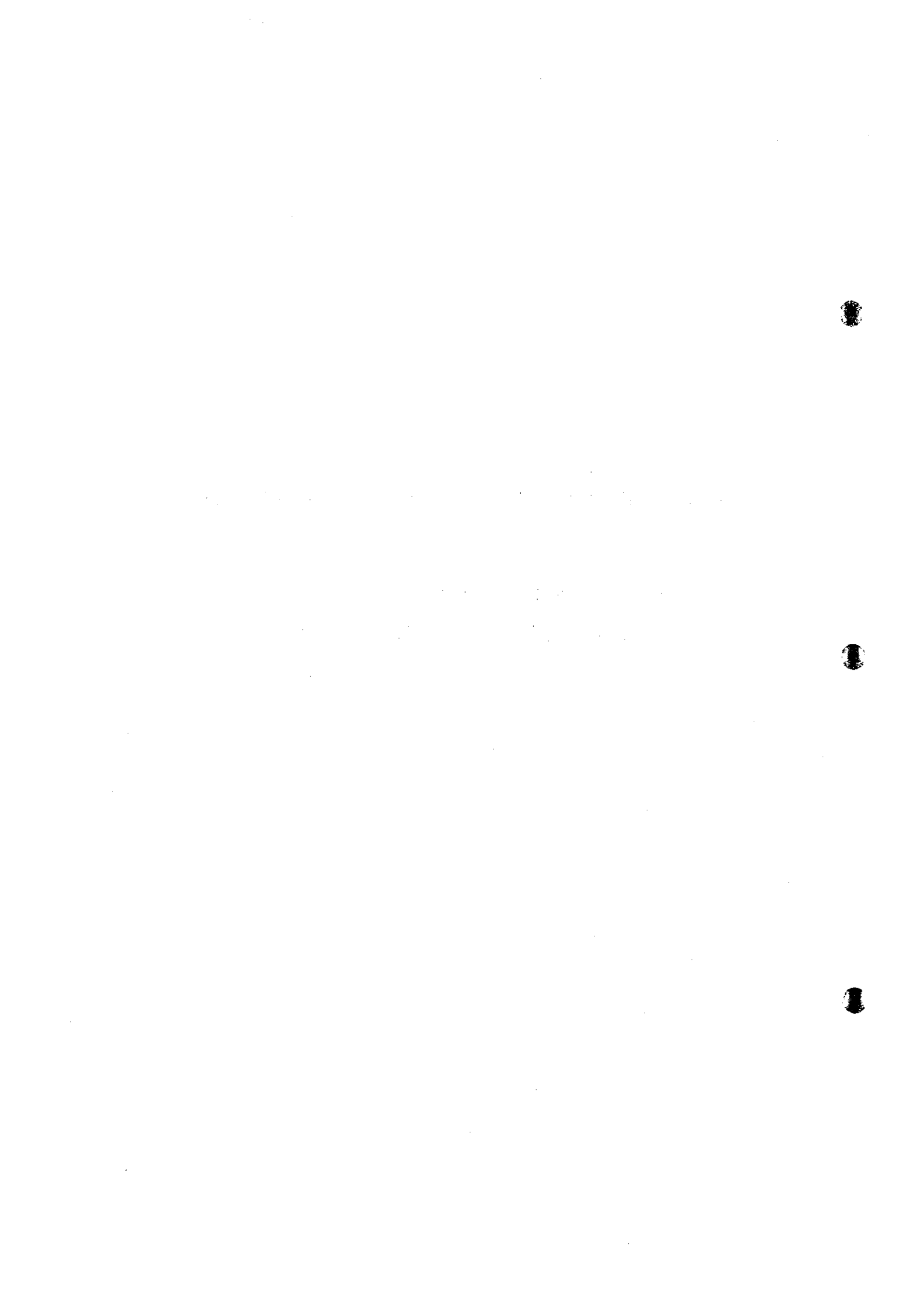


**4.3 PLAN FOR INDIVIDUAL COMUNIDADES**

**FOREST MANAGEMENT PLAN FOR  
SANTA MARIA LAS NIEVES**



### 4.3 Plan for Individual Comunidades

#### Santa María Las Nieves

##### 1. Outline

This plan has been formulated to consolidate the anticipated function(s) of each forest situated in S.M. Las Nieves in view of the sustainable use of all local forests. In particular, as forests for commercial use, which form the basis for the comunidad's development, do not have a composition enabling sustained production, the plan incorporates a range of forestry operations to be conducted in the next 10 years from a long-term perspective to achieve a forest composition which is capable of sustained production. In addition, it is planned to ensure that those forests used for the collection of firewood, which is a daily necessity for local life, perform the function of sustained firewood production.

The components of the plan are the general conditions of the comunidad, the direction for forest improvement, basic principles, forest categorisation and operations in production areas and work plan.

##### 2. General Conditions of Comunidad

###### (1) Natural Conditions

The natural conditions of S.M. Nieves are summarised in Table Ni-1.

Table Ni-1 Summary of Natural Conditions

Climate	<ul style="list-style-type: none"><li>- Mean temperature for the period from November to January: maximum 15 - 27°C; minimum 6 - 12°C</li><li>- Mean rainfall in arid areas during the dry season (November - April): less than 100 mm</li><li>- The level of rainfall increases in accordance with the higher elevation towards the northeast from the Rio Grande</li><li>- Highest mean monthly rainfall for the period from November to April: more than 300 mm</li></ul>
Topography	<ul style="list-style-type: none"><li>- Elevation range: 1,400 - 3,020 m</li><li>- Horizontal distance: 6,250 m, relative height: 1,620 m</li><li>- The ridge extending from Cerro Zacate to Cerro Viento is situated in the southeastern part of the comunidad and, from there, another ridge extends northwestwards to pass Llano de Portillo</li><li>- The southwestern slope facing Rio Ardilla is very steep.</li></ul>
Geology	<ul style="list-style-type: none"><li>- Widely covered by metamorphic rocks</li><li>- Distribution of sandstone, conglomerate, limestone and mudstone, etc. along the Rio Grande</li></ul>
River System	<ul style="list-style-type: none"><li>- Catchment area of a tributary of the Rio Grande</li><li>- Rio Arroyo Blanco runs along the northern border of the comunidad while Rio Arroyo Ardilla to the south runs along the border with S.M. Totomoxtla</li></ul>

Soil	<ul style="list-style-type: none"> <li>- CMx (Chromic Cambisols) is dominant in areas with an elevation of 1,800 m or higher → the thick layer is suitable for forestry use</li> <li>- LVx (Chromic Luvisols) is dominant at western slopes with an elevation of 1,800 m or lower → the presence of an illuvial clay horizon some 30 m below the surface reduces the land productivity but forestry use is still possible</li> <li>- LPe (Eutric Leptosols) is found on steep slopes in the south and north → forestry use is difficult as soil with a thickness of less than 30 cm lies above the rock</li> <li>- PZ (Podzols) is found on the ridge of high Cerro Zacate → unsuitable for forestry use</li> </ul>
Vegetation	<ul style="list-style-type: none"> <li>- Elevation of 2,500 m or higher → mesofilo forests, i.e. broad-leaved forests consisting of diverse species</li> <li>- Elevation of 2,500 m - 2,000 m → semi-moist pine-Quercus forests, i.e. mixed forests of pine and Quercus with a generally high tree height and high density; the physiognomy has changed in many forests because of pine felling in the past but the undergrowth is rich</li> <li>- Elevation of 2,000 m - 1,400 m → semi arid pine-Quercus forests; the tree height is lower, the quality is poorer and the undergrowth is simpler and less abundant</li> </ul>
Wildlife	<ul style="list-style-type: none"> <li>- Flora → mesofilo forests consist of diverse species while most pine-Quercus forests mainly consist of pine and Quercus <ul style="list-style-type: none"> <li>• three species fall under CITES Annex II</li> <li>• Five species fall under NOM-59</li> </ul> </li> <li>- Fauna → very diverse, ranging from those preferring an arid climate to those preferring a moist climate <ul style="list-style-type: none"> <li>• Five species fall under CITES Annex I</li> <li>• Two species fall under CITES Annex II</li> <li>• Eight species fall under NOM-59</li> </ul> </li> <li>- Aves <ul style="list-style-type: none"> <li>• One species falls under CITES Annex I</li> <li>• Three species fall under CITES Annex II</li> <li>• Seven species fall under NOM-59</li> </ul> </li> <li>- Amphibia, Reptilia <ul style="list-style-type: none"> <li>• One species falls under CITES Annex II</li> <li>• Three species fall under NOM-59</li> </ul> </li> </ul>

## (2) Living Conditions

The people of S.M.Las Nieves are Chinanteco. There are 285 inhabitants (105 men, 180 women) and about 50 households. Community bond is strong; no social and political conflict exists. Population growth rate, if calculated from census (1976), is as high as 4.5%. But the population rate based on data of the last five years is as low as 1.5%. If the population increases at the rate of 1.5%, by the year of 2007, it is estimated that it will be 333. The reasons cited for not having more children are low income and family planning education and programs.

S.M.Las Nieves has one kindergarten and one elementary school. Teachers in the elementary school are interested in planting fruit trees in school yards. The percentage of people who can not speak Spanish is high among women and the aged. As for the health care, there is a medical post with a person who received basic medical training. Medicinal

herbs are commonly used to cure daily illness. In serious cases, patients are taken to hospitals in Ixtlan or Oaxaca. Transportation and treatment are very expensive. All households have electricity and water supply, and nearly all have toilet facilities. There is no sewerage system, and there is concern for sanitation problem.

The major industry in the community is agriculture. All inhabitants are engaged in subsistence farming. Major crops are corn and beans (frijoles). In areas with an altitude of 2,300-2,650m where temperatures are lower, the Matutake mushroom is grown. The low productivity of corn planted in the community is a serious problem, as corn is the basis of their diet. Particularly in the lower part of the settlement, the productivity of corn is low (500kg/ha). They claim that even though they use fertilizers, they can not produce a good harvest. Many of the inhabitants no longer expect to have a sufficient harvest from their land. They cultivate because it is their custom. Around the settlement, there are 50ha of farm land, of which 20ha is out of production due to rotation or abandoned due to low productivity. Besides these 50ha, there are 20ha of communal farm land in the upper part of the settlement. Nobody mentions the lack of farm land as a problem, but it was observed that many young comuneros only cultivate their father's land and do not make an effort to acquire their own land.

Table Ni-2 shows the intensity of agricultural activities, rainfall, festivals by month and the months in which they have time to engaged in forestry productive activities. About 27 comuneros who live in the community engage in tequio at least 12 times a year. It is mentioned that January, May, July, August, September, October, and December are the months during which they can engage in forestry productive activities. Even during the rainy season, from July to October, S.M. Las Nieves enjoys relatively good road conditions and can export their wood products. Thus people can work in sawmill, or in wood working plants in this season, if there are sufficient trees. Also they can utilize the surplus work force to do thinning and improving the stand of forest.

Table Ni-2 Annual Calendar

Activities • Rainfall intensity	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Volume of farming work												
Main farming work												
Rainfall intensity				△	△	△△	△△△		△△△	△		
Festivals • Events		◎	◎		◎			◎			◎	
Forest production activities	■				■		■	■	■	■		■

The intensity of agricultural activities perceived by the local inhabitants

△: Quantity of rainfall

◎: Festival

■: Possibility of engaging in forestry productive activities

The main source of cash income is the money sent by emigrants labors who work mainly in United States of America. Some 12 women and 28 comuneros out of 55 are reported to work out side of the community. But we estimate that the real number is more, as all households where we conducted interviews had more than one emigrant. Most of emigrants are single men. The ages of the emigrants lie between 18 and 40 years old. As for other cash income, there is the opportunity for seasonal field labor in the months of February, March, April and November when farming activities increases in the nearby communities. Daily salaries are 35pesos for men and 30 pesos for women. Between 5 and 7 individuals participate in this work.

The problems and needs recognized in the community in general are: (1) Low agriculture productivity; (2) No improvement of the forest quality; (3) Lack of job opportunities within the community; (4) Lack of transportation; (5) Lack of medicine and medical equipment. Specifically the women cite; (1) Lack of job opportunities for their sons and husbands; (2) Lack of improvement of basic infrastructure, such as the water supply, electricity, sanitation and roads; (3) Lack of improvement of sanitation and nutrition; (4) Lack of medicine and medical equipment. In S.M.Las Nieves, the women's daily activities are limited to their households, and they are rarely consulted in the community councils. But

as showed above, the needs and problems mentioned by men and women are related to the different aspects of their life. Therefor it is important to take into account opinions from both gender to make a balanced improvement of their living conditions.

### (3) History of Forest Use and Development of Comunidad through Forest Use

#### 1) History of Forest Use

1964: Road construction commenced together with the felling of pine trees from Cerro Machin on National Route 175 linking Oaxaca and Tuxtepec in the direction of Buenavista.

1965: This road reached S.M. Las Nieves in 1965 and felling by a private timber company, a subsidiary of an Italian related company, commenced. Some local people were employed as labourers for this selective felling of fine pine trees along the newly constructed road.

1968-1972: Standing trees were sold to another private timber company. The felling volume was approximately 1,000 m<sup>3</sup>/year.

1975-1976: Standing trees were sold to a paper company in Tuxtepec and felling was conducted throughout the comunidad. Labourers were firstly brought in from outside but the number of locally recruited labourers gradually increased.

1993-1994: The Chinantla Regional Council (Consejo Regional Chinantla) was established by S.M. Las Nieves, S.M. Totomoxtla, S.F. Reforma and S.M. Buenavista for mutual assistance between comunidades in regard to forest fire-fighting, road improvement and petitioning of the government, etc.

1996-1998: Felling recommenced. A forest management body was established in 1997 and almost all fine trees which had survived the early felling have so far been felled.

In addition to the above-described events, forest fires occurred in 1965, 1973, 1987 and 1997 and that in 1965 was a major fire.

## 2) Development of Comunidad through Forest Use

The income from felling has mainly been used for the following purposes.

- 1969: Construction of a tank to store water from Rio Ardilla
- 1970: Construction of a primary school
- 1979: Construction of a road connecting the settlement to a trunk road
- 1980: Construction of a church
- 1981: Construction of a basketball court
- 1985: Installation of an electricity supply system (the comunidad and the government shared the cost on a fifty-fifty basis)
- 1990: Improvement and construction of church facilities
- 1995: Construction of a roof over the basketball court

## 3. Current State of Land Use and Vegetation

The area by land use and vegetation type in S.M. Las Nieves is shown in Table Ni-3.

Table Ni-3 Area by Land Use and Vegetation Type

Land Use and Vegetation Type		Symbol	Area (ha)
Forest	Pine Forest	P	40
	Quercus Forest	Q	111
	Pine-Quercus Forest	PQ	445
	Mesofilo Forest	Me	120
	Sub-Total		
Non-Forest	Cultivated Land	Ag	53
	Abandoned Cultivated land (including Fallow Land)	Ag(a)	3
	Shrub Land	Ab	4
	Highland Grassland	Ch	5
	Settlement	Hu	5
	Sub-Total		
Total			786

Note: Land use and vegetation condition prior to the May, 1998 forest fire.



#### 4. Current Conditions of Forest Resources

The forest resources survey identified the forest resources in the comunidad as shown in Table Ni-4.

Table Ni-4 Current Conditions of Forest Resources

Area/Volume	Pine/Quercus Forests				Other Than Left		Total
	P	Q	PQ	Sub-Total	Me	Cultivated Land, etc.	
Area (ha)	40	111	445	596	120	70	786
Standing Tree Volume (m <sup>3</sup> )	6,400	8,700	80,200	95,300	-	-	-
Standing Tree Volume per ha (m <sup>3</sup> /ha)	160	78	180	Average: 160	-	-	-

Note: Forest resources conditions prior to the May, 1998 forest fire.

The volume of commercial timber production forest resources is described in 8-(1) below.

#### 5. People's expectation toward the use of the forest

As mentioned in 2-(3), the people in S.M.Las Nieves constructed a water tank, an elementary school, a church, a basket ball court, and introduced electricity using the money obtained from the sales of trees. Both men and women well understand the economic value of the forest.

The forest also has an important role in community as a provider of firewood. Most inhabitants use wood as fuel. Annual consumption of firewood per household is 6m<sup>3</sup> and they collect wood once or twice a week. Nearly half of comuneros who can rent a truck, collect twice a year. Women pointed out other roles of the forest, such as a provider of edible mushrooms, medicinal herbs, and a supplier of wood for house construction.

The following problems and solutions related to the forest are listed by the member of the Rapid Rural Appraisal (RRA) study team which consisted of the local inhabitants and specialists from outside the community. Due to the inadequate cutting done by the timber dealer, who did not consider the regeneration of forest, a healthy growth of the forest has been hampered. This was pointed out as a serious problem. Besides this, the low quality of the pine forest and the lack of means to collect firewood were mentioned as problems. Local inhabitants which are members of the study team show a strong willingness to participate in forest activities, but on the other hand, they worry about their poor knowledge of forest management and operation methods. As for women, they claimed that the decrease in the forest due to domestic construction and fire wood gathering is problem.

