

SECTION I OUTLINE OF STUDY

1. Background of Survey

Presently, about 40% of Paraguay's territorial land of 406,752 km² is covered by forest, and the forest products which are produced from it are the nation's important sources of foreign currency earnings next only to livestock products. However, due to unplanned felling, these forest resources are rapidly diminishing.

The Government of Paraguay, in view of the situation, has come to recognize afforestation as an urgent task and is desirous to disseminate afforestation throughout the country.

The country, however, lacks the experience in regional afforestation or the necessary knowhow and therefore, finds it difficult to carry out afforestation by itself.

It is against such a background that the Government of Paraguay has requested the Government of Japan for technological cooperation in implementing its regional afforestation plan by helping it to prepare a forest development plan in its model area, to have its forestry technologists acquire the necessary afforestation technology and to prepare a manual on afforestation.

In compliance with the above request, the Government of Japan has decided to extend its technological cooperation, according to the Scope of Work (S/W) which was signed in June 23, 1983 between Paraguay government agency and Japan International Cooperation Agency (JICA) in preparing the Master Plan (M/P) and enforcement the Feasibility Study (F/S) on planting of pine and local tree species as well as in

regenerating its natural forests in the model area of about 27,000 ha which was set up in Capiibary District in the central part of Paraguay by the Government of Paraguay.

2. Purpose of Survey and Outline of Study Area

The objective of this study is to prepare the afforestation plan in the study area in order to contribute to the development of highly productive forest and to the development of regional communities.

The study area is located approximately between latitude 24°37' and 24°49' S, between longitude 55°52' and 56°20' W in Capiibary District of San Estanislao in the southeastern part of Department of San Pedro, Paraguay and covers approximately 27,000 ha.

Also it is located in the 225 km point from the Capital City of Asuncion. (Fig. I-2-1)

The study area was formerly under the possession of Financiera Piccolo (FINAP), but due to its bankruptcy it was attached by Banco Nacional de Fomento (BNF) as mortgage. BNF subsequently transferred the title to the property to the Ministerio de Hacienda (MH) which in turn plans to place it under the jurisdiction of the Servicio Forestal Nacional (SFN) of the Ministerio de Agricultura y Ganaderia (MAG) for which it is now taking formal procedural steps.

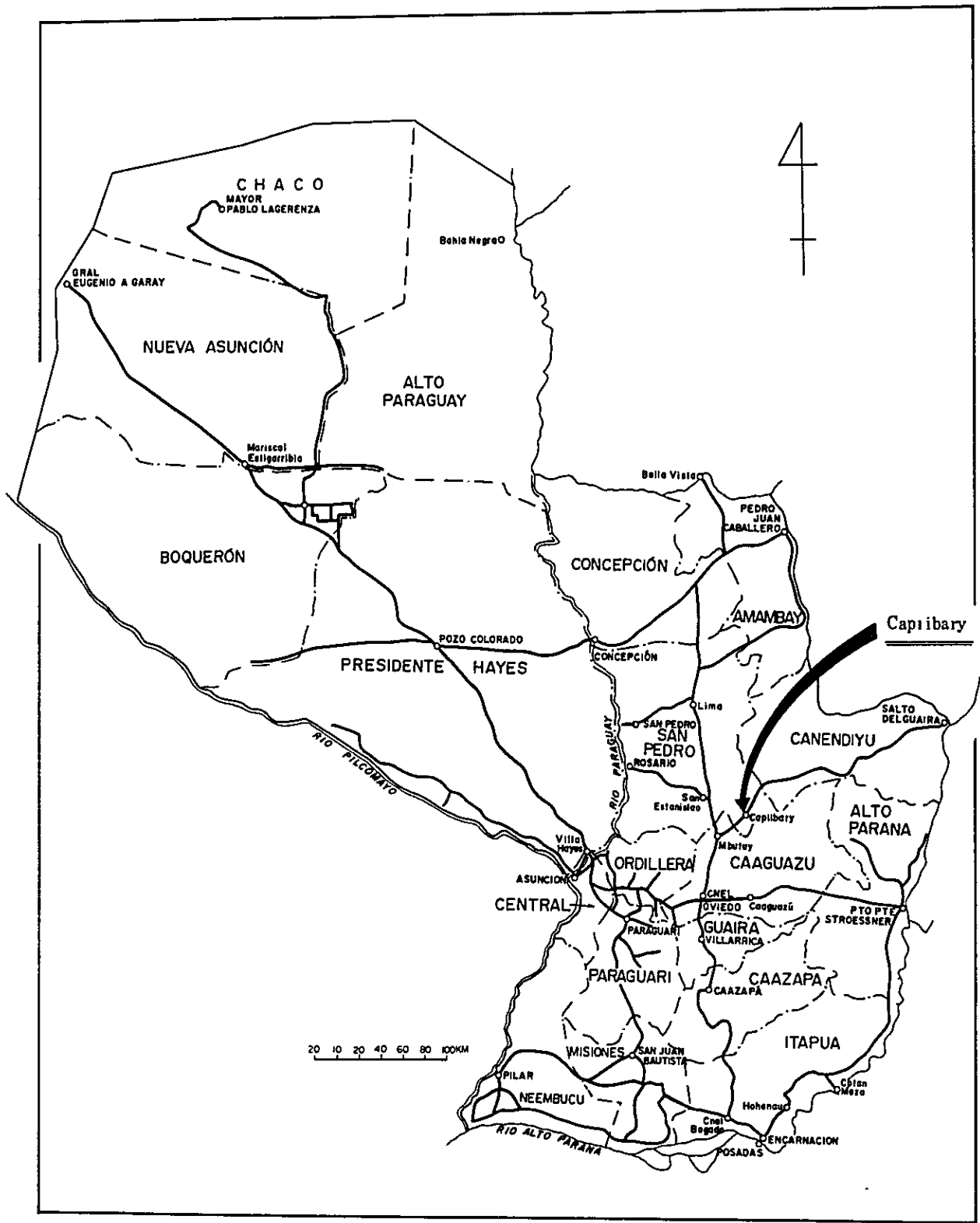


Fig. I-2-1 Location of study area

3. Contents of Survey

The survey is to be conducted for two years between fiscal year 1983 - 1984.

Fiscal Year 1983 was spent to obtain basic data for preparing afforestation plan with which in order to grasp the prevalent state of forests, by way of taking photographs, drafting basic maps and field survey by sample plots.

Besides field survey and analysis of soil and topography was conducted.

Survey and analysis were also conducted to obtain basic data on socio-economic conditions, forest product industries and market conditions, forestry-related enterprises and agroforestry.

Fiscal Year 1984 will be denoted to preparing the working design for the afforestation program. The working design on afforestation will cover nursery, planting, forest road and other relevant facilities.

Still more, the method of utilization will be studied for lumbering of natural trees and planted trees, as crude wood for pulp making and charcoal production, and development effect of agroforestry for local inhabitants. And economic analysis, financial analysis, development influence will be assessed for feasibility of enforcement of afforestation plan.

Fiscal Year 1983:

I. Scope of Survey

1. Aerial photographing

- a) Installation of aerial markers
- b) Aerial photographing
- 2. Preparation of basic maps
- 3. Demarcation and appraisal of study area
- 4. Acquisition and analysis of data on:
 - a) Natural conditions
 - b) Socio-economic conditions
 - c) Forest products industry and market conditions
 - d) Forestry
 - e) Agroforestry
- 5. Field survey and analysis on:
 - a) Forest resources
 - b) Forest soils
 - c) Artificial (planted) forest
 - d) Natural (forest) regeneration
 - e) Forestry related facilities

II. Contents of Survey

- 1. Preparatory work in Japan
 - a) Compilation and analysis of existing data
 - b) Preparatory work for field survey
- 2. Filed survey
 - a) Aerial photographing (of the study area on the scale of 1/20,000)
 - i) Installation of aerial markers
 - ii) Contract for aerial photographing
 - iii) Supervision of photographing and inspection of photographs
 - iv) Preparation of photo coverage index map
 - b) Demarcation of study area
 - c) Acquisition of data
 - i) Natural conditions
 - ii) Socio-economic conditions

- . General socio-economic conditions
 - . Infrastructure
 - . Bank's lending conditions and procedure for obtaining loans
 - iii) Forest product industries and market conditions
 - . Supply & demand of forest products and their prices
 - . Import and export of forest products
 - . Paper and pulp industry
 - . Charcoal manufacturing industry
 - . Other lumber industries
 - iv) Forestry related enterprises, etc.
 - . Prevalent state of building construction enterprises
 - . Prevalent state of civil engineering enterprises
 - . Prevalent state of timbering enterprises
 - . Prevalent state of forest developing enterprises
 - v) Agroforestry
 - d) Field survey
 - i) Quantity of forest resources
 - ii) Forest soils
 - iii) Growth increment of artificial forest
 - iv) Natural (forest) regeneration
 - v) Forestry related facilities
3. Analysis at home-office
- a) Preparation of enlarged basic maps (1/20,000, 5 m contour line, based on existing basic maps (1/50,000) and aerial photographs)
 - b) Appraisal of study area
 - i) Appraisal of the value of demarcated area
 - ii) Appraisal of the value of forest resources

- c) Analysis and compilation of data on natural and socio-economic conditions
- d) Analysis and compilation of data on forest products industries and market conditions
- e) Analysis and compilation of field survey findings
 - i) Classification of forest type on aerial photograph and preparation of forest type map
 - ii) Set up forest compartment
 - iii) Calculation of growing stock and increment, and preparation of forest inventory register
 - iv) Preparation of soil map
 - v) Analysis of forest productivity and preparation of a forest productivity map
 - vi) Examination and determination of appropriate tree species for planting
 - vii) Preparation of yield table of estimated of artificial forest and examination and determination of optimum cutting age
 - viii) Examination of testing and research methods for natural regeneration
- f) Preparation of appraisal sheet on the values of land and stumpage, and preparation of interim report

Fiscal Year 1984:

I. Scope of Survey

- 1. Field survey of basic design and plan on:
 - a) Forestry related facilities
 - b) Forest roads
 - c) Nursery facilities
 - d) Afforestation
 - e) Forest protection
 - f) Harvest and logging

- g) Charcoal production
- h) Agroforestry
- i) Testing and research on natural regeneration
- 2. Preparation of afforestation plan
- 3. Field examination and discussion of afforestation plan
- 4. Appraisal of afforestation plan
 - a) Financial analysis
 - b) Economic analysis
 - c) Impact of development

II. Contents of Survey

- 1. Preparatory work at home office
 - a) Determination of basic policy for formulating the afforestation plan
 - b) Preparatory work for field survey
- 2. Field survey
 - a) Field survey for basic design and plan
 - i) Forestry related facilities
 - ii) Forest roads
 - iii) Nurseries
 - iv) Afforestation
 - v) Forest protection
 - vi) Harvesting and logging
 - vii) Charcoal production
 - viii) Agroforestry
 - ix) Testing and research on natural regeneration
 - b) Field examination and discussion on afforestation plan
 - c) Explanation of draft final report
- 3. Analysis at home-office
 - a) Examination, evaluation and formulation of afforestation plan

- i) Preparation of total plan
 - . Related facilities
 - . Forest roads
 - . Nurseries
 - . Afforestation
 - . Forest protection
 - . Harvesting and logging
 - . Charcoal production
 - . Agroforestry
 - . Testing and research on natural regeneration
- ii) Preparation of project implementation program
 - . Preparation of annual program
 - . Preparation of budget and financing plan
 - . Preparation of logging and planting program register
 - . Examination of project executing organization
- iii) Examination and evaluation of forest development program
 - . Financial program
 - . Economic analysis
 - . Analysis of the impact of development
- b) Preparation of draft final report
- c) Preparation of final report

4. Survey in Fiscal Year 1983

4-1 Composition of Survey Team and Field Work

Field work was separately conducted for aerial photography and for forest inventory and other surveys.

Composition of the survey team and their field work were as follows.

Table I-4-1 Composition of survey team and field work (1983)

| Classification | Responsibility | Name | Period | Employee of |
|-----------------------------|---|----------------------|--------------------------|------------------------------------|
| Aerial photography | Photographing, mapping | SUNAOISHI, Mitsuo | Aug. 15 - Sept. 18, 1983 | KOKUSAI KOGYO CO., LTD. |
| First afforestation survey | General leader, forest survey | YAMAYA, Koichi | Oct. 7 - Dec. 5, 1983 | Japan Forest Technical Association |
| | Socio-economic survey, forestry-related facilities | NAKANO, Masato | ditto | ditto |
| | Demarcation of boundaries, appraisal of land and stumpage | SHOJIGUCHI, Seishiro | ditto | ditto |
| | Appraisal of land and stumpage and forest survey | MASUI, Hiroaki | ditto | ditto |
| | Demarcation of boundaries | KAWAMURA, Misao | ditto | ditto |
| Second afforestation survey | Forest survey | AZUMA, Yojo | ditto | ditto |
| | Forest survey | MASUI, Hiroaki | Jan. 13 - Feb. 6, 1983 | ditto |
| | " " | AZUMA, Yojo | ditto | ditto |

(Note) All members belong to the joint venture for survey on Afforestation Project in Capiibary, Paraguay.

