FEASIBILITY SURVEY REPORT
ON
THAI–JAPANESE COOPERATIVE DEMONSTRATION PROJECT
FOR THE DEVELOPMENT OF
EXPORTABLE AGRICULTURAL PRODUCTS

FEBRUARY 1971

OVERSEAS TECHNICAL COOPERATION AGENCY
T O K Y O
JAPAN

INTRODUCTION

The aim of this Report lies in presenting the findings, and the observations based on such findings, of the Survey Team which the Overseas Technical Cooperation Agency deputed to Thailand through assignment by the Government of Japan.

The Team was commissioned to explore the ways and means for developing the agricultural co-operatives in the northern part of the Central Region of Thailand and enabling them to play a vital role in increasing productivity, and rationalizing marketing, of maize, in whose production on the most important crops in their service-area. The Team was also expected to prepare a program for implementing such co-operative development scheme and to identify the form and content of the technical co-operation which the Government of Japan is prepared to extend.

The Team stayed in Thailand from November 29th to December 19th 1970 and visited in the meanwhile, Government-offices and agricultural co-operatives to intimate themselves of the actual conditions prevailing in the localities and to obtain necessary information, while exchanging opinions with the people concerned.

In its activities in Thailand, the Team very much enjoyed the assistances provided by the Department of Credit and Marketing Co-operative, Ministry of National Development, and it also owed a great deal to the valuable information and advices given by the Department of Agriculture, Ministry of Agriculture, on the technical aspects of the cultivation of maize and that of leguminous crops as the preceding or succeeding crops of maize. The Team likes to avail itself of this opportunity in expressing the sincere thanks to the Directors and the staff-members of

these two Departments. It earnestly hopes that the close coordination between these two Departments would be maintained in implementing the project outlined in this Report.

Agricultural co-operatives in three candidate-sites of Lamnarai, Nongphai and Promphiram were visited by this Team; the strong wishes for production-increase and marketing improvement of maize being shared by office-bearers, employees and members of all these three co-operatives were impressive. We hope that this Project will offer a real chance to these people for attaining their cherished desires.

It is an ardent hope of the Team that this Report would offer a good basis for the Governments, both Thai and Japanese, to arrive at full agreement at setting up the technical co-operation project and putting it into an effective implementation.

Motonaga Ohto
Head of Feasibility Survey Team

Table of Contents:

Introduction

Chapter I : Actual Conditions of the Co-operatives and the Maize-Producing Farmers in the Surveyed Areas

1. Objectives of the Survey 1
2. Lamnarai Co-operative 1
3. Nongphai Co-operative 19
4. Promphiram Co-operative 30
5. Conclusive Remarks 35

Chapter II : Current Maize Cultivating Techniques

1. Natural Environment 41
2. Current Techniques of Cultivation 47
3. Conditions of Plant Growth 53
4. Achievements at Agricultural Experiment Station 54
5. Improvement of Cultivating Techniques and Relevant Problems 57
6. Annual Program for Technical Demonstration 66

Chapter III : General Observations

Chapter IV : Guidelines of Technical Co-operation

1. "Development Co-operation Project" 81
2. Questions pertinent to Implementation of the Project 81

Chapter I: Actual Conditions of the Co-operatives and the Maize-Producing Farmers in the Surveyed Areas

1. Objectives of the Survey

Our survey was centered at three co-operatives at (i) Lamnarai in Lopburi Province, (ii) Nongphai in Phetchabbon Province, and (iii) Promphiram in Phisanuloke Province. The survey at lamnarai Co-operative could have been replenished by the inquiries through interviews with some of the local farmers and the data-analysis at Chaibadan District Office; that of two remaining co-operatives rests on the hearings from the responsible officers of the respective co-operatives, mainly due to limitation of time on our hand. The outcome of our survey will be assimilated and presented here, under the heading of each Co-operative.

2. Lamnarai Co-operative

(1) Outline of Its Service Area

Administrative Aspect

Registration of its establishment at Buachum Village (Tambol), Chaibadan District, Lopburi Province, is dated on August 17, 1966. The co-operative activities undertaken by this organization extends, as far as its by-laws are concerned, all over the District of Chaibadan, but it is now functioning only among the colonists at Nikhom which lies along the highway running between Lamnarai and Phetchaboon. Most of its member-farmhouseholds are belonging to Silathip Village (Tambol).

Land-Use

Lopburi is one of the principal maize-producing Provinces in Thailand, with Chaibadan as its center. 1969 Statistics of Upland Crops compiled by Thai Government provides the following figures about the area under maize-cultivation in some of the Provinces:

Table 1 : Area under Maize-Cultivation (1967)

Name of the Province	Area under Maize-Cultivation
Nakornsawan	1,096,296 rai
Lopburi	917,433 "
Saraburi	556,100 "
Korat	349,346 "
Phetchaboon	210,000 "

(Source: Statistics of Upland Crops in Thailand, 1967, Miistry of Agriculture)

District-wise distribution of the area under maize cultivation in Lopburi Province for the same year of 1967 will be known from the following Table.

Table 2 : District-wise Area under Maize-Cultivation in Lopburi Province (1967)

Name of District (Ampoe)	Area under Maize-Cultivation
Chaibadan	438,121 rai
Phathananikhom	251,265 "
Khoksamrong	235,800 "
Muang	58,724 "
Banmi	24,151 "
Thamung	3,537 "

(Source: Agricultural Division, Provincial Government of Lopburi)

Note: Cumulative total of the area under maize-cultivation in six Districts of Lopburi Province does not coincide with the figures given for the same Province in the Upland Crop Statistics by the Ministry of Agriculture. But this is immaterial for our immediate purpose of grasping the rough proportion of its District-wise maize-cultivating areas.

Roughly 30% of the total area of Chaibadan District has been turned into upland field for maize-cultivation, and its acreage has not experienced any major changes for the last several years (see Table 3 below). Pulses like mugbean, soya-bean and ground-nut are grown as succeeding crops of maize, but not in sizeable quantities.

Table 3 : Land-Use of Chaibadan District (1966-1969)
(unit: rai)

Year	Maize	Milo	Mug Bean	Ground-Nut
1966	432,963	14,109	18,501	8,247
1967	438,121	18,109	20,470	9,850
1968	431,760	14,605	21,450	3,460
1969	441,436	6,220	32,997	3,476

(Source: Agricultural Division, Chaibadan District Office)

Production of paddy is limited to a small acreage of 19,517 rai in the whole Chaibadan District, in 1969. The Tambol (village)-wise crop statistics of this District will throw some lights on this situation:

Table 4 : Area under Cultivation of Principal Crops in Chaibadan District (1969) (unit: rai)

Name of Tambol	Maize	Milo	Mug Bean	Ground-Nut	Paddy	Soya-Bean
Buachum	141,426	3,295	21,921	2,574	7,696	4,925
Chaibadan	120,843	632	6,128	318	2,425	284
Makokwang	61,627	1,364	2,901	184	5,160	302
Nongyaito	117,540	929	3,047	400	4,236	2,831

(Source: Agricultural Div., Chaibadan District Office)

No data is available in connection with the land-use in the area under cooperative organization, but we may be able to make a fairly realistic guess about it from the figures pertaining to Nikhom which, under the jurisdiction of the Ministry of Interior, is a nucleus of cooperativization in this area. It is reported that, out of the total area of Nikhom which approximates at 120 km^2 (750,000 rai), maize covers almost 300,000 rai. This shows that the land-use in Nikhom is comparatively more maize-centered than in other parts of the District.

Population

The population of Chaibadan District as on January 1, 1970 is comprised of 70,175 (36,983 males and 33,192 females) 11,464 households. Its population-increase for the last several years has been phenomenal: some 20,000 souls within 3½ years (or 40% increase) from 52,457 in December 1966 to 72,520 in September 1970.

Table 5 : Population-Increase in Chaibadan District

Year	Number of Household	Population
December 1966	7,629	52,457

December 1967	7,868	59,410
December 1968	11,448	66,556
December 1969	11,863	69,583
June 1970	12,126	71,546
September 1970	12,233	72,520

(Source: Division of Resident Registration, Chaibadan District Office)

This is due to a sizeable inflow of people who started maize-cultivation after clearing and reclaiming the forest-land there.

No reliable data was made available to us as for the population of Nikhom. Its estimated population of 7,350 emerging from 1966 survey was induced from the figure of 1,470 colonists' families, on the assumption of 5 members per family. The number of registered farmhouseholds in Nikhom was 2,198 on July 13 1970.

Other Relevant Matters

District-Office of Chaibadan is located at Lamnarai. Agricultural Officer belonging to the Department of Agriculture is attached to the District-Office to discharge his duty concerning multiplication of maize-seed upon contract with the nearby farmers and demonstration of a few crops.

Kind of A.O.'s Duty	Number of Cases	Planted Acreage	Seeds Sown
1. Multiplication of Maize-seed	2	50 rai	P.B.5
2. Maize Demonstration Farm	2	20 rai	P.B.5
3. Soya-Bean Demonstration Farm	1	8 rai	M.C.2

4. Green-Bean Demonstration Farm	3	10 rai	

Chaibadan District has a farmers' union under the control of the Ministry of Agriculture in the name of Upland Crop Growers Union, which is affiliated by 243 families who are cultivating 22,548 rai. Agri-business in the same District consists of 8 Rice Mills, 3 Groundnut decorticating plants, and 18 dealers of fertilizers and farm-chemicals. Out of the last category of dealers, 6 are sales-agents of Tractors. There are 14 tractor-repair shops in Lamnarai and, excepting the one run by the Thai, others are exclusively operated by the Chinese merchants.

(2) Outline of Lamnarai Cooperative

Designation and Aim of the Cooperative

This cooperative was established and registered as "Lamnarai Farm-products Marketing Cooperative", on August 17 1966.

Site of the Cooperative Office and Its Service-Area

This cooperative was originally registered at the old village of Buachum, with the whole District of Chaibadan as its service-area, but it is actually functioning in a very much limited way only on behalf of the farmhouseholds in Nikhom Colony. The rate of cooperativization in Nikhom Colony is a little over 10%, as only 224 farmhouseholds are full-members of this Cooperative while there are 2,000 farmhouseholds in the whole Colony, 353 of which are interested to join the Cooperative. The Cooperative is made up of area-wise groups, 13 in number, at present.

Membership

353 households joined the Cooperative as the founder-members at the time of its organization, but a great many of them, including 144 who were reluctant to pay share capital, have so far withdrawn from the organization and the present full-members count 224.

Table 6 : Increase/Decrease in Membership

Point of Time	Number of Members	Reasons for Increase/Decrease New Admission	Withdrawal
August 17 1966 (date of establishment)	353		
April 1 1967	412	61	2
April 1 1968	263	1	150
April 1 1969	221		39/3 dead
April 1 1970	224	4	1

Capital

The capital needful for operating cooperative business consits of share-capital paid by its members, deposits, borrowings, and reserves, etc. Its paid-up share-capital amounted to 82,700 Bahts as in April 1970.

(3) Contents of Cooperative Activities

This cooperative's activities are primarily meant for marketing. Purchasing and credit activities are undertaken in a limited way, as and when forced upon it by the circumstances.

Marketing Activities

The core of marketing activities lies at collection and marketing of maize. The volume of maize collected or purchased by this Cooperative since its establishment is given on Table 7.

The achievement of 816 ton in 1966 was considerably discounted in the following year, when only 515 ton could have been collected. These records clearly betray the annual collection-target of 4,000 ton envisaged prior to its establishment.

Table 7 : Maize-Collection by Lamnarai Cooperative

Year	Amount Purcahsed (in ton)
1966	816
1967	515
1968	410
1969	609
1970	1,000 or over

(Source: Lamnarai Cooperative Office)

Such a downfall in maize-collection is attributable to the complex causes and reasons: the long drought which cut down the maize-production itself, the purchasing started by Calabrian Co., Ltd. which usurped upon a considerable amount of maize otherwise destined for the Cooperative and, more basically, the exhaustion of credit-fund in the Cooperative. During 1970, however, thanks to favourable rains, 1,000 ton or more maize was reported to have been collected. Bulk of maize thus collected by Lamnarai Cooperative is shipped out to the Cooperative Marketing and Purchasing Federation of Thailand, Ltd. in Bangkok. The Cooperative also started purchasing pulses and cotton, since 1968. Table 8 gives figures of these collection in value.

Table 8 : Collection of Pulses and Cotton (in Bahts)

Year	Soya-Bean	Green-Bean	Cotton
1968	7,500	3,856	60,000
1969			36,000

(Source: Annual Reports of Lamnarai Cooperative)

The above covers the whole picture of Lamnarai Cooperative's marketing activities.

Purchasing Activities

This Cooperative was rather forced to start purchasing activities because the farmers' sales of their maize to this Cooperative during 1966 were retaliated by the middle-men's refusal of rice-supply on credit to these farmers. The Cooperative was thereupon obliged to purchase 375 bags of polished rice for distribution among 76 member-farmers at 250 Bahts per bag on post-harvest payment terms. Similar services were offered during 1968.

Year	Value of Rice Purchased	Value of Rice Supplied
1967	83,780 Bahts	93,700 Bahts
1968	58,350 "	65,355 "

During 1969, a pump was also purchased and delivered for irrigation purposes.

Credit Activities

Credit activities by this Cooperative occupy a place only secondary, though indispensable, to marketing. In the countires where the middlemen provide credit facilities with the producers in order to collect their products – Thai is no exception –, credit service is 'sinequanon' of farm-products collection. This Cooperative offers a sort of short-term loans to its member-farmers. These loans are meant to be recovered in kind, that is, in term of sales of farm-products by the loanees, within a single year. Since 1967, however, turnover of the fund, or regular revolving of loans and their recoveries, does not look smooth enough. The outstanding balance of loans appearing on the balance-sheet on each closing date (March 31) is given on Table 9.

Table 9 : Outstanding Balance of Loans (unit: Bahts)

Year:	1966	1967	1968	1969
Head:				
Business transaction				220,441
Cultivation		223,339	218,505	205,218
Service		26,715	21,735	21,197
Harvesting			83,250	83,250
Advance-Payment	114,736	39,375	39,375	39,375
Rice Sales		69,450	100,276	
Loans	92,885	88,185		
TOTAL:	207,621	447,064	463,142	569,481

(Source: Statements of Accounts, Lamnarai Cooperative)

Although itemization of accounts under yearly changing head prohibits minute comparison, harvesting loan and advance-payment unmistakeably remain unrecovered. According to our inquiries through hearing, no new loans are being offered since after 1968. This leads us to the conclusion that the poor maize crops for three consecutive years since 1967 made loan-recovery impossible and this resulted at less and less collection of maize due to the Cooperative's financial operation which was made tight through irrecoverability of previous loans.

A sudden spurt in the outstanding loan balance at the end of 1969 was due to the financial arrangement made by the Cooperative Marketing and Purchasing Federation.

Business Administration of the Cooperative

1) Financial Management

Capital requirement of the cooperative is normally met, as explained in the above, by share-capital, borrowings, deposits and reserves but, in case of Lamnarai Cooperative, it is al-

most entirely dependent on a loan called "Cooperative Promotion Fund." Table 10 is a statement of capital- and debt-accounts of this Cooperative.

Table 10 : Financial Management of Lamnarai Co-op.
(in Bahts)

	Mar 31 '67	Mar 31 '68	Mar 31 '69	Mar 31 '70
Share-Capital	82,200	82,700	82,700	82,700
Co-op. Promotion Fund	500,000	500,000	500,000	500,000
Other Borrowings				164,800
Total Accounts Paybale	2,466	33,775	36,309	46,309
Reserve Fund		616	616	616
Other Reserves		600	600	600
Profit	31,011			
TOTAL:	615,676	617,690	620,224	795,027

(Source: Statements of Accounts, Lamnarai Co-op.)

Note: Excluding Depreciation, Bad Reserve and Fund for Buying Share.

827 shares have so far been issued (82,700 Bahts); shares held by the retiring members are to be transfered to other people through the arrangements made by the Coop. or purchased by the Co-operative from the accumulated fund for procurement of shares. Shares purchased by the Co-operative as in March 1970 were 79, and the accumulated fund was 800 Bahts.

500,000 Bahts borrowed in the name of the Co-op. Promotion Fund had almost completely stopped revolving. Loan provided by the Cooperative Marketing and Purchasing Federation in 1969 gave certain relaxation to the financial position, but if maize-collection in 1970 should betray its expectation and turn out

to be a poor one, the financial position of the Co-op. would be worsened.

2) Profit

In the initial year of its establishment, the netprofit raised by Lamnarai Cooperative amounted to over 30,000 Bahts after depreciation, but since then, each succeeding year showed more or less deficit and the cumulative deficit on March 31 1970 is as big as 131,389.20 Bahts.

