

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF FORESTRY, REPUBLIC OF INDONESIA

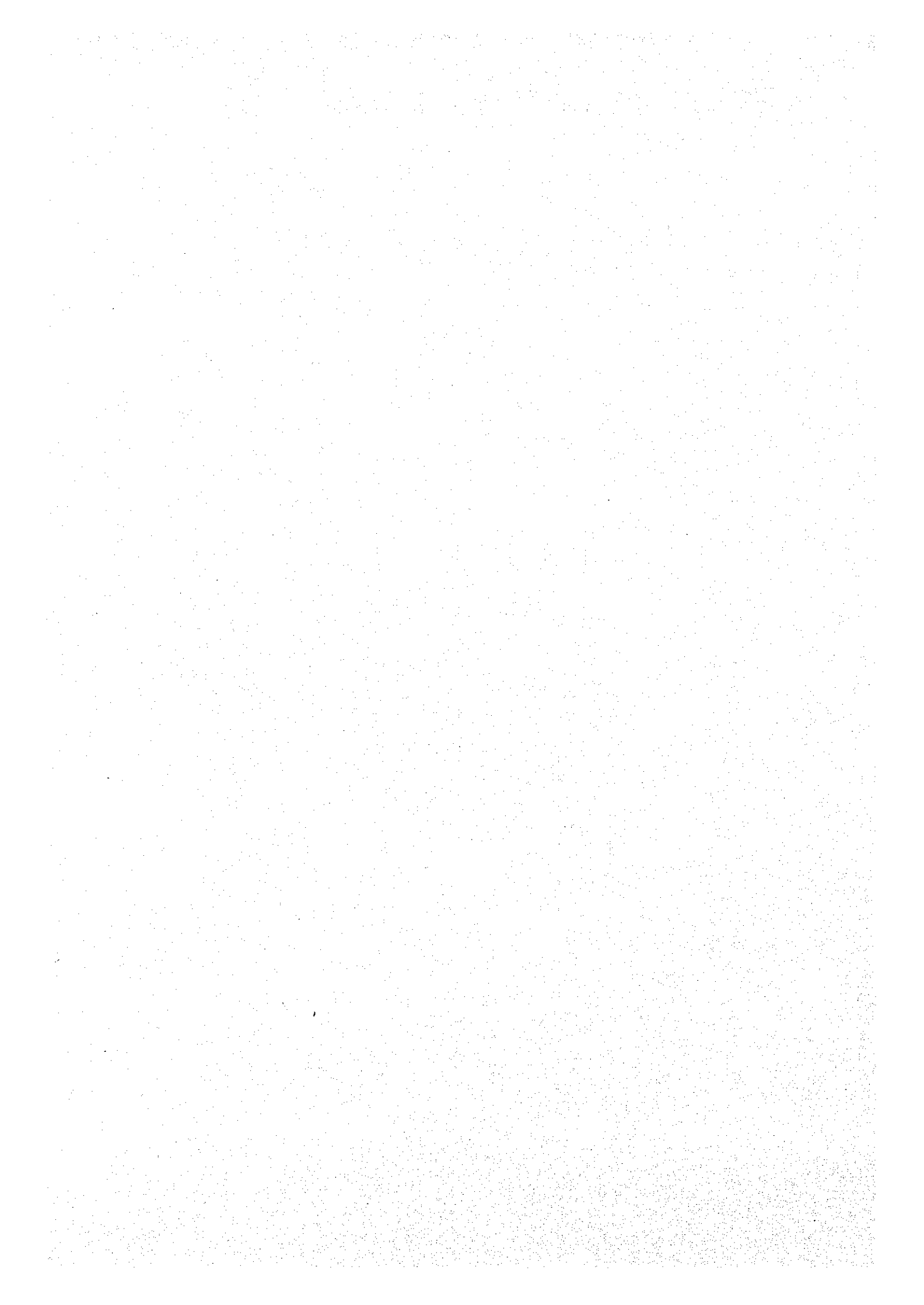
**THE DEVELOPMENT STUDY
ON
LAND REHABILITATION OF SEMI ARID ZONE
IN
EAST NUSA TENGGARA**

FINAL REPORT

DECEMBER, 1985

**JAPAN FOREST TECHNICAL ASSOCIATION (JAFTA)
PASCO INTERNATIONAL INC.**

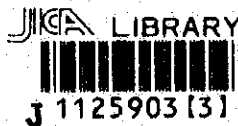




**JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF FORESTRY, REPUBLIC OF INDONESIA**

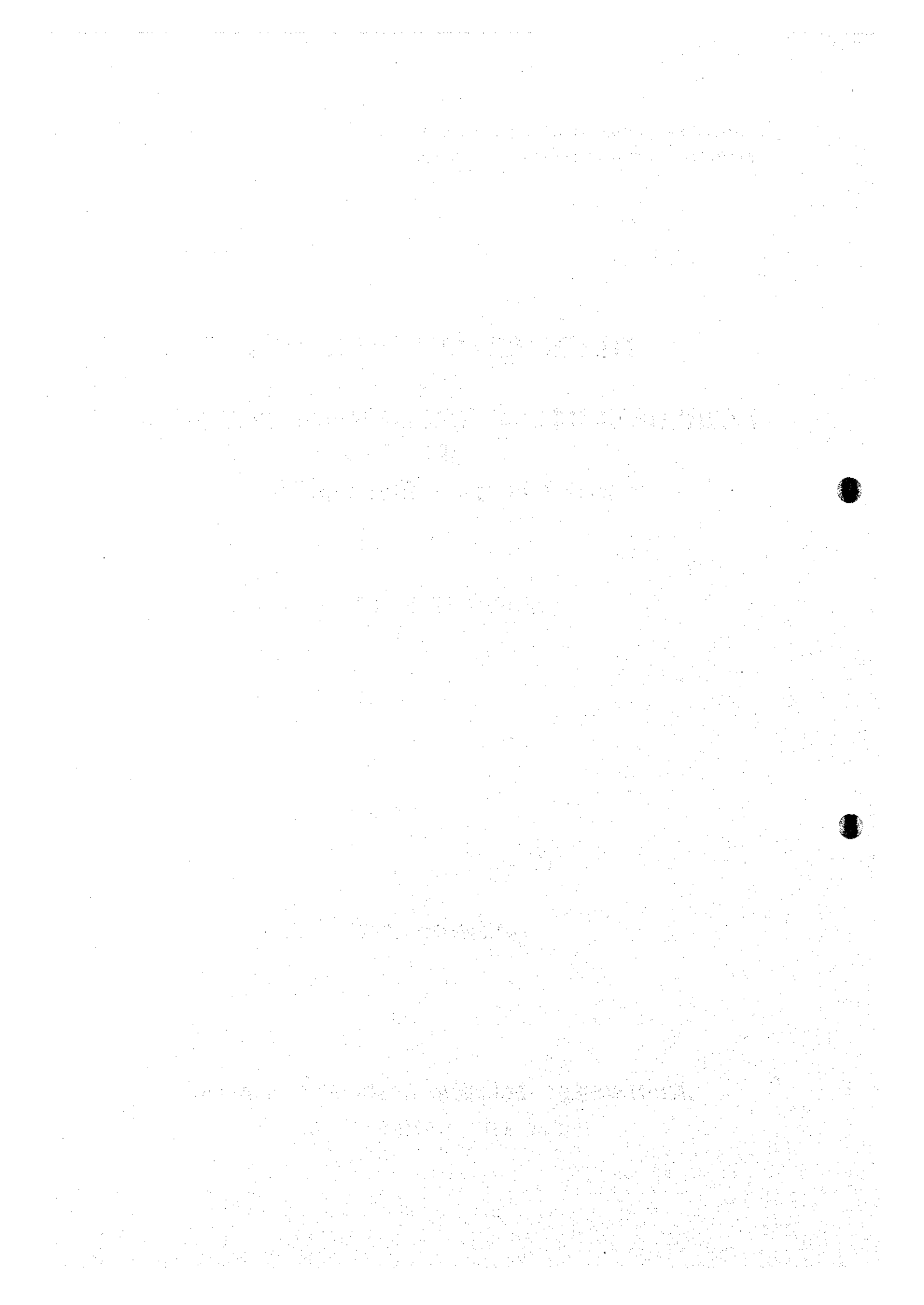
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FOREWORD

In response to a request made by the Government of Indonesia, the Government of Japan decided to conduct the Development Study on Land Rehabilitation of Semi Arid Zone in East Nusa Tenggara (the Study) and commissioned the Japan International Cooperation Agency (JICA) to conduct the said Study.

JICA sent the Study Team (led by Dr. Kinji Hachiya), jointly formed by the Japan Forest Technical Association (JAFTA) and Pasco International Inc., to Indonesia on 5 occasions in the period between March, 1994 and October, 1995. The Study Team held a series of consultations with government officials in Indonesia, conducted field surveys in the Study Area and have now compiled the present Final Report on completion of the work in Japan.

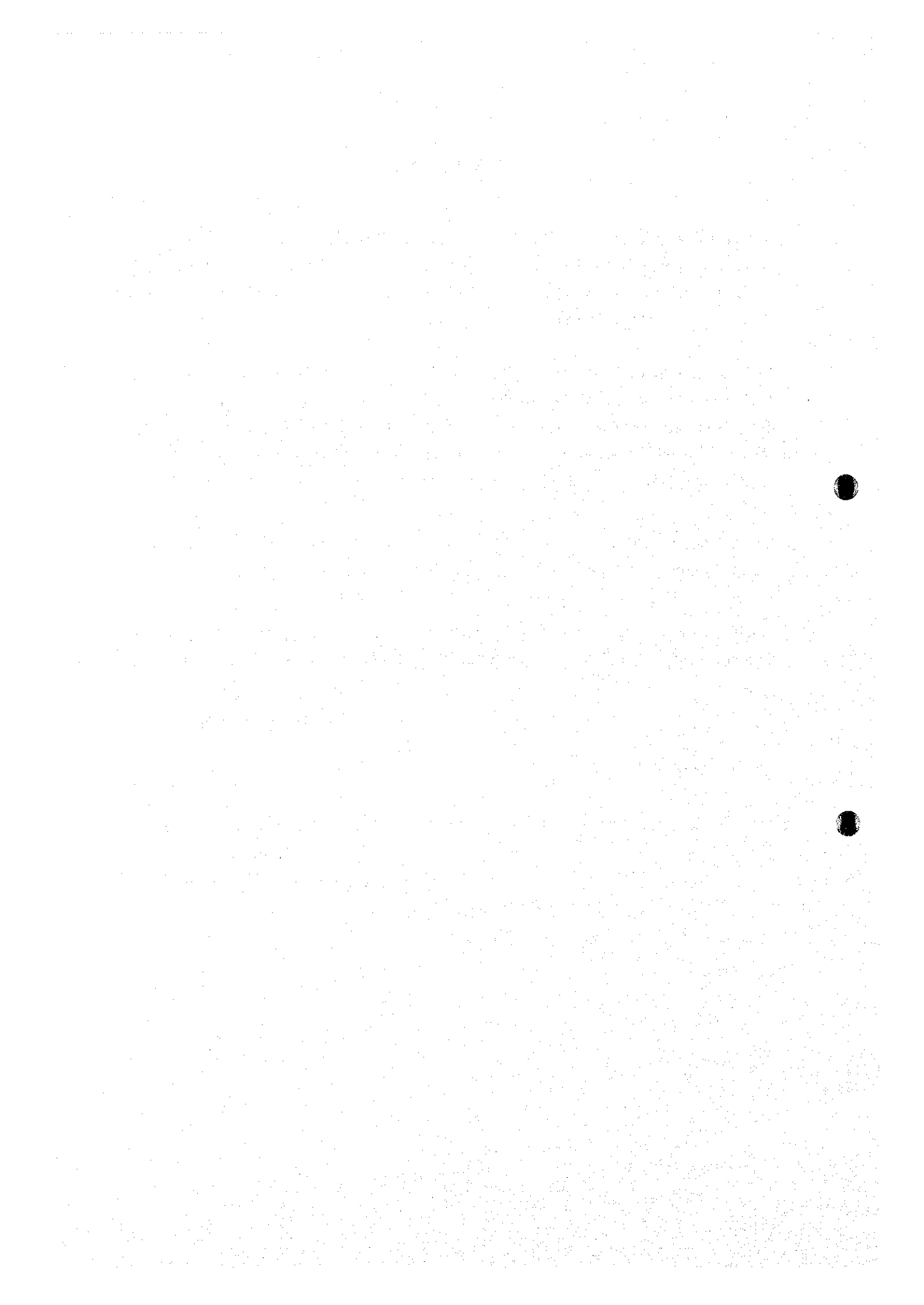
It is my sincere hope that this Final Report will contribute to the further promotion of the Study as well as to development of the friendship between Japan and Indonesia.

