# REPORT OF THE BASIC SURVEY TEAM

# FOR

# THE AGRICULTURAL DEVELOPMENT IN CEYLON

December 1968

OVERSEAS TECHNICAL COOPERATION AGENCY

GOVERNMENT OF JAPAN

# FOREWORD

Japan has been extending technical cooperation to Ceylon for her agricultural development for more than ten years by providing, under the Colombo Plan, services of experts in agricultural research and experiments.

In July 1967, when the Prime Minister of Ceylon, H.E. Mr. Dudley, S. Senanayake, visited Japan, he expressed his desire to the Japanese Prime Minister to get further cooperation from Japan for the development of agriculture to solve the urgent problems of food shortage confronting his country.

Subsequently, the Overseas Technical Cooperation Agency, under the instruction of the Government, studied the matter with the advise of Dr. Shiroshi Nasu, Professor Emeritus of Tokyo University and Ex-Ambassador to India.

Dr. Nasu advised that the technical cooperation for agricultural development to Ceylon should take an intergrated approach in which the improvement of agricultural technologies and the social or institutional adjustment are closely combined, so that the benefits of improved techniques may permeate among the tillers of soil and result in actual increase of production.

Thus the Overseas Technical Cooperation Agency organized a survey mission comprising top-level experts on technical matters, such as rice cultivation and irrigation combined with economists and rural sociologists; Dr. Nasu himself assumed the responsibility of the team leader.

The Mission, which stayed in Ceylon for three weeks in July 1968, endeavoured to make the best use of the limited time available in investigating the situation and laying out some basic guide-lines for forthcoming cooperation, as are presented in this report.

Thanks are amply due to the leader and members of the Survey Mission for their streneous efforts, to the officials of the concerned Ministries and Departments of the Government of Ceylon and to the staff of the Japanese Embassy in Colombo, without whose all-out sympathy and generous help, the Mission could have hardly attained its purpose.

Tokyo, November 1968

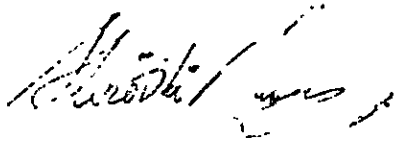
Shinichi Shibusawa
Director General
Overseas Technical Cooperation Agency

## ACKNOWLEDGEMENT

The undersigned had the privilege of visiting Ceylon last summer as the leader of the Agricultural Survey Mission sent by the Overseas Technical Co-operation Agency of Japan under the auspices of the Japanese Government. The mission consisted of a number of eminent scholars in the field of agricultural science as well as rural sociology, and it attempted, despite its rather limited stay, to make observations and to collect enough materials to work out a new project of Japan's co-operation to the ambitious National Programme of Ceylonese Agricultural Development. Its findings are presented in this report, and the Mission hopes most sincerely that the suggested project will turn out to be the new promising approach of diffusing advanced technology among the far-larger portion of farming population.

The undersigned expresses, on behalf of the Survey Mission, his sincere gratitude to the concerned authorities of both Ceylonese and Japanese Governments, the Overseas Technical Cooperation Agency, as well as the members of Ceylonese Embassy and Japan-Ceylon Society.

November 1968



Shiroshi Nasu

Leader

Ceylon Agricultural

Survey Mission

The Member List of the Japanese Mission for the Fundamental Agricultural Development Survey in Ceylon

| | | |
|---|---|---|
| Dr. Shiroshi Nasu | Chief | Professor Emeritus, The University of Tokyo. Former Ambassador of Japan to India. |
| Dr. Shigeto Kawano | Agricultural Economics | Professor, The University of Tokyo |
| Dr. Tsuneo Eguchi | Horticulture | Professor, The Nihon University. |
| Dr. Hitoshi Fukuda | Irrigation and Drainage | Professor Emeritus, The University of Tokyo. |
| Dr. Yoshitsugu Togari | Agronomy | Professor, The University of Tokyo |
| Mr. Shigeru Iijima | Agricultural Economics | Associate Professor, The University of Kyoto |
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# I GENERAL DESCRIPTION

By Shiroshi Nasu

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1. Agricultural Development of Ceylon

The Ceylonese Government plans to bring about promotion of the national economy and the stability of people's living through agricultural development, for which the Japanese Survey Team (JST) has profound respect and full appreciation.

JST has also reached the conclusion, as a result of its investigations, that it is urgently needed to prevent the outflow of foreign exchange for the importation of food by establishing the self-sufficiency of food, if the economy of Ceylon is to be stabilized. To that end, it is believed important that the structure of agriculture should be so improved as to enable the farmers, who have charge of agricultural production, to get profits through agriculture. The Ceylonese Government will have to establish on a long-term basis and carry out steadily an agricultural policy to meet this requirement. If it succeeds, it will induce the conditions for the so-called take-off and expedite the development of manufacturing industry.

2. Field Survey by the Survey Team

Although the period for survey was short, being only three weeks, JST was able to conduct fruitful surveys, thanks to the extraordinary goodwill of the Ceylonese Government. The survey had two objectives, namely, (1) diagnosis of the whole range of the agricultural development of Ceylon as requested by Prime Minister Senanayake and (2) the kind of cooperation that Japan can offer effectively to the agricultural development of Ceylon.

Before leaving Japan, JST had made a preliminary study of the agricultural condition of Ceylon and presumed that Japanese cooperation would be effective and true to purpose, if it was centered on the improvement of local farming, with the development of village communities in mind.

JST was divided into separate groups of specialists and made a survey of the agriculture of Ceylon according to specialized fields. In addition, an over-all was made in Kuda Galnewa in the dry zone and Hunuwala and Idallawala in the wet zone to know the actual conditions of villages and local farming. As a result of these surveys, all specialists agreed in the conclusion that in order to increase the total agricultural production of Ceylon, steps should be taken first of all to reconstruct the production structure based on villages already existing as regional

communities and thus to enable stabilized agricultural production.

3. Outlook of Agriculture of Ceylon

The agricultural production of Ceylon registered a remarkable increase during the 1967-68 term owing to the efforts of the present Cabinet, particularly in the output of rice, the staple food. It is therefore expected that in fiscal 1968, there will be a sharp decrease in the import of rice, which amounted to 480,000 to 640,000 tons yearly during the past decade. It is believed that the policy, placing the priority on the development of agricultural production, pursued under the personal leadership of Prime Minister Senanayake, deserves highest appreciation. JST earnestly hopes that Ceylon will persist in its present zeal for increase of agricultural production in order that self-sufficiency in food supply may be attained at an early date. The members of JST were in full accord in confirming that Ceylon has full potential capacity to realize such self-sufficiency. It must be noted, however, that the remarkable increase of agricultural production in 1967-68 was attained by the use of fertilizer and the selection of species highly responsive to fertilizer, without much change to the existing structure of agricultural production, and that therefore the rate of self-sufficiency in the staple food may possibly stop at 70-80%. To break this barrier, it is believed necessary to establish a policy to improve the structure of agricultural production and give a constant incentive to the farmers' zeal for production.

Self-sufficiency in other produces than the staple food, such as onions, potatoes, chillies, etc., is also quite possible. With regard to onions and chillies, self-sufficiency can be realized in a relatively early stage with appropriate technical guidance. In the case of potatoes, the import of seed potatoes will have to be continued for the time being.

Tea, rubber and coconuts are representative of agricultural products for export. Though coconuts have some prospects for future, it will not be wise to expand their plantation area. Instead, the coconut farms in the plains of the wet zone should be converted into truck farms and managed under intensive farming. In the districts where the plantation of rubber and tea is not always profitable, the introduction of the citrus, cashew-nuts and oil palms would seem advantageous in view of their current international marketability.

4. Characteristics of Agriculture of Ceylon

The physical conditions bringing about the characteristics of the agriculture of Ceylon are : (1) effects of the monsoon, (2) the topography of the island, and (3) the latitude and altitude. The social conditions are : (1) the disparity between estate farming and local farming, (2) the complexity of the tenant system in the wet zone, (3) the high rate of latent unemployment in the farming villages, (4) human relationships in the farming villages, and (5) the location of authoritative power in the farming villages.

JST carried out a field survey in three representative villages with the object of finding the characteristics of the agriculture of Ceylon. The particulars of the survey will be dealt with in detail elsewhere. At any rate it was found that each of the three has its own characteristics, except the low productivity which is common to all three and which requires much improvement. It was concluded, however, that there should be different approaches to improvement according to villages. In Ceylon, the districts where the rainfall exceeds 75 inches a year are designated as the wet zone, while the districts where it does not exceed 75 inches a year are called as the dry zone. These designations proved to be a convenient key to the understanding of the general conditions of the agriculture of Ceylon. The same conclusion can perhaps be reached by taking the area the rainfall is below 20 inches during the southwest monsoon as the dry zone. The field survey made it clear that there is a great difference in the farming setup between the dry and wet zones. It seems the agriculture in the dry zone is more strongly affected by the physical conditions, while in the wet zone it is more influenced by the social conditions.

5. Improvement of Agriculture of Ceylon

As stated above, agriculture in the dry zone is strongly affected by the physical conditions. In concrete terms, the decrease of productivity owing to the shortage of agricultural water and the damage caused by drought which occurs at intervals of three to four years may be mentioned as general characteristics. Although the geographical conditions for agriculture, excepting the shortage of water, permit two crops a year, cultivation ceases during the Yala season and is carried out only in the Maha season. It was found that the volume and time of rainfall fluctuate considerably even in the Maha season and then this was one of the causes of the stagnation of agricultural production.

The Ceylonese Government is now planning to alter the courses of the Mahaweli River and draw water to the dry zone for the fundamental remedy of the shortage of water. The determined will of the Ceylonese people to carry out this ambitious plan, requiring a total cost of 4,584 million rupee, profoundly impressed the members of JST. The basic concept of the plan resembles the elaborate network of irrigation canals projected in ancient times by the Singhalese kings and has many merits from a technical point of view, according to the opinion of a member of JST who is an irrigation specialist. However, it will take a long time for the plan to be completed and water to be fed to the terminal fields, even if the fund is made available in a satisfactory manner. According to the current plan, the Mahaweli River master plan is to be divided into three periods and the work of the first period is to be completed under a five-year plan. This work alone has a scale of the first class magnitude in the world. The Ceylonese Government should do its utmost for the completion of the work. JST was interested in the terminal facilities under the Mahaweli plan, but the planning of these facilities was not sufficient and there remain many problems to be studied. In this connection, it will perhaps be possible for the Japanese Government to send experts under the Colombo Plan, if the Ceylonese Government so desires.

JST also made a survey as to what is needed for the improvement of local agriculture, by selecting the Kuda Galnewa area downstream of Kalawewa as a representative community in the dry zone, in view of that fact that agriculture in that zone is being carried on by irrigation from the tanks. The details will be mentioned in the other chapters. The consensus of JST experts is that agricultural production can be raised two to three times from the present level by improving the agricultural infrastructures and giving managerial guidance, without depending on the water of the Mahaweli River. In this area, 250 acres of paddy fields are irrigated by water taken from the village tanks, with a yield of about 45 bushels per acre from one crop during the Maha season. With a minimum investment in the order of 600 rupees per acre for the improvement of the basic conditions of land, by establishing a plan for effective utilization of irrigation water, by investing 2,000 rupees per acre for 150 acres (300,000 rupees) to establish facilities for irrigation by sprinklers where conditions are appropriate, and by giving proper guidance in agricultural operation, this area will be able to double its agricultural production and redeem the investment by itself within a short period. In other words, much improvement is possible in the villages in the dry zone, without waiting for the completion of the Mahaweli plan.

It is suggested that the Ceylonese Government conducts a survey on the technical possibility of revitalizing the village tanks, which exists in such a large number in the dry zone, and, where feasible, establishes a plan of rural reconstruction, which will cover also the villages in the tank basin. When sufficient water is supplied to this area in future by the Mahaweli plan, production will be further increased.

In connection with the physical conditions in the wet zone, attention should be paid to the improvement of drainage in the Yala season. With regard to the rainfed paddy fields, the equipment at the source of water in the Maha season should be considered. It is possible to construct a reservoir of a suitable size by taking advantage of the topographical formation at the upstream side of rainfed paddy fields. The most important problem in the improvement of agriculture in the wet zone is the small size of arable lot held per farm household. It is closely related to the tenant system. This situation can be improved by raising the efficiency of land utilization.

It will be difficult to attempt the reform of agricultural land by a frontal attack on the tenant system, which has come into existence out of historical usage, since the landowners will put up stiff resistance. Under the existing system of agriculture in the wet zone, however, it is hardly possible to raise production by stirring up the will to work of the farmers, and an adjustment of farm land is essential. Generally speaking, the improvement of the agricultural production structure in the wet zone is considered more difficult than in the case of the dry zone. The mode of tenancy in the wet zone is mostly on the ande system or the kuru-ande system, and it will be difficult to change this system by the Government's administration guidance alone to the fixed rent system which is prevailing in the dry zone. JST believes that it will be advisable to bring about a gradual solution by such realistic measures as follows.

The kuru-ande system still existing should be rectified. It will cease to exist, if the financial measures of the People's Bank are strengthened and the seeds, fertilizers, and tools required by the farmers are provided through the activities of the farmers' unions (excluding absentee landlords).

The Ministry of Agriculture will have to improve the organization for agricultural statistics and surveys and conduct a survey on the unit area field of each district, and, taking the past records into account, determine the average yield per area in as much detail as possible.

The above-mentioned two matters are the pre-conditions for the improvement of the agricultural production structure which is to be carried out in the next stage. There seems to be no way to rectify the kuru-ande system but the increase of productivity. Because the wet zone has no crown land suitable for expanding the area of the arable land except for the damp ground along the coast, the gross production must be increased by greater utilization of the cultivated land, two-crop farming system, and the increases of the per unit area yield.

For better utilization of the cultivated land, the following measures can be considered :

1. Improve the drainage system to increase cultivation in the Yala season;
2. Execute work on the sourse of water to secure irrigation water and increase cultivation in the Maha season,
3. Convert a part of the palm groves into vegetable fields to be irrigated by pumping.

These are considered appropriate and effective measures. Agricultural productivity will certainly increase, with the improvement of the foundation for agricultural production by these measures coupled with the introduction of new farming techniques. At the same time, marketing channels will be developed by the activities of the farmers' unions, and agricultural cooperatives will be established by farmers' investments. When the agricultural productivity per village has increased as a result of these measures, a new method of distribution regarding the share of the increase should be determined by the administrative guidance by the Government, in terms of the average per area yield which shall have been determined by the Ministry of Agriculture as previously stated.

JST considers it proper that the allocation of the increase be fixed at a ratio of 75% for the tenants and 25% for the land owners. JST also considers that it will be most useful if a pilot project for the development of farming villages is undertaken on the basis of the above conception at two or three selected villages.

6 Comments on Youth Settelment

JST expresses its deep respect for the Youth Settlement program now being carried out in Ceylon and sincerely wishes its success. JST visited only one area down stream of Rajangana out of 27 where this program is in progress, but was deeply impressed by the work being done with zeal. It is possible to obtain irrigation water in this area, but further studies seem to be required concerning the method of irrigating the fields. There is difference according to topography, but it is suggested that the gravity irrigation method should be learned first, and, according as the yield increases, terminal irrigation should be improved by the use of pipes or sprinklers. It is considered important that the soil should be mulched with organic matters or covered by cover crops to prevent leaching of fertilizers out of the soil or its erosion during the period from the clearance of the dense forest to planting.

It will be possible for Japan to send young Japanese who have learned agricultural techniques and provide necessary material and equipment, if Ceylon so desires. Through such cooperation, friendly relations between the two nations will be further strengthened.

7 Comments on Mechanization of Agriculture

JST has found that the Ceylonese Government has great interest in the mechanization of agriculture. Since 1967, Japanese-made small size tractors, tillers, and their accessories have been introduced and replaced the large size tractors formerly in use. JST considers that these machines must be improved or adjusted to meet the farming conditions of Ceylon. Generally speaking, there are similarities of conditions between Japan and Ceylon in the use of farming machinery, and the Japanese type of mechanization of agriculture is certainly a useful example for the modernization of agriculture in Ceylon. It is considered necessary, therefore, to confer on the actual method for carrying out such modernization.

8 Promotion of Truck Farming in Highland and Dry Zone

Potatoes and European vegetables are cultivated principally in the Nuwala Eliya highland, and the cultivation of chillies, eggplants, tomatoes, corns, peanuts, and onions has been started in the dry zone. There is much room for improvement in the way of betterment of species, introduction of new species, technique of

cultivation, and preparation of farm grounds. If requested by the Ceylonese Government, it may be possible to send specialists from Japan under the Colombo plan and supply necessary equipment for the purpose of giving technical guidance on vegetable cultivation, or to train agricultural technicians of Ceylon in Japan.

9 Considerations for Agricultural Development of Ceylon

Having made an overall study of the results of various surveys as mentioned above, JST believes that there should be the following considerations for the agricultural development of Ceylon.

It is believed most approriate to utilize effectively the limited fund, material and equipment and highly developed technology and to conduct integrated activities at selected villages of a suitable size for the completion of infrastructures, adoption of modernized techniques of agricultural operation and their popularization, and improvement of the social system including the farmers' organization, in order to contribute to the development of agriculture in Ceylon, by extending the benefits of these steps to the neighboring areas.

The villages where this formula of development is put into practice will be three to five, all of which must meet the following conditions:

1) Such villages should each have about 500 acres of arable land with representative features ;

2) Such villages should be inhabited by people with zeal for development;

3) The local administrative authorities should have keen interest in the development of such villages ;

4) Such villages must be situated within 150 miles from Colombo.

It is considered advisable to select places of cooperation from among eligible villages through consultation between the Ceylonese Government and the second survey team to be sent hereafter. It would be appreciated if the Ceylonese Government would select the place in advance.

It would seem proper to proceed with the development of villages attaching primary importance to the following matters :

a) Establishment of farmers' unions or agricultural cooperatives

It is necessary in any industry to conduct organized activities for its satisfactory development. Espesially in agriculture, it is necessery to establish a union as an organ to carry out, partly or wholly, the work of land improvement, reform of the land system, agricultural financing, collection and marketing of agricultural products, joint purchase and distribution of material for productive operation, dissemination of and guidance in new techniques, development and furtherance of village industries, and other works such as cultural activities. For the present, therefore, the existing organs engaged in these activities should be strengthened, or a new organ of the same kind should be established and assisted in conducting its activites.

b) Improvement of infrastructures

In order to increase agricultural productivity, it is necessary to improve infrastructures, which are, for instance, irrigation and drainage networks, agricultural roads, consolidation of boundaries, soil improvement, etc; particularly in the case of irrigation and drainage facilities, it is most important to prepare adequately not only the main facilities but also the terminal facilities. Efforts should be made to ensure the full performance of their functions.

c) Adoption and dissemination of techniques of agricultural operations

For the increase of agricultural productivity in Ceylon, adoption and dissemination of new techniques of agricultural operations, such as the improvement of species, introduction of new species, fertilization, eradication and prevention of damage by blight and noxious insects, mechanization, etc., are urgently required, in addition to the completion of infrastructures mentioned under b). The objectives hereafter will be the full two season crop system in the wet zone and the popularization of the double crops mostly of rice and other crop in the dry zone.

It is important for the practice of techniques of agricultural operations to train extension service personnel who will take charge of the popularization of new techniques.

10 Japanese Cooperation for Village Development

JST considers it necessary that a second survey team should be sent by the Japanese Government to cooperate in the village development of Ceylon and

establish a programme for village development through consultation with the Ceylonese Government.

The following matters will be considered regarding the second survey team;

a) For the method of village development, the two governments should fully exchange views to obtain agreement ;

b) A Japanese-Ceylonese joint field survey should be conducted with regard to the villages to be designated by the Ceylonese Government for village development, and the subject village for cooperation should be selected, fully hearing the opinions of the village inhabitants;

c) A basic programme should be established for the selected village, and the two parties should fully consult on and study its contents;

d) Field surveys (land surveying, hydrology, geology, soil, etc.) necessary for the completion of infrastructures should be conducted, and a report should be made ;

e) By investigating the actual conditions of local farming and farmers, a plan should be made, considering the local conditions, for the process of land improvement, reform of the land system, and establishment and strengthening of the farmers' union, which is the organ carrying out financing and the purchase and marketing of commodities;

f) A study should be made about how to improve local farming in future, on the basis of its present conditions, and a programme of agricultural operations should be made;

g) Full consultations with the Ceylonese Government should be held about the above-mentioned items d) - f) and a concrete plan (including the period of agreement, extent of cooperation, etc.) should be made.

Composition and Time of Sending of the Second Survey Team

The second team will be composed of 14 to 15 experts in farmers' unions, infrastructures, and techniques of agricultural operation, and a programme covering each field will be drawn up. Judging from the above-mentioned tasks of the team, the period of survey will require 80 days. The appropriate time for its tour will be the harvest period (early December to March) of the Maha season.

With regard to infrastructures, however, these surveys may not be sufficient, in which case a supplementary survey may have to be made later.

Methods of Cooperation

To practice the above-mentioned cooperation, the aid formula under the Kennedy Round to be put into effect in the near future may be utilized, besides various forms of cooperation extended so far by the Japanese Government to other countries (refer to the appended Technical Cooperation for Agriculture).

11 Proposal for Establishing a Japan-Ceylon Committee for Agricultural Development.

It is hoped that Japan and Ceylon will continue to promote their friendly relations through cooperation for agricultural development based on mutual understanding. In order to carry out cooperation effectively, it would seem desirable to establish a committee for satisfactory mutual understanding and exchange of information between the two Governments and for smooth conduct of business as required.

