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The Study
on
The Embung Development Project
(Small Scale Impounding Pond Development Project)
in
East Nusa Tenggara and West Nusa Tenggara
in
The Republic of Indonesia

Final Report
(Volume 4)

Feasibility Study Report
on
Ten Embung Development Projects
in
East Nusa Tenggara and West Nusa Tenggara

May 1995

NIPPON KOEI CO., LTD.

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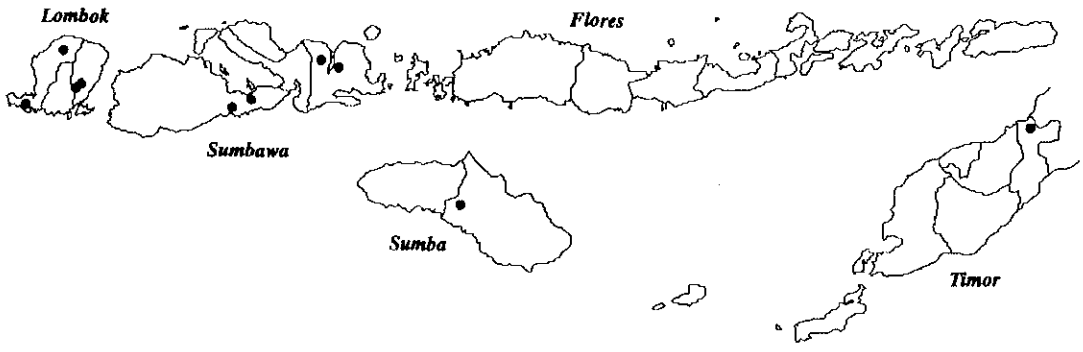

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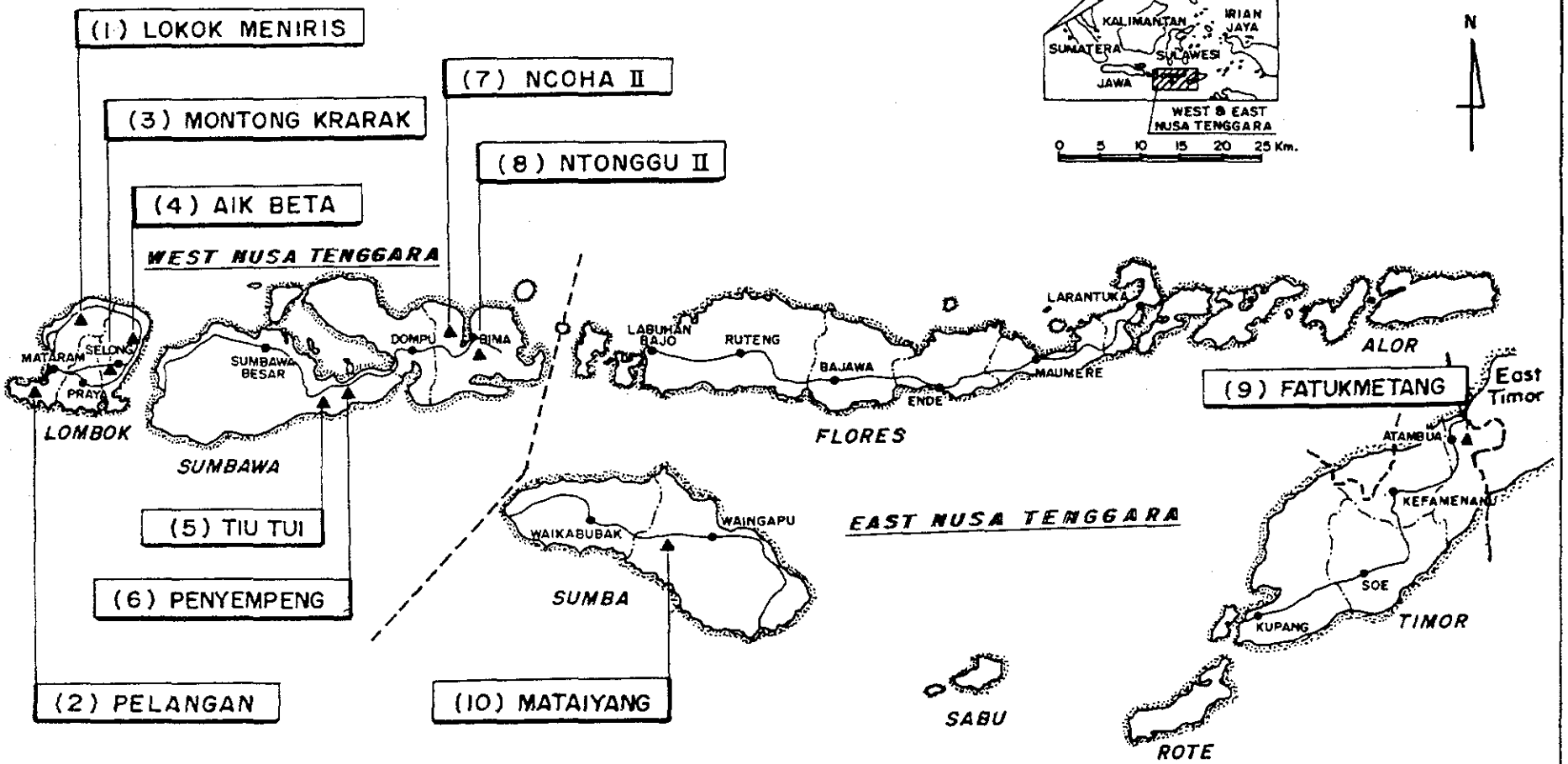

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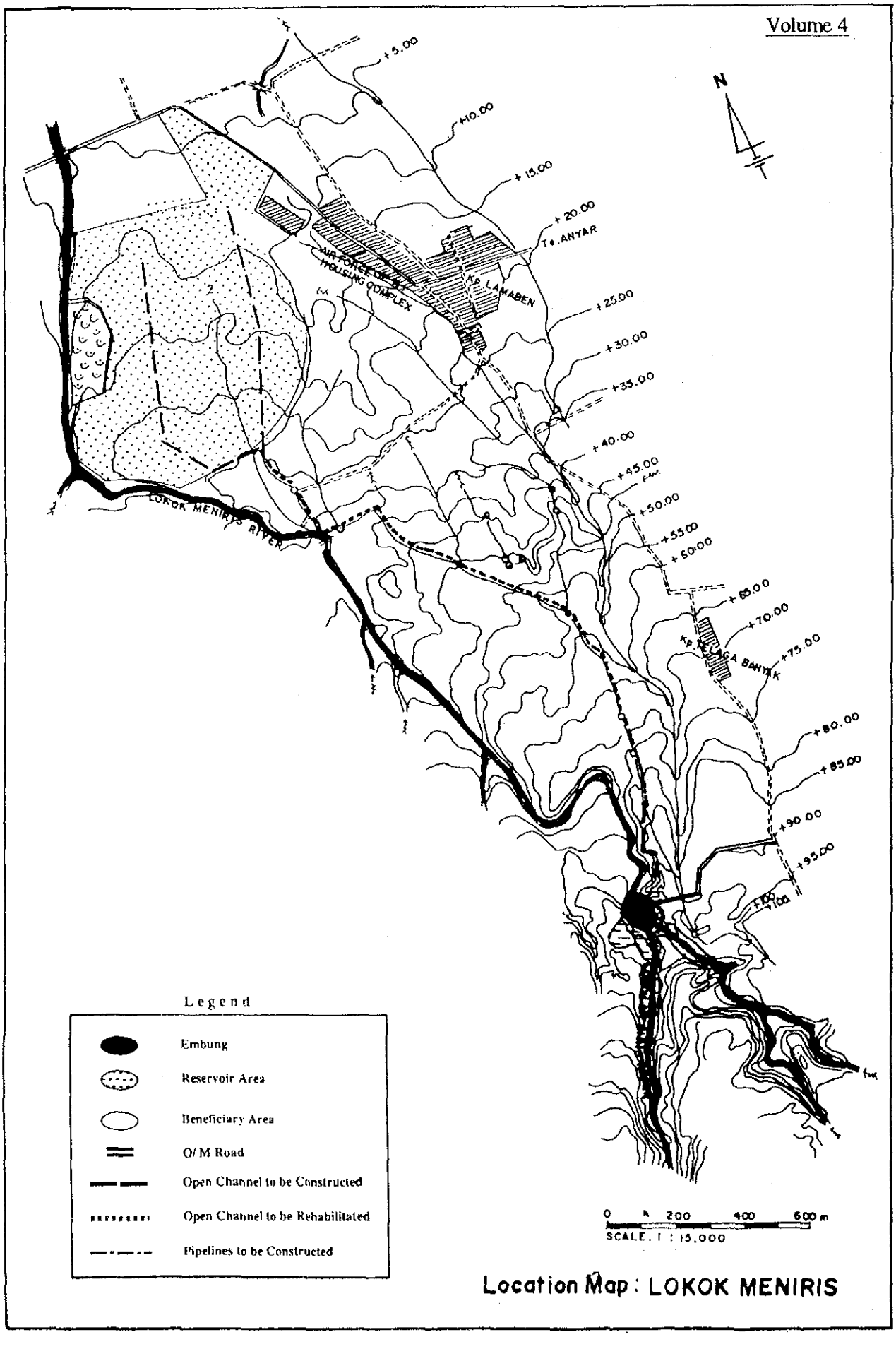

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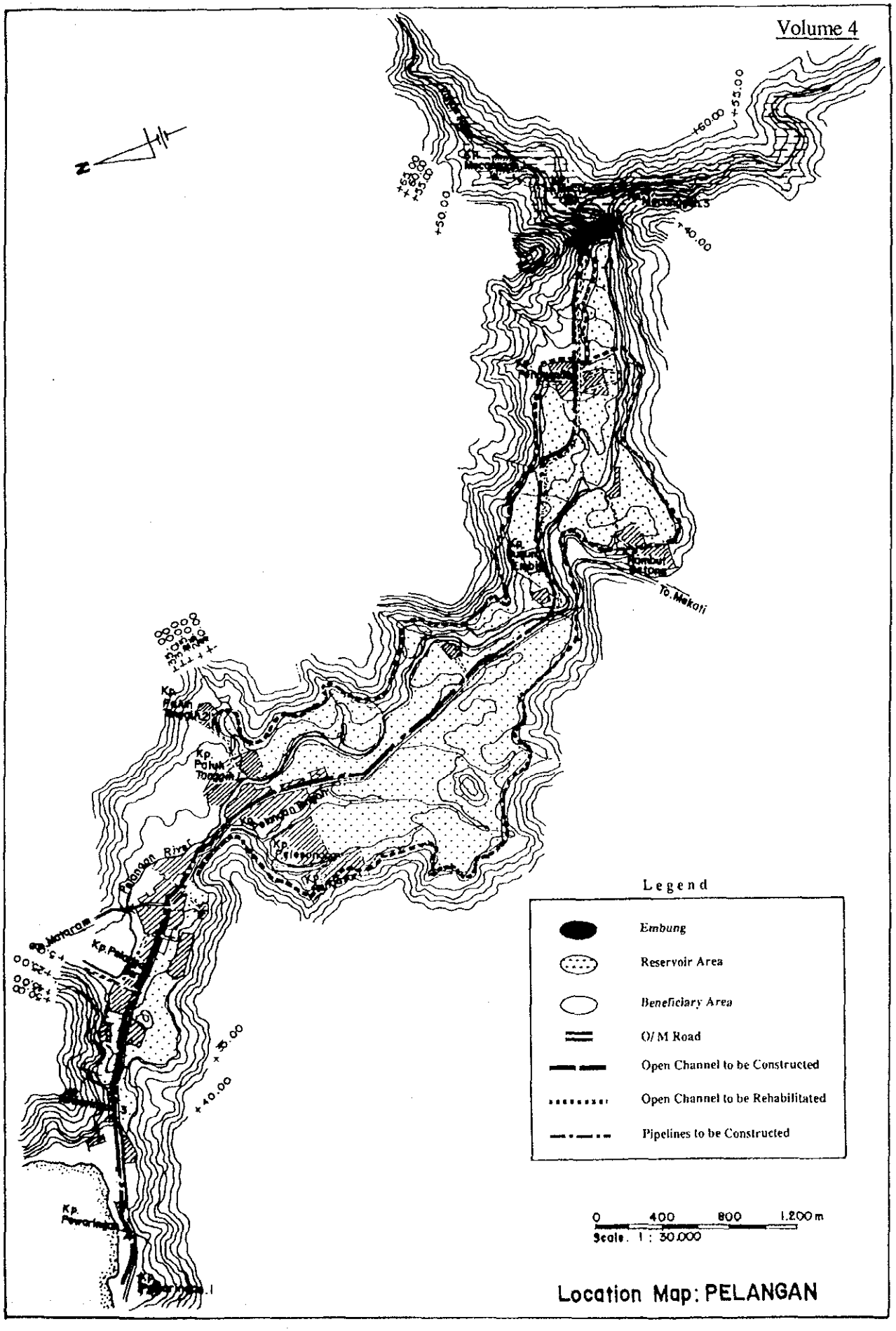

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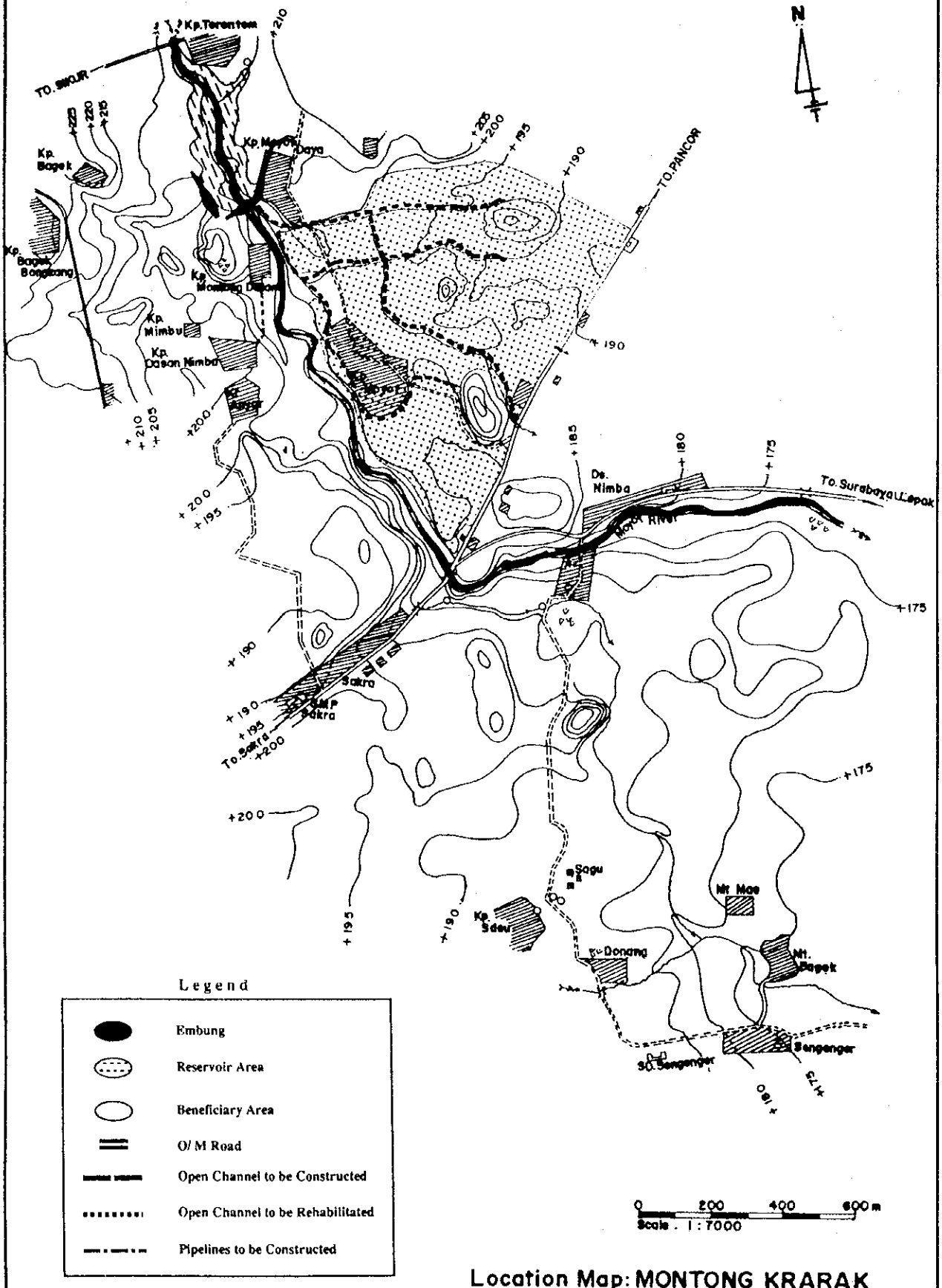

