


**REPORT ON THE IMPLEMENTATION DESIGN SURVEY TEAM  
FOR  
THE RESEARCH AND TRAINING IN RE-AFFORESTATION PROJECT  
(PHASE II)  
IN  
THAILAND**

**NOVEMBER 1989**

**JAPAN INTERNATIONAL COOPERATION AGENCY  
(JICA)**

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## ABBREVIATION

RFD: Royal Forest Department  
DF: Demonstration Forest  
TIC: Teak Improvement Center  
AIFM: ASEAN Canada Institute of Forest Management  
RFO: Regional Forest Office  
FIO: Forest Industry Organization  
JICA: Japan International Cooperation Agency



CHAPTER 1

Basic Plan of Project Implementation



## 1. Basic Plan for Project Implementation

### 1.1 Background of the Study

The Kingdom of Thailand forms part of the Malaysian Peninsula and consists of mountainous areas in the north, a large alluvial plain in the centre, plateaus in the northeast and a narrow stretch of land in the south.

Thailand's climate is generally determined by the rainy season (May-October) and dry season (November - April) with mean annual rainfall of approximately 1,600mm.

Thailand has a total land area of 51.4 million ha, i.e. 1.4 times larger than Japan, and a population of 53 million. The forest area of 14.91 million ha which covers 29% of the national land is mostly owned by the government and the forest types include tropical rain forest, tropical rain green forest, mixed deciduous forest, dry dipterocarp forest, mangrove forest and bamboo forest.

The main afforestation species include Tectona grandis (teak), Pinus merkusii, Pinus kesiya, Eucalyptus camaldulensis and Casuarina spp. The forest area has been decreasing due to the development of farmland and shifting cultivation, etc. and, with an average annual loss of forest of some 300,000ha, there is much concern not only for the loss of forest resources but also for the increasing difficulties in regard to basin management.

Against this background, the Research and Training in Re-Afforestation Project (1st Phase) was implemented from July 1981 with Japanese in July 1981 technical cooperation in response to a request made by the Government of Thailand to develop afforestation techniques and to foster the relevant researchers and engineers required for the active promotion of extensive afforestation work in Thailand. With the completion of the 1st Phase of 5 years, the Project is now in its 8th year (3rd year of the 2nd Phase which commenced in 1986) and has come to the stage where the project achievements, i.e. the techniques developed

through extensive research in such diverse fields as afforestation, forest ecology, forest soil, forest protection, forest tree breeding and forest management, have been spread and adopted nationwide.

However, it now appears necessary to establish a base to conduct comprehensive research and to effectively diffuse the various techniques in the northern area which is one of the most important forestry areas in Thailand. While the initiative to establish such a base was first taken by the Royal Forestry Department (RFD) in 1964 with the creation of a demonstration forest of approximately 150,000ha in Lampang, this demonstration forest has so far failed to fully perform the expected functions due to the inadequate provision of exhibition forests, experimentation forests and related facilities.

To improve the above situation, it was decided in a meeting between the Study Team, Thai officials and JICA project experts to create exhibition forests to diffuse the selective felling technique for teak plantations, the tending technique to assist the regeneration of natural forests and the fire prevention/fire-fighting techniques, to construct an observation footpath, to improve forest roads and to construct related facilities. When the cost estimate was made for the preliminary design based on the above design, however, the resulting cost far exceeded the anticipated budget for the Pilot Infrastructure Project (see Table 1), necessitating further consultations between all project-related people and it was finally decided that the detailed design and cost estimate would be based on the facilities listed in Table 1.

Table 1  
Cost Estimate (Based on Preliminary Design)

No	Type of Work	Quantity	Cost (Baht)	Remarks
1	Land Preparation (including curbstone and gravel paving)	1	1,077,000	Baht/¥5.4
2	Center Building	320m <sup>2</sup>	3,033,000	
3	Glasshouse	108m <sup>2</sup>	574,000	
4	Stump Storage	52.5m <sup>2</sup>	121,000	
5	Stump Preparation House	40m <sup>2</sup>	204,000	
6	Seed Storage	24m <sup>2</sup>	296,000	
7	Car Port	72m <sup>2</sup>	138,000	
8	Information Board at Access Point	1	170,000	
9	Information Board at Exhibition Forest	1	150,000	
10	Footpath (Exhibition Forest)	1	52,000	
11	Name Plates for Trees (Exhibition Forest)	1	100,000	
12	Public Conveniences (Exhibition Forest)	13m <sup>2</sup>	128,000	
13	Water Tank	45 ton	180,000	
14	Construction of Access Road	1	1,805,000	
15	Foot Bridge	1	127,000	
16	Barbed Wire Fence (Exhibition Forest)	1	498,000	
17	Firebreaks (20m wide) (Experimentation Forests)	1	1,226,000	
18	Water Supply Facilities	1	2,881,000	

No	Type of Work	Quantity	Cost (Baht)	Remarks
19	Power Supply Facilities A) Independent Generation B) Public Power Supply Total Direct Cost A Total Direct Cost B	1	2,710,000 8,530,000 15,470,000 21,290,000	
20	Site Expenses (10%) A B	1	1,547,000 2,129,000	
21	Miscellaneous Expenses (5%) A B	1	773,500 1,064,500	
22	Taxes (3.4%) A B	1	604,877 832,439	
	Total Expenses A B		2,925,377 4,025,939	
	Grand Total A B		18,395,377 25,315,939	



## 1.2 Basic Study Policies

The purpose of the present study is the completion of the detailed designs for the exhibition forest, experimentation forests and related facilities to be introduced in the demonstration forest area of the Thai Royal Forest Department (RFD) for the Pilot Infrastructure Project (the Project) under the second phase of the Research and Training in Re-Afforestation Project in Thailand. The implementation of the Project is expected to contribute to (i) the vitalization of survey, research and training functions in forestry work, (ii) the establishment of a comprehensive forestry research system model where afforestation and forest management work are combined and (iii) the diffusion of a model forestry work system.

