro-chemicals on Water Quality

(a) The proposed verification trials include variety adaptability trials, fertilisation trials, and trials on cultivation practices, etc.

(b) The Project respects the location of the proposed site of the oxidation pond in the urban development plan of Moshi Municipality.

(c) It is planned to closely cooperate with research institutes such as KATRIN for the development of practices for controlling possible pests and diseases in and around the Project Area.

(3) To Conserve and Protect Land against Soil Salination

(a) It is planned to exclude from the Project Area strongly salt affected areas covered with Eutric Combisols, Saline/Sodic Phase which are assessed currently not suitable for irrigation farming.

(b) In the cropping pattern under the Project, the cultivation of rice and alfalfa as a soil amelioration crop is proposed in accordance with the basic concepts for agriculture development.

(4) To Solve Solid Waste Problems

The requirements of small scale rice mills in the Project Area are identified to handle the increasing rice consumption in the Area. After the development and operation of KPHC under the Project, appropriate methods will be examined for this issue on post-harvest facilities.

(5) To Minimise or Prevent Water-born Diseases and Harmful Species

(a) In order to avoid the possibility of crocodiles being carried away to the main canals, the headworks will be provided with barriers like wire-mesh and fence along the first part of the diversion channel.

(b) Proposed canal cleaning will increase the water velocities and destroy snail's habitation and mosquito breeding sites. The channels will be lined for prevention of weeds growing. The conveyance efficiency of lined canals is 97% to 98% and that of unlined canals is 90%. This indicates that possible ponding might occur in the case of unlined canals and therefore causes a health jeopardy.

(c) Field drains are responsible for the existence of vectors of diseases particularly bilharzia snails and malaria mosquitoes. They are therefore to be designed in such a way that they convey the water fast enough without causing ponding. The design velocities above 0.65 m/s are recommended.

(6) To Improve Living Standards of Local Societies

(a) The development concept of the rural infrastructure in the Project Area is to aim at improving the social environmental and elevating living quality. In the Project development plan, a farm road with a length of 24 km between the headworks and the irrigation area will be provided and farm roads in the Existing Lower Moshi Project Area will be rehabilitated and new farm roads networks will be established in the Expanded and New Extension Areas.

(b) The objectives of development of rural infrastructure are also targeted to the development of domestic water supply.

CHAPTER 9 WOMEN IN DEVELOPMENT

9.1 Changes Expected to Occur to Women after Project Implementation

Major changes expected are increase of paddy production, change of upland crop cultivation to rice production, and improvement of rural infrastructure. These changes can effect women development from both social and economic aspects.

(1) Social Aspect

(a) Improving living standard of women in particular and community in general,

(b) Changing negative attitudes towards women,

(c) Reduced women workload through application of appropriate technology and improvement of rural infrastructure, and

(d) Adequate water supply for both domestic and irrigation purposes

(2) Economic Aspect

(a) Increase of income enabling women to have purchasing power to meet their daily family needs, and

(b) Effective participation of women in the Project and increase of food production.

9.2 Women Development Plan

(1) Objectives of Women Development Plan

Women are vital and play an important role in society in bringing up development. The plan for women development is designed purposely to emancipate women from oppressions and discriminations and enable them to participate effectively to the implementation of the Project, especially putting a focus on 1) the drawing up of priorities and strategies in order to reduce women's heavy workload, to eliminate all forms of discrimination against women, and to empower women socially and economically, 2) ensuring of full participation and involvement of women in the Project activities, 3) identifying of obstacles hindering women development, and 4) to propose measures/solution to combat them.

(2) Priorities and Strategies

Priorities and strategies of the women development plan are shown in Table 9.1.

CHAPTER 10 SMALL-SCALE HYDROPOWER DEVELOPMENT PLAN

10.1 Background

The irrigation water abstracted from the Kikuletwa river will be carried to the irrigation command area through a diversion channel. The intake water level is set at EL.813.9 m at the headworks, the required water level in the command area is estimated to be EL.746.0 m, and the head between the intaked water level and the required water level in the command area is 68 m. The diversion channel will have a total length of approximately 24 km, of which 12 km pass through a gently sloped tableland (highland area) with a ground elevation from EL.840.0 m to EL.760.0 m. The channel route in the highland area will have two steep slope portions, and the head between them is estimated to be approximately 45 m in total. A chute structure is planned to be applied for these portions and the energy head of about 45 m would be dissipated without any use.

On the other hand, since the Kilimanjaro Region is situated at the end of the interconnected power system, it frequently suffers from voltage fluctuations and transmission line faults. In other words, the power supply to the Region is not enough and stable. In order to secure stable power supply to meet the increasing power demand, it is necessary to reinforce the power supply sources within the Region. From this point of view, it is proposed to implement a hydropower scheme utilising the water head created by the diversion channel mentioned above.

The electric power generation using the water head of the diversion channel would be very advantageous, not only to the Project but also to the socio-economy of the surrounding areas. The generated electricity is planned to be sent to the national grid of TANESCO. Electric charges obtained through TANESCO will be used for O&M activities under the Project. In addition, this electricity generation is much attractive for the habitants in the Project Area, especially in the sense that it will help raise their living standard and public welfare.

10.2 Development Scale

(1) Power Station Sites

The power stations to be constructed on the route of the diversion channel are determined through the site reconnaissance and considering the topographic and geological conditions. The No.1 Power Station is proposed station to be located in the upstream channel portion (5.4 km) and the No.2 Power Station in the downstream portion (11.7 km).

(2) Power Station Components

The proposed both power stations will be composed of intake and headrace, head tank, penstock, powerhouse, generating equipment, outdoor swichyard, tailrace and transmission line.

(3) Development Scale

The firm output at the time of firm discharge is calculated at 797 kW for the No.1 Power Station and 2,399 kW for the No.2 Power Station, using the following equation:

$$P=9.8 \times Q \times H \times E$$

where,
P: firm output (kW)
Q: firm discharge (m^3/s)
H: effective head (m)
E: total generating efficiency (0.8)

(4) Hydropower Facilities Plan

The hydropower facilities will consist of penstock, powerhouse, electro-mechanical equipment, main circuit and outdoor switchyard. The general features of the No.1 and No.2 Power Stations are summarised below:

General Features of No.1 and No.2 Power Stations

Description	No.1 Power Station	No.2 Power Station
(a) Hydraulic conditions		
- Firm discharge (m^3/s)	9.0	9.0
- Water level. at head tank (m)	808.00	789.30
- Water level at tailrace (m)	796.55	755.50
- Effective head (m)	11.3	34.0
(b) Penstock		
- Diameter (mm)	1,800	1,800
- Length (m)	10.0	65.0
(c) Electro-mechanical equipment		
- Turbine		
Type/No.	S-type tubular/1	Francis/1
Rated capacity (kW)	790	2,390
- Generator		
Type/No.	3-p, synchronise/1	3-p, synchronise/1
Capacity (kVA)	920	2,800
- Main transformer		
Type/No.	Outdoor, 3P/1	Self-cooled/1
Capacity (kVA)	920	2,800
Rated voltage (kVA)	11/33	11/33
- Transmission line		
Voltage (kV)	11/33	11/33
Length to Kiyungi Substation	8 km	3 km

10.3 Construction Plan

The No.1 Power Station is planned to be consructed in Phase-II first and followed by the No.2 Power Station in Phase-I, respectively, taking into account early accrual of benefits

and impact of rural economy. The required construction period will be 1.5 years for the No. 1 Power Station and 2 years for the No.2 Power Station.

10.4 O & M Plan

(1) Operation Plan

Operation of the proposed power stations shall be conducted in accordance with the operation rule for small scale hydropower plants. In the operation, however, careful attention shall be paid on the following items:

(a) Trash condition at the intake screen
(b) Temperature conditions at bearings, windings and elsewhere
(c) Presence of vibration or abnormal sound at rotating machines
(d) Load conditions such as voltage, current, output, and power factor of generators
(e) Occurrence of abnormal situation of equipment inside and outside the power stations, and of other structures concerned

(2) Maintenance Plan

(a) Water turbines and ancillary equipment

Maintenance works of water turbines and ancillary equipment are divided into three inspections: daily inspection, external inspection and internal inspection. The frequency of these inspections are as follows:

- Daily inspection : Every day
- External inspection : Every 6 months
- Internal inspection : Every 5 years.

(b) Electric facilities

The standard frequency of external and internal inspections of electric facilities is as follows:

Standard Frequency of and External and Internal Inspections

Equipment	External Inspection	Internal Inspection
Generator and exciter	One year	5 years
Main transformer	6 years	3 years
Main circuit breaker	One year	4 to 5 years
Switchboard	6 months	4 to 5 years
Other switchboard and housing device	6 months	4 to 5 years

As for the maintenance of the No.1 and No.2 Power Stations, two methods will be applied: one is to hand over all of them to TANESCO, and the other is to operate and maintain them (by KADP). The former method is easier since TANESCO has much experience in operation and maintenance of hydropower stations, but it is reported that TANESCO is one of

candidate agencies to be privatised. Accordingly, it is proposed that the No.1 and No.2 Power stations be operated by KADP, and their maintenance shall be executed on a contract basis.

10.5 Project Cost

(1) Construction Cost of Power Stations

The construction costs for the No.1 and No.2 Power Stations are estimated at US$ 2,760,000 and US$ 4,570,000, respectively.

(2) Project Cost

The Project cost including the No.1 and No.2 Power Stations is estimated at US$ 64 million, as summarised below:

Summary of Project Cost

Item	Foreign Currency (US$1,000)	Local Currency (Tsh.million)	Total (US$1,000)
(a) Phase-I Works			
- Headworks	2,597	429	3,289
- Diversion Channel	8,454	1,485	10,850
-No.2 Power Station	3,975	369	4,570
- Existing Lower Moshi Area	3,434	892	4,874
Sub-total of (a)	18,460	3,175	23,583
(b) Phase-II Works			
- Extension and Expanded Area	11,388	2,616	15,607
-No.1 Power Station	2,436	201	2,760
Sub-total of (b)	13,824	2,817	18,367
(c) O&M Equipment	1,000	–	1,000
(d) Administration Expenses	–	632	1,020
(e) Engineering Services	4,400	682	5,500
Sub-total of (a) to (e)	37,684	7,306	49,469
(f) Physical Contingency	3,768	731	4,947
(g) Price Contingency	3,149	4,197	9,920
(h) Total	44,602	12,234	64,336

The annual fund requirement for the Project implementation is as follows:

Annual Disbursement Schedule

(Unit: US$1,000)

Description	Fiscal Year*					
	1998	1999	2000	2001	2002	2003
(a) Construction Works	0	12,340	11,243	8,371	5,938	4,057
(b) O&M Equipment	0	0	500	0	0	500
(c) Administration Expenses	170	170	170	170	170	170
(d) Engineering Services	734	1,393	1,393	660	660	660
(e) Physical Contingency	90	1,390	1,331	920	677	539
(f) Price Contingency	0	939	1,873	2,251	2,384	2,473
Total	994	16,232	16,510	12,372	9,829	8,399

*: *Tanzanian fiscal year (July to June)*

(3) O & M Cost

O & M Cost

(Unit: Tsh. million)

Item	1st Stage		2nd Stage	
	KADP	Farmers' Organisations	KADP	Farmers' Organisation
(a) Salary of project staff	42.4	-	11.3	12.1
(b) Office running cost	22.3	-	11.1	3.7
(c) O&M equipment	29.0	-	2.9	26.1
(d) Labour cost	2.9	4.1	0.2	5.0
(e) Materials cost	1.4	1.5	0.4	1.9
(f) Hydropower stations	30.80	-	30.80	-
Total	128.8	5.6	56.7	48.8
Total for each stage	134.4 (US$216,800)=US$46/ha		105.5 (US$170,200)=US$36/ha	

(4) Replacement Cost

The useful life time and replacement cost for turbines, generators and penstocks are as follows:

Useful Life Time and Replacement Cost

Item	Life Time (year)	Replacement Cost (US$1000)
(a) Turbine, generator and penstock of the No.1 Power Station (790 kW)	50	2,045
(b) Turbine, generator and penstock of the No.1 Power Station (2,390 kW)	50	3,400

(5) Water Charge

The O&M cost and replacement cost of O&M equipment and electro-mechanical equipment will be collected from the beneficial farmers as a water charge, which will be used for operation, maintenance and management of the Project. The replacement cost of O&M equipment is estimated at US$ 54 /ha. Thus, the water charge comes to US$ 100 /ha at the 1st stage and US$ 90 /ha at the 2nd stage.

10.6 Economic Evaluation

The Project including hydropoer plan is evaluated under the same conditions mentioned in Chapter 7. O&M for the Project is estimated at US$ 46/ha for the first 5 years and US$ 36/ha for the remaining period.

(1) Economic Benefits from Electricity Generation

The average revenue per kWh is estimated at US Cents 7.95 which is derived from the Feasibility Study on the Small-scale Hydroelectric Power Development Project in the Kilimanjaro Region in 1989. The estimated total revenue from the No. 1 and No.2 Hydropower Stations is US$ 539,000 and US$ 1,631,000 per year, respectively.

(2) Economic Cost

Useful Life Time and Replacement Cost

(Unit: US$1000)

Area/Items	Direct Const-ruction Cost	O & M Equipment	Engineering Services	Administration Expenses	Physical Contingency	Total
(a) Whole Project Area	33,559	1,000	5,500	1,020	4,108	45,187
(b) Existing Lower Moshi Project Area	11,685	500	2,516	467	1,517	16,685
(c) New Extension Area and Expanded Area	21,874	500	2,984	553	2,591	28,502

(3) Economic Evaluation

EIRR is calculated for the following 3 cases:

Estimated EIRR

Case	Description	EIRR (%)
(a) Case - 1:	Whole Project Area (4,700 ha)	15.5
(b) Case - 2:	Existing Lower Moshi Project Area (2,150 ha)	19.1
(c) Case - 3:	New Extension Area and Expanded Area (2,550 ha)	13.2

As can be seen in the above table, it is proved that the Project including the hydrpower plan is proved to be economically viable.

(4) Sensitivity Analysis

A sensitivity analysis for each area individually and for the whole area is performed to evaluate the soundness of the Project against unexpected adverse changes in the future in the following cases:

(a) The Project cost and physical contingency increase by 10%

(b) The market prices of crops decrease by 10%

(c) Combination of (a) and (b)

The effects of these changes in EIRR are summarised as follows:

Results of Sensitivity Analysis

Case	Existing Lower Moshi Project Area	New Extension Area and Expanded Area	Whole Project Area
(a) 10% increase of cost	17.6 %	12.2 %	14.2 %
(b) 10% decrease of benefit	17.4 %	12.1 %	14.1 %
(c) Combination of (a) and (b)	15.9 %	11.1 %	12.9 %

The sensitivity analysis result demonstrates that the Project including the hydropower plan is still economically viable even under the most severe case.

10.7 Financial Evaluation

(1) Cash Flow Statement Analysis

The financial sustainability of the Project was assessed using a cash flow statement analysis which presents the financial soundness of the Project by comparing all revenues collected from the benificial farmers with the fund requirement for the project operation. For the assessment, the following assumptions have been applied:

(a) The capital funds of the project works and tractor hiring services will be arranged by the Government of Tanzania.

(b) The cash flow statement analysis was prepared from the viewpoint of CHAWAMPU.

(c) Revenue sources for the project operation are:1) annual water charge of Tsh.62,000/ha (US$ 100) in the 1st stage and Tsh.55,800/ha (US$ 90), and 2) tractor hiring services fees of Tsh.50,000/ha for paddy cultivation and Tsh.12,500/ha for alfalfal cultivation. The water charge consists of replacement cost and O & M cost of the project facilities including O & M equipment, administration cost, etc. as shown in Clause 6.4. The tractor hiring service fees includes the O & M cost and replacement cost of tractors.

On the basis of these assumptions, the cash flow statement of the project implementation and operation stages was tabulated as shown in Table 10.1. The results of the analysis indicated that the anticipated revenues collected from the beneficial farmers would be able to provide sufficient funds for O & M cost and replacement cost of O & M equipment and tractors for the Project, and thus the financial sustainability of the Project for CHAWAMPU.

(2) Farm Budget Analysis and Capacity to Pay

The payment capacity is defined as the ability of the beneficiary farmers to bear the expenses required for operation and maintenance of the Project facilities. The analysis results for respective cases are summarised in the following table.

Results of Farm Budget Analysis

(Unit:Tsh.)

Description	Ex Lower Moshi Project Area			Expanded Area			New Extension Area		
	Marginal 0.5 ha	Small 1.5 ha	Medium 3.0 ha	Marginal 0.5 ha	Small 1.5 ha	Medium 3.0 ha	Marginal 0.5 ha	Small 1.5 ha	Medium 3.0 ha
(1) Income Structure									
(a) Net farm crop income									
- Gross farm income	885,500	2,656,500	5,313,000	819,900	2,459,600	4,919,300	885,500	2,656,500	5,313,000
- Production cost*	237,600	712,800	1,425,500	231,200	693,600	1,387,300	237,600	712,800	1,425,500
- Net farm crop income	647,900	1,943,700	3,887,500	588,700	1,766,000	3,532,000	647,900	1,943,700	3,887,500
(b) Livestock income	99,600	83,000	66,400	213,600	178,000	142,400	51,600	43,000	34,400
(c) Homestead income	12,500	12,500	12,500	61,000	61,000	61,000	35,000	35,000	35,000
(d) Non-farm income	290,000	130,000	0	250,000	221,000	0	290,000	153,000	0
(e) Household income	1,050,000	2,169,200	3,966,400	1,113,300	2,226,000	3,735,400	1,024,500	2,174,700	3,956,900
(2) Living Expenditure	854,000	915,800	1,089,900	950,000	1,078,000	1,293,600	872,000	1,003,000	1,203,600
(3) Net Reserve	196,000	1,253,400	2,876,500	163,600	1,148,000	2,441,800	152,500	1,171,700	2,753,300
- in US$	316	2,022	4,640	263	1,852	3,938	246	1,890	4,441
(4) Water Charge	31,000	93,000	186,000	31,000	93,000	186,000	31,000	93,000	186,000
- in US$	50	150	300	50	150	300	50	150	300
(5) Payment Ratio(4/5)	16 %	7 %	6 %	19 %	8 %	8 %	20 %	8 %	7 %
(6) Balance	165,000	1,160,400	2,690,500	132,600	1,055,000	2,255,800	121,500	1,078,700	2,567,300
- in US$	266	1,872	4,340	214	1,702	3,638	196	1,740	4,141

**: Production cost consists of farm inputs cost, chemicals cost, labour cost, O&M costs of tractors.*

The analysis result shows that the payment ratio ranges from 6 % to 20% of net reserve, and comes to about 8 % in average as a whole since the average farm size in the whole Project Area is about 1.5 ha. From this analysis, it is apparent that the water charge including O & M cost could be covered even by the marginal farmers and would not represent a heavy financial burden.

As mentioned in Item (1) of Sub-section 10.6, the total revenue from both Hydro-power Stations is estimated at US$ 2,170,000/year (Tsh.1,345 million/year). It is also possible that not only the water charge (Tsh.262 million/year), but also the tractor hiring services fee (Tsh.372 million/year) will be covered by this revenue can cover.

CHAPTER 11 CONCLUSIONS AND RECOMMENDATIONS

11.1 Conclusions

Through the feasibility study, the Project is proved to be economically viable and technically feasible from the viewpoints of national economy, engineering, institution, and environment. The Project will be conducive to increase of food production and elevation of living standard by providing agriculture and rural infrastructures, which will lead to contribution to achievement of national self-sufficiency in food as well as stabilisation and development of regional economy in Kilimanjaro. In addition, the Project will bear the social impacts such as 1) increase of employment opportunity, 2) activation of regional economy, 3) improvement of sanitary condition, and 4) saving of foreign currency.

The results of hearing survey and public meetings related that the Project was fully accepted by relevant farmers, and its early implementation was supported by them. The farmers presented an active attitude toward participation in the project implementation through execution of minor works such as sod facing, construction of small drains and final land levelling at paddy fields.

The Project will also enable power generation of 3.2 MW by harnessing the extra water head occurred on the proposed route of diversion channel. The economic evaluation shows that the Project with hydropower plan becomes more economically viable, because its EIRR comes to 15.5 % which is 2.1 % higher than without hydropower plan. In addition to such direct benefit, it is expected to activate the social economy in and around the Project Area, and also to generate the O & M cost of the Project facilities.

11.2 Recommendations

Judging from the conclusions and development demands obtained through the Feasibility Study, it is recommended that the Project be implemented as early as possible.

Especially, in order to realise the early implementation of the Project and to ensure the sustainability of the Project, the special attention shall be given the following as well as the urgent grant of the provisional water right for the Project:

(1) Urgent Selection of Optimal Rice Varieties

The farming practices for irrigated paddy recommended by KADP have been successfully practised with an average yield of over 6 t/ha. However, the introduction of other varieties than IR 54 in rotation should be promoted urgently in order to avoid huge crop losses because of the outbreak of a certain pest or disease induced by the continuous cultivation of a single variety. It is therefore recommended to implement the proposed experimental programs urgently.

(2) Urgent Enactment for Water Users Association

At present, CHAWAMPU has a legal status, having water rights under the Existing Lower Moshi Project, and has fulfilled its function as an O & M executing agency on the

farmers' side. However, after implementation of the Project, its scale will become more than double. Under such a situation, it is difficult for CHAWAMPU to play the same role especially from legal viewpoints because it was established under the Cooperative Society Act. Accordingly, it is recommended that GOT shall urgently satisfy the legal requirements such as vesting of legal status to WUAs, compulsory affiliation of beneficiaries to WUAs, and compulsory collection of water charge.

(3) Phase-wise Development

The proposed Project works are divided into four portions: 1) construction of headworks, diversion channel, and related structures; 2) rehabilitation and enhancement works for the Existing Lower Moshi Project Area; 3) construction works for the Expanded Area; and 4) construction works for the New Extension Area. Taking into consideration the proper work scale, early occurrence of benefit, and need of urgent solution in water conflict among beneficiaries, it is recommended that the Project works be implemented in two phases:

(a) Phase-I
- Kikuletwa headworks and diversion channel
- Rehabilitation and enhancement works for the Existing Lower Moshi Project Area

(b) Phase-II
- Construction works for the Expanded Area and the New Extension Area

(4) Farmers' Participation Works

It is important to induce the farmers' participation in the Project from the early stage so that the sense of local ownership and responsibility is created. In this Project, it is recommended that minor works such as sod facing for minor canals, construction of small drains and final levelling of field plots be carried out by the beneficiary farmers themselves. In order to execute such works on a participatory basis, it is also recommended that a Farmers' Participation Section be established in the Project construction office, to supervise the farmers' participation works.

(5) Execution of the Environmental Conservation Plan

The EIA study proved that the Project is environmentally viable and significant adverse impacts are not identified, however, it is recommended that preventive/mitigate measures and monitoring works be executed for checking regularly the long-term environmental sustainability and conservation of the areas inside and outside the Project Area.

(6) Execution of the small-scale hydroelectric development plan

As mentioned previously, it is possible to generate electricity of 3.2 MW by constructing two hydropower stations on the proposed diversion channel. This hydropower development plan will contribute to the improvement of electricity condition in the Kilimanjaro Region as well as the financial support to the O & activities for the Project. Since the hydropower generation development can acerue the benefit immediately after its completion and also considering each phase scale by phase-wise development, it is recommended that No.1 and No.2 Power Stations be constructed in Phase-II and Phase-I, respectively.

