

**THE UNITED REPUBLIC OF TANZANIA**

**BASIC DESIGN STUDY REPORT**

**ON**

**THE PROJECT FOR IMPROVEMENT OF**

**THE POST-HARVEST FACILITIES**

**IN**

**KILIMANJARO REGION**

**JULY 1987**

**JAPAN INTERNATIONAL COOPERATION AGENCY**

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国際協力事業団

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## PREFACE

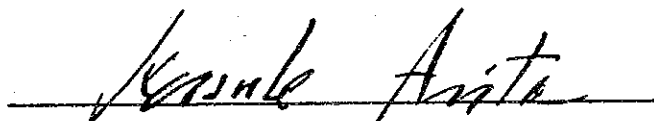
In response to the request of the Government of the United Republic of Tanzania, the Government of Japan has decided to conduct a Basic Design Study on the Project for Improvement of Post-Harvest Facilities in Kilimanjaro Region and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Tanzania from April 3 to 28, 1987 a study team headed by Mr. Yasuyuki SAKAI, Instructor, Agricultural Engineering Training Center, Training Institute of Agricultural Administration, Ministry of Agriculture, Forestry and Fisheries.

The team had discussions on the Project with the officials concerned of the Government of Tanzania and conducted a field survey in Kilimanjaro Region. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between the two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the United Republic of Tanzania for their close cooperation extended to the team.

July 1987

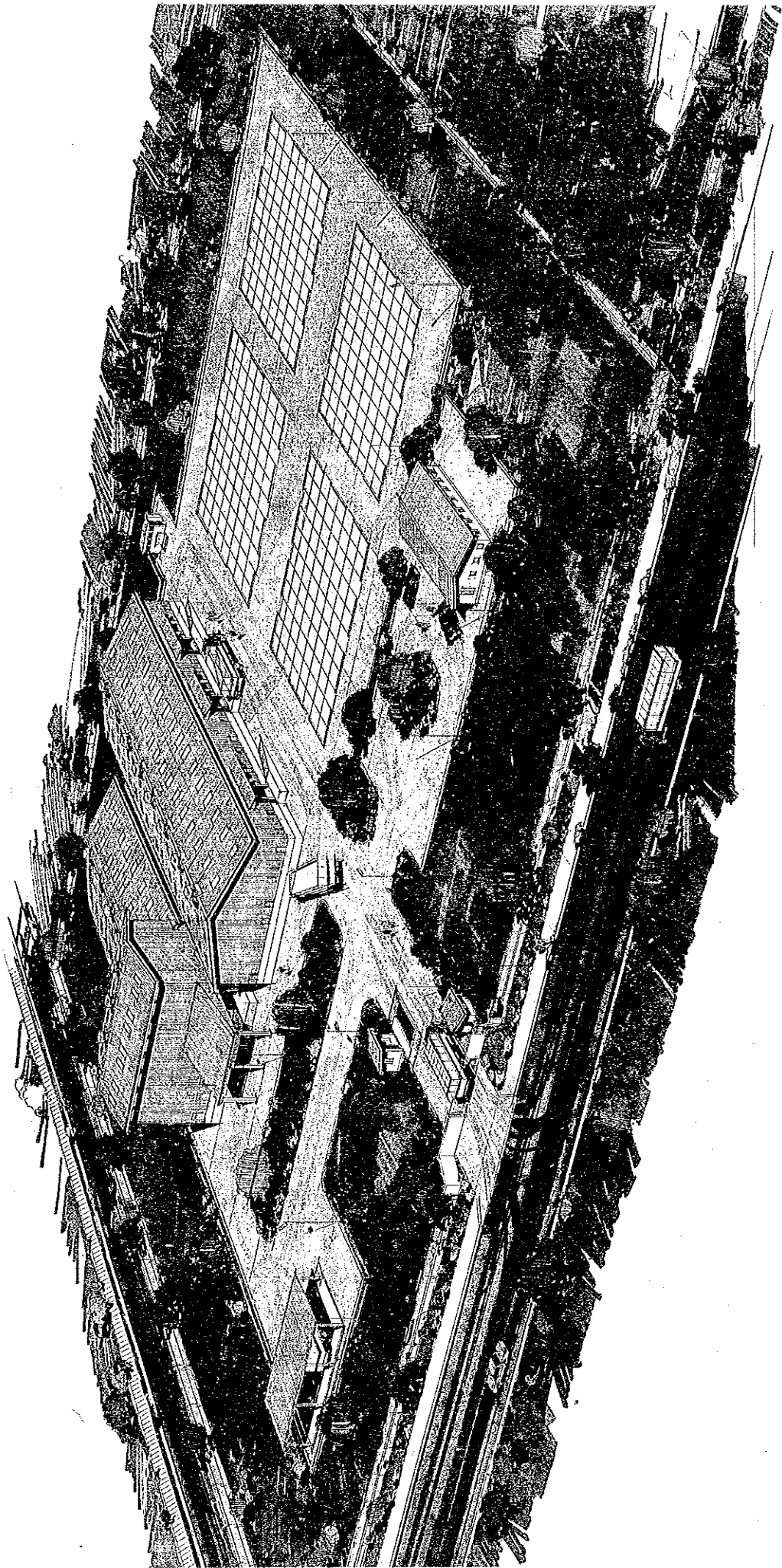
A handwritten signature in black ink, reading "Keisuke Arita", is written over a horizontal line.

Keisuke Arita  
President

Japan International Cooperation Agency

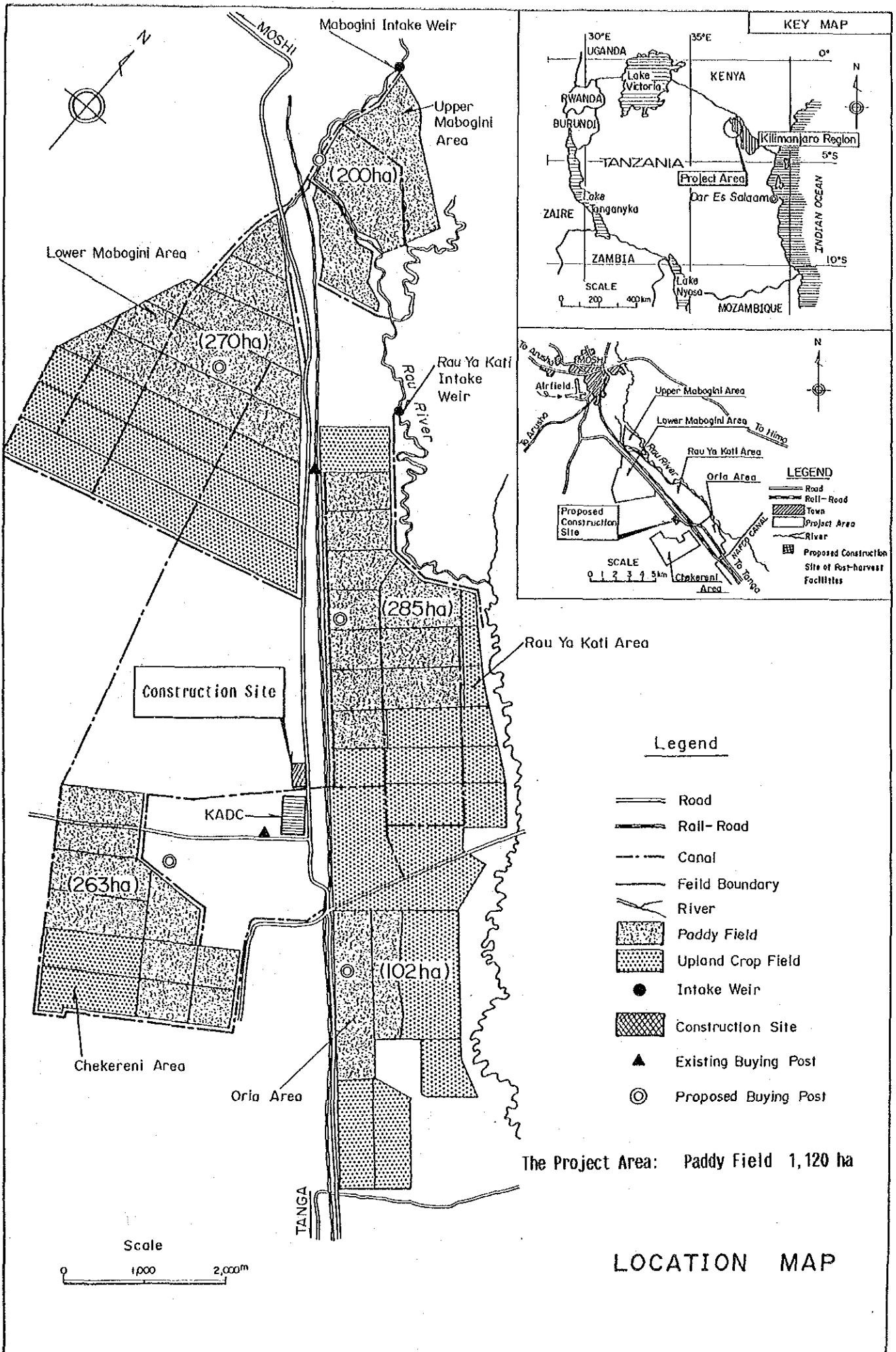




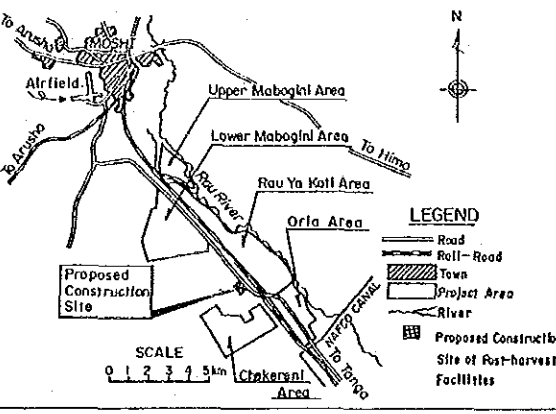
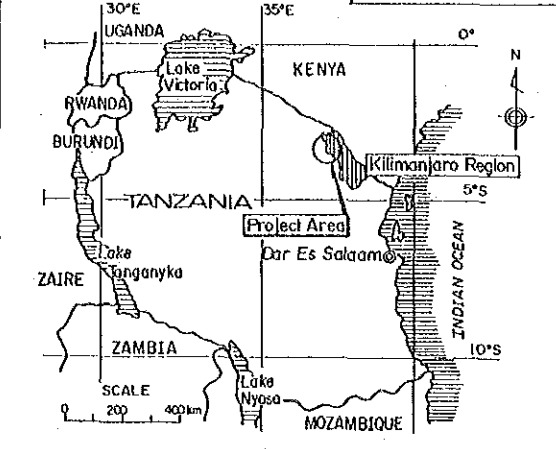


PERSPECTIVE VIEW OF POST-HARVEST FACILITIES





KEY MAP



Legend

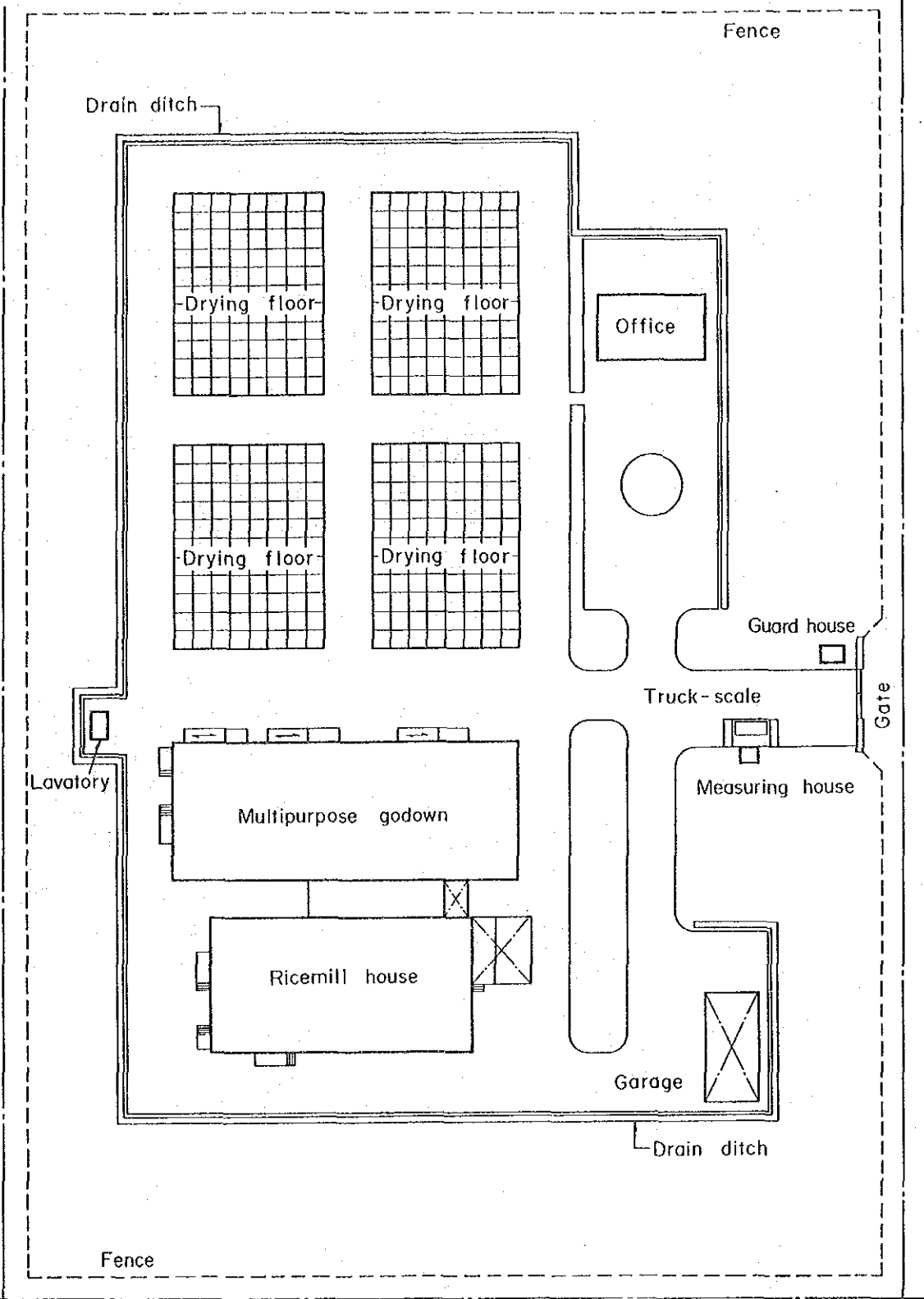
- Road
- Rail-Road
- - - Canal
- - - Field Boundary
- ~ River
- ▨ Paddy Field
- ▤ Upland Crop Field
- Intake Weir
- ▩ Construction Site
- ▲ Existing Buying Post
- ⊙ Proposed Buying Post

The Project Area: Paddy Field 1,120 ha

LOCATION MAP



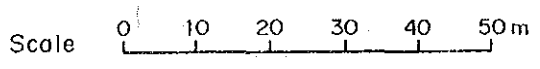




→ To MOSHI

ROAD

ROAD

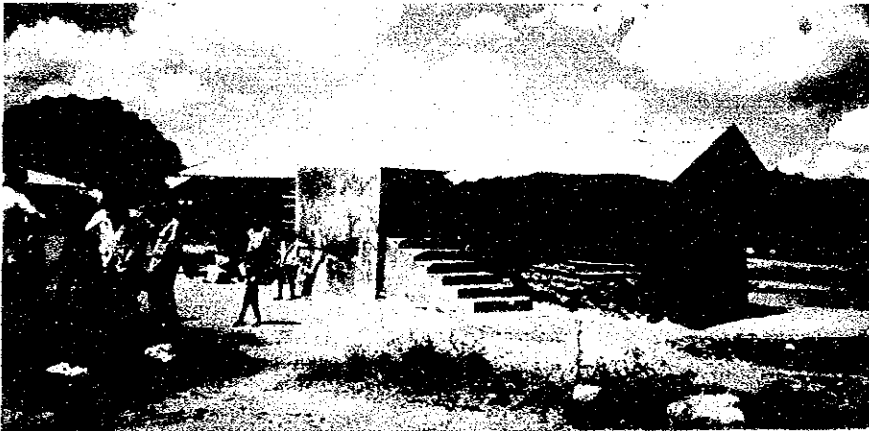


GENERAL LAYOUT OF PROPOSED FACILITIES





Project Area ( Upper Mabogini Irrigation Area in Rau River System )



