F 50114

THE IMPLEMENTATION PLAN FOR SERICULTURAL DEVELOPMENT IN INDONESIA

FEBRUARY 1976

JAPAN INTERNATIONAL COOPERATION AGENCY

TOKYO, JAPAN

PREFACE

We were dispatched, as the Survey Mission for the Development of Sericulture in Indonesia, to the country, and conducted a survey for 25 days from November 20, 1975, to formulate an enforcement plan for technical cooperation. In this survey we received valuable support and cooperation from the interested persons in Indonesia and long-term surveyors from Japan. Furthermore, officials of the Embassy of Japan and JICA Jakarta branch were kind enough to give us precious advice and help. Thanks to their kindness, we could conduct a survey along the anticipated objectives without hindrance. We must express our heartfelt gratitude to them.

In this report, we were permitted to cite many of informations, data, results, etc., which long-term surveyors had accumulated by hard work. Without their extraordinary endeavors, the present survey and this report could not be fully satisfactory as such, we believe. We owe profound respect for their toil.

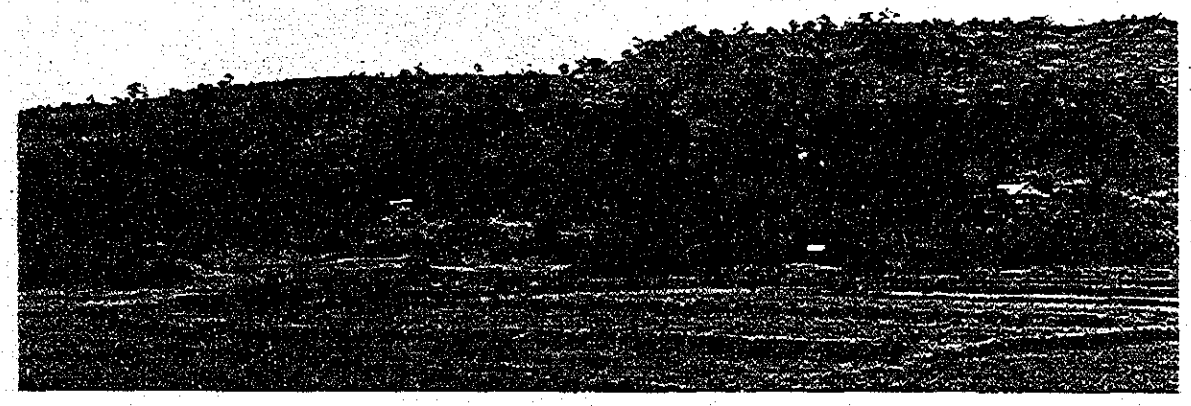
Finally, if this report turns out to be helpful in development of Indonesian sericulture and in realization of technical cooperation at an earliest possible date, we should be very happy.

February, 1976

M. Kumamoto

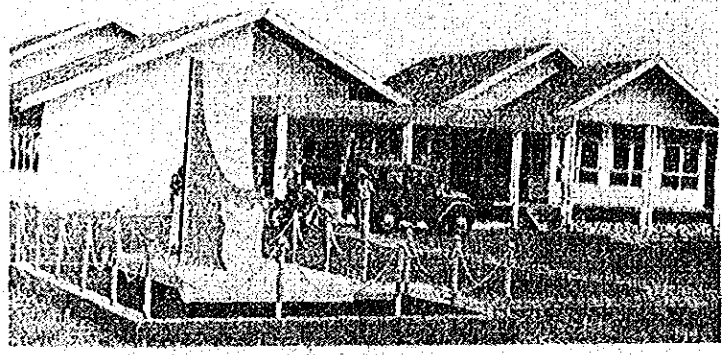
MORIYOSHI KUMAMOTO

Leader, of
the Japanese Survey Team for
Sericultural Development Project
in Indonesia



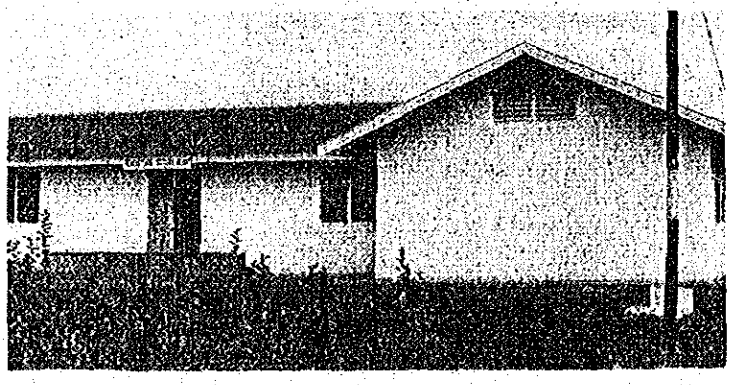
Proposed site viewed from the Highway of Marino

(1) The Proposed Site for Sericulture Centre on the Hill's Top of Bili-bili Village

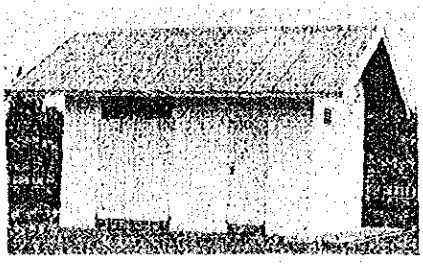


(2) Main Building of Sericulture Station of Soppeng

(3) Silkworm Rearing House of Sericulture Station of Soppeng

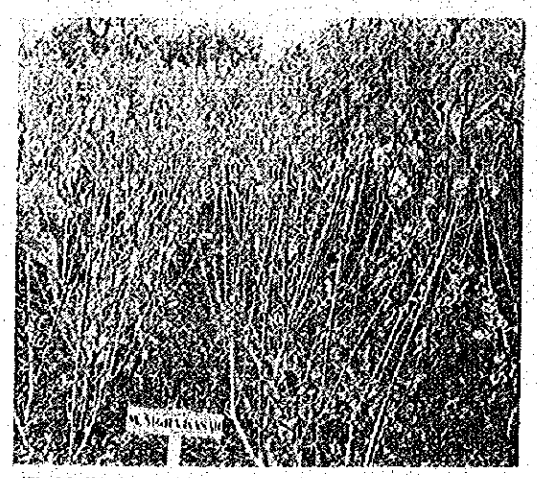


(4) Egg Production House of Sericulture Station of Soppeng established by the President's Special Fund



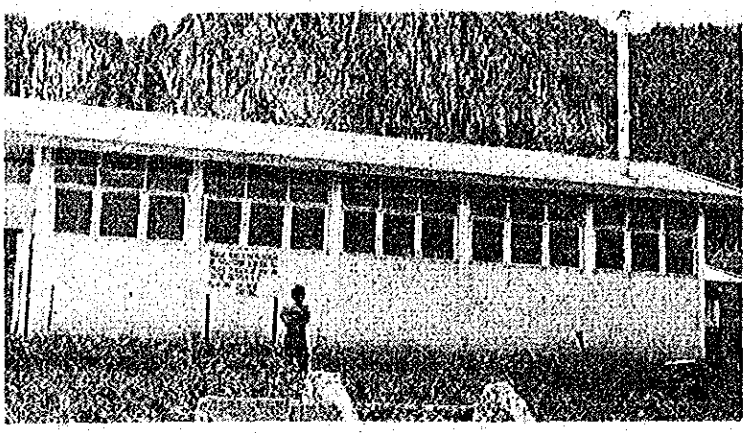
(5) Generator Room of Sericulture Station of Soppeng

(6) Silk Reeling Plant established by the President's Special Fund (Sericulture Station of Soppeng)

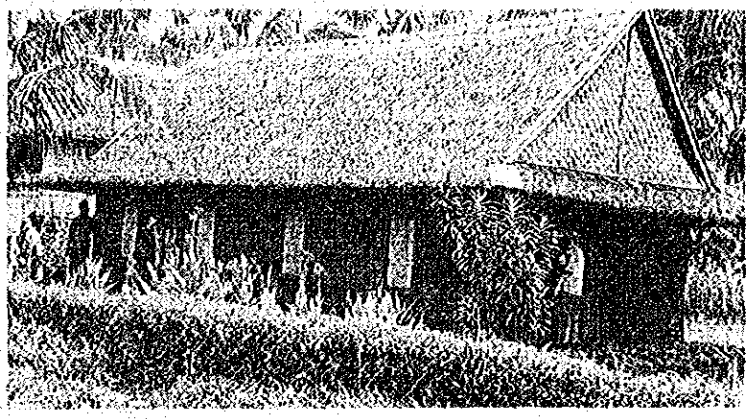


(7) Mulberry Field in Sericulture Station of Soppeng

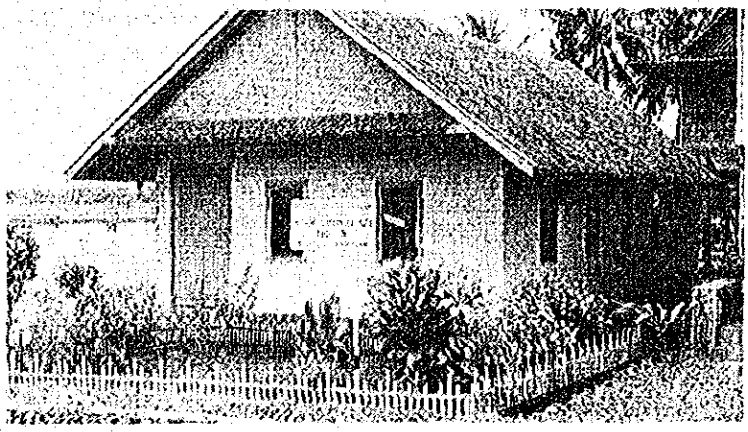
(8) The Proposed Land for Additional Mulberry Field of Sericulture Station of Soppeng



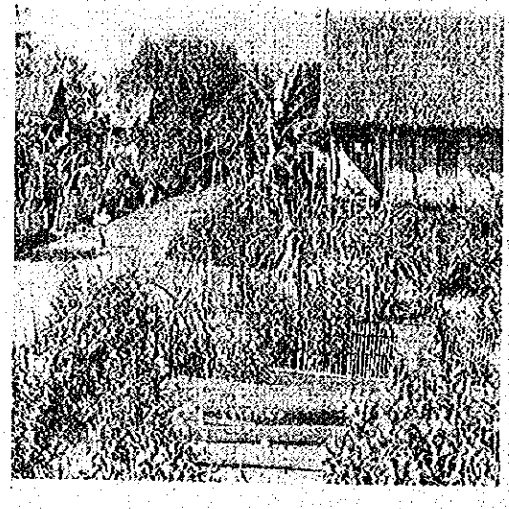
(9) Silk Reeling Plant in Enrekang Pref. established by the President's Special Fund



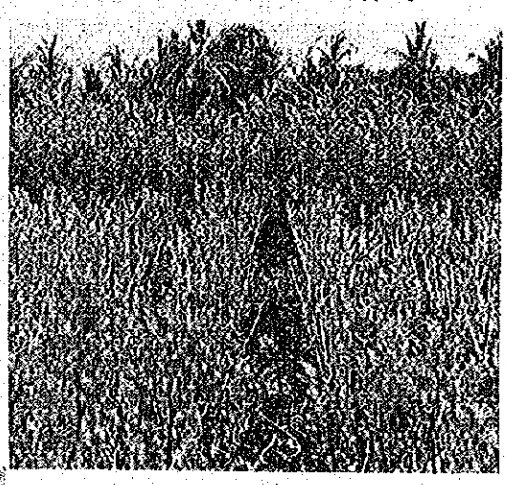
(10) Young Silkworm Rearing Unit established by Farmers



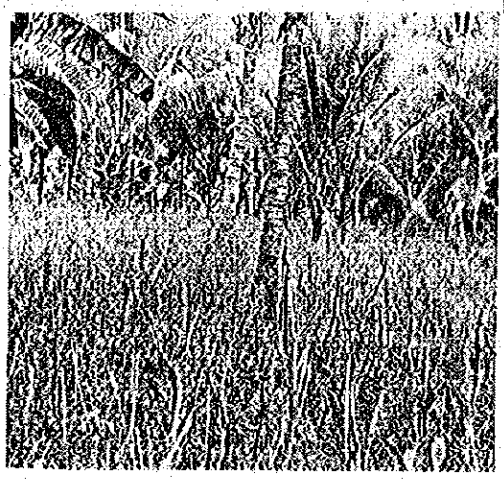
(11) Young Silkworm Rearing Unit (No. 5) established by the Government's Aid



(12) Sericultural Farms surrounded with Mulberry Trees around the Unit in Soppeng Pref.



(13) Collective Mulberry Field in Soppeng Pref. (about 2 ha)



(14) Collective Mulberry Field in Farmers' Coconut Field after Harvest

CONTENTS

I. Outline of the Survey Team

1. Background and Objective 1
2. Composition of the Survey Team 1
3. Interested Indonesian Dignitaries 1
4. Schedule of the Survey 2

II. Summary of Survey Results and Outline of Discussions

1. Summary of Survey Results 7
   (1) Objective of Sericultural Development 7
   (2) Difference in Sericultural Form between South Sulawesi Province and Java 7
   (3) Administrative Mechanism and Experiment and Research Organs 7
   (4) Current Situation of Sericulture 8
   (5) Situation of Raw Silk Reeling 8
   (6) Weaving Industry 8

2. Outline of Discussions 9
   (1) Consolidation and Substantiation of Administrative Mechanism 9
   (2) Reinforcement and Substantiation of Sericultural Experts 9
   (3) Establishment of Technique in Mulberry Cultivation and Silkworm Rearing 9
   (4) Establishment of Supply System of Silkworm Eggs 9
   (5) Scale of Silkworm Egg Production 10
   (6) Breeding of Silkworm Varieties Suitable for Indonesia by Selection 10
   (7) Diffusion of New Technique 12
   (8) Regional Priority in Technical Cooperation 12
      (i) Sericulture Centre 12
         (a) Desirable Location 12
         (b) Character and Role 12
         (c) Scope of Japanese Experts 12
         (d) Counterparts 13
         (e) Kinds of Buildings, Facilities, Equipments and Machines and Tools 13
         (f) Area of Mulberry Field 14
      (ii) Sub-Centre 14
         (a) Desirable Location 14
         (b) Character and Role 14
         (c) Kinds of Buildings, Facilities, Equipments and Machines and Tools 14

(d) Area of Mulberry Field 15
(iii) Pilot Unit 15
(iv) Transitional Measures concerning the Task and Role of Japanese Experts 15

III. Technical Cooperation Project between Japan and Indonesia

1. Contents of Technical Cooperation Project 19
(1) Objective 19
(2) Concrete Contents of Technical Cooperation Project 19
(i) Target of Improvement 19
(A) Items Concerning Mulberry Cultivation 20
(a) Selection of Mulberry Varieties 20
(b) Establishment of Growing Method of Mulberry for Young Silkworms 20
(c) Establishment of Training and Harvesting Methods of Mulberry for Grown Silkworms 20
(d) Establishment of Techniques for Increasing Soil Fertility of Mulberry Field 20
(B) Items concerning Silkworm Egg 20
(a) Advancement of Egg Producing Technique 20
(b) Breeding of Silkworm Varieties by Selection 21
(C) Items concerning Silkworm Rearing 21
(a) Establishment of Technique in Rearing Method of Young and Grown Silkworms 21
(b) Establishment of Improved Mounting Method 21
(D) Establishment of Controlling Techniques of Diseases and Insect Pests 21
(ii) Training Plan 22
(A) Training of Technicians 22
(B) Training of Sericultural Leaders 22
(a) Training in Sericulture Centre 22
(b) Training in Sub-Centre 22
(c) Training in Pilot Unit 22
(C) Training in Japan 22
(iii) Introduction and Diffusion of Technique 23
(iv) Installation of Pilot Farmers' Group 23
(3) Suitable Location of Sericulture Centre, Sub-Centre and Pilot Farmers' Group; Their Function, Role and Relations 23
(i) Sericulture Centre 24
(ii) Sub-Centre 24
(iii) Pilot Unit 27
(4) Allotment of Execution of Cooperation between Japan and Indonesia 27
(i) Contents of Cooperation on the Part of Japan 27
(ii) Reception on the Part of Indonesia 28

2. Arrangement of Indonesian Staff 28

3. Required Facilities and Their Arrangement 28
(1) Sericulture Centre 28
(2) Sub-Centre 31

4. Required Machines and Instruments 34
(1) Sericulture Centre 34
(2) Sub-Centre 49
(3) Pilot Unit 50

IV. Proposals for Measures to be Taken to Develop Sericulture

1. Technical Improvement to Develop Sericulture 52
(1) Relative to Mulberry Cultivation 52
(a) Survey of Practical Characters of Mulberry Varieties 52
(b) Establishment of Growing Method of Mulberry for Young Silkworms 52
(c) Establishment of Training and Harvesting Technique for Grown Silkworms 52
(d) Examination of Improving Method of Soil Fertility of Mulberry Field 52
(2) Relative to Silkworm Rearing 54
(i) Silkworm Egg Producing Technique 54
(a) Modernization and Full Equipment of Facilities, Machines and Instruments 55
(b) Learning of Egg Producing Technique 56
(c) Breeding of Silkworm Varieties by Selection 56
(ii) Rearing Technique 56
(a) Examination of Multiple Rearing 56
(b) Examination of Mounting Technique 56
(c) Examination of Harvesting and Sorting Technique 56
(3) Relative to Disease and Insect Pest Damage 56
(4) Summary 57

2. Desirable Administrative Organization and Research Institute for Sericultural Development 57
(1) Substantiation of Administrative Organization 57
(2) Establishment of Technical Organization 57

V. Present Situation and Problems of Principal Sericultural Districts

1. Their Position in Indonesian Sericulture 59

2. General Condition of the Area 61
(1) Natural Condition 61
(2) Position of Sericultural Sector in Agricultural Management 65
(3) Relation of Sericultural Farmers to External Economy 66
(a) Purchase of Silkworm Egg, Fertilizer, Rearing Tools, etc. 66
(b) Present State of the Circulation of Cocoon and Raw Silk 67
(4) Development of Sericulture in Soppeng Prefecture 70

3. Current State of Sericultural Technique and Problems 70

4. Trend of Yearly Cocoon Output 72

5. Outline of the Projects for Sericultural Development under Way or Plan in Indonesia 73
(I) Installation and Substantiation of Experiment and Research Organs ... 73
(ii) Sericulture Promotion Measures in South Sulawesi Province 75
(a) Rearing of Polyvoltine Varieties Stopped Allover 75
(b) Encouragement of Units and Buildup of Collective Mulberry Fields 75
(c) Installation of Modern Silk Reeling Mills 75
(d) Modernization of Weaving Industry 75
(iii) Sericulture Promoting Measures in Java 76
(iv) Sericulture Promoting Plan 76

6. Present State of Administrative Organization and Experiment and Research Organs for the Promotion of Sericulture 76
(i) Administrative Organization 76
(ii) National Forestry Public Corporation (PERHUTANI) 77
(iii) Sericulture Development Committee 77
(iv) Experiment and Research Organs 79
(a) Sericulture Division and Sericulture Station 79
(b) Forestry Faculty of Gajamada University 80
(c) Batik Research Institute 81

TABLES

Table
1. Bases to Calculate Yearly Target of Egg Production 10
2. Required Technical Staff in Sericulture Centre and Sub-Centre 29
3. Construction Plan of Buildings by Year (Sericulture Centre) 32
4. Area of Mulberry Field (Sericulture Centre) 32
5. Yearly Plan of Multiplying Eggs for Distribution at Sub-Centre 33
6. Yearly Plan for Construction and Remodeling of Buildings (Sub-Centre) 33
7. Area of Mulberry Field (Sub-Centre) 34
8. List of New Construction or Remodeling in Sericulture Centre and Sub-Centre .. 35
9. Farmhouses Applying Fertilizer in Donri[2] and Lalabata Riaja Village 54
10. Silkworm Egg Supplying Plan of Indonesia (1975) 55
11. Egg Exports to Indonesia 55
12. Raw Silk Production, by Year, in Indonesia 60
13. Present Situation of Indonesian Sericulture 60
14. Soil of Mulberry Field in Watansoppeng 61
15. Air Temperature 62
16. Precipitation and Rainy Days in Watansoppeng 62

17. Air Temperature and Precipitation in Java and South Sulawesi 63
18. Average Farmer's Own Land in Donri[2] and Lalabata Riaja Village 64
19. Area under Mulberry in Donri[2] and Lalabata Riaja Village 64
20. State Land and Private Land in Sericulture Regions 64
21. An Example of the Profitability of Sericulture 66
22. Profitability of Sericulture and Other Crops 66
23. Fertilizing Farmers in Donri[2] and Lalabata Riaja Village 67
24. Development of Sericulture in Soppeng Prefecture 69
25. Trend of Area of Mulberry Field and Raw Silk Production 72
26. Present State and Targets of Indonesian Sericulture 76
27. Business of Sericulture Division and Sericulture Station 80
28. Research Workers, etc. and Area of Mulberry Field in Sericulture Division and Sericulture Station 81
29. Kinds of Buildings 81

FIGURES

Fig.
1. Survey Route in Java 6
2. Survey Route in South Sulawesi Province and Proposed Site for Sericulture Centre and Sub-Centre 6
3. Basic Policy of Production and Distribution of Silkworm Eggs 11
4. Sketch Map of Proposed Site for Sericulture Centre ..... 25~26
5. Arrangement Plan for the Sericulture Centre 36
6. Sericulture Centre ..... 37~42
   A. Main Building B. Rearing Room for Rearing Method
   C. Rearing Room for Egg Production D. Pathological Rearing Room
   E. Pebrine Inspection Building F. Silkworm Egg Refrigerator
   G. Artificial Hatching Room H. Chemicals Warehouse I. Garage
   J. Mulberry Field Maintenance Room K. Compost Shed
   L. Agricultural Machine and Tools Warehouse M. Expert's Residence
7. Arrangement Plan to Reinforce Sericulture Station of Forest Research Institute in Soppeng Prefecture as Sub-Centre 43
8. Sub-Centre ..... 44~46
   A. Rearing Room, grown silkworm B. Rearing Room for Egg Production
   C. Pebrine Inspection Buidlding D. Silkworm Egg Refrigerator
9. Training and Harvesting Method of Mulberry and Rearing Time 53
10. Precipitation (mean of 6 years, 1970-1975) 63
11. Trend of Raw Silk Prices on Soppeng Market 68
12. Monthly Silk Production in Soppeng Prefecture 70
13. Monthly Precipitation and Monthly Means of Maximum and Minimum Air Temperature in Bontbili 74
14. Organization Chart of Administration on Sericulture 78
15. Arrangement Plan of Sericutre Division of Forest Research Institute 82
16. Arrangement Plan of Buildings, by Uses, of Sericulture Division of Forest Research Institute 83
17. Sericulture Division of Forest Research Institute 84

1. Outline of the Survey Team

1. Background and Objective

In the matter of technical cooperation with Indonesia, a preliminary survey team was sent out there for 21 days from March 5, 1974. As a result of the survey, it was reported that Indonesia is very aggressive in her sericultural development; it is sufficiently adequate and feasible to carry out this project, when worked out; and that it should be put into practice as soon as possible. On the other hand, it was made clear that there are many problems in the realization of the project.

In order to pinpoint these problems, therefore, Kyoshi AOKI and other 2 long-term surveyors were dispatched on March 31, 1975, to gather informations and conduct various kinds of survey. The examination of their survey results and analyses of the informations assembled have clarified the contents of future cooperation, places of cooperation as well as the intention, reasons, etc., for encouraging sericultural development on the part of Indonesia. Long-term surveyors were also thoroughly consulted. And then this survey team was sent out to make out draft contents of cooperation.