4-2 Officials Concerned of the Government of Paraguay

The officials of the Servicio Forestal Nacional (SFN), the Government of Paraguay who have been taking part in the survey are listed below.

| | |
|----------------------------|--------------------|
| Ing. Agr. y Ftal. Director | Pedro F. Calabrese |
| Ing. Agr. | Rogelio Vidal |
| Ing. Agr. | Luciano Cabral |
| Ing. Agr. | Carlos Cuevas |
| Ing. Agr. | Dionisio González |
| Ing. Agr. | Hipolito López |
| Tech. Ftal. | Gilbert Bareiro |
| Tech. Ftal. | Miguel León |
| Tech. Ftal. | Ramón Lombardo |

5. Supervisory Committee

In accordance with its rules, JICA established a Supervisory Committee for the Feasibility Study on the Afforestation Project in Capiibary, Paraguay.

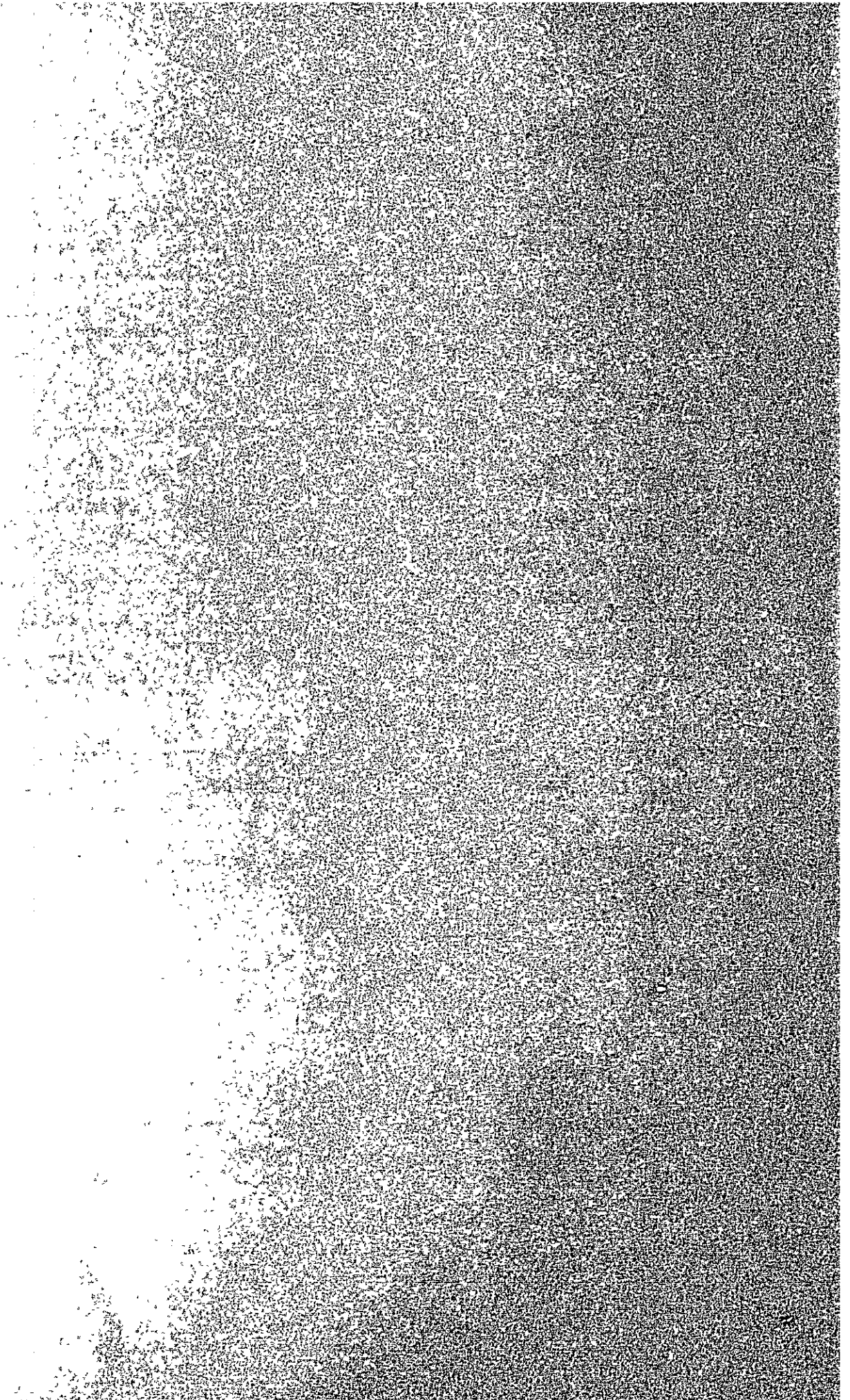
The roster of the committee members and the itinerary of the members who were dispatched to Paraguay during the field survey period are as follows:

Table I-5-1 Roster of the supervisory committee

| Assignment | Name | Affiliation | Field dis- patch period |
|---------------------------------|---------------------|--|----------------------------|
| Chairman, General supervision | SUZUKI, Susumu | Curriculum Counsellor, Forestry Training Institute, Forestry Agency | |
| Member, Socio-economic analysis | YASUNAGA, Tomomi | Director, Management Research Office, Kyushu Branch, Forestry and Forest Products Research Institute | Oct. 14 - Nov. 1, 1983 |
| Member, Market analysis | MIYAZAKI, Nobumitsu | Assistant Director, Forest Products Division, Forestry Agency | Oct. 14 - Nov. 1, 1983 |
| Member, Soil and silviculture | KARIZUMI, Noboru | Senior Research Officer, Silviculture Sub-Division, Silviculture Division, Forestry and Forest Products Research Institute | Oct. 14 - Nov. 1, 1983 |
| Member, Resources survey | KAMIJO, Kunihiro | Chief, Forest Resources Survey Unit, Planning Division, Forestry Agency | |
| Member, Forest management | WATANABE, Yoshihiko | Forest Planning Officer, Planning Division, Forestry Agency | |

SECTION II

**AERIAL PHOTOGRAPHY AND
DEMARCATON OF THE STUDY AREA**



SECTION II AERIAL PHOTOGRAPHY AND DEMARCATION
OF THE STUDY AREA

1. Aerial Photography

Aerial photographing was carried out over the entire study area of approximately 27,000 ha. The key data with respect to said photographing are presented in Table II-1-1.

For information, photographing work was subcontracted to Terra Foto S/A Atividades de Aerolevantamentos in Brazil.

Table II-1-1 Key data on photographing

| Item | Content |
|-----------------------------|----------------------------|
| Aircraft | EMB Navajo PT-EHJ |
| Focal distance | $f = 152.43 \text{ mm}$ |
| Photo film | CODAK DOUBLE X |
| Photo scale | 1 : 20,000 |
| Limit on overlap | Within 60% \pm 5% |
| Limit on side lap | Within 30% \pm 5% |
| Limit on inclination camera | Tip, and/or tilt within 5% |
| | Crab within 10% |
| Date of photographing | September 9, 1983 |
| Base airport | Asuncion |

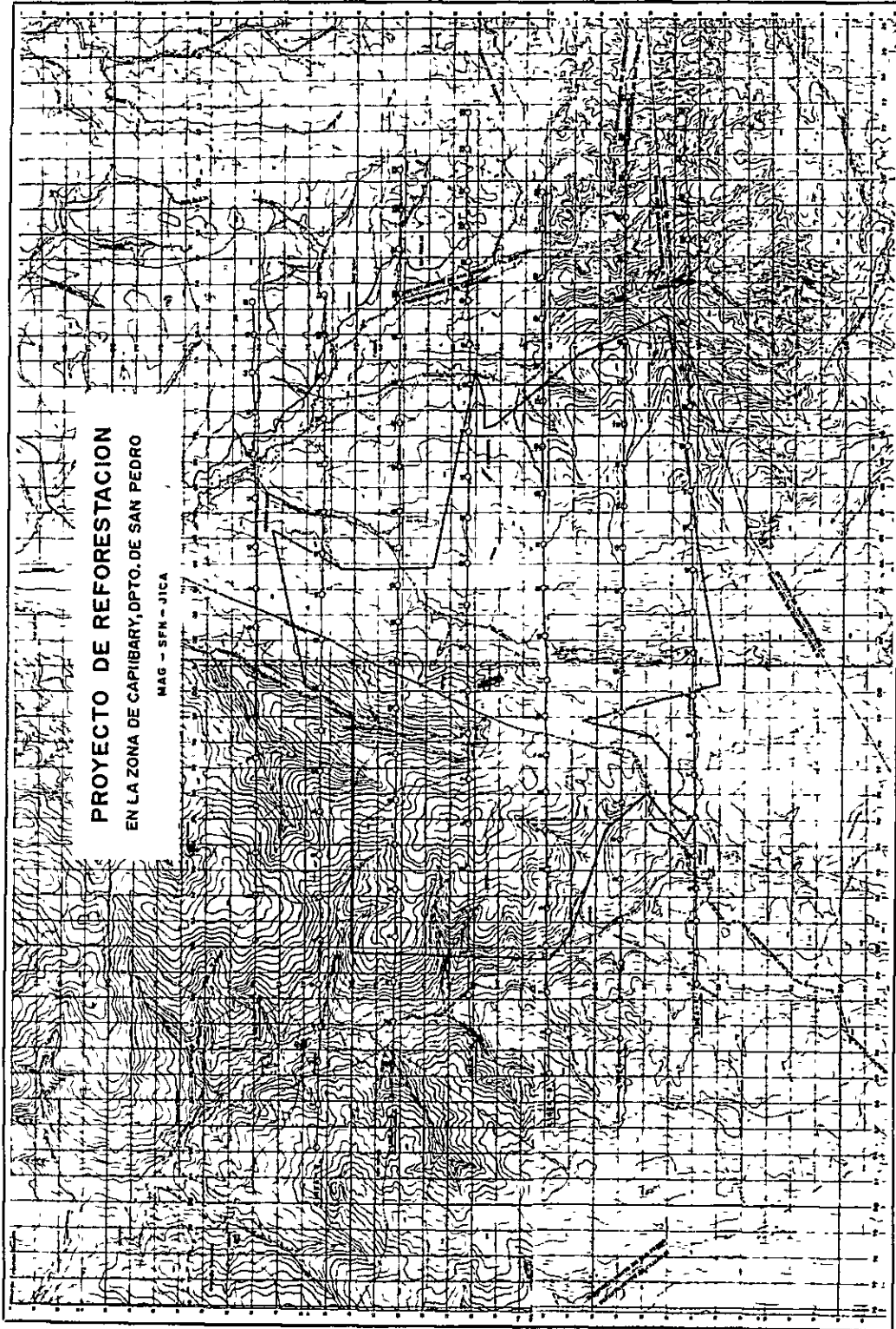


Fig. II-1-1 Aerial photographing orientation map

There were seven courses altogether, and the number of photographs taken for each course is as shown in Table II-1-2. Aerial-photo signals were installed by the SFN counterparts.

Table II-1-2 Numbers of photographs

| Course | Photo No. | No. of photographs |
|--------|-----------|--------------------|
| 1 | 1 ~ 16 | 16 |
| 2 | 1 ~ 21 | 21 |
| 3 | 1 ~ 23 | 23 |
| 4 | 1 ~ 23 | 23 |
| 5 | 1 ~ 22 | 22 |
| 6 | 1 ~ 24 | 24 |
| 7 | 1 ~ 23 | 23 |
| - | - | 152 |

2. Demarcation of the Study Area

The boundaries of the study area were determined by transit surveying by the Banco Nacional de Fomento (BNF), as shown in Table II-2-1.

Prior to confirmation of boundaries on the spot,

- 1) Air photo signals were installed at 6 major points along the course of traverse,
- 2) aerial photographs were taken (on September 9, 1983),
- 3) photographs were printed on the scale of 1/20,000.

Air photo signals were confirmed on the spot by stereoscopy of aerial photographs upon which the photographs were pricked to demarcate the boundaries.

