(Unit: ton/ha)

Crops	Boloti	Mungushi	Sanya	District*
Maize				
Pure stand	1.5	1.5	1.1	(1.04)
Inter-crop with beans	1.5	0.8	1.1	
Inter-crop with sunflower	-	-	0.8	
Beans				
Pure stand	0.5	0.5	0.5	(0.54)
Inter-crop with maize	0.1	0.5	0.2	
Inter-crop with sunflower	-	0.5	-	
Sunflower				
Inter-crop with beans	-	0.4	-	(0.78)
Inter-crop with maize	-	-	0.4	
Vegetables				
Tomato	-	8.5	-	(10-25)
Onion	-	4.5	-	(7-15)
Banana	-	3.9	-	(13.15)

Remark: *; Average from 1979/80 to 1988/89

Present crop production from the Project area are calculated from net cultivated lands, cropping intensity and above crop yields as given in Table 4-5 and summarized as follows:

(Unit: ton)

	Maize	Beans	Sunflower	Vegetable	Banana
Hai District*	25,694	5,115	223	21,759	298,125
Project area					
Boloti	276	35	-	-	-
Mungushi	101	10	3	85	98
Sanya Plain	545	82	12	-	-
Total	922	127	15	85	98
Proportion (%)	3.6	2.5	6.7	0.4	0.03

Remarks: *; Average from 1979/80 to 1988/89, see Table 4-4

4.3.7 Livestock production

In the Project area, livestock plays an important role for the farmers as the main source of not only diet protein but also cash for supplement of farm economy. Cattle, goats and sheep are dominant in the Project area. In general, livestock are grazed extensively in the savanna and/or Masai steppe in the Sanya Plain. While, zero grazing is commonly practiced in the Boloti and Mungushi areas. Small scale poultry is extensively managed by individual farmers in the Project area. On the basis of the data provided by the Hai District office, The population of livestock and annual production of livestock were estimated on the basis of the data obtained from the Hai district office as follows:

	Boloti	Mungushi	Sanya Plain
Population (head)			
Beef cattle	1,311	1,588	11,064
Dairy cattle	524	635	4,426
Goat	1,375	1,625	3,395
Sheep	683	743	2,017
Chicken	2,491	1,509	1,029
Production			
Meat (head)			
Beef cattle	190	230	1,660
Goat	275	325	679
Sheep	137	149	403
Chicken	498	302	206
Milk (1,000 lit)	105	127	885
Egg	6,200	3,800	2,600

4.4 Agro-economic Condition

4.4.1 Agro-economic background

The present condition of farm economy in the Project area differ between north and south of the Moshi-Arusha highway.

On the south side of the highway is pasture land centering on Sanya plain where the traditional migrating stock raising which is currently dominant in the Hai district will gradually give way to settlements with the area eventually being divided into farmland for settlers and areas for collective stock raising. The latter will become a stable meat and egg supply base for Moshi as well as for Hai district as a whole. The southern part of the Project area will gradually be incorporated into the Boma Ng'ombe (capital of Hai district) economic zone as a food production base and residential areas in accordance with the expansion of Boma Ng'ombe urban functions.

The northern part of the Project area will develop into an economic zone with Boma Ng'ombe and Sanya Juu, the previous capital of Hai district, forming an axis. The commercial production of staple crops in addition to coffee and bananas in mountainous areas. The production volume of various vegetables such as tomatos, aubergines and onions, etc. will increase.

Boma Ng'ombe will become a center of domestic or foreign trades if the commercial production of high quality products is advanced in the future.

4.4.2 Land tenure

Under the land registration programme, the Government of Tanzania specified the following two (2) land tenure systems:

(1) Kihamba tenure

Kihamba is in principle a free-holding type of tenure. The land of this tenure is freely inherited, and bought/sold with the price depending on the farm conditions to be appraised by the existence of irrigation facilities, productivity of crops, etc.

(2) Shamba tenure

Shamba tenure is primarily a cultivation right which is granted by the local authority, for instance, the village committee.

At present, the registration of Shamba tenure has covered only 45 villages, out of the total 362 villages in the region. Therefore, most local farmers are still cultivating the land by traditional right.

According to the information obtained from the relevant village chiefs through interview, all the lands in the Project area which belong to each village is owned by the villagers under traditional cultivation right. Therefore, all the lands in the Project area are covered by Shamba tenure system.

4.4.3 Land holding size

Land holding size in the Project area was estimated on the basis of the farmers list obtained from the ten (10) traditional furrow leaders. Estimated present land holding size distribution of the Project area by number of farmers, accumulated areas, resident and non-resident is given in Table 4-6 and illustrated on Fig. 4-2 and summarized as follows:

Category	Boloti	Mungushi	Sanya Plain
Average Holding Size (ha)			
Resident	1.1	0.8	1.9
Non-resident	0.9	0.6	1.7
Total	1.0	0.8	1.8
Dominant Land Holding Group*			
By number of farmers			
<0.5 ha	46%	47%	-
0.5-1.0 ha	24%	35%	26%
1.0-2.0 ha	-	-	27%
By accumulated areas			
<0.5 ha	-	20%	-
0.5-1.0 ha	-	32%	-
1.0-2.0 ha	22%	21%	-
2.0-3.0 ha	-	-	23%
>10.0 ha	-	-	22%
Ratio of Resident and Non-resident			
Resident	52%	93%	64%
Non-resident	48%	7%	36%

Remarks: *; The groups selected have ratio of more than 20%.

About 90% of farmers in the Boloti and Mungushi areas concentrate in the less than 2.0 ha land holding size group and occupy about 65% to 75% of the total areas. Although about 70% of the farmers in the Sanya Plain concentrate in the less than 2.0 ha, farmers only occupy about 33% of the total area. However, the farmers holding more than 10 ha of lands account about 3% and occupy about 22% of the total area.

4.4.4 Marketing and prices

Hai province has five local markets, i.e. Kwa Sadana and Boma Ng'ombe along the Arusha-Moshi highway, Lawati and Sanya Juu to the north of Boma Ng'ombe and Rundugai along the Arusha-Moshi railway. Of these, the Sanya Juu market is the largest and the market in Lawati in the subject area can be described as a sub-market of the Sanya Juu market. There is no market in Sanya Station. The present conditions of the market mentioned above are given in Table 4-7.

Except the market in Sanya Juu, all the markets mentioned above are consumer markets and do not have a function for collecting base of agricultural products. Only wholesalers who set up temporary branches in the markets have measuring scales. In essence, these markets are in the stage of transition from barter trade to money economy. Wholesalers and buyers from urban areas are virtually absent except during the harvesting season of the main staple foods such as maize and beans.

Main agricultural products, such staple crops as maize and beans, sell on farm to the local office of the cooperative union or the buying agent of the urban markets on the harvest time. And surplus farm products such as unsold balance of grains and vegetables are sold in heaps or tins along the highway or are transported to Boma Ng'ombe on foot.

For livestock, the Weru Weru livestock market is located at Kimashuku in Hai district. The Weru Weru market, about 11 km from Moshi on the west, plays an important role of meat supply base for the Moshi economic zone. The annual handling volume of the Weru Weru market was 25,195 heads in 1988/89. The Steer Grade 2, the most representative type of cattle handled, accounted for 8,029 heads.

For appraising the financial viability of the Project as well as farmers' economy, the present market and farm gate prices are fully referred. In this connection, the data and information of the prices of agricultural products and inputs are collected from the government offices and authorities concerned and farm economic survey. The official retail prices of staple food crops, open market prices of agricultural products in the region and Moshi market prices are given in Table 4-8 to 4-10 and estimated farm gate prices of agricultural products and inputs are given in Table 4-11. The farm gate prices of maize, beans and tomato are estimated at

Tsh. 21.9/kg, Tsh. 48.9/kg and Tsh. 35.0/kg respectively. The monthly transition of beef and goat meat prices for the last three (3) years are given in Table 4-12. The prices of beef and goat meat showed large increase, and do not necessarily reflect the livestock prices.

4.4.5 Crop budget

Crop budgets per ha for maize, beans, sunflower and tomato were calculated from the farm input and labour requirement, crop yields and current prices. The crop budgets per ha are given in Table 4-13 and net incomes can be summarized as follows:

(Unit: Tsh./ha)

Crops	Boloti	Mungushi	Sanya Plain
Maize	24,336	24,336	18,656
Maize/Beans	32,519	37,370	28,189
Maize/Sunflower	-	-	32,980
Beans	18,290	20,050	19,016
Beans/Sunflower	-	35,420	-
Vegetables	-	235,235	-
Banana	-	39,780	-

4.5 Agricultural Support Services

4.5.1 Agricultural extension

The activities of the Ministry of Agriculture and Livestock Development at regional level are under the control of the Regional Agricultural and Livestock Development Officer (RALDO), and at district level of the District Agricultural and Livestock Development Officer (DALDO). At both regional and district levels there are headquarters staff of subject matter specialists, including Regional and District Irrigation Officers.

Agricultural extension services are controlled by the District Agriculture and Livestock Development Officers (DALDO). Extension activities are carried out by the Agricultural Field Officer (AFO) basically appointed to each ward consisting three (3) to four (4) villages and about 1,000 farmers. AFOs are supported by trained Assistant Field Officers and Field Assistants who are on the job trained. In addition to the extension activities, AFO has responsibility for reporting to the DALDO on areas cultivated, yield of crops, fertilizer consumption, etc.

At present, the number of agricultural staff working in the Hai district is 110 and given in Table 4-14 by grade and their main active location. Among them 25 staff are working in Hai district office, 10 staff are in the wards and 75 staff are in the villages. According to the District Agricultural

and Livestock Development Officer (DALDO), at least one (1) agricultural officer is allocated to the each village.

In addition, the Zonal Irrigation Unit (ZIU) is located in the region and covers three (3) regions, such as Kilimanjaro, Arusha and Tanga. Because of its zonal responsibilities, the ZIU does not come under the control of the RDD office, but is centrally controlled under Assistant Commissioner of Irrigation of Ministry of Agriculture in Dar es Salaam. The ZIU, technical centers for irrigation development, assists the respective regions in carrying out feasibility study, designing, construction and advising of proper operation and maintenance of the irrigation Project.

The organization structure for the agricultural extension is illustrated on Fig. 4-3.

4.5.2 Cooperatives

In Kilimanjaro region, the Kilimanjaro Native Cooperative Union (KNCU) and the Vuasu Cooperative Union (VCU) were established in 1984. The former takes charge of the Project area. Under KNCU, every village or group of villages has a cooperative. The functions of a cooperative are:

(1) purchase of farm inputs,
(2) provision of service such as tractor ploughing, and
(3) storage and sale of marketable surpluses.

The cooperative has a permanent manager appointed by the committee and recruits casual labour for storage, or lorry loading/unloading operations. Cooperative operation costs are charged to the farmers who pay fees on each input they buy through the cooperative or a fixed amount of money for commodities they sell through the cooperative.

At present, three (3) rural cooperative societies are operating in the Project area. All the cooperative societies are newly established; Nkwansira in 1988, Mungushi and Sanya in 1989. Therefore, these cooperatives are not efficiently functioning. The activity of these societies are given in Table 4-15.

According to the Agricultural Machinery Census in 1987/88, about 400 tractors are in good and/or serviceable conditions at present in Hai district and are properly operated under the regional farm mechanization programme through KNCU Hai branch office.

The inventory of agricultural machinery in the Hai district is given in Table 4-16. Data for existing post-harvest facilities for Hai district are only available for the storage facilities. The number and capacity of the storage facilities in Hai district are shown below:

Kind	Number	Capacity (ton)	Materials
Godown	51	10,000	Cement block
Vihenge	325	5,000	Corrugated iron
Drum	6,153	1,303	Mud and wood
Tank	6	50	Metal sheet

According to the village storage questionnaire carried by Hai district office, there is no storage facility in the Project area.

4.5.3 Agricultural credit

Under the ERP the credit structure has been liberalized to allow greater freedom of access to more sources. The main sources of credit for the Agriculture sector are the Co-operative and Rural Development Bank (CRDB), the National Bank of Commerce (NBC), the Tanzania Investment Bank (TIB) and the Tanganyika Development Finance Company (TDFC).

The CRDB is essentially oriented towards small farmers and traditional export crops. The NBC is also essentially oriented to small farmers. Both the CRDB and the NBC have a good distribution of outlets throughout the country. Both provide seasonal finance and medium term loans. The latter are usually limited to six (6) or seven (7) year periods, say two (2) grace years plus four (4) to five (5) years for repayment. Interest rates at the time of the study were 29 % for overdrafts and 27 % for term loans. Although these seem high rates, in real terms they are not high, because inflation is projected at 20 % to 30 % a year. The CRDB loan disbursement in Tanzania of last four (4) years is given in Table 4-17.

Share percentages of loan disbursements 1988 in Hai district and Kilimanjaro region are given in Table 4-18 and 4-19 and summarized as follows:

Sector	CRDB		NCB	
	Hai	Kilimanjaro	Hai	Kilimanjaro
Cooperative Society	0	22.1%	0	1.9%
Village	2.3%	61.7%	0	-
Parastatals	0	0	0	78.9%
Private companies	0	3.8%	0.7%	17.7%
Individual & others	2.0%	12.4%	0.1%	1.5%
Total	4.3%	100.0%	0.8%	100.0%

Both loan disbursements shares of CRDB and those of NCB in Hai district are extremely low. The amounts of loan disbursement 1986/87 of CRDB and those of NCB are Tsh. 184.3 million and Tsh. 1,135.7 million respectively. CRDB's loan disbursements to the cooperative societies and villages shared

83.8 %, while those of NCB are negligible in the region. NCB's loan disbursements to parastatals shared 78.9 %, while those of CRDB are zero in the region. Shares of loan disbursements to private companies are 3.8 % by CRDB and 17.7 % by NCB in the region. Growth rate in index of loan disbursements of CRDB and NCB in the region between 1986 and 1988 are shown below:

Bank	1986	1987	1988
CRDB	100	78	71
NCB	100	163	336

CRDB in Moshi explained the reasons for the decline in loan disbursement in 1988 as being mainly due to the decrease of lending to individuals as shown in Table 4-18.

4.6 Farm economy

In order to assess the farmers and their livelihood, farm economic survey was carried out in the Project area. For sampling of farmers, farmers' list obtained from the traditional furrow leaders were sorted and grouped against land holding size and residential status in the first place. From the above farmers' list, about 10 % of residential farmers were selected from each land holding size group using random sampling method. Number of farmers interviewed are summarized by each area as follows:

Area	Number of Resident	Sampling Size
Boloti	159	17
Mungushi	253	24
Sanya Plain	384	43
Total	796	84

The analysis results of farm economic survey so far made are summarized as follows:

(1) With regard to civil status of farmers, about 95 % are married. About 60 % of the heads of families are over 45 years old in Boloti and Mungushi areas. While, about 60 % of the heads of families are less than 45 years old in Sanya Plain.

(2) The ratio of marketed crop production of Maize is about 25 % in Boloti and Mungushi areas and 35 % in Sanya Plain and of Beans is about 30 % and 45 % respectively. It is considered that the difference between Boloti/Mungushi and Sanya Plain is mainly due to difference of land holding size. Other food crops are mainly used for home consumption. On the other hand, most of vegetables are produced for sale.

(3) In Boloti and Mungushi areas, more than 50 % of marketed crops is through the rural cooperative societies. However, more than 90 % is marketed to private sectors in Sanya Plain.

(4) The farm households in Boloti and Mungushi are mainly depending on the farm and non-farm incomes. While, the farm households in Sanya Plain are mainly depending on the farm and livestock incomes. The ratio of the farm and livestock incomes to the total income is estimated at about 80 %.

(5) No farmers use the agricultural credits or other credits in the Project area. It is considered that the farm lands cannot be used as security for a mortgage because all farm lands are cultivated under traditional cultivation rights by farmers and have not been registered yet.

In regard to farm economy, the farm budget analysis on farmers having average size of lands in each area was studied on the basis of present cropping pattern, the farm economic survey results and crop budgets per ha as shown in Table 4-20 and summarized as follows:

(Unit: Tsh.)

	Boloti	Mungushi	Sanya
Farm Size (ha)	1.1	0.8	1.9
Net income			
Farm income	23,790	32,730	23,780
Livestock income	2,330	2,130	25,450
Non-farm income	22,270	25,450	11,460
Sub-total	48,390	60,310	60,690
Living expense	45,280	58,230	59,660
Tax and others	550	630	610
Net reserve	2,560	1,450	420

5. AGRICULTURAL DEVELOPMENT PLAN

5.1 Agricultural Development Concept

The basic agricultural development concepts for the Project area are formulated on the basis of national and regional agricultural development policies as follows:

(1) To remove and/or improve the present constraints for agricultural development.
(2) To increase and stabilize yield and production of food crops such as maize and beans particularly of the rainy season cropping through efficient utilization of available water resources and introduction of modernized irrigation farming practices, so as to contribute to the policy for self-sufficiency in food.
(3) To increase production of cash crop such as vegetable by means of crop diversification in the areas where lands are suitable for intensive farming and irrigation water is available throughout the year.
(4) To raise the living standards of the farmers by increasing of their crop production.

5.2 Agricultural Development Plan

5.2.1 Agricultural development plan

Through the survey so far made, it is pointed out that the main constraints for agricultural development in the Project area are shortage of available water resources compared with the total water requirement for all the arable lands due to short duration of rain season, uneven distribution of rain and unreliable surface flow in Sanya river. Therefore, the agricultural production in the Project area is still remains at a low level i.e. "low input and low return" by means of risk avoidance although supplementary irrigation water is supplied through traditional furrow system.

The agricultural development plan in the Project area was formulated on the basis of the development concepts, the water availability and land suitability for irrigation farming as follows:

(1) Sanya Plain

In Sanya Plain, surface and groundwater resources are available and most of the lands are classified as suitable for irrigation farming because of flat topography and deep and fine to medium soil characteristics. Therefore, maximum utilization of lands in the Sanya Plain is proposed from the viewpoints of effective utilization of the water resources as a well as higher return from crop production.

(2) Boloti and Mungushi areas

In Boloti and Mungushi areas, only surface water is available and the lands are classified as restricted arable for irrigation farming due mainly due to shallow soil depth. However, if the Boloti swamp will be developed as a reservoir for irrigation purpose, both areas should be included in the Project area from the vested water rights viewpoints and the social aspects. Therefore, maintaining of present cropping pattern and stabilization of yields and production of the crops through stable irrigation water supply be proposed.

5.2.2 Proposed cropping pattern

In formulation of the proposed cropping pattern, the following basic principles were applied:

(1) The cropping pattern must create maximum benefits for the farmers as well as the nation as a whole, and
(2) The cropping pattern must conform with the existing social tradition and be acceptable to the farmers.

According to the Implementation Programme of the National Agricultural Policy in Tanzania, Kilimanjaro Region is selected as the Area Specialization in Agriculture Production for the following 14 crops out of 32 nationwide priority crops.

Crops	Location
Food Crops:	
Maize	All Districts except Same District
Rice	Same District
Millet Bull	Mwanga and Same Districts
Wheat	All Districts
Bananas	All Districts
Potatoes	All Districts
Sweet potatoes	All Districts
Beans	All Districts
Cash crops:	
Coffee	All Districts
Sisal	All Districts
Cotton	All Districts
Cardamon	All Districts
Vegetables:	All Districts
Fruits:	All Districts

Among the crops mentioned above and basic principles, maize and beans are selected as the main crop for the proposed cropping pattern of the Project area. Maize and beans are the most profitable crop among other possibly grown crops under the present economic situations. The farmers have long experience in maize and beans cultivation and realize maximum irrigation

benefits under the Project. In addition to maize and beans, vegetables, sunflower and banana are selected as diversified crops for the Project area due to the farmers' intention, soils, marketability of crops, profitability of crops and farmers' ability in cultivation of crops.

The optimum cropping calendar was planned on the basis of the climatic conditions, particularly rainfall distribution and air temperature. The proposed cropping pattern was formulated on the basis of the agronomic study on the critical conditions for crop cultivation and also making reference to the study on the most optimum utilization of irrigation water mentioned in Annex F IRRIGATION AND DRAINAGE.

The proposed cropping pattern of the Project is illustrated in Fig. 5-1 and the future land use in the Project areas based on the proposed cropping pattern is estimated as follows:

(Unit: ha)

Area	Rainy Season		Dry Season		Total of Harvest	Cropping Intensity (%)
	Plant	Harvest	Plant	Harvest		
Boloti Area						
Maize	160	160	0	0	160	-
Beans	130	130	0	0	130	-
Sub-total	290	290	0	0	290	100
Mungushi Area						
Maize	85	85	0	0	85	-
Beans	45	45	0	0	45	-
Sunflower	5	5	0	0	5	-
Vegetables	0	0	10	10	10	-
Banana	25	25	-	-	25	-
Sub-total	160	160	10	10	170	106
Sanya Plain						
Maize	530	530	530	530	1,060	-
Beans	210	210	420	420	630	-
Sunflower	50	50	50	50	100	-
Vegetables	210	210	420	420	630	-
Banana	50	50	-	-	50	-
Sub-total	1,050	1,050	1,420	1,420	2,470	235
Total	1,500	1,500	1,430	1,430	2,930	195

5.2.3 Proposed farming practices

Proper farming practice is one of the essential factors for realizing full exploitation of the agricultural potential in the Project area. The proposed farming practices and farm inputs for maize, beans, sunflower and tomato under the "with project" condition were planned on the basis of the data obtained from the authorities concerned and are given in Table 5-1. The main farming practices to be proposed are outlined as follows:

(1) Land preparation

Land preparation for the crops proposed will be made by tractor in the Sanya Plain. While, land preparation in Boloti and Mungushi areas will be made by oxen because of stony and shallow soil characteristics.

(2) Seeds

High yielding varieties will be introduced for the proposed crops, even in Boloti and Mungushi areas.

(3) Fertilizers

Application of fertilizers is essential so as to maintain crop production at a high level. The soils in the Project area are slightly alkaline so that ammonium sulphate as a nitrogen source, triple super-phosphate as a phosphorous and potash as potassium are recommendable. A split application of fertilizers method will be proposed to optimise crop growing.

(4) Agro-chemicals

Application of insecticides and pesticides is required for control of stem borers, plant hoppers, blast, etc. as regard to plant protection and to keep high yield. Systematic application of insecticides and pesticides using of sprayers be proposed to the plant protection works. However, herbicides are still harmful not only for human beings but also for animals; livestock and wild life, when used for weed control. Therefore, using of herbicides is not recommended for the Project from the viewpoints of environmental aspects.

(5) Others

Other works such as planting, weeding, harvesting be proposed to carry out by both family and hired labour forces. This will be expected to create employment opportunities of the local people and to contribute the regional policy to transmigrate the people from high zone to low zone.

In the "without project" condition, no significant changes in the present farming practices and farm inputs were considered.

The labour balance study of the Project area was made through comparison between the labour requirement for proposed farming practices and the present available labour force in the Project area as follows:

(Unit: man-day/year)

System	Labour Requirement	Available Labour*	Balance
Boloti	22,130	114,756	92,626
Mungushi	12,145	212,576	200,431
Sanya Plain	332,410	291,708	-40,702
		(411,191) **	

Remarks: * ; Available labour force x 365 days x rate of workable day (80%)

** ; Available labour force in Sanya station village.

As a result of the labour balance study, no shortage of labour force will occur in Boloti and Mungushi areas even under the "with project" condition. On the other hand, in Sanya plain labour shortage will occur due to introduction of intensive farming under irrigated condition. Peak labour requirement will occur during the harvesting in rainy season and is estimated at 1,350 men per day. However, the labour force not only adjacent villages but also high or middle zone in the region where high population pressure problem is occurred will be enough to cover these labour shortage in Sanya plain.

Peak requirements for tractors will occur during land preparation in the rainy season and is estimated at about 14 tractors per day. This requirement only 3.5 % of the total serviceable tractors in Hai district and will be covered by these tractors. However, ownership of tractors for the Project area will be recommended to assure timely land preparation.

5.2.4 Anticipated crop yields and production

After completion of the Project, the yields of crops will be increased and will attain anticipated yields through supply of sufficient irrigation water and proper farming practices. In the Sanya plain, the anticipated yields of maize and beans are estimated on the basis of the experimental data obtained from the Agricultural Research Center in Lyamungu. Anticipated yields for tomato are the maximum present yields of the range in Hai district. In Boloti and Mungushi areas, the anticipated crop yields of maize, beans and sunflower were estimated at 60 % of the figures of Sanya plain because of poor soil conditions and tomato was estimated as the same as at present as follows:

(Unit: ton/ha)

Crops	Boloti	Mungushi	Sanya Plain
Maize	3.0	3.0	5.0
Beans	1.2	1.2	2.0
Sunflower	-	0.81	1.35
Tomato	-	8.5	25.0
Banana	-	3.9	3.9

The yields of crops under without project condition was estimated as the same as at present.

Te anticipated production of crops in the Project area was estimated on the basis of the proposed land use, cropping pattern and anticipated yield of crops as given in Table 5-2 and summarized as follows:

(Unit: ton)

	Maize	Beans	Sunflower	Tomato	Banana
Boloti	450	156	-	-	-
Mungushi	255	54	4	85	98
Sanya Plain	5,300	1,260	135	15,750	195
Total	6,005	1,470	139	15,835	293

5.3 Marketing and Price Prospects

5.3.1 Staple food crops

The staple foods such as maize, rice, wheat, banana, beans, etc. are the most important crops grown in Tanzania and are the main sources of food in the country. Therefore, the production of staple foods is recognized in the agricultural policies and plans of the government from the food security point of view.

Marketability of the staple food crops screened in the previous section was studied from the demand and supply conditions of the Kilimanjaro region, Hai district and Project area.

According to the overview of staple food consumption and marketing 1987/88 analyzed by the Marketing Development Bureau, maize, rice, wheat, sorghum/millets, cassava, potatoes, and bananas were defined as the important calorie sources in Tanzania. The consumption and marketing situation estimated are given in Table 5-3 and summarized below:

(1) Maize is the dominant source of calories and accounts for about 61 % of total calorie intake. This percentage is somewhat lower in the urban areas, but still remaining above 50 %.
(2) Rice accounts for 10 % of total calorie intake, but it is much more important in the urban areas. In rural areas it is less important than cassava.
(3) Wheat accounts for only 1 % total calorie intake. Although this may be an under estimate of wheat consumption, wheat is certainly the least important of the staple cereals.
(4) Cassava is the second most important calorie source overall and accounts for 12 %.

(5) Potatoes and bananas are consumed in the large quantities, are more important in rural areas and account for 5 % and 4 % respectively.
(6) Beans are increasingly becoming part of the staple diet in many regions, but regretfully no figures are available.

For estimation of demand in the Kilimanjaro region, Hai district and Project area, calorie intake percentages mentioned above were modified taking into account of the food situation of the region as follows:

(Unit: %)

Crops	Tanzania	Kilimanjaro		
		Higher	Lower*	Average**
Maize	61	15	61	38
Paddy	10	10	10	10
Wheat	1	1	1	1
Millet	7	7	7	7
Cassava	12	2	2	2
Potatoes	5	5	5	5
Bananas	4	61	15	38
Total	100	100	100	100

Remarks: *; For the Project area
**; For the region and district

The following per capita food requirement estimated by Tanzania Food and Nutrition Center was adopted for the demand estimation:

Crops	Unit	Adults	Children
Maize	kg/year	350	250
Banana	kg/year	1,095	-
Beans	kg/year	36.5	-

Remark: Requirement of maize and banana means that if 100% of calorie to be taken from these crops.

Thus, the demand and supply situation in the Kilimanjaro region and Hai district was calculated on the basis of the conditions and population in the year 1988 and projected population in the year 2000 using the annual growth rate (2.1 %) of the region from 1978 to 1988. The results are given in Table 5-4 and summarized below:

(Unit: ton)

	Kilimanjaro	Hai District	Project Area
Supply			
Maize	83,107	25,694	922
Bananas	593,608	298,125	98
Beans	14,595	5,115	127
Demand			
Maize	162,191	29,278	1,045
Bananas	591,998	106,864	938
Beans	51,930	9,374	208
Balance			
Maize	-79,084	-3,584	-123
Bananas	1,610	192,261	-840
Beans	-37,335	-4,259	- 81

According to the above results, the expectative surplus crop production of staple food crops from the Project area after completion of the Project will be able to consume within the region.

5.3.2 Horticultural crops

At present, horticultural production has been considered primarily as a means to improve the diet and nutritional standards of the local population in Tanzania. It is yet to be recognized as sustainable activity of the export economy and hence has not in the past received much attention under the Economy Recovery Programme (ERP). However with the development of the ERP has come an increasing awareness that the horticultural sector can make a real contribution to the National economy in generating the export earnings.

A detailed study for the development of horticultural crops was made by the Tanzania Investment Bank (TIB) and compiled as "Sector Study for the Development of Selected Horticultural Crops" on November 1988. According to the report, the following regions are suitable for production of horticultural crops from the infrastructural consideration of air and sea freights as shown in Fig. 5-2 and plant physiological condition.

(1) Central Zone : Dar es Salaam, Tanga (coast)
(2) Highland Zone : Arusha, Kilimanjaro, Tanga (Mt. Usambara), Iringa, Mbeya

The recommended crops for each zone mentioned above are as follows:

	Coast Zone	Highland Zone
Fruit	pineapple, mango, papaya, citrus, banana, coconut, cashew.	avocado, pineapple, passion fruit, citrus, banana, cashew, plums, pears, apples, grapes, loquat, jack fruit, strawberries.
Vegetables	tomato, chili, okra, mchicha, onion, aubergine.	green beans, beans, sweet corn, courgettes, asparagus, tomato, eggplant, okra, cucumber, pumpkin, cabbage, mchicha, peas, carrots, radish, onions, leeks, potatoes, cauliflower.
Flower		cut flower, decorative, foliage, flower seed.