(Reference)

Technical Cooperation for Agriculture

The forms of technical cooperation for agricultural development now extended by the Japanese Government are as follows:

(1) Reception of foreign trainees;

(2) Assignment abroad of experts;

(3) Granting of equipment;

(4) Investigations necessary for development;

(5) Establishment of training centres for agricultural technology;

(6) "Agricultural cooperation projects", under which various forms of technical cooperation as above-mentioned are concentrated in a certain area and carried out in an integrated manner.

"Agricultural cooperative projects" mentioned under (6) were started in 1967. The Japanese Government will envisage an agricultural development project of suitable proportions as a model and send a survey team for making a feasibility study and drawing up a plan of execution; it will also select a pilot area in the centre of the project area and cooperate in the completion of necessary infrastructures and the improvement and dissemination of techniques of agricultural operations, by sending specialists and providing equipment.

For village development in Ceylon, assistance in the form of "agricultural cooperation project" is considered suitable, in view of the comprehensive nature of the work.

# II PROBLEM OF RICE PRODUCTION INCREASE IN CEYLON AND PROBLEMS INVOLVED IN TECHNICAL COOPERATION WITH JAPAN

By Shigeto Kawano

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## 1. PRESENT SITUATION AND PROBLEMS INVOLVED

### (1) Background of rice production increase plan

The purpose of our survey was to draw up a rice production increase plan and to examine the system and type of technical cooperation which Japan may be able to provide for the agricultural development in Ceylon. Although the sphere of survey was extensive, here are commented first of all the present situation and the problematic factors involved, placing emphasis on the rice production increase problem.

Ceylon is an island country occupying an area equal to that of Kyushu and Shikoku together of Japan. The population in mid-1967 was 11,741,000. The rate of increase is declining in recent years, but it was as yet 2.2% in 1967. The increase in per capita income is very slow. The rate of growth of gross national product in 1966 was less than the rate of population increase. Ceylon in that year was therefore under the process of curtailed reproduction. Although a large recovery was recorded for 1967, the rate of increase in per capita income still remained at 2.0%. (See Central Bank of Ceylon: Annual Report, 1967, p. 2)

Ceylon originally has been a country of plantation agriculture centering on the cultivation of tea, rubber and coconut. The agricultural population accounts for 53% of the total population and the percentage of agricultural income to total national income is 32% (1966). (Government of Ceylon : Report to the Food and Agriculture Organization of the United Nations, 1964 - 66, p. 3) With the foreign currency obtained by the export of plantation agricultural products, Ceylon has been importing food including rice, onion and pepper, other consumer goods and production materials. Under the plantation agriculture in 1966, the total area planted with tea was 596,445 acres, with rubber 672,592 acres and with coconut 771,908 acres. (Government of Ceylon, ibid, p. 4-5) The total export earnings by these agricultural products were as high as 91% of the total national exports. In the meantime, the total area planted to rice is 1,580,000 acres, and the rate of self-supply is on the 50% level. Production of rice in terms of polished rice was 520,000 tons in 1958, which increased to 721,000 tons in 1964, but decreased sharply to 517,000 tons in 1965 because of unfavorable weather, and was recovered to 635,180 tons in 1966. A further increase of 20.6% was recorded for 1967. (Central Bank of Ceylon, ibid, p. 34) On the other hand, yearly import of rice was 549,297 tons in 1964, 574,833 tons in 1965, and 549,172 tons in 1966, maintaining a 500,000-odd-ton level. The percentage of yearly rice import to the total

national imports in the four years from 1964 to 1967 was 16.5, 9.8, 18.1 and 12.1 respectively. Since the percentage held by all food and drink imports was somewhat over 50, it must be called that the position of rice is significant. (Central Bank of Ceylon, ibid, p.160) Since Ceylon is making efforts for increasing capital investment amid the present adverse trade balance which is brought about by a fall in price and quantity for export agricultural products, and a price rise of imports, this should be called an avoilable burden shouldered by Ceylon as economization seems to be practicalbe. Inasmuch as Ceylon is an agricultural country. agricultural production in this country must have been under comparatively favorable economic conditions. Therefore, such an adverse situation as seen at present can be concluded to have been brought about by the past history where Ceylon depended excessively on plantation farming. Accordingly, it was decided to take up the problem of domestic production increase of rice, as an important issue of the Five-Year Agricultural Development Plan covering 1966-1970 period, so as to reduce the burden of foreign exchange deficiency and contribute to promote the economic development centered on industries, transportation and communications.

The annual trade balance is shown in the following table, where in stability and big deficit in 1966 are conspicuous.

Trade Balance of Ceylon

(Unit: 1,000,000 rupees)

| Year | Export | Import | Balance |
|---|---|---|---|
| 1960 | 1,832 | 1,960 | -128 |
| 1961 | 1,733 | 1,703 | +30 |
| 1962 | 1,808 | 1,660 | +148 |
| 1963 | 1,731 | 1,490 | +241 |
| 1964 | 1,876 | 1,975 | -99 |
| 1965 | 1,949 | 1,474 | +475 |
| 1966 | 1,700 | 2,028 | -328 |
| 1967 | 1,690 | 1,738 | -48 |

(Central Bank of Ceylon, Annual Report, 1967, p.145)

(2) Rice production increase plan

Under the rice production increase plan, production of unhulled rice of 50,000,000 bushels recorded for fiscal 1964 ( or more precisely, fiscal 1963-64)

is adopted as the basic figure, and a production increase of 20,000,000 bushels, or 290,000 tons in terms of polished rice, is to be achieved by 1970. This is an increase of 40% during the period. It is therefore a highly ambitious plan, because the expected average yearly increase is 8%, which is about 2 times the yearly rate of increase recorded in the past. (Government of Ceylon, Report to the Food and Agriculture Organization, p. 14.) The measures being taken for this purpose were as follows:

i) Studies on the variety improvement, fertilization and cultivation

The principal aim of the study was a high yield, resistance to disease and insect pests, and excellent quality. Such varieties as H4 and H8 have been created as a result. Efforts are also being made for the introduction and dissemination of IR-8, the so-called miracle rice, parallel to the expansion of H4 and H8. The soil survey has been carried out in 1963 for all rice fields in the country, and these lands have been classified according to the degree of fertility. The test on fertilizers for rice has been carried out in five seasons from July 1964 to 1966, using private farms as experiment site. The test plots numbered 2,490, and technical cooperation was rendered by Australia. As a result of the test, it has been clarified that the yield of unhulled rice per acre in the dry zone can be increased from the present 40 bushels to 70 bushels, and in the wet zone from the present 40 bushels to 60, if the fertilization is reasonable, and further can be boosted to 100 bushels and even to 200 bushels eventually. It is mentioned in the said report of the Government of Ceylon to FAO that services for the soil test are now being rendered by Mr. UCHIDA, a technician dispatched from Japan under the Colombo Plan, and that a study on the effects of water control in rice culture was also carried out by another Japanese technician.

ii) Increased application of fertilizers

The consumption of fertilizers is showing steady and conspicuous increase yearly as shown below since fiscal 1960 (1959-60) where 20,000 tons were recorded (though a decrease was recorded for 1965 due to unfavorable weather), and it is reported that three factors are involved in this.

| Fiscal year | Consumption of chemical fertilizers (tons) |
|---|---|
| 1960 - 61 | 29,000 |
| 1961 - 62 | 38,000 |
| 1962 - 63 | 47,000 |
| 1963 - 64 | 60,000 |
| 1964 - 65 | 42,000 |
| 1965 - 66 | 41,982 |

The first is propaganda campaign and enlightenment and education of farmers, the second is the nation-wide establishment of fertilizer marketing networks centered on the cooperatives, and the third is a discount sale of fertilizers for rice growing farmers. The rate of discount is 1/2 for cash sales, and 1/3 for credit sales. It is estimated on the basis of the present area under cultivation that the future annual demand for fertilizer will reach 200,000 tons. For this increased use of fertilizers, Australia is also rendering cooperation under the Freedom from Hunger Campaign.

However, a bottleneck to increased application of fertilizers is the sharp increase in price. Each Ceylonese farmer paid 300 rupees in 1960, which decreased to 250 rupees in 1962, but thereafter increased to 330 rupees in 1963, and to 412 rupees in 1966. Therefore, the Government of Ceylon in its report to FAO complains that curtailment of fertilizer imports would be inevitable. (Government of Ceylon, Report to the Food and Agriculture Organization, p. 17)

iii) Rationalization of land tenure system

The total tenanted lands in Ceylon are about 40% of the total arable lands, and for these tenanted lands the Paddy Lands Act was enacted in 1958. The purpose of this act is to stabilize the tenant right and reduce the rent, and the Committee of Cultivators has been organized in each village under this act. It is intended under this act to provide the rice growing farmers with the benefits of the joint management and large scale cultivation on the basis of individual land ownership and individual farming. This act has been amended and supplemented by the Paddy Lands (Amendment) Act of 1964.

iv) Agricultural credit system

There are a total of about 4,000 farmers' cooperatives in Ceylon, and a system to lend out low interest fund to rice farmers through these cooperatives has been in force since 1947. Regrettably, however, the actual results have been extremely unsatisfactory. The Government accordingly conducted a sampling survey on the factors involved in 1962. Taking the obtained findings into consideration, the agricultural credit system has been reformed drastically in 1963, and various new measures have been introduced into the new system. Restrictions on the amount of loan to be lent out to individual farmers at the time when they adopt the improved farming methods, such as the effective fertilization on the adoption of new rice varieties, have been relaxed. On the other hand, farmers became able to get a loan as a marketing fund while the rice is still in the field to cope with the middlmen. Thus, the loans to rice-growing farmers in fiscal 1964 - 65 totalled 32,000,000 rupees. This was a leaping increase, as the annual average total for the preceding years ranged between 10,000,000 and 12,000,000 rupees. It must be noted in this connection that farmers' cooperatives are in charge of the money lending only and do not accept the savings.

v) Distribution and price support system

The price support system for agricultural products is enforced for, in addition to rice, more than 10 kinds of crops including onion, pepper and chilli. From the point of view of value, top position is held by rice. The Government purchase of unhulled rice increased from 22,400,000 tons in 1961 to 29,000,000 tons in fiscal 1963 - 64, and the rate to the total production also from 51% to 56%. However, because of the poor harvest recorded for 1965 due to the dry spell, the Government purchase in 1966 sharply dropped to 25%. In the meantime, as a result of the price increase of imported rice, the rice rationing system was amended by the Government. The former onerous ration of 2 kg per capita weekly was amended to gratuitous ration of 1 kg per capita weekly, thus the amount of ration being reduced to half. As a natural consequence, the demand, which had formerly been fulfilled by the ration, rushed to free markets in the form of free competitive purchase, and brought about the rise in market price. The supported price itself was revised in November 1967 from 12 rupees to 14 rupees per bushel.

vi) Improvement of irrigation and drainage

As commented below, Ceylon is divided into the wet and dry zones (yearly precipitation is 75 inches or more in the former, and below 75 inches in the latter). The northeast and southwest monsoons alternately bring about the rainfall to each of the two zones. In the wet zone the rice growing is hampered by excessively deep rain water, while in the dry zone it is hampered by the water shortage during the drought season. This means that the irrigation and drainage facilities are insufficient, and that the supply of water for rice is at the mercy of natural rainfall. In the total area of land planted to rice, the districts where artificial, systematic and large-scale irrigation and drainage projects are comparatively good are only 27%, the districts having traditional small-scale water control facilities are 30%, and the remaining 43% districts include solely the rain fed paddy fields. Accordingly, the aim of the agricultural water control programme is to alleviate or eliminate the instability of water supply and to promote the fertilization agriculture actively by the adoption of excellent rice varieties and machinery. The programme includes an intensive irrigation project to be carried out with the World Bank loan, and many other major and minor projects. The total expenditure for these projects reaches 55% of the national budget for agricultural appropriations. Further, it is scheduled to increase this expenditure for agriculture by 75% and for the irrigation and development by 150% during the 1966 - 71 period. (FAO - IBRD, Report of the Irrigation Program Review --- Ceylon. Jan. 1968. pp. 21 - 23.)

vii) Establishment of special experimental areas

In 1967 two special experimental areas including the Elahera Colonization Project area have been selected by the Government. For promoting rice production, intensive aids were offered to these areas, e.g. introduction of new varieties, increased fertilization, consolidation for the use of machinery, etc. under thoroughgoing guidance, so as to identify the probabilities of production increase in the existing arable lands, and to disseminate the obtained results widely. It seems that encouraging results are being obtained. Eight special experimental areas will be established additionally in fiscal 1968 - 69, and experiments will be continued on a nation-wide scale in these 10 areas. The results of experiments in the Elahera area will be commented later.

(3) General difficulties

There are a great number of difficulties facing the rice production increase program, though most of them are the factors involved inevitably in the economic development of developing countries in general. These factors include the farmers' intellectual and technical level, their enthusiasm and capability for investment, social environment and so forth. However, when the problem is limited to the impeding rice production increase, the factors which call for our attention are as follows:

i) Instability of water supply

Although a comment has already been made partially on this problem, it must be noted in this connection that, in cultivating rice in Ceylon, 2 or even 3 crops a year are possible from the point of view of the temperature. Nevertheless, the rate of total area planted to rice is only 130% of the area of paddy fields in the country. In other words, the land where double cropping is carried on occupies only 30% of the total paddy field.

The factors contributing to this in the wet zone is the excessive water during the Maha Season which renders planting of rice difficult because of the high water level, and in the dry zone is the water shortage during the Yalá Season which also makes the planting difficult. The factor common to both zones is the in sufficiency of water control facilities whereby extraordinary heavy rainfall and the lack of water in the drought season could be levelled. Accordingly, the Government is placing a particular emphasis on water control projects for alleviating the shortage of water in the dry zone, and expects much from the water transmission from the wet zone under the Mahaweli Ganga Project, on which comment will be made later. This is only natural, because the area of land under management of one household in the dry zone is 4 to 5 times that in the wet zone, and the dry zone still have vast wild lands permitting reclamation. However, a problem is generally involved in such an large-scale water control project that the project cannot be concluded to be complete only with the major water channels. Full effects cannot be expected if farmers lack in enthusiasm and financial capability for the building up of terminal water control facilities. Careful attention must be paid to this issure.

On the other hand, the problem to be solved in the wet zone is the regulation of excessively deep water deposit due to the frequent rainfall during

the Yala Season by means of drainage. Most of the paddy fields have levees simply for depositing water, and there are almost nothing which can be called drainage facilities. Naturally there are no access roads. Simple square tray-shaped paddy fields are lying lose together. The fundamental problem here is also the water control which is not limited to the Yala Season frequented by heavy rainfall.

ii) Seasonal shortage of labor

Labor is in surplus as a general trend in developing countries, where some people even feign to be jobless or underemployed and others are reluctant to work energetically. From the point of view of available water in both the wet and dry zones, there are areas where single cropping is in practice despite the possibility of double cropping. Such area was found everywhere during our survey. This is because soil preparation for the second crop, including such works as tilling and paddling, must be carried out immediately after the harvest of the first crop, under the condition that the seasonal labor cannot meet the concentrated demand. Average annual working days in the dry zone are 150, and farmers say that they have to work for 12 to 14 hours a day during the busiest farming season. As long as they continue to work in the traditional way of low efficiency and follow the long established working schedule during the busy season, shortage in labor force is a natural consequence. According to the explanation of the officials of the Ministry of Agriculture and Food daily capacity of work of 1 unit consisting of 1 man and 2 buffaloes is 1/2 acre, and the cost of labor per acre is 30 rupees. (Daily charge for a buffalo is 5 rupees, and daily wage of a laborer is also 5 rupees.) Since the soil preparation work is carried out 2 times as a rule, the cost of cultivation per acre comes up to 60 rupees. For assisting the cultivation work, the Government got 225 large tractors of 35 HP-class, most of which had been donated by the government of Australia, and undertook the work at a charge. There are also about 4,000 tractors mostly owned by rich farmers. Cultivation by these tractors are also charged. Each tractor is capable of cultivating 3 acres per day. The amount of charge is similar to that for buffaloes. The area cultivated by these large-type tractors, according to national average, is 45% of the total area of paddy fields, and this rate goes up higher in the dry zone. However, the practice of double cropping is restricted by the shortage of these tractors. This is a problem to be

solved hereafter.

Further, we were told that the demand is concentrated on the 5 - 10 HP - class cultivators because they demonstrate high mechanical capacity, and the price of about 5,000 rupees is also moderate. Two-wheeled cultivators made in Japan are popular among the farmers because their tilling capacity is greater than the British-made "Landmasters". However, the farmers do not have adequate capital fund, and the Government of Ceylon has no definite plan for increasing its own tractors. Also it is not planned to have the cooperatives possess and control the tractors. Therefore, solution of this problem seems to be difficult.

iii) Rice cropping hardly remunerative

Generally speaking, the price of rice is half of that in Japan, whereas the price of imported fertilizers and machinery is naturally higher than the price in Japan. Moreover, response to fertilization of rice plant is weaker than in Japan. At the experimental farms, the yield per acre is 150 bushels, for which about 60 kg of ammonium sulphate is being consumed. The volume of fertilizer per yield is about 3 times that in Japan. From the theoretical point of view of economics, however, production of rice, in this country, under the present international competition is possible even under such unfavorable circumstances, because the land rent is low, and the wages are particularly low, although exact computation of the limit of this possibility is not easily made at present. From the results of tests and experiments, a yield of 100 - 120 bushels per acre is quite possible. However, it is indisputable that the present average yield of 40 bushels per acre cannot be boosted to such a high mark at a leap.

iv) Limits from technical and financial conditions

In adopting new techniques, farmers must possess some technical knowledge beforehand. In reference to the rate of literacy of farmers, Mr. NAKAMURA, a researcher of the Institute of Asia Economic Affairs of Japan, quotes an example in an agricultural village located 70 miles south of Colombo, and declares that those who can write their own names are about 10% of the total village population. In regard to the agricultural education in Ceylon, we were told that, in addition to the Agricultural Faculty of the National Ceylon University, there are only 1 junior agricultural college and 2 agricultural schools in all, although each State-operated local farm has a "practical farm" where extension agents are trained.

Each village has at least one extension worker. Therefore, unless it is carried out through these instructors, dissemination or delivery of agricultural knowledge by letters is restricted largely. In making investments in agriculture, farmers must be able to disburse the required capital. However, ordinary owner-farmers have no such financial capabilities ( Their average annual income may be somewhere between 1,000 and 1,500 rupees.), and needless to say, tenant farmers have far less capabilities. The term of loans through agricultural cooperatives is 3 years at the longest, and most are short-term loans. This is because the cooperatives have not a large capital sufficient for lending out long-term loans.

According to the explanation of researcher NAKAMURA mentioned above, a high rate of eating rice meal is held by rich farmers in each village. Those who eat rice meal 3 times daily are 60%, 2 times daily are 20%, and once daily are also 20% respectively of all farmers. The rate of spreading of radio receivers is 10%. (Needless to say, batteries are used for the radio power source, because they are not enjoying the benefits of electric lights.) According to a survey conducted for about 400 farmers, not a single farmer was found to be the regular newspaper subscriber. A survey report says that the farmers have some money savings at home or at post offices, but also have some debts. More than 30% of the village population are the indebted farmers, and the average amount of such debts per family is a little over 200 rupees. According to the breakdown of principal creditors, 35% are agricultural cooperatives, 1.2% are commercial banks, 15.9% are money-lenders 21.5% are agricultural brokers, and 28.4% are the relatives. (Government of Ceylon, Agrarian Problems and Reform Measures, 1968. Unpublished.) For achieving increased production and development, rice farming must be placed on a paying basis first of all, by introducing techniques. Knowledge, techniques and financial capabilities for investment are indispensably required for this purpose. Regrettably, however, it can be concluded that all of these three requirements are generally in serious shortage under the present circumstances.

## 2. POSSIBILITIES OF DEVELOPMENT

Although there are many adverse situations as mentioned above, there are also certain possibility of development, as are seen in respective cases. The examples can be seen clearly in the establishment and achievements of the special experimental areas commented above. The reference data adopted for this chapter are mainly from the Elahera Special Project Office, Progress up to 31 December 1967 and the Faculty of Agriculture, University of Ceylon in collaboration with the Department of Agriculture, Ministry of Agriculture and Food, Socioeconomic Survey of the Elahera Colonization Project, 1968.

i) Outline of the special experimental area plan

When the Elahera Special Project area was opened as a plantation about 20 years ago, the land allocated to each farmhousehold was 5 acres of paddy field and 3 acres of upland field. The present total area of land in the project area is 5,535 acres of paddy field and 2,709 acres of upland field. There are now a total of 903 farm households, and a total of 66 officials specially dispatched from the Ministry of Agriculture and Food, including the technicians and instructors totaling 9, and extension agents and development leaders totaling 57. These officals are in charge of intensive guidance and promotion of the project. In the area there are 17 cultivation committees resembling the agricultural committees in Japan, and 8 multipurpose cooperatives similar to those in Japan.

ii) Application of new techniques and new production factors.

The experiments were made on the rice cropping during the Maha Season in fiscal 1967 - 68, and the primary purpose is to compare the achieved results with the past records.

(a) Ploughing

| | |
|---|---|
| By Dept. of Agriculture | 1,287 acres |
| By Private tractors | 500 " |
| By buffaloes with local and light iron ploughs | 3,476 " |
| Uncultivated | 272 " |
| Total | 5,535 acres |

(b) Sales of certified sead paddy

| | Maha 66-67 (bushel) | Maha 67-68 (bushel) |
|---|---|---|
| Through cooperatives | 1,866 | 5,090 |
| For Private seed Farms | 120 | 250 |
| Through agricultural extension centers | -- | 66 |
| Others | -- | 200 |
| Total | 1,986 | 5,606 |

Thus, the distribution of seed paddy increased 3 times in 1 year.

