(b) To increase the food production: The regional Government puts the highest priority on paddy cultivation particularly in the lowlying area where the land is irrigable. In case of the rainfed upland farm, a stabilization of land productivity is assumed by introduction of such drought resistant crop as sorghum, and

(c) To strengthen the agricultural support services, such as farmers credit, farm input supply, training of leading farmers, etc.

Under the regional development plan summarized above, irrigation development is promoted as a fundamental investment project. The Mkomazi Valley Area Irrigation Development Project has been taken up as one of the priority projects of the programme envisaged. The Regional Government places particular emphasis on the development of this Irrigation Project, in that the present infrastructure for agricultural production should be improved through irrigation and drainage control. Paddy cultivation is programmed to be introduced as the main farm product for not only sustaining the farmers economy but satisfying the regional or national demand of food consumption. Furthermore, the resettlement of farmers from the densely populated highland in the South Pare Mountains is promoted to the project area.

3.1.2 Major constraints for agricultural development

Through the study so far made on the physical conditions in the project area, major constraints for agricultural development can be summarized as follows:

(a) A shortage of sustainable soil moisture for crop growth due mainly to uneven seasonal and annual distribution of rainfall as well as defective irrigation system provided,

(b) Seasonal flooding and/or inundation due to lack of drainage system and depressed topography, and

(c) Deficient soil conditions such as plastic and sticky consistence when wet and hard or firm consistence when dry, high salinity and/or alkalinity, etc.

Among them, a shortage of soil moisture and poor drainage conditions are the largest constraints prevailing over the whole project area. The present agricultural production and land use in the area are influenced by drought even in the rainy season. Inadequate operation and maintenance of the existing irrigation system, so-called traditional furrow, make a supply of soil moisture difficult at present.

Seasonal flooding and inundation, though somewhat is used for paddy cultivation and it is also convenient for leaching out the salts accumulated in the soil surface, restrict the crop cultivation in time, particularly in the lowlying area.

Deficit of soil consistence makes smooth soil preparation difficult. Recently, the regional government has started to provide a tractor service for soil preparation, but more than 80% of the farm land is still cultivated by hand. As a result, farmers are often missing a chance to grow crops in the most suitable crop season, and some 300 ha or more of arable land in the project area lies fallow annually. High salinity and/or alkalinity of soils are another limitation to the land use and land productivity.

Other than the above physical constraints, lack of a farm road network discourages farm operation, particularly of tractor work and constrain the farmers to apply farm inputs and harvesting the crop in time. An extensive operation of the supporting services also puts the present agricultural practices in less active. The land fragmentation and distribution of land to several locations are the agrarian problem. In view of the facts that the land productivity is substancially low at present, infrastructural development as well as redistribution or agrarian restructure are one of the important factor, to realize the maximum exploitation of agriculture in the project area. Strengthening of the agricultural supporting services is the vital importance.

3.1.3 Specific objectives for development

As studied in the preceding ANNEX D,the agricultural production in the Kilimanjaro Region is still short of meeting the self-sufficiency in food due to the heavy pressure on rapid population increase which would bring about more serious pressure in the future.

Food production in the Mkomazi Valley Area is rather surpassing to meet the requirement of rural consumption at present. However, the present agricultural farming is still at low level which results in low income of the farmers. Hence, the farmers' livelihood is still at subsistence level. The land fragmentation due to population growth is also constraints on improvement of living standard of the people.

In order to overcome such situations, an intensification of land use pattern and introduction of modern farming practices through intensified irrigation are essential. Rehabilitation and improvement of the existing irrigation system and drainage improvement are the basic requirement for successful intensification of land use and improvement of the traditional farming practices.

In due paying attention to the above circumstances, besides, taking into account the national and regional development policy as well as the constraints prevailing in the project area as a whole, specific objectives for the agricultural development is set as follows:

(a) Removal of the present constraints is of the prime significant. Among the major constraints, shortage of sustainable soil moisture for crop growth should be solved by rehabilitation of the irrigation system. Likewise, seasonal flooding and/or inundation in the lowlying area should be prevented by the flood control and drainage improvement to the extent economically feasible. Soils which are plastic and sticky when wet and hard consistence when dry will have to be more efficiently utilized for paddy cultivation. It is

anticipated that high salinity and alkalinity of soils can be lowered to suitable range for crop growth through paddy cultivation under irrigated condition.

(b) The agricultural productivity, which remains substantiall low in the project area, should be heightened by modernized farming practices including irrigated farming, drainage control, use of high-yielding varieties, application of chemical fertilizers and other farm inputs, effective utilization of soils, and adequate operation of agricultural supporting services. Increase in land productivity will be attainable by the crop diversification with paddy.

(c) A production increase is attainable through heightening of land productivity and increase in land use opportunity or cropping intensity. Since acreage of arable land has limitation to some extent in the project area, land will have to be utilized more intensively under proper irrigation operation.

(d) Improvement of infrastructures for agricultural production is indispensable for the stabilization of agriculture as well as for increases in productivity and production. In this context, irrigation and drainage improvement and flood control as well as provision of farm road network are essential.

(e) Farmers' living standard is to be improved and stabilized by increases in production of farm products. Although a potential arable land is limited to small extent, transmigration or resettlement of farmers would be contemplated in this development.

3.1.4 Basic Strategies for Development

In view of the major constraints and the development potentials, the basic strategies for attaining the specific objectives for the agricultural development in the project area are formulated hereunder:

(1) Irrigation development

Irrigated farming will be introduced to solve the problem of shortage in soil moisture by efficiently utilizing available water resources. Since available water for irrigation is rather limited when compared with the total irrigation requirement for all the arable land, the most efficient irrigation network and facilities are to be provided. In this context, the maximum use of water resources in the basin will be studied.

(2) Drainage improvement and flood control

Poor drainage conditions in the lowlying area should be improved to the maximum extent. When the seasonal stagnation is substantially drained from alluvial depressions, 750 ha of land would be turned into arable land for paddy production. With respect to flood control,

provision of floodways will be studied so as to release flood water as quick as possible. In particular case in the Kihurio scheme training of the Mkomazi river will be required in order to improve the drainage conditions in the lowlying area.

(3) Construction of dams

Since the seasonal runoff of each river irregularly fluctuates from time to time according to the rainfall distribution, it is difficult to secure effective and/or constant operation of irrigation even in the rainy season. Besides, because the majority of runoff in the rainy season is wasted ineffectively to the downstream, and in contrast, quite limited amount of runoff in the dry season, the land use opportunity in the dry season is limited to small extent at present. Thus, in order to solve the above problems and to utilize the water resources at the maximum extent, construction of reservoirs with dams in the upstream of the rivers will be studied in the framework of the development plan of irrigation from the technical and economical point of view.

(4) Network of farm road

To support effective and smooth operation of the crop production, the farm road network will extend all over the arable land. The construction of farm road will be in principle made along the irrigation canal, i.e. main, secondary and tertiary canals, so as to minimize the construction cost and operation and maintenance of the canals.

(5) Crop production

The present staple crops, such as maize, paddy and beans will be the major crops in the future. Among them, paddy is taken up as the principal product in the irrigation area, in consideration of crop productivity, soil characteristics, familiality to the farmers, regional policy, etc. Double croppping of paddy a year is practiced as far as the irrigation water is available.

Maize and beans will be cultivated under the rainfed conditions where the land will lie waste fallow from the irrigation due to areawise rotation of irrigation operation.

(6) Inroduction of modernized farming practices

Improvement of the traditional farming and/or modernization of farming practices are indispensable, including use of high-yielding varieties, application of fertilizers and chemicals, and extension of effective farm mechanization, etc.

(7) Livestock production

In principle, the present condition of livestock grazing will continue into the future. It is anticipated that the productivity and quality of production will be improved by the use of by-product of paddy

cultivation, such as straw, bran, etc.

(8) Conservation of environment

Agricultural development sometimes causes a deterioration of natural environment. Thus, herein the development plan, the works will be designed in such a manner as to conserve natural environment and ecological systems. In this context, particular attention will be paid to the soil conservation, especially against the salinization cum alkalinization. Attention is also to be paid to prevent contamination by application of agro-chemicals and to conserve ecological systems of the rivers.

3.2 Change of Demographic Constitution

As stated in section 2.2, the project area is inhabited by 24,500 of farm population, as of 1982. The total farm families are estimated at about 5,020 in which one family consists of 4.9 persons on an average.

An annual growth rate of population in the Kilimanjaro Region as well as Same District has been estimated at 3% on an average during the past seven years from 1976 to 1982. As for the prospective increase of population, the International Bank for Reconstruction and Development (IBRD) has been forecasted in case of both medium (1985 and 1990) and long terms (1995 and 2000) annual growth rate of population concerning the specific zonal areas in the world/1. According to the reference available, the population of Tanzania would increase rather sharply at the annual growth rate of 3.0% for 1983-1990, 2.9% for 1991-1995, and 2.8% for 1996-2000.

If the above figures are directly applied to the population forecast in the project area, the population engaged in agriculture will increasingly grow to 31,000 persons (or about 1.3 times the present population) in 1990 and about 41,100 persons (or about 1.7 times) in 2000, as estimated in Table E-27.

The farm families in future are also estimated based on the present population of both teenage and old age groups. The present population of teenagers consist of 3,000 males and 3,080 females. The assumption preliminarily made that these teenagers will attain marriageable age by the year 2000 and be set up about 3,000 new families. On the other hand, older generation more than 55 ages, which consists of 1,850 males and 1,500 females and they form some 2,000 households, will be retired from the agricultural production. Their patriarchy in household will be, then, relayed to these younger generations. In this view, it is estimated that about 1,000 new farm families will be added to the present 5,020 in the year 2000 as shown in Table E-27.

According to the forecast of future farm population and farm families made above, it is estimated that an average family size will increase to about 6.8 persons per household, or which some 2.9 persons are considered to be family labour force for the agricultural production.

/1 : Price Prospect for Major Primary Commodities (July 1982), IBRD

In addition to the above estimation, if the proposed development plan is implemented, about 1,300 farm families with 9,000 persons will be able to migrate in the expanded area as stated in the section 3.5. Accordingly, population and farm families in the project area will be about 50,000 and 7,300, respectively in the target year of 2000.

3.3 Forecast Change of Land Holding Size

As presented in the preceding section 2.3,the land holding under the traditional cultivation right has been recently diminished in size by the land fragmentation through change of generation. It is foreseenable that this condition will be continuously proceeded for future because of further increase of population and farm families, limited employment opportunities, and limited potential arable land in and around the project area.

As estimated in the former section 3.2, total farm family will be about 6,000 in the year 2000. Out of them, a certain part will engage in the works of other economic sectors particularly in the industrial development which is being promoted by RDD office, Kilimanjaro Region, but greater parts will remain in the project area.

Based upon the assumption made above, prospective size of land holding will diminish in 0.65 ha per farm family on the average in the year 2000.

3.4 Proposed Land Use

As stated in detail in the preceding Chapter 2, the present land use has been almost exploited to its potential maximum. In the future condition without the project implementation, it is foreseeable that further expansion of the farm land will be quite limited to the small extent, because such physical constraints and hazards as poor drainge, seasonal flooding, saline/alkaline soils, etc. are dominating over the potential arable land.

As for the future condition with the project implementation, which is selected through the alternative study made in Annex G, present land use conditions will considerably change as shown in Table E-28. All or most of the present arable land and non-agricultural land will convert into the rotational paddy field and the right of way for newly installd irrigation and drainage facilities. In case of the Gonja and Ndungu schemes, however, 160 ha and 170 ha of non-agricultural land will remain as what it is, respectively. Further in the Ndungu scheme, 70 ha of present arable land will be submerged coused by hightening the Kalimawe dam. Accordingly, the irrigable area in the project area will come to 4,760 ha in total.

According to the future development preliminarily foreseen above, the development effect by the increment of irrigation area as well as land use opportunity is assessed as shown in Table E-29 and as summarized below:

Unit: ha

Category	Without Project Implementation	With Project Implementation	Incremental Effect
Arable Land	3,890	4,760	870
Cultivated Area	4,080	8,820	4,740
Rainy season irrigation	1,090	4,060	2,970
Dry season irrigation	490	2,780	2,290
Rainfed	2,500	1,980	-520
Crop Intensity	1.0	1.9	0.9

It is expected that about 870 ha of arable land will be newly developed by the project implementation and convert into the irrigable area. Thus, the toal irrigable area to be developed is estimated at 4,760 ha as already mentioned in the above. However, year-round irrigation for the total irrigable area will not be expected even in the future with project condition because of the low availability of irrigation water. In the total irrigable area, therefore, 4,060 ha of paddy field will be irrigated in the rainy season and 2,780 ha in the dry season under the annual rotational programme to be introduced in the project area, but 1,980 ha of land will be left from the annual rotational irrigation programme as a rainfed area.

3.5 Transmigration

As shown in Table E-29, 940 ha of arable land, i.e. 210 ha in the Kihurio scheme and 730 ha in the Igoma scheme will be newly developed in the future with project condition. Out of 210 ha of arable land newly developed in Kihurio scheme, 70 ha of land will be given preferentially to about 100 farm households who will lose their 70 ha of farm land caused by heightening the Kalimawe dam. Accordingly, the net incremental arable land will be expected 870 ha in total in the project area. These areas are considered to be accepted migrants of about 1,300 farm households, if each farmer will be given 0.65 ha of farm land which is estimated as an average holding size in the target year of 2000.

3.6 Selection of Crops and Varieties

In planning the future agricultural production programme in the area to be contemplated for the development, selection of major crops is made in the light of the following factors:

(a) The national and regional policy on food security as well as the basic strategies for the future agricultural development, as outlined in the preceding Section 3.1,

(b) Adaptability of crops to the local conditions, such as climate, soils, etc.,

(c) Familiality to the local farmers, and

(d) Marketability and profitability of crops.

In due consideration of such major factors, paddy which is now being cultivated rather extensively in the project area, is first selected as the most essential crop for cultivation in the irrigation area. Maize and beans are also selected as major staple crops, particularly for rainfed cultivation under the rotational irrigation operation which will be designed in the following Sections.

With respect to the livestock development the present free-grazing will be continued even in the future condition with the project. No diversification to the special feeder crops is contemplated at the moment, due to limited potentiality both on the land and water resources.

In order to attain higher return of the crop cultivation, introduction of the high-yielding varieties is the essential significant. In selection of the high-yielding varieties, further consideration should be paid to the specific terms of crop growing, which will have to be shorter period for maturation, so as to secure the most optimum crop season particularly from the viewpoint of effective water utilization. To this end, the following varieties of each crop are selected:

Recommendable Crop and Variety		Specific Growing Days Estimated
Paddy	: TOS-103	120 - 135
	BG-90-2	120 - 130
	IR.22	120 - 130
	IR.24	120 - 130
	IR.28	100 - 110
	Afaa Mwanza	130 - 140
	Afaa Kilombero	130 - 140
Maize	: Katumani	90
	ICW	110 - 120
	UCA	110 - 120
Beans	: Canadian Wonder	90 - 110
	Kidney Dark Red	90 - 95
	Santa Ana	90 - 110
	California Red	80 - 95

Note: The specific growing days in each variety except paddy are directly referred to those provided by TANSEED, Arusha. Gorwing days of paddy varieties are estimated based on the experimental data obtained from the Uzowani Rice Pilot Farm, Nigeria Abu Gasaba Rice Pilot Farm, Sudan and Mombo Irrigation Project, Tanzania.

Out of the crop varieties selected above, some varieties of paddy are not available in Tanzania at present. Thus, it is recommended to establish the seed multiplication system for paddy so as to extend suitable varieties, smoothly.

With respect to maize varieties, various high-yielding varieties have been recently developed in Tanzania and extensively propagated under the previous campaign on maize production increase programme. In this development plan, the composite varieties in Tanzanian original are primarily selected. The hybrid varieties of maize, which is also available in Tanzania, is conceptually precluded from the selection, because their long maturation period will restrict the land use opportunity for dry season cropping under the conditions without the irrigation. The seed preparation of hybrid, which will have to be changed year and year for maintaining the high-yielding conditions, is another reason of this exception mainly from the farm economic viewpoint.

The high-yielding varieties of beans have been multiplied by TANSEED and the annual seed productions are to be enough to meet the requirement estimated in this development plan.

3.7 Proposed Cropping Pattern

In programming the most adaptable cropping calendar to be proposed in the area for development, the climatic conditions as noted in ANNEX A are thoroughly studied. Particular attention is paid to rainfall distribution in the rainy season as well as lower air temperature and shorter sunshine hour in the dry season. A heavy precipitation, which mainly occurs during November to December and again in March and April, will restrict an effective farm operation especially of soil preparation and harvesting works.

As for the air temperature, our rice trial cultivation made in Sudan reveals that a lower temperature ranging between 15°C and 17°C is a critical factor for the generative growth of paddy. In due consideration of this fact, it is better to preclude the generative growth stage of the paddy cultivation from the cool season which is characterized by the minimum temperature ranging from 13°C to 17°C during mid-May to October, though the said plant physiological stress shall be confirmed through the agronomical monitoring in the project area. A shorter sunshine and rather low solar-radiation would also result in damage of the specific growting of paddy. Thus, from the effective and economical water utilization viewpoints, this season is preliminarily excluded, from the main vegetative stage in paddy cultivation.

With regard to maize for the proposed crop production, no significant seasonal variation on yielding conditions is observed in the project area. Thus, the suitable cropping calendar for maize is set on a season during the months from October to May where the soil moisture is available under the rainfed conditions.

Based upon 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 the recommendable cropping calendar for each crop is formulated as follows:

Major Crops	1st Cropping		2nd Cropping	
	Seeding	Harvesting	Seeding	Harvesting
Under irrigated conditions;				
Paddy	September	January to mid-February	mid-January to February	June
Under rainfed conditions:				
Maize	November	February	-	-
Beans	November	February	-	-

As explained in the preceding Section 3.6, the paddy cultivation is primarily introduced in the area to be irrigated both in the rainy and dry seasons. Maize and beans will be cultivated in the non-irrigated area where the land lies waste fallow from irrigation to be operated according to the proposed annual rotation programme. Since the land holding size per farm household will diminish gradually, maize cultivation mixed-cropping with beans is planned in this cropping pattern.

Based upon the basic layout of the cropping pattern and the prospective development, cultivation area of major crops in each scheme is estimated in the following table, and the proposed cropping patern is illustrated on Fig. E-12.

Unit: ha

Major Crop	Kisiwani	Gonja	Ndungu	Kihurio	Igoma	Total
Paddy						
-Dry season	180	300	230	1,320	750	2,780
-Rainy season	360	600	680	1,670	750	4,060
Total	540	900	910	2,990	1,500	6,840
Maize/Beans	180	740	710	350	-	1,980

3.8 Proposed Farming Prctices

In order to expect the highest return of crop production under the conditions with project implementation, improved farming techniques will have to be introduced in the operation of the proposed crop production programme. In this context, the study is made to introduce the most practical and applicable farming techniques and practices, in the light of the following conditions:

(a) Field conditions to be improved,

(b) Familiality of farmers with irrigation practices and modernized farming techniques,

(c) Desire and intention of farmers,

(d) Extent of present mechanization, and

(e) Availability of labour force in the project area.

The major farming practices to be recommendable are outlined as follows:

(1) Farm-machinery use

- Soil preparation for all the crop cultivation will be made by tractor. To this end, the farm mechanization programme being promoted by RADO will be fully referred to.

- As regards the plant protection, intensive application of insecticides are required for control of stem borers, plant hoppers, blast, bacterial leaf blight, etc. It is recommended that the plant protection works should be carried out in a systematic way through use of sprayers.

(2) Inputs use

- High-yielding varieties recommended in the preceding section will be introducted for all the crops, even cultivation of maize and beans under the rainfed conditions.

- Application of fertilizers and agro-chemicals is essential so as to maintain the production. Since the soils are, more or less, alkaline in the project area, ammonium sulphate as nitrogen source is recommendable for both paddy and upland crops, and super-phosphate for the element of phosphorous for both crops. An application of potash is not required in this area. To favorably control crop growing, a split appliation method is recommendable.

- Weed control is one of the essential practice for maintaining the maximum production of crops. A variety of herbisides, have been developed for weeding. However, these chemicals are still harmful for human being and livestock producion as well as for the natural environment. Therefore, it is proposed weeding is be to carried out by the labour force to the maximum extent. Based on the experimental data obtained from the Mombo Irrigation Project, Tanzania Region, Uzowani Rice Pilot Farm, Nigeria and Abu Gasaba Rice Pilot Farm, Sudan, the dosage of farm inputs are preliminarily estimated for each crop as shown in Table E-30.

(3) Improved farming practices

The result of analysis of yield survey indicate that the important factor for the increase of paddy yield are to increase the number of grains per unit area and percentage of ripened grains. The essential points to be taken for these two factors are presented in section 2.7.1.

Referring to the above mentioned theoritical paddy cultivation techniques, the following farming practices are proposed to be introduced into the project area after completion of the irrigation facilities.

Nursery

The transplanting method requires raising healthy seedling in the seedbed. Healthy seedling can cope better with field conditions which may effect the growth of young rice plant. The wetbed nursery is

recommended to the project area because irrigation water will be abundant in future. Varietal purify is the most important requisite for the selection of seed. Varietal purify means that the seed must not contain seed of other varieties in excess of stipulated maximum percentage as shown in the following table. This is to insure genetic identity and uniformity of the rice crops.

International Seed Standards (Minimum) - Rice/1

Factors	Standard for each class		
	Foundation	Registered	Certified
Pure seed (minimum)	98%	98%	98%
Red rice (maximum)	None	1 per 5 kg	1 per 2.5 kg
Other varieties (maximum)	None	None	2 per 0.5 kg
Inert matter (maximum)	2.0%	2.0%	2.0%
Total weed seeds (maximum)	0.05%	0.05%	0.1%
*Total objectionable weeds	None	None	None
Germination rates (minimum)	80%	80%	80%
Moisture content (maximum)	14%	14%	14%

/1: "Seed Production and Certification", Beachell and Barker, International Rice Research Institute. February, 1968.

Land preparation and Fertilizing

There should be enough water in the paddy field to soften the soil before repairing the dikes. Repairing the dikes is essential particularly in the area where is characteristics of leaking paddy field. Paddy field should be tilled at least 15 days before transplanting. Immediately after plowing add water to speed up decomposition of weeds and crop residues that are plowed under. Keep the field flooded until transplanting to minimize loss of nitrogen, released by decomposing organic matter. After the first plowing, let 7 to 10 days pass before harrowing, lower the depth of water in the field to show the high and low spots. Then harrow the field lengthwise and crosswise. These operation break the soil clods and incorporate weeds, straw and stubble in the mud. Just before transplanting puddling will be carried out for land leveling.

Proper application of fertilizer is essential for full exploitation of agricultural potential under irrigated condition. The total fertilizer requirement for substaining the target yield would be 90 kg and 80 kg/ha of nitrogen, 70 kg and 60 kg/ha of phosphate for dry and wet season paddy. The basic fertilizer application is a half of total nitrogen and whole quantity of phosphate when field preparation is practiced. Top dressing is made in 2 times, i.e., just before the maximum tillering stage of about 15 day after transplanting and at the spikelet differentiation stage corresponding to 25 days before heading. The amount of fertilizer to be applied per hectare is one-fourth of total nitrogen in the stages mentioned above.

Transplanting

Straight row planting is recommended. In this method, the seedlings are planted in straight rows. The benefits derived from this practice are; 1) Optimum plant spacing is possible. 2) It facilitates topdressing of fertilizer and application of insecticides. Generally, rice plants are spaced wider in the wet than in the dry season because in the wet season, the plants tend to grow more profuse leaves and tillers. These increase mutual shading. The transplanting will be better spaced 25 cm x 20 cm in the wet and 30 cm x 15 cm in the dry season. When the use of hand rotary, it must be taken more than 30 cm wider between from row to row.