Finally, I would like to express my utmost gratitude to those people and organizations without whose cooperation and assistance the Study could not have been completed.

December, 1995

Kimio Fujita
President

Japan International Cooperation Agency



LETTER OF SUBMITTAL

Mr. Kimio Fujita
President
Japan International Cooperation Agency

It is my great pleasure to inform you that the Development Study on Land Rehabilitation of Semi Arid Zone in East Nusa Tenggara Indonesia has been successfully completed and that the Final Report has also been completed for submittal to your agency.

The present Report compiles the results of the surveys and analyses conducted and the plans, etc. formulated by the Development Study Team for Land Rehabilitation of Semi Arid Zone in East Nusa Tenggara Indonesia, jointly formed by the Japan Forest Technical Association and Pasco International Inc., in the period from March 7, 1994 to December 27, 1995 in accordance with the contract made with the Japan International Cooperation Agency. The land rehabilitation plan established by the Study incorporates appropriate land use for the topographical and soil conditions of the Study Area and various measures which have been carefully formulated in view of the socioeconomic conditions surrounding the local inhabitants.

I would like to take this opportunity to express my utmost gratitude for the considerable assistance and guidance afforded to the Study Team by JICA, as well as the Ministry of Foreign Affairs and the Ministry of Agriculture, Forestry and Fisheries. I would also like to draw your attention to the facts that the Study Team was provided with useful advice and assistance in Indonesia by the JICA Office, Embassy of Japan, Directorate General of Reforestation and Land Rehabilitation of the Ministry of Forestry, East Nusa Tenggara Regional Office of the Ministry of Forestry and many other organizations involved in the Study.

It is sincerely hoped that the Report submitted here to your organization will prove useful for the further promotion of the land rehabilitation of the semi arid zone in East Nusa Tenggara Province.

December, 1995

Kinji Hachiya, Team Leader
Development Study Team for Land Rehabilitation of
Semi Arid Zone in East Nusa Tenggara, Indonesia



A downstream section of Oebelo river
(Desa Noelbaki, December, 1994)



Grazing in state forest land
(Desa Tuatuka, June, 1995)



Overgrazed and degraded forest
(Desa Bokong, November, 1994)



Landslide in the upstream of Olio Watershed
(Desa Bokong, November, 1994)



Stones have been exposed as the result of severe surface erosion due to repeated slash and burn cultivation
(Desa Oenoni, December, 1994)



Traditional terraces
(Desa Kotabes, December, 1994)



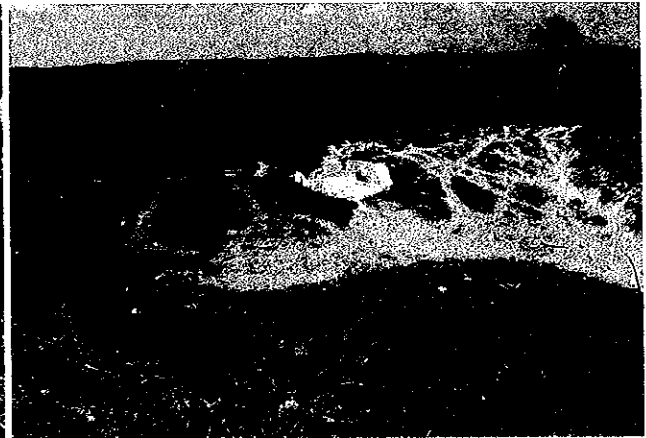
Teak man-made forest planted in December, 1976
(Desa Nekkese, November, 1994)



A model unit for natural resources conservation project
(UP-UPSA) in Desa Ponain, November, 1994



Kinggrass field
(Desa Oesao, December, 1994)



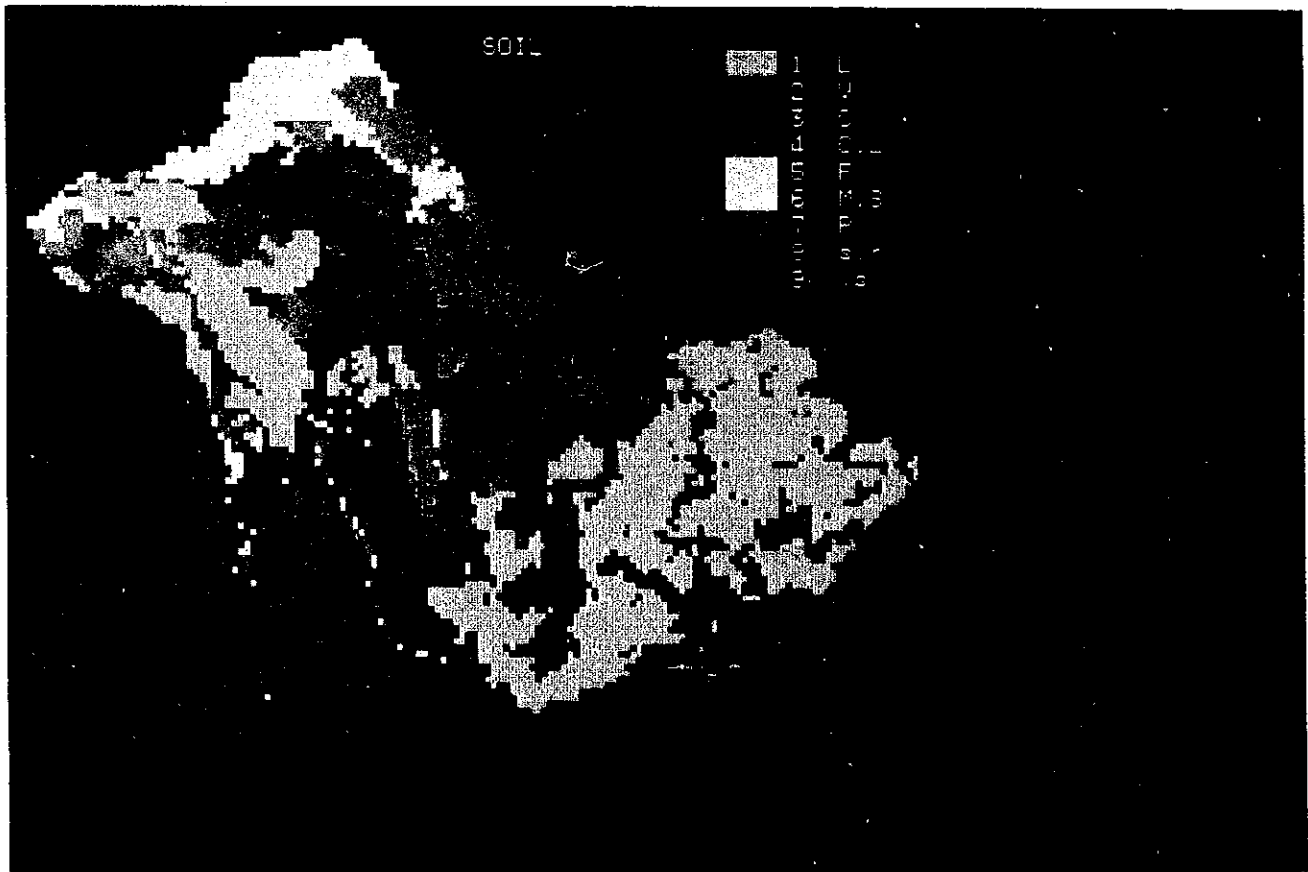
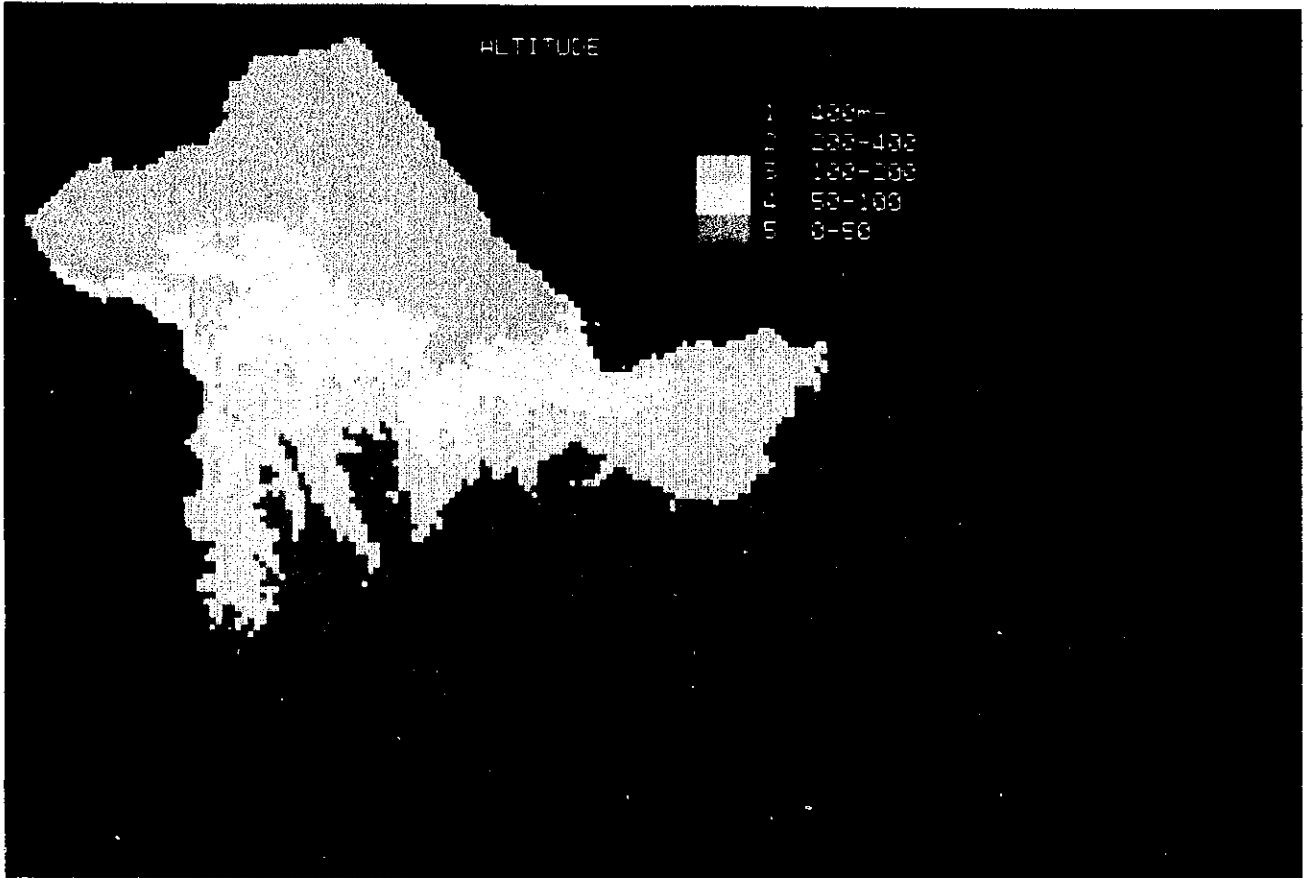
Ponain earth check dam
(July, 1994)



