Table To-12 Ideal Pine Forest Composition of Forests Subject to Forestry Operations in S.M. Totomoxtla

Age Class	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total
Area (ha)	15	15	15	15	15	15	15	15	15	15	15	15	174
Growing Stock (m^3/ha)	1	7	16	29	92	140	205	217	228	276	321	362	-
Growing Stock (m^3)	15	105	240	435	1,380	2,100	3,075	3,255	3,420	4,140	4,815	5,430	28,410

Note: Due to rounding to the nearest whole number, the total figure may not coincide with the sum of individual figures.

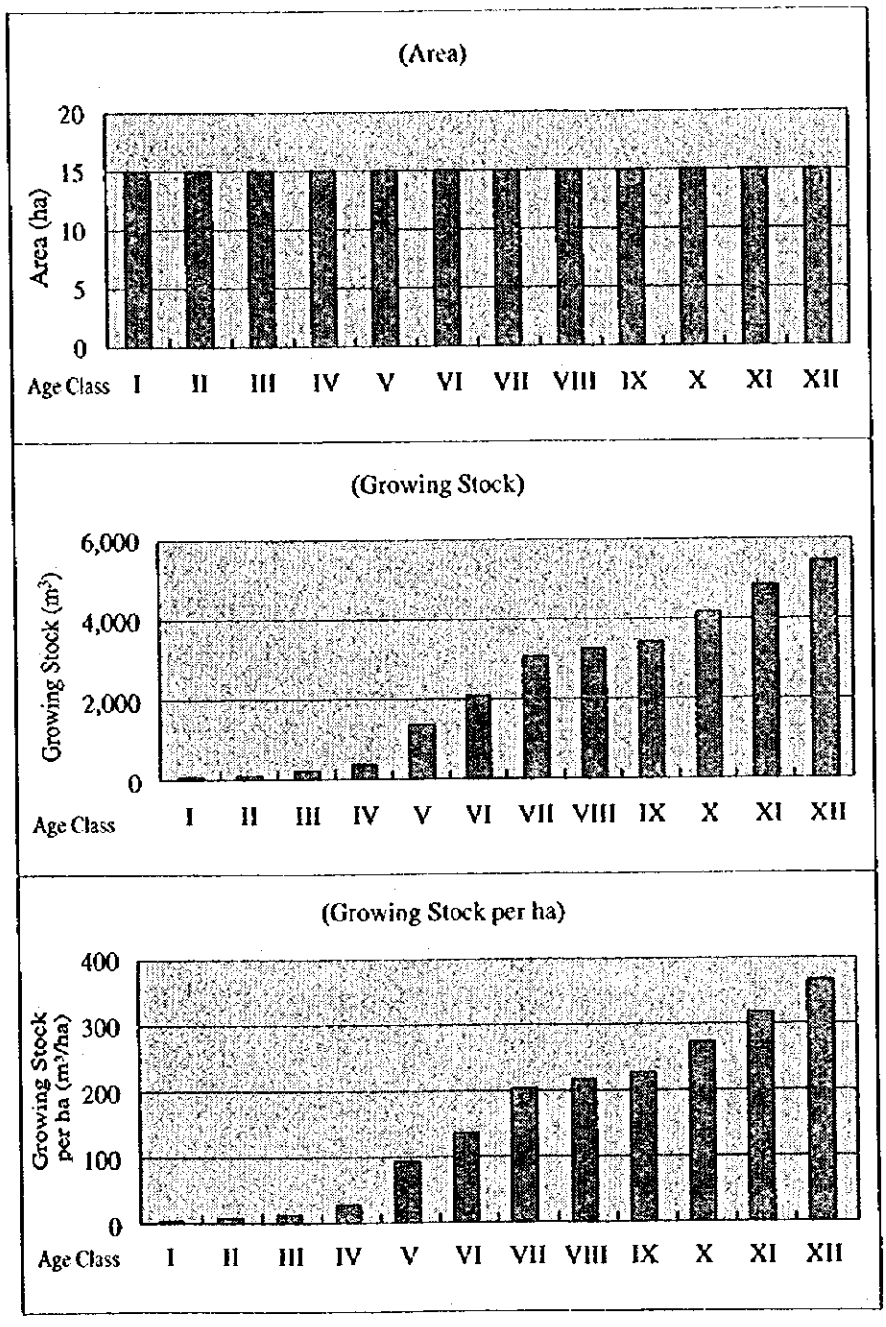

Fig. To-4 Ideal Pine Forest Composition of Forests Subject to Forestry Activities in S.M. Totomoxtla

ii. Thinning

There are some stands with densely growing pine trees but all of these are rather small in size and within larger stands which require improvement. Consequently, stands subject to thinning are not specially set up and thinning will be conducted together with stand improvement work.

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 4.6 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 the 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 operations (stand improvement) in the next 10 years. The forestry activities 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.

A suitable area to enable the sustained collection of the firewood volume required by the comunidad will be developed as firewood production forests.

b. Area of Firewood Production Forests

Assuming that the annual firewood consumption volume of 48 households in S.M. Totomoxtla is 6 m^3, the total annual consumption volume is 290 m^3. Based on the mean increment of a firewood production forest of 4.9 m^3 and a firewood production yield of 75%, at least 78 ha of land must be earmarked for firewood production forests. Under the plan, 130 ha of land around the settlement is classified as firewood production forests to meet the future population increase and damage by the most recent forest fire (May, 1998).

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 facts that the number of encino trees with a DBH of 20 cm or more is small in firewood production forests around the settlement and that many have been damaged by forest fire, the necessary firewood will be collected from stands subject to improvement for some time to compensate for the shortage of supply from firewood production forests. Encino trees at former forest fire sites have regenerated by sprouting and felling will be refrained from at these sites for some time until the DBH of these trees reaches some 20 cm.

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 Totomoxtla, since the scale of work 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 To-13.

Table To-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	5	3	6	3	13	6	1	6	10
1	2	2	6	3	7	3	14	6	4	7	1
1	3	3	1	3	8	4	9	6	5	7	2
1	4	3	2	4	9	4	10	6	6		
1	5	3	3	3	10	4	11	6	7		
1	6	3	4	3	11	5	6	6	8		
2	4	3	5	3	12	5	7	6	9		

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 To-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 To-14 Subject Sub-Compartments of Regeneration Felling for 10 Year Period

C	S/C	C	S/C	C	S/C	C	S/C
2	4*	3	2	3	7	3	11*
2	5	3	3	3	8	3	12*
2	6	3	4	3	9*	3	13*
3	1	3	6	3	10*	3	14*

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 To-14 is 91 ha, of which stand improvement will actually be conducted in 46 ha. The area and volume of the regeneration felling to be conducted in the 10 year plan period are shown in Table To-15.

Table To-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^3)			Area (ha)	Standing Tree Volume (m^3)		
	Total	Pine	Others		Total	Pine	Others
91	16,923	5,923	11,000	46	8,550	3,000	5,550

c. Area and Volume of Annual Regeneration Felling

As regeneration felling will be conducted at 4.6 ha/year, the standing tree volume of pine corresponding to this area will be 300 m^3 (3,000 ÷ 10). Assuming that 20 m^3/ha is left for seed trees, the regeneration felling volume of pine trees will be 210 m^3/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 To-16 Area and Volume of Annual Regeneration Felling

Area	Standing Tree Volume of Pine
4.6 ha	210 m^3

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 clearing 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 clearing 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) 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 4.6 ha/year. The standing tree volume of species other than pine which will be felled through stand improvement work is shown in Table To-17.

Table To-17 Annual Area and Volume of Stand Improvement

Area (ha)	Standing Tree Volume of Species Other Than Pine (m^3)
4.6	550

(2) Firewood Production Forests

Although encino trees with a DBH of 20 cm or more will be used, the existing trees in firewood production forests are generally thin. In addition, nearly half of the standing trees are assumed to have sustained damage by the most recent forest fire in May, 1998, making it necessary to ensure that felling is not conducted for some time at extensively damaged stands except for the collection of dead trees. This supply shortage will be supplemented by encino to be felled under the stand improvement work. The felling volume under the stand improvement work is planned to be 550 m^3/year and there will be a sufficient supply exceeding the present demand of 290 m^3.

(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. The actual log production volumes based on the above assumptions are shown in Table To-18.

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

Table To-18 Annual Log Production Volume

(Unit: m^3)

Year	Regeneration Felling	
	Timber Wood	Pulp Wood
1 - 10	100	50

(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 9 km as shown in Table To-19.

Table To-19 Length of Existing Forest Roads

Existing Route	Length (km)
1. Starts at the boundary with Yolox on the trunk road towards mesofilo forests	1.8
2. Starts from the road heading towards the settlement towards Rio Ardilla	1.2
3. Heads towards Rio San Martin	2.0
4. Road running through the settlement and used for forestry work	4.0
Total	9.0

b. Repair of Existing Forest Roads

The repair work listed in Table To-20 will be conducted for existing forest roads.

Table To-20 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

As the repair of only those sections directly related to the planned forestry operations will be conducted, the annual repair length is estimated to be one-third 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 To-21 will be required for felling, stand improvement, regeneration and tending.

Table To-21 Required Tools/Equipment for Production Activities

Tool/Equipment	Quantity Required	Life Expectancy (years)
Gancho	4	4~5
Chainsaw	7	4
Hatchet	20	1~2
Rake	4	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^3 of logs by regeneration felling is 0.68 man-days (Table 4-2-16 Feling and Transportation Processes). As the annual production volume is 150 m^3, the annual labour requirement is 102 man-days.

2) Regeneration and Tending Work

Raking 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 4.6 ha, ground clearing will require 14 man-days/year, weeding will require 12 man-days in the first year, 24 man-days in the second year and 36 man-days in the third year and thereafter and improvement felling will require 12 man-days in the seventh year and thereafter.

3) Forest 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. As forest improvement work will be carried out each year in 4.6 ha, each year 56 chainsaw operator and 129 workers will be needed.

4) Repair of Existing Forest Roads

Assuming a labour requirement of 30 man-days/1 km for forest road repair, 90 man-days will be required to conduct the planned repair of 3 km.

5) Total Labour Requirement

The required labour volume for each year in the 10 year period is shown in Table To-22. The ratio between such technicians as chainsaw operators and grua operators and labourers is 1 to 2.

Table To-22 Annual Labour Input Requirement

(Unit: man-days)

Year	Regeneration Felling	Tending			Stand Improvement	Forest Road Repair	Total
		Clearing	Weeding	Improvement Felling			
1	102	14	12		185	90	403
2	102	14	24		185	90	415
3	102	14	36		185	90	427
4	102	14	36		185	90	427
5	102	14	36		185	90	427
6	102	14	36		185	90	427
7	102	14	36	12	185	90	439
8	102	14	36	12	185	90	439
9	102	14	36	12	185	90	439
10	102	14	36	12	185	90	439

10. Environmental Considerations

The actual forestry 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. When the repair of forest roads is undertaken, it will be necessary to pay careful attention to drainage at stream crossing sections and shoulders to prevent the contamination of river water. Such care will lead to the prevention of unnecessary damage to roads. Careful attention will also be required in regard to not conducting excessive land clearing for the regeneration of pine trees on steep slopes. It is believed that felling should be avoided in the mist forest zone in the northeast from the viewpoints of conservation of the natural environment and the prevention of mountain disasters.

At present, cultivated land spreads around the water supply sources and there is a chance that the water quality will be adversely affected by fertiliser and sediment. The creation of forests around the water supply source is desirable in view of its protection.

11. Measures Regarding Former Forest Fire Sites

A forest fire which started in S.J. Quiotepec in May, 1998 damaged most of the forests distributed at a lower elevation than the settlement. While the damaged area covered as much as some 60% of the area of S.M. Totomoxtla, high elevation forests subject to commercial timber production were hardly affected. As a result, only minor revisions of the present plan were necessary.

The damaged area is approximately 900 ha and, in terms of the degree of damage[1], 10% suffered minor damage, 30% suffered light damage, 20% suffered medium damage and 40% suffered severe damage.

Those sites where the damage is minor or light are expected to be quickly restored naturally and sites where the damage is medium may also be restored after a certain period. In contrast, the natural restoration of severely damaged sites is expected to take a long time and, therefore, the category of restoration area is introduced to specially mark these sites. While artificial regeneration may be one way of quickly restoring the vegetation at these sites, reliance on the force of nature for natural regeneration appears more appropriate because of the absence of conservation subjects except for cultivated land at these sites and also because of the difficulty of using these sites for commercial timber production forests even if the artificial restoration of vegetation is feasible. Encino has strong sprouting power and has already sprouted at these sites. For the natural restoration of vegetation, it is important not to fell trees to produce timber or firewood for own use at these sites for some time so that the regenerated trees can grow without any disturbance.

Most of the areas planned as firewood production forests were lightly damaged. Even though firewood resources are not expected to deplete in the future because of the light damage, regenerated encino trees will not be felled as in the case of restoration areas. It is desirable not to fell trees other than damaged trees in firewood production forests for some time with a view to conducting forestry activities which are appropriate for these forests in the future depending on the state of restoration of the remaining forests. It will be necessary to supplement the shortage of firewood by the use of encino, etc. to be felled during the stand improvement work.

12. Evaluation on Forest Management Plan

Out of the total area of 1,523 ha in S.M. Totomoxtla, the area for the commercial production forest amounts to 290 ha. A unrestricted forest area to be utilized for the cutting accounts for 60% of the total production forest, i.e. 174 ha.

(1) With Project Case

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

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[1] 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)

1) Log Production

a. Regeneration Cutting in the Area for Forest Stand Improvement

Out of the total unrestricted forest area of 174 ha, the area for the forest stand improvement will be 139 ha. The forest stand improvement will be carried out over a 30-year period. Simultaneously, the regeneration cutting will be conducted. A yearly size of 4.6 ha (=139ha/30years) will be subject to the forest stand improvement and regeneration cutting during this period. An annual volume of the log production will amount to 150 m^3/4.6 ha which is calculated from a standing tree volume of 210 m^3/4.6 ha to be cut in a 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 carried out 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 20 th year after the regeneration cutting. Considering that the final cutting age of trees is 60 years, the area for the regeneration cutting will be 2.9 ha per year (=174 ha/60years).

2) Silvicultural Work

a. Forest Stand Improvement

Since an area for the forest stand improvement is 4.6 ha per year, this activity requires about 180 man-days (= 40 man-days × 4.6 ha).

b. Regeneration and Tending

In an annual area of 4.6 ha for the forest stand improvement and the regeneration cutting, the ground clearance requires 14 man-days. The weeding needs 12 man-days per 2.3 ha in a year. Since the weeding is planned over a three-year period including the year for the regeneration cutting, a number of man-days required for the weeding will be 12 man-days in the first year, 24 man-days in the second year, and 36 man-days in the third year. The cleaning cutting will be done in the area of 2.3 ha per year in the 7th year from the completion of the regeneration cutting. It requires 12 man-days.

A maximum number of annual man-days required for the forest stand improvement, regeneration and tending is estimated at some 280 man-days. Out of 60 comuneros,

a number of comuneros who resides in the comunidad and is able to participate in these activities will be 40. Therefore, if these activities are done without payment (i.e. Tequio), a comunero is required to spend additional 7 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 To-23 Equipment and Tools Currently Owned by Comunidad

Item	Quantity	Year of Procurement	Remarks
Pickeroon	N.A.	N.A.	
Chainsaw	0	N.A.	There exist 4 chainsaws privately owned in the comunidad.
3 Ton Truck	1	1992 (new)	Aside from a truck owned by the comunidad, there exists another 3 ton truck privately owned in the comunidad.

Base on the existing ownership of the equipment and tools required for the log produciton, the following, including those for spare use, are planned to be purchased:

Table To-24 Equipments and Tools Planned to be Purchased

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

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 9 km. The rehabilitation of the existing forest roads will be conducted when the log production

is implemented. A yearly length of forest roads to be rehabilitated will be one-third of the total length and accordingly, an annual cost of the rehabilitation is estimated at 4,200 pesos.