Table Ni-5 Problems and Needs related to the Forest and Solutions

Problems	Solutions
- Community has not actively participated in the forest management	- Seek for an engineer
- Lack of thinning where there is a high density of pine trees	- Reforestation
- Low quality of commercial pine trees	- Seek technical and economical assistance
- Lack of regeneration of pine trees	- Obtain information about PRODEFOR
- Lack of reforestation of pine trees	- Construct a sawmill
- Damages from insects	
- Lack of transportation for collecting fire wood	

Note: Construction of sawmill is related to the "creation of job opportunities" mentioned in 2-(2)

Through the RRA study, the local inhabitants which are members of the team drew a map (Fig. Ni-1) describing the future use of community land, which categorizes the forest into the following uses: (1) Commercial timber production forest; (2) Forest recuperation area; (3) Forest for domestic timber; (4) Firewood production; (5) Headwaters conservation area; (6) Farm land; (7) Pasture area; (8) Soil conservation; (9) Animal protection area.

For the area designated (1) Commercial timber production forest, they want to know the possibility for the commercial use of forest because they are not sure whether the forest can be used commercially. The area designated as (2) forest recuperation area, is a young forest or has bad quality due to former cutting practices. People recognized the necessity to organize thinning and other activities to improve the stand of forest of in this area. People chose two places for (3) firewood production forest. The area designated as (7) Pasture area, was allocated with a idea of starting to create pasture for a future source of income. This area has many Encino trees which are suitable for firewood, thus this area also can be utilized as source of firewood.

The present (June 1998) community authorities understand the necessity of forest management and mentioned that they can dedicate time twice a month to tequio for forest activities. It is very important to keep the people motivated for future forest management.

## 6. Direction for Forest Improvement

The ideal of forest management is the sustainable production of high value wood by means of increasing the production capacity of a forest through the creation of a healthy forest while conducting felling, regeneration and other forestry operations. It is also necessary to ensure that the subject forest performs its public benefit function, if any.

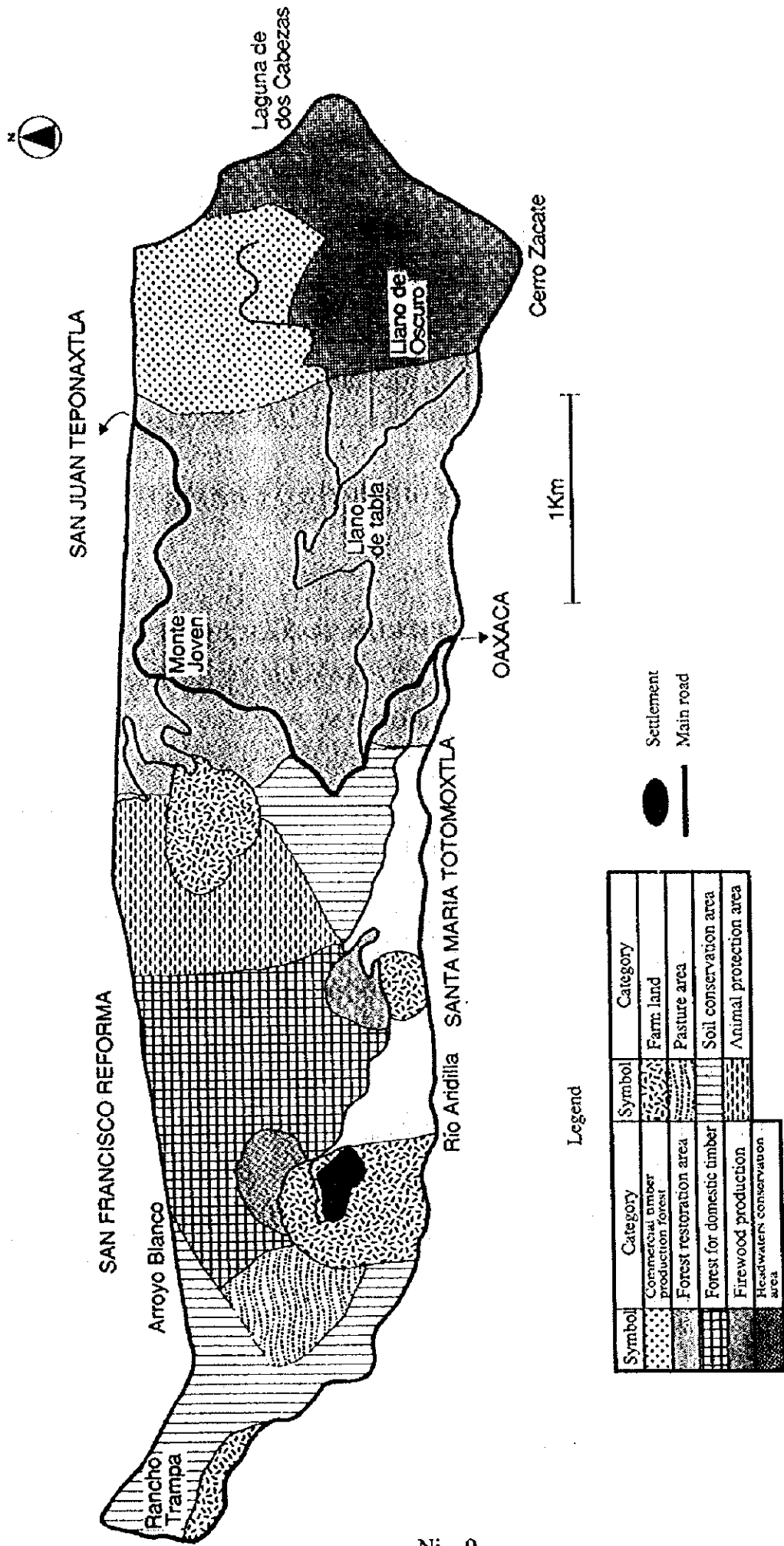


Fig. Ni-1 S.M. Las Nieves  
 Map of the future use of the community land drew by local inhabitants  
 which are members of the RRA team

Almost all areas where commercially usable pine trees grow in S.M. Las Nieves have been subject to felling several times in the past 30 years. The felling method employed was the selective felling of fine trees and no regeneration or tending operations were conducted thereafter. As a result, large diameter pine trees can still be found to be scattered although there is no forest where these trees which have reached their rotation age exist in a group. In many forests, regenerated trees to form the next generation simply do not exist. This situation implies a difficulty of ensuring a sustained supply of forest resources which are the funding source for the development of the comunidad.

Apart from forests with commercial implications, firewood resources which constitute the daily fuel for local people are depleting near the settlement due to excessive collection. The improvement of these forests is also necessary to support the lives of local people.

Under these circumstances, the priority for forest improvement appears to be conversion of the forest composition where the sustained production of timber is difficult to that which is capable of such production in the future.

Some forests have a high mix ratio of pine trees and there are many areas with a high production potential. In the case of these forests or areas, there is a strong possibility of developing high value forests through appropriate forestry operations. What is necessary in the immediate future to secure opportunities for the stable employment of local people and forest resources as economic resources to support the comunidad's development is the implementation of forestry operations designed to create forests with a high mix ratio of pine trees while aiming at developing highly productive forests which are capable of the sustained production of high quality pine timber.

## **7. Basic Principles**

The present Plan is formulated on the basis of the following principles in line with the direction for forest improvement described above.

- (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.

- (3) Firewood production forests should be established so that local people can collect a sufficient quantity of firewood which they need for the daily lives.

## **8. Forest Categorisation and Production Area Development**

### **(1) Forest Categorisation and Composition of Resources**

#### **1) Subject Area of Each Forest Category**

Prior to categorisation, the present forest distribution and situation of forest use are identified as follows.

##### **a. Forest Distribution**

- Mesofilo forests consisting of broad-leaved trees spread from near Cerro Zacate to the east to an area at an elevation of 2,700 m and rare wildlife is observed in these forests.
- Pine-Quercus forests are observed below mesofilo forests down to an area at an elevation of around 1,400 m.
- Pine-Quercus forests are divided into a semi-moist area at a higher elevation and a semi-arid area at a lower elevation with the dividing line being around an elevation of 2,200 m. The semi-moist area has many forests with high productivity and tall trees while the semi-arid area has many sparse forests with low productivity or forests with trees of a low height.
- Soil conservation work is required at steep slopes where the elevation is lower than that of the settlement and which face Rio Ardilla.

##### **b. Situation of Forest Use**

- Fine pine trees have been used for commercial purposes.
- Drinking water is taken from Rio Ardilla.
- Local people use forests to collect timber for their own use to build homes and other structures.
- Local people use forests to collect firewood as their daily fuel.
- Local people collect medicinal herbs and mushrooms, etc. in forests.

Based on the general assessment of the present forest distribution, situation of forest use and intentions of local people, the forest categories shown in Table Ni-6 and Fig. Ni-2 have been finalised. In the case of categories dotted in a small area in other categories areas, these have been ignored to facilitate uniform forestry activities which are suitable vis-a-vis the dominant category. Further details are shown on the forest management plan maps (scale: 1/10,000).

Table Ni-6 Subject Area by Forest Category

Forest Category		Description	
Production Area	Timber Production Forest	Commercial	- Area between approximately an elevation of 2,200 m and mesofilo forest area
		Non-Commercial	- Area between approximately an elevation of 2,200 m and soil conservation forests at a lower elevation
	Firewood Production Forest	- Encino rich forests near the settlement	
Protection Area	Nature Preservation Forest	- Mesofilo forest area near Cerro Zacata with an elevation of approximately above 2,700 m	
	Soil Conservation Forest	- Belt-like area along Rio Ardilla where an intake is located to the upper part of the trunk road - Steep southern slopes facing Totomoxtla in areas with a low elevation along Rio Ardilla	
	Headwater Conservation Forest	- Mesofilo forest area upto the summit of Cerro Zacate above soil conservation forests	

## 2) Forest Division

Forest division was conducted and compartments and sub-compartments were established. Fig. Ni-2 shows the compartments while the sub-compartments are shown on the forest management plan maps.

## 3) Area by Forest Category

The area by forest category and compartment is shown in Table Ni-7.

Table Ni-7 Area by Forest Category

(Unit: ha)

Forest Category		Compartment	1	2	3	4	5	6	7	Total
Production Area	Timber Production Forest	Commercial	79	74	76	-	-	30	74	333
		Non-Commercial	--	--	15	36	--	--	--	51
	Firewood Production Forest		--	--	--	44	69	5	--	118
Protection Area	Nature Preservation Forest		101	--	--	--	--	--	--	101
	Soil Conservation Forest		--	--	--	--	67	13	10	90
	Headwater Conservation Forest		--	--	--	--	--	--	27	27
Sub-Total			180	74	91	80	136	48	111	720
Others			--	--	21	3	42	--	--	66
Total			180	74	112	83	178	48	111	786

(2) Production Area Improvement

Production areas will be improved in the following manner in accordance with the basic principles.

1) Timber Production Forests

a. Commercial Timber Production Forests

(a) Improvement Targets

- Improvement of forests to ensure sustained timber production
- Implementation of thinning at stands with excessively dense pine trees to hasten the process of producing large-diameter wood
- Improvement of forests where the number of pine trees has declined due to felling in the past and where the number of Encino has increased to forests with many pine trees of a high commercial value

(b) Plan Period

i. 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 forestry operations will be conducted on this basis.

ii. Plan Period - 10 years





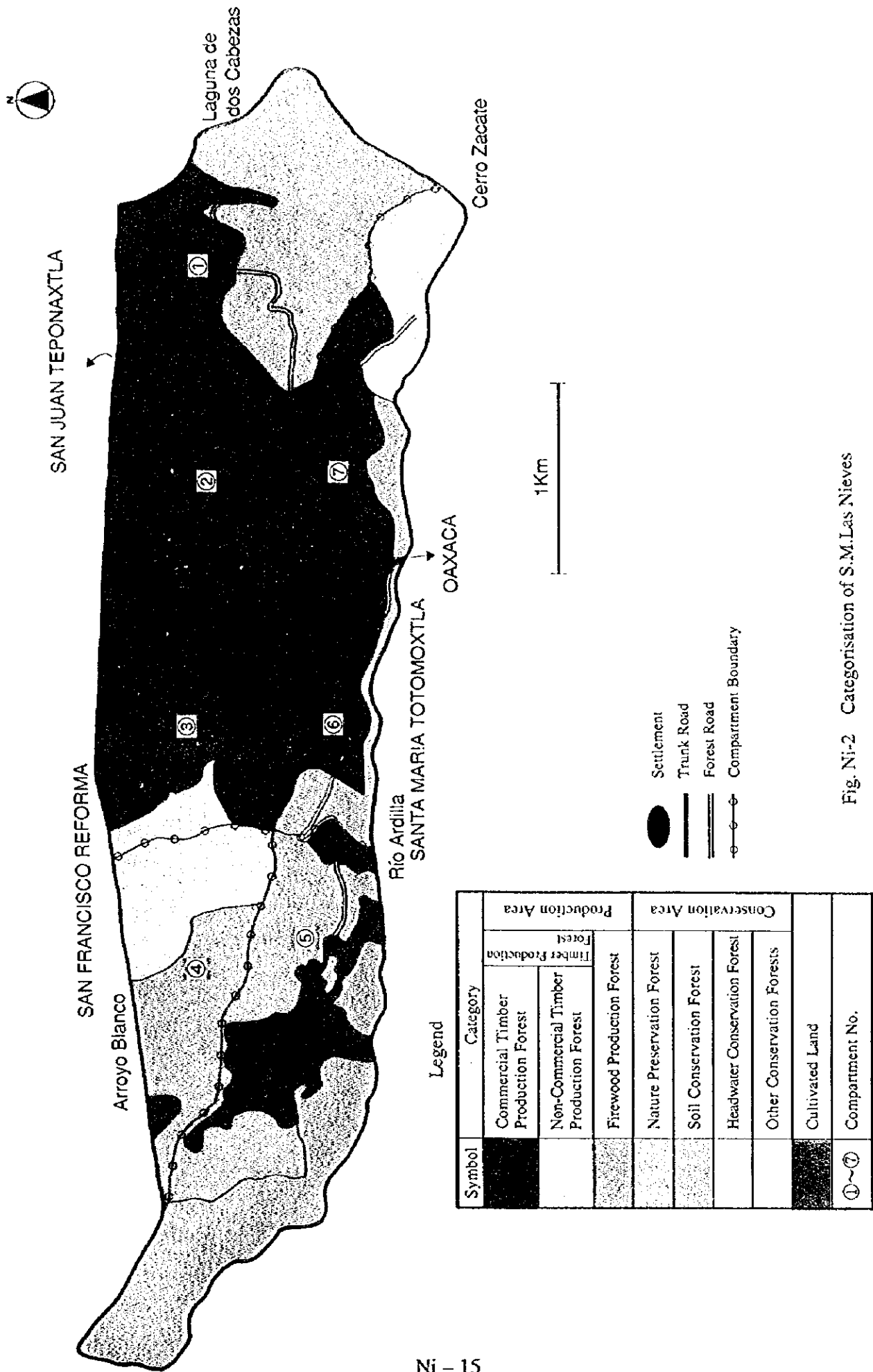


Fig. Ni-2 Categorisation of S.M. Las Nieves



(c) Characteristics of Commercial Timber Production Forests

The characteristics of commercial timber production forests by compartment are described in Table Ni-8.

Table Ni-8 Characteristics of Commercial Timber Production Forests

Compartment No.	Characteristics
1	Forests are located to the north of the nature preservation forests near Cerro Zacate and a forest road runs in the east-west direction almost at the centre of these forests. Scattered large-diameter trees left from earlier felling were felled in 1997 on both sides of the forest road. Many forests have a high proportion of encino trees which were left behind after felling.
2	The ridgeline extending westwards from Cerro Zacate comprises the boundary with Compartment No. 7 and forests lying to the north of this ridgeline are sandwiched by Compartment No. 1 and the trunk road. Many forests require thinning and pine trees grow densely. Forests are classified as those with small-diameter pine trees and mixed forests of pine and Quercus trees.
3	Lower elevation forests than Compartment No. 2, the boundary with which is marked by the trunk road. There is a large area (some 25 ha) of cultivated land in this compartment. A forest road runs from the trunk road, forming part of the boundary with the cultivated land and leading to S.F. La Reforma. The large-diameter pine trees along this forest road were almost completely felled in 1996.
6	Forests located to the south of the westward ridgeline from Cerro Zacate and also to the south of the trunk road. A road branching from the trunk road to the settlement runs through these forests. Only a small number of large-diameter pine trees exist because of felling activities in the past.
7	The westward ridgeline from Cerro Zacate comprises the boundary with Compartment No. 2. Forests are located to the south of the ridgeline but at a higher elevation than the trunk road. A forest road runs from the trunk road towards mesofilo forests. Areas along this forest road were subject to felling in the past and areas with a high elevation were also subject to felling in 1997, leaving virtually no large-diameter pine trees.