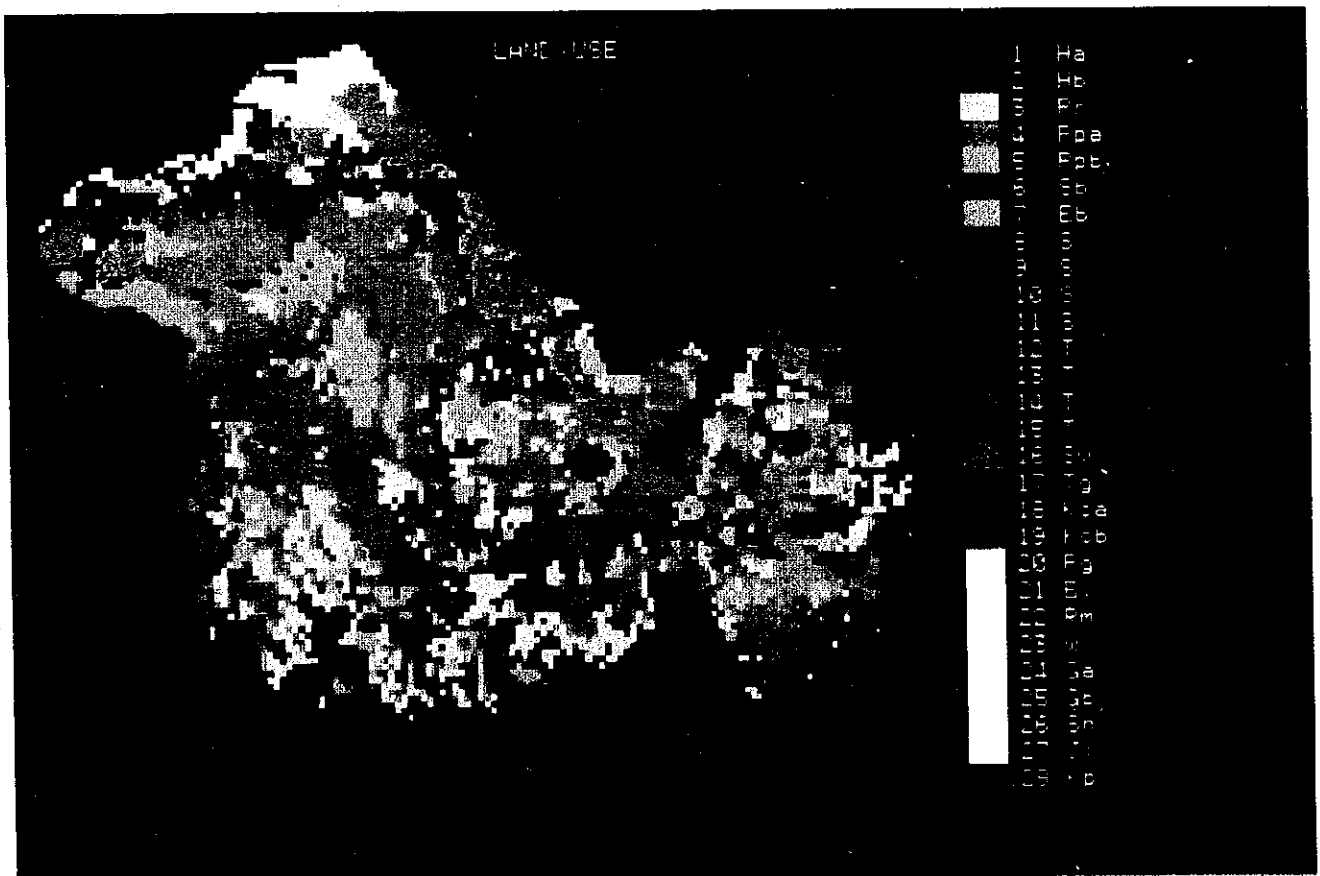
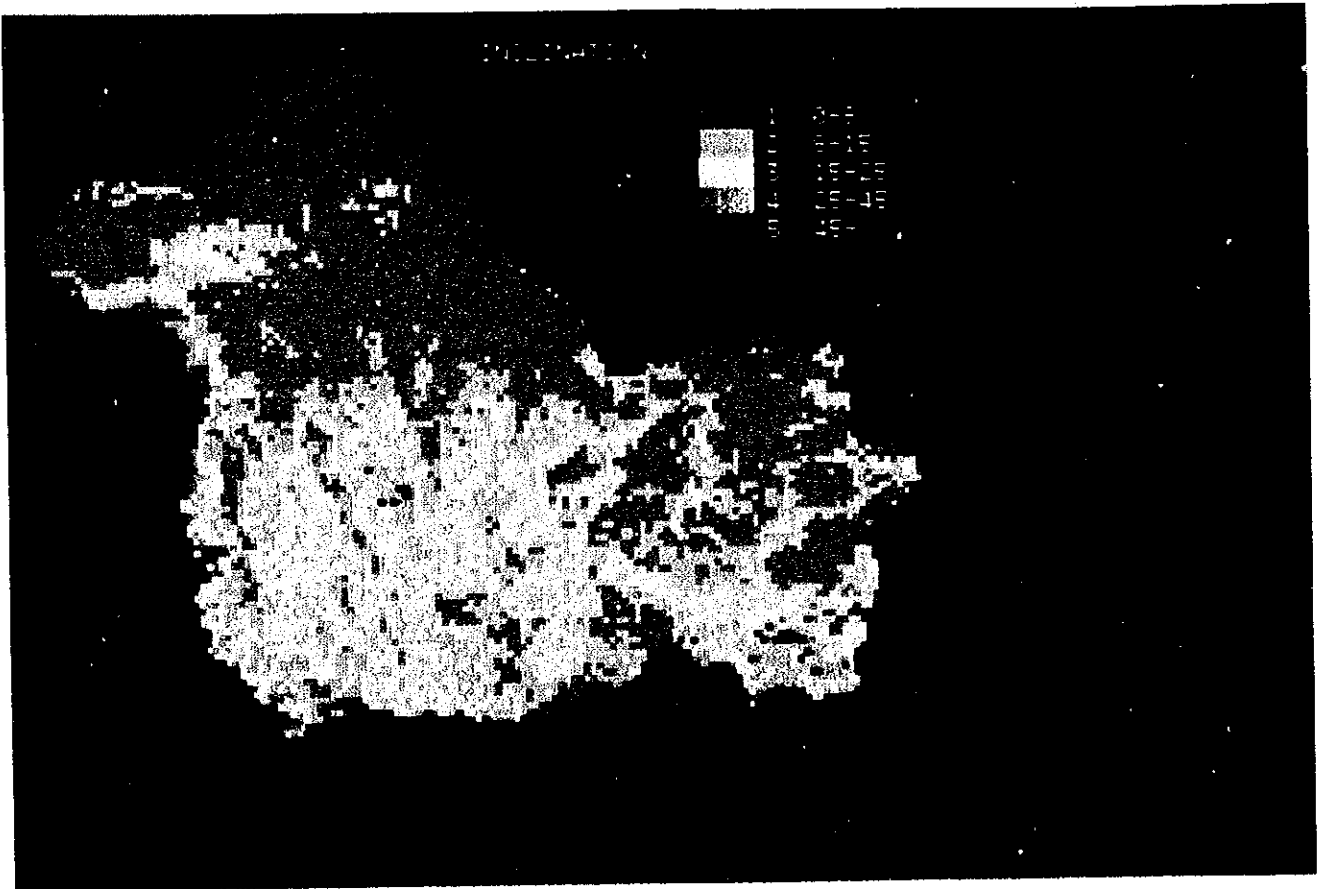
Forest road constructed by Dinas Kehutanan
(Desa Tesbatan, December, 1994)



A forest nursery under construction
at Nevonaek, Kabupaten Kupang
(June, 1995)



Refer to Table II-1



Refer to Table II-7

NATIONAL FOREST ENCLAVE AND PRIVATE USE LAND



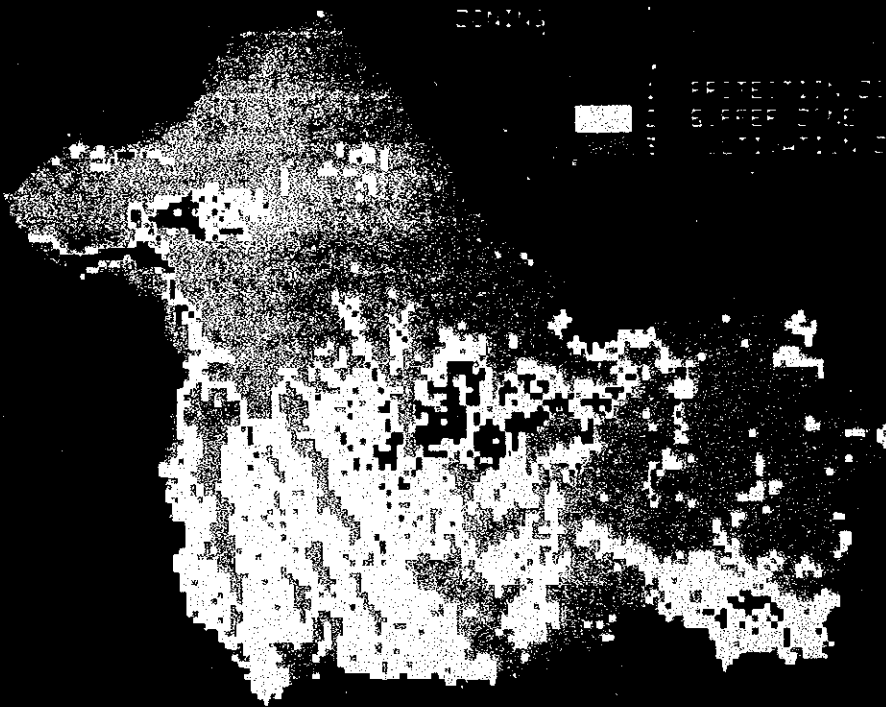
NATIONAL FOREST
ENCLAVE
PRIVATE USE LAND