Table 11 : Settlement of Accounts of Lamnarai Co-op.
(in Bahts)

Year	Net Profit	Cumulative Deficit
1966	(+)31,011	
1967	(-)48,448	43,288.32
1968	(-)53,609	96,897.47
1969	(-)34,492	131,389.20

(Source: Statements of Accounts, Lamnarai Co-op.)

The diminishing collection and marketing of maize is the reason why the Co-op. accounts have been chronically in deficit since its second year of establishment. Poor collection of maize is also responsible, as will be seen on Table 12, for the higher ratio of direct-cost such as transportation cost. The fact that the Co-op. had to close its overall account for receipts and disbursement in red figures in 1968, inspite of lesser deficit in maize-branch, and in both 1967 and 1969 when it could enjoy incomes from other kinds of products than maize, shows that the Co-op. account has been under the heavy burden of interest-payable and reserves and, ultimately, that the purchase of maize by it does not reach the break-even point. Table 13 will clarify this point.

Table 12 : Ratios of Purchasing & Marketing Costs in the Overall Purchase Amount (in Bahts & %)

Year	Purchase Amount	Purchase Cost	(Ratio)	Marketing Cost	(Ratio)
1966	783,953	1,459	(0.19)	126,702	(16.2)
1967	462,185	5,926	(0.13)	111,625	(24.2)
1968	293,880	5,089	(0.17)	84,003	(28.6)
1969	526,486	9,073	(0.17)	103,992	(19.8)

(Source: Statements of Accounts, Lamnarai Co-op.)

Note: Purchasing-cost is mainly made of the labour-cost and the marketing-cost, of transportation-cost. Ratio of marketing-cost has been calculated by (Marketing-cost ÷ Purchase Amount) and not by (Marketing-cost ÷ Sales Amount), because of the problem of stock-on-hand.

Table 13 : Statement of Profit & Loss (in Bahts)

	1966	1967	1968	1969
Principal Incomes				
Income from Maize	46,866	(-)35,358	(-)4,358	(-)11,658
Income from Other Crops	9,223	7,753	6,375	(-) 9,600
Income from Servicing		35,761		
A/c Receivable		1,860	18,279	11,189
Other Business Incomes				24,075
Principal Expenditure				
General Expenses	16,594	20,105	18,938	23,062
Interest on Co-op. Promotion Fund	2,466	30,000	30,000	10,000
Depreciation	1,374	1,375	1,810	816
Bad Reserve	4,644	6,378	23,157	5,821

(Source: Statements of Accounts, Lamnarai Co-op.)

In view of the smallness of own-capital in the total capital position, a considerable efforts are called for, at present and in future, to raise a sizeable profit under the heavy burden of interest-payable.

(4) Actual Conditions of the Member-Farmers

The following report about the actual conditions of the member-farmers is based on information made available through questionnaire and a few interviews with the farmers joining this Co-op.

Land Ownership

As touched upon in the above, most of the farmers in this area obtained their land through encroachment on the reserve forest. Most of them, therefore, are supposed to be engaged at cultivation of farm-products on their 'chapchong' (pre-empted area), but there are some important differences among their method of obtaining land, according to the differences of time of their arrival and of their economic conditions before migrating to this region. Those who were interviewed by us are apparently from comparatively wealthier group of farmers, including the headman of the settlement and some important members of the Co-op. Many of these people purchased their lands by selling their properties (mainly paddyland and upland field) previously held in their home-land. Table 14 gives details of the motives of their migration and the method of their obtaining land here. Reasons for their migration are far from being simple.

Table 14 : Motivation for Migration

Farmers Interviewed	Age	Motivation for Migration	Method for Acquisition of Land
Farmer No.1	40	1. Moved into Chaibadan with his parents 20 years ago from Ubol where they got 6 rai of land; 2. Inherited parents' property with 6 brothers and obtained 11 rai of paddy-field at Chaibadan; 3. Migrated here 7 years ago while leaving his paddy-field there for tenant cultivation.	Paid 8,000 Bahts for procurement of 125 rai of upland field.
Farmer No.2 (Woman)	55	1. Inherited 15 rai of paddy-field at Chaiyaphum which was disposed of at 4,000 Bahts and distributed among 5 brothers.	Obtained 25 rai of upland field at 800 Bahts.
Farmer No.3	50	1. Held 15 rai of paddy-field at Ubol but sold it off for 3,000 Bahts because of many wicked people there; 2. Purchased 15 rai field at Chaibadan at 3,000 Bahts; 3. Disposed of the same land for 3,000 Bahts after sometime.	Obtained 75 rai of upland field at 13,000 Bahts (borrowed 8,000 Bahts from other man).
Farmer No.4	64	1. Held 40 rai of land at Korat but sold it away at 4,000 Bahts because of poor soil and little rain.	Secured 50 rai paddy-field, 50 rai upland-field and 25 rai fruit orchard all through 'chapchong'.

Farmers Interviewed	Age	Motivation for Migration	Method for Acquisition of Land
Farmer No.5	49	1. 25 rai land at Ubol failed to produce anything due to flood; 2. Invited here by his friend.	Obtained 1,000 rai land through 'chap-chong' but sold all the land excepting 25 rai.
Farmer No.6	34	1. Served as a soldier at Lopburi; 2. Moved into this area 8 years ago.	Saved money as a tenant in the first stage and obtained 75 rai of land at 2,300 Bahts.
Farmer No.7	46	1. Owned 80 rai of paddyfield at Nakornsawan; 2. Deserted from the place abandoning his property due to fear of robbers.	Purchased 50 rai at 6,500 Bahts.
Farmer No.8	46	1. Disposed 18 rai land at Saraburi for 5,400 Bahts and distributed the money among 6 brothers; 2. Land which he had at Saraburi was too small for living.	Purchased 75 rai at 3,300 Bahts which he earned through sales of farm-products.
Farmer No.9	48	1. Owned 47 rai of Paddyfield at Lopburi but it sold because of too small for living. 2. Migratod here 13 years ago.	Obtained 50 rai through reclamation; purchased another 50 rai out of the profit from selling farm-products.
Farmer No.10		1. 25 rai of land at Phra Phuttabad in Saraburi;	Purchased 50 rai of land at 10,000 Bahts.

Farmers Interviewed Age	Motivation for Migration	Method for Acquisition of Land
	2. It sold because of too small for living	

(Source: Survey at Lamnarai.)

As seen in the above, some obtained land through reclamation, some purchased it with the money they raised through disposal of old land, some paid for their land out of the savings they made while working as tenant-farmers, and one farmer who had a large tract of land through 'chapchong' sold most of such land away. We may say that while the pioneers obtained their land through 'chapchong', the newcomers did so by paying money. Anyway, the majority of the farmers settling down here are the owner-farmers. According to the survey undertaken by Lamnarai Co-operative among 90 of its member-farmers, 76 of them were identified as owner-farmers and the remaining 14, as owner-farmer-cumtenant.

Table 15 : Member-Farmers by the Size of Holdings
(unit: farmhousehold)

Size of Own-Farming Field (Rai) / Size of Tenant-Farming Field (Rai)	1 ~ 10	11 ~ 20	21 ~ 30	31 ~ 40	41 ~ 50	51 ~ 75	76 ~ 100	101 ~ 200	201 ~ above	Total
0		3	18	7	23	12	6	5	2	76
1 ~ 10	1		1							2
11 ~ 20		1								1
21 ~ 30			2	1				1		4
31 ~ 40										
41 ~ 50			1		1	2	1			5
51 ~ 75										
76 ~ 100			1			1				2
Total	1	4	23	8	24	15	7	6	2	90

(Source: Survey by Lamnarai Co-op. on December 2 1969.)

Farm-management of the owner-farmers is mainly confined within the scale of 30-rai and 50-rai; there are only two owner-farmers who are managing more than 200 rai, one of whom cultivating as much as 400 rai. Farmers who are woking also as tenants may be categorized into two groups: one of them are holding, as a standard, 30 rai and the other having more than 50 rai. This latter group seems to represent those who are intending to develop their farming to the level of "enterprise." In this part of the country, the extent of ownership and the planted acreage is extremely unstable and can hardly taken as of permanency.

Marketing of Farm Products

Ten families interviewed during our survey there are all used to sell their maize-crop to the merchants straight after shelling on their field. They seem to justify such act as a due procedure because of their dependence upon the merchants for their ploughing and daily provisions. Only one of them answered to the effect of outright sales of pulses to the merchants from the field. All others are used to harvest their pulses and bring them for sales in the market. Some answered that because of smaller lots of bean-crops by individual producers, a few of them collect such limited crops into a marketable quantity to sell in the bazar. Most probably, pulses will follow the pattern of marketing similar to that of maize once they come to establish themselves as the stable cash-crop.

Dependence of the producing-farmers in the survey-area upon the middlemanly merchants assumes the form of advancement of (i) seed; (ii) ploughing services, (iii) harvesting expense, (iv) shelling services, and (v) daily necessities. Excepting

(iii) harvesting expense, the farmers get these facilities either in kind or in term of services. Delivery of their crops to anybody else would result at the merchants' refusal in providing these advances in the following year as mentioned in the above and hence, difficulty in reproduction of their crops.

Maize-producing farmers' bondage to the merchants is made stronger because of rice which consists of an important part of the daily necessities offered in advance by the latter. In reply to the questionnaire of the Co-op., 77 out of 90 farmers categorically mentioned rice under essential supply-items by the Co-op. to its members. Ten families personally questioned by us are getting supply of rice, but while the members of 6th Group could get a bag of rice at 160-200 Bahts, those of 12th Group had to pay 220-300 Bahts per bag because of long distance from the market. For the assured collection of maize-crops by the Co-op., it seems imperative for the co-op. to look after the credit facilities toward these five needs of the producing farmers.

3. Nongphai Co-operative

(1) Brief History of the Co-op.

This co-operative is situated in Nongphai District of Phetchaboon Province, some 100 km north of Lamnarai, along the highway. It was registered on August 13 1964 as 'Production & Credit Co-operative' and started functioning since September 15 the same year. Although its by-laws specify the whole District of Nongphai as its organizational zone, it is actually operating within three administrative villages (Tambol) of Nachalian, Konkun and Sapsamotot. As its name implies it started functioning as a co-operative organization meant for short-term and

medium-term production loans to its member-farmers. It had the same purpose as that of Hatun co-operative (credit co-op) which had been organized in Thailand since long ago. To cope with the development of cash crops - maize as one of the most important of them -, the agricultural co-operatives meant for their production underwent processes of modernization, such as the change from unlimited joint liability to limited liability. (At the time of this co-op's establishment, there were in existence the similar co-operatives such as Pakchong Production-Credit Cooperative, Rayong Provincial Production-Credit Co-operative, Khonkaen Provincial Production-Credit Co-operative, etc., all through the assistance made available by U.S. Counterpart Fund.)

This type of cooperatives later (in 1969) changed their name to 'Sahakorn Karnkaset' (meaning, Agricultural Cooperative Society).

Membership

At the time of its establishment, this Cooperative had 157 members in ten groups spreading over two Tambol (administrative villages). Its membership continued increasing until it reach 406 by March 1968. Its later territorial expansion brought about a minor decrease in membership which today stand at 394 in 17 groups.

Change of Membership in Nongphai Co-operative

Point of Time	Number of Group	Number of Members	Reasons for Increase/Decrease New Admission	Withdrawal
August 13, 1964	10	157		
March 31, 1965	11	164	13	10
March 31, 1966	13	242	81	3
March 31, 1967	17	353	126	15
March 31, 1968	17	406	76	23
March 31, 1969	17	403	13	16
March 31, 1970	17	394	5	14

(Source: Annual Reports, Nongphai Co-operative)

Capital

This Co-op. had as its capital 46,920 Bahts in term of members' share-capital numbering 4,692 (10 Bahts per share) in March 1965. Out of these shares, 820 were purchased by its members at the time of their admission, 3,438 shares were distributed among them when the members were given credit facilities, at the rate of 1 share for each 200 Bahts of the loan, and the remaining 434 shares were voluntarily purchased by the members.

Since then, the number of shares continued increasing till they were made ten-times more than that at the time of its establishment, that is 48,098 shares, at the end of March 1970.

Table 16 : Total Number of Shares issued by Nongphai Co-op.

Time	At the time of admission	At the time of borrowing	Voluntarily purchased	Total Shares
Mar 31 '65	820	3,438	434	4,692
Mar 31 '66	1,225	10,609	2,775	14,609
Mar 31 '67	1,885	18,387	1,623	21,894

Time	At the time of admission	At the time of borrowing	Voluntarily purchased	Total Shares
Mar 31 '68	2,265	28,201	1,623	32,089
Mar 31 '69				
Mar 31 '70	2,355	44,120	1,623	480,980

(Source: Annual Reports, Nongphai Co-op.)

This phenomenal increase in the number of shares issued was mainly due to the increase in share-procurement by the members at the time they were granted loans by the Co-op. Beside this, State made budgetary allocation of 1,000,000 Bahts at the time of its establishment, in the name of Agricultural Credit Organization Promotion Fund, from which this co-op. could get the credit source of a considerable amount.

(2) Business Administration of the Co-op.

Credit Activities

The primary objective of this Co-op. is the provision of production-loan to its member-farmers, as its name clearly shows. Two kinds of loans, one the short-term and the other medium-term loans, are being offered to its members. The short-term loans are to be repaid within one year or, at the longest, within 15 months under the special circumstances, while the medium-term loans need to be repaid within three years and, in some particular case, within five years. Short-term loan is generally for production-purpose and medium-term loan is for procurement and improvement of the land and purchasing of farm-machinery. Interest-rate is 1% per month. Since 1965, harvesting loan came to be offered specially for the harvesting of maize and it was for this purpose that the Co-operative borrowed the Co-operative Promotion Fund from the Department of Credit and Marketing Co-operative.

Loans provided, their recoveries and outstanding balances of both short-term and medium-term loans from 1964 to 1969 are given on Tables 17 and 18. It is noteworthy that 1968 saw a remarkable increase in short-term loans and equally remarkable decline in medium-term loans. Outstanding balance of the short-term loans is also sharply increasing since that year. Observation as to the significance of this phenomenon will be made later.

Table 17 : Short-term Loans, Their Recoveries and Outstanding Balances (in Bahts)

Year	Loans provided during the year	Loans paid back within the year	Outstanding Balance at the end of the year
1964	332,900	210,100	122,800
1965	868,050	510,680	480,170
1966	539,550	582,850	431,870
1967	668,600	628,700	471,770
1968	1,874,700	530,500	1,815,970
1969	1,210,150	1,087,724	1,938,296

(Source: Annual Reports, Nongphai Co-operative)

Table 18 : Medium-term Loans, Their Recoveries and Outstanding Balances (in Bahts)

Year	Loans provided during the year	Loans paid back within the year	Outstanding Balance at the end of the year
1964	331,700	82,600	249,100
1965	402,100	274,200	377,000
1966	928,923	321,370	986,923
1967	1,363,600	849,023	1,501,500
1968	347,400	1,208,465	640,435
1969	161,400	120,450	681,385

(Source: Annual Reports, Nongphai Co-operative)

Tables 19 and 20 are giving details of the purposes for which short-term loans and medium-term loans were asked for..

60 to 70% of the short-term loans are against cultivating expenses (possibly the wages and fees for planting as well as harvesting) and the medium-term loans are primarily purported for reclamation-cost and, secondarily, for procurement of farm-machinery.

Table 19 : Purpose-wise Classification of Short-term Loans (in %)

Purposes \ Years		1964	1965	1966	1967	1968	1969
Cultivation	Upland	77.76	67.54	72.44	65.71	62.65	57.07
	Paddyf'ld		9.31	8.53	15.96	30.44	30.27
Seeds, Fertilizers, and Chemicals		4.05	7.19	10.80	6.98	0.67	3.77
Agric. Materials		3.62	1.62			0.20	0.54
Living Expenses		5.86	6.92	2.34	6.03	0.20	0.99
Marketing Expenses		1.80					0.11
Share-Acquisition		5.22	4.87	5.05	5.43	5.02	5.05
Land-Rent			0.74				0.16
Piggery & Sericulture.			0,60	0,84	0,43	0,41	0.62
Miscellaneous		1.69	1.21			0.80	0.38

(Source: Annual Reports, Nongpahi Co-operative)

Table 20 : Purpose-wise Classification of Medium-term Loans (in %)

Purposes \ Years	1964	1965	1966	1967	1968	1969
Reclamation, Improvement & Acquisition of Land	38.73	40.70	60.98	49.68	44.85	49.88
Pumps, Engines & other Farm-Machinery	20.97	8.75	9.65	13.79	26.15	13.73
Procurement of Vehicles needed for Farming	10.57	24.69	12.48	12.92	6.07	14.04
Construction & Repair of Buildings	9.58	3.24	3.21	3.24	2.59	3.87
Liquidation of Debts	8.26	0.92		0.22		0.96
Irrigation	4.82	14.57	7.90	14.80	14.31	11.72
Improvement of Machinery	0.74					
Opening of Orchards	1.21	2.13	0.30		2.00	0.63
Share-Acquisition	5.12	5.00	5.46	5.14	4.03	5.08
Livestock				0.22		0.09

(Source: Annual Reports, Nongphai Co-operative)

Other Activities

As mentioned in the above, the main purpose of this Co-operative is the provision of productive credit to its member-farmers and, naturally enough, its activities are centered at credit services. However, this Co-operative collected, in the year 1965, 1,296 ton of maize and, in the following year of 1966, accepted members' deposits, supplied improved seeds, sprayers, farm-chemicals, pumps, fertilizers, rice, etc. as purchasing activities and, also, started educational activities through publication of pamphlets aimed at extension of agricultural knowledge. In the same year, the Co-operative acquired

2.2 rai land as its own at 25,000 Bahts. It started offering conveniences on the ceremonial occasions to economize members' expenses, from 1966. Purchasing activities, however, did not follow after that.

