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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

DIRECTORATE GENERAL OF FORESTRY, UNDERSECRETARIAT OF NATURAL  
RESOURCES, SECRETARIAT OF ENVIRONMENT, NATURAL RESOURCES AND  
FISHERIES (SEMARNAP), THE UNITED MEXICAN STATES

**THE STUDY ON THE SUSTAINABLE  
DEVELOPMENT PLAN OF FORESTS  
AT VILLAGES IN OAXACA  
IN THE UNITED MEXICAN STATES**

**FINAL REPORT**

**JANUARY, 1999**

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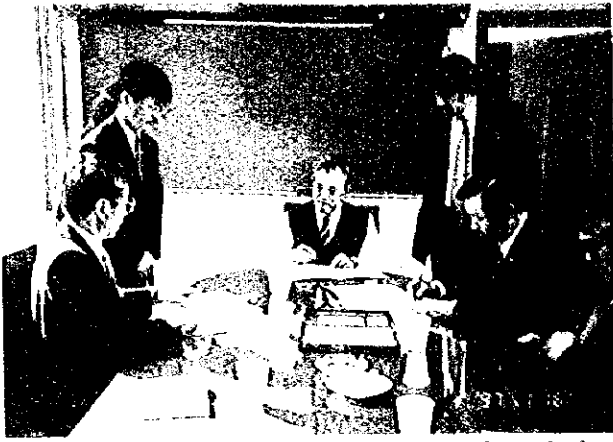
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Discussion with Mr. Victor Sosa, Director General of Forestry, SEMARNAP



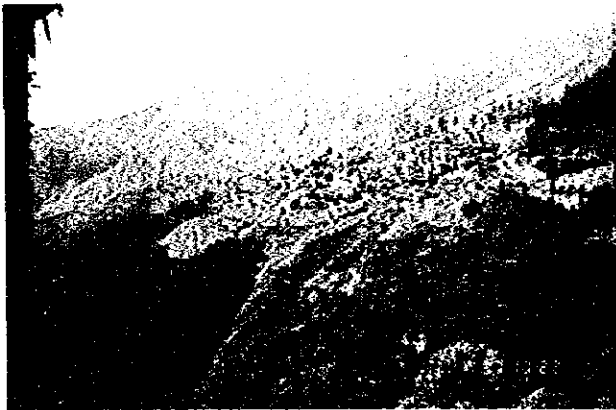
Discussion at Delegación en Oaxaca, SEMARNAP



Technology transfer Seminar (December 10, 1998, Guelatao)



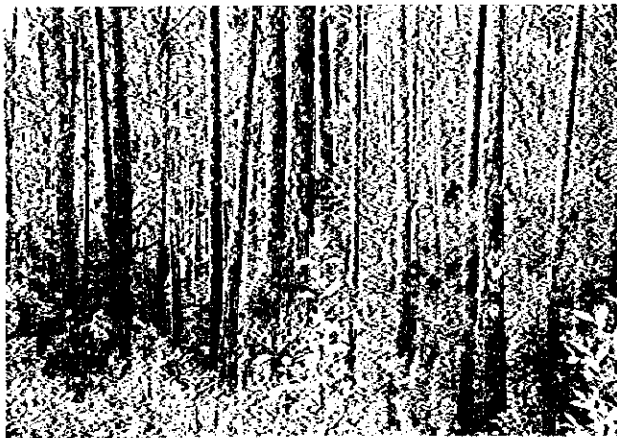
Technology transfer Seminar (December 10, 1998, Guelatao)



A distant view of Santa María Las Nieves



A distant view of San Juan Teponaxtla



A pine forest of excellent growth



A pine forest where natural regeneration did not occur after clear felling. Stand improvement should be conducted in this type of forest



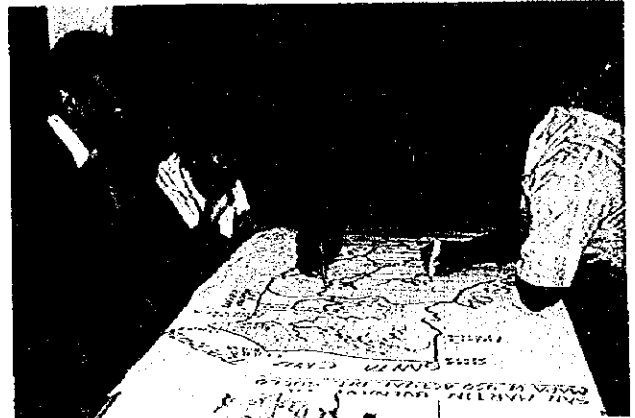
Forest inventory with the participation of comunidad inhabitants (San Juan Teponaxtla)



Forest operation survey with the participation of Comunidad inhabitants. Explanation to the inhabitants on forest development method (San Juan Teponaxtla)



Soil survey. Description of a soil profile



Socio economic survey (RRA survey with the participation of Comunidad inhabitants)



Discussion with Comunidad inhabitants on forest management plan formulation (Santa María las Nieves)



Explanation by Comunidad inhabitants on forest development based on the knowledge they gained through participation in forest operation survey



A view of an area affected by forest fire of May, 1998 (San Martín Buenavista)



Discussion on post forest fire measures by Comunidad inhabitants in a workshop held with their participation

## PREFACE

In response to the request from the Government of the United Mexican States, the Government of Japan decided to conduct the Study on The Sustainable Development Plan of Forests at Villages in Oaxaca in the United Mexican States and entrusted the study to Japan International Cooperation Agency (JICA).

JICA sent to the United Mexican States the study team headed by Mr. Noriyuki Anyoji, Japan Forest Technical Association and Pasco International Inc., five times between January 1997 to October 1998.

The team held discussions with the officials concerned of the Government of the United Mexican States, and conducted field studies in the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the United Mexican States for their close cooperation extended to the team.

January, 1999



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Kimio Fujita  
President

Japan International Cooperation Agency



## LETTER OF TRANSMITTANCE

January, 1999

Mr. Kimio FUJITA  
President  
Japan International Cooperation Agency

Dear Mr. FUJITA,

It is our great pleasure to submit the Final Report for the Study on the Sustainable Development Plan of Forests at Villages in Oaxaca in the United Mexican States.

The Report compiles the findings of the field surveys conducted between January, 1997 and January, 1999 by the joint venture (Japan Forest Technical Association and Pasco International INC.), analysis results of the field survey findings and prepared plans, etc. based on the contract between Japan International Cooperation Agency and the joint venture.

In the course of the Study, a sustainable forest development plan designed to contribute to the development of comunidades by means of forestry development utilising forest resources controlled by comunidades in the Study Area has been formulated together with a forest management plan for three of the four comunidades selected from among comunidades in the Study Area and forest management guidelines incorporating rehabilitation measures for the one remaining selected comunidad which had been affected by forest fire.

It is our strongest hope that the Sustainable Development Plan of Forests at Villages in Oaxaca will be precisely implemented through the efforts of the Government of Mexico as well as all other related bodies to make forests in Mexico richer and to promote forestry in Mexico.

We would like to express our gratitude to the officials of JICA, the Ministry of Foreign Affairs and the Ministry of Agriculture, Forestry and Fisheries for their understanding of and assistance for the Study. We would also like to point out the importance of the advice and assistance given to the Study Team by members of JICA's Mexico Office, the Japanese Embassy in Mexico, the Directorate General of Forestry, Undersecretariat of Natural Resources, Secretariat of Environment, Natural Resources and Fisheries (SEMARNAP) and the Secretariat of Agriculture, Livestock and Forest Development of the Oaxaca State (SEDAF).

We sincerely hope that this Report will be actively used by JICA to materialise and promote the Plan concerned.

安養寺紀幸

---

Noriyuki ANYOJI

Team Leader,

Study Team for the Study on the Sustainable Development  
Plan of Forests at Villages in Oaxaca in the United  
Mexican States

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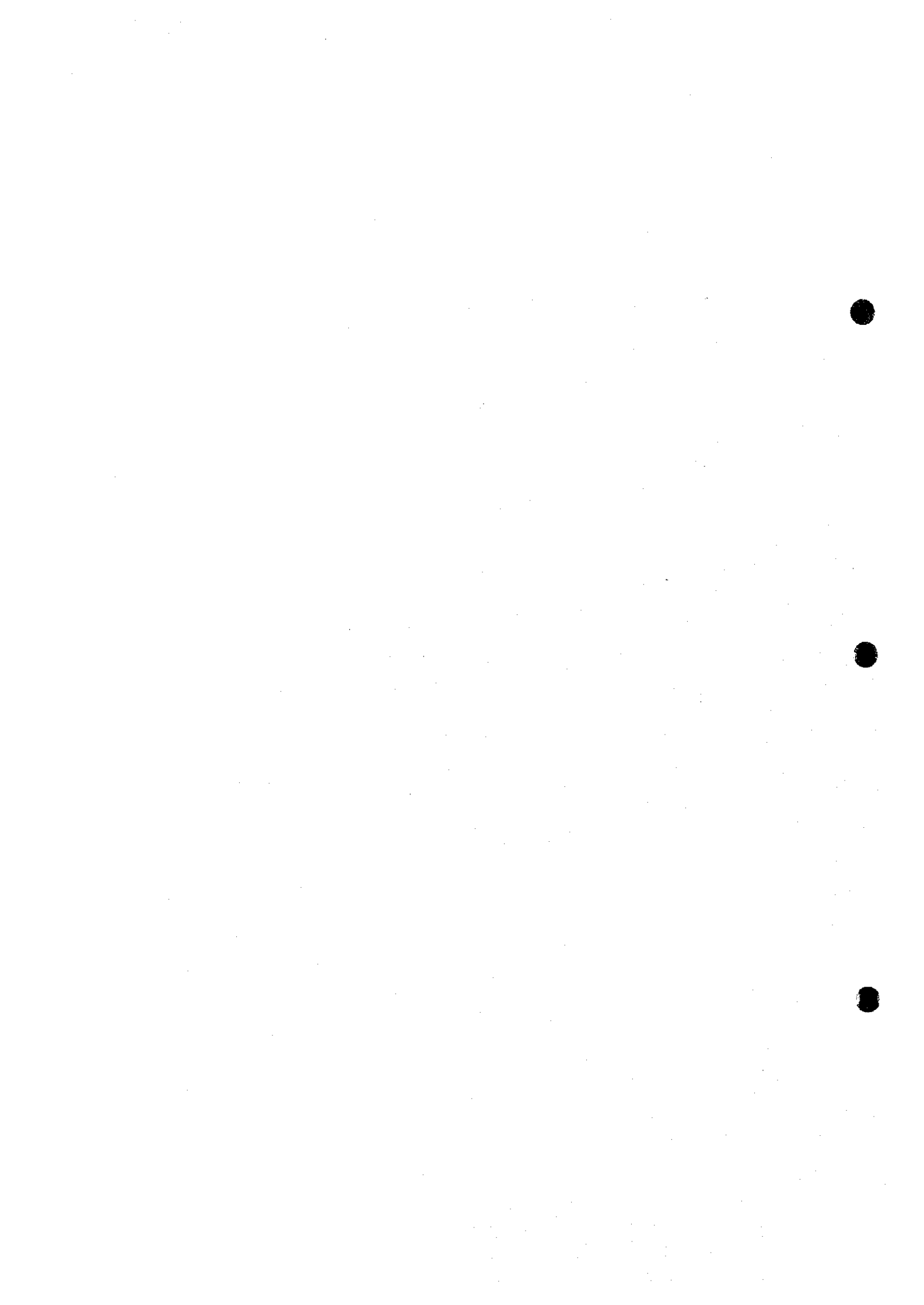
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## SUMMARY



# SUMMARY

## 1. Outline of the Study

This Study has been conducted to achieve three objectives, i.e. (i) formulation of a sustainable forestry development plan (Master Plan) designed to facilitate the conservation as well as use of forests in the Study Area of some 160,000 ha in the Sierra Juarez area in Oaxaca State, (ii) formulation of a forest management plan for each of four Pilot Areas, namely, S.M. Las Nieves, S.M. Totomoxtla, S.M. Buenavista and S.J. Teponaxtla, which were selected from among comunidades (communities) in the Study Area and (iii) transfer of technologies required for forestry activities to the Mexican side through work related to the Study. In the case of S.M. Buenavista, forest management guidelines have been formulated instead of a forest management plan as most of the forests in this comunidad were damaged by a major forest fire in May, 1998.