(c) Sales of fertilizers (unit: 100 pounds)(up to end of 1967)

| | Urea | Ammonium sulphate | Phosphate | Potash | Total |
|---|---|---|---|---|---|
| 66-67 Maha | -- | 780 | 257 | 156 | 1,193 |
| 67-68 Maha | 222 | 5,203 | 2,735 | 1,363 | 9,523 |

All of them were sold through cooperatives. Seed disinfection started for the first time in 1967 - 68 Maha Season, and 242 farmhouseholds about 25% participated.

(d) Types of planting method (unit: acre) (up to end of 1967)

| | Row seeding | Row transplanting | Ordinary planting | Broadcast sawing | Uncultivated | Total |
|---|---|---|---|---|---|---|
| 66-67 Maha | 15 | 95 | 1,442 | 3,863 | 120 | 5,535 |
| 67-68 Maha | 29 | 552 | 2,317 | 2,365 | 272 | 5,535 |

(e) Rate of H4 seeding (unit: acre) (up to end of 1967)

| | H4 variety | Other variety | Uncultivated | Total |
|---|---|---|---|---|
| 66-67 Maha | 3,339 | 2,076 | 120 | 5,535 |
| 67-68 Maha | 4,714 | 549 | 272 | 5,535 |

The rate of H4 variety thus increased from about 60% in 1966-67 to 85% in 1967-68 of the total area.

(f) Weed control (unit: acre) (up to end of 1967)

| | Japanese weeder | Agro-chemicals | Hand weeding | Not weeded | Others | Uncultivated | Total |
|---|---|---|---|---|---|---|---|
| 66-67 Maha | 110 | 83 | 1,901 | 3,321 | -- | 120 | 5,535 |
| 67-68 Maha | 543 | 138 | 3,307 | -- | 1,275 | 272 | 5,535 |

This record roughly shows that the rate of land under weed control increased from 42% to 72%.

(g) Sales of agricultural machines (up to end of 1967)

| | Seeders | Weeders | Sprayers | Dusters | Power dusters |
|---|---|---|---|---|---|
| Stock up to 67-68 Maha | 51 | 61 | 20 | 11 | 1 |
| Sales in 67-68 Maha | 5 | 35 | -- | -- | 9 |

(h) Agricultural loans

| Items | 66-67 Maha Debtors | 66-67 Maha Amount (Rs) | 67-68 Maha Debtors | 67-68 Maha Amount (Rs) |
|---|---|---|---|---|
| Plonghing | 500 | 95,920 | 867 | 198,646 |
| Seed paddy | 314 | 20,861 | 742 | 91,952 |
| Fertilizers | 258 | 15,791 | 863 | 167,257 |
| Transplanting | 487 | 53,580 | 866 | 83,144 |
| Weeding | 487 | 51,740 | 859 | 85,119 |
| Harvest | 282 | 33,755 | 862 | 89,368 |
| Total | | 271,647 | | 715,127 |

iii) Effect of production increase programme

The foregoing data are mostly the results of progress up to the end of 1967 announced by the Elahera Special Project Office. It is to be noted that through this record a fact is clearly seen in comparison with the preceding year that new techniques and new production systems are being adopted with remarkable enthusiasm. Of course actual achievements cannot be confirmed only through these data. However, the report of the joint survey carried out by the University of Ceylon and the Ministry of Agriculture and Food says as follows:

"During Maha 67/68, 83% of the farmers used fertilizer. But only 62% of the total paddy acreage received fertilizer treatment. More-over only 2.5 cwt. were applied per acre per farm using fertilizer which is only about 70% of the rate of 3.5 cwt. per acre recommended by the Govenment. If the farmer were to apply the recommended rate on all his allotted low-land in paddy, he would require nearly twice the amount he used this season. ..... There are reliable findings from the Ceylon. Fertilizer Project

that a rate twice as high as the one currently recommended has consistently prove much more profitables from an economic point of view". (p. 17)
At the same time, pointing out that there is fear of wasteful use of fertilizers in the Yala Season as a result of the insufficient supply of water, the joint survey report further emphasizes the need for stabilization of water supply as follows:
"The average yield in Yala 67 was only half that in Maha 66/67, mainly due to water shortage. Under such conditions, much fertilizer may be wasted." (p. 19)
"The increase in paddy production that can be expected from the recommended fertilizer rate is about 20 bus. per acre, and from double that rate it is 30 bus. over nonfertilized paddy, under prevailling field conditions and adequate water supply. Using Maha 66/67 as a base when very little fertilizer was used and the average yield was 42 bushels per acre, the recommended fertilizer rate applied to the whole paddy acreage would increase the Maha paddy production from 228,000 bus. to 337,000 bus. and the double rate to 392,000 bus. for the project area as a whole, that is by 48 and 72 percent respectively. This increase would be attributable to fertilizer applied to an improved variety. Since certified seed of H-4 has increased greatly each year these fertilizer rates combined with improved varieties and other modern practies can be expected to produce even greater yield responses". (p. 19)

When we visited the project area, the authorities of the Project Office definitely told us. "The volume of fertilizers used per acre has increased from 20 pounds to 200 pounds, and the rice yield has increased from 48 bushels to 90 bushels. These are the effects achieved."

iv) General trend of production increase

The foregoing is a study on the possibility of production increase through participation of the Administration in a specially selected experimental area. This possibility is to be affirmed on the ground that, it will be supported by the price mechanism which makes the production increase be achieved eventually as a natural economic process. Although there are a number of obstacles as commented above, in such phases as techniques, knowledge and capital, we believe that the projected production increase in Ceylon will be accomplished, if rational price relations are provided, with the given technical conditions as a requisite. In reference to this

point, the Annual Report for 1967 of the Bank of Ceylon says that the rise in rice price as a result of the opening of free markets following the reduction in rice ration served as a great stimulation to the increase of production of rice in 1967, and points out as follows:

"Paddy production increased in 1967 reaching a record level of 55.1 million bushels compared to 45.7 million bushels in 1966. ..... It is noteworthy that the output in 1967 was 1.7 million bushels over the target set out in the agricultural development proposals of the Ministry of Agriculture and Food. The average yield per acre in Maha 1966/67 was 40.85 bushels compared to 35.91 bushels in Maha 1965/66. The figures for Yala were 42.33 bushels in 1967 and 35.04 bushels in 1966. These figures constitute an all-time record in paddy production in Ceylon. The increase in production in 1967 is attributable to the higher open market price, higher intake of fertilizer, increased use of high quality seed paddy, availability of more storage facilities at the district, divisional and village levels, and vigorous propaganda work by the Government. The open market price of paddy in 1967 increased following the reduction of rationed rice from 2 measures to 1 measure in December, 1966. The guaranteed price was itself increased from Rs 12 to Rs. 14 per bushel in November, 1967". (p.34) Even under such circumstances, the rate of Government purchase of rice to total sales by farmers is decreasing, as already commented. In other words, the rice production increase is being stimulated by the function of price and market system.

## 3. POSSIBILITIES OF COOPERATION

Under such circumstances surrounding rice production in Ceylon at present, in what phases can we offer cooperation?

i) Cooperation in devising and spreading new techniques

Devising and application of new techniques in wide range is a prerequisite of rice production increase. Regarding the improvement of rice varieties, H4 and H8 have already been created, and the spreading of IR18, as a Government-designated variety, is also progressing. For providing cooperation in the field of research, dispatching of technicians under the Colombo Plan and dispatching of researchers of the Institute of Tropical Agriculture of Japanese Ministry of Agriculture and Forestry are being continued steadily. Of course, expansion of cooperation in this field may

be possible. However, it must be noted in this connection that new rice varieties showing big fertilizer response have already been obtained. Therefore, all of those technicians and researchers sent to Ceylon from Japan unanimously emphasized that the increase of yield per acre from the present 40 bushels to 80 bushels is not a hard task, if only the conditions for water control, price of fertilizers, price of unhulled rice, and land tennure system are fulfilled. Accordingly, we entertained a deep concern about the Special Project mentioned above. In achieving water control system, Elahera is endowed with comparatively favorable conditions in the dry zone, putting aside the problem in the Yala Season. As long as the measures mentioned above are enforced in such a favorably situated experimental area, fairly satisfactory achievements can naturally be expected. Necessary conditions for accomplishing the project are the dispatching and stationing of technicians and instructors to take charge of the spot guidance and control, the smooth supply of production materials including fertilizers and so forth.

As for land tenure system, a legal regulation stipulating the reduction of the tenant rent to a 25% level is already enforced. However, this legal control over the tenant rent appeares effectless according to what we heard or witnessed during the spot survey. This might be a natural consequence, because the majority of the landowners were petty owner-farmers or landlord-farmers, and there were no big landlords worthy of name. Accordingly, in case a small experimental area patterned after Elahara is to be established hereafter, a careful attention must be paid in dealing with this problem. This is because any attempts by outsiders to interfere in the problem of reforming the traditional rights and power relations in a local society must be avoided strictly.

ii) Cooperation for a mechanization center

In adopting agricultural machinery, high utility is shown by cultivators, but utilization of threshing, hulling and polishing machines is lagging far behind. It strongly appears that the pattern and progress of agricultural mechanization have been largely influenced by the granting of some cultivators (tractor-type) from Australia. Speaking conversely, this means that rice culture in Ceylon had no direct relations with the mechanization techniques in the similar rice producing countries in Asia. As a result, antiquated methods are still in practise as witnessed by us during the survey, such as threshing by treading of the buffalo, or winnowing in the wind.

Export from Japan of small-sized cultivators is under way competitively by 6 Japanese trading companies. What have been exported from Japan worth mentioning are the textile machinery alone. Thus, from the point of view of technical cooperation, introduction and extension of agricultural machinery still remains a subject to be studied hereafter.

In this connection, the author would like to report here about the wishes for Japan's cooperation expressed by Mr. D.V. PERARA, Director of Agriculture, Ministry of Agriculture and Food, at a private interview with the author, concerning the agricultural mechanization in Ceylon.

He said he would deeply appreciate if Ceylon could obtain Japan's cooperation for the establishment of the Agricultural Machinery Design and Testing Unit. According to his explanation, the reasons are as follows: Ceylon is introducing agricultural machinery from various countries. However, their types and capacities occasionally do not meet the climatic and soil conditions of Ceylon. Ceylon wants to improve them to make them suitable for the Ceylonese use, and at the same time promote the mechanization efficiently. Accordingly, Ceylon wishes to obtain Japan's cooperation in two points specifically. Point 1 is that Ceylon wants to get all the testing unit, and point 2 is the dispatching of required specialists from Japan and sending of technical trainees from Ceylon to undergo necessary trainings in Japan.

By this unit the mechanization center will carry out.

a) Test and design of agricultural machinery
b) Trainings in the test and design techniques, and
c) Training in operation of tractors, as an additional course

Since such a mechanization center already exists in Mahaillupallama, the purpose may be to expand that center. Mr. PERARA added that, when the present Ceylonese prime minister visited Japan, he was deeply interested in a rice-transplanting machine witnessed at the Hiratsuka Experimental Station. Accordingly, he brought the machine to Ceylon and subjected it to tests at the center. However, the machine was found unserviceable, because longer seedlings of rice were in use in Ceylon. Mr. PERARA emphaiszed that Ceylon is eager to re-build them into serviceable machines for Ceylon and disseminate their use by all means. The author believes

that Japan must pay a serious attention to this problem and study it as an item of cooperation. The author wants to emphasize this particularly, because the necessity for mechanization is now greater than our estimates as commented above.

iii) Cooperation for rationalization of institutional systems

Mr. PERARA also expressed his wishes for obtaining advice and cooperation of Japanese specialists for rationalization of various systems, which are required for the following two points at present: Point 1 is the rationalization of the land tenure system. The implications in his statement may have been that he wants to listen to the opinions of Japanese specialists on how to amend the Paddy Lands Act, which is virtually ineffectual as commented above, and how to utilize the vast land owned by the state.

Point 2 is the betterment of the agricultural credit system centered on agricultural cooperatives. Under the present system, the fund is loaned out from the People's Bank to the agricultural cooperative at the rate of 4% per annum, and then it is loaned out from the agricultural cooperative to farmers for a term of 9 months at the interest rate of 12% per annum, and in case the farmers fulfill the repayment within the term, the rate is to be reduced to 9%. Smooth functioning of the system was thus expected. However, the rate of repayment within the term of loan, which was 85% in the past, dropped to 50% in the Maha Season of fiscal 1967-68, and the tendency of arrears is becoming worse yearly. The problem is how to settle such a deplorable situation. However, there are many factors hampering the solution. The farmers believe that, as long as they borrow from the Government fund, they would not be subjected to any severe disciplinary action even if they neglect the repayment. The Government purchase of rice through agricultural cooperatives is being curtailed yearly, and as a result, farmers are losing their mortgage capacity. Ceylon wants to find good examples of solution in Japan. The author received an impression that the first step of the solution must be the reformation of the setup of agricultural cooperatives which are at present engaging the one-sided business of lending.

# III SURVEY ON FARMERS' ATTITUDES IN THREE VILLAGES IN CEYLON

By Shigeru Iijima

CONTENTS

Introduction

Selection of three villages as the proposed site for the survey was finalized after Agricultural Development Survey Team Members had consulted with their counterparts in Ceylon, who comprised experts in various fields. Needless to say, the selection of these three villages does not necessarily mean that they would be the ones to be covered when the Japanese Government extends its cooperation to Ceylon for agricultural development in the future. The survey in these villages was only aimed at obtaining the knowledge on the subjective conditions of farmers who play a major role in the development of agriculture to provide necessary data for drafting a future plan.

1. Survey Method

Survey forms were prepared in English while the writer was sitll in Japan and the contents of the form were translated into Sinhalese language by Mr. S. Melder, trade attache, Mr. Henry Perera and Mr. Barnard Peiris. The survey forms thus prepared were brought to Ceylon along with the team members and were used for the survey in the three villages.

In each of these villages, residents hired as survey members were given training of a short duration with the cooperation of Mr Noguchi and Mr. Ilangaratne. Two school teachers in village "A", three residents in village "H" and ten residents in village "K" were selected for this assignment.

In village "A", out of a total of 513 households, 200 were farms and from these 94 were picked up at random for the survey. In village "H", farmers numbered 103 out of a total 110 and all households were surveyed. In village "K", a total of 153 households were surveyed.

Upon completion of the survey forms they were collected at Colombo and tabulated with the cooperation of Mr. Ilangaratne, Mr. Wijeratne and Mr. Noguchi. Necessary calculations and analysis were made on these data by the writer after returning to Japan.

2. Outline of Farming Villages

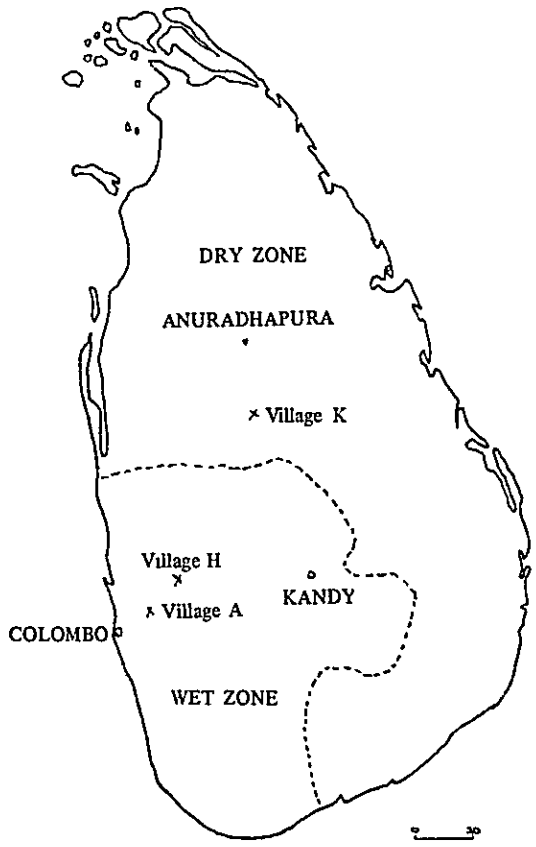
Areas covered by the survey were all inhabitated by Sinhalese people. Two villages were located in the Wet Zone and the remaining one in the Dry Zone.

Since part of the questionnaires covered private life of the villages, the

writer refrained from using real name of the villages in referring to them in compliance with the promise given the residents.

Village "A" is in the alluvial plain of the Wet Zone and is within the paddy field area surrounded by coconut trees. The village, being located approximately 16 miles northwest of Colombo, is within commuting distance by train. For this reason, it has a strong color of a suburban farm village.

Fig. 1 Location of villages surveyed in Ceylon



Village "H", like village "A", is a paddy farming village located in the Wet Zone in a gorge between low hills, surrounded by coconut trees. Situated in an area 42 miles northwest of Colombo, it is little influenced by the urban culture and is a typical farming village seen in the Wet Zone.

Village "K", unlike the other two villages, is a farming village in the Dry Zone. It is located in the area approximately 60 miles south of the Mahailparuma Agricultural Experimental Station. As is usual with villages in the Dry Zone, village "K" has a reservoir, though it is small in scale, and the water from the reservoir is used during the dry season while the rain water is used during the rainy season for agriculture centering on rice production.

## 3. Present Conditions of Farms

### (1) Category of farmers

As stated previously, in order to probe into the actual state of farmers who play a major role in the agricultural development project, they were classified into groups. Then, a study was made on the type of role that each group should play.

Table 1 Classification of farms by conditions

(Village A)

| | | | Subjective conditions | | | |
|---|---|---|---|---|---|---|
| | | | Strong | | Weak | |
| Objective Conditions | High | A | 8 (8.5%) | C2 | 17 (18%) | |
| | Medium | B | 0 ( 0%) | C3 | 2 ( 2.1%) | |
| | Low | C | 9 (9.17%) | C4 | 58 (61.7%) | |

Note: Method of classification by questionnaire survey is explained hereunder. (This survey was conducted in July 1968)

Classification of farmers was made in such a manner as follows:[1] "Strong" and "Weak" subjective conditions were determined by three conditions described

1) "Actual conditions of agriculture in hill areas and the measures for its development" 1968, published by Seminar for the Principles of Agriculture, Department of Agriculture and Forestry Economics, Faculty of Agriculture, Kyoto University.

hereinafter. Subjective conditions of farmers fulfilling all three conditions were designated as "Strong" and those lacking any of the three were designated as "Weak".

The three conditions are: (1) having in the family member a youth or male adult, who is engaged in agriculture; (2) possessing arable land of at least one acre of more[2)] and (3) expressing a positive will to participate in agricultural development.

Basis for the classification of objective conditions into "High", "Medium" and "Low" is as follows. "High" group includes the farms whose per capita cash income from agriculture is above the average desiring per capita cash income from agriculture in the village. "Medium" group includes farmers whose per capita cash income is lower than those of "High" group but is higher than the average. "Low" group farmers belong to a stratum whose cash income per capita from agriculture is lower than the average of the village. In this manner, farms may be classified into six categories: A, B, $C_1$, $C_2$, $C_3$, and $C_4$. Each category is considered to have the following characteristics.

A, B Stratum: Farms benefited by better subjective conditions and at the same time high per capita cash income from agriculture. These farms are expected to be the forerunner in agricultural development.

$C_1$ Stratum: Although per capita cash income from agriculture is low, farms in this stratum have sufficient subjective conditions. Accordingly, with the progress of amelioration of the basic conditions of

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2) Average yield is 40 bushels of unhulled rice per acre, (equivalent to production of approximately 25 bushels of polished rice per household). The average number of members in a farming household is 8.3. Yearly rice consumption per capita is 90 kg and the consumption of rice per family is 750 kg = 25 bushels. This shows that the minimum acreage of paddy field required for self-support in food is one acre. A census shows, on the other hand, that the average acreage of arable land owned by each of the 1,170,000 farm-households in Ceylon is 2.5 acres, which includes an average of one acre of paddy field. One third of the total farmers are petty farmers each having arable land less than one acre. Although the size of farming varies in the Dry Zone and Wet Zone, an area of one acre has been temporally decided as the basic index.

agriculture, these farms are considered to take the lead of selected farmers for directed change following those pioneer type farmers of "A" and "B" stratum in the agricultural development project.

$C_2$ & $C_3$ Strata: Although their per capita cash income from agriculture is higher than that of $C_1$ stratum, their subjective conditions are not favorable. However, if proper guidance and certain conditions are provided, it is expected that these farmers will play a role like the farmers of $C_1$ stratum.

$C_4$ Stratum: Farms in this category do not have either sufficient subjective conditions or objective conditions. It may be said that this stratum should come under social policy rather than agricultural development.

The results of classification of farmers in villages "A", "H" and "K" into above categories are shown in Table 1 mentioned previously and the following Tables 2 and 3.

Table 2 Classification of farmers by conditions

(Village H)

| | | | Subjective conditions | | | | |
|---|---|---|---|---|---|---|---|
| | | | Strong | | | Weak | |
| Objective Conditions | High | A | 2 | (1.9%) | $C_2$ | 19 | (18.5%) |
| | Medium | B | 2 | (1.9%) | $C_3$ | 19 | (18.5%) |
| | Low | C | 3 | (2.9%) | $C_4$ | 58 | (56.3%) |

Note : Same as the note for Table 1.

Here, making contrast to village "A", total number of farmers in "A" and "B" stratum, who can be expected to play a role of pioneer for agricultural development, accounts for only 8.5% of the total farms surveyed.

