REPORT

ON

PRELIMINARY SURVEY OF THE FORESTRY DEVELOPMENT COOPERATION IN THE REPUBLIC OF PERU

November 1979

JAPAN INTERNATIONAL COOPERATION AGENCY

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FOREWORD

More than half of the land in Peru is covered with forest, most of which remains undeveloped..
Consequently, there is a large potential in the development of the forestry and forest industry in Peru.

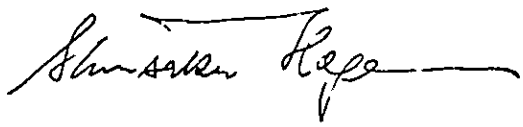
In light of the ever increasing world demand for tropical broad leaved trees, the Government of Peru, which intends to develop forest resources, has requested technical and economical assistance from the Japanese Government in conducting a preliminary survey on forestry development

In response to this request, the Japanese Government has decided to conduct the survey and has entrusted the Japan International Cooperation Agency (JICA) to carry out this survey.

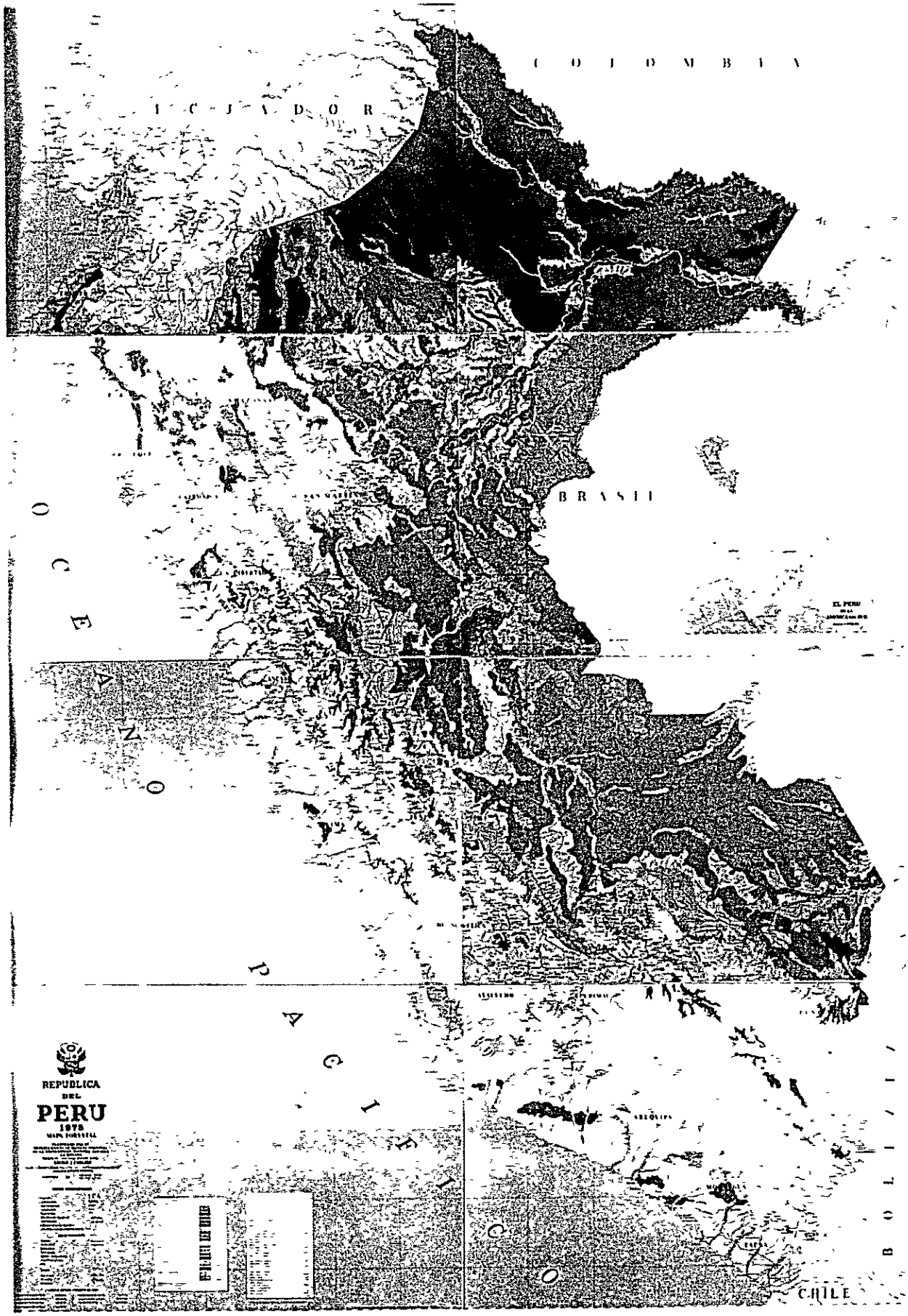
The JICA dispatched a preliminary survey team to Peru headed by Mr. Katsuhiro Kotari from March 4 to April 2, 1979.
The current report contains the results of the survey. I anticipate this report will prove to be useful in the development of the forest and lumber industry in Peru.

I wish to express may deep appreciation to the Peruvian Government and officials concerned for close cooperation extended to the team.

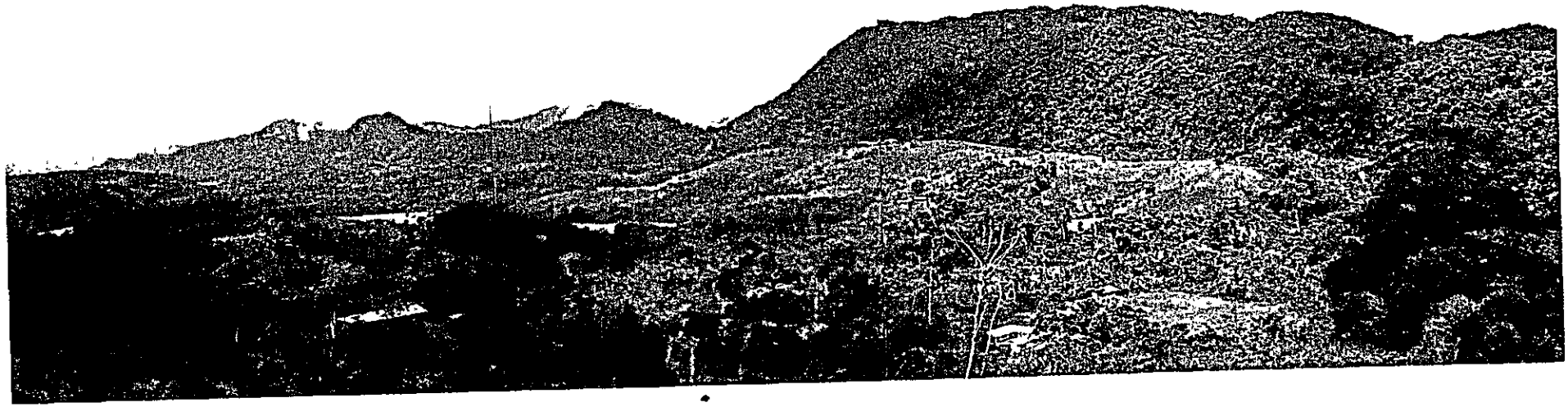
November , 1979



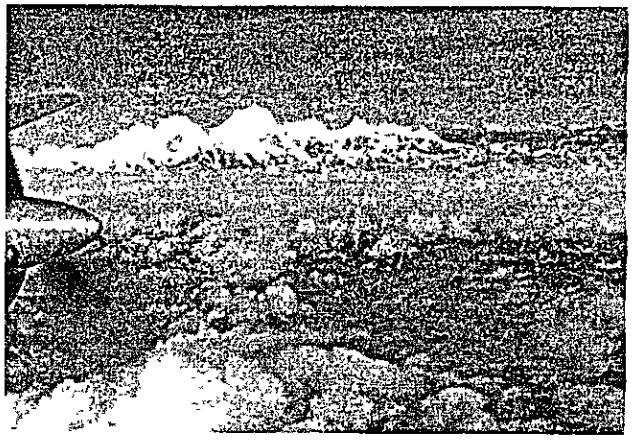
Shinsaku Hogen
President, Japan International
Cooperation Agency



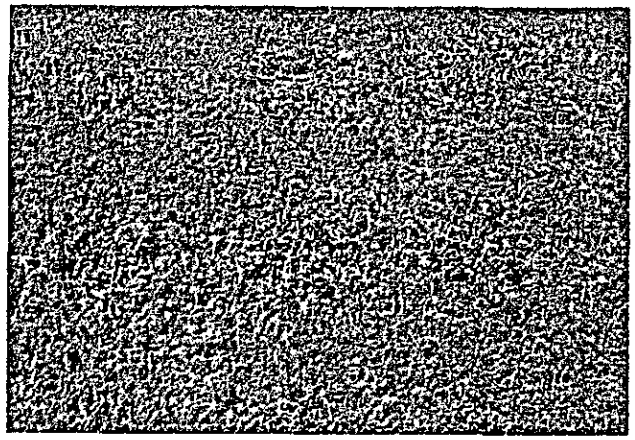
Stock map in Peru



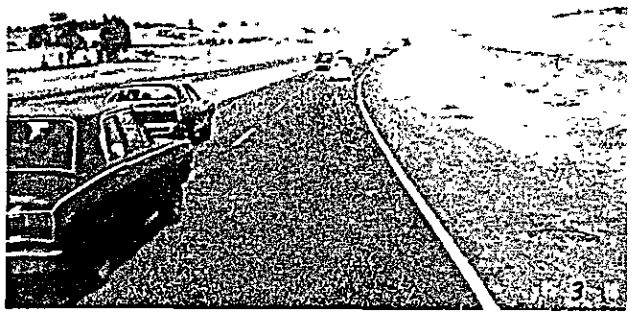
Tingo Maria District
Overall view of upper stream of Tulumayo River
Tingo Maria District



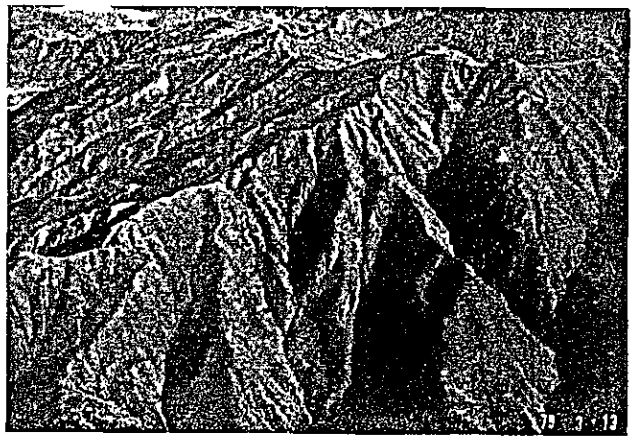
Distant view of Andes Mountains



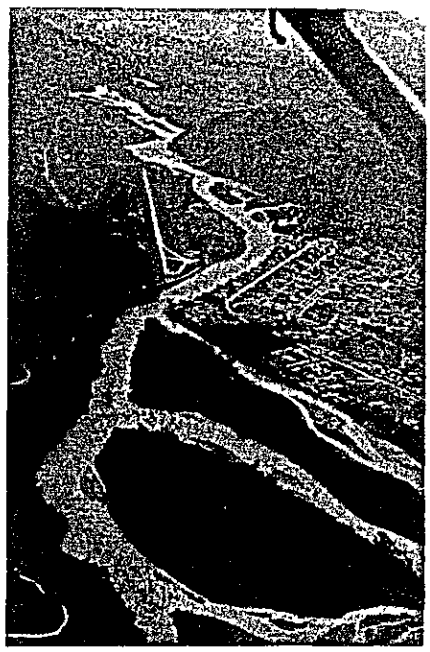
Great forest zone in Peru



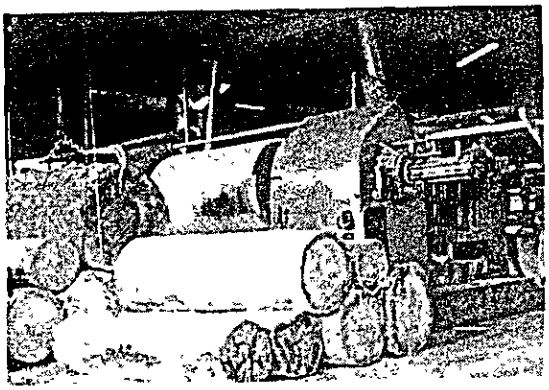
Desert zone in the Suburbs of Lima



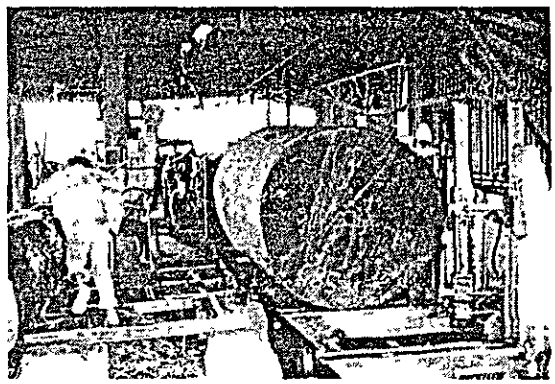
Death zone in Andes Mountain Syster



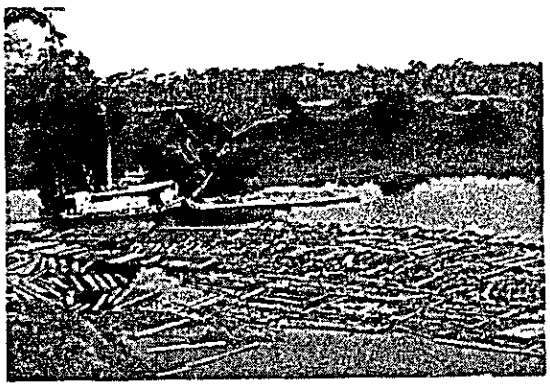
Upper stream of Amazon River
viewed from small airplane



Lumber mill in Pucallpa



Lumber mill in Pucallpa

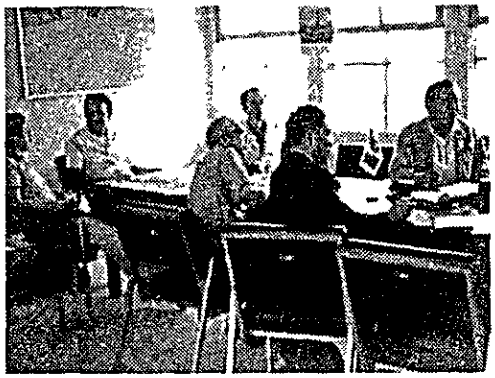


Natural stream used to move lumber to Pucallpa

Eucalyptus plantation in Cuzco

Experimental land for the Taungya system by Alexander von Humboldt as a joint project between the General Forestry Bureau and FAO

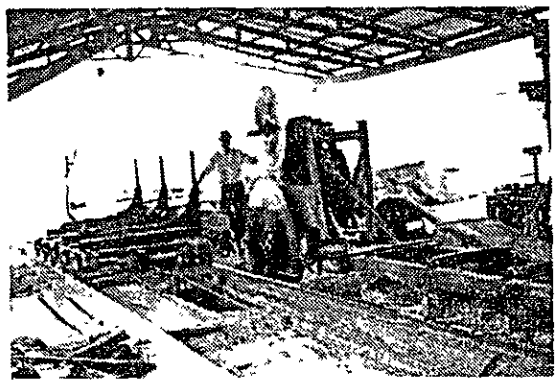
Nursery by Alexander von Humboldt



Prearrangements in the district office of the Forestry and Wild Animal Bureau in Tarapoto

Discussion with a university professor at Forestry Division in LA MORINA UNIVERSITY

Cultivation of coca in Tingo Maria



Lumber mill in TINGO Maria

Pucallpa Harbor

Lumber mill in Tingo Maria

CONTENTS

CHAPTER 1 OBJECT AND CONTENTS OF SURVEY

1.1 OBJECT

The current survey team was dispatched upon formal request of the Peruvian government to obtain first-hand knowledge of basic matters required to discuss the possibility of Japanese technical and economic cooperation related to the Peruvian forest development project.

