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REPORT
OF
PROJECT-FINDING SURVEY
IN
EAST AFRICA
{TANZANIA}

1973

OVERSEAS TECHNICAL COOPERATION AGENCY

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FOREWORD

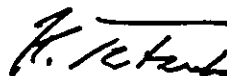
Japan's overseas agricultural cooperations activity, which began in 1967, is now in its sixth year.

With the recent changes in the agriculture and general domestic situation of developing countries. Japan's agricultural cooperation has also undergone changes in the method of implementation. With the growing need in the recipient countries for comprehensive regional development, cooperation came to be offered in more diversified patterns covering a wider area than before. Further, Japan's agricultural cooperation, which was formerly concentrated in Asian countries, is now being expanded to other parts of the world, such as the Middle and Near East, Africa, and Central and South America.

It was against a such background that the Project Finding Team was dispatched by the Overseas Technical Cooperation Agency, under a commission from the Ministry of Foreign Affairs, to four East African countries, i. e., Tanzania, Zambia, Malawi and Kenya, for a period of four weeks from March 22, 1973. The team's mission was to investigate the existing state of agriculture in the four countries and to find, prior to a formal request for cooperation from the recipient country, suitable projects in which Japan might be able to offer cooperation. The team was comprised of experts specialized in agricultural civil engineering and crop science and was headed by Dr. Tsuyoshi Shiroshita, Director of the Kyushu Agricultural Experiment Station, Ministry of Agriculture and Forestry. With the participation of officials in charge of technical cooperation of the Ministry of Foreign Affairs and the Ministry of Agriculture and Forestry in a part of the itinerary, the team investigated the existing state of agriculture in the said four countries and exchanged views and opinions with the competent authorities in each country. The team is now engaged in the task of formulating the policy to be adopted in extending agricultural cooperation to Tanzania.

I shall be more than pleased if this report proves to be of some use for those concerned with Japan's agricultural cooperation for the four countries.

I take this opportunity to thank the leader and member of the team for their effort and express my gratitude to the governments of the four countries, Japanese embassies abroad and Japanese experts for their good offices and whole hearted assistance in making this study possible.



Keiichi Tatsuke

Director General

Overseas Technical Cooperation Agency

Members of the Survey Team

Dr. Tsuyoshi Shiroshita	Leader, Dr. of Agriculture	Director, Kyushu Agricultural Experiment Station, Ministry of Agriculture and Forestry
Mr. Masahiko Asakawa	Crop Science	Research Coordinator Agriculture, Forestry and Fisheries Research Council MAF
Mr. Isao Morishima	Agricultural Civil Engineering	Assistant Chief, Design Division Agricultural Land Bureau MAF
Mr. Masahisa Ezaki	Planning and Co-ordination	Agricultural Cooperation Dept., Overseas Technical Cooperation Agency
Mr. Narehito Ikeda	(Participated in Project Finding Survey in Tanzania)	Technical Cooperation Division Economic Cooperation Bureau Ministry of Foreign Affairs
Mr. Masao Kikuchi	(Participated in Project Finding Survey in Tanzania)	International Cooperation Division Agricultural and Forestry Economic Affairs Bureau MAF
Mr. Kancyoshi Noda	(Japanese Expert Cooperating in Project Finding Survey in Tanzania)	
Mr. Akihiko Tohgo	(Japanese Expert Cooperating in Project Finding Survey in Tanzania)	

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Since the lowland area has a typical savanna-type climate, supply and utilization of irrigation water in the dry season is the essential prerequisite for its development. From the field survey conducted on the basis of development projects presented by the Tanzanian government, the team reached the conclusion that the development of the Msarange-Mandaka lowland area embracing Moshi city and extending to an elevation of less than 1,000 m to the southeast of the city would yield the quickest effect and would also be most feasible. Problems entailed on the development of this area are include more effective use of water and the damage to crops due to habitual submerging of the farmland caused by flood waters in the wet season. There is fair prospect, however, that in the greater part of the area under cultivation, the crop damage can be avoided by constructing drainage canals and infrastructural improvement can be attained through construction of simple facilities for storage and efficient use of flood water.

To ensure that the said project will be implemented steadily in a wide area, data on water must be consolidated in a satisfactory manner. It will be necessary, for a substantially long period of time, to carry out basic studies, such as rainfall observation in mountainous districts, investigation of surface water, groundwater and spring water, and studies for infrastructural improvement, by hydraulic model tests. It is most desirable that all these basic studies are incorporated in the Water Master Plan of the Tanzanian government, and serve as the basis early application in the agricultural development of the extensive undeveloped area.

In the area of farm management, a land-use plan based on the principle of "right crop for right land" should be mapped out after completion of a series of agricultural surveys covering the entire Kilimanjaro region. This should be backed up by research and experiment activities such as selection of crops, establishment of rational cropping patterns, improvement of techniques for soil productivity, rationalization of farm work and studies for saving farm labor.

If Japan is to cooperate in Tanzania's agricultural development project, it will be necessary, to obtain a long-range perspective of the project and full information on the project area, and to request by gradual steps more intensified activities on the part of the existing research and experiment organization to find solutions for the aforementioned problems. It will also be necessary to improve the farmers' technical level through training of local technicians and cooperation in the establishment of model farms. The team wishes to point out that both Tanzanian authorities and Japanese Embassy in Dar es Salaam have already agreed on this fundamental course of agricultural cooperation.

The enthusiasm evinced by the central government and the relevant local government for the success of the new rural community programme now in progress in Ujamaa Villages (agricultural community) is truly enormous. During its observation of Ujamaa,

however, the team noted that despite their high desire for increased production, the farmers are handicapped by a shortage of farming machines and equipment and low level of techniques. The team felt that greater development effect would be attained if members of the Japan Overseas Cooperation Volunteers are stationed to give technical guidance in major communities of the lowland area in which the Ujamaa system is adopted. Additional and enhanced effect will be brought about if their activities are backed up by financial aids for agricultural input such as machines and materials.

I. JAPAN'S COOPERATION IN AGRICULTURAL DEVELOPMENT OF THE KILIMANJARO REGION

1. Background

Among a number of its many development projects, the Tanzanian government gave top priority to the comprehensive development project of the Kilimanjaro region and has requested Japan's cooperation on a number of occasions in the past. The great importance attached to the project by the Tanzanian government can be justified by the fact that nearly 70% of Tanzania's total land area is lowland similar in both latitude and natural conditions to the Kilimanjaro region. Success of the project would be quite meaningful in that the development pattern adopted for its implementation can be applied in other undeveloped parts and will undoubtedly contribute to the country's economic development.

Responding to these requests, Japan commissioned IDC to undertake a survey in 1971 to study how Japan could cooperate in Tanzania's development, particularly in the development of the Kilimanjaro region.

This survey was conducted on the basis of the IDC's report, to collect fundamental data and findings which would serve as the basis for determining the type and scope of agricultural cooperation Japan might be able to offer to Tanzania.

The survey was therefore a project finding survey which was limited to the Kilimanjaro region, only for 6 days.

2. Desires Expressed by the Tanzanian Government to Japan under Technical Cooperation

(1) Expectations Placed on Japan's Technical Cooperation

Prior to the dispatch of this survey team, the Japanese government requested the Tanzanian government for its cooperation through the Japanese Embassy in Dar es Salaam, explaining the purport of the survey. The Tanzanian Ministry of Finance and Ministry of Agriculture, responded that the team would warmly welcome. During meetings with Tanzanian officers at the Prime Minister Office, the Ministry of Agriculture, and the government of the Kilimanjaro region, the team was felt that Tanzania looked forward keenly to Japan's cooperation and assistance. At every government office visited, the team found the said IDC's report with its cover worn out, indicating that the officers concerned had read it over and over again. All the Tanzanian officers interviewed by the team were unanimous in pointing to the report and saying, "Hasn't the survey been conducted sufficiently already? This report covers every detail for implementing the project. We're only waiting for Japan's cooperation."

Before the team's arrival in Tanzania, the Director of the Research Training Farmers' Education Division expressed the hope that the following would be materialized through Japan's agricultural cooperation.

- 1) Acceptance of large numbers of Tanzanian agricultural trainees in Japan.
- 2) Establishment of an agricultural research centres at the various field.
- 3) Establishment of a training centre for cultivation and utilization of vegetables.
- 4) Dispatch of five Japanese poultry experts to Tanzania.
- 5) Dispatch of instructors to the existing training centres, supplying of training materials to the centres, and the dispatch of a preliminary survey team for such cooperation.

During its stay in Tanzania, the team was unable to meet the Director of the Research Training Farmers Education Division since he was on a trip abroad on official duties.

(2) Desires Expressed by Tanzanian Government for Japan's Cooperation

The following is a summary of the desires and explanations made clear to the team at meetings held with competent Tanzanian officials including vice ministers, relevant division chieives and other officials of the Prime Minister Office and Ministry of Agriculture.

Following the administrative reforms enforced in April 1972, the power of the central government is being transferred increasingly to local governments for reinforcement of the decentralization system. However, the small scale of the budget of local governments sets inevitable limits on the scope of their activities. Hence, the Prime Minister Office, which has the authority and function corresponding to those of the Japanese Ministry of Autonomy, assumes the responsibility for coordinating, from the national viewpoint, all the projects planned and submitted by respective local governments. Other government offices, on the other hand, provide assistance in such projects chiefly in the technical aspects.