Particular emphasis was given to the following in the course of the study.

- (1) The existing demonstration forest was established by the RFD as a pilot exhibition/experimentation forest covering all aspects of forestry work, including a management test. However, the existing demonstration forest has not yet been fully utilized due to a number of reasons. The exhibition forest (partially existing), experimentation forests (expansion of existing experimental forest), forest roads (partial improvement of existing forest roads) and related facilities have now been designed based on thorough consultations with the Thai side and JICA experts so that the demonstration forest is fully able to perform its function.
- (2) The study consists of survey and design work implemented as the Pilot Infrastructure Project which in turn is part of the project-type cooperation. Design priority is given to technical rationality and economic efficiency taking the local conditions into careful consideration so that the facilities to be constructed can be easily managed and maintained.
- (3) With regard to the power supply, it is planned to extend the public power line in the near future, the current terminal of which is 5km

from the access point along the national road to the project site. The detailed design has, therefore, been made for both cases, i.e. the use of the public power supply and the use of independently generated power. All wiring and power facilities have been accordingly designed even if the initial power source is a generator to ensure continuous use when the public power supply becomes available in the future.

- (4) Based on consultations with the Thai side, it has been decided that the Center will be named the Forest Research, Demonstration and Extension Center (FRDEC) and that the information board posted at the access point on the national road will carry this name.

### 1.3 List of Project-Related People and Study Schedule

#### 1.3.1 List of Project-Related People

##### (1) Study Team Members

The study team members for the Detailed Design Study for the Pilot Infrastructure Project of the Research and Training in Re-Afforestation Project are as follows.

<u>Name</u>	<u>Assignment</u>	<u>Attachment</u>
Eitaro Mitoma	Team Leader	Japan International Cooperation Agency
Tadami Imai	Demonstration Forest Work Planning	Japan Forest Technical Association
Keiji Horiuchi	Facility Design	Japan Forest Technical Association

##### (2) Related Thai Officials of Royal Forest Department

<u>Name</u>	<u>Attachment</u>
Narong Grittanugul	Director, Forest Management Division
Thanit Yingwanasiri	Director, Silviculture Division
Boonchoob Boontawee	Director, Silvicultural Research Sub-Division

Vichien Sumantakul	Deputy Director II, Central Forest Research Laboratory
Apichart Kaosa-rd	Chief, Teak Improvement Center (TIC)
Surasak Ruaugchan	Forest Management Division
Verapong Suangtho	Chief, Mae Tha Seed Orchard, Lampang
Thirdpong Supapern	Chief, Demonstration Forest Sub-Division
Kasama Ratanachai	Director, Lampang Regional Forest Office
Vallobh Maimongkol	Deputy Director, Lampang RFO
Sompon Tanhan	Chief, Aerial Photo and Mapping Section
Suraphong Chaweepak	Demonstration Forest Sub-Division
Phanuwat Nuntisuntikun	Demonstration Forest Sub-Division
Thannarin Nanakoon	Demonstration Forest Sub-Division
Suwan Fanunampa	Demonstration Forest Sub-Division
Sathaporn Tantacharoengit	TIC
Somwang Kreamanorom	TIC
Mr. Kampalanont	Architect Design and Construction Land Forest Division
Mr. Veerasak	Architect Design and Construction Land Forest Division

(3) JICA Experts

<u>Name</u>	<u>Attachment</u>
Ryosuke Kato	Chief Advisor, Research and Training in Re-Afforestation Project
Masaharu Sakai	Forest Soil Expert, Research and Training in Re-Afforestation Project
Shozo Nakamura	Forest Ecology Expert, Research and Training in Re-Afforestation Project
Toshifumi Serizawa	Coordinator, Research and Training in Re-Afforestation Project

### 1.3.2 Study Schedule

The field survey was conducted for 45 days between 10 August and 23 September, 1989.

(Work Report)

- 10 Aug. (Thu.) Departure from Tokyo and arrival in Bangkok (TG 641)
- 11 Aug. (Fri.) am Meeting with JICA experts of the Research and Training in Re-Afforestation Project (Phase II)  
pm Courtesy call to JICA Office and RFD and briefing on the schedule
- 12 Aug. (Sat.) Meeting with JICA experts and discussion on the contents and schedule of the survey, data arrangement and information gathering
- 13 Aug. (Sun.) Procurement of survey materials and aerial photo interpretation. Departure from Bangkok and arrival in Lampang via Chiangmai (TG100)
- 14 Aug. (Mon.) am Meeting with staff of the ASEAN Canada Institute of Forest Management (AIFM)  
pm Meeting with staff of the Teak Improvement Center, RFD (refer to appendix)
- 15 Aug. (Tue.) am Courtesy call to Lampang Regional Forest Office (RFO) and briefing on the project  
pm Visit to Mae Moh FIO Nursery and meeting at AIFM Office
- 16 Aug. (Wed.) am Meeting at AIFM Office accompanied by Mr. Kato, Chief Advisor  
pm Discussions on dry dipterocarp forests and access roads
- 17 Aug. (Thu.) am Meeting at Lampang RFO  
pm Inspection of experimentation forest of dry dipterocarp forest and project site
- 18 Aug. (Fri.) Inspection of resort facilities of Jae Sorn National Park under the supervision of Lampang RFO
- 19 Aug. (Sat.) am Survey on construction material prices at Chiangmai  
pm Departure from Chiangmai and arrival in Bangkok (TG113)
- 20 Aug. (Sun.) Aerial photo interpretation and survey on construction material prices at Bangkok
- 21 Aug. (Mon.) am Aerial photo interpretation at RFD's Mapping Division Office  
pm Meeting with JICA experts