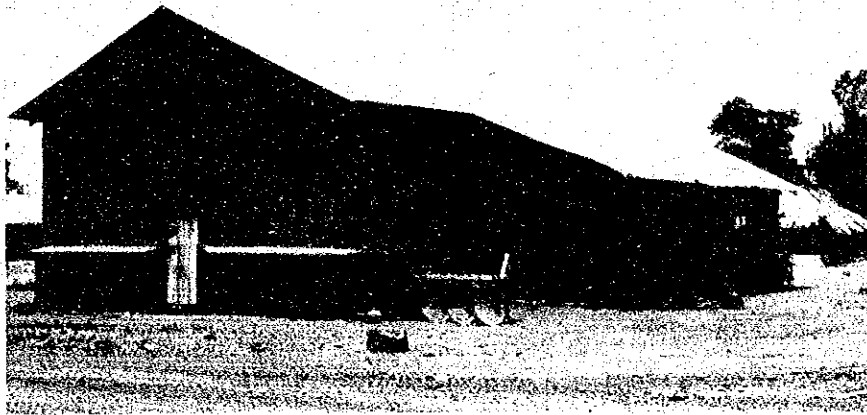
Existing Rice Mill Facilities  
( Chekereni Village )



Existing Rice Mill Machine  
( Mabogini Village )







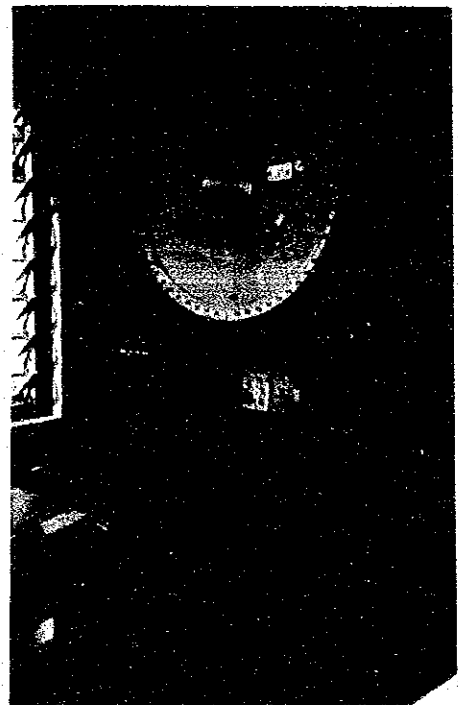
Godown ( Mabogini Village )



Sun-drying Floor of KNCU  
( Moshi )



Godown and Truck Scale of NMC ( Moshi )





## **SUMMARY**



## SUMMARY

(1) The Project for Improvement of the Post-Harvest Facilities in Kilimanjaro Region, for which the Government of Tanzania has requested Japan's grant aid, aims at improving the post-harvest facilities, especially for the paddy produced in the Rau River System area of the Lower Moshi Agricultural Development Project.

The Lower Moshi Agricultural Development Project is one of the six (6) priority projects implemented with Japan's cooperation which were selected through discussions between the Governments of Tanzania and Japan as part of the Kilimanjaro Integrated Development Plan. This plan was formulated by the Japan International Cooperation Agency (JICA) in 1977 and included 38 specific projects. The Rau River System is one of the component schemes of the Lower Moshi Agricultural Development Project, to which high priority is given from both technical and socio-economic standpoints, and which was commenced with financial assistance from the Government of Japan in 1984.

The objectives of the Rau River System are to attain self-sufficiency in food as well as to raise the living standards of farmers in the area, in conformity with the Government's national objectives. The main elements of the Rau River System are land consolidation works for 1,120 ha of paddy fields and 1,180 ha of upland fields including irrigation and drainage works. Construction of the Rau River System is progressing smoothly. In respect to production, about 100 ha of paddy cropping was practised in 1985, and in dry season of 1986 the area of paddy cropped reached about 510 ha, and 6.6 tons/ha of unit yield were realized.

As mentioned above, the Rau River System has shown good progress. However, with the increases in the area cropped and in the production of paddy, the shortage of the post-harvest facilities such as godowns, drying and milling plants, transport equipment and so on, has become serious.

(2) Based on the background mentioned above, the Government of Tanzania has formulated an improvement project for the post-harvest facilities of which the objective area will be the 1,120 ha of paddy fields in the Rau River System area, and has requested the Government of Japan for grant aid for implementation of the project. In response to the request from the Government of Tanzania, the Government of Japan agreed to conduct a basic design study to examine the viability of the project and to work out a specific basic

design. Accordingly, a Basic Design Study Team was dispatched from April 3rd to 28th, 1987 through JICA. The study team surveyed and investigated the project area to grasp the present conditions and constraints, collected the data required for the basic design study and had a series of discussions with the officials concerned of the Government of Tanzania, and then both sides exchanged Minutes of Discussions.

(3) The main work for which the Government of Tanzania requested Japan's grant aid in relation to the project is as follows:

- 1) Rice processing facilities with building for:
  - a) receiving
  - b) milling
  - c) drying
  - d) weighing and packing
  - e) processing of by-products (bran and husks)
- 2) Multi-purpose godown
- 3) Transportation equipment
- 4) Office for operation and maintenance

(4) The objective of the project is to provide the Rau River System area with sufficient the post-harvest facilities to improve the post-harvesting process from the collection and storage of harvested paddy to the milling and marketing of rice.

(5) Assessments of the adequacy of the project and the contents of the request from the Government of Tanzania have been based on the present conditions of the national development plan, agriculture in Kilimanjaro Region and the Rau River System area. The results are shown below.

- 1) Annual paddy production after the completion of construction of the Rau River System is estimated to be 9,700 tons. In relation to such production, improvement of the post-harvest facilities to dispose of such large amounts of paddy is lagging far behind. The capacity of existing rice milling facilities is 5.2 tons/hour (3.4 tons/hour actual capacity) for small rice mills in the project area and around Moshi town, and 11.2 tons/hour (7.8 tons/hour actual capacity) for the rice mills of KNCU and the 5 private millers in Moshi town. This is a relatively large capacity. However, the small rice mills are frequently utilized for petty orders from neighbouring farmers for home consumption. Therefore, it is difficult for the small

rice mills to operate continuously for processing large amounts. By contrast, the rice mills of KNCU and the private mills are mainly employed for milling paddy for consumption in Moshi town, and these can work at high capacities. Regarding drying facilities, KNCU and the above-mentioned private millers have only small drying floors of 100 to 200 m<sup>2</sup>. The farmers have no drying facilities and thus market their harvested paddy in wet or semi-dried condition. As a result, the shortage of drying facilities becomes a serious problem. Regarding storage facilities, NMC and KNCU already have godowns in Moshi town, but these are already fully utilized for the storage of coffee, maize, beans and so on, so there is little space for paddy. There are three (3) other godowns in the project area, but these are all very small in scale such as 55 to 113 m<sup>2</sup> with restricted storage capacities. It is anticipated that the shortage of godowns will become increasingly serious with the increasing amounts of seed, fertilizers and pesticides required for expansion of the cropped area and the increasing production of paddy. Consequently, it is considered necessary to improve multipurpose godown capacity for the storage for paddy, seed, fertilizers and pesticides. Also, as paddy production increases, transportation of the collected paddy needs to be improved. It is recognized in the Rau River System area, therefore, that post-harvest facilities for paddy must be improved to correspond with the production increases.

- 2) It is judged that the project has great significance; (i) by implementation of the project, a comprehensive and consistent system from production to the post-harvest processing will be realized in Kilimanjaro Region. This will have a strong demonstration effect as a national model, (ii) it may be expected to contribute to paddy price stabilization, (iii) intensification of the KNCU will be attained, which corresponds with the national policy aiming at intensification and promotion of farmers' cooperatives, (iv) it will directly satisfy the desire of the farmers for improvement of the post-harvest facilities and (v) it is already recognized and desired by the Tanzanian government.

(6) Basic items for formulating the project such as the project crop, harvesting period, collected amount etc. were determined as follows.

- 1) Object crop: Paddy produced in the Rau River System area.
- 2) Object area: Paddy fields in the project area; 1,120 ha (1,120 ha in rainy season, 820 ha in the wet season).

- 3) Unit yield: 5 tons/ha (in dried, milled condition) for both rainy and dry season paddy.
- 4) Production: Rainy season; 5,600 tons  
Dry season; 4,100 tons
- 5) Harvesting period: For rainy season paddy; June to July (60 days)  
For dry season paddy; December to following January (60 days)
- 6) Collected amount: For rainy season paddy; 3,600 tons  
For dry season paddy; 2,400 tons
- 7) Amount to be disposed: All of the collected paddy (3,600 tons in rainy season, 2,400 tons in dry season)
- 8) Multi-purpose godown: The objects to be stored are; paddy, seed, fertilizers and pesticides. Storage of paddy will be temporary during the post-harvest processes; long term storage is not anticipated.

(7) The outline of the post-harvest facilities to be improved is shown below.

1) Milling facility and building

a) Receiving facility

- Max. receiving quantity : 80 tons/day
- Equipments : Truck-scale (15 tons) x 1 set  
Hopper (10 tons/hr.) x 1 set  
Pre-cleaner (10 tons/hr.) x 1 set  
Grain moisture meters and carts

b) Drying facilities

- Drying methods : Both sun-drying and mechanical drying are proposed. Half of the received paddy will be dried by each method. Mechanical drying will be ventilated drying at normal temperature, with added supplementary heat when necessary during rainy days or at night when high humidity occurs.
- Sun-drying floor : Fuel tank (12,000 l) x 2 sets  
Diesel electric generator (16 kVa) x 1 set  
Pre-cleaner x 2 sets  
Water-proof sheet (86 m<sup>2</sup>) x 4 sheets



c) Milling facility

- Two (2) lines of machinery for the process from dehusking to bran removal and rice polishing will be furnished, so that the entire process need not be stopped in the case of some breakdown or in the case of machinery repair operations.
- Proposed plant capacity : 3 tons/hr. introducing two (2) shift operation
- Machinery : Paddy storage tank x 2 sets  
Cleaner x 1 set  
Hopper scale x 1 set  
Discharge adjusting tank x 1 set  
Husker x 2 sets, Separator x 2 sets  
Brown rice tank x 2 sets, De-stoner x 2 sets  
Whitener x 2 sets, Rice polisher x 2 sets  
Separator (bran & broken rice) x 1 set  
Length separator x 1 set

d) Weighing and bagging facilities

- Whitened rice tank x 1 set, Blender x 3 sets, Tank for shipping x 1 set, Sewing machine x 1 set, Scale shutter (measuring capacity 50 to 100 kg) x 1 set

e) By-product processing facilities

- Processing method : Husk to be smashed, bran to be shipped without any treatment.
- Equipment : Husk smasher (750 kg/hr.) x 1 set  
Platform scale x 2 sets

- f) Building : Steel framed, one-storied building, 1 building, total area 1,297 m<sup>2</sup>

2) Multi-purpose godown

- a) Max. storage capacity : Dried paddy 1,800 tons  
Seed 12 tons  
Fertilizers 600 tons  
Pesticides 2,240 l
- b) Building : Steel framed, one-storied building, 1 building, total area 1,297 m<sup>2</sup>
- c) Transportation carts : 6 ton-truck x 6 units
- d) Administration office : Block framed, one storied building, 1 building

total area 198.0 m<sup>2</sup>

(8) The proposed construction site is located about 15 km away from Moshi town and faces onto the Kahe road which runs from Moshi town south-eastward. The elevation of the site is about 725 m, almost the same elevation as the adjacent roads. The site is flat and has roads on two (2) sides, runs about 210 m along the Kahe road, and is 146 m in depth and 3.1 ha in area. No specific problems are anticipated regarding supplies of power and water or the ground conditions on the site. The right of use of the site must be bestowed by Chekereni Village. However, no problem is expected in acquiring the right.

(9) The executing agency of the project is the Kilimanjaro Regional Development Director's office (the RDD's office). The RDD's office will also take charge of liaison, and coordination and maintenance of the post-harvest facilities will be conducted by KNCU, a cooperative union, under control of the RDD's office. The required number of staff for operation and maintenance of the facilities is 55 persons consisting of technical experts, clerks and a manager.

(10) The implementation period to completion of the project will be 15 months, after agreement on the Exchange of Notes (E/N), which will cover all preliminary work, detailed design, preparation of tender documents, tendering, approval of tenders, contracts etc. The scope of the construction works allotted to Japan's side will be: construction of the buildings including the rice mill plant, godown and administration office, procurement and installation of the rice mill equipment, godown and other equipment, and procurement of transport. Those allotted to the Tanzanian side will be: land preparation of the construction site, lead-in of power and water lines, installation of gate, etc. The construction cost to Japan is estimated at about ¥598 million. The construction costs required on the Tanzanian side are estimated at TSh.0.75 million (equivalent to ¥1.82 millions at the exchange rate of ¥2.42 to TSh.1.00).

(11) The direct project benefits to be expected by implementation of the project are: stabilization of rice supply in the Mosi District, improvement of living conditions, reduction of post-harvest losses and stabilization of rice farming in the project area. The expected indirect benefit will be: reinforcement of cooperatives, demonstration effects, extension of post-harvest technology, increase in employment opportunities, stabilization of social welfare conditions, etc.

The RDD's office, the executing agency of the project, has already experienced similar

projects with Japan's grant aid, and no hindrance is expected in the implementation of the project. Furthermore, KNCU, an O/M organization, already has various functions as a marketing agency of farm products including control of godowns, transport facilities, cotton ginning factories, etc. Thus, making use of this experience, KNCU will be able to function as the O/M organization of the facilities. Costs of O/M of the rice mill plant will be small enough to be absorbed in the price difference between the buying price of paddy and the retail price of milled rice offered by KNCU. Thus no financial burden is expected from implementation of the project. Any technical assistance required on operation of the facilities is expected from Kilimanjaro Agricultural Development Center (KADC). Thus implementation of the project would appear to be viable.

(12) As a result of the field survey and homework analysis carried out by the Basic Design Study Team, it is recognized that the various direct and indirect benefits stated above are expected from implementation of the project, thus, the project is judged to be viable. The project may be seen as a leading model for the post-harvest facilities which will become important in the future agricultural development plan in Kilimanjaro Region. In addition, as construction of the Rau River System has already been completed and production is getting into full swing, implementation of the project is required as soon as possible. Taking these conditions into consideration, it is concluded that the Project for Improvement of the Post-Harvest Facilities in Kilimanjaro Region is favorable and appropriate for Japan's Grant Aid Program. And in order to realize smooth implementation of the project and adequate operation and maintenance of the facilities, the following actions are recommended to be taken by the Government of Tanzania.

- 1) Appointment of responsible organizations for the construction work of the project such as a construction office, management committee, etc.
- 2) Timely implementation and completion of the construction work for which the Government of Tanzania will be responsible.
- 3) Strengthening of the organization which will be responsible for operation and management of the project facilities.
- 4) Preparation of an adequate number of staff for operation and maintenance of the project facilities.
- 5) Establishment of a technical assistance system with KADC.