Table 3. Classification of farmers by conditions

(Village K)

| | | Subjective conditions | | | | | |
|---|---|---|---|---|---|---|---|
| | | Strong | | | Weak | | |
| Objective Conditions | High | A | 12 | (7.8%) | $C_2$ | 13 | (8.5%) |
| | Medium | B | 29 | (19%) | $C_3$ | 21 | (13.8%) |
| | Low | C | 52 | (34%) | $C_4$ | 26 | (17%) |

Note : Same as the note of Table 1

Moreover, aside from their attitude, positive or passive, farmers in $C_1$, $C_2$, and $C_3$ strata, who can assume part of the responsibility for agricultural development as selected farmers accounts for only 29.7% of the total number surveyed.

Against this number, farmers in $C_4$ stratum, who can not be considered to have direct contribution to agricultural development, accounts for as high as 61.7% of the total number surveyed.

As for the village "H", the number of pioneer-type farmers is extremely small and they account for only 3.8% of the total farmers, including both of those in "A" and "B" strata. However, the number of selected farmers, including $C_1$, $C_2$ and $C_3$ strata, accounts for as high as 39.9% of the total number surveyed. Therefore, the total number of farmers who are eligible for the bearer of the responsibility for agricultural development as the pioneer or the selected farmer accounts for as high as 43.7% of the total farmers surveyed. Their ratio is higher than the 38.2% for village "A". However, it should be noted that though the ratio of farmers in $C_4$ stratum falls short of the 61.7% in village "A", it still stands at 56.3%, surpassing the majority of the total number.

In village "K", on the other hand, the number of pioner type farmers in "A" and "B" strata accounts for as high as 26.8% of the total farmers surveyed and those in $C_1$, $C_2$ and $C_3$ strata, who can be expected to play their role as the selected farmers, accounts for the majority of 56.2%. This indicates that as high as 83% of the total number of farmers can be the bearer of the responsibility for agricultural development. Moreover, the ratio of farmers in $C_4$ stratum is considerably low compared with village "A" and village "H" and it accounts for 17% of total farmers surveyed.

(2) Primary crops and most suited crops

A survey was made on primary crops in the village and the crops considered to be most suited for cultivation, which will play an important role in the progress of agriculture.

The result of the survey is as shown in Table 4.

Table 4. Primary crops and the most suited ones

| Crops | Number of farms cultivating and the percentages to total | | | | | |
|---|---|---|---|---|---|---|
| | Village "A" | | Village "H" | | Village "K" | |
| | Actual | Ideal | Actual | Ideal | Actual | Ideal |
| Paddy rice | 84 (41.4%) | 87 (29.4%) | 38 (48.1%) | 7 (6.9%) | 74 (85.1%) | 35 (19.8%) |
| Dry land rice | 0 | 0 | 0 | 0 | 13 (14.9%) | 72 (40.7%) |
| Coconut | 52 (25.6%) | 31 (10.5%) | 35 (44.3%) | 0 | 0 | 0 |
| Pineapple | 6 ( 3.0%) | 52 (17.6%) | 0 | 0 | 0 | 0 |
| Banana | 33 (16.3%) | 59 (19.9%) | 1 ( 1.3%) | 0 | 0 | 0 |
| Grains | 0 | 0 | 0 | 84 (83.5%) | 0 | 0 |
| Vegetable | 5 ( 2.5%) | 26 ( 8.8%) | 1 ( 1.3%) | 1 ( 0.9%) | 0 | 0 |
| Kurakkan | 0 | 0 | 0 | 0 | 0 | 33 (18.7%) |
| Others | 23 (11.2%) | 41 (13.8%) | 4 ( 5.0%) | 9 ( 8.7%) | 0 | 37 (20.8%) |

Note : Survey was made by questionnaires (conducted in July 1968)

In village "A", the number of farmers cultivating paddy rice for their primary crop totaled 41.4% of those answered the questionnairs, followed by those whose primary crops are coconuts accounting for 25.6% and those for bananas accounting for 16.3%. As to the crops considered most suited for cultivation, paddy rice accounted for 29.4% followed by coconuts accounting for 10.5% and bananas for 19.9%. It is worthy to note, however, that pineapple which accounted for only 3% as the primary crop accounted for as high as 17.6% as a crop most suited. As for village "A", primary crops are concentrated on two kinds, paddy rice accounting for 48.1% and coconuts for 44.3%. As to the crops most suited for cultivation, as high as 83.5% of the total farmers mentioned "grain" which probably refers to paddy rice.

In village "K", 85.1% of the farmers who answered the questionnaire mentioned paddy rice as their primary crop and 14.9% mentioned upland rice. As to the crops most suited for cultivation, it is interesting to note that 19.8% of the

farmers mentioned paddy rice and 40.7% of them mentioned upland rice, showing a wide difference in their ratio. Furthermore, 18.7% of the farmers, almost equal to the percentage for paddy rice, mentioned Kurakkan (beans for green manure) as the crop most suited for cultivation, though it was not mentioned as their primary crops.

From the study of villages "A", "H" and "K", it is evident that the primary crop in these villages is the paddy rice. In the Wet Zone, although paddy rice farming and coconut raising are mainstay of agriculture at present, in village "A", which has strong characteristics of a suburban town, bananas, present primary crops, and pineapples are expected as the most suited crop in the future.

Against this, in the case of village K in Dry Zone, center of agriculture is the cultivation of paddy rice and upland rice. As to the crops most suited, upland rice is drawing farmers attention. It is worthy of note that the Kurakkan is also being mentioned as the best suited to the village.

Table 5. Present Situation of Livestock and Poultry Farming.

| | Village "A" | | Village "H" | | Village "K" | |
|---|---|---|---|---|---|---|
| | No. of farms | Average No. of animals and birds raised per farm | No. of farms | Average No. of animals and birds raised per farm | No. of farms | Average No. of animals and birds raised per farm |
| Cattle | 24 (28.7%) | 3.2 | 23 (22.3%) | 1.57 | 11 ( 7.2%) | 3.5 |
| Water buffalo | 6 ( 7.2%) | 4.5 | 37 (35.9%) | 1.65 | 12 ( 7.8%) | 6.2 |
| Milck Cow | 32 (38.3%) | 1.5 | 4 ( 3.8%) | 1.5 | 16 (10.4%) | 3.2 |
| Goat | 0 ( 0%) | 0 | 0 ( 0%) | 0 | 2 ( 1.3%) | 2.5 |
| Chicken | 16 (19.6%) | 6.5 | 7 ( 6.9%) | 3.5 | 4 ( 2.6%) | 7.5 |

Note : Same as the note for Table 4.

(3) Livestock and poultry farming

Regarding livestock and poultry, they can not necessarily be a promising farm product since the Sinhalese as Hinayana Buddhists are strictly following the Buddhist precept forbidding destruction of animal life. In addition, because of some taboo on food, livestock farming is not considered to be of much expectation at present, except raising milch cows and egg laying chickens in the suburbs of the city, putting aside and water buffaloes, and as for draught. For reference, Table 5 shows "Present Livestock and Poultry Farming," and Table 6, "Livestock and Poultry best suited to the village.

Table 6 Optimum Number of Animals and Poultry Suited to the Villages

| Most suited livestock and poultry / Villages | Village "A" | Village "H" | Village "K" |
|---|---|---|---|
| Cattle | 48 | 1 | 22 |
| Water buffalo | 2 | 10 | 35 |
| Cow | 9 | 1 | 0 |
| Goat | 0 | 0 | 6 |
| Chicken | 27 | 4 | 19 |

Note : Same as the note for Table 4

(4) Attitude of Farmers Toward Agricultural Development

As indicated in Table 7, 30.9% of the farmers surveyed in village "A" expressed their intention of "positive participation" and 2.1% indicated their intention "to participate if others do the same". However, as high as 67% of the farmers did not answer the questionnaires.

In village "H", 40.8% of the surveyed farmers indicated "positive participation" and 57.2% expressed intention to "participate if others do the same". Those not answering the questionnaire accounted for only 1.9%.

In village "K", 90.5% of the surveyed farmers sought "positive participation" and 0.4% said that they would "participate if others do the same". Those not answering the questionnaire accounted for 9.1% of the total farmers surveyed.

Table 7. Attitude of Farmers Toward Agricultural Development

| Villages / Attitude of farmers | Village "A" | Village "H" | Village "K" |
|---|---|---|---|
| Positive participation | 29 (30.9%) | 42 (40.8%) | 138 (90.5%) |
| Participation depending on others | 2 ( 2.1%) | 59 (57.2%) | 1 ( 0.4%) |
| No intention to participate | 0 ( 0%) | 0 ( 0%) | 0 ( 0%) |
| No answer | 63 (67%) | 2 ( 1.9%) | 14 ( 9.1%) |

Note : Same as the note for Table 4.

(5) Problems expected to be encountered in agricultural development.

To the question posed to the farmers "what kind of problems are foreseen if agricultural development project is to be carried out in this village?", they answered as shown in Table 8.

Table 8. Problems Accompanying Agricultural Development

| Villages / Problems | Village "A" | Village "H" | Village "K" |
|---|---|---|---|
| | (Number of farmers who mentioned) | | |
| Lack of available funds | 3 ( 3.5%) | 32 (31.1%) | 32 (20.9%) |
| Lack of technique on the part of farmers | 0 ( 0%) | 0 ( 0%) | 0 ( 0%) |
| Lack of labor force | 0 ( 0%) | 0 ( 0%) | 0 ( 0%) |
| Inadequate marketing system | 0 ( 0%) | 0 ( 0%) | 0 ( 0%) |
| Unstable price of farm products | 1 ( 8.2%) | 0 ( 0%) | 0 ( 0%) |
| Unfavorable natural conditions | 0 ( 0%) | 0 ( 0%) | 0 (0%) |
| Insufficient preparations in land improvement | 26 (30.9%) | 8 ( 7.8%) | 106 (70.9%) |
| Shortage of arable land | 47 (55.9%) | 61 (59.2%) | 9 ( 5.8%) |
| Shortage of agricultural chemicals, fertilizers and seeds? | 0 ( 0%) | 2 ( 1.9%) | 0 ( 0%) |
| No answer | 7 ( 8.3%) | 0 ( 0%) | 6 ( 3.9%) |

Note : Same as the note for Table 4.

It is noted that in village "A" two items, "shortage of arable land" accounting for 55.9% and "insufficient land improvement accounting for 30.9% are shown as an overwhelming concern of the farmers.

In village "H" like village "A", farmers complaining of the "shortage of arable land" account for as high as 59.2% and those concerned over "funds available" accounts for 31.1%.

As for the village "K" in the Dry Zone, its aspect is different from those of villages "A" and "H" in the Wet Zone. That is, against the approximate 60% of farmers surveyed in villages "A" and "H", who complain of the shortage of arable land, only 5.8% of the surveyed farmers mention it in village "K". The problems

they pointed out are "poor land improvement" which accounts for 70.9% followed by "lack of fund available" accounting for 20.9%.

## 4. Closing Remarks

As stated above, the true picture of farmers in village "A", "H" and "K" has been dealt with and their conditions have been analysed. In conclusion, all the foregoings are summarized as follows.

In villages "A" and "H" in the Wet Zone the ratio of farmers in A and B strata, who are considered to meet the expectation to play the role of pioneers in agricultural development and that of farmers in $C_1$, $C_2$ and $C_3$ strata, who are the selected farmers following the pioneers, is not necessarily high compared with the ratio of farmers in village "K" in the Dry Zone. Even together, the number of pioneer farmers and the selected farmers, who will be the bearer of the responsibility for agricultural development, accounts for only 43.7% in village "H" and only 38.2% in village "A" respectively. Moreover, in both villages farmers whose positive role can hardly be expected in agricultural development, like those in $C_4$ stratum, accounts for as high as approximately 60% of the total farmers.

Against this, the number of pioneer farmers in village "K" in the Dry Sone accounts for 26.8% and that of selected farmers accounts for 56.2%. Thus, the number of farmers who may become the bearer of the responsibility for agricultural development accounts for as high as 83% of the total farmers.

In view of this fact, I can not but mention village "K" as the village having subjective conditions most appropriate for agricultural development programme among these three villages. Of course, the difficulties in the field of technique and agricultural administration are not discussed in this survey.

Also, as to the $C_4$ stratum, farmers in this stratum accounts for 17% of the surveyed farmers in village "K", the lowest of the three villages, followed by 56% in village "H" and as high as 61.7% in village "A". The fact that such a great number of agricultural population are not favored by either subjective conditions or objective conditions and have strong characteristics of the so-called agricultural laborer is peculiar to Southeast Asian countries as well as to Ceylon. This very fact, I am afraid, may make agricultural development project more difficult to accomplish. This is because the land reform of the type that was carried out in Japan "to let cultivators own their paddy field" does not necessarily

result in the benefit to agricultural laborers in this country.

However, forcing the agricultural development project without solving this problem will cause accelerated class differentiation of farmers into strata, one of which will be able to absorb the result of the project and the other will not be able to absorb the result. This, in its turn is feared to increase social instability in the area. It is hoped, therefore, that a full consideration is given to this point in drafting agricultural development project.

Finally, a study was made on a generally believed superstition that the farmers in the developing countries "lack the will toward production improvement". In our survey also, farmers were asked about their willingness to participate in the agricultural development project. Tabulation of their answers revealed that 33% of the farmers surveyed in village "A" in the suburbs of the city area, 90.5% in village "K" and as high as 98% in village "A" were hoping to participate in the project positively or passively. Thus, the zeal for production is latent among farmers. The point is how to find out and encourage the will of farmers and to materiarize and convert it into energy for agricultural development. This will be a question to be solved in the future.

# IV CHARACTERISTIC FEATURES OF IRRIGATION AND DRAINAGE IN CEYLON AND THEIR IMPROVEMENT

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CONTENTS

# INTRODUCTION

Small and medium sized irrigation and drainage schemes play on important role in achieving self sufficiency in food production in Ceylon. The characteristic feautures of these schemes, with special reference to model agricultural villages, and the relevant factors involved have been discussed in this report. It is obvious that minor schemes also have to play their part in the organic concert in conjunction with Mahaweli Project; which is the biggest project in Ceylon, planned for development of Mahaweli river.

## 1. Feautures of Irrigation and drainage

The fundamental techniques concerning irrigation and drainage are equally applicable to all the tropical and temperate regions. In practice, however, their form of application, and their relative importance in the entire plan will vary and be largely dependent on the soical and economic situations prevaling in the country, as also the feautures of climate and land. These situations are not independant of each other. For instance, climate has been an important factor in Ceylon, contributing in no small measure to its prosperity and thus shaping the economic and social conditions.

### 1-1 Climatic features

As is well known, the territory of Ceylon can be subdivided into two zones- the wet and dry. The former one fourth of the national land (where the yearly precipitation is over 75 inches or 1900 mm) and the rainy seasons are the 'Maha' or the northeast monsoon which lasts from November to March, and the 'Yala' or the southwest monsoon which lasts from May to September. The dry zone (where the yearly precipitation is below 75 inches) has only one rainy season which is 'Maha' lasting from November to March. Although the land is divided into the wet and dry zones in this manner, the dry zone is very much different from the so-called desert, from the point of view of the total precipitation. For example, the great desert of Syria has a region where the yearly precipitation is below 200 mm. What is important in Ceylon is the seasonal distribution of precipitation, because variations in the monthly precipitation have a great significance in the utilization of water. (See table 1.)

In Japan the greater part of the precipitation is concentrated in the rice-cultivating season. In the dry zone of Ceylon also the rainy season occurs in the Maha period, in which the precipitation is 25-55% of the yearly precipitation, and

rice cultivation becomes possible in almost the entire zone. However, dry spell visits during the Yala period when the precipitation is only 9-25% of the yearly precipitation.[1] Therefore, in land where rain-water rice cultivation has been carried out in the Maha period, cultivation in the Yala period becomes impossible. Moreover, since the cycle of rainfall is very irregular, not only floods but also dry spells occur frequently even during the rainy season.

Table 1. Monthly Precipitation in Wet and Dry Zones

| Zone | Location \ Month | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Yearly | Period |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wet | Colombo | inch | 396 | 260 | 4.66 | 907 | 1549 | 866 | 549 | 403 | 684 | 1371 | 1309 | 561 | 9321 | 30yrs. |
| | | mm | 88 | 96 | 118 | 260 | 353 | 212 | 140 | 124 | 153 | 354 | 324 | 175 | 2397 | 1931-60 |
| Dry | Anuradhapura | inch | 5.80 | 172 | 415 | 643 | 354 | 073 | 132 | 1.62 | 376 | 9.72 | 1067 | 752 | 5698 | 29yrs. |
| | | mm | 148 | 44 | 106 | 164 | 90 | 18 | 33 | 41 | 95 | 247 | 270 | 191 | 1450 | ditto |

Thus, the staple food-rice, is cultivated in both the wet and dry zones, and the area planted with rice in each zone is about $0.25 \times 10^6$ ha ($0.10 \times 10^6$ acres). Particularly, according to the records of increase in the area of land planted with rice in the recent 6 years, most of the annual mean increase of 14,400 ha (36,000 acres) was in the dry zone, and in the Maha period which falls under the rainy season. However this fact is not contradictory to the world-wide trend according to which irrigation has demonstrated its highest utility and importance in regions where even though precipitation is large, irrigation, is still needed.

It is a widely recognized fact that in improving the agricultural techniques in the wet and dry zones, the control of water is very important, provided that the atmospheric temperature and sunshine are adequate. Moreover, it is easily understandable that the nature of water control in the two zones differs.

In the Yala period, the dry zone on the lee is subject to dry strong winds. This fact cannot be overlooked in studying the wind erosion, surface evaporation and other influences exerted on land, especially the arable land.

1-2 Irrigation and drainage, with particular reference to the features of irrigation.

Because of the peculiar climatic features of Ceylon, rice cultivation in the wet zone was carried out by transporting water through a system of weirs and canals, chiefly utilizing the abundant river flow, establishing a form of the so-called river civilization. In the past, the rice cultivation in the dry zone was carried out with a great number of reservoirs (Tanks), which established a dome of the so-called reservoir civilization.

Such effective and stabilized supply of water and cooperation by drainage are the fundamental requirements for the increased production of paddy. Depending on the scope and the cost of project, the irrigation projects are classified by the Government of Ceylon into major projects and minor projects which are placed under the control of the Irrigation Bureau and the Agricultural Land Bureau respectively. Approximately, the total area of land planted to rice is $0.5 \times 10^6$ ha ($1.26 \times 10^6$ acres), [2] of which about 60% is covered by irrigation. The so-called irrigation ratio (irrigated area/ arable area) is 18%, and according to a rough breakdown, the major projects are estimated to cover 27% and the minor projects to cover 30% of the total rice cultivation area. [3] The irrigation ratio is almost equal to that in Thailand, larger than that in such Southeast Asian countries as Burma, the Philippines, Cambodia, India and Malaya, and is smaller than that in Indonesia. Many of the irrigation reservoirs numbering over 12,000. which were constructed by the Sinhalese kings are in disuse and abandoned at present, but these are being restored by the Irrigation Bureau. More than 137 reservoirs are now under the control of this Bureau. Irrigation involves the efforts of man to use the available water resources with the help of appropriate techniques for conveying and distributing the water. From this point of view, irrigation in Ceylon can be said to have a history of long standing. Although the ancient glory of the reservoir civilization has faded away, the instinct of the Ceylonese farmers to adopt irrigation is comparatively higher than that of the farmers of other Southeast Asian countries, where rice cultivation on the alluvial soil is being carried on merely with the support of natural rain-water or flood water and very few instances of artificial water control are seen. Accordingly, when the modern irrigation techniques, particularly the water controlling techniques in arable land, together with the fertilization and species techniques are introduced, the resultant improvements on efficiency of irrigation will be by no means small.

In the dry zone, the river water is being stored in large and small reservoirs, which are being interlinked by canals, and while carrying on irrigation by these canals, efforts are being made to limit and reduce the wastage of water in the distribution system. Divided water from a canal is led to a neighboring diversion dam so as to augment available water for downstream area, which is termed by farmers as cross leveling. These efforts by the Ceylonese farmers merit high evaluation. They are skilled in such microscopic water control where the role of regulating pondage is given to the reservoirs. These activities can be said to have certain similarity to the modern irrigation techniques.

However, the water control facilities at terminal in the arable areas are not yet satisfactory. There are many instances to show that reasonable utility of water in both irrigation and drainage facilities is not achieved fully. Considering that individual lots of paddy fields are small, the facilities concerning irrigation canals and drainage canals are defective. Since well-skilled, large-scale, water control is being planned, the farmers must pay more attention to small-scale water control at the end of canals i.e. in the field.

We would like to add some more words here to the comment made so far. It is reasonable that the microscopic water control must be accompanied by the improvement of the farming techniques, which is an indispensable requirement for successful infrastructure. In the regions where this infrastructure is improved to a certain extent, extention of farming techniques at the farmer's level can be carried out easily, and the fertilizer response is also high. From 1967 to the Maha period of 1968, the yield in the two districts of Elahera and Minneriya increased to two times the past average, and fertilization (the Ceylon standard is N $45^{lbs}$/ acre, $p_2 0_5$ 35, K 28.) in this case can be regarded to be the direct factor contributing to the increased production. It cannot also be overlooked that the irrigation and drainage facilities in these districts are conditioned far better than in the other districts. These two districts in the Maha period can obtain their water from the Amban River, a tributary of the Mahaweli River, and are therefore able to get a comparatively abundant volume of water through the existing irrigation facilities. The land here has a slope ranging from 1/300 to 1/2000, and the state of drainage is also good. Moreover, both districts are situated in the dry zone, and most of the inhabitant farmers are the owner-farmers. Therefore, to arouse their production any stimulation from outside in highly effective.