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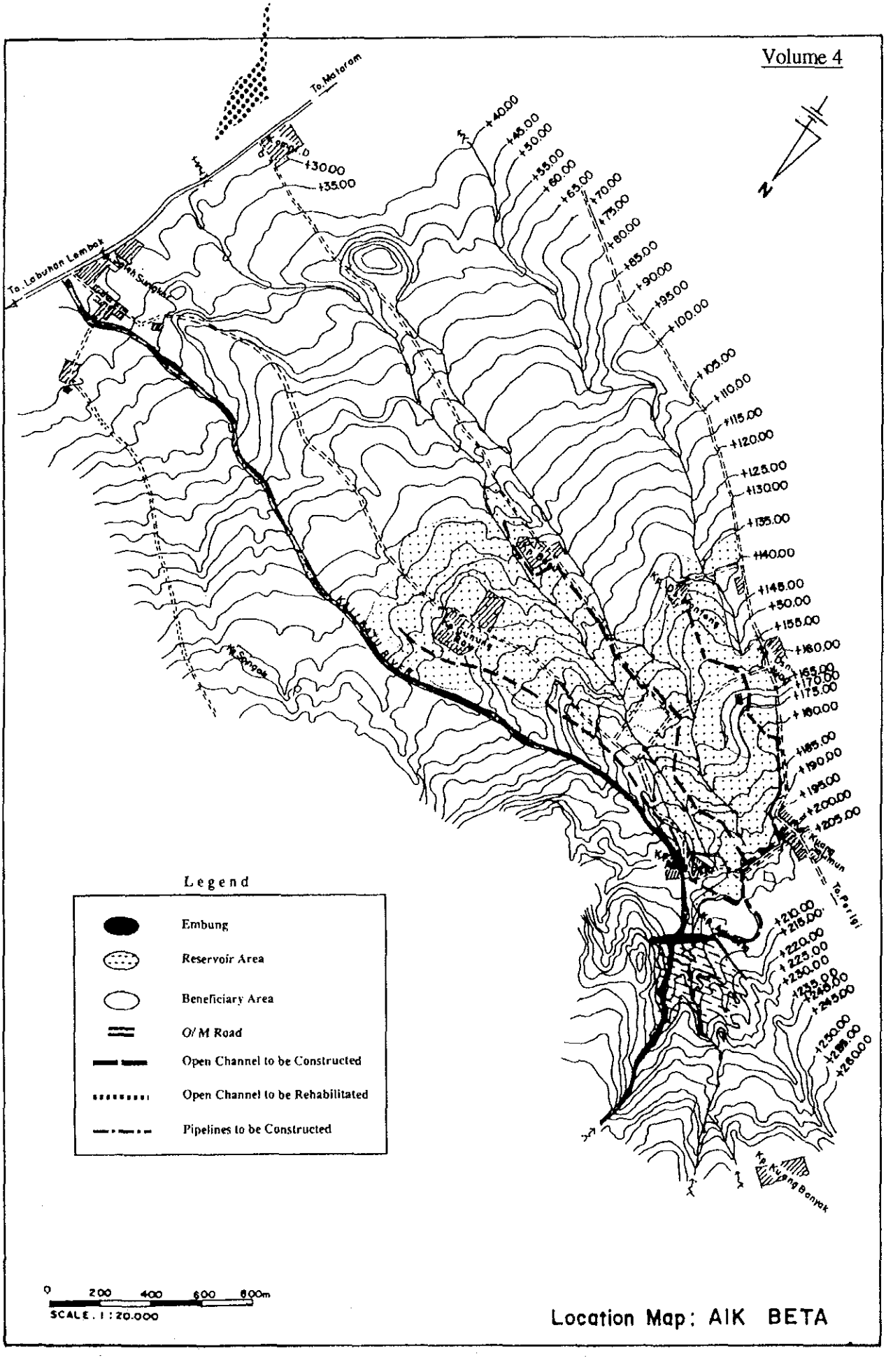

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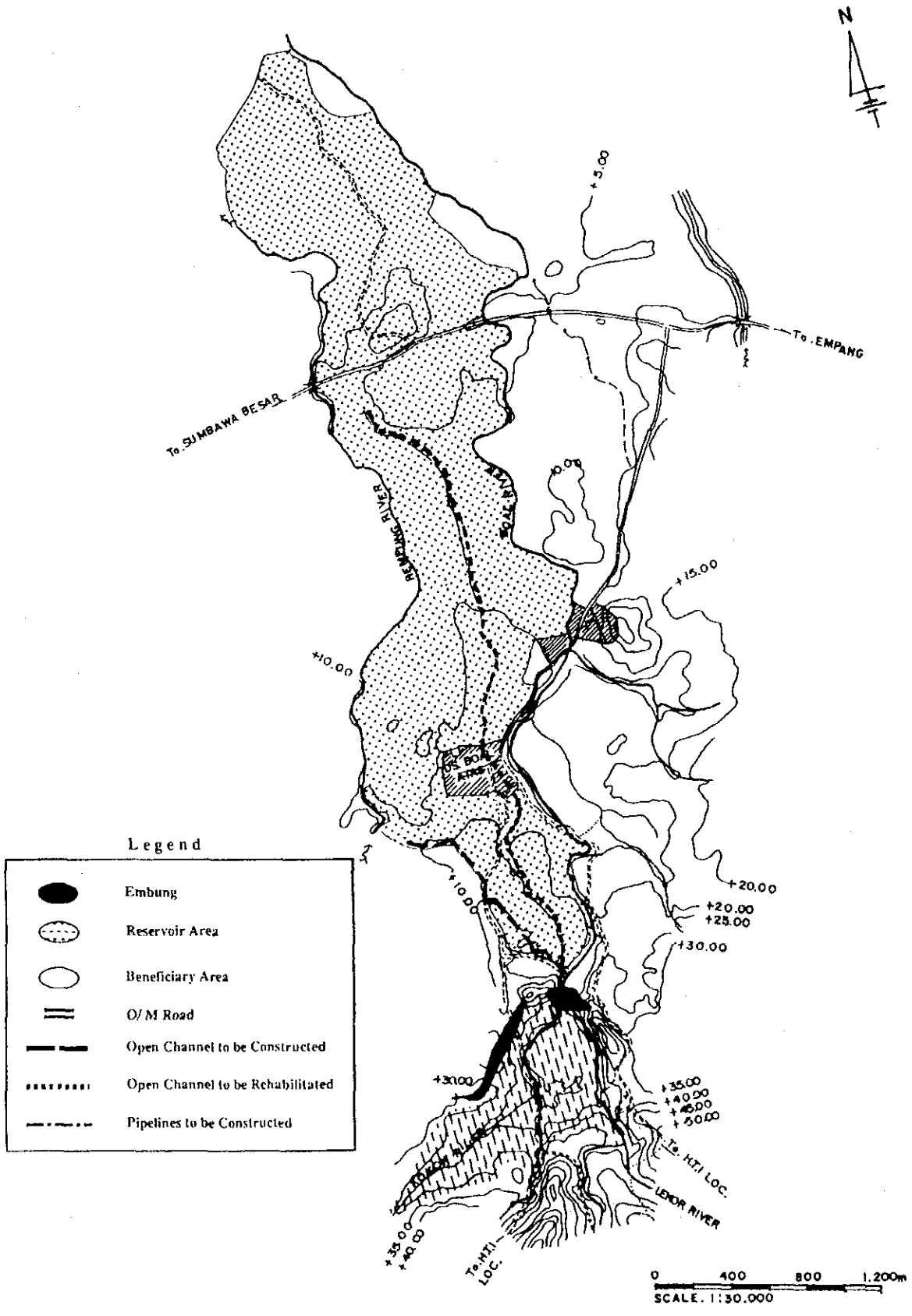

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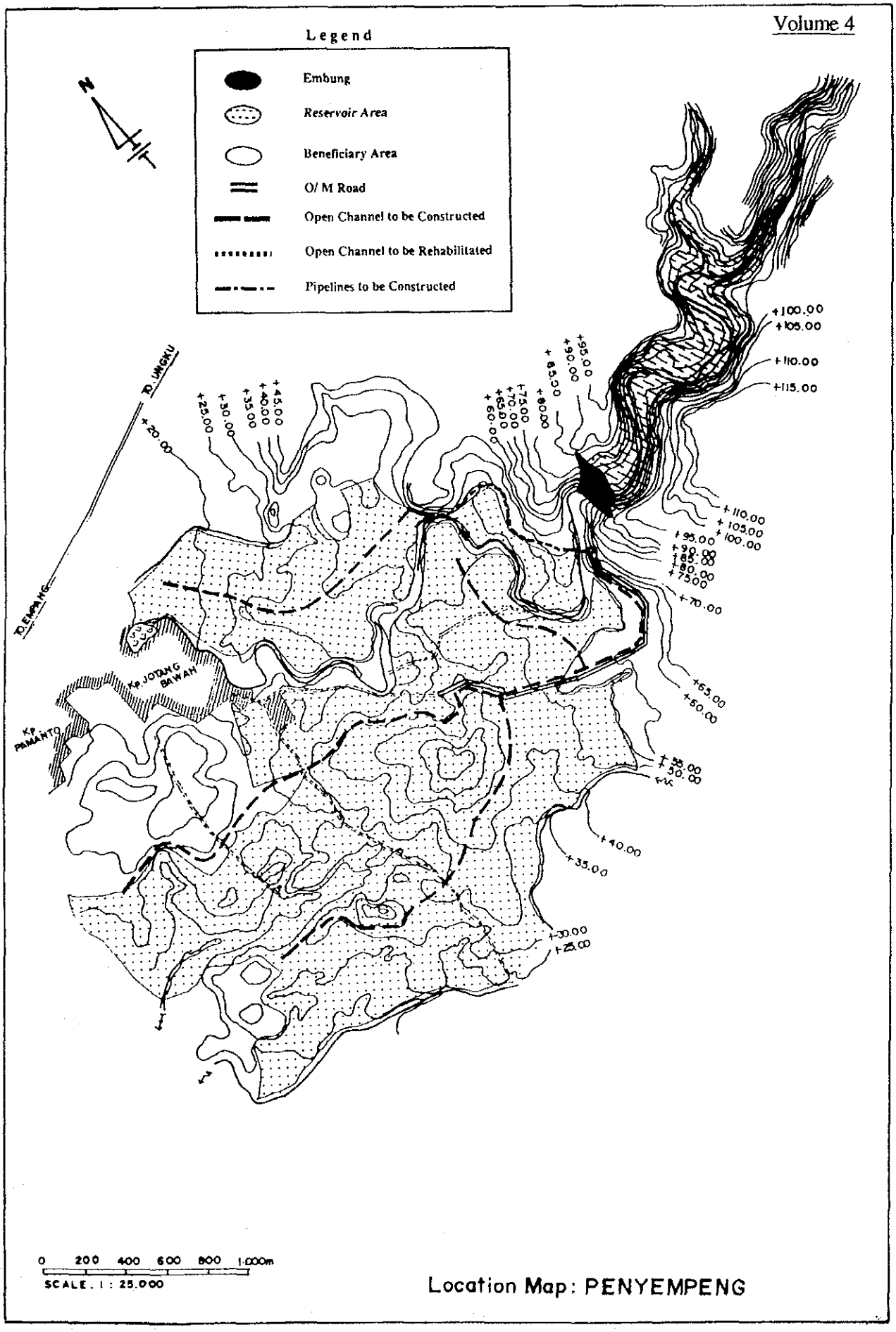

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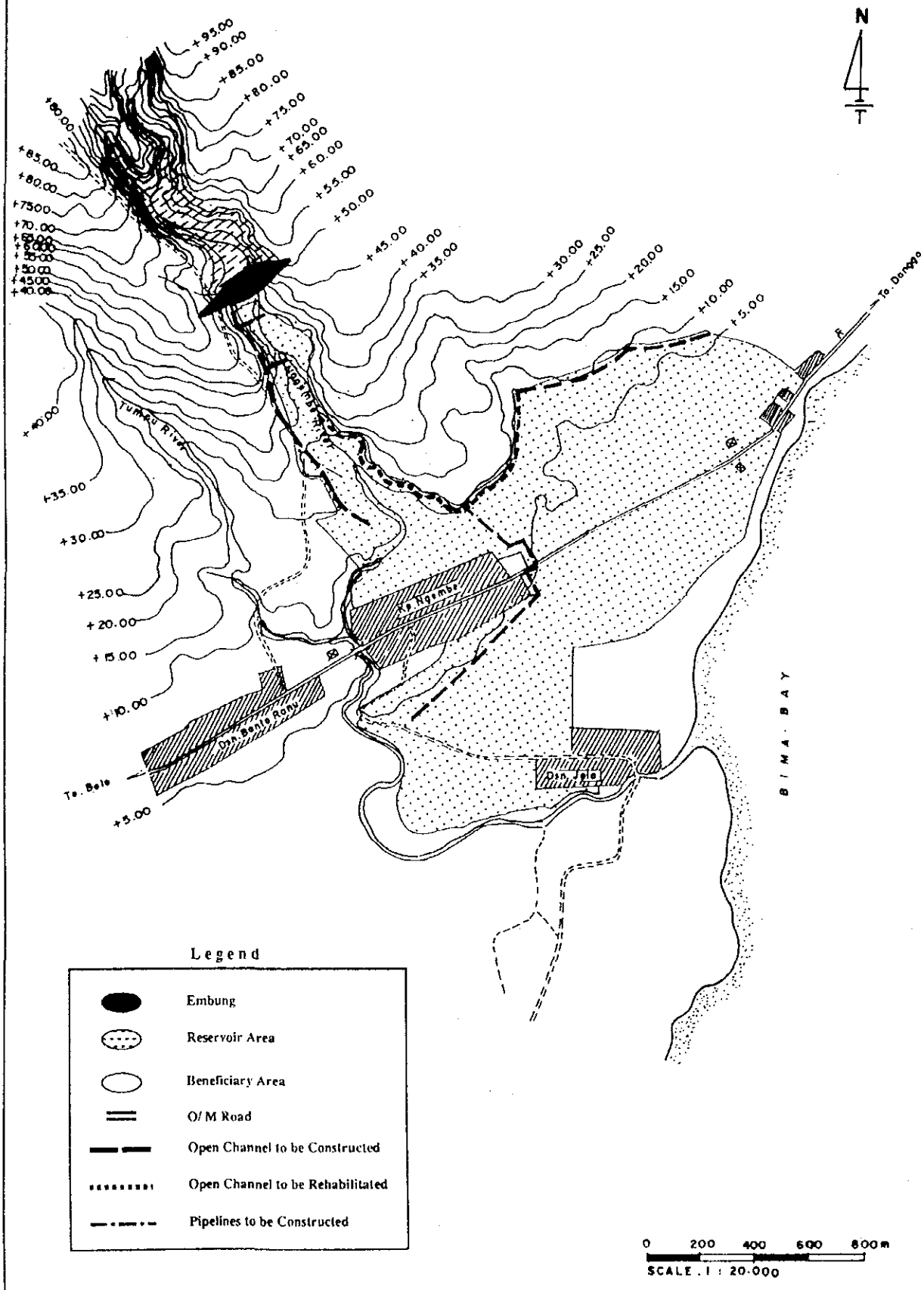

