⑤   Gleysols (G)

This is a type of soil is distributed in the lowlands, depressions and along dales. It indicated hydromorphic properties due to the influence of stagnant waters ascribable to poor drainage, high ground water level, or immense surface water due to large discharges during the rainy season.

At places affected by stagnant water and ground water, clayey soils containing iron and manganese mottles and concretions can be observed near the top soil. At present, many of the places have been turned into so-called swamps where hygrophytic herbs grow thick.

At places which are affected by surface water during the rainy season, the soils are close to sandy loam as fine clay particles run off with water and a large amount of lime accumulations and concretions are seen contained even in the topsoil.

Gleysols is unsuitable for forestry and is mainly utilized for paddy field and for growing bananas and palm trees.

4.6 Survey on the Forest Work

(1) Timber production

In 1986, the Ban Pong Regional Forest Office which has jurisdiction over the survey area granted concessions to 7 planning areas allowing the operation of the logging at 7 sites covering an area of about 17,880 ha in the Kanchanaburi provinces.

Actually however, 44,691 trees amounting to a cut volume of 156,510 m³ were felled in 5 planning areas. About the same volume of yearly production is considered to be scheduled for the future in this area.

(Refer to Table 4-20)

(2) Reforestation project

①   Activity of reforestation

There is no reforestation place in the model area. Reforestation projects accomplished in Amphoe Thong Pha Phum and Amphoe Sai Yok outside the model area were investigated by the form of execution as shown in Table 4-21. According to this table, reforestation seems to have been implemented under three different systems, of which the ratio of compulsory planted area accompanying felling under the concession is characteristically high at 67.6%.

Table 4 −20　Current State of Timber Production in 1986, the Ban Pong Regional Forest Office

Amphoe	Planning Area No.	Acreage of Planning Area (km²)	Logging Block No.	No. of Operation area	Acreage of operation (km²)	No. of permitted tree	Logging quantity			Remarks
							No. of tree	No. of log	Volume (m³)	
Sai Yok	No. 1	1,782.0	7	19	58.0	22,512	18,487	23,613	89,462.75	War Veterans Organization
Thong Pha Phum	No. 2	2,424.0	10	30	30.0	30	18,115	4,000	23,693.80	Forest Industry Organization (FIO)
Si Sawat	No. 3	867.3	9	25	20.2	1,400	1,341	1,798	5,172.41	
Sangkhla Buri Thong Pha Phum	No. 4	597.4	9	25	13.2	5,200	—	—	—	Kanchanaburi Forest Co. LTD.
Si Sawat	No. 5	1,312.0	6	16	19.0	7,200	4,366	5,394	17,864.69	
Bo Phloi Si Sawat	No. 6	455.9	10	28	10.1	1,738	—	—	—	
Si Sawat Ratcha Buri Suen Phung	No. 7	2,566.0	—	—	—	—	—	—	—	No utilization
Sangkhla Buri	No. 9	1,080.5	5	15	28.3	5,317	2,382	4,240	20,316.00	Kanchanaburi Forest Co. LTD.
Bo Phloi	No.10	1,116.0	—	—	—	—	—	—	—	Stoppage to use by the Army Thei Paper Manufacturing Co. LTD.
Total			7	7	178.8	43,397	44,691	39,045	156,509.65	

(Source) Data of the Ban Pong Regional Forest Office

Table 4—21 Actual Reforestation in 1986 by the Form of Execution

Execution form	Amphoe Thong Pha Phum			Amphoe Sai Yok			Total			Rate (%)
	Planting	Tending	Area	Planting	Tending	Area	Planting	Tending	Area	
(RED)										
Watershed management	600	1,150	5,050	—	—	—	600	4,450	5,050	9.7
Silviculture Div.	600	3,517	5,067	300	2,700	6,800	900	6,217	11,867	22.7
Sub-total	1,200	7,967	10,117	300	2,700	6,800	1,500	10,667	16.917	32.4
(Concessions)										
Kanchananburi Forest Co. Ltd.	1,729	4,251	13,127	3,000	3,934	13,888	5,729	8,185	27,015	
Thong Pha Phum Forest Industry Organization (FIO)	949	1,048	8,267	—	—	—	949	1,048	8,267	
Sub-total	3,678	5,299	21,394	3,000	3,934	13,888	6,678	9,233	35,282	67.6
Total	4,878	13,266	31,511	3,300	6,634	20,688	8,178	19,900	52,199	100.0

(Note) Surveyed by interview.

Unit in rai. Silviculture refers to the operation of tending two to six year old planted forests.

② Growth conditions of planted trees

In order to acquire a grasp of the growth conditions of the planted teak trees, a growth survey was conducted by the sample plot method, selecting 9 planted areas in Thong Pha Phum District and 5 planted areas in Sai Yok District as described below.

a. Survey method

o Each sample plot is 0.08 ha in area and rectangular in shape, being 40m x 20m, and set up at a place that indicated average growth conditions typical of each applicable planted area.

o The following items were measured on all the trees planted within the sample plots.

Number of trees

Spacing

Year planted

Total tree height (T.H.) ....

    in units of 1cm on trees less than 1m high, 10 cm on trees between 1.1 m and 2 m high, and 50 cm on trees 2.1 m or higher.

Girth breast height (G.B.H.) ...

    in units of 1cm. Basal girth was measured on trees less than 1.3m high.

Table 4—22 Results of the Growth Survey of the Teak Plantation

Plot No.	Location	Plot size (40×20 cm) (ha)	Spacing	Species	Age (Planted Year)	Number of trees per plot	Number of trees per ha.	G.B.H. (cm) Min.	G.B.H. (cm) Max.	G.B.H. (cm) Mean	T.H. (m) Min.	T.H. (m) Max.	T.H. (m) Mean	Soil type
1	Thong Pha Phum Forest Village(RFD)	0.08	4 × 4	Teak	6 (1981)	44	550	17	70	45	4.0	14.5	11.1	Bv
2	"	0.08	4 × 4	Teak	1 (1986)	38	475	(1)	(12)	(6)	0.1	1.3	0.7	Be
3	"	0.08	4 × 4	Teak	7 (1980)	61	763	5	39	24	2.0	7.5	5.5	Bg
4	"	0.08	4 × 4	Teak	4 (1983)	44	550	9	54	41	1.3	8.0	6.6	Be
5	"	0.08	4 × 4	Teak	5 (1982)	38	475	15	60	34	4.0	8.5	6.4	Be
6	"	0.08	4 × 4	Teak	5 (1982)	46	575	17	49	38	4.5	10.0	8.0	Be
7	"	0.08	4 × 4	Teak	4 (1983)	39	488	8	32	23	2.0	7.0	5.3	Be
8	"	0.08	4 × 4	Teak	3 (1984)	48	600	1	29	16	0.6	6.0	4.3	Lc
9	"	0.08	4 × 4	Teak	2 (1985)	28	350	(2)	(16)	(7)	0.3	4.0	2.2	Lc
10	Sai Yok National Park	0.08	3 × 3	Teak	33 (1954)	21	263	83	159	114	22.0	31.0	26.7	Be
11	"	0.08	4 × 4	Teak	7 (1980)	36	450	9	85	48	7.0	17.0	14.0	Be
12	"	0.08	4 × 4	Teak	12 (1975)	40	500	47	89	68	14.0	21.0	18.1	Be
13	"	0.08	2 × 4	Teak	10 (1977)	41	513	10	75	53	3.0	19.0	14.4	Gp
14	"	0.08	2 × 2	Teak	30 (1957)	27	338	71	179	97	17.0	22.0	20.6	Gp
15	Thong Pha Phum FIO	0.04	4 × 4	Melia azedarach	6 (1981)	23	575	22	68	45	6.5	17.5	14.8	
16	"	0.04	4 × 4	Eucalyptus tereticornis	6 (1981)	20	500	17	60	45	11.0	21.0	16.8	
17	"	0.04	4 × 4	Eucalyptus tereticornis	4 (1983)	19	475	22	78	53	12.0	24.0	18.6	
18	"	0.04	4 × 4	Melia azedarach	8 (1979)	20	500	53	81	62	18.0	23.0	20.5	
19	"	0.04	1 × 1.5	Acacia sp.	6 (1981)	78	1,950	10	49	29	6.0	19.0	13.9	

(Note) ( ) : Basal girth

b. Survey results

The results of this survey are outline below and also summarized in Table 4-22.

O The spacing was 3m x 3m at one location, 2m x 2m at one location, 4m x 2m at one location and 4m x 4m at the remaining 11 locations.

O When compared with the height curve of the site class drew from the yield table for teak prepared as research data by Kasetsart University, the tree heights of the planted trees ranged between site indexes 15 and 30. (Fig. 4-13)

As above, teak is considered a fairly promising species for planting in the model area judging from the survey results in the areas already planted.
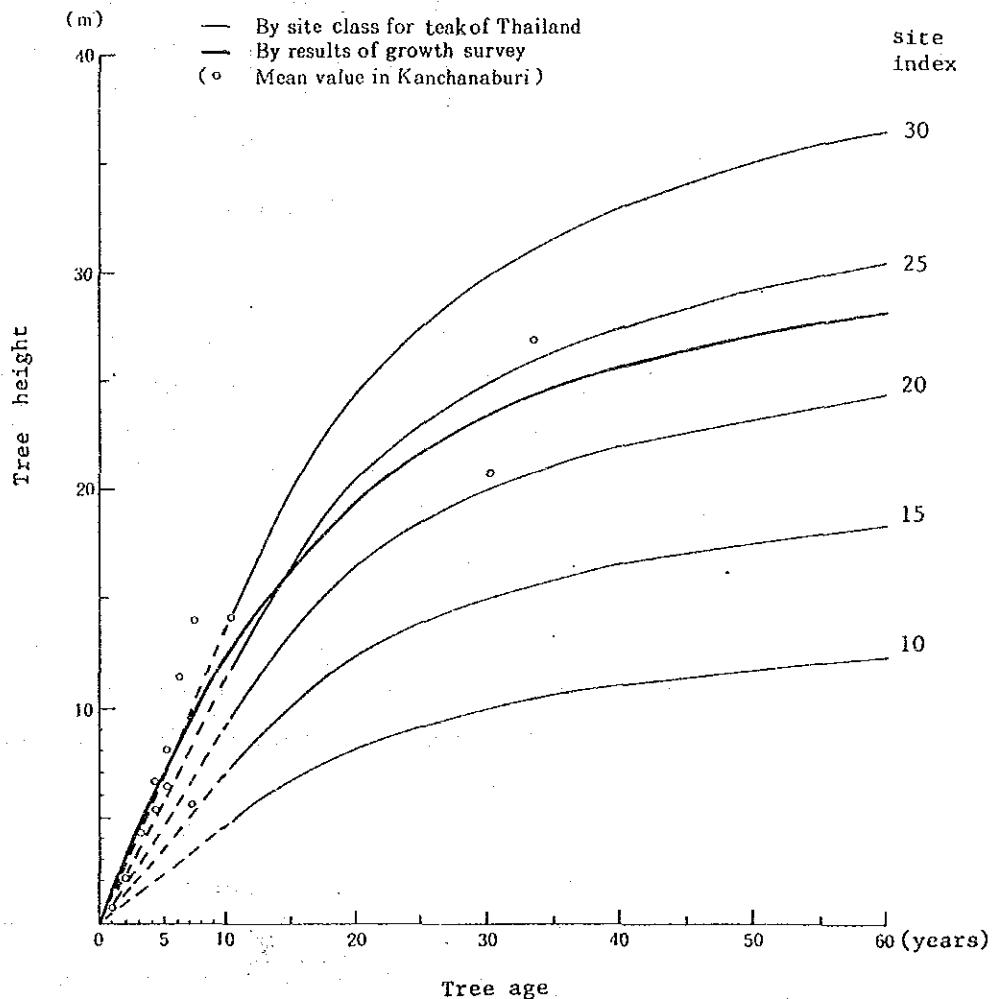
Fig. 4-13 Tree Height Curve of the Teak Plantation

(Note) Derived from research data by Kasetsart University

(3) Work at national parks

① Current status of forest for recreational area

Thailand has 7 types of forest reserve, recreational forest, including national parks. There are 50 national parks (26,053.80 km²), 57 forest parks (1,501.12 km²), 27 wildlife sanctuaries (20,362.48 km²), 37 prohibited hunting areas (2,998.47 km²), 2 wildlife parks (24.55 km²), 5 botanical gardens (10.00 km²) and 42 tree gardens (31.27 km²), totalling 220 places and 50,981.69 km².

In view of promoting forest conservation, the RFD has been actively engaged in the expansin of national parks and forest parks, resulting in a rapid increase of the number of designated areas as shown in Table 4 -23.

Table 4-23 Acreage of National Park and Forest Park

Division \ Year		1979	1985	Increase
National Park	Number	16	50	313%
	Acreage	9,329.15km²	26,053.80km²	279%
Forest Park	Number	32	57	178%
	Acreage	354.29km²	1,501.12km²	424%

(Source) Forestry Statistics of Thailand 1985. RFD

② National park management plans

The national park are managed by dividing zones of 6 types indicating the different characteristics of the area. Classification of the zones is as shown in Table 4-24. On the 50 officially designated national parks throughout the country, only a few have established management plans, including the Tarutao National Park, Khao Samro National Park and Ramkhamhaeng National Park.

③ Utilization of national parks.

According to the 1985 statistics, national parks had some 4.05 million visitors, approximately 7.7% of Thailand's total population of 52.73 million.

As shown below, the most popular national parks for visitors are located within easy travelling distance of Bangkok.

1	Erawan National Prak		466,241	Persons/Year
2	Khao Yai	〃	461,528	〃
3	Doi Suthep-pui	〃	353,073	〃
4	Nam Tok Prew	〃	313,554	〃
5	Doi Inthanon	〃	295,860	〃
6	Khao Laemya	〃	166,864	〃
7	Khao Chamao-Khao Wong	〃	164,217	〃
8	Sai Yok	〃	157,164	〃
9	Khlong Lan	〃	157,077	〃

(Data)　Statement for Management (National Park in Thailand).
　　　　1985　RFD

Table 4-24 Classification of Zones for National Park

Symbol	Name	Designated contents
IUZ	Intensive Use Zone	The zone in which buildings for the lodging of visitors and staff are located.
ORZ	Outdoor Recreation Zone	Area larger than IUZ for sightseeing and rest. The zone calls for particular care lest it be devastated by trespassers.
PZ	Primitive Zone	The zone shall be retained in its natural state as botanical resources are abundant. The zone also serves as a source of agricultural water to irrigate the plains.
SNRZ	Strict Nature Reserve Zone	The most important resource of the national park where abundant plant societies exist, including easily decayable, beautiful and rare plants. The zone also occupies an important position as a water source.
SUZ	Special Use Zone	The zone in which various activities had been carried out even before the area was designated as a national park, and where such activities if their continuation were approved, would conform to the purpose of administering and operating the national park.
RZ	Recovery Zone	Although nature has been savaged, there is either some forests left or other environmental conditions are such that nature can be restored and where recovery of nature is necessary.

(Source) Statement for Management (National Park in Thailand). 1985 RFD.

④　National Park in the model area

The southern half of the model area belongs to the territory of the Srinagarind National Park. Traffic facilities for access to the Srinagarind National Park are extremely poor compared with the Erawan National Park and Sai Yok National Park. For instance, there is no paved national highway that goes as far as the park. The number of visitors to the park, therefore, is not many, being 1/15 that of the Erawan National Park and 1/5 that of the Sai Yok National Park. However, since the area was designated as a national park relatively recently and plans for its improvement are now under way while survey work for the construction of a national highway is also in progress, increased utilization of the park is anticipated in the future.

The duties and responsibilities of the administration office of the park which has direct jurisdiction over the model area mainly consists of maintenance and repair work, as shown in Table 4-25.

Table 4-25 Srinagarind National Park Office

```
1. National park office
   o   Center
           5 staff, 50 workers
   o   Stations
           No.1    5 staff
           No.2    6 staff
2. Number of visitors
   o   Annual number of tourists: about 25,000 - 30,000
               (almost all of them from  Bangkok)

3. Work of office
   o   Provision of services to the tourists
   o   Execution of survey on forests
   o   Forest protection
4. Facilities (for accommodation)
   o   Bungalows         4 (each accommodates 15 guests)
   o   Floating houses   5 (each accommodates 10 guests)
       *   Whatever planned were completed five years ago.
```

⑤　Administration policy and administration plan for the national park

Besides the National Park Law, the RFD's National Park Department provides the park offices with guidance on park administration based on the following way of thinking.

   o   Although squatters living within parks are tolerated now, the department wishes to move them if any similar settlement can be found.
   o   Designated boundaries of parks will not be changed.
   o   Planting of only existing tree species will be permitted within the parks. The planting of teak which is not indigenous to this area will not be permitted as a rule.

(4) Countermeasures against forest fire

① Existing conditions in the survey area

The Forest Fire Control Department of the Kanchanaburi Provincial Government has set up preventive fire fighting centers at the four locations of Tha Thong Mon, Si Sawat, Sai Yok, and Thong Pha Phum, and provides each of them with a lookout tower, fire fighting and communications equipments, and two patrol men, etc.

② Forest fire incidence

The forest fire incidence in the province of Kanchanaburi in 1986 was as shown in Table 4-26, and the same tendency is expected to reoccur every year.

③ Forest fire countermeasures

As preventive measures against forest fire, education, advertisement, publicity, patrolling, etc. are carried out relatively actively.

It is understandable that even if fire lines and fire belts were provided, their maintenance and management would not be easy in this area where the mean annual temperature is high and trees and herbs grow quickly. However, it is considered necessary to set up fire break tree belts and the like in areas where the risk of fire is high.