- 12 Sep. (Tue.) Location survey of experimentation forest site of teak plantation
- 13 Sep. (Wed.) Location survey of experimentation forest site of dry dipterocarp forest
- 14 Sep. (Thu.) as above
- 15 Sep. (Fri.) Location survey of experimentation forest site of mixed deciduous forest
- 16 Sep. (Sat.) as above
- 17 Sep. (Sun.) am Analysis of survey data  
pm Departure from Lampang and arrival in Bangkok (TG105)
- 18 Sep. (Mon.) am Analysis of survey results and drawing at RFD Office  
pm Meeting with JICA experts and preparation of draft final plan
- 19 Sep. (Tue.) am Preparation of draft final plan, drawing and data adjustment at RFD office  
pm Survey on construction companies based in Bangkok
- 20 Sep. (Wed.) am Preparation of draft final plan, drawing and data adjustment at RFD Office
- 21 Sep. (Thu.) am Preparation of draft final plan at RFD Office  
pm Final discussion with RFD Officials and JICA experts
- 22 Sep. (Fri.) Courtesy call to JICA Office prior to departure from Thailand for Japan and briefing on draft final plan. Courtesy call to RFD Office
- 23 Sep. (Sat.) Departure from Bangkok and arrival in Tokyo (TG640)

\* Between 2 September and 16 September, Keiji Horiuchi was fully occupied with building design work.

CHAPTER 2

Study Implementation Method





## 2. Study Implementation Method

### 2.1 Study Area

The subject area of the Study (Study Area) is the demonstration forest of the Royal Forest Department (RFD) which is located in Lampang in the north of Thailand. The demonstration forest has an area of approximately 150,000ha and is some 2.5 hours drive from Chaingmai. It was originally established as a pilot demonstration/experimental forest covering all aspects of forestry work, including management tests, Fig. 1 show the location of the Study Area.

### 2.2 Study Contents

The study contents are as follows.

- (1) Survey on current conditions of the demonstration forest.
- (2) Surveying, design and cost estimation of the planned exhibition and experimentation forests.
  - ① Types, locations and sizes of exhibition and experimentation forests.
  - ② Locations and sizes of access roads and observation footpaths.
- (3) Surveying, design and cost estimation for the related facilities.
  - ① Center building for exhibition
  - ② Workshop, garage and nursery, etc.
  - ③ Power generation and water supply facilities.
- (4) Collection of data to provide the basis for design and cost estimation.
- (5) Collection of information on local construction companies and data on work contracts.

(6) Preparation of draft work contract.

Note:

The scope of the study has been partially changed following consultations between the Japanese and Thai sides in view of the budgetary limitations referred to earlier.