For Kilimanjaro region, this study notified that Kilimanjaro region has the greatest potential for horticultural production than any region in Tanzania because the soils and climate and availability of water for irrigation enable a wide range of horticultural crops to be grown in a number of location. And it is indicated that the following outlets are open to Kilimanjaro region from a marketing point of view:

(1)	The local market	:	oranges, pineapples
(2)	Regional trade	:	potatoes, bananas, tomatos, onions, peas, carrots, etc.
(3)	Export to Kenya	:	vegetables
(4)	Export to Europe	:	horticultural products

Thus, the anticipated surplus horticultural crop production will be expected to trade local and/or domestic market in the short term and to export Kenya and Europe as well in the long term.

5.3.3 Price prospects

Economic farm gate prices are used in the economic evaluation of the Project in view of its place in the national economy. Economic farm gate prices of tradable commodities such as maize and fertilizers were estimated on the basis of the projected world market prices of the World Bank in the long range for the period of 1988 to 2000. The World Bank forecast prices of tradable commodities were adjusted to 1990 constant prices using the manufacturing unit value (MUV). Calculation of economic prices of maize and fertilizers is given in Table 5-5. Economic farm gate prices of other tradable commodities were valued at their financial prices. On the other hand, economic farm gate prices of non-tradable agricultural commodities were estimated at five (5) years average by applying the deflator as shown in Table 5-6. Economic farm gate price of unskilled labour was estimated by using of 0.8. Economic farm gate prices of agricultural outputs and inputs are summarized as Table 5-7.

5.4 Agricultural Extension

The present extension works emphasis on the introduction of recommended farming practices and not function effectively due to shortage of adequately trained extension staff and insufficient facilities particularly transportation for the target operations. However, the "National Agricultural and Livestock Extension Rehabilitation Project" financed by World Bank (IDA) and Africa Development Bank has been implemented since 1987. The proposed project would strengthen Ministry of Agriculture and Livestock Development's (MALD) capacity to plan, carry out and supervise extension activities through training, logistical support and technical assistance. The project would provide investment and recurrent expenditures for the:

(1) setting up of an appropriately staffed and streamlined organization and management structure, based on a single chain of command from headquarters to the field, and able to provide effective leadership;
(2) introduction of a cost-effective extension methodology to enhance the adoption of improved technologies by project participants;
(3) acquisition and maintenance of new or upgraded physical infrastructure, including staff housing and training facilities, equipment and materials, and vehicles required to enable staff to attain a higher degree of coverage of the farming community;
(4) strengthening MALD's implementation capacity through the provision of technical assistance; and
(5) preparation of the second phase of the agricultural and livestock extension rehabilitation process.

In the above project, Kilimanjaro region is selected as the priority region. Therefore, the present circumstances of the agricultural extension in the region as well as the project area will be expected to improve.

For horticultural crops, Horti-Tengeru in Arusha provides the following items:

(1) research of horticulture crops such as vegetables, citrus, banana, fruits tree, etc.,
(2) production of vegetable seeds to ensure regular and adequate supply of quality seeds adopted to local conditions presently supported by FAO,
(3) extension work to the farmers, and
(4) training of extension staff and farmers on two (2) years "Horticultural Diploma Course".

Horti-Tengeru will expected to provide valuable supports to develop horticulture crop production in the Project area in terms of research, technical advice and a source of trained staff.

5.5 Project Benefit

5.5 1 Crop budgets

Irrigation benefit to be expected is defined as the difference of primary profit from crops between future with and without project conditions. On the basis of the estimated production cost and gross income, primary profit per ha of crop was calculated both under with and without project conditions. Details are given in Table 5-8 and 5-9 summarized as follows:

(Unit: Tsh./ha)

Crops	Boloti	Mungushi	Sanya Plain
With Project			
Maize	22,437	22,437	42,592
Beans	12,426	12,426	37,134
Sunflower	-	10,115	25,949
Tomato	-	199,066	642,978
Banana	-	33,540	33,540
Without Project			
Maize	6,861	6,861	1,298
Maize/Beans	598	4,577	4,542
Maize/Sunflower	-	-	15,477
Beans	570	218	504
Beans/Sunflower	-	9,920	-
Tomato	-	199,066	-
Banana	-	33,540	-

5.5 2 Project benefits

Applying the primary profit per crop estimated to crop area, the total primary profits accrued from agricultural production by the Project were estimated both under with and without project conditions for the following three cases:

(1) Case-2 : Boloti dam development plan,
(2) Case-4 : Groundwater development plan, and
(3) Case-5 : Combination of Case-2 and Case-4.

The irrigation benefits of each case was calculated as shown in Table 5-10 and summarized below.

(Unit: million Tsh./year)

	Boloti	Mungushi	Sanya Plain	Total
Case-2				
With project	5,205	5,346	300,681	311,681
Without project	588	3,414	1,454	5,457
Increment	4,617	1,932	299,227	305,775
Case-4				
With project	-	-	260,733	260,733
Without project	-	-	822	822
Increment	-	-	259,911	259,911
Case-5				
With project	5,205	5,346	477,890	488,441
Without project	588	3,414	1,454	5,457
Increment	4,617	1,932	476,436	482,984

The irrigation benefit is expected to increase year by year and will reach the full benefit in and after five (5) years after the completion of irrigation facilities. The expected irrigation benefit during build-up period is assumed as follows:

(Unit: %)

Year in Order	Rate to the Full Benefit
1	40
2	55
3	70
4	85
5	100

The irrigation benefit flow of each case for the Project area is shown in Table 5-11.

5.5.3 Farm economy

In order to assess the irrigation project from the farmers' economic viewpoint, financial analysis of crop budget per ha was examined under "with project" conditions as given in Table 5-12.

After implementation of the irrigation project, the Project will provide bases for introduction of improved irrigation farming through year round irrigation. As a result, increase of cropping intensity and unit yield of crops will be much expected in the future "with project" condition. Under such situations, drastic increase of farm income in the future "with project" condition can be expected in the Project area.

Accordingly, substantial increase of farm income can be expected for the farmer whose land is presently supplementarily irrigated by traditional furrow. The farm budgets of average size farmers in both present and "with project" condition are

presented in Table 4-20 and 5-13 respectively and outlined below:

(Unit: Tsh.)

	Boloti	Mungushi	Sanya Plain
With Project Condition			
Farm Size (ha)	1.1	0.8	1.9
Net income			
Farm income	51,930	48,740	1,044,250
Livestock income	2,330	2,130	25,450
Non-farm income	22,270	25,450	11,460
Sub-total	76,530	76,320	1,081,160
Living expense	45,280	58,230	59,660
Tax and others	550	630	610
Net reserve	30,700	17,460	1,020,890
Present Condition			
Net Reserve	2,560	1,450	420

The annual net reserve or capacity-to-pay under "with project" condition will be much larger than that under present condition.

Table 1-1 ECONOMIC AND FINANCIAL SUMMARY OF TANZANIA

	1985	1986	1987	1988
GDP at 1976 constant price (million Tsh.)				
All Sectors	24,278	25,008	25,972	27,039
Agricultural Sector	10,931	11,557	12,066	12,609
	(45.0%)	(46.2%)	(46.5%)	(46.6%)
Balance of Payment (million US$)				
Export				
Total	285.6	347.6	347.3	372.0
Coffee	118.5	184.7	109.4	96.7
Cotton	29.6	30.4	43.9	75.3
Import	999.2	1,047.5	1,150.0	1,185.0
Trade balance	-713.6	-699.9	-802.7	-813.0
Current Account	-415.0	-312.0	-264.8	-248.5
Capital Account	-50.5	-49.0	-34.0	39.6
Overall Balance	-394.6	-383.6	-365.4	257.0
Exchange Rate (Every Dec. Tsh./US$)	16.50	51.72	83.71	125.00
Rate of Inflation (%)	33.3	32.2	28.9	28.2
Government Budget (million Tsh.)	(84/85)	(85/86)	(86/87)	(87/88)
Revenue	17,958	20,832	31,387	46,430
Expenditure				
Total	26,728	33,219	55,481	76,856
For development	5,391	5,817	15,091	15,091
Financing				
Total	7,159	9,144	8,567	21,072
Foreign grant and loans	1,539	1,422	5,455	6,624
Interest Rate (%)	(1/7/86)	(1/1/87)	(1/7/87)	(1/12/88)
Deposit Rate (saving)	15.00	17.25	24.00	26.00
Lending Rate (Short term)	13.0-21.0	15.0-24.0	20.0-29.5	20.0-31.0

Source: Tanzania Economic Trends

Table 1-2 GROSS DOMESTIC PRODUCT (GRDP) BY ECONOMIC ACTIVITY AT 1976 CONSTANT PRICES

Economic Activity	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
VALUE (Tsh. million)													
1. Agriculture, Forestry, Fisheries and Hunting	9,046	9,150	8,998	9,066	9,418	9,511	9,639	9,914	10,312	10,931	11,557	12,066	12,609
2. Mining and Quarrying	214	231	189	200	189	193	193	174	186	174	154	149	138
3. Manufacturing	2,811	2,641	2,730	2,821	2,683	2,382	2,304	2,103	2,159	2,075	1,991	2,075	2,187
4. Electricity and Water	219	244	286	318	400	417	420	413	439	461	482	522	537
5. Construction	884	915	783	879	932	890	930	549	660	601	705	721	757
6. Whole Sale, Retail Trade, Hotels and Restaurants	2,839	2,782	2,797	2,839	2,839	2,725	2,668	2,612	2,640	2,662	2,958	3,112	3,236
7. Transport and Communication	1,685	1,652	1,699	1,634	1,818	1,652	1,694	1,473	1,482	1,509	1,504	1,551	1,652
8. Finance, Insurance, Real Estate and Business Services	2,036	2,089	2,208	2,338	2,483	2,529	2,702	2,817	2,984	3,318	3,318	3,395	3,500
9. Public Administration and Other Services	2,342	2,497	2,997	3,255	3,188	3,551	3,556	3,543	3,549	3,616	3,225	3,243	3,343
10. Total Industries	22,076	22,201	22,687	23,350	23,950	23,850	24,106	23,598	24,411	25,347	25,894	26,834	27,959
11. Imputed Bank Service Charge	-424	-462	-485	-501	-531	-549	-667	-716	-755	-797	-886	-862	-920
12. Gross Domestic Product (GDP)	21,652	21,739	22,202	22,849	23,419	23,301	23,439	22,882	23,656	24,550	25,008	25,972	27,039
13. GDP per Capita at FC	1,362	1,320	1,303	1,306	1,295	1,249	1,217	1,152	1,154	1,172	1,181	1,186	1,201
SHARE (%)													
1. Agriculture, Forestry, Fisheries and Hunting	41.8	42.1	40.5	39.7	40.2	40.8	41.1	43.3	43.6	45.0	46.2	46.5	46.6
2. Mining and Quarrying	1.0	1.1	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.7	0.6	0.6	0.5
3. Manufacturing	13.0	12.2	12.3	12.4	11.5	10.2	9.8	9.2	9.1	8.6	8.0	8.0	8.1
4. Electricity and Water	1.0	1.1	1.3	1.4	1.7	1.8	1.8	1.8	1.9	1.9	1.9	2.0	1.9
5. Construction	4.1	4.2	3.5	3.9	4.0	3.8	4.0	2.4	2.8	2.5	2.8	2.8	2.8
6. Whole Sale, Retail Trade, Hotels and Restaurants	13.1	12.8	12.6	12.4	12.1	11.7	11.4	11.4	11.2	11.0	11.8	12.0	12.0
7. Transport and Communication	7.8	7.6	7.6	7.2	7.8	7.1	7.2	6.4	6.3	6.2	6.1	6.0	6.1
8. Finance, Insurance, Real Estate and Business Services	9.4	9.6	10.0	10.2	10.6	10.9	11.5	12.3	12.7	12.6	13.3	13.1	13.0
9. Public Administration and Other Services	10.8	11.5	13.5	14.3	13.6	15.2	15.2	15.5	15.0	14.9	12.9	12.5	12.4
10. Total Industries	102.0	102.2	102.2	102.4	102.3	102.3	102.8	103.1	103.4	103.4	103.6	103.5	103.4
11. Imputed Bank Service Charge	-2.0	-2.2	-2.2	-2.4	-2.3	-2.3	-2.8	-3.1	-3.4	-3.4	-3.6	-3.5	-3.4
12. Gross Domestic Product (GDP)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Tanzania Economic Trends

Table 1-3 BALANCE OF PAYMENTS OF TANZANIA FROM 1980 TO 1988

(Unit: million US$)

	1980	1981	1982	1983	1984	1985	1986	1987	1988
TRADE ACCOUNT									
Export (F.O.B.)	505.8	553.7	415.4	379.4	330.5	338.5	347.6	347.3	372.1
Import (C.I.F.)	1,218.6	1,161.0	112.8	814.5	835.8	999.2	1,047.5	1,150.0	1,185.0
Balance	-712.8	-607.3	-697.4	-435.1	-505.3	-660.7	-699.9	-802.7	-812.9
SERVICES (NET)									
Receipts	178.9	195.7	117.2	108.1	107.4	108.1	110.0	101.6	120.4
Payments									
Total	159.9	125.8	78.4	84.9	150.6	176.2	195.1	270.7	278.0
Interest	27.6	32.2	27.6	18.0	89.3	97.3	112.8		
Balance	19.0	69.9	38.8	23.2	-43.2	-68.1	-85.1	-169.1	-157.6
TRANSFERS (NET)									
Inflows	154.2	153.4	137.3	128.3	180.9	394.3	501.0		
Outflows	25.5	23.2	18.0	25.0	21.4	27.6	28.0		
Balance	128.7	130.2	119.3	103.3	159.5	366.7	473.0	707.0	722.0
CURRENT ACCOUNT (NET)	-565.1	-407.2	-539.3	-308.3	-389.0	-415.0	-312.0	-264.8	-248.6
CAPITAL ACCOUNT (NET)									
Receipts	256.9	284.9	214.7	270.9	292.6	200.0	165.0	157.7	226.0
Payments	30.1	26.2	21.3	62.9	256.9	250.5	214.4	191.7	186.4
Balance	226.8	258.7	193.4	208.0	35.7	-50.5	-49.4	-34.0	39.6
EXCEPTIONAL FINANCING	122.9	90.8	177.1	153.5	49.1	60.0	83.0		
ERRORS AND OMMISSIONS	37.3	-44.0	59.5	-190.7	125.9	10.9	-78.2	76.4	35.2
OVERALL BALANCE	-178.1	-101.7	-109.3	-137.5	-130.8	-394.6	-288.6	-365.4	-257.0
MONETARY MOVEMENTS	178.1	101.7	109.3	137.5	158.7	394.6	383.6	345.4	257.0

Source: Bank of Tanzania

Table 1-4 TANZANIA EXPORT FROM 1980 TO 1988

(Unit: US$ million)

		1980	1981	1982	1983	1984	1985	1986	1987	1988
Coffee:	Value	143.38	157.09	124.24	139.29	153.59	118.50	184.67	109.40	96.70
	Volume (ton)	43.54	67.88	54.76	50.70	54.96	44.02	50.38	48.34	8.67
	Unit Price	3,293.00	2,314.00	2,969.00	2,570.00	2,795.00	2,692.00	3,366.00	2,263.00	2,493.00
Cotton:	Value	48.43	77.03	56.06	61.69	49.52	29.60	30.40	43.92	75.26
	Volume (ton)	31.47	44.48	38.86	39.84	28.94	22.10	31.69	42.15	51.70
	Unit Price	1,539.00	1,732.00	1,443.00	1,548.00	1,711.00	1,339.00	959.00	1,042.00	1,455.00
Sisal:	Value	30.53	32.47	24.28	13.10	10.54	5.90	5.20	5.88	4.86
	Volume (ton)	48.87	57.50	50.68	26.80	21.50	15.49	15.06	13.76	11.19
	Unit Price	625.00	565.00	479.00	489.00	490.00	381.00	345.00	427.00	435.00
Tea:	Value	22.07	20.24	18.61	21.79	23.47	17.00	13.61	17.02	16.03
	Volume (ton)	13.26	15.44	11.95	16.60	11.10	11.65	9.54	14.02	11.19
	Unit Price	1,664.00	1,311.00	1,557.00	1,313.00	2,114.00	1,459.00	1,427.00	1,260.00	1,433.00
Tobacco:	Value	12.49	17.45	19.05	11.52	8.99	13.60	12.70	11.94	15.35
	Volume (ton)	8.51	10.95	10.06	5.38	4.62	7.74	7.10	8.23	9.78
	Unit Price	1,468.00	1,594.00	1,894.00	2,141.00	1,946.00	1,757.00	1,766.00	1,451.00	1,569.00
Cashew nuts:	Value	7.32	34.34	9.54	6.50	21.92	11.50	15.00	12.43	16.05
	Volume (ton)	9.06	25.15	17.22	10.50	33.49	23.61	17.81	11.19	16.25
	Unit Price	808.00	1,365.00	554.00	619.00	655.00	487.00	842.00	1,111.00	987.00
Sub-total		264.22	338.62	251.78	244.89	268.03	196.10	261.58	201.24	224.25
Petro Product		11.10	5.70	8.70	13.80	22.70	13.70	4.63	7.05	12.21
Minerals		48.51	51.12	35.13	43.60	33.94	21.60	13.00	22.00	15.91
Manufactures Prod.		84.63	55.39	38.00	44.21	33.10	32.80	39.10	63.00	72.10
Other		97.29	102.91	81.74	33.20	30.56	22.40	29.30	54.00	47.56
Sub-total		241.53	215.12	163.57	134.81	120.30	90.50	86.03	146.05	147.78
Grand Total		505.75	553.74	415.35	379.70	388.33	286.60	347.61	347.29	372.03

Source: Coustoms & Excise Dept. and Bank of Tanzania

Table 1-5 TANZANIA IMPORT FROM 1980 TO 1988

(Unit: US$ million)

	1980	1981	1982	1983	1984	1985	1986	1987	1988
CAPITAL GOODS:									
Transport Equipment	131.52	136.85	82.79	64.26	87.74	108.40	123.70	185.80	80.40
Building & Construction	93.71	92.37	96.56	79.65	87.96	95.14	108.70	130.90	183.60
Machinery	281.22	338.93	305.89	182.10	70.77	230.70	261.60	297.20	151.00
Sub-total	506.45	568.15	485.25	326.01	346.46	434.28	494.00	610.90	415.00
INTERMEDIATE GOODS:									
Oil *	290.20	259.62	269.99	225.57	210.62	223.44	144.96	169.50	276.20
Crude	151.44	132.88	151.89	132.27	135.09	117.89	71.70	92.00	
Products	138.76	126.74	118.10	93.30	75.53	105.55	73.26	77.50	
Fertilizer	13.45	6.33	5.87	3.90	9.64	8.77	11.00	6.40	3.90
Industrial Raw Material	145.88	115.06	144.98	111.08	142.09	156.98	170.00	170.80	217.30
Sub-total	462.15	403.53	433.68	348.99	370.33	400.56	340.96	346.70	497.40
CONSUMER GOODS:									
Textiles	37.73	23.55	32.09	19.00	19.76	34.32	42.00	31.40	44.90
Food	148.78	103.70	108.60	74.19	91.10	77.97	95.00	76.00	105.40
Other	61.65	61.38	51.25	44.83	3.69	49.94	3.00	84.60	122.20
Sub-total	248.16	188.63	191.94	138.02	154.55	162.23	210.00	192.00	272.50
UNCLASSIFIED IMPORTS:	1.83	0.75	1.91	1.51	0.61	2.12	2.30	0.40	0.14
Total	1,218.59	1,161.04	1,112.78	814.54	873.95	999.19	1,047.46	1,150.00	1,185.00

Remark: *; Data for all years from TPDC
Source: Coustoms & Excise Dept. and Bank of Tanzania

Table 1-6 GROSS REGIONAL DOMESTIC PRODUCT (GRDP) AT CURRENT PRICES

Region	1980	1981	1982	1983	1984	1985	1986	1987	1988
VALUE (Tsh. million)									
Arusha	2,696	3,142	3,793	4,520	5,454	7,479	9,856	13,508	20,267
Coast	463	547	690	745	860	1,124	1,408	1,930	2,709
Dar es Salaam	9,462	10,621	11,718	13,386	16,754	22,395	28,155	28,945	37,333
Dodoma	1,065	1,289	1,541	1,678	2,242	3,124	4,224	5,789	7,799
Iringa	1,752	2,197	2,726	3,362	4,517	6,290	8,448	11,578	18,300
Kagera	1,707	2,075	2,652	3,243	3,829	5,210	7,040	9,648	14,929
Kigoma	921	1,037	1,213	1,703	2,313	3,383	4,224	5,789	8,822
Kilimanjaro	1,944	2,045	2,441	2,914	2,383	3,243	4,224	7,719	9,992
Lindi	541	615	727	1,027	1,102	1,535	1,408	1,930	3,419
Mara	945	1,120	1,284	1,715	2,657	3,869	5,632	7,719	11,474
Mbeya	2,104	2,692	3,442	4,188	6,025	8,571	11,263	15,438	22,397
Morogoro	1,949	2,377	2,899	3,187	3,516	4,810	5,632	9,648	11,701
Mtwara	1,096	1,277	1,601	1,903	2,360	3,134	4,224	5,789	8,764
Mwanza	2,827	3,603	4,295	5,390	6,908	9,987	12,671	19,297	27,494
Rukwa	635	617	769	958	2,133	2,983	4,224	5,789	7,947
Ruvuma	1,152	1,396	1,757	2,122	2,626	3,610	4,224	7,719	10,547
Shinyanga	2,088	2,386	3,055	3,587	4,142	5,793	8,448	11,578	15,627
Singida	876	1,060	1,338	1,596	2,118	2,864	4,224	5,789	8,764
Tabora	1,185	1,406	1,749	2,072	2,462	3,469	4,224	5,789	8,764
Tanga	2,046	2,404	2,856	3,312	3,742	5,210	7,040	11,578	14,667
Total	37,454	43,906	52,546	62,608	78,143	108,083	140,793	192,969	271,716
SHARE (%)									
Arusha	7	7	7	7	7	7	7	7	7
Coast	1	1	1	1	1	1	1	1	1
Dar es Salaam	25	24	22	21	21	21	20	15	14
Dodoma	3	3	3	3	3	3	3	3	3
Iringa	5	5	5	5	6	6	6	6	7
Kagera	5	5	5	5	5	5	5	5	5
Kigoma	2	2	2	3	3	3	3	3	3
Kilimanjaro	5	5	5	5	3	3	3	4	4
Lindi	1	1	1	2	1	1	1	1	1
Mara	3	3	2	3	3	4	4	4	4
Mbeya	6	6	7	7	8	8	8	8	8
Morogoro	5	5	6	5	4	4	4	5	5
Mtwara	3	3	3	3	3	3	3	3	3
Mwanza	8	8	8	9	9	9	9	10	10
Rukwa	2	2	2	2	3	3	3	3	3
Ruvuma	3	3	3	3	3	3	3	4	4
Shinyanga	6	6	6	6	5	5	6	6	6
Singida	2	2	3	3	3	3	3	3	3
Tabora	3	3	3	3	3	3	3	3	3
Tanga	5	6	5	5	5	5	5	6	6
Total	100	100	100	100	100	100	100	100	100

Table 1-7 PER CAPITA GRDP AT CURRENT PRICES

(Unit: million Tsh.)

Region	1980	1981	1982	1983	1984	1985	1986	1987	1988
Arusha	2,704	3,056	3,565	4,094	4,772	6,322	8,033	10,603	14,990
Coast	889	1,019	1,252	1,330	1,511	1,945	2,390	3,217	4,246
Dar es Salaam	9,072	9,871	10,453	11,100	12,927	16,065	18,820	18,034	27,431
Dodoma	1,048	1,230	1,424	1,512	1,965	2,668	3,508	4,672	6,300
Iringa	1,823	2,217	2,670	3,214	4,210	5,718	7,469	9,921	15,136
Kagera	1,566	1,844	2,280	2,689	3,056	4,014	5,219	6,906	11,258
Kigoma	1,358	1,481	1,680	2,298	3,039	4,326	5,254	6,992	10,318
Kilimanjaro	2,055	2,097	2,424	2,815	2,242	2,967	3,755	6,660	9,010
Lindi	1,006	1,108	1,275	1,768	1,861	2,541	2,282	3,059	5,284
Mara	1,257	1,443	1,607	2,094	3,163	4,488	6,364	8,501	11,817
Mbeya	1,841	2,283	2,826	3,332	4,649	6,420	8,168	10,864	15,174
Morogoro	1,983	2,344	2,769	2,965	3,185	4,242	4,826	8,027	9,567
Mtwara	1,396	1,578	1,927	2,249	2,738	3,569	4,709	6,320	9,858
Mwanza	1,875	2,317	2,679	3,275	4,083	5,753	7,091	10,510	14,640
Rukwa	1,275	1,203	1,445	1,726	3,690	4,947	6,715	8,825	11,435
Ruvuma	1,943	2,281	2,780	3,260	3,914	5,224	5,924	10,647	13,470
Shinyanga	1,479	1,639	2,029	2,302	2,574	3,486	4,914	6,508	8,814
Singida	1,373	1,611	1,973	2,296	2,975	3,923	5,632	7,518	11,080
Tabora	1,318	1,515	1,818	2,064	2,354	3,185	3,718	4,885	8,459
Tanga	1,896	2,160	2,492	2,816	3,105	4,218	5,543	8,872	11,423
Tanzania Mainland	2,072	2,354	2,729	3,151	3,811	5,221	6,715	8,811	12,076

Table 4-1 DEMOGRAPHIC CONDITIONS OF THE PROJECT AREA

	1978			1988			
	Male	Female	Total	Male	Female	Total	(%)
Nkwansira							
0- 4	147	144	291	164	171	334	16.3
5- 9	170	167	337	189	198	387	18.8
10-14	145	122	267	161	145	306	14.9
15-24	146	176	322	163	209	371	18.1
25-34	81	106	187	90	126	216	10.5
35-44	76	80	156	85	95	180	8.7
45-54	52	40	92	58	47	105	5.1
55-64	41	33	74	46	39	85	4.1
>65	34	28	62	38	33	71	3.5
Total	892	896	1,788	993	1,063	2,056	100.0
Annual growth rate (%)						1.41	
Total Household in 1988						413	
Persons per Household in 198:						5.0	
Mungushi							
0- 4	149	153	302	192	195	387	17.2
5- 9	142	176	318	183	224	408	18.1
10-14	138	119	257	178	152	330	14.6
15-24	160	155	315	206	198	404	17.9
25-34	94	119	213	121	152	273	12.1
35-44	95	75	170	122	96	218	9.7
45-54	56	42	98	72	54	126	5.6
55-64	17	15	32	22	19	41	1.8
>65	41	10	51	53	13	66	2.9
Total	892	864	1,756	1,150	1,102	2,252	100.0
Annual growth rate (%)						2.52	
Total Household in 1988						370	
Persons per Household in 198:						6.1	
Sanya Station							
0- 4	173	167	340	230	237	466	16.3
5- 9	210	178	388	279	252	531	18.5
10-14	118	111	229	157	157	314	10.9
15-24	205	195	400	272	276	549	19.1
25-34	98	140	238	130	199	329	11.5
35-44	89	71	160	118	101	219	7.6
45-54	87	46	133	115	65	181	6.3
55-64	46	50	96	61	71	132	4.6
>65	74	35	109	98	50	148	5.2
Total	1,100	993	2,093	1,460	1,408	2,868	100.0
Annual growth rate (%)						3.20	
Total Household in 1988						544	
Persons per Household in 198:						5.3	

Remark: Age distribution in 1988 was estimated from 1978
Source: Population Census, 1978 and 1988
Hai district office
Village offices
Regional statistic office

Table 4-2 SOCIO-ECONOMIC CONDITIONS OF THE PROJECT AREA

	Nkwansira	Mungushi	Sanya Station
Education			
Primary School			
Name	Nkwansira	Mungushi	Sanya Station
Enrollment			
Male	243	143	91
Female	211	150	70
Total	454	293	161
No. of Teacher	13	10	7
Teacher/Student Ratio	1 : 35	1 : 30	1 : 23
Adult Education			
Male	40	45	90
Female	39	28	73
Total	79	73	163
Name	-	Nkwamakuu	Tindigani
Enrollment			
Male	-	79	65
Female	-	71	48
Total	-	150	113
No. of Teacher	-	10	4
Teacher/Student Ratio	-	1 : 15	1 : 28
Adult Education			
Male	-	35	43
Female	-	31	46
Total	-	66	89
Medical Care			
Inside of Village			
Dispensary	1*	0	1
Health Center	0	0	0
Clinic	0	0	0
Hospital	0	0	0
Nearest			
Health Center	Kware	Kware Boma Ngombe	Boma Ngombe
Hospital	Kibongoto	Kibongoto Moshi	Moshi
Domestic Water Supply	Existing tap water	Existing tap water	Sanya river or furrows
Factory	2 maize mill	None	None

Remark: *; Under construction
Source: Hai district office
Village offices

Table 4-3 PRESENT FARMING PRACTICES IN THE PROJECT AREA (1/4)