However, it must be noted that the districts possessing such favorable production conditions as these two are only limited in Ceylon. Any increased production plan depending on fertilization only has its own limitations. A plan will demonstrate the long-range fertilizer-bearing effects only when it is supported technically by the provision of adequate irrigation drainage facilities. This has been proved by the example of the two districts mentioned above. This fact is applicable to other Southeast Asian countries also. In Ceylon the conditions no doubt admit of improvement to the infrastructure of the paddy-field agriculture.

Irrigation in Ceylon is generally centered on the maintenance of water source and intake works (reservoir or tank, barrage or head work) as mentioned above, and the efforts made to date must be appreciated. Regrettably, however, the

irrigation facilities and methods, from the secondary canal down to the arable land, leave much to be desired. The farmers have no organization of their own, such as the irrigation control association.' Therefore, the merits of the water control are not demonstrated fully in the terminal phase.

The drainage facilities are as important as the terminal irrigation facilities. Particularly, increase in the production in the wet zone cannot be accomplished unless the drainage is improved. Accordingly, for the improvement of drainage in the wet zone, we would like to point out the following a) By improvement of the drainage, the unit volume of water for irrigation will naturally show an increase. Presumably, it will increase from the present value which is about 40-50 $^{acre}/$ cusec to about 30-40 $^{acre}/$ cusec. (From the point of view of the duty of water, this will be a decrease, and the area of irrigation by 1 cusec will be reduced.) Thus, the water source must be boosted for this end.

b). Attention also must be paid to the fact that there are many regions where topographically natural drainage (namely, gravity drainaged) is difficult.

These points will be further amplified later in paragraph 2-3.

The improvement of drainage is also no less important in the dry zone. Most of the means of water source are the tanks. About 3/4 of them perform the irrigation for one crop of rice in the Maha period only. The water drawn out of the tank is led through the primary canal to the secondary canal and is distributed by the continuous flow method to the paddy fields. Since the use of canal is primarily for irrigation, the function of drainage during the cultivation period is exceedingly unsatisfactory. In cases, where the irrigated area is part of a collective area, the water deposited in the lower part of paddy fields hampers the growth of rice plants. Riparian works also are not applied to natural streams which have to play the role of main drainage canals. The capacity of river is insufficient for carrying the yearly flood volume of water. Accordingly, many regions suffer from the inundation too often.

2. Technical Improvement for Irrigation and Drainage

Even in the November-March season when cultivation is carried out widely throughout the island of Ceylon, about 20% of the land which is in arable condition is not cultivated, and one of the principal reasons is the lack of irrigation and drainage facilities. In another season where precipitation is concentrated on the wet zone, this percentage is as high as 50%. In case the construction of these facilities is coupled with the techniques for fertilization and species, it will largely

contribute to the expansion of arable area and increase of yield. Both major and minor projects generally are recommendable for this purpose, but hereinafter a some concrete comments will be made on matters to be attended to, which are centered on the techniques concerning the irrigation and drainage in or close to arable land.

2-1 Collection and replenishment of basic data

Adoption of intensive agriculture, particularly for rice crop, in Ceylon in the near future is expected. Accordingly, for planning the irrigation and drainage covering the entire land, including the rationalization of water control, effective compilation of the following basic data is recommended.

2-1-a Regional survey on evapotranspiration and percolation.

From the point of view of rice cultivation, farm experiments have hitherto been carried out by Ceylonese specialists and the specialists despatched from Japan. The water of requirement for irrigation estimated by the Irrigation Bureau is 4 feet in the Maha period, and 6 feet in the Yala period. However, it is recommended to carry out a survey on the evapotranspiration in different regoins (at places in both the wet and dry zones where the conditions vary) and during different period, to compare the results with the conventional calculation formulas and ascertain their applicability, it is also neccessary to carry out a survey on the percolation under ponded water, particularly its relation with the soil property. The same can be said for crops other than rice, such as chillies and onion.

Another problem is the standard whereby the available rainfall is to be estimated, as it is one of the factors to be considered in determining the duty of irrigation water. Eventually, the duty of irrigation water is determined after studying all of these factors collectively. According to a research report given in FAO Mahaweli Ganga Project Survey Report (Irrigation),[4] the duty of water in regions vary even in the dry zone, as shown in Table 2.

Table 2. Volume of Irrigation Water By Regions (net water duty) acre-ft/acre

| Location, Season | Kalawewa | | Kaudulla | | Ulhitiya | |
|---|---|---|---|---|---|---|
| | Maha | Yala | Maha | Yala | Maha | Yala |
| Net Water duty | 2.03 | 3.33 | 2.06 | 4.02 | 1.70 | 3.72 |

In such regions in the dry zone where availability of irrigation water is not guarantee determination of the volume of irrigation water must be made as precisely as possible. Accordingly, further research on this problem is desirable.

2-1-b Survey on intake rate

In planning the irrigation for crops other than rice, the survey on the intake rate should be made separately for different soil categories.

2-1-c Control of surface evaporation

The yearly volume of surface evaporation in the dry zone is very large. In the dry season of May-September which is also the season when strong wind prevails, it is said that the daily evaporation reaches 0.3-0.4 inch, which is about 9-12 inches monthly, and is greater than the monthly precipitation in the dry zone shown in Table 1. However, since this value was obtained by a gauge, it may actually be smaller than the gauge value on the reservoir surface, but at the same time it is also evident that it still exceeds the precipitation figure. To control this evaporation is a problem which most of the countries in the world have to face. [5] Thus, it is of prime importance to carry out an actual experiment on this, chiefly in the dry zone. When the results of the experiment are adopted in the irrigation projects in future, it will contribute to the rational use of water.

2-1-d Water level-discharge curve of principal rivers

As many water gauges are installed at various points on the great river Mahaweli, the nature of variations in its discharge can be ascertained easily. We hope that the observation of water level and measurement of discharge also will be carried out periodically and continuously for other principal rivers also.

2-1-e Survey on situations of catchment area and runoff

With reference to the foregoing paragraph 2-1-d, and as one of the programmes under the United Nations 10-year Hydrological Survey, a long-range survey on various catchment areas and the situations of the runoff during the progress of development of rivers must be carried out, as it constitutes the fundamental basis of the planning for irrigation . However, considering the present capacities of the survey agencies, it may be difficult to extend the survey to all medium and small rivers in Ceylon. Accordingly, it is recommended to carry out a survey on such natural rivers which may serve as drainage channels, classify them into regions and then select a total of 10 medium and small rivers, and then study the

runoff data. This may be enough for the data required for the irrigation plan. In view of the present progress of the development in Ceylon, the data showing the 2-5year frequency floods is necessary, because it will prove to be of practical use for the 10 year plan.

## 2-2. Expansion of Farm Lot Size and Creation of Agricultural Roads

Although there may be inevitable reasons, the narrowness of each lot of the paddy field and insufficiency of agricultural roads seen everywhere in Ceylon are a major disadvantage from the point of view of water utility, introduction of agricultural machinery, and transportation of products. Although efforts are being made for leveling of surface in the existing paddy fields where direct sowing is adopted, many of the newly opened paddy fields have undulating surface. While considering the new agricultural system expected in the near future, creation of larger lots of paddy field than the present ones must be planned. At the same time it is strongly recommended to construct the agricultural roads in the areas served by irrigation and drainage canals.

## 2-3. Improvement of Supply and Drain Canals in Arable Land

When the supply canal is close to the arable land, regardless of whether the irrigation area is major or minor, there are many instances where it lacks proper facilities or its functions are not fulfilled. Also there are many instance where proper drainage facilities are required for the disposal of tail water of irrigation. As mentioned above, the continuous irrigation for one collective area consisting of several lots, is carried out at present. Although immediate adoption of elaborate water control system, where supply and drain routes for each lot are separated, is not necessary, a rational and complete junction must be established between the disposal of irrigation water at the terminal of the collective area and the irrigation water in the adjoining collective area located downstream. In other words, it takes a long time until water in the continuous irrigation reaches the terminal paddy field in the collective area, and it is often difficult for some paddy fields to get sufficient amount of water. It is also probable that the downstream-side paddy field or paddy field located in topographical depression suffer from water logging. An experimental proposal for improving the continuous irrigation from the secondary canal, which is at present seen in many areas, is shown in Fig. 1.

Fig-1 Field Irrigation & Drainage System

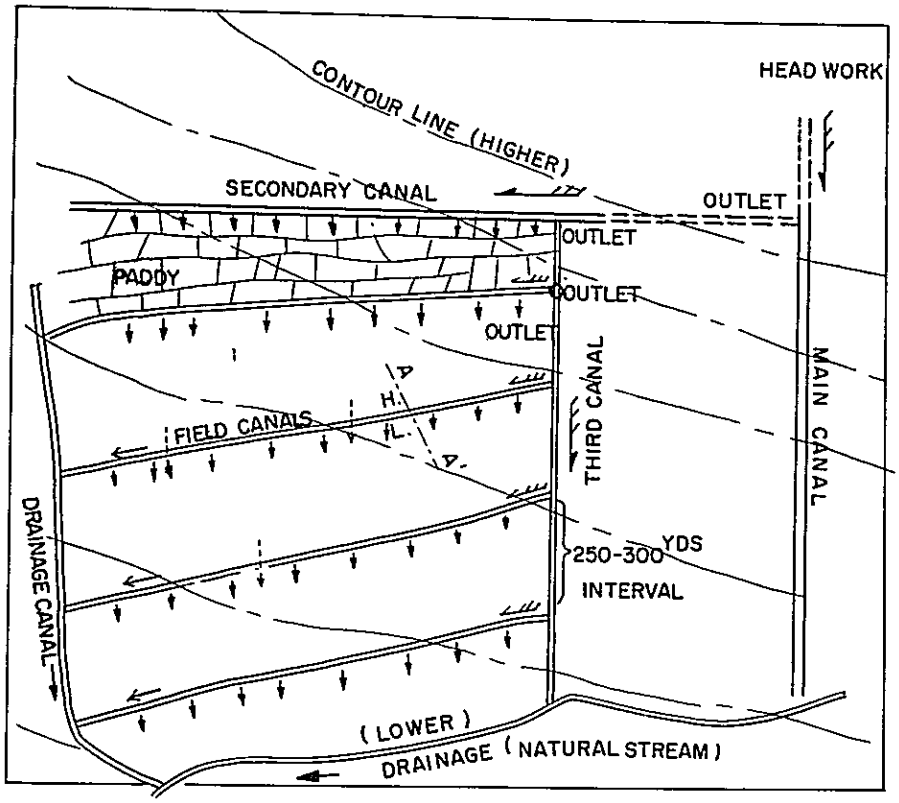
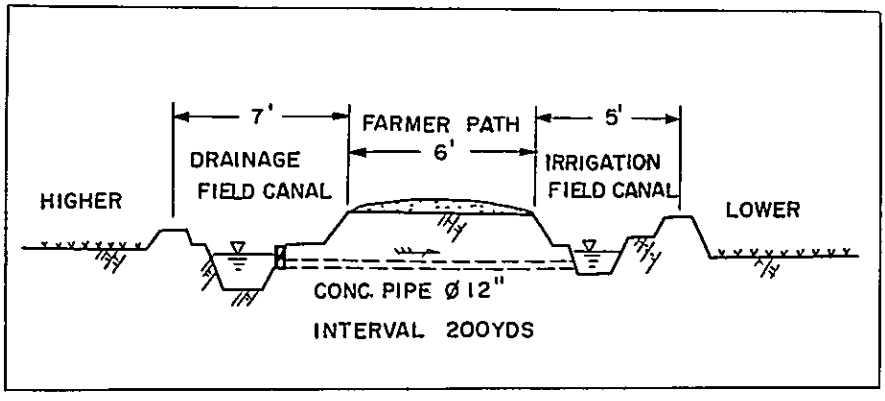



Fig-2 Improvement of Field System(A-A')



In Fig. 1, a third canal is taken off from the secondary canal, at approximately right angle to the contour line, and utilizing the excavated earth from the irrigation canal, a branch agricultural road is established parallel to the canal. Field canals are constructed along this third canal, at intervals of approximately 250 - 300 yards. Approximately parellel to the contour line, small irrigation and drainage canals with a slope of 1/400 - 1/600 as shown in Fig. 2 are established. For each one bloc of paddy lots, excepting the bloc near the uppermost stream section, continuous method of irrigation is used from the small irrigation and drainage canals. (Note: Depending upon the land slope, the water diversion is made for several lots collectively at certain intervals.) The tail water is intercepted into the small drain canal and sent away along the slope. In ordinary instances, this water reaches natural streams. During the irrigation period, however, depending upon the water supply capacity at that time, the water is led by the culvert pipes laid at intervals of about 200 yards along the small drain canal to the downstream-side small supply canals and is utilized repeatedly in successive block. A farmer path with a breadth of 6 feet as shown in Fig. 2 is also established to permit the passage of small-sized tractors and cultivators.

## 2-4. Harmonization between Regulation of Water Supply to Irrigation Canals and Farming Practices

In view of the conditions of atmospheric temperature, rice cultivation can be conducted at any time of the year, subject to the availability of water. Nevertheless, sowing, cultivating and harvesting works can be carried out simultaneously in one rice cultivation area under the charge of one irrigation canal. The demand for water results in the need for differentiation of time. In regulating the transported in the irrigation canal meant for a combination of paddy rice crop with other truck crops, a rational and flexible policy must be maintained in implementing the irrigation programme. Even when the irrigation is planned at the estimated duty of 40 - 50 acre/cusec, water transportation and distribution harmonized with the actual progress of agricultural works are desirable. Especially, this applies to the dry zone where water is invaluable. It is also important to keep flexible the scheduled variation in time for the water transportation.

## 2-5. Establishment of Water Measurement and Outlet Facilities

As in the case of electricity and waterworks, quantitative account is necessary for the rational and systematic use of water. It is desirable to measure the flow of not only rivers but also of canals, and to establish the facilities for dividing the expected discharge out of that flow. These facilities should be made as simple as possible (such as weirs and orifices) as long as they are strong and durable. When the water is to be obtained not only from the rivers but also from reservoirs or by pumping, the need for the water measurement and diversion facilities will become more pronounced.

The authors are aware that the Ceylonese authorities decided to levy a uniform charge of Rs. 5/per acre yearly for the use of irrigation water, but the implementation of this policy and money-collection are unsatisfactory. The authors expect that the farmers will come forward to voluntarily pay the price of water by volume some time in the future and carry out the intensive agriculture.

## 2-6. Elevation of Efficiency for Rotational or Intermittent Irrigation

The desirable sequence in the irrigation system in connection with the growth of the paddy rice, particularly in the irrigation for the dry zone where water saving is required, is the water ponded condition during the initial growth period, the curtailment of water during the fruitless tiller period, and the intermittent feeding in and after the young panicle formation period. This has been confirmed by experimental stations. It is said that the desirable intermittent irrigation during the head sprouting period in the dry zone is the feeding of 1.6 inch (4.0 cm) of water once in 3 or 4 days. However, it is no easy task to have the farmers carry out such a system faithfully. It may be a goal to be attained in the future. What is to be carried out in the immediate future is the rotational irrigation mentioned above. Needless to say, the present continuous irrigation system in the collective area in charge is not desirable, because it leads to the wash-away of fertilizer and loss of good soil. However, what can be done under the existing circumstances is the effort for accomplishing the reduction in size of the collective area in charge and the gradual increase of the number of outlets. The separate irrigation for each lot of paddy field is a hope which will become a reality in the future after the adoption of intensive agriculture.

In short, it is desirable to evaluate the matters concerning the water utility for rice cropping enumerated in paragraph 2-1, such as the water supply capacity

and the required volume in each zone and season, the relations with the rice productivity, and to study the technical scale required for achieving the economic effects of the irrigation plan.

## 2-7. Limits to Investment in Irrigation Facilities

The irrigation project naturally requires a large investment. In the recent five years, the Ceylonese Government invested about 38% of the agricultural development fund in the irrigation and land development. However, when compared with the amount of investment, the production was rather low. According to the estimation by the Government, the ratio of investment to production was only 12:1.

According to the FAO/IBRD joint survey this ratio is about 17:1. (This was the yearly mean from 1961/1962 to 1964/1965)[6] Needless to say, a major project needs more cost than a minor project, and the cost also differs according to the scope of the distribution or the extent of small irrigation and drainage canals, the consolidation of arable land including agricultural roads. Also the cost of a new construction project differs from that of an improvement project. Since the farmers are not yet fully skilled in the water control for irrigation and drainage, the emphasis should be placed on comparatively small projects or small improvements on existing facilities. The scope of the consolidation of arable land also should be limited to small improvements of the existing conditions, instead of a complete separation of the irrigation and drainage or a complete land readjustment. The level of the improvement should be raised gradually as the farmers' skill improves.

In short, priority must be given to projects which promise early results of the investment. It is also important to stimulate the farmers' potential capabilities.

The problem is with what size of investment the infrastructure needed for improving the present situations can be achieved. It may be difficult in Ceylon to apply the yardsticks of the projects now progressing in the paddy field regions in Japan. Assuming that the present production in Ceylon is to be increased to about 2 - 3 times, the required cost may be about 1000 - 1,500 Rs./acre.

It is said that a major project now progressing in Ceylon includes a region for which the investment exceeded 3,000 Rs./acre (450,000 yen/ha.), but the construction of the infrastructure is still incomplete and the water supply for arable land also is not yet under way. It is therefore important in drafting a plan to investigate such factors as the expected effects of the government funds, and the

amount of various charges to be shouldered by farmers after the improvement of the agricultural practices.

## 2-8. Survey on Existing Reservoirs and Boosting of Their Capacities

A great number of reservoirs built hundreds of years ago are still in existence today, though the exact history of many of them is not known. As a result of the weathering for so many years, the majority of them are unable to perform their functions fully at present, and their capacities also may have been reduced markedly. The embankment may have sunken, and the deposit of silt on the reservoir bed may be large. These charges can be expected to have occured, because the soil in the dry zone is mon-lateritic and therefore is easily subject to erosion.

VERMAT, Who has surveyed many of the reservoirs lying between Dambulla and Anuradhapura, reports that the thickness of the deposited silt layer in the reservoir site is 3 - 5 ft. or more.[7] In repairing the reservoirs, the Irrigation Bureau carried out the raising of embankment and spillway crest alone for boosting their capacities, and did not carry out the removal of the deposited silt (desilting). Since the present depth of water in the reservoir is 2 - 3 ft. to 5 - 6 ft., the water-containing capacity can be boosted largely by desilting. Presumably, the desilting will not cause leakage of water.

Surveying of the highest elevation of the paddy field, the height of intake pipe, spillway crest, the reservoir site, and the thickness of the silt deposit, and study of their relationships with each other, have a great significance. When this survey is carried out for a number of reservoirs, particularly those in the dry zone in the Maha period having small water depth, and their regional variations have been studied thereby, it will greatly contribute to the raising of the irrigation efficiency. It might also serve to throw further light on the character of the ancient reservoir civilization.

For the desilting of the so-called village tanks, employment of small-sized pump dredger is recommendable. A 7-inch diameter dredger equipped with a 150 HP diesel engine is capable of removing 30 to 40 cubic yards of silt per hour. If a delivery pipe of about 300 yards long is used, the paddy field can be dressed with the fertile soil dredged out of the reservoir, and it also can be utilized for raising the embankment. As a result of the exploitation for so many years, the paddy fields in the dry zone have lost their soil fertility. The fertilization by flood seen in the delta zones of the southeast Asia is not seen here. Accordingly, we expect much from this transportation of the fertile soil deposited in the reservoirs to the

paddy fields.

The dredger must be of a portable type of a low floored trailar, which can be transported easily. We believe that this is as effective system for restoring the vital power to the village tanks. As an experiment, it is recommended to introduce a set of such dredgers, and conduct a test on its operating method.

2-9. Land Reclamation and Prevention of Erosion

In creating arable land by clearing the jungles, the exposed ground surface is subject to severe influence of high temperature, high humidity and wind erosion, and serious leaching of the soil fertility takes place consequently. In conducting the reclamation of land in the dry zone, the felling of plants is carried out from April to May, the scorching from July to August, and the seeding in September, these operations must be linked with some cover crop introduction as early as possible, although experiments on this seem to be going on already. We expect satisfactory results due to the soil properties in the dry zone being easily subject to erosion. Accordingly, for the preservation of the moisture content in soil, planning for cover crop or mulching, establishment o the dry farming techniques, in parallel to the replenishment of the irrigation facilities, are desirable.

2-10. Construction of Windbreaks

As mentioned in foregoing paragraph 1-1, strong southwesterly dry winds prevail in the monsoon season, and particularly in the Yala period in the dry zone, and as a result, damage caused by wind erosion seems to be not small. Accordingly, in planning the introduction of upland crops in addition to the paddy rice, a windbreak construction plan is necessary.

During the May - Spetember period in the dry zone where southwesterly winds prevail, strong winds with velocity exceeding 50 miles per hour blow from the central mountain zone. The wind has very small humidity and aids evaporation of the precious moisture. To counteract these harmful effects, a windbreak extending from the southeast to the northwest consisting of a belt zone of standing trees with a width of about 100 yards is proposed.