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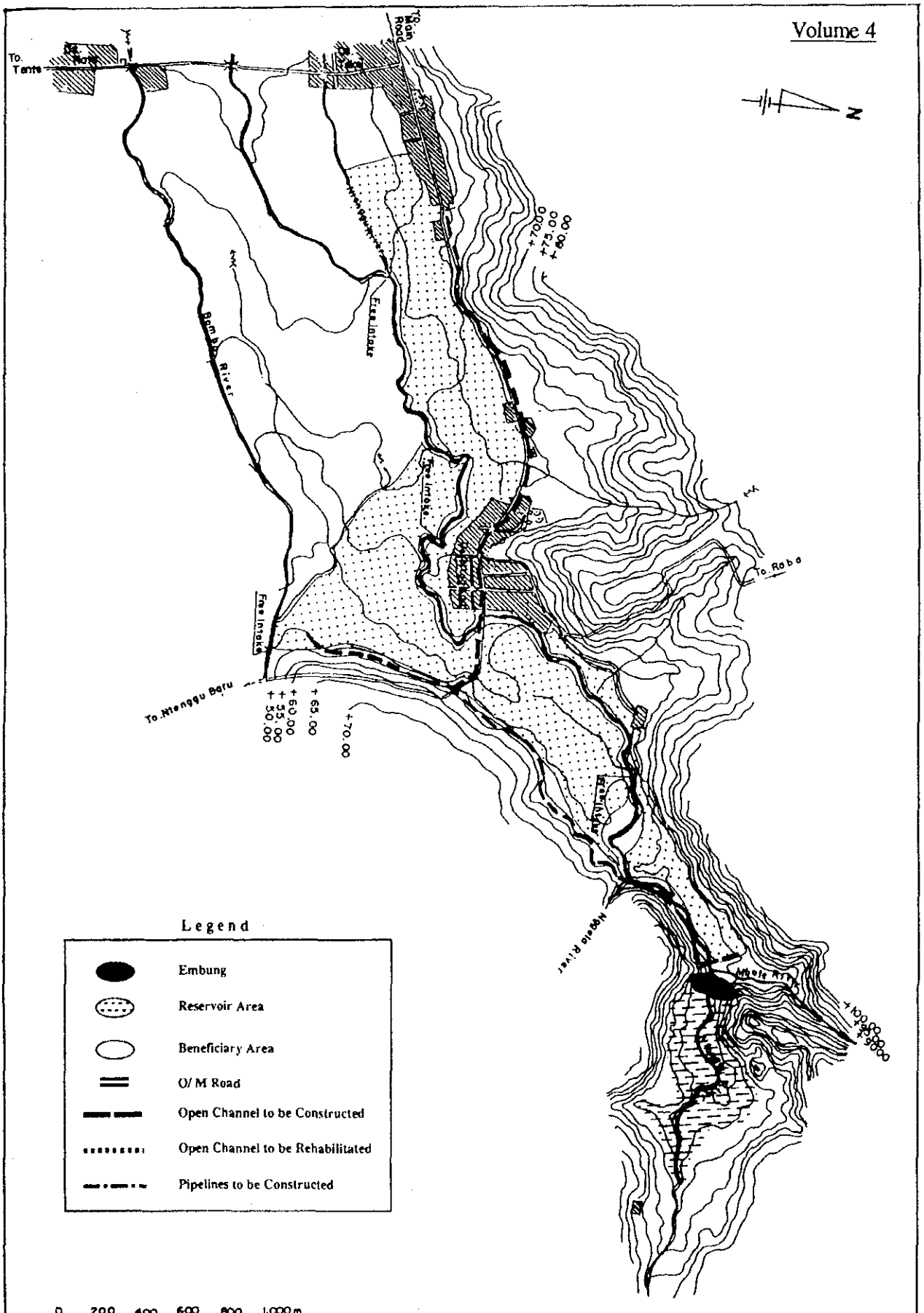

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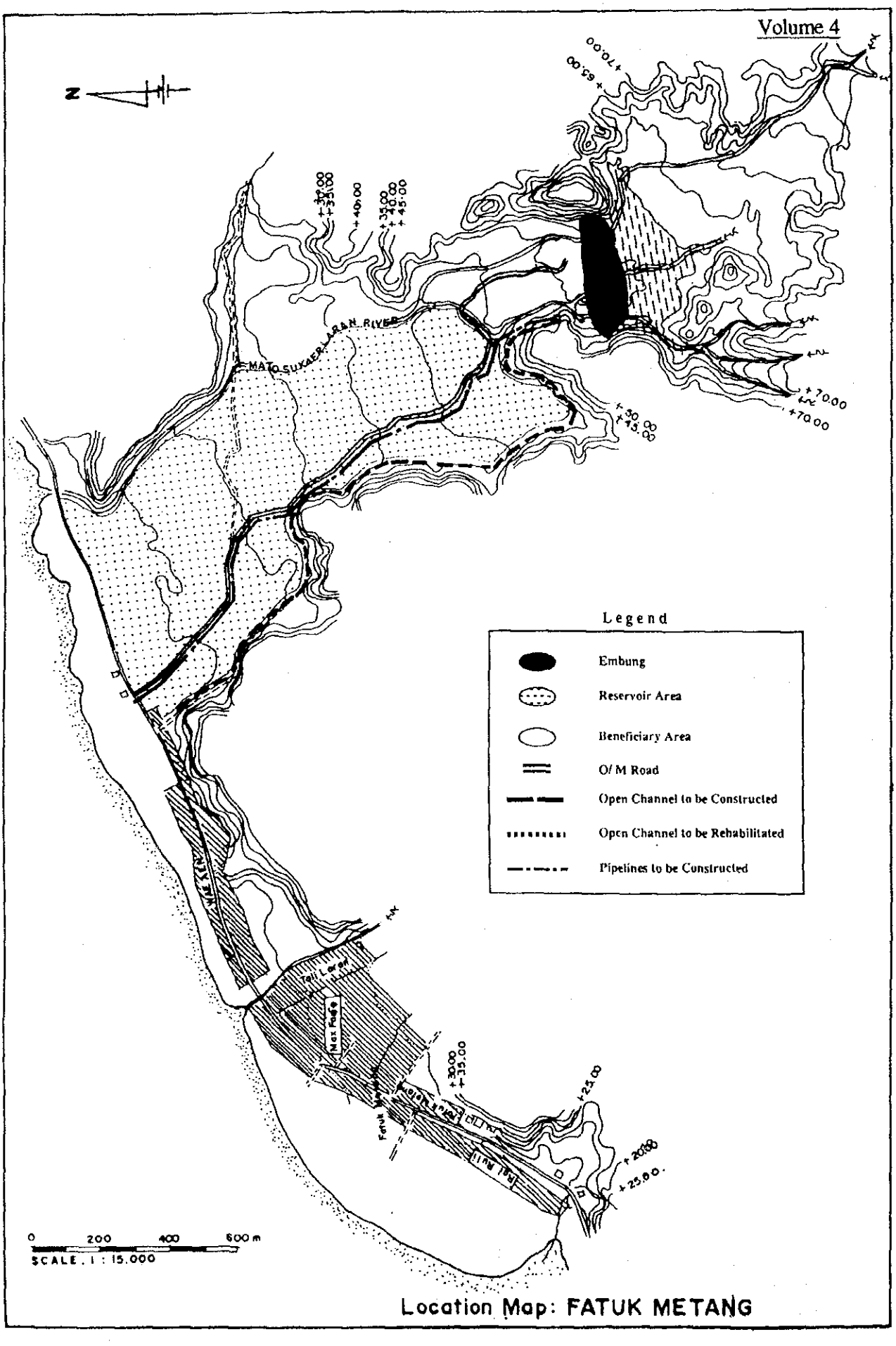

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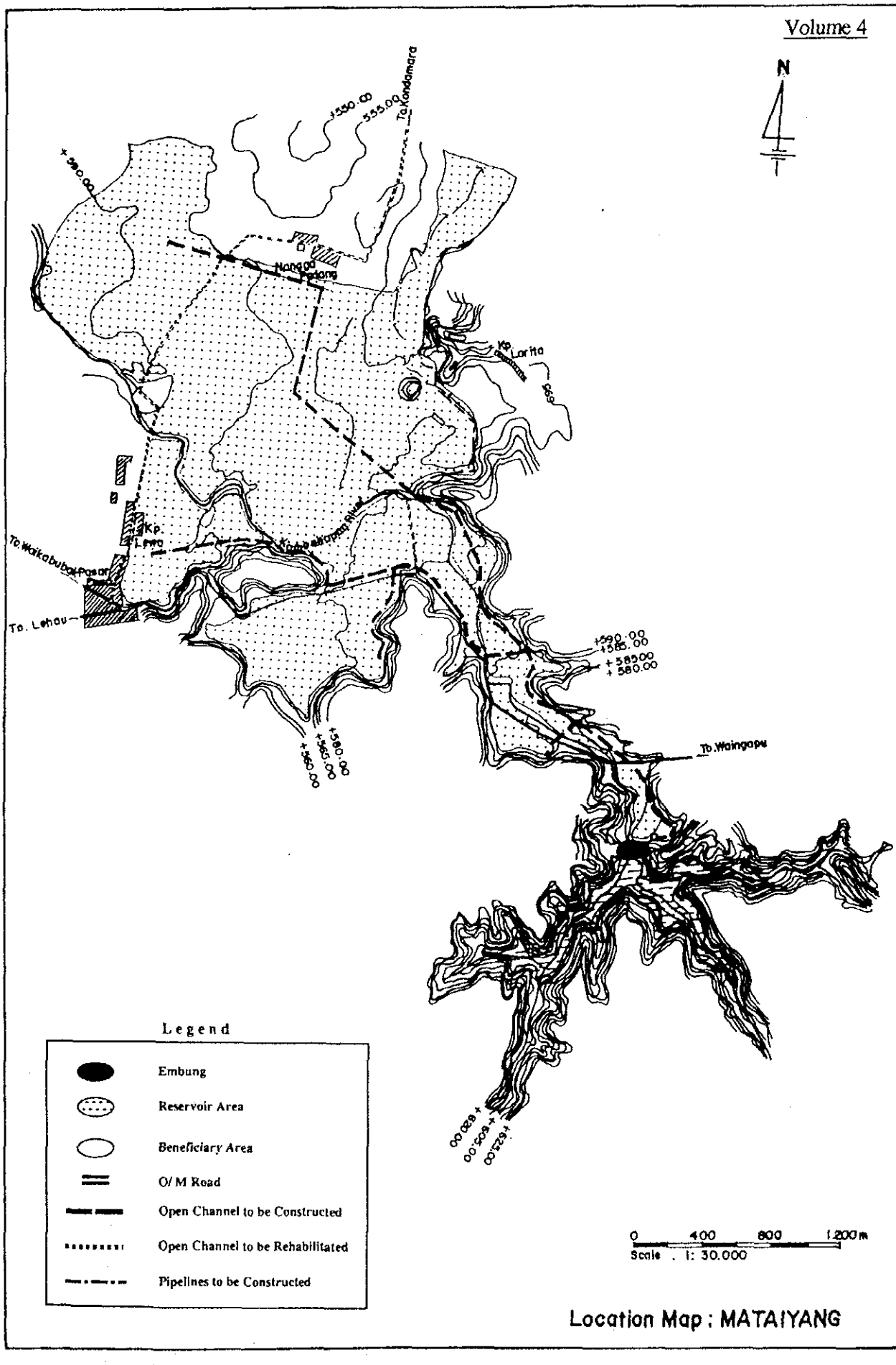

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THE STUDY
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IN
EAST NUSA TENGGARA AND WEST NUSA TENGGARA
IN
THE REPUBLIC OF INDONESIA

FINAL REPORT

VOLUME 4

Feasibility Study Report on Then Embung Development Projects

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1. INTRODUCTION

1.1 Introduction

This is the Final Report prepared in accordance with the Scope of Work on the Study on the Embung Development Project in West Nusa Tenggara (NTB) and East Nusa Tenggara (NTT) in the Republic of Indonesia (the Study) agreed upon between the Directorate General of Water Resources Development (DGWRD) of the Ministry of Public Works and Japan International Cooperation Agency (JICA) on October 15, 1993. The Report presents the results of feasibility study on 10 representative schemes are summarized, while the Volumes 8 to 10 describe the details of planning, preliminary design, construction plan, cost estimate, project evaluation, socio-economic justification and environment assessment of the respective schemes.

1.2 The Feasibility Study

It is prerequisite to assess development potential of the respective candidate Embungs from the technical, economical and social viewpoints for clarificating development needs and priority. A Guideline presented in Volume 5 of this Draft Final Report has been prepared as a tool for meeting the above requirement for development potential assessment on each Embung. Various methodology and procedures taken up in the Draft Guideline have to be put to the test for the purpose of designing the Guideline for practical use. To do so, a total of 10 sample schemes representing different categories of Embungs is selected from the 157 candidate schemes.

The feasibility study on the 10 representative schemes shows how to assess technical feasibility, economic soundness and social necessity on Embung development as well as how to interpletate the assessment results for justification of project implementation based on the Guideline. The followings show the name of each representative scheme with its location and Volume number.

List of 10 Representative Embungs

Scheme	Island/Province	Location	No.
Lokok Meniris	Lombok/NTB	Lombok Barat	8-1
Pelangan	Lombok/NTB	Lombok Barat	8-2
Montong Krarak	Lombok/NTB	Lombok Timur	8-3
Aik Beta	Lombok/NTB	Lombok Timur	8-4
Tiu Tui	Sumbawa/NTB	Sumbawa	9-1
Penyempeng	Sumbawa/NTB	Sumbawa	9-2
Ncoha II	Sumbawa/NTB	Bima	9-3
Ntonggu II	Sumbawa/NTB	Bima	9-4
Fatukmetang	Timor/NTT	Belu	10-1
Mataiyang	Sumba/NTT	Sumba Timur	10-2

The results of the feasibility study are further fed back to formulation of a master plan comprising mid- and long-term action plans of Embung development in NTB and NTT as well as finalization of the Guideline.

1.3 Work Performed

Field investigations for the feasibility study were conducted in Indonesia for 2.5 months from September 21,1994 followed by home works in Japan between December 11,1994 and January 24, 1995. Major works done during this period are summarized below:

- Field Work in Indonesia covers; (1) field investigations in the representative scheme areas, (2) identification of prevailing constraints against improvement of agricultural productivity, and (3) preparation and explanation of the Progress Report (II); and,

- Home Work in Japan consists of ; (1) formulation of an optimum development plan based on the results of examination of Embung development potential and alternative study on development plans of agriculture and livestock, irrigation and drainage, and rural water supply, (2) preparation of a preliminary design of major project facilities, (3) preparation of an operation and maintenance (O/M) plan of the major facilities, (4) preparation of a project implementation schedule, (5) estimation of the project costs and benefits, (6) economic evaluation, socio-economic justification and environment assessment of the schemes, (7) preparation of the draft feasibility study report, and (8) preparation of the Draft Guideline for Embung Development.

The work quantities of field investigations entrusted to Indonesian consultants are shown in Table 1.1.

2. BACKGROUND INFORMATION OF THE FEASIBILITY STUDY

2.1 Provincial Background

(1) Nusa Tenggara Barat (NTB)

The land of NTB extends over the chain of islands forming the Lesser Sundas with the total area of about 20,150 km^2. It consists of two main islands; Lombok and Sumbawa. The administrative division of NTB comprises six Regencies (Kabupaten) and one Municipality (Kotamadya), and further divided into 59 Districts (Kecamatan) with 524 Villages (Desa) as the lowest administration unit. The total population and household of NTB were 3.50 million and 781,800, respectively, in 1993 and the population density was 174 person/km^2. The Gross Regional Domestic Product (GRDP) in NTT was Rp. 2,188 billion at current market price in 1993. Per capita GRDP was Rp. 625,100 being 45% of the national average.

The climate of NTB is rather dry, which is a consequence of the physiological location and orientation of the islands with respect to the prevailing circulation of air masses and wind movements. The north-facing mountain slopes of Lombok and Sumbawa receive moisture-laden air from Java Sea from December to March. The rainfall distribution is highly complex and affected by local topography. Annual rainfall reaches to 3,000 mm in the higher parts of these islands but declines to less than 1,500 mm in coastal areas and inland plains sheltered by mountains.

The existing major communication facilities in NTB consist of three airports, seven seaports, roads with a length of 5,368 km in total and 14,585 telephone sets. Electricity produced and sold in 1993 was 161 MWh and 126 MWh, respectively. The road network is formed of asphalt road of 3,200 km, gravel road of 569 km and earth road of 1,599 km.

In NTB, springs or rivers are predominant drinking water sources on which 75% the whole households rely, while 4% gets piped water and 21% depends on wells or pumps. In terms of the domestic water supply condition, a total of 36,223 customers was provided with piped water and their water consumption amounted to 9.2 million m^3 in 1993. These customers include public and private offices, shops, hospitals, hotels and so on other than urban people paying water charge of Rp. 2,528 million in total.

In NTB, agriculture is the most important sector gaining Rp. 969 billion and contributing 44.3% of GRDP at current market price in 1993 and is the main income source of rural areas. Number of farm labor force was estimated to be about 1.03 million accounting for 62% of the total working people in 1993.

The present land use for crop production in NTB amounted to 748,800 ha comprising wet paddy field of 201,000 ha, dry upland field of 405,300 ha, estate crop field of 126,100 ha and fruit field of 16,400 ha as at 1993. In addition, there were shifting cultivation area of 51,200 ha, temporary fallow land of 75,600 ha and grassland of 35,200 ha.

In NTB, major crops grown are rice and Palawija crops such as maize, cassava and sweet potato. The harvested area of each crop in 1993 was 253,000 ha for wet paddy, 18,900 ha for upland paddy, 26,300 ha for maize, 11,200 ha for cassava and 3,900 ha for sweet potato. Recently, beans have become popular as new Palawija crops with the planted areas of 30,300 ha for mungbean, 129,900 ha for soybean and 19,900 ha for groundnut. The planted areas of major estate crops and fruit trees in 1993 were 62,600 ha for coconut, 24,500 ha for cashew nut, 7,600 ha for coffee, 5,600 ha for kapok, 9,300 ha for tobacco and 16,400 ha for fruit. The wet paddy cultivation is concentrated in the wet season while limited in the dry season due to water availability. In the dry upland, Palawija crops are mainly cultivated in the wet season.

