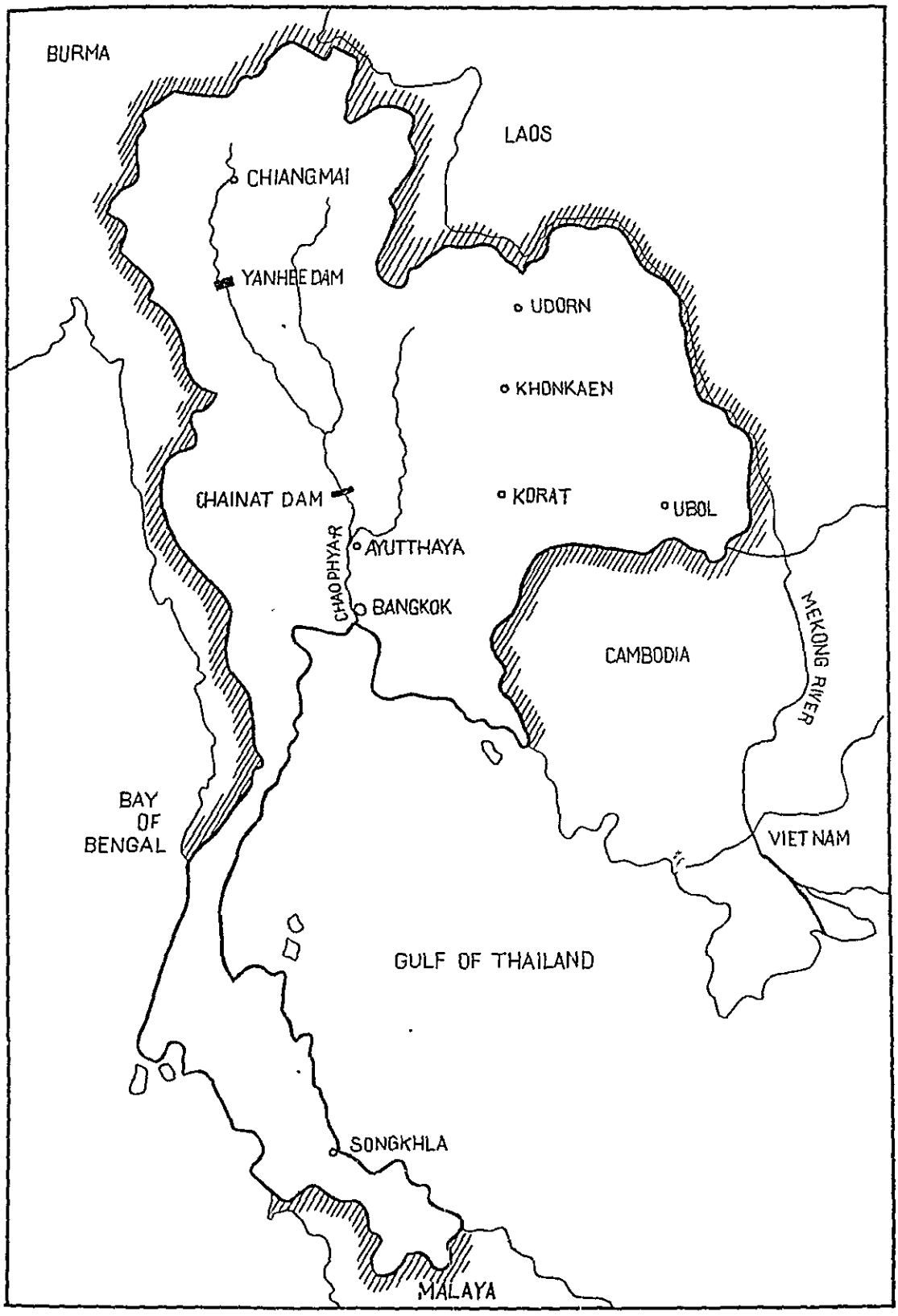
REPORT
ON
AGRICULTURAL DEVELOPMENT OF THAILAND

1963

OVERSEAS TECHNICAL COOPERATION AGENCY OF JAPAN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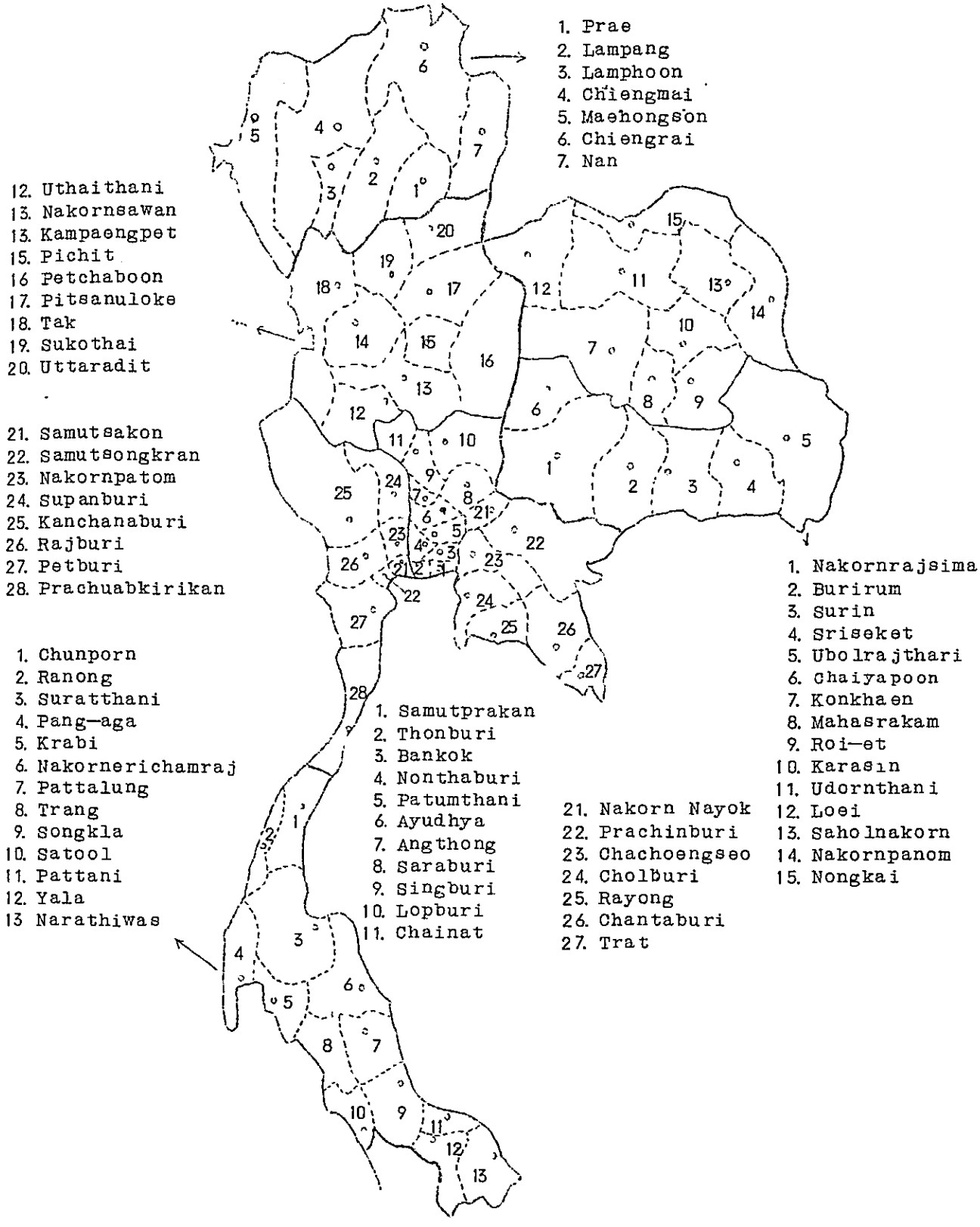
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19. Sukothai
20. Uttaradit
21. Samutsakon
22. Samutsongkran
23. Nakornpatom
24. Supanburi
25. Kanchanaburi
26. Rajburi
27. Petburi
28. Prachuabkirikan
1. Nakornrajsima
2. Burirum
3. Surin
4. Sriseket
5. Ubolrajthari
6. Chaiyapoon
7. Konkhaen
8. Mahasrakam
9. Roi—et
10. Karasin
11. Udornthani
12. Loei
13. Saholnakorn
14. Nakornpanom
15. Nongkai
1. Chunporn
2. Ranong
3. Suratthani
4. Pang—aga
5. Krabi
6. Nakornerichamraj
7. Pattalung
8. Trang
9. Songkla
10. Satool
11. Pattani
12. Yala
13 Narathiwas
1. Samutprakan
2. Thonburi
3. Bankok
4. Nonthaburi
5. Patumthani
6. Ayudhya
7. Angthong
8. Saraburi
9. Singburi
10. Lopburi
11. Chainat
21. Nakorn Nayok
22. Prachinburi
23. Chachoengseo
24. Cholburi
25. Rayong
26. Chantaburi
27. Trat

C O N T E N T S

I. INTRODUCTION

1. Purpose and organization of the survey.

Japan and Thailand, the long-time independent sovereign countries in Asia, have a lengthy history of friendly relations. Especially after World War II, economic ties between the two countries became much closer. Thailand now is the largest market in South-East Asia for Japanese exports, and Japan is the largest buyer of Thai products.

The impressive growth of Thailand's economy in the post-war years is due mostly to her agricultural development. With abundant production and exports of rice and other agricultural commodities, Thailand is not only self sufficient in food for her increasing population but also enjoys favourable balance of trade, permitting necessary imports of various consumer goods and capital equipment for industrialization.

In view of the natural conditions and human resources of the country, the agriculture of Thailand possesses a great potential for further development. It requires, however, well-thought-out planning and technical and financial means to bring the potential into reality. The Government of Thailand is well aware of this and is giving high priority to agriculture in its six-year national development plan.

Against the above background, the agricultural development survey was conducted by our team for about 40 days during March - April 1963.

The purpose of the survey was to study the present situation and future potential of Thailand's agriculture and to examine its agricultural development programs with a view to providing a basic information on which useful and effective investment and technical cooperation programs may be planned.

The team consisted of the following members:

Motonaga Ohto (Leader)	Director, Overseas Technical Cooperation Agency.
Shigeo Harada (Agronomy)	Chief of Crop Division, Chugoku Agricultural Experiment Station, Ministry of Agriculture and Forestry.
Kazu Kunimata (Agricultural Planning)	Chief of Planning Section, Overseas Technical Cooperation Agency.
Takeo Musha (Industrial Crops)	Special Crop Section, Horticultural Bureau, Ministry of Agriculture and Forestry.
Takashi Tomosugi (Agricultural economy)	Institute of Asian Economic Affairs.

2. Activities of the Team.

The activities of the team are shown in the itinerary attached to this chapter.

About half of the period was spent in the capital city for collection of existing data and for discussions. It was our great pleasure that we were able to collect more data than we had expected to exist.

As only one of our team members could read the Thai language, the utilization of data in Thai was very limited. Most of the data we utilized were in English, and some was in Chinese and Japanese. Data used in preparing this report are listed at the end of the relevant chapters, but following publications served as basic information throughout the report.

Agriculture in Thailand; Ministry of Agriculture, 1961.

Agricultural Statistics; Division of Agricultural Economics, Ministry of Agriculture, 1962.

Thailand; Robert Pendleton, American Geographic Society, 1962.

A Public Development Program for Thailand; Report of a mission organized by the International Bank for Reconstruction and Development, 1959.

Statistical Yearbook of Thailand (in Chinese); Nammei Limitted Co., 1963.

Agricultural Economy of Thailand (in Japanese); Chujiro Ozaki, Japan Agricultural Productivity Council, 1959.

In view of the importance of the Northeast for the agricultural development, our field trip covered mainly that region.

We were of course fully aware of the importance of the Central Plain as the main rice area, but we avoided duplication of servey conducted in that region a few months ago by an ECAFE Team which included three Japanese experts. (Ref. Report on Delta Development Survey in South East Asia. OTCA, March, 1963.)

3. General impressions.

To the eyes of Japanese, the agriculture of Thailand, although more advanced than that of neighboring countries, seems to be several decades or even a century backward.

The primitive means of production and processing which died out in Japan in the last century are still observed, such as the threshing of paddy by treading buffalos or the hand-reeling of silk from cocoons.

In some fields of agriculture, however, well-advanced technics and devices are utilized, even more elaborate than in Japan; examples are the Chainat irrigation dam and the breeding of synthetic varieties of maize.

The production increase of maize in the past decade in Thailand has been impressive, perhaps one of the most successful examples shown in any country. Main factors for the success were the increasing demand for maize in Japan, the successful breeding programs, assisted by USOM, which brought about higher yields, and construction of new highways along which maize production was expanded. Above all, however, strong and promt response of farmers to profitable crops must be noted. This perhaps indicates that Thai farmers are more advanced or more economic minded than those in her neighboring countries, a very encouraging indication for the agricultural development of Thailand.

The construction of highways was being actively carried out in various places we visited. We were interested to see many Japanese trucks and cars in remote areas where new roads had been opened.

However, we often experienced difficulties in getting into villages by automobil from the main highways, and we felt strongly the need for construction of feeder roads for agricultural development.

Construction of irrigation facilities such as the Chainat Dam in the Central Plain and numerous water tanks in the North-East were also impressive. Completion of these irrigation facilities will bring about fundamental changes in Thai agriculture. Irrigation, first of all, will stabilize and increase rice yields which hitherto depended almost entirely on natural flooding. It will also enable farmers to grow second crops in the dry season, as is practiced in Japan. The resultant increase in agricultural production of the country should be very large.

It must be emphasized, however, that irrigation alone can not bring about production increases. Since crop varieties, cultural methods and cropping system to be used for irrigation farming are substancially different from those under rain-bed agriculture, a great deal of research on irrigation agriculture and extension of the results to farmers are essential if irrigation facilities are to be useful. In our opinion, research work on this important subject should be strengthened.

The present research staff is not only small in number but is divided into components of the Rice Department, the Agriculture Department and the Irrigation Department.

Moreover, the research workers have little or no experience in irrigation farming, because it is a new field of agricultural technique for Thailand.

We believe that the long experience and advanced techniques of irrigation agriculture in Japan can be effectively utilized, and therefore consider that Japanese technical cooperation in this field would contribute greatly to the agricultural development of Thailand

Thailand is a "developing country" in its real meaning (as against synonymous term of under-developed country as sometimes used). Further development of the country would of course depend primarily on the wisdom and efforts of the people and the government, but economic and technical cooperation from abroad would assist and accelerate it.

International organizations, particularly the World Bank, and foreign governments have already contributed in great measure to the economic development of Thailand. On the other hand, the economic and technical cooperation provided by Japan thus far seems to be too small, if we

consider the fact that Japan has great commercial interests in Thailand both for exports and imports.

Since the economic development of Thailand depends greatly on agricultural improvement, we consider that Japanese technical cooperation in this field would contribute most to Thailand's economic growth, which in turn would benefit the Japanese economy. We will be most happy if this report on our study of Thailand's agriculture provides useful information in working out effective investment and technical cooperation for the future.

4. Acknowledgments.

The survey team extends grateful thanks to many officials of the Thai government, especially in the Ministry of Agriculture and the National Economic Development Board. They are too numerous to be thanked individually, but we can not omit the names of Mr. Piew Phsavat, Chief of the Planning Division, NEDB; Dr. Roem Purnariksha, Deputy Director of the Agricultural Development; Dr. Samai Chareonratha, Chief of the Experiment Division of the same Department; Mr. Chote Suvipakit of the same Division, and Dr. Pote Panyatip, Chief of the Planning Division of the Royal Irrigation Department.

The team leader is grateful to the useful advice and information given by Mr. G.H. Bacon, who was the member in charge of agriculture of the World Bank Mission to Thailand in 1958, and presently is the agricultural advisor to NEDB of the Thai government.

Mr. Maddock and other staff members of USOM in Bangkok generously gave us information on AID's agricultural programs in Thailand and other useful data.

The Team is grateful for the generous cooperation of the FAO Regional Office in Bangkok in providing information and the use of library and other facilities. The team leader, who was once a staff member of FAO, was particularly happy to receive such cooperation from FAO and to renew his attachment to the Organization.

Assistance and encouragement given by Minister Saito, Councillor Arita, Mr. Nagata and other members of the Japanese Embassy in Bangkok, including Mr. Munehisa, OTCA liaison officer, are also gratefully acknowledged.

II NATIONAL ECONOMY AND ECONOMIC DEVELOPMENT PLAN

1. Present Situation

Thailand covers an area of 514,000 square km., 1.4 times as large as Japan, with a population of 26,250,000. Thus, the density of population is 51 persons to a square kilo-meter; a fairly favorable ratio of recources to population.

The gross national product in 1962 amounted to approximately Bht 61.5 billion or 3 billion US Dollars (See Note 1) and per-capita income was $86. These figures can be compared favorably with many other countries in South-East Asia.

As for industrial structure, about 11,000,000 persons or 80% of the population in employment are engaged in agriculture. (See Note 1).

If the number of people employed in the industries related to agriculture such as rice-milling, jute-processing, oil extraction and marketing of farm products are taken into account, more than 90% of the total population are dependent directly or indirectly on agriculture for their livelihood.

On the other hand, the ratio of agricultural production (including animal products) in value to the gross national product has decreased from 43% in 1951 to 33% in 1961. (See Note 2). This decrease in the relative importance of agriculture indicates the advance of industrialization of the nation which is a desirable trend in itself but entails the problem of income discrepancy between farmers and industrial population. It also indicates the lower productivity of agriculture in comparison with other occupations.

Among non-agriculture sectors, commerce and other services account for 10% of the national employment population and 30% of the total value of the national products. Manufacturing industry, which consists mainly of processing of agricultural products, takes only 3% of the employment population but its production accounts for 12% of the gross national product in value.

The foreign trade has much contributed to the economic stability and development of Thailand. Although some trade deficits have been recorded in the past few years, export and import are fairly balanced, the deficits being offset by invisible receipts including foreign grants. And the volume of international trade has been remarkably expanding; the export increased 2.5 fold and the import 3.6 fold during the period of 1950-1960.

Rice and rubber are the main export items, accounting for 35% and 20% respectively of the total exports. Agricultural products in total, including kenef, maize, cassava and teak in addition to rice and rubber, constitute more than 80%. Among non-agricultural products, tin is the only item of appreciable export (6%).

More than 70% of the total imports are occupied by manufactured goods, among which various machines as capital goods account for 24% of the total imports.

With respect to trade relation, Japan is the biggest buyer and seller.

She buys about 15% of the Thailand export and supplies 29% of the latter's import.

Other important destinations of Thailand's exports are Malaya, Hong Kong, Australia, U.S.A., U.K. and India, whereas, U.S.A., U.K. and West Germany are the major exporters to Thailand competing with Japan.

For Japan, Thailand is the fourth largest customer for industrial goods and an important source of maize and other agricultural imports.

The marked development of Thailand's economy in the post-war years owes much to the increased exports of the primary products such as rice, crude rubber, teak and tin, and more recently to such new export items as kenaf, cassava and maize. The political and economic stability of the country enabled her to accumulate internal capital and also to attract foreign investment which are the pre-requisite for industrialization and diversification of the national economy.

For further industrialization, Thailand needs more imports of capital goods and supply of raw materials. Hence she has to produce more agricultural commodities for export and also for raw materials. It is considered that for several decades to come Thailand will have to depend mostly on the income from agriculture to finance her economic development. (See Note 2).

As Professor Rostow rightly observed on his visit to Thailand, the present stage of the country's economy is "about to take off". Thailand, therefore, is now in need of "revolutional changes in agricultural productivity" which Professor Rostow counts as indispensable conditions for "take off". (See Note 3).

It is also important for Thailand to develop other primary industries such as forestry, teak production in particular, and fisheries. Mineral resources are not very abundant except for tin and lignite which have already been exploited to a considerable extent. Possibility of exploiting oil-shale resources in the Northeast is suggested by the World Bank mission. (See Note 4). A Japanese firm is reportedly interested in this venture. (See Note 5).

2. Economic Development Plan

(1) Six-year Plan for National Economic Development

The economic development of Thailand is now under way in line with its Six-year Development Plan. The Development Plan was prepared basing upon the recommendations presented in the Report of the World Bank mission. The Bank assisted the Thai Government in preparing the plan by providing an advisory group of experts (the group included an agricultural expert provided by the U.K. government under the Colombo Plan).

The Plan sets forth the following targets to be attained during the period of 1961-1966.

1) The gross national product to be raised to 5% every year and the annual rate of increase of per-capita income to be raised to the level of 3%.

2) Agricultural production to be increased by 3% every year.

3) The rate of annual capital savings to be maintained at more then 10% of the gross national product.

4) Manufacturing products to be increased to 12% of the gross national product.

These targets were based upon the average growth rate attained during the period of 1952-1959 that preceeded the preparation of the plan. In view of the rapid development took place in the latter part of the period and thereafter, the targets appear to be rather modest.

The plan calls for the increase of annual growth rate of national product from 4%, which is the average for 1952-59, to the level of 5%, and likewise the increase of per-capita income from 2% to 3%. Already in the first year of the plan period, i.e. 1961, the gross national product recorded the increase of 5% in real value (7.7% in nominal value). The agricultural production in 1961 was 4% larger than in the previous year, exceeding the 3% target set in the plan. The manufacturing products in the same year amounted to 11.8% of the gross national product thus nearly attained the set target of 12%.

It must be noted in this connection that the increase rate of gross national product must be 6%, in stead of 5% as set out in the plan, if the per-capita income is to be raised at the rate of 3%, since the population is growing at the rate of 3% per annum. (See Note 5).

The target of 3% annual increase of agricultural production is also too low, because the actual increase during the period of 1952 and 1959 was 3.3% in average per year. (See Note 6).

The financial requirement for the execution of the Six-year Plan will amount to Bht 21.2 billion (about $1.1 billion), of which Bht 14.1 billion or 67.5% will be disbursed from the national budget. For the rest of requirement (32.5%), foreign grants and loans have to be sought.

The Plan allocates the largest portion (Bht 4 billion) of the above mentioned national budget (Bht 14.1 billion) to the agricultural projects (including fisheries, forestry and cooperatives).

The second largest amount (Bht 3.3 billion) is earmarked for the transport (road and railways) and communication.

With respect to manufacturing industry, the policy of the plan is to promote private industries by providing them with basic facilities in transport, communication and power, rather than direct investment or subsidy on the industry. Thus the allocation of the development budget to the manufacturing industry is only Bht 200 million out of Bht 14,100 million.

(2) Northeast Development Plan

As mentioned earlier, the Six-year National Development Plan set out the magnitude and basic lines of the economic development

of the country as a whole. Basing upon this national plan, the government prepared regional plans for more specific programs.

As the first regional plan, the government formulated the Northeast Development Plan which was approved by the cabinet in October, 1961. The Plan covers the period of five years starting from 1961. Plans for other regions are still under preparation. The government has reportedly formulated the plan for the North, but it has not been yet made public.

The Northeast is the most backward region of the country but is considered highly significant economically and politically. Being adjacent to Laos and Cambodia, the region, furthermore, has the largest military importance. The region is also the birth place of the present Prime Minister.

From these considerations, the government took up the Northeast as the first region for development planning.

The aim of the Northeast Development Plan, as manifested in the text of the plan, is "to raise the standard of living of the North-eastern people to the level comparable with other regions, bringing about greater welfare and happiness to the inhabitants of this region, and to lay down economic and social infrastructures for economic stability and progress".

To achieve this aim, the plan calls for various measures in the following fields to be undertaken jointly but in the descending order of priority.

1) Irrigation.

2) Traffic and communication.

3) Improvement of agriculture.

4) Electricity.

5) Trade.

6) Social welfare, included education.

The total expenditures for the Five-year Northeast Development Plan is estimated at about $300 million, including $190 million of expected loans and grants from abroad. The Government budget of $110 million consists of $50 million already included in the Six-year National Development Plan, and additional $60 million budgeted specifically for the Northeast Development.

The development outlays for 1962-1966 and source of finance with their sectoral allocation under the Northeast Development Plan are summarized in the following table.

(Unit in million baht)

Sector	Budget	Grants & Loans	Total	Ratio (%)
Traffic & Communication	657.0	1,870	2,527.0	42
Agriculture and cooperatives	788.1	1,121	1,909.1	32
Development, land use, public utility	325.2	456	781.2	13
Education	127.3	179.2	241.2	4
Public Welfare (Medical and sanitary facilities)	106.8	35	141.8	2
Manufacturing industry and power	127.3	301	438.3	7
Total	2,193.6	3,845	6,038.6	100
Equivalent (in US Million dollars)	110	190	300	

The total estimated cost of various projects for which foreign aids are are expected amounts to Bht 3,800 million. Of this amount, Bht 2,800 million will be loan in foreign currency and the rest (Bht 1,000 million) will be grants in the form of technical assistance.

The Thai government has already made requests to the World Bank and foreign governments for loans on various projects with considerable success.

Road construction in the Region is in active progress with American aid. Out of the seven multipurpose dams proposed in the Northeast Development Plan, loans have been given on three dams with U.S.A. and West Germany. The construction of Nam Pung Dam, which is another one of the seven, is reportedly scheduled to be financed from the Spcial Yen Account, and the Japan Electric Development Company has been engaged by the Thai government as the engineering consultant for the project.

Notes: -

1. Exchange rate is about $1 = Bht 20. The rate is stable.

2. The Role of Agriculture in Thailand; by Bunchana Atthakor, Secretary General of National Economic Development Board, Proceeding of the First Conference on Agricultural Economics, Feb. 14-17, 1962, Kasetsart University.

3. W.W. Rostow, the Stage of Economic Growth, Cambridge Univ. Press, 1961.

4. A Public Development Program for Thailand, Report of the Mission organized by the World Bank for Reconstruction and Development. P.109.

5. Japan Economic News (the Nippon Keizai), 3 May 1963.

III. OUTLINE OF AGRICULTURE

1. Natural Condition

The agriculture in Thailand, as in her neighboring countries, is heavily dependent upon natural rainfall.

Rice growing which is the mainstay of Thailand agriculture is possible only in rainy season (May - October) when the lands are submerged by the natural floods from rivers. Most of the upland crops also depend on natural rainfall in this season. Hence, agricultural production is almost suspended during the dry season which occupies the other half of the year. (See Note 1)

As mentioned earlier, agriculture in Thailand, with more than 80% of the total working force of the country, produces only 33% in value of the gross national product. This clearly indicates the lower productivity of labor in agriculture, compared with non-agriculture sectors.

This low productivity of agriculture is attributable in great measure to the involuntary unemployment, or under-employment at best, of farmers in dry season. This fact, on the other hand, suggests a great possibility of raising agricultural productivity by means of irrigation in dry season.

As shown in the separate chart (See Appendix A), the rainfall in Thailand, except the South, is concentrated upon the rainy season from May through October, with scarecely any in the dry season from December through March of the following year.

The year-to-year variations in the volume and timing of the rains seriously affect farm production, especially of rice.

The influence of temperature on agriculture is not significant because the yearly change and geological variation in temperature, as shown in the separate chart,B are much smaller than those of precipitation.

Generally speaking, soils are not rich in nutrients. According to the soil map (See Note 2), which classifies the soils throughout the country into 21 types, the Central Plain is covered mostly with fertile clay suitable for rice growing. The soils in Northeast are mostly light sandy loam and poor in nutrient. The alluvial zone of the North is covered by light sandy soils which is generally fertile.

2. Geographical Division of Agriculture

The Kingdom is divided into four regions, the Central, the North, the Northeast and the South. Due to the differences in natural conditions among these regions, the agricultural patterns also vary.

(1) The Central Region

The region occupies the flat alluvial zone formed by the Chao Phya River (See Note 3) and its tributaries, and constitutes the main, and the oldest, rice-producing area with 47% of the country's total area of rice. The region accounts for about 52% of the total rice output.

From the agricultural point of view, the Central Region can be divided further into three. The main part is the delta area long the lower Chao Phya (Bangkok Plain). Rice-growing is predominant on this delta, although some vegitables are grown in the surrounding areas of Bangkok for city market.

The upper plain of the northern part of the Central Region north of Nakon Sawan consists largely of the valleys and plains formed by such tributaries as Ping, Wang, Yom and Nan. Rice is extensively grown in lowland, but various upland crops are grown on higher areas.

The southern part on the boarder with Cambodia is hilly or undulating. Rice is the principal crop in this area, too, but upland crops especially cassava are extensively grown.

(2) The North

This is a mountainous region with scattered farm lands. Average farm size is the smallest of the four regions and the agriculture is intensive and diversified. Irrigation is most advanced in this region and many farmers practice double-cropping of rice or grow second crop in dry season.

(3) The Northeast

The Northeast region comprises a vast area of highland known as Khorat Plateau. Being sparsely inhabited, the average farm size is larger than in other regions. The rice production is widely distributed but the crop is uncertain and the yield is low because of uncontrolled water conditions and shortage of rain-fall. The agricultural development in this region should, therefore, directed toward promotion of upland farming and livestock raising.

(4) The South

The rain-fall is most abundant in this region. The annual precipitation generally ranges 1,300 - 3,000 m.m. In the western coast of the Malaya Peninsula, it amounts as much as 4,800 m.m. The rainfall is distributed more evenly throughout the year than other regions. This climatic condition favors for forest and tree crops, especially rubber and coconuts. Rice is grown on most of the plains and lower parts of the valleys, but the production is sufficient only for local consumption.

3. Land Use

Of the total land area of 510,000 square kilometers (about 1.4 times of Japan), 58% consists of forest and grazing land, 21% is unclassified and 20% or about one million hectares are farm land. The farm land consists of 67% of paddy fields, 16% of upland fields, 10% of fruits orchards and 6% for tree crops (rubber and coconuts). (See attached table C.)

The average size of farm, calculated on the basis of 3,410,000 farm families against 6,446,000 rai (about one million hectares) of total farm land, is 19 rais (3 hectares). Most of the farms range in size from 6 to 50 rai and are mostly operated by owner cultivators. Tenant

farmers represent about 17% of the total farm families and occupy 10% of the farm lands. Estate farming or plantation is rather exceptional in Thailand. Even rubber is mostly grown by owner farmers.

The area under irrigation is 10,130,000 rai, representing only 18% of the total cultivated area. (See Note 5). Even in these irrigated areas, water can be controlled only in rainy season for rice-growing. Irrigation in dry season is rarely possible except in the North.

No data are available of the area irrigated in dry season. But the Farm Economy Survey of 1953 indicated that 27% of the farm households surveyed in the North practiced second cropping; whereas the average figure for the whole country was only 12%. The area double cropped by these farmers were very small, only 0.33 rai (0.05 hectare) per farm on the average.

4. Agricultural Production

The agriculture of Thailand has for many centuries been predominantly of rice-monoculture. Production of other commercial crops, however, markedly increased in recent years. As the result, the relative importance of rice is gradually decreasing, although it still occupies 67% of the total cultivated area.

The production amount and planted area of various crops in Thailand are shown in the attached table C-2.

In order to analyze the production increase of various crops during the past 10 years, the index numbers of production and planted area for major crops are presented in the following table. The index numbers for each crop were computed on the basis of 1950 figures as 100. (See Note 6)

Agricultural Production Index of Thailand (1950 = 100)

	Area	Production
Rice	107	115
Maize	818	2,015
Mang beans	129	163
Cassava	526	472
Sugar canes	293	641
Castor beans	730	1,344
Peanut	167	242
Sesame seed	114	196
Soya beans	113	221
Coconut	222	268
Raw cotton	152	224
Jute	144	248
Kenaf	2,826	2,857
Garden crops	157	182
Fruit	154	184
Crude rubber	130	149
Tobacco leaves	191	348

All crops listed above showed increase in the ten years period both in area and production. In particular, kenaf production increased 28 times, maize 20 times, caster beans 13 times, sugar canes 6 times and cassava 5 times. Among these crops, the production increase of cassava and kenaf was due to the expansion of planted area. For other crops, notably maiz, the increase in production was attributable both to the expansion of area and the increase in yield.

Rice production was stagnant both in area and yield. The average yield of rice in Thailand is 1,370 kg. per hectare: less than one third of the yield in Japan and among the lowest in Southeast Asia. In contrast to rice, the yield of maize in Thailand, 1,380 kg. on an average, is the highest in the region, although slightly lower than in Japan.

The explanations on the low yield of rice and the contrasting high yield of maize in Thailand will be given in the following chapter.

5. Farmers

Farmers in Thailand are mostly owner-cultivators. They depend mainly on their family labor for farming, although supplemental labors are also employed in busy season.

There is a wide-spread conception among foreign observers that farmers in Southeast Asia are contented people and unwilling to work. Even among Thais, such opinion is held of their farmers. (See Note 7)

The fact remains, however, that Thai farmers, by their initiative, rapidly increased the production of such crops as maize and kenaf when they found these crops sell. They are responsive to economic stimuli, not necessarily contented with present low income.

It is true that most of farmers live idle during the dry season, but it is only because no crop can be grown. Lack of profitable markets also causes involuntary idleness of farmers.

In regard to the education level of Thailand farmers, it can be estimated from available data (see Note 8) that about half of the farmers of age from 45 to 49 have never attended school. Among younger generation, 30 to 35 years of age, those who have never attended school decrease in number to 20%. According to another survey made in 1958 in the Central Plain, 68% of the farmers in that region had received school education. (See Note 9)

6. Production Means

Farm implements commonly used by Thai farmers are simple and rather primitive, consisting of spade, hoe, and sickle. Buffaloes or cows are widely used as draft animals. Capital investment in use of machines is limited to the large scale farms (more than 5 hectares), although the number of tractors in use is increasing recently.

Fertilizers are used only for such profitable cash crops as vegetable, fruits and tobacco, and are rarely applied to the principal food crops, i.e., rice and maize.

Experiments on fertilizer effects to rice and maize have shown good results in various parts of the country (See Note 10), but the present price relationship between fertilizers and the crops prohibits the wide use by farmers of fertilizers for these crops. Moreover, application of fertilizers to paddy fields involves a great economic risk, as the rice culture in Thailand depends heavily upon the vagary of natural rainfall.

Fertilizers may be used profitably for rice in the Central Plain where the price of rice is high and that of fertilizers is comparatively low. The water control in that area also favors for the fertilizer application.