## 2. Aerial Photography and Preparation of Topographical Maps

### 2.1 Aerial Photography

Aerial photographs with a scale of 1/25,000 were taken over an area of 190,000 ha, consisting of the Study Area and areas outside the Study Area but belonging to the same administrative area as the Study Area.

### 2.2 Preparation of Topographical Maps

The existing topographical maps of the Study Area (scale: 1/50,000) were enlarged and roads, settlements and other items were revised based on the aerial photographs to produce new topographical maps (scale: 1/25,000). In the case of the Pilot Areas, new topographical maps (scale: 1/10,000) were prepared using the aerial photographs.

## 3. Sustainable Forestry Development Plan (Master Plan)

### 3.1 Characteristics of Sustainable Forestry Development Plan

For many comunidades in the Study Area, forest resources are the only natural resources worthy of consideration. The appropriate management of forest resources and the development of forestry are essential for the development of comunidades. Such forestry development using forest resources can contribute to the development of a comunidad in the following manner.

- (1) Improvement of the living infrastructure using the income from forest management.
- (2) Increased income and employment opportunities by means of participating in forest production activities.
- (3) Establishment of the commitment of local people by means of demonstrating their ability to act with a sense of purpose through the active participation in forest management and forest production activities and also the formation of an internal development force through such activities.

The present state of forest use varies from one comunidad to another depending on the site conditions and available forest resources while the development stage of the living infrastructure also varies depending on the degree of forest use. Those comunidades with rich pine resources can aim at facilitating further local development through forestry development and, therefore, can be described as forestry development areas.

The main focus of the Master Plan is the implementation of forest management which is capable of sustaining the various public benefit and economic functions of forests. It also indicates preferable measures to be implemented by each comunidad for forestry development in view of its particular site conditions, available forest resources and state of forest production activities so that each comunidad can understand the suitable direction for its forest management using the Master Plan as a model for such management.

### **3.2 General Conditions of Study Area**

Of the administrative area of 190,000 ha which incorporates the Study Area, forests occupy 160,000 ha (83%), consisting of 9,000 ha (5%) of Pine Forests, 76,000 ha (40%) of Pine-Quercus Forests, 10,000 ha (5%) of Quercus Forests, 14,000 ha (7%) of Selva Baja and 50,000 ha (26%) of Mountain Mesofilo Forests and their secondary forests.

The Study Area is divided into the northern part and the southern part by the Sierra Juarez mountain range. The northern part consists of Mesofilo Forests due to the influence of wet air from the Gulf of Mexico while the southern part shows varying vegetation from high, dense forests at a higher elevation to low, less dense forests at a lower elevation and further to Selva Baja in the lowest elevation areas.

There are 25 comunidades and two ejidos in the Study Area with a total population of some 23,000, of which 99% belong to such local ethnic groups as Zapoteco, Chinanteco and

Cuicateco. The economic reality of each comunidad is determined by its accessibility to a trunk road and the availability of forest resources and the level of living infrastructure in place differs from one comunidad to another.

### 3.3 Basic Concept of Land Use and Forest Use

#### (1) Concept of Land Use

The Study Area has a relative height of 2,500 m and the presence of many steep slopes and gravelly soil make agricultural use difficult in many places. From a legal point of view, the allocation of forest land for farming purposes is illegal. Local people prohibit the liberal felling of pine trees and, in some cases, afford forests spiritual value as they believe them to be sacred. The maintenance of forest land, except that which has been used for settlements or farmland, as forests is appropriate from the natural, socioeconomic and cultural viewpoints.

#### (2) Concept of Forest Use

As there is a limit to the performance of all the functions of forests to the full, forests are categorised based on their priority function(s) in view of the implementation of appropriate forestry operations for each category as described below.

Table 1 Forest Categorisation

Area	Forest Category	Description
Production Area	Timber Production Forest	< Commercial Timber Production Forest > - Forest where commercial timber can be actively produced < Non-Commercial Timber Production Forest > - Forest where commercial timber cannot be actively produced but timber for home use can be produced
	Firewood Production Forest	- Forest where firewood production can be conducted
	Nature Preservation Forest	- Forest where the very existence of the forest or nature requires preservation
Conservation Area	Headwater Conservation Forest	- Forest which is required for water source and river system conservation
	Soil Conservation Forest	- Forest where there is a need to prevent soil erosion or loss
	Other Conservation Forests	- Forests with less vegetation than usual due to climatic and other reasons, requiring preservation or enhancement of the present forest vegetation
Restoration Area		- Forest requiring restoration as the loss of forest vegetation has reduced the soil productivity; this type of forest should be classified as either a production or conservation area in the future

### 3.4 Direction for Future Development

The forest management principles for each forest category are summarised below.

Table 2 Principles of Forest Management by Forest Category

Area	Forest Category		Principles of Forest Management
Production Area	Timber Production Forest	Commercial Timber Production Forest	Clear cutting leaving seed trees for natural regeneration is basically employed for Pine Forests and Pine-Quercus Forests.
		Non-Commercial Timber Production Forest	In principle, such forests are left to natural transition although selective felling is allowed to obtain timber for home use.
	Firewood Production Forest		In principle, selective felling with regeneration by sprouting or natural seeding is employed.
Conservation Area	In principle, no timber production takes place in this area but the following principles apply to felling to maintain local life.		
	Nature Preservation Forest		Minor selective felling is permitted.
	Headwater Conservation Forest		Felling on a minor scale by means of the selective felling or clearcutting of a small area is permitted.
	Soil Conservation Forest		In principle, only minor selective cutting is permitted and felling is prohibited in areas with exposed ground.
	Other Conservation Forests		Minor selective felling is permitted.
Restoration Area			Forest restoration is attempted by means of either natural or artificial regeneration.

The following points must be taken into careful consideration in regard to forest management.

#### (1) Felling

The subject sites, felling volume and felling method must be carefully determined while assuming the state of growth of succeeding stands, including the method of regeneration after felling.

In the case of commercial timber production forests, the target diameter class for production and the rotation age must be determined in accordance with the production target. The standard felling volume must also be determined with the ceiling being the expected level of increment.

## (2) Regeneration

Natural regeneration is the most appropriate way of regenerating pine forests from the technical and economic viewpoints. Ground treatment, including ground clearance, is required to ensure proper regeneration.

## (3) Thinning

Thinning is a type of felling which is conducted prior to regeneration felling and does not involve regeneration. It is conducted at those stands requiring density adjustment.

## (4) Stand Improvement

Stand improvement is conducted at those stands where the regeneration of pine is poor compared to encino (*Quercus* spp.) and other species, which are not the target species for regeneration, after such regeneration felling as selective felling or clear cutting in timber production forests with a view to increasing the growing stock of pine by means of removing encino and other unwanted species to achieve stands with a high pine mix ratio.

### **3.5 Forest Management**

The basic idea of forest management is to manage forests by the formulation of a forest management plan which incorporates the method, scale and subject sites, etc. of the management work for each forest category while taking the sustainable use of forests and desirable direction for forest management into consideration in view of the full performance of the function required of each forest category.

#### (1) Forest Management Plan Period

While the plan period for forest management is generally 5 - 10 years, it is necessary to review the plan at regular intervals.

#### (2) Forest Division

In general, a forest is divided into compartments which in turn are divided into sub-compartments.

#### (3) Management of Production Areas

The management direction is determined by the different forest vegetation reflecting the specific environmental conditions which in turn are determined by the elevation and

specific intentions of an individual comunidad and suitable management in the required direction must be implemented.

(4) Management of Timber Production Forests (Commercial Timber Production)

Fore-running comunidades are required to aim at achieving a more mature style of management which is characterised by intensive forestry work and the improved productivity of forestry operations. In the case of late starting comunidades, their main tasks are to determine the direction for forest improvement based on the present state of forest resources and to identify feasible forest production activities at present in order to consolidate the necessary foundations for forest management with a view to developing forestry activities in the future along the desirable path.

(5) Operation System

A thorough review of the operational components is highly desirable to make workers fully understand operational standards and arrangements in order to improve productivity as well as labour safety.

(6) Production Equipment

As expensive machinery greatly affects the production cost, its efficient use must be achieved through a thorough analysis of its operational status.

(7) Forest Roads

Ordinary roads must be properly maintained for use as local trunk roads. The priority regarding forest roads and spur roads is to improve and repair existing roads for their continued use.

(8) Forest Protection

1) Prevention of Forest Fires

Forest fires in the Study Area are mainly caused by the accidental spread of fire due to burning for agricultural and stock raising purposes. It is desirable for the SEMARNAP, SEDAF and other administrative organizations to improve awareness of the need for fire prevention among local people through the provision of guidance for local people and promotion of the necessary understanding in comunidades by means of mutual warning between local people. Once a forest fire occurs, early fire-fighting prior to the spread of the fire is preferable and a quick response by the nearest comunidad is essential to minimise fire damage. A system should be established



which enables comuneros to thoroughly understand the arrangements and requirements to conduct effective fire-fighting activities and to equip them with the necessary fire-fighting knowledge and skills through field exercises.

## 2) Prevention of Diseases and Pests

The most damage to trees by either disease or pest in the Study Area is caused by the decorticator (*Dendroctonus* spp.) to pine forests. At present, the most effective and economical method is to fell and peel damaged trees at the initial stage of damage, followed by burning of the peeled bark and logging of the peeled logs outside the area.

## (9) Forest Management Organization

Forests must be managed in a continual manner based on certain principles under some kind of management system. For stable management from a long-term perspective, the long service of officials and engineers of the management body is necessary. It may, therefore, be a good idea to try to foster engineers within comunidades.

## (10) Individual Plans Related to Forest Production

Forest production activities are currently dominated by felling. The basis of forest management is the development of a system whereby forest resources can be sustained and improved on a permanent basis. Efforts must be made to plan the sites, method and work volume, etc. for not only felling but other works based on a relevant forest management plan prior to the implementation of work each year.

## (11) Recording of Forestry Activities

Recording of the forestry activities conducted each year not only provides basic data for subsequent activities but is also necessary to establish a clear understanding of the state of forests. The existence of such records contributes to the continuity of activities even if the persons responsible for forest management change.

## 3.6 Promotion of Forestry and Forest Products Industry

### (1) Basic Concept of Promotion of Forestry and Forest Products Industry

Based on the state of forestry activities and the availability of pine resources in comunidades, the Study Area can be divided into the southern area, northern area, central area and mesofilo forest area. Of these, part of the central area and mesofilo forest area cannot be subject to forestry promotion efforts as hardly any pine forests which are

suitable for commercial use exist. The direction for the promotion of forestry and the forest products industry in areas subject to forestry promotion are described below.