Tables

Table 2.1 Area, Production and Yield of Principal Crops in Tanzania Mainland (1985/86 - 1993/94)

(1000 ha, 1000 ton, ton/ha)

Crops	1985/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94
(1) Maize									
Area	1576.28	1481.19	1674.7	1668.95	1641.26	1848.3	1968.16	1581.79	1628.94
Production	2630.77	2241.53	2123.33	2528.05	2227.38	2331.8	2226.42	2282.05	2158.81
Yield	1.7	1.5	1.4	1.5	1.4	1.3	1.2	1.4	1.3
(2) Sorghum									
Area	415.88	409.19	492.23	476.7	486.96	856.3	683.07	611.61	663.69
Production	383.61	363.05	423.51	429.66	537.15	750.2	587.13	719.14	478.3
Yield	0.9	0.9	0.9	0.9	1.1	0.9	0.9	1.1	0.7
(3) Paddy									
Area	265.66	315.03	399.32	385.31	289.29	368.7	396.57	326.76	352.64
Production	437.8	510.77	782.3	767.16	735.99	895.7	892.22	639.91	611.3
Yield	1.6	1.6	1.9	2.0	2.5	1.1	1.5	1.7	1.7
(4) Wheat									
Area	13.45	56.76	60.83	57.85	52.01	50.3	48.79	33.78	31.8
Production	97.9	71.58	75.21	75.21	105.85	83.7	64	59.43	59.41
Yield	2.3	1.3	1.2	1.3	2.0	1.7	1.5	1.7	1.7
(5) Millet									
Area	315.61	300.92	311.9	271.91	145.16	na	308.56	321.59	339.52
Production	300.87	250.17	199.02	217.2	na	na	262.78	210.25	217.29
Yield	0.9	0.8	0.6	0.8	na	na	0.9	0.6	0.6
(6) Cassava									
Area	665.53	639.26	756.11	731.76	590.23	601.2	683.71	657	693.37
Production	1533.5	1124.66	1399.2	1271.94	1730.61	1506.4	1772.65	1708.22	1802.27
Yield	2.3	1.8	1.8	1.7	2.9	2.6	2.6	2.6	2.6
(7) Sweet Potatoes									
Area	97.17	188.68	180.65	198.51	306.51	232	197.68	199.77	205.13
Production	177.35	335.86	319.18	337.31	996.07	290.8	256.99	259.73	266.69
Yield	1.8	1.8	1.8	1.7	3.2	1.3	1.3	1.3	1.3
(8) Pulses									
Area	595.59	326.1	561.02	525.93	579.52	564.7	591.26	514.16	554.15
Production	432.11	251.35	329.2	385.31	381.38	424.6	311.28	405.84	186.69
Yield	0.7	0.8	0.7	0.7	0.7	0.8	0.5	0.7	0.3
(9) Bananas/plantains									
Area	262	266	270.85	na	225.96	252.2	264.57	270.06	281.62
Production	777	792.3	792.3	na	823.2	750	793.7	799.68	834.34
Yield	3.0	3.0	2.9	na	3.0	3.0	2.9	3.0	3.6
(10) Cashewnuts									
Area	na	na	na	na	na	na	na	na	na
Production	19.2	18.49	22.47	19.26	17.06	29.85	40.15	na	na
Yield	na	na	na	na	na	na	na	na	na
(11) Tea									
Area	9.18	12.64	12.57	12.57	12.57	12.57	19.36	na	na
Production	15.54	14.11	15.89	15.99	24.71	21.88	39.53	na	na
Yield	1.7	1.1	1.3	1.3	2.0	1.7	1.0	na	na
(12) Coffee									
Area	254.24	254.24	257.73	256.2	242.06	242.06	242.06	na	na
Production	54.77	41	45.51	48.8	53.42	46.21	56.03	na	na
Yield	0.22	0.16	0.18	0.19	0.22	0.19	0.23	na	na
(13) Tobacco									
Area	18.91	21.1	26.29	20.52	22.84	20.58	31.5	na	na
Production	12.55	16.47	12.92	11.56	11.06	11.81	16.45	na	na
Yield	0.66	0.78	0.49	0.56	0.48	0.57	0.52	na	na
(14) Pyrethrum									
Area	7.5	8	8	8	8	8	7.78	na	na
Production	1.35	1.23	1.41	1.31	1.59	1.68	2.22	na	na
Yield	0.18	0.15	0.18	0.16	0.20	0.21	0.29	na	na
(15) Fibres/Cotton									
Area	456.9	486.07	418.07	353.83	389.31	501.29	564.73	na	na
Production	152.66	231.28	222.15	207.58	178.97	251.91	247.24	na	na
Yield	0.33	0.48	0.53	0.59	0.46	0.51	0.44	na	na
(16) Sisal									
Area	51.53	43.08	41.52	42.52	78.23	77.91	77.97	na	na
Production	32.84	30.35	33.17	33.28	32.26	33.74	36	na	na
Yield	0.64	0.70	0.80	0.78	0.41	0.43	0.46	na	na

Source: Basic Data Agriculture and Livestock Sector 1987/88-1993/94
Ministry of Agriculture, 1995
Note: na= Not Available

Table 2.2 Imports of Cereals (1990-1994)

(Unit: ton)

Year	Maize	Rice	Wheat	Wheat Flour
1990	2,200	4,908	40,000	-
1991	0	5,416	19,700	-
1992	24,500	41,000	33,000	5,000
1993	-	-	-	-
1994	21,916	50,500	50,500	-

Source: Food Security Department/MAMO
Cited in Baseline Review of Maize, Rice and Wheat, MAC, 1994

Table 3.1 Results of Water Quality Test

(1) Phase - I Study

Potential Irrigation Problem	Units	Degree of Restriction on Use: None (N)	Slight to Moderate (SM)	Severe (S)	Test Item	Unit	Location No.1 Kukichawa Intake Site: 1-1	1-2	1-3	Location No.2 Chemuka Spring: 2-1	2-2	2-3	Location No.3 Kukichawa TFC Pump Station: 3-1	3-2	3-3	Location No.4 Kukafu River: 4-1	4-2	4-3
Salinity																		
ECw	dS/m	< 0.7	0.7 - 3.0	> 3.0	ECw	dS/m	0.81 SM	0.83 SM	0.81 SM	0.75 SM	0.76 SM	0.80 SM	0.26 N	0.25 N	0.25 N	0.26 N	0.26 N	0.26 N
Infiltration																		
SAR = 0 - 3 and ECw =		> 0.7	0.7 - 0.2	< 0.2														
SAR = 3 - 6 and ECw =		> 1.2	1.2 - 0.3	< 0.3	Na	me/l	3.80	3.93	3.90	8.75	8.56	8.50	0.26	0.29	0.25	0.26	0.26	0.26
SAR = 6 - 12 and ECw =		> 1.9	1.9 - 0.5	< 0.5	Ca	me/l	0.42	0.41	0.41	0.89	0.88	0.86	0.16	0.15	0.26	0.05	0.05	0.05
SAR = 12 - 20 and ECw =		> 2.9	2.9 - 1.3	< 1.3	Mg	me/l	2.61	2.89	2.96	4.81	4.98	4.92	1.71	1.02	0.97	0.13	0.15	0.42
SAR = 20 - 40 and ECw =		> 5.0	5.0 - 2.9	< 2.9	adj.RNa		6.76 SM	6.82 SM	6.51 SM	5.91 S	5.92 S	5.91 S	4.36 SM	5.50 SM	5.05 SM	0.87 S	0.86 S	0.86 S
Specific Ion Toxicity																		
Sodium (Na)	SAR	< 3	3 - 9	> 9	adj.RNa		6.76 SM	6.82 SM	6.51 SM	5.91 SM	5.92 SM	5.74 SM	4.36 SM	5.50 SM	4.96 N	0.87 N	0.86 N	0.86 N
Chloride (Cl)	me/l	< 4	4 - 10	> 10	Cl	me/l	0.73 S	0.78 S	0.75 S	1.92 S	1.93 S	1.91 S	0.39 N	0.39 N	0.39 N	0.13 N	0.20 N	0.13 N
Boron (B)	mg/l	< 0.7	0.7 - 3.0	> 3.0	Boron	mg/l												
Miscellaneous Effects																		
Nitrogen (NO3-N)	mg/l	< 5	5 - 30	> 30	NO3-N	mg/l	0.21 N	0.20 N	0.20 N	2.62 N	2.60 N	2.60 N	0.65 N	0.50 N	0.70 N	0.19 N	1.30 N	1.20 N
Bicarbonate (HCO3)	me/l	< 1.5	1.5 - 8.5	> 8.5	HCO3	me/l	7.67 SM	7.98 SM	8.09 SM	11.93 S	11.70 S	11.75 S	2.67 SM	2.42 SM	2.49 SM	0.45 S	0.43 S	0.41 S
pH		Normal Range 6.5 - 8.4			pH		7.25 OK	7.25 OK	7.25 OK	6.91 OK	6.56 OK	6.69 OK	7.30 OK	7.31 OK	7.30 OK	6.80 OK	6.43 OK	6.81 OK

Potential Irrigation Problem	Units	Degree of Restriction on Use: None (N)	Slight to Moderate (SM)	Severe (S)	Test Item	Unit	Location No.5 Nyamkwazi Mahogany Intake: 5-1	5-2	5-3	Location No.6 Ruo River at Ruo Intake: 6-1	6-2	6-3	Location No.7 Mahogany Main Canal: 7-1	7-2	7-3	Location No.8 Ruo Ya Kuti Main Canal: 8-1	8-2	8-3
					EC	MS/cm	209	207	203	176	177	163	158	262	262	162	170	176
Salinity																		
ECw	dS/m	< 0.7	0.7 - 3.0	> 3.0	ECw	dS/m	0.22 N	0.21 N	0.20 N	0.18 N	0.18 N	0.16 N	0.19 N	0.20 N	0.20 N	0.18 N	0.17 N	0.18 N
Infiltration																		
SAR = 0 - 3 and ECw =		> 0.7	0.7 - 0.2	< 0.2														
SAR = 3 - 6 and ECw =		> 1.2	1.2 - 0.3	< 0.3	Na	me/l	1.39	1.43	1.39	0.58	0.69	0.83	0.68	0.67	0.58	0.83	0.83	0.83
SAR = 6 - 12 and ECw =		> 1.9	1.9 - 0.5	< 0.5	Ca	me/l	0.13	0.14	0.12	0.13	0.13	0.11	0.13	0.12	0.13	0.12	0.12	0.12
SAR = 12 - 20 and ECw =		> 2.9	2.9 - 1.3	< 1.3	Mg	me/l	0.33	0.57	0.48	0.22	0.87	0.62	0.63	0.80	0.45	0.42	0.42	0.45
SAR = 20 - 40 and ECw =		> 5.0	5.0 - 2.9	< 2.9	adj.RNa		1.93 SM	1.95 SM	1.99 SM	1.98 S	1.96 S	1.89 S	1.25 S	1.38 SM	1.36 SM	1.31 S	1.31 S	1.28 S
Specific Ion Toxicity																		
Sodium (Na)	SAR	< 3	3 - 9	> 9	adj.RNa		1.93 N	1.95 N	1.99 N	1.98 N	1.96 N	1.89 N	1.23 N	1.38 N	1.36 N	1.31 N	1.31 N	1.28 N
Chloride (Cl)	me/l	< 4	4 - 10	> 10	Cl	me/l	0.32 N	0.36 N	0.35 N	0.28 N	0.30 N	0.31 N	0.35 N	0.35 N	0.48 N	0.23 N	0.25 N	0.25 N
Boron (B)	mg/l	< 0.7	0.7 - 3.0	> 3.0	Boron	mg/l												
Miscellaneous Effects																		
Nitrogen (NO3-N)	mg/l	< 5	5 - 30	> 30	NO3-N	mg/l	3.84 N	3.80 N	3.82 N	0.80 N	0.81 N	0.90 N	4.20 N	4.30 N	4.00 N	0.91 N	0.90 N	0.90 N
Bicarbonate (HCO3)	me/l	< 1.5	1.5 - 8.5	> 8.5	HCO3	me/l	1.07 N	1.07 N	1.08 N	0.56 N	0.58 N	0.56 N	1.05 N	1.05 N	1.01 N	1.16 N	1.20 N	1.20 N
pH		Normal Range 6.5 - 8.4			pH		6.53 OK	6.53 OK	6.52 OK	6.90 OK	6.89 OK	6.95 OK	7.02 OK	7.00 OK	7.02 OK	7.06 OK	7.04 OK	7.06 OK

(2) Phase - II Study

Potential Irrigation Problem	Units	Degree of Restriction on Use: None (N)	Slight to Moderate (SM)	Severe (S)	Test Item	Unit	Location No.1 Kukichawa Intake Site: 1-1	1-2	1-3	Location No.2 Chemuka Spring: 2-1	2-2	2-3	Location No.3 Kukichawa TFC Pump Station: 3-1	3-2	3-3	Location No.4 Kukafu River: 4-1	4-2	4-3
Salinity																		
ECw	dS/m	< 0.7	0.7 - 3.0	> 3.0	ECw	dS/m	0.59 N	0.67 N	0.67 N	1.32 N	1.30 N	1.34 N	0.29 N	0.30 N	0.30 N	0.05 N	0.05 N	0.05 N
Infiltration																		
SAR = 0 - 3 and ECw =		> 0.7	0.7 - 0.2	< 0.2														
SAR = 3 - 6 and ECw =		> 1.2	1.2 - 0.3	< 0.3	Na	me/l	4.28	4.59	4.70	9.98	10.74	11.89	1.95	1.75	1.94	0.16	0.15	0.15
SAR = 6 - 12 and ECw =		> 1.9	1.9 - 0.5	< 0.5	Ca	me/l	0.26	0.23	0.26	0.84	0.84	0.88	0.14	0.14	0.14	0.06	0.06	0.06
SAR = 12 - 20 and ECw =		> 2.9	2.9 - 1.3	< 1.3	Mg	me/l	1.30	1.45	1.29	0.85	0.55	4.06	0.55	0.54	0.57	0.09	0.09	0.06
SAR = 20 - 40 and ECw =		> 5.0	5.0 - 2.9	< 2.9	adj.RNa		4.61 SM	4.77 SM	5.06 SM	8.34 SM	8.69 SM	7.92 SM	2.81 SM	2.56 SM	2.61 SM	0.25 S	0.24 S	0.23 S
Specific Ion Toxicity																		
Sodium (Na)	SAR	< 3	3 - 9	> 9	adj.RNa		4.61 SM	4.77 SM	5.06 SM	8.34 SM	8.69 SM	7.92 SM	2.81 N	2.56 N	2.61 N	0.25 N	0.24 N	0.23 N
Chloride (Cl)	me/l	< 4	4 - 10	> 10	Cl	me/l	0.24 N	0.25 N	0.26 N	1.30 N	1.24 N	1.36 N	0.29 N	0.41 N	0.36 N	0.30 N	0.16 N	0.26 N
Boron (B)	mg/l	< 0.7	0.7 - 3.0	> 3.0	Boron	mg/l												
Miscellaneous Effects																		
Nitrogen (NO3-N)	mg/l	< 5	5 - 30	> 30	NO3-N	mg/l	0.01 N	0.01 N	0.01 N	4.10 N	0.81 N	1.63 N	0.01 N	0.01 N	0.01 N	0.01 N	0.01 N	0.01 N
Bicarbonate (HCO3)	me/l	< 1.5	1.5 - 8.5	> 8.5	HCO3	me/l	4.1 SM	3.7 SM	4.0 SM	4.8 S	9.5 S	9.8 S	3.7 SM	3.6 SM	3.6 SM	0.2 N	0.2 N	0.2 N
pH		Normal Range 6.5 - 8.4			pH		7.3 OK	7.2 OK	7.3 OK	6.8 OK	6.8 OK	6.9 OK	6.8 OK	6.9 OK	6.8 OK	6.8 OK	6.7 OK	6.8 OK

Potential Irrigation Problem	Units	Degree of Restriction on Use: None (N)	Slight to Moderate (SM)	Severe (S)	Test Item	Unit	Location No.5 Nyamkwazi Mahogany Intake: 5-1	5-2	5-3	Location No.6 Ruo River at Ruo Intake: 6-1	6-2	6-3	Location No.7 Mahogany Main Canal: 7-1	7-2	7-3	Location No.8 Ruo Ya Kuti Main Canal: 8-1	8-2	8-3
					EC	MS/cm	209	207	203	176	177	163	158	262	262	162	170	176
Salinity																		
ECw	dS/m	< 0.7	0.7 - 3.0	> 3.0	ECw	dS/m	0.17 N	0.19 N	0.17 N	0.15 N	0.15 N	0.15 N	0.16 N	0.16 N	0.16 N	0.15 N	0.15 N	0.18 N
Infiltration																		
SAR = 0 - 3 and ECw =		> 0.7	0.7 - 0.2	< 0.2														
SAR = 3 - 6 and ECw =		> 1.2	1.2 - 0.3	< 0.3	Na	me/l	0.85	0.81	0.79	0.55	0.54	0.54	0.76	0.61	0.54	0.54	0.53	0.55
SAR = 6 - 12 and ECw =		> 1.9	1.9 - 0.5	< 0.5	Ca	me/l	0.10	0.11	0.11	0.13	0.12	0.12	0.14	0.11	0.11	0.13	0.12	0.12
SAR = 12 - 20 and ECw =		> 2.9	2.9 - 1.3	< 1.3	Mg	me/l	0.23	0.23	0.22	0.34	0.35	0.36	0.23	0.23	0.22	0.26	0.24	0.27
SAR = 20 - 40 and ECw =		> 5.0	5.0 - 2.9	< 2.9	adj.RNa		1.31 S	1.34 S	1.32 S	0.77 S	0.84 S	0.78 S	0.27 N	1.36 N	0.90 N	0.27 N	0.85 N	0.78 N
Specific Ion Toxicity																		
Sodium (Na)	SAR	< 3	3 - 9	> 9	adj.RNa		1.31 N	1.34 N	1.32 N	0.77 N	0.84 N	0.78 N	0.27 N	1.36 N	0.90 N	0.27 N	0.85 N	0.78 N
Chloride (Cl)	me/l	< 4	4 - 10	> 10	Cl	me/l	0.31 N	0.33 N	0.32 N	0.03 N	0.03 N	0.03 N	0.74 N	0.74 N	0.05 N	0.24 N	0.25 N	0.25 N
Boron (B)	mg/l	< 0.7	0.7 - 3.0	> 3.0	Boron	mg/l												
Miscellaneous Effects																		
Nitrogen (NO3-N)	mg/l	< 5	5 - 30	> 30	NO3-N	mg/l	2.80 N	1.89 N	2.10 N	0.76 N	0.96 N	0.50 N	2.00 N	2.30 N	2.20 N	0.01 N	0.01 N	0.01 N
Bicarbonate (HCO3)	me/l	< 1.5	1.5 - 8.5	> 8.5	HCO3	me/l	0.8 N	0.9 N	1.0 N	0.9 N	0.9 N	0.8 N	0.8 N	0.9 N	0.8 N	0.5 N	0.9 N	0.8 N
pH		Normal Range 6.5 - 8.4			pH		6.6 OK	6.3 OK	6.8 OK	6.8 OK	6.9 OK	6.8 OK	6.7 OK	6.8 OK	6.7 OK	6.7 OK	6.3 OK	6.2 OK

Table 3.2 Present Cropped Area and Crop Production in the Study Area

Subject Area	Land Use Category Net Area(ha)	Estimated Cropped Area & Cropping Intensity 1/ Season	Crops	Cropped Area (ha)	Intensity (%)	Crop Yield (t/ha)	Estimated Production (t)	Remarks
Existing Lower Moshi Project Area	1. Irrigated Paddy Field 1,104 ha	Rainy Season	Rice	140	13	5.9	826	2/
			Maize	440	40	2.0	880	3/
		Rainy Season Total		580	53	-	1,706	
		Early Dry Season	Rice	360	33	6.5	2,340	2/
		Late Dry Season	Rice	280	25	7.0	1,960	2/
		Dry Season Total		640	58	6.7	4,300	
		Annual	Rice	780	71	6.6	5,126	
			Maize	440	40	2.0	880	
			Total	1,220	111	-	6,006	
	2. Irrigable Upland Field 1,046 ha	Rainy Season	Maize	1,046	100	2.0	2,092	
Overall of Existing Area	2,150 ha	Rainy Season	Rice	140	7	5.9	826	
			Maize	1,486	69	2.0	2,972	
			Total	1,626	76	-	3,798	
		Dry Season	Rice	640	30	7.0	4,300	
			Maize	0	0	-	-	
			Total	640	30	-	4,300	
		Annual	Rice	780	36	6.6	5,126	
			Maize	1,486	69	2.0	2,972	
			Total	2,266	105	-	8,098	
Expanded Area 1. Mandaka Mnono	1. Irrigated Paddy Field 300 ha	Rainy Season	Rice	300	100	3.5	1,050	
		Dry Season	Rice	210	70	4.5	945	
		Annual	Rice Total	510	170	3.9	1,995	
	2. Rainfed Upland Field 250 ha	Rainy Season	Maize	250	100	2	500	
	Mandaka Area Total 550 ha	Rainy Season	Rice	300	55	3.5	1,050	
			Maize	250	45	2.0	500	
			Total	550	100	-	1,550	
		Dry Season	Rice	210	38	4.5	945	
			Maize	0	0	-	-	
			Total	210	38	-	945	
		Annual	Rice	510	93	3.9	1,995	
			Maize	250	45	2.0	500	
			Total	760	138	-	2,495	
2. Kaloleni	1. Irrigated Paddy Field 160 ha	Rainy Season	Rice	160	100	3.5	560	
		Dry Season	Rice	80	50	4.5	360	
		Annual	Rice Total	240	150	3.8	920	
	2. Rainfed Upland Field 60 ha	Rainy Season	Maize	60	100	2	120	
	Kaloleni Area Total 220 ha	Rainy Season	Rice	160	73	3.5	560	
			Maize	60	27	2.0	120	
			Total	220	100	-	680	
		Dry Season	Rice	80	36	4.5	360	
			Maize	0	0	-	-	
			Total	80	36	-	360	
		Annual	Rice	240	109	3.8	920	
			Maize	60	27	2.0	120	
			Total	300	136	-	1,040	
Overall of Expanded Area	770 ha	Rainy Season	Rice	460	60	3.5	1,610	
			Maize	310	40	2.0	620	
			Total	770	100	-	2,230	
		Dry Season	Rice	290	38	4.5	1,305	
			Maize	0	0	-	0	
			Total	290	38	-	1,305	
		Annual	Rice	750	97	3.9	2,915	
			Maize	310	40	2.0	620	
			Total	1,060	138	-	3,535	
New Extension Area	3. Rainfed Upland Field 3,430 ha	Rainy Season	Maize	3,260	95	1.2	3,912	
Study Area Total	6,350 ha	Rainy Season	Rice	600	9	4.1	2,436	
			Maize	5,056	80	1.5	7,504	
			Total	5,656	89	1.8	9,940	
		Dry Season	Rice	930	15	6.0	5,605	
			Maize	0	0	-	0	
			Total	930	15	6.0	5,605	
		Annual	Rice	1,530	24	5.3	8,041	
			Maize	5,056	80	1.5	7,504	
			Total	6,586	104	2.4	15,545	

1/: Minor upland crops represented by maize 2/: Average from 1992 to 1996 3/: Average from 1995 to 1996

Table 3.3 Field Water Requirement Measured by KADC

(Unit:mm)

Period		ETc + P	ETc	P
1 Measurement in 1982				
September	8 - 10	30.9	12.0	18.9
	11 - 20	101.0	64.9	36.1
	21 - 30	122.0	46.0	76.0
	Average	11.0	5.3	5.7
October	1 - 10	137.7	69.6	68.1
	11 - 20	134.9	63.1	71.8
	21 - 31	285.0	143.6	141.4
	Average	18.0	8.9	9.1
November	1 - 10	179.0	136.0	43.0
	11 - 20	218.0	122.8	95.2
	21 - 30	140.3	83.8	56.5
	Average	18.0	11.4	6.6
Average for Total		16.3	8.9	7.4
		(100%)	(55%)	(45%)
2 Measurement in 1984				
October	1	8.4	1.5	6.9
	7	7.7	2.4	5.3
	14	6.9	3.7	3.2
	21	9.6	4.5	5.1
	28	11.4	6.2	5.2
	Average	8.8	3.7	5.1
November	5	9.6	6.5	3.1
	12	12.1	7.1	5.0
	19	12.1	8.3	3.8
	26	13.5	9.5	4.0
	Average	11.8	7.8	4.0
December	2	10.0	8.1	1.9
	9	10.2	8.6	1.6
	16	10.5	8.9	1.6
	Average	10.2	8.5	1.7
Average for Total		10.2	6.3	3.9
		(100%)	(60%)	(40%)

Note:

ETc: Crop Evapotranspiration (Consumptive use water)

P: Percolation

Table 3.4 Summarised Site Description (SD)

1. Social Conditions of Project Site	
Land tenure & Land use systems	Tenure regimes are still heavily influenced by "customary tenure systems" where land is communally owned, user rights are administered within the clan, and transfers to outsiders are rare. Governmental control may at one time have been exercised through the village allocation mechanism, but by 1991, this mechanism was firmly in the hands of local authorities.
Economic activities	The agriculture centering crop cultivation such as maize and paddy, and livestock is predominant, and there are no remarkable industries. Inland fishery is popular around the Nyumba ya Munga (NYM) dam reservoir.
Traditional systems	In the surrounding expanded area, farmers' organization has been established for water management and operation and maintenance of facility, but is not managed in the systematic manner like the existing Lower Moshi Project area.
Characteristics of local residents	Tribes living in and around the Project area are Chaga, Masai, Pare, Sanpa, and Arusha.
Health & Sanitation	Several kinds of water-borne diseases including Schistosomiasis have been prevailing. Sewer collection systems in the Moshi city leak into groundwater. This has resulted in outbreaks of cholera, typhoid and dysentery.
Population	As in 1995, population and households in the agricultural on-site of the Project, are 63,500 and 10,800 respectively.
Transportation road	Road density is insufficient. Bridges over rivers are inadequate, producing transportation bottlenecks during the flood season.
2. Natural Conditions of Project Site	
Climate	Climate is characterized by three seasons : wet season from March to May, dry season from June to October and small wet season from November to February. The average annual rainfall is about 900 mm.
Geography	The area generally has a gently undulating topography with land slopes ranging from 0.5 % to 0.2 %. The elevation is 800 ~ 700 m.
Hydrology & drainage	The Rau river flows down southwardly across the Project area. The Kikuletwa river flows into the Nyumba Ya Munngu dam after confluence with the Kikafu river.
Soil	They are generally quite fertile with relatively high humus contents, and can be broadly divided into Dystric Cambisols, Mollic Gleysols and Eutric Gleysols.
Vegetation	Almost all the area is under cultivation with scattered trees and ample grazing land, except a forest area extended along the Rau river.
Valuable fauna/flora & nature	Very few animals have remained in the area due to human activities. Thus, either they have been poached or have migrated to other places. Flora and fauna species seen there are common types. No species requiring special preservation have been seen.
Water pollution at Moshi city	The priority areas of concentration include Moshi city. Most of the industries discharge untreated wastewater.

