

**REPORT OF JAPANESE GUIDANCE TEAM FOR 1976**

**ON**

**THAI SERICULTURAL DEVELOPMENT COOPERATION PROJECT**

**DECEMBER 1976**

**AGRICULTURAL DEVELOPMENT COOPERATION DEPARTMENT**

**JAPAN INTERNATIONAL COOPERATION AGENCY**

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## PREFACE

Eight years has passed since our cooperation in sericultural development to Thailand started. In the meantime, the foundation of the project has been consolidated more and more steadily, though slower than initially expected, thanks to endeavors made by Japanese experts and Thai people concerned, which should be a matter for mutual congratulations. I am convinced, however, that technique is history. In the case of agriculture, in particular, no technique would be established without regard for the natural conditions of a country. In Japan, modern sericultural technique germinated about 250 years ago, and was improved gradually. After the opening of ports to foreign trade in 1854, particularly, raw silk ranked high among important exports, resulting in a remarkable development of the production technique of the fiber, to be handed down to the present time. In the meantime, needless to add, we brought in advanced reeling techniques, etc., from abroad, and made a great effort to adapt them to the conditions of Japan.

The object of the current Guidance Team was to investigate the degree of achievement in the technical cooperation as mentioned in the 3rd R/D which would terminate in March 1978, and discuss the contents of the cooperation in the remainder of the term. As I visited Thailand in November 1975 as the leader of the Evaluation Team of the 2nd R/D, I could not but observe a considerable advance toward modernization in the northeastern region of Thailand in the last 2 years. In sericulture also, modern techniques were staying there, and based on which sericultural farms were expanding in size among others. On the other hand, however, differentials in farmers' management were,

in some cases, widening, which will pose a problem in the future, I would point it out here. This problem has a relation with the mode in which techniques are diffused, but in further depth, there lies individualism, peculiar to Thai people, I should think. Such a nationality is an important facet which is to be duly considered in extending technical cooperation. The mode of technical extension in Thailand is to be carefully examined through sufficient consultation between 2 countries, I should consider.

Our Guidance Team stayed in Thailand for 17 days. Thanks to valuable cooperation of Japanese people concerned and Thai officials in charge, we have attained our object as was expected. Lastly but not /in the least, we would express our deep gratitude to all the persons we met on the occasion of this mission for their esteemed assistance

March 1977

Dr. Kazuo HAZAMA

Leader of the Japanese Guidance  
Team on the Development of  
Thai Sericulture

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## CHAPTER I. MEMBERS OF THE GUIDANCE TEAM AND ITINERARY

### 1. Members of the Guidance Team

#### Assignment

Leader	Dr. Kazuo HAZAMA	Director of Research Planning Division, National Sericultural Experiment Station, Ministry of Agriculture and Forestry
Raw Silk in General	Mr. Yoshiaki HORIUCHI	Director of Shinjō Silkworm Egg Experiment Station, Ministry of Agriculture and Forestry
Cooperation Planning	Mr. Shiro TAZAWA	Assistant Chief of Raw Silk Improvement Section, Agricultural Production Bureau, Ministry of Agriculture and Forestry
Coordination	Mr. Masakatsu ISHII	Agricultural Technical Cooperation Section, Agricultural Development Cooperation Office, Japan International Cooperation Agency

### 2. Survey Itinerary

<u>Date</u>	<u>Contents of Survey</u>
Nov. 30 (Tue.)	Tokyo (12:05) — <u>J A I, 463</u> → Bangkok (17:22) (Stayed in Bangkok)
Dec. 1 (Wed.)	Previous arrangement at Bangkok office of JICA on the line, schedule, etc., of the survey. (Attended by: Mr. Kuwabara, the Head of the office, Messrs. Niwa and Iwaguchi, staff of the office, Mr. Yamakawa, Japanese expert, and the members of the Guidance Team.)

Note: Thai permanent Vice-Minister of Agriculture and Forestry, Japanese Ambassador in Thailand, etc., visited the Centre in Korat.

(Stayed in Bangkok)

Dec. 2 (Thu.)

Previous arrangement at the Department of Agriculture on the object, schedule, etc., of the survey.

(Attended by: Mr. Prokob, the Director of the Department, Mr. Chote, the Chief of Sericulture Division, Mr. Sugiyama, the Leader of Japanese experts, Mr. Yamakawa, Japanese expert, and the members of the Guidance Team.)

Inspection of Khon Kaen Agricultural Experiment Station.

At Bangkok office of JICA, reported the results of the prearrangement with the Department of Agriculture and listened to the explanation of the state of affairs in Thailand.

(Attended by: Mr. Kondo, agricultural attaché, Mr. Kuwabara, the Head of the office, Mr. Sugiyama, Leader of Japanese experts, Mr. Yamakawa, Japanese expert, and the members of the Guidance Team.)

At the Japanese Embassy, paid our respects to Mr. Hitomi, Ambassador, and Mr.

Nonoyama, Councilor.

(Stayed in Bangkok)

- Dec. 3 (Fri.) Bangkok —————> Korat  
 At Korat Centre, prearrangement with Japanese experts on the line, schedule, etc., of the survey.  
 (Attended by: all the experts and members of the Guidance Team.)  
 (Stayed in Korat)
- Dec. 4 (Sat.) Plenary meeting with experts (the whole field, research field, training field, etc.)  
 Discussed the promotion, development, state of progress, results, remaining problems, etc., on the tasks pursued in research and training fields under the sericultural cooperation and development project.)  
 Social gathering sponsored by the Leader of experts.  
 (Attended by: All the experts and families, Mr. and Mrs. Somchart, Director of Sericultural Research and Training Centre, all the counterparts in the Centre and all the members of the Guidance Team.)  
 (Stayed in Korat)
- Dec. 5 (Sun.) Meeting of the Guidance Team.  
 Discussed the results of the meeting with experts on the previous day to decide (1) basic way of thinking and (2) concrete items to which the priority research is to be given for timely conclusions.  
 The plenary meeting with experts.

Proposed the said basic way of thinking and concrete items to experts for consultation.

(Stayed in Korat)

Dec. 6 (Mon.)

Korat → Phimai → Khon Kaen

Inspection and survey of Phimai Land-settlement office and Phimai Pilot Sericultural Village.

Inspection and survey of Khonkaen Sub-centre. (Accompanied by: Mr. Sugiyama, Leader of experts and Mr. Sombot, Vice-Director of Sericultural Research and Training Centre.)

(Stayed in Khon Kaen)

Dec. 7 (Tue.)

Khon Kaen → Ubonrat → Udon → Nongkhai → Udon

Another inspection and survey of Khon Kaen Sub-centre.

Inspection and survey of Ubonrat Land-settlement office and Ubonrat Pilot Sericultural Village.

Inspection and survey of Udon Sub-centre.

Inspection and survey of Nongkhai Sericultural Experiment Station.

(Accompanied by: the same persons as on Dec. 6th.)

(Stayed in Udon)

Dec. 8 (Wed.)

Udon → Chonnabot → Banpai → Korat

Inspection and survey of sericultural farms and weaving industry in Chonnabot Village.

Inspection and survey of Banpai weaving factories.

(Accompanied by: the same persons as on Dec.

6th.) (Stayed in Korat)

Dec. 9 (Thu.) Korat → Ban Kruat → Prasart → Surin → Korat

Inspection and survey of Ban Kruat Land-settlement office and Ban Kruat Pilot Sericultural Village.

Inspection and survey of Prasart Land-settlement office and Prasart Pilot Sericultural Village.

Inspection and survey of Surin Sericultural Experiment Station

(Accompanied by: Mr. Chote, Chief of Sericulture Division, Mr. Pirapon, counterpart, Messrs. Ryochi, Fujimoto and Yamakawa, experts.)

Discussion in the Guidance Team.

(Stayed in Korat)

Dec. 10 (Fri.) Inspection and survey of the facilities, etc., of the Korat Sericultural Research and Training Centre.

Discussion with Thai Government officials on the future plan of Thai sericulture and Thai Government's targets to achieve on the Record of Discussions.

(Attended by: Mr. Chote, Director of Sericulture Division, Mr. Sompot, Vice-Director of Sericultural Research and Training Centre, all experts and all the members of the Guidance Team.)

Social gathering sponsored by the Leader of

- the Guidance Team.  
 (Attended by: all experts and their families and all the members of Guidance Team.)  
 (Stayed in Korat)
- Dec. 11 (Sat.) Korat—→ Wanchomp—→ Korat  
 Inspection and survey of Chul Thai Silk Company and enterprising sericultural farms.  
 (Accompanied by: Mr. Chote, Chief of Sericulture Division, Mr. Sugiyama, Leader of experts, and Mr. Yamakawa, expert.)  
 (Stayed in Korat)
- Dec. 12 (Sun.) Final Discussion and consultation with all experts. (Stayed in Korat)
- Dec. 13 (Mon.) Consultation with Thai Government officials.  
 (Attended by: Mr. Chote, Chief of Sericulture Division, Mr. Somchard, Director of Sericultural Research and Training Centre, Mr. Sompot, Vice-Director, all experts and all members of the Guidance Team.)  
 Social gathering sponsored by the Japanese Embassy. (Stayed in Bangkok)
- Dec. 14 (Tue.) Reported the results of the survey.  
 (Attended by:  
 On Thai side, Department of Agriculture---  
 Mr. Sombat, Vice-Director, Mr. Chote, Chief of Sericulture Division  
 DTEC---Mr. Stin  
 On Japanese side, Mr. Sugiyama, Leader of experts, Messrs. Maruyama and Yamakawa,

experts, Mr. Kuwabara, Chief of JICA Bangkok office and the members of the Guidance Team.)

Social gathering sponsored by the Thai Government (lunch)

(Attended by: Mr. Chote, Chief of Sericulture Division, and others from the Department of Agriculture, Mr. Somchard, Director of Sericultural Research and Training Centre, officials concerned from DTEC, staff of JICA Bangkok office, experts, members of the Guidance Team.)

In the Japanese Embassy, reported the results of survey to Mr. Nonoyama, Councilor, and Mr. Kondo, Agricultural Attaché, and bade farewell.

Social gathering sponsored by the Leader of Guidance Team.

(Attended by: Mr. Chote, Chief of Sericulture Division, officials concerned from DTEC, Mr. Kondo, Agricultural Attaché, staff of JICA Bangkok office, experts and members of the Guidance Team.) (Stayed in Bangkok)

Dec. 15 (Wed.)

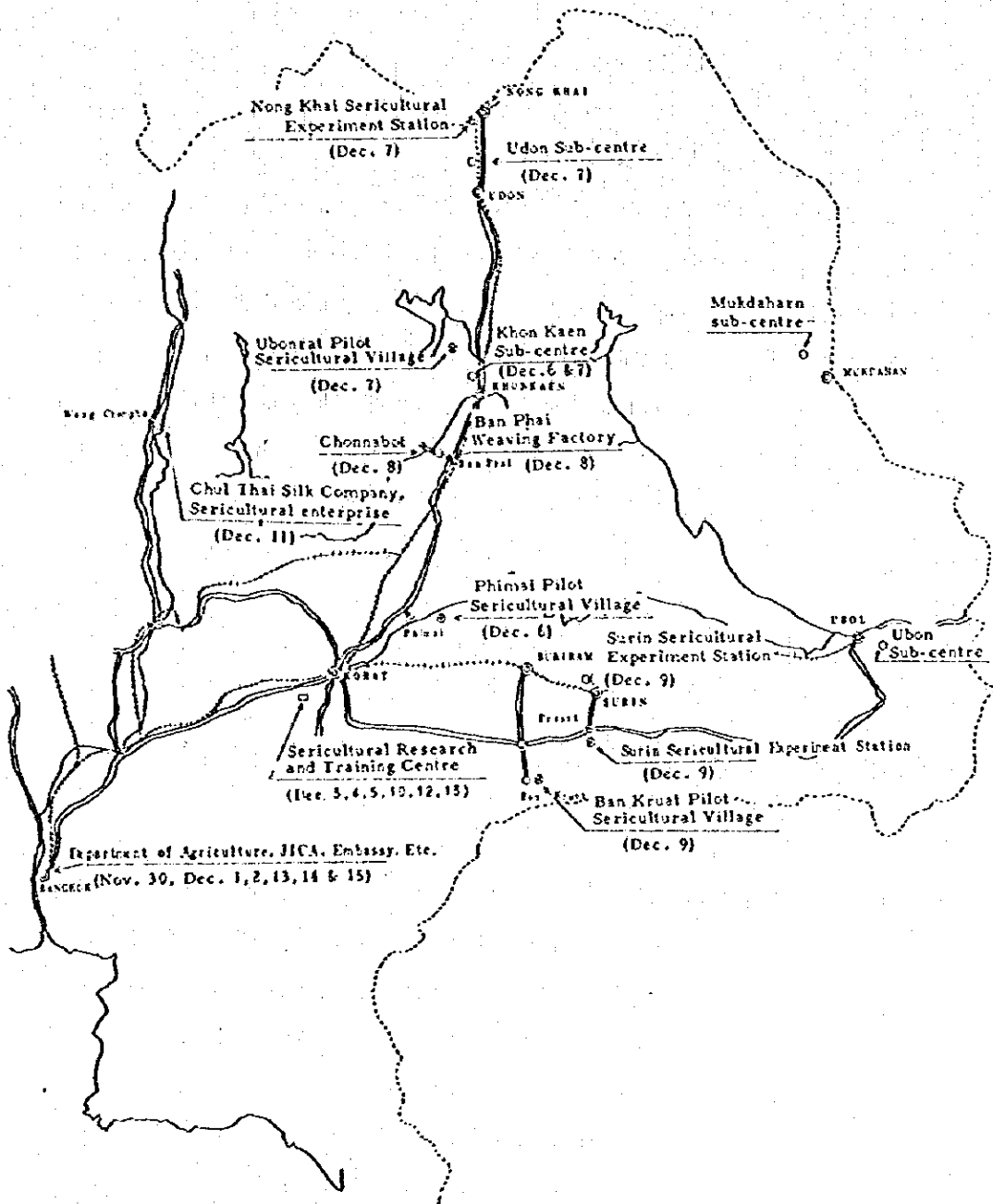
Preparation for going home, and consultation between the Leader of the experts and the Leader of the Guidance Team.

(Stayed in Bangkok)

Dec. 16 (Thu.)

Bangkok (11:35)  $\xrightarrow{\text{J A L 718}}$  Tokyo (22:05)

3. Itinerary Map of the Guidance Team





## CHAPTER 2. OUTLINE OF THAI SERICULTURAL DEVELOPMENT PROJECT AND THE OBJECT OF THE GUIDANCE TEAM

### 1. Outline of Thai Sericultural Development Project

In Thailand, higher production of cocoon and raw silk became necessary in order to meet yearly increasing demand for Thai Silk. Thai Silk was woven with wefts of raw silk produced in Thailand from cocoons of native, polyvoltine races, and warps of better raw silk imported from Japan or South Korea, etc. The sericultural promotion project in the northeastern region of the country aims at the production of cocoons and raw silk which can be used as warps to satisfy the increased production of Thai Silk, and at the same time, more income to farmers to contribute to the stabilization of livelihood.