(d) Long-Term Prospects

i. Desirable Forest Composition

The most desirable forest composition is that where stands of the same age have a similar area so that the growing stock produces an almost constant annual yield.

ii. Present Forest Composition

In general, the forest composition is shown by age class. However, the age of local forests is not clearly known, making it necessary to estimate the age class based on the tree height. For this estimation purpose, the tree height classes by 5 m intervals used for the forest type interpretation were replaced by the age classes shown in Table Ni-9. Age classes are used to integrate the stand age into certain age bands to avoid complications and, here, the stand ages are grouped in age classes using five years as the unit.

Table Ni-9 Relationship between Age Class and Tree Height Class

Age Class	I	II	III	IV	V	VI
Stand Age (years)	1 - 5	6 - 10	11 - 15	16 - 20	21 - 25	26 - 30
Tree Height Class (m)	5	10	10	15	15	20
Age Class	VII	VIII	IX	X	XI	XII
Stand Age (years)	31 - 35	36 - 40	41 - 45	46 - 50	51 - 55	56 - 60
Tree Height Class (m)	20	25	25	30	30	30, 35

When the same tree height class was included in different age classes, the area and volume of such a tree height class were equally divided in the said age classes. The resulting composition of pine forests and pine-quercus forests is shown in Table Ni-10 and Fig. Ni-3.

Although the forest composition established here is not entirely accurate because of conversion of the tree height to the stand age, it still reasonably shows the general picture. Sustained production requires an almost equal distribution of the area by age class and gradually increasing growing stock from Age Class I to Age Class XII. At present, local forests mostly belong to Age Classes VIII and IX, failing to show the desirable forest composition from the viewpoint of sustained production. The present forest composition will not allow regeneration felling for at least the next 15 years.

### iii. Future Forest Composition

If the present forest composition is improved to the desirable forest composition through appropriate forestry activities, the future forest composition will show the state shown in Table Ni-12 and Fig. Ni-4. The estimated mean tree height, mean DBH, mean volume and mean increment, etc. for each age class of this desirable forest composition is shown in Table Ni-11 using the activity model of clear felling leaving seed trees described in 4.1-(8)-1).

Table Ni-10 Present Pine Resources Composition of Commercial Timber Production Forests in S.M. Las Nieves

Age Class		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total
P	Area (ha)	0	3	3	14	14	3	3	0	0	0	0	0	40
	Growing Stock (m <sup>3</sup> )	0	261	261	1,644	1,644	617	617	0	0	0	0	0	5,041
PQ	Area (ha)	0	0	0	20	20	35	35	76	76	10	10	10	293
	Growing Stock (m <sup>3</sup> )	0	0	0	820	820	2,109	2,109	6,600	6,600	1,079	1,079	1,079	22,295
Total	Area (ha)	0	3	3	34	34	38	38	76	76	10	10	10	333
	Growing Stock (m <sup>3</sup> )	0	261	261	2,464	2,464	2,726	2,726	6,600	6,600	1,079	1,079	1,079	27,336
	Growing Stock (m <sup>3</sup> /ha)	0	87	87	72	72	72	72	87	87	108	108	108	82

Note: Because of the proportional division of the area and growing stock, the total area is not necessarily the same as the sum of the areas of individual classes.

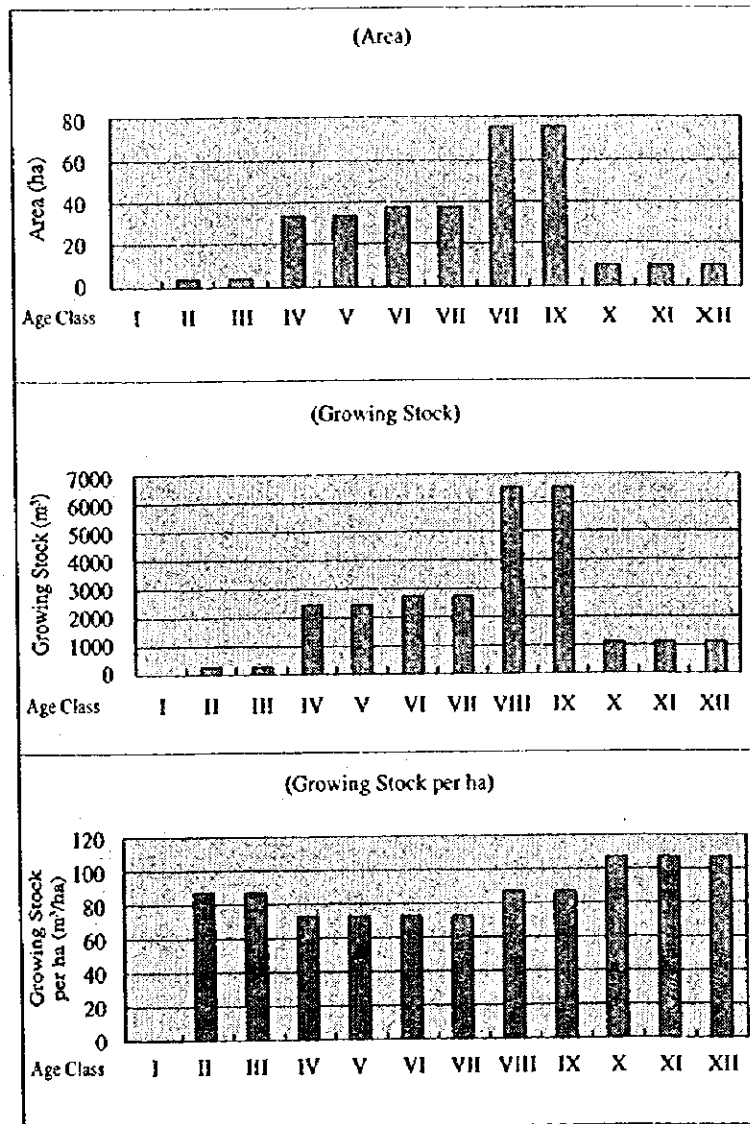


Fig. Ni-3 Current Pine Resources Composition of Commercial Timber Production Forests in S.M. Las Nieves

Table Ni-11 Tree Height, DBH and Volume, etc. of Desirable Forest Composition

Age Class	I	II	III	IV	V	VI
Stand Age (years)	1 - 5	6 - 10	11 - 15	16 - 20	21 - 25	26 - 30
Mean Tree Height (m)	1	5	8	12	13	16
Mean DBH (cm)	-	-	-	17	19	22
Mean Volume (m <sup>3</sup> /ha)	-	-	-	17	92	140
Mean Growth Rate (%)	-	-	-	-	25.3	11.1
Age Class	VII	VIII	IX	X	XI	XII
Stand Age (years)	31 - 35	36 - 40	41 - 45	46 - 50	51 - 55	56 - 60
Mean Tree Height (m)	20	23	25	26	28	29
Mean DBH (cm)	26	31	33	35	37	39
Mean Volume (m <sup>3</sup> /ha)	205	217	228	276	321	362
Mean Growth Rate (%)	8.2	4.5	4.3	4.1	2.7	2.4

As real forests include riparian forests to be protected, forest edges, ridgelines, sites with poor hauling conditions and steep slopes of generally more than 40°, these sites are assumed to account for some 40% of the total forest area. The remaining sites constitute the subject forests of forestry operations, i.e.  $333 \text{ ha} \times 0.6 = 200 \text{ ha}$ , and the ideal composition of pine resources in these forests is shown in Table Ni-12 and Fig. Ni-4, taking Table Ni-11 into consideration. Judgement on whether an area should be designated as left-over area will be made in the field at the implementation stage of forest operation.

#### iv. Future Felling Volume

Assuming that the forests subject to forestry operations improve to the composition shown in Table Ni-12, the feasible felling volume each year will be approximately  $1,300 \text{ m}^3$  (mean volume at final age:  $380 \text{ m}^3/\text{ha}$ , area of 3.4 ha, the volume of seed trees is not considered as it exists from the beginning).

#### v. Timing of Regeneration Felling in the Future

The timing of future regeneration felling is assumed to be 40 years after thinning for those stands where thinning is conducted under the present plan as such timing is determined by the years remaining after thinning upto the time of regeneration felling, i.e. (60 years - age of stand subject to thinning) and 60 years after stand improvement for those stands where the same

forestry operations as stands after regeneration felling are conducted following the said improvement.

(e) Immediate Plan

i. Regeneration Felling

As almost all of the timber production forests lack sizable stands which are ready for regeneration felling because of selective felling being conducted several times in the past, it is impossible to plan regeneration felling for these forests. However, the pine trees to be felled during stand improvement work are equivalent to those felled by regeneration felling and, therefore, the felling volume of pine trees by stand improvement work is considered to be the volume of regeneration felling.

Forest improvement will be conducted at the forests subject to activities (total of 200 ha) except at those stands where thinning will be conducted. Assuming that the area subject to stand improvement is 80% of the total forest area, the actual area subject to stand improvement will be 128 ha  $[(333 \text{ ha} \times 0.6 - 40) \times 0.8]$ . Meanwhile, the total area of sub-compartments subject to stand improvement under the work plan will be 293 ha.

Table Ni-12 Ideal Pine Forest Composition of Forests Subject to Forestry Operations in S.M. Las Nieves

Age Class	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total
Area (ha)	17	17	17	17	17	17	17	17	17	17	17	17	200
Growing Stock (m <sup>3</sup> /ha)	1	7	16	29	92	140	205	217	228	276	321	362	-
Growing Stock (m <sup>3</sup> )	17	117	267	484	1,536	2,338	3,424	3,624	3,808	4,609	5,361	6,045	31,630

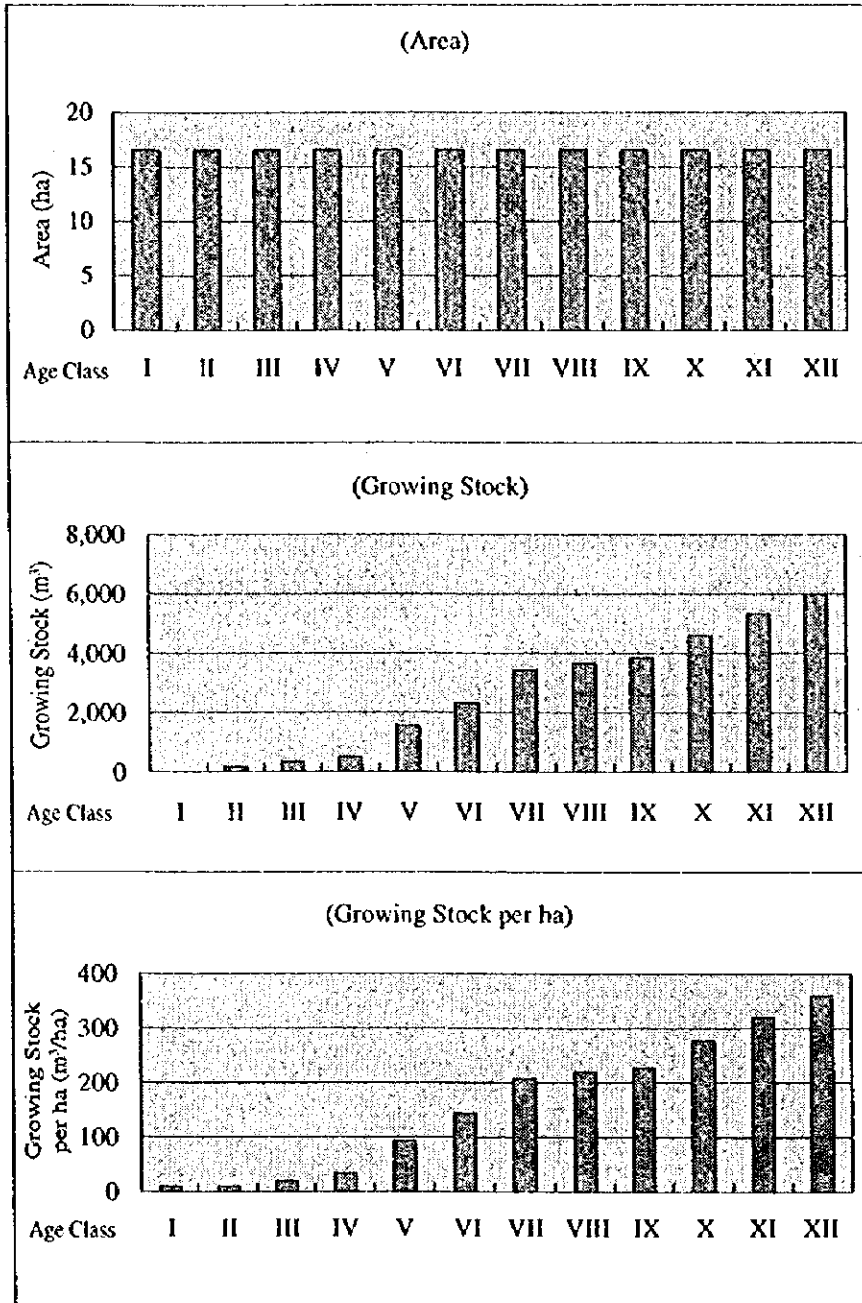


Fig. Ni-4 Ideal Pine Forest Composition of Forests Subject to Forestry Operations in S.M. Las Nieves



Although the early implementation of regeneration felling for stand improvement can lead to an increased volume of resources in the future, there is a limit to the amount of labour which can be provided by local people. Accordingly, it is more realistic to aim at completing stand improvement in half of the rotation period. Assuming that stand improvement is to be completed in 30 years, the actual area subject to stand improvement will be 4.3 ha/year.

ii. Thinning

Thinning will be conducted at those stands where the density of growing pine trees is excessive. Following the activity model for clear felling leaving seed trees, thinning equivalent to the first thinning will be conducted at stands where small-diameter pine trees are densely growing. At those stands where low intensity thinning was recently conducted, thinning equivalent to the second thinning will be conducted.

< Thinning Equivalent to First Thinning >

As high intensity thinning at stands with dense, small-diameter pine trees could also lead to the death of the remaining trees, low intensity thinning will be conducted twice at these stands in the 10 year plan period. The first thinning will be conducted in the first five years, followed by the next thinning in the next five years. The subject area is 30 ha and the annual thinning area will be 6 ha.

< Thinning Equivalent to Second Thinning >

The total area of stands where low intensity thinning has been conducted in the past is 9 ha and thinning will be conducted at a rate of 3 ha/year in three years of the plan period.

iii. Stand Improvement

Stand improvement will involve the felling and clearance of broad-leaved trees which are mainly encino. In addition, the improvement thinning of excessively dense pine forests which partially occupy the subject stands will also be conducted. The subject area will be equivalent to the area of regeneration felling described earlier and will be 4.3 ha/year.

Some of the stands where stand improvement is difficult due to the presence of many large-diameter encino trees are included in the area subject to stand improvement. This decision has been taken based on the judgement that the conversion of encino forests to pine forests is appropriate due to the current poor demand prospects for encino as a timber-producing species, partly because of the forest site conditions in this comunidad. As it may be possible to encourage the demand for encino in this area in the next 30 years, sites dominated by encino are included in the area subject to stand improvement. However, they are not included in the sites subject to forestry activities (stand improvement) in the next 10 years. The forestry operations at these stands should be reviewed when the pattern of the timber demand changes in the future to include encino.

b. Non-Commercial Timber Production Forests

This type of forest has low productivity and no active forestry operations are planned. Selective felling will be permitted to allow local people to obtain timber for their own use. As the felling volume for this purpose is extremely small, an allowable felling volume is not introduced.

2) Firewood Production Forests

a. Development Target

An area of an appropriate size to permit the sustained collection of firewood to meet the demand of the comunidad will be established as firewood production forests.

b. Area of Firewood Production Forest

Assuming that the annual firewood consumption of 50 households in S.M. Las Nieves is  $6 \text{ m}^3$ , the total annual consumption volume is  $300 \text{ m}^3$ . Based on the mean increment of a firewood production forest of  $4.9 \text{ m}^3$  and a firewood production yield of 75%, at least 82 ha of land must be earmarked for firewood production forests. Under the plan, 118 ha of land around the settlement is classified as firewood production forests to meet the future population increase.

c. Development Method

In principle, the felling of encino trees with a DBH of 20 cm or more will be permitted in firewood production forests.

Given the fact that the number of encino trees with a DBH of 20 cm or more is small in firewood production forests around the settlement, the necessary firewood will be collected from stands subject to thinning and improvement for some time.

In order to establish firewood production forests with a high mix ratio of encino, pine trees in forests with a high mix ratio of pine will be felled and used as timber and firewood for own use. Pine seedlings will also be removed. It will be necessary for local people to consciously conduct this work without fail whenever they enter forests to collect firewood. To quickly develop firewood production forests to their ideal state, it will be preferable not to touch the designated firewood production forests as long as encino can be collected from the stands subject to thinning or improvement.