Collection and Marketing of Maize

The Co-operative's records in this branch of activity are 1,296 ton for 1965-66, 10,200 Bahts for 1966-67 and, for 1969-70, the answer to our question said that collection and marketing of 2,500 ton maize brought 11,699.50 Bahts profit to the Co-operative.

Profit of the Co-operative

Interest-income consists of the major income of this Co-op. as it is mainly functioning as credit organization. Table 21 gives details of its gross income, gross expenditure, profit and interest-income. As is clearly known from this Table, interest-income represents between 70% and 90% of Nongphai Co-op's income. This Table also gives us impression that Nongphai Co-op. has been doing quite well as its profit has been in an increase year after year.

Table 21 : Income and Disbursement of Nongphai Co-op.
(unit: 1,000 Bahts)

Year	① Gross Income	② Interest-Income (②/①)	③ Gross Expenditure	④ Profit
1964	24.6	22.3 (91.9)	19.2	5.4
1965	118.9	100.3 (84.6)	65.1	53.8
1966	144.7	118.5 (81.9)	74.2	70.6
1967	230.0	214.6 (93.3)	114.7	115.3
1968	284.4	220.0 (77.4)	158.4	126.0
1969	322.4	214.6 (66.6)	180.4	142.1

(Source: Annual Reports, Nongphai Co-operative)

In view, however, of a rapid increase in the amount of outstanding balance of loans and of the possibility of a considerable unsound credit hidden therein, we may not be able to make an open commendation about this Co-operative's management. Table 22 refers to the rate of recovery of both short-term and medium-term loans provided by Nongphai Co-operative.

Table 22 : Rate of Recovery of the Co-op. Loans
(Amount in Bahts Rate in %)

	SHORT-TERM LOANS			MEDIUM-TERM LOANS		
Year	Amount Due	Amount Repaid	Recovery Rate	Amount Due	Amount Repaid	Recovery Rate
1964	217,100	210,100	96.78	68,700	82,600	120.23
1965	576,100	510,680	88.59	298,300	274,200	91.92
1966	670,120	582,850	86.98	374,970	321,370	85.71
1967	684,270	628,700	91.85	832,723	849,023	101,96
1968	663,570	530,500	79.95	1,207,400	1,208,469	100.09
1969	2,007,020	1,087,724	54.20	539,435	120,450	22.33

(Source: Annual Reports, Nongphai Co-operative)

As for the short-term loans, their recovery which was almost complete in the initial year deteriorated, excepting in 1967, year after year, particularly in 1969, when only half as much as the due amount could have been paid back. Recovery-rate of the medium-term loan is quite good and some loans were e paid back even before due. Recovery-rate of 22.33% in the year 1969 is an exceptional case but, because of comparatively small amount involved, does not look so serious.

In case of the loanees are not in a position to pay back their debts before due date, they are expected to submit application for postponement of re-payment. As will be seen on Tables 23 and 24, however, increasing number of loanees began defaulting which the Co-operative office-bearers seem to have

generously attributed to the forgetfulness or lack of knowledge about the co-op. by-laws on the part of the defaulting members. In the year 1969, the loans left unpaid without submission of the applications for postponement of repayment reached to the amounts of 539,996 Bahts for the short-term loan and of 374,985 for the medium-term loans, totalling at 922,481 Bahts. In this connection, the annual report of this Co-operative for 1969 is drawing a special attention, after touching upon two continuous years of poor crops due to irregular rains, to the Co-op's legal action being taken in regard to these defaulting members who were intending to shirk their responsibility of repayment by resorting to abscondence.

Table 23 : Short-term Loans Unpaid

	Postponement of Repayment applied for		Postponement of Repaym't not applied for	
Year	Number of Case	(in Bahts) Amount Unpaid	Number of case	(in Bahts) Amount Unpaid
1964	2	7,000		
1965	30	65,720		
1966	31	69,150		
1967	10	26,300	9	37,270
1968				
1969	73	379,300	126	539,996

(Source: Annual Reports, Nongphai Co-operative)

Table 24 : Medium-term Loans Unpaid

	Postponement of Repayment applied for		Postponement of Repaym't not applied for	
Year	Number of Case	(in Bahts) Amount Unpaid	Number of Case	(in Bahts) Amount Unpaid
1965	14	24,100		
1966	14	21,100		
1967	9	77,000	17	64,900
1968				
1969	8	44,000	98	374,985

(Source: Annual Reports, Nongphai Co-operative)

Under these circumstances, possibilities for occurance of bad loans will always be in stock in the course of future development of agricultural production and transition of farm-products' prices.

Four reasons are made responsible for such failure in repayment of loans before due in the Co-op's annual reports. They are: (i) crop-failure due to irregular rains or occurance of insect pests and diseases; (ii) down-fall of the farm-products' prices; (iii) transport difficulties for shipment of products to the market; and (iv) illness unabling the cultivators to turn out on the field. For instance, the price of kidney-bean suffered a terrible down-fall from 120-150 Bahts per bucket in the previous year to 20-30 Bahts at the harvesting season in 1965, the steadily downward trend of maize price during 1967 season (from 80 to 73 and finally 64 Satang per kg.) and similar deterioration in price of water-melon seed whose quotation of 14 Bahts in the previous year dropped to 12.8 Bahts at the beginning of 1967 season which further dropped to 4 at mid-season, finally reaching the bottom of 2.5 Bahts at the end of the season. Such an adverse price fluctuations did an enormous damage to the income of the member-farmers of this Co-op.

Nongphai Co-op. management has been a success as far as its past records speak for a steady increase in its profit through interest-revenue. However, this does not preclude the worries over rapidly growing outstanding balance of its loans and the contents thereof. The Co-op. is doing quite well in accumulating a part of annual profit as a reserve which amounted to 243,634 Bahts in 1969. This represents about 10% of the total amount of loans given by this Co-op. Once such threatening factors as the foul weathers and adverse fluctuations of the farm-products' prices should be taken into consideration,

it would be advisable to create a bad reserve equalling to the profit reserve.

Table 25 : Balance Sheet of Nongphai Co-op. (March 31 1970)

ASSETS		CAPITAL & LIABILITIES	
Land	46,100	Paid-Up Share Capital	480,980
Co-op.Office Building	5,531	Borrowings from Agricultural Bank & Co-op. Bank	2,258,556
Durable Consumer Goods	5,574	Borrowings from the Co-op. Marketing & Purchasing Federation	278,194
Shares of the Co-op. Marketing & Purchasing Federation	500	Account Payable	395
Shares of the Agricultural Bank & Co-op. Bank	40,000	Advance Payment of Farm-products' Price	1,210
Printing Machinery	2,894	Members' Deposits	54,314
Advance Payment of Farm-products price	396,231	Contributions for Co-op.office building	64,758
Interest Receivable	175,476	Employees' Reservefund	133
Loans to the Members	627,181	Profit Reserve	243,634
Deposits	396,412	Public Works Fund Reserve	6,000
		Fund for buying share	33,300
		Reserve for Training	13,334
		Profit	142,083
TOTAL:	3,676,891	TOTAL:	3,676,891

4. Promphiram Co-operative

(1) Outline of Its Service-Area and Membership

This Co-operative is situated at Wangkon Village (Tambol), Promphiram District, Phisanuloke Province. Its office is standing in front of Nongtom Station about 20 km north of Phisanuloke

Station on Bangkok-Chiengmai Government Railway. Road traffic inconveniences are made good by railway transport of maize because of the location of the co-op. office and adjacent co-op. warehouse for collection of maize. This Co-operative was established, on September 12 1966, as Agricultural Product Marketing Co-op, same as Lamnarai Co-operative.

Promphiram District is comprised of 10 Tambols (villages) and 80 settlements, covering 842 km^2 = 526,250 rai, and its total population is 6,915 people. 70% or so of its land is covered by forest-land. Land-use in Promphiram District reads as follows:

Paddyfield	:	125,557 Rai
Upland-field	:	36,463 "
Reserve-forest	:	19,156 "
Hills & Forests	:	345,178 "

Membership at the time of establishment of this Co-op. was 170 which was slightly increased to 182 by March 1970.

Point of Time	Membership	New Admission	Withdrawal
Mar 31 '67	167		
Mar 31 '68	170	13	12
Mar 31 '69	171	1	
Mar 31 '70	182	13	1

There are 36 credit co-operatives in this District, covering the land-area of 39,88 rai with the total membership of 612. 80% of the members of Promphiram Co-op. are also affiliated to these credit co-operatives.

(2) Business-Administration of the Co-op.

Collection and Marketing of Farm-products and Profit

This Co-op. is mainly working at collection and marketing

of maize, having a good record of annually increasing its amount of business, as shown on Table 26:

Table 26 : Collection of Farm-products by Promphiram Co-op.
(in Ton)

Year	Maize	Black-mappe	Mug-bean	Soya-bean	Others
1966	945	58			
1967	1,274				
1968	2,427	150	18	20	
1969	5,981	200	20	69	30
1970	7,470				

(Source: Survey at Promphiram Co-operative)

Maize collected by this Co-op. remained at a modest level of 945 ton in 1966 but, in 1970, as much as 7,470 ton of maize had been collected by the time of the present survey, at the beginning of February 1970. Limited quantity of pulses are also being handled. Yet, in 1967 and 1968, the Co-op. had to close its accounts in red figures, and the accumulated deficits could have been liquidated, with some surplus, only in 1969. As for 1970, good collection of maize at fairly lucrative price in view will bring a considerable profit to this Co-op.

Table 27 : Profit & Loss of Promphiram Co-op. (in Bahts)

Year	Net Profit	Deficit	Cumulative Deficit
1967		19,584	11,835
1968		13,572	25,407
1969	37,441		

(Source: Statements of Accounts, Promphiram Co-op.)

The deficits during 1967 and 1968 are due to the fact that the profits raised by marketing of maize and pulses were nullified by general administrative-cost plus interest payable, as will be seen on Table 29. The combined cost of these last

two items was as big as 50,000 Bahts in 1969, and to cover this much cost, this Co-operative needs to handle not less than 4,000 ton every year.

This Co-operative is run by four people: one manager, one office worker, one officer deputed by the Department of Credit & Marketing Cooperative, and one clerk.

Table 28 : Profit & Loss of Promphiram Co-op.
(in Bahts)

Item	1967	1968	1969
Proceeds:			
Profit from Maize	6,482	24,000	81,951
Profit from Pulses	17,900	9,087	6,267
Admission Fee	130	10	130
Interest Received	52	9,175	4,765
Others		9,885	772
Expenditure & Profit:			
General Admin. Cost	29,155	34,734	39,302
Interest Paid	8,000	16,001	12,000
Bad Reserve, etc.	5,697	3,792	10,133
Net Profit	(-) 19,484	(-) 13,572	37,441

Assets - Capital - Liabilities

Promphiram Co-op. started operation with 200,000 Bahts of Co-op. Promotion Fund, plus 44,600 Bahts of share-capital. This amount was let out as loans for procurement of land and maize-harvesting fund but, because of poor recovery-rate, more than 60,000 Bahts is still left unrecovered. As on March 31 1970, this Co-op. has paid-up capital (448 shares valued at 44,800 Bahts) and land ¼ rai in size, but it has no office nor warehouse of its own and is borrowing office and warehouse at a daily rent of 600 Bahts. Balance-sheets of this Co-op. at the

Table 29 : Balance-Sheets of Promphiram Co-operative (in Bahts)

ASSETS			CAPITAL - LIABILITIES		
	Mar 31 '68	Mar 31 '70		Mar 31 '68	Mar 31 '70
Land	34,000	34,000	Capital	44,600	44,800
Fixtures	10,655	14,497	Co-op.Promotion Fund	200,000	200,000
Depreciation	2,897	6,989	Public Works Fund Reserve	1,000	1,000
Fund for Buying Share	2,900	700	Borrowings From Co-op. Marketing & Purchasing Federation		488,175
Loans:	113,724	53,110	Others		10,950
Advance for Maize	71,375	38,562	Accounts Payalbe:	9,596	12,610
Harvesting Fund	40,878	24,548	Dividend	306	306
Accounts Receivable	1,387		Rebate	304	304
Other Advances	85		Interest-payable for Co-op. Promotion Fund	8,986	12,000
Bad Reserve	6,574	9,994	Current Profit	(-) 11,835	12,034
Farm-product in Stock	31,966	649,144			
Gunny Bags in Stock	19,006	2,000			
Cash on Hand	28,121				
Deposits	13,462	3,879			
Shares of Co-op. Marketing & Purchasing Federation		2,000			
TOTAL:	243,362	769,570	TOTAL:	243,362	760,570

end of 1967 and 1968 are given on Page 34.

5. Conclusive Remarks

Conclusive remarks on the possible pattern of economic co-operation and the role to be played by the agricultural co-operatives therein will follow, in good consideration of the main characteristics and conditions common among the local farmers and their co-operatives.

(1) Farmers, Land and Agricultural Production

1) With possible exception of Promphiram (further study is required), both Lamnarai and Nongphai are the area where farmers who migrated from outside reclaimed the forest-land, and are cultivating maize.

2) They obtained land through encroachment on the State forest-land and are enjoying 'chapchong' though without proprietorship of the land they cultivate. This 'chapchong' is openly made an object of free transactions. Most of the farmers there are personally cultivating their land for agricultural production and, accordingly, there is no landlord tenant relationships. Some of the farmers who have big holdings are now emerging as enterprising agricultural producers by emloying hired labourers.

3) The farmers are generally free and frank, and endowed with enterprising spirit, but often lack tenacity so that they are easily tempted to abandon their land for migratory journey, under not very serious difficulties of life, or unfulfilled expectations.

4) Ploughing and shelling of maize is done by the tractors and corn-shellers owned by the middlemanly merchants which are

provided on the condition that the harvested crops shall be delivered to the middlemen. With little or no savings due to them, farmers have to depend on the finance to be arranged either by the middlemanly merchants or the co-operative, through all the processes of their ploughing, harvesting and marketing. Among such services, rice is an indispensable item in case the cultivators are producing no other crops but maize. Whenever such finance is given, the producers must surrender their crops to the giver of finance. Although the interest-rate charged by the middlemanly merchants is claimed to be around 3% per month, they are used to play, as a matter of course, shrewd tricks in weighing and measuring of the crops at the time of marketing, and surcharge the price of commodities when these are supplied to the farmers.

5) Farmers are unprotected against various menacing factors such as bad weathers and fluctuations of farm-products' prices.

6) Farmers' mode of life is literally "from hand to mouth" and, even in the years when they find more or less surplus on and above their cost of living, they scarcely think about savings.

(2) Agricultural Co-operatives

1) No agricultural co-operative can collect farm-products on a solid basis unless it offers, in lieu of the middlemanly merchants, finances and other services in return to the delivery of goods by the producers.

2) Those farmers who deliver their produce to the agricultural co-operative cannot expect for producer- and consumer-goods in advance from the middlemanly merchants for the next

season; this makes obligatory for the co-operative to enter into purchasing or supply activities which, however, are hardly sufficient at the moment.

3) Management of any marketing co-operative is doomed for financial difficulties if it fails to handle maize in the minimum quantity of 4,000 ton. Lamnarai Co-op. is not quite commendable in its maize-collection in this respect. This Co-op. is the one which was entangled into the vicious-cycle whose starting-point lies at poor agricultural production in a certain year which, by making the co-op's fund-revolving difficult (due to poor recovery of production-loans for the year), unables it to offer enough credit in the succeeding year, thus ending at insufficient collection of crops in the same year. Nongphai Co-operative is apparently in good managerial condition, but no one knows when it might receive a fatal blow as a result of continued uncertainity in local production and instability of the farm-product's price.