To realize this object, field surveys and data collections were carried out, and their contents analyzed and discussed an outline of the Peruvian forest, as well as the natural economic, and social environment, forestry policy of the state, current forestry and lumber industry conditions, and so forth could be undertstood. We listened to the forest policy of the state and exchanged views with the Forest and Wild Animals Bureau and Ministry of Agriculture, representing the forestry policy executive body of the Peruvian government, regarding the promotion of the lumber industry utlizing forest resources. We were able to confirm what was expected of Japan by the Peruvian government for this cooperation and obtained the necessary background.

1.2 ORGANIZATION OF SURVEY TEAM AND ITINERARY

(1) Organization

Name	Assignment	Title
Katsuhiro Kotari	Leader	Special Assistant, Japan International Cooperation Agency
Isao Takahashi	Cooperation and planning	Assistant chief of the Business Section, Forestry Agency
Kenjiro Morita	Silviculture	Chief of the Planning Room, Planning Section, Forestry and Forest Products Research Institute Forestry Agency
Masayki Hori	Aerial Photography	Managing Director, Japan Forestry Technology Association
Yoji Kikata	Lumber processing	Nagoya University Assistant Professor
Hiroshi Muroi	Cultivation	Himeji Gakuin Women's Junior College Professor
Tosniharu Kai	Coordinater	Forestry Development Section, Forestry Development Cooperation Department, Japan International Cooperation Agency

(2) Survey itinerary

Itinerary number 1 (for the Leader of the team only; March 4 through March 16)

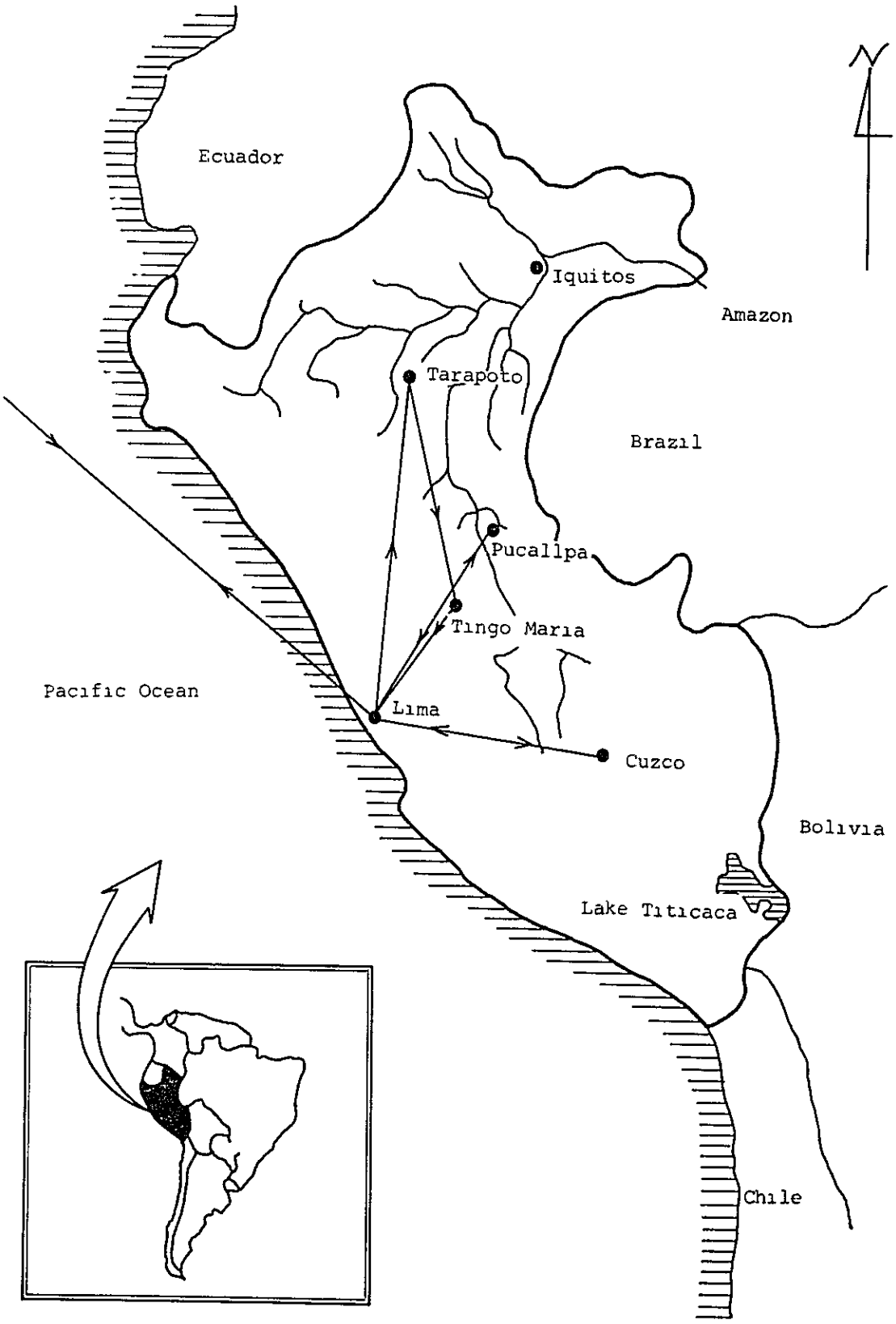
Number of days	Date	Weekday	Location	Contents of survey
1	March 4	Sun.	Tokyo - Lima	Departure
2	March 5	Mon.	Lima	Lima, Japanese Embassy,
3	March 6	Tue.	Lima	Making arrangements with the Deputy Chief of the JICA Office in Lima.
4	March 7	Wed.	Lima	Courtesy call on the Chief of the Forest and Wild Animals Bureau. Preliminary. Making arrangements with officers of the Turumayo Development Public Corporation
5	March 8	Thurs.	Lima	Discussion on the survey itinerary with the Forest and Wild Animals Bureau.
6	March 9	Fri.	Lima	} Data arrangement
7	March 10	Sat.		
8	March 11	Sun.	Lima	Making arrangements with all members of the team after their arrival
9	March 12	Mon.	Lima	Making arrangements with the Japanese embassy staff in charge of technical cooperation
10	March 13	Tue.	Lima	Final arrangements with the Ambassador of Japan.
11	March 14	Wed.	Lima	Data arrangement
12	March 15	Thurs.	Lima Mexico City	Returning home
13	March 16	Fri.	Mexico City-Tokyo	

(3) Itinearary Number 2 (for members arriving later, March 10 through April 2)

Number of days	Date	Weekday	Location	Contents of Survey
1	March 10	Sat.	Tokyo → Los Angeles	Departure
2	March 11	Sun.	Los Angeles → Lima	Making arrangements with the leader of the survey team
3	March 12	Mon.	Lima	Courtesy call on the Japanese Embassy to make arrangements on the survey schedule. Making arrangements with the Forest and Wild Animals Bureau on survey activities
4	March 13	Tue.	Lima → Tarapoto → Tingo Maria	Arrangements with the Chief of the District Agricultural Office in Tarapoto
5	March 14	Wed.	Tingo Maria	Survey of forest conditions and forestry industry around Tingo Maria
6	March 15	Thurs.	"	Survey of forest conditions, shifting cultivation, and so forth near Tingo Maria, and aerial Survey of forest
7	March 16	Fri.	"	Forest survey at the experimental Selva Agricultural College plantation in Tingo Maria
8	March 17	Sat.	Tingo Maria → Lima	
9	March 18	Sun.	Lima → Pucallupa	
10	March 19	Mon.	Pucallupa	Visits to a plywood plant and a lumber mill in Pucallpa
11	March 20	Tue.	"	Tour of experimental agro-forest in von Humboldt national forest in Pucallpa

Number of days	Date	Weekday	Location	Contents of survey
12	March 21	Wed.	Pucallpa	Tour of a forest near Pucallpa
13	March 22	Thurs.	Pucallpa→Lima	Tour of a forest near Pucallpa Harbor
14	March 23	Fri.	Lima→Cuzco	Tour of a planted forest near Cuzco
15	March 24	Sat.	Cuzco	Tour of a planted forest near Cuzco
16	March 25	Sun.	"	
17	March 26	Mon.	Cuzco→Lima	
18	March 27	Tue.	Lima	Intermediate report preparation and data arrangement
19	March 28	Wed.	"	Notice of returning home to the Japanese Embassy and meeting with La Morina University staff
20	March 29	Thurs.	"	Notice of returning home to the Forest and Wild Animals Bureau
21	March 30	Fri.	"	Meeting with the counterparts in the Forest and Wild Animal Bureau and final data arrangement
22	March 31	Sat.	Lima→Mexico City	Returning home
23	April 1	Sun.	Mexico City	
24	April 2	Mon.	Mexico City→Tokyo	

1.3 MAP OF THE SURVEY TEAM TRIP



1.4 INTERMEDIATE REPORT

Intermediate Report on the Preliminary Survey for Forestry Development

It is with great pleasure to be able to submit this intermediate report after the completion of a 21-day investigation from March 11 to March 31, 1979 by the Peruvian Forestry Development Basic Primary Investigating Mission dispatched by the Japan International Cooperation Agency.

The object of the visiting mission was to gain an understanding on the present forest, forestry, and lumber industry conditions in Peru, to exchange views with the Peruvian authorities on the development and promotion of these industries, and to investigate and discuss the possibility of Japanese technical and economical cooperation through private sector.

1. What is expected by Peru for the investigating mission

The investigation mission exchanged poinions with authorities in the Forest and Wild Animal Bureau on March 12 and understood what is expected by Peru of Japan and the background is as follows:

(1) In spite of abundant forest resources in Peru, the development of forestry and the lumber in dustry is not adequate to be of a sufficient contribution to the national economy. In order to improve the present situation, measures must be taken to develop the domestic demand for lumber in Peru and to export lumber onto the world market.

For this purpose, it is necessary: 1) to be completely familiar with the demand and supply, price, the present situation of lumber trade in the wordl; 2) to improve the system of lumber production.

(2) In the Peru region near the Amazon, land productivity is being lost due to unplanned felling and migrating slash-and-burn agriculture, and in some part, to erosion.

In order to solve the problem, it is important: 1) to develop technology for planting the land after migrating slash-and-burn farming; 2) to develop a system of management whereby forestry is run along with agriculture and livestock farming using land resources collectively; 3) to improve the quality of the forestry and lumber industry to increase the chances of employment and to improve and stabilize the living conditions of the people in the region, and so forth.

2. Carrying out the field survey

The investigating mission carried out field surveys as follows to become acquainted with actual conditions:

March 13: Toured the forest near Tarapoto

14: Surveyed the forest conditions and forestry business around Tingo Maria

15: Surveyed the forest conditions, migrating slash-and-burn farming, also forth around Tingo Maria, and on air survey of the forest

16: Toured the Selva University of Agriculture forest in Tingo Maria

19: Toured the plywood plant and lumber mill in Pucallpa

20: Toured the experimented agroforest in von Humboldt National Forest in Pucallpa

21: Toured the forest around Pucallpa extension

22: Toured the Pucallpa area and actual condition of the plantation

23: Toured the eucalyptus plantation near Cuzco

24: The same as March 23

3. Results of the field investigation are itemized as follows.

(1) Land utilization

Migrating slash-and-burn farming is used extensively around Tingo Maria where coca is mostly planted, and the arable land is wasted, and erosion is evident in some parts. In some areas, a secondary forest has been regenerated, but is mostly of cecrapea spp. (low value) and this poses a problem from the point of view of effective land utilization and watershed control.

The migrating slash-and-burn farming area in the region is about 20,000 ha, from which an estimated 6,000 ha is being wasted. The wasted land area will continue to increase if the present condition is left unchanged.

(2) Forestry

① Forests are controlled by dividing them into protection forests and felling-permitted forests. Their efforts to keep the balance between forest conservation and lumber production impressed us.

② It is recommended that a felling plan based on a forest survey be established and the region for felling be specified according to that plan.

③ For every 1 m^2 of forest felled two young trees must be planted, but technical plantation, items and so forth are not clear and any further lumber output is difficult under the present situation.

④ Development of a multiple managing system for forestry, livestock farming, and agriculture was considered necessary in order to stabilized and improve living conditions of the people in the watershed. The results of

model experimenal agroforest and so forth, in the National Humboldt Forest in Pucallpa in cooperation with FAO is being waited for with much expectation.

⑤ Mecnanization forest work must be implemented. Chain saws, tractors, etc. have been introduced in some parts, but there are not enough. Lumber felled commercially is of a large diameter, and also there is a limit to man-power. By man-power operations it is difficult ot convert wood to gain the most profit and a prolonged period of production loss in fresh wood is feared.
In the future mecnanization of felling and transportation by introduing chain saws, tractors, prehauling machines and loading machines, etc., is necessary.

⑥ Forest roads are indispensable for efficient forestry operating, but the roads do not exist at present, the logs are transported by river. In the future transportation by river must continues to be used, but the building of forest roads to meet the planned felling is important. These roads could also be used by the inhabitants of the region.

⑦ Apart from building forest roads, the principal roads of the state must also be built. The roads connecting the producing and consuming (including export) centers are the major hindrance for smooth transportation of lumber in Peru.