## 9. Work Plan

Forest work is planned for forestry operations regarding thinning and stand improvement, forest roads and production facilities. Each type of work will be conducted in accordance with the method described in the common plan for all comunidades. The average annual amount of work as well as the amount of work for 10 year period are as mentioned below. As far as actual work is concerned, the amount of work by fiscal year will be decided by taking into consideration various circumstances. In case of S.M. Nieves, since the work scale is small, conducting felling will be considered each 2-3 years.

### (1) Commercial Timber Production Forests

#### 1) Regeneration Felling

##### a. Subject Sites of Regeneration Felling

The subject sites of regeneration felling coincide with the subject sites of stand improvement and the subject sub-compartments in the 30 years of operation are shown in Table Ni-13.

Table Ni-13 Subject Sites of Regeneration Felling (Sites Requiring Stand Improvement)

C	S/C	C	S/C	C	S/C	C	S/C	C	S/C	C	S/C
1	1	2	8	3	2	6	2	7	1	7	8
1	2	2	9	3	3	6	3	7	2		
1	3	2	11	3	4	6	4	7	3		
1	4	2	12	3	6	6	5	7	4		
2	1	2	15	3	7	6	7	7	5		
2	3	2	16	3	8	6	8	7	6		
2	4	3	1			6	9	7	7		

Note: C = Compartment, S/C = Sub-Compartment

The objective of stand improvement is to change the present forest stands to stands with high growing stock and a high mix ratio of pine trees in order to use forest land in an intensive manner. Given the lack of relevant experience on the part of local people, stand improvement work is planned for a 10 year period for those sub-compartments listed in Table Ni-14, taking the following conditions and people's intentions into consideration.

- (i) Stand with high productivity and vigorous tree growth
- (ii) Stand with good site conditions, including access
- (iii) Stand where improvement is possible with less labour

Table Ni-14 Subject Sub-Compartments of Regeneration Felling for 10 Year Plan Period

C	S/C	C	S/C	C	S/C	C	S/C
2	1	2	9	2	16	3	4
2	3	2	11	3	1	3	6*
2	4	2	12	3	2*	3	7*
2	8	2	15	3	3*		

Notes:

- 1. C = Compartment, S/C = Sub-Compartment
- 2. An asterisk (\*) indicates work priority.

b. Area and Volume of Regeneration Felling

The total area of the sub-compartments subject to regeneration felling in the 10 year plan period shown in Table Ni-14 is 95 ha, of which stand improvement will actually be conducted in 43 ha. The area and volume of the regeneration felling to be conducted in the 10 year plan period are shown in Table Ni-15.

Table Ni-15 Area and Volume of Regeneration Felling Sites

Area and Volume of Sub-Compartments Subject to Regeneration Felling in 10 Year Plan Period				Actual Area and Volume of Regeneration Felling			
Area (ha)	Standing Tree Volume (m <sup>3</sup> )			Area (ha)	Standing Tree Volume (m <sup>3</sup> )		
	Total	Pine	Others		Total	Pine	Others
95	19,846	6,932	12,913	43	8,980	3,140	5,840

c. Area and Volume of Annual Regeneration Felling

As regeneration felling will be conducted at 4.3 ha/year, the standing tree volume of pine corresponding to this area will be 314 m<sup>3</sup> (3,140 ÷ 10). Assuming that 20 m<sup>3</sup>/ha is left for seed trees, the regeneration felling volume of pine trees will be 230 m<sup>3</sup>/year. Species other than pine will be felled through stand improvement.

The allowable felling volume for regeneration felling is determined by dividing the current growing stock by the rotation period and adding half of the annual increment. The forests in the subject areas have already undergone the selective felling of large diameter trees and the remaining pine trees are relatively old. In addition, many of these trees are competing with encino trees. Accordingly, no increment is considered for the present felling volume calculation.

Table Ni-16 Area and Volume of Annual Regeneration Felling

Area	Standing Tree Volume of Pine
4.3 ha	230 m <sup>3</sup>

2) Regeneration and Tending Work

As the physiognomy of forests which have undergone stand improvement is the same as that of sites which have undergone regeneration felling, ground clearance will be conducted after felling. If the number of regenerated trees does not meet the criterion for the completion of regeneration 2 - 3 years after stand improvement, ground clearance will again be conducted. Weeding will be conducted in the first 1 - 3 years after regeneration felling while improvement felling will be conducted between the fifth and tenth years after the completion of regeneration.

3) Thinning

a. First Thinning

i. Subject Sites

The sub-compartments where the first thinning should be conducted are Sub-Compartment Nos. 2, 5, 6, 7, 10, 13 and 14 in Compartment No. 2.

ii. Area and Volume of Thinning

The area, volume and thinning volume of the sites subject to the first thinning are shown in Table Ni-17. As the actual stands are over-crowded, the timing and volume of thinning suggested by the operation model have been modified so that the first thinning will be conducted in two phases. The thinning rate for pine trees in the first phase will be 20% (some eight trees if 20 pine trees exist in an area of 10 m × 10 m as this figure of 20% indicates the thinning rate by volume). Although species other than pine should, in general, be completely felled in this phase, a 60% thinning rate is employed to ensure the health of the subject stands. In the second phase, the thinning rates for pine and other species will be 30% and 100% respectively.

Table Ni-17 Area and Volume of First Thinning

First Phase	Area (ha)	Standing Tree Volume Prior to First Phase (m <sup>3</sup> )			Thinning Volume (in Five Years) (m <sup>3</sup> )		
		Total	Pine	Others	Total	Pine (20%)	Others (60%)
	30	5,400	3,900	1,500	1,700	800	900
Second Phase	Area (ha)	Standing Tree Volume Prior to Second Phase (m <sup>3</sup> )			Thinning Volume (in 10 Years) (m <sup>3</sup> )		
		Total	Pine	Others	Total	Pine (20%)	Others (100%)
	30	5,250	4,400	850	1,750	900	850

Note: The growth rate after the first phase is estimated to be 7%/year.

iii. Area and Volume of Annual Thinning

As 30 ha of forests will be thinned in five years, the annual thinning area will be 6 ha. The felling volume in regard to pine will be 160 m<sup>3</sup>/year in the first five years and 180 m<sup>3</sup>/year in the second five years.

Table Ni-18 Area and Volume of Annual Thinning

First Five Years				Second Five Years			
Area (ha)	Standing Tree Volume (m <sup>3</sup> )			Area (ha)	Standing Tree Volume (m <sup>3</sup> )		
	Total	Pine	Others		Total	Pine	Others
6	310	160	150	6	350	180	170

b. Second Thinning

i. Subject Site

The sub-compartment where the second thinning should be conducted is Sub-Compartment No. 5 in Compartment No. 3.

ii. Area and Volume of Thinning

The area, volume and thinning volume of the site subject to the second thinning is are shown in Table Ni-19. The thinning rates will be 30% for pine (approximately 40 - 50% in terms of the number of trees) and 50% for other species.

Table Ni-19 Area and Volume of Second Thinning

Area (ha)	Standing Tree Volume Prior to Second Thinning (m <sup>3</sup> )			Volume of Second Thinning (m <sup>3</sup> )		
	Total	Pine	Others	Total	Pine	Others
9	1,364	1,057	307	470	320	150

iii. Area and Volume of Annual Thinning

Nine hectares of forests will be thinned in years 1,3 and 5 and the annual thinning area will be 3 ha. The thinning volume will be 110 m<sup>3</sup>/year for pine and 50 m<sup>3</sup>/year for other species, totalling 160 m<sup>3</sup>/year.

Table Ni-20 Area and Volume of Annual Thinning

Area (ha)	Years 1,3 and 5		
	Standing Tree Volume (m <sup>3</sup> )		
	Total	Pine	Others
3	160	110	50

4) Stand Improvement

Those sites in need of stand improvement coincide with the subject sites of regeneration felling and the subject area of stand improvement is 4.3 ha/year. The standing tree volume of species other than pine which will be felled through stand improvement work is shown in Table Ni-21.

Table Ni-21 Annual Area and Volume of Stand Improvement

Area (ha)	Standing Tree Volume of Species Other Than Pine (m <sup>3</sup> )
4.3	580

(2) Firewood Production Forests

Many trees growing in firewood production forests are thin and the number of encino trees with a DBH of 20 cm or more is small. The encino trees to be felled under the thinning and stand improvement work will be used to supplement the shortage of firewood from firewood production forests. The standing tree volume of encino, etc. subject to thinning and stand improvement will be 800 m<sup>3</sup>/year which will substantially exceed the estimated annual firewood demand of 300 m<sup>3</sup>.

(3) Production and Marketing

1) Form of Production and Marketing

The comunidad intends to produce logs for marketing. As it was engaged in log production until last year, this form of production and marketing should be appropriate.

2) Log Production Volume

It is assumed that the log production yield of regeneration felling is 70% and that 70% and 30% of the logs produced are timber wood and pulp wood respectively. It is also assumed that the log production yields of the first thinning and second thinning are 50% and 60% respectively. The produced logs from the first thinning are used as pulp wood only while the ones from the second thinning are used as timber wood and pulp wood on a 50-50 basis. The actual log production volumes based on the above assumptions are shown in Table Ni-22.

These figures are based on the assumption that operations will be conducted every year. However, as the production volume, i.e. sales volume, each year is rather small, it should be considered to conduct regeneration felling every 2 - 3 years and stand improvement work every year.



Table Ni-22 Annual Log Production Volume

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

Year	Regeneration Felling		First Thinning	Second Thinning		Total	
	Timber Wood	Pulp Wood	Pulp Wood	Timber Wood	Pulp Wood	Timber Wood	Pulp Wood
1, 3, 5	110	50	80	30	30	140	160
2, 4	110	50	80	–	–	110	130
6 - 10	110	50	90	–	–	110	140

Note: Second thinning will be conducted in the first, third and fifth year.

(4) Forest Roads

1) New Construction

The construction of new forest roads is not planned and, instead, existing forest roads will be repaired for their continued use.

2) Repair of Existing Forest Roads

a. Extension of Existing Forest Roads

The total length of existing forest roads is 10 km as shown in Table Ni-23.

Table Ni-23 Length of Existing Forest Roads

No.	Existing Route	Length (km)
1	Starts from the trunk road in Compartment No. 2 and runs through Compartment No. 2 and then Compartment No. 1	2.7
2	Starts from the trunk road in Compartment No. 7 and reaches the mesofilo forest in Compartment No. 1	5.5
3	Starts from the trunk road in Compartment No. 3 and reaches the boundary with S.F. La Reforma	1.8
Total		10.0

b. Repair of Existing Forest Roads

The repair work listed in Table Ni-24 will be conducted for existing forest roads.

Table Ni-24 Planned Repair Work for Existing Forest Roads

Type of Work	Method
Levelling	Repair of uneven road surfaces (manual work)
Prevention of Muddy Surface	Banking and gravelling of muddy areas (manual work)
Repair of Side Ditches	Excavation of buried ditches and banking at eroded sites (manual work)
Removal of Shrubs	Felling and uprooting (manual work)

c. Work Volume

Most of the existing forest roads were improved to assist felling in 1997 and the sub-grade is still stable. As the repair of only those sections directly related to the planned operations will be conducted, the annual repair length is estimated to be one-fifth of the total length.

(5) Production Equipment

The large trucks and yarding cranes to be used for the yarding and transportation of logs will be rented. In addition, the tools/equipment listed in Table Ni-25 will be required for felling, stand improvement, regeneration and tending.

Table Ni-25 Required Tools/Equipment for Production Activities

Tool/Equipment	Quantity Required	Life Expectancy (years)
Pickeroon (Gancho)	5	4 ~ 5
Chainsaw	7	4
Hatchet	20	1 ~ 2
Rake	5	1 ~ 2

Note: The quantity of chainsaws includes two reserve chainsaws.

(6) Labour Volume

1) Regeneration Felling

The man-days required to produce 1 m<sup>3</sup> of logs by regeneration felling is 0.68 man-days based on Table 4-2-16 (Felling and Transportation Processes). As the annual production volume is 160 m<sup>3</sup>, the annual labour requirement is 109 man-days.

## 2) Regeneration and Tending Work

Ground clearance will be conducted after regeneration felling and will require three workers/ha. Weeding will be conducted for 1 - 3 years after regeneration, covering 50% of the regeneration felling area, and will require five workers/ha. Improvement felling will be conducted in the seventh year after regeneration for 50% of the regeneration felling area and will require five workers/ha. As the regeneration felling area is 4.3 ha, ground clearance will require 13 man-days/year, weeding will require 11 man-days in the first year, 22 man-days in the second year and 33 man-days in the third year and thereafter and improvement felling will require 11 man-days in the seventh year and thereafter.

## 3) Thinning

When thinned wood is produced, the labour requirement is increased by 60% compared to wood produced by regeneration felling because of the small diameter. The resulting labour requirement will be 1.10 man-days/m<sup>3</sup>. In the case of the felling of hitherto unused species, the labour requirement is estimated to be 0.4 man-days/m<sup>3</sup> based on Table 4-2-16.

As 140 m<sup>3</sup> of log wood will be produced from thinned wood every year for 1, 3, 5 years, the labour requirement will be 154 man-days. The labour requirement regarding hitherto unused species will be 80 man-days based on a felling volume of 200 m<sup>3</sup> (150 m<sup>3</sup> from first thinning + 50 m<sup>3</sup> from second thinning) and will be 88 man-days for thinned pine trees and 60 man-days for other trees in the 2, 4 year. In the second five year period, the labour requirement will be 99 man-days for thinned pine trees and 68 man-days for other trees every year.

## 4) Stand Improvement

Stand improvement work to fell encino and other broad-leaved trees left over from regeneration felling will require 40 man-days/ha. Assuming that chainsaw operators account for 30% of the manpower, the labour requirement will be 12 man-days for chainsaw operators and 28 man-days for labourers. Annual labour requirement for 4.3 ha of stand improvement work consists of 52 man-days for chainsaw operators and 121 man-days for labourers.

## 5) Repair of Existing Forest Roads

Assuming a labour requirement of 30 man-days/1 km for forest road repair, 60 man-days will be required to conduct the planned repair of 2 km.

## 6) Total Labour Requirement

The required labour volume for each year in the 10 year period is shown in Table Ni-26. The ratio between such technicians as chainsaw operators and operators for vehicle equipped with crane and labourers is 1 to 2.

Table Ni-26 Annual Labour Input Requirement

(Unit: man-days)

Year	Regeneration Felling	Tending			Thinning	Improvement	Forest Road Repair	Total
		Ground Clearance	Weeding	Improvement Felling				
1	109	13	11		234	173	60	600
2	109	13	22		148	173	60	525
3	109	13	33		234	173	60	622
4	109	13	33		148	173	60	536
5	109	13	33		234	173	60	622
6	109	13	33		167	173	60	555
7	109	13	33	11	167	173	60	566
8	109	13	33	11	167	173	60	566
9	109	13	33	11	167	173	60	566
10	109	13	33	11	167	173	60	566

## 10. Environmental Considerations

The actual operations will simply consist of stand improvement for some time and work to repair existing forest roads will not be required on a large-scale. Consequently, no major environmental problems are anticipated. However, careful attention will be required not to conduct excessive ground clearance for the regeneration of pine trees on steep slopes.

## 11. Measures Regarding Former Forest Fire Sites

A forest fire which started in S.J. Quiotepec in May, 1998 partially damaged low elevation forests in S.M. Las Nieves. Because only a small area with low productivity was damaged, the implementation of the present plan will not be affected. In fact, the damaged area extends over some 90 ha but the degree of damage<sup>1)</sup> is mainly minor or light damage. Most of the damaged

<sup>1)</sup> Degree of Damage

- Minor (there is a possibility of the death of less than 10% of the standing trees)
- Light (there is a possibility of the death of 10 - 40% of the standing trees)
- Medium (there is a possibility of the death of 40 - 80% of the standing trees)
- Severe (there is a possibility of the death of more than 80% of the standing trees)

sites fall in the category of soil conservation forest although some fall in the category of firewood production forest.

While soil erosion may be possible in the future, the absence of any conservation subject below the damaged sites means that no special soil conservation measures will be urgently required. Nevertheless, it will be necessary to suspend felling for several years at damaged firewood production forests in order to facilitate the quick restoration of vegetation with a view to conducting operations which are suitable for these forests in the future depending on the state of restoration of the remaining forests.

## **12. Evaluation on Forest Management Plan**

Out of the total area of 786 ha in S.M. Las Nieves, the area for the commercial production forest amounts to 333 ha. A unrestricted forest area to be utilized for the cutting accounts for 60% of the total production forest, i.e. 200 ha.

### **(1) With Project Case**

Under a With Project case, the log production is expected in the unrestricted forest.