Maize

	Boloti Area	Mungushi Area	Sanya Plain
Variety	Hybrid 511*	Hybrid 622*	Malawi*
	Hybrid 512*	Hybrid 511	Kilima*
	Hybrid 622	Ilonga Composise (ICW)	Hybrid 511
	Ilonga Composise (ICW)	Tuxpeno	Starha
	Local	Local	Ilonga Composise (ICW)
			Local
Ploughing			
Method	Oxen*	Oxen*	Oxen
	Tractor	Tractor	Tractor*
Planting			
Method			
Pure stand	Direct seeding	Direct seeding	Direct seeding
Inter-cropping with beans	Direct seeding	Direct seeding	Direct seeding
Inter-cropping with sunflower	-	-	Direct seeding
Spacing			
Pure stand	90cm between row	90cm between row	60cm between row
	30cm between seeds in row	30cm between seeds in row	45cm between seeds in row
	2-3 seeds per hill	2-3 seeds per hill	2-3 seeds per hill
Inter-cropping with beans	90cm between row	180cm between row	60cm between row
	30cm between seeds in row	30cm between seeds in row	45cm between seeds in row
	2-3 seeds per hill	2-3 seeds per hill	2-3 seeds per hill
Inter-cropping with sunflower	-	-	150cm between row
	-	-	45cm between seeds in row
	-	-	2-3 seeds per hill
Seed rate			
Pure stand	25 kg per ha	25 kg per ha	25 kg per ha
Inter-cropping with beans	25 kg per ha	12 kg per ha	25 kg per ha
Inter-cropping with sunflower	-	-	10 kg per ha
Weeding			
Method			
1st			
Pure stand	Oxen	Oxen	Manual
Inter-cropping with beans	Manual	Manual	Manual
Inter-cropping with sunflower	Manual	Manual	Manual
2nd	Manual	Manual	-
Timing			
1st	3-4 weeks after germination	2-3 weeks after germination	2-3 weeks after germination
2nd	During flowering	During flowering	-
Fertilizing			
Kind	Nitrogen (N)	Nitrogen (N)	-
Rate	25 kg per ha	25 kg per ha	-
Timing	Plant at the knee hight	Plant at the knee hight	-
Spraying	-	-	-
Harvesting	Manual	Manual	Manual
Average Yield			
Pure stand	1.5 ton per ha	1.5 ton per ha	1.1 ton per ha
Inter-cropping with beans	1.5 ton per ha	0.8 ton per ha	1.1 ton per ha
Inter-cropping with sunflower	-	-	0.8 ton per ha

Remark: *; Dominant in the area

Source: Interview survey with farmers and extension staff in the Hai district office

Table 4-3 PRESENT FARMING PRACTICES IN THE PROJECT AREA (2/4)

Beans

	Boloti Area	Mungushi Area	Sanya Plain
Variety	Canadian Wander*	Canadian Wander*	Canadian Wander*
	Masai Red	Masai Red	Masai Red
	Local	Local	Local
Ploughing			
Method	Oxen*	Oxen*	Oxen
	Tractor	Tractor	Tractor*
Planting			
Method			
Pure stand	Direct seeding	Broadcasting	Broadcasting
Inter-cropping with maize	Direct seeding	Broadcasting	Direct seeding
Inter-cropping with sunflower	-	Broadcasting	-
Spacing			
Pure stand	30cm between row	-	-
	10cm between seeds in row	-	-
	2-3 seeds per hill	-	-
Inter-cropping with maize	90cm between row	-	60cm between row
	10cm between seeds in row	-	10cm between seeds in row
	2-3 seeds per hill	-	2-3 seeds per hill
Seed rate			
Pure stand	50 kg per ha	60 kg per ha	60 kg per ha
Inter-cropping with maize	20 kg per ha	60 kg per ha	25 kg per ha
Inter-cropping with sunflower	-	60 kg per ha	-
Weeding			
Method			
1st			
Pure stand	Oxen	Manual	Manual
Inter-cropping	Manual	Manual	Manual
2nd	Manual	Manual	-
Timing			
1st	3-4 weeks after germination	2 weeks after germination	2 weeks after germination
2nd	During flowering	During flowering	-
Fertilizing	-	-	-
Spraying	-	-	-
Harvesting	Manual	Manual	Manual
Average yield			
Pure stand	0.5 ton per ha	0.5 ton per ha	0.5 ton per ha
Inter-cropping with maize	0.1 ton per ha	0.5 ton per ha	0.2 ton per ha
Inter-cropping with sunflower	-	0.5 ton per ha	-

Remark: *; Dominant in the area

Source: Interview survey with farmers and extension staff in the Hai district office

Table 4-3 PRESENT FARMING PRACTICES IN THE PROJECT AREA (3/4)

Sunflower

	Boloti Area	Mungushi Area	Sanya Plain
Variety	-	Record*	Record*
	-	Jupiter	Jupiter
Ploughing			
Method	-	Oxen*	Oxen
	-	Tractor	Tractor*
Planting			
Method			
Inter-cropping with beans	-	Broadcasting	-
Inter-cropping with maize	-	-	Direct seeding
Spacing			
Inter-cropping with beans	-	-	-
	-	-	-
	-	-	-
Inter-cropping with maize	-	-	150cm between row
	-	-	45cm between seeds in row
	-	-	2 seeds per hill
Seed rate			
Inter-cropping with beans	-	2.5 kg	-
Inter-cropping with maize	-	-	2.5 kg
Weeding			
Method	-		
Timing		Manual	Manual
1st	-	2 weeks after germination	2-3 weeks after germination
2nd	-	After flowering of beans	-
Fertilizing	-	-	-
Spraying	-	-	-
Harvesting	-	Manual	Manual
Average yield			
Inter-cropping with beans	-	0.4 ton per ha	-
Inter-cropping with maize	-	-	0.4 ton per ha

Remark: *: Dominant in the area

Source: Interview survey with farmers and extension staff in the Hai district office

Table 4-3 PRESENT FARMING PRACTICES IN THE PROJECT AREA (4/4)

Tomato

	Boloti Area	Mungushi Area	Sanya Plain
Variety	-	Mangrove*	-
	-	Moneymaker	-
	-	Local	-
Ploughing			
Method	-	Oxen	-
Planting			
Nursery			
Area	-	40 square meter per ha	-
Method	-	Broadcasting	-
Seed rate	-	100 g per ha	-
Field			
Method	-	Transplanting	-
Spacing	-	90cm between row	-
	-	90cm between plants in row	-
	-	3 plants per hill	-
Weeding			
Method	-	Manual	-
Timing	-		-
1st	-	2 weeks after transplanting	-
2nd	-	4 weeks after transplanting	-
3rd	-	6 weeks after transplanting	-
Fertilizing			
Kind	-	Nitorgen (N)	-
Rate		25 kg per ha	
Timing		Just after 1st weeding	
Spraying			
Fungicide			
Rate of dosage	-	5 kg per ha	-
Timing	-	Weekly	-
Insecticide			
Rate of dosage		7 liter per ha	
Timing		Weekly after transplanting	
Harvesting			
Method	-	Manual	-
Frequency	-	6 times (2 times/week)	-
Average yield	-	8.5 ton per ha	-

Remark: *; Dominant in the area

Source: Interview survey with farmers and extension staff in the Hai district office

Table 4-4 PLANTED AREA, PRODUCTION AND YIELD BY CROP IN HAI DISTRICT

	Maize	Beans	Paddy	Wheat	Finger Millet	Bananas	Irish Potato	Sunflower	Tomato	Onoin	Other Veg.
Planted Area (ha)											
1979/80	19,000	7,000	270	-	-	19,000	2,500	-	-	-	-
1980/81	21,000	7,200	270	-	-	19,000	2,500	-	-	-	-
1981/82	27,000	7,200	330	-	-	20,000	-	-	-	-	-
1982/83	-	-	-	-	-	-	-	-	-	-	-
1983/84	25,260	8,225	480	1,000	100	20,000	2,500	-	-	-	-
1984/85	25,261	8,327	560	750	380	21,000	2,500	100	540	55	462
1985/86	29,150	12,000	560	1,000	450	-	2,500	390	670	70	470
1986/87	25,261	13,000	560	1,000	450	21,000	2,500	-	670	70	478
1987/88	-	-	-	-	-	21,000	-	-	1,243	89	757
1988/89	-	-	-	-	-	21,000	-	-	907	536	1,083
Average	24,562	8,993	433	938	345	20,250	2,500	245	806	164	650
Production (ton)											
1979/80	25,000	2,670	520	-	-	200,000	20,000	-	-	-	-
1980/81	26,000	3,000	600	-	-	200,000	20,000	-	-	-	-
1981/82	41,000	4,536	520	-	-	200,000	-	-	-	-	-
1982/83	-	-	-	-	-	-	-	-	-	-	-
1983/84	14,500	4,000	52	1,665	66	420,000	30,000	-	-	-	-
1984/85	14,575	3,296	620	1,875	80	105,000	20,000	55	-	-	-
1985/86	52,470	14,400	2,520	2,500	670	525,000	30,000	390	-	-	-
1986/87	6,315	3,900	2,520	1,250	287	420,000	12,500	-	-	-	-
1987/88	-	-	-	-	-	-	-	-	-	-	-
1988/89	-	-	-	-	-	315,000	-	-	-	-	-
Average	25,694	5,115	1,050	1,823	276	298,125	22,083	223	-	-	-
Yield (ton/ha)											
1979/80	1.32	0.38	1.93	-	-	10.53	8.00	-	-	-	-
1980/81	1.24	0.42	2.22	-	-	10.53	8.00	-	-	-	-
1981/82	1.52	0.63	1.58	-	-	10.00	-	-	-	-	-
1982/83	-	-	-	-	-	-	-	-	-	-	-
1983/84	0.57	0.49	0.11	1.67	0.66	21.00	12.00	-	-	-	-
1984/85	0.58	0.40	1.11	2.50	0.21	5.00	8.00	0.55	-	-	-
1985/86	1.80	1.20	4.50	2.50	1.49	-	12.00	1.00	-	-	-
1986/87	0.25	0.30	4.50	1.25	0.64	20.00	5.00	-	-	-	-
1987/88	-	-	-	-	-	-	-	-	-	-	-
1988/89	-	-	-	-	-	15.00	-	-	-	-	-
Average	1.04	0.54	2.28	1.98	0.75	13.15	8.83	0.78	10-25	7-15	3-15

Source : Regional office
Hai district office

Table 4-5 ESTIMATED PRESENT CROP PRODUCTION IN THE PROJECT AREA

	Area (ha)	Yield (ton/ha)	Production (ton)
Boloti			
Maize			
Maize	72	1.5	108.0
Maize/beans	112	1.5	168.0
Total	-	-	276.0
Beans			
Beans	60	0.5	30.0
Maize/Beans	140	0.1	14.0
Total	-	-	44.0
Mungushi			
Maize			
Maize	44	1.5	66.0
Maize/beans	44	0.8	35.2
Total	-	-	101.2
Beans			
Beans	12	0.5	6.0
Beans/Sunflower	8	0.5	4.0
Total	-	-	10.0
Sunflower			
Beans/Sunflower	8	0.4	3.2
Vegetable*	10	8.5	85.0
Banana	25	3.9	97.5
Sanya Plain			
Maize			
Maize	378	1.1	415.8
Maize/beans	96	1.1	105.6
Maize/Sunflower	30	0.8	24.0
Total	-	-	545.4
Beans			
Beans	126	0.5	63.0
Maize/Beans	96	0.2	19.2
Total	-	-	82.2
Sunflower			
Maize/Sunflower	30	0.4	12.0

Remark: *; Calculated as tomato

Table 4-6 LAND HOLDING SIZE DISTRIBUTION IN THE PROJECT AREA

Holding Size Distribution (ha)			<0.5	0.5-1.0	1.0-2.0	2.0-3.0	3.0-4.0	4.0-5.0	5.0-10	>10	Total
Boloti	Number of Farmers	Resident	81	22	26	18	0	8	4	0	159
		Non-resident	60	50	28	3	3	1	3	0	148
		Total	141	72	54	21	3	9	7	0	307
	Accumulated Area (ha)	Resident	30	17	36	41	0	34	21	0	178
		Non-resident	23	36	34	7	11	4	18	0	133
		Total	53	52	69	48	11	38	40	0	312
Mungushi	Number of Farmers	Resident	117	87	30	15	1	2	1	0	253
		Non-resident	10	7	1	0	0	0	0	0	18
		Total	127	94	31	15	1	2	1	0	271
	Accumulated Area (ha)	Resident	40	65	43	35	3	9	9	0	204
		Non-resident	4	5	2	0	0	0	0	0	10
		Total	44	69	45	35	3	9	9	0	214
Sanya Plain	Number of Farmers	Resident	79	93	86	81	14	10	11	10	384
		Non-resident	34	62	74	26	6	7	4	5	218
		Total	113	155	160	107	20	17	15	15	602
	Accumulated Area (ha)	Resident	30	70	118	189	46	46	71	168	738
		Non-resident	12	44	97	63	19	31	26	82	375
		Total	42	115	215	252	65	77	97	249	1,113
Boloti	Number of Farmers (%)	Resident	26.4	7.2	8.5	5.9	0.0	2.6	1.3	0.0	51.8
		Non-resident	19.5	16.3	9.1	1.0	1.0	0.3	1.0	0.0	48.2
		Total	45.9	23.5	17.6	6.8	1.0	2.9	2.3	0.0	100.0
	Accumulated Area (%)	Resident	9.7	5.3	11.4	13.1	0.0	10.9	6.9	0.0	57.2
		Non-resident	7.3	11.5	10.8	2.3	3.5	1.4	5.8	0.0	42.8
		Total	17.0	16.8	22.2	15.4	3.5	12.3	12.7	0.0	100.0
Mungushi	Number of Farmers (%)	Resident	43.2	32.1	11.1	5.5	0.4	0.7	0.4	0.0	93.4
		Non-resident	3.7	2.6	0.4	0.0	0.0	0.0	0.0	0.0	6.6
		Total	46.9	34.7	11.4	5.5	0.4	0.7	0.4	0.0	100.0
	Accumulated Area (%)	Resident	18.6	30.3	20.1	16.4	1.4	4.2	4.4	0.0	95.2
		Non-resident	1.8	2.2	0.8	0.0	0.0	0.0	0.0	0.0	4.8
		Total	20.4	32.4	20.8	16.4	1.4	4.2	4.4	0.0	100.0
Sanya Plain	Number of Farmers (%)	Resident	13.1	15.4	14.3	13.5	2.3	1.7	1.8	1.7	63.8
		Non-resident	5.6	10.3	12.3	4.3	1.0	1.2	0.7	0.8	36.2
		Total	18.8	25.7	26.6	17.8	3.3	2.8	2.5	2.5	100.0
	Accumulated Area (%)	Resident	2.7	6.3	10.6	16.9	4.1	4.1	6.4	15.1	66.3
		Non-resident	1.1	4.0	8.8	5.7	1.7	2.8	2.3	7.4	33.7
		Total	3.8	10.3	19.3	22.6	5.9	6.9	8.7	22.4	100.0

Source: Farmers' list obtained from traditional furrow leaders in the project area

Table 4-7 SITUATION OF LOCAL MARKET IN HAI DISTRICT

Name of Local Market	Marketing Date	Distance from Hai H.Q. (km)	Size of Market (Ranking)	Road Condition
Sauya Juu (old Hai H. Q.)	Wed/Sat	14	2	Territorial Bitumen Road
Liwati	Mon/Thu	8	4	Territorial Bitumen Road (between Sanja Juu end B'gombe)
Boman Ng'ombe (near Hai H.Q.)	Wed/Sat	0	2	Trunk Bitumen Road (along with the Highway Moshi/Arusha)
Sanya Station	none	6	-	Local Earth Road (unpaved)
KIA	none	15	-	Trunk Bitumen Road (connected with Highway Moshi/Arush)
Mutakuya	none	22	-	Local Earth Road (unpaved)
Rundugai	Mon/Thu	8	3	Local Earth Road (unpaved)
Kwa Sadoma	Tue/Fri	8	3	Trunk Bitumen Road (along with the Highway Moshi/Arusha)
Kimashuku	-	13	-	Highway 12km from moshi 3km Earth Road to South
Moshi (Food material only)	Every Day	25		Trunk Bitumen Road (located in Center Moshi City)
Kiborironi (Biggest in Region)	Every Day	28	1	Trunk Bitumen Road (located in East side Moshi City)

Table 4-8 OFFICIAL RETAIL PRICES OF STAPLE FOODS

(Unit: Tsh./kg)

	1983	1984	1985	1986	1987	1988
Maize	4.39	5.40	7.60	12.20	12.20	17.00
Maize*	2.50	8.00	13.75	-	-	-
Rice	7.20	13.40	14.50	19.50	32.00	59.70
Wheat*	8.00	14.50	17.20	25.15	35.00	55.85

Remark: *; Flour
Source: Basic Data, Agriculture and Livestock Sector, 1983/84-1987/88

Table 4-9 OPEN MARKET PRICES OF AGRICULTURAL PRODUCTS IN KILIMANJARO REGION

(Unit: Tsh./kg)

Commodity	1988	1989				Change per Year
	September	March	June	August	September	
Maize	21.25	-	31.50	34.00	27.50	29%
Maize*	29.60	-	35.00	30.00	51.25	73%
Rice	62.83	-	80.00	75.00	73.75	17%
Wheat*	57.50	-	105.00	130.00	92.50	61%
Cassava	18.25	-	35.00	50.00	-	-
Beans	37.50	-	72.50	57.50	56.25	50%
Irish potato	40.00	-	57.50	60.00	45.00	13%
Banana**	4.38	-	4.00	4.78	4.50	3%
Onion	55.00	-	112.50	80.00	57.50	5%
Tomato	35.00	-	107.50	55.00	65.00	86%
Beaf	147.50	-	220.00	210.00	225.00	53%
Egg**	10.75	-	14.00	15.00	16.00	49%

Remarks: *; Flour
**; Per piece
Source: Marketing Development Bureau

Table 4-10 MOSHI MARKET PRICES

(Unit: Tsh./kg)

	1986	1987	1988	1989
Maize	13.75	16.49	22.34	25.77
Beans	32.50	27.50	50.00	57.50
Tomato	27.50	47.50	55.00	70.00
Banana	6.00	5.55	10.50	14.63
Sunflower	-	35.20	33.60	60.00

Source: Kilimanjaro Agricultural Development Center (KADC)

Table 4-11 CURRENT FARM GATE PRICES IN THE PROJECT AREA

	Unit	Farm Gate Price
1. Agricultural Products*		
Maize	Tsh./kg	21.9
Beans	Tsh./kg	48.9
Tomato	Tsh./kg	35.0
Sunflower	Tsh./kg	51.0
Banana	Tsh./kg	7.4
2. Agricultural Inputs		
Seed		
Maize	Tsh./kg	84.0
Beans	Tsh./kg	70.0
Tomato	Tsh./kg	6,000.0
Sunflower	Tsh./kg	60.0
Fertilizers		
Nitrogen (N)	Tsh./kg	21.6
Phosphorous (P)	Tsh./kg	64.9
Potassium (K)	Tsh./kg	49.1
Agro-chemicals		
Fungicide	Tsh./kg	1,160.0
Insecticide	Tsh./kg	1,133.0
Herbicide	Tsh./kg	1,196.0
Average		1,163.0
Tractor	Tsh./ha	4,940.0
Oxen	Tsh./animal-day	800.0
Labour	Tsh./man-day	400.0

Remarks: *; Extimated from Moshi market prices using following conversion rate in consideration of transportation cost, transportation damage and retail margin:
1) Maize, beans and sunflower is 0.85
2) Tomato is 0.50
3) Banana is 0.70

Source: Tanzania Farmers Association (TFA)
Kilimanjaro Agricultural Development Center (KADC)
Hai district office
Farm economic survey in the project area

Table 4-12 MONTHLY AVERAGE PRICES OF LIVESTOCK IN WERU WERU MARKET

(Unit: Tsh./kg)

	Mixed Beef				Goat Meat			
	1986	1987	1988	1989	1986	1987	1988	1989
Jan	-	100	120	200	-	150	150	300
Feb	-	100	120	200	-	-	160	250
Mar	-	100	120	200	-	150	150	300
Apr	-	100	120	200	-	150	150	275
May	-	100	120	180	-	150	150	-
Jun	-	100	120	200	-	150	150	250
Jul	80	90	150	200	120	150	250	250
Aug	80	100	150	200	100	150	200	250
Sep	90	100	120	200	120	150	150	250
Oct	80	100	140	200	120	150	150	250
Nov	90	120	150	200*	150	150	200	250*
Dec	100	120	150	200*	-	140	200	250*
Year Average	-	103	132	198*	-	149	172	261*
Index (1987:100)	-	100	128	192	-	100	115	175

Remarks: *; Estimate

Table 4-13 PRESENT CROP BUDGET PER HA (1/4)

MAIZE PURE STAND

		Unit		Amount	Price	Cost
Boloti Area						
Production Cost						
Seed		kg		25	84.0	0
Fertilizers	Nitrogen (N)	kg		25	21.6	540
	Posphorus (P)	kg		0	64.9	0
	Potassium (K)	kg		0	49.1	0
Agro-chemicals		lit		0	1,163.0	0
			Family	Hired		
Ploughing	Tractor	ha	0	0	4,940.0	0
	Oxen	ad	0	5	800.0	4,000
Planting	Manual	md	10	0	400.0	0
Weeding	Oxen	ad	0	4	800.0	3,200
	Manual	md	0	0	400.0	0
Fertilizing	Manual	md	2	0	400.0	0
Harvesting	Manual	md	20	0	400.0	0
Shelling	Manual	md	10	0	400.0	0
Miscellaneous	10% of above cost					774
Total						8,514
Gross Income		kg		1,500	21.9	32,850
Net Income						24,336
Mungushi Area						
Production Cost						
Seed		kg		25	84.0	0
Fertilizers	Nitrogen (N)	kg		25	21.6	540
	Posphorus (P)	kg		0	64.9	0
	Potassium (K)	kg		0	49.1	0
Agro-chemicals		lit		0	1,163.0	0
			Family	Hired		
Ploughing	Tractor	ha	0	0	4,940.0	0
	Oxen	ad	0	5	800.0	4,000
Planting	Manual	md	10	0	400.0	0
Weeding	Oxen	ad	0	4	800.0	3,200
	Manual	md	0	0	400.0	0
Fertilizing	Manual	md	2	0	400.0	0
Harvesting	Manual	md	20	0	400.0	0
Shelling	Manual	md	10	0	400.0	0
Miscellaneous	10% of above cost					774
Total						8,514
Gross Income		kg		1,500	21.9	32,850
Net Income						24,336
Sanya Plain						
Production Cost						
Seed		kg		25	84.0	0
Fertilizers	Nitrogen (N)	kg		0	21.6	0
	Posphorus (P)	kg		0	64.9	0
	Potassium (K)	kg		0	49.1	0
Agro-chemicals		lit		0	1,163.0	0
			Family	Hired		
Ploughing	Tractor	ha	0	1	4,940.0	4,940
	Oxen	ad	0	0	800.0	0
Planting	Manual	md	10	0	400.0	0
Weeding	Oxen	ad	0	0	800.0	0
	Manual	md	20	0	400.0	0
Fertilizing	Manual	md	0	0	400.0	0
Harvesting	Manual	md	15	0	400.0	0
Shelling	Manual	md	7	0	400.0	0
Miscellaneous	10% of above cost					494
Total						5,434
Gross Income		kg		1,100	21.9	24,090
Net Income						18,656

Table 4-13 PRESENT CROP BUDGET PER HA (2/4)

BEANS PURE STAND

		Unit		Amount	Price	Cost
Boloti Area						
Production Cost						
Seed		kg		60	70.0	0
Fertilizers	Nitrogen (N)	kg		0	21.6	0
	Posphorus (P)	kg		0	64.9	0
	Potassium (K)	kg		0	49.1	0
Agro-chemicals		lit		0	1,163.0	0
			Family	Hired		
Ploughing	Tractor	ha	0	0	4,940.0	0
	Oxen	ad	0	5	800.0	4,000
Planting	Manual	md	10	0	400.0	0
Weeding	Oxen	ad	0	2	800.0	1,600
	Manual	md	0	0	400.0	0
Fertilizing	Manual	md	0	0	400.0	0
Harvesting	Manual	md	20	0	400.0	0
Threshing	Manual	md	20	0	400.0	0
Miscellaneous	10% of above cost					560
Total						6,160
Gross Income		kg		500	48.9	24,450
Net Income						18,290
Mungushi Area						
Production Cost						
Seed		kg		60	70.0	0
Fertilizers	Nitrogen (N)	kg		0	21.6	0
	Posphorus (P)	kg		0	64.9	0
	Potassium (K)	kg		0	49.1	0
Agro-chemicals		lit		0	1,163.0	0
			Family	Hired		
Ploughing	Tractor	ha	0	0	4,940.0	0
	Oxen	ad	0	5	800.0	4,000
Planting	Manual	md	3	0	400.0	0
Weeding	Oxen	ad	0	0	800.0	0
	Manual	md	15	0	400.0	0
Fertilizing	Manual	md	0	0	400.0	0
Harvesting	Manual	md	20	0	400.0	0
Threshing	Manual	md	20	0	400.0	0
Miscellaneous	10% of above cost					400
Total						4,400
Gross Income		kg		500	48.9	24,450
Net Income						20,050
Sanya Plain						
Production Cost						
Seed		kg		60	70.0	0
Fertilizers	Nitrogen (N)	kg		0	21.6	0
	Posphorus (P)	kg		0	64.9	0
	Potassium (K)	kg		0	49.1	0
Agro-chemicals		lit		0	1,163.0	0
			Family	Hired		
Ploughing	Tractor	ha	0	1	4,940.0	4,940
	Oxen	ad	0	0	800.0	0
Planting	Manual	md	3	0	400.0	0
Weeding	Oxen	ad	0	0	800.0	0
	Manual	md	10	0	400.0	0
Fertilizing	Manual	md	0	0	400.0	0
Harvesting	Manual	md	20	0	400.0	0
Threshing	Manual	md	20	0	400.0	0
Miscellaneous	10% of above cost					494
Total						5,434
Gross Income		kg		500	48.9	24,450
Net Income						19,016

Table 4-13 PRESENT CROP BUDGET PER HA (3/4)

MAIZE INTERCROPPING WITH BEANS

		Unit		Amount	Price	Cost
Boloti Area						
Production Cost						
Seed	Maize	kg		25	84.0	0
	Beans	kg		20	70.0	0
Fertilizers	Nitrogen (N)	kg		25	21.6	540
	Posphorus (P)	kg		0	64.9	0
	Potassium (K)	kg		0	49.1	0
Agro-chemicals		lit		0	1,163.0	0
			Family	Hired		
Ploughing	Tractor	ha	0	0	4,940.0	0
	Oxen	ad	0	5	800.0	4,000
Planting	Manual	md	16	0	400.0	0
Weeding	Manual	md	30	0	400.0	0
Fertilizing	Manual	md	2	0	400.0	0
Harvesting	Manual	md	24	0	400.0	0
Shelling	Manual	md	10	0	400.0	0
Threshing	Manual	md	4	0	400.0	0
Miscellaneous	15% of above cost					681
Total						5,221
Gross Income	Maize	kg		1,500	21.9	32,850
	Beans	kg		100	48.9	4,890
	Total					37,740
Net Income						32,519
Mungushi Area						
Production Cost						
Seed	Maize	kg		12	84.0	0
	Beans	kg		60	70.0	0
Fertilizers	Nitrogen (N)	kg		0	21.6	0
	Posphorus (P)	kg		0	64.9	0
	Potassium (K)	kg		0	49.1	0
Agro-chemicals		lit		0	1,163.0	0
			Family	Hired		
Ploughing	Tractor	ha	0	0	4,940.0	0
	Oxen	ad	0	5	800.0	4,000
Planting	Manual	md	8	0	400.0	0
Weeding	Manual	md	30	0	400.0	0
Fertilizing	Manual	md	0	0	400.0	0
Harvesting	Manual	md	31	0	400.0	0
Shelling	Manual	md	5	0	400.0	0
Threshing	Manual	md	20	0	400.0	0
Miscellaneous	15% of above cost					600
Total						4,600
Gross Income	Maize	kg		800	21.9	17,520
	Beans	kg		500	48.9	24,450
	Total					41,970
Net Income						37,370
Sanya Plain						
Production Cost						
Seed	Maize	kg		25	84.0	0
	Beans	kg		25	70.0	0
Fertilizers	Nitrogen (N)	kg		0	21.6	0
	Posphorus (P)	kg		0	64.9	0
	Potassium (K)	kg		0	49.1	0
Agro-chemicals		lit		0	1,163.0	0
			Family	Hired		
Ploughing	Tractor	ha	0	1	4,940.0	4,940
	Oxen	ad	0	0	800.0	0
Planting	Manual	md	12	0	400.0	0
Weeding	Manual	md	15	0	400.0	0
Fertilizing	Manual	md	0	0	400.0	0
Harvesting	Manual	md	23	0	400.0	0
Shelling	Manual	md	7	0	400.0	0
Threshing	Manual	md	8	0	400.0	0
Miscellaneous	15% of above cost					741
Total						5,681
Gross Income	Maize	kg		1,100	21.9	24,090
	Beans	kg		200	48.9	9,780
	Total					33,870
Net Income						28,189

Table 4-13 PRESENT CROP BUDGET PER HA (4/4)