2. Composition of the Survey Team

MORIYOSHI KUMAMOTO (Leader)	Member of the Advisory Committee for Cocoon and Raw Silk Industry, MAF (The Ex-Chief of Sericulture Division, Sericulture and Horticulture Bureau, MAF)
MINORU ITO (Mulberry Cultivation)	Sericultural Experiment Station, MAF, Kansai Branch
HISASHIGE MIZUSAWA (Silkworm Egg Production)	Sericultural Experiment Station, MAF, Shinjo Egg Experiment Station
TAKUO TSUCHIYA (Sericulture, Raw Silk and Cocoon Administration)	Agricultural Production Bureau, Cocoon' and Raw Silk Division, MAF
RYONOSUKE GOTO (Liaison and Coordination)	Agricultural Technical Cooperation Division, Agricultural Development Department, JICA

3. Interested Indonesian Dignitaries

Director of Directorate General of Forestry, Ministry of Agriculture
Director of Forest Research Institute
Chief of Sericulture Division, Forest Research Institute
Governor of South Sulawesi Province
Chief of Sericulture Station, Forest Research Institute
Dean of Forestry Faculty, Gadjamada University
Director of Batik Research Institute

4. Schedule of the Survey

Date	Contents of Schedule
1975	
Nov. 20, Thursday	Tokyo – Jakarta (JL711) Consultation with staff of JICA Jakarta office and long-term surveyors at the hotel (Stayed at Jakarta)
Nov. 21, Friday	Courtesy call on Ambassador SUNOBE at Embassy of Japan in Indonesia, etc. After briefing to long-term surveyors (Leader AOKI and KUZUMA and TAKATORI surveyors), Secretary UESUGI and Researcher HIRATA at the Embassy, and MIYASHITA, staff in charge of this survey at Jakarta office, JICA, on the objective and items of this survey, we discussed the survey schedule. Listened to long-term surveyors' explanation on the data they had gathered. (Stayed at Jakarta)
Nov. 22, Saturday	Paying a courtesy call to the Director of Directorate General of Forestry, had a familiar talk. Explained the objective of the present survey and the outline of cooperation including the stress on South Sulawesi in our country's cooperation for sericultural development. Director expressed a great expectation put on our cooperation in this field. (Stayed at Jakarta)
Nov. 23, Sunday	Jakarta – Bogor – Puntjak Pass Preview of Bogor Forest Research Institute. Listened to surveyors' explanation on the data they gathered. Inspected Bogor Central Agricultural Research Institute, Pathology Department. (Stayed at Puntjak)
Nov. 24, Monday	Puntjak – Bogor – Chibogo At the Forest Research Institute, Sericulture Division, listened to Chief SANUSI, Sericulture Division, and other staffs on the current situation of Indonesian sericulture. Inspected facilities of Sericulture Division and mulberry field. (Stayed at Chibogo)

Nov. 25, Tuesday	Chibogo – Bogor – Jakarta
	Courtesy call on the Director of Forest Research Institute.
	Explained the objective, etc., of the present survey. Listened to the Director's brief on the activities of the Institute. At the demonstration room of the Institute, listened to the explanation of the current situation of lumber production in Indonesia. (Stayed at Jakarta)
Nov. 26, Wednesday	Jakarta – Ujung Pandung (GA-082)
	Talked with Indonesian staff on the schedule. (Stayed at Ujung Pandung)
Nov. 27, Thursday	Inspection of silk weaving mills in the city.
	Inspecting the Industrial Vocational Training Centre in Ujung Pandung, listened to their precautions in enforcing cooperative project. (Stayed at Ujung Pandung)
Nov. 28, Friday	Paying a courtesy call to the Governor of South Sulawesi Province, had a familiar talk.
	Explained the objective of the present survey and our design for sericultural development and so forth. Governor strongly demanded our cooperation in sericulture, recommending Malino as the site for the Sericulture Centre.
	Ujung Pandung – Malino
	Explored the Malino highway including Malino in search of the site for the Sericulture Centre.
	Decided Bili-bili as one of the most suitable sites. Asked to gather detailed topographies, etc. (Stayed at Ujung Pandung)
Nov. 29, Saturday	Ujung Pandung – Camba Pass – Watansoppeng (Soppeng Prefecture)
	There was no suitable place for the sericulture Centre along the highway.
	At the Sericulture Station of Forest Research Institute at Watansoppeng, discussed the items to survey and the design for sericultural development with the Director.
	Courtesy call on the Governor fo Soppeng Prefecture. (Stayed at Watansoppeng)

Nov. 30, Sunday	Surveyed the facilities and mulberry field of the Sericulture Station of Forest Research Institute and listened to the briefing of current situation. Surveyed cooperative young silkworm rearing houses (Units), sericultural farmers, collective mulberry fields and silk reeling mills in Soppeng Prefecture. (Stayed at Watansoppeng)
Dec. 1, Monday	Watansoppeng – Singkang (Wajo Prefecture) – Watansoppeng – Panakaiene (Sidenrengrapang Prefecture) – Enrekang (Enrekang Prefecture) Surveyed weaving center in Singkang. Surveyed Units in Wanio (Sidenrengrapang Prefecture). Courtesy call on the Governor of Sidenrengrapang Prefecture and explained the objective of the present survey and so forth. Courtesy call on the Governor of Enrekang Prefecture, and had a familiar talk with him, explaining the objective of the present survey, etc. (Stayed at Enrekang)
Dec. 2, Tuesday	Enrekang – Kalasi (Enrekang Prefecture) – Rantepao (Tanatoraja Prefecture) Inspection and survey of sericultural farms, cooperative young silkworm rearing houses at Kalasi and silk reeling plant founded on the special fund granted by the President of Indonesia, etc. (Stayed at Rantepao)
Dec. 3, Wednesday	Rantepao – Enrekang – Parepare – Ujung Pandung Surveyed agriculture along the highway. Inspected Parepare City. (Stayed at Ujung Pandung)
Dec. 4, Thursday	In the morning: arrangement of survey results and discussion on the design for sericultural development. In the afternoon: precise inspection of the site for the Sericulture Centre at Bili-bili. (Stayed at Ujung Pandung)
Dec. 5, Friday	Arrangement of the design for sericultural development in order, and survey of living environments. (Stayed at Ujung Pandung)

II Summary of Survey Results and Outline of Discussions

1. Summary of Survey Results

(1) Objective of Sericultural Development

Although Indonesia is in the tropics, her climatic condition is suitable for silkworm rearing, the yearly mean air temperature ranging from 30 to 24°C. So, the country expects, by developing sericulture, to increase the opportunities of employment for farmers, expand their income and improve and stabilize the standard of living of the nation.

Furthermore, they intend to expand the use of raw silk which is currently consumed only for sarong to the manufacture of silk batik to attract tourists. In view of a declining tendency of the world production of raw silk, in addition, the country expects to increase the production of the fiber to earn more foreign currency.

(2) Difference in Sericultural Form between South Sulawesi Province and Java

In South Sulawesi Province, individual farmers own their mulberry fields, and produce cocoons to sell at their own account. In Java, on the other hand, the National Forestry Public Corporation (PERHUTANI) builds up large-scale mulberry fields and carries on a vertical enterprise from cocoon production to silk reeling.

(3) Administrative Mechanism and Experiment and Research Organs

Sericulture is under the jurisdiction of the Directorate General of Forestry, Ministry of Agriculture. In the light of the flow of funds, etc., however, it is not always clear which Division of the Directorate takes administrative responsibility. In South Sulawesi Province, the Industry Division seems to take charge. Either in the Directorate General of Forestry or in the office of South Sulawesi Province, there is no sericultural expert. In the former, the chief of Sericulture Division of Forest Research Institute concurrently handles administrative affairs and acts as the "window" of this project.

After the long-term surveyors arrived there, the Sericulture Development Committee has been set up as a consultative organ to the Director of Directorate General of Forestry to consider how to receive this project, etc., although it is too early to expect full-fledged activity from the Committee.

The experiment and research on sericulture are conducted by the Sericulture Division of Forest Research Institute and the Sericulture Station of Forest Research Institute in Soppeng Prefecture, South Sulawesi Province.

At the Sericulture Division, there are few researchers, equipped with insufficient machinery and tools. They are engaged mainly in breeding of silkworm varieties by selection without any noticeable result at least so far.

The Sericulture Station is being sustantiated by degrees. It is because the complete

abandonment of the use of polyvoltine eggs has necessitated the Station to produce and distribute hybrid eggs. Therefore, the main task of this Station is the production of silkworm eggs. Thanks to the President's fund, a plant for egg production has been set up. But the plant is narrow and the equipment is not yet complete. Egg producing technique is still immature. So, the Station is not in a position to meet the demand for silkworm eggs from sericultural farmers.

(4) Current Situation of Sericulture

In March 1974, we sent a Preliminary Survey Team for the Cooperation in Indonesian Sericulture. From the results of the survey, we concluded that it is necessary to take measure to control pebrine disease promptly, and made a recommendation that for the purpose, the rearing of polyvoltine races should be stopped and shifted to that of hybrid.

The Chief of Sericulture Division accepted and put it into practice immediately. Thus, the rearing of polyvoltine varieties has been stopped to be replaced with that of hybrids overall. In parallel with this measure, a unit system (a group of cooperative young silkworm rearing house and 20 - 25 surrounding sericultural farms) has been encouraged to organize (Plate 10, 11 and 12). Besides 15 units which were set up by the aid of the Government, 100 units have been formed by the funds invested by sericultural farmers themselves. The number is expected to increase in the future. Through the rearing of pebrine-free hybrids and the installation of units, the damage of pebrine disease has decreased sharply from 75 to 15% during the last one year.

Furthermore, mounting apparatus made of vinyl have been introduced from Japan to improve the mounting of mature silkworms. Also, the installation of collective mulberry fields is being encouraged (Plates 13 and 14). In this manner, a full-fledged sericulture is on its way.

However, the facilities at a unit is far from complete, many of rearing tools are made of bamboo fraught with danger of aspergillus disease, and mounting technique is not skillful. It is essential to improve rearing methods as well as the supply system of silkworm eggs.

(5) Situation of Raw Silk Reeling

In South Sulawesi Province, there are 2 silk reeling mills with 2 semi-automatic reeling machines (20 ends) and cocoon drying machines, each in Soppeng and Enrekang constructed with the President's Special Funds (Plates 4 and 9). The mill in Soppeng was in operation, but that in Enrekang was just completed. Both mills are run by the Sericulture Station, but will be transferred to the Prefecture concerned.

With the completion of these mills, farmers have stopped self-reeling to sell cocoons to the mills. There were reeling mills from fresh cocoons, but they were not operating due to materials shortage.

(6) Weaving Industry

The weaving center is in Singkang City and its suburbs, Wajo Prefecture. Fabrics are mostly sarong, a product of cottage industry. Installing a loom at a house, the weaver produces fabric of raw silk which his boss supplies on commission. Textiles were yarn-dyed.

This outline of survey results was submitted to the authorities of Indonesia (Director of Directorate General of Forestry) as mentioned in the attached document (P. 16).

2. Outline of Discussions

(1) Consolidation and Substantiation of Administrative Mechanism

Since there is hardly any administrative mechanism on sericulture, it is necessary to set up a Division or Section on Sericulture in Directorate General of Forestry and South Sulawesi Province office promptly. If this is infeasible, some official who has knowledge of sericulture should be appointed to the responsible post of the Division taking charge of sericulture, at the least. Under the present system where the Chief of Sericulture Division is concurrently served, efficient administration of affairs is almost out of the question.

In order to advance this project smoothly, the "window" is unavoidable. So, a Division or Section takes charge of sericulture must be clearly defined.

(2) Reinforcement and Substantiation of Sericultural Experts

There are very few sericultural experts in Indonesia. Even in the Sericulture Division and the Sericulture Station of Forest Research Institute, sericultural researchers and technicians are few in number. Furthermore, they are not skillful in designing experiment, technique, method of putting the results together, etc., as well as silkworm egg producing technique, such as preservation and raising of eggs, inspection of pebrine disease and so on. If Indonesia intends to promote sericulture sincerely, it is essential to reinforce and substantiate experts who are well versed in techniques in silkworm rearing and silkworm egg production.

(3) Establishment of Technique in Mulberry Cultivation and Silworm Rearing

From the meteorological condition in Indonesia, it is possible to rear silkworms 8 times a year. Under the current situation, however, mulberry field is not well maintained; no manure is applied; and mulberry is harvested without plan. On the other hand, there is no standard in rearing method, such as the density of silkworms, amount of mulberry supplied, etc. Nor is there any training method of mulberry for young silkworms. Many of rearing tools are made of bamboo fraught with danger of aspergillus disease.

Then, it is necessary to establish a technique of mulberry cultivation to cope with 8 times a year silkworm rearing, make out a standard table for silkworm rearing, and set up a technique of controlling diseases and insect pests. No less important is that some measures should be taken to disseminate these techniques established.

(4) Establishment of Supply System of Silkworm Eggs

Currently, silkworm eggs which are imported from Japan are used as they are, or in some cases after being multiplied, for distribution among farmers. Facilities for egg production are narrow and incomplete. Moreover, egg producing technique is so immature that egg supply is in shortage, notwithstanding that polyvoltine eggs have been replaced with hybrids. In anticipation of 8 times a year rearing on a large scale, it is essential to set up a supply system of silkworm eggs which can meet the demand for eggs on the part

of farmers any time. For the purpose, equipment should be enlarged and modernized. Needless to add, workers' skill in egg producing technique is also important.

(5) Scale of Silkworm Egg Production

Let us set the target of raw silk production at 250 tons. Area of mulberry field will remain almost constant, we expect. But cocoon yield per ha and per case of egg will increase and raw silk percentage of cocoon will advance as technique improves.

Then, egg requirements will be 75,000 cases in 1980 or 5 years later. Of these needs, Indonesia will produce 65,000 cases, with the balance relied on imports (Table 1).

Table 1. Bases to Calculate Yearly Target of Egg Production

Item	Current situation	1976	1977	1978	1979	1980	
						Quant.	Index
Sericultural households	5,000	5,000	5,000	5,000	5,000	5,000	100%
Mulberry field (ha)	15,400	15,400	15,400	15,400	15,400	15,400	100
Cocoon output (tons)	380	500	700	1,000	1,380	1,725	454
„ per ha (kg)	30* 20**	32.5	45.5	64.9	89.6	112.0	448
„ per case (kg)	15.2	17.9	20.0	22.2	23.0	23.0	151
„ per household (kg)	76	100	140	200	276	345	454
Raw silk production (tons)	49.4	65.0	91.0	140.0	193.2	258.8	524
„ per ha (kg)	3.2	4.2	5.9	9.1	12.5	16.8	525
„ per case (kg)	2.0	2.3	2.6	3.1	3.2	3.5	175
Raw silk % of cocoon	13	13	13	14	14	15	115
Egg requirements (case)	25,000	28,000	35,000	45,000	60,000	75,000	300

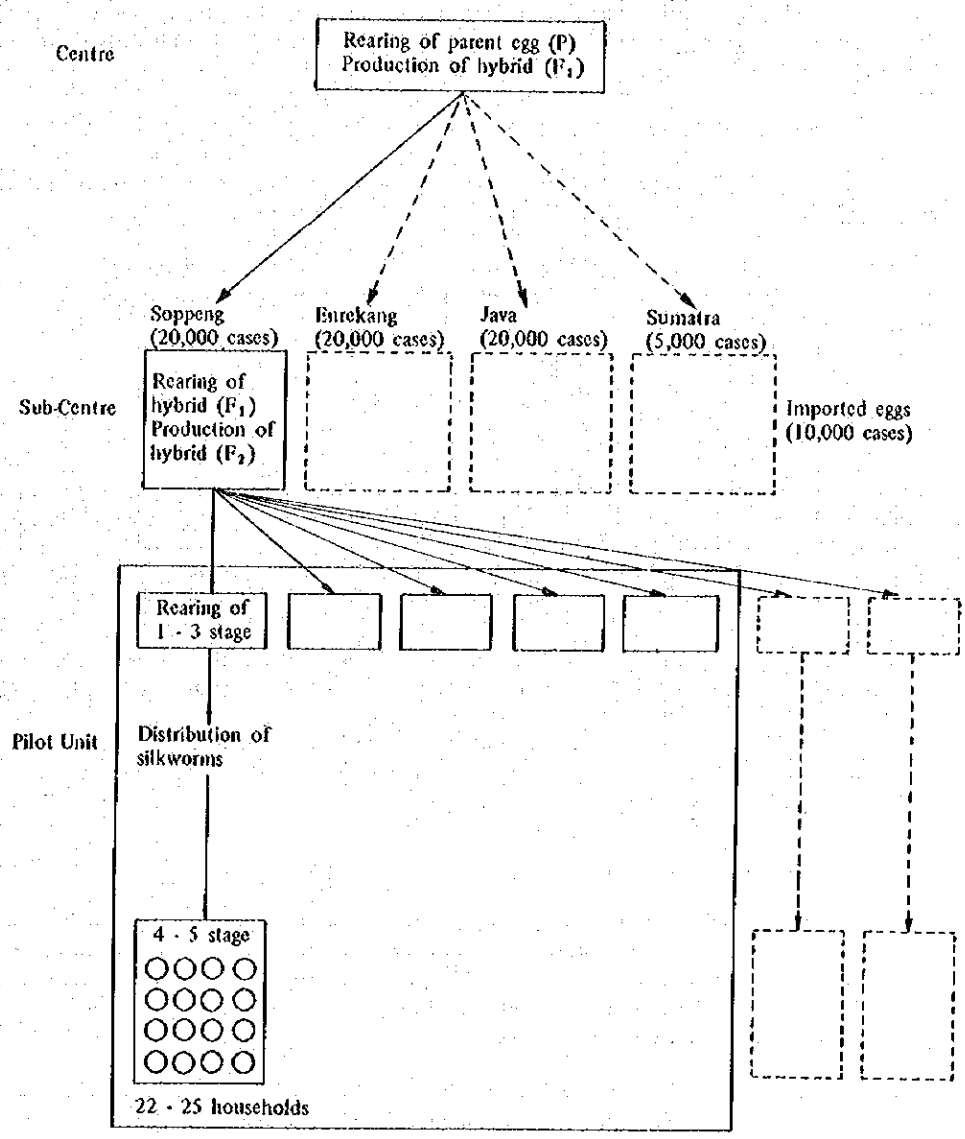
Note: Indexes for 1980 are based on the current situation. *Sulawesi **PERHUTANI

To produce 65,000 cases of egg, Sericulture Centre produces parent egg of F_1 hybrid and hybrid egg (F_1) and distributes the eggs to Sub-Centres, which produce F_1 and F_2 eggs, multiplying the number, and distribute. Egg production at Sub-Centres will be: 20,000 cases each at Soppeng, Enrekang and Java, and 5,000 cases at Sumatra. The object of this project will be the Sericulture Station at Soppeng (Fig. 3).

(6) Breeding of Silkworm Varieties suitable for Indonesia by Selection

Currently, Indonesian sericulture is carried on by means of eggs imported from Japan (F_1) or eggs multiplied from them (F_2). Under this method, however, the quality and quantity of cocoon fiber become inferior to F_1, and larvae decline in stoutness, due to diminishing heterosis, etc. In order to correct such shortcomings, it is necessary to breed by selection such varieties as are suitable for the country.

Fig. 3. Basic Policy of Production and Distribution of Silkworm Eggs



Remarks: 1) The objective of technical cooperation is confined within the limits of solid lines.
2) Up to the day when the Centre normally functions, commercial eggs from Japan will be used.

(7) Diffusion of New Technique

However new techniques may be established, it has no meaning, unless farmers take them up. So, a system should be set up by which new techniques are diffused among farmers promptly.

(8) Regional Priority in Technical Cooperation

Since South Sulawesi Province accounts for 80 - 90% of Indonesian raw silk production, the priority in technical cooperation should be given to this province.

From these discussions, we have come to a conclusion that Sericulture Centre Sub-Centres and Pilot Units are to be set up at some suitable places in South Sulawesi Province.

(i) Sericulture Centre

(a) Desirable Location

Indonesian sericulture is carried on at places 100 - 800 m above sea level. In order to establish standard techniques, the Sericulture Centre is to be set up at some mountainous area 300 - 400 m above the sea, with fertile soil, wide enough to accommodate necessary buildings and mulberry field, easy of access (considering the transportation of silkworm eggs, etc.), and is to be supplied with plenty of water.

As a result of surveys conducted by the team and long-term surveyors, Malino is too cool and wet, and Camba Pass is inferior in soil -- both places are disqualified (Fig. 2).

The mountainous area near Bili-bili satisfies, though its height above the sea does not meet the condition, all other conditions sufficiently. So, we decided to take it among most desirable places (Fig. 2).

(b) Character and Role

In order to develop sericulture in Indonesia, we have judged it urgent that the research and experiment on sericulture be conducted for the establishment of technique and that technicians be trained and secured. Sericulture Centre shall, therefore, endeavor to establish sericultural technique, and at the same time, train sericultural technicians during the process of establishing technique.

Judging from the meteorological conditions in Indonesia, it is possible to rear silkworm 8 times a year. On this premise, standard technique of silkworm rearing and mulberry cultivation will be established; parent eggs of F_1 hybrid and shoots for cutting will be produced and distributed; controlling methods of diseases and insect pests of silkworm and mulberry will be established; technicians at Sub-Centres will be trained; and a short course for training of the first-line leaders will be held.

(c) Scope of Japanese Experts

The scope of Japanese experts will be, except for the leader and the coodinator,

mulberry cultivation, silkworm rearing, production of silkworm eggs and diseases and insect pests of silkworm and mulberry.

(d) Counterparts

Two to three Indonesian counterparts will be attached to a Japanese expert. Japanese experts will, in principle, not be engaged in the guidance of Sub-Centres and Pilot Units directly, which will be conducted by counterparts. Japanese experts will guide and advise counterparts on the design of experiment, technique and how to put the results of survey together, etc. And the experiment and survey for the establishment of technique will be done by counterparts.

(e) Kinds of Buildings, Facilities, Equipments and Machines and Tools

Buildings will be: main building, rearing rooms for the study of rearing method, rearing rooms for the production of silkworm eggs, rearing rooms for the study of pathology, pebrine inspection rooms, refrigerators of silkworm eggs, incubation rooms, acid treatment rooms, warehouse of chemicals, garage, research room, washing pool, building for maintenance of mulberry field, compost shed, warehouse of agricultural machines and tools, etc. These are necessary for conducting experiment and survey and the production of silkworm eggs. Also, dormitory for trainees and residence of Japanese experts will be built.

Principal buildings are as follows:

The main building is one-storied, containing: room of the Director, rooms of Japanese experts, room for the experiment of pathology and soil, lecture rooms, conference rooms, demonstration rooms, office, etc. Necessary equipment is: business machines, audiovisual aids, instrument for experiment, and other apparatus.

The rearing room for the study of rearing method will be capable of rearing 5 cases of eggs per season, equipped with necessary, modern rearing tools.

Two rooms for producing eggs will be built to produce parent egg of F_1 hybrid and hybrid eggs for distribution. One rearing room will handle 500 moths per season. These rooms will be equipped with machines and tools necessary for the rearing and raising of eggs.

The rearing room for pathology will be a small-scale one, where material silkworms can be reared for experiment and research to control diseases and insect pests. Modern rearing tools will be equipped there.

Two pebrine inspection rooms are to be built, one for egg production and another for training purposes. For the parent egg of F_1 hybrid, each mother moth is inspected. For training, mass pebrine inspection of moths is conducted. Both rooms are equipped with necessary testing machines and instruments, including several phase-difference microscopes.

Silkworm egg refrigerators can maintain temperatures at 2.5, 5, 10 and 15°C. Incubation rooms are two which can keep 25°C and 80%.

Dormitory for trainees will accommodate 20 persons or so.

Egg refrigerator, incubation room and male moth refrigerator will be designed in Japan and constructed according to the specification.

(f) Area of Mulberry Field

The area of mulberry field will be 8.0 ha, including grassland. Of which, 2.5 ha is for the experiment on mulberry cultivation; 3.0 ha for the production of silkworm eggs; 1.5 ha for the study of rearing method; and 1.0 ha of grassland.

Since silkworm eggs are produced even in the dry season, mulberry field is equipped with sprinklers to cope with water shortage in the dry season. Tractors, etc., needed to maintain mulberry field are also furnished.

(ii) Sub-Centre

(a) Desirable Location

The Indonesian Government designs to set up 4 Sub-Centres, of which the Sericulture Station in Soppeng Prefecture is considered adequate as the object of our technical cooperation. The Station can, if reinforced and substantiated, fulful functions as a Sub-Centre.

(b) Character and Role

The Sub-Centre conducts experiment and survey for the purpose of adapting standard techniques which have been established by Sericulture Centre to its district. But it is mainly engaged in the production of silkworm eggs. Also, it carries on the guidance of pilot units and training of the first-line leaders and sericultural farmers.

In conducting experiment and survey, guidance, training, etc., Japanese experts shall be fully consulted to raise the efficiency of the activities. Japanese experts will directly give guidance and training as they consider it proper.

(c) Kinds of Buildings, Facilities, Equipments and Machines and Tools

Besides changing the uses of existing buildings, are newly constructed: rearing rooms for egg production, mother moth inspection rooms, silkworm egg refrigerators, etc.

Rearing rooms for the study of rearing method will be converted from the present incubation room and refrigerator room.

The rearing room for egg production is divided into 3 sections: rearing room of young silkworm, rearing room of grown silkworm, and egg-raising room, for it takes 2 months from the start of rearing to the raising of egg, and 8 rearings a year are to be carried out. For the rearing of young silkworm, the present rearing room is used, while are newly constructed: 2 buildings for the rearing of grown silkworm, each of which can handle 5 cases of egg used, and also 2 buildings for egg raising, attached with male moth refrigerators.

The mother moth inspection room is to be newly built, where pebrine inspection is conducted with the machines for mass pebrine inspection of moths.

Egg refrigerator and incubation room will be newly constructed. Five egg preserving refrigerators at 2.5, 5 (2 rooms), 10 and 15°C are built. Three incubation rooms at 23°C, 80% and 25, 80 (2 rooms) are built.

Like the Sericulture Centre, male moth refrigerator, egg refrigerator and incubation room will be designed in Japan, and executed according to the specification.

As for artificial hatching room, chemicals warehouse, sheds, etc., existing buildings will be used with modification.

In the matter of machinery and tools, rearing tools, egg raising tools, mass mother moth inspecting machine, etc., are to be equipped.

(d) Area of Mulberry Field

The mulberry field will be 19.5 ha in area, including grassland. Of which, 14.0 ha will be used for egg production.

The maintenance of mulberry field is conducted with 2-wheeled tractors. The maintenance building for the field will not be necessary. Although training, etc. are conducted, trainees will lodge in nearby farmers' (dormitory will be unnecessary). As lectures are given on the spot, lecture rooms are not needed, either.

(iii) Pilot Unit

Pilot Units will be set up at 5 places: 2 in Soppeng Prefecture, 1 each in Wajo, Sidenrengrapang and Enrekang Prefecture. Among existing 115 places, superior ones will be selected as such.

Sub-Centre will introduce new techniques established by itself to the Pilot Unit to make it a base for demonstration and extension.

Therefore, a mulberry field for young silkworms must be installed there. As for the Unit, the cooperative young silkworm rearing house is mainly reinforced and substantiated. Modern machines and tools are introduced. With power sprayers, disinfection is to be thoroughly carried out.

As for farmers, stress is put on the improvement of mounting method, and only modern mounting apparatus are introduced. Because, if we conduct a thorough disinfection during young stages (1 - 3) and distribute pebrine-free silkworms among farmers, they can rear such stout grown silkworms without further ceremony and harvest good cocoons.

In addition, the cooperative young silkworm rearing house install cocoon floss removers and collect cocoons from member farmers to sort cocoons and remove floss.

(iv) Transitional Measures concerning the Task and Role of Japanese Experts

Although the task and role of Japanese experts are such as mentioned above, up till the day when the construction of Sericulture Centre is completed, they will guide and advise on the build-up of mulberry field and construction of building, and further

cooperate in new construction work. They will, also, guide the production of silkworm eggs by Sericulture Station of Forest Research Institute in Soppeng. Pilot Units will be properly guided in technology, too. On the sericulture in Java, also, they may directly guide if interested persons request.

(The Attached Document)

Tentative Report of The Japanese Survey Team for Sericultural Development Project in Indonesia

I. Following the result of the preliminary survey team dispatched in March 1974 and a draft plan on sericultural development in Indonesia made out by the expert team led by Dr. K. Aoki, the Japanese Survey Team headed by Mr. M. Kumamoto, organized by Japan International Cooperation Agency, visited Indonesia to form an implementation plan for sericultural development in Indonesia for 25 days from November 20, 1975 to December 14, 1975.

The team studied a present situation of activities and facilities including mulberry fields for research and experiment both Sericulture Division of Forestry Research Institute and its branch stations. The team also investigated the present situation in various sphere of sericultural industries including silk reeling and weaving, giving priority to South Sulawesi where produces a great part of raw silk production in Indonesia.