(3) Lumber Industry

① Three small scale lumber mills near Tingo Maria, a large scale lumber mill a utility pole plant, and a plywood plant (a large scale integrated plant producing ordinary playwood, and printed playwood) near Pucallpa were inspected, and no major technical problems were found. However, it is thought necessary to improve the following:

(i) the saw sharpening technic and wood conversion technic in the lumber mills, and (ii) the technique for intensive utilization of raw lumber in the plywood plant.

② There more than 20 kinds of trees used as raw material and they seem to be used for the proper purposes.
As for the technique for treating long wood, that is expected as a result building forest roads and mechanization of forest operations, and utilization of unutilized species of trees, more study by public organizations is hoped for, without depending only on the effort to private enterprises.

③ Attention should be paid to the following items to promote the export of wood products.

a. Wood conversion for ornamental products on the fashion in the importing countries, and this is why the countries want to import logs. Therefore, even if export of logs cannot be permitted, positive consideration should be given for exporting flitches.

b. Sufficient establishment of production organization for lumber and wood products in Peru and the infra-structure such as transportation facilities and harbor and cargo works are the basis of export promotion.

(4) Cultivation of bamboo

Bamboo is cultivated in the districts of Tingo Maria, Pucallpa, etc,; but this kind of bamboo (Arthrostylidum sp., Bambusa sp., Dendrocalamus sp.) is heavy and too coarse to be used for building, and the sprout is not suitable for eating. On the other hand the Japanese bamboo (Phyllostachys aurea form takemurai) is light, excellent as building material, and is suitable for eating. It also extends long subterranean roots which are excellent for protecting

against erosion of river banks. For the cultivation of bamboo, transplanting the Japanese type is recommended because technically and climatically it will be easy.

4. Direction of Cooperation by Japan

(1) Cooperation through civil enterprises

① A Japanese enterprise has already started exporting lumber purchased near Tarapoto to Japan. Development has been carried out in the district recently, and good lumber was accumulated in considerable amounts. The opening of a new road to the north of the lumber site made it possible to transport the lumber by land, and this is the reason why the Japanese company is interested in forest development, oil manufacture, and export, etc.
If, as a result of the survey it could be agreed upon to develop the forest resources, and if the Japanese enterprise requests it, the Japanese Government will discuss investing and/or financing, by a public organization, and cooperation related to equipment and enterprises by JICA.

② Anotner Japanese enteprise would like to cultivate Japanese bamboo grass near Tingo Maria as a raw material for medicine. The technical opinion of the survey mission is as follows:

a. Cultivation of bamboo grass on land, where there is forest at present, would not be impossible but would be economically difficult because of competition with other plants.

b. Cultivation on the waste land after migrating slash-and-burn farming seems possible, for the land has little nourishment and the competition with other plants would be less. The climate and soil conditions are favorable for the cultivation of bamboo grass.

The Japanese enterprise will decide on whether they will

undertake cultivation of bamboo grass after considering the problems of land use, etc., based on the technical report by the survey mission. The Japanese enterprise may proceed with experimental cultivation on a small scale, and make plans for future large sacle cultivation. The Japanese Government would discuss financial cooperation through the JICA if the Japanese enterprise requests it.

(2) Cooperation on a Government Basis

① Upon their return the survey mission will make a report to the Japanese Government based on the opinions exchanged between the Forest and Wild Animal Bureau of Peru and the results of the survey. The Japanese Government will discuss the direction of their cooperation in the future, to realize the development and maintenance of forests, promotion of the forestry and lumber industry, stability and improvement of life for the inhabitants of the watersned, etc., and with enphasis on the following:

a. Development of a technic for the revival of waste land after migrating slash-and-burn farming.

b. Development a technic for turning a secondary forest of low value into a forest of high value.

c. Establishing a pertinent operating method of felling for the future (including the establishment of a composite managing system, and the introduction of agriculture and stock-farming and mechanization of forest operations).

d. An aerial servy for forest mapping

e. Improving woodworking technics

② In the future Peruvian Engineers should be trained in Japan and Japanese specialists should be sent to Peru, so that cooperation will be concrete and steady.

Lastly we must deeply thank the persons concerned of the Forest and Wild Animal Bureau for their earnest cooperation and for providing us with much valuable data.

We will try our best to make prompt cooperation by making a report to the concerned organizations of the Japanese Government on our return, and will further analyze the data collected and prepare the final survey report.

We deeply wish that the present investigation will be useful for the promotion of friendly relations between Peru and Japan.

CHAPTER 2 FORESTRY CONDITIONS IN PERU

2.1 TYPE OF FOREST AND KIND OF CONSTITUENT TREES

(1) Type of Forest and Kind of Consituent Trees in South America

The type of forest in South America can be classified into tropical rain forest, moist deciduous forest, dry deciduous forest, savannan, moist broadleaved forest, coniferous forest, and others.

In a tropical rain forest there are several hundred different kinds of trees, but the commercialy important ones are Swietenia sp., Hura sp., Tabebuia sp., Hevea sp., Cybistax sp., Bertholettia sp., and Cedrela sp.

In a moist deciduous forest there are not so many different kinds as in a rain forest. The useful kinds are Cedrela sp., Liquidambar sp., Quercus sp., Tebebuia sp., Chlorophora sp., Ochroma sp., and Piptadenia sp., and they often grow alongside coniferous trees such as Pinus, Cedar, and Podocarpus sp.

The most important kinds in a dry deciduous forest and savannan are Piptadenia sp., Tabebuia sp., Aspidosperma sp., Schinopsis sp., Prosopis sp., etc., and they often grow alongside plants of the cactaceae family.

In the moist broadleaved forest, Nothofagus sp., Lomatia sp., Laurelia sp., Eucryphia sp., drymis sp., etc. grow well alongside Podocarpus sp., and are considered commercially valuable.

In a coniferous forest, Pinus sp. and Abies sp. in Mexico, Pinus sp. in Cuba and Honduras, Araucaria angustifolia in Brazil and Argentina, Araucaria sp. and Podocarpus sp. in Chile and Argentian, and podocarpus sp. in Peru are the principla trees.

Other types of trees such as Orbignya martiana for palm oil,

Corpernicia cerifera for wax. Bambusa sp., Rhizophora sp. etc. can also be listed.

(2) Type of Forest and Constituent trees in Peru

The forest in the watershed of the Amazon extends over an area of about 40 million ha, and is the richest forest in Peru in variety and the rumleet of trees.
80% of lumber production consists of only a few species, eg. Cedrela sp. (40%), Swietenia sp. (13%), and Podocarpus sp. (11%), but the number of species beking used has been increasing recently due to the development in wood utilization and working tecnnic.

Table 1 shows the area of natural forest, artificial forest and suitable land for revival in Peru by division into coastal zone, mountain zone and forest zone.

Table 1 Forest area in Peru in 1976

Zone division	Natural forest	Artificial forest	Suitable land for revival	Total
Coastal zone	950,000	6,683	493,317	1,450,000
Mountain zone	50,000	97,672	7'402,328	7'550,000
Forest zone	73'000,000	1,785	2'498,215	75'500,000
Total	74'000,000	106,140	10'939,860	84'500,000

(1) 60% production zone and 40% protection zone (2 and 3) productive forest.

According to the data, the total area of forest in Peru is 84.5 million ha. 98.7% is natural forest that is divided into productive forest (60%) and protected forest (40%).

The artificial forest lines mostly in the mountainaus zone where 92% of the forest is found. This means that most of the plantations in Peru are in the mountainaus zone.

The amount of land most suitable for revival out of 10,393,860 ha. lies in the mountain zone 71%, forest zone 24%, and coastal zone, 5%, respectively.

The coastal zone is mostly desert, but 34.5% of it is artificial forest and land suitable for revival.

The amount of land for artificial forest and revival is the highest in the mountainous zone, 99% of the area being considered suitable for revival.

In the forest zone, only 3% of the area is considered suitable for revival or artificial forest.

The reson why a large area in the mountainous zone is considered suitable for revival is that eucalyptus plantations were laid-out in the past and were successful to an extent, and that planting on felled land and the forming of protected forests in canyons were planned positively.

The reason for the small ratio of land for revival in the forest zone may not be because of an actual shortage in suitable land, but because of a lack of technology for reviving the waste land after migration farming.

(3) Types of Forest

The types of forest are divided as follows: Production forest

I. Production forest, mixed forest

1	Alluvial foresc (low-land forest)	Class 1
2	"	Class 2
3	"	Class 3
4	Hill forest (high-land forest)	Class 1
5	"	Class 2
6	"	Class 3

II. Production forest, simple forest

7 Mangrove forest

8 Thick forest on dry land

9 Shrubbery on dry land (savannah)

10 Oak forest

11 Polylepsis sp. forest

12 Podocarpus sp. forest

13 Palm forest

III. Artificial forest

B. Suitable land for forestry

14 Shrubbery

15 Suitable land for plantation

16 Plantation district

C. Protected forest

17, 18 Protected Forest District Class 1, Class 2

D. Non-forestry region

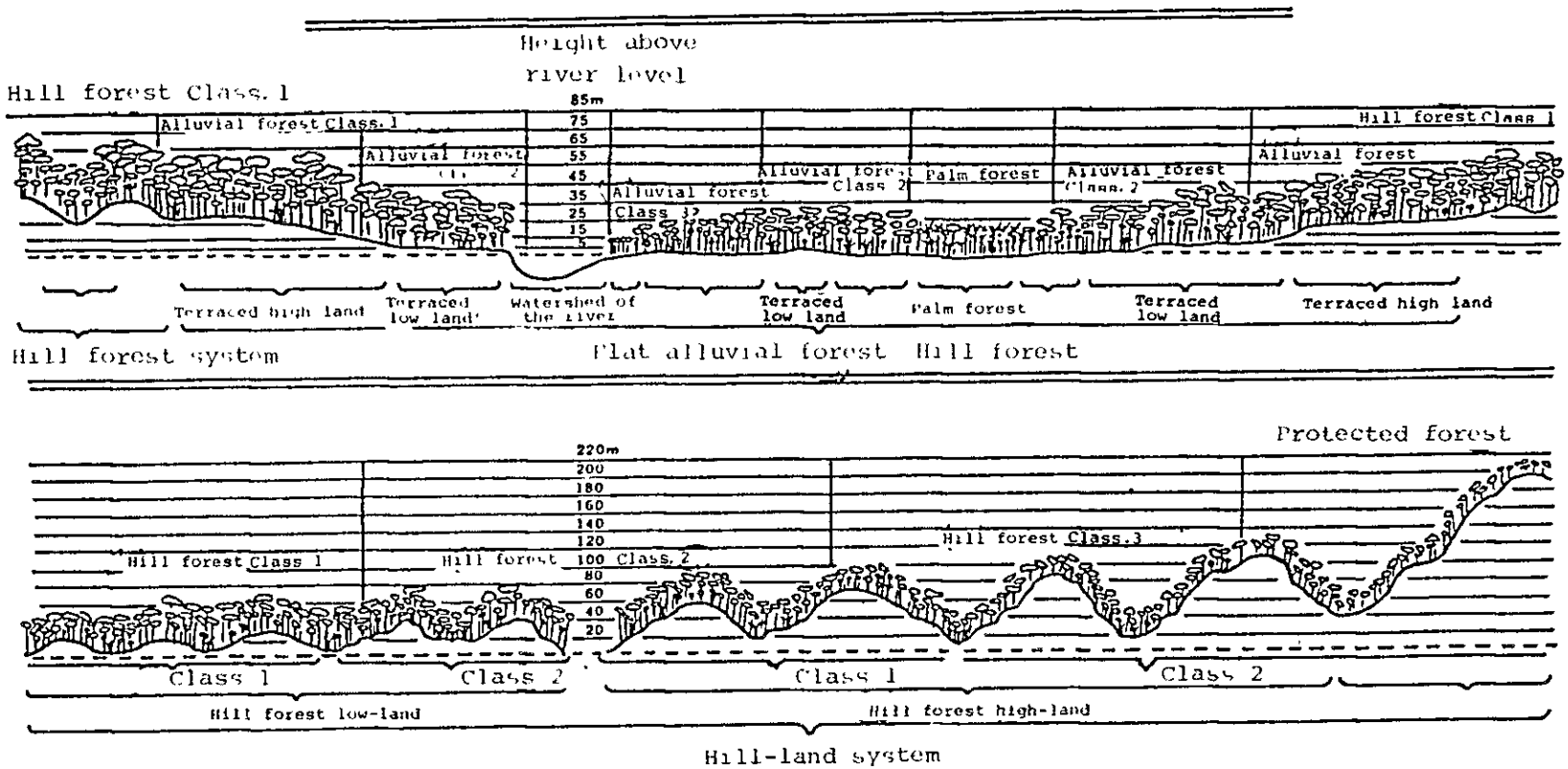
19 Desert or non-productive area

20 Pastureland area

21 Agricultural area

The division of areas can be shown diagramatically as in Fig. 1.

Fig. 1 Division of forest zones in Peru



A. Productive Forest

A productive forest means a forest that can give a profit by economical utilization. At present, most of the forest is not utilized effectively, being only partially developed. Most of the lumber produced is utilized as raw material, and the profit earned is extremely small.

The productive forest is divided as follows:

Productive forest, mixed forest

This means trees of various types are mixed at the certain ratio in the stand, and the variety of trees is large.

The various kinds of trees constituting the Peruvian forest is estimated at about 2,500, but those actually confirmed and classified are 685 or about 25% of the total, and they are distributed according to the environmental factors of each district.

263 species have been surveyed and recorded in Huallago Central, while 174 species by Tenero Herrera for Bajo ucayali (low-land or Ucayali) and 97 in the survey by Nueva Italia.

Most of the mixed forest grows in the zones of moist tropical forest, subtropical forest, and tropical dry forest on the eastern slopes of the Andes.

Owing to the variety of trees constituting a stand in the mixed forest, utilization of the lumber from the forest is extremely difficult.

In this type of forest, integral utilization by various lumber industries should be considered. It is feaned the high coast required to utilize the lumber may weaken the competitive power of the lumber industry.

The mixed forest in a production forest is further divided as follows:

1. Alluvial forest (low land forest) Class 1

This type of forest extends onto alluvial land with good water drainage and abundant kind of trees and stand type.

The main districts for this type of forest is Yurimaguas and Proyecto del Huallago Central, where the commercially useful stands reach 150 m^3/ha with a chest height diameter of more than 25 cm, a crown height of 35-40 m, and 98 trees per ha. The chest height diameter of yieling trees is estimated at 25-30 cm giving 150-190 m^3 per ha, and the average volume per tree is 1.7 m^3.