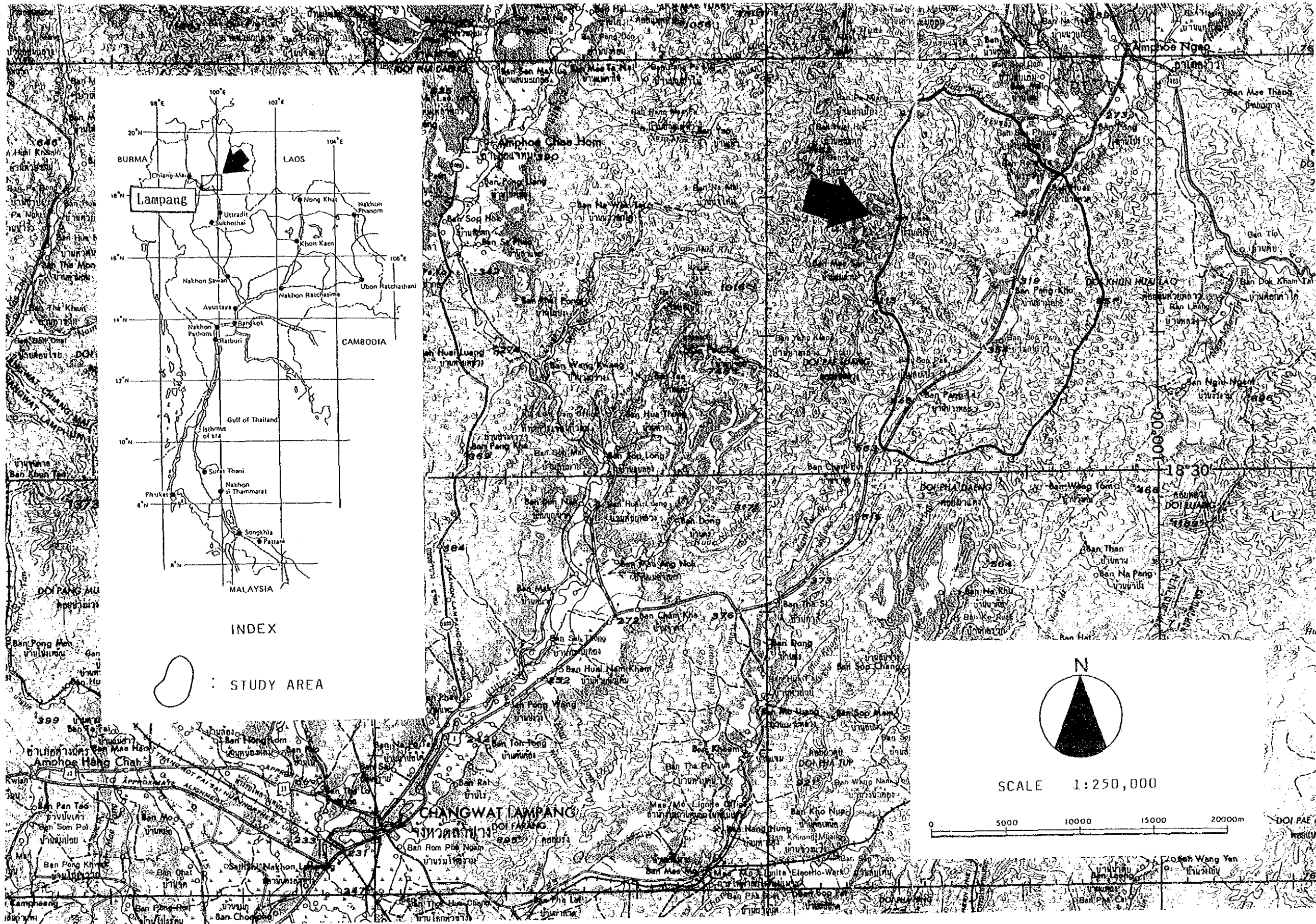


Fig. 1 Location Map of Study Area



## 2.3 Study Activities

### 2.3.1 Consultations with Related Organizations

The following consultations on the sizes and locations of the planned exhibition and experimentation forests and also on the types, locations and sizes of the related facilities were held with Thai officials of the related organizations and JICA experts.

11th August 1989

Place: Central Forest Research Laboratory and Training Center

Topics: Briefing by the Study Team on the project outline to the Forest Management and other division officials of the RFD and discussion on arrangements for the Thai counterparts, manner of involvement of the local RFD office at the project site and the provision of conveniences by the Thai side.

#### Participants

##### Thai side:

Narong Grittanugul (Director of Forest Management Division, RFD)

Vichien Sumantakul (Deputy Director of Central Forest Research Laboratory, RFD)

Surasak Ruaugchan (Forest Management Division, RFD)

Thirdpong Supaperm (Forest Officer of Demonstration Forest in Ngao, Lampang, RFD)

Verapong Suangtho (Chief, Mae Tha Seed Orchard, Lampang, RFD)

##### JICA Experts:

Ryosuke Kato (Chief Advisor for Research and Training in Re-Afforestation Project (Phase II))

Masaharu Sakai (Forest Soil)

Shozo Nakamura (Forest Ecology)

Toshifumi Serizawa (Project Coordinator)

##### Study Team:

Eitaro Mitoma (Team Leader)

Tadami Imai (Co Leader, Demonstration Forest Design)

Keiji Horiuchi (Related Facility Design)

14th August 1989

Place: Teak Improvement Center (TIC)

Topics: Briefing by the Director of the TIC on the status and various activities of the TIC

Participants

Thai side:

Apichart Kaosa-rd (TIC)

Suraphong Chaweepak (Demonstration Forest Sub-Division)

Phanuwat Nuntisuntikun ( " )

Thannarin Nanakoon ( " )

Suwan Panunampa ( " )

Sathaporn Tantacharoengit (TIC)

Samwang Kreamanorom (TIC)

JICA Experts:

Masaharu Sakai (as previously described)

Toshifumi Serizawa ( " )

Study Team:

as above

15th August 1989 (1)

Place: Lampang Regional Forest Office

Topics: Discussion with the Deputy Director of the Lampang RFO on the nomination of counterparts, cooperation with the Study Team, support system and data collection.

Participants

Thai Side:

Vallobh Maimongkol (Deputy Director of Lampang RFO)

Verapong Suangtho (as previously described)

JICA Experts:

as above

Study Team:

as above

15th August 1989 (2)

Place: Mae Moh Nursery of Forest Industry Organization

Topics: Discussion on nursery practices and related facilities in Thailand

Participants

Thai Side:

Verapong Suangtho (as previously described)

JICA Experts:

as above

Study Team:

as above

16th August 1989

Place: Team Improvement Center, ASEAN Institute of Forest Management Office

Topics: Briefing by the Study Team on the project outline and exchange of opinions on the Project.

Participants

Thai Side:

Apichart Kaosa-rd (as previously described)

Thirdpong Supaperm ( " )

Suraphong Chaweepak ( " )

Phanuwat Nuntisuntikun ( " )

Thannarin Nanakoon ( " )

Suwan Panunampa ( " )

Sathaporn Tantacharoengit ( " )

JICA Experts:

as above

Study Team:

as above

17th August 1989 (1)

Place: Lampang Regional Forest Office

Topics: Courtesy visit to the Director of the Lampang RFO and request for cooperation in data gathering. Briefing by the Director on the outline of the activities of the Regional Office

Participants

Thai side:

Kasama Ratanachai (Director of Lampang RFO, RFD)

Verapong Suangtho (as previously described)

JICA Experts:

as above

Study Team:

as above

17th August 1989 (2)

Place: Project Site

Topics: Discussion on water and electricity supply systems and protection forests.