3) Transportation Costs

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

It is assumed that a forest production unit of the comunidad will be 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 114 m^3 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 44 peso 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 98 thousand pesos. This means that with preconditions set as above, the project will be financially feasible. If the forest stand improvement, regeneration and tending activities are implemented by Tequio, the net present value of the incremental net cash flow is calculated at 220 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 To-25 Sensitivity Analysis in Case of Alteration of Sales Price of Timber Wood

Sales Price of Timber Wood (Pesos/m^3)	Net Present Value (1000 Pesos)
480	140
430	70
400	27
380	-24

Table To-26 Sensitivity Analysis in Case of Alteration of Discount Rate

Discount Rate (%)	Net Present Value (1000 Pesos)
18	404
22	13
23	-1

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

A cumulative net cash flow under the With Project case shows a negative value in the 33rd year when a thinning activity is planned. The forest production unit is expected to have financial difficulty in this year. In the analysis, it is assumed that the forest production unit will procure non-interest bearing funds and continue its forest activities. However, in reality, the production unit may raise funds within the comunidad, carry out the project with Tequio, or defer payments to comuneros who are engaged in the activities.

(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, which amounts to 19 thousand pesos. Accordingly, with the above conditions being applied, the project will be feasible from an economic perspective.

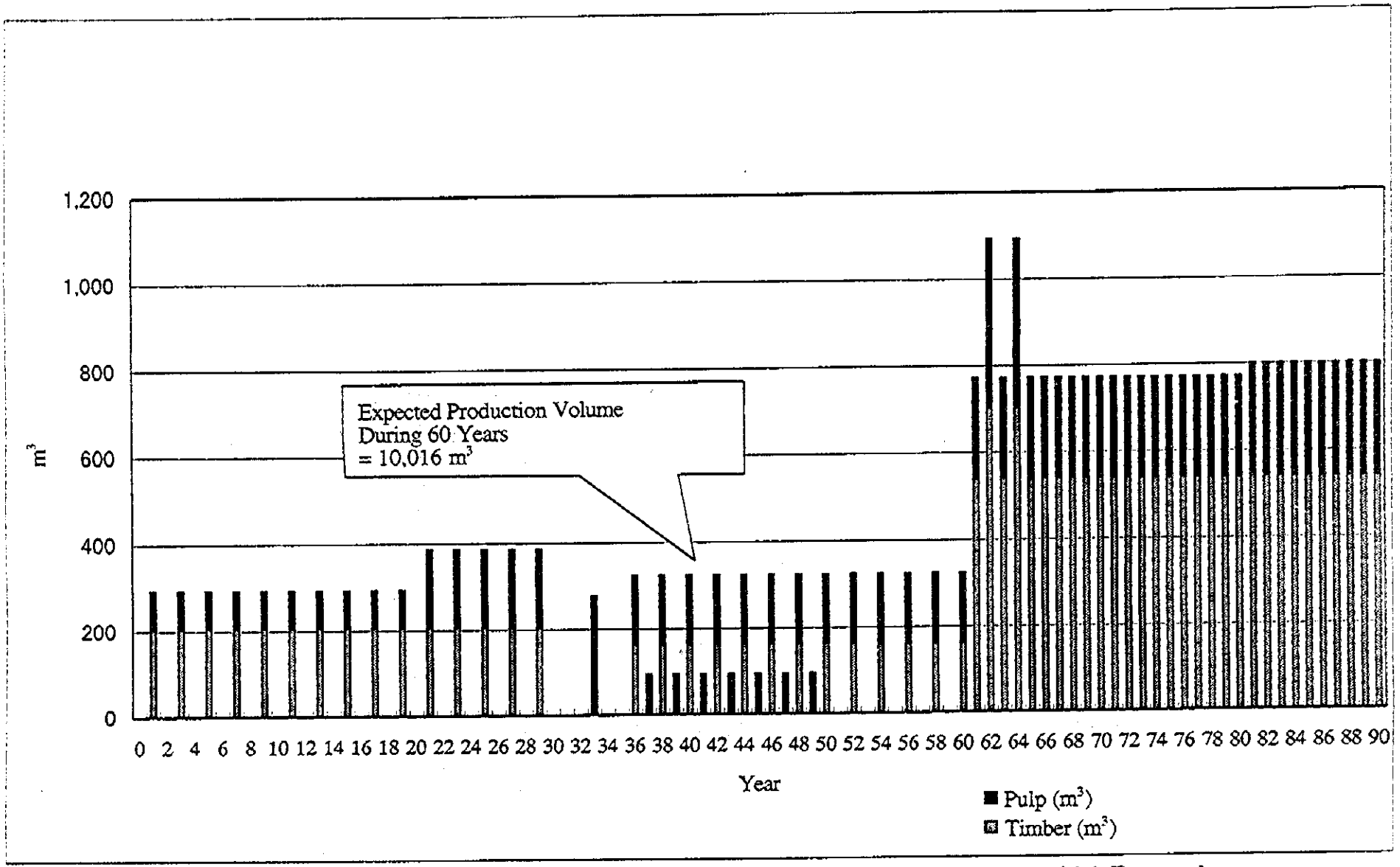


Fig. To-5 Expected Annual Production Volumes of Timber and Pulp Woods at S.M. Totomoxtla
(With Project Case)

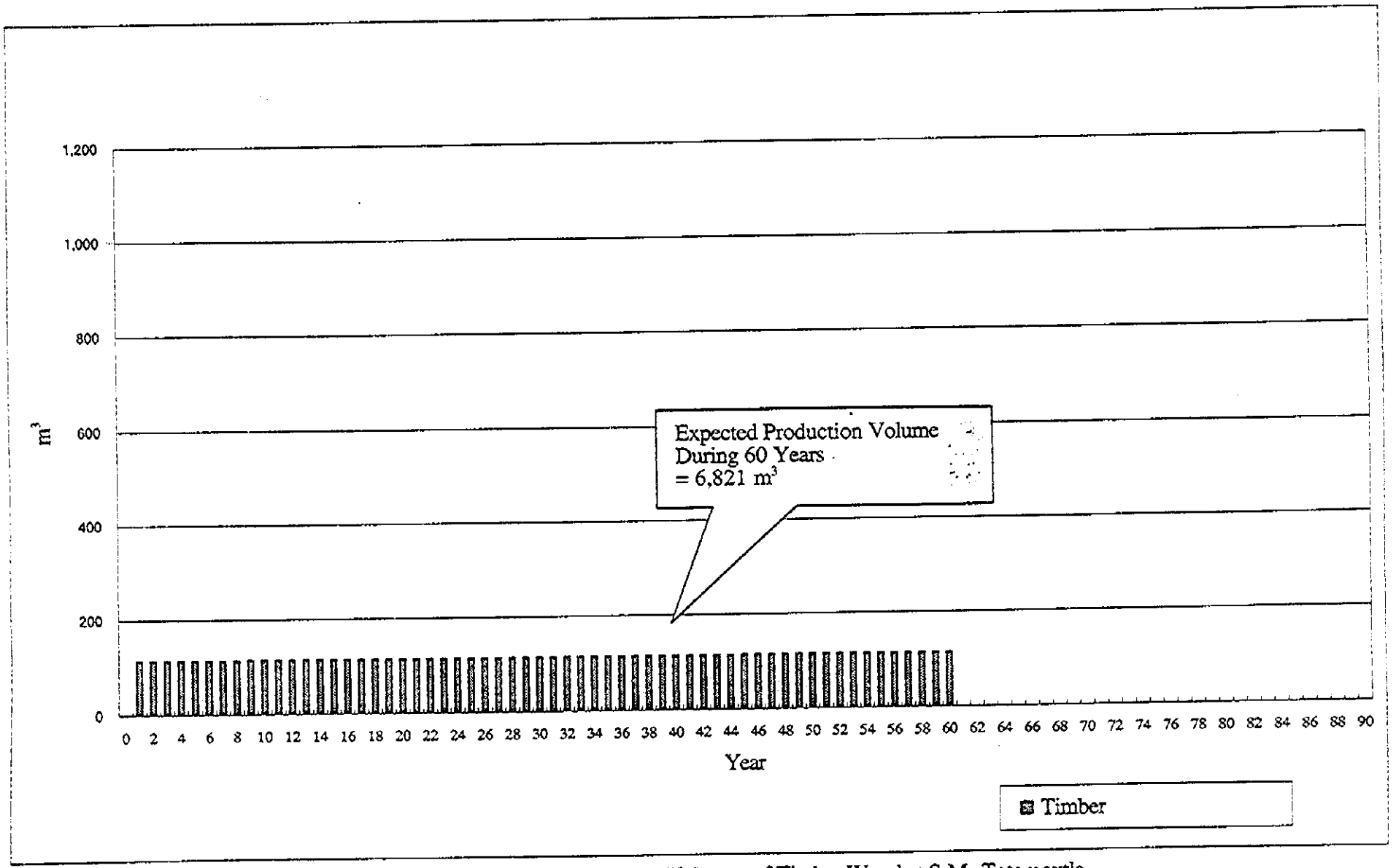


Fig. To-6 Expected Annual Production Volumes of Timber Wood at S.M. Totomoxtla
(Without Project Case)

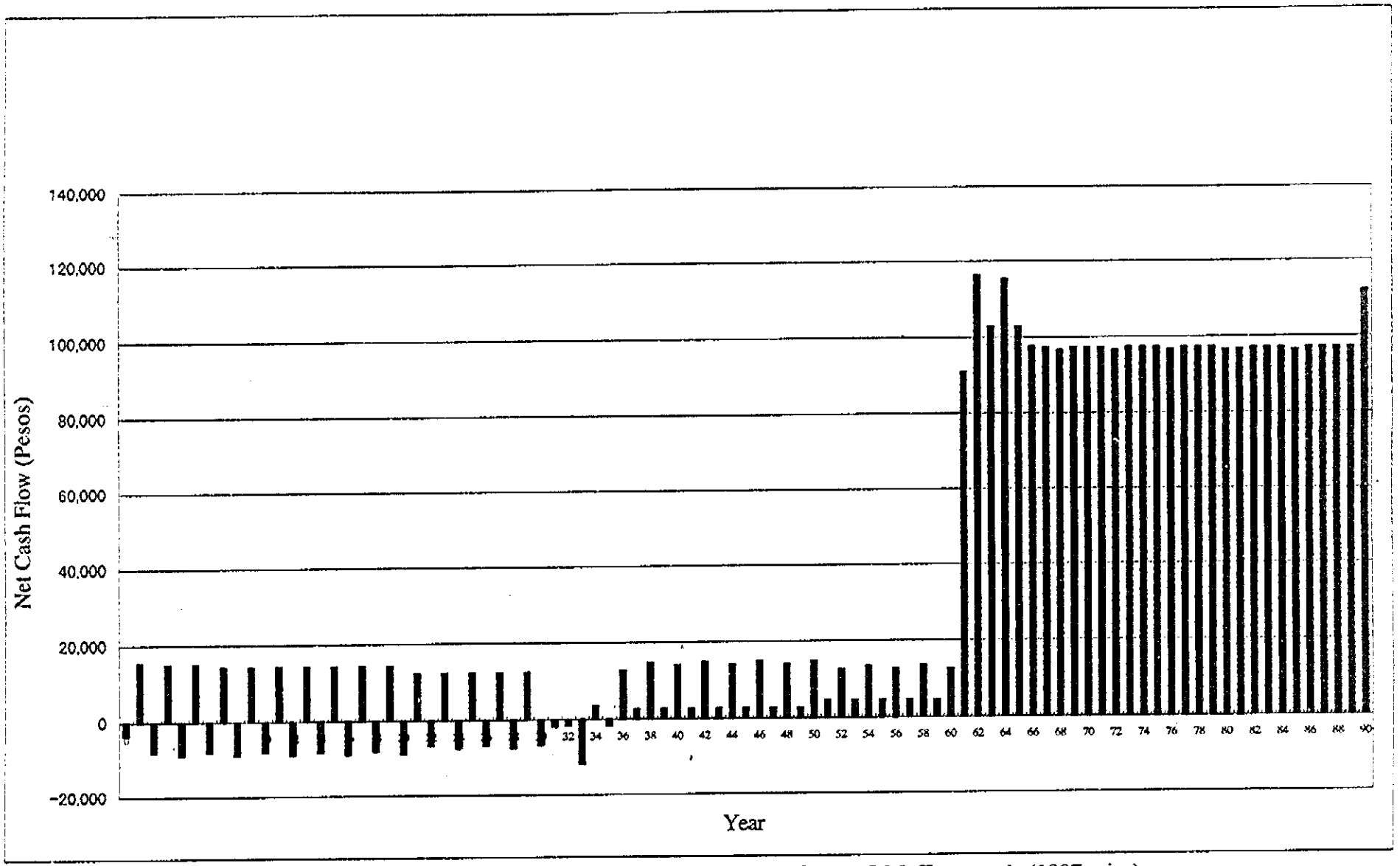


Fig. To-7 Expected Net Cash Flow from With Project Case at S.M. Totomoxtla (1997 price)

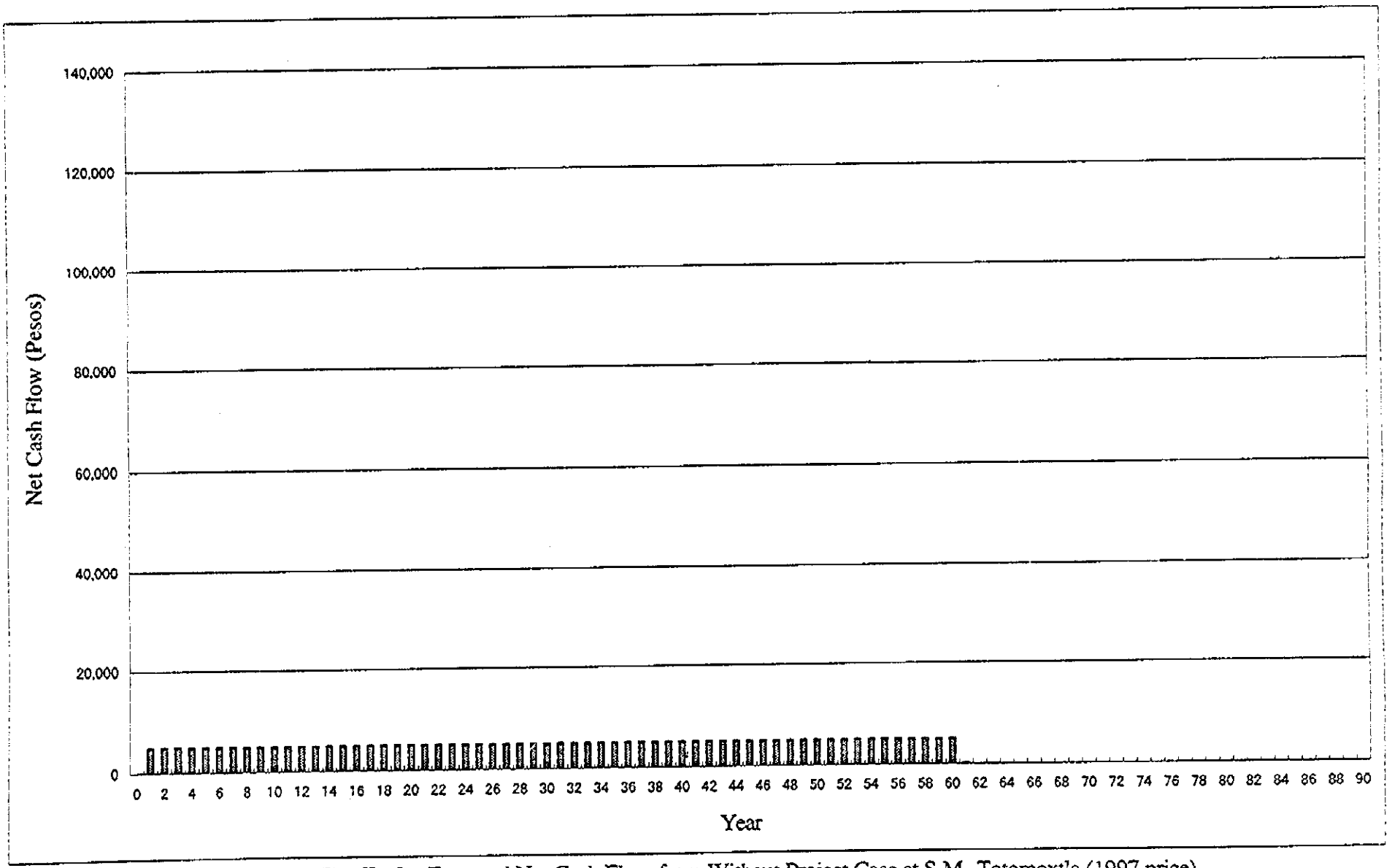


Fig. To-8 Expected Net Cash Flow from Without Project Case at S.M. Totomoxtla (1997 price)