Projects taken up on the government level involve development of fertilizers and farming machines and equipment, nation-wide increase of crop yield per unit area, and production increase of maize and paddy in the whole country. Development plans covering these aspects are mapped out for each region or district of the country, but implementation of all such regional development plans is made impossible because of the unavailability sufficient funds from the National Treasury. Hence, the early implementation of development projects is possible only if the fund requirements can be met either by relevant local governments or through foreign aid. The Kilimanjaro region development project is thus a government project but its implementation is left chiefly in the hands of the provincial government of the region.

Tanzania's population is increasing at an annual rate of 2.7%, whereas the annual growth rate of food production is 2.3% according to FAO' data. This sharp population increase makes it a pressing need for Tanzania to attain a stable supply of foods.

The government intends to increase the production of food crops and then of export crops in the Kilimanjaro region, and is hoping for Japan's technical co-operation in vegetable-growing, fruit-growing, cotton cultivation, dairy farming, poultry raising and sericulture.

Japan's cooperation is also expected for accelerated production of maize and rice which are not only food crops but also important foreign exchange earners. As for rice, paddy production by irrigation farming is planned for the marshy Msaranga Mandaka area which extends near Moshi city and is subjected to flood water submerging each year. The government expressed the hope that Japan would study the feasibility of this plan and cooperate in the execution if it proves feasible. (In actuality, the said area is not a marshy district although it is under water for three to seven days a year during the peak period of the wet season. If proper flood protection measures are taken, it can be turned into an fertile upland field.) Desire for accelerated rice production was evinced by the Prime Minister Office. The officers of the Ministry of Agriculture, however, stated that they are not planning rice production in the region because there better suited areas in other parts of the country, and expressed the hope of introducing kenaf cultivation in the region if irrigation farming becomes a reality.

The Ministry of Agriculture, also expressed the hope for increased production of onions which are now imported in large quantities because they are produced only in April in Tanzania because of rainfall. The Ministry's hope is to realize self-sufficiency in onions by prompting year-round irrigation farming in areas like Morogoro, Arusha and Moshi and thereby cover the demand from urban areas. The team was informed that onions thus produced would be marketed through the cold chain of fishes and vegetables to be soon established with Dutch aid. The team also learned that onions were once exported to West Germany and the Netherlands on an experimental basis.

The Prime Minister Office hopes to grow vegetables for export in the Kilimanjaro region, and stated that DDC (District Development Corporation) is now engaged in experimental exports of vegetables and fruits which are supplied twice a week by air to the European market from Kilimanjaro airport. The experimental export of vegetables and fruits, which is carried out also in Kenya, is intended to supply the demand in Europe during the bottom of harvest, and it appears to be yielding successful results.

The Ministry of Agriculture, on the other hand, expressed the hope for accel-

erated production of wheat, Brewage barley, sugar and dairy products in the Kilimanjaro region in view of the large import volume of these commodities. The Ministry further evinced a strong intention to increase production of forage crops in addition to beans and horticulture.

On the whole, the Tanzanian government expects that Japan will provide technical cooperation not only in the production sector but in the implementation of an integrated development project covering transportation, distribution and maketing.

Norteworthy is the fact that the promotion of light industries in rural area is given high priority by the government. The team was informed that the government is earnestly hoping to develop light industries in the Kilimanjaro region since it is densely populated by farmers belonging to the people who would consequently provide abundant and excellent manpower. The types of light industries envisaged by the government include leather processing which is related to animal husbandry, wood-working industry utilizing to the forest resources, and textile industry to be backed up by cotton production.

II. AGRICULTURAL DEVELOPMENT IN KILIMANJARO REGION AND JAPAN'S AGRICULTURAL COOPERATION

1. Future Course of Development of Kilimanjaro Region

In the following pages, the future course of development in the foothill areas of Mt. Kilimanjaro (Lombo and Moshi districts) and in the Pare district will be studied, taking into account the existing state of agriculture in the three districts.

(1) Improvement of Agricultural Structure

Improvement of the agricultural structure of the Kilimanjaro region should be mapped out with consideration given to the differences in the agricultural situation and the problems presented by the three districts.

1) Lombo District

Lombo district extends to the east of Mt. Kilimanjaro and the wet season in its highland (more than EL1000 m) area lasts, unlike in the Moshi and Pare districts, lasts from October to December. Coffee is planted in a smaller area than in the Moshi district and there are no large coffee plantations. Banana, maize, potatoes and pyrethrum are cultivated in large areas. The district has a high density of population supported by the high yield of major food crops.

The operational holding per farm household is said to average about 4 acres in the district. However, due to the existence of the equal inheritance system, the farmland area tends to be divided into increasingly small lots. Many farmers who left the district and worked in and around Moshi city before independence returned to their villages after the country achieved independence, this aggravating the land problem of the district. Migration of farming population of other parts of the country and early enforcement of measures for second and third sons of farmers are therefore a pressing need for the district.

Three promotional measures can be considered as means to solve these problems.

The first is the redevelopment of the existing farmland area. Probability is high that the yield and population supporting capacity of the land can be largely increased by the planting of right crop for right land, the introduction of a rational rotation system, the breeding and diffusion of improved varieties, and the improvement of farming techniques involving planting system, fertilization, farm management and care, and plant protection.

The second is the development of the virgin lowland area (below EL1000 m). Only a limited part of the lowland area is now utilized for the cultivation of

maize, cotton and oil crops and for pasturing on natural grassland, and the greater part of the area is covered by savannah. Creation of farmland in the savannah area as an inducement of highland farmers is an important problem to be solved in the near future for the development of the Lombo district. Development of the savannah area has been hindered chiefly by the shortage of water supply. Although rainfall in the lowland area is smaller than in the highland area and farmers find it extremely difficult to secure the necessary drinking and irrigation water, it registers about 800 mm which is more than the 600 mm rainfall observed in the southern lowland area of the Moshi district.

Small scale waterworks are now in progress in respective communities of the area based on the domestic water supply plan set up to secure drinking water for farm households and domestic animals, but no such plan has yet been mapped out for the supply of irrigation water.

The idea of taking irrigation water from Lake Chara entails problems because the Tanzania-Kenya border line crosses the centre of the lake. The technical feasibility of such an idea is not known, due to the lack of data on the annual fluctuation of the lake's water level and storage capacity.

The third is the development small industries. In considering Tanzania's economic development to a rigid analysis from a long-range perspective, it is felt that it should not be limited to agriculture as a national policy but should start out with emphasis on "agribusiness" closed tied in with agriculture, proceeding from these toward the establishment of light industries and further to full-scale industrialization. Development of the Lombo district should therefore aim at two objectives, i. e., agricultural development to accelerate production and thereby promote both the absorption and diffusion of population, and establishment of light industries on the basis of increased agricultural production to absorb the working population and enhance industrial development.

As already mentioned described, the people living in this district is known to be industrious. There is little doubt that the people will exhibit its capacities not only in agricultural development but also in light industry development.

Development of light industries in this district should start with processing industries using agricultural products as raw materials. Industries to be developed in the initial stage should therefore be limited to those which are compatible with the district's situation, such as the textile industry using cotton as raw material, meat processing and leather industries based on

animal husbandry, and wood-working industry utilizing to forest resources.

2) Moshi District

It is considered that agriculture in the highland area of the Moshi district presents just about the same pattern as that in the Lombo district. However, since the Moshi district has a larger rainfall than the Lombo district and its peak wet season lasts from March to May, some differences are observed between the two districts in the cropping season and in the kinds of crops cultivated. Another factor in this district different from the Lombo district is that coffee plantations are found in its highland area and sisal and sugar cane plantations in its lowland area.

The three fundamental courses proposed for the Lombo district should also be pursued for the development of this district.

Most important for the future development of this district is effective flood protection in the approximately 4,000 acre wide Msaranga-Mandaka area which extends to the southeast of Moshi city. This area is a fertile and highly productive farmland area where maize and other crops are grown, but it suffers from flood damage each year. The losses as incurred by flood varies by year according to the flood duration and depth of flood water, but the team learned that it amounts to about 1 million shilling each year. Implementation of a flood protection plan to eliminate this huge annual loss will not only provide an immense economic benefit but will also open up the way for more intensive agriculture which is very important for future regional development.

Sisal plantations in this area are not given sufficient care. Redevelopment of these plantations through crop conversion is also a problem that requires serious consideration for the district's development.

3) Pare District

The team's survey of the Pare district did not cover its eastern mountainous part. It is considered, however, that the district has the same development problems as the above-mentioned Lombo and Moshi districts. The district is very sparsely populated compared with the other two districts, and its lowland area is much larger than the mountainous area. Hence, future development efforts should be concentrated in the lowland area on the basis of plans drawn up not only for the district alone but for the entire region for future population migration from the other two districts.

During this survey, the team made a study of the plan to take irrigation water from Nyumba Ya Mungu dam and supply it to the three downstream areas, i. e. , Marwa, Naururu, and Hedaru. This irrigation plan, which will be described in detail later in this report, covers an area of 30,000 acres. At the pilot farm constructed in 1971 at Kiliya which is downstream from the

Nyumba Ya Mungu dam, experimental irrigation farming is being conducted for the selection of suitable crops and cultivation methods.

The plan was worked out on the basis of the FAO survey, and the Tanzanian government is strongly desires Japan's cooperation in materializing it.

The migration of farmers from the Lombo and Moshi districts to the Pare district may cause various problems such as the sudden change in living environments, conflicts between tribes, and the location of the Pare district which is quite distant from where the farmers are now settled. Promotion of agricultural development in this district will therefore hinge on the progress of collective resettlement under the Ujamaa Scheme.