Intermittent Irrigation

Intermittent irrigation is to supply water at irregular intervals. The yield in this practice is variable depending upon the ability to maintain the soil at least in a saturated conditon especially during period from panicle initiation to about crop maturity. Plant growth varies depending upon the amount and distribution of rain and irrigation water. When it is not possible to maintain a flooded condition in the paddy field, Rice plant tend t be shorter and have more tiller and great resistance to lodging.

Plant protection

Plant protection for paddy cultivation will also be carried out without delay from the proper time. Recommendable agrochemicals for insects are sumithion, diazinon, etc., and for disease control, Kasumin and Kitazin are recommended. The rat damage is very serious. Rodenticides like zink-phosphate will be applied at the rate of about 0.2 kg per ha.

Harvesting

It is essential to harvest the paddy crop on time in the project area, otherwise grain losses may result from feeding by rats, birds and insects and from shattering and lodging. There is conclusive evidence that both early and late harvests are detrimental to the grain yield and to milling returns of rice. The paddy grains should be ready to harvest when 80% of the panicles ar straw-colored and the grain in the lower proten of the panicle are in the hard-dough stage. In general, it is well known that the best time for harvestig transplanted paddy are between 30 and 42 days after heading in the wet season and between 28 and 34 days after heading in the dry season. All growers of paddy should give attention to reduce the harvest losses to the minimum.

Based on the farming practices mentioned above, the labour requirement for each crop per ha with project is estimated as shown in Table E-31. The monthly labour requirement with project condition in the project area is estimated on the basis of the proposed cropping pattern and the labour requirement per ha of each crop as shown in Table E-32. The peak of labour requirment is estimated at 342,900 man-days in February. While, labour force available in the project area is

estimated at 515,000 man-days/month. As the results of the above estimation, it is considered that all the proposed farming practices will be done by labour force available in the project area.

3.9 Anticipated Yield and Production

3.9.1 Anticipated crop yield

The crop yield is generally low partly due to the application of unimproved varieties and partly due to lack of fertilizers applicaton, plant protection against pest and diseases and proper farming practices. The low yield is attributable to uncontrolled water supply subject to even distribution of the rainfall.

Under the future condition with project, the productivity of paddy is expected to increase considerably through solution to the problems of small number of grains per square meter and low percentage of ripened grains by effective counter measures discribed in the Section 2.7.

Based on the assessment in said section 2.7 and further the results of field trials in the Mombo irrigation Scheme in 1979, the unit yield of rainy season paddy is expected to be 5.0 tons per hectare. As for the dry season paddy, it is rather conservatively estimated at 4.5 tons per heatare considering the fact that low temperature during the early growing period of paddy affects adversely to paddy growth.

The productivity of maize and beans are also expected to increase through extensive use of inputs, expansion of introduced farming technics and effective irrigation. The anticipated crop yield is estimated as follows:

Crops	Yield (ton/ha)
Dry season paddy	4.5
Wet season paddy	5.0
Maize	2.0
Beans	0.8

3.9.2 Build-up period of target yield

The yield of paddy will increase gradually corresponding to the increase of land productivity and will attain the expected yield in the 3rd year for the Kisiwani, Gonja, Ndungu and Kihurio schemes and 5th year for the Igoma shceme after completion of the irrigation facilities. Though intensive extension services will be provided for the Igoma scheme, it is expected to take longer time for attaining the target yield than the other schemes since this scheme is not well accustomed to irrigated farming. The yield during the build-up period are presented in the following table.

Unit: ton/ha

Build-up period(Year)	1	2	3	4	5
Igoma:					
Dry seson paddy	3.0	3.7	4.1	4.4	4.5
Rainy season paddy	3.3	4.1	4.6	4.9	5.0
Kisiwani, Gonja, Ndungu, Kihurio:					
Dry season paddy	3.7	4.3	4.5		
Rainy season paddy	4.2	4.8	5.0		
Kisiwani, Gonja, Ndungu, Kihurio, Igoma:					
Maize	1.7	1.9	2.0		
Beans	0.7	0.75	0.8		

3.9.3 Anticipated crop production

Based on the crop yield estimated before and reference to the cropping pattern stated in the preceding section 3.7, anticipated annual crop production is estimated as follows:

Unit: ton

Crop	Kisiwani	Gonja	Ndungu	Kihurio	Igoma	Total
Paddy						
Dry season	810	1,350	1,035	5,940	3,375	12,510
Rainy season	1,800	3,000	3,400	8,350	3,750	20,300
Total	2,610	4,350	4,435	14,290	7,125	32,810
Maize	360	1,480	1,420	700	-	3,960
Beans	140	590	570	280	-	1,580

Upon the basis of the prospective agricultural conditions in the future with and without project implementaiton, incremental production of major products is estimated as shown in Table E-33, and summarized hereunder. The production of paddy for future with project condition will be increased about 30,260 tons or about 13 times the production without project. As for both of maize and beans will also be increased about 1.5 times.

Unit: ton

Crop	With Project	Without Project	Increment
Paddy	32,810	2,550	30,260
Maize	3,960	2,380	1,580
Beans	1,580	945	635

3.10 Market and Price Prospects

3.10.1 Marketing prospects of crops

In Tanzania, the present productive level of cereals such as maize, paddy, wheat, sorghum and millet is still low due to the lesser development of infrastructures and the insufficient agricultural support services. Recent crop production rather decreases and gives an impetus of spending a large amount of capital for the import of supplementary food. The average import of cereals during 1978 to 1980 amounted to 190,000 tons per annum.

In the past, in the Kilimanjaro Region, production of cereals except finger millet had a surplus above the regional demand. However, because of recent crop production decrease mainly due to drought problem and population increase, the Region is obliged to import cereals; mainly rice and maize, from outside. The total amount imported was 13,300 tons in 1980/81 and 12,500 tons in 1981/82, and it is expected that the demand for these cereals will increase because of population increase particularly in urban areas in th Region.

The marketable surplus of products in the project area after implementaiton of the project is estimated based on the following assumptions:

(a) Population in the project area will be increased (See section 3.3).

(b) Seeds and waste requirements are taken as 10% of total production.

(c) Milling recovery rate from paddy to rice is 62%

(d) Per capita consumption of products are assumed at 80 kg of rice, 50 kg of maize and 30 kg of beans per annum.

In the target year of 2000, the expected marketable surplus of products is about 23,000 tons of paddy and 1,000 tons of maize. As for beans, however, the production will not meet the home consumption in the project area and about 80 tons of inflow will be required to the project area. The results of the above discussion are summarized in the table

below:

Unit: ton

Item	Paddy	Maize	Beans
Crop requirement in 2000	6,450	2,500	1,500
Total production	32,810	3,960	1,580
Seeds and waste requirement	3,280	400	160
Marketable surplus	23,080	1,060	-80

From the above study, the surplus of paddy and maize would be consumed in the urban areas in the Region.

3.10.2 Processing and storage facilities

The milling capacity of rice at the existing 20 mills is estimated at 35 tons per day in the project area. Supposing that working days for milling are 250 days in the year, about 8,750 tons of rice can be milled by the present milling facilities which indicate sufficient milling capacity for home consumption in the future with project condition.

On the other hand, the present godown capacity in the project area is estimated at about 4,000 tons even inclusive of NMC's godown in Same town, while the marketing surplus of paddy is estimated at about 23,000 tons in the future with project condition. Consequently, it is required to establish new godown facilities in the project area.

3.10.3 Price prospects

The estimation of economic prices for the farm inputs and outputs is examined on the basis of the following conditions.

(a) Major crops, such as paddy, maize and beans will be imported supplementally, and hence, the prices of these crops are estimated on the basis of import substitution.

(b) Because of limited assembling and manufacturing in Tanzania, the prices of farm inputs except the improved seeds and miscellaneous consumables are estimated on import substitution.

(c) The other prices of farm inputs such as seeds and sacks are estimated by applying price indexes in the short range to the current prices.

In setting the prospective prices on the farm inputs and outputs, shadow price factor (SPF) is also studied to assess economic variability of the proposed agricultural development realistically. Based on the current external trade in Tanzania, SPF is estimated at 1.12 as shown in Table E-34. Then, the current exchange rate of US$1.00 equal to TSh. 12.00 (as of the end of July 1983) in terms of the financial price factor is converted to a rate at US$1.00 equal to TSh. 13.50 in terms of the economic price factor. In addition, conversion between international market prices and farm-gate prices is made, making reference to "The Price Prospects for Major Primary Commodities" prepared by IBRD, July 1982.

Based on the conditions established above and the consitutional factors affecting price prospects, the economic prices of farm inputs and outputs are estimated as shown in Tables from E-36 to E-37 and summarized in Table E-35 together with financial prices.

As for the financial prices, the present market prices are fully refered. The economic prices are the price for the economic evaluation of the project in view of its place in the national economy. The financial prices are the price for appraising the financial viability of the project.

3.11 Project benefits

The project benefits to be expected are defined as the difference of net return from crop production between future with project and without project conditions. On the basis of the estimated gross income and producion cost, net return per ha of each cropping condition is calculated both with and without project conditions in future as shown in Table E-38 to E-39.

Applying the estimated net return mentioned above to the cropping area, total net return accrued from agricultural production is estimated on both with and without project conditions as shown in Table E-40 to E-41.

The project benefits are calculated based on the above result. The benefits are expected to increase year by year and reach the full benefits within seven years in the Igoma scheme and five years in the other four schemes after commenement of the partial operaion of the project as shown in Table E-42. On the other hand, production losses for 70 ha of farm land due to submargence by the hightening the Kalimawe dam are evaluated in terms of negative benefit, and deducted from the incremental benefit in the Kihurio scheme. This negative benefit is estimated at TSh. 170 x 10^3 as shown in Table E-40. Consequently, the benefits at full stage is estimated at about TSh. 112,100 x 10^3 as summarized below.

Unit: TSh.x 10^3

Scheme	Total Net Return With Project	Total Net Return Without Project	Negative Benefit	Net Incremental Benefit
Kisiwani	10,350	1,910	-	8,440
Gonja	20,550	3,160		17,390
Ndungu	20,690	3,240		17,450
Kihurio	51,560	6,840	170	44,550
Igoma	24,310	40		24,270
Total	127,460	15,190	170	112,100

3.12 Farm Economy

In order to asess the project from the viewpoint of the farmers' economy, the financial balance of crop production by each cropping condition under the future with project condition is estimtaed as shown in Table E-43. Based on the above financial balance and cropping acreage, gross and net production return are also estimated at about TSh. 225,372 x 10^3 and TSh. 188,459 x 10^3 , respectively as shown in Table E-44.

As for the livestock, it is considered that the present condition will be continued even in the future with project condition, although some improvement of productivity will be expected by the use of by-products of paddy cultivation. The gross and net income of livestock production per farm household in the future with project condition, then, are estimated at about TSh. 1,050 and TSh. 890, respectively. In addition to the above estimation, following asumptions are applied for preparation of farm budget for future with project condition.

(a) Forecasted number of farm household including migrant is applied (about 7,300 farm households in the target year of 2000).

(b) The increase rate of living expenses except home consumption of crop produciton is at 30%.

(c) Off-farm income is not counted.

(d) Amounts of annual home consumption of rice, maize and beans in the average farm household having 6.8 family members are 545 kg, 340 kg and 205 kg, respectively.

As the results, the farm budget for average farmer in the future with project condition is prepared together with the farm budget without project as shown in Table E-45 and outlined below:

Unit: TSh.

Item	Without Project Condition	With Project Condition
A) Gross Icome	8,000	31,920
(1) Farm inome	7,500	31,920
(2) Off-farm income	500	-
B) Gross Outgo	8,000	17,310
(3) Production cost	1,240	5,220
(4) Living expences	6,760	12,090
C) Net Reserve (capacity to pay)	0	14,610
D) Net Farm Income (1-3)	6,760	26,700

Gross farm income with project on the farmer will be expected to become about 4 times of that of without project condition. Net farm income with project will also be expected to increase about 4 times . Annual net reserve or capacity to pay of the average farmer will be about TSh. 5,710 on average farmer with project condition.

Table E-1 POPULATION AND FAMILY IN THE PROJECT AREA (1982)

Category	Scheme					Total/ Average
	Kisiwani	Gonja	Ndungu	Kihurio	Igoma	
Farm Population	2,720	6,400	5,840	9,390	150	24,500
Male	1,350	3,180	3,000	4,650	75	12,255
(%)	(50)	(50)	(51)	(50)	(50)	(50)
Female	1,370	3,220	2,840	4,740	75	2,245
(%)	(50)	(50)	(49)	(50)	(50)	(50)
Teenager (10-19)	590	1,440	1,290	2,730	35	6,085
Male	280	690	640	1,380	15	3,005
(%)	(47)	(48)	(50)	(51)	(43)	(49)
Female	310	750	650	1,350	20	3,080
(%)	(53)	(52)	(50)	(49)	(57)	(51)
Work Age Pop. (15-54)	1,120	2,730	2,610	4,070	60	10,590
Male	530	1,310	1,310	2,010	30	5,190
(%)	(47)	(48)	(50)	(49)	(50)	(49)
Female	590	1,420	1,300	2,060	30	5,400
(%)	(53)	(52)	(50)	(51)	(50)	(51)
Old Age Pop. (over 55)	410	1,050	730	1,140	20	3,350
Male	230	580	410	620	10	1,850
(%)	(55)	(55)	(56)	(54)	(50)	(55)
Female	180	470	320	520	10	1,500
(%)	(45)	(45)	(44)	(45)	(50)	(45)
No. of Farm Family	570	1,440	1,200	1,780	30	5,020
Ave. Family Size	4.8	4.4	4.9	5.2	5.0	4.9
Ave. Labour Force per Farm Family	2.0	1.9	2.2	2.3	2.0	2.1

Note: All the figures are prepared on the basis of the estimation in Table E-2 except Igoma Scheme. The figures for Igoma Scheme are estimated on the basis of the results of the village survey.

Table E-2 DEMOGRAPHY IN VILLAGES RELATED TO THE PROJECT AREA IN 1982

Scheme / Village	Total Population			Teenager (10-19)			Work Age Population (15-54)			No. of Families	Average Family Size
	Total	Male	Female	Total	Male	Female	Total	Male	Female		
Kisiwani											
Mkonga	1,780	890	890	370	170	200	710	340	370	360	4.9
Kisiwani	3,560	1,770	1,790	780	380	400	1,480	700	780	760	4.7
Sub-total	5,340	2,660	2,680	1,150	550	600	2,190	1,040	1,150	1,120	4.8
Gonja											
Maore	4,940	2,410	2,530	1,120	520	600	2,100	980	1,120	1,110	4.4
Kadando	1,350	680	670	290	140	150	570	270	300	310	4.4
Mpirani	1,560	810	750	340	170	170	720	380	340	370	4.2
Mheza	2,240	1,120	1,120	520	260	260	920	440	480	480	4.7
Sub-total	10,090	5,020	5,070	2,270	1,090	1,180	4,310	2,070	2,240	2,270	4.4
Ndungu											
Nsufini	1,710	900	810	380	200	180	800	410	390	370	4.6
Ndungu	5,450	2,670	2,780	1,240	590	650	2,350	1,110	1,240	1,110	4.9
Kalimawe	1,800	1,030	770	360	190	170	850	480	370	360	5.0
Sub-total	8,960	4,600	4,360	1,980	980	1,000	4,000	2,000	2,000	1,840	4.9
Kihurio											
Usambara	1,780	840	940	400	200	200	760	360	400	320	5.6
Kankokoro	2,640	1,320	1,320	690	350	340	1,110	540	570	440	6.0
Mvure	3,600	1,790	1,810	820	420	400	1,650	830	820	760	4.7
Mugandu	1,740	880	860	930	470	460	710	360	350	330	5.3
Sub-total	9,760	4,830	4,930	2,840	1,440	1,400	4,230	2,090	2,140	1,850	5.3
Total or Average	34,150	17,110	17,040	8,240	4,060	4,180	14,730	7,200	7,530	7,080	4.8

Note: /1 = All the figures are estimated on the basis of "1978, Population Census" prepared by Bureau of Statistics.

/2 = The average population growth rate of 3.0% in the Same District during the period 1967-1978 is applied for the estimation.

Table E-3 (1/5) MONTHLY LABOUR FORCE IN THE PROJECT AREA (KISIWANI SCHEME)

Unit: 1,000 man-days

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
A) Labour Force Available	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2	326.4
B) Labour Requirement	8.4	8.9	6.2	5.6	6.1	7.1	8.7	5.9	1.9	3.8	9.9	13.5	86.0
1) Maize, 1st crop,													
Irrigated/H.Y.V.	0.3	0.5	0.5	0.4	0.2	-	-	-	-	0.2	0.7	1.0	3.8
Irrigated/L.V.	0.8	1.4	1.2	1.3	0.5	-	-	-	-	0.6	2.2	2.9	10.9
Rainfed/L.V.	0.5	0.9	0.7	0.7	0.4	-	-	-	-	0.5	1.7	2.2	7.6
2nd cropping													
Rainfed/L.V.	-	0.2	0.3	0.2	0.1	0.1	-	-	-	-	-	-	0.9
Rainfed/L.V.	-	0.2	0.3	0.2	0.1	0.1	-	-	-	-	-	-	0.9
3rd cropping													
Irrigated/H.Y.V	0.1	-	-	-	-	0.1	0.4	0.5	0.1	0.2	0.2	0.2	1.8
Irrigated/L.V.	0.2	-	-	-	-	0.2	0.7	1.0	0.3	0.5	0.4	0.4	3.7
Rainfed/L.V.	0.3	-	-	-	-	0.6	1.6	2.0	0.4	0.7	0.6	0.6	6.8
2) Paddy													
Irrigated/L.V.	2.1	1.8	1.0	0.6	2.4	2.3	2.3	-	-	-	1.9	2.8	17.2
Rainfed/L.V.	3.0	2.8	1.1	1.1	1.3	2.6	2.6	1.3	-	-	1.1	2.3	19.2
3) Livestock raising	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	13.2
C) Balance (A - B)	18.8	18.3	21.0	21.6	21.1	20.1	18.5	21.3	25.3	23.4	17.3	13.7	240.4

Table E-3 (2/5) MONTHLY LABOUR FORCE IN THE PROJECT AREA (GONJA SCHEME)

Unit: 1,000 man-days

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
A) Labour Force Available	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4	796.8
B) Labour Requirement	20.6	27.4	20.7	17.6	13.2	18.8	20.2	15.0	4.0	7.7	14.5	17.6	197.3
1) Maize, 1st crop.													
Irrigated/H.Y.V.	0.3	0.5	0.5	0.4	0.2	-	-	-	-	0.2	0.7	1.0	3.8
Irrigated/L.V.	0.8	1.4	1.2	1.1	0.5	-	-	-	-	0.6	2.2	2.9	10.7
Rainfed/L.V.	2.1	3.6	3.0	3.0	1.5	-	-	-	-	2.1	7.1	9.2	31.6
2nd cropping													
Rainfed/L.V.	-	0.7	0.9	0.6	0.2	0.4	0.3	0.3	-	-	-	-	3.4
Rainfed/L.V.	-	5.4	7.1	4.8	1.7	3.2	2.3	2.3	-	-	-	-	26.8
3rd cropping													
Irrigated/H.Y.V.	0.1	-	-	-	-	0.1	0.4	0.5	0.1	0.2	0.2	0.2	1.8
Irrigated/L.V.	0.3	-	-	-	-	0.3	1.1	1.4	0.4	0.7	0.6	0.6	5.4
Rainfed/L.V.	0.4	-	-	-	-	0.8	2.2	2.8	0.6	1.0	0.8	0.8	9.4
2) Paddy													
Irrigated/L.V.	1.4	1.2	0.7	0.4	1.4	1.4	1.3	-	-	-	-	-	7.8
Rainfed/L.V.	12.3	11.7	4.4	4.4	4.8	9.7	9.7	4.8	-	-	-	-	61.8
3) Livestock raising	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	34.8
C) Balance (A - B)	45.8	39.0	45.7	48.8	53.2	47.6	46.2	51.4	62.4	58.7	51.9	48.8	599.5

Table E-3 (3/5) MONTHLY LABOUR FORCE IN THE PROJECT AREA (NDUNGU SCHEME)

Unit: 1,000 man-days

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
A) Labour Force Available	63.5	63.5	63.5	63.5	63.5	63.5	63.5	63.5	63.5	63.5	63.5	63.5	762.0
B) Labour Requirement	25.5	26.8	20.1	16.6	15.4	19.2	22.5	15.6	4.7	9.3	25.1	34.2	235.0
1) Maize, 1st crop.													
Irrigated/H.Y.V.	0.4	0.7	0.7	0.7	0.3	-	-	-	-	0.3	1.1	1.4	5.6
Irrigated/L.V.	1.0	1.6	1.4	1.3	0.6	-	-	-	-	0.7	2.5	3.3	12.4
Rainfed/L.V.	2.1	3.6	3.0	3.0	1.5	-	-	-	-	2.1	7.1	9.2	31.6
2nd Cropping													
Rainfed/L.V.	-	0.9	1.2	0.8	0.3	0.5	0.4	0.4	-	-	-	-	4.5
Rainfed/L.V.	-	4.0	5.2	3.5	1.2	2.3	1.7	1.7	-	-	-	-	19.6
3rd cropping													
Irrigated/H.Y.V.	0.4	-	-	-	-	0.4	1.4	1.9	0.6	1.0	0.9	0.9	7.5
Irrigated/L.V.	0.9	-	-	-	-	1.0	3.6	4.8	1.4	2.3	2.0	1.9	17.9
Rainfed/L.V.	0.2	-	-	-	-	0.3	0.8	1.0	0.2	0.4	0.3	0.3	3.5
2) Paddy													
Irrigated/L.V.	6.1	5.0	2.9	1.6	5.7	5.5	5.4	-	-	-	5.5	7.9	45.6
Rainfed/L.V.	8.9	8.5	3.2	3.2	3.3	6.7	6.7	3.3	-	-	3.2	6.8	53.8
3) Livestock raising	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	30.0
C) Balance (A - B)	41.0	36.7	43.4	46.9	48.1	44.3	41.0	47.9	58.8	54.2	38.4	29.3	530.0

Table E-3 (4/5) MONTHLY LABOUR FORCE IN THE PROJECT AREA (KIHURIO SCHEME)

Unit: 1,000 man-days

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
A) Labour Force Available	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	1,188.0
B) Labour Requirement	25.6	26.2	19.8	16.7	15.7	22.5	36.7	34.5	9.6	19.4	38.1	48.5	313.3
1) Maize, 1st crop.													
Irrigated/H.Y.V.	1.5	2.7	2.5	2.4	1.1	-	-	-	-	1.1	4.0	5.3	20.6
Irrigated/L.V.	4.0	6.6	5.7	5.5	2.6	-	-	-	-	2.9	10.5	13.9	51.7
Rainfed/L.V.	1.1	1.9	1.6	0.8	-	-	-	-	-	1.1	3.7	4.8	15.0
2nd cropping													
Rainfed/L.V.	-	0.5	0.6	0.4	0.1	0.3	0.2	0.2	-	-	-	-	2.3
Rainfed/L.V.	-	1.6	2.1	1.5	0.5	1.0	0.7	0.7	-	-	-	-	8.1
3rd cropping													
Irrigated/H.Y.V.	0.8	-	-	-	-	0.8	2.9	3.8	1.1	1.9	1.8	1.7	14.8
Irrigated/L.V.	1.8	-	-	-	-	2.0	7.2	9.6	2.8	4.5	4.0	3.8	35.7
Rainfed/L.V.	2.2	-	-	-	-	4.4	11.9	15.1	3.2	5.4	4.4	4.4	51.0
2) Paddy													
Irrigated/L.V.	5.7	4.7	2.7	1.5	6.3	6.2	6.0	-	-	-	5.1	7.5	45.7
Rainfed/L.V.	6.0	5.7	2.1	2.1	2.6	5.3	5.3	2.6	-	-	2.1	4.6	38.4
3) Livestock raising	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	30.0
C) Balance (A - B)	73.4	72.8	79.2	82.3	83.3	76.5	62.3	64.5	89.4	79.6	60.9	50.5	874.7