But techniques in mulberry cultivation, silkworm rearing, raw silk reeling, etc., were on extremely low levels, when compared with those in advanced countries. It was felt of urgent necessity, therefore, to establish techniques on mulberry cultivation, silkworm rearing, raw silk reeling, etc., which are the bases for the promotion of sericulture through researches and the formulation of practical, technical systems, train technicians, spread the results among farmers, and so on. Thus, they set up a development project, which may be summarized as follows:

#### (1) Establishment of Sericultural Research and Training Centre

Fully equipping the Centre in Korat with facilities to conduct experiment and research on mulberry cultivation, silkworm rearing, raw silk reeling, etc., they promote experiment and research, create techniques which are suited to the country and national character, and perform technical training for technical

leaders with perfectly equipped facilities.

(2) Reinforcement of Local Sericultural Experiment Stations

Fully equipping and reinforcing the facilities of local Sericultural Experiment Stations, they try to establish techniques on mulberry cultivation, and silkwormrearing which are suited to respective localities, and also distribute mulberry saplings and silkworm eggs of their own producing.

(3) Setting Up of Bases for Technical Dissemination

As bases for disseminating sericultural techniques, model areas are set up, equipped with cooperative young silkworm rearing houses, joint mulberry fields, etc.

2. Outline of Japanese Cooperation Plan

The technical cooperation project for the development of Thai sericulture was started by the first 3-year plan from 1969 to 1971 to cooperate in the implementation of the plan mentioned above. Under which, Japanese experts were dispatched; machines and instruments for experiment and research, sericultural tools, agricultural machines and tools for mulberry cultivation and various other materials were donated; trainees were received, among other things, putting stress on the buildup of the foundation. The cooperation was extended for 3 years (1972 - March 1975) on:

- (1) in the Sericultural Research and Training Centre in Korat, experiment and research to establish new / sericultural technique, and production of parent eggs of F<sub>1</sub> hybrid, and the training of staff of the Centre and Sub-centres (Khon Kaen, Udon, Mukudaharn and Ubon), local leaders and farmers;
- (2) in the Centre and Sub-centres, the production, multiplication and distribution of silkworm eggs as bred by the

Centre; and

- (3) technical guidance and dissemination on priority by the establishment of pilot sericultural farm groups;
- (4) and furthermore, the training of other nations to sericultural technique was examined;
- (5) and various machines and materials were donated, among others.

In the meantime, the Thai Government, on the occasion of the implementation of the second cooperation project, set up the Sericulture Division in the Department of Agriculture to reinforce its administrative mechanism. The Sericulture Division established, in conjunction with the Reclamation Division, Public Welfare Department, Ministry of Home Affairs, pilot sericultural villages, etc., to expedite the buildup of the bases for the diffusion of new sericultural techniques.

In March 1975, when the cooperation project came to an end after 6 years duration, the Thai Government strongly requested its extension. In compliance, it was prolonged for 3 years, up to March 7, 1978.

The third cooperation project is now under way along the line of the second Record of Discussion, in expectation that the consolidation of the foundation of Thai raw silk industry on the fruit of 6 years endeavors according to the first and second R/D, such as new sericultural techniques spreading deep root, will produce a happy result that Thai people themselves operate the Centre, Sub-centres, etc., in research work, training and so forth, and lead farmers in a proper direction.

### 3. Object of the Guidance Team

Since the cooperation project for the development of Thai

sericulture will terminate at the end of the term prescribed by the third R/D, namely on March 7, 1978, the guiding principle for the remaining term, that is to say, one year and several months, be formulated from the field survey, discussion with experts and consultation with Thai officials.

### CHAPTER 3. RESULTS OF SURVEY AND EXAMINATION OF THEM

#### 1. Fields of Research

Since the start of this project, basic and practical researches have been enthusiastically pursued in the fields of mulberry cultivation, silkworm rearing, improvement of silkworm races, production of silkworm eggs, pathology and raw silk reeling, in order to establish modern sericultural techniques which are suited to the natural features and climate of Thailand. The result of researches has been steadily accumulating, though gradually, which will become a valuable data for the development of Thai raw silk industry in the future. Research works have been carried on by dispatched experts as the core in cooperation with counterparts who, during the course, may acquire the basic knowledge on raw silk. After the termination of this cooperation project in March 1978, counterparts will, it is expected, play leading parts in the promotion of research in respective fields.

The effects of research are reflected in the rearing results in the pilot sericultural villages, which is proved by the fact that 5 pilot villages are already harvesting cocoons from bivoltine F<sub>1</sub> or F<sub>2</sub> eggs that the Centre has produced. However, there still remain not a few problems.

Research results are presented by experts and counter-

parts at the annual meeting held in March every year, and published in the Bulletin of the Thai Sericultural Research and Training Centre, already coming up to No. 6. The articles number 318 in total.

#### (1) Cultivation of Mulberry

In Thailand, sericultural farmers had no custom to tend mulberry field, resulting in extremely poor leaf yield. In order to carry on a systematic, modern sericulture, it is necessary to examine the manner of field maintenance, and training and harvesting methods to raise the productivity of land. Since this cooperation project began, experiments to this end have been pursued. They have established training and harvesting methods and the corresponding technique for field maintenance to comply with 4 rearings a year. Illustrated, the techniques are spreading among farmers, though there seem to remain some difficulties on the facet of manuring. It is necessary to establish, based on these, applied manuring techniques suitable to respective localities.

As regards the countermeasures for root rot disease which poses a great obstacle to mulberry cultivation, they are, in cooperation with the pathology sector, pushing experiments centering around the search of resistant mulberry races and the control by means of grafting. Furthermore, they are conducting experiments on the densely planted mulberry field through the SUBUSE method (cuttings are horizontally laid about 10cm deep) and grafting.

In addition, the Korat Centre currently holds mulberry fields of 75.2 rai, of which 11.6 rai or 15.4%, suffers from the disease on top of very poor soil fertility. So, mulberry fields must be expanded and soil fertility be increased, if the research work in the centre is to proceed smoothly.

In this connection, Fig. 2-5 show the air temperature and rainfall from 1972 onward, as recorded by the Centre.

### (2) Silkworm Rearing

It is already known that the stabilization of cocoon crop can be achieved by the techniques based on the thoroughgoing disinfection of rearing rooms and tools as well as the disinfection of silkworm body and rearing beds. Incorporating these facts, they have formulated a table of young silkworm rearing standard, by which pilot sericultural villages are conducting the raising of young silkworms.

Currently, they are examining the amount and number of feeds a day as well as the area of rearing bed by silkworm races in order to formulate a table of grown silkworm rearing standard. A standard rearing table in shoot rearing is already completed, though it contains only the techniques for training use.

They are going to take up the examination on the systematization of multiple rearing and the standard technique for the mass rearing of F<sub>2</sub> races. In addition, many rearing rooms in pilot villages are of closed type, made of brick or concrete blocks as the building cost is equal to that of wood. In Thailand, however, where high temperature prevails, it will be necessary to examine the mounting method.

### (3) Pathology

As for mulberry diseases, root rot disease is the greatest trouble. Although its infection route and the manner of attack have partially been made clear, the pathogen is still unknown, claiming the study in the future. It has been ascertained that resistance to the disease varies with the race: Pai which is poor in practical character shows a higher resistance, while Noi

producing much leafage of good quality, weak. They are, therefore, pursuing experiment, in conjunction with the sector in charge of mulberry cultivation, on the graft of Pai (stock) and Noi (scion), and on the densely planted, early-yield mulberry field, in order to establish a practical, controlling measure.

On the side of insect pests of mulberry, researches have been focused on the mulberry mealy bug and mulberry borer, with their physiology and ecology having been partially clarified. The controlling method is being established.

In this connection, pebrine which was most feared at the start of the cooperation project has almost disappeared from the pilot sericultural villages thanks to the spread of bivoltine silkworm races, and the polyvoltine silkworm tachina fly thanks to the dissemination of rearing rooms conformable to the model design. Muscardine has been controlled with Ceresan-Lime. But the production of this chemical has been stopped in Japan. Looking for some substitutes, they have found out 2 chemicals which are equally effective. Although studies on grasserie are carried on, high temperature in Thailand causes victims soften and decompose so quickly that sericultural diseases are difficult to classify. Studies are going on to fix these diseases.

#### (4) Improvement of Silkworm Races

No pains have been spared to select and breed parent races of F<sub>1</sub> hybrid which are suited to the natural conditions of Thailand and to conduct aptitude tests on their crossing forms. As a result, 2 strains of Japanese race (K<sub>1</sub>, K<sub>6</sub>), 3 strains of Chinese race (T, K<sub>8</sub>, K<sub>14</sub>) and 5 crossing forms: K<sub>1</sub> × K<sub>14</sub>, K<sub>6</sub> × K<sub>14</sub>, K<sub>1</sub> × T, K<sub>1</sub> × K<sub>8</sub>, (K<sub>1</sub> × K<sub>6</sub>) × K<sub>14</sub> have been put into practice. K<sub>6</sub> × K<sub>7</sub> which was bred in 1974 as a good crossing form is heavy

in the weight of cocoon filament, but poor in healthiness, with some problems in egg production. As a result, its distribution has been stopped (see the Report by the previous Surbey Mission).

In pushing forth the development of Thai sericulture, it is very important to breed good silkworm races and establish superior crossing forms. Strenuous efforts are therefore/being made in these directions. But we should take a long range view of the fruit, since the improvement of silkworm races requires many years researches.

In addition, a comparative test of hybrids /was carried out early this year, by the Centre, part of Sub-centres and local Sericultural Experiment Stations, obtaining the results shown in Table 1. Such a test should be conducted aggressively, since it will avoid another  $K_6 \times K_7$ , if held prior to the distribution of eggs among farmers. Besides, it will engender the feeling of one body between the Centre and Sub-centres.

Table 2 shows the rearing results of hybrids in the Centre.

#### (5) Production of Silkworm Eggs

The production of good silkworm eggs of the races that have been bred for a stable supply to Pilot Sericultural Villages constitutes a basis for the development of Thai sericulture. Accordingly, researches have been pursued on the rearing method of parent silkworms for hybridization, a working process from the preservation of cocoons for egg production to egg raising, artificial hatching and the preservation of eggs. And standard techniques have been nearly established.

As more and more groups of sericultural farmers are installed in the future, demand for silkworm eggs will increase. It is necessary, therefore, to establish techniques in the mass



production of eggs which are suited to the natural and social conditions of Thailand at an earliest possible date. But egg production is composed of such high techniques that some measures are to be taken to substantiate counterparts both qualitatively and quantitatively through the repetition of proper training.

In this connection, Table 3 shows the state of the production and distribution of silkworm eggs by the Centre in Korat.

#### (6) Raw Silk Reeling

In the purchase of fresh cocoons, fixing of prices, drying and storage of cocoons, cocoon cooking, reeling, re-reeling and general finish, winding, doubling, throwing, winding/and a series of techniques in the processing of cocoons and raw silk, standard techniques have been almost established. Hereafter they are going to pursue researches to supplement individual techniques, and on the other hand, advance reeling techniques and let them stay in Thailand through the production of raw silk from fresh cocoons pilot sericultural villages supply. Also, a raw silk testing and classification method which is suited to the manufacture of Thai Silk will be studied before long.

In addition, the production of raw silk (thrown silk) by the Centre is shown in Table 4.

So far, we have outlined the development of researches by respective fields. Remaining problems which we have heard from experts are listed in Table 5 by research items according to the WORKING PLAN (1975-1977). Table 6 shows research tasks under way; the column "Measure" indicates proposals made by this Guidance Team based on the results of discussion to be mentioned in CHAPTER 4.

Table 5. Remaining Problems by Research Items on Working Plan (1975 - 1977)  
(brought forward by Experts)

I t e m s	Remaining problems
1. Systematization of Mulberry culture and Silkworm rearing Technics	
1.1 Experiment on establishment of high productivity mulberry fields -----	Test on the relation between the training and harvesting methods and field maintenance by areas
1.2 Experiment on manuring to mulberry fields -----	Examination of the kind, amount and time of manuring, taking the rainy and dry seasons into consideration Necessity of common experiments at Branch Stations in different conditions of location
1.3 Experiment on relationship between mulberry training methods and harvesting methods -----	Establishment of training and harvesting methods suited to the number of rearings
1.4 Experiment on controlling root rot of mulberry trees -----	Experiment on grafting as a countermeasure for root rot disease
1.5 Mulberry field establishment methods (Planting methods, spacing, manuring practice and irrigation control, etc.) ----	Examination of herbicides Management technique of the control of insect pests (mulberry borer, mulberry mealy bug)
1.6 Mulberry propagation (Grafting method, cutting method, etc.)-	Test on grafting
1.7 Survey of characteristics of mulberry varieties -----	Survey on leaf crop and characteristics (continued) Characteristics of mulberry trees of Japanese origin (continued) Unification of the same strain with different names
1.8 Survey on weather conditions -----	Need of composite agricultural meteorological recorders which produce less trouble and are easy to handle, as the existing ones break down too frequently
1.9 Technics on multiple silkworm rearings and stabilization of cocoon crops -----	Education of problems in multiple rearing technique by a composite survey of actual condition (relative to countermeasure for sericultural diseases, higher productivity, and economical rearing room and tools, in particular)
1.10 Influence of newly introduced pesticides to silkworm growing-	Examination of new chemicals
1.11 Preparation of chart of grown silkworm rearing standards by each instar -----	Adaptability of silkworm races by rearing season; establishment of the disinfecting method of silkworm body at each stage; examination of mounting method
1.12 Silkworm rearing method by crossing forms of silkworms (F <sub>1</sub> , F <sub>2</sub> )	Selection of silkworm races which produce better combination of F <sub>2</sub> , and examination of rearing methods Establishment of the standard of appraising F <sub>2</sub>
1.13 Experiment on quality of mulberry leaves and cocoon crops -	Shortage of material mulberry leaves (due to the use of sample fields)
1.14 Separation of pathogenic cause of mulberry root rot and its physiology and ecology -----	Pathogens are not identified yet. Clarification of infectious function Establishment of controlling methods