The principal kinds of trees are as follows:

Cumala	7 trees/ha
Machimengo	5
Quina Quina	4
Shimbillo	4
Chimicua	4
Uchumullaca	3

In Nueve Italia District, there is 158 m^3/na for a stand crown height of 35 m, and the kinds of trees per ha are as follows:

Cumala	6 trees/ha
Cumala colorada	3
Copal	6
Cumala blanca	5
Machimango	6
Moena	9
Caimitillo	4
Chimicua	4
Quina Quina blanca	3
Shimbillo	6
Uvilla	5

2. Alluvial Forest (low land forest) Class 2

This type of forest is found mostly in the Tingo Maria District. It grows on terraces in alluvial low-land where heavy rainfall and flooding prevail and water drainage is comparatively poor.

The growth of trees is moderate, and about 100 m^3/ha for a crown height of 30m, and chest diameter more than 25 cm is expected.

In Tingo Maria District, 121 m^3/ha is expected for a commercial stand with a chest height diameter of 25 cm and over with 95 trees per ha.

The principal kinds of trees are as follows:

Moena	5 trees/ha
Capirona	7
Machinga	10
Yacushapana	9
Zapote	14
Huimba	10

A stand in the forest in Pucallpa District shows accumulation of 102.5 m^3/ha in alluvial forest No. 2, with number of trees 80/ha.

The principal kinds of appearance are as follows:

Moena	7 trees/ha
Cumala	4
Chimicua	5
Ovilla	4
Ucshaguiro	4
Tushmo	4
Uchumullaca	3

Caraira	3 trees/ha
Espintana	3
Shimbillo	2
Copal	2
Machimango	2

This type of forest is developed more extensively than alluvial forest Class 1, and uncontrolled felling as in the case of migrating slash-and-burn faming shall be strictly forbidden in this kind of forest as well as in alluvial forest Class 1.

3. Alluvial forest (low land) Class 3

This type of forest develops on alluvial soil where it is inundated every season with hollows, shallow streams, and small swamps and marshland conditions.
Therefore, the construction of forest is apt to be many kinds of stands with complicated phases, having great difference in a accumulation of high and low places. The accumulation of commercially useful stand is said to be 70 m^3/ha.

Accumulation in Madere de Dios in the watershed of River Alto is about 55 m^3/ha, while in Inambari about 78.5 m^3/ha.

Principal kinds of appearance are as follows:

Camala	3 trees/ha
Suimbillo	6
Uvilla	3
Oje	1
Caranuasca	4
Mashonaste	2
2 apote	2
Cauchomasha	3

4. Hill-land forest (high-land forest) Class 1

This type of forest is located on comparatively high land. It develops on a 5-20 degree slope and is 20-30m in height from the water level with undulation. Groups of trees are favorably formed, depending on the climatic but on alluvial soil in certain areas the stand is not rich in useful kinds of trees.

The number of trees per ha in a forest of this class in Tingo Maria and Montenegro is about 38 for those with a chest height diameter of 40 cm, or larger with the commercial kind, and there is about 143 m^3/ha.

The principal kinds of trees are as follows:

Tornillo	2 trees/ha
Moena	3
Quinilla	4
Cumala	1
Masnonaste	1
Poshaco	1

5. Hill-land forest (high-land forest) Class 2

The kinds of trees in this type of forest are similar to that of the hill-land forest Class 1, but the topographical range is small. The height of the land is 45-100 m, 80 m average, and the slopes are rather steep at 18-45 degrees. The number of commercial kinds is estimated at about 120 m^3/ha.

6. Hill-land forest (high-land forest) Class 3

This type of forest is located between the productive forest and the protected forest and is generally called hill-land forest in high (Colina Alta). The number of commercial kinds is about 80 m^3/ha.

The height of the land is 60-150 m with slopes of 36-60 degrees.

Due to such topography, the cost of utilization is high and transportation is not developed.

The area of hill-land forest Class 3 is located in the moist subtropical forest and mountain forest low-land, and in some area where people live, the forest is ruined and the land is partly eroded. Controlling migrating farming and nomads in these areas seems to be essential.

In this type of forest on Inabambari ground in Madre de Dios, the principal kinds are 82/ha and the number is estimated at 95 m^3/ha.

The principal kinds are as follows:

Tornillo	10.4	m^3/ha
Shiringa	5.9	"
Apacarama	6.4	"
Cumauba	4.2	"
Anonilla	5.5	"
Ghihuahuaco	4.3	"
Pashaco	3.0	"
Atadijo	2.9	"
Copal	2.9	"
Shimbillo	2.9	"
Oje	5.1	"
Moena	2.1	"

II. Production forest, simple forest

The forest in this category consists of a single or caparatively small number of kinds of trees. A simple forest of this easier to utilize, as compared with the compound storied forest, and shows higher profitability.

The distribution of the forest extends from the tropical coniferous forest through the semi-high mountain rain forest to high-land tundra.

7. Mangrove forest

Mangrove (Manglar) forest appears mainly in the Tumbes District and the Litoral District on the North coast. It is distributed in the swamps where the sea water and river water are mixed, and the area of distribution is small. It is a protected area and is used for sight-seeing, and it also provides a good place for wild animals, especially lizards, to live.

However, the forest is being destroyed by felling for fuel; and the wild animals are also on the brink of extinction.

The constituent kinds of trees in a mangrove forest are as follows:

Crown stand	Rhizopnora mangle
Medium and lower stand	Lagurcularia racemosa
	Avicenia tomentora
	Conoearpus erectus

8. Dry-land thick forest

Most of this kinds of forest is in the districts of Piura and Tumbes, adjacent to the Ecuador border.
The land is hilly and steep, so that access is difficult as compared with the savannan type forest.

however, development is proceeding even with this type of forest, and protection is required.

The lumber from this type of forest is valuable as a material of handicrafts and woodworks, and it provides the people with an important source of income.

The kinds of trees constituting this type of forest in El Caucbo in Tumbes District has about 39 m^3/ha with the number of trees being 110/ha to 160/ha, all larger than 15 cm chest height diameter.

The following is the kind of trees according to use:

(1) Furniture, handicraft

Amarillo, Palo de Vaca, Sanchez, Colorado, Hualtaco, Almendro, Guayacan

(2) Structural material

Guayacan, Colorado, Huapal, Huarapo, Berbasco, Zapote, Huasino, Caguito, Tochuelillo

(3) Civil engineering

Pasallo, Ajo, Angoto, Palo de sangre, Tego, Pergo

(4) Unused material and raw material

9. Dry-land shrubbery (savannar forest)

This type of forest extends along the northern coast. Ecologically, it belongs to the tropical and subtropical coniferous forest zone.

This type of forest seems to have resulted from excessive grazing and uplanned development that cause the degeneration of a useful forest. Due to little rainfall, protection and revival of the forest seems to be difficult. Forbidding grazing is one possible measure, but the use of timber for fuel by the innabitants cannot be controlled at present.

Among the kind of trees intruding into and multiplying in this type of forest and the dispersed forest, Cerbo (Bambacaceae) is found. There is enough of this kind to be utilized as material for pulp or paper manufacture.

Algarrobo (prosopis pasiblora) is another kind and is ued as livestock feed and fuel. Sapote (Copparis angulete) is another typical kind.

Among shrubs growing on coastal low plain and hill-land adjacent to the mountain foothills, the following kinds are found:

Perlillo (Vallesis dichotorua)
Huarangs (Acacia macracantha)

Paloverde (Cercidium proecox)

In Tumbes and Piura Districts in the north, the following kinds of arbores are found.

Hualtaco (Loxopterigium huascayo)
Palo Santo (Bursera graucolers)
Huasimo (Guazuma ulacifolia)

10. Oask forest (Chaparral)

This type of forest constitute shrubs in tropical and subtropical dry-land similar to the tropical coniferous forest in the tropical desert. The morphological features of the trees constituting the forest are a transverse extension of the crown and crooked weaving trunks with thorns on the branches.

It is distributed mainly in La Libertad, Lambayegue, and Piura Districts on low-land and coastal regions.

The principal kinds of trees are as follows:

Capparis spp
Prosopis juliflora (algarrobo)

In addition to these, Acacia, Schinus (Salix sp.), Caesal pinea, and Tessaria are also found. In the coastal forest in marshy land, groups of Algarroboles (Prosopis juliflora) are found.

Among the kinds of cacti, Cereus sp. is scattered and is known as (parque xerofitico).

On the forest floor, true grasses or winders are rampant.

11. Quinual

This type of forest lies mostly in the Andes and grows on the humid subalpine wasteland, and on the tundra slopes in the subalpine rainy district, and at the foot of the mountains. Resagos is another plant, and grows in an isolated region where transportation is difficult. Recently, however, its use as a fuel has been

increasing in the district, and its utilization as an ornamental tree and as material for artifacts and furniture is being developed.

The lumber in Resagos is very hard, and has a very colourful grain.

Ir grows on gravel at a height of 3,400-4,500 m above sea level, forming a steep slope from the top of the mountains.
Measurement is difficult owing to the crooked trunks, but it is estimated at 200-500 trees/ha in the range of 5-7.5 cm chest height diameter.

12. Podocarpus forest

Podocarpus forest is a special forest growing in a small area of humid hilly low-land, and between humid subtropical forests in Cajamarca District in northern Peru. It is distributed in hill land Class 2 and hill land Class 3.

Poducarpus is the only coniferous tree distributed naturally in Peru and is known as Diablo in Ulcumatu and Oxapampa Districts. It has already disappeared in Oxapampa owing to uncontrolled felling.

It is called Romevillo in Cajamarca District, but it may also disappear here within 10 years unless it is protected.

Podacarpus can be used as structural material, raw material for pulp and paper, and special lumber, as a substitute for Pino oregon and Pino insigne.

For a continuing supply of Podocarpus, protetion is necessary, along with proper growing and felling technics.

The amount Podscarpus in Chirinos zone in Montenegro is estimated at 71 m^3/ha.

Table 2 Area of artificial forest by district and year of planting

DEPARTAMENTO	1964 TOTAL	1965 TOTAL	1966 TOTAL	1967 TOTAL	1968 TOTAL	1969 TOTAL	1970 TOTAL	1971 TOTAL	1972 TOTAL	1973 TOTAL	TOTAL GENERAL
Tumbes	100	200	200	250	300	500	1000	8500	8880	6840	26770
Piura	–	–	500	800	1000	1000	1000	9550	9720	10930	34500
Lambayeque	400	500	700	1000	1000	800	600	14100	10100	–	29200
Cajamarce	–	–	2700	18440	16500	12250	21050	46440	47160	67000	231540
Amazonas	–	–	–	–	–	–	–	41000	133600	41100	215700
La Libertad	500	1000	1500	1500	1700	1600	6760	12050	29660	32650	88920
Ancash	600	54100	17300	70550	63460	38620	27610	27180	45020	70600	415040
Ica	–	–	500	1000	1500	1200	1000	1000	1200	1300	8700
Arequipa	1900	2700	3300	4300	2400	2500	2700	2600	5600	7100	35100
Tacna	–	–	–	–	–	–	100	1000	1000	1200	3300
Moquegua	–	–	–	–	–	–	–	1000	500	500	2000
Junfn	485.20	3000	20330	46100	41100	73400	14560	40300	2730	27400	317440
Huánuco	–	–	5000	7000	37050	49500	78950	12850	51740	45170	287260
Pasco	–	700	3300	1000	11700	35500	40300	6390	4820	2950	106660
Huancavelica	–	100	2600	100	100	1600	3480	17620	2900	8150	30650
Ayacucho	–	–	3040	1430	6570	38830	23500	16780	11070	36800	138020
Cuzco	48260	8760	11340	68460	66080	81200	95600	290600	223500	194360	1088160
Apurimac	1500	1300	6100	20730	32640	31900	42500	149440	169600	228640	684350
Madre de Dios	–	–	–	–	–	–	1200	500	450	350	2500
Puno	–	–	300	500	1000	1500	2000	3000	3000	15000	26300
TOTAL	101780	78360	78710	243160	284100	371900	363910	701900	762250	798040	3778110

NOTA : 1 – Los Departamentos de LIMA, LORETO y SAN MARTIN, no figuran en el Cuadro por no existir informes.

2 – La distribución porcentual por especies de las plantaciones, es el siguiente :

Eucalyptus globulus	98%
Otras especies	2%
T o t a l	100%

Northern district (La Liberted, Cajamara, Ancash)
Middle District (Lima, Junin, Psco, Huanuco)
Southern District (Cuzco, Ayacuchs, Huancavelia, Apurimac)

The initial 4-5 years after planting were good the middle district but poor in the sourthern district, but after a further 10 years, growth in the southern district exceeded that of the northern or middle district.

For each district the height of trees as against chest height diameter is shown in Table 3.

Table 3 Tree height against breast height diameters

DBH cm	Tree height		
	Southern district	Middle district	Northern district
10	2.4	7.3	4.4
15	6.7	9.3	7.3
20	11.3	11.3	9.7
25	15.4	13.2	12.2
30	19.6	15.2	14.9
35	24.3	17.1	17.6
40	28.3	19.2	20.2
45	32.6	21.1	22.9
50	36.9	23.1	25.3

2. Forest-Type Characteristics of the secondary forest

Migrating slash-and-burn farming is carried out in the forest zone of Peru along the river and also downstream districts.
The revival of the land deserted after slash-and-burn farming is active in the region of thick forest in the low-lands in the tropical region, but in the thick forest region on the high-lands where the inclination of the land is steep, erosion and disruption are taking place, and revival in some districts is extremely

difficult.

The transition of vegetation in the thick forest region of the lowland type, from migrating slash-and-burn farming, into secondary forest is shown in Table 4.

13. Palm forest

A palm forest consists of Mauritia sp., and aguaje constitutes a pure forest of Mauritia sp. Mauritia sp. belongs to Mauritia vinifera and is sometimes mixed with Mauritia flexuosa.

In the lower stratum of a stand, economically valuable palms and Pana grow. In a stand of medium thickness, Ficus sp., Simphonia sp., Virola sp., etc. are mixed.

Aguaje palm is useful for production of edible oil, and livestock feed, and industrial materials, and its economic importance is growing. The trunk and leafstalk are useful for making paper.

The number of trees in a thick stand is 450-500/ha, and the trees constituting the crown show a chest height diameter of 25-30 cm.

Huasai is a valuable species in the palm industry. Aguaje palm provided fruit and raw materials for soft drinks, ice-cream, etc., for which tere is a large demand in eastern Peru at present.

III. Artificial forest

96% of the artificial forest in Peru is located in the mountains. 98% of the trees planted are Eucalyptus sp., others being only 2%, which consist of Pinus radiata, Pinus insignis, and Populus sp., with a small amount of Cedrel sp.