Note:

(1) The Soils of Thailand: Robert L. Pendleton and Sarot Montrokun. Technical Bulletin, Department of Rice, Ministry of Agriculture, 1960.

(2) This river is generally called the Menam by foreigners. But what is meant by the word is originally "river" in the Thai language. The correct name should be River Chapia.

(3) Agricultural statistics of Thailand, 1961. One rai correspondents to 0.16 hectare.

(4) Agricultural Statistics of Farmland, 1961. Table

(5) These production figures are referred to the Statistics as of 1955/56 to 1959/60, by FAO.

(6)

(7) Report of the Demographic and Economic Survey, 1954.

(8) Udis Nark-swadi, Kasetsard Univ., Farm Management Problem in Thailand, Journal Research Council of Thailand, Vol. 2 No.4, December 1961.

(9) Report of Experiment in Fertilization in Thailand, by Japan Chemical Fertilizer Export Promotion Association, Issue II, 1959.

Reference Notes

1) i. Some Aspects of Monsoonal Rain in Thailand: Journal of the National Research Council of Thailand, Vol.2, No.2, May 1961.

   ii. Hydrologic Features of River Basin in Thailand: Journal of the National Research Council, Vol.2, No.1, Feb. 1961.

2) The Soils of Thailand: Robert L. Pendleton and Sarot Montrakun, Technical Bulletin, Department of Rice, Ministry of Agriculture, 1960.

3) This river is generally called by foreigners "Menam River". But since Menan in Thai language means river, it should be called Chaopia River or Menam Chaopia.

4) Agricultural Statistics of Thailand, 1961, Table 109.
1 rai = 0.16 hectare

5) Above statistics, Table 108.

6) Index figures were computed by USOM, Bangkok from Agricultural Statistics of Thailand, and included in an report entitled "An Agricultural Plan for Thailand Proposed to Begin in 1963", compiled by David G. White, USOM, Agricultural Research Advisor.

7) Farm Management Problem in Thailand: Udhis Narkswasdi, Kasetsard Univ., Journal of the National Research Council of Thailand, Vol.2, No.4, Dec. 1961.

8) The Role of the Farmer in the Economic Development of Thailand: Gordon R. Sitton, CECA Paper, Sept. 1962 issued by the Council on Economic and Cultural Affairs Inc.

9) Farm Management Problem in Thailand: Udhis Narkswardi.

10) Report on Fertilizer Application in Thailand (in Japanese): Japan Chemical Fertilizers Export Promotion Association, April 1959.

Attached Tables

A

Regional and Seasonal Distribution of Precipitation

	North	Central	North East	South	
				East	West
January	6.4	7.5	4.5	126.0	31.0
February	7.5	20.4	16.5	48.3	37.8
March	16.5	31.2	51.6	65.9	71.3
April	63.0	84.4	94.4	98.2	178.0
May	145.0	143.7	175.8	133.4	277.6
June	156.8	158.4	177.0	118.7	342.6
July	196.3	191.9	183.0	110.3	332.0
August	226.3	171.2	211.5	125.2	363.3
September	239.3	300.2	255.9	154.0	423.3
October	111.3	174.3	123.6	249.2	304.1
November	43.0	66.5	33.9	350.7	184.5
December	7.0	9.9	3.0	295.2	60.1
Total	1,218.6	1,359.6	1,330.7	1,875.1	2,605.6

B

Temperature

	Maximum	Minimum	Average	Differencial
North (Chiengmai)	(June) 27.5	(January) 21.9	25.8	6.9
Central (Bangkok)	(May) 29.5	(December) 25.3	27.7	4.2

C. Land Use

(1) Land Classification

	North		Northeast		Central		South		Total	
		%		%		%		%		%
Land in farm	4,692	8.23	22,585	21.63	28,340	24.62	8,846	19.79	64,463	20.07
Forest	34,188	59.91	64,165	61.45	65,539	56.96	23,634	52.87	187,526	58.37
Marshland	19	0.03	396	0.38	255	0.22	626	1.40	1,296	0.40
Others	18,163	31.83	17,269	16.54	20,939	18.20	11,594	25.94	67,965	21.16
Total	57,062	100.00	104,415	100.00	115,073	100.00	44,700	100.00	321,250	100.00

Source: Agricultural Statistics of Thailand., 1961.

(2) Classification of Land in Farm by Crops

	North		Northeast		Central		South		Total	
		%		%		%		%		%
Rice	2,589	55.18	14,772	65.40	17,720	62.57	2,869	32.42	37,948	58.88
Rubber and Coconuts	23	0.49	38	0.16	456	1.60	2,903	32.81	3,420	5.31
Fruits	1,013	21.59	1,515	6.70	2,029	7.14	1,519	17.17	6,076	9.42
Upland Crops	666	14.19	3,705	16.43	4,284	15.11	368	4.16	9,023	13.99
Woodlands for Farm use	131	2.79	1,828	8.09	2,052	7.24	515	5.82	4,526	7.02
Others	270	5.76	727	3.22	1,799	6.34	674	7.62	3,470	5.38
Total	4,692	100.00	22,585	100.00	28,340	100.00	8,846	100.00	64,463	100.00

Source:The Same (1)

D. Planted Areas and Production of Major Crops

Unit: Area in 1,000 rai

Production in 1,000 m.t.

	Planted area	Production
Rice (Unhasked)	37,948	7,845
Maize	1,916	598
Cassava	621	Roots 1,726
		Flour 287
Sugar Cane	776	3,984
Oil Crops	1,786	367
Fiber Crops	2,389	622
Vegitables	565	435
Fruits	948	1,213
Rubber	2,621	186
Tabacco	256	48
Total	50,055	15,625

Source : Agricultural Statistics of Thailand , 1961.

IV. MAIN CROPS

Under this chapter, the discussions will be attempted to be carried on in relation to the main farm crops in Thailand, chiefly from the technical viewpoints.

Though rice is the most important farm crop item in Thailand, it will be described here rather briefly, because several reports have already been made by authors (Note 1) and because our Mission placed stress chiefly on the survey of upland crops.

The rubber crop, most important next to rice crop, has from the outset been excluded from our Mission's survey purposes for the reason that the rubber production is confined to the southern part of the country not falling on our Mission's survey schedule and partly due to the fact that we are lacking in knowhow about rubber planting. However, when taken into consideration the Japanese cooperation in rubber industry in the future, it may become necessary for Japan to despatch a special Mission to Thailand.

Out of upland crops, such crops as maize, sugar cane, beans, cassava, cotton, kenaf (ambari), jute, rammy, and cocoons were taken up as the survey items of our Mission. Out of them, maize, cassava and kenaf are newly-developed exported crops in Thailand in contrast with rice and rubber which are her traditional exported farm crops. In recent years, it shows a marked increase in the production of the latter. Particularly, maize being the very crop in which much interest is taken by Japan, the greatest purchasing country in the world, we tried to describe in detail as far as possible. We have made not only the technical survey but also attempted to make clear its shipping and exporting situations.

Sugar cane and cotton are regarded as very important industrial crops for the purpose of developing the sugar industry or spinning industry in future Thailand. At the same time such crops are connected closely with the Japanese industrial cooperation with Thailand. Cassava is also an important export crop item and by using this crop, the development of various food industries may become possible as well.

Silkworm cocoon production was taken up by our Mission in view of the rising world demand for Thailand silk as well as in view of the possibility of rendering the Japanese industrial cooperation to this country.

Although peanuts and green beans are exportable, the planting of legume is significant for the purpose of crop rotation practice from the viewpoint of soil fertility conservation.

1. PADDY RICE

(1) Production

The planting area in 1961 reached 37,950,000 rai (6,070,000 hectares), the harvested area 35,340,000 rai (5,650,000 hectares) and paddy output 7,850,000 tons. Though the area is fairly wide, average yield is very low, being 222 kgs. per rai (138 kgs per 10 ares).

Table 1. Paddy Yields in the Leading Rice Producing Countries (1960)

Country	Average yield per rai	Average yield per ha.
Thailand	220 kgs.	1,375 kgs.
Burma	259	1,618
Malaya	396	2,475
The Philippines	185	1,156
Taiwan	497	3,106
Japan	777	4,856
U.S.A.	614	3,838
Brazil	271	1,694
Spain	876	5,475
Italy	768	4,800
India	244	1,525
Pakistan	256	1,600

Sources: Agricultural Statistics of Thailand, 1961.

In 1960, approximately 1,580,000 tons of rice were exported. The exports amounted to about 3,600 million baht, or 36 per cent of the total exports (about 10,000 million baht) in Thailand. Rice ranks first in the export crop items from Thailand. Thai rice is destined mainly for Singapore, Hong Kong and Indonesia.

Rice planting is chiefly practised in the central plain area in the basin of the Chao Phya River and in the basin of the Mekong River and its tributaries in the northeastern part of the country, and relatively low in rice production in the northern and southern parts of the country (Table 2).

Table 2. Rice Production, by Areas (1961)

Area	Planted area	Production
Northern part	2,589,000 rai	810,000 tons
N E part	14,772,000	2,247,000
Central plain	17,720,000	4,101,000
Southern part	2,867,000	678,000

Source: Agricultural Statistics of Thailand, 1961.

Note: 1 rai = 0.16 hectare.

Rain water is the only irrigation water source, except for the central plain area where creeks have ramified, and the northern part, or a part equipped with irrigation facilities. In dry spell years, it suffers from want of rain, while in wet spell years, it suffers from flood damage. Besides, the rice production shows a sharp

decrease owing to the damage by diseases and insect pests. In most years, some 10 per cent decrease in production is resulted in. In the northern part where is favored with irrigation water, rice is planted twice in the same year or a double cropping practice is permissible.

(2) Cultural Techniques

i. Rice varieties

Rice varieties are mostly of *indica* type. Rice is divided into two kinds: non-glutinous one and glutinous one. Non-glutinous rice is grown mainly in the delta area in the central part of the country, constituting a great part of the exported rice. Glutinous rice is grown mainly in the northern or north-eastern parts of the country and consumed by the people in the local districts, but with the progress in commercialization, it is becoming replaced by the non-glutinous rice planting. The maturity of rice differs according to the varieties, i.e., it takes 120 - 140 days in the case of early-maturing varieties, 140 - 160 days in the case of medium-maturing ones, and as many as 160 - 180 days in the case of late-maturing ones.

In Thailand, the rice breeding program has been pushed forward since 1916, but it is after 1950 that the modern breeding experiment work was started. Since that year, new variety selection tests have been carried on based upon the results of comparative tests between native and foreign varieties as well as upon the pure line selection method or the hybridization techniques. Thus the recommended varieties have been designated according to the planting areas, and their propagation or extension has been carried on. On the lower level land in Ayudya in the central plain, in view of the fact that paddy fields are brought under deep submergence due to the river flood in rainy season every year, a floating-rice planting system is practised. The tests for its technical improvement are now under way at the Rangsit Experiment Station.

ii. Rice cultural methods

A direct-sowing method is practised in paddy fields (accounting for about 20 per cent of the total) lying in the deep submerged areas or in the floating-rice planting areas. Seeds are broadcasted in late May - early June when the rainy season sets in. If it rains heavily after sowing, the paddy field soils would become hard and seedlings would be affected adversely. If met with dry spell, the germination would become poor. Little or no care-taking is done after the seeding.

The rice growing by means of transplanting practice is prevalent in the paddy fields constituting about 80 per cent of the total. Flat nurseries are prepared by plowing, paddling and levelling. Germinated seeds are sown to the dried nurseries. As a principle, 30-day old seedlings are recommended as suitable ones for transplanting, but older ones are apt to be transplanted due partly to the lack of rain water.

For transplanting the seedlings, some of their blades are cut. They are planted at the intervals of 30 cm x 30 cm, but the uniform space between hills and between rows is not maintained. Clumps of 5 or 6 seedlings are planted in each hill.

For weeding, only tall grasses are weeded and discarded or trampled into the mud of the field. Little or no other care-taking is done.

For harvesting, it is usual to cut off the rice plant at the part of 30 - 45 cm long from the panicle.

(Note) The cutting is prevalent not only in Thailand but also in countries in Southeastern Asia. For this reason, the use of threshers of Japanese type is not permissible.

(3) Problems of Rice Planting in Thailand

The national economy in Thailand can be said to have been supported by rice exports, but with the increase in its population at the rate of about 3 per cent per year, the domestic consumption of rice is on the increase every year. If the rice production remains as it is, the rice export availability could not but decrease. It is reported that there is a fear that the rice export availability in ten years ahead will show a decrease to 400,000 - 700,000 tons a year. The instability of rice crop due to the dry or wet spell is also an important problem which cannot be overlooked.

From the viewpoint of the current farmland conditions in Thailand, the rice acreage seems to have nearly reached the limit. As a result, in order to develop rice cropping in future Thailand, it is deemed rather important to improve land productivity than to expand the area of rice fields. For this purpose, the Government of Thailand, under the leadership of the Rice Bureau or the Irrigation Bureau, is now driving the irrigation program and pushing ahead the experiment works in such phases as rice breeding, fertilizer applications, disease and insect pest control, introduction of improved farm machinery and implements, and improvement in rice cultural methods, and is giving encouragement in the extension of improved techniques. About all, the problems in relation to irrigation, rice breeding and fertilizer application improvements are taken up as particularly important ones to be tackled.

(a) Irrigation projects

On completion of irrigation projects in the central plain area and the building of reservoirs in the northeastern part of the country (see VI-3), a great part of problems of instability and low productivity of rice cropping in Thailand could be solved immediately. And owing to the improved water control, the yield of rice is expected to be increased by 10 per cent on an average. The completion of irrigation facilities not only contributes to the prevention from rice production decrease caused by drought or floods but also gives help in adopting the improved techniques for fertilizer applications and other care-taking by means of better adjustment of irrigation water. Thus, in parallel with the introduction of improved cultural techniques, it will make possible a marked increase in rice production. However, for this

purpose, the comprehensive experiment study on rice cultural techniques is indispensable. As to this matter, it will be described later.

(b) Rice breeding

As already described before, the selection and extension of superior varieties are now conducted at the Experiment Stations and seed farms belonging to the Rice Bureau.

(c) Fertilizer applications

The greatest cause for the low land productivity can be found in the poor soil fertility. Therefore, the education of fertilizer application techniques is very important. As to the fertilizer application techniques, the nation-wide experiments have been carried on since 1950 through the US technical assistance, and it has been clarified that the effect of phosphates is great and that the effect of nitrogen becomes greater according to the application of phosphates. In 1958, the Japan Fertilizer Service Centre was also opened in Bangkok and the effect of fused phosphates was made clear. For the purpose of extension, fertilizer application demonstration farms were also opened, but the paddy fields to which chemical fertilizer has been applied account for as low as 1.6 per cent of the total. This is partly due to the fact that even if more rice could be produced by the increased application of expensive fertilizers, it would not pay because the price of rice is fixed at an unduly low level from the viewpoint of the government special policy for rice export promotion, and partly due to the fact that even if fertilizer is applied to paddy fields, the fertilizer would easily be carried away by a flood because of the lack of effective water control. However, with the completion of irrigation and drainage facilities, fertilizer application practice is expected to become increasingly popular.

(d) Other matters

Disease and insect pest control is now encouraged by the Rice Bureau by providing the Government subsidy and by supervising the local government officials in charge, but the control is now practised only in the limited area. Besides paddy borer, among other insect pests are rice midge, purplish stem borer, grasshopper, land crab, etc. Among the diseases are blast, Helminthosporium leaf spot, or sheath spot, but the damage by these diseases is relatively slight. Improvement of disease and insect pest control and introduction of improved machinery and implements are also important problems to be tackled in the future.

2. MAIZE (Indian Corn)

(1) Production

i. Annual changes in production

Maize production is on the increase year after year from 1949 on (see graph 1), particularly rapid increase has been made since 1958 owing to the marked increase in exports to Japan.

As seen in Graph 1, the increased production has been resulted from the increase both in the planted areas and yields. The planted areas showed a particularly marked increase in 1959 and 1960. The yield is on the steady increase every year from 1951 onward. An increasing trend in rate is as given in Table 3. The yield in 1961 is as high as 2.5 times that in 1950. As to the reliability of such statistical figures, some doubt is entertained, but such increased production can be attributed to the maize breeding program as described later.

Graph 1. Trend in Maize Production

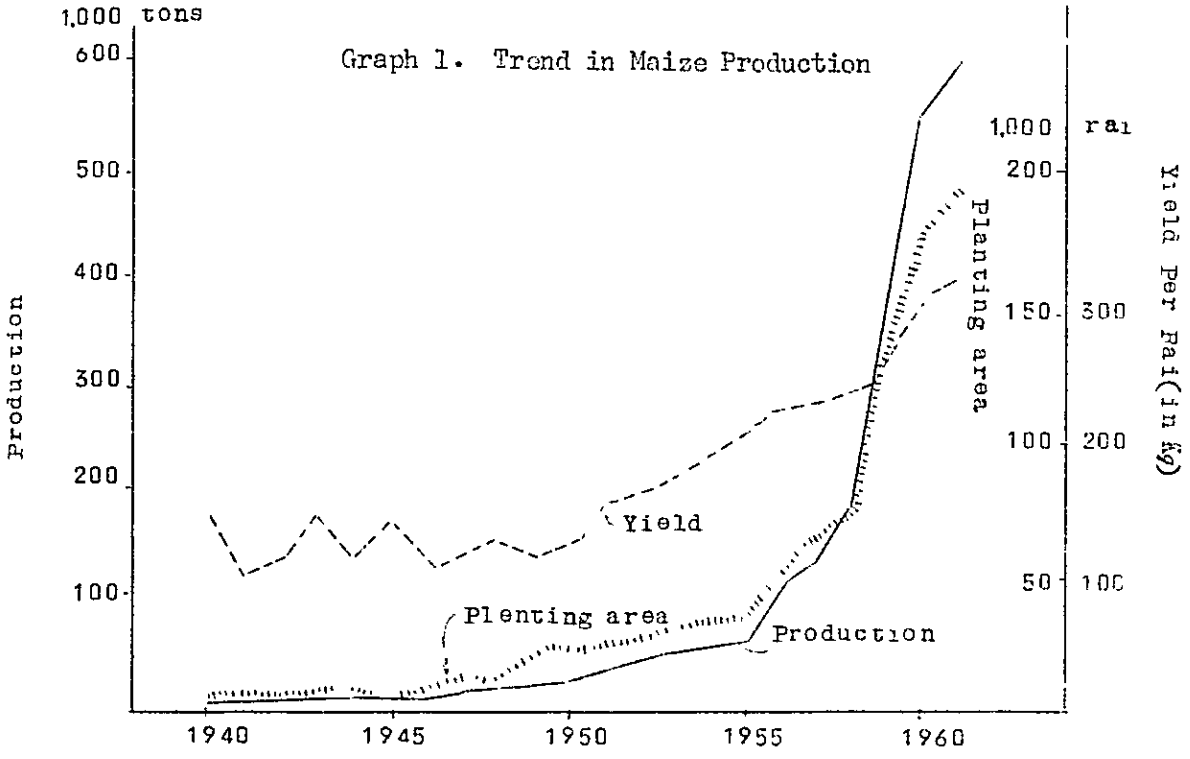


Table 3. Increase in Yields and Production of Maize

Year	Planting area (1,000 rai)	Yield (kg/rai)	Production (1,000 tons)
1950	218 (100)	127 (100)	26.9 (100)
1957	606 (278) (100)	229 (180) (100)	136.7 (508) (100)
1961	1,916 (879) (316)	321 (253) (140)	598.3 (2,224) (438)

Notes: (1) Upper parenthesized figures indicate index (1950 = 100)

(2) Lower parenthesized figures indicate index (1957 = 100)

ii. Production distribution by regions.

For maize growing, higher temperature, much sunshine, optimum rainfall in the growing period, and dry spell in the maturing season are preferable. Maize shows relatively great adaptability for any soils, and newly-reclaimed farms with deeper surface soils containing somewhat higher moisture are suited best, but infertile lands are undesirable. From such viewpoints, almost all the uplands in Thailand are regarded as suitable for maize growing, if the soils are fertile and contain moisture to some extent.

Graph 2 and Table 4 indicate the 1957 and 1960 maize production distribution, and an increasing trend in production according to the provinces in Thailand. Maize is grown mostly in the provinces in the central plain area and in the northeastern part in the basin of the Chao Phya River. In 1960, three provinces such as Salaburi, Lopburi and Nakornrajsima were the greatest maize producing provinces, followed by Nakornsawan, Pitoanulok, etc. Out of these provinces, three provinces such as Salaburi, Nakornrajsima and Nakornsawan were the major producing ones in 1957 also. Maize production in Lopburi in about 1957 was very minor, but after that it showed a rapid increase. Fairly marked increase was shown also in other provinces in the central plain area and in the northeastern part of the country. Such production distribution indicates that the convenience for transportation of farm products has an important bearing upon the qualifications for suitable maize growing areas. In recent years, the rapid increase in maize production has been seen in the upland area near-by Bangkok as well as in the hinterland areas lying in the north and northeast of Bangkok, and the rapid expansion of maize growing in the northeast is attributed greatly to the result of the completion of the trunk roads, including Friendship Highway. In recent years, however, the maize growing in the areas along the trunk roads is rather on the decrease owing to the soil depletion. It is reported that the growing in somewhat inaccessible lands is becoming greater. The same is heard of the production in Prabudabaht area in Salaburi. We learned that many farmers have flowed out into other areas by giving up their farms on account of recent diminishing in the land productivity.

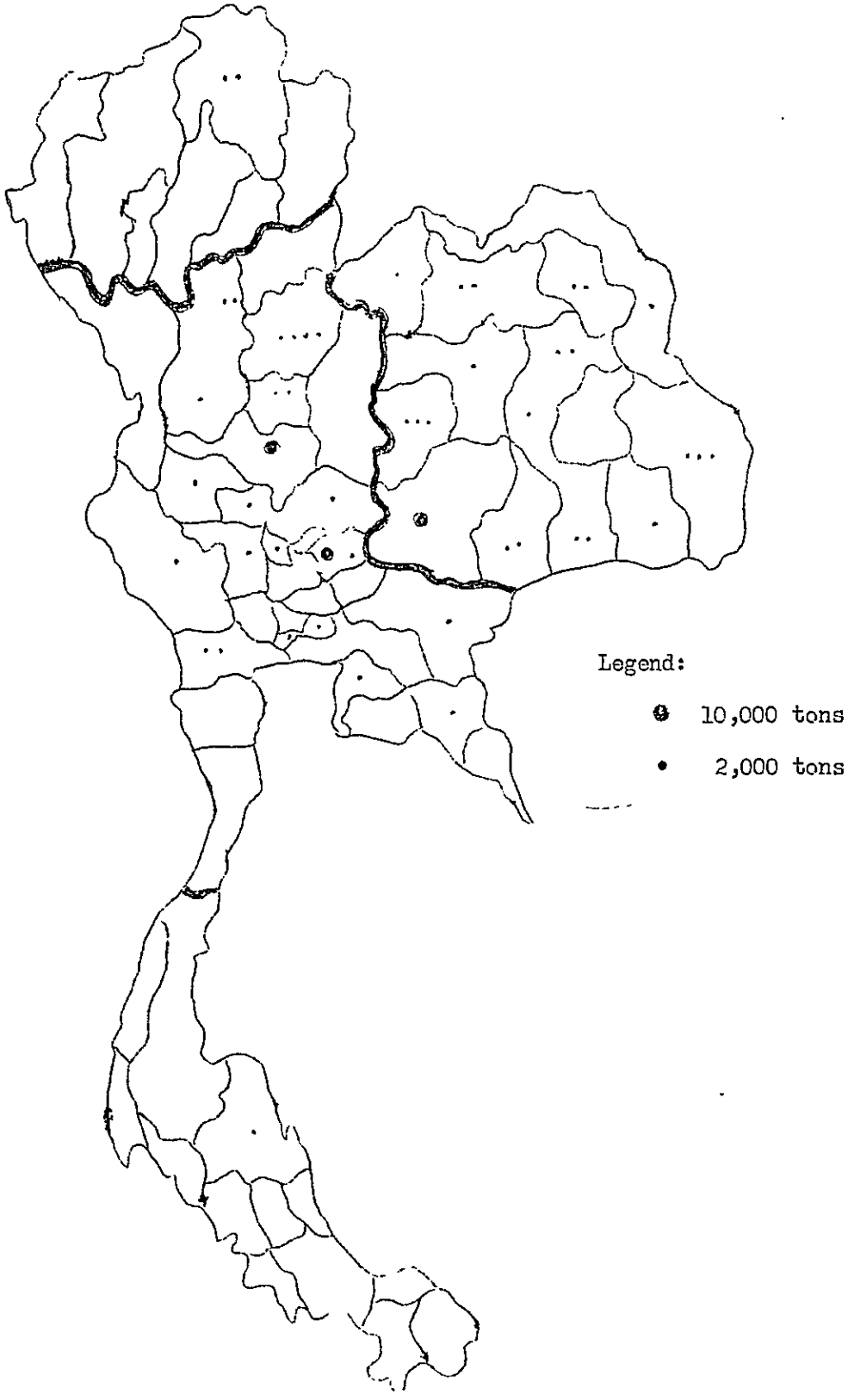
(2) Cultural Techniques

Connected with the techniques of maize production, the problems such as varieties, growing season, fertilizer applications, disease and insect pest control, crop rotation practice, etc. are of the particularly importance.

i. Varieties

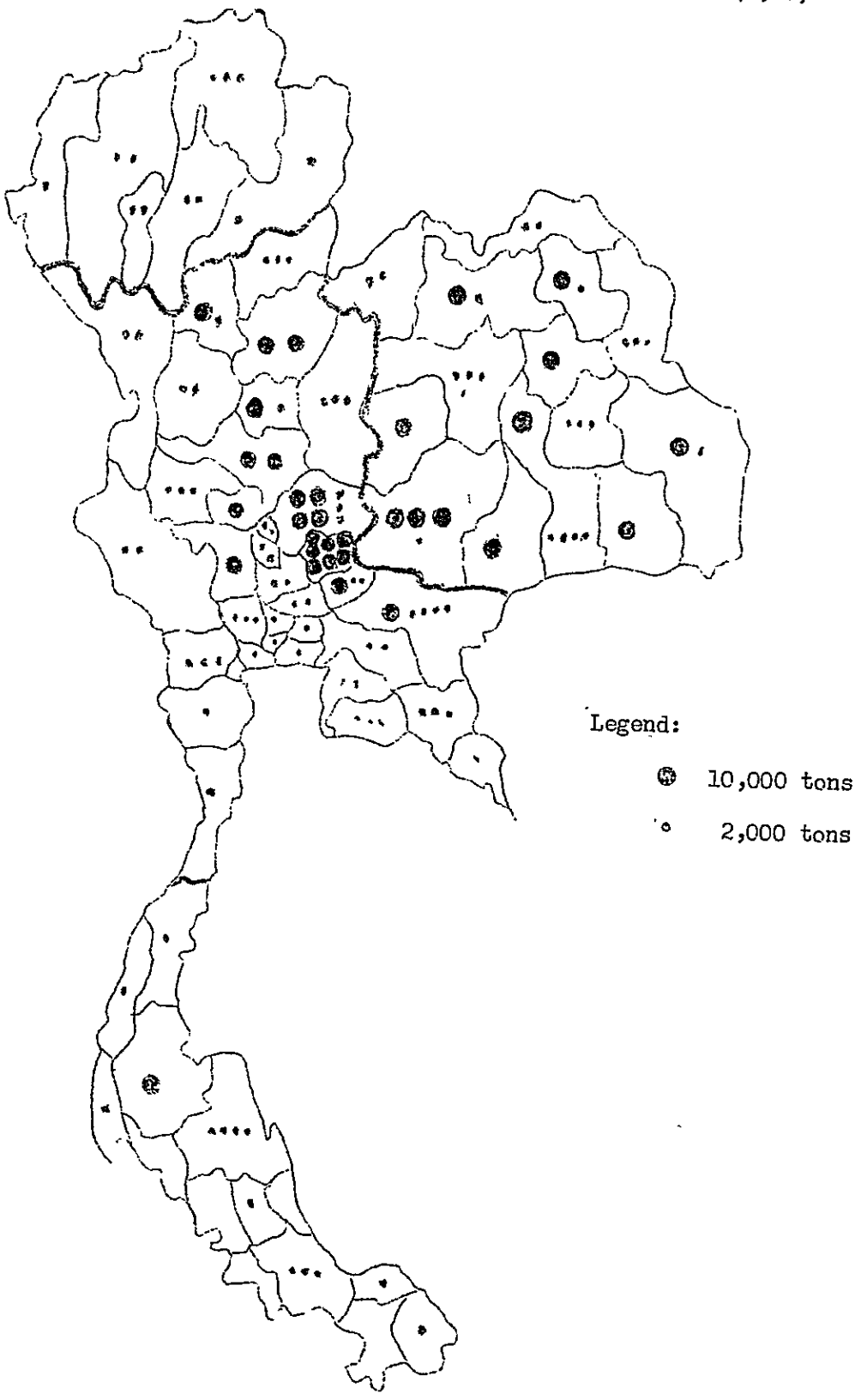
It is needless to say that plant breeding contributes much to the increased crop production, decreased production cost, and quality improvement. Superior quality varieties can easily be adopted even by poor farmers because the superior quality seeds have an advantage in that they can be obtained at a low cost, in comparison with fertilizers, agricultural chemicals, farm machinery and implements, etc. For this reason, Thailand is stressing most on the crop breeding project as the first step

Graph 2-(1) Maize Production, By Provinces (1957)



Source: Agricultural Statistics of Thailand.

Graph 2-(2) Maize Production, By Provinces (1960)



Source: Agricultural Statistics of Thailand.

Table 4. Comparison of Maize Production between 1957 and 1960 (Tons)

Ranking (1960)	Province	Production		Increase	Increasing rate (%)
		1960	1957		
	Total	543,935	136,757	407,178	398
1	Salaburi	70,744	11,223	59,521	630
2	Lopburi	46,320	1,407	44,913	329.2
3	Nakornrajsima	31,477	10,356	21,121	304
4	Nakornsawrn	21,215	9,471	11,744	224
5	Pitoanulok	20,988	7,809	13,179	269
6	Prachinburi	17,558	1,983	15,575	885
7	Nakonnayok	13,175	967	12,408	171.8
8	Ubolrajadhani	12,837	5,764	7,073	223
9	Pichit	12,724	4,497	8,227	283
10	Sukhothai	12,662	3,941	8,721	321
11	Udornthani	11,694	4,419	7,257	265
12	Sakglnokorn	11,507	4,564	6,943	252
13	Burium	10,631	4,685	5,946	227
14	Chainat	10,321	2,367	7,954	436
15	Kalasin	10,301	4,438	5,863	232
16	Chaiyapoon	10,126	5,655	4,471	179
17	Supanburi	9,701	2,241	7,460	433
18	Sisaket	9,205	2,584	6,621	356
19	Mahasarakam	9,005	2,363	6,642	381
20	Surin	8,595	3,019	5,576	285

Note: The rest is omitted.

to the agricultural technique improvement. Above all, the progress of the maize breeding work has been made markedly. In this respect, notable difference is found from Burma or Cambodia where the crop breeding work has been started quite recently.

The maize breeding work in Thailand has been pushed forward since 1950 mainly under the USOM technical assistance program. As a result, Guatemala Variety was selected first and has been extended widely, thus contributing greatly to the present rapid increase in maize production in Thailand. As to the increased production of maize in Thailand, the effect of the USOM technical assistance program seems to be appreciated highly, notwithstanding that it owes substantially much to the increased imports from Japan. Connected with this, Japan should take into consideration the fact that Japan lagged far behind other countries in extending the agricultural technical assistance to Thailand. At present, almost all the native varieties have come to be replaced by Guatemala Variety, but native flint corn (yellow small kernels) are still now grown in Nakornsawan area. It is said that the flint corn is sold at price by 5 - 10 per cent higher than other varieties because it is suited best for feeds of pegions. Hawaiian Sugar Variety of the introduced sweet-corn strain is also grown as the second crop on paddy fields.

Guatemala Variety, as implied by the name, was selected in Guatemala from the subsequent generations of Guatemala golden flint hybrid between Cuban golden flint and Antigue yellow dent, and in 1950 it was imported to Thailand through Indonesia and in 1951 it was imported directly from Guatemala. After trial culture, Guatemala C-110 strain was selected and has been extended widely. However, being a hybrid, the segregation of its characters is liable to occur frequently. As a result, original Guatemala C-110 strain has become impossible to be identified. Guatemala Variety segregates into flint, dent and intermediate types. In general, ears of flint type are short and the yield is low, while ears of dent type are long and the yield is high. For this reason, high yielding dent corns are mostly selected by general farmers as seed purposes. In consequence, dent type is on the increase. But since dent type corns are not welcome by buyers, attention is paid by the Government so as to keep the intermediate type maize as seeds because this type is of comparatively superior quality with higher yields, but the yield is lower than dent type one. Therefore, the maize specialists in Thailand are anxious to know the allowable limit of dent type maize to meet the import requirements on the part of Japanese consumers. A further description will be made in Item iii (quality).

In view of the importance of the maize breeding work, from 1962 on the work has come to be pushed forward with close cooperation among the Agricultural Bureau, Kasetsart University, USOM and the Rockefeller Foundation. Agricultural Bureau Director Loem takes the highest responsibility for this work (Note 2).