Table To-27 Parameter Table

Comunidad: S.M. Totomoxtla
Table of Parameters

Net Present Values
With Case 203,893
Without Case 105,851
Incremental NPV 98,042

1.Domestic Inflation and Discount Rate
Expected Rate of Inflation 15%

Financial Discount Rate 20% (Nominal)
4.3% (Real)

2.Standing Tree Volume (for Sales of Standing Trees)
for Without Project Case

	(Standing Tree Volume)
Area for Forest Stand Improvement	113.68 m3/year

3.Price of Logs in case of Sales of Standing Trees
Without Case 44 pesos/m3

4.Sales Price of Logs
Timber Wood (Milrum) in Oaxac 450 pesos/m3
Pulp Wood in Tuxtepec 290 pesos/m3

5.Area of Commercial Production Forests 290 ha
Area for Forest Stand Improvement
Area for Regeneration Cutting for 30 yrs 139 ha
Annual Area for Regeneration Cutting 4.6 ha
① Annual Volume of Standing Trees for Regeneration Cutting 210 m3/4.6ha
Yield Ratio of Log Production
to be used for Pulp Wood 70%
to be used for Timber Wood 30%
② Standing Tree Volume for First Thinning 70%
Yield Ratio of Log Production 20 m3/ha
③ Standing Tree Volume for Second Thinning 50%
Yield Ratio of Log Production 70 m3/ha
to be used for Pulp Wood 50%
to be used for Timber Wood 50%
④ Annual Area for Regeneraition Cutting 50%
after Forest Stand Improvement 2.9 ha
Standing Volume of Trees per ha 380 m3/ha
Yield Ratio of Log Production 70%
to be used for Pulp Wood 30%
to be used for Timber Wood 70%
⑤ Standing Tree Volume for First Thinning 20 m3/ha
Yield Ratio of Log Production 50%

Final Cutting Age 60 years

6.Distance from Oaxaca 120 km

7.Tax
Value Added Tax 15%

8.Cost of Forest Stand Improvement, Regeneration and Tending

		Unit Cost (pesos/MD)	Quantity/Year (Man-Days)	
(1)Forest Stand Improvement	Labor	30	28	Man-Days/ha
	Chainsaw Operator	150	12	Man-Days/ha
(2)Ground Clearance		30	3	Man-Days/ha
(3)Weeding		30	5	Man-Days/ha
Area for Weeding	50% of Areas for Regeneration Cutting			
(4)Cleaning Cutting		30	5	Man-Days/ha
Area for Cleaning Cutting	50% of Areas for Regeneration Cutting			

(5)Yield Survey 10 Pesos/m3 in Standing Stem Volume of Trees

(6)Cost of Log Production 52 Pesos/m3
(Cutting, Processing, Limbing & Bucking, and Yarding)
Work Volume at the time of Regeneration Cutting 5 m3/day/team
Work Volume at the time of Thinning 5 m3/day/team
Number of Teams for Log Production per Day 1 team/day

(7)Rental Fee of Grua Monthly Rental Fee 8,000 pesos/month

(8)Cost Increase in Log Production Cost at the time of Thinning over Regeneration Cutting 1.625 times
(Cost increase for Cutting, Processing, limbing and bucking, and Yarding)

(9)Transportation

To Oaxaca	100 (Pesos/m3/10t Truck/Timber Wood)
To Tuxtepec	100 (Pesos/m3/10t Truck/Pulp Wood)
Loading Volume	10 m3 of log/Truck

(10)Construction Cost of New Forest Road 70,000 Pesos/km

	Unit Cost/Month	Quantity	Total Cost	
Rental Fee of Tractor de D-7	75,000	1	75,000	pesos/200hrs/1.5Km/month
Operator	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 2% of Construction Cost
Length of Forest Roads to be Rehabilitated 3 km/year

(12)Tools for Log Production

	Unit Cost (Pesos)	Quantity/Year	Total Cost
Pickeroon	200	4	800
Hatchet	30	20	600
Rake	75	4	300
3 tons truck		1	0

(13)Forest Production Unit

	Daily Wage
Coordinator	30 Pesos/Day
Secretary	30 Pesos/Day
Treasurer	30 Pesos/Day
Site Supervisor	30 Pesos/Day
	120 Pesos/Day

Operating Cost of The Unit 50% of the total personnel expenses

(14)Working Capital

Account Receivables	2.1% of Annual Sales
Account Payables	0.4% of Annual Operating Expenses
Cash	4.2% of Annual Sales

FOREST MANAGEMENT PLAN FOR SAN JUAN TEPONAXTLA

San Juan Teponaxtla

1. Outline

This plan has been formulated to consolidate the anticipated function(s) of each forest situated in S.J. Teponaxtla in view of the sustainable use of all local forests. While some local forests for commercial use, which form the basis for the comunidad's development, have undergone vigorous felling at least once, others are still intact. The plan incorporates a range of forestry activities to be conducted in the next 10 years from the long-term perspective for both types of commercial forests in order to achieve a forest composition which is capable of sustained production. On the other hand, forests for firewood daily needed by the local inhabitants are planned and secured in a sustainable manner. 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.J. Teponaxtla are summarised in Table Te-1.

Table Te-1 Summary of Natural Conditions

Climate	- Mean temperature for the period from November to January: maximum 15 ~ 27℃; minimum 6 ~ 12℃ - Mean rainfall in arid areas during the dry season (November - April): less than 100 mm - The level of rainfall increases in accordance with the higher elevation towards the northeast from the Rio Grande. - Highest mean monthly rainfall for the period from November to April: more than 300 mm
Topography	- Elevation range: 880 - 2,660 m - Horizontal distance: 10,500 mm, relative height: 1,780 m - The ridge extending from Cerro Chino to Cerro Jicara runs in the east-west direction, dividing S.J. Teponaxtla into the northern and southern parts. - The northern part consists of the Mesofilo Forest Zone while the southern part consists of the Pine-Quercus Forest Zone. - Several minor ridges branch from the main ridge extending from Cerro Chino to Cerro Jicara towards the Rio Grande at the lowest elevation in the southern part.
Geology	- Widely covered by metamorphic rocks - Distribution of sandstone, conglomerate, limestone and mudstone, etc. along the Rio Grande
River System	- All rivers south of the ridge extending from Cerro Chino to Cerro Jicara and dividing the comunidad into two parts are tributaries of the Rio Grande. Rio Contado, Rio Palomas and Rio Cotoche, etc. flow into the Rio Grande. - Rivers to the west of the mesofilo forest zone in the northern part are tributaries of the Rio Grande and those to the east are tributaries of Rio Papaloapan.

Soil	- CMx (Chromic Cambisols) is dominant in areas with an elevation of 1,800 m or higher in the southern part → the thick layer is suitable for forestry use. - LVx (Chromic Luvisols) is dominant at areas with an elevation of 1,800 m or lower in the southern part → the presence of an illuvial clay horizon some 30 m below the surface reduces the land productivity but forestry use is still possible. - LVv (Vertic Luvisols) is found at cultivated land near Loma la Cruz in the southern part → similar to LVx but the productivity is higher. - LPe (Eutric Leptosols) is found on steep slopes in both the southern and northern parts → forestry use is difficult as soil with a thickness of less than 30 cm lies above the rock. - PZ (Podzols) is found on ridges at a high elevation → unsuitable for forestry use. - CMx is found in the northern mesofilo forest zone except at those sites of LVx or PZ.
Vegetation	- Elevation of 2,500 m or higher → Mesofilo Forests, i.e. broad-leaved forests consisting of diverse species - 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 some forests because of pine felling in the past but the undergrowth is rich - 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 - Elevation of less than 1,400 m → Selva Baja, i.e. mainly consists of low trees, shrubs and spiky broad-leaved trees with some cacti; generally sparse forest of 4 - 8 m in height
Wildlife	- Flora → mesofilo forests consist of diverse species while most Pine-Quercus Forests mainly consist of pine and quercus • Three species fall under CITES Annex II • Five species fall under NOM-59 - Fauna → very diverse, ranging from those preferring an arid climate to those preferring a moist climate • Five species fall under CITES Annex I • Two species fall under CITES Annex II • Eight species fall under NOM-59 - Aves • One species falls under CITEX Annex I • Three species fall under CITES Annex II • Seven species fall under NOM-59 - Amphibia, Reptilia • One species falls under CITES Annex II • Three species fall under NOM-59

(2) Living conditions

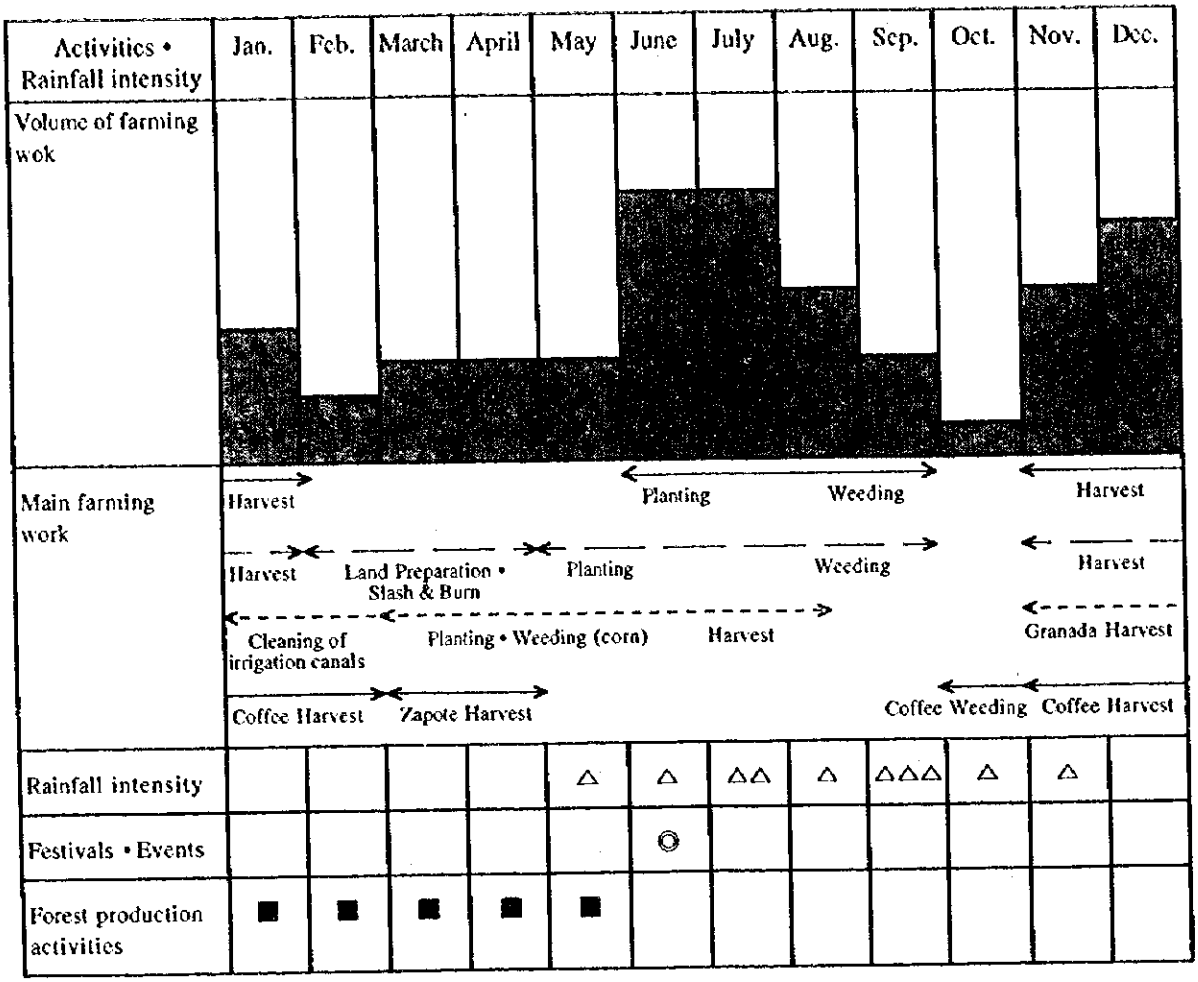
The people of S.J.Teponaxtla are Cuicateco. There are 809 inhabitants (394 men,415 women) and 163 households. The total population including those who live outside the community is estimated to be about 900. If the population growth rate is similar to that of nearby communities, by year of 2007, it is estimated that the population will be more than 1,000. The population under 10 years constitutes 33% of the entire population. This predicts a large increase in the work force. A lack of farmland and job opportunities will become problems in the near future.

The community can be divided into two groups, based on religious differences. Some 40% of the inhabitants are Catholics and 60% are Evangelists. The community can be also divided based on the degree of land ownership. Among 241 comuneros 70 (29%) are small scale land owners and the rest cultivate land which is not their own. In spite of this apparent difference, there is no big conflict among them.

S.J.Teponaxtla has one kindergarten, one elementary school and one TV secondary school (distant education). The elementary school teachers are interested in planting fruit trees in the school yard. Because to the formal education in Spanish began in the 1940's, all inhabitants can now speak Spanish. As for health care, there is a clinic with one doctor and two nurses. In addition to medical services, those professionals have been providing information concerning nutrition and pregnancy. Except for the 10 households which customary have not used electricity, all households have electricity. People bring water to their houses from headwaters or an irrigation system, which was constructed by tequio 70 years ago. Some 87% of the households have toilet facilities and none of them have sewage system.

The major industry in the community is agriculture. Most of the inhabitants are engaged in farming. They cultivate corn and beans (frijoles) for domestic use, and coffee, passion fruit, and zapote for cash crops. There are three types of farm land: irrigated land, seasonally cultivated land, and land cleared by slash and burn. All of comuneros have seasonal cultivate land. The total agriculture area is 20ha and each household has 0.5-3ha. The corn harvest is 800kg/ha and that of frijoles is 200kg/ha. The area of slash and burn farming is 350-400ha in monte chango and around settlement. Some 70 households who do not have irrigated land, cultivate land by slash and burn farming. The farming area with irrigation is 240ha, and it I owned among 80 households. The average area of agriculture land for each household is 0.5-1ha, and some of households have up to 4ha. Corn harvest is 1-1.5ton/ha and that of frijoles is 400-500 kg/ha. People are interested in expanding irrigated land, because the production is much higher than in other areas.

Table Te-2 Annual Calendar



The intensity of agricultural activities perceived by the local inhabitants
←→ Seasonal Cultivation ←- → Shifting Cultivation
<-- → Irrigated Land's Corn
△: Quantity of rainfall
◎: Festival
■: Possibility of engaging in forestry productive activities

Table Te-2 shows the intensity of agricultural activities, rainfall, festival by month, and the months in which they have time to engage in forestry productive activities. There are 161 comuneros who live in the community, and they have to participate in tequio 15-20 times a year. The number of *tequio* varies every year. It is mentioned that January, February, March, April, and May are the months during which they can engage in forestry productive activities. This is because they think that it is difficult to engage in forest activities in the rainy season, which starts in July. They have surplus work force in the rainy season, they can utilize this for thinning or improving the stand of forest.

The prime cash income is derived from coffee sales; this is followed by the sale of passion fruit and zapote. There are only five households which receive money from emigrants. The

price of coffee is 12-20peso/kg and this price is strongly influenced by the external market. The total amount of coffee product is not clear, but it is estimated that about 85 households (70%) in the community produce 5t of coffee beans with skin. And additional 15-20 ton are produced in monte chango or on the private land. Many people sell their fruits. As the amount of fruits harvest for each household is small, the intermediaries visit each household and collect the fruit to carry to the local market. In the communities, there are bakers, millers, a store owner, seasonal labors, and forest workers.

The age range of the migrants are between 15 and 19 years old. There are about 100 people who live outside of the community, including emigrants. Most of them are in Mexico and only 10% are in the United Stated of America. The most important reason for emigration is economic. Nevertheless a few mentioned that they leave the community because they do not want to participate in tequio or other duties in the community. Half will eventually return to the community. The daily salaries of seasonal workers are 25 pesos for men and 20 pesos for women. Some 60 comeneros and 60 women who are relatively poor are engaged in this work. There is concern related to the economic gap in the community.

There are two channels for products to flow to markets outside of the community. One channel is to Oaxaca and another is to Cuicatlan. The condition of the road to Oaxaca is bad, and it takes 9-10 hours by car. The products move 2-3 times a month. To Cuicatlan, the product first have to be carried on foot to Rio Cobos. It takes 2-3 hours to get to Rio Cobos on foot or with donkey. From Rio Cobos to Cuictlan, it takes 2 hours by car. The road conditions from Rio Cobos to Cuicatlan are good. Products move 2-3 times a day. From Rio Cobos to Tolacolura a communal bus makes the trip once a day. The lack of a road to Cuicatlan is the greatest obstacle to the improvement of the sales of their products.