Table E-3 (5/5) MONTHLY LABOUR FORCE IN THE PROJECT AREA (IGOMA SCHEME)

Unit: 1,000 man-days

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
A) Labour Force Available	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	18.0
B) Labour Requirement	0.7	0.8	0.8	0.8	0.6	0.5	0.5	0.5	0.5	0.7	1.2	1.4	9.0
1) Maize, 1st crop.													
Irrigated/H.Y.V.	-	-	-	-	-	-	-	-	-	-	-	-	
Irrigated/L.V.	-	-	-	-	-	-	-	-	-	-	-	-	
Rainfed/L.V.	0.2	0.3	0.3	0.3	0.1	-	-	-	-	0.2	0.7	0.9	3.0
2nd cropping													
Rainfed/L.V.	-	-	-	-	-	-	-	-	-	-	-	-	
Rainfed/L.V.	-	-	-	-	-	-	-	-	-	-	-	-	
3rd cropping													
Irrigated/H.Y.V.	-	-	-	-	-	-	-	-	-	-	-	-	
Irrigated/L.V.	-	-	-	-	-	-	-	-	-	-	-	-	
Rainfed/L.V.	-	-	-	-	-	-	-	-	-	-	-	-	
2) Paddy													
Irrigated/L.V.	-	-	-	-	-	-	-	-	-	-	-	-	
Rainfed/L.V.	-	-	-	-	-	-	-	-	-	-	-	-	
3) Livestock raising	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	6.0
C) Balance (A - B)	0.8	0.7	0.7	0.7	0.9	1.0	1.0	1.0	1.0	0.8	0.3	0.1	9.0

Table E-4 RESULTS OF SURVEY ON LAND HOLDING AND TENURE
(FARMS - NUMBER, BY SIZE)

Name of Village	Under 0.5 ha		0.5 - 1.0		1.0 - 1.5		1.5 - 2.0		2.0 - 3.0		3.0 - 4.0		4.0 - 5.5		Over 5.5 ha		Total	
(Scheme)	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Kisiwani (Kisiwani)	217	40.2	266	49.3	39	7.2	12	2.2	5	0.9	1	0.2	-	-	-	-	540	100
Maore (Gonja)	179	38.2	225	48.0	42	9.0	10	2.1	7	1.5	2	0.4	1	0.2	3	0.6	469	100
Ndungu (Ndungu)	84	20.0	227	53.9	90	21.4	11	2.6	6	1.5	2	0.4	1	0.2	-	-	421	100
Uzambara (Kihurio)	107	19.8	310	57.3	90	16.6	19	3.5	8	1.5	4	0.7	2	0.4	1	0.2	541	100
Total	587	29.8	1,028	52.2	261	13.2	52	2.6	26	1.3	9	0.5	4	0.2	4	0.2	1,971	100

Table E-5 RESULTS OF SURVEY ON LAND HOLDING AND TENURE
(FARMS - AREA, BY SIZE)

Name of Village	Under 0.5 ha		0.5 - 1.0		1.0 - 1.5		1.5 - 2.0		2.0 - 3.0		3.0 - 4.0		4.0 - 5.5		Over 5.5 ha		Total	
(Scheme)	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Kisiwani (Kisiwani)	67.5	19.8	183.8	53.8	52.0	15.2	22.8	6.7	12.3	3.6	3.1	0.9	-	-	-	-	341.5	100
Maore (Gonja)	58.0	17.1	147.7	43.5	53.5	15.8	19.1	5.6	17.3	5.1	6.8	2.0	4.9	1.4	32.1	9.5	339.4	100
Ndungu (Ndungu)	27.3	7.7	160.8	45.4	118.0	33.3	21.0	5.9	15.5	4.4	6.8	1.9	4.9	1.4	-	-	354.3	100
Uzambara (Kihurio)	29.2	6.6	215.7	48.7	115.3	26.0	35.1	7.9	20.1	4.5	12.3	2.8	9.2	2.1	6.1	1.4	443.0	100
Total	182.0	12.3	708.0	47.9	338.8	22.9	98.0	6.6	65.2	4.4	29.0	2.0	19.0	1.3	38.2	2.6	1,478.2	100

Table E-6 RESULTS OF SURVEY ON LAND HOLDING AND TENURE
(FARMS-NUMBER AND AREA, BY TENURE)

Name of Village (Scheme)	Number			Holding Area (ha)		
	Holder/1 (%)	Borrower (%)	Total (%)	Holder/1 (%)	Borrower (%)	Total (%)
Kisiwani	479	61	540	304.8	36.7	341.5
(Kisiwani)	(89)	(11)	(100)	(89)	(11)	(100)
Maore	426	43	469	307.4	31.9	339.3
(Gonja)	(91)	(9)	(100)	(91)	(9)	(100)
Ndungu	387	34	421	324.2	30.1	354.3
(Ndungu)	(92)	(8)	(100)	(92)	(8)	(100)
Uzambara	480	61	541	403.9	39.2	443.1
(Kihurio)	(89)	(11)	(100)	(91)	(9)	(100)
Total	1,772	199	1,971	1,340.3	137.9	1,478.2
	(90)	(10)	(100)	(91)	(9)	(100)

Note: /1 = Cultivation right holder

Table E-7 RESULTS OF SURVEY ON LAND HOLDING AND TENURE
(FARMS-NUMBER, BY RESIDENT AND NON-RESIDENT)

Name of Village (Scheme)	Resident		Non-resident from Lower Area		Non-resident from Mountain Area		Total	
	No.	%	No.	%	No.	%	No.	%
Kisiwani (Kisiwani)	458	84.8	76	14.1	6	1.1	540	100
Maore (Gonja)	349	74.4	113	24.1	7	1.5	469	100
Ndungu (Ndungu)	405	96.2	3	0.7	13	3.1	421	100
Uzambara (Kihurio)	319	58.9	222	41.1	-	-	541	100
Total	1,531	77.7	414	21.0	26	1.3	1,971	100

Table E-8 RESULTS OF SURVEY ON LAND HOLDING AND TENURE
(FARMS-AREA, BY RESIDENT AND NON-RESIDENT)

Name of Village (Scheme)	Resident		Non-resident from Lower Area		Non-resident from Mountain Area		Total	
	ha.	%	ha	%	ha	%	ha	%
Kisiwani (Kisiwani)	297.1	87.0	41.1	12.0	3.3	1.0	341.5	100
Maore (Gonja)	271.0	79.9	61.9	18.2	6.4	1.9	339.3	100
Ndungu (Ndungu)	339.0	95.7	4.6	1.3	10.7	3.0	354.3	100
Uzambara (Kihurio)	257.1	58.0	186.0	42.0	-	-	443.1	100
Total	1,164.2	78.7	293.6	19.9	20.4	1.4	1,478.2	100

Table E-9 PRESENT LAND USE IN THE PROJECT AREA

Unit: ha

Category	Kisiwani	Gonja	Ndungu	Kihurio	Igoma	Total
A. Arable Land	360	1,040	1,010	1,460	20	3,890
1) Irrigated land	140	120	280	600	-	1,140
- double cropping area	(30)	(40)	(140)	(280)	(-)	(490)
- single cropping area	(110)	(80)	(130)	(280)	(-)	(600)
- fallow land	(-)	(-)	(10)	(40)	(-)	(50)
2) Land cropped in later half of the dry season	70	90	40	490	-	690
- single cropping area	(60)	(80)	(30)	(440)	(-)	(610)
- fallow land	(10)	(10)	(10)	(50)	(-)	(80)
3) Land cropped in earlier half of the dry season	10	250	180	80	-	520
- single cropping area	(10)	(230)	(170)	(70)	(-)	(480)
- fallow land	(-)	(20)	(10)	(10)	(-)	(40)
4) Land cropped in the rainy season	140	580	510	290	20	1,540
- single cropping area	(130)	(530)	(460)	(270)	(20)	(1,410)
- fallow land	(10)	(50)	(50)	(20)	(-)	(130)
B. Non-agricultural Land	40	260	280	340	840	1,760
1) Swamp	30	120	70	120	-	340
2) Seasonal marshes	10	60	160	80	100	410
3) Grass savanna	-	80	40	100	460	680
4) Brush savanna	-	-	10	40	280	330
C. Road/Rivers/Others	20	60	50	80	-	210
Total	420	1,360	1,340	1,880	860	5,860

Table E-10 CROPPING ACREAGE IN THE PROJECT AREA

Unit: ha

Crop	Kisiwani	Gonja	Ndungu	Kihurio	Igoma	Total
I. Maize						
1st cropping maize/1						
Irrigated/H.Y.V.	20	20	30	110	-	180
Irrigated/L.V.	60	60	70	290	-	480
Rainfed/L.V.	50	210	210	110	20	600
2nd cropping maize/2						
Rainfed/L.V.	10	30	40	20	-	100
Rainfed/L.V./4	10	230	170	70	-	480
3rd cropping maize/3						
Irrigated/H.Y.V.	10	10	40	80	-	140
Irrigated/L.V.	20	30	100	200	-	350
Rainfed/L.V./4	60	80	30	440	-	610
Total	240	670	690	1,320	20	2,940
II. Paddy						
Irrigated/L.V.	60	40	170	160	-	430
Rainfed/L.V.	70	290	210	140	-	710
Total	130	330	380	300	-	1,140
III. Beans/5	220	410	480	1,230	20	2,360
IV. Others/6	some	some	some	some	some	some

Note: /1 = Rainy season maize, mixed cropping with Beans
/2 = Rainy season maize
/3 = Dry season maize, mixed cropping with Beans
/4 = Cropping in the lowlying land
/5 = Mixed cropping with Maize
/6 = Including banana, coconut, Cassava, etc.

Table E-11 AREA SERVED, BY TRACTOR HIRE SERVICE PROGRAMME IN THE PROJECT AREA

Unit: ha

	1979/80	1980/81	1981/82	1982/83	Four Years Average
Kisiwani Ward					
Short Rainy Season	114	86	123	108	108
Long Rainy Season	-	1	13	-	3
Dry season	1	-	40	26	17
Sub-total	115	87	176	134	128
Gonja Ward					
Short Rainy Season	85	69	123	92	92
Long Rainy Season	24	26	2	-	13
Dry Season	81	159	138	127	126
Sub-total	190	254	263	219	231
Ndungu Ward					
Short Rainy Season	-	71	123	122	79
Long Rainy Season	16	8	-	-	6
Dry Season	5	43	97	62	52
Sub-total	21	122	220	184	137
Kihurio Ward					
Short Rainy Season	-	-	-	-	-
Long Rainy Season	8	16	19	-	11
Dry Season	51	186	138	200	144
Sub-total	59	202	157	200	155
Project Area, Total					
Short Rainy Season	199	226	369	322	279
Long Rainy Season	48	51	34	-	33
Dry Season	138	388	413	415	339
Grand-total	385	665	816	737	651

Source: DADO, Same

Table E-12 AVERAGE DOSAGE OF PRESENT FARM INPUTS PER HA

Cropping Condition	Seed (kg)	Fertilizer (kg) N	P_2O_5	K_2O	Chemicals (kg)	Sacks (No.)
Maize						
1st cropping, mixed with Beans/1						
Irrigated/H.Y.V.	Maize 25	-	-	-	-	21
	Beans 25					
Irrigated/L.V.	Maize 30	-	-	-	-	16
	Beans 25					
Rainfed/L.V.	Maize 30	-	-	-	-	10
	Beans 25					
2nd cropping/1						
Rainfed/L.V.	30	-	-	-	-	6
Rainfed/L.V./3	30	-	-	-	-	6
3rd cropping mixed with Beans/2						
Irrigated/H.Y.V.	Maize 25	-	-	-	-	21
	Beans 25					
Irrigated/L.V.	Maize 30	-	-	-	-	16
	Beans 25					
Rainfed/L.V.	Maize 30	-	-	-	-	10
	Beans 25					
Paddy						
Kisiwani and Kihurio schemes						
Irrigated/L.V.	85	-	-	-	-	33
Rainfed/L.V./3	85	-	-	-	-	33
Gonja scheme						
Irrigated/L.V.	85	-	-	-	-	24
Rainfed/L.V./3	85	-	-	-	-	24
Ndungu scheme						
Irrigated/L.V.	85	-	-	-	-	22
Rainfed/L.V./3	85	-	-	-	-	22

Note: /1 = Rainy season cropping
/2 = Dry season cropping
/3 = Cropping in the lowlying land

Table E-13 (1/2) PRESENT LABOUR REQUIREMENT

Unit: Man-day/ha

Requirement	Irrigated Maize (H.Y.V.) Mixed with Beans			Irrigated Maize (L.V.) Mixed with Beans			Rainfed Maize (L.V.) Mixed with Beans			Rainfed Maize (L.V.)		
	Family Labour	Hired Labour	Total	Family Labour	Hired Labour	Total	Family Labour	Hired Labour	Total	Family Labour	Hired Labour	Total
Nursery Preparation	-	-	-	-	-	-	-	-	-	-	-	-
Land Preparation	42	8	50	42	8	50	43	7	50	50	-	50
Seeding or Transplanting	28	-	28	28	-	28	28	-	28	14	-	14
Plant Protection	-	-	-	-	-	-	-	-	-	-	-	-
Weeding	29	6	35	29	6	35	25	5	30	22	-	22
Irrigating	12	-	12	12	-	12	-	-	-	-	-	-
Harvesting	27	5	32	24	4	28	20	3	23	17	-	17
Threshing	20	-	20	17	-	17	14	-	14	9	-	9
Hauling and Others	10	-	10	8	-	8	6	-	6	4	-	4
Total	168	19	187	160	18	178	136	15	151	116	-	116

Note: In case of using hired tractor for plowing, labour requirement of land preparation for family labour is decreased to 10 man-days and hired labour is not required.

Table E-13 (2/2) PRESENT LABOUR REQUIREMENT

Unit: Man-day/ha

Requirement	Irrigated and Rainfed Paddy in Kisiwani and Kihurio			Irrigated and Rainfed Paddy in Gonja			Irrigated and Rainfed Paddy in Ndungu		
	Family Labour	Hired Labour	Total	Family Labour	Hired Labour	Total	Family Labour	Hired Labour	Total
Nursery Preparation	5	-	5	5	-	5	5	-	5
Land Preparation	53	7	60	53	7	60	53	7	60
Seeding or Transplanting	44	6	50	44	6	50	44	6	50
Plant Protection	-	-	-	-	-	-	-	-	-
Weeding	41	5	46	41	5	46	41	5	46
Irrigating	12 (-)	- (-)	12 (-)	12 (-)	- (-)	12 (-)	12 (-)	- (-)	12 (-)
Harvesting	49	6	55	45	5	50	43	5	48
Threshing	39	5	44	36	4	40	34	4	38
Hauling and Others	14	-	14	10	-	10	9	-	9
Total	257 (245)	29 (29)	286 (274)	246 (234)	27 (27)	273 (261)	241 (229)	27 (27)	268 (256)

Note: Parentheses show the requirement for rainfed paddy.

In case of using hired tractor for plowing, labour requirement of land preparation for family labour is decreased to 20 man-days and hired labour is not required.

Table E-14 CROPPING ACREAGE AND PRODUCTION IN THE PROJECT AREA

Crop	Kisiwani		Gonja		Ndungu		Kihurio		Igoma		Total	
	Cropped Area (ha)	Production (ton)	Cropped Area (ha)	Production (ton)	Cropped Area (ha)	Production (ton)	Cropped Area (ha)	Production (ton)	Cropped Area (ha)	Production (ton)	Cropped Area (ha)	Production (ton)
I. Maize												
1st cropping maize/1												
Irrigated/H.Y.V.	20	30	20	30	30	45	110	165	-	-	180	270
Irrigated/L.V.	60	60	60	60	70	70	290	290	-	-	480	480
Rainfed/L.V.	50	30	210	125	210	125	110	70	20	10	600	360
2nd cropping maize/2												
Rainfed/L.V.	10	5	30	20	40	25	20	10	-	-	100	60
Rainfed/L.V./4	10	5	230	140	170	100	70	40	-	-	480	285
3rd cropping maize/3												
Irrigated/H.Y.V.	10	15	10	15	40	60	80	120	-	-	140	210
Irrigated/L.V.	20	20	30	30	100	100	200	200	-	-	350	350
Rainfed/L.V./4	60	35	80	50	30	20	440	260	-	-	610	365
Total	240	200	670	470	690	545	1,320	1,155	20	10	2,940	2,380
II. Paddy												
Irrigated/L.V.	60	170	40	80	170	305	160	450	-	-	430	1,005
Rainfed/L.V./4	70	195	290	580	210	380	140	390	-	-	710	1,545
Total	130	365	330	660	380	685	300	840	-	-	1,140	2,550
III. Beans	220	90	410	165	480	190	1,230	490	20	10	2,360	945

Note: /1 = Rainy season maize, mixed cropping with Beans
/2 = Rainy season maize
/3 = Dry season maize, mixed cropping with Beans
/4 = Cropping in the lowlying land

Table E-15 ANNUAL PRODUCTION OF LIVESTOCK IN THE PROJECT AREA

Livestock/ Production	Kisiwani	Gonja	Ndungu	Kihurio	Igoma	Total
Livestock Population (head)						
- Cattle	540	1,650	1,240	1,240	160	4,830
- Goats	1,610	4,780	3,710	3,730	120	13,950
- Sheep	1,400	3,850	3,220	3,240	110	11,820
- Chickens	3,810	10,490	8,770	8,820	200	32,090
Meat (head)/1						
- Cattle	80	250	190	190	20	730
- Goats	320	960	740	750	20	2,790
- Sheep	280	770	640	650	20	2,360
- Chickens	760	2,100	1,750	1,760	40	6,410
Milking Animals (head)/2						
- Cattle	80	250	190	190	20	730
- Goats	560	1,670	1,300	1,310	40	4,880
- Sheep	490	1,350	1,130	1,130	40	4,140
Milk (kℓ)/3						
- Cattle	16.0	50.0	38.0	38.0	40.0	182.0
- Goats	9.5	28.4	22.1	22.3	0.7	83.0
- Sheep	8.3	23.0	19.2	19.2	0.7	70.4

Note: /1 = Annual slaughtering rate is estimated as follows.
Cattle: 15% of total population
Others: 20% of total population
/2 = Percentage of milking animals are estimated on the basis of the assumptions below.
Cattle : 15% of total population
Goats and Sheep: 35% of total population
/3 = Annual milk yield per head is estimated at 200 lit. for cattle, 17 lit. for goats and sheep per lactation.

Table E-16 DEMONSTRATION FARM IN THE PROJECT AREA (1982/83)

Scheme Village	Crop	Plot (m^2)	Demonstration
Kisiwani			
Kisiwani	Maize	800	Different rate of fertilizer and varieties
Gonja			
Maore	- do -	- do -	- do -
Ndungu			
Msufini	- do -	- do -	- do -
Ndungu	- do -	- do -	- do -
Kihurio			
Uzambara	Paddy	200	With and without fertilizer
Mgandu	- do -	- do -	- do -

Source: DADO, Same

Table E-17 AREA SERVED, BY TRACTOR HIRE SERVICE PROGRAMME, BY EACH CROPPING CONDITION

Cropping Condition	Cropping Acreage (ha)	Area, Plowed by Tractor/1 (ha)	%
I. Maize			
1st cropping maize/2			
Irrigated/H.Y.V.	180	76	42
Irrigated/L.V.	480	203	42
Rainfed/L.V.	600	-	
2nd cropping maize/3			
Rainfed/L.V.	100	6	6
Rainfed/L.V./5	480	27	6
3rd cropping maize/4			
Irrigated/H.Y.V.	140	29	21
Irrigated/L.V.	350	72	21
Rainfed/L.V./5	610	-	
II. Paddy			
Irrigated/L.V.	430	89	21
Rainfed/L.V./5	710	148	21

Note: /1 = This figure is estimated on the basis of the data provided by DADO, Same (See Table E-11).

/2 = Rainy season maize, mixed cropping with beans

/3 = Rainy season maize

/4 = Dry season maize, mixed cropping with beans

/5 = Cropping in the lowlying area

Table E-18 NUMBER AND CAPACITY OF RICE MILLS AND GODOWNS IN THE PROJECT AREA

Scheme / Village	Rice Mill		Godown	
	No./1	Capacity/2 (t/day)	No./2	Capacity/2 (ton)
Kisiwani				
Mkonga	-	-	-	-
Kisiwani	1	6.0	1	120
Total	1	6.0	1	120
Gonja				
Maore	3	3.0	1	50
Kadando	-	-	1	1,500
Mpirani	1	1.0	1	30
Mheza	-	-	-	-
Total	4	4.0	3	1,580
Ndungu				
Msufini	1	0.5	1	30
Ndungu	4	8.0	1	10
Kalimawe	2	2.0	-	-
Total	7	10.5	2	40
Kihurio				
Uzambara	3	7.0	1	170
Kankokoro	-	-	n.a.	n.a.
Mvure	3	4.0	1	10
Mgandu	2	3.5	n.a.	n.a.
Total	8	14.5	2	180
Grand Total	20	35.0	8	1,920

Source: /1 = District Commerce and Trade Office, Same
/2 = Village Survey, 1983

Table E-19 BALANCE OF CROP PRODUCTION IN THE PROJECT AREA (1981/82)

	Category	Paddy	Maize	Beans
1.	Production (ton)	2,550	2,380	945
2.	Seeds & Waste (ton)/1	255	235	95
3.	Available Production (ton)	2,295	2,250	850
4.	Processed Amount (ton)/2	1,425	2,145	850
5.	Home Consumption (ton)/3	980	2,205	735
6.	Marketable Surplus (ton)	715/4	-60	115
7.	Purchased by NMC (ton)/5	50	-	85

Note: /1 = 10% of production

/2 = 62% of milling recovery rate only for paddy

/3 = Annual per capita consumption is estimated at 40 kg for rice, 90 kg for maize and 30 kg for beans based on the farm economic survey.

/4 = Paddy (counted backward using with a rate of /2)

/5 = Annual statistical data, NMC, Same

Table E-20 FARM GATE PRICE OF AGRICULTURAL CROPS

Unit: TSh.

Crops	Unit	1980/81	1981/82	1982/83	1983/84 /1
Maize /2	1 kg	1.00	1.50	1.75	4.00
Paddy /2	1 kg	1.75	2.50	3.00	6.00
Sorghum /2	1 kg	1.00	1.30	1.60	n.a.
Beans grade I /2	1 kg	3.50	3.50	3.50	8.00
Beans grade II /2	1 kg	2.75	2.75	2.75	n.a.
Cassava grade I /2	1 kg	0.65	0.65	0.70	n.a.
Cassava grade II /2	1 kg	0.50	0.50	0.50	n.a.
Cotton AR /3	1 kg	3.20	4.70	4.70	n.a.
Cotton BR /3	1 kg	1.50	2.50	2.50	n.a.
Mango /4	1 fruit	n.a.	n.a.	1.00	-
Coconut /4	1 nut	n.a.	n.a.	7.00	-
Banana /4	1 bunch	n.a.	n.a.	40.00	-

Note: /1 = Prices for 1983/84 crop season announced by the Government

Source: /2 = National Milling Corporation
/3 = Tanzania Cotton Authority
/4 = Village Cooperative and Extension Staff

Table E-21 PRICE OF LIVESTOCK PRODUCTS IN 1982/83

Unit: TSh.