4) High interest-rate charged by the middlemanly merchants may be justified by the unstable crop prospects, cultivators' migratory nature, and the risk of non-recovery of loans as the result. The co-operative's rivalry to the middlemanly merchants with the weapon of low interest-rate of 1% per month (against 3% of the middlemanly merchants) is precariously maintained by the generous State protection.

5) Full-brossomed functioning of the co-operative calls for link-up services of crediting, marketing and purchasing, but it is not enough unless it serves as a machinery for capital-accumulation on behalf of the farmers who badly lack propensity for savings. Co-operative needs to work as a sort of 'shock-absorber' in case of agricultural crisis, by neutrali-

zing various uneasinesses in Thai villages.

6) Prosperous development of Thai co-operative movement will necessarily intensify competitions between the middlemanly merchants. Sooner or later, therefore, we shall be faced with the problem of how to adjust antagonistic relationships between these two.

(2) Economic Cooperation and the Role of Agricultural Co-ops.

The present economic cooperation project aimes at raising the production-level of the upland crops (maize and pulses, in particular) in Thailand, in view of socio-economic betterment of Thai farmers and an increased import of such products into Japan. The principal strategy in attaining this aim lies in development of agricultural co-operatives there. The part to be played by Thai agricultural co-operatives, therefore, needs to be studied in more pragmatic manner.

Extension among the actual producing farmers of the improved techniques developed or demonstrated at the Training and Demonstration Farm project is no doubt one of the responsibilities of the agricultural co-operatives, but the present part of the Report will mainly deal with the operational aspect of the co-operatives, and economic aspect of the producing farmers. The first proposal to be made in this connection is the necessity to strengthen the farmers and their co-operatives through improving their common weaknesses and short-comings as briefed in the above. In our opinion, the weakest point common among the farmers is their lack of propensity for savings, and that of the co-operative is their financial position. As the farmers' savings-habits can not be nurtured within a short span of time, the co-operative needs to function as a machinery for capital-accumulation on behalf of their member-farmers.

The following suggestions are made as some of the ways and means to attain this purpose:

(a) Farm-machinery provided by Japan under this Project shall be fully utilized, not only for the experimental purposes at the Center but also by the agricultural co-ops., either on hire or on rental basis.

(b) The agricultural co-operatives which are given chances to utilize these farm-machinery shall allow their member-farmers to use them on rent and or themselves operate these machinery for the servicing towards the member-farmers at the charges on the market rate.

(c) Agricultural co-operatives, thereupon, will be able to divert the available credit-fund away from loans meant for ploughing and shelling to harvesting loan which will help bring correspondigly more crops to their warehouses.

(d) The proceeds from rental or servicing by use of the farm-machinery are hoped to be reserved in the entire amount, after deducting the expenses, as depreciation. It is also hoped for that such income, which will turn a profit upon completion of depreciation-reserve, to be withheld within the co-operatives in the name of appropriate reserves.

(e) Demonstration Farms are to be established under the co-operative operation in order to acclimatize the study-results at the Center to the local conditions but, in view of more effective extension among the cultivating farmers and of giving fillips to the co-operative development through such extension services, gradual expansion of such Demonstration-Farms, and eventually turning them into the co-operative farms, may deserve a full consideration in times to come. Higher productivity and

more rational farm-management in our mind, two prevailing conditions of (i) the uncertainity in claims on land, and (ii) the poor sense of attachment towards land, involvement of a part or the whole of the farmers' holdings into the co-operative consignment farming seems to have good possibility in future, and when irrigation work will come to be taken up in earnestness, the cooperative may assume the leadership in interchange of farmers' holdings for their optimal consolidation.

(f) Farmers feel certain uneasiness in hoarding a considerable sum of cash and their established habit of getting necessities on credit from the middlemanly merchants seems to be working as its palliative. It is always desired for that the member-farmers will deposit the major part of the sales-amount of their farm-products to the co-operatives in the same co-operatives. This will solve the question provided that the supply of daily necessities among the depositor-members can be reasonably looked after by the cooperatives themselves which, in actuality, is too far to seek, because the farmers are living scattered in a large tract of area. In future, it would help promoting amicable relationships between the co-operatives and the middlemanly merchants to give sanction to the idea of "Purchase-Book", a kind of pass-book valid between the consumers and suppliers, whose purchasing-power will be endorsed by the co-operatives on the outstanding balance of the members' savings accounts with the co-operatives.

Chapter II: Current Maize Cultivation Techniques

1. Natural Environment

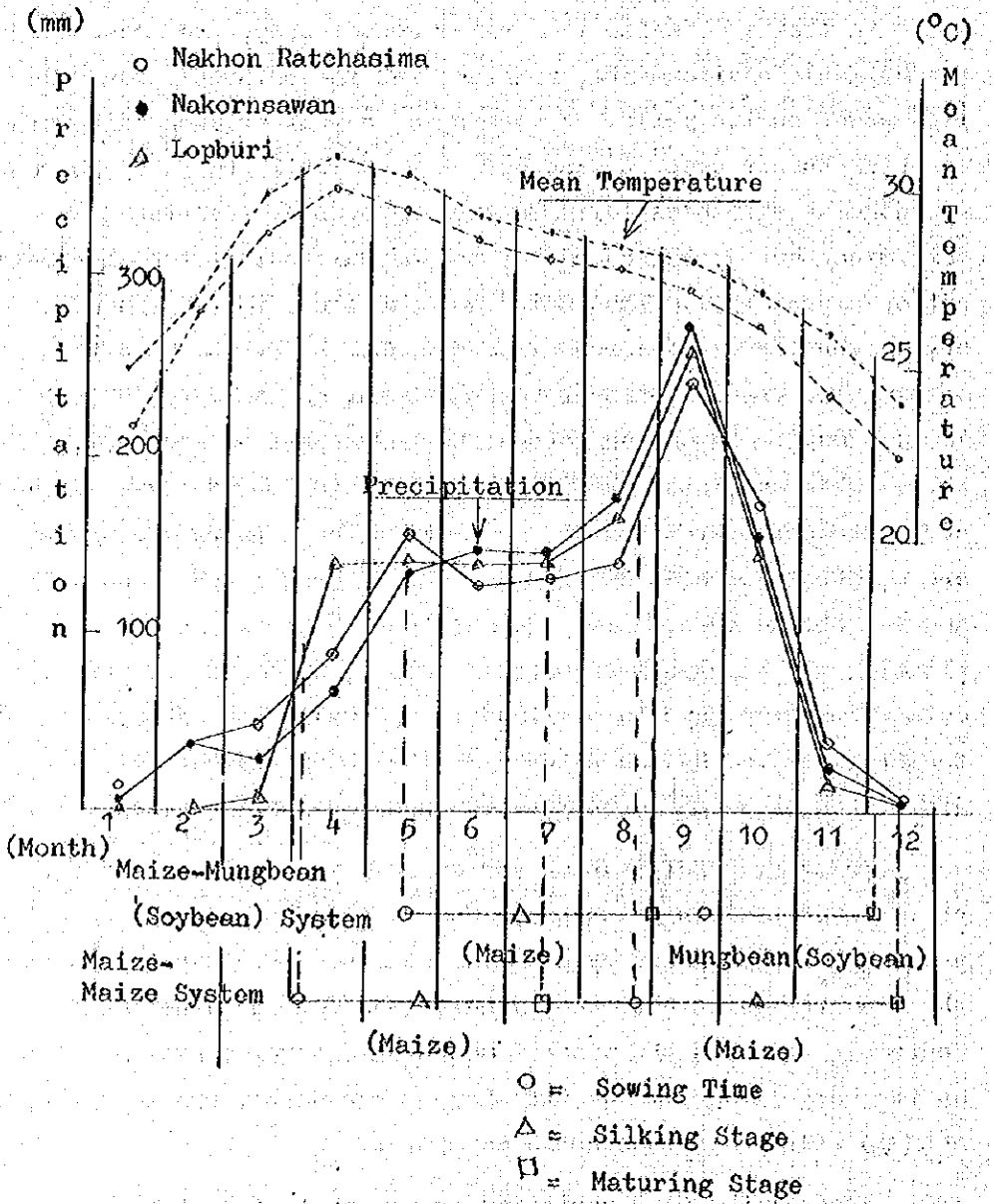
(1) Climatic Conditions

In Thailand, maize is a rainy season crop, and among all the climatic environments, rainfall has the principal controlling power on its yeild. Accordingly, a year of much rain would bring bumper crop and another year of little rain brings correspondingly less yield. Its farming season, therefore, is determined not by the change of temperature but by the distribution of rainfall. Thus maize is sown close to the end of dry season (dry season runs from December to March) when the accumulated precipitation reaches 200 mm, and harvested after 100-110 days. In Nakhon Ratchasima and a part of Saraburi, where the accumulated precipitation reaches 200 mm-level earlier than elsewhere, maize can be grown twice a year. In these areas, the first crop of maize is raised druing April and July and the second crop, during August and November. Annual precipitation which amounts to more or less 1,200 mm in the principal maize producing zone in Thailand is generally concentrated in the Provinces of Nakhon Ratchasima, Saraburi and Lopburi, and diminishes as we go north-ward to the Province of Nakornsawan.

However, precipitation varies from year to year and the yield of maize is made unstable due to drought or flood which are alternately caused by such variations. Local variation in the same region is not exceptional, too. On the other hand, as September which is the wettest month of the rainy season falls on the harvesting time of the single-crop maize, problems remain in relation to the grain moisture.

Against the wide variation in precipitation, temperature

Fig. 1 : Cropping Season in Relation to Seasonal Changes of Mean Temperature and Precipitation



remains almost constant between seasons. The mean temperature is above 22°C even in the coolest month, causing no worries about weather injuries particularly from coldness, but no such weather injuries are actually experienced as sowing takes place while it is hotter than 35°C, which is the critical temperature of pollen survival, and well out of the pollen scattering period. Accordingly, plentifulness of water gives a good assurance to double cropping and sowing can be done within a wide movable extent.

(2) Soil Conditions

The topographical conditions in each maize producing area may be described as follows: Lamnarai is located on undulating plain with many gently sloping fields; Nongphai is made up of Maize-Rice fields on the low land, Maize-Mungbean fields spreading over the plateau away from the highway, and gently sloping fields in the interior; and Promphiram is standing on almost a flat land vulnerable to flood-damages due to heavy rains.

Gently sloping fields which are spreading in Lamnarai and Nongphai do not preclude mechanized farming, and contour cultivation is also believed to be easily introduceable there, provided that proper counter-measures to soil erosion due to heavy rains can be taken. Spacious land is left unutilized, particularly in the outer fringes (further than some 4 km) of the highway, in Lamnarai and Nongphai.

Soil in Lamnarai is mainly made up of Lopburi loam, with deep surface soil of dark or dark-brownish colour; it looks more blackish on the low land and turns increasingly brownish as it rises towards plateau. Its acidity being almost neutral, the soil there is said to be rather fertile. Nongphai has two different types of soil: the one which is similar to that of

Lamnarai, on the low land, and the other which is rather sandy and supposedly akin to Korat fine sandy loam, on the plateau. In Promphiram, surface soil is rich in clay and blackish in colour, and its soil is comparatively fertile.

The sorghum belt spreading along the road which runs from Saraburi to Lamnarai seems to contain a lot of laterite, and a spacious unutilized land extending on both sides of the road between Lamnarai and Nakornsawan appears to be mainly made up of Korat fine sandy loam, apparently unproductive with little weed and scattering shrubs on it.

The results of surface soil analysis as given on Table 1 will allow us to make the following observations: Soil at Lamnarai contains acidity close to neutral and is comparatively phosphoric; soil at Sawankhalok is acidic, with little available phosphorus; and that at Promphiram is more acidic with less available phosphorus than Sawankhalok. In both Sawankhalok and Promphiram, soil has very little nitrogen, though the latter's generally contains more nitrogen than the former's, and in both cases, nitrogen is apparently the limiting factor. This is ascertainable from the fact that, in Sawankhalok, the soil of the fields where maize grows better contains more NO_3-N than others. Cropping system also makes differences in N contents in the soil. For instance, the soil of the land where mung bean or soya bean is grown after maize contains more NO_3-N than the land where maize is succeeded by cassava (observation at Lamnarai). This shows that nitrogen in the soil can be better preserved through improvement of cropping-system. Soils at Nongphai and Promphiram are highly acidic, of which we are not very sure if it is due to a frequent flooding or difference in soil type, because of the limited number of such surveys there.

Table 1 : Chemical Properties of the Soils (1/100 g.Soil)

Sampling Field	Cropping System	PH (Kc1)	Nitrogen NH_4	Nitrogen NO_3	Phosphorus (P_2O_5)	Phosphorus Absorption	Potash (K_2O)	Soil Colour	Flooding during rainy season	
Lamnarai	Maize-Cassava	7.0	2 mg	0.125 mg	7.5 mg	500	3 mg	Dark brown	NO	
-do-	Maize-Soyabean	6.5	1 "	0.500 "	5.0 "	500	4 "	-do-	NO	
-do-	Maize-Mungbean	7.0	1 "	0.500 "	5.0 "	500	2 "	-do-	NO	
-do-	Maize-Mungbean	7.5	1 "	1.250 "	10.0 "		4 "	black	NO	
Nongphai	Maize-Rice	5.5	4 "	0.125 "	2.5 "	1250	2 "	-do-	YES	
Sawankhalok	Maize	6.5	1 "	0.125 "	2.5 "		5 "		NO	(*1)
-do-	Maize	6.5	1 "	0.500 "	1.0 "		5 "		NO	(*2)
-do-	Maize-Black mappe	5.5	1 "	0.250 "	5.0 "		5 "		NO	
Promphiram	Maize(little weed)	4.0	1 "	2.000 "	0.1 "		3 "	black	YES	(*3)
-do-	Maize (much weed)	4.5	2 "	1.250 "	0.1 "		3 "	-do-	YES	(*3)
-do-	Maize-Mungbean	5.0	1 "	2.500 "	0.1 "		5 "	-do-	YES	(*3)

Notes: (1) Soil analysis by YAGI Type Simple Soil-Tester;

(2) Soil taken at Promphiram turned gel-like while measuring its Phosphorus Absorption, and no supernatant solution was obtainable;

(3) (*1) = Maize-growth not vigorous

(*2) = Maize-growth vigorous

(*3) = Flooded during the medium stage of its growth.

From the preceding observations, on one hand, and from the conditions of weeds growing there (kinds, volume and heights), on the other, we are induced to make the following judgement: Soil fertility is the highest at Lamnarai, to be followed by Sawankhalok, and that at Nongphai is the lowest; at Promphiram, the maturing of soil through cultivation is rectified by frequent flooding.

Statements by the cultivating farmers agree in one point that high yield for a few years after reclamation is usually followed by diminishing returns. We suspect that this phenomenon of diminishing returns is influenced to a considerable extent by climatic reasons. Although we could not clarify this quantitatively during our survey, it would be quite possible to conclude that the deprivation of nitrogen of the reclaimed land is responsible for less fertility of its soil compared to virgin soil. It was also stated that the reclaimed land has to be abandoned after sometime because, while the maize production becomes less and less due to lowering fertility of the soil, the weeds (commonly known by the name of "Communistgrass") start growing in more abundance.

Ploughing and harrowing is easier in Lamnarai because of less clay in its soil, but more difficult in Promphiram exactly because of more clay in its low situated land. We know that the soil rich in clay tends to cement together under the sun and to turn heavy in the rain, both detrimental to efficient farming and inhibiting to emergence (germination) and root growth. Therefore, selection of the demonstration farm needs to be made after careful soil surveys at each candidate site.

2. Current Maize Cultivating Techniques

(1) Varieties and Procurement of Seeds

Guatemala is the dominant variety being cultivated there, although some mixture with local varieties is noticeable. Ratio between Dent and Flint is almost equal, with a shade of higher proportion to the former, as long as the inspection of the harvested ears goes.

Farmers cultivating maize on the fields over 30 rai in size generally get their seeds from the dealers, while those working at maize fields less than 20 rai obtain their seeds out of their own harvested crops. Seeds harvested in the farmers' own fields are prepared through the following processes: (i) collect large-sized Dent ears and dry them in the sun; (ii) shell the grains and dry them again in the sun; (iii) put these grains (seeds) in drum-shaped paper vessel together with insecticide, like DDT; and (iv) keep them in store at cool place. The qualitative properties of the seeds supplied by the dealers are unknown, but they are most probably coming from those collected by the dealers from amongst the farmers. Renewal of maize-seed, therefore, needs to be taken care of by each and every maize-cultivating farmer in a planned manner.

(2) Cropping Pattern

Survey on cropping pattern was carried out at some representative places in each area and its findings show some difference among each other, as shown on Table 2.