#### **1) Log Production**

Out of 200 ha of the unrestricted forest, the log production is planned in the area for the forest stand improvement of 161 ha as well as in the area for the thinning of 39 ha.

##### **a. Regeneration Cutting in the Areas for the Forest Stand Improvement**

In the area for the forest stand improvement, the actual area in which the forest stand improvement is done will be 128 ha and in this area, both the forest stand improvement and regeneration cutting are planned over a 30-year period. During this period, the area which is subject to the forest stand improvement and regeneration cutting will be 4.3 ha per year ( $=128\text{ha}/30\text{years}$ ). An annual volume of the log production will be calculated at  $160\text{ m}^3$  per 4.3 ha based on the standing stem volume of pine trees ( $230\text{m}^3/4.3\text{ha /year}$ ) and the yield ratio of the log production. As an annual volume of the log production and sales is low, the regeneration cutting will be done every other year in practice but the forest stand improvement will be conducted every year.

In this type of forest areas, after twice of the thinning, the regeneration cutting will be planned in the 61st year after the forest stand improvement and regeneration

cutting are completed. Furthermore, in the same area, the first thinning will be done in the 20th year after the regeneration cutting. Considering that the final cutting age of trees is 60 years, the area for the regeneration cutting will be 2.7 ha per year (=161 ha/60years).

b. Area for Thinning

Out of the area of 39 ha for the thinning, 30 ha will be for the thinning equivalent to the first one while 9 ha will be for the thinning equivalent to the second one. In the area for the thinning equivalent to the first one, the thinning will be carried out twice in the same areas over a period of 10 years. During the first half of the 10-year period, a standing stem volume of pine trees for the yearly thinning will be 160m<sup>3</sup> per 6 ha. During the second half of the same period, a standing stem volume of pine trees for the yearly thinning will be 180m<sup>3</sup> per 6ha. As an annual volume of the log production and sales is low, the thinning will be done once two years in practice but the forest stand improvement will be conducted every year. After trees in the thinning area reaches their final cutting ages, the regeneration cutting will be conducted in the area of 0.5 ha per year over a 60-year period.

The thinning equivalent to the second one is planned in the area of 9 ha over a period of 3 years (first, third, and fifth years). Consequently, an annual thinning area will be 3 ha. A log production volume from 3 ha of the thinning area will be 110 m<sup>3</sup> per year.

2) Silvicultural Works

a. Forest Stand Improvement

Since an area for the forest stand improvement is 4.3 ha per year, this work requires about 170 man-days every year (= 40 man-days × 4.3 ha).

b. Regeneration and Tending

In an annual area for the forest stand improvement which is 4.3 ha, the ground clearance requires 13 man-days. The weeding requires 11 man-days per 2.2 ha/year. Since the weeding will be planned over a three-year period including the year for the regeneration cutting, the weeding needs 11 man-days in the first year, 22 man-days in the second year, and 33 man-days in the third year. The cleaning cutting will be done in the area of 2.2 ha per year in the 7th year from the completion of the regeneration cutting. It requires 11 man-days per year. In case of the thinning area,

similar activities such as the ground clearance, weeding, and cleaning cutting will be planned after the regeneration cutting.

A maximum number of annual man-days required for the forest stand improvement, regeneration and tending will be about 400. Out of 55 comuneros, a number of comuneros who currently resides in the comunidad and can actually participate in these activities will be 27. Therefore, if these activities are done without payment (i.e. Tequio), a comunero is required to spend additional 15 days for Tequio.

c. Purchase of Equipment and Tools to be required for Log Production

The following shows a list of equipment and tools which the comunidad currently owns:

Table Ni-27 Equipment and Tools Owned by Comunidad

Item	Quantity	Year of Procurement	Remarks
Pickeroon	2	N.A.	
Chainsaw	1	N.A.	Aside from a chainsaw owned by the comunidad, there exist 6 chainsaws privately owned in the comunidad.
3 Ton Truck	1	1992 (new)	Aside from a truck owned by the comunidad, there exist a 3/4 ton truck and a 12 ton truck, both privately owned in the comunidad.

Based on the existing ownership of the equipment required for the log production, the following, including those for spare use, are planned to be purchased:

Table Ni-28 Equipment and Tools Planned to be Purchased

Types of Equipment and Tools	Quantity	Timing for Purchase
Pikeroon	5	Every 4 to 5 years from Year 1
Hatchet	20	Every 4 to 5 years from Year 1 (Note)
Rake	5	Every year form Year 1 (Note)

Note: Purchase is made only at a time when the log production is conducted.

d. Rehabilitation Cost of Forest Roads

The construction of new forest roads is not planned but existing forest roads will be rehabilitated for use. The total length of the existing forest roads is 10 km and the yearly length of roads for rehabilitation will be one-fifth of the total length of the roads. Therefore, an annual cost of 2,800 pesos will be expected for the rehabilitation.

3) Transportation Cost

A unit transportation cost from the comunidad to Oaxaca will be 100 peso per cubic meter of logs. A similar unit cost will be applied to the transportation cost from the comunidad to Tuxtepec.

4) Management of the Forest Production Unit

The forest production unit of the comunidad is consisted of four members: a coordinator, a secretary, a treasurer, and a site supervisor.

(2) Without Project Case

In a Without Project case, sales of standing trees are planned over a period of 60 years. An annual volume of the log production is estimated at 179 m<sup>3</sup> based on the extent of the areas to be cut and the yield ratio of the log production. A price of logs will be calculated at 50 pesos per cubic meter after deducting all required expenses for the production and sales of logs from a sales price of logs in Oaxaca.

(3) Results of the Financial Analysis

Based on a comparison of a With Project case net cash flow and a Without Project case net cash flow, the net present value of an incremental cash flow is calculated at 140 thousand pesos. This means that with preconditions set as above, the project will be financially feasible. If forest stand improvement, regeneration and tending activities are implemented by Tequio, the net present value of the incremental net cash flow is calculated at 250 thousand pesos.

The following show results of the sensitivity analysis in case either of a sales price of a timber wood or a discount rate is altered.



Table Ni-29 Sensitivity Analysis in Case of Alteration of Sales Price of Timber Wood

Sales Price of Timber Wood (Pesos/m <sup>3</sup> )	Net Present Value (1000 Pesos)
480	266
430	55
420	13
410	-28

Table Ni-30 Sensitivity Analysis in the Case of Alteration of Discount Rate

Discount Rate (%)	Net Present Value (1000 Pesos)
18	545
22	11
23	-16

As shown above, the feasibility of the project will be greatly influenced by both a price of a timber wood and a discount rate.

The With Project net cash flow shows negative figures in some years as the forest stand improvement is implemented every year and the regeneration cutting is planned every other year. However, a cumulative net cash flow continues to be positive except Year 0 of the preparation year. Therefore, problems are not seen in terms of the project cash flow.

#### (4) Result of Economic Analysis

A comparison of the With Project and Without Project cases led to a positive net present value of the incremental net cash flow for the project. The net present value is calculated at 45 thousand pesos. Accordingly, with the above conditions being applied, the project will be feasible from an economic perspective.

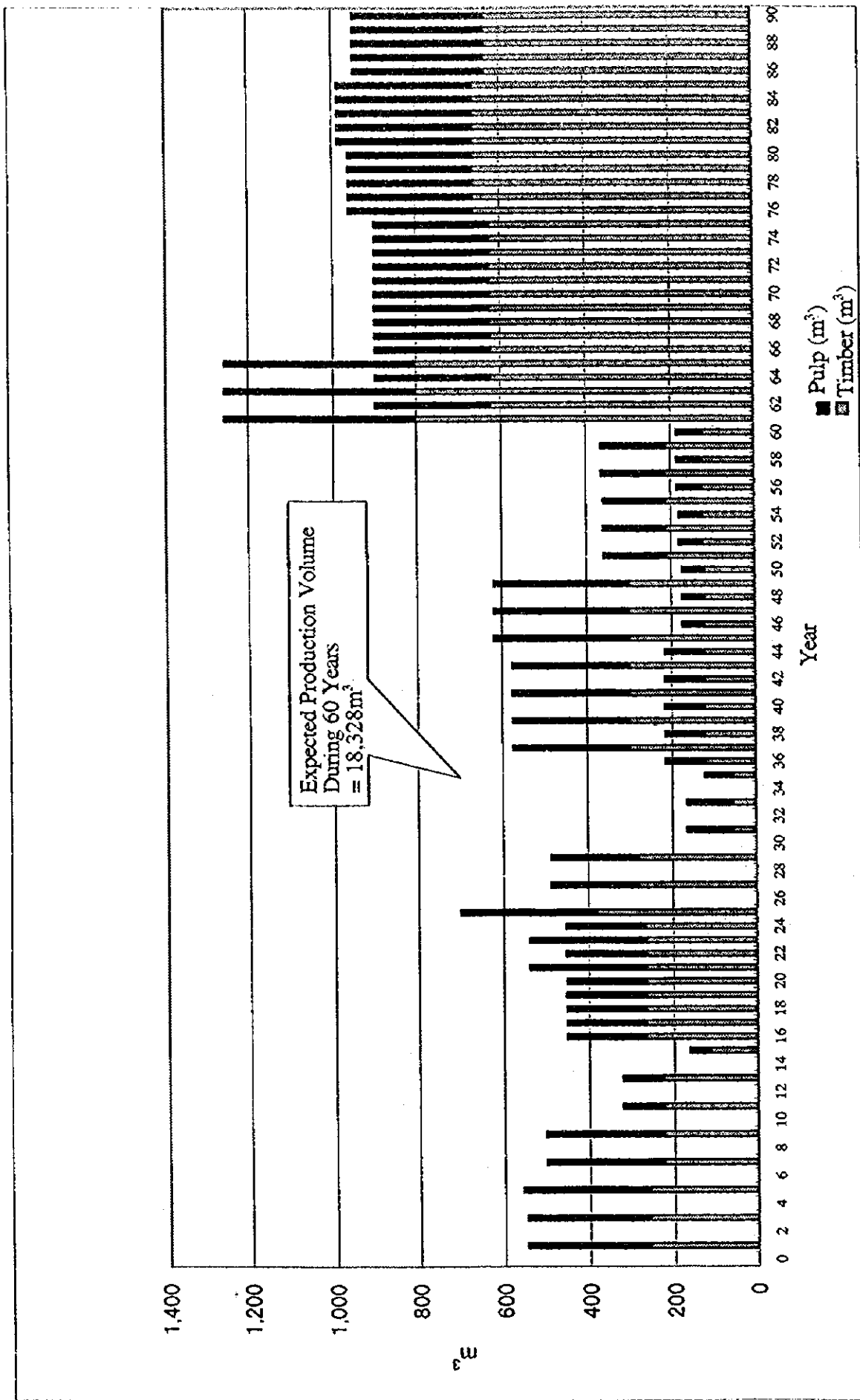


Fig. Ni-5 Expected Annual Production Volumes of Timber and Pulp Woods at S.M. Las Nieves  
(With Project Case)

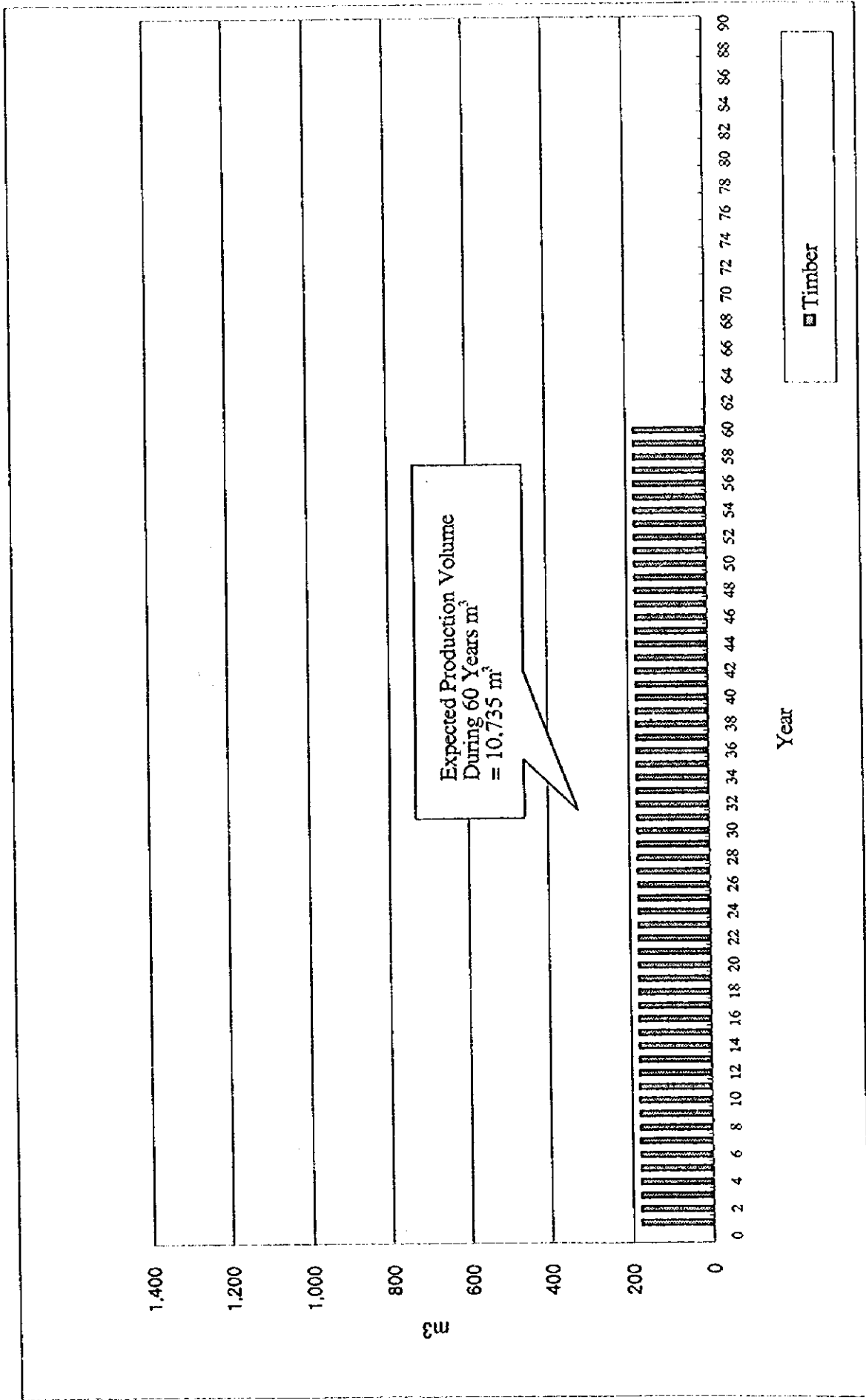


Fig. Ni-6 Expected Annual Production Volumes of Timber Wood at S.M. Las Nieves  
(Without Project Case)

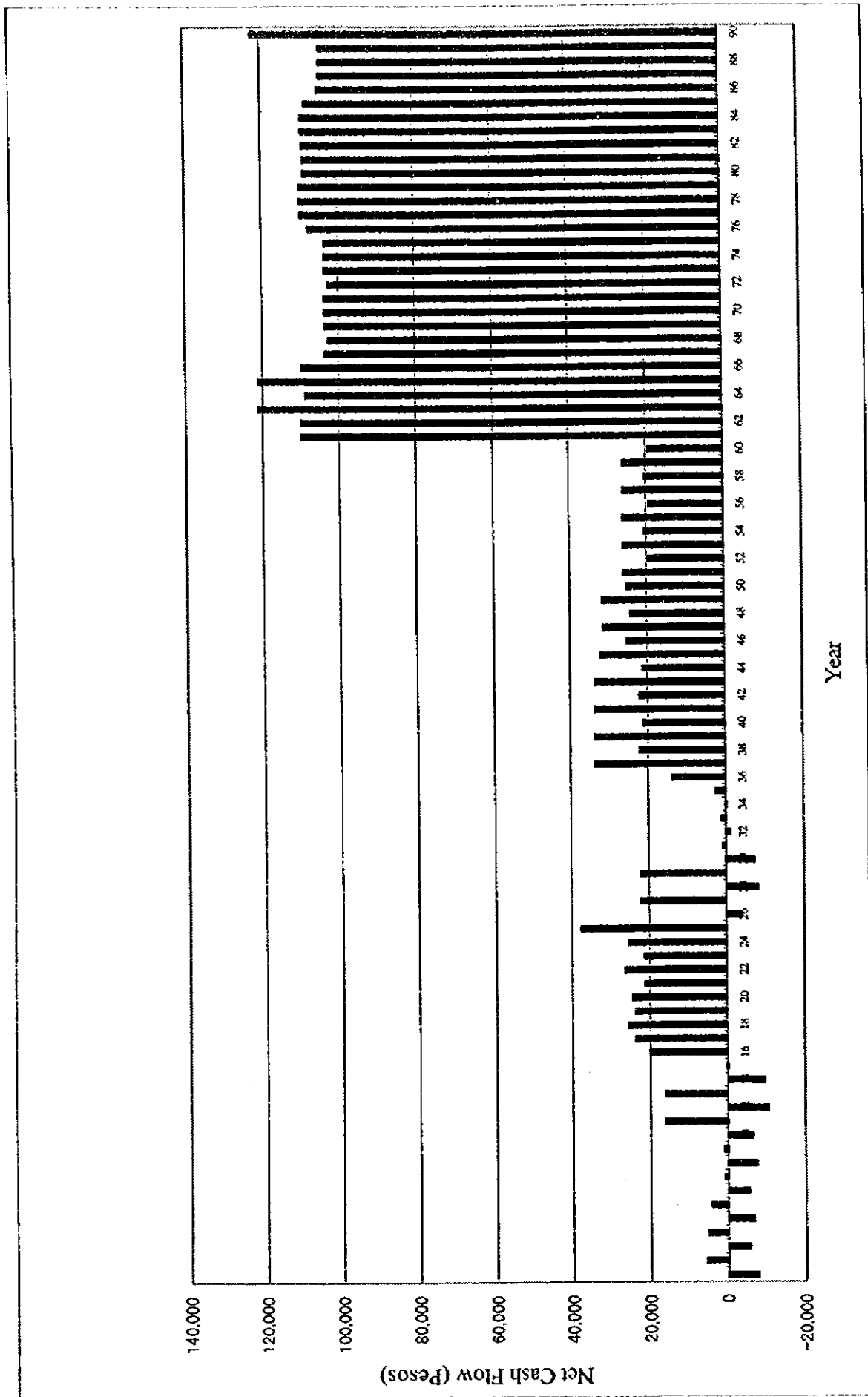


Fig. Ni-7 Expected Net Cash Flow from With Project Case at S.M. Las Nieves (1997 price)