1.15 Examination of resisting power to root rot of mulberry varieties -----	Clarification of the difference in resistance among mulberry races Cultivating utilization of resistant mulberry races (grafting, etc.)
1.16 Physiology and ecology of mulberry pests (mealybugs, stem borers, etc.) and control methods -----	Surveys of physiology and ecology Establishment of controlling methods
1.17 Diagnosis of silk worms in tropical countries -----	Establishment of the method of diagnosis of sericultural diseases
1.18 New disinfection chemicals for silkworm rearing room, instruments and body surface of silkworms -----	Examination of new chemicals
2. Establishment of Technics for Silkworm Breeding and Mass Production of Silkworm eggs	
2.1 Improvement of silkworm races (parent silkworms (sex-limited races included), F <sub>1</sub> , F <sub>2</sub> and double cross hybrid) -	Examination of sex-limited races, double cross hybrids, and crossing forms of F <sub>1</sub> to obtain good F <sub>2</sub> Reinforcement of the aptitude test of hybrids in order to obtain efficient selection of good crossing forms Heating apparatus for abnormally low temperature
2.2 Parent silkworm rearing method -----	Simplification of rearing methods and mass rearing Manufacture of rush nets, cocooning frame, etc., from materials on the spot, and their practical use
2.3 Egg raising method (parent worms, F <sub>1</sub> , F <sub>2</sub> ) -----	How to make plans on mass production, rational and efficient works, manufacture of simple tools for raising silkworm eggs Installation of moth keeping rooms (prefabricated refrigerators) in order to rationalize the production of F <sub>1</sub> Manufacture of egg-cards on the spot
2.4 Artificial hatching method (common acid-treatment, acid-treatment after chilling) -----	Confirmation test of new silkworm races Continued training on artificial hatching technique
2.5 Preservation method of silkworm eggs (Cold storage, artificial hibernation method, etc.) -----	Limit in the cold storage of new silkworm races Scheme for the maintenance and operation of refrigerators
2.6 Simplification of sex-discrimination technics -----	Training and higher efficiency in pupal sex-discrimination Adoption of instrument for sex-discrimination by pupal body weight Practical use of sex-limited silkworm races
3. Establishment of Raw Silk Reeling Technics	
3.1 Preparation of cocoon testing standards -----	Appraisal of economic value of eliminated cocoons
3.2 Drying method of fresh cocoons -----	Examination of existing drying machines
3.3 Change of cocoon quality by cocoon storage at higher temperature -----	Influence of much moisture in the rainy season over cocoon storage
3.4 Cooking method of low quality cocoons -----	Clarification of primary factors in the cooking method of inferior cocoons
3.5 Survey of cocoon and raw silk qualities by rearing season	Prevention of the deterioration of cocoons in the rainy season
3.6 Survey of cocoon and raw silk qualities by districts of production -----	To be continued

Table 6. Tasks Currently Under Way

Field	Name of Tasks	Measure
Mulberry cultivation	<ol style="list-style-type: none"> <li>1. Investigation of economical character of Thai mulberry races</li> <li>2. Experiment on the density of mulberry planting</li> <li>3. Experiment on the early-yield mulberry field by the utilization of cutting</li> <li>4. Experiment on the harvesting method of mulberry shoots for 3 rearing seasons</li> <li>5. Experiment on the higher productivity of mulberry field on dry land</li> <li>6. Experiment on the root rot control by the utilization of grafting</li> <li>7. Chemical control of stem borer in the mulberry field</li> <li>8. Meteorological observation</li> </ol>	
Silk-worm rearing	<ol style="list-style-type: none"> <li>1. Experiment on the relation between mounting environment and the quality of cocoon, particularly reelability</li> <li>2. Test of new rearing instrument</li> <li>3. Experiment on the relation between leaf quality and cocoon crop</li> <li>4. Rearing method according to the crossing forms (F<sub>1</sub> F<sub>2</sub>) of silkworm races.</li> <li>5. Effect of new chemicals over the growth of silkworm</li> </ol>	x
Training	<ol style="list-style-type: none"> <li>1. Tabulation of old silkworm rearing standard by seasons</li> <li>2. Experiment on the practical use of the spinning and mounting method on a flat board</li> <li>3. Experiment on the pupal sex-discrimination by brine assortment</li> </ol>	x x
Breeding	<ol style="list-style-type: none"> <li>1. Breeding of healthy commercial silkworm races</li> <li>2. Aptitude test of F<sub>1</sub> hybrid</li> <li>3. Aptitude test of F<sub>2</sub> hybrid</li> <li>4. Aptitude test of multiple (double cross, triple) hybrid</li> <li>5. Common experiment to compare hybrids</li> <li>6. Experiment on sex-limited silkworm races</li> <li>7. Preserving method of eggs for the annual rearing of material silkworm for breeding</li> </ol>	x

Egg production	<ol style="list-style-type: none"> <li>1. Experiment on the common acid-treatment</li> <li>2. Experiment on the acid-treatment after chilling</li> <li>3. Preservation of artificially chilled eggs prior to the cold-storage, and the relation between the days of cold-storage and hatchability</li> <li>4. Advisability of the exposure to intermediate temperature of artificially hatched eggs before and after the acid-treatment after chilling at 5°C, and the relation to hatching</li> <li>5. Investigation of duration of feeding period from "HAKITATE" to eclosion on primary parent silkworms for hybridization</li> <li>6. Investigation of the amount of supplied leaves on primary parent silkworms for hybridization</li> <li>7. Investigation of the capacity for sex-discrimination</li> </ol>	Test of new races "
Pathology	<ol style="list-style-type: none"> <li>1. Control of aspergillus disease of silkworm <ol style="list-style-type: none"> <li>1) Experiment on the inoculation of silkworm body</li> </ol> </li> <li>2. Control of grasserie <ol style="list-style-type: none"> <li>1) Experiment on additament to feed</li> </ol> </li> <li>3. The nature and performance of violet muscardine and its pathogenity</li> <li>4. Control of root rot disease of mulberry <ol style="list-style-type: none"> <li>1) Separation of pathogen</li> <li>2) Search of resistant mulberry races</li> <li>3) Investigation of occurrence</li> </ol> </li> <li>5. Insect pest Ecology and control of pul insect pests of mulberry, stem borer and mealy bug</li> </ol>	x x
	<ol style="list-style-type: none"> <li>1. Establishment of cocoon testing standard-- appraisal of the value of eliminated cocoons</li> <li>2. Relation between cooking conditions and the solution of sericin-- relation between the pH of cooking hot water and the solution of sericin</li> <li>3. Change in cocoon quality due to cocoon storage at high temperatures</li> <li>4. Cooking method of inferior cocoons</li> </ol>	

- |   |
|---|
| <ul style="list-style-type: none"> <li>5. Investigation of the quality of cocoon filament by rearing seasons</li> <li>6. Investigation of the quality of cocoon filament by areas of production and by silk worm races</li> </ul> |
|---|

## 2. Field of Training

The training in the Korat Centre includes, besides daily training of counterparts, 4-times-a-year training in the so many rearing seasons of the staff of Sub-centres and Sericultural Experiment Stations, extension agents, sericultural farmers in the pilot sericultural villages, etc. So far, 25 sericultural trainings have been held, as shown in Table 7, with trainees totaling 718, comprising diverse sectors. Sericultural farmers number 499, the staff of Experiment Stations, Department of Extension, Department of Agriculture, etc., 179 and others 40. Recently, more and more feminine trainees are participating. In addition, special trainings were held once: raw silk reeling in 1971, stabilization of cocoon crop in 1976, and maintenance of refrigerators in the same year. Since training forms the foundation on which modern raw silk technique may settle down in Thailand, it is necessary to organize trainings for respective purposes densely.

The training of counterparts appears progressing smoothly through ordinary research work, on-the-spot guidance, or dispatch to Japan, etc. For reference, Table 8 shows the counterparts so far sent to Japan. Counterparts are expected to play an active part as the executives of the Centre, Sub-centres or Sericultural Experiment Stations in the future. Their quality should be further advanced so that they can conduct research or technical guidance without the help of dispatched Experts. On the other hand, able persons are to be secured. Training in Japan is main-

ly given to those in 6 research sectors. In addition, others in the sectors of reeling machine, refrigerator, etc., who cannot be trained on the spot should be duly considered. In this connection, the Directors of the Centre and Sub-centres who are to lead and supervise these counterparts, and have more parts to play in the fields of egg production, agricultural guidance, etc., would need be trained for greater capacity for the management and operation in and out of their posts.

As for the training of the staff in charge of extension, 40 officials of the Department of Extension and 27 of the PWD have been trained as shown in Table 7. It is necessary, for the moment, to put stress on the consolidation of the extension system in the pilot sericultural villages. Especially, a thorough-going training is required on those technical officers of the Reclamation Office who are selected to take charge of sericulture so that they will acquire such ability and knowledge as to guide farmers on the spot under various conditions.

Furthermore, the Department of Extension is going to increase about 100 sericultural extension agents in each County under the 5-year plan. Since the promotion of modern sericulture in Thailand centering around bivoltine silkworm races depends entirely on the consolidation of the guidance and extension system, the training should not be limited to once, but repeated to raise the qualities of the officials concerned. The training for the stabilization of cocoon crop in 1976 which was conducted as a special one was a re-training of those technical officials in the Centre, Sub-centres, local Sericultural Experiment Stations, and PWD who have experience in silkworm rearing or technical extension. The results appear to have been

remarkable.

The training of sericultural farmers is to be performed by extension staff. But the present cooperation project prescribes Sub-centres to take the charge. Yet Sub-centres are not sufficiently equipped, so the Centre is performing the duties. The situation will require further examination. According to Table 9, 387 farmers from 11 pilot sericultural villages have already been trained.

The 3rd training was conducted for 6 months from March of 1975 for 4 Laotian Government officials covering the whole research fields and special branches. As the Laotian language closely resembles Thai, the two parties understood each other, producing satisfactory results, it seems.

### 3. Fields of Extension

As the bases for the extension of sericultural techniques established by the Centre in Korat, 2 pilot sericultural villages each are going to be set up around the Centre and 4 Sub-centres. These will serve as the foundation for the deployment of modern sericulture in Thailand, affecting the future development greatly. Eleven pilot villages are to be set up as the undertaking by P. W. D. In addition to the settlements at Phimai, Prasart and Ban Kruat, where they are producing cocoons already, Mukdaharn and Ubonrat will start cocoon raising this year. The remaining 6 settlements, except for Hoilan, are expected to enter into the implementation structure. Particularly in Phimai which started the project in 1973 as No. 1 pilot village, cooperative young silkworm rearing houses are additionally being constructed to meet the demand. Modern sericultural techniques are favorably taking root in these pilot villages, though varying slightly with individual



farmers (Tables 10-13).

But the construction cost of a silkworm rearing room increased recently to 20,000 bahts from the initial 4,000 or so, apparently causing a bottleneck in the increase of sericultural farms. The relation among the Centre, Sub-centres and pilot villages is shown in Fig. 6. As regards the extension and guidance system in pilot sericultural villages, that in Phimai is directly handled by the Centre, while that in Prasart and Bangruad is currently guided by the Centre in close cooperation with Surin and Bruiran Sericultural Experiment Stations, though, properly speaking, it should be under the jurisdiction of Ubon Sub-centre. In any case, these 3 villages appear to be enjoying a thoroughgoing technical extension as the project initially attempted. But some farms in places where water supply is insufficient have no water, in the dry season, to wash and disinfect rearing rooms, arousing concern about cocoon crop. It is necessary to examine water wagons, etc. In addition, Mukdaharn and Ubonrat Pilot Sericultural Villages are conducting sericulture under the guidance of Mukdaharn and Khon Kaen Sub-centres, respectively.

Fig. 6. Relation among Centre, Sub-centres and Pilot Villages

Centre	Sub-centre	Pilot Village
Korat		Phimai *
	— Khon Kaen —————	Ubolrat *
	— Udon —————	Chieng Pin, Phomphi Sai, Huay Luong
	— Mukdaharn —————	Mukdaharn *, Kuchinarai, Lampao
	— Ubol —————	Lam Dom Noi
	— (Briran) - - - - -	Bangruad *
	— (Surin) - - - - -	Prasart *

- Note: 1. Except for Huay Luong, 10 pilot villages have got into action (incl. schedules).  
2. \* raising cocoons

Pilot sericultural villages are ranked as the base for the extension of new sericultural techniques in Thailand. But their rearing results vary noticeably according to farmers technical achievement, volition to raise cocoons, conditions of location, etc. In the future, therefore, a denser technical guidance is needed. As more and more pilot villages will be set up around a Sub-centre, it is necessary to formulate a close guiding plan in order to have technique stay there for long.

#### 4. Donation of Machinery and Materials

For the last 7 years, machinery and materials have been donated for the Sericultural Centre, Sub-centres and pilot villages as listed in the following table. These have been effectively used for the introduction of bivoltine silkworm rearing by Sub-centres, pilot villages, to say nothing of the Centre. During the survey, however, we have noted wear and tear of reeling machinery, trouble of attachments for refrigerator of silkworm eggs, etc. Since this project has been carried out for a long time and is supposed to end in March of 1978, donation for 1977 should be stressed on the replacements of machinery and materials already provided.

Table 14. List of Donated Machinery and Materials

Year	Sum '000 yen	Destination (kinds)
1969	68,368	For the Centre (rearing machinery, machinery for pathological research, refrigerators of silkworm eggs, machinery for mulberry cultivation, vehicles)
1970 (carry-over)	409	For the Centre (reeling machines, machines for mulberry cultivation, books)

1970	55,270	For Sub-Centres (refrigerators of silkworm eggs)
1971 (carry-over)	2,824	For the Centre supplements to (reeling machines, machines for mulberry cultivation, and refrigerators of silkworm eggs)
1971	49,858	For the Centre (trenchers of back-hoe type, supplements to donated machinery and materials) For Sub-centres (rearing machinery and materials, refrigerators of silkworm eggs)
1972	49,377	For the Centre (reeling machines, machinery for engineering and iron works, vehicles) For Sub-centres (rearing machinery and materials, refrigerators of silkworm eggs) For sericultural farmers groups (machinery and materials for cooperative rearing of young silkworms)
1973	55,000	For the Centre (supplements to agricultural machinery, reeling machines, fertilizers, books) For Sub-centres (machinery and materials for silkworm rearing, refrigerators of silkworm eggs) For sericultural farmers groups (machinery and materials for cooperative rearing of young silkworms, fertilizers)
1974	57,000	For the Centre (machinery and materials for engineering and iron works)

		<p>For Sub-centres (apparatus for pebrine inspection, vehicles, machinery and materials for communications)</p> <p>For pilot villages (rearing tools, fertilizers, machinery and materials for mulberry cultivation)</p>
1975	41,192	<p>For the Centre (agricultural machines, supplements to reeling machines, fertilizers, audio-visual aids)</p> <p>For Sub-centres (machinery and materials for silkworm rearing)</p> <p>For pilot villages (machinery and materials for silkworm rearing, fertilizers)</p>

#### 5. Relation between the Centre and Sub-centres

The cooperation for the development of Thai sericulture is supposed to be promoted by the consolidation and reinforcement of the Sericultural Research and Training Centre in Korat and sub-centres in 4 other places. But the Centre and Sub-centres are, as shown in Fig. 7. Organization of Department of Agriculture, on a par with other local Sericultural Experiment Stations. As a matter of fact, there is no official name of Sub-centre. The administrative structure in Thailand is essentially different from that in Japan where there are one main station and several branch stations. This poses a big problem in pushing forward the cooperation under this project. Since it would be difficult to revise the organization there, it is necessary, on the phase of implementation, to clarify the division of business and cooperation between the Centre and Sub-centres and take measures to strengthen the

cooperation and liaison among them. Without this cooperative relation, common consciousness, or a responsible system, we cannot expect a future development. In this connection, Table 15 shows the budget of the Sericulture Division. In distributing the budget, the Director of the Division assigns different ranks to the Centre, Sub-centres, etc., it is said (the Centre accounting for about 20% of the total budget of the Sericulture Division).