		Unit	Farm Gate Price
Animal			
	Cattle	1 head	1,780.00
	Goats	1 head	330.00
	Sheep	1 head	300.00
	Chicken	1 head	38.00
Meat			
	Cattle	1 kg	20.00
	Goats	1 kg	23.00
	Sheep	1 kg	23.00
Milk		1 ℓ	7.00
Egg		1 egg	4.00

Source: Livestock Development Office, Same

Table E-22 PRICE OF FARM INPUTS IN 1983

Unit: TSh.

Farm Input		Unit	Farm Gate Price
Maize Seed /1,	ICW	1 kg	13.00
	UCA		13.00
	Katumani		13.00
Paddy Seed /1,	Kilombero	1 kg	8.75
	Surinam		8.75
	Taiwan 14		8.75
	IR 8		8.75
	IR 579		8.75
Beans Seed /1,	Canadian Wander	1 kg	10.60
	Masai Red		10.60
Sorghum Seed /1,	Lulu	1 kg	8.30
	Serena		8.30
Fertilizer /2,	Ammo. Sulphate	50 kg	94.05
	TSP		105.00
Agro-chemical /2,	Thiodan 25%	1 lit.	18.00
	Hostathion 25%	1 lit.	35.00
Tractor Plowing /3		1 ha	650.00
Labour /4		1 man-day	23.00

Source: /1 = Tanzania Seed Company Ltd.
/2 = Tanzania Cotton Authority
/3 = District Development Director Office, Same
/4 = Farm economy survey

Table E-23 FINANCIAL BALANCE OF CROP PRODUCTION BY CROPPING CONDITION - SUMMARY

Unit: TSh./ha

Cropping Condition	Gross Return	Production Cost	Net Return
I. Maize (All the schemes)			
1st cropping /1			
Irrigated/H.Y.V.	9,200	1,623	7,577
Irrigated/L.V.	7,200	1,494	5,706
Rainfed/L.V.	5,600	1,113	4,487
2nd cropping /2			
Rainfed/L.V.	2,400	450	1,950
Rainfed/L.V. /4	2,400	450	1,950
3re cropping /3			
Irrigated/H.Y.V.	9,200	1,505	7,695
Irrigated/L.V.	7,200	1,376	5,824
Rainfed/L.V. /4	5,600	1,113	4,487
II. Paddy (Kisiwani, Kihurio schemes)			
Irrigated/L.V.	16,800	2,000	14,800
Rainfed/L.V. /4	16,800	2,000	14,800
Paddy (Gonja scheme)			
Irrigated/L.V.	12,000	1,810	10,190
Rainfed/L.V. /4	12,000	1,810	10,190
Paddy (Ndungu scheme)			
Irrigated/L.V.	10,800	1,779	9,021
Rainfed/L.V. /4	10,800	1,779	9,021

Note: /1 = Rainy season maize, mixed cropping with beans
/2 = Rainy season maize
/3 = Dry season maize, mixed cropping with beans
/4 = Cropping in the lowlying land

Table E-24 (1/3) FINANCIAL BALANCE OF CROP PRODUCTION WITHOUT PROJECT BY CROPPING CONDITION

Description	Cropping Condition: 1st cropping Maize/1 Irrigated/H.Y.V. Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)	Cropping Condition: 1st cropping Maize/1 Irrigated/L.V. Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)
A) Gross Income						
Maize	1,500	4.00	6,000	1,000	4.00	4,000
Beans	400	8.00	3,200	400	8.00	3,200
Total			9,200			7,200
B) Production Cost						
1) Farm Inputs						
- Seed Maize	25	13.00	325	30	10.00	300
Beans	25	10.60	265	25	10.60	265
- Fertilizer	-	-	-	-	-	-
- Chemicals	-	-	-	-	-	-
2) Labour Cost/2						
- Family Labour	-	-	-	-	-	-
- Hired Labour	16 M-D	23.00	368	15 M-D	23.00	345
3) Machinery						
- Tractor			273/3			273/3
4) Sacks	21 Nos.	15.00	315	16 Nos.	15.00	240
5) Miscellaneous	5% of above		77	5% of above		71
Total			1,623			1,494
C) Net Return (A - B)			7,577			5,706

Description	Cropping Condition: 1st cropping Maize/1 Rainfed/L.V. Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)	Cropping Condition: 2nd cropping Maize Rainfed/L.V. Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)
A) Gross Income						
Maize	600	4.00	2,400	600	4.00	2,400
Beans	400	8.00	3,200	-	-	-
Total			5,600			2,400
B) Production Cost						
1) Farm Inputs						
- Seed Maize	30	10.00	300	30	10.00	300
Beans	25	10.60	265	-	-	-
- Fertilizer	-	-	-	-	-	-
- Chemicals	-	-	-	-	-	-
2) Labour Cost/2						
- Farming Labour	-	-	-	-	-	-
- Hired Labour	15 M-D	23.00	345	-	-	-
3) Machinery						
- Tractor	-	-	-	-	-	39/4
4) Sacks	10 Nos.	15.00	150	6 Nos.	15.00	90
5) Miscellaneous	5% of above		53	5% of above		21
Total			1,113			450
C) Net Return (A - B)			4,487			1,950

Note: /1 = Mixed standing with Beans
/2 = Decreased labour force by tractor plowing is deducted.
/3 = Average tractor plowing area of 42% is counted.
(TSh650 x 42% = TSh273)
/4 = Average tractor plowing area of 6% is counted.
(TSh650 x 6% = TSh39)

Table E-24 (2/3) FINANCIAL BALANCE OF CROP PRODUCTION WITHOUT PROJECT BY CROPPING CONDITION

Description	Cropping Condition: 3rd cropping Maize/1 Irrigated/H.Y.V. Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)	Cropping Condition: 3rd cropping Maize/1 Irrigated/L.V. Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)
A) Gross Income						
Maize	1,500	4.00	6,000	1,000	4.00	4,000
Beans	400	8.00	3,200	400	8.00	3,200
Total			9,200			7,200
B) Production Cost						
1) Farm Inputs						
- Seed Maize	25	13.00	325	30	10.00	300
Beans	25	10.60	265	25	10.60	265
- Fertilizer	-	-	-	-	-	-
- Chemicals	-	-	-	-	-	-
2) Labour Cost/2						
- Family Labour	-	-	-	-	-	-
- Hired Labour	17 M-D	23.00	391	16 M-D	23.00	368
3) Machinery						
- Tractor			137/3			137/3
4) Sacks	21 Nos.	15.00	315	16 Nos.	15.00	240
5) Miscellaneous	5% of above		72	5% of above		66
Total			1,505			1,376
C) Net Return (A - B)			7,695			5,824

Description	Cropping Condition: 3rd cropping Maize/1 Rainfed/L.V. Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)
A) Gross Income			
Maize	600	4.00	2,400
Beans	400	8.00	3,200
Total			5,600
B) Production Cost			
1) Farm Inputs			
- Seed Maize	30	10.00	300
Beans	25	10.60	265
- Fertilizer	-	-	-
- Chemicals	-	-	-
2) Labour Cost/2			
- Farming Labour	-	-	-
- Hired Labour	15 M-D	23.00	345
3) Machinery			
- Tractor	-	-	-
4) Sacks	10 Nos.	15.00	150
5) Miscellaneous	5% of above		53
Total			1,113
C) Net Return (A - B)			4,487

Note: /1 = Mixed standing with Beans

/2 = Decreased labour force by tractor plowing is deducted.

/3 = Average tractor plowing area of 21% is counted.
(TSh650 x 21% = TSh137)

Table E-24 (3/3) FINANCIAL BALANCE OF CROP PRODUCTION WITHOUT PROJECT BY CROPPING CONDITION

Description	Cropping Condition: Irrigated & Rainfed Paddy/L.V. in Kisiwani & Kihurio Schemes			Cropping Condition: Irrigated & Rainfed Paddy/L.V. in Gonja Scheme		
	Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)	Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)
A) Gross Income						
Paddy	2,800	6.00	16,800	2,000	6.00	12,000
B) Production Cost						
1) Farm Inputs						
- Seed	85	7.40	629	85	7.40	629
- Fertilizer	-	-	-	-	-	-
- Chemicals	-	-	-	-	-	-
2) Labour Cost/1						
- Family Labour	-	-	-	-	-	-
- Hired Labour	28 M-D	23.00	644	26 M-D	23.00	598
3) Machinery						
- Tractor			137/2			137/2
4) Sacks	33 Nos.	15.00	495	24 Nos.	15.00	360
5) Miscellaneous	5% of above		95	5% of above		86
Total			2,000			1,810
C) Net Return (A - B)			14,800			10,190

Description	Cropping Condition: Irrigated & Rainfed Paddy/L.V. in Ndungu Scheme		
	Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)
A) Gross Income			
Paddy	1,800	6.00	10,800
B) Production Cost			
1) Farm Inputs			
- Seed	85	7.40	629
- Fertilizer	-	-	-
- Chemicals	-	-	-
2) Labour Cost/1			
- Farming Labour	-	-	-
- Hired Labour	26 M-D	23.00	598
3) Machinery			
- Tractor			137/2
4) Sacks	22 Nos.	15.00	330
5) Miscellaneous	5% of above		85
Total			1,779
C) Net Return (A - B)			9,021

Note: /1 = Decreased labour force by tractor plowing is deducted.

/2 = Average tractor plowing area of 21% is counted.
(TSh650 x 21% = TSh137)

Table E-25 (1/5) GROSS AND NET PRODUCTION RETURNS AT PRESENT CONDITION - FINANCIAL PRICE BASE (Kisiwani Scheme)

	Cropped Area (ha)	Unit Gross Income (TSh/ha)	Total Gross Income (TSh x 10^3)	Unit Production Cost (TSh/ha)	Total Production Cost (TSh x 10^3)	Unit Net Return (TSh/ha)	Total Net Return (TSh x 10^3)	Net Return per Farm Household (TSh)
I. Maize								
1st cropping maize/1								
Irrigated/H.Y.V.	20	9,200	184	1,623	32	7,577	152	267
Irrigated/L.V.	60	7,200	432	1,494	90	5,706	342	600
Rainfed/L.V.	50	5,600	280	1,113	56	4,487	224	393
2nd cropping maize/2								
Rainfed/L.V.	10	2,400	24	450	5	1,950	19	33
Rainfed/L.V./4	10	2,400	24	450	5	1,950	19	33
3rd cropping maize/3								
Irrigated/H.Y.V.	10	9,200	92	1,505	15	7,695	77	135
Irrigated/L.V.	20	7,200	144	1,376	28	5,824	116	204
Rainfed/L.V./4	60	5,600	336	1,113	67	4,487	769	472
II. Paddy								
Irrigated/L.V.	60	16,800	1,008	2,000	120	14,800	888	1,558
Rainfed/L.V.	70	16,800	1,176	2,000	140	14,800	1,036	1,817
Total			3,700		558		3,142	5,512

Note: /1 = Rainy season maize, mixed cropping with Beans
/2 = Rainy season maize
/3 = Dry season maize, mixed cropping with Beans
/4 = Cropping in the lowlying land

Table E-25 (2/5) GROSS AND NET PRODUCTION RETURNS AT PRESENT CONDITION - FINANCIAL PRICE BASE (Gonja Scheme)

	Cropped Area (ha)	Unit Gross Income (TSh/ha)	Total Gross Income (TSh x 10^3)	Unit Production Cost (TSh/ha)	Total Production Cost (TSh x 10^3)	Unit Net Return (TSh/ha)	Total Net Return (TSh x 10^3)	Net Return per Farm Household (TSh)
I. Maize								
1st cropping maize/1								
Irrigated/H.Y.V.	20	9,200	184	1,623	32	7,577	152	106
Irrigated/L.V.	60	7,200	432	1,494	90	5,706	342	238
Rainfed/L.V.	210	5,600	1,176	1,113	234	4,487	942	654
2nd cropping maize/2								
Rainfed/L.V.	30	2,400	72	450	14	1,950	58	40
Rainfed/L.V./4	230	2,400	552	450	104	1,950	448	311
3rd cropping maize/3								
Irrigated/H.Y.V.	10	9,200	92	1,505	15	7,695	77	53
Irrigated/L.V.	30	7,200	216	1,376	41	5,824	175	122
Rainfed/L.V./4	80	5,600	448	1,113	89	4,487	359	249
II. Paddy								
Irrigated/L.V.	40	12,000	480	1,810	72	10,190	408	283
Rainfed/L.V.	290	12,000	3,480	1,810	525	10,190	2,955	2,052
Total			7,132		1,216		5,916	4,108

Note: /1 = Rainy season maize, mixed cropping with Beans
/2 = Rainy season maize
/3 = Dry season maize, mixed cropping with Beans
/4 = Cropping in the lowlying land

Table E-25 (3/5) GROSS AND NET PRODUCTION RETURNS AT PRESENT CONDITION - FINANCIAL PRICE BASE (Ndungu Scheme)

	Cropped Area (ha)	Unit Gross Income (TSh/ha)	Total Gross Income (TSh x 10^3)	Unit Production Cost (TSh/ha)	Total Production Cost (TSh x 10^3)	Unit Net Return (TSh/ha)	Total Net Return (TSh x 10^3)	Net Return per Farm Household (TSh)
I. Maize								
1st cropping maize/1								
Irrigated/H.Y.V.	30	9,200	276	1,623	49	7,577	227	189
Irrigated/L.V.	70	7,200	504	1,494	105	5,706	399	332
Rainfed/L.V.	210	5,600	1,176	1,113	234	4,487	942	785
2nd cropping maize/2								
Rainfed/L.V.	40	2,400	96	450	18	1,950	78	65
Rainfed/L.V./4	170	2,400	408	450	77	1,950	331	276
3rd cropping maize/3								
Irrigated/H.Y.V.	40	9,200	368	1,505	60	7,695	308	257
Irrigated/L.V.	100	7,200	720	1,376	138	5,824	582	485
Rainfed/L.V./4	30	5,600	168	1,113	33	4,487	135	113
II. Paddy								
Irrigated/L.V.	170	10,800	1,836	1,779	302	9,021	1,534	1,278
Rainfed/L.V.	210	10,800	2,268	1,779	374	9,021	1,894	1,578
Total			7,820		1,390		6,430	5,358

Note: /1 = Rainy season maize, mixed cropping with Beans
/2 = Rainy season maize
/3 = Dry season maize, mixed cropping with Beans
/4 = Cropping in the lowlying land

Table E-25 (4/5) GROSS AND NET PRODUCTION RETURNS AT PRESENT CONDITION - FINANCIAL PRICE BASE (Kihurio Scheme)

	Cropped Area (ha)	Unit Gross Income (TSh/ha)	Total Gross Income (TSh x 10^3)	Unit Production Cost (TSh/ha)	Total Production Cost (TSh x 10^3)	Unit Net Return (TSh/ha)	Total Net Return (TSh x 10^3)	Net Return per Farm Household (TSh)
I. Maize								
1st cropping maize/1								
Irrigated/H.Y.V.	110	9,200	1,012	1,623	179	7,577	833	468
Irrigated/L.V.	290	7,200	2,088	1,494	433	5,706	1,655	920
Rainfed/L.V.	110	5,600	616	1,113	122	4,487	494	278
2nd cropping maize/2								
Rainfed/L.V.	20	2,400	48	450	9	1,950	39	22
Rainfed/L.V./4	70	2,400	168	450	32	1,950	136	76
3rd cropping maize/3								
Irrigated/H.Y.V.	80	9,200	736	1,505	120	7,695	616	346
Irrigated/L.V.	200	7,200	1,440	1,376	275	5,824	1,165	654
Rainfed/L.V./4	440	5,600	2,464	1,113	490	4,487	1,974	1,109
II. Paddy								
Irrigated/L.V.	160	16,800	2,688	2,000	320	14,800	2,368	1,330
Rainfed/L.V.	140	16,800	2,352	2,000	280	14,800	2,072	1,164
Total			13,612		2,260		11,352	6,377

Note: /1 = Rainy season maize, mixed cropping with Beans
/2 = Rainy season maize
/3 = Dry season maize, mixed cropping with Beans
/4 = Cropping in the lowlying land

Table E-25 (5/5) GROSS AND NET PRODUCTION RETURNS AT PRESENT CONDITION - FINANCIAL PRICE BASE
(Igoma Scheme)

	Cropped Area (ha)	Unit Gross Income (TSh/ha)	Total Gross Income (TSh x 10^3)	Unit Production Cost (TSh/ha)	Total Production Cost (TSh x 10^3)	Unit Net Return (TSh/ha)	Total Net Return (TSh x 10^3)	Net Return per Farm Household (TSh)
I. Maize								
1st cropping maize/1								
Irrigated/H.Y.V.	-	-	-	-	-	-	-	-
Irrigated/L.V.	-	-	-	-	-	-	-	-
Rainfed/L.V.	20	5,600	112	1,113	22	4,487	90	3,000
2nd cropping maize/2								
Rainfed/L.V.	-	-	-	-	-	-	-	-
Rainfed/L.V./4	-	-	-	-	-	-	-	-
3rd cropping maize/3								
Irrigated/H.Y.V.	-	-	-	-	-	-	-	-
Irrigated/L.V.	-	-	-	-	-	-	-	-
Rainfed/L.V./4	-	-	-	-	-	-	-	-
II. Paddy								
Irrigated/L.V.	-	-	-	-	-	-	-	-
Rainfed/L.V.	-	-	-	-	-	-	-	-
Total			112		22		90	3,000

Note: /1 = Rainy season maize, mixed cropping with Beans
/2 = Rainy season maize
/3 = Dry season maize, mixed cropping with Beans
/4 = Cropping in the lowlying land

Table E-26 (1/5) LIVESTOCK PRODUCTION AND NET RETURN - FINANCIAL PRICE BASE (KISIWANI SCHEME)

Products	Annual Production (head or k/)	Unit Price (TSh)	Gross Return (TSh x 10^3)	Production Cost (TSh x 10^3)	Net Return (TSh x 10^3)	Net Return per Farm Household (TSh)
Meat						
- Cattle	80	1,780	142.4	21.4	121.0	212
- Goats	320	330	105.6	15.8	89.8	158
- Sheep	280	300	84.0	12.6	71.4	125
- Chickens	760	38	28.9	4.3	24.6	43
Milk						
- Cattle	16.0	7,000	112.0	16.8	95.2	167
- Goats	9.5	7,000	66.5	10.0	56.5	99
- Sheep	8.3	7,000	58.1	8.7	49.4	87
Total			597.5	89.6	507.9	891

Table E-26 (2/5) LIVESTOCK PRODUCTION AND NET RETURN - FINANCIAL PRICE BASE (GONJA SCHEME)

Products	Annual Production (head or k/)	Unit Price (TSh)	Gross Return (TSh x 10^3)	Production Cost (TSh x 10^3)	Net Return (TSh x 10^3)	Net Return per Farm Household (TSh)
Meat						
- Cattle	250	1,780	445.0	66.8	378.2	263
- Goats	960	330	316.8	47.5	269.3	187
- Sheep	770	300	231.0	34.7	196.3	136
- Chickens	2,100	38	79.8	12.0	67.8	47
Milk						
- Cattle	50.0	7,000	350.0	52.5	297.5	207
- Goats	28.4	7,000	198.8	29.8	169.0	117
- Sheep	23.0	7,000	161.0	24.1	136.9	95
Total			1,782.4	267.4	1,515.0	1,052

Table E-26 (3/5) LIVESTOCK PRODUCTION AND NET RETURN - FINANCIAL PRICE BASE (NDUNGU SCHEME)

Products	Annual Production (head or k/)	Unit Price (TSh)	Gross Return (TSh x 10^3)	Production Cost (TSh x 10^3)	Net Return (TSh x 10^3)	Net Return per Farm Household (TSh)
Meat						
- Cattle	190	1,780	338.2	50.7	287.5	240
- Goats	740	330	244.2	36.6	207.6	173
- Sheep	640	300	192.0	28.8	163.2	136
- Chickens	1,750	38	66.5	10.0	56.5	47
Milk						
- Cattle	38.0	7,000	266.0	39.9	226.1	188
- Goats	22.1	7,000	154.7	23.2	131.5	110
- Sheep	19.2	7,000	134.4	20.2	114.2	95
Total			1,396.0	209.4	1,186.6	989

Table E-26 (4/5) LIVESTOCK PRODUCTION AND NET RETURN - FINANCIAL PRICE BASE (KIHURIO SCHEME)

Products	Annual Production (head or k/)	Unit Price (TSh)	Gross Return (TSh x 10^3)	Production Cost (TSh x 10^3)	Net Return (TSh x 10^3)	Net Return per Farm Household (TSh)
Meat						
- Cattle	190	1,780	338.2	50.7	287.5	161
- Goats	750	330	247.5	37.1	210.4	118
- Sheep	650	300	195.0	29.3	165.7	93
- Chickens	1,760	38	66.9	10.0	56.9	32
Milk						
- Cattle	38.2	7,000	267.4	40.1	227.3	128
- Goats	22.3	7,000	156.1	23.4	132.7	75
- Sheep	19.2	7,000	134.4	20.2	114.2	64
Total			1,405.5	210.8	1,194.7	671

Table E-26 (5/5) LIVESTOCK PRODUCTION AND NET RETURN - FINANCIAL PRICE BASE (IGOMA SCHEME)

Products	Annual Production (head or kℓ)	Unit Price (TSh)	Gross Return (TSh x 10^3)	Production Cost (TSh x 10^3)	Net Return (TSh x 10^3)	Net Return per Farm Household (TSh)
Meat						
- Cattle	20	1,780	35.6	5.3	30.3	1,010
- Goats	20	330	6.6	1.0	5.6	187
- Sheep	20	300	6.0	0.9	5.1	170
- Chickens	40	38	1.5	0.2	1.3	43
Milk						
- Cattle	4.0	7,000	28.0	4.2	23.8	793
- Goats	0.7	7,000	4.9	0.7	4.2	140
- Sheep	0.7	7,000	4.9	0.7	4.2	140
Total			87.5	13.0	74.5	2,483

Table E-27 POPULATION FORECAST FOR 1985, 1990, 1995 AND 2000 IN THE PROJECT AREA

Year	Annual Growth Rate (%)	Farm Population	Farm Household	Family Size
1982 (present)	3.0	24,500	5,020	4.9
1985	3.0	26,800		
1990	2.9	31,000		
1995	2.8	35,800		
2000	-	41,100	6,000	6.8

Note: Anticipated annual growth rate in estimated making reference to the population forecast for 2000 made by IBRD, July 1982.