Participants

Thai side:

Apichart Kaosa-rd (as previously described)

Verapong Suangtho ( " )

JICA Experts:

as above

Study Team:

as above

21st August 1989

Place: Central Forest Research Laboratory and Training Center

Topics: Clarification of JICA views on discussed issues.

Participants

JICA Experts:

as above

Study Team:

as above

22nd August 1989 (1)

Place: Land Management Division Office

Topics: Collection of information on building and civil engineering work in Thailand.

Participants

Thai Side:

Mr. Kampalanont (Architect Design and Land Forest Division)

Mr. Veerasak ( " )



Study Team:

as above

22nd August 1989 (2)

Place: Central Forest Research Laboratory and Training Center

Topics: Interim decision on the study items and discussion on issues  
to be included in the interim report to the JICA HQ.

Participants

Thai Side:

Boonchoob Boontawee (Director of Silvicultural Research  
Sub-Division, RFD)

Vichien Sumantakul (as previously described)

Apichart Kaosa-rd ( " )

Thirdpong Supaperm ( " )

JICA Experts:

Ryosuke Kato ( " )

Masaharu Sakai ( " )

Shozo Nakamura ( " )

Toshifumi Serizawa ( " )

Study Team

as above

23rd August 1989

Place: Central Forest Research Laboratory and Training Center

Topics: Confirmation of the interim decision and exchange of the  
Minutes of Discussions.

Participants

Thai Side:

Thanit Yingwanasiri (Director of Silviculture Division, RFD)

Boonchoob Boontawee (as previously described)

Vichien Sumantakul ( " )

Apichart Kaosa-rd ( " )

Thirdpong Supaperm ( " )

JICA: Ben Saitou (Resident Representative)

JICA Experts:

as above

Yasunori Yamashita (JICA concerned)

Study Team:  
as above

11th September 1989

Place: AIFM office

Topics: Briefing on the study progress and exchange of opinions

Participants

Thai side:

Apichart Kaosa-rd (as previously described)

Thirdpong Supaperm ( " )

Suraphong Chaweepak ( " )

Phanuwat Nuntisuntikum ( " )

JICA Experts:

Toshifumi Serizawa ( " )

Study Team:

Tadami Imai ( " )

Keiji Horiuchi ( " )

21st September 1989

Place: Central Forest Research Laboratory and Training Center

Topics: Final discussion on the study findings and exchange of  
opinions

Participants

Thai side:

Vichien Sumantakul (as previously described)

Apichart Kaosa-rd ( " )

Thirdpong Supaperm ( " )

JICA Experts:

Ryosuke Kato ( " )

Masaharu Sakai ( " )

Toshifumi Serizawa ( " )

Study Team:

as above

### 2.3.2 Field Survey

#### (1) Natural Conditions

The Study Area is characterized by very mountainous topography. The northern part consists of steep mountains with an elevation ranging from 500m to 1,200m while the western part also consists of mountains with an elevation ranging from 500m to 1,000m. The mountains in the central part of the Study Area where the project site is located have an elevation of between 300m and 900m while the mountains in the east have an elevation of between 400m and 600m. There are 2 plains in the Study Area, one of which extends from the central part of the Ngao District to the southeast while the other spreads in the east along the Mae Teep river.

The Study Area's most conspicuous geological feature are outcrops of Ratburi limestone which is extremely useful as ballast for road paving. Although lateritic soil is scarce, iron-concretionary pea gravel is commonly found in the dry dipterocarp forests.

Most of the Study Area consists of alluvial soil and stony surface soil. The alluvial soil, which has a high moisture storage capacity, good drainage and good fertility, provides favourable growth conditions for teak. Dry dipterocarp forests are found on plateaus and ridges consisting of stony soil and areas with surface soil covering hard shale and sandstone.

The nearest meteorological station is located at the Teak Improvement Center. The Study Team obtained climatic data for 1978 to 1987, according to which the annual rainfall ranges from 950mm to 1,321.7mm. The minimum mean monthly rainfall is 4.8mm (December) while the maximum mean monthly rainfall is 198.0mm (July). The climate diagram of this station is shown in Fig. 2 based on the World Atlas of H. Walter and H. Lieth (1967).