1) Sericultural Research and Training Centre, Korat

In 1976, 3 long-term experts were changed, and 2 short-term experts were dispatched. As mentioned above, the project proceeded favorably. Table 16 outlines the posting of personnel and distribution of business. In each field, successors seem to be under training. But in the fields of the planning, drafting, implementation and putting together the results of research, further guidance and training are needed.

2) Sub-centre

When the business of Sub-centres is put in the right direction, the cooperation project advances more than a step. But their consolidation is not sufficient yet. The degree of achievement of R/D by Sub-centres is shown in Table 17. They produce and distribute silkworm eggs, and distribute mulberry saplings, but have not carried out the training of farmers; sufficient personnel has not been secured. In the production of silkworm eggs, however, they obtained results this year as shown in Table 18. What is worth noticing is that they started the production of F<sub>1</sub> eggs which had been considered difficult at Sub-centres. Although in the production of F<sub>1</sub> eggs, counterparts in the Centre appear to have given guidance, we would expect that this business will be really launched by their acquisition of techniques for the sex-

discrimination in a large quantity, control of eclosion, etc. On the other hand, some Sub-centres are producing eggs not only of bivoltine races, but also polyvoltine, which should be stopped, as this is not desirable in the prevention of pebrine.

As for the training of farmers, which is one of Sub-centres' tasks, it would be necessary to conduct it not in 4 Sub-centres, but in one, since there are differences in the acquired technique among Sub-centres, and also farmers' visit is not welcome, from a standpoint of pebrine prevention, if egg production is to be a primary task. In any case, the securement of necessary personnel and a thoroughgoing training are most important.

In addition, the rearing room of the Centre type is under construction not only in Sub-centres, but also in 6 local Sericultural Experiment Stations already. Furthermore, a substantial sum of money is appropriated in the budget for the current year for this purpose (Table 15). Although this aims at the production of polyvoltine silkworm eggs for weft yarns, too, it is essentially due to the fact that the Centre, Sub-centres and local Sericultural Experiment Stations are on the same status, which is partly revealed by the dispatch of technical staff to Japan.

#### 6. Thai Government's Future Plan for the Development of Sericulture

##### 1) Complete Self-supply of Warp of Thai Silk

The country imported 175 tons, on a yearly average, of thrown silk for warps during 10 years, 1963-1973, and 110 tons, 1972-1973. As more and more Thai raw silk is produced, the importation of warps has been limited to 3 times as much as the holdings of Thai raw silk from March 1976 by law. The target is that warps will be completely selfsupplied in 5 years.

2) Plan for the Promotion of Sericulture in Northeastern Region of Thailand

In September 1976, an aid plan for 5 years, 1976-1980, by USOM (United States Operations Mission to Thailand) was signed, which may be outlined:

(1) In 10 settlement areas, 150 selected sericultural farmers each, totaling 1,500, conduct modern sericulture. A farm has 4 rai of mulberry field, harvesting 4,212 kg of leafage to rear about 100 moths (2 cases of eggs) per rearing season. Rearing 6 times a year, they plan to crop 316 tons of cocoon in total (4 rearings are furnished with homemade eggs and 2 with imported ones).

(2) From these works, each farm will get a gross income of 12,000 bahts as cocoon price.

(3) The aid amounting to 52 million bahts will be refunded in 40 years, with low interest of 2% for 10 years and 3% for the subsequent 30 years.

3) Measures for raising the income of minor sericultural farmers

The general farmer in the northeastern region earns 16 bahts per day per head. But sericultural farmers of polyvoltine silkworm races, numbering 300,000, makes only 7-8 bahts. They have a plan to increase their income to 16 bahts.

For the purpose, (a) mulberry fields of low productivity, 200 kg/rai, will be replanted. (b) The same techniques to prevent sericultural diseases and control fly pests as used in the rearing of bivoltine races will be introduced to that of polyvoltine races.

Note: The general sericulturist rears polyvoltine races for west use, while farmers in settlement areas raise bivoltine races for warp.

4) Plan to increase sericultural extension staff

To cope with the sericultural promotion project, the Department of Technical Extension will increase, under a 5-year plan, extension staff by 5-6 per county, or about 100 for 15 counties. They will be trained in the Centre, Korat.

#### CHAPTER 4. CONTENTS OF THE DISCUSSION WITH THAI PEOPLE

On the future plans to cooperate in this project, the Guidance Team held repeated discussions with dispatched experts, and deduced "basic way of thinking" and "concrete items on which priority researches are to be conducted for timely conclusions," as summarized below, which were almost agreed upon by Thai Government officials (Mr. Sombat, Vice-Director of the Department of Agriculture, Mr. Chote, Chief of Sericulture Division, Mr. Stin, DTEC, Mr. Somchard, Director of Sericultural Research and Training Centre, and Mr. Somport, Vice-Director of the Centre) after minute discussions.

1. Basic Way of Thinking

1) Respect R/D. In the field of extension, however, take broad measures to cope with the actual conditions.

2) On the premise that the cooperation in this project terminates in 1978, researches are narrowed down to those which are under way, without starting new tasks in principle.

3) Re-checking the results of previous researches and the contents of the researches under way, classify them into: (1) those which are to be disseminated, (2) those on which researches are to be continued, and (3) those which are not likely to produce results. In addition, preparation will be made so that after the end of the project, Thai people may perform researches independently.



4) For a closer linkage between the Centre and Sub-centres, carry out common experiments, as a concrete measure.

5) For the purpose of having techniques stay for long, completed techniques are practiced preferentially at one Sub-centre and one pilot village selected, so that a system for the extension of model sericultural techniques be built up.

6) As regards the donation of machinery and materials, make it, in principle, for replacements based on the present size of the Centre, Sub-centres and pilot sericultural villages.

7) Training of counterparts and posting of right men in the right places.

2. Concrete Items on Which Priority Researches are to be Conducted for Timely Conclusions

See the attached table below.

(Attached Table)

## Concrete Items on Which Priority Researches are to be Conducted for Timely Conclusions

Classification	Standard	Target of Research	Subjects of Research	Remarks
Rearing (mulberry cultivation, silkworm rearing, pathology)	6 rearings a year	1. Establishment of training and harvesting methods of mulberry field for young silkworms 2. Establishment of training and harvesting methods of mulberry field for old silkworms	1. Experiment on the management of mulberry field 2. Experiment on the manuring according to the conditions of location 3. Experiment on the countermeasures to root rot disease (1) Establishment of grafting technique (2) Appraisal of the effectiveness of dense planting-early-yield mulberry cultivation (3) Selection of disease-resistant mulberry races 4. Establishment of the ecology and control method of insect pests (stem borer and mealy bug) 5. Experiment on the relation between leaf quality and cocoon crop 6. Experiment on the mass rearing of $F_2$ silkworm eggs 7. Examination of mounting environment 8. Diagnostic methods of various sericultural diseases 9. Establishment of the controlling method of aspergillus disease 10. Establishment of disinfecting methods of silkworm body and rearing bed (incl. examination of new chemicals) 11. Tabulation of the standard of old silkworm rearing by rearing seasons	Common test
(Training) Silkworm Race (Improvement of races, Production of eggs)	Breeding healthy silkworm races, produce and distribute silkworm eggs based on R/D according to the rearing plan	3. Tabulation of rearing standard of young silkworms 4. Tabulation of rearing standard of old silkworms	12. Breeding of healthy silkworm races 13. Aptitude test of hybrids ( $F_1$ , $F_2$ -multiple cross) 14. Comparative test of hybrids 15. Survey of the duration of feeding period (hatching-eclosion) on main parent races eggs of $F_1$ hybrids 16. Survey of the amount of supplied leaves on main parent eggs of $F_1$ hybrids 17. Experiment on sex-discrimination 18. Experiment on artificial chilling 19. Rearing experiment of inferior cocoons	Common test
Raw Silk Reeling	Try to raise reeling techniques and make them easy	5. Breeding of healthy commercial races 6. Tabulation of the rearing standard of parent silkworm of $F_1$ hybrid 7. Drawing up of working procedure of egg procedure 8. Larger amount of raw silk, improved quality, higher working efficiency		Reeling of reeling technicians
Others	Training of in the management and operation of reeling operators and of their operators			

Of the above, 1. Basic Way of Thinking was arranged in a Tentative Report (below), excluding 6) and making 7) a comment, which was submitted to the Department of Agriculture (Vice-Director). 2. Concrete Items on Which Priority Researches Are to Be Conducted for Timely Conclusions was transmitted to the Department verbally. Whereupon, we received a reply that they would examine items 1)-5), as these are difficult problems under the administrative organization of Thailand; other items appeared to have been understood. In this connection, Thai Government officials made requests as follows:

- (1) They want the project will not terminate completely in 1978, but step by step.
- (2) Although it will be difficult to extend the project, they want experts in certain fields, e.g., egg production, dispatched continuously. As after-care, please consider the dispatch of short-term experts, e.g., reeling machine-- including the training of factory technicians, refrigerators, sex-discrimination, technical extension.
- (3) The training of counterparts be prolonged so that they may formulate a planning in respective themes.
- (4) As there is no university giving a special course in sericulture in Thailand, please take measures to allow students to study in a university, etc., in Japan.
- (5) In case parts of donated machinery and materials become insufficient, please create a "window" through which parts are purchased.
- (6) They want the Director of the Centre of Sub-centre be dispatched to Japan for training.

## Tentative Report on Sericultural Technical Cooperation Project

by

Japanese Guidance Team

The Japanese Guidance Team for the Sericultural Project in Thailand, which was assembled by Japan International Cooperation Agency (J.I.C.A.) and headed by Dr. K. HAZAMA, Director, Division of Research Planning, National Sericultural Experiment Station, visited Thailand from November 30 to December 16, 1976.

The technical cooperation project for the sericultural development in Thailand had been carried out for 8 years under the Record of Discussion between Japan and Thailand signed on 8th March 1969, and is expected to expire in March 1978. In order to confirm a guide line and implementation plan for a final year of the project, the Guidance Team has studied the present situation of the sericultural research and training centre in Korat, Sub-centres in Khon Khaen and Udon, several local sericultural experiment stations and pilot villages.

The other hand, this guidance team has a series of discussion with the authority concerned in Thailand, the project leader and other Japanese experts.

The result of survey by the guidance team outlined the Basic Items of implementation plan of the project for a final year as follows:

- I. While the cooperation in a final year will be carried out under the Record of Discussion, as to fit in with results of research should be extended to farmers, existing status of farmers.
- II. As this project is expected to expire in March 1978, new research subjects will not be established as a rule.

III. All of research subjects conducted so far and in future would be classified as follows, while they should be carried out by Thailand after expiration of Record of Discussion.

- 1) to be transferred to extension
- 2) to be continued
- 3) to be stopped due to the difficulty to get effective results in only one year

IV. In order to extend results of research and to keep close contact between centre and sub-centre, several experiments under the harmonized system should be carried out.

V. In order to settle the technique developed in farmers in a final year, the guidance should be concentrated to one sub-centre and one pilot village with close relation to the sub-centre for establishing a model sericultural extension system.

\*Comment. The team hopes to be paid due attention to the post of officers who were trained in Japan pursuant to the Record of Discussion.

The team takes this opportunity to express its appreciation and thanks to Dr. Prokob Kanjanasoen and other officers concerned for most helpful cooperation and courtesies extended to its members during their stay in Thailand.

December 16, 1976

Dr. Kazuo Hazama  
The Leader of Japanese  
Sericulture Guidance Team

## CHAPTER 5. IMPORTANT MATTERS IN PROMOTING COOPERATION PROJECT

The cooperation project in the development of Thai sericulture which started in 1969 has developed favorably. The current cooperation based on the 3rd R/D is expected to end in March 1978. The remaining time is only a year and 3 months. This Sericulture Guidance Team, taking these situations into consideration, investigated the current state and problems of the project, and conferred with Thai officials concerned and the team of dispatched experts. As a result, matters mentioned in Chapter 4 are decided to be promoted. It is necessary, furthermore, to put stress on the following items in the future cooperation project:

### 1. How to Tackle the Cooperation Project

In March 1978 when the cooperation project terminates and is taken over by Thai people, many problems may remain in research, investigation, etc., and many others will occur thereafter. But the sericultural promotion plan in the northeastern region of Thailand to manufacture warps of Thai Silk from bivoltine silkworm races is, on the whole, set on the right track. The modernization of sericulture is advancing steadily, though fairly slower than expected, thanks to the results obtained in each special field. It would be difficult, however, achieve the targets in all fields within the cooperation term.

It is to be expected therefore that (1) to set the target in the consolidation of the foundation on which Thai people can, independently, operate the Centre, set up pilot sericultural villages, and guide them smoothly, and (2) elicit problems in close cooperation with Experts' teams to find out solutions through repeated discussions.

## 2. Solution of Problems in the Production of Silkworm Eggs

From the standpoint of the principle in the promotion of Thai sericulture that silkworm eggs are domestically supplied, the establishment of a system by which good silkworm eggs are secured to meet increasing demand from pilot sericultural villages, etc., is mandatory. Without this system, there would be no bright prospect of higher cocoon crops.