Problems and needs recognized in the community in general are: (1) Improvement of forest management; (2) Lack of agriculture and forestry technology; (3) Conservation of the headwaters and Mesofilo Forest; (4) Lack of means to improve agriculture; (5) No road to Cuicatlan; (6) Lack of job opportunities; (7) Lack of capacity training and organization of women's groups. As for women they cite; (1) Participation in the decision-making process of the community; (2) Lack of job opportunities; (3) Projects for women; (4) Improvement of nutrition. Generally speaking women have limited opportunities to participate in decision making in the community and to obtain information about the issues discussed in the community council. We observed that some women seem to have leadership. It might be possible to enhance the potential of women to resolve some of the problems in the community.

(3) History of Forest Use and Development of Comunidad Through Forest Use

1) History of Forest Use

Upto the early 1980's, no commercial felling was conducted because of the lack of road access to S.J. Teponaxtla although parts of local forests were used to produce firewood and for so-called *'huamil'* (shifting cultivation using the slash and burn method). The commercial use of pine trees commenced in 1984.

1984:	Standing trees were sold for the first time to a paper company which was constructing a road to San Mateo while felling trees to use pine; this company also opened a forest road in the direction of Cerro Jicara for felling purposes.
1986:	A forest fire occurred on the mid-slope of Cerro Jicara.
1988:	The road reached S.J. Teponaxtla in February and the paper company felled trees along the road upto the site of the settlement. A private timber company repeated felling around the road.
1988:	A forest production unit was established.
1989:	A different private timber company repeated felling at sites along the road once felled by the paper company.
1990:	The forest production unit commenced business operation.
1990:	The forest production unit began the construction of the main forest road (towards the high elevation area in the upperstream of Rio Teponaxtla).
1990:	Standing trees along the trunk road were sold for felling to raise money to electrify the comunidad and to obtain electricity poles.
1992 - 1994:	Construction of a sawmill.
1993:	A forest fire damaged more than 1,000 ha around Cerro la Cumbre.
1994 - 1996:	Sawing machinery was procured.

1996: The sale of sawn timber commenced.

2) Development of Comunidad Through Forest Use

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

- Repayment of the loan for the construction of a sawmill
- Maintenance and repair of the trunk road
- Construction of a diconsa (comunidad-owned store)
- Introduction of electricity supply system (cost-sharing ratios: comunidad - 20%, national government - 60%, state government - 20%)
- Construction of a warehouse building for a forest production unit
- Procurement of vehicles (three 12 ton trucks, one three ton truck, two pick-up trucks and one vehicle equipped with a yarding crane)
- Procurement of furniture, etc. for the clinic
- Payment of passage fee to Tlacolula

3. Current State of Land Use and Vegetation

The area by land use and vegetation type in S.J. Teponaxtla is shown in Table Te-3.

Table Te-3 Area by Land Use and Vegetation Type

Land Use and Vegetation Type		Symbol	Area (ha)
Forest	Pine Forest	P	567
	Quercus Forest	Q	891
	Pine-Quercus Mixed Forest	PQ	4,446
	Selva Baja	Sb	897
	Mountain Mesofilo Forest	Me	3,154
	Secondary Forest in Mountain Mesofilo Forest Area	Bs	196
	Sub-Total		10,151
Non-Forest	Agricultural Land	Ag	428
	Abandoned Agricultural Land (including Fallow Land)	Ag(a)	86
	Shrub Land	Ab	63
	Residential Area	Hu	41
	Sub-Total		618
Total			10,769

4. Current Conditions of Forest Resources

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

Table Te-4 Current Conditions of Forest Resources

Area/Volume	Pine-Quercus Forests				Other Than Left					Total
	P	Q	PQ	Sub-Total	Me	Bs	Sb	Cultivated Land, etc.	Sub-Total	
Area (ha)	567	891	4,446	5,904	3,154	196	897	618	4,865	10,769
Standing Tree Volume (m^3)	187,100	60,800	532,400	780,300	–	–	–	–	–	–
Standing Tree Volume per ha (m^3/ha)	330	68	120	Average: 132	–	–	–	–	–	–

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 money obtained from the sale of trees, has mainly been used for these purposes: to buy a track and a tow car for forestry productive activities; to repay the debt

for the construction of a sawmill, to buy electric poles, and to buy equipment for the clinic. Only a few men and none of the women were informed as to how the forest resources were spent. Most habitants use firewood as fuel. Most of the women well understand that the forest is a important provider of firewood, water, and wood for domestic use.

The following problems and solutions related to the forest are listed by the members of Rapid Rural Appraisal (RRA) team which consisted of the local inhabitants and specialists from outside the community. The local inhabitants who are members of the team mentioned the need to create forest, and the lack of economic resources and machinery to improve the economic value of the forest resources. Women mentioned the lack of firewood around the settlement as the principal problem, and recommended a discussion on ways in which firewood forest and headwaters should be protected.

Table Te-5 Problems and Needs Related to the Forest and Solutions

Problems and needs	Solutions
(1) Improvement of the forest management -- Cutting of encino and the cultivation the value trees (pine) – No regeneration of pine trees – The quality of forest is degrading due to the lack of forest operation – Lack of thinning in the dense area of the forest – Lack of a budget for thinning the forest – Forest fire and damage from insects – Damage from insects in the commercial forest; Thinning of the forest in the Cerro Jicara – Improvement of cutting techniques – Lack of machinery to improve the quality of the wood product (2) Techniques for the improvement of agriculture management and forestry – Lack of knowledge of adequate forest resource utilization – Lack of forestry techniques – Lack of capacity building – No school for youth where they can learn agriculture techniques (3) Conservation of the headwaters area and Mesofilo forest – Need for the conservation of the headwaters area – Motivate and increase the consciousness of the people to protect the headwaters area – Research on the adequate use of Mesofilo forest – Lack of consciousness on of the people for utilization of their resources	– Seek expert from SEDAF – Obtain economic assistance from SEDAF and other organizations – Utilize the forest management plan which was designed by the Japanese – Obtain assistance in forestry from PRODEFOR and the World Bank

Through the RRA study, the local inhabitants who are members of the team designed a map (Fig. Te-1) for future community land use, which categorize the forest into the following uses: (1) Commercial timber production forest; (2) Firewood production forest; (3) Forest for domestic timber; (4)Mesofilo forest protection area; (5) Farm land with irrigation; (6) Seasonal farm land. Besides these categories, there are areas for tourism and areas with the possibility of irrigation etc.

The (2) Firewood production forest, is the same area where they presently collect firewood. Women mentioned the degradation of the forest in this area. Thus it will be necessary not only to cut trees as firewood but also at the same time apply some means to create the forest. There is no particular area designated to the recuperation of the forest, but this is included in (1) Commercial timber production forest. The people expect to use an area where there are ruins for tourist development.

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.

Forests for commercial use in S.J. Teponaxtla consist of those which have undergone felling in the past and those which have not. In the case of the former, fine trees have been felled since the 1980's and no regeneration or tending operations have been conducted. As a result, these forests have become forests of left-over encino trees and hardly any regeneration of pine trees is observed or forests of former forest fire sites where a large quantity of pine trees have densely regenerated.

It will be difficult to secure a sustained supply of forest resources in the future from forests without regenerated trees. It will, therefore, be necessary to change the composition of these forests to forests where the sustained production of timber is possible due to high productivity by means of conducting standing improvement with the aim of creating forests with a high mix ratio of pine trees.

Meanwhile, in the case of those forests where felling has never been conducted, historical felling unaccompanied by regeneration activity must be replaced by forestry operations to ensure regeneration to make sustained production a reality.

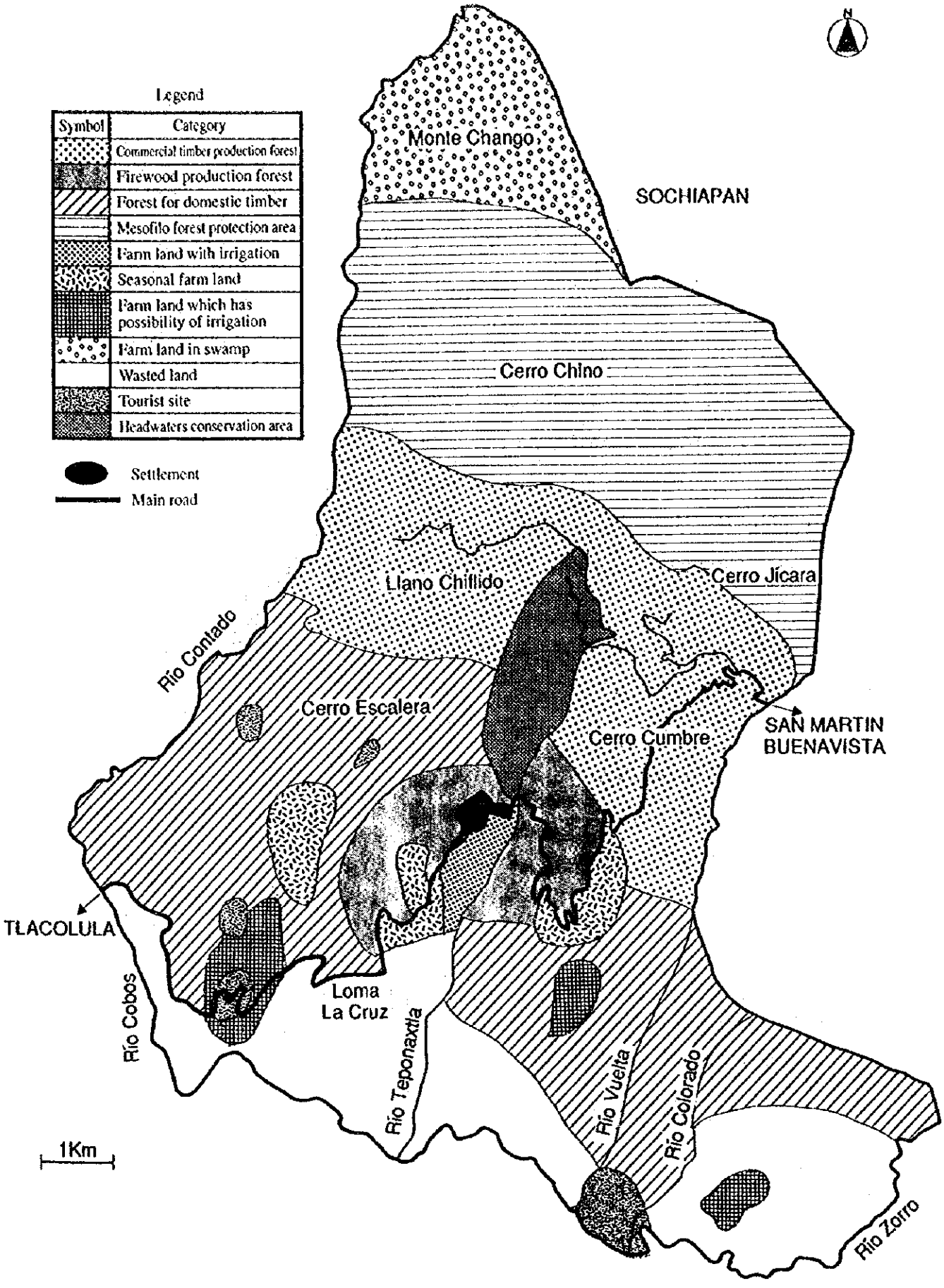


Fig. Te-1 S.J. Teponaxtla
Map of the future use of the community land drew by local inhabitants which are members of the RRA team

S.J. Teponaxtla has a sawmill and as the stable operation of this sawmill is the key to the development of the comunidad, a continual supply of raw materials must be ensured.

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 for both types of forests appears to be conversion of the forest composition to one which is capable of sustained production. Particularly in the case of those forests which have undergone felling in the past, the left-over quercus trees have not yet grown to be dominant in many forests because of relatively recent felling. This implies that there is a possibility for the early implementation of stand improvement to put local forests on the proper felling cycle of pine trees.

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 put the priority on stand improvement of those forests felled in the past and ensure regeneration of the unfelled ones, while aiming at developing highly productive forests which are capable of the sustained production of high quality timber from a long-term perspective.

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 should be planned to make the composition of those forests which have undergone felling in the past resemble that of commercial timber production forests. For those ones which have not, the sustainable production should be secured in the planning.

(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.J. Teponaxtla are identified as follows.

a. Forest Distribution

- The forest cover is divided into the northern part with mesofilo forests and the southern part with pine-quercus forests by the ridge running from Cerro Chino to Cerro Jicara.

- Mesofilo forests in the northern part consist of broad-leaved trees and rare wildlife is observed.

- 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 2,000 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 and places with a thin soil layer.

- Low elevation areas below the semi-arid area constitute a much dryer Selva Baja zone with shrubs and short trees.

b. Situation of Forest Use

- A forest production unit has been established to use forests for commercial purposes and pine trees are felled and sawn timber is marketed by the unit.

- The ancestors of local people constructed a water channel to obtain water from the upperstream of Rio Teponaxtla for drinking and irrigation purposes.

- 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 Te-6 and Fig. Te-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. In the case of categories dotted in a small area in other category areas, these have been ignored to facilitate uniform forestry operations which are suitable vis-a-vis the dominant category. Further details are shown on the forest management plan map (scale: 1/10,000).

Table Te-6 Subject Area by Forest Category

Forest Category			Description
Production Area	Timber Production Forest	Commercial	- Area along the forest road running below as well as to the south of the ridge from Cerro Chino to Cerro Jicara; northwestern slope of the ridge running from Cerro China to Cerro Escalera
		Non-Commercial	- Forests with a high mix ratio of pine located below an elevation of 2,000 m between Rio Teponaxtla and the ridge running southwards from Cerro Jicara - Forests with a high mix ratio of pine along the road running from the settlement towards Tlacolula
	Firewood Production Forest		- Forests with a high mix ratio of encino above the settlement of S.J. Teponaxtla - Forests with a high mix ratio of encino near the nursery - Forests with a high mix ratio of encino along the road heading towards Tlacolula
Protection Area	Nature Preservation Forest		- Mesofilo forests to the north of the ridge running from Cerro Chino to Cerro Jicara
	Soil Conservation Forest		- Downstream area of the slope facing San Andres Papalo along Rio Arroyo Contado - Steep slope between Rio Teponaxtla and the ridge extending from Loma la Cruz - Steep western slope near the summit of Cerro Escalera - Steep slope located above the point where the trunk road crosses Rio Teponaxtla
	Headwater Conservation Forest		- Upper reaches from the intake point and water channel in the catchment of Rio Teponaxtla
	Other Conservation Forests		- Selva Baja zone
Left-Over Forest			- Area where forestry operations will not be conducted for some time

2) Forest Division

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

3) Area by Forest Category

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

Table Te-7 Area by Forest Category

(Unit: ha)

Forest Category \ Compartment			1	2	3	4	5	6	7	8
Production Area	Timber Production Forest	Commercial	196	336	–	–	–	5	235	88
		Non-Commercial	–	–	68	40	–	–	10	167
	Firewood Production Forest		–	–	–	40	56	177	–	–
Protection Area	Nature Preservation Forest		101	–	–	–	–	–	–	26
	Soil Conservation Forest		54	264	–	13	100	87	43	–
	Headwater Conservation Forest		–	–	–	–	–	162	204	–
	Other Conservation Forests		–	4	134	288	110	–	–	–
Left-Over Forest			34	129	276	341	61	227	69	56
Sub-Total			385	733	478	722	327	658	561	337
Others			–	–	20	129	81	166	4	22
Total			385	733	498	851	408	824	565	359

Forest Category \ Compartment			9	10	11	12	13	14	15	Total
Production Area	Timber Production Forest	Commercial	–	–	222	–	–	–	–	1,082
		Non-Commercial	176	–	–	–	–	–	300	761
	Firewood Production Forest		14	–	81	–	–	–	–	368
Protection Area	Nature Preservation Forest		–	–	94	–	1,201	766	797	2,985
	Soil Conservation Forest		–	–	–	–	–	–	–	561
	Headwater Conservation Forest		–	–	–	–	–	–	–	366
	Other Conservation Forests		107	337	–	589	–	–	–	1,569
Left-Over Forest			288	486	161	332	–	–	–	2,460
Sub-Total			585	823	558	921	1,201	766	1,097	10,152
Others			74	21	43	0	0	0	57	617
Total			659	844	601	921	1,201	766	1,154	10,769