Table 2 : Cropping Pattern

Surveyed Area	Row Spacing	Space between Plants	Number of Plants per Hill	Remarks
Lamnarai	90 cm	90 cm	3 - 4 plants	Large farmer
-do-	80 "	80 "	3 - 4 plants	Small farmer
Promphiram	80 "	60 "	3 - 4 plants	
Pakchong	75 "	40 - 50 cm	3 - 4 plants	

Square-planting of 90x90cm or 80x80cm is common in Lamnarai, while in Promphiram, where farmers have longer experience in maize, closer spacing is practiced. Farmers with smaller acreage tend to plant more densely. These differences in cropping pattern are probably due to local characteristics, such as: in Lamnarai, little or no knowledge of row and spacing between plants sends the farmers there to square-planting, keeping an equal distance between the hills, so that sowing can be taken up at any time and place by manual labour, while, in Promhiram, the necessity of postplanting management work like weeding developed the concept of row among the cultivators who began shortening the space between the plants; and the trend of increasing plant population as is witnessed in Pakchong seems to have developed side by side with the use of fertilizer for maize cultivation under the guidance of the experiment station and the extension workers.

As for the number of plants per hill, the current practice is 3 to 4, but 5 is not very uncommon. Promphiram cultivators learnt through experience that, as more plants than 3 per hill would cause earlessness or barren ears, they are used to thinning extra plants after emergence.

Judging from the height (180 - 200cm) and the number of leaves (21 - 23) per plant, leaf area would hardly become more than L.A.I.2 or so and, therefore, the main cause of the emergen-

ce of earless or barren plants could not be attributed to excessive mutual shading but rather to the retardation to the plant's growth due to over-competition among the total plants in a hill.

(3) Ploughing and Harrowing

Disk-plough does both ploughing and harrowing jobs. As for the tractor, most of the big farmers own it, but small farmers have to depend on its hirage. It is doubtful, however, if residues of the preceding crops and the weeds are properly ploughed into the soil, and the harrowing is adequately done to allow wholesome emergence, through the current practice of tractor operation with disk plough.

(4) Fertilizer Application

Excepting in Pakchong where the farmers have long experience in maize cultivation, most of the farmers elsewhere grow maize without using fertilizer. This does not mean that they are totally ignorant of the merit of fertilizer-use; on the contrary, they all admit its good effect because in each area the Agricultural Co-operative Society took lead in propagation of fertilizer use among the local maize growing farmers. Promphiram farmers are particularly eager to start using fertilizer for their maize cultivation as some of the leader farmers have experience of its application: half the amount as basal- and the remaining half as top dressings. As will be known from this example, technical improvement is not very difficult a task if we can find out good leaders. The trouble lies at the indecision on the part of the maize-cultivators, because of the high price they have to pay for fertilizer, if an increment in yield through its use can be big enough to recompensate its cost. Adoptation to fertilized cultivation will be facilitated by offering financial support to the farmers in the meanwhile.

(5) Cultivation, Weed Control and Hilling

Weeding is done by hand, hoe or primary hilling instrument drawn by buffalo. The good effect of weeding is well recognized by the farmers in Nongphai and Promphiram. No herbicide is in use. The volume of weeds on the field then under mung-bean cultivation was big enough the bring home the heaviness of weeding-work required for maize cultivation; it is dubious if farmers are weeding at the optimal time not injurious to an early growth of maize. The previous Report on this subject says that weeding by maize cultivating farmers is being done to such a degree of near-perfection that little additional merit is hoped for from its further encouragement. As if to endorse this statement, the tobacco field was discovered in almost weedless condition during our last survey and it is not surprising to hear that maize cultivators are keen in weeding since maize is as leading a crop as tobacco is. Nevertheless, inhibition to early growth of maize by weeds remains as a glaring fact. Apparently, no maize cultivator does intermediary cultivation and hilling and no implements for the purpose are discernible among their tools.

(6) Irrigation

Irrigation for maize cultivation is in effect simply in Maize-Rice Belt in Nongphai, where maize is grown on paddy field, and among a group of progressive farmers in Pakchong. According to Dr. Matsuo(FAO Expert) the latter group of farmers are using sprinklers for the purpose. As most of the other cultivators are developing their maize field on the plateau, away from an economical water source, and they can ill-afford to invest in irrigation because of low price maize fetches on their behalf. Alternatively, we would better study the ways

and means to hold the run-off water in the soil to meet the demand of the plant.

(7) Insect Pests and Diseases and Their Control

Against the commonly accepted theory that the northern leaf blight is the principal disease in Thailand, Mr. S. Chang from Formosa says that downy mildew invaded into this country, of which Maize Experiment Station at Pakchong has a serious concern. Even if it is true, the damage due to downy mildew would not be as serious as in the Philippines or Indonesia, because in Thailand the rainy season is clearly demarcated from the dry season when the crops and weeds which may serve as its hosts perish in quasi-totality.

Corn-borer and grass-hopper are two champion-insects against the maize, but the former is not so remarkably mischievous while planned prevention of the latter is rather difficult as nobody can foresee its outbreaks.

Use of farm chemicals is unknown in all of the districts we visited. It seems that maize in Thailand is comparatively immune from the insect pests and diseases.

(8) Harvesting

They use one hand in felling the stalk, while plucking off the ear by the other hand; husking is done while bringing the ears to several convenient points on the field, wherefrom a tractor carries the husked ears away. Maize-ears thus harvested are packed as they are, namely with cobs and all, into a gunny bag to be sold to the dealers, or shelled by corn sheller (Thai-made), as done by most of the cultivators, before selling. Dealers have tractors for hire as well as corn shellers which they use for shelling, just like the cultivating farmers, with

tractor-engine as their motive power.

Percentage of water in the grain at the time of shelling is said to average at as high as 20 - 25%, so that the grains would give stuffy feeling to one's hand when grasped soon after shelling. From the quality point-of-view, it is advisable to dry the crop as well as possible in the sun before shelling, and when its harvest takes place during rainy season, a drier would do a great deal in improving the quality of the grains. Alternatively, people will better try to grow maize in such a way that it will reach ripening stage when it does not rain very much.

Yield per 1ha. is between 1,800 and 2,300 kg in Lamnarai, but 2,700 kg on an average and 3,600 - 4,000 kg at the maximum in Promphiram, a fairly good yield in consideration of fertilizerless cultivation.

(9) Cropping System

Maize-Mungbean or Maize-Blackmappe is the ruling cropping system, being followed by Maize-Soyabean, Maize-Rice and finally, Maize-Tobacco. Unless it is tobacco or rice, the succeeding crops are generally grown in extremely careless manner, almost always sown by broadcasting and suffocated and overwhelmed by weeds. Such succeeding crops are useful not only for maintaining soil fertility but also economically benefit the formers and need more attention for higher yield of such succeeding crops.

(10) Farm Machinery in Use

Mechanization is limited within the scope of ploughing, harrowing and shelling, each represented by 4-wheel tractors ranging from 52 to 65 HP (Ford and Fugurson), diskplough (3 to 7 harrow) and corn sheller (Thai-make). The remainder of farm-

ing is entirely left to manual labour. With such an inconsistent system of mechanization sowing and weeding might often miss optimal timing.

3. Condition of Plant Growth

As our survey period coincided with dry season, maize from single cropping area was in the process of marketing and shelling, and its conditions during growth had escaped our observation. Fields in Promphiram had been overflooded after silking stage and decayed plants were seen standing on the water as if to show the severeness of flood. Condition of maize plant growth during its second crop was studied some at Lamnarai and much in Pakchong.

Lamnarai maize is not tall, with 180 - 200cm length of stalk and some 70cm ear-height, while Pakchong maize is 280 - 300cm in stalk length and 170cm in ear-height, telling that fertilizer works at extending the ear-height and bringing the plant to near lodging. In fact, however, they were standing erect on thin stalks (20mm in diameter) and the growth condition of the stalks from a single hill was most uneven, mixed up with extremely thin ones, each bearing 20 - 21 leaves. Leaf-colour betrayed their nutritive conditions which severely lack in nitrogen wherever we went and those at mafuring stage scarcely had green leaves. Deficiencies in phosphorus and potash were not observed. Although phosphorus content of the soil is poor as was mentioned in the above, Guatemalan variety seems to posess good capacity to absorb a rather low soil phosphorus.

Ears are much shorter than Japanese Tomorokoshi Koh No.7 (length 14 - 15cm/tickness 4.0 - 4.5cm) and many of them are suffering from tip kernel barrenness. As tip kernel starts fattening only at the closing period of the plant's growth.

this symptom is believed to have been caused by deficiency in nutrients, particularly nitrogen, in the later stage of the plant's growth. Another possible cause of this must be water stress.

As for the characteristics of the ear, the percentage of the ears bearing grains left unshelled around their cobs after going through the corn sheller is higher with Dent, while Flint is easier to dry and shell and contains less moisture in the grain, than Dent. This was confirmed through our observation at shelling yards.

From the above observations and, particularly, in consideration of the height of the plant and the number of its leaves which combinedly keep the leaf area within 2 L.A.I or so, twice as much growth as at present will not cause serious light competition (light competition comes into picture only when L.A.I. becomes bigger than 3.5). Question still remains if this much increase in growth can be sustained by the actual water-content of the soil.

4. Achievements in Agricultural Experiment Station

Phraphutthabad Experiment Station in Saraburi Province has been engaged at experiments concerning seed multiplication and farm management of maize and sorghum, under the direction of Bangken Station.

Bangken Experiment Station is the center of Maize and Sorghum Project which is carrying on research-work hand in hand with the Branch Experiment Station in each Province and Kasetsart University, under the auspices of Rockefeller Foundation. The results of the Project's research and experimental works can be summarized as follows:

The target of breeding is an early maturing, good variety

meant for cultivation during rainy season: Cupurice, for instance, brings as much yield as 5,800 per 1ha. in the field test, a much higher yield than Guatemala, Hybrid, again, attains 15 - 20% increase in yield throughout its experiments. Guatemala PB5 was taken up for experiment on leaf-area-index and obtained high yield at 1.39 in L.A.I. (total L.A.I. being 3.77) calculated upper leaves above the primary ears. This result is close to 3.5 L.A.I. which was obtained in Japan and Africa.

In land preparation, combinations of plough and disk-harrow are being experimonted with 3.5% difference within treatments, which is not very important. Plant population tests brought a high yield of 4,000/ha. by 40,000 - 50,000 hills/ha. (75 x 25cm, 75 x 33cm) with the local variety, and the maximum yield from the hybrid through dense population of 71,040 hills/ha., shows that hybrid has an appitutude for dense population.

Atrazin was found to be a very effective herbicide if applied soon after emergence, and even by hand-weeding 100% yield increase was made possible. The optimal weeding period was identified as 40 days after sowing and after that growing maize itself inhibits the growth of weeds. Some experiments on weed-control tell that there is little difference in yield whether weeds are dealt with herbicide or hand-picked.

Experiments with fertilizer brought the optimal comparison as N2: P2: K1, and 20 - 30% yield increase was obtainable by use of 50kg/rai compound fertilizer (16-16-8), which correponds to about 1/3 of the Japanese dosage. Local adaptive tests in the upland crop area in the north-eastern part of the country determined the optimal dosage of N-75kg: P_2O_5-75kg: K_2O-35kg. Top dressing test of nitrogen proved that the most successful application is to give ½ as basal dressing 2 - 3 days after sowing, and the remaining ½ 20 days later, and this would be 10%

more effective than applying the whole amount in basal dressing alone; top dressing later than 20th day brings diminishing return. This finding almost fully agrees with that carried on in Japan. Dr. Jisuke Takahashi (FAO Export), highly evaluates the effect of top dressing at the stage when the plant grows to the height of about 40cm (approximately 12th leaf stage), which corresponds to 20 days after sowing in Thailand. Both approve the good effect of fertilizing at ear-forming stage, in fattening the ears. Effects of phosphorus can not be ignored but, as it has poor mobility and its effect is accelerated by high temperature, it seems to attract less attention than in Japan whose soil contains much volcanic acid.

Maize and Sorghum Project also puts much emphasis on Downy Mildew as a new menance to maize cultivation in Thailand.

Recapitulation of the above experiment results would provide us with an idea of yield increasing potentiality in each branch of extension, as follows:

Fineness of ploughing and harrowing:	5%
Weed-control at an early stage:	10%
Weed-control within the first 40 days:	50 - 60%
Fertilizer application:	15 - 20%
Improvement in Cropping Pattern:	20 - 30%

Corn and Sorghum Center at Pakchong was working hard at breeding an early maturing, short-stalked and sun-light utilizing (having erect leaf angle) variety. This center was also interested in resistance to downy mildew and evaluation of economicality of mechanized cultivation of maize.

Dr. Jisuke Takahashi has been working at experiments called for maize cultivation on paddyfields in mountain regions, and pointed out the merit of separate dressing of nitrogen and

high effectiveness of phosphorus for maize cultivation. He stressed the importance of introducing new variety adapted to heavy fertilizer application, such as hybrid, if higher yield is aimed at through an increased input of fertilizer, as Guatemala responds to fertilizer-input with a longer stalk below the primary ear, almost to the danger of lodging.

A series of experiment are being carried on to find out better maize-cultivating method but they lack dynamic studies in such as the processes of the plant's growth and are largely untheorized yet, and problems still remain to be solved before they will be locally applied for. First of all, local characteristics of cultivation techniques will need to be more systematically studied and secondly, water problem will have to be explored more intensively, not simply on the aspect of irrigation but further on utilization of run-off water, vitalization of potential soil fertility, etc.

5. Improvement Feasibilities of Cultivation Techniques and Relevant Problems

Through examination of the current cultivation techniques and the achievements by the Experiment Stations, the gap between these two throws light on the fact that the extension service is not smoothly functioning. This gap is partly attributable to a lack or unanimity in economic evaluation of new techniques between the actual cultivating farmers and the Experiment Stations, which needs to be adjusted for successful extension meant for technical innovation. Economicality of technical innovation being kept apart, we shall discuss here mainly on improvement feasibilities, on the proper understanding and appreciation of the significance of the current cultivation techniques, with necessary references to the results of experiments and available documentary findings.

Renewal of Seeds: Guatemalan variety now in wide cultivation will continue to claim its position for sometime to come, by reason of its fine quality and comparatively high yield. In order to attain phenomenal increase in yield through heavy fertilizer application and increased plant population, however, the necessity of introducing proper hybrid with adequate fertilizer response is clear.

Assured Supply of Improved Seeds, or Establishment of Breeding System: An assured supply of the improved seeds is indispensable not only for uniformity of the plants but also for betterment of quality. As long as the farmers are relying upon the seeds harvested in their own fields or those supplied by the dealers, impurity will remain as a necessary result. Here arises the need for renewal of seeds but the supply of the improved seeds through the Ministry of Agriculture are quantitatively insufficient for the purpose. Alternative method would, therefore, be: (i) educating the actual cultivators on proper methods of seed-raising, and (ii) breeding of the improved seeds supplied by the Ministry of Agriculture by each agricultural co-operative society. In future, it would be advisable to develop seed-farms on the undulating land in the upland crop area in the north-eastern part of the country and to establish a distribution system of these seeds to all the maize producing zones of the country.

Uniformity of Standing Crops: Unlike other graminae crops, maize can not afford to increase the number of its ears through tillering. Emergence has direct bearing on the number of ears and they are often inhibited to grow and turn earless or barren through competition between plants. Assured standing and uniformity of the plants is, therefore, most important for crop

increase. Healthy growth is often detered by insufficient harrowing, excessively thick molding, and smallness of seeds. Even when improved seeds are available, they will be in vain if residues of the pre-crops and weeds are not properly ploughed into the soil and the soil itself is not carefully harrowed. For this purpose, tooth-harrow will have to be used in addition to disk-plough. If cutter or forage harvester is conveniently used for chopping the organic matters returned by the pre-crop and weeds before they are ploughed back in to the soil, the soil fertility will be maintained much better.

Promotion of Elongation of Roots: In the tropical zone, decrease of productivity takes place, side by side with evaporation of water-content, much quicker on the surface soil than in the deeper soil. Therefore, by encouraging the plant to spread its roots quickly in the deeper soil, it can better stand against the drought and absorb more nutrition. Deep ploughing and promotion of early growth will meet this purpose. Careful harrowing is very necessary where soil contains a lot of clay. Reversible-plough and subsoiler are quite useful for deep ploughing, and early growth of the plant would be very much facilitated by timely sowing (to be determined by water content of the soil) and weed-control in an early stage.

Adequate Plant Population: Frequent occurance of tip kernel barrenness is not due, as mentioned in the above, only to deficiency of nutrition in the later period of the plant's growth, but also to the current cropping pattern. Inter-plant competition is definitely more possible when 3 - 4 plants stand in the same hill as at present than when a single plant stands in a hill, and earless and barren plant and tip kernel barrenness are the results of such competition among the plants

themselves. Accordingly, even if the number of plants per hectare remains the same, it is better to plant one per hill. Judging from the experiment-results and available data, the total number of plants per hectare may be 50,000 - 60,000 in case of Guatemala, and 60,000 - 70,000 in case of hybrid with shorter stalk; row spacing and the space between plants can be determined accordingly. Plant population will depend on the fertility (or dosage of fertilizer to be applied) of the field: higher plant population if fertility is higher, and low plant population if it is low. Row spacing would be optimal at 70 - 75cm, which should also facilitate for weed-control.