Table 4—26　Forest Fire Incidence in Kanchanaburi Province

1.Forest Fire Incidence of Each Month in Kanchanaburi Province　　　　　　Year 1986

Center / Month	Si Sawat Frequency	Si Sawat Area (rais)	Sai Yok Frequency	Sai Yok Area (rais)	Tha Thong Mon Frequency	Tha Thong Mon Area (rais)	Thong Pha Phum Frequency	Thong Pha Phum Area (rais)	Total Frequency	Total Area (rais)
Dec.	—	—	—	—	—	—	—	—	—	—
Jan.	10	163	6	160	8	118	2	21	26	462
Feb.	42	504	32	468	39	468	21	252	134	1,692
Mar.	34	426	24	265	32	407	18	201	108	1,299
Apr.	13	97	7	46	10	68	4	24	34	235
May.	4	30	3	14	3	22	2	10	12	76
Total	103	1,220	72	953	92	1,083	47	508	314	3,764

2.Forest Fire Incidence by Causes in Kanchanaburi Province

Center / Causes	Si Sawat Frequency	Si Sawat %	Sai Yok Frequency	Sai Yok %	Tha Thong Mon Frequency	Tha Thong Mon %	Thong Pha Phum Frequency	Thong Pha Phum %	Total Frequency	Total %
Burnt field	26	25.24	22	30.56	23	25.00	14	29.78	85	27.07
Camping	21	20.39	14	19.44	20	21.74	8	17.02	63	20.06
Felling man	18	17.48	13	18.06	16	17.39	6	12.77	53	16.88
Livestock farming	11	10.68	7	9.72	10	10.87	5	10.64	33	10.51
Forest recreation	11	10.68	6	8.33	9	9.78	5	10.64	31	9.87
Hunting	9	8.74	6	8.33	8	8.70	6	12.77	29	9.24
Officers' carelessness	2	1.94	2	2.78	11	1.09	3	6.38	8	2.55
Fire/Burn	3	2.91	—	—	2	2.17	—	—	5	1.59
Unknown	2	1.94	2	2.78	3	3.26	—	—	7	2.23
Total	103	100.00	72	100.00	92	100.00	47	100.00	314	100.00

(Source) Forest　Fire Control (Kanchanaburi Province). 1986 RFD

5.0 SITE ANALYSIS AND LAND USE CLASSIFICATION

5.1 Analysis of the Basic Factors

(1) The following six factors of altitude, aspect of slope, gradient microtopography and valley density as analysing factors were metered or measured on a mesh of 2 cm x 2 cm (24 ha) each which were set up on the 1 : 10,000 topographical map. Categorical classification of each factor is as shown Table 5—1.

○ Altitude

The altitude in the center of each mesh was metered at an interval of 100 m.

○ Aspect of the slope

The aspect of the longest slope in each mesh was measured in terms of nine azimuthes

○ Gradient

The gradient was measured in terms of the number of contour lines inside the inscribed circle of each mesh.

○ Microtopography

Local microtopography within each mesh was measured.

○ Valley density

The number of rivers and streams (as determined on the 1 : 10,000 contour map) in each mesh was counted.

(2) Other basic factors

According to the existing data and data collected on the field, each mesh was classified by each of the following factors. Categorical classification of each factor is as shown Table 5—1.

○ Climate

The "Climatic Regions of Thailand" was used, according to which the survey area belongs to the climatic zone of "Mountainous with a cool dry season in valleys " (B5) within a "Tropical monsoon climate with a long rainy season".

Table 5-1 Categorical Classification of Each Factor

Item	Topographical analysis									
	Altitude		Aspect of the slope		Gradient		Microtopography		Valley density	
	Code No.	Category (m)	Code No.	Category	Code No.	Category (°)	Code No.	Category	Code No.	Category (Number of rivers & streams)
Classification	1	— 100	1	N	1	— 5	1	Mountain ridge, Plateau (Gradient 1)	1	0
	2	101— 200	2	NE	2	6— 8	2	Mountain side (convex surface)	2	1— 3
	3	201— 300	3	E	3	9—13	3	Mountain side (concave surface)	3	3— 9
	4	301— 400	4	SE	4	14—18	4	Mountain side (except 1 & 2)	4	10—19
	5	401— 500	5	S	5	19—23	5	Mountain foot (Gradient 1)	5	20—
	6	501— 600	6	SW	6	24—30	6	Steep cliff (Gradient 8, 9)		
	7	601— 700	7	V	7	31—40				
	8	701— 800	8	NW	8	41—45				
	9	801— 900	9	none (Gradient 1)	9	46—				
	10	901—								

Item	Basic Factors					
	Geological Structure		Soil Type		Forest Type	
	Code No.	Category	Code No.	Category	Code No.	Category
Classification	1	Quaternary, Tertiary q-ng	1	Eutric Nitosols Ne	1	Tropical evergreen forests TE
	2	Jurassic, Triassic j-t	2	Eutric Cambisols Be-c	2	Mixed deciduous forests MD
	3	Permian P (sh,ss,ls) P2-1 (ls)	3	Eutric Cambisols Be-r Vertic Luvisols Lv	3	Deciduous diptero- carp forests DD
	4	Carboniferous h	4	Lithosols I		
	5	Carboniferous, Devonian h-s	5	Rendzinas E		
	6	Devonian, Silurian d-s				
	7	Ordovician o (ls,sh) o′ sh(sh) o′ l (ls)				

o Geological structure

Sheet No.7, "Thong Pha Phum" of the "Geological Map of Northern Thailand, 1 : 250,000" was used as the geological map.

o Major class of terrain

Macrotopography was classified into mountainous terrains, hilly terrains and flat terrains.

o Forest type

Forest type was classified into tropical ever green forests, mixed deciduous forests and deciduous dipterocarp forests.

o Soil type

The soil type according to the results of the soil survey conducted on the spot in survey area was used.

5.2 Land Type Classification

For proper administration and management of the national forest, a land use plan for forest land is necessary. The land use classification which is necessary as the basic information for formulating such a plan ought to be based, not on existing land use, but on the natural conditions of the site. The first step in land type classification is therefore to roughly group the land subject to land use capability classification and land use classification by their common natural properties. The grouping of land in the current survey was carried out by respectively overlaying the results of the topographical analysis and applicable basic factors. The factors taken up for grouping were climate, geological structure, macrotopography, forest type and soil type. However, each of the climate and geological structures of the entire model area were assumed to belong to the same category in view of the fact that the climate of the entire model area belongs to Category B5 (Mountainous with a cool dry season in the valleys) and its geological structure, comprises of Mesozoic to Paleozoic sedimentary rock consisting of ls (limestone), ss (sandstone) and sh (shale), although some portions are not yet determined the formation erea.

As a result, the three factors, namely, major class of terrain classified into M, H and F, forest type classified into T_E , M_D and D_D,, and soil type classified into Ne, Be, Lv, I and E were used for the grouping, from which the following 18 combinations emerged.

Table 5—2 Combination of 3 factors

Major class of terrain	Forest type	Ne	Be-c	Lv · Be-r	E · I
F	T_E	○	—	—	—
	M_D	○	○	○	○
	D_D	—	—	○	○
H	T_E	—	—	—	—
	M_D	○	○	○	○
	D_D	—	—	○	○
M	T_E	—	—	○	○
	M_D	—	○	○	○
	D_D	—	—	—	—

(○ : existence , — : non existence)

Upon further study from the viewpoint of soil productivity, the area was classified into the following eight groups. However, the mountainous topography (M) which is neither fit for farming or live- stock raising nor a production forest was deemed as one group as the area of protection forest. (Refer to Table 5—3 and Fig. 5—1)

Table 5—3 Group of Land Type Classification

Group No.	Types belonging to each group
I	FT_E Ne
II	FM_D Ne, FM_D Be-c
III	FM_D Lv · Be-c
IV	HM_D Ne, HM_D Be-c
V	HM_D Lv · Be-r
VI	FD_D Lv · Be-r, HD_D Lv · Be-r
VII	FM_D E · I, HM_D E · I, FD_D E · I, HD_D E · I
VIII	MT_E (Lv · Be-r, E · I), MM_D (Be-c, Lv · Be-r, E · I)
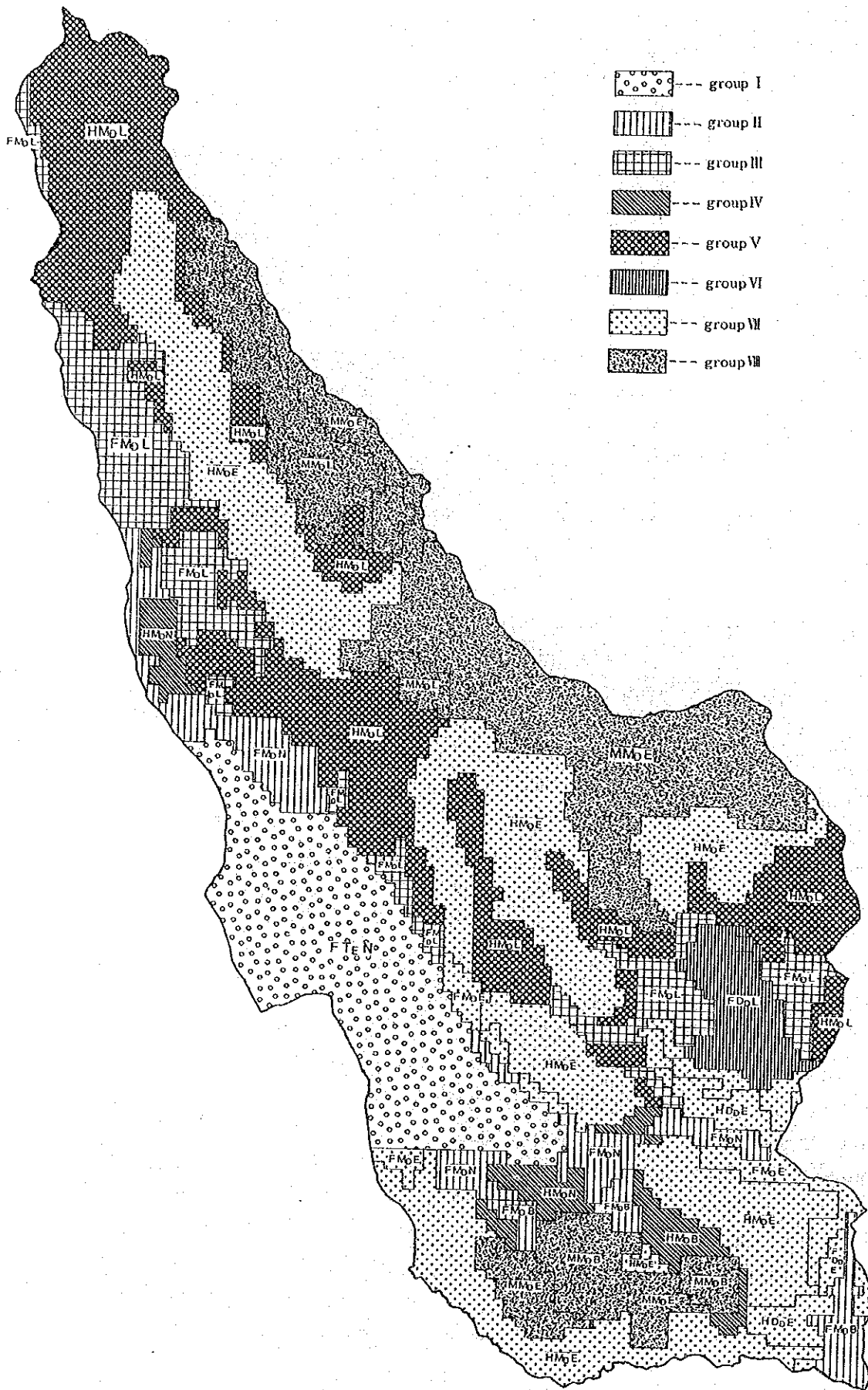
Fig. 5-1 Land Type Classification

5.3 Land Use Capability Classification

Land use capability classification means to further classify the land which was grouped by the type of natural condition, into grades according to its potential use, whether it is for agriculture, forestry or livestock raising. Seven groups excluding Group Ⅷ (mountainous topography) in the model area were classified in terms of the natural conditions of each site on the basis of comprehensive evaluation by using the factors restricting the productivity of agriculture, forestry, and livestock raising , respectively.

(1) Land use capability classification for agriculture
  ① Suitability for arability
  The relative ease of cultivation and the preventability of erosion were evaluated in relation to the gradient which is a limiting factor, and suitability of each site in terms of arability which combines both of the foregoing was determined.

Table 5--4 Suitability for Arability

Gradient	Relative ease of Cultivation	Preventability of erosion	Arability
∼ 5°	5	5(5)	5(5)
6°∼ 8°	4	4(4)	4(4)
9°∼13°	3	3(2)	3(2)
14°∼18°	2	2(1)	2(1)
19°∼23°	1	1(0)	1(0)
24°∼	0	0(0)	0(0)

( ) : in case of soil type Nc

  ② Suitability for growability
  The limitations on the growth range of roots and the maintain ability of soil fertility were evaluated in relation to the soil which is a limiting factor, and suitability of each site in terms of grow ability which combines both of the foregoing was determined.

Table 5—5 Suitability for Growability

Soil Type	The growth range of roots	Maintainability of soil fertility	Growability
Ne	4	3	4
Be-c	3	4	3
Lv · Be-r	2	2	2
E · I	1	2	1

③ Land use capability classification for agriculture

The suitability of each site as a result of an interaction between arability and growability was evaluated, based on which the model area was classified into four classes of farmland, namely, Grades 1 through 3 and unsuitable place. (Refer to Fig. 5—2)

Table 5—6   Land Use Capability Classification for Agriculture

Gradient	Soil type			
	Ne	Be-c	Lv · Be-r	E · I
～ 5°	1	1	2	3
6°～ 8°	1	2	3	3
9°～13°	3	2	3	3
14°～18°	3	3	3	×
19°～23°	×	3	×	×
24°～	×	×	×	×

(× — unsuitable place)

(2) Land use capability classification for forestry
① Suitability for silviculture

The relative ease of reforestation, tending and maintainability of soil fertility for silviculture were evaluated in relation to the gradient of each site which is a limiting factor. The suitability of each site for silviculture which combines both of the foregoing was also determined.
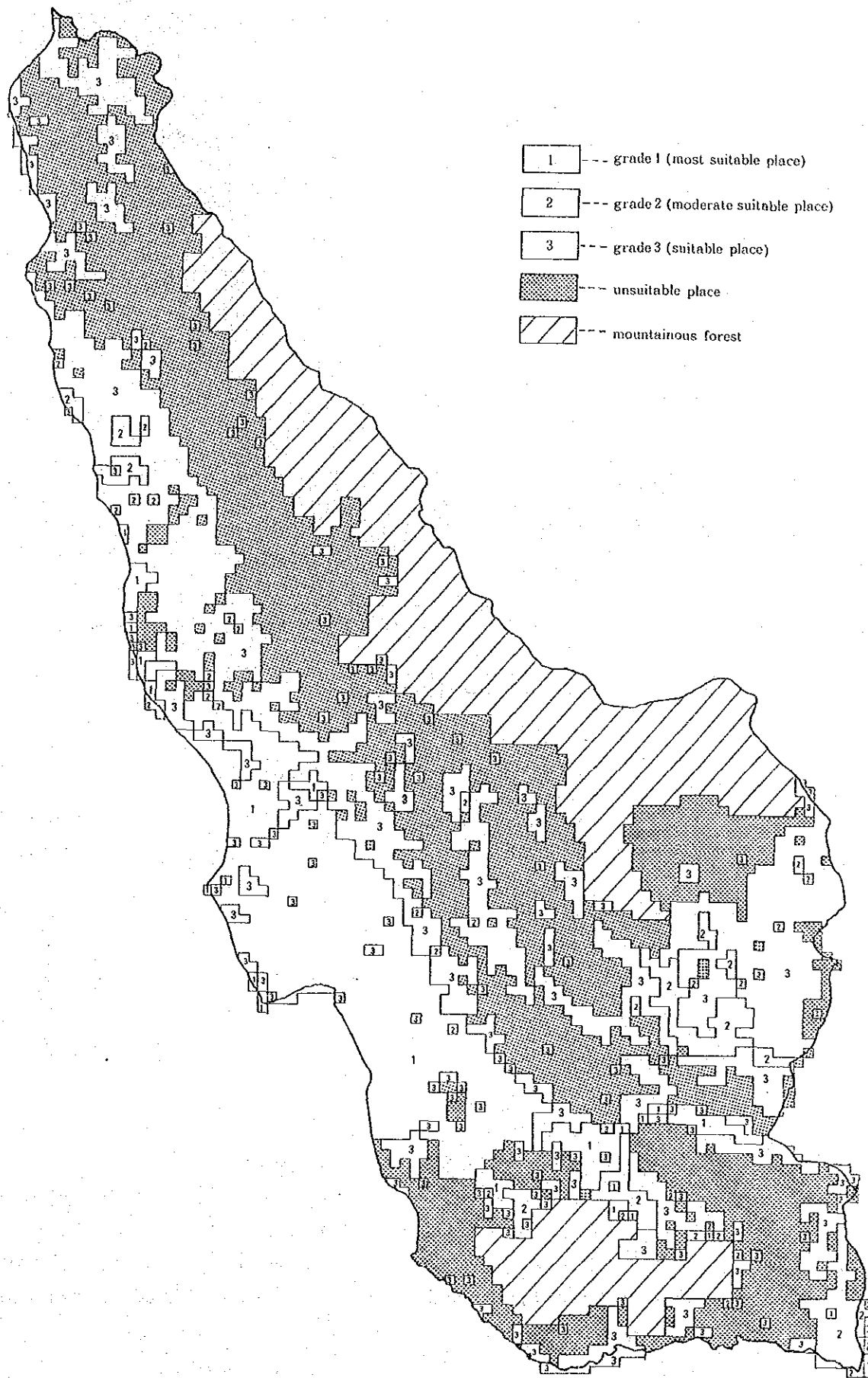
Fig. 5—2   Land Use Capability Classification
— for Agricultural Land —

Table 5—7 Suitability for Silviculture

Gradient	Relative ease of reforestation and tending	Maintainability of soil fertility	Suitability for Silviculture
~13°	4	4	4
14°~18°	3	3	3
19°~23°	2	2	2
24°~30°	1	1	1
31°~	0	0	0

②Suitability for growability

The limitations on the growth range of roots and the restrictions on the absorption of nutrients and water were evaluated in relation to the soil which is a limiting factor. The suitability of eachsite in terms of growability which combines both of the foregoing was also determined.