1) Southern Area

This is a fore-running area in terms of forest management regarding the production of commercial timber and the preferable direction for future development is further enhancement of the productivity by means of fostering excellent stands to make the area a model for other areas and an increase of the profits by means of intensive forest management.

2) Northern Area

The northern area has rich pine resources which are suitable for commercial forestry activities and there is large potential for more vigorous forestry activities.

- a. At comunidades with rich pine resources but where forestry activities are not conducted, forest management aimed at producing commercial timber should be introduced.
- b. At comunidades hoping to further vitalise their forestry activities, more advanced management should be aimed at.
- c. At comunidades where some production activities are conducted with a sawmill but where the operation management system is still immature, the establishment of appropriate operation under a coherent system should be aimed at.

3) Central Area

In this area, good quality trees in many pine forests have been selectively felled but the past existence of large diameter pine forests illustrates the high production potential.

- a. At comunidades which have many commercial timber production forests which have been subject to the selective felling of pine trees in the past, forest management should focus on stand improvement.
- b. At comunidades with few commercial timber production forests, small-scale forest management should be aimed at.

The preferable direction for the promotion of forestry and the forest products industry by each area is outlined in Table 3.

**Table 3 Direction for Promotion of Forestry and Forest Products Industry**

Area	Contents of the Direction
Southern	1) Improved productivity and profits through intensive forestry activities
Northern	2) Commercial forestry activities 3) Forestry activities aimed at producing logs 4) Establishment of a forest operation management system
Central	5) Forestry activities focusing on stand improvement 6) Small-scale, intensive forestry activities

**(2) Required Action of the Administration**

For the promotion of forestry activities, such as thinning, the administration can implement positive actions, including (i) development of the use of small diameter logs and markets for products made out of small diameter logs and (ii) research and experiments to develop the use of quercus.

One good idea to assist the balanced development of the Study Area is the construction of a through road which is passable for vehicles between National Route 175 to the east of the Study Area and National Route 131 to the west of the Study Area in the direction of Cuikatlan to consolidate the basic conditions for the development of the central and northern areas of which the development lags behind the southern area.

**(3) Quick View of Forestry and Forest Products Industry Promotion Measures**

Table 4 Options for Forestry and Forest Products Industry Promotion Measures

Item	Option	Southern Area	Northern Area			Central Area	
		(1)	(2)	(3)	(4)	(5)	(6)
Commitment by Comunidades	Forest Management Plan	○	○		⊙	○	○
	Forest Operation	⊙			○	⊙	⊙
	Forest Management Body		○	⊙	⊙	○	○
	Machinery	○			⊙		
	Appropriate Sale	○	○	○	○	○	○
	Log Production	⊙		⊙	⊙		
	Sawmills	⊙			⊙		
	Training of Engineers	⊙		○	⊙	○	○
Commitment by Administration	Ordinary Roads		○	○	⊙		
	Forest Management Plan		○			○	○
	Forest Operation		○	○	○	⊙	⊙
	Forest Management Body		○	⊙	⊙		○
	Machinery	○			○		
	Development of Demand	○	○	○	○		

Notes: ○- Important, ⊙- Very Important

- (1) Improved productivity and profits through intensive forest management
- (2) Commercial forest management
- (3) Forest management aimed at log production
- (4) Establishment of forest management system
- (5) Forest management centering on forest improvement
- (6) Small-scale intensive forest management

### **3.7 Comunidad Development**

#### **(1) Concept of Comunidad Development**

The successful development of a comunidad depends on the spontaneous commitment of local people to activities organized by the comunidad. This spontaneity on the part of local people can only be achieved if the living infrastructure is properly developed together with development of the social environment and a secured income to enable them to enjoy their lives without worry. In addition to the implementation of specific measures for each comunidad, a wider perspective is required to address problems which cannot be solved by individual comunidades, including the general development of local human resources, the establishment of an inter-comunidad network and social as well as gender care.

#### **(2) Comunidad Development through Forestry Development**

##### **1) Forest Management with Spontaneous Participation of Local People and Implementation of Forest Production Activities**

Through their spontaneous involvement in forest management and forest production activities, local people can learn how to positively plan the future of their comunidad. As a result, an internal development force is nurtured in the comunidad to seek the comunidad's further development, creating the basis for more advanced forest management. Such spontaneity can be fostered by encouraging local people to conduct participatory assessment so that they understand the potential of their own forest resources and want to implement such forest management.

##### **2) Improvement of Social and Living Conditions Using Income From Forest Management**

The profits from forestry activities can be used to improve the social and living conditions of a comunidad. In the case of comunidades with less forest resources, the willingness of local people to participate in forest management should be fostered to maintain their commitment to forest management with a view to the future utilisation of forest resources.

##### **3) Increased Income Through Participation in Forest Production Activities**

Employment opportunities will be created and secured by means of continually conducting forest production activities to increase the income of local people.

### **3.8 Gender Consideration**

#### **(1) Gender Consideration**

The following four points have been taken into consideration regarding gender consideration.

- 1) Whether or not the benefits of forestry activities can be shared by men and women in a fair manner.
- 2) What are the important points to increase the efficiency of a project?
- 3) What can be done to improve the sustainability of project effects?
- 4) Is it possible to prevent the negative impacts of project implementation?

#### **(2) Status of Men and Women in Comunidades**

Men and women in comunidades in the Study Area are assigned distinct roles based on the gender line. While women are mainly engaged in reproductive activities, men are engaged in production activities to earn cash income and communal activities to determine the future direction for the comunidad.

#### **(3) Participation in Forestry Activities by Local Men and Women**

As women find it physically difficult to participate in the main types of forest production activities, such as logging and transportation, facilitation of the participation of women in such work is unlikely. The use of profits from the sale of timber to improve the living infrastructure is of benefit to the entire comunidad. If a fairer distribution of the profits is required, the holding of a general meeting of the comunidad with the participation of both men and women to discuss the subject is desirable.

In the case of those forestry activities which can be more efficiently conducted by women or conducted in a sustainable manner because of the large number of men working outside the comunidad and other reasons, it should prove effective to provide women with the relevant opportunities. No negative impacts are foreseen in regard to project implementation.

### 3.9 Forest Management Model

The future state of forest management by comunidades was inferred if comunidades conduct forest management in line with the Master Plan.

Different models were established based on the respective timber production forest areas of 200 ha (Model A), 600 ha (Model B), 1,200 ha (Model C) and 3,000 ha (Model D) and two distances to market, i.e. 100 km and 150 km, were introduced to estimate the profit in the immediate 10 years and after the development of forests to the desirable state in the future. Future profit was also estimated in the case of sawn timber production.

#### (1) Profit in Immediate 10 Years

The profit in the immediate 10 years when forest management is conducted in accordance with the Master Plan is estimated as follows.

Table 5 Annual Profit

(Unit: Pesos)

Distance to Market	Model			
	A	B	C	D
In Case of 100 km	22,000	125,000	288,000	898,000
In Case of 150 km	5,000	62,000	159,000	538,000

#### (2) Future Profit

Future profit when forest management is conducted in accordance with the Master Plan is estimated as follows.

Table 6 Annual Profit

(Unit: Pesos)

Item		Model			
		A	B	C	D
Production of Logs	100 km	142,000	538,000	1,142,000	3,120,000
	150 km	102,000	406,000	878,000	2,480,000
Production of Sawn Timber	100 km	172,000	638,000	1,343,000	3,647,000
	150 km	132,000	506,000	1,079,000	3,007,000

### (3) Future Prospects

The larger the scale of a commercial timber production forest, the larger the size of profit. At present, the construction of a sawmill is expected to increase the profit provided that the scale of commercial timber production forests corresponds to Model C, i.e. 2,000 ha or larger, with a certain level of forest resources in place. Once forests are improved in the future, the stable as well as sustainable production of timber in commercial timber production forests will produce a profit which can be used to develop various infrastructure for comunidades. Moreover, local people will be able to find employment opportunities in forestry. To summarise, the promotion of forestry will enable local people to envisage a future in which harmonious and stable living conditions are secured.

## 4. Forest Management Plan for Pilot Areas

### 4.1 General Conditions of Pilot Areas

#### (1) Land Use and Vegetation

Forests account for more than 90% of the land in the three comunidades. While most forests are Pine-Quercus Forests, Mountain Mesofilo Forests account for 30% in Teponaxtla. Cultivated land accounts for 3 - 7%.

#### (2) Forest Resources

The growing stock and increment of pine in commercial timber production forests are estimated as shown in Table 7.

Table 7 Pine Increment of Commercial Timber Production Forests

Item	S.M. Las Nieves	S.M. Totomoxtla	S.J. Teponaxtla
Growing Stock (m <sup>3</sup> )	29,370	20,320	231,340
Increment (m <sup>3</sup> /ha)	5.07	5.70	10.6

#### (3) Forest Management Tasks

The following activities are deemed to be urgently required at present for those forests subject to selective felling since the 1960's.

- 1) Change of the existing stands which are mixed with many encino trees to stands with a higher ratio of pine trees



## 2) Urgent thinning of excessively dense forest stands

As these activities do not involve felling to produce income, their implementation is a future task to be examined in terms of both the funding and technical aspects.

## (4) Socioeconomic Factors Relevant to Formulation and Implementation of Forest Management Plan

A forest management plan aims at achieving not only adequate forest management but also improvement of the living conditions of local people which should enjoy the following benefits.

- 1) The active use of the plan maps will enable local people to understand the characteristics of existing forests and land so that they can consider the land use of their comunidad in terms of the more effective use of public benefit functions of forests in a sustainable manner. This can be considered an educational effect of a forest management plan through its implementation.
- 2) Other benefits resulting from forest production activities can be divided into the direct benefit of employment creation and the indirect benefit of improving the living infrastructure using income from the sale of timber. The beneficiaries are (i) temporary migrant workers, (ii) women and (iii) male farmers living in the comunidad. It is important that the opinions of each group are reflected on the spending of income from the sale of timber.

The benefits of forest production activities are only feasible when comunidades have forests which are ready for felling. Comunidades which do not have suitable forests for felling cannot achieve these benefits and are required to invest both labour and funds in the creation of forests so that forests can produce future profits. The actual work relies on tequio (free labour for communal work). In order to realise a long-term commitment to forestry activities based on the free labour of tequio, it is essential to establish a strong will among local people to develop their own forests. One way of maintaining such a will is the establishment of a forest committee or forest production unit to be responsible for the forestry activities of a comunidad.

## 4.2 Common Plan for All Comunidades

### (1) Basic Principles for Formulation of Forest Management Plan

- 1) Forests should be categorised based on their expected functions and operation and management principles and standards should be determined accordingly.
- 2) The plan period should be 10 years with priority given to urgently required forestry operations (felling, regeneration, tending, etc.) while having a long-term perspective.
- 3) The plan must take the intentions of local people regarding land and forest use based on the specific socioeconomic conditions of each comunidad into full consideration.
- 4) The plan contents should be as simple as possible for easy understanding by local people.

### (2) Basic Concept of Land Use

In regard to future land use, a significant change of the present land use appears difficult. Accordingly, what is important in the case of forests is improvement of the forest functions by means of appropriate operations while improving farming techniques to improve the agricultural productivity.

### (3) Concept of Land Use

Each forest is categorised based on its priority function, following the formulation of appropriate operation standards for each category to improve the performance of such priority function.

### (4) Forest Division

Forest compartments and sub-compartments are introduced as forest divisions to be shown on the relevant map.