II. The team was composed of the following members.

Mr. M. Kumamoto	Leader	The Member of The Advisory Committee for Cocoon and Raw Silk Industry, MAF (The Ex-Chief of Sericulture Div., Sericulture and Horticulture Bureau, MAF)
Mr. M. Itoh	Mulberry Cultivation	Chief, The Laboratory of Mulberry Cultivation, Kansai Branch Station, Sericulture Experiment Station, MAF
Mr. T. Tsuchiya	Sericulture, Law Silk and Cocoon Administration	Assistant Chief, Raw Silk and Cocoon Div., Agricultural Production Bureau, MAF
Mr. H. Mizusawa	Silkworm Egg Production	Chief, The Laboratory of Silkworm Egg, Shinjo Egg Experiment Station, Sericulture Experiment Station, MAF
Mr. R. Goto	Liaison and Coordination	Agricultural Technical Cooperation Div., Agricultural Development Cooperation Dep't., JICA

Remarks; MAF = Ministry of Agriculture and Forestry

III. Results of investigation and comments of the team are as follows.

(1) Sericulture in South Sulawesi has been changed greatly, compared with the time when the Preliminary Survey Team visited. The biggest change noted that the province has been producing lots of cocoon of high quality by introducing the Bivoltine variety discontinuing the reproduction of the Polyvoltine variety and also by restraining pebrine disease with a rapid set-up of "Unit" in which rears young silkworm separating from aged silkworm.

As for the Unit, in parallel with the 15 Units established as pilot model with the assistance and technical guidance by the Government, Sericultural farmers, they theirselves, invested to construct the young silkworm rearing units at their own cost for the purpose of distribution of silkworm after rearing one to three ages. The units reached as so many as 115 in number.

The team observed that this fact mentioned above was brought up by an exertion of the efforts of the people concerned of the Government and Research Institute of Forestry and at the same time, sericultural farmers' advancing attitude to adopt new technology on sericulture.

(2) Two modern raw silk reeling plants were established by assistance of the President. One plant has been operating and producing high quality raw silk. The other one was about to enter into operation only when a good amount of cocoon is supplied.

(3) Silk weaving in Kab. Singkang and Ujung Pandang has been done by hand operated weaving machine with threads already dyed. The products seem to be good quality as Salon cloth.

(4) To mention our comments to the results of the survey, the sericultural farmers having a positive attitude to improve their technique, production of cocoon will rapidly increase provided that enough supply of excellent F_1-Hybrid eggs which meet the demand of farmers and introduction of new technology is extended. Under this condition, therefore, the modern reeling plants will be expected to operate throughout the year and produce high amount of excellent raw silk. Consequently, quality of yarn-dyed (SAKIZOME) silk cloth will be upgraded more and more, and a possibility of production of piece-dyed (ATOZOME) silk cloth will be very great. In addition to the above, increase of sericultural farmers' income will highly be expected.

(5) It is observed that, at present, number of technical staff in sericulture promotion is small in number and silkworm egg production facilities are small in size and scale.

To promote a progress of sericulture industry in Indonesia, it is advised to take the following countermeasures to improve the above mentioned situation.

(a) To bring up and secure the Indonesian Technical personnel under guidance of the Japanese experts.

(b) To develop and establish the method of silkworm rearing and mulberry cultivation fitted with in Indonesian condition and to demonstrate and diffuse them to sericultural farmers.

(c) To acquire the method of reproduction of original variety and F_1 Hybrid variety and to strengthen the egg production facilities and to establish a distribution system of silkworm eggs which meet the demand of farmers.

(d) To train technical staff who extend an adoptable sericultural technique to sericultural farmers in each district.

(e) To send Indonesian staff to Japan to acquire the method of sericultural technique in Japan.

To implement comprehensively the above mentioned matters, Sericulture Center, its Sub-Center and Pilot Unit are thought necessary to be established in suitable district.

The team positively makes a proposal to the Government of Japan and works for the realization of the proposed project, if the Government of Indonesia agrees to the above proposal.

Jakarta, December 14, 1975

M. Kumamoto

Mr. Moriyoshi Kumamoto
Leader of the Japanese Survey
Team for Sericultural Development
Project in Indonesia

III. Technical Cooperation Project between Japan and Indonesia

1. Contents of Technical Cooperation Project

(1) Objective

Indonesian sericulture has a long history. In South Sulawesi, especially, which accounts for 80 - 90% of total raw silk production, sericulture contributes greatly toward raising farmers' income. There is a strong demand for traditional silk fabric, but raw silk is insufficient, and they rely upon imports.

The Indonesian Government set up Sericulture Division in Forest Research Institute, Directorate General of Forestry, Ministry of Agriculture, and the Sericulture Station in Soppeng Prefecture, South Sulawesi Province. In Java, on the other hand, the National Foresty Public Corporation (PERHUTANI) has developed a large collective mulberry field and carries on a vertical enterprise from silkworm rearing to silk reeling. The South Sulawesi Province, furthermore, has encouraged the unit system and stopped the rearing of polyvoltine silkworm allover; taken measures against pebrine by the distribution of hybrid eggs; installed a modern reeling mill with the President's fund. The authorities are taking measures for sericultural development aggressively.

However, the results are not yet satisfactory, with the production target of raw silk not yet attained. It is because sericultural technicians are few in number; the techniques for mulberry cultivation and silkworm rearing are low in level; eggs are insufficient due to unskilled workers and incomplete equipment.

In order to realize these measures for sericultural development, first of all, sericultural technicians are to be secured; secondly, locally suited techniques for silkworm rearing to be established; thridly, a supply system of silkworm eggs to be established by acquired skill in egg producing techniques and reinforced facilities; fourthly, the modernization of units to be promoted; and finally, leaders of farmers to be secured by training.

The direct objective of technical cooperation between Japan and Indonesia lies in the prompt achievement of these projects. If these are attained, the technology of farmers will be raised; good cocoons produced; income from sericulture will expand; and increased production of raw silk will prosper weaving industry, contributing to the national welfare greatly, When good raw silk is produced, piece-dyed fabric will gradually replace yarn-dyed, expanding the resources of tourist industry to contribute to the national treasury.

(2) Concrete Contents of Technical Cooperation Project

(i) Target of Improvement

The natural condition of Indonesia is suitable for sericulture. In order to increase income from cocoons, therefore, we shall aim at multiple rearing (8 times a year). The techniques for mulberry cultivation and silkworm rearing should be built up with this aim in view.

(A) Items concerning Mulberry Cultivation

(a) Selection of Mulberry Varieties

Many of mulberry varieties in rearing centers are M. nigra. Are they suitable for conducting multiple rearing? It is necessary to conduct surveys on practical characters with native varieties widely to select varieties more suitable for multiple rearing.

(b) Establishment of Growing Method of Mulberry for Young Silkworms

In the unit, young silkworms (1 - 3 stage) are reared, but the training method of mulberry for young silkworms has not been established. Needless to say, good cocoons depend upon the quality of mulberry leaves given in the early stage and adequacy of rearing method. It is necessary, therefore, to establish the growing method of mulberry for young silkworms which is suitable for multiple rearing, and install in Units mulberry field exclusively for young silkworms to secure good mulberry leaves.

(c) Establishment of Training and Harvesting Methods of Mulberry for Grown Silkworms

To rear grown silkworms, they harvest, without planning, mulberry which continues to grow. Planless harvesting shortens the life of the plant, with leaf yield declining year after year. Mulberry should be harvested under a plan. It is necessary to establish techniques of training and harvesting under a plan which has been set with multiple rearing in view.

(d) Establishment of Techniques for Increasing Soil Fertility of Mulberry Field

The soil of South Sulawesi Province is, though the surveys were partially conducted, neutral in pH or alkaline, with high absorption coefficient of phosphoric acid, and the effect of nitrogeous fertilizer will be great, we consider. On the other hand, high temperature and much rain will cause organic matter dissolve extremely and soil fertility will be dissipated. To comply with these soil conditions, it is necessary to conduct soil survey and analysis of survey results and establish technique for improving soil fertility by means of the use of chemical fertilizer (though it is difficult to realize for the time being) and organic matter for the purpose of securing maximum yield and good quality of mulberry leaves. Since the security of rice straw seems difficult in view of rice harvesting practice, it is necessary to select and introduce some useful pasture for organic matter.

(B) Items concerning Silkworm Egg

(a) Advancement of Egg Producing Technique

Currently, commerical eggs (F_1) imported from Japan are used directly or after being multiplied (F_2). In South Sulawesi Province, polyvoltine eggs have been replaced with hybrid; Sericultural Station in Soppeng mainly distributes hybrid eggs (F_2). But the level of egg producing technique is so low that the absolute amount is short; farmers' demand for egg cannot be met.

For the time being, it is necessary to produce F_2 hybrid from imported eggs. So, egg producing techniques should be advanced. Workers will be trained in rational cocoon

preservation, method of egg raising, artificial hatching as well as the methods of sex-discrimination and pebrine inspection.

For the purpose, one the other hand, the facilities, machines and tools for the production of eggs should be substantiated and modernized.

(b) Breeding of Silkworm Varieties by Selection

Silkworm eggs are imported from Japan and multiplied before use. This method, however, unavoidably deteriorates the quality of cocoon fiber and productivity, as it causes physiological disturbance during transportation, lower heterosis in F_2 generation, less larval stoutness and separation of characters. In the future, therefore, it is necessary to breed locally suitable varieties by selection and get rid of the dependence on Japanese imports.

(C) Items concerning Silkworm Rearing

(a) Establishment of Technique in Rearing Method of Young and Grown Silkworms

Farmers formerly reared polyvoltine silkworms, but nowadays they rear hybrids. Young silkworms up to the 3rd stage are reared cooperatively. Farmers rear only 4 - 5 stage. But this practice has just begun, and the technique of rearing hybrids has not yet been established. If multiple rearing of hybrid is to be conducted in the future, techniques of handling both young and grown silkworms, such as rational rearing time, the number of feedings, the quantity of silkworms reared, the treatment of silkworms in moulting stage and immediately after ecdysis, should be established.

(b) Establishment of Imporved Mounting Method

As they carry on the simultaneous mounting, some cocoons do not pupate. As regards mounting, discrimination of mature silkworms, urine-removing method, the improvement of mounting apparatus, etc, are to be advanced.

(D) Establishment of Controlling Techniques of Diseases and Insect Pests

White peach scale seems to break out frequently. As for silkworm, the loss from pebrine is declining sharply on the farmers' level, but lowering the efficiency of egg production considerably, constituting a factor in egg shortage. Against pebrine, therefore, the technique to secure germ-free silkworm eggs be acquired, and at the same time, the cooperative young silkworm rearing house of the Unit be disinfected thoroughly. Then pebrine will cause no loss. But farmers use rearing stands and rearing trays made of bamboo because of easy availability. Boards are also widely used. These may cause the damage of aspergillus disease in the future, we fear.

Furthermore, as silkworm rearing spreads widely, diseases and insect pests of mulberry may tend to increase. It is necessary, therefore, to conduct surveys on the diseases and pests of silkworm and mulberry to establish their controlling techniques. In the unit, on the other hand, the modernization and disinfection of rearing tools are to be carried on thoroughly.

For reference, the pebrine inspection in Japan is provided for by law, under which for parent egg of F_1 hybrid (P), all the mother moths are inspected, while for hybrid egg (F_1), sampling inspection is conducted. Since hybrid egg is for reeling cocoon which is mass-produced, whole moth inspection is economically difficult. With the establishment of statistical method, moreover, a certain number of mother moths are taken out from a lot, and put under inspection by microscope. The number of diseased moths is compared with the standard of judgment to decide whether the lot is qualified or not. This test is performed by the mass-pebrine-inspection-of-moth machine. Therefore, Sericulture Centre conducts the whole moth inspection, while Sub-Centre uses sampling inspection as in Japan.

(ii) Training Plan

(A) Training of Technicians

Experts dispatched from Japan, staying in the Sericulture Centre, will give guidance and training to counterparts attached to them by Indonesian side on the design of experiment and survey, method of management, how to put the results of experiment and survey in order, etc., in respective fields. By this method, counterparts will accumulate experience and training in technique in their scope, finally to become excellent technicians.

The number of counterparts to be attached to a Japanese expert shall be 2 - 3 persons, taking the installation plan of Sub-Centre and the degree of importance of technicians in respective fields.

(B) Training of Sericultural Leaders

(a) Training in Sericulture Centre

Sericulture Centre will receive sericultural leaders whom the Indonesian Government recommends at a proper time and let them help Japanese experts to conduct experiment and survey for a certain period as a training. Besides, necessary experimentations and lectures are given to them. The number of trainees will be 20 persons or so each time. Especially, the training in mass pebrine inspection of moths should be conducted thoroughly each year, as Sub-Centre adopts this method for higher efficiency.

(b) Training in Sub-Centre

Sub-Centre also receives leaders in the first-line whom the Indonesian Government recommends at a proper time and let them help in the business of Sub-Centre to learn higher techniques. Sericultural farmers will be called at Sub-Centre from time to time to learn new techniques. In this case, Japanese experts will be consulted on the training plan, the contents of technique to be taught, etc., for a successful training.

(c) Training in Pilot Unit

Calling up farmers and responsible persons of the unit to the Pilot Unit at proper time, let them acquire new techniques by demonstration.

(C) Training in Japan

To train technicians whom are urgently needed, several persons will be sent to Japan

upon consultation of both countries. Japan shall receive them for training.

(iii) Introduction and Diffusion of Technique

Indonesian sericulture is carried on in vast districts, ranging 100 - 800 m above sea level, in various natural conditions. There is no established method of mulberry cultivation, silkworm rearing, or control of diseases and insect pests which is suited to the locality. Judging from yearly air temperature, etc., it is possible to rear silkworms 8 times a year. If locally adapted techniques are established and diffused, cocoon output would increase substantially.

Due to unskilled technique and insufficient facilities for egg production, however, eggs are not enough to cope with multiple rearing. So, mulberry leaves which are plenty remain unused. It is necessary to cultivate a mental attitude that all the mulberry leaves should be turned to cocoons. For the purpose, silkworm eggs must be enough to meet farmers' demand; there must be a supply system which can satisfy farmers at any time. If egg shortage is dissolved, cocoon production would be much easier.

Sericulture Centre therefore will establish standard techniques of mulberry cultivation and silkworm rearing; Sub-Centre will establish local standard techniques based upon these, which will be introduced to pilot units and diffused among units and farmers through demonstration.

In addition, when the Centre tries to establish the standard technique mentioned above, it will need to conduct a fairly wide scope of research and experiment, since many of Japanese techniques cannot apply in Indonesia as they are.

In the case of Sub-Centre, there is no problem which requires full-dress experiment and research. So, it is enough to introduce sericultural techniques from Japan and based on it, adapt them to local conditions. As for egg production, imported technique will do; but facilities, machines and instrument need be substantiated and modernized.

Against pebrine disease, Sericulture Centre conducts one batch inspection, but Sub-Centre does mass pebrine inspection of moths and supplies germ-free eggs.

On the part of farmers, if they continue cocoon raising in the present mode, there is danger that mulberry field will be devastated, and the damage from sericultural diseases will stay unabated. So, those Japanese technique, machines and tools which are capable of diffusion without modification are introduced to pilot units as bases for demonstration and diffusion.

In order to establish these techniques and a supply system of silkworm eggs, etc., promptly, sericultural technicains and leaders are insufficient. So, their training system is to be established to substantiate needed personnel.

(iv) Installation of Pilot Farmers' Group

In order to diffuse locally adapted, better sericultural technique, it is essential to set up a base for demonstration. So, a certain number of units will be selected from among 115 units (cooperative young silkworm rearing house) which are scattered in main

cocoon raising centers in South Sulawesi Province to function as pilot units.

Currently, a unit is organized by 20 - 25 sericultural farmers; a one-storied house of about 45 m^2 in area, capable of rearing 20 cases of eggs each season (1 - 3 stage). Many of them are annexed with mulberry field exclusively for young silkworms (Plates 10, 11).

Its facilities are to be reinforced so that they can be thoroughly disinfected. Present rearing tools made of bamboo or board are replaced with Japanese modern tools. In order to carry on modern silk reeling, furthermore, floss of cocoon must be removed. So, floss-removing machines are equipped. Disinfecting machines are also installed for thorough disinfection. For a good maintenance of mulberry field, on the other hand, small cultivators are to be introduced.

(3) Suitable Location of Sericulture Centre, Sub-Centre and Pilot Farmers' Groups; Their Function, Role and Relations

(i) Sericulture Centre

Sericulture Centre shall be established in a mountainous area, 200 m above the sea, called Bili-bili, about 30 km away from Ujung Pandung (Fig. 2).

Reasons why this place is selected are: although we looked for a place 300 - 400 m above the sea to establish standard techniques of mulberry cultivation and silkworm rearing which are carried on in places 100 - 800 m above sea level, we failed. This place is lower in height above the sea than desired. But it is a mountainous area of 200 m above the sea, so, there will be no trouble in establishing technique, we consider.

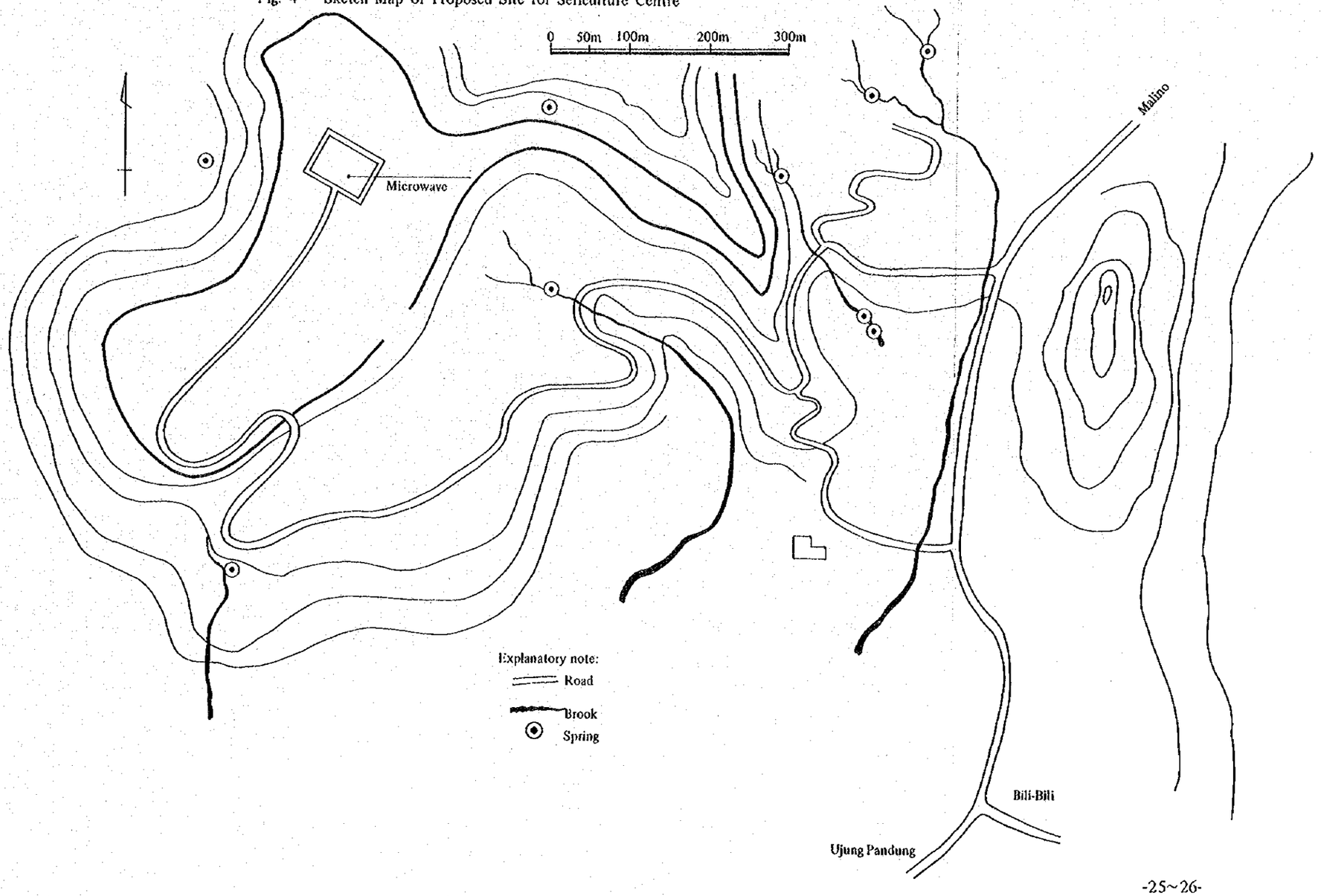
At this place, we can secure the sites of necessary buildings and mulberry field centering around the summit. Sloped mulberry field may be built up. Although there is lot of gravel, alang-alang and banana are growing; the soil must be fertile; gravel can be removed when mulberry field is built up (Fig. 4, Plate 1).

As for water, it is welling up at various places; there are streams where water never decreases even in the dry season, we hear. Water can be secured.

This place is near Ujung Pandung City (about 30 km); roads are in good condition to facilitate the transportation of silkworm eggs. When Sub-Centres are set up in Enrekang, Java, and Sumatra, in addition to Soppeng Prefecture in the future, it is convenient for the transportation of eggs, guidance of technique and liaison with upper organs. The road leads to the summit; it is not necessary to build a new one. Living environments are good. The land belongs to the Government; it would easily be acquired. For these reasons, we selected this place as a most suitable site for Sericulture Centre.

Sericulture Centre's function and role are: To establish standard techniques in mulberry cultivation and silkworm rearing; to produce and distribute good shoots for cutting and good parent eggs of F_1 hybrid; breeding of good silkworm varieties by selection; to conduct experiment and survey on sericultural diseases and insect pests, and establish technique of controlling method; to train in pebrine inspection method; to train technicians of Sub-Centre and conduct shor-term training of the first-line leaders whom the Government has recommended; etc.

Fig. 4 Sketch Map of Proposed Site for Sericulture Centre



(ii) Sub-Centre

The Indonesian Government plans to set up 2 Sub-Centres in South Sulawesi Province and 1 each in Java and Sumatra. Of which, the object of technical cooperation between two countries shall be the Sericulture Station of Forest Research Institute in Soppeng Prefecture, which will be substantiated as a Sub-Centre.

The function and role of Sub-Centre are: under the guidance of Sericulture Centre, to adapt the standard techniques as established by Sericulture Centre to local conditions and try to diffuse them; multiply silkworm eggs which have been distributed by Sericulture Centre, and distribute pebrine-free eggs among farmers through mass pebrine inspection of moths. In this case, a supply system of eggs is set up so that farmers' demand can be supplied at any time.

Furthermore, it multiplies good shoots for cutting and distributes them to famers.

It still guides Pilot Units directly and also conducts the training of first-line leaders and farmers.

(iii) Pilot Unit

There are 115 units in South Sulawesi Province, of which 5 comparatively good ones are selected as Pilot Units: 2 in Soppeng Prefecture and 1 each in Enrekang, Sidenregrapang and Wajo Prefecture.

The pilot unit is the base for diffusing new techniques which have been established by Sub-Centre by demonstration.

Pilot unit is to be annexed with mulberry field exclusively for young silkworms without fail. The mulberry field is perfectly maintained to produce good mulberry for young silkworms. Farmers' group, on the other hand, will perform training and harvesting methods for grown silkworms.

Silkworms are reared 8 times a year, using modern rearing tools and machines which Japan provides and by means of rearing methods established by Sub-Centre.

To help improve the quality of cocoons, furthermore, cocoons produced by farmers' group are shipped to the pilot unit and removed floss by means of floss remover and sorted out.

As mentioned above, the pilot unit serves as the base for demonstration to diffuse technique established by Sub-Centre as promptly as possible.

(4) Allotment of Execution of Cooperation between Japan and Indonesia

(i) Contents of Cooperation on the Part of Japan

Experts in respective fields shall be dispatched at its expenses.

Necessary machines, instruments, apparatus, rearing tools, etc. will be provided so that Sericulture Centre, Sub-Centre and Pilot Units may fulfill their function sufficiently.

Furthermore, a few Indonesian technicians who are engaged in this project will be received by Japan each year at its expenses for necessary training and instruction, under the Colombo Plan Technical Cooperation Scheme.

Machines, instruments, apparatus, rearing tools, etc., Japan provides shall belong to Indonesia. They will, however, be used exclusively for the project under the guidance of Japanese experts.

(ii) Reception on the Part of Indonesia

Indonesia shall take the following measures at its expenses in order that Sericulture Centre, Sub-Centre and Pilot Units may fulfill expected facilities:

To secure, besides counterparts, regular or part-time staffs and temporary laborers and office clerks.

To secure land necessary for Sericulture Centre and mulberry field for Sub-Centre, and construct and fix buildings and apartment facilities necessary for this project;

To supplement and replace machines, instruments, apparatus, rearing tools, etc., which Japan has provided.

Transportation, safekeeping, installation, operation, maintenance, in Indonesia, of machinery, instrument, etc., which Japan has provided shall be performed by Indonesia on its responsibility and at its expenses.

To secure necessary running expenses for the execution of this project.

2. Arrangement of Indonesian Staff

Counterparts, regular and part-time staffs will be arranged, in the required number, by speciality, as shown in Table 2.

The number of office clerks will be calculated by Indonesian side.

The Indonesian Government shall secure the technical staff, especially counterparts, absolutely.

3. Required Facilities and Their Arrangement

(1) Sericulture Centre

(a) Main Building

The main building shall be one-storied housing: Director's room, experts' rooms (research rooms), laboratories for pathology and soil analysis, laboratories for training and research study, demonstration room, lecture rooms (films may be projected), office room, etc. Six research rooms will be provided in anticipation of the dispatch of experts for a short-time, or the increase of regular members. A tank is installed on the roof. 664 m^2 in total floor space, and 476 m^2 in floor space (Fig. 6-A).

Table 2. Required Technical Staff in Sericulture Centre and Sub-Centre

	Sericulture Centre				Sub-Centre			
	Count. parts	Regular	Part-time	Tem. laborers	Chief	Regular	Part-time	Tem. laborers
Mul. cult. method (incl. harvesting & soil)	3	6	20	20	1	5	40	40
Egg pro.	3	6	20	5	1	10	20	15
Rearing	1		5			5	5	
Egg raising & art. hat.	1	6	5	5	1	3	5	5
Pebrine insp.	1		10			2	10	10
Rearing meth.	3	6	5		1	2	5	•
Disease. Pest	2	2	2		•	•	•	•
Total	11	20	47	25	3	17	65	55

(b) Rearing Room for Rearing Method

The rearing room can handle 5 cases of eggs per season, consisting of: young silkworm room, grown silkworm room, mulberry store room, research room, etc., surrounded by eaves of 3 m. Total floor space of 456 m^2 and floor space of 192 m^2 (Fig. 6-B).