Thus the breeding work by the controlled mass selection is

under way at 11 experiment stations and seed propagating farms, the breeding work by means of double crossing is under way at Tha Pra and Prabudhabat Experiment Stations, and the breeding work under the synthetic variety development system by using Caribbean Variety is now conducted at Prabudhabat and Bangken Experiment Stations. In addition, the trial cultivation of overseas varieties are also carried on. Four varieties of F_1 hybrid corns selected in Japan are also tested. Yellow Corn No.3 showed a 33 per cent increase in yield over Guatemala Variety, but the kernels being closely resemble dent type one, it is not welcome on the Thailand market. But the Japanese varieties became notable in Burma, since high yields were proved in a short growing period when they were submitted to trial cultivation in Meiktila Experiment Farm (Note 3). Now is the good time for Thailand to begin to attempt the breeding tests of the Japanese maize varieties by taking due consideration into account the time of planting.

ii. Cultural methods

(a) Time of Planting

According to the experiment results, early May to June or mid-July to August is regarded as the generally-accepted seeding season. The results differ somewhat according to the years and areas. In Nakornrajsima, maize is permissible to grow twice a year, for doing so, it is desirable to seed till the end of April provided that it rains. If delayed, the second seeding should be done in September when it sets in heavy rainy season. When our Mission happened to pass through this area late in March, the seeding was being done immediately after rain. Maize is harvested 100-110 days after seeding. The maize seeded in the May-June period is harvested in the September-October period falling on the rainy season. As a result, maize is forced to be shipped in a semi-dried state. For this reason, buyers wish to obtain such maize as seeded in the July-August period and harvested in the November-December period. In such growing season, leguminous crops can be cultivated as the first crops in order to maintain soil fertility, because maize is a soil-depleting crop. From the viewpoint of the crop rotations, the legume cropping is also important.

(b) Seeding methods

Among the seeding methods are: (i) seeding in the holes digged with wood stick; (ii) seeding in the holes digged with hoe; (iii) dotting immediately after plowing; and (iv) seeding by using a seeding machine.

Note: It is recommended to maintain the spacing ranging 80-100 cm between rows and 50 - 80 cm between hills, and to grow two or three plants for each hill, but it is usually seeded at random at the intervals of about 80 - 100 cm. Pictures 6-A and 6-B (taken by our Mission) are the seeding done near Korat area. Four or five seeds are sown in a hole digged with wood stick at about one meter interval, and after seeding, seeds are covered with earth by treading.

(c) Fertilizer Application

Although the Agricultural Bureau encourages to apply a mixed fertilizer, a 12-12-6 fertilizer, i.e., containing 12 per cent of nitrogen (N), 12 per cent of phosphoric acid (P_2O_5), and 6 per cent of potash (K_2O), at the rate of some 50 kgs per rai, farmers, except rich farmers, apply no fertilizers. It is reported that most of the poor class farmers in Prabudhabat area would cultivate maize two or three years on the newly-reclaimed farms without fertilizer applications and when it shows a marked decrease in the harvest due to the soil-depletion, they would flow into other places, abandoning their soil-depleted farms. We heard that in this area red soils are depleted more severely than black soils. In order to improve such shifting agricultural system, it is necessary to strengthen the positive study as to the fertilizer application methods and crop rotations.

(d) Diseases and Insect Pests

An Agricultural Bureau specialist informed us that leaf blight (Helmint-hosporium turcicum Passerini) is the chief disease and other serious diseases are also found, but kernels damaged by smut (Ustilago Zeal - Beckm - UNGER) were found recently in the samples collected by the OMIC. It is reported that smut was also found in the farms in Salaburi area. If damaged kernels should mix in the lot, the commercial value of maize would be affected seriously. Attention must be paid so as to prevent the spread of diseases by removing or burning the infected plants at the earliest possible time.

Corn borers (Pyrausta nubilalis HÜBNER) and corn worms (Cirphis unipuncta HAWORTH) are the main insect pests, but their damage is not so serious at present.

iii Quality

The greater part of maize is exported. Importance is attached to moisture-content, insect pest damage and quality. Regarding moisture-content and insect pest damage, please refer to the detailed report made by the OMIC (Note 7). We described before that Guatemala Variety is becoming shifted to dent type. Such trend is found also in the lots collected. The OMIC informs that kernels of Thai maize are becoming larger in size and becoming less yellowish in color due to the mixture of whitish kernels. Maize specialists in Thailand are now deeply interested in the fact that what quality of kernels is suited for the exportation. Connected with this, they are earnestly anxious to know the target of maize breeding. About this matter, we asked for the views of one or two Japanese experts and their views were as follows:

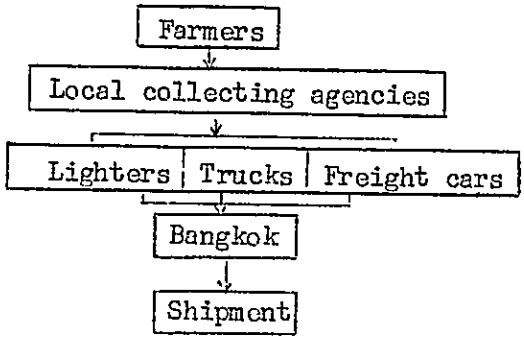
It is true that Japanese poultry raisers in general care much rather for dark yellow flint type maize in order to produce eggs of better-colored yolk, but as someone holds an opinion that the yolk color is affected rather by xanthophyll

than by carotene, poultry raisers seem to stick unduly to the color of kernels of maize. Importers in West Japan attach a particular importance to the kernel color. Though such tendency may become lessened gradually, it will be unavoidable for the time being to attach importance to the kernel color. At present, dent type maize is imported to Japan from the USA, Rumania and China, and red-yellowish or yellowish flint type maize from Thailand, Argentina, South Africa, etc. The greater part of the imported maize is of flint type. American maize is lowest in prices and Thai maize is appreciated highly on account of the yellowish flint type. In order to compete successfully with other countries, it is important for Thailand to maintain the reputation of Thai maize. Regarding the degree of kernel colors, any special standards are not set up, but the intermediate type maize among those samples as offered by Thailand to our Mission was recognized by the experts as permissible.

(3) Marketing

i. Trading in maize

Particulars about marketing situation and the problems of marketing of Thai maize are described in detail in the "Report of the Survey Mission for the Promotion of Purchases of Primary Products in Thailand" made by the Mission sent in 1962 as well as in the OMIC's Report (Note 5). The marketing channels of Thai maize are illustrated below.



Maize is collected from farmers by local collecting agencies (in most cases, Overseas Chinese merchants) and transported to importers in Bangkok by lighter, truck or freight car. According to the Primary Products Survey Mission's Report, 80 per cent of the total maize shipped from Nakornsawan is conveyed by lighter and the remaining 20 per cent by truck, while 50 per cent of the maize from Salaburi is conveyed by lighter and another 50 per cent by truck. About 80 per cent of the maize from Korat is conveyed by truck and the remaining 20 per cent by lighter, and the maize in Phitoanulok is conveyed almost by lighter.

Most of the local collecting agencies are usually engaged in the grocery line. A part of payment for maize is paid to farmers in advance or sometimes the payment for maize is set-off by the price paid for the sundry goods. Under such marketing system, no one can gainsay that farmers are forced to be

put at great disadvantage. As such agricultural cooperative system as prevalent in Japan has not developed as yet, the marketing activities through cooperatives are not permissible. The defects of the marketing system in Thailand is pointed out often in other segments as well, but in order to improve the marketing system, the development of a cooperative system is thought to be the first consideration. However, even if the cooperatives were organized, marketing cooperatives would encounter keen competition from the present capitalistic Overseas Chinese merchants. Therefore, it is absolutely necessary to take powerful administrative measures in order to settle this problem radically.

On the other hand, the lack of collecting places and storehouses in the maize producing centres can also be pointed out as factors affecting the quality of maize, but when taken into consideration the present local collecting system and the lack of storing facilities even in Bangkok, it is by no means easy to equip with collecting and storing facilities in the maize producing centres in the near future.

Apart from the producing areas along the trunk roads or places from which maize can be conveyed by lighter, in the case of inaccessible places the transporting cost becomes greater. In recent years, cultivating farms are, as stated before, shifting to further inaccessible places. Such tendency will cause the rise in transporting cost, thus killing the competition of Thailand in the international maize markets.

From the viewpoint of improving the agricultural production techniques in Thailand, for the purpose of the expansion of maize production, stress should be placed to the land productivity improvement in the present main producing centres convenient in transportation, instead of shifting to further inaccessible areas. For this purpose, it is recommended that a crop rotation system be established by introducing leguminous crops for soil conservation purposes and that fertilizer application practice be encouraged powerfully.

ii. Exports

Maize exports in Thailand are on the rapid increase from 1958 onward. This is, as stated before, due to the marked increase in Japan's imports. Recent exports of Thai maize are on the rapid increase as given in Table 5.

Table 5. Recent Exports of Thai Maize

Year	Quantity		Value	
	Quantity (tons)	%	Value (baht)	%
1950	12,630	100	10,479	100
1955	68,186	532	79,998	763
1958	162,914	1,290	182,667	1,733
1959	236,781	1,875	249,512	2,371
1960	514,745	4,075	550,734	5,255
1961	567,236	4,491	597,256	5,699

Source: Agricultural Statistics of Thailand, 1961.

Next, Japan's imports of Thai maize are, as given in Table 6, as high as some 400,000 tons since 1960, or 60 - 85 per cent of the total maize exports from Thailand. However, it shows a slightly decreasing trend in the ratio between the total maize exports and maize exports to Japan.

Table 6. Exports of Thai Maize to Japan

Year	Exports to Japan (B)	Total Exports (A)	(B)/(A) (%)
1958	149,283 tons (100.0)	162,651 tons (100.0)	91.7
1959	188,961 (126.6)	236,779 (145.6)	79.8
1960	441,262 (295.6)	514,957 (315.6)	85.6
1961	414,923 (277.9)	572,432 (351.9)	72.4
1962	407,511 (272.9)	643,719 (395.7)	63.3

Source: (1) Figures for 1958-61 are derived from the Primary Products Import Promotion Survey Mission's Report.

(2) Figures for 1962 from the OMIC Report (figures for the period from July 1962 to March 1963).

The OMIC Report informs that in the year 1962 a fairly great deal of maize was exported also to Hongkong, Singapore, Malaya, Red China, etc. As the Thai maize export market is on the expansion, there seems to be every indication that the Government of Thailand has intention to expand its maize market widely, without sticking chiefly to the market in Japan.

In the past, the shipment of maize began in July and would reach a peak in September-December, while in recent years, owing partly to the shift of maize farms to further inaccessible areas, it shows a time lag in the shipment peak. For example, the export of the 1962 maize reached a peak in the period from November 1962 to January 1963.

We know it by hearsay that American feed businessmen, taking a deep interest in Japan's import of Thai maize, have recently sent the Survey Mission to Bangkok.

iii. Maize Quality and Quality Testing

Regarding the quality of exported maize, moisture-content and insect pest damage are pointed out. These two points have hitherto caused frequent troubles, as pointed out in the Primary Products Import Promotion Survey Mission's Report and in the OMIC Report as well. But these points have been improved

increasingly since the establishment of a new testing method and test items in 1959 under the agreement between Japan and Thailand. However, such test system seems to be far from the international level and to present many a problem, particularly in 1961 a great deal of troubles were caused. Due to the time lag in the export season (i.e., delay from September-December months to November-January months), the moisture-content problem has become fairly eased, while the insect pest damage problem has become serious. This problem can be solved by fumigation practice, but as air-tight warehouses are not available as yet, there is no alternative but to fumigate by using vinyl cover or hatches in lighters. From this angle, the installation of warehousing facilities is also in the pressing need.

In Thailand, the specifications for the exportable maize are not set up and the tests are now carried on by the OMIC, FSCO and INTECO.

(4) Maize Consumption in Japan

For your reference, we will touch upon the maize consumption in Japan. The uses of maize are legion, but in Japan the maize is used mostly for feed purposes, particularly for poultry feeding. A great deal of maize is consumed in Japan as concentrated feeds. Due to the small quantity of domestic maize production, almost all the poultry feeds depend upon the imported maize. Recent imports of maize in Japan are on the rapid increase, as shown in Table 7.

Table 7. Imports of Maize for Feed Purposes in Japan

Year	Imports (A) (Quantity)	Imports (Value)	Imports from Thailand		(A):(B)
			Quantity (B)	Value	
		mil.yen		mil.yen	
1959	842,000 tons (100.0)	17,819	108,400 tons	2,275	12.8 %
1960	1,306,000 (155.1)	28,171	313,600	6,663	24.0
1961	1,769,000 (210.0)	37,026	457,800	9,437	25.8
1962	2,197,400	45,640			

Source: Japan Annual Foreign Trade Report (Ministry of Finance in Japan)

Note: Disparity of imports between Table 6 and Table 7 is thought due to the difference in arrival dates.

As indicated in Table 7, the imports in 1961 reach as much as two times those in 1959, and those in 1962 increased 1.2 fold. The imports from Thailand in 1960 and 1961 account for 24 per cent and 25.8 per cent, respectively. The maize imported from Thailand in 1961 was greatest in quantity next to the imports from the USA.

Among other exporting countries are South Africa, Argentina, etc.

The main reason for Japan's increased consumption of maize can be found in the increase in poultry numbers, but partly in the increase in the number of hogs fed on concentrated feeds. In Japan, as the rapid increase in livestock numbers is expected in the years ahead, the import requirements in about 1970 are estimated to increase closely approximate to 2 times those at present.

3. SUGAR CANE

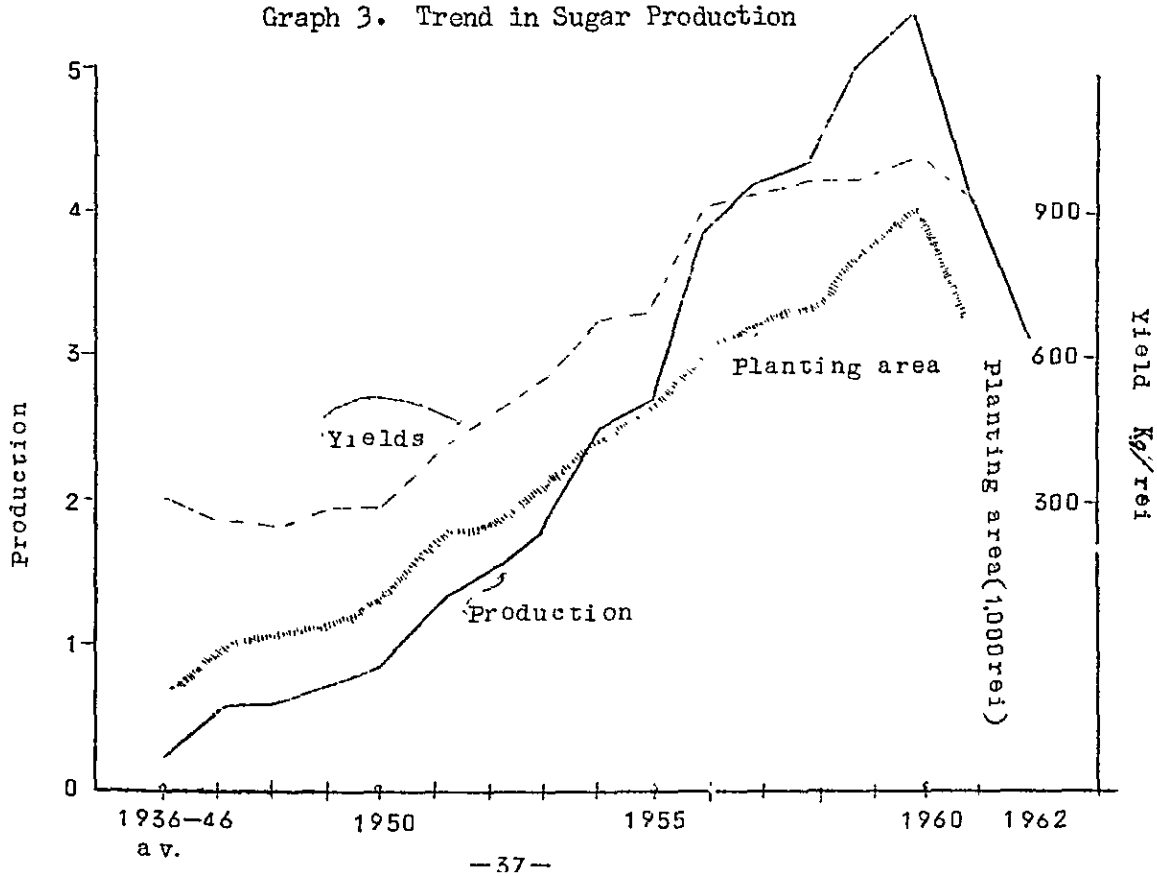
As the sugar cane production in Thailand is described in detail in the Report of the Primary Products (Raw Sugar) Import Promotion Survey Mission to Thailand (Note 6), the current situation and important problems of the sugar cane production in Thailand will be described below briefly, by adding further reference data (Note 7) and our Mission's survey results.

(1) Production

i. Annual trend in production

Sugar cane production in Thailand was started from the latter half of the 19th century. The planting of this crop showed violent fluctuations due to the trading conditions or due to the competitive crops. Formerly cane sugar had been exported in a state of raw sugar, but being affected by the imports of refined sugar, the planting area for sugar cane decreased to some 700 hectares in 1931. In the postwar years, it showed an increasing trend, as shown in Graph 3. In 1960, the production of cane stalks reached 5,380,000 tons (in fresh weight). Such production exceeds by a great deal the sugar cane consumption (2,000,000 tons) estimated basing upon the sugar output in refineries. The remaining part will be used for brewing purposes or food purposes in a raw state, but it is not known clearly. After 1960, it showed a slight decrease in production.

Graph 3. Trend in Sugar Production



ii. Distribution of Producing Regions

Sugar cane shows comparatively great adaptability to every soil, ranging from sandy loam soils to heavy clay ones. Sugar cane being vigorous crop, sufficient soil fertility and moisture-content are needed for attaining the full growth of plants at the growing stage. In harvesting stage, the dry soils are preferable for obtaining higher sugar-content canes. Due to the lack of transport roads, it takes many days to transport. As a result, the planting is confined to the areas near to the sirup manufacturing plants or refineries. The distribution of producing regions in 1960 is shown in Graph 4.

Cholburi is overwhelmingly large in production, with 2,000,000 tons or about 40 per cent of the total production in Thailand, followed by Uttaradit, Udornthani, and Nakornrajsima. The production in 1957 and 1960 is as given in Table 8. It showed marked decreases in production in Ubolrajthani, Lompang, and Rachoubkirikhan, while it showed marked increases in production in Cholburi, Nakornrajsima, Rayong, and Udornthani. The statistics for 1962 are not yet available, but it is reported that the planting of sugar cane in such main producing provinces as Cholburi or Rayong has recently declined due to the inroads made by cassava, i.e., it showed a decrease in the ratio from 7:3 to 3:7.

As the reason therefor, two factors seem to contribute greatly: i.e., (a) cassava can easily be dug out because of sandy soils in these areas; and (b) some refineries have delayed in payments for sugar cane. On the other hand, it is reported that Kanchanaburi has become a promissing producing area. Thus sugar cane cropping is characterized by the violent fluctions due to the trading conditions or due to the competitive crops.

Natural environments in the producing areas: - Soils in Cholburi area consists of sandy soils (weathered sandy rocks and quarty rocks). Though poor in soil fertility, it is favored with occasional showers even in the dry season. Rainfall is distributed well for the growth of sugar cane (See Graph 5. Monthly Distribution of Precipitations). Next, in the areas ranging over Uttaradit and Lampong, sugar cane is planted in the fertile alluvial soil area in the river basin or in the fertile humus loamy soils in the cleared teak forestlands, and is planted by a great deal in the infertile sandy loam soil area as well. In Uttaradit, there is plentiful rainfall in summer months, and Lampong area, though lower in temperature in winter months, has an advantage in rich sugar-content owing to the dry climate with lower temperature in the harvesting season.

Soils in the northeastern part of the country consist mostly of light sandy soils or sandy loam soils, and poor in soil fertility as a whole. Temperature in winter is low in Udornthani, and Nakornrajsima area is less in rainfall in winter. In the southwestern part of the country, sugar cane is planted in the alluvial soils consisting of humus and loam, but due to less rainfall, the crop is sometimes affected seriously by dry

Graph 4. Sugar Cane Stalk Production, By Provinces (1960)

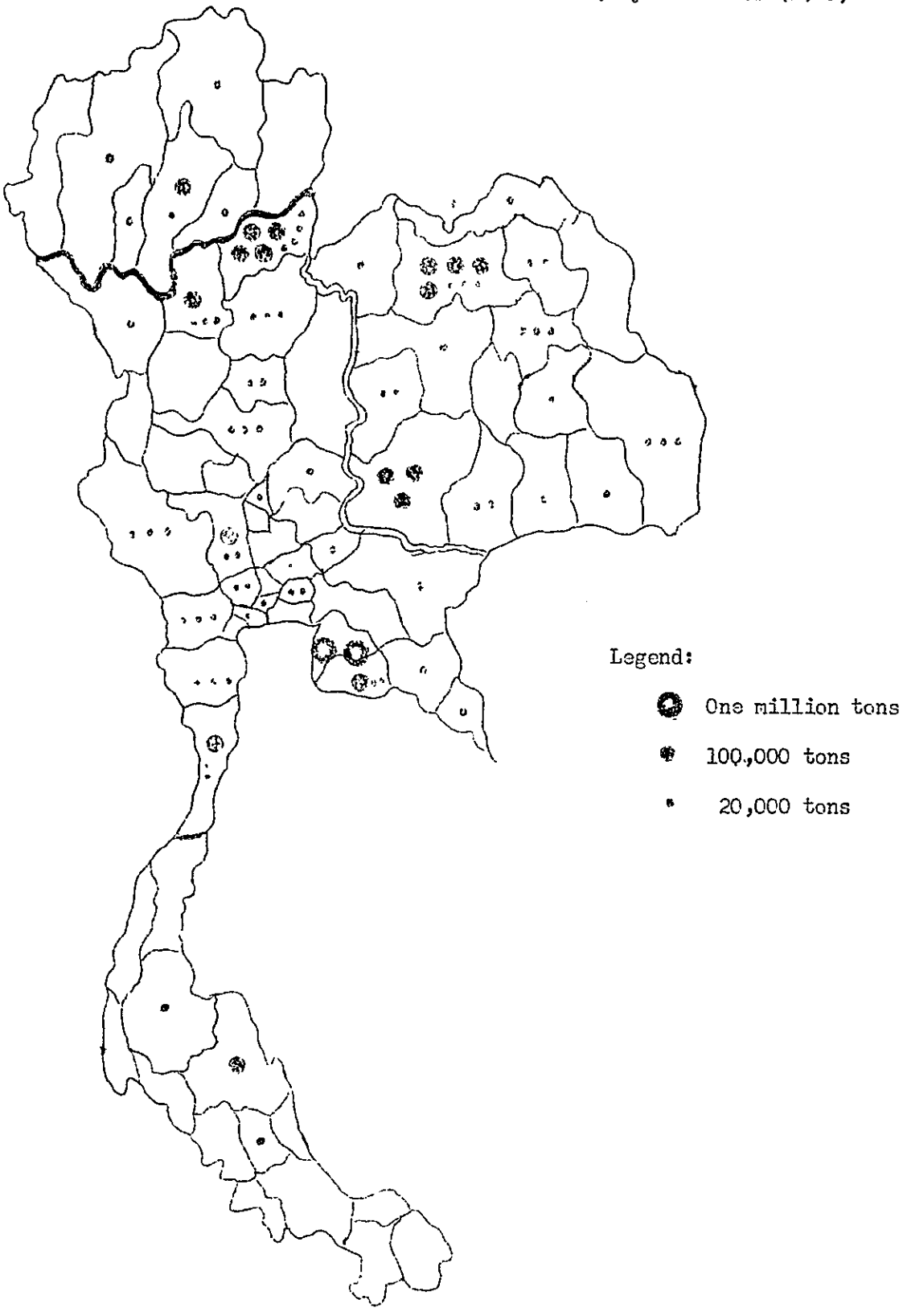
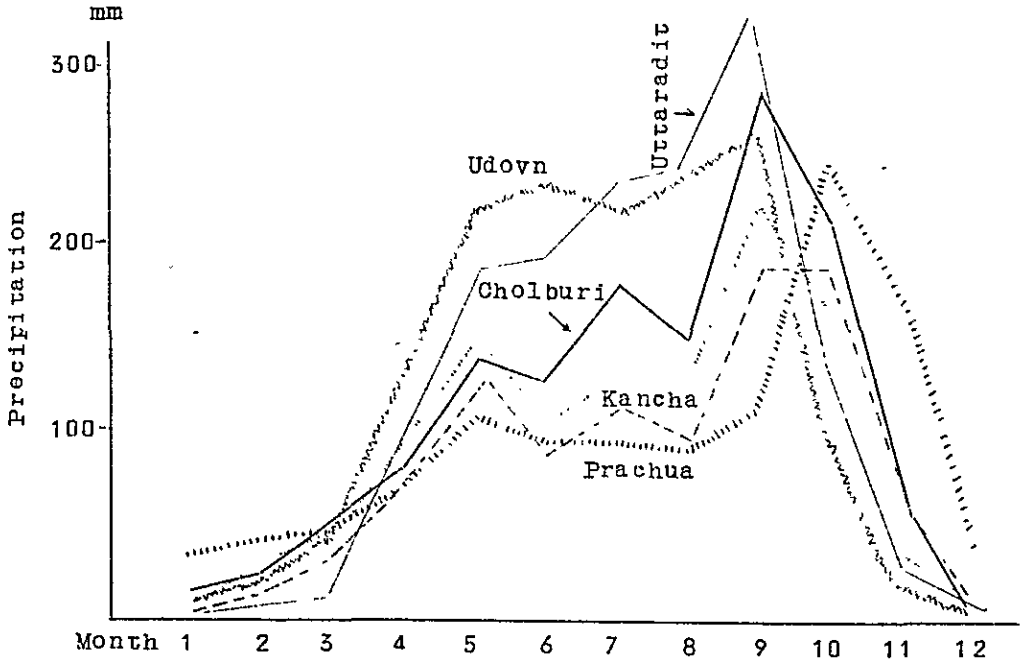


Table 8. Comparison of Sugar Cane Production Between 1957 and 1960 (in tons)

Rank in 1960	Province	1960	1957	Decrease (-) or Increase (+)	%
	Entire country	5,382,274	4,146,844	+1,235,430	130
1	Cholburi	2,157,611	981,304	+1,176,307	220
2	Uttaradit	482,430	405,593	+ 76,837	119
3	Udornthani	459,488	342,860	+ 116,628	134
4	Nakornrajsima	298,474	149,150	+ 149,324	200
5	Sukhothai	156,504	162,488	- 5,984	96
6	Rayong	145,152	11,632	+ 133,520	124.8
7	Supanburi	136,944	76,902	+ 60,042	178
8	Rachoubkirikahn	135,000	223,345	- 88,345	60
9	Lampong	129,675	233,901	- 104,226	55
10	Nakornsithamraj	93,644	273,227	- 179,583	34
11	Kanchanaburi	69,740	87,390	- 17,650	80
12	Nakornsawan	67,782	76,185	- 8,403	89
13	Pisanulok	61,730	52,908	+ 8,822	117
14	Ratburi	61,663	6,860	+ 54,803	899
15	Ubolrajthani	61,016	195,618	- 134,602	31
16	Petburi	57,301	17,820	+ 39,481	322
17	Kalasin	52,248	43,241	+ 9,007	120

Note: The rest is omitted.

Graph 5. Monthly Distribution of Precipitations in Sugar Cane Producing Areas



spell. Prachuabkirikhan is the southern limit for sugar cane cropping. Areas south of this area is not suitable for planting of sugar cane for sugar manufacturing purposes due to the lack of dry season.

Next, comparison of sugar cane yield per rai in 1960 according to the provinces indicates wide spread ranging from two tons in Khonkaen, Surin and Kanchanaburi to some nine tons in Cholaburi and Prachuabkirikhan. The latter is as high as 4 times the former. Such difference in yields according to the areas is attributed to the distribution of precipitations, soil moisture-content, soil fertility as well as to the difference in fertilizer applications or in care-taking. For instance, Cholburi area is not so rich in soil fertility, but better in distribution of rainfall and the fertilizers are applied more liberally. As a result, the yield is higher. In contrast to this, in the northeastern part of the country, due to the poor soil fertility as well as to the lack of fertilizers, the yields are generally lower. In the case of sugar cane, the yields differ greatly according to the areas, while in the case of maize, the average yields in most of the provinces reach some 300 kg per rai, except a few provinces where the yields show 240 kg or 400 kg. Sugar cane can be said to be the crop which is affected greatly by the environmental conditions or by the difference in fertilizer applications and cultural care-taking practices.

(2) Cultural Techniques

Besides the small scale sugar cane farms managed by small holders, there are large scale sugar cane farms under the management of refineries or rich class farmers. The former are generally cultivated

extensively, while the latter are brought under modernized management by the use of machinery of large type and facilities for irrigation. Technical level of the latter is by far higher. Regarding the production techniques there are a great deal of problems to be tackled in such segments as crop breeding, planting season, irrigation, fertilizer applications, and stubble or ratoon cropping. As to the refining techniques, there are many points to be improved further.

i. Varieties

Prior to the advent of foreign varieties, native varieties such as Chicken Leg Cane, Chinese Cane, or Haney Cane had been planted. Chicken Leg Cane and Chinese Cane are still now planted in paddy field areas to obtain the cane to be eaten in a raw state. Either of the two is slow in growing. For obtaining better crop, the irrigation practice is indispensable. The introduction of foreign varieties was started from 1939. At the very beginning, varieties prevalent in the Philippines, India and Africa were introduced by the students of Los Banos Agricultural University in the Philippines and by hand of the refinery in Lampang. Out of them, such varieties as POJ2878, PSA14, Co.419, Co.421, and Co.281 have become varieties now under cultivation. In 1949-50, varieties such as F108, F109, POJ3016 and C.P. Vors were also introduced by hand of the Agricultural Bureau from the Philippines and America. These varieties together with those introduced subsequently are now under trial cultivation. Besides these, there are varieties introduced and cultivated for trial by individual refineries. At present, Co.421 and Co.527 are planted by a great deal in Cholburi, top level producing area. POJ2878 and POJ2883 are, though the plants grow vigorously, on the steady decrease in planting due to the low yielding of ratoon crops and due to the low sugar-content. Co.421 is planted extensively also in Uttaradit because of higher yield of ratoon crops and higher sugar-content, accounting for as high as 60 per cent of the total planted area. Co.421 and Co.281 are achieving the best results at Boonkuer Refinery in Udornthani, but Co.281 is not welcomed by farmers because the stalks are too tiny. Other varieties such as H38, F134 and U31 are also notable ones. Recently introduced variety, known as NCO310, was planted once in the same area, but it is not welcomed so much because of the poor ratoon crops, but as this variety is drought resistant, it is suitable for the dried southeastern part of the country. In view of this, the said variety attracts the attention of the Osaka Refinery Co., Ltd.

Sugar cane experiments of the Agricultural Bureau were inaugurated at Ubslrajthani only six years ago and the conclusion of cane breeding works has not as yet come to be brought about, but the following are worth noticing.

POJ2714u; Alunan; Co.419; CP29/291; Co.421

ii. Planting Methods

(a) Time of planting

Though the time of planting differs according to the areas,

sugar cane usually is planted in April-May (at the start of rainy season) and the refining starts in November-December (dry season). In such case, the growing period lasts only for 7 or 8 months. As a result, the cane is low in yield and sugar-content. Therefore, it should be devised to prolong the growing period. For this purpose, two methods are devised: (a) retardation of harvesting date; and (b) earlier planting. In the case of the former, the dryness in the planting season is taken into consideration. This is under study at the Ubolrajthani Experiment Station. When sugar cane is planted in May-June and harvested 18-20 months after, it is proved that the yield (including the yield of ratoon crop) is higher than usual. Such planting method, however, has not as yet been practised by general farmers. On the other hand, the earlier planting method has an advantage in that land can be used more profitably, and when planted in the previous fall, the spring weeds can be suppressed. However, as the dry season sets in immediately after planting, the rooting and growth at the incipient stage become less sufficient. As a result, the farms are required to be kept under irrigation during the winter. But in the case of farms attached to the Boonkuer Sugar Manufacturing Plant in Udornthani, as the groundwater level is high, the practice of this planting method is permissible without any irrigation facilities. We heard that when the price of sugar cane is reasonable, fall or winter planting is practised usually by farmers in this area. Besides the above, stalk cuttings are grown in nurseries and planted in the rainy season. When canes are planted in this way, though the plant growth at the incipient stage is better, the subsequent growth and yields are inferior to the directing-planting canes.

(b) Planting

In the northern and northeastern parts of the country, canes are planted in the holes (18cm x 30cm in size and 18cm in depth, each), spacing 80-100 cm between rows and 30-40cm between hills. it is usual to plant top cuttings or stalk cuttings, but in the area near Boonkuer Plant, farmers plant two cuttings of stalks (with two-joints each) each, side by side, in a furrow (about 80 cm in width). Boonkuer Plant encouraged to change so as to plant multiple-joint stalk cuttings in a row. In order to make possible the use of a tractor, the Plant encouraged to maintain the spacing between rows ranging from 100 to 120 cm. In Cholburi area, it is usual to plant stalk cuttings in the furrow (dug with a plow) ranging from 100 to 120 cm between rows and ranging from 40 to 50 cm between hills.

(c) Irrigation

As described before, the planting date can be advanced by the irrigation practice. The irrigation practice is also important for drought damage control as well as for increased production of canes in cooperation with the fertilizer applica-

cations. In 1962, due to the dry spell in the southeastern part of the country, it showed a decrease in sugar cane production, thus resulting in the rise in price of canes. In view of this, the installation of irrigation facilities with the Government investments has become desirable. In the case of some large scale farms, the irrigation facilities are provided with their own investments. For instance, a part of the farms belonging to the aforesaid Boonkuer Plant has been brought under irrigation, but it is said that the irrigation practice has no effect due to the higher groundwater level. As to the effect and methods of irrigation practice for sugar cane growing, it is considered important to make careful studies according to the climatic and land conditions in the respective areas, by taking into consideration the fertilizer application methods and the time of planting as well.

(d) Ratoon cropping

Ratoon cropping is permitted from the second year. Ratoon cropping is usually continued for 3-5 years, but sometimes it is continued as long as some ten years. In the case of ratoon cropping, particular attention must be paid to the problem of soil depletion. In the newly-developed farms, ratoon crops are harvested at the rate of 10-12 tons per rai in the first crop year, but in the second crop year the yield would be decreased to 4-5 tons when kept under non-fertilizer condition. In the case of farms of the Boonkuer Plant, the ratoon cropping is practised for 2 or 3 years with liberal applications of fertilizer, and after that crotalaria (summer annual cover crop) is grown in order to improve the depleted soil fertility. It is important to find out the proper ratoon cropping method, including the proper methods of fertilizer applications and crop rotations.