### (5) Forest Categories

See Table 1.

### (6) Principles of Forestry Operations by Forest Category

See Table 2.

1) Commercial Timber Production Forest

Clear felling leaving seed trees will be conducted at pine forests. The target diameter class for production is 40 - 50 cm and the rotation age is 60 years. In order to achieve sustained yield, the felling volume will be planned by using the annual increment as the upper limit. However, there are not many stands for regeneration felling except in S.J. Teponaxtla and succeeding stands are not in place. Under these circumstances, urgent commencement of thinning and stand improvement is necessary to make forests achieve the normal state and felling will be restricted to stand improvement. In the case of S.J. Teponaxtla, the yield will be controlled and the upper limit of the felling volume will be the annual increment of stands where regeneration felling can be conducted in the next 60 years.

The maximum felling area size should be limited to 5 ha and the felling areas should be separated from one another.

2) Firewood Production Forests

Felling to obtain firewood should generally be conducted with standing trees with a DBH of 20 cm or more. If the demand cannot be met during the fostering period of a firewood production forest, the encino to be felled under the stand improvement of a commercial timber production forest will be used to supplement the shortfall.

(7) Operation Model for Commercial Timber Production Forests and Changing Method for Existing Stands

1) Operation Model for Commercial Timber Production Forests

Table 8 Forestry Activity Model for Commercial Timber Production Forests

Activity	Stand Age (years)	Description
Regeneration Felling	60	- Leaving seed trees with a density of 10 - 16 trees/ha (distance of 25 - 30 m between seed trees)
Regeneration	0 - 3	- Ground clearance - Minimum density of regenerated trees three years after regeneration felling of 1,250 trees/ha (12 - 13 trees in an area of 10 m × 10 m) throughout the stand - Further ground clearance if this density is not achieved
Weeding	0 - 5	- Removal of vegetation competing with regenerated trees to be conducted 2 - 3 years after the completion of regeneration
Improvement Felling	5 - 10	- Removal of trees other than pine and poor quality pine trees 5 - 10 years after the completion of regeneration - Density of remaining trees of approximately 800 - 1,000 trees/ha (8 - 10 trees in an area of 10 m × 10 m)
First Thinning	15 - 20	- To be conducted when a stand is closed after the completion of regeneration - Thinning intensity of leaving some 400 -- 600 trees/ha (4 - 6 trees in an area of 10 m × 10 m)
Second Thinning	30 - 40	- To be conducted when the stand is closed after the first thinning - Thinning density of leaving some 200 - 300 trees/ha (2 - 3 trees in an area of 10 m × 10 m)
Regeneration Felling	60	- Return to the stage of regeneration felling when the stand reaches its final age, i.e. 60 years

## 2) Operation Method of Existing Stands

As many of the existing stands require thinning or improvement, the priority of forestry operations for these stands is to lead them to one of the stages described in the operation model (Table 8).

### a. Thinning

At those stands where the density of standing pine trees is particularly high or where the healthy growth of pine trees is hampered by a high mix ratio of encino, thinning and the selective felling of encino should be urgently conducted to stimulate the growth of the remaining pine trees. The target stage is that after the first or second thinning in the model.

### b. Stand Improvement

#### < Stand Improvement Work Type 1 >

If the regeneration of pine is poor throughout the stand, work similar to the regeneration felling of the operation model for commercial timber production

forests should be conducted, leaving 10 - 16 seed trees per ha and felling all other standing trees (including encino and other broad-leaved trees). The target stage is that of regeneration in the model.

#### < Stand Improvement Work Type 2 >

In regard to those areas where pine trees with a positive growth prospect do not exist, those areas with little regeneration of pine trees due to the dominance of pine and encino in the upper-story will be subject to spot clear felling with a radius of 25 - 50 m to encourage regeneration from the side. The target stage is that of regeneration in the model.

#### (8) Felling and Transportaion

##### 1) Work Method

Felling and transportation will follow the standard method employed in the Sierra Juarez area.

##### 2) Work Safety Measures

As felling and transportation are hazardous work, measures should be introduced to deal with the risks involved to ensure work safety.

#### (9) Forest Protection

##### 1) Forest Fires

The first principle of forest fire prevention is obviously the eradication of the causes of forest fires. The first step should be for each comunidad to prepare rules for burning and to strictly enforce these rules.

##### 2) Pest Damage

As the generally most effective way of controlling pest damage is the disposal of damaged trees at the initial stage of damage, forest patrols should be regularly conducted to detect such damage as early as possible.

#### (10) Forest Roads and Production Equipment

##### 1) Forest Roads

In the case of ordinary roads, maintenance/repair work, including the levelling of uneven surfaces and the repair of side ditches, should be conducted in an appropriate

manner. In the case of forest roads and spur roads, the existing roads extending to the planned sites of forestry activities will be improved and maintained for their continued use.

## 2) Production Equipment

Either procurement or borrowing must be carefully decided in regard to expensive machinery based on a detailed analysis of the actual use prospects.

## (11) Work Management System

### 1) Forest Management Bodies and Their Activities

#### a. Forest Management Bodies

##### < Forest Production Unit >

The forest production unit will be responsible for the planning and implementation of forestry activities. In order to ensure the continuity of forestry activities, the officials of the forest management body should not all be replaced at once.

##### < Forest Committee >

A forest committee should be newly established to (i) improve the awareness of local people of the importance of forests in order to maintain local people's interest in and commitment to forest management and (ii) provide advice and recommendations to the forest production unit.

#### b. Preparation of Various Documents

The compilation of the following documents should prove very effective to improve forestry activities in subsequent years.

- Forest activity planning books
- Forest activity plan maps
- Forest activity implementation records

## 2) Extension of Forest Education and Improvement of Forestry Techniques

It is necessary for local people to improve their basic knowledge of forests and forestry in view of active forest management. It is, therefore, necessary to develop an

environment in which local people actively participate in forest management while maintaining their commitment to and enthusiasm for forestry activities. Supervising forestry engineers are expected to provide education and guidance for local people in addition to their standard work.

### 3) Necessity for Tequio

Thinning and stand improvement which must be urgently conducted but which has no prospect of providing income despite the necessary investment must rely on tequio. Apart from providing incentives for local people to actively participate in tequio, it will be essential for local people to be fully aware of the significance of their participation in thinning and stand improvement under the tequio scheme.

### 4) Subsidy Schemes of Administration

There is a limit to the use of the economic resources currently available in a comunidad and to the reliance on tequio to promote forest production activities in a comunidad and, therefore, the active use of the subsidy schemes of the administration is essential.

## (12) Environmental Impacts Assessment

The forestry activities under the plan intend the creation of healthy and highly productive forests through felling, regeneration and other work without causing any major change of the land's character and while using natural forces to stimulate the growth of trees. In its formulation, the plan takes all factors relevant to the environment into consideration and positive impacts are anticipated in regard to most of the environmental factors.

## (13) Plan Evaluation

### 1) Financial Analysis

The rotation age of commercial timber production forests is assumed to be 60 years while the subject period of financial analysis is set at 90 years. In this analysis, the predicted cash flow for the case with the project is compared with that of the case without the project to calculate the net present value of increase. It is also assumed that log production will be conducted in S.M. Las Nieves and S.M. Totomoxtla and that both log production and sawn timber production will be conducted in S.J. Teponaxtla for the case with the project. In contrast, the sale of standing trees is assumed for the case without the project. The sale of standing trees is planned for S.M. Las Nieves and S.M. Totomoxtla for a period of 30 years and also for S.J. Teponaxtla for a period of 60 years.

## 2) Economic Analysis

Although the analysis preconditions and analysis method are the same as those used for the financial analysis, financial prices and taxes, etc. are changed to economic prices.

### 4.3 Plan for Individual Comunidades

#### (1) Basic Principles

- 1) Commercial timber production forests should aim at establishing a forest composition capable of allowing regeneration felling every year as a long-term prospect.
- 2) For the more immediate future, thinning and stand improvement work should be planned to make the forest composition approach the state of (1) above as soon as possible. In the case of S.J. Teponaxtla, sustainable production is planned for the felling of hitherto unfelled forests.
- 3) Firewood production forests should be established so that local people can collect a sufficient quantity of firewood which they need for their daily lives.

#### (2) Development of Commercial Timber Production Forests

##### 1) Development Targets (S.M. Las Nieves and S.M. Totomoxtla)

- To develop forests capable of sustained timber production.
- To conduct thinning at stands where pine trees are excessively dense to produce large diameter logs as soon as possible.
- To improve forests where the number of pine trees has decreased and where the number of encino trees has increased due to felling in the past to forests with many pine trees with a high economic value.

##### 2) Development Targets (S.J. Teponaxtla)

- To develop both unfelled forests and forests subject to felling in the past to forests which are capable of sustained timber production.
- To improve forests where the number of pine trees has decreased and where the number of encino trees has increased due to felling in the past to forests with many pine trees with a high economic value.



- To conduct thinning at stands in forests subject to felling in the past where pine trees are excessively dense to produce large diameter logs as soon as possible.
- To conduct appropriate operation to ensure the regeneration in the case of felling in unfelled forests.

### 3) Plan Period

#### a. Long-Term Prospects

The rotation (the period in which a felled stand reaches the stage of next regeneration felling) is assumed to be 60 years and the necessary operations will be conducted on this basis.

#### b. Plan Period - 10 years

### (3) Work Plan

The annual work volume of the operations to be conducted in commercial timber production forests for the first 10 years is shown in Table 9.

Table 9 Annual Work Volume for First 10 Years

Type of Forestry Operation		Annual Work Volume												
		S.M. Las Nieves					S.M. Totomoxtla				S.J. Teponaxtla			
		Area (ha)	Volume (m <sup>3</sup> )			Area (ha)	Volume (m <sup>3</sup> )			Area (ha)	Volume (m <sup>3</sup> )			
	Total	Pine	Others	Total	Pine	Others	Total	Pine	Others					
Regeneration Felling										2-3	1,070	720	340	
Stand Improvement		4.3	810	230	580	4.6	760	210	550	3.8	900	550	350	
Thinning	First	1	6	310	160	150								
		2	6	350	180	170								
	Second		3	160	110	50				11	1,660	1,100	560	
Regeneration and Tending	Ground Clearance	Clearance will be repeated if the completion criterion for regeneration is not reached 2-3 years after regeneration felling or stand improvement												
	Weeding	To be conducted for 1-3 years after regeneration												
	Improvement Felling	To be conducted between five and 10 years after the completion of regeneration. Improvement felling will also be conducted at a rate of 4.3 ha/year for one to three years at Cerro Jicara in S.J. Teponaxtla												
Forest Roads	New	None					None				2.5 km			
	Repair of Existing Roads	2 km					3 km				2 km			

1) Log Production and Marketing Volume

The annual log production (and marketing) volume is shown in Table 10.

Table 10 Annual Log Production (Marketing) Volume

(Unit: m<sup>3</sup>)

Year	S.M. Las Nieves		S.M. Totomoxtla		S.J. Teponaxtla	
	Timber Wood	Pulp Wood	Timber Wood	Pulp Wood	Timber Wood	Pulp Wood
1 - 5	120	135	120	50	1,000	550
6 - 10	120	140				

2) Labour Volume

The annual man-days required are shown in Table 11.

Table 11 Annual Man-Days Required

(Unit: man-day)

S.M. Las Nieves	S.M. Totomoxtla	S.J. Teponaxtla
approximately 570	approximately 430	approximately 2,100

3) Plan Evaluation

The project evaluation results are shown in Table 12.