(c) Rearing Room for Egg Production

Two buildings of rearing rooms which can handle 500 moths per season will be constructed, with the research room (with male moth refrigerator annexed) as the center. A building is 456 m^2 in total floor space and 192 m^2 in floor space; research room is 70 m^2 in total floor space and 40 m^2 in floor space (Fig. 6-C).

(d) Pathological Rearing Room

The building is 264 m^2 in total floor space and 96 m^2 in floor space, including research room and rearing rooms (Fig. 6-D).

(e) Pebrine Inspection Building

This building, 372 m^2 in total floor space and 252 m^2 in floor space, contains the pebrine inspection room for parent eggs of F_1 hybrid and the room for the training of inspection method, etc. (Fig. 6-E).

(f) Silkworm Egg Refrigerator

For preserving eggs, 4 rooms of 2.5, 5, 10 and 15°C each and for incubation 2

rooms of 25°C in temperature and 80% in relative humidity, and machine room will be constructed with total floor space of 180 m^2 and floor space of 107 m^2. As this building is designed in Japan, there may be some modification (Fig. 6-F).

(g) Artificial Hatching Room

Artificial hatching room has roof only; floor is covered with concrete. Water tank and concrete shelves are installed. 48 m^2 in total floor space and 24 m^2 in floor space (Fig. 6-G).

(h) Chemicals Warehouse

Chemicals warehouse is used to store formalin, hydrochloric acid, chemicals for soil analysis, etc., with a floor space of 4 m^2 (Fig. 6-H).

(i) Garage

Egg trucks (equipped with refrigerating apparatus in anticipation of long-distance transportation), an official vehicle and 2 jeeps are housed. 60 m^2 in floor space (Fig. 6-I).

(j) Mulberry Field Maintenance Building

This maintenance building contains research room, resting room for laborers, etc., with a total floor space of 165 m^2 and floor space of 117 m^2. (Fig. 6-J).

(k) Compost Shed

Compost shed is composed of fertilizer warehouse which stores chemical fertilizer and piled-up compost shed, with a total floor space of 192 m^2 and floor space of 140 m^2 (Fig. 6-k).

(l) Agricultural Machine and Tool Warehouse

This warehouse houses 4-wheeled tractors and attached working machines and 2-wheeled tractors, with a total floor space of 187 m^2 and floor space of 120 m^2 (Fig. 6-L).

(m) Rearing Tool Washing Pool, Shower Room

Two washing pools of one m deep, shower rooms and water closets are set up at proper places (Fig. 6-B, C).

(n) Residence of Experts

The residence of Japanese expert is constructed for each person (Fig. 6-M). This residence will be further examined by Indonesian side.

(o) Dormitory for Trainees

A dormitory to accommodate about 20 persons each time will be constructed. Its design will be drawn up by Indonesian side.

(p) Besides, water storing tubs, dams, etc. will be constructed at proper places.

As for the arrangement of these buildings, the main building stands in the center, and various buildings for egg production, rearing rooms of silkworms, and rear-rooms for pathology are grouped respectively. Buildings related to the maintenance of mulberry field, such as maintenance building, are set up at proper places in mulberry field. Machines and instrument for meteorological observation are set in the bare ground and connected with synthetic meteorological recording apparatus room in the main building (Fig. 5).

The yearly construction plan of these buildings is shown in Table 3.

The area of mulberry field will be in Table 4.

(2) Sub-Centre

(a) Rearing Room for Rearing Method

The present incubation and cold-storage rooms will be remodeled for the purpose (Fig. 7).

(b) Rearing Room for Egg Production

The number of moths to raise per case is 100 cases; 8-time rearing per year. The amount of silkworms reared per building is: 25 cases by 1 - 3 stage rearing room, and 10 cases by grown 4 - 5 stage rearing room, and 20 cases by egg-raising rearing room. The rearing rooms of grown silkworms and for egg raising shall be 2 buildings, respectively (Table 5).

For young silkworm rearing, the present rearing rooms are used (Fig. 7). But the rearing rooms of grown silkworms (to rear 10 cases each time) and those for raising eggs (to handle eggs of 20 cases) will be newly constructed. A building is constructed symmetrically, with the research room at the center. A building is 494 m^2 in total space and 224 m^2 in floor space. A research room is 110 m^2 and 56 m^2 in total floor space and floor space, respectively (Fig. 8-A, B).

(c) Male Moth Refrigerator

Male moth refrigerator is annexed to the rearing room for egg produciton (egg raising). This will be designed in Japan (Fig. 8-B).

(d) Pebrine Inspection Building

A pebrine inspection building is newly constructed. As the mass pebrine inspection of moths is conducted, a preparatory room and a microscopic examination room are installed. The building is 180 m^2 in total floor space and 105 m^2 in floor space (Fig. 8-C).

(e) Silkworm Egg Refrigerator

Five rooms at 2.5, 5 (2 rooms), 10 and 15°C are installed for egg preservation. For incubation, 3 rooms which can maintain 23°C, 80% and 25°C, 80% will be constructed.

Table 3. Construction Plan of Building by Year (Sericulture Centre)

	Kind of building	1st year	2nd year
(a)	Main building	0	
(b)	Rearing room for rearing method		0
(c)	Rearing room for egg production (1)	0	
	Rearing room for egg production (2)		0
	Research room	0	
(d)	Pathological rearing room		0
(e)	Pebrine inspection building	0	
(f)	Silkworm egg refrigerator		0
(g)	Artificial hatching room		0
(h)	Chemicals warehouse		0
(i)	Garage	0	
(j)	Mulberry field maintenance building	0	
(k)	Compost shed		0
(l)	Agricultural machine and tool warehouse		0
(m)	Rearing tool washing pool	0	
(n)	Residence of experts	0	
(o)	Dormitory for trainees		0
(p)	Water storing tubs and dams	0	

Remarks: Garage is to be taken up soonest. It will serve, until the day of the completion of main building, as Japanese experts' staying place for business, and a temporary warehouse of machines and instruments.

Table 4. Area of Mulberry Field (Sericulture Centre)

(1)	Research field for cultivation method	2.5 ha
(2)	Field for egg production	3.0
(3)	Field for the study of silkworm rearing	1.5
(4)	Grassland	1.0
	Total	8.0

Remarks: Research field for mulberry cultivation method includes 0.2 ha devoted to the production of shoots for cutting.

This refrigerator, including machine room, will be 216 m^2 in total floor space and 135 m^2 in floor space. As the design is worked out in Japan, the area may change, but it is to be executed according to the design (Fig. 8-D).

(f) Rearing tool washing pool

A washing pool of rearing tools, etc., 1 m deep, will be constructed to each rearing room of grown silkworms and that for egg raising (Fig. 8-A, B).

(g) Chemicals Warehouse

The warehouse to store formalin, hydrochloric acid, etc. will be remodeled from the present pebrine inspection room (Fig. 7).

Table 5. Yearly Plan of Multiplying Eggs for Distribution at Sub-Centre (Sericulture Station in Soppeng)

Item		1976	1977	1978	1979	1980	Remarks
Egg production (cases)		5000	5000	10000	15000	20000	No. of moths to raise per case: 100 cases; 8 rearings a year
Consumption of eggs: (cases)	per season	6.3	6.3	12.5	18.8	25.0	
	annual sum	50	50	100	150	200	
Mulberry required: (kg)	young worms	1250	1250	2500	3750	5000	
	grown worms	25000	25000	50000	75000	100000	
Area of mul. field: (ha)	young worms	0.3	0.3	0.6	0.9	1.25	Harvest of 4000 kg p. ha
	grown worms	3.1	3.1	6.3	9.4	12.50	Harvest of 8000 kg p. ha
Required rearing rooms: (buildings)	1 – 3 stage	1	1	1	1	1	25 cases per building
	4 – 5	1	1	2	2	2	10 cases per building
	egg raising	1	1	1	1	2	20 cases per building

(h) Artifical Hatching Room

The artificial hatching room will be remodeled from the present storeroom (Fig. 7)

The sites of new buildings and the arrangement of remodeled ones are shown in Fig. 7.

The yearly plan for construction and remodeling is as per Table 6.

The area of mulberry field will be as per Table 7.

Table 6. Yearly Plan for Construction and Remodeling of Buildings (Sub-Centre)

	Kinds of building	1st year	2nd year
(a)	Rearing room for the study of rearing method (remodeled)		0
(b)	Rearing room for egg production of:		
	Grown silkworms (1)	0	
	Grown silkworms (2)		0
	Research room	0	
	Egg production (1)	0	
	Egg production (2)		0
	Research room	0	
(c)	Male moth refrigerator	0	
(d)	Pebrine inspection building	0	
(e)	Silkworm egg refrigerator	0	
(f)	Rearing tool washing pool	0	
(g)	Chemicals warehouse (remodeled)		0
(h)	Artificial hatching room (remodeled)	0	

Table 7. Area of Mulberry Field (Sub-Centre)

(1)	Research field for cultivation method	1.0 ha
(2)	Field for egg production	14.0
(3)	Field for the study of silkworm rearing	1.5
(4)	Grassland	3.0
	Total	19.5

Remarks: (1) Research field for mulberry cultivation method includes 0.2 ha of the field for the multiplication of shoots for cutting.

To sum up, the area of main building and other buildings necessary for experiment and research is: for Sericulture Centre, 3,510 m^2 in total floor space and 2,024 m^2 in floor space; for Sub-Centre, 2,592 m^2 in total floor space and 1,248 m^2 in floor space. Residence of experts (6 buildings) and the dormitory for trainees (10 m^2 each for 20 persons) will be 1,412 m^2 in total floor space. As for washing pool, in Sericulture Centre, 40 m^3 in total volume and in Sub-Centre, 26 m^3. Although Sericulture Centre will be attached with water-storing tanks, dams, independent electric power plant, etc., they are left unsettled (Table 8).

4. Required Machines and Instruments

Required machines and instruments are mainly as follows:

(1) Sericulture Centre

(a) Relative to Build-up

Bulldozer (with blades and baskets), rakedozer

(b) Relative to Mulberry Cultivation Method

4-wheeled tractors (wheel tractors, 25 ps, with rotary)

Attachment to the above (fertilizer applying machines, rotary plows, sprayers, rotary mowers, etc.)

2-wheeled tractors, maintenance machines, mini-trucks

Power sprayers, shoulder sprayers

Sprinklers

Synthetic meteorological recording apparatus

Hand-elters, power sythes, cutters

Complete set of small agricultural tools for the maintenance of mulberry field

Balances (100 kg - 0.2 kg)

Table 8. — List of New Construction or Remodeling in Sericulture Centre and Sub-Centre

Kind	Seri. Centre		Sub-Centre		Remarks
	Total m^2	Floor m^2	Total m^2	Floor m^2	
Main building	664	476	–	–	
Rearing room, rearing method	456	198	(remodeled)		Including shower room
Rearing room, egg production(1)	456	192	–	–	Grown & young
Rearing room, egg production(2)	456	192	–	–	reared; egg raising
Rearing room, research room	70	46	–	–	Including shower room
Rearing room, egg production(grown)(1)			494	224	
Rearing room, egg production(grown)(2)			494	224	
Rearing room, research room			110	56	
Rearing room, egg raising(1)			494	224	
Rearing room, egg raising(2)			494	224	
Rearing room, research room			110	56	
Rearing room, pathology	264	96	–	–	
Pebrine inspection building	372	252	180	105	
Egg refrigerator	180	107	216	135	
Artificial hatching room	48	24	(remodeled)		
Chemicals warehouse	–	4	(remodeled)		
Garage	–	60	–	–	
Mulberry field maintenance building	165	117	–	–	
Compost shed	192	140	–	–	
Agric'l machine and tool warehouse	187	120	–	–	
Storeroom	–	–	(remodeled)		
Rearing room, egg production(young)	–	–	(no change)		
Total	3,510	2,024	2,592	1,248	
Experts' residence	–	1,212	–	–	202 m^2 x 6
Dormitory for trainess	–	200	–	–	10 x 20
Total	–	1,412	–	–	
Washing pool	(4x5x1)x2 40 m^3				Circumference concreted
Washing pool			(2x3x1) 6 m^3		1 m wide
Washing pool			(4x5x1) 20 m^3		"
Total		40 m^3		26 m^3	
Water-storing tank	o	o	–	–	
Dams	o	o	–	–	
Independent electric power plant	o	o	–	–	

Note: (–) means unnecessary.
(o) means that area, volume, etc., left unsettled.

Pots (Wagner pots 1/2000 - 1/5000)

Set of measuring instruments

Complete set of soil survey instruments (soil testing sticks, soil taking borings, mechanical analysis of soil, weight/volume measuring machines, net volume measuring machines, grain analyzers, etc.)

Fig. 5. Arrangement Plan for the Sericulture Centre

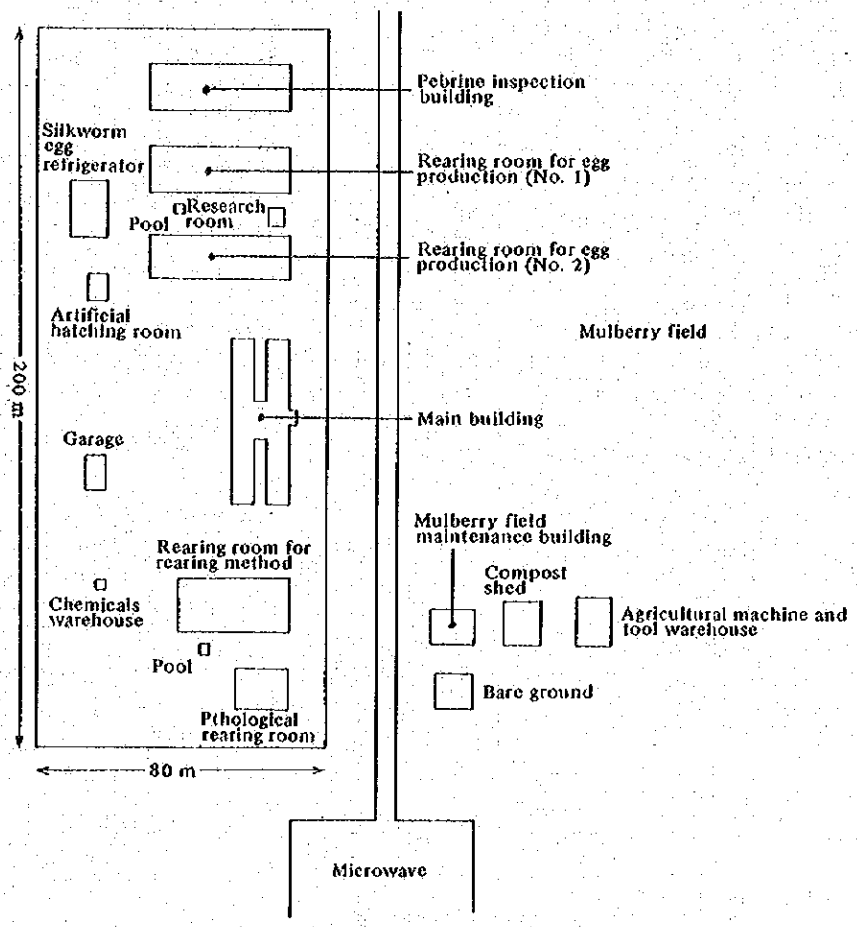
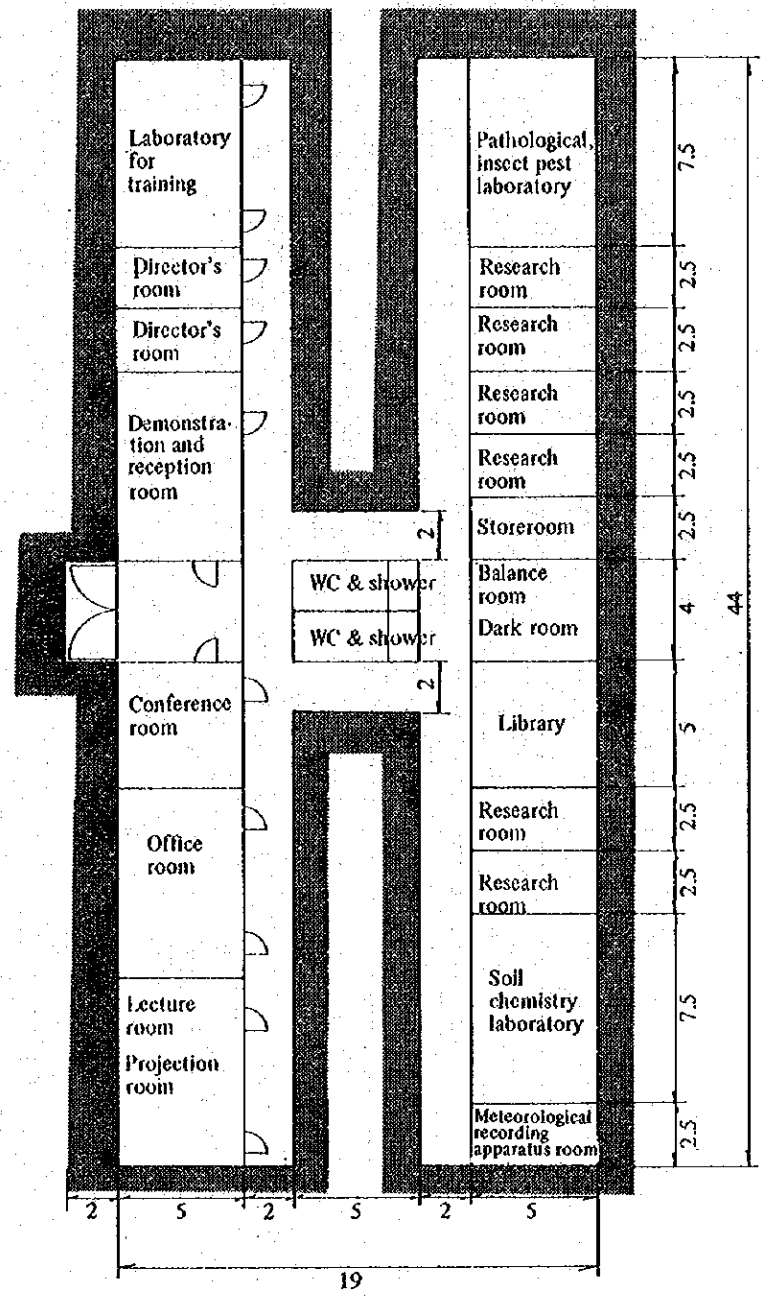


Fig. 6. Sericulture Centre

A. Main building

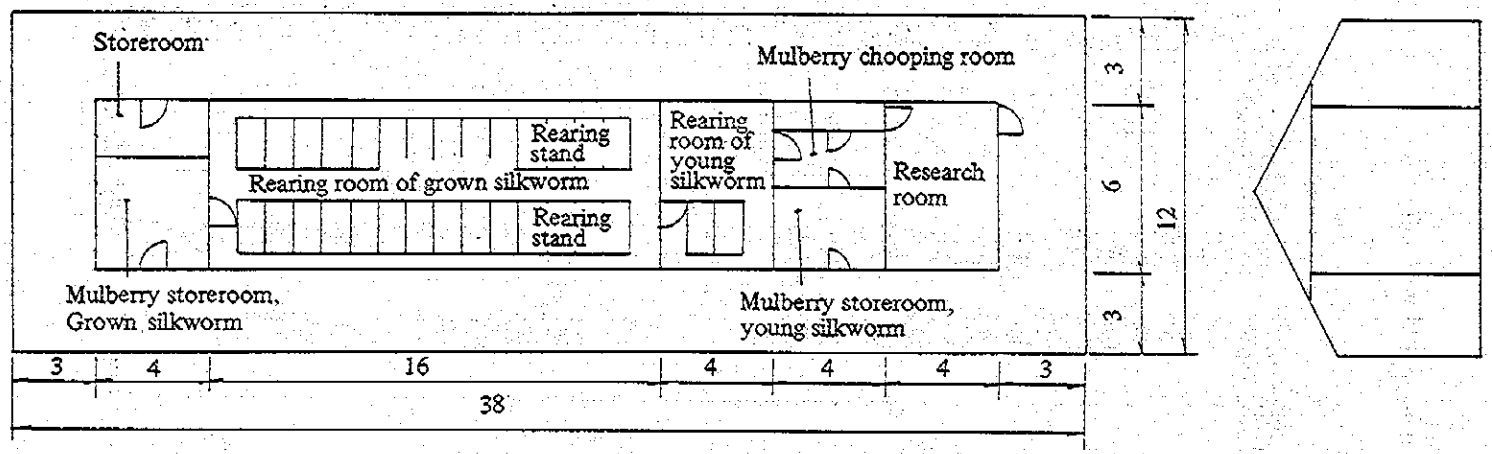
Total Floor space: 664 m²
Floor space: 476 m²

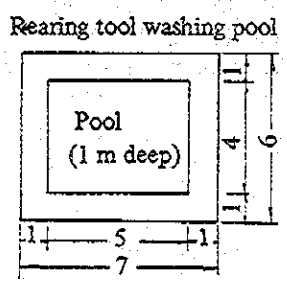


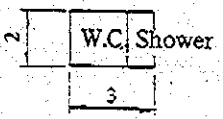
B. Rearing room for rearing method

5 cases of eggs per season

Total floor space: 12 m x 38 m = 456 m^2 (incl. eaves)
Floor space: 6 m x 32 m = 192 m^2
Shower: 3 m x 2 m = 6 m^2



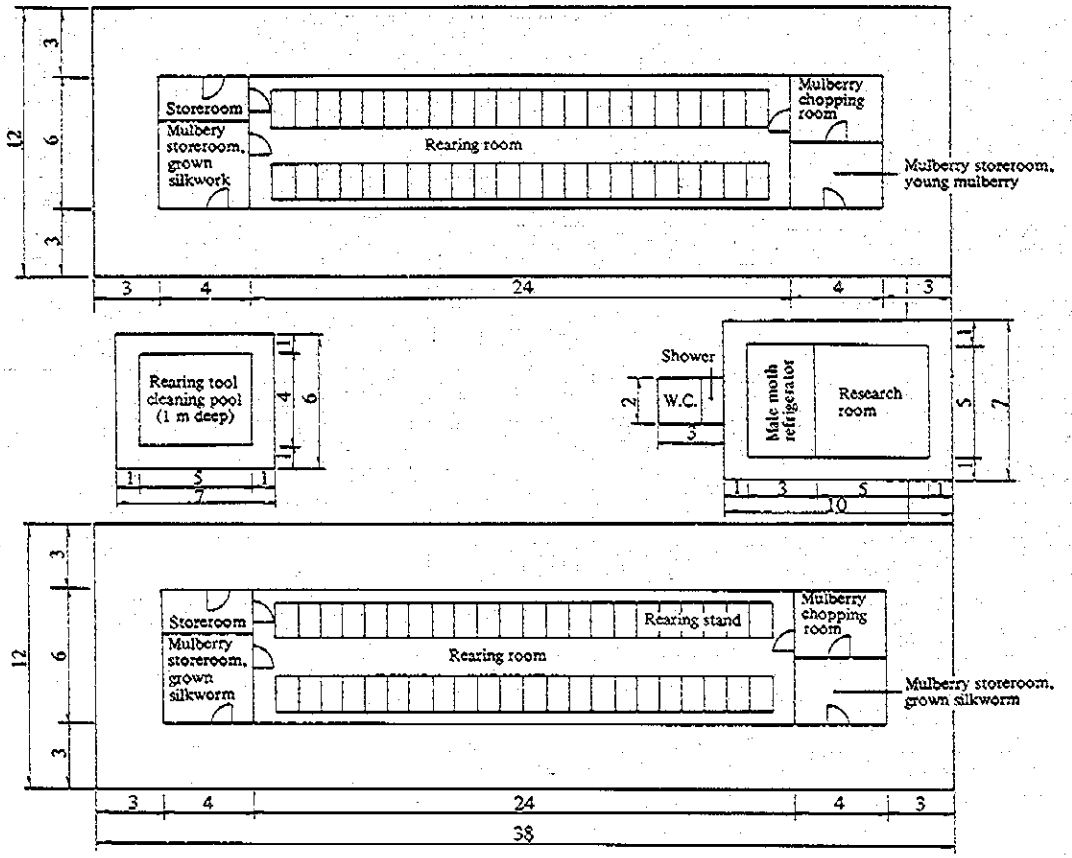




C Rearing room, egg raising 500 moths per season

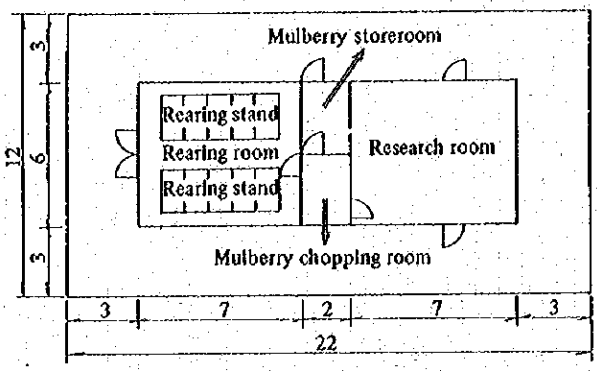
Rearing room: Total floor space : 12m x 38m = 456m^2
Floor space : 6m x 32m = 192m^2

Research room: Total floor space : 10m x 7m = 70m^2
Floor space : 5m x 8m = 40m^2
Shower : 2m x 3m = 6m^2
Grand total : 40m^2 + 6m^2 = 46m^2