MAIZE INTERCROPPING WITH SUNFLOWER, BEANS INTERCROPPING WITH SUNFLOWER, VEGETABLES

		Unit		Amount	Price	Cost
Mungushi Area (Beans intercropping with Sunflower)						
Production Cost						
Seed	Beans	kg		60	70.0	4,200
	Sunflower	kg		2.5	60.0	0
Fertilizers	Nitrogen (N)	kg		0	21.6	0
	Posphorus (P)	kg		0	64.9	0
	Potassium (K)	kg		0	49.1	0
Agro-chemicals		lit		0	1,163.0	0
			Family	Hired		
Ploughing	Tractor	ha	0	0	4,940.0	0
	Oxen	ad	0	5	800.0	4,000
Planting	Manual	md	3	0	400.0	0
Weeding	Manual	md	30	0	400.0	0
Fertilizing	Manual	md	0	0	400.0	0
Harvesting	Manual	md	27	0	400.0	0
Threshing	Manual	md	23	0	400.0	0
Miscellaneous	15% of above cost					1,230
Total						9,430
Gross Income	Beans	kg		500	48.9	24,450
	Sunflower	kg		400	51.0	20,400
	Total					44,850
Net Income						35,420
Sanya Plain (Maize intercropping with Sunflower)						
Production Cost						
Seed	Maize	kg		10	84.0	0
	Sunflower	kg		2.5	60.0	0
Fertilizers	Nitrogen (N)	kg		0	21.6	0
	Posphorus (P)	kg		0	64.9	0
	Potassium (K)	kg		0	49.1	0
Agro-chemicals		lit		0	1,163.0	0
			Family	Hired		
Ploughing	Tractor	ha	0	1	4,940.0	4,940
	Oxen	ad	0	0	800.0	0
Planting	Manual	md	8	0	400.0	0
Weeding	Manual	md	10	0	400.0	0
Fertilizing	Manual	md	0	0	400.0	0
Harvesting	Manual	md	18	0	400.0	0
Shelling	Manual	md	5	0	400.0	0
Threshing	Manual	md	3	0	400.0	0
Miscellaneous	15% of above cost					741
Total						4,940
Gross Income	Maize	kg		800	21.9	17,520
	Sunlower	kg		400	51.0	20,400
	Total					37,920
Net Income						32,980
Mungushi (Tomato)						
Production Cost						
Seed		kg		0.10	6,000.0	600
Fertilizers	Nitrogen (N)	kg		25	21.6	540
	Posphorus (P)	kg		0	64.9	0
	Potassium (K)	kg		0	49.1	0
Agro-chemicals		lit		12	1,163.0	13,956
			Family	Hired		
Nursery						
Preparation	Tractor	ha	0	0	4,940.0	0
	Oxen	ad	0	1	800.0	800
Sowing and others	Manual	md	20	0	400.0	0
Ploughing	Tractor	ha	0	0	4,940.0	0
	Oxen	ad	0	5	800.0	4,000
Field Preparation	Manual	md	25	0	400.0	0
Transplanting	Manual	md	25	0	400.0	0
Weeding	Manual	md	20	40	400.0	16,000
Fertilizing	Manual	md	4	0	400.0	0
Spraying	Manual	md	10	0	400.0	0
Irrigation	Manual	md	5	0	400.0	0
Harvesting	Manual	md	15	30	400.0	12,000
Miscellaneous	30% of above costs					14,369
Total						62,265
Gross Income		kg		8,500	35.0	297,500
Net Income						235,235

Table 4-14 NUMBER OF AGRICULTURAL OFFICERS IN HAI DISTRICT

Position/Degree	District	Ward	Village	Total
Agricultural Officer	1	0	0	1
Agricultural Field Officer				
Grade II	2	0	0	2
Grade III	5	1	1	7
Grade IV	5	6	41	52
Sub-total	12	7	42	61
Irrigation Technician				
Grade III	1	0	0	1
Grade IV	3	0	0	3
Sub-total	4	0	0	4
Agricultural Technician	3	0	0	3
Senior Agricultural Field Assistant	1	0	1	2
Agricultural Field Assistant				
Grade I	0	0	3	3
Grade II	4	0	12	16
Grade III	0	0	1	1
Coffee development project	0	3	16	19
Sub-total	4	3	32	39
Total	25	10	75	110
Bachelor of Science	1	0	0	1
Diploma in Agriculture	19	7	42	68
Certificate in Agriculture	5	0	16	21
Agricultural Course	0	3	17	20
Total	25	10	75	110

Source: Hai district office

Table 4-15 RURAL COOPERATIVE SOCIETY IN THE PROJECT AREA

	Nkwansira	Mungushi	Sanya Plain
Name	Nkwansira Rural Cooperative Society	Mungushi Rural Cooperative Society	Sanya and KIA Cooperative Society
Established	1988	1989	1989
Number of Participated	466	331	Not yet registerd
Buying of Crops			
Quantity (kg)			
Beans	0	34,800	0
Maize	0	27,600	0
Coffee	84,551	330	0
Price (Tsh./kg)			
Beans	35	35	35
Maize	11	11	11
Coffee	126.00	126	126
Amount (Tsh.)			
Beans	0	1,218,000	0
Maize	0	303,600	0
Coffee	10,653,468	41,580	0
Total	10,653,468	1,563,180	0
Selling of Inputs			
Quantity			
Sprayer (nos)	0	5	0
Tray wire (roll)	0	2	0
Gramaxone (liter)	0	12	0
Secateurs (prunner)	0	25	0
Maize seed (kg)	500	500	0
Acttelic (pkt)	0	600	0
Dasban (liter)	0	34	0
NPK (20:10:10)	12,500	0	0
CAN	7,500	0	0
Unit price (Tsh.)			
Sprayer	-	7,500	-
Tray wire	-	14,812	-
Gramaxone	-	900	-
Secateurs	-	700	-
Maize seed	86	75	-
Acttelic	-	100	-
Dasban	-	0	-
NPK (20:10:10)	10.8	-	-
CAN	9.2	-	-
Amount (Tsh.)			
Sprayer	-	37,500	-
Tray wire	-	29,624	-
Gramaxone	-	10,800	-
Secateurs	-	17,500	-
Maize seed	43,000	37,500	-
Acttelic	-	60,000	-
Dasban	-	-	-
NPK (20:10:10)	135,000	-	-
CAN	69,000	-	-
Total	247,000	192,924	-

Source : Village offices

Table 4-16 INVENTORY OF AGRICULTURAL MACHINERY IN HAI DISTRICT

	Good Condition	Serviceable	Total
Tractor	384	15	399
Attachments of Tractor			
Disk plough	234	0	234
Chisel plough	23	0	23
Harrow	39	0	39
Sprayer	36	0	36
Planter	26	0	26
Cultivator	17	0	17
Seed driller	26	0	26
Trailer	102	0	102
Combine Harvester	10	0	10
Other Machinery			
Maize sheller	22	0	22
Milling Machine	94	0	94
Fertilizer distributor	8	0	8
Coffee pulper	1	0	1
Coffee huller	2953	0	2953
Hand sprayer	5324	2915	8239
Milking machine	3	0	3
Water dowser	7	0	7

Source: Agriculture Machinery Census 1986/87, Hai distirct

Table 4-17 CRDB LOAN DISBURSEMENT IN TANZANIA

(Unit: Ths. million)

	1983/84	1984/85	1985/86	1986/87
By Type				
Villages	84.1	244.5	33.8	27.9
Individuals	21.4	84.1	91.8	326.5
Companies/Parastatals	11.3	63.1	35.0	131.9
Associations	29.9	-	-	-
Partners	0.6	-	-	-
Cooperative Societies	0.2	68.9	-	-
Cooperative Unions	-	-	1,075.0	1,524.3
Total	147.8	460.8	1,235.6	2,010.6
By Region				
Arusha	8.7	23.7	44.4	96.0
Coast	1.4	14.5	21.0	66.4
D'Salaam	3.8	53.3	25.5	67.6
Dodoma	0.2	5.1	12.0	40.0
Iringa	53.3	42.5	187.4	322.6
Kagera	1.2	17.3	23.5	31.2
Kigoma	1.4	12.3	34.1	55.6
Killimanjaro	7.7	24.7	124.5	184.3
Lindi	1.7	6.8	12.7	35.7
Mara	0.7	3.0	62.5	58.1
Mbeya	5.3	32.0	115.3	296.7
Morogoro	1.6	21.0	32.0	65.7
Mtwara	1.7	11.7	5.0	24.3
Mwanza	7.6	13.0	92.1	93.8
Rukwa	14.3	45.6	79.0	31.6
Ruvuma	15.5	34.2	88.1	60.2
Shinyanga	6.3	25.0	71.0	154.7
Singida	0.3	5.3	12.1	50.6
Tabora	8.5	59.0	166.4	222.5
Tanga	6.6	11.0	27.0	50.4
Zanzibar				2.6
Total	147.8	460.8	1,235.6	2,010.6
By Sector				
Seasonal Inputs	87.5	211.9	1,042.7	1,272.2
Farm Machinery	15.2	84.8	60.5	116.4
Small Scale Industries	23.5	18.5	3.9	28.3
Rural Transportation	13.7	118.8	76.5	528.2
Livestock	5.4	13.8	24.8	24.9
Fisheries	1.6	10.1	5.1	12.7
Storage	0.3	0.9	0.1	-
Farm Development	0.3	1.4	22.0	27.8
Commercial Enterprises	-	-	-	0.1
Total	147.8	460.8	1,235.6	2,010.6

Source: CRDB Annual Report and Accounts

Table 4-18 CRDB LOAN DISBURSEMENT IN KILIMANJARO REGION

(Unit: %)

Type of Borrower	Hai District			Kilimanjaro Region		
	1986	1987	1988	1986	1987	1988
Farm mechanization						
Villages	-	-	-	1.5	-	5.9
Individuals	7.0	9.0		18.7	34.9	6.6
Livestock				-	-	-
Individuals	0.3	-	-	27.6	3.6	0.1
Transport						
Coop Unions	-	-	-	24.1	-	-
Coop Society	-	-	-	-	9.0	22.1
Parastatals	-	-	-	6.9	-	-
Partnership	-	-	-	2.5	14.6	3.8
Villages	-	4.9	-	7.9	4.9	51.3
Individuals	-	-	-	9.5	16.9	-
Small Scale Industry						
Parastatals	-	-	-	-	1.1	-
Partnership	-	-	-	-	2.0	-
Villages	-	-	2.3	-	-	4.5
Individuals	0.2	2.9	2.0	1.3	13.0	5.7
Total						
Coop Unions	-	-	-	24.1	-	-
Coop Society	-	-	-	-	9.0	22.1
Parastatals	-	-	-	6.9	1.1	-
Partnership	-	-	-	2.5	16.6	3.8
Villages	-	4.9	2.3	9.4	4.9	61.7
Individuals	7.5	11.9	2.0	57.1	68.4	12.4
Total	7.5	16.8	4.3	100.0	100.0	100.0

Source: CRDB, Moshi, Kilimanjaro

Table 4-19 NBC LOAN DISBURSEMENT IN KILIMANJARO REGION

(Unit: Tsh. million)

Type of Borrower	Hai District			Kilimanjaro Region		
	86/87	87/88	88/89	86/87	87/88	88/89
Agriculture						
Parastatals	-	-	-	841.4	1,290.6	2,831.5
Export & Marketing						
Coop/Villages	-	-	-	34.1	11.4	48.2
Private Companies	-	-	-	-	-	0.4
Primary Production						
Parastatals	-	-	-	41.1	58.5	19.7
Coop/Villages	-	-	-	13.0	20.6	21.9
Private Companies	-	-	11.1	4.9	16.9	40.1
Industry (Medium & Large)						
Parastatals	-	-	-	36.3	148.9	132.7
Coop/Villages	-	-	-	0.2	0.4	0.4
Private Companies						
Industry (Small & cab)						
Parastatals	-	-	-	0.6	0.9	0.8
Coop/Villages	-	-	-	0.3	0.4	0.3
Private Companies	7.8	11.0	13.5	39.7	66.7	134.6
Commercial						
Parastatals	-	-	-	19.8	36.5	24.9
Coop/Villages	-	-	0.1	3.0	3.7	2.1
Private Companies	0.2	0.3	0.2	44.3	83.3	126.3
Private Individuals	1.6	0.5	0.7	10.8		34.8
Staff	0.1	0.1	0.1	0.9	1.0	1.5
Others	-	-	-	6.4	8.5	17.5
Total						
Parastatals	-	-	-	939.2	1,535.4	3,009.6
Coop/Villages	-	-	0.1	50.6	36.5	72.9
Private Companies	8.0	12.9	24.8	127.8	264.2	676.7
Others	1.7	0.6	0.8	18.1	9.5	53.8
Total	9.7	11.9	25.7	1,096.8	1,748.3	3,437.7

Source: NBC Moshi, Kilimanjaro

Table 4-20 PRESENT FARM ECONOMIC ANALYSIS

	Area			Crop Budget	Net Farm	Income from	Non-farm	Total Farmer's	Living	Tax and	Net
	Rainy (ha)	Dry (ha)	Total (ha)	per ha (Tsh.)	Income (Tsh.)	Livestock (Tsh.)	Income (Tsh.)	Income (Tsh.)	Expense (Tsh.)	Others (Tsh.)	Reserve (Tsh.)
Boloti Area											
Holding Size	1.10	-	-	-	-	-	-	-	-	-	-
Harvested Area											
Maize	0.27	0.00	0.27	24,336	6,646	-	-	-	-	-	-
Maize/Beans	0.42	0.00	0.42	32,519	13,815	-	-	-	-	-	-
Beans	0.18	0.00	0.18	18,290	3,330	-	-	-	-	-	-
Sub-total	0.88	0.00	0.88	-	23,791	2,330	22,270	48,391	45,280	550	2,561
Mungushi Area											
Holding Size	0.80	-	-	-	-	-	-	-	-	-	-
Harvested Area											
Maize	0.22	0.00	0.22	23,436	5,156	-	-	-	-	-	-
Maize/Beans	0.22	0.00	0.22	37,370	8,221	-	-	-	-	-	-
Beans	0.06	0.00	0.06	20,050	1,203	-	-	-	-	-	-
Beans/Sunflower	0.04	0.00	0.04	35,420	1,417	-	-	-	-	-	-
Vegetable	0.00	0.05	0.05	235,235	11,762	-	-	-	-	-	-
Banana	0.13	-	0.13	39,780	4,973	-	-	-	-	-	-
Sub-total	0.67	0.05	0.72	-	32,731	2,130	25,450	60,311	58,230	630	1,451
Sanya Plain											
Holding Size	1.90	-	-	-	-	-	-	-	-	-	-
Harvested Area											
Maize	0.68	0.00	0.68	18,656	12,761	-	-	-	-	-	-
Maize/Beans	0.17	0.00	0.17	28,189	4,897	-	-	-	-	-	-
Beans	0.23	0.00	0.23	19,016	4,336	-	-	-	-	-	-
Maize/Sunflower	0.05	0.00	0.05	32,980	1,790	-	-	-	-	-	-
Sub-total	1.14	0.00	1.14	-	23,784	25,450	11,460	60,694	59,660	610	424

Table 5-1 PROPOSED FARMING PRACTICES (1/2)

			Boloti Area	Mungushi Area	Sanya Plain
Maize					
Variety			Hybrid 622	Hybrid 622	Hybrid 622
			Hybrid 511	Hybrid 511	Hybrid 511
			Ilonga Composise (ICW)	Ilonga Composise (ICW)	Ilonga Composise (ICW)
			Tuxpeno	Tuxpeno	Tuxpeno
Ploughing			Oxen	Oxen	Tractor
Planting	Method		Direct seeding	Direct seeding	Direct seeding
	Spacing		75cm between row	75cm between row	75cm between row
			60cm between seeds in row	60cm between seeds in row	60cm between seeds in row
			2-3 seeds per hill	2-3 seeds per hill	2-3 seeds per hill
	Seed rate		25 kg per ha	25 kg per ha	25 kg per ha
Weeding	Method	1st	Oxen	Oxen	Manual
		2nd	Manual	Manual	Manual
	Timing	1st	2-3 weeks after germination	2-3 weeks after germination	2-3 weeks after germination
		2nd	During flowering	During flowering	During flowering
Fertilizer	Nitrogen (N)		50 kg per ha	50 kg per ha	90 kg per ha
	Phosphorus (P)		15 kg per ha	15 kg per ha	30 kg per ha
	Potassium (K)		15 kg per ha	15 kg per ha	30 kg per ha
Agro-chemical			1 liter per ha	1 liter per ha	2 liter per ha
Harvesting			Manual	Manual	Manual
Beans					
Variety			Canadian Wander	Canadian Wander	Canadian Wander
			Masai Red	Masai Red	Masai Red
			Lyamungo 85	Lyamungo 85	Lyamungo 85
			Selian Wonder	Selian Wonder	Selian Wonder
Ploughing			Oxen	Oxen	Tractor
Planting	Method		Direct seeding	Direct seeding	Direct seeding
	Spacing		45cm between row	45cm between row	45cm between row
			15cm between seeds in row	15cm between seeds in row	15cm between seeds in row
			2-3 seeds per hill	2-3 seeds per hill	2-3 seeds per hill
	Seed rate		60 kg per ha	60 kg per ha	60 kg per ha
Weeding	Method	1st	Oxen	Oxen	Manual
		2nd	Manual	Manual	Manual
	Timing	1st	2 weeks after germination	2 weeks after germination	2 weeks after germination
		2nd	During flowering	During flowering	During flowering
Fertilizer	Nitrogen (N)		25 kg per ha	25 kg per ha	50 kg per ha
	Phosphorus (P)		15 kg per ha	15 kg per ha	30 kg per ha
	Potassium (K)		15 kg per ha	15 kg per ha	30 kg per ha
Agro-chemical			1 liter per ha	1 liter per ha	2 liter per ha

Table 5-1 PROPOSED FARMING PRACTICES (2/2)

				Boloti Area	Mungushi Area	Sanya Plain
Sunflower						
Variety				-	Record	Record
				-	Jupiter	Jupiter
Ploughing				-	Oxen	Tractor
Planting	Method				Direct seeding	Direct seeding
	Spacing				75cm between row	75cm between row
				-	30cm between seeds in row	30cm between seeds in row
				-	2-3 seeds per hill	2-3 seeds per hill
				-	6 kg per ha	8 kg per ha
Weeding	Method		1st	-	Oxen	Oxen
			2nd	-	Manual	Manual
	Timing		1st	-	2-3 weeks after germination	2-3 weeks after germination
			2nd	-	During flowering	During flowering
Fertilizer	Nitrogen (N)			-	35 kg per ha	45 kg per ha
	Phosphorus (P)			-	10 kg per ha	15 kg per ha
	Potassium (K)			-	10 kg per ha	15 kg per ha
Agro-chemical				-	1 liter per ha	2 liter per ha
Harvesting				-	Manual	Manual
Tomato						
Variety				-	-	Mangrove
				-	-	Moneymaker
Ploughing	Method			-	-	Tractor (2 times)
Planting	Nursery		Area	-	-	40 square meter per ha
			Method	-	-	Broadcasting
			Seed rate	-	-	500 g per ha
	Field		Method	-	-	Transplanting
			Spacing	-	-	75cm between row
				-	-	45cm between plants in row
				-	-	3 plants per hill
Weeding	Method			-	-	Mnual
	Timing		1st	-	-	2 weeks after transplanting
			2nd	-	-	4 weeks after transplanting
			3rd	-	-	6 weeks after transplanting
Fertilizer	Nitrogen (N)			-	-	100 kg per ha
	Phosphorus (P)			-	-	150 kg per ha
	Potassium (K)			-	-	100 kg per ha
Agro-chemical				-	-	30 liter per ha
Harvesting				-	-	Manual

Table 5-2 CALCULATION OF ANTICIPATED CROP PRODUCTION

	Planted Area (ha)		Harvested Area (ha)			Yield	Production
	Rainy	Dry	Rainy	Dry	Total	(ton/ha)	(ton)
Boloti Area							
Maize	160	0	160	0	160	3.000	480
Beans	130	0	130	0	130	1.200	156
Mungushi Area							
Maize	85	0	85	0	85	3.000	255
Beans	45	0	45	0	45	1.200	54
Sunflower	5	0	5	0	5	0.810	4
Vegetables	0	10	0	10	10	8.500	85
Banana	25	-	25	-	25	3.900	98
Sanya Plain							
Maize	530	530	530	530	1,060	5.000	5,300
Beans	210	420	210	420	630	2.000	1,260
Sunflower	50	50	50	50	100	1.350	135
Vegetables	210	420	210	420	630	25.000	15,750
Banana	50	-	50	-	50	3.900	195
Total							
Maize	775	530	775	530	1,305	-	6,035
Beans	385	420	385	420	805	-	1,470
Sunflower	55	50	55	50	105	-	139
Vegetables	210	430	210	430	640	-	15,835
Banana	75	-	75	-	75	-	293

Table 5-3 OVERVIEW OF STAPLE FOOD CONSUMPTION AND MARKETING 1987/88

	Maize	Paddy	Wheat	Sorghum/ Millet	Cassava	Potatos	Bananas	Total
% of Calories Intake from Staple Foods								
Rural	62	8	0	8	13	5	4	100
Urban	53	24	2	5	11	3	2	100
Average	61	10	1	7	12	5	4	100
Production (1,000 ton)	2,339	615	67	-	-	-	-	-
Marketed Production								
Quantirties (1,000 ton)								
Through Cooperatives	257	74	43	-	-	-	-	-
Open Market	327	234	7	-	-	-	-	-
Total	584	308	50	-	-	-	-	-
% of total production								
Through Cooperatives	11	12	64	-	-	-	-	-
Open Market	14	38	10	-	-	-	-	-
Total	25	50	75	-	-	-	-	-

Source: Annual Review, Markeiting Development Bera

Table 5-4 ESTIMATED DEMAND AND SUPPLY SITUATION OF FOOD CROPS

	Kilimanjaro	Hai District	Project Area
In 1988			
Population	1,108,699	200,136	4,451
Per Capita Consumption (kg/year)			
Maize	300	300	300
Banana	1,095	1,095	1,095
Beans	36.5	36.5	36.5
Calorie Intake Ratio			
Maize	38%	38%	61%
Banana	38%	38%	15%
Beans	-	-	-
Demand (ton/year)			
Maize	126,392	22,816	815
Banana	461,330	83,277	731
Beans	40,468	7,305	162
Supply (ton/year)			
Maize	83,107	25,694	922
Banana	593,608	298,125	98
Beans	14,595	5,115	127
Balance (ton/year)			
Maize	- 43,285	2,878	107
Banana	132,278	214,848	- 633
Beans	- 25,873	- 2,190	- 35
In 2000			
Population	1,422,730	256,823	5,712
Per Capita Consumption (kg/year)			
Maize	300	300	300
Banana	1,095	1,095	1,095
Beans	36.5	36.5	36.5
Calorie Intake Ratio			
Maize	38%	38%	61%
Banana	38%	38%	15%
Beans	-	-	-
Demand (ton/year)			
Maize	162,191	29,278	1,045
Banana	591,998	106,864	938
Beans	51,930	9,374	208
Supply (ton/year)			
Maize	83,107	25,694	922
Banana	593,608	298,125	98
Beans	14,595	5,115	127
Balance (ton/year)			
Maize	- 79,084	- 3,584	- 123
Banana	1,610	191,261	- 840
Beans	- 37,335	- 4,259	- 81

Table 5-5 CALCULATION OF ECONOMIC FARM GATE PRICE (AT 1990 CONSTANT PRICE)

Description	Unit	Operation	Price
A. Maize (Export Parity)			
a) Projected 1995 International Market Price (FOB US Gulf Port)	US$/ton		94
b) Ocean Freight and Insurance	US$/ton	+	32
c) CIF Price at Mombasa	US$/ton	=	126
d) Ocean Freight and Insurance	US$/ton	-	1
e) CIF Price at Tanga	US$/ton	=	125
f) Converted to Tanzania Shilling	Tsh./ton	x 195	24,375
g) Cost for Port Charge, Handling and Warehousing	Tsh./ton	-	1,561
h) Ex-warehouse Price	Tsh./ton	=	22,814
i) Cost for Transportation, Handling and Retail Margin	Tsh./ton	-	2,100
j) Farm Gate Price	Tsh./ton	=	20,714
	(Tsh./kg)		(20.7)
B. Fertilizers (Import Parity)			
1) Nitrogen			
a) Projected 1995 International Market Price (FOB N.W. Europe, Urea, Bagged)	US$/ton		195
b) Ocean Freight and Insurance	US$/ton	+	25
c) CIF Price at Tanga	US$/ton	=	220
d) Converted to Tanzania Shilling	Tsh./ton	x 195	42,900
e) Cost for Port Charge, Handling and Warehousing	Tsh./ton	+	2,025
f) Ex-warehouse Price	Tsh./ton	=	44,925
g) Cost for Transportation, Handling and Retail Margin	Tsh./ton	+	2,100
h) Farm Gate Price	Tsh./ton	=	47,025
i) Conversion to Price of Nitrogen (N)	Tsh./ton	x 2.22	104,394
	(Tsh./kg)		(104.4)
2) Phosphorus			
a) Projected 1995 International Market Price (FOB US Gulf, TSP, Bulk)	US$/ton		189
b) Ocean Freight and Insurance	US$/ton	+	32
c) CIF Price at Tanga	US$/ton	=	221
d) Converted to Tanzania Shilling	Tsh./ton	x 195	43,095
e) Cost for Port Charge, Handling and Warehousing	Tsh./ton	+	2,029
f) Ex-warehouse Price	Tsh./ton	=	45,124
g) Cost for Transportation, Handling and Retail Margin	Tsh./ton	+	2,100
h) Farm Gate Price	Tsh./ton	=	47,224
i) Conversion to Price of Phosphorus (P)	Tsh./ton	x 4.55	214,871
	(Tsh./kg)		(214.9)
3) Potassium			
a) Projected 1995 International Market Price (FOB Vancouver, Muriate of Potash, Bulk)	US$/ton		104
b) Ocean Freight and Insurance	US$/ton	+	25
c) CIF Price at Tanga	US$/ton	=	129
d) Converted to Tanzania Shilling	Tsh./ton	x 195	25,155
e) Cost for Port Charge, Handling and Warehousing	Tsh./ton	+	1,581
f) Ex-warehouse Price	Tsh./ton	=	26,736
g) Cost for Transportation, Handling and Retail Margin	Tsh./ton	+	2,100
h) Farm Gate Price	Tsh./ton	=	28,836
i) Conversion to Price of Potassium (K)	Tsh./ton	x 1.92	55,365
	(Tsh./kg)		(55.4)

Source: Price Prospects for Major Primary Commodities, 1988-2000,
Quarterly eview of Commodity Markets, Fourth Quarter 1989

Table 5-6 CALCULATION OF ECONOMIC FARM GATE PRICE

(Unit: Tsh./kg)

	1986	1987	1988	1989	Average
Deflator*	47.8	62.1	81.5	100.0	-
Current Farm Gate Price**					
Beans	27.6	23.4	42.5	48.9	35.6
Tomato	13.8	23.8	27.5	35.0	25.0
Sunflower	-	29.9	28.6	51.0	36.5
Banana	4.2	3.9	7.4	10.2	6.4
Farm Gate Price at 1989 Constant Price					
Beans	57.8	37.6	52.1	48.9	49.1
Tomato	28.8	38.2	33.7	35.0	33.9
Sunflower*	-	48.2	35.0	51.0	44.7
Banana	8.8	6.3	9.1	10.2	8.6

Remarks: *; Using consumer price index refered by International Financial Statistics, June 1990, IMF
**; See Table 4-10 and 4-11

Table 5-7 SUMMARY OF FARM GATE PRICES

	Unit	Ecomomic*	Financial**
1. Agricultural Products			
Maze	Tsh./kg	20.7	21.9
Beans	Tsh./kg	49.1	48.9
Tomato	Tsh./kg	33.9	35.0
Sunflower	Tsh./kg	44.7	51.0
Banana	Tsh./kg	8.6	10.2
2. Agricultural Inputs			
Seed			
Maze	Tsh./kg	84.0	84.0
Beans	Tsh./kg	70.0	70.0
Tomato	Tsh./kg	6,000.0	6,000.0
Sunflower	Tsh./kg	60.0	60.0
Fertilizers			
Nitrogen (N)	Tsh./kg	104.4	21.6
Phosphorous (P)	Tsh./kg	214.9	64.9
Potassium (K)	Tsh./kg	55.4	49.1
Agro-chemicals			
Fungicide	Tsh./lit	1,160.0	1,160.0
Incecticide	Tsh./lit	1,133.0	1,133.0
Herbicide	Tsh./lit	1,196.0	1,196.0
Average	Tsh./lit	1,163.0	1,163.0
Tractor	Tsh./ha	4,954.8	4,940.0
Oxen	Tsh./ha	800.0	800.0
Labour			
Family	Tsh./man-day	240.0	0.0
Hired	Tsh./man-day	240.0	400.0

Remarks: *; See Table 5-5 and Table 5-6
**; See Table 4-11

Table 5-8 ECONOMIC CROP BUDGET PER HA UNDER WITH PROJECT CONDITION (1/3)