3. Remarkable Social and Natural Features			
Special reserve area	On-site	Off-site	Remarks
Under Washington Convention	---	O	Wild animals
Under Ramsar Convention	---	---	
National park	---	O	Kilimanjaro
Forest reserve	O	O	2 (on), 2 (off)
Game controlled area	---	O	Sanya Lelatema
Socially fragile area	The Nyumba ya Munga dam reservoir for fishery		
Naturally fragile area	Ecosystem of the NYM dam reservoir		

4. Experiences of Negative Environmental Impacts around Project Sites	
Social aspect	- malaria and schistosomiasis - unstable water allocation - no or poor irrigation & drainage facility out of Lower Moshi Project area - inadequate water management system - unmatured agricultural product and farmers organization - low unit yield/productivity in outside area of Lower Moshi Project - unmatured supporting system for agricultural productivity - poor rural infrastructure - poor loan and credit services
Natural aspect	- shortage of irrigation water - husk accumulation and its poor treatment at the existing rice mill

Table 3.5 Summary and Countermeasures of Significant Negative Impacts on Social Aspects

Environmental Impact	Ecological Region No.[1] / Project Stage[2]				
	1		3		6
	DC	PC	DC	PC	PC
Social Issues					
Involuntary resettlement	?	?	O	O	
Countermeasures : Covering of expenses for resettlement ; support of the livelihood of affected population by providing employment opportunities in the construction ; and monitoring of social impacts during the operation stage, to execute mitigation measures.					
Conflict among communities and peoples		O		O	
Countermeasures : Monitoring of social impacts to execute mitigation measures.					
Demographic Issues					
Population increase	O				
Countermeasures : Careful monitoring of possible deterioration of social fabric or value upheaval as a result of rapid population increase.					
Drastic change in population composition	O				
Countermeasures : Careful monitoring of possible deterioration of social fabric or value upheaval as a result of rapid population increase.					
Economic Activities					
Relocation of bases of economic activities					?
Countermeasures : Monitoring of economic impacts to execute mitigation measures.					
Occupational change					?
Countermeasures : Monitoring of economic impacts to execute mitigation measures.					
Institutional and Custom Related Issues					
Adjustment of water or fishing rights		O			?
Countermeasures : Monitoring of social impacts to execute mitigation measures.					
Changes in social & institutional structures		O			
Countermeasures : Monitoring of social impacts to execute mitigation measures.					
Health and Sanitary Issues					
Increased use of agrochemicals		O			
Countermeasures : Monitoring of sanitary impacts to execute mitigation measures.					
Outbreak of endemic diseases				O	
Countermeasures : Monitoring of sanitary impacts to execute mitigation measures.					
Prevalence of epidemic diseases		O		O	
Countermeasures : Monitoring of sanitary impacts to execute mitigation measures.					
Residual toxicity of agrochemicals		O			
Countermeasures : Strict application of relevant regulations.					
Increase in domestic & other human wastes		O		O	
Countermeasures : Provision of waste disposal measures ; and monitoring of environmental impacts to execute other mitigation measures.					

Notes : 1) See Section 3.12.3 and Figure 3.7 for more detail of ecological regions.

2) DC = During the construction stage of the Project, and

PC = During the operation and post-construction stage of the Project

Table 3.6 Summary and Countermeasures of Significant Negative Impacts on Natural Aspects

Environmental Impact	Ecological Region No.[1] / Project Stage[2]						
	1		2	3	4	5	6
	DC	PC	PC	PC	PC	PC	PC
Biological and Ecological Issues							
Impacts on important fauna & flora							?
Countermeasures : Monitoring of ecological impacts to execute mitigation measures.							
Degradation of ecosystem							?
Countermeasures : Monitoring of ecological impacts to execute mitigation measures.							
Proliferation of hazardous species			O	O	O		
Countermeasures : Monitoring of ecological impacts to execute mitigation measures.							
Soil Resources							
Soil erosion				O			
Countermeasures : Monitoring of soil erosion to execute mitigation measures.							
Soil salinization	?	?					
Countermeasures : Monitoring of salt accumulation to execute mitigation measures.							
Hydrology Issues							
Changes in surface water hydrology							?
Countermeasures : Monitoring of hydrological impacts to execute mitigation measures.							
Changes in groundwater hydrology		?					
Countermeasures : Monitoring of impacts on groundwater to execute mitigation measures.							
Riverbed degradation							?
Countermeasures : Monitoring of impacts on riverbed to execute mitigation measures.							
Water Quality Issues							
Water contamination & pollution		?				?	?
Countermeasures : Monitoring of water quality to execute mitigation measures.							
Water eutrophication							?
Countermeasures : Monitoring of water to study and execute mitigation measures.							

Notes : 1) See Section 3.12.3 and Figure 3.7 for more detail of ecological regions.

2) DC = During the construction stage of the Project, and

PC = During the operation and post-construction stage of the Project

Table 3.7 Results of Impact Assessment and Necessity of Measures and Monitoring

Selected Item	Ecological Region 1 (Direct agricultural development sites)						Ecological Region 2 (Headworks construction site and its direct upstream)						Ecological Region 3 (Construction sites of diversion channel)					
	Incremental Negative Impacts *		Necessity of Additional Measures		Necessity of Monitoring		Incremental Negative Impacts *		Necessity of Additional Measures		Necessity of Monitoring		Incremental Negative Impacts *		Necessity of Additional Measures		Necessity of Monitoring	
	Construction St.	Operation St.	Construction St.	Operation St.	Construction St.	Operation St.	Construction St.	Operation St.	Construction St.	Operation St.	Construction St.	Operation St.	Construction St.	Operation St.	Construction St.	Operation St.	Construction St.	Operation St.
1. SOCIAL ENVIRONMENT																		
(1-a) Involuntary resettlement	X	X	No	No	No	No	X	X	No	No	No	No	O	X	Yes	No	No	Yes
(1-b) Conflict among communities and people	X	X	No	No	No	Yes	X	X	No	No	No	No	X	X	No	No	No	Yes
(1-c) Population increase and drastic change in population composition	O	O	Yes	Yes	Yes	Yes	X	X	No	No	No	No	O	X	Yes	No	Yes	Yes
(1-d) Relocation of bases of economic activities and occupational change	X	X	No	No	No	No	X	X	No	No	No	No	X	X	No	No	No	No
(1-e) Adjustment of water or fishing rights	X	X	No	No	No	Yes	X	X	No	No	No	Yes	X	X	No	No	No	No
(1-f) Changes in social and institutional structures	X	X	No	No	No	No	X	X	No	No	No	No	X	X	No	No	No	No
(1-g) Increased use and residual toxicity of agro-chemicals	X	X	No	No	No	No	X	X	No	No	No	No	X	X	No	No	No	No
(1-h) Outbreak of endemic diseases and prevalence of epidemic diseases	X	O	No	Yes	No	Yes	X	X	No	No	No	No	X	X	No	No	No	Yes
(1-i) Increase in domestic and other human wastes	X	O	No	Yes	No	Yes	X	X	No	No	No	No	X	X	No	No	No	Yes
2. NATURAL ENVIRONMENT																		
(2-a) Impacts on important fauna and flora, and degradation of ecosystem	X	X	No	No	No	No	X	X	No	No	No	No	X	X	No	No	Yes	No
(2-b) Proliferation of hazardous species	X	X	No	No	No	No	X	X	Yes	No	No	No	X	O	No	No	No	Yes
(2-c) Soil erosion	X	X	No	No	No	No	X	X	No	No	No	No	X	X	No	No	No	Yes
(2-d) Soil salination	X	X	No	No	No	Yes	X	X	No	No	No	No	X	X	No	No	No	No
(2-e) Change in surface water hydrology	X	X	No	No	No	No	X	X	No	No	No	No	X	X	No	No	No	No
(2-f) Change in groundwater hydrology	X	X	No	No	No	No	X	X	No	No	No	No	X	X	No	No	No	No
(2-g) Riverbed degradation, water pollution and eutrophication	X	X	No	No	No	No	X	X	No	No	No	No	X	X	No	No	No	No

Selected Item	Ecological Region 4 (Downstream of the new headworks)						Ecological Region 5 (Downstream of the Rio river)						Ecological Region 6 (In and around the Nemba ya Monga dam reservoir)					
	Incremental Negative Impacts *		Necessity of Additional Measures		Necessity of Monitoring		Incremental Negative Impacts *		Necessity of Additional Measures		Necessity of Monitoring		Incremental Negative Impacts *		Necessity of Additional Measures		Necessity of Monitoring	
	Construction St.	Operation St.	Construction St.	Operation St.	Construction St.	Operation St.	Construction St.	Operation St.	Construction St.	Operation St.	Construction St.	Operation St.	Construction St.	Operation St.	Construction St.	Operation St.	Construction St.	Operation St.
1. SOCIAL ENVIRONMENT																		
(1-a) Involuntary resettlement	X	X	No	No	No	No	X	X	No	No	No	No	X	X	No	No	No	No
(1-b) Conflict among communities and people	X	X	No	No	No	Yes	X	X	No	No	No	No	X	X	No	No	No	No
(1-c) Population increase and drastic change in population composition	X	X	No	No	No	No	X	X	No	No	No	No	X	X	No	No	No	No
(1-d) Relocation of bases of economic activities and occupational change	X	X	No	No	No	No	X	X	No	No	No	No	X	X	No	No	No	No
(1-e) Adjustment of water or fishing rights	X	X	No	No	No	Yes	X	X	No	No	No	No	X	X	No	No	No	Yes
(1-f) Changes in social and institutional structures	X	X	No	No	No	No	X	X	No	No	No	No	X	X	No	No	No	No
(1-g) Increased use and residual toxicity of agro-chemicals	X	X	No	No	No	No	X	X	No	No	No	Yes	X	X	No	No	No	Yes
(1-h) Outbreak of endemic diseases and prevalence of epidemic diseases	X	X	No	No	No	No	X	X	No	No	No	No	X	X	No	No	No	No
(1-i) Increase in domestic and other human wastes	X	X	No	No	No	No	X	X	No	No	No	No	X	X	No	No	No	No
2. NATURAL ENVIRONMENT																		
(2-a) Impacts on important fauna and flora, and degradation of ecosystem	X	X	No	No	No	No	X	X	No	No	No	No	X	X	No	No	No	Yes
(2-b) Proliferation of hazardous species	X	X	No	No	No	Yes	X	X	No	No	No	No	X	X	No	No	No	No
(2-c) Soil erosion	X	X	No	No	No	No	X	X	No	No	No	No	X	X	No	No	No	No
(2-d) Soil salination	X	X	No	No	No	No	X	X	No	No	No	No	X	X	No	No	No	No
(2-e) Change in surface water hydrology	X	X	No	No	No	Yes	X	X	No	No	No	No	X	X	No	No	No	No
(2-f) Change in groundwater hydrology	X	X	No	No	No	No	X	X	No	No	No	No	X	X	No	No	No	No
(2-g) Riverbed degradation, water pollution and eutrophication	X	X	No	No	No	No	X	X	No	No	No	No	X	X	No	No	No	Yes

Note : * O = Significant negative impacts, even with the built-in plans or measures friendly to environment which have been already proposed in the Report of the JICA study team ;

X = No or minor negative impacts, with the built-in plans or measures friendly to environment which have been already proposed in the Report of the JICA study team

Environmental items having significant negative impacts, and/or needing counter-measures and monitoring

Table 4.1 Problems and Constraints in the Study Area

Description	Existing Lower Moshi Project Area	Expanded Area	New Extension Area	Headworks and Diversion Channel
(1) Agronomic and Agroeconomy	Common Constraints in the Study Area (a) Restricted cropping seasondue to climatic conditions; unreliable and limited rainfall and prolonged dry spell. (b) Possibility of occurrence of cool temperature injury to paddy in winter season. (c) Low and unstable upland crops productivity depending on unreliable rainfall distribution in the mai rainy season. (d) Absence of a quality rice seed supply system and continuous use of a single variety of self-multiplied seed. (e) Less intensive farming practices for upland crops: use of self multiplied seed, limited use of fertiliser, late planting and late weeding. (f) Need of soil and water management to avoid salinity/sodicity problems. (g) Poor financial stastus of farmers limiting access to necessary farm inputs. (h) Limitation of grazing lands due to crop cultivation in the dry season. (i) Poor cooperative activities and economic activities such as farm inputs supply and marketing of farm products.			Less agricutural cultivation activity
	Specific Constraints in respective Areas (a) Limitation of irrigation water supply.	(a) Poor drainage condition and partly susceptible to seasonal inundation. (b) Restriction for mechanisation of land preparation due to lack of farm roads, small plot size and poor drainage condition.	(a) Presence of salt affected areas. (b) Existence of shallow groundwater of very poor quality and dange of further accumulation of salts (sourthern parts). (c) Extremely poor financial status of farmers.	
(2) Institution and Farmers' Organisation	(a) Low participation rate of CHAWAMPU. (b) Existence of many offenders against irrigation schedule. (c) Imperfect CHAWAMPU's By-Law. (d) Lack of solidarity as a rural community.	(a) Organisational weakness. (b) Financial constraints (c) Lack of technical know-how in O& M of irrigation facilities.	No farmers' organisation.	No farmers' organisation.
(3) Irrigation and Drainage	(a) Shortage of irrigation water (b) Damage of intake and turnout gates (c) Much leakage from watercources (d) Water stagnant by RS-4 and MR-3	(a) Poor canalization system (b) No drains (c) Less access roads (d) Damages by floods	No facility	No facility
(4) Water Management	(a) Need of strengthening of organization (b) Insufficient number of capable staff (c) Constant water shortage (d) No observation of irrigation calendar by Upper Mabogini area (e) Insufficient number of gate keepers (f) No proper filing of data	(a) Lack of technical know-how (b) No technical staff (c) No measuring device and control facility (d) Low irrigation efficiency	No activity	No activity
(5) O & M	(a) Need of strengthening of organization (b) Insufficient number of capable staff (c) Shortage of equipment for O & M	(a) Organisational weakness. (b) No capable staff	No activity	No activity
(6) Rural Road Network	(a) Poor maintenance (b) No passing control of heavy vehicles (c) Poor condition of side drains (d) Lack of O & M equipment	(a) Less proper maintence (b) Poor road density	(a) No proper maintence (b) Poor road density	(a) No proper maintence (b) Poor road density
(7) Water Supply System	(a) Insufficient public water supply system	(a) Poor public water supply system	(a) Very limited water source for domestic water	(a) Very limited water source for domestic water

Table 4.2 Crop Production in the Project Area under With -Project and Present Conditions

With-Project Conditions

Area/Net Farm Land(ha)	Crops	Rainy Season		Dry Season		Annual	
		Cropped Area (ha)	Production (t)	Cropped Area (ha)	Production (t)	Cropped Area (ha)	Production (t)
Existing Lower Moshi Project Area 2,150 ha	Rice	2,150	13,975	1,075	7,525	3,225	21,500
	Maize						
	Alfalfa			430	1,290	430	1,290
	Subtotal	2,150	13,975	1,505	8,815	3,655	22,790
New Extension Area 460 ha	Rice	2,090	13,585	1,045	7,315	3,135	20,900
	Maize						
	Alfalfa			418	1,254	418	1,254
	Subtotal	2,090	13,585	1,463	8,569	3,553	22,154
Expanded Area 2,090 ha	Rice	460	2,760	230	1,495	690	4,255
	Maize						
	Alfalfa			92	276	92	276
	Subtotal	460	2,760	322	1,771	782	4,531
Project Area Total 4,700 ha	Rice	4,700	30,320	2,350	16,335	7,050	46,655
	Maize	0	0	0	0	0	0
	Alfalfa	0	0	940	2,820	940	2,820
	Total	4,700	30,320	3,290	19,155	7,990	49,475

Present Conditions

Area/Net Farm Land(ha)	Crops	Rainy Season		Dry Season		Annual	
		Cropped Area (ha)	Production (t)	Cropped Area (ha)	Production (t)	Cropped Area (ha)	Production (t)
Existing Lower Moshi Project Area 2,150 ha	Rice	140	826	640	4300	780	5,126
	Maize	1,486	2,972			1,486	2,972
	Alfalfa						
	Subtotal	1,626	3,798	640	4,300	2,266	8,098
New Extension Area 2,289 ha	Rice						
	Maize	2,175	2,610			2,175	2,610
	Alfalfa						
	Subtotal	2,175	2,610	0	0	2,175	2,610
Expanded Area 487 ha	Rice	391	1368	263	1184	654	2,552
	Maize	96	192			96	192
	Alfalfa						
	Subtotal	487	1,560	263	1,184	750	2,744
Project Area Total 4,996 ha 1/	Rice	531	2,194	903	5,484	1,434	7,678
	Maize	3,757	5,774	0	0	3,757	5,774
	Alfalfa	0	0	0	0	0	0
	Total	4,288	7,968	903	5,484	5,191	13,452

1/: Including grass land of 70 ha

Incremental (With - Present)

Area	Crops	Rainy Season		Dry Season		Annual	
		Cropped Area (ha)	Production (t)	Cropped Area (ha)	Production (t)	Cropped Area (ha)	Production (t)
Existing Lower Moshi Project Area	Rice	2,010	13,149	435	3,225	2,445	16,374
	Maize	-1,486	-2,972	0	0	-1,486	-2,972
	Alfalfa	0	0	430	1,290	430	1,290
	Subtotal	524	10,177	865	4,515	1,389	14,692
New Extension Area	Rice	2,090	13,585	1,045	7,315	3,135	20,900
	Maize	-2,175	-2,610	0	0	-2,175	-2,610
	Alfalfa	0	0	418	1,254	418	1,254
	Subtotal	-85	10,975	1,463	8,569	1,378	19,544
Expanded Area	Rice	69	1,392	-33	311	36	1,703
	Maize	-96	-192	0	0	-96	-192
	Alfalfa	0	0	92	276	92	276
	Subtotal	-27	1,200	59	587	32	1,787
Project Area Total	Rice	4,169	28,126	1,447	10,851	5,616	38,977
	Maize	-3,757	-5,774	0	0	-3,757	-5,774
	Alfalfa	0	0	940	2,820	940	2,820
	Total	412	22,352	2,387	13,671	2,799	36,023

Table 4.3 Major Development Issues in Existing Lower Moshi Project Area and Agriculture Supporting Services

Year/Month	Major Development Issues: Issues	Agency	JICA Technical Cooperation	Major Training Activities BY KADC, KADP & KATC: Activities	Agency
1980	Construction of KADC	GOJ			
1981 2	KADC Start(long term experts)	MAC/JICA			
1982	Construction of KADC Trial Farm	GOJ		Training(machinery) 1 course	KADC
1983	Construction of KADC Pilot Farm	GOJ	KADC	Training(paddy cultivation) 2 courses Training(irrigation) 1 course Training(machinery) 1 course	KADC KADC KADC
1984	Start of Lower Moshi Project	OECF		Training(paddy cultivation) 2 courses Training(irrigation) 1 course Training(machinery) 2 courses	KADC KADC KADC
1985	Start of rice cultivation in Project	Beneficiary		Introduction of communal nursery system Training(paddy cultivation) 1 course Training(machinery) 1 course Training(irrigation) 2 courses Seminar on paddy cultivation	Beneficiary KADC KADC KADC KADC
	Tractor supplied under KR-II	GOJ		Start of tractor hiring services	KADC
1986 3	Start of KADP	MAC/JICA		Training(paddy cultivation) 1 course Training(machinery) 2 course Training(irrigation) 1 course Seminar on paddy cultivation	KADP KADP KADP KADP
1987 5	Completion of Lower Moshi Project	OECF		Full Operation of Existing Lower Moshi Project Training(paddy cultivation) 3 courses Training(machinery) 2 courses Training(irrigation) 1 course Seminar on paddy cultivation	KADP KADP KADP KADP KADP
1988 1	Introduction of 3 cropping seasons		KADP	Training(paddy cultivation) 1 course Training(machinery) 2 courses Training(irrigation) 3 courses	KADP KADP KADP
1989 4	Construction of Rice Mill	GOJ		Training(paddy cultivation) 1 course Training(machinery) 1 course	KADP KADP
1990				Training(machinery) 1 course Training(irrigation) 2 courses	KADP KADP
1991.3 3	Completion of KADP			Training(machinery) 1 course	KADP
3	KADP Project Follow-up		KADP Follow-up		
1993 3	Establishment of CHAWAMPU	Beneficiary KADP		Start of Joint Committee	KADP
1994	Tractor supplied under KR-II	GOJ	KADP Expert		
1994 7.0	Start of KATC Project	MAC/JICA		No major activities directed to the Existing Area	KATC
1995 3	Enaction of By-Laws *II*		KATC		
1996					
1997 3	Commencement of JICA F/S Study				

II: The Moshi District Council(Regulation of Agriculture in The Lower Moshi Irrigation Development Project) By-Laws, 1995

Table 4.4 Proposed Implementation Schedule of Experimental Programs, Seed Multiplication Plan and Tractor Hiring Services Strengthening Plan