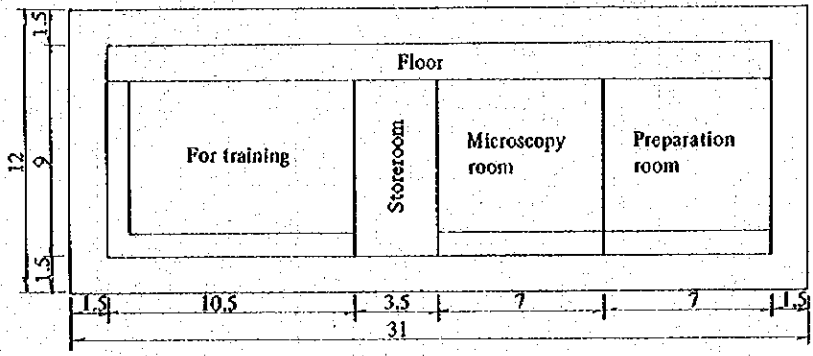
D. Pathological Rearing Room

Total floor space: 12 m x 22 m = 264 m²
Floor space: 6 x 16 m = 96 m²



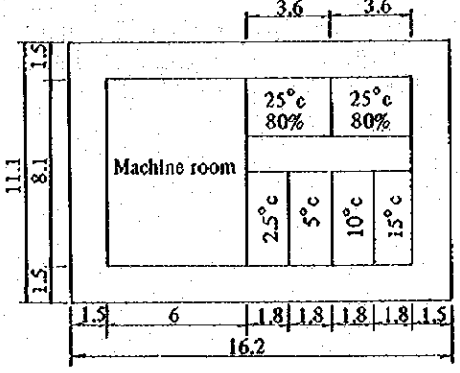
E. Pebrine Inspection Building

Total floor space: 12 m x 31 m = 372 m²
Floor space: 9 m x 28 m = 252 m²



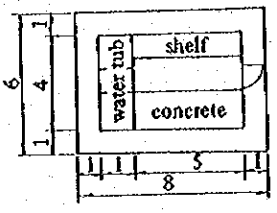
F. Silkworm Egg Refrigerator

Total floor space: 11.1 m x 16.2 m = 180 m²
Floor space: 8.1 m x 13.2 m = 107 m²



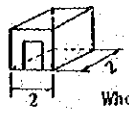
G. Artificial Hatching Room

Total floor space: 6 m x 8 m = 48 m²
Floor space: 4 m x 6 m = 24 m²



H. Chemicals Warehouse

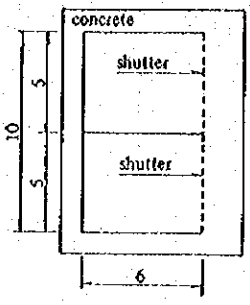
Floor space: 2 m x 2 m = 4 m²



Whole concrete, windowless
Exhaust on roof: 2

I. Garage

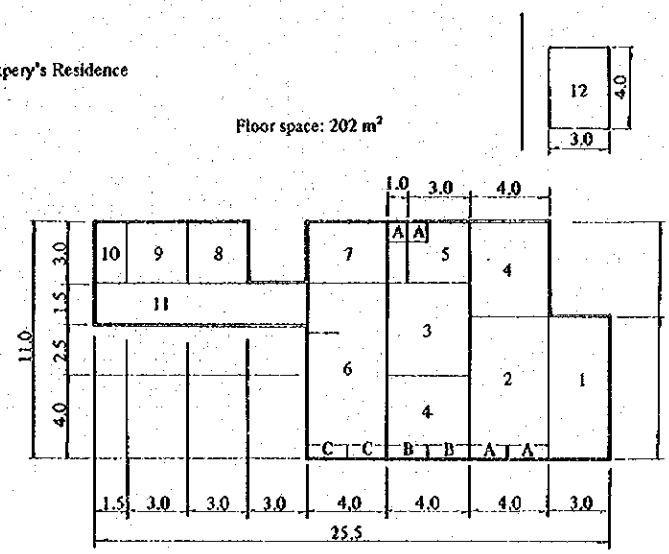
Floor space: 6 m x 10 m = 60 m²



Housing: Egg truck: 1
Official vehicle: 1
Jeep: 2

M. Expery's Residence

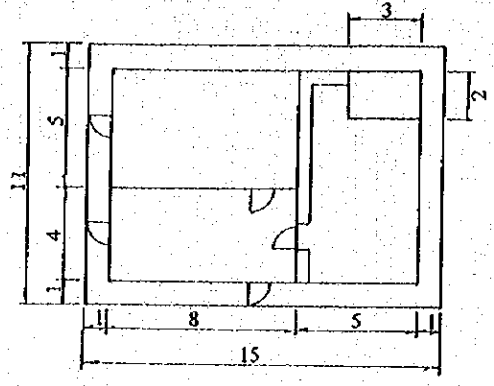
Floor space: 202 m²



1	Veranda
2	Reception room
3	Dining room
4	Bed room
5	Study room
6	Kitchen room
7	Bath room, W.C.
8	Store room
9	Maidservants room
10	Shower, W.C.
11	Corridor
12	Garage

A	Shelf
B	Closet
C	Wardrobe

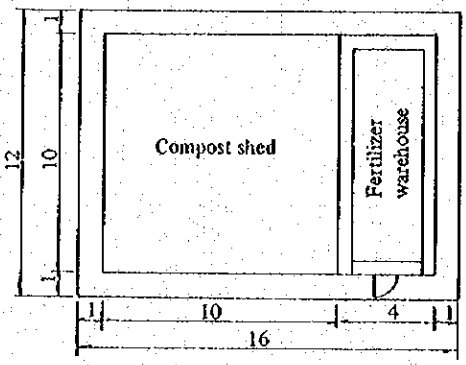
J. Mulberry Field Maintenance Room



Total floor space: 11 m x 15 m = 165 m²
Floor space: 9 m x 13 m = 117 m²

Surrounding concrete of 1 m wide

K. Compost Shed

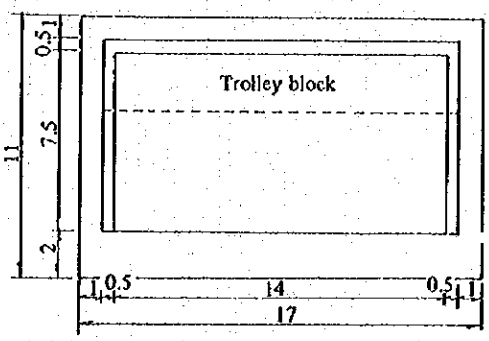


Total floor space: 12 m x 16 m = 192 m²
Floor space: 10 m x 14 m = 140 m²

Surrounding concrete of 1 m wide

Note: In fertilizer warehouse,
are installed shelves
of 0.5 m wide in 2 layers.

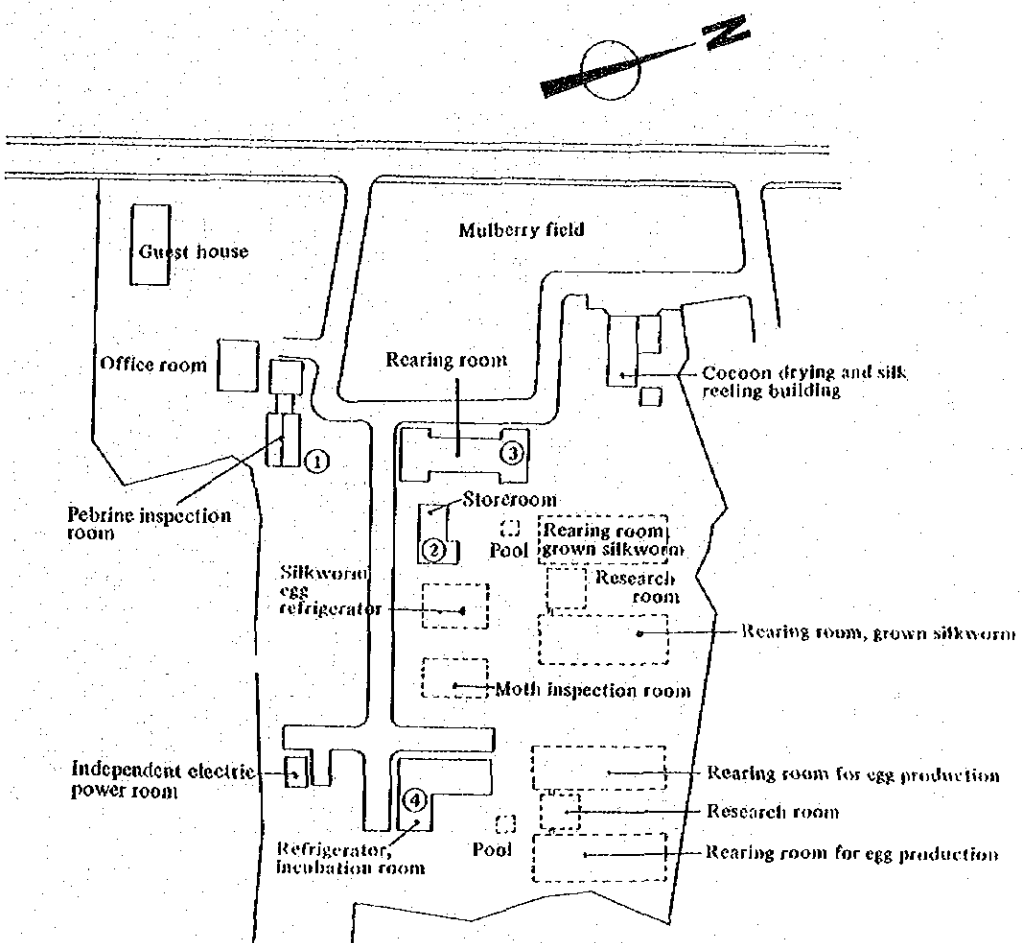
L. Agricultural Machine and Tools Warehouse



Total floor space: 11 m x 17 m = 187 m²
Floor space: 8 m x 15 m = 120 m²

Surrounding concrete of 1 – 2 m wide

Fig. 7 Arrangement Plan to Reinforce Sericulture Station of Forest Research Institute in Soppeng Prefecture as Sub-Centre



No	Name of existing buildings	Name of remodeled buildings
1	Pebrine inspection	Chemicals warehouse
2	Storeroom	Art. hat. room
3	Rearing room	Rear. rm. for young silkworm, only
4	Refrig., incubation	Rearing rm., rearing method

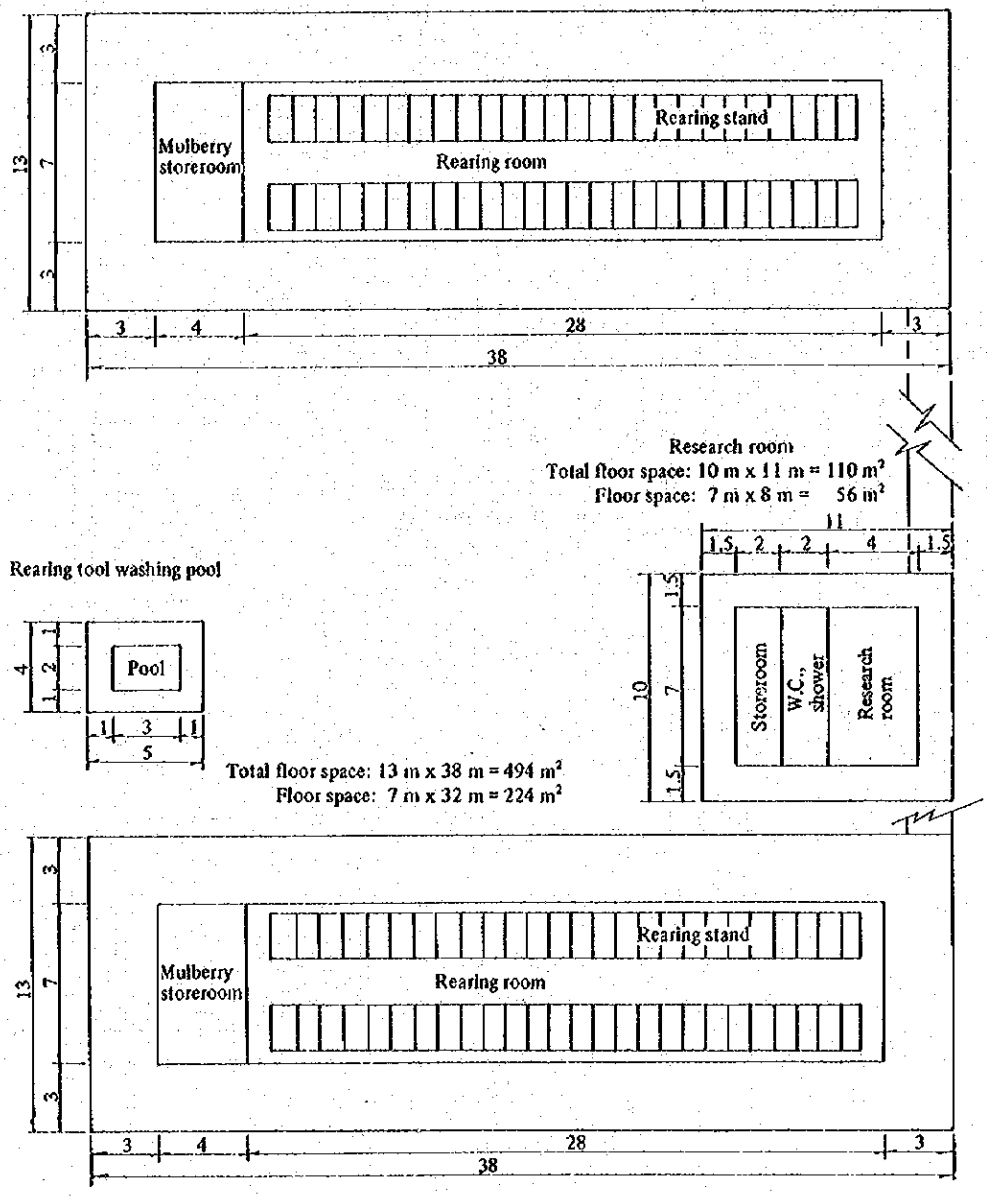
Reamrks: - - - - new construction
—— exhisting building

Fig. 8. Sub-Centre

A. Rearing Room, grown silkworm

10 cases per season

Total floor space: 13 m x 38 m = 494 m²
Floor space: 7 m x 37 m = 224 m²

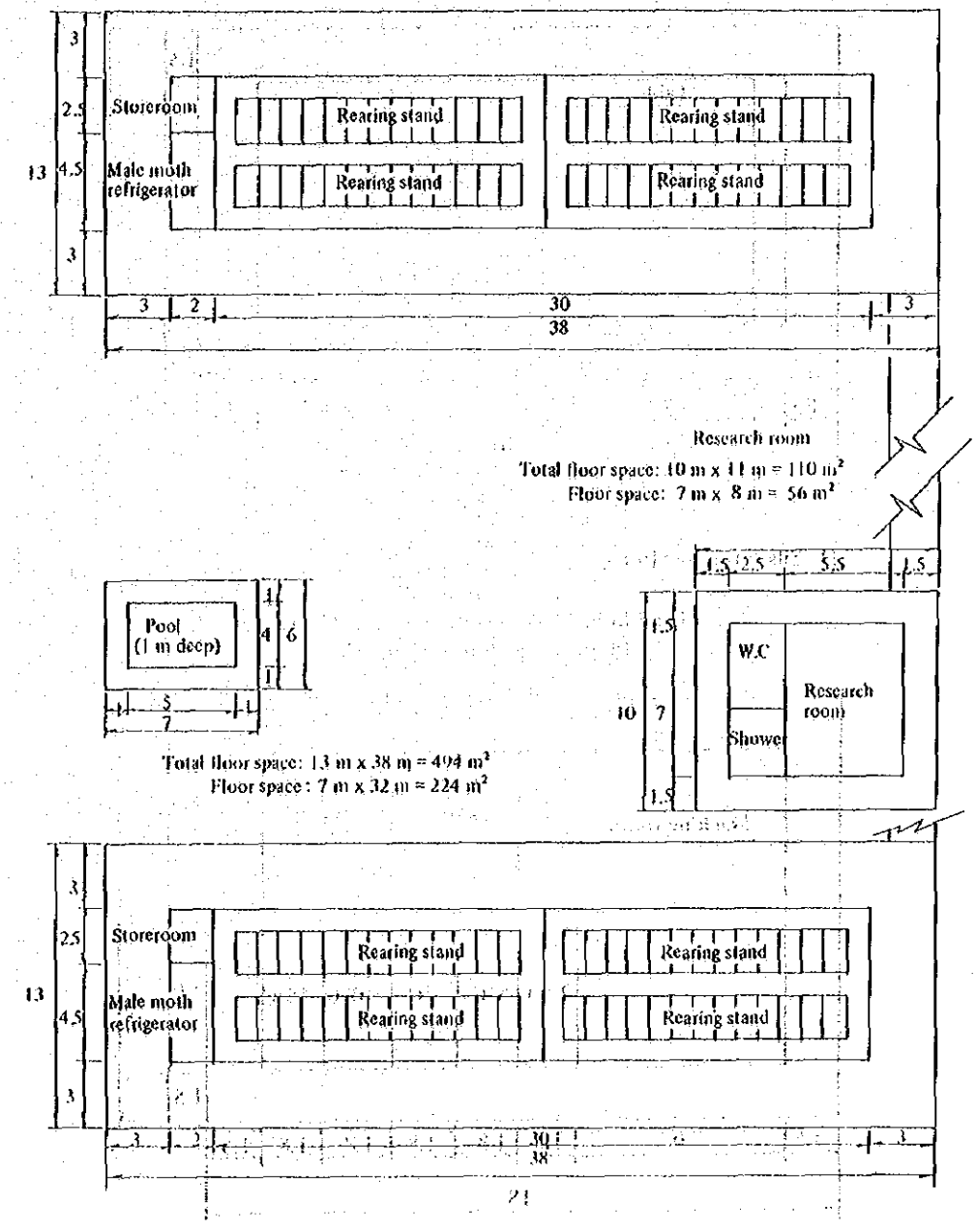


B. Rearing Room for Egg Production

For raising eggs (20 cases used)

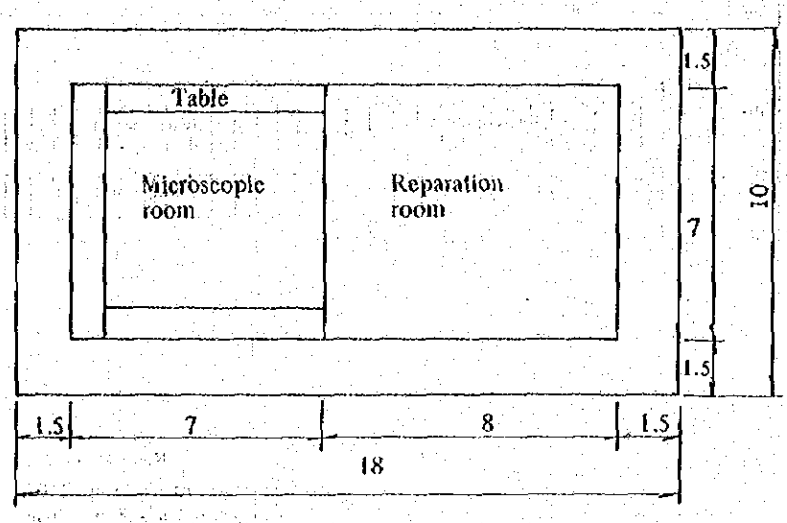
Total Floor space: 13 m x 38 m = 494 m²

Floor space: 7 m x 32 m = 224 m²



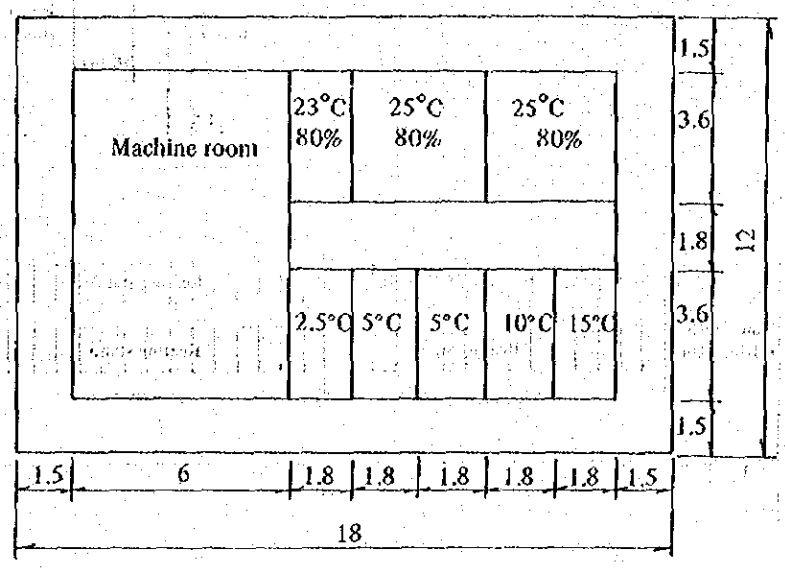
C. Pebrine Inspection Building

Total floor space: 10 m x 18 m = 180 m²
Floor space: 7 m x 15 m = 105 m²



D. Silkworm Egg Refrigerator

Total floor space: 12 m x 18 m = 216 m²
Floor space: 9 m x 15 m = 135 m²



Complete set of chemical analysis instruments of soil (auto distillers, fat extraction apparatus, N dissolution apparatus, N distilling apparatus, photoelectric colorimeters, water purifying apparatus, fixed temperature electric dryers, atomic absorbed light spectroanalyzers, etc.)

Complete set of chemicals

Complete set of glass instruments

Agricultural drugs (herbicides and controlling chemicals of diseases and pests)

Fertilizer (synthetic fertilizer, ammonium sulphate, urea, calcium superphosphate, etc.)

Also, supplies (recording paper of synthetic meteorological meter, temperature and humidity self-register, etc.)

(c) Relative to Egg Production

Complete set of disinfecting machines and tools (power sprayer, hand sprayer, antigas masks, power suction pumps, etc.)

Complete set of rearing machines and tools (power and hand mulberry chopping machines, movable rearing stands, collapsible rearing stands, 3P rearing trays, self-registering thermometers, torsion balances, various weighing instruments, power floss remover, seed cocoon cutting machines, pupal sex discriminating machines, etc.)

Complete set of egg raising instruments (mother moth dryers, moth covers, etc.)

Complete set of acid treatment instruments (specific gravity meters, float thermometers for acid treatment, etc.)

Complete set of testing machines and instruments of the quality of cocoon fiber (cocoon drying machines, fixed temperature dryers, single cocoon reeling machines, cocoon cooking machines, cocoon sorting machines, silk reeling testing machines, rereeling machines, steam generators, boilers, counter reels, etc.)

Chemicals for disinfection (formalin, ARIBAND, etc.)

Supplies for silkworm rearing (silkworm seat paper, pyrosheets, recording paper, etc.)

Supplies for egg raising (egg-cards, moth preserving cases, etc.)

Supplies for acid treatment (hydrochloric acid, etc.)

(d) Relating to Pebrine Inspection

Complete set of pebrine mother moth grinders

Complete set of mass pebrine inspecting machine of moth

Phase-difference microscopes, polaroid land microphotography

Supplies for pebrine inspection (glass instruments, filter paper, caustic potash, etc.)

(e) Relative to Silkworm Rearing Method

Complete set of disinfecting machines and tools (power sprayers, antigas masks, etc.)

Complete set of rearing machines and tools (power mulberry chopping machines, movable rearing stands, collapsible rearing stands, 3P rearing trays, self-registering thermometers, etc.)

Complete set of mounting apparatus (power floss removers, plastic years-use mounting apparatus, etc.)

(f) Relative to Diseases and Insect Pests

Microscopes, autocraves, pyrostats, pasteurizing machines, auto distilling apparatus, projectors, microtomes, digital balances, reciprocating cultivating machines with fixed temperature tubs, insect rearing boxes, shelves for insect specimens, etc.

Supplies for diseases and insect pests control (glass instruments, chemicals, paste-boards, name-labels, etc.)

(g) Relative to Silkworm Egg, Male Moth Refrigerator and Incubation

Mechanical apparatus, water cooling apparatus, heat-insulating materials, heat-insulating doors, electricity control apparatus, independent electric power plants, etc.)

(h) Relative to Education and Training

Complete set of cameras

Epidiascope

Cameras and projectors (8mm, 16mm, slides)

Wireless amplifier microphones, tape recorders, transistor megaphones

VTR (including cameras)

(i) Relative to Business and Experimental Machines and Instruments

Business machines and instruments (Recopie, Zelox, etc.)

Machines and instruments for common experiment (various balances, complete set of machines and instruments for developing photographs, various computing machines, etc.)

Supplies (Recopie paper, computer paper, notebooks, etc.)

(j) Books and Periodicals

(k) Relative to Laboratories, Research Rooms, etc.

Testing benches, sinks, shelves for chemicals and instruments, research desks, etc.

(l) Relative to Electricity and Water

Independent electric power plants, complete set of pumps, complete set of water purifiers, etc.

(m) Relative to Transportation

Official vehicles, jeeps (two), silkworm egg trucks

(n) Cement for the rearing tool washing pool and the storage of water

(2) Sub-Centre

(a) Relative to Mulberry Cultivation

2-wheeled tractor (with rotary), maintenance machine, mini-truck

Power sprayer, shoulder sprayer

Sprinkler

Meteorological observation apparatus (screen, thermometer, hygrometer, etc.)

Hand-elter, power sythe, cutter

Small agricultural tools for mulberry field maintenance (pruner, mulberry sickle, etc.)

Balances (platform scales, 100 - 0.2 kg)

Pots (Wagner pots 1/2000, 1/5000)

Complete set of soil survey instruments

Agricultural chemicals (herbicide, disease and pest controlling chemicals)

Ferlitizer (synthetic fertilizer, ammonium sulphate, urea, calcium superphosphate, etc.)

Supplies (recording paper, etc.)

(b) Relative to Silkworm Egg Production

Complete set of machines and instruments for disinfection (shoulder sprayer, antigas mask, etc.)

Complete set of rearing machines and tools (power and hand mulberry chopping machine, movable rearing stand, collapsible rearing stand, 3P rearing tray, self-

registering thermo-hygrometer, torsion balance, power floss remover, seed cocoon cutter, pupal sex discriminator, etc.)

Complete set of mounting machines and instruments (floss removers, plastic years-use mounting apparatus, etc.)

Complete set of egg raising instruments (mother moth dryer, moth covers, etc.)

Complete set of acid treatment instruments (specific gravity meter, float thermometer for acid treatment, etc.)

Disinfectants (formalin, ARIBAND, etc.)

Supplies for silkworm rearing (silkworm seat paper, pyrosheets, recording paper, etc.)

Supplies for egg raising (egg-card, moth box, etc.)

Supplies for acid treatment (hydrochloric acid, etc.)

(c) Relative to Rearing Method

Complete set of disinfecting machines and instruments (hand sprayer, antigas mask, etc.)

Complete set of rearing machines and tools (power mulberry chopping machine, movable rearing stand, collapsible rearing stand, 3P rearing tray, self-registering thermo-hygrometer, power floss remover, etc.)

Disinfectants (formalin, ARIBAND, etc.)

Supplies for silkworm rearing (silkworm seat paper, pyrosheets, recording paper, etc.)

(d) Relative to Pebrine Inspection

Complete set of mass pebrine inspecting machines of moth

Phase-difference microscope

Supplies (glass instruments, filter paper, caustic potash, etc.)

(e) Relative to Silkworm Egg, Male Moth Preserving Refrigerator and Incubation

Mechanical apparatus, water cooling apparatus, heat-insulating materials, heat-insulating doors, electricity control apparatus, independent electric power plants, etc.)