(e) Fertilizer applications

In the northern and northeastern parts of the country, with the exceptions for the farms under industrial management, sugar canes are usually grown without applications of fertilizers. This is due to the fact that farmers in general are lacking in the wherewithal to buy fertilizer. As a result, though the first year crops are relatively bountiful, it is quite natural that it will show a decreasing trend in the yield during the ratoon cropping years. In the southeastern part of the country, however, in order to prevent soil depletion or according to the habitual practices of Chinese, fertilizers are applied by a good deal. Adding to ducks' drops, brewer's lees and rice-bran, chemical fertilizers are applied. Ducks' drops are applied at the rate of about 3 tons per rai. Higher yields in this area can be ascribed to the fertilizer application practice. However, when Thailand viewed as a whole, a great deal of farmers are growing sugar canes without fertilizer. Therefore, it is necessary to make further positive study of proper methods of fertilizer applications and to extend the

improved methods among general farmers.

(f) Harvesting

Intercultivation is done 3 or 4 times during the growing period. By the beginning of August when the plants grow thickly, the earthing-up must have been done. Harvesting is cut with native hatchet. After stripping off the leaves, cutting off the stalks at the bottom and removing the tops, the cut stalks are bound. Among the suggestions made by the Boonkuer Plant to be improved are: (1) removing of tops is insufficient; (2) cutting-off of stalks is a little too far from the bottom; (3) as stalks are bound with leaves, some parts of old leaves remain unremoved.

(g) Quality and prices

It is said that the sugar canes in Thailand could not meet the foreign competition without the Government price support because the extracting rate of Thai canes is low while the cost of production is high. However, in Udorn area where the Boonkuer Plant is situated we heard that the Plant's purchasing price of canes is equivalent to 100 baht per ton, while farmer's net proceeds (after reducing the transport cost or intermediate expenses) are 40 baht per ton (see Note 8). The purchasing price of 100 baht (¥1,800) per ton can be said to be far lower than the price of Hawaiian canes (¥3,000), even though the extracting rate of the former is lower, and the very reason that the price of Thai sugar is higher than international price can be ascribed to the low manufacturing efficiency or to unduly high intermediate profits. On the other hand, since the farmer's net proceeds are 40 baht per ton of canes, canes are by no means lucrative for farmers. In reality, as described before, sugar cane farms in cassava producing areas are now being replaced rapidly by cassava cropping. The Sugar Survey Mission (Note 6) has reported that in order to make possible the Thai sugar price so as to meet the international competition without the Government price support, it is necessary to raise the purchasing price of sugar canes in Thailand to the extent of 60 baht per ton and to raise the extracting rate to 11 per cent. For this purpose, it is required to increase the yields and sugar-content of canes by means of variety and planting technique improvement as well as to bring the cane producing areas closer by sugar manufacturing plants, or to save transport cost by road improvements, or to reduce the intermediate expenses, thus increasing the farmer's net proceeds from sugar canes over those from other crops. When more effective measures are taken for cane production and sugar manufacturing, Thailand can, as reported by the Sugar Survey Mission, become an important sugar producing country, holding high rank in the world.

4. CASSAVA

(1) Increasing Trend in Production

The planting area of cassava in Thailand was limited to 80,000 - 90,000 rai in the 1950-56 period, but in and after 1957 the area is on the rapid increase, reaching 620,000 rai in 1961. It has increased nearly sevenfold during 4 or 5 years. The increasing trend in cassava production is given in Table 9.

Table 9. Increasing Trend in Cassava Production

Year	Planting area (1,000 rai)	Production		Wholesale price of starch (Baht/kg) //
		Cassava roots (1,000 tons)	Starch equivalent (1,000 tons)	
1950	80 (100)	256 (100)	42.6	1.70
1955	86 (111)	258 (100)	42.8	2.20
1959	391 (460)	1,083 (423)	179.8	2.18
1960	447 (526)	1,222 (477)	202.9	2.02
1961	621 (731)	1,726 (674)	286.5	1.92

Source: Agricultural Statistics of Thailand, 1961.

Notes: Conversion: 1 ton of root = 160 kg of starch.
1 rai = 0.16 ha.

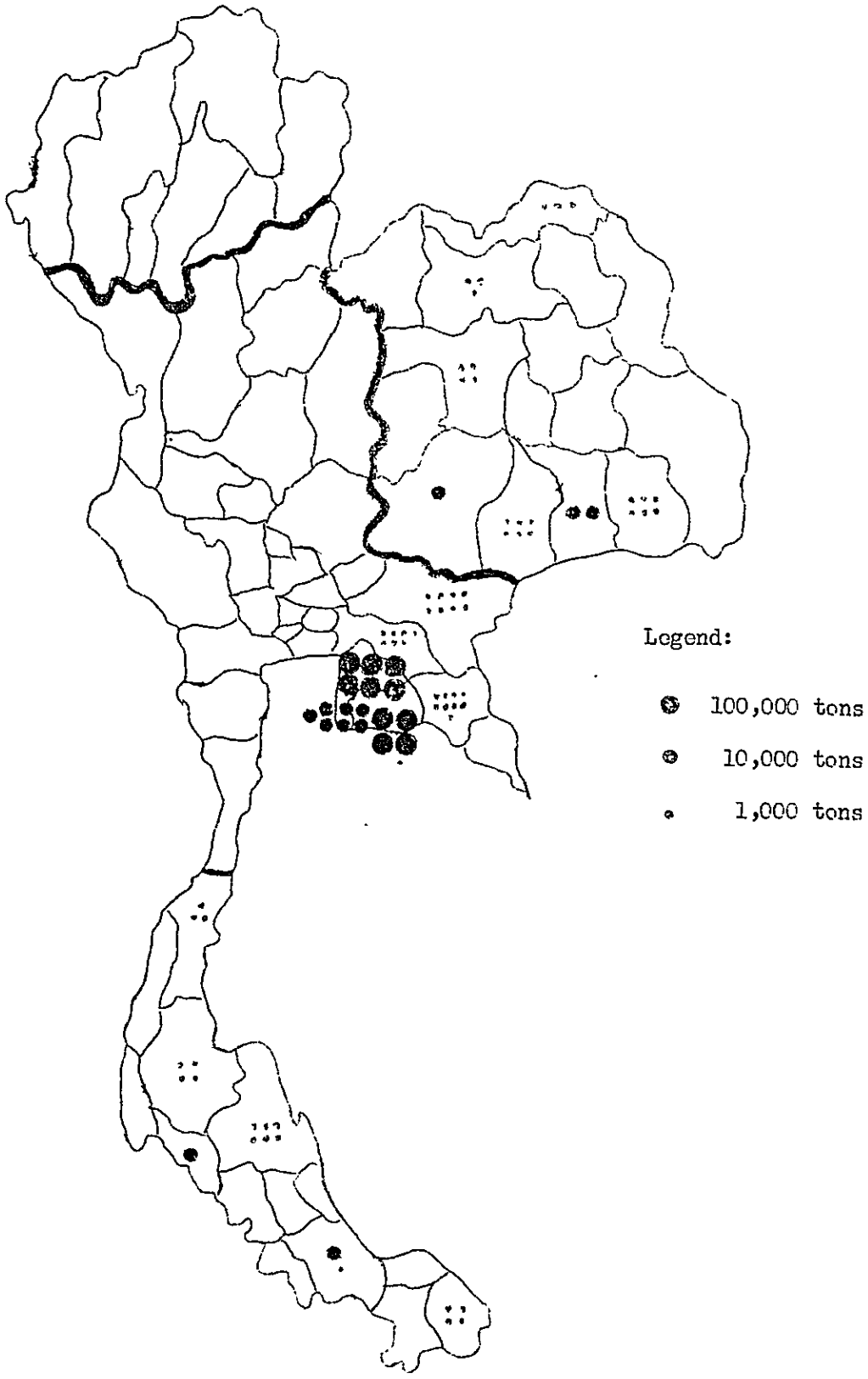
// in Bangkok.

Such rapid increase in production can be ascribed to the rapid increase in exports to the USA and Europe (particularly to West Germany). Cassava is one of the important farms crops in Thailand, as is the case with maize or kenaf.

(2) Geographical Distribution of Producing Areas

Cassava is high in adaptability to any climatic and soil conditions, except heavy clay soils, highly-acidified soils, or ill-drained areas in the growing season of tubers. Well-drained sandy loam soils with pH value of 5.5 - 6.5 are most suitable for cassava cultivation. Lightness of soils is convenient to the digging of tubers. Optimum rainfall for some 45 days after planting and in the 5th or 6th month after planting (in which the accumulation of starch is in full activity) can be said a deciding factor in the growth of tubers. Colburi and Rayong in the east coast area are the main cassava producing centre. The production in such area accounts for about 90 per cent of the total production in the country. The distribution of cassava production is shown in Graph 6. The concentration of cassava cultivation in the east coast area is not only due to the suitability for cassava cultivation but also to the existence of processing plants numbering 300 and more including small ones as well as large ones.

Graph 6. Cassava Production (1960)



The quality of cassava tubers will be degraded when left alone for a long time after digging, and cassava is susceptible to disease similar "soft rot" (potato disease). For such reasons, cassava tubers are required to be conveyed to a processing plant at least not later than 48 hours after harvesting. In Cholburi and Rayong areas, there exist, as stated above, 300 or more processing plants. After all, the cassava producing centres are formulated connected closely with processing plants. Cassava produced in the areas other than east coast district is mostly destined for home consumption.

(3) Cultural Techniques

i. Varieties

From the viewpoint of botanical classification, cassava is divided into two groups: bitter variety and sweet one. The former is stout and grows well. Tubers grow larger and contains more starch. It is grown in Africa, Southeast Asia and the South Sea Islands. Whereas, in the case of sweet variety cassava, the growing conditions are limited. Tubers are relatively slender and not bitter, containing less cyanic acid than bitter variety. As a result, this variety is mostly used for food. It is grown mostly in the northern part of Argentina, Brazil and in the northern part of Paraguay. Though various varieties of cassava are grown in Thailand, particulars are not known clearly.

ii. Cultural methods

In Thailand, two cultural types can be found, i.e., cash cropping type and non-cash cropping type. The former is cultivated as is the case with ordinary crops, while the latter is cultivated extensively on newly-developed lands.

In the case of the former, when cassava is thought more lucrative than other competitive cash crops (e.g., maize, sugar cane or kenaf), farms are planted to cassava. When cassava is cultivated, attention is paid to the care-taking and fertilizer applications (in practice, no fertilizer is applied) in order to gain profits. In the case of extensive culture, cassava is grown on the farms developed by burning the trees on the ground. After planting, neither fertilizer is applied nor care-taking operation is done. The harvested cassava is sometimes destined also for cash crop.

In the cassava producing districts, i.e., Cholburi and Rayong areas, the competition between cassava and sugar cane is becoming most intensified. Either cassava or sugar cane is choosen depending upon the market prices of the two crops. In recent years, as cassava is more lucrative than sugar cane. As a result, it showed a marked expansion of areas planted to cassava during the past 3 or 4 years, thus giving rise to a great boom in cassava in the east coast districts.

Planting: - Cassava is propagated from stem cuttings generally by the propagative propagation method. In order to obtain stem cuttings, matured stems are cut close to the surface of the

ground and the cut stem (of 1.5m length from the bottom) is used as stem for cuttings. The stem is cut into some 30 cm lengths. As a result, about 5 stem cuttings can be obtained from each cut stem. In Thailand these cuttings are planted in the cassava farm during the November-January period. The spacing between rows ranges one meter and that between hills ranges from 70 to 80 cm.

Care-taking: - About one week after the cuttings have been planted, cassava will take roots. The weather conditions, particularly rainfall, during about one month after the rooting have important bearing upon the cassava crop. After the rooting, weeding and intercultivation are done. However, when cassava is grown on the newly developed land, almost no care-taking operation is done. Our Mission found often many a cassava farm with void space (see Photo 9).

Harvesting: - In Thailand, it is regarded as best to harvest cassava in the 11th or 12th month after cuttings have been planted. Tubers are dug together with stems with hand hoes. Attention should be paid so that tubers may not be injured because tubers would become rotten shortly, if injured.

The optimum harvesting season is as described above, but in Thailand cassava is not always harvested at the best time. The harvest season is put under the control of the market price of cassava. When the price is higher, some farmers will dig immature tubers about 8 months after cuttings have been planted in order to place them earlier in the market. It is usual for farmers to do harvesting about 10 months after the planting of cuttings taking into account the marketing price.

Yields: - Yields differ widely according to the producing districts, care-taking or cropping types (e.g., cropping in recurrent succession on the same land or cropping under rotation practice). For instance, the first year's yield on newly-developed land is as low as 1,000-2,000 kg per rai, but in the case of well-managed farms, the yield is as high as 3,500 - 4,000 kg per rai.

When cassava is grown in recurrent succession on the same farm, the yield is on the decrease year after year, as given below:

First year,	4,800 kg per rai
Second year,	3,600 kg per rai
Third year,	2,400-3,000 kg per rai

In general, farmers lay it fallow and do not grow it for four consecutive years on the same farm, or they will try to regain the soil fertility by growing legume on it.

iii. Experiment study.

Since cassava is the crop which has been grown rapidly in Thailand quite recently, no experiment study has been attempted

at any national experiment station. Although the test of fertilizer effect has recently been conducted at the Agricultural Ministry's Experiment Station in Chalburi Province, any systematic study has not been conducted at all.

iv. End-use and Name of Cassava.

Cassava (Manihot utilitissima Pohl) is a perennial shrub native to the tropics or subtropics. Tubers growing under the ground contain a great quantity of starch. Cassava starch is used for home and industrial purposes. Besides, the demand for cassava as animal feeds is becoming greater with rapidity.

Cassava is known also as "manioc", "tapioca", etc., but these cannot be distinguished clearly from one another. Cassava products are known as "tuber", "Chip", "Meal", or "Flour", respectively, but any authentic ground therefor cannot be found.

Names and end-uses of the respective products are as follows:

(1) Cassava Chip (or Tapioca Chip), used chiefly as ferment materials.

(2) Manioc Meal (or Cassava Meal), used chiefly as animal feeds.

(3) Tapioca Flour (or Tapioca Starch), used both for home and industrial purpose starch.

(4) Tapioca Waste (or Cassava Waste), used for animal feeds (hog feeds).

The term "Tapioca" seems to be a popular name of starch made from cassava tubers.

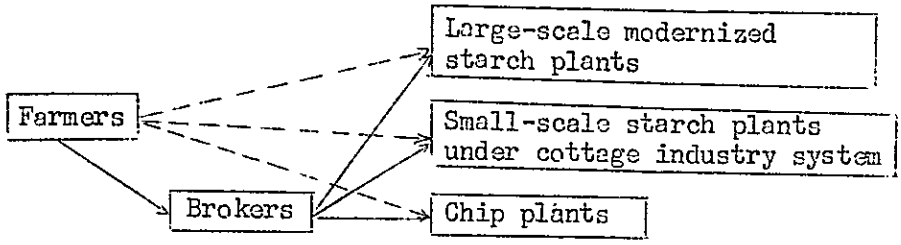
v. Marketing and Exporting.

(a) Marketing.

In the past 3 or 4 years, cassava production in Thailand is on the rapid increase, as stated before. Such rapid increase in the cassava production can also be ascribed to the increasing demand for cassava from foreign countries. In Thailand, the increased production of individual crops depends largely upon the lucrative market for them. If it is proved that there is a good market, increased production of the crops would be forced disregarding the natural conditions or techniques and management. During the past 3 or 4 years, it showed a phenomenal expansion of cassava production in Thailand. After all, it is ascribed to the very fact that there is a good and lucrative market for cassava. Though the cassava production has been so expanded, in the phase of marketing, there are many problems awaiting solution.

Since cassava is required to be processed immediately after the harvest, it is impossible to grow it as cash crop on the farm far distant from processing plants. For this reason, cassava production is centralized in Cholburi and Rayong areas where a great number of processing plants exist.

The marketing channels of cassava tubers are as shown below.



As indicated in the above, cassava tubers are marketed in two ways: (i) marketing to starch or chip plants through brokers by truck; and (ii) marketing by farmers directly to starch or chip plants.

Brokers sometimes buy tubers before the harvest. In such case, farmers are put at great disadvantage. Since actual power of brokers or plant managers is held by Overseas Chinese merchants, the modernization of cassava trading practices cannot readily be expected.

(b) Exporting.

It showed an increasing trend in Thai cassava exports from about 1956 onward, particularly from 1959.

Among the main exporting countries are the U.S.A., West Germany, the Netherlands, etc. In West Germany cassava is used for mixed feeds for cattle as barley substitute. According to the Japanese firms in Bangkok, a great confusion occasioned in the 1961 exports and the prices of cassava were also subject to violent fluctuations. This is partly due to the defects of the exporting system in Thailand and partly due to the defects of the marketing system in importing countries (West Germany and others). In the importing countries, cassava is not sold directly to actual consumers, but through brokers. Such marketing system seems to constitute a deciding factor in price fluctuations in importing countries.

Furthermore, when cassava commands a good price, in order to increase the quantity of cassava for animal feeds, some wicked traders will try to adulterate them with other matters such as tops of peanuts. But it is not clear at what process of the trading channels such adulteration is done. It is said that claims are after all lodged before the trading firms. These facts present great complexity in cassava trading practices.

Table 10. Cassava Exports in Thailand.

Year	Cassava roots		Cassava flour		Cassava waste		Total Value 1,000 baht
	Quantity tons	Value 1,000 baht	Quantity tons	Value 1,000 baht	Quantity tons	Value 1,000 baht	
1950	34	23	18,915	24,898	14,934	5,019	30,147
1951	59	65	9,661	12,568	12,046	4,852	18,007
1952	425	222	12,488	18,233	13,935	5,634	24,089
1953	985	727	21,939	36,312	17,362	8,771	45,810
1954	1,054	767	29,733	58,524	22,249	11,288	70,519
1955	909	750	29,359	52,864	23,854	15,551	69,165
1956	673	545	56,482	94,603	28,276	17,005	112,153
1957	286	217	76,990	127,237	21,053	9,224	136,678
1958	2,063	1,870	124,708	177,383	24,475	12,012	191,265
1959	208	34	149,248	193,646	44,574	29,511	223,191
1960	2,925	2,585	241,424	270,447	24,988	14,006	287,038
1961	7	7	416,022	427,930	18,568	10,805	438,742

Source: Agricultural Statistics of Thailand, 1961.

Recent exports of tapioca flour and cassava meal from Thailand to the main importing countries are as given in Table 11.

Table 11. Exports of Tapioca Flour and Cassava Meal, By Importing Countries in 1960 and 1961 (M/T)

Country	1960		1961	
	Tapioca flour	Cassava meal	Tapioca flour	Cassava meal
Japan	1,279.3	-	2,020	2,885
Hongkong	1,573.0	200.2	3,875	23
Singapore	719.7	67.0	1,156	31
Bolneo	275.4	9.6	386	-
U.K.	151.9	6,779.5	16,325	9,389
Belgium	705.9	3,432.2	603	2,235
Netherlands	15,060.5	2,772.8	23,865	17,363
Germany	52,274.8	50,972.8	53,523	132,918
U.S.A.	99,132.4	100.8	117,471	298
Taiwan	-	-	501	-
Australia	266.8	-	177	100
Hawaii	317.4	-	186	-
Norway	-	-	31	-
Canada	260.3	-	1	-
Switzerland	-	101.6	-	102
Others	887.8	137.2	48	268
Total	176,860.2	64,563.8	220,173	165,612

Source: Cassava in Thailand, August, 1962, the OMIC.

(c) Exporting Prices.

Cassava is one of the international commodities and its prices are subject to violent fluctuations. FOB prices in Bangkok are as shown below:

	September, 1961	April, 1962
Tapioca Flour		
A	฿ 38-0-0	฿ 44-0-0
B	35-0-0	40-10-0
C	32-0-0	37-0-0
Cassava Chip	16-10-0	23-10-0
Manioc Meal	17-10-0	25-0-0

Source: Derived from data of the OMIC.

According to a Japanese firm in Bangkok, if the price of Manioc Meal is stabilized at the level of £20-22 per ton, there will be a good market in West Germany as animal feeds.

It is informed that West Germany is contemplating to have a new cassava processing plant in Thailand, but it has not been set up as yet.

The changes in prices of Cassava Meal in Thailand are as given in Table 12.

Table 12. Changes in Prices of Cassava Meal, By Months (1961-62) (per kg.) in Bangkok.

Month	1961 (TCS)	1962 (TCS)
January	32-32	55-53
February	33-34	50-56
March	34-34	55-53
April	34-35	58-60
May	37-37	62-64
June	37-38	58-55
July	38-39	50-55
August	39-40	
September	41-45	
October	49-46	
November	48-48	
December	50-57	

(d) Test standards

Test standards that are now enforced in general are as follows:

a. Tapioca Dry Root

Moisture-content, 15% or less
(starch-content is sometimes tested)

b. Tapioca Chip

Moisture-content, 15% or less
Starch-content, 68% or more
Foreign matters, 4% or less

c. Tapioca Meal

Moisture-content,	15% or less
Starch-content,	68% or more
Foreign matters,	4% or less

d. Tapioca Flour

Moisture-content,	12% or less
Starch-content,	80% or more
Ash	0.20% or less
Viscosity	150 or more
Acid value	5.0 cc or less

Since tapioca dry root contains cyanic acid, in the case of tapioca destined for Japan, cyanic acid-content is rigidly tested. Tapioca containing 5 mg or more of cyamic acid per 100 gram of tapioca is prohibited by the Food Sanitation Law in Japan from importing to Japan.

Moisture-content in Thai tapioca is an important test item. Special attention is paid to the moisture-content test since semi-dried tapioca of high moisture-content is likely to undergo fermentation.

Color and luster is an important characteristic of tapioca. Special attention is required to be paid in the dry season because chip or dryroot will be discolored when it rains in the dry season.

vi. Import requirements in Japan.

The recent imports of Cassava Root and Tapioca Flour to Japan are as shown in Table 13. In 1961, as much as 8,255 tons (¥148,477,000 in value) of Cassava Root were imported from Thailand. In 1959, 200 tons of Cassava Root were imported from North Vietnum. Tapioca Flour (including Mamioc) is imported almost exclusively from Thailand. Namely 1,055 tons were imported in 1959 from Thailand and 1,510 tons in 1961. (in 1961 (In 1960, both Cassava Root and Tapioca Flour were not imported.)

In Japan, white and sweet potatoes are used as raw material for starch making and until recently there has been a tendency to overproduction of starch. The prices of Japanese potato-starch are fairly higher than cassava starch in Thailand, but it is not permissible for Japan to import cassava starch from abroad without any restriction, even though the foreign products are inexpensive. For this reason, the import of foreign starch (tapioca flour) is now kept under the FA system. The import of foreign starch is determined by the Government of Japan taking into account the supply and demand of domestic starch. The FA system is expected to be continued for the time being. In recent years, however, there is a growing demand for starch used for such goods as ordinary glucose, millet jelly, crystalline or refined glucose, mono-sodium glutamate, etc.;

Table 13. Imports of Cassava Root and Tapioca Flour to Japan

Year	Exporting Countries	Cassava Root			Tapioca Flour		
		Quantity (tons)	Value (1,000¥)	¥ per kg.	Quantity (tons)	Value (¥1,000)	¥ per kg.
1959	Thailand	599	11,330	¥ 19	1,055	31,940	¥ 30
	N. Vietnum	200	4,032	20	-	-	-
	Taiwan	-	-	-	-	-	-
	U.S.A.	-	-	-	0	48	453
	Total	799	15,362	19	1,055	31,988	30
1960	Thailand	-	-	-	-	-	-
	N. Vietnum	-	-	-	-	-	-
	Taiwan	-	-	-	-	-	-
	U.S.A.	-	-	-	-	-	-
	Total	-	-	-	-	-	-
1961	Thailand	8,255	18	¥18	1,510	47,762	¥31
	N. Vietnum	-	-	-	-	-	-
	Taiwan	-	-	-	0	13	43
	U.S.A.		-	-	2	794	442
	Total	8,255	18	18	1,512	48,569	32

Source: Annual Report on Japanese Foreign Trade.

distilled drinks; and alcohol as well. As the domestic starch is not ample sufficient to meet the rising demand, the imports of tapioca and the like are expected to be on the increase. With the rapid increase in livestock numbers in Japan, foreign starch could be used for animal feeds, but since foreign starch has not hitherto been used in Japan for animal feeds, its import requirements will become the problem to be tackled in the future.

By the way, it is informed that instances have been experienced in which some foreign matters were found in Cassava Chip imported to Japan from Thailand. With due regard to this respect, the Thailand authorities are requested to take special consideration.

5. LEGUMES

Legumes are crops fitted best for maintenance of soil productivity. As a result, a good crop rotation includes a legume crop. In this sense, legume cropping is always encouraged, but the reckless increased production of legumes should be avoided. Due to the increased production in excess of the demand, the prices of legumes will decline. In order to increase the production of legumes, it is necessary to take effective measures to expand the domestic consumption or to find outlets abroad.

For the purpose of maintaining or improving the soil productivity, the utilization of leguminous green manures is also important, but any cash income cannot be derived directly from such green manure legumes. In giving farmers the encouragement to grow such legumes, it is primary important to give farmers full knowledge of the fact that the costs of legumes and labour can be compensated fully by the increased production of the second crops to be grown after green manure legumes. Among the main legumes grown in Thailand are peanuts, green beans, cowpeas, soybeans, and crotalaria (summer annual cover crop).

(1) PEANUTS (Goober, Pindar, Grundnut or Earthnut)

i. Production

The peanut is far ahead in the planting acreage among the legumes grown in Thailand. The planting area of peanuts is largest next to that of castorbeans among oil plants in Thailand (Tables 14 and 15). The peanut exports reached 20,000 - 21,000 tons in 1955 and 1956, but in recent years it is on the decrease, showing 13,500 tons in 1961.

Peanuts are used for food purposes or crushed for oil. Crushing is made in Bangkok. Peanut oils and the residual cakes are exported.

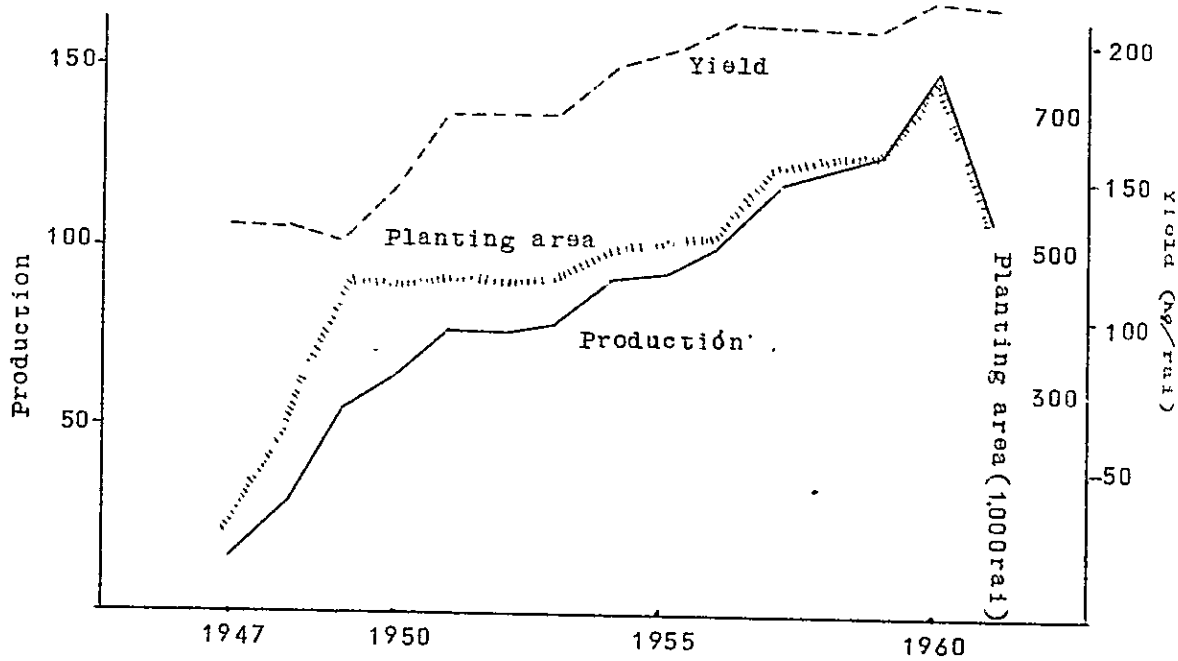
Table 14. Exports of Oil Plants (1961)

Item	Quantity	Value
Castorbeans	32,600 tons	94.2 mil. baht
Peanuts	13,500	51.9
Kapok seed	16,500	23.1
Sesame seed	4,000	19.7
Cotton seed	6,200	7.7
Soybeans	2,100	5.2

Table 15. Changes in Peanut Exports (1955 - 61)

Year	Quantity	Value
1955	20,300 tons	77.2 mil. baht
1956	21,200	82.5
1957	12,600	54.4
1958	15,500	59.2
1959	12,900	46.1
1960	9,900	39.3
1961	13,500	51.9

Graph 7. Changes in Peanut Production



It shows an increasing trend in the peanut planting area year after year, but it shows a decrease in 1961 (Graph 7). The peanut shows great adaptability both for climatic and soil conditions. It is grown throughout the country (Graph 8). In view of the fact that peanuts are easily loosened from the soils and no earth is sticked to the pods, light sandy soils and sandy loam soils are particularly preferable. Newly-developed land consisting of light soils containing organic matter is suited best for peanut growing. Peanuts can also be grown on the furrowed clayey soil ground near Bangkok.

The peanut is grown between the rows of maize or cotton farms, and it can be grown twice a year on the same farm. In the area equipped with irrigation facilities, the peanut is important as

the second crop after rice has been harvested. For instance, in Chiengmai, Prae or Nan areas in the northern part of the country, since paddy fields can also be brought under irrigation after rice has been harvested even in the dry season and the paddy rice field soils are not so heavy clayish, peanut is grown as the second crop on paddy fields. But in this area, relatively light sandy loam soils are chosen for peanut growing, and the clayish soil fields are planted to soybeans.

ii. Cultural techniques

(a) Varieties:

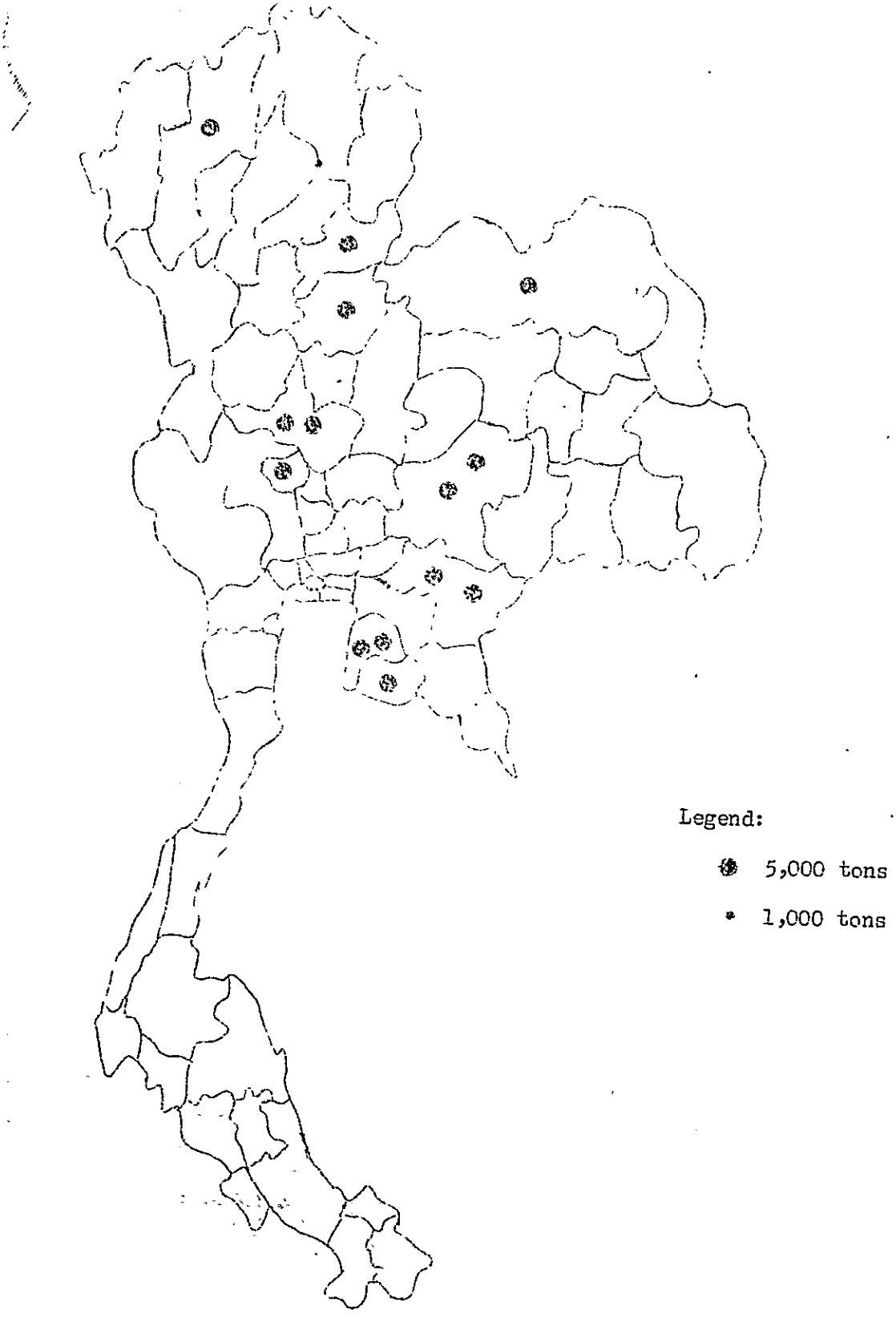
Local varieties are found in the respective areas, but any recommended varieties are not found as yet. Local native varieties and foreign ones are now under trial culture at the Roi-et and Mae-jo Experiment Stations in Chiengmai Province, but the experiments are now at the preliminary tests. High yielding test and leaf spot resistance are now under way.