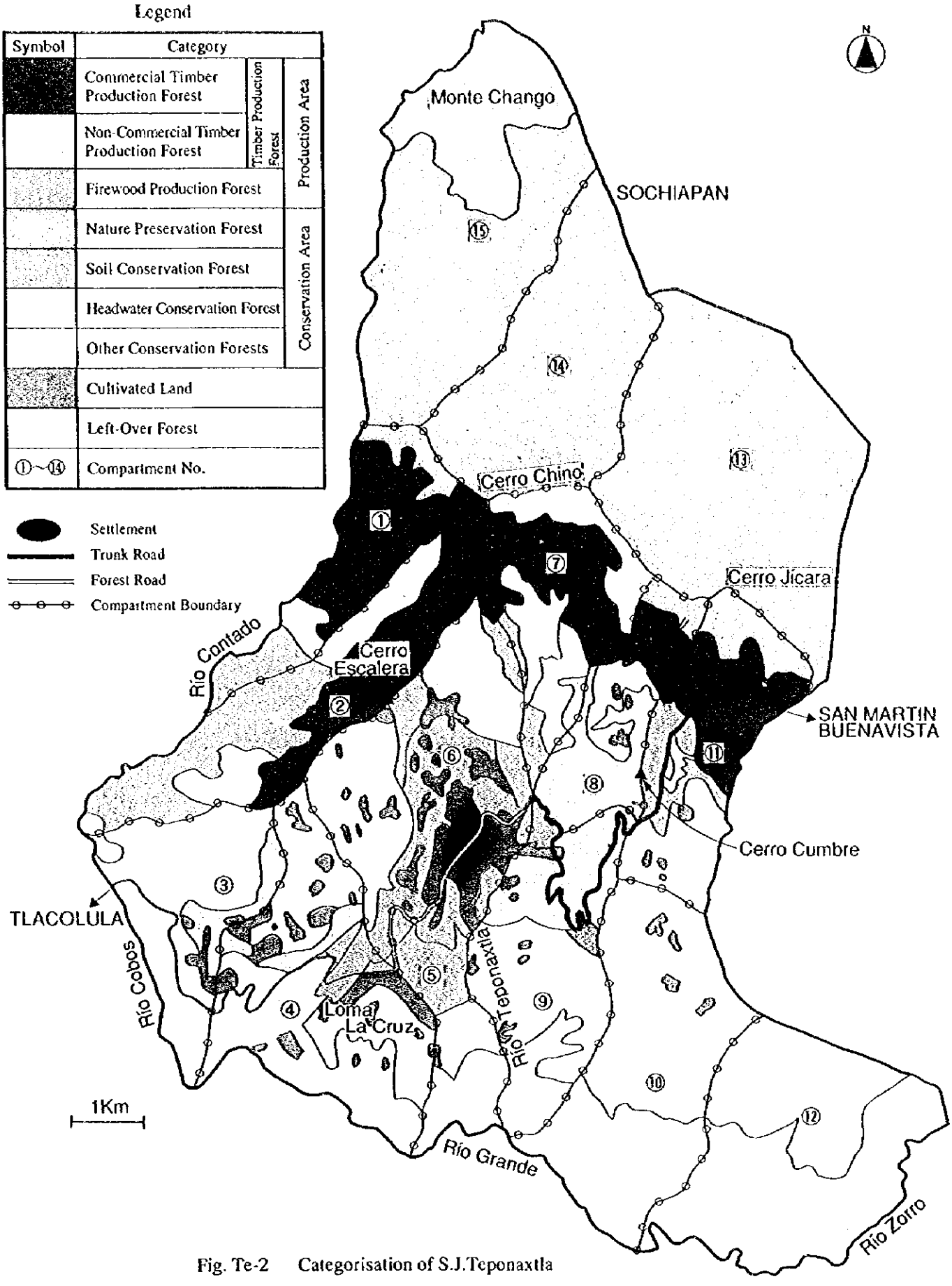


Fig. Te-2 Categorisation of S.J.Teponaxtla

(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 both forests felled in the past and unfelled forests to ensure sustained timber production

- Improvement of forests felled in the past where the number of pine trees has declined and the number of encino trees has increased to forests with many pine trees of a high commercial value

- Implementation of thinning at stands of forests felled in the past where pine trees are excessively dense to hasten the process of producing large-diameter wood.

- Implementation of appropriate operations if felling is conducted at unfelled forests to ensure regeneration

(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 Te-8.

Table Te-8 Characteristics of Commercial Timber Production Forests

Compartment No.	Characteristics
1	- The main road stretches to the ridge constituting the border of this compartment. An unfelled forest is situated in a high elevation area at the end of this forest road in the northwest. - The northwestern slope on the left bank of Rio Cantado has many pine trees with a small diameter.
2	- Areas around the main forest road are dominated by pine forests subject to felling in the last few years. There are many large-diameter trees because of the low felling intensity. - The northwestern slope of the ridge heading towards Cerro Escalera via Llano Chiflido has many pine trees with a small diameter.
7	- Areas around the main forest road are dominated by pine forests subject to felling in the last few years. There are many large-diameter trees because of the low felling intensity.
8	- Areas around the main forest road and areas along the forest road heading towards Cerro Jicaro do not have many large-diameter trees because of felling being conducted several times in the past. - Pine trees with a height of 2 - 5 m grow densely at former forest fire sites.
11	- The situation along the main forest road is similar to that of Compartment No. 8. - There are many forests with a high mix ratio of liquidambar around the point of the trunk road where the forest road starts. - Unfelled forests are situated on the eastern slope below the trunk road.

(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 Te-9. Age classes are used to integrate the stand age into certain bands to avoid complications and, here, the stand ages are grouped in age classes using five years as the unit.

Table Te-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 Te-10 and Fig. Te-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, Age Classes VI through IX are more prominent than others in terms of area. However, each of Age Classes IV, V, X through XII also occupies nearly half of that of Age Classes VI through IX. Other age classes occupy only a small area each. Although the growing stock by age group does not show a gradual accumulation, the growing stock per ha is relatively close to the desirable state. The small area and growing stock of Age Classes X through XII can be attributed to the selective felling of fine trees.

Table Te-10 Present Pine Resources Composition of Commercial Timber Production Forests in S.J. Teponaxtla

Age Class		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total
P	Area (ha)	28	0	0	5	5	64	64	52	52	45	45	69	429
	Growing Stock (m^3)	711	0	0	357	357	15,018	15,018	16,677	16,677	19,206	19,206	30,953	134,180
PQ	Area (ha)	0	4	4	52	52	119	119	100	100	19	19	19	607
	Growing Stock (m^3)	0	183	183	4,715	4,715	18,101	18,101	18,212	18,212	4,763	4,763	4,763	96,711
Q	Area (ha)	0	3	3	20	20	0	0	0	0	0	0	0	46
	Growing Stock (m^3)	0	16	16	181	181	0	0	0	0	0	0	0	394
Total	Area (ha)	28	7	7	77	77	183	183	152	152	64	64	88	1,082
	Growing Stock (m^3)	711	199	199	5,253	5,253	33,119	33,119	34,889	34,889	23,969	23,969	35,716	231,285
	Growing Stock (m^3/ha)	25	28	28	68	68	181	181	230	230	375	375	406	2,195

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 categories.

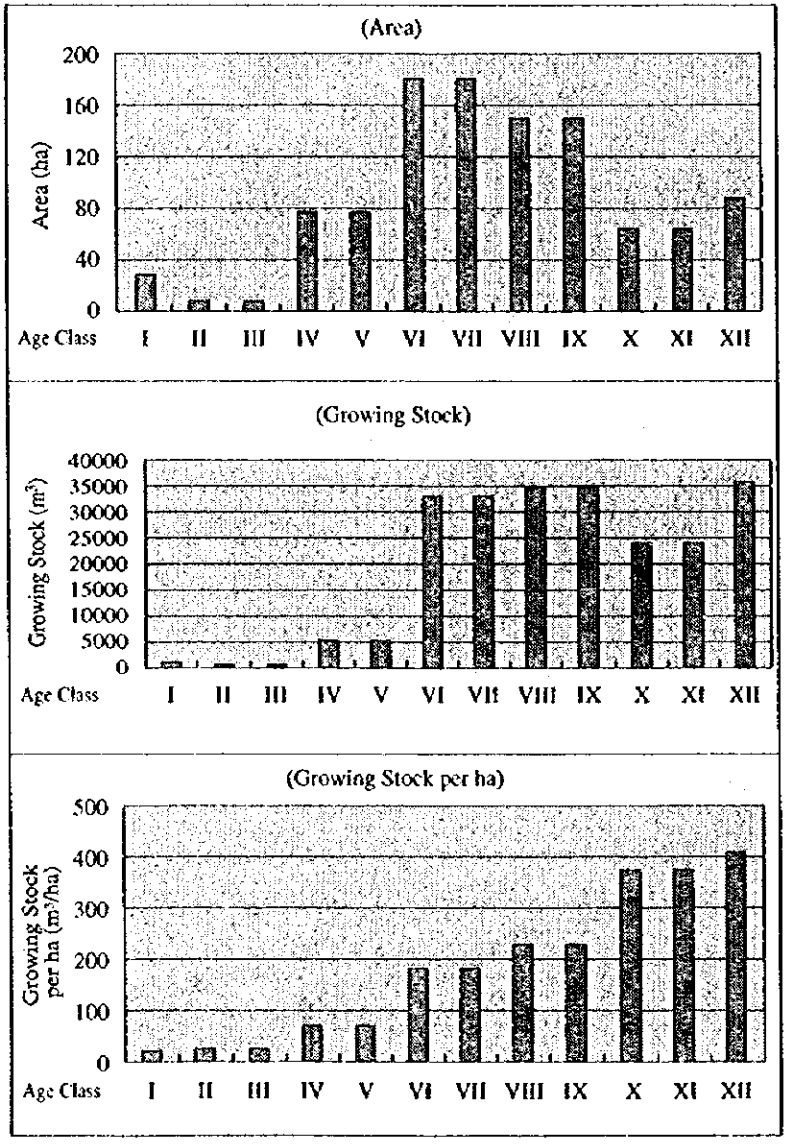


Fig. Te-3 Current Pine Resources Composition of Commercial Timber Production Forests in S.J. Teponaxtla

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 Te-12 and Fig. Te-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 Te-11 using the operation model of clear felling leaving seed trees described in Table 4-2-3.

Table Te-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^3/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^3/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. 1,082 ha × 0.6 = 649 ha, and the ideal composition of pine resources in these forests is shown in Table Te-12 and Fig. Te-4, taking Table Te-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 Te-12, the feasible felling volume each year will be approximately 4,000 m^3 (mean volume at final age: 380 m^3/ha, area of 10.7 ha, the volume of seed trees is not considered as it exists from the beginning).

Table Te-12 Ideal Pine Forest Composition of Forests Subject to Forestry Operations in S.J. Teponaxtla

Age Class	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total
Area (ha)	54	54	54	54	54	54	54	54	54	54	54	54	649
Growing Stock (m^3/ha)	1	7	16	29	92	140	205	217	228	276	321	362	-
Growing Stock (m^3)	54	378	864	1,566	4,968	7,560	11,070	11,718	12,312	14,904	17,334	19,548	102,276

Note: Due to rounding to the nearest whole number, the total figure may not coincide with the sum of individual figures.

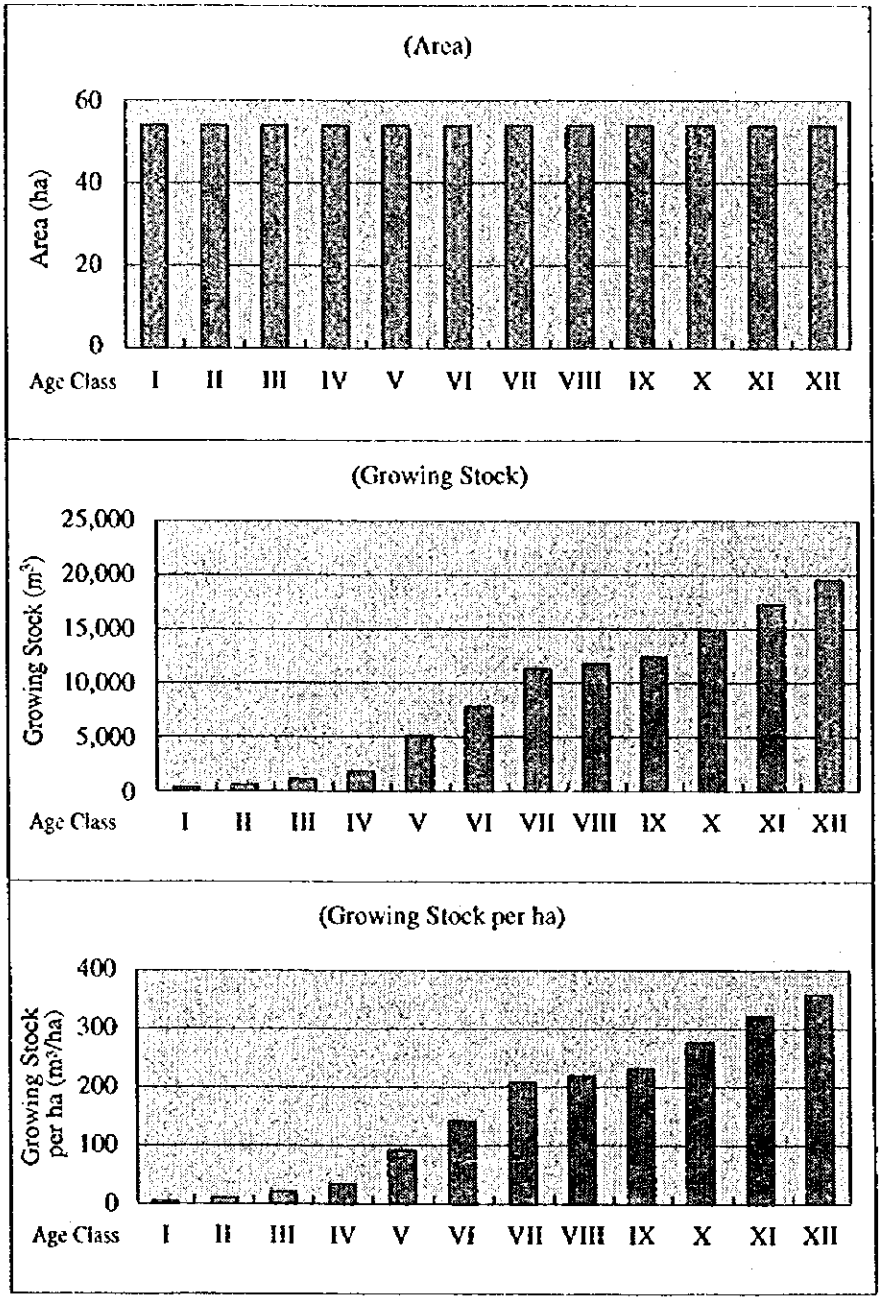


Fig. Te-4 Ideal Pine Forest Composition of Forests Subject to Forestry Activities in S.J. Teponaxtla

v. Timing of Regeneration Felling in the Future

The timing of future regeneration is assumed to be 60 years after felling for hitherto unfelled forests or after the number of years calculated by subtracting the age of the stand subject to thinning from 60 years for stands subject to thinning. As the stands subject to thinning in S.J. Teponaxtla generally appear to be ready for second thinning, their regeneration felling is expected to be conducted in 25 years time. In the case of those stands subject to improvement, the timing of regeneration felling is expected to be 60 years after stand improvement as the same forestry operations as those for stands after regeneration felling will be implemented at these stands.

(e) Immediate Plan

The purpose of the immediate plan is to put existing forests on the proper pine forest operation cycle as soon as possible to achieve a forest composition which is capable of sustained production.

i. Regeneration Felling

The stands subject to regeneration felling in the near future consist of unfelled forests and forests felled in the past and subject to stand improvement. To respect the intentions of local people, the felling of hitherto unfelled forests and the stand improvement of forests felled in the past will be simultaneously conducted.

If the work concentrates on the felling of unfelled forests, stand improvement work will be delayed. As encino trees are growing in stands requiring improvement, improvement work will become more difficult with the passing of time, illustrating the importance of giving priority to stand improvement rather than to regeneration felling. However, given the facts that the supply of wood to the sawmill is necessary, that felling has so far been conducted at unfelled forests and that it is necessary for local people to learn an appropriate felling method for unfelled forests in the future, the felling of unfelled forests at the same time as stand improvement work appears appropriate.