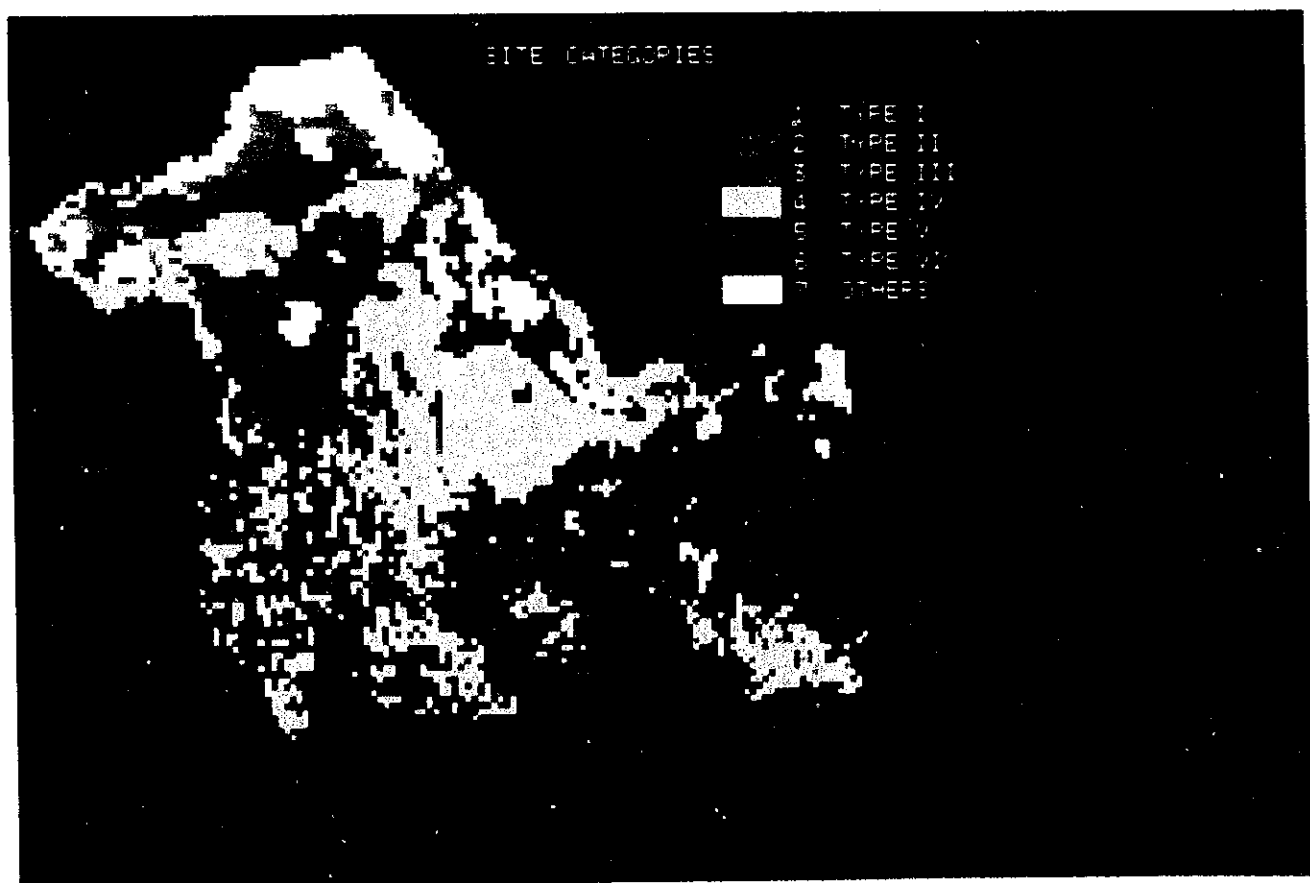
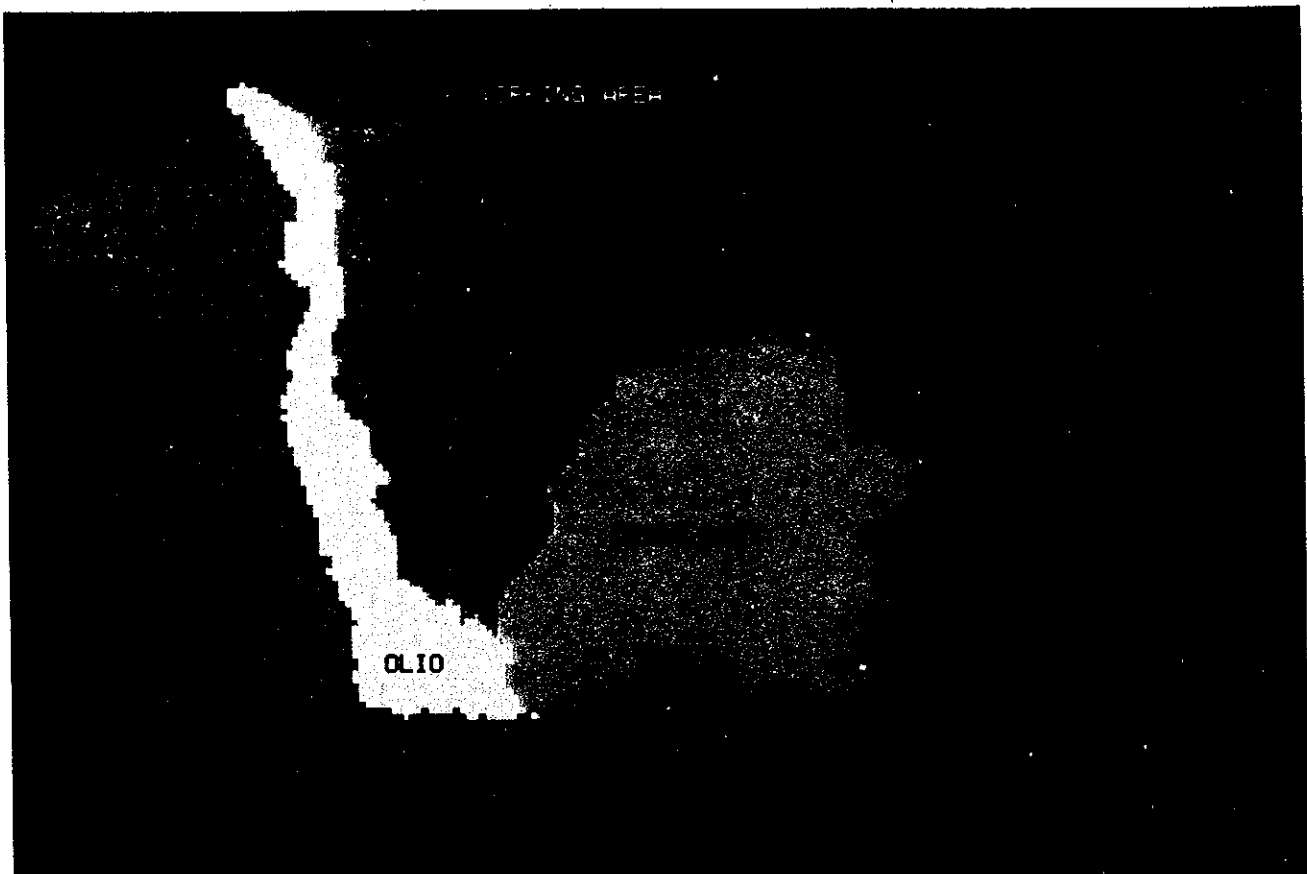


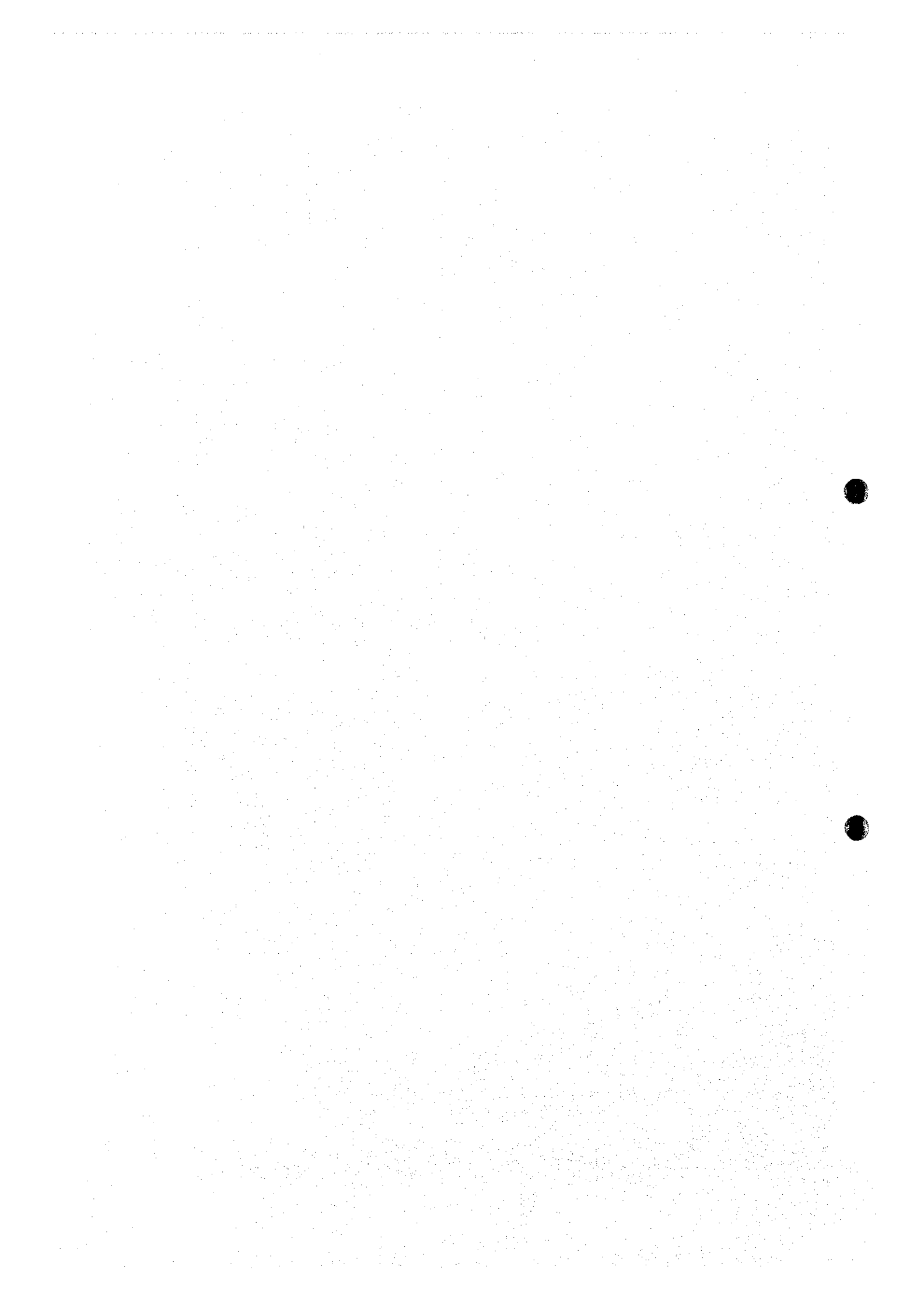
ZONING



PROTECTION ZONE
SUPPORT ZONE
UTILIZATION ZONE







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ABBREVIATIONS

AMDAL	Analisis Mengenai Dampak Lingkungan (Analysis concerning environmental impact)
ANDAL	Analisis Dampak Lingkungan (Environmental impact analysis)
BAPPEDA I	Badan Perencanaan Pembangunan Daerah Tingkat I (Provincial Development Planning Board)
BAPPEDA II	Badan Perencanaan Pembangunan Daerah Tingkat II (District Development Planning Board)
BAPPENAS	Badan Perencanaan Pembangunan Nasional (National Development Planning Agency)
BIPHUT	Balai Inventarisasi dan Perpetaan Hutan (Forest Inventory Center)
BKSDA	Balai Konservasi Sumber Daya Alam (Natural Resources Conservation Center)
BPK	Balai Penelitian Kehutanan (Forestry Research Center)
BPP	Balai Penyuluhan Pertanian (Agriculture Extension Center)
BPS	Biro Pusat Statistik (Central Bureau of Statistics)
BLK	Balai Latihan Kehutanan (Forestry Training Center)
BRLKT VII	Balai Rehabilitasi Lahan dan Konservasi Tanah Wilayah VII (Land Rehabilitation and Soil Conservation Center of Region 7)
Cabang Dinas	Branch Office of Dinas Kehutanan or Provincial Forestry Service. One Cabang Dinas exists in each Kabupaten or District.
Cabang RLKT	Branch office of Sub-RLKT or Sub Balai Rehabilitasi Lahan dan Konservasi Tanah. One Cabang RLKT exists in each Kabupaten or district.
DJRRL	Direktorat Jenderal Reboisasi dan Rehabilitasi Lahan (Directorate General of Reforestation and Land Rehabilitation)
KRPH	Kepala Resort Polisi Hutan (Forest Rangers Office)
NTT	Nusa Tenggara Timur (East Nusa Tenggara Province or NTT Province)

PHPA	Directorat Jenderal Perlindungan Hutan dan Pelestarian Alam (Directorate General of Forest Protection and Nature Conservation)
PELITA	Pembangunan Lima Tahun (5 year development plan)
PIL	Penyajian Informasi Lingkungan (Preliminary Environmental Information Report)
Pola	A 25 year land rehabilitation and Soil conservation master plan prepared by BRLKT on watershed basis
PLP	Penyuluh Lapangan Pertanian (Forestry Extension Advisor)
PU	Pekerjaan Umum (Ministry of Public Works)
RKL	Rencana Penge Loloan Lingkungan (Environmental Management Plan)
RPL	Rencana Peman Tauan Lingkungan (Environmental Monitoring Plan)
RLKT	5 year Technical Plan for Land Rehabilitation and Soil Conservation prepared by Sub-RLKT on Sub-watershed basis
RTT	Annual Technical Plan for Land Rehabilitation and Soil Conservation on sub-watershed basis
Rancangan	Design for Land Rehabilitation and Soil Conservation
Sub-Dinas Pengairan, Pu	Irrigation Division, Under Ministry of Public Works
Sub Balai RLKT Benain Noelmina	Sub Center for Land Rehabilitation and Soil Conservation Benain Noelmina
UP, UPSA	Unit Percontohan Usaha Pelestarian Sumberdaya Alam (Demonstration Plot of Natural Resources Conservation)
UP, UPM	Usaha Pertanian Mentap (Permanent Settlement Agriculture Plot)

SUMMARY

1. Outline of the Study

1.1 Objectives of the Study

The objectives of the Study are to clarify the current conditions of land use and vegetation, etc. in sub-watersheds, which are characterised by large tracts of degraded land requiring forest land conservation work, in the Oesao Watershed in the province of East Nusa Tenggara in the Republic of Indonesia and to formulate a land rehabilitation plan (master plan) for the said semi arid area. The Study commenced in fiscal 1993.