Planned operation are necessary for continued production of lumber from the abundant forest resources existing in the mountain district at present.

The total area of artificial plantations in Peru in 1977 is 111,983 ha. The breakdown for this figure is as shown in Table 2.

Eucalyptus globulus is well adapted to the climated and location and shows good growing results. Eucalyptus viminalis, Eucalyptus bicostata and Ecucalyptus regemans also show good results.
By dividing Peru into three zones Gonzalez et al (1972) studied the results of silviculture of Eucalyptus in Peru.

Table 4. Forest type and the characteristics of a secondary forest in a tropical region

	Pre-forest	Early secondary forest	Late secondary forest	Final forest type
Age of tree, year	1 - 5	5 - 15	20 - 50	100 years or more
Kinds of trees	1 - 5	1 - 10	30 - 60	100 species or more
Height of stand, m	5 - 8	12 - 20	20 - 30, rarely 50 or more	30 - 45, rarely 60 ore more
Predominant species	Euphorbiaceae Compositae Malvaceae Ulmaceae Melastomaceae Tiliaceae Celastracfae	Cecropia Trema Ochroma Jacaranda Pouruma	Meliaceae Bouibacaceae Tiliaceae Cedrela, Cavanillesia Swielenia, Quararibea	Many including Lecythidaceae
Distribution of predominant species	Distributed area wide area	Extremely wide area	Extremely wide area	Extremely limited due to many species or small area
Stratified structure	Mono-stratum, too thick and crowded	Clear stratification into two	Three strata of different ages	4-5 strata, but extremely complex in stratification and heterogeneous age

Growth	Extremely fast growth, DBH 5 cm within 2-3 years	Extremely fast growth, DBH 5-8 cm	Growth of predominant species: fast; that of subordinate species and intermediate species: slow	Growth of intermediate stratum slow, that of lower stratum extremely slow

The table shows the cycle of revival in transitional series: intruding and generation cycle of pre-forest species upto 5 years of age, early secondary forest of about 15 years of age, mature late secondary forest of about 50 years of age, and the extreme phase of revival after 100 or more years.

The number of species constituting the stand, the height of the crown, the predominant species constituting the crown, the lateral distribution of the predominant species, the stratified structure, and the conditions of growth are also shown in the table for each phase of the cycle.

According to the present survey, the secondary forest in the tropical rain forest region of thick and low-land seems to revive to the final phase within 20 to 50 years.

However, depending on the kinds of threes in the final phase, perhaps 100 years or more will be needed.

In order to reach the final phase faster and have a forest of high density and useful species, the introduction of repairing technology is necessary. Investigation of the intrusion of floor plants and pre-forest species in detail, felling technology for renewal of a stand, technology for the promotion of natural renewal into useful species, artificial cultivation, etc. must be promoted and discussed taking into consideration the ecology, climate and local conditions.

3. Forest accumulation

A statistical survey of Peruvian forests has been carried out with the cooperation of the F.A.O. It contains a survey of the forests areas and types of trees but not an estimation of the number of trees. This is due to topographical and transportation difficulties and the shortage of engineers for the purpose.

However, a ground survey was carried out interprete the aerial photograph for each type of forest, by dividing the forests into types and determining the average accumulation, average number of trees per

ha, principal kinds of trees, etc. of for each of the types of forest, as is published in MAPA FORESTAL DEL PERU by Jorge Malleux Orjeda of La Morina University. We have tried to estimate the number based on the data and the results are as shown in Table 5.

Table 5.

Table 5. Estimation of the area and the type of forest

Type of forest	Area 1000 ha.	Average accumulation per ha.	Available accumulation 1000 m^3
Alluvial forest Class 1	3,612	160	577,920
" Class 2	7,375	115	848,125
" Class 3	5,071	90	456,390
Sub-total	16,058		1,882,435
Hill-land forest Class 1	12,754	160	2,040,640
" Class 2	16,169	135	2,182,815
" Class 3	9,841	80	787,280
Sub-total	38,764		5,010,735
Grand total	54,822	126	6,893,170

The construction of a forest, the principal species, and the utilization as a basis for estimating the above are shown in Table 6.

Table 6. Principal characteristics of each group in the map of forest types

(D.a.p. in the column of number of trees: chest height diameter)

Type of forest	Area of the region	Available volume of lumber	Number of trees/ha	Principal species	Present state of utilization	Means of Utilization recommended	Recommended control plan
Alluvial forest Class 1	3.6118	140 180	120 d.a.p more 25cm	Cumala, machimango, moena, copal, shimbillo, quinaquina	Selective felling of commercially valuable species, active agriculture and stock-farming along the roads and rivers	Most suitable for integral forest utilization	? Integral forest utilization, establishing an integral forest, and a re-building plan for a forest of substitute multi-purpose species
Alluvial forest Class 2	7,3753	100 130	100 d.a.p more 25cm	Cumala, machimango, copal, Zapote, huimba, shimbillo, moena	Selective felling of commercially valuable species along the roads and rivers	Integral utilization of forest	Utilization of forest with exclusion and/or integration with the settlement plan, rebuilding of forests with species of rapid growth, control of wild animals
Alluvial forest Class 3	5.0707	80 100	65 d.a.p more 25cm	Oje, Palo azfre, requia, cumala, lagarto-caspi, cetico	Felling of exhausted forest, active farming and limited stock-farming (nomads, self-supply) bog farming	Utilization for agriculture, stock-farming and forestry	Integral forest utilization according to the settlement plan for farmers and stock-farmers, rebuilding of

							forests with fast growing species control of wild animals
Hill forest Class 1	12,7540	140 180	110 d.a.p. more 25cm	Tornillo, moena, quinilla, cumadla, mashonaste, poshaco, copal, chimicua	Selective felling, active farming and stock-farming	Rational and integrated forest utilization according to the plan	Strict plan for gradual felling, limiting farming and stock-farming to suitable locations
Hill forest Class 2	16.1690	120 150	90 d.a.p more 25cm	Tarnillo, moena, quilla, cumala	Selective felling, of commercially valuable species, more active farming and stock-farming	Rational and integral utilization of forest according to the plan	Total limit of farming and stock-farming, strict plan for controlling gradual felling
Hill forest Class 3	9.8414	70 120	30 d.a.p more 40cm 70 d.a.p more 25cm	Tornillo, quihilla, moena, pashaco, Cedro	Mostly unutilized due to difficult access, selective felling of commercially valuable species (Cedro, Caoba, Tornillo),	Rational and integral utilization of forest according to the plan	Total limit of farming and stock-farming, well-controlled plan except protected regions, gradual felling
Manglar	0.0283			Mangle, del, avicenla, conocarpus	Indiscriminate felling for fuel and fences, killing wild animals	Rational utilization of forests for lumber production (pillar, charcoal) and wild life	Make the whole region a protected forest in order to utilize trees and animals under the plan, and also sightseeing and business

As already stated, Peru has excellent forestry resources, with a total forest area of 84.5 million ha, including 54.82 million ha (60%) of mixed forests available for production, with a total accumulation of 6,893.17 million m^3 or an average of 126 m^3/ha, and 160 m^3/ha for both alluvial forest No. 1 and hill-land forest No. 1. Most of the forest is located in the watershed of the Amazon, being distributed in the 9 prefectures of Huanuco, Pasco, Junin, Cuzco, Pino, Amazonas, Sanmartiiy, Loreoto, Madre de Dios.

The amount of trees in Huanuco Pref. surveyed by us is estimated as shown in Table 7.

Table 7. Resources in Huanuco Pref.

Type of forest	Area ha.	Average accumulation per na.	Available accumulation 1000 m^3
Alluivial forest Class 1	66,000	160	10,560
" Class 2	33,000	115	3,795
" Class 3	14,000	90	1,260
Sub-total	113,000		15,615
Hill-land forest Class 1	195,000	160	31,200
" Class 2	285,000	135	34,230
" Class 3	337,000	80	26,960
Sub-total	790,000		92,990
Grand total	903,000		108,605

As shown in the table, the area of forest in Huanuco Pref. available for development is 903,000 ha (22% of the total area of the pref.), and the accumulation is estimated at 108.6 million m^3.

The principal regions where forest development is under way at present are located in the northern part of the watershed of the Amazon, from Pucallpa to Iquitos along the River Ukayari at a distance of 2-10 km front the river and felling is being done

in only a small region in Huayuco Pref., which is located upstream, most of the forest is preserved as a national forest or protected forest.

4. Aerial Photography Utilization

Aerial photography was used in Peru as a means of understanding the outline of the forest. Thus is contributed greatly to mapping of the forest, and analysis of the photographs is considered indispensable. The survey is inexpensive and objective, and the informa is detailed. An enormous amount of information is also available regarding overall inclination of the region (topography, hydric system, vegetation, and others) through careful interpretation of the photographs, along with detailed statistical data which can be used evaluating the forests and forest land, and the kinds of trees, amount of trees, density, tree height, available amount of lumber, etc.

By using the alone method a survey and study of any region in Peru - natural forests in Selva, the region suitable for planting in Sierra, and the region in Selva alta or Ceja de Selva or in Sierra and Cozta (coastal region), where protection is needed, can be carried out.

A photographic air survey and developing the pictures is undertaken by the Air Force, while the maps are prepared by the Army Geographical, and the resulting data can be purchased at the Geographical Survey sales office.

(1) Aerial photograpny

Photographing and preparation of pictures is controlled by the Air Force, and about 80% of Peru is already photographed. Ordinary photographs are in a scale of 1:20,000 to 1:25,000 and are taken by f:150 mm Wild lense.

At the present the emphasis is on the watershed of the Amazon, and the same area is photographed several times.

The area of our survey in Tingo Maria has bad weather with unfavorable air currents, and much difficulty is encountered when photographing. Thus the whole record for the area was not available during our stay, although the aerial survey has recently been finished. But, due to lack of time, detailed data could not be obtained. The pictures near the city of Tingo Maria, Photos 1 and 2, and the mosaic picture for operation were obtained. These were taken on September 14, 1974 and June 26, 1963 respectively, while another picture taken on September 20, 1943 is also available.

Fig. 2 Outline of photographed area.