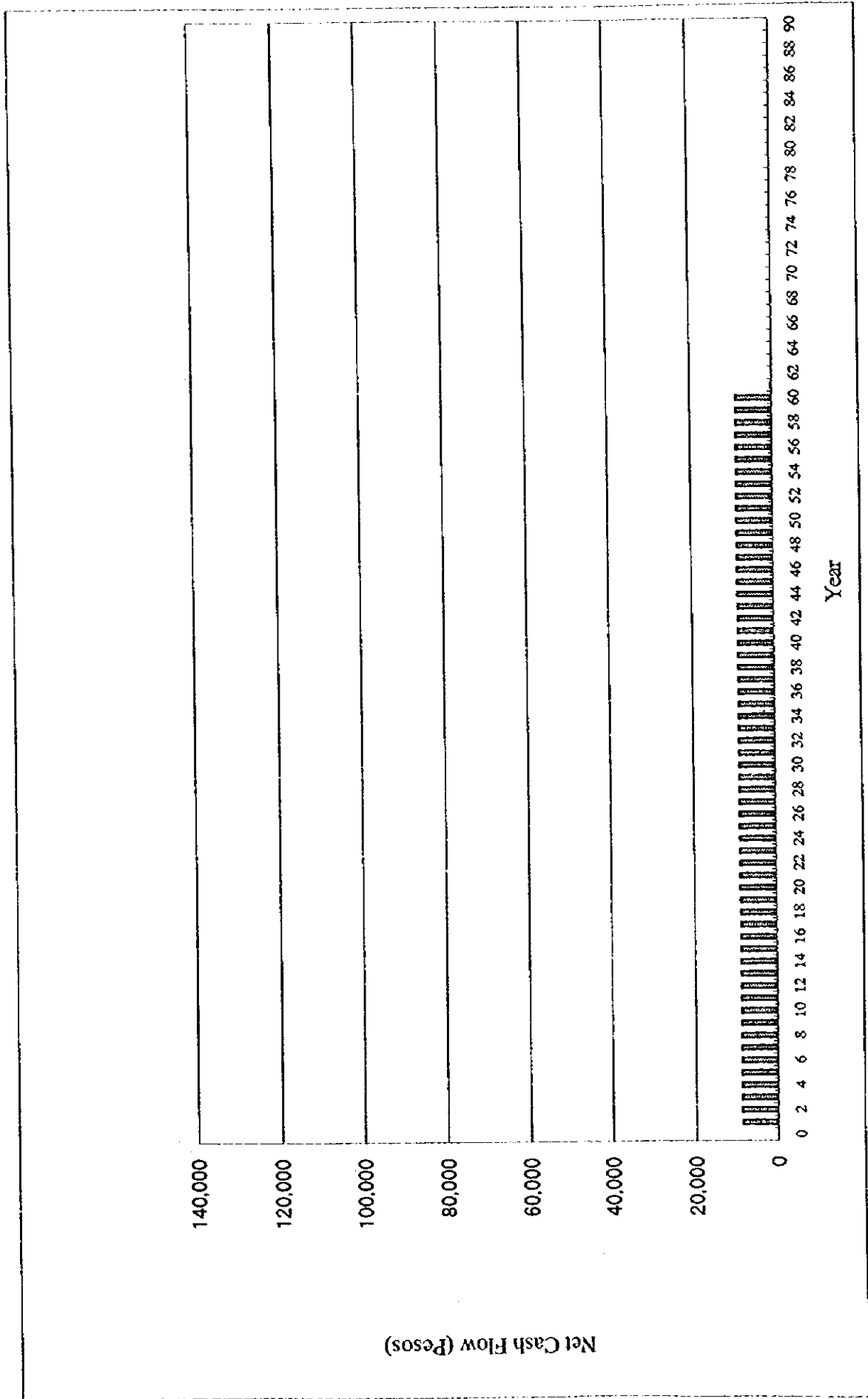


Fig. Ni-8 Expected Net Cash Flow from Without Project Case at S.M. Las Nieves (1997 price)





Table Ni-31 Parameter Table

Comunidad : S.M. Las Nieves		Net Present Value	
Table of Parameters		With Case	Without Case
1.Domestic Inflation and Discount Rate		329,063	189,228
Expected Rate of Inflation		139,835	
		15% p.a.	
Financial Discount Rate		20% (Nominal)	
		4.3% (Real)	
2.Standing Tree Volume (for Sales of Standing Trees) for Without Project Case		450 pesos/m <sup>3</sup>	290 pesos/m <sup>3</sup>
Area for Forest Stand Improvement		125.16 m <sup>3</sup> /year	
Area for Thinning		53.76 m <sup>3</sup> /year	
3.Price of Logs in case of Sales of Standing Trees Without Case		50 pesos/m <sup>3</sup>	
4.Sales Price of Logs Timber Wood (Milium) in Oaxaca Pulp Wood in Tuxtotec			
5.Area of Commercial Production Forest		333 ha	
A. Area for Forest Stand Improvement Area for Regeneration Cutting for 30 years		128 ha	
Annual Area for Regeneration Cutting		4.3 ha/year	
Yield Ratio of Log Production to be used for Pulp Wood		230 m <sup>3</sup> /year	
to be used for Timber Wood		70%	
to be used for Pulp Wood		30%	
to be used for Timber Wood		70%	
to be used for Pulp Wood		50%	
to be used for Timber Wood		50%	
to be used for Pulp Wood		70%	
to be used for Timber Wood		60%	
to be used for Pulp Wood		50%	
to be used for Timber Wood		50%	
to be used for Pulp Wood		2.7 ha	
to be used for Timber Wood		380 m <sup>3</sup> /ha	
to be used for Pulp Wood		70%	
to be used for Timber Wood		30%	
to be used for Pulp Wood		70%	
to be used for Timber Wood		50%	
to be used for Pulp Wood		20 m <sup>3</sup> /ha	
to be used for Timber Wood		30 ha	
to be used for Pulp Wood		6 ha	
to be used for Timber Wood		160 m <sup>3</sup>	
to be used for Pulp Wood		50%	
to be used for Timber Wood		100%	
to be used for Pulp Wood		70 m <sup>3</sup> /ha	
to be used for Timber Wood		60%	
to be used for Pulp Wood		50%	
to be used for Timber Wood		50%	
to be used for Pulp Wood		380 m <sup>3</sup> /ha	
to be used for Timber Wood		70%	
to be used for Pulp Wood		30%	
to be used for Timber Wood		70%	
to be used for Pulp Wood		0.5 ha	
to be used for Timber Wood		20 m <sup>3</sup> /ha	
to be used for Pulp Wood		50%	
to be used for Timber Wood		9 ha	
to be used for Pulp Wood		3 ha/year	
to be used for Timber Wood		36.7 m <sup>3</sup> /ha	
to be used for Pulp Wood		60%	
to be used for Timber Wood		50%	
to be used for Pulp Wood		50%	
to be used for Timber Wood		0.15 ha/year	
to be used for Pulp Wood		380 m <sup>3</sup> /ha	
to be used for Timber Wood		70%	
to be used for Pulp Wood		30%	
to be used for Timber Wood		70%	
to be used for Pulp Wood		20 m <sup>3</sup> /ha	
to be used for Timber Wood		50%	
to be used for Pulp Wood		380 m <sup>3</sup> /ha	
to be used for Timber Wood		70%	
to be used for Pulp Wood		30%	
to be used for Timber Wood		70%	
to be used for Pulp Wood		20 m <sup>3</sup> /ha	
to be used for Timber Wood		50%	
to be used for Pulp Wood		60 years	
to be used for Timber Wood		120 km	
to be used for Pulp Wood		15%	
to be used for Timber Wood			

8. Cost of Forest Stand Improvement, Regeneration and Tending, and Log Production

	Unit Cost (Pesos/M <sup>3</sup> )	Quantity/Year (Man-Days)
(1) Forest Stand Improvement	20	28 Man-Days/ha
(2) Ground Clearance	150	12 Man-Days/ha
(3) Weeding	30	3 Man-Days/ha
(4) Cleaning Cutting	30	5 Man-Days/ha
(5) Yield Survey	30	5 Man-Days/ha
(6) Cost of Log Production (Cutting, Processing, Limbing & Bucking, and Yarding)	52	5 m <sup>3</sup> /day/team
(7) Rental Fee of Grúa	8,000	1 team/day
(8) Cost Increase in Log Production Cost at the time of Thinning over Regeneration Cutting (Cost increase for Cutting, Processing, limbing and bucking, and Yarding)		1,625 times
(9) Transportation		

	Unit Cost/Month	Quantity	Total Cost
(10) Construction Cost of New Forest Road	75,000	1	75,000 pesos/200hrs/1.5Km/month
Rental Fee of Tractor de D-7	3,750	1	3,750 pesos/1.5Km/month
Assistant	1,000	2	2,000 pesos/1.5Km/month
Fuel (Diesel)	2,54	10,000	25,400 pesos/1.5Km/month
			70,767 Pesos/Km

(11) Rehabilitation Cost of Forest Roads

Length of Forest Roads to be Rehabilitated 2 km/year

2% of Construction Cost

2 km/year

50% of the total personnel expenses

2.1% of Annual Sales

0.4% of Annual Operating Expenses

4.2% of Annual Sales

200

30

75

3 tons truck

40 Pesos/Day

40 Pesos/Day

40 Pesos/Day

160 Pesos/Day

50% of the total personnel expenses

2.1% of Annual Sales

0.4% of Annual Operating Expenses

4.2% of Annual Sales

2.1% of Annual Sales

0.4% of Annual Operating Expenses

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4.2% of Annual Sales



**FOREST MANAGEMENT PLAN FOR  
SANTA MARIA TOTOMOXTLA**

## Santa Maria Totomoxtla

### 1. Outline

This plan has been formulated to consolidate the anticipated function(s) of each forest situated in S.M. Totomoxtla in view of the sustainable use of all local forests. In particular, as forests for commercial use, which form the basis for the comunidad's development, do not have a composition enabling sustained production, the plan incorporates a range of forestry operations to be conducted in the next 10 years from a long-term perspective to achieve a forest composition which is capable of sustained production. In addition, it is planned to ensure that those forests used for the collection of firewood, which is a daily necessity for local life, perform the function of sustained firewood production.

The components of the plan are the general conditions of the comunidad, the direction for forest improvement, basic principles, forest categorisation and operations in production areas and work plan.

### 2. General Conditions of Comunidad

#### (1) Natural Conditions

The natural conditions of S.M. Totomoxtla are summarised in Table To-1.

Table To-1 Summary of Natural Conditions

Climate	<ul style="list-style-type: none"><li>- Mean temperature for the period from November to January: maximum 15 - 27°C; minimum 6 - 12°C</li><li>- Mean rainfall in arid areas during the dry season (November - April): less than 100 mm</li><li>- The level of rainfall increases in accordance with the higher elevation towards the northeast from the Rio Grande</li><li>- Highest mean monthly rainfall for the period from November to April: more than 300 mm</li></ul>
Topography	<ul style="list-style-type: none"><li>- Elevation range: 1,180 - 3,010 m</li><li>- Horizontal distance: 8,600 m, relative height: 1,830 m</li><li>- The ridge extending from Cerro Zacate to Cerro Viento is situated in the southeastern part of the comunidad. The ridge extends northwestwards from Cerro Viento and Rio San Martin and forms the comunidad's border with S.M. Buenavista.</li><li>- The northern slope facing Rio Ardilla is very steep.</li></ul>
Geology	<ul style="list-style-type: none"><li>- Widely covered by metamorphic rocks</li><li>- Distribution of sandstone, conglomerate, limestone and mudstone, etc. along the Rio Grande</li></ul>
River System	<ul style="list-style-type: none"><li>- All local rivers are tributaries of the Rio Grande.</li><li>- Rio Ardilla forms the western border with S.M. Las Nieves and joins Rio San Martin.</li><li>- Rio Luz runs in the southern part of the comunidad and joins Rio San Martin.</li><li>- Rio San Martin forms the boundary with S.M. Buenavista.</li></ul>

Soil	<ul style="list-style-type: none"> <li>- CMx (Chromic Cambisols) is dominant in areas with an elevation of 1,800 m or higher → the thick layer is suitable for forestry use.</li> <li>- LVx (Chromic Luvisols) is distributed at both slopes between Rio Luz → the presence of an illuvial clay horizon some 30 m below the surface reduces the land productivity but forestry use is still possible.</li> <li>- LPe (Eutric Leptosols) is found on steep slopes in the south and north → forestry use is difficult as soil with a thickness of less than 30 cm lies above the rock.</li> <li>- PZ (Podzols) is found on a ridge with a high elevation → unsuitable for forestry use.</li> </ul>
Vegetation	<ul style="list-style-type: none"> <li>- Elevation of 2,500 m or higher → mesofilo forests, i.e. broad-leaved forests consisting of diverse species</li> <li>- Elevation of 2,500 m - 2,000 m → semi-moist Pine-Quercus forests, i.e. mixed forests of pine and Quercus with a generally high tree height and high density; the physiognomy has changed in many forests because of pine felling in the past but the undergrowth is rich</li> <li>- Elevation of 2,000 m - 1,400 m → semi-arid Pine-Quercus forests; the tree height is lower, the quality is poorer and the undergrowth is simpler and less abundant</li> </ul>
Wildlife	<ul style="list-style-type: none"> <li>- Flora → mesofilo forests consist of diverse species while most Pine-Quercus forests mainly consist of pine and Quercus <ul style="list-style-type: none"> <li>• Three species fall under CITES Annex II</li> <li>• Five species fall under NOM-59</li> </ul> </li> <li>- Fauna → very diverse, ranging from those preferring an arid climate to those preferring a moist climate <ul style="list-style-type: none"> <li>• Five species fall under CITES Annex I</li> <li>• Two species fall under CITES Annex II</li> <li>• Eight species fall under NOM-59</li> </ul> </li> <li>- Aves <ul style="list-style-type: none"> <li>• One species falls under CITES Annex I</li> <li>• Three species fall under CITES Annex II</li> <li>• Seven species fall under NOM-59</li> </ul> </li> <li>- Amphibia, Reptilia <ul style="list-style-type: none"> <li>• One species falls under CITES Annex II</li> <li>• Three species fall under NOM-59</li> </ul> </li> </ul>

## (2) Living Conditions

The people of S.M.Totomoxtla are Chinanteco. According to the census of September 1997, there are 316 inhabitants (162 men, 154 women) and 48 households. If the population increases at the same rate as the data of the last five years, by year of 2007, the population will reach a total of 410. The work force, which includes people age 15 to 54 years old, will increase from 140 to 173 by 2007.

S.M.Totomoxtla has one kindergarten and one elementary school. The president of elementary school is interested in planting fruit trees in school yards and in creating a school forest. According to the December 1996 data, the percentage of non-Spanish speaking people above 16 years of age is 26.6%. It is high among women (36.6%) and the aged (55.0%). As for health care, there is a medical post with a person who received basic medical training. Medicinal herbs from the forest are widely used in the community

and there are three curer who are specialized in practicing medicinal herbs treatment. In serious cases, patients are taken to hospitals in Ixtlan or Oaxaca. Transportation and treatment are very expensive. Some 90% of households have electricity and 100% have water supply, but only 50% of them have toilet facilities and none of them have sewage system. There is a concern for sanitation problem.