Table 5—8 Suitability for Growability

Soil type	Growth range of roots	Absorption of nutrients and water		Grow-ability
		Water permeability	Water holding capacity	
Ne	4	4	4	4
Be-c	3	2	3	3
Lv・Be-r	2	1	2	2
E・I	1	4	1	1

③ Land use capability classification for forestry

The suitability of each site as a forest land resulting from the interaction between the suitability for silviculture and growability was evaluated, based on which the model area was classified into the four classes of forest land, namely, Grades 1 through 3 and unsuitable place. (Refer to Fig. 5—3)

Table 5-9 Land Use Capability Classification for Forestry

Gradient	Soil type			
	Ne	Be-c	Lv · Be-r	E · I
~13°	1	1	2	3
14°~18°	1	2	2	3
19°~23°	2	2	3	×
24°~30°	2	3	×	×
31°~	×	×	×	×

(× — unsuitable place)

(3) Land use capability classification for livestock raising
  ① Suitability for maintainability
   The relative ease of maintenance work and the preventability oferosion for maintenance as a natural grass land were evaluated in relation to the gradient of each site which is a limiting factor. The suitability of each site in terms of maintainability which combines both of the foregoing was also dertermined.

Table 5-10 Suitability for Maintainability

Gradient	Relative ease of maintenance work	Preventability of erosion	Maintainability
~ 8°	4	4(4)	4(4)
9°~18°	3	3(2)	3(2)
19°~23°	2	2(1)	2(1)
24°~30°	1	1(0)	1(0)
31°~	0	0(0)	0(0)

( ) : in case of soil type Ne

  ② Suitability for growability
   The restrictions on the absorption of nutrients and water were evaluated in relation to the soil which is a limiting factor, and suitability of each site in terms of growability which combines both of the foregoing was determined.
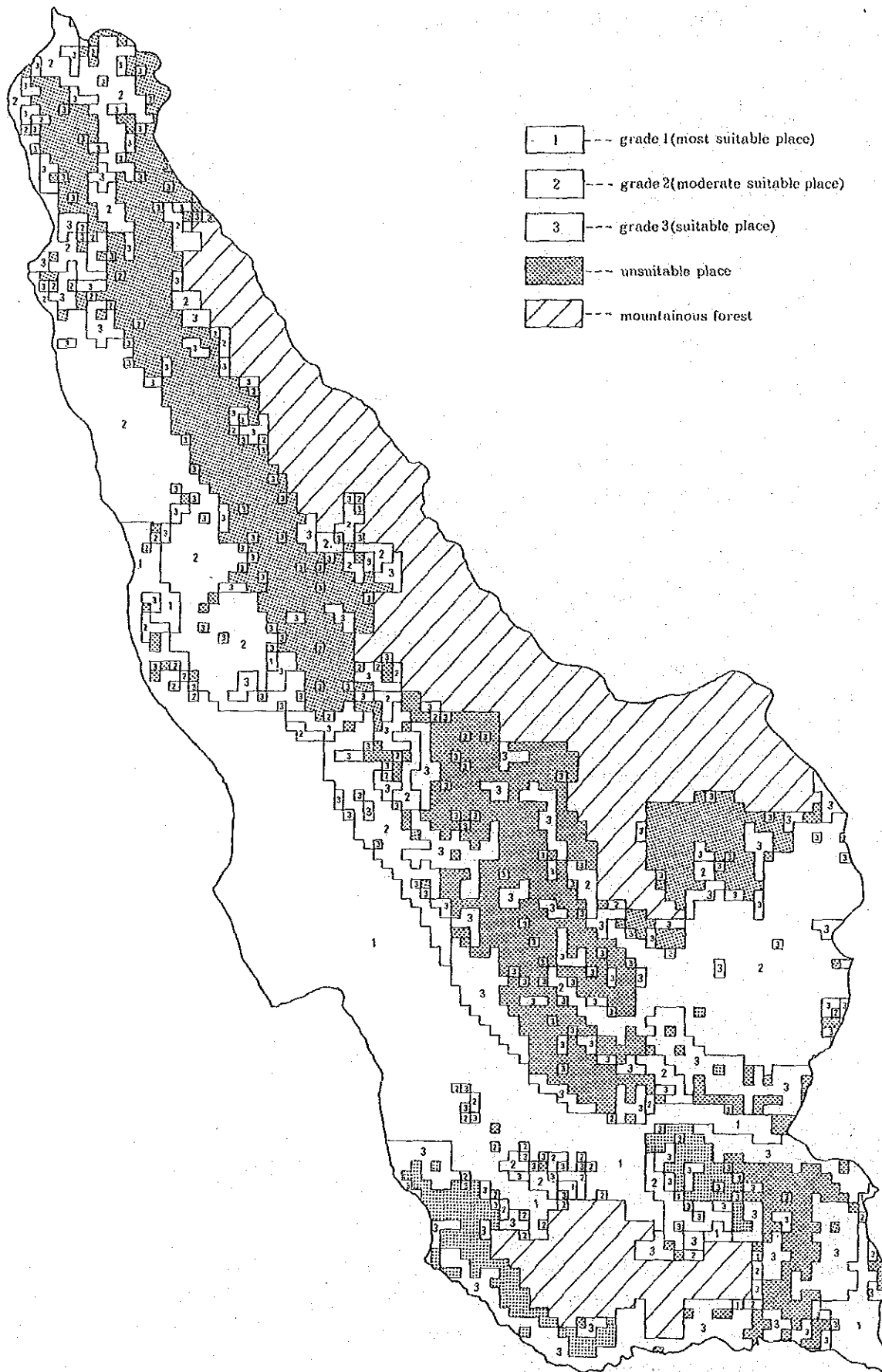
Fig. 5－3　　Land Use Capability Classification
— for Forestry Land —

—90—

Table 5-11 Suitability for Growability

Soil type	Growth range of roots	Absorption of nutrients and water		Grow-ability
		Water permeability	Water holding capacity	
Ne	4	4	4	4
Be-c	4	2	3	3
Lv · Be-r	3	1	2	2
E · I	2	4	1	1

③ Land use capability classification for livestock raising

The suitability of each site as a natural grass land resulting from an interaction between the maintainability and the growability was evaluated. It was based on which the model area and was classified into the four classes of grazing land, namely, Grades 1 through 3 and unsuitableplace. (Refer to Fig. 5-4)

Table 5-12　　Land Use Capability Classification for Livestock Raising

Gradient	Soil type			
	Ne	Be-c	Lv · Be-r	E · I
~ 8°	1	1	2	3
9 °~18°	2	2	2	3
19 °~23°	3	2	3	3
24 °~30°	×	3	3	×
31 °~	×	×	×	×

(× — unsuitable place)

Table 5–13 shows the judgement of land use capability for agriculture, forestry and livestock raising.

Table 5–13   Table of Judgement of Land Use Capability for Agriculture, Forestry and Livestock Raising

Soil type	Division	Gradient						
		~5°	6~8°	9~13°	14~18°	19~23°	24~30°	31°~
Ne	A	├──────1──┤		├─3───────┤		×	×	×
	F	├──────1───────┤				├─2─┤	├─3─┤	×
	L	├──────1──┤		├────────2─┤		├─3─┤	×	×
Be-c	A	├─1─┤	├─2───────┤		├─3───────┤		×	×
	F	├──────1────────┤			├─2───────┤		├─3─┤	×
	L	├──────1──┤		├──────────2─┤			├─3─┤	×
Lv. Be-r	A	├─2─┤	├──────3───────┤			×	×	×
	F	├──────2───────┤				├─3─┤	×	×
	L	├──────2───────┤				├─3───────┤		×
E·l	A	├──────3──────┤			×	×	×	×
	F	├──────3───────┤				×	×	×
	L	├──────3───────┤					×	×

(Note) Suitability for agriculture (A), forestry (F) and livestock raising (L)
   1 : Large 2 : Medium 3 : Small × : Unsuitable
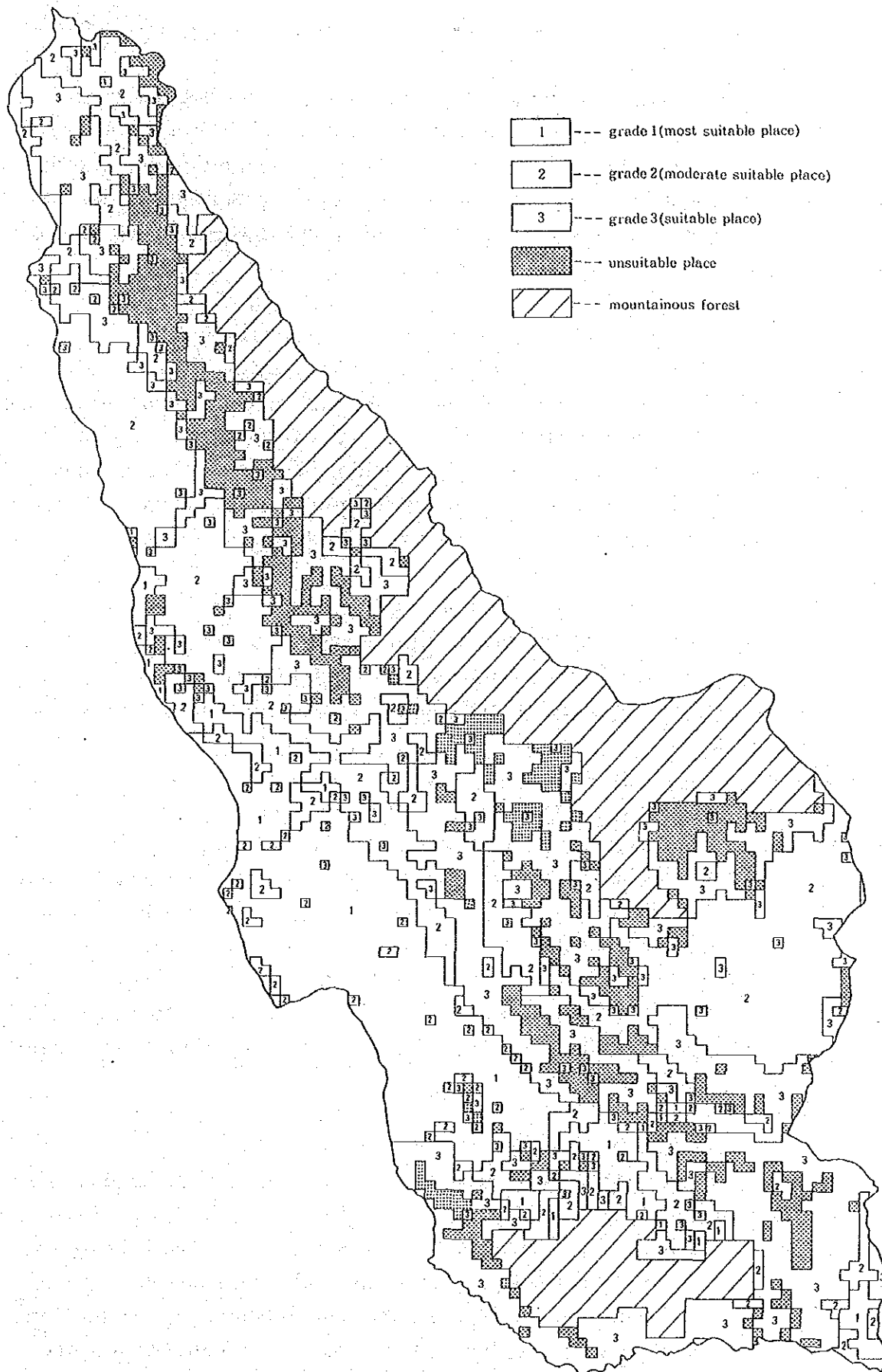
Fig. 5—4   Land Use Capability Classification
— for Livestock Raising Land —

5.4 Land Use Classification

Land classification was established on the basis of a land use priority rating in view of agricultural, forestry and livestock production purposes taking the social and economic conditions into consideration in order to further elaborate the suitability classes of the land based on the natural conditions of the site. The land use classification was then determined on the basis of this land classification.

(1) Priority rating based on the traffic conditions of the site

As already stated in 4.1 (3), the road connecting Erawan and Thong Pha Phum runs through the model area. The road is unpaved and has many damaged sections and is especially dangerous during the rainy season. Since the transportation conditions in the model area are considered to be uniform, there is no priority rating in the land use of the model area in terms of agriculture, forestry and livestock production.

(2) Priority rating based on damage liability

As no land in the model area is subject to soil erosion, collapse, landslide, flooding or inundation, etc., no priority is given to any part of the model area in terms of the agricultural, forestry or livestock production prospects.

(3) Priority rating based on public functions of forests

As Srinagarind Dam is located to the east of the model area, the model area has such important functions as water supply and the prevention of sediment runoff to the dam and these functions should be given priority over agriculture, forestry and livestock production. Accordingly, the slopes on both sides of the river flowing into the dam in Compartment 8 of the Khao Praleusri Bor Rae Working Area and Compartments, 10, 11 and 12 of the Srinagarind Working Area are reserved for these functions.

(4) Priority rating for land utilization

The areas classified as Group VIII on the basis of the land classification (M T_E L_V · B_e, M T_E I · E, M M_D L_V · B_e, M M_D I · E)showing mountainous topography in the model area are unsuitable for either agriculture or livestock production and their use as productive forests is also difficult. The use of these areas as mountain protection forests should be given priority over their use for agricultural, forestry and livestock production purposes and, therefore, these areas have been removed from the subjects for productive land utilization.

According to the Survey on Forest Villages and Tropical Farming, few farmers own cattle or water buffaloes which are entirelyused for farming purposes, showing thier very little interest in live stock production. As a result, the land use priority is given to agriculture and forestry in the present study.

If it becomes necessary to use land for livestock production, the gentle slope areas classified as Group VII (F M_D I $\cdot$ E, H M_D I $\cdot$ E, F D_D I $\cdot$ E, H D_D I $\cdot$ E) will be suitable sites. While the soil in the Group VII areas mostly consists of narrowly layered Rendzinas and Lithosols with many outcropping rocks and boulders, making them unsuitable for agricultural use, their use as pasture land is possibledue to the high degree of base saturation containing many weatherable minerals and organic matters. At present, however, the use of these areas for livestock production is not under consideration and, therefore, the preservation of the present forests is recommended rather than attempting to use them for agricultural or forestry purposes.

(5) Land classification

By overlapping the priority ratings of each mesh in terms of use for agricultural and forestry purposes, land classification based on combined priority ratings was established. The demarcation lines were decided by taking aerial photographs and topographical maps showingthe actual topography of the subject areas in consideration. As a result, 10 classifications, i.e. ①$A_1 \cdot F_1$, ②$A_2 \cdot F_1$, ③$A_2 \cdot F_2$, ④$A_3 \cdot F_1$, ⑤$A_3 \cdot F_2$, ⑥$A_3 \cdot F_3$, ⑦$A_0 \cdot F_1$, ⑧$A_0 \cdot F_2$, ⑨$A_0 \cdot F_3$, and ⑩$A_0 \cdot F_0$, were obtained and these were further classified into the following 5 types.

o Type I $\cdots$ Suitable for both agriculture and forestry ($A_1 \cdot F_1$, $A_2 \cdot F_1$)

o Type II$\cdots$ Most suitable for forestry rather than agriculture but usable for agriculture depending on the local conditions ($A_2 \cdot F_1$)

o Type III $\cdots$ More suitable for foresty rather than agriculture ($A_3 \cdot F_1$, $A_3 \cdot F_2$, $A_3 \cdot F_3$)

o Type IV $\cdots$ Only suitable for forestry ($A_0 \cdot F_1$, $A_0 \cdot F_2$, $A_0 \cdot F_3$)

o Type V ⋯ Unsuitable for either agriculture or forestry ($A_0 \cdot F_0$)

The final land classification was made by judging the suitability of each type for either agriculture or forestry.

The correspondence between the combined priority rating and the land classification is shown in Table 5—14.