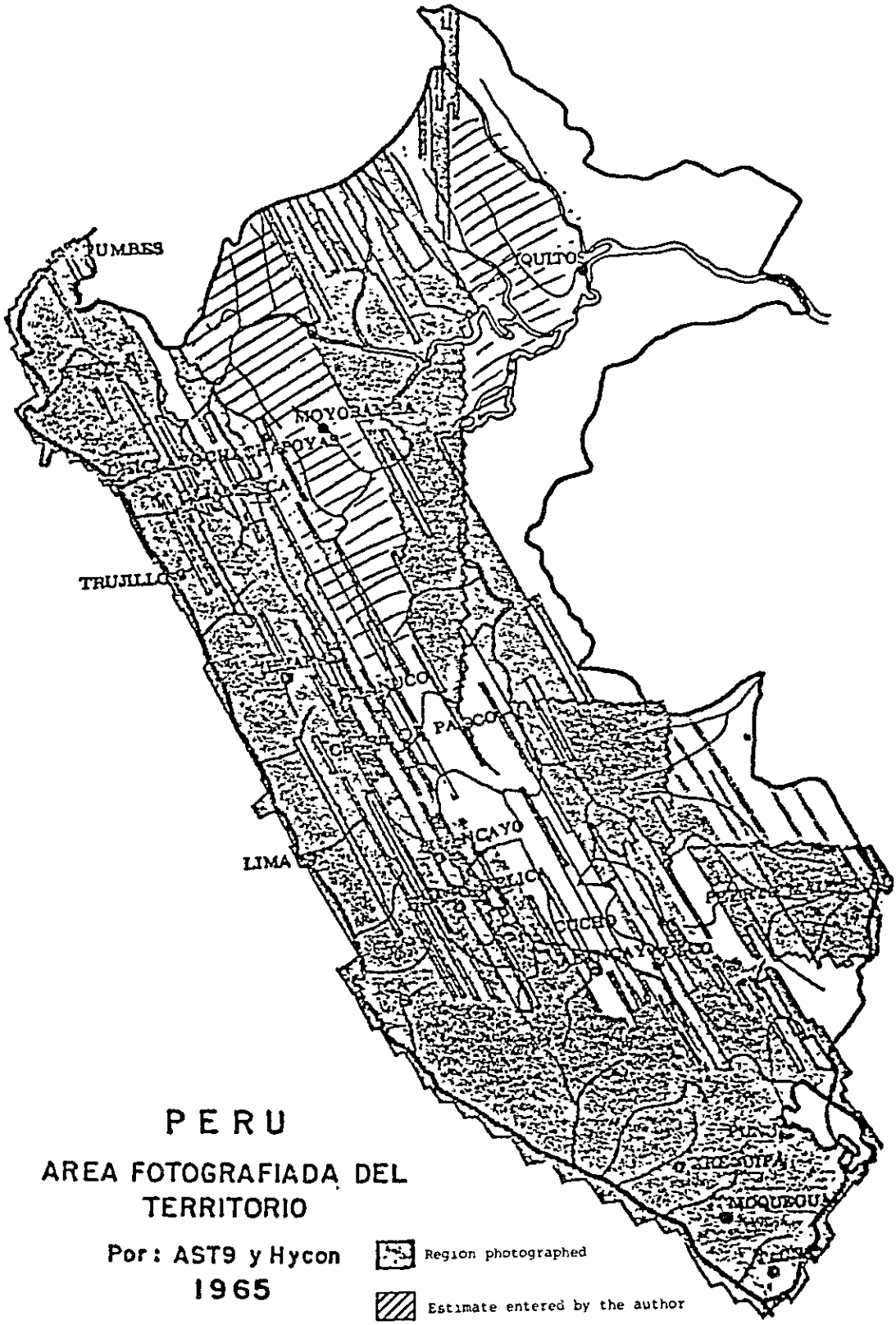
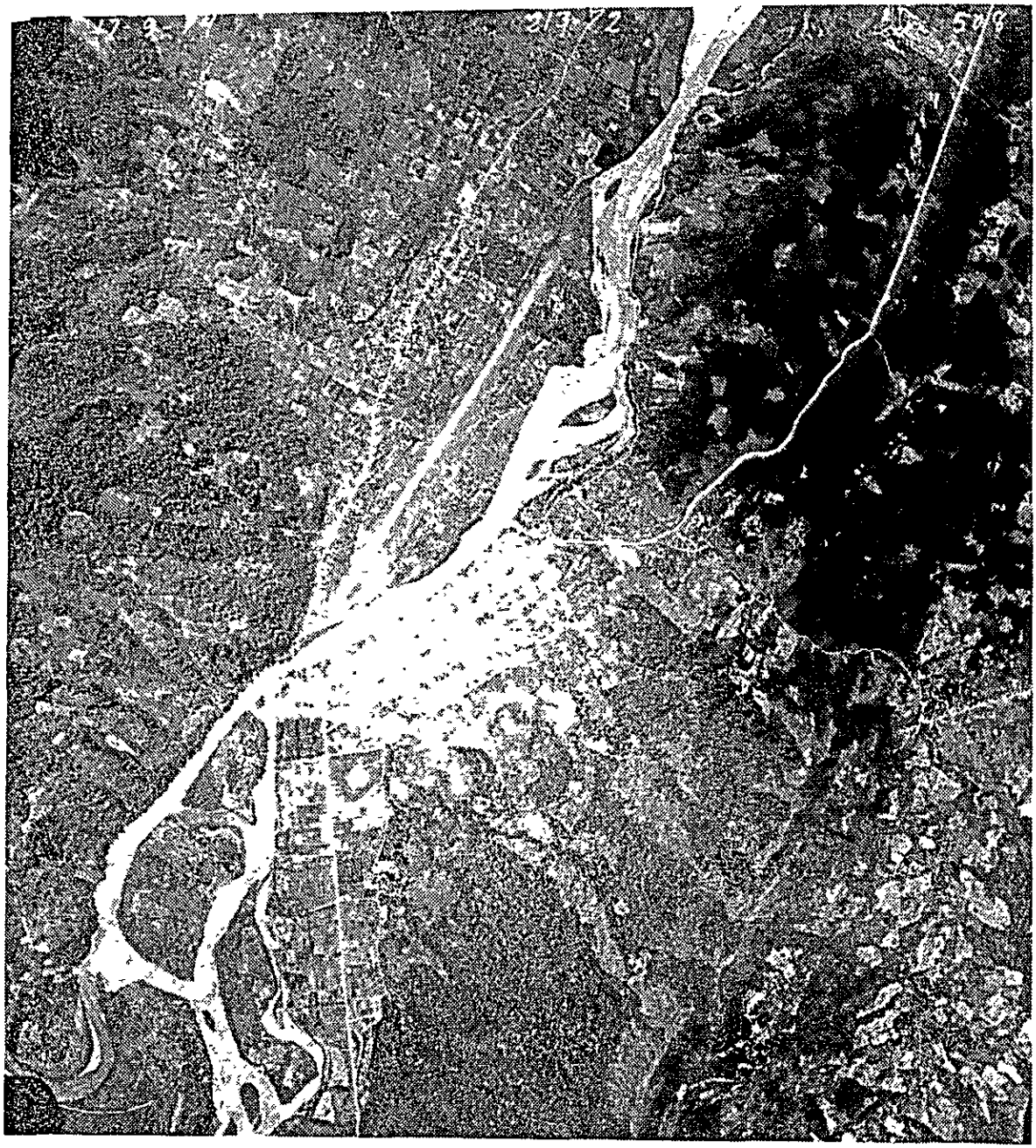
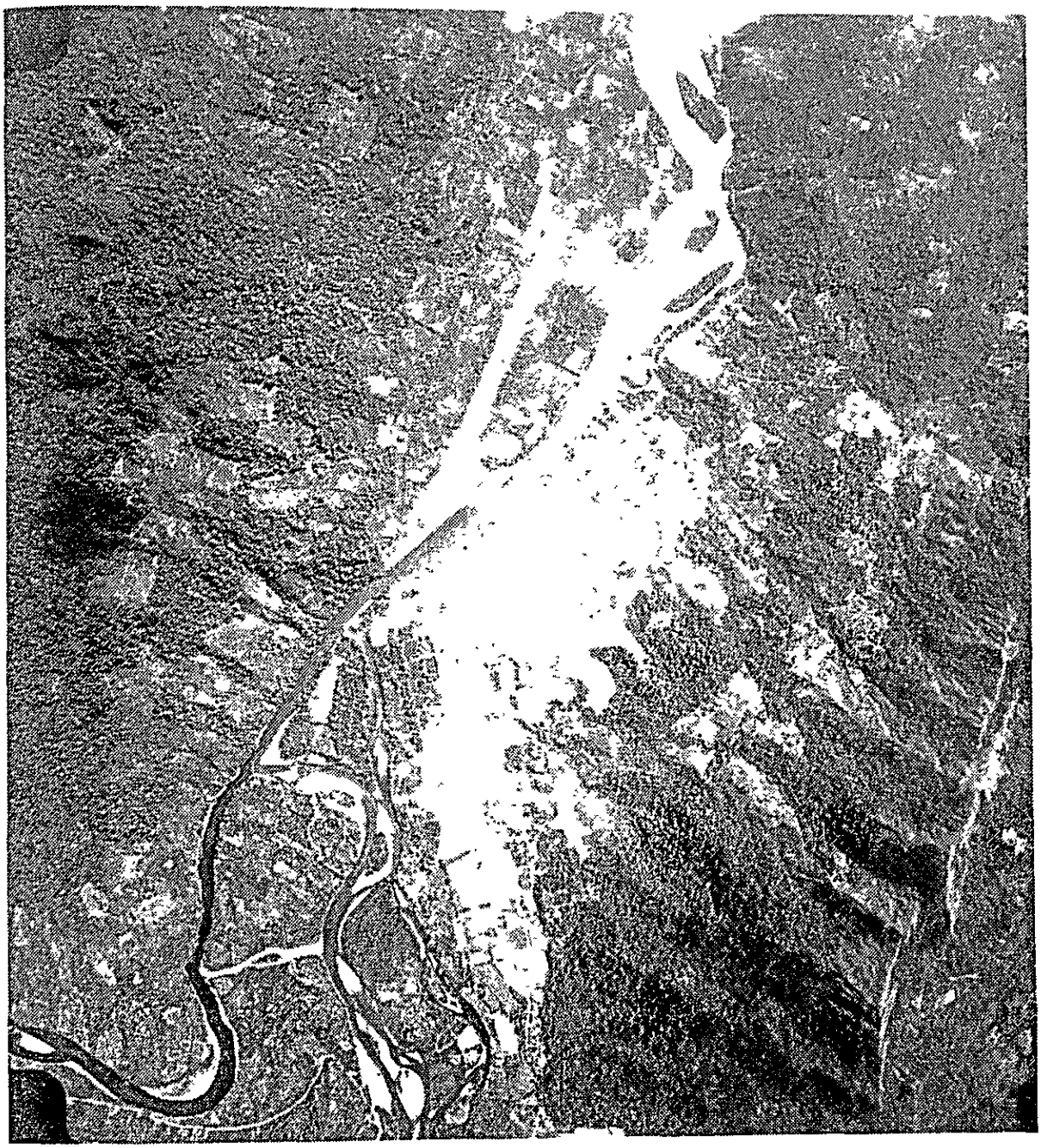


Photo 1. Tingo Maria, contact print, September, 1974



Region photographed: 213-72; date 17-9-74,
Picture No. 508; S = 1:20,000

Photo 2. Tingo Maria, contact print, June 1963



Region photographed: 96-63-A-2; date: 26-6-63

Picture No.: 33; S = 1:25,000

By comparison of above two picture, long-term changes in the District at Tingo Maria can be clearly seen, especially the construction of an airport and roads, and the change in the flow and sedimentation of the river.

The aerial photographs are available from the following organization.

Name of organization: Servicio Aerofotografico Naciona
(Ministerio de Aeronautica)

Price: 180 S/L per sheet

Recent picture: Operation N
Operation No.: 213.72
Date photographed: 17-9-74
City of Tingo Maria: Photo No. 509, 508
Camera: Made by Wild, focal lenth 153 mm

(2) Mosaic picture

Mosaic orientation pictures are prepared for each of the districts to be photographed for the convenience of selecting the pictures needed.

A mosaic picture of Tingo Maria District (1:20,000) is available. Although Picture No. 3 was taken in September, 1943, it is still good and can be utilized for topographical operations.
Another orientation picture was taken in 1974, but it was not available to us.

Photo 3. Mosaic photograph of Tingo Maria District

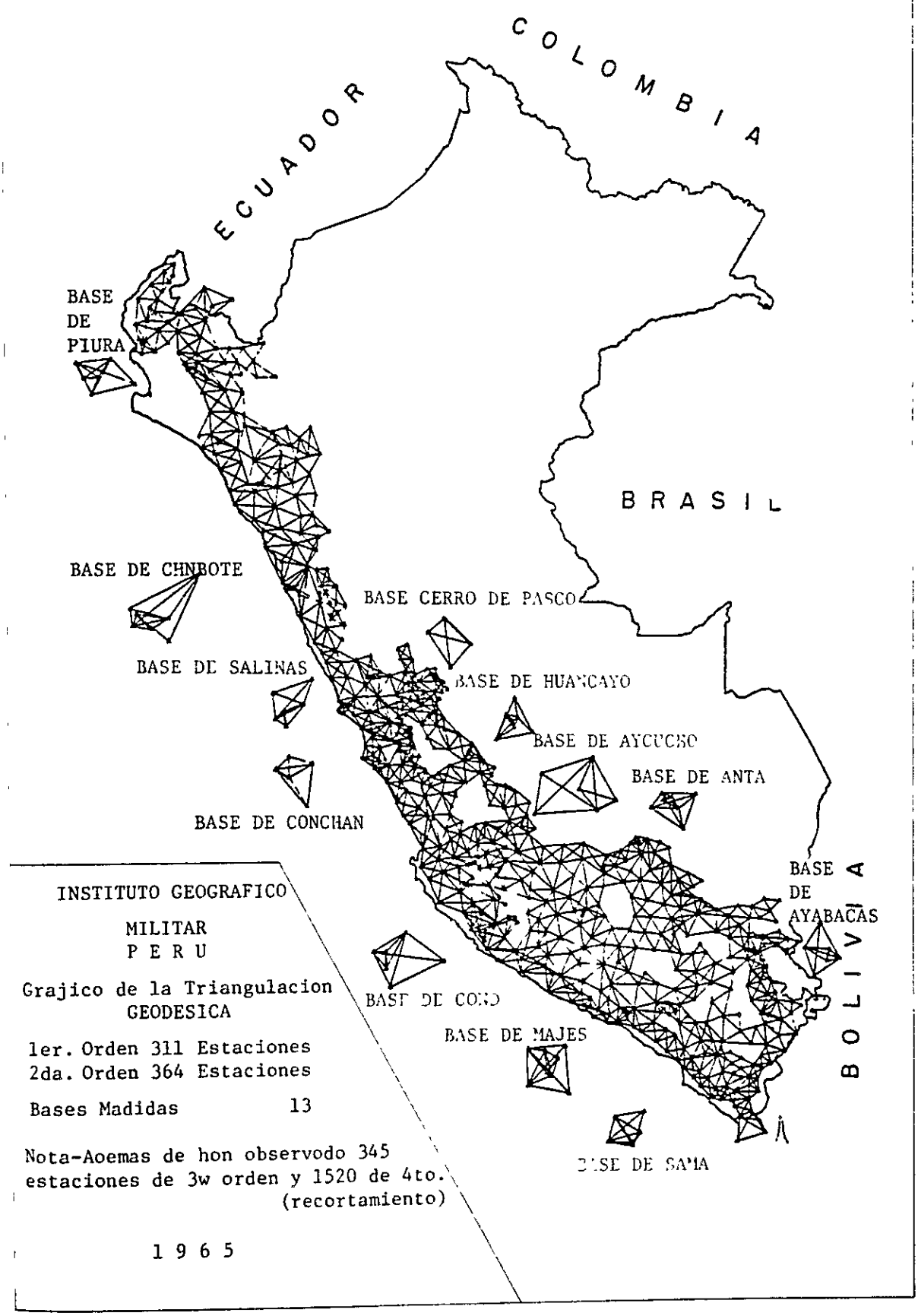
S: 1:20,000

(3) Triangulation

A land survey is made by the Army Geographical Survey (Instituto Geografico Militar Peru) and its operations are as follows:

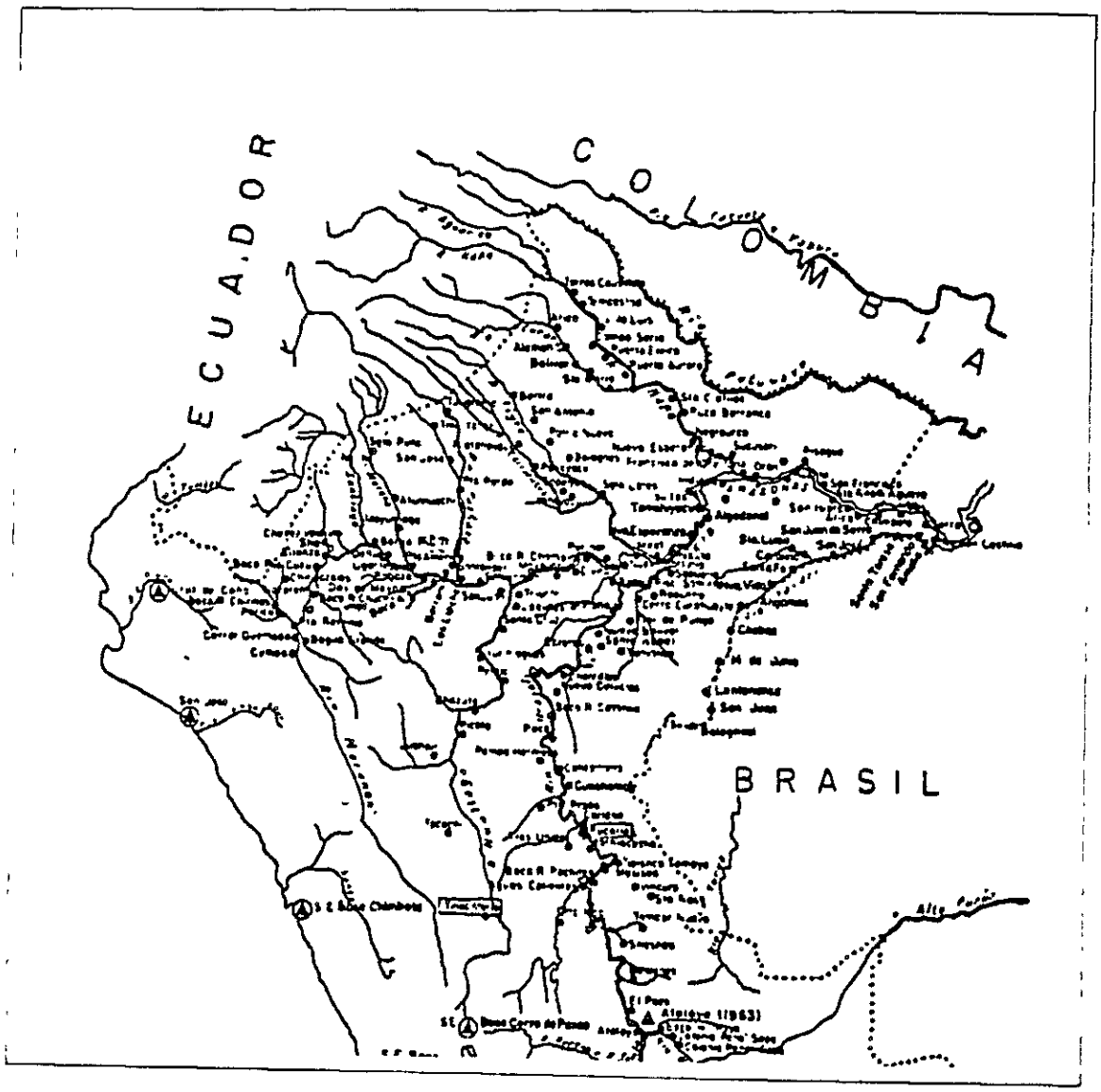
All of the triangulation of the coastal region has been completed and that of the watershed of the Amazon is proceeding, with Iquitos as its center. Operations for increasing mapping near Tingo Maria with reference to the existing maps is under way. Fig. 3 shows old data, but recent results are being compiled at present and are expected be published about May, 1979.