When the boundaries were first surveyed by the Banco Nacional de Fomento, it had set up marking stakes at every corner and at an interval of 1 km along the course of traverse. Some of these marking stakes at major points were therefore confirmed and the forest clearance lines for surveying were also confirmed by stereoscopy of photographs to determine the boundaries.

On the basis of the survey results of the Banco Nacional de Fomento and the foregoing field work of confirming them, the boundaries were demarcated on the 1/20,000 topographic map as shown in Fig. II-2-1 and the attached figure.

Table II-2-1 Results of boundary survey

PLANILLA DE CALCULOS DE SUPERFICIE DE LA FINCA NO199 DE SAN ESTANISLAO, PADRON NO378, PROPIEDAD DEL BANCO NACIONAL DE FOMENTO. -

| Linea | umbos | Distancia | Coseno | Senó | Y | X | ΣY | ΣX | ΣY Sen. | ΣX Cos. |
|--|------------------|-----------|----------|-----------|-----------|-----------|-----------|-----------|--------------|---------------|
| 1-2 | S.W. 53° 54' 10" | 370.00 | -217.99 | -298.97 | 0.00 | 0.00 | -217.99 | -298.97 | +65172.4703 | +65172.4703 |
| 2-3 | S.W. 71° 49' 10" | 800.00 | -249.61 | -760.06 | -217.99 | -298.97 | -685.59 | -1358.00 | +521089.5354 | +338970.38 |
| 3-4 | S.W. 89° 18' 10" | 1100.00 | -10.20 | -1100.95 | -467.60 | -1059.03 | -945.40 | -3219.01 | +1040838.13 | +32833.902 |
| 4-5 | S.W. 26° 27' 50" | 400.00 | -358.09 | +178.25 | -477.00 | -2159.90 | -1313.69 | -4141.71 | -234165.2425 | +1483104.933 |
| 5-6 | S.E. 39° 03' 50" | 4300.00 | -3338.71 | +2709.80 | -835.89 | -1981.73 | -5010.49 | -1253.66 | -13577425.8 | +4185607.178 |
| 6-7 | S.E. 26° 27' 50" | 4025.00 | -3603.24 | +1793.68 | -4174.60 | +728.07 | -11952.44 | +3249.82 | -21438852.57 | -11709881.41 |
| 7-8 | S.W. 79° 58' 10" | 10315.20 | -1796.05 | -10157.54 | -7777.84 | +2521.75 | -17352.33 | -5114.04 | +176256986 | +9188139.966 |
| 8-9 | S.W. 75° 30' 22" | 4213.52 | -1054.55 | -4079.42 | -9574.49 | -7635.79 | -20203.53 | -19351.00 | +82418684.35 | +20406597.05 |
| 9-10 | N.W. 16° 50' 32" | 5847.70 | +5596.87 | -1694.30 | -10629.04 | -11715.21 | -15661.21 | -25124.72 | +26534788.1 | -140619791.6 |
| 10-11 | S.W. 11° 15' 34" | 2936.40 | -2879.88 | -573.34 | -5032.17 | -13409.51 | -12944.22 | -27392.36 | +7421439.094 | +78866709.71 |
| 11-12 | S.W. 47° 41' 07" | 1008.20 | -678.72 | -745.52 | -7912.05 | -13982.85 | -16502.82 | -28711.22 | +12303182.36 | +19486879.23 |
| 12-13 | S.W. 87° 24' 54" | 1815.50 | -81.88 | -1813.65 | -8590.77 | -14728.37 | -17263.42 | -31270.39 | +31309801.68 | +2560419.533 |
| 13-14 | S.W. 27° 07' 37" | 1267.10 | -1127.72 | -577.75 | -8672.65 | -16542.02 | -13473.02 | -33661.79 | +10672787.3 | +37961073.81 |
| 14-15 | N.W. 67° 19' 00" | 922.49 | +355.75 | -851.13 | -9800.37 | -17119.77 | -19244.99 | -35090.67 | +16379988.33 | -12483505.85 |
| 15-16 | N.E. 46° 37' 00" | 2447.75 | +1681.30 | +1778.76 | -9444.62 | -17970.90 | -17207.94 | -34162.84 | -30612236.94 | -57437982.89 |
| 16-17 | N.W. 43° 56' 00" | 2185.00 | +1573.52 | -1516.00 | -7763.32 | -16191.94 | -13953.12 | -33899.88 | +21152929.92 | -53342139.17 |
| 17-18 | N.W. 72° 25' 00" | 4254.00 | +1285.10 | -4055.25 | -6139.80 | -17707.94 | -11094.50 | -39471.13 | +44990971.12 | -50724349.16 |
| 18-19 | N.W. 56° 13' 00" | 1243.00 | +691.17 | -1033.11 | -4904.70 | -21763.19 | -9118.23 | -44559.49 | +9420134.595 | -30798182.7 |
| 19-20 | N.W. 00° 05' 32" | 8303.38 | +6303.37 | -13.36 | -4213.53 | -22796.30 | -123.69 | -45605.96 | +1652.4984 | -378683160.08 |
| 20-21 | N.E. 87° 53' 23" | 9310.46 | +342.84 | +9304.15 | +4089.84 | -22809.66 | +8522.82 | -36315.17 | +79294804.45 | -12450292.88 |
| 21-22 | N.E. 24° 26' 22" | 2148.76 | +1956.23 | +889.01 | +4432.68 | -13505.51 | -10821.59 | -26122.01 | +9620591.725 | -41100659.62 |
| 22-23 | N.E. 74° 35' 07" | 6361.83 | +1691.00 | +6132.98 | +6388.91 | -12616.50 | -14468.82 | -19100.02 | +83736983.68 | -32298133.82 |
| 23-24 | S.W. 25° 05' 31" | 3280.99 | -2971.36 | -1391.38 | -8079.91 | +6483.52 | -13188.46 | -14358.42 | -13350159.47 | +42664034.85 |
| 24-25 | S.E. 02° 15' 25" | 3804.06 | -3801.11 | +149.81 | +5108.90 | +7874.90 | +6415.99 | -15599.99 | +961179.4619 | +59297277.98 |
| 25-1 | S.E. 80° 23' 38" | 7834.95 | -1307.44 | +7725.09 | +1307.44 | -7725.09 | +1307.44 | -7725.09 | +10100091.66 | +10100091.66 |
| 2S = +544991165.8 2S = -544991165.8 | | | | | | | | | | |
| Superficie Poligonal 27249 ha 5582 m ² - | | | | | | | | | | |
| Superficie Ruta -85 " - | | | | | | | | | | |
| Superficie Intra Poligonal -94 " 8769 " 5924 " | | | | | | | | | | |
| Superficie Liquida 27069 ha 6813 m ² 3076 cm ² - | | | | | | | | | | |

Superficie Liquida : Veintisiete mil sesenta y nueve hectarea con seis mil ochocientos trece metros cuadrados y tres mil setenta y seis centímetros cuadrados.-

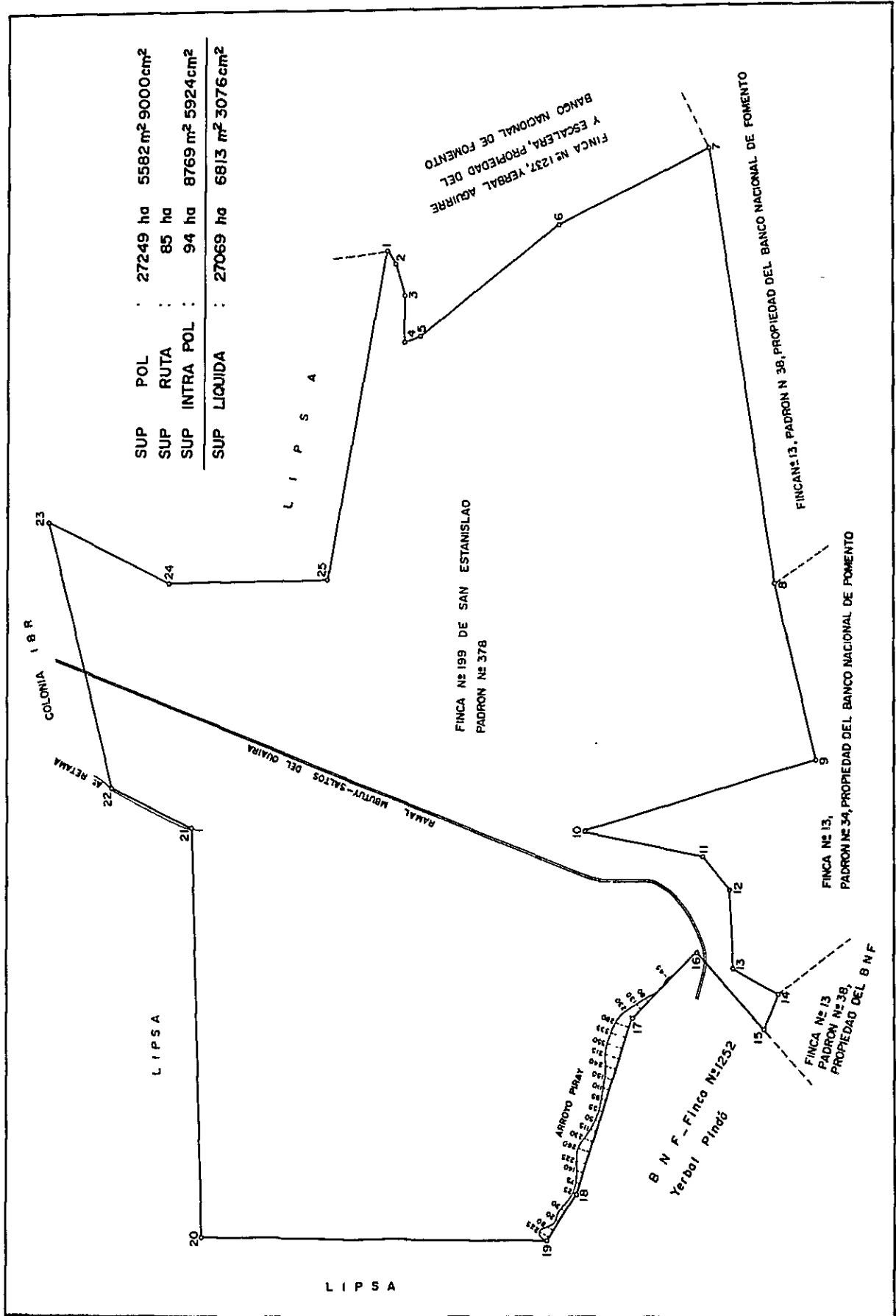


Fig. II-2-1 Demarcation and land area

3. Area of the Study Area

At first, the study area was about 25,000 ha. by S/W. However, it was decided to use the survey results of BNF as the area of the study area. This BNF's survey results excluded national road and others (about 180 ha) from the study area. But from the view point of its shape and area, these areas were included in the study area. As the results, the area of the study area was decided 27,250 ha.

Also, in the study area (1) 81 blocks covering 1,312 ha are said to have been sold during the days of FINAP for which the title deeds have not been registered or the boundaries clearly marked; (2) some of the land belong to former FINAP employees who settled there in return for unpaid wages but the boundaries and other details of settlement are unclear; and (3) there are about 25 families within the study area who have illegally settled and are making a living there.

4. Land Use Pattern

Area of land use areas in the study area were classified after photo interpretation and confirmation work in the study area. Land use areas were transferred on the basic map of 1/20,000. These areas were measured by using a dot plate of a 5 mm interval (1 point corresponds to 1 ha). (Table II-4-1, Fig. II-4-1)

Table II-4-1 The present condition of land use

| Land use | Area (ha) | Percentage(%) |
|--------------|-----------|---------------|
| Forest | 26,022 | 95.49 |
| Farmland | 401 | 1.47 |
| Pasture | 128 | 0.47 |
| Cutover area | 471 | 1.73 |
| Damp land | 133 | 0.49 |
| Road | 85 | 0.31 |
| Others | 10 | 0.04 |
| Total | 27,250 | 100.00 |

- (Note)
1. Aerial photographs were taken on September 9, 1983.
 2. Forest includes areas where clearing is under way for future cultivation as they could not be read from the photographs.
 3. Others are areas where could not be interpreted.
 4. BNF's survey results excluded national road of 85 ha and forests of 95 ha. These areas are excluded from the afforestation plan area.