The major industry in the community is agriculture. All inhabitants except one who runs a store, are engaged in subsistence farming. Major crops are corn and beans (frijoles), and fruit such as peaches and walnuts are cultivated. There are 80ha of farm land (20ha are on idle due to rotation) around the settlement. Also, 10 households own 3ha of farm land in the area known as "hot area", with altitude of 1,240 -1,760m. In *Cuasimulco*, the community also has fertile farm land which they received as compensation for helping in the construction of a church of Yetla in 1800. Only five households which cultivate their land around settlement and Cuasimulco can achieve self-sufficiency in corn production. The rest produce half the amount required to sustain them, due to the low productivity (500kg/ha) and to the small size of the farms. Scarcity of farmland is obvious; 20 young comuneros do not have their own land.

Table To-2 shows the intensity of agricultural activities, rainfall, festivals by month and the month in which they have time to engage in forestry productive activities. There are about 40 comuneros who live in the community, and they have to participate in tequio 12-15 times a year. It's mentioned that January, August, September, October and December are the months during which they can engage in forestry productive activities. Even in the rainy season, from August to October, S.M.Totomoxtla can transport their products due to the relatively good conditions of the road. People can work in sawmill or in wood working plant, if there are enough trees. Otherwise they can utilize the surplus work force in this rainy season for thinning the forest or for activities to improve the stand of forest.

Table To-2 Annual calendar

Activities • Rainfall intensity	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Volume of farming work												
Main farming work												
Rainfall intensity					△	△	△△	△△	△	△△	△	
Festivals • Events		⊙	⊙		⊙				⊙		⊙	
Forest production activities	■							■	■	■		■

The intensity of agricultural activities perceived by the local inhabitants

--- Agricultural activities in Cuasimulco      ↔ Agriculture activities near settlement and hot area

△: Quantity of rainfall

⊙: Festival

■: Possibility of engaging in forestry productive activities

The main source of cash income is the money sent by the emigrants who work in United States of America. The number of emigrants has increased since 1980's, and 37 (20 men, 17 women) are currently working outside the community. The number of male and female emigrants are nearly equal, and most of them are married. Other cash income derived from seasonal field labor in February, March, April, and November, when farming activities increase in the nearby communities. Daily salaries are 35pesos for men and 30 pesos for women. Some 6-7persons are engaged in this work. Sales of peaches and walnuts are another source of income. The price of walnuts is 10 pesos per 100 pieces and the price of peaches is 3 for 1peso. Walnut trees produce 6,000-8,000 nuts and peach trees produce 250 fruits each year. Almost all household have walnut or peach trees.

Problems and needs recognized in the community in general are: (1) Disappearance of the forest; (2) No improvement in living standard; (3) Lack of basic infrastructure; (4) Lack of means to educate the youth; (5) Low agriculture productivity; (6) Lack of job opportunities within the community. Women specifically cite: (1) Lack of job opportunities for their husbands and sons; (2) Lack of introduction of improved stoves, (3) Lack of toilet installation and (4) Alcoholism. Besides these problems and needs, the school teacher mentioned the bad nutrition of the students. Generally speaking women's activities are limited to their households. But as showed above, the needs and problems mentioned by men and women are related to different aspects of life. Therefor it is important to take into account opinions from both gender to make a balanced improvement of their living conditions

### (3) History of Forest Use and Development of Comunidad through Forest Use

#### 1) History of Forest Use

1964: Road construction commenced together with the felling of pine trees from Cerro Machin on National Route 175 linking Oaxaca and Tuxtepec in the direction of Buenavista. The felling was conducted by a private timber company, a subsidiary of an Italian related company, and the selective felling of pine trees was conducted along the newly constructed road.

Around 1975: Standing trees were sold to a paper company in Tuxtepec which annually felled some 500 m<sup>3</sup>/year in exchange for the construction of a road linking the settlement to the trunk road.

1991: Standing trees were sold to a private timber company in Oaxaca for a period of three years. The company constructed a road from the settlement towards the downstream of the Rio Grande while conducting felling, including the felling of scattered large-diameter trees left behind from earlier felling.

1993-1994: The Chinantla Regional Council (Consejo Regional Chinantla) was established by S.M. Totomoxtla. S.F. Reforma and S.M. Buenavista for mutual assistance between comunidades in regard to forest fire-fighting, road improvement and petitioning of the government, etc.

## 2) Development of Comunidad through Forest Use

The income from felling has mainly been used for the following purposes.

- Construction of a road linking the settlement to the trunk road
- Construction of a church
- Construction of a basketball court
- Introduction of electricity supply
- Development of a drinking water supply system
- Procurement of a 30 ton truck

## 3. Current State of Land Use and Vegetation

The area by land use and vegetation type in S.M. Totomoxtla is shown in Table To-3.

Table To-3 Area by Land Use and Vegetation Type

Land Use and Vegetation Type		Symbol	Area (ha)
Forest	Quercus Forest	Q	65
	Pine-Quercus Forest	PQ	1,274
	Mesofilo Forest	Me	69
Sub-Total			1,408
Non-Forest	Cultivated Land	Ag	96
	Highland Grassland	Ch	5
	Settlement	Hu	5
	Denuded Site	D	9
Sub-Total			115
Total			1,523

Note: Land use and vegetation condition prior to the May, 1998 forest fire.

## 4. Current Conditions of Forest Resources

The forest resources survey identified the forest resources in the comunidad as shown in Table To-4.

Table To-4 Current Conditions of Forest Resources

Area/Volume	Pine-Quercus Forests				Other Than Left		Total
	P	Q	PQ	Sub-Total	Me	Cultivated Land, etc.	
Area (ha)	–	65	1,274	1,339	69	115	1,523
Standing Tree Volume (m <sup>3</sup> )	–	2,300	152,300	154,600	–	–	–
Standing Tree Volume per ha (m <sup>3</sup> /ha)	–	35	120	115	–	–	–

Note: Forest resources conditions prior to the May, 1998 forest fire.

The volume of commercial timber production forest resources is described in 8-(1) below.

### 5. People's Expectations toward the Use of Forest

As mentioned in 2-(3), the most important source of income for the community has been the sale of trees in their forest. Comuneros well understand that without the resources from their forest, it would have been impossible to construct a school, roads, a church and to introduce electricity. On the other hand, even though women often utilize forest to collect mushrooms, firewood, and medicinal herbs, they are not informed as to how those resources generated by the forest were spent.

The forest plays an important role in the community as a provider of firewood. Most inhabitants use wood as fuel. The collecting area is located within 3 km from the settlement and people collect wood 2-3 times a week.

The following problems and solutions related to forest are listed by the members of Rapid Rural Appraisal (RRA) study team, which consisted of the local inhabitants and specialists from outside the community. Due to the inadequate cutting by the timber dealer which did not consider the regeneration of the forest, a healthy growth of the forest has been hampered. This was pointed out as a serious problem. Also, the construction of forest roads is mentioned as a great need. Women claimed that lack of firewood around settlement is a problem.



Table To-5 Problems and Needs related to the Forest and Solutions

Problems	Solutions
<ul style="list-style-type: none"> <li>- Community has not actively participated in forest cutting</li> <li>- Regeneration of pine trees is insufficient</li> <li>- The need to create a forest where there are few trees</li> <li>- Reforestation in Loma de Portillo</li> <li>- Financial support for pine tree reforestation</li> <li>- Construct a forest road to the Ladera de viento to make it possible to cut the old pine trees</li> <li>- Construct forest roads to areas where commercial timber can be obtained</li> <li>- Remove damages from insects</li> </ul>	<ul style="list-style-type: none"> <li>- Reforestation</li> <li>- Construct forest roads</li> <li>- Recuperation of forest</li> <li>- Combat insect pests</li> <li>- Create a forest fire brigade system</li> </ul>

Through the RRA study, the local inhabitants who are members of the team drew a map (Fig. To-1) describing the future use of community which categorizes the forest in the following uses; (1) Commercial timber production forest; (2) Forest recuperation area; (3) Forest for domestic timber; (4) Farm land; (5) Soil conservation area; (6) Animal protection area; (7) Headwaters conservation area.

The local members of the team understand the need to create forest in all of the areas where they formerly cut trees. Never the less they still expect to cut trees in four places.

The area for collecting firewood is included in (3). Though they are actually collecting firewood from the south-western part of the community, they designated this area as (2) Forest recuperation area, because they are aware of degraded state of the forest. The present (June 1998) community authorities understand the necessity of forest management and mentioned that comuneros can dedicate time twice a month to tequio for forest activities. It is very important to keep the people motivated for future forest management.

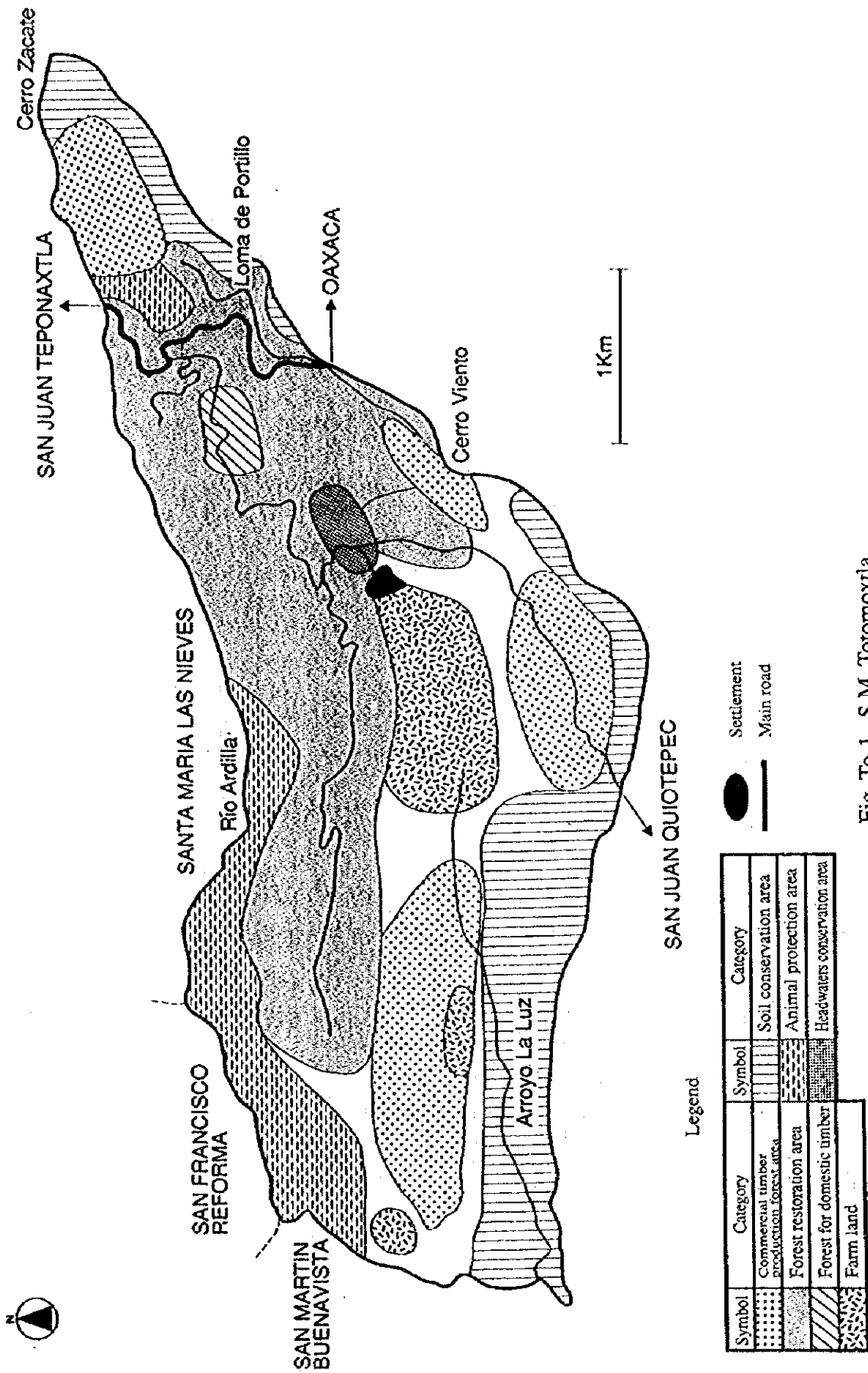


Fig. To-1 S.M. Totomoxtla  
 Map of the future use of the community land draw by local inhabitants  
 which are members of the RRA team

## **6. Direction for Forest Improvement**

The ideal of forest management is the sustainable production of high value wood by means of increasing the production capacity of a forest through the creation of a healthy forest while conducting felling, regeneration and other forestry operations. It is also necessary to ensure that the subject forest performs its public benefit function, if any.

Almost all areas where commercially usable pine trees grow in S.M. Totomoxtla have been subject to felling several times in the past 30 years. The felling method employed was the selective felling of fine trees and no regeneration or tending activities were conducted thereafter. As a result, large diameter pine trees can still be found to be scattered although there is no forest where these trees which have reached their rotation age exist in a group. In many forests, regenerated trees to form the next generation simply do not exist. This situation implies a difficulty of ensuring a sustained supply of forest resources which are the funding source for the development of the comunidad.

Apart from forests with commercial implications, firewood resources which constitute the daily fuel for local people are depleting near the settlement due to excessive collection. The improvement of these forests is also necessary to support the lives of local people.

Under these circumstances, the priority for forest improvement appears to be conversion of the forest composition where the sustained production of timber is difficult to that which is capable of such production in the future.

At present, there are not many forests with a high mix ratio of pine trees and, therefore, some difficulties are anticipated in improving the composition of local forests to that which is capable of sustained production. What is necessary in the immediate future to secure opportunities for the stable employment of local people and forest resources as economic resources to support the comunidad's development is the implementation of forestry operations designed to create forests with a high mix ratio of pine trees while aiming at developing highly productive forests which are capable of the sustained production of high quality pine timber.

A forest fire in May, 1998 damaged most of the forests located below the elevation of the settlement, making efforts to restore the forest state in some parts of the damaged area necessary.

## **7. Basic Principles**

The present plan is formulated on the basis of the following principles in line with the direction for forest improvement described above.

- (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.
- (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.

## **8. Forest Categorisation and Production Area Development**

### **(1) Forest Categorisation and Composition of Resources**

#### **1) Subject Area of Each Forest Category**

Prior to categorisation, the present forest distribution and situation of forest use in S.M. Totomoxtla are identified as follows.

#### **a. Forest Distribution**

- Mesofilo forests consisting of broad-leaved trees spread from near Cerro Zacate to the east to an area at an elevation of 2,700 m and rare wildlife is observed in these forests.
- Pine-quercus forests are observed below mesofilo forests down to an area at an elevation of around 1,400 m.
- Pine-quercus forests are divided into a semi-moist area at a higher elevation and a semi-arid area at a lower elevation with the dividing line being around an elevation of 2,200 m. The semi-moist area has many forests with high productivity and tall trees while the semi-arid area has many sparse forests with low productivity or forests with trees of a low height.
- Soil conservation work is required at steep slopes where the elevation is lower than that of the settlement and which face Rio Ardilla.

- Forest restoration work is required at sites which have been severely damaged by forest fire which are located at a lower elevation than that of the settlement.

b. Situation of Forest Use

- Fine pine trees have been used for commercial purposes.
- Drinking water is taken from a local stream which originates from Cerro Viento above the settlement.
- Local people use forests to collect timber for their own use to build homes and other structures.
- Local people use forests to collect firewood as their daily fuel.
- Local people collect medicinal herbs in forests.

Based on the general assessment of the present forest distribution, situation of forest use and intentions of local people, the forest categories shown in Table To-6 and Fig. To-2 have been finalised. Forests which do not fall in any category and which are not subject to forestry operations are classified as left-over forests. Further details are shown on the forest management plan maps of scale 1/10,000.

Table To-6 Subject Area by Forest Category

Forest Category		Description	
Production Area	Timber Production Forest	Commercial	-- Area between approximately an elevation of 2,200 m and mesofilo forest area
		Non-Commercial	-- Area between approximately an elevation of 2,200 m and soil conservation forests at a lower elevation
	Firewood Production Forest	-- Encino rich forests near the settlement	
Protection Area	Nature Preservation Forest	-- Mesofilo forest area near Cerro Zacate with an elevation of approximately above 2,700 m	
	Soil Conservation Forest	-- Steep slopes along Rio Ardilla with a lower elevation than headwater conservation forests	
	Headwater Conservation Forest	-- Mesofilo forest area near Cerro Zacate with an elevation of approximately above 2,700 m -- Area above the settlement where the intake point(s) of drinking water is located	
Restoration Area		-- Sites severely damaged by forest fire	
Left-Over Forest		-- Area not subject to immediate forestry operations	

2) Forest Division

Forest division was conducted and compartments and sub-compartments were established. Fig. To-2 shows the compartments while the sub-compartments are shown on the forest management plan maps.