2-11. Utilization of Small Pumps

As mentioned above, the Ceylonese traditional irrigation system is the gravity type under which the water source is the reservoirs in the dry zone and

the natural streams in the wet zone. In the beginning of 1966, the pumping irrigation system was adopted for the first time, and utilization of the underground water became possible. Although this system has such disadvantages as comparatively high cost of maintenance and short durability, it also has such advantages as small initial cost, short period of construction, and early realization of profits. Accordingly, adoption of this system for the cultivation of high market-priced crops such as chillies, onion, corn, sugar cane and cotton other than rice is desirable. Moreover, good results can be expected if it is used be supplement the irrigation capacity of the paddy rice in both the Maha and Yala periods by the existing reservoirs, and also used for the irrigation in the dry season of the paddy rice and other upland crops. The sprinkler irrigation system is also effective for the development of table lands with fairly undulating topography in cultivating the high market-priced crops. However, before applying this system by farmers themselves, they must organize a farmers cooperative and be fully trained in the management of agriculture by this system.

3. Training of Farmers in Agricultural Techniques (including irrigation and drainage)

When new techniques are introduced simultaneously with the old ones which have been derived from the experiences over several years, a new environment centered on the combined techniques must come into being, and all related factors must be placed under a new and rational equilibrium. In the meantime, the scope of friction to be brought about by super imposition of techniques will vary depending on the number, volume, and nature of the factors involved. For coping with such situations, the friction must be minimized, and a high productivity must be ensured, as early as possible. For this purpose, and also for easing the burden weighing upon the farmers, easy ways and means for familiarizing the farmers with the new techniques must be devised and carried out. In this connection, establishment of primary training centers at the farmers' level, which differ from the traditional concept of "schools", is desirable. High-level experimental and research institutes are already in existence in both the dry and wet zones. What is needed is the efforts to be made for associating the farmers with such institutes so as to establish the mechanism and facilities for disseminating the techniques among the farmers. In fact what is recommended here is the so-called "on the job training". The subjects of training must cover a wide range. As for the Japanese technicians who are to be deputed from Japan for technical assistance

programme, to work together with the farmers, medium-ranking technicians, including some low-ranking technicians if necessary, are preferable to high-ranking technicians.

4. Administrative Measures for Irrigation and Drainage

It is being emphasized at the International Conference for Irrigation and Drainage in recent years that the success in irrigated agriculture means a state where the farmers are able to carry out the water control freely and obtain the profits, and does not simply mean the completion of the dams and weirs. Needless to say, the Ceylonese Government is making efforts in this direction. As already commented, the Irrigation Bureau which belongs to the Ministry of Land, Irrigation and Power is executing the major projects, and on the other hand, the Agricultural Land Bureau which belongs to the Ministry of Food and Agriculture is also executing the major projects, and there seems to be no close liaison between the two. Moreover, the provision of the irrigation canals in major projects are limited to blocks of 100 acres, and completion of the subsidiary canals within the block is left entirely to the farmers' own capabilities. Furthermore, the water control facilities in the terminal arable land are not satisfactory. Thus, despite such a huge investment, the corresponding benefits are not being achieved. It may be no easy task to solve these problems. However, in the interests increased production of food, consistent administrative measures must be taken so as to enable the farmers to carry out the water control efficiently.

In the meantime, on the part of the farmers who receive the water at the terminal, establishment of some organization of their own, resembling those in the Land Improvement Districts in Japan, is desirable. In this case, larger, all-inclusive farmers' cooperatives are preferable to smaller land improvement associations. The Ceylonese villages stand on various levels of development at present. Accordingly, in providing guidance for them, a throughgoing research is necessary for determining the measures to be taken in individual cases.

## CONCLUSION

In this report the authors have commented on the irrigation and drainage techniques in both the dry and wet zones of Ceylon and the desirable improvement to be applied on them, and also environment under which the projects will be carried out in conformity to the wishes and enthusiasm of farmers. However, the recommendations cover a wide range and also involve a large variety of problems.

Accordingly, in studying a measure to be applied to a particular locality, the natural, social and economic conditions, as well as the existing level of technical development, naturally must be taken into consideration. Therefore, any of the recommended measures is subject to modifications in its significance and sequence, depending upon the local conditions.

(Appendix)

Kuda Galnewa Village in the dry zone is one of the several villages which have tentatively been selected as the villages requiring the introduction of techniques for increased food production. The estimated cost needed for the fundamental construction works for this village is shown in the following table, the village is 15 miles to Maha-illupallama where the agricultural experiment station is located, and has a small reservoir located only 1.5 miles from the Kalaoya River. The village is primarily engaged in rice cropping agriculture.

Estimated Cost of Infrastructure for Kuda Galnewa Village

| Classification | Quantity | Unit price | Total amount | Remarks |
|---|---|---|---|---|
| Dredging of reservoir bottom | 10,000 yds | 2.00 Rs. | 20,000 Rs. | Pump dredger |
| Excavation of the same | 10,000 | 2.50 | 25,000 | Bulldozer |
| Raising of embankment (5 ft) | 3,000 | 4.00 | 12,000 | the same as above |
| Improvement of intake | Allow | | 30,000 | Gate, pipe, earthwork |
| Small irrigation and drainage canal construction | 100 acres | 250 | 25,000 | Concrete, pipe, earthwork |
| Consolidation of farms | 100 | 120 | 12,000 | Bulldozer |
| Misccellaneous items | Allow | | 26,000 | |
| Total | | | 150,000 Rs | |

per acre: 150,000 Rs/100 acres = 1,500 Rs/acre

Expected benefits:

| | | |
|---|---|---|
| Maha period | 100 acre x 80 bushels x 14 Rs/bushel = | 112,000 Rs (paddy gross) |
| Yala period | 100 acre x 500 Rs/acre = | 50,000 Rs (crop gross) |
| | | 162,000 (Annual gross) |
| Net benefit | 162,000 x 0.7 = 113,400 Rs | |

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# V PADDY RICE CULTURE IN CEYLON

By Yoshitsugu Togari

# CONTENTS

## 1. PROGRESS OF PADDY RICE CULTURE IN CEYLON

Until 20 years ago, average yearly rice yield in Ceylon had been estimated at approximately 14 bu/ac which was said to be the lowest in the world. The figures were, however, not the result of scientific survey but were merely based on reports made by village headman. Test reaping conducted by a survey team led by Dr. Chandratne in 1949 showed the figure of 27 bu/ac. Since the Maha period in 1951 - 52, scientific survey of nationwide scale on paddy rice area and production has been carried on. Yearly average of rice yield revealed by these surveys since 1953 are 30.5, 30.0, 32.5, 29.5, 32.2, 34.5, 35.6, 36.5, 36.0, 37.9, 37.9, 38.8, 33.0, 35.5, 41.6 bu/ac respectively. It is clearly seen that rice yield in Ceylon gained constant figure of 40 bu/ac, exceeding the level of 35 bu/ac.

In the past, agricultural administration in Ceylon had put stress on the development of estate farming such as tea, rubber, coconut, etc., while rice farming had been left uncared for a long time. It is since the independence of the nationa in 1947 that much importance has been attached to rice farming from the viewpoint of food production to sustain the nation. During this other short period of 20 years, rice yield increased from 30 bu/ac to 40 bu/ac. This successful achievement well deserves praise. However, the average yield of 40 bu/ac which corresponds to one third of that in Japan offers plenty room for increased production, and if proper efforts be made, the level of 60 bu/ac might possibly be reached not in far distant future.

## 2. PRESENT PRODUCTIVITY AND MEASURES FOR ITS IMPROVEMENT

In any country, development of rice farming must be attained by raising the productivity through yield increase and labour saving. In Ceylon, from this viewpoint, following problems have been taken up for consideration:

A. Regarding acre-yield increase
   - (a) Irrigation in the dry zone
   - (b) Drainage in the wet zone
   - (c) Land reclamation and settlement the dry zone
   - (d) Increased application of chemical furtilizers.
   - (e) Rotation of paddy rice and vegetables.
   - (f) Plant breeding.
   - (g) Plant protection

B. Regarding labour saving
   - (a) Improvement of agricultural machines.

(b) Machanization

As the items (a), (b) and (c) in A will be covered by Dr. Fukuda and (e) by Dr. Eguchi, the author will express his views on the remaining items.

(1) Increased Application of Chemical Fertilizers

The following table shows the close relation between the recent increase in paddy rice yield in Ceylon and the quantity of fertilizers applied.

| Year | Fertilizers (t) applied | Production (1,000 bu) | Planted Acreage (ac) | Yield (bu/ac) |
|---|---|---|---|---|
| 1959 | 26,341 | 36,900 | 1,330,219 | 35.6 |
| 1960 | 20,173 | 43,000 | 1,468,406 | 36.5 |
| 1961 | 29,041 | 43,100 | 1,471,983 | 36.0 |
| 1962 | 38,075 | 48,000 | 1,535,932 | 37.9 |
| 1963 | 47,058 | 49,200 | 1,561,920 | 37.9 |
| 1964 | 60,096 | 50,500 | 1,585,198 | 38.8 |
| 1965 | 42,046 | 35,600 | 1,455,349 | 33.0 |
| 1966 | 40,485 | 45,700 | 1,512,312 | 35.5 |
| 1967 | 57,601 | 55,100 | 1,566,967 | 41.6 |

Note : Yield is calculated basing on the harvested acreage (85% of planted acreage).

It is clear from the table that fertilization contributed much to the yield increase. Total quantity of fertilizers currently applied for paddy rice is estimated to be approximately 70,000 tons which corresponds to about a quater of the average quantity of 3 cwts to a unit area which the Government recommends. Therefore, further efforts should be made to put the Government recommendation in practice as far as possible.

In Ceylon, application of fertilizer to paddy rice was advised for the first time about 20 years ago. The standard quantity of fertilizer which was then called the "chemist's fertilizer recommendation for rice" was as follows:

In principle, in the wet zone, 50 lbs of ammonium sulphate, 100 lbs of rock phosphate and 50 lbs of potassium chloride per acre should be applied immediately before the second inter tilling and additional 100 lbs of ammonium sulphate 30 days before heading, while in the dry zone, 70 lbs of ammonium sulphate, 80 lbs of superphosphate and 100 lbs of potassium chloride be applied immediately before

heading. In sandy soil or ill, drained area, ammonium sulphate should be substituted by urea.

Since 1957, however, under the guidance of the Chemical Section of the Agriculture Experiment Station and with the cooperation of extension officials, a number of different standards have been set forth basing on the results of fertilization tests in private farms and of experiments conducted by Agriculture Experiment Stations and Government Farms on the quantity of fertilizer and method of its application. These standards vary according not only to the condition of wet or dry zones but also to the specific characters of soil, climate, varieties of rice and methods of cultivation in various districts.

It goes without saying that the fertilizer standards currently recommended should be further improved on the basis of future experiments and experiences, and therefore, experiments for determing proper quantity of fertilizers to be applied and soil survey should be promoted further.

Due to the growing interest of rice farmers in the fertilization, total quantity of fertilizer applied has been increasing steadily, though there have been yearly differences. Regarding this, credit should be attributed to the proper policy of the Government, setting up and executing the Paddy Fertilizer Subsidy Scheme in which the Government grants subsidy, for the purpose of encouraging fertilization, through the Cooperative Agricultural Production and Sales Society, of the amount equaling to half of the value of fertilizer in case of cash-purchase and 40% in case of on-credit purchase.

Though the villages our survey team visited did not necessarily represent those of whole Ceylon, it may be conjectured that they have fairly good knowledge about fertilization, considering the fact that the villagers had, upon the team member's questions, promptly explained about the varieties and quantity of fertilizers and methods of application they had been using. This is a remarkable progress one could never imagine 10 years ago.

(2) Plant Breeding

The effect of fertilizer can be attained by creating varieties of rice which have such characteristics as larger response to fertilizer, higher productivity and stronger resistance to blight. Hitherto, it has been said that Indica type rice responds to fertilizer by excessive growth of stems and leaves and less production of seeds than in case of Japonica type. It is true Indica rice has such charactors in general, but among so many varieties of them there are a few which have ferti-

lizer response somewhat similar to that of Japonica rice. In order to increase the productivity by fertilization, desirable characteristics of Japonica rice must be given to Indica varieties through plant breeding.

Though the selection of high-yield varieties has been undertaken in Ceylon since 1920's, it was comparatively recent that full scaled rice breeding work to seek those responding well to fertilizer started. At present rice breeding is carried on by the Paddy Rice Breeding Experiment Station at Bathalagoda, under the supervision of the Central Research Institute at Peradenia, and with the cooperation of Bombuwela and other experimental farms. In 1958, they succeeded in breeding by artificial crossing, some new varieties of excellent quality such as H-4 and others. Among them, H-4 has several excellent characters including high fertilizer response, less shedding, strong resistance to blight and lodging, having plant type similar to Japonica varieties and powerful resistance to "Brozing" – a kind of physiological disease often found in low countries of the wet zone. By these favourable features, improved varieties headed by H-4 have made amazing success in covering 60% of whole paddy rice area in Ceylon, driving away the Murungkayan-302 variety which had been widely planted.

Quite recently, the IR-8 created by the IRRI in the Philippines was introduced to Ceylon, and on this variety, large scale experiments are under way by various experimental stations so as to solve at a stretch all the questions to be conjectured in practical cultivation, such as time of sowing, density of planting, quantity of fertilizers to be given, blight prevention measures, etc. The IR-8 is a powerful rival to the H-4. Excepting its weakness against leaf blight, it will be equal, or possibly superior, to the H-4 in high productivity and strong resistance to lodging. It is hoped, however, that the appearance of IR-8 will give a good impetus to rice breeding work in Ceylon and serve to promote them so that they will find excellent varieties of rice better suited to Ceylon than IR-8 or H-4.

Attention must be given especially to the fact that, with the extension of fertilized paddy rice area and increase in quantity of fertilizer per acre, the damage by blight and noxious insects will increase, and, therefore, resistance to blight should be stressed in breeding of rice. Blight will probably be rife in the wet zone and noxious insects in the dry zone. Further, as the fertilization inevitably brings with it increased lodging of plant, care must be given to prevent lodging.

It may be said a splendid success that, in such a short period of 10 years

after the successful breeding of H-4, the newly bred rice variety has come into such a high rate of diffusion as to occupy 60% of the whole paddy rice cultivated. Nearly all of the farmers we had visited told us that the variety they were planting were H-4 and praised the high productivity of this variety. H-7 was poor in resistance against lodging, but was good in quality. These farmers' remarks well endorse the wide and rapid diffusion of H-4 and also reveal the keen interest of formers in varieties of rice.

(3) Cultivation Method

The period of rice planting in Ceylon can be roughly divided, by two monsoons, into two periods of Maha and Yala. In Maha period, taking advantage of the north-east monsoon, rice is sown in July-November and harvested in February-May next year, while in Yala the south-west monsoon is utilized and sowing is done in February-June and harvest in July-October. Beside them, there is Meda crop which comes between the two rainy seasons. As the acreage of Meda crop is quite small, it is included in either Maha or Yala whichever is the nearer. The Maha crop prevails in whole island and the Yala crop is grown mainly in the wet zone which is affected by the south-west monsoon.

As explained above, in the rice culture in Ceylon, although there are periods to be named as the season, sowing and harvesting are done throughout the year, and, therefore, it is difficult to set forth any definite standard for rice cultivation method. Generally speaking, in Maha period which is comparatively abundant with irrigation water, medium or late varieties of rice taking more than 4 months for ripening are planted. Especially when and where water supply is insufficient, 3-month rice is cultivated. In the flood frequented districts, early sowing of late rice is made so that the plant grows tall enough before the flood-time and saves itself from being submerged under the water.

The proper time for sowing is, in the wet zone, to be the period when the sunshine is expected to be abundant after the heading of rice variety, while in the dry zone the period when water-shortage does not occur after the plant develops panicles. With the exception of the districts having adequate irrigation facilities, particularly in the so called rain-fed paddy districts, selection of proper sowing time is not an easy task.

Standard seed-rate is 2 - 3 bushels per acre. Considering the fairly high degree of impediments to germination, however, thin sowing is not necessarily

recommendable. But, in case the fertilizers are applied to the plant having high fertilizer response, increase of number of tillers will be a prerequisite, and, therefore, it is a matter of course that the sowing should be comparatively thinner than that in the past. At this juncture, attention must be paid to the problem of weed. It is considered that, in case of the Ceylonese rice which has inherited the characteristic of vigorous growth of Indica rice, weeds are suppressed by thick sowing. If sown thinly, it will permit the rampancy of weeds. Thus, the improved rice farming represented by the procedure of "selected variety fertilization-thin sowing" will, if measures to suppress the growth of weeds do not accompany, be difficult to attain sufficient results.

Next, a brief comment is to be made on the transplanting. Approximately 80% of paddy rice cultivation in Ceylon is done by broadcast sowing, 20% by line sowing or transplanting. In Kandy and its neighbouring district where cultivation techniques of farmers are said to be fairly advanced, transplanting is adopted in about 50 - 15% of whole paddy area. It is doubtless that the cultivation of a variety of many tillering type and high fertilizer-response with ample fertilization will result in increased yield. However, when a paddy field, on which old rice stabbles are standing 30 cm high above the ground and weeds growing profusely among them is tilled by manual hoeing or by the buffaloes tread back and forth, the soil of the paddy, excluding the surface layer of 1 - 2 cm thick, will develop strong reducing property, having the stubbles and weeds turned in. The young rice plant transplanted in such soil of strong reducing condition will have poor root-taking and less primary growing. To prevent these defects, it would be better to adopt broadcast sowing, utilizing the surface oxidised layer of 1 - 2 cm thick, so as to accelerate primary growth at sprouting.

Therefore, the transplanting method should be recommended only for the paddy which has good drainage and less reducing soil, to attain sufficient results. It can never be said that the method is suitable to every paddy field in Ceylon. After the Second World War, so called Japanese method of transplanting cultivation represented by the procedure of "superior variety checkrow planting-fertilization-weeding" was recommended as the high productivity paddy rice cultivation method. The fact that the said recommendation has not brought about the result as expected may be attributed to the lack of requisite conditions of soil.

As explained above, it is extremely difficult to set forth a standard for rice cultivation method in Ceylon where the rice planting is done all the year round

successively without proper conditions of water supply, prerequisite for paddy r rice. To seek the standard, there is no choice but to turn to the Agricultural Bureau's guiding principle which was prepared basing on the results of research works conducted by the Agricultural Experiment Stations and on the experience of expert extension advisors. It is a matter of course that the guiding principle of the Bureau is subject to modification by the future progress of research and experience. In that case, it is hoped that above mentioned points will be taken into account.

Under these conditions, the improvement of rice cultivation in Ceylon should be done by placing priority on fertilization and breeding. Other problems such as seeding time, seed-rate and transplanting may be tackled as the secondary problem. Traditional practices may be followed generally for the time being.

(4) Introduction of Agricultural Machines

As to the agricultural tools in Ceylon, there are hoes, village ploughs and wooden harrows, all of which being operated by human power or by the buffalo. In some cases, after the tilling is done by the buffalo, a man, supporting himself by a stick, mixes the soil and breaks clods to make the paddy surface even by his feet. As this is too inefficient, the Government is now preparing iron ploughs to supply farmers. In the wet zone, it is not a rare sight that farmers are making buffaloes tread in the paddy field for the purpose of tilling and puddling.

In any case, to do work with traditional tools is expremely ineffective and improvement of them is quite necessary. Especially in the dry zone where the population is smaller and the duration of rice planting period shorter, there exists keen shortage of labour, and, therefore, labour saving by mechanization is more urgent than in the wet zone. To cope with this situation, tractors are being introduced from U.K. and other countries. At present 4,000 tractors are available for operation, of which 250 are said to be owned by the Government. These large tractors are, irrespective of their owners such as the government, agricultural cooperatives or private farmers, hired out, if demanded, for tilling works. In the areas under the jurisdiction of a Local Agricultural Extension Office in Kandy District which has 2,000 farm households and 3,500 acres of paddy field, there were 22 Ferguson tractors introduced by private farmers. When the survey was made on one of the farmers who had a tractor of his own, he told the surveyor that the tractor was purchased 3 years before at the price of 16,000 Rps and was used for 8 acres of his paddy field and for hire-out at a rate of 35 Rps per acre. Due to the broken tires, however, he told, the machine could have done only 20 acres.

Generally speaking, in the present state, of defective roads and scattered paddy fields, the use of tractors are not effective. Though these tractors seemed to have not been used fully for tilling, their use for transportation was surprisingly extensive. A large number of tractors engaging in transportation were seen on the road between Anuradhapura, Puttalam and Colombo.

For most paddy fields in Ceylon today, excluding a few districts in which proper use of large tractor is possible, Hand tractor of 6-8 h.p. or a riding tractor of about 20 h.p. are considered to be more serviciable. In this connection, Japanese agricultural machines will be able to serve greatly to Ceylon. It must be noted that the Landmaster of Germany were received unfavourably by local

farmers due to its too small engine of 5 h.p. and inability to make a small turn at a corner. The current Japanese tilling machines will be welcome by Ceylonese farmers if some technical modification is made on them or some improved means of operation are devised, taking into consideration such specific conditions as ill drainage and deep paddy field in the wet zone and hard soil in the dry zone.

Beside the tilling machines, Japanese harvesters and threshing machines may possibly be introduced for effective use in this country. Ceylonese way of harvest is to cut the rice plant with a sickle and pile up the reaped plants in about 1 meter thick, let buffaloes tread, or run rubber tyred tractors on them for threshing. Winnowing is made in the natural wind by casting the paddy up in the air. Modern Japanese harvesters have excellent efficiency, but there are some problems in introducing them for the varieties of rice which have natures of easy lodging and shedding. For the variety such as H-4 which has strong resistance to lodging and shedding, Japanese machines can be introduced without any remodeling. The Japanese rotary threshers have excellent efficiency. In the paddy rice cultivation in Ceylon, for such difficult shedding variety as H-4 which threshing can not be done sufficiently by treading of buffalo. When H-4 or other variety similar to it in shedding nature, is used widely in the future, Japanese rotary threshers will be in much demand.