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## ABBREVIATIONS

DADO	:	District Agricultural Development Office
DED	:	District Executive Director
EC	:	European Community
EEC	:	European Economic Community
E/N	:	Exchange of Notes
EL	:	Elevation
FAO	:	Food and Agriculture Organization of the United Nations
F/S	:	Feasibility Study
GDP	:	Gross Domestic Product
HYV	:	High Yielding Variety
IDA	:	International Development Association
IMF	:	International Monetary Fund
IRRI	:	International Rice Research Institute
JICA	:	Japan International Cooperation Agency
KADC	:	Kilimanjaro Agricultural Development Center
KADP	:	Kilimanjaro Agricultural Development Project
KIDC	:	Kilimanjaro Industrial Development Center
KNCU	:	Kilimanjaro Native Cooperative Union
KRTC	:	Kilimanjaro Regional Trading Company
LV	:	Local Variety
NMC	:	National Milling Corporation
OECF	:	Overseas Economic Cooperation Fund
O & M	:	Operation and Maintenance
RADO	:	Regional Agriculture Development Office
RDD	:	Regional Development Director
SAP	:	Structural Adjustment Program
TAFCO	:	Tanzania Animal Feed Company
TANESCO	:	Tanzania Electric Supply Company Limited
TPTC	:	Tanzania Posts and Telecommunications Corporation
USDA	:	United States Department of Agriculture
VCU	:	Vuasu Cooperative Union

## UNITS OF MEASUREMENT

### 1. Length and Height

mm	:	millimeter
cm	:	centimeter
m	:	meter
km	:	kilometer

### 2. Area

cm <sup>2</sup>	:	square centimeter
m <sup>2</sup>	:	square meter
ha	:	hectare
km <sup>2</sup>	:	square kilometer

### 3. Volume

cm <sup>3</sup> , cc	:	cubic centimeter (= ml)
ml	:	milliliter (= cc)
lit.	:	liter (= 1,000 ml)
m <sup>3</sup>	:	cubic meter

### 4. Weight

mg	:	milligram
g	:	gram
kg	:	kilogram
t	:	ton (= 1,000 kg)

### 5. Time

S, sec	:	second
min	:	minute
hr	:	hour

### 6. Electrical Measurements

V	:	volt
kV	:	kilo volt
Hz	:	hertz
kWh	:	kilo watt hour
MVA	:	mega volt ampere

### 7. Other Measure

%	:	percent
HP, PS	:	horse power
°C	:	degree centigrade
ppm	:	parts per million
Nos	:	number(s)
μΩ	:	micron ohm
°S	:	south latitude
°E	:	east longitude

### 8. Currencies

US\$	:	US dollar
Tsh.	:	Tanzanian shilling



# **CHAPTER 1 INTRODUCTION**



## CHAPTER 1 INTRODUCTION

The Government of the United Republic of Tanzania (hereinafter referred to as "the Government of Tanzania") has been promoting a series of national development plans since its independence in 1961. In its Second 5-year Plan (1969-1974), the Government of Tanzania adopted a policy whereby the formulation of integrated development plans of major regions would be requested from the developed countries, together with the principal policy of decentralization under which each region should be responsible for its own development and the Central Government would coordinate the whole. In line with this policy, the Government of Tanzania requested the Government of Japan to extend technical aid for preparation of an integrated development plan for Kilimanjaro Region. The Government of Japan accepted the request and entrusted the Japan International Cooperation Agency (JICA) with its execution.

Since 1974 JICA has dispatched several study teams, and has formulated the Kilimanjaro Integrated Development Plan, in which 38 specific development projects were listed as having promising development potential. Of these 38 projects, 6 priority projects were selected through discussions between the Government of Tanzania and the Government of Japan, and these have been commenced. The selected projects and the present situation in regard to Japan's assistance on these projects are summarized as follows:

Project	Present Situation
1. Lower Moshi Agricultural Development Project (Rau River System)	OECF loan (Construction was completed in April 1987.)
2. Mkomazi Valley Area Irrigation Development Project	Feasibility study (F/S) was executed by JICA in 1982/83.
3. Development, Extension and Training of Agricultural Techniques	Kilimanjaro Agricultural Development Center (KADC) was established under Japan's Grant Aid Program. Technical assistance is ongoing (1978-1991).
4. Promotion of Agricultural Mechanization	Granted 205 tractors in 1985.
5. Establishment of Kilimanjaro Industry Development Center (KIDC)	KIDC was installed under Japan's Grant Aid Program. Technical assistance is ongoing (1978-1991).
6. Kilimanjaro Transmission and Distribution Network Project	OECF loan in 1981

The Government of Tanzania has given a high priority to Kilimanjaro Region in the execution of its Regional Integrated Development Plan. Regarding agricultural development which is the core of the Regional Integrated Development Plan, the Government of Tanzania has laid greatest emphasis on two projects, KADC and the Lower Moshi Agricultural Development Project. Accordingly, Kilimanjaro Region received about 40% of the national agricultural development budget in fiscal 1985.

The Government of Tanzania completed the Lower Moshi Agricultural Development Project in April 1987 with the funds provided by Japan. Present the post-harvest facilities for paddy produced in the area are not sufficient to deal with the increased paddy production. Accordingly, the Government of Tanzania requested the Government of Japan to extend grant aid for improvement of the post-harvest facilities.

In response to this request, the Government of Japan entrusted the Japan International Cooperation Agency (JICA) with execution of the basic design study for the project which was entitled "Project for Improvement of the Post-harvest Facilities in Kilimanjaro Region". JICA dispatched a basic design study team headed by Mr. Y. Sakai, Chief Instructor, Agricultural Technical Training Center, Ministry of Agriculture, Forestry and Fisheries to Tanzania from April 3 to April 28, 1987. The survey team confirmed the background and the details of the request and investigated the project area to understand the present conditions. The team had discussions with the concerned officials of the Government of Tanzania on fundamental items, then both sides exchanged the agreed minutes of discussions. The Minutes of Discussion, members of the study team, itinerary of the study team, and list of personnel contacted are as given in Annexes 1-4.

This report represents the results of the basic design study on the Project for Improvement of the Post-Harvest Facilities in Kilimanjaro Region.



## **CHAPTER 2 BACKGROUND OF THE PROJECT**



## CHAPTER 2 BACKGROUND OF THE PROJECT

### 2.1 General Conditions in Tanzania

#### 2.1.1 General

Tanzania is a nation established in 1965 through the combination of Tanganyika and Zanzibar which gained independence in 1961, in 1964 respectively. Tanzania is located between lat. 1° and 11°45'S, and between long. 29°20' and 40°38'E, and covers 945,000 km<sup>2</sup>. Most of its territory is covered with savanna and dry-savanna, with some tropical rain forests and coastal mangrove forests. The climate is cool around Mt. Kilimanjaro in the north and around the Lake Nyasa in the west.

The climate can be divided into two seasons; a dry season from June to October and a rainy season from November to May. In Tanzania most parts suffer from flood or drought because of insufficient or irregular rainfall. The mean temperature is influenced by altitude, and ranges from around 26°C on the coastal plains to under 20°C above 1,200 m.

In 1984 the total population of Tanzania was 21.2 million, and the average annual growth rate during the period 1980-1984 was 3.4%. The population density was 22.4 persons/km<sup>2</sup>. Kilimanjaro Region has the second highest population density following Dar es Salaam, the capital, with a density of 68 persons/km<sup>2</sup>. As for the educational system, it takes 6 years for elementary school, 6 years for junior high school, and 3 years for university. The literacy rate was as high as 79% in 1980 since the Government puts much stress on education.

#### 2.1.2 Recent Economic Trends

The Gross Domestic Product (GDP) in 1985 amounted to Tsh.91,600 million (US\$5,240 million) in total and Tsh.4,320 (US\$247) per person. The export value in 1985 amounted to US\$340 million. Tanzania's economy is based on agriculture which puts weight on such crops as coffee, cloves, cotton, cashew nuts, tobacco and tea. The agricultural sector provided 46% of GDP in 1984, and the export value of products of the above six crops amounted to 70% of the total export value in 1984. Both GDP and agricultural products were growing steadily at rates of 5.4% and 3.4% during the period of 1968-1972 when economic difficulties intervened. Economic growth was depressed from

1977 due to hostilities with Uganda (1978-1979) and the sudden rise of oil prices in 1979. The situation deteriorated further due to the worldwide recession, bad export conditions and droughts in early 1980s. The economic situation became stagnant as may be seen from the average growth rate of GDP during the period of 1980-1982 which was 1.1%. To cope with the decline, the Government of Tanzania announced a three year Structural Adjustment Program (SAP) in 1982 to launch an economic recovery. As a result of this Program GDP reached from Tsh.12,200 million in 1983 to Tsh.12,500 million in 1984 at 1976 constant prices with an annual growth rate of 2.6%. The growth rate of per capita GDP, however, was negative due to the increasing population.

The inflation rate, which was 10% in 1970s, became 36% in 1984, and 27% in 1985. Wages declined sharply compared with those of 1980, while the nominal wage was raised by 25% in 1981 and 35% in 1984.

Tanzania's national budget has shown deficits since 1980, thus the development budget has been severely constrained. Such policies as subsidy curtailment to semi- government enterprises, partial charge of the cost of junior high school education to individuals, and the introduction of development tax on people over 18 years old, have been introduced. Since SAP the Government has also been promoting reduction of imports and the maximum use of domestic materials, restraining new investment and giving priority to rehabilitation and ongoing projects.

Measures such as SAP to activate the economy and increase production, have already had some effect, but not yet enough. Foreign exchange insufficiency continues to seriously restrain the nation from reconstructing the economy and growing properly.

### 2.1.3 Agriculture

Five (5) percent of the territory of Tanzania, or 4.1 million ha, is agricultural land. About 90% of the population live in the rural areas, and agriculture employs nearly 90% of the economically active population.

As mentioned earlier, the amount of agricultural products such as coffee, cloves, cotton, cashew nuts, tobacco and tea, corresponded to 70% of total exports, coffee corresponding to 39% in 1985. These export crops, however, have a tendency to decrease in quantity. Sisal, which used to be the main export product now corresponds to only 2-3% of total exports.

Regarding cereal crops, in 1979, there was an exportable surplus of maize after the maximum harvest in history, but this declined suddenly in 1984 to 70,000 tons, only 32% of the maximum, and 230,000 tons of maize had to be imported. In 1985, production of other food crops such as rice, wheat and cassava also decreased sharply to about 38%, 58% and 31% of the past maximum production.

It has been pointed out that the stagnation of agriculture in Tanzania has been caused by the production base being influenced by weather, the shortage of materials and equipments due to insufficient foreign currency and the restraints on farm gate prices. The farm gate price of maize continued to decline during the period of 1978-1983, and in parallel with this maize for the market decreased from 220,000 tons in 1979/80 to 70,000 tons in 1984. On the other hand, the production quickly increased when the farm gate price was raised, partly because the weather improved.

Organizational problems have been another cause of stagnation in agriculture. Therefore, the marketing organization has now been reformed by the Government in such a way that the Cooperative Union will handle farm products in the rural areas, limiting the Corporation's activity to the urban area.

There has thus been slight recovery in the food situation as indicated above since the import of basic foods was started in the latter half of 1960s. However, the situation is still serious as cash crops for export will increasingly be converted to food crops unless the ongoing agricultural development plan to establish self-sufficiency in food proves to be successful.

## 2.2 Outline of Related Development Plans

### 2.2.1 National Development Plans

The Government of Tanzania has had five (5) National Development Plans since independence in 1961;

- |          |             |             |
|----------|-------------|-------------|
| - First  | 3-year Plan | (1961-1964) |
| - First  | 5-year Plan | (1964-1969) |
| - Second | 5-year Plan | (1969-1974) |
| - Third  | 5-year Plan | (1976-1981) |
| - Fourth | 5-year Plan | (1981-1986) |

The fundamental purpose of the economic development plans up to the 1970s, was that the growth rate during the objective period should be over 6% per annum, based on the principle of promotion of increased industrialization and agricultural production. In practice, however, the growth rates during the First, Second and Third 5-year Plans were only 5%, 4.8%, and 0.4%, respectively.

The Forth 5-year Plan was interrupted and the 3-year Structural Adjustment Program (SAP) was introduced in 1982. This was followed by the Economic Recovery Program (ERP), framed in cooperation with the World Bank, and agreed with IMF.

To cope with the rapid economical decline towards the end of 1970s, the Fourth 5-year Plan was suspended, and a National Economic Survival Program (NESP) was introduced 1981. During the period 1982-1984, the Government further adopted the Structural Adjustment Program (SAP) with the objectives of; i) increasing production, especially agricultural production, ii) recovery of financial deficit and restriction of money supply, iii) promotion of exports and iv) equalization of income distribution. However, the achievement of these objectives has so far been limited. The subsequent Economic Recovery Program (ERP) was launched in 1986 for the period 1986-1990. In the ERP, the target annual growth rate of GDP was set at 4.5% on average to be attained in the following manner:

- Increased production of food crops and export crops through incentives to production, improvement of the marketing system and increased supply of agricultural inputs
- Rehabilitation of social infrastructures
- Provision of foreign exchange to priority sectors
- Improvement of terms of national and international finance

The ERP lays stress on; i) stabilization of farm gate prices, ii) promotion of free trade, iii) establishment of a financial policy for inflation control and effective resource distribution and iv) system reform for the purpose of rationalization of the public sector.

Through the SAP, devaluation was achieved in 1984 as recommended by IMF, and adjustments made to the controlled economy and the corporations leading to gradual promotion of free trade. The price control has been partially abolished, and is now restricted

to only twenty (20) items: it is expected to be decreased further to twelve (12) items. Liberalism of economy, which was launched during the economic crisis of the early 1980s, continues.

## 2.2.2 Agricultural Development Plans

### (1) Administration

The administration of Tanzania consists two (2) Offices and sixteen (16) Ministries under the President as shown Fig. 1. The Ministry of Finance, Economic Affairs and Planning is responsible for foreign economic cooperation.

The Ministry of Agriculture and Livestock Development, and the Ministry of Local Government and Cooperatives are directly concerned with agricultural development. The former is responsible for agricultural research and extension, and agricultural development schemes; the latter is responsible for promoting the development of village communities and the Cooperative Union/Cooperative Society.

All the development activities of the Region are the responsibility of the Regional Development Director's office (the RDD's office), which is organized under the Office of the Prime Minister. The RDD's office consists of four (4) executive divisions and twelve (12) divisions under the control of the RDD as shown in Fig. 2. The RDD's office is responsible for the District Executive Director's offices (DED's offices) which are located in each district. Agricultural administration is undertaken by the Ministry of Agriculture and Livestock Development though in the name of the RDD's office. The organization of the DED's office at district level is similar to that of the RDD's office.

### (2) Agricultural Development Plans

The Government of Tanzania currently has two policy documents "The Agricultural Policy of Tanzania" and "Tanzania National Food Strategy", which set out agricultural strategies to attain independence of national economy through self-sufficiency in food. The "Tanzania National Food Strategy" provides a comprehensive prescription covering production, processing and marketing for the three target terms; short-term (1980-1985), medium-term (1985-1990) and long-term (1990-2000).