MAIZE PURE STAND

		Unit		Amount	Price	Cost
Boloti Area						
Production Cost						
Seed		kg		25	84.0	2,100
Fertilizers	Nitrogen (N)	kg		50	104.4	5,220
	Posphorus (P)	kg		15	214.9	3,224
	Potassium (K)	kg		15	55.4	831
Agro-chemicals		lit		1	1,163.0	1,163
			Family	Hired		
Ploughing	Tractor	ha	0	0	4,940.0	0
	Oxen	ad	0	5	800.0	4,000
Planting	Manual	md	10	0	240.0	2,400
Weeding	Oxen	ad	0	4	800.0	3,200
	Manual	md	10	0	240.0	2,400
Fertilizing	Manual	md	3	0	240.0	720
Harvesting	Manual	md	30	0	240.0	7,200
Shelling	Manual	md	15	0	240.0	3,600
Miscellaneous	10% of above cost					3,606
Total						39,663
Gross Income		kg		3,000	20.7	62,100
Net Income						22,437
Mungushi Area						
Production Cost						
Seed		kg		25	84.0	2,100
Fertilizers	Nitrogen (N)	kg		50	104.4	5,220
	Posphorus (P)	kg		15	214.9	3,224
	Potassium (K)	kg		15	55.4	831
Agro-chemicals		lit		1	1,163.0	1,163
			Family	Hired		
Ploughing	Tractor	ha	0	0	4,940.0	0
	Oxen	ad	0	5	800.0	4,000
Planting	Manual	md	10	0	240.0	2,400
Weeding	Oxen	ad	0	4	800.0	3,200
	Manual	md	10	0	240.0	2,400
Fertilizing	Manual	md	3	0	240.0	720
Harvesting	Manual	md	30	0	240.0	7,200
Shelling	Manual	md	15	0	240.0	3,600
Miscellaneous	10% of above cost					3,606
Total						39,663
Gross Income		kg		3,000	20.7	62,100
Net Income						22,437
Sanya Plain						
Production Cost						
Seed		kg		30	84.0	2,520
Fertilizers	Nitrogen (N)	kg		90	104.4	9,396
	Posphorus (P)	kg		30	214.9	6,447
	Potassium (K)	kg		30	55.4	1,662
Agro-chemicals		lit		2	1,163.0	2,326
			Family	Hired		
Ploughing	Tractor	ha	0	1	4,940.0	4,940
	Oxen	ad	0	0	800.0	0
Planting	Manual	md	14	0	240.0	3,360
Weeding	Oxen	ad	0	0	800.0	0
	Manual	md	14	15	240.0	6,960
Fertilizing	Manual	md	4	0	240.0	960
Harvesting	Manual	md	30	15	240.0	10,800
Shelling	Manual	md	15	10	240.0	6,000
Miscellaneous	10% of above cost					5,537
Total						60,908
Gross Income		kg		5,000	20.7	103,500
Net Income						42,592

Table 5-8 ECONOMIC CROP BUDGET PER HA UNDER WITH PROJECT CONDITION (2/3)

BEANS PURE STAND

		Unit		Amount	Price	Cost
Boloti Area						
Production Cost						
Seed		kg		60	70.0	4,200
Fertilizers	Nitrogen (N)	kg		25	104.4	2,610
	Posphorus (P)	kg		15	214.9	3,224
	Potassium (K)	kg		15	55.4	831
Agro-chemicals		lit		1	1,163.0	1,163
			Family	Hired		
Ploughing	Tractor	ha	0	0	4,940.0	0
	Oxen	ad	0	5	800.0	4,000
Planting	Manual	md	15	0	240.0	3,600
Weeding	Oxen	ad	0	4	800.0	3,200
	Manual	md	10	0	240.0	2,400
Fertilizing	Manual	md	3	0	240.0	720
Harvesting	Manual	md	34	0	240.0	8,160
Threshing	Manual	md	34	0	240.0	8,160
Miscellaneous	10% of above cost					4,227
Total						46,494
Gross Income		kg		1,200	49.1	58,920
Net Income						12,426
Mungushi Area						
Production Cost						
Seed		kg		60	70.0	4,200
Fertilizers	Nitrogen (N)	kg		25	104.4	2,610
	Posphorus (P)	kg		15	214.9	3,224
	Potassium (K)	kg		15	55.4	831
Agro-chemicals		lit		1	1,163.0	1,163
			Family	Hired		
Ploughing	Tractor	ha	0	0	4,940.0	0
	Oxen	ad	0	5	800.0	4,000
Planting	Manual	md	15	0	240.0	3,600
Weeding	Oxen	ad	0	4	800.0	3,200
	Manual	md	10	0	240.0	2,400
Fertilizing	Manual	md	3	0	240.0	720
Harvesting	Manual	md	34	0	240.0	8,160
Threshing	Manual	md	34	0	240.0	8,160
Miscellaneous	10% of above cost					4,227
Total						46,494
Gross Income		kg		1,200	49.1	58,920
Net Income						12,426
Sanya Plain						
Production Cost						
Seed		kg		60	70.0	4,200
Fertilizers	Nitrogen (N)	kg		50	104.4	5,220
	Posphorus (P)	kg		30	214.9	6,447
	Potassium (K)	kg		30	55.4	1,662
Agro-chemicals		lit		2	1,163.0	2,326
			Family	Hired		
Ploughing	Tractor	ha	0	1	4,940.0	4,940
	Oxen	ad	0	0	800.0	0
Planting	Manual	md	15	0	240.0	3,600
Weeding	Oxen	ad	0	0	800.0	0
	Manual	md	14	15	240.0	6,960
Fertilizing	Manual	md	4	0	240.0	960
Harvesting	Manual	md	20	20	240.0	9,600
Threshing	Manual	md	20	20	240.0	9,600
Miscellaneous	10% of above cost					5,552
Total						61,067
Gross Income		kg		2,000	49.1	98,200
Net Income						37,134

Table 5-8 ECONOMIC CROP BUDGET PER HA UNDER WITH PROJECT CONDITION (3/3)

SUNFLOWER AND VEGETABLES

		Unit		Amount	Price	Cost
Mungushi Area (Sunflower)						
Production Cost						
Seed	Sunflower	kg		6.0	60.0	360
Fertilizers	Nitrogen (N)	kg		35	104.4	3,654
	Posphorus (P)	kg		10	214.9	2,149
	Potassium (K)	kg		10	55.4	554
Agro-chemicals		lit		1	1,163.0	1,163
			Family	Hired		
Ploughing	Tractor	ha	0	0	4,940.0	0
	Oxen	ad	0	5	800.0	4,000
Planting	Manual	md	12	0	240.0	2,880
Weeding	Oxen	ad	0	4	800.0	3,200
	Manual	md	10	0	240.0	2,400
Fertilizing	Manual	md	3	0	240.0	720
Harvesting	Manual	md	8	0	240.0	1,920
Threshing	Manual	md	3	0	240.0	720
Miscellaneous	10% of above cost					2,372
Total						26,092
Gross Income	Sunflower	kg		810	44.7	36,207
Net Income						10,115
Sanya Plain (Sunflower)						
Production Cost						
Seed	Sunflower	kg		8.0	60.0	480
Fertilizers	Nitrogen (N)	kg		45	104.4	4,698
	Posphorus (P)	kg		15	214.9	3,224
	Potassium (K)	kg		15	55.4	831
Agro-chemicals		lit		2	1,163.0	2,326
			Family	Hired		
Ploughing	Tractor	ha	0	1	4,940.0	4,940
	Oxen	ad	0	0	800.0	0
Planting	Manual	md	12	0	240.0	2,880
Weeding	Manual	md	14	15	240.0	6,960
Fertilizing	Manual	md	4	0	240.0	960
Harvesting	Manual	md	12	0	240.0	2,880
Threshing	Manual	md	5	0	240.0	1,200
Miscellaneous	10% of above cost					3,018
Total						34,396
Gross Income	Sunlower	kg		1,350	44.7	60,345
Net Income						25,949
Sanya Plain (Tomato)						
Production Cost						
Seed		kg		0.50	6,000.0	3,000
Fertilizers	Nitrogen (N)	kg		100	104.4	10,440
	Posphorus (P)	kg		150	214.9	32,235
	Potassium (K)	kg		100	55.4	5,540
Agro-chemicals		lit		30	1,163.0	34,890
			Family	Hired		
Nursery						
Preparation	Tractor	ha	0	1	4,940.0	4,940
	Oxen	ad	0	0	800.0	0
Sowing and others	Manual	md	10	10	240.0	4,800
Ploughing	Tractor	ha	0	2	4,940.0	9,880
	Oxen	ad	0	0	800.0	0
Field Preparation	Manual	md	15	10	240.0	6,000
Transplanting	Manual	md	15	10	240.0	6,000
Weeding	Manual	md	15	45	240.0	14,400
Fertilizing	Manual	md	10	5	240.0	3,600
Spraying	Manual	md	15	5	240.0	4,800
Irrigation	Manual	md	10	0	240.0	2,400
Harvesting	Manual	md	10	50	240.0	14,400
Miscellaneous	30% of above costs					47,198
Total						204,523
Gross Income		kg		25,000	33.9	847,500
Net Income						642,978

Table 5-9 ECONOMIC CROP BUDGET PER HA UNDER WITHOUT PROJECT CONDITION (1/4)

MAIZE PURE STAND

		Unit		Amount	Price	Cost
Boloti Area						
Production Cost						
Seed		kg		25	84.00	2,100
Fertilizers	Nitrogen (N)	kg		25	104.40	2,610
	Posphorus (P)	kg		0	214.90	0
	Potassium (K)	kg		0	55.40	0
Agro-chemicals		lit		0	1,163.00	0
			Family	Hired		
Ploughing	Tractor	ha	0	0	4,940.00	0
	Oxen	ad	0	5	800.00	4,000
Planting	Manual	md	10	0	240.00	2,400
Weeding	Oxen	ad	0	4	800.00	3,200
	Manual	md	0	0	240.00	0
Fertilizing	Manual	md	2	0	240.00	480
Harvesting	Manual	md	20	0	240.00	4,800
Shelling	Manual	md	10	0	240.00	2,400
Miscellaneous	10% of above cost					2,199
Total						24,189
Gross Income		kg		1,500	20.70	31,050
Net Income						6,861
Mungushi Area						
Production Cost						
Seed		kg		25	84.00	2,100
Fertilizers	Nitrogen (N)	kg		25	104.40	2,610
	Posphorus (P)	kg		0	214.90	0
	Potassium (K)	kg		0	55.40	0
Agro-chemicals		lit		0	1,163.00	0
			Family	Hired		
Ploughing	Tractor	ha	0	0	4,940.00	0
	Oxen	ad	0	5	800.00	4,000
Planting	Manual	md	10	9	240.00	2,400
Weeding	Oxen	ad	0	4	800.00	3,200
	Manual	md	0	0	240.00	0
Fertilizing	Manual	md	2	0	240.00	480
Harvesting	Manual	md	20	0	240.00	4,800
Shelling	Manual	md	10	0	240.00	2,400
Miscellaneous	10% of above cost					2,199
Total						24,189
Gross Income		kg		1,500	20.70	31,050
Net Income						6,861
Sanya Plain						
Production Cost						
Seed		kg		25	84.00	2,100
Fertilizers	Nitrogen (N)	kg		0	104.40	0
	Posphorus (P)	kg		0	214.90	0
	Potassium (K)	kg		0	55.40	0
Agro-chemicals		lit		0	1,163.00	0
			Family	Hired		
Ploughing	Tractor	ha	0	1	4,940.00	4,940
	Oxen	ad	0	0	800.00	0
Planting	Manual	md	10	0	240.00	2,400
Weeding	Oxen	ad	0	0	800.00	0
	Manual	md	20	0	240.00	4,800
Fertilizing	Manual	md	0	0	240.00	0
Harvesting	Manual	md	15	0	240.00	3,600
Shelling	Manual	md	7	0	240.00	1,680
Miscellaneous	10% of above cost					1,952
Total						21,472
Gross Income		kg		1,100	20.70	22,770
Net Income						1,298

Table 5-9 ECONOMIC CROP BUDGET PER HA UNDER WITHOUT PROJECT CONDITION (2/4)

BEANS PURE STAND

		Unit		Amount	Price	Cost
Boloti Area						
Production Cost						
Seed		kg		60	70.00	4,200
Fertilizers	Nitrogen (N)	kg		0	104.40	0
	Posphorus (P)	kg		0	214.90	0
	Potassium (K)	kg		0	55.40	0
Agro-chemicals		lit		0	1,163.00	0
			Family	Hired		
Ploughing	Tractor	ha	0	0	4,940.00	0
	Oxen	ad	0	5	800.00	4,000
Planting	Manual	md	10	0	240.00	2,400
Weeding	Oxen	ad	0	2	800.00	1,600
	Manual	md	0	0	240.00	0
Fertilizing	Manual	md	0	0	240.00	0
Harvesting	Manual	md	20	0	240.00	4,800
Threshing	Manual	md	20	0	240.00	4,800
Miscellaneous	10% of above cost					2,180
Total						23,980
Gross Income		kg		500	49.10	24,550
Net Income						570
Mungushi Area						
Production Cost						
Seed		kg		60	70.00	4,200
Fertilizers	Nitrogen (N)	kg		0	104.40	0
	Posphorus (P)	kg		0	214.90	0
	Potassium (K)	kg		0	55.40	0
Agro-chemicals		lit		0	1,163.00	0
			Family	Hired		
Ploughing	Tractor	ha	0	0	4,940.00	0
	Oxen	ad	0	5	800.00	4,000
Planting	Manual	md	3	0	240.00	720
Weeding	Oxen	ad	0	0	800.00	0
	Manual	md	15	0	240.00	3,600
Fertilizing	Manual	md	0	0	240.00	0
Harvesting	Manual	md	20	0	240.00	4,800
Threshing	Manual	md	20	0	240.00	4,800
Miscellaneous	10% of above cost					2,212
Total						24,332
Gross Income		kg		500	49.10	24,550
Net Income						218
Sanya Plain						
Production Cost						
Seed		kg		60	70.00	4,200
Fertilizers	Nitrogen (N)	kg		0	104.40	0
	Posphorus (P)	kg		0	214.90	0
	Potassium (K)	kg		0	55.40	0
Agro-chemicals		lit		0	1,163.00	0
			Family	Hired		
Ploughing	Tractor	ha	0	1	4,940.00	4,940
	Oxen	ad	0	0	800.00	0
Planting	Manual	md	3	0	240.00	720
Weeding	Oxen	ad	0	0	800.00	0
	Manual	md	10	0	240.00	2,400
Fertilizing	Manual	md	0	0	240.00	0
Harvesting	Manual	md	20	0	240.00	4,800
Threshing	Manual	md	20	0	240.00	4,800
Miscellaneous	10% of above cost					2,186
Total						24,046
Gross Income		kg		500	49.10	24,550
Net Income						504

Table 5-9 ECONOMIC CROP BUDGET PER HA UNDER WITHOUT PROJECT CONDITION (3/4)

MAIZE INTERCROPPING WITH BEANS

		Unit		Amount	Price	Cost
Boloti Area						
Production Cost						
Seed	Maize	kg		25	84.00	2,100
	Beans	kg		20	70.00	1,400
Fertilizers	Nitrogen (N)	kg		25	104.40	2,610
	Posphorus (P)	kg		0	214.90	0
	Potassium (K)	kg		0	55.40	0
Agro-chemicals		lit		0	1,163.00	0
			Family	Hired		
Ploughing	Tractor	ha	0	0	4,940.00	0
	Oxen	ad	0	5	800.00	4,000
Planting	Manual	md	16	0	240.00	3,840
Weeding	Manual	md	30	0	240.00	7,200
Fertilizing	Manual	md	2	0	240.00	480
Harvesting	Manual	md	24	0	240.00	5,760
Shelling	Manual	md	10	0	240.00	2,400
Threshing	Manual	md	4	0	240.00	960
Miscellaneous	15% of above cost					4,613
Total						35,363
Gross Income	Maize	kg		1,500	20.70	31,050
	Beans	kg		100	49.10	4,910
	Total					35,960
Net Income						598
Mungushi Area						
Production Cost						
Seed	Maize	kg		12	84.00	1,008
	Beans	kg		60	70.00	4,200
Fertilizers	Nitrogen (N)	kg		0	104.40	0
	Posphorus (P)	kg		0	214.90	0
	Potassium (K)	kg		0	55.40	0
Agro-chemicals		lit		0	1,163.00	0
			Family	Hired		
Ploughing	Tractor	ha	0	0	4,940.00	0
	Oxen	ad	0	5	800.00	4,000
Planting	Manual	md	8	0	240.00	1,920
Weeding	Manual	md	30	0	240.00	7,200
Fertilizing	Manual	md	0	0	240.00	0
Harvesting	Manual	md	31	0	240.00	7,440
Shelling	Manual	md	5	0	240.00	1,200
Threshing	Manual	md	20	0	240.00	4,800
Miscellaneous	15% of above cost					4,765
Total						36,533
Gross Income	Maize	kg		800	20.70	16,560
	Beans	kg		500	49.10	24,550
	Total					41,110
Net Income						4,577
Sanya Plain						
Production Cost						
Seed	Maize	kg		25	84.00	2,100
	Beans	kg		25	70.00	1,750
Fertilizers	Nitrogen (N)	kg		0	104.40	0
	Posphorus (P)	kg		0	214.90	0
	Potassium (K)	kg		0	55.40	0
Agro-chemicals		lit		0	1,163.00	0
			Family	Hired		
Ploughing	Tractor	ha	0	1	4,940.00	4,940
	Oxen	ad	0	0	800.00	0
Planting	Manual	md	12	0	240.00	2,880
Weeding	Manual	md	15	0	240.00	3,600
Fertilizing	Manual	md	0	0	240.00	0
Harvesting	Manual	md	23	0	240.00	5,520
Shelling	Manual	md	7	0	240.00	1,680
Threshing	Manual	md	8	0	240.00	1,920
Miscellaneous	15% of above cost					3,659
Total						28,049
Gross Income	Maize	kg		1,100	20.70	22,770
	Beans	kg		200	49.10	9,820
	Total					32,590
Net Income						4,542

Table 5-9 ECONOMIC CROP BUDGET PER HA UNDER WITHOUT PROJECT CONDITION (4/4)

MAIZE INTERCROPPING WITH SUNFLOWER, BEANS INTERCROPPING WITH SUNFLOWER, VEGETABLES

		Unit		Amount	Price	Cost
Mungushi Area (Beans intercropping with Sunflower)						
Production Cost						
Seed	Beans	kg		60	70.00	4,200
	Sunflopwer	kg		2.5	60.00	150
Fertilizers	Nitrogen (N)	kg		0	104.40	0
	Posphorus (P)	kg		0	214.90	0
	Potassium (K)	kg		0	55.40	0
Agro-chemicals		lit		0	1,163.00	0
			Family	Hired		
Ploughing	Tractor	ha	0	0	4,940.00	0
	Oxen	ad	0	5	800.00	4,000
Planting	Manual	md	3	0	240.00	720
Weeding	Manual	md	30	0	240.00	7,200
Fertilizing	Manual	md	0	0	240.00	0
Harvesting	Manual	md	27	0	240.00	6,480
Threshing	Manual	md	23	0	240.00	5,520
Miscellaneous	15% of above cost					4,241
Total						32,511
Gross Income	Beans	kg		500	49.10	24,550
	Sunflower	kg		400	44.70	17,880
	Total					42,430
Net Income						9,920
Sanya Plain (Maize intercropping with Sunflower)						
Production Cost						
Seed	Maize	kg		10	84.00	840
	Sunflower	kg		2.5	60.00	150
Fertilizers	Nitrogen (N)	kg		0	104.40	0
	Posphorus (P)	kg		0	214.90	0
	Potassium (K)	kg		0	55.40	0
Agro-chemicals		lit		0	1,163.00	0
			Family	Hired		
Ploughing	Tractor	ha	0	1	4,940.00	4,940
	Oxen	ad	0	0	800.00	0
Planting	Manual	md	8	0	240.00	1,920
Weeding	Manual	md	10	0	240.00	2,400
Fertilizing	Manual	md	0	0	240.00	0
Harvesting	Manual	md	18	0	240.00	4,320
Shelling	Manual	md	5	0	240.00	1,200
Threshing	Manual	md	3	0	240.00	720
Miscellaneous	15% of above cost					2,474
Total						18,964
Gross Income	Maize	kg		800	20.70	16,560
	Sunlower	kg		400	44.70	17,880
	Total					34,440
Net Income						15,477
Mungushi (Tomato)						
Production Cost						
Seed		kg		0.10	6,000.00	600
Fertilizers	Nitrogen (N)	kg		25	104.40	2,610
	Posphorus (P)	kg		0	214.90	0
	Potassium (K)	kg		0	55.40	0
Agro-chemicals		lit		12	1,163.00	13,956
			Family	Hired		
Nursery						
Preparation	Tractor	ha	0	0	4,940.00	0
	Oxen	ad	0	1	800.00	800
Sowing and others	Manual	md	20	0	240.00	4,800
Ploughing	Tractor	ha	0	0	4,940.00	0
	Oxen	ad	0	5	800.00	4,000
Field Preparation	Manual	md	25	0	240.00	6,000
Transplanting	Manual	md	25	0	240.00	6,000
Weeding	Manual	md	20	40	240.00	14,400
Fertilizing	Manual	md	4	0	240.00	960
Spraying	Manual	md	10	0	240.00	2,400
Irrigation	Manual	md	5	0	240.00	1,200
Harvesting	Manual	md	15	30	240.00	10,800
Miscellaneous	30% of above costs					20,558
Total						89,084
Gross Income		kg		8,500	33.90	288,150
Net Income						199,066

Table 5-10 CALCULATION OF PROJECT BENEFIT (1/3)
CASE-2

(Unit: 1,000 Tsh.)

	Planted Area (ha)		Harvested Area (ha)			Net Benefit	Net
	Rainy	Dry	Rainy	Dry	Total	per ha	Benefit
Without Project Conditions							
Boloti Area							
Maize	90	0	72	0	72	6.861	494
Maize/Beans	140	0	112	0	112	0.598	67
Beans	60	0	48	0	48	0.570	27
Sub-total	290	0	232	0	232	-	588
Mungushi Area							
Maize	55	0	44	0	44	6.861	302
Maize/Beans	55	0	44	0	44	4.577	201
Beans	15	0	12	0	12	0.218	3
Beans/Sunflower	10	0	8	0	8	9.920	79
Vegetable	0	10	0	10	10	199.066	1,991
Banana	25	-	25	-	25	33.540	839
Sub-total	160	10	133	10	143	-	3,414
Sanya Plain							
Maize	630	0	378	0	378	1.298	491
Maize/Beans	160	0	96	0	96	4.542	436
Beans	210	0	126	0	126	0.504	64
Maize/Sunflower	50	0	30	0	30	15.477	464
Sub-total	1,050	0	630	0	630	-	1,454
Total	1,500	10	995	10	1,005	-	5,457
With Project Conditions							
Boloti Area							
Maize	160	0	160	0	160	22.437	3,590
Beans	130	0	130	0	130	12.426	1,615
Sub-total	290	0	290	0	290	-	5,205
Mungushi Area							
Maize	85	0	85	0	85	22.437	1,907
Beans	45	0	45	0	45	12.426	559
Sunflower	5	0	5	0	5	10.115	51
Vegetables	0	10	0	10	10	199.066	1,991
Banana	25	-	25	-	25	33.540	839
Sub-total	160	10	160	10	170	-	5,346
Sanya Plain							
Maize	530	220	530	220	750	42.592	31,944
Beans	210	180	210	180	390	37.134	14,482
Sunflower	50	20	50	20	70	25.949	1,816
Vegetables	210	180	210	180	390	642.978	250,761
Banana	50	-	50	-	50	33.540	1,677
Sub-total	1,050	600	1,050	600	1,650	-	300,681
Total	1,500	610	1,500	610	2,110	-	311,232
Increment	0	600	505	600	1,105	-	305,775

Table 5-10 CALCULATION OF PROJECT BENEFIT (2/3)
CASE-4

(Unit: 1,000 Tsh.)

	Planted Area (ha)		Harvested Area (ha)			Net Benefit	Net
	Rainy	Dry	Rainy	Dry	Total	per ha	Benefit
Without Project Conditions							
Boloti Area							
Maize	0	0	0	0	0	6.861	0
Maize/Beans	0	0	0	0	0	0.598	0
Beans	0	0	0	0	0	0.570	0
Sub-total	0	0	0	0	0	-	0
Mungushi Area							
Maize	0	0	0	0	0	6.861	0
Maize/Beans	0	0	0	0	0	4.577	0
Beans	0	0	0	0	0	0.218	0
Beans/Sunflower	0	0	0	0	0	9.920	0
Vegetable	0	0	0	0	0	199.066	0
Banana	0	-	0	-	0	33.540	0
Sub-total	0	0	0	0	0	-	0
Sanya Plain							
Maize	340	0	204	0	204	1.298	265
Maize/Beans	90	0	54	0	54	4.542	245
Beans	110	0	66	0	66	0.504	33
Maize/Sunflower	30	0	18	0	18	15.477	279
Sub-total	570	0	342	0	342	-	822
Total	570	0	342	0	342	-	822
With Project Conditions							
Boloti Area							
Maize	0	0	0	0	0	22.437	0
Beans	0	0	0	0	0	12.426	0
Sub-total	0	0	0	0	0	-	0
Mungushi Area							
Maize	0	0	0	0	0	22.437	0
Beans	0	0	0	0	0	12.426	0
Sunflower	0	0	0	0	0	10.115	0
Vegetables	0	0	0	0	0	199.066	0
Banana	0	-	0	-	0	33.540	0
Sub-total	0	0	0	0	0	-	0
Sanya Plain							
Maize	290	290	290	290	580	42.592	24,703
Beans	110	290	110	290	400	37.134	14,854
Sunflower	30	30	30	30	60	25.949	1,557
Vegetables	110	230	110	230	340	642.978	218,613
Banana	30	-	30	-	30	33.540	1,006
Sub-total	570	840	570	840	1,410	-	260,733
Total	570	840	570	840	1,410	-	260,733
Increment	0	840	228	840	1,068	-	259,911

Table 5-10 CALCULATION OF PROJECT BENEFIT (3/3)
CASE-5

(Unit: 1,000 Tsh.)

	Planted Area (ha)		Harvested Area (ha)			Net Benefit	Net
	Rainy	Dry	Rainy	Dry	Total	per ha	Benefit
Without Project Conditions							
Boloti Area							
Maize	90	0	72	0	72	6.861	494
Maize/Beans	140	0	112	0	112	0.598	67
Beans	60	0	48	0	48	0.570	27
Sub-total	290	0	232	0	232	-	588
Mungushi Area							
Maize	55	0	44	0	44	6.861	302
Maize/Beans	55	0	44	0	44	4.577	201
Beans	15	0	12	0	12	0.218	3
Beans/Sunflower	10	0	8	0	8	9.920	79
Vegetable	0	10	0	10	10	199.066	1,991
Banana	25	-	25	-	25	33.540	839
Sub-total	160	10	133	10	143	-	3,414
Sanya Plain							
Maize	630	0	378	0	378	1.298	491
Maize/Beans	160	0	96	0	96	4.542	436
Beans	210	0	126	0	126	0.504	64
Maize/Sunflower	50	0	30	0	30	15.477	464
Sub-total	1,050	0	630	0	630	-	1,454
Total	1,500	10	995	10	1,005	-	5,457
With Project Conditions							
Boloti Area							
Maize	160	0	160	0	160	22.437	3,590
Beans	130	0	130	0	130	12.426	1,615
Sub-total	290	0	290	0	290	-	5,205
Mungushi Area							
Maize	85	0	85	0	85	22.437	1,907
Beans	45	0	45	0	45	12.426	559
Sunflower	5	0	5	0	5	10.115	51
Vegetables	0	10	0	10	10	199.066	1,991
Banana	25	-	25	-	25	33.540	839
Sub-total	160	10	160	10	170	-	5,346
Sanya Plain							
Maize	530	530	530	530	1,060	42.592	45,148
Beans	210	420	210	420	630	37.134	23,394
Sunflower	50	50	50	50	100	25.949	2,595
Vegetables	210	420	210	420	630	642.978	405,076
Banana	50	-	50	-	50	33.540	1,677
Sub-total	1,050	1,420	1,050	1,420	2,470	-	477,890
Total	1,500	1,430	1,500	1,430	2,930	-	488,441
Increment	0	1,420	505	1,420	1,925	-	482,984

Table 5-11 PROJECT BENEFIT FLOW

(Unit: 1,000 Tsh.)

	Case-2			Case-4			Case-5		
	Phase 1	Phase 2	Total	Phase 1	Phase 2	Total	Phase 1	Phase 2	Total
Development Area									
1st year	0	0	0	0	0	0	0	0	0
2nd year	890	0	890	190	0	190	890	0	890
3rd year	890	610	1,500	190	380	570	890	610	1,500
4th year	890	610	1,500	190	380	570	890	610	1,500
Project Benefit									
1st year	0	0	0	0	0	0	0	0	0
2nd year	0	0	0	0	0	0	0	0	0
3rd year	0	0	0	0	0	0	0	0	0
4th year	54,486	0	54,486	51,982	0	51,982	84,009	0	84,009
5th year	74,918	67,824	142,742	71,476	51,982	123,458	115,512	109,185	224,697
6th year	95,350	93,259	188,608	90,969	71,476	162,444	147,015	150,129	297,145
7th year	115,782	118,693	234,475	110,462	90,969	201,431	178,519	191,073	369,592
8th year	136,214	144,127	280,341	129,956	110,462	240,418	210,022	232,018	442,040
9th year	136,214	169,561	305,775	129,956	129,956	259,911	210,022	272,962	482,984

Remark: After 9th year, benefit will constant.