1.2 Study Area and Watershed Boundaries

The Study Area forms part of Kabupaten (Kab.) Kupang and is divided into 3 areas, i.e. Kecamatan (Kec.) Kupang Timur, Kec. Amarasi and Kec. Kupang Tengah. The Study Area covers the Oesao, Oebelo and Olio Watersheds, the areas of which total 33,180 ha. The topography of the region is dominated by gentle slopes from the watershed divide at EL. 500-600 m to the coastline.

2. Natural Environment

2.1 Climate

The lowland part of the Study Area has a mean annual temperature of approximately 27°C, an annual fluctuation range of the mean monthly temperature of 3-4°C and a generally high temperature during the rainy season, indicating a tropical climate. There is a clear distinction between the rainy season and dry season as more than 93% of the annual rainfall (Average, 1,375mm) is concentrated between November and April.

2.2 Geology and Topography

The geology of the Study Area is relatively simple with recent fluvial deposits, Pleistocene coralline rock, marl believed to have been deposited between the Pliocene and Pleistocene (containing some sandstone and tuff) and Triassic shale. The mineral resources are poor. The topography is also simple as alluvial lowland, raised coral terraces, hills and mountains are distributed in an almost regular pattern.

2.3 Soil

A soil survey was conducted and the soil maps required for preparation of the land rehabilitation plan were prepared. Seven soil types, i.e. Chromic Luvisols, Eutric Vertisols, Humic Cambisols, Eutric Cambisols, Lithic Leptosols, Rendzic Leptosols and Eutric Fluvisols, were identified in the Study Area, excluding soils related to paddy fields, mangrove, swamps, rocky land, sandy beaches and landslide sites, etc.

2.4 River System

The main rivers in the Study Area are Oebelo River in the west, Olio River in the centre and Oesao River in the east. All of these rivers originate from the mountain range located in the south of the Study Area and flow northwest to Kupang Bay.

2.5 Land Use and Vegetation

Aerial photographs taken in 1991 (scale: 1/25,000) and 1993 (scale: 1/30,000) were used for the Study to produce the land use and vegetation maps (scale: 1/10,000). Grassland with scattered stands of palm trees has the largest area of 10,656 ha, accounting for 32.1% of the Study Area, followed by shrub land of 5,892 ha (17.8%), grassland with scattered stands of other than palm trees of 3,652 ha (11.0%) and open grassland of 3,428 ha (10.3%). Combined together, these four land use categories account for 71.2% of the Study Area.

3. Socioeconomic Environment

The administrative hierarchy in Indonesia is composed of provinces, kabupatens (districts), kecamatans (sub-districts) and desas (villages). Those desas related to the Study Area are 23 desas of 3 kecamatans, i.e. Kupang Tengah, Kupang Timur and Amarasi, all of which are located in Kab. Kupang of East Nusa Tenggara Province.

3.1 Regional Gross Domestic Products (RGDP)

The economy of East Nusa Tenggara in terms of the RGDP per capita is the lowest in the country. The RGDP per capita figures for the 3 kecamatans in which the Study Area is located show that the figure for Kec. Amarasi is similar to the provincial average and that the figures for the other two kecamatans are slightly higher than the provincial average. Apart from cement and fabrics, the main provincial products for domestic consumption

domestic consumption are dominated by such agriculture products as coffee, horses/oxen/water buffaloes, fish, green peas, copra and cashew nuts, etc.

3.2 Agriculture

With regard to the main agricultural products, the items of which the production volume of the three kecamatans in question is relatively high are paddy rice, maize and sweet potatoes. As part of the local farming practice, shifting cultivation, i.e. slash-and-burn farming, is conducted in all three kecamatans in the Study Area. A farmer generally cultivates a field of 0.5-1.0 ha for upto 2 years before moving on to another field. Normally, one shifting cultivation cycle involves 3-6 sites.

3.3 Livestock Production

The production of beef cattle and chickens is very popular in the three kecamatans in which the Study Area is located. The number of beef cattle raised in the Study Area is estimated to be approximately 23,000 heads (1993 data). The resulting density of 69 heads/km² is more than double the average density of 32 heads/km² for the three kecamatans. The free grazing method has traditionally been popular in the Study Area with some 80% of the cattle being raised using these method while the remaining 20% are raised by non-free grazing methods. While the number of cattle raised by ordinary farming households in mountainous areas in the Study Area is generally small, the number of households engaged in large-scale operation increases in the lowland areas.

3.4 Land Use Plan

According to the Spatial Plan for East Nusa Tenggara Province, the Study Area is listed as one of the 15 priority areas with emphasis placed on the construction and rehabilitation of irrigation facilities and the control of soil erosion and landslides. The comprehensive development plan for the Study Area also emphasises farming, plantation, stock raising and tourism, etc.

4. Forestry

4.1 Outline of Forestry

Forest zones in the Study Area consist of either protection forests or limited production forests and the total size of forest zones of 12,824 ha accounts for 38.6% of the Study

Area's total land area, exceeding the corresponding figure for both East Nusa Tenggara Province and Kab. Kupang. The real forest size in the Study Area, combining natural forests, secondary forests, bamboo forests, man-made forests and lowland forests, is 2,336 ha, a mere 7.0% of the total land area.

4.2 Reforestation, Regreening and Industrial Afforestation

A total of 800 ha of land was planted in the period between fiscal 1984 and fiscal 1993 in the Study Area but the results for approximately 70% of this land were poor, mainly because of fire, drought, damage by animals and inferior seedlings, etc. Fires occur every year at some of the planted sites of reforestation and regreening projects, hindering the progress of these projects. Nevertheless, official data on fire damage is unavailable. The causes of fire are believed to be burning for grazing and slash-and-burn agriculture purposes and the throwing away of cigarettes. The planted species were *Acacia auriculiformis*, *Cassia siamiae* (johar), *Celba pentandra* (kapok), *Tectona grandis* (jati), *Aleurites moluccana* (kemiri) and *Anacardium occidentale* (jambu mente: cashew), etc. Industrial reforestation commenced in East Nusa Tenggara Province in fiscal 1987 by the State Forestry Corporation (Perum Perhutani) with the participation of local inhabitants and some 18,000 ha were covered by fiscal 1993. The main species planted are teak, mahogany, johar, *Pterocarpus indicus*, *Gmelina arborea*, *Eucalyptus urophylla*, *Enterolobium seclocarpum* (Sengon butto) and sandalwood.

4.3 Social Forestry

Most of the forestry activities in the Study Area are conducted based on the concept of social forestry. It is, however, still premature to say that social forestry is firmly rooted in the Study Area. As stock raising has important implications in the Study Area as a local industry and also from the viewpoint of environmental conservation, the urgent development of the practice of silvo-pasture is deemed necessary through grassland improvement and the creation of grazing forests. Regardless of the type of forest to be developed, the selection of appropriate species vis-a-vis the subject site is essential to ensure successful growth and to avoid adverse impacts on the local ecosystem. In the case of social forestry, the wishes of local inhabitants must be met.

4.4 Forest Protection

(1) Diseases and Insect Damage

In mid-1986, East Nusa Tenggara Province experienced an onslaught by jumping lice *Heteropsylla cubana* which caused extensive damage to lamtoro. By the end of August, the estimate area of damage reached some 50% of the lamtoro planted area. Several measures have been adopted in the fight against jumping lice, including the trimming and burning of branches, both ground and aerial spraying of insecticide. The attack by jumping lice had almost ceased by the end of 1992 and at present, the introduction of a lamtoro variety with a high resistance to jumping lice and mixed planting with other fodder trees are in progress.

(2) Fire Prevention Facilities

The Dinas Kehutanan and Perum Perhutani maintain such fire prevention facilities as firebreaks, fire look-outs and fire extinguishers, etc.

4.5 Forest Roads

There is a one km-long forest road (3 m wide) in the Study Area which was manually constructed by the Dinas Kehutanan at a reforestation site (100 ha) at Desa Tesbatan in the Oesao East Working Area in fiscal 1991.

4.6 Forest Products

Timber production in Kec. Kupang Tengah, Kec. Kupang Timur and Kec. Amarasi cannot be said to be active at present. Moreover, there is little prospect of sandalwood production for some time to come. Most households use firewood for cooking purposes and the species supplying firewood include kesambi, acacia spp., lamtoro, jati and various palm trees. Some 75% of the respondents of the questionnaire survey currently find it more difficult to collect wood compared to the situation several years ago. Many local inhabitants point out that there is a construction timber supply shortage and that land rehabilitation is necessary to provide timber from national forests to meet the local demand.

4.7 Extension

The main extension activities currently practiced are the management of village nurseries, guidance of nursery techniques, the supervision of and guidance on reforestation and

regreening work and the promotion of understanding of the necessity for soil and water resources conservation and related techniques among local inhabitants.

5. Watershed Conservation

5.1 Hydrological Conditions

In terms of the monthly discharge of Oesao River, January is the highest month, followed by February and then March. The discharge from mid-March to December is extremely low, indicating a long dry season.

5.2 Water Resources and Water Utilisation

(1) Surface Water

Rivers in the Study Area are the main sources of irrigation water for farm lands and paddy fields. Desa Tunabaun in the Study Area has 86 sites where rain water is stored for domestic use. The competent authority in charge of irrigation at the kabupaten level also constructs dam embung (small ponds) for supplying local inhabitants with drinking water (main purpose), supply drinking water for animals and water for small domestic gardens. The main purpose of dam pengendali (earth check dams) is to control sediment loss while also supplying drinking water for local inhabitants as well as domestic animals.

(2) Groundwater

Many wells in the Study Area dry up in dry season. Another important groundwater resource in the area is fountain water. It seldom dries up during the dry season, provides a source of the river's base flow and is used for domestic water, drinking water for domestic animals and irrigation water. In this sense, fountain water is one of the most important water resources of the area.

5.3 Current Conditions of Degradation

In the case of open grassland, grassland with scattered trees and shrub and bush land, the loss of vegetation cover due to over-grazing and burning in the dry season lead to the creation of bare land. In addition, strong rain reaching a maximum daily rainfall of 140 mm causes serious surface erosion, in turn leading to land degradation. Landslides mainly occur at steep slopes in the upper reaches of Oebelo River and Olio River in the western part of the Study Area. In general, these sites consist of shale and marlstone.

Gully erosion is rare but is still observed at several sites in the Study Area. Bank erosion is widely observed in the Study Area along Oebelo River, Olio River, Oesao River and their tributaries, particularly in the Oebelo and Olio Watersheds.

5.4 Soil Loss

For the present Study, the method used to predict the level of soil loss in the Study Area is the measurement of the sedimentation volume at check dams, taking the availability of related data and study period into consideration. The total volume of soil loss in the Study Area is estimated by adding the soil loss due to gully erosion and river bank erosion, both of which are separately estimated, to the soil loss due to surface erosion. The soil loss by type of soil erosion, excluding the loss from landslide sites, and by working area is shown in Table 1.