On the side of egg production, we may enumerate these problems: breeding of commercial silkworm eggs, improvement of egg producing technique, complete equipment of egg preserving facilities, higher productivity of mulberry field, establishment of a system of business division relative to egg production, clarification of yearly sericultural plans in reclaimed land and others, retraining of the staff of Sub-centres, Sericultural Experiment Stations, etc. Since these have relation to the administrative organization, budget, personnel administration, operation, etc. of Thai Government, it would be difficult to improve them quickly. Currently, however, the Centre can produce eggs of 1,200 - 1,400 cases (70,000 moths) a year at the most, including F<sub>1</sub> and F<sub>2</sub>. Demand for eggs, on the other hand, is exceeding the capacity of the Centre, as pilot villages are consolidating their foundation steadily, with 5 villages entering into a cocoon raising structure. They are coping with the situation through the cooperation of Sub-centres. Furthermore, the progress in the sericultural promotion project by USOM aid from 1976 (see Chapter 4) will make imbalance between supply and demand for eggs more remarkable. It is especially necessary, therefore, to raise the technical level of the personnel in charge of egg production, particularly, in Sub-centres. It is hoped, moreover, that Sub-centres may bring their

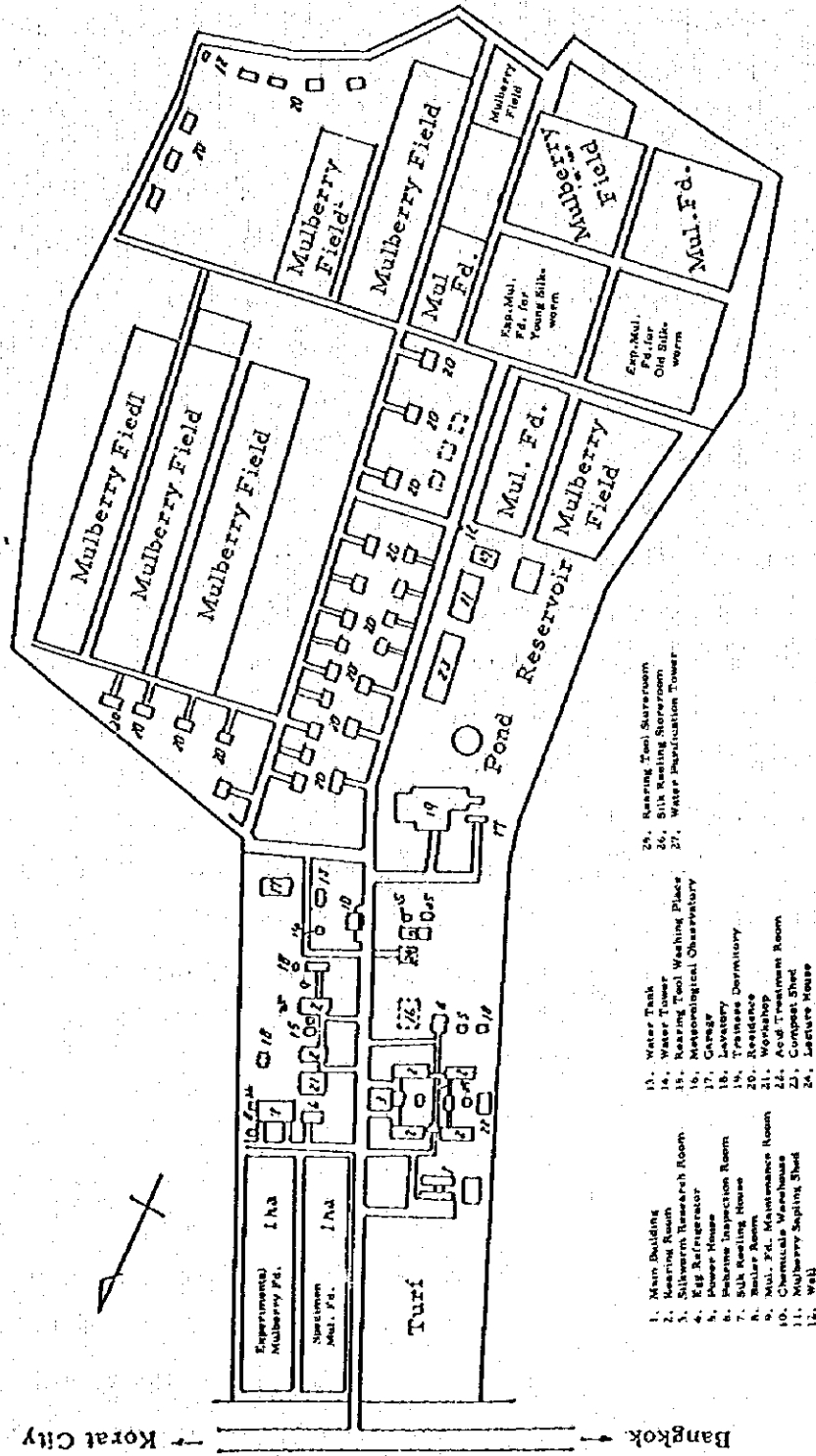
function into full play.

3.           **Strengthening of the Extension and Guidance System for Pilot Villages**

With respect to pilot sericultural villages which are to be the base of operation to make modern sericulture stay in Thailand, those in Phimai, Prasart, Bangruad, etc., are, thanks to the proximity to the Centre, receiving the technical guidance from experts or technicians of the Centre for the purpose. In case, however, where pilot villages and sericultural farmers increase in the future, the current system will not be able to cope with the situation. So, the staff of settlement offices and Sub-centres should, in concert, afford technical guidance to farmers. Since the staffs of POD, Department of Extension and Department of Agriculture who are concerned in pilot villages lack horizontal liaison due to the organization of Thai Government, measures should be taken to make liaison and coordination closer. Furthermore, leaders are to be given capacity for technical guidance suitable to the spot, and farmers supplied with sufficient guidance repeatedly, so that pilot sericultural villages may function to the full, we should expect.



Fig. 1. Map of Sericultural Research and Training Centre, Korat



- |                               |                                    |                              |
|-------------------------------|------------------------------------|------------------------------|
| 1. Main Building              | 13. Water Tank                     | 25. Rearing Tool Storehouse  |
| 2. Rearing Room               | 14. Water Tower                    | 26. Silk Reeling Storehouse  |
| 3. Silkworm Research Room     | 15. Rearing Tool Washing Place     | 27. Water purification Tower |
| 4. Egg Refrigerator           | 16. Neurophysiological Observatory |                              |
| 5. Power House                | 17. Canteen                        |                              |
| 6. Quarantine Inspection Room | 18. Laboratory                     |                              |
| 7. Mulberry Rearing House     | 19. Trainees Dormitory             |                              |
| 8. Mulberry Rearing House     | 20. Residence                      |                              |
| 9. Mul. Fd. Maintenance Room  | 21. Workshop                       |                              |
| 10. Chemicals Warehouse       | 22. Acid Treatment Room            |                              |
| 11. Mulberry Sapling Shed     | 23. Compost Shed                   |                              |
| 12. Well                      | 24. Lecture House                  |                              |

Fig. 2. Air Temperature at the Korat Centre (Average)

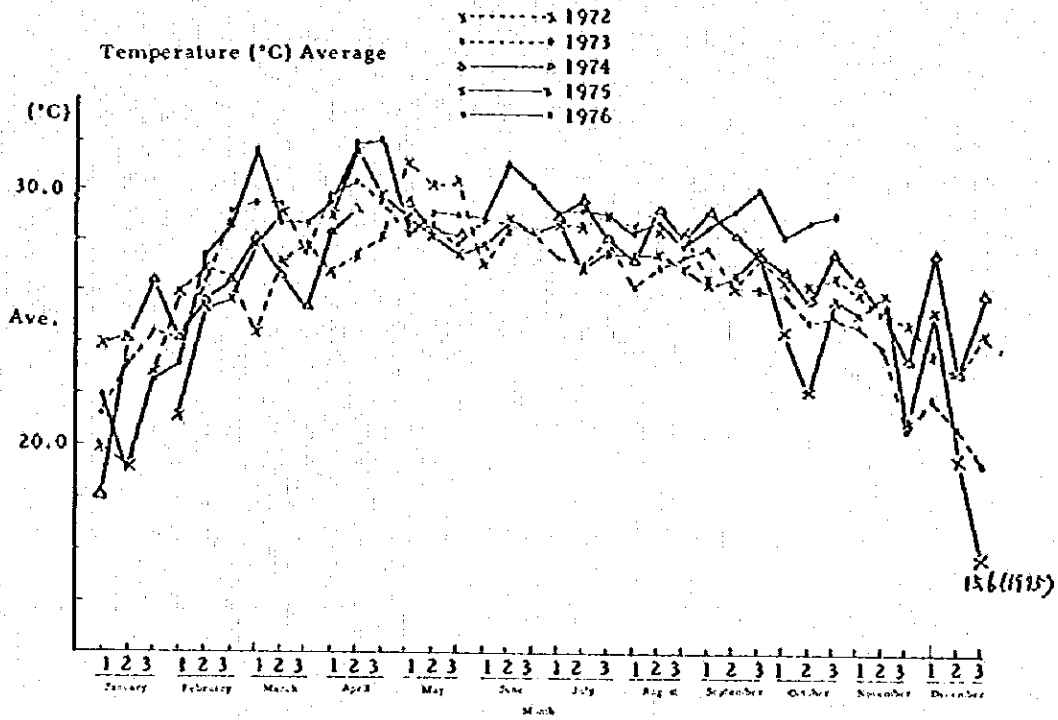


Fig. 3. Rainfall at the Korat Centre

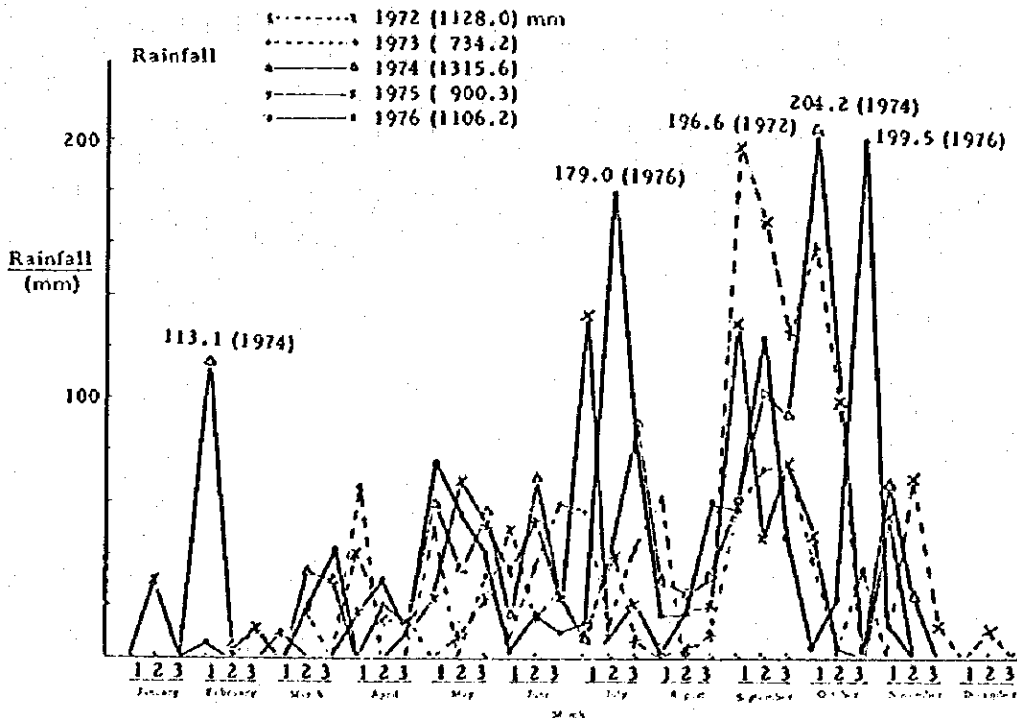


Fig. 4. Air Temperature at the Kora Centre (Highest)

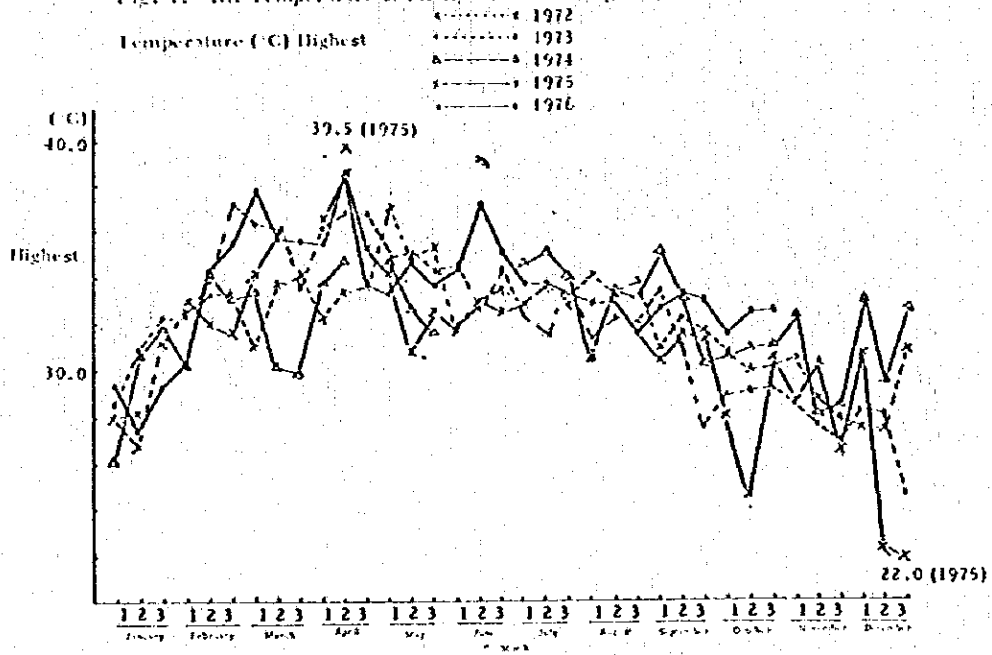


Fig. 5. Air Temperature at the Kora Centre (Lowest)

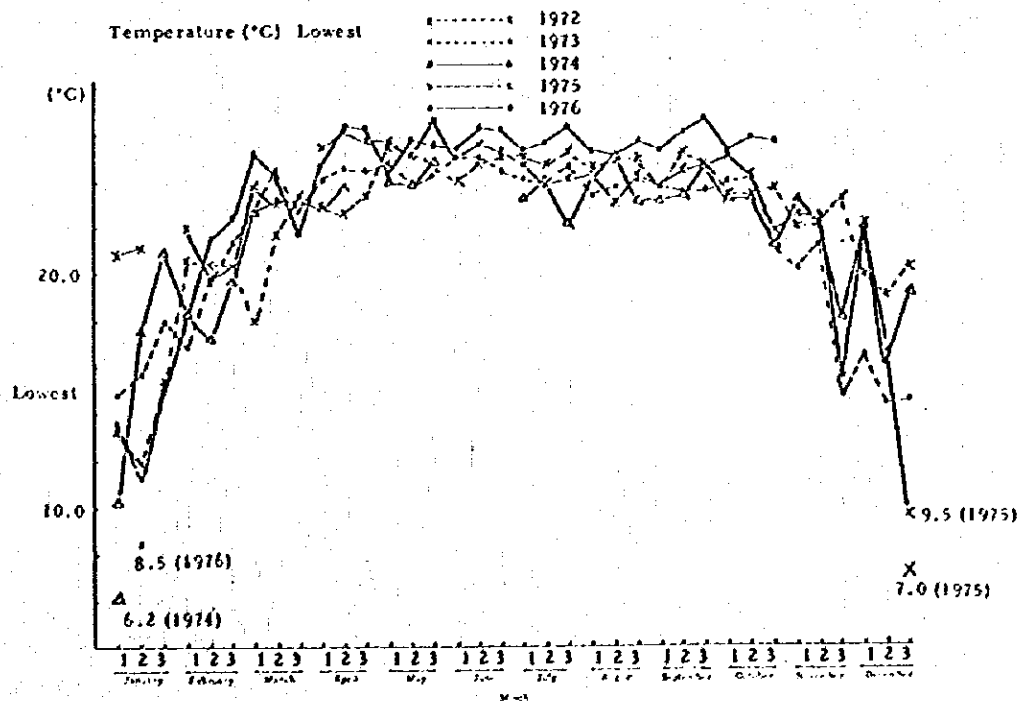


Fig. 7. ORGANIZATION

DEPARTMENT OF AGRICULTURE

- OFFICE OF THE SECRETARY
- FINANCE DIVISION
- PERSONNEL DIVISION
- PLANNING DIVISION
- RICE DIVISION
- FIELD CROPS DIVISION
- HORTICULTURE DIVISION
- SERICULTURE DIVISION
- RUBBER DIVISION
- AGRICULTURAL ENGINEERING DIVISION
- PLANT PATHOLOGY AND  
MICROBIOLOGY DIVISION
- ENTOMOLOGY AND ZOOLOGY DIVISION
- AGRICULTURAL CHEMISTRY DIVISION
- ATECHNICAL DIVISION
- REGULATORY AGRICULTURE DIVISION