Table 5 —14 Type of Suitability Classification for Agriculture and Forestry

Type	Classification combined both of suitabilities for agriculture and forestry			Land classification
I	Agriculture 1	Forestry 1	A_1F_1	A_1F_1
	〃 2	〃 2	A_2F_2	A_2F_2
II	〃 2	〃 1	A_2F_1	A_2F_1
III	〃 3	〃 1	A_3F_1	F_1
	〃 3	〃 2	A_3F_2	F_2
	〃 3	〃 3	A_3F_3	F_3
IV	〃 0	〃 1	A_0F_1	F_1
	〃 0	〃 2	A_0F_2	F_2
	〃 0	〃 3	A_0F_3	F_3
V	〃 0	〃 0	A_0F_0	NANF

Figure 5—5 shows the correspondence in Compartment 8 of the Srinagarind Working area. (Land Classification Map of the model area is as shown in Appendix Fig. —5.). The areas of each type of land classification area shown in Table 5—15.
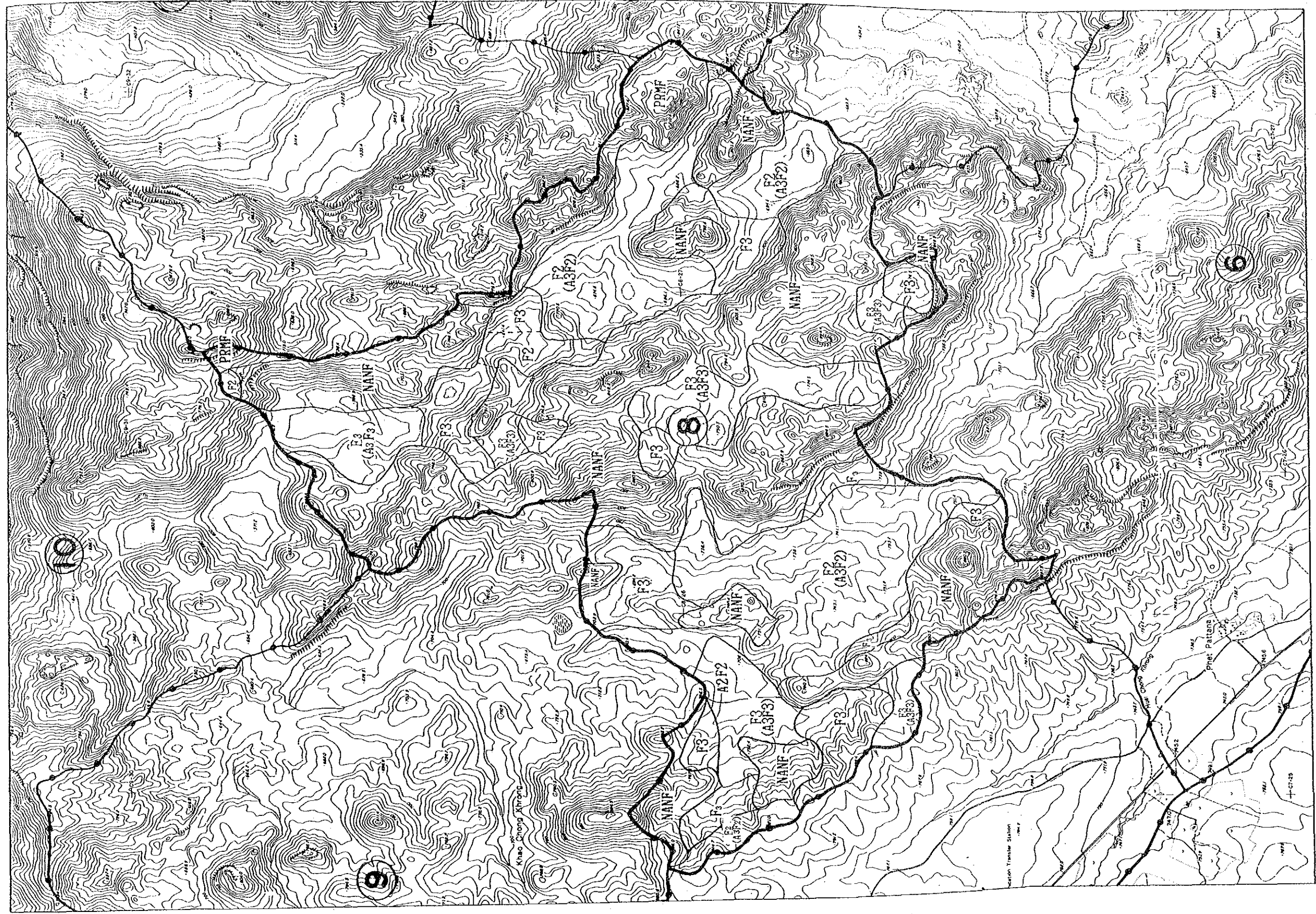
Fig. 5-5 Conditions of Land Classification and Classification Combined Both of Suitabilities for Agriculture and Forestry in Compartment No. 8 of Srinagarind Working Area

Table 5 —15   Acreage by Type of Suitability Classification

(Unit : ha)

Type	Classification combined both of suitabilities	Acreage			
		Khao Praleusri Bor Rae Working Area	Srinagarind Working Area	Sub-total	Total
I	Agriculture 1 Forestry 1 (A_1F_1)	952.01	1,807.54	2,759.55	3,483.73
	〃 2 〃 2 (A_2F_2)	174.86	549.32	724.18	
II	〃 2 〃 1 (A_2F_1)	0	294.99	294.99	294.99
III	〃 3 〃 1 (A_3F_1)	373.57	291.05	664.62	5,205.79
	〃 3 〃 2 (A_3F_2)	1,809.06	1,708.58	3,517.64	
	〃 3 〃 3 (A_3F_3)	57.50	966.03	1,023.53	
VI	〃 0 〃 1 (A_0F_1)	3.45	4.00	7.45	2,940.76
	〃 0 〃 2 (A_0F_2)	309.14	83.27	392.41	
	〃 0 〃 3 (A_0F_3)	966.95	1,573.95	2,540.90	
V	〃 0 〃 0 (A_0F_0)	2,328.38	3,095.77	5,424.15	5,424.15
Preserved mountainous forest		1,918.86	2,318.61	4,237.47	4,237.47
River		4.11	55.92	60.03	60.03
Total		8,897.89	12,749.03	21,646.92	21,646.92

(6) Land use classification

Based on the foregoing examination, the entire model area was divided into 7 land classifications; i.e. A_1 F_1, A_2 F_1, A_2 F_2, F_1,F_2, F_3 and NANF. As the A_1 • F_2, A_2 • F_1 and A_2 • F_2 areas are suitable for both agriculture and forestry and, in fact, consist of national forests,they should be integrated to classification F_1 which is suitable for foresty. However, their priority rating for agricultural use is also high and they are considered areas where agroforestry is feasible.

With regard to the F_1, F_2 and F_3 areas, although they consist of 2 types, i.e. Type III to which forestry is better suited and Type IV to which only forestry is possible, they are considered collectively as areas suitable for productive forests,

Those areas classified as NANF are unsuitable for either agriculture or forestry and will be kept as conservation areas without any work, including extraction. Some other areas are also designated as conservation areas for landslide and flood prevention. (Refer to Appendix Fig. — 6 Land Use Classification Map)

6.0 NATIONAL FOREST MANAGEMENT PLAN

6.1 Forest Land Use Plan

(1) Basic policy for plan preparation

The ratio of forest area in Thailand which accounted for 53.3% of the total national land in 1961 (273,629 km² out of 513,115 km²) declined to 29. 1% or 149,053 km2 in 1985 (refer to Table 6—1). In comparison, however, timber production has continued at a rate of 1.8 - 2.0 million m a year from 1981 (3.1 million m³ in 1979, 2.54 million m³ in 1980, 1.8 million m³ in 1981, 1.77 million m³ in 1982, 1.82 million m³ in 1983 and 2.03 million m³ in 1984) although the absolute volume has shown a declining tendency in accordance with the decrease of the forest area. And it is feared that sustained yield of timber in future will not be obtained. The preparation and implementation of a management plan is, therefore, urgently required to strictly control national forests and to effectively improve the various function of the forests.

The contents of the plan are to increase timber production by active reforestation efforts, to prevent the increase of encroachment in national reserve forests and to mobilize the farmers to promote the conservation of forests.

Table 6 — 1　Change of Forest Area and Timber Production

1. The Comparison of Forest Existing and Its Periodic Change Between 1961—1985

(Unit : km²)

Region ＼ Year	1961	1973	1976	1978	1982	1985
North	116,275	113,595	102,327	94,937	87,756	84,126
South	29,626*	18,435**	20,139	17,603	16,442	15,485
North-east	70,904*	50,671**	41,494	31,221	25,886	24,224
Central plain	35,661	23,970	27,826	20,426	18,516	17,228
East	21,163	15,036	12,631	11,037	8,000	7,990
Total	273,629	221,707	198,417	175,224	156,600	149,053
% to Whole Kingdom (513,115km²)	53.33	43.21	38.67	34.15	30.52	29.05

　※　In 1961 there was no aerial survey of the area.
　※※　In 1973 not including cloud coverd area.

2. Acreage of National Forest Reserves

(Unit : km²)

Region \ Year	1982	1983	1984	1985	1986
North	95,544	97,493	99,406	103,701	106,294
North-east	48,880	48,901	52,245	53,436	53,559
Central and east	31,429	31,383	35,394	34,840	34,865
South	23,831	24,205	25,484	25,742	27,444
Total	199,684	201,982	212,529	217,719	222,162

3. Production of Timber

(Unit : 1,000m³)

Year	Timber production	Import	Export	Wood domestic apparent consumption			
				Total	Lumber	Plywood, etc.	Fire wood and wood charcoal
1976	3,210.4						
1977	3,370.0						
1978	2,608.6						
1979	3,100.7						
1980	2,544.2						
1981	1,798.6	575.6	7.8	2,366.4	1,276.6	189.9	899.9
1982	1,769.4	488.5	1.5	2,256.4	801.7	256.8	1,197.9
1983	1,819.7	632.2	2.0	2,449.9	1,091.0	294.5	1,064.4
1984	2,031.7	584.0	6.7	2,609.0	1,111.3	242.4	1,255.3
1985	1,882.6	417.6	16.7	2,283.5	1,008.0	221.0	1,054.5
1986	2,014.7	356.9	25.2	2,346.4	1,070.9	244.3	1,031.2

(Source) Forestry Statistics of Thailand 1986. RFD

The following basic policy for the preparation of the Land Use Plan of national reserve forest has been determined to achieve both efficient and rational land use to meet the above requirements.

i) In principle, forest areas shall be excluded from agricultural land use.

ii) Reforestation efforts shall be introduced as soon as possible at such sites as farmland and bare land in forest areas.

iii) Due consideration shall be given to the protection of forests, including national parks and those required for the conservation of mountains and river basins.

iv) Those forests designated as reference forests in view of their importance in terms of ecology and those required for the preservation of genes shall be protected.

v) The boundaries of existing rights shall be clarified.

vi) The Forest Village Plan shall be promoted in addition to the promotion of the relocation of those farmers scattered in national reserve forests in order to form local communities of an appropriate size.

vii) Reforestation and the conservation of forests shall be promoted in forest areas by introducing agroforestry in the appropriate areas.

viii) Coordination with the existing plan of the Royal Forest Department (RFD) shall be promoted.

(2) Forest land use basic plan

① General status in the model area

Of the model area's total 21,647 ha, 592 ha (including farmland, grassland and bare land) is used for purposes other than forestry. 100 households (55 households in the Khao Praleusri Bor Rae Working Area and 45 households in Srinagarind Working Area) are located in the model area and the number of households has shown an increasing tendency in the last 3 years. Phu Toei village of the Khao Praleusri Bor Rae Working Area has a total of 71 households (including 5 STK), i.e. 52 households (including4 STK) in the model area and 19 households (including 1 STK) outside the model area on the other side of the road which forms the boundary of the model area, forming an independent community with the Government Health Center built by the Amphoe Thong Pha Phum and a school built by the community itself.

In regard to Logging Blocks 1—5 located in the model area, most of Logging Blocks 1 and 2 and all of Logging Block 3 are currently designated as national park areas.

Logging operation started in Logging Blocks 1 in 1962 and finished in Logging Blocks 5 in 1975. Of the 8,898 ha of productive forest covering part of Logging Blocks 2 and all of Logging Blocks 4 and 5, 8, 167 ha are actual forest consisting of 497 ha of tropical evergreen forest (T_E), 7,509 ha of mixed deciduous forest (M_D), 100 ha of secondary forest (S_F) and 61 ha of bamboo forest (B_F).

The stand volume of T_E and M_D in their total 8,006 ha of forest is 83 m^3 with 173 trees per ha (including 12 m^3 with 8 Depterocarpus trees and 4 m^3 with 7 other useful trees). Although M_D accounts for 7,509 ha or 94% of the above area, its stand volume of 47 m^3 with 106 trees per ha (including 2 m^3 with Depterocarpus trees and 4 m^3 with 7 other useful trees) is extremely poor for aproductive forest, necessitating the planning of a more productive forest by reforestation.

②Forest land use plans for the model area

i) Since the Srinagarind Working Area was designated as the Srinagarind National Park on December 23, 1981, this Working Area shall be designated as preserved area.

ii) Areas required for the conservation of mountains and river basins shall be designated as conservation areas.

iii) The Khao Praleusri Bor Rae Working Area shall be divided into a timber production area and an agroforestry area (consisting of those areas classified as $A_1 \cdot F_1$) where reforestation work and exclusive farming on partial sites will be conducted.

iv) The size of the agroforestry area shall be 911 ha with the $A_1 \cdot F_2$ and $A_2 \cdot F_2$ areas in Compartments 1—3 in the Khao Praleusri Bor Rae Working Area. Compartments 1, 2 and 3 have areas of 376 ha, 374 ha and 161 ha respectively.

v) A forestry area of 6,065 ha has been obtained by deducting 911 ha of agroforestry area, 1,918 ha of conservation area and 4ha of rivers from the total 8,898 ha of the Khao Praleusri Bor Rae Working Area in which only timber production from artificial and natural forests shall be conducted and where no land for farming or agroforestry will be allocated.

vi) The areas designated as NANF in the above forestry areas shall be designated as conservation areas where the present forests shall be maintained.

Table 6 — 2　Land Classification and Acreage in Each Working Area

(Unit : ha)

Land use Capability	Land classification	Khao Praleusri Bor Rae Working Area			Srinagarind Working Area	Total
		Agroforestry Area	Forestry Area	Sub-total	National Park	
A_1F_1	A_1F_1	691	261	952	1,808	2,760
	F_1		3	3		3
A_2F_1	A_2F_1				295	295
A_3F_1	F_1	201	172	373	291	664
A_2F_2	A_2F_2	10		10	443	453
	F_2		165	165	106	271
A_3F_2	F_2	6	1,803	1,809	1,708	3,517
A_3F_3	F_3		57	57	966	1,023
F_1	F_1		3	5	4	7
F_2	F_2		309	309	83	392
F_3	F_3	3	964	967	1,574	2,541
NANF			2,328	2,328	3,096	5,424
Mountainous Forest			1,918	1,918	2,319	4,237
River			4	4	56	60
Total		911	7,987	8,898	12,749	21,647

(3) Forest land type

The forest land in the model area is classified into the following forest land type based on the main purpose of use pursuant to the Forest Land Use Basic Plan described in (2) above.

Table 6-3   Forest Land Type and Acreage

(Unit: ha)

Forest land use classification	Forest land type	Purpose of utilization	Acreage		Remarks
Forestry Area	Artificial forest	Area for timber production by artificial forest works	* 1,614	6,065	
	Natural forest	Area for timber production by selective cutting method	* 1,206		
	Bamboo forest	Area for bamboo production by bamboo forest works	17		
	Reserved forest	Reserving area for forest works in future	900		
	Over-left area	Unsuitable area for forest works, etc.	2,328		
Agroforestry Area	Artificial forest	Area for timber production by artificial forest works	* 510	911	
	Communal forest	Area for fire wood production	30		
	Farming land	Area for cultivated land, housing & public facilities	270		
	Bamboo forest,	Area for bamboo material	29		
	Natural forest	Reserving forest	72		
Preserve Area	National park	Area for National park in Model area	12,749	14,671	Including river.
	Conservation area	Area for conservation of mountains forest & basin conservation forest	21,647		
Total			21,647	21,647	

* including forest road, fire break and left-over area.

(Refer to Appendix Fig.—7 Map of Forest Management Plan)

6.2 Forestry Area Plan

(1) Basic matters for Forestry Area

① Sustained yield

1) Unit for sustained yield calculation

A sustained yield is one of the guiding principles for forestry management. A single management entity, i.e. entire national reserve forests, can logically qualify as the subject area for the sustained yield calculation. In the present plan, the KBR No.3Planning Area of 86,700 ha approximately including the model area was used as a sustained yield calculation unit (refer to Table 6−4 and Fig. 1−3).

Table 6−4 Basic Acreage for Calculating Sustained Yield

Planning Forest land use classification	KBR No.3 Planning Area		Model area		Remarks
	Acreage (ha)	Ratio (%)	Acreage (ha)	Ratio (%)	
National Park	21,058	24.32 (100)	12,749	58.89 (61)	Including river 56ha.
Preserve Area	7,699	8.88 (100)	1,922	8.88 (100)	Including river 4ha.
Agroforestry Area	911	1.05 (100)	911	4.21 (100)	Reforestation 510ha is the objective area for calculating sustained yield.
Forestry Area	57,032	65.78 (100)	6,065	28.02 (10)	
Total	86,700	100	21,647	100	
Objective acreage for calculating sustained yield	57,542	(100)	6,575	(11)	

This subject area for the sustained yield calculation was then divided into 2 unit, i.e. artificial forest work unit 〔Artificial forest work inside the model area : (A) and outside the model area : (B)〕 and natural forest work unit (covering the KBR No.3 Planning Area), in view of the different cutting and regeneration methods involved. Table 6−5 reflects the area, stand volume and stocks of useful trees in each work class provide the basis for the sustained yield calculation. The said value is estimated by the field survey and aerial photo interpretation.