The total production of paddy in 1993 was 1,186,900 tons as dry paddy and the converted amount of rice was 771,500 tons. Per capita production of rice in 1993 was estimated to be 220 kg/year. This is remarkably higher than the national target of per capita consumption of 138 kg/year for Pelita V, indicating that rice cultivation area on Lombok island has contributed to meet rice demand in other islands in NTB and NTT.

There exist 270 irrigation schemes under the management of the Provincial Department of Public Works (DPUP) of NTB. The designed irrigation command area is 148,996 ha in total. Its breakdown by type of water source facility is: 219 weirs covering 118,921 ha and 51 Embung/dams covering 30,075 ha. According to the grade of irrigation system, it is classified into three groups; 33 technical irrigation systems of 44,505 ha, 212 semi-technical irrigation systems of 96,696 ha and 25 non technical irrigation systems of 7,795 ha. The average size of command area is 552 ha as a whole and that of Embung scheme is 590 ha.

In NTB, Sumbawa island has traditionally played an important role in functioning as cattle feeder stock areas for other regions in Indonesia. The number of livestock as at 1993 amounted to 409,000 cows, 212,400 buffaloes, 78,500 horses, 287,700 goats and sheep, 22,400 pigs, 4,496,000 domestic hens, 171,800 layers and 501,200 ducks in total.

(2) Nusa Tenggara Timur (NTT)

The area of NTT covers about 47,350 km^2, being located in the chain of islands forming the Lesser Sundas. It includes three main islands; Sumba, Flores and the western part of Timor, and a number of smaller islands. The administrative division of NTT is composed of 12 Regencies (Kabupaten), and further divided into one City (Kota Administrasi) and 114

Districts (Kecamatan) with 1,743 Villages (Desa) as the lowest administration unit. The total population and household of NTT were 3.36 million and 634,300, respectively, in 1993 and the population density was 71 person/km^2. The Gross Regional Domestic Product (GRDP) in NTT was Rp. 1,632 billion at current market price in 1993. Per capita GRDP was Rp. 491,600 being 35% of the national average.

The climate of NTT is distinctly dry, which is a consequence of the physiological location and orientation of the islands with respect to the prevailing circulation of air masses and wind movements. The north coast of Timor and central Lomblen are arid with mean annual rainfall of less than 1,000 mm and on average eight months with rainfall of less than 100 mm. Most of Sumba, Timor, Alor, Pantar, Lomblen, Solor and eastern and northern Flores are dry. In each island, coastal areas are subject to scarcity of rainfall.

The existing major communication facilities in NTT consist of 14 airports, 11 seaports, roads with a length of 14,081 km in total and 9,840 telephone sets. Electricity produced and sold in 1993 was 103 MWh and 95 MWh, respectively. The road network is formed of asphalt road of 4,209 km, gravel road of 3,182 km and earth road of 6,690 km.

In NTT, springs or rivers are predominant drinking water sources on which 56% the whole households rely, while 19% gets piped water and 25% depends on wells or pumps. In terms of the domestic water supply condition, a total of 31,877 customers was provided with piped water and their water consumption amounted to 9.8 million m^3 in 1993. These customers include public and private offices, shops, hospitals, hotels and so on other than urban people paying water charge of Rp. 3,001 million in total.

In NTT, agriculture is the most important sector gaining Rp. 769 billion and contributing 47.1% of GRDP at current market price in 1993 and is the main income source of rural areas. Number of farm labor force was estimated to be about 1.31 million accounting for 78% of the total working people in 1993.

The present land use for crop production in NTT amounted to 1,039,400 ha comprising wet paddy field of 129,700 ha, dry upland field of 388,400 ha, estate crop field of 459,900 ha and fruit field of 61,400 ha as at 1993. In addition, there were shifting cultivation area of 140,600 ha, temporary fallow land of 492,400 ha and grassland of 783,500 ha. The utilization rate of wet paddy field was estimated to be about 69% because of existence of idle paddy field of 40,000 ha caused by prolonged and severe dry months and short wet season. Besides only 4% of wet paddy field are under technical irrigation system at present. This figure is extremely low comparing to the national average of 23%.

In NTT, major crops grown are rice and Palawija crops such as maize, cassava and sweet potato. The harvested area of each crop in 1993 was 83,700 ha for wet paddy, 58,000 ha for upland paddy, 206,500 ha for maize, 72,400 ha for cassava and 12,100 ha for sweet potato. Recently, beans have become popular as new Palawija crops with the planted areas of 21,800 ha for mungbean, 3,900 ha for soybean and 7,500 ha for groundnut. The planted areas of major estate crops and fruit trees in 1993 were 164,300 ha for coconut, 80,200 ha for cashew nut, 65,100 ha for candle nut, 49,700 ha for coffee, 33,400 ha for areca nut, 29,200 ha for kapok, 20,800 ha for cocoa, 10,900 ha for clove and 61,400 ha for fruit trees. The wet paddy cultivation is concentrated in the wet season while limited in the dry season due to water availability. In the dry upland, Palawija crops are mainly cultivated in the wet season.

The production of wet paddy and upland paddy in 1993 amounted to 377,600 tons of paddy and the converted amount of rice was 245,400 tons. Per capita production of rice in 1993 was estimated to be 73 kg/year. This is remarkably lower than the national Pelita V target of per capita consumption of 138 kg/year and the provincial Pelita V target of 105 kg/year. It is therefore considered that starchy palawija crops are cultivated for staple food of local people due to shortage of rice and play a valuable role for food security in NTT.

There exist 133 irrigation schemes under the management of the Provincial Department of Public Works (DPUP) of NTT. The designed irrigation area is 73,942 ha in total. Its breakdown by type of water source facility is: 104 weirs covering 66,780 ha, 13 Embungs commanding 3,392 ha and 16 groudwater and spring water sources covering 3,770 ha. According to the grade of irrigation system, it is classified into three groups; 49 technical irrigation systems of 27,425 ha, 16 semi-technical irrigation systems of 7,296 ha and 68 non technical irrigation systems of 39,221 ha. The average size of command area is 556 ha as a whole and that of Embung scheme is 290 ha.

In NTT, Sumba and Timor islands have traditionally played an important role in functioning as cattle feeder stock areas for other regions in Indonesia and are also playing a new role in supplying live cattle to Jakarta and Surabaya to meet increasing market demand of beef meat. The number of livestock as at 1993 amounted to 767,700 cows, 187,100 buffaloes, 170,200 horses, 650,000 goats and sheep, 1,453,600 pigs, 6,426,200 domestic hens and 595,900 layers in total. These livestock are distributed to the respective main islands with a wide variation according to the difference of natural circumstances and inhabitants' religious backgrounds.

2.2 Selection of Representative Schemes

In order to select typical samples for making technical, economical and social assessment of water resource development potential by means of constructing Embung, it is

indispensable to categorize 157 candidate schemes from such viewpoints as the present condition of farming system and irrigation water source facilities as well as inhabitants' needs for the future water use in each candidate scheme area. For this purpose, the inventory survey was carried out twice under the Study. By referring to information obtained through the inventory survey, three kinds of criteria have been established to categorize the candidate schemes.

The first criteria is to classify the present farming system into the following three types focusing upon the level of irrigated cropping:

- Type a : fallow, rainfed cropping on dry upland, single cropping of rainfed wet paddy or single cropping of irrigated paddy to a partial extent, having the cropping intensity of up to 100%;
- Type b : single cropping of irrigated paddy fully for the wet season and rainfed Palawija crops partly to fully for the dry season, having the cropping of more than 100%; and,
- Type c : two cropping of the wet season paddy and the dry season Palawija crops partly to fully under irrigated condition, double cropping of irrigated paddy, single cropping of the wet season paddy and double cropping of the dry season Palawija crops under irrigated condition, or double cropping of irrigated paddy coupled with the dry season Palawija crops under either irrigated or rainfed condition, having the cropping intensity of 200% to 300%.

The second criteria is to classify the present status of irrigation water source facilities into the following three types taking into account the location of water intake facility:

- Type A : No irrigation water intake facility;
- Type B : Intake facility available on the source river of the candidate Embung; and,
- Type C : Intake facility available on the different river and conveying water to the downstream irrigation area of the candidate Embung.

The third criteria is to classify the utilization type of water to be newly developed by the candidate Embung based on inhabitants' intention to the future use of new water source facility:

- Type 1 : Permanent source of irrigation, domestic and livestock water;
- Type 2 : Permanent source of irrigation and livestock water;
- Type 3 : Permanent source of irrigation and domestic water; and,
- Type 4 : Permanent source of irrigation water.

Through the categorization of 157 candidate schemes based on the above-mentioned criteria, 10 schemes are selected representing typical categories as shown below.

Classification of 10 Representative Schemes by Category

Scheme	Province	Island	Water Source Facility	Farming System	Future Water Use
Lokok Meniris	NTB	Lombok	C	c	3
Pelangan	NTB	Lombok	B	c	3
Montong Krarak	NTB	Lombok	B	b	3
Aik Beta	NTB	Lombok	A	a	4
Tiu Tui	NTB	Sumbawa	B	b	2
Penyempeng	NTB	Sumbawa	B	c	4
Ncoha II	NTB	Sumbawa	B	b	4
Ntonggu II	NTB	Sumbawa	B	c	2
Fatukmetang	NTT	Timor	A	a	1
Mataiyang	NTT	Sumba	B	a	3

3. PRESENT SITUATION OF THE PROJECT AREA

3.1. Natural Condition

(1) Location and topography

Out of the 10 representative Embungs, four each are located on Lombok and Sumbawa Islands in NTB and one each is on Timor and Sumba Islands in NTT. On Lombok, the Lokok Meniris and Pelangan project areas are situated in Desa (village) Anyar and Desa Sekotong Barat, respectively, of the Kabupaten (Regency) Lombok Barat, while the Montong Krarak and Aik Beta project areas are in the Kabupaten Lombok Timur. Desa Sakra and Desa Rumbuk cover the Montong Krarak project area, and Desa Perigi includes the Aik Beta project area. On Sumbawa, the Tiu Tui and Penyempeng project areas are located in Desa Boal and Desa Jotang, respectively, of the Kabupaten Sumbawa, while the Ncoha II and Ntonggu II project areas are in Desa Nggembe and Desa Ntonggu II of the Kabupaten Bima. On Timor, the Fatukmetang project area is located in Desa Janilu of the Kabupaten Belu. On Sumba, the Mataiyang site is situated in Desa Lewa/Paku of the Kabupaten Sumba Timur.

The physiography and location of 10 Embung sites are summarized below.

Physiography and Location of 10 Representative Embungs

Site	Physiography	East Longitude	South Latitude	Altitude El. (m)
Lokok Meniris	Flat to gently sloped plateau	116° 24'43"	8° 59'00"	80
Pelangan	Mountainous site with three-stairs terraces	115° 57'29"	8° 49'06"	20
Montong Krarak	Hilly upland with gentle slope	116° 28'23"	8° 40'09"	200
Aik Beta	Flat to gently sloped plateau	116° 36'52"	8° 30'11"	200
Tiu Tui	Hilly site with wide alluvial plain	117° 57'59"	8° 52'37"	20
Penyempeng	Mountainous site with limited alluvial plain	118° 05'39"	8° 46'39"	50
Ncoha II	Flat to gently sloped plateau	118° 38'09"	8° 28'58"	30
Ntonggu II	Mountainous site with limited alluvial plain	118° 45'46"	8° 30'30"	55
Fatukmetang	Mountainous site with wide alluvial plain	124° 53'32"	8° 59'00"	40
Mataiyang	Hilly to mountainous site with limited alluvial plain	123° 07'57"	9° 43'03"	580

(2) Climate and hydrology

The wet season usually starts from late November and ends early April in each project area. At the existing rainfall stations located near each Embung site, the average annual rainfall varies from 1,150 mm to 1,340 mm in Lombok, from 1,030 mm to 1,220 mm in Sumbawa, 1,130 mm in Timor, and 2,420 mm in Sumba. The followings indicate climatic features around the 10 representative project areas.

Climatic Features around 10 Representative Project Areas

Project Area	Mean Annual Rainfall (mm)	Mean Annual Temperature (°C)	Mean Relative Humidity (%)	Average Sunshine Hour: Wet Season Average (hr/day)	Average Sunshine Hour: Dry Season Average (hr/day)	Average Wind Velocity (km/hr)
Lokok Meniris	1,320	25.9	71	4 to 5	7 to 9	5.0
Pelangan	1,340	26.3	80	5	6 to 7	9.1
Montong Krarak	1,200	27.7	80	6 to 7	8 to 9	3.8
Aik Beta	1,150	27.2	81	5 to 6	7 to 9	7.0
Tiu Tui	1,220	27.8	85	3 to 5	6 to 7	5.8
Penyempeng	1,220	27.8	85	3 to 5	6 to 7	5.8
Ncoha II	1,030	27.8	84	3 to 5	6 to 7	4.8
Ntonggu	1,030	27.8	84	3 to 5	6 to 7	4.8
Fatukmetang	1,130	26.5	74	5 to 7	8 to 9	3.6
Mataiyang	2,420	26.4	75	4 to 5	6 to 7	5.0

The water source river in each Embung site is listed below. There is no gauging station on the respective rivers. The river resume reflects the monthly rainfall pattern. Dry season flows are very little or the rivers may dry up completely in the dry season.

Water Source Rivers of 10 Representative Schemes

Site	Source River	Catchment Area at Site (km^2)
Lokok Meniris	Lokok Meniris	7.4
Pelangan	Pelangan	46.0
Montong Krarak	Kali Moyot	5.4
Aik Beta	Aik Beta	22.4
Tiu Tui	Brang Tiu Tui	21.2
Penyempeng	Brang Penyempeng	41.1
Ncoha II	Nggembe	12.6
Ntonggu II	Nggela	6.2
Fatukmetang	Tarilalan	4.0
Mataiyang	L. Laimoh	19.1

(3) Geology

The Lokok Meniris, Montong Krarak and Aik Beta Embung sites in Lombok and the Ncoha II Embung site in Sumbawa are mainly underlain by volcanic products of Quaternary age. Basal rock in these sites is half-consolidated and not homogeneous. The Pelangan Embung site in Lombok and the Tiu Tui, Penyempeng and Ntonggu II Embung sites in Sumbawa are mainly underlain by volcanic rocks of Tertiary age. The Fatukmetang Embung site in Timor is underlain by the oldest rocks such as basic rock complex and crystalline limestone. The Mataiyang Embung site in Sumba is mainly underlain by limestone of Neogene age. This limestone is characterized by big caves in some parts. The followings show geological features of the respective Embung sites.

Geological Features of 10 Representative Embung Sites

Site	Base Rock	Characteristics
Lokok Meniris	Volcanic products of Quaternary	Half-consolidated rock
Pelangan	Volcanic rocks, sedimentary rock of Tertiary	Moderately hard to soft rock
Montong Krarak	Volcanic products of Quaternary	Half-consolidated rock, dam height to be limited
Aik Beta	Volcanic products of Quaternary	Half-consolidated rock, dam height to be limited
Tiu Tui	Volcanic rock of Tertiary	Many low saddles in reservoir
Penyempeng	Volcanic rock of Tertiary	-
Ncoha II	Volcanic products of Quaternary	Half-consolidated rock, dam height to be limited
Ntonggu II	Volcanic rock of Tertiary	Small basin
Fatukmetang	Limestone of Triassic to Permian and Volcanic rock of Pre Permian	Oldest rock in Timor island
Mataiyang	Limestone of Neogene	Big caves and spring in reservoir

(4) Soil and land use

Soils in project areas of the eight representative Embungs in Lombok and Sumbawa are originated from basalt rocks, volcanic pumice and mixed alluvial materials, while those in the remaining two project areas in Timor and Sumba are of mixed alluvial materials composed of sand and breccia or calcareous rocks. Predominant land form and soil conditions in each project area are summarized below.

Land Form and Soil Conditions in 10 Representative Project Areas

Project Area	Land Form	Land Slope (%)	Soil Depth	Soil Drainage
Lokok Meniris	Undulating plain	2 to 5	Shallow to Very deep	Well to Excessive
Pelangan	Valley Bottom	0.3	Deep to Very deep	Moderate to Well
Montong Krarak	Undulating plain	2 to 3	Deep to Very deep	Moderately well
Aik Beta	Hilly slope	5 to 10	Deep to Very deep	Well
Tiu Tui	Alluvial fan to Alluvial plain	1.0	Very deep	Well
Penyempeng	Alluvial fan to Undulating plain	1.0	Shallow to Very deep	Moderate to Well
Ncoha II	Valley bottom to Coastal plain	1 to 2	Very deep	Moderate to Well
Ntonggu II	Valley bottom to Alluvial fan	1 to 2	Very deep	Poor to Well
Fatukmetang	Valley bottom to Alluvial plain	2.0	Deep to Very deep	Well
Mataiyang	Hilly plain	<1.0	Very deep	Poor to Moderate

The present land use condition in the 10 project areas is summarized below. Out of the existing wet paddy field in eight project areas, a total of 922 ha in gross or 54.5% of gross paddy field is provided with irrigation facilities varying widely from simple to technical in the level of irrigation facility condition.