In view of the problems existing in the three districts, it can be said that the future development of the Kilimanjaro region must be planned with prime consideration given to the development of the yet undeveloped lowland areas as well as to the solution of the water problem in such areas.

(2) Water Supply

The problem of water supply bears closely on the development of the Kilimanjaro region.

For more than two hundred years in the past, farmers in the region have made continuous endeavors and contrived various means to secure water for domestic use and agricultural purposes. As a result, there are now established water rights and various water facilities, and not only surface water but also spring water and groundwater are being utilized.

Development of new water sources is a pressing need at present because the region's development inevitably calls for the smooth supply of city water and industrial water in addition to irrigation water.

The problem of water supply in the region is described at length later in this report. The following description therefore touches on a few major points of this problem.

- 1) It is felt that Nymba Ya Mungu dam is the only large water source that can cover a wide farmland area in future. Water source development in the coming years should therefore be planned for irrigation of a small area. To be more precise, farm ponds should be constructed to store rainwater during the wet season for irrigation farming during the transitional period from the wet season to the dry season. This will solve for the instability of the cropping season of crops cultivated during the wet season. Further, if water thus stored is supplied to crops at their critical irrigation point at the outset of the dry season, higher productivity will be attained through stabilization of crop cultivation and extension of the cropping season.

Development of lowland areas must be preceded by the improvement of techniques for effective utilization of limited water sources. It also calls for selection of crops suited for the climatic and soil conditions in these areas as well as the establishment of a cultural practice which ensures efficient water utilization. Irrigation farming inevitably is accompanied by leaching of soil nutrients and decline of soil fertility due to increased yield. To prevent this, it is necessary to exert efforts for the preservation and improvement of soil productivity and to establish the most efficient and advantageous farm management plan on the basis of a rational cropping pattern in which forage crops, cash crops and food crops are to be suitably combined according to the soil fertility.

The team is of the opinion that fundamental researches and experiments on water supply should be undertaken to solve all the above-mentioned problems in order to establish and extend a farm management plan intended chiefly for efficient utilization of small scale irrigation facilities and thereby promote the region's development.

2) The farm ponds which are simple in structure but fit the practical purpose and have a life of about ten years. They are considered to construct at as many places as practicable. It will be necessary to make a selection among various construction methods such as mortar finishing work, rubber lining work, etc. according to the condition of the respective project sites.

3) In studying the problem of water supply, efforts should be directed not only to the development of new water sources but also to an examination of the existing water sources. If any of the existing sources has a surplus availability of water, a new distribution system should be established for maximum and rational utilization of water.

There are views that the area irrigated by spring water in Miwaleni Ir. is too small. The team felt that the currently practiced sprinkler irrigation causes a large water loss which may perhaps be reduced by some other method, although the application of a new irrigation method should naturally be preceded by a field survey on the account of water duty and the irrigation system. If a detailed survey discloses that surplus water is available during the wet season or at the beginning of the dry season, a plan for its effective utilization should be mapped out and implemented.

(3) Land Use Plan

Planning of the Kilimanjaro region development project presupposes the establishment of a land-use plan. A rational land use plan worked out with due consideration given to the natural as well as socio-economic conditions viewed from a long-range perspective is an essential prerequisite to the region's devel-

opment.

Preparation of the land use plan should start with a detailed survey on the region's natural conditions and agriculture.

Natural conditions to be surveyed include rainfall and its seasonal fluctuation, soil conditions, topography, irrigation condition, land fertility, kinds of crops and their yield per unit area, annual change in yield, cropping pattern, etc.

Agricultural practices to be surveyed include planting system, fertilizer application techniques, plant protection techniques, livestock feeding and management techniques, measures taken for preservation and improvement of soil productivity, and measures taken for soil conservation and soil erosion.

Socio-economic conditions to be covered by the survey are the number of farm households and their family structure, farmers engaged in non-agricultural sectors, operational holding of farmers, planted area by crops, number of domestic animals by kind, shipment and sales of farm produce, farmers' relations with the market, etc.

The results of the above survey should be reviewed taking into account the outcome of the experimental crop cultivation and of the respective field conditions in order to provide the basis for selecting crops suited for cultivation in each locality on the principle of "right crop for right land." Needless to say, future prospects of demand and supply should be taken into consideration in selecting the crops.

Data obtained by this process of survey should then be used for establishing an optimal pattern of farm management with the future productivity improvement taken into account.

The land use plan is important for the redevelopment of the existing farmland, and it carries greater weight in the development of the lowland areas. The settlement plan aiming at population migration from highland areas to lowland areas should be worked out on a firm basis by taking full advantage of the land-use plan and farming plan.

(4) Selection of Crops

Selection of crops also bears very closely on regional development.

Selected crops should of course be useful, but they should also meet the climatic and soil conditions. Further, selection should be made so that crops can be suitably combined to establish a rational rotation system which satisfies various requirements arising from the farming condition such as the need for satisfactory distribution of farm labor and for the preservation and improvement of soil productivity.

There are various opinions as to the crops to be grown for the development of the Kilimanjaro region, particularly that of the lowland areas. If the region is to

pursue a steady course of development, it is advisable to select the crops which can be grown for both domestic consumption and export and are also suited for either food or feed because they can be disposed of with flexibility according to yield of each year. Maize is one of the crops that meet this condition.

Cotton is also an important crop because it can be consumed at home or exported and also because it provides the raw material required for development of light industry. Export crops which have no domestic demand, if cultivated extensively, must run the risk of changes in the international market. Export of vegetables to Europe which is currently carried out on an experimental basis is justifiable if such vegetables are cultivated in a limited suitable area by farmers with high technical level. When such export vegetables are to be cultivated in an extensive area, careful studies and surveys should be made in advance.

Products listed by the provincial government of the Kilimanjaro region for development of lowland areas are maize, cotton, beef cattle and onion. Maize and desirable crops as described above. Beef cattle raising is also considered commendable because it serves for rational land use through production of maize and forage crops, improves land productivity through application of stable manure, and provides the bases for developing the meat-processing industry and leather industry.

Onion is listed by the regional government to satisfy the domestic demand which is now met by large quantities of imported onions. On account of the climatic condition, onions are produced only in April in Tanzania. The government is therefore hoping to introduce irrigation farming for year-round production of onions. The team wishes to point out that year-round supply of onions must be accompanied by the development of storage techniques.

Stabilized high yield by irrigation farming is considered as being the basic promise for the cultivation of maize, cotton and onions. While these crops are naturally important, selection of other crops to be combinedly grown in combination with them such as drought resistant crops, soil fertility improving crops and cash crops, is equally important.

Grain sorghum shows greater drought resistance than maize and it is a useful forage crop. It can be used as feed for beef cattle and can also be exported. It should therefore be taken up as a promising crop.

Forage crops save farm labor and can withstand extensive growing. If proper varieties are selected, they can be grown in areas with poor land fertility and limited water supply. Further, by cutting them and plowing them under the surface soil, the land productivity can be largely increased.

Cash crops which can be considered for cultivation in lowland areas are sunflower and other drought resistant oil crops.

It might also be added that the cultivation of vegetables and fruit trees in areas with favorably conditions in the region is important for the betterment of the nation's dietary needs.

(5) Improvement of Farming Techniques

In the Kilimanjaro region, mixed cropping prevails and farming techniques are still rather poor, so that the yield per unit area is low. Infrastructural improvement is limited to irrigation works conducted in irrigable areas. Mechanized farming is virtually absent except for tractors and cattle-driven implements used for plowing. Plowing is carried out with tractors rented by the agricultural cooperative association before the advent of the wet season. After that, all the farm work from sowing to harvesting is done by manpower. Mechanized farming will therefore have to be implemented by gradually introducing equipment that are easy to handle according to the progress of agricultural techniques.

Improvement of farming techniques should also be adopted by slow degrees with careful consideration given to the situation in each locality. For instance, in the case of maize, which needs so much-fertilizers, shifting cultivation prevails in the region. In this farming method, maize is grown for two or three years in a field which is burnt down before seeding, and when the soil fertility declines, farmers shift to another place and repeat this pattern. If the local variety is replaced by a high yielding F₁ hybrid, therefore, the yield will rise but the decline of soil productivity will be much quicker. If the yield is trebled in a year, the field which is otherwise cultivable for three years would become exhausted in a year or two. Hence, hasty introduction of new techniques not based on a carefully worked out plan will break the balance of conventional farming practices and invite unexpected trouble. Introduction of a high yielding F₁ hybrid of maize should therefore be preceded by measures for preserving soil productivity and the introduction of fertilization techniques.

Improvement of farming techniques calls, among other things, for the preservation and improvement of soil productivity, and this, in turn, necessitates application of compost and stable manure, improvement of fertilization techniques, and establishment of a rational rotation system in which fertility improving crops are incorporated.

It is necessary to select improved and high yielding varieties which are resistant against insects and diseases. To maintain stabilized high yield, intercropping and mixed cropping should be avoided and a single crop should be planted at a proper density and not by the conventional thin spacing. A suitable standard

should be established for the planting density according to the soil productivity.

It is also necessary to establish rational fertilization techniques which are compatible with the soil productivity and the crop to be grown. In addition, harvesting techniques should be studied to improve the quality and reduce the loss of products, and plant protection techniques and weeding techniques should be established for continuous high yielding.