Table 6-5　Acreage and Total Volume by Working Method for Calculating Sustained Yield

Item		Acreage			Volume		
		Objective area		Target area of forest work ha	per ha	total	%
		ha	%				
Artificial forest works	Inside model area (A)	2,124	a 32	1,920	82.6	158,592	4
	Outside model area (B)	16,290	b 32	14,700	82.6	1,214,220	33
	Whole planning area	18,414	c 32	16,620	82.6	1,372,812	37
Natural forest works	Inside model area	2,106	a 32	2,106	85.4	179,852	5
	Outside model area	25,514	b 50	25,514	85.4	2,178,896	58
	Whole planning area	27,620	c 48	27,620	85.4	2,358,748	63
No forest works	Inside model area	2,345	a 36	—	—	—	—
	Outside model area	9,163	b 18	—	—	—	—
	Whole planning area	11,503	c 20	—	—	—	—
Total	Inside model area	6,575	a 100	4,026	—	338,444	9
	Outside model area	50,967	b 100	40,214	—	3,393,116	91
	Whole planning area	57,542	c 100	44,240	—	3,731,560	100

(Note) :　1.　a — percent of acreage inside model area
　　　　　　　　b — percent of acreage outside model area
　　　　　　　　c — percent of acreage whole planning area
　　　　　2.　Stand volume per ha is the results of the forest inventory.
　　　　　3.　The acreage of artificial forest works inside model area (A) was totalled including the agrosilviculture subject acreage 510 ha in the agroforestry area.

Note : Area and Stand Volume Calculation Method

1. Artificial Forest Work

Appropriate area in those forest sites in the model area with a land classification of F_1, F_2 and/on (F_3) and a soil type of Ne-s , Ne-f, Be-c , Be-r, Bg or Lv were identified as subject sites for artificial forest work [Artificial forest work (A)] .

2. Natural Forest Work

Appropriate area in those forest sites where the natural regeneration of useful trees can be expected in view of the land and forest conditions, with a land classification of F_1, F_2 and/or F_3 and a soil type of Ne-s, Be-c, Be-r, Bg, Lv, E and/or I were identified as subject sites for natural forest work.

3. Stand Volume of Useful Trees for Selective Cutting

Of the 106 species of trees identified in the model area by the survey, 47 species are currently used for various purposes in Thailand. The stand volume of useful trees for commercial extraction was estimated based on the assumption that the distribution ratio of these useful trees in the model area indicates the ratio of their stand volume vis-a-vis the total stand volume.

In view of the possibility of expanding the number of species of useful trees due to future technological advances, the estimated standvolume should be treated as only a tentative figure.

Table 6−6 Ratio of Useful Trees for Felling

Number of plots in model area	50 (50 ha)
Total number of trees	9,225
Total number of useful trees	4,054
Ratio of useful trees	44%

② Target forests
1) Artificial forests
There are currently no artificial forests in the model area and the creation of artificial forests, mainly teak, as in the case of the adjacent Thong Pha Phum and Sai Yok Areas, is aimed at.
In principle, the target artificial forests should be of medium density and of a uniform forest type with good quality. The cutting period of species for long cutting period, such as teak, will be 50 years and the target stand volume at the cutting time will be based on the Teak Yield Table for the Lampang District. The cutting period for fast growing species will be between 5 and 15 years and these trees will be used for chips, firewood, charcoal and simple building materials.

2) Natural forests

All natural forests in the model area show traces of early selective cutting. In comparison, in the case of untouched forests adjoining the model area, the old natural forests have reached climax stage and fallen trees due to natural death and natural regeneration are observed. Regulative felling will, therefore, be necessary prior to the death of large trees to achieve the effective utilizationof resources and land productivity. It is desirable that the target natural forests show multi-storied forest form, have a usable stand volume of around 300 m³/ha prior to felling and mostly consist of commercial tree species.

3) Bamboo forests

The model area currently has 144 ha of bamboo forest (approximately 0.7% of the total area). In addition, bamboo trees are invading many other forests, some of which are felled for various purposes. A plantation for production of bamboo may be established at the highly productive sites. The target bamboo forests should be of a uniform type with good character and their densities will be decided in accordance with the target production volumes. 6 bamboo species have so far been identified in the model area.

③ Standard of working method

1) Artificial forests

The subject sites for artificial forests will be selected from those sites which have a land classification of F_1 and/or F_2 (including parts of F_3) and a soil type of Ne, Be, Bg and/or Lv where poor forests have grown following felling.

The sites will be distributed so that the size of each forestis as small as less than 2.0 ha and their harmony with natural forests will be stressed. The application of a line planting method and other techniques is also recommended. The establishment of artificial forests will be carried out step-by-step while confirming the tree growth situation for each soil type.

The planting tree species will be teak and those trees given in Table 6—12. Fast growing tree species will be planted at certain sites in the model area with a view to adjusting the felling volume and securing income in the early stages. Priority for the introduction of fast growing tree species will be given to the area of M_D and some part of D_D.

2) Natural forests

The subject sites for natural forests will be selected from those sites which have a land classification of either F_1, F_2 and/or F_3 and a soil type of Ne, Be, Bg and/or Lv (including parts of E and I). In principle, the selective cutting of those trees whose G.B.H. exceeds the girth limit will be introduced for upto 20% of the usable stand volume. At the time of felling, consideration should be given to removing badly formed old trees which considerably disturb natural regeneration and also not to leaving large empty spaces for bamboo trees to invade. Depending on the forest type, forest improvement work based on the planting of economically useful trees will be carried out to foster good forests.

3) Bamboo forests

The subject sites for bamboo forests will be basically those sites where the present forest is of the B_F type and where many good bamboo trees are found. Sites with a high groundwater level or those liable to be water logged should be avoided.

The felling of bamboo trees by the selective cutting method will be conducted annually, the subjects being trees of 3−4 years of age, while badly grown or old bamboo trees and shrubs will be simultaneously removed to maintain a good quality of bamboo.

Thinning and land treatment preparation must be actively conducted if the production of bamboo shoots is to be aimed at.

④ Standard yield
1) Standard yield calculation method

The calculation methods to determine the standard yield and the standard regeneration area for the present management plan are the area allotment method and the volume-period method based on the actual area and stand volume which would be highly reliable in view of the collected data and survey accuracy. The final decision on these figures will, however, be made taking the feasibility of the relevant work into consideration.

2) Growth volume of first working period

The yield calculation was only made for the first working period (10 years). Yields for the second working period onwards willbe revised upon inspection at the beginning of each period. The increment of natural forests up to the half-way point of the first working period, required for the standard yield calculation for the first working period, was estimated using the following method.

a. The difference of average stand volume of MD forest between Logging Block 7 (selectively felled over 6 years ago) and Logging Block 1 (selectively felled over 24 years ago), which were found to have similar tree distributions based on the G.B.H. and the same forest types with similar environments lacking bamboo invasion by the sample plot survey, was regarded as stand volume growth.

Table 6–7 Average Annual Stand Volume Growth

Average stand volume of Logging Block 1 (Felled 24 years ago)	98.3 m³/ha
Average stand volume of Logging Block 7 (Felled 6 years ago)	51.9 m³/ha
Difference of avaerage stand volume	46.4 m³/ha
Period	18 years
Average annual stand volume growth	2.6 m³/ha

b. The stand volume growth up to the halfway point of the working period is 13.0 m³/ha as it includes 5 years' growth.

(2) Working Plan
① Standard yield calculation
1) Artificial forest work area inside the model area (A)

As no artificial forests currently exist in the model area,the total yield of natural trees felled in the 1,920 ha of land designated as artificial forest work sites of 2,124 ha and that of newly created artificial forests will be the subject yield.

a. Natural tree yield

Given a rotation period for natural forest of 30 years, the annual cutting area is 64 ha (1,920 ha/30 years) and the 10 year total is 640 ha. Since the present stand volume in the artificial forest work area and the increment up to halfway through the working period are 82.6 m³/ha and 13.0 m³/ha, the cutting volume for the 10 year period is 61,184 m³, i.e. (82.6 + 13.0) m³/ha x 640 ha = 61,184 m³.

b. Newly planted tree yield

In the long-term perspective, the trees to be planted will be those of a long cutting period, mainly teak. However, fast growing tree species also be introduced.

While there will be no yield from the trees of a long cutting period in the initial 10 year period, the cutting area for fast growing tree species will be 160 ha for 10 years (refer to Table 6—8). As a result, the yield (Spacing 2m × 2m) from trees of fast growth will be 22,560 m³ (141 m³/ ha x 160 ha). N.B. About 141 m³/ha, refer to "6.3(5) Communal forest".

The overall yield for the initial 10 years for the artificial forest work area (A) will be as follows:

$$61,184 \text{ m}^3 + 22,560 \text{ m}^3 = 83,744 \text{ m}^3$$

Teak has been chosen as the long cutting period tree and a sustained yield of teak has been planned for. Based on the data (Teak Yield Table for Lampang District) collected during the survey, a rotation period of 50 years has been decided. Its site index is between 20 to 25. The volume at the rotation age is 204 m³/ha approximately.

In view of the tree growth situation in the Kanchanaburi Province and the immediate production targets of chips, firewood, charcoal and simple construction materials, a rotation period of 5—15 years has been assumed for trees of fast growth (refer to Table 6—8). However, for the present sustained yield calculation, a 5 year rotation period and 2 coppice regeneration for each reforestation work are assumed. With regard to the 1,920 ha of the prospective artificial forest area in the model area, the area for trees of fast growth is planned to be one-fifth of the area for trees of a longcutting period (teak and others) taking the inspection results of the model reforestation area, the requirement to secure a cash income at an early stage and the possible labour supply, etc. into consideration. In other words, the areas subject to teak reforestation work and fastgrowing tree reforestation work will be 1,600 ha and 320 ha respectively.

Although the total planned area for trees of fast growth is 320 ha, they will also be planted in those sites subject to teak reforestation before the completion of the latter planting in view of the efficient utilization of forest land, the early realization of cash income and the firm establishment of reforestation techniques. As a result, the reforestation area will show a complicated pattern with a slight increase or decrease depending on the subject year.

Year / (ha/year)

Fast growing species

Working period: First 32, Second 32, Third 32, Fourth 32, Fifth 32, Sixth 32, Seventh 32

Regeneration: 32 (ha/year)
Cutting: 32 (ha/year)

	5 years	10 years	15 years	20 years	25 years	30 years	35 years	40 years	45 years	50 years	55 years	60 years	65 years	70 years	75 years
Regeneration (ha)	480 (P 320, C 160)		1,120 (P 480, C 640)		1,760 (P 640, C 1.120)	1,440 (P 320, C 1.120)		800 (P 160, C 640)		640 (P 160, C 640)	640 (P 320, C 320)	640 (P 160, C 480)	640 (P 160, C 480)	640 (P 160, C 480)	
Cutting (ha)	160 (320)	800 (320)	800 (320)	1,440 (320)		1,760		1,120		640	640	640	640	640	

Teak, etc.

Planting working period: 32 (ha/year)
Cutting working period: 32 (ha/year)

	5 years	10 years	15 years	20 years	25 years	30 years	35 years	40 years	45 years	50 years	55 years	60 years	65 years	70 years	75 years
Regeneration (ha)	320 (P)	320 (P)	320 (P)	320 (P)	320 (P)	320 (P)	320 (P)	320 (P)	320 (P)						
Cutting (ha)	0 (320)	0 (320)	0 (320)	0 (320)	0 (320)	0	0	0	0						

Working period

	5 years	10 years	15 years	20 years	25 years	30 years	35 years	40 years	45 years	50 years	55 years	60 years	65 years	70 years	75 years
Regeneration (ha)	No. I — 800	No. II — 1,440		No. III — 2,080		No. IV — 1,760		No. V — 1,120		No. VI — 960		No. VII — 960		No. VII — 960	
Cutting (ha)	160	800		1,440		1,760		1,120		960		960		960	

Remarks

| Planting |
| Cutting and Coppice |
| Cutting |

Cutting period until Oct. — Mar.
Planting period until May — Aug.
( ) Cutting acreage of natural forest
P : Planting
C : Coppice

Fig.6—1 Reforestation and Felling Plans for the Model Area

The details of the reforestation progress are given in Fig. 6—1, Reforestation and Felling Plans for Model Area, and Fig. 6—2, Illustration of the Reforestation Plan for the Model Area.

Table 6 — 8   Transition of Logging and Regeneration Acreage of Artificial Forest Working (A) (Fast Growing Species)

(Unit : ha)

| Acreage Working Period	Logging			Regeneration		
	Natural forest	Reforestation	Total	Planting	Coppice	Total
No. 1	320	160	480	320	160	480
〃 2	320	800	1,120	480	640	1,120
〃 3	320	1,440	1,760	640	1,120	1,760
〃 4	—	1,760	1,760	320	1,120	1,440
〃 5	—	1,120	1,120	160	640	800
〃 6	—	640	640	320	320	640
〃 7	—	640	640	160	480	640
〃 8	—	640	640	160	480	640
〃 9	—	640	640	320	320	640
〃 10	—	640	640	160	480	640
〃 11	—	640	640	160	480	640
〃 12	—	640	640	320	320	640
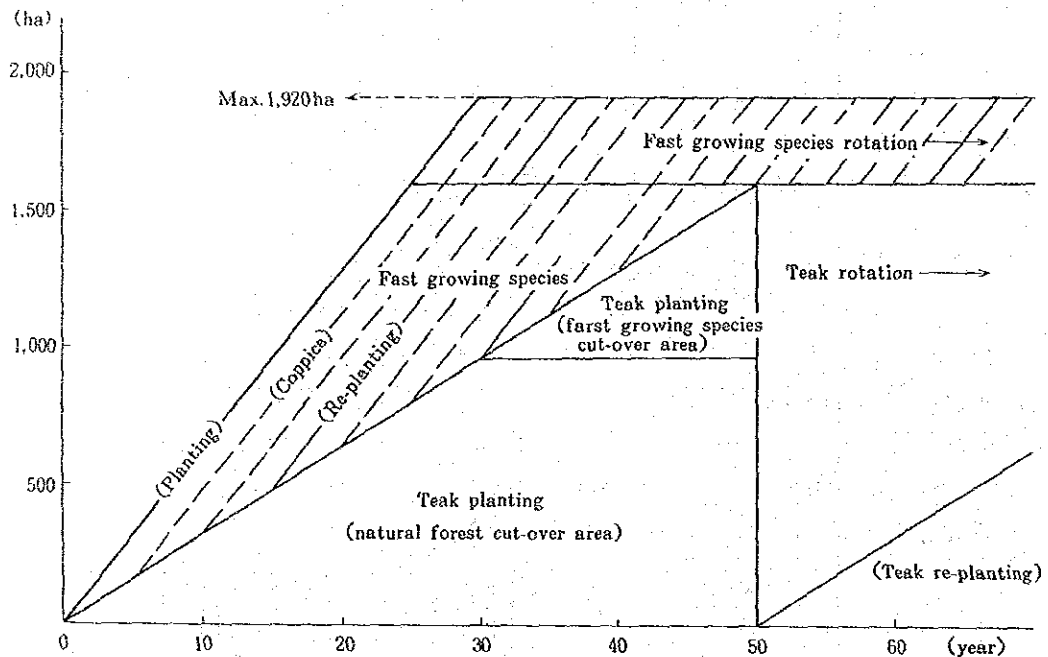
Fig.6—2 Illustration of the Reforestation Plan for the Model Area

2) Artificial forest work outside the model area (B)

Assuming the ratio of the artificial forest work area outside the model area to be the same as that in the model area (32% of the forestry area, the planting area is 14,700 ha in the artificial forest area of 16,290 ha).

As no artificial forests currently exist outside the model area, as in the case of the model area, the yield will be the total of that from natural trees in the subject area and that from newly planted trees.

Since no trees of fast growth will be planted in the subject sites, upper trees in the reforestation sites will provide the yield for the first working period. Given a rotation period of 50 years and the completion of the reforestation work during this period, the annual cutting area and yield are as follows.

Annual cutting area: $14,700 \div 50 = 294$ ha
Annual yield: $(82.6 + 13.0)$ m³ x 294 ha $= 28,106$ m³

This yield covers all tree species.

3) Natural forest work

A cutting cycle of 40 years and a felling ratio of 20% are assumed for the natural forest work area. As the total natural forest work area of KBR No.3 Planning Area consists of 27,620 ha, the annual cutting area will be 690 ha (27,620 ha $\div$ 40 years).

The annual yield will be 13,579 m³, i.e. $(85.4 + 13.0)$ m³ x 0.2 x 690 ha $= 13,579$ m³, consisting of all tree species.

Note: 1.   Although a cutting cycle of 30 years is currently used for felling on concession, a cutting cycle of 40 years is employed for the present purpose in view of the actual forest recovery situation on the spot. This mustbe further examined in the future as the required cutting cycle will depend on the girth limit for each tree species the designation of trees to be left standing at the time of felling, the increment percentage and the state of the logging method.

2.   A selective cutting ratio of 20% has been determined in view offorest composition, actual felling work efficiency and tree utilization purposes. As the ratio is closely related to the

Table 6-9　Standard Cutting Volume

Division	Target area of forest work (ha)	Species	Rotation age (cutting cycle) (year)	Annual cutting area (ha)	Annual cutting volume (m³)		
					1 to 30 years	31 to 50 years	51 years or longer
Artificial Forest Works inside Model Area (A)	1,600	Teak, etc.	50	32	NF : 3,059	—	AF : 6,530
	320	Fast growing tree species	5	32 ~ 160	NF : 3,059 AF : 4,510~22,560	AF : 13,540~22,560	AF : 9,024
	Total 1,920						
Artificial Forest Works outside Model Area (B)	14,700	Teak, etc.	50	294	NF : 28,106	NF : 28,106	AF : 59,980
Natural Forest Works (Whole KBR No.3 Planning Area)	27,620	Natural broad leaved tree species	40	690	NF : 13,580	NF : 13,580	NF : 13,580

(Note)　NF: Natural Forest,　AF: Artificial Forest

growth situation of the remaining trees and the cutting cycle, this must be carefully examined as in the case of the cutting cycle.

3. The annual selective cutting area constitutes the subject area for natural regeneration.

The above considerations are summarized in Table 6—9.