< Regeneration Felling at Unfelled Forests >

Unfelled forests are mainly located at two sites, i.e. near the end of the forest road and below the starting point of the forest road. The former is

further divided into sites with a higher and lower elevation than the forest road. Regeneration felling at the lower site at the end of the forest road will require fairly long extension of the forest road in the direction of Cerro Escalera. As the forest road construction is very expensive, it appears more realistic to postpone felling at this site until such time when the trunk road linking Tlacolula is opened to allow a useful link between this trunk road and the extension of the present forest road.

For the immediate future, it appears appropriate to consider those forests situated above the end of the forest road and those situated below the trunk road near the starting point of the forest road in view of the fact that felling can be conducted with only minor extension of the forest road.

The prospective forest areas are 76 ha (126 ha × 0.6) for forests situated above the end of the forest road and 54 ha (90 ha × 0.6) for forests situated below the trunk road near the starting point of the forest road.

< Regeneration Felling Through Stand Improvement Work >

The pine trees to be felled through stand improvement work can be treated the same as those of regeneration felling and, therefore, the felling volume of pine trees through stand improvement work is accounted for in the regeneration felling volume. Although the total area of the sub-compartments subject to stand improvement is 120 ha, stand improvement will not be conducted throughout this area. Assuming that stand improvement is conducted at 80% of the total area, the subject area of stand improvement will be 96 ha.

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. On the other hand, the following stands subject to thinning will fall on the time for regeneration felling. Assuming that stand improvement is to be completed in 25 years in order to stabilize the log supply, the actual area subject to stand improvement will be 3.8 ha/year.

ii. Thinning

Thinning will be conducted at those stands where the density of growing pine trees is excessive. There is a dense growth of pine trees with a small

DBH at former forest fire sites of Cerro Jicara. Considering the length of time which has elapsed since the fire, this stand is classified as a stand which has lost the chance of improvement felling. Consequently, regeneration and tending work will be conducted at this stand. All other stands subject to thinning can be regarded as the subject stands of the second thinning described in the operation model of clear felling leaving seed trees because they have some growing stock. The area subject to second thinning will be 109 ha.

iii. Stand Improvement

Stand improvement will involve the felling and clearance of broad-leaved trees which are mainly encino. The subject area will be equivalent to the area of regeneration felling described earlier and will be 3.8 ha/year.

b. Non-Commercial Timber Production Forests

This type of forest has low productivity and no 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

A suitable area to ensure the sustained collection of the firewood volume required by the comunidad will be developed as firewood production forests.

b. Area of Firewood Production Forests

Assuming that the annual firewood consumption of 163 households in S.J. Teponaxtla is 6 m^3 per household, the total annual consumption volume is 978 m^3. Based on the mean increment of a firewood production forest of 4.9 m^3 and a firewood production yield of 75%, at least 266 ha of land must be earmarked for firewood production forests. Under the plan, 368 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 regeneration felling thinning or improvement.

9. Work Plan

Forest work is planned for forestry operations regarding thinning and stand improvement, forest roads and production equipment. 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.

(1) Commercial Timber Production Forests

1) Regeneration Felling

a. Regeneration Felling of Unfelled Forests

(a) Regeneration Felling Sites at Unfelled Forests

Unfelled forests are located in Sub-Compartment Nos. 2 through No. 13 in Compartment No. 1, Sub-Compartment Nos. 7 through 24 in Compartment No. 2, Sub-Compartment No. 1 in Compartment No. 6, Sub-Compartment Nos. 17 through 19 in Compartment No. 7 and Sub-Compartment Nos. 23 through 27 in Compartment No. 11. Of these, the subject sites of regeneration felling are listed in Table Te-13. All other sites will be reserved.

Table Te-13 Subject Sub-Compartments of Regeneration Felling in Unfelled Forests

Above End of Forest Road				Below Starting Point of Forest Road			
C	S/C	C	S/C	C	S/C	C	S/C
1	2	1	7	11	15	11	27
1	3	1	8	11	23		
1	4	7	17	11	24		
1	5	7	18	11	25		
1	6	7	19	11	26		

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

The area and volume of the subject sites of regeneration felling and reserved area in unfelled forests are shown in Table Te-14.

Table Te-14 Area and Volume of Regeneration Felling and Reserved Area in Unfelled Forests

Site		Present Status				Area and Volume Subject to Felling			
		Area	Standing Tree Volume (m^3)			Area	Standing Tree Volume (m^3)		
		(ha)	Total	Pine	Others	(ha)	Total	Pine	Others
Regeneration Felling Site	Above End of Forest Road	126	38,700	27,200	11,500	76	23,200	16,300	6,900
	Below Starting Point of Forest Road	90	42,600	28,000	14,600	54	25,600	16,800	8,800
	Sub-Total	216	81,300	55,200	26,100	130	48,800	33,100	15,700
Regeneration Felling Site in Reserved Area		359	94,000	50,100	43,900	215	56,400	30,100	26,300
Site Not Subject to Stand Improvement		285	48,700	28,700	20,000	171	29,200	17,200	12,000
Total		860	224,000	134,000	90,000	516	134,400	80,400	54,000

There is a question of whether regeneration felling should firstly commence at sites above the end of the forest road or sites below the starting point of the forest road or at both sites. The conclusion of the study team is to proceed with sites above the end of the forest road, taking into consideration such aspects as the need to construct a new forest road to facilitate felling, the need to maintain the existing forest road, the historical fact that the forest road has been constructed towards areas of a higher elevation and the intentions of local people.

(b) Allowable Felling Volume at Regeneration Felling Sites in Unfelled Forests

As the pine trees in S.J. Teponaxtla are approaching their climax, their annual increment is assumed to be 1.0%, resulting in an annual allowable felling volume of 720 m^3 [33,100/60 + (33,100 × 0.01)/2].

(c) Annual Regeneration Felling Area and Volume in Unfelled Forests

The upper limit of the annual felling volume of pine will be set at the allowable felling volume of 720 m^3. Species other than pine will also be felled to produce an annual felling volume of 340 m^3.

Felling will proceed from Sub-Compartment No. 8 in Compartment No. 1 to Sub-Compartment Nos. 7, 2 and 5 in the same compartment. Felling at sites below the starting point of the forest road will start at Sub-Compartment Nos. 15 and 26 in Compartment No. 11.

Table Te-15 Area and Volume of Annual Regeneration Felling in Unfelled Forests

Area (ha)	Standing Tree Volume (m^3)		
	Total	Pine	Others
2 - 3	1,060	720	340

b. Regeneration Felling at Stand Improvement Sites

(a) Stand Improvement Sites

The sub-compartments where stand improvement work will be conducted in the 25 year period are listed in Table Te-16.

Table Te-16 Locations of Stands in Need of Improvement

C	S/C	C	S/C	C	S/C	C	S/C
2	1	7	13	8	28	11	22
2	2	7	16	11	3	11	39
2	3	7	20	11	9		
2	4	7	21	11	10		
2	5	7	25	11	12		
2	6	7	41	11	13		
7	6	8	11	11	14		
7	10	8	12	11	16		
7	11	8	13	11	17		
7	12	8	27	11	18		

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 Te-17, 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 Te-17 Subject Sub-Compartments of Regeneration Felling

Near End of Forest Road				Near Starting Point of Forest Road			
C	S/C	C	S/C	C	S/C	C	S/C
2	1*	7	13	11	9	11	22
2	3*	7	16	11	10		
7	10	7	20	11	12*		
7	11*	7	21	11	13*		
7	12*	7	25	11	14*		

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 Te-17 is 79 ha, of which stand improvement will actually be conducted in 38 ha. The area and volume of the regeneration felling to be conducted in the 10 year plan period are shown in Table Te-18.

Table Te-18 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^3)			Area (ha)	Standing Tree Volume (m^3)		
	Total	Pine	Others		Total	Pine	Others
79	36,000	28,700	7,300	38	17,300	13,800	3,500

(c) Area and Volume of Annual Regeneration Felling at Stand Improvement Sites

As regeneration felling will be conducted at 3.8 ha/year, the standing tree volume of pine corresponding to this area will be 1,400 m^3 (13,800 ÷ 10). Assuming that 20 m^3/ha is left for seed trees, the regeneration felling volume of pine trees will be 1,320 m^3/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 Te-19 Area and Volume of Annual Regeneration Felling at Stand Improvement Sites

Area	Standing Tree Volume of Pine
3.8 ha	550 m^3

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 while improvement felling will be conducted between the fifth and tenth years after the completion of regeneration.

Improvement felling will also be required at the mid-slope of Cerro Jicara and the subject sites are Sub-Compartment Nos. 3, 4 and 6 in Compartment No. 8. The total area for improvement felling will be 13 ha. Assuming that improvement felling is completed in three years, the annual area subject to improvement felling will be 4.3 ha.

3) Thinning

a. Subject Sites

The sub-compartments requiring thinning equivalent to the second thinning are Sub-Compartment Nos. 8, 9, 14, 15, 23, 24, 26, 27, 29, 30, 32, 33, 35, 36 and 37 in Compartment No. 7.

b. Area and Volume of Thinning

The area, volume and thinning volume at the subject sites prior to thinning are shown in Table Te-20. The thinning rate for pine trees will be 30% (approximately 40 - 50% in terms of the number of trees). Although special other than pine should, in general, be completely felled, a thinning rate of 60% is employed to ensure the health of the subject stands.

Table Te-20 Area and Volume of Thinning

Area (ha)	Standing Tree Volume Prior to First Phase (m^3)			Thinning Volume (m^3)		
	Total	Pine	Others	Total	Pine (30%)	Others (60%)
109	46,300	36,900	9,400	16,700	11,100	5,600

c. Area and Volume of Annual Thinning

As 109 ha of forests will be thinned in 10 years, the annual thinning area will be 11 ha. The felling volume will be 1,100 m^3/year for pine and 560 m^3/year for other species, totalling 1,660 m^3/year.

Table Te-21 Area and Volume of Annual Thinning

Area (ha)	Standing Tree Volume (m^3)		
	Total	Pine	Others
11	1,660	1,100	560

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 3.8 ha/year. The standing tree volume of species other than pine which will be felled through stand improvement work is shown in Table Te-22.

Table Te-22 Annual Area and Volume of Stand Improvement

Area (ha)	Standing Tree Volume of Species Other Than Pine (m^3)
3.8	350

(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 some 1,300 m^3/year which will substantially exceed the estimated annual firewood demand of 980 m^3.

(3) Production and Marketing

1) Form of Production and Marketing

The comunidad currently has a sawmill which processes all of logs and has been engaged in the sale of sawn timber. The comunidad intends to continue the sale of sawn timber. This form of production and marketing should be appropriate.

2) Log Production Volume

It is assumed that the log production yield of regeneration felling will be 70% and that 80% and 20% of the logs produced at unfelled forests will be timber wood and pulp wood respectively. In the case of logs produced by regeneration felling at stand improvement sites, it is assumed that 70% and 30% will be timber wood and pulp wood respectively because of the higher percentage of poor quality trees. In regard to second thinning, the log production yield is assumed to be 60% and the produced logs will be used as timber wood and pulp wood on a 50-50 basis. The expected log production volume is shown in Table Te-23.

Table Te-23 Annual Log Production Volume

(Unit: m^3)

Year	Regeneration Felling at Unfelled Forests		Regeneration Felling by Stand Improvement		Second Thinning		Total	
	Timber Wood	Pulp Wood	Timber Wood	Pulp Wood	Timber Wood	Pulp Wood	Timber Wood	Pulp Wood
1 - 10	400	100	270	120	330	330	1,000	550

(4) Forest Roads

1) New Construction

The construction of a 1.5 km forest road at the regeneration felling site in Compartment No. 1 above the end of the existing forest road and a 1.0 km forest road in a mainly thinning area in Compartment No. 8, totalling 2.5 km, is planned.

2) Repair of Existing Forest Roads

a. Extension of Existing Forest Roads

The total length of existing forest roads is 14.0 km as shown in Table Te-24.

Table Te-24 Length of Existing Forest Roads

Existing Route	Length (km)
1. Main route (from the starting point to the end)	10.0
2. Secondary route heading towards Cerro Jicara	2.5
3. Secondary route in Compartment No. 7 along the upperstream of Rio Teponaxtla	1.5
Total	14.0

b. Repair of Existing Forest Roads

The repair work listed in Table Te-25 will be conducted for existing forest roads.

Table Te-25 Planned Repair Work for Existing Forest Roads

Type of Work	Method
Levelling	Repair of uneven road surfaces (bulldozer and 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

As the forest road will be extended upward from the present end point to conduct forestry operations along the new route, repair of the existing main route of 10 km will be necessary every year. Assuming that one-quarter of the total length (6.5 km)

of other routes (including new ones) is repair each year, the total length of forest roads to be repaired each year will be 12 km.

(5) Production Equipment

The large trucks and vehicles equipped with a yarding crane to be used for the felling, yarding and transportation of logs to be produced by regeneration felling and thinning will be those currently possessed by the comunidad. The following quantities of tools and equipment will be required as the work will be conducted by several groups.

Table Te-26 Required Tools/Equipment for Production Activities

Tool/Equipment	Quantity Required	Life Expectancy (years)
Pickeroon (Gancho)	25	4~5
Chainsaw	25	4
Hatchet	60	1~2
Rake	25	1~2

Note: The quantity of chainsaws includes five reserve chainsaws.

(6) Labour Volume

1) Regeneration Felling

The man-days required to produce 1 m^3 of logs by regeneration felling is 0.68 man-days based on Table 4-2-16. As the annual log production volume is 890 m^3, the annual labour requirement is 606 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 including the area of stand improvement is 6 ha, ground clearance will require 18 man-days/year, weeding will require 15 man-days in the first year, 30 man-days in the second year and 45 man-days in the third year and thereafter and improvement felling will require 15 man-days in the seventh year and thereafter. In the case of improvement felling at Cerro Jicara, a work volume of four times higher than usual is estimated because of the state of densely growing pine trees throughout the subject

sites due to the delayed work so that the work can be completed in 1 - 3 years. It will require 44 man-days every year during these three years.

3) Thinning

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^3. In the case of the felling of hitherto unused species, the labour requirement is estimated to be 0.4 man-days/m^3 based on Table 4-2-16. As the thinning volume to produce logs is 660 m^3, 720 man-days will be required. The volume of simple felling for disposal will be 560 m^3, requiring 224 man-days.

4) Forest Improvement

Stand improvement work to fell broad-leaved trees left over from regeneration felling and pine trees except seed trees, which were not felled 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. Stand improvement work will be conducted at 3.8 ha every year and 46 man-days and 107 man-days will be required for chainsaw operators and labourers respectively every year.

5) Repair of Existing Forest Roads

Assuming a labour requirement of 30 man-days/1 km for forest road repair, 360 man-days will be required to conduct the planned repair of 12 km. If bulldozers are rented to repair the forest roads, the manpower requirement will be reduced.

6) Total Labour Requirement

The required labour volume for each year in the 10 year period is shown in Table Te-27.

Table Te-27 Annual Labour Input Requirement

(Unit: man-days)

Year	Regeneration Felling	Tending			Thinning	Stand Improvement	Forest Road Repair	Total
		Ground Clearance	Weeding	Improvement Felling				
1	606	18	15	44	944	153	360	2,140
2	606	18	30	44	944	153	360	2,155
3	606	18	45	44	944	153	360	2,176
4	606	18	45		944	153	360	2,126
5	606	18	45		944	153	360	2,126
6	606	18	45		944	153	360	2,126
7	606	18	45	15	944	153	360	2,141
8	606	18	45	15	944	153	360	2,141
9	606	18	45	15	944	153	360	2,141
10	606	18	45	15	944	153	360	2,141

10. Environmental Considerations

For regeneration felling, it is desirable for each felling block to be small and not continuous to each other. Given the slightly inferior water permeability, forest road repair and ground clearance for pine regeneration purposes should be carefully conducted to prevent road damage and stream water contamination. In the case of existing forest roads, damage to the sub-grade as well as shoulders is particularly noticeable at stream crossing sites, illustrating the importance of taking drainage into consideration when conducting repair work. Felling should be avoided in the mist forest area in the north from the viewpoints of natural environment conservation and the prevention of mountain disasters.

11. Evaluation on Forest Management Plan

Out of the total area of 10,769 ha in S.J. Teponaxtla, the area for the commercial production forest amounts to 1,082 ha. A unrestricted area to be utilized for the cutting accounts for 60% of the total production forest, i.e. 643 ha.