Table 12 Project Evaluation Results

	S.M. Las Nieves	S.M. Totomoxtla	S.J. Teponaxtla
Net present value of increased net cash flow as the difference between the case with the project and the case without the project			
Financial Analysis: Without Tecio	140,000 pesos	98,000 pesos	530,000 pesos
Financial Analysis: With Tecio	250,000 pesos	220,000 pesos	600,000 pesos
Economic Analysis	450,000 pesos	19,000 pesos	1,010,000 pesos

#### 4.4 Forest Management Guidelines for San Martin Buenavista

##### 1. Situation of Forest Damage

Table 13 Area by Damage Category

Area of Light Damage (Death Rate of forest trees: upto 40%)	Area of Medium Damage (Death Rate of forest trees: 40 - 80%)	Area of Severe Damage (Death Rate of forest trees: more than 80%)	Total
2,690 ha (67%)	440 ha (11%)	870 ha (22%)	4,000 ha (100%)

The damage tends to be severe in the case of forests along ridgelines and forests with rich combustible materials, such as undergrowth and litter, and humus layers on the ground while it tends to be light in the case of forests along rivers, mountain mesofilo forests and selva baja.

##### 2. Impacts of Forest Fire

- ① Forests cannot be expected to provide earnings to create the necessary funds for the development of the comunidad in the near future.
- ② There is concern in regard to the depletion of firewood resources.
- ③ It has become difficult to secure the supply of domestic water.
- ④ Damage has occurred to farmland, etc. due to the discharge of sediment following the occurrence of erosion.
- ⑤ Unattended damaged trees face a risk of damage due to pests and diseases.

##### 3. Proposed Projects by Local Inhabitants

A workshop was held to identify the problems affecting local life and possible solutions. Detailed discussions took place on the drinking water shortage and firewood shortage, both of which are judged to be particularly important by local people, and four possible projects to deal with each type of shortage, totalling eight projects, were put forward. Of these, three projects were selected and an action programme was formulated for each project.

Table 14 Proposed Projects

Project Title	Project 1: Introduction of Improved Ovens	Project 2: Creation and Improvement of Firewood Forests	Project 3: Construction of Drinking Water Intake
Purpose	To reduce firewood consumption	To nurture forests to secure the supply of firewood	To provide sufficient drinking water for the settlement
Description	To diffuse the use of improved ovens to all households	<ul style="list-style-type: none"> <li>- To nurture firewood forests around the settlement</li> <li>- To implement stand improvement and the thinning of pine forests</li> </ul>	<ul style="list-style-type: none"> <li>- To construct a new drinking water intake at Rio Negro and to lay pipes upto the settlement</li> <li>- To encourage rational water use</li> </ul>
Activities	<ul style="list-style-type: none"> <li>- Establishment of a relevant committee with the approval of a general meeting of local people</li> <li>- Visits to comunidads where improved ovens are already in use</li> </ul>	<ul style="list-style-type: none"> <li>- Establishment of a relevant committee with the approval of a general meeting of local people</li> <li>- Use of encino produced by the operation of pine forests</li> <li>- Nurturing of new firewood forests</li> </ul>	<ul style="list-style-type: none"> <li>- Establishment of a relevant committee with the approval of a general meeting of local people</li> <li>- Search for subsidies</li> <li>- Search for engineers</li> <li>- Establishment of rules for water use</li> </ul>

#### 4. Forest Management Guidelines

##### (1) Forestry Activities by Fire Damage Category

In areas of minor and medium damage, forests are categorised based on the categorisation principles adopted by the common plan. At sites where forest restoration by natural regeneration is less than favourable, planting will be conducted.

Areas of severe damage are classified as restoration areas and forests are categorised based on the currently predictable state after restoration. Regenerating undergrowth vegetation will be protected and restoration of the expected forest functions in the future will be attempted in these areas.

##### (2) Forest Development

###### ① Firewood Production Forests

###### a. Development Targets

The target is the creation of firewood production forests which can produce firewood in a sustainable manner.

b. Development Method

- The felling of encino trees with a DBH of less than 20 cm should, in principle, be suspended. Partially burnt encino and pine trees should be used.
- Any supply shortage should be supplemented by the encino trees to be produced by stand improvement work in areas not affected by the forest fire to meet the actual firewood demand.
- 3 - 5 vigorous shoots growing from burnt encino trees should be selected while others should be pruned to encourage the growth of the selected shoots.
- Species other than encino should be gradually felled in view of conversion to encino forests.
- When the natural regeneration of encino appears difficult, acorns should be collected for seeding purposes.
- Implementation should start from accessible areas such as the areas adjacent to roads, etc.

② Commercial Timber Production Forests

a. Development Targets

The development target is the establishment of a forest composition which is capable of the sustained production of timber for all commercial production forests, including areas to be restored from the state of severe damage.

b. Forest Activities in Areas of Severe Damage (Restoration Areas → Future Commercial Timber Production Forests)

(a) Felling of Damaged Trees

Damaged trees should be felled as soon as possible.

(b) Regeneration

The natural regeneration of pine will be the main regeneration method employed. Planting will be conducted in places of poor regeneration

(particularly at steep slopes). The seedlings used will be supplied by the SEMARNAP and SEDAF, etc.

(c) Tending

Forest operations after regeneration will follow the forestry operation model for commercial timber production forests shown in the common plan.

c. Forestry Operations in Areas of Minor or No Damage

(a) Forestry Operation Principles

- Stands where the regeneration of pine is less apparent than the vigorous growth of encino due to the felling of pine trees in the past will be improved to high value forests with many pine trees.
- Stands with an excessive density of pine trees will be subject to thinning in order to produce larger diameter logs soon rather than later.

d. Long-Term Perspective

(a) Rotation

The rotation age from regeneration after felling to the arrival of the next final felling age is assumed to be 60 years and forestry operations will be conducted on this basis.

(b) Desirable Forest Composition

The desirable forest composition is one where stands of different ages cover a similar area so that the stock can produce an equal volumetric yield every year.

③ Protection Areas

a. Headwater Conservation Forest

Headwater conservation forests will be established in the upperstream of Rio Negro. Forest operations in headwater conservation forests will follow those adopted by the common plan. In severely damaged areas planting will be conducted if the state of natural regeneration is poor.

#### b. Other Protection Forests

Forest operations in other protection areas will follow those adopted by the common plan. Planting will be conducted if the state of natural regeneration is poor. No human interference, ranging from the collection of timber for personal use and the collection of firewood (including leaves and branches) to stock raising, will be permitted in soil conservation forests in order to ensure the recovery of the vegetation.

### (3) Erosion Control Measures

Since the forest fire, the ground surface protection function and surface runoff water control function of forests are not sufficiently performed, leading to soil erosion, ranging from gully erosion and slope failure to river bank erosion and road erosion. Erosion control measures will, therefore, be implemented based on the following principles.

- The subject sites will be those in the vicinity of which conservation objects (mainly farmland and roads) are located.
- Simple, low cost structures for which the necessary equipment and materials are locally available and can be made by local people will be constructed.
- Subject sites will be protected from stock raising and fire for the protection of structures and for promotion of the regeneration and growth of vegetation.

#### ① Gully Erosion Control Measures

##### Step 1: Slopes above the gully head and around the gully

In the case of steep slopes, 3- 4 layers of branches will be laid at 10 m intervals along the contour lines while gentle slopes will be covered by a mulch consisting of scattered branches.

##### Step 2: Inside the gully

A series of check dams will be constructed using stones and logs at a rate of 8 - 12 dams per 100 m stretch of gully.

**Step 3: Disposal of deposited debris on farmland due to gully erosion**

A stone masonry dam will be constructed at the gully mouth, backed by 2 - 3 further dams upstream, using large and medium-size stones from among the deposited debris.

**② Slope Failure Control Measures**

**Step 1: Diversion of surface runoff water from the head of the slope failure**

If the source of surface runoff water is a road located above a slope failure, the existing drainage facilities will be improved. If such facilities do not exist, new facilities will be constructed. Tension cracks at the head of the failure will be filled with clayey soil.

**Step 2: Construction of a retaining wall at the toe section of the failure.**

**Step 3: Eradication of small rills and gullies in the scar of the failure to make a flat surface, followed by the application of wattling works in the scar using logs and branches.**

**③ Bank Erosion Control Measures**

Step 1 and Step 2 of the gully erosion control measures will be applied to slopes in the upstream of torrents to control surface water discharge.

**④ Road Erosion Control Measures**

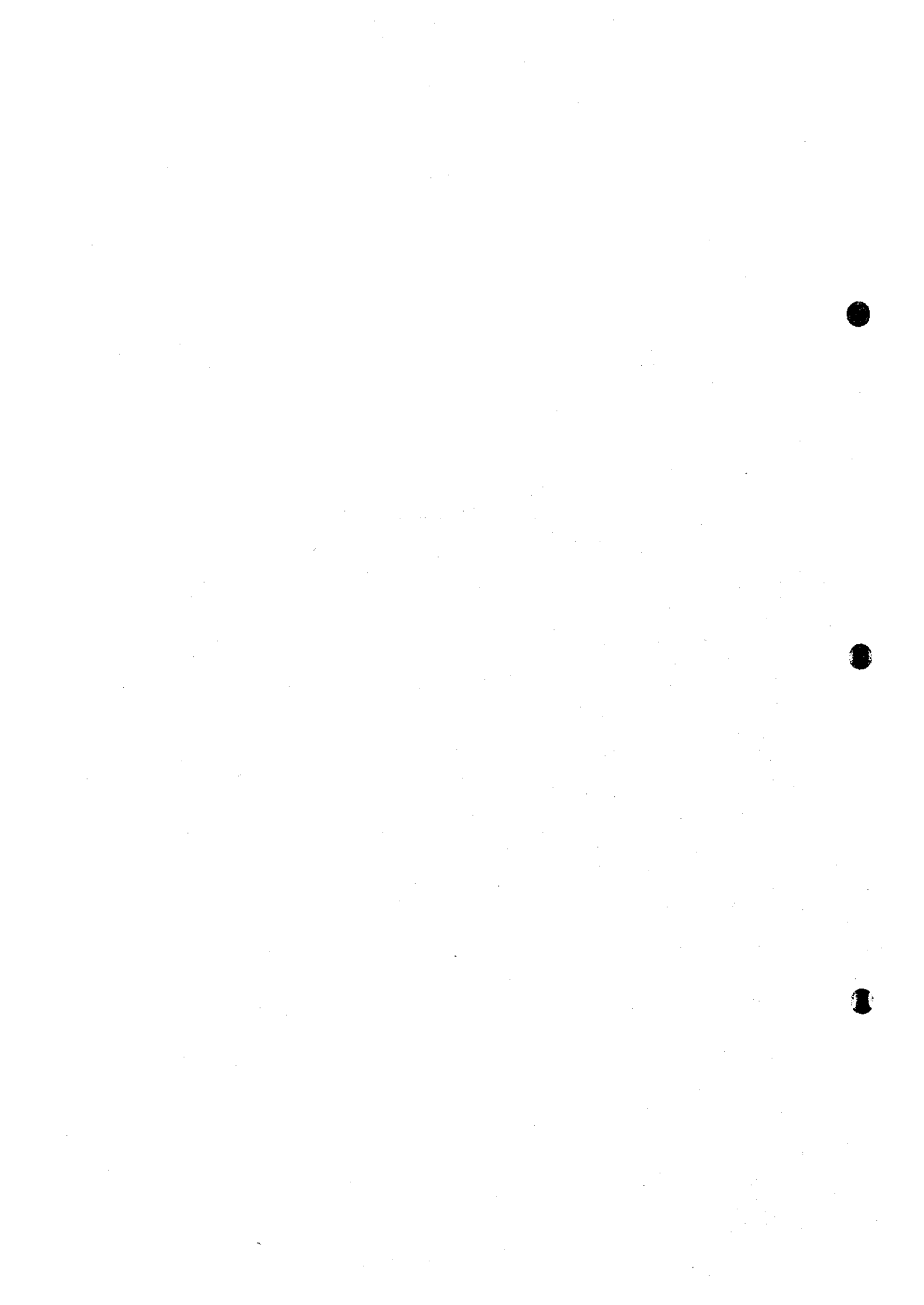
- Deposits in drainage ditches will be removed prior to the rainy season to ease the flow of discharged surface water.
- Drainage ditches will be constructed for roads with no drainage ditches or of which the drainage ditches have been destroyed.
- A stepped structure will be introduced using either stones or logs at the drainage ditches where erosion is in progress or is expected to occur.
- Cross ditches will be constructed using logs at those sections of drainage ditches where water flow concentration is expected to occur.
- Gullies on fill or cut slopes will be stabilised through the application of Step 1 and Step 2 of the gully erosion control measures.