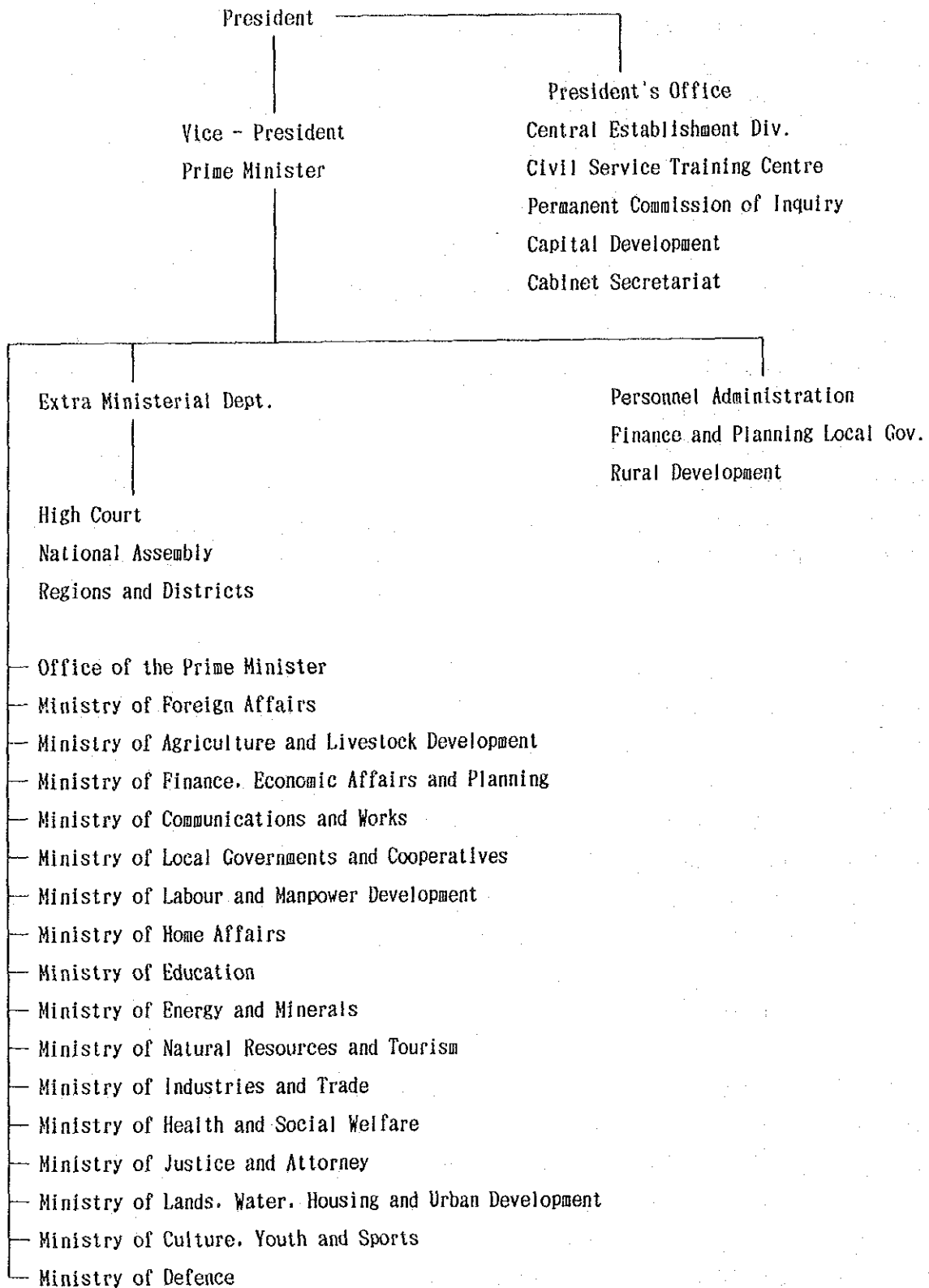


Fig. 1 ADMINISTRATION MAP OF THE GOVERNMENT OF TANZANIA



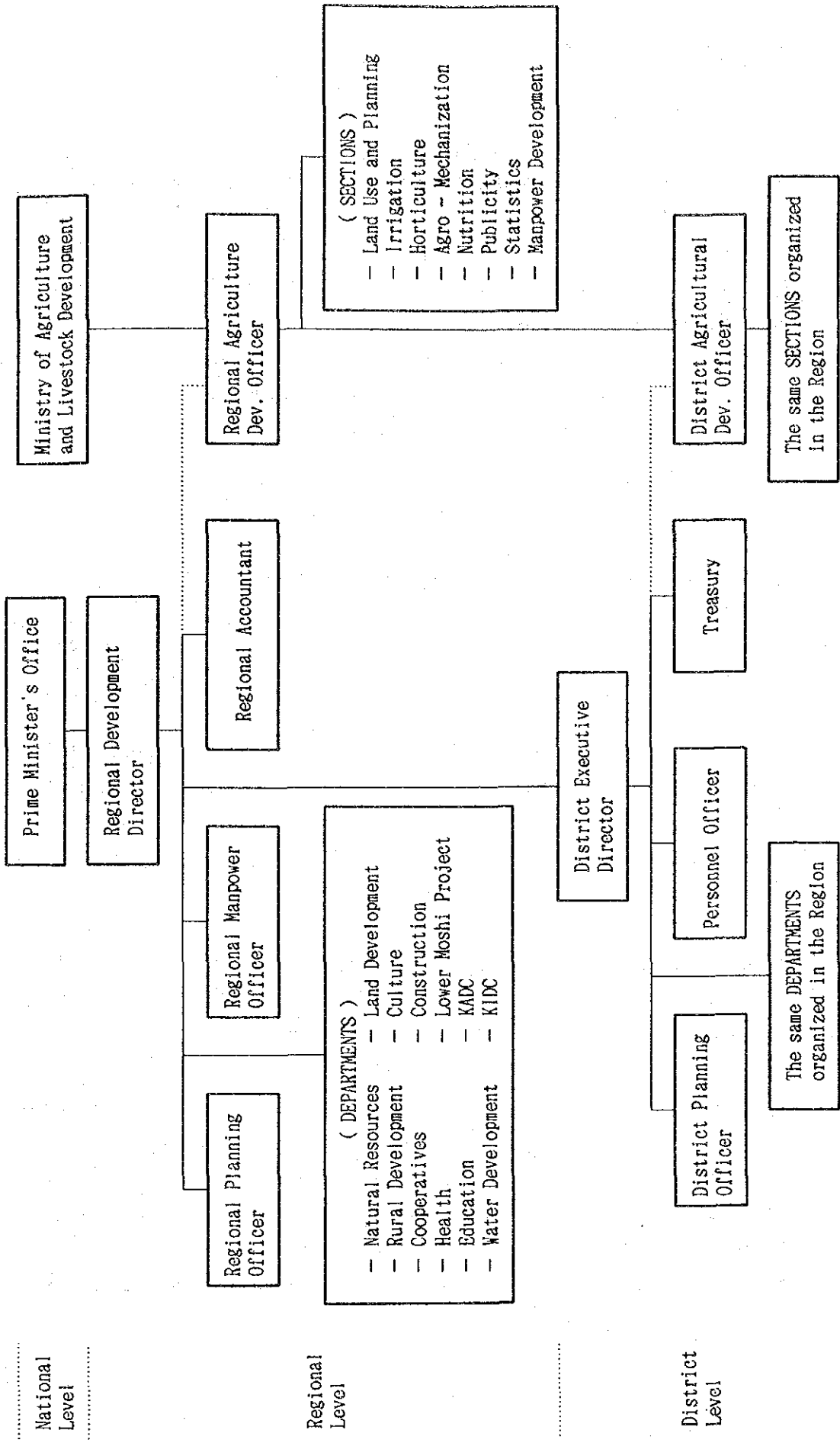


Fig. 2 ORGANIZATION MAP OF REGIONAL DEVELOPMENT DIRECTOR'S OFFICE

The main goals are as follows:

#### Goals for the short-term plan

- Improvement of the transport and storage facilities for the smooth conveyance of food crops and farm inputs,
- Timely supply of the proper amounts of fertilizers, agricultural chemicals and farm implements for small-scale farmers, and
- Rationalization of the prevailing price policy for the purpose of promoting effective and economic food production.

#### Goals for the medium-term plan

- Agricultural research and multiplication of improved seeds for food crops,
- Upgrading of technique through provision of acceptable packages of techniques for each crop and area,
- Improvement of existing small-scale irrigation systems and the maintenance of irrigation facilities in the rural areas,
- Strengthening of agricultural extension and training services, as well as of the agricultural credit system, and
- Taking measures for prevention of pre- and post-harvest losses.

#### Goals for the long-term plan

- Expansion of irrigation systems

The irrigation development plan, which is emphasized in "Tanzania National Food Strategy", projects that the irrigation area will be extended from 127,300 ha up to 380,000 ha by the year 2000. As the objective areas, six (6) irrigation zones in the respective regions of Mbeya, Morogoro, Kilimanjaro, Tabora, Mwanza and Rukwa were programmed to be developed.

Agricultural development of Kilimanjaro Region is being promoted mostly with aid from Japan. The main projects are as follows:

<u>Lower Moshi Area</u>	<u>6,320 ha</u>	
- Rau River System	2,300 ha	(construction completed)
- Miwaleni River System	2,000 ha	(F/S completed)
- Himo River System	1,000 ha	(F/S completed)
- Groundwater	1,020 ha	(F/S completed)
<u>Mkomazi Valley Area</u>	<u>4,060 ha</u>	
- Kisiwani Scheme	360 ha	(F/S completed)
- Gonja Scheme	600 ha	(F/S completed)
- Ndungu Scheme	680 ha	(B/D completed)
- Kihurio Scheme	1,670 ha	(F/S completed)
- Igoma Scheme	750 ha	(F/S completed)
<u>Hai &amp; Rombo Area Ground Water Development</u>		
	5,000 ha	(F/S not done yet)
<u>Ruvu River System, Jipe Lake Area</u>		
	6,000 ha	(F/S not done yet)

Of above projects, the construction of the Rau River System was completed in April 1987 with a loan from Japan's Overseas Economic Cooperation Fund, the basic design study for the Ndungu Scheme was done under Japan's Grant Aid Program for the fiscal year 1986 the study for the Hai & Rombo Area Groundwater Development was carried out by a contact mission in April 1987, Kilimanjaro Agricultural Development Center (KADC) was established under the Grant Aid Program and technical assistance, and is now the center for agricultural research and extension as well as for training activity. The comprehensive agricultural development plan will be achieved when the project for improvement of the post-harvest facilities in Kilimanjaro Region, under which the post-harvest facilities for paddy produced in the Rau River System area are to be constructed, is realized. It will be a model scheme not only for Kilimanjaro Region but for the whole nation.

### (3) Foreign aid

Foreign aid to Tanzania in recent years is summarized in the following table:

(Unit: million US\$)

Year	DAC Countries	International Organizations	OPEC Countries	Total
1977	257.4	75.9	6.9	340.2
1978	332.6	90.8	1.0	424.4
1979	457.4	127.4	3.6	588.4
1980	523.4	127.5	7.4	658.3
1981	484.8	173.2	43.9	701.9
1982	483.7	187.5	11.3	682.5
1983	427.8	149.6	43.4	620.8
1984	407.4	140.4	11.1	558.9

Source: OECD, Geographical Distribution of Financial Flows to Developing Countries, 1981 & 1986.

The total amount of foreign aid for Tanzania was growing steadily up to 1981, almost doubling compared with 1977, but it declined US\$558.9 million in 1984, since countries of the west, mainly West Germany, restrained aid until stand-by credit was agreed with IMF.

Scandinavian countries including Sweden are important donor countries, and constantly account for over 20% of the total amount of aid. Bilateral aid provided a high percentage of between 60% and 70% throughout the period from 1977 to 1984. Of the international organizations, International Development Association (IDA) and EEC are the main donors. As for the form of the aid, grants provides the largest amount, of around 70% from 1981 to 1984, since Tanzania is one of the least-developed countries and was very badly influenced by the oil crisis. Of the total amount of technical aid, US\$216 million, agriculture, forestry and fishery amount to 28%, industry 14% and sanitation 12%. Main recent aid objects concerning agricultural development are as follows:

Name of Study	Donor	Year Commenced
1 Small-scale paddy cultivation development project	AfDB	1982
2 Irrigation development project for paddy cultivation in Morogoro Region	AfDB	1982
3 Paddy cultivation development project in Dakawa	AfDB	1983
4 Water supply project for Iringa, Mbeya and Ruvuma	Denmark	1983
5 Pest control project	Denmark	1983
6 Iringa development project	EC	1983
7 Nordic project	DANIDA (Denmark)	1984

In main recent aid as mentioned in the preceding table, on the other hand, it might be related to the Nordic Project in the operation of this project. At present KNCU, which is responsible for the operation and management of the post-harvest facilities, has four (4) consulting advisers supplied by DANIDA under the Nordic Project by which the Government of Tanzania hopes to strengthen cooperative societies in general. The outline of the Nordic Project is summarized as follows:

- 1) Purpose: Strengthening of cooperative societies in the whole country.
- 2) Implementation agency: DANIDA, Denmark
- 3) Period: 1984 - 1988
- 4) Activities in KNCU: Prepare an Operation Manual and give guidance on administrative matters in particular. ( Consulting advisers of KNCU consist of 4 experts; Management, Transport, Financial and Credit Service Advisers. In the whole country, about 80 advisers have been dispatched.)

There is the trend in Tanzania aid requests for each region to be allotted to an individual donor country. It is because of this that the specific region's comprehensive development plan was requested from a specific donor in the third 5-year Plan. Hence Japan's cooperation has become concentrated on Kilimanjaro Region and Dar es Salaam, and in the case of Kilimanjaro Region as follows:

Name of Project	Remarks
1. Kilimanjaro Agricultural Development Center (KADC) and Kilimanjaro Industry Development Center (KIDC)	established under the Grant Aid Program
2. Procurement of agricultural machinery	under the Grant Aid Program
3. Lower Moshi Agricultural Development Project	by OECF loan in 1981
4. Kilimanjaro Transmission and Distribution Network Project	by OECF loan in 1981
5. KADC and KIDC Project	Technical assistance is ongoing sequent to above said establishment of KADC and KIDC
6. Basic design study on the Ndungu Agricultural Development Project	under the Grant Aid Program in 1986

## 2.3 General Condition of Kilimanjaro Region and Present Condition of Agriculture

### 2.3.1 General Conditions in Kilimanjaro Region

Kilimanjaro Region is located in northeastern Tanzania, bordering on Kenya, Arusha Region and Tanga Region. It covers an area of 13,210 km<sup>2</sup>, corresponding to 1.4% of the area of the entire country. Out of the entire region, 2,820 km<sup>2</sup> or 21% is agricultural land, 512 km<sup>2</sup> or 4% is natural pasture, and the remaining 75% is left as preserved forest, savanna and steppe. The Region had a population of 900,000 in 1978 with a population density of 68 persons/km<sup>2</sup>. Administratively, Kilimanjaro Region is divided into 5 districts, namely Moshi, Hai, Rombo, Mwanga and Same. These are subdivided into 23 Divisions, 117 Wards and 358 Villages.

This Region can be divided into two distinctive areas, so called highlands and lowlands, according to the natural conditions such as climate and topography and the extent of sociological and economic development. The highlands are located on the slopes of Mt. Kilimanjaro and Pare mountains in belts from 800 to 1,800 m in altitude. This area is favoured with moderate temperature and abundant rainfall. Under these conditions, intensive cultivation of coffee and bananas has been practised for very many years. One of the most serious problems in this area, however, is that farm land has been divided into small pieces and self-sufficiency in food has decreased due to the rapid increase in population. Accordingly, farmers are immigrating to the lowlands so as to obtain new farm land.

By contrast, the lowlands, which include the Ndungu area, are located below 800 m, and are characterized by insufficient rain and high temperature. They extend over the basins of the Pangani river, the Mkomazi river and the Arusha-Chimi plain. Such food crops as maize, millet, beans and paddy are mainly produced in the lowlands, but most of the area is left uncultivated.

### 2.3.2 Present Condition of Agriculture

Agriculture is the main industry in the region with more than 90% of the region's population engaged. Agriculture in the region plays an important role in Tanzania, coffee produced in the region in particular accounts for about 50% of the total national production. About 3,000 tons of coffee and 1,600 tons of sisal are produced and the region is one of the main producers of cash crops.

The main food crops of the Region are banana, maize, roots, tubers and rice, of which cultivated area and production are shown in Table 1. The production of food crops, however, is unstable since the cultivation depends on rain.

## 2.4 Background and Contents of the Request

### 2.4.1 Background of the Request

The Rau River System, one of the preferred programs of the Lower Moshi Agricultural Development Project from the view points of technology and socio-economy, has been implemented since 1984 with funds provided by the Government of Japan. The project, based on reclamation of 1,120 ha of paddy field and 1,180 ha of upland field, with land consolidation including irrigation and drainage, aims at self-sufficiency of food, one of the national targets, and upgrading of farmers' living standards. Construction has been progressed smoothly, and a 100 ha of land was planted with paddy in 1985. By dry season of 1986 the planted area had reached around 510 ha and the unit yield recorded 6.6 tons/ha. Several problems, however, have been experienced with expansion of planted area and increased paddy production, namely:

- (1) Shortage of godowns
- (2) Lack of processing facilities
- (3) Shortage of transportation equipment
- (4) Difficulties in communications regarding cultivation method such as determining the cropping pattern and water management.

Accordingly, the Government of Tanzania plans to improve the post-harvest facilities, and has requested the Government of Japan to extend grant aid for the implementation of its plan.

### 2.4.2 Contents of the Request

The request submitted by the Government of Tanzania provides for improvement of the post-harvest facilities for 1,120 ha of paddy field in the Rau River System, is summarized as follows:

- (1) Rice Processing Facilities with Buildings for:
  - Receiving

Table 1 CULTIVATED AREA AND PRODUCTION OF FOOD CROPS IN KILIMANJARO REGION AND MOSHI DISTRICT

Crop	Kilimanjaro Region				Moshi District			
	1984/1985		1985/1986		1984/1985		1985/1986	
	Area (ha)	Production (tons)	Area (ha)	Production (tons)	Area (ha)	Production (tons)	Area (ha)	Production (tons)
Rice	4,420	11,440	5,090	17,090	1,000	4,440	1,420	6,400
Maize	61,010	72,740	73,880	122,480	10,700	28,890	23,190	46,370
Wheat	3,200	4,000	5,000	6,250	-	-	-	-
Sorghum	1,990	1,320	5,520	1,590	100	140	690	690
Pulses	21,340	9,100	29,030	20,980	1,500	1,080	3,700	3,700
Banana	78,280	54,630	73,520	769,650	26,900	280,000	26,900	322,800
Roots and Tubers	7,660	38,970	9,550	29,880	20	80	-	-

Source: The RDD's Office, Kilimanjaro Region



- Drying
  - Milling
  - Weighing/packing
  - Processing of by-products (bran and husks)
- (2) Multi-Purpose Godown
  - (3) Transportation Equipment
  - (4) Office for Operation and Maintenance

The above multi-purpose godown will be built so as to store fertilizer, agricultural chemicals and seeds as well as unhulled rice produced in the Rau River System area. The transportation equipment will be prepared for the purpose of conveyance of the unhulled rice from buying posts to the post-harvest facilities in the project area. Details of Tanzania's request are attached as Annex 4, Minutes of Discussion.