Local native varieties produce satisfactory yields in general, though somewhat lower in yielding capacity than Spanish varieties. The former are of erect type and disease resistant, and the growth period lasts for 100 days or more. Local native varieties closely resemble with one another. These are regarded as the varieties derived from the same origin. The 1959 Report of the Department of Agriculture informs that Ban Mai Variety and Chanburi Variety prevalent in the northeastern part of the country and Lanpang Variety in the northern part are recognized as best. After that year, Rayong Variety (small-podded variety) is now under test as the typical variety planted at the beginning of the wet season in the northeastern part of the country.

Spanish varieties are higher in yields and stronger in disease resistance, and smaller in seeds than any local native varieties. Though the former are suitable for oil extracting purpose, they are not kept longer. For this reason, they are not welcomed in Thai market. Valencia Variety is regarded as good one. It was informed that the Roi-et Experiment Station has a promising variety though the strain cannot be identified.

At present, many imported varieties are under test at the Roi-et Experiment Station. It is reported that Japanese varieties do not produce satisfactory yields when planted on infertile soils, though high in yields when fertilizers are applied liberally. For instance, Chiba 55 (prostrate type variety) tested at the Roi-et Experiment Station was proved poor in yield. At the Mae-jo Experiment Station, Chiba Handachi (semi-erect type), Rakuda Variety and Chiba Small-Podded Variety are now under trial cultivation together with other foreign varieties. It is reported that since the test was started only one year ago, it is premature to arrive at the conclusion, and that partly due to the lack of fertilizer element, the plant growth is poor as a whole.

Graph 8. Peanut Production in 1960, By Provinces



(b) Cultural methods

(i) Summer crops:

It is best to plant summer plant in mid-May and late May. The generally-accepted spacing ranges from 30 to 40 centimeters between rows and from 20 to 30 centimeters between hills. At the Tah Pra Experiment Station higher yields were produced in some years by sparser planting. At this station, two seeds are dotted in each hill and one of the two plants is thinned out. Afterwards clipping is done. When summer crop is planted after the opening of July, harvesting is delayed until November. When it sets in dry season, the digging would sometimes become harder.

The Mae-jo and Rai-et Experiment Stations have tested lime applications. By the use of lime at the rate of 100-200 kg per rai, it showed a fairly marked increase in yield, but the effect of combined use of potash was not clarified.

Diseases damaging peanuts include root rot and leaf spot (caused by M.berkeleyii - Cercospora personata). As stated before, selection of leaf spot resistant variety is of importance at present. Velvet bean caterpillars occur, but the damage by this insect is not so serious.

(ii) Second crop:

In Chiengmai, it has become possible the planting of peanuts as the second crop in paddy fields after rice has been harvested. Furrowing is needless for soybean planting, while it is indispensable for peanut planting. A furrow ranges from 60 - 100 cm in width. Peanuts are planted on the furrow in 2 - 4 rows spacing 30 cm between rows. Small-sized seeds of local native variety are used.

Peanuts are planted in January, somewhat later than planting of soybeans, because furrowing operation is needed for the planting of peanuts. Three or four peanuts are planted in a hill, thinning is not done. In the case of soybean farms, the water is poured between furrows only, while in the case of peanut farms, water between furrows is scooped up with water-pail for the purpose of irrigation.

Until germination, water is poured at 3- or 4-day intervals. Even after germination, water is poured during dry spell. Thus the farms are irrigated at least five times. Weeding is done about three times. Peanuts are harvested in April or May, as in the case with soybean harvesting. Unshelled peanuts are harvested at the rate of 60 - 120 liters per rai.

(2) SOYBEANS

i. Production

A mean temperature of 25° to 30°C appears to be optimum for soybean growing. In general, as the summer temperature in the tropics is too high, it is not suitable for the growing of soybeans. In Thailand, soybeans are mostly grown in the northern areas suffering less damage from the summer heat. In case where irrigation is permissible, soybeans are grown as winter crop. Soybeans are consumed for home use in each producing area. Some 10-20 per cent of the products are also exported. The exports (in value) of soybeans are equivalent to nearly 10-20 per cent of the peanut exports (Table 16). As shown in Graph 9, it shows neither marked increase nor decrease in the recent planting area.

Graph 10 indicates the soybean producing areas in the country. In 1960, soybeans were grown much in Chiengmai, Nakornsawan, Sukhothai, Lampoon, etc. In Chiengmai and Lampoon Provinces, soybeans are grown much as second crop in paddy fields after rice has been harvested. By the way, our Mission was informed that, in recent years, soybean planting in Nakornsawan and Sukhothai is becoming increasingly replaced by cotton growing.

ii. Cultural techniques

Basing upon the results of our interview in Chiengmai, the soybean culture in Thailand will be outlined below.

Soybean culture can be divided into two types: (1) upland crop grown in the wet season; and (2) paddy field crop grown in dry season as second crop in paddy fields after rice has been harvested.

(a) Upland soybeans

Among the varieties, slightly larger-seeded variety grown near Korat, known as "Bakchon" is regarded as superior one. Soybeans are planted in May-June and harvested in November-December. Farms are plowed mainly by using cattle. Spacing ranges 60cm x 60cm. About 4-5 seeds are seeded in each hill. Cattle dung is applied to soybean farms as fertilizers. Weeding is done two or three times.

Diseases damaging soybeans include rust (Phakopsora Pachyrhizi SYD) and Mosaic (Virus); but the damage is not so serious. In wet season plants grow too large and leaves grows too many, and it shows a decrease in the number of pods from those in dry season.

About 7 or 8 varieties (native ones and Japanese one combined) are now under test at the Mae-jo Experiment Station. Japanese variety "Jikkoku" is used as one of the test sample varieties. This variety is disease resistant by the quality is not so good. The Japanese varieties show generally higher yields in the year when rain-fall is plentiful. In compliance

with the request for some Japanese varieties as samples used for the trial culture, 7 or 8 selected varieties were sent to Thailand, on return home.

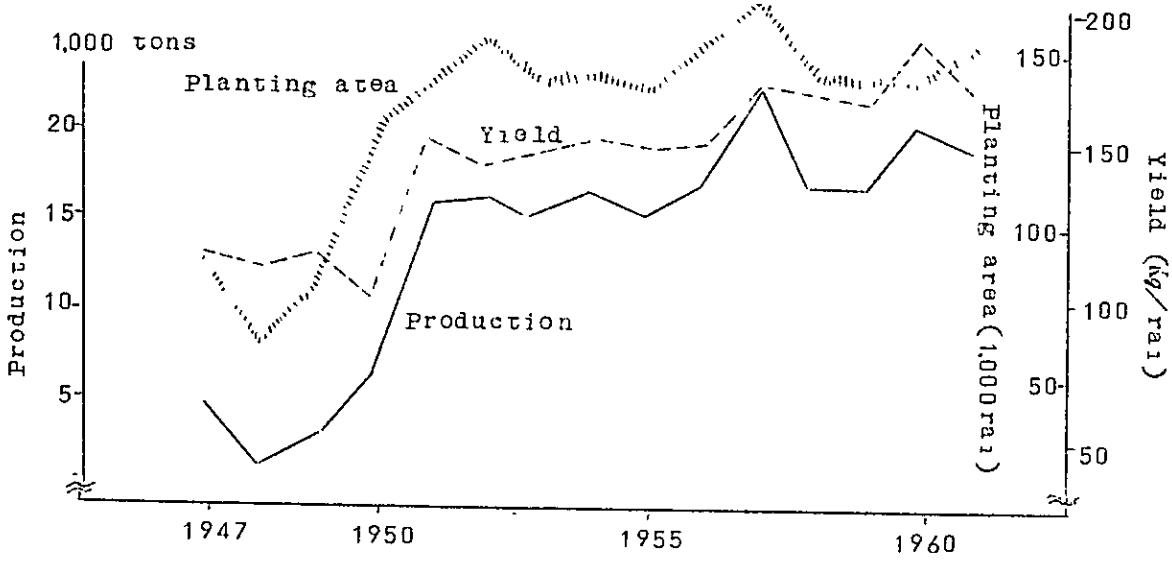
(b) Soybeans planted as second crop in paddy fields after rice has been harvested

Farmers obtain soybean seeds from soybeans they produced, or purchase them from seed dealers. In Chiengmai, the native varieties grown in the farms near the Mae-jo Experiment Station are regarded as superior ones. Soybeans are planted in December-January season, mostly in January. Soybeans are planted in the holes by the side of rice-plant stubbles which were burned. Spacing is similar to the case of rice planting, i.e., 30cm x 30cm. About 3-5 seeds are sown in each hill. A certain farm advisor expressed the fear that the planting is too close. Undoubtedly, it is a little too closer. Regarding this, however, it will be necessary to give farmers more exact advice basing upon the results of a further test on the techniques of soybean culture after rice has been harvested.

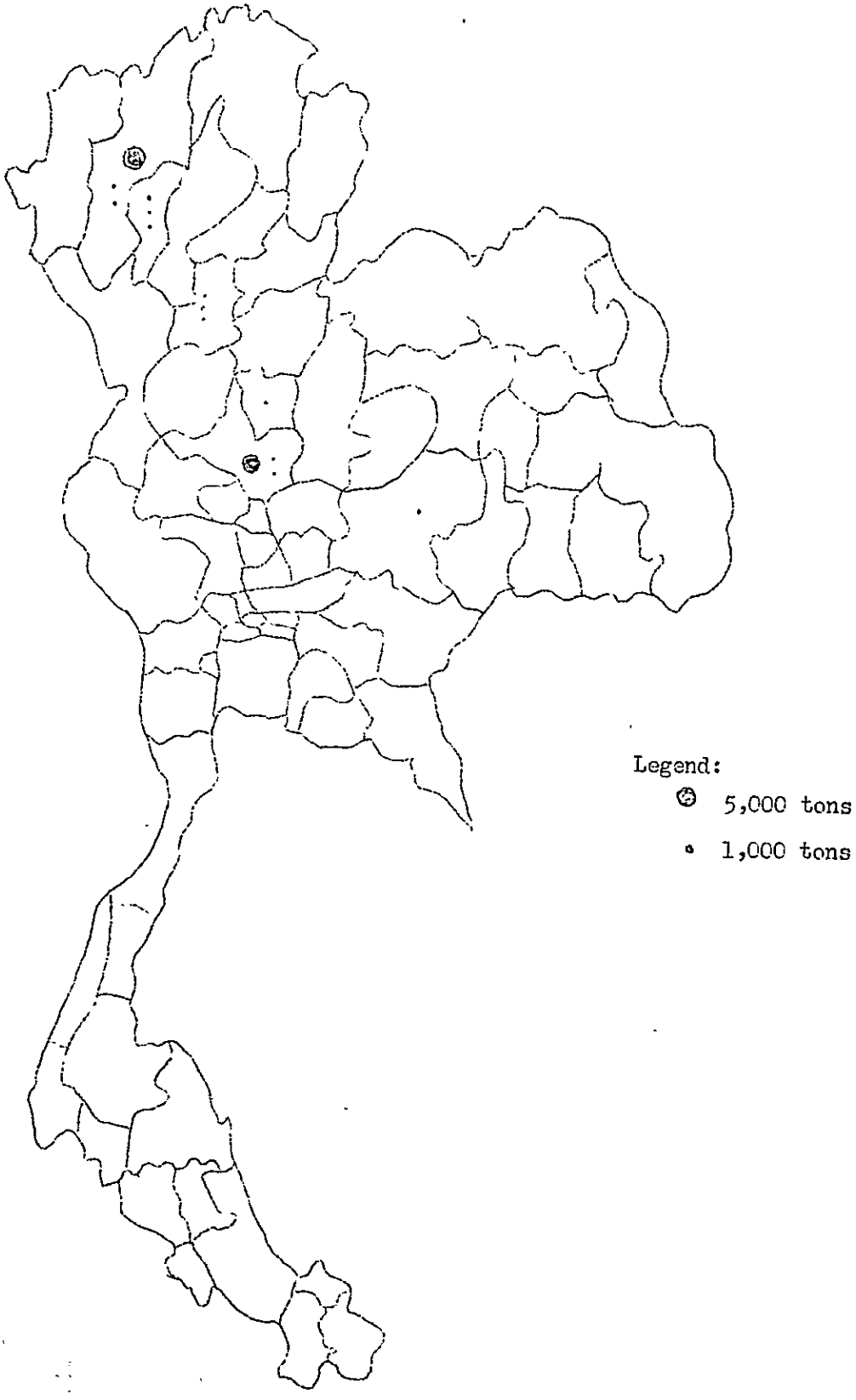
Table 16. Production and Exports of Soybeans

Year	Soybeans			Peanuts (for reference)
	Production (1,000 tons)	Exports in value (1,000 tons)	Exports in value (mil.baht)	Exports in value (mil.baht)
1956	22.4	7.1	14.5	82.5
1957	27.5	1.4	3.5	54.4
1958	21.7	1.8	4.5	59.2
1959	22.5	4.7	10.6	46.1
1960	25.6	4.1	8.6	39.3
1961	24.2	2.1	5.2	51.9

Graph 9. Changes in Soybean Production



Graph 10. Soybean Production in 1960, By Provinces



As shown in Graph 9, it does not show so marked increase in planting area.

Cattle dung is applied as fertilizers. Irrigation is practised two or three times. Soybeans are harvested in April-May. Larger-seed varieties are preferable for wet season crop. It is reported that the yield from the second crop in paddy fields after rice has been harvested is rather higher because the after effect of paddy fields can be made use of. Varieties planted in Thailand are characterized by smaller-seeds as a whole. This can be ascribed to the higher temperature in the maturing season.

As to winter-crop (soybeans), the tests are now conducted at the Mae-jo Experiment Station (in Chiengmai) and the Surisumrong Experiment Station (in Sukhothai), but either of the two being the upland crop experiment station, the test results will not be permissible to apply directly to the soybeans planted in paddy fields after rice has been harvested, particularly the application of test results at the Mae-jo Experiment Station would be undesirable because its test farm soils are infertile. On the other hand, in Chiengmai Province, the varietal tests of soybeans planted in paddy fields after rice has been harvested are now under way at the Sanpatong Paddy Rice Experiment Station. Besides, at the paddy rice experiment farms in Chainat area, the study for the selection of suitable varieties of legumes including soybeans was also under way. It is desirable that such studies on the upland crops planted in paddy fields after rice has been harvested are carried on in a closer contact between the upland crop experiment stations of the Department of Agriculture and the paddy rice experiment stations of the Department of Rice.

In addition, at the Chaophya Dam in Chainat area, the study of introduction of second crops planted in paddy fields after rice has been harvested is under way in anticipation of the completion of Yan Hee Dam project. A stress is placed on the legumes as second crops. Soybeans were subject to a trial culture, but the growth of soybeans was proved unsatisfactory. Viewed from the recent supply and demand of soybeans, it will become a debatable question how much soybeans can be introduced as second crop in this area. Anyhow, it is absolutely necessary to make full study from the technical viewpoint.

(3) GREEN BEANS (MUNG BEANS, GREEN GRAM)

Regarding the green bean production in Thailand, some reviews will be presented below based upon the detailed report of the CMIC (Note 9).

Green beans are used for food purposes such as boiled beans, and as materials in making of bean-vermicelli or sprouting-beans as well.

Both domestic consumption and exports are on the increase year after year. In 1961, as shown in Table 17, the exports to Hongkong and other Southeastern countries are overwhelmingly great. The exports to Japan accounted for only two per cent of the total.

Table 17. Exports of Thailand Green Beans (ton)

Country	1959	1960	1961
Total	15,316	22,916	26,351
Hong Kong	4,273	7,225	7,015
Singapore	4,217	4,348	4,681
Penang	2,491	4,020	4,129
Taiwan	183	1,856	4,115
Malaya	2,733	3,681	3,415
Borneo	736	994	911
Okinawa	4	22	609
Japan	443	538	599

The rest is omitted here.

Imports of green beans as materials in making of sprouting-beans into Japan from Thailand is as given in Table 18.

Table 18. Imports of Green Beans to Japan

Year	Imports (ton)
1953	5,717
1954	10,996
1955	12,463
1956	16,228
1957	12,027
1958	13,819
1959	20,125
1960	21,362
1961	29,669

Until 1955, sprouted-beans had been made mainly from green beans, but in the subsequent years, mostly Black Mapte from Burma has come to be used for sprouted-bean making, thus replacing Thailand green beans.

In 1962, due to the rise in price of Mapte, Mapte was replaced by green beans, but with the decline in Mapte price, the latter would be replaced again by Mapte. That is, there is a tendency that in Japan, Thailand green beans are serving as crop competitive with Burmese Mapte. However, sprouted-beans made of green beans being appreciated more at the palatability by some dealers, green beans are expected by some body to be used as material in sprouted-bean making to the extent of 20-30 per cent of the total.

Either of the two is the family of Phaseolus Mungo, but Mapte is suitable for growing in relatively cooler regions. In Burma, Mapte is planted in October-November (latter of wet season). While, during the growth period of green beans, relatively higher temperature and relative humidity are required. Mapte is by far greater in sprouting activity. In making of sprouted-beans, Mapte must be treated at higher temperature, while green beans can be treated at lower temperature condition.

Green beans in Thailand can be divided into four groups as below.

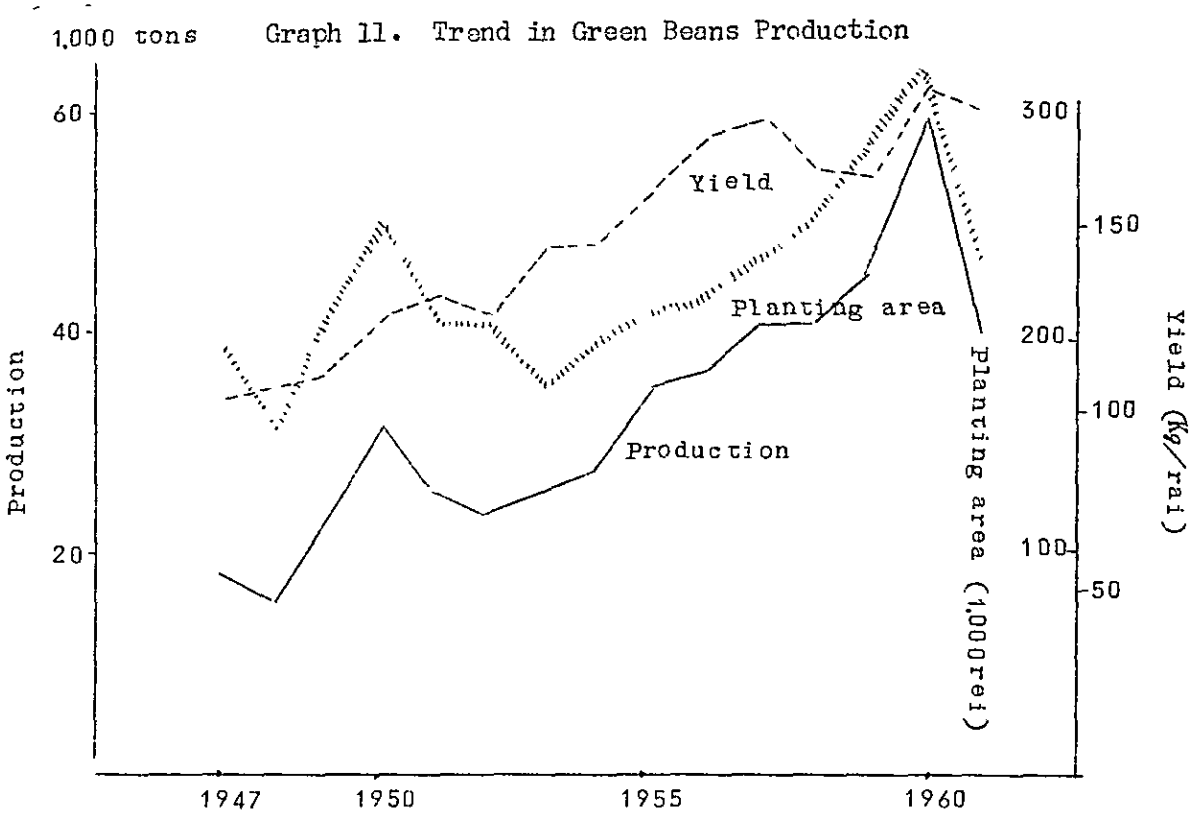
(i) Green beans (small-seeds), for sprouting-bean making.

(ii) Maung beans

(iii) Small Maung beans, surface layer is glossy.

The reasons for not growing Mapte in Thailand can be found in that (a) Mapte was planted according to the information that Japan would purchase Mapte, but in reality, Mapte was not purchased by Japan, thus resulting in great loss; and (b) it is reported that Mapte bears a specific odour. Our Mission heard in Chiengmai that in 1962 a certain Japanese dealer distributed Mapte seeds among Thailand farmers, intending to make them a trial culture, but no farmer attempted to plant Mapte due to the lack of assurance of its purchase.

Recent production of green beans in Thailand is, as shown in Graph 11, on the increase year after year, but in 1961 it showed a slight decrease in the production.



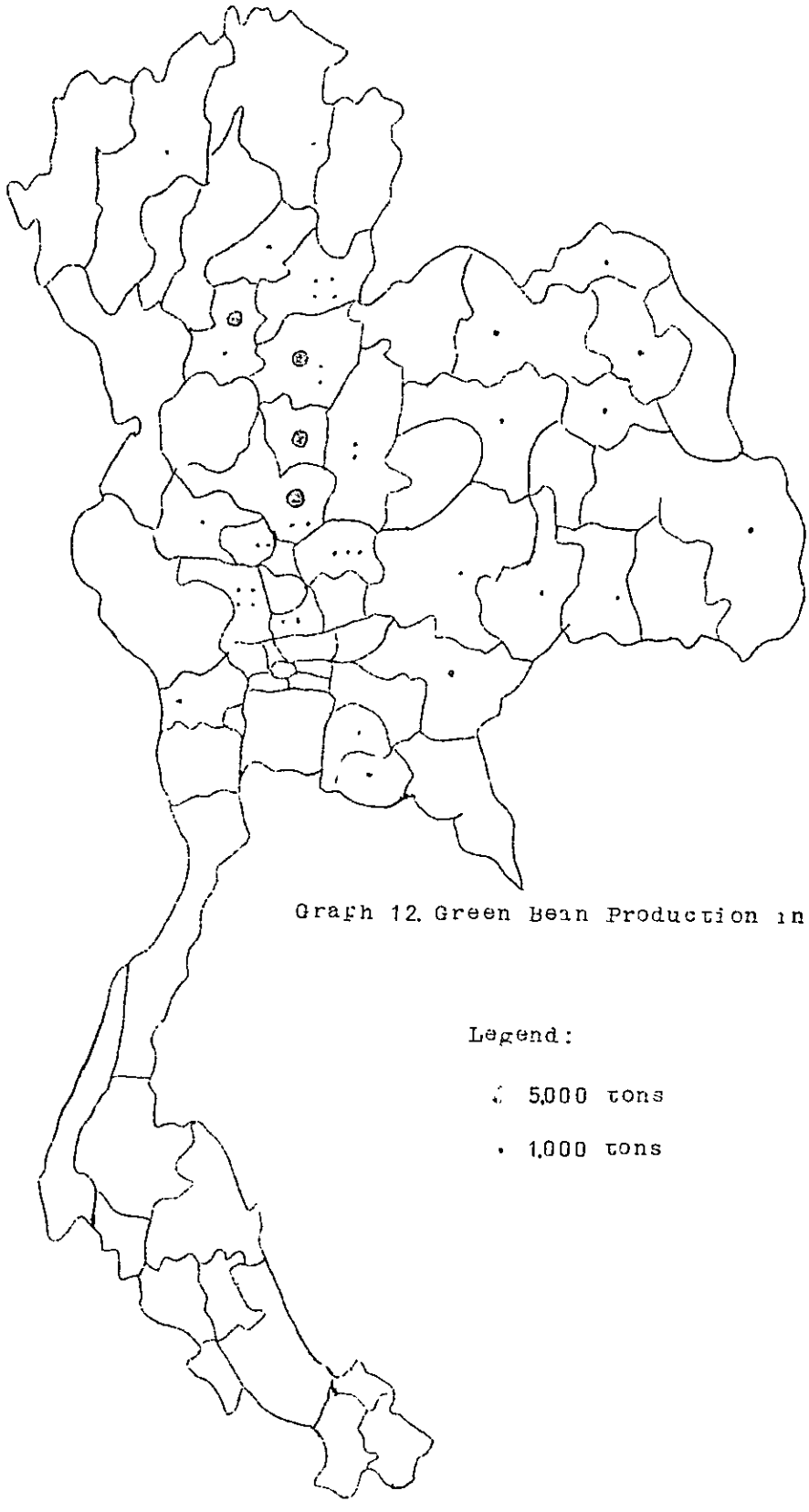
As shown in Graph 12, the main producing areas are centralized in the central plain region. Green beans are mostly grown in the level lands after flood water has been drained. Particularly, the black soil district north of Takly is spoken of as superior quality green bean producing area.

Green beans are planted in September-October (latter part of wet season). Harvesting is done 70-80 days after planting. Green beans are also planted in paddy fields prior to the rice planting. In addition, green beans are sometimes planted in April-May and harvested in June-July.

Four varieties are now under test at the Srisumrong Experiment Station. Shing beans and Early beans are recognized as superior varieties. According to the results of tests on the time of planting carried on at the Ulolrajthani Experiment Station, early July or mid-July is the optimum, and green beans planted in about Setpember showed a marked decrease in yield. Such study of the time of planting is of importance viewed from the land utilization practices. It will be important to expedite the experiments in combination of time of planting, varieties and spacing.

6. COTTON

Cotton growing in Thailand has come into the limelight from as early as prewar days. The increased production of cotton was once encouraged under the direction of Dr. S. Mihara (Japan) (Note 10). For the purpose of protection and development of spinning industry in Thailand, measures



Graph 12. Green Bean Production in 1960 By Provinces.

Legend:

5,000 tons

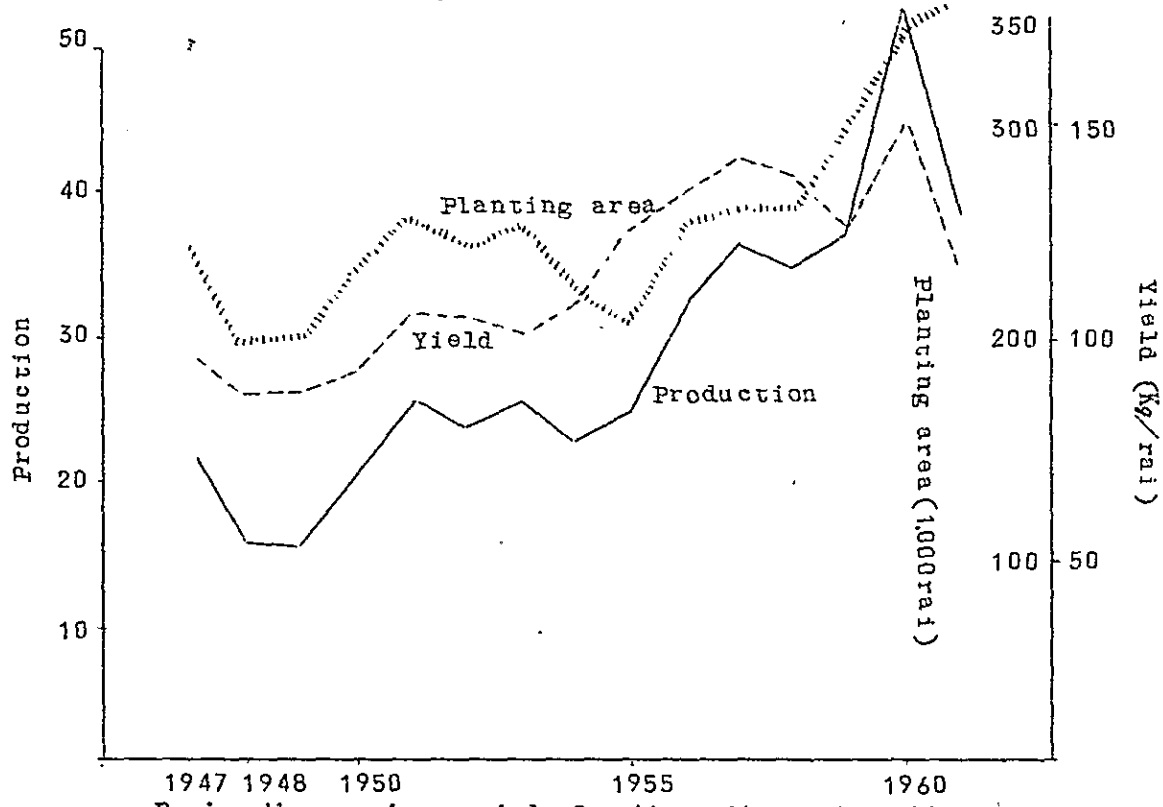
1,000 tons

such as raise in import tariff rate on cotton products or promotion of foreign investments have been taken. The Toyo Cotton Co., Ltd. in Japan has recently come to do processing on a subcontract basis with the factory of the Ministry of Defense situated at Pitsamulske. In making synthetic fibre fabrics, the Taito Rayon Co., Ltd. started with the Japanese capital in full. It is said that it will shortly set up the cotton spinning. At present, cotton piece goods lower in grade of No.30 count or less are now at the self-sufficient stage, but due to the inferior quality of Thailand cotton, Thailand is now forced to depend largely upon the imported cotton.

(1) Production

In recent years, both planting area and production are on the increase step by step from about 1956 on (Graph 13).

Graph 13. Trend in Cotton Production

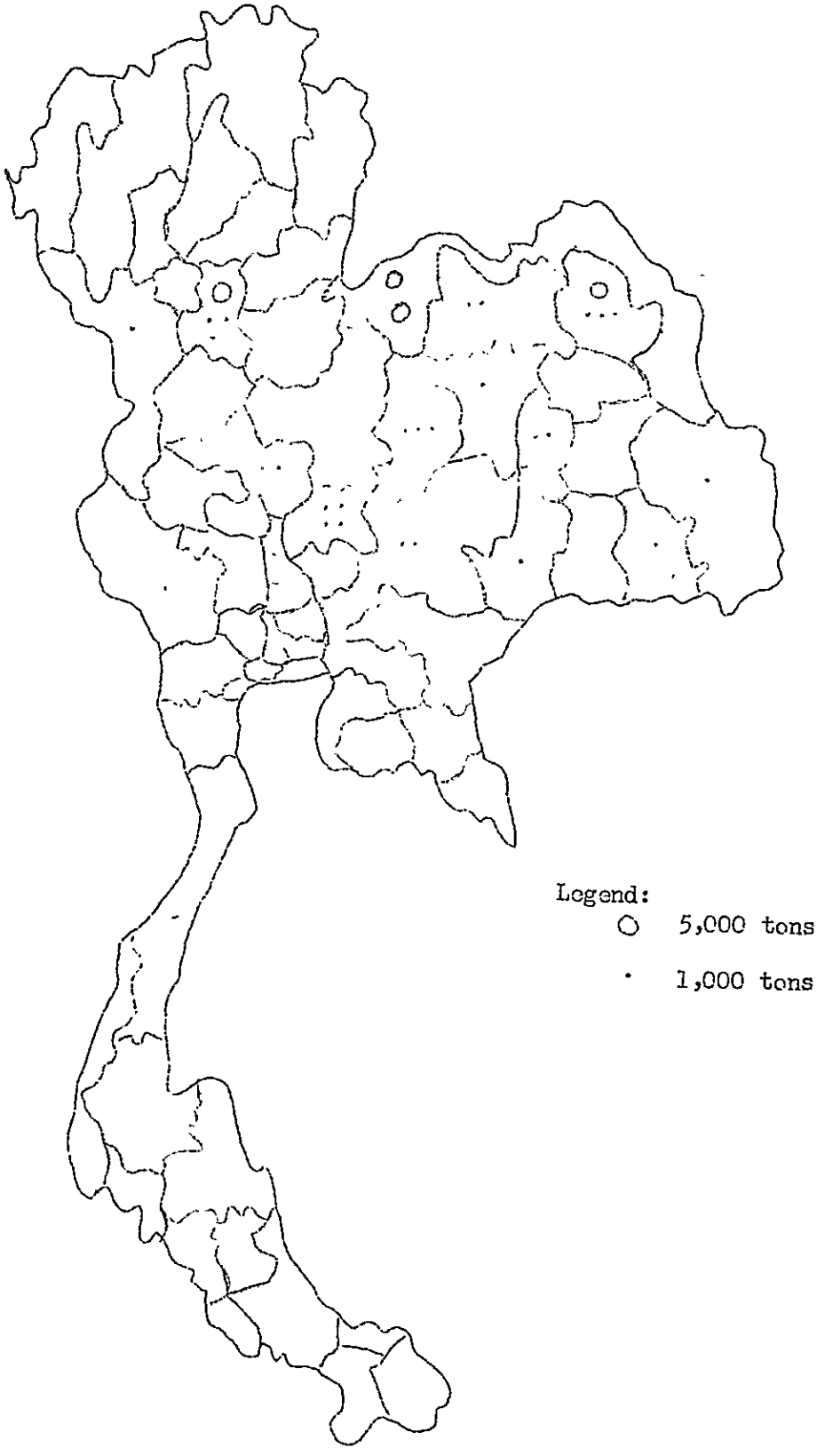


During the growing period of cotton, it requires timely rain-fall and at the fruiting season it requires dry weather. If the climatic conditions are good, cotton adapts relatively well to any soils. In case where rain-fall is too much, well-drained and light soil land is better because the excessive vegetable growth can be held back.

In the tropics, cotton is generally damaged seriously by cotton fleahoppers (jassid). Rith or poor cotton crop depends largely upon the damage by such insect pests.