② Yardsticks for work volume and others

The yardsticks for the work volume and others in the first working period (10 years) are described below.

1) Cutting
a. Designation of cutting volume

The process for the designation of felling sites differs according to whether the sites are subject to either natural forest work or artificial forest work.

In the case of natural forest work sites, the selected sites in the model area have already been subject to felling and natural regeneration has not been completed. As a result, no designation of felling sites is possible during the first working period. However, although definite designation cannot be made in the present plan, possible sites for designation include the T₅ forest located to the west of Logging Block 8 outside the model area because of the current forest composition and other factors.

Those sites with good soil conditions along existing roads in the agroforestry area will be given prioity for the implementation of Type A artificial forest work (inside the model area). In the case of Type B artificial forest work outside the model area, no designation can be made, as in the case of natural forest work. However, a tentative yield is given here based on the current designation status of the model area and in anticipation of the independent implementation of a survey and designation in the future by the Thai side.

Table 6—10 Designated Cutting Volume

(Unit: m³)

Womk type	Subject area	Standard cutting volume	Designated cutting volume
Artificial forest work(A)	Model area	53,150	53,150
Artificial forest work(B)	Outside model area	281,060	(281,060)
Natural forest work	Outside model area	135,800	(135,800)

While the felling of trees of fast growth will commence at Type A artificial forest sites in the second half of the first working period, the designated cutting volume for natural trees and trees of fast growth are 30,590 m³ and 22,560 m³ respectively.

The yield for bamboo forests has not been designated here because of the requirement for detailed surveys on feasible production volumes, usage situation and other relevant matters.

b. Felling method

ⓐThe commencement year for felling and the locations of the felling sites will be decided taking into consideration the situation of forest road construction and other relevant matters.

ⓑNo selective cutting designation has been made for the model area. When felling is intended, however, due consideration should be given to not exceeding the cutting ratio of 20%, to selecting trees within the girth limits determined for each type of tree and to an almost equal distribution of crowns upon completion of felling so that no large empty spaces are left.

ⓒWith regard to artificial forest work sites, the main regeneration method at felling sites is new planting (although coppice occurs in parts). Proper attention should, therefore,be paid not to fell damage low trees and branches.

ⓓAs artificial forests are scattered over a wide area, the subject forests should be divided into compartments reflecting the topographical conditions at the beginning of works. If forest fire prevention work is required, fire breaks should be provided at such appropriate locations as ridges, valleys and mountain slopes.

2) Regeneration
   a. Designation of regeneration areas
   The principle, regeneration is planned by means of planting trees in the case of artificial forest sites and natural regeneration (natural seeding or coppice but also including the planting method inside Tᴇ forest with good soil cinditions) in the case of natural forest sites.

Table 6—11 Designated Regeneration Areas

(Unit: ha)

Type	Subject area	Method	Standard regenerated area	Designated area
Artificial forest (A)	Model area	Planting	800	800
Artificial forest (B)	Outside model area	Planting	2,940	(2,940)
Natural forest	Outside model area	Natural regeneration	6,900	(6,900)

   b. Regeneration methods
   ⓐArtificial forest work
   Regeneration in the case of artificial forest sites will be conducted by the following method.

   i)   The trees to be planted will be selected from the 11 species listed in Table 6—12. In view of profitability and the degree of difficulty to succeed as a business operation, mainly teak will be planted. Other trees will also be introduced, mainly to test their suitability to the local conditions.

   ii)   In principle, the number of trees to be planted in the forestry area will be 1,100 ha (with a spacing of 3m x 3m). However, the number will be flexible up to 2,500/ha (with a spacing 2m x 2m) depending on the local conditions, tree species and seed and seedling supply situation.

   iii)   Weeding and the climber cutting should, in principle, be properly conducted so that tree growth is not disturbed by weeds, shrubs and bamboo, etc.

iv) The mixed planting of shade bearers or those which thrive in the shade with light demanders or under-tree planting should be promoted to achieve a multistoried forest effect for the reforestation sites.

v) The line planting of profitable trees should be actively promoted when the stand volume of unprofitable trees is high at prospective artificial forest sites, necessitating large expenditure in view of land preparation.

vi) Detailed records of the planting and tending of the trees should be maintained for analysis in the future.

vii) Protection zones and fire prevention belts should be introduced as required.

Table 6 −12   List of Main Planting Species

	Code No.	Species name	Planting type				Applied forest type	Natural growth in the study area	Rotation age (year)	Remarks
			open planting	under-tree planting	mixed planting	line planting				
Long cutting period species	101	*Dipterocarpus alatus* Roxn.		◯		◯	T_E	Yes	30 ~ 50	
	201	*Tectona grandis* Linn F	◯				M_D	No	50	
	302	*Afzelia xylocarpa* Craib.	◯				$T_E \cdot M_D$	Yes	30	
	305	*Hopea odorata* Roxb.		◯	◯	◯	T_E	Yes	30 ~ 50	
	310	*Pterocarpus macrocarpus* Kurz.	◯				$T_E \cdot M_D$	Yes	30 ~ 50	
	564	*Xylia kerrii* Craib. & Hutch.			◯		$T_E \cdot M_D$	Yes	30 ~ 50	
Fast growing species	—	*Acacia auriculiformis* A. Cunn.	◯				$M_D(D_D)$	No	5 ~ 8	
	—	*Acacia mangium* Willd.	◯				$M_D(D_D)$	No	5 ~ 8	
	—	*Eucalyptus camaldulensis* Dehn.	◯				$M_D(D_D)$	No	5 ~ 8	
	—	*Eucalyptus deglupta* Bl.	◯				$T_E(M_D)$	No	5 ~ 15	wet site
	—	*Melia azedarach* L.	◯				$M_D(D_D)$	No	15 ~ 20	

(Note)   In the case of under-tree planting, no designation is made in regard to kind of trees under which planting will be conducted (either fast growing or long cutting period species).

ⓑ Natural forest work
i)   Land preparation should be conducted at those sites of previous selective cutting so that natural seeding regeneration is possible. The

land should be cleared and dead roots and fallen trees, etc. removed wherever the coppice regeneration of useful trees is considered feasible.

ii) Useful trees should be actively planted wherever natural regeneration cannot be expected in space forests at former selective cutting sites.

iii) As bamboo trees which have invaded former felling sites prevent the germination or growth of the next generation of trees, they should be removed and their further invasion prevented.

3) Nursery practice

An appropriate site near the model area will be decided for a nursery for stocks for reforestation work taking the soil, water supply and other relevant conditions into account. The production volume should meet the requirements of both the forestry and agroforestry areas.

Excepting teak and eucalyptus, the nursery techniques for some species have not been firmly established. The production of the stocks of these species, including seed acquisition, therefore, will commenceon an experimental scale. The production quantities are not given here in view of this being an experimental operation.

Refer to (6) ②, Nursery Plan of 6.3, Agroforestry Area Plan for the Raising Stock Plans for teak (10 years) and eucalyptus (5 years) to be planted in the reforestation and commmunal forest areas.

4) Forestry roads network in the model area
    a. Designated distance of forestry roads

The distance of the forestry roads in the forestry area are designated as follows.

Table 6 −13 Designated Forestry Roads in the Model Area

(Unit : m)

Division	Artificial forest working			Natural forest working			Total		
	Main roads	Branch roads	Sub-total	Main roads	Branch roads	Sub-total	Main roads	Branch roads	Sub-total
Whole Plan (Density per ha)	21.400 (10.1)	15,800 (7.4)	37,200 (17.5)	21,800 (10.3)	1,000 (0.5)	22,800 (10.8)	43,200 (10.2)	16,800 (4.0)	60,000 (14.2)
Designated	6,400	5,800	12,200	0	0	0	15,000	10,000	25,000

b. Forestry road construction method

ⓐThe forestry road network described above is based on the details given in Table 6—14.

Table 6—14 Forestry Road Network

Item	Main roads	Branch roads
Road connection	Circulatory and connected to existing roads	Possibly dead-end type
Use	All the year round	Dry season only
Location	Ridgelines, midslopes of mountains	Unlimited
Width	6m	3m
Others	Connected with facility sites and reforestation sites, etc.	For the implementation of various forestry work

ⓑThe structures and relevant standards for these forestry roads should take the current conditions of existing roads, loading capacities of transportation vehicles, topography of subject areas and soil conditions, etc. into consideration. The reference standards are given in Table 6—15.

Table 6—15 Reference Structures and Standards
for Forestry Road Construction

Item	Standards · Structures
Design speed	30 km/hr
Curve radius	Minimum radius: 40 m
Longitudinal slope	Maximum: 12%, Minimum: 2%
Crossfall	Main roads: 3%, Branch roads: 2%
Layby	Every 1 km
Traversing method	Torrents and small rivers: Riverbed roads Medium size rivers: Concrete pipes, Corrugated tubes
Surface work	Gravel of paved sections for gradient of 8% or higher. All main roads are paved.

c. Forestry road maintenance

The key point in regard to forestry road maintenance lies with measures dealing with rainwater. Measures to facilitate drainage and to prevent sediment from being washed away should be properly implemented for those main roads used throughout the year while repair work should be immediately carried out at the end of the rainy season for branch roads used only in the dry season.

5) Forest conservation

There are currently no sites in the model area requiring any special forestry conservation facility. However, attention should be paid to the prevention of disasters, possibly caused by the expansion of grassland on steep sloped, decline of soil fertility due to excessive grazing, construction of forestry roads and the commencement of felling work, until land use classification and forest management have been firmly established.

6) Forest management

With the introduction of new policies, including the clarification of land use classification, control of slash-and-burn cultivation, commencement of new reforestation work, opening of new forestry roads and the designation of protected forests, strict forest management will be strongly required in the future, necessitating the introduction of the following measures.

a. General measures
i) Clear identification of the boundaries of different land use areas.

ii) Provision of notice boards and warning signs.

iii) Construction of paths for forest management purposes.

iv) Provision of control gates to limit access to forestry roads.

v) Briefing of local inhabitants.

vi) Provision of boundary signs.

b. Forest fire prevention measures
The prevention of forest fires is an important task in the management of Thailand's national reserve forests. However, in view of the vigorous plant growth reflecting the high thermal indices, burning following for-

estry work cannot be ignored as a part of the tending operations.

The following forest fire prevention measures should be introduced with the above background in mind.

ⓐForest fire prevention plan
ⅰ) Prohibited entry to the forest by unauthorized persons
Priority should be given to the installation of gates at the entry points for vehicle traffic.

ⅱ) Reinforcement of the watch system
Given the scattered existence of high limestone peaks in the area, the construction of watchtowers on these peaks is recommended to minimize the cost of the watch system and to maximize its effectiveness.

ⅲ) Introduction of a burning permit system
Although it may prove difficult to introduce the blanket prohibition of customary burning at roadside ditches, sides of footpaths on farmland or after weeding, the provision of certain conditions to control the burning practice should prove extremely useful to prevent forest fires. Therefore, the introduction of a permit system for burning and the proper management of this system is highly recommended. As the settlement of farmers is expected to take place with the commencement of the reforestation work in the model area, a permit system should prove very effective.

ⓑForest fire-fighting plan
ⅰ) Reinforcement of the fire-fighting system
With the implementation of the forest management plan in the model area, a branch station of the Forest Fire Control Station of the Thai Government should be opened in the area and an organization to promote the active participation of the local inhabitants in fire-fighting should be established.

ⅱ) Provision of fire-fighting equipment
As much of the fire-fighting equipment for forest fires can also be used for forestry work, the procurement of this equipment should be considered in the forest management plan and the emergency use directions clearly determined in advance.

6.3 Agroforestry Area Plan

(1) Current land use in agroforestry area

The area designated as an agroforestry area in the Forest Land Use Plan consists of 911 ha in Compartment 1−3, in the Khao Praleusri Bor Rae Working Area. The current land use and vegetation in these Compartments is 717 ha of forest, i.e. 590 ha of mixed deciduous forest (M_D), 38 ha of bamboo forest (B_F) and 89 ha of secondary forest (S_F), and 194 ha of other than forest use, i.e. 123 ha of farmland (A), 5 ha of village settlement (V), 41 ha of bareland (B) and 25 ha of grassland (G).

Table 6 − 16 Acreage by Compartment, Land Use and Vegetation

(Unit : ha)

Land use and vegetation	Compartment No.	1	2	3	Total
Forest land	Mixed Deciduous Forest (M_D)	207	303	80	590
	Bamboo Forest (B_F)	24	9	5	38
	Secondary Forest (S_F)	38	15	36	89
	Sub-total	269	327	121	717
Non-forest area	Farm Land (A)	77	29	17	123
	Village (Resident) (V)	3	—	2	5
	Barren Land (B)	24	17	—	41
	Grass Land (G)	3	1	21	25
	Sub-total	107	47	40	194
Total		376	374	161	911

54 households are located in this area, of which 48 are engaged in either full-time or part-time farming. Interviews with these households revealed that the total area of farmland is 333 ha (325 ha of dry fields and 8 ha of paddy fields) and that the actual farming area in 1986 was 90 ha (82 ha of dry fields and 8 ha of paddy fields). The remaining fields were either left fallow or farming was suspended, corresponding to such current land use items as grassland and secondary forest.

With regard to the land use classification of this 911 ha of agroforestry area, a total of 701 ha is classified as AF (691 ha of $A_1 \cdot F_1$ and 10 ha of $A_2 \cdot F_2$) which is suitable for both agriculture and forestry and the remaining 210 ha is classified as F (201 ha of F_2, 6 ha of F_2 and 3 ha of F_3) which is suitable for forestry. Table 6−17 shows the correspondence between the current land use and the land use classification in the respective areas in each compartment.

Table 6—17 Acreage by Compartment in the Agroforestry Area

(Unit: ha)

Forest type & land use	Land classification	Compartment No.	AF		F				Total
					F_1	F_2		F_3	
			A_1F_1	A_2F_2	A_2F_1	A_2F_2	F_2	F_3	
Forest land	MD	1	177		30				207
		2	219		84				303
		3	46		34				80
		Sub-total	442		148				590
	BF	1	23		1				24
		2	2		7				9
		3	5						5
		Sub-total	30		8				38
	SF	1	23		15				38
		2	12		3				15
		3	18	10	2	2	4		36
		Sub-total	53	10	20	2	4		89
	Total	1	223		46				269
		2	233		94				327
		3	69	10	36	2	4		121
		Sub-total	525	10	176	2	4		717
Non-forest area	Farm land(A) & village (V)	1	71		9				80
		2	28		1				29
		3	19						19
		Sub-total	118		10				128
	Bare land(B)	1	16		8				24
		2	16		1				17
		Sub-total	32		9				41
	Grass land(G)	1	3						3
		2	1						1
		3	12		6			3	21
		Sub-total	16		6			3	25
	Total	1	90		17				107
		2	45		2				47
		3	31		6				41
		Sub-total	166		25				195
Grand-total		1	313		63				376
		2	278		96				374
		3	100	10	42	2	4	3	161
		Sub-total	691	10	201	2	4	3	911

(2) Basic plan for agroforestry area

54 households (71 households including those outside the model area) are located in the agroforestry area, forming an independent local community named Phu Toei which has a medical center built by the Amphoe Thong Pha Phum and a school built by the community itself.

The average term of residence of these 54 households is 4 years, with 7 households having a 3 years' term of residence, 7 households having a 2 years' term of residence, and 17 households having a 1 year's term of residence, showing the recent rise of immigration in the area (57% of the households have lived in the area for less than 3 years).

The forest management plan to be introduced in the area should focus on the relocation of the scattered farmers to permanent settlement in Phu Toei in order to arrest the further destruction and depletion of the forests. In addition, these farmers should be mobilized to establish plantation forestry for the sustainable yield of timber. And at the same time, this activity will help to conserve the forest.

The following plans have so far been prepared to achieve the above.
① Sor Tor Kor Plan (Case I)
② Forest Village Plan (Case II)
③ Agrosilviculture Plan (Case III)

As the Sor Tor Kor Plan (Case I) currently in force states that no Sor Tor Kor certificates will be given to inhabitants of national reserve forests after 1983, no residence in the model area is officially permitted at present. Even if the criteria of the Sor Tor Kor Plan are changed to allow farmers to live in the agroforestry area in question, the effective management of the forests, including the control of farmers and farmland scattered in the area, will be difficult to achieve while the prevention of newcomers engaged in illegal farming will be even more difficult. In view of this, consideration should be given to the application of the Forest Village Plan (Case II) aiming at the permanent relocation of scattered inhabitants and the Agrosilviculture Plan (Case III) aiming at reforestation and protection by means of planting and intercropping with the cooperation of the relocated people.

(3) Forest land use plan for agroforestry area

The land use in those plans suitable for the agroforestry area (Forest Village Plan and Agrosilviculture Plan) is determined as follows.

① Compartment 1

a. Those fields with the $A_1 \cdot F_1$ land classification will be reserved for farming. $A_1 \cdot F_1$ fields which are currently forests must be preserved except those areas necessary for farming.

b. F_1 fields which are currently forests will be preserved as much as possible.

c. F_1 fields which are not currently forests will be reserved for communal forests for the production of firewood.

d. Those fields which are currently used as village land (V) will be made into a new settlement area to include present residences and the relocation of scattered farmers.

e. Large bamboo (B_F) forests will be actively used for production of bamboo stem and bamboo shoots.

② Compartment 2

a. $A_1 \cdot F_1$ and F_1 fields will be subject to reforestation.

b. Farmers living in this compartment will be relocated to the new settlement area in Compartment 1.

③ Compartment 3

a. Those fields which are adjacent to Compartment 1 and which are currently used as either farmland or village land will not be touched.

b. $A_1 \cdot F_1$ and $A_2 \cdot F_2$ fields which are adjacent to Compartment 2 will be subject to reforestation.

c. Those fields owned by the STK will not be touched.