Needless to say, improvement of all the above-mentioned farming techniques is possible only if it is backed up by experiments and research activities

(6) Breeding

Breeding so far conducted covers only a very small portion of the cash crops, and improved seeds are almost all imported. Farmers sow seeds produced by themselves, and the diffusion of improved varieties among them is still very limited.

The Research and Training Institute at Lyamungu is not adequately equipped and its activities are not yet well established.

Improvement of farming techniques depends heavily on breeding because it is not possible without the availability of improved and high yielding varieties having resistance against insects and diseases. Considering, however, the long period of time usually required for breeding, it would be advisable, for some time to come, to place stress on the selection of suitable varieties from among the imported improved varieties. When varieties suited for cultivation in the region are thus selected, they should be used for breeding parents of even more improved varieties.

(7) Preservation and Improvement of Soil Productivity

Land is the basis of agricultural production, and the preservation and improvement of soil productivity are the basic elements of agriculture.

With the increase in production and yield per unit area, the decline in soil fertility is proportionately accelerated. It is therefore necessary to take positive measures to preserve and improve soil productivity before it drops.

Such measures include fertility preservation with compost and stable manure through farm management combined with livestock farming, adoption of a rational rotation system in which forage crops are incorporated, establishment of rational fertilization practices, and promotion of research activities to establish necessary measures and techniques.

(8) Prevention of Soil Erosion

Soil erosion is a problem which calls for immediate solution in the Kilimanjaro region. Erosion due to rain is being aggravated in the region with the development of mountainous areas and resultant felling of trees. Felling of trees has changed the water-holding capacity of mountainous land and has brought about changes in the

groundwater condition. If this situation is neglected, the region's agriculture will encounter a perilous situation in the near future. Afforestation and other suitable measures should be taken to prevent the progress of soil erosion through implementation of the land-use plan.

(9) Promotion of Livestock Farming

Substantially large numbers of domestic animals are being raised in the region, especially in the lowland areas. Promotion of livestock farming, combined with the cultivation of forage crops, is important for the region's agricultural development.

In the region's highland areas, dairy cattle may be raised for development of dairy farming. In the lowland areas, however, maximum use should be made of the natural grassland for increased beef cattle production. Most of the beef cattle now raised are zebu, but there can be found a limited number of improved F₁ hybrid.

For the future promotion of livestock farming, it is advisable that farm households breed and raise beef cattle by grazing them in savannahs and grassland in mountainous areas and that the Ujamaa villedgers or agricultural cooperative association fatten them with sorghum, maize and forage crops. In view of the global shortage of meat, it is possible to develop livestock farming into the region's main export industry.

Livestock farming serves to preserve and improve soil fertility with stable manure and also contributes to the development of light industry such as meat-processing, leather-tanning and other manufacturing industries.

(10) Light Industry

Development of light industries utilizing the abundant and excellent working population is important for the desired regional development. Both the central government and the government of the region expressed the hope for Japan's cooperation in this field.

The region's light industry should start with the processing of agricultural products. Enterprises which can be established in the initial stage will therefore be limited to textile enterprises using cotton as raw material, meat processing enterprises and leather and dairy products manufacturing enterprises which will be supported up by the region's livestock farming, and wood-working enterprises utilizing the forest resources. With the region's industrial development, there will be established a greater variety of enterprises.

(11) Relationship with Ujamaa Villedges

The new rural community construction scheme now in progress in Tanzania under the Ujamaa Villedges will play a vital role in the development of the Kilimanjaro region, specially in its lowland areas. For the development of sparsely

populated lowland areas which are left intact at present, systematic settlement should be pushed forward when the land use plan and farming pattern are established. It is believed that collective production with solid of community support will lead to the success of development. The farming system should be established for each Ujamaa and put in practice by each Ujamaa. Extension of new techniques will also prove successful if it is conducted through the organization of each Ujamaa.

It might be added that the development of the Kilimanjaro region hinges on the activities of the Ujamaa Villages.

2. Future Course of Japan's Technical Cooperation

(1) Cooperation in Agricultural Development Project and Water Master Plan

For the planned development of the Kilimanjaro region, the team studied technical cooperation in two projects, i. e., the agricultural development project and the water master plan.

The water master plan is to be prepared by the Tanzanian Ministry of Water and Power, and Japan has been repeatedly requested to cooperate in its preparation by the said Ministry. The present survey was therefore conducted to study the scope of Japan's cooperation in the agricultural development project as well as in the water master plan. The team's findings about the water master plan will be described in detail later in this report. The impression of these projects where the team surveyed is as follows.

It is desirable that the two projects are both important because the agricultural development of the Kilimanjaro region is a scheme which depends heavily on water resources development and utilization and should therefore be started from the basic survey on the availability of water resources. Water to be utilized for agricultural development includes drinking water which is just as important as irrigation water and should be secured for villagers who will be engaged in the development of lowland areas. The future economic progress of the region will inevitably give rise to the need coordinating water utilization for various purposes such as domestic use, hydropower generation, etc. In mapping out the region's development plan, these problems should be taken into due account because they are related to both agricultural development and the water master plan. With respect to the preparation of the water master plan, there are of course other problems to be considered such as hydropower generation.

If such parallel implementation of cooperation activities is not difficult then the practical measure would be to start with the cooperation in the agricultural development project and simultaneously cover, in substance, part of the cooperation activities for the water master plan. The team considers that this is not only

feasible but will also provide the basis for making a quick switchover from the agricultural development project to the water master plan when cooperation activities for the latter are formally commenced.

The team is therefore of the opinion that if the two projects cannot be implemented in parallel, cooperation in the agricultural development project should be started first.

(2) Range of Japan's Cooperation in Agricultural Development Project of the Kilimanjaro Region

1) If Japan's cooperation to Tanzania starts with that for the said agricultural development project, it will have to be offered for a substantially long period of time at a steady pace.

Technical cooperation with Tanzania should not be limited to mere demonstration of Japan's agricultural techniques. If the cooperation is to be offered for implementing the region's agricultural development project, it should be based on the prevailing domestic condition and existing state of agriculture in Tanzania.

Hence, the cooperation should cover such activities as preparation of the project plan mapped out on the basis of agricultural surveys to be conducted to clarify the existing state of each locality, technical feasibility and future prospect of agricultural development; development of water resources required for implementing the project; improvement of farming techniques to solve technical problems. All these activities are indispensable for the agricultural development of the region. Thus, the cooperation should not be limited to any single aspect or problem but should cover the entire scope of activities required for the region's agricultural development.

2) Such being the nature of the cooperation, the position of Japanese experts in Tanzania must be made clear.

Since the cooperation aims at materializing the policy adopted by the central and regional governments, it is essential that Japanese experts be in a position to be able to maintain close contact with the government authorities. Surveys should be conducted according to the government policy and survey results would be reflected in the new government policy. Technical problems should likewise be studied and reflected on the government policy.

To make the technical cooperation truly fruitful, the leader of the cooperation team will have to be given the position of adviser to the government so that he may be able to maintain close contact with the government officers for project implementation.

The Kilimanjaro region development project will be put in execution by the regional government. But this project is given top priority by the Ministry of

Agriculture, and in addition, the Prime Minister Office exercises administrative control over project implementation. The administrative organ at which the leader is to be stationed should therefore be determined before starting cooperation activities.

If the leader is stationed in Dar es Salaam as adviser to the Ministry of Agriculture, to the Prime Minister Office, he will be able to maintain close contact with both the central government and the provincial government and will therefore find it possible to take necessary actions on a government level for smooth progress of the cooperation activities.

The function of the Prime Minister Office is to coordinate inter-ministerial problems and determine and enforce government policies. If the leader is stationed at this office, he will find his position quite adequate for smooth project implementation.

In case he is stationed at the central government, he will be expected to play the role of a supreme adviser providing advice and suggestions for agricultural development of the whole country besides performing his duties to push forward technical cooperation in the region's agricultural development.

(3) Substance of Technical Cooperation in Agricultural Development Project

Technical cooperation in Tanzania's agricultural development project should include basic surveys for preparation of the project plan, preparation of the land use plan, studies infrastructural improvement for more efficient land use, experiment and research activities for improvement of farming techniques, establishment of the cropping pattern and farm management system, and preparation of the Kilimanjaro region development project. The following is a summary of these cooperation activities.

1) Basic surveys for establishment of agricultural development project

The agricultural development project should be based on basic surveys in the Kilimanjaro region. The following are some of the survey items to be covered.

a) Natural conditions

Annual distribution by season and locality of atmospheric temperature, sunshine and rainfall, topography, soil texture, soil properties, soil fertility, and land use potentiality.

b) Water resources

Surface water, groundwater and their annual distribution by season and locality, utilization of existing water resources, and possibility of developing new water resources.

c) Agricultural techniques

Possibility of creating farmland through infrastructural improvement; existing state of farming techniques involving kinds of crops and their yield

per unit area, sowing season, harvesting season, sowing method; fertilization management method, and harvesting method; discrimination between cultivable crops and non-cultivable crops; cropping pattern (planting sequence and planting ratio in particular); method employed for soil productivity; method employed for preventing soil erosion; kinds of insects and diseases and damages caused by them, and plant protection practices; utilization of farming implements; utilization of farming machines and equipment; kinds of domestic animals and raising techniques; and prospects for future productivity increase through technical improvements.

d) Farm management

Number and distribution of farm households by operational holding; number of family members, number of family members engaged in agriculture, number of family members engaged in non-agricultural occupations; kinds of crops grown by each farm household and their planted area, planting ratio and planting sequence; and kinds and number of domestic animals raised by each farm household.

e) Transportation

Distance to the market, and means and conditions of transportation.

f) Others

Prospects and significance of agricultural development in the Kilimanjaro region in relation to world agriculture (e. g. , production for domestic demand and export), and production target etc.