- Administration Section
- Sericultural Research and Training Centre, Korat
- Udon Thani Sericultural Experiment Station
- Khon Kaen Sericultural Experiment Station
- Muk Dahan Sericultural Experiment Station
- Ubol Ratchathani Sericultural Experiment Station
- Put Thai Song Sericultural Experiment Station
- Nong Khai Sericultural Experiment Station
- Roi Et Sericultural Experiment Station
- Buri Ran Sericultural Experiment Station
- Chaiya Phum Sericultural Experiment Station
- Surin Sericultural Experiment Station
- Sakon Nakhon Sericultural Experiment Station
- Sri Saket Sericultural Experiment Station

Fig. 3. SERICULTURE & SILK DEVELOPMENT IN THAILAND

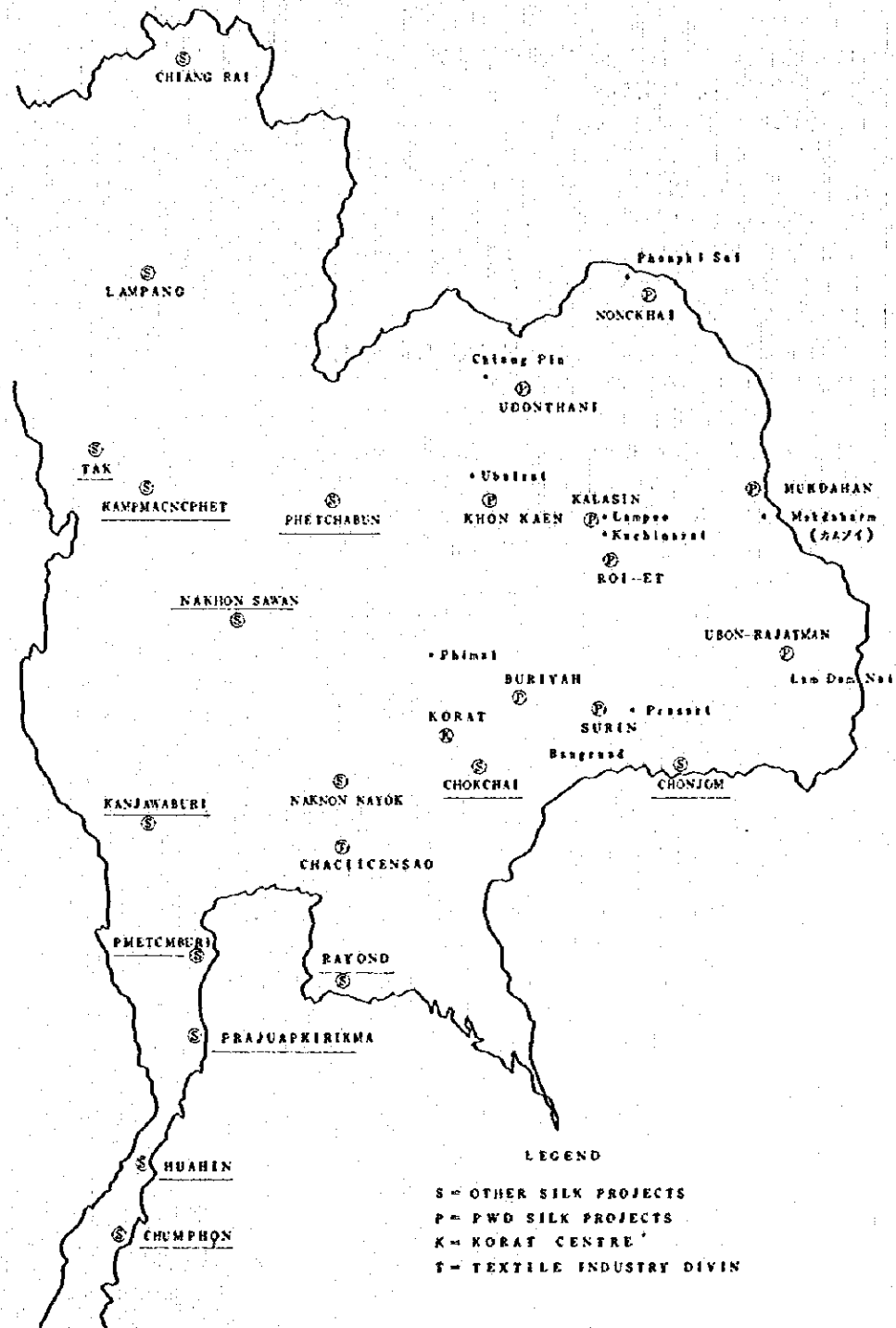


Table 1. Comparative Test of Hybrids (Common Test) 1976

Hybrid	Place	Flakitate	Feeding 5 age d.h.	Term 1-5 age d.h.	Sound Pupa Ratio %	Normal Cocoon Percentage %	Cocoon Weight g	Shell Weight cg	Shell Ratio %
A (K <sub>14</sub> × K <sub>6</sub> ) × (K <sub>1</sub> × T)	Korat	Aug 13	6.03	22.00	94.3	91.5	1.55	28.5	18.4
	Mukdahan	Seep 13	5.06	19.03	73.6	81.0	1.89	37.8	20.0
	Surin	Seep 21	5.00	17.19	90.0	81.9	1.75	33.8	19.4
	Khan Kaen	Seep 21	5.19	20.01	89.0	78.6	1.98	38.5	19.4
	Ave		5.13	19.18	86.8	83.3	1.79	34.7	19.3
B (K <sub>1</sub> × K <sub>4</sub> ) × (K <sub>10</sub> × K <sub>9</sub> )	Korat	Aug 13	6.03	22.00	90.7	87.5	1.53	29.3	19.2
	Mukdahan	Seep 13	5.06	19.03	70.3	87.7	1.83	37.6	20.5
	Surin	Seep 21	5.00	17.19	94.7	85.8	1.60	21.2	19.5
	Khan Kaen	Seep 21	5.19	20.01	87.3	78.9	2.01	39.1	19.5
	Ave		5.13	19.18	85.8	85.0	1.74	34.3	19.7
C (K <sub>6</sub> × K <sub>1</sub> ) × (K <sub>10</sub> × K <sub>9</sub> )	Korat	Aug 13	6.03	22.00	95.3	90.8	1.77	37.0	20.9
	Mukdahan	Seep 13	5.06	19.03	80.4	87.4	1.98	42.9	21.7
	Surin	Seep 21	5.00	17.19	90.1	84.0	1.79	36.6	20.5
	Khan Kaen	Seep 21	5.19	20.01	85.9	80.5	2.13	43.9	20.7
	Ave		5.13	19.18	87.9	85.7	1.92	40.1	21.0
D (A <sub>8</sub> × K <sub>6</sub> ) × (K <sub>8</sub> × T)	Korat	Aug 13	6.03	22.00	94.0	89.2	1.60	30.1	18.8
	Mukdahan	Seep 13	5.06	19.03	72.0	87.0	1.88	38.5	20.6
	Surin	Seep 21	5.00	17.19	90.7	87.0	1.81	35.7	19.8
	Khan Kaen	Seep 21	5.19	20.01	97.1	87.1	2.08	39.8	19.2
	Ave		5.13	19.18	88.5	87.6	1.84	36.0	19.6

Table 2. Improved Silkworm Hybrid Test

27th Test  
"HAKITATE" on Oct. 15, 1976

NO	Hybrids	Feeding term		Sound Pupa Ratio %	Cocoon		Shell Ratio %	Remark
		5 age	d.h		Normal %	Whale Weight g		
		d.h	d.h		%	cg		
171	K <sub>1</sub> × T	5.17	19.00	92.3	1.59	28.5	17.9	
172	K <sub>6</sub> × T	5.17	19.00	94.0	1.72	32.0	18.6	
173	A <sub>8</sub> × T	5.17	19.00	82.7	1.69	30.5	18.0	
174	A <sub>14</sub> × T	5.03	19.00	92.3	1.75	30.8	17.6	
175	K <sub>8</sub> × K <sub>1</sub>	6.03	20.00	91.0	1.72	34.5	20.1	
176	K <sub>10</sub> × K <sub>1</sub>	6.03	20.00	90.7	1.70	34.8	20.5	
177	K <sub>14</sub> × K <sub>1</sub>	6.03	20.00	89.7	1.74	33.1	19.0	
178	A <sub>10</sub> × K <sub>1</sub>	6.03	20.00	92.3	1.77	33.9	19.2	
179	A <sub>8</sub> × K <sub>8</sub>	6.03	20.00	77.0	1.74	37.2	21.4	
180	A <sub>8</sub> × K <sub>14</sub>	6.03	20.00	85.3	1.92	39.3	20.5	
181	A <sub>8</sub> × A <sub>9</sub>	5.17	20.00	74.6	1.50	29.7	19.8	
182	A <sub>9</sub> × A <sub>14</sub>	5.17	21.00	86.7	1.62	30.5	18.8	
183	(K <sub>1</sub> × T) <sub>2</sub>	5.03	19.00	83.7	1.40	23.6	16.9	
184	(A <sub>10</sub> × K <sub>1</sub> ) <sub>2</sub>	5.17	21.00	47.3	1.57	28.6	18.2	
185	(A <sub>9</sub> × A <sub>14</sub> ) <sub>2</sub>	5.22	21.00	42.0	1.53	27.2	17.8	
186	*(K <sub>8</sub> ·K <sub>1</sub> ) × (K <sub>1</sub> ·T)	6.03	20.00	86.3	1.45	25.8	17.8	*J-C x J-C
187	*(K <sub>14</sub> ·K <sub>6</sub> ) × (K <sub>1</sub> ·T)	6.03	21.00	83.3	1.58	28.4	18.0	"
188	(K <sub>8</sub> ·T) × (K <sub>4</sub> ·K <sub>1</sub> )	6.03	21.00	87.0	1.53	28.1	18.4	
189	(K <sub>4</sub> ·K <sub>1</sub> ) × (A <sub>9</sub> ·A <sub>10</sub> )	5.22	21.00	76.0	1.47	27.5	18.7	
190	(K <sub>1</sub> ·K <sub>4</sub> ) × (K <sub>10</sub> ·K <sub>9</sub> )	5.17	20.00	79.7	1.64	31.1	19.0	
191	(K <sub>8</sub> ·T) × (K <sub>6</sub> ·K <sub>4</sub> )	6.03	21.00	84.0	1.65	31.7	19.2	
192	(K <sub>6</sub> ·K <sub>4</sub> ) × (A <sub>9</sub> ·A <sub>10</sub> )	5.17	21.00	74.0	1.60	31.8	19.9	
193	(K <sub>8</sub> ·T) × (K <sub>6</sub> ·K <sub>1</sub> )	6.03	21.00	90.7	1.60	30.2	18.9	
194	(A <sub>9</sub> ·A <sub>10</sub> ) × (K <sub>6</sub> ·K <sub>1</sub> )	6.03	21.00	81.3	1.67	32.4	19.4	
195	(K <sub>6</sub> ·K <sub>1</sub> ) × (K <sub>10</sub> ·K <sub>9</sub> )	5.17	20.00	79.0	1.62	33.6	20.7	
196	(K <sub>8</sub> ·T) × (A <sub>8</sub> ·K <sub>6</sub> )	5.03	20.00	89.3	1.69	31.8	18.8	
197	(K <sub>11</sub> ·A <sub>14</sub> ) × (K <sub>8</sub> ·T)	5.17	20.00	81.0	1.63	30.2	18.5	
198	(B <sub>15</sub> ·B <sub>14</sub> ) × (K <sub>8</sub> ·T)	5.17	21.00	78.7	1.70	33.0	19.4	
199	(B <sub>15</sub> ·B <sub>14</sub> ) × (A <sub>9</sub> ·A <sub>10</sub> )	6.03	21.00	75.3	1.85	38.0	20.5	
200	(A <sub>14</sub> ·K <sub>1</sub> ) × (K <sub>14</sub> ·K <sub>10</sub> )	5.17	21.00	47.7	1.61	31.8	19.8	

Table 3. Production and Distribution of Silkworm Eggs in the Korat Centre

Classi- fication \ Year		1973	1974	1975	1976*	Total
		moths	moths	moths	moths	moths
Pro- duction	F <sub>1</sub>	30.529	61.054	59.904	66.037	217.524
	F <sub>2</sub>	33.869	35.350	21.485	18.991	109.695
	Poly- voltine	1.224	—	—	—	1.224
	Total	65.622	96.404	81.389	85.028	328.443
Distri- bution	F <sub>1</sub>	14.270	40.827	68.285	42.104	165.486
	F <sub>2</sub>	32.353	31.935	23.384	17.450	105.122
	Poly- voltine	1.790	—	—	—	1.790
	Total	48.413	72.762	91.669	59.554	272.398

\*Distribution for 1976 covers January - November.