Present Land Use Condition in 10 Representative Project Areas

Unit : ha

Project Area	Irrigated Paddy Field	Rainfed Paddy Field	Gross Paddy Field	Dry Upland	Tree Crop Field	Grass-land	Others	Total
Lokok Meniris	112	55	167	44	0	12	16	239
Pelangan	96	161	257	16	52	195	77	597
Montong Krarak	153	74	227	0	5	39	15	286
Aik Beta	0	64	64	365	0	97	15	541
Tiu Tui	37	416	453	170	8	140	19	790
Penyempeng	96	151	247	328	0	62	27	664
Ncoha II	44	233	277	13	0	125	120	535
Ntonggu II	321	72	393	54	0	95	41	583
Fatukmetang	0	0	0	0	0	126	7	133
Mataiyang	63	467	530	100	0	103	24	757
Total	922	1,693	2,615	1,090	65	994	361	5,125

3.2 Social Condition

(1) Demographic condition

The demographic condition in each project area of the representative Embung as at 1993 is tabulated below. The ethnic condition is: dominated by the Sasaknese with a few Balinese and Javanese in Lokok Meniris; composed of the Balinese in Pelangan; multiracial in Montong Krarak and Aik Beta; of the original Sumbawanese in Tiu Tui and Penyempeng; the Bajonese as majority in Ncoha II and Ntonggu; formed of the native Timorian in Fatukmetang; and dominated by the Sumbanese in Mataiyang. The religious condition is represented by Islamic people in seven project areas located in Lombok and Sumbawa, while Hindu people share more than half in the Pelangan area of Lombok and Christian people predominate in the remaining two project areas in Timor and Sumba.

Demographic Condition in 10 Representative Project Areas

Project Area	Desa covering Project Area	Total Population (person)	Total Household (No.)	Average Family Size (person)	Farm Household (No.)	Breeding Household (No.)
Lokok Meniris	Anyar	977	222	4.4	177	12
Pelangan	Sekotong Barat	3,577	982	3.6	943	424
Montong Krarak	Sakra and Rumbuk	3,977	818	4.9	647	170
Aik Beta	Perigi	1,660	262	6.3	202	83
Tiu Tui	Boal	4,298	949	4.5	888	493
Penyempeng	Jotang	3,258	761	4.3	702	608
Ncoha II	Nggembe	2,274	443	5.1	422	118
Ntonggu	Ntonggu II	2,307	424	5.4	412	187
Fatukmetang	Jenilu	572	156	3.7	156	62
Mataiyang	Lewa / Paku	776	206	3.8	206	206

(2) Domestic and livestock water supply

The main source of domestic water in eight project areas in Lombok and Sumbawa depend mainly on dug wells and supplement sources are public water basins and springs.

Further, rivers and ponds are used as the main water source for livestock water supply. Year-round drinking water supply to inhabitants is secured only in the Aik Beta and Penyempeng project areas. Shortage of drinking and livestock water is common during the later part of the dry season in other six project areas on Lombok and Sumbawa Island. In the Fatukmetang project area on Timor island, people commonly carry their drinking and livestock water from dug wells with the average walking distance of 200 m. Water shortage period is usually from October to December. Inhabitants of the Mataiyang project area on Sumba island depend their drinking water source on springs and supplement their livestock water by taking river flow. As these springs are perennial, spring water is not only distributed to the project area but also supplied to town areas adjacent to the project area. Table 3.1 gives the present situation of domestic and livestock water use in the respective project areas.

(3) Social infrastructure

The main access and distances from each main town of the major islands to the project areas of the 10 representative schemes are summarized below.

Access Condition to 10 Representative Project Areas

Site	Main Town	Main Access	Distance (km)	Access to Site
Lokok Meniris	Mataram	Mataram-Bayan	85	Rough road
Pelangan	Mataram	Mataram-Lembar	70	Earth road
Montong Krarak	Mataram	Mataram-Labuhan Lombok	45	Earth road
Aik Beta	Mataram	Mataram-Labuhan Lombok	65	Earth road
Tiu Tui	Sumbawa Besar	Trans-Sumbawa	80	Earth road
Penyempeng	Sumbawa Besar	Trans-Sumbawa	90	Rough road and foot path
Ncoha II	Bima	Trans-Sumbawa	35	Rough road
Ntonggu	Bima	Trans-Sumbawa	25	Rough road
Fatukmetang	Kupang	Trans-Timor	320	Rough road
Mataiyang	Waingapu	Trans-Sumba	45	Foot path

Recently, rural electrification has been fast promoted in remote villages of NTB and NTT. Among 10 project areas, no electricity is supplied to the Lokok Meniris, Fatukmetang and Mataiyang project areas at moment. In the respective project areas, no hospital is available but community health sub-center and health integrated post are established to serve inhabitants with the minimum health care.

Most rural people have no facilities for bathing, washing and defecating inside their houses. Instead, they are using public facilities or river bed for their washing and bathing purposes and further public or own toilets outside their houses. Under such circumstances, they are often suffering from various waterborne diseases.

3.3 Agricultural Condition

(1) Agriculture

Irrigated farming is conducted in eight project areas except for the Aik Beta and Fatukmetang project areas where no irrigation system is available. The present cropping system in the respective project areas is briefed below together with planted area and cropping intensity. On dry upland field, single cropping of food crops is common. Major Palawija and upland crops grown are maize, soybean, mungbean, groundnut, red onion and tobacco.

Present Cropping System, Planted Area and Intensity in 10 Representative Project Areas

Project Area	Wet Season Cropping	Dry Season Cropping	Total Planted Area (ha)	Total Net Farmland (ha)	Cropping Intensity (%)
Lokok Meniris	Irrigated paddy	Irrigated Paddy	202		
	Rainfed paddy	Rainfed Palawija	75		
	Dry upland crop	-	40	191	166
Pelangan	Irrigated paddy	Irrigated Palawija	112		
	Rainfed paddy	-	145		
	Dry upland crop	-	14	245	111
Montong Krarak	Irrigated paddy	Rainfed Palawija	178		
	Rainfed paddy	-	67	205	120
Aik Beta	Rainfed paddy	Rainfed Palawija	73		
	Dry upland crop	-	239	297	105
Tiu Tui	Irrigated paddy	Rainfed Palawija	43		
	Rainfed paddy	Fallow	374		
	Dry upland crop	-	153	560	102
Penyempeng	Irrigated paddy	Irrigated paddy	172		
	Rainfed paddy	-	135		
	Dry upland crop	-	295	516	117
Ncoha II	Irrigated paddy	Rainfed Palawija	60		
	Rainfed paddy	-	210		
	Dry upland crop	-	12	262	108
Ntonggu II	Irrigated paddy	Irrigated Palawija	358		
	Rainfed paddy	-	65		
	Dry upland crop	-	49	403	117
Fatukmetang	-	-	0	57	0
Mataiyang	Irrigated paddy	-	57		
	Rainfed paddy	-	380		
	Dry upland crop	-	90	527	100

Normally, the wet paddy field is prepared by an animal-drawn plough and harrow. The high yielding rice varieties of IR 36, IR 64, Krueng Aceh, Pelita and C4 are commonly used, while fertilizer application amounts vary according to a farming size. No serious plant pests are reported under the hot and dry weather condition, and farmers put insecticide if necessary. Harvesting is principally done by family labor force with an additional input of hired labors at its peak time. Farming practices for growing dry upland crops are very simple and primitive with direct sowing on harrowed field and no fertilizer application.

Major crop production in each project area in 1993 is summarized below.

Major Crop Production in 10 Respective Project Areas

Unit : ton

Project Area	Paddy	Maize	Soy-bean	Mung-bean	Ground-nut	Red Onion	Tobacco
Lokok Meniris	655	-	-	-	53	32	-
Pelangan	634	28	-	13	-	-	-
Montong Krarak	686	-	-	-	6	-	36
Aik Beta	116	311	-	-	-	-	18
Tiu Tui	847	-	54	80	-	-	-
Penyempeng	786	-	266		-	-	-
Ncoha II	672	-		18	-	-	-
Ntonggu	1174	49	50		30	-	-
Fatukmetang	-	-	-	-	-	-	-
Mataiyang	855	117	-	-	-	-	-

(2) Livestock

Among 10 project areas, cattle feeding is predominant in Lokok Meniris and Pelangan on Lombok island, Tiu Tui and Ntonggu II on Sumbawa island and Fatukmetang on Timor island. Buffalo is used as draft cattle on wet paddy field, while cow is fed for dual purposes of holding draft power and getting cash income by selling beef cattle. The present livestock population in and around each project area is shown below.

Livestock Population in Project Areas of 10 Representative Schemes

Unit: head

Project Area	Cow	Buffalo	Horse	Goat & Sheep	Pig	Chicken & Dug
Lokok Meniris	1,119	113	20	944	0	2,836
Pelangan	3,913	101	94	2,177	1,282	27,831
Montong Krarak	147	96	9	54	0	284
Aik Beta	77	0	2	39	0	315
Tiu Tui	366	3,811	1,219	0	0	1,192
Penyempeng	15	293	153	55	0	640
Ncoha II	114	33	6	240	0	0
Ntonggu	203	245	26	259	0	0
Fatukmetang	237	104	71	316	148	800
Mataiyang	200	76	52	218	125	700

(3) Irrigation

Irrigation facilities are available in eight schemes, namely Lokok Meniris, Pelangan, Montong Krarak project areas on Lombok island, Penyempeng, Ncoha II and Ntonggu II project areas on Sumbawa island and Mataiyang project area on Sumba island among the 10 representative schemes. In the Lokok Meniris project area, the upstream part of the command area of around 110 ha is well irrigated by using the water conveyed from the neighboring watershed. In the Pelangan project area, there is a permanent weir with irrigation canal covering around 100 ha of the both sides of river. In the Pelangan project area, the existing irrigation facilities condition is rather well in upstream portion of irrigation system but severely deteriorated in downstream part. In the Montong Krarak project area, three existing weirs are commanding unstably around 150 ha and the irrigation system is very complicated.

In the Penyempeng, Ncoha II and Ntonggu II project areas on Sumbawa island, river flow is diverted from the existing weirs and conveyed to each irrigation area covering around 90, 50 and 300 ha, respectively. Irrigation facilities of these project areas are graded into semi-technical level. In the Mataiyang project area on Sumba island, simple irrigation system is available and commanding around 500 ha.

(4) Agro-economy

Farmers' groups organized are Agricultural Cooperative (KUD) and Water Users' Association (P3A). Although KUD is responsible for providing members with farm inputs through its branch network. But its performance is not active at present so that farmers, even members, are forced to buy their necessary farm inputs from local markets or merchant shops. Though P3A has been recently established in the respective irrigation areas for managing on-farm irrigation service facilities by beneficiary farmers themselves, further training of on-farm water management practices is required taking into account low level of members' know-how.

Agricultural extension services including veterinary service are provided to farmers through field extension workers of the existing rural extension centers. Due to limitation of operational budget, however, farmers have usually received less frequent visiting services by the field extension workers. Credit services are available in KUD as well as the network of the Indonesian People's Bank (Bank Rakyat Indonesia/BRI), both of which are offering short-term credits to lend working capital for every crop season and a mid-term credit of five years to finance farmers' small investments. However, farmers' access to such services are restricted because of small farming size in general and lack of transportation means in some project areas located in remote places.

Responsible agencies for water resources and irrigation development in the project areas are the Provincial Water Resources Services (Sub Dinas Pengairan) of the Provincial Public Works Services (DPUP) in the respective Provinces of NTB and NTT. The both DPUPs are principally controlled by the Governors of the Provincial Governments and also directed by DGWRD of the Ministry of Public Works through its Provincial Office (Kanwil) in terms of technical issues and development budgets as illustrated in Figures 3.1 and 3.2. Under DPUPs, several project offices are established to undertake project implementation as well as operation and maintenance of project facilities. Of these, water resources development and watershed management works are the responsibility of Lombok and Sumbawa Water Resources Development and Conservation Project Offices (PPKSA) under DPUP NTB, and Timor and Flores-Sumba Water Resources Development and Conservation Project Offices (PPKSA) and Project Office for Provincial Embung Development in Kabupaten Kupang under DPUP NTT. Construction of new irrigation facilities and rehabilitation of the existing ones in NTB are obligations of Lombok Irrigation Project Office, Sumbawa Irrigation Project Office

and Provincial Project Office for Rehabilitation and Upgrading of Irrigation. These works in NTT are responsibilities of Timor-Sumba Irrigation Project Office and Flores Irrigation Project Office. Operation and maintenance works of all the existing facilities are conducted by Provincial Project Office for Operation and Maintenance under DPUP in each Province.

Food crop production in the 10 project areas is firstly consumed for farmers' own use and secondly sold to local markets or middlemen when farmers need cash. The present condition of farmers' household economy clarified through the agro-economy survey conducted under the Study is summarized in Table 3.2.

4. DEVELOPMENT NEEDS AND CONCEPTS

4.1 Development Needs and Constraints

(1) Population increase

The future population in the representative project areas is projected by referring to "Projection of Population for Kabupaten/Kotamadya in Indonesia 1990-2000" prepared by National Statistic Bureau and the Second Long Term Development Plan (PJPT II). The total number of inhabitants living in the project area at the last year of each Pelita period is prospected as shown below. Further, the future population of Lewa town withdrawing domestic water from a spring located at the potential site of Mataiyang Embung is projected to be 3,189 persons in 1993, 3,517 persons in 1998, 3,845 persons in 2003, 4,158 persons in 2008, 4,442 persons in 2013 and 4,704 persons in 2018.

Projected Population in 10 Representative Project Areas

Project Area	1993	1998	2003	2008	2013	2018
Lokok Meniris	977	1,081	1,185	1,285	1,375	1,459
Pelangan	3,649	4,037	4,427	4,800	5,138	5,451
Montong Krarak	3,977	4,191	4,396	4,584	4,794	4,898
Aik Beta	1,660	1,749	1,835	1,913	1,982	2,044
Tiu Tui	3,477	3,715	3,945	4,159	4,347	4,519
Penyempeng	3,258	3,479	3,695	3,895	4,071	4,232
Ncoha II	2,274	2,426	2,574	2,711	2,832	2,943
Ntonggu II	2,307	2,461	2,611	2,855	2,983	3,100
Fatukmetang	572	618	658	700	738	772
Mataiyang	876	966	1,056	1,142	1,220	1,292

(2) Basic human needs (BHN)

The inhabitants in the representative project areas are unsatisfied with the present condition of rural infrastructures to some to considerable extent as summarized below. Extension of electricity distribution lines to the project areas not yet electrified are planned or under implementation through the on-going rural electrification programs. Those who are unsatisfied with the existing water supply systems are eager to secure new water source facilities to fulfill their water demand.

Satisfaction Level of Rural Infrastructures to Inhabitants in Each Project Area

Project Area	Domestic Water	Livestock Water	Electricity
Lokok Meniris	Short for 4 months	Rather convenient	Not available
Pelangan	500 m away	Rather convenient	Not available
Montong Krarak	Low quality	Convenient	Available
Aik Beta	Rather convenient	Rather convenient	Not available
Tiu Tui	Rather convenient	Short for 6 months	Available
Penyempeng	Convenient	Convenient	Available
Ncoha II	Solution already planned	Rather convenient	Available
Ntonggu II	Rather convenient	Short for 3 months	Available
Fatukmetang	Short for 3 months, 200 m away	Inconvenient	Not available
Mataiyang	1,500 m away	Rather convenient	Not available

(3) Economic development needs

In the representative project areas, farmers have principally consumed their farm products for their own use and then sold the remaining amount to local markets. There is not much possibilities of developing manufacturing and service industries in and around the project area so as to offer new job opportunities to farmers. It is thus indispensable for promoting public investment to economic infrastructures, especially for irrigation water source facilities, which encourage farmers to improve their farming system and enable them to increase their agricultural production. Increasing farm outputs could clue farmers themselves to upgrade their living standard and to catch up with faster economic growth of other sectors and places.

(4) Inhabitants' intention to development pattern

Inhabitants in the project area intend to use their farm land more intensive as no expansion of land holding size can be expected due to limited land resources suitable for food crop cultivation. To do so, they are anxious for all year-round water source facilities from which they will be able to get sufficient irrigation water for growing the dry season crops. Those who are suffering from water shortage problems during the dry season also intend to change their common time-consuming pattern from carrying drinking water and removing cattle to gaining more farm income. In this connection, such inhabitants need permanent water source facilities which enable them to secure stable drinking water throughout the year.