Fig. 3 List of triangulation results



(4) Astronomical Survey

An astronomical survey has been undertaken along major roads and rivers to determine the latitude andlongitude. The places determined are shown in Fig. 4.



(5) Leveling

Leveling has been completed for all of the coastal regions. It is under way for the watershed of the Amazon after completing it for the Lima-Oroya-Hunuco-Pucallpa and Cuzco regions.

(6) Topographical map

Topographical maps in a scale of 1 : 1,000,000 have been completed for all of the land, and the emphasis now is on the preparation of mosaic photographs in a scale of 1 : 100,000 with simultaneous preparation in a scale of 1 : 200,000.
Those for the coastal regions are already completed, while those for the watershed of Amazon have not been started yet.

CHAPTER III FORESTRY CONDITIONS IN PERU

3.1 DEFORESTATION AND REFORESTATION

The forests in Peru are divided into preserved forests and productive forests where the harvesting of logs is permitted under certain conditions, reflecting the national effort to maintain a favorable balance between the protected forest land in the country and the promotion of timber production.

Table 1 Free cutting allowed forests

Agricultural district		Forestry zone	Log production forest	Area (in ha.)
Ⅱ	Lambayeque	Jean	Jean-San Ignacio	809, 000
		Jean	Santiago	757, 000
		Jean	Utcubamba	335, 000
Ⅷ	Iquitos	Atalaya	Alto Ucayali	1, 500, 000
		Contamana	Contamana	1, 538, 000
		Iquitos	Amazonas	1, 645, 000
		Iquitos	Nanay	2, 590, 000
		Iquitos	Napo	1, 885, 000
		Iquitos	Tigrillo	1, 415, 000
		Iquitos	Yavari	1, 628, 000
		Pucallpa	Abujas-Sheshea	2, 554, 000
		Pucallpa	Aguaytia	190, 000
		Requena	Tapiche	3, 035, 000
Ⅸ	Tarapoto	Aucayacu	Tocache-Aucayacu	559, 000
		Juanjui	Saposoa	490, 000
		San Lorenzo	Morona	530, 000
		San Loreozo	Pastaza	1, 320, 000
		Ynrimaguas	Aipena	767, 000
Ⅹ	Huancayo	Oxapampa	Huancabamba	328, 000
		Puerto Bermudez	Palcazu	362, 000
		Puerto Bermudez	Pichis	446, 000
		San Ramon	Perene	349, 000
		Satipo	Satipo	276, 000
Ⅺ	Cuzco	Cuzco	Paucartambo	72, 000
		Pilcopata	Pilcopata	273, 000
		Puerto Maldonado	Inambari	1, 798, 000
		Quillabamba	Urubamba	328, 000
Ⅻ	Puno	Sandia	Tambopata	558, 000
Total				28, 337, 000

Source Direccion General Forestal y Faana del Ministerio de Agricultura

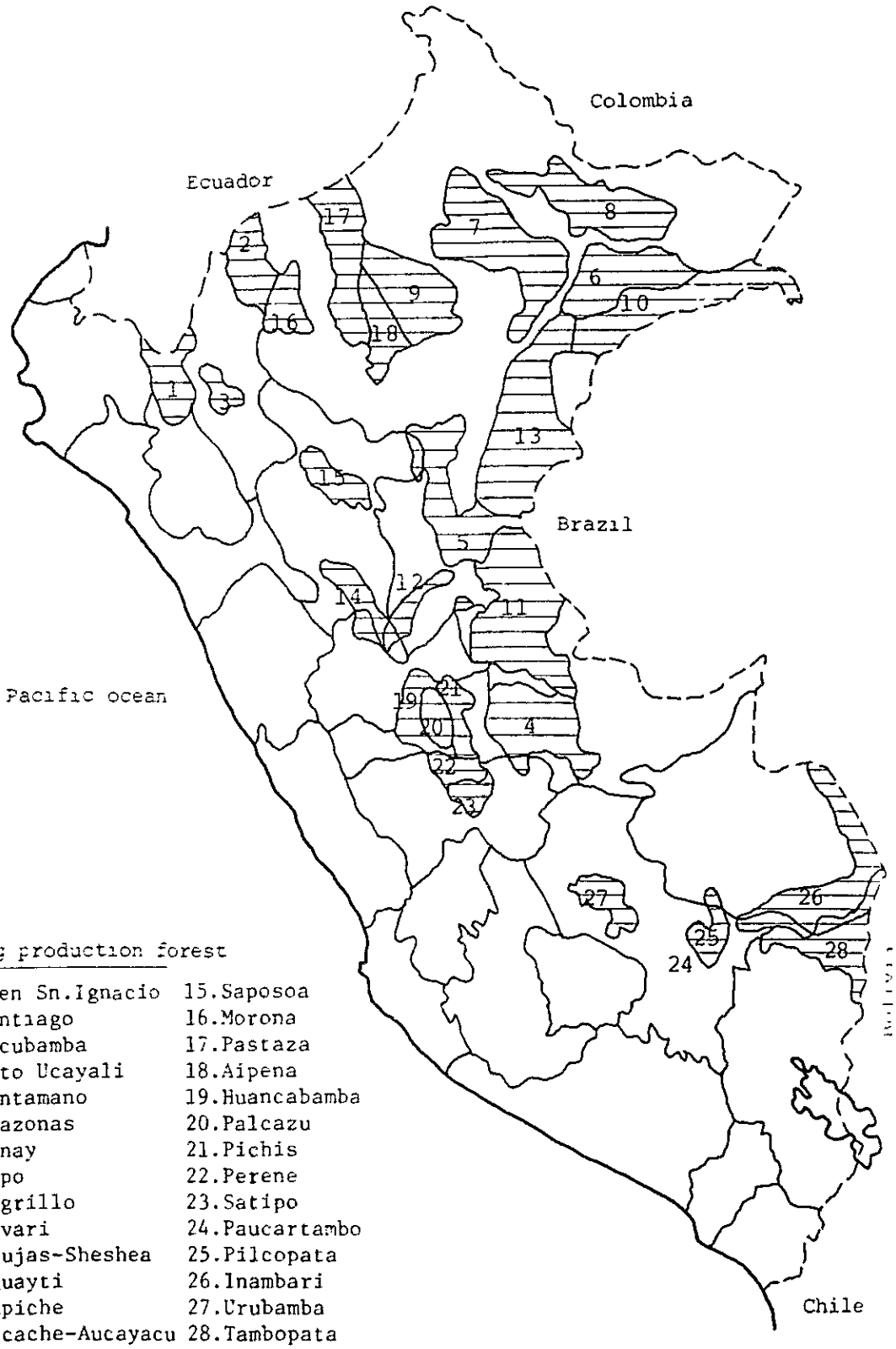
As shown in Table 1 and Fig. 1, the productive forest land is approximately 28,000,000 ha., accounting for roughly 38% of the land covered with forest in the country. The log producer can obtain a concession in the productive forest land to fell trees and transport them to the saw mill. The felling of trees by the authorized log producer is usually selective because he is permitted to cut only several useful tress (cedro, caoba, etc.) per hectare of the concession.

He is also duty-bound to plant two seedlings for every 1 m^3 of tress he has felled. But there is no provision as to the species of the seedling or where they must be planted.

The concession breakdown by the agricultural area is given in Table 2. Concessions averaged about 610,000 ha. in total per year from 1968 to 1976 and the yield ran roughly 1,040,000 m^3. A concession averaged 230 ha. approximately, yielding 390 m^3 of logs. This translates into a yield of 1.7 m^3 per ha. The volume of trees felled per given area is thus very small.

As reforestation started in the country fairly recently, and many technical issues remain to be settled, the planting of useful broadleaf trees is scarcely developed in any currently used area. The reforested land of about 1,000,000 ha. in Table 2 is centered mainly on the mountainous district in the southern part of the country and consists of eucalyptus trees, which are growing well.

Fig. 1 Free cutting allowed forests



Log production forest

1.Jaen Sn.Ignacio	15.Saposoa
2.Santiago	16.Morona
3.Utcubamba	17.Pastaza
4.Alto Ucayali	18.Aipena
5.Contamano	19.Huancabamba
6.Amazonas	20.Palcazu
7.Nanay	21.Pichis
8.Napo	22.Perene
9.Tigrillo	23.Satipo
10.Yavari	24.Paucartambo
11.Abujas-Sheshea	25.Pilcopata
12.Aguayti	26.Inambari
13.Tapiche	27.Urubamba
14.Tocache-Aucayacu	28.Tambopata

Source: DGFF-MA

Table 2 Concession breakdown by agricultural districts

Agricultural district	Land area (in ha.)	Forest area (natural forest)	Log production forest (ha.)	Concessions granted (1968-1976)		
				Number of areas	(ha.)	Yield (m^3)
1. PIURA	3,654,680	-		314	82,798	42,836
2. LAMBAYEQUE	9,212,200	-	1,901,000	682	69,141	109,518
3. HUARAZ	5,462,237	-				
4. LIMA	3,943,356	-				
5. ICA	3,842,017	-				
6. AREQUIPA	7,394,018	-				
7. TACNA	3,094,128	-				
8. IQUITOS	41,507,259	-	17,980,000	14,147	4,597,080	5,405,355
9. TARAPOTO	13,200,776	-	3,666,000	1,105	293,739	502,188
10. HUANCAYO	8,267,443	-	1,761,000	4,372	720,274	2,236,677
11. CUZCO	17,490,544	-	2,471,000	2,922	628,708	639,399
12. PUNO	6,761,077	-	558,000	257	15,839	413,843
13. AYACUCHO	4,691,895	-		19	3,575	5,549
Total	128,521,560	74,000,000	28,337,000	23,818	5,498,504	9,355,465
Yearly average				2,646	610,945	1,039,496

Table 3 Agricultural Districts and Areas

Agricultural district	Agricultural area	Location of ministry agency
I. Piura	Tumbe Piura	Jr Lima 53L
II. Chiclayo	Lambayeque Cajamarca	Av. Bolognesi 200
III. Trujillo	Lalibertad	Av. Lavco 338
IV. Huaraz	Ancash	Av. Circunvalacion y Prolongacion Raymondi s/n
V. Lima	Lima Metropolitana Lima Ica	Av. Uruguay 5/4
VI. Arequipa	Arequipa	Av. Alfonso Ugarte s/n
VII. Huanuco	Pasco Huqnuco	Puente Calicanto s/n
VIII. Huáncayo	Junin Huancavelica Ayacusho	Av. 13 de Noviember 504
IX. Cuzco	CUZCO Aprimac Madre de Dios	Matará 394-3ey. Piso
X. Puno	Puno	Moquegua 264
XI. Movobamba	San Martin	Calle Angel Delgado Morey s/n
	Amazonas	Calle Pevas 350

XII. Iquitos	Iquitos	
XIII. Tacna	Tacna	Unanue 327
	Moquegua	

Source: Direccion General Forestal y de Fauna Marcn 1979.

3.2 FOREST WORK

Chain saws are increasingly used in felling and processing tress. They are used for about 60% of felling. Transportation still depends primarily on man-power and river, although tractors are being introduced in some districts. In places where there is no river suitable for floating and tractors or loaders are not available, felled trees are cut into short logs using chain saws and ripsawed into flitches to reduce the weight before they are transported using man-power.

Generally speaking, any large-scale investment depending on a well thought-out harvesting program based on an extensive forest survey and mechanization and the construction of appropriate forest paths, are isolated instances. As a result, the felling of useful trees and their transportation are mostly limited to those places where suitable roads or rivers are available, and primarily depends on man-power.

3.3 GENERAL CONDITIONS FOR FORESTRY IMPROVEMENT, ETC.

(1) Administrative setup

The Forest/Animal Bureau, Ministry of Agriculture and Foodstuffs, is responsible for forest management and for the forestry and timber industries in the country. The ministry divides the land into 13 agricultural districts, which are further separated into 24 agricultural area. The ministry has its outpost agency in each area to implement its policies. The forest land is divided into agricultural districts for management by the ministry.

Table 3 shows the agricultural districts and areas. The organization of the Forest/Amimal bureau is given in Fig. 2. The administrative responsibilities of its respective divisions are listed below.

Forest asset/statistics div.

- Preparation and updating of registers concerning forests and animals.

- Preparation, evaluation, analysis and dissemination of statistics concerning forests and animals.

Management div.

- Personnel management, financial management, commodity prodUrement, assistance investment projects, and management of documents.

- Stock management.

Technology div.

- Assistance for the execution of investment projects.

- Supervision of enterprises involving forests and wild aminals.

- Preparation of forest maps.

Planning div.

- Drafting of ploicies concerning forests and animals.

- Formulation of standards for enterprises in the forestry products field and their supervision.

- Adjustment of international technical cooperation investment projects.

Legal affairs div.

- Drafting of forestry-related laws, regulations, ordinances and rules.

- Establishment of rules concerning administrative procedures

Conservation div.

- Establishment, enforcement and evaluation of standards for enterprises involving the preservation of plants and animals.

- Establishment of conservation, no-hunting and community reserve areas.

- Dissemination of technical standards concerning the preservation of the natural environment.

Forestry adjustment div.

- Establishment of standards for the rational application of forest resources and the creation and execution of forest resources application programs.

- Assistance for the preparation of programs for reforestation and land evaluation/sorting/management.