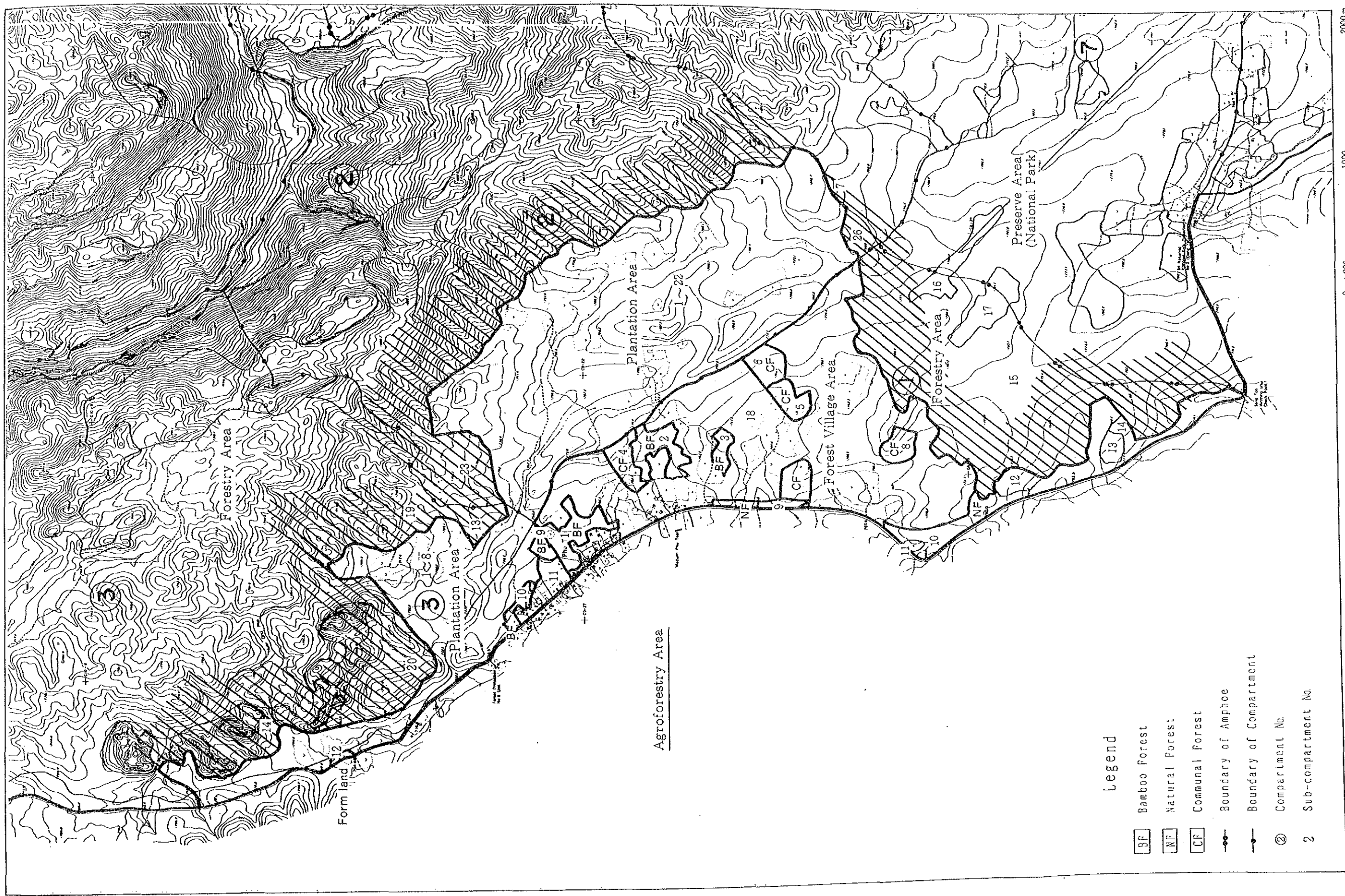Fig.6-3 Forest Land Use Plan in Agroforestry Area

Legend

BF	Bamboo Forest
NF	Natural Forest
CF	Communal Forest
	Boundary of Amphoe
	Boundary of Compartment
②	Compartment No.
2	Sub-compartment No.

d. Farmland and grassland other than that classified as either a. or c. above will be subject to reforestation.

e. Bamboo forests (B$_F$) will not be touched.

f. F$_2$ and F$_3$ fields which are currently grassland will be subject to reforestation.

In addition to the above land use classifications for each Compartment, land use priority based on soil types has also to be considered. In short, agriculture and reforestation are possible for Ne-s, Ne-f, Be-c, Be-r and Lv, reforestation but not agriculture is possible for Bg, selective felling of natural forests but not reforestation through clear cutting is possible for E and neither agriculture nor forestry are possible for I and G.

The Forest Land Use Plan for Compartments 1−3 is shown in Figure 6−3 while Table 6−18 gives their respective areas.

Table 6−18 Acreage for Forest Land Use Plan in the Agroforestry Area

(Unit : ha)

Compartment No. Land use	1	2	3	Total
Residential plot, Farm land and Public institution plot	250		20	270
Communal forest for firewood	30			30
Reforestation		374	136	510
Bamboo forest	24		5	29
Natural forest	72			72
Total	376	374	161	911

(4) Forest Village Plan
① General plan
As referred to in the forest land use classification, A$_1$ · F$_1$ fields in Compartment 1 and farmland and village land in Compartment 3 which is adjacent to Compartment 1 are subject to the Forest Village Plan. The planned area for the Forest Village is 376 ha and 25 ha in Compartments 1 and 3 respectively, totalling 401 ha.

According to interviews, the average living area per household is 267.7 wah² (0.67 rai) and the average active farming area per household is 15.6 rais which is almost equivalent to the farmland area per household in the Forest Village Plan currently being implemented by the RFD (living area of 0.5 - 1.0 rai and farmland of 14.0 - 14.5 rais, totalling 15 rais).

In view of the above, the maximum area, including living space and farmland, per household is set at 15 rais (2.4 ha) in the present Forest Village Plan which is equivalent to the figure set by the RFD's Forest Village Plan. The number of households to be accommodated in one village will be 100 with a total area of 240 ha (1,500 rais). In addition, 30 ha will be provided for roads and public facilities, etc. The remaining 131 ha will be kept as bamboo forest (29 ha), firewood forest for communal use (30 ha) and natural forest (72 ha).

The key points of the Forest Village Plan are as follows.

o The location of the new settlement will be centred on the present Phu Toei village along the road.

o Farmland will be located near the settlement.

o The allocated land area per household will be 2.4 ha (15 rais), consisting of both residential land and farmland.

o The relevant infrastructure, including the demarcation of farmland and the construction of farm roads, shoud be improved for efficient farming.

o The existing school, medical center and roads should be improved and such public facilities as an administration office and a meeting hall should be provided to raise the living standard of the inhabitants.

o Those houses and farmland belonging to Sor Tor Kor farmers living in Phu Toei will not be touched.

Table 6—19　Land Requirement for Forest Village Plan for an Expected 100 Households

Item	Area (ha)	Remarks
Residential and farming area	240 ha	Residential area per household:0.5-1.0 rai, Farmland:14.0-14.5 rais, totalling 15 rais (2.4 ha)
Public facility site	30 ha	Roads: 15 ha, Buildings and others: 15 ha
Sub-total	270 ha	
Bamboo forest	29 ha	Source of bamboo supply for local use
Communal forest for firewood	30 ha	Source of firewood supply for local use
Natural forest	72 ha	Reserved forest along the road side
Sub-total	131 ha	
Total	401 ha	

② Farming Plan

With a living area of 0.5 - 1.0 rai and farmland of 14.0 - 14.5 rais, totalling 15 rais (2.4 ha), a plan will be made to secure food for self-consumption by planting relevant crops and to stabilize village life through cash income obtained from cash crops.

The Forest Village Plan area is very suitable for farming purposes since it has excellent growability and arability based on the soil characteristics; a good pH value, favourable soil properties, a thick soil layer and less gravels. The annual cash income of farmers in the model area is less than farmers in the project area due to the selection of cash crops and the low level of cultivation techniques.

Based on interview, it has been determined that the area required to produce sufficient rice for self-consumption is approximately 6.0 rais (1 ha) per household Crops for which there is a strong demand and which are highly profitable will be planted on farmland other than that used for rice production. Possible cash crops include chilli, castor beans, groundnuts, mung beans and cotton.

Fruit raising is also recommended for farmland far from villages and for sloping land.

With regard to cultivation techniques, it is important that a crop rotation system be introduced, that compost be applied to preserve the soil productivity and that farmland is not burnt. Multiple cropping, including the double cropping of paddy rice and vegetables, will become feasible with the provision of irrigation facilities. The well balanced distribution and effective utilization of the labour force should be achieved by the proper selection of crops and coordinated seeding and control work in order that reforestation and intercropping in the agrosilviculture area is not disturbed.

In regard to domestic animals, the raising of chickens for self-consumption is recommended to provide a source of protein.

Furthermore, sales channels for the agricultural products should be secured and finance and technical guidance, etc. should be provided.

(5) Communal Forest Plan

A communal forest will be established to provide a source of firewood for self-consumption by the 100 households planned to constitute the Forest Village. This forest will be established based on the following considerations.

① Volume of wood consumption for firewood

An annual wood consumption volume of 0.705 m³ per person was found by the interview survey. As the average number of people per household in the model area is 5.0 persons, the annual wood consumption per household is 3.525 m³ (0.705 m³/person x 5 persons). 353 m³ a year will, therefore, be required for the entire Forest Village consisting of 100 households.

② Tree species and cutting age

The planting tree species will be eucalyptus (*Eucalyptus camaldulensis*) with a cutting age of 5 years and a 5 years rotation by coppicing will be repeated twice.

③ Yield

According to the available information, the average stand volume is 141 m³ (125 - 156 m³)/ha at the spacing of 2m x 2m at the cutting age of 5 years. The average stand volumes calculated by the ratio of trees at the same age are 71 m³/ha at the spacing of 4m x 2m and 35 m³/ha at the spacing of 8m x 2m.

④ Spacing and planting area

Spacing of 4m x 2m (1,250 trees/ha) will be employed as the standard and spacing of 8m x 2m (625 trees/ha) will also be planned to conduct intercropping tests. The planting area required to correspond to the annual consumption of 353 m³ by 100 houdeholds will be 6ha, (354m³/ha in each 5 years cutting age), consisting of 4 ha of the 4m x 2m spacing area (1,250 trees/ha producing a growth volume of 284 m in each 5 year cutting age) and 2 ha of the 8m x 2m spacing area (625 trees/ha producing a growth volume of 70 m³ ineach 5 year cutting age). As the cutting age is given as 5 years, the required area will be 30 ha.

⑤ Establishment of communal forests

Communal forest sites are those which are currently secondary forests and farmland in Compartment 1 which are subject to the Forest Village Plan and which are classified as F_1. Establishment and the usage of communal forests will be based on the following principles.

a.   Seedings will be provided by the RFD.

b.   Site preparation, planting and weeding is to be communally conducted by the inhabitants of the Forest Village under the guidance and supervision of the RFD.

c.   Harvesting will be communally conducted by the inhabitants of the Forest Village under the guidance and supervision of the RFD.

d.   Branches, etc. produced following the reforestation and farm land preparation work during the 5 year growth period will be collected for use as firewood.

e.   Firewood obtained from the communal forest will be used for self-consumption.

f.   Sites for communal forests will be lent by the Government with authorized ground rights for planting trees. However, in view of the communal use principle, a contract specifying the ground rights will be made between the RFD and the Communal Forest Association.

(6) Agrosilviculture Plan

① Reforestation plan

a.　Basic plan

Reforestation activities in the agroforestry area will be implemented in accordance with the artificial forest work

criteria and the reforestation plan for forestry areas, an agrosilviculture system will be introduced with planting afterclear cutting and intercropping between planting rows.

Tree species for planting will be teak (*Tectona grandis*) which has long cutting period and eucalyptus (*Eucalyptus camaldulensis*) which has fast growth.

The areas subject to annual reforestation will be 32 ha for teak and 32 ha for eucalyptus, totalling 64 ha. The regularcutting ages are 50 years for teak and 5 years for eucalyptus.In the case of eucalyptus, however, 2 further fellings are anticipated at coppice rotation of5 year intervals.

510 ha will be subject to agrosilviculture as follows.

Reforestation area: Teak	320 ha
Eucalyptus	160 ha
Other use areas (forest roads, firebreaks and facility sites, etc.)	30 ha
Total	510 ha

A reforestation compartment consisting of 16 ha of planting area and 1 ha of left-over area (consisting of forest roads and firebreaks, etc.) totalling 17 ha, will be designated as a sub-compartment. Reforestation activities will be conducted annually to establish 2 sub-compartments of teak and 2 sub-compartments of eucalyptus and their locations will be planned so that they are dispersed and not adjacent.

The spacing for each tree species will be as follows.

Teak   4m x 3m (833 trees/ha)
              4m x 4m (625 trees/ha)

Eucalyptus   4m x 2m (1,250 trees/ha)

Table 6—20 shows the planting, felling and regeneration plan for each tree species.

b. Work implementation plan
The preparatory work should be completed as described below prior to the implementation of reforestation work.

i) The boundaries of the planned 510 ha for the reforstation area should be clearly staked.

ii) There will be 30 sub-compartments in the reforestation area and the locations of those sub-compartments should be identified in accordance with the annual plan. Following the location identification, the total area should then be calculated (the basis unit area for 1 sub-compartment is 17 ha).

iii) Clear cutting will be conducted if the subject site consists of natural, secondary or bamboo forest. Branches, etc. left on the site will be collected by the local inhabtants for use as firewood.

iv) Forest roads will be constructed in accordance with the forest road plan.
The necessary work for the implementation of reforestation will consist of the following.

i) Planting a site of 16 ha in 1 sub-compartment, left-over and reserved for forest roads and firebreaks, will be determined.

ii) Following the completion of felling, the land preparation method of burning will be employed.

iii) Marking sticks of planting positions will be erected in accordance with the correct spacing of the tree species to be planted.

Table 6-20 Transition of Acreage of Planting, Harvesting and Regeneration by Coppice in the Agroforestry Area

Species	Compartment No.	Sub-compartment No.	Average (ha)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Teak	2	1	16) 32	P																				
		2	16																					
		3	16) 32		P																			
		4	16																					
		5	16) 32			P																		
		6	16																					
		7	16) 32				P																	
		8	16																					
		9	16) 32					P																
		10	16									Foresty area after 11 years												
		11	16) 32						P															
		12	16																					
		13	16) 32							P														
		14	16																					
		15	16) 32								P													
		16	16																					
		17	16) 32									P												
		18	16																					
		19	16) 32										P				→							
		20	16																					
		Planting acreage Total		32 / 32	32 / 64	32 / 96	32 / 128	32 / 160	32 / 192	32 / 224	32 / 256	32 / 288	32 / 320											
Eucalyptus	2	21	16) 32	P					C					C					C					The rest is repeated.
		22	16																					
	3	1	16) 32		P					C					C					C				The rest is repeated.
		2	16																					
		3	16) 32			P					C					C					C			The rest is repeated.
		4	16																					
		5	16) 32				P					C					C					C		
		6	16																					
		7	16) 32					P					C					C					C	
		8	16																					
		Planting acreage Total		32 / 32	32 / 64	32 / 96	32 / 128	32 / 160	0 / 128	0 / 96	0 / 64	0 / 32	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 32	0 / 96	0 / 64	0 / 32	0 / 0	The rest is repeated.
		Harvesting acreage Total							32	32	32	32	32	32	32	32	32	32	32	96	64	32	0	The rest is equaled.
		Coppice regeneration acreage Total							32 / 32	32 / 64	32 / 96	32 / 128	32 / 160	32 / 160	32 / 160	32 / 160	32 / 160	32 / 160	0 / 128	0 / 96	0 / 64	0 / 32	0 / 0	The rest is repeated.

P: Planting, C: Cutting

Table 6 −21 Work Step per ha

Item	Work step per labourer per day		Labourer/day/ha	Remarks
Demarcation of planting area	125 m		3.2	Cutting, surveying, drafting
Land preparation	Manpower 300 m²	4×2ᵐ 4×3 4×4	8.3	Planting row 4 m, 1m wide line weeding 2,500 m²
		8×2	4.2	Planting row 8 m, 1m wide line 1,250 m²
	Bush cutter 1,000 m²	4×2ᵐ 4×3 4×4	2.5	Planting row 4 m, 1m wide line weeding 2,500 m²
		8×2	1.3	Planting row 8 m, 1m wide line 1,250 m²
Sticking	300 sticks	4×2ᵐ	4.2	1,250 sticks
		4×3	2.8	833 sticks
		4×4 8×2	2.1	625 sticks
Planting	Teak 400 plants	4×3ᵐ 4×4	2.1 1.6	Stump stock 833 plants 〃 625 〃
	Other species 150 plants	4×2 8×2	8.3 4.2	Potted seedling 1,250 plants 〃 625 〃
Replacement planting	Teak 400 plants	4×3ᵐ 4×4	0.4 0.3	Replacement rate 167 plants 20% 125 〃
	Other species 150 plants	4×2 8×2	1.7 0.8	Replacement rate 250 plants 20% 125 〃
Weeding	Manpower 250 m²	4×2ᵐ 4×3 4×4	10.0	Planting row 4 m, 1m wide line weeding 2,500 m²
		8×2	5.0	Planting row 8 m, 1m wide line weeding 1,250 m²
	Bush cutter 1,000 m²	4×2 4×3 4×4	2.5	Planting row 4 m, 1m wide line weeding 2,500 m²
		8×2	1.3	Planting row 8 m, 1m wide line weeding 1,250 m²

iv) Actual planting will be carried out. In Thailand, the transportation and planting of stock is usually conducted by the same worker. While this method is suitable in the case of bare rooted seedlings, the introduction of an independent transportation method where the work is conducted by a group of 4—5 workers will facilitate work in the case of potted seedlings.

v) A weeding and growth rate survey will be conducted. It is a general practice in Thailand used biannually for 5 years. The required weeding period will be decided taking the tree species to be planted and the vegetation of the subject sites into consideration.

c. Work processes

Based on the collected information and the interview survey results, the processes for each type of the required work per ha have been determined as shown in Table 6—21. The number of labours per annual reforestation area for each tree speciesis shown in Table 6—22.