(5) Development constraints

The present constraints against social upgrade and economic development in the project area are featured by the condition that available surface runoff of the river has not been fully utilized. The reason is that all the intake weirs available on the source river can divert only the wet season discharge, because either the water levels at the weir sites become go down below the designed intake levels or the available discharge is very limited during the dry season. Due to such situation of limited use of surface runoff, no more utilization of all the source rivers can be expected unless countermeasures to regulate the wet season runoff are practiced.

4.2 Development Concepts and Approach

(1) Development concepts

The current economic status of NTB and NTT are still left behind that of other provinces due to insufficient fulfillment of BHN, slow pace of poverty alleviation and less concerns about a balanced investment to regional development. In harmony with the national policy to correct this economic imbalance, the development concept aims to improve the present condition of social and economic infrastructures with the highest priority so as to meet BHN and to increase agricultural outputs. Among others, it is prerequisite to pay special attention to how to solve irrigation, domestic and livestock water shortage problems originated from insufficient use of potential water resources in the respective river basins.

(2) Development strategies and approach

To overcome development constraints prevailing in the respective project areas, water resources seasonally available is to be regulated by means of constructing Embung on the source rivers. Approach to development planning of the potential Embungs is as follows:

- To put the first priority to supply irrigation water and the second to domestic and livestock water in NTB, whereas the first priority to BHN followed by irrigation in NTT taking into account inhabitants' needs and intention;
- To project the future water demand for irrigation, domestic and livestock use at the target year of 2008 being the last year of Pelita VIII;
- To examine development potential of the representative Embungs from the technical viewpoints;
- To determine the optimum development scale of each Embung;
- To make preliminary design and cost estimate; and,
- To conduct project justification from the viewpoints of economic soundness, social satisfaction and environmental impact.

4.3 Land Resources Potential

In due consideration of the present land use, soil characteristics, crop suitability, topographic condition in relation to the proposed site of Embung and the layout of existing irrigation canals, irrigable area of each project area is demarcated on topographic map of 1/5,000 newly prepared under the Study. The conversion rate of the gross irrigable area to the net irrigable area is assumed to be 0.9 for the existing irrigated and rainfed paddy field and 0.8 for dry upland field, estate crop field and fallow land. Available land resources which can receive irrigation water by gravity from the proposed sites of Embung are summarized below.

Irrigable Land Resources Available in Representative Project Areas

Unit: ha

Project Area	Gross Irrigable Area					Net Irrigable Area
	Irrigated paddy	Rainfed paddy	Dry upland	Tree crop field	Fallow land	
Lokok Meniris	0.0	55.0	35.0	0.0	7.0	83.0
Pelangan	96.0	144.0	4.0	36.0	0.0	248.0
Montong Krarak	49.0	0.0	0.0	0.0	0.0	44.0
Aik Beta	0.0	46.0	20.0	0.0	0.0	57.0
Tiu Tui	27.0	305.0	41.0	0.0	0.0	331.0
Penyempeng	96.0	71.0	250.0	0.0	0.0	350.0
Ncoha II	44.0	130.0	0.0	0.0	0.0	157.0
Ntonggu II	111.0	99.0	0.0	0.0	0.0	210.0
Fatukmetang	0.0	0.0	0.0	0.0	72.0	57.0
Mataiyang	63.0	437.0	0.0	0.0	0.0	450.0

4.4 Agricultural and Livestock Development Plan

(1) Alternative cropping patterns

In formulating the future cropping patterns in the respective project areas, the following basic principles have been adopted:

- Higher benefit for farmers;
- Optimum use of irrigation water;
- Practical farming system for family labor; and,
- Crops and cropping patterns acceptable to farmers.

Wet paddy is the most predominant crop in NTB and NTT and also acceptable to farmers in each project area as most of them are familiar to rice cultivation. Therefore, they could easily master intensive rice farming practices under irrigated condition and thereby to realize higher production and to large irrigation benefit under the condition of "with project". Aiming to determine the optimum development scale of the proposed Embung, several alternative cropping patterns are established as shown in Table 4.1.

(2) Farm input and labor requirements

Under the "with project" condition, farmers can be expected to get stable irrigation water supply. They will be able to increase farm inputs to the optimal level with less risk. Proposed farm inputs are estimated in consideration of the present levels in advanced irrigation areas as well as data collected from agricultural extension services. Labor requirements are also expected to increase substantially in cultivation under the technical irrigation system. Table 4.2 shows the proposed farm input and labor requirements. On the other hand, farm

inputs and labor requirements are expected to remain at present level under the "without project" condition.

(3) Proposed farming practices

Proposed farming practices of wet paddy are: to conduct land preparation by draft animal; to use high yielding rice varieties of IR64, Krueng Aceh, Pelita, C4 and IR36 with maturing periods of 110 to 135 days; to practice split application of fertilizers; to perform weeding two to three times with timely control of insects, pest and diseases; and to guarantee irrigation water supply at the most critical stages of rice plant growth.

For growing Palawija crops under irrigated condition, advanced farming practices similar to wet paddy cultivation and high yielding varieties are to be adopted. Land preparation will require animal-draft in order to enhance efficiency and accuracy of the work. Proper fertilization matching with soil conditions and timely insect/disease control are also indispensable. These farming practices need to be applied to following technical instructions of extension agents.

(4) Anticipated crop yield

The future yield of proposed crops under the "with-project" condition is anticipated as shown in Table 4.3 in due consideration of the present yield levels in well established irrigation areas on Lombok island as well as introduction of high yielding varieties and advanced farming practices, stable irrigation water supply and optimum use of farm inputs. As for build-up period to attain the anticipated yield, it is also prospected that crop yield levels are 60% of the target in the first year, 70% in the second year, 80% in the third year, 90% in the fourth year and 100% from the fifth year and onward.

(5) Projected livestock population

The future livestock population in the project area for 2008/2009 is projected as shown below taking into account the actual growth rate of each livestock in the both NTB and NTT Provinces during the Pelita V period.

Projected Population of Livestock in Respective Project Areas

Unit: head

Project Area	Cow	Buffalo	Horse	Goat/ Sheep	Pig	Chicken /Duck
Lokok Meniris	1,508	189	23	1,047	0	1,815
Pelangan	5,274	169	107	2,414	1,838	17,816
Montong Krarak	189	120	48	48	0	1,627
Aik Beta	99	0	11	35	0	1,792
Tiu Tui	1,820	3,999	1,281	0	0	2,999
Penyempeng	27	307	161	16	0	1,605
Ncoha II	289	13	2	130	0	0
Ntonggu II	299	99	7	141	0	0
Fatukmetang	370	125	73	650	352	2,276
Mataiyang	313	91	63	424	242	2,000

4.5 Water Demand

(1) Domestic water demand

The future domestic water consumption level in rural areas of NTB is set to be 60 lit/day/capita up to 1998/99 for the Pelita VI period, 70 lit/day/capita up to 2003/04 for the Pelita VII period and 80 lit/day/capita from 2004/05 and onward. The public water demand is to be 30 lit/day for 10% of the projected population, while the unaccounted-for is to be equivalent to 20% of the total water demand.

The future domestic water consumption level in rural areas of NTT is set to be 60 lit/day/capita up to 2003/04 for the Pelita VII period and 70 lit/day/capita from 2004/05 and onward. The public water demand and the unaccounted-for are to be included into these unit water requirements.

Following the population projected for the target year of 2008, the future domestic water demand for the representative schemes of the Categories 1 and 3 is estimated as shown below.

Projected Domestic Water Demand

Item	Unit	Lokok Meniris	Pelangan	Montong Krarak	Fatuk-metang	Mataiyang
Population	person	1,285	4,800	4,584	700	5,300
Domestic water	'000m^3/yr.	37.5	140.2	133.9	17.9	153.2
Public water	'000m^3/yr.	1.4	5.3	5.0	-	-
Un-accounted for	'000m^3/yr.	7.8	29.1	27.8	-	-
Total demand	'000m^3/yr.	46.7	174.6	166.7	17.9	153.2

(2) Livestock water demand

The future livestock water consumption level in NTB and NTT is set to be 40 lit/day/head for cow, buffalo and horse, 5 lit/day/head for sheep and goat, 6 lit/day/head for pig and 0.6 lit/day/head for poultry according to "The Study for Formulation of Irrigation Development Program in the Republic of Indonesia". Additional water demand for buffalo's bathing is considered to be 20 lit/day/head in NTB.

Following the livestock population projected for the target year of 2008, the future livestock water demand for the representative schemes of the Categories 1 and 2 is estimated as shown below.

Projected Livestock Water Demand

Unit : 1,000 m^3/year

Item	Tiu Tui	Ntonggu II	Fatuk-metang
Cow	26.6	4.4	5.4
Buffalo	58.4	1.4	1.8
Horse	18.7	0.1	1.1
Goat/Sheep	-	-	1.2
Pig	-	-	0.8
Chicken/Duck	0.6	0.3	0.5
Additional	29.2	0.7	-
Total demand	133.5	6.9	10.8

(3) Irrigation water demand

Table 4.4 presents the annual unit diversion requirement of irrigation water for the proposed crops in the respective project areas.

5. EXAMINATION OF EMBUNG DEVELOPMENT POTENTIAL

5.1. Topographic Condition

Based on the result of the topographic survey for ten priority Embung schemes performed by local surveying firm during October and November 1994, possibility of the Embung development has been examined.

The shape and width of valley at the Embung sites, and topographical maximum height of the each Embung are as shown below :

Topographical Condition of 10 Embungs

No.	Embung	Shape of Valley	Topographical Maximum Height (m)	Crest Length at Max. Height (m)
1.	Lokok Meniris	V-shape, shallow/narrow	20.0	200.0
2.	Pelangan	Rather deep/wide	40.0	380.0
3.	Montong Krarak	V-shape, shallow/narrow	12.0	190.0
4.	Aik Beta	Shallow/very wide	25.0	470.0
5.	Tiu Tui	Rather deep/wide	19.5	230.0
			(saddle dike)	660.0
6.	Penyempeng	V-shape, deep/wide	40.0	380.0
7.	Ncoha II	Rather shallow/very wide	28.0	500.0
8.	Ntonggu II	Deep/wide	20.0	290.0
9.	Fatukmetang	Deep/very wide	30.0	390.0
10.	Mataiyang	V-shape/rather narrow	30.0	230.0

5.2 Geological Condition

The geological investigation conducted at the ten Embung sites under the Study consists of core drilling, field permeability test, standard penetration test and unconfined compression test. The engineering geological features is presented in Volumes 8 to 10.

The coefficient of permeability of the foundation rocks varies from 2.1 x 10^{-5}cm/sec to 9.8 x 10^{-6} cm/sec for Alluvium, 1.8 x 10^{-4} to 9.8 x 10^{-6}cm/sec for Andestic Breccia, 1.1 x 10^{-4} to 8.1 x 10^{-5} cm/sec for Crystalline Limestone, 1.3 x 10^{-5} to 2.2 x 10^{-6} cm/sec for Volcanic Breccia, and 3.6 x 10^{-5} to 8.5 x 10^{-6} cm/sec for Tuff.

In each reservoir area, no major fault and landslide are recognized in the field.

5.3. Availability of Construction Materials

The construction material survey entrusted to the local consultants consists of field test pitting, sampling and laboratory test for embankment material (soil) and concrete aggregate (sand and gravel) for all of 10 representative Embung sites. It also includes rock test

(comprehensive strength test) using core samples taken from drilling exploration at each Embung site. The results of the construction material investigation and the site reconnaissance survey indicate that the earth materials are sufficiently available in the reservoir area of each Embung site or beneficiary area. The sand and gravel materials for the filter of the dam embankment and concrete aggregates are also available in the river. The random material is obtained from the reservoir area or excavated material in spillway and the dam foundation. The survey result is shown in the Volumes 8 to 10. In due consideration of the results of the above soil mechanical investigations, the type of Embung is selected.

5.4 Availability of Water Resources

(1) Catchment yield

As no discharge record is available for the water source river, runoff at each Embung site is estimated by using the rainfall record near each site: Dusun Anyar rainfall station for Lokok Meniris, Sekotong rainfall station for Pelangan, Pegondang/Sakra rainfall station for Montong Krarak, Suela rainfall station for Aik Beta, Empang rainfall station for Tiu Tui and Penyempeng, Sila rainfall station for Ncoha II and Ntonggu II, Fatuoni rainfall station for Fatukmetang, and Waikabubak rainfall station for Mataiyang. These rainfall stations have rainfall records continuing 15 to 36 years. The rainfall data were converted to the catchment rainfall by use of an isohyet map. A runoff coefficient adopted is 0.30 to 0.40 considering the characteristics of each catchment area and available hydrological analysis data in Nusa Tenggara. The details of estimation of the monthly discharge is presented in the Volumes 8 to 10 and its summary is shown below.

Mean Monthly Discharge at 10 Embung Sites

Embung	Catchment Area (km^2)	Mean Monthly Discharge (1,000 m^3)												
		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
L. Meniris	7.4	1,455	1,169	1,081	223	147	113	8	0	52	13	114	644	5,019
Pelangan	46.0	4,727	4,174	3,252	1,636	1,357	324	330	242	517	1,040	2,295	3,469	23,565
Mt. Krarak	5.4	508	422	289	88	95	50	44	4	17	87	262	409	2,273
Aik Beta	22.4	2,811	2,322	1,497	612	229	27	182	78	0	558	1,142	2,560	12,019
Tiu Tui	21.2	3,545	2,998	2,163	763	312	175	128	46	165	258	863	2,369	13,694
Penyempeng	41.1	6,179	5,366	3,870	1,367	534	302	230	82	296	460	1,509	4,221	24,415
Ncoha II	12.6	1,024	980	712	231	91	47	12	0	29	141	531	896	4,692
Ntonggu II	6.2	596	572	414	135	55	32	7	0	19	86	310	524	2,750
Fatukmetang	4.0	401	312	186	84	19	0	11	0	0	17	126	205	1,361
Mataiyang	19.1	2,425	2,229	2,626	1,219	1,045	216	145	74	474	865	1,408	2,368	15,093

(2) Floods

To determine the design discharge of the structures, the flood analysis is made by adopting the rational formula in due consideration of the availability of flood records and the

size of catchment area under the Study. The details of this analysis is presented in the Volumes 8 to 10. The estimated probable flood for each Embung is summarized below.

Probable Flood at 10 Embung Sites

Unit : m^3/s

Embung	Return Period						
	1 in 2 year	1 in 5 year	1 in 10 year	1 in 20 year	1 in 50 year	1 in 100 year	1 in 200 year
Lokok Meniris	62	87	104	120	143	159	176
Pelangan	212	281	332	385	459	522	587
Montong Krarak	19	24	27	29	32	35	37
Aik Beta	151	192	221	251	293	328	364
Tiu Tui	134	184	218	248	291	323	355
Penyempeng	84	115	136	155	182	202	222
Ncoha II	79	98	109	120	133	143	152
Ntonggu II	54	67	75	82	91	98	104
Fatukmetang	33	44	52	59	69	77	85
Mataiyang	136	164	182	198	217	231	246

(3) Sediment load and water quality

As no data on sediment load is available for each source river, the sedimentation rate is assumed to be 0.4 - 0.5 $mm/km^2/year$ for the ten Embungs taking into account the characteristics of catchment areas and referring to the previous study on Sumbawa water resources development.

According to the results of laboratory test on water quality of samples taken at each Embung site in October and November 1994, it can be considered that water quality often declines during the dry season due to contamination by inhabitants' and livestock's defecating activities.

6. EMBUNG DEVELOPMENT PLAN

6.1 Optimization of Development Scale

In order to determine the optimum development scale of each Embung, special attention is paid to two types of Embung indicating orientation of optimization. The one is water supply oriented type of which development scale coincides with the maximum limitation of either topography of the proposed Embung site or runoff from the catchment area. In this case, irrigable area and cropping pattern are restricted by the effective storage capacity of Embung. The other is water demand oriented type of which development scale is in line with the future water demand for domestic, livestock and irrigation use in the prospected beneficiary area of Embung. In this case, there is no limitation of topography and runoff at the potential Embung site and the future water demand is determined by number of water users and livestock as well as farming system and then maximized by the availability of irrigable land resources.

Under the Study, a simulation model of reservoir operation is employed as the basic tool for determining the optimum development scale of each Embung. This simulation model is presented in the Volumes 8 to 10 in detail. In carrying out the simulation on the half monthly basis, alternative cropping patterns are referred to and attention is paid to: inflow to reservoir; water losses from the reservoir caused by evaporation; flow of water over the spillway; outflow needed for domestic water; outflow needed for livestock water; outflow needed for irrigation water; volume of water in the reservoir at the beginning of the simulation period; and, volume of water in the reservoir at the end of the simulation period.