Regarding the hullers and rice pearling machines, it is deemed difficult to alter the traditional Ceylonese way of producing polished rice directly from the paddy having been parboiled and stored, to Japanese way represented by the process of "paddy-brown rice-polished rice". However, if investigation is made on this point by Japanese experts of advanced technical knowledge in the field of agricultural machines, some means for improvement can be found. In this connection, Japan can render cooperative assistances to them.

In short, regarding the agricultural machines, efforts must be made to produce machines suitable for rice cultivation in Ceylon, refraining from introducing foreign machines as they are. Concerning the tilling machines, due attention must be paid to the conditions of soil, and concerning the processing machines to the characteristics of varieties.

The Chief Officer of the Agricultural Machinery Division of the Maha Illupallma Expreiment Station, who has been in Japan some time ago for study, is endeavoring in producing the agricultural machines most suitable to Ceylon. It may be said his effort is just and proper.

(5) Extention System

The Agricultural Experimental Farms and Research Stations of the Universities in the so-called developing countries have, without exception, been doubling or trippling the average rice yield in the country. This means that it is not ture to say that the country lacks the techniques for high productivity. In fact it lacks means of extension of new technique among the farmers. Therefore, the extension of advanced technique is the most important problem for the improvement of rice cultivation.

The organizational structure for extension of agricultural techniques in Ceylon is as follows :

Ministry of Agriculture and Food
(Department of Agriculture)
↓ ↑
District Agricultural Committee
↓ ↑
Divisional Committee
↓ ↑
Cultivation Committee

A cultivation committee is composed of 12 farmers representing 100-200 farmer's households, the average total area of farming land being 300 acres. Total number of the committees in the country is approximately 4,000. A divisional committee is composed of 4 Divisional Government Officials including Agricultural Extension Officer, Agrarian Service Officer, Cooperative Society Officer and District Revenue Officer who acts as Chairman. Sometimes an official of the District level participates in the committee as additional member. There are 150 Divisional Committees throughout the country. The number of the District Agricultural Committee corresponds to that of the Districts, i.e. 22 in total, the composition of which being made by the Governor (Government Agent) who acts as President. District Agricultural Extension Officer, Assistant Commissioner of Agrarian Service, Assistant Commissioner of Cooperative Development, Irrigation Officer (engineer) and a few other agricultural officers are the members.

It is stipulated that the Department of Agriculture and the District Agriculture Committee is to meet together 3 times a year to discuss the relevant matters while the latter holds its meetings once in every 3 months. Through these organizations, the policies of the Government will be delivered to the farmers in general and the opinions of farmers, Divisions and Districts will be reported to the Government.

Though the above committees were set up fairly long time ago, it is since 1965 that the committees have become active in performing their functions cooperatively centering around the specific targets. At first, the Minister of Agriculture and Food delivered its policy to the lower bodies, but at present the procedure has changed so that the opinion of the lower bodies be reported to the superior. Namely, at the beginning, the Cultivation Committee, advised by the Village Extension Workers, will decide the important matters and report them to the Divisional Committee. These important matters be coordinated by the said committee and further by the District Agriculture Committee and finally by the Agriculture and Food Ministry to make the definite plans. Basing on these plans, the Ministry declares the implementation programme and targets for each fiscal year which covers all the national agricultural problems including tea, rubber, coconut, garden crops, upland field crops, irrigation works, cattles and forestry. Concerning the paddy rice farming, the programmes for promotion of production of seeds of recommended varieties and its distribution as well as means of its diffusion, distribution of fertilizer, financing, budget appropriation for minor irrigation works, purchase of produced rice, storage of seeds and fertilizers, etc. are published.

Upon this government programme, the District Agriculture Committee sets up an operation plan for the district under its jurisdiction and, publishing it as the District Implementation Programme and Targets, proceeds with it. It seems that the Governmental as well as the District Implementation Programmes are well organized formally. Four years has passed since this system was first put into practice and by now it is getting into smooth running order, though further efforts having been made to improve its substance.

The activities of the above mentioned organizations for extension are made uniformly throughout the country, having the individual farmers as the subject. In contrast to this, there are the Elahera and Minnerya Special Projects which offer guidances for improvement mainly of paddy rice cultivation to the farmers of the colonies which have comparatively even conditions, taking approximatly 5,000 acreas as a unit. Having the Agricultural Officer as the Project Manager, the project aims to increase the production of foods, with the cooperation of the officers of the Agriculture and Food Ministry and also the Land and Irrigation Ministry.

In the Elahera District, which the Survey Team had visited for survey on farming works including tilling with the Government owned tractors, purchse of good seeds and fertilizers through cooperatives,seed sterilization, transplanting and line sowing, use of H-4 variety, weeding, utilization of agricultural machines

and tools, etc. have been more remarkably promoted in 1968 compared with those in the previous year. Especially the use of fertilizers was increased by 9 times and the yield of rice showed a surprising increase from 40 bu/ac to 80 bu/ac.

Encouraged by this splendid achievement, the Government is planning to increase the number of the Special project districts by 6 and make them 8 districts in total. Judging from the fact that, among the farmers in the district under the project with whom our survey team made contact, there were some who had gained the rice yield of over 100 bu/ac, it is thought that the thorough and close guidance given to the farmers for the whole period from cultivation to marketing was certainly effective. Implementation of such special projects may be also useful.

## 3. CONCLUSION

The important points of the findings of our survey on the paddy rice cultivation in Ceylon may be summarized as follows:

It is not wrong, through present and future, that the agricultural authorities of Ceylon have taken the policy to put great stress on the fertilization and breeding of rice suitable for fertilization. It is true the use of chemical fertilizer now being recommended by the authorities contributes much to promote productivity, but one must realize that the high productivity is inevitably accompanied by the decreasing of land fertility including the exhaust of microelements. To cope with this situation, proper measures must be taken, taking into account the farmyard or green manuares is important to promote and maintain the land fertility.

The Japanese agricultural machines, if proper modification is made to make them suitable for Ceylon, will be able to contribute to the promotion of Ceylonese paddy rice cultivation.

The organizations for extension of advanced agricultural techniques are splendidly formed and activities of these bodies are being carried on smoothly. Farmer's knowledge in rice cultivation techniques is rapidly increasing and their will to improve rice cultivation is favorably stimulated by the Government's policy of the so-called "Food Drive" as well as by the higher price of rice.

Those who are concerned with agriculture in Ceylon including not only administrative or technical officials but also farmers in general, are all full of spirit. Judging from this, there seems to be no doubt that Ceylon can achieve the improvement of agriculture by herself. However, progress of agriculture goes on at slow

tempo in any country, and, therefore, various measures for improvement must be carried on slowly but steadily, not hastily acting on rash impulse.

It is hoped that, in addition to the existing cooperation in the fields of plant breeding and fertilization, technical cooperation of Japan should also be offerred, in the field of agricultural machines.for the improvement of paddy rice cultivation in Ceylon. To materialize the cooperation sending of Japanese agricultural machine experts, offer of training in mechanization of agricultural works, setting up of agricultural machine repairing shops, etc. may be cited as proper means.

# VI PRESENT STATUS AND PROBLEMS OF HORTICULTURE IN CEYLON

By Tsuneo Eguchi

C O N T E N T S

## 1. INTRODUCTION

Research in horticulture appears to be the most underdeveloped sector of agricultural study which has been neglected so far in South East Asian countries. As it has a close relation with the welfare of people, increased attention should be paid to the promotion of this particular branch of study.

In the survey in Ceylon, the author conducted researches the following subjects.

(1) Vegetables

a) Common vegetables

1) Suburban vegetables

2) Highland vegetables

3) Fruit crops

b) Special vegetables

1) Potato

2) Chillies

3) Onion

(2) Fruits

1) Pineapple 2) Banana 3) Papaya

(3) General Crops

How maize, groundnut, soy bean, red bean and tobacco are cultivated after paddy rice in dry zone.

(4) Fruit and Vegetable Market

Effort was made to visit various places concerned wherever possible to obtain first hand knowledge of the present status of cultivation.

## 2. THE RESULT OF RESEARCH AND PROBLEMS

(1) Vegetables

a) Common Vegetables

1) Suburban vegetables(Seidorit village, in the suburbs of Colombo)

The bulk of common vegetables ( indigenous heat resistant leaf vegetables) supplied to Colombo comes from Seidorit village (with alluvial soil and underground water level of about 3 feet), situated about 4 miles north

of Colombo along the both banks of the river Kalani.

According to survey interview in the village, the area under vegetables is around 50 acres (about 200 a.), which is shared by around 200 vegetable growing farmers of petty scale with about 10 a. of land per farmer. As for the kind of vegetables grown here as of end of July, Ceylon Spinach accounts for the bulk with Kangkong and Amaranthus cultivated at a portion of the land. Seed-production of Ceylon Spinach was exercised in an enclosed block at a corner.

In the suburbs of big cities in the tropic such as Jakarta and Surabaya in Java, Saigon of Vietnam, Phnom-penh in Cambodia, there are intensive vegetable growing belts, in most cases, along the rivers. The vegetable growing belts of similar types can be found in Japan as well, for instance, in Suna-machi, Tokyo, Minato in Osaka, Yasuoka in Shimonoseki, Hakozaki in Fukuoka.

Photo 1: Vegetable garden in Seidorit village, (Photographed July 26) Children are taking care of Ceylon Spinach by weeding and intermediate ploughing.

In suburban vegetable farms, in most cases, vegetables with short growing period (indigenous leaf vegetables) are intensively cultivated. Most of vegetable farms are situated in places with high groundwater level and are innundated during the rainy season. Village Seidorit in the suburbs of Colombo is not an exception to this.

Vegetable washing place and other installations were found unsanitary.

2) Transported vegetables (Nuwara Eliya, highland).

The place is in the vegetable growing belt (highland) at 1,000 - 1,500 m above the sea level, about 50 - 60 miles (linear distance) to the east of Colombo city, growing cabbage, beet, carrot, leek, radish (Shogoin-radish

of Japan was also grown), peas, beans, lettuce and other western-type vegetables.

According to interviews in the field, the volume of vegetables delivered to Colombo city by middlemen amounts to as much as 5-6 car loads on 5 ton wagon a day.

Photo 2: Outlook of the vegetable garden in Nuwara Eliya (Phtographed July 20, rain). Slopes on the hill are mostly residential area, whereas vegetable gardens are found in the valleys. As expansion of area under cultivation is limited these days, yield increase by means of fertilization is being promoted.

While Seidorit village may be taken as an example of vegetable supplying belt in the suburbs, this village is in a horticultural belt within 6-7 hours of reach by track. Most of the big cities in the tropic are provided with vegetable supplying belts in their suburbs or in highland districts. To name some of such famous highland area (1,000 - 1,500 m.) growing vegetables, we can mention Dalat in Saigon, Baguio in Manila, Tikadjan, Galu and Pachett in Djakarta, Tosari in Surabaya. They are famous as a site for resort and on sanatorium as well.

One of the remarkable things in Nuwara Eliya highland in Ceylon is that there is a Seed Potato Experiment Sation set up since in 1959, which is in charge of self-supply of and cultivation tests on seed potatoes.

Successful implementation of self-supply program of seed potatoes after the ban on potato import of last June can be attributed to the technical back -up by the Experiment Station.

Welimada district is another outstanding area for vegetable production, about 1,000 m above sea level, located about 20 miles east of Nuwara Eliya.

This is a peculiar area where dry zone climate with fine weather is prevailing at this time of the year (end of July), when southwestern part of

Ceylon as a whole including Nuwara Eliya is in the rainy season ( Yala season). (the weather was fine only in this district on the day of our survey, July 20) Paddy field is found in this district with high altitude (about 1,000 m) and temperature as low as about 25-15 c. If potatoes are introduced in this area, and production is good quality potatoes will be secured which would contribute greatly to the self-supply of food.

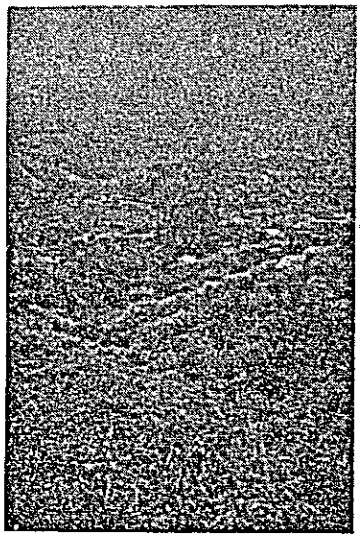

Photo 3: Hills of Welmada in the dry zone (Photographed evening July 20, fine). The area is a special region where rainfall is very little with a spell of fine days even during Yala (rainy season.) The weather there may be due to the peculiar topographic condition, which can be highly appreciated for horticultural farming.

3) Fruit-bearing vegetables

Fruit bearing plants found in general are egg-plant, tomato, chili, cucumber, water melon, cantaloup, pumpkin, white gourd, bottle gourd, snake gourd, bitter cucumber. All of these are highly heat-resistant and most of them are indigenous to the tropic. In Japan, these plants are cultivated mainly in summer during the period from May to September (no-frost period), whereas they can be cultivated throughout the year in the tropic.

Among them most widely cultivated ones in Japan are eggplant, cucumber, tomato, water melon and cantaloup. In Ceylon, on the other hand, eggplant, pumpkin, bottle gourd, wax gourd, angled 100fah are most widely cultivated, while cucumber, water melon, tomato and chili are comparatively less.

When classified by regions, the aforementioned leaf vegetables (in Japan grown in Autumn) are cultivated intensively in Nuwara Eliya highlands and in village Sediorit in the suburbs. As for the fruit-bearing vegetables, on the other hand, eggplant, cucumber, tomato and chili are cultivated widely under irrigation in Jaffna region in the north.

Photo 4. Eggplant at the Agricultural Guidance Center in Jaffna (Photographed July 28). Most of summer vegetables had good harvest in Jaffna. All the eggplants, though they were of the variety pubescant and thornyon the back of the leaves, showed good growth. In the tropic in general, this variety of eggplant is cultivated widely.

Further, in a semi-dry zone of Galewera and Ibbagamuwa situated between Kurnnegala and Damblu, a substantial amount of eggplant, tomato, and tobacco are cultivated in drained paddy field after the harvest of rice. In a region ( wet zone ) between Kurnnegala and Colombo, eggplant, pumpkin, chili, bottle gourd and loofah were observed to be most commonly cultivated.

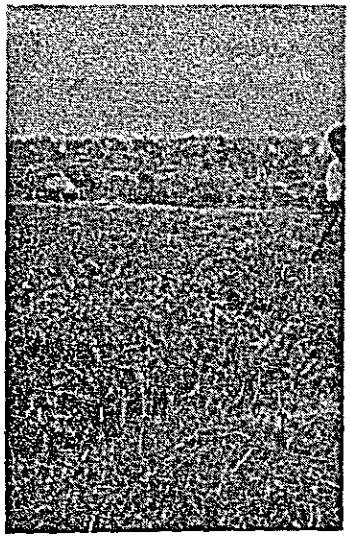

Photo 5: Tomato cultivated in the paddy field after harvest of rice in the semi-dry zone (Photographed July 26). Vegetables and tabacco are being introduced as dry season crop in the semi-dry zone between Kurunegala and Dambulla. Though small and of uneven shape, the tomato had strong resistance against heat and gave good yield.

Photo 6: At a shop of a local middleman (Photographed July 26) – (1)
The middlemen having this sort of shop were numerous in the area (wet zone) between Colombo and Kuruneagala. Bottle gourd in front and white gourd behind. Angled loofahs are seen around bottle gourd. To the extreme front, sweet potato, of which size is most typical of the local sweet potato.

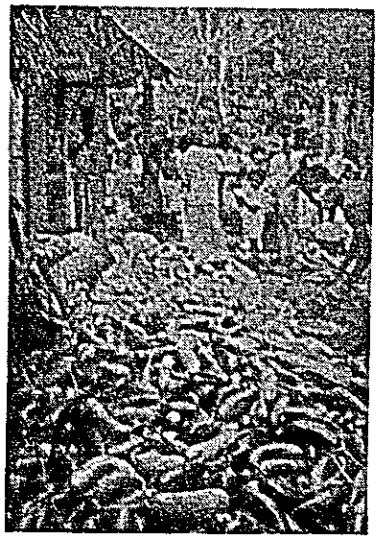

Photo 7 At a shop of a local middleman (Phtographed July 26) – (2)
A picture taken at the same place as in Photo 6, though eggplants are ill-formed and seemingly hard, this would not matter as they are usually boiled or fried before serving in the tropic. The shop had a scale and vegetables were sold by weight.

In other words, in Jaffna region which can be regarded as a horticulture area in Ceylon, successful cultivation of tomato and chili, which have been regarded difficult to grow in the tropic is observed, whereas in a wet zone near Colombo, fruit bearing vegetables of conventional type are widely grown. In a semi-dry zone situating between Colombo and Jaffna, positive efforts for cultivation of cash crops such as eggplant, tomato, chili, and tobacco are seen.

In Java, Cambodia or Vietnam where the author made survey on vegetables production, the aforementioned kinds of vegetables are found in these places too. Comparing Ceylon with these countries, the author mentioned, however, that making a good use of high-land area, seed potato supply and food potato production were fully attained domestically. Tomatoes and chillies which had been assumed difficult to grow in the tropic are grown successfully in Jaffna region in dry zone with some irrigation, and in semi-dry zone (Galewera, Ibbagamuwa), eggplant, tomato and tobacco are cultivated widely in drained paddy field after harvest of rice. None of the above practices were found elsewhere tropical region.

The tendency toward wider chilli cultivation by farmers in general has been already observed and this seems to provide the Ceylon Government that has taken up years with a bright outlook for the future.

To sum up the section on fruit crops, the author wishes to make a few comments. Comparing with conventional types of cucurbits that have been grown in Ceylon and other toropical regions, such as pumpkin, white gourd and bottle gourd tomatoes and chilies require more intensive techniques (especially in nursery), management (fertilizing, spraying, etc.) soil fertility (physical as well as chemical). According to the author's survey, however, the soil of the nursery is of inferior quality, poor in organic matter and receives little fertilization. Transplanting of seedlings

is not practiced carefully. (In general, transplantation period is late, handling of seedlings is rude, and post-transplantation management is poor).

According to the results of experiments conducted so far on these fruit crops formation of the first flower cluster is observed 30 days after sowing, in tomato and 40-50 days in chilli. With the intervals of 10 days each, the second and the third flower clusters are formed. That is, the seedlings of tomato and chilli form flowers up to the third or the fourth level during the nursery period of 60-70 days, and in general the seedlings are considered to be already in the stage of reproductive growth. Moreover, the growth of flowers of eggplant, tomato and chilli are to a great extent subject to nutritional conditions and environments of the seedlings. Taking above factors into consideration, in this field survey, a special attention was paid to the relation between handling of seedlings and growth of the first and second flower clusters after transplantation.

In the case of tomato as observed in Jaffna and Ibbagamuwa, the first flower cluster was poor, and the second cluster was almost fallen. This tells clearly that in the process of formation and growth of the first and

Photo 8: Picking of chili seedlings (Anuradhapura) (Photographed July 26) Photo shows picking-out of a chili seedlings planted in nursery densely. In Japan, prior to this work, thinning is practiced to give space between seedlings. They are then transplanted once or twice, prior to final transplantation. In this place, such procedure was seemingly unobserved.

Photo 9: Failure of first and second flowers clusters if timoto (July 28) (Jaffna). Tomatoes grown in the Agricultural Guidance Center were apparently giving good yield. But when examined closely, it was found that the first and second flowers clusters were nothing but remnant without any fruit, on them. Fruit-bearing started only at the third cluster of flowers.

second flowers, unsuitable handling of seedlings and other nuisances have taken place.

In nursing the seedling of tomato, eggplant, and chilli, much more care should be taken in preparation of bed soil of the nursery, handling of seedlings, and management of the nursery in order to eliminate the difficulties listed above.

Studying the cultivation of tomato and chilli in Ceylon in the aspect so far not dealt with, there are plenty of insects by the name of Two-spoted smaller green leaf hopper (Chloripa bipuncttula I.) that attach tomato, eggplant, chilli and cotton in Taiwan, Java, Cambodia, and Vietnam, whereas the insect was rarely found in the course of the survey in spite of the special attention paid to identify the presence of and the damage by the insects. The search was conducted in the nursery as well as in the upland field but no sympton of damage by the insect was found on the crop. It can be concluded therefore that in Ceylon Two-spoted smaller green leaf hopper which is the stubborn enemy of eggplant, tomato, and chilli are not so common. Leaving the argument why Two-spoted smaller green leaf hopper is not numerous in Ceylon, results of all the survey made so far imply that the cultivation of eggplant, tomato and chilli are far easier in Ceylon than in the tropical plains in general. Considering the above, the government should set chilli cultivation on its way and promote extention and increased production of this crop in terms of the policy it is taking (import ban).

Tomato is a plant originally from the highlands of about 600 m above the sea in South America. The temperature between 25°C-16°C is best fitted for its growth, therefore its cultivation in the tropical plain ( 30°C-20°C) is relatively difficult. It is this tomato that should be grown in Welimada region with dry zone climate at the altitude of some 1,000 m above the sea. The author believes that when the full-fledged cultivation of tomato sets in there, splendid and good shaped tomato would be produced. (Sea following section on highland vegetables)

(b) Special Vegetables (Vegetables heretofore imported)

1) Potatoes

An account was given in the section concerning highland vegetables of Nuwara Eliya.

2) Chilli

An account was given in the section of fruit-bearing common vegetables.