Table 1 Average Soil Loss by Type of Soil Erosion and Working Area and Gross Soil Loss

Working Area	Average Soil Loss (tons/ha/year)			Average Soil Loss (tons/ha/year)	Gross Soil Loss (tons/year)
	Surface Erosion	Gully Erosion	Bank Erosion		
Oesao East	12.53	-	0.2	12.7	135,000
Oesao West	36.50	-	1.1	37.6	362,000
Olio	39.10	-	1.3	40.4	182,000
Oebelo	19.85	0.4	1.2	21.4	179,000
Total	-	-	-	-	858,000

5.5 Existing Soil and Water Conservation Facilities

The existing soil and water conservation facilities in the Study Area consist of earth check dams, gabions and traditional terraces, etc.

6. Basic Framework

6.1 Basic Principles

(1) Land Rehabilitation Plan and Land Use

- 1) It is necessary to prepare a land rehabilitation plan, designed to establish rational land use, to prevent the further degradation of land and to promote local development.

- 2) In the preparation of the plan, land use improvement criteria from the viewpoint of soil and water conservation will be established, taking the zoning for national land conservation purposes, site classification to judge appropriate land use, current conditions of land use and opinions of local farmers, etc. into consideration and the project will be based on these criteria.
 - 3) Realistic soil loss control targets will be determined, taking their impacts on agriculture and stock raising and likely project cost into consideration.
 - 4) Although the emphasis of soil loss control is placed on such vegetative measures as afforestation, farmland improvement and grassland improvement, civil engineering measures will also be employed, including the creation/rehabilitation of terraces, earth check dams and revetment works.
 - 5) While the plan will actively promote reforestation, it will also encourage the expansion of agroforestry and silvo-pasture, taking the characteristics of local agriculture and stock raising into consideration.
 - 6) The seedlings required for the plan will be supplied by the state nursery (currently under construction). Some of the fruit tree and fodder tree seedlings will be supplied by village nurseries.
 - 7) The plan details will be in line with the contents of the existing spatial plan for the Study Area.
- (2) Local Development and Participation of Local Inhabitants
- 1) It is essential that the plan be implemented with the active participation of local inhabitants from the viewpoint of social forestry. In this sense, the plan will not only contribute to land rehabilitation but also to local development.
 - 2) Incentives vis-a-vis local inhabitants will be clearly presented. In addition, the education and training of local inhabitants by extension workers will be actively conducted to consolidate the local extension work. For these purposes, training facilities and demonstration plots will be established.
 - 3) The group activities of local inhabitants will be actively encouraged by means of promoting the establishment of groups, training of leaders and participation of women, etc. Close liaison with local NGOs should also be sought in this context.
 - 4) The construction or repair of local roads will be promoted to improve the village infrastructure together with the drilling of wells for drinking water and

infiltration wells and the creation of hedges, etc., all of which are intended to conserve the village environment.

- 5) In preparing the plan details, priority will be given to those technologies which are well established in the area and readily accepted by local inhabitants. Efforts will also be made to procure as much labour, materials and equipment as possible locally.

(3) Consideration of Environmental Impacts

- 1) The local environmental conditions will be surveyed and possible environmental impacts will be forecast and evaluated.
- 2) The plan contents will favour environmental conservation and will also contribute to the development of the local socioeconomy.
- 3) As part of the plan implementation process, monitoring will be conducted to evaluate the plan with a view to modifying the contents for continual plan implementation.

(4) Consolidation of Plan Implementation System

- 1) The plan implementation system will facilitate the participation of local inhabitants in the project and smooth coordination between related administrative organizations.
- 2) A project management centre will be established in the Study Area to supervise the implementation, coordination and evaluation of the plan and to provide both training and guidance for local inhabitants.
- 3) For the convenience of plan implementation, the Study Area will be divided into four working areas. The project period will be 10 years.

6.2 Classification of Working Areas

The Study Area is divided into four working areas, i.e. Oesao East, Oesao West, Olio and Oebelo.

6.3 Soil Loss Control Target

For the present soil and water conservation plan, soil loss of 9.6 tons/ha/year is assumed as the target ceiling for the allowable soil loss.

6.4 Zoning

The Indonesian Ministry of Forestry classifies national land into 4 zones, for the preparation of watershed management plans using the three factors affecting soil erosion, i.e. slope gradient, soil type and rainfall intensity. Based on this official classification, the Study Area is also classified into 3 zones, i.e. protection zones, buffer zones, cultivation zones.

6.5 Site Classification

Site classification based on the natural conditions has been conducted to establish the criteria for appropriate land use.

- Type I : Suitable for use as cultivation land, forest land or grassland
- Type II : Suitable for use as either forest land or grassland but may be used as cultivation land depending on the location
- Type III : Desirable use as either forest land or grassland but its use as cultivation land may be feasible depending on the location
- Type IV : Feasible as either forest land or grassland
- Type V : Feasible as forest land
- Type VI : Unsuitable for use as cultivation land, forest land or grassland

6.6 Land Use Criteria

The land use criteria given in Table 2 have been prepared based on the zoning results, site classification results and current land use.

Table 2 Land Use Criteria

Zone	Land Use Prior to Plan Implementation	Site category Type					
		I	II	III	IV	V	VI
Protection Zone	Mangrove Forests	-	-	-	-	-	-
	Lowland Forests (except Mangrove Forests)	-	-	-	-	-	-
	Open Grassland	F1	F1	F1	F1	F1	F1
	Grassland with Palm Trees	F2	F2	F2	F2	F2	F2
	Grassland with Trees other than Palm Trees	F2	F2	F2	F2	F2	F2
	Shrub Land	F3	F3	F3	F3	F3	F3
	Bamboo Groves	-	-	-	-	-	-
	Natural/Secondary Forests	-	-	-	-	-	-
	Man-Made Forests	-	-	-	-	-	-
	Paddy Fields	-	-	-	-	-	-
	Dry Crop Fields	FI1	FI1	FI2	FI2	FI2	FI2
	Mixed Gardens (crown density < 70%)	FI2	FI2	FI2	FI2	FI2	FI2
	Mixed Gardens (crown density > 70%)	-	-	-	-	-	-
Others	-	-	-	-	-	-	
Buffer Zone	Mangrove Forests	-	-	-	-	-	-
	Lowland Forests (except Mangrove Forests)	-	-	-	-	-	-
	Open Grassland	GI1,2	GI1,2	-	F1	F1	F1
	Grassland with Palm Trees	GI1,2	GI1,2	-	F2	F2	F2
	Grassland with Trees other than Palm Trees	GI1,2	GI1,2	-	F2	F2	F2
	Shrub Land	FI2	FI2	FI2	FI2	F3	F3
	Bamboo Groves	-	-	-	-	-	-
	Natural/Secondary Forests	-	-	-	-	-	-
	Man-Made Forests	-	-	-	-	-	-
	Paddy Fields	-	-	-	-	-	-
	Dry Crop Fields	-	-	FI1	FI1	FI2	FI2
	Mixed Gardens (crown density < 70%)	-	-	FI2	FI2	FI2	FI2
	Mixed Gardens (crown density > 70%)	-	-	-	-	-	-
Others	-	-	-	-	-	-	
Cultivation Zone	Mangrove Forests	-	-	-	-	-	-
	Lowland Forests (except Mangrove Forests)	-	-	-	-	-	-
	Open Grassland	GI1,2	GI1,2	GI2	-	F1	F1
	Grassland with Palm Trees	GI1,2	GI1,2	-	-	F2	F2
	Grassland with Trees other than Palm Trees	GI1,2	GI1,2	GI2	-	F2	F2
	Shrub Land	FI1	FI1	FI2	FI2	F3	F3
	Bamboo Groves	-	-	-	-	-	-
	Natural/Secondary Forests	-	-	-	-	-	-
	Man-Made Forests	-	-	-	-	-	-
	Paddy Fields	-	-	-	-	-	-
	Dry Crop Fields	-	-	-	FI1	FI1	FI1
	Mixed Gardens (crown density < 70%)	-	-	-	FI2	FI2	FI2
	Mixed Gardens (crown density > 70%)	-	-	-	-	-	-
Others	-	-	-	-	-	-	

- Notes
- F1 (Reforestation Type 1) : All-out reforestation
 - F2 (Reforestation Type 2) : Intensive planting
 - F3 (Reforestation Type 3) : Less intensive planting
 - FI1 (Farmland Improvement Type 1) : Crop cultivation with the introduction of fruit and other trees
 - FI2 (Farmland Improvement Type 2) : Mixed gardens of fruit and other trees
 - GI1 (Grassland Improvement Type 1) : Introduction of grazing grass and fodder trees
 - GI2 (Grassland Improvement Type 2) : Establishment of fodder trees
 - : Continuation of the existing land use

7. Land Rehabilitation Plan

7.1 Forest Establishment Plan

Forest establishment work (reforestation) will be conducted at those sites with low land productivity and also at those requiring special care from the viewpoint of soil conservation in such areas classified as open grassland, grassland with palm or other trees and shrub land.

(1) Reforestation Type 1: All-out Reforestation

Reforestation will be conducted over the entire area due to the importance and urgency of the soil conservation of existing grassland which is classified as F1 in Table 2.

(2) Reforestation Type 2: Intensive Planting

Reforestation using forest trees will be conducted for grassland with palm or other trees which is classified as F2 in Table 2.

(3) Reforestation Type 3: Less Intensive Planting

In the case of present shrub land which is classified as F3 in Table 2, less intensive planting will be conducted to create firewood forests or fodder forests.

7.2 Farmland Improvement Plan

Trees will be planted for existing dry crop fields, mixed gardens with a crown density of less than 70% and shrub land to increase the ground coverage by trees so that the farming use of these land types can be conducted with care being taken in regard to soil conservation.

(1) Farmland Improvement Type 1: Crop Cultivation with Fruit and Other Trees

Existing dry crop fields and shrub land which are classified as Farmland Improvement Type 1 in Table 2 will be subject to the planting of fruit and other trees so that crop cultivation can be accompanied by fodder production.

(2) Farmland Improvement Type 2: Mixed Gardens of Fruit and Other Trees

Trees, mainly fruit trees, will be planted at existing dry crop fields, mixed gardens with a crown density of less than 70% and shrub land which are classified as FI2 in Table 2 in order to create mixed gardens with a tree crown density of 70% or more.

(3) Construction of Terraces

Improvement of the existing traditional terraces is planned. If the introduction of new terraces is found necessary, either improved terraces or teras gulud will be constructed.

(4) Mulching and Contour Cropping

Mulching and contour cropping will be conducted at existing shrub land (gradient: 0-8%) designated for FI1 or FI2 improvement work, at existing dry crop fields with a gradient of 0-8% and at existing mixed gardens without terraces (some 20% of the total mixed garden area).

(5) Vegetative Barriers

Vegetative barriers will be created at existing dry crop fields and shrub land with a gradient of 8-25%.

7.3 Grassland Improvement Plan

Grassland Improvement Type 1 which combines the introduction of grazing grass and the creation of fodder forests is planned for all Type I and Type II sites in cultivation zones on private land and in enclaves while Grassland Improvement Type 2 which aims at creating fodder forests is planned for that grassland without trees in cultivation zones. In the case of state forest land, Grassland Improvement Type 2 is planned for all grassland designated as Type I or Type II cultivation zones and grassland with palm or other trees designated as a Type III cultivation zones in order to create fodder forests to boost the local fodder production (see Table 2). At those sites where Grassland Improvement Type 1 is planned and where irrigation is feasible, fodder fields of king grass will be created as part of the demonstration plot and at those sites in natural grassland, watering places are planned. The seeds for grazing grass will also be distributed to those willing to grow grazing grass on paddy fields to alleviate the fodder shortage.

7.4 Soil and Water Conservation Plan

(1) Control of Soil Loss Caused by Surface Erosion

After implementation of the Plan, the land size of grassland where grazing and burning, two major causes of surface erosion, are frequently conducted will be reduced together with the shrub land used for shifting cultivation. In contrast, the

total land area of forests, terraced dry crop fields and mixed gardens will substantially increase. The overall effect of these changes should be a considerable decline of the surface soil loss.