Under this feasibility study, priority of water use is put to supply irrigation water and the second to domestic and livestock water in NTB, whereas the first priority to BHN followed by irrigation in NTT taking into account inhabitants' needs and intention. The reservoir capacity is to have 100% dependability to meet the domestic and livestock water demand and 80% dependability for irrigation water demand. It is assumed that the minimum water level securing a capacity of sedimentation volume for 25 years in the reservoir coincides with 0.50 m above the lowest water level , while the maximum water level is equal to the crest elevation of spillway. The results of simulation for the respective Embung is summarized in Table 6.1 and depicted in Figures 6.1 to 6.10.

Optimum Scale of Embung

Project	Type	Dan Height (m)	Effective Storage Capacity (m^3)	Limiting Factor
Lokok Meniris	Supply-oriented	20.0	165,000	Topography
Pelangan	Demand-oriented	29.5	5,040,000	Irrigable area
Montong Krarak	Supply-oriented	12.0	62,000	Topography and runoff
Aik Beta	Supply-oriented	25.0	309,000	Topography
Tiu Tui	Demand-oriented	19.5	3,962,000	Irrigable area
Penyempeng	Demand-oriented	39.0	7,200,000	Irrigable area
Ncoha II	Demand-oriented	25.0	1,024,000	Irrigable area
Ntonggu II	Supply-oriented	17.0	1,159,000	Runoff
Fatukmetang	Demand-oriented	19.0	840,000	Irrigable area
Mataiyang	Demand-oriented	20.0	1,832,000	Irrigable area

6.2 Delineation of Beneficiary Area

The beneficiary area of each Embung is finally delineated according to the optimum development scale of each Embung. In case of the supply-oriented type of Embung such as Lokok Meniris, Montong Krarak, Aik Beta and Ntonggu II, the beneficiary area is delineated from the irrigable land resources available in the project area up to the maximum limit of irrigation area. While, the beneficiary area of the demand-oriented type of Embung such as Pelangan, Tiu Tui, Penyempeng, Ncoha II, Fatukmetang and Mataiyang coincides with the maximum irrigable area.

The inhabitants provided with domestic water, animals benefited by livestock water and net irrigation area of the respective Embung projects are summarized below. No domestic water is supplied to inhabitants in the Lokok Meniris and Montong Krarak project areas due to the limited storage capacity of the proposed Embungs. In Pelangan, Tiu Tui, Ntonggu II, Fatukmetang and Mataiyang project areas, the domestic and livestock water demand can be fully met by storage water of each reservoir. The irrigation area reduces from 83 to 44 ha in the Lokok Meniris project area and 210 to 187 ha in the Ntonggu II project area

Beneficiary Areas of Respective Embungs

Project	No. of Beneficiary Inhabitants (person)	No. of Beneficiary Animals (equiv. head)	Net Irrigation Area (ha)
Lokok Meniris	0	-	44
Pelangan	4,800	-	248
Montong Krarak	0	-	44
Aik Beta	-	-	84
Tiu Tui	-	133.5	331
Penyempeng	-	-	350
Ncoha II	-	-	157
Ntonggu II	-	6.9	187
Fatukmetang	700	10.8	57
Mataiyang	5,300	-	450

The proposed cropping pattern as shown in Table 6.2 is chosen from alternative cropping patterns for the respective projects taking into consideration the results of optimization study, sustainable maintenance of soil fertility and benefit generation.

6.3 Embung Development Plan

Following the results of the examination on the development potential of Embung and the optimization study on the development scale of Embung, the development plan of each Embung is formulated. In due consideration of the foundation strength and the availability of embankment materials at the proposed site, dam types applied are zoned embankment dam for the proposed Lokok Meniris, Pelangan, Tiu Tui, Penyempeng, Ncoha II and Mataiyang Embung projects, masonry gravity dam for the Montong Krarak and Aik Beta Embung projects, and homogeneous embankment dam for the Ntonggu II and Fatukmetang Embung projects. Foundation treatment methods applied are grout for the proposed Lokok Meniris, Pelangan, Penyempeng and Mataiyang Embung sites, and cut-off for the proposed Tiu Tui, Ncoha II, Ntonggu II and Fatukmetang Embung sites. Seepage protection work is practiced for the proposed reservoir area of Mataiyang Embung with earth blanket method.

Figure. 6.11 to 6.20 present the general layout plan of each Embung.

7. PRELIMINARY DESIGN OF FACILITIES

7.1 Preliminary Design of Embung

The main components of each Embung are main dam, spillway, river diversion works, outlet works. In order to provide an optimum storage capacity, the full supply level (F.S.L.) is determined by using the reservoir storage curve of each Embung. The height of Embung is determined considering F.S.L., overflow depth of spillway and freeboard.

Preliminary design works for each Embung are carried out based on the following basic concepts and procedures. The details are presented in the Volumes 8 to 10.

(1) Freeboard

The freeboard of Embung is designed taking into account the rise of the reservoir water surface due to extraordinary flood discharge and wave uprush on the dam slope. Under the Study, the designed freeboard comprises 5% of height from the river bed to the designed flood level and allowance of 1.0 m.

(2) Horizontal filter drain and toe rock drain

As for such homogeneous fill dam as the Ntonggu II and Fatukmetang Embungs, horizontal filter drain (drainage mattress) and toe rock drain are provided below the dam body and the toe portion of the main dam in order to reduce the seepage line within the dam body under the F.S.L. condition.

(3) River diversion during construction

River diversion works are required during performing the embankment works of the main dam of all Embungs for the dry season. The design discharge of river diversion channel is decided on the basis of the flood discharge with a return period of 1 in 5 years during the dry season from May to November. River diversion can be effectively and economically made by providing diversion tunnel, by pass conduit, or open channel.

(4) Spillway

A spillway is planned to be provided on the right or left abutment of each earth fill Embung while it is provided on the middle of dam body in masonry type Embung. The spillway is composed of overflow weir, throughway, shuteway, and downstream channel. The non-gated overflow weir is designed to cope with the inflow design flood determined for

100 year probable flood. A bridge is considered over the throughway of the spillway if required.

(5) Outlet works

Outlet works are provided to release the impounded water to the downstream beneficiary water users and consist of intake structure, pipe line and valve house. The intake structure is located above the sediment deposition level of each Embung. Fixed trash racks are provided on the intake structure. Cast iron pipe is connected from the intake structure to the valve house along the river diversion conduit. The valve house is constructed near the downstream toe of each Embung consisting of check valve and flow meter to control the released water.

Main features of the ten Embungs are shown in Table 7.1 and summarized below.

Representative Embungs on Lombok Island

Item	Unit	L.Meniris	Pelangan	Mt.Krarak	Aik Beta
Catchment area	km^2	7.4	46.0	5.4	22.4
Reservoir area	km^2	0.05	0.58	0.04	0.08
Dam Type		Zone	Zone	Masonry	Masonry
Dam height	m	20.0	29.5	12.0	25.0
Crest length	m	200	360	210	470
Effective storage capacity	m^3	165,000	5,040,000	62,000	309,000
Embankment volume	m^3	79,500	621,900	-	-
Masonry volume	m^3	-	-	11,700	86,300
Design flood discharge of spillway	m^3/s	159	522	35	330
Crest width of spillway	m	40	73	35	53

Representative Embungs on Sumbawa Island

Item	Unit	Tiu Tui	Penyempeng	Ncoha II	Ntonggu II
Catchment area	km^2	21.2	41.1	12.6	6.2
Reservoir area	km^2	0.64	0.55	0.13	0.23
Dam Type		Zone	Zone	Zone	Homogeneous
Dam height	m	19.5	39.0	25.0	17.0
Crest length	m	230	360	400	260
Effective storage capacity	m^3	3,962,000	7,200,000	1,024,000	1,159,000
Embankment volume	m^3	251,700	614,600	454,600	252,200
Design flood discharge of spillway	m^3/s	323	411	107	106
Crest width of spillway	m	52	85	50	20

Representative Embungs in NTT Province

Item	Unit	Fatukmetang	Mataiyang
Catchment area	km^2	4.0	19.1
Reservoir area	km^2	0.17	0.30
Dam Type		Homogeneous	Zone
Dam height	m	19.0	20.0
Crest length	m	370	240
Effective storage capacity	m^3	840,000	1,832,000
Embankment volume	m^3	460,400	188,400
Design flood discharge of spillway	m^3/s	77	231
Crest width of spillway	m	13	38

7.2 Preliminary Design of O&M Road for Embung

There exist well conditioned access roads to the Pelangan, Aik Beta, Tiu Tui, and Ncoha II Embung sites. While, no all weathered road is available in and around the Lokok Meniris, Montong Krarak, Penyempeng, Ntonggu II, Fatukmetang, and Mataiyang Embung sites. It is therefore planned to provide O&M roads to these three sites aiming at smooth undertaking of O&M works after completion of Embungs. Main features of O&M Road with gravel pavement are summarized below.

Main Features of O&M Road for Representative Embungs

Item	Unit	L.Meniris	Mt.Krarak	Penyempeng	Ntonggu II	Fatukmetang	Mataiyang
Required length	km	0.47	0.15	1.64	0.98	2.2	0.60
Width	m	7.0	7.0	7.0	7.0	7.0	7.0
Pavement		Gravel	Gravel	Gravel	Gravel	Gravel	Gravel
Cross drain	Nos.	1	-	1	-	1	-

7.3 Preliminary Design of Water Distribution Facilities

The main components of water distribution facilities to inhabitants and livestock in the beneficiary area of each Embung are pipe lines, division boxes with filter system for inhabitants, division boxes for livestock and related structures of pipelines. The pipeline system will be provided in such four projects as Pelangan, Fatukmetang, and Mataiyang. As for the Tiu Tui and Ntonggu projects, water for livestock will be distributed by use of the irrigation canal system.

Preliminary design works for each water distribution system are carried out based on the following basic concepts and the details are presented in Volumes 8-2, 10-1, and 10-2:

- Distribution facilities to the beneficiary areas are laid out taking into consideration the effective storage capacity of each Embung, topographic condition of each Project area, village boundary and the existing water supply facilities;

- Water demand for inhabitants and livestock are fully reflected in the preliminary design of pipeline and the layout of division boxes in the beneficiary areas;

- Pipeline system with pressure flow is taken up for water distribution network from each Embung to its beneficiary area. Pipes are laid along the existing roads as much as possible from the viewpoint of easy O&M of pipeline system. Pipes are laid under the ground with a depth of 50 cm;

- Division boxes for inhabitants are arranged based on the water demand in each beneficiary area, water conveyance distance between a division box and its users' houses and topographic condition of a site for constructing a division box. The designed capacity of division box for inhabitants is 6,000 lit to cover daily water demand of 100 persons;

- Division boxes for livestock are arranged in separate places from the division boxes for inhabitants to reduce risks such as contamination of water quality in and damages to division boxes for inhabitants, and so on. The designed capacity of division box for livestock is 900 lit to meet daily water demand of 22 heads of cattle indicating the total number of cow converted from the number of the respective livestock;

- Related structures of pipelines such as check valves, air valves and blowoffs are set taking into account the topographic condition along and layout of each pipeline system; and,

- High Density PVC pipes are used for the water supply in due consideration of the safety against unexpected high pressure to the pipes, the steep and undulating topographic condition and the easiness to get the materials in Indonesia.

The design discharge of pipeline is decided on the basis of the unit water demand of inhabitants and livestock as well as the projected population of inhabitants and livestock for the beneficiary area of each Embung. Main features of the pipeline system are shown Table 7.2 and summarized below.

Main Features of Pipeline System for Representative Embungs

Item	Unit	Pelangan	Fatukmetang	Mataiyang
Design Discharge	lit/s	5.5	0.9	4.3
Total length of pipeline	km	7.50	3.90	0.10
Total numbers of related structures	Nos.	49	47	-

7.4 Preliminary Design of Irrigation Facilities

The main components of water distribution facilities to the beneficiary irrigation areas of ten projects are irrigation inlet box, concrete flume type canal, masonry flume type canal, turnout, siphon, aqueduct, cross drain, irrigation division boxes, and livestock division boxes. Preliminary design works for irrigation facilities are carried out based on the following basic concepts and the details are presented in the Volumes 8 to 10:

- Irrigation canals are laid from the outlet of each Embung to the head of beneficiary irrigation area by an open channel as much as possible from the economical viewpoint;

- Canal alignment for gravity irrigation system is designed in harmony with the present environmental circumstances; and,
- On-farm irrigation service facilities of the beneficiary areas are to be improved or upgraded by beneficiary farmers themselves.

Main features of the irrigation water distribution system are shown Table 7.3 and summarized below.

Main Features of Irrigation Water Distribution System for Representative Embungs on Lombok Island

Item	Unit	L.Meniris	Pelangan	Mt.Krarak	Aik Beta
Design discharge	lit/s	60	500	60	110
Irrigation inlet box	Nos.	1	1	1	1
Canal to be constructed	km	1.8	-	-	5.5
Canal to be rehabilitated	km	1.8	11.7	2.96	-
Type of canal		Masonry flume	Masonry Trapezoidal	Masonry flume	Concrete flume
Irrigation diversion box	Nos.	15	-	-	43
Livestock division box	Nos.	-	-	-	-

Main Features of Irrigation Water Distribution System for Representative Embungs on Sumbawa Island

Item	Unit	Tiu Tui	Penyempeng	Ncoha II	Ntonggu II
Design discharge	lit/s	350	900	160	200
Irrigation inlet box	Nos.	1	1	1	1
Canal to be constructed	km	1.2	8.2	3.0	5.4
Canal to be rehabilitated	km	3.5	1.1	1.2	-
Type of canal		Masonry Trapezoidal	Masonry Trapezoidal	Masonry Trapezoidal	Masonry Trapezoidal
Irrigation diversion box	Nos.	22	82	29	54
Livestock division box	Nos.	5	-	-	14

Main Features of Irrigation Water Distribution System for Representative Embungs in NTT Province

Item	Unit	Fatukmetang	Mataiyang
Design discharge	lit/s	70	400
Irrigation inlet box	Nos.	1	1
Canal to be constructed	km	2.2	11.0
Canal to be rehabilitated	km	-	-
Type of canal		Concrete Flume	Masonry Trapezoidal
Irrigation diversion box	Nos.	22	110
Livestock division box	Nos.	-	-

8. EMBUNG CONSTRUCTION PLAN

8.1 Construction Plan of Embung

In order to secure smooth implementation of each project, it is planned to carry out Embung construction works by using heavy equipment. The proposed construction plan for major construction items are described in general and its details are presented in the Volumes 8 to 10.

(1) Preparatory works

The preparatory works consist of preparation of temporary buildings, construction plant, repair shop, power and water supply systems, communication system, construction of access reads and haul roads. The temporary buildings required for the construction would include office, quarters, workshop, warehouse and storage yards.

(2) River diversion works

To release the river flow in the dry season during which embankment works of the main dam are undertaken, the river diversion works is carried out. Considering the proposed location of the outlet works and the topographic condition of the site, the river diversion facilities is arranged.

(3) Main dam works (Fill dam type)

Following the completion of foundation excavation works and river diversion conduit arrangement, embankment works of the main dam are started as soon as possible. Embankment material is quarried from the quarry site and borrow area in the reservoir.

(4) Spillway construction works (Fill dam type)

After completion of the spillway excavation, concrete work of weir and shuteway will be commenced. Most of the excavated materials may be used for the main dam embankment so that the excavated material will be stocked on designated area. Major concrete works need to be completed before starting to impound water in the reservoir so as to release the flood discharge in the wet season.

(5) Main dam and spillway masonry works (Masonry dam type)

Following the foundation excavation, and completion of the river diversion conduit, the masonry works for the main dam and the spillway will be commenced.

(6) Outlet works

Outlet works are carried out to construct inlet structure above the inlet portion of the river diversion conduit and to install a cast iron pipe along the river diversion conduit up to valve house. The cast iron pipe is connected to check valve and flow meter in the valve house.

8.2 Construction Plan of Water Distribution and Irrigation Facilities

Construction works of water distribution and irrigation facilities are carried out in parallel with the construction works of Embung. Compared with the construction of Embung, work quantities and the scale of facilities are rather small and most part of construction works can be manually carried out. Heavy construction equipment is thus used for clearing, stripping, excavating, embanking and paving works of mainly O&M roads and if necessary water distribution and irrigation facilities.

8.3 Construction Schedule

The construction schedule of each Embung is determined on the basis of the following conditions and assumptions:

- All the construction works are carried out by contractor(s) selected through the competitive bidding(s);
- The construction plan is formulated taking into account the mode of construction, the completion target of construction works, the site, weather and topographic conditions, the availability of laborers, construction materials and equipment, and so on. The mechanized construction method is principally adopted and supplemented by ordinary construction method locally practiced;
- It is assumed that, for every year, 200 working days are available for undertaking earthfill embankment works, 270 days for filter drain and toe rock works, and 300 days for concrete works in view of the daily rainfall distribution in each Project area. For every working day, 8-hour shift is applied; and,
- The embankment works for the main dam are carried out during only the dry season and completed within one dry season to secure quality and profitability of construction works.