2) Preparation of land-use plan

Natural conditions, development potentiality and difficulties involved in infrastructural improvement should be judged for each locality on the basis of the above surveys in order to classify land into farmland, grassland, orchard or other tree growing site, grass field, pasture land, forest, etc. and to establish a land-use plan taking into account taken of the principle of "right crop for righ land."

3) Studies and implementation of infrastructural improvement for efficient land-use

Infrastructural improvement should be effected for lowland area development and in the highland areas if necessary.

For development of lowland areas, studies should be made on the possibility of farm ponds at low cost and on the method of farmland reclamation, and plans should be mapped out for irrigation works meeting the situation of each locality, drainage works in habitually inundated areas, and irrigation of the Pangani river basin extending downstream from Nyumba Ya Mungu dam.

These infrastructural improvement projects should be put into plan one by

one with the order of priority determined according to their practicability and importance.

4) Experiment and research activities for improvement of farming techniques

The experiment and research activities should be conducted to redevelop highland areas by increasing productivity of the existing farmland and to develop those parts of lowland areas which are still undeveloped.

The research activities should cover the following.

a) Selection of crops and varieties that meet the conditions of each locality.

b) Breeding of important crops.

c) Establishment of farming techniques to increase yield of each crop.

To attain increased yield for each crop, experiments and researches should be conducted on the planting method, fertilization method, sowing season, sowing method, plowing and soil preparation method, weeding method, plant protection method, and harvesting and processing method, etc.

d) Establishment of irrigation farming for each crop.

Irrigation farming techniques should be established for each crop to attain the maximum results with the minimum supply of water. Special emphasis should be placed on extending the cropping period from the end of the wet season towards the dry season by supplying irrigation water and on attaining increased and stabilized yield by introducing suitable crops and farming techniques.

e) Establishment of techniques for controlling major insects and diseases.

f) Establishment of techniques for preserving and improving soil productivity.

g) Establishment of techniques for preventing soil erosion.

h) Studies on introduction of mechanized farming techniques.

It is desirable that research and experiment activities for improving farming techniques be conducted jointly with the Tanzanian researchers at Layamungu Research and Training Institute, using the Institute's facilities and equipment. Any experimental equipment and facilities which are needed for the joint research activities but not found at the Institute would be supplied by Japan.

The institute, located about 14 miles to the northwest of Moshi city, was established in 1934 as the Lyamung Coffee Research Institute whose primary objective was to study the cultivation and processing of coffee and to conduct breeding of coffee varieties. It was reorganized into the present research and

training institute in 1968 by integrating part of Northern Research Center located at Tengeru.

It has a ground area of 616 acres including the floor space. It is under the direct control of the Research and Training Division (Director : Mr. G. A. Semiti) of the Ministry of Agriculture.

The Institute has the following seven research sections in addition to an information section.

- i. Plant protection
- ii. Soil chemistry
- iii. Agronomy (general agronomy)
- iv. Breeding (chiefly coffee)
- v. Animal husbandry
- vi. Coffee processing
- vii. Horticulture

Before it was reorganized in 1968, the Institute's research activities mainly on coffee. At present, its scope of activities has been expanded and covers research and training in agriculture as a whole including common crops, fruit trees, vegetables, animal husbandry, pasture land improvement, soil and fertilization, and plant protection. Due to the shortage of research workers, however, research activities in other fields than coffee are conducted on a limited scale. The team felt that breeding, plant protection, and research in soil and fertilizers are conducted chiefly for coffee cultivation. The Institute is now hoping that the following eight senior researchers will be dispatched under Japan's technical aid programme.

Breeding	2 (1 for coffee and 1 for other crops)
Soil chemistry	1
Plant physiology	1
Crop cultivation	2
Nematode control	1
Herbicide application	1

In conducting water utilization research which constitutes part of the activities for improving farming techniques, it is necessary to make use of the Institute's substation established for irrigation farming in the savannah area lying about 15 miles to the southeast of Moshi city. At this substation, groundwater is pumped up for experimental irrigation farming. The substation will enable the Japanese Cooperation Team to start activities immediately because it is equipped with irrigation facilities such as pumps, storage reservoirs for water distribution, irrigation canals and even fields. It also has a laboratory, a barn and a set of farming equipment. The team learned that maize, alfalfa,

fruit trees, bananas, vines, citrus trees, and vegetables are all growing well in the substation.

Research activities for improving farming techniques will prove effective if conducted in collaboration with the Tanzanian researcher and by taking advantage of the facilities of the Institute and its substation.

5) Establishment of cropping pattern and farm management plan

Crops suited for each locality should be selected on the basis of the aforementioned land-use plan and the results of the farming techniques improvement tests. Crops thus selected should then be suitably combined to determine the cropping pattern and to establish the farm management plan.

In preparing the farm management plan for development of lowland areas, care should be taken so that water stored in farm ponds will be utilized by each production unit. It is necessary to delineate a certain area of farmland as the production unit taking into account the selected crops, water utilization techniques and crop rotation, and to establish the farm management plan in which land-use and planting sequence are stipulated for each year. Settlement in undeveloped lowland areas should be based on the farm management plan thus prepared.

As described already, crops having a wide range of use and suited for cultivation in lowland areas should be selected. In the initial stage of development, stress should be placed on food crops rather than cash crops because self-sufficiency in food is of primary importance for farmers settled in lowland areas and also because Tanzania's economic development cannot be attained without a stabilized supply of staple food.

The farm management plan should incorporate cultivation of forage crops and raising of dairy cattle or beef cattle so as to ensure efficient utilization of both land and water resources and to preserve and improve soil productivity.

6) Establishment and implementation of Kilimanjaro region agricultural development project

The Kilimanjaro region agricultural development project should be planned on the basis of the aforementioned land-use plan, infrastructural improvement plan and farm management plan.

The region's agricultural development should be pushed forward by developing and reclaiming farmland based on the infrastructural improvement plan and by encouraging the settlement of farmers according to the farm management plan.

Economy of the whole region will pursue a steady course of development if light industries are established and fostered in parallel with the agricultural development.

It is believed that the success of the project depends on the activities of the Ujamaa Villages formed under Tanzania's new rural community development scheme. It is no exaggeration to say that the region's agricultural development hinges on whether this cooperative agricultural community is successfully established in each locality and performs its expected functions.

To bring the project to a success through the proposed technical cooperation, Japanese experts should be sent to each Ujamaa Village when the project enters the execution stage to provide guidances and advice needed in each community to ensure smooth progress of its farm management plan and to solve the problems encountered by each community. The technical guidance should be offered in close collaboration with the agricultural experts now serving in Tanzania. These agricultural experts will be required to maintain close contact with the members of J O C V to solve common problems found in a wide area.

Japan's technical cooperation in the region's agricultural development will rapidly yield fruitful results over an extensive area if it is backed up by the joint efforts of the cooperation team which will be engaged in research and experiment activities, agricultural experts who will provide technical guidance and advices, and members of J O C V who will give field guidance to the farmers.

(4) Sequence of Cooperation in Agricultural Development Project

It is probable that the cooperation will be extended in the order of the substance of the cooperation described in Item (3) above. The team considers it both effective and possible to provide cooperation in two or more items at all times by combining, for example, agricultural surveys with water resources surveys and irrigation planning or farming techniques improvement tests with infrastructural improvement works.

It is to be noted that in order to plan the project and set it on the right course of progress, technical cooperation adaptable to each locality should be offered at a steady pace to attain the target set for six to ten years ahead.

3. Conclusion

Technical cooperation to Tanzania, if extended along the lines described in the foregoing pages, will encounter substantial difficulties. However, it is because of such difficulties that Tanzania places great hopes on Japan's technical cooperation.

(1) Difficulties Involved in Cooperation Activities

1) Natural conditions (water resources in particular)

While the agricultural development of the Kilimanjaro region needs to be planned specifically for lowland areas, it is known that lowland area develop-

ment depends heavily on the utilization of water resources. Planning and implementation of the agricultural development project will therefore be largely affected by the availability of water. If water is available to any substantial degree, development can be expected to proceed smoothly. On the other hand, the availability of water is limited, the development plan should be so mapped out that the water available can be utilized to the maximum extent. At the outset of cooperation activities, therefore, concentrated efforts should be made to learn the prospects for future water supply.

2) Broad expanse of required activities

When the scope and details of technical cooperation are known in advance, as in the case where research cooperation in a comprehensive regional development plan or an agricultural development plan calls for clarification of a limited number of research items, the technical cooperation staff need only to fulfill the given assignment so that they suffer little mental burden. This, however, is not the case with the present technical cooperation which must cover a wide range of activities and a great diversity of problems. Japanese experts participating in technical cooperation in the region's agricultural development will be required to possess a comprehensive and broad knowledge and perform all-round activities, and their responsibility will be heavy because the progress of the development project will directly and clearly reflect on the situation of the project area.

The development project should be planned and implemented with careful consideration given to agricultural condition, production feasibility and technical level in the project area, and technical cooperation in the project thus formulated should be provided by experts with broad knowledge and long experience such as agronomists with rich experience in actual services and experts having experience in both research and administrative fields. Success of technical cooperation offered to developing countries depends to a large extent on the capability of the participating experts. Since the proposed technical cooperation to Tanzania involves a wide range of problems and calls for a broad expanse of practical knowledge, the team wishes to point out that particular care should be taken in recruiting experts.