It is reported that trial culture of Cambodian varieties in Thailand proved them to be inacclimatized, except in Loei, Sukothai and Lopburi. As shown in Graph 14, Roei, Sukothai and Sakolnakorn are the leading cotton producing provinces. These areas can be said the provinces relatively suited well for cotton growing because of less

Graph 14. Cotton Production in 1960, By Provinces



rain-fall. The cotton expert of the Dept. of Agriculture gave comments that the valuable contribution of the cotton crop experiment station existed in Roei and the station existing now in Sukhothai to the cotton growing in the two provinces can never be overlooked.

In the past, cotton was grown chiefly for the purpose of obtaining the material for self-made clothing because the exchange of goods in the central market was interrupted due to its great traffic inconvenience, but in recent years the trade with Bangkok has become easy. As a result, the cotton growing for farmers' own home consumption is becoming gradually decreased, it is said. In the future, cotton growing should be expanded in order to supply more cotton as material for cotton spinning.

(2) Cultural techniques

Cotton growing farmers in Thailand have suffered seriously from insect damage from older times. Growing mostly of the native cotton varieties of extremely short-staple or the Cambodian varieties of short-staple in former days is ascribed mainly to the fact that these varieties were resistant to insect damage, particularly to jassid (cotton fleahopper). However, either of them is too poor in quality to be used as material for cotton spinning. In view of this, the development of superior quality varieties resistant to insect pests is the important question at issue.

i. Diseases and insect pests

Blossom weevel (Amorphoidea ap) and pink bollworm (Pectinophora gosspiella) occur at the boll-development season. Damage by jassid is serious (Note 11). Jassid damage is the grave problem from old times. Frequent failures in the trial culture of American cotton varieties are ascribed chiefly to this jassid damage. Among other insect pests are aphid (Aphis gossypii Glover), American bollworm (Heriotis), spring bollworm (Aerias Fabia), stem borer (Pempheres affinis), red spider and leaf-roller (Sylepta dersgata).

For the purpose of jassid control, the selection of jassid resistant varieties is now taken up, or the control by the application of market chemicals is sometimes attempted by farmers, it is reported.

Diseases damaging cotton crop include boll rot, anthracnose (Glomerella gossypii-south - Fdg), angular leaf spot (Pseudomones Malvacearum Smith), leaf curl (virus?), and leaf blight. Boll rot occurs in such year in which wet spell continues till late.

ii. Varieties

Varieties native to Thailand are Asian cotton strains with coarse staple. About 50 years ago, Cambodian short-staple varieties of upland cotton strains were introduced. Leaves of Cambodian cotton varieties are covered with short hairs. As a result, the varieties are resistant to jassid, but the staple being as short as about 3/4 inches, the cotton falls on far lower grade as spinning material. In view of this, American varieties of Upland cotton strains or Sea-island cotton varieties of superior quality suited best for cotton spinning were introduced

from the prewar days, but as stated before, no satisfactory results were obtained due to the insect damage. Therefore, the breeding by separation of Cambodian cottons has been attempted. From 1948, the breeding by crossing between Cambodian cottons and American ones has been tried. As a result, the following varieties have been selected at the Sukhothai Experiment Station.

New Varieties	Staple length, maturing, etc.
SK 14	Coarse staple
SK 68	7/8 inch, late-maturing
SK 32	1-1/8 inches, late-maturing, larger boll
SK 6	" , fine staple
SK 14-4A	" , "
SK 55	" , late maturing

Of the above ones, SK 14 and SK32 are now under trial culture at the experiment stations in the respective areas in the country. SK 55 being regarded as a promising long-staple variety, the plan for its propagation is now under contemplation. SK 55 is not subject to trial culture as yet because of the smallness in quantity of seeds available. Our Mission had no opportunity to see SK 55. We could observe SK 14 and SK 32 cotton farms then in the harvesting stage at every cotton experiment station in the country. The staple of SK 14 is rather coarse, while SK 32 was considered fairly promising variety with staple of about one inch in length and resistant to leaf curl. The staple of SK 32 cottons which were presented to us later proved to have about 1 1/8 inches in length. This fact indicates well the effect of the cotton breeding works.

At present, in Sukhothai area the cottons are planted at the ratio: 20% for native varieties and 80% for Upland ones. SK 13 is the major Upland cotton variety. At present, SK 14, which is higher in yield and shows larger adaptability than SK 13, is becoming more popular, it is said. Though we had no opportunity of fact-finding, we felt that if SK 32 is high-quality variety and the result of its trial culture proves to be superior variety, it is necessary to make efforts at the earliest possible time for extending SK 32 as sole recommended variety, excluding any other varieties.

In the case of the irrigated pirot farm lying in the irrigated project plot in Korat, the demonstration of irrigation by sprinkling has been carried on from 4 years ago, and cottons were also subject to trial culture, but proved the failures for the first 3 consecutive years. In this year, insect control was practised thoroughly under the direction of a French technical expert, and the average yield of 335 kg per rai (a maximum of 480 kg) was obtained. The irrigated farm culture is done by an Israelitic farm advisor. In this area, SK varieties are not accepted on account of the inferior quality of their staples. Instead, good-

quality American varieties such as Stoneville 2B, Acala 442, Acala 1,517 are grown under the satisfactory insect pest control. However, since SK 32, which is of fine quality approximating to that of Stoneville 2B has been selected, it should be included in the varieties under trial culture.

iii. Other matters

Cotton is usually planted in July-August, but in the irrigated cotton farms in Korat, the planting is practised in October. We think such planting is practised in the hope of producing an effect of irrigation on the cotton culture. Cotton is planted with spacing: 1m x 20 - 50 cm. Harvesting begins at dry season and ends in February-March. In Sakhothai area, the yields reach from 80 kg to 350 kg per rai. Seed cotton is quoted at about 3 baht per kilogram. Cotton are ginned on a power roller gin, we heard, there is a spinning plant in Sukhothai, but none in Roei. Ginned cotton in Roei are shipped to Bangkok market.

7. KENAF AND JUTE

A. KENAF

Regarding kenaf in Thailand, there are reports available in Japan (Note 12). Basing upon these reports, some comments on kenaf will be given below.

Kenaf fibre is slightly higher in lignification and coarser than jute fibre. As a result, its price is lower, and has been used for blended spinning purpose as jute substitute. With the recent progress in blended spinning techniques, whitish products have come to be obtained by using fine-quality kenaf fibre which is lower in price than jute (lower by 5 - 10% than Pakistan jute). In consequence, the kenaf consumption is on the increase. Such being the case, Thailand has taken possible measures for protection and expansion of kenaf production, with a view to increasing the exports as well as to securing the material for gunny bag making. As a result, kenaf exports are on the increase year after year, reaching about $30,000,000 in 1961 or about 6.2 per cent of the total of Thailand exports. Kenaf ranks third (rice ranks first, and rubber ranks second) in her export commodities. The imports to Japan reach about $6,000,000, ranking second among the importing countries. A further increase in Japan's import requirements can be expected.

Table 19. Exports of Kenaf Fibre

1958	27,587 tons
1959	37,297
1960	61,768
1961	143,476
1962	260,000 (estimates) 1/

Note: 1/ 40,000 tons are for the processing purposes on a contract basis.

On the other hand, the annual consumption of gunny bags in Thailand amounts to about 30,000,000 bags. At present, there are gunny-bag plants cited below. The annual total capacity is at about 10,000,000 unit level. New plants are now under contemplation.

Gunny Bag Co. (Nonthaburi);
North Eastern Gunny Bag Mfg. Co. (Nakornrajsima);
Gunny Bag Ind. Co. (Saraburi);
Other plants (Thonburi).

The consumption of materials available at the above plants amounted to about 10,000 tons in 1961 (about 10 per cent of the total fibre production), and gunny bags of about 1/5 of the domestic total requirements were made. Within several years ahead, the domestic consumption of materials is expected to reach 35,000 tons. Some foreign countries are making gunny bags for Thailand on a contract basis. In 1962, about 40,000 tons (estimates) of kenaf fibre were exported to Japan, Taiwan and India as material for gunny bag making on a contract basis.

(1) Production

i. Trend in kenaf production

In response to the growing demand for kenaf fibre, it shows a rapid increase from about 1958 (Graph 15). It is said that the increase in production has been stimulated particularly by the rise in price of jute in Pakistan due to the crop failures two or three years ago. Graph 15 indicates that the recent production increase owed chiefly to the increased planting area. Kasetsart University (Note 13) carried on the fact-finding survey on the kenaf growing by 3,396 sample farmers. The following are the results of survey on the farmers' motives to take up the kenaf cropping in the year 1961 when the planting area showed a rapid increase.

(i) Due to the high price of kenaf in the previous crop year;

(ii) Stimulated by the kenaf grown near-by;

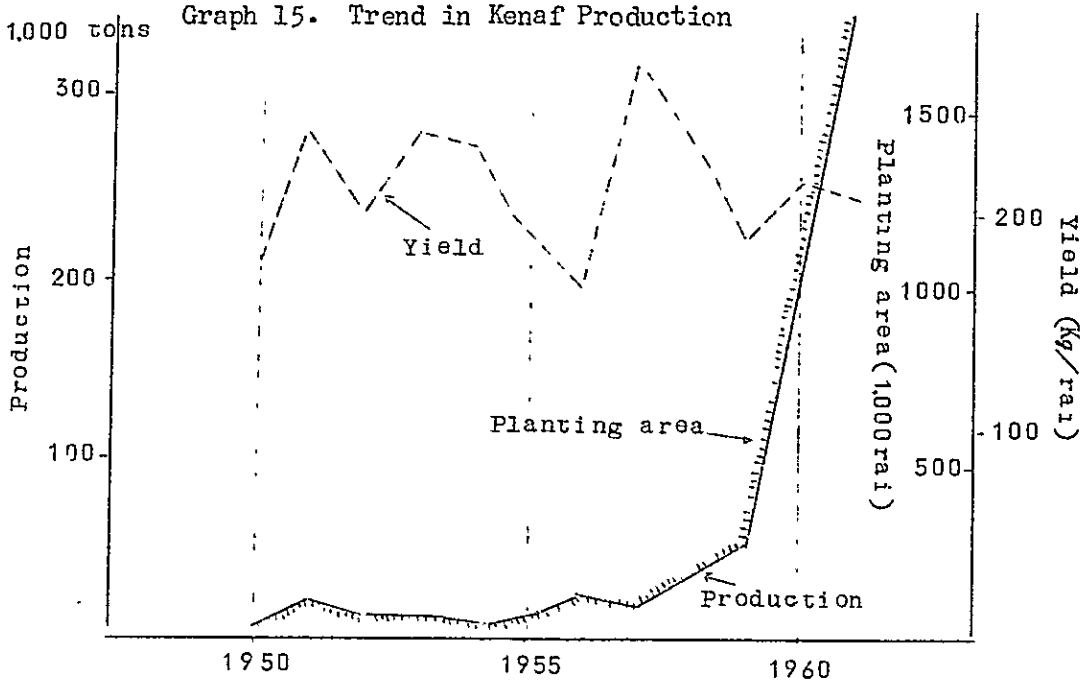
(iii) Accepting the idea on the part of provincial or county authorities;

(iv) According to the intention of association;

(v) Encouraged by the dealers.

Farmers' willingness to crop selection is surprisingly strong. Needless to say, the effect of prices is particularly great. For instance, kenaf fibre was marketed at the rate of 1.30 - 5.30 baht per kilogram in 1960, while in Udorthani or Chonlot where our Mission made a field survey, the kenaf production was slowed-down due to the lowering of price of the 1961 kenaf fibre (as low as 0.50 baht per kilogram for a while). In Chonlot, kenaf growing has been replaced by cocoon raising.

Graph 15. Trend in Kenaf Production



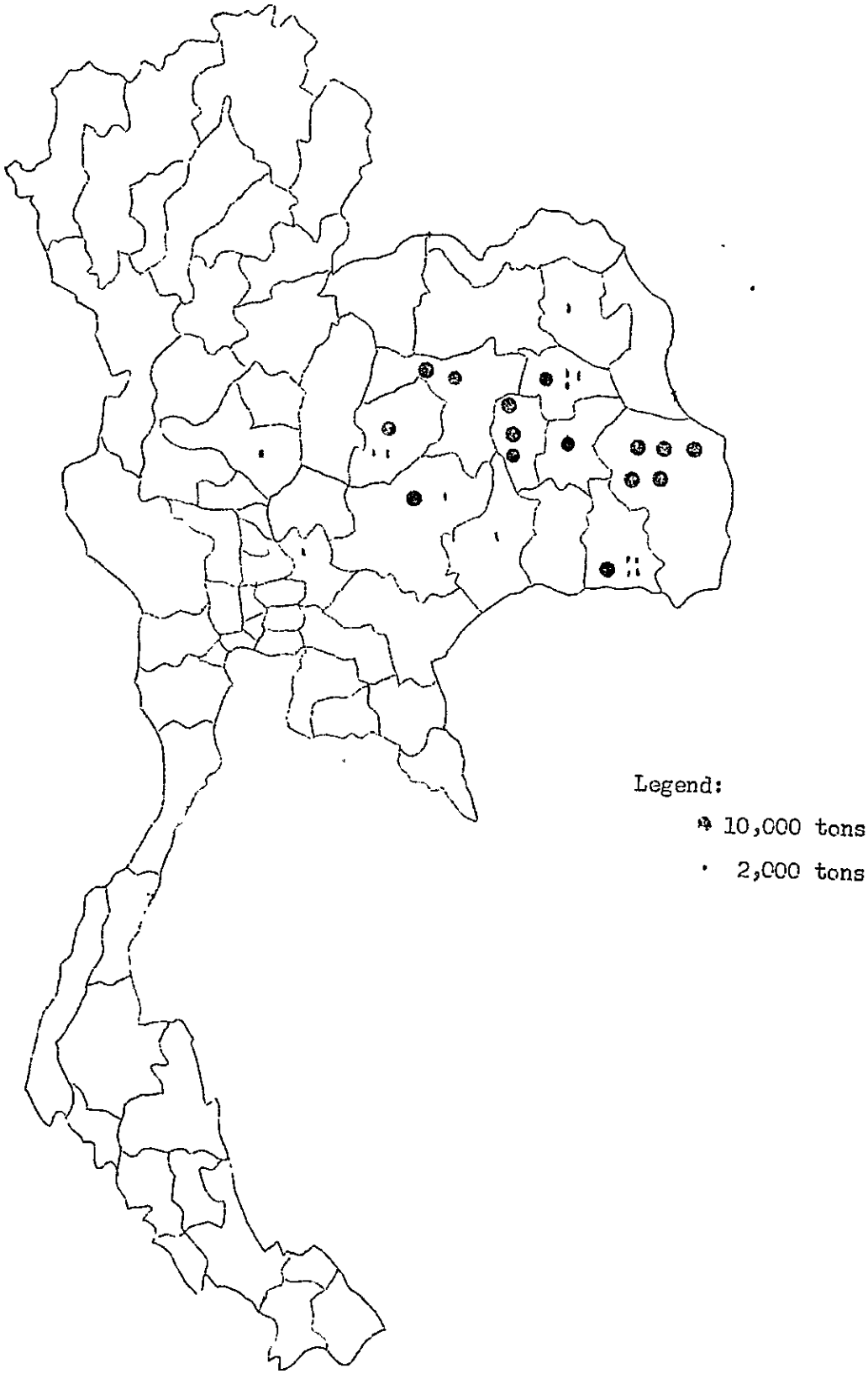
ii. Distribution of producing centres

Jute is grown mainly in the central plain areas because jute is suitable for the heavy clay and fertile alluvial soil area, but not for dried land area. In contrast to this, kenaf is suitable for well-drained fertile soil area, but it can be grown on the sloping land low in moisture-content or on the low productive area. As a result, kenaf is grown mostly in the upland area in the northeastern part where is relatively infertile and dry. In Korat, kenaf is mostly grown in reddish brown soils consisting of latcrite at the lower layer (known as "sandy loam soils"). Kenaf is also grown in light-greyey-white sandy soils consisting of weathered liparite or silica sand rock. However, the latter can not be considered suitable for kenaf growing due to the lack of humus-content and due to the poor soil fertility.

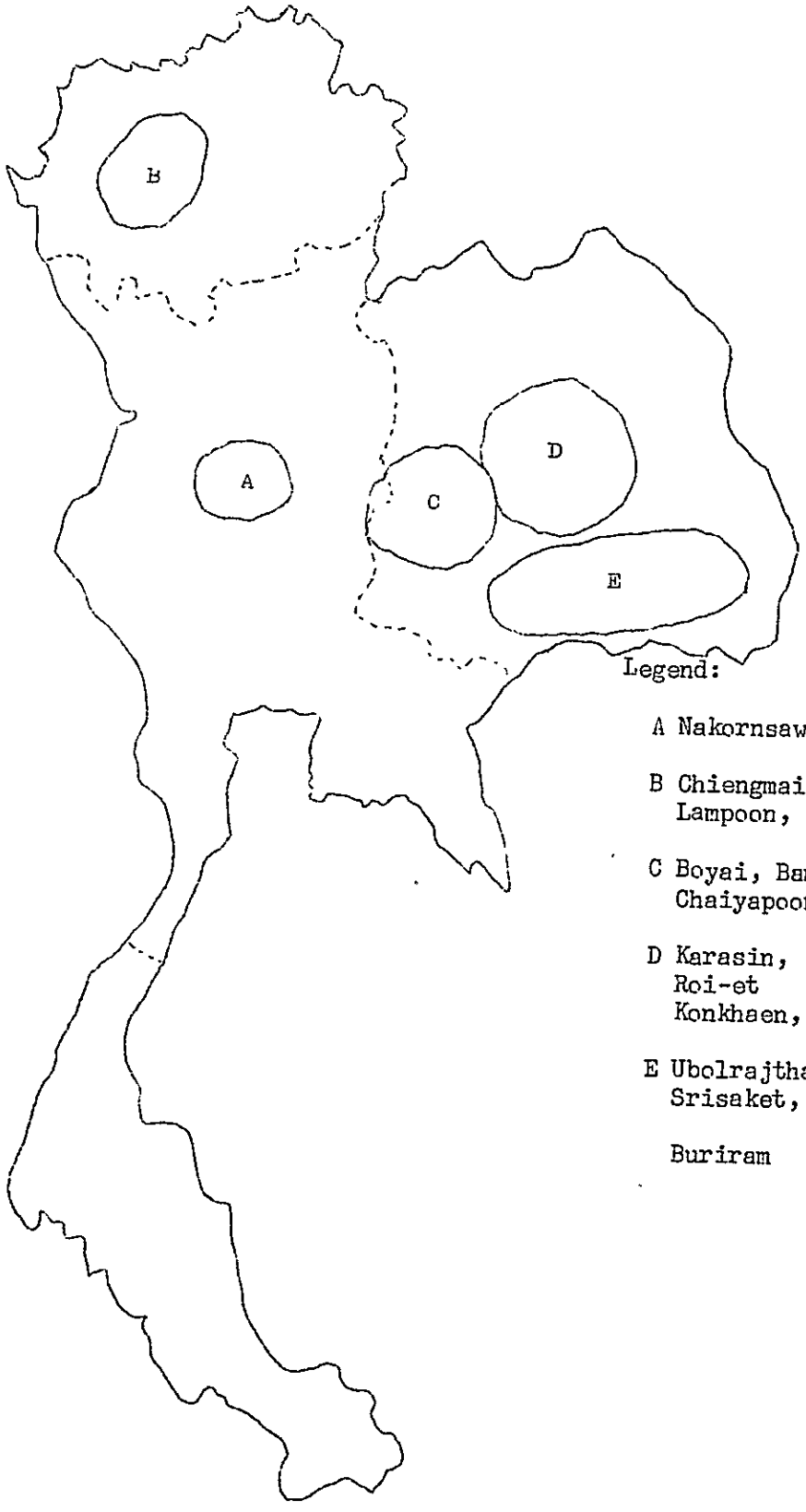
Graph 16 indicates the kenaf production in 1960 in the respective provinces. As indicated in Graph 16, kenaf is produced much in such provinces as Ubolrajthani, Mahasarakan, Konkhen, Srisaket, Karasin, Nakornrajsima, Chaiyapoon, Roi-et, etc.

Graph 17 indicates the kenaf production according to the regions in 1961-62. The production as a whole is larger than that indicated in Graph 16. Such disparity may be ascribed to the difference in the survey year.

Graph 16. Kenaf Production in 1960, By Provinces



Graph 17. Kenaf Production in 1961-62, By Regions



Legend:

A Nakornsawan, 10,000 t

B Chiengmai
Lampoon, 5,000 t

C Boyai, Bampai
Chaiyapoon, 100,000 t

D Karasin,
Roi-et
Konkhaen, 80,000 t

E Ubolrajthani
Srisaket, 80,000 t

Buriram

(2) Cultural techniques

With a few exceptions, almost all the kenaf cropping is operated by small holders. According to the fact-finding survey of Kasetsart University, planting area ranges from one to 200 rai, 8 rai on an average. The number of farmhouseholds holding 10 or less rai accounts for nearly 80 per cent of the total. Due to the small-scale management, the cultural technique level is very low. The University's fact-finding survey results inform that the yields are affected most greatly by the seeding method and soil fertility. Among the important problems to be tackled are the technical improvements in the time of harvesting or varieties in connection with staple quality as well as in retting methods.

i. Varieties

In addition to the native Chinese varieties, there are Cuban varieties. The latter include early-, medium-, and late-maturing varieties. Early-maturing varieties, Cuba 977-044 being superior ones, they are propagated. The growth period of native varieties is somewhat longer and the crop is harvested in about October, while that of Cuba 977-044 is shorter and the crop can be harvested in mid-September. As a result, the retting of the latter can be done within the plentiful water supplying season. Though Cuban varieties are superior in quality to native ones, the latter are higher in yields than the former. Either of them has its advantages and disadvantages, but it is sometimes reported that the former are superior as a whole. It seemed, in reality, impossible to decide between them. Among the varieties under test are included Guatemalan and Taiwan varieties. It is recommended that a further varietal test be carried on by collecting more varieties.

ii. Cultural methods

(a) Seeding

Since kenaf is one of the long-day plants, the season of blooming is accelerated by specific longer days, irrespective of the seeding dates. Such characteristics differ according to the varieties. For instance, Cuban variety plants begin to flower when the day length reaches 11.5 hours, while the flowering of Chinese variety plants is somewhat delayed. For this reason, if the seeding is delayed, the period till the flowering date is shortened, and the vegetative growth of kenaf plants cannot be attained fully. Test results indicate that the period ranging from early May to early June is optimum seeding season.

In the reference data for extension work prepared by the Ministry of Agriculture (Note 14), the following three seeding methods are cited.

(i) Broadcasting: Seeds are broadcasted on the prepared farms at the rate of 3-4 kg per rai. Owing to a closer planting, the plant growth is apt to become poorer.

(ii) Dotting: This seeding method is applicable to the land from which standing trees or stubbles are not removed completely. About 3-4 seeds are dotted at 30-40 cm intervals. About 2-3 kilograms of seeds are required for each rai.

(iii) Drilling: Seeds are sown in drill, spacing 30cm between rows and 5-10 cm between hills (on the well-prepared farms). Seeds are sown at the rate of about 2 kilograms per rai.

However, according to Kasetsart University's fact-finding survey, broadcasting method and "dropping of seeds into holes" method are practised generally by farmers. Seeding rate is 1.5 kg per rai in case of the former, and about one kilogram in the case of the latter. Farmers' seeding rates somewhat differ from those described in the data prepared by the Department of Agriculture.

Broadcasting method being a labour-saving device, it is practised by farmers constituting 69 per cent of the total, but the test results of the Ubolrajthani reported that the yield from the farms planted to kenaf by "dropping into holes" method was higher by 60-100 kg per rai.

(b) Fertilizer applications

Though the application of a 2-2-1 fertilizer (containing 2% of N, 2% of P_2O_5 and 1% of K_2O) at the rate of 50 kg per rai is encouraged, no chemical fertilizers are applied in general. Some farmers apply cattle dung to the farms before seeding at best. In the case of farms of poor soil fertility, it is clear that fertilizer applications make possible the increased production. It is also reported that the effect of phosphates applied at the incipient growth stage is particularly great. To sum up, it is an important point that due to the lower price of kenaf fibre, is it worthwhile to secure the increased production of kenaf by fertilizer applications. In this respect, a further field study is required to be made throughout the producing centres in the country.

(c) Weeding, disease and insect control

Weeding is done twice: once at the stage of plant growth of about 10-20 cm, and another at 40-50 cm plant growth stage. Insect pests damaging kenaf plants include stem borer, leaf hopper, mealy bog, aphid and cricket. Among the diseases are root knot, stem rot (Sclerotisia sp.) and Corticium Salmonicolor.

iii. Harvesting and retting

When kenaf is harvested too early, fibre will not mature fully, thus resulting in poor yield. The later the harvesting, the higher the yield, but due to the progress in lignification, the fibre is becoming coarser. From the viewpoints both of

quality and yield of kenaf fibre, the optimum harvest season is found in the sheathing stage after anthesis. That is, in case where seeds are sown in mid-May or late May, kenaf is harvested 110-120 days after. In general, farmers reap kenaf plants one after another ranging from late September to December. After drying the cut plants for several days, the cut plants are retted, but some farmers store the dried cut plants to ret them in winter season. The yield of kenaf fibre amounts to 150-450 kg per rai, or 250 kg on an average.

The following method is encouraged by the Department of Agriculture.

(i) To cut the plants close to the surface of the ground, and the cut plants are let alone on the farm for 3-4 days for the purpose of defoliation.

(ii) To band the cut plants to the size of about 30 cm in diameter, at three spots (in case of plant of 3 meters long) or two spots (in case of shorter ones).

(iii) To ret them in the clear reservoir. A pond, pool or water tank is used.

(iv) To refine the fibres 12-16 days after.

In most cases, however, due to the unskilful retting, the fibre quality is degraded, particularly due to the lack of water available for retting in dry season, retting is repeated again and again in a small pool, and the lustre or color of fibre is usually spoiled owing to the muddy water, and the final washing becomes unsatisfactory. In view of this, it is in the pressing need to equip with good retting facilities to supply the required water and to give the technical advices on retting.

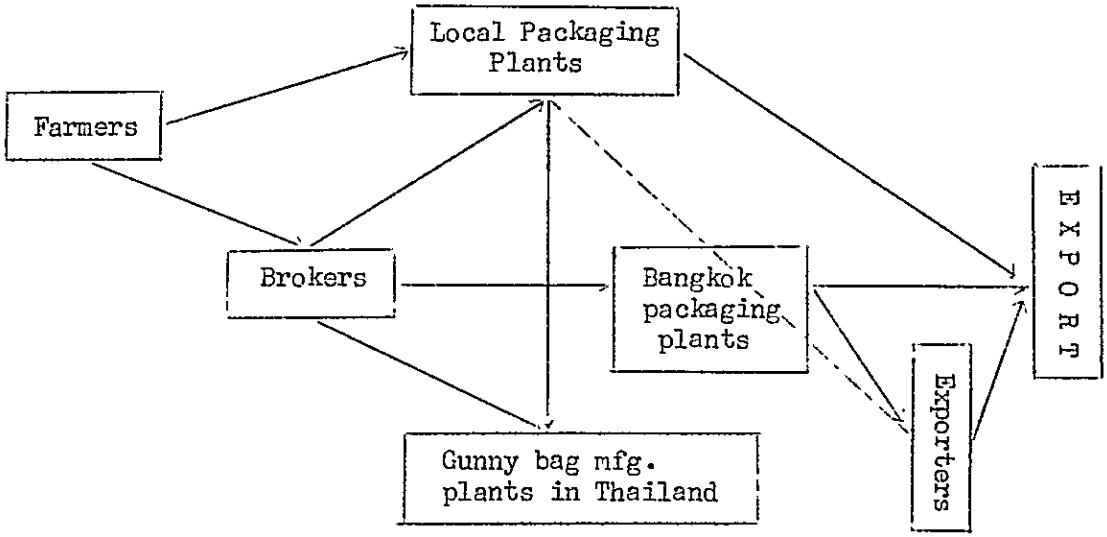
In order to meet the shortage in the supply of water, the use of peelers is in contemplation. The results of test conducted at the Nonsoong Experiment Station by using the finished fibre peeled with a peeler of the Diamond Company indicated that the quality of gunny bags made of such fibre was very good. In view of this, a further study will be required as to the practical use of peeling machine.

In the reference data for extension works prepared by the Ministry of Agriculture, it is written that in case of dry land insufficient in water supply, retting can be completed by burying kenaf under ground for 25-30 days. But the quality of fibre peeled by such method is most inferior. Originally speaking, it is manifestly absurd to grow kenaf in such dry land area, but with the popularization of the use of peeling machines, the circumstances may become favourable.

(3) Marketing

(a) Trading in materials

Marketing channel for kenaf in Thailand is as illustrated below:



Dried kenaf fibre after retting are conveyed to the local packaging plants through brokers. Kenaf fibre is also shipped to local packaging plants directly by some near-by farmers, but kenaf fibre conveyed through brokers are overwhelmingly greater in quantity. Kenaf fibre carried by brokers from farmers to local packaging plants are assorted and packed at the latter. Some lots are sent to packaging plants in Bangkok. Some portions of the lots carried into local packaging plants are also shipped to gunny bag manufacturing plants.

Packaging Plant in Ban-Pai to which our Mission visited is the collecting agency and packaging company financed with the capital invested by overseas Chinese merchants, handling as many as 1,000 tons a year. Regular labourers number 90 (reaching 300 labourers including seasonal ones at the peak time). Most of the labourers are women or girls (by nature of sorting work), and wages are paid according to the efficiency (Note 15). The Company's purchasing price of material fibre was 2-3 baht per kilogram (at the time of our visit in March, 1963).

(b) Exports

Table 20. Exports of Thailand Kenaf

Year	Quantity	Value	Remarks
		1,000 baht	
1950	605 t	1,296	In kenaf is included some portions of jute.
1955	2,936	8,537	
1958	27,587	69,449	
1959	37,320	88,323	
1960	61,789	230,024	
1961	143,477	626,452	

Source: Agricultural Statistics of Thailand, 1961.

Exports of Thailand kenaf is, as shown in Table 20, on the rapid increase from 1958 onward, particularly, showing a markedly increase in 1961, i.e., an increase of more than doubled, as compared with the exports in the previous year. The reasons therefor are, as started at the outset, ascribed largely to the expansion of consumption of Thailand kenaf in overseas jute consuming countries including Japan as material for blended spinning purposes as jute substitute due to the soaring price of jute reflecting the crop failure in Pakistan. Kenaf has come to be highlighted at a bound as a star farm-export item in Thailand.

Table 21. Exports of Thailand Kenaf, By Importing Countries (1961)

Importing Country	Quantity	Value	Remarks
		1,000 baht	
U.K. 1/	71,500 tons (49.8%)	313,766	1/Including some quantity destined for European countries
Japan	28,800 (20.0%)	131,011	
India	14,200 (9.9%)	50,113	
Germany	6,900 (4.8%)	32,161	
Others	22,100 (15.4%)	99,499	
Total	143,500 (100.0%)	626,450	

Kenaf exports in 1961 amounted to 143,500 tons, and the UK, Japan and India are the main importing countries. India had never imported the kenaf, but imported a great deal of kenaf for the first time in 1961. Japan imported the kenaf accounting for 20 per cent of the total of the exports of kenaf.

(4) Quality and testing

The inferior quality of kenaf produced in Thailand is pointed out from every part. This is due to the inadequate refining on account of the shortage in the supply of water for retting purposes.

Kenaf production in Thailand showed a rapid increase in recent 4 or 5 years owing to its recent favourable exports. The areas enjoying the expansion of kenaf production are the northeastern part of the country particularly not benefited with irrigation facilities or retting water. As a result, retting is kept under most unfavourable condition and owing to the limited water supply, the quality of the kenaf fibre is affected seriously.

Kenaf producing centres are being put under such unfavourable

condition, the improvement of quality of kenaf fibre is a matter of great urgency. This matter is fully recognized by Thailand also, but the development of irrigation facilities in the northeastern district is a problem which cannot be solved in an instant. In view of this, though the quality of kenaf fibre produced in the northeastern district suffering from the shortage in the supply of water for retting purposes can be improved somehow or other to some extent, but the drastic solution depends entirely upon the future program. The Japan-Thailand Jute Association has come into existence of late. Through this organization, the mutual cooperation has been promoted in improving the trading practices or quality of the fibre.

The inspection of exported kenaf fibre is enforced basing upon the standards established by the Government of Thailand. The OMIC, FESCO, etc., are playing their functions as testing agencies. For further particulars of the inspection procedures, please refer to the reports (Note 16).

(5) Consumption in Japan

At present, kenaf fibre is used in Japan as blend with jute. In Japan kenaf fibre has never been used as blending purposes, but due to the rise in the prices of jute fibre in Pakistan, kenaf fibre has come to be used as blending.

The consumption of jute (including kenaf) in Japan is on the increase year after year. Recent imports of jute (and kenaf) are as shown in Table 22. (In the Japanese customs statistics, kenaf is treated as the same import item with jute).

Table 22. Imports of Jute (including Kenaf) in Japan

Year	Quantity	Value	Imports from Thailand	
			Quantity	Value
	tons	mil.yen	tons	mil.yen
1959	44,600	2,938	5,300	256
1960	53,900	4,384	10,200	643
1961	58,200	6,768	25,200	2,372

Source: Japan Annual Foreign Trade Report (Customs Division, Ministry of Finance)

As shown in Table 22, the total imports of jute in Japan in 1961 amounted to 58,200 tons. Of them, 25,200 tons (43.2% of the total) were the imports of kenaf from Thailand.

The allowable rate of blending of kenaf with jute is 50 per cent at the maximum. The blending at the rate of higher than 50 per cent is regarded as undesirable from the qualitative viewpoint of the finished goods. Consequently, supposing Japan's current import requirements of jute be 60,000 tons a year, 30,000 tons of kenaf can be consumed in Japan.

However, since the blending rate of kenaf with jute depends upon the price of jute from Pakistan, further costdown and quality improvement of kenaf fibre from Thailand are keenly desired.

B. JUTE AND OTHER FIBRE CROPS (Note 17)

Jute production in Thailand is minor. The planting area covers only 66,000 rai in 1961, or about 3.8 per cent of the planting area for kenaf (1,720,000 rai).