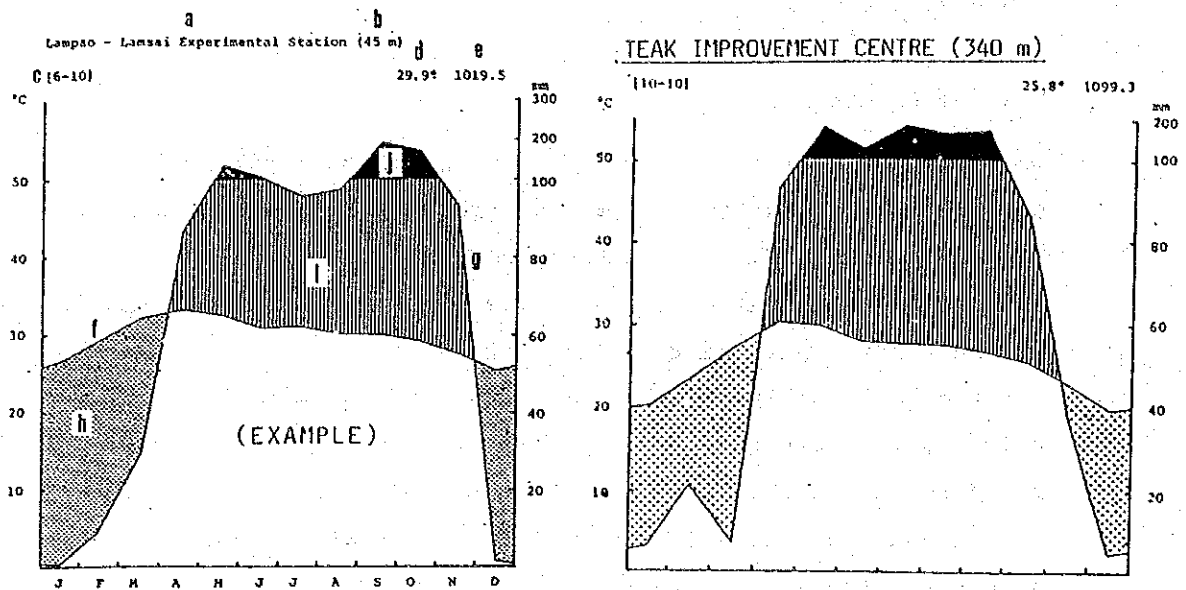


Fig. 2 Climate Diagram

Key to Climate Diagram

- a: station
- b: elevation above sea level
- c: length of observation period (where two figures are given, the first indicates temperature and the second indicates precipitation)
- d: mean annual temperature ( $^{\circ}\text{C}$ )
- e: mean annual precipitation (mm)
- f: curve of mean monthly temperature (1 division =  $10^{\circ}\text{C}$ )
- g: curve of mean monthly precipitation (1 division = 20mm, i.e.  $10^{\circ}\text{C} = 20\text{mm}$ )
- h: period of relative drought (dotted)
- i: period of relative humidity (vertical shading)
- j: mean monthly precipitation over 100mm (scale reduced to 1/10, black area)

(2) Socio-Economic Conditions

The project site is located along National Road No. 1 (NR. 1). The distances between the access point from NR. 1 to the site and Lampang, a city to the south with a population of some 170,000, and Ngao, a town to the north, are 70km and 20km respectively. The NR. 1 connecting these three locations is an asphalt paved single carriageway and is busy with tourists visiting Mae Sai, a town bordering Myanmar. A 1.5km section between the access point and the actual project site is unpaved but is passable throughout the year.

There are two tourist sites along NR. 1 between Lampang and Mae Sai, i.e. the Young Elephant Training School (for timber transportation) and Tham Pha Tai (a large limestone cave located in the depths of a natural teak forest). Both sites are under the control of the RFD and are the subject of picture postcards. They seem to be visited by a large number of tourists travelling to Chiang Rai or Mae Sai. Ngao District where the project site is located has a population of 55,267 of which 7,924 are primary and secondary school children as shown in Table 2.

Table 2 Demography of Ngao District

Number of Sub-district	Number of Villages	Total Population	Males	Females	Number of Households
10	55	55,267	28,263	27,004	12,564

February, 1987

Data on the natural and socio-economic conditions is still inadequate to predict the possible number of visitors to the Center and data on holidays and holiday preferences is also necessary. The number of people visiting the planned facilities will also largely depend on the character and sizes of the facilities and transportation conditions. However, a large number of visitors to the Center can be expected once the new facilities have been completed.