(1) With Project Case

Under a With Project case, the log production is planned in the unrestricted forest and some of timber woods will be processed at a sawmill in the comunidad.

1) Log Production

Out of the unrestricted forest area, the log production will be planned in the following areas: the area of 130 ha for the regeneration cutting in the uncut area; the area of 120 ha for the forest stand improvement; the area of 109 ha for the thinning.

a. Uncut Forest Area

In the area of 130 ha for the regeneration cutting in the uncut area, the regeneration cutting is planned in a cycle of 60 years. An area to be cut in a year is 2.2 ha (=130 ha/60 years) and an annual volume of pine standing trees to be cut is 720 m^3. In consideration of the yield ratio of the log production, an annual volume of the log production will be 500 m^3.

b. Area for Forest Stand Improvement

Out of 120 ha for the forest stand improvement, an area of 96 ha will be subject to the forest stand improvement and regeneration cutting over a period of 25 years. An annual area for the forest stand improvement and regeneration cutting will be 3.8 ha (=96 ha/25 years). An annual volume of the log production is estimated at 385 m^3/3.8 ha based on a standing volume of pine trees to be cut, which is 550 m^3, and the yield ratio of the log production. 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 conducted 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 ha per year (=120 ha/60 years).

c. Area for Thinning

In the area of 109 ha for the thinning, a standing volume of trees will total 11,100 m^3/109 ha and the thinning equivalent to the second one will be carried out in a 10-year period. During this period, an annual log production volume will be 660 m^3/10.9 ha based on an annual standing volume of pine trees to be cut, which is 1,100 m^3, and the yield ratio of the log production. In the area planned for the thinning, the regeneration cutting will be implemented in the 15th year from the thinning. The area for the regeneration cutting will be 1.8 ha per year (=109 ha/60 years) and the cycle of the cutting will be 60 years. In the 20th year after the regeneration cutting, the first thinning is planned.

2) Silvicultural Work

a. Forest Stand Improvement

Since an area for the forest stand improvement is 3.8 ha per year, this activity requires about 150 man-days (= 40 man-days × 3.8 ha) per year.

b. Regeneration and Tending

In an annual area for the regeneration cutting in the uncut area (2.2 ha/year) and an annual area for the forest stand improvement (3.8 ha/year), a number of man-days required for the ground clearance will be 18. The weeding is planned over three years after the regeneration cutting, including the year for the cutting. Therefore, the weeding needs 15 man-days in the first year, 30 man-days in the second year, and 45 man-days in the third year. The cleaning cutting will be planned in the area of 3 ha in the 7th year after the regeneration cutting is completed. The cleaning cutting requires an annual number of 15 man-days. For the cleaning cutting in Cerro Jicara, 44 man-days will be spent every year from the first to the third years. Furthermore, in the area for the thinning, similar types of activities such as the ground clearance, weeding, and cleaning cutting will be planned after the regeneration cutting.

A maximum number of annual man-days to be spent for the forest stand improvement as well as regeneration and tending is estimated at some 490. Out of 241 comuneros, comuneros who reside in the comunida and are able to participate in these activities will number 161. If the forest stand improvement, regeneration and tending are carried out by Tequio, each comunero needs to add extra 3 days to the existing work volume of 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 Te-28 Equipment and Tools Currently Owned by Comunidad

Item	Quantity	Year of Procurement	Remarks
Pickeroon	6	N.A.	Aside from pickeroons owned by the comunidad, there exist seven pickeroons privately owned in the comunidad.
Chainsaw	1	N.A.	Aside from a chainsaw owned by the comunidad, there exist seven chainsaws privately owned in the comunidad.
3/4 Pick-Up Truck	2	1991 (New) 1996 (Used)	
12 Ton Truck	3	1990 (2 units) 1996 (1unit)	
Grua	1	1996 (Used)	

Trucks in the comunidad have been used not only for transportation of logs and processed woods but also for transportation of various items such as construction materials, sand, and firewood. A transportation by a 12-ton truck costs 2,200 pesos from the comunidad to either Oaxaca or Tuxtepec, and the amount includes fuel costs. A user of the truck will make a payment to the comunidad. This transportation cost is similar to the one quoted by a freight company in Oaxaca. In this financial analysis, therefore, a 12-ton truck is not assumed to be owned by either the comunidad or the forest production unit. Instead, it is assumed that the forest production unit will pay 2,200 pesos per transportation to anyone who is able to transport processed woods to Oaxaca and pulp woods to Tuxtepec.

Base on the existing ownership of the equipment and tools, the following, including those for spare use, are planned to be purchased.

Table Te-29 Equipment and Tools Planned to be Purchased

Item	Quantity	Timing for Purchase
Pickeroon	25	Every 4 to 5 years after Year 1
Hatchet	60	Every year from Year 1
Rake	25	Every year from Year 1
3 ton Truck	2	After an economic depreciation period has passed
Grua	1	After an economic depreciation period has passed

Note: Purchase of equipment and tools in the year when log production is conducted.

d. Construction and Rehabilitation Costs of Forest Roads

The construction of new forest roads is planned in a length of 2.5 km. The construction cost is estimated at 175,000 pesos/2.5 km. The construction work of new roads will go along with the cutting schedule of trees. Accordingly, the length of the forest roads will be extended every year by 0.25 km over a 10-year period.

The rehabilitation of the existing forest roads is planned in a length of 12 km per year. The cost of the rehabilitation work will be 2 % of the construction cost of the forest road per km. Therefore, the forest production unit is expected to spend 17,000 pesos per year for the rehabilitation work. In addition, newly constructed forest roads will become subject to the annual rehabilitation work.

3) Timber Processing

It is postulated that all timber wood will be processed at a sawmill in S.J. Teponaxtla. The construction work of a sawmill in S.J. Teponaxtla began from 1992 and sales of processed woods started from 1995.

Main equipment and machinery at the sawmill are band saw equipment (a band saw is 6 inches in width), a round saw, pendulum, and so on. Sawmill equipment and machinery are made in Mexico and the following procurement costs are estimated on the assumption that all the equipment and machinery are purchased at the time of the field survey:

Table Te-30 Main Equipment and Machinary for Sawmill

Item	Price (Pesos)
Band Saw Equipment	140,000
Log Carriage	23,000
Conveyer Belt	32,000
Track for Log Carriage	16,000
Round Saw	35,000
Pendulum	18,000
Roller	29,000
Motor	76,000
Transmission	48,000
Installation Work	35,000
Building	40,000
Value Added Tax	76,800
Total	568,800

In the financial analysis, a depreciation period is set at 20 years for these equipment and machinery.

The operational efficiency of the sawmill is estimated as follows:

Maximum Capacity of Timber Processing:	40m^3/day in a log volume
Normal Capacity of Timber Processing:	30m^3/day in a log volume
Yield Ratio of Timber Processing:	40%
Fuel Consumption (Diesel):	5.4 liters/m^3
Fuel Consumption (Oil):	18 liters/month
Band Saw:	One band saw per 500 m^3 of logs processed
Maintenance Cost:	2% to 5% of the total investment costs
Personnel costs:	450 peso/day (included in personnel costs are daily wages for a sawmill administrator and a recorder)

4) Transportation Cost

A transportation cost from a yard on the spot to the sawmill will be 25 pesos/m^3. A transportation cost from the comunidad to Oaxaca will be 2,200 pesos/3,500PT/Truck in case of processed woods, excluding a value added tax. A transportation cost of pulp woods will be 2,200 pesos/10m^3/Truck from the comunidad to Tuxtepec.

5) Management of the Forest Production Unit

The forest production unit of the comunidad is comprised of five members: a coordinator, a secretary, a site supervisor, an administrator at a sawmill, and a recorder at a sawmill. Daily wages of the sawmill administrator and recorder are included in the operation costs of the sawmill and an annual amount of wages is calculated based on a number of days for which the sawmill is run in a year.

(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 784 m^3 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 27 pesos per cubic meter after deducting all necessary 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 530 thousand pesos. This means that with preconditions set as above, the project will be financially feasible. If the forest stand improvement, regeneration and tending activities are implemented by Tequio, the net present value of the incremental net cash flow is calculated at 600 thousand pesos.

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

Table Te-31 Sensitivity Analysis in Case of Alteration of Sales Price of Timber Wood

Price of Processed Wood (Pesos/PT)	Net Present Value (1000 Pesos)
3.3	398
3.2	263
3.1	127
3.0	-8

Table Te-32 Sensitivity Analysis in Case of Alteration of Discount Rate

Discount Rate (%)	Net Present Value (1000 Pesos)
22	915
24	673
28	446
30	385
32	342

As shown above, the feasibility of the project will be greatly influenced by a price of a processed wood.

The cumulative amount of the net cash flow under the With Project case shows negative figures at the early years of the project period when sawmill equipment and machinery are replaced. The forest production unit is expected to have financial difficulty during this period. In the analysis, it is assumed that the forest production unit will procure non-interest bearing funds and continue its forest activities. However, in reality, the production unit may raise funds within the comunidad, postpone the time for replacing equipment and machinery, or carry out the project with Tequio.

(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, which amounts to 1,010,000 pesos. Accordingly, with the above conditions being applied, the project will be feasible from an economic perspective.

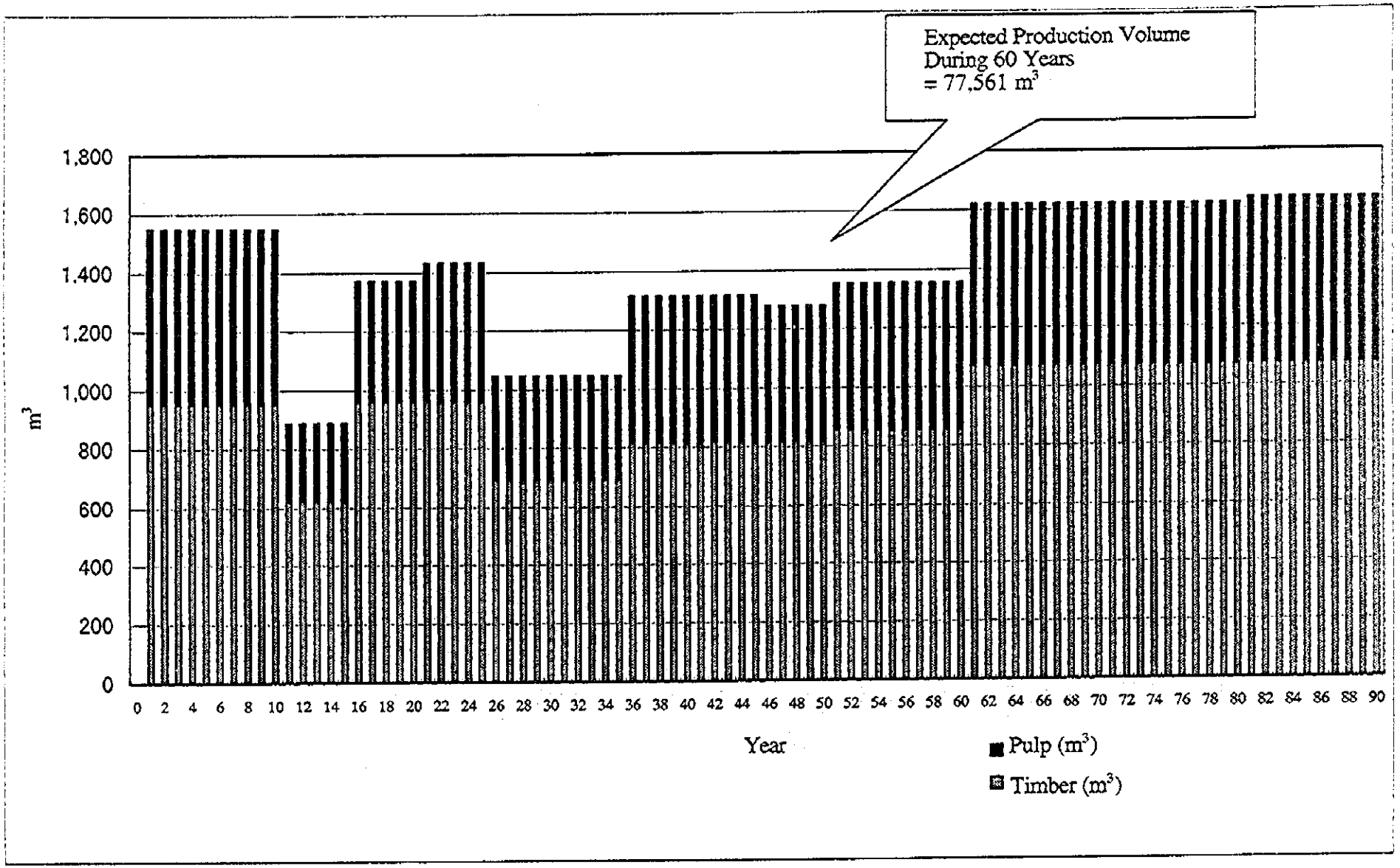


Fig. Te-5 Expected Annual Production Volumes of Timber and Pulp Woods at S.J. Teponaxtla (With Project Case)

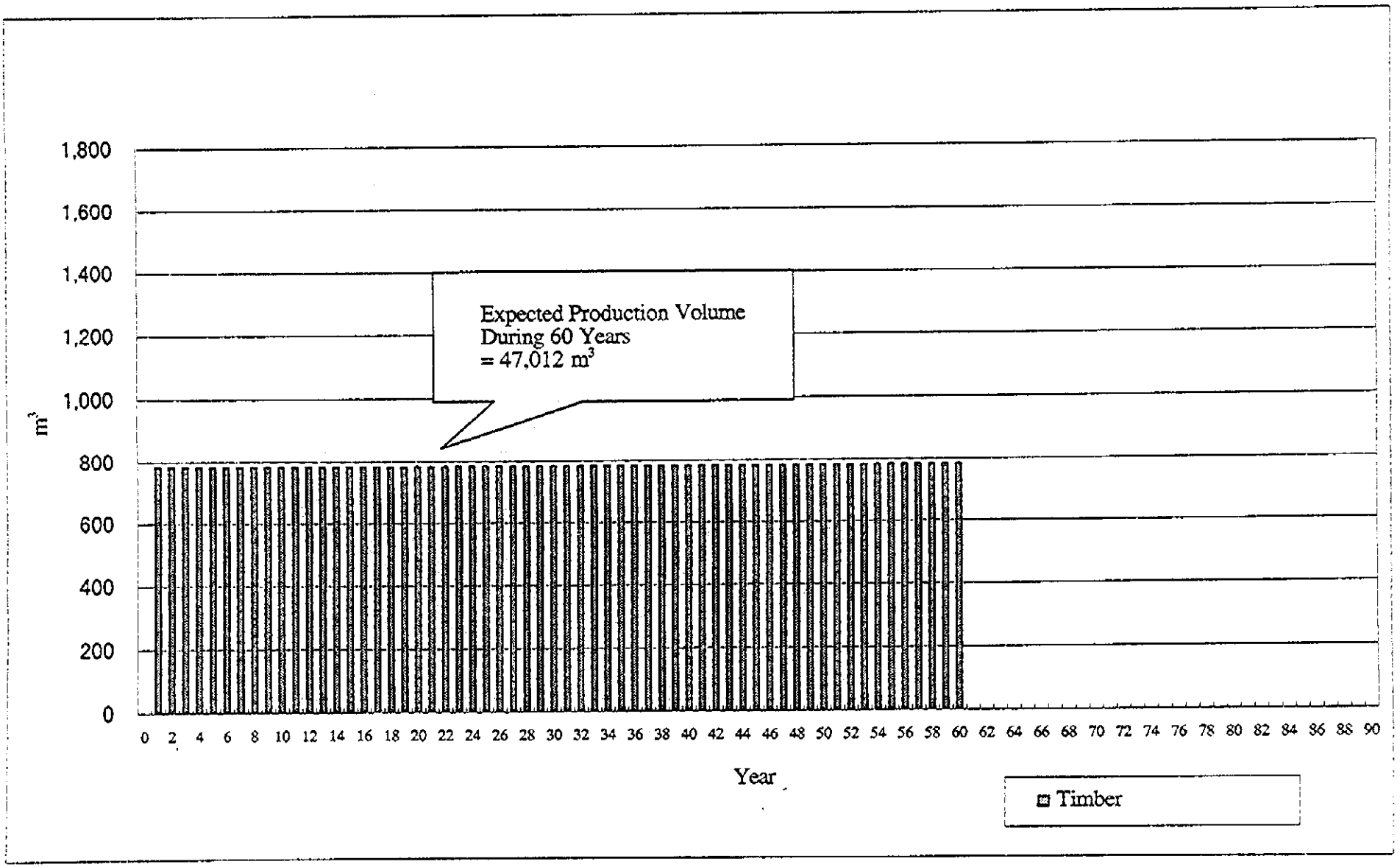


Fig. Te-6 Expected Annual Production Volumes of Timber Wood at S.J. Teponaxtla
(Without Project Case)