Table 6—22 Labourers for Annual Planting Acreage by Species

Item	Agrosilviculture			Communal forest	
	Teak		Eucalyptus	Eucalyptus	
	4×3^m	4×4^m	4×2^m	4×2^m	8×2^m
Acreage (ha)	16	16	32	4	2
No. of planting tree (sticks)	13,328	10,000	40,000	5,000	1,250
Demarcation of planting area (labourer)	12.8	12.8	25.6	7.8	
Land preparation (labourer)	132.8	132.8	265.6	33.2	8.4
Sticking (labourer)	44.8	33.6	134.4	16.8	4.2
Planting (labourer)	33.6	25.6	265.6	33.2	8.4
Replanting (labourer)	6.4	4.8	54.4	6.8	1.6
Sub-total (labourer)	(230.4)	(209.6)	(745.6)	(9.0)	(22.6)
	440.0		745.6	120.4	
Weeding (2times/year, every year) (labourer)	640.0		640.0	90.0	

Table 6-23 shows the total number of labourers required for the teak and eucalyptus planting activities, ranging from the identification of the work sites (determination of subcompartments) to weeding for each according to the reforestation plan. The number of labourers given in this table does not include the work by survey engineers and work supervisors.

Table 6 -23 Total Labourers by Year

Year	Teak				Eucalyptus				Total
	Planting		Weeding		Planting		Weeding		
	ha	labourer	ha	labourer	ha	labourer	ha	labourer	labourer
1	32	440	32	640	32	745.6	32	640	2,465.6
2	32	440	64	1,280	32	745.6	64	1,280	3,745.6
3	32	440	96	1,920	32	745.6	96	1,920	5,025.6
4	32	440	128	2,560	32	745.6	128	2,560	6,305.6
5	32	440	160	3,200	32	745.6	160	3,200	7,585.6
6	32	440	160	3,200	Regeneration by coppice		160	3,200	6,840.0
7	32	440	160	3,200	↓		160	3,200	6,840.0
8	32	440	160	3,200			160	3,200	6,840.0
9	32	440	160	3,200			160	3,200	6,840.0
10	32	440	160	3,200			160	3,200	6,840.0

d. Intercropping plan

The introduction of intercropping in the fields between the planting rows in the agrosilviculture and communal forest for firewood areas will eliminate the necessity for weeding and will provide the participating inhabitants with a source of cash income.
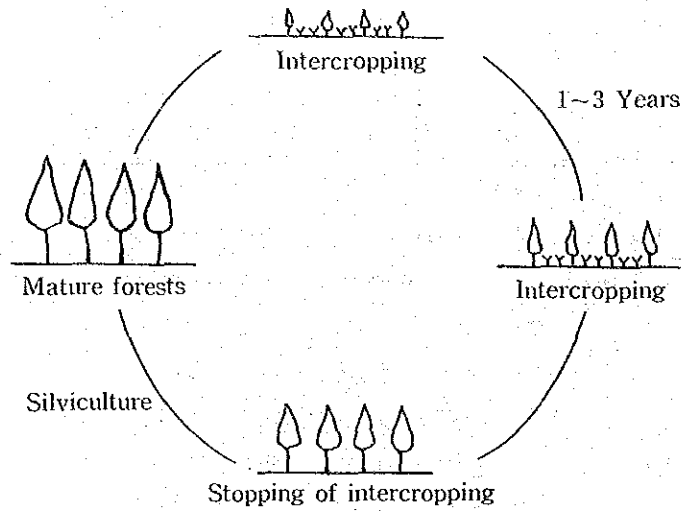
Fig.6-4 Agrosilviculture System

On the slope land
trees should be planted
along the contour line.

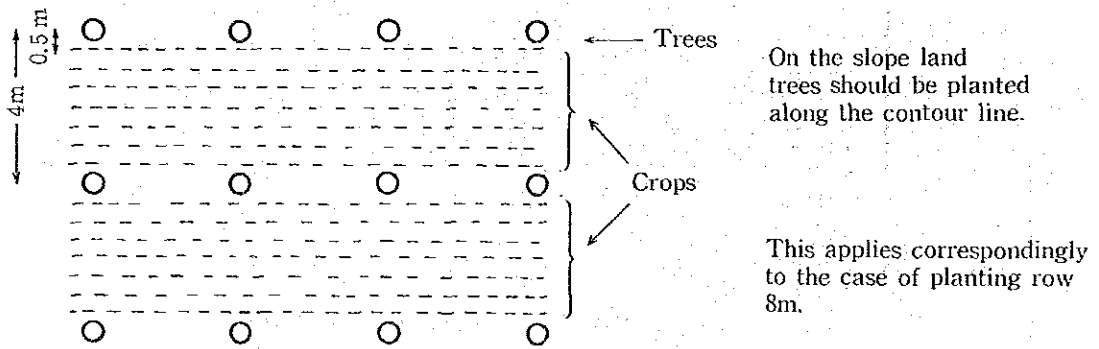This applies correspondingly
to the case of planting row
8m.

Fig.6-5 Plane Arrangement of Intercropping
(in case of planting row 4m)

The subject area for intercropping covers planting sites of 32 ha of teak, 32 ha of eucalyptus and 6 ha of communal forests, totalling 70 ha. The intercropping periods will be 2 years for teak planting sites, 1 year for eucalyptus planting sites with spacing of 4m x 2m and 3years for eucalyptus planting sites with a spacing of 8m x 2m.

The participation of the local inhabitants in agrosilviculture will be promoted by the following means.

i) Intercropping by the inhabitants at all the planting sites will be encouraged to avoid the necessary weeding.

ii) Participating inhabitants will enter into an agreement with the RFD concerning the intercropping location, area and duration.

The crops will be cultivated at a distance of at least 50 cm from the trees. Given a distance between the planting rows of 4 m, the ratio of farmland will be 75%. As $F_1 \cdot F_2$ areas are particularly suitable for farming, labour productivity will be further increased by mechanization. Contour farming must be introduced in the sloping areas in view of soil conservation and work efficiency (refer to Fig 6—4 and 6—5).

As the repeated cultivation of the same crops will result in a gradual decline of the yield, a crop rotation system (eg. rice, beans and potatoes) will be introduced.

The crops to be selected should be suitable for extensive farming and should have a good cash income prospect. Possible crops include maize, groundnuts, soy beans and cassava.

② Planting stock raising plan

Table 6—24 shows the annual planting area based on the reforestation and communal forest plans.

Table 6—24 Planting Acreage by Year

(Unit : ha)

| Year | Reforestation area | | | Communal forest | | Total |
| | Teak | | Eucalyptus | Eucalyptus | | |
	$4^m \times 3^m$	$4^m \times 4^m$	$4^m \times 2^m$	$4^m \times 2^m$	$8^m \times 2^m$	
1	16	16	32	4	2	70
2	16	16	32	4	2	70
3	16	16	32	4	2	70
4	16	16	32	4	2	70
5	16	16	32	4	2	70
6	16	16	—	—	—	32
7	16	16	—	—	—	32
8	16	16	—	—	—	32
9	16	16	—	—	—	32
10	16	16	—	—	—	32
Total	160	160	160	20	10	510
	320			30		

o Teak

Spacing 4m × 3m   833 trees/ha × 16 ha = 13,328
        4m × 4m   625 trees/ha × 16 ha = 10,000

Sub-total   23,328

For replacement planting (20%)   4,666

Grand-total   27,944

                       Approximately   28,000

o Eucalyptus

Spacing 4m × 2m   1,250 trees/ha × 36 ha = 45,000
        8m × 2m   625 trees/ha × 2 ha = 1,250

Sub-total   46,250

For replacement planting (20%)   9,250

Grand-total   55,500

Based on the above planting area planned for each year, the rate of stock production required annually for each tree species with a plantable plant rate of 80% is given as Table 6—25.

Table 6 —25   Nursery Stock Production for Each Species

(Unit : Number of stock)

Year	Species	Stocks for planting	Stock production	Total
1	Teak	28,000	35,000	104,400
	Eucalyptus	55,500	69,400	
2	Teak	28,000	35,000	104,400
	Eucalyptus	55,500	69,400	
3	Teak	28,000	35,000	104,400
	Eucalyptus	55,500	69,400	
4	Teak	28,000	35,000	104,400
	Eucalyptus	55,500	69,400	
5	Teak	28,000	35,000	104,400
	Eucalyptus	55,500	69,400	
6	Teak	28,000	35,000	35,000
	Eucalyptus	—	—	
7	Teak	28,000	35,000	35,000
	Eucalyptus	—	—	
8	Teak	28,000	35,000	35,000
	Eucalyptus	—	—	
9	Teak	28,000	35,000	35,000
	Eucalyptus	—	—	
10	Teak	28,000	35,000	35,000
	Eucalyptus	—	—	
Total	Teak	28,000	35,000	697,000
	Eucalyptus	277,500	347,000	
Grand-total		857,500	697,000	697,000

③ Facilities plan

The administration of a national reserve forest involved forest management, reforestation work, nursery management and forest village management, etc. Therefore, a national reserve forest administration office to supervise the said works will be located on the site reserved for public facilities in the Forest Village.

The following additional facilities will be set up to be responsible for the various types of work.

a. Facilites for the reforestation works

The reforestation work office will be responsible for the control of the reforestation work and will be located on the above-mentioned site adjacent to the planned reforestation area. The office plot should be sufficiently large enough to accommodate the following.

- o Reforestation work office
- o Warehouse
- o Machine storage
- o Others

b. Facilities for the nursery works

The requirement for a nursery depends on whether all the stocks are self-produced or purchased externally. Here, selfproduction is assumed. The site for the nursery should be preferably flat with fertile soil and should satisfy the following requirements.

i) Stable water supply
ii) Short distance from reforestation sites
iii) Sufficient size
iv) Stable labour supply

The currently proposed site is near Forest Protection Unit 6 although it is located outside the model area. The size of the nursery will be some 10 ha and the following facilities will be provided.

- o Administration office
- o Fields (nursery and watering facilities)
- o Workshop (germination house, soil storage, potting house and seedling storage)
- o Water supply and reservoir
- o Warehouse
- o Machine storage
- o Others

c. Forest Village administration office

This office will be responsible for the administration of the Forest Village and will be located on the site in the village reserved for public facilities. In addition, a meeting hall for the inhabitants will be constructed. The site will have a size of some 3 ha.

6.4 Conservation Area Plan

(1) National park area

12,749 ha of the southern half of the model area belongs to the Srinagarind National Park.

The Thai National Park Act prohibits felling and the conversion of forest land to farmland, etc. within national parks.

The current land use of the model area inside the Srinagarind National Park consists of 12,319ha of forest area (11,732ha of forest and 587 ha of rocky, left-over area) and 430 ha of land other than forest (261 ha of farmland, plantation and village land, 46 ha of grassland, 61 ha of bare land and 62 ha of rivers and others). Approximately 45 families live in the said area and the number of families and the amount of land used for farming has shown a tendency to increase while felling in view of obtaining firewood has continued. As it is clear that forest destruction will be accelerated with the advancement of the current tendency described here, the early implementation of forest protection measures is called for.

Plans to be introduced in the national park area are as follows.

① Forest protection and recovery

In view of the area's designation as a national park, priority is given to forest protection with the following measures.

i) National park boundaries will be clearly determined and the park's existence clearly indicated by notice boards and signs, etc.

ii) Afforestation efforts will be implemented for the early recovery of forests in the 368 ha of land which is currently used as farmland or which is grassland or barren land. As most of the land where there are few trees is fertile, it is believed that forest recovery will not be difficult.

The forests will reappear even if the land is left unattended. However, to show the intention of forest management, it is recommended that artificial forest recovery measures be urgently taken.

iii) The trees to be planted will be those found in adjacent forests or those assumed to have existed prior to felling. Possible species include *Depterocarpus* spp., *Hopea* spp., *Shorea* spp., *Afzelia* spp., *Pterocarpus* spp., *Dalbergia* spp. and *Xylia* spp.. Additional species suitable for reforestation will also be selected in view of producing mixed forests.

iv) With regard to secondary forests (79 ha), natural recovery is intended without artificial assistance.

v) Trees will be planted where they are scarce in areas classified as T_E, M_D, and D_D.

vi) The renewal of forests classified as D_D will not be easy due to frequent burning although it has a tendency towards natural regeneration. The practice of burning will, therefore, be prohibited to facilitate forest establishment.

vii) Many old work roads used for felling and other types of roads are found all over the area. As the existence of these roads facilitates illegal felling, thus leading to further forest destruction, all entries to them from main roads will be blocked.

viii) While work roads for maintenance, reforestation and forest recovery purposes will be improved, their use will be prohibited except by authorized persons.

② Designation of research forests

As national parks are not subject to artificial manipulation, including felling, they are extremely suitable for various research. Accordingly, research forests with study units will be designated and the locations of these study units will be fixed so that continuous data can be obtained. Research to be conducted will include a growth survey on the planted trees, a survey on the growth and the sequence of forest tree composition, etc. of natural forests once extracted (T_E, M_D and D_D).

The locations and areas of research forests will be clarified by surveying at the time of their designation. The forest composition found by the forest survey will be recorded in the forest survey register. The existence of research forests will be clearly indicated by signs and the size and number of the locations of study units will be determined onthe basis of the intended purposes.

The proposed sites for research of natural forests are: Sub-compartment 25 of Compartment 5, Sub-compartment 20 of Compartment 7 for T_E, the relevant Sub-compartment of Compartment 4, 6 and 7 for M_D, and Sub-compartment 26 and 37 of Compartment 1 and Sub-compartment 9 and 10 of Comparment 13 for D_D.

Since continuous study over a long period of time is required to obtain effective research results, the responsible organization and data processing accumulation method must be clearly determined in advance.

③ Utilization plan

The designation of the Srinagarind National Park was a relatively recent decision made mainly in view of forest preservation and protection. While the adjacent Erawan National Park and the Saiyok National Park located nearby are very popular, as shown by the annual number of visitors, i.e. 466, 241 (ranked first in terms of visitors) and 157,164 (ranked eighth), the Srinagarind National Park only attracts some 30,000 visitors a year (one-fifteenth and one-fifth of the visitors to the Erawan and Saiyok National Parks respectively) due to its extremely poor access. If the conditions of the roads leading to the Srinagarind National Park are improved, the number of visitors will definitely increase due to its proximity to the most popular Erawan National Park. To achieve this, a plan with the following contents should be considered for implementation in the future.

According to the Thai National Park Act, national parks are divided into 6 zones, i.e. intensive use zone, outdoor recreation zone, primitive zone, strict nature reserve zone, special use zone and recovery zone. This zoning system should be applied to the Srinagarind National Park (see Table 4−24 for details of the zoning system) and the current site of the Srinagarind Park Administration Office and accommodation facilities should be considered for the intensive use zone although it is outside the national park area and within the model area. In the case of the other zones, a draft plan indicating

their locations should be prepared in advance taking aerial topography maps, field survey data, forest protection plans, forest recovery plans and test and research forest plans into consideration.

(2) Land and water conservation area

The mountainous area in the east of the model area will be designated as a land and water conservation area (mountain conservation area and water basin conservation area) and its current state will be preserved.

As this area is characterized by steep slopes, a thin soil layer and many outcropping rocks, forest regeneration (either artificialor natural renewal) would appear to be difficult. The area is vulnerable to any sudden changes in the environment. In the case of felling, land devastation will certainly spread from the felling site. Forest destruction in this area will cause an increased sediment flow and floodrunoff and most likely result in severe damage to the Srinagarind Damand downstream areas. In view of this, forests in this area will not be touched except to preserve their present condition.

7.0 RECOMMENDATION

(1) The present report denotes the results of the forest resources survey and the model plan of forest management in order to contribute to the optimum management of national reserve forests. The plan was formulated around the basic matters. Therefore if these plans are to be executed by the RFD, and the implementation design based on the past operating results, it will be necessary to establish detailed data and so on.

(2) The execution of these plans will require the consideration of the following counterplans.

① Road Improvement

Roads constitute the basis of forestry production. The main roads such as that running along the western shore of Lake Srinagarind, and that leading to Thong Pha Phum and also the mining road, should be improved.

② Consolidation of Research Work

An understanding of tree growth is the basis of forest management. The only way to obtain this growth data is through setting up government-owned research forests for long-term observation and, therefore, it is hoped that research forests will be systematically established by the appropriate section of the RFD for the immediate commencement of tree growth observation. It is recommended that these research forests be located in protected national parks in view of being maintained for a long period of time.

③ Recreation Facilities

National parks near by have been attracting quite a number of visitors. The basic data accumulated through this project must be well utilized in order to prepare several facilities to the national park.

④ Forest Village Plan

When the proposed plan of the establishment of a forest village in the model area, excepting national park area is executed, the RFD will nead to adjust the handling of the settlement with the persons concerned.

(3) The plan serves as a model plan of forest management planning. In conclusion, it is hoped that in the future similar plans will be prepared for all the national reserve forests of Thailand following this model and employing the same survey techniques.