Table 5-12 FINANCIAL CROP BUDGET PER HA UNDER WITH PROJECT CONDITION (1/3)

MAIZE PURE STAND

		Unit		Amount	Price	Cost
Boloti Area						
Production Cost						
Seed		kg		25	84.00	2,100
Fertilizers	Nitrogen (N)	kg		50	21.60	1,080
	Posphorus (P)	kg		15	64.90	974
	Potassium (K)	kg		15	49.10	737
Agro-chemicals		lit		1	1,163.00	1,163
			Family	Hired		
Ploughing	Tractor	ha	0	0	4,940.00	0
	Oxen	ad	0	5	800.00	4,000
Planting	Manual	md	10	0	400.00	0
Weeding	Oxen	ad	0	4	800.00	3,200
	Manual	md	10	0	400.00	0
Fertilizing	Manual	md	3	0	400.00	0
Harvesting	Manual	md	30	0	400.00	0
Shelling	Manual	md	15	0	400.00	0
Miscellaneous	10% of above cost					1,325
Total						14,578
Gross Income		kg		3,000	21.90	65,700
Net Income						51,122
Mungushi Area						
Production Cost						
Seed		kg		25	84.00	2,100
Fertilizers	Nitrogen (N)	kg		50	21.60	1,080
	Posphorus (P)	kg		15	64.90	974
	Potassium (K)	kg		15	49.10	737
Agro-chemicals		lit		1	1,163.00	1,163
			Family	Hired		
Ploughing	Tractor	ha	0	0	4,940.00	0
	Oxen	ad	0	5	800.00	4,000
Planting	Manual	md	10	0	400.00	0
Weeding	Oxen	ad	0	4	800.00	3,200
	Manual	md	10	0	400.00	0
Fertilizing	Manual	md	3	0	400.00	0
Harvesting	Manual	md	30	0	400.00	0
Shelling	Manual	md	15	0	400.00	0
Miscellaneous	10% of above cost					1,325
Total						14,578
Gross Income		kg		3,000	21.90	65,700
Net Income						51,122
Sanya Plain						
Production Cost						
Seed		kg		30	84.00	2,520
Fertilizers	Nitrogen (N)	kg		90	21.60	1,944
	Posphorus (P)	kg		30	64.90	1,947
	Potassium (K)	kg		30	49.10	1,473
Agro-chemicals		lit		2	1,163.00	2,326
			Family	Hired		
Ploughing	Tractor	ha	0	1	4,940.00	4,940
	Oxen	ad	0	0	800.00	0
Planting	Manual	md	14	0	400.00	0
Weeding	Oxen	ad	0	0	800.00	0
	Manual	md	29	0	400.00	0
Fertilizing	Manual	md	4	0	400.00	0
Harvesting	Manual	md	30	15	400.00	6,000
Shelling	Manual	md	15	10	400.00	4,000
Miscellaneous	10% of above cost					2,515
Total						27,665
Gross Income		kg		5,000	21.50	107,500
Net Income						79,835

Table 5-12 FINANCIAL CROP BUDGET PER HA UNDER WITH PROJECT CONDITION (2/3)

BEANS PURE STAND

		Unit		Amount	Price	Cost
Boloti Area						
Production Cost						
Seed		kg		60	70.00	4,200
Fertilizers	Nitrogen (N)	kg		25	21.60	540
	Posphorus (P)	kg		15	64.90	974
	Potassium (K)	kg		15	49.10	737
Agro-chemicals		lit		1	1,163.00	1,163
			Family	Hired		
Ploughing	Tractor	ha	0	0	4,940.00	0
	Oxen	ad	0	5	800.00	4,000
Planting	Manual	md	15	0	400.00	0
Weeding	Oxen	ad	0	4	800.00	3,200
	Manual	md	10	0	400.00	0
Fertilizing	Manual	md	3	0	400.00	0
Harvesting	Manual	md	34	0	400.00	0
Threshing	Manual	md	34	0	400.00	0
Miscellaneous	10% of above cost					1,481
Total						16,294
Gross Income		kg		1,200	48.90	58,680
Net Income						42,386
Mungushi Area						
Production Cost						
Seed		kg		60	70.00	4,200
Fertilizers	Nitrogen (N)	kg		25	21.60	540
	Posphorus (P)	kg		15	64.90	974
	Potassium (K)	kg		15	49.10	737
Agro-chemicals		lit		1	1,163.00	1,163
			Family	Hired		
Ploughing	Tractor	ha	0	0	4,940.00	0
	Oxen	ad	0	5	800.00	4,000
Planting	Manual	md	15	0	400.00	0
Weeding	Oxen	ad	0	4	800.00	3,200
	Manual	md	10	0	400.00	0
Fertilizing	Manual	md	3	0	400.00	0
Harvesting	Manual	md	34	0	400.00	0
Threshing	Manual	md	34	0	400.00	0
Miscellaneous	10% of above cost					1,481
Total						16,294
Gross Income		kg		1,200	48.90	58,680
Net Income						42,386
Sanya Plain						
Production Cost						
Seed		kg		60	70.00	4,200
Fertilizers	Nitrogen (N)	kg		50	21.60	1,080
	Posphorus (P)	kg		30	64.90	1,947
	Potassium (K)	kg		30	49.10	1,473
Agro-chemicals		lit		2	1,163.00	2,326
			Family	Hired		
Ploughing	Tractor	ha	0	1	4,940.00	4,940
	Oxen	ad	0	0	800.00	0
Planting	Manual	md	15	0	400.00	0
Weeding	Oxen	ad	0	0	800.00	0
	Manual	md	14	15	400.00	6,000
Fertilizing	Manual	md	4	0	400.00	0
Harvesting	Manual	md	20	20	400.00	8,000
Threshing	Manual	md	20	20	400.00	8,000
Miscellaneous	10% of above cost					3,797
Total						41,763
Gross Income		kg		2,000	48.90	97,800
Net Income						56,037

Table 5-12 FINANCIAL CROP BUDGET PER HA UNDER WITH PROJECT CONDITION (3/3)

SUNFLOWER AND VEGETABLES

		Unit		Amount	Price	Cost
Mungushi Area (Sunflower)						
Production Cost						
Seed	Sunflower	kg		6.0	60.00	360
Fertilizers	Nitrogen (N)	kg		35	21.60	756
	Posphorus (P)	kg		10	64.90	649
	Potassium (K)	kg		10	49.10	491
Agro-chemicals		lit		1	1,163.00	1,163
			Family	Hired		
Ploughing	Tractor	ha	0	0	4,940.00	0
	Oxen	ad	0	5	800.00	4,000
Planting	Manual	md	12	0	400.00	0
Weeding	Oxen	ad	0	4	800.00	3,200
	Manual	md	10	0	400.00	0
Fertilizing	Manual	md	3	0	400.00	0
Harvesting	Manual	md	8	0	400.00	0
Threshing	Manual	md	3	0	400.00	0
Miscellaneous	10% of above cost					1,062
Total						11,681
Gross Income	Sunflower	kg		810	51.00	41,310
Net Income						29,629
Sanya Plain (Sunflower)						
Production Cost						
Seed	Sunflower	kg		8.0	60.00	480
Fertilizers	Nitrogen (N)	kg		45	21.60	972
	Posphorus (P)	kg		15	64.90	974
	Potassium (K)	kg		15	49.10	737
Agro-chemicals		lit		2	1,163.00	2,326
			Family	Hired		
Ploughing	Tractor	ha	0	1	4,940.00	4,940
	Oxen	ad	0	0	800.00	0
Planting	Manual	md	12	0	400.00	0
Weeding	Manual	md	14	15	400.00	6,000
Fertilizing	Manual	md	4	0	400.00	0
Harvesting	Manual	md	12	0	400.00	0
Threshing	Manual	md	5	0	400.00	0
Miscellaneous	10% of above cost					1,643
Total						18,071
Gross Income	Sunlower	kg		1,350	51.00	68,850
Net Income						50,779
Sanya Plain (Tomato)						
Production Cost						
Seed		kg		0.50	6,000.00	3,000
Fertilizers	Nitrogen (N)	kg		100	21.60	2,160
	Posphorus (P)	kg		150	64.90	9,735
	Potassium (K)	kg		100	49.10	4,910
Agro-chemicals		lit		30	1,163.00	34,890
			Family	Hired		
Nursery						
Preparation	Tractor	ha	0	1	4,940.00	4,940
	Oxen	ad	0	0	800.00	0
Sowing and others	Manual	md	10	10	400.00	4,000
Ploughing	Tractor	ha	0	2	4,940.00	9,880
	Oxen	ad	0	0	800.00	0
Field Preparation	Manual	md	15	10	400.00	4,000
Transplanting	Manual	md	15	10	400.00	4,000
Weeding	Manual	md	15	45	400.00	18,000
Fertilizing	Manual	md	10	5	400.00	2,000
Spraying	Manual	md	15	5	400.00	2,000
Irrigation	Manual	md	10	0	400.00	0
Harvesting	Manual	md	10	50	400.00	20,000
Miscellaneous	30% of above costs					37,055
Total						160,570
Gross Income		kg		25,000	35.00	875,000
Net Income						714,431

Table 5-13 FARM ECONOMIC ANALYSIS UNDER WITH PROJECT CONDITION

	Area			Crop Budget per ha	Net Farm Income	Income from Livestock	Non-farm Income	Total Farmer's Income	Living Expense	Tax and Others	Net Reserve
	Rainy (ha)	Dry (ha)	Total (ha)	(Tsh.)	(Tsh.)	(Tsh.)	(Tsh.)	(Tsh.)	(Tsh.)	(Tsh.)	(Tsh.)
Boloti Area											
Holding Size	1.10	-	-	-	-	-	-	-	-	-	-
Harvested Area											
Maize	0.61	0.00	0.61	51,122	31,026	-	-	-	-	-	-
Beans	0.49	0.00	0.49	42,386	20,901	-	-	-	-	-	-
Sub-total	1.10	0.00	1.10	-	51,926	2,330	22,270	76,526	45,280	550	30,696
Mungushi Area											
Holding Size	0.80	-	-	-	-	-	-	-	-	-	-
Harvested Area											
Maize	0.43	0.00	0.43	51,122	21,727	-	-	-	-	-	-
Beans	0.23	0.00	0.23	42,386	9,537	-	-	-	-	-	-
Sunflower	0.03	0.00	0.03	29,629	741	-	-	-	-	-	-
Vegetable	0.00	0.05	0.05	235,235	11,762	-	-	-	-	-	-
Banana	0.13	-	0.13	39,780	4,973	-	-	-	-	-	-
Sub-total	0.80	0.05	0.85	-	48,739	2,130	25,450	76,319	58,230	630	17,459
Sanya Plain											
Holding Size	1.90	-	-	-	-	-	-	-	-	-	-
Harvested Area											
Maize	0.96	0.96	1.92	79,835	153,131	-	-	-	-	-	-
Beans	0.38	0.76	1.14	56,037	63,882						
Sunflower	0.09	0.09	0.18	50,779	9,189	-	-	-	-	-	-
Vegetable	0.38	0.76	1.14	714,431	814,451	-	-	-	-	-	-
Banana	0.09	-	0.09	39,780	3,599	-	-	-	-	-	-
Sub-total	1.90	2.57	4.47	-	1,044,252	25,450	11,460	1,081,162	59,660	610	1,020,892

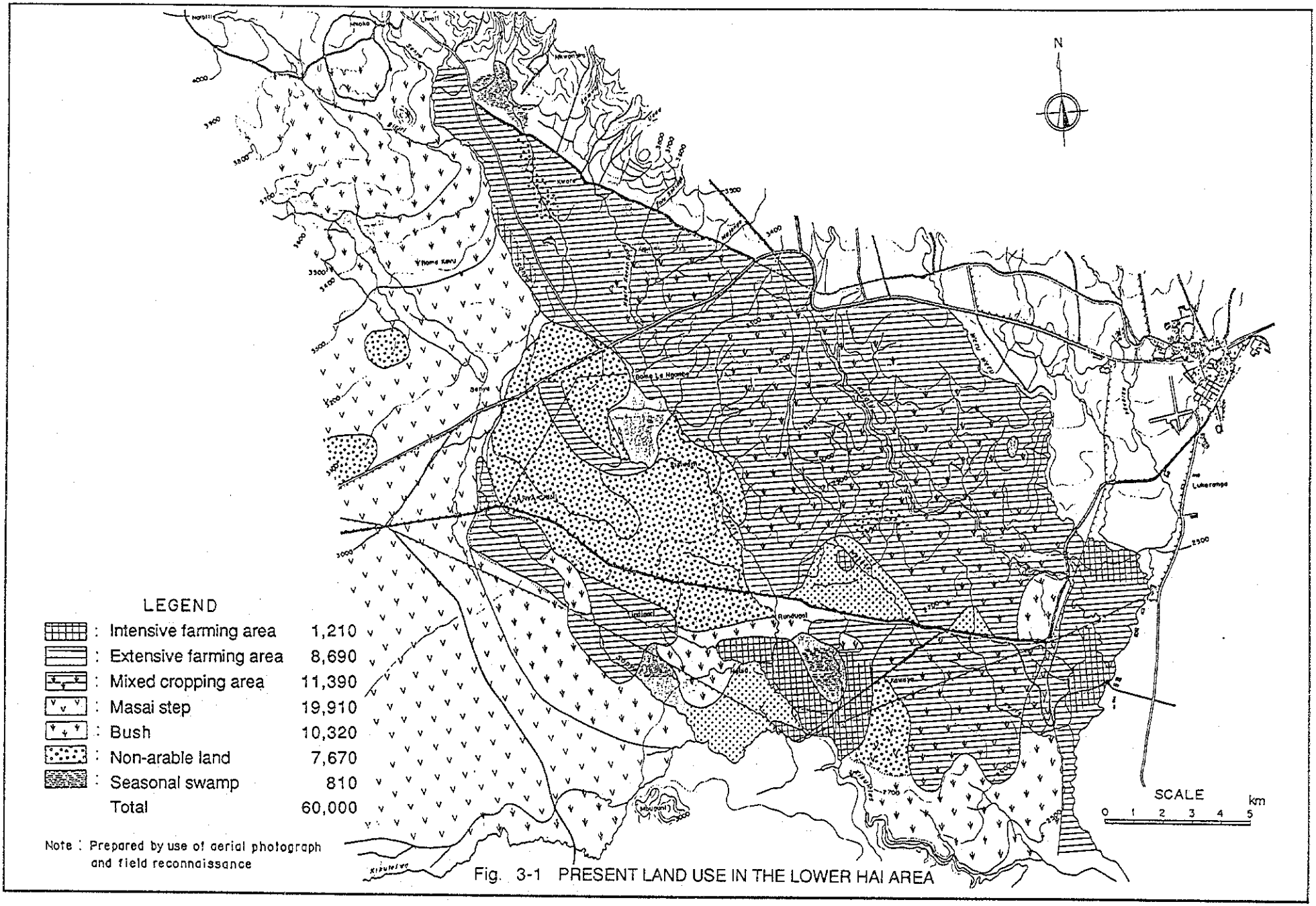


Fig. 3-1 PRESENT LAND USE IN THE LOWER HAI AREA

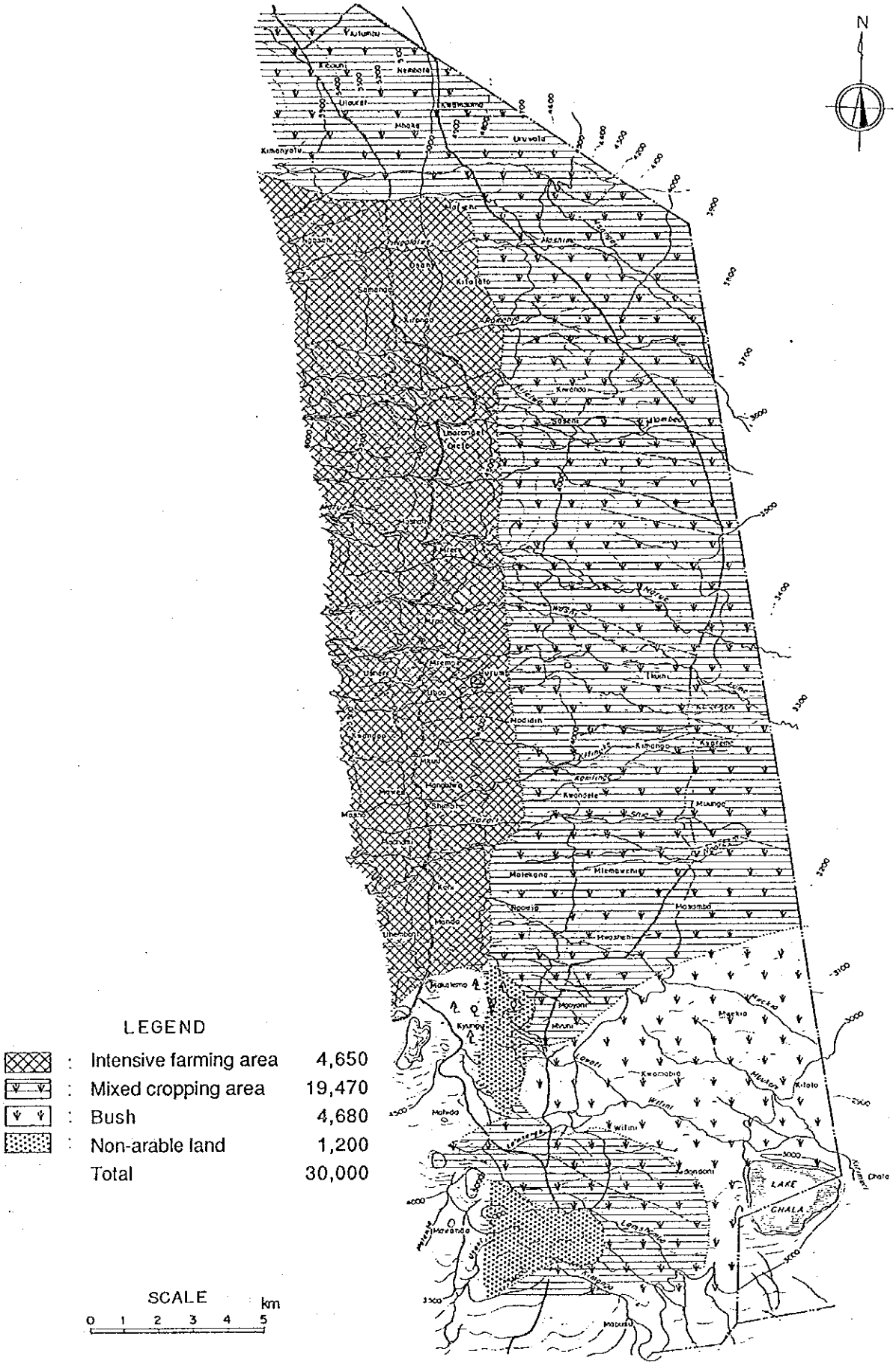


Fig. 3-2 PRESENT LAND USE IN THE LOWER ROMBO AREA

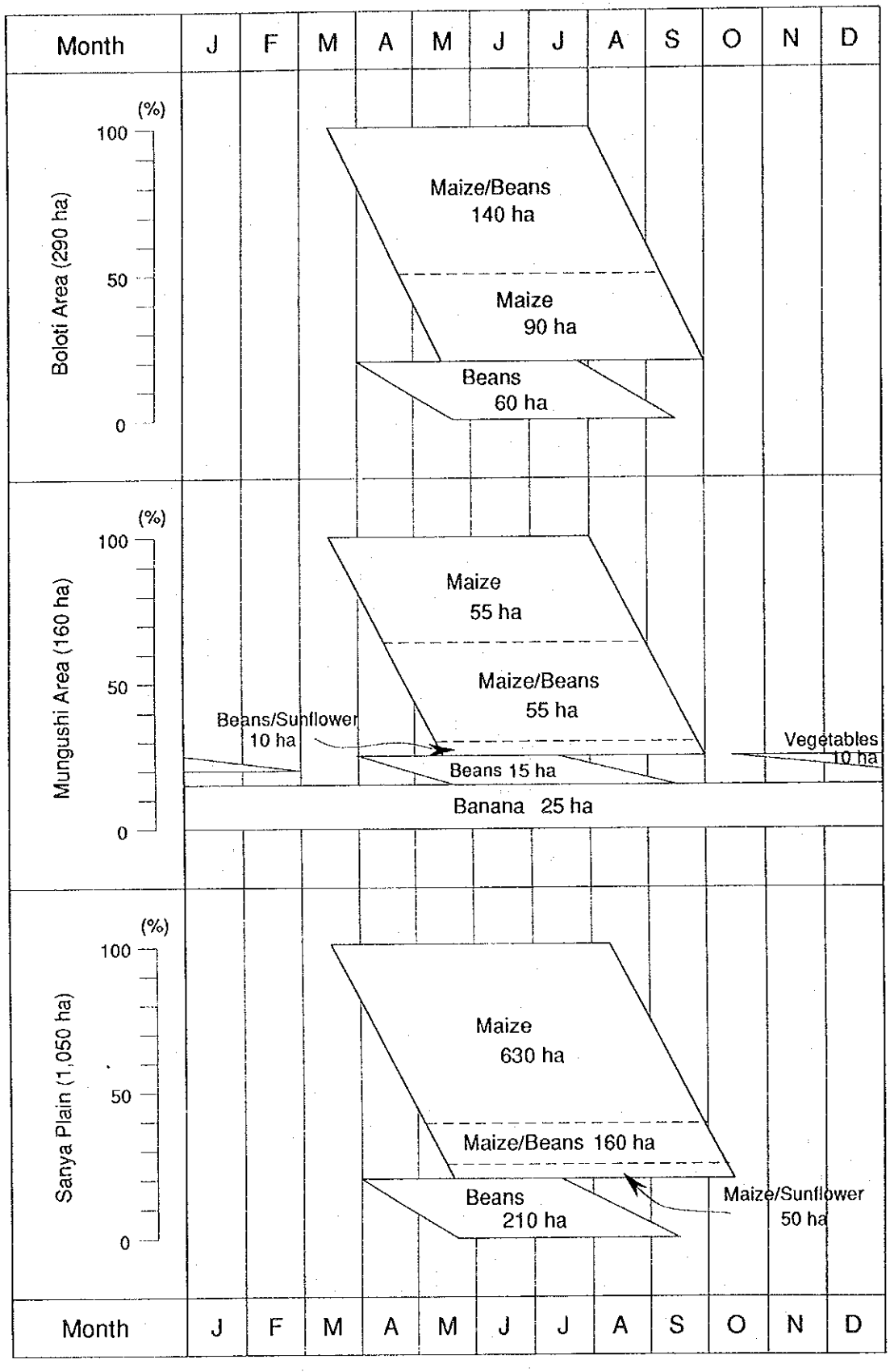
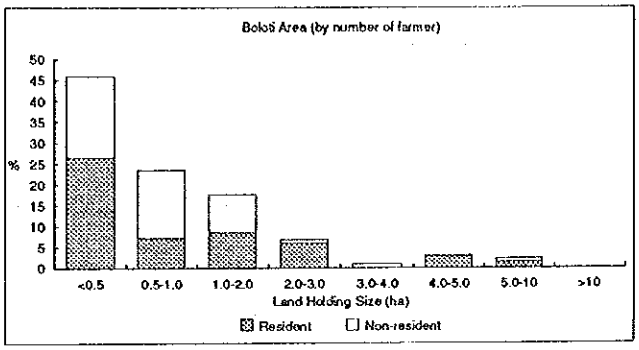
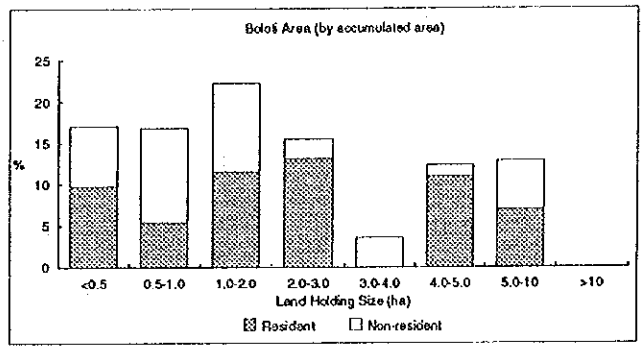
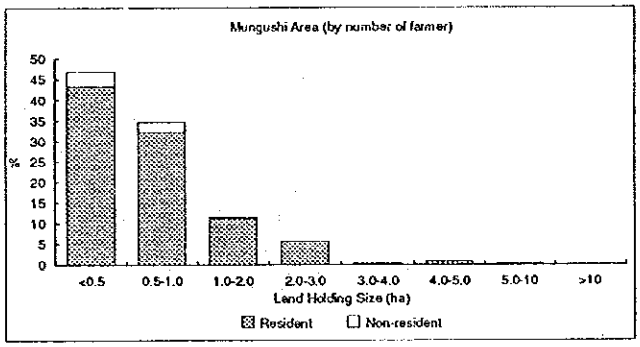
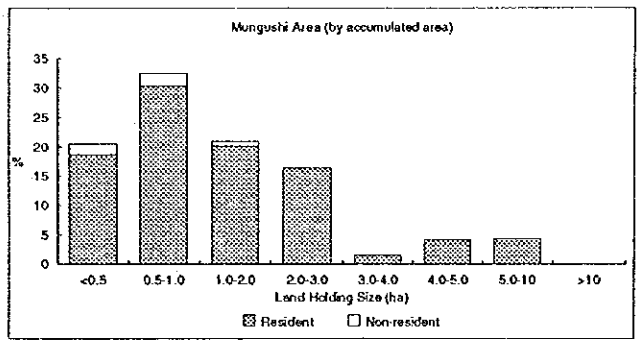


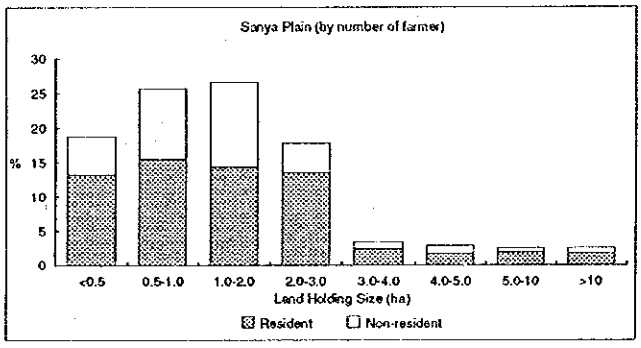
Fig. 4-1 PRESENT CROPPING PATTERN











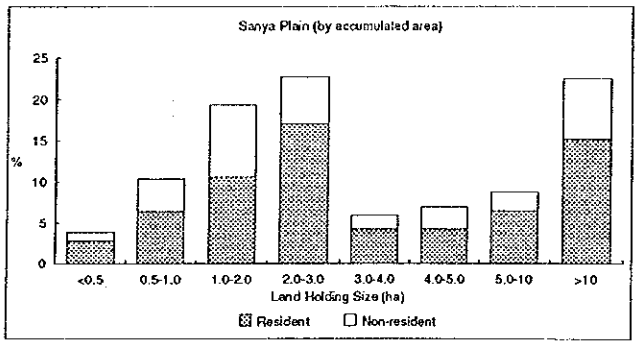
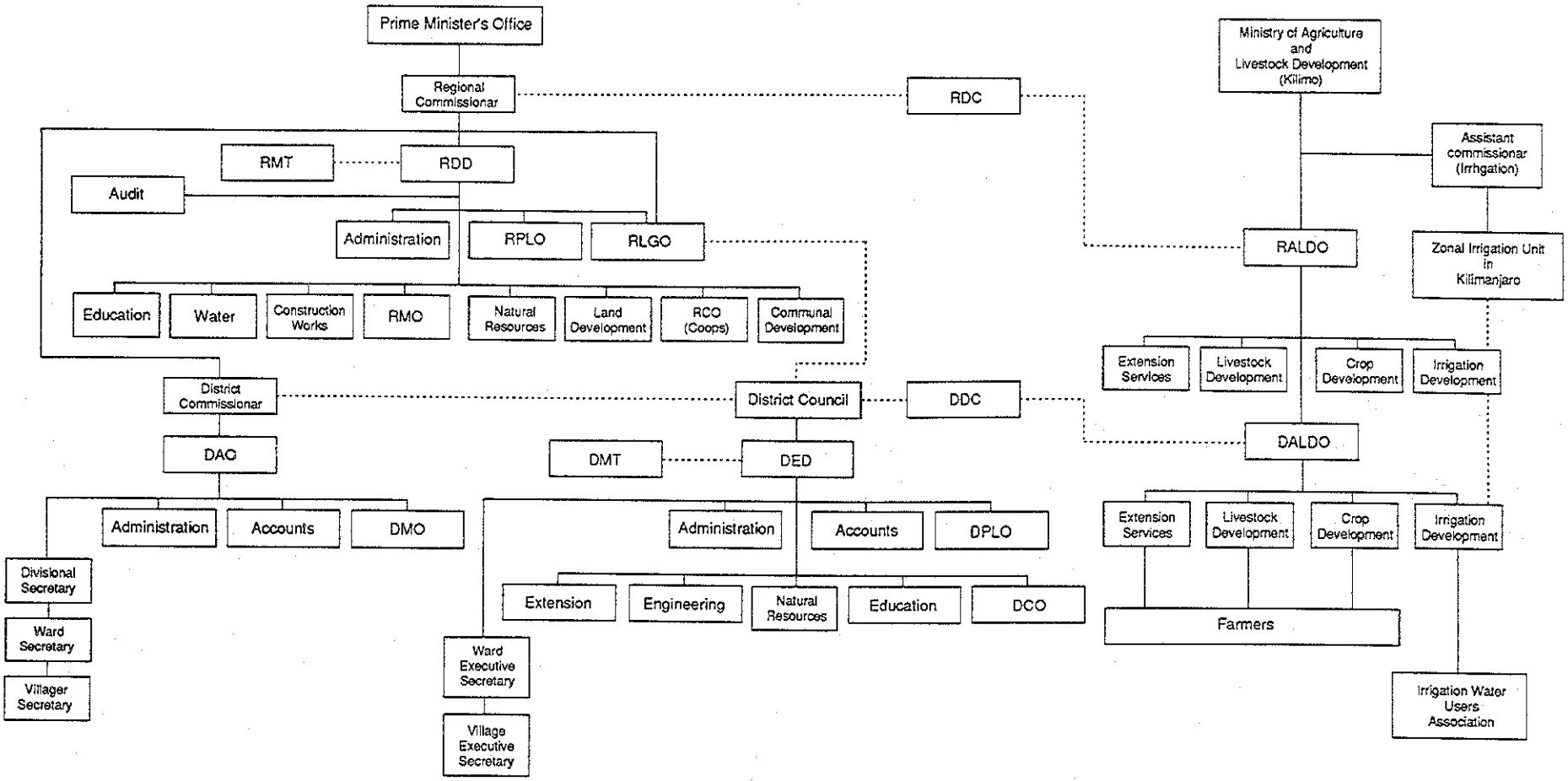