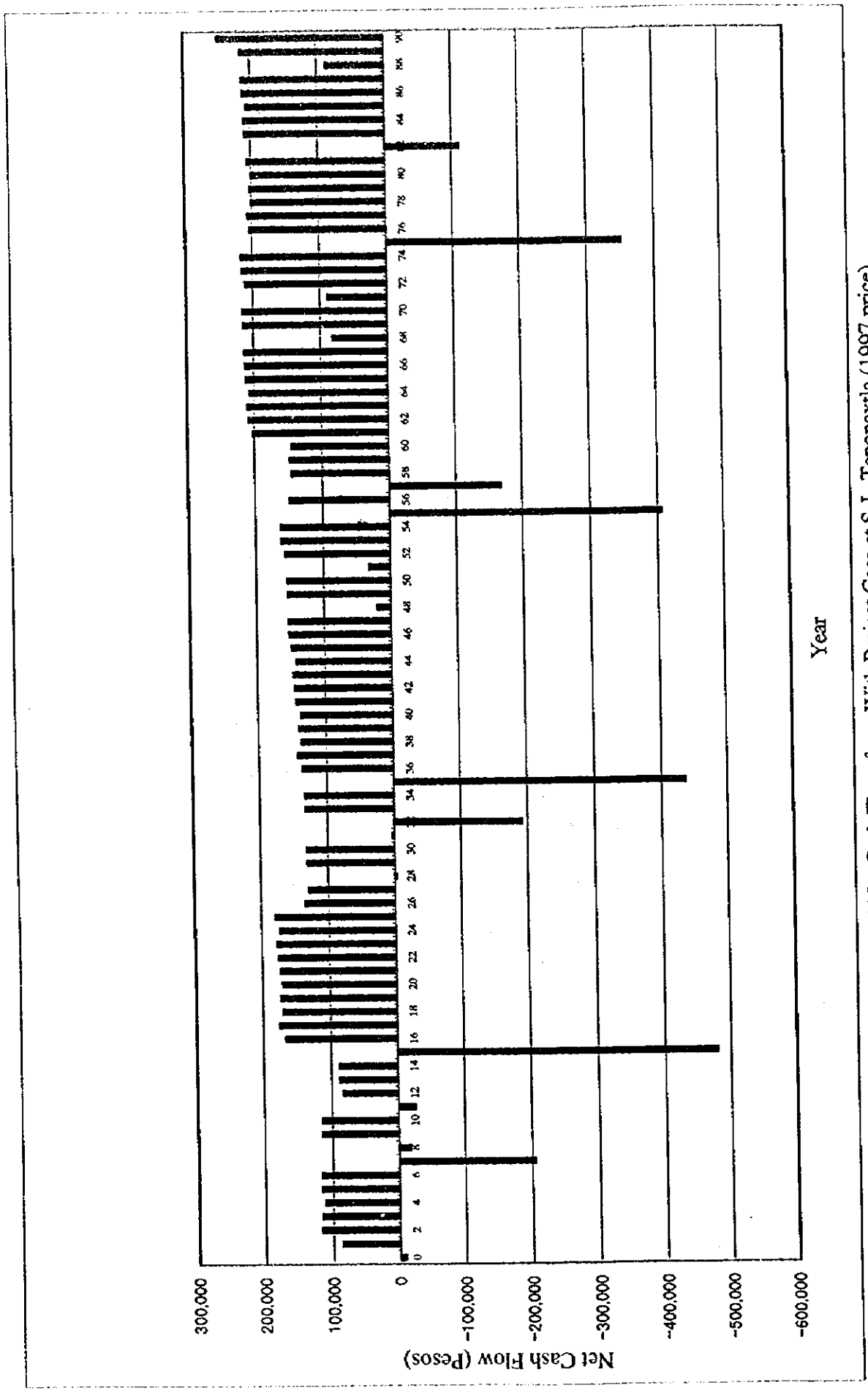


Fig. Te-7 Expected Net Cash Flow from With Project Case at S.J. Teponaxtla (1997 price)

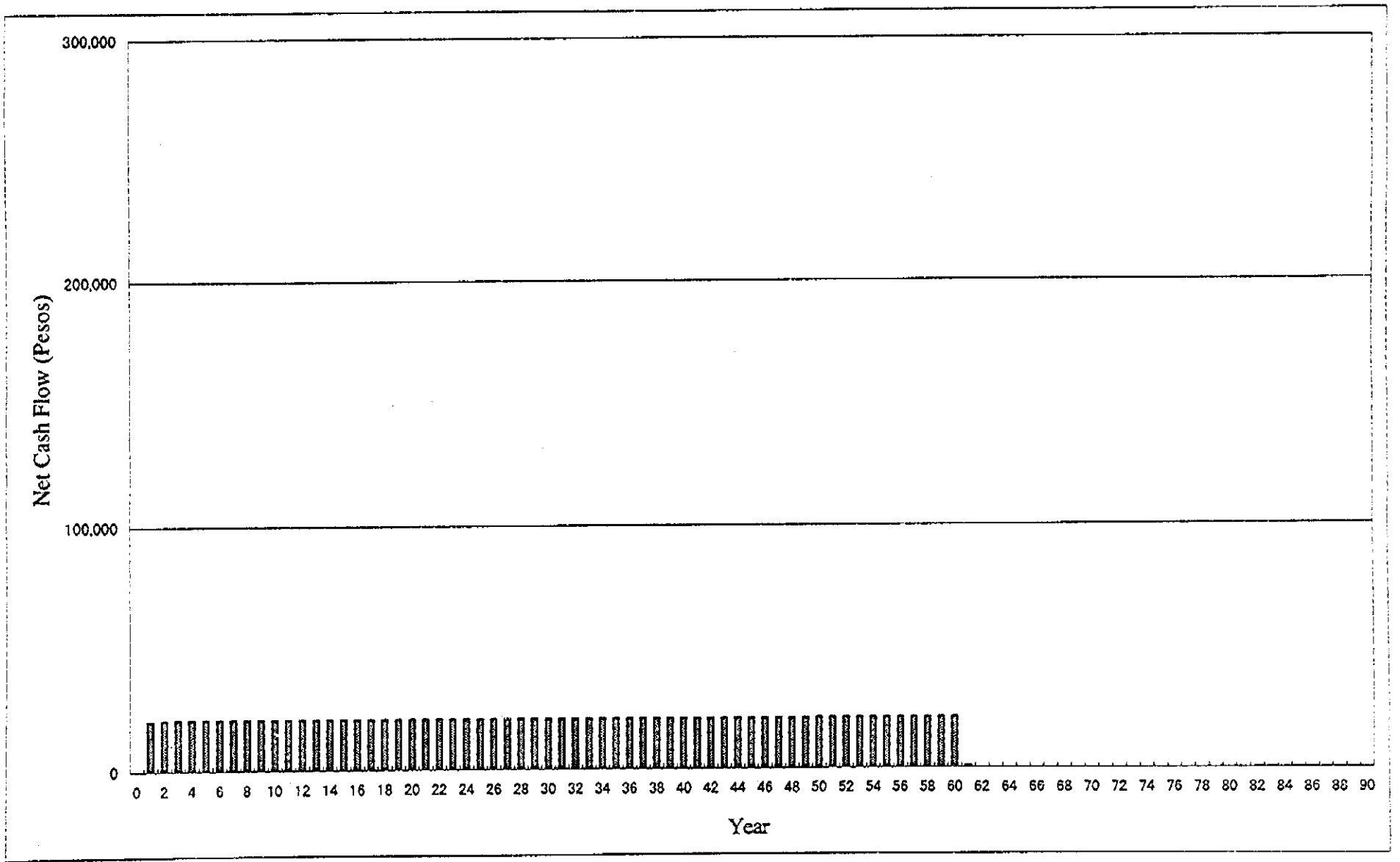


Fig. Te-8 Expected Net Cash Flow from Without Project Case at S.J. Teponaxtla (1997 price)

Table Te-33 Parameter Table

Comunidad: S.J. Teponaxtla
Table of Parameters

Net Present Value
With Case 753,672
Without Case 219,126
Incremental NPV 534,546

1.Domestic Inflation and Discount Rate
Expected Rate of Inflation 15% p.a.

Financial Discount Rate 26% (Nominal)
9.6% (Real)

2.Standing Tree Volume (for Sales of Standing Trees)
for Without Project Case

	(Standing Tree Volume)
Area for Forest Stand Improvement	321 m3/year
Area for Thinning	46 m3/year
Uncut Areas	417 m3/year
Total	784 m3/year

3.Price of Logs in case of Sales of Standing Trees
Without Case 27 pesos/m3

4.Sales Price of Logs
Timber Wood (Milrum) in Oaxaca 450 pesos/m3
Pulp Wood in Tuxtepec 290 pesos/m3

5.Sales Price of Processed Wood in Oaxaca
Milrum including Value Added Tax 3.4 pesos/PT
Milrum excluding Value Added Tax 3.0 pesos/PT

6.Area for Commercial Production Forest 1082 ha
Out of which:
A. Area for Regeneration Cutting in Uncut Areas 130 ha
Annual Area for Regeneration Cutting over 60 yrs 2.17 ha/year
①Annual Volume of Standing Trees for Regeneration Cutting 720 m3
Yield Ratio of Log Production 70%
to be used for Pulp Wood 30%
to be used for Timber Wood 70%
②Standing Tree Volume for First Thinning 20 m3/ha
Yield Ratio of Log Production 50%
③Standing Tree Volume for Second Thinning 70 m3/ha
Yield Ratio of Log Production 60%
to be used for Pulp Wood 50%
to be used for Timber Wood 50%
④Annual Area for Regeneration Cutting after Forest Stand Improvement
Standing Tree Volume 720 m3
Yield Ratio of Log Production 70%
to be used for Pulp Wood 30%
to be used for Timber Wood 70%

B. Area for Forest Stand Improvement
Area for Regeneration Cutting 96 ha
Annual Area for Regeneration Cutting over 25yrs 3.84 ha
①Annual Volume of Standing Trees for Regeneration Cutting 550 m3
Yield Ratio of Log Production 70%
to be used for Pulp Wood 30%
to be used for Timber Wood 70%
②Standing Tree Volume for First Thinning 20 m3/ha
Yield Ratio of Log Production 50%
③Standing Tree Volume for Second Thinning 70 m3/ha
Yield Ratio of Log Production 60%
to be used for Pulp Wood 50%
to be used for Timber Wood 50%
④Annual Area for Regeneration Cutting after Forest Stand Improvement 1.6 ha
Standing Tree Volume per Ha 380 m3/ha
Yield Ratio of Log Production 70%
to be used for Pulp Wood 30%
to be used for Timber Wood 70%
⑤Standing Tree Volume for First Thinning 20 m3/ha
Yield Ratio of Log Production 50%

C. Area for Thinning 109 ha
①Annual Area for Thinning over 10 yrs 10.9 ha/year
Annual Volume of Standing Trees for Thinning 1100 m3
Yield Ratio of Log Production
Equivalent to 2nd Thinning 60%
to be used for Pulp Wood 50%
to be used for Timber Wood 50%
②Regeneration Cutting
Standing Tree Volume per Ha 380 m3/ha
Yield Ratio of Log Production 70%
to be used for Pulp Wood 30%
to be used for Timber Wood 70%
③Standing Tree Volume for First Thinning 20 m3/ha
Yield Ratio of Log Production 50%
④Standing Tree Volume for Second Thinning 70 m3/ha
Yield Ratio of Log Production 60%
to be used for Pulp Wood 50%
to be used for Timber Wood 50%
⑤Regeneration Cutting
Standing Tree Volume per Ha 380 m3/ha
Yield Ratio of Log Production 70%
to be used for Pulp Wood 30%
to be used for Timber Wood 70%
⑥Standing Trees Volume for First Thinning 20 m3/ha
Yield Ratio of Log Production 50%

Final Cutting Age 60 year

7.Distance from Oaxaca 180 km

8.Tax
Value Added Tax 15%

9.Cost of Forest Stand Improvement, Regeneration and Tending, Log Production, Timber Processing

		Unit Cost (pesos/MD)	Quantity/Year (Man-Days)
(1)Forest Stand Improvement	Labor	30	28 Man-Days/ha
	Chainsaw Operator	150	12 Man-Days/ha
(2)Ground Clearance		30	3 Man-Days/ha
(3)Weeding		30	5 Man-Days/ha
Area for Weeding	50% of Areas for Regeneration Cutting		
(4)Cleaning Cutting		30	5 Man-Days/ha
Area for Cleaning Cutting	50% of Areas for Regeneration Cutting		
Cleaning Cutting in Cerro Jicara Mountain will be done from 1st to 3rd			44 Man-Days/year

(5)Yield Survey 10 Pesos/m3 in Standing Stem Volume of Trees

(6)Cost of Log Production 52 Pesos/m3 (including 20% direct cost)
(Cutting, Processing, Limbing & Bucking, and Yarding)
Work Volume at the time of Regeneration Cutting 5 m3/day/team
Work Volume at the time of Thinning 5 m3/day/team
Number of Teams for Log Production per Da 3 team/day

(7)Cost Increase in Log Production Cost at the time of Thinning over Regeneration Cutting 1.625 times
(Cost increase for Cutting, Processing, limbing and bucking, and Yarding)

(8)Transportation
Within the Comunidad 250 (pesos/12t truck/10m3)
To Oaxaca 2,200 (pesos/12t truck/3500PT/processed wood)
Loading Volume of Processed Wood 3,500 PT/12t truck
To Tuxtepec 2,200 (pesos/12t truck/10m3/pulp wood)
Loading Volume of Logs 10 m3/truck

(9)Construction Cost of New Forest Road 70,000 Pesos/km

	Unit Cost/Month	Quantity	Total Cost	
Rental Fee of Tractor de D-7	75,000	1	75,000	pesos/200hrs/1.5Km/month
Operator	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

Length of the road to be newly constructed 2.5 km

(10)Rehabilitation Cost of Forest Roads 2% of Construction Cost
Length of Forest Roads to be rehabilitated. 12 km/year

(11)Tools for Log Production	Unit Cost (Pesos)	Quantity/Year	Total Cost
Pickeroon	200	25	5,000
Hatchet	30	60	1,800
Rake	75	25	1,875
3 ton Truck	127,000	2	254,000
Grua	320,000	1	320,000
Grua (used)	120,000	1	120,000

(12)Timber Processing
Capacity of Timber Processing 30 M3/day
Yield Ratio of Timber Processing 40%
m3 per Board Foot 0.00236 m3/PT
Number of PT per m3 423.776 PT/m3

①Equipment and Machinery	Unit Cost (Pesos)	Quantity	Cost
Band Saw Equipment	140,000	1	140,000
Log Carriage	23,000	1	23,000
Conveyer Belt	32,000	1	32,000
Track for Log Carriage	16,000	1	16,000
Round Saw	35,000	1	35,000
Pendulum	18,000	1	18,000
Roller	29,000	1	29,000
Motor	76,000	1	76,000
Transmission	48,000	1	48,000
Installation Work	35,000	1	35,000
Building	40,000	1	40,000
VAT	76,800	1	76,800
Total Cost			568,800

②Operation and Maintenance Cost

	Unit Cost	Quantity	
Diesel	2.73 pesos/liter	5.4 liter/M3(in log volume)	
Oil	15.8 pesos/liter	18 liter/month	20 days/month
Sharpening Cost	480 pesos/piece	5 days	
Band Saw	2,875 pesos/piece(incl.vat)	500 m3 in log volume/band saw	
Personnel Costs	450 pesos/month		

(13)Forest Production Unit	Daily Wage
Coordinator	30 pesos/day
Treasurer	30 pesos/day
Site Supervisor	30 pesos/day
Total	90 pesos/day

Operating Cost of The Unit 50% of the total personnel expenses

(14)Working Capital
Account Receivables 2.1% of Annual Sales
Account Payables 0.4% of Annual Operating Expenses
Cash 4.2% of Annual Sales