(3) Pilot Unit

(a) Relative to Mulberry Field

2-wheeled tractor (8 ps. with rotary)

Maintenance machine

Shoulder sprayer

Self-registering thermo-hygrometer (for 7 days)

Small agricultural tools for mulberry field maintenance (pruner, mulberry sickle, etc.)

Platform scale (100 kg, with a sensitivity of 200 g)

Supplies (recording paper, etc.)

(b) Relative to Silkworm Rearing

Power sprayer, shoulder sprayer, hand electric generator, antigas mask, etc.

Mulberry chopping machine, balances, movable rearing stand, 3P rearing tray, feeding stand, wet and dry bulb thermo-hygrometer for silkworm rearing.

Floss remover, plastic years-use mounting apparatus

Disinfectants (formalin, ARIBAND, calcium hypochlorite, etc.)

Supplies for silkworm rearing (silkworm seat paper, paraffin paper, pyrosheets, etc.)

Other supplies (recording paper, etc.)

IV. Proposals for Measures to be Taken to Develop Sericulture

1. Technical Improvement to Develop Sericulture

(1) Relative to Mulberry Cultivation

The technical level in Indonesia, as far as mulberry cultivation is concerned, is low. Generally speaking, mulberry tree is regarded as forest tree. No noteworthy result of experiment or research has been recorded at research institutes. Under such circumstances, it is necessary to take the following measures for improvement:

(a) Survey of Practical Characters of Mulberry Varieties

Many of mulberry varieties in principal sericultural districts of Indonesia are M. nigra. In order to promote sericulture in the future, it is necessary to introduce a planned sericulture, that is to say, multiple rearing (8 rearings a year).

For the purpose, suitable mulberry varieties for multiple rearing must be selected. Therefore, a survey on characters of mulberry varieties, with native varieties as the main object, is to be conducted promptly to select stout, good and high-yielding ones.

(b) Establishment of Growing Method of Mulberry for Young Silkworms

In order to rear stout silkworms to yield good cocoons, it is necessary to discriminate mulberry for young silkworms and that for grown silkworms. There is no such practice in Indonesia. As the quality of mulberry leaves given during the young silkworm stage affects the larval stoutness greatly, it is necessary to examine the growing method of mulberry for young silkworms to establish standard techniques, which are suitable for multiple harvesting. The mulberry field exclusively for young silkworms is to be annexed to the cooperative young silkworm rearing house (Unit) urgently.

(c) Establishment of Training and Harvesting Techniques for Grown Silkworms

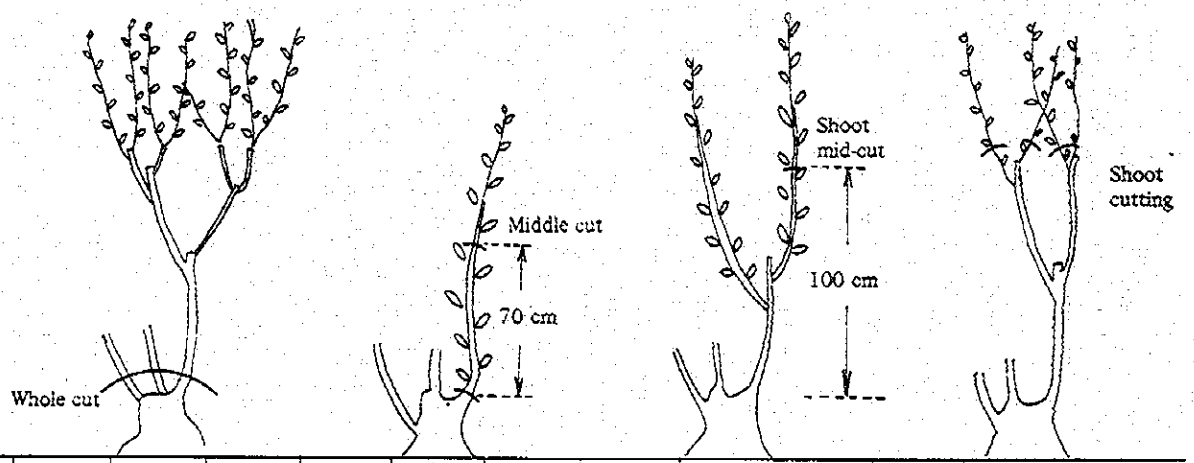
There is no technique of training or harvesting mulberry under a fixed plan in Indonesia. Farmers cut mulberry at random which always continue to grow thanks to blessed meteorological conditions.

As for the training and harvesting of mulberry for grown silkworms, shoots can be harvested 4 times a year from the same tree trained in low-cut. So, if we set up 2 mulberry fields of the same harvesting form, and shift the harvesting time of one field from the other according to the start of rearing, we can conduct 8 rearings a year under a plan. In this case, the leaf yield is 800 kg per 10 a year, so that 2.0 cases of eggs can be reared. But this is a tentative plan, on which the training and harvesting methods must be established as soon as possible (Fig. 9).

(d) Examination of Improving Method of Soil Fertility of Mulberry Field

The soil of South Sulawesi Province contains limestone in many cases; pH is neutral

Fig. 9 Training and Harvesting Methods of Mulberry and Rearing Time (Masamichi TAKATORI)

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Rearing Time			Start-Mount.			Start-Mount.			Start-Mount.			Start-Mount.
Training and Harvesting Methods of Mulberry												
Leaf yield kg/10 a			200			100			400			100
Eggs used cases/10 a			0.5			0.25			1.0			0.25
Cocoon crop kg/10 a			10			5			20			5
Maintenance of field				Weeding Compost, stable manure 1-2tons/10 a						Weeding Mixed fert. 10-20 kg/10 a		

or alkaline rather frequently. So, its absorption coefficient of phosphoric acid is high and nitrogenous fertilizer gives good effect. On the other hand, high temperature and much rain will decompose and exhaust organic matter greatly, we consider. These points are to be duly noted.

The mulberry field around farmhouses is well maintained; thickly planted, almost no weed was observed. But we cannot say definitely that there is no problem in the collective mulberry field which tends to increase recently.

As for chemical fertilizer, almost no mulberry field is applied with it, perhaps due to the difficulty to obtain (Table 9).

Table 9. Farmhouses Applying Fertilizer in Donri[2] and Lalabata Riaja Village

	No. of seri. farmhouses	Area of mulberry field	Fertilizer applying farmhouses		Manured mulberry field	
		ha		%	ha	%
Donri-Donri	1,501	632.59	20		9.80	
Lalabata Riaja	1,161	336.74	22		18.75	
Total	2,662	969.33	42	1.6	28.55	3.0

Source: Survey by Kiyoshi AOKI in September 1972

Under such conditions, if we aim at the introduction of planned training and harvesting techniques for higher leaf yield in the future, the use of chemical fertilizer will naturally come out. In the light of the maintenance of soil fertility, also, it will be necessary to secure and apply organic matter. It is essential to conduct soil survey and examine soil fertility improving methods which are suited to the local mulberry field.

As for organic matter, rice straw seems best. But it will be difficult to secure it in view of the current form of rice harvesting. So, some measures must be taken promptly to select and introduce useful pasture for the self-supply of organic matter.

(2) Relative to Silkworm Rearing

(i) Silkworm Egg Producing Technique

The first step toward the stabilization and advancement of cocoon crop is the use of good silkworm eggs. But there is almost no egg producing technique in Indonesia. It is partly because they, until recently, reared polyvoltine silkworm varieties; this kind of technique was not needed. Since the rearing of polyvoltine varieties has been replaced with that of hybrids allover, it is necessary to establish egg producing technique promptly.

So far, they have used commercial eggs imported from Japan and F_2 hybrid eggs reproduced from them for multiplication. Although F_2 hybrid eggs are produced by the Sericulture Station at Soppeng Prefecture with a capacity of 5,000 - 10,000 cases.

In South Sulawesi Province, they planned to rear 20,000 cases of eggs in 1975. Of which 15,000 cases were to be imported and 5,000 cases to be produced by the Sericulture

Station (Table 10). Both sources did not proceed as expected; farmers demand was not met. For reference, eggs imported from Japan for Silk Year 1975 were 3,733 cases by the end of January (Table 11).

If we rely on imported eggs, the physiology of eggs will be deteriorated very much during transportation. In the F_2 generation, heterosis declines; stoutness decreases; and characters separate. The quality of cocoon fiber and productivity will unavoidably fall.

In order to develop Indonesian sericulture, therefore, we must, first of all, breed silkworm varieties which are suitable to the country by selection, and then establish the technique to produce pebrine-free eggs for itself and a distribution system of eggs to sericultural farmers.

(a) Modernization and Full Equipment of Facilities, Machines and Instruments

Although the Sericulture Station is producing eggs, its facilities, machines and instruments are incomplete nor modern. It is essential therefore to expand and reinforce its facilities as soon as possible, in order to meet farmers' demand quickly.

Table 10. Silkworm Egg Supplying Plan of Indonesia (1975)

District			1975
Java	Imported	PERHUTANI	1,800 cases
		Western Java	150
	Self-supplied	PERHUTANI	200
		Western Java	50
	Total		2,200
South Sulawesi	Imported		15,000
	Self-supplied		5,000
	Total		20,000
	Imported		16,950
	Self-supplied		5,250
	Grand total		22,200

Table 11. Egg Exports to Indonesia

Year	Cases	Year	Cases
1968	4	1972	1,353
1969	–	1973	3,939
1970	–	1974	7,901
1971	10	1975	3,733

Note: Data compiled by Ministry of Agriculture and Forestry
Year from June 1 to May 31 of the following year
1975: up to the end of January 1975

(b) Learning of Egg Producing Technique

Technicians who are engaged in egg production are not yet skillful. It is essential therefore to have them try to learn basic techniques, such as egg preservation, egg raising, sex discrimination, mass pebrine inspection of moths for the securement of many technicians.

(c) Breeding of Silkworm Varieties by Selection

For the time being, F_2 eggs will be produced from imported eggs. In the future, however, it is necessary to distribute F_1 hybrid eggs which produce stout larvae and much silk. For the purpose, it is essential to breed silkworm varieties of good lineage by selection, and establish locally suited egg adjustment and artificial hatching method.

(ii) Rearing Technique

As for rearing technique which has not been established in the country, standard techniques concerning rational rearing plans, rearing time, the number of rearings, the amount of silkworms to be reared and other related techniques are to be established.

(a) Examination of Multiple Rearing

In the light of climatic conditions and labor situations in Indonesia, it seems possible to conduct multiple rearing (8 times). It is necessary, therefore, to examine rearing techniques, such as starting time, the amount of silkworm to be reared, in parallel with mulberry cultivation.

On the facet of general rearing technique, it is necessary to establish a chart of standard rearing; rearing density of silkworms per tray, the amount of mulberry to be fed, handling methods of silkworms during moulting and immediately after ecdysis, the number of bed-cleanings, disinfection of body surface of silkworms, prevention of withering of mulberry leaf, etc.

(b) Examination of Mounting Technique

As reelability of cocoons in silk reeling affects the reeling efficiency and the quality of raw silk considerably, it is necessary to establish mounting techniques, such as the discrimination of mature silkworms, proper mounting time, preservation of silkworms during mounting, etc., to say nothing of the importance of selection of the kind of mounting apparatus.

(c) Examination of Harvesting and Sorting Techniques

In Indonesia, harvesting and sorting of cocoons remain room to be desired. The quality of these processes has a large influence on the efficiency of modern silk reeling mills. It is necessary, therefore, to establish techniques, such as the determination of harvesting time, floss removal, rejection of soiled cocoons and nonpupated cocoons.

(3) Relative to Disease and Insect Pest Damage

Except for the losses caused by white peach scale, etc., there is no disease or insect pest at present which throws a serious hindrance to mulberry cultivation in Indonesia, it appears. In

the future, however, when multiple rearing is introduced, incidental losses from disease and pest may arise. Then, it will beconie necessary to examine their controlling methods.

On the side of silkworms, aspergillus disease may spread as farmers use bamboo tools, etc., widely, in addition to pebrine. It is necessary to establish controlling method of aspergillus disease quickly. Furthermore, the rearing of hybrid eggs may cause flacherie. It will become necessary to take countermeasures against flacherie some day.

(4) Summary

For the development of Indonesian sericulture, technical improvement on these matters should be carried out. Of which, most urgently needed are the establishment of egg producing technique and multiple rearing technique. In order to establish egg producing technique, it is necessary, needless to say, to expand and reinforcement of egg producing facilities, equipment, etc.

First dissolve silkworm egg shortage, and then raise the productivity by multiple rearing, and the target of raw silk production in Indonesia will be surely attained.

2. Desirable Administrative Organization and Research Institutes for Sericultural Development

(1) Substantiation of Administrative Organization

At present, the Directorate General of Forestry, Ministry of Agriculture, and the office of South Sulawesi Province take charge of Sericulture. In both offices, there seem no technicians who are specialized in sericulture. In the light of the flow of funds, these are not the only offices taking charge of sericulture, it seems. In the Directorate General of Forestry, the chief of Sericulture Division concurrently administers affairs and acts as the "window" of this project.

Under such conditions, it may be difficult to carry out the project to achieve targets, even if we desire to develop sericulture. Also, we fear that such administrative organization may hinder the sufficient fulfillment of this project.

Therefore, if Indonesia tackles with sericultural development seriously to achieve the objectives of this project, it is necessary to conduct sericultural administration forcefully. For the purpose, it will be necessary to set up a Division in the Government which is composed of technicians who have knowledge of sericulture.

If such mechanism is established, mulberry will not be regarded as a forest tree, and mulberry field will be built up with determination that mulberry leaf is food for silkworm; this project will be set up and operated; new technique will be diffused to farmers promptly. Then raw silk industry will surely be developed.

It is necessary to establish an administrative organization promptly which makes clear who takes the responsibility for sericultural development.

(2) Establishment of Technical Organization

The Sericulture Centre establishes standard techniques, such as mulberry cultivation

and silkworm rearing; and Sub-Centre in various places establishes their locally suited techniques from standard techniques developed by the Sericulture Centre. In order to diffuse techniques among farmers, there must be first-line leaders. For the purpose of stabilizing farmers' management, the introduction of new techniques among them should be proceeded smoothly, which entirely depends on the activities of these leaders. Their responsibility is very heavy.

The training of leaders is to be shared by the Sericulture Centre and Sub-Centres, but this plan is to be formulated by the Government. The Government should grasp the appointment, number, location, etc. of leaders, and the method and means of diffusion as well as the effect of diffusion, and furthermore conduct direct guidance and supervision, if necessary. Otherwise, good results from this project will not be expected. Therefore, administrative organization should be fully substantiated and the technique diffusing system established, if sericulture is to be developed.

V. Present Situation and Problems of Principal Sericultural Districts

1. Their Positions in Indonesian Sericulture

In Indonesian sericulture, South Sulawesi Province plays a major role, followed by Java. Recently, Sumatra has started silkworm rearing, too (Tables 12, 13).

In South Sulawesi Province, people have traditionally liked silk sarong very much. So, sericulture has developed gradually, shifting the center from place to place. Currently, the Province accounts for more than 90% of the national total in the sericultural households, the area of mulberry field, and raw silk production. Sericulture is an important side business for farmers, with self-reeling spreading.

The sericulture of South Sulawesi Province was born at Tanatraja Prefecture in the mountainous area in the north. (Legend has it that sericultural technique was transmitted from the same mountainous tribe in North Sulawesi.) But it declined gradually under the pressure of the burgeoning sericulture in other districts.

At present, sericulture is carried on in 4 Prefectures: Soppeng, Sidenregrapang, Enrekang and Wajo. These account for more than 90% of the total raw silk production in South Sulawesi Province. Besides, silkworm is reared in 2 - 3 other Prefectures in the south of the Province.

The history of sericulture in principal centers of South Sulawesi Province is young – only about 10 years. But it has developed rapidly, with sericultural areas expanding. Since 1972 when a great drought wrought a havoc, however, production has tended downward due to increasing damage from pebrine disease caused by the rearing of polyvoltine varieties, and the shortage of hybrid egg after the abandonment of polyvoltines. In 1975, the facilities for hybrid egg production was reinforced, and egg supply increased, resulting in a higher cocoon output. When egg producing technique is put into the orbit, cocoon production will increase. But a jumping increase may be precluded the present scale of egg producing facilities, unskilled workers, and the stagnant imports of egg which are lower than expected.

The sericulture in Java is older than that in South Sulawesi Province, tracing back to prewar days. The sericulture which was started by PERHUTANI (National Forestry Public Corporation) in Java is the newest in Java. The sericulture of PERHUTANI was started to secure the source of income for forestry farmers during their leisure season. PERHUTANI itself builds up mulberry field, supplies mulberry to farmers for rearing silkworm, buys cocoon they harvest, and reels raw silk. This is its main form. In other words, its sericulture is operated in an integrated form–buildup of mulberry field, cocoon production and raw silk reeling.

Sericulture by PERHUTANI which developed smoothly for some time has been dwindling later on account of difficult problems: Whether it is adequate for PERHUTANI to be the subject of rearing and reeling management, building up mulberry field as a link in afforestation (as the Corporation has built up mulberry field on a large scale, some part of field cannot be maintained properly and is left to run waste. The area of mulberry field which was initially 54,000 ha in 1969 ha has decreased to 1,400 ha.

Table 12. Raw Silk Production, by Year, in Indonesia

District	Mul. field (1970)		Raw Silk Production									
			1970		1971		1972		1973		1974	
	ha	%	ton	%	ton	%	ton	%	ton	%	ton	%
Central Java	1,000	5.5			1	0.7	•	0.4	1	3.2		
East Java	150	0.8	6	2.1	1	0.7	•	0.1	•	0.0	3	11.5
West Java	500	2.7					•	0.1	•	0.4		
Jogyakarta	1,500	8.2			4	2.8	•	0.6	•	0.1		
Sub-total	3,150	17.2	6	2.1	6	4.2	1	1.2	2	4.8	3	11.5
S. Sulawesi	15,000	82.0	120	97.9	138	95.8	75	98.8	40	94.1	20	88.5
N. Sulawesi	150	0.8	–	–	–	–	–	–	–	–	–	–
Sub-total	15,150	82.8	120	97.9	138	95.8	75	98.8	40	94.1	20	88.5
Others	–	–	–	–	–	–	–	–	•	1.1	–	–
Total	18,300	100.0	126	100.0	144	100.0	76	100.0	42	100.0	23	100.0

Note: (•) indicates 1 ton or below. (–) no production.
: Surveyed by Kiyoshi AOKI.

Table 13. Present Situation of Indonesian Sericulture

Area of mulberry field	Java Island	PERHUTANI	1,400 ha
		Jogyakarta	800
		West Java	200
	South Sulawesi Prov.		13,000
Cocoon output per ha	PERHUTANI		20 kg
	South Sulawesi Prov.		30
Egg used			25,000 cases
Cocoon output per case			15 kg
Sericultural households			5,000
Cocoon output per household			80 kg
Cocoon production			380 tons
Raw silk production			50 tons

Note: Estimate for 1975, including guesswork.
Surveyed by Kiyoshi AOKI.

The sericulture in Java holds, besides PERHUTANI's, 800 ha of mulberry field in Jogyakarta and 200 ha in West Java, bringing the total up to 2,400 ha. Cocoon output accounts for about 10% of the total production (Table 12 · 13)

As for the possibility of future growth of sericulture in these districts, opinions differ on the basis of various appraisal of merits and demerits of sericultural conditions there. Java where labor is plenty and backed up by PERHUTANI introducing new silkworm egg producing house and modern semi-automatic silk reeling machines, Sumatra which most blessed in land condition, and South Sulawesi Province where three requisites of production are all complete. In the future also, South Sulawesi Province will remain as

the largest producer, sharing 80% of total cocoon output.

We may cite 4 items as the reason. (1) Despite the fact that cocoon output and sericultural households are declining, mulberry field of 13,000 ha is still maintained. Comparatively well managed, mulberry field there has higher productivity than in Java. (2) Farmers are earnestly willing to produce, and put technical guidance into practice faithfully and meekly. There were 9,600 sericultural households in 1972. We may guess that the whole South Sulawesi Province embraced nearly 20,000 farm households. So, if silkworm egg is smoothly supplied, a pretty large number of farmers will come back to sericulture. (3) Disposal of cocoon after having been produced and the distributing system of raw silk are well established. Sinkang City of Wajo Prefecture, the largest weaving center of Indonesia, is near at hand. There are less extraneous factors which hinder cocoon production than other districts. (4) The officials of the National Government, Provincial and Prefectural Offices are aggressive in sericultural promotion, as a link in the drive for higher welfare of the people and more income to farmers.

2. General Condition of the Area

(1) Natural Condition

Soppeng Prefecture which is the main sericultural area of South Sulawesi Province is situated almost in the middle of the Province. Watansoppeng, the seat of Prefectural office, is about 185 km in the north of Ujung Pandung, the seat of Provincial office. It is some 100 m above the sea, generally flat, and one of agricultural regions, with 85% of total population engaged in farming.

The Sericulture Station of Forest Research Institute lies here.

The mother materials soil contain limestone in many cases; pH is neutral or alkaline rather frequently. The absorption coefficient of phosphoric acid is high (Table 14).

Table 14. Soil of Mulberry Field in Watansoppeng

Sample No.	pH	Mumsell's soil color	Great soil group	Mother material
1	7.20	7.5YR 3/4 Dark brown	Mediterranean soil	Claystone and alkaline volcanic tuff
2	8.05	10 YR 3/2 Brownish black	Mediterranean soil	Claystone and alkaline volcanic tuff
3	7.98	10 YR 2/2 Brownish black	Mediterranean soil	Claystone and alkaline volcanic tuff
4	7.05	10 YR 3/1 Brownish black	Grumusol	Alkaline volcanic tuff
5	6.90	10 YR 3/1 Brownish black	Grumusol	Alkaline volcanic tuff
6	6.18	10 YR 2/3 Brownish black	Grumusol	Alkaline volcanic tuff
7	6.71	10 YR 3/3 Dark brown	Mediterranean soil	Claystone and alkaline volcanic tuff
8	7.10	10 YR 4/2 Grayish yellow brown	Mediterranean soil	Claystone and alkaline volcanic tuff

Note: Surveyed by Masamichi TAKATORI in July 1975.

Although the detailed results of recent meteorological survey is not available, daily mean temperature is about 28°, with very narrow range of change (Table 15).

Annual precipitation is 1,500 - 2,000 mm; the dry season is August - October (Table 16).

Air temperature and precipitation in Jakarta, Bogor and Ujung Pandung are shown in Table 17. Precipitation recorded at the Farm of Agriculture Research Institute which is near the site proposed for the Sericulture Centre averaged 3,500 mm throughout 6 years from 1970 to 1975. The rainy season is from December through May, precipitation ranging

Table 15. Air Temperature

In the morning	25 - 26°C
In the daytime	29 - 30
At night	28 - 29

Note: Surveyed by Kiyoshi AOKI in September 1972.

Table 16. Precipitation and Rainy Days in Watansoppeng

Year	Precipitation (mm) and Number of Rainy Days													
	Jan.		Feb.		Mar.		Apr.		May		June		July	
1952	36	4	174	9	123	9	246	5	264	13	155	6	76	6
1954	108	4	106	5	188	8	106	6	309	8	291	14	131	8
1957	105	4	113	9	167	8	82	2	327	15	143	8	109	5
1960	241	7	155	10	52	4	292	11	314	11	188	12	305	12
Avg.	123	5	137	8	133	7	182	6	304	12	194	10	155	8
1972	291		132		64		112		207		9		295	
1973	270		279		98		226		339		324		295	

Year	Precipitation (mm) and Number of Rainy Days										Yearly total	
	Aug.		Sep.		Oct.		Nov.		Dec.		Precipitat.	Rainy days
1952	60	4	74	3	123	5	73	5	221	11	1625	80
1954	111	6	63	4	115	8	119	9	305	12	1952	92
1957	60	4	0	0	41	2	81	11	210	9	1438	77
1960	88	10	54	4	31	1	149	11	68	9	1937	102
Avg.	80	6	48	3	78	4	106	9	201	10	1741	88
1972	21		0		0		21		205		1357	
1973	n.a.		236		112		301		103		(2583)	

Note: Surveyed by Kiyoshi AOKI, Tsutae KUTSUMA (Data for 1972 and 1973: Statistics by the Directorate General of Forestry).

350 - 500 mm. The dry season sets in June, with a precipitation less than 50 mm in September (Fig. 10).

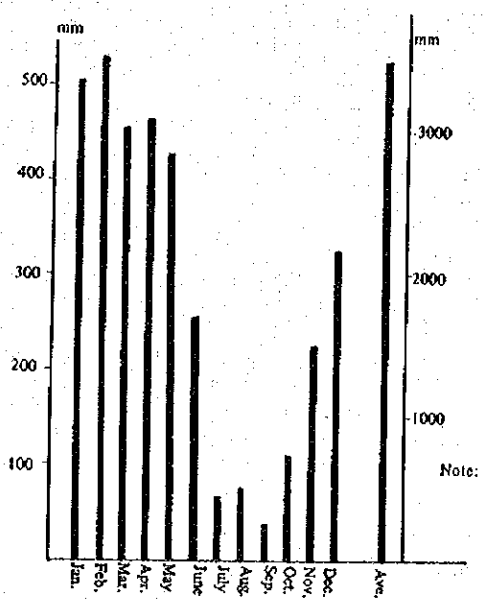
As for the state of land utilization, we may cite a few examples: an agricultural household owns 1.4 ha in Donridonri Village and 2.7 ha in Lalabata Riaja Village, of which the area of mulberry field is 0.3 ha (23%) and 0.8 (30%), respectively (Table 18).

Table 17. Air Temperature and Precipitation in Java and South Sulawesi

Month	Jakarta		Bogor		Ujung Pandung	
	Temp.	Preci.	Temp.	Preci.	Temp.	Preci.
	°C	mm	°C	mm	°C	mm
Jan.	25.4	270	24.1	424	25.6	276
Feb.	25.4	241	24.2	422	25.8	590
Mar.	25.8	175	24.5	387	25.8	417
Apr.	26.2	131	25.1	403	26.4	153
May	26.4	139	25.2	347	26.2	87
June	26.0	105	25.0	268	25.4	74
July	25.8	72	25.2	243	25.2	36
Aug.	25.9	65	25.3	238	25.6	11
Sep.	26.2	146	25.3	328	25.4	15
Oct.	26.3	169	24.6	420	26.0	173
Nov.	26.0	183	24.4	408	26.2	182
Dec.	25.7	185	24.8	338	25.4	597

Note: Surveyed by Kiyoshi AOKI, Tsutae KUTSUMA

Fig. 10. Precipitation (mean of 6 years, 1970 – 1975)



Note: Compiled by Minoru ITO from the data on precipitation observed by the Farm of Agricultural Research Institute at Bontibili

These seem to indicate the general situation there. Table 19 shows the proportions of paddy field, mulberry field and other crops. Both villages depend on sericulture rather heavily. Farmers are surely expecting income from silkworm rearing.