Development Progress	Existing Project Area							2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150
Irrigation Command Area	New Extension Area									181	181	181	181	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
ha	Expanded Area								100	100	360	360	360	460	460	460	460	360	360	360	360	360	360	360	360	460	460	360	360	360	360
			Year																												
			1999		2000		2001		2002		2003		2004		2005		2006		2007		2008		2009		2010						
Supporting Program	Items		Rainy	Dry	Rainy	Dry	Rainy	Dry	Rainy	Dry	Rainy	Dry	Rainy	Dry	Rainy	Dry	Rainy	Dry	Rainy	Dry	Rainy	Dry	Rainy	Dry	Rainy	Dry					
Experimental Program	No. of Staff in Experimental Section	No.	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2							
	1. Varietal Selection	Schedule																													
	2. Verification Trails 1/																														
	- Variety Adaptability Trails	Schedule																													
		Q'ty	2	1	2	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							
	- Crop Adaptability Trials(alfalfa etc.)	Schedule																													
		Q'ty		2		2		2		1		1		1																		
	- Fertilizer Trial	Schedule																													
		Q'ty							1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1							
	- Soil Management	Schedule																													
		Q'ty					2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1							
	- Cultivation Practices	Schedule																													
		Q'ty													1	1	1	1	1	1	1	1	1	1							
		Schedule																													
	Verification Trials Total	Q'ty	2	3	2	3	4	5	5	5	4	5	4	4	4	4	4	4	4	4	4	4	4	4							
Seed Multiplication Plan	1. Estimated Cropped Area																														
Rice	(Estimated cropped area in Project Area)	ha						1,505	1,930	1,810	2,576	1,990	2,791	2,213	4,127	2,350	4,509	2,350	4,700	2,350	4,700	2,350	4,700	2,350	4,700	2,350					
	2. Seed Requirement for Planting																														
	(1 x 33 kg/ha)	t						50	64	60	85	66	92	73	136	78	149	78	155	78	155	78	155	78	155	78					
	3. Certified Seed Requirement/Production 2/																														
	(2 / 2: replacement of every 2 plantings)	t						50	32	30	43	33	46	37	68	39	74	39	78	39	78	39	78	39	78	39					
	4. Requirement of Seed Production Fields 3/																														
	(3 / 2,000 kg/ha)	ha						16	15	21	16	23	18	34	19	37	19	39	19	39	19	39	19	39	19	39					
	5. No. Seed Grower Required 4/																														
	(4 / farm size per seed grower (0.6 ha)	No.						27	25	35	27	38	30	57	32	62	32	65	32	65	32	65	32	65	32	65					
	6. Foundation Seed Requirement/Production																														
	(4 x 33kg/ha)	kg					525	493	701	542	260	602	1,124	680	1,228	640	1,280	640	1,280	640	1,280	640	1,280	640	1,287	653					
	7. Requirement of Seed Farm 5/																														
	(6 / 1,000 kg/ha)	ha					0.5	0.5	0.7	0.5	0.8	0.6	1.1	0.6	1.2	0.6	1.3	0.6	1.3	0.6	1.3	0.6	1.3	0.6	1.3	0.7					
Tractor Hiring Services																															
Strengthening Plan	1. Estimated Cropped Area/Service Area	ha						1,505	1,930	1,810	2,576	1,990	2,791	2,213	4,127	2,350	4,509	2,350	4,700	2,350	4,700	2,350	4,700	2,350	4,700	2,350					
for Land Preparation																															
	2. Requirements of Tractor Units for Operation 6/	No.						21	27	25	36	28	39	31	57	33	63	33	65	33	65	33	65	33	65	33					
	3. Repairment Requirements (2 x 10%) 7/	No.						2	3	3	3	3	3	3	4	3	6	3	7	3	7	3	7	3	7	3					
	4. Total Requirements (2+3)	No.						23	29	28	39	31	42	34	61	36	69	36	72	36	72	36	72	36	72	36					
	5. Tractors Passed by KADP 8/	No.						16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16					
	6.Procurement of Tractor	No.						7	6	0	10	0	3	0	20	0	7	0	3	0	0	0	0	0	0	0					
	7. No. of Tractor in Service (3 + 4) 9/	No.						23	29	29	39	39	42	42	61	61	69	69	72	72	72	72	72	72	72	72					

1/: Experimental staff x 2-3units 2/: Assuming seed replacement after cultivating 2 times(one self-multiplication) 3/: Assuming certified seed production of 2,000 kg/ha 4/: Assuming seed production farm 0.6 ha per seed grower 5/: Assuming production of foundation seed 1,000kg/ha
6/: Operation capacity of land preparation works: 1.2 ha/day x 60 days works/2 month/season = 72 ha/unit/season 7/: Assuming operation efficiency of 90 % 8/: Counting only new tractors supplied under KRII in 1994 and assuming replacement by beneficiaries
9/: Assuming replacement by beneficiaries

Table 4.5 Proposed Extension and Training Programs

Subjects To Be Addressed	Proposed Extension & Training Programs
Existing Project Area: Existing Paddy Fields: Net 1,014 ha	
- Requirements for technical training & extension on most agronomic aspects are low as successful rice cultivation in the past. - Requirements exists for training & extension on O&M, plant protection, soil management & feeding system in animal husbandry. - Requirements high for training & extension on cooperative and organizational activities. - Introduction of new variety & new crop(alfalfa)	Extension Programs Demonstration plots(variety, crop, soil management,etc.) - size: 0.3 ha/plot Demonstration area(variety, crop, soil management,etc.) - size: 40 ha/unit Mass guidance/campaign - target groups:50 representative farmers/ Field extension activities(TV system) by KADP - subjects: O&M, coperatives, group activities, soil management, new variety/crop, animal feeding, crop protection, seed production, etc. Training Programs Farmer Training - target groups & duration: 25 selected farmers/5 days - subjects: O&M, coperatives, group activities, soil management, new variety/crop, animal feeding, crop protection, seed production, etc.
Existing Project Area: Current Upland Fields: Net 1,046 ha & New Extension Area: Net 2,020 ha	
- Most farmers have experiences in intensive rice cultivation being employed as farm labourers. - However, limited experiences in management aspects of rice farming from seeding to harvesting. - Requirements high for training & extension on O&M, plant protection, soil management & feeding system in animal husbandry. - Requirements high for training & extension on cooperative and organizational activities. - Introduction of new variety & new crop(alfalfa)	Extension Programs Demonstration plots(recommended practices) - size: 0.3 ha/plot Demonstration plots(variety, crop, soil management,etc.) - size: 0.3 ha/plot Demonstration area(recommended practices) - size: 40 ha/unit Demonstration area(variety, crop, soil management,etc.) - size: 40 ha/unit Mass guidance/campaign - target groups:50 representative farmers/ Field extension activities(TV system) by KADP - subjects: recommended practices, O&M, coperatives, group activities, soil management, new variety/crop, animal feeding and plant protection etc. Training Programs Farmer Training - target groups & duration: 25 selected farmers/5 days - subjects: recommended practices, O&M, coperatives, group activities, soil management, new variety/crop, animal feeding and plant protection etc. Field Practical Training - timing: 1 season prior to the start of rice cultivation in the area - target groups: preferably all beneficiary farmers not having paddy fields at present - duration: 1 cropping season
Expanded Area: Net 460 ha	
- Requirements for technical training & extension on agronomic aspects still exist. - Requirements high for training & extension on O&M. - Requirements high for training & extension on cooperative and organizational activities. - Introduction of new variety & new crop(alfalfa)	Extension Programs Demonstration plots(recommended practices) - size: 0.3 ha/plot Demonstration plots(variety, crop, soil management, etc.) - size: 0.3 ha/plot Demonstration area(recommended practices) - size: 40 ha/unit Demonstration area(variety, crop, soil management, etc.) - size: 40 ha/unit Mass guidance/campaign - target groups:50 representative farmers/ Field extension activities(TV system) by KADP - subjects: recommended practices, O&M, coperatives, group activities, soil management, new variety/crop, animal feeding and plant protection etc. Training Programs Farmer Training - target groups & duration: 25 selected farmers/5 days - subjects: recommended practices, O&M, coperatives, group activities, soil management, new variety/crop, animal feeding and plant protection etc.

Table 4.6 Proposed Implementation Schedule of Extension and Training Programs (1/2)

1/ Irrigation command area/42ha(standard size of a tertiary block) 2/: In principle, 1 course 25 participants; 1 participant per tertiary block

Target Area/Program	Programme(unit)		Year 1999 Rainy	1999 Dry	2000 Rainy	2000 Dry	2001 Rainy	2001 Dry	2002 Rainy	2002 Dry	2003 Rainy	2003 Dry	2004 Rainy	2004 Dry	2005 Rainy	2005 Dry	2006 Rainy	2006 Dry	2007 Rainy	2007 Dry	2008 Rainy	2008 Dry	2009 Rainy	2009 Dry	2010 Rainy	2010 Dry
Development Progress	Existing Project Area								2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150		
Irrigation Command Area	New Extension Area										181	181	181	181	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000		
(ha)	Expanded Area								100	100	460	460	460	460	460	460	460	460	460	460	460	460	460	460		
Existing Project Area																										
1. Existing Paddy Fields	No. of Tertiary Block 1/	26																								
Extension Programs	No. of Extension Staff Assigned		2	2	2	2	1	1	1	1	1	1	1	1	1											
	Demonstration Plot(plots)																									
	No. of Extension Staff x 2 - 5	Q'ty					3	3	4	4	4	4	2	2	2											
	Demonstration Area(units)																									
	No. of Extension Staff x 1 - 2	Q'ty					1	1	2	2	2	2	1	1	1											
	Mass Guidance/Campaign(units)	Schedule					x	x	x	x			x		x	x		x				x		x		
		Q'ty					2	1	1	1			1		4	2		1				1		1		
	Field Extension Activities	Schedule																								
Training Programs	Farmer Training(course)	Schedule					x	x	x				x				x				x			x		
	No.Tertiary Block/25 x 1 2/	Q'ty					1	1	1				1				1				1			1		
2. Current Upland Fields	No. of Tertiary Block 1/	24																								
Extension Programs	No. of Extension Staff Assigned							2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1		
	Demonstration Plot(plots)																									
	No. of Extension Staff x 2 - 5	Q'ty						10	10	10	10	10	10	10	3	3	3	3	3	3	3	3	3	3		
	Demonstration Area(units)																									
	No. of Extension Staff x 1 - 2	Q'ty						4	4	4	4	4	4	4												
	Mass Guidance/Campaign(units)	Schedule						x	x	x	x	x	x	x	x	x		x		x				x		
		Q'ty						2	2	2	2	2	2	2	1	2		1		1				1		
	Field Extension Activities	Schedule																								
Training Programs	Farmer Training(course)	Schedule							x	x	x	x	x	x	x		x		x		x		x			
	No.Tertiary Block/25 x 1 2/	Q'ty							2	2	2	2	2	2		1		1		1		1		1		
	Field Practical Training	Schedule																								
All Existing Project Area	No. of Tertiary Block 1/	50																								
Extension Programs	No.of Extension Staff Assigned		2	2	2	2	1	3	3	3	3	3	3	3	2	1	1	1	1	1	1	1	1	1		
	Demonstration Plot(plots)																									
	No. of Extension Staff x 2 - 5	Q'ty	0	0	0	0	3	13	14	14	14	14	12	12	5	3	3	3	3	3	3	3	3	3		
	Demonstration Area(units)																									
	No. of Extension Staff x 1 - 2	Q'ty	0	0	0	0	1	5	6	6	6	6	5	5	1	0	0	0	0	0	0	0	0	0		
	Mass Guidance/Campaign(units)	Schedule					x	x	x	x	x	x	x	x	x	x	x	x				x		x		
		Q'ty	0	0	0	0	2	3	3	3	2	2	3	2	5	4	0	2	0	0	2	0	0	2		
	Field Extension Activities	Schedule																								
Training Programs	Farmer Training(course)	Schedule							x	x	x	x	x	x		x	x	x		x	x	x		x		
	No.Tertiary Block/25 x 1 2/	Q'ty	0	0	0	0	0	1	3	3	2	2	3	2	0	1	1	1	0	1	1	1	0	2		
	Field Practical Training	Schedule																								

Table 4.6 Proposed Implementation Schedule of Extension and Training Programs (2/2)

1/ Irrigation command area/42ha(standard size of a tertiary block) 2/ In principle, 1 course 25 participants: 1 participant per tertiary block

Development Progress	Existing Project Area								2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150
Irrigation Command Area	New Extension Area										181	181	181	181	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
(ha)	Expanded Area									100	100	460	460	460	460	460	460	460	460	460	460	460	460	460	460

Target Area/Program	Programs(unit)		Year																						
			1999		2000		2001		2002		2003		2004		2005		2006		2007		2008		2009		2010
			Rainy	Dry	Rainy	Dry	Rainy	Dry	Rainy	Dry	Rainy	Dry	Rainy	Dry	Rainy	Dry	Rainy	Dry	Rainy	Dry	Rainy	Dry	Rainy	Dry	Rainy
New Extension Area	No. of Tertiary Block 1/	80																							
Extension Programs	No. of Extension Staff Assigned								1	1	1	1	1	2	2	4	4	4	4	4	4	4	4	4	
	Demonstration Plot(plots)																								
	No. of Extension Staff x 2 - 5	Qty							3	3	3	3	3	6	6	15	15	15	15	8	8	8	8	8	
	Demonstration Area(units)																								
	No. of Extension Staff x 1 - 2	Qty												2	2	6	6	0	6	2	2	2	2	2	
	Mass Guidance/Campaign(units)	Schedule							x	x	x			x	x	x	x	x	x		x			x	
		Qty							1	1				2	4	1	1	1	1		1			1	
	Field Extension Activities	Schedule																							
Training Programs	Farmer Training(course)	Schedule							x	x				x	x	x	x	x			x			x	
	No.Tertiary Block/25 x 1 - 2/	Qty							1	1				1	1	2	2	2	2		1			1	
	Field Practical Training	Schedule																							
Expanded Area	No. of Tertiary Block 1/	11															1	1	1	1	1	1	1	1	
Extension Programs	No. of Extension Staff Assigned																								
	Demonstration Plot(plots)																								
	No. of Extension Staff x 2 - 5	Qty															3	3	3	3	2	2	2	2	
	Demonstration Area(units)																								
	No. of Extension Staff x 1 - 2	Qty															1	1	1	1					
	Mass Guidance/Campaign(units)	Schedule															x	x			x			x	
		Qty															1	1			1			1	
	Field Extension Activities	Schedule																							
Training Programs	Farmer Training(course)	Schedule															x				x				
	No.Tertiary Block/25 x 1 - 2/	Qty															1				1				
Whole Project Area	No. of Tertiary Block 1/	1121																							
Extension Programs	No. of Extension Staff Assigned		2	2	2	2	1	3	4	4	4	4	4	5	4	5	6	6	6	6	6	6	6	6	
	Demonstration Plot(plots)																								
	No. of Extension Staff x 2 - 5	Qty	0	0	0	0	3	13	17	17	17	17	15	18	11	18	21	21	21	14	13	13	13	13	
	Demonstration Area(units)																								
	No. of Extension Staff x 1 - 2	Qty	0	0	0	0	1	5	6	6	6	6	5	7	3	6	7	7	7	3	2	2	2	2	
	Mass Guidance/Campaign(units)	Schedule					x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
		Qty	0	0	0	0	2	4	4	4	2	2	3	4	9	5	2	4	1	0	4	0	0	4	
	Field Extension Activities	Schedule																							
Training Programs	Farmer Training(course)	Schedule					x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
	No.Tertiary Block/25 x 1 - 2/	Qty	0	0	0	0	0	1	4	4	2	2	3	3	1	3	4	3	2	1	3	1	0	3	
	Field Practical Training	Schedule																							
	Staff Training(course)	Schedule			x	x		x					x		x					x					
		Qty			1	1		1					1		1										

Table 4.7 Result of Water Balance Study

(1) Irrigable Area per Water Source

(Unit : ha)

Area	River	Abstraction point	Rainy season	Dry season
Expanded Area	Rau	Mandaka Mnono	360*	252
	Njoro	Kaloleni**	100*	70
Existing Lower Moshi Area	Njoro	Mabogini Intake Weir	257	180
	Rau	Rau Ya Kati Intake Weir	160	294
Extension Area	Kikuletwa		3,823	2,494
Total			4,700	3,290

*Note : * Maximum Development Area, ** Total of 4 systems*
70 ha of sugar estate and 80 ha of KATC farm can also be irrigated.

(2) Diversion Water Requirement

(Unit : m^3/s)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Northern Kaloleni	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.00
Eastern Kaloleni	0.01	0.04	0.06	0.05	0.05	0.03	0.01	0.02	0.03	0.03	0.04	0.02
Southern Kaloleni 1	0.02	0.04	0.07	0.06	0.06	0.03	0.01	0.03	0.03	0.04	0.04	0.03
Southern Kaloleni 2	0.02	0.05	0.08	0.07	0.07	0.04	0.01	0.03	0.04	0.04	0.05	0.03
Mabogini	0.19	0.40	0.64	0.56	0.53	0.33	0.11	0.28	0.34	0.38	0.41	0.29
Mandaka Mnono	0.17	0.46	0.79	0.69	0.65	0.36	0.06	0.29	0.38	0.44	0.47	0.30
Rau Ya Kati	0.17	0.23	0.35	0.29	0.27	0.16	0.04	0.34	0.44	0.51	0.55	0.35
Kikuletwa	1.90	5.87	8.96	7.81	7.04	3.99	0.72	2.30	4.26	4.65	4.97	3.16

Table 4.8 Rehabilitation and Improvement Plan of Village Roads

Location and Mark	Name of Village	Length (m)	Road Width (m)	Pavement	Remarks
(1) Diversion Channel Route					
A-1	Kawaya	500	4.0	Unpaved	
A-2	Mkalama	800	- do -	- do -	
A-3	- do -	1,000	- do -	- do -	
A-4	- do -	900	- do -	- do -	
A-5	Longoi	700	- do -	- do -	
A-6	Longoi/Kikafu Chini	600	- do -	- do -	
A-7	Kikafu Chini	400	- do -	- do -	
Sub-total		4,900			
(2) Extension Area					
B-1	Chekereni/Mikuja	1,000	4.0	Unpaved	System B
Sub total		1,000			
(3) Expanded Area					
C-1	Kaloleni	200	4	Unpaved	
C-2	- do -	300	- do -	- do -	
C-2	- do -	200	- do -	- do -	
C-3	Mandaka/Chekereni	3,100	- do -	- do -	
Sub-total		3,800			
Total		8,700			

Table 4.9 Estimate of Population and Livestock in 2015

Project Area/Village	Area (ha)	Basic Data 1988		*1 Growth Rate per year (Ai)	Estimated 1997		Estimated 2015		*2 Ratio for Canal User (Ai)	*2 Estimate Canal User (nos.)	Cattle		Goat *5		Sheep *5	
		Household (nos.)	Population (nos.)		Household (nos.) (1)	Population (nos.)	Household (nos.)	Population (nos.) (2)	(3)	(4)=(2) x (3)	*4 Acutual 1997 (nos.)	Estimate 2015 (nos.)	*4 Acutual 1997 (nos.)	Estimate 2015 (nos.)	*4 Acutual 1997 (nos.)	Estimate 2015 (nos.)
1. Existing Lower Moshi Area												*3		*3		*3
Mabogini	955	432	2,741	2.2	530	3,340	790	4,940	60	2,970	827	900	1,650	1,700	284	300
Rau Ya Kati	632	327	1,695	2.2	400	2,070	600	3,070	90	2,770	670	700	1,428	1,500	724	800
Chekereni	420	316	1,571	2.2	390	1,920	570	2,840	30	860	449	500	1,356	1,400	348	400
Oria	293	694	3,783	2.2	840	4,610	1,250	6,830	70	4,700	1,880	1,900	2,802	2,900	916	1,000
sub total	2,300	1,769	9,790		2,160	11,940	3,210	17,680		11,300	3,826	4,000	7,236	7,500	2,272	2,500
2. Expanded Area												*3		*3		*3
Mandaka	360	319	1,444	2.2	400	1,760	580	2,610	90	2,350	682	700	1,104	1,200	439	500
Kaloleni	100	697	2,568	2.2	850	3,130	1,260	4,630	30	1,390	6	100	298	300	49	100
sub total	460	1,016	4,012		1,250	4,890	1,840	7,240		3,740	688	800	1,402	1,500	488	600
3. Extension Area												*3		*3		*3
Mabogini	480	215	1,364	2.2	270	1,660	390	2,460	60	1,480	412	500	821	900	142	200
Chekereni	340	258	1,280	2.2	320	1,560	470	2,320	60	1,400	365	400	1,104	1,200	284	300
Mtakuja	770	596	2,713	2.2	720	3,310	1,070	4,900	90	4,410	3,024	3,100	4,000	4,000	1,800	1,800
Mvuleni	500	448	1,845	2.2	550	2,250	820	3,340	80	2,680	350	400	500	500	200	200
sub total	2,090	1,517	7,202		1,860	8,780	2,750	13,020		9,970	4,151	4,400	6,425	6,600	2,426	2,500
Sub Total	4,850	4,302	21,004		5,270	25,610	7,800	37,940		25,010	8,665	9,200	15,063	15,600	5,186	5,600
4. Diversion Channel Route											*4		*4		*4	
Kawaya	-	-	-	2.2	1,360	3,690	2,030	5,470	20	1,100	(7,500)	11,100	(14,300)	21,200	(4,100)	6,100
Mkalama	-	-	-	2.2	370	2,580	550	3,820	60	2,300	(2,100)	3,200	(3,900)	5,800	(1,100)	1,700
Longoi	-	-	-	2.2	620	4,000	920	5,920	60	3,560	(3,500)	5,200	(6,500)	9,700	(1,900)	2,900
Kikafu Chini	-	-	-	2.2	560	2,800	830	4,150	40	1,660	(3,100)	4,600	(5,900)	8,800	(1,700)	2,600
Mijyongweni	-	-	-	2.2	850	3,000	1,270	4,440	40	1,780	(4,700)	7,000	(8,900)	13,200	(2,600)	3,900
Sub total	-	-	-		3,760	16,070	5,600	23,800		10,400	(20,900)	31,100	(56,000)	58,700	(11,400)	17,200
Total	-	-	-		9,030		13,400	61,740		**35,410**	29,565	40,300	71,063	74,300	16,586	22,800

Snuce : Hearing Survey, 1997, JICA Study Team.

Note : 1.Growth ratio per year is applied for 2.2% which is the average from 1979 to 1988.

2. Ratio for Canal user in 2015 is applied for same ratio on data of 1997.

3. Livestock numbers of Existing Lower Moshi, Proposed Extension, Expanded Area are based on the results of discussion with RALDO.

4. Livestock number of Diversion Channel Route in 1997 is calculated by the following formula, "â@:Household estimated 1997Â~average number of each livestock in other three areas".