3) Area by Forest Category

The area by forest category and compartment is shown in Table To-7.

Table To-7 Area by Forest Category

(Unit: ha)

Forest Category \ Compartment			1	2	3	4	5	6	7	8	Total
Production Area	Timber Commercial		63	30	74	28	18	58	19	-	290
	Production Non-Commercial		-	-	-	-	26	-	-	-	26
	Firewood Production Forest		-	-	-	-	-	8	52	70	130
Protection Area	Nature Preservation Forest		17	-	-	-	-	-	-	-	17
	Soil Conservation Forest		31	30	-	140	-	-	-	-	201
	Headwater Conservation Forest		61	-	-	-	-	17	-	-	78
Restoration Area			-	-	-	145	186	-	-	-	331
Left-Over Forest			-	-	-	-	159	-	-	183	342
Sub-Total			172	60	74	313	389	83	71	253	1,415
Others			-	-	2	11	17	6	6	66	108
Total			172	60	76	324	406	89	77	319	1,523

1

2

3

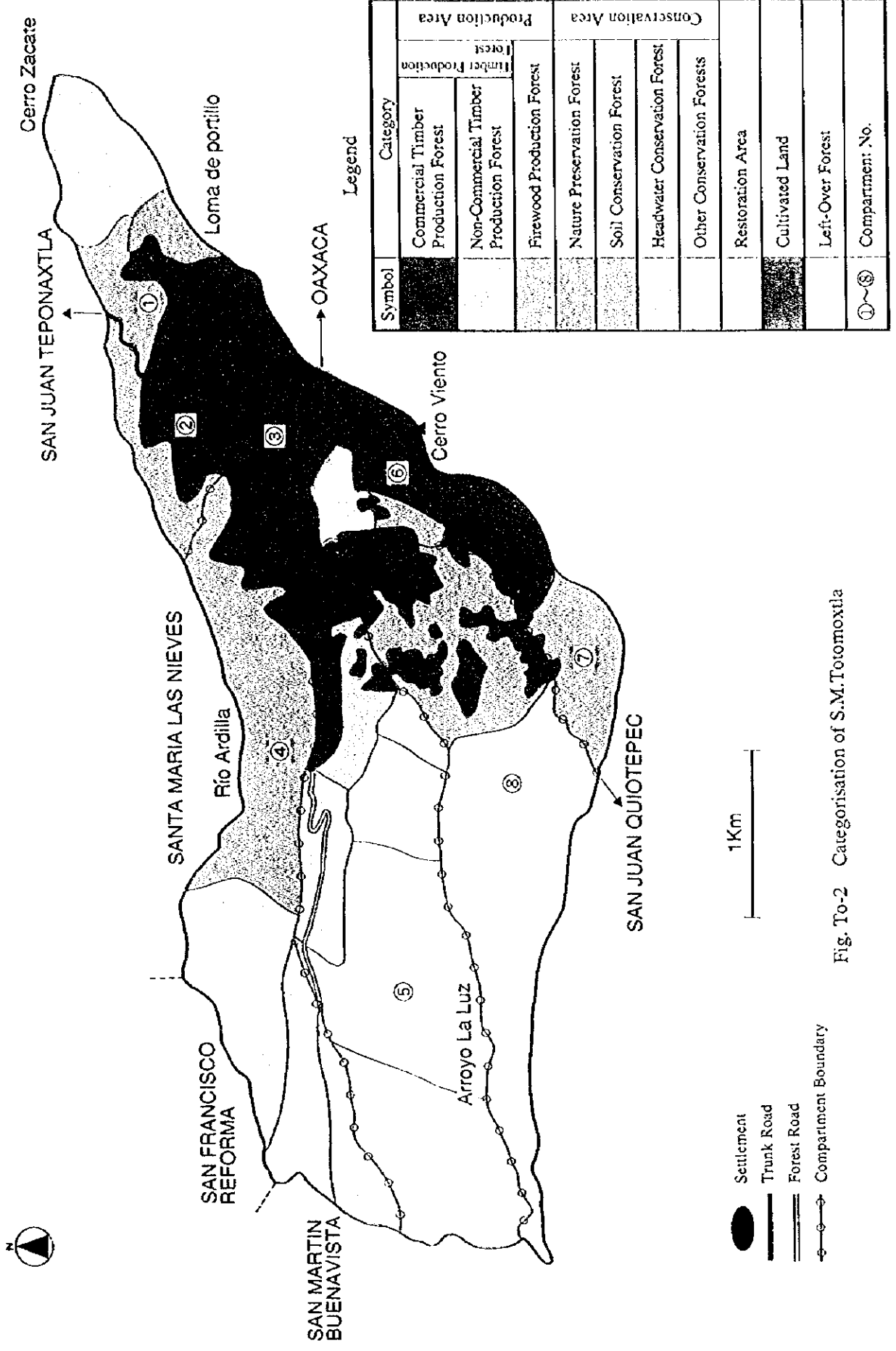


Fig. To-2 Categorisation of S.M. Totomoxtla





## (2) Production Area Improvement

Production areas will be improved in the following manner in accordance with the basic principles.

### 1) Timber Production Forests

#### a. Commercial Production Forests

##### (a) Improvement Targets

- Improvement of forests to ensure sustained timber production
- Implementation of thinning at stands with excessively dense pine trees to hasten the process of producing large-diameter wood
- Improvement of forests where the number of pine trees has declined due to felling in the past and where the number of encino has increased to forests with many pine trees of a high commercial value

##### (b) Plan Period

###### i. 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 forestry operations will be conducted on this basis.

###### ii. Plan Period - 10 years

##### (c) Characteristics of Commercial Timber Production Forests

The characteristics of commercial timber production forests by compartment are described in Table To-8.

##### (d) Long-Term Prospects

###### i. Desirable Forest Composition

The most desirable forest composition is that where stands of the same age have a similar area so that the growing stock produces an almost constant annual yield.

## ii. Present Forest Composition

In general, the forest composition is shown by age class. However, the age of local forests is not clearly known, making it necessary to estimate the age class based on the tree height. For this estimation purpose, the tree height classes by 5 m intervals used for the forest type interpretation were replaced by the age classes shown in Table To-9. Age classes are used to integrate the stand age into certain age bands to avoid complications and, here, the stand ages are grouped in age classes using five years as the unit.

When the same tree height class was included in different age classes, the area and volume of such a tree height class were equally divided in the said age classes. The resulting composition of pine forests and pine-quercus forests is shown in Table To-10 and Fig. To-3.

Although the forest composition established here is not entirely accurate because of conversion of the tree height to the stand age, it still reasonably shows the general picture. Sustained production requires an almost equal distribution of the area by age class and gradually increasing growing stock from Age Class I to Age Class VII. At present, local forests mostly belong to Age Classes VI and VII, failing to show the desirable forest composition from the viewpoint of sustained production. The present forest composition will not allow regeneration felling for at least the next 25 years.

## iii. Future Forest Composition

If the present forest composition is improved to the desirable forest composition through appropriate forestry operations, the future forest composition will show the state shown in Table To-12 and Fig. To-4. The estimated mean tree height, mean DBH, mean volume and mean increment, etc. for each age class of this desirable forest composition is shown in Table To-11 using the activity model of clear felling leaving seed trees described in 4.1-(8)-1).

Table To-8 Characteristics of Commercial Timber Production Forests

Compartment No.	Characteristics
1	<ul style="list-style-type: none"> <li>- Located at a higher elevation than the trunk road and between the trunk road and mesofilo forests.</li> <li>- Forests at the former forest fire sites along the trunk road are sparse.</li> <li>- A forest road starts from the trunk road near the boundary with Yolox and runs along the mid-slope towards mesofilo forests; not only pine trees but also standing Encino trees used to be sold along this forest road.</li> <li>- Most forests and pine-quercus forests have hardly any large-diameter pine trees.</li> </ul>
2	<ul style="list-style-type: none"> <li>- Located north of the road heading towards the settlement and between this road and Rio Ardilla.</li> <li>- A forest road starts from the road to the settlement and heads towards Rio Ardilla. Some large-diameter trees are scattered along this forest road but no stand containing a group of large-diameter trees exists.</li> <li>- In general, the mix ratio of encino is high with pine trees being thin with a diameter of approximately 10 - 20 cm.</li> </ul>
3	<ul style="list-style-type: none"> <li>- Area sandwiched by the trunk road and road heading towards the settlement.</li> <li>- No large-diameter trees in a group exist and most forests are pine-quercus forests with a high mix ratio of encino.</li> <li>- Some pine forests require thinning albeit a small area.</li> </ul>
4	<ul style="list-style-type: none"> <li>- Located to the north of the ridgeline running from Cerro Viento towards Rio San Martin and the north of the compartment is bordered by Rio Ardilla.</li> <li>- Commercial timber production forests, mainly pine-quercus forests with a high mix ratio of encino, lie to the north of the road heading towards the settlement.</li> </ul>
5	<ul style="list-style-type: none"> <li>- Located to the south of the ridgeline running from Cerro Viento towards Rio San Maria to the west at a lower elevation.</li> <li>- Hardly any large-diameter trees exist because of felling around 1991 and the productivity is low.</li> </ul>
6	<ul style="list-style-type: none"> <li>- Located below the ridgeline running from Cerro Viento towards Puntos Cuatrinos.</li> <li>- Some large-diameter pine trees are found scattered but not in groups.</li> </ul>
7	<ul style="list-style-type: none"> <li>- Area to the west of Puntos Cuatrinos and below the ridgeline.</li> <li>- Many forests are pine-quercus forests with a high mix ratio of encino and no stand has a group of large-diameter trees.</li> </ul>

Table To-9 Relationship between Age Class and Tree Height Class

Age Class	I	II	III	IV	V	VI
Stand Age (years)	1 - 5	6 - 10	11 - 15	16 - 20	21 - 25	26 - 30
Tree Height Class (m)	5	10	10	15	15	20
Age Class	VII	VIII	IX	X	XI	XII
Stand Age (years)	31 - 35	36 - 40	41 - 45	46 - 50	51 - 55	56 - 60
Tree Height Class (m)	20	25	25	30	30	30, 35

Table To-10 Present Pine Resources Composition of Commercial Timber Production Forests in S.M. Totomoxtla

Age Class		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total
P	Area (ha)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Growing Stock (m <sup>3</sup> )	0	0	0	0	0	0	0	0	0	0	0	0	0
PQ	Area (ha)	0	2	2	41	41	76	76	15	15	7	7	7	290
	Growing Stock (m <sup>3</sup> )	0	15	15	1,860	1,860	5,757	5,757	1,386	1,386	761	761	761	20,317
Total	Area (ha)	0	2	2	41	41	76	76	15	15	7	7	7	290
	Growing Stock (m <sup>3</sup> )	0	15	15	1,860	1,860	5,757	5,757	1,386	1,386	761	761	761	20,317
	Growing Stock (m <sup>3</sup> /ha)	0	8	8	45	45	76	76	92	92	109	109	109	70

Note: Because of the proportional division of the area and growing stock, the total area is not necessarily the same as the sum of the areas of individual classes.

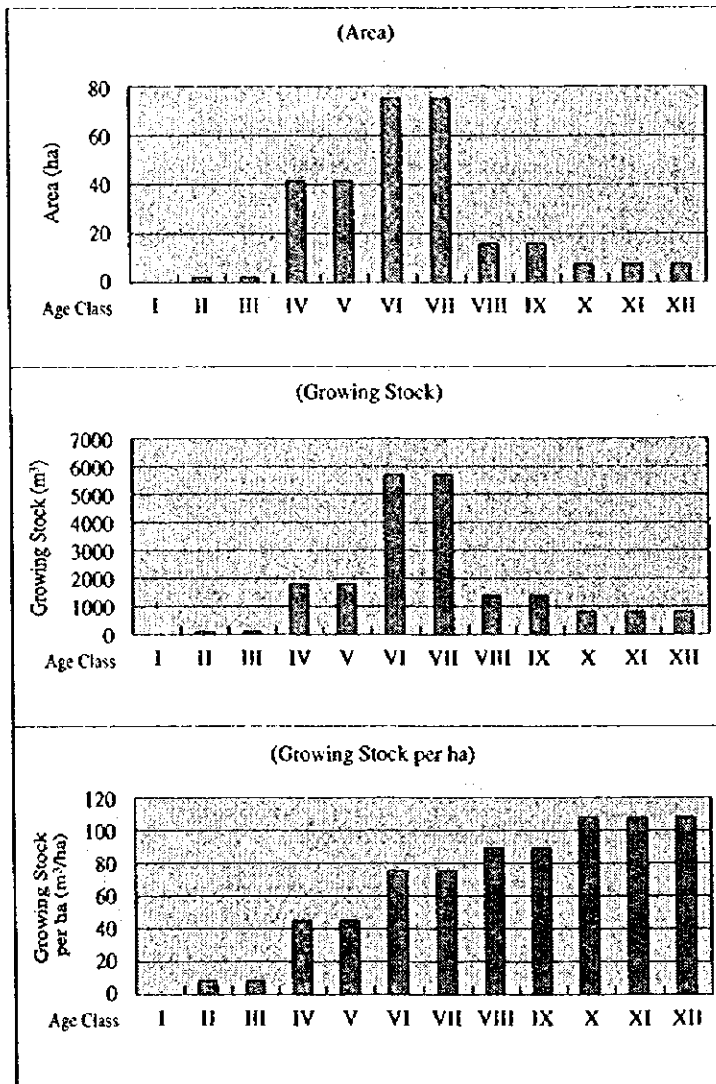


Fig. To-3 Current Pine Resources Composition of Commercial Timber Production Forests in S.M. Totomoxtla

Table To-11 Tree Height, DBH and Volume, etc. of Desirable Forest Composition

Age Class	I	II	III	IV	V	VI
Stand Age (years)	1 - 5	6 - 10	11 - 15	16 - 20	21 - 25	26 - 30
Mean Tree Height (m)	1	5	8	12	13	16
Mean DBH (cm)	-	-	-	17	19	22
Mean Volume (m <sup>3</sup> /ha)	-	-	-	17	92	140
Mean Growth Rate (%)	-	-	-	-	25.3	11.1
Age Class	VII	VIII	IX	X	XI	XII
Stand Age (years)	31 - 35	36 - 40	41 - 45	46 - 50	51 - 55	56 - 60
Mean Tree Height (m)	20	23	25	26	28	29
Mean DBH (cm)	26	31	33	35	37	39
Mean Volume (m <sup>3</sup> /ha)	205	217	228	276	321	362
Mean Growth Rate (%)	8.2	4.5	4.3	4.1	2.7	2.4

As real forests include riparian forests to be protected, forest edges, ridgelines, sites with poor hauling conditions and steep slopes of generally more than 40°, these sites are assumed to account for some 40% of the total forest area. The remaining sites constitute the subject forests of forestry operations, i.e.  $290 \text{ ha} \times 0.6 = 174 \text{ ha}$ , and the ideal composition of pine resources in these forests is shown in Table To-12 and Fig. To-4, taking Table To-11 into consideration. Judgement on whether an area should be designated as left-over area will be made in the field at the implementation stage of forest operation.

#### iv. Future Felling Volume

Assuming that the forest subject to forestry operations improve to the composition shown in Table To-12, the feasible felling volume each year will be approximately 1,100 m<sup>3</sup> (mean volume at final age: 380 m<sup>3</sup>/ha, area of 2.9 ha, the volume of seed trees is not considered as it exists from the beginning).

#### v. Timing of Regeneration Felling in the Future

The timing of future regeneration felling is assumed to be 60 years after stand improvement for those stands where the same forestry activities as stands after regeneration felling are conducted following the said improvement.

(e) Immediate Plan

The purpose of the immediate plan is to put existing forests in the proper pine forest operation cycle as soon as possible.

i. Regeneration Felling

As almost all of the timber production forests lack sizable stands which are ready for regeneration felling because of selective felling being conducted several times in the past, it is impossible to plan regeneration felling for these forests. However, the pine trees to be felled during stand improvement work are equivalent to those felled by regeneration felling and, therefore, the felling volume of pine trees by stand improvement work is considered to be the volume of regeneration felling.

Forest improvement will be conducted at the forests subject to activities (total of 174 ha) except at those stands where thinning will be conducted. Assuming that the area subject to stand improvement is 80% of the total forest area, the actual area subject to stand improvement will be 139 ha  $[(290 \text{ ha} \times 0.6) \times 0.8]$ .

Although the early implementation of regeneration felling for stand improvement can lead to an increased volume of resources in the future, there is a limit to the amount of labour which can be provided by local people. Accordingly, it is realistic to aim at completing stand improvement in half of the rotation period. Assuming that stand improvement is to be completed in 30 years, the actual area subject to stand improvement will be 4.6 ha/year.