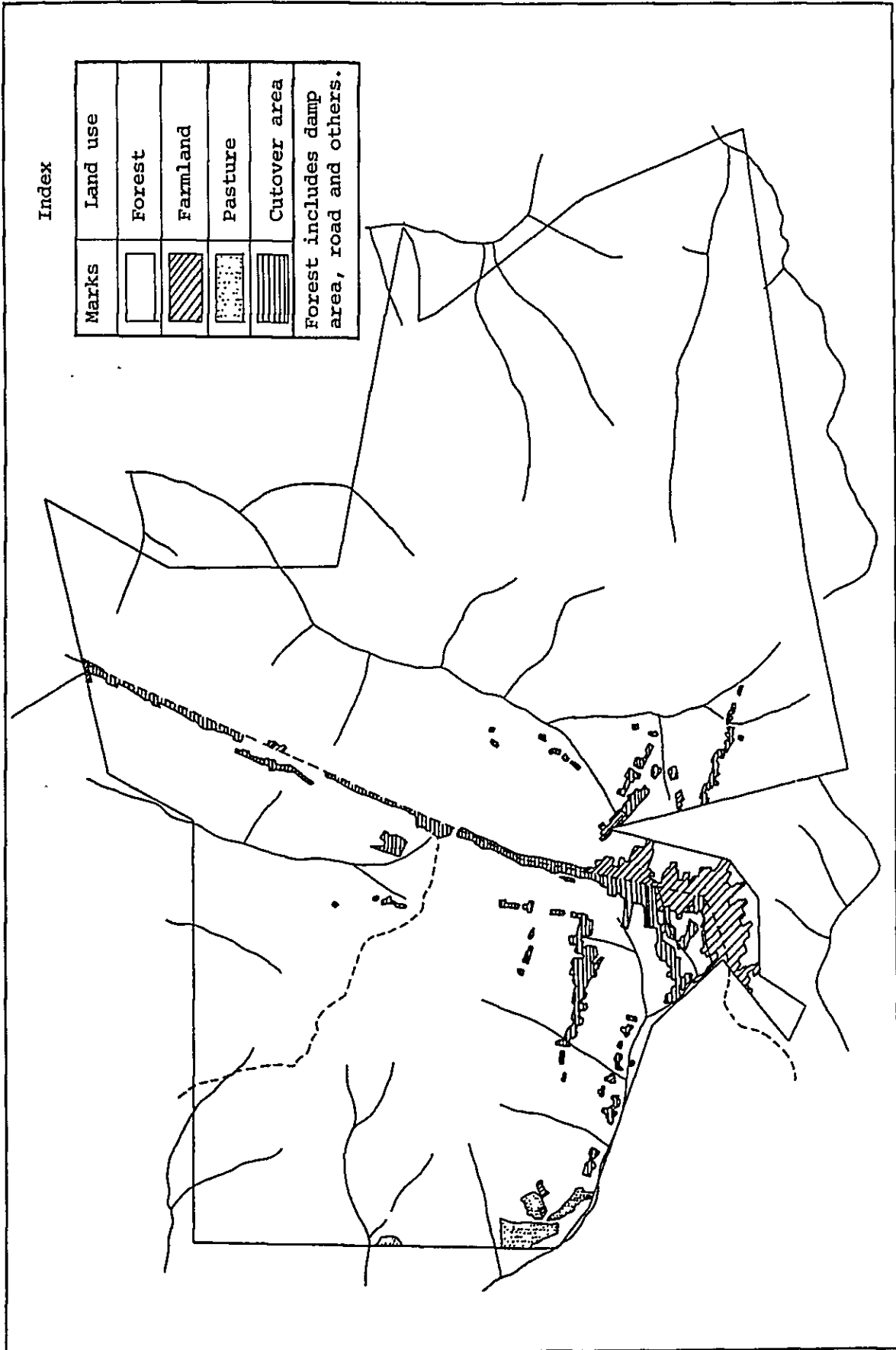


Fig. II-4-1 Land use

5. Planned Demarcation of the Afforestation Project Area

5-1 Afforestation Plan Area

The SFN's basic concept for the afforestation plan area is as follows.

- 1) A width of 1 km on each side of National Highway No. 10 shall be excluded from the afforestation plan area and shall be set aside for future settlements.
- 2) Where, as a result of aerial photo-interpretation, the already cultivated land of the settlements is found to be large in area and clustered together, shall be expanded by planning future settlements in areas adjacent to it, and same shall be excluded from the afforestation plan area.
- 3) Settlements in areas other than on the lots partitioned and sold and the small settlements which are scattered shall be considered for relocation to the land contiguous to the afforestation plan area earmarked for future settlements by de Instituto Bienestare Rural (IBR). Even though negotiation between SFN and settlers is still pending, such areas shall be included in the afforestation plan area.
- 4) The area around Cerro dos de Oro between National Highway No. 10 and Arroyo Rojas shall be reserved as the facilities zone for the afforestation plan.
- 5) The areas excluded from the afforestation plan area as in 1) and 2) above shall be about 6,000 ha.

Table II-5-1 and Fig. II-5-1 show the afforestation plan area demarcated in accordance with the basic concept of the Servicio Forestal Nacional. For the implementation plan scheduled for the next fiscal year, the above demarcation will be used in preparing the implementation plans on man-made afforestation zone, natural forest working zone, experimental zone, facilities zone, etc.

Table II-5-1 Planned demarcation of the afforestation plan area

| Division | Item | Area (ha) |
|---|--|-----------|
| Afforestation plan area | Forests | 21,553 |
| | Reserved for the facilities | 479 |
| | Total | 22,032 |
| Excluded from the afforestation plan area | A width 1 km of road except sites for the facilities | 3,345 |
| | Expanded settlements (East side) | 572 |
| | Expanded settlements (West side) | 1,301 |
| | Total | 5,218 |
| Total Area | | 27,250 |

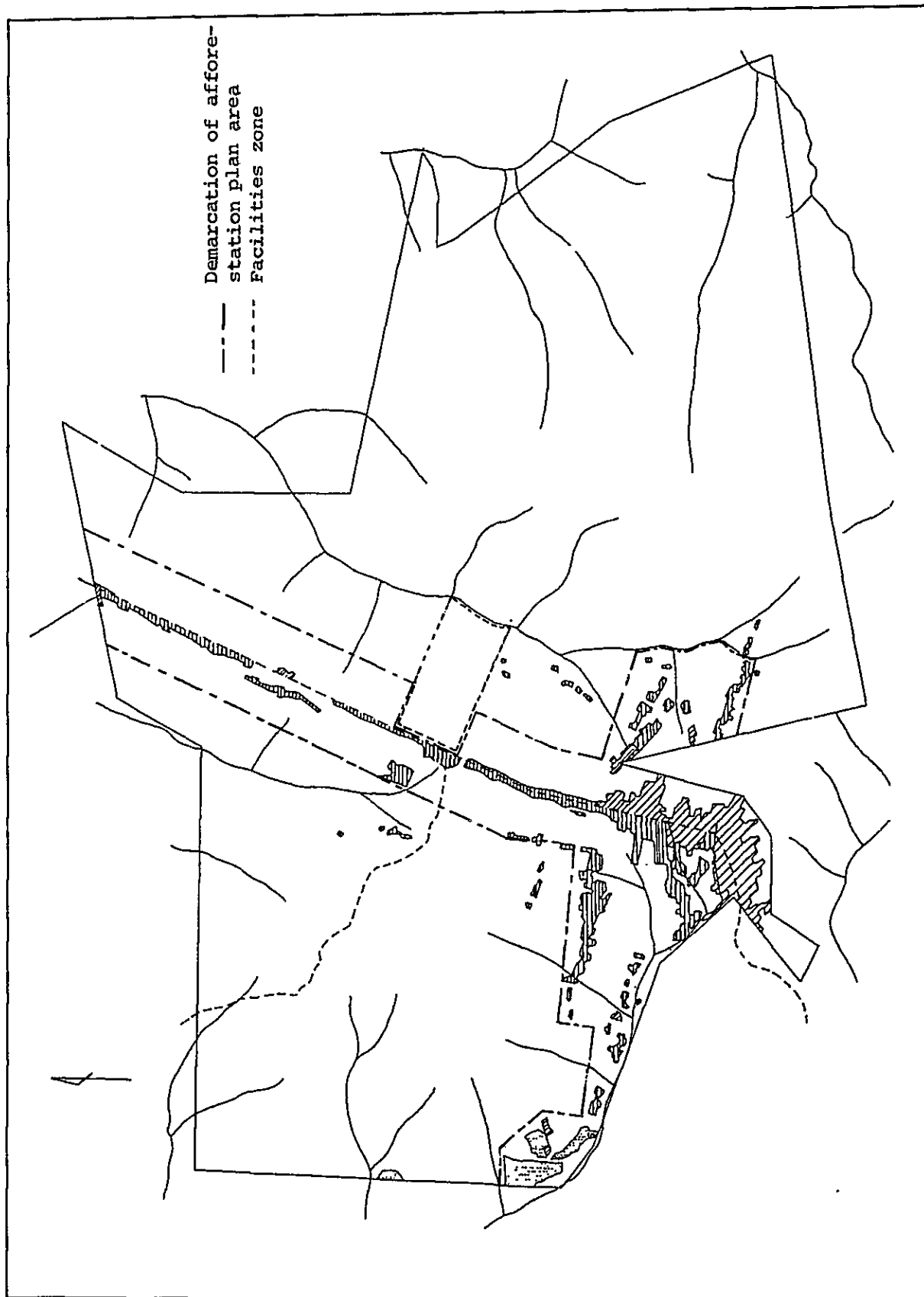


Fig. II-5-1 Planned demarcation of afforestation plan area

5-2 Demarcation of Compartment

5-2-1 Basic Consideration for Demarcation of Compartment

a. Compartment

To clarify the location of the forests as well as to facilitate project implementation, the project area should be divided into compartments, or fixed blocs.

The area of a compartment varies depending on the degree of concentration of management and conditions of forest area, but in principle, natural boundaries such as ridge tops and rivers, or stationary roads or fire breaks are utilized, while in flat land forests where these planimetric features do not exist, a clearcut artificial demarcation line is used.

In the case of the Capiibary Study Area, National Highway No. 10 cuts almost through the center of the study area which is mostly flat land and gentle slopes, and although there are small rivers in the area there is hardly any planimetric features to speak of which might serve as a proper boundary save for the national highway. Therefore, in the case of this study area, it is considered appropriate to use the mesh division (one mesh, 25 ha) or the artificial blocs already adopted in various analyses and, as a principle, to consider 400 ha as constituting one compartment.

Also, the use of Arabic figures is deemed appropriate to indicate each compartment.

b. Sub-compartment

It is a temporary small lot set up within a compartment for the convenience of land use or work execution.

In principle, sub-compartments are set up by dividing the compartment into portions in which species or treatment method is different from the rest of the compartment, or into portions in which stand age, site class, locality or hauling route is remarkably different from the rest, or into portions in which land use classification or administrative jurisdiction is likewise different from the rest of the compartment.

Also, it is convenient to classify sub-compartments by the use of different symbols such as for forest area and left-over area of the compartment, and in this case, the use of capital letters of alphabet for forest area and small letters of alphabet for left-over area is considered appropriate.

5-2-2 Suggested Plan for Setting up Compartments

Fig. II-5-2 shows the suggested plan for setting up compartments based on the above described basic idea, which should be finalized after consultation with the Servicio Forestal Nacional.

Sub-compartments should be studied and determined on the basis of the principles for partitioning after a decision has been reached on the division of compartments.