Table 6.1 Breakdown of Construction Cost

Work Description	Foreign Currency (US$1,000)	Local Currency (Tsh.1,000)	Total (US$ 1,000)
1.Phase-I Works			
(1) Headworks			
Preparatory Works	125	21,000	159
Diversion Works	96	10,782	113
Diversion Weir	1,985	342,332	2,537
Intake Structure	166	33,023	219
Metal Works	176	12,035	195
Control Facility	50	9,600	65
Sub-total (1)	**2,597**	**428,771**	**3,289**
(2) Diversion Channel			
Preparatory Works	160	30,000	208
Earth Works	3,126	383,806	3,745
Lining Works	2,657	677,886	3,751
Related Structure	2,306	351,230	2,873
Domestic Facility	108	4,972	116
Metal Works	96	37,559	157
Sub-total (2)	**8,454**	**1,485,453**	**10,850**
(3) Rehabilitation and Enhancement Works of Existing Lower Moshi Area			
Preparatory Works	165	43,000	234
Rehabili. Intake	5	584	5
Rehabili. Irrigation, Main System	10	42,100	78
Rehabili. Irrigation, Structure	17	69,011	128
Rehabili. Drainage	37	6,926	48
Rehabili. Farm Road	702	202,050	1,028
Rehabili. Flood Protection Dike	0	28,967	47
Rehabili. On-Farm	0	16,949	27
Enhancement, Irrigation System	356	104,833	525
Enhancement, Drainage System	25	10,609	42
Enhancement, Farm Road	172	93,627	323
Enhancement, On-Farm	1,931	265,836	2,359
Rural Facility	14	8,000	27
Sub-total (3)	**3,434**	**892,491**	**4,874**
Phase-I Total	**14,484**	**2,806,716**	**19,013**

Work Description	Foreign Currency	Foreign Currency (US$1,000)	Local Currency (Tsh.1,000)	Total (US$1,000)
2. Phase-II Work				
(1) Extension Area				
- Preparatory Works	430,000	430	95,000	583
- Main Irrigation Canal, Earth Works	37,190	37	10,852	55
- M.Irrigation Canal, Lining Works	211,210	211	88,223	354
- M.Irrigation Canal, Structure Works	56,356	56	33,309	110
- M.Irrigation Canal, Gate Works	42,811	43	2,585	47
- Sec.Irrigation Canal, Earth Works	173,960	174	41,175	240
- S.Irrigation Canal, Lining Works	505,588	506	223,341	866
- S.Irrigation Canal, Structure Works	99,646	100	69,001	211
- S.Irrigation Canal, Gate Works	32,490	32	5,964	42
- Tertiary Irrigation Canal, Earth Works	1,494,480	1,494	480,488	2,269
- Tertiary Irrigation Canal, Structure	71,295	71	28,664	118
- Main Drainage Canal, Earth Works	22,940	23	2,960	28
- Main Drainage Canal, Structure Works	57,692	58	21,382	92
- Sec. Drainage Canal, Earth Works	29,760	30	3,840	36
- Sec. Drainage Canal, Structure Works	57,293	57	21,898	93
- Tert. Drainage Canal, Earth Works	35,520	36	4,416	43
(2)-1 Mandaka Munono Area				
- Preparatory Works	94,000	94	27,000	138
- Intake Facility	16,081	16	4,833	24
- Main Irrigation Canal	122,663	123	50,886	205
- Secondary Irrigation Canal	450,592	451	186,232	751
- Tertiary Irrigation Canal	198,745	199	72,925	316
- Main Drainage Canal	0	0	0	0
- Secondary Drainage Canal	14,470	14	3,893	21
- Tertiary Drainage Canal	11,276	11	4,513	19
- Main Farm Road	21,235	21	3,579	27
- Secondary Farm Road	110,875	111	18,545	141
- Tertiary Farm Road	66,965	67	11,315	85
- Flood Dike	157,946	158	48,842	237
- On-Farm	599,356	599	95,805	754
- Rural Facility	113,463	113	31,071	164
Sub-total (2)-1	**1,977,667**	**1,978**	**559,439**	**2,880**
(2)-2 Kalorem Area				
- Preparatory Works	20,000	20	4,700	28
- Intake Facility	28,971	29	6,629	40
- Main Irrigation Canal	20,960	21	10,007	37
- Secondary Irrigation Canal	0	0	0	0
- Tertiary Irrigation Canal	96,914	97	35,142	154
- Main Drainage Canal	0	0	0	0
- Secondary Drainage Canal	9,969	10	4,110	17
- Tertiary Drainage Canal	2,830	3	563	4
- Main Farm Road	0	0	0	0
- Secondary Farm Road	3,689	4	613	5
- Tertiary Farm Road	32,246	32	5,448	41
- Flood Dike	0	0	0	0
- On-Farm	166,488	166	26,613	209
- Rural Facility	14,877	15	3,036	20
Sub-total (2)-2	**396,944**	**397**	**96,860**	**553**
Sub-total (2) Expanded Area	**2,374,611**	**2,375**	**656,299**	**3,433**
Phase - II Total		**11,388**	**2,615,720**	**15,607**
Total (Phase I + II)		**25,873**	**5,422,435**	**34,620**

Table 7.1 Cost Allocation and Disbursement

Case-1 Whole Project Area (4,700 ha) (Unit :US$1,000)

Item	Financial Cost	C.F.	Economic Cost	Fiscal Year 1998	1999	2000	2001	2002	2003	2004	2005
1 CivilWorks and Hydropower Plants Cost to be allocated											
(a) Headworks	3,289	0.8	2,631	0	1,763	868	0	0	0	0	0
(b) Diversion channel	9,944	0.8	7,955	0	3,978	3,977	0	0	0	0	0
(c) Trucnk road	906	0.8	725	0	377	348	0	0	0	0	0
Sub-total of Item 1	14,139		11,341	0	6,118	5,193	0	0	0	0	0
2 Original Cost for Each Area											
(a) Existing Lower Moshi Project Area (2,150ha)	4,874	0.8	3,899	0	1,950	1,949	0	0	0	0	0
(b) New Extension Areas (2,090ha)											
- System-A (224 ha)	1,305	0.8	1,044	0	0	0	1,044	0	0	0	0
- System-B (1,526ha)	8,887	0.8	7,110	0	0	0	1,422	2,844	2,844	0	0
- System-C (340 ha)	1,981	0.8	1,585	0	0	0	1,327	258	0	0	0
(c) Expanded Area (460ha)											
- Mandaka Mnono Area (360 ha)	2,880	0.8	2,304	0	0	0	1,544	760	0	0	0
- Kaloleni Area (100 ha)	553	0.8	442	0	0	0	442	0	0	0	0
Sub-total of (2)	20,480		16,384	0	1,950	1,949	5,779	3,862	2,844	0	0
Total of Item 1 and 2	34,619		27,695	0	8,068	7,142	5,779	3,862	2,844	0	0
3 O & M equipment	1,000	1.0	1,000	0	0	500	0	0	500	0	0
4 Administration cost	841	1.0	841	204	205	204	76	76	76	0	0
5 Engineering Services	4,536	1.0	4,536	1,102	1,102	1,101	411	410	410	0	0
Total of Items 1, 2, 3, 4 and 5	40,996		34,072	1,306	9,375	8,947	6,266	4,348	3,830	0	0
6 Physical Contengency (10% of Items 1,2,3,4 and 5)	4,100		3,407	130	938	894	627	435	383	0	0
Grand Total	45,096		37,479	1,436	10,313	9,841	6,893	4,783	4,213	0	0

Case-2 Existing Lower Moshi Project Area (2,150 ha) (Unit :US$1,000)

Items	Financial Cost	C.F.	Economic Cost	Fiscal Year 1998	1999	2000	2001	2002	2003	2004	2005
1 Construction Works											
(1) Allocated Cost for civil works & hydropower plant											
(a) Headworks	1,491	0.8	1,193	0	800	393	0	0	0	0	0
(b) Diversion channel	4,508	0.8	3,606	0	1,803	1,803	0	0	0	0	0
(c) Trucnk road	411	0.8	329	0	171	158	0	0	0	0	0
Sub-total of (1)	6,410		5,128	0	2,774	2,354	0	0	0	0	0
(2) Original Cost											
(a) Rehabilitation, rural infrastructure and on-farm works	4,874	0.8	3,899	0	1,950	1,949	0	0	0	0	0
Sub total of (2)	4,874		3,899	0	1,950	1,949	0	0	0	0	0
Total of Item 1	11,284		9,027	0	4,724	4,303	0	0	0	0	0
2 O & M equipment	500	1.0	500	0	0	500	0	0	0	0	0
3 Administration cost	385	1.0	385	128	129	128	0	0	0	0	0
4 Engineering Services	2,075	1.0	2,075	692	692	691	0	0	0	0	0
Total of Items 1, 2, 3 and 4	14,244		11,987	820	5,545	5,622	0	0	0	0	0
5 Physical Contengency (10% of Items 1,2,3 and 4)	1,425		1,199	82	555	562	0	0	0	0	0
Grand Total	15,669		13,186	902	6,100	6,184	0	0	0	0	0

Case-3 New Extension Area Area (2,090 h) and Expanded Area (460 ha) (Unit :US$1,000)

Item	Financial Cost	C.F.	Economic Cost	Fiscal Year 1998	1999	2000	2001	2002	2003	2004	2005
1 Construction Works											
(1) Allocated Cost for civil works & hydropower plant											
(a) Headworks	1,798	0.8	1,438	0	963	475	0	0	0	0	0
(b) Diversion channel	5,436	0.8	4,349	0	2,175	2,174	0	0	0	0	0
(c) Trucnk road	495	0.8	396	0	206	190	0	0	0	0	0
Sub total of (1)	7,729		6,183	0	3,344	2,839	0	0	0	0	0
(2) Original Cost of New Extension Area											
(a) System-A (224 ha)	1,305	0.8	1,044	0	0	0	1,044	0	0	0	0
(b) System-B (1,526 ha)	8,887	0.8	7,110	0	0	0	1,422	2,844	2,844	0	0
(c) System-C(340 ha)	1,981	0.8	1,585	0	0	0	1,327	258	0	0	0
Sub total of (2)	12,173		9,739	0	0	0	3,793	3,102	2,844	0	0
(3) Original Cost for Expanded Area											
(a) Mandaka Area (360 ha)	2,880	0.8	2,304	0	0	0	1,544	760	0	0	0
(b) Kaloleni Area (100 ha)	553	0.8	442	0	0	0	442	0	0	0	0
Sub-total of (3)	3,433		2,746	0	0	0	1,986	760	0	0	0
Total of Item 1	23,335		18,668	0	3,344	2,839	5,779	3,862	2,844	0	0
2 O & M equipment	500	1.0	500	0	0	0	0	0	500	0	0
3 Administration cost	456	1.0	456	76	76	76	76	76	76	0	0
4 Engineering Services	2,461	1.0	2,461	410	410	410	411	410	410	0	0
Total of Items 1, 2, 3 and 4	26,752		22,085	486	3,830	3,325	6,266	4,348	3,830	0	0
5 Physical Contengency (10% of Items 1,2,3 and 4)	2,675		2,208	48	383	332	627	435	383	0	0
Grand Total	29,427		24,293	534	4,213	3,657	6,893	4,783	4,213	0	0

Note C.F. : Conversion Factor

Table 7.2 Cash Flow Statement of Project Implementation and Operation

Year	(1) Cash Outflow (Tsh.1,000)								(2) Cash Inflow (Tsh.1,000)							Balance	
	Capital Costs 1/			O&M Works		Tractor Hiring Services		Total Cash Outflow	Capital Investment 1/			Revenue			Total Cash Inflow	Annual (II - I)	Cummulative
	Project Works	Tractor Hiring Services	Total	Total O&M Cost	Replacement Costs	Operation Costs	Replacement Costs		Project Works	Tractor Hiring Services	Total	Water Charge 2/	Tractor Hiring Service Fees 3/	Total			
1998	484,220		484,220					484,220	484,220		484,220			0	484,220	0	0
1999	8,234,220		8,234,220					8,234,220	8,234,220		8,234,220			0	8,234,220	0	0
2000	8,374,340		8,374,340					8,374,340	8,374,340		8,374,340			0	8,374,340	0	0
2001	6,139,240	154,700	6,293,940	46,500		48,913		6,389,353	6,139,240	154,700	6,293,940	99,975	75,250	175,225	6,469,165	79,812	79,812
2002	5,178,860	136,400	5,315,260	46,500		121,996		5,483,756	5,178,860	136,400	5,315,260	99,975	187,688	287,663	5,602,923	119,167	198,979
2003	4,839,100	221,000	5,060,100	46,500		148,841		5,255,441	4,839,100	221,000	5,060,100	99,975	228,988	328,963	5,389,063	133,622	332,601
2004		66,300	66,300	101,680		163,076		331,056		66,300	66,300	218,550	250,888	469,438	535,738	204,682	537,283
2005		445,800	445,800	101,680		214,277		761,757		445,800	445,800	218,550	329,675	548,225	994,025	232,268	769,551
2006		154,700	154,700	88,660		226,854		470,214		154,700	154,700	205,220	349,025	554,245	708,945	238,731	1,008,282
2007		73,900	73,900	88,660		236,739	41,000	440,299		73,900	73,900	205,220	366,300	571,520	645,420	205,121	1,213,403
2008				88,660		236,739	95,000	420,399				205,220	369,000	574,220	574,220	153,821	1,367,224
2009				73,160		236,739	95,000	404,899				189,410	369,000	558,410	558,410	153,511	1,520,735
2010				73,160	310,000	236,739	95,000	714,899				189,410	369,000	558,410	558,410	-156,489	1,364,246
2011				73,160		236,739	95,000	404,899				189,410	369,000	558,410	558,410	153,511	1,517,757
2012				73,160		236,739	117,100	426,999				189,410	370,295	559,705	559,705	132,706	1,650,463
2013				73,160	310,000	236,739	153,100	772,999				189,410	371,905	561,315	561,315	-211,684	1,438,779
2014				73,160		236,739	149,000	458,899				189,410	371,890	561,300	561,300	102,401	1,541,180
2015				73,160		236,739	149,000	458,899				189,410	371,700	561,110	561,110	102,211	1,643,391
2016				73,160		236,739	149,000	458,899				189,410	371,890	561,300	561,300	102,401	1,745,792
2017				73,160		236,739	149,000	458,899				189,410	371,700	561,110	561,110	102,211	1,848,003
2018				73,160		236,739	149,000	458,899				189,410	371,890	561,300	561,300	102,401	1,950,404
2019				73,160		236,739	153,100	462,999				189,410	371,905	561,315	561,315	98,316	2,048,720
2020				73,160	620,000	236,739	153,100	1,082,999				189,410	371,905	561,315	561,315	-521,684	1,527,036
2021				73,160		236,739	149,000	458,899				189,410	371,700	561,110	561,110	102,211	1,629,247
2022				73,160		236,739	149,000	458,899				189,410	371,890	561,300	561,300	102,401	1,731,648
2023				73,160	310,000	236,739	149,000	768,899				189,410	371,700	561,110	561,110	-207,789	1,523,859
2024				73,160		236,739	149,000	458,899				189,410	371,890	561,300	561,300	102,401	1,626,260
2025				73,160	750,200	236,739	149,000	1,209,099				189,410	371,700	561,110	561,110	-647,989	978,271
2026				73,160		236,739	153,100	462,999				189,410	372,095	561,505	561,505	98,506	1,076,777
2027				73,160		236,739	153,100	462,999				189,410	371,905	561,315	561,315	98,316	1,175,093
2028				73,160	310,000	236,739	149,000	768,899				189,410	371,890	561,300	561,300	-207,599	967,494
2029				73,160		236,739	149,000	458,899				189,410	371,700	561,110	561,110	102,211	1,069,705
2030				73,160	310,000	236,739	149,000	768,899				189,410	371,700	561,110	561,110	-207,789	861,916
2031				73,160		236,739	149,000	458,899				189,410	371,700	561,110	561,110	102,211	964,127
2032				73,160		236,739	149,000	458,899				189,410	371,890	561,300	561,300	102,401	1,066,528
2033				73,160	310,000	236,739	153,100	772,999				189,410	371,905	561,315	561,315	-211,684	854,844
2034				73,160		236,739	153,100	462,999				189,410	372,095	561,505	561,505	98,506	953,350
2035				73,160		236,739	149,000	458,899				189,410	371,700	561,110	561,110	102,211	1,055,561
2036				73,160		236,739	149,000	458,899				189,410	371,890	561,300	561,300	102,401	1,157,962
2037				73,160		236,739	149,000	458,899				189,410	371,700	561,110	561,110	102,211	1,260,173
2038				73,160		236,739	149,000	458,899				189,410	371,890	561,300	561,300	102,401	1,362,574
2039				73,160		236,739	149,000	458,899				189,410	371,700	561,110	561,110	102,211	1,464,785
2040				73,160	310,000	236,739	153,100	772,999				189,410	371,905	561,315	561,315	-211,684	1,253,101
2041				73,160		236,739	153,100	462,999				189,410	371,905	561,315	561,315	98,316	1,351,417
2042				73,160		236,739	149,000	458,899				189,410	371,890	561,300	561,300	102,401	1,453,818
2043				73,160	310,000	236,739	149,000	768,899				189,410	371,700	561,110	561,110	-207,789	1,246,029
2044				73,160		236,739	149,000	458,899				189,410	371,890	561,300	561,300	102,401	1,348,430
2045				73,160	310,000	236,739	149,000	768,899				189,410	371,700	561,110	561,110	-207,789	1,140,641
2046				73,160		236,739	149,000	458,899				189,410	371,890	561,300	561,300	102,401	1,243,042
2047				73,160		236,739	153,100	462,999				189,410	371,905	561,315	561,315	98,316	1,341,358
2048				73,160		236,739	153,100	462,999				189,410	372,095	561,505	561,505	98,506	1,439,864
2049				73,160		236,739	149,000	458,899				189,410	371,700	561,110	561,110	102,211	1,542,075
2050				73,160		236,739	149,000	458,899				189,410	371,700	561,110	561,110	102,211	1,644,286

1/: Cpital funds of the project works and tractor hiring services are arranged by the Government of Tanzania
2/: Revenue from water charge to be collected from the beneficiaries
3/: Tractor Hiring Service fees to be collected from the beneficiaries(paddy cultivation Tsh. 50,000/ha & alfalfa cultivation Tsh. 12,500/ha) + salvage value of machinery(5%)

Table 9.1 Priorities and Strategies

Area	Priorities	Impact/Objective	Strategies
1. Women's Workload	1. Introduction of appropriate technologies, i)Conservation on fuel a. Improved/efficiency energy conserving stoves; b. Utilization of timber saw dusts and rice husks for brequest making c. Establishing of local tree nurseries in the homesteads.		* Promotion of appropriate technologies biogas, improved stoves, grinding mills. * Training of community members in appropriate technologies. * Promote women's participation in manufacture of technologies. * Train women in manufacture installation utilization of different
	2. Introduction/enhancement of child care and health centers	Lessened women's burden	* Community mobilization. * Creation of awareness on the importance of child care centers and health services.
2. Education and Training	1. Training and education on women's right, agriculture, health, etc. 2. Food security.	* Improve agricultural production * Sharpen women's ability and skills and increase efficiency.	* Training in management , planning, business administration and entrepreneurship skills. * Training in farming methods. * Study tour visits. * Preparation of gender sensitive training materials and participatory methods * Provide cooperative education.
3. Water	1. Irrigation water	* Increase food production	* Constructing irrigation facilities under the Project
	2. Safe drinking water	* Alleviate women from the hardship incurred in fetching water * Reduce the incidence of water borne diseases * Use excess water for kitchen, gardens to produce nutritious foods	* Introduction of ate harvesting techniques * Construction water supply facilities under the Project
4. Food Production		* Application of modern farming technologies * Change peoples attitudes towards land ownership to the women.	* Construction of intakes * Protect water source * Construction of new water canals * Mobile women farmers organizations
5. Improve women's Income	Fight poverty	* Improve the economic status of Women * Promote/establish viable women projects * Promote entrepreneurial capabilities. * Encourage women to form socio-economical groups	* Help women to produce more in agriculture * Help women to set up business * Help women in small scale business get a wider market for their products * Identification of viable economic projects. * Improve women business mind.
6. Decision making and Leadership	* Establishment of Women pressure groups	* To force action on sensitive issues. * To sensitize leadership at all levels. * To compel access to and control over resources (land, water right, loans etc.) for women.	* Sensitization and mobilization of women * Encourage women to compete with men in the election of leaders at all level * Encourage women to utilize their abilities in making decision which affect their lives
7. Cooperative/Organization and Credit Scheme	* Encourage women to join cooperatives and organization * Enable women to have access to loans both cash and for agricultural inputs.	* Women to join cooperatives and/or organization	* Sensitize community that women also have ability to hold leadership posts.

Table 10.1 Cash Flow Statement of Project Implementation and Operation with Small Scale Hydropower Development Plan

Year	(1) Cash Outflow (Tsh.1,000)								(2) Cash Inflow (Tsh.1,000)							Balance	
	Capital Costs 1/			O&M Works		Tractor Hiring Services		Total Cash Outflow	Capital Investment 1/			Revenue			Total Cash Inflow	Annual (II - I)	Cummulative
	Project Works	Tractor Hiring Services	Total	Total O&M Cost	Replacement Costs	Operation Costs	Replacement Costs		Project Works	Tractor Hiring Services	Total	Water Charge 2/	Tractor Hiring Service Fees 3/	Total			
1998	616,280		616,280					616,280	616,280		616,280			0	616,280	0	0
1999	10,063,840		10,063,840					10,063,840	10,063,840		10,063,840			0	10,063,840	0	0
2000	10,236,200		10,236,200					10,236,200	10,236,200		10,236,200			0	10,236,200	0	0
2001	7,670,640	154,700	7,825,340	61,318		48,913		7,935,571	7,670,640	154,700	7,825,340	133,300	75,250	208,550	8,033,890	98,319	98,319
2002	6,093,980	136,400	6,230,380	61,318		121,996		6,413,694	6,093,980	136,400	6,230,380	133,300	187,688	320,988	6,551,368	137,674	235,993
2003	5,208,000	221,000	5,429,000	61,318		148,841		5,639,159	5,208,000	221,000	5,429,000	133,300	228,988	362,288	5,791,288	152,129	388,122
2004		66,300	66,300	134,044		163,076		363,420		66,300	66,300	291,400	250,888	542,288	608,588	245,168	633,290
2005		445,800	445,800	134,044		214,277		794,121		445,800	445,800	291,400	329,675	621,075	1,066,875	272,754	906,044
2006		154,700	154,700	120,714		226,854		502,268		154,700	154,700	278,070	349,025	627,095	781,795	279,527	1,185,571
2007		73,900	73,900	120,714		236,739	41,000	472,353		73,900	73,900	278,070	366,300	644,370	718,270	245,917	1,431,488
2008				120,714		236,739	95,000	452,453				278,070	369,000	647,070	647,070	194,617	1,626,105
2009				104,904		236,739	95,000	436,643				262,260	369,000	631,260	631,260	194,617	1,820,722
2010				104,904	310,000	236,739	95,000	746,643				262,260	369,000	631,260	631,260	-115,383	1,705,339
2011				104,904		236,739	95,000	436,643				262,260	369,000	631,260	631,260	194,617	1,899,956
2012				104,904		236,739	117,100	458,743				262,260	370,295	632,555	632,555	173,812	2,073,768
2013				104,904	310,000	236,739	153,100	804,743				262,260	371,905	634,165	634,165	-170,578	1,903,190
2014				104,904		236,739	149,000	490,643				262,260	371,890	634,150	634,150	143,507	2,046,697
2015				104,904		236,739	149,000	490,643				262,260	371,700	633,960	633,960	143,317	2,190,014
2016				104,904		236,739	149,000	490,643				262,260	371,890	634,150	634,150	143,507	2,333,521
2017				104,904		236,739	149,000	490,643				262,260	371,700	633,960	633,960	143,317	2,476,838
2018				104,904		236,739	149,000	490,643				262,260	371,890	634,150	634,150	143,507	2,620,345
2019				104,904		236,739	153,100	494,743				262,260	371,905	634,165	634,165	139,422	2,759,767
2020				104,904	620,000	236,739	153,100	1,114,743				262,260	371,905	634,165	634,165	-480,578	2,279,189
2021				104,904		236,739	149,000	490,643				262,260	371,700	633,960	633,960	143,317	2,422,506
2022				104,904		236,739	149,000	490,643				262,260	371,890	634,150	634,150	143,507	2,566,013
2023				104,904	310,000	236,739	149,000	800,643				262,260	371,700	633,960	633,960	-166,683	2,399,330
2024				104,904		236,739	149,000	490,643				262,260	371,890	634,150	634,150	143,507	2,542,837
2025				104,904	750,200	236,739	149,000	1,240,843				262,260	371,700	633,960	633,960	-606,883	1,935,954
2026				104,904		236,739	153,100	494,743				262,260	372,095	634,355	634,355	139,612	2,075,566
2027				104,904		236,739	153,100	494,743				262,260	371,905	634,165	634,165	139,422	2,214,988
2028				104,904	310,000	236,739	149,000	800,643				262,260	371,890	634,150	634,150	-166,493	2,048,495
2029				104,904		236,739	149,000	490,643				262,260	371,700	633,960	633,960	143,317	2,191,812
2030				104,904	310,000	236,739	149,000	800,643				262,260	371,700	633,960	633,960	-166,683	2,025,129
2031				104,904		236,739	149,000	490,643				262,260	371,700	633,960	633,960	143,317	2,168,446
2032				104,904		236,739	149,000	490,643				262,260	371,890	634,150	634,150	143,507	2,311,953
2033				104,904	310,000	236,739	153,100	804,743				262,260	371,905	634,165	634,165	-170,578	2,141,375
2034				104,904		236,739	153,100	494,743				262,260	372,095	634,355	634,355	139,612	2,280,987
2035				104,904		236,739	149,000	490,643				262,260	371,700	633,960	633,960	143,317	2,424,304
2036				104,904		236,739	149,000	490,643				262,260	371,890	634,150	634,150	143,507	2,567,811
2037				104,904		236,739	149,000	490,643				262,260	371,700	633,960	633,960	143,317	2,711,128
2038				104,904		236,739	149,000	490,643				262,260	371,890	634,150	634,150	143,507	2,854,635
2039				104,904		236,739	149,000	490,643				262,260	371,700	633,960	633,960	143,317	2,997,952
2040				104,904	310,000	236,739	153,100	804,743				262,260	371,905	634,165	634,165	-170,578	2,827,374
2041				104,904		236,739	153,100	494,743				262,260	371,905	634,165	634,165	139,422	2,966,796
2042				104,904		236,739	149,000	490,643				262,260	371,890	634,150	634,150	143,507	3,110,303
2043				104,904	310,000	236,739	149,000	800,643				262,260	371,700	633,960	633,960	-166,683	2,943,620
2044				104,904		236,739	149,000	490,643				262,260	371,890	634,150	634,150	143,507	3,087,127
2045				104,904	310,000	236,739	149,000	800,643				262,260	371,700	633,960	633,960	-166,683	2,920,444
2046				104,904		236,739	149,000	490,643				262,260	371,890	634,150	634,150	143,507	3,063,951
2047				104,904		236,739	153,100	494,743				262,260	371,905	634,165	634,165	139,422	3,203,373
2048				104,904		236,739	153,100	494,743				262,260	372,095	634,355	634,355	139,612	3,342,985
2049				104,904		236,739	149,000	490,643				262,260	371,700	633,960	633,960	143,317	3,486,302
2050				104,904	2,108,000	236,739	149,000	2,598,643				262,260	371,700	633,960	633,960	-1,964,683	1,521,619
2051				104,904		236,739	149,000	490,643				262,260	371,905	634,165	634,165	143,522	1,665,141
2052				104,904	1,267,900	236,739	149,000	1,758,543				262,260	372,095	634,355	634,355	-1,124,188	540,953

1/: Cpital funds of the project works and tractor hiring services are arranged by the Government of Tanzania
2/: Revenue from water charge to be collected from the beneficiaries
3/: Tractor Hiring Service fees to be collected from the beneficiaries(paddy cultivation Tsh. 50,000/ha & alfalfa cultivation Tsh. 12,500/ha) + salvage value of machines(15%)
Note: This analysis is made until 2052 when the replacement cost for No.1 Power Station occurs.