(2) Stream Conservation Plan

The eroded soil flowing into streams will be deposited at the existing and planned earth check dams and small check dams in the Study Area to prevent its sedimentation at intake weirs, reservoirs, riverbeds and coastal areas in the Study Area which is the subject of soil and water conservation.

(3) Landslide Site Rehabilitation

Such activities as burning and grazing which control the invasion of vegetation will be prohibited at landslide sites and in their vicinity in order to facilitate the permanent spread of vegetation. If necessary, civil engineering measures using gabions will also be employed.

(4) Gully Erosion Control

The planned measures to control gully erosion include bamboo gully plugs, gabion gully plugs, infiltration ditches and the planting of trees and grasses.

(5) Bank Erosion Control

A revetment will be constructed at those banks where lateral erosion due to flowing river water is particularly severe. Planting at river banks is planned to stabilise the banks and to control soil discharge from nearby areas to river channels.

(6) Environmental Conservation for Settlement Sites

In view of the importance of reducing soil loss from settlement sites and conserving the environment around settlements, several measures will be implemented with the cooperation of local inhabitants, including infiltration wells, wells for drinking water, planting of fruit trees and the creation of hedges, etc.

7.5 Seedling Production Plan

The seedlings required for the Land Rehabilitation Plan will be supplied by the nursery under construction at Nevonaek in Kab. Kupang as part of the Central Nursery Development Programme with assistance by Finland and by the village nurseries to be newly created in the Study Area.

7.6 Road and Forest Protection Plan

(1) Road Plan

1) Road Improvement Plan

Some sections of the existing roads in the Study Area have become sources of soil loss and improvement of the surface by means of asphalt paving or the laying of gravel is essential. Moreover, it may be necessary to review the alignment.

2) New Road Construction

The planned forest roads will serve for reforestation, greening and forest management purposes and an average total length of 300 m per 100 ha of the subject area has been decided. The total length of new forest roads is calculated by multiplying the planned land area for the reforestation plan by the above unit length. An increase of the public road density in areas with a relatively low density, i.e. 4.9 m/ha in the Oesao West Working Area, 6.0 m/ha in the Olio Working Area and 7.8 m/ha in the Oebelo Working Area, is aimed at to match the public road density of some 10 m/ha in the Oesao East Working Area.

(2) Forest Protection Plan

In order to deal with the largest task of forest protection, i.e. the prevention and mitigation of damage caused by forest fires, the introduction of several measures is planned, including firebreaks, fire monitoring and reporting system, fire-fighting system and improved awareness of local inhabitants.

7.7 Extension Plan

(1) Extension, Guidance and Cooperation Systems

The main components of the extension activities under the Land Rehabilitation Plan are the training and extension work of the village, community and group leaders and extension workers with a view to developing villages and achieving local soil and water conservation by means of reforestation, social forestry, agroforestry and silvo-pasture, etc. In addition, the extension facilities and equipment will be improved.

(2) Creation of Demonstration Plots

Demonstration plots will be created and local farmers will be encouraged to participate in the Plan by showing farmers actual examples of the beneficial effects of such participation so that they can learn the various techniques and methods for successful reforestation and soil conservation from the achievements at the demonstration plots.

(3) Activities to Assist Local Inhabitants

Given the facts that most land in the Study Area is private land and that the majority of local inhabitants rely on agriculture and/or stock raising as the main source of income, the implementation of the Plan with the active understanding and cooperation of the local inhabitants is essential.

7.8 Management Plan

For the efficient management of the Plan's implementation, an office (centre) will be established locally and education/training facilities will be attached to this office in order to facilitate the extension programme under the Plan. The entire plan implementation period is set at 10 years.

7.9 Monitoring

As part of the Plan implementation process, it is desirable to conduct monitoring to assess the suitability of the components of the Plan and work progress and to identify problems and remedial measures so that the Plan components can be revised even at the implementation stage and so that the findings can be used for other plans and projects.

7.10 Estimate of Plan Implementation Cost

The total cost of the plan to be implemented is estimated to be Rp 35,000 million.

8. Initial Environmental Survey

The initial environmental survey was conducted to check the environmental conditions of the Study Area to determine the natural, as well as socioeconomic, environmental issues to be examined as part of the Land Rehabilitation Plan and the possible environmental impacts of the Plan's implementation have been predicted and evaluated. The evaluation results indicate

that the conservation targets in terms of the natural environment and socioeconomic environment will be achieved.

9. Transfer of Technology

The transfer of technology was conducted by means of OJT during the field survey period and training in Japan for those counterparts selected from among staff members of the Land Rehabilitation and Soil Conservation Sub-Centre (Sub-Balai RLKT Benain Noelmina).

10. Proposals

- (1) The Land Rehabilitation Plan is judged appropriate from the technical and social points of view. Accordingly, the implementation of the Plan without delay is desirable.
- (2) The establishment of close cooperation and coordination between the organizations concerned is essential from the preparatory stage of planning and detailed design for the smooth implementation of the Plan. The establishment of an appropriate implementation system is also highly desirable.
- (3) To fully publicise the principles of the Plan's implementation adopted by the central, provincial and kabupaten authorities, the participation of local inhabitants in the Plan's implementation process from the preparatory stage should be secured with the provision of clear incentives for local inhabitants, taking the local conditions into consideration.
- (4) Active monitoring with the participation of local inhabitants is proposed for such subjects as soil loss, harvest changes and impacts on those people living in the Study Area.
- (5) The highest priority should be given to the development of protection forests where forests are encouraged to perform their functions to the highest standard and to protected zones.
- (6) It is necessary to rapidly expand the scope of research and surveys on reforestation techniques using local species, agroforestry and silvo-pasture techniques and the realities of soil erosion and hydrology, etc. for the future socioeconomic development of the Study Area.

CHAPTER I

OUTLINE OF THE STUDY

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I-1 Background of the Study

The province of East Nusa Tenggara where the Study Area is located is situated in Eastern Indonesia, reputedly the least developed region in the country. The Government of Indonesia, which is fully aware of the situation, emphasises the importance of the region's development in its 5th 5-Year National Development Plan. Geographically speaking, East Nusa Tenggara Province is composed of the western half of Timor Island, Flores Island and Sumba Island, etc. The province has a short rainy season and is a semi arid area with low land productivity. Most of the local population is engaged in agricultural activities which are often characterised by such extensive farming as shifting cultivation and stock raising.

In this part of Indonesia, forests are diminishing due to the excessive utilisation of this resource and this is leading to land degradation. The resulting manifestation of such problems as soil erosion and sedimentation as well as flooding in the lower reaches has led to general concern in regard to the loss of the water conservation function of forests.

This situation has called for the preparation of a land rehabilitation plan, taking the lives of local inhabitants into full consideration, for the Oesao Watershed in East Nusa Tenggara Province as the rehabilitation of forest land and improvement of the living environment will contribute to not only improvement of the welfare of local inhabitants but also the general development of the region.

Under these circumstances, the Government of Indonesia made a request to the Government of Japan in December, 1992 for the provision of technical cooperation designed to prepare the said land rehabilitation plan. In response to this request, the Government of Japan dispatched the Preparatory (Preliminary) Study Team to Indonesia in April, 1993, following by the Scope of Work (S/W) Preparatory Study Team in September, 1993 to conclude the S/W.

I-2 Objectives of the Study

The objectives of the Study are to clarify the current conditions of land use and vegetation, etc. in sub-watersheds, which are characterised by large tracts of degraded land requiring forest land conservation work, in the Oesao Watershed in the province of East Nusa Tenggara in Indonesia and to formulate a land rehabilitation plan (master plan) for the said semi-arid area.

I-3 Study Area

Timor Island where the Study Area is located is said to have been formed by the uplift of coral reefs as a result of the orogenic movement of the Pacific Rim and outcrops of limestone are observed in many places. The Study Area forms part of Kabupaten (Kab.) Kupang and is divided into 3 Kecamatan, i.e. Kecamatan (Kec.) Kupang Timur, Kec. Amarasi and Kec. Kupang Tengah. The Study Area covers the Oesao, Oebelo and Olio Sub-Watersheds (hereinafter referred to as watersheds), the areas of which total 33,180 ha. The topography of the region is dominated by gentle slopes from the watershed divide at EL. 500 - 600 m to the coastline. More than 90% of the annual rainfall is recorded in the rainy season between November and April which is followed by a long, severe dry season from May to October. While some natural secondary forests are observed around the watershed divide, the predominant forests are sparse, open forests, such as bushwood (Belukar) and savannah. (See Fig. I-1 - Map of Study Area and Fig. I-2 - Locations of Kecamatans and Desas in Study Area.)

I-4 Outline of the Study

The Study has been in progress for 3 years, from fiscal 1993 to fiscal 1995, and Fig. I-3 shows the flow of the Study-related work. The work conducted in each year is outlined below.

(1) Fiscal 1993 (Phase I First Term)

1) Work in Japan

- ① Preparation of implementation plan for entire Study
- ② Preparations for local subcontracting in relation to preparation of topographical maps and land use and vegetation maps, tracing of soil maps and survey on local inhabitants
- ③ Preparation of Inception Report

2) Work in Indonesia

- ① Explanation of contents of Inception Report
- ② Gathering of information and data for initial environmental survey
- ③ Preparations for local subcontracting

3) Field investigation

(2) Fiscal 1994 (Phase I Second Term)

1) Work in Japan

- ① Gathering and analysis of information and data
- ② Preparation of draft contracts, as well as specifications, for local subcontracting

2) Work in Indonesia

- ① Basic field surveys
- ② Preparation of topographical maps
- ③ Preparation of land use and vegetation maps
- ④ Preparation of soil maps
- ⑤ Survey on local inhabitants

3) Further Work in Japan

- ① Preparation of Progress Report

(3) Fiscal 1994 (Phase II)

1) Work in Indonesia

- ① Explanation of contents of Progress Report
- ② Full-scale field surveys

2) Work in Japan

- ① Preparation of Interim Report

(4) Fiscal 1995 (Phase III)

1) Work in Indonesia

- ① Explanation of and discussions on Interim Report
- ② Field verification

2) Work in Japan

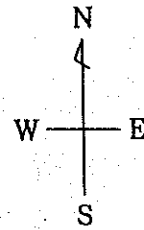
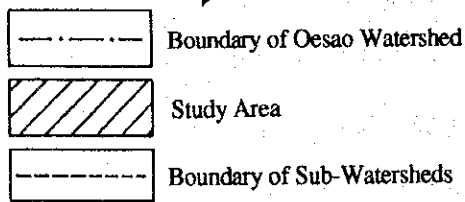
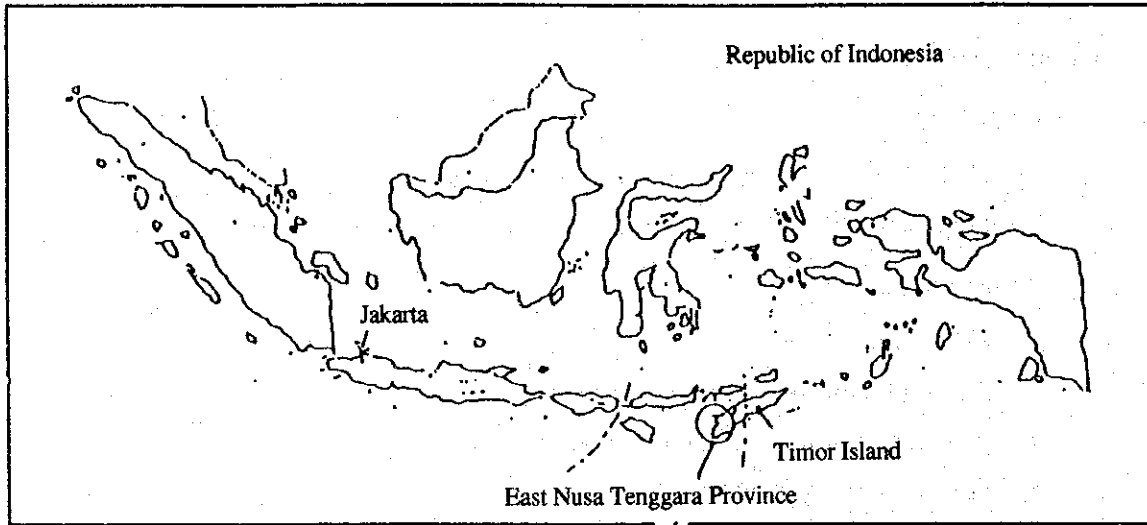
- ① Preparation of Draft Final Report
- ② Preparation of papers for Transfer of Technology Seminar