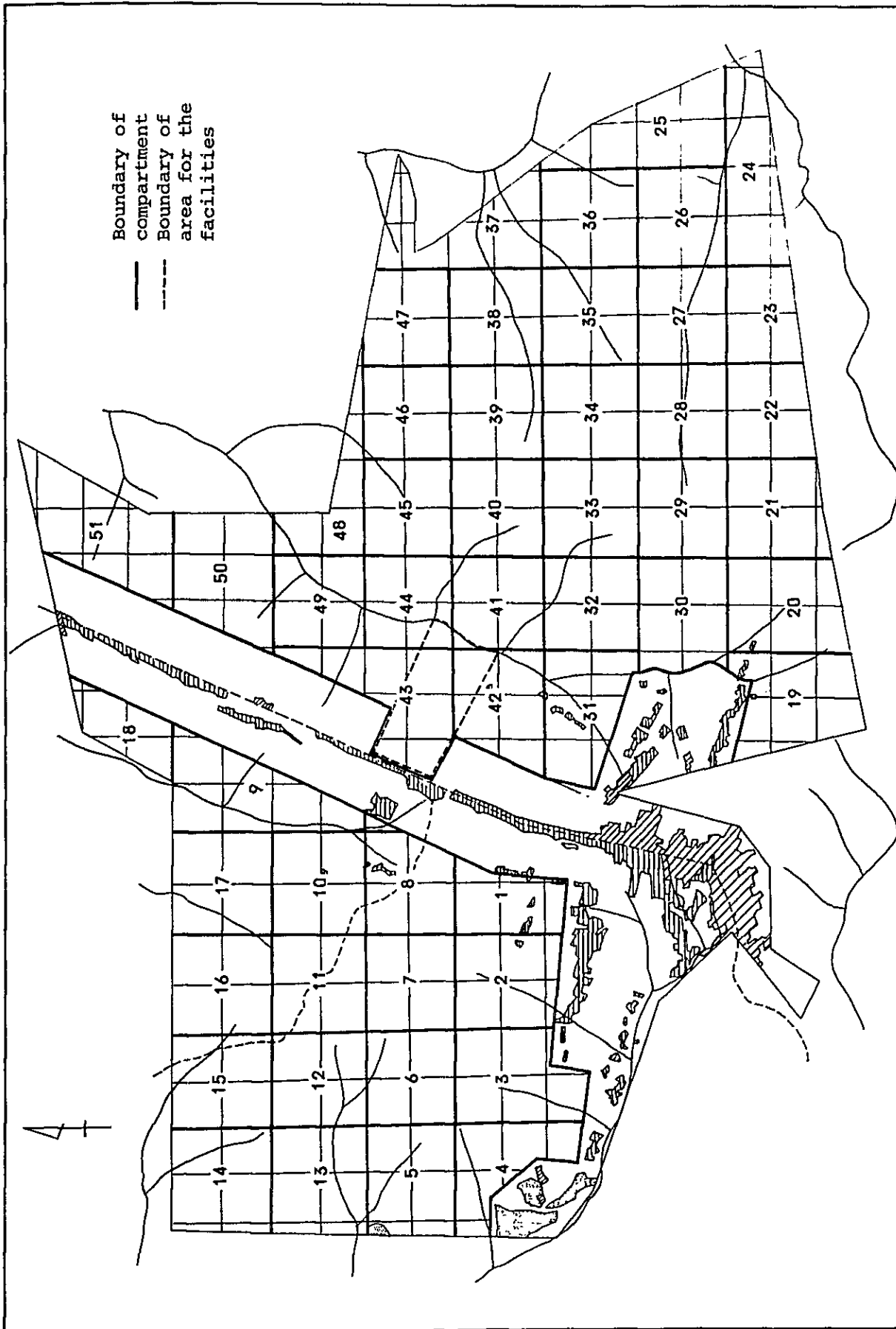


Fig. II-5-2 Planned demarcation of compartment

6. Appraisal of Land and Stumpage

At first, the jurisdiction of study area was expected to be transferred with compensation from Ministerio de Hacienda (MH) to Servicio Forestal Nacional (SFN). However in the Consejo Nacional de Coordinación Económica in October 27, 1983, it was decided to transfer to SFN without compensation. Appraisal of land and stumpage was bounded for a reference as separate volume.

SECTION III

SURVEY OF NATURAL CONDITIONS



SECTION III SURVEY OF NATURAL CONDITIONS

1. Climate, Soil and Topography

1-1 Climate

1-1-1 Climatic Classification

Paraguay is located in the inland area between the "Los Andes" in the west and the Brazilian plateau in the east, and is influenced by both the high temperature, wet equatorial air mass of the north and the low temperature, dry polar front of the south.

As for climate, the dry season lasts from May to September and the rainy season from October to April. Spring is supposed to be the months of September and October, summer from November through March, autumn in April and May and winter from June to August, but it is difficult to divide the seasons by the months because the meteorological conditions are unstable and also because the temperature varies wildly depending on which way the wind happens to be blowing.

Observed data of the meteorological observatories are shown in V Data 1-1~19. Isothermal lines based on annual mean temperature and isopluviometric lines based on annual mean precipitation are shown in Fig. III-1-1, 2 respectively. Also, III Data 2-1~22 show the meteorological conditions by Walter's climatic graph. From these, the climate in Paraguay may be classified as being subtropical in the Chaco region, west of Rio Parana while in the east of Rio Parana the climate is subtropical with a dry season in the areas northwest of the isopluviometric line of 1,700 mm annual mean precipitation and wet subtropical in the southeast of the line.

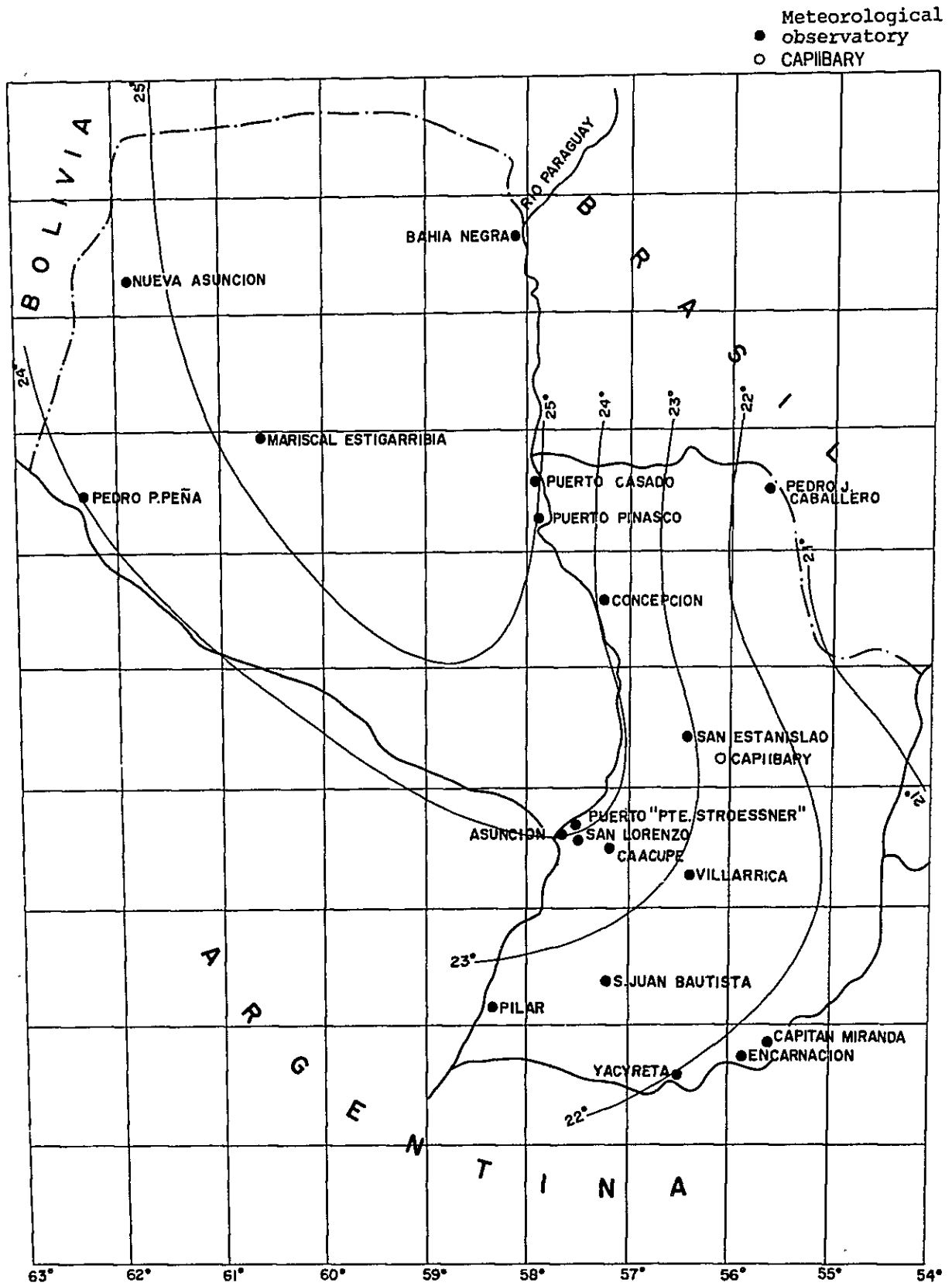


Fig. III-1-1 Mean annual temperature (C°)

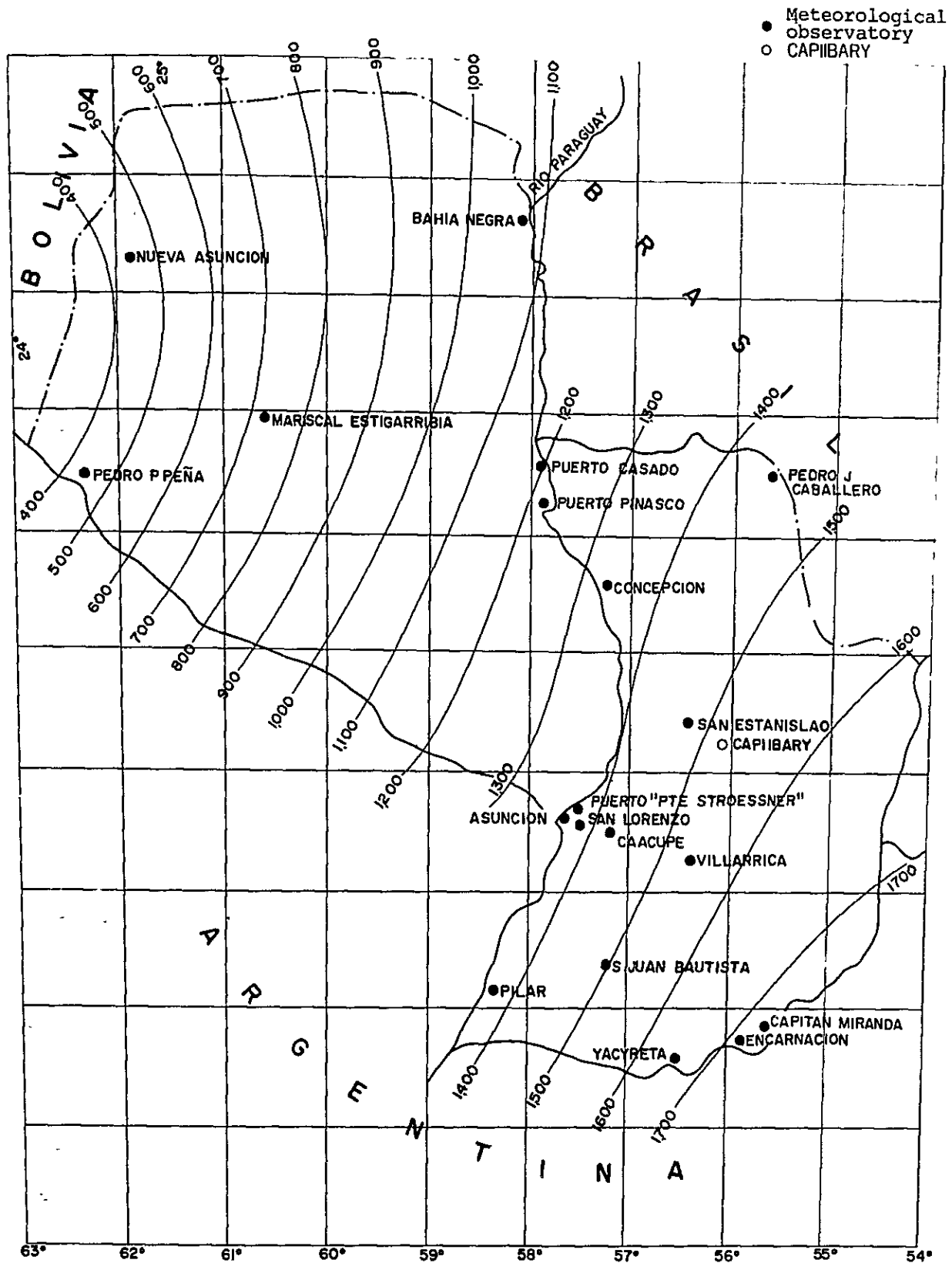


Fig. III-1-2 Mean annual precipitation (mm)

1-1-2 Meteorological Disasters

Major meteorological disasters are caused by frost, heavy rain and drought and occasional cloudbursts, hailstorms and strong gusts of wind.

o Damage by frost

Coffee is the most susceptible to damage in the event of frost. Coffee is cultivated mainly in the Department of Amanbai in the northeastern plateau where frost has the least chances of falling in Paraguay, but when it does frost the most devastating damage is sustained where frost is most likely to fall, that is, where the land is flat.