Harvesting/forest products div.

- Establishment of standards for the rational harvesting of forest crops, and preparation and execution of harvesting programs.

- Establishment of standards concerning the processing of forest products.

- Management of log production forests and issuing of concession licenses.

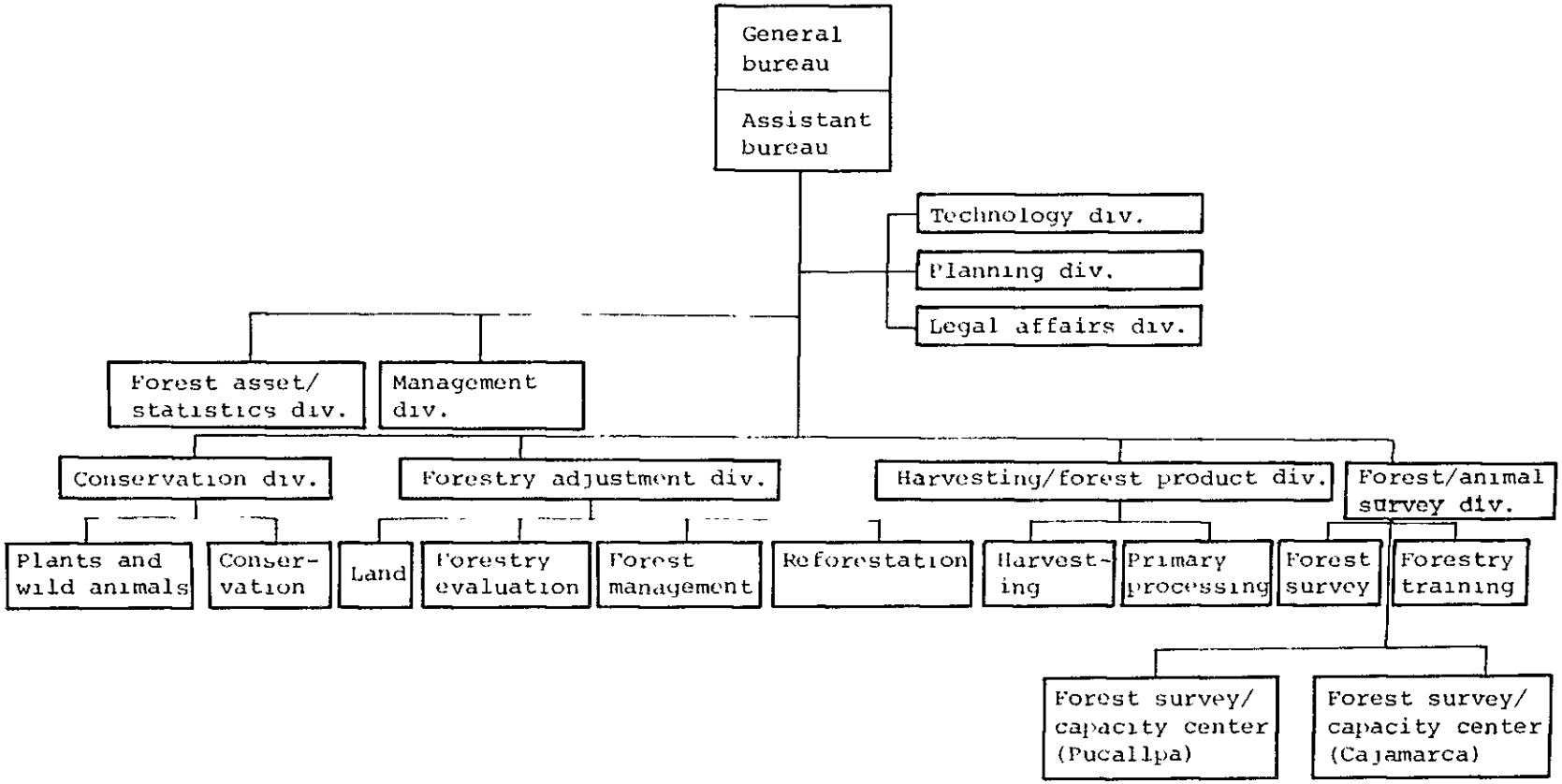
Forest/animal survey div.

- Guidance and supervision concerning national forests and animal surveys.

- Managing of activities concerning the execution of forest surveys and the establishment of forestry training centers.

- Managing activities concerning international cooperation in the forest/animal survey and training fields.

Fig. 2 Forest/Animal Bureau Organization



Source: Direction General Forestal y de Fauna - M.A.

(2) Forestry-related laws and regulations

a. Of the many laws and regulations involving the forest management and forestry and timber industries the most important is Law No. 21147 "Forest/Wild Animal Law (La Ley Forestal y de Fauna Silverstre)". This law prescribes the following:

1) The forests must belong to the public.

2) The wild animal resources must be raised to the same level as the forest resources and protected.

3) Public enterprises or cooperative associations of natives must be treated preferentially when granting a log production concession and the development of processed forest products.

4) Integrated forest product enterprises must be able to handle different species of tropical trees.

5) The export of logs for industrial or commercial purposes is prohibited.

6) The forestry policy must be established in Peru.

7) In order to improve the management of resources the forest districts have been created as a sub-area of the agricultural districts.

8) The Forestry Bureau must begin to participate in the forest product processing field.

b. The law lays down more detailed provisions concerning the felling of trees. They read as follows.

1) The forest activities of the natives or the person who is granted the right to fell trees are limited to the forest land that is designated as log production forest for the perpetual production of timber and other forest products.

2) A Ministry of Agriculture licence for industrial or commercial purposes is issued according to the following order of preference.

i) Public enterprise and native societing.

ii) State enterprise

iii) Farmer societies, SAIS and cooperative associations

iv) Private enterprise

v) Small-scale wood-cutters

3) The felling of trees by the different enterprises and groups listed above is carried out, except for state enterprises and small-scale wood-cutters, according to the tree cutting contract which is issued by the Ministry of Agriculture and is not transferable. In this case the following conditions must be satisfied.

i) Area of cutting: Up to 100,000 ha.

ii) Terms: 10 years, renewable

iii) The relationship between tree species to be felled and the volume of felling and the price.

iv) Preparation of the reforestation program.

4) A written program defining the technical and economic feasibility must be submitted to the Ministry of Agriculture prior to the conclusion of the contract. When the area applied for is 50,000 ha. and above, a presidential order (government ordinance) must be officially announced. If the state takes part in wood cutting activities, the state does so through a government-sponsored enterprise which holds a reserve district called the national forest.

5) When a small-scale wood-cutter takes part in wood cutting activities, he does so according to the non-transferable contract having been granted by the Ministry or Agriculture, provided that the following conditions are

satisfied.

i) Area: Less than 1,000 ha.

ii) Terms: Two years or longer not exceeding 10 years, renewable

iii) Tree species to be felled, volume and price

iv) Preparation of the reforestation program

c. As to the incentive measures and tax considerations for the forestry development the law reads as follows in Chapter 7.

1) Overall technical assistance by the forestry machinery division.

2) Forest product processing service.

3) Services concerning the distribution and marketing of materials and products.

4) Promotion of forest product processing industries.

5) Credit granting for reforestation activities.

6) When providing a loan to the forestry enterprise in the district, the state-owned Development Bank underwrites at par value the agricultural obligation certificate which is worth up to 70% of the asset of the said enterprise, provided that the holder of this certificate bears the balance of 30%.

7) The integration of small-sacle wood-cutters must be realized in order to reduce costs.

(3) Forestly Development Policies

Although Peru is substantially rich in forest resources, they are not yet fully exploited for the development of the national economy. The major obstacles include: (1) the absence of adequate means of transportation due to the poor development of infrastructure in the form of roads and ports, and hence the Peruvian export of forest products; (2) the domestic timber demand is too small and the market too young to justify forestry

development through large-scale investment; and (3) the slow development and dissemination of modern techniques of forest management from the felling of trees to reforestation, thus impairing the acceptability of more efficient forest management systems.

Although the rich forest resources remain to be tapped, the impact of the following problems are already being felt: (1) the increasing felling of the more useful trees such as mahoganies, without adequate reforestation of the felled areas, is enlarging the share of low-value secondary forests in the total forest area; and (2) the slash-and-burn method of agriculture of rural farmers is claiming the growing portion of the forest land, allowing nature to take its course after the farmers have left, and hence erosion problems of growing proportions.

It is against this background that the Peruvian Government announced on October 9, 1977, El Plan Tubac Amaru, a policy designed to correct these problems and pave the way for a more rewarding use of the country's forest resources. It aims at attaining the following:

i) An integrated policy in respect to the application of renewable natural resources such as the soil, water, and wild plants and animals.

ii) The more rational application of natural forests, placing primary emphasis on the satisfaction of the domestic demand for forest products, followed by an expansion of exports.

iii) Administrative guidance to promote the employment of natives and other inhabitants in the forest district by enterprises engaged in the felling of trees, processing of forest products and their distribution.

iv) The conclusion of state-of-affairs surveys across the country in respect to forest resources and wild animals.

v) The promotion of scientific and technical surveys for the more profitable application of the soil, forest resources and wild animals, and a wider use of these surveys findings.

vi) The establishment of standards related to forest activities in the agricultural division of the national effort.

vii) A reduction of the danger of natural disasters, and conservation of hydro-electric energy resources and enlargement to the economic resources of the country through the enlargement of reforestation activities and the restoration of natural plant life in hydrographic water basins.

viii) The promotion of the inhabitants' participation in presarvation, and a more rational application of renewable natural resources.

ix) The creation of a special organization which will be instrumental in establishing a legal order and securing soil preservation.

x) The conservation of the land in its natural condition in order to protect those species of animals and plants which are on the verge of extinction, and to use it for cultural and recreational purposes (parks and natural reserves).

The protected forests and others designeted by the state are listed below.

Table 4 Protected Forests and Others Designated by State

Table 4-1 Special Protection District Area Breakdown by the Type of Legal Status Designated by the State

Status	Date of designation	Area (in ha.)	Location
1. National park		1,954,606	
1-1 CUTERVO	20 SET.'61	2,500	CEJAMACE
1-2 TINGO MARIA	14 MAR.'65	18,000	HUANUCO
1-3 NANU	29 MAY '73	1,532,806	CUZOCO
1-4 HUASCRAN	01 JUL.'75	340,000	ANCASH
1-5 CERROS AMOTAPE	22 JUL.'75	91,300	PIURA
2. State-designated protected forest		1,787,070	
2-1 PAMPA GALERAS		6,500	AYACUCHO
2-2 PACAYA-SAMIRIA		1,367,500	LORETO
2-3 JUNIN		53,000	JUNIN
2-4 PARACAS		335,000	ICA
2-5 LACMAY		5,070	LIMA
3. Shrine/temple-owned forest		6,815	PASCO
3-1 HUALLAY		6,815	
4. Natural beauty/ historic interest		2,500	
4-1 CHACAMARCA		2,500	JUNIN
Total		3,780,991	

Source: Vademecum Forestal 1977, Peruvian Ministry of Agriculture

Table 4-2 Protected Districts Scheduled to be Designated by the State

Status	Area (in ha.)	
1. National park	2,235,900	
1-1 LORETO	2,000,000	LORETO
1-2 CUTUVIRE	235,000	JUNIN
2.	50,000	PUNO
2-1 TITICACA	50,000	
3. Shrine/temple-owned forest	31,440	
3-1 TITANCAYOC	440	AYACOCHO
3-2 CALIPUY	30,000	
3-3 HUARUS	1,000	LIMA
4. Natural beauty/historic interest	50,000	
4-1 MACHU PICHU	50,500	cuzuco
4-2 PAMPA DE LAQUINUA	PORETEMINAR	AYACUCHO
Total	2,367,840	

Source: Vademecum Forestal 1977, Peruvian Ministry of Agriculture

Table 4-3 State-designated Protected Area Breakdown

Area share	128,521,560 ha.	100.00%
Area of protected districts designated by government ordinance	6,148,831	4.28
Already designated	3,780,991	2.94
Scheduled to be designated	2,637.840	1.84
Breakdown of already designated areas	3,780,991 ha.	100.00%
PAROQUE NACIONAL DEL MARU	1,532,806	40,54
RESERVI NACIONAL SAMIRIA-PACAYA	1,382,500	36,70
PARQUE NACIONAL HUASCARAN	340,000	8.99
RESERVA NACIONAL DE PARACAS	335,000	8.86
PARQUE NACIONAL CERROS DE AMOTAPE	91,300	2.41
RESERVA NACIONAL DE JUNIN	53,000	1.40
PARQUE NACIONAL DE TINGO MARIA	18,000	0.48
RESERVA NACIONAL DE PAMPA GALERAS	6,500	0.17
SANTUARIO NACIONAL DE HUALLEY	6,815	0.18
RESERVA NACIONAL DE LACHAY	5,070	0.13
PARQUE NACIONAL DE CUTERVO	2,500	0.07
SANTUARIO HISTORICO DE CHACHAIMARCA	2,500	0.07

Source: Vademecum Forestal 1977, Peruvian Ministry of Agriculture

Table 4-4 General Forest Districts for Animal Protection

	Reserve	Area (in ha.)	National forest	Area (ha.)
1.	PARQUE NATIONAL CERROS DE AMOTAPE	91,300	1. PASTAZA-MORONA MAPARON	375,000
2.	PARQUE NATIONAL CUTERVO	2,800		
3.	RESERVO NATIONAL PACAYA SAMIRIA	1,328,000	2. HAMSCAL CACERES	337,000
4.	RAYQUE NATIONAL HUARCARAN	34,000		
5.	PARQUE NATIONAL TINGO MARIA	18,000	3. DIAVO-CORDIUERA AZUL	2,084,000
6.	RESERVA NATIONAL JUNIN	53,000	4. APRINAC	2,071,700
7.	SANTUARIO PATRIO NATIONAL CHAMURGA	2,500	5. MANU	300,000
8.	SANTARIO NATIONAL HUAYLLN	6,618	6. TUMRES	25,102
9.	RESERVA NATIONAL LAEMAN	5,070	Sub-total	5,242,802
10.	RERERVIA NATIONAL FARACAS	335,000	Hunting reserve	Area ha
11.	PARQUE NATIONAL MADCHU PICCNU	50,500	1. EL ALOLD	65,000
12.	PARQUE NATIONAL MAIYU	1,533,000	Sub-total	65,000
13.	RESERUA NATIONAL PAMPA GALERAS (ZOKA RESAKVADA 6,500)			
14.	RESERUA NATIONAL TITICACA	50,000		
Sub-total		3,509,788	TOTAL	8,817,590

Souce; Vademecum Forestal 1977, Peruvian Ministry at Agriculture