Figures

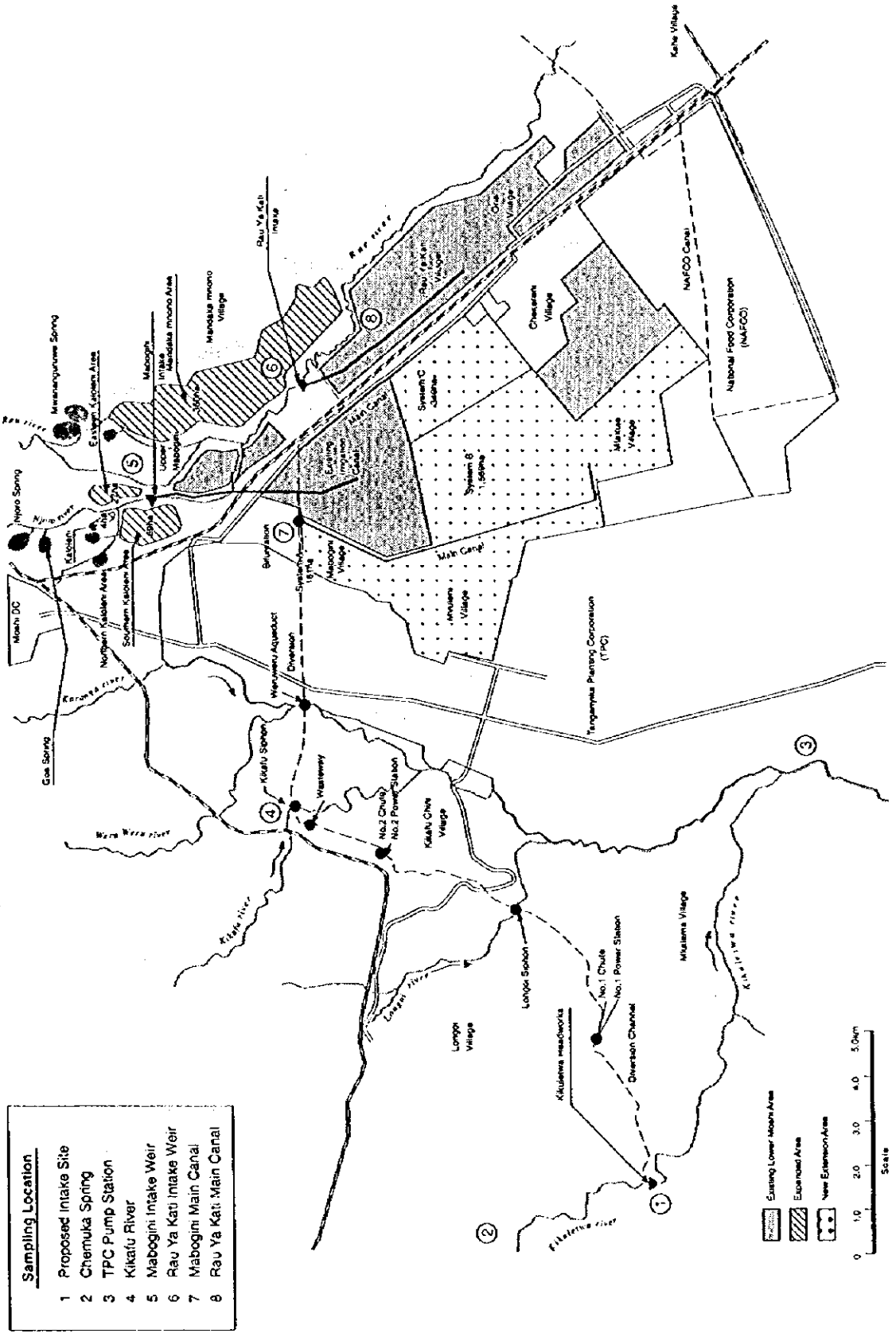


Figure 3.1

Location of Water Sampling

The Feasibility Study on Lower Moshi Integrated Agriculture and Rural Development Project in the United Republic of Tanzania

Japan International Coopertion Agency

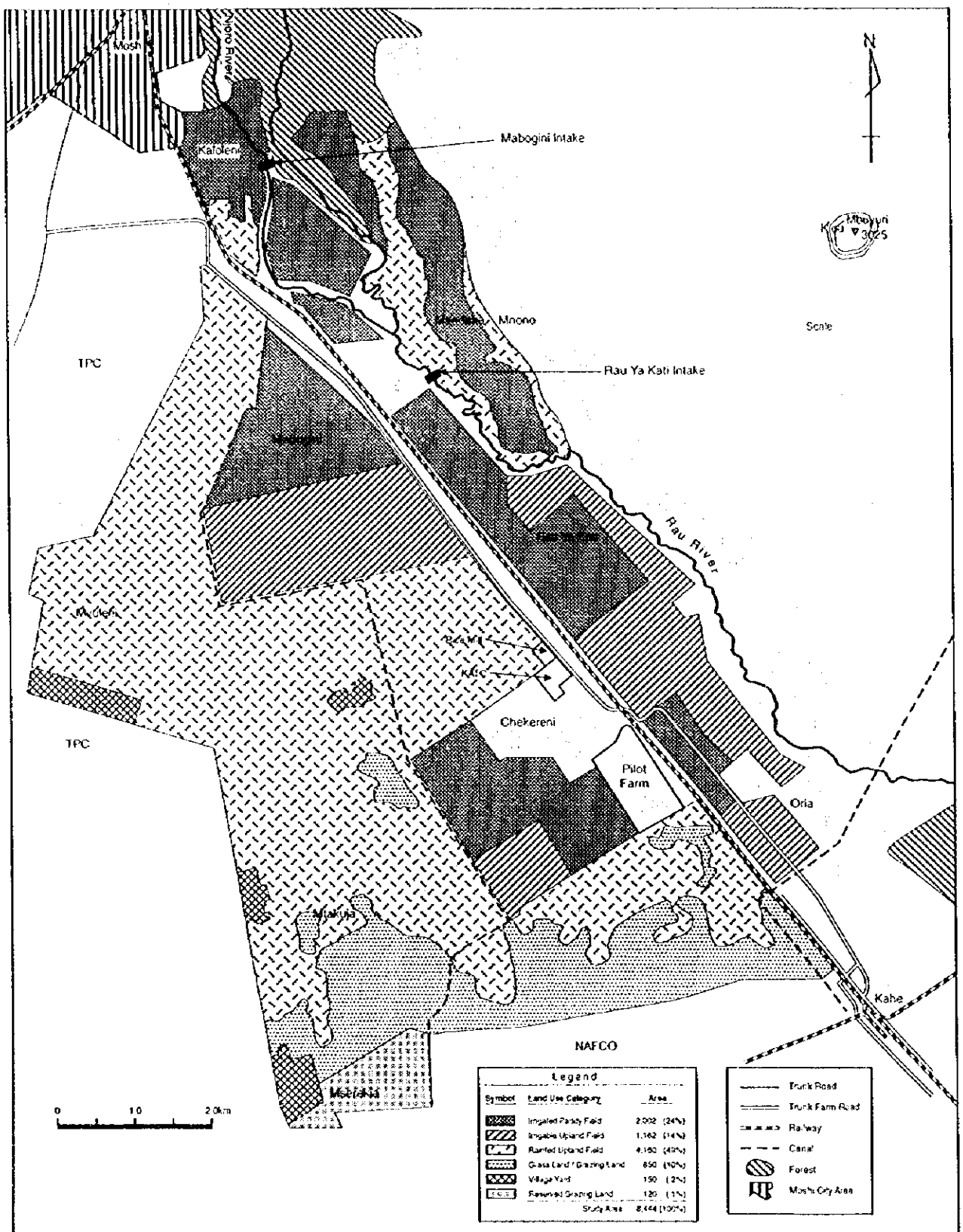


Figure 3.2
Present Land Use Map

The Feasibility Study on Lower Moshi Integrated Agriculture and Rural Development Project in the United Republic of Tanzania

Japan International Cooperation Agency

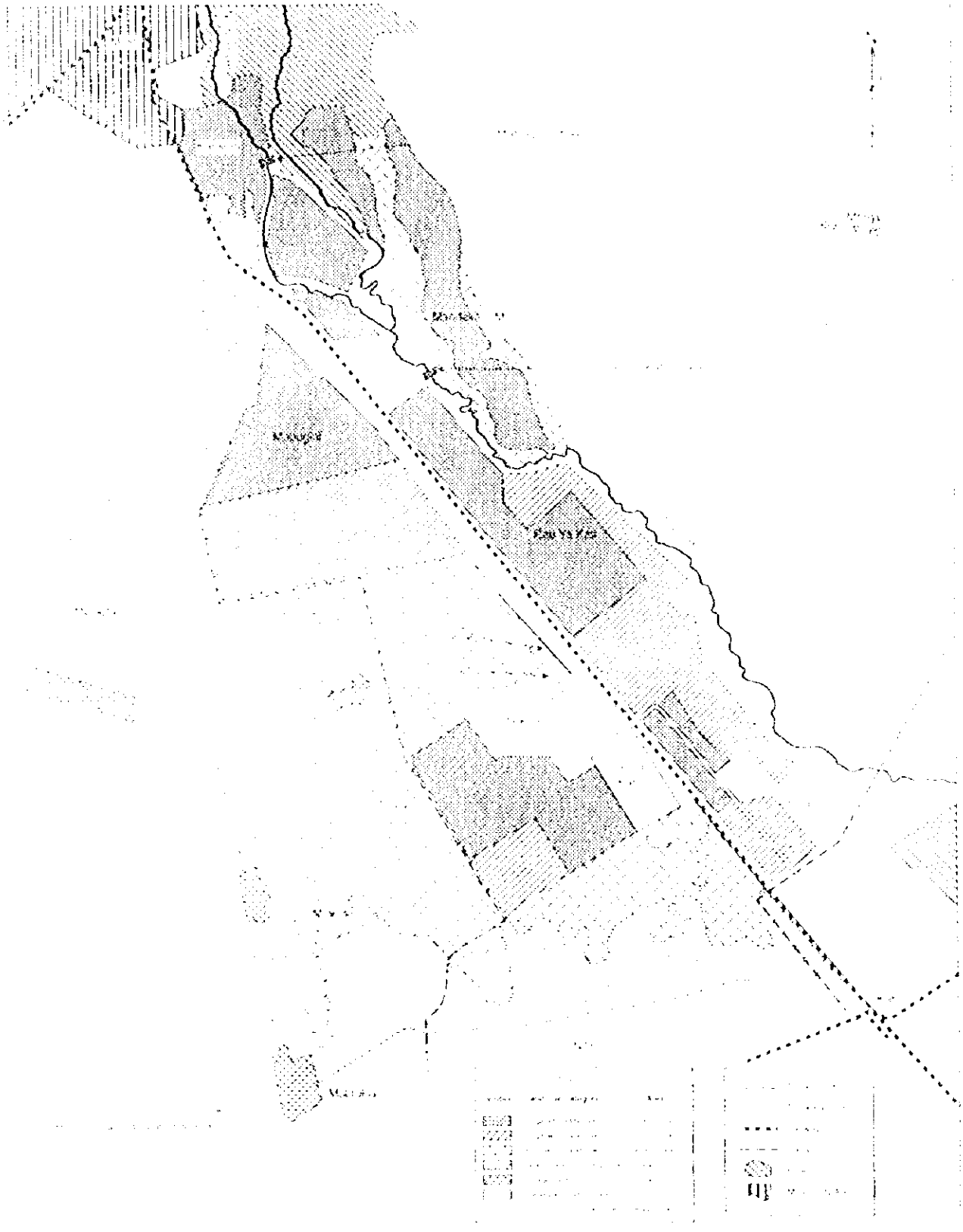
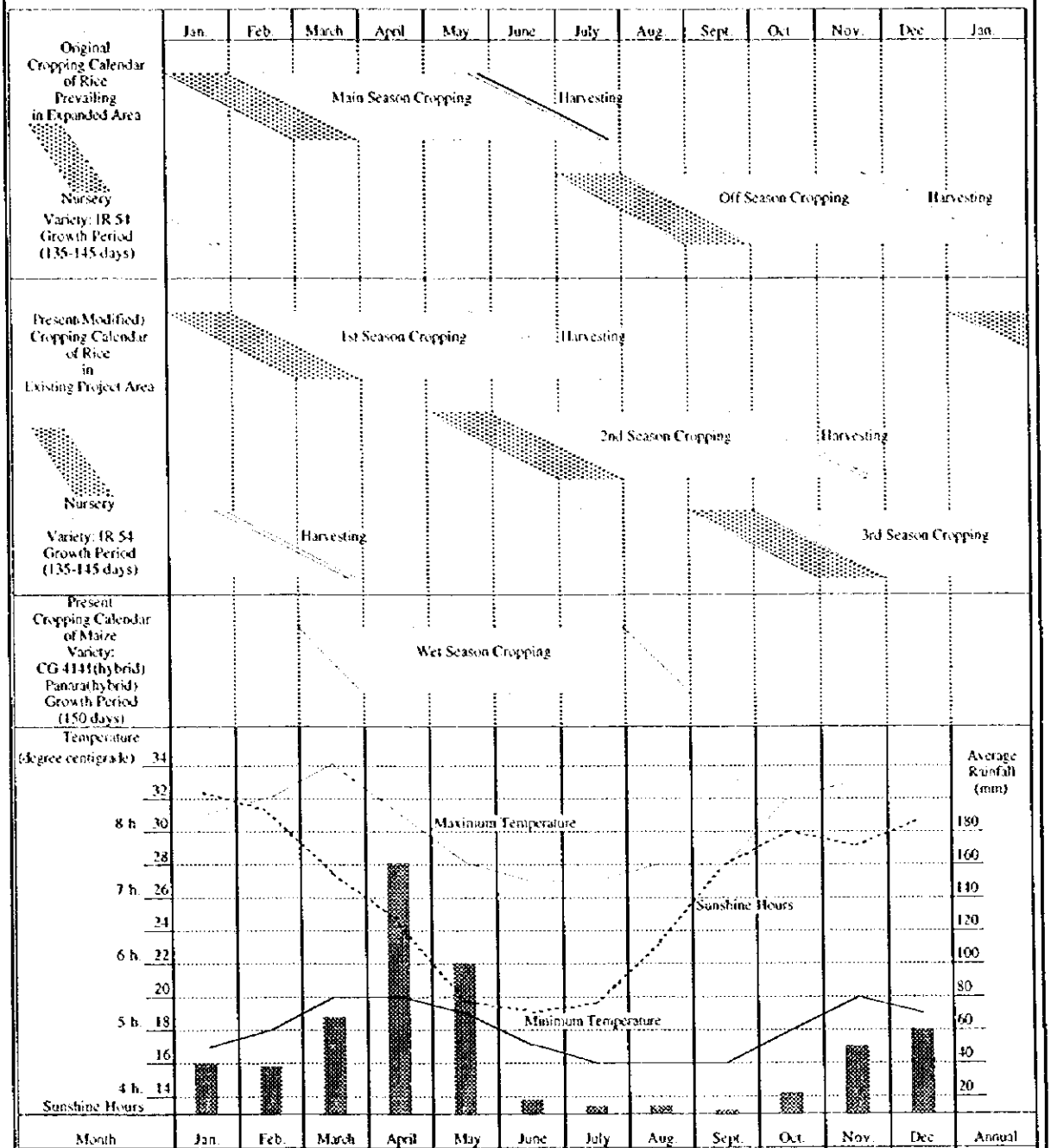


Figure 3.2

Present Land Use Map

The Feasibility Study on Lower Moshi Integrated Agriculture and Rural Development Project in the United Republic of Tanzania

Japan International Cooperation Agency



Month	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Av. Rainfall (mm) 1/	40	38	68	161	100	18	10	10	6	21	30	60	560
Mean Temperature 1/	23	23	25	24	22	21	20	20	20	24	25	25	-
Av. Max. Temp. 1/	31	32	34	31	28	27	27	28	28	32	33	33	-
Av. Min. Temp. 1/	17	18	20	20	19	17	16	16	16	18	20	19	-
Sunshine Hours 2/	8.6	8.4	7.7	6.7	5.4	5.3	5.4	6.3	7.5	8.0	7.8	8.2	81.0

Source of meteorological data: 1/: Chekereni, KADP(1981 - 1996); 2/: TPC, 1977 - 1996)

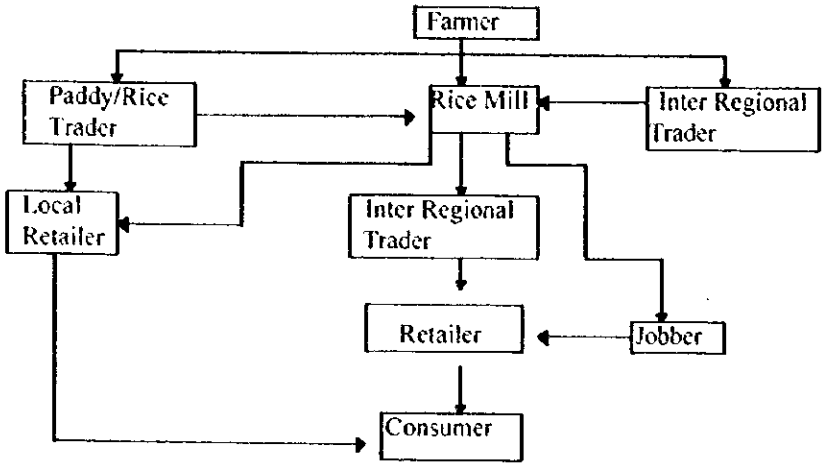
File: IR-F352

Figure 3.3
Prevailing Present Cropping Calendar in the Study Area

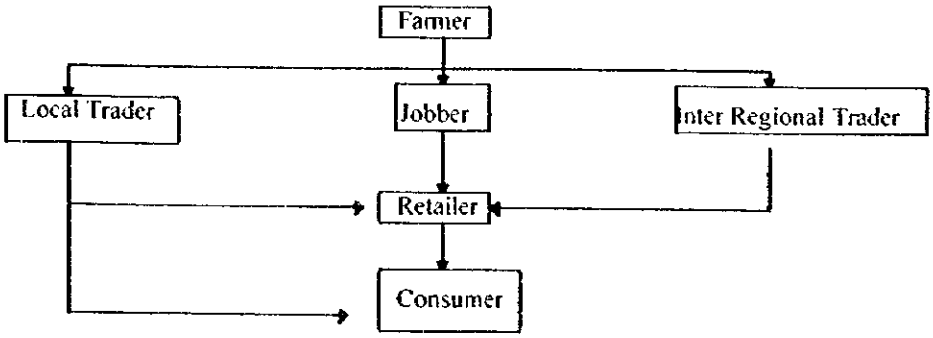
The Feasibility Study on Lower Moshi Integrated Agriculture and Rural Development Project in the United Republic of Tanzania

Japan International Cooperation Agency

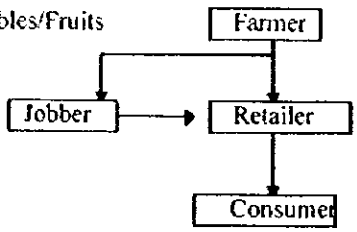
(1) Paddy and Rice



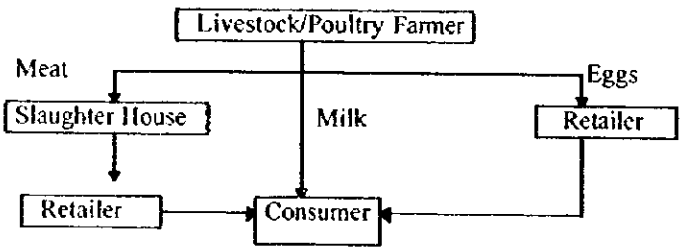
(2) Maize



(3) Vegetables/Fruits



(4) Livestock Products



Source: Based on Hearing Survey, 1997

Figure 3.4
Flow of Agriculture and Livestock Products in and around the Study Area

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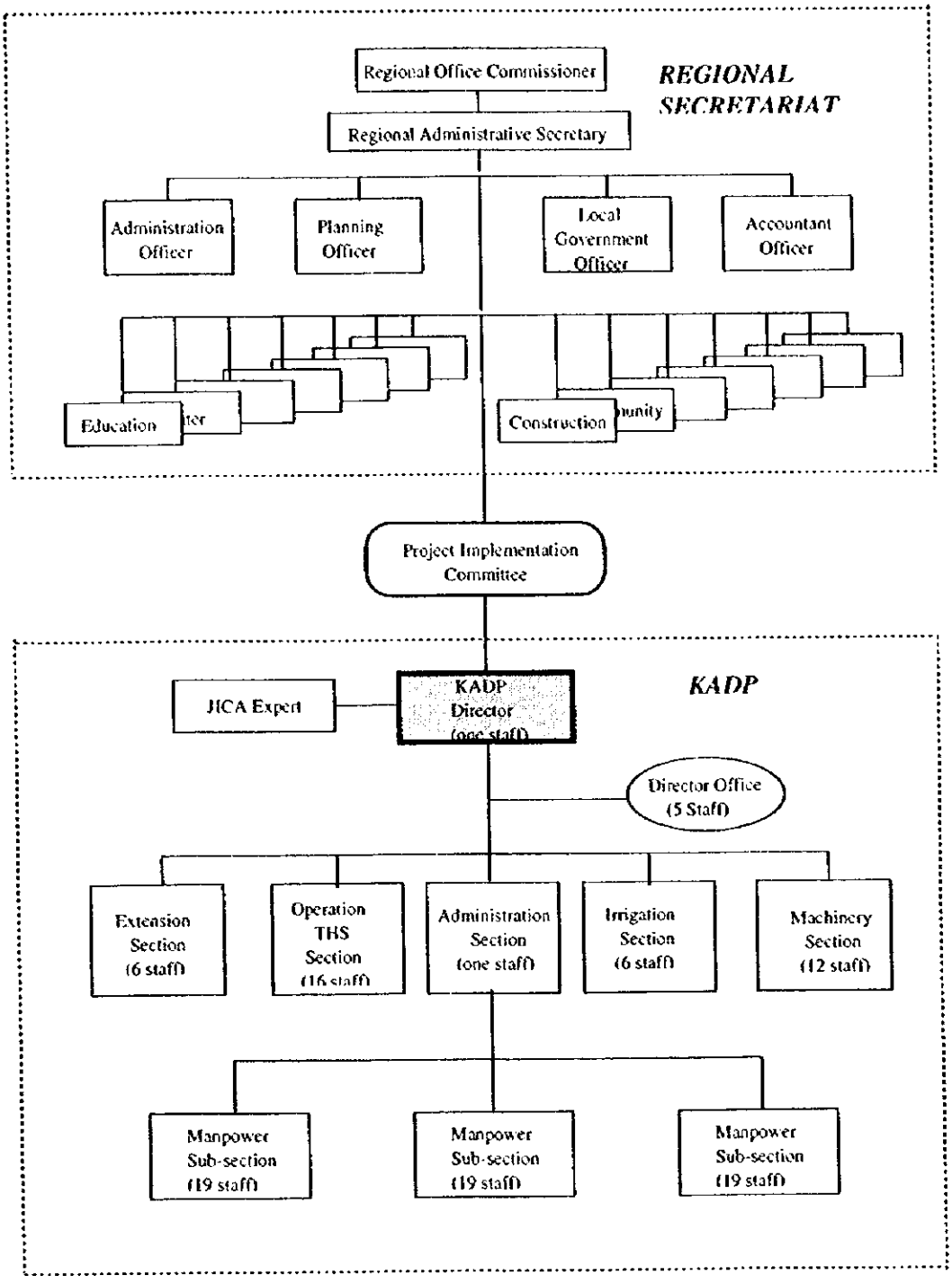