3) Long cooperation period

Considering the period required for planning and implementing the project after completing of field surveys, a minimum of six to ten years would be required before completing cooperating activities. This is an important factor that should be taken into consideration when preparing the schedule of cooperation activities. It is also necessary to proceed at a slow but steady pace with necessary modifications effected according to the situation in each locality so

as to be able to cope with the problems that may arise with the progress of cooperation activities.

III. FARMLAND DEVELOPMENT

1. Recommendations

The team wishes to make the following recommendations on Japan's cooperation in agricultural development of the Kilimanjaro region.

(1) In Tanzania's highland areas favored by good natural conditions such as abundant rainfall, land-use is in fair progress and there is not much room for further development. Future development efforts should therefore be concentrated in lowland areas not favoured with natural conditions. These undeveloped areas can be turned into farmland areas if water resources are fully utilized and measures are taken for flood prevention.

Japan cooperation activities for Tanzania should be concentrically carried out in these lowland areas in a manner which promises to yield development benefit in a short time.

(2) The flood protection project planned for Msaranga Mandaka area of the Kilimanjaro region will eliminate the flood damage of cultivated fields suffered each year in the flatland area adjoining Moshi city on its southeast and will also make it possible to develop some thousands of acres of undeveloped land in this area. The irrigation project for Naururu Ir. and Marwa Ir. occupying the central part of Pare district aims at drawing irrigation water from Nymba Ya Mung dam on the mid-stream of the Pangani to develop about 10 thousand acres of land (a total of about 30 thousand acres can be turned into arable land by implementing this project). These two projects are given top priority for farm land development and improvement in the region. The former project, in particular, is quite promising since it covers an area adjoining the existing farmland area, incurs a relatively small cost, and produces development effect within a short time.

To cooperate in these two project, Japan should undertake to conduct a feasibility survey and work out a construction plan at an early date. It is to be noted that due to the domestic situation of Tanzania, Japan's cooperation will be required not only in the planning but implementation of the two projects. It is also to be noted that development of rural communities such as construction of roads and domestic water supply works should be included in the scope of cooperation in addition to the construction of irrigation facilities.

(3) While there is no doubt that Tanzania's agricultural development will expand from highland areas to undeveloped lowland areas, feasibility of lowland area development is directly affected by the development and effective utilization of water (drinking water and irrigation water). Cognizant of this fact, Tanzanian government has long entertained the intention to map out a water master plan covering the entire Kilimanjaro region and requested Japan's cooperation in its prepa-

ration. Water resources survey required for the above-mentioned two farmland development projects will naturally have to be conducted in the project areas. It is desirable that Japan undertake to conduct a survey on water distribution and pattern in other parts of the region to provide basic data required for preparation of the water master plan because this will comply, though partly, with the Tanzanian government's request to cooperate in the master plan preparation and will also facilitate future development of the region. This additional survey will also provide data which will prove quite valuable when Japan agrees to offer cooperation in the formulation of the master plan.

The team therefore considers it necessary to collect and analyze available data on water resources and to conduct a supplementary survey on groundwater and installation of observation facilities in the entire region in parallel with the cooperation in the above-mentioned two projects.

2. Necessity of Farmland Development

Tanzania's advanced agricultural zones are found in the peidmont of Mt. Kilimanjaro and Mbeya, Iringa and Morogoro. All of them have been developed in areas lying at high elevations and having copious rainfall, and none can be found in savannah areas.

Agricultural zones in Kilimanjaro region are also found on the slope of Mt. Kilimanjaro (a mountainous peak at Tanzania's northeastern end rising to an elevation of 19,300 ft.). The areas on this slope are called highland areas and have an elevation of more than 2,500 ft. In highland areas, rainfall is plentiful, the wet season is long, and water for domestic use and irrigation can be obtained with relative ease even in the dry season.

In the same Kilimanjaro region, the lowland areas lying below El. 2,500 ft. and Pare district in the south present a sharp contrast to highland areas in the small rainfall, difficulty in obtaining drinking water, and considerable damage caused by flooding that lasts for a short time in some localities. In these lowland areas, no extensive agriculture can be observed except at a small number of sugar cane and ke naf plantations equipped with facilities for drawing river water and spring water and estates growing drought resistant sisal.

Agriculture in Kilimanjaro region has thus developed on the southeastern slope of Mt. Kilimanjaro.

However, highland areas have a heavy population density so that the average holding per farm household is as small as 1.5 to 4.0 acres. There is no room for further farmland development in these areas because land with an average grade of incline from 1/6 to 1/20 is already under cultivation. To add to these adverse conditions, highland areas are now confronted with the problem of rapid population increase, division of farmland into smaller lots, and increase of the latent unemployed. To bring solution for these problems, it is necessary to introduce sericulture and dairy farming for

diversification of farm management and to increase the yield by application of advanced farming techniques. What is far more urgently required at present is to promote improvement of agricultural infrastructure of lowland areas. Establishment of light industries, though necessary to absorb the latent unemployed, will be limited to processing of agricultural products which are the only raw materials available in these areas. Farmland development and expansion for diversification of farm management is therefore the pressing need to be fulfilled for the region's future development.

As one of the top priority policies adopted by Tanzanian government, one can cite the establishment of Ujamaa villages. During the present survey, the team visited the Ujamaa village under construction in Chekereni district 10 km to the south of Moshi city and noted that efforts were directed towards the community's development by pumping up groundwater for the community members' domestic use. It was felt, however, that accelerated effort should be made to introduce farming techniques best suited to the climatic condition and to establish facilities needed for development and effective utilization of water resources. Such effort should also be made for crop conversion at sisal estates not provided with irrigation facilities.

It goes without saying that in planning infrastructural improvement of lowland areas, the cost of necessary facilities and the types and production cost of crops that can be grown with the aid of such facilities should be subjected to a rigid analysis from the national point of view. Considering the demand-supply condition of staple foods and Tanzania's foreign trade, agricultural development is an absolute requisite for the future of Tanzania and development of lowland areas should be given high priority.

3. Feasibility of Lowland Area Development

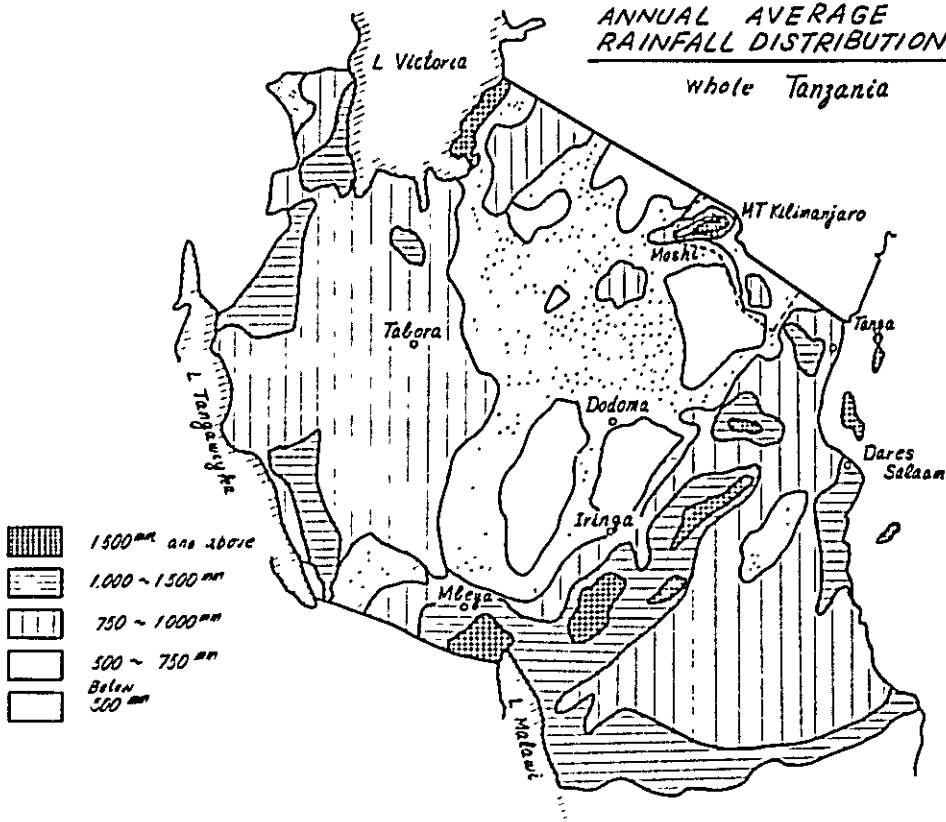
Development of lowland areas calls for establishment of farming techniques compatible with the soil nature, climate and other conditions which are all divergent from those in highland areas as well as for establishment of villages by settlement of farmers. It can be said, however, feasibility of development will be determined by the development and utilization of water for drinking and agricultural purposes and the farmland infrastructural improvement including flood protection. Selection of suitable development areas should be based on the survey of chemical properties of soil. Generally speaking, soil in areas closer to highland areas is fertile and its chemical properties are suited for crop cultivation if satisfactory irrigation is carried out.