3) Work in Indonesia

- ① Explanation of Draft Final Report
- ② Transfer of Technology Seminar

4) Work in Japan

- ① Preparation of Final Report
- ② Preparation of Land Rehabilitation Plan Map



1. Bipolo
2. Nunurus
3. Pulukayu
4. Oesao
5. Oebelo, Olio
6. Manikin
7. Oesapa Besar

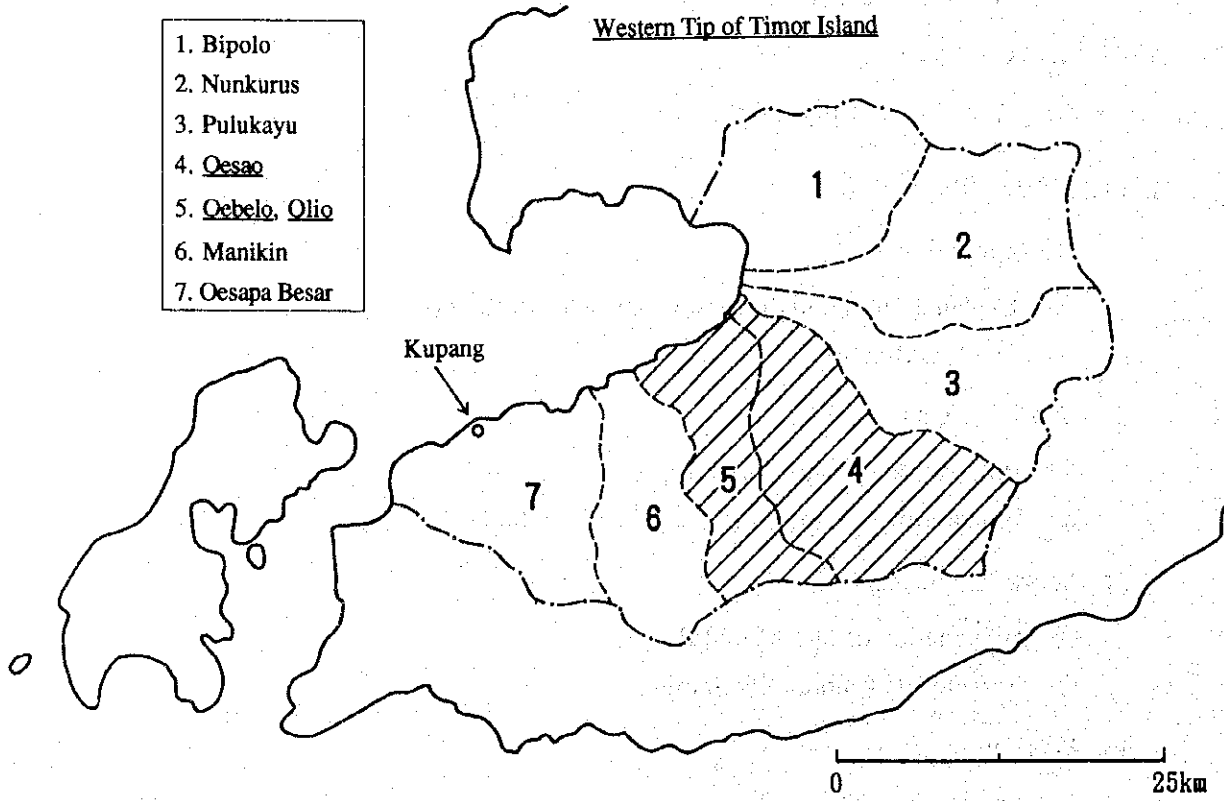


Fig. I-1: Map of Study Area

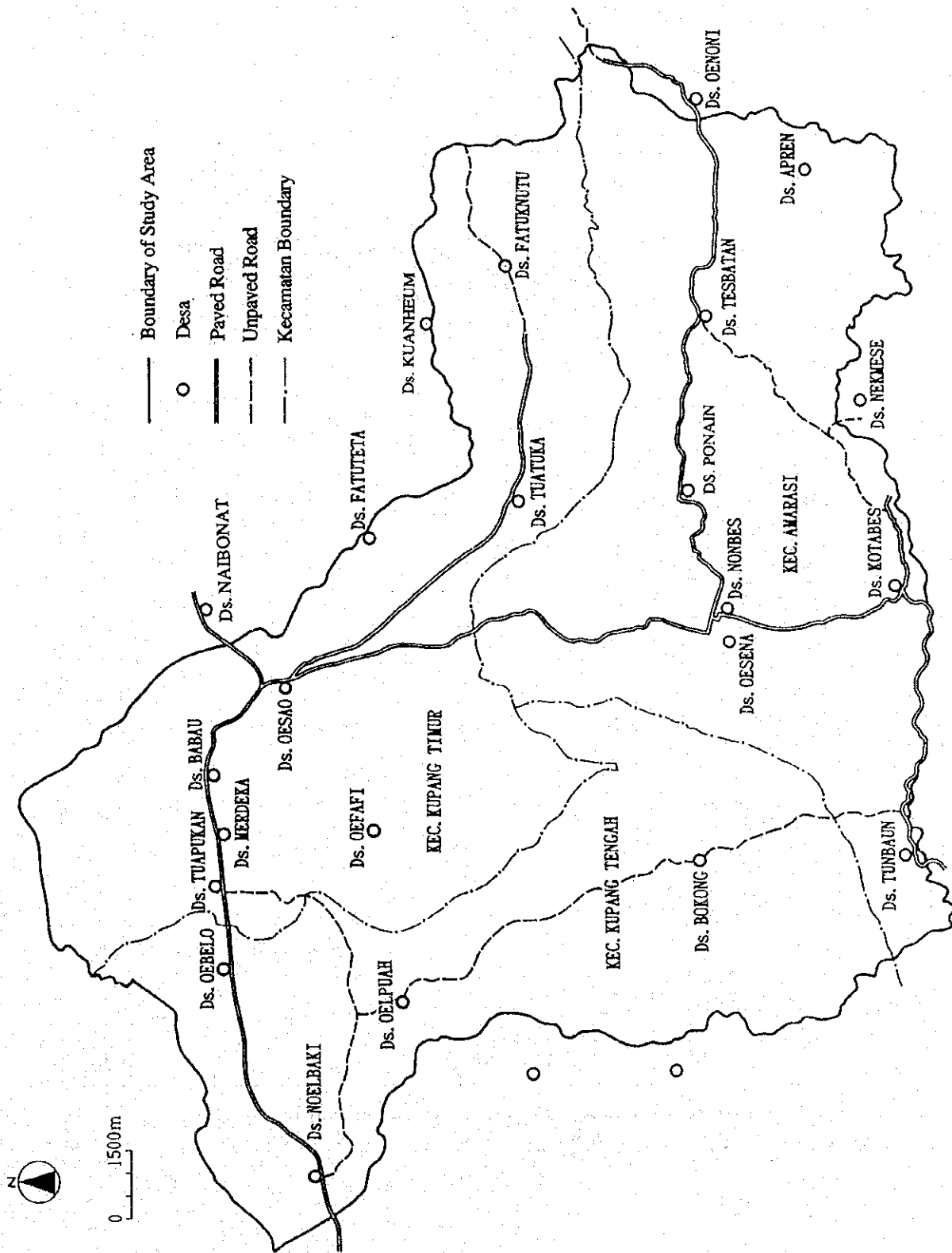
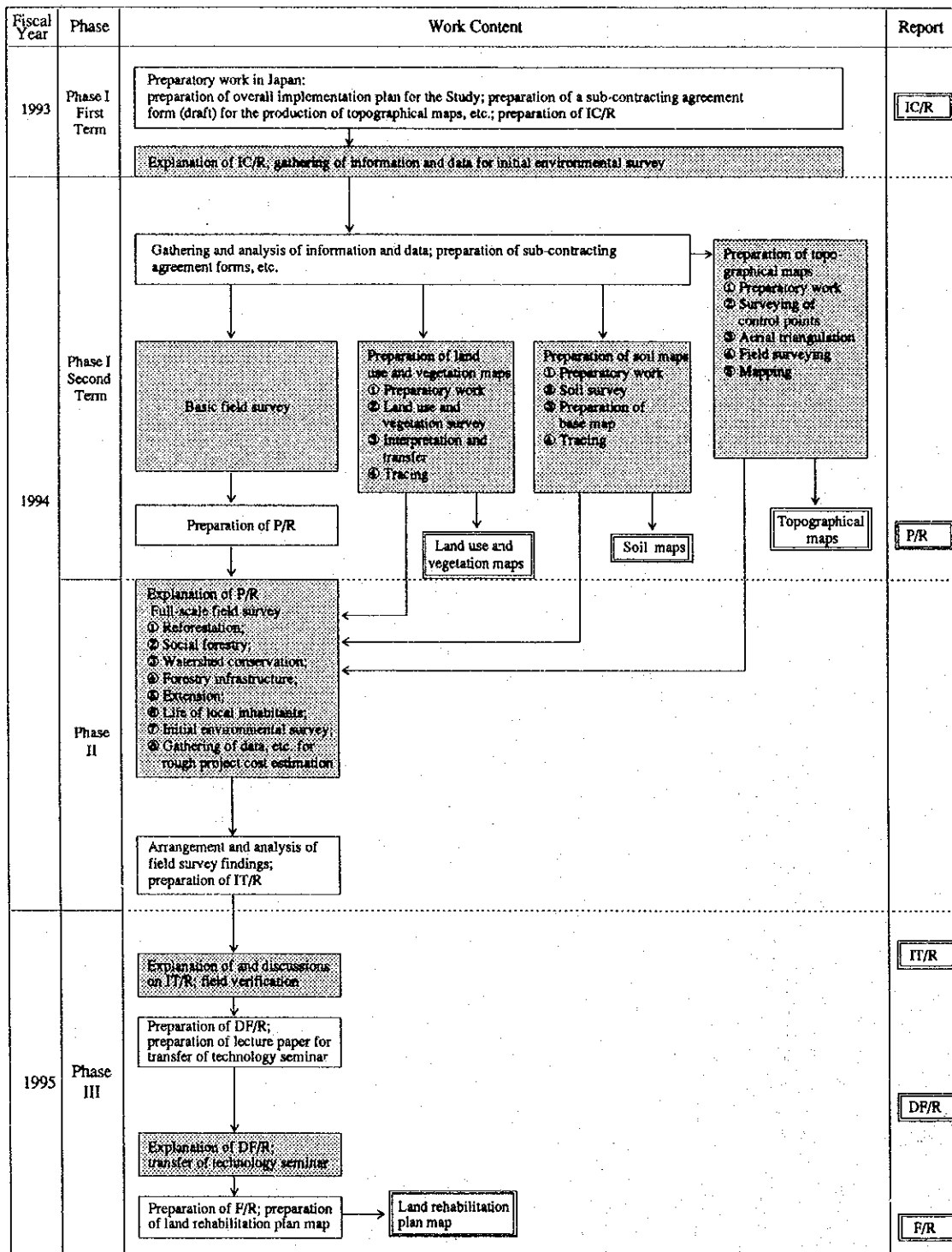


Fig. 1-2 Location of Kecamatan (Kec.) and Desas (Ds.) in the Study Area



Note

IC/R: Inception Report, P/R: Progress Report, IT/R: Interim Report, DF/R: Draft Final Report, F/R: Final Report

□ : Work in Japan ■ : Work in Indonesia □ : Results

Fig. I-3 Flow Chart of Study