- Slope failures at fill or cut slopes will be stabilised through the application of Step 1 and Step 2 of the slope failure control measures.



## **RECOMMENDATIONS**



## RECOMMENDATIONS

Comunidades located in the Sierra Juarez Mountain Range possess rich forest resources which are capable of producing excellent pine timber. As these forests constitute the area's largest natural resource, the introduction of active forest management utilising forest resources to promote local forestry is crucial to achieve local development.

The present forest management plan (the Plan) has been formulated from the above-described viewpoint and issues considered to be particularly important are described below to realise the objectives of the Plan in order to promote effective and efficient forestry.

### 1. Effective Realisation of the Plan in Pilot Areas

- The special characteristics of the Plan are (i) clear felling leaving seed trees as the basic pine forest operation method, (ii) a management plan for the entire forest areas of local comunidades, incorporating the idea of forest categorisation and (iii) long-term prospects of achieving sustainable forest management in addition to a sustainable yield in a specific period while incorporating the socioeconomic survey results. It is essential that engineers in both the public and private sectors and local people fully understand the underlying principles of the Plan prior to its implementation. For this purpose, training and extension activities may be required.
- The Plan should be implemented without disruption as a model for other comunidades with similar conditions. Given the lack of sufficient experience in the field of forest management and a weak management system in the subject comunidades, the active assistance of such administrative organizations as the SEMARNAP and SEDAF should be sought in terms of the provision of necessary guidance as well as applications for various subsidy schemes.

### 2. Simplified Forest Management Plan Formulation Process and Cost Reduction

- The cost of formulating a forest management plan is a heavy financial burden on comunidades in their pursuit of efficient forest management. Particularly in the case of those comunidades where the size of forest resources is small, the implementation of forest management is sometimes difficult because of the much lower income than cost. The following measures could reduce the forest management planning cost.

- Provision of common basic data on the area, including volume tables, increment tables and yield tables, by the administration to reduce the survey cost.
  - Introduction of standard forms describing the general natural and socioeconomic conditions to simplify plan preparation.
  - Simplified planning components depending on the management size and operation details.
  - Provision of a sample forest management plan to simplify the plan formulation process.
- In the case of thinning, stand improvement and other forestry operations which do not produce income or forestry operations focusing on tending with small income, it will be necessary to examine measures to allow a comunidad to adequately conduct the said activities without assigning a supervising forestry engineer and to provide ways in which the PRODEFOR and others can assist comunidades to conduct forestry activities.

### **3. Administrative Aid for Forest Production Activities and Forestry Extension**

- Late-starting comunidades have little technical and managerial skills and lack sufficient knowledge of forest operation techniques, legal procedures relating to forest management, application procedures for various subsidy schemes and timber sale methods, etc. In order to identify their problems and requirements and to provide the necessary guidance, the regular dispatch of engineers of the SEMARNAP, SEDAF and NGOs, etc. as visiting instructors will be necessary.
- Many administrative organizations and aid organizations provide wide-ranging programmes for forests and forestry. As late-starting comunidades in particular do not understand the purposes, systems and application procedures of such programmes, they often fail to secure aid which meets their requirements. It is, therefore, necessary to systematically explain the scheme(s) of each aid programme with a view to providing comunidades with advice on suitable programme(s) and also to explain the actual application method using a sample application form, etc. Fore-running comunidades understand these programmes very well and actively use them, widening the gap between themselves and late-starting comunidades. It may be necessary to give late-

starting comunidades priority in obtaining aid as part of the efforts to help them understand various aid programmes.

- In case the administration conducts some sort of support countermeasure, it will be desirable for comunidades to bear a part of the work force or funds necessary for the countermeasure. The idea behind comunidad bearing a part of the cost of a countermeasure jointly with the administration is that through this activity the comunidad will become the main participant in the countermeasure and not merely a receiver. However, in the case of emergencies such as a natural disaster or outbreak of pests and disease this idea will not be applied.
- What is important is the creation of a basis for the people of comunidades to develop their understanding of the available quantity of resources and the structural link between local problems and their solutions to enable them to take the initiative in forest production activities and comunidad development. The introduction of measures by the administration to assist participatory surveys is desirable.
- In the Pilot Areas, roads constitute the most important infrastructure for the development of comunidades. In fact, those comunidades which are situated far from a national road tend to be slow to develop due to their disadvantageous position in terms of forest management and other aspects compared to those comunidades which are situated near a national road. Active assistance for late-starting comunidades will be necessary specially in terms of road and other infrastructure development, manpower development and managerial guidance, etc. in order to improve their disadvantageous position.
- Recognising the fact that pine is a species which naturally regenerates, the planting of pine trees should only be conducted after proper examination of (i) the necessity to urgently restore forests from the environmental point of view, (ii) the availability of seed trees (the number of seed trees of the target species may be insufficient when forest vegetation is lost due to a forest fire, etc.) and (iii) economic advantage, etc. to determine the suitability of planting.
- The encino mixed in the stands subject to improvement cannot expect much of a demand other than its use as firewood. In the case of encino and other hitherto unused species for which the development of processing technologies or markets is difficult by individual forest owners, it will be necessary for the administration to develop uses of these species in cooperation with both research and educational organizations in order to ensure the maximum use of local resources.

#### **4. Improved Understanding of and Commitment to Forestry by Comunidades and Local People**

- People living in comunidades must realise that they are responsible for forest management as forest owners. In other words, they should not rely on timber traders and supervising forestry engineers to conduct felling and other types of forestry operations. Instead, they should improve their own knowledge of forests and actively participate in forestry operations. The members of the forest production unit and forest committee should participate in training, workshops and study tours to fore-running comunidades in terms of forest management to establish a strong identity and awareness as persons responsible for forest management. In addition, they must conduct extension and awareness activities to help ordinary people improve their awareness of the importance of forests, to encourage their active participation in sustained forestry activities and to improve their knowledge of forests and forestry.
- Comunidades must understand the necessity for the implementation of appropriate forestry operations if the value of forests as economic resources is to be sustained. They must be made aware of the fact that the lack of such forestry operations upto the present has deteriorated the conditions of resources, making it difficult to leave valuable resources for the next generation. As much effort as possible to restore the desirable state of forests must, therefore, be made. This indicates the necessity for local people to actively participate in tequio even though it may not result in immediate material gain.

#### **5. Role of Supervising Forestry Engineers**

- A proper understanding of the forest management plan contents and yield surveys, etc. by local people promises more effective forest management. Supervising forestry engineers should clearly explain the need to participate in various surveys, the present state of forests and the principles of planning, etc. to local people in order to facilitate the latter's understanding of the significance of forests and forest management for the purpose of improving the awareness of the latter of not only the importance of forest management but also their own status as forest owners.

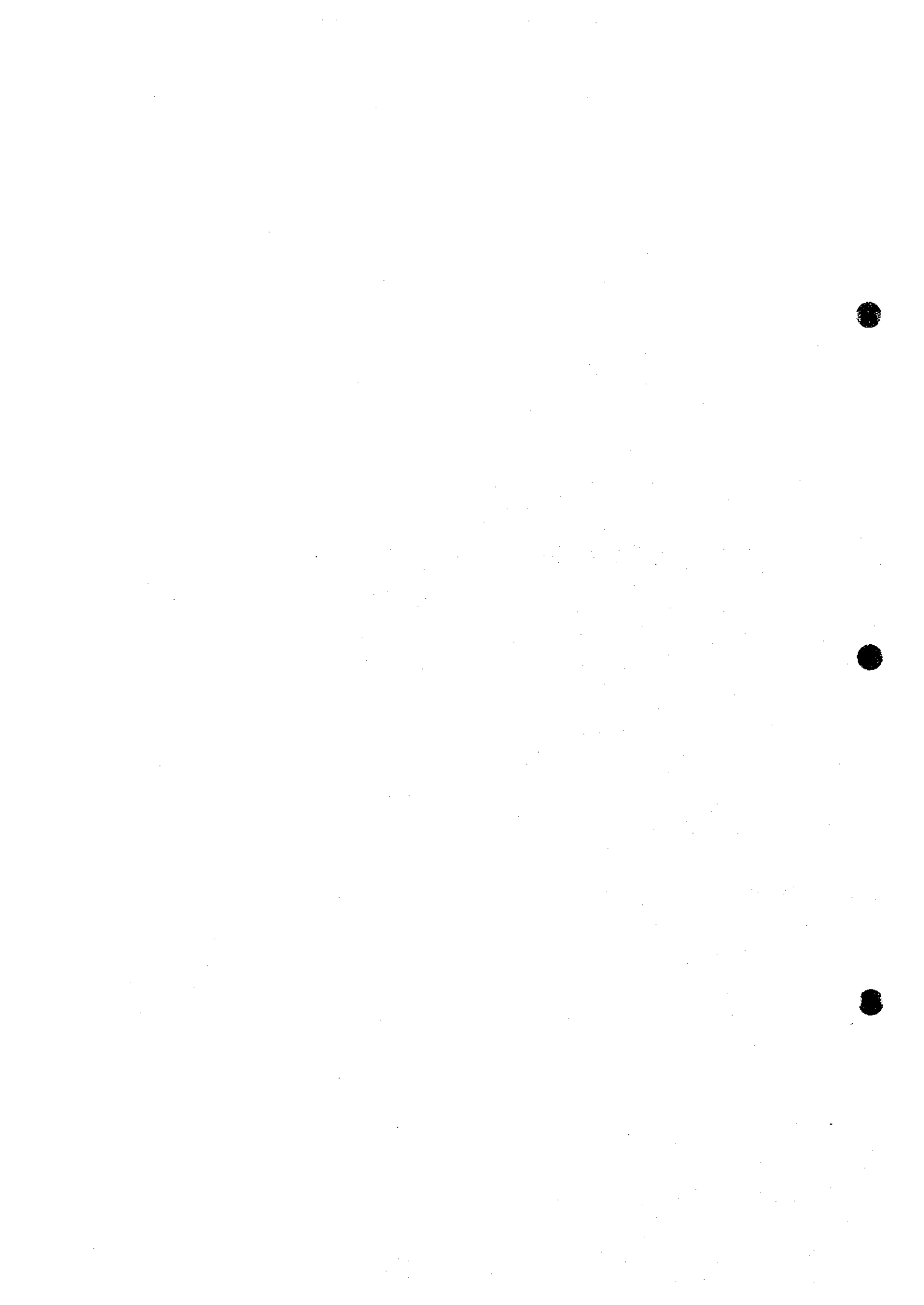


## **6. Strengthening of Forest Fire Prevention/Control Measures**

- Forest fire prevention/control measures will be most effective if such central government organizations as the SEMARNAP, state governments, the military and such land owners as comunidades and ejido work together. The SEMARNAP and SEDAF should take a lead and implement the following priority measures in particular.
  - Provision of forest fire prevention education and guidance on burning techniques
  - Establishment of a cooperative system and a communication network capable of quickly responding to the outbreak of a forest fire
  - Establishment of fire-fighting teams and the provision of guidance on fire-fighting methods at the time of a forest fire
- The early felling of as many trees damaged by forest fire or hurricane as possible is important from the viewpoints of preventing disease and pest damage and also effectively using forest resources. Such an early response will also reduce the overall loss of disaster victims. For the swift use of damaged trees and reduction of the shifting cost of damaged trees, the administration should take the initiative in the processing of damaged trees. In this context, surveying and documentation processes to approve the felling of damaged trees should be simplified as much as possible to facilitate the above.