Table E-28 PROPOSED LAND USE

Unit: ha

Category	Kisiwani	Gonja	Ndungu	Kihurio	Igoma	Total
A. Arable Land	360	1,040	940	1,670	750	4,760
a. Upland field						
1) Irrigated land	-	-	-	-	-	-
- double cropping	(-)	(-)	(-)	(-)	(-)	(-)
- single cropping	(-)	(-)	(-)	(-)	(-)	(-)
2) Rainfed land	-	440	260	-	-	700
b. Paddy field						
Irrigated land	360	600	680	1,670	750	4,060
- double cropping						
(Paddy/Paddy)	(180)	(300)	(230)	(1,320)	(750)	(2,780)
(Maize/Paddy)	(180)	(300)	(450)	(350)	(-)	(1,280)
- single cropping	(-)	(-)	(-)	(-)	(-)	(-)
c. Fallow land	-	-	-	-	-	-
B. Non-agricultural Land	-	160	240/1	-	-	400
C. Road/Rivers/Others	20	60	50	80	-	210
D. Right of Way	40	100	110	130	110	490
Total	420	1,360	1,340	1,880	860	5,860

Note: /1 = Including 70 ha of the submerged area caused by raising the level of the Kalimawe dam

Table E-29 INCREMENTAL EFFECT OF LAND USE

Unit: ha

Category	Kisiwani	Gonja	Ndungu	Kihurio	Igoma	Total or Average
A. Without Project Implementation						
Arable Land	360	1,040	1,010	1,460	20	3,890
Cultivated Area:	370	1,000	1,070	1,620	20	4,080
Rainy season irrigation	140	120	270	560	-	1,090
Dry season irrigation	30	40	140	280	-	490
Rainfed area	200	840	660	780	20	2,500
Crop Intensity	1.0	1.0	1.1	1.1	1.0	1.0
B. With Project Implementation						
Arable Land	360	1,040	940	1,670	750	4,760
Cultivated Area:	720	1,640	1,620	3,340	1,500	8,820
Rainy season irrigation	360	600	680	1,670	750	4,060
Dry season irrigation	180	300	230	1,320	750	2,780
Rainfed area	180	740	710	350	-	1,980
Crop Intensity	2.0	1.6	1.7	2.0	2.0	1.9
C. Incremental Effect (B - A)						
Arable Land	-	-	-70	210	730	870
Cultivated Area	350	640	550	1,720	1,480	4,740
Rainy season irrigation	220	480	410	1,110	750	2,970
Dry season irrigation	150	260	90	1,040	750	2,290
Rainfed area	-20	-100	50	-430	-20	-520
Crop Intensity	1.0	0.6	0.6	0.9	1.0	0.9

Table E-30 PROPOSED DOSAGE OF FARM INPUTS PER HA

Discription	Irrigated Paddy		Maize Mixed with Beans
	Dry Season	Rainy Season	
Seed (kg)	40	40	Maize: 25 Beans: 30
Fertilizer (kg)			
- Nitrogen	90	80	70
- Phosphorous	70	60	60
Chemicals (kg)			
- Insecticides	12	12	8
- Fungicides	2	2	1
Sacks (No.)	53	59	30

Table E-31 LABOUR REQUIREMENT WITH PROJECT

Unit: Man-day/ha

Requirement	Irrigated Paddy (H.Y.V.) Rainy Season Cropping	Irrigated Paddy (H.Y.V.) Dry Season Cropping	Rainfed Maize (H.Y.V.) Mixed with Beans
Nursery Preparation	5	5	-
Land Preparation	25	25	20
Seeding or Transplanting	45	45	15
Plant Protection	4	4	4
Weeding	50	50	40
Irrigating	15	15	-
Harvesting	50	48	29
Threshing	9	7	10
Hauling and Others	20	19	13
Total	223	218	131

Table E-32 MONTHLY LABOUR REQUIREMENT WITH PROJECT

Unit: 1,000 man-days

	Description	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
A)	Labour Force Available/1	515.0	515.0	515.0	515.0	515.0	515.0	515.0	515.0	515.0	515.0	515.0	515.0	6,180.0
B)	Labour Requirement	152.9	342.9	227.0	99.1	99.1	191.4	124.6	16.2	19.3	218.4	136.6	124.9	1,752.4
	Irrigated Paddy/H.Y.V.													
	Rainy season	26.5	146.7	201.8	99.1	99.1	191.4	124.6	16.2	-	-	-	-	905.4
	Dry season	86.0	112.5	13.2	-	-	-	-	-	19.3	206.2	84.4	84.4	606.0
	Rainfed Maize/H.Y.V.	40.4	83.7	12.0	-	-	-	-	-	-	12.2	52.2	40.5	241.0
C)	Balance (A - B)	362.1	172.1	288.0	415.9	415.9	323.6	390.4	498.8	495.7	296.6	378.4	390.1	4,427.6

Note: /1 *Labour force available is estimated as follows:*

Total farm household x Family labour force per farm household x Annual workable days
= 7,300 x 2.9 x (365 days x 80%) ≒ 6,180,000 man-days/year.

Table E-33 INCREMENTAL CROP PRODUCTION

Unit: ton

Scheme/Crop	With Project Implementation	Without Project Implementation	Increment
Kisiwani			
Paddy	2,610	365	2,245
Maize	360	200	160
Beans	140	90	50
Gonja			
Paddy	4,350	660	3,690
Maize	1,480	470	1,010
Beans	590	165	425
Ndungu			
Paddy	4,435	685	3,750
Maize	1,420	545	875
Beans	570	190	380
Kihurio			
Paddy	14,290	840	13,450
Maize	700	1,155	-455
Beans	280	490	-210
Igoma			
Paddy	7,125	-	7,125
Maize	-	10	-10
Beans	-	10	-10
Project Area, Total			
Paddy	32,810	2,550	30,260
Maize	3,960	2,380	1,580
Beans	1,580	945	635

Table E-34 (1/2) CALCULATION OF STANDARD CONVERSION RATE AND SHADOW PRICE FACTOR

Major Commodities	Total Amount (CIF. TShx10^6)	Share of Total (%)	Tax & Duty (%/CIF)
I. Import Portion			
- Cereals and cereal preparations	868	6.0	15.0
- Petroleum and petroleum products	2,336	21.0	-
- Chemicals	1,076	11.0	15.0
- Paper, paperboard and manufactures thereof	177	3.0	15.0
- Textile yarn fabrics and related products	324	4.0	15.0
- Iron and steel	345	4.0	15.0
- Non ferrous metals	123	1.0	15.0
- Manufactures of metal	316	4.0	15.0
- Machinery, other than electric	1,838	21.0	15.0
- Electrical machinery, apparatus and appliances	530	7.0	10.0
- Transport equipment	1,152	18.0	20.0
Total or Average	9,085	100.0	16.0
II. Export Portion			
- Fruit and vagetables	324	-	almost free
- Coffee, tea, cocoa, spices and manufactures thereof	1,973	-	- do -
- Textile fibres	650	-	- do -
- Crude fertilizer and crude materials	220	-	- do -
- Petroreum and petroreum products	204	-	- do -
- Textile yarn fabrics	253	-	- do -
- Non metalic mineral manufactures	376	-	- do -
- Clothing	116	-	- do -
Total or Average	4,116	100	- do -

to be continued

Table E-34 (2/2) CALCULATION OF STANDARD CONVERSION RATE AND SHADOW PRICE FACTOR

III. Calculation of Shadow Price Factor (SPF)

$$SPF = \frac{E_f \cdot X(1 - S) + Im \cdot M(1 + t)}{E_f \cdot X + Im \cdot M}$$

where: E_f ; Elasticity of foreign exchange for trade of agricultural products

Im ; Price elasticity of domestic demand and supply

$$\text{Then, } SPF = \frac{0.5 \times 4{,}116\ (1 - 0) + 0.6 \times 9{,}085\ (1 + 0.16)}{0.5 \times 4{,}116 + 0.6 \times 9{,}085}$$

$$\fallingdotseq 1.12$$

Note: Figures shown in E_f ; (0.5) and Im ; (0.6) are the elasticity factors preliminarily estimate, making reference to the IBRD price projection.

Source: Annual trade report on Tanzania, 1980

Table E-35 PRICES OF MAJOR FARM INPUTS AND OUTPUTS

Item		Unit	Financial Price	Economic Price
Farm Product, /1	Paddy	TSh/kg	6.00	5.28
	Maize	TSh/kg	4.00	4.83
	Beans	TSh/kg	8.00	5.58
Seed, /2	Paddy (H.Y.V.)	TSh/kg	8.75	10.10
	(L.V.)	TSh/kg	7.40	5.28
	Maize (H.Y.V.)	TSh/kg	13.00	10.20
	(L.V.)	TSh/kg	10.00	4.83
	Beans	TSh/kg	10.60	12.25
Fertilizer, /1	N	TSh/kg	9.40	15.20
	P_2O_5	TSh/kg	4.60	12.20
Agro-chemical, /1	Insecticides	TSh/kg	32.25	49.90
	Fungicides	TSh/kg	39.50	65.90
Machinery, /3	Tractor plowing	TSh/ha	650.00	500.00
	Tractor harrowing	TSh/ha	250.00	350.00
	Spraying	TSh/ha	40.00	26.00
	Threshing	TSh/ton	60.00	40.00
Material, /2	Sack	TSh/unit	15.00	17.90
Livestock, /2	Cattle	TSh/head	1,780.00	2,040.00
	Goat	TSh/head	330.00	380.00
	Sheep	TSh/head	300.00	340.00
	Chicken	TSh/head	38.00	44.00
	Milk	TSh/k(	7.00	8.00
Labour, /4	Family labour	TSh/man-day	-	14.00
	Hired labour	TSh/man-day	23.00	23.00

Note: /1 = Economic prices of farm products, fertilizers and agro-chemicals are estimated based on the calculation made in Table E-36.

/2 = Economic prices of seed, livestock and material are estimated based on the International Market Price Index by the Document of the IBRD, July 1982 "Price Prospects for Major Primary Commodities".

/3 = Economic price of machinery is estimated by the calculation made in E-37.

/4 = Economic price of family labour is assumed 60% of the price of hired labour.

Table E-36 (1/6) ECONOMIC PRICE OF RICE/PADDY

(1983 Constant US Dollar)

Item	Price
	(US$/ton)
FOB at Bangkok/1	460
Transportation cost to Tanga port	210
CIF at Tanga port	670
	(TSh/ton)
Converted CIF at Tanga port/2	9,045
Wharfage/3	135
Unloading/Loading cost/3	20
Handling and storing cost/3	70
Transportation cost to Moshi	165
Store-gate price at Moshi	9,435
Handling and storing cost/4	-470
Processing cost/5	-400
Mill-gate price	8,565
Price converted to primary product/6	5,310
Local transportation cost	-30
Farm-gate price	5,280

Note: /1 = Price in 1995 at 1983 constant US dollar forecasted in the Document of IBRD, July 1982, "Price Prospects for Major Primary Commodities".

/2 = Border price is converted at the shadow rate of US$1.0 = TSh13.5.
(Shadow price factor: 1.12)

/3 = These costs are based on "Tariff Book of Harbour Dues and Charges".

/4 = 5% of store-gate price is applied in the estimation.

/5 = Estimated based on the actual cost in 1982/83.

/6 = Converted at the milling rate of 62%.

Table E-36 (2/6) ECONOMIC PRICE OF MAIZE

(1983 Constant US Dollar)

Item	Price
	(US$/ton)
FOB at Florida/1	155
Transportation cost to Tanga prot	200
CIF at Tanga port	355
	(TSh/ton)
Converted CIF at Tanga port/2	4,790
Wharfage/3	70
Unloading/Loading cost/3	20
Handling and storing cost/3	70
Transportation cost to Moshi	165
Store-gate price at Moshi	5,115
Handling and storing cost/4	-255
Local transportation cost	-30
Farm-gate price	4,830

Note: /1 = Price in 1995 at 1983 constant US dollar forecasted in the Documents of IBRD, July 1982, "Price Prospects for Major Primary Commodities".

/2 = Border price is converted at the shadow rate of US$1.0 = TSh13.5 (Shadow price factor: 1.12).

/3 = These costs are based on "Tariff Book of Harbour Dues and Charges".

/4 = 5% of store-gate price is applied in the estimation.

Table E-36 (3/6) ECONOMIC PRICE OF BEANS

(1983 Constant US Dollar)

Item	Price
	(US$/ton)
CIF at Tanga port/1	412
	(TSh/ton)
Converted CIF at Tanga prot/2	5,560
Wharfage/3	85
Unloading/Loading cost/3	20
Handling and storing cost/3	70
Transportation cost to Moshi	165
Store-gate price at Moshi	5,900
Handling and storing cost/4	-295
Local transportation cost	-30
Farm-gate price	5,575
	≒ 5,580

Note: /1 = Estimated based on CIF Tanzania in 1983.

/2 = Border price is converted at the shadow rate of US$1.0 = TSh13.5 (Shadow price factor: 1.12).

/3 = These cost are based on "Tariff Book of Harbour Dues and Chargers".

/4 = 5% of store-gate price is applied in the estimation.

Table E-36 (4/6) ECONOMIC PRICE OF UREA

(1983 Constant US Dollar)

Item	Price
	(US$/ton)
FOB at NW Europe/1	302
Transportation cost to Tanga port	220
CIF at Tanga port	522
	(TSh/ton)
Converted CIF at Tanga port/2	7,045
Wharfage/3	105
Unloading/Loading cost/3	20
Handling and storing cost/3	70
Transportation cost to Moshi	165
Store-gate price at Moshi	7,405
Handling and storing cost/4	-370
Local transportation cost	-30
Farm-gate price	7,005
Nutrient farm-gate price (TSh/kg)	15.2

Note: /1 = Price in 1995 at 1983 constant US dollar forecasted in the Documents of IBRD, July 1982, "Price Prospects for Major Primary Commodities".

/2 = Border price is converted at the shadow rate of US$ 1.0 = TSh13.5 (Shadow price factor: 1.12).

/3 = These costs are based on "Tariff Book of Harbour Dues and Charges".

/4 = 5% of store-gate price is applied in the estimation.

Table E-36 (5/6) ECONOMIC PRICE OF T.S.P.

(1983 Constant US Dollar)

Item	Price
	(US$/ton)
FOB at Florida/1	215
Transportation cost to Tanga port	200
CIF at Tanga port	415
	(TSH/ton)
Converted CIF at Tanga port/2	5,600
Wharfage/3	85
Unloading/Loading cost/3	20
Handling and storing cost/3	70
Transportation cost to Moshi	165
Store-gate price at Moshi	5,940
Handling and storing cost/4	-300
Local transportation cost	-30
Farm-gate price	5,610
Nutrient farm-gate price (TSh/kg)	12.2

Note: /1 = Price in 1995 at 1983 constant US dollar forecasted in the Documents of IBRD, July 1982, "Price Prospects for Major Primary Commodities".

/2 = Border price is converted at the shadow rate of US$1.0 = TSh13.5 (Shadow price factor: 1.12).

/3 = These costs are based on "Tariff Book of Harbour Dues and Charges".

/4 = 5% of store-gate price is applied in the estimation.

Table E-36 (6/6) ECONOMIC PRICE OF INSECTICIDES AND FUNGICIDES

(1983 Constant US Dollar)

Item	Insecticides	Fungicides
	(US$/ton)	(TSh/ton)
CIF at Tanga port/1	3,820	4,680
	(TSh/ton)	(TSh/ton)
Converted CIF at Tanga port/2	51,570	68,180
Wharfage/3	775	950
Unloading/Loading cost/3	20	20
Handling and storing cost/3	70	70
Transportation cost to Moshi	165	165
Store-gate price at Moshi	52,600	69,385
Handling and storing cost/4	-2,630	-3,470
Local transportation cost	-30	-30
Farm-gate price	49,940	65,885
	≒ 49,900	≒ 65,900

Note: /1 = Estimated based on CIF Tanzania in 1980

/2 = Border price is converted at the shadow rate of US$1.0 = TSh13.5 (Shadow price factor: 1.12).

/3 = These costs are based on "Tariff Book of Harbour Dues and Charges".

/4 = 5% of store-gate price is applied in the estimation.

Table E-37 (1/2) CALCULATION OF ECONOMIC COST OF FARM MACHINERY

I. Expression

$$Cha = \frac{P \cdot Fc}{h} + F + O + (T)$$

where, Cha: Economic cost per hour (TSh)
P : Economic procurement cost of machinery (TSh)
Fc : Ratio of maintenance cost (%)
h : Working hour per annum (h)
F : Economic cost of fuel per hour (TSh/h)
O : Economic cost of lubricant per hour (TSh/h)
T : Maintenance cost of tractor per hour (P.Fc/h)

II. Assumptions

	Item	Tractor (80 HP)	Dist Plow	Disk Harrow	Power Sprayer	Power Thresher
(1)	Economic procurement cost	334,000	35,000	33,000	5,000	13,000
(2)	Ratio of maintenance cost	23.6	28.8	29.2	24.4	21.4
(3)	Working hour per annum	720	720	720	300	300
(4)	Economic cost of fuel per hour	-	TSh7.9/ℓ x 10 ℓ/h	TSh7.9/ℓ x 10 ℓ/h	TSH7.9/ℓ x 1.5 ℓ/h	TSh7.9/ℓ x 2 ℓ/h
(5)	Economic cost of lubricant per hour	30% of (4)	-	-	30% of (4)	30% of (4)
(6)	Working capital	-	0.45 ha/h	0.65 ha/h	0.75 ha/h	750 kg/h

Note: Economic procurement cost in 1995 at 1983 constant prices are projected based on the International Market Price Index by the Document of the IBRD, July 1982 "Price Prospects for Major Primary Commodities"

to be continued

Table E-37 (2/2) CALCULATION OF ECONOMIC COST OF FARM MACHINERY

III. Calculation

(1) Tractor plowing per ha

$$= \frac{\text{TSH35,000 x 28.8\%}}{720\text{h}} + \text{TSh79} + \text{TSh24} + \frac{\text{TSh334,000 x 23.6\%}}{720\text{h}}$$

$$= \text{TSh226/h}$$

$$\fallingdotseq \text{TSh500/ha}$$

(2) Tractor horrowing per ha

$$= \frac{\text{TSh33,000 x 29.2\%}}{720\text{h}} + \text{TSh79} + \text{TSh24} + \frac{\text{TSh34,000 x 23.6\%}}{720\text{h}}$$

$$= \text{TSh226/h}$$

$$\fallingdotseq \text{TSh350/ha}$$

(3) Spraying per ha

$$= \frac{\text{TSh5,000 x 24.4\%}}{300\text{h}} + \text{TSh11.9} + \text{TSh3.6}$$

$$= \text{TSh20/h}$$

$$\fallingdotseq \text{TSh26/ha}$$

(4) Threshing per ha

$$= \frac{\text{TSh13,000 x 21.4\%}}{300\text{h}} + \text{TSh15.8} + \text{TSh4.7}$$

$$= \text{TSh30/h}$$

$$\fallingdotseq \text{TSh40/ton}$$

Table E-38 (1/4) ECONOMIC BALANCE OF CROP PRODUCTION WITHOUT PROJECT BY CROPPING CONDITION

Description	Cropping Condition: 1st cropping Maize[/1] Irrigated/H.Y.V. Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)	Cropping Condition: 1st cropping Maize[/1] Irrigated/L.V. Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)
A) Gross Income						
Maize	1,500	4.83	7,245	1,000	4.83	4,830
Beans	400	5.58	2,232	400	5.58	2,232
Total			9,477			7,062
B) Production Cost						
1) Farm Inputs						
- Seed Maize	25	10.20	255	30	4.83	145
Beans	25	12.25	306	25	12.25	306
- Fertilizer	-	-	-	-	-	-
- Chemicals	-	-	-	-	-	-
2) Labour Cost[/2]						
- Family Labour	155 M-D	14.00	2,170	147 M-D	14.00	2,058
- Hired Labour	16 M-D	23.00	368	15 M-D	23.00	345
3) Machinery						
- Tractor			210[/3]			210[/3]
4) Sacks	21 Nos.	17.90	376	16 Nos.	17.90	286
5) Miscellaneous	5% of above		184	5% of above		168
Total			3,869			3,518
C) Net Return (A - B)			5,608			3,544

Description	Cropping Condition: 1st cropping Maize[/1] Rainfed/L.V. Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)	Cropping Condition: 2nd cropping Maize Rainfed/L.V. Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)
A) Gross Income						
Maize	600	4.83	2,898	600	4.83	2,898
Beans	400	5.58	2,232	-	-	-
Total			5,130			2,898
B) Production Cost						
1) Farm Inputs						
- Seed Maize	30	4.83	145	30	4.83	145
Beans	25	12.25	306	-	-	-
- Fertilizer	-	-	-	-	-	-
- Chemicals	-	-	-	-	-	-
2) Labour Cost[/2]						
- Family Labour	136 M-D	14.00	1,904	116 M-D	14.00	1,624
- Hired Labour	15 M-D	23.00	345	-	-	-
3) Machinery						
- Tractor	-	-	-	-	-	30[/4]
4) Sacks	10 Nos.	17.90	179	6 Nos.	17.90	107
5) Miscellaneous	5% of above		144	5% of above		95
Total			3,023			2,001
C) Net Return (A - B)			2,107			897

Note: /1 = Mixed standing with Beans
/2 = Decreased labour force by tractor plowing is deducted
/3 = Average tractor plowing area of 42% is counted (TSh500 x 42% = TSh210)
/4 = Average tractor plowing area of 6% is counted (TSh500 x 6% = TSh30)

Table E-38 (2/4) ECONOMIC BALANCE OF CROP PRODUCTION WITHOUT PROJECT BY CROPPING CONDITION

Description	Cropping Condition: 3rd cropping Maize/1 Irrigated/H.Y.V. Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)	Cropping Condition: 3rd cropping Maize/1 Irrigated/L.V. Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)
A) Gross Income						
Maize	1,500	4.83	7,245	1,000	4.83	4,830
Beans	400	5.58	2,232	400	5.58	2,232
Total			9,477			7,062
B) Production Cost						
1) Farm Inputs						
- Seed Maize	25	10.20	255	30	4.83	145
Beans	25	12.25	306	25	12.25	306
- Fertilizer	-	-	-	-	-	-
- Chemicals	-	-	-	-	-	-
2) Labour Cost/2						
- Family Labour	161 M-D	14.00	2,254	153 M-D	14.00	2,142
- Hired Labour	17 M-D	23.00	391	16 M-D	23.00	368
3) Machinery						
- Tractor			105/3			105/3
4) Sacks	21 Nos.	17.90	376	16 Nos.	17.90	286
5) Miscellaneous	5% of above		184	5% of above		168
Total			3,871			3,520
C) Net Return (A - B)			5,606			3,542

Description	Cropping Condition: 3rd cropping Maize/1 Rainfed/L.V. Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)
A) Gross Income			
Maize	600	4.83	2,898
Beans	400	5.58	2,232
Total			5,130
B) Production Cost			
1) Farm Inputs			
- Seed Maize	30	4.83	145
Beans	25	12.25	306
- Fertilizer	-	-	-
- Chemicals	-	-	-
2) Labour Cost/2			
- Family Labour	136 M-D	14.00	1,904
- Hired Labour	15 M-D	23.00	345
3) Machinery			
- Tractor	-	-	-
4) Sacks	10 Nos.	17.90	179
5) Miscellaneous	5% of above		144
Total			3,023
C) Net Return (A - B)			2,107

Note: /1 = Mixed standing with Beans
/2 = Decreased labour force by tractor plowing is deducted
/3 = Average tractor plowing area of 21% is counted

Table E-38 (3/4) ECONOMIC BALANCE OF CROP PRODUCTION WITHOUT PROJECT BY CROPPING CONDITION

Description	Cropping Condition: Irrigated Paddy/L.V. in Kisiwani & Kihurio Schemes			Cropping Condition: Irrigated Paddy/L.V. in Gonja Scheme		
	Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)	Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)
A) Gross Income	2,800	5.28	14,784	2,000	5.28	10,560
B) Production Cost						
1) Farm Inputs						
- Seed	85	5.28	449	85	5.28	449
- Fertilizer	-	-	-	-	-	-
- Chemicals	-	-	-	-	-	-
2) Labour Cost/1						
- Family Labour	250 M-D	14.00	3,500	239 M-D	14.00	3,346
- Hired Labour	28 M-D	23.00	644	26 M-D	23.00	598
3) Machinery						
- Tractor			105/2			105/2
4) Sacks	33 Nos.	17.90	591	24 Nos.	17.90	430
5) Miscellaneous	5% of above		264	5% of above		246
Total			5,553			5,174
C) Net Return (A - B)			9,231			5,386

Description	Cropping Condition: Irrigated Paddy/L.V. in Ndungu Scheme		
	Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)
A) Gross Income	1,800	5.28	9,504
B) Production Cost			
1) Farm Inputs			
- Seed	85	5.28	449
- Fertilizer	-	-	-
- Chemicals	-	-	-
2) Labour Cost/1			
- Family Labour	234 M-D	14.00	3,276
- Hired Labour	26 M-D	23.00	598
3) Machinery			
- Tractor			105/2
4) Sackes	22 Nos.	17.90	394
5) Miscellaneous	5% of above		241
Total			5,063
C) Net Return (A - B)			4,441

Note: /1 = Decreased labour force by tractor plowing is deducted.