Figure 3.5

Organization Chart of KADP

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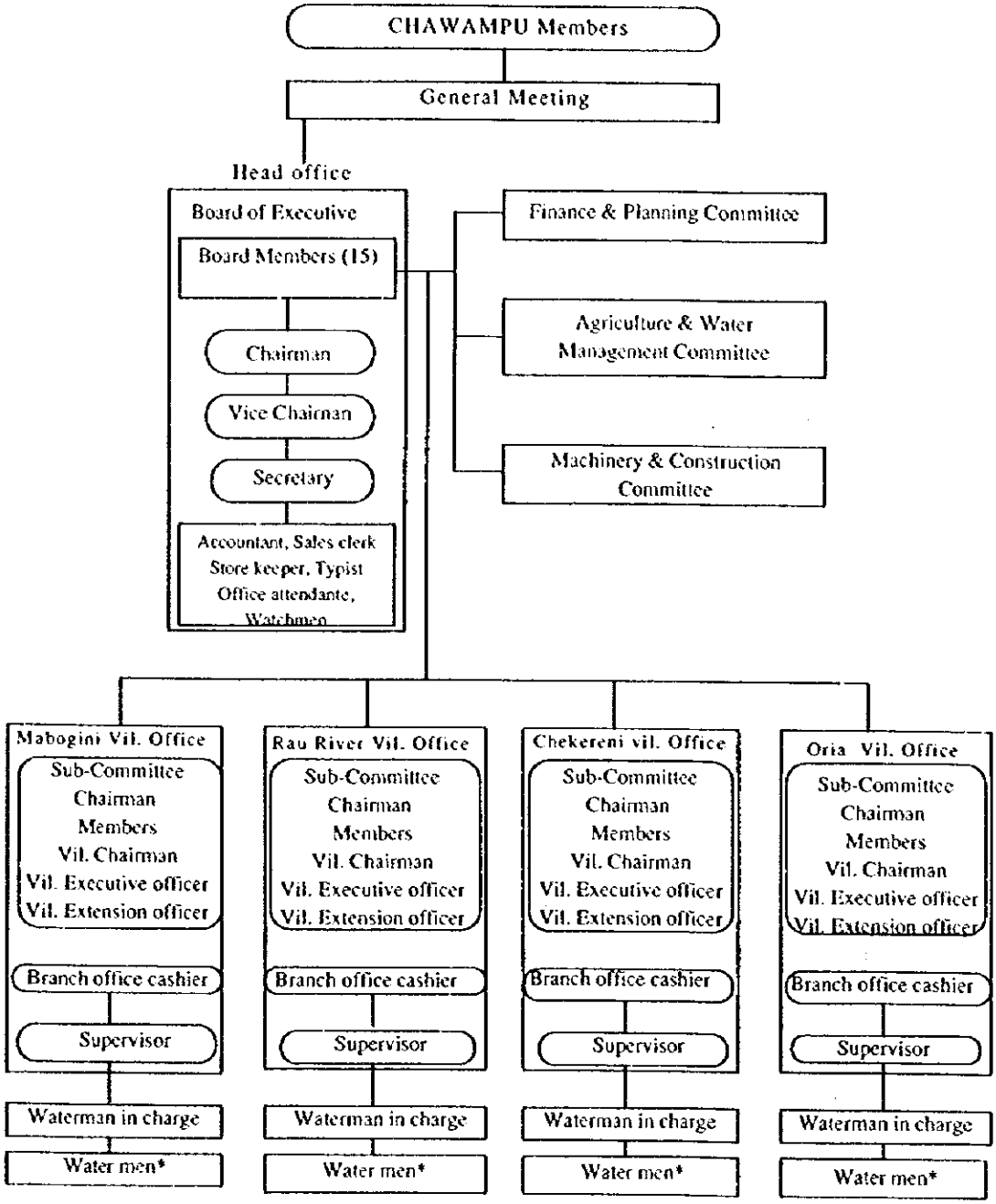

Figure 3.6
Organisation Chart of CHAWAMPU

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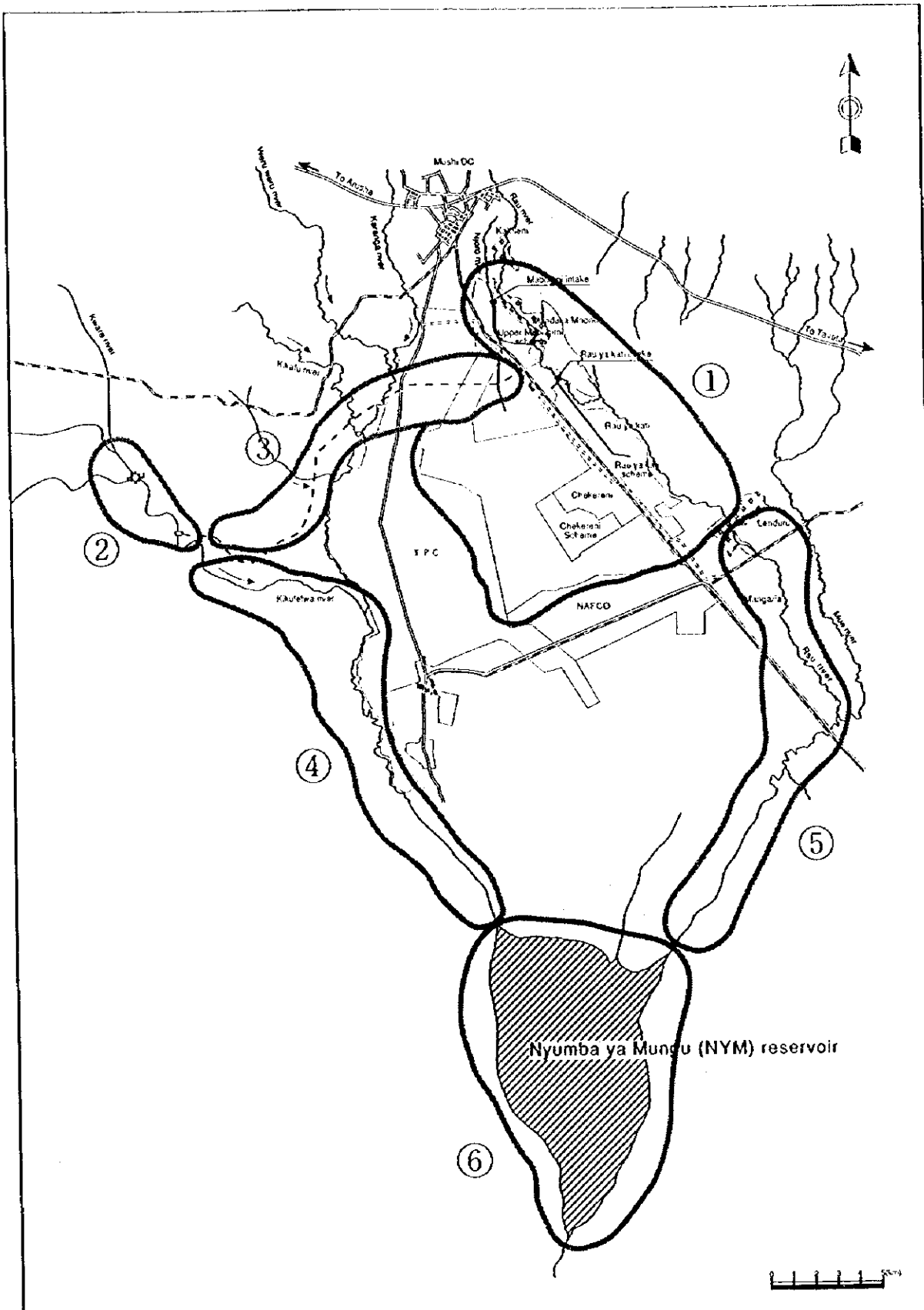

Figure 3.7
Ecological Regions for IEE and EIA

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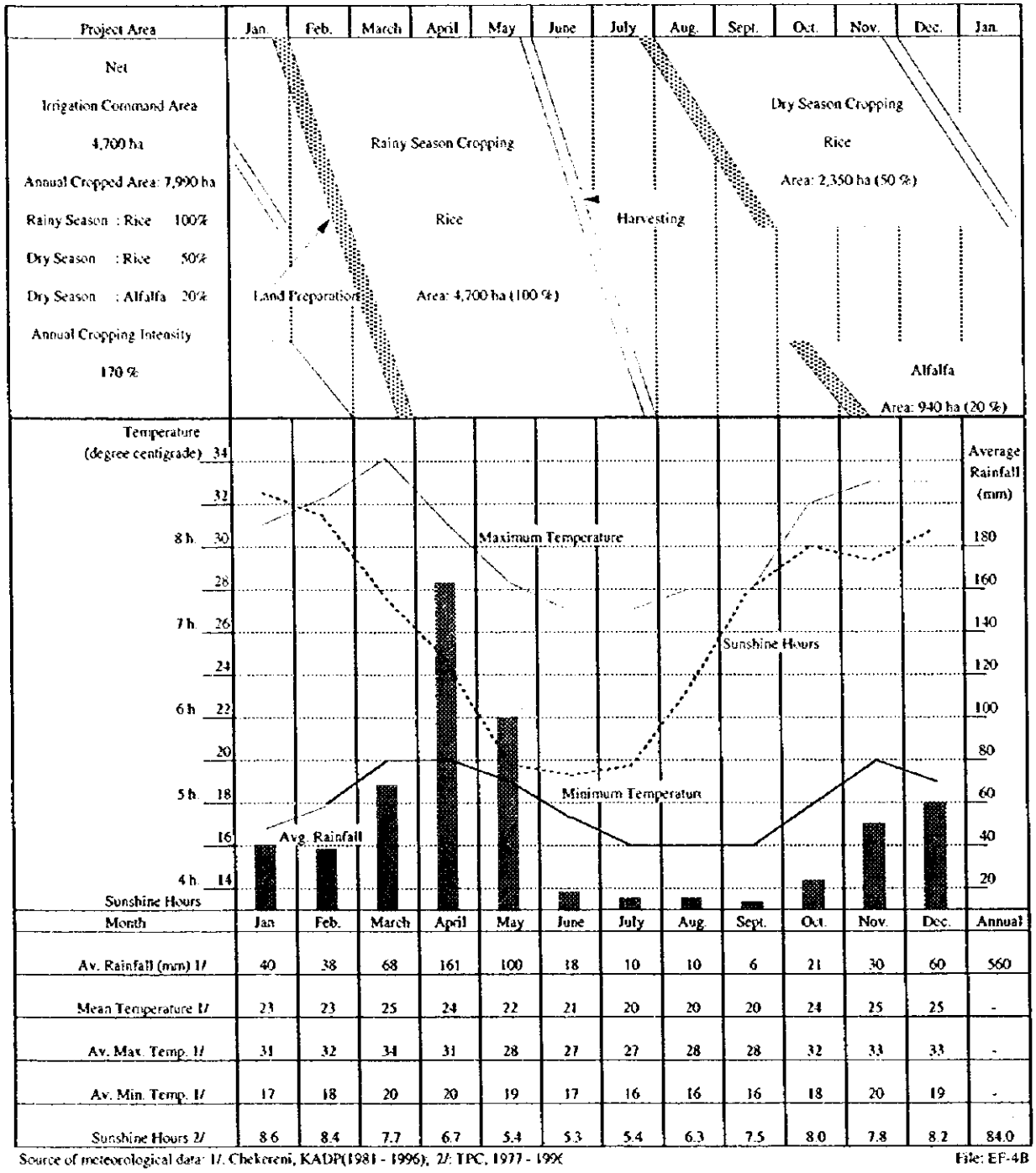

Month	Jan	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Av. Rainfall (mm) 1/	40	38	68	161	100	18	10	10	6	21	30	60	560
Mean Temperature 1/	23	23	25	24	22	21	20	20	20	24	25	25	-
Av. Max. Temp. 1/	31	32	34	31	28	27	27	28	28	32	33	33	-
Av. Min. Temp. 1/	17	18	20	20	19	17	16	16	16	18	20	19	-
Sunshine Hours 2/	8.6	8.4	7.7	6.7	5.4	5.3	5.4	6.3	7.5	8.0	7.8	8.2	84.0

Source of meteorological data: 1/: Chekereni, KADP(1981 - 1996), 2/: TPC, 1977 - 199X

File: EF-4B

Figure 4.1
Proposed Cropping Pattern

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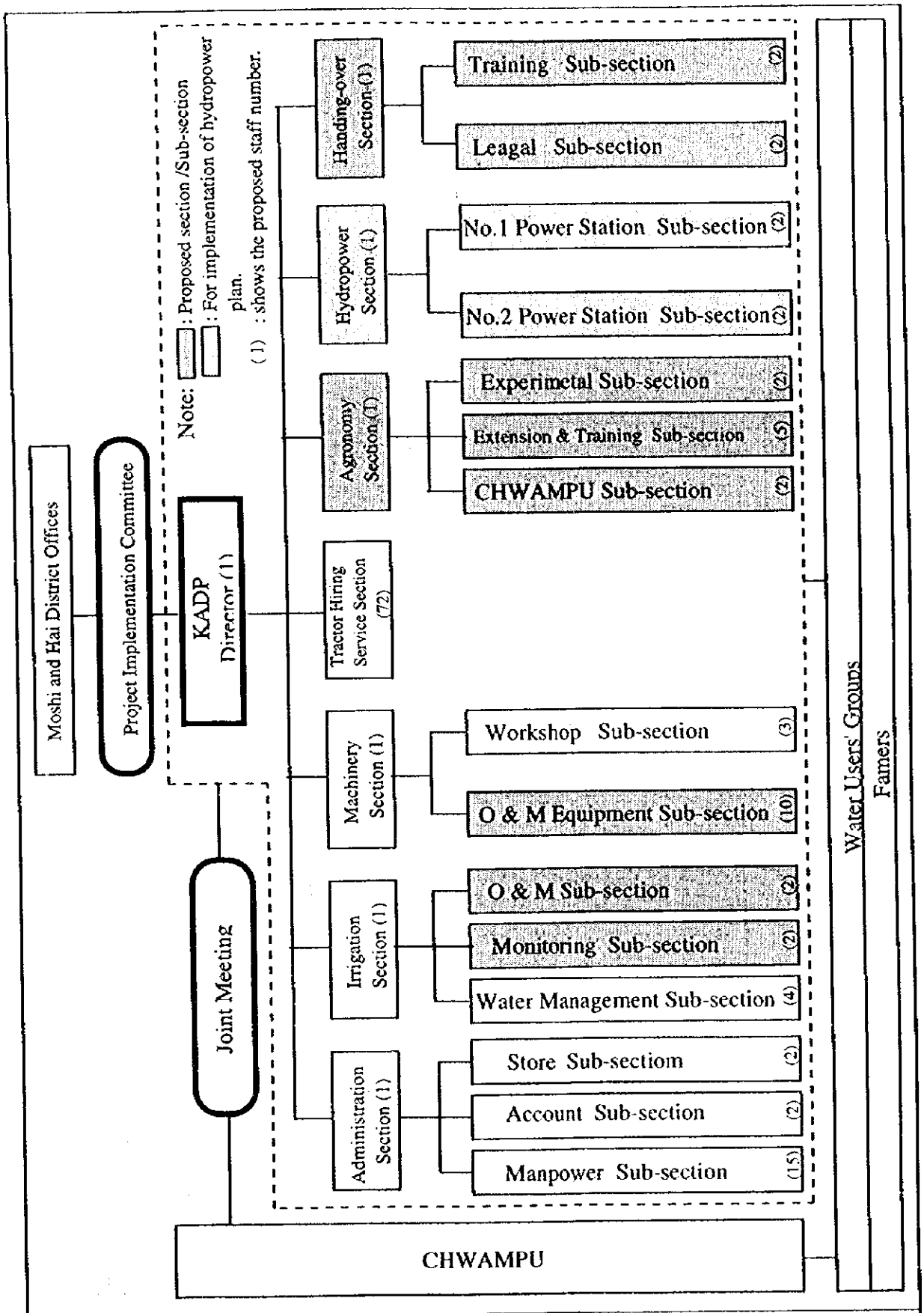

Figure 4.2
Proposed Organisation Structure of KADP on First Stage

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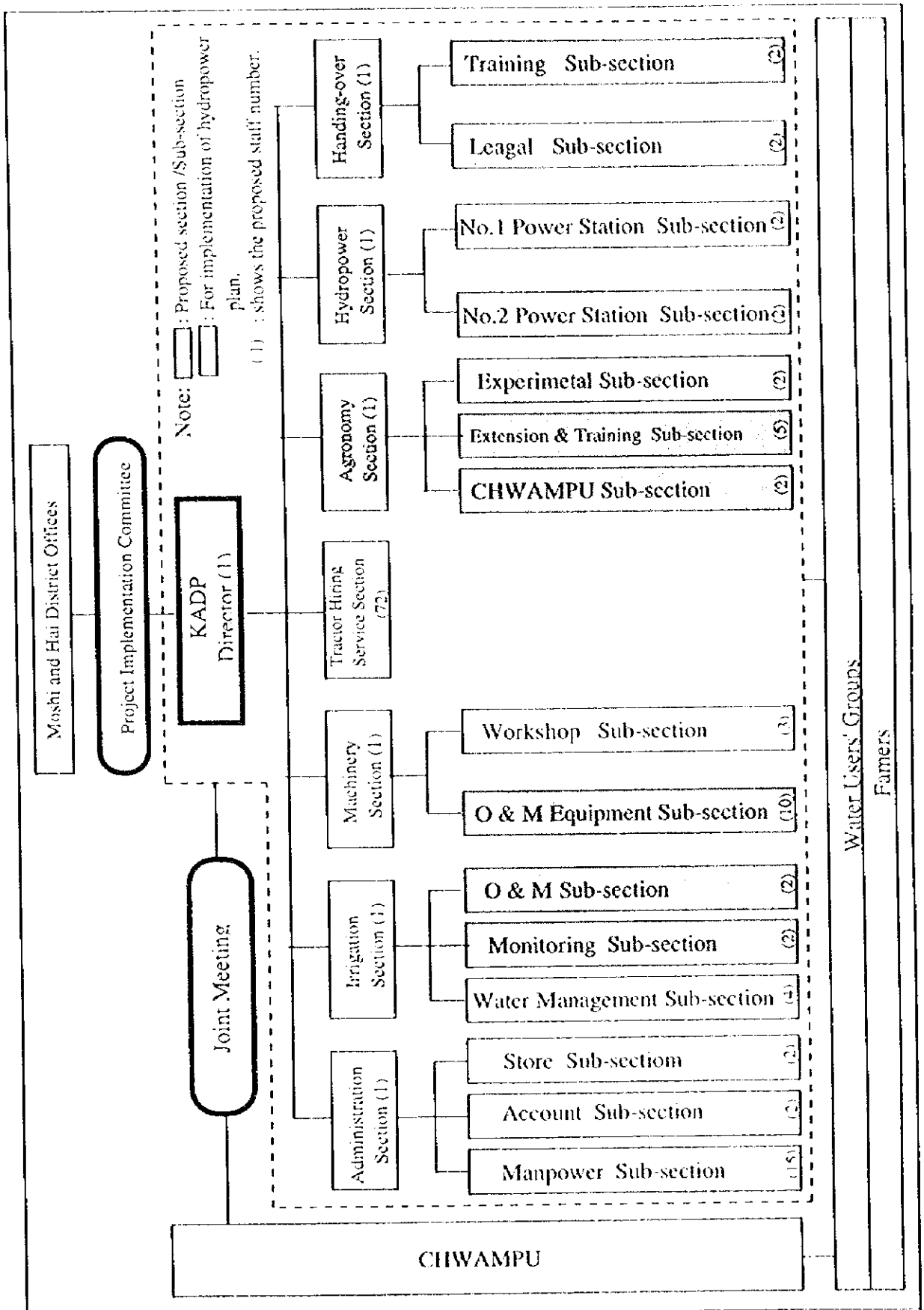

Figure 4.2
Proposed Organisation Structure of KADP on First Stage

The Feasibility Study on Lower Moshi Integrated Agriculture and Rural Development Project in the United Republic of Tanzania

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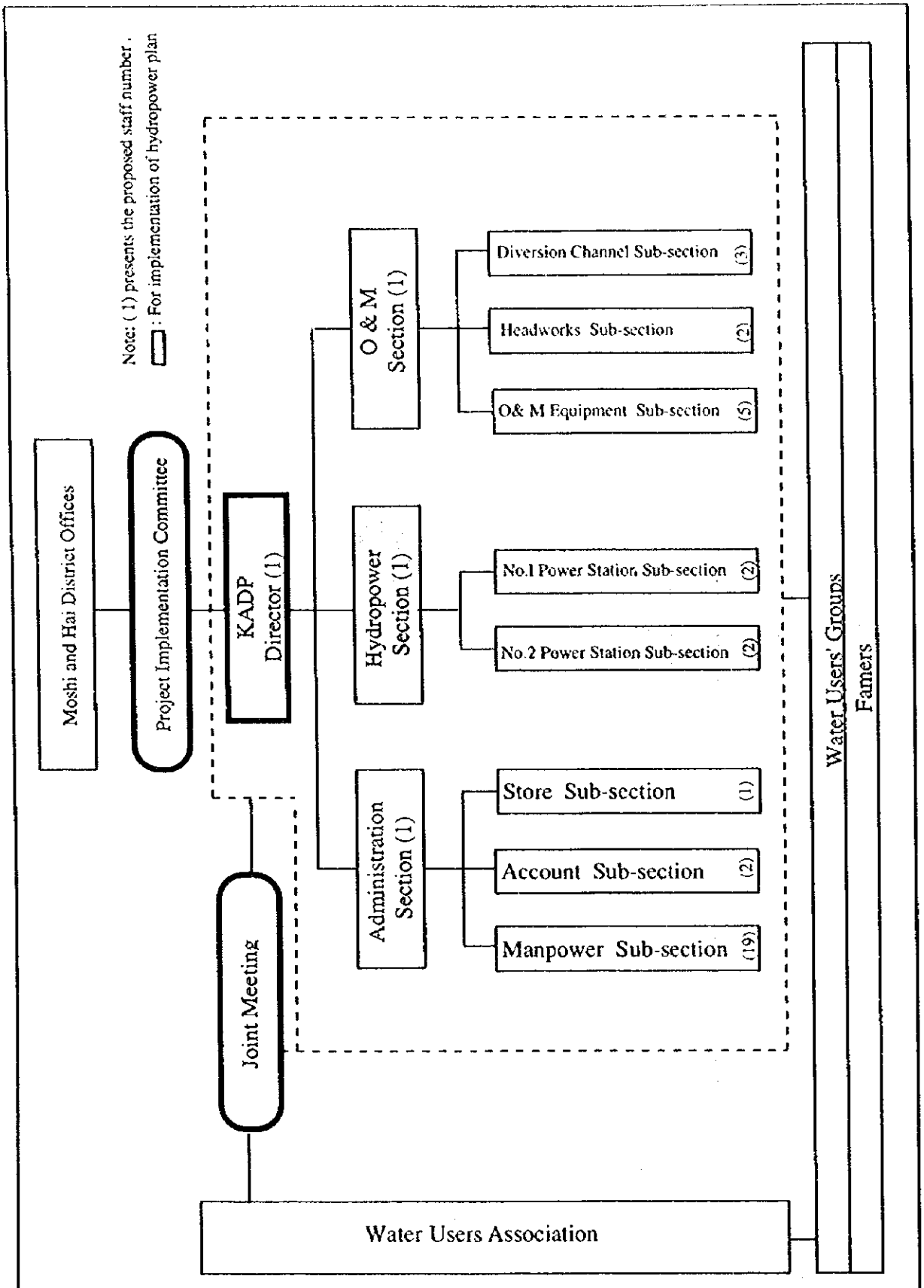