**CHAPTER 1**  
**OUTLINE OF THE STUDY**



# CHAPTER 1 OUTLINE OF THE STUDY

## 1.1 Background of the Study

Forests in Mexico occupy some 57 million ha or 29% of the national land and temperate forests and tropical forests roughly account for half each. Half a million ha of forests are disappearing every year, mainly because of conversion to farmland and grazing land. In contrast, the planting of a mere 50,000 ha is conducted each year. Promotion of the sustainable use and development of forests is, therefore, a pressing task for Mexico to improve the situation.

The Government of Mexico plans to modernise the forestry sector by revising the Forest Law in line with the promotion of policies aiming at achieving a liberalised economy and one important issue is for local people to be responsible for the conservation, restoration and appropriate use of forest resources to improve their standard of living.

The state of Oaxaca has rich forest resources as nearly half of its area is covered by forests. However, the depletion of forests has been accelerating in recent years due to their conversion to farmland and grazing land. The Sierra Juarez area is situated in Oaxaca State in a mountainous area with an elevation of 1,000 - 3,000 m and within the state the forest ratio is particularly high in Sierra Juarez with a high dependency on forestry. Most local forests are managed by comunidades, i.e. local communities. Promotion of the sustainable use and development of forests is urgently required to improve the local standard of living and also for environmental conservation in the area and neighbouring areas.

Taking these local conditions of the Sierra Juarez area into consideration, the Government of Mexico plans to make the area a model area for the sustainable use and development of forests. Its aim is to promote the conservation, restoration and rational use of forest resources with the participation of local people in order to improve their standard of living and to apply the experience and achievements gained in the model area to the development of other similar areas.

Against this background, the Government of Mexico requested the Government of Japan's assistance for formulation of a sustainable forestry development plan for the Sierra Juarez area. In response to this request, the Government of Japan confirmed the background of the request, dispatched the Preparatory Study Team (discussions on S/W) to Mexico to determine the contents and scope of the full-scale study and signed the S/W.

## **1.2 Objective of the Study**

The primary objective of the Study is the formulation of a sustainable forestry development master plan for the conservation and use of forests using some 160,000 ha land in Sierra Juarez area which is located in Oaxaca State as the Study Area in response to the request made by the Government of Mexico. In addition, some 20,000 ha area near San Pedoro Yolox is designated as Pilot Areas for a feasibility study to formulate village-based forest management plans. Moreover, the transfer of technology to Mexican counterparts will be made through the Study.

## **1.3 Study Area**

Some 160,000 ha of land in the Sierra Juarez area in Oaxaca State is designated the Study Area and some 20,000 ha of land near San Pedoro Yolox is designated as Pilot Areas. The locations of these areas are shown in Fig. 1-3-1. The Pilot Areas were decided through consultations with the counterpart organization in Mexico during the second field survey. As it was found that some areas outside the Study Area are, in fact, part of the administrative area which incorporates the Study Area, it was decided to prepare land use and vegetation maps and topographical maps (scale: 1/25,000), which would form the base maps for the land use and vegetation maps, covering the entire Study Area as well as those areas outside the Study Area but belonging to the same administrative area as the Study Area.

## **1.4 Scope of the Study**

The Study has been conducted in two phases and the respective scope of the Study is described below. Fig. 1-4-1 shows the planned flow of the Study.

### **[Phase I]**

#### **(1) Preparatory Work in Japan**

- 1) Gathering and analysis of the existing relevant information/data
- 2) Finalisation of the study principles and detailed survey plan and methods
- 3) Preparation of specifications regarding the subcontracting of aerial photography
- 4) Preparation of the Inception Report
- 5) Formulation of the technology transfer plan (draft)

#### **(2) First Field Survey**

- 1) Explanation of the Inception Report to the Mexican side

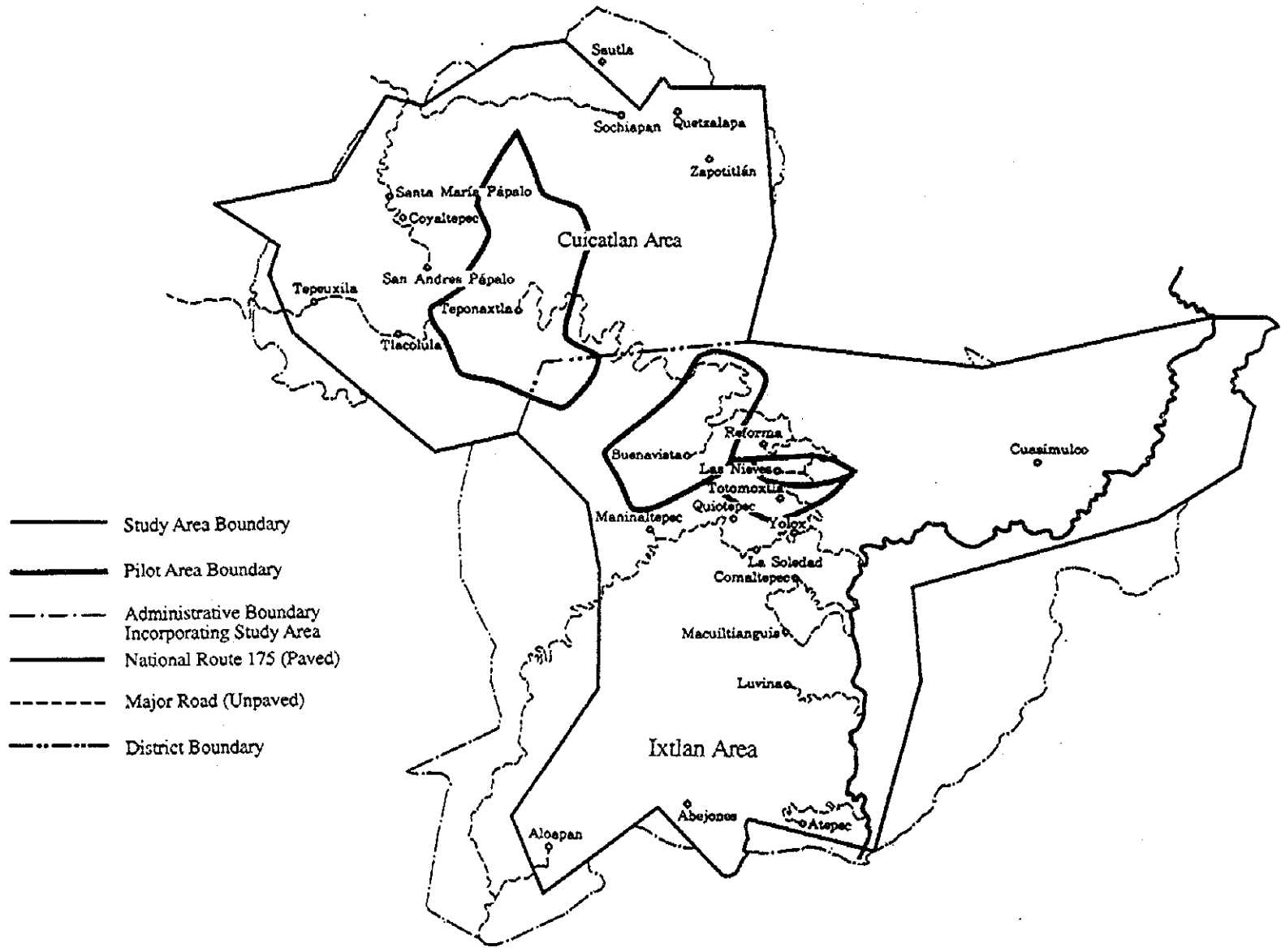


Fig. 1-3-1 Study Area and Pilot Areas

- 2) Formulation of the technology transfer plan
- 3) Aerial photography (subcontracted to a local company; Study Area of some 160,000 ha; scale: 1/25,000)
- 4) Gathering of information/data on the natural, socioeconomic and cultural conditions of Mexico and the Study Area
- 5) Land use and vegetation conditions survey
- 6) Survey for the formulation of sustainable forestry development master plan
- 7) Finalisation of the basic concept of the master plan
- 8) Implementation of the initial environmental survey
- 9) Examination of the selection criteria for the Pilot Areas
- 10) Survey on possible subcontractors for the socioeconomic and cultural conditions survey to be conducted as part of the third field survey
- 11) Preparation of the Field Report (I)

(3) First Work in Japan

- 1) Analysis of the field survey findings
- 2) Preparation of the land use and vegetation maps (for the Study Area of some 160,000 ha; scale: 1/25,000)
- 3) Formulation of the sustainable forestry development master plan
- 4) Selection of the Pilot Areas
- 5) Formulation of the third field survey plan (draft)
- 6) Preparation of the Progress Report

(4) Preliminary Ground Surveying in the Field

- 1) Preliminary surveying for the candidate Pilot Areas and observation of control points



## **[Phase II]**

### **(5) Second Field Survey**

- 1) Explanation of and discussions on the Progress Report

### **(6) Second Work in Japan**

- 1) Preparation of the specifications (draft) required for subcontracting of the surveying and preparation of the topographical maps (subcontracted work, Pilot Areas of some 20,000 ha; scale: 1/10,000)
- 2) Preparation of the specifications (draft) required for subcontracting of the socioeconomic and cultural conditions survey (subcontracted work, Pilot Areas)

### **(7) Third Field Survey**

- 1) Surveying of the Pilot Areas and plotting of the topographical maps (subcontracted work, Pilot Areas of some 20,000 ha)
- 2) Natural conditions survey of the Pilot Areas
- 3) Socioeconomic and cultural conditions survey of the Pilot Areas (subcontracted work, Pilot Areas)
- 4) Forest survey of the Pilot Areas
- 5) Survey on forest management and other issues
- 6) Survey on plan evaluation and other issues
- 7) Environmental impacts assessment
- 8) Preparation of the Field Report (II)

### **(8) Third Work in Japan**

- 1) Arrangement and analysis of the field survey findings
- 2) Preparation of draft thematic maps of the Pilot Areas
  - a. Land use and vegetation maps (area of some 20,000 ha; scale: 1/10,000)
  - b. Soil maps (area of some 20,000 ha; scale: 1/25,000)
  - c. Preparation of draft forest inventory books
- 3) Formulation of the draft forest management master plan
- 4) Preparation of the draft forest management master plan maps (area of some 20,000 ha; scale: 1/10,000)