(1) Effective Use of Water

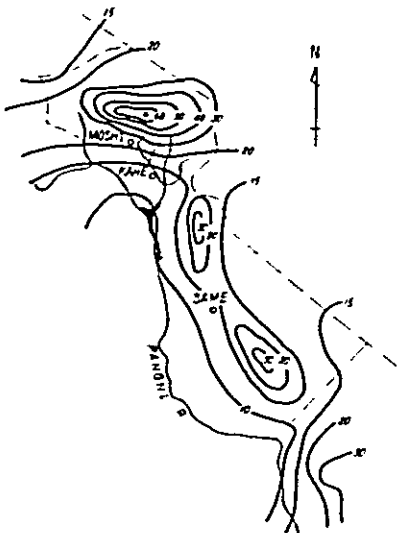
1) Utilization of Water of the Pangani

The Pangani is the largest river in the region which rises in Mt. Kilimanjaro. In its midstream section, it collects water flowing from mountainous areas of northern Pare and southern Pare, flows down along the Kilimanjaro-Arusha border and empties into Indian Ocean after crossing Tanga region.

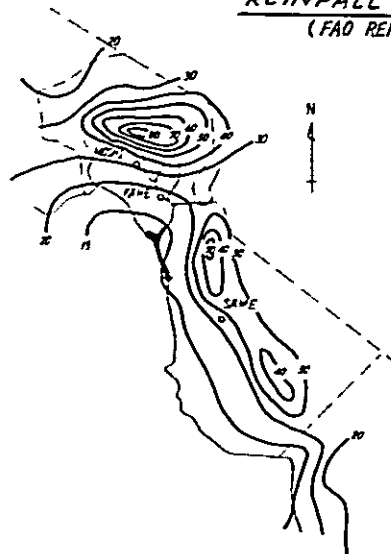
ANNUAL AVERAGE RAINFALL DISTRIBUTION
whole Tanzania



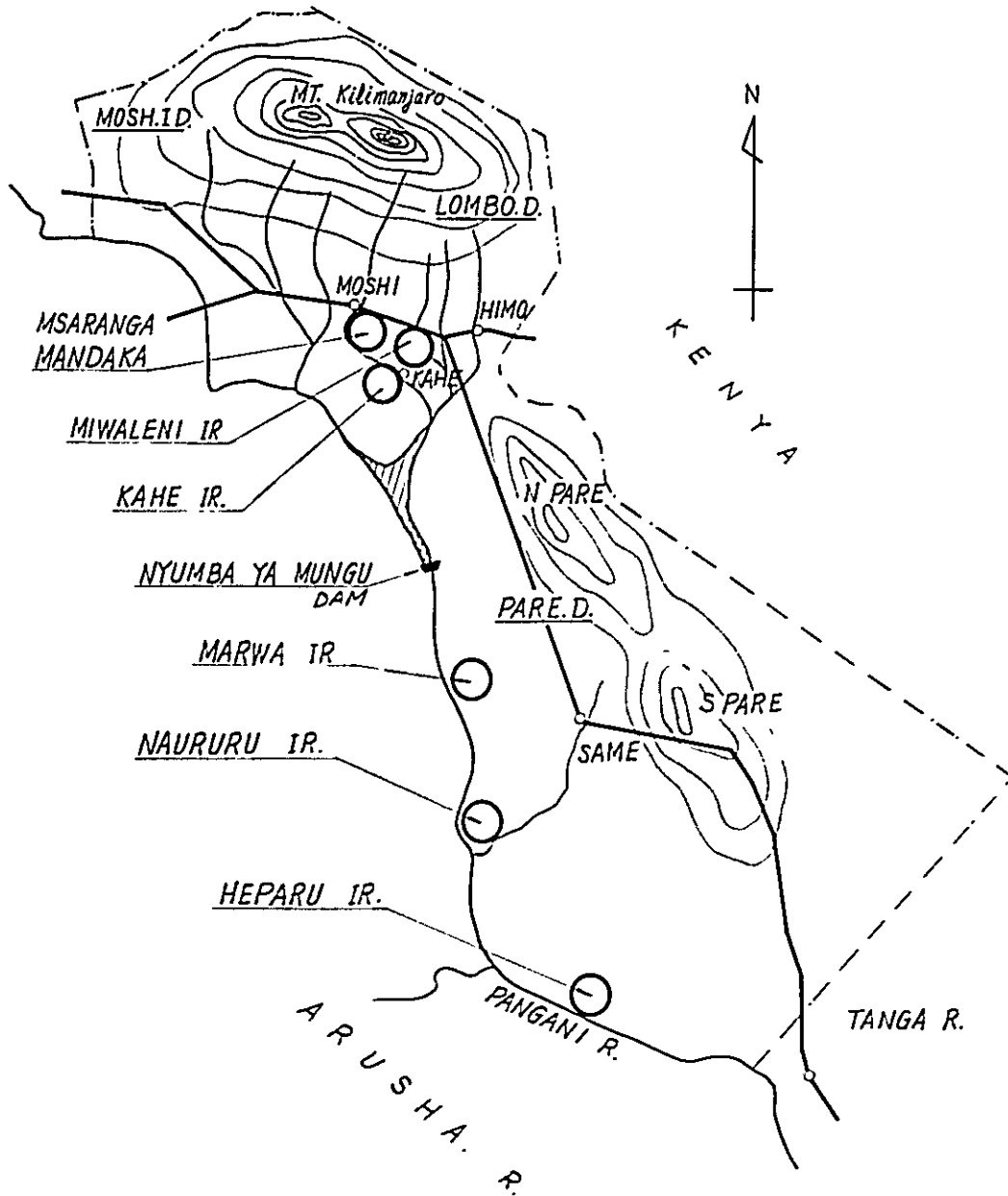
RAINFALL IN 1/5 PROBABLE YEAR
(FAO REPORT)



ANNUAL AVERAGE REINFALL
(FAO REPORT)



LOCATION MAP OF
KILIMANJARO REGION



At Kiliya located in its midstream section is found Nyumba ya Mungu dam which was constructed for power generation, flood control and agricultural development. Completed in 1969, this dam is now used for power generation and flood control, but about 280 million m³ of its effective water which is appropriated for irrigation has not yet been utilized.

The team learned from the officials in charge of agriculture in the Ministry of Water and Power that the dam's power plant is not in full-load operation and generated power is supplied only to Moshi city and Arusha region because of the absence of transmission facilities to Tanga region and Dar es Salaam. The team also learned that water is planned to be supplied to two power plants constructed in Tanga region. At present, discharge from this dam goes totally to downstream power plants and there is no surplus water for irrigation. The officials explained, however, that this problem will be solved in 1975 when the construction of Kidatu dam on the Rufiji which flows through the central part of the country will be completed. The team was not given a clear elucidation of the reason for which the dam's water is not available for irrigation at present, nor was any explanation given on the difference between the water utilization plan initially worked out for the dam and the existing utilization practice. The plausible reason would be the capacity increase of downstream power plants to meet the power shortage in the Tanga region and Dar es Salaam or the excess of discharge loss over the design value. At any rate, the dam's water utilization plan will have to be reexamined when planning the development of downstream areas with the dam as the water source.

Construction of Nyumba ya Mungu dam was planned for flood protection of about 35,000 acres of downstream area. The dam is the main water source required for agricultural development of downstream areas. The FAO report states that the dam is capable of irrigating about 30,000 acres.

2) Utilization of surface water

In its upstream section, the Pangani is joined by permanent rivers such as the Himo, the Mua, the Kikafu and the Kikuletwa. All of them are natural rivers rising far above their banks in the flood season but in the dry season, virtually all of their water is used for domestic or irrigation purposes. It is not possible to draw any surface water from these rivers during the peak of the dry season.

However, deficient supply of irrigation water during the peak of the dry season is not a fatal impediment to the planned lowland area development. If the supply of irrigation water can be secured during a certain period before and after the dry season, then lowland areas can be developed by selecting crops or farm management system compatible with such irrigation condition.

This is the key to developing lowland areas.

During the survey, the team was unable to obtain reliable observation data of rivers in Moshi and Lombo districts. Judging from the topography and rainfall in the two districts, however, it does not seem totally impossible to find surface water which can be effectively utilized during the period of the team's stay. Needless to say, utilization of such surface water, if any, should be planned with careful examination of the production cost calculated from the type of farm management and irrigation to be adopted and the cost of necessary facilities.

3) Utilization of groundwater (spring water)

In Miwaleni Ir. about 15 km to the southeast of Moshi city, the groundwater level is high and natural spring water flows out. Since Kabe irrigation project is now in progress using the total yield of the said spring water which is said to be $3.3 \text{ m}^3/\text{sec.}$, there is no surplus spring water for planning a new irrigation project. Near the Kabe irrigation project area, there is a pilot farm of about 100 acres which is operated satisfactorily with groundwater pumped up for irrigation. If new irrigation projects resorting to groundwater are to be planned in this part of the region, it is necessary to make a detailed survey on the potentiality and distribution of groundwater. It is to be noted, however, that any large scale groundwater utilization planned for such new irrigation projects will perhaps result in the decline of yield of Miwaleni spring water. Considering the source of groundwater which is Mt. Kilimanjaro, it appears difficult to plan a large scale groundwater irrigation project.

Apart from Miwaleni Ir., groundwater utilization is observed in Chekereni Ujamma where a bore hole pump with a diameter of 3 inches is operated to pump up drinking water from a depth of about 40 ft. The data of a groundwater survey conducted in the area about 10 to 15 km south of Moshi city indicates that the groundwater level in that area ranged from 10 to 20 ft. below the ground surface but the groundwater discharge was small and salt content was detected after continuous pumping operation. The data also indicates that in the area upstream (north) of the said survey site, the bedrock is found at a shallow depth below the ground surface so that pumping up of groundwater is difficult. In this part of the region, therefore, groundwater utilization will be limited to the supply of drinking water and it will not be possible to plan a groundwater irrigation project.