Standardization of Fertilized Cultivation: Maize cultivation by use of fertilizer which is now localized at a part of Pak-chong needs to be universalized to cover the diminishing soil fertility through years of continued cultivation and to increase the yield per unit acreage. 50kg of the compound fertilizer (16-16-8) per rai would be enough for Guatemala. This dosage represents 1/3 of that applied in Japan. The fact that Guatemalan yield reaches its peak with this much fertilizer with the flooding solar energy betrays its nonadaptability to heavy fertilizer application and, again, its suitability to cultivation without using fertilizer. This is the very reason why Guatemala was deliberately selected and popularized as a reliable variety in Thailand. To attain higher yield of maize through fertilizer-input, therefore, it is quite necessary to introduce into this country some appropriate hybrid which has better fertilizer-response.

Soil nitrogen is quickly nitrified and disappears very soon in the tropics and lack of soil nitrogen in the later stage of the plant's growth would bring about tip kernel bar-

renness. We thus strongly recommend top dressing in the 12th leaf stage, when the plant reaches at the height of 40cm. Such top dressing is quite effective for head sprouting of maize. On the other hand, maize is equipped with less soil phosphorus absorption power than other upland crops like soyabean and white potato, and yet its distribution ratio of the absorbed phosphorus to the grains is quite high. These properties of maize will justify an increased application of phosphorus where it is lacking in the soil.

Weed-Control: The mischief of weeds takes a form of impediment to the maintenance and uniformity of the plants' standing in the early stage of their growth, and that of usurpation of nutrition (including water) and eventual poor yield, in the middle stage. As is known from the results of experiments, weed-control plays the role which is more important than improvements in fertilizing and or cropping pattern do, as far as Guatemala is concerned. While hand-weeding is a common practice among the farmers, timing of such hand-weeding is often ignored. In view of enabling them to attend at weed control at the optimal time with less labour, the use of herbicide (after emergence) side by side with intermediary cultivation cumhilling is highly recommendable. Employment of cultivator 2 - 3 times within 30 days after sowing and light hilling during 13th - 14th leaf stage is also recommendable.

Danger of Insect Pests and Diseases accompanying Higher Yield and Their Control: Outbreak of insect pests and diseases is contained within a limited degree with ignorable damage, because of nonfertilizing cultivation of Guatemalan variety today. Heavy application of fertilizer and introduction of hybrid for dense cultivation will invite not only more damages from the north-

ern leaf blight but emergence of new kinds of insect pests and diseases also. While disease-resistant varieties need to be introduced in the first place, use of chemicals will have to be studied at the same time to fight against the increasing menance of insect pests and diseases.

Insect damages, particularly by corn borers, can be properly prevented by spraying the systemic insecticide two to three times - with 10 day intervals - around the silking stage. Individual control is both difficult and meaningless against grass-hopper as its outbreak is unforeseeable. But as its damage spreads over both maize and paddy, counter-measures to grass-hopper damages will need to be taken up by the State, including chemical spraying by use of a helicopter.

Utilization of Run-Off Water, or Improvement of Productivity of Water: Lamnarai and other maize producing areas scarcely have irrigation facilities and there is little prospect for their installation in near future. If irrigation facilities are not forthcoming for maize-cultivation there, we have to try ways and means to store run-off water in the soil and to allow maize to use it for its own growth (soil management). For instance, shalow cultivation side by side with weeding will help cutting capillary and thereby discounting the damages from drought to some extent and, at the same time, it will induce permeation of run-off water into soil. Mulching likewise checks both surface evaporation of soil-water and running off of the rain water. To promote the plants' growth in the gently sloping fields as are seen at Lamnarai, a trencher may be employed to dig some ditches where run-off water can be caught and given chance to permeate into the sub-soil of the fields.

Prevention of Soil Erosion: We have already expressed our fear

of a considerable soil erosion due to heavy rains on the gently sloping fields in Lamnarai and Nongphai. Prevention of such soil erosion is quite necessary for the maintenance of soil productivity there. Erosion can be checked through easy means of contour-cultivation and mulching. However, the best preventive measure to soil-erosion will have to be devised on the ground of precipitation and degree of erosion at each maize-producing area.

Maintenance of Soil Productivity: The yield of maize in its principal producing areas starts showing diminishing trend after a few years' continuous cropping on a reclaimed land; instead, weeds begin growing in full vigor until the field comes to be abandoned by reason of it being entirely occupied by such weeds. Injuries due to continuous cropping such as the outbreak of insect pests and diseases and exhaustion of soil-untrients are suggested as the main causes of this phenomenon. The determining factor, however, is the latter, that is the exhaustion of soil nutrients, as already approved by a couple of studies to the effect that an increased application of fertilizer can prevent, to a great measure, the injuries from continuous cropping. Vigorous growth of maize thus depends upon well maintained soil fertility, and this assures the stabilized yield in good quantity. This is made possible through: switching-over to cultivation by use of fertilizer, ploughing-back of pre-crop residues and weeds into the soil, making the most of the lower soil through deep ploughing, and introduction of leguminous crops into the cropping system. Instruments like sub-soiler and forage harvester or cutter will become necessary for this purpose.

New Cropping System and the Optimal Timing of Maize-Cultivation: The current cropping system is mainly rotating with

Maize-Mungbean (Black-mappe and Soybean) as a hinge, which is not illogical from the view-point of soil fertility maintenance. However, mungbean is being cultivated in the most careless manner - probably due to its low price - thus allowing a rampant growth of weeds. We like to propose an introduction of new cropping system centerring around Maize-Soybean, on the ground that the good qualitied soybean which has a bright future as a lucrative merchandise to meet an increasing demand would give the maize cultivators incentives to attend at its more intensive and planned cultivation, bringing as its results the double benefits of increased income and prevention of perrenial growth of weeds.

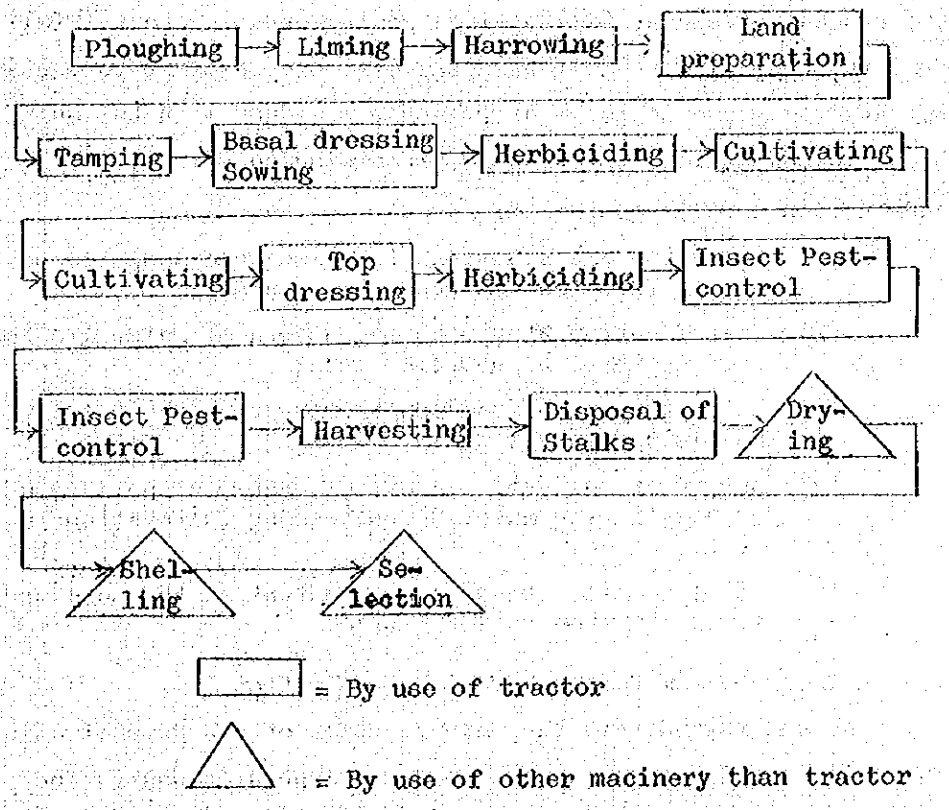
Even under the proposed cropping system, maize shall remain as the principal crop for whose cultivation the optimal season needs to be pre-decided. That means the cropping season of the soybean is to be adjusted to that of maize as a principal crop. In other words, the cropping system may spell as Soybean-Maize, instead of Maize-Soybean. The current cropping method is climatically ill-arranged as maize is so grown that its harvest and drying falls during the wettest month of September and thereby causing the problem of higher water-content of its grain. Under the new cropping system, it needs to be so arranged that the ripening stage of maize will be brought either closer to or in the dry-season, on the base of Soybean-Maize system.

Establishment of Consistent Mechanized Cultivation: Tractor is very much under-utilized today. This simply used for ploughing, harrowing, transport and shelling. Unless and until a more consistent mechanized cultivation system will come to evolve currently forgotton work-load in fertilizing-sowing, intermedi-

ary cultivation-weeding, and harvesting, we can not hope to make a full use of tractor nor to attend at sowing, weeding and harvesting at the optimal timing. Consistent mechanized cultivation system will definitely help not only economizing labour but also in expanding the scale of management towards currently unutilized land.

Some specimens of operational and technical systems envisaged for mechanized cultivation of maize by use of 40 HP tractor on 10a.-field will be given in the below:

Fig. 2 ; Operational System



In addition to the machinery mentioned in the above chart; sub-soiler and trencher will be useful for soil-improvement purpose, and bulldozer and rakedozer, for reclamation of the field. Soybean cultivation will be greatly facilitated if drill-seeder and combine are replenished on and above the machinery meant for maize-cultivation.

The targets given in the above for an overall technical renovation are idealistic ones. Under the current maize cultivation without using fertilizer or farm-chemicals through employment of the minimum machinery, technical improvement which would bring about a remarkable yield-increase is not impossible if the cultivators will be trained in five key-operations of: (i) renewal of seeds; (ii) optimal sowing obedient to rainfall distribution; (iii) timely weeding; (iv) proper plant population; and (v) ploughing-back of pre-crop residues into the soil.

In conclusion, the probelms remaining to be solved now and in future will consist of:

(1) Area-wise distribution of optimal cropping season viewed from the frequency of rainfall;

(2) Clarification of the basic pattern of maize growing process in each producing area;

(3) Establishment of soil-management techniques for utilizing run-off water;

(4) Survey of the real picture of change of soil productivity during maturing process by cultivation in reclaimed soil.

(5) Relationship between water content of the soil and field officiency of machine.

6. Annual Program for Technical Demonstration

We understand that the main function of the Demonstration Farms lies at implementation of wisely planned demonstration programs of mechanized cultivation techniques which are based

Kind of Crop: Maize Variety: Tomorokoshi Koh No.7 Expected Yield: 7 ton/ha. Acreage: 10 ha.

		Plough-ing	Spread-ing of Lime	Harrow-ing	Land Prepara-tion	Tamping	Basal dressing and Sowing	Herbicid-ing	Inter-mediary cultiva-tion	Top dressing	Herbicid-ing	Pest-control	Pest-control	Harvest-ing	Drying	Shelling	Selection	Disposal of Stalks	Total
Pattern of Cultivation	Technical Details (per ha.)	Depth: 25cm	0.8 ton per ha.	Two times	Two times	One time	Row spacing/Space between Plants: 60 x 30cm Seed sown: 40kg Fertilizer N-180kg P-150kg K-120kg	Atrazin: 1.5kg Water: 800 l.		N: 50kg	Atrazin: 1.5kg Water: 800 l.	Insecti-cide: 60kg	Insecti-cide: 60kg		Drying in the sun				
Operational Technique	Instruments Used	Plough	Lime Sower	Disk-Harrow	Tooth-Harrow	Roller	Corn planter (w/fertilizer feeder)	Sprayer	Steerage-Hoe	Fertilizer feeder	Sprayer	Speed Duster	Speed Duster	Corn-picker	Drier	Power Corn-sheller	Grain Fan	Forage Harvestor	
	Man-Power																		
	Time Factor per 1 ha: Running Hour																		
	Time Factor per 1 ha: Labour Hour																		
	Machinery Required	Tractor 1 Plough 1	Tractor 1 Lime Sower 1	Tractor 1 Lime Sower 1	Tractor 1 Lime Sower 1	Tractor 1 Roller 1	Tractor 1 Corn-planter 1	Tractor 1 Sprayer 1	Tractor 1 Steerage-Hoe 1	Tractor 1 Fertili-zer Feeder 1	Tractor 1 Sprayer 1	Tractor 1 Speed-Sprayer 1	Tractor 1 Speed-Sprayer 1	Tractor 1 Corn-picker 1 Trailer 1		Corn-sheller 1	Grain Fan 1	Tractor 1 Forage Harves-ter 1	
	Material Consumption per 1 ha.	Gasoline: 16.0 ℓ. Oil: 0.36 ℓ.	Gasoline: 3.5 ℓ. Oil: 0.12 ℓ. Lime: 0.8 ton	Gasoline: 10.0 ℓ. Oil: 0.23 ℓ.	Gasoline: 5.6 ℓ. Oil: 0.12 ℓ.	Gasoline: 3.6 ℓ. Oil: 0.11 ℓ.	Gasoline: 6.3 ℓ. Oil: 0.23 ℓ. Seeds: 40kg. Compound Fertili-zer: 1 ton	Atrazin: 1.5kg. Gasoline: 3.5 ℓ. Oil: 0.12 ℓ.	Gasoline: 4.2 ℓ. Oil: 0.12 ℓ.	Ammonium sulphate: 250kg. Gasoline: 6.3 ℓ. Oil: 0.18 ℓ.	Atrazin: 1.5kg. Gasoline: 5.0 ℓ. Oil: 0.18 ℓ.	Insecti-cide: 60kg. Gasoline: 4.5 ℓ. Oil: 0.08 ℓ.	Insecti-cide: 60kg. Gasoline: 4.5 ℓ. Oil: 0.08 ℓ.	Gasoline: 19.8 ℓ. Oil: 0.6 ℓ.		Electri-city: 8kw		Gasoline: 12.0 ℓ. Oil: 0.32 ℓ.	Seed : 40kg Compound Fertilizer : 1 ton Ammonium sulphate : 250kg Lime : 800kg Atrazin : 30kg Insecticide: 120kg Gasoline : 119 ℓ. Oil : 3.26 ℓ. Grease : 0.7kg Electricity: 8kw
	Important Technical Points	Complete ploughing back of pre-crop residues			Good levelling		Timely & careful sowing							Synchro-nization of catur-ing stage.					

on the accumulated knowledge and experience, thereby, proving the economic justification of mechanized cultivation and, for this purpose, to carry out comparative studies of different sets of technical systems meant for mechanized cultivation. The followings are a few suggestions which are made towards such demonstration tactics from the cultivation technique point-of-view.

The core of mechanized cultivation system will consist of Tractors, 65HP and 35HP in their capacities. Immediate application of any technique developed and tested in the experiment station straight to the farmers' field often proves a failure due to ecological differences between the environmental conditions where it was developed and where it needs to be extended. Mechanized cultivation technique of maize is no exception. Confirmation of local adaptability of any technique needs to be done as a part of the Center's job.

Inter-relation ships among the demonstration-farms at three different levels of the Center, the agricultural co-operative and the cultivating farmers, may be put in this way:

Center's Demonstration Farm

(i) Demonstration of "systematized techniques" or sets of technical systems which combine all the "partial" techniques dealing with various aspects of maize cultivation, such as variety, cropping pattern, fertilizer-application, etc. into consistent entities;

(ii) Local adaptability tests of ploughing techniques, fertilizer placements and other techniques whose immediate application may require careful treatment.