Figure 4.3
Proposed Organisation Structure of KADP on Second Stage

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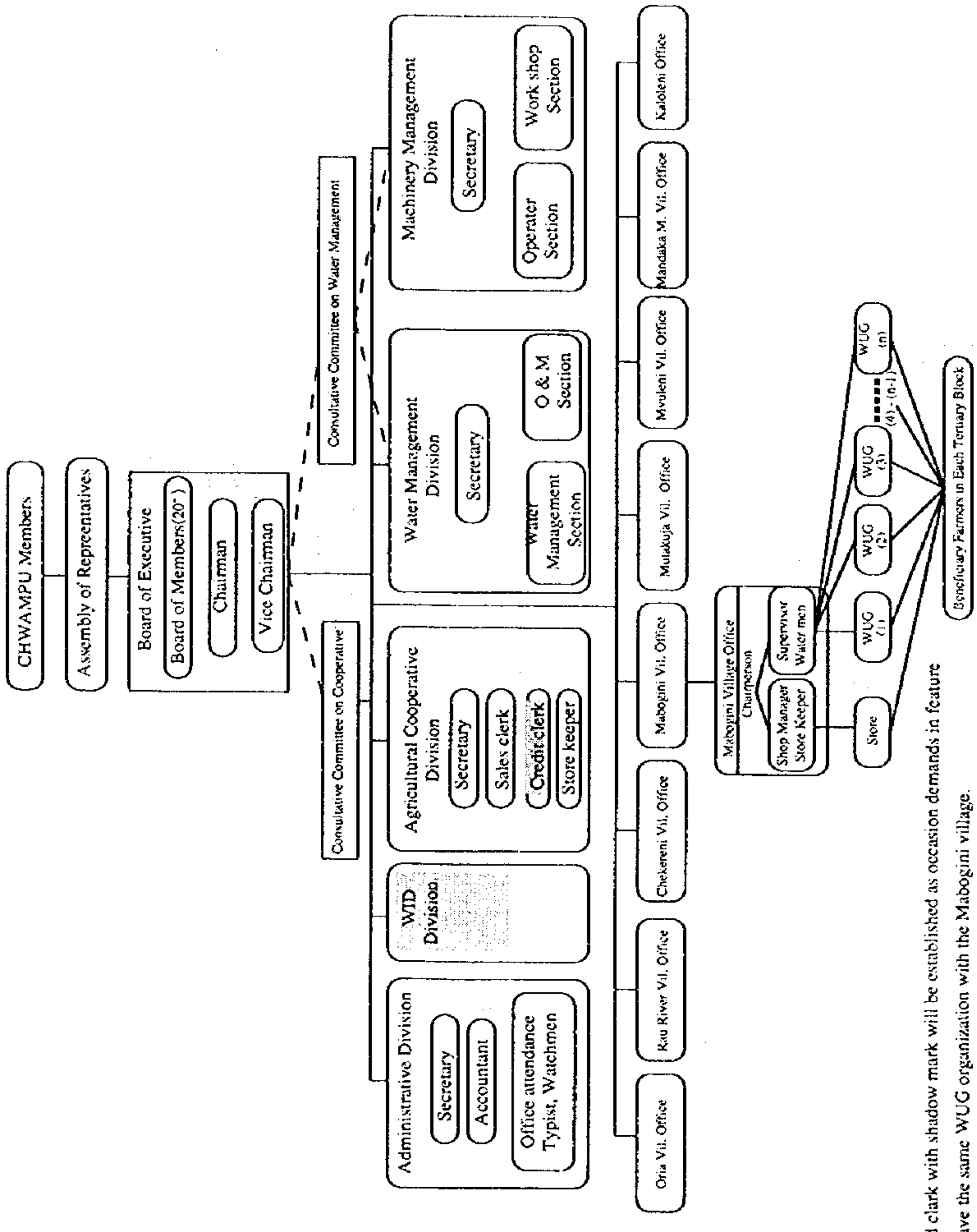
Japan International Cooperation Agency



Note: The division and clark with shadow mark will be established as occasion demands in feature
Seven village have the same WUG organization with the Mabogini village.

Figure 4.4
Organisation Chart of CHAWAMPU

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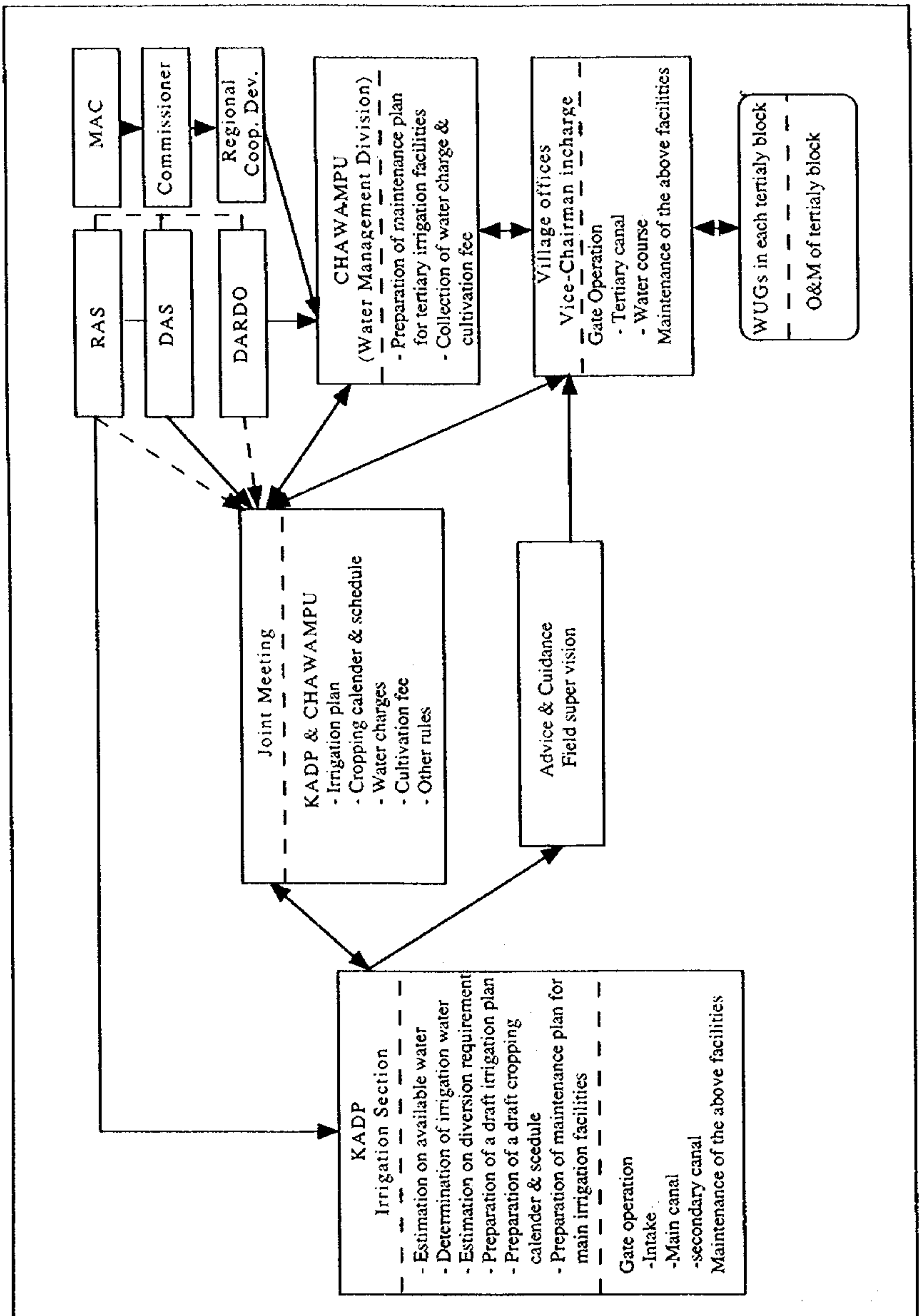

Figure 4.5
Proposed Plan on Water Management and O&M in First Stage

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Japan International Cooperation Agency

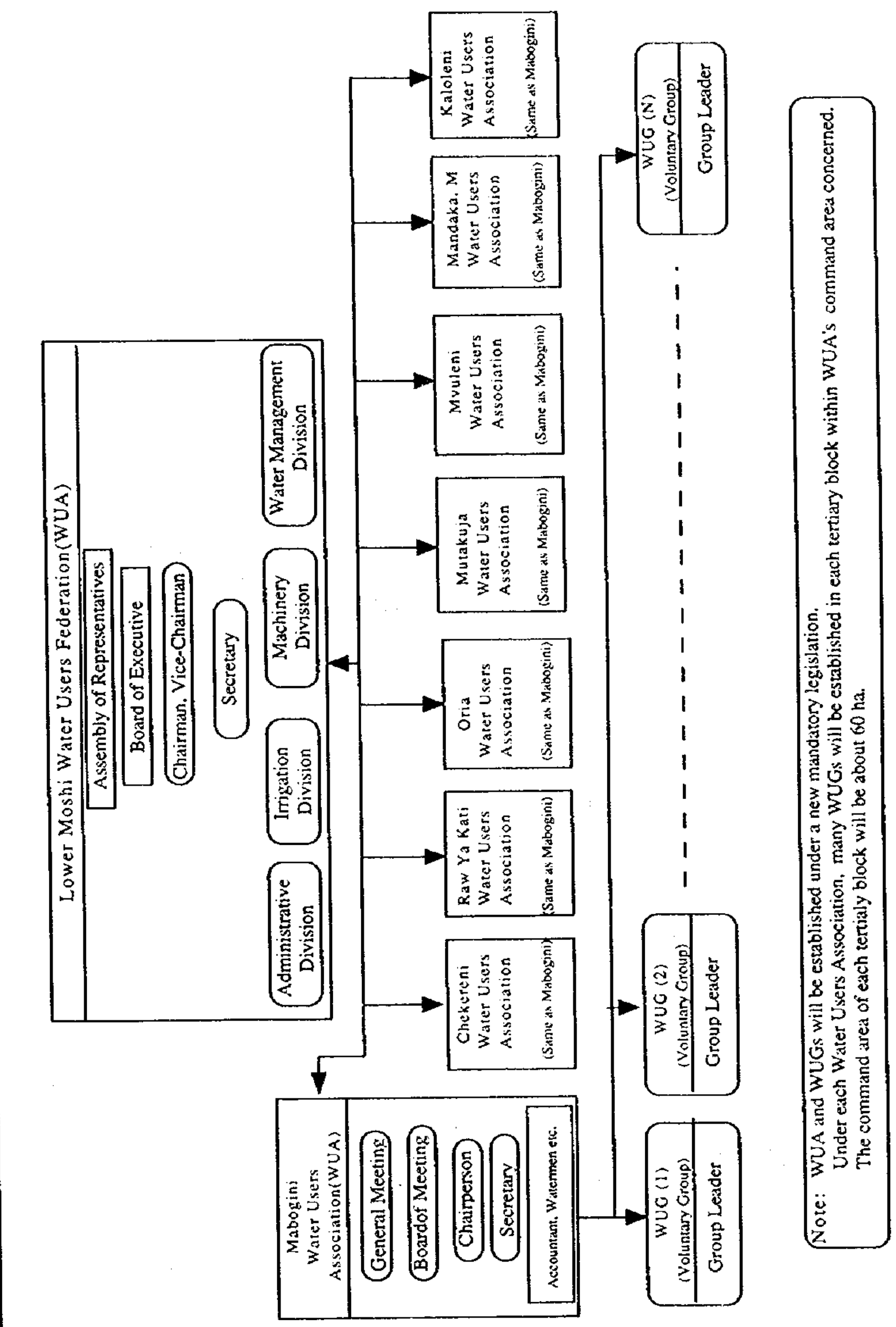

Figure 4.6
Proposed Water Management and O&M System in Second Stage

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Japan International Cooperation Agency

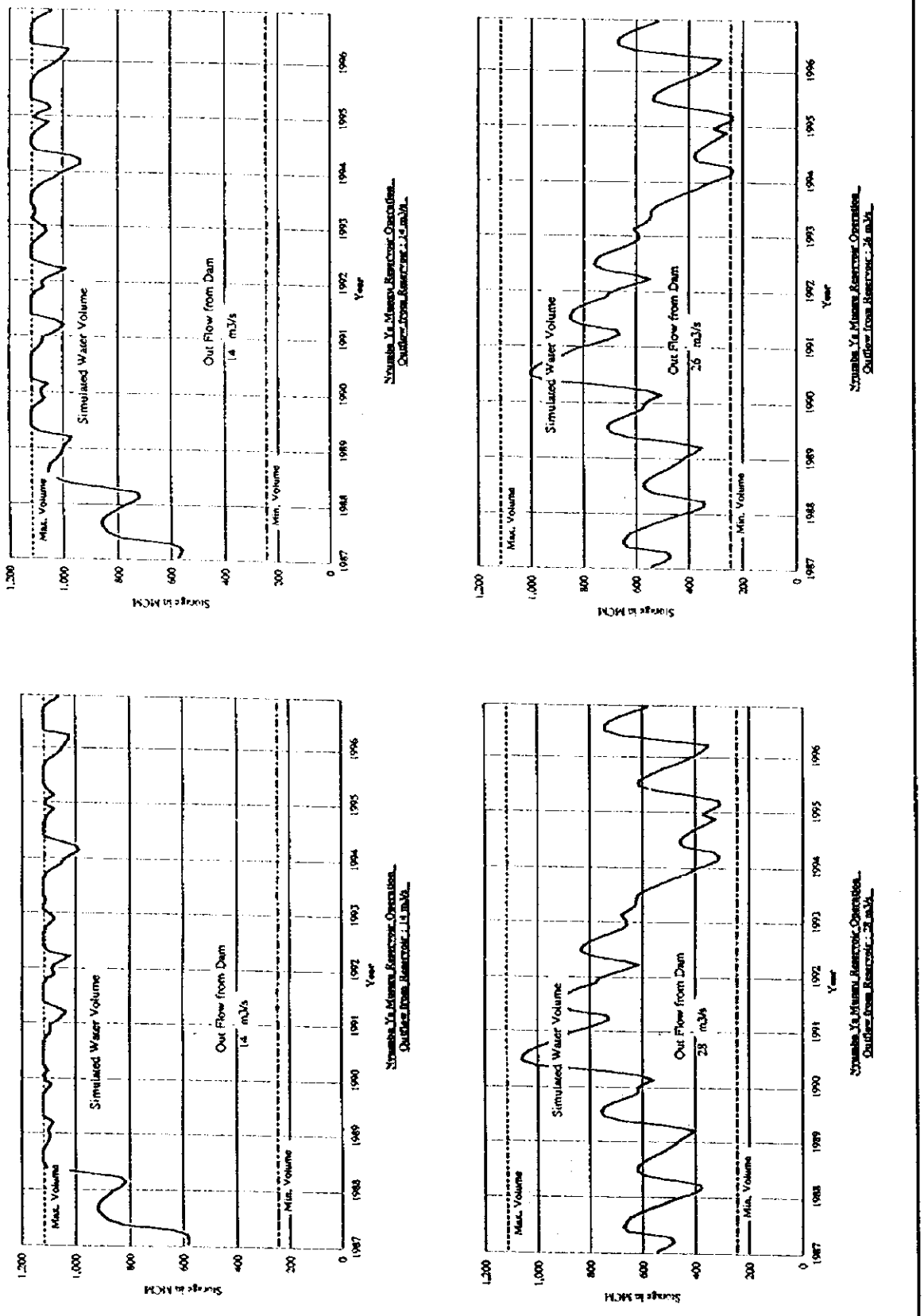

Figure 4.7
Nyumba Ya Mungu Reservoir Operation

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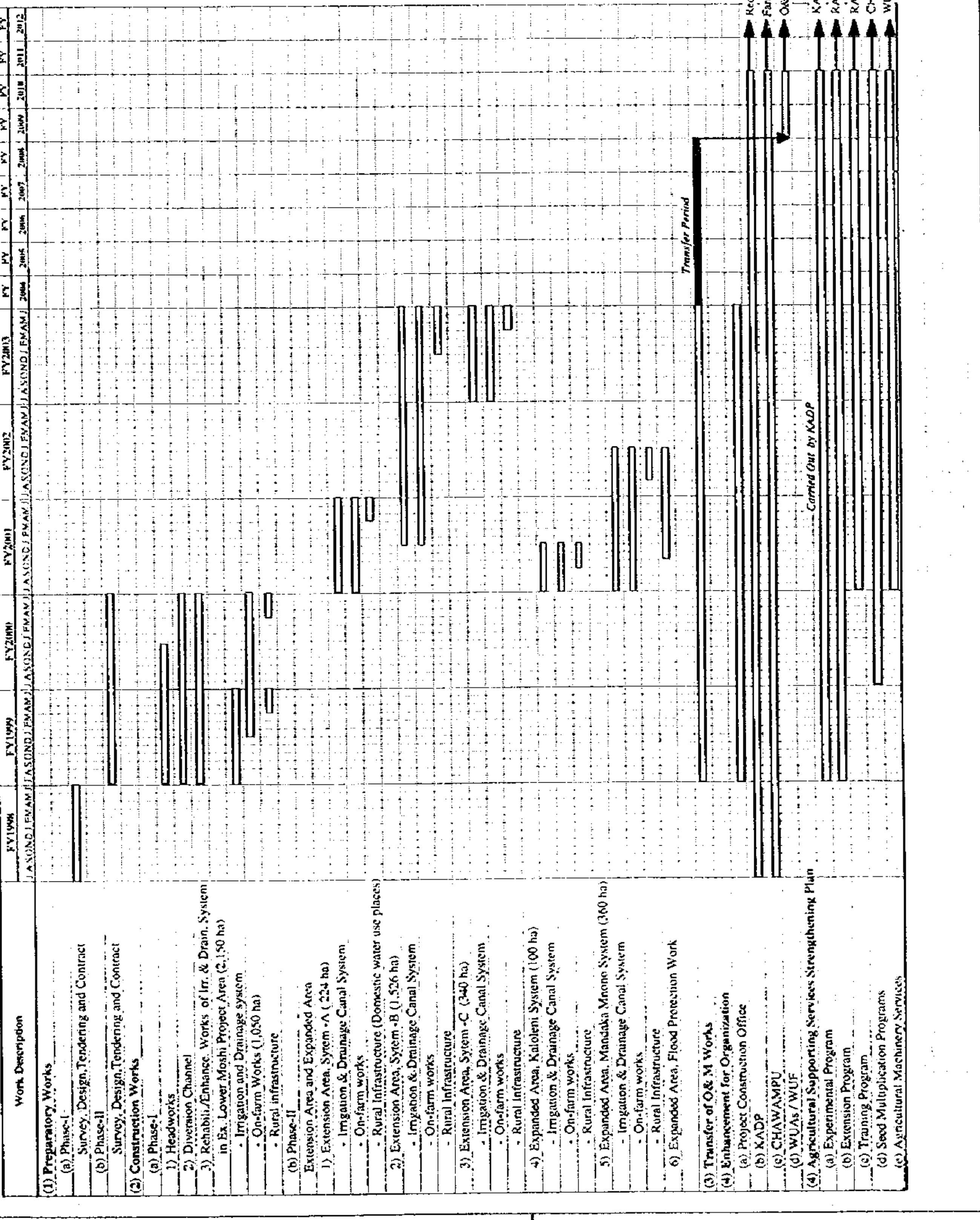

Figure 5.1

Implementation Schedule

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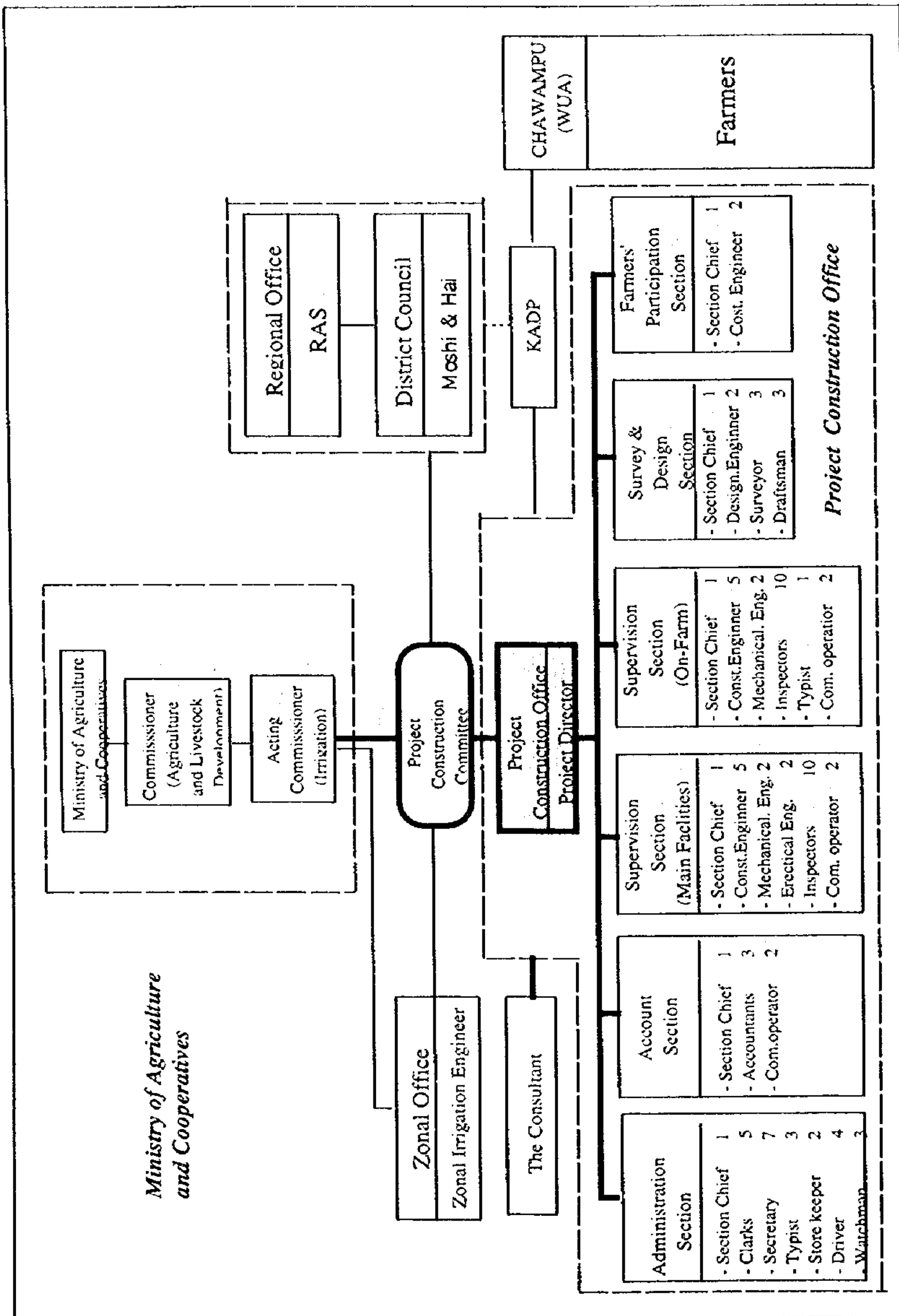

Figure 5.2
Organisation of Construction Office

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