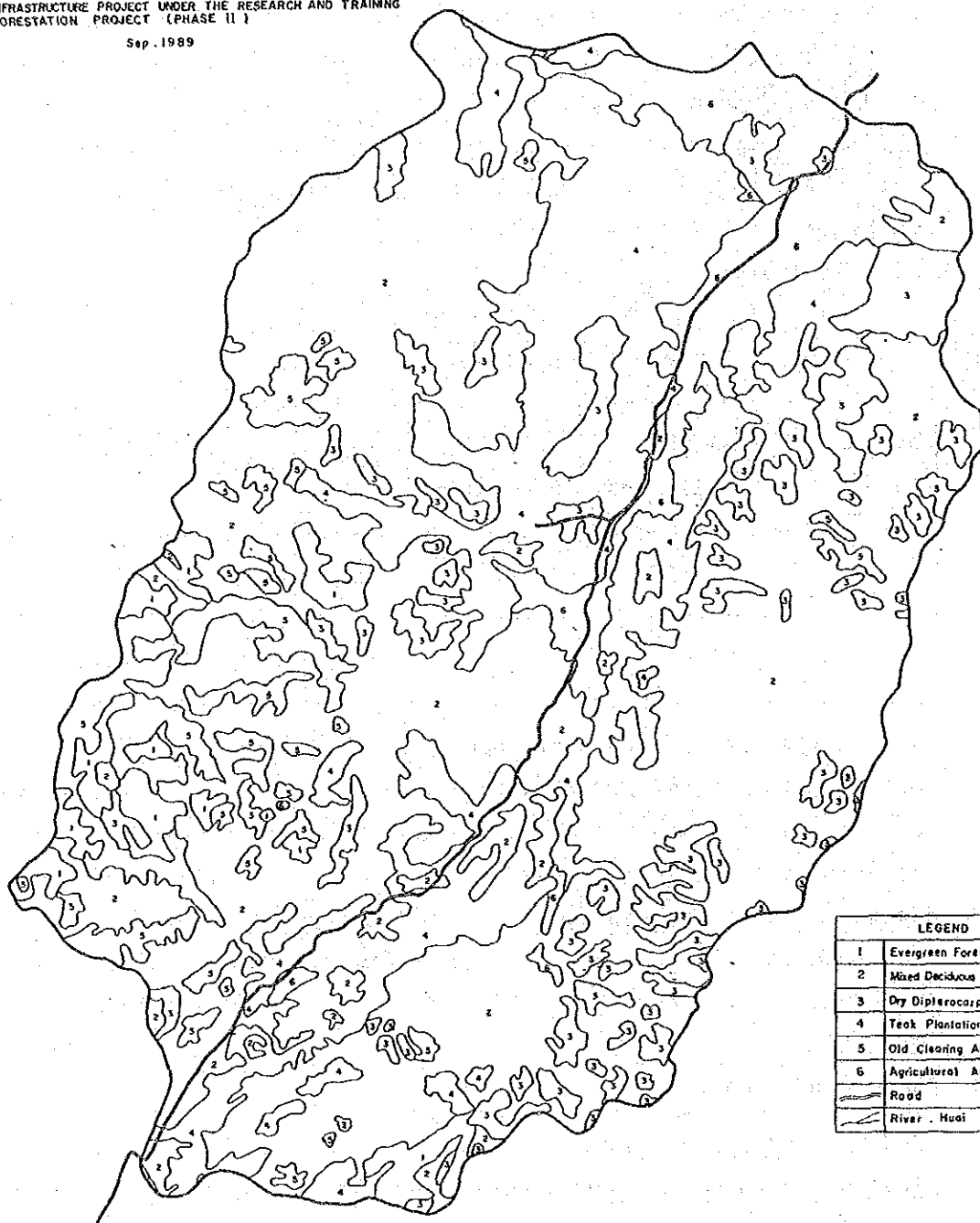
### (3) Stand Conditions

Land use categories of teak plantation, mixed deciduous forests, dry dipterocarp forests, evergreen forests, brushland/grassland, farmland/villages and other land use were decided based on the interpretation of aerial photographs of the Mapping Division of the RFD (Zeiss MRB, f=151.99mm, taken on December 14, 1983 with a scale of 1:15,000) and were transferred to a topographical map (1:50,000) to prepare a forest type map (see Fig. 3).

# FOREST TYPE MAP

THE PLOT INFRASTRUCTURE PROJECT UNDER THE RESEARCH AND TRAINING  
IN RE-AFFORESTATION PROJECT (PHASE II)

Sep. 1989



LEGEND	
1	Evergreen Forest
2	Mixed Deciduous Forest
3	Dry Dipterocarp Forest
4	Teak Plantation
5	Old Clearing Area
6	Agricultural Area
	Road
	River - Huai

1: 50,000



Fig. 3 Forest Type Map

A stand conditions survey was conducted at 12 sites in designated stands located in the demonstration and experimentation forest of dry dipterocarp and mixed deciduous forests and the survey results were used for the design of the new exhibition and experimentation forests based on the following survey criteria.

- . Small Circle: counting of the number of young trees with a height of less than 1.3m in a small circle with a 3.98m radius (area of 0.005ha)
- . Medium Circle: counting of the number of trees with a height of 1.3m or more and a breast height diameter of less than 46cm in a medium circle with a radius of 7.98m (area of 0.02ha)
- . Large Circle: counting of the number of trees with a height of 1.3m or more and a breast height diameter of 46cm or more in a large circle with a 17.84m radius (area of 0.10ha)

#### (4) Existing Facilities

The Study Team visited and examined such facilities as the research building, lecture rooms, laboratories, seed storage (structure and storage capacity), garage (size) and displayed objects, etc. of the Teak Improvement Center of the RFD in addition to the research building (interior finish) of the ASEAN Canada Institute of Forest Management (AIFM), irrigation system and stump storage (structure and storage capacity) of the FIO Mae Moh Nursery Station and the glasshouse of Kasetsart University and the opinions and advice of those responsible for these facilities were referred to in the preparation of the detailed design.

### 2.3.3 Exhibition Forest Plan

The essential functions of a demonstration forest are to upgrade the survey, research, training and technology diffusion work as well as to diffuse a model forestry work system covering all aspects of forestry work from afforestation to forest management. In addition, an exhibition forest can also contribute to increasing the understanding of the significance of nature and the role forests play in human life. Therefore, the planned exhibition forest will have both an indoor display (pictures and drawings, etc.) and an outdoor display which will be concentrated in a small area to provide an interesting place to visit and to teach the ecological system to not only adults but also to school children. The efficient utilization of the exhibition forest is planned by the introduction of carefully considered accessibility.

Two information boards explaining the purpose of the exhibition forest, the history of the facilities, the sizes, types and stands of the forest and the general layout will be erected at the access point from NR. 1 and outside the Center building. The distribution of leaflets carrying the same information as these boards to visitors is also planned. It is proposed that the RFD will be responsible for this aspect within its operational budget.

#### (1) Teak Plantation

The planned construction site of the Center building is bordered by teak plantation to the north and southeast (used as a seed orchard). The AIFM site is also bordered by another teak plantation to the west which was planted in 1942. There is an experimental mixed forest of teak and Pinus kesiya along the access road which stretches east for 200m. With these various teak plantation, therefore, it is expected that the demonstration effect will be extremely high. As various experiments and research are in progress by the TIC in these teak plantations which have well constructed footpaths, no budgetary appropriation for them under the Project is necessary.