/2 = Average tractor plowing area by 21% is counted.
(TSh500 x 21% = TSh105)

Table E-38 (4/4) ECONOMIC BALANCE OF CROP PRODUCTION WITHOUT PROJECT BY CROPPING CONDITION

	Description	Cropping Condition: Rainfed Paddy/L.V. in Kisiwani & Kihurio Schemes Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)	Cropping Condition: Rainfed Paddy/L.V. in Conja Scheme Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)
A)	Gross Income	2,800	5.28	14,784	2,000	5.28	10,560
B)	Production Cost						
	1) Farm Inputs						
	- Seed	85	5.28	449	85	5.28	449
	- Fertilizer	-	-	-	-	-	-
	- Chemicals	-	-	-	-	-	-
	2) Labour Cost/1						
	- Family Labour	236 M-D	14.00	3,304	227 M-D	14.00	3,178
	- Hired Labour	28 M-D	23.00	644	26 M-D	23.00	598
	3) Machinery						
	- Tractor			105/2			105/2
	4) Sacks	33 Nos.	17.90	591	24 Nos.	17.90	430
	5) Miscellaneous	5% of above		255	5% of above		238
	Total			5,348			4,998
C)	Net Return (A - B)			9,436			5,562

	Description	Cropping Condition: Rainfed Paddy/L.V. in Ndungu Schemes Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)
A)	Gross Income	1,800	5.28	9,504
B)	Production Cost			
	1) Farm Inputs			
	- Seed	85	5.28	449
	- Fertilizer	-	-	-
	- Chemicals	-	-	-
	2) Labour Cost/1			
	- Family Labour	222 M-D	14.00	3,108
	- Hired Labour	26 M-D	43.00	598
	3) Machinery			
	- Tractor			105/2
	4) Sacks	22 Nos.	17.90	394
	5) Miscellaneous	5% of above		233
	Total			4,887
C)	Net Return (A - B)			4,617

Note: /1 = Decreased labour force by tractor plowing is deducted.
/2 = Average tractor plowing area of 21% is counted.
(TSh500 x 21% = TSh105)

Table E-39 ECONOMIC BALANCE OF CROP PRODUCTION WITH PROJECT BY CROPPING CONDITION

	Cropping Condition: Irrigated Paddy/H.Y.V. in Dry Season			Cropping Condition: Irrigated Paddy/H.Y.V. in Rainy Season		
	Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)	Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)
A) Gross Income	4,500	5.28	23,760	5,000	5.28	26,400
B) Produciton Cost						
1) Farm Inputs						
- Seed	40	10.10	404	40	10.10	404
- Fertilizer N	90	15.20	1,368	80	15.20	1,216
P_2O_5	70	12.20	854	60	12.20	732
K_2O	-	-	-	-	-	-
- Chemicals						
Insecticides	12	49.90	599	12	49.90	599
Fungicides	2	65.90	132	2	65.90	132
2) Labour Cost	218 M-D	14.00	3,052	233 M-D	14.00	3,122
3) Machinery						
- Tractor						
Plow			500			500
Harrow			350			350
- Spraying	4 times	26.00	104	4 times	26.00	104
- Threshing	4,500	0.04	180	5,000	0.04	200
4) Sacks	53 Nos.	17.90	949	59 Nos.	17.90	1,056
5) Miscellaneous	5% of above		425	5% of above		421
Total			8,917			8,836
C) Net Return (A - B)			14,843			17,564

	Cropping Condition: Rainfed Maize/1		
	Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)
A) Gross Income			
Maize	2,000	4.83	9,660
Beans	800	5.58	4,464
Total			14,124
B) Production Cost			
1) Farm Inputs			
- Seed Maize	25	10.20	255
Beans	30	12.25	368
- Fertilizer N	70	15.20	1,064
P_2O_5	60	12.20	732
K_2O	-	-	-
- Chemicals			
Insecticides	8	49.90	399
Fungicides	1	65.90	66
2) Labour Cost	131 M-D	14.00	1,834
3) Machinery			
- Tractor Plow			500
Harrow			350
- Spraying	3 times	26.00	78
- Threshing	2,800	40.00	112
4) Sacks	30 Nos.	17.90	537
5) Miscellaneous	5% of above		315
Total			6,610
C) Net Return (A - B)			7,514

Note: /1 = Mixed Standing with Beans

Table E-40 (1/2) GROSS AND NET PRODUCTION RETURN IN EACH SCHEME AREA WITHOUT PROJECT - ECONOMIC PRICE BASE

Crop	Area (ha)	Unit Gross Income (TSh/ha)	Total Gross Income (TShx10^3)	Unit Production Cost (TSh/ha)	Total Production Cost (TShx10^3)	Unit Net Return (TSh/ha)	Total Net Return (TShx10^3)
(1) Kisiwani							
1st Maize/1							
Irrigated/H.Y.V.	20	9,477	189	3,869	77	5,608	112
Irrigated/L.V.	60	7,062	424	3,518	211	3,544	213
Rainfed/L.V.	50	5,130	256	3,023	151	2,107	105
2nd Maize/2							
Rainfed/L.V.	10	2,898	29	2,001	20	897	9
Rainfed/L.V./4	10	2,898	29	2,001	20	897	9
3rd Maize/3							
Irrigated/H.Y.V.	10	9,477	95	3,871	39	5,606	56
Irrigated/L.V.	20	7,062	141	3,520	70	3,542	71
Rainfed/L.V./4	60	5,130	307	3,023	181	2,107	126
Paddy							
Irrigated/L.V.	60	14,784	887	5,553	333	9,231	554
Rainfed/L.V./4	70	14,784	1,035	5,348	374	9,436	661
Total (rounded)			3,390		1,480		1,910
(2) Gonja							
1st Maize/1							
Irrigated/H.Y.V.	20	9,477	189	3,869	77	5,608	112
Irrigated/L.V.	60	7,062	424	3,518	211	3,544	213
Rainfed/L.V.	210	5,130	1,077	3,023	635	2,107	442
2nd Maize/2							
Rainfed/L.V.	30	2,898	87	2,001	60	897	27
Rainfed/L.V./4	230	2,898	666	2,001	460	897	206
3rd Maize/3							
Irrigated/H.Y.V.	10	9,477	95	3,871	39	5,606	56
Irrigated/L.V.	30	7,062	212	3,520	106	3,542	106
Rainfed/L.V./4	80	5,130	410	3,023	242	2,107	168
Paddy							
Irrigated/L.V.	40	10,560	422	5,174	207	5,386	215
Rainfed/L.V./4	290	10,560	3,062	4,998	1,449	5,562	1,613
Total (rounded)			6,640		3,480		3,160
(3) Ndungu							
1st Maize/1							
Irrigated/H.Y.V.	30	9,477	284	3,869	116	5,608	168
Irrigated/L.V.	70	7,062	494	3,518	246	3,544	248
Rainfed/L.V.	210	5,130	1,077	3,023	635	2,107	442
2nd Maize/2							
Rainfed/L.V.	40	2,898	116	2,001	80	897	36
Rainfed/L.V./4	130	2,898	377	2,001	260	897	117
3rd Maize/3							
Irrigated/H.Y.V.	40	9,477	379	3,871	155	5,606	224
Irrigated/L.V.	100	7,062	706	3,520	352	3,542	254
Rainfed/L.V./4	30	5,130	154	3,023	91	2,107	63

(to be continued)

Table E-40 (2/2) GROSS AND NET PRODUCTION RETURN IN EACH SCHEME AREA WITHOUT PROJECT - ECONOMIC PRICE BASE

Crop	Area (ha)	Unit Gross Income (TSh/ha)	Total Gross Income (TShx10^3)	Unit Production Cost (TSh/ha)	Total Production Cost (TShx10^3)	Unit Net Return (TSh/ha)	Total Net Return (TShx10^3)
Paddy							
Irrigated/L.V.	160	9,504	1,520	5,063	810	4,441	710
Rainfed/L.V./4	190	9,504	1,806	4,887	929	4,617	877
Total (rounded)			6,910		3,670		3,240
(4) Kihurio							
1st Maize/1							
Irrigated/H.Y.V.	110	9,477	1,042	3,869	425	5,608	617
Irrigated/L.V.	290	7,062	2,048	3,518	1,020	3,544	1,028
Rainfed/L.V.	110	5,130	564	3,023	332	2,107	232
2nd Maize/2							
Rainfed/L.V.	20	2,898	58	2,001	40	897	18
Rainfed/L.V./4	70	2,898	203	2,001	140	897	63
3rd Maize/3							
Irrigated/H.Y.V.	80	9,477	758	3,871	310	5,606	448
Irrigated/L.V.	200	7,062	1,412	3,520	704	3,542	708
Rainfed/L.V./4	440	5,130	2,257	3,023	1,330	2,107	927
Paddy							
Irrigated/L.V.	160	14,784	2,365	5,553	888	9,231	1,477
Rainfed/L.V./4	140	14,784	2,070	5,348	749	9,436	1,321
Total (rounded)			12,780		5,940		6,840
(5) Igoma							
1st Maize							
Rainfed/L.V.	20	5,130	100	3,023	60	2,107	40
Project Area, Total			29,820		14,630		15,190

Note: /1 = Rainy season maize, mixed cropping with Beans
/2 = Rainy season maize
/3 = Dry season maize, mixed cropping with Beans
/4 = Cropping in the lowlying area

Negative Benefit in Kihurio scheme							
2nd Maize							
Rainfed/L.V.	40	2,898	116	2,001	80	897	36
Paddy							
Irrigated/L.V.	10	9,504	95	5,063	51	4,441	44
Rainfed/L.V.	20	9,504	190	4,887	98	4,617	92
Total (rounded)			400		230		170

Table E-41 GROSS AND NET PRODUCTION RETURN IN EACH SCHEME AREA WITH PROJECT - ECONOMIC PRICE BASE

Scheme Production	Area (ha)	Unit Gross Income (TSh/ha)	Gross Income (TShx10^3)	Unit Production Cost (TSh/ha)	Total Production Cost (TShx10^3)	Unit Net Return (TSh/ha)	Total Net Return (TShx10^3)
(1) Kisiwani							
Paddy (dry season)	180	23,760	4,277	8,917	1,605	14,843	2,672
(rainy season)	360	26,400	9,504	8,836	3,181	17,564	6,323
Maize with Beans	180	14,124	2,542	6,610	1,190	7,514	1,353
Total (rounded)			16,320		5,970		10,350
(2) Gonja							
Paddy (dry season)	300	23,760	7,218	8,917	2,675	14,843	4,453
(rainy season)	600	26,400	15,840	8,836	5,302	17,564	10,538
Maize with Beans	740	14,124	10,452	6,610	4,891	7,514	5,560
Total (rounded)			33,420		12,870		20,550
(3) Ndungu							
Paddy (dry season)	230	23,760	5,465	8,917	2,051	14,843	3,414
(rainy season)	680	26,400	17,952	8,836	6,008	17,564	11,944
Maize with Beans	710	14,124	10,028	6,610	4,693	7,514	5,335
Total (rounded)			33,440		12,750		20,690
(4) Kihurio							
Paddy (dry season)	1,320	23,760	31,363	8,917	11,770	14,843	19,593
(rainy season)	1,670	26,400	44,088	8,836	14,756	17,564	29,332
Maize with Beans	350	14,124	4,943	6,610	2,314	7,514	2,630
Total (rounded)			80,400		28,840		51,560
(5) Igoma							
Paddy (dry season)	750	23,760	17,820	8,917	6,688	14,843	11,132
(rainy season)	750	26,400	19,800	8,836	6,627	17,564	13,173
Maize with Beans	-	-	-	-	-	-	-
Total (rounded)			37,620		13,310		24,310
Project Total			201,200		73,740		127,460

Table E-42 ANNUAL INCREMENTAL BENEFIT

Unit: TSh x 10^3

Year	1	2	3	4	5	6	7	8	9	10
Kisiwani Scheme			1,890	7,300	8,150	8,440	8,440	8,440	8,440	8,440
Gonja Scheme				12,900	16,420	17,320	17,390	17,390	17,390	17,390
Ndungu Scheme			3,610	12,240	16,560	17,360	17,450	17,450	17,450	17,450
Kihurio Scheme				14,140	32,010	42,300	44,160	44,550	44,550	44,550
Igoma Scheme					3,840	17,879	20,680	22,920	23,910	24,270
Total			5,500	46,580	76,980	103,290	108,120	110,750	111,740	112,100

Table E-43 FINANCIAL BALANCE OF CROP PRODUCTION WITH PROJECT BY CROPPING CONDITION

Description	Cropping Condition: Irrigated Paddy/H.Y.V. in Dry Season Q'ty (kg/ha)	Unit Price (TSh/ha)	Amount (TSh/ha)	Cropping Condition: Irrigated Paddy/H.Y.V. in Rainy Season Q'ty (kg/ha)	Unit Price (TSh/ha)	Amount (TSh/ha)
A) Gross Income						
	4,500	6.00	27,000	5,000	6.00	30,000
B) Production Cost						
1) Farm Inputs						
- Seed	40	8.75	350	40	8.75	350
- Fertilizer N	80	9.40	752	90	9.40	846
P	60	4.60	276	70	4.60	322
K	-	-	-	-	-	-
- Chemicals						
Insecticides	12	32.25	387	12	32.25	387
Fungicides	2	39.50	79	2	39.50	79
2) Labour Cost	218 M-D			223 M-D		
3) Machinery						
- Tractor						
Plow			650			650
Harrow			250			250
- Spraying	4 times	40.00	160	4 times	40.00	160
- Threshing	4,500	0.06	270	5,000	0.06	300
4) Sacks	53 Nos.	15.00	795	59 Nos.	15.00	885
5) Miscellaneous	5% of above		198	5% of above		211
Total			4,167			4,440
C) Net Return (A - B)			22,833			25,560

Description	Cropping Condition: Rainfed Maize/1 Q'ty (kg/ha)	Unit Price (TSh/kg)	Amount (TSh/ha)
A) Gross Income			
Maize	2,000	4.00	8,000
Beans	800	8.00	6,400
Total			14,400
B) Production Cost			
1) Farm Inputs			
- Seed Maize	25	13.00	325
Beans	30	10.60	318
- Fertilizer N	70	9.40	658
P	60	4.60	276
K	-	-	-
- Chemicals			
Insecticides	8	32.25	258
Fungicides	1	39.50	40
2) Labour Cost	131 M-D		
3) Machinery			
- Tractor Plow			650
Harrow			250
- Spraying	3 times	40.00	120
- Threshing	2,800	0.06	168
4) Sacks	30 Nos.	15.00	450
5) Miscellaneous	5% of above		176
Total			3,689
C) Net Return (A - B)			10,711

Note: /1 = Mixed Standing with Beans

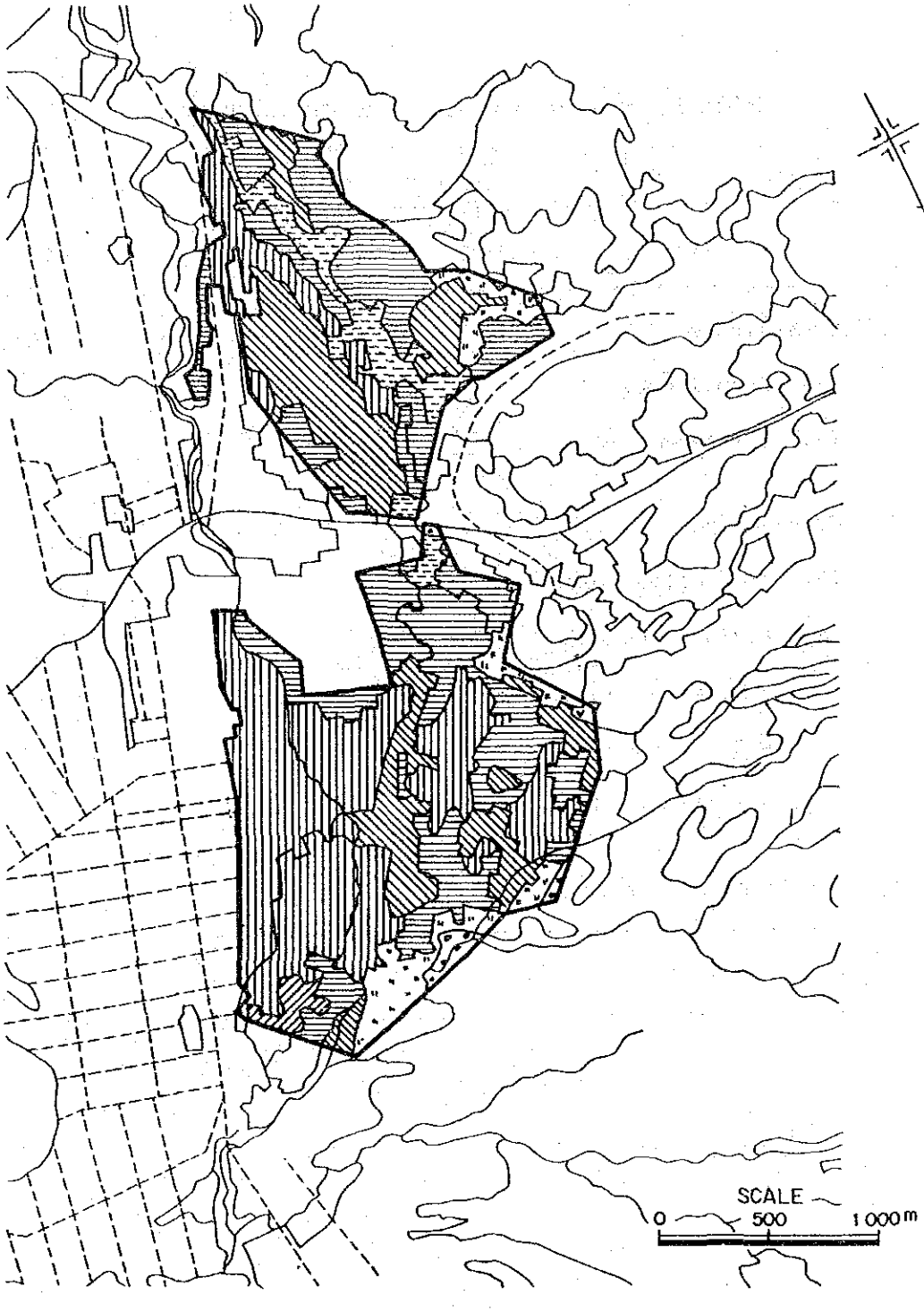
Table E-44 GROSS AND NET PRODUCTION RETURN IN EACH SCHEME AREA WITH PROJECT - FINANCIAL PRICE BASE

Scheme Production	Area (ha)	Unit Gross Income (TSh/ha)	Gross Income (TShx10^3)	Unit Production Cost (TSh/ha)	Total Production Cost (TShx10^3)	Unit Net Return (TSh/ha)	Total Net Return (TShx10^3)
(1) Kisiwani							
Paddy (dry season)	180	27,000	4,860	4,167	750	22,833	4,110
(rainy season)	360	30,000	10,800	4,440	1,598	25,560	9,202
Maize with Beans	180	14,400	2,592	3,689	664	10,711	1,928
Total			18,252		3,012		15,240
(2) Gonja							
Paddy (dry season)	300	27,000	8,100	4,167	1,250	22,833	6,850
(rainy season)	600	30,000	18,000	4,440	2,664	25,560	15,336
Maize with Beans	740	14,400	10,656	3,689	2,730	10,711	7,926
Total			36,756		6,644		30,112
(3) Ndungu							
Paddy (dry season)	230	27,000	6,210	4,167	958	22,833	5,252
(rainy season)	680	30,000	20,400	4,440	3,019	25,560	17,381
Maize with Beans	710	14,400	10,224	3,689	2,619	10,711	7,605
Total			36,834		6,596		30,238
(4) Kihurio							
Paddy (dry season)	1,320	27,000	35,640	4,167	5,500	22,833	30,140
(rainy season)	1,670	30,000	50,100	4,440	7,415	25,560	42,685
Maize with Beans	350	14,400	5,040	3,689	1,291	10,711	3,749
Total			90,780		14,206		76,574
(5) Igoma							
Paddy (dry season)	750	27,000	20,250	4,167	3,125	22,833	17,125
(rainy season)	750	30,000	22,500	4,440	3,330	25,560	19,170
Maize with Beans	-	-	-	-	-	-	-
Total			42,750		6,455		36,295
Project Total			225,372		36,913		188,459

Table E-45 FARM BUDGET WITH ADN WITHOUT PROJECT

Unit: TSh.