Fig. 4-2 LAND HOLDING SIZE DISTRIBUTION



LEGEND

RDD	Regional Development Director	DED	District Executive Director	RALDO	Regional Agriculture and Livestock Development Officers
RDC	Regional Development Committee	DDC	District Development Committee	DALDO	District Agriculture and Livestock Development Officers
RMT	Regional Management Team	DMT	District Management Team		
RPLO	Regional Planning Officer	DPLO	District Planning Officer		
RLGO	Regional Local Government Officer	DAO	District Administration Officer		
RCO	Regional Cooperative Officer	DMO	District Medical Officer		
RMO	Regional Medical Officer	DCO	District Cooperative Officer		

Fig. 4-3 AGRICULTURAL DEVELOPMENT ORGANIZATION IN KILIMANJARO REGION

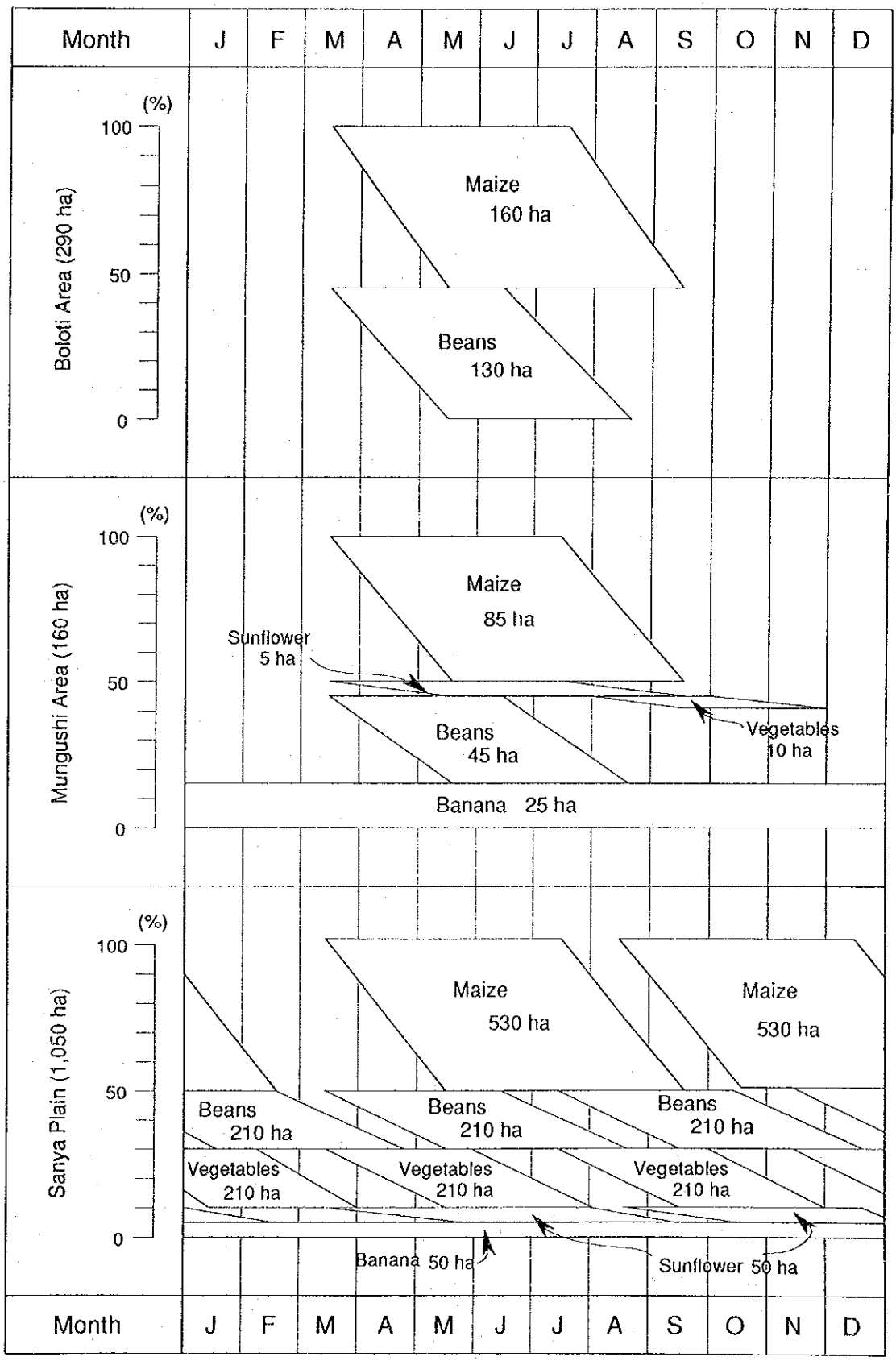
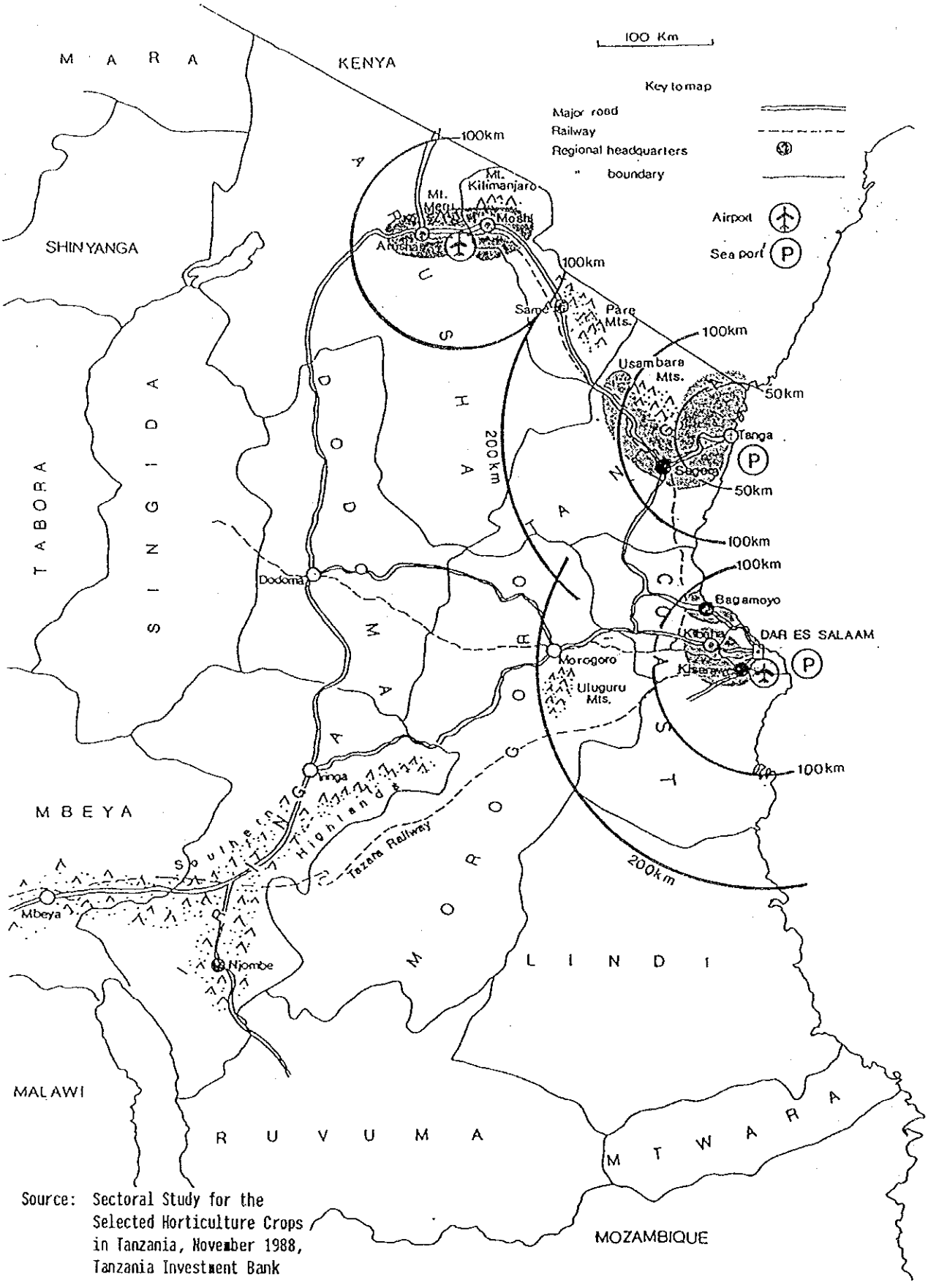


Fig. 5-1 PROPOSED CROPPING PATTERN



Source: Sectoral Study for the Selected Horticulture Crops in Tanzania, November 1988, Tanzania Investment Bank

Fig. 5-2 SUITABLE HORTICULTURAL CROP PRODUCTION AREA

ANNEX F

IRRIGATION AND DRAINAGE

ANNEX F

IRRIGATION AND DRAINAGE

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1. GENERAL

Investigations and study concerning irrigation, drainage and rural development were carried out to clarify the present conditions of existing irrigation areas and potential areas to be irrigated, to select the potential areas for agricultural development and finally to formulate irrigation and drainage development plan for development priority area.

Actually, the present conditions of irrigation and drainage were clarified in the Study areas and development potential areas were selected through the Phase-1 and -2 stages. Then the first priority area for agricultural development was selected among the development potential areas through the preliminary economic evaluations considering land resources, water resources, and topographic and agricultural situations as well. About the selection of development areas, it is stated in Annex A. Then in the Phase-3, more investigation and study for the selected area for the feasibility study were conducted and irrigation and drainage development plan was formulated with along rural development plan. This Annex describes the results of these investigations and studies.

2. PRESENT CONDITION

2.1 Existing Irrigation System

2.1.1 Lower Hai area

There are small-scale irrigation systems existing along major rivers flowing through the Lower Hai area. The scale of each irrigation area is small due to shortage of irrigation water resources as well as land resources. The only large-scale irrigation system is the Rundugai system commanded by an irrigation system depending on water from springs located in the Kware river. Total commanded irrigation area in the Lower Hai area is roughly estimated at 5,800 ha. Location of major irrigation systems is shown in Fig. 2-1.

(1) Along the Sanya river

There are eight small scale irrigation systems along the Sanya river in the Lower Hai area, known as Mungushi, Ernest, Station, Nzegazega, Palestine, Mayaseki, Tindigani, and Hemedi furrows. Except for Mungushi irrigation system, all the irrigation systems are located in the downstream of the crossing point with the Arusha-Moshi railway as shown in Fig. 2-2, where those lands are alluvial flat plain and the soils are fine to medium texture. All the irrigation systems obtain their water from the Sanya river.

In the dry season, the river flow is extremely low and most of river water is taken by the Mungushi intake and the Sanya Chini intake which is a headworks of the Ernest and Station furrows. Thus no water is available further downstream in the dry season. Irrigation is applied mainly in the rainy season from April to June when the river water increases. The total area commanded by irrigation canals along the Sanya river is estimated at about 1,300 ha.

In order to examine the severe shortage of irrigation water in the irrigation areas existing along the Sanya river and in the downstream of the Boloti swamp, water balance study is made between the surface water resources and irrigation water demands estimated on the basis of present cropping pattern and on the assumption of the irrigation efficiency of 25 %. The results are shown in Table 2-1 and Fig. 2-3. It indicates that water shortage occur in most years in both the Boloti area and the Sanya plain. Once in almost every two years 20 ha of upland crops can be irrigated with no shortage of water during the rainy season in the Boloti area. In the Sanya plain, only one forth of the total planting area can be irrigated with no shortage in almost every two years in the rainy season, while the Mungushi area, banana fields of about 20 ha can be fully irrigated once in two years throughout a year.

It is understood through these analysis and the interview survey that areas actually irrigated are quite limited along the existing canals, although the existing irrigation systems are commanding a large area of 1,120 ha along the Sanya river and about 290 ha in the Boloti area.

The Mungushi irrigation system is the most upstream among the eight irrigation systems and so is the most advantageous in view of water-taking opportunity. Most of the river water is diverted to the scheme in the dry season. A headworks is located some 3 km downstream of the confluence point of the Lawati river to the Sanya river. The weir was firstly constructed by villagers and improved by the Hai District Office in 1982 and 1983. The weir is of concrete overflow type and no scouring sluice has been provided. The intake is located on the left bank of the river and is equipped with a steel slide gate. The weir and intake are maintained well. An irrigation canal runs along the left bank of the Sanya river and supplies irrigation water to a narrow strip along the Sanya river. The irrigation canal is earthen-made. The cross sectional shape is trapezoid in the most of the reaches and partially rectangular. According to the discharge measurement in the rectangular section, the capacity of the main canal is assumed to be around 0.2 m^3/sec. The irrigation canal length and the area commanded by the irrigation canal were examined by using detailed topographic maps and interview surveys. It is estimated at about 7.5 km and 210 ha in gross, however the irrigable area seems to be limited due to insufficient water resources especially in the dry season and lack of on-farm canals and facilities.

Ernest and Station furrow systems are served by the Sanya Chini Headworks, which is located at about 1.5 km downstream of the crossing point of Arusha-Moshi highway. The headworks is of concrete-made type. The weir is of overflow type with no scouring sluices. The crest length of the weir is 26.8 m and the height is 1.5 m above the downstream apron of which length is 8.0 m. There are two intakes; one is located on the left bank and the other on the right bank. Both intakes are provided facing to the river flow direction and have such same dimensions such as a width of 90 cm and a height of the wall of 2.0 m from the sill, and are equipped with a sluice gate of which the leaf has a width of 90 cm and a height of 125 cm. The headworks is well maintained. Much sediment is, however, deposited in front of the weir. The Station furrow conveys irrigation water to the left bank area of the Sanya river and the Ernest furrow serves the right bank area. Both canal systems had been registered in Maji Office. The water right granted for each furrow is 5 cusec. These canals are earthen-made trapezoidal canal and few structures are provided. The Ernest furrow joins

the Nzegazega furrow system in the downstream. Total length of the Ernest and the Station furrow systems are about 7 km and 8 km, respectively and the commanding area of both systems are about 150 ha and 130 ha, respectively.

Nzegazega weir is located at around 1 km downstream of the railway crossing point where the Sanya river bends to east. The weir is a concrete-made overflow weir. The length of the weir is about 5.5 m and the height of the weir is 0.6 m. The height of the guide wall is 1.2 m. The weir has been partly destroyed and thus the intake which is provided at the right side of the weir, cannot divert river water. It is only provided with stoplog guides having a width of 1.06 m and a height of 0.9 m (guide wall has height of 1.0 m). Nzegazega furrow serves the area of right bank of the Sanya river, about 100 ha.

The Palestine furrow which has a free intake made by villagers to abstract river water to the right bank area of the Sanya river. The area commanded by the furrow is roughly estimated at 180 ha.

The Mayaseki and the Hemedi furrows serve the left bank of the Sanya river. Their headworks are of free intake type. The commanded area is about 380 ha.

The Tindigani furrow system serves the right bank of the Sanya river. The intake weir is made of concrete but the intake is only a free intake with no structures. It is estimated from the detailed topographic maps that the commanded area is about 170 ha.

All the existing canals of these irrigation systems are earthen-made and maintained poorly at present. Most of canals suffer from structural deterioration, sedimentation and weed-growing. Only structures are provided. No drainage systems are provided.

(2) Along the Kware River and its tributary (Boloti swamp)

There are springs along the downstream reaches of the Kware river between the railway crossing point and the confluence of the Kware river with the Kikuletwa river. Water from these springs flows into the Kware river or the Kikuletwa river. One of the irrigation systems so-called, the Rundugai Irrigation system depends entirely on such spring water. Two intakes are provided on the Kware river and divert spring water flowing the Kware river to left bank area along the Kware river. The irrigation area is estimated at about 1,400 ha. The discharge of the Kware river, most of which is spring water, is around 1 m^3/sec at existing intake points. Both intakes are concrete-made overflow weir with a gated

intake. All the irrigation canals are of earthen-made. The canals are in poor condition such that sedimentation and weed-growing has occurred. The irrigation system is being planned to be rehabilitated by the Zonal Irrigation Office with technical and financial assistance of FAO.

Besides the irrigation system, Kikuletwa hydropower station which was constructed in 1937 is also served with spring water flowing into the Kware and the Kikuletwa rivers. This hydropower station is located at just upstream of the confluence of the Kware and Kikuletwa rivers. The hydropower station was granted the use of all the spring water except for 25 cusec which is supposed to be used by villagers.

In addition to the irrigation system mentioned above, a small irrigation system utilizing small amount of spring water flowing the Kware or the tributaries of the Kware river can be found along the Kware river at Kware village located at north end of the Lower Hai area, the foot of Mt. Kilimanjaro. Also, there are two small irrigation systems feeding water of the Boloti swamp which is located at upstream of one of tributaries of the Kware river, one is the Mwangaza furrow and another is the Nkwansira furrow. Both are small earthen channel. The length of the Mwangaza furrow system is estimated at about 6 km and the commanding area is about 200 ha. The Nkwansira furrow is about 1.7 km in length and commands an area of about 80 ha.

(3) Along the Makuna/Longoi river

The Makuna river has a catchment area as small as 26 km^2 at the Arusha-Moshi railway crossing point, however there is water springs of about 0.2 m^3/sec even in the dry season. By utilizing such spring water and flood water, irrigation is practiced in the downstream area of railway crossing point as well as the small-scale paddy farming near water-spring points. The irrigation area is roughly estimated at 370 ha at maximum in the rainy season, while in the dry season the irrigation area is very limited due to small amount of available water.

(4) Along Kikafu river

One small irrigation system, so-called Kikafu Chini is situated along the Kikafu river in its lower reach. The small irrigation system irrigates about 250 ha extending along the left bank of the Kikafu river with abundant water of The Kikafu river. This system being is planned to be rehabilitated by the Zonal Irrigation Office with technical and financial assistance from FAO.

(5) Along Weru Weru river

There are three existing irrigation systems along the Weru Weru river in its middle and lower reaches; one is Kimashuku irrigation system, the second is Musa Mwijanga, and the third is irrigation system of Tanganika Planting Company(TPC) which is located at Moshi District.

The Kimashuku irrigation system serves the area bordered by the Weru Weru river and the Kikafu river mainly in the southern part of the Arusha-Moshi highway, of about 1,600 ha, assuming from the aero-photographs and information from the District Office. According to the field reconnaissance, river water of about 0.8 m^3/sec was diverted in November, 1988 and about 0.5 m^3/sec in September, 1989. According to the information of Hai District Office, water of about 0.5 m^3/sec(20 cusec) or more has been taken even in the dry season since 1979 when the intake was completely improved. However, the intake discharge granted by water right is only 0.06 m^3/sec. The intake is located at some 3 km upstream the crossing point of the Arusha-Moshi highway. The intake consists of a fixed overflow weir and a gated-intake. It is maintained well. Irrigation canals are earthen-made. On-farm irrigation facilities have not been developed yet. It seems that actual irrigation practice is limited to the area of 100 ha or less along irrigation canals.

The Musa Mwijanga irrigation area is surrounded by the Weru Weru river, the Kikafu river and the Arusha-Moshi railway. The irrigation area is about 570 ha. The irrigation system is planned to be rehabilitated by Zonal Irrigation Office with technical and financial assistance from FAO.

TPC is granted to take water from the Weru Weru river, 2.83 m^3/sec at minimum and actually takes water at two points; one is at some 1 km downstream of the confluence point with the Kikafu river which is one of the largest tributaries and another is at some 3 km upstream of the confluence point with the Kikuletwa river. According to the field reconnaissance, almost all river water is taken by first and second intakes and a negligibly small amount of water flows into the Kikuletwa river. Other than river water, groundwater is also utilized for irrigating sugarcane at T.P.C.

(6) Along the Kikuletwa river

There is one existing system, so-called Katambai canal along the Kikuletwa river in Mtakuja village. Irrigation has been practiced since 1945 when Katambai canal was constructed by the villagers.

This canal has been getting its water from the Kikuletwa river. Irrigation was being practiced mainly during the month of March to June (rainy season). There is no intake structure at the intake site. Water is just being taken without any control to the canal by some earthen weir on Kikuletwa river. Since the canal is steeper and deeper than the river, water will just flow into Katambai canal without any complicated weir on the Kikuletwa river.

From the year 1980 to 1986, however, water reaching Katambai intake was getting reduced year after year and in recent years since 1987, no water was reaching the intake due to flood in upstream along the Kikuletwa river as stated below.

Majengo village is the village just upstream of Mtakuja village in Arumeru District, Arusha Region. It is said that this village has been experiencing floods since 1978 in the rainy season.

There are three major furrows in Majengo village which draw water from the Kikuletwa river. These furrows are known as (1) Yamanuel, (2) Baba, and (3) No. 9 furrow.

No. 9 furrow/canal intake is located approximately at 9 Km upstream of Katambai canal intake. Just like Katambai intake there is no any intake structure constructed at No. 9 intake. Whole of the remaining water in the Kikuletwa river is being taken by this No. 9 Canal in Arumeru district. Similar to Katambai canal, No. 9 canal is deeper than the Kikuletwa river bed level. Due to sediments settlement in the river which has resulted in the river to be higher even during the rainy season the water in the river follows entirely the three canals mentioned above and thus floods this canal and flows into Majengo village area.

Also the floods in Majengo village and in portion of Kiteto District of Arusha Region, which is located at the south, bordering Kikuletwa river, is spearheaded by the banks of the Kikuletwa river being too shallow when the river reaches Majengo village. Due to floods in Majengo area during the rainy season many crops are damaged and subsequently no water is available in Mtakuja area.

2.1.2 Lower Rombo area

There is only one existing irrigation system in the Lower Rombo Area. It is called Ikuini irrigation system. Water is diverted from the Lume river which is the only one perennial river in the Lower Rombo area. This system serves the area bordered by the Lume river in the east and the Kifunuka river in the west, about 300 ha. The intake is a concrete-made fixed weir and a gated intake. The main canal goes down along the

Lume river. It is an earthen canal. On the way, at some 0.5 km downstream of the intake, one night storage pond made by earth is located. The outlet is equipped with a slide gate. This irrigation system has no on-farm facilities. The zonal Irrigation Office is carrying out rehabilitation of this system with technical and financial aid from FAO.

2.2 Irrigation Practice

There is a traditional water committee in each irrigation system. Operation and maintenance are planned and supervised by the water committee. The committee is composed of four to six personnels generally such as the head of the canal, secretary/treasurer, canal inspector, water allocator, alarm man who calls people for work, and two security guards who are elected after every five years. The committee is responsible for the following duties.

(1) to plan and to supervise the construction and the maintenance of canal,
(2) to plan the irrigation schedule,
(3) to cooperate with ten cell leaders in all disputes caused by the canals rules in the village, and
(4) to keep all account of the canal income

According to Bylaw of Hai District, the canal income depends on (1) fees collected from users of canal water, (2) grants from the village council and (3) payment of fines due to the breakage of any canal Bylaw.

According to interview survey, the committee actually holds meetings with water users every week when river water is available. At this meeting, the water supply schedule is set and water is distributed in accordance with the schedule. The members of the committee directly carry out the operation of water distribution as well as minor repair and maintenance. If major repair is required in major irrigation facilities, the committee requests to District Office (District Irrigation Officer) through the village chairman to repair the damaged portion. No water charge is collected from farmers and the operation and maintenance made by the committee is made as voluntary service at present. In order to evenly distribute limited water resources, rotation water supply is applied among the small furrow systems.

Most of irrigation systems have actually no or few control structures such as intake gates, checks, turnouts, division box and measuring devices and no on-farm irrigation facilities are available. Accordingly no systematic irrigation operations are actually being made at present. Irrigation water is taken often without ânу control.

As for on-farm irrigation practices, upland fields are customarily ploughed by tractor and planted with crops without any harrowing and ridging. Accordingly the ground surface is

so rough that no effective irrigation method seems to be applicable. In addition, there are small undulations of the ground surface especially in Boloti, Mungushi, and Kimashuku areas. Due to the undulations, certain areas are often either not irrigated or over-irrigated, resulting in inefficient irrigation supply.

2.3 Rural Infrastructure

(1) Lower Hai area

1) Roads

There is a highway which runs between Arusha and Moshi in the mid-northern part of the Lower Hai area in east-west direction. A road branching off from the above trunk road at Sanya Chini runs to the north for Sanya Juu. The connecting road to the Kilimanjaro International Airport branches away from the Arusha-Moshi highway at the western part of Sanya Chini. These trunk roads are paved with asphalt. No other roads are paved. Most of other roads are not well built up, and just have wheel tracks. So it is difficult to drive on traditional roads in the rainy season when the road surface is wet with rain water causing slippage even in four-wheel-drive vehicles. Many of the crossing points with rivers have no crossing structures in these roads.

2) Railway

There is a railway running through the Lower Hai area in the east-west direction connecting Moshi and Arusha. The railway is single line and used only for cargo transportation between Moshi and Arusha. One station is provided at Sanya Chini which is located in almost the center of the Study area, but it does not seem to be used.

3) Domestic water supply

There are poor domestic water supply systems in main villages such as Sanya Juu, Sanya Chini, and Rundugai. Even at such main villages, most of the villagers rely directly on rivers and springs for their domestic use. There are not enough systems in other villages, so villagers actually rely on rivers, and springs around Rundugai and on wells in the Mtakuja area near the border with Arusha Region along the Kikuletwa river. Domestic water of Kilimanjaro International Airport is pumped-up groundwater and spring water conveyed by a pipeline from the south foot of Mt.Kilimanjaro.

4) Electrification

Transmission lines of 11 KV are run parallel to the Arusha-Moshi highway and the road from Boma Ng'ombe to Sanya Juu. Also, transmission lines of 33 KV and 66 KV from Kikuletwa hydropower station to Arusha is running across the Study area. Boma Ng'ombe and a few other major villages are electrified, but most of villages are left from electricity supply.

(2) Lower Rombo area

1) Road

In the Lower Rombo area, a trunk road runs along the foot of Mt.Kilimanjaro at the western end of the Study area. This road branches away from the highway connecting Moshi and Taveta in Kenya. The area along this road has become a center of agricultural production and has provided homesteads for many inhabitants. The road is about 6 m wide and metalled with sand and gravel. Most of the river-crossing structures are so-called cause-ways, which are submerged at flood time, except for one road bridge at the Lume river. Other than the above road, there is a road running along the foot of Mt.Kilimanjaro in lower part of the Study area near Kenyan border after branching off from the above trunk road at the south of the Study area. This road has not been paved yet. There are a few earthen roads connecting the above two roads in the study area. These roads are also in the same poor condition as those in Lower Hai areas.

2) Domestic water supply

East Kilimanjaro Truck Main Scheme (EKTM) was constructed in 1966. Total length of main pipe line is about 37.5 km long which comprise 305 mm diameter of cast iron pipe at its head and 150 mm diameter of asbestos concrete pipe at its lower end. About 30 branch lines with approximately 310 km long branched off from EKTM to distribute water for about 150,000 people and about 200,000 heads of livestock. At present, approximately two million gallons of water from three rivers i.e. Wona River, Wasi river and Monjo River are diverted into EKTM and distributed to the people of approximately 100,000 living in the southern half of Rombo District. Except for the people in upper EKTM, however, most of beneficiaries are suffering from shortage of water supply, particularly those in the downstream of the pipes, mainly due to insufficient capacity of

pipes, poor management of water supply, breakdown of valves, leakage of water, etc.

Along the EKTM, four storage tanks, one million gallon, two 30,000 gallons and one 50,000 gallon, are provided for night storage, but not properly functioned because of shortage of water. There are many structures and devices, most of which are either deteriorated or damaged. Three intake structures are required to be improved. In addition, the service roads of about 15 km along EKTM are disconnected due to collapse of bridges and cause way.