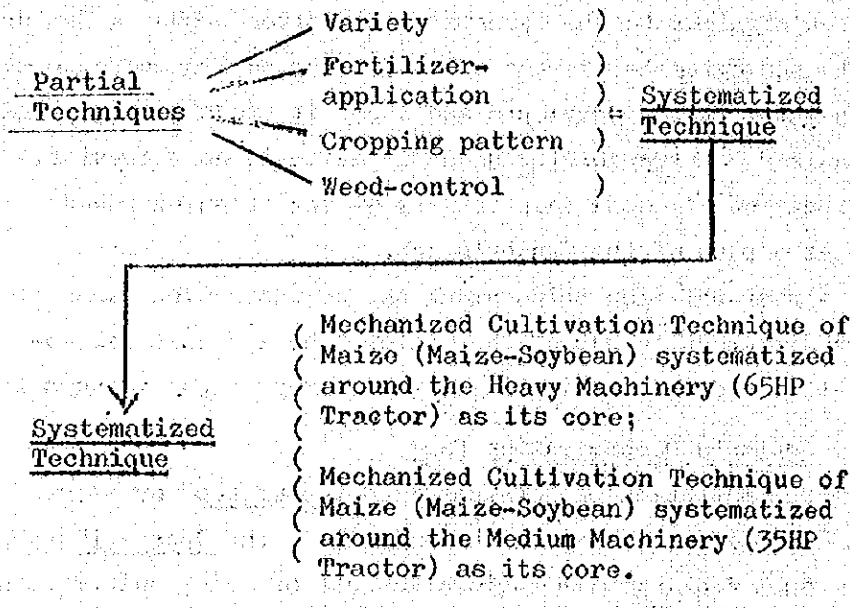
Co-operative Demonstration Farm

(i) Demonstration of "partial" techniques in 2 - 3 different combinations;

Demonstration Farm attached to Individual Farmer

(i) Demonstration of "partial" techniques;

(ii) Gradually advancing to demonstration of different combinations of "partial" techniques, and then to "systematized" techniques, whose adptability to the specific locale might have been well proven of.



Year / Demonstration Farm	1	2	3	4	5	6
Center	Partial	Partial Combination	Partial Combination	Partial Systema-tized	Systema-tized	Systema-tized
Co-op.	Partial	Partial	Combination	Combination	Systema-tized	Systema-tized
Farmer	Partial	Partial	Partial	Combination	Combination	Systema-tized

Note: (i) Center deals with Heavy- and Medium-Machinery, but Co-op. and Farmer deal only Heavy-Machinery;

(ii) The above Table has been prepared on an assumption that only one technical system will annually flow downward from the Center to the Farmer via Co-op, hence 6 years. In case 2 - 3 technical systems can be processed and handed down within a year to both Co-op. and Farmers, it would not take as long as 6 years.

Land-Space required by Demonstration Farms:

A considerable land-space will be required by the Center as it will have to demonstrate "systematized techniques" side by side with local adaptability tests of "partial techniques." For the tests required for "partial techniques", 1 rai will be enough, as was pointed out by the preceding Mission. Demonstration of "systematized techniques", however, presupposes tests in operational efficiency (capacity) and economicality measurement. Comparative studies of operational efficiencies generally require a rectangular farm of 175 x 28m, that is 5ha. per technical system. When two technical systems, one for heavy machinery and the other for medium machinery, are to be tested, 108a. land-space becomes necessary, plus 162a. as traditional farming plot. In term of rai, approx. 6 rai for two technical systems, 9 rai for traditional farming plot, plus 1 rai for "partial techniques", totalling at 16 rai.

Co-operative Demonstration-Farm will occupy 6 rai for one technical system (heavy machinery only) and a traditional farming plot.

Farmer's Demonstration-Farm will be 3 rai in size, as it does not require any traditional farming plot.

The above are the minimum required land-space for three different kinds of Demonstration Farms, but they will probably have to be enlarged to a considerable extent depending on various "combinations" of technical systems.

Chapter III: General Observations

The production of maize in Thailand has attained a phenomenal increase since the early part of 1950's. This has been made possible through expansion of its cropping area, on one hand, and yield-increase per unit acreage, on the other. More concretely speaking, during those 10 years ending in 1963, maize production became 20 times bigger, due to 8-fold expansion of the cropping area and 2.5 times increase in yield per unit acreage. While the expansion of its cropping area has been continuously going on even after 1963, the yield of maize per unit acreage which attained its peak in the same year, has remained stagnant and even shows a downward tendency.

Although the exhaustion of soil-fertility due to continuous cropping in the same field without using fertilizer has been pointed out as a principal cause of such a downward trend of yield per unit acreage, no less important cause of this tendency may be attributed to the mode of its cultivation which is turning less and less intensive since the use of tractor has been popularized enormously among its cultivators.

As is well known, fleet after fleet of heavy tractors flowing into the principal maize-producing regions of Thailand for the last several years have expelled manual labour from the ploughing operation. While expansion of cropping area has definitely been made easier through tractor-ploughing, post-ploughing jobs could not attract but less intensive care because they are still almost entirely left to manual labour.

Everybody will hint upon the use of fertilizer as a means to check the downward tendency of maize yield by increasing its output per unit acreage; yet maize cultivation in Thailand is going on without using fertilizer and that is not without very

good reasons. There are two major reasons against wide usage of fertilizer there: one is variety and the other is weather. The current variety, that is Guatemala, have been selected and bred primarily because of its high-yielding ability without fertilizer application. The application of fertilizer to this variety for increasing yield is not always profitable due to the low fertilizer-response of the variety. Maize-production, again, is under the mercy of weather, particularly the rainfall, in Thailand, which varies from year to year once bringing a bumper crop and crop-failure in another time; under such uncertain natural evnironment, fertilizer-use can hardly become a popular practice.

The validity of cropping-system, combining cultivation of maize with that of leguminous crops, in preventing depletion of soil-fertility is well known, and we could observe in our survey-areas that leguminous crops, especialy mungbean are grown as succeeding crops of maize. It was also confirmed that the soil of the field where leguminous crops were grown after maize is more fertile than where they were not. The yields of these leguminous crops, however, seemed to be poor. In often cases the beans were dominated by weeds.

There is no reason, however, why these leguminous crops grown as succeeding crops of maize cannot be made more productive, excepting that mungbean being cultivated simply for a limited demand of the domestic market. If mugbeans covered all may areas as succeeding crop there would be surplus problem with sharp decline in price. It will be worthy for consideration to introduce soy bean which has a big export market if the quality meets the requirement of foreign markets.

Yield-increase of maize and its succeeding leguminous

crops is a feasible proposition on the condition that more intensive operational care will be put in their cultivation. Effectiveness of weeding for yield-increase of maize, for instance, has been proved through experiments in the agricultural experiment stations of the Department of Agriculture. It is no doubt effective because usurpation of soil nutrients by weeds and deminution of soil-moisture through their foliar evaporation can be checked by this practice.

Through the above observation, we wonder if mechanized farming which is currently limited only to ploughing and shelling cannot be extended over general operational management called for cultivation of maize and its succeeding leguminous crops. In our mind, the current mode of mechanization with its concentration at ploughing out of the whole range of work which is entirely left unmechanized, and the current mode of ownership of machinery (heavy tractor, in the main) are very much inter-related between each other. The ownership of tractor is quasi-monopoly of the merchants and big farmers, and its benefits can reach the grass-root farmers only through hirage. Does this productively fit into the pattern of general farm-management exclusive of ploughing? Individual ownership of tractor and other farm-machinery by individual farmers is both impossible and uneconomical; impossible because farmers in general cannot economically afford to do so, and uneconomical because it would go far beyond the optimal point of utility. Logical alternative would, therefore, be the joint-use of such machinery on co-operative basis.

Co-operatives in Thailand are functionally specialized at each of credit, marketing, land-improvement, irrigation, etc. and seldomly purported for such services as technical guidance, joint-use of farm-machinery and other productive benefits on

behalf of the member-farmers. Whether this type of agricultural co-operatives can properly respond to the real needs of the farmers or not is apparently answered by the co-operative's inability to enjoy patronage of farmers who are traditionally bound to the merchants, who supply not only production-loan but also daily necessities on credit which is to be paid back by their products with very high interests.

Thai Government was not unaware of this when it organized a model Multi-Purpose Co-operative Society at Chainat, a center of paddy producing area. Chainat Multi-Purpose Co-operative Society is following the pattern of 'Agricultural Society' in Formasa which offers not only credit and marketing services but also production-oriented services like technical guidance and irrigation water-management to its member-farmers. There are 16 Chainese experts now attending at technical guidance on its management, water-control and agricultural extension-work.

In contrast to Chainat which is a typical rice area, the areas of our survey, i.e., Lamnarai, Nongphai and Promphiram are maize-producing centers. They are really pioneer-organizations collecting among themselves some 10,000 ton, or 2/3 of the national total of co-operatively marketed maize (15,000 ton) in 1969/70. Through rather detailed analysis of their organizational setup, scale of management, business contents and financial conditions, we are left with general impression that optimism is allowed only with more or less danger about their financial standings, and their foundation is not yet quite firm.

Under these circumstances, the Department of Credit & Marketing Co-operative proposes provision of managerial guidance and Co-operative Promotion Fund, on one hand, and establishment of Demonstration-Farms run by co-ops. themselves and also

by the member-farmers, on the other. The former proposal is meant for improvement and strengthening of the managerial aspect of these three co-operatives, while the latter is aimed at extension of better cultivation techniques, particularly mechanized farming techniques, with the ultimate purpose of bringing up the member-farmers' economic position and augmenting the amount of maize to be handled by these co-operatives. As an appex body of such technical extension program through the agricultural co-operatives, the Department envisages an establishment of a Center of its own where demonstration of technical systems of mechanized cultivation of maize side by side with local adaptability-tests would be undertaken, and technical staff of the agricultural co-operatives would also be trained.

The above proposals by the Department of Credit & Marketing Co-operative stood as the guidelines along which our Survey Team prepared an outline of the technical co-operation project, after deliberate studies of the natural as well as socio-economic coditions prevailing in those localities, the real position of agricultural co-operatives and the current patterns of agricultural production there. This outline is projected in full details under Chapter IV of the present Report. Nevertheless, we think it worth its while to touch upon a few problems which will have to be kept in mind through the stages of both planning and implementation.

1. <u>The Problem of Jurisdiction</u>

It is to be pointed out that Thai application for Japanese co-operation toward this project was officially made by the Department of Credit & Marketing Co-operatives of the Ministry of National Development, by virtue of the very project coming under its own jurisdiction, via Department of Technical & Eco-

nomic Co-operation. Research and experiment-work and extension services in agriculture belong, however, to the jurisdiction of the Ministry of Agriculture. The relationships between these two Ministries have important bearings on this project.

The competent office responsible for research and experiment on upland crops including maize and leguminous crops which are the immediate concern of this project is the Department of Agriculture (that for rice comes under the Department of Rice). Again, the research and experimental activities being undertaken with maize and sorghum through joint-venture of the Ministry of Agriculture and Kasetsart University (Agricultural College), with the co-operation of the Rockefeller Foundation, will no doubt have a lot of things to deal with our project. Agricultural extension, on the other hand, rests with the Department of Agricultural Extension which executes its administrative assignment through the network of agricultural extension-workers at district-level.

On and above this extension service originating at the Ministry of Agriculture and steered through district-wise extension workers, the Ministry of Interior is also not unconcerned with extension-work, as a part and parcel of the Collective Settlement Scheme and the Rural Rehabilitation Scheme (which is under implementation in the frontier regions in view of maintenance of peace and order there), in the areas which come under these Schemes. These two approaches are not duplicating among each other but rather dove-tailed for more intensive technical guidance in the areas concerned. For example, the Ministry of Interior has a concern with field-tests and extension work of the Demonstration and Training Center run through the West German technical assistance, in the Collective Settlement area in Saraburi, one of the important centers of maize-

production in Thailand. Under these arrangements, the concentrated technical guidance undertaken by agricultural co-operatives in their own service-areas would legitimately belong to the jurisdiction of the Ministry of National Development which administers over the agricultural co-operatives, and it would hardly mean an entrenchment upon the jurisdictional domain of the Ministry of Agriculture. The problem arises, however, because co-operation of the Ministry of Agriculture is required for implementing this project, for instance, in procurement of improved seeds to be distributed among the member-farmers of agricultural co-operatives, and technical advices and data on the results of agricultural research and experiment. These and other facilities would have to be made easily available through the Department of Agriculture, for the successful implementation of our project.

2. The second Mission for the Project Implementation

The basic survey called for preparing the technical cooperation program under this project has probably been concluded by the present Survey Team. The survey-period of the present Team which was limited within the first-half of December provided its members with excellent opportunities to make observation of post-harvest field conditions, cultivation of succeeding leguminous crops, and qualitative properties of the harvested maize, etc. but, on the other hand, could not observe the conditions of maize during different stages of its growth, cultivation methods, particularly weeding, and other important aspects for techno-economic improvement.

This is the reason why the second Mission needs to visit Thailand to bring about the final decision as to the kinds of machinery to be provided under the project, and to make selec-

tion of proper sites for the Center and Demonstration Farms, together with other important works called for implementation of this project. The Mission would preferably be sent in the months of June and July so that its members should be given chances to study the maize under cultivation, while it falls in the budget-preparing period by Thai Government.

Chapter IV: Guideline of Technical Co-operation

I. "Development Co-operation Project"

Technical co-operation envisaged by this project will be extended under the Colombo Plan through the normal procedures as prescribed by it, with the understanding that the assistance not coverable by the same Plan would be provided through mutual discussions and agreement between these two governments.

1. Designation of the Project

This project will be called by the name of: "Thai-Japanese Co-operative Demonstration Project for the Development of Exportable Agricultural Products", and abbreviated as: "Thai-Japanese Co-operative Project."

2. Aims and Purposes of the Project

This project aims at combining the technical guidance to the farmers in a specific area for them to adopt modern cultivation techniques meant for productivity increase of their products with the managerial guidance to the agricultural co-operatives there for them to develop a well-integrated production-cum-marketing program so that, while it would become possible for the farmers to enjoy production-increase in the mutual relationships with the strengthening of their co-operatives, the export of the farm-products grown by the former and marketed through the latter could eventually be augmented.

Hesitation, if not resistance, by individual farmers to practical application of the improved techniques which are developed by the Department of Agriculture through its experiment stations is much due to the probability of risk which used to accompany a hasty introduction of such techniques on the field. Under this project, therefore, the improved techniques will be made as accommodative as possible to the farmers by "Mechaniza-

tion Center, which will be newly established by the Department of Credit & Marketing Co-operative, where various tests and studies pertaining to their technical and economic applicabilities to the locale will be undertaken and, then, brought downward to the grass-root farmers through the network of agricultural co-operatives, via demonstration media.

3. Project Area

Our technical co-operation will be extended to the service-areas of three agricultural co-operatives: (i) Lamnarai in Lopburi Province, (ii) Nongphai in Phetchaboon Province, and (iii) Promphiram in Phisanuloke Province. Mechanization Center will be located at Lamunarai, and Demonstration-Farms at each of the above three co-operatives. When the entire service-areas of these three co-operatives are put together, the total project-area would become the one which covers a very large territory, and the Mechanization Center is expected to function as a principal core of the project activities there.

4. Organization and Function

(1) Mechanization Center

Mechanization Center will be established under the supervision and with the responsibility of the Director general of Credit & Marketing Co-operative, Ministry of National Development, and will be put under co-operative management of the staff-members of the said Department and a team of Japanese experts.

Center's function may be divided into: (i) inside-work, and (ii) outside activities.

Inside-work of the Mechanization Center will consist of:

(a) Technical check of local adaptability of the techniques developed in the agricultural experiment

stations (varieties, seeds, fertilizer-application, plant population density, etc);

(b) Economic and safety check of new techniques to be introduced among the cultivating farmers (cropping system, mechanized farming, product management, etc);

(c) Economic justification of various systems of mechanized farming;

(d) Solution of various problems confronting the farmers (co-operative members) through their technical analysis;

(e) Repairing of tractors and other farm-machinery in the workshop attached to the Center; and

(f) Training of the technical staff of the Center and the members of the agricultural co-operatives (subjects concerning cultivation; operation, maintenance and repair of farm-machinery, and co-operative management).

Outside activities by the Mechanization Center would be:

(a) Overall guidance on establishment and operation of the Demonstration Farms to be maintained by the local agricultural co-operatives. (Risks borne by the agricultural co-operatives by application of the new techniques introduced on their Demonstration-Farms will have to be recompensated by the Mechanization Center.);

(b) General managerial guidance to the agricultural co-operatives for their development;

(c) Guidance on Demonstration Farms run by the farmers;

(d) Free long-term lease of a portion of the farm-mechinery provided with the Mechanization Center to the agricultural co-operatives' use;

(e) Technical extension on behalf of these agricultural co-operatives; and

(f) Effective utilization of the farm-machinery provided with the Mechanization Center for strengthening of the agricultural co-operatives and increasing of their member-farmers' productivity.

(2) The Role of Agricultural Co-operatives under This Project

(a) Maintenance and Operation of Demonstration Farms

Agricultural co-operatives will attend at demonstration-work of the new techniques approved by the Mechanization Center, at their Demonstration Farms, which need to be maintained and operated by their own responsibilities, under the general guidance of the Mechanization Center.

(b) Guidance to the Farmers' Demonstration Farms

The farm-machinery leased by the Mechanization Center will be used on the Farmers' Demonstration Farms.