5) Preparation of the Interim Report

(9) Fourth Field Survey

- 1) Explanation of and discussions on the Interim Report
- 2) Field verification relating to the draft thematic maps, etc. (three comunidades in the Pilot Areas, excepting S.M. Buenavista)
- 3) Survey on former forest fire sites at S.M. Buenavista

(10) Fourth Work in Japan

- 1) Preparation of the forest management master plan and thematic maps, etc.
- 2) Preparation of the Draft Final Report
- 3) Preparation of texts, etc. for the technology transfer seminar
- 4) Preparations for the survey to formulate forest management guidelines for S.M. Buenavista

(11) Fifth Field Survey

- 1) Explanation of and discussions on the Draft Final Report
- 2) Participation in and cooperation for the technology transfer seminar
- 3) Survey to formulate forest management guidelines for S.M. Buenavista

(12) Fifth Work in Japan

- 1) Preparation of the Final Report



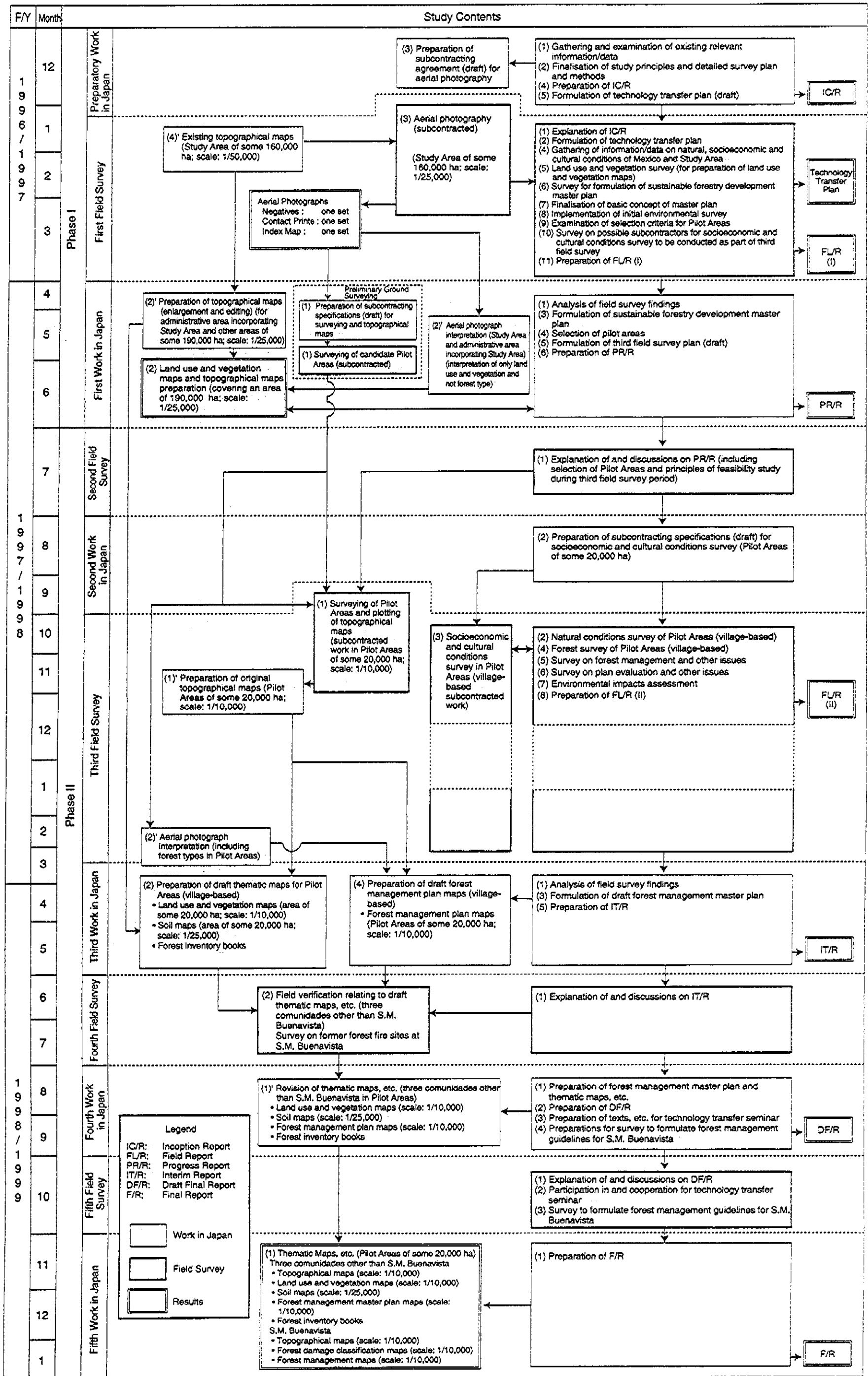


Fig. 1-4-1 Study Flow



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**CHAPTER 2**  
**AERIAL PHOTOGRAPHY AND**  
**PREPARATION OF TOPOGRAPHICAL MAPS**

## CHAPTER 2 AERIAL PHOTOGRAPHY AND PREPARATION OF TOPOGRAPHICAL MAPS

### 2.1 Aerial Photography

Aerial photography (scale: 1/25,000) covering the entire Study Area of 160,000 ha was conducted by the subcontractor (Sistemas de Informacion Geografica S.A. de C.V.: SIGSA) under the supervision of the Study Team members who also conducted the inspection of the photographs taken.

#### (1) Photography Specifications

The main specifications for the photography work are listed below.

Photography Base	: Oaxaca Airport
Camera Used	: Wild RC-8
Lens	: AVIOGON
Focal Distance	: 151.96 mm
Frame Size	: 23 × 23 cm
Photography Altitude	: average of 3,750 m based on datum plane for each course
Overlapping, etc.	: Overlap : 60 ± 5%
Sidelap	: 40 ± 10%
Photography Area	: approximately 1,900 km <sup>2</sup>
Photography Scale	: 1/25,000
Number of Courses	: 26 courses
Others	: based on Technical Specifications included in Subcontracting Agreement

#### (2) Photography Quantity and Courses

The aerial photography commenced after obtaining the relevant permission of the INEGI. By late January, 1997, the flight along some 420 km of the planned total flying length of 600 km was completed but an area lying northeast of the Sierra Juarez Mountain Range, facing the direction of the Gulf of Mexico, was left out because of cloud cover exceeding 50%. The situation had not improved by February 20th as cloud appeared almost every



day at an altitude of 2,500 - 4,000 feet over the unphotographed area and it was impossible to find a suitable photography opportunity for the Study. The term of the subcontract was, therefore, extended upto March 17th but the weather conditions over the unphotographed area did not improve, leaving the photography of some 30% of the planned area uncompleted. However, the SIGSA voluntarily conducted aerial photography of the area in May, 1997. JICA then purchased the negatives, contact prints and twice enlarged prints and such subsequent work as plotting and the preparation of thematic maps, etc. was mostly completed as originally planned. The photography courses are shown on the aerial photography index map (Fig. 2-1-1).

Table 2-1-1 Number of Photographs Taken for Each Aerial Photography Course

Course No.	No. of Photographs	Course No.	No. of Photographs
L-01	10	L-02b	10
L-02	10	L-03b	11
L-03	18	L-04b	14
L-04	12	L-05b	13
L-05	16	L-06b	21
L-06	14	L-07b	23
L-07	17	L-08b	14
L-08	19	L-09b	14
L-09	17	L-10b	14
L-10	21	L-11b	8
L-11	21		
L-12	23		
L-13	24		
L-14	24		
L-15	20		
L-16	17		
		Total	425

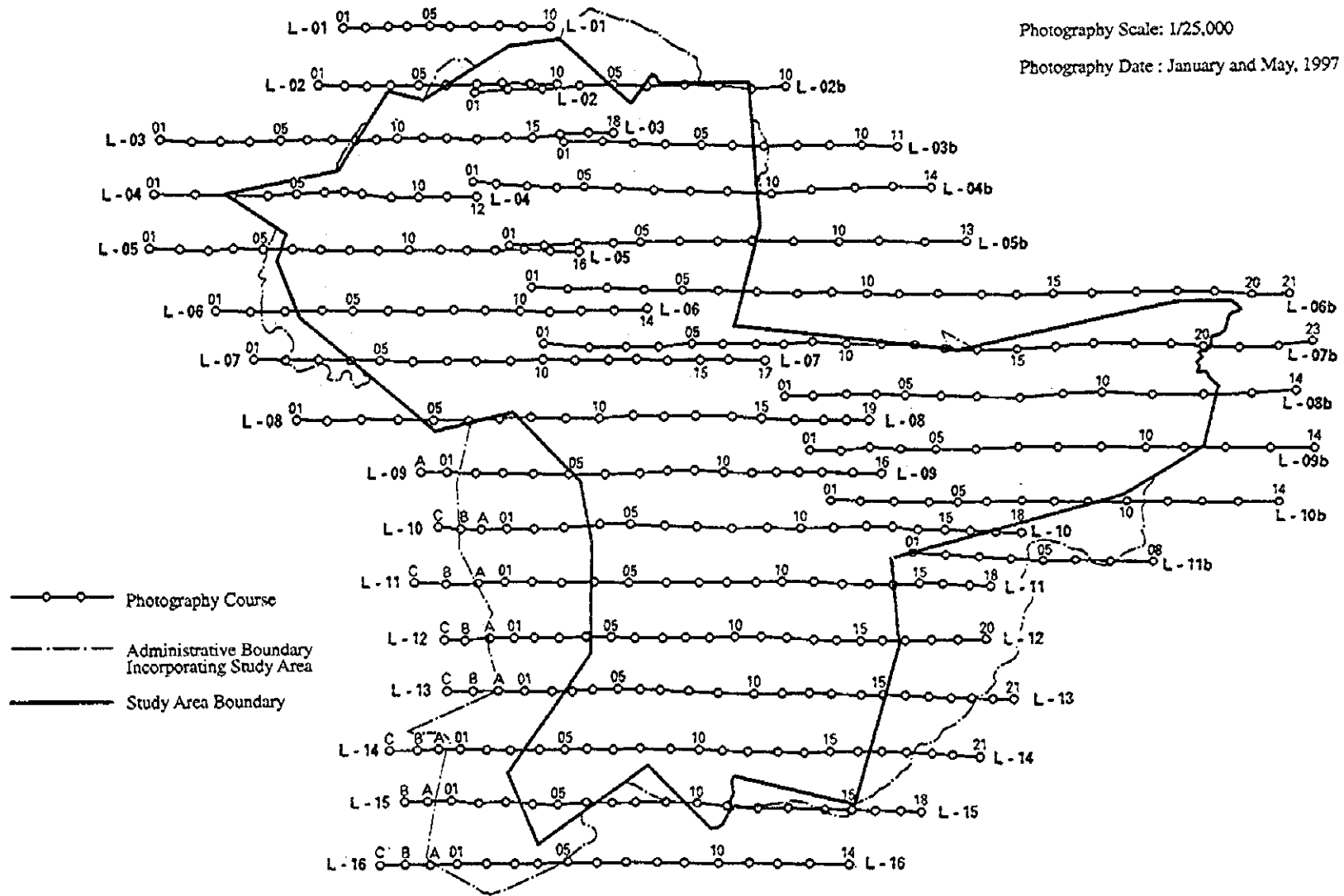


Fig. 2-1-1 Index Map for Aerial Photography