The construction site is located along the trunk road from Moshi town to Chekereni Village, 15 km south-east of Moshi town. The RDD's office will be responsible for implementation of the project, and Kilimanjaro Native Cooperative Union (KNCU) will take charge of facilities' operation entrusted by the RDD's office. The Government of Tanzania has strongly requested technical support of KADC in operation and maintenance of the post-harvest facilities.



## **CHAPTER 3 THE PROJECT AREA**



## CHAPTER 3 THE PROJECT AREA

### 3.1 Location

The objective area of the Project for Improvement of the Post-Harvest Facilities (the project area) is located at lat. 3° 26'S and long. 37°24'E, and is 1,120 ha of paddy field (including 20 ha of paddy field in the pilot farm), out of 2,300 ha of irrigated fields consolidated through the Lower Moshi Agricultural Development Project. The project area corresponds to the area of the Rau River System formulated through the feasibility study on the Lower Moshi Agricultural Development Project, and consists of four (4) irrigated areas: the Upper Mabogini, the Lower Mabogini, the Rau Ya Kati and the Chekereni. The outline of the Lower Moshi Agricultural Development Project is shown in Fig. 3.

### 3.2 Administrative Organizations and Population

The project area administratively belongs to Moshi District, Kilimanjaro Region. The Upper Mabogini area and the Lower Mabogini area pertain to Mabogini Village, Mabogini Ward, and the Chekereni area to Chekereni Village, Mabogini Ward. The Rau Ya Kati area belongs to both Rau Ya Kati Village and Oria Village, Kahe Ward.

The population and the numbers of households are shown below:

Village	Population	Nos. of Households	Average Nos. of Persons per Household
Mabogini	6,700	700	9.6
Rau Ya Kati	2,100	270	7.8
Chekereni	4,100	930	4.4
Oria	7,000	910	7.7
Total	19,900	2,810	7.1

Remarks: The population and numbers of households are estimated for 1987 assuming a population growth rate of 3%, and based on a survey of the administrative clerks of each village.

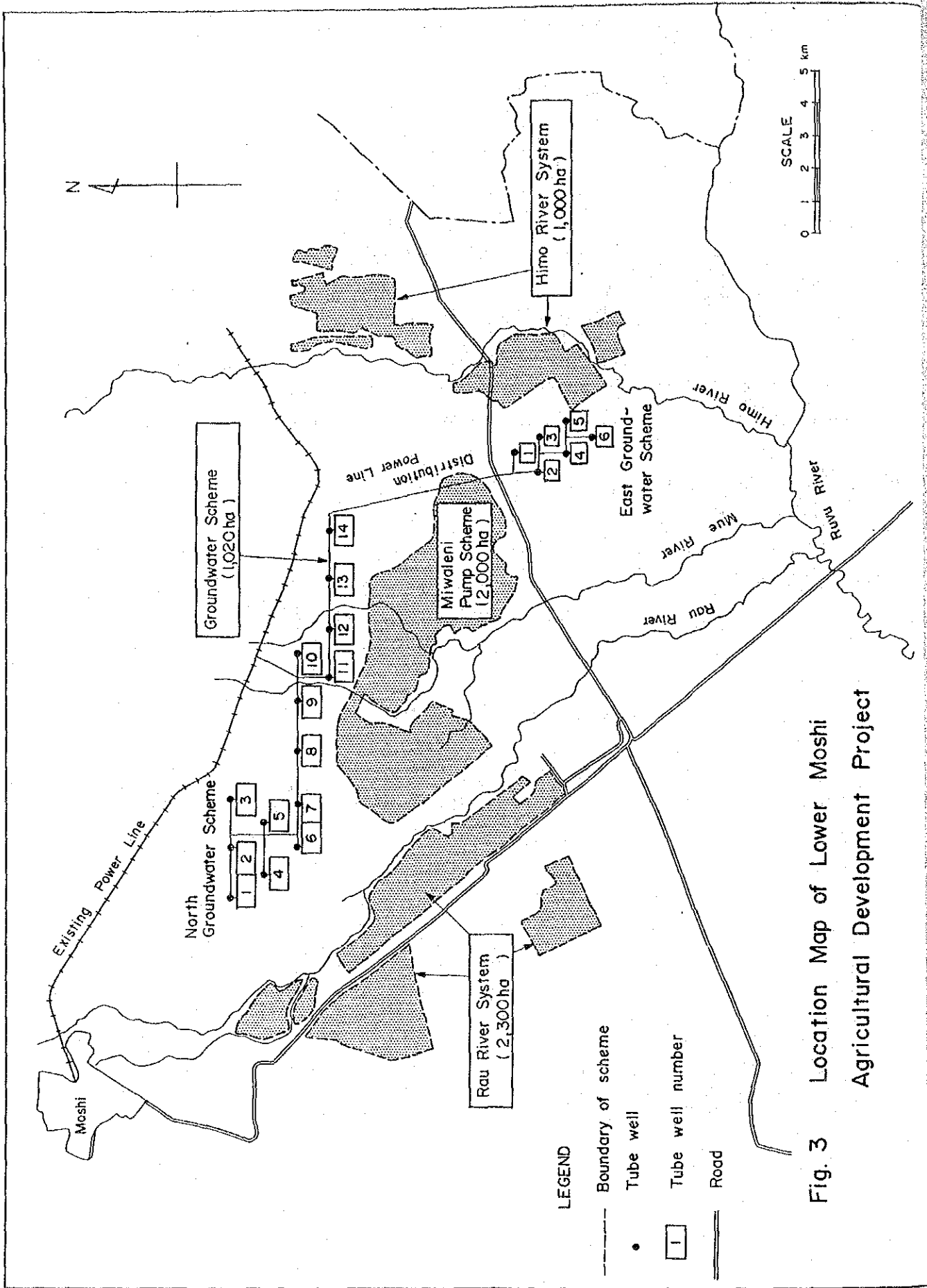


Fig. 3 Location Map of Lower Moshi Agricultural Development Project

### 3.3 Physical Conditions in the Project Area

#### 3.3.1 Topography

The project area is located to the southeast of Moshi town, the capital of Kilimanjaro Region, at a distance of between 3 and 15 km, extending along the right bank of the Rau river. The area borders on the Rau river to the east, the sugarcane fields of the Tanganyika Planting Corporation (TPC) to the west and north, and the main canal of the National Food Corporation (NAFCO) to the south.

The project area is generally composed of gently sloping land with a gradient ranging from 0.5% near Moshi town, to 0.2% close to NAFCO. The elevation at the meteorological station at Chekereni Village is 725 m.

#### 3.3.2 Meteorology and Hydrology

##### (1) Meteorology

There are three (3) working meteorological stations (Moshi town, Miwaleni and NAFCO) around the project area. Meteorological observations have also been made since 1981 by KADC in Chekereni Village, where the facilities on the project are planned to be constructed. The meteorological data for recent five (5) years recorded by this KADC station are presented in Annex 5.

The climate in the project area is divided into three seasons: namely, rainy season from March to May, dry season from June to October and short-rains season from November to February. Annual rainfall averages 580 mm, of which 260 mm or 44% falls in rainy season, 50 mm or 9% in dry season and 270 mm or 47% in short-rains season. There is rainfall on 70 days in a year. The monthly rainy days may be 15 days during rainy season, compared with only 2 to 4 days during dry season.

The mean temperature varies from 20 to 25°C throughout the year. The average daily maximum temperature rises above 30°C from October to April, while the average daily minimum temperature falls close to 16°C from June to August.

The annual average relative humidity is 71%, being over 70% from April to August with its maximum in May. The winds are light from April to August and moderate from

September to October. South and southeast winds are predominant. The daily sunshine hours average over 8 hours with a maximum of over 9 hours in January, and a minimum of under 5 hours from May to July.

## (2) Hydrology

The Rau river and the Njoro river are available as sources of irrigation water in the project area. The Rau river flows from the south slope of Mt. Kilimanjaro and meanders to the southeast of Moshi town, before joining the Ruvu river in Mwanga District. The river has the gradient of between 1/200 and 1/400, in the project area, while it is steeper further upstream part. The Njoro river by contrast originates from numerous scattered springs and joins the Rau river at a point of 7 km southeast of Moshi town, after traversing the project area.

The catchment areas of the Rau and the Njoro rivers are 122 km<sup>2</sup> and 15 km<sup>2</sup> respectively, and the average total discharges are 50 million m<sup>3</sup> and 70 million m<sup>3</sup> a year.

### 3.3.3 Soils

The soils may be broadly classified into three (3) as follows:

#### (1) Dystric Cambisols

These are derived from old alluvium deposited mainly by the Rau river, covering most of the soils in the project area. They are generally of silty clay to clay texture, being neutral to slight acid.

#### (2) Mollic Gleysols

These mainly extend over the Rau Ya Kati area, especially the depression along the Rau river and the old river bed. These soils, which have a silty clay texture, have slight salinity problems.

#### (3) Entic Gleysols

These are found mainly in the Upper Mabogini area, especially the low land along the upper Rau river. They are classified as clay and have no salinity problems.



### 3.4 Existing Infrastructures in the Project Area

#### 3.4.1 Transportation

There are trunk roads radiating in all directions from Moshi town. Of these the main route connecting Tanga and Arusha is asphalt-paved and crosses Moshi town in an east-west direction. The distance from Moshi town to Tanga is around 390 km.

The trunk road leading to the project area is the Kahe road with a width of 12.5 m, which runs from Moshi town along the Rau river a south easterly direction. The Kahe road is surfaced with a gravel, and is the artery of the rural area. This road, corrugated in places and not in good condition, is passable throughout the year.

Tanga, the main port of Tanzania, and Arusha are connected by railway through Same and Moshi town. Passenger trains are operated twice a week and a goods train every day. The distance between Moshi town and Tanga is 350 km.

#### 3.4.2 Electricity Supply and Communication

The 220 kV super high-tension line between Dar es Salaam and Kidatu, with 132 kV branch lines, forms the core of the power transmission system in Tanzania. Eastern and northern areas in Tanzania are covered by these lines as a transmission network.

In the project area, there is an 11 kV transmission line alongside the Kahe road which runs south east from Moshi town. Power is transmitted from the Kiungi transformer station to the Boma Mbuzi transformer station in Moshi town at 33 kV which is stepped down to 11 kV at this station. Power is supplied to the project area by this transmission line.

Regarding communications, there is a telephone line from Moshi town to the project area running parallel to Kahe road but the capacity of the telephone circuit is not enough.

#### 3.4.3 Domestic Water Supply

Public water supply is available in and around Moshi town from nearby springs. Water is supplied from Pasua reservoir, which is located to the south of Moshi town with a capacity of 230 tons, using the PVC pipe gravity facilities. Supply hours are limited at present due to insufficient water.

### 3.5 Present Conditions of Agriculture

#### 3.5.1 Land Use

There are two land use patterns in the Rau River System area, namely paddy and upland fields. The areas of paddy and upland fields are 1,120 ha and 1,180 ha, respectively, in total 2,300 ha. The land use pattern in each irrigation block is shown below:

(Unit: ha)

Irrigation Block	Paddy Field	Upland Field	Total
Upper Mabogini	200	70	270
Lower Mabogini	270	415	685
Rau Ya Kati	387	553	940
Chekereni	263	142	405
Total	1,120	1,180	2,300

As stated earlier, the project area is administratively composed of 4 villages. Of these four (4) villages, paddy is presently cropped in parts of Mabogini, Rau Ya Kati and Chekereni (only in the pilot farm) Villages, not cropped in Oria Village yet. The proportions of paddy and upland fields planned for each village area are shown below:

(Unit: ha)

Village	Paddy Field	Upland Field	Total
Mabogini	470	485	955
Rau Ya Kati	285	475	760
Chekereni	263	142	405
Oria	102	78	180
Total	1,120	1,180	2,300

The area of paddy cropped in rainy season of 1987 totaled 475 ha as shown below:

(Unit: ha)

Irrigation Block	Paddy Field	Upland Field	Total
Upper Mabogini	151	70	221
Lower Mabogini	152	-	152
Rau Ya Kati	152	-	152
Chekereni	20	60	80
<b>Total</b>	<b>475</b>	<b>130</b>	<b>605</b>

Because water availability in dry season is limited, double cropping of paddy cannot be practised over the whole area. Thus, it is proposed that cropping of paddy in dry season be limited to 820 ha, being 330 ha in the Mabogini blocks and 490 ha in the Rau Ya Kati and Chekereni blocks. Annual land use plan for each irrigation block is summarized below:

(Unit: ha)

Irrigation Block	Rainy Season			Dry Season			Annual		
	Paddy	Upland	Total	Paddy	Upland	Total	Paddy	Upland	Total
Upper Mabogini	200	70	270	330	<u>1</u> 70	400	800	555	1,355
Lower Mabogini	270	415	685						
Rau Ya Kati	387	553	940	490	<u>2</u> 60	550	1,140	755	1,895
Chekereni	263	142	405						
<b>Total</b>	<b>1,120</b>	<b>1,180</b>	<b>2,300</b>	<b>820</b>	<b>130</b>	<b>950</b>	<b>1,940</b>	<b>1,310</b>	<b>3,250</b>

1: Sugarcane farm

2: Pilot farm

Reallocation of farm land in the project area is undertaken by the Village Committee and Project Office. Reallocation has already been completed in Mabogini, Chekereni and Rau Ya Kati Villages on the basis of land cultivation rights before commencement of the project work. In the case of Oriavillage, where provisional reallocation has been completed, final reallocation will be completed by the end of April, 1987.

The reallocated area of farm land per household varies from village to village in the project area, but over the whole it averages about 0.4 ha to 0.5 ha. The area in Chekereni

Village is 0.4 ha and 0.7 ha in Rau Ya Kati Village. The area in Mabogini Village varies from 0.3 ha to 0.9 ha.

### 3.5.2 Present Cropping Pattern

According to experts of KADC, the cropping season for paddy is divided into rainy and dry seasons. With rainy season paddy, seeding is commenced from early January to late February. Transplanting is practised after about 25 days in the nursery beds. Harvesting is carried out from early in June to late in July. Seeding in dry season is practised from early July to late August, with harvesting from early December to late January.

Planting of upland crops is limited to rainy season. Main upland crops planted in the project area are maize, cotton, sorghum, kidney beans and so on. Cotton, which was previously the dominant crop in the project area, has been much reduced since the introduction of paddy.

### 3.5.3 Present Farming Practices

Overall guidance on paddy cultivation in the project area is provided by KADC. The guidelines on paddy cultivation by KADC are well-extended among the farmers. These guidelines may be summarized as follows:

- (1) Seed Treatment: Seed soaking for 24 hours should be practised 3 days before planting, after that, the seed should be allowed to sprout for two days.
- (2) Seeding and Nursery: During nursery preparation, puddling should be practised for weed control. The nursery bed should be 1.5 m x 27 m. Seedlings for 1 plot (0.3 ha) would be provided from 3 beds of this size. The seeding rate should be 30 kg/ha or 3 kg/nursery bed.
- (3) Recommended Varieties
  - For dry season: IR20, IR36, IR54, IR56
  - For rainy season: Affa Muanza, Matandiko, Super IR20, IR36, IR54 (with attention to low temperature)

(4) Planting Spaces

For the improved varieties: 20 cm x 20 cm (25 seedlings/m<sup>2</sup>)

For the traditional varieties: 20 cm x 25 cm (20 seedlings/m<sup>2</sup>)

Transplanting depth should be no more than 3 cm to 4 cm

(5) Fertilizers

For the improved varieties: 65 kg/plot (100 kg N/ha) of urea  
( 150 kg N/ha at present )

- as basal application 2/3 bag ( 50 kg/bag ) at the time of puddling

- as top dressing 1/3 bag at 2 weeks after transplanting

1/3 bag at 70 to 80 days after transplanting

For the traditional varieties: 33 kg/plot (50 kg N/ha) of urea

- as basal application 1/3 bag at the time of puddling

- as top dressing 1/6 bag at 2 weeks after transplanting

1/6 bag at young-panicle formation stage

(6) Pesticides Application: Diazinon or Thiodan, 135ml/plot

1,000 dilution should be applied at the time of nursery period,

2 weeks after transplanting, after then, as occasion calls.