4) Water source development by storage reservoir construction

Mt. Kilimanjaro is a mountainous peak which has many sharp slopes incidental to volcanos and lacks any large valleys. During the survey, the team was not able to find any site suited for construction of a large reservoir.

(2) Flood Protection

The Pangani and all its upstream tributaries are natural rivers having a small discharge so that they rise high above their banks during the flood season. Rain-water flowing down from mountainous areas by heavy local rain inundates lowland areas and flows downstream. The inundation of lowland areas is caused by the flat topography and absence of rivers which is assignable to complete drying up all surface water in the dry season. (With a few exceptions, rivers flowing through the slope (highland) areas disappear when they reach the flat (lowland) areas). For this reason, land-use is retarded in some areas having a relatively high elevation and enjoying favourable rainfall and other neutral conditions.

Low-lying areas extending near downstream rivers are considered to suffer a long period of inundation during the flood season, but this cannot be remedied unless river improvement is effected on a large scale. Even if flooding is prevented, such areas cannot generally be turned into arable land due to the chemical properties of soil and difficulty in securing water supply. In areas with higher elevations, duration of inundation is shorter and rainwater flowing down from mountains can be controlled by constructing drainage canals, so that land use can be promoted. A substantially wide area of this type is found in the southeast of Moshi city.

4. Farmland Development Project

Outlined below are the projects for which Japan's cooperation was requested during the survey. It is to be pointed out that the request made by the Tanzanian government was neither followed by presentation of definite development plans nor backed up by survey data for preparation of such plans.

(1) Flood Protection Project in Msaranga-Mandaka Area

Msaranga-Mandaka area adjoining Moshi city on its southeast embraces 4,000 acres of arable land which is subjected to flood damage each year.

The team learned that the loss incurred by the flood amounts to 1 million shilling each year so that farming in that area is like a bet. The flooding is caused by rainwater flowing down from the mountainous area due to heavy local rain in the wet season. The submerged depth reportedly ranges from 1 to 4 ft. The following table shows the relationship between the maximum flood and the rainfall intensity observed in 1971 and 1972.

Period	Maximum Submerged Depth	Flooding Duration	Rainfall Intensity (In Kahe)
Latter part of April, '71	Approx. 4.0 ft.	1 week	Rainfall on 3 days from April 20 to 22 163 mm 3 hour rainfall intensity 50 mm
Latter part of March, '72	Approx. 1.0 ft.	5 days	Rainfall on 2 days from March 20 to 21 130 mm 1 hour rainfall intensity 70 mm

Notes: The above table was prepared from the data recorded in Kahe since no rainfall observation was made in the mountainous district.

As described elsewhere in this report, the sharp change of slope in Kahe from 1/20 to 1/200 - 300 is the cause of the flood. It will therefore be possible to prevent the inundation of the farmland area if drainage canals running all the way from valleys in the sharp gradient area or levees are constructed. The Tanzanian officials interviewed by the team entertain the plan to excavate a catch-drain which branches off from the Rau river flowing in the eastern end of Moshi city, runs along the Moshi-Himo section of the national highway and connects with the Uchiro river, and to improve the Uchiro river to the junction with the Mua river. If this plan is realized, not only the aforementioned 4,000 acres of farmland will become immune from flood damage but flood protection of about 10,000 acres of this area will become possible. Benefit to be derived from the implementation of this plan is great because this lowland area can be turned into arable land by taking surface water from each valley through the catch-drain. Even if no water distribution facilities are installed, the drainage function of the catch-drain will promise agricultural development of this area because it adjoins the highland area and enjoys more rainfall than other lowland areas and part of it is already under cultivation. In addition, the area is favourably conditioned for settlement of farmers because it is close to the existing farmland area, and this makes it possible to give high priority to the area's development.

In formulating this plan, careful consideration should be given to how the downstream area will be affected by cutting flood in this area and to the discharge capacity of the subdrain across the Kahe-Tbeta railway line. It is also necessary to conduct a survey on the flooding of each tributary and on the rainfall in the mountains area which directly affects the outflow. If supply of irrigation water is to be planned for this area, it should be preceded by the basic water resources

survey described in the preceding item.

Since this drainage plan requires a relatively small cost, it will promise a very high investment effect.

(2) Irrigation Project of Naururu and Marwa Areas

The downstream areas of Nyumba ya Mungu dam were made available for development by the dam's flood control function. This project aims at developing these areas by establishing irrigation and drainage facilities with necessary water taken from the dam.

The Tanzanian officials concerned expressed the strong hope that Japan would cooperate in developing the 30,000 acre downstream area with water supplied from the dam. The team received the impression they hoped that Japan would offer all-out cooperation including execution of a feasibility survey and financial aid required for construction work.

Areas that can be developed by utilizing water from Nyumba ya Mungu dam are Naururu and Marwa areas and Heparu area which is further downstream. The development plan mapped out for the former two areas on the basis of the FAO survey is outlined in the following table.

Area	Irrigation Area (acre)	Unit Construction Cost (Tan. Sh. /acre)	Annual Water Requirement (acre/ft)	Water Source
Naururu	2,200	3,380	20,000	The Pangani (gravity flow)
Marwa	7,000	3,500	36,000	The Pangani (Pumping up)

Tanzanian Sh. 7.14 = US\$ 1.00

Since the Pangani has a width of about 50 m, construction of an intake dam does not present any problem. However, it is a natural river with no levees and has a mild gradient of 1/1,000 to 1/2,000. The effect of the dam construction on the upstream area must therefore be studied with care. Installation of a pump station calls for the transmission line from Nyumba ya Dam-power plant. The team noted that Tanzanian officials interviewed preferred gravity flow because it incurs less cost and promises easier intake operation.

In mapping out the drainage plan, the rise of the Pangani's level and flood from the mountainous area of Pare district must be studied because of the dam's present flood control capacity. Soil in the project area is reported to contain salt and alkali by FAO, so that necessary countermeasures will have to be taken by referring to the results of experimental cultivation conducted by the pilot farm at Kiliya.

Nyumba ya Mungu dam provides valuable water resources to Pare district whose development is delayed relative to other districts. The district's development

should be promoted for early and effective utilization of investment funds.

However, the project area is very sparsely populated waste land where practically no crops are cultivated. Creation of villages in this area demands that strenuous effort be made to promote settlement of farmers on a large scale from distant places. In addition, improvement of farmland infrastructure such as irrigation and drainage facilities calls for a considerably large capital input which should be recovered by highly productive agriculture. It is therefore necessary that settled farmers be given guidance for a substantially long time so that they will be able to operate the irrigation facilities in an effective way and acquire a high level of farming techniques. Considering the scale of the development work, due account should be taken of selection, marketing and transportation of crops if it is desired to develop the area within a limited time. For reasons described above, cooperation in the area's development should be offered to establish new rural communities in a small district in collaboration with Tanzanian government without attempting to implement any large project from the beginning. The team considers it both essential and effective for the area's future development to bring solution for various development problems one by one with the growth of such rural communities.

(3) Survey of Water Resources

As described in the preceding item, farmland development of any large scale cannot be expected from groundwater utilization in Miwaleni area, utilization of Lake Chara, groundwater development in Lombo district, or surface water utilization. It remains true, however, that these water resources are a valuable asset for future development. It is therefore necessary to conduct continuous survey on groundwater and surface water in order to grasp the availability and occurrence of water and thereby establish an effective water master plan under which such water resources are to be utilized for domestic and irrigation purposes.

For this purpose, consolidation, collection and analysis of data produced by FAO or by surveys now in progress should be prompted and surveys on groundwater and surface water should be continuously carried out.

5. Relationship between Water Master Plan and Farmland Development Project

Preparation of the Water Master Plan of Kilimanjaro region for which Japan's cooperation was requested consists of two activities, i. e. , the water resources survey and development and the establishment of the water resources utilization plan. The team was informed that cooperating countries now engaged in preparation of the water master plan of other regions are offering technical and financial aid for implementing water resources development plans or water resources utilization projects. This suggests that in requesting Japan to cooperate in the preparation of the water master

plan, Tanzanian government expects that Japan would provide technical or financial aid required for implementing the plan after its completion.

Effective utilization of water carries great weight in the farmland development in Kilimanjaro region. Needless to say, projects described in the preceding item can not be implemented unless surveys and development of water resources and technical of financial aid in any of the projects, it must will follow the cooperation pattern adopted by other advanced countries, and this does not run counter to the desire of Tanzanian government. On the contrary, Tanzanian government would welcome the quick development result derived from such pattern of cooperation. Further, the team is of the opinion that the cooperation in the farmland development can be taken up as part of the cooperation in the preparation of the water development can be taken up as part of the cooperation in the preparation of the water master plan.

Regional development which is to precede preparation of the water master plan is planned to be carried out along the lines of the plan presented in FAO report on survey and utilization of water resources in the Pangani basin. Upstream tributaries of the Pangani dry up completely in the dry season so that the water utilization plan for upstream areas is not directly related with that for downstream areas. In addition, the region's water master plan is required to place stress on securing drinking water and irrigation water. Implementation of the farmland development project before preparation of the water master plan is considered to create no serious impediment to Japan's cooperation activities but is a desirable method that promises to yield quick development effect.