Table 4. Output of raw silk in the Centre

Month	1974	1975	1976
	kg	kg	kg
Jan.	-	111.0	127.2
Feb.	37.9	76.7	97.6
Mar.	11.1	91.3	73.6
Apr.	17.4	70.4	68.1
May	50.0	108.4	68.1
Jun.	21.5	56.8	65.5
Jul.	38.0	79.7	108.1
Aug.	19.6	77.2	122.2
Sept.	79.6	155.9	134.6
Oct.	71.8	121.6	85.3
Nov.	74.1	125.3	102.1
Dec.	94.6	117.0	
Total	515.6	1191.3	



Table 8. Reception of Trainees in Japan (1971 - 1976)

Year	Name	Specialized Course	Term	Remarks	Receiving Institution
1971	Mr. Pisem Prao-HANTASEN	Refrigerator management for silkworm egg storage	Aug. 4-Nov. 30		Silkworm Physiology Division, Seri. Expt. Station, MAF
1972	Mr. Sombat MANEECHOTE	Mulberry Cultivation	July 9-Oct. 9	Chief of Mukdaharn Stn.	Moriculture Division, Seri. Ex. St., MAF
	Mr. Pann PAN NENGPRET	Silkworm breeding	"		Chubu Branch St., Seri. Ex. St., MAF
	Mrs. Chanya PANENCPET	Silk reeling	"		Okaya Filature Ex. St., Seri. Ex. St., MAF
	Miss. Laksanawadee SARANOKUL	Pathology	"		Pathology Division, Seri. Ex. St., MAF
1973	Mr. Sombat SUPALSA	Silkworm rearing	Aug. 20-Dec. 19	Chief of Loai-ed Stn.	Sericulture Div. Seri. Ex. St., MAF
	Mr. Viteckhart CHOMOCHUEN	Silkworm egg production	"		Shinjo Silkworm Egg Ex. St., Seri. Ex. St., MAF
	Miss. Wallapa LAOESTHAKUL	Training for sericulture	"		Chubu Branch St., Seri. Ex. St., MAF
	Miss. Paitawan LEKUTHAI	Silkworm breeding	"		Tohoku Branch Station, Seri. Ex. St., MAF
1974	Mr. Manoch PANYAWANICH	Mulberry cultivation	Sept. 1-Oct. 19		Moriculture Div., Seri. Ex. St., MAF
	Mr. Nimit MUTTAMRA	Mulberry cultivation	Aug. 25-Dec. 24		Kyushu Branch St., Seri. Ex. St., MAF
	Miss. Jaree JAROONCHAI	Silkworm breeding	"		Chubu Branch St., Seri. Ex. St., MAF
	Mrs. Konthawirat CHOMHUEN	Silk reeling	"	Puriyam Stn.	Okaya Filature Ex. St., Seri. Ex. St., MAF
	Mr. Tienchai AUNCHITWANTANA	Silkworm egg production	"		Miyazaki Silkworm Egg Ex. St., Seri. Ex. St., MAF
	Mr. Narchai SITHKAN	Silkworm egg production	"	Mukdaharn Stn.	Same as above
1975	Mr. Svit INTRAWANKOOL	Mulberry cultivation	May 22-Sept. 21	Ubol Stn.	Chubu Branch St., Seri. Ex. St., MAF
	Mr. Lek SRISWAN	"	"	Surin Stn.	Same as above
	Miss. Sutsitip BUTCHUND	Silkworm breeding	"		Tohoku Branch Station, Seri. Ex. St., MAF
	Mrs. Ponthip PETHMONT	Silkworm rearing	"	Buriram Stn.	Sericulture Div. Seri. Ex. St., MAF
1976	Mr. Cheum KAMKLA	Silkworm egg production	May 14-Feb. 16	(JETRO)	Shinjo Silkworm Egg Ex. St., Seri. Ex. St., MAF
	Mr. Puchong PTHMONT	"	June 18-Oct. 17		Kyushu Branch St., Seri. Ex. St., MAF
1977	Mr. Gata CHEENCHIEM	Mulberry cultivation	"		Same as above
	Mr. Teera NGARMPRASIT	Silkworm rearing	"		Miyazaki Silkworm Egg Ex. St., Seri. Ex. St., MAF
	Mr. Peerapong CHAOSATTAKUL	Silkworm egg production	"	Udon Stn.	Same as above
	Mr. Banjab HARNTONGCHAI	"	"	Khonkaen Stn.	Same as above
Station Directors Counterparts			1 - 2 Months		
			4 Months		

Table 9. Settlers Trained

(by the end of 1976)

Pirot Village	Province	Trained Settlers	Remarks
Phimai	Korat	67	Raising cocoons already
Prasert	Surin	64	
Bangruad	Buriram	60	
Mukdaharn	Nakorn Panom	31	
Ubolrat	Khonkaen	30	
Lampao	Kalasin	20	
Lam Dom Noi	Ubol	21	
Kuchinarai	Kalasin	41	
Phonphi Sai	Nongkhai	39	
Cheng Pin	Udon	3	
Huoy Luong	Udon	11	
<b>Total</b>		<b>387</b>	

Table 10. Receipt of Cocoons (kg) 1973 - 1976 Oct.

Year	Month	Locality						Total
		Pimai	Prasat	Bangruad	Mukdaharn	Kabinburi	Others	
1973	8	494						494
	10	370						370
	11	547						547
	total	1,415						1,411
1974	1	470					22	492
	2							115
	3	106		9				115
	4	414		17			14	445
	5				158			158
	6	379					71	450
	7						36	36
	8	886	307				108	1,301
	9						97	97
	10	907	442	11	146		80	1,586
	11	1,300					131	1,431
	12	863	307				166	1,336
	total		5,325	1,056	37	304		725
1975	1						150	150
	2	178	377					555
	3						144	144
	4	745	571					1,316
	5						24	24
	6	995	722				77	1,794
	7	524	702			343	129	1,698
	8	1,178	538				54	1,770
	9	716		205			90	1,011
	10	1,020	317	640				1,977
	11	465	305			129	351	1,250
	12						155	155
	total		5,821	3,532	845		472	1,174
1976	1	612	294	409		30		1,345
	2							
	3					180		180
	4		80	111				191
	5		631					631
	6			374		30		404
	7	791	224	218		288	19	1,540
	8		635	168				803
	9	700			94	258	22	1,074
	10		199	312	128	228		867
	total		2,103	2,063	1,592	222	1,014	41

Table 11. Rearing Conditions by Numbers in Pilot Sericultural Villages

Phimai

Number	Rearing farms	Date of "HAKITATE"	Eggs Used	Cocoon Crop	Cocoon Weight	Cocoon Shell Weight	Cocoon Shell Percent.	Eliminated Cocoon %	Cocoon Price	Silkworm Races Reared
			sheets	kg	g	g	%	%	Baht	
1	27	1973. 7.21	28	494.3	1.17	19.7	16.8			(K <sub>4</sub> xT)F <sub>2</sub> -K <sub>4</sub> xT
2	27	9.10	28	369.6	1.51	29.5	19.5			K <sub>1</sub> xT
3	27	10.18	29	546.5	1.38	26.5	19.2			K <sub>4</sub> xT <sub>1</sub> K <sub>1</sub> xT
4	27	12.18	30	470.0	0.88	15.5	17.6			TxK <sub>1</sub>
5	5	1974. 2.15	7	106.2						TxK <sub>4</sub>
6	21	3.26	25	414.0	1.08	20.1	16.9	21.9		(K <sub>4</sub> xT)F <sub>2</sub> K <sub>1</sub> xT
7	26	5.30	33	378.8	1.29	22.7	17.6	16.1		K <sub>1</sub> -K <sub>1</sub> xT-Ta
8	9	7.15	23	246.4	1.34	23.7	17.7			TxK <sub>1</sub>
9	27	7.24	36	640.0	1.34	23.7	17.7			TxK <sub>1</sub>
10	31	9.15	70	907.0	1.56	27.6	17.7	10.9		TxK <sub>1</sub>
11	32	10.15	72	1300.7	1.33	22.4	16.8	12.7		K <sub>1</sub> xT-TxK <sub>1</sub>
12	30	11.27	48	863.0	1.41	24.9	17.7	14.8		TxK <sub>1</sub> -K <sub>1</sub> xT
13	10	1975 1.30	15	177.9	1.36	22.9	16.8	14.5		TxK <sub>1</sub> -K <sub>1</sub> xT
14	28	3.10	31	391.1	1.30	23.3	17.9	18.8		TxK <sub>1</sub> -K <sub>1</sub> xT
15	5	3.24	20	353.6	1.27	23.9	18.8	21.6		K <sub>1</sub> xT
16	31	5.21	59.5	995.0	1.49	32.8	22.0	17.9		K <sub>7</sub> xK <sub>6</sub>
17	27	6.6	38	272.4	1.36	28.2	20.7	41.1		(K <sub>6</sub> xK <sub>7</sub> )F <sub>2</sub>
18	6	6.19	31	252.0	1.38	28.1	20.4	26.3		K <sub>6</sub> xK <sub>7</sub>
19	32	7.6	72.5	914.0	1.43	30.2	21.1	28.6		K <sub>6</sub> xK <sub>7</sub>
20	18	7.25	67	264.2	1.39	27.2	21.0	59.6		(K <sub>6</sub> xK <sub>7</sub> )F <sub>2</sub>
21	32	8.22	52.5	715.6	1.65	34.2	20.8	17.2		K <sub>6</sub> xK <sub>7</sub>
22	18	9.17	60	200.3	1.72	37.1	21.6	34.3		K <sub>6</sub> xK <sub>7</sub>
23	30	10.6	50	818.8	1.40	23.8	17.2	23.4		(K <sub>1</sub> xT)F <sub>2</sub>
24	13	10.22	28	464.7	1.58	32.5	20.6	20.2		K <sub>6</sub> xK <sub>7</sub>
25	28	12.10	75	611.9	1.08	20.3	19.2	18.8		K <sub>1</sub> xK <sub>14</sub>
26	28	1976 6.20	20	791.1	1.28	25.4	19.9	37.1		K <sub>14</sub> xK <sub>6</sub>
27	25	8.27	55	700.2	1.61	32.3	20.1	42.8		K <sub>14</sub> x(K <sub>1</sub> xK <sub>6</sub> )

Prasart Number	Rearing farms	Date of "HAKIATE"	Eggs Used sheets	Cocoon Crop kg	Cocoon Weight		Cocoon Shell Weight cg	Cocoon Shell Percent.	Eliminated Cocoon %	Cocoon Price Baht	Silkworm Races Reared
					g	%					
1	15	1974. 8. 6	15	307.0	1.41	25.6	18.2				K1, K10x1, 1a
2	25	9.25	23	442.0	1.69	32.9	19.5				T-TaxK1, K6
3	23	11.25	18	307.4	1.40	25.3	18.1				K1x1, T-xK1
4	25	1.17	22.5	377.4	1.83	32.5	17.8				K6xK7
5	26	3. 3	26	571.1	1.41	25.9	18.4				K6xK7
6	15	5.10	30	337.8	1.71	34.4	20.1				K6xK7
7	14	6. 5	18	384.4	1.65	35.8	21.7	20.0			K6xK7
8	28	6.29	48	702.0	1.72	36.3	21.1	15.3	51.8		K6xK7
9	27	8. 1	40	537.7	1.80	37.8	21.0	24.5	47.4		K6xK7
10	27	9.17	40	317.1	1.79	38.1	21.3	14.5	51.0		K6xK7
11	20	10.22	54	305.0	1.43	22.8	16.0	46.7	33.0		K6xK7
12	14	12.15	35	293.6	1.16	21.5	18.6	12.9	48.8		K1xK14
13	9	1976. 3.10	30	80.0	1.53	33.9	22.2	34.1	44.8		K1xK14
14	27	5. 5	38	631.1	1.51	30.8	20.4	25.8	44.5		K14xK1
15	13	6.10	44	224.0	1.57	32.0	20.8	17.9	49.2		K6xK14
16	31	7.30	58.6	635.2	1.75	38.3	21.9	28.0	46.2		K10xK1
17	19	9.30	40	198.5	1.07	19.5	18.2	42.5	36.6		K1xK14

Table 12. Degree of Technique of Representative Farmers in Pilot Villages

Name of Farmers	Date of "RAKITATE"	Silkworm Eggs Used	Cocoon Crop	Cocoon Weight	Cocoon Shell Weight	Cocoon Shell Percentage	Reelable Cocoon Percentage	Unit Cocoon Price	Income from Cocoons	Cocoon Crop per Sheet of Eggs	1975	
											kg	kg
13. Yard (1st)	May	1.0	19.2	1.63	35.0	21.4	92.6	56	1,075.20	19.2	K <sub>7</sub> xK <sub>6</sub>	
	July	1.5	20.4	1.61	35.6	22.1	70.2	46	938.40	13.6	K <sub>6</sub> xK <sub>7</sub>	
	Aug.	1.3	21.6	1.61	34.1	19.0	92.1	54	1,166.40	16.2	K <sub>6</sub> xK <sub>7</sub>	
	Oct.	1.0	17.0	1.37	24.2	17.7	87.4	46	782.00	17.0	(K <sub>1</sub> xT)F <sub>2</sub>	
	Dec.	1.0	14.4	1.21	23.1	19.2	94.9	52	748.80	14.4	K <sub>1</sub> xK <sub>14</sub>	
Total	5.8	92.6	-	-	-	-	-	-	4,710.8	-	-	
Average	1.1	18.5	1.48	30.4	19.8	87.4	50.8	942.1	16.1	-	-	
47. Pa (2nd)	May	1.3	34.3	1.96	42.9	21.9	39.4	56	1,920.80	25.7	K <sub>7</sub> xK <sub>6</sub>	
	July	2.0	42.3	1.74	37.6	21.6	78.0	50	2,115.00	21.2	K <sub>6</sub> xK <sub>7</sub>	
	Aug.	1.3	26.9	1.66	33.3	16.0	82.3	48	1,291.00	20.2	K <sub>6</sub> xK <sub>7</sub>	
	Oct.	2.0	44.5	1.57	33.0	21.0	92.0	50	2,225.00	22.2	K <sub>6</sub> xK <sub>7</sub>	
	Total	6.6	148.0	-	-	-	-	-	-	7,551.80	-	-
Average	1.6	37.0	1.73	36.7	20.1	85.4	51.0	1,887.95	22.3	-	-	
7. Ma (3rd)	May	1.0	17.8	1.48	32.7	22.1	88.5	56	996.80	17.8	K <sub>7</sub> xK <sub>6</sub>	
	July	1.5	16.1	1.27	26.2	20.6	83.6	50	805.00	10.7	K <sub>6</sub> xK <sub>7</sub>	
	Aug.	1.3	17.1	1.66	33.2	19.0	92.4	54	923.40	12.8	K <sub>6</sub> xK <sub>7</sub>	
	Oct.	1.0	14.9	1.39	24.6	17.6	93.0	46	685.40	14.9	(K <sub>1</sub> xT)F <sub>2</sub>	
	Dec.	1.0	18.9	0.92	16.8	18.2	84.4	46	409.40	18.9	K <sub>1</sub> xK <sub>14</sub>	
Total	5.8	94.8	-	-	-	-	-	-	3,820.00	-	-	
Average	1.2	16.9	1.34	26.7	19.5	86.4	50.4	764.00	15.0	-	-	