3) Onion

Onion originated in the temperate region. As few areas in the tropical region were cultivating onions, most of the tropical countries imported onions from the temperate region. A breakthrough was made, however, about 20 years ago when cultivation of a variety of Bermuda onion (Express Globe) was successfully experimented around Takao in Southern Formosa. Nowadays, Japan imports this onion in the period from March to April. In vietnam, experimental cultivation of Express Globe, Bermuda a variety, was successively conducted about 10 years ago, and now the country is in the stage of self-supply in onion.

What interested us most in Jaffna area in Ceylon was the experimental cultivation (for about 3 a.) of onion (Bombay Red) showing good growth with the plant height of about 20 cm. and bulbs of about 5 cm. in diameter. (see photograph)

Photo 10 Cultivation of onion (Bombay Red) at the Agricultural Guidance Center in Jaffna. Experimental cultivation of onion started only this year but with success. The garden had irrigation facilities, with tight lime stone soil fit for onion cultivation. Here they didn't suffer from any damage by thrips which is quite common in the dry zone.

Good care was apparently taken for the onion which showed almost no damage by insects (severe damage is often caused by trips during the dry season) in the stage near ripening, promising a good harvest.

Efforts should be made next year for expansion of cultivating area of Bonbay Red Breed and Express Globe (yellow, upright bulbs) to make the onion a speciality of the region. The soil of the region is fit for onion cultivation, (the soil is tight enough) with the provision of irrigation facilities. The inhabitants of the region are gradually geting the know-how in Shallot (small onion) and onion cultivation. With this knowledge, they are sure to be successful in near future.

Note : (i) The outline of onion (Express Globe) culture in southern Formosa is as follows : sowing in August (in nursery), transplantation (to the field) in October , harvesting in March - April.

(ii) Summer (May-September) in southern Formosa is rainy season with high temperature (30°C-20°C), while October - April period is dry season with low temperature (22°C-12°C)

(2) *Fruit Trees*

(a) Pineapple

The world famous pineapple production area is Hawaii, at latitude 20 - 22 N blessed with mild temperature and good distribution of rains. Average monthly rainfall of 100 mm is favorable for the growth of pineapples. (Of Ananas plants genus can store rain-water in the core and absorb it together with the fertilizer nutrients.)

The author had an opportunity (on July 17) of visiting the Pineapple Experimental Station at Gampaha which was established this year. The experimental station is situated in the area blessed with good landform (being on a hill, drainage is good) and with the best distribution of rain in the south-western part of Ceylon. The growth of pineapple there is very good, if not better than those in Hawaii, Formosa and Singapore where the cultivation of pineapple has a longer history. The region from Colombo to Kurunegala centering around Gampaha was supposed to have many pineapple farms: along the street, a number of pineapple growers were seen opening small booths (see photo 11) selling fresh fruits (smooth Cayenne, Yellow Mauritius.

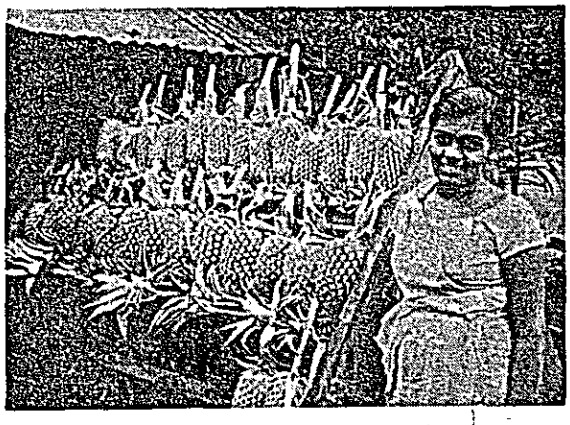

Photo 11: A pineapple booth on the road side, run by farmers. (Photographed by Mr. Tanino July 19) On the upper shelf are Yellow Mauritius (for eating raw) and on the second shelf, smooth Cayenne (for processing and eating raw). On both sides of the road to Pineapple Experimental Farm in Gampaha many booths of this kind were found. We were along the Colombo - Kurunegala route where they were blessed with good rainfall.

Though fresh pineapples are themselves valuable, the processed products (canned pineapples and juice) are appreciated all over the world. So, it is expected that, if more pineapples are produced on a commercial scale

in this south-western part of Ceylon blessed with favorable rain distribution and processing industry is established, it will not only enrich national diet but also benefit the country by giving the capacity to export processed pineapples in due time.

Note: Two factories were said to have already been established near the pineapple farming belt.

(b) Banana

Banana is the most wide spread and popular fruit in tropical region. The author has long held the opinion that banana in the tropics corresponds to potato in the north in terms of its value as food. Banana was observed everwhere along the roadsides and paddy fields in Ceylon. Banana trees in the wet zone from Colombo to Kurunegala especially were very fine.

All of these trees were, however, grown as they were, without fertilizing thinning or other care. These trees are delayed in bearing fruit and many fruits fall to ground before ripening. Fruits are small in size and the yield is very little. It was only in Jaffna region in the North that I observed banana trees grown in the form of orchard (3 stems each tree, at a distance of 8 feet x 10 feet or 9 feet x 9 feet). About 130 trees were planted over 10 a. of land. The orchard was well-managed and irrigated with ground water. Growth of trees and setting of fruits were splendid.

Photo 12. A Banana Garden in Jaffna (Photographed July 28). Every banana tree was pruned to 3-stem standing. (2 main stems and 1 tiller) About 130 trees were cultivated per 10 a., with good success. Being in a windy place in the dry season, leaf tips were damage to some extent. In the rainy season, however, poor sunlight due to thickly thriving leaves is apprehended.

The banana farm the author visited had a history dating back to 25 - 26 years since its establishment, though trees and fruits do not show any sign of degradation in their growth or fertility.

One thing that interested us in this farm was a simple kraal of movable type (about 3,305 $m^2$, keeping 2 - 4 small-size cows) (see photo 13) set in the orchard. Excretion of cows, mixed with fallen banana leaves served as manures.

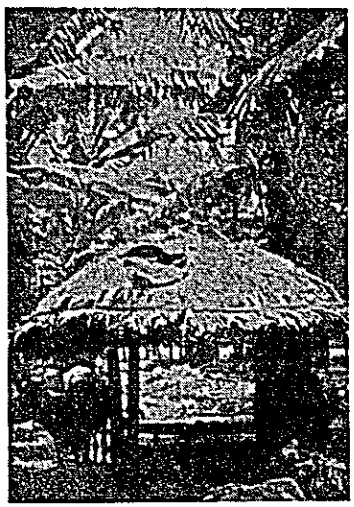

Photo 13: A Movable Kraal in the Banana Garden. (Photographed July 28) A shed of very simple structure which is moved around in the banana garden in order to fertilize the soil evenly by cattle excrements.

Banana orchards of this type were found in mass over a wide area in this region. According to the result of the market research (interviewing), shipment of banana to Colombo market from this locality is made by the co-operative three times a week and the average amount per day is about 15 carloads on 5-ton wagons. Judging from this figure, the amount of banana supplied to Colombo city from Jaffna region is of a considerable size.

(c) Papaya

Alike banana, most of papayas are grown under laissez-faire condition without special care. The culture is very inefficient and the harvest is very poor.

In Hozan Tropical Horticultural Experiment Station near Takao in Formosa, where the author was stationed prior to his assignment in Ceylon he dug planting pits (1 foot x 1 foot x 2 feet) as practiced in orchard, in an infertile elevated land of about 10 a. and cultivated papaya with fertilization. The experience of that experiment taught that papaya bears enormous amounts of fruits when some additional care is given. The harvest obtained there was at least more than 5 times the harvest from papaya left uncared, and the taste was very much improved under cultivation with care.

Photo 14: A prolific papaya tree (at Peradeniya). (Photographed July 20) Picture shows a papaya tree planted at the end of the playing ground of the Officials Training Institute in Peradeniya. Trees were growing in sunny place with fertile soil showing good growth and bearing many fruits. (There were 14 - 15) trees in the ground and most of them bore fruits abundantly.) Papaya is very easy to grow and the yield of such size as was seen there can be expected from any papaya tree planted in a breezy sunny place and well fertilized. Compared with a tree left uncared, the yield seems to be as much as 5 times.

Since then, the author often had opportunities of tasting papaya at first-class hotels in Java and Singapore. Judging from the taste which was not so good, he imagined those papayas grown without special care.

Banana and papaya cultivation in Ceylon pose us many problems which are not simple in the light of the above situations. It is recommended strongly here that inefficient cultivation without care which has been an old practice in the tropic should be abandoned once and for all and be replaced by an improved standard pattern of cultivation. In the region suitable for cultivation groups of orchards should be established for rationalization and modernization of management.

(3) Other Crops (Mainly, second crops for drained paddy field after the harvest of rice in a dry zone)

Major crops cultivated in a dry zone in the drained paddy field after rice harvest are maize, soybeans, azuki-beans, shallots, (small onions), eggplant, tomato, chili and tobacco, most of which have been quite recently introduced in to the region. They are cultivated either for experiments in the related experimental stations, for test by progressive farmers or, as in the case of tobacco, under construct with tobacco companies.

In terms of cultivated localities they stand follows:

(i) In the Special Experimental Station for Irrigated in the dry zone more or less in the middle of Ceylon, shallot, maize, groundnuts, soybeans, and azuki beans were experimentally cultivated in the field of about 5 - 10 a. Of all the crops cultivated there, soybeans and azuki-beans gave the best result, whereas shallot showed medium growth and maize was most retarded. Groundnuts over grew were weak and due to over-feeding of

water. This crop, being originally from dry region, should not be watered abundantly. It is advisable, further, to introduce variety such as Southern Cross which is widely cultivated in the dry zone in southern Java.

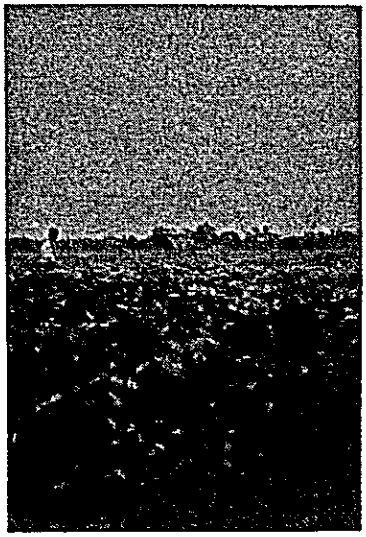

Photo 15: Soybeans cultivated in the Special Irrigation Experimental Station. (Dry zone) (Photographed July 23) Soybeans were grown as dry season crop in the dry zone. They showed good growth.

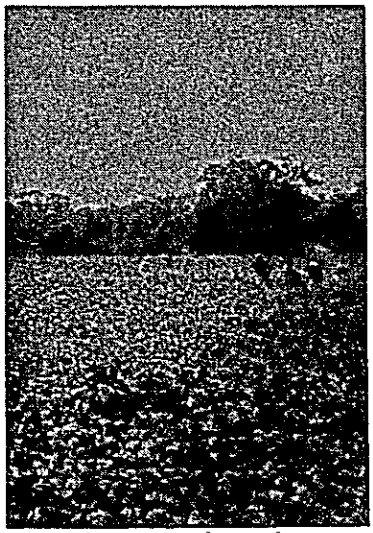

Photo 16: Red beans cultivated in the Special Irrigation Experimental Station (Dry zone) (Photographed July 23). Red beans were cultivated with success in a paddy field in the dry zone after water had been drained. They were being harvested.

Photo 17: Shallot cultivation in the Special Irrigation Experimental Station. (Dry zone) (Photographed July 23) Being satisfy the expectation. This may be due to small size of the bulbs, new soil lacking in organic matter and nutritious elements.

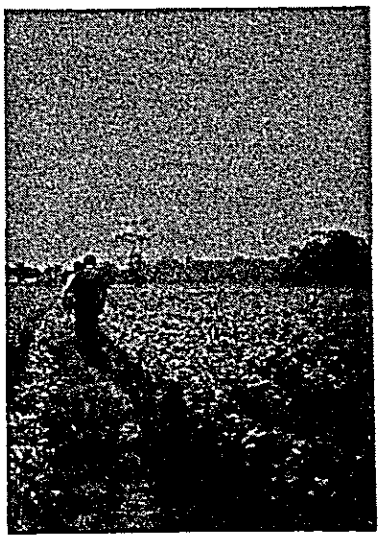

Photo 18: Groundnuts cultivated in the Special Irrigation Experiment Station. (Dry zone) (Photographed July 23) Apparently due to excessive irrigation, groundnuts were overgrown and weak. It is advisable to feed less water to groundnuts.

(ii) Following the above observation, the author visited the exprimental station in Anuradhapura where eggplant and chili (about 10 a.) were grown in the drained paddy field after the harvest of rice. The growth of these plants were more or less satisfactory, though the development was some-what retarded. As mentioned in the section pertaining to fruit crops, improvement in seedling raising techniques and fertilization of soil of nursery and paddy field should be given first priority.

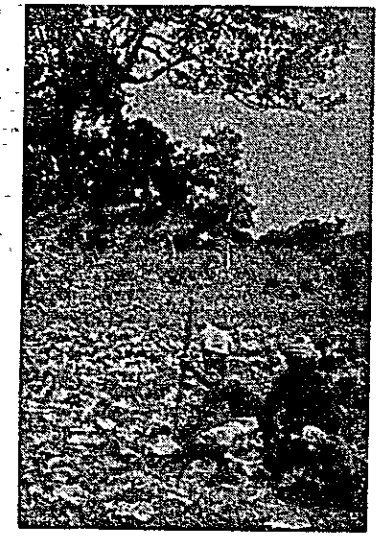

Photo 19: Eggplants cultivated in Anuradhapura Experimental Station. (Dry zone) (July 29) Eggplants and chili were cultivated in this experimental station in dry zone. Though both crops showed considerable yield, better harvest can be expected by a bit more effort.

(iii) In Vavuniya, further north of the above experimental station, the author visited a vegetable garden run by a farmer ranking some-what above the middle class, making use of the drained paddy field. Approximate size of the field was 1 ha., regularly and distinctly marked off. There were two big wells dug outside the field; One of them operated by pump and the other by power of draft cattle to irrigate the field. The soil was rather sandy with good drainage and was similar to that of upland field.

The author visited the garden on July 27th when shallots (small onions) grown on the drained field were being harvested. Shallots were cleaned and sorted by some 10 female laborers in a nearby hut.

The rotation system most favored in this farm was the combination of paddy rice and groundnuts, which could be managed to double or triple cropping. In triple cropping, paddy rice is cultivated during the rainy season from November to February, and groundnuts are grown before and after the paddy rice. In double cropping, groundnuts are grown only after paddy rice. Besides groundnuts, eggplant, chili, shallot were from time to time adopted in the rotation.

Photo 20: Working place of a farm in Voruniya. (Dry zone) (Photographed July 27) The farm had gone out of experimental stage in vegetable growing during the dry season. It introduced various vegetables to establish an effective system of crop rotation in combination with rice. The photograph shows harvesting and cleaning work of shallot (small onion)

This paddy rice farm, equipped with irrigation facilities, established a good system of rotation including paddy rice, which lead to remunerative farm management. To sum up, cultivation experiments on various crops to be cultivated in the dry season in paddy field have been started already in several experimental stations and good results have been reported. On the other hand, a farmer in Vavuniya, equipped with rather simple irrigation facilities, has established successful systems of double cropping and triple cropping including paddy rice. These examples provide us with precious data as to how to extend dry season cropping in the dry zone in the future. The results obtained in these farms are to be compared with each other and be examined to formulate systems of rotation suitable to respective areas, following which the development of the dry zone should be promoted strongly.

4. Fruit and Vegetable Markets

In Colombo, there are two fruit and vegetable markets, that is, new and old. The new market which may as well as called Tipoli market (center) is situated in Petal street. The market consists of general fruit and vegetable market and that run by the cooperative which deals in fruit and vegetables shipped by producers' cooperatives. General market is the aggregate of wholesalers, who individually purchase vegetables from the middlemen in the producing area and sell them directly to merchants and citizens of Colombo. The author paid special

attention to onion and potato. The former was imported from India and of yellow variety group. The shap Bulbs were not uniform in shape flat and erect type being mixed.

These onions were dealt in shops of some sort of grocery, unlike ordinary fruit and vegetable shops. (same as in the market in Phnom Penh) Potatoes here, were dealt in ordinary fruit and vegetable shops. (In Phnom Penh, potatoes were sold in the same shops as for onions)

The fruits being sold in the market at the time of the author's visit were pineapples, bananas, citrus fruits, rambutan, and late mangoes. As for fruit crops, eggplants, tomatoes (small-size, odd shape), pumpkins, bottle gourds, cucumbers, angled loofahs and beans and as for green vegetables, Malabar night-shade, Bayam, En-tsai, and edible amaranth, supplied from the suburbs were most dominant in the market.

The old market is also called Peta market, being situated in Peta street of Colombo. The market is divided into five divisions that deal respectively in bananas citrus fruits, vegetables, meat and fish. The mechanism of the market in which middlemen of each section own shops in the market and negotiate on the articles individually is much the same as that in the new market, except that the old market is narrower and messier.

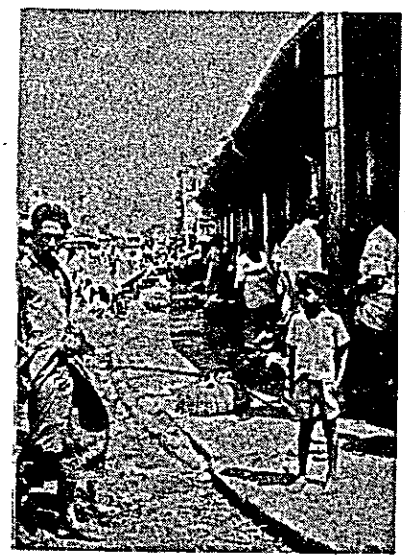

Photo 21: Peta Market (old market) in Colombo (Photographed August 1) The Photograph shows the outside of the market along the road, in the afternoon, after the morning rush hours.


Photo 22: The Market run by the cooperative. (New Market) (Photographed August 1) The market handles vegetables and fruits shipped through cooperatives. The photograph was taken late in the afternoon. Business was over.

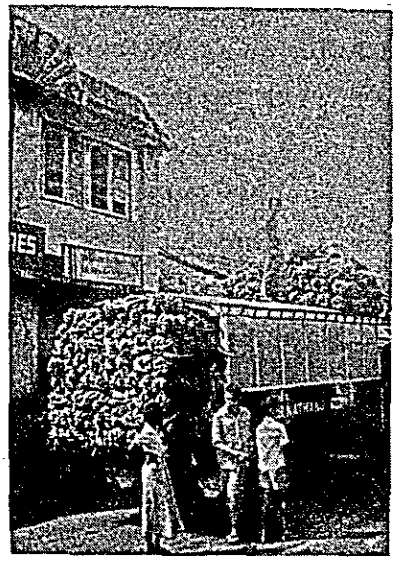

Photo 23: Banana delivered to the market (Photographed August 1) The photograph shows a 5 ton load of banana shipped from the area between Colombo and Kandy.

The impression the author got at the fruit and vegetable markets was that both of them, being situated in the busy streets of the city, were limited in space and were not in good order. The old market appeared even unsanitary.

With an increasing population of the city, distant vegetable gardens are expected to develop and consolidate themselves steadily, as stated in previous paragraphs. In view of such a development, the fruit and vegetable markets as they are today are apprehended to be too small and inefficient to handle the increased amount of goods in the future. It is fortunate, however, that the market runs by the cooperative is organized separately with broader roads and front yard, and consolidated office. It is recommended, therefore, at least for the time being to utilize this market, to encourage the growers to ship through cooperatives so as to increase efficiency, thus paving the way to prosperity.

## 3. SUMMARY

The aforementioned can be summarized as follows.

(1) Along with the expansion of vegetable cultivating area to meet urban demand, more effort should be made to develop Welimada region, the only place enjoying highland climate in the Wet zone with an aim to increase production and to reduce import of potatoes, thus preparing for the self-sufficiency in food.

(2) As a catch crop (during dry season) to be grown in paddy field in the dry zone after rice harvest, maize, groundnut, soybean, azuki-bean, shallot, eggplant, tomato, chilly and tobacco were seen cultivated either experimentally in experimental farms and by advanced farmers, or, especially in the case of tobacco, under contract with a firm. Of these crops, maize could be exported as feed grains whereas chilly is highly valued for import prevention and self-sufficiency. Cultivation of these crops should be encoraged under good guidance.

(3) As for onion (Bombay Red), experimental cultivation was successfully done this year in Agricultural Guidance Center in Jaffna as we observed. Next year, further step should be taken to increase the number and area of experimental plots, as well as to test a larger number of varieties. On the basis of the result of such experiments, guidance and encouragement are to be given for the earliest possible realization of import suspension and successful selfsupply of this project.

(4) An experimental station was already established for pineapple. As this crop is extensively grown in many localities in wet zone and we can find more places fit for pineapple cultivation, it is advisable to take steps for increased production and industrialization of the crop.

(5) We saw bananas cultivated in an orchard in Jaffna. It was a well-establishing group cultivation of a similar type in many places is desirable.

(6) In general, many banana and papaya trees were seen along the road side and within the residential compound in the country, and most of them were left to grow by themselves (care-free cultivation) without any fertilizing management, thus bearing less fruits which are less tasty. More careful and appropriate method of growing should be gradually developed in order to increase land productivity.

(7) The Vegetable and Fruit markets of Colombo were narrow and messy. The Old Market even looked dirty. In view of the increasing population in Colombo and the steady development of truck farming belt, the markets as of today will possibly become too narrow and inefficient, unable to handle all the goods to be brought in. Consolidation and expansion of the markets are urgently needed.