Item	Without Project Condition	With Project Condition
A) Gross Income	8,000	31,920
(1) Farm income	7,500	31,920
(2) Off-farm income	500	-
B) Gross Outgo	8,000	17,310
(3) Production cost	1,240	5,220
(4) Living expences		
- Home consumption of crop	4,850	8,270
- Other food	500	1,000
- Except food	1,410	2,820
C) Net Reserve (capacity to pay)	0	14,610
D) Net Farm Income (1 - 3)	6,260	26,700



LEGEND

Agricultural Land

- Land cropped throughout year
- Land mainly cropped in later half of dry season
- Land mainly cropped in earlier half of dry season
- Land cropped in rainy season

Non-agricultural Land

- Swamp
- Seasonal marshes
- Grass savanna
- Brush savanna

Fig. E-1 (1/5) PRESENT LAND USE MAP (KISIWANI SCHEME)

LEGEND

Agricultural Land

- Land cropped throughout year
- Land mainly cropped in later half of dry season
- Land mainly cropped in earlier half of dry season
- Land cropped in dry season

Non-agricultural Land

- Swamp
- Seasonal marshes
- Grass savanna
- Brush savanna

Fig. E-1 (2/5) PRESENT LAND USE MAP (GONJA SCHEME)

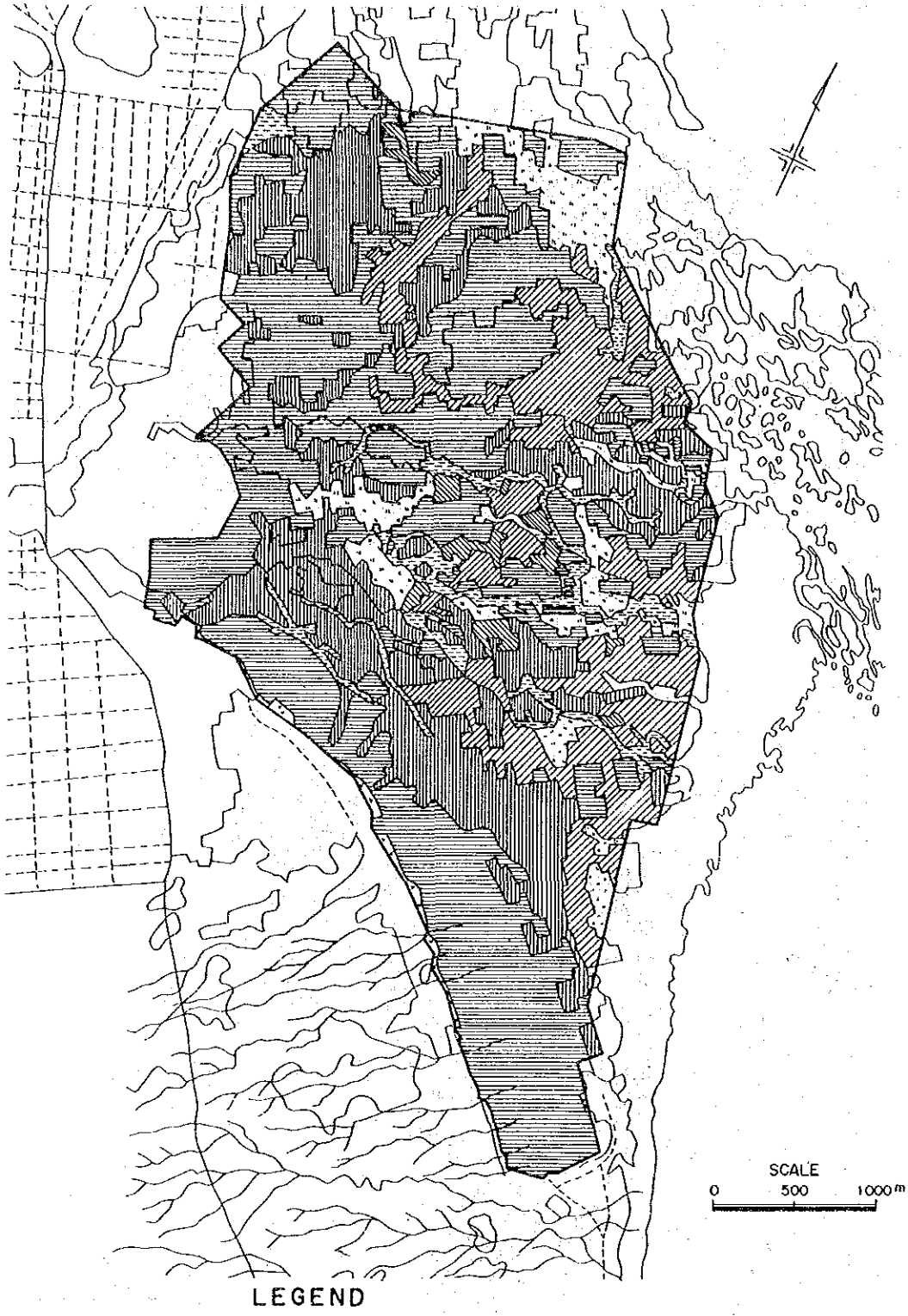


Fig. E-1 (3/5) PRESENT LAND USE MAP (NDUNGU SCHEME)

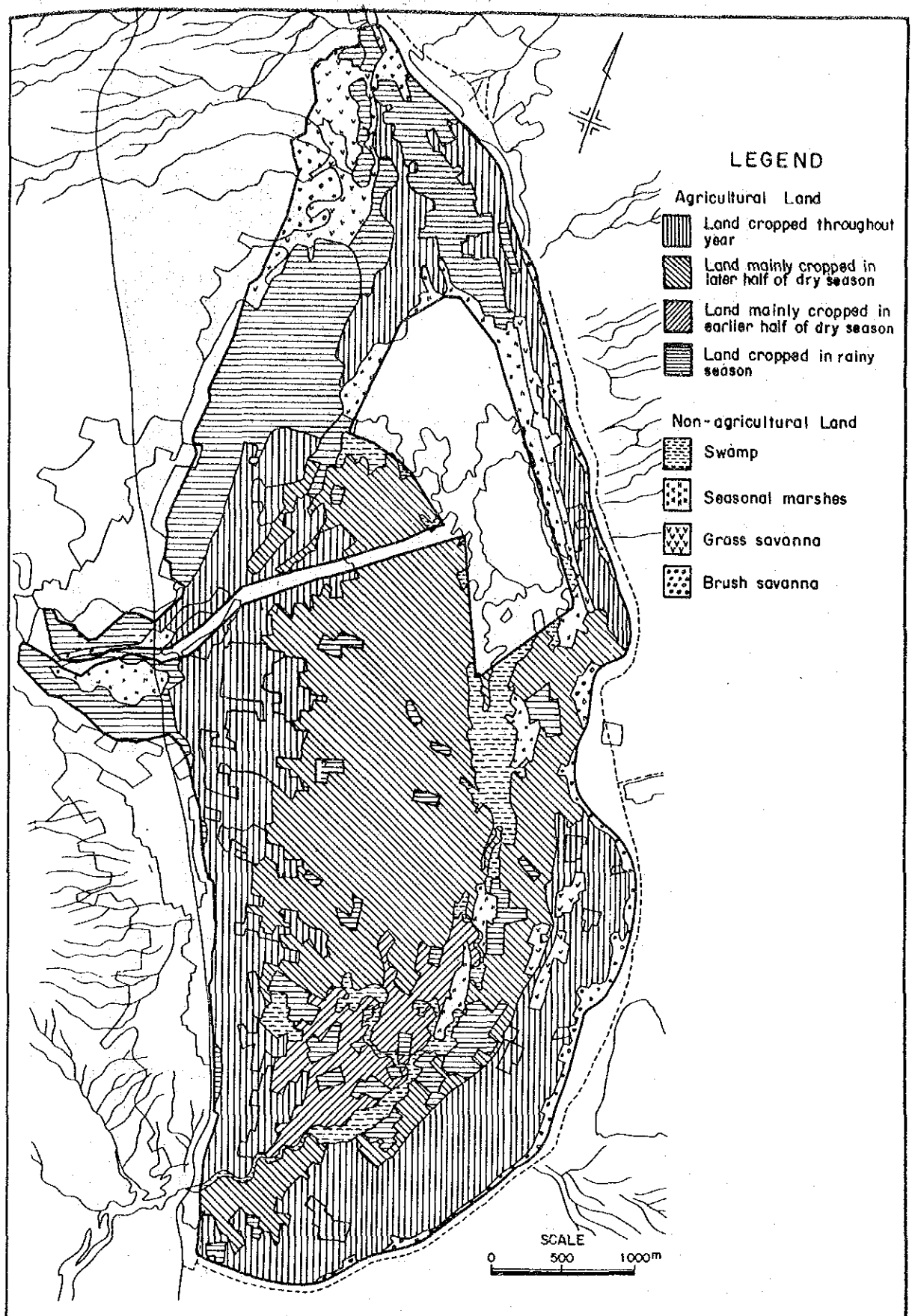


Fig. E-1 (4/5) PRESENT LAND USE MAP (KIHURIO SHCEME)

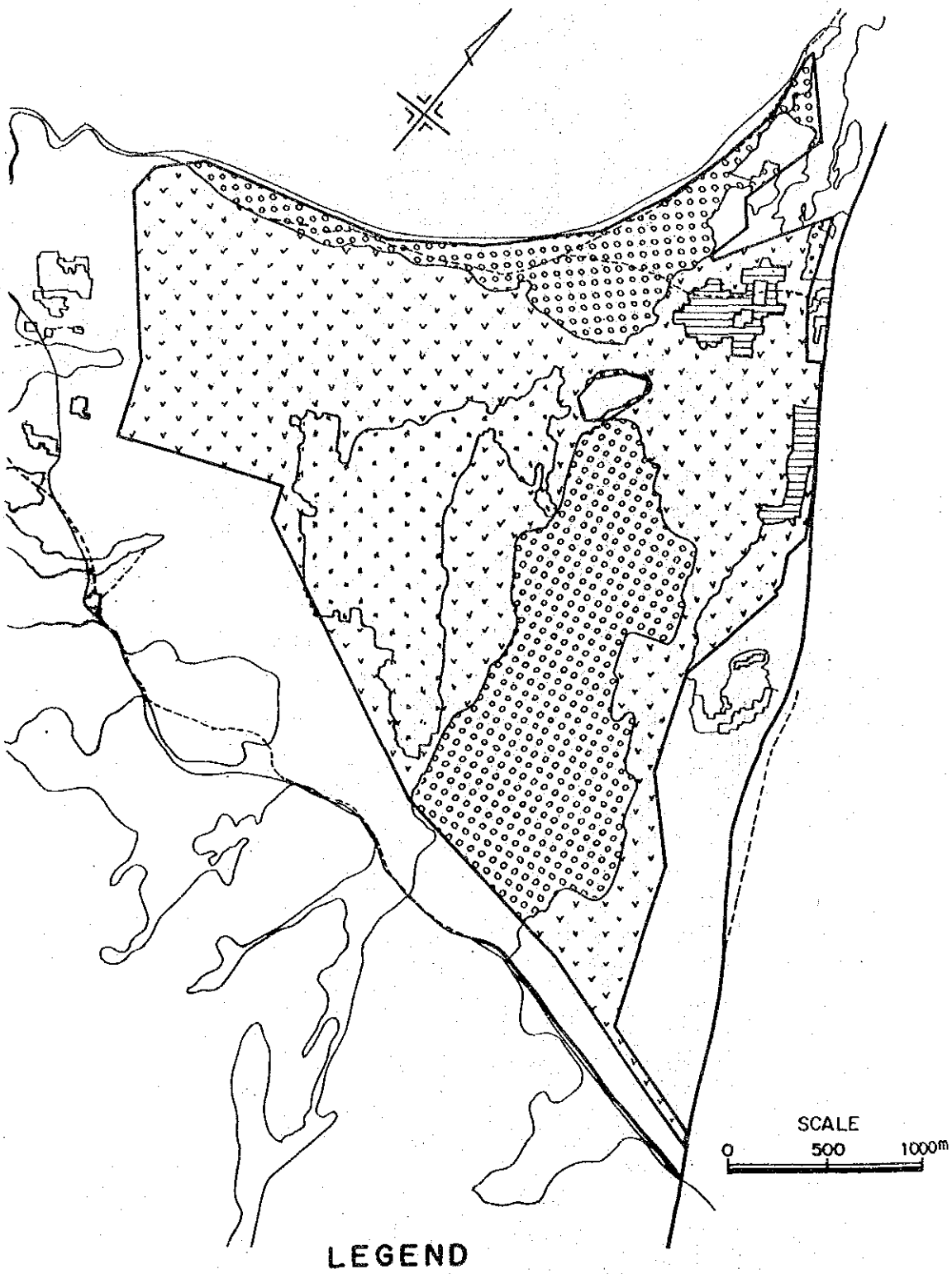


Fig. E-1 (5/5) PRESENT LAND USE MAP (IGOMA SCHEME)