Note: Prize winners in the contest



1975

2. Praaart Village

Name of Farmers	Date of "HAKITATE"	Silkworm Eggs Used	Cocoon Crop	Cocoon Weight	Cocoon Shell Weight	Cocoon Shell Percentage	Reclaimable Cocoon Percentage	Unit Cocoon Price	Income from Cocoons	Cocoon Crop per Sheet of Eggs	Silkworm Races Reared
3 Wer (1st)	May	1.5	23.2	1.57	30.0	19.1	91.0	51.50	1,194.80	15.5	K <sub>6</sub> XK <sub>7</sub>
	June	1.5	18.6	1.59	32.7	20.5	90.2	52.0	967.20	12.4	K <sub>6</sub> XK <sub>7</sub>
	Aug.	1	18.6	1.87	38.6	20.6	96.2	48.0	892.80	12.3	K <sub>6</sub> XK <sub>7</sub>
	Dec.	1.5	19.2	1.10	19.8	17.9	85.5	46.0	883.20	9.6	K <sub>1</sub> XK <sub>14</sub>
	Total	6.0	79.6	-	-	-	-	-	3,938.00	-	-
Average	1.5	19.9	1.53	30.2	19.5	90.7	49.4	984.50	12.4	-	
16.Klin (2nd)	May	1.5	20.9	1.53	30.2	21.0	91.0	55.5	1,159.95	13.9	K <sub>6</sub> XK <sub>7</sub>
	June	1.5	24.8	1.75	36.9	21.0	88.0	52.0	1,289.60	16.5	K <sub>6</sub> XK <sub>7</sub>
	Aug.	1	17.8	1.80	38.9	21.6	79.8	48.0	854.45	11.9	K <sub>6</sub> XK <sub>7</sub>
	Sep.	1.5	11.3	1.85	37.6	21.8	87.0	54.0	610.20	7.5	K <sub>6</sub> XK <sub>7</sub>
	Dec.	1.5	21.8	1.17	22.8	19.4	94.5	52.0	1,133.60	10.9	K <sub>1</sub> XK <sub>14</sub>
Total	7.7	96.6	-	-	-	-	-	5,047.89	-	-	
Average	1.5	19.3	1.62	33.3	20.9	88.1	52.3	1,009.50	12.1	-	
4. Toom (3rd)	May	1.5	20.5	1.57	33.6	21.4	82.0	54.0	1,107.00	13.7	K <sub>6</sub> XK <sub>7</sub>
	June	2.0	33.9	1.80	36.3	21.2	87.9	54.0	1,830.60	17.0	K <sub>6</sub> XK <sub>7</sub>
	Aug.	1	22.4	1.85	41.7	22.5	91.1	56.0	1,254.40	13.4	K <sub>6</sub> XK <sub>7</sub>
	Sep.	2.0	10.6	1.92	40.3	20.9	73.9	46.0	487.60	5.3	K <sub>6</sub> XK <sub>7</sub>
	Oct.	2.3	31.2	1.56	27.3	17.4	81.9	44.0	1,372.80	13.4	K <sub>6</sub> XK <sub>7</sub>
Dec.	1.5	31.9	1.35	25.6	19.0	91.3	50.0	1,595.00	16.0	K <sub>1</sub> XK <sub>14</sub>	
Total	11.2	150.5	-	-	-	-	-	7,647.40	-	-	
Average	1.8	25.1	1.67	34.1	20.3	84.7	50.6	1,274.56	13.1	-	

Note: Prize winners in the contest

Table 13. Contest of Mulberry

Phimai Settlement							
Name	Area	Time of planting	Variety	Density of trees	Type of training	Manured	Reference
21-22 Feb. 1974							
1. Tuam	6	1972 April 1973 April	Noi. Tadarn	2.0x0.8	Low-cut training	Compost per rai 4,000 kg	Water sprinkling in the dry season Mulching at the base of trees
2. Yey	11	1972 Aug.	Noi. Tadarn Keaw	1.7x0.7	Low-cut training	Compost per rai 4,000 kg	Well maintained
3. Leau	11	1972 Sept. 1973 Sept.	Noi. Tadarn Keaw	2.15x0.75	Low-cut training	Compost per rai 7,000 kg	
20-21 Jan. 1975							
1. Tiang	4				Low-cut training	B.D. half a truck	
2. Yey	20				Low-cut training	B.D. half a truck	
3. Nark(R)	5				Low-cut training	B.D. half a truck	Some root rot
15 May 1976							
1. Tongbai	10		Noi	2.5x0.75	Low-cut training	B.D. applied C.F. 40kg	
2. Pan	6		Noi. Tadarn	2.0x0.75	Low-cut training	B.D. applied	Well maintained; attacked by stem borer
3. Nark(R)	10		Noi. Others	2.0x0.75	Low-cut training	B.D. applied	Base well pruned Fallen leaves applied; well maintained
Prasart Settlement							
22-23 Jan. 1975							
1. Heng	4				Low-cut training	R.S. applied	
2. Yoo	4				Low-cut training	R.S. 1 ton	
3. Sai	4				Low-cut training	R.S. 1 ton	
11 May 1976							
1. Mee	5		Noi	1.5x0.75	Low-cut training	R.S. applied B.D. much	Well maintained, much fertilizer, mulberry growing fine
2. Senern	4		Noi	1.5x0.75	Low-cut training	R.S. applied B.D. much	8 rearings, poor soil, much compost applied
3. Joom	6		Noi	1.5x0.75	Low-cut training	B.D. much R.S. applied	Well maintained
Rangmuat Settlement							
12 Mar. 1976							
1. Daranee	4		Noi	3.0x0.75 1.5x0.75	Low-cut training	B.D., R.S. applied	Well maintained Supplementary Planting in the space of 3 m
2. Bunta	5		Noi		Low-cut training	C.F. 180kg B.D., R.S. much	Well maintained, straw mulching
3. Piroj	4		Noi	2.0x0.75	Low-cut training	B.D., R.S. applied	

C.F.= Chemical fertilizer B.D.= Buffalo Droppings R.S.= Rice Straw

Table 15. Yearly Budgets of Sericulture Division, Department of Agriculture

	1974 - 5		1975 - 6		1976 - 1977		Remarks
	Korat	Other	Korat	Other	Korat	Other	
	Total	Total	Total	Total	Total	Total	
Building	1,677,000	2,744,400	1,175,500	1,811,500	2,987,000	5,076,000	Revaluing fund in 1975 - 6
Equipment	18,000	149,300	85,000	825,900	910,900	1,676,200	
Wages*	999,570	4,218,130	1,197,600	4,616,800	5,816,400	4,974,700	
Others**	194,400	4,500,300	945,000	7,868,000	6,813,000	6,199,600	
Total	2,888,970	11,612,130	3,404,100	15,122,200	18,525,300	17,621,500	
						20,715,300	

(Unit: Bahts)

\*Including laborers. \*\*Including Administration Section, 4 Sub-centres, and 8 Sericultural Experiment Stations.

Table 16. Posting of Personnel and Allocation of Business in the Korat Centre

Section	Expert	Officer	Worker	Administration	Research	Extension (Training)	Business	Successor
				%	%	%	%	
Chief	1	1		90		10%		
General Affairs	2	4					100	
Moriculture	1	19			60	10	30	
Breeding	1	2			50	40	10	
Training	4	0			40	50	10	
Improvement of Silkworm Race	1	5	12		70	0	30	
Silkworm Eggs	1	8	8		40	30	40	
Pathology	1	4	1		80	10	10	
Silk Reeling	1	5	14		30	0	70	
Refrigerator	1	1	1				100	
Total	7	39	61					

Table 17. Degree of Achievement of R/D in Sub-centres

Item	R/D	Khon Kaen	Udon	Muk Daharn	Ubon	Remarks
a. Production and distribution of silkworm eggs	0	0	0	0		
b. Distribution of mulberry sapling	0	0	0	0	x	
c. Training of agricultural farmers	0	-	-	-	-	
d. Equipment	0	0	0	0	0	Number of rearing rooms of "Centre" type
Rearing room	0	0	0	0	0	
Refrigerator	0	50/71	100/625	66	100	
Mulberry field(rai)	0					
Director of Branch	1 x 4	1	1	1	1	
Station	10 x 4	6	6	8	6	Desired yearly increase
Technical officials	3 x 4	1	1			
Clerks						
Others			(Extension)			

Table 18. Amount of Production and Distribution of Bivoltine Silkworm Eggs in Sub-centres  
(Oct. 1975 - Sept. 1976)

	Production of F <sub>1</sub> and F <sub>2</sub>		Distribution to farmers		Remarks
	Moths	Remainder	Moths	Remainder	
Khon Kaen	7,000		3,806	3,194	The whole is F <sub>1</sub> , besides 69,000 moths of polyvoltine eggs distributed F <sub>1</sub> 4,200 moths and F <sub>2</sub> 7,500 moths distributed; no polyvoltine egg.
Udon	35,000		11,700	23,300	
Muk Daharn	20,147		11,673	8,474	
Ubon	2,955		2,444	511	
Total	65,102		29,623	35,479	

Source: Department of Agriculture

Note: Besides, Udon Sub-centre produced 14,037 moths of K<sub>1</sub> x K<sub>9</sub> and K<sub>1</sub> x K<sub>14</sub> on Nov. 26 - 27 ("HAKITATE" on Oct. 20).  
Remarks and note by the Guidance Team

Table 19. List of Experts dispatched on the Cooperation Project for the Development of Thai Sericulture  
(Long-term Experts)

Speciality	Name of Experts	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Project Leader	Seinosuke OSMURA	Sep. 1 ←						Apr. 9 Apr. 1 ←			Mar. 7 →
	Tashiro SUGIYAMA										
Moriculture	Shiroshi GOTO	Sep. 1 ←	June 13 May 19 →								
	Eki IWATA					Mar. 31 Mar. 26 →			Sep. 20 Sep. 24 →		Mar. 7 →
	Kazuhiro YAMAKAWA							Mar. 28 Mar. 25 →			
	Yoshito YANO										
Silkworm Rearing	Tsunoo KUWANO				Aug. 22 ←						
	Shigeji KURIBAYASHI							Mar. 31 Mar. 25 →	Sep. 24 Sep. 20 →		Mar. 7 →
	Makoto SUDO										
Improvement of Races	Noriaki AZUMA	Sep. 1 ←		Aug. 31 Sep. 14 →				Mar. 31 Mar. 25 →			Mar. 7 →
	Hideo ONODERA										
	Yoshikiyo EGUCHI										
EGK Production	Yujiro HAYASHI		June 10 ←			June 9 May 30 →					
	Tadashi RYOCHI										Mar. 7 →
Pathology	Kiyoshi AOKI	Sep. 1 ←			Aug. 31 Sep. 14 →				Mar. 7 Mar. 19 →		Mar. 7 →
	Setsumi ITOI										
	Isao FUJIMOTO										
Silk Reeling	Takashi KOJIMA		Mar. 24 ←				Mar. 23 Feb. 9 →				
	Josuke MURAYAMA							Mar. 28 Apr. 1 ←			Mar. 7 →
	Giji MARYAMA										

## (Short-term Experts)

Speciality	Short-term Expert	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Reeling Technique	Haruko SHIRAKURA			↔ (Sep. 23 - Nov. 23, 60 days)							
Regulation of doubling and throwing machine	Kazuo KODA YASHI			↔ (Dec. 5 - Dec. 16, 11 days)							
Installation of egg coldstoring equipment	Satoshi TAMAIISHI			↔ (Nov. 27 - Jan. 30, 43 days)							
"	Minoru SANO			↔ ( )							
"	Naotake HAYAKAWA			↔ ( )							
Installation of cocoon drying machine	Yuji OHTSU			↔ (Mar. 7 - Mar. 28, 11 days)							
Installation of automatic reeling machine	Akitake KOMATSU			↔ (May 21 - June 23, 32 days)							
"	Kiyoshi YOSHIZAWA			↔ ( )							
Reeling Technique	Reiko TATE			↔ (Aug. ) - Aug. 30, 30 days)							
Installation of refrigerator	Tsuyoshi NAKAMURA			↔ (June 20 - July 19, 30 days)							
"	Tadashi SANO			↔ ( )							
"	Takao AKASHI			↔ ( )							
Soil Survey	Makoto SUZUKI			↔ (Nov. 1 - Dec. 31, 60 days)							
Reeling Technique	Koyoko MURAYAMA			↔ (Nov. 25 - Dec. 24, 30 days)							
Sericultural Management	Atsushi CHIHARA			↔ (Mar. 25 - July 27, 43 days)							
Maintenance of Egg Refrigerator	Saburo IGARASHI			↔ (June 14 - July 27, 43 days)							
Reeling technique	Hiroo YAMAMOTO			↔ (June 14 - July 13, 30 days)							

Table 20. List of Survey Missions on the Cooperation Project for the Development of Thai Sericulture

Name of Survey Mission	Term of Dispatch	Leader and no. of members	Remarks
Japanese Survey Mission on the Agricultural Development Cooperation in Thailand	July 3 - Aug. 8, 1968	ISHIKURA and 4 members	
Japanese Survey Mission on the Implementation of Cooperation in the Development of Thai Sericulture	Feb. 18 - Mar. 10, 1969	OHMURA and 4 members	Signed the 1st Record of Discussion
Japanese Guidance Team on the Cooperation Project for the Development of Thai Sericulture for 1969	Feb. 26 - Mar. 18, 1970	KOIWAI and 3 members	
" for 1970	Nov. 9 - 28, 1970	NIKI and 2 members	
" for 1971 (1st)	Dec. 11 - 25, 1971	FUKUDA and 2 members	
" for 1971 (2nd)	Feb. 27 - Mar. 9, 1972	FUKUDA and 2 members	Signed the 2nd Record of Discussion
" for 1972	Mar. 22 - Apr. 11, 1973	ASHINO and 4 members	
" for 1973	Feb. 23 - Mar. 15, 1974	ITO and 4 members	
Japanese Evaluation Mission of the Development of Thai Sericulture for 1974	Nov. 1 - 15, 1974	HAZAMA and 3 members	
Japanese Consultation Team on the Cooperation Project for the Development of Thai Sericulture	Aug. 25 - Sept. 6, 1975	SUGIHARA and 3 members	
Japanese Guidance Team on the Cooperation Project for the Development of Thai Sericulture	Nov. 30 - Dec. 6, 1976	HAZAMA and 3 members	

Table 21. List of Publications on the Cooperation Project for the Development of Thai Sericulture

Name of Publications	Month of Publication	Publisher
Report of the Japanese Survey Mission on Agricultural Development Cooperation in Thailand	December 1968	Overseas Technical Cooperation Agency
Report of the Japanese Survey Mission on the Implementation of Cooperation in the Development of Thai Sericulture	March 1969	"
Pebrine Disease of Silkworm	March 1971	"
" (in English)		"
Report of Japanese Guidance Team on the Cooperation Project for the Development of Thai Sericulture for 1970	June 1971	"
" for 1971	May 1972	"
" for 1972	June 1973	"
Bulletin of the Thai Sericultural		
Bulletin of the Thai Sericultural Research and Training Centre, No. 1	June 1971	"
" (in English)	June 1971	"
" , No.2 (in English)	December 1972	"
" , No.3 (in English)	August 1973	"
SILKWORM REARING TECHNIQS IN THE TROPICS	March 1973	"
List of Donated Machinery and Materials on the Development Cooperation Project for Thai Sericulture	March 1973	"



Business Report on the Co-operation in the Development of Thai Sericulture (September 1969-December 1973)	January 1974	Overseas Technical Cooperation Agency
Bulletin of the Thai Sericultural Research and Training Centre, No. 4	May 1974	"
Report of Japanese Guidance Team on the Sericultural Cooperation Development in Thailand for 1973	August 1974	Japan International Cooperation Agency
Summary Report on the Technical Cooperation Project for the Sericultural Development in Thailand for 1974	January 1975	"
Bulletin of the Thai Sericultural Research and Training Centre, No. 5	May 1975	"
Report of Japanese Consultation Team on the Cooperation Project for the Development of Thai Sericulture	September 1975	"
Report on the Sericultural Management on the Cooperation Project for the Development of Thai Sericulture	November 1975	"
Bulletin of the Thai Sericultural Research and Training Centre, No. 6	May 1976	"