In some places, frost occurs more than 10 times a year, including both light and heavy.

o Damage by rainfall

The damage caused by the rainfall of 1983, known to be the worst that has ever happened during this century, is still fresh in our memory. The rivers which had been on a rising trend since the year before kept on rising due to the heavy rainfalls that continued since the start of April until the big rivers like Rio Parana, Rio Paraguay, Rio Iguazú and Rio Uruguay began to overflow one after the other in late May, resulting in a catastrophic flood that inundated all of the southern part of South America.

Such a rainfall is of course exceptional, but even in normal years, when it rains for a long time during the harvesting season the heaviest damages are sustained by soybeans partly because of their large cropping area. Also, damages to cotton, tomatoes and other vegetables are sometimes seen to occur due to blight and insects induced by long rainfalls. Damage by long rainfalls are

particularly severe in the areas where the infrastructures are still underdeveloped, resulting in inundation of houses, collapse of roads, burying of side gutters and underground drains and washing away of bridges.

o Damage by drought

Heavy damages in case of drought are suffered by the short term crops like maize, soybeans and cotton. The damages are particularly severe when the drought occurs during the sowing season or in the early growth period, particularly, during germination.

o Other damages

There are no such thing as a typhoon in Paraguay but sudden gusts of winds sometime blow due to low atmospheric pressure. A wind storm as strong as to cause wind-fall damage is said to occur only once in several decades. Hailstorms are said to pass over with a certain width so that it is the places that are within its passage that suffer damages, though limited in area.

1-1-3 Meteorological Conditions in Capiibary

San Estanislao Meteorological Observatory located 40 km north west of Capiibary is the nearest observatory to the Capiibary area. The observatory has been performing irregular observations since the middle of 1974 and its observed data are shown in V Data 1-19. 1978 is the only year for which complete annual data are available which are insufficient with which to analyze the meteorological conditions in Capiibary, but they have been represented by Walter's climatic graph in V Data 2-19~22 anyway. Dry weather began in 1976 and lasted until the middle of 1979. According to local information, there was more rainfall in April 1979 than in normal years while rainfall in June (1.1 mm) was extremely small.

Gathering from the above, the meteorological conditions in Capiibary in normal years seem pretty close to the observed values at Villarrica. The observed results at Villarrica Observatory between 1961 and 1970 (V Data 1-13 and V Data 2-13) indicate an annual mean temperature of 22.2°C, maximum temperature of 38.6°C and minimum temperature of -2.4°C, with a range of 11.3°C between maximum and minimum annual mean temperatures.

Annual amount of rainfall is 1,659.3 mm, which more than 100 mm of rainfall each month except during the three months of June, July and August. The number of rainy days per month is more or less the same, ranging between six to nine days which suggests that in the months of little rainfall, the amount of rainfall per rainy day is also small.

Prevailing winds are NE and S throughout the year. In terms of annual average, NE winds account for 21% and S 28%, the two jointly accounting for about 50%. Windless days account for 20% of the year.

1-2 Topography

1-2-1 Topography

The study area in Capiibary District is located in the upstreams of Arroyo Capiibary and Arroyo Corrientes. Arroyo Capiibary is the river that originates in Sierra de San Joaquin and runs through San Pedro as it flows north and merges with Rio Paraguay.

Table III-1-1 shows the results of having analyzed each factor of the study area by the mesh (= 25 ha) method. According to the results, the study area has a gently undulating topography with 71.2% of the area being either upper

plain of plateau or plain of plateau, 76.5% above 250 m (maximum elevation 380 m) in elevation and 77.9% of the area sloped below 3° and 99.0% below 6°. The azimuth of study area has approximately the same direction, and 4.8% of the area with no bearing below 1°.

A dissection is seen on the eastern side of the area caused by Arroyo Rojas, a tributary of Arroyo Corrientes, and other factors.

1-2-2 Geology

In Eastern Paraguay, Jurassic Misiones formation spreads widely from Canendiyu to Caaguazu and further into Misiones. Capiibary merges with the western edge of this formation.

This formation consists of amorphous red sandstone called Misiones sandstone, and includes a small quantity of red shale and pelite. The formation is continental clastic deposit formed on Parana basin by the action of Brazilian shield during the period from the Devonian to the Cretaceous. (FAO-UNESCO, 1971, Juan H. Palmieri, Juan C. Velazquez, 1982).

The study area is covered with this red sandstone, which is the parent material of soil. The sandstone is composed of large round grains of quartz sand. Comparatively new hard sandstone is colored pink. Weathered and softened stone shows ironcoated quartz particles heavily tinged with dark red.

Table III-1-1 General situation of topography

| Division | | | | | | (%) |
|------------|--------------------------|------------------|---------------------------------|------------------------|-----------|---------|
| Topography | Upper plain of plateau | Plain of plateau | Gentle slope on the valley head | Valley slope | Monadnock | |
| % | (12.0) | (59.2) | (15.8) | (12.6) | (0.4) | (100.0) |
| Elevation | Above 300 m (max. 380 m) | 300-250 m | 250-200 m | 200-150 m (min. 160 m) | - | |
| % | (34.1) | (42.4) | (19.8) | (3.7) | - | (100.0) |
| Slope | 0-3° | 3-6° | 6-9° | 9-12° | Above 12° | |
| % | (77.9) | (21.1) | (0.8) | (0.2) | (0.0) | (100.0) |
| Bearing | N | E | S | W | Nil | |
| % | (27.5) | (24.9) | (20.4) | (22.4) | (4.8) | (100.0) |

2. Forest Inventory

This forest resources survey was carried out to make clear the condition of forest resources in the study area. The survey consists of forest inventory, forest soil survey, and socio-economic investigation and so on. These results are the basic data to prepare a suitable afforestation project for this area, and to appraise the value of stumpage.

There are a lot of methods to estimate the growing stock. This time we adopted the sample plot method, because the useful trees has been extracted from the study area, at the same time we had to perform forest soil survey and natural regeneration survey in a short period. The sample plots were extracted by means of photo-interpretation so that enough precision can be maintained.

2-1 Survey Method

2-1-1 Forest Type Interpretation

Forest type interpretation is for forest classification.

Tree height, crown density and crown diameter were adopted for forest interpretation as volume estimate. The standard interpretation classification is shown in Table III-2-1.

Table III-2-1 Interpretation classification factors

| Factor | Symbol | Contents | |
|----------------|-----------------|------------------------|-----------|
| Height grade | H ₁ | Average height | 1-5 m |
| | H ₂ | Average height | 6-10 m |
| | H ₃ | Average height | 11-15 m |
| | H ₄ | Average height | 16-20 m |
| | H ₅ | Average height | Over 21 m |
| Crown diameter | D ₁ | Average crown diameter | 1 m |
| | D ₂ | Average crown diameter | 2 m |
| | ⋮ | | ⋮ |
| | D ₁₄ | Average crown diameter | 14 m |
| | D ₁₅ | Average crown diameter | 15 m |
| Crown density | C ₅ | Crown density | 0-5% |
| | C ₁₀ | Crown density | 6-10% |
| | ⋮ | | ⋮ |
| | C ₉₀ | Crown density | 86-90% |
| | C ₉₅ | Crown density | 91-95% |

According to this standard, the aerophotograph was interpreted. And the forest was divided into High forest (A), Medium forest (M), Low forest (B) by tree height and crown diameter. From the general forest condition, tree height and crown diameter used for to divide forest type. Those standard are 15 m and 12 m.

Table III-2-2 Forest type classification

| Forest type | Symbol | Tree hight | Crown diameter |
|---------------|--------|--------------------------|---------------------------|
| High forest | A | More than H ₄ | More than D ₁₂ |
| Medium forest | M | More than H ₄ | Less than D ₁₂ |
| Low forest | B | Less than H ₄ | --- |

The following table is the area of each forest type.

Table III-2-3 Areas by Forest Types

| Forest Type | Symbol | Area (ha) | Percentage (%) |
|---------------|--------|-----------|----------------|
| High forest | A | 8,683 | 33.37 |
| Medium forest | M | 15,627 | 60.05 |
| Low forest | B | 1,712 | 6.58 |
| Total | | 26,022 | 100.00 |

2-1-2 Sample Plot Survey

a. Plot setting

Forest areas of high forest, medium forest and low forest were estimated and rated as follows 3.4:6:0.6 by aerial photograph interpretation result and we found that high forests had variation in volume.

Considering these results, tree height, crown diameter and crown density, sample plots were chosen to get a various kind of pattern.

Sample plot area is 100 m x 40 m (0.4 ha) and is divided into four blocks as follows:

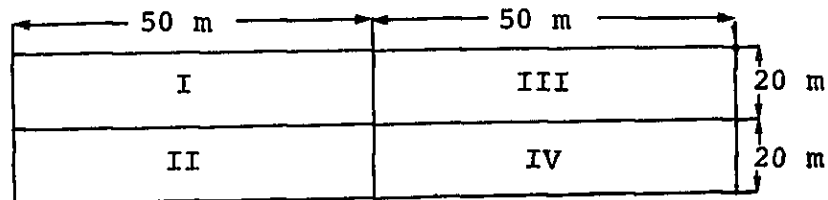


Fig. III-2-1 Sample plot shape

b. Stumpage researching method in sample plot area

The following items were measured on all stumpages which diameter breast height (DBH) (height \approx 1.3 m) was more than 10 cm.

- 1) Species
- 2) Diameter breast height (DBH)
- 3) Diameter at 5 m
- 4) Diameter at commercial height
- 5) Commercial height
- 6) Total tree height
- 7) Observation of irregularities

Species name were written by local name and "No. identificado" was used for unidentified species. Diameter breast height was measured at 1.3 m by a diameter tape. Diameter at 5 m and diameter at commercial height were measured by Pentaprism (dendrometer made in U.S.A.). Observation of irregularities was used to judge whether the dendrometry tree could be used for commercial material or not and judged whether it was defective tree or not.

c. Stumpage counting method in sample area

① Single tree counting method

Volume of single tree was counted by each tree height and diameter and counted in more than 5 m and less than 5 m. Sumarian formula was adopted as follows.

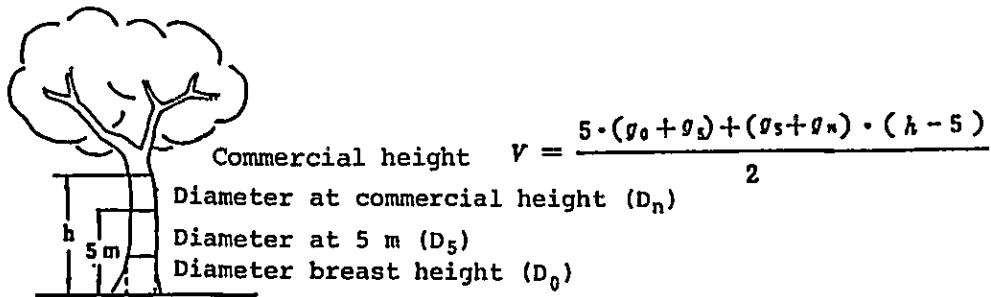


Fig. III-2-2 Measuring place of single tree
(In case of more than 5 m of commercial height)

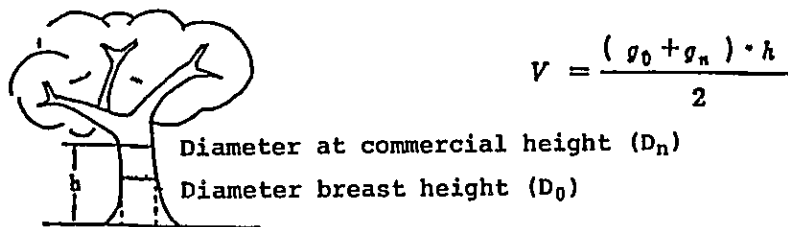


Fig. III-2-3 Measuring Place of single tree
(In case of less than 5 m of commercial height)

h = Commercial tree height

$g_n = \frac{\pi}{4} d_n^2$ = Slide area at commercial height

$g_5 = \frac{\pi}{4} d_5^2$ = Slide area at 5 m

$g_0 = \frac{\pi}{4} d_0^2$ = Diameter breast slide area

d_n = Diameter at commercial height

- Diameter at 5 m

d_0 = Diameter breast height

② Bark thickness measuring method

Commercial volume without bark was needed to obtain a volume. Volume was counted at volume without bark and at volume with bark. Bark thickness is shown as follows:

This was based on FAO research report. In this report each species had each formula and were divided into four groups according to similar character.

$$\text{Group I : } y = 0.0236x + 0.0093$$

$$\text{II : } y = 0.0632x + 0.0023$$

$$\text{III: } y = 0.0768x + 0.0013$$

$$\text{VI : } y = 0.0824x + 0.0030$$

(Y: Bark thickness,
x: Diameter)

Volume and diameter of trees without bark were measured according to above method. Species of each group has species No. which are shown in V Data 5. And species belonging to each group are shown in V Data 5.

d. Volume counting at each sample plot

Total volume of each sample plot was obtained by adding volume of single tree. This was counted at 10 cm diameter, by grade, by class, and by species. This is shown in appendix V Data 6~11.