(7) Weeding:

Protection by puddling should be practised to reduce weed infestation. The first weeding should be done 2 weeks after transplanting, and the second at 1 month after transplanting.

(8) Harvesting:

Practised at the time when the percentage of ripened grains reaches to 80%.

(9) Cropping Period

Rainy season: Seeding is done from January to February. Damage may be suffered from low temperatures, if seeding after March.

Harvesting is practised during the period from May to June.

Dry season: Seeding is from July to August and harvesting from December to January.

Major insects reported in the project area are Stalk-eyed fly, Pink Stem Borer, White Rice Stem Borer and so on. Major weeds in the paddy field are Barnyard Millet, Chufa and so on. Manual weeding is generally practised.

Land preparation consists of tillage and puddling by use of a tractor-mounted rotary tiller. Machinery service to farmers is provided by KADC on a contract base. Pesticides are applied by individual farmers with knapsack type sprayers. Manual harvesting is commonly practised by the farmers, the rice plant hills being cut down to the root by sickles. Threshing is also carried out by manual labour. After threshing and rough winnowing, the grain is either sold in bags or brought back to the farmer's house.

#### 3.5.4 Unit Yields and Production of Paddy

##### (1) Unit Yield of Paddy

KADC has carried out various trials and research on unit yields of paddy in the project area, as summarized in Table 2. In addition, sample survey on unit yield was carried out at the pilot farm in Chekereni Village and paddy fields in the Lower Moshi town area. The results of this survey are shown in Table 3, with details presented in Annex 6.

According to these data, the unit yields of paddy ranged from 5 to 7 tons/ha. Of these, the yield obtained at upper Mabogini area showed the highest achievements. According to the KADC, the reason for this high yield achievement was not only the good natural conditions such as ample solar radiation and the large difference in temperature between day and night but also the following:

- 1) Good relations between farmers and technical experts,
- 2) Establishment of appropriate farming practices,
- 3) Little damage by insects on the newly cultivated lands, and
- 4) Fertilizers and pesticides supplied and applied on schedule.

In addition farm guidance such as in water management and so on, provided in detail by Japanese experts contributed to these high unit yields.

##### (2) Production of Paddy

The past records of paddy production at pilot farm and paddy fields in the project area

Table-2 RESULTS OF PADDY YIELD RESEARCHES BY JAPANESE EXPERTS

Ref.No.	Variety	Date of S. L1	Date of H. L2	Fertilizers	Yield
15	IR36	7 Sept. '83	18 Jan. '84	(kg/ha) N:100 P: 40	(kg/ha) L3 5.774 (13.1%)
16	IR20	21 Sept. '83	8 Feb. '84	N:100 P: 40	L3 8.258 (17.8%)
17	IR42	13 Jan. '84	15 Jun. '84	N:100 P: 40	4.718
18	IR54	10 Feb. '84	30 Jun. '84	N:100 P: 40	4.598
28	IR36	9 Aug. '85	16 Dec. '85	N:150 P: 80	6.027
30	IR 8			N: 75	5.870 (Average)
31	IR20	'83		N:100 P: 40	4.530
	IR20	'84			3.340
	IR36	'83			5.520
	IR36	'84			3.990
	IR54	'83			5.020
	IR54	'84			3.880
	IR56	'83			4.040
	IR56	'84			3.880
32	IR36	'84			6.066
33	IR54	13 Sept. '83	16 Feb. '84	N:150 P: 80	8.520
34	IR54	13 Oct. '83	20 Mar. '84	N:100 N:150	7.450 7.140

L1: Seeding L2: Harvesting L3: Moisture Contents  
(Source) KADC Report

Table-3 RESULTS OF PADDY YIELD SAMPLING SURVEY IN THE PILOT FARM AND LOWER MOSHI AREA (DAY SEASON 1986)

## Pilot Farm

Variety	No. of Sample	yield		Actual Yield	
		Arithmetic Mean (t/ha)	Geometric Mean (t/ha)	Arithmetic Mean (t/ha)	Geometric Mean (t/ha)
IR 20	14	6.75	6.82	6.31	6.23
IR 36	2	6.75	6.71	7.07	7.05
IR 54	37	7.52	7.42	7.56	7.51
Total	53	7.28	7.18	7.21	7.13

## Lower Moshi Area

Variety	No. of Sample	Arithmetic Mean (t/ha)	Geometric Mean (t/ha)
IR 20	9	5.16	4.84
IR 54	45	6.41	6.22
Total	54	6.20	5.96

(Source) KADC Second Quarter Report, 1986/87

are shown below. Production in dry season of 1986 was about 3,380 tons (paddy).

Year/Crop Season	Area Cropped (ha)	Average Yield (ton/ha)	Production (ton)
<u>Pilot Farm</u>			
1982	3.0	4.29	13
1983	6.0	5.53	33
1984	20.7	4.15	86
1985	21.6	4.18	90
1986 (Rainy season)	18.9	6.80	129
(Dry season)	18.9	7.29	138
<u>Rau River System Area</u>			
1985 (Dry season)	97.2	7.03	683
1986 (Rainy season)	124.5	6.73	838
(Dry season)	491.1	6.60	3,240

Source: KADC

### 3.6 Agricultural Support System

With respect to agricultural support activities in the project area such as extension service, supply of farm inputs (fertilizers, pesticides, etc.), collecting, processing and marketing of farm products, farm credits and so on, the responsible agencies are the District Agricultural Development Office (DADO), KADC and KNCU.

Agricultural extension services are provided farmers by DADO and KADC. DADO, under the District Agricultural Development Officer, has 9 sections with 12 technical experts specializing in the following fields:

Section	No. of Experts
1) Irrigation	2
2) Horticulture	1
3) Farm Machinery	2
4) Fertilizer	1
5) Plant Protection	1
6) Pest Control	1
7) Land Use	1
8) Coffee	1
9) Demonstration	2
<b>Total</b>	<b>12</b>



At the subordinate level, DADO has a staff of 91 comprising officers, supervisors and extension workers in 4 divisions, 27 wards and 132 villages as shown below:

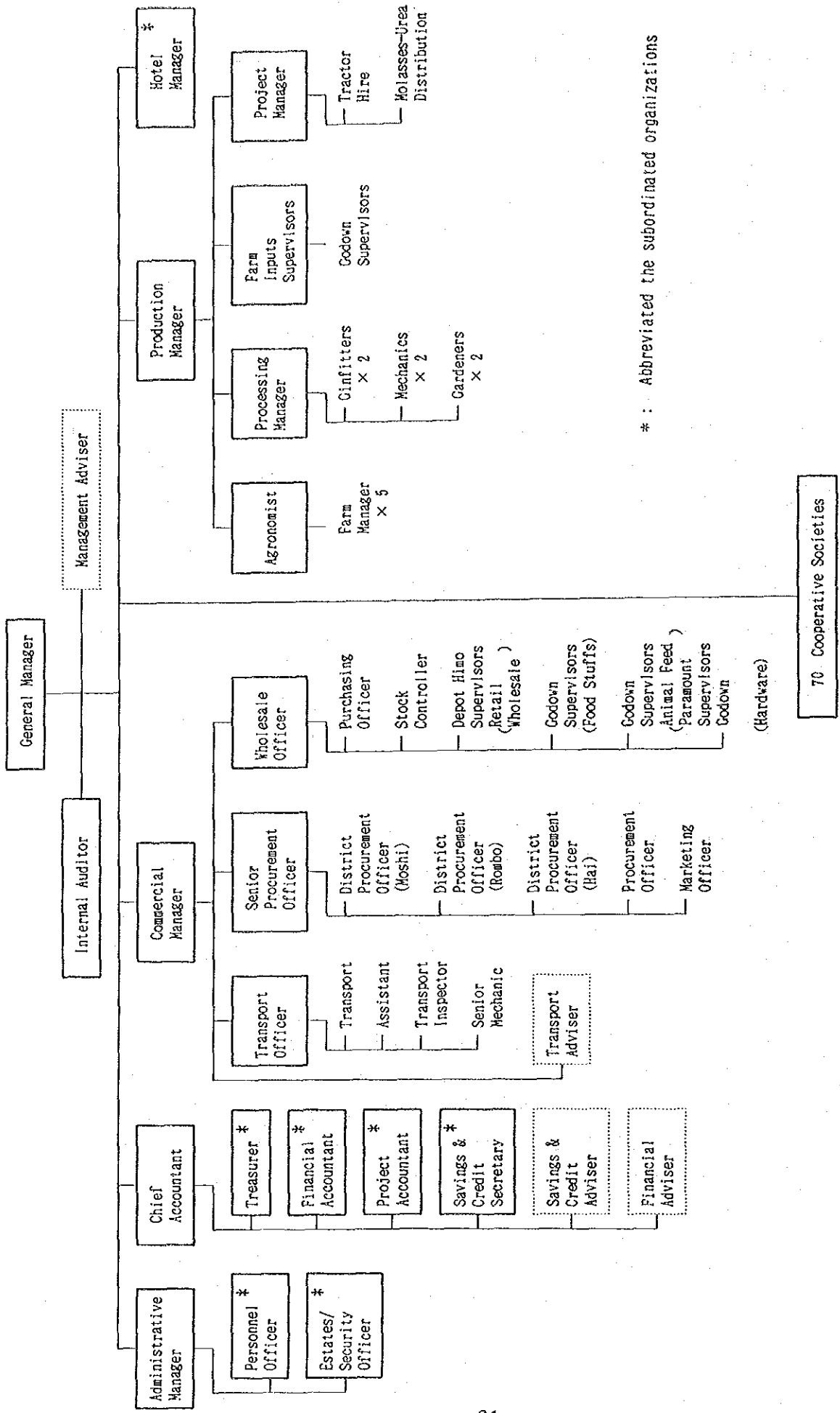
- 4 Divisions : 4 Officers
- 27 Wards : 27 Supervisors
- 132 Villages : 60 Extension workers

In the 4 villages of the project area, 1 extension worker is allocated to each village. In addition, 1 coordinator is assigned to the project area for coordination with KADC.

KADC, established under technical cooperation from the Government of Japan for promotion of agricultural development in Kilimanjaro Region, is trying to establish and extend irrigated cultivation of paddy and upland crops, also to prepare and give technical advices on agricultural development in Kilimanjaro Region. As technical cooperation in implementing these tasks, 7 Japanese experts and 1 coordinator are assigned to KADC. KADC has a rice mill with processing capacity of 1 ton/hour, operated by the staff trained in Japan. In addition, KADC has 35 tractors, out of the 205 tractors granted to Kilimanjaro Region by the Government of Japan, and provides farm machinery services to farmers on a contract basis.

KNCU, established as a union of cooperative societies located in Moshi, Hai and Rombo districts in 1984, has 70 associated member societies at present. In the project area, there are 2 cooperative societies, at Mabogini and Kahe. KNCU provides farmers with such services as collection, processing (hulling and milling) and marketing of products, distribution of farm inputs and farm credits. In addition to these activities, KNCU provides a wide range of services such as contract mechanized services (mainly on upland crops), transportation of products, operation of a cotton ginning factory, sales of living goods, operation of farm, hotel and so on.

The organization of KNCU, headed by a General Manager, is composed of five (5) departments; Administrative, Finance, Commercial, Production and Hotel Departments. Its organization is shown in Fig. 4. The Government of Tanzania has assigned 4 consulting advisers who are experts of DANIDA, Denmark, to KNCU as a part of the government's programs to promote and improve the cooperative societies.



\* : Abbreviated the subordinated organizations

70 Cooperative Societies

Fig. 4 ORGANIZATION MAP OF KNCU

### 3.7 Present Conditions of Marketing System and the Post-Harvest Facilities

#### 3.7.1 Marketing System of Farm Products

In Tanzania, all aspects of marketing of farm products, from collection to sales, have been carried out by various public corporations. However, after the institutional reforms of 1984, these public corporations were discontinued or reduced in their activities. Nowadays, for marketing of the main food crops such as paddy, maize, beans and so on, the National Milling Corporation (NMC) is limited to marketing of these products in urban areas. The collection of farm products and sales in rural areas are left to the free market as conducted by the cooperative societies which were reopened in 1984 after being discontinued in 1976.

The present marketing system for paddy in and around the project area is shown in Fig. 5. For marketing purposes, harvested paddy is classified into three types; i.e. seed paddy, paddy for home consumption, and surplus paddy. Surplus paddy is marketed through KNCU and NMC or channel of private brokers.

The paddy marketed through KNCU and NMC is divided into delivery to NMC, which obliges farmers to deliver 10 bags/plot (750 kg/0.3 ha), and free marketing by KNCU. Paddy is delivered to buying posts, which are the local offices of the cooperative societies. At each buying post there is a godown, weighing machine and moisture content meter in order to measure weight and moisture content of paddy. The moisture content of paddy in dry season averages from 15 to 18%, but in rainy season often exceeds 20%. The buying prices of paddy at the beginning of April 1987 were Tsh.9.6/kg for NMC delivery and Tsh.13.5/kg for KNCU marketings. In the middle of April, 1987, NMC delivery price was raised to Tsh.14.4/kg. As this buying price is offered for paddy of which moisture content is 12 to 14%, the following weight discount rate is applied to the carried paddy according to its moisture content.

Moisture Content of Paddy (%)	Discount Rate to Weight (%)
21 - 22	12
19 - 20	10
18	9
17	8
16	7
15	6
12 - 14	0

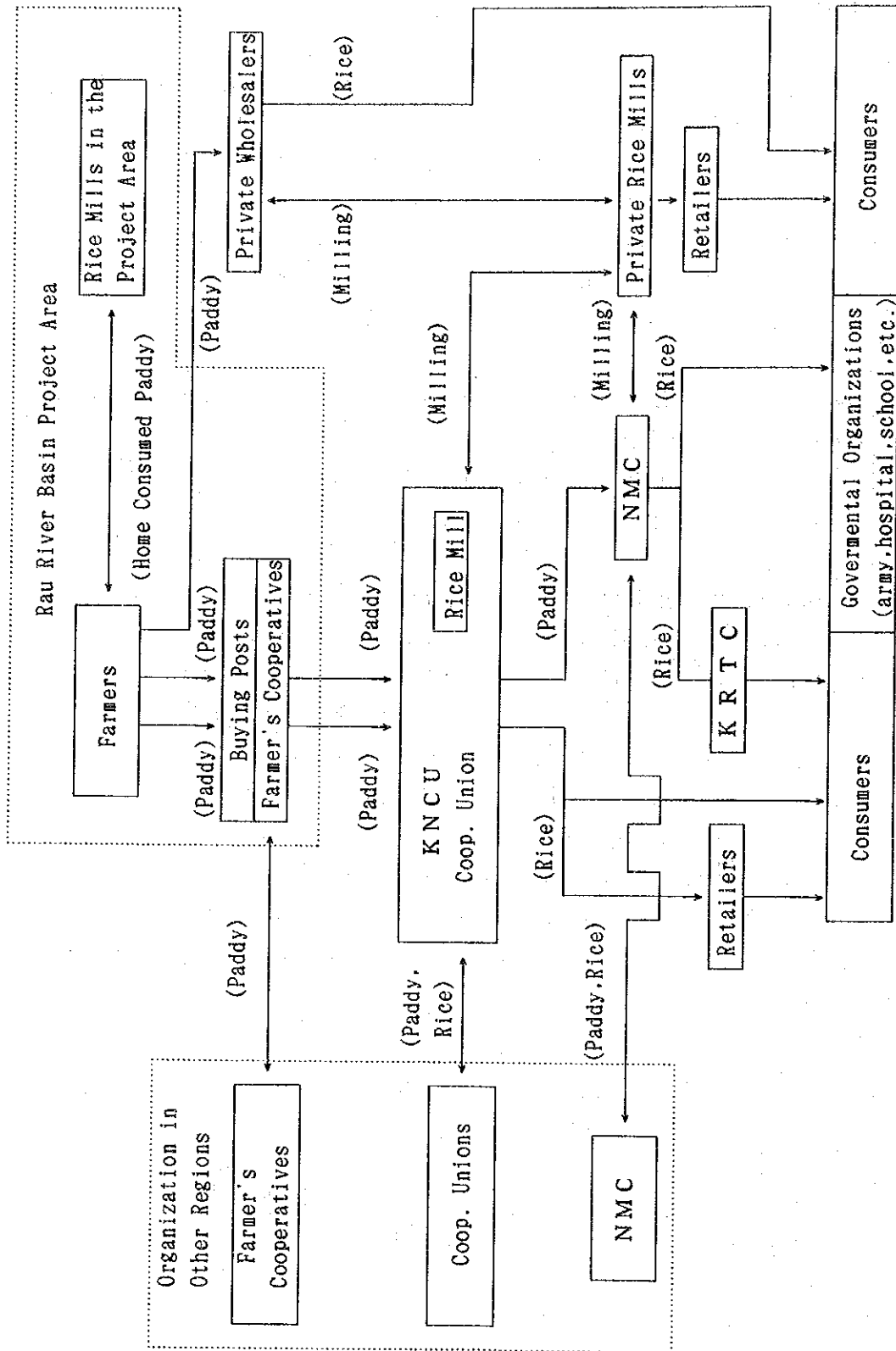


FIG. 5 EXISTING MARKETING SYSTEM OF PADDY

The paddy containing excessive amounts of straw, leaf, dust, etc. is returned to farmers. Transportation of paddy from field to the buying post is done by sisal bag, each weighing 75 kg. The main system of transport is tractor-trailers owned by the cooperative societies.