(2) Mixed Deciduous Forests

While there are no suitable stands around the project site, the stand co-existing with an experimentation forest along NR. 1 some 5km to the southwest of the access point to the project site forms a 3km stretch of mixed forest along the road which can be observed by passing cars. As various experiments are also in progress in this forest which has an access road and footpaths, it has been decided that no budgetary appropriation for it under the Project is necessary.

(3) Dry Dipterocarp Forests

The subject stand is located some 200m east of the Center and has some 78 species in their original state. The introduction of two types of exhibition forests is planned here.

- ① The first exhibition forest will be surrounded by barbed wire to protect the virgin forest state. This forest will be used for observation of the ecosystem and nature from outside. The cost to erect barbed wire fence will be borne by the RFD and, therefore, is not accounted for under the Project.
- ② In the case of the second exhibition forest, low trees will be cleared to leave only large trees of all the 78 species. Wooden benches will be provided along the observation footpaths and a simple building with thatched roof to keep out rain will be constructed so that visitors can directly observe and understand the ecosystem through leisurely walks in the forest. The current conditions of the forest will be preserved except for the above-mentioned clearance of low trees. 500 metal plates (3cm x 5cm) with engraved numbers and 300 ceramic plates (15cm x 35cm) with engraved names of the species will be prepared as part of the Project. Public conveniences will also be provided.

#### 2.3.4 Experimentation Forest Plan

Experimentation forests will be established to accumulate the basic data required for the improvement of forestry work and to diffuse effective work methods by means of enlightening those people engaged in forestry work through the demonstration of these methods for three types of forests, i.e. dry dipterocarp forests, mixed deciduous forests and teak plantation, which are the most typical forests in northern Thailand. An experimental plot for each experiment item will be designated in the experimentation forest and an experimental compartment will be established in each plot to obtain data. In regard to the experimental plot site, it has been decided that the existing experimentation forest site will be used and that RFD will be responsible for any future extension work and the relevant implementation cost.

##### (1) Types of Experimentation Forests

- . An experimentation forest for survey on forest fire protection treatment effect for regeneration and growth in dry dipterocarp forest. It is planned to establish firebreaks of 20m in width for experimental purposes. In view of the limited project budget, the RFD has agreed to construct these firebreaks with its own budget.
- . An experimentation forest for survey on natural forest tending effect for regeneration and growth in disturbed mixed deciduous forest by selective cutting.
- . An experimentation forest for teak plantation thinning experimentation.

##### (2) Locations of Experimentation Forests

The experimentation forests will be located in those areas where the most representative stands of the subject species are found and where a series of follow-up studies and the management and maintenance of the experimental compartments can be easily conducted.

##### (3) Size of Experimentation Forests

The size of the experimentation forests should be large enough to

accommodate at least two experimental plots for each experiment item. The size of an experimental plot will be 130m x 130m (1.69ha) in which an experimental compartment of 100m x 100m (1ha) will be introduced.

(4) Details of Experimental Forests

a) Dry Dipterocarp Forest

- . Purpose of Experiment: to study forest regeneration and growth after the introduction of forest fire protection treatment.
- . Types of Plots: treated plots and comparison (untreated) plot with the following combinations.

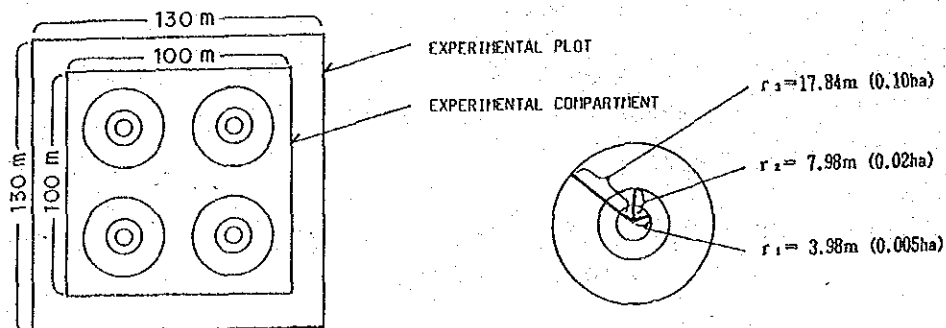
Treatment Conditions of Experimental Compartments

	Enrichment planting		Weeding Method	
	Yes	No	Full	Spot
Forest Fire Prevention Compartment				
Ordinary Compartment Inside Firebreaks	o			o
Ordinary Compartment Inside Firebreaks		o	o	
Compartment With Firebreaks and Preburning line around the Area		o	o	
Compartment with Firebreaks and Preburning all of the Area		o	o	
Compartment Damaged by Forest Fire	o			o
Compartment Damaged by Forest Fire		o	o	

Full Weeding: Full weeding of a small area will be conducted at naturally regenerated places.

Spot Weeding: Spot weeding will be conducted at replanted places.

- Size of Experimentation Forest: (6 treated plots + 1 comparison plot) x 1.69ha x 2 = 23.66ha.
- Establishment of Experimental Compartments: an experimental compartment of 1ha will be introduced in a treated plot of 1.69ha. In addition, inspection points will be determined as shown below for the collection of useful data.



b) Mixed Deciduous Forest

- Purpose of Experiment: to study the impact of tending work on natural forest regeneration and growth after selective felling.
- Types of Plots: there will be 12 plot types with the following combinations (2 x 2 x 3 = 12), of which one will be a comparison plot.

	Enrichment planting		Weeding Method		
	Yes	No	Full	Spot	No Weeding
Tending Cutting of Natural Forest Conducted	o	o	o	o	o
Tending Cutting of Natural Forest Not Conducted	o	o	o	o	o