2-2 Results of Field Survey

2-2-1 Location and Number of Sample Plot

32 sample plot consisting of 15 high trees, 15 medium trees and 2 low trees were surveyed considering area

ratio, tree height, crown diameter and crown density. These location are shown in Fig. III-2-4.

2-2-2 Results of Sample Plot Survey

Table III-2-4 and III-2-5 show the number of trees and volume per ha for each factor of surveyed 32 plots.

V Data 3, 4 show values within 0.4 ha of the standard site.

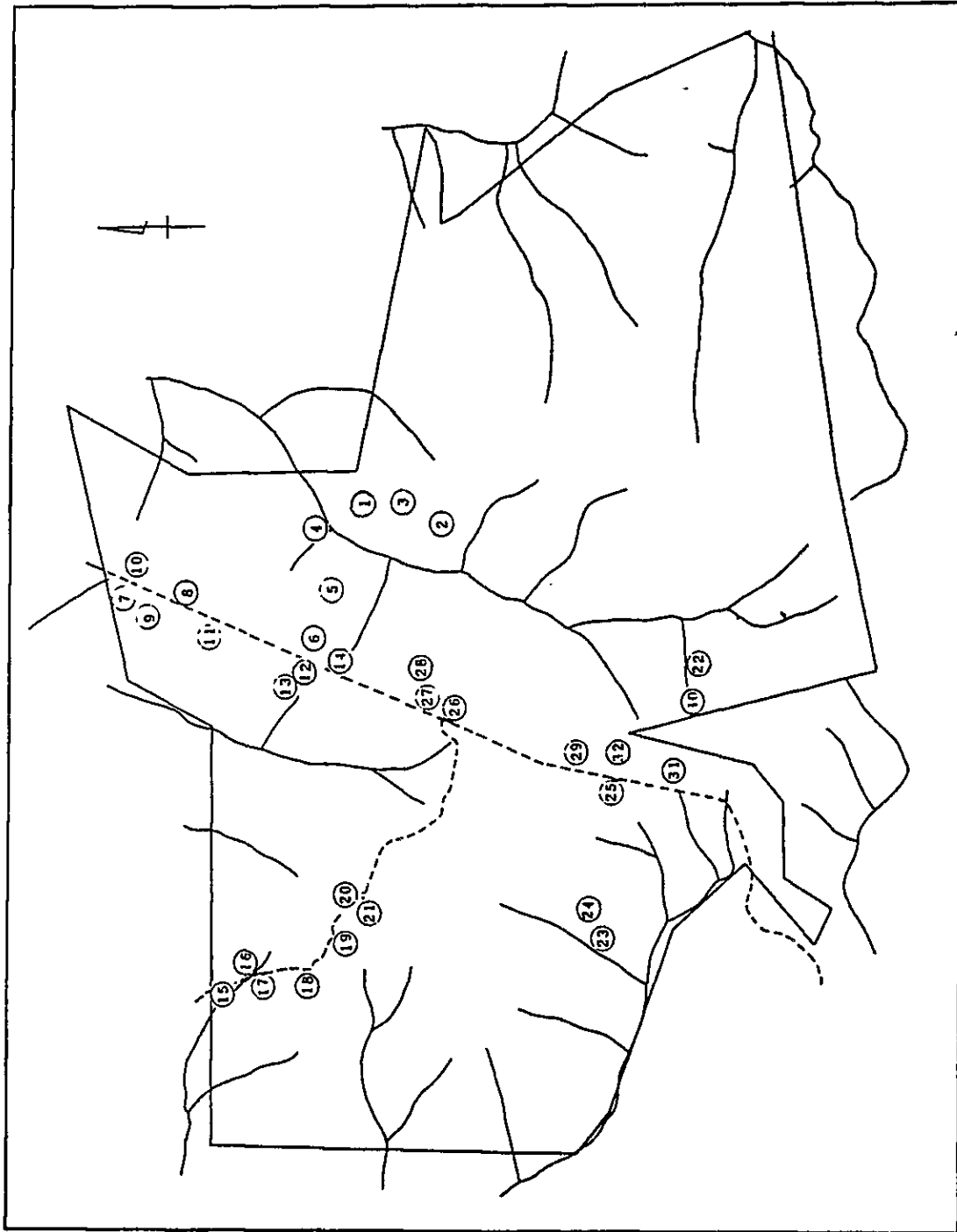


Fig. III-2-4 Location of sample plots

Table III-2-4 Results of sample plot survey (Number of trees per ha)

No. _____

| Plot No. | Forest Type | More than 10cm of diameter breast height total | More than 41cm of diameter breast height total | More than 10cm of diameter breast height wholesome tree | | | | | More than 10cm of diameter breast height defective tree | | | | | More than 41cm of diameter breast height wholesome tree | | | | | More than 41cm of diameter breast height defective tree | | | | |
|----------|-------------|--|--|---|-------|---------|---------|---------|---|-----|------|-------|-------|---|-------|-------|-------|-------|---|-----|-----|------|-------|
| | | | | A | B | C | D+E | Total | A | B | C | D+E | Total | A | B | C | D+E | Total | A | B | C | D+E | Total |
| 1 | M | 310.0 | 35.0 | 30.0 | 2.5 | 60.0 | 210.0 | 302.5 | 2.5 | 0.0 | 0.0 | 5.0 | 7.5 | 12.5 | 0.0 | 7.5 | 12.5 | 32.5 | 0.0 | 0.0 | 0.0 | 2.5 | 2.5 |
| 2 | M | 250.0 | 35.0 | 30.0 | 35.0 | 70.0 | 115.0 | 250.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.0 | 10.0 | 15.0 | 5.0 | 35.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3 | M | 177.5 | 22.5 | 32.5 | 2.5 | 50.0 | 82.5 | 177.5 | 0.0 | 2.5 | 0.0 | 7.5 | 10.0 | 7.5 | 2.5 | 10.0 | 0.0 | 20.0 | 0.0 | 0.0 | 0.0 | 2.5 | 2.5 |
| 4 | B | 375.0 | 2.5 | 0.0 | 5.0 | 20.0 | 345.0 | 370.0 | 0.0 | 0.0 | 0.0 | 5.0 | 5.0 | 0.0 | 0.0 | 0.0 | 2.5 | 2.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 5 | A | 242.5 | 32.5 | 32.5 | 15.0 | 40.0 | 155.0 | 242.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.5 | 7.5 | 12.5 | 10.0 | 32.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 6 | A | 247.5 | 50.0 | 30.0 | 25.0 | 32.5 | 150.0 | 227.5 | 2.5 | 0.0 | 2.5 | 15.0 | 20.0 | 7.5 | 2.5 | 12.5 | 22.5 | 45.0 | 0.0 | 0.0 | 0.0 | 5.0 | 5.0 |
| 7 | A | 290.0 | 35.0 | 60.0 | 10.0 | 20.0 | 187.5 | 277.5 | 0.0 | 0.0 | 2.5 | 10.0 | 12.5 | 15.0 | 0.0 | 7.5 | 10.0 | 32.5 | 0.0 | 0.0 | 0.0 | 2.5 | 2.5 |
| 8 | A | 215.0 | 47.5 | 50.0 | 17.5 | 25.0 | 112.5 | 205.0 | 0.0 | 0.0 | 2.5 | 7.5 | 10.0 | 22.5 | 5.0 | 7.5 | 12.5 | 47.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 9 | A | 185.0 | 22.5 | 32.5 | 12.5 | 32.5 | 105.0 | 182.5 | 2.5 | 0.0 | 0.0 | 0.0 | 2.5 | 7.5 | 2.5 | 5.0 | 5.0 | 20.0 | 2.5 | 0.0 | 0.0 | 0.0 | 2.5 |
| 10 | A | 245.0 | 37.5 | 27.5 | 10.0 | 45.0 | 162.5 | 245.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 10.0 | 2.5 | 5.0 | 20.0 | 37.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 11 | A | 162.5 | 35.0 | 15.0 | 17.5 | 20.0 | 105.0 | 157.5 | 0.0 | 0.0 | 0.0 | 5.0 | 5.0 | 5.0 | 2.5 | 2.5 | 25.0 | 35.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 12 | A | 267.5 | 47.5 | 35.0 | 22.5 | 45.0 | 160.0 | 262.5 | 0.0 | 0.0 | 0.0 | 5.0 | 5.0 | 10.0 | 12.5 | 12.5 | 10.0 | 45.0 | 0.0 | 0.0 | 0.0 | 2.5 | 2.5 |
| 13 | A | 222.5 | 37.5 | 42.5 | 12.5 | 35.0 | 125.0 | 215.0 | 5.0 | 0.0 | 0.0 | 2.5 | 7.5 | 20.0 | 2.5 | 10.0 | 2.5 | 35.0 | 0.0 | 0.0 | 0.0 | 2.5 | 2.5 |
| 14 | M | 202.5 | 25.0 | 30.0 | 17.5 | 20.0 | 110.0 | 177.5 | 0.0 | 2.5 | 10.0 | 12.5 | 25.0 | 5.0 | 7.5 | 7.5 | 2.5 | 22.5 | 0.0 | 2.5 | 0.0 | 0.0 | 2.5 |
| 15 | A | 285.0 | 25.0 | 55.0 | 12.5 | 60.0 | 155.0 | 282.5 | 0.0 | 0.0 | 0.0 | 2.5 | 2.5 | 7.5 | 2.5 | 7.5 | 7.5 | 25.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 16 | M | 270.0 | 30.0 | 57.5 | 20.0 | 30.0 | 162.5 | 270.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17.5 | 5.0 | 5.0 | 2.5 | 30.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 17 | A | 235.0 | 22.5 | 45.0 | 5.0 | 42.5 | 140.0 | 232.5 | 0.0 | 0.0 | 0.0 | 2.5 | 2.5 | 15.0 | 0.0 | 7.5 | 0.0 | 22.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 18 | A | 287.5 | 25.0 | 50.0 | 10.0 | 42.5 | 185.0 | 287.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 12.5 | 5.0 | 7.5 | 0.0 | 25.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 19 | A | 237.5 | 27.5 | 22.5 | 10.0 | 35.0 | 157.5 | 225.0 | 0.0 | 0.0 | 2.5 | 10.0 | 12.5 | 5.0 | 5.0 | 10.0 | 5.0 | 25.0 | 0.0 | 0.0 | 2.5 | 0.0 | 2.5 |
| 20 | A | 285.0 | 55.0 | 17.5 | 27.5 | 47.5 | 185.0 | 277.5 | 0.0 | 0.0 | 0.0 | 7.5 | 7.5 | 5.0 | 10.0 | 20.0 | 20.0 | 55.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 21 | M | 225.0 | 22.5 | 15.0 | 2.5 | 37.5 | 165.0 | 220.0 | 0.0 | 0.0 | 0.0 | 5.0 | 5.0 | 2.5 | 0.0 | 17.5 | 2.5 | 22.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 22 | A | 287.5 | 35.0 | 50.0 | 12.5 | 47.5 | 175.0 | 285.0 | 0.0 | 0.0 | 0.0 | 2.5 | 2.5 | 7.5 | 0.0 | 15.0 | 12.5 | 35.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 23 | M | 292.5 | 32.5 | 27.5 | 10.0 | 50.0 | 200.0 | 287.5 | 0.0 | 0.0 | 2.5 | 2.5 | 5.0 | 10.0 | 2.5 | 12.5 | 7.5 | 32.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 24 | M | 265.0 | 20.0 | 20.0 | 20.0 | 40.0 | 182.5 | 262.5 | 0.0 | 0.0 | 0.0 | 2.5 | 2.5 | 5.0 | 7.5 | 2.5 | 5.0 | 20.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 25 | M | 280.0 | 17.5 | 42.5 | 15.0 | 35.0 | 180.0 | 272.5 | 0.0 | 0.0 | 0.0 | 7.5 | 7.5 | 5.0 | 2.5 | 5.0 | 2.5 | 15.0 | 0.0 | 0.0 | 0.0 | 2.5 | 2.5 |
| 26 | M | 282.5 | 62.5 | 27.5 | 17.5 | 62.5 | 167.5 | 275.0 | 0.0 | 0.0 | 0.0 | 7.5 | 7.5 | 12.5 | 12.5 | 10.0 | 27.5 | 62.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 27 | M | 232.5 | 22.5 | 30.0 | 12.5 | 20.0 | 165.0 | 227.5 | 0.0 | 0.0 | 0.0 | 5.0 | 5.0 | 7.5 | 2.5 | 5.0 | 7.5 | 22.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 28 | A | 237.5 | 27.5 | 35.0 | 7.5 | 32.5 | 157.5 | 232.5 | 0.0 | 0.0 | 0.0 | 5.0 | 5.0 | 7.5 | 2.5 | 5.0 | 10.0 | 25.0 | 0.0 | 0.0 | 0.0 | 2.5 | 2.5 |
| 29 | M | 390.0 | 17.5 | 27.5 | 5.0 | 27.5 | 307.5 | 367.5 | 0.0 | 0.0 | 2.5 | 20.0 | 22.5 | 2.5 | 0.0 | 5.0 | 7.5 | 15.0 | 0.0 | 0.0 | 0.0 | 2.5 | 2.5 |
| 30 | M | 345.0 | 30.0 | 37.5 | 17.5 | 62.5 | 222.5 | 340.0 | 0.0 | 0.0 | 0.0 | 5.0 | 5.0 | 10.0 | 5.0 | 12.5 | 2.5 | 30.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 31 | B | 272.5 | 10.0 | 35.0 | 2.5 | 37.5 | 192.5 | 267.5 | 0.0 | 0.0 | 2.5 | 2.5 | 5.0 | 0.0 | 0.0 | 2.5 | 7.5 | 10.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 32 | M | 230.0 | 20.0 | 12.5 | 7.5 | 47.5 | 157.5 | 225.0 | 0.0 | 0.0 | 0.0 | 5.0 | 5.0 | 0.0 | 0.0 | 17.5 | 2.5 | 20.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total | - | 8,332.5 | 967.5 | 1,055.0 | 420.0 | 1,272.5 | 5,382.5 | 8,130.0 | 12.5 | 5.0 | 27.5 | 167.5 | 212.5 | 262.5 | 120.0 | 282.5 | 270.0 | 935.0 | 2.5 | 2.5 | 2.5 | 25.0 | 32.5 |