The paddy collected at each buying post is transported to KNCU using the trucks owned by KNCU of 7 tons capacity. KNCU has rice mill facilities, and paddy handled by KNCU is dried and milled. The paddy bought by KNCU in dry season of 1986 amounted to 1,027 tons, of which 812 tons for milling by KNCU had to be entrusted to private millers because of trouble with the KNCU's own milling machines. The remaining 215 tons, for delivery to NMC, were handed over to NMC in the form of unmilled paddy. The price on delivery from KNCU to NMC at the beginning of April, 1987 was Tsh.14.8/kg. As NMC does not have rice mill facilities of its own, it entrusts private millers in Moshi town with paddy milling. Drying is practised at NMC. Drying of paddy in KNCU and NMC is carried out by sunlight. The milling charge by private millers is Tsh.1/kg. Classification of milled rice is not practised, and the proportion of broken rice is estimated at 30 to 50%. There is no price discrimination for the proportion of broken rice or quality.

Hull and bran, the by-products of paddy at the milling stage, are sold to Tanzania Animal Feed Company (TAFCO) in Moshi town, for processing into feeds, and these are sold to livestock farmers through KNCU or KRTC (Kilimanjaro Regional Trading Company). The buying price of hull and bran offered by TAFCO at April, 1987 was Tsh.1/kg, and the selling price of feed was Tsh.668/50kg.

The rice milled in KNCU is sold to consumers directly, or through private retailers. On the other hand, NMC disposals are divided into sales to consumers through KRTC and direct sale to government-related organizations such as the military, hospitals, schools and so on. The present marketing prices for disposals by KNCU and NMC average around Tsh. 26 to 36/kg, and this rice is generally marketed in resinous bags in units of 50 kg.

As shown in Fig. 5, farmers cooperatives, KNCU and NMC trade in paddy and milled rice with similar organizations in different regions. However, farmers cooperatives in the project area, rarely trade with similar cooperatives in other regions. In the case of KNCU and NMC in Moshi town, most of their trade is inflow from other regions.

In addition to the above-mentioned regular marketing system controlled by KNCU and NMC, paddy and milled rice are marketed by private traders. This is estimated to amounts to

more than 50% of the surplus paddy. The production of paddy in the project area in dry season of 1986 was about 3,380 tons, of which, the amount bought by KNCU was 1,027 tons, only 30% of the total. Of the remaining 70%, a considerable amount were estimated to have been marketed through private traders. The buying price of paddy offered by the private traders is Tsh.16/kg, higher than that of KNCU and NMC. Furthermore, the selling price of rice prevailing on this marketing system was Tsh.50/kg, which is 1.4 to 1.9 times higher than that of KNCU and NMC.

### 3.7.2 Existing the post-harvest facilities

Existing the post-harvest facilities for grains, especially paddy in the project area and in and around Moshi town may be summarized as follows:

Facilities	Location and Name	No. of Unit/ Building <sup>1</sup>	Capacity/ Scale <sup>1</sup>	Remarks
			(ton/hour)	
	<u>Project Area</u>			
	1) Mabogini Village	2	0.8	Private/Church owned
	2) Chekereni Village	1	0.4	Village owned
	<u>Moshi and its Surrounding Area</u>			
Rice Mill	3) KNCU	4	1.6	KNCU
	4) Shah Ramji Kanji	7	2.8	Private
	5) Shah Lanji Khetshi & Sons	5	2.0	Private
	6) Shah Kachra Versi	2	0.8	Private
	7) Bharti Stores	5	2.0	Private
	8) R.K. Gogo	5	2.0	Private
	9) Others (Small Millers)	10	4.0	Private
	<u>Project Area</u>			
	1) Mabogini Village	1	113 m <sup>2</sup>	KNCU
	2) Chekereni Village	2	77 + 55 m <sup>2</sup>	Village owned
	<u>Moshi and its Surrounding Area</u>			
Godown	3) NMC	1	15,000 ton	NMC
	4) KNCU	1	1,500 ton	KNCU
	5) - do -	1	320 m <sup>2</sup>	- do -

Note: <sup>1</sup>: Including No. of unit and capacity of facilities out of order.

Source: Verbal from NMC, KNCU and private traders.

In addition to these facilities, at KADC there are drying and milling facilities with a capacity of 1 ton/hour, and a godown for research and training. Except for KADC's facilities, there is no drying machine in the project area nor in and around Moshi town because all drying is done in these areas with sunlight. The drying floors which are made of

concrete and have area of 100 to 200 m<sup>2</sup> are provided by KNCU and the five major private millers numbered 4 to 8 in the table above. NMC does not have a concrete floor. Instead it uses sheets.

Existing the post-harvest facilities in the project area and in and around Moshi town have characteristics and problems summarized below:

#### (1) Rice Mills

There are 31 units of rice milling machine in the project area and Moshi town. In addition, according to private millers, there are about 10 small-scale rice mills with only 1 unit of rice milling machine, making a total of 41 units. Almost all of these rice milling machines are of the steel huller type which does pearling in parallel with hulling. The average working capacity per unit is estimated at 0.4 ton/hour, making a total of 16.4 tons/hour. However, these machines tend to go out of order due to defacement and damage of a hulling roll. According to some private millers, the actual working efficiency is estimated at about 70%, thus the actual working capacity would be 11 to 12 tons/hour. At present all 4 units of milling machine owned by KNCU are out of order.

Three units of milling machine located in the project area and 10 units installed in the small-scale rice mills around Moshi town are mainly operated for small orders for home consumption. Therefore, it is not expected that these milling machines would operate smoothly with large amounts of paddy. On the other hand, as KNCU and major private millers in Moshi town are milling paddy for Moshi town which is a large consumer of rice, their work capacity could be as much as 11.2 tons/hour (actual capacity 7.8 tons/hour). Of paddy produced in the project area in dry season of 1986, the amount bought and collected by KNCU and NMC (1,027 tons) was milled by these five major private millers. According to KNCU and NMC, the maximum milling capacity of KNCU and five major private millers is estimated to correspond with the sum of the paddy presently flowing in Moshi town plus the aforesaid 1,000 tons.

#### (2) Drying Facilities

Most of the paddy delivered to the buying posts of the cooperative societies is wet or only half-dried. Drying of this paddy presents a serious problem. Drying is carried out by KNCU, NMC and private millers, and the only method is sun-drying. However, their concrete floored drying spaces are as small as 100 to 200 m<sup>2</sup>. NMC makes use of a sheet

instead of concrete floor. Furthermore, no drying facilities are installed in the rice mills in the project area nor in the small-scale mills around Moshi town.

### (3) Godown

There are 3 godown buildings at 2 sites in the project area. At present, these godowns are utilized for a temporary storage of fertilizers, oil and collected products. There is no intention of long-term storage, and the scale is very small. On the other hand, in Moshi town, there are godowns of 15,000 tons owned by NMC and of 1,500 tons and 320 m<sup>2</sup> owned by KNCU. These godowns are at present used for storage of maize, beans, coffee, cotton, sugar and so on, so no space is available for the paddy which will be produced in the project area. The moisture contents of grains in storage averages 12 to 14%. According to KNCU and NMC, as fumigation is periodically practised, there is little damage by pests. However, damage by rats seems to be serious, though related data are not available.

### (4) Transport Carriers

KNCU which is responsible for marketing of farm products in the rural area, has 31 trucks with a loading capacity of 7 tons. However, the number in working order trucks is only twelve (12). Eleven (11) of the remaining are to be scrapped and eight (8) are under repairs. KNCU expected to need twenty-three (23) trucks for transport work related to marketing of farm products. Considering the shortage of truck numbers at present and the increase in marketable volume in the future, KNCU has a purchasing plan for six (6) trucks. Under this plan, the number of trucks owned by KNCU will become twenty-six (26) units including those under repair.



## **CHAPTER 4 THE PROJECT**



## CHAPTER 4 THE PROJECT

### 4.1 Objectives of the Project

The objectives of the project are; to provide the post-harvest facilities which the Government of Tanzania has requested, to improve post-harvesting processes from collection and storage of harvested paddy to milling and marketing of rice, and thus to help realize steady supply and self-sufficiency in food, to raise the living standards of farmers.

### 4.2 Assessment of the Request

Assessment of the adequacy of the project, the contents of the facilities and equipments requested by the Government of Tanzania have been based on the present conditions of the national development plan, agriculture in Kilimanjaro Region and the Rau River System area. The results are summarized below.

#### 4.2.1 Assessment of the Project

##### (1) Necessity of the Post-Harvest Facilities

Annual paddy production after the completion of construction of the Rau River System is estimated to be 9,700 tons. Of this, the surplus paddy, which is the residue after deductions for seed and home consumption, is estimated to be 7,390 tons (4,440 tons for rainy season and 2,950 tons for dry season). On the other hand, as compared with such production, the improvement of the post-harvest facilities in the project area is now left far behind.

Therefore, the improvement of the post-harvest facilities in the project area is needed to match future paddy production. Furthermore, as construction has now been completed and paddy is being produced, it is urgent that the project be commenced as soon as possible.

##### (2) Importance of the Project as a National Model

As stated earlier, with the financial assistance of the Government of Japan, the project area is becoming an important paddy production area in Kilimanjaro Region. Also, through grant aid from Japan, KADC has been established to promote agricultural development and

extension works, and is being actively operated with technical cooperation provided by Japanese experts. If improvement of the post-harvest facilities is added to these projects, it will realize a comprehensive and consistent the project combining development, extension work, production and processing of paddy. It is believed that such a comprehensive project will have a strong demonstration effect as a national model.

### (3) Price Stabilization of Rice

Of the amount of paddy produced in the project area in dry season 1986, 3,380 tons, only 30% (1,027 tons) was collected by KNCU. Of the remaining 70% (2,353 tons), surplus paddy except for seed and saving for home consumption uses, seems to have been marketed by private traders.

The shortage of facilities for collecting and transporting paddy is pointed out as the reason for so little marketing of paddy by KNCU. In contrast to private traders who collect paddy directly from each farmer or field using their own trucks, KNCU collects paddy only from their own 2 buying posts in the project area, which are located away from the related paddy fields, which creates problems for farmers. However, by the implementation of the project, buying posts will be constructed to correspond with the distribution of the paddy fields, and the transport facilities will be strengthened, so that the amount of paddy collected by KNCU would be increased significantly. There is a clear correlation between the collection and the marketing amounts of paddy by KNCU and NMC. Since the retail price of paddy by KNCU and NMC is 50% to 70% lower and more steady than that of private traders, it will directly benefit to rice consumers. Taking these matters into account, the significance of the project is judged to be profound.

### (4) Demand of the Related Farmers for the Post-Harvest Facilities

The farmers in Rau Ya Kati Village already feel the shortage of buying posts and storage facilities, and have requested KNCU for the construction of such facilities in their village. They also have their own plan for construction of storage facilities. However, the latter would seem difficult to realize on account of shortage of funds. Such things demonstrate the demand for greater capacity of buying posts and storage facilities. With the completion of the Rau River System, it is anticipated that paddy production in the project area will increase largely. As a result, the demand for the post-harvest facilities will become greater. The project would directly meet this demand.

#### (5) Promotion and Intensification of Farmers' Cooperative

The marketing system had been one of constraints on increasing agricultural production in Tanzania. In 1984, the Government carried out institutional reform of the agricultural marketing system. By this reform, NMC, which has had a monopoly in agricultural marketing, was limited in its activities to the urban areas. Marketing activity in rural areas was assigned to farmers' cooperatives. The Government further intends to promote and intensify farmers' cooperatives. For these activities, two cooperative unions have already been established in Kilimanjaro Region, namely KNCU which covers Moshi town, Hai and Rombo Districts, and VUASU which covers Same and Muanga Districts. Up to now, the main crops handled by KNCU have been coffee, cotton, maize and beans. In respect to paddy, the volume has not been so large and milling and storage facilities are making a poor show. Although possessing old-type rice hullers, all are out of order. In 1987 KNCU collected about 1,000 tons of paddy from the project area, but hulling of the paddy was contracted to private millers. However, the facilities of the project are expected to be operated by KNCU, and in this way, KNCU could also improve its activities in rice marketing. In addition, it is expected that its whole function as a farmers' cooperative will be strengthened by this improvement.

#### (6) Receiving Conditions for the Project

##### 1) Organizations for operation and maintenance

In respect of operation and maintenance of the post-harvest facilities, the RDD's office proposes to assign this to KNCU which is responsible for the existing paddy marketing system. This idea is supported from the following standpoints; 1) it would contribute to promotion and strengthening of cooperative societies, 2) it coincides with the agricultural policy of the Government of Tanzania, which states that the marketing of agricultural products in rural areas should be controlled by cooperative societies, and 3) as compared with other implementing organizations it facilitates unification and simplification of the marketing system which should produce good results and reduce intermediate marketing margins.

##### 2) Staffing

The required number of technical experts and clerks for operation and maintenance of the proposed the post-harvest facilities is estimated as 55 persons. KNCU at present has no ideas on the staffing plan of these experts and clerks. However, judging from the following considerations, it would seem that staffing for operation

and maintenance works of the proposed facilities should present no problems.

- a) KNCU presently has hullers of 1.6 tons/hour capacity in Moshi town. These are of steel huller type as generally used in Tanzania, and easy to operate. The hullers now required for the project, however, will have to be of different scale and structure, and it is necessary to ensure that they could be operated satisfactorily. The type required under the project is similar to a Japanese made huller of 1 ton/hour capacity which has already been supplied to KADC. And there are some Tanzanian experts in KADC who have been trained on operation and maintenance works of this huller. Therefore it is expected that the project will be able to obtain technical guidance on the O&M works from these Tanzanian experts of KADC.
- b) In addition to operation of the facilities, a management system should be installed for buying, processing, selling, and marketing paddy. At present KNCU has four (4) consulting advisers supplied by DANIDA under the Nordic Project by which the Government of Tanzania hopes to strengthen cooperative societies in general, prepare an Operation Manual and give guidance on administrative matters in particular. Strengthening of the management is already taking place. Strengthening of management, therefore, appears to be well provided for.

#### (7) Overlap with the Other Projects

Kilimanjaro Region has great potential for development and occupies an important position in national politics. The Government of Japan is already playing a central role in providing assistance to the Region. There is no conflict of interest with development assistance from other countries. Thus, it is considered to be appropriate for a Japan's grant aid project. It might be related to the aforesaid Nordic Project in the operation of the facilities. However the Nordic Project mainly puts stress on the software aspects, whereas this project is concerned with improving the post-harvest facilities. Therefore, it is concluded that there will be no overlap between these two projects.

#### 4.2.2 Assessment of the Facilities and Equipments Requested

The Government of Tanzania has requested for this project: 1) buildings and facilities for rice milling including receiving, drying, hulling, weighing, packing and processing for

by-products of paddy, 2) a multi-purpose godown, 3) transport carriers and 4) additional facilities for operation and administration. An assessment of these requests is given below:

#### (1) Buildings and Facilities for Rice Milling

The existing capacity of rice milling facilities is 5.2 tons/hour (3.6 tons/hour actual capacity) for small rice mills in the project area and around Moshi town, and 11.2 tons/hour (7.8 tons/hour actual capacity) for the rice mills of KNCU and 5 private millers in Moshi town. This is a relatively large capacity. However, the small rice mills are required frequently for petty orders from neighbouring farmers for home consumption. Therefore, it is difficult for the small rice mills to operate continuously for processing a large amount. By contrast, the rice mills of KNCU and the private mills are mainly employed for milling paddy for consumption in Moshi town, and these can work at high capacities.