Jute is suited best for heavy clayey fertile alluvial soil area with high temperature where the plant growth period is prolonged and favoured with monthly rain-fall of 75-100 mm throughout the growth period. Jute was grown mostly in the central plain area in the basin of the Menam River, e.g., Ayuthga or Narcornrasima, but in 1961 it showed an increase in production in the northeastern district (Table 23).

Table 23. Jute Production, By Districts

Year	Central Plain area		Northeastern district		Northern district		Total	
	Area	Production	Area	Production	Area	Production	Area	Production
	1,000 rai	tons	1,000 rai	tons	1,000 rai	tons	1,000 rai	1,000 tons
1956	8	1,232	7	1,310		6	16	2.5
1957	7	1,602	5	1,170		10	12	2.8
1958	8	1,740	5	1,097	0.4	73	13	2.9
1959	13	8,063	4	711	0.4	78	17	3.9
1960	19	5,256	6	941	0.2	51	26	6.2
1961	17	3,627	48	7,961	0.3	54	66	11.6

Varieties: The variety now mostly grown is Corchorus capslaris. This is the native variety resistant to water, with many branches and with reddish peels. The native variety is higher in yield, but the plant growth period lasts for too long and inferior in quality. In view of this, Indian, Pakistan and Taiwan varieties are now under test. Of these, Decka Variety is relatively promising one. This variety requires shorter plant growth period, and superior in quality, but lower in yield.

Seeding: Jute is planted usually in May-June (beginning of wet season). Seeds are generally broadcasted, but sometimes drilled at intervals of 30 cm in width. Seeding rate is 1.5 - 2 kilograms per rai. Seeds are rather small and the germination at the beginning being important, farms are required to be prepared carefully.

Fertilizer: About 1,000 kg (per rai) of composts or stable manures are applied, but it is recommended that ammonium sulphates also be dressed 2-4 weeks after.

Harvesting: Jute is harvested for fibre in September-October when the male plants are in full flower and shedding pollen. Jute plants are reaped close to the surface of the ground. For obtaining fibre from the cut plants,

there are two ways: (1) by way of ribboning with a simple tool, immediately after reaping or after retting for a while; and (2) by way of retting the cut plants for 10-14 days in the stream. In this case, the cut plants are dried on the farms and leaves are removed and then tied into bundles. Fibre is obtained at the rate of about 200-300 kg per rai.

Disease and insects: Stem rot (disease) occurs and seni-loapers (insect pest) occur also, but the damage is not so serious.

Sisal hemp (hard fibre): This fibre is imported into Japan as much as 30,000 tons a year. In view of this, the opinion is also put forth that attention should be paid to the planting of sisal hemp in Thailand. The trial culture has been carried on for these five years at the Nonsoong Experiment Station, though on a limited scale. Taiwan and African varieties are now under test. The former are planted at the intervals of 2 meters wide (between rows) and 90 cm wide (between hills) and the latter are planted in rows of 3 m and 1 m in width, alternatively, and 90 cm wide between hills. The yields amount to about 250 kg per rai.

Ramie: At the Nonsoong Experiment Station, Japanese and Taiwan Varieties, and two native varieties are now under culture test. In addition, winter-flax (sown in November and harvested 3 months after) is under trial culture as well.

8. CASTORBEANS

As to the cultivation of castorbeans, the detailed survey was achieved by Prof. Nishikawa and Mr. Ueda who were sent to Thailand as the experts under the 1962 Colombo Plan (Note 18). Brief comments will be given below.

(1) Production

The uses of castor oil are legion, i.e., for industrial use, medical use, or paints. The demand for castor oil is on the increase world-widely. The increased production of castorbeans is now under contemplation in Thailand as well. In 1961, the planting area covered 229,000 rai, with the production of 32,800 tons (yield per rai, 148 kg), and 32,644 tons (17,940,000 baht in value) were exported. A great quantity of castorbeans have been imported into Japan from Thailand every year. In 1961, Japan imported 27,300 tons from Thailand, or 84 per cent of the total of castorbean exports from Thailand. In this meaning, Japan is the greatest purchasing country in the world.

During the plant growth period, there is a plentiful rain-fall, but less rain and much sunshine are desirable at the flowering and fruiting stages in order to check the vegetative growth and obtain better beans. In this respect, the main producing regions such as northeastern district and the central plain district are favoured with better conditions.

(2) Cultural techniques

i. Varieties

There are Kao Dam and Damyai varieties. At present Kao Dam is grown at the rate of 10 per cent of the total, while Damyai

at the rate of 50 per cent. This is ascribed to the fact that farmers were encouraged to grow the latter on the ground that the latter is higher in oil-content, but, in reality, Kao Dam is rather higher in oil-content (about 56%) than Damyai (about 54%). Kao Dam is by far higher in yield (210 kg per rai) than Damyai (about 140 kg per rai). As a result, Kao Dam is encouraged more at present. Prof. Nishikawa et al. give various comments on the castorbean breeding.

ii. Cultural methods

Castorbean seeds produced in Thailand include foreign matters or immature seeds and are high in moisture-content, unstable in oil-content (often lower), and high in oil-oxidation. Owing to such various faults, they were not welcomed. Connected with the cultural improvement measures to be taken in the future, Prof. Nishikawa et al. pointed out the following measures.

(a) Castorbean is a perennial plant cultivable for 2-5 years, but the older the plant, the lower in yield. As a result, it is better to grow it as an annual plant, and in order to stimulate branching the plants are headed back. Attention should be paid to secure higher yield by increasing the number of pods, and to save the labour for harvesting, and to improve the quality by reducing the damage caused by rainfall.

(b) Farmers usually do not apply any fertilizer (even cattle dung is not applied). It is, therefore, recommended that fertilizer be applied. For the time being, it is advised to prevent the soils from being depleted by planting legume crops as catch-crops or mixed-crops on the castorbean farms.

(c) Measures should be taken for avoiding the mixing of immature seeds at the harvesting stage or at the stage of sorting or preparation of seeds.

iii. Marketing

Castorbeans are purchased by brokers at farmers' farms. Prices fluctuate, but as there is a good market for castorbeans, it is sure that these are sold. Maize is the main competitive crop. Castorbeans were sold at 2 baht per kilogram last year. The planting is still on the increase.

9. SORGHUMS AND WHEAT

New crops such as sorghum and wheat are now under trial culture. Sorghum is a dry resistant crop and since it is possible to increase the production of sorghum by means of irrigation practice, Mr. Brannor, USOM expert, found that sorghum is the crop suited best for the second crop to be grown in paddy fields after rice has been harvested. Hegori 13 (grain sorghum variety) is grown and is attaining fairly good results in the various parts of the country, but there is no market for this crop in the country. The marketing is the question at issue. However, sorghum is used as food in some of the neighbouring countries. And in Japan also,

milo maize was imported for food purpose from the USA by a great deal immediately after the war. It is important to make a further study of the markets for grain sorghum, in parallel with its trial culture.

In Thailand, since the demand for vermicelli is strong, the self-sufficiency in wheat is keenly desired. For this purpose, the trial culture of wheat is now carried on at certain experiment stations in the northern district. At the Mae-joe Experiment Station, wheat variety imported from Burma was tested, but the growth of grains was very poor (perhaps due to the damage caused by high temperature), though the external appearance of spikes was very fine. Though wheat culture in Thailand seems very hard, if it is grown in the area where is relatively cool in winter, it would become possible. And it is also recommended that the trial culture be carried on by collecting the wheat varieties suitable for warm climate from wider areas.

10. COCOONS

(1) Historical background

Thailand cocoon production has a history ranging over a period of several centuries, but the attempt to develop cocoon raising as the national industry was initiated for the first time by the then King (grandfather of the present King) at the end of the previous century. At that time (1901), the technical Mission headed by Dr. Toyama (sericultural expert who contributed greatly to extension of F_1 hybrid in Japan) rendered technical assistance to sericultural industry in Thailand at the invitation of the Royal Household. Silk reeling women were also invited from Japan, and it is said that the Queen herself learned the reeling method from them. Afterwards, silkworm raising training institute, textile fabric training institute (Japanese experts were invited as instructors) or the national silk reeling plant were established, but all such schemes had fallen through, representing no appreciably significant achievements (Note 19).

After the end of World War II, silk industry in Thailand was again to the fore. Captain Thompton of the American Army stationed in Thailand happened to be interested in Thai silk. After the discharge from his military service, he started the Thai fabric export business with the Americans as customers. Fortunately, the musical show entitled "KING AND I" which was derived from Thailand made a hit throughout the U.S. Taking advantage of such Thai boom, Thai silk was sold like wild-fire. By and by, Thai silk has made inroads upon European markets. Thai silk is on the increase in sales as a sourvenir from Thailand to foreign visitors who are becoming increased in the number year after year.

It showed an increase in demand for Thai silk, but the production of cocoons and raw silk used as material for the silk goods cannot meet the demand. As a result, the export silk fabrics in Thailand are made by blending Thai raw silk with raw silk imported from Japan.

(2) Current status

i. Cocoon raising

Cocoons are produced mainly in the northeastern district.

Statistics on sericultural farmhouseholds and mulberry areas are not available.

The fact-finding survey carried on in September-November, 1961 by the Ministry of Agriculture (Note 18) indicates that cocoon raising is practised mostly by medium- and small-farm holders. Of 214 sample farmers, farmers holding 2-3 hectares accounted for 40 per cent, and those holding 2-5 hectares accounted for 31 per cent of the total. Mulberry area per sample farmers ranges from 10 ares to 2 or 3 ares, showing that the size of cocoon raising is extremely small.

Malberry varieties prevalent in Thailand number 11. Amongst them, Mon Som Variety accounts for 60 per cent, Mon Nai Variety and Ta Dam Variety account for 26 per cent each. These varieties are of white mulberry strain. These are said to have been brought about to Thailand by Dr. Toyama towards the end of Meiji Era (1867 - 1912). Japanese and Italian mulberry varieties are also under trial culture on test farms.

Mulberry trees on farmers' farms are mostly planted closely at the intervals of 40cm x 50cm. These on test farms are planted sparsely at the intervals of 100 cm x 100 cm. Farmers have been encouraged in planting at the intervals of 100 cm x 100 cm, but farmers have liking for a closer planting for the purpose of checking the outgrowth of weeds, we were told. Silk-worm litters or cattle dung are dressed on the surface of the farm ground at best. These are not plowed under. No chemical fertilizers are applied.

Mulberry leaves grow well whenever water supply is ample. In dry season, due to the lack of water, leaves do not grow. Consequently, silkworms are raised centring about the season ranging from September to February in the year following. During this season, cropping is permissible at about 3 times. Under irrigation, cropping is permissible all the year round, say, about 8 times in a year. Mulberry farm irrigation is not practised, except for the case of experiment farms. Even in the dry season, silkworms are sometimes raised on a limited scale for egg making purpose.

Yellow cocoon variety is prevalent in Thailand. Cocoons of native varieties are very small in shape. Silkworm eggs produced at experiment stations from improved Thai varieties or cross-breeds between Japanese varieties and Thailand ones are distributed among farmers. There are many farmers who make eggs of native varieties. No detailed reports on the characters of cocoons are available, but the data for length of filament of one cocoon are available. It is as follows:

Variety	Length of filament
Native variety	150 - 220 meters
Improved Thai variety	400 - 450
Japan & Thailand cross breeds	800
Introduced Japanese variety	1,143

Silkworms are raised on a round-shaped bamboo-tray (with about 80 cm in diameter, and 5 cm in depth), at the rate of about 1,500 worms on a tray. A tray is covered with gauze to protect worms from being attacked by other insect pests. Full-grown worms are shifted to the mounting tray on which silkworms spin cocoons. Mulberry leaves are fed to silkworms 2 or 3 times a day.

ii. Raw silk reeling and fabrics

Reeling is made by women with hand reelers at their own homes. Thread-collecting apparatus is not attached to the reeler. About 30 - 50 cocoons are reeled, as is the case with douppion reeling. Raw silk thus reeled is full of knots and very coarse. In view of this, it is rather similar to douppion. Silk fabrics known as "Thai Silk" are of "shantang" type with specific appearance. Since raw silk is reeled from non-dried cocoons, it has a peculiar touch.

Prices of raw silk delivered to weavers directly by farmers or through collecting agencies are as follows:

Superior grade (reeled after fluffs have been removed from cocoons) is quoted at 200 baht (¥3,600) per kilogram; ordinary grade (reeled without removing fluffs) at 120 - 150 baht (¥2,100-¥2,700); and raw silk reeled exclusively from outer layer of cocoons at 100 baht (¥1,800). Prices are by far lower than the current prices of Japanese raw silk.

Silk fabrics are made at home on hand-loom for home-use purposes, particularly for festival or wedding dress making purposes. In addition, silk fabrics for export purpose or Thai silk as sourvenir use are manufactured by professional weavers. In this case, as stated before, Thai raw silk is blended with thrown silk yarns imported from Japan. German-made dystuffs are used. Most of the mills are on a limited scale, except the modernized large mills nearby Bangkok. The mill weaving high-quality fabrics for the royal family uses exists at Royet in the northeastern area. It is a small-scale mill equipped with only five looms.

iii. Possibility of Development

Raw silk industry can be said a very promising industry in Thailand (particularly in the northeastern part of the country). Under "5-Year Plan for the Development of the Northeastern District," the Government of Thailand is now in contemplation of the strengthening of research works and extension works at 5 sericultural experiment stations located in the northeastern district (the Ubol Experiment Station is functioning as the central station). For this purpose, the request has been made to receive technical specialists from Japan.

However, in order to secure the desired development of raw silk industry in Thailand, any appreciably great achievements could not be attained merely by piecemeal improvements of varieties or technical research works. It is absolutely

necessary to draw out the integrated development plan, involving mori-culture, silkworm raising and raw silk reeling enterprises. Basing upon this integrated plan, the improvements in the respective integral parts are required to be expedited.

N.B. Since the present raw silk industry in Thailand is at the developing stage similar to that in Japan in the earlier years of the Meiji Era (1867 - 1912). Appropriate measures should be taken step by step. To cite a case in point, Burma proved a failure in attempting to bring about the raw silk reeling mills at a bound under the modernized management through the introduction of automatic reeling machines from Japan.

In order to expedite the development of raw silk industry in Thailand, it is recommended that firstly the production of Thai silk with specific features be increased by following the primitive cottage industrial manufacturing system, and then possible efforts be made for improving the cocoon raising productivity, with a view to securing ample material raw silk for Thai silk making, through the extension of healthy and high-yielding silkworm varieties, as well as through the year round silkworm raising by the increased production of mulberry leaves by bringing the mulberry farms under irrigation. Thus when cocoon production is increased far more, a great deal of cocoons can not be dealt with the present primitive and low-efficient hand reelers. Then the raw silk enterprise will be brought under the medium or smaller scale management by using somewhat improved reelers (e.g., peddal reelers) or it will give rise to the raw silk reeling under farmers' cooperative management.

To sum up, it will mark a forward step toward the development of raw silk industry to expedite the shifting of cocoon production from the stage of production on a home-use basis to the stage on a cash crop production basis.

Notes on the Main Crops

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ii. Agriculture and Rice Growing in Thailand, 1962, Agr. Exp. Sta.

iii. Rice Growing in Thailand, 1961, By the Japan Chemical Fertilizer Promotion Society.

iv. Report on Fertilizer Application Tests in Thailand, 1959. (Ditto)

Note 2. Proposed Corn Improvement Program for Thailand, Department of Agriculture, 1962.

Note 3. Results of Experiment on Maize in Meikitila Exp. Farm, Report of Japanese Colombo Plan Maize Breeding Expert, 1962.

Note 4. Corn (popular pamphlet), Dept. of Agriculture.

Note 5. i. Recent Production of Maize in Thailand, OMIC, 1960.

ii. Exported Goods in Thailand, OMIC, 1961.

Note 6. Primary Products Purchasing Promotion Survey Report, 1963. Japan Sugar Refining Ind. Association.

Note 7. i. Sugar Cane Cultivation in Thailand, Praduan Predipason, North Pacific Science Congress Report, Vol. 8 (crop Improvement), p.68, 1960.

ii. Survey Report on the Sugar Cane Supply Situation of Bunka Sugar Refinery Plant in Udon, Thailand, By Kajita Ando.

Note 8. Sugar cane price is quoted at 125 baht, which serves as a basis for computing 280 baht ($133.33) per ton of sugar to be purchased from the TSC.

Note 9. Recent Supply and Demand of Raw Material Beans for Sprouting-Bean Making, OMIC., 1962.

Note 10. i. Cotton Survey Report in Thailand, Ministry of Foreign Affairs, 1935.

ii. Agriculture in Thailand, Farm Production Resources in East Asia, 1942.

Note 11. The Annual Report of the Cotton Experiment Station, Vol. II, 1938: Cotton Experiment Station, Swankoloke, Thailand.

Note 12. i. Field Survey on Kenaf Production, Collecting and Marketing Mechanism in Thailand, 1962, Ministry of Foreign Affairs.

ii. Production and Marketing Problems Affecting the Expansion of Kenaf and Jute in Thailand: Kasetsart University, 1962.

iii. Kenaf Culture in Thailand, 1952, By T. Yamaguchi.

Note 13. Note 12-ii.

Note 14. Kenaf and Jute, Dept. of Agriculture.

Note 15. Wage: 8 baht (¥144). (2 baht for sorting per bale; sorting per day: 3-4 bales).

Note 16. i. Field Survey on Farm Product Testing System in Thailand, 1961, Ministry of Foreign Affairs.

ii. Note 5-ii. Field Survey on Export Goods Items in Thailand.

iii. Note 12-i.

Note 17. Outline of Cultural Methods, Kenaf and Jute, 1961, Ministry of Agriculture in Thailand.

i. A.

ii. Castorbean Insect Pest Survey and Control in Thailand, By D. Okamoto.

Note 18. i. A Report of the Investigation for the Castor Cultivation in Thailand: Dr. Goro Nishikawa, Professor of Tokyo University of Education, and Takao Ueda, Lecturer of Tokyo Univ. of Education, Colombo Plan Experts, 1962, OTCA.

ii. Note 17-ii.

Note 19. Overseas Silk Market Report, No.96, Japan Silk Association, Inc.

V. AGRICULTURAL DEVELOPMENT PROGRAMS

1. TARGETS

The Six-year National Development Plan proposes various programs for agricultural development.

It is planned to increase the production of rice in proportion to the increase of domestic consumption due to the increase of population so that the export of rice can be maintained at the present level. At the same time, the plan envisages to increase the production of various exportable crops. For example, the plan envisages annual increase of 20% in production of maize, 10% each in kenaf and cassava.

The agricultural development plan, as a part of the Six-year Development Plan, places priority on the following programs:

(1) Increase in agricultural productivity through a comprehensive irrigation program.

(2) Improvement of production techniques by way of disseminating the knowledge of agricultural sciences (diversification of agriculture, dissemination of improved seeds, better cultural methods, application of fertilizers, insect and pest control, etc.)

(3) Promotion of animal husbandry, control and eradication of animal diseases.

(4) Improvement of agricultural practices through experiments on aplicability in respective areas (priority to the North East Region).

(5) Land use survey.

(6) Self-help land settlements.

2. ORGANIZATION

Ministry of Agriculture is responsible for execution of the agricultural development programs. But such programs as promotion of agricultural cooperatives and self-help settlement fall in the responsibility of other ministries, i.e., Ministry of Cooperative and Interior Ministry.

The Ministry of Agriculture, as is shown in the attached chart, consists of six Departments and the Office of the Under-Secretary.

The Ministry deals mostly with technical aspects of agriculture and very little of economic or institutional problems, such as agricultural price support and farm credit. The Division of Agricultural Economics in the Office of the Under-Secretary is in charge of economic research, but the Division is too small to cope with various economic problems related to the agricultural development.

Development programs for forestry, fishery and animal industry, come under the responsibilities of the respective Departments. Programs for increasing and improving rice production come under the Rice Department, whereas the Agriculture Department is in charge of other crops than

rice. In view of the predominance of rice in Thailand, separate Department exclusively for rice may be justified.

Nevertheless, there should be more efforts to avoid duplication, on one hand, between the Rice Department and the Agriculture Department, and also there should be more joint programs of the two Departments. This need will become much larger if diversification of agriculture is to be promoted.

The Irrigation Department, perhaps the largest one in the Ministry, is undertaking a number of irrigation projects all over the country. This Department, however, will be transferred to the Ministry of Public Works. This organizational change may result in better coordination of irrigation projects with hydro-electric projects which are now carried out by the National Authority. On the other hand, however, the coordination of irrigation programs with other agricultural programs may be weakened. Special arrangement will be necessary to avoid such short-coming.

3. IRRIGATION PROJECTS

The importance of irrigation for agricultural development has for long been recognized by the government. Already in the first decade of this century, the Government invited foreign experts to work out irrigation plan in the Central Plain.

The network of irrigation water-ways in the lower area of Chaophia river (Bangkok Plain) was constructed before World War II.

After the War, the Government planned, with technical advice from FAO, the great Chao-Phya Irrigation Project, which covers the vast rice areas of the Central Plain. The construction of a diversion dam at Chainat was started in 1952 and completed in 1956. The total cost of the dam construction was $18 million, of which the World Bank financed $7 million. Main canals from the dam have been almost completed and branch water-ways are under construction. When the project is completed, it will irrigate about 900,000 hectares of existing farm lands and will bring another 140,000 hectares into agricultural use.

The great Chao-Phya Project is to extend and improve the distribution of water rather than to regulate seasonal flow. The volume of water reserved at Chainat dam is not sufficient to permit irrigation in dry season. This, however, will become possible by regulating water at Yanhee dam on upstream (see Note 1). For construction of the Yanhee Dam, the World Bank made a loan of $66 million. The dam was completed in January 1963 and electric generation is scheduled to begin within the year.

In contrast to the Central Plain where irrigation water can be taken from the great Chao-Phya River, the North East is less favored with water resources. Agriculture in this region therefore is more unstable and less productive.

It is estimated that about 280,000 hectares of farm land in the North East can be brought under irrigation from rivers. For this, however, construction of 16 dams is necessary. As stated earlier, the North East Development Plan proposes the construction of 7 dams within 5 years to make 110,000 hectares irrigable. Yet, the utilization of river water in the North East is much limited due to its topography. Hence the irrigation in this region has to depend greatly on numerous small water reservoirs or tanks.

The Government has since 1951 constructed 120 water-tanks in the North East with U.S. aid. (See Note 4). About 24,000 hectares of land became irrigable by these tanks, but the area actually irrigated is much smaller due to incomplete water-ways and intake facilities. (See Note 5)

Under the North East Development Plan the construction of 16 irrigation tanks of medium scale (each with storage capacity of more than 500 m^2) is carried out to irrigate some 17,000 hectares of land. The Plan proposes further to construct 19 tanks for irrigation over 35,000 hectares in the Region.

Completion of these irrigation projects in the Central Plain and the North East will bring about a great changes in the agricultural pattern of the country and the resultant increase in production will be enormous. For such changes, however, a great deal of research and extension of technics for irrigation agriculture is needed.

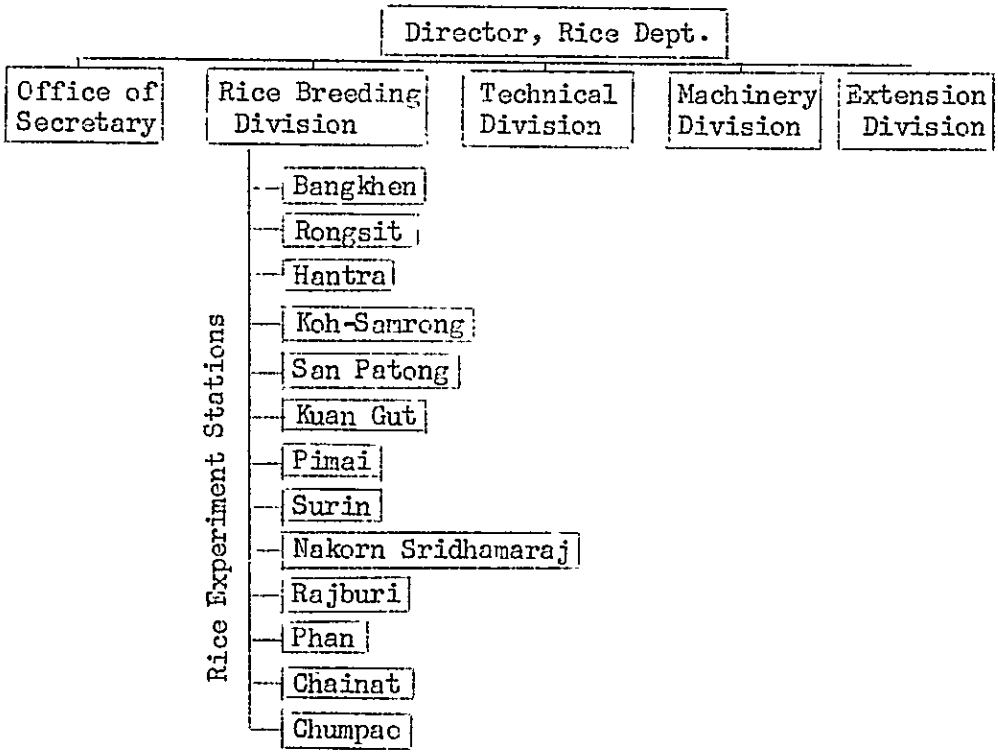
4. RESEARCH WORK PROGRAMS

Research works in relation to agriculture are carried on at the experiment stations under the direction of three Departments of the Ministry of Agriculture, i.e., research works relating to rice are carried on at the central and local rice experiment stations under the charge of the Rice Department; research works in relation to crops other than rice are carried on at the central and local crop experiment stations under the charge of the Agriculture Department; and the research works in the segment of irrigation are conducted at the central and local irrigation experiment stations under the charge of the Irrigation Department, respectively. Such organization is accompanied by the defects such as duplication of research works and low-efficient use of research facilities. Those defects were also pointed out in the World Bank Survey Mission's Report in 1958. As stated later, there is a movement of unification and adjustment of the existing organizations, but not as yet brought into enforcement. The present activities of experiment stations and the views on the problems involved therein will be described below.

1) Research works in relation to rice (paddy field rice)

Research works in relation to paddy field rice are carried on at rice experiment stations under the charge of the Rice Breeding Division of the Rice Department (Table 1). Research works of paddy field rice breeding and cultural improvement and the works of propagation of superior varieties are conducted. The rice breeding works have been stated before. In recent years, research works of second crops grown in paddy fields after rice has been harvested has come to be conducted. For instance, at the Sakornnakorn Experiment Station at which our Mission visited, the following research project items have been conducted.

Table 1. Rice Experiment Stations under the charge of The Rice Department



(1) Paddy field rice: rice breeding, fertilizer application, farm machinery and implements, and disease and insect pest control;

(2) Upland rice;

(3) Second crops (legumes, water melon).

In the area near the experiment station, few or no second crop growing is now practised, but the researches are made in anticipation that the irrigated second cropping practice will become possible in the future. From the same viewpoint, varietal tests of second crops such as cowpeas and other legumes, green manure crops, sesame and peanuts, and trial culture of sorghum and sugar cane were also under way at the Chainat Paddy Field Rice Experiment Station.

In Chiengmai, second crop growing under irrigation is now practised generally. At the San Patong Experiment Station in this province, the varietal tests of soybean, peanuts, sugar cane and green beans and the trial culture of cowpeas and sorghum were under way. However, those crops, except sugar cane, are not crops ever grown in this area. Such varietal tests or trial culture of the proposed second crops grown under irrigation are worth noticing.

2) Research works in relation to upland crops

i. Organization

The research works are under the charge of the Research Division of the Agriculture Department. The organization thereof is as illustrated in Table 2. Agricultural experiment stations are kept under the direct charge of the Experiment Station Division. Their scale and the main crops under study are as shown in Table 3. For your reference, the organization of the Mae-joe Experiment Station (the largest one) situated in Chiengmai is given in Table 4. Of 8 officers, one is an officer in charge of general affairs.

ii. Research project items

The list of the 1961 research project items is as given in Table 5. There are some experiment stations where the research project items of various crops are taken up. Research project items are divided into two groups: (1) research projects relating to improvement and selection of varieties; and (ii) research projects in relation to the establishment of standard cultural methods, i.e., spacing, seeding time, fertilizer application, and harvesting season.

iii. Introduction of foreign crop varieties

It will take many years to achieve crop improvement, but the crop improvement can be achieved easily in relatively short years by selecting the varieties suited for the areas from among the improved crop varieties introduced from other countries, and the desired crop varieties can be extended rapidly. Foreign crops can also be used as test samples. From such viewpoint, Thailand has put special stress on the introduction of foreign crop varieties.

Table 2. Experinent Stations in Charge of Agricultural Department

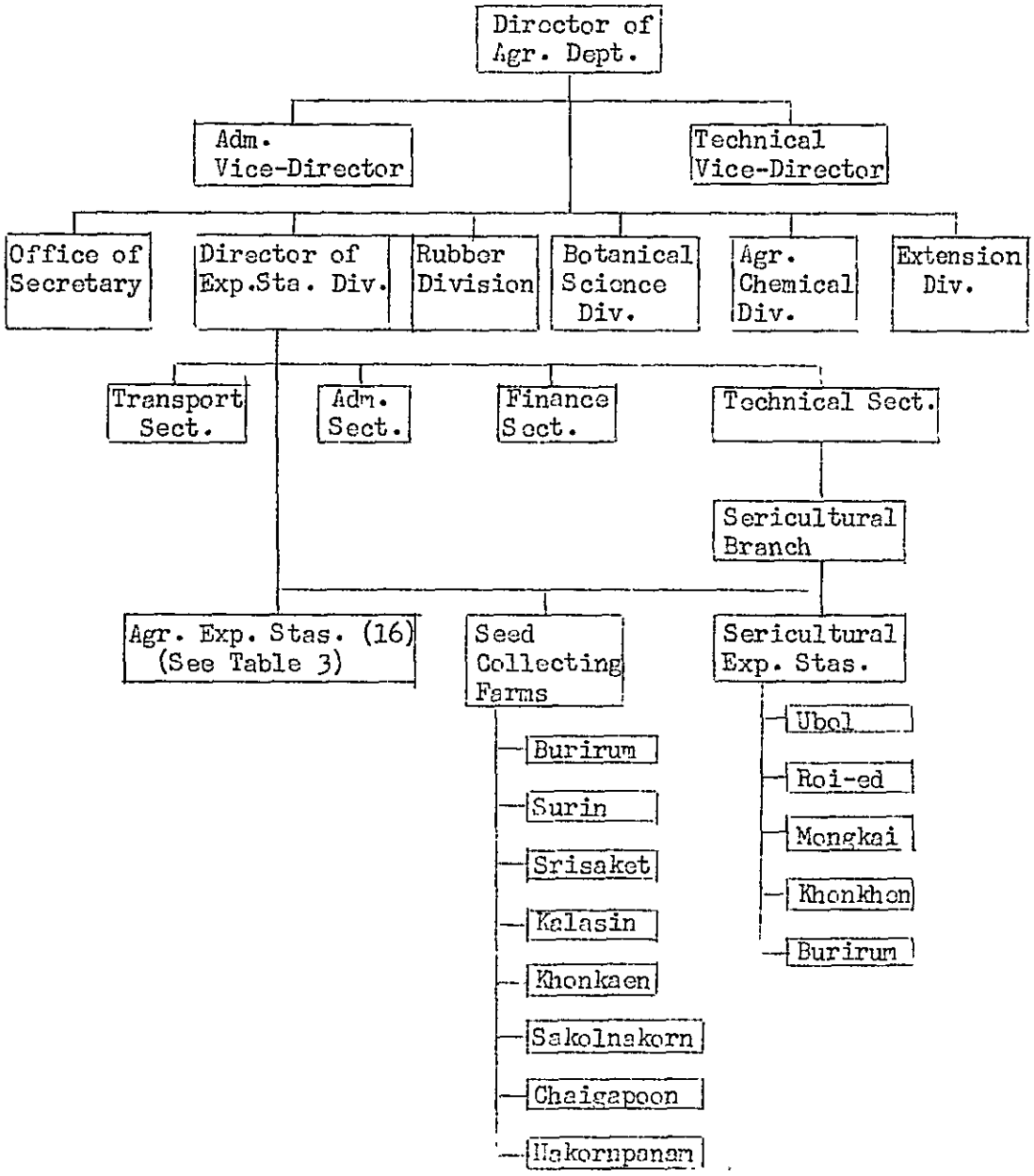


Table 3. Scale of Agricultural Experiment Stations and the Main Crops under Test

Experiment Station	Location	Area *	Number of Research Officers	Main Crops **
		rai		
Prabudabaht	Saraburi	100	3	Maize
Banmaisumrong	Nakornrajsima	400	4	Castorbeans
None Soong	"	866	4	Kenaf
Tha Pra	Khonkaen	100	5	Maize, Sorghum
Roi-et	Roi-et	225	4	Peanuts, water melon, upland rice
Ubol	Ubol	97	3	Sugar cane, castorbeans (foreign varieties)
Loei	Loei	472	4	Cotton
Fang	Chiengmai	406	4	Tea, foreign fruits, vegetables (seed collection)
Mae-jo	Chiengmai	439	8	Soybeans
Srisumrong	Skhothai	660	7	Cotton
Bangkhen	Bangkok	14	8	Seed testing
Bangkok Noi	Dhonburi	62	7	Fruit garden
Prew	Chantaburi	625	8	Fruits, rubber, pepper
Huay pong		227	3	Cassava
Sawee		228	4	Coconuts
Roi mooser		1500	3	Coffee

Note: * Great part of areas are for seed collecting farms.

** Other crops are tested at each station, taking over a portion of test works.

Table 4. Organization of the Mae-joe Agr. Exp. Stn.