Table III-2-5 Results of sample plot survey (Volume per ha)

No. _____

| Plot No. | Forest Type | More than 10cm of diameter breast height total | More than 41cm of diameter breast height total | More than 10cm of diameter breast height wholesome tree | | | | | More than 10cm of diameter breast height defective tree | | | | | More than 41cm of diameter breast height wholesome tree | | | | | More than 41cm of diameter breast height defective tree | | | | |
|----------|-------------|--|--|---|--------|--------|--------|----------|---|------|------|-------|-------|---|--------|--------|--------|----------|---|------|------|-------|-------|
| | | | | A | B | C | D+E | Total | A | B | C | D+E | Total | A | B | C | D+E | Total | A | B | C | D+E | Total |
| 1 | M | 84.81 | 38.81 | 18.73 | 0.38 | 20.60 | 41.89 | 81.60 | 1.00 | 0.00 | 0.00 | 2.21 | 3.21 | 14.29 | 0.00 | 8.28 | 14.36 | 36.93 | 0.00 | 0.00 | 0.00 | 1.88 | 1.88 |
| 2 | M | 51.48 | 24.93 | 10.56 | 11.94 | 15.98 | 13.00 | 51.48 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 4.75 | 8.79 | 9.14 | 2.25 | 24.93 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | M | 47.26 | 19.34 | 13.40 | 1.88 | 20.45 | 10.52 | 46.25 | 0.00 | 0.23 | 0.00 | 0.78 | 1.01 | 5.20 | 1.88 | 11.86 | 0.00 | 18.94 | 0.00 | 0.00 | 0.00 | 0.40 | 0.40 |
| 4 | B | 41.46 | 1.70 | 0.00 | 0.48 | 5.07 | 35.11 | 40.66 | 0.00 | 0.00 | 0.00 | 0.80 | 0.80 | 0.00 | 0.00 | 0.00 | 1.70 | 1.70 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5 | A | 47.19 | 21.84 | 8.01 | 8.46 | 10.53 | 20.19 | 47.19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.80 | 7.33 | 7.49 | 5.22 | 21.84 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6 | A | 90.04 | 54.60 | 14.75 | 13.31 | 17.54 | 37.17 | 82.77 | 0.28 | 0.00 | 0.10 | 6.89 | 7.27 | 10.28 | 7.90 | 14.85 | 18.77 | 51.80 | 0.00 | 0.00 | 0.00 | 2.80 | 2.80 |
| 7 | A | 68.21 | 31.19 | 23.85 | 2.31 | 8.67 | 30.74 | 65.57 | 0.00 | 0.00 | 0.05 | 2.59 | 2.64 | 13.62 | 0.00 | 6.23 | 9.29 | 29.14 | 0.00 | 0.00 | 0.00 | 2.05 | 2.05 |
| 8 | A | 90.22 | 61.30 | 31.98 | 18.34 | 12.50 | 25.64 | 88.46 | 0.00 | 0.00 | 0.83 | 0.93 | 1.76 | 25.83 | 14.45 | 6.88 | 14.14 | 61.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 9 | A | 62.75 | 32.16 | 16.08 | 11.49 | 14.56 | 18.34 | 60.47 | 2.28 | 0.00 | 0.00 | 0.00 | 2.28 | 7.91 | 8.70 | 9.66 | 3.61 | 29.88 | 2.28 | 0.00 | 0.00 | 0.00 | 2.28 |
| 10 | M | 77.25 | 43.06 | 17.53 | 5.43 | 13.15 | 41.14 | 77.25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 12.23 | 4.83 | 6.46 | 19.54 | 43.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 11 | A | 66.91 | 41.06 | 9.39 | 6.32 | 8.39 | 42.30 | 66.40 | 0.00 | 0.00 | 0.00 | 0.51 | 0.51 | 4.58 | 2.15 | 5.45 | 28.88 | 41.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 12 | A | 80.77 | 54.63 | 16.03 | 23.92 | 15.52 | 22.90 | 78.37 | 0.00 | 0.00 | 0.00 | 2.40 | 2.40 | 11.51 | 22.51 | 10.06 | 8.20 | 52.28 | 0.00 | 0.00 | 0.00 | 2.35 | 2.35 |
| 13 | A | 68.09 | 35.16 | 25.22 | 4.66 | 10.55 | 25.28 | 65.71 | 1.23 | 0.00 | 0.00 | 1.15 | 2.38 | 22.62 | 2.10 | 7.01 | 2.28 | 34.01 | 0.00 | 0.00 | 0.00 | 1.15 | 1.15 |
| 14 | M | 59.86 | 34.89 | 12.03 | 9.56 | 16.74 | 16.15 | 54.48 | 0.00 | 2.43 | 1.81 | 1.14 | 5.38 | 8.00 | 6.53 | 14.23 | 3.70 | 32.46 | 0.00 | 2.43 | 0.00 | 0.00 | 2.43 |
| 15 | A | 80.84 | 38.39 | 30.03 | 8.24 | 18.15 | 23.87 | 80.29 | 0.00 | 0.00 | 0.00 | 0.55 | 0.55 | 16.70 | 5.63 | 7.68 | 8.38 | 38.39 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 16 | M | 78.01 | 33.40 | 33.72 | 9.13 | 10.89 | 24.27 | 78.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 18.33 | 6.36 | 6.73 | 1.98 | 33.40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 17 | A | 61.14 | 24.89 | 27.69 | 1.68 | 14.39 | 17.03 | 60.79 | 0.00 | 0.00 | 0.00 | 0.35 | 0.35 | 18.81 | 0.00 | 6.08 | 0.00 | 24.89 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 18 | A | 83.09 | 52.00 | 33.08 | 21.84 | 13.43 | 14.74 | 83.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 22.51 | 20.96 | 8.53 | 0.00 | 52.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 19 | A | 78.95 | 40.50 | 11.38 | 9.21 | 23.11 | 31.77 | 75.47 | 0.00 | 0.00 | 2.20 | 1.28 | 3.48 | 8.43 | 6.80 | 15.32 | 7.75 | 38.30 | 0.00 | 0.00 | 2.20 | 0.00 | 2.20 |
| 20 | A | 116.46 | 76.37 | 7.95 | 13.83 | 46.54 | 46.58 | 114.90 | 0.00 | 0.00 | 0.00 | 1.56 | 1.56 | 4.53 | 10.46 | 39.32 | 22.06 | 76.37 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 21 | M | 54.46 | 26.36 | 8.87 | 0.48 | 24.10 | 20.43 | 53.88 | 0.00 | 0.00 | 0.00 | 0.58 | 0.58 | 5.20 | 0.00 | 19.61 | 1.55 | 26.36 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 22 | A | 91.40 | 37.43 | 26.77 | 4.47 | 23.05 | 36.98 | 91.27 | 0.00 | 0.00 | 0.00 | 0.13 | 0.13 | 9.73 | 0.00 | 14.54 | 13.16 | 37.43 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 23 | M | 80.89 | 38.28 | 18.62 | 3.81 | 23.10 | 34.85 | 80.38 | 0.00 | 0.00 | 0.28 | 0.23 | 0.51 | 13.33 | 2.18 | 15.07 | 7.70 | 38.28 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 24 | M | 75.29 | 23.95 | 10.70 | 16.27 | 14.62 | 32.95 | 74.54 | 0.00 | 0.00 | 0.00 | 0.75 | 0.75 | 4.73 | 12.13 | 2.28 | 4.81 | 23.95 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 25 | M | 52.27 | 20.34 | 8.94 | 4.08 | 6.81 | 25.51 | 45.34 | 0.00 | 0.00 | 0.00 | 6.93 | 6.93 | 3.63 | 2.30 | 3.80 | 4.43 | 14.16 | 0.00 | 0.00 | 0.00 | 6.18 | 6.18 |
| 26 | M | 88.05 | 59.66 | 14.87 | 19.79 | 15.98 | 36.08 | 86.72 | 0.00 | 0.00 | 0.00 | 1.33 | 1.33 | 10.47 | 19.34 | 8.82 | 21.03 | 59.66 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 27 | M | 65.48 | 34.70 | 15.63 | 4.45 | 12.84 | 31.56 | 64.48 | 0.00 | 0.00 | 0.00 | 1.00 | 1.00 | 13.31 | 1.68 | 7.48 | 12.23 | 34.70 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 28 | A | 66.61 | 37.95 | 15.98 | 4.48 | 14.21 | 30.03 | 64.70 | 0.00 | 0.00 | 0.00 | 1.91 | 1.91 | 10.83 | 2.95 | 8.58 | 14.26 | 36.62 | 0.00 | 0.00 | 0.00 | 1.33 | 1.33 |
| 29 | M | 67.56 | 21.65 | 7.70 | 1.36 | 12.59 | 42.11 | 63.76 | 0.00 | 0.00 | 0.53 | 3.27 | 3.80 | 1.95 | 0.00 | 6.91 | 11.71 | 20.57 | 0.00 | 0.00 | 0.00 | 1.08 | 1.08 |
| 30 | M | 88.01 | 43.13 | 18.05 | 9.91 | 30.89 | 28.95 | 87.80 | 0.00 | 0.00 | 0.00 | 0.21 | 0.21 | 12.79 | 8.05 | 19.44 | 2.85 | 43.13 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 31 | B | 34.63 | 5.93 | 5.42 | 0.50 | 8.43 | 20.00 | 34.35 | 0.00 | 0.00 | 0.18 | 0.10 | 0.28 | 0.00 | 0.00 | 1.20 | 4.73 | 5.93 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 32 | M | 65.70 | 25.54 | 3.17 | 1.58 | 31.87 | 28.68 | 65.30 | 0.00 | 0.00 | 0.00 | 0.40 | 0.40 | 0.00 | 0.00 | 23.01 | 2.53 | 25.54 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total | - | 2,265.14 | 1,135.14 | 516.13 | 253.59 | 535.25 | 906.76 | 2,211.73 | 4.79 | 2.66 | 5.98 | 39.98 | 53.41 | 317.90 | 186.01 | 332.00 | 273.10 | 1,109.01 | 2.28 | 2.43 | 2.20 | 19.22 | 26.13 |

1. The first step in the process of identifying a problem is to define the problem clearly and concisely. This involves identifying the symptoms and the underlying causes of the problem. Once the problem has been defined, the next step is to gather information about the problem. This can be done through a variety of methods, including interviews, surveys, and observation. The information gathered should be used to identify the root cause of the problem and to develop a plan of action to address the problem. The final step in the process is to implement the plan and to monitor the results. This involves tracking the progress of the plan and making adjustments as needed. The goal is to identify the problem, understand its causes, and develop a solution that will effectively address the problem.