Regarding drying facilities, KNCU and the above private millers have only small drying floors sizing 100 to 200 m<sup>2</sup>, and the farmers have none. In general farmers thresh harvested paddy manually in the field, and then market it in wet or semi-dried condition. Therefore, the moisture contents of the paddy marketed by farmers is 15 to 18% (average 17%) in the dry season, and sometimes more than 20% in rainy season. As a result the shortage of drying facilities is a serious problem and it is necessary to improve both drying and milling facilities in the project area. Also, the future annual amount of paddy to be processed in the project area is estimated to be about 6,000 tons. In order to dispose of such large amount of paddy smoothly, it is needed to install weighting and packing facilities.

The requested facilities for by-products processing are intended for chaff and bran to make use of them as fodder. This is significant for the effective use of agricultural resources and increasing productivity in operation of facilities. Fodder production is undertaken at TAFCO in Moshi town and chaff is utilized as a filler. When used as a fodder filler, the particle size of the crushed chaff is important, and a small size is preferred. However, as no crusher is available to TAFCO, the particle size of chaff used at TAFCO is too large. With the project, facilities for by-products processing will be improved so that small chaff can be supplied as a fodder filler, and so contribute to quality improvement of fodder, and thus to promotion of livestock farming in the project area.

#### (2) Multi-purpose Godown

NMC and KNCU already have godowns in Moshi town, but these are already fully

utilized for storage of coffee, maize, beans and so on, so there is little space for paddy. There are three (3) other godowns in the project area, but these are all very small in scale such as 55 to 113 m<sup>2</sup> with restricted storage capacities. It is anticipated that the shortage of godowns will become increasingly serious with increased amounts of seed, fertilizers and pesticides required for expansion of the cropped area and increased production of paddy. Consequently, it is considered necessary to improve multi-purpose godown capacity for storage for paddy, seed, fertilizers and pesticides.

### (3) Transport Carriers

It is expected that paddy production in the project area will increase very considerably with the completion of construction works. With this production increase, transport of paddy from fields to buying posts and to rice mills, also of milled rice to market place will become a constraint unless facilities are improved.

At present, the paddy is transported from fields to buying posts by the tractors and trailers owned by the cooperative societies. Installation of new buying posts will require intensification of this kind of transport. There are two (2) buying posts in the project area at present, but these buying posts are intended mainly for upland crops, so that no consideration has been given to the distribution of paddy fields in location of these buying posts. Transportation of paddy is not yet effectively operated in the project area. This condition will be improved with the addition of buying posts corresponding to the distribution of the paddy fields. Transportation of paddy from the fields to the buying posts and the installation of additional buying posts should be implemented by KNCU and cooperative societies as a part of their cooperative works. Therefore these works are not included in this project.

Transportation of paddy from buying posts to rice mills and the marketing of milled rice are carried out by KNCU. KNCU is responsible for agricultural products and inputs in rural areas, and already possesses 20 units of 7-ton trucks (including those out of order). KNCU estimates that at least 23 units of 7-ton trucks will be needed to fulfill these responsibilities. KNCU has a plan to purchase six (6) new 7-ton trucks. With these, KNCU expects to have enough capacity for marketing the milled rice, but this will still be insufficient for transportation of harvested paddy from the buying posts to the rice mills to be constructed by the project. As explained later in Section 5.1, the daily amount of rice marketed by the project is estimated to be about 30 tons (milled rice). Transportation of this amount of rice to Moshi town, the main consumption area, will necessitate three (3) 7-ton trucks. Also, as



stated later in Section 5.1, a further six (6) units of trucks will be necessary for the transportation of the paddy from buying posts to the milling facilities to be constructed by the project. Thus, it is expected that KNCU which will have 26 units of truck including the planned 6 units, to provide transportation of rice to Moshi town, but not for transportation of the paddy in the project area.

Therefore, it is necessary to increase the transport capacity of paddy from the buying posts to the rice mills in the project area by a further six (6) units of trucks.

#### (4) Additional Facilities for Operation and Maintenance

The post-harvest facilities to be improved for the project are for a scale of about 6,000 tons of annual capacity. The total number of technical experts, officials and permanent labourers necessary for operation and administration of the facilities are expected to be about 100 persons. Operation and administration will require not only post-harvesting staff such as for buying, marketing or milling, but also for personnel management, documentation, general affairs and accounting. Therefore, it is necessary for the operation and administration office to operate smoothly for above-mentioned works. In particular it is necessary to provide room spaces for a chief, advanced experts and general officers.

### 4.3 Outline of the Project

#### 4.3.1 Organizations for Project Execution and Operation

The executing agency of the project is the Regional Development Director's office (the RDD's office). The RDD's office is therefore expected to be responsible for coordination with the related organizations for the project's execution.

The implementing agency of the project is KNCU. KNCU will establish the Chekereni branch office (a tentative name) as an organization for operation and maintenance of the proposed facilities, which, under the general manager, will consist of four (4) sections; collection & shipping, drying & milling, general affairs and accounting sections. The required number of staff for operation and maintenance of the proposed facilities is estimated at 55 persons including the general manager. Of these staffs, 16 persons including the manager may be required for the administration office as stated later in Section 4.3.2. Detailed information on organizations for the project execution, operation and maintenance are shown in Chapter 6 and 7 respectively.

### 4.3.2 Outline of the Facilities and Equipment

An outline of the post-harvest facilities and equipments to be improved and granted is as follows:

#### (1) Milling Facility and Building

##### 1) Receiving facility

- Max. receiving quantity : 80 tons/day
- Equipment : Truck-scale (15 tons) x 1 set  
Hopper (10 tons/hr.) x 1 set  
Pre-cleaner (10 tons/hr.) x 1 set  
Grain moisture meters and carts

##### 2) Drying facilities

- Drying methods : Both sun-drying and mechanical drying are introduced. Half of the received paddy will be dried by each method. Mechanical drying will be by ventilated drying at normal temperature, and with supplementary heat when required taking into account the operation during rainy days or night time when high humidity occurs.
- Drying machine : Batch, circulating type (20 tons x 4 sets)
- Sun-drying floor : Fuel tank (12,000 liters) x 2 sets  
Diesel electric generator (16 kVA) x 1 set  
Pre-cleaner x 2 sets  
Water-proof sheet (86 m<sup>2</sup>) x 4 sheets

##### 3) Milling facility

- Two (2) lines of machinery for the process from dehusking to bran removal and rice polishing will be furnished, so that all processes may not be stopped in event of some breakdown or need for repair.
- Proposed dealing capacity : 3 tons/hr. introducing two (2) shift operation
- Machineries : Paddy storage tank x 2 sets  
Cleaner x 1 set  
Hopper scale x 1 set  
Discharge adjusting tank x 1 set

Husker x 2 sets, Separator x 2 sets  
 Brown rice tank x 2 sets, De-stoner x 2 set  
 Whitener x 2 sets, Rice polisher x 2 sets  
 Separator (bran & broken rice) x 1 set  
 Length separator x 1 set

4) Weighing and bagging facilities

- Whitened rice tank x 1 set, Blender x 3 sets, Tank for shipping x 1 set, Sewing machine x 1 set, Scale shutter (measuring capacity 50 to 100 kg) x 1 set

5) By-product processing facilities

- Processing method : Husk to be smashed, bran to be shipped without any treatment.
- Equipments : Husk smasher (750 kg/hr.) x 1 set  
Platform scale x 2 sets

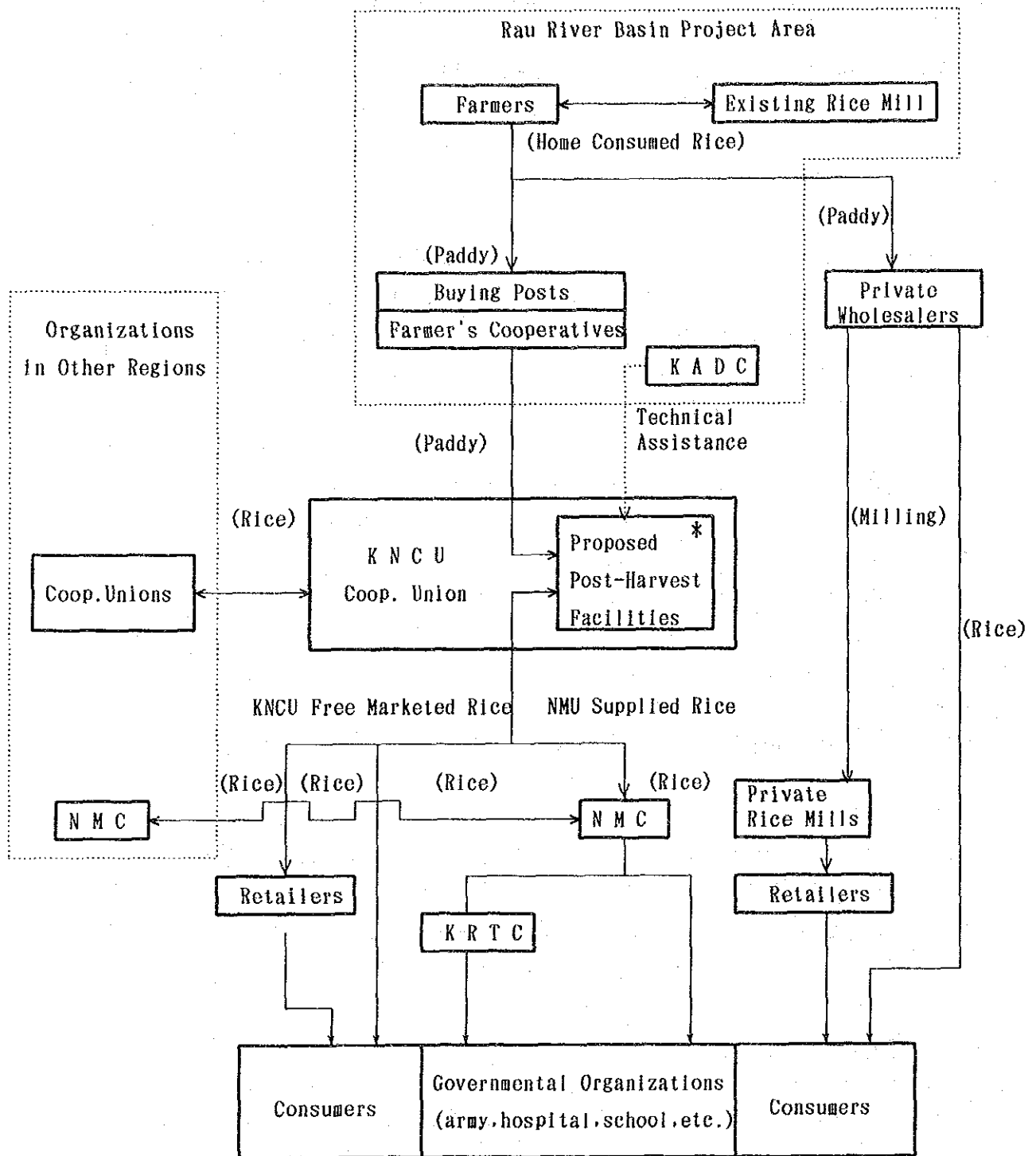
- 6) Building : steel framed, one-storied building, 1 building  
total area 1,047.7 m<sup>2</sup>

(2) Multi-purpose Godown

- 1) Max. storage capacity : Dried paddy 1,800 tons  
Seed 12 tons  
Fertilizers 600 tons  
Pesticides 2,240 liters
- 2) Building : Steel framed, one-storied building, 1 building,  
total area 1,297 m<sup>2</sup>
- 3) Transportation carts : 6 ton-truck x 6 units
- 4) Administration office : Block framed, one storied building, 1 building,  
total area 198.0 m<sup>2</sup>

4.3.3 Marketing System of Paddy with the Project

The paddy marketing system with the project is shown in Fig. 6. The harvested paddy in the project area would be collected at the buying posts operated by cooperative societies,



(Note) \* Constructed in the Rau River Basin Project Area

Fig. 6 MARKETING SYSTEM OF PADDY WITH THE PROJECT IMPLEMENTATION

then sold to KNCU, which is an associated unit of the cooperative societies. KNCU, as an operator of the post-harvesting facilities, would be responsible for drying, storing and hulling of the paddy bought from the cooperative societies. The post-harvest facilities of the project would be expected to dispose of the all paddy bought from the cooperative societies. For the milled rice supplied (compulsorily) to NMC, there will be two ways of marketing it, namely to consumers by way of Kilimanjaro Regional Trading Company (KRTC), and directly to such official organizations as the army, hospitals, schools and so on. Other paddy could be sold by KNCU to consumers through retailers or directly by KNCU.

The marketing system is not so different from the present one. No large change is expected in the paddy marketing system after implementation of the project (see Section 3.7).

#### 4.3.4 Outline of the Construction Site

The proposed construction site, facing with the Kahe road which extends southeast from Moshi town, is located in about 15 km from Moshi town. The elevation of the site is about 725 m, almost same elevation as the surrounding roads. The site, 210m x 146m (3.1 ha), is flat and will have roads on two (2) sides, its long side being beside the Kahe road. The right of use of the site is presently held by Chekereni Village. However, no problem is expected in acquiring the right.

The present conditions of the site in regard to power and water supplies, telephone communication, etc. are shown below:

##### (1) Power Supply

Electric power will be taken from the 11,000 V transmission line beside the Kahe road. According to Tanzania Electric Supply Company Ltd. (TANESCO), there are enough power reserves for supply without voltage drops causing any hindrances. The power supply for consumers is three (3) phase, four (4) lines, 230/400 V, 50 Hz.

##### (2) Water Supply

Water will be taken from the public waterworks (6" Ø, PVC Pipe) laid along the Kahe road. However, the present water supply from this waterworks is frequently insufficient for present demand.

(3) Telephone

A telephone line is located 200 m to the north of the Kahe road and running parallel with the road. Therefore it would be possible for a telephone line to the site to be led in from the existing line. However, at present no circuits is available. When an application has been made to Tanzania Posts and Telecommunications Corporation (TPTC), TPTC will take action based on the results of the investigations implemented by TPTC itself.

(4) Gas

No public facilities for gas supply are available in and around the construction site.

(5) Drainage of Rain Water

There is only an excavated drain ditch (1.5 m in width, 0.4 m in depth) on the each sides of the Kahe road.

(6) Drainage of Sewage

No public drainage for sewage is available in and around the construction site. In this region, including Moshi town, sewage disposal is practised by the pit latrines system.

(7) Ground Conditions

According to the results of the geological survey carried out 1 km south east of the construction site, the ground condition in and around the constructions site may be characterized as follows: from the surface to 1 m in deep consists of loamy soils; below this is a layer of gravelly sandy clay; groundwater level is at in 2 to 3 m below ground level. According to boring survey carried out at the construction site, there is gravel and sandy clay within 1 m of ground surface. All in all, it may be concluded that no geological problems are likely to be found at the construction site.

The proposed construction site has the following advantages:

- (1) Being located almost at the center of the paddy fields to be covered by the proposed facilities, transport of paddy from buying posts to the facilities will be minimal.

- (2) Being adjacent to a trunk road (the Kahe road), there will be no access problems.
- (3) There is ample space for the proposed facilities.
- (4) Being close to KADC, there will be easy access to technical assistance when required on the O&M works.
- (5) As power transmission lines and public water supplies are available along the Kahe road, where the construction site will be situated, access to water and power supplies will present no problems.

Taking the above into consideration, it is concluded that the proposed site is the most suitable for the construction of the post-harvest facilities.

#### 4.3.5 Technical Assistance System

In respect of technical assistances on administration, operation and maintenance of the facilities after implementation of the project, it is expected that these will be provided from the Nordic Project which gives KNCU guidance on administrative affairs, and from KADC Project which is implemented with technical assistance from the Government of Japan.

The Nordic Project, which aims to promote and strengthen farmers' cooperatives, assigns four (4) experts (Management Adviser, Transport Adviser, Financial Adviser and Credit Service Adviser) from DANIDA (Denmark) to KNCU. It gives KNCU administrative guidance as well as preparation of the O & M manuals.

KADC, as stated in Section 3.6, has milling facilities similar to those to be provided by the project both in structure and function. Therefore, it is assumed that the milling techniques of KADC will be available to the project.