(c) Strengthening of Their Own Financial Position

Proceeds in term of farm-machinery service charges, interests receivable on the loans provided with their member-farmers in term of fertilizer, etc. or profits raised through distribution of fertilizer, etc. among their members will have to be kept apart as reserve-fund which can be released for the purposes of agricultural improvement and co-operative development.

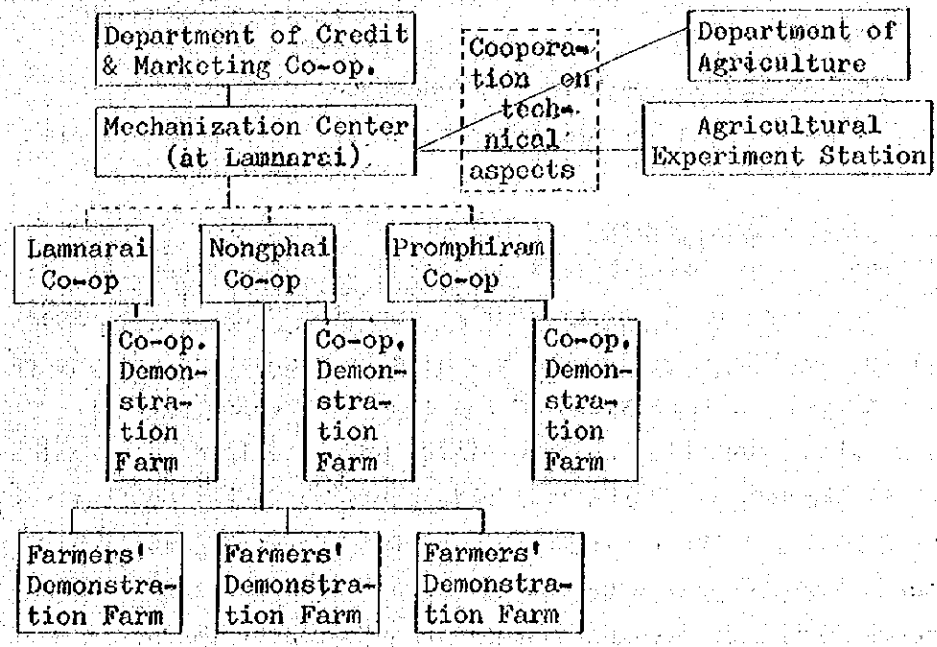
(e) Multiplication of the Farmers' Demonstration Farms

The co-operatives will try to multiply the number of the Farmers' Demonstration Farms in their own service-area.

(3) Farmers' Demonstration Farms

Farmers' Demonstration-Farms will be maintained and operated under the general guidance by the agricultural co-operatives, but with the personal responsibilities of the farmers concerned. The contract or contracts to be signed between the agricultural co-operatives and their member-farmers will specify the location, size, and number of the Farmers' Demonstration-Farms and the method and contents of demonstration to be carried on such Demonstration Farms.

Functional Chart of the Project



5. Obligations on Japanese Side

The Government of Japan will take necessary measures to provide at its own expense the services of the technical experts as well as material assistance for the successful implementation of this project, as listed in the below:

(1) Technical Experts from Japan:

Japanese experts who will be assigned technical co-operation duty will have their residences in Bangkok and work mainly at the Department of Credit & Marketing Co-operative and the Mechanization Center at Lamnarai, visiting the three agricultural co-operatives as and when necessary.

Initial Year

One Expert on Crop Cultivation (with knowledgeable experience in mechanized farming by the use of tractor)

One Expert on Co-operative Management

One Expert on Operation, Maintenance and Repair of Farm-Machinery

Second Year Onward

Additional experts will be despatched when necessity arises in the course of the project's expansion. Expert or experts with short-term assignment may also be despatched when necessity arises. The services of the Japanese technical expert may be withdrawn when the role played by him will become replaceable, through his successful cooperative efforts, by Thai technicians. All these matters concerning despatch, stay and return of the Japanese technical experts will be decided upon through mutual discussions between the two Governments.

(2) Material Cooperation:

The undermentioned machinery, equipment, and materials

will be supplied to the Department of Credit & Marketing Co-operative to be utilized by the Mechanization Center and the agricultural co-operatives as specified under this project.

List of Requisite Machinery, Equipment & Materials

Tractors (55 - 65 HP)
Corn-Shellers
Pumps
Trucks
Jeeps
Sets of Repair Tools
Fertilizers
Farm-chemicals
Others

(3) Technical Training of Thai Personnel in Japan:

(a) Fields of Training in Japan

Upland crop (maize) Cultivation
Mechanized Farming of the above
Machinery repair
Co-operative Management

(b) Recruitment of Trainees

(i) Technical-staff of the Department of Credit & Marketing Co-operative who are directly concerned with this project;

(ii) Leaders of Co-operative Movement.

6. Obligations on Thai Side

The Government of Thai will provide at its own expense and with its own responsibility:

By the Department of Credit & Marketing Co-op

(1) Establishment of Mechanization Center

Mechanization Center will consist of the following installations:

- Office
- Warehouse
- Garage
- Workshop
- Living Quarters
- Demonstration Field (100 rai)
- Other Installations necessary for its operation

(2) Staff-Members of Mechanization Center

(a) Project-Manager (preferably an officer above Grade I)

(b) Technical-staff on:
Cultivation, Mechanized Farming, Machinery-Repair, Extension, Co-operative Management, etc.

(c) Clerks

(d) Drivers

(e) Other staff-members necessary for its operation

(3) Cost required for operation of Mechanization Center and op-operative development guidance.

(4) Privileges, exemptions and benefits no less favourable than those granted to other Colombo Plan experts.

By Agricultural Co-operatives

(1) Buildings such as, Office, Warehouse, Garage, Temporary Living Quarters etc.;

(2) Establishment of Co-operative Demonstration Farms, 30 rai in size, and their operational cost; and

(3) Other expenses necessary for guidance towards their member-farmers.

7. Annual Program of the Co-operation Project

This co-operation project which will be initiated during the Japanese fiscal year 1971 (from April 1971 to March 1972) will enter into actual implementation from the rainy-season of 1972, and remain in force for five years, till October 1976. Despatch of Japanese technical experts, provision of machinery and invitation to Thai trainees for their trainings in Japan will take place during the initial year, together with technical co-operation centerring around the Mechanization Center and Promphiram Co-operative Society. Three Japanese technical experts will be assigned on duty during October to December 1971. One unit of machinery will be supplied to the Mechanization Center and necessary machinery to Promphiram Co-operative by April - May 1972 when the project activities shall be started there.

In the second year, demonstration guidance at Lamnarai and Nongphai co-operatives will be started side by side with consolidation of co-operation activities at the Mechanization Center and Promphiram co-operative. Three Japanese technical experts will be continuously attending at their work and necessary machinery, equipment and materials will be replenished to those already supplied in the initial year, particularly to meet the demands in Lamnarai and Nongphai Co-operatives.

From the third year onward, the same technical experts from Japan will remain on duty, while replenishments to the previously supplied machinery and materials will follow in accordance with the degrees of their utility and demand in the project-area.

Annual Program of the Cooperation Project

Year	Japanese Obligations	Thai Obligations
1971 Nov. =	Despach of technical experts	
1972 Feb. = Apr. =	Arrival of machinery meant for Mechanization Center and Promphiram Co-op.	Establishment of Mechanization Center; commencement of activities at the Center and Promphiram Co-op.
1973 Feb. = Apr. =	Arrival of machinery meant for Lamnarai & Nogphai Co-ops.	Commencement of activities at Lamnarai & Promphiram Co-ops.
1974	Continuation	Continuation
1975	Continuation	Continuation
1976 Nov. =	Termination of Cooperation period.	

II. Questions portinent to Implementation of the Project

During its stay in Thailand and in the course of its negotiations with the authorities concerned of the Thai Government and field surveys, the present Survey Team came across some points of prominent importance which may well be kept in mind of all those who will be held responsible for implementation of this project.

1. Project-Area

As the result of the field-surveys and deliberate studies on the conditions prevailing in the candidate sites as suggested by the Thai Government, the Survey Team has decided to organize the service-areas of three agricultural co-operatives of Lamnarai, Nongphai and Promphiram, into a whole project-area. Among these three co-operatives, Lamnarai has been discovered as the weakest in every aspect, inspite of its central position amidst the so-called "Corn-Belt" of Thailand, the newly developing upland crop area. Such strategical importance of Lamnarai makes strengthening of its co-operative imperative for successful implementation of this project. Accordingly, technical as well as material co-operation of Japan will be focused at bolstering this co-operative through establishing the Mechanization Center there by the hand of the Department of Credit & Market Co-operative.

2. Net Contents of the Project-activities

For attainment of the aims and-purposes of this project, intensive efforts need to be made in diversified branches of work, and the core of such work-force shall be Thai staff-members. This does not allow simultaneous on-start of all aspects of the project from the very beginning; it would necessarily be a gradual process until the project should be put in

full operation with all its multi-Phased activities going on abreast. All this depends on the driving force of Thai people who shall work in adequate organizational setup called for successful implementation of the project. The Department of Credit & Marketing Co-operative is now trying to mobilize more than 20 officers for this project, and to secure budgetary appropriation necessary for materialization of this project.

We know that the future of this project depends on the capability as well as the honesty to purpose possessed by this group of staff-members. As only the limited number of Japanese technical experts would be residing in Bangkok and working mostly in the Headquarters of the Department, the services made available by them could not go far beyond these related with technical guidance in the Mechanization Center and on the Demonstration-Farms attached to three agricultural co-operatives, their activities should be mainly concentrated at training of Thai staff and giving them pertinent advices.

Under these circumstances, project implementation rests on an organizational setup substantially filled by Thai personnel and their success or failure may provide positive or negative avenue for the whole scheme. Extension-work, in particular, almost entirely depends on Thai staff-members of the Mechanization Center and on how effectively they may utilize the network of the agricultural co-operatives.

3. Extension of New Techniques

The basic approach of this project toward extension is an introduction and extension of modern techniques useful for production-increase of maize for export, through own-demonstration by the co-operative member-farmers, resulting at technical improvement and income-growth of the member-farmers themselves.

New techniques meant for production-increase may be conveniently categorized into: (i) those already developed and successfully experimented in the agricultural experiment stations in Thailand; (ii) those not yet introduced into Thailand; and (iii) solution of the problems now confronting the cultivating farmers. Benefits accruing from these new techniques have been left unexperienced among the majority of grass-root farmers.

In bringing these new techniques closer to the farmers, this project proposes to establish the Mechanization Center to both check and improve their local adaptability and, then, demonstration at the Co-operative Demonstration-Farms and, finally, to the cultivating farmers. Judging from the keen interest felt by the ranks and files of the agricultural co-operative members, the new techniques made quite accommodative to the general farmers through the above processes will see themselves rapidly disseminated among the cultivating farmers through the co-operative networks, by virtue of their own economic benefits. The new techniques meant for extension will thus claim the stricter scientific endorsement and the more exacting economic justification under this project.

4. Strengthening of Agricultural Co-operatives as a Key-Note of the Project

Whether it is known as Marketing Co-operative or Credit & Marketing Co-operative, Lamnarai and Promphiram belonging to the former, and Nongphai to the latter, none of these three co-operatives is up to the mark in its servicing towards its own member-farmers.

Maize-cultivators' dependence on the middlemanly merchants, not only in their productive necessities like ploughing and shelling services but also in sheer maintenance of their

daily livelihood, makes it obligatory for the former to surrender their products almost entirely to the latter. The weakness of agricultural co-operatives stems from their inability to break through such traditional pattern of production-marketing relationships which is very much ill-inclined towards the producing farmers. Head-on collision with the well-entrenched merchants' power, however, is to be postponed until the co-operatives will accumulate enough strength to stand up on their own feet, with the majority of the cultivating farmers as their allies.

In compliance with the co-operative principles, the agricultural co-operatives will offer ploughing and shelling services to the increasing number of cultivating farmers by use of the project's tractors, in lieu of those monopolized by the merchants. The proceeds from tractor service will be reserved in the cooperative for strengthening the financial position of the co-operative. The co-operatives should increase the amount of harvesting loans to the cultivators so that they can collect maize in more quantity - at least, in the beginning, the increased portion of the products resulting from the adoption of new techniques.

The Department of Credit & Marketing Co-operative and the staff-members of the Mechanization Center need to enlighten the office-bearers and the members of the co-operatives in the above logics, and supervise the co-operatives with disciplinary attitudes against their appropriation of their revenues accruing from tractor services charges and profits from distribution of fertilizers etc. for unjustifiable purposes.

5. Material Supply from Japan

Machinery, equipment and materials supplied by the

Japanese government will be consigned to the Director of Credit & Marketing Co-operative. These machinery, equipment and materials will be kept and used by the Mechanization Center. The Center may offer a pait of them to the co-operatives on long-term, free lease. Allocation of the machinery, equipment and materials among them will read as follows:

Distribution of Machinery, Equipment & Materials

Kinds	Bangkok	Mechanization Center	Lamnarai Co-op.	Nongphai Co-op.	Promphiram Co-op.
Tractor		3 (1)	(2)	(2)	2
Attachment to the above		◎			
Corn-sheller		2	(1)	(1)	1
Pump		1	(1)	(1)	1
Truck		1 (1)	(1)	(1)	1
Jeep	2	1	(1)	(1)	1
Bulldozer		(1-2)			
Repair-tool		◎			
Fertilizer		◎	(◎)	(◎)	◎
Farm-chemicals		◎			

Note: (1) Figure without parenthesis stands for number of unit suppliable during 1971 fiscal year;

(2) Figure within parenthesis stands for the number of unit suppliable during 1972 fiscal year.

The employment and use of these machinery, equipment and materials by the Mechanization Center and the agricultural co-operatives for the other purposes than the project's is not permissible. The agricultural co-operatives may be deprived of their privileges of free, long-term lease of the machinery from

the Mechanization Center if they are used very much against the prescribed principles.

6. Training of Thai Personnel in Japan

Training of Thai personnel who may be in a working connection with this project has a great significance. Candidates for such training, however, will be limited to those who will come into close connection with this project and those who may be destined to work for a specific length of time with this project upon completion of their training in Japan. Priority will logically be given to the staff-members working at the proposed Mechanization Center.

The leading staff of the agricultural co-operatives will also be given the opportunity to visit Japan for the study on Japanese agricultural co-operatives. Since these people understand Thai language only, their training in Japan will need to be so arranged that they are either accompanied with English-speaking Thai officials or addressed upon through Thai-Japanese translators. The first group of the co-operative leaders may prefarably come to Japan even for a short period (1 - 2 weeks) prior to the commencement of the project, i.e., sometime in 1971.

7. Annual Program

This is a five-year project commencing from 1972 rainy-season till 1976, although the Japanese technical experts will be despatched during October to December 1971, so that they may be able to acclimatize themselves and learn Thai language which is the important medium of communication and technical guidance, particularly, with the local co-operative workers. Establishment of the Mechanization Center and organization of Thai staff-members into workable teams will have to be completed within

1971 through the arrangement on Thai side. Even in case the construction of the buildings of the Mechanization Center should be delayed due to some unavoidable reasons, at least the group of Thai staff-members and the demonstration fields would have to be ready in good time. The Thai project-leader should preferably be Grade I officer.

8. Suitable Pre-Maize or Post-Maize Crops

In the upland crop area in and around Lamnarai, leguminous crops, particularly, mungbeans (black-mappe, green-mappe, etc.) are generally grown as post-crops of maize. The increased-production of mungbeans as the result of improved cultivation techniques which will be introduced to benefit both the main crop and its pre- or post-crops, however, will unmistakeably cut down their price because of the limitation of their market. Soybean which is rather unpopular as a post-crop of maize at present has a promising international market including Japan which is very eager to find a reliable source of soybean supply in Thailand Already the Department of Agniculture is carrying out soybean improvement project arond Chiengmai with Japanese technical cooperation. If the improved soybean seed selected by Chiengmai project can be introduced and sown as pre- or post-crop of maize in our project-area, the production-increase of maize and ensuing income-growth of its cultivators would be multiplied by addtional source of income due to soybean cultivation. Possibility of growing soybean before maize may also deserve for study.

9, Utilization of Facilities Once Owned by Calabrian Co.

We understand that the facilities once owned by Calabrian Co., Ltd. and now kept by the Bangkok Bank will soon be put into sales. Those of them which are scattering in Lamnarai

district such as office, warehouse, silo, etc. are fairly good and will prove valuable for this project, if they can be handed over to Mechanization Center and or Lamnarai agricultural co-operative, through the Department of Credit & Marketing Co-operative. The old Calabrian assets include what can be conveniently used for drying maize which will be increasingly marketed by the agricultural co-operative under this project. The utilization of these idle equipment by agricultural cooperatives would be very useful for the agniculture development of the country, not alone for this project.