The proportion of state land and private land in sericultural regions is shown in Table 20. The private land in South Sulawesi is higher in ratio than Java both in upland and paddy fields (Table 20).

Table 18. Average Farmers' Own Land in Donri[2] and Lalabata Riaja Villages

	Donri[2] Village		Lalabata Riaja Village	
	ha	%	ha	%
Paddy field	0.65		0.95	
Upland field	0.43		0.92	
Mulberry field	0.32	22.9	0.80	30.0

Note: Surveyed by Kiyoshi AOKI in September 1972

Table 19. Area under Mulberry in Donridonri and Lalabata Riaja Village

Village	Area	Paddy field	Mulberry field	Planted land
		ha	ha	ha
Donridonri	1	22.63	44.50	3.68
	2	130.09	212.46	1.46
	3	181.19	159.67	4.22
	4	293.86	136.45	11.40
	5	34.57	79.51	1.59
Lalabata Riaja	1	146.60	138.40	6.38
	2	175.75	78.68	2.46
	3	396.38	106.96	4.62
	4	45.05	12.70	0.32
Total		1,426.12	969.33	36.13

Note: Surveyed by Kiyoshi AOKI in September 1972.

Table 20. State Land and Private Land in Sericultural Regions

	Upland field		Paddy field		Forest land	
	State	Private	State	Private	State	Private
	%	%	%	%	%	%
S. Sulawesi	10	90	5	95	95	5
Java East	30	70	10	90	100	0
Java Mid.	30	70	10	90	100	0
Java West	30	70	10	90	100	0

Note: Surveyed by Kiyoshi AOKI.

(2) Position of Sericultural Sector in Agricultural Management

As statistical data are not complete, we cannot make clear what position sericulture holds in the overall agricultural management. But sericulture in South Sulawesi Province is concentrated in Soppeng Prefecture and 3 other Prefectures; even in Soppeng, it is concentrated in upland field except for paddy field and mountainous regions. Then we may say that in dense sericultural regions, sericulture holds an important position in agricultural management.

As stated above, the survey conducted in two villages in Soppeng Prefecture, though the object of the survey is very few in number, shows that the area under mulberry is larger in proportion than paddy field, revealing the significance of silkworm rearing. A village of South Sulawesi Province has about 2,000 families. Then almost all farmers are engaged in sericulture. For the farmers who carry on sericulture permanently, sericulture is becoming their principal occupation instead of side business, we may conclude.

In principal sericultural regions, mulberry shoots are harvested from trees planted around farmers' houses (about 3 a at the most) and from collective mulberry field built up in the palm field or wasteland (large ones reaching 200 ha) (Plates 13, 14). Enclosing the space under the floor which is high, they rear grown silkworm from the 4th stage. When polyvoltine silkworm varieties were reared, they raised 10 times a year, using 0.5 case of egg each time. At present, imported egg or its F_2 hybrid egg is reared at the cooperative young silkworm rearing house during the young stage. Farmers are distributed grown silkworm. On account of egg shortage, however, the amount of silkworm reared is small compared with mulberry leaf productivity.

As the amount of silkworm reared is small, few farmers crop over 150 kg of cocoon, it seems. The sericultural scale in Soppeng Prefecture in 1972 was: mulberry field of about 50 a per household, harvesting some 50 kg of cocoon. In 1975, they raised 80 kg of cocoon in spite of egg shortage, we estimate.

If 80 kg of cocoon is harvested, its gross income comes to Rp. 80,000 against Rp. 75,000 per ha from double-crop of paddy rice. Judging from the area of paddy field owned by the average farmer, gross income from sericulture is favorably compared with rice growing, which is another evidence that sericulture is emerging from the role as side business.

In addition, South Sulawesi Province has no noticeable upland field crop, as "estate agriculture" has not developed. This kind of crop is low in agricultural management. In this connection, 95% of forest land belongs to the state in South Sulawesi Province, contributing almost nill to farmers' economy.

The profitability of sericulture ranges widely according to the degree of utilizing the cooperative young silkworm rearing system. The income of the farmer who rears grown silkworm only is Rp. 40,000 (Table 21).

Income from paddy field (double-crop of rice) is Rp. 36,000 per ha; Rp. 57,000 if a secondary crop of Indian corn and soybean is added; and Rp. 72,000 if a secondary crop of peanut and Indian corn is added. Although income from sericulture is less than that from paddy rice and a secondary crop, the practice of growing a secondary crop is not popular in South Sulawesi Province. So, it is more realistic to compare it with that from the

Table 21. An Example of the Profitability of Sericulture

Cocoon output	Unit price	Gross income	Necessary expenses Rp/ha			Income
kg/ha	Rp/kg	Rp/ha	Material	Coop. young rearing	Total	Rp/ha
100	1,000	100,000	40,000	20,000	60,000	40,000

Note: Data released by the Sericulture Division of Forest Research Institute.
Surveyed by Kiyoshi AOKI, Masamichi TAKATORI.

Table 22. Profitability of Sericulture and Other Crops

Item	Yield (ha)	Unit price (kg)	Gross income (ha)	Necessary expenses (ha)	Income (ha)
	kg	Rp	Rp	Rp	Rp
Cocoon	100	1,000	100,000	60,000	40,000
Rice (rainy)	3,751	16	58,770	24,601	34,169
(dry)	922	17.3	16,273	14,769	1,504
Soybean/corn	--	--	--	--	22,699
Peanut/corn	--	--	--	--	37,302

Note: Data released by Toropical Agriculture Centre and Sericulture Division of Forest Research Institute.
Surveyed by Masamichi TAKATORI, Kiyoshi AOKI

double-crop of rice. In view of the latter and Rp. 150 of daily farm wage, sericulture rewards farmers fairly well. Furthermore, it gives cash income to women. As for the overlapping of farm work, there is no such occasion except for the planting and harvesting of rice. With the diffusion of cooperative young silkworm rearing, the overlapping part is becoming smaller and smaller. Thus, sericulture is gaining ground as an important sector of agricultural management in densely sericultural regions, we may assert (Table 22).

(3) Relation of Sericultural Farmers to External Economy

Not only sericultural farmers but also farmers as a whole live on a self-supporting economy. As the life is modernized, however, monetary economy sets in. Farmers are groping for some other cash income than the sales of surplus rice or fruit. This is the current state of rural villages. In this respect, we may say that the sericulture in South Sulawesi Province is in a comparatively favorable economic environment, as there are raw silk markets in major cities.

(a) Purchase of Silkworm Egg, Fertilizer, Rearing Tools, etc.

Heretofore, they did not buy silkworm egg in the rearing of polyvoltine silkworm varieties, as they produced egg for themselves. But the rearing of polyvoltines has been stopped allover, and they must purchase hybrid egg. Each Unit imported egg or its incubated F_2 hybrid egg, which is reared up to the 3rd stage at the cooperative young silkworm rearing house, and then distributed among farmers. Farmers rear silkworm in the 4th and

5th stage. Since this Unit system is encouraged by the Government, this form of raising will spread briskly in the future.

As regards the supply of hybrid egg in South Sulawesi Province, in 1974, 1,864 cases (part of which was used to produce F_2 hybrid egg) were imported, and 620 cases were multiplied by the Sericulture Station. Some farmers in major sericultural regions stopped the rearing of polyvoltines from this year. But many of farmers are still adhere to polyvoltines. The amount is about 3 times as much as hybrid egg, we estimate. In 1975, however, hybrid egg increased substantially: 7,590 cases were imported and 2,700 cases were multiplied by the Sericulture Station. As the supply rose, principal sericultural regions abandoned polyvoltines completely.

In case egg is bought, the division of profit will be divided as follows:

Supplier of egg and material	40% of profit
Young silkworm rearer and furnisher of land and building	20%
Farmers who rear grown silkworm	40%

(Source: Survey by Kiyoshi AOKI)

Almost no fertilizer is applied to mulberry field, as fertilizer is expensive, and further mulberry tree is considered as a kind of forest tree. For example, in Donridonri and Lalabata Riaja Village, of 2,662 sericultural farms, only 42 gave fertilizer (Table 23). Even the mulberry field of cooperative young silkworm rearing house is rarely given fertilizer. We may say that there is no practice of buying fertilizer.

Rearing tools, such as rearing trays, mounting apparatus, are made by farmers for themselves using bamboo which are growing wild in abundance. Some farmers were using plastic mounting apparatus imported from Japan. Bamboo rearing tools may cause aspergillus disease. But if we rear young silkworm strong enough to resist the disease, grown silkworm does not suffer from it. So, the cooperative young silkworm rearing house should avoid the use of bamboo or board. It should introduce steel rearing stands, 3P rearing trays, etc., in which aspergillus never lurks, like the counterpart in Japan. It is also essential to conduct disinfection thoroughly. Thus, farmers who rear only grown silkworm can maintain the present way of rearing which is of course more economical.

Table 23. Fertilizing Farmers in Donridonri and Lalabata Riaja Village

Village	Sericultural farm	Area of mulberry field	Fertilizing farm	Mulberry field fertilized
		ha		ha
Donridonri	1,501	634	20	10
Lalabata Riaja	1,161	337	22	19
Total	2,662	971	42	29

Note: Surveyed by Kiyoshi AOKI in September 1972.

(b) Present State of the Circulation of Cocoon and Raw Silk

About 70% of cocoon is reeled by farmers, with the balance sold, in fresh state, though the sales ratio varies from place to place.

Current sales price is Rp. 1,000 per kg of fresh cocoon.

In home reeling, fresh cocoon is cooked in a pan, and raw silk is reeled directly onto grand reel by manual operation. Raw silk is made in skeins without rereeling, and sold on a market. Home weaving is not so popular. The sales price of raw silk is Rp. 10,000 per kg.

Cocoon sold is sent to silk reeling mill where a couple to dozen of basins (3 ends each) of wooden reeling machines of standing system are installed. Pupas are killed by drying in the sun. As cocoon is in short supply, reeling starts whenever cocoon comes into hand. Reeling efficiency is naturally low. (Some rellers concurrently do weaving business.) In these mills, raw silk is reeled onto regular reel, from which raw silk is packed in "small" skeins without rereeling, and sold. Sales price of this kind is Rp. 12,000, higher than farmers' home-reeled silk.

With the President's fund, 2 silk reeling mills equipped with cocoon drying machines and 2 semi-automatic reeling machines (20 ends each) were set up at the Sericulture Station and Enrekang Prefecture. The mill in Sericulture Station has started operation in October 1975. Currently, it reels 6 kg of raw silk from cocoon it buys from farmers on trial. Skeined silk, 32/34 in size judged from the number of cocoons put together into a thread, is Rp. 12,500 on the Soppeng market and Rp. 13,500 on the Sinkang.

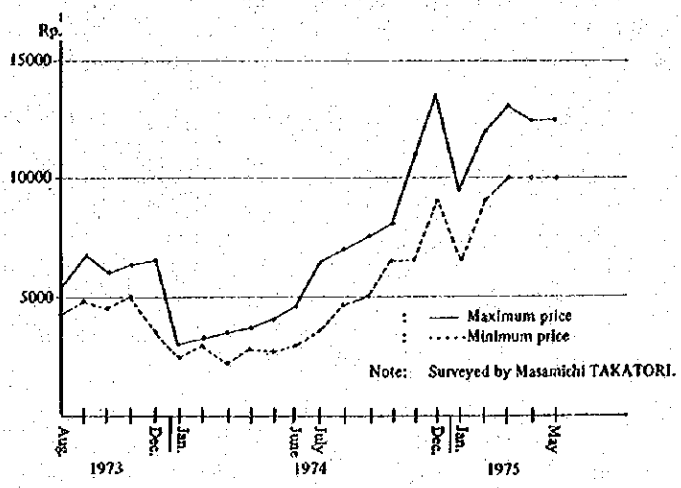
The raw silk produced by farmers and ordinary silk mills is 33/35 deniers judged from the number of cocoons.

Raw silk collected by brokers is delivered to weavers through the markets in Soppeng, Sinkang and Ujun Pandung City which are held twice or so in a week.

Raw silk price on the Soppeng market in 1974 doubled that 2 years ago. Recently, however, fluctuation has narrowed down (Fig. 11).

Fig. 11. Trend of Raw Silk Prices on Soppeng Market

(per kg)



The largest silk consumer is Sinkang City. Around the city, there are some 5,000 domestic weavers and sub-contract farmers, operating presumably 10,000 crude handlooms.

A loom of this kind produces 2 sarongs a month, on an average. Since 1 kg of raw silk makes 4 sarongs, Sinkang alone consumes 60 - 80 tons of raw silk a year, it is estimated.

The price of silk sarong cloth ranges Rp. 7,000 - 12,000 or more a piece, while synthetic sarong is Rp. 2,000 - 2,500. Furthermore, the standard of income is low. Then, it will be difficult to consume 250 tons of raw silk, the target of production, by sarong alone, in South Sulawesi Province. It is necessary to develop new outlet for silk.

Silk sarong is a yarn-dyed, flat fabric, like *meisen* in Japan. Some are checkered, splashed in a fine workmanship, or embroidered. In sarong cloth, defects are noticeable, such as caused by slugs in raw silk. In this regard also, it is necessary to improve the quality of raw silk by all means.

We saw a few silk weaving mills in Ujung Pandung City, too. Some were weaving handkerchiefs on trial. They have no power loom. Their products were on the same level as Sinkang's. Raw silk consumption was small.

At the Batik Research Institute in Jogyakarta, they were weaving silk batik on trial. The Government of Indonesia intends to expand the use of silk from sarong to silk batik.

Turning to silk reeling mills, the plant in the Sericulture Station was trially operated, but that in Enrekang was not running, as it had just been completed. These silk mills are now managed by the Sericulture Station, but they will be turned over to respective Prefectural offices later. When they start a full-dress operation and furthermore cocoon production from hybrid egg is put on the orbit, the quality of raw silk will rise by leaps and bounds, raising the quality of sarong cloth substantially, paving the way for the production of piece-dyed silks, to say nothing of good yarn-dieds.

Table 24. Development of Sericulture in Soppeng Prefecture

Year	Area of mulberry field	No. of farmers			Raw silk production
		Permanent	Side business	Total	
1962	200 trees				
1963	1 ha				
1964	3				
1965	30	20	100	120	
1966	1,500	100	1,000	1,100	6 tons
1967	2,000	500	2,000	2,500	18
1968	4,000	1,000	4,000	5,000	24
1969	5,000	1,500	5,000	6,500	42
1970	5,500	1,750	6,000	7,750	60
1971	5,500	2,000	6,953	8,953	72
1972	5,500	2,053	6,953	9,606	70

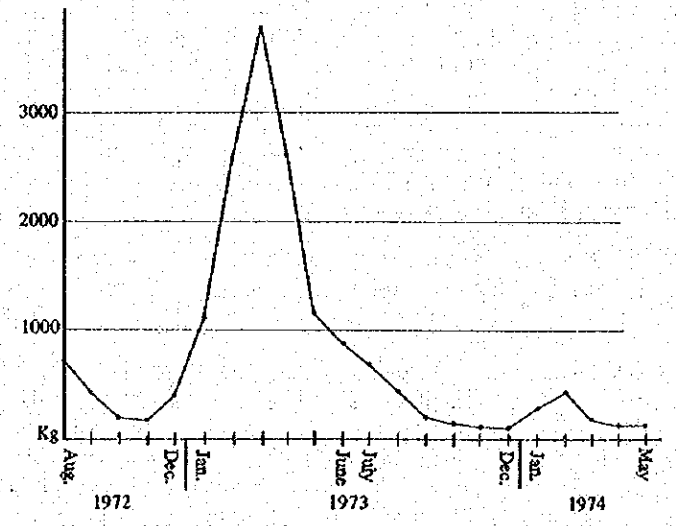
Note: Surveyed by Kiyoshi AOKI.

(4) Development of Sericulture in Soppeng Prefecture

Sericulture in Soppeng Prefecture which planted 200 mulberry trees in 1962 had since continued a smooth development. In 1972, the area of mulberry field came to 5,500 ha and sericultural farmers (including side business) 9,600 households, producing 70 tons of raw silk (Table 24).

Thereafter, however, silk production has declined on account of great drought, damage from pebrine disease, egg shortage, etc. (Fig. 12).

Fig. 12. Monthly Silk Production in Soppeng Prefecture



Note: 1973 totaled 13,398 kg.
Surveyed by Kiyoshi AOKI.

The largest sericultural village in Soppeng Prefecture is Lalabata Riaja, accounting for more than 80% of the Prefectural total.

3. Current State of Sericultural Technique and Problems

The level of technique in mulberry cultivation of Indonesia is very low. There is no notable research or survey on mulberry cultivation by Sericulture Division and Sericulture Station, Forest Research Institute. Since mulberry tree is regarded as a kind of forest tree there, the technique of planned cultivation has not been established. It is not too much to say that farmers planlessly harvest mulberry which continues to grow thanks to blessed weather condition.

Mulberry field can be built up readily. The preparation of field is not needed. Plant cuttings, and they strike root and grow; rooting percentage is 70% or thereabouts. Cuttings of diverse varieties are planted.

They do not distinguish mulberry for young silkworm from that for grown silkworm. Mulberry for young silkworm is extremely important, exerting a great influence on the

success of cocoon crop. Nevertheless, they have no growing method of mulberry for young silkworm.

Field maintenance is not practiced. Only the mulberry field around farmer's house is well managed, without any weed. But collective mulberry fields which are increasing of late are not well maintained. If such condition continues, mulberry field might be devastated in time. Careful field maintenance is a must.

Many mulberry fields are not fertilized. As chemical fertilizer is so expensive that farmers cannot buy it. In order to keep up soil fertility, then, organic manure should be applied. Seeking out some adequate pasture, we should intercrop it on the field to plow it back to the soil.

In brief, lacking technique in mulberry cultivation, we should establish one on the mulberry cultivation method as a whole, and diffuse it among farmers. Then, the productivity of mulberry field will rise greatly, under the very favorable meteorological conditions.

Silkworm egg which farmers rear has been overall shifted from polyvoltine egg heretofore used to hybrid egg (F_1 hybrid egg imported from Japan and F_2 hybrid egg multiplied by Sericulture Station from part of imported egg). Pebrine of silkworm which was the greatest problem in Indonesia has decreased sharply at the level of sericultural farmers: the damage rate has fallen substantially from 75% to 5 - 25%. In the process of egg production, however, the efficiency is extremely low as there are many contaminated eggs.

But imported egg from Japan has been inspected the disease by sampling; rearing rooms at Sericulture Station and the cooperative young silkworm rearing house of the Unit are still polluted pretty much. It is necessary therefore to improve rearing tools, etc., and perform a perfect cleaning and disinfection using good disinfectants.

Imported egg is transported after it is treated with artificial hatching method. So it is likely to distrub physiology during transportation. Also, it is expensive: Rp 4,050 a case in Jakarta and 5,000 in Soppeng. Egg takes 40% of cocoon price. Furthermore, in the F_2 generation, heterosis declines; larvae become weaker; characters separate; the quality of cocoon fiber and productivity may be deteriorated. It is essential, therefore, to establish a system and technique so that F_1 hybrid egg which produces stout larvae and much silk may be reared by farmers in Indonesia.

For the time being, however, unskillful egg producing technique and incomplete and narrow facilities are obstructing an efficient egg production. It is necessary, therefore, to substantiate and reinforce these facilities to multiply germ-free F_2 hybrid egg enough to meet demand. At present, Sericulture Station is inspecting individual moths on pebrine disease. But this is not efficient. In case of mass production, mass pebrine inspection of moths will have to be introduced.

Young silkworm rearing at Unit seems successful: silkworm is growing favorably, producing comparatively good cocoon. But rearing technique is not skillful enough. There are many bamboo articles in rearing buildings and tools, which is fraught with the danger of aspergillus breakout. At the cooperative young silkworm rearing house, at least, rearing tools must be modernized, and disinfection thoroughly conducted.

Sericultural farmers are carrying on planned rearing. It is necessary to establish standard techniques, such as rational starting time of rearing, the number and amount of feeding, along with the technique of mulberry harvesting. Bed cleaning and disinfection are to be executed strictly before, during and after rearing. Good ventilation should not be neglected to avoid damage of hot environment, especially, during mounting. Material cocoons at reeling mills contained a pretty large number of bad ones. As countermeausures in the future, establishing techniques of mounting method, cocoon harvesting at proper time, strict sorting of cocoon, etc., let farmers execute them to the letter, then they will be able to ship good cocoon to reeling mills.

4. Trend of Yearly Cocoon Output

Though statistical data on sericulture are not yet complete, based on various kinds of data, we may depict the yearly changes of area under mulberry and raw silk production as in the following Table 25.

Table 25. Trend of Area of Mulberry Field and Raw Silk Production

Year	Java (PERHUTANI)		South Sulawesi, etc.		Total	
	Area of mul. fld.	Raw silk production	Area of mul. fld.	Raw silk production	Area of mul. fld.	Raw silk production
	ha	kg	ha	kg	ha	kg
1969	5,400	421	13,000	85,579	18,400	86,000
1970	1,400	667	13,000	125,533	14,400	126,200
1971	1,400	830	13,000	143,170	14,400	144,000
1972	1,400	441	13,000	75,559	14,400	76,000
1973	1,400	1,818	13,000	40,682	14,400	42,500
1974	1,400	2,637	13,000	20,363	14,400	23,000

Note: Data by Sericulture Division of Forest Research Institute.
The area of mulberry field does not include 800 ha in Jogyakarta or 200 ha in west Java.
Surveyed by Kiyoshi AOKI.

As shown in Table 25, despite fixed area of mulberry field, raw silk production had increased favorably up to 144 tons in 1971. From 1972, however, it declined substantially. Raw silk production by PERHUTANI in Java increased smoothly except for 1972 when severe drought set in. In contrast, South Sulawesi which is the main force continued lower and lower production.

The reason may be found in the fact that compared with South Sulawesi, PERHUTANI was low in the utilization ratio of mulberry field and also in productivity, alleviating the bad effect of drought on the use of egg.

Furthermore, imported egg was higher in egg consumption than multiplied egg at the PERUHUTANI, bringing about less damage from pebrine. In evidence, we may cite the fact that raw silk production of individual farmers other than PERHUTANI in the same Java declined more severely than in South Sulawesi Province.

Here are a few comments on the trend of yearly production of raw silk with South

Sulawesi, the main force, as the center.

(1) Reduced production in 1972 was caused mainly by a long-term failure in mulberry harvest which was caused by the great drought of the year hitting a vast area where soil fertility was already low due to exploitation of mulberry leaves up to the preceding year. Incidentally, data observed by the Farm of Agricultural Research Institute in Bontbili in the suburbs of Ujung Pandung City (in the neighborhood of the site proposed for the Sericulture Centre on a hill) are shown in Fig. 13. The precipitation for 5 months from June to October was only 10 mm, revealing how severe the drought was.

(2) In 1973, it was difficult to restore from the damage of the drought. The cause of lower production was mainly the stoppage of expansion of sericultural area and increase in the damage of pebrine disease.

(3) In view of higher damage of pebrine, some farmers suspended home raising of egg in 1974. The supply of bivoltine egg was less than 2,500 cases, as silkworm rearing was extremely restrained.

(4) In 1975, major producing regions were suffering from egg shortage, as self-raising of egg was completely stopped. In the latter half, however, egg producing facilities set up with the President's fund began operation; the supply of bivoltine egg was increasing. More cocoon output is expected than the preceding year. Compared with the supplying capacity of mulberry leaf, however, egg shortage cannot be denied.

As for the cocoon crop per case of egg, imported egg produced 11.6 kg in 1975, down from 15.9 kg in the preceding year and multiplied egg 7.9 kg against 11.4 kg. The stabilization of cocoon crop would be the key to higher cocoon production in the future.

5. Outline of the Projects for Sericultural Development under Way or Plan in Indonesia

Indonesia is carrying on projects for sericultural development against the background as the following:

(1) Although lying in the tropics, indonesia has many cool places where silkworm can be reared.

(2) In South Sulawesi Province, there are densely sericultural regions with a long history. So, the Government tries to increase sericultural farmers to raise their income by the sale of cocoon. On the other hand, Java where there are many state forests wants to develop the cash resources to forest laborers at leisure time through sericulture. Silkworm rearing is taken up as a link in the measures for the stabilization of national livelihood.

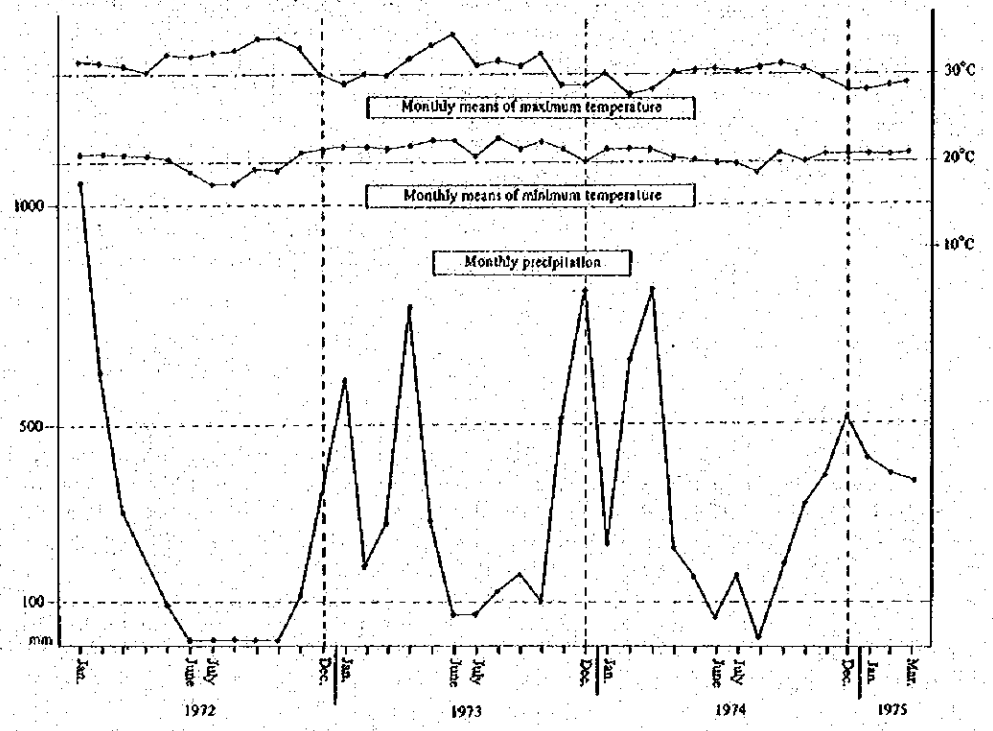
(3) Currently, domestic raw silk is woven as sarong cloth. Expanding the use of raw silk to silk ,batik, the Government intends to increase tourism resources, and after meeting home demand for silk, export raw silk to earn foreign currency.