In the northern District, there are about 6 small scale pipe lines, i.e. Mashati, Olele, Nanjara Nolemoru, Njoro and Kimengelia. Except for the Mashati scheme, most of the schemes provide less than 40% of water needed for consumers due to insufficient capacity of pipe lines, breakage of pipes and valves and leakage of water. Accordingly, people in the lower reach of pipe lines are compelled to get minimum drinking water for people and livestock raised coming up to the domestic points located at upper reach of pipe.

3) Electrification

Electricity is available along the road connecting Moshi and Tarakia which is located near the border with Kenya, however, most of residence is left from electricity supply.

3. DEVELOPMENT ALTERNATIVES AND OPTIMUM DEVELOPMENT SCALE

In order to determine the optimum development scale of Sanya river basin, covering Boloti, Mungushi, and Sanya plain schemes including Boloti swamp, development alternatives were identified and water balance studies made between available run-off and irrigation water demands.

3.1 Development alternatives

Water balance calculations were made taking into account the land resources in Boloti, Mungushi and Sanya plain, and surface and groundwater resources. The surface water resources are expected in the Sanya river and the Boloti Swamp which is only the site suitable for a reservoir in the Lower Hai area. The catchment area is, however, limited to 14 km^2 and thus water resources are limited to about 3 MCM/year in the drought year. Thus in case of development alternatives with the reservoir, water available in the Lawati river which is a major tributary of the Sanya river is planned to be diverted to the reservoir. Groundwater resources are expected in the lower half of the Sanya plain as described in Annex C.

The Boloti and Mungushi areas are mostly classified into Class 4 in the land classification as described in Annex D. Consequently high returns by irrigation farming may not be expected in these areas. Thus in order to evaluate such a situation, alternatives for the development are set for (1) with development of the Boloti and Mungushi areas and (2) without their development.

The Sanya plain is divided into two areas in terms of water resources, one is the upstream area, 440 ha in net, which is expected to be served by only surface water resources and the other is the downstream area, 610 ha in net, which is served with groundwater resources or by the conjunctive use of surface water and groundwater resources. If the downstream area is developed independently from the upstream area by conjunctive use of surface and groundwater resources, an intake will be built at the place suitable for river water supply. In this case, the irrigation area will be 570 ha in net instead of 610 ha.

In the lower half of Sanya plain, agricultural development by groundwater resources or the conjunctive use of groundwater and surface water resources is conceivable as afore-said. In order to reduce the operation cost of tubewells, it is necessary that surface water resources shall be utilized as much as they are available. At present the water of the Sanya river is utilized in the Sanya plain including its lower half where groundwater is expected to be abundant. Considering the present condition and to save the operational costs, the alternative of conjunctive use only is taken into account.

The alternative study is made for following five cases:

Case	Condition
1	Development of Sanya plain without dam development (Boloti area is not taken into account because of no dam development. Priority of water allocation is put on Mungushi area without its development.)
2	Development of Sanya plain with dam development (Priority of water allocation is put on Boloti and Mungushi areas without their development)
3	Development of Boloti, Mungushi and Sanya with dam development
4	Development only in Sanya downstream area (groundwater area) by conjunctive use of surface and groundwater resources without dam development (Boloti area is not taken into account because of no dam development. Priority of water allocation is put on Mungushi area without its development)
5	Full development of Sanya plain by conjunctive use of surface water and groundwater resources development (Priority of water allocation is put on Boloti and Mungushi areas without their development)

3.2 Water balance study

3.2.1 Conditions of water balance calculation

Water balance study is made on the basis of the monthly run-off of the Sanya river and the Rawashi river which is a river flowing to the Boloti swamp, for 17 years period from 1972 to 1988 and the irrigation water demand estimated in Section 3.2 under the following conditions and considerations:

(1) Priority of water allocation

The Boloti area is served with water of the Boloti swamp and the Mungushi area with the Sanya river at present. In these areas, crop cultivation is practiced mainly in the rainy season. These areas are situated upstream of the Sanya plain. Therefore, in order to guarantee irrigation water for present cropping in both areas, priority of water allocation is given to them.

(2) Losses in Boloti reservoir

In order to estimate water losses from the proposed reservoir, measurement of water level in the Boloti

swamp, inflow from upstream of the swamp, outflow discharge, as well as permeability tests were carried out in February 1990.

The results are shown in Table 3-1. Inflow for 16 days from 1st February to 16th February varies slightly and averaged 0.043 m^3/sec which corresponded to 3.87 mm in depth with 0.95 km^2 of wetted surface. Water level was decreasing constantly in this period, 3.27 mm/day on average. Thus the losses in the Boloti swamp is estimated at 7.13 mm/day. The Boloti swamp area is very wet and is densely covered with grass or water. Evaporation estimated by modified Penman method by use of the meteorological data of KIA is 7.2 mm/day in February. The evaporation from such green covered area is almost the same as that estimated by the Penman method. It is thus judged that seepage losses through the bottom of the Swamp are negligibly small at present condition. By the creation of the dam, the water head increases. Due to the increase, seepage losses may be anticipated. As explained in Annex G "Engineering Design", the seepage losses from the dam section and the foundation are estimated at about 3 lit/sec. Thus total seepage losses in this water balance is conservatively estimated at 10 lit/sec. Losses from the Boloti reservoir are estimated by deducting rainfall directly reaching the Boloti swamp from the sum of evaporation and seepage losses.

(3) Losses in the reach of the Sanya river between the reservoir and the Sanya Chini intake

Water stored in the reservoir will be conveyed about 11 km to the Sanya Chini intake through the Sanya river. In order to examine water losses in the reaches, river discharge measurement was continuously carried out in February, 1990 at three or four points such as the confluence point of the Lawati river, the Mungushi intake, the Biriri river confluence to the Sanya and the just upstream of the Arusha-Moshi highway. The results are shown in Table 3-2 and Fig. 3-1. They indicate that no water losses occur in the reaches and discharge downstream almost equals to that of upstream. Accordingly, no loss or surplus is considered for the water balance study.

3.2.2 Calculation results

The results are compiled in Table 3-3 to 3-7 and summarized as follows:

In Case 1, without water resources development, only about 250 ha of the Sanya plain can be irrigated in the rainy season and with about 80 % dependability. In the dry season, even the Mungushi area which is situated upstream of the Sanya plain suffers from water shortage. It is therefore recognized

that water resources development is prerequisite for the development of the irrigation project.

Case 2 indicates that if surface water resources are used to almost the maximum possible extent, the Sanya plain can be irrigated on an area of 440 ha for two croppings in the dry season as well as whole area in the rainy season and that the required reservoir capacity becomes 7.5 MCM. The variation of the reservoir storage during 17 years is shown in Fig. 3-2.

In Case 3, which is the case that the Boloti and Mungushi areas are developed in addition to the development of the Sanya plain of case 2, reservoir capacity becomes 6.6 MCM against 7.5 MCM in the case 2, since the irrigation water demands decrease by improvement of irrigation efficiency in the Boloti and Mungushi areas, which is assumed 25 % at present condition and 40 % with project condition as afore-mentioned in Section 5.2. The variation of storage in this case is shown in Fig. 3-3.

In Case 4, which aims to develop the groundwater area of the Sanya plain, all the areas are irrigated in accordance with proposed cropping patterns with surface and groundwater resources. The groundwater demands are 4.7 MCM per year for 570 ha or 8,300 m^3/ha.

Case 5, "conjunctive use of surface water and groundwater" is combines Cases 2 and 4. Regulation of reservoir operation should be set to efficiently use water stored in the reservoir for saving the operation cost of tubewells. Actually in this water balance, considering practical operation, the operation is set at three stages such that (1) if actual storage at the end of previous month is more than the certain amount of A, water will be released for irrigation in all the areas, (2) if the actual storage is in the range from A to B, then water will be released for irrigation of upstream area and a half of the downstream area, and (3) if actual storage is less than a certain amount of B, the upstream area only be irrigated. The storage amount of A and B was determined as follows so that the stored water can be used efficiently as much as possible under the condition that the deficit of irrigation water caused by the empty of the reservoir is not revealed as far as possible.

(Unit: MCM)

Area to be irrigated in next month	Amount of Stored Water at the end of Dec.	Jan.	Feb.	Mar.	Apr	May
All the area	> 3.7	> 2.0	> 0.85	-	> 4.0	> 6.0
Upstream area and downstream half	3.7-3.1	2.0-1.6	0.85-0.6	-	4.0-3.0	6.0-5.0
Upstream area only	3.1 >	1.6 >	0.6 >	-	3.0 >	5.0

Area to be irrigated in next month	Amount of Stored Water at the end of Jun.	Jul.	Aug.	Sep.	Oct.	Nov.
All the area	7.5	7.5	7.5	7.5	6.2	5.0
Upstream area and downstream half	7.5-6.0	7.5-6.0	7.5-6.0	7.5-6.0	6.2-5.5	5.0-4.2
Upstream area only	6.0 >	6.0 >	6.0 >	6.0 >	5.5 >	4.2 >

Note: In April, all the areas are irrigated.

The water balance calculation which is shown in Table 3-7 indicates that all the areas can be irrigated by surface water resources to be developed by dam having a reservoir capacity of 7.5 MCM and groundwater resources. The groundwater demands are about 5.2 MCM/annum for 610 ha or 8,300 m^3/ha/annum. This amount is almost the same as Case 4.

The results of the water balance study may be summarized as follows:

Case	Development Area	Irrigable Area	Reservoir Capacity (MCM)	Groundwater Demands (MCM/annum)
1	Sanya plain	250 ha in rainy season	-	-
2	Sanya plain, 1,050 ha	Sanya plain 1,050 ha in rainy season & 440 ha in dry season. Boloti area 290 ha in rainy season. Mungushi area 180 ha in rainy season, 35 ha in dry season.	7.5	-
3	Sanya,1,050 ha Boloti, 290 ha Mungushi,180 ha	Same as Case-2	6.6	-
4	Sanya downstream area, 570 ha	570 ha	-	4.7
5	Sanya plain, 1,050 ha	Sanya plain 1,050 ha. Boloti area 290 ha in rainy season only. Mungushi area 180 ha in rainy season, 35 ha in dry season.	7.5	5.2

3.3 Optimum Development Scale

Based on these results of water balance study and preliminary design of facilities, the development scale is determined through the economic comparison of alternatives.

In Case 1, in which surface water resources without dam development is utilized for irrigation, irrigable area is estimated about at 250 ha only in the rainy season in the Sanya plain as described in previous Section, which is only about one forth of the present agricultural area of 1,040 ha suitable for intensive agricultural farming. Accordingly the development in line with the Case 1 is not judged as a prospective development plan.

In Case 2 and 3, all the areas suitable for intensive agriculture in the Sanya plain can be irrigated by surface water resources in the rainy season and about 40 % of the area be irrigated in the dry season. The required reservoir capacity is 6.6 MCM in Case 3 against 7.5 MCM in Case 2. Thus the dam embankment volume in Case 3 is smaller than that in Case 2 by about 30,000 m^3. However, instead of the smaller volume, development for Boloti and Mungushi areas; about 450 ha must be incorporated into the project works. As the results of construction cost as shown below, the construction cost in Case 3 is higher than that in Case 2 by Tsh.128 million.

Case 2	Dam Construction Cost	470	Tsh.x 10^6
Case 3	Dam Construction Cost	428	Tsh.x 10^6
	Development Cost for Mungushi and Boloti areas	170*	Tsh.x 10^6
	Difference	128	Tsh.x 10^6

Remark: *; The cost estimated in December 1989 was adjusted by variation of exchange rate from Tsh.145 = US$ 1.0 in December, 1989 to Tsh.195 = US$ 1.0 in March, 1990.

Mungushi and Boloti areas are classified as Class 4 "Restricted Arable" in the land classification as stated in Annex D. As irrigation water is guaranteed in both areas, benefits coming from irrigation are supposed to be almost the same between both cases. It is accordingly concluded that Case 2 is more economical than Case 3.

Case 4, which is a plan to develop lower half of the Sanya plain with groundwater exploitation and to remain the upper half without development, will introduce only partial development between the upper and lower halves in the Sanya plain area of 1,050 ha suitable for intensive agricultural farming.

Case 5, which is a full development case in the Sanya plain under irrigation condition throughout a year with dam

development and groundwater exploitation, will bring maximum benefit with maximum development costs.

Taking the above into account, economic evaluation is made for comparing the Alternatives of Case 2, 4, and 5. The results are as follows:

Case	Benefit - Cost*	Benefit/Cost*	IRR
	(Tsh.x 10^6)		(%)
2	307	1.17	11.7
4	573	1.48	15.4
5	1,156	1.55	15.1

Remark:* Using the discount rate of 10 %
Note: - Development cost of each case is shown in Table 3-8.
- Annual disbursement schedule, annual O/M cost and replacement cost of each case are shown in Table 3-9, 3-10 and 3-11, respectively.
- Benefits are estimated in Annex E.

From the economic view of internal rate of return, all the three Alternatives are economically feasible. Although the Case 4 would provide the highest economic rate of return, the Case 5 would show the largest returns of benefits with maximum use of suitable irrigation area. In view of development scale and construction costs needed, accordingly, the irrigation and drainage development plan for Case 5 is formulated as the optimal development scheme.

4. WATER RESOURCES DEVELOPMENT PLAN

4.1 Surface Water Resources

The required capacity of the Boloti reservoir is estimated at 7.5 MCM, but the inflow to the Boloti from the own catchment area is estimated only 3.1 MCM in draught year. Thus water available in the Lawati river, of which annual runoff is estimated at 9.7 MCM in draught year is diverted by the construction of a diversion weir and a diversion canal to the reservoir. In order to convey water from the reservoir to the Sanya river, an outlet canal is planned with an outlet structure. Also to release water to the existing canal of Boloti area, an outlet structure is to be provided. Spillway will be provided in the left side end of the dam. By such a surface water development, excess water of the own catchment and the Lawati river is stored in the reservoir especially in the rainy season, and then in the dry season when irrigation water becomes short, water stored in the reservoir is released to the Sanya plain and the Mungushi area through the outlet canal and the Sanya river.

Fig. 4-1 shows the dam and the related facilities development plan. The dam height required for storing water of 7.5 MCM is estimated at 7.8 m considering the freeboard of 2.4 m. The dam type is decided to be earthfill type considering the availability of the dam embankment material and topographic condition of the dam site. The details are given in Annex G.

The point of the diversion weir is determined at about 800 m upstream of the crossing point of the Lawati river with the Sanya Juu road considering the topographic conditions of the diversion route and diversion site. The length of the diversion canal is 2.6 km. The design discharge is decided to be 3 m^3/sec so as to divert almost all water of the Lawati river except peak flood time.

The outlet canal from the reservoir to the Sanya river is about 1.5 km. The design capacity is estimated at 0.7 m^3/sec from the water balance study.

The design discharge of the spillway is estimated at only 4.8 m^3/sec against the flood of 200 year return period considering the storage effect in the reservoir. The features of these facilities are described in Annex G.

4.2 Groundwater Resources

Tubewells are planned in the groundwater-promising area located downstream of the Sanya project area; about 610 ha to supplement irrigation water especially in the dry season. The capacity of one tubewell is estimated at 50 lit/sec on average and peak irrigation requirement is estimated at 0.9 lit/sec/ha. Thus 12 tubewells are to be provided. The proposed sites of

tubewells are shown in Fig. 5-2 and the features are described in Annex G.

5. IRRIGATION AND DRAINAGE DEVELOPMENT PLAN

5.1 Irrigation Water Requirements

5.1.1 General

Based on the present and proposed cropping patterns shown in Annex E, the irrigation water requirement is estimated for water balance study and preliminary design of irrigation system on a monthly basis using monthly climatic and rainfall data applying the method mentioned in the FAO Irrigation and Drainage Paper No.24. The estimate procedure is as follows:

(1) Estimate consumptive use of water (Cu) by multiplying potential evapo-transpiration (ETo) by crop coefficient (k),
(2) Estimate effective rainfall (Er) by USDA method and obtain net irrigation water requirement (NIR) deducting Er from Cu and,
(3) Estimate irrigation water requirement by dividing NIR by overall irrigation efficiency.

5.1.2 Potential evapotranspiration

Consumptive use of water by crops is estimated based on the potential evapotranspiration (ETo) calculated from climatic data and crop coefficient (kc) relating crop growth stages. The climatic data necessary for estimating the potential evapotranspiration are available at Moshi and Kilimanjaro International Airport meteorological stations. Based on the available climatic data, ETo is calculated by Modified Penman method in FAO's Irrigation and Drainage Paper 24, Crop Water Requirements, revised in 1977. The calculation and the results are shown in Table 5-1 and summarized below.

(Unit: mm/day)

Month	J	F	M	A	M	J	J	A	S	O	N	D
Moshi	7.1	7.3	7.4	5.1	3.6	3.4	3.5	4.1	6.3	7.5	6.7	6.2
KIA	7.0	7.2	6.8	4.9	3.5	3.4	3.4	4.5	5.8	6.8	6.6	6.5

Potential evaporation between the two stations is nearly the same. The KIA station is located near the project area. Therefore, potential evaporation at KIA is used in estimate of irrigation requirement, since it is situated near the Sanya plain.

5.1.3 Crop coefficient and consumptive use of water

Maize and beans are extensively planted in the project area at present. The proposed cropping pattern consists of such maize and beans as well as sunflower, vegetables and

banana. Crop coefficients of such crops are derived from the afore-mentioned FAO publication.

The consumptive use of water by each crop is calculated by multiplying potential evapotranspiration by crop coefficient as shown in Table 5-2.

5.1.4 Effective rainfall and net water requirement

In order to estimate effective rainfall for each crop, rainfall data obtained from Kilimanjaro International Airport (KIA) are used for Sanya plain and rainfall data at Kibongoto or Lerongo if Kibongoto rainfall data are not available, are used for Boloti and Mungushi areas, since these stations are located near the project areas.

The rainfall amount is clearly dependent on altitude and location. The Kibongoto and Lerongo stations are located at altitudes of 1,250 m and 1,402 m, respectively, while the Boloti and Mungushi areas are located at around 1,000 m. The Kibongoto is located almost upstream of the Boloti and Mungushi areas, but the Lerongo is located in the western skirt of Mt. Kilimanjaro where rainfall amount is 770 mm/year, less than the Kibongoto where it is 990 mm/year on average. Consequently, rainfall data of Kibongoto are converted by multiplying by 0.75 to estimate rainfall in Boloti and Mungushi areas and rainfall data of Lerongo station is regarded as the rainfall in Boloti and Mungushi area.

The effective rainfall is calculated by USDA SCS method on the assumption that the net depth of irrigation application is 70 mm.

5.1.5 Irrigation efficiency

(1) Application efficiency

Sanya plain is flat and has deep soil layers. In this area, border irrigation method or furrow irrigation method can be applied for upland crops. While, in Boloti and Mungushi areas, the area is steep and top soil layer is shallow, and therefore counter furrow or corrugation irrigation only is applicable. Taking the above conditions into account, the application efficiency of 70% is adopted for Sanya plain and 55 % is adopted for Boloti and Mungushi areas.

(2) Losses in canal system in tertiary block

1) Field canal losses

Seepage losses in a small earth canal are estimated by measurement of seepage in an existing small earth canal in Sanya plain and also by the

relationship known as the Moritz formula proposed by the USBR.

Seepage losses in earthen canal were measured in an existing canal running near the soil sampling point of SS15 where the cylinder intake test results show almost average among the results of intake rate tests made in the fields and thus the seepage losses in the existing canal near the SS15 are expected to be an average of seepage losses in earth canals. It was made by ponding method. According to the results, the seepage losses from the wetted perimeter are estimated at 0.5 lit/min/m^2 as shown in Table 5-3, which is almost similar to the results of basic intake rate carried out in SS15 point. By use of this result, seepage losses in small earthen canals having the canal bottom width of 30 cm and side slope of 1 : 1 are estimated. They are shown in Table 5-4 and summarized below:

(Unit: %)

Velocity	Canal Length (m)			
(m/sec)	500	750	1,000	1,250
0.6	6.4	9.8	13.5	17.3
0.5	7.0	10.8	14.8	19.1
0.4	7.8	12.1	16.7	21.6
0.3	9.1	14.2	19.6	25.5

The distance from the tertiary head to the fields is about 750 m on an average through a tertiary canal and a field ditch, and the canal gradient is 1/200 to 1/300 in the most of tertiary and distribution canals which nearly correspond to canal velocity of 0.6 to 0.5 m/sec. Thus the seepage losses in canals in tertiary block are estimated at 10 to 11 %.

The seepage losses estimated by the following Moritz formula under the conditions of the discharge of 0.06 m^3/sec, the velocity of 0.6 m/sec, and C of 0.68 for soil type of sandy loam is 2.4 lit/sec/km (0.14 cusecs/mile).

$$S = 0.2 \times C \times \sqrt{Q/V}$$

Where, S : seepage losses (cusecs per mile)
Q : discharge (cusecs)
V : velocity (ft/sec)
C : constant value depending on soil type

The seepage losses of 2.4 lit/sec/km are converted to 1.8 lit/sec/750 m of average distance of tertiary head to fields which account for 3 % of canal of discharge.

Seepage losses based on the experiment in the field are much higher than those obtained by the Moritz formula. It is supposed to be caused by the conditions that the existing canal is usually used only in the rainy season and that the soil of which the canal is composed is dry and loosened with no compaction and no maintenance.

According to the tests made in loess soils in a reach of the Courtland Canal, Missouri River Basin Project, Nebraska, seepage losses remarkably decrease by compaction of canal-formed soil (approximate reduction in seepage rate of 33 % in water depth of 4.5 ft) and seepage losses decrease with the decrease of water depth. This test suggests that if an earth canal is compacted and maintained well, the seepage losses can be remarkably reduced.

Considering the above, the seepage losses in earth canals to be constructed are taken as twice the value obtained by Moritz formula.

Besides the seepage loss, loss caused every day by filling tertiary and distribution canals with water is estimated at 3 to 4 % on the assumption that all water in these canals becomes loss.

2) Losses in night storage pond

Seepage losses in night storage pond is estimated by the following formula:

$$Q = (4 \times k \times H^2 / 9 / l + k \times H \times h/l) \times L$$

Where, Q : seepage losses
k : permeability coefficient
H : average water depth in pond
l : horizontal length of seepage line
h : depth of impermeable layer from the bottom of the pond
L : length of pond embankment

For safety a permeability of 5×10^{-4} cm/sec is adopted. Water depth is assumed to be 1 m. The horizontal length of seepage line in the embankment is 6 m. The depth of impermeable layer is assumed to be 3 m, because tuff is exposed in the bed of the Sanya river which is nearly 3 m below the field surface. The length of pond embankment is assumed 150 m. Seepage losses are estimated at

0.25 m^3/day/m or 37 m^3/day pond which corresponds to 1.2 to 2 % of total amount of flow to ponds.

3) Losses in canal system in tertiary block

Adding losses caused by error of discharge measurement and mis-operation of control facilities to the above-mentioned losses, losses in the canal system in the tertiary block are judged to be 15 % for the Sanya plain and 20 % for Boloti and Mungushi areas where night storage ponds will not be furnished.

(3) Conveyance efficiency

According to the analysis of seepage losses in earth canals, much loss is expected to occur without lining in long earth canals. If the existing earth canals are used as they are, seepage losses in the canals having a length of 3 km reach 20 to 30 % of total discharge. Thus, the main and secondary canals are proposed to be lined with concrete or concrete blocks to save conveyance losses.

Seepage loss in concrete lining canal or concrete block lining canal is estimated by the equation suggested by Davis and Wilson.

$$Sl = 0.45 \times C \times Pw \times L \times Hw^{1/3}/(4 \times 10^6 + 3,650/v)$$

Where, Sl : seepage losses (m^3/day)
L : length of canal
Pw : wetted perimeter (m)
Hw : water depth in the canal (m)
v : velocity of flow (m/sec)
C : constant value depending on lining, concrete = 1

The calculation results are negligibly small. Also, according to the seepage measurement of concrete block lining in Boise Project, Idaho, USA, the seepage is only 0.06 m^3/m^2 of wetted perimeter in 24 hours. Total wetted perimeter of lining canal in Sanya plain is approximately 40,000 m^2 and water conveyance capacity of canals in total is about 100,000 m^3 in 24 hours. Thus the seepage loss is 2.4 % out of total conveyance.

Adding losses caused by uneven diversion of water at control structures to the seepage losses, conveyance losses is determined to be 10 %.

(4) Overall irrigation efficiency

1) With project condition

The overall irrigation efficiency are estimated as summarized below:

(Unit: %)

	Sanya	Boloti/ Mungushi
Application efficiency	70	55
Field canal efficiency	85	80
Conveyance efficiency	90	90
Overall irrigation efficiency	54 (60)	40

Remark: Figure in parenthesis for Sanya plain is for groundwater irrigation.

2) Without Project condition

At present, few on-farm canals are available in the Project area, and the irrigation run is obliged to be very long in the most of the area due to few on-farm canals, which is supposed to cause water-logging at upstream and water shortage in the downstream parts resulting in very low application efficiency. Also, as afore-mentioned, seepage losses in the existing earth canals are very large. Taking such situations into account, irrigation efficiency at present condition is estimated to be 25 %.

5.1.6 Irrigation water requirements

Irrigation water requirements are calculated by dividing crop water requirements by irrigation efficiency. The results are shown in Table 5-5 to 5-10. Peak irrigation requirements are 1.0 lit/sec/ha at the head of irrigation system and 0.9 lit/sec/ha at the tubewells in the Sanya plain and 0.85 lit/sec/ha in the Boloti and Mungushi areas.

5.2 Canal Layout and Irrigation Scheduling

5.2.1 Cylinder intake rate

The cylinder intake rate tests were carried out at 11 sites with representative soils in the envisaged irrigation scheme areas as described in Annex D.

The basic intake rate is defined the intake rate at which water absorption into soil becomes nearly constant after water supply and is practically obtained as intake rate at the elapsed time of 600 (n-1) minutes after test commencement.

The test result show that the basic intake rates lies between 0.3 to 5.6 cm/hr except one result obtained at SS 5, north end of the Sanya plain, from which soils in the project

area are judged to be optimum or suitable for surface irrigation method. The higher values are observed mainly in the upstream area in the Sanya Plain and lower values in the downstream area of the Sanya.

5.2.2 Furrow intake rate

In general, furrows in the field should be long enough to permit economical handling of the farm equipment but not too long for safe irrigation. Erodibility of the soil, size of the stream, gradient of the furrow should be carefully determined. Because of the lack of enough information for evaluation of the future condition to cover the whole project area, irrigation planning is supplemented by the commonly used criteria prepared by USDA.

In accordance with the criteria, relationship for slopes and depth application in medium soil texture is as follows:

Furrow slope (%)	Max. non-erosive furrow stream (lit/sec)	Depth of irrigation application 50 mm	100 mm	150 mm
		Max. allowable length of run (m)		
0.50	1.20	170	240	295
0.75	0.80	135	190	235
1.00	0.60	112	165	200
1.50	0.45	105	135	160
2.00	0.30	80	115	140
3.00	0.20	65	90	110
5.00	0.12	50	70	80

The gradient of the field in the Sanya plain is 0.5 to 0.8 % and the soil is medium texture. Thus the maximum allowable length of run is around 165 m in depth of irrigation application of 100 mm. While the gradient in Boloti and Mungushi areas ranges from 1 % to 5 %. Thus if the furrow is laid out in perpendicular to the contour line in the steep field having a slope more than around 3 %, the allowable length of run is quite limited. By this is meant that the furrows in such steep fields more than 3 % should be laid so as to intersect the contour line diagonally.

5.2.3 Irrigation schedule

Field irrigation schedules are based on the crop water balance and are expressed in depth and interval of irrigation. Depth of irrigation application is the depth of water that can be stored within root zone between the field capacity and the allowable soil depletion level of water which is easily made available for crops and is interpreted as water contents at initial wilting points. In order to know the relationship between water content at the field capacity level and the

initial wilting point, undisturbed soil samples were taken at 11 points out of which nine points were from the Sanya plain area and remaining two were from the Mtakuja area. These samples were tested at the Agricultural Institute of Ministry of Agriculture and Livestock, Mlingano in Tanga. The results are shown in Annex D. The available water is presented as the difference of water contents at 0.1 bar and 15 bar.

Irrigation interval of each of cropping and depth of irrigation application at the period of peak irrigation water requirements are estimated in Table 5-11 and summarized as follows:

Cropping	Irrigation Interval	Depth of Irrigation Application
	(days)	(mm)
Maize-1	22	121
Maize-2	13	121
Sunflower-1	20	91
Sunflower-2	10	91
Beans-1	13	57
Beans-2	7	57
Beans-3	7	57
Vegetables-1	7	30
Vegetables-2	4	30
Vegetables-3	4	30
Banana	7	53

5.2.4 Daily operation at on-farm level

Water supply operation greatly influences irrigation water supply efficiencies and irrigation system capacities.

It is clear that operation of 24-hr supply makes the minimum canal system capacity and thus leads minimum cost of initial investment, however, irrigation for upland crops needs timely rotation of water from plot to plot or furrow to furrow to avoid water-logging and water shortage and to efficiently use irrigation water. It is however hardly possible to carry out proper water distribution at night when no farmers work in their fields and thus night irrigation causes not only water-logging in some of the fields and water shortage in other areas, but also a lot of losses of water resources much limited especially in the dry season in the Sanya basin. Considering above into account, day-time irrigation is contemplated in the field level.

The time of daily operation is analyzed in the relation between irrigation water requirements and daily working hours of farmers. As afore-mentioned, longer the daily irrigation operation is planned, less investment induces due to smaller canal capacity. Principally the daily working hour is 8 hours