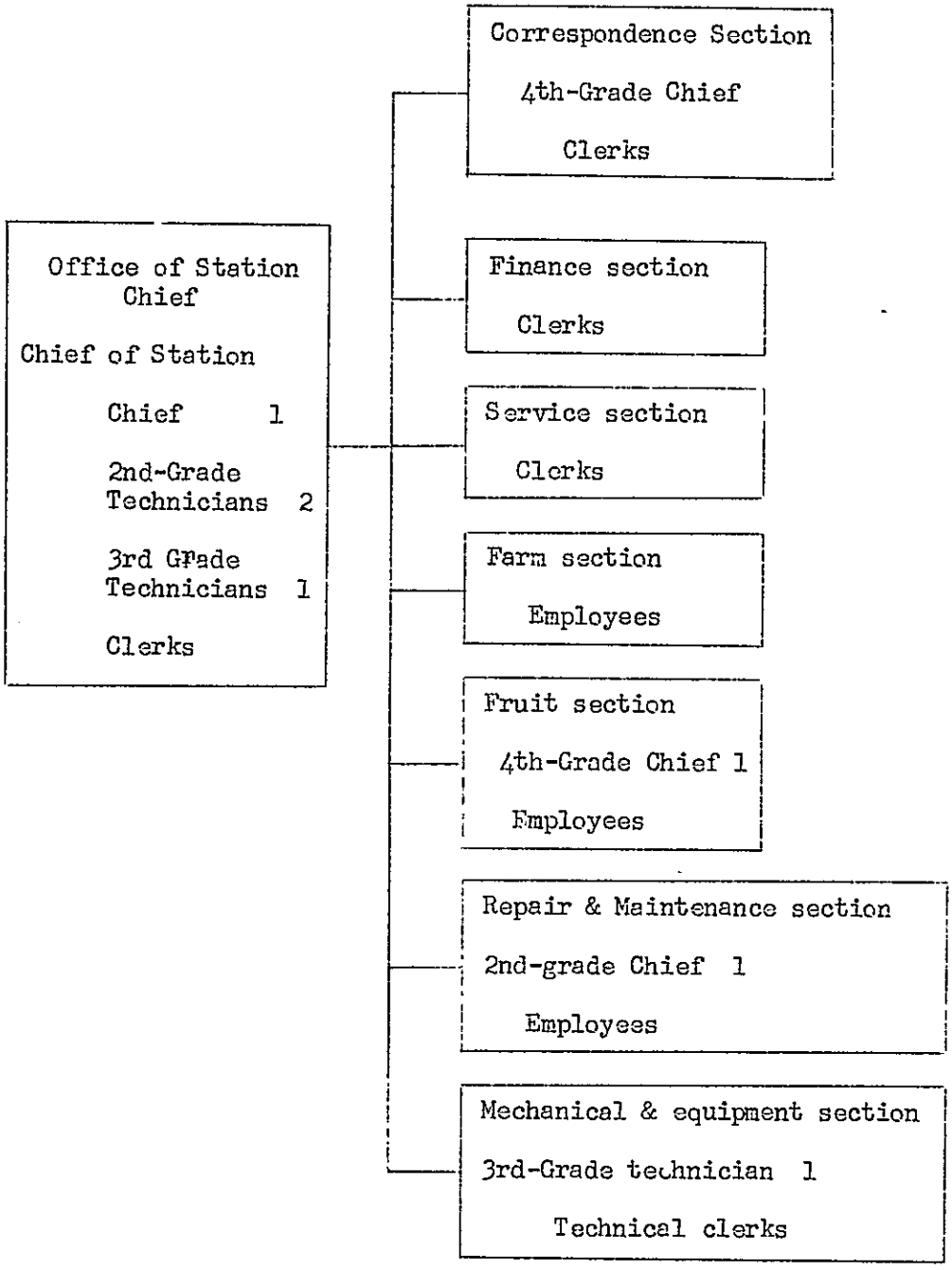


Table 5. List of Research Project Items

Name of Exp.Sta. / Research project item	Prabud	Banmai	Nonsо	Tahpra	Roi-et	Ubol	Loei	Fang	Maejo	Surisum	Bangken	Bangkok	Huey	Prew
Maize														
Breeding works														
Mass selection														
Multi-crossing	○			○										
Synthetic varieties	○										○			
Introduced varieties	○										○			
Cultural method														
Spacing	○	○		○										
Time of Planting	○	○								○				
Seed											○			
Fertilizer	○													
Propagation														
Sugar cane														
Varieties, time of planting						○								
Planting method, harvesting time														
Kenaf														
Spacing			○			○								
Cuban kenaf						○								
Ritting			○											
Seed collecting method			○											
Cotton														
Selection of varieties										○				
Cotton breeding														
Disease and insect pests														

Research project item \ Name of experiment stations	Prabud	Banmai	Noneso	Tahpre	Roi-et	Ubol	Loei	Fang	Maejo	Surisum	Bangken	Bangkok	Huey	Prew
Peanuts														
Spacing				○	○	○							○	
Lime and potash application					○				○					
Breeding					○									
Field tests				○	○	○								
Castor beans														
Selaction of varioties														
Catch cropping														
Time for heading back														
Fertilizer applications						○								
Spacing						○								
Cassava														
Spacing														
Planting method													○	
Harvesting time and composition														
Green beans														
Varieties										○				
Seeding time						○								
Soybeans														
Varieties						○			○					
Garlic														
Varieties									○					
Sesarne														
Varieties									○					
Vegetables								○						
Fruits												○		○

* In 1962, adaptability tests of S. K. 14 and SK 32 were carried on at each station.

In 1961, the following crop varieties were introduced from abroad by sending the specialists to foreign countries and by the help from foreign governments.

Crop	Number of varieties	Export countries
Castor beans	3	Texas (USA)
Wheat, barley, oats	19	Australia
Maize	7	Australia
Cotton	Many	Tanganyika, Cambodia, Israel, Calcutta
Vegetables	Various	India
Fruits	Various	Africa, India, Malaya, Liberia, Japan (Ginkgo)

Most of the above introduced crops are tested first at the Bangkhen Experiment Station, and those destined for cooler areas are tested at the Fang Experiment Station. Besides these, the selection tests are made also at each specialized experiment station.

iv. Achievements of research works

Crop improvement works in combination with the works for foreign crop introduction has met with a fairly great success in improvement of the respective crops, particularly, marked achievements have been added to the maize and cotton crop improvement, as already described before. In the phase of cultural method improvement, tentative standard cultural methods applicable to the respective areas have come to be set up. On the other hand, such achievements will serve as a basis for judging the fact that to what extend the general farmers' farm techniques or productivity can be improved in the future.

3. Problems confronting Thailand

i. Strengthening of research work programs

As indicated in Table 3, in the case of upland crops, research works are under way on a "one-place-one-crop" basis, in the main, at each specialized experiment station. However, since each experiment station takes charge of trial culture of various upland crops as well as of seed propagation works in addition to the improvement of a specialized upland crop item, the volume of research works is too heavy for the present technical stuff members. As a result, it is limited to the relatively simple research works the object of which is to take up a single research project item in relation to varieties, seeding time, spacing, fertilizer application, etc., of each specialized crop. In order to widen the applicability or popularization of the research achievements, it is required to expedite the study of more synthetic factors, i.e., the studies in relation to the relationship between the natural environmental conditions of various descriptions and the plant growth or crop yields in order to make it clear the correlation between them. For such purpose, it is recommended that not only

the research works at experiment stations be strengthened but also the field surveys be made in combination as far as possible. However, since the enforcement of such comprehensive research works is not expected by the present limited technical stuff members, a further strengthening of the research work program is desirable.

At present, the research works of cotton crop carried on at the Surisumrong Experiment Station (manned with experts in disease and insect pest control, soil and fertilizer, farm machinery and implements, etc.) can be cited only as a successful station. Our Mission were impressed with the fact that the rest were mostly manned with breeding and cultural specialists only. In practice, we observed that perhaps due to the lack of research workers, some of the experiment stations are not able to carry on the required experiments satisfactorily owing to the poor plant growth caused by the shortage in the supply of elements or by diseases and insect pest damage. It is, needless to say, very hard to provide the respective specialists at each experiment station, but it will be required to allocate the specialists of various descriptions to some representative experiment stations at least, thus making them perform their full functions.

ii. Research administration

Perhaps owing to the lack of research workers, it is schemed so that all the research data are intact sent directly to the Agriculture Department where statistics are compiled and a few comments are given and then disclosed publicly. In consequence, it is quite possible that in some cases full discussions on the progress of research works may not be made or the views on the part of the research workers may not be reflected to the fullest extent. With a view to improvement in the qualifications for research workers also, it is recommended to change the present scheme to a new system under which the research data may be sent to the Agriculture Department after the research workers themselves have made careful discussions to wind them up, and then the Agriculture Department may give summarized comments on them.

iii. Cooperation among the related organs

Our Mission have felt that a closer contact is required to discuss fully the questions at issue among the related organs, i.e., among agricultural experiment stations, between research works and extension works, or among the Departments of Agriculture, Rice and Irrigation.

For instance, the research works of cotton or maize are now shared among the respective agricultural experiment stations under the supervision of the Agricultural Department in accordance with the plan set up by the Department. Like this, when the research works in relation to other crop items are carried on jointly among several stations according to the project items, a greater contribution can surely be rendered to the research works. For that purpose, it is of prime necessity to recruit the research workers at each experiment station. A closer contact is required also between research workers and extension advisors. For instance, a research achievement meeting of the research workers of the experiment stations was held during the stay of our Mission in Bangkok. On that occasion, extension advisors were not present. It is considered as valuable to exchange

opinions between the research workers and the extension workers, taking such opportunity. After all, it is important to make a closer contact so that all the achievements of research workers may be conveyed to extension workers and the requirements on the part of extension workers may be conveyed to the former.

Moreover, stress has been laid on the researches of single crop item, but in the future, the stress should also be laid upon the problems to be solved by the well-coordinated techniques by promoting the research projects for establishing the agriculture under irrigation or the research projects for maintaining and improving the soil fertility. At present, duplication is often found in the research project items taken up by the respective Departments. To cite an example of the research work for the introduction of second crops in paddy fields after rice has been harvested, (i) experiments of winter upland crops are now conducted at agricultural experiment stations, (ii) researches of upland crops in paddy fields are carried on at paddy rice experiment stations, and (iii) researches of introduction of second crops in paddy fields are conducted at the test farms under the supervision of the Irrigation Department.

iv. Unification of research institutes

It is considered very inefficient that the research works are carried on separately under the direction of the Agriculture, Rice and Irrigation Departments. This is particularly true on the occasion that it is an important matter for agriculture in Thailand to incorporate paddy rice cropping and upland cropping into one farming system by developing the irrigation works. The Agriculture and Rice Departments have many local experiment stations, but the technical research workers at each station are very small in number and each station is poorly equipped.

This is the fact pointed out earlier by the World Bank Survey Mission. In the Mission's Report, it is recommended that all the
7 research institutes be brought under the supervision of the Research Division of the Agricultural Department. But the research works in relation to rice crop were not brought under the supervision of the Agricultural Department on the ground that the research works of rice crop constitute a great part of the Rice Department, and that to transfer the said works to the Agricultural Department is to try to undermine the position of the Rice Department. After all, the agronomical works under the charge of the Ministry of Agriculture are now assigned both to the Rice Department and the Agricultural Department. Herein lies the question.

Under the 6-Year Plan for Economic Development, it is schemed that the Agriculture Research Institute may render services with the technical assistance from abroad, but the relation between the proposed Institute and the experiment stations under the supervision of the Rice and Agricultural Departments is not clarified. And it is informed that the new Institute is kept under the direction of the National Research Council under the direct control of the Cabinet, instead of under the control of the Ministry of Agriculture. Consequently, there is a fear that the new Institute may, in reality, meet with resistance from the Ministry of Agriculture.

Apart from the above proposed Institute, another plan is proposed by the USOM to unify the agricultural research works according to the regions. For instance, it is devised to set up an agricultural centre in Khonkaen (this is expected to be a central area for the development of the northeastern region) as an integral part of the regional development program and to make this centre as the backbone of the experiment stations (about 30 in all) of the Agriculture and Rice Departments situated in the northeastern region, and to intend this centre for as the headquarters of the extension works as well in the northeastern region. It is informed that the USOM is expected to provide about $1,000,000 for the operation cost and the required specialists. The Ministry of Agriculture has much interest in this plan. In January 1963, the Survey Mission, composed of the Agriculture Vice-Director and Ministry Stuff, USOM officers, and the stuff members of the FAO Regional Representative Office, made the field survey and selected the proposed area for the agricultural centre.

5. AGRICULTURAL EDUCATION AND EXTENSION WORKS

(1) Agricultural Education

Among the agricultural educational institutes in Thailand are Kasetsart University in Banken in the suburb of Bangkok, four higher agricultural colleges, and 18 agricultural schools (including 3 schools attached to higher agricultural colleges.)

Kasetsart University is composed of six colleges: Agricultural Science, Cooperative Associations, Forestry Science, Fisheries, Veterinary Science and Irrigation Engineering.

School years differ according to the colleges, and are divided into two classes: 4-year course and 5-year course. As of 1962, the university had an enrollment of 2,103, made up as follows:

College	Enrollment
Agriculture	1,005
Forestry	259
Cooperative Assns.	376
Fisheries	101
Veterinary	149
Irrigation Engineering	213

Graduates are mostly destined for Government officers or school teachers. The data for Agricultural College graduates in the 1950-59 period indicate as follows: (Note 6).

Government officers	58.6%
Teachers	27.3
Engaged in farm work	5.9
Entered higher grade schools 1/	4.1
Company employees	1.2
Unknown	2.9

Note: 1/ Study abroad, or stay in laboratories.

There is a room for improvement in the educational or research facilities and curriculum, and professors and the like are required to be recruited. From 1955 to 1960, under the US Assistance Program, the University had retained the contact with Oregon University. Some professors were sent from and some students were received by the Oregon University. Some material aids were also given. From 1962 on, it is determined to obtain the cooperation of Hawaii University under the US Assistance Program.

School years of agricultural colleges last for three years, the level is similar to the seminor agricultural high schools in Japan. Each of these colleges turns out graduates of about 100 every year. The results of survey of the graduates from Chiengmai Agricultural College (Note 7) indicate that 28.8 per cent of the total entered into the Government offices, 17.3 per cent entered higher grade schools and the remaining are unknown (Most of them are estimated to have flowed-out into the segments other than agriculture.)

Eighteen agricultural schools (Japanese junior high school level) turn out graduates of 1,200 every year. The number of the graduates engaged in teaching accounts for the highest percentage, being 19.7 per cent, and those engaged in farm work accounted for as low as 12.8 per cent, 14.1 per cent of the total engaged in businesses other than farming, and 37.5 per cent are unknown (most of them are considered to have flown out into other sectors).

For the purpose of agricultural development in Thailand, it is important to strengthen the research works and extension works. In view of this, the training of youth engaged in those works is in the prossing need. For the purpose of training of high rank technicians, it will be nearly enough, if the curriculum of Kasetsart University is improved, but for the purpose of recruiting the middle-rank technicians engaged in research and extension works, it will be most important to expand agricultural colleges. With this end in view, the Government is now under contempletion to establish agriculture and engineering colleges in every region. To start with, the Government asked FAO and UNESCO for working out the concrete plan in order to establish Khonkaen Institute of Technology in Khonkaen, the centre of the north-eastern district. The report prepared by the two specialists (each one sent from the two organizations) was submitted to the Government of Thailand in December 1962. Under their plan, the proposed Institute

includes two courses (agriculture and engineering), and has for its object to train technicians in charge of the development works in the northeastern district. It is reported that the Government of Thailand has made request to the USA and New Zealand for obtaining material and technical assistance (professors and other personnel).

(2) Extension Works

Extension work system in Thailand was inaugurated in 1950 when the Extension Division was formulated in the Agricultural Department. Under the FAO and the US technical assistance program, the 4-Year Plan for Agricultural Extension (1952-55) had been carried on, but the works are still now on a limited scale and the activities are not in full swing.

As is the case with research works, each of the four Departments (Agriculture, Rice, Livestock and Irrigation) has its own extension system, the number of extension workers amounts, in the aggregate, to some 400 against nearly 20,000 farm advisors in Japan where is smaller than Thailand in the land area. This fact proves well a great shortage of extension advisors in Thailand. On the other hand, there are two farm advisors in the same district, i.e., a farm advisor of the Rice Department gives advice on rice culture, and a farm advisor of the Agricultural Department gives advice on upland crop culture. The area in charge of one farm advisor is very wide (Note 8).

(Note 8) According to the AID Report, in the northeastern district, 7,500 farm households are under one farm advisor (An Agricultural Rregnan for Thailand: USOM, Bangkok)

Moreover, due to the lack of traffic facilities in rural districts, the full activity of farm advisors cannot be desired. As a result, farm advisors have been engaged chiefly in the distribution of the recommended seeds among farmers. In this phase, they met with great success as seen in the case of rice and maize.

The maize planting area shows a rapid increase of late. According to the results of survey of farmers' motives for the start of their planting of maize (Note 9), the reply to the effect that "started following the neighbouring farmers" accounted for 92 per cent of the total sample farmers, while those who started according to the advice of farm advisors or pioneer advisors accounted for as low as 7 per cent. And to the question "From whom did you learn how to grow maize?" 32 per cent of the total farmers replied that he learned from his neighbours, those who learned through radio or other information media accounted for 48 per cent, those who learned from farm advisors constituted 17 per cent, and only 3 per cent learned from pioneer advisors. This fact is indicative of that, though the activity of extension workers is not so great, the effect of other farmers' successful farming is very great. Viewed from this angle, the derivative effect of pioneer or expert farmers, or of model or pilot farms is considered to be striking.

In the World Bank Survey Mission's Report on the improvement of extension work system in Thailand, it is recommended that the existing extension activities carried on under the direction of the respective Departments (i.e., specialized activities) be abolished, and instead

the extension works be pushed forward in unity throughout the country by grouping the entire country into 448 amphurs to each of which two general farm advisors are stationed. This recommendation, however, has not been brought into practice as yet due to the resistance arising from the sectionalism lurking in the Ministry of Agriculture. Whereas, with a view to unifying the extension works under the direction of each Department, the Office of Agriculture Extension has been set up of late in the Ministries - Secretariat and the Extension Administrator (a person receiving similar treatment as a Director of the Department) was appointed as the head of the Office. Thus the existing shortcomings will be remedied to some extent.

Increase in the number of extension workers: For receiving the World Bank Mission's recommendation, it is required to increase the extension workers to about 1,000 level (two times more the present number). Apart from the budget requirements, the expansion of agricultural colleges is of prime importance in order to provide more farm technicians. In view of this, it will be very hard to recruit the required number of extension workers.

As a means to bring about the desired effect of the extension works by remedying the shortcomings, it is preferable to give overall and concentrated guidance to the selected pilot districts, thus giving the derivative effects to the neighbouring districts. This idea has been taken up as the fundamental one under the US assistance program for developing the northeastern district. The feasible plan is now under preparation in cooperation between the USOM and the Government of Thailand. Under the proposed plan, it is devised that three Changwat (provinces) (i.e., Roi-et, Kalasin and Mahasarakam) will be selected out of 15 Changwat in the northeastern district and the overall and concentrated guidance both in technical and farm management will be given to each Changwat basing upon the results of field survey on the natural environmental conditions (soils, rain-fall, etc.) as well as on the economic conditions. The agricultural centre proposed to be set up in the northeastern district is expected to perform the extension works (in addition to the research works) as a regional headquarters.

Furthermore, under the agricultural development plan, an integral part of the 6-Year Economic Plan, the agricultural productivity improvement centre is also contemplated. This plan has for its object to expedite the extension of the overall agricultural improvement projects to be mapped out based upon the productivity analysis in each of the selected plots from the natural, technical and socio-economic viewpoints. In this case, certain districts (Note 10) will be selected, and out of them irrigation plots and non-irrigation plots will be selected. The devices for setting-up of the aforesaid agricultural centre in the northeastern district and for the concentrated guidance are on the initiative of the USOM, and this plan is now under joint-study between the USOM and the Ministry of Agriculture and is expected to be carried on chiefly under the US Technical Assistance Program. Whereas, the device for setting-up of the agricultural productivity improvement centre is on the initiative of Mr. Bacon, agricultural consultant to the NEDB. For the purpose of materializing this plan, the technical assistance is expected to be derived from the

the UK, Australia and New Zealand under the Colombo Plan, it is said.

Notes on Agricultural Developments

Note 1: Yanhee is the geographical name of the Dam Site. This Dam is named as "Bhumiphol Dam" after the present Emperor. Storage capacity, 12,200,000,000 m^2; droughty water discharge, 400 m^2/sec.

Note 4: Approximately $380,000 providing chiefly for construction materials.

Note 5: According to the AID Report, of 120 reservoirs, 39 are used for irrigation purpose. The available area for irrigation is estimated at about 12,000 hectares. (An Agri. Program for Thailand, USOM, 1962.)

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Note 6 and 7: Present Status of Agri. Education in Asia and the Far East, C. W. Chang, FAO, 1961.

Note 8: An Agricultural Program for Thailand.

Note 9: Production and Marketing Problems Affecting the Expansion of Corn Growing in Thailand: Kasetsart Economic Report, No. 8, Kasetsart Univ., Nov., 1962.

Note 10: Lopburi, downstream of the Chainat Dam is thought to be selected as the proposed area.

VI. FOREIGN ASSISTANCE TO AGRICULTURAL DEVELOPMENT

The remarkable post-war development of Thailand's agriculture primarily owes to the wisdom and efforts of the Thai government and people, but the capital aid and technical assistance from foreign governments and international organizations also played a considerable part.

1. Bilateral Assistance

Among foreign countries, assistance from the United States is by far the largest.

The amount of U.S. technical assistance to the agriculture of Thailand amounted to some 25 million dollars (See Note 1). About 30% of this amount was for irrigation work. The remaining were distributed to various agricultural programs such as research, extension, livestock improvement and agricultural credits.

During the decade, the United States provided the services of about 70 agricultural experts and sent abroad 604 Thai technicians in various fields of agriculture (See Note 2).

In addition, the US Government financed the provision of teaching staff and equipments to Kasetsart (Agriculture) University by Oregon University (from 1962 by Hawaii University).

The United Stats also contributed great deal to the agricultural development through capital and technical assistance in road construction (See Note 3). Typical example is the Friendship Highway to Korat in the North East which enabled the remarkable expansion of corn production in that area.

The assistance from other advanced countries is far smaller if compared with American aid. The United Kingdom has for several years been providing expert services for improvement of cotton. An English advisor for agricultural planning is also provided under the Colombo Plan to the National Economic Development Board.

Denmark is assisting the development of dairy industry by granting the equipments and cows for the Dairy Centre as well as expert service. An expert on upland irrigation is provided by the Iranian Government.

The Government of West Germany is increasing its efforts to assist the Thai agriculture. As already mentioned, the loan of about $11 million has been committed by the German government for construction of the Nam Pong multipurpose dam. The establishment of a livestock centre in Chiengmai is also under way by the German aid. Plans for assistance in establishing a farm machization centre, fisheries research institute and forest products research institute are also contemplated by the German Government. (See Note 4).

2. Multilateral Assistance

Assistance by the United Nations and its special agencies consists of capital aid (loan) by the World Bank, technical assistance (UN regular programs and EPTA) and Special Fund programs.

The World Bank loan has been given for the construction of Chainat Irrigation Dam ($18 million) and of Yanhee Multipurpose Dam ($66 million): the effects of these dams to the agricultural development were already mentioned.

Agricultural programs of EPTA are carried out by FAO. Four EPTA agricultural experts are now serving in Thailand. (See Note 5). In addition to the services of these experts, the regional technical officers (21 in number) stationed in the FAO Regional Office in Bangkok are available for technical advice and consultation.

The aid from the UN Special Fund, for which FAO is also the executing agency, was given to Thailand for establishment of Rice Disease and Insect Research Institute. A Japanese expert (entermologist) is already in Bangkok under FAO assignment for this project.

Establishment of a pilot farm for irrigation agriculture is contemplated under the Mekong River Development Plan. The UN Special Fund was granted for preparation and designing of the farm.

3. Technical Assistance Programs for the Execution of Six-Year Development Plan.

Since the creation of the National Economic Development Board, the requests for foreign aid are screened and presented through that Board.

The Board envisages the following 26 programs for technical assistance in the field of agriculture (including fishery and forestry) for implementation of the Six-Year Development Plan (Note 6). The list includes both new programs and the programs for which continuation of aid is sought. No priority order is given to these projects.

(1) Aerial photography for cadastral and soil survey.

(2) Establishment of Soil Service for systematic development of soil survey for forestry and agriculture.

(3) Development of an Agricultural Research Institute.

(4) Establishment of Sugar Institute for improvement of production and processing of sugar cane.

(5) Expansion and improvement of agricultural education.

(6) Establishment of a Farm Productivity Centre.

(7) Agricultural engineering service.

(8) Better use of irrigation water.

(9) Feasibility studies for flood control.

(10) Water-tank construction in the Northeast.

(11) Highways and feeder roads construction.

(12) Inland water transport survey.

(13) Acceleration of village health programs.

(14) Construction of grain silos (especially for maize for export).

(15) Improvements in ginning and marketing of cotton.

(16) The land settlement schemes.

(17) Veterinary research and disease control.

(18) Establishment of dairy industry.

(19) Development of beef industry.

(20) Strengthening of research in use of forest products.

(21) Pre-investment survey for commercial exploitation of forest areas.

(22) Development of plantation forestry with quick-growing species.

(23) Inland fisheries research.

(24) Development of marine fisheries by research in the resources of the Gulf of Thailand's west peninsular coast.

(25) Agricultural census and survey.

(26) Agricultural developing planning.

4. Japanese Contribution

1) Purchase of Thai agricultural products

It can be said that Japan contributed great deal to the agricultural development of Thailand through purchase of agricultural commodities. This also enabled Thailand to become the third largest customer of Japanese manufactured products.

Since Japan has to buy more from Thailand in order to sell more to that country, the Japanese Government is taking promotional measures for imports of agricultural products from Thailand with such measures as Primary Products Purchase Promotion Subsidy.

Japan will continue to import such products as maize and caster beans from Thailand and possibilities are that the demand for these commodities in Japan will still increase. It will be also necessary to explore the possibility of importing other commodities which have not been imported from Thailand.

For example, imports of banana from Thailand will become possible if they are free from danger of meditarrenean fruit flies or other harmful insects. An investigation team of plant-protection experts was recently sent to Thailand for this purpose.

In view of the fact that Germany is importing a large quantity of cassava roots for animal feeds from Thailand, possibilities to export

it to Japan may deserve investigation.

There seems much remain to be done for Thailand to promote her agricultural exports. Decrease in cost of production and improvement of qualities are most important. As the largest buyer of Thai products, Japan is in a good position to give useful advice and technical cooperetion in this respect. The report of the sugar survey mission, for example, and also the report of the Colombo Plan expert on caster bean include a number of useful suggestion (See Note 7).

2) Capital aid

As mentioned earlier, the World Bank, US and Germany are giving huge amounts of capital aid in such public works as dam and road construction. No such public investment has been given by Japan except for the Special Yen arrangement which is used mostly for public work. (See Note 8).

The Japanese Government, however, is assisting private investment in Thailand through the Export-Import Bank. The Osaka Sugar Manufacturing Co., for example, made use of that loan for establishing sugar factory in Thailand. The Ajinomoto Co. also received the loan for cassava processing. Shibaura Sugar Manufacturing Co., has a plan to buy a sugar factory in the North East with the loan. These private investments in various agricultural processing industries will be no less important for agricultural development plan public investments. The government of Thailand, in fact, welcomes such investments.

Inducement of private investment in agricultural processing industries have to be accompanied with improvement of quality of raw materials. For example, technical assistance program for sugar cane improvement may be carried out together with capital aid in sugar industry. If the quality of cotton in Thailand is improved Japanese spinning industry may be more interested in investment in cotton manufacturing in Thailand. Same may apply to silk industry if production of cocoons increases in Thailand.

3) Technical Cooperation

Since participation of Japan to the Colombo Plan in 1954, Japan provided to Thailand 67 experts, received 667 trainees (See Note 9) and helped establish Telecommunication Centre and Virus Research Institute.

Of the 67 experts, 14 were agricultural experts and their fields of speciality were: beef fattening (4 in number), rice breeding (1), caster bean cultivation (2), and entermology (1 for caster, 2 for banana and 4 others). Except for the experts on beef fattening and rice breeding, the services of these experts were of short period.

The number of trainees in the field of agriculture were 119 out of the total number of 667. The subjects of their studies covered almost all aspects of agriculture, including, for example, plant breeding, animal health, rice culture, agricultural credit and extension.

Selection of programs for technical cooperation has in the past been made without much thought on their possible effects on the

agricultural development of Thailand. For example, the beef fattening program for which Japan provided 4 experts (one of them died by malaria) was technically successful in that the experts made a good success in producing quality beef almost comparable to the Japanese Kobe beef. However, as there was no demand in Thailand for quality beef at higher price, the techniques developed by the experts were not brought into practical use by farmers.

In order to make the best use of the technical cooperation for the country's agricultural development, programs have to be carefully selected. First of all, the programs must be in line with the national development plan.

Programs of other assisting countries and UN agencies have to be fully taken into account in order not only to avoid duplication but further to be coordinated with other programs. Technical cooperation program may also be effectively connected with capital aid programs. From these considerations, the following programs seem to be effective and suitable to Japanese cooperation.

(A) Training of Research Workers

For agricultural development of Thailand, more trained research workers are needed. This need will become even larger as the proposed regional agricultural centres are established.

Japan can contribute to this need by accepting more research workers for study in Japan or sending experts to be attached to agricultural experiment stations in Thailand.

(B) Irrigation Agriculture

As was mentioned earlier (see V-3), irrigation projects are extensively carried out in Thailand. However, unless new techniques of agriculture under irrigation are developed, the irrigation facilities for which millions of dollars have been spent would not bring about increased production. Since irrigation agriculture (agriculture under controlled water) is new for Thailand, experiences and techniques already developed in other countries should be fully utilized. In this respect, Japan and China (Taiwan) are in the best position to assist Thailand (See Note 10).

It is scheduled under the Great Chaophia Project to irrigate nearly one million hectares of farm land in the Central Plain. It would be practically impossible to introduce new techniques and cropping patterns all over the area within a short period. It seems to be more practical to select several pilot areas where research and extension are concentrated.

As combination of various techniques is necessary for such pilot project, services of a group or groups of Japanese experts would be effective.

(C) Improvement of Sugar Cane

There is a great possibility of increasing sugar production (See IV-3), but present cost of production is too high to be

competitive in foreign markets. The processing techniques are much improved by Japanese firms operating in Thailand, but there still remain much to be improved in sugar cane production. Expert services on this subject will be useful.

(D) Improvement of Cotton Varieties

Promotion of cotton industry is an important policy for industrialization of Thai economy. However, the cotton grown in Thailand is inferior quality and is not suitable for modern spinning industry (See IV-6). Variety improvement of cotton in Thailand has hitherto placed more importance on disease and insects resistance than on quality.

Selection or breeding of cotton of higher quality will become more important if cotton industry of Thailand is to be developed. In this respect, cotton breeders have to be well familiar with qualities that cotton has to possess as raw material of modern spinning industry. It will be useful for variety improvement of cotton to send research workers to modern spinning mills and cotton testing and grading laboratories in other countries. As one of the largest cotton-spinning countries and also big importer of raw cotton, Japan would be a suitable place for such training.

(E) Farm Mechanization

Agricultural implements used in Thailand are primitive. In some cases, however, tractors are used by large scale farmers or on rental basis.

Soils in rice producing areas are generally heavy clay. If second crops are to be grown on this type of soil, the ploughing by manual labor or even animal power in dry season will be extremely difficult (See Note 11). On the other hand, ploughing has to be done quickly after harvest of rice to permit timely planting of second crop.

In order to solve this problem, careful study has to be made on selection and design of farm machines suitable to soils and crops in the respective areas. It has also to be studied from economic point of view whether the machines should be owned individually or by cooperative association or by the government for renting service. Cooperation by Japanese government and farm machinery industry for such studies will be helpful.

(F) Promotion of Silk Industry

Export of silk fabrics (so called "Thai silk")has recently been increasing, but production of cocoons does not expand in proportion. Hence Japanese raw silk are imported to be mixed with Thai silk (See IV-10). for exports. Thus the government of Thailand is anxious to increase the cocoon production with technical assistance from Japan.

For the development of silk industry in Thailand, an integrated and well-thought-out planning is necessary. Such a plan should include programs for improvement of silk-worm varieties, mulvery culture,

silk-worm raising, silk realing, grading and marketing of cocoon. Japan should help Thailand work out such plan and carry it out.

(G) Public Works related to Agriculture

Agricultural development depends greatly on construction and improvement of transportation. Much progress has been made with the financial and technical assistance from USA,and construction of new highways are actively carried out. Furthermore, the government of Thailand is seeking foreign assistance for construction of feeder roads to link villages to the highways for shipment of products. Since such projects are very important for agricultural development, Japan should give favorable consideration to the request for assistance.

Reference

1) Ten Years of Agricultural Assistance to the Kingdom of Thailand: USOM, Bangkok, 1961.

2) Of the 604 agricultural trainees, 382 were trained in USA, and 222 were trained in other countries including Japan.

3) Following projects are now under way by US aid, amounting to $48 million.

   Korat-Nongkai Highway
   Bangkok-Saraburi Highway
   Bangkok-Nakorn Pathom Highway
   Bridge replacement program
   Regional telecommunication construction

4) Compendium of Technical Assistance to Thailand: DAC Coordinating Group in Thailand, 1963.

5) The figure does not include EPTA regional experts stationed in Bangkok.

6) Thailand's Agricultural Planning 1961-66 (Summary): The Planning Office, NEDB, December 1961.

7) Report of Sugar Purchase Promotion Mission (in Japanese): Japan Sugar Refinery Association, March 1963.
   Report on Investigation of Caster Cultivation in Thailand: Dr. Goro Nishikawa and Takao Ueda, 1962.

8) The Thai Government reportedly considering to finance the Nam Pun Dam project from the Special Yen.

9) i. The number of the experts (67) is those under Colombo Plan, and does not include the experts provided under special arrangement to the Telecommunication Centre and Virus Centre.

   ii. Of the 667 trainees, 237 are under Colombo Plan, and 237 are under other arrangements, such as US-Japan Joint Training Program.

10) The Thai Government (Royal Irrigation Department) has a Chinese advisor on irrigation (Chaophia project) under special arrangement with FAO.

11) Report on ECAFE Delta Development Survey, 1963.