Against such background, the Government is carrying on the following measures and furthermore trying to reinforce and expand them:

(i) Installation and Substanitation of Experiment and Research Organs

In Bogor, the Sericulture Division was set up in the Forest Research Institute with

Fig. 13. Monthly Precipitation and Monthly Means of Maximum and Minimum Air Temperatures in Bontbili



Source: Farm of Agricultural Research Institute.
Note: Surveyed by Kiyoshi AOKI.

tasks of: breeding of silkworm varieties by selection, improvement of methods of mulberry cultivation as well as silkworm rearing, and diffusion of technique. The Government is trying hard to increase research workers, build new rearing houses, and expand mulberry field.

South Sulawesi Province, on the other hand, set up the Sericulture Station of the said Forest Research Institue in Soppeng Prefecture, which takes charge of: research and survey for technical improvement, production of silkworm egg and distribution of good silkworm egg. Sericulture in the Province had used polyvoltine egg which farmers had produced for themselves, which was under the threatening of pebrine damage and furthermore produced inferior cocoon. Farmers even reeled raw silk for themselves on a small scale. From 1974, however, the Government has changed its policy to remove these defects and let farmers produce good cocoon in quantity. For the purpose, good silkworm egg must be distributed; for higher cocoon output, silk reeling mills are needed. So, the Sericulture Station has been expanded; with the President's fund, egg producing facilities and semi-automatic reeling machines with cocoon drying machines have been introduced. And other measures for large-scale sericulture are under way step by step.

As for fabrics, the Batik Research Institute is studying silk batik for some time, and has woven the cloth on trial.

(ii) Sericulture Promotion Measures in South Sulawesi Province

(a) Rearing of Polyvoltine Varieties Stopped Allover

The Government has encouraged to stop the rearing of polyvoltine silkworm varieties since 1975. This measure has penetrated the Province except for 2 Prefectures in the south. But the egg producing capacity of Sericulture Station is not big enough to meet growing demand from sericultural farmers. Although egg shortage in a transitional stage from polyvoltine egg to hybrid is unavoidable, if such condition lasts too long, the old state of affairs may come back. It is necessary therefore to meet farmers' demand for egg. Farmers have built up collective mulberry fields and are making effort to increase their income. It is important to keep up their willingness for sericulture by all means.

(b) Encouragement of Units and Build-up of Collective Mulberry Fields

Fifteen Units have been subsidized by the Government. Encouraged by the results of Units, farmers have set up 115 Units with their own funds (Plates 10, 11). Increase in the number of Units has facilitated the shift from polyvoltine to hybrid egg. On the other hand, collective mulberry fields have been encouraged with successful results (Plates 13, 14). Sericulture with mulberry leaf around the houses is metamorphosing to that of mulberry plantation.

(c) Installation of Modern Silk Reeling Mills

When polyvoltine silkworm was reared, egg was raised at home, silkworm was reared, cocoon was dried in the sun and hand-reeled by farmers themselves – that is to say a multiple rearing on a small scale. As the rearing scale is enlarged using hybrid egg, farmers hand-reeling cannot dispose of much cocoon; reeling efficiency is low; and the product, raw silk, is inferior in quality. So, farmers are so guided that all the cocoon they have produced be shipped to reeling mills, and this practice is spreading gradually.

With the President's fund, semi-automatic reeling machine mills with cocoon drying apparatus have been set up at the Sericulture Station and in Enrekang Prefecture (Plates 6, 9). Reeling mill at the Sericulture Station is now operating, but that in Enrekang Prefecture has just been installed and will start operating before long. The President was so willing to encourage sericulture that he attended the inauguration ceremony of the reeling mill at the Sericulture Station.

These 2 reeling mills are currently managed by the Sericulture Station, but will be transferred to respective Prefectural offices.

(d) Modernization of Weaving Industry

With the aid of FAO, the Silk Fabric Training Centre has been established in Ujung Pandung to modernize weaving industry and develop new silk products. But the leaders were invited from Thailand; the products were the same as the Thai Silk, without any characteristic as Indonesian silk goods.

The center of weaving industry is Wajo Prefecture. For modernization, the weaving mills were pulled down for new construction.

(iii) Sericulture Promoting Measures in Java

As stated above, the promotional measures for sericulture in the middle and eastern parts of Java are carried on by PERHUTANI. It has built up a vast mulberry field. In 1969, it came to 5,400 ha, but thereafter was reduced to 1,400 ha, because the initial scale was too big and mulberry fields were not managed so well as forest laborers conducted sericulture, though PERHUTANI took the charge in part. Mulberry fields have been left to run waste. Also, imported egg on which they depended so heavily was in short supply. With the installation of Egg Producing Station in Cantiroto in 1975 with annexed mulberry field of 20 ha (Fig. 2), the demand of PERHUTANI itself in the eastern and middle parts of Java is expected to be met.

The special area in West Java and Jogyakarta has no PERHUTANI at present. At a part of West Java, Barmus, the build-up of 20 ha of mulberry field on forest land and the construction of rearing house have been subsidized as a sericultural project. Besides, about 5 ha of mulberry field on forest land was built up in West Java, Ganungmeryan, for veterans, although rearing has not yet been commenced.

(iv) Sericulture Promoting Plan

Indonesia has formulated a plan for promoting sericulture, with the targets as in Table 26.

In addition, the cocoon yield per case of egg will be raised from 15 kg to 23 kg, and the raw silk percentage of cocoon from 13% to 15%.

Table 26. Present State and Targets of Indonesian Sericulture

	Present state	Target
Area of mulberry field	15,400 ha	15,400 ha
Cocoon output	380 tons	2,000 tons
Raw silk production	50 tons	300 tons

Note: Surveyed by Kiyoshi AOKI.

6. Present State of Administrative Organization and Experiment and Research Organs for the Promotion of Sericulture

(i) Administrative Organization

Affairs concerning sericulture are under the jurisdiction of the Directorate General of Forestry, Ministry of Agriculture. But it is not clear which Division is in charge. In the office of South Sulawesi Province, its Division of Industry takes charge of affair. In neither of the offices, furthermore there is any expert in sericulture. Currently, the chief of Sericulture Division of Fores Research Institute concurrently manages the business related to sericulture and takes charge of administrative affairs.

In the light of the flow of funds, however, the Division which takes charge of sericulture may not be clearly defined. The expenses of the Sericulture Division of Forest

Research Institute are mainly paid from the expenses of the Forest Research Institute. But part of expenses is directly paid by the Directorate of Forest Production Promotion.

The expenses of the Sericulture Station of Forest Research Institute in Soppeng, though it is a branch station of the Forest Research Institute, are paid by the Directorate of Re-forestation and Rehabilitation through the Division of Agriculture and Forestry of the Provincial office, directly paid by the Directorate of Forest Production Promotion as the Sericulture Project, or paid directly by the President as the President's fund, etc. Funds flow in a very complex way. It is difficult to think that the Directorate of Forest Production Promotion alone takes charge of sericultural promotion, undertaking the whole responsibility (Fig. 14).

In South Sulawesi Province, there are cases where the Directorate of Forest Production Promotion regards the mulberry tree a forest tree, and plants it on a large scale irrespective of silkworm rearing.

In brief, it appears that sericultural promotion has not been administered under a consistent responsible system, and each Division is managing business from its own standpoint alone.

(ii) National Forestry Public Corporation (PERHUTANI)

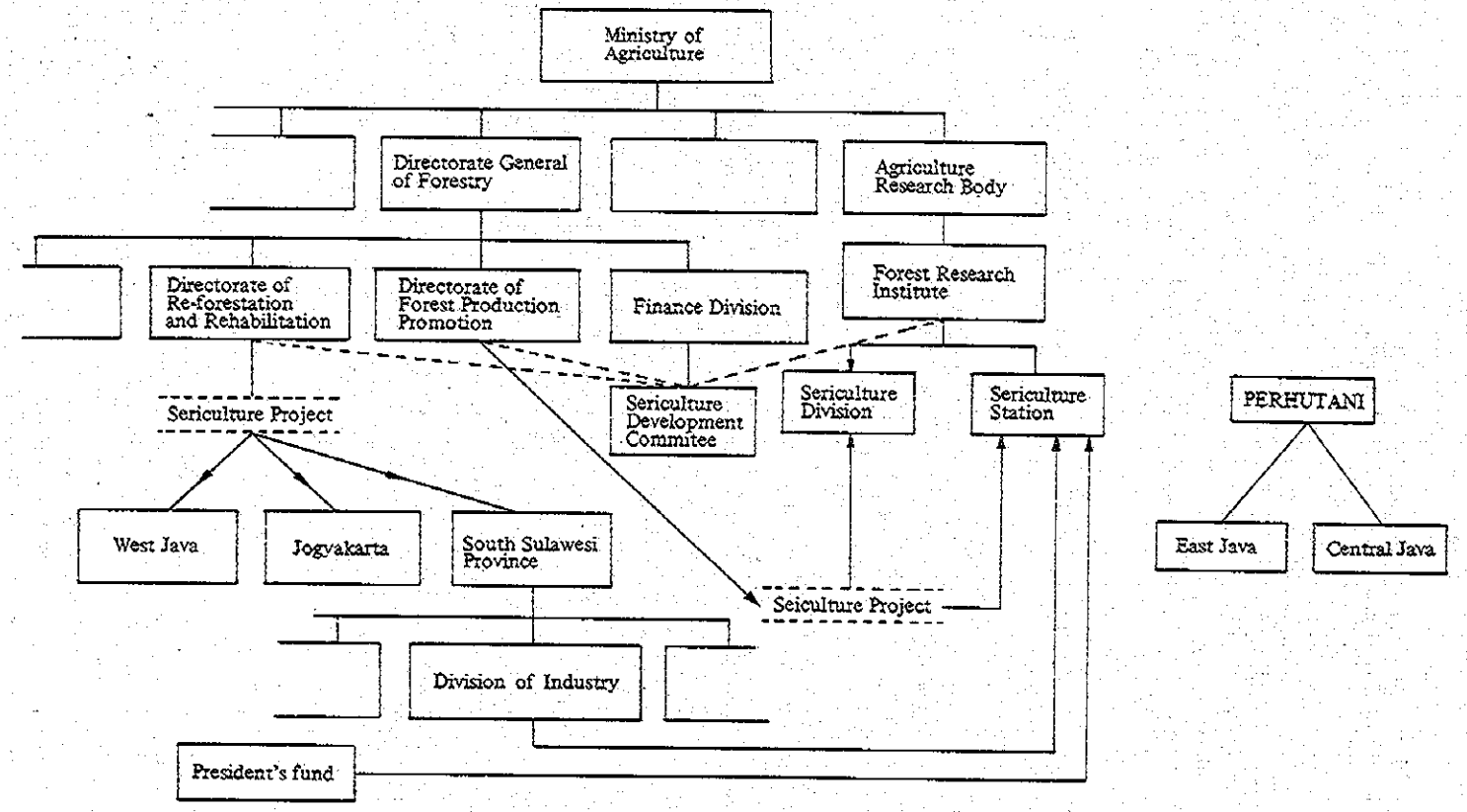
The sericulture in East and Mid Java is mainly promoted by PERHUTANI, which is different from that in South Sulawesi Province in character. The introduction of sericulture was motivated by the fact that forest laborers have no continuous work throughout the year; it was necessary to employ them at the leisure and increase their income, it is said. PERHUTANI has built up a vast mulberry field, let laborers rear silkworm on commission, and buys up all cocoon they produced. The Corporation rears silkworm itself, and reels cocoon for itself, also. Thus, it conducts a vertical management of sericulture from mulberry cultivation – silkworm rearing and raw silk reeling. In 1969, it built up mulberry field of 5,400 ha, but field could not be maintained properly by itself. Taking the conditions of location into consideration, later, it has reduced the scale to the current 1,400 ha or thereabouts, though it holds in Paty mulbery field of 800 ha to handle young silkworm of 200 cases of egg (Fig. 2). Besides there is mulberry field of 200 ha in Badas, but generally in small lots of 20 - 30 ha. As to silkworm egg, hybrid egg imported from Japan have been reared. Recently, an egg producing station has been set up in Chandilot (Fig. 2) for a self-sufficient system. They expected to equip cocoon drying machines and semi-automatic reeling machines before long.

But the productivity is extremely low, because sericultural technique is inferior.

(iii) Sericulture Development Committee

Long-term surveyors found out that the administrative organization and its operation are very complex; in the present system, the results of sericultural development, particularly when the technical cooperation comes from Japan, would not amount to much. As a result of frequent discussions with authorities concerned on the simplification and substantiation of the system, they came to a conclusion that it is difficult to adjust and substantiate the mechanism promptly; with a view to supplementing its weakness, a committee has been set up on sericultural development in the Directorate General of Forestry in order to unify

Fig. 14 Organization Chart of Administration on Sericulture



Note: Surveyed by Kiyoshi AOKI

the budgetary measures for experiment and research organs and receive the technical cooperation from Japan.

By the appointment of members by the Director of Directorate General of Forestry, the committee started on June 12, 1975, with the following composition:

Chairman	Director of Forest Research Institute, GDF
Member	Director of Directorate of Re-forestation and Rehabilization, GDF
Member	Director of Directorate of Forest Production Promotion, GDF
Member	Director of Finance Division, GDF
Member	Chief of Sericulture Division of Forest Research Institute

At the meeting of this committee, the representative of Japanese experts will attend for discussion from time to time.

For various circumstances, however, the committee has not been held; its operation appears difficult.

(iv) Experiment and Research Organs

The experiment and research on sericulture is conducted by the Sericulture Division and the Sericulture Station of Forest Research Institute.

The Forest Research Institute was transferred from the Directorate General to the Agriculture Research Body on September 25, 1975. But the affairs concerning sericulture are administered under the jurisdiction of the Directorate General as heretofore for the time being, as it is not long since A.R.D. started functioning and so forth. But the Sericulture Centre is established in South Sulawesi, the treatment of this Division in the relation of the Sericulture Centre will be examined in the future.

As the Division has facilities and mulberry field, these attachments will have to be utilized by some measures.

As for the sericulture station, it will be substantiated as a Sub-Centre attached to the Sericulature Centre.

(a) Sericulture Division and Sericulture Station

The business of Sericulture Division is divided into: silkworm egg, experiment and research and diffusion. Experiment and research now under way are shown in Table 27. But research workers are few in number and machines and instruments in laboratories are rather poor. So, the results are not remarkable. As for Sericulture Station, on the other hand, its business is shown in Table 27. But it is devoted to the production of egg and the operation of reeling niill.

Especially, it shoulders the whole responsibility on the production and distribution of

hybrid egg, since polyvoltine egg has been replaced with hybrid egg. To discharge its task, it has been equipped with refrigerating facilities with the President's fund. Furthermore, it has pebrine inspecting apparatus in order to distribute pebrine-free egg. But equipment is incomplete, and facilities are narrow and small. Workers are not skillful. These and others hamper the achievement of satisfactory results by the egg producing capacity. In the meantime, the silk reeling mill was making a trial run. But the sorting of cocoon is inferior; reeling technique is under training. These and other factors hinder the reeling machines from demonstrating its productive capacity to the full. In time, however, when reelers become skillful, they will produce high-quality raw silk.

This reeling plant which is operated by the Sericulture Station will be transferred to Soppeng Prefecture before long.

Table 27. Business of Sericulture Division and Sericulture Station

Sericulture Division	Sericulture Station
Silkworm egg – breeding of silkworm varieties by selection	Silkworm egg – breeding of silkworm varieties by selection
Experiment and research – method of mulberry cultivation	production of silkworm egg
Diffusion	Experiment and research – method of mulberry cultivation

Note: Surveyed by Kiyoshi AOKI.

At the Sericulture Station, the water level is raised in the rainy season. This place is not suitable for mulberry field.

The number of research workers and the area of mulberry field of both organs are shown in Table 28.

Also, the kinds of buildings are shown in Table 29, and their arrangement plan and scale in Fig. 15, 16 and 7 (in solid line). The mulberry field of Sericulture Division, 12 ha, is 4 km from the Division (Fig. 17).

(b) Forestry Faculty of Gajamada University

The Forestry Faculty of Gajamada University in Jogyakarta has been carrying on experiment and research on sericulture to some extent. When we visited the Faculty, mulberry trees in the field were rooted up to construct buildings on the field. According to long-term surveyors, the Faculty, too, regarded the mulberry tree as a forest tree, and trained it as such. Accordingly, the results of its studies on sericulture do not amount to much, it seems.

We had familiar talks with the Dean, Assistant Professors and Lecturers, explaining the objective of the present survey. In order to develop Indonesian sericulture in the future, it is necessary to train many experts in sericulture. For the purpose, Japan offers technical cooperation. When the Sericulture Centre is established, Japan will dispatch several experts in respective fields to stay here. They will guide counterparts in developing sericultural technique which suits Indonesia. So, we strongly requested their cooperation in the security of University graduates as counterparts by all means. In response, they said that they would gladly cooperate with us as the Faculty.

Table 28. Research Workers, Etc., and Area of Mulberry Field in Sericulture Division and Sericulture Station

	Sericulture Division	Sericulture Station
Esperiment and research Diffusion		
Research workers	5	4
Assistants (regular)	11	0
Assistants (temporary)	8	69
Total	24	73
General affairs		
Chief	1	1
Assistants (regular)	4	0
Assistants (temporary)	14	11
Total	19	12
Area of mulberry field	12 ha	6 ha

Note: Surveyed by Kyoshi AOKI.

Table 29. Kinds of Buildings

Sericulture Division		Sericulture Station	
1. Main building		1. Main building	
Director's room	1	Director's room	1
General affairs room	1	Pebrine inspection room	1
Library	1	Cocoon and raw silk testing room	1
Silkworm rearing room	2	Demonstration room	1
Laboratory	2	General affairs room	1
Conference room	1	2. Silkworm rearing building	1
Demonstration room	1	3. Refrigerator, Incubation building	1
Warehouse	2	4. Electric power plant	1
2. Rearing building	1	5. Silk reeling building	1
3. Silk reeling building	1	6. Dormitory	1

Note: Nos. 3, 4 and 5 were constructed with the President's fund.
Surveyed by Kiyoshi AOKI.

(c) Batik Research Institute

Batik Research Institute is situated in Jogyakarta, carrying on experiment and research on batik. So far, this Research Institute has concentrated on the cotton batik, but recently took up silk batik, the production of which is among the objectives of the development of Indonesian sericulture. It was weaving silk batik on trial.

Fig. 15. Arrangement Plan of Sericulture Division of Forest Research Institute

Total area: 6170 m^2

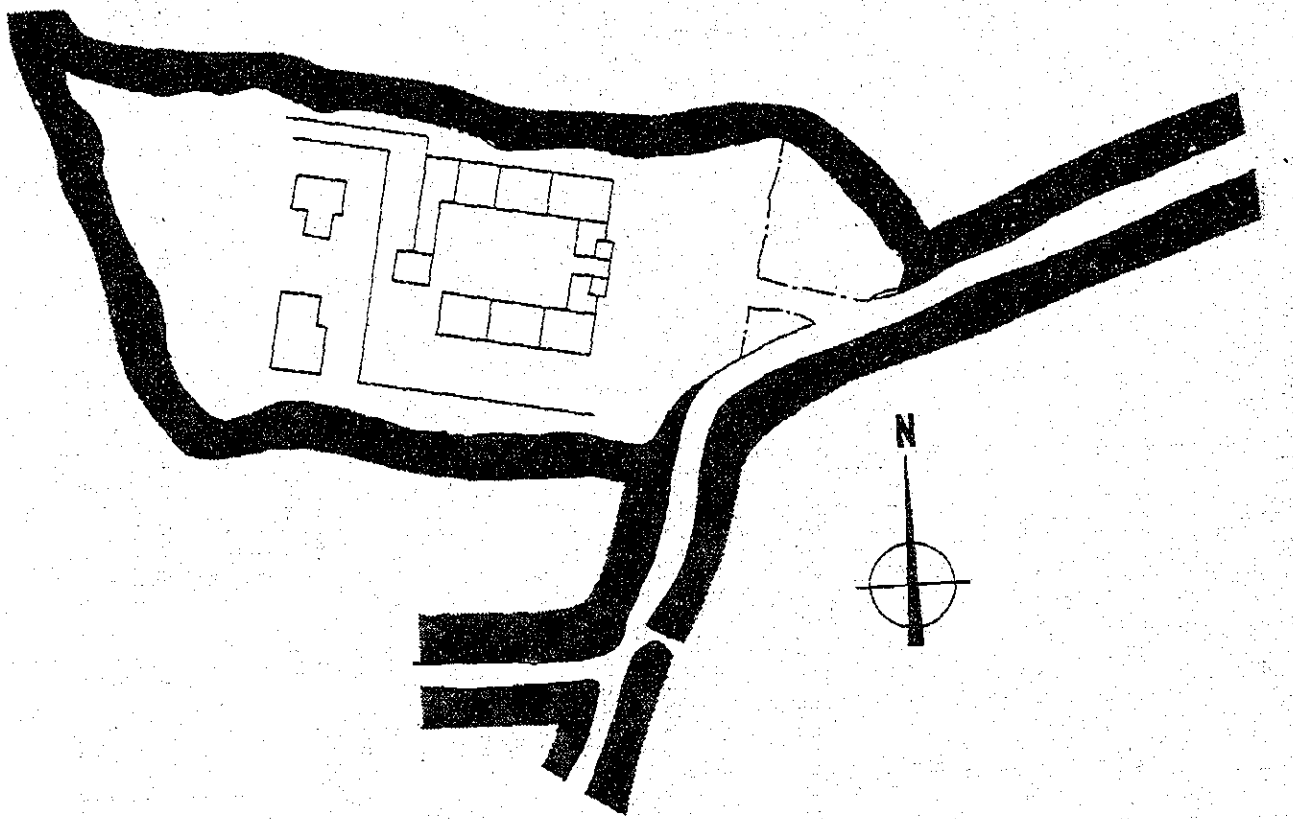


Fig. 16. Arrangement Plan of Buildings, by Uses, of Sericulture Division of Forest Research Institute

Floor space: 612 m²
Court: 459 m²

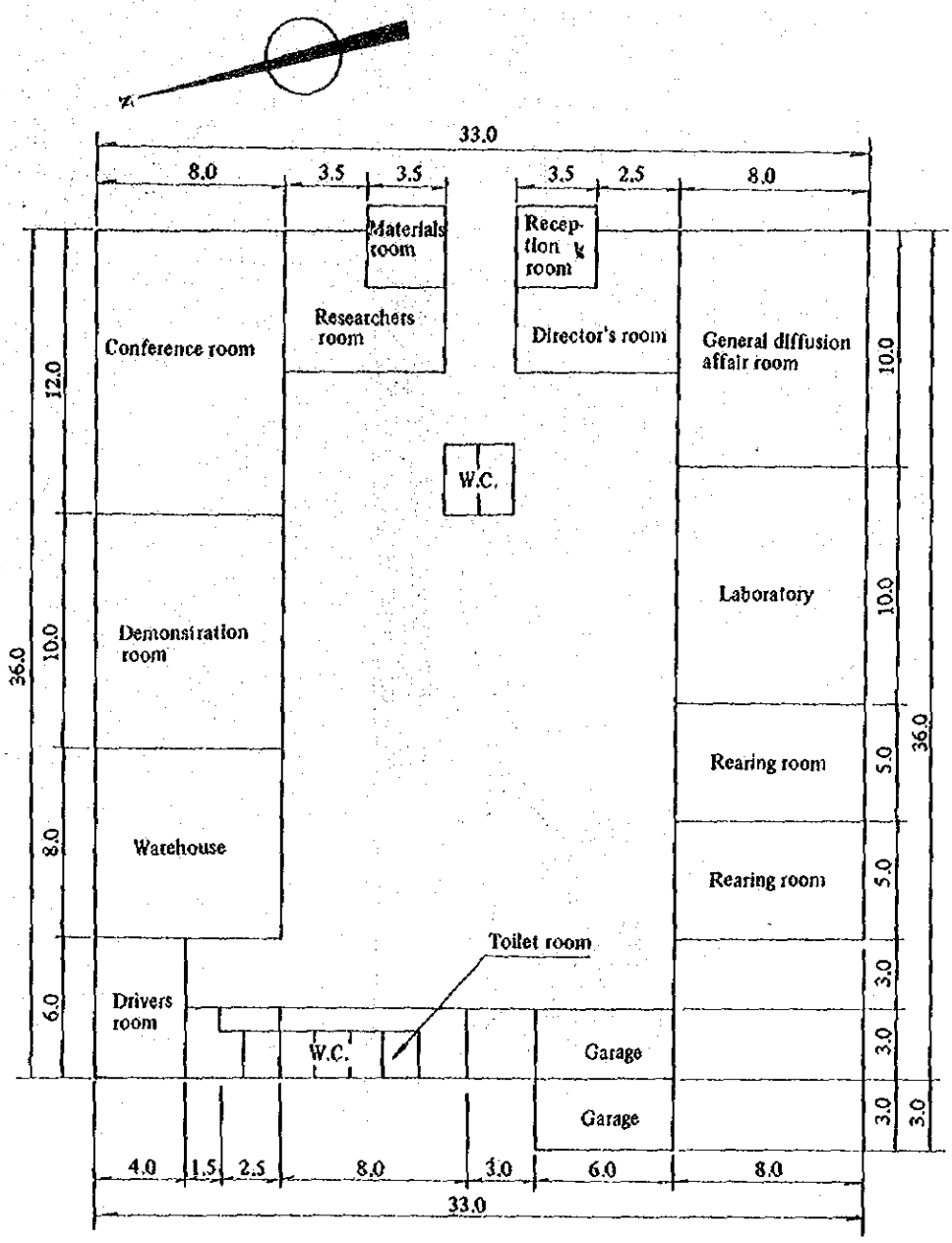


Fig. 17. Sericulture Division of Forest Research Institute

(Mulberry field: 12 ha)