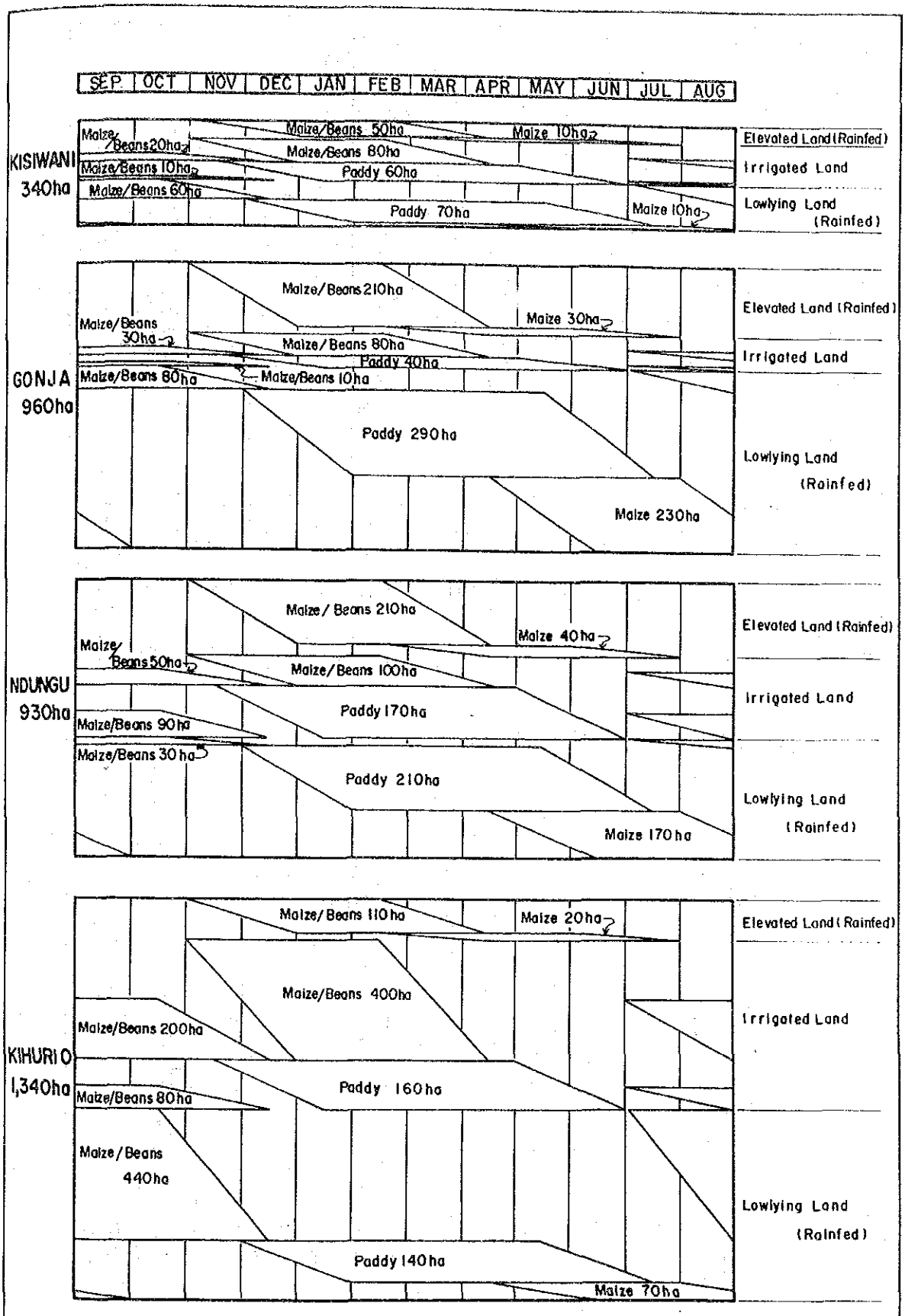


Fig. E-2 PRESENT CROPPING PATTERN

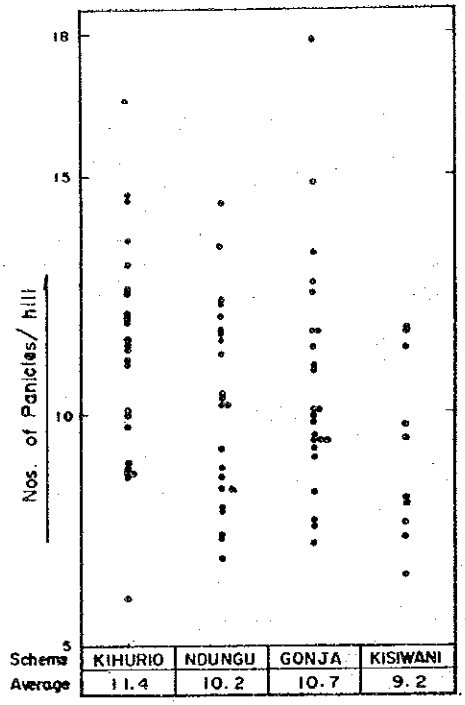


Fig. E-3 NUMBERS OF PANICLES PER HILL

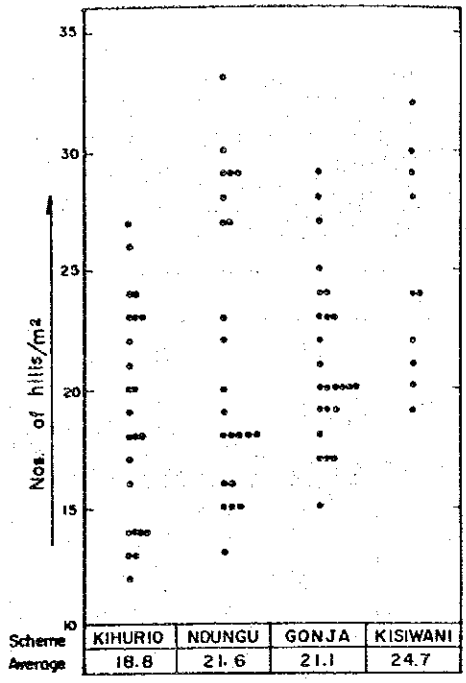


Fig. E-4 NUMBERS OF HILLS PER M^2

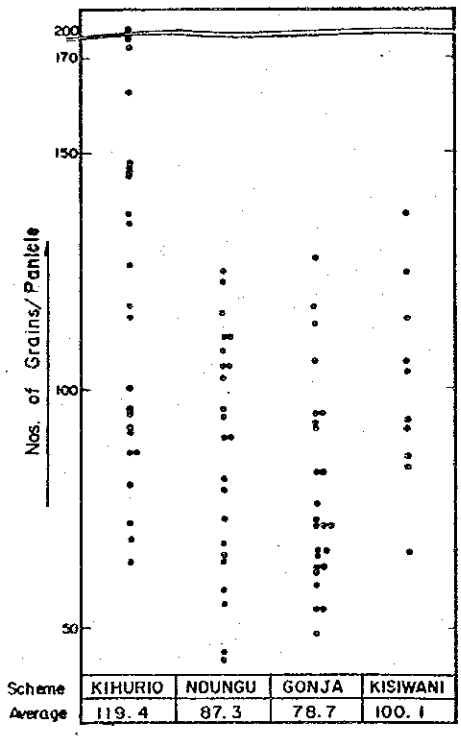


Fig. E-5 NUMBERS OF GRAINS PER PANICLE

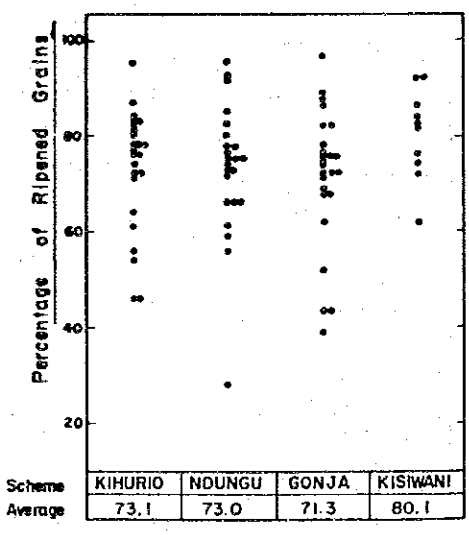


Fig. E-6 PERCENTAGE OF RIPENED GRAINS

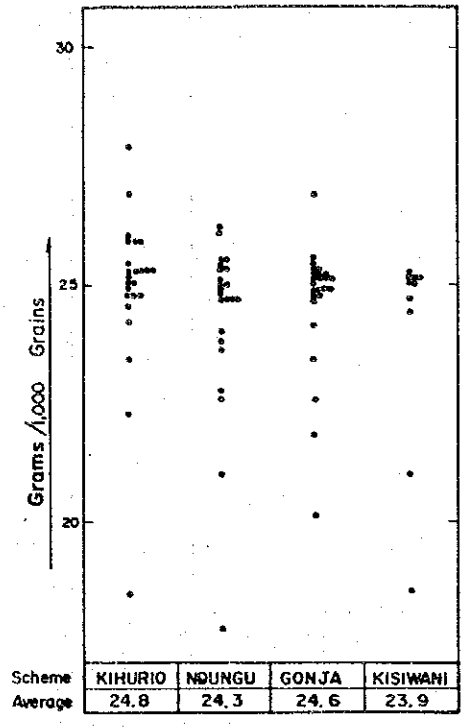


Fig. E-7 WEIGHT OF 1,000 GRAINS

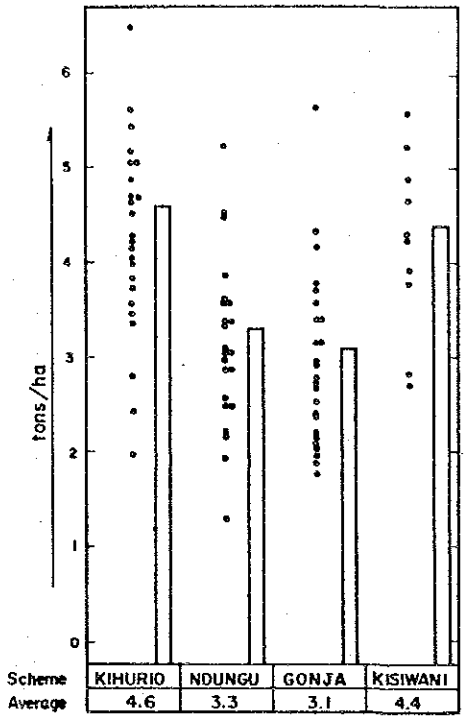


Fig. E-8 POTENTIAL YIELD OF PADDY ESTIMATED BY SAMPLE SURVEY JULY 1983

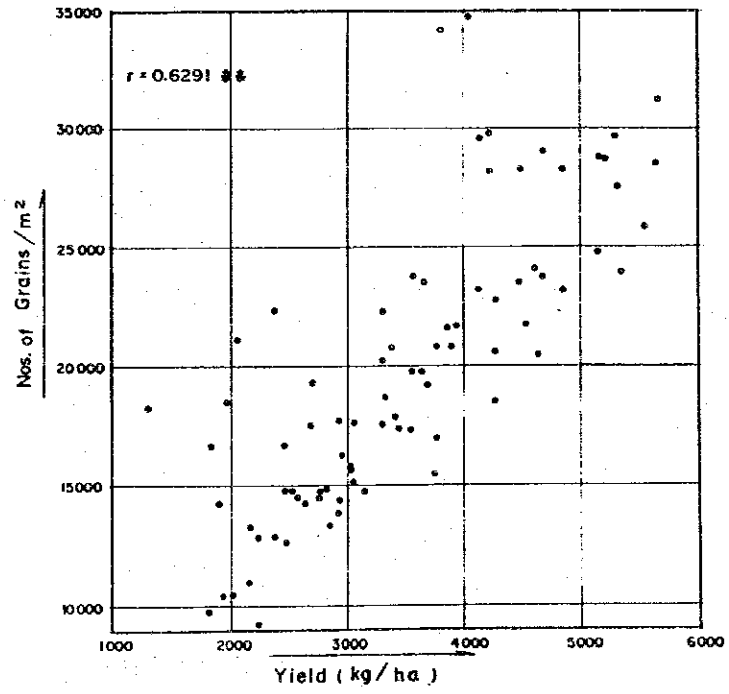


Fig. E-9 CORRELATION BETWEEN NUMBERS OF GRAINS/M^2 AND YIELD OF PADDY

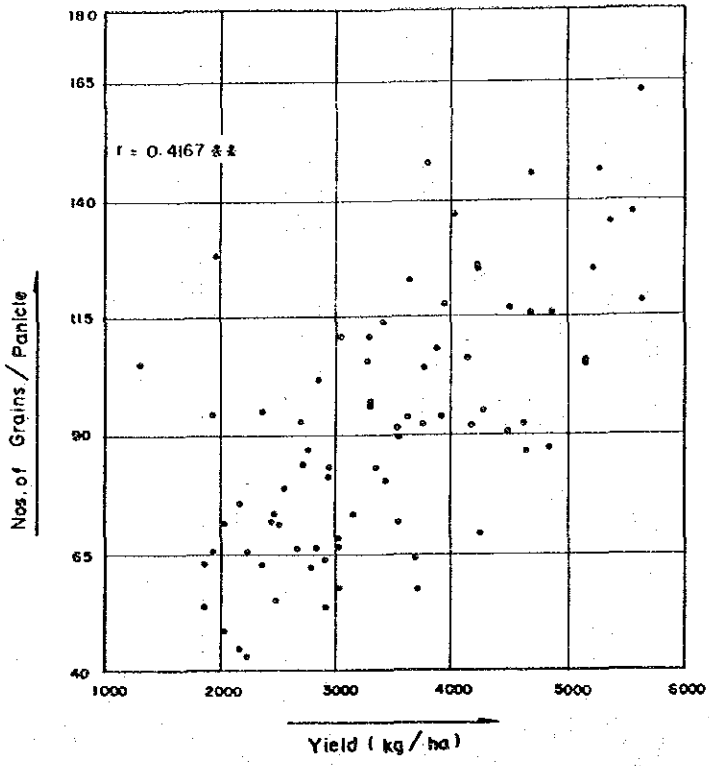


Fig. E-10 CORRELATION BETWEEN NUMBERS OF GRAINS/PANICLE AND YIELD OF PADDY

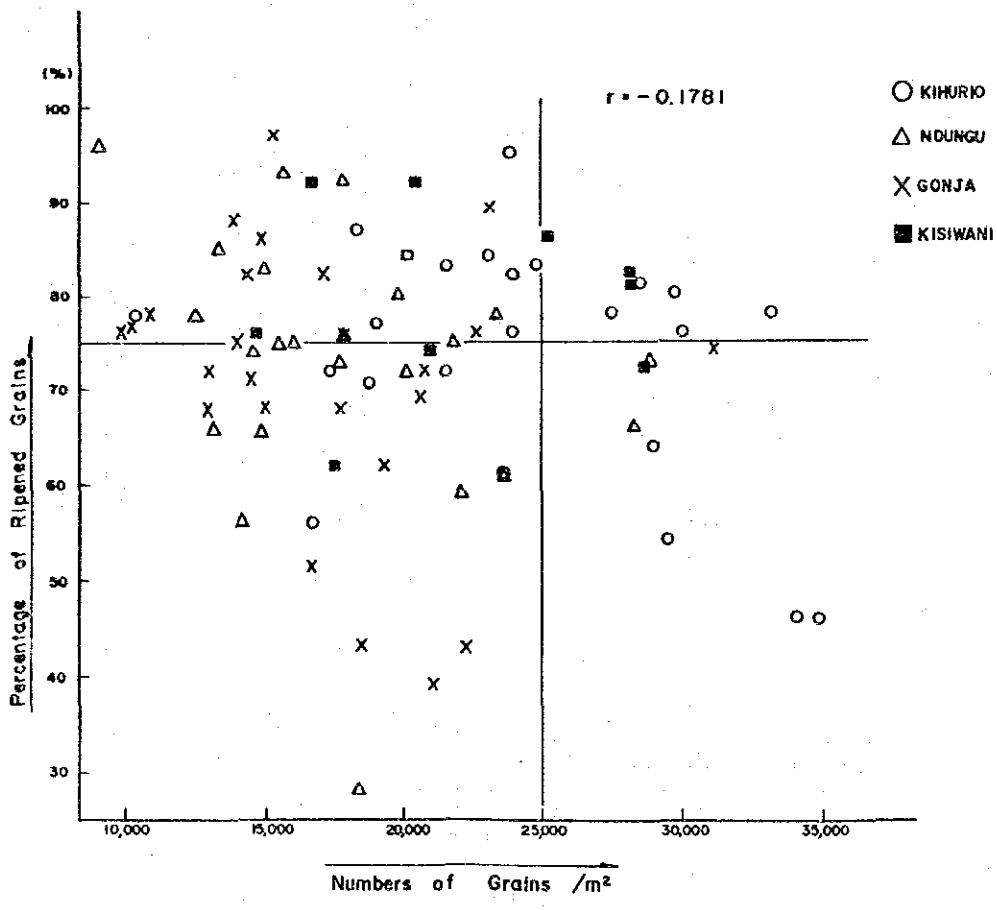


Fig. E-11 CORRELATION BETWEEN PERCENTAGE OF RIPENED GRAINS AND NUMBERS OF GRAINS/M^2

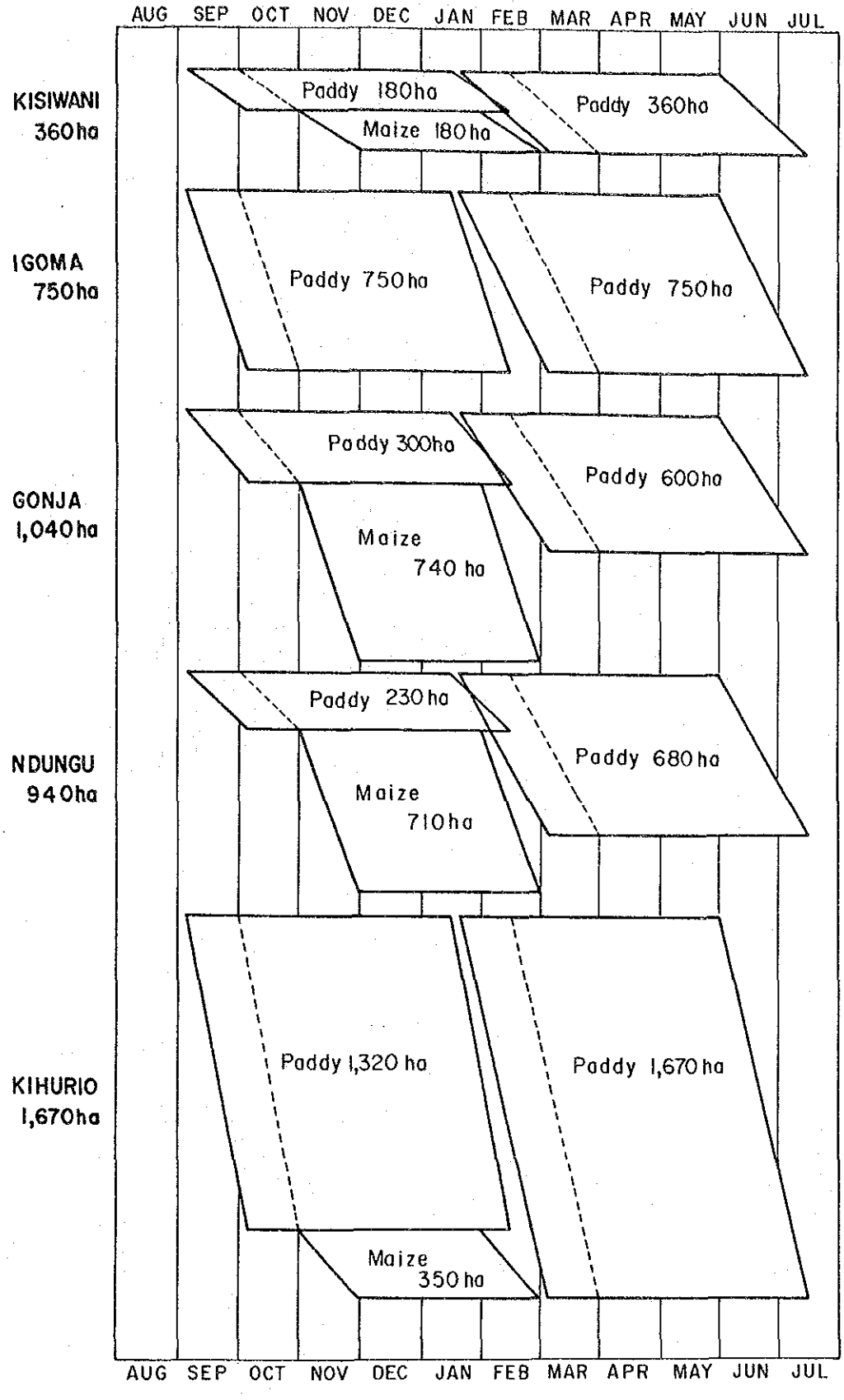


Fig. E-12 PROPOSED CROPPING PATTERN

ANNEX F

DAM DEVELOPMENT PLAN

ANNEX F

DAM DEVELOPMENT PLAN

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1. SELECTION OF DAM SITE

For the purpose of selecting the sites for dams and reservoirs which are best suited for the development of water resources in the Mkomazi Valley, maps of scale 1: 50,000 are studied at first.

As the result, 9 sites are found on 6 rivers as shown in Fig. F-1. One site is on the Nakombo river, one site on the Kambaga river, two alternative sites and one dam site (Tia) on the Hingilili river, one site on the Bwaya river, two alternative sites on the Yongoma river and one site on the Saseni river.

Adding to the above 9 new dams and reservoirs, re-development of the existing Kalimawe dam and reservoir is also studied.

(1) Nakombo dam site

This dam site is located at 8 km upstream from Same-Tanga road on the Nakombo river. The catchment area is nearly 10 km^2. An access road should be constructed of length of more than 5 km from an existing trunk road in the South Pare Mountains. Hence, this site is considered to have low priority for the development.

(2) Igoma dam site

This site is located near Njiro bridge on the Same-Tanga road. The catchment area is about 740 km^2. Topography and geology is suited for constructing a dam of fill type. This site is remained for further study.

(3) Tia dam site

This site is located at about 3 km upstream from the Kiruka gauge site on the Hingilili river. A boring investigation was carried out by the Government and rainfall observation has been made since 1963 by the Government. The catchment area is about 21 km^2. Since other suitable dam sites are found on the Hingilili river, this site is replaced by others.

(4) Hingilili dam sites

Two alternative dam sites are located at 2 km upstream from Bombo village on the Hingilili river. Both sites are accessible from Gonja village through an existing trunk road in the South Pare Mountains. The catchment at both sites is 41.5 km^2 and 42.0 km^2 respectively. The sites have rather large catchment areas and have perennial flow. The sites are quite suitable for hydroelectric generation. The water is diverted to the Bwaya river which is located at the left side of the Hingilili river. The effective head is estimated approximately 800m. These are sites for further study but hydroelectric generation is considered to have low priority in view of the present conditions of demand and supply.

(5) Bwaya dam site

This site is located 3 km upstream of the Bwaya river from Gonja village. An existing trunk road branching from Same-Tanga road should be widened for access road. The catchment area is only about 20 km^2 so that river flow can be observed only in the rainy season. This site is suitable for the afterbay of hydro power station to be considered on the Hingilili river as mentioned above. Hydroelectric power generation, however, might be envisaged in future. This site is considered to have low priority for the development.

(6) Yongoma dam sites

Two alternative dam sites are located at 1 km and 2 km upstream of Kambani Falls on the Yongoma river. The catchment areas are 56 km^2 and 57 km^2 respectively. Both sites are accessible from Ndungu village on foot. An access road is be necessary in length of about 8 km from the Same Tanga-road. The Yongoma river has perennial flow. The sites are also quite suitable for hydroelectric generaion. The effective head is estimated about 500 m. This site is remained for further study, however, the hydroelectric generation is considered to have low priority.

(7) Mkuyu dam site

This dam site is located on the Mkuyu river which is a tributary of the Saseni river and at 9.5 km upstream from Gulutu gauging station on the Saseni river. The catchment area is 45 km^2. The river has a perennial flow. The site is quite accessible through a trunk road which branches from Same-Tanga road. This site also has a hydroelectric potential with an effective head of 300 m approximately. This site is remained for further study, however, the hydroelectic potential is considered to have low priority.

(8) Kalimawe dam site

The Kalimawe dam was constructed in 1963 to control the flood of the Mkomazi river and to supply irrigation water to the downstream. It has a catchment area of 1,492 km^2 and has about 5.5 million m^3 of effective storage capacity. An intake gate for irrigation is equipped at the left bank of the dam in order to supply irrigation water. Water taken from the intake passes through the concrete conduit is the dam body and flows into two canals at the outlet structure. The amount of water to be released from the intake is determined based on the farmers and inhabitants requests in the Kihurio scheme. The principal features of these structures are listed below and shown in Fig. F-2. The reservoir capacity curve and reservoir surface area curve are shown in Fig. F-3.

Dam : Effective reservoir capacity
21,000,000 m^3 at full surface water level
(EL. 506.52 m)
5,500,000 m^3 at crest of spillway
(EL. 504.76 m)
Reservoir surface area
1,140 ha at EL. 506.52 m
680 ha at EL. 504.76 m

Spillway: Overflow section with stop log
20 spans, width of one span = 3.36 m
total height of stop log = 0.93 m
Flushing sluice with slide gate
2 bays width of one bay = 1.50 m
Flow capacity at water level EL.507.43 m
with stoplogs 320m^3/sec approximately.
without stoplogs 520m^3/sec approximately.

Diversion structure
: Diameter of conduit = 0.91 m
Flow capacity 1.2 m^3/sec approx. in maximum

The operation and maintenance works have been carried out by the Water Office in Kilimanjaro Region. The reservoir water level and the opening of the intake gate have been recorded since 1963 though there are some interruptions.

2. PROPOSED DAM SITES

2.1 General

The Igoma, Hingilili, Yongoma and Mkuyu dam schemes are formulated as area-development projects. They are the cores in the long-term water supply plan over the Mkomazi Valley area.

The proposed dam sites selected based on the map study are investigated during the second field survey period.

Proposed dam sites	Alternatives	River	Catchment area (km^2)
Igoma		Kambaga	749
Hingilili	upstream	Hingilili	41.9
	downstream		42
Yongoma	upstream	Yongoma	56
	downstream		57
Mkuyu		Mkuyu	45

2.2 Topographic Condition

The topography of each dam site is explained hereunder. The area-storage curve of each reservoir is developed based on the topographic maps of 1/50,000 scale.

(1) Igoma dam sites

Two alternative dam sites are located at a gorge of the Kambaga river near Njiro bridge of Same-Tanga road about 4 km downstream from the confluence of both the Nakombo and Kisiwani rivers. Out of these two sites, the downstream one located about 350 m downstream from the upper one was eliminated because the geological exploration revealed that it was located in an extensive rock slide area.

The proposed Igoma dam site is located just at the crossing point of the Same-Tanga road and the river. The reservoir area is flat with a very gentle slope. The river flows with a gradient of about 1/250 in upstream of dam site. The riverbed is approximately at EL. 640.0 m on the dam axis. The area-storage curve of reservoir is presented on Fig. F-4.

(2) Hingilili dam sites

Two alternative dam sites are located at a narrow valley of the Hingilili river, about 2 km upstream from Bombo village. Both sites are accessible from Gonja by a jeepable road in the South Pare mountains. The distance between these two sites is about 350 m.

Of these two sites, the upstream one is selected, requiring two saddle dams on the rim of the reservoir area. The river flows with a gradient of about 1/50 at upstream of the dam site. The riverbed of up-and downstream dam sites are approximately at EL.1,410.5 m and EL.1,403.0 m, on the dam axis respectively. The area-storage curves of reservoir are presented on Figs. F-5. and F-6.

(3) Yongoma dam site

Two alternative dam sites are located at a narrow valley of the Yongoma river. The river flows with gradient of about 1/200 at upstream of the dam sites.

The riverbed of up and downstream dam sites are approximately at EL.1,075.5 m and EL 1,068.0 m, on the dam axis respectively. The area-storage curves of the reservoirs are presented on Figs. F-7 and F-8.

(4) Mkuyu dam sites

The proposed dam site is located at a narrow valley of the Mkuyu river and at about 9.5 km upstream from Gulutu gauge site.

No alternative dam site can be found due to the topographic conditions. The river flows with gradient of abourt 1/45 at upstream of the dam site. The riverbed of the dam site is approximately at EL. 972.0 m on the dam axis. The area-storage curve of the reservoir is presented on Fig.F-9.

3. OPTIMIZATION STUDY

3.1 General

The Igoma dam serves the irrigaiton water supply. The Hingilili dam serves irrigaiton water supply and domestic water supply. The Yongoma dam serves irrigation water supply and domestic water supply. The Mkuyu dam serves irrigation water supply. Any space for hydroelectric generation and for flood control are not considered specifically in this study.

The optimization is made through the comparative study on relationship between the annual irrigation area and development scale of dam. The relationship is developed by means of simulation of reservoir operation.

3.2 Reservoir Operation Study

3.2.1 General conditon

The simulation of reservoir operation was made on a monthly basis using the meteo-hydrological data for 20 years from January, 1963 to December, 1982 for which hydrological data are available.

Several reservoir operation studies were carried out in order to obtain the relationship between irrigation area and the reservoir effective storage. Each reservoir is operated based on the operating rule mentioned below.

The reservoir provides irrigation water and domestic water. Monthly mean diversion requirement, QIR is estimated in accordance with the proposed cropping pattern and irrigation area. The domestic water requirement QDR is assumed at 0.05 m^3/sec for each of Hingilili and Yongoma reservoirs.

The basic equation for reservoir operation is

$$ds/dt = O - I \quad \ldots\ldots\ldots\ldots \quad (3.1)$$

Where, ds : differential of reservoir capacity between time interval dt,
O : outflow,
I : inflow

The simulation of reservoir operation is carried out by computer, since many trials are necessary. A flow chart of the computation procedure is shown in Fig. F-10.

Evaporation loss, QEVP is taken into account as a function of reservoir area. The daily depth of evaporation is assumed 4.2 mm/day based on the observation record at Kalimawe meteorological station.

3.2.2 Specific conditions

The specified figures and limitations adopted for the computation of each reservoir are listed below.

(1) Igoma reservoir

Monthly mean discharge at the Njiro bridge is used as a water supply source at dam site. The surface area of reservoir is assumed at 5 km^2 in average. Normal high water level of EL.661 m is a topographic limitation from viewpoint of the land boundary of Kisiwani scheme. About 750 ha of arable land in Igoma scheme is the maximum limit for irrigation development from the topographic view point.

(2) Hingilili reservoir

Monthly mean discharge at both dam sites is estimated by converting monthly mean discharge at Kiruka gauging station in proportion to the catchment area at the respective dam sites. Normal high water level of both dam sites is set at EL. 1,457.0 m in maximum development scale, since the elevation of the left side rim is assumed at EL. 1,445 m and saddle dam can be constructed up to EL. 1,455.5 m in the maximum scale. About 1,200 ha of arable land in the Gonja scheme is the maximum extent of irrigaton area from the topographic point of view.

(3) Yongoma reservoir

Monthly mean discharge at both dam sites is estimated by converting the estimated discharge at proposed weir site in proportion to the catchment area at the respective dam sites. The allowable maximum height of dams have topographic limitation, since the lowest point of reservoir ridge of upsteam and downstream dam sites is assumed at EL.1,145.0m and EL. 1,127.0m respectively. The maximum extent of irrigation area in the Ndungu scheme is 1,180 ha from the topographic point of view.

(4) Mkuyu reservoir

Monthly mean discharge at the dam site is estimated by using the discharge at Gulutu gauging station in proportion to the catchment area at the dam site.

(5) Kalimawe reservoir

The inflow of Kalimawe reservoir varies according to the situation of upsteam development i.e. the Nakombo, Kambaga, Hingilili and Yongoma rivers. Therefore, the reservoir operation study of the Kalimawe reservoir should be made after selection of optimum development scale of the above four schemes.

As a result of reservoir operation study, the relationship between irrigation area and reservoir effective storage is shown in Fig. F-11.

3.3 Economic Comparison

3.3.1 Four new dams

Based on the relationship between irrigation area and reservoir effective storage requirement shown in Fig. F-11, several development alternatives are selected to establish an optimum scheme.

The direct benefit concerned herein is only that generated from irrigation water supply. The irrigation benefit per unit area (ha) is assumed to be constant even though the irrigation area increases. Accordingly, an alternative plan gives minimum development cost of dam is selected as the optimum one. The development cost of dam is obtained by dividing dam consruction cost by incremental irrigation area due to the dam development. The construction cost is estimated based on the condition mentioned in Chapter 5 in this annex.

(1) Igoma dam

Three alternative cases are selected as shown below.

Unit: ha

	Case 1	Case 2	Case 3
1. Irrigation are without dam development			
Rainy season	Nil	Nil	Nil
Dry season	Nil	Nil	Nil
Total	Nil	Nil	Nil
2. Irrigation area with dam development			
Rainy season	750	750	750
Dry season	750	500	250
Total	1,500	1,250	1,000
3. Incremental irrigation area due to the dam	1,500	1,250	1,000
4. Construction cost ($US\$ \times 10^3$)	8,660	7,590	6,540
5. Development cost (US$/ha)	5,770	6,070	6,540

Based on the above result, the Case 1 which indicates the minimum development cost as shown in Table F-1 is selected as the optimum

development plan. The result of reservoir operation study of Case 1 is shown in Fig. F-12.

(2) Hingilili dam

Five alternative cases are selected from the upstream and downstream alternative dam sites respectively.

(Upstream) Unit: ha

	Case 1	Case 2	Case 3	Case 4	Case 5
1. Irrigation area without dam development					
Rainy season	600	600	600	600	600
Dry season	300	300	300	300	300
Total	900	900	900	900	900
2. Irrigation area with dam development					
Rainy season	1,200	1,200	1,200	1,200	1,200
Dry season	970	850	800	750	300
Total	2,170	2,050	2,000	1,950	1,500
3. Incremental irrigation area due to the dam	1,270	1,150	1,100	1,050	600
4. Construction cost (US$x10^3)	21,600	18,320	17,180	16,460	12,100
5. Development cost (US$/ha)	17,000	15,930	15,620	15,680	20,170

(Downstream) Unit: ha

	Case 6	Case 7	Case 8	Case 9	Case 10
1. As shown in above table					
2. Irrigation area with dam development					
Rainy season	1,200	1,200	1,200	1,200	1,200
Dry season	1,200	900	850	800	300
Total	2,400	2,100	2,050	2,999	1,500
3. Incremental irrigation area due to the dam	1,500	1,200	1,150	1,100	600
4. Construction cost (US$x10^3)	33,370	23,390	22,210	21,060	15,910
5. Development cost (US$/ha)	22,240	19,490	19,310	19,150	26,500

Based on the above result the Case 3 which indicates the minimum development cost is shown in Table F-2 is selected as the optimum development plan. The result of reservoir operation study of case 3 is shown in Fig. F-13.

(3) Yongoma dam

Five alternative cases are selected from the upstream and downstream alternative dam sites respectively.

(Upstream) Unit: ha

	Case 1	Case 2	Case 3	Case 4	Case 5
1. Irrigation area without dam developent					
Rainy season	680	680	680	680	680
Dry season	230	230	230	230	230
Total	910	910	910	910	910
2. Irrigation area with dam development					
Rainy season	1,180	1,180	1,180	1,180	1,180
Dry season	1,180	820	770	700	230
Total	2,360	2,000	1,950	1,880	1,410
3. Incremental irrigation area due to the dam	1,450	1,090	1,040	970	600
4. Construction cost (USx10^3$)	26,600	14,860	14,010	13,160	11,110
5. Development cost (US$/ha)	18,380	13,630	13,560	13,570	18,520

(Downstream) Unit: ha

	Case 6	Case 7	Case 8	Case 8	Case 10
1. As shown in above table					
2. Irrigation area					
Rainy season	1,180	1,180	1,180	1,180	1,180
Dry season	1,180	820	770	700	230
Total	2,360	2,000	1,950	1,880	1,410
3. Incremental irrigation due to the dam	1,450	1,090	1,040	970	600
4. Construction cost (USx10^3$)	21,990	16,290	15,210	14,360	11,910
5. Development cost (US$/ha)	15,170	14,910	14,630	14,800	19,850