Major items considered in determining the construction schedule are described below:

- Mobilization and preparatory works : Detailed design and tendering works are carried out for about 10 months. Successful contractor's construction equipment and key staff are mobilized to the project site immediately after the "Notice to Proceed" is received by the contractor. Following the mobilization, the preparatory works are commenced to set out all structures at the project site and to construct temporary access to the major structural sites. These two works require about four months. The detailed design works need to be commenced at the beginning of the first year;

- Excavation works : Excavation works need to be commenced at the river diversion works, main dam foundation and spillway sites following the preparatory works;

- Embankment / Masonry works : After concrete works of river diversion conduit are finished, embankment works of the main dam and concrete works of spillway, or masonry works are started and simultaneously completed by the end of a dry season;

- Reservoir water impounding : Reservoir water impounding works are started from the beginning of the wet season after completion of the main dam embankment and spillway construction works. According to rainfalls in November and December, the impounding water will rise up to F.S.L. and can be supplied to the beneficiary areas in January. Therefore, the total construction period requires 14 months each for constructing Lokok Meniris and Montong Krarak Embungs, 26 months for constructing Pelangan, Aik Beta, Tiu Tui, Ncoha II, Ntonggu II, Fatukmetang Embungs, and 36 months in case of Penyempeng, and Mataiyang Embungs because of work quantities of construction works; and,

- Water distribution system and irrigation facilities : Construction works of water distribution system and irrigation facilities are executed in parallel with the Embung construction works.

The proposed construction schedule for each Embung is presented in the Volume 8 to 10.

8.4 Institutional Arrangement for Project Implementation

(1) Responsible organization for project implementation

In the course of project implementation, each of DPUP NTB and DPUP NTT, after getting approval from DGWRD, will direct its PKSA Project Offices to commence undertaking of detailed investigation and design works of the proposed Embung. Based on cost estimate, the both DPUPs will disburse budget for land acquisition as well as construction of Embung and related facilities to the PKSA Project Office using development budget allocated from the Central Government. Before starting construction work, land acquisition will be carried out by each PKSA Project Office. Supervision of construction works, being entrusted to a contractor through tendering, will be also the responsibility of the PKSA Project Office. Figures 8.1 to 8.4 depict the organizational structure of four Project Offices for PKSA Lombok and PKSA Sumbawa under DPUP NTB and for PKSA Timor and Flores-Sumba under DPUP NTT.

(2) Technical resources input

In due consideration of the current availability of engineers and technical staff as well as the annual target of project implementation in the respective PKSA Project Offices, it is necessary to utilize technical resources outside DPUP to the full extent for enabling each Project Office to realize its target. In this connection, undertaking of detailed investigation and design works as well as construction supervision need to be entrusted to consultants aiming to

secure smooth implementation of the project in accordance with the implementation program made by the PKSA Project Offices and approved by DUPUs.

(3) Organization for O & M

After completing all implementation works of Embung, each DPUP will have to submit its completion report of the project to the Minister for Public Works through DGWRD and therefrom the notice of project completion will be transferred to the Minister for Home Affairs. After receiving the Home Affairs Minister's direction, the Governors of NTB and NTT Provinces will order DPUP NTB and DPUP NTT, respectively, to take a necessary action for operation and maintenance of the newly completed project facilities. Following this, the both DPUPs will direct those Provincial Project Offices for Operation and Maintenance to arrange O&M works with the Provincial Government's budget allocation to the relevant DPUP Kabupaten Offices.

(4) Water User's Association (P3A)

If no P3A has been established yet in each beneficiary area, agencies concerned at provincial and district levels will have to promote organization of beneficiary farmers into P3A and to train them by using training materials and modules prepared by the Water User Training Program under DGWRD.

9. COST ESTIMATE

9.1 Basic Assumption of Cost Estimate

Cost estimate of the proposed project works is made on the feasibility level based on the following basic assumptions:

- All the civil works of each project are performed by contractor(s), selected through the competitive bidding, on the contract basis;
- For physical contingency, 15% of the total amount of direct construction, administration and engineering costs is appropriated, while 10% of the total cost is added as price contingency;
- The direct construction cost is estimated on the basis of work quantities of the proposed construction works and unit price of each work item. The unit price is estimated for each work item taking into account the market price as of June 1994 and referring to data collected from the on-going projects in NTT. The unit price includes delivery cost of construction materials and equipment to each project site;
- For engineering service cost to cover detailed design and construction supervision works by consultants, around 15% of the direct construction cost is appropriated;
- For the contract tax as a value added tax imposed by the GOI, around 10% of the total contract cost is appropriated;
- Administration cost covers staff salary and office running cost of PRWS's responsible section to manage implementation of each works. Taking into account the actual condition of on-going projects in NTT, around 5% of the direct construction cost is appropriated;
- Land acquisition cost is estimated to be 0.5% of the direct construction cost. The both administration and land acquisition costs need to be borne from the budget of the Government of Indonesia;
- The cost estimated excludes other associated costs necessary for strengthening extension services, organizing water users' association, improving social infrastructures, and so on because these costs have to be arranged by the Government of Indonesia; and,
- The currency used for the cost estimate is Indonesian Rupiah (Rp.).

9.2 Project Cost

The project cost is composed of direct construction cost, administration cost, engineering service cost, physical contingency, contract tax, land acquisition cost, and price contingency. The Total cost for ten projects amounts Rp. 148,309 million. The details of cost estimate for each Embung are presented in the Volumes 8 to 10. The project cost estimated on the feasibility level is shown in Table 9.1 and summarized below.

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Project Cost for Representative Embungs on Lombok Island

Unit : million Rp.

Item	Lokok Meniris	Pelangan	Montong Krarak	Aik Beta	Total
Direct construction cost	2,617	12,982	1,472	9,188	26,259
Preparatory works	125	618	70	438	1,251
Embung construction	2,269	11,627	1,230	8,345	23,471
Irrigation facilities	190	114	163	405	872
Domestic water supply	0	623	0	0	623
O&M road	33	0	9	0	42
Administration cost	131	649	74	459	1,313
Engineering services	392	1,947	221	1,378	3,938
Physical contingency	471	2,337	265	1,654	4,727
Contract tax	348	1,727	196	1,222	3,493
Land acquisition	13	65	7	46	131
Price contingency	794	3,941	447	2,789	7,971
Total	4,766	23,648	2,682	16,736	47,832

Project Cost for Representative Embungs on Sumbawa Island

Unit : million Rp.

Item	Tiu Tui	Penyem-peng	Ncoha II	Ntonggu II	Total
Direct construction cost	5,994	13,889	8,526	6,165	34,574
Preparatory works	285	661	406	294	1,646
Embung construction	5,480	11,648	7,807	5,389	30,324
Irrigation facilities	229	1,477	313	425	2,444
Domestic water supply	0	0	0	0	0
O&M road	0	103	0	57	160
Administration cost	300	694	426	308	1,728
Engineering services	899	2,083	1,279	925	5,186
Physical contingency	1,079	2,500	1,535	1,110	6,224
Contract tax	797	1,847	1,134	820	4,598
Land acquisition	30	69	43	31	173
Price contingency	1,820	4,217	2,588	1,872	10,497
Total	10,919	25,301	15,531	11,229	62,980

Project Cost for Representative Embungs in NTT Province

Unit : million Rp.

Item	Fatuk-metang	Mataiyang	Total
Direct construction cost	10,430	10,155	20,585
Preparatory works	497	484	981
Embung construction	9,328	8,472	17,800
Irrigation facilities	187	1,159	1,346
Domestic water supply	284	4	288
O&M road	134	36	170
Administration cost	521	508	1,029
Engineering services	1,564	1,523	3,087
Physical contingency	1,877	1,828	3,705
Contract tax	1,387	1,351	2,738
Land acquisition	52	51	103
Price contingency	3,166	3,083	6,249
Total	18,999	18,498	37,497

9.3 Operation and Maintenance Cost

The O&M cost covers salary of O&M staff, maintenance cost of project facilities, material and labor costs for repairing works and running cost of project facilities. For the O&M cost, 0.5% of the project cost is appropriated amounting to Rp. 742 million every year.

10. PROJECT JUSTIFICATION

10.1 Benefits Attributable to Embung Development

In general, it can be considered that direct benefits attributable to development of new water resources by constructing Embung in NTB and NTT are derived from supply domestic, livestock and irrigation water to inhabitants who have been suffering from chronic water shortage problems. Among these, the domestic water supply benefit comprises two main portions: saved time for fetching water from distant sources and reduced health problems or morbidity. It is however hard to evaluate such type of benefit in quantitative manner.

Regarding the livestock water supply benefit, special attention needs to be paid to the fact that inhabitants usually raise livestock as draft animal under open yard feeding system. In such case, the livestock water supply benefit is derived from: saving of time to bring large cattle to places where water is available and to carry water for small animal from those places to inhabitants' houses; and betterment of feeding condition. It is also hard to quantify these benefits.

On the other hand, the irrigation water supply benefits principally born from increased crop production under stable irrigated condition coupled with full utilization of available farm land resources and optimum use of farm inputs. This benefit can be quantified by increment net production value which is obtained by estimating surplus of the both net production values under the condition of "With Project" and "Without Project".

In due consideration of the above characteristics of water supply benefits, therefore, the irrigation benefit is to be employed as economic benefit for project justification.

10.2 Satisfaction of BHN

(1) Domestic water supply benefit

The benefit of domestic water supply could be indicated as the value of water and the investment amount to each beneficiary inhabitant. If the total amount of direct construction cost is defined as the total amount of investment for the construction of the proposed Embung, this investment amount could be allocated to the investment in domestic water supply according to the proportion of annual domestic water demand against the total annual water demand. Then, the value of water can be estimated by dividing the sum of allocated amount of direct construction cost for the proposed Embung and the whole amount of domestic water supply system by the annual domestic water demand, while the investment amount to each beneficiary inhabitant can be given by dividing the said sum by the total number of domestic water users.

Based on the above method, the domestic water supply benefits attributable to the investment in development of Pelangan, Fatukmetang and Mataiyang Embung projects are examined and summarized below. The per capita investment in domestic water supply indicates that the most efficient case is the proposed Mataiyang Embung project followed by the Pelangan and Fatukmetang projects.

Domestic Water Supply Benefit

Item	Unit	Pelangan	Fatukmetang	Mataiyang
No. of beneficiary inhabitants	person	4,800	700	5,300
Domestic water demand	'000 m^3/yr.	177	18	175
Total water demand	'000 m^3/yr.	7,577	799	5,215
Proportion	%	2.34	2.25	3.36
Direct cost of Embung	Rp. million	12,245	9,959	8,991
Allocated cost	Rp. million	286	224	302
Domestic water supply cost	Rp. million	623	176	2
Total cost	Rp. million	909	400	304
Value of domestic water	Rp./m^3	5,136	12,708	1,737
Per capita investment amount	Rp./pers.	189,375	571,429	57,358

(2) *Livestock water supply benefit*

The benefit of livestock water supply could be indicated as the net value of additionally increasing cattle weight, either cow or buffalo, attributable to stabilized livestock water supply condition. In order to estimate this net value, it is assumed that a cow or buffalo aged 1.5 to 2 years old and with the initial weight of 200 kg will be an additional increase of 0.6 kg/day in weight during four months of the dry season as a result of stable supply of livestock water. Further assumptions made for other unit values are Rp. 2,500/kg for the both initial and increasing weights, Rp. 490,000/head for the overall feeding cost and Rp. 24,000/head for by-products.

Based on the above method, the livestock water supply benefits attributable to the investment in development of the proposed Tiu Tui, Ntonggu II and Fatukmetang Embung projects are examined and summarized below. When the total net value of additionally increasing cattle weight is compared with the total cost of livestock water supply, the most efficient case is the proposed Tiu Tui Embung project followed by the Ntonggu II and Fatukmetang projects.

Livestock Water Supply Benefit

Item	Unit	Tiu Tui	Ntonggu II	Fatukmetang
No. of livestock	eqiv. head	7,145	423	736
Livestock water demand	'000 m^3/yr.	134	7	799
Total water demand	'000 m^3/yr.	5,174	1,817	11
Proportion	%	2.59	0.39	1.38
Direct cost of Embung	Rp. million	5,765	5,740	9,959
Allocated cost	Rp. million	145	25	137
Livestock water supply cost	Rp. million	0	0	108
Total cost	Rp. million	145	25	245
Value of livestock water	Rp./m^3	1,115	3,125	22,273
Total amount of net value	Rp. million	1,286	76	133

10.3 Economic Consideration

(1) Economic cost

The financial costs are to be converted into the economic costs by applying the economic conversion factor (ECF) established by DGWRD in 1985. The ECFs applied are: 0.71 for preparatory works and all civil works including Embung, irrigation facilities, domestic water supply system and road networks; 0.75 for unskilled on-farm labor and farm labor; 0.80 for land clearing, on-farm development and operation and maintenance cost; and tertiary irrigation system development, 0.90 for design and survey works and administration; and 1.00 for O&M equipment and replacement cost. The economic cost converted and its annual disbursement schedule are shown in Table 10.1.

(2) Economic benefit

The irrigation benefits of the project are principally derived from increased crop production attributable to stable irrigation water supply, full utilization of available farm land resources and optimum farm input supply. Tables 10.2 to 10.5 shows economic price structures of paddy, maize, Palawija crops and fertilizers. Table 10.6 gives financial and economic prices of farm inputs and outputs estimated for major islands. Based on the proposed quantity of farm inputs, anticipated crop yield and economic farm gate prices, the economic crop budget is estimated as shown in Table 10.7.

The net production value is estimated on the basis of the anticipated crop yield, and economic farm gate prices of farm inputs and outputs. The annual net incremental benefit is will accures from the first year when irrigation water can be released from the proposed Embung and attain to the target yield at the fifth year. If there are some crop cultivation areas in the proposed reservoir areas, the value of production foregone is estimated under the same condition of "Without Project". The estimated increment net production value of each Embung project is summarized in Table 10.8.

(3) Economic evaluation

The economic internal rate of return (EIRR) is examined for the respective Embung projects as described in the Volumes 8 to 10 on the basis of costs and benefits as at August 1994. The result of economic analysis reveals that the feasible Embung project is Tiu Tui with EIRR of 14.4% and the marginal one is Penyempeng of 6.5%, Mataiyang of 5.5%, Ncoha II of 5.0% and Pelangan of 3.6%, while the unfeasible one is Lokok Meniris, Aik Beta, Ntonggu II and Fatukmetang with negative EIRR.

(4) Farm budget analysis

With the implementation of the respective Embung projects, the net on-farm income of farmers holding a unit farm size of 1.0 ha can be expected to increase to a large extent resulting from improvement of the cropping intensity and increase in crop yields. Such improvement of farm budget as shown below would give much incentive for farmers to make further investment in improvement of their living standard and also could increase their payment capacity enabling beneficiary farmers to pay irrigation water charge.

Farm Budget for Unit Farm Size of 1 Ha

Project	Without Project		With Project	
	Cropping Intensity (%)	Net Income (Rp.)	Cropping Intensity (%)	Net Income (Rp.)
Lokok Meniris	100	449,800	200	1,879,700
Pelangan	111	499,800	300	4,772,700
Montong Krarak	100	449,800	300	2,814,600
Aik Beta	118	560,500	300	2,725,800
Tiu Tui	100	456,400	300	4,428,600
Penyempeng	139	720,300	300	4,255,500
Ncoha II	114	519,200	300	5,711,800
Ntonggu II	105	538,400	200	1,849,000
Fatukmetang	-	-	200	6,094,700
Mataiyang	100	431,000	300	

10.4 Environmental Impact Assessment

By referring to "Environmental Guidelines for Agriculture and Rural Development Projects of JICA Development Study", prospected environmental impacts of development the proposed Embung projects are assessed according to the following procedure:

- To identify the scope of environmental impact assessment;
- To choose environmental issues in due consideration of the project components and demarcation of places where environmental issues occur;
- To collect the information and data concerning the environmental issues;
- To identify actual environmental aspects and impacts;

- To assess potential environmental aspects and impacts, both positive and negative;
- To suggest mitigatory measures against negative environmental impacts; and,
- To identify environmental issues authorized by "Guidelines for Selecting Environmental Impacts Analysis Management (AMDAL) Procedure for Projects of Ministry of Public Works, Republic of Indonesia".

As described in the Volumes 8 to 10, minor negative impacts are potentially recognized by Embung construction in the Pelangan and Aik Beta project areas. The results of environmental impact assessment reveal however that there exist no residual negative impacts with appropriate mitigatory measures. Potential negative impacts appreciated in the Pelangan and Aik Beta project areas are:

- Acceleration of soil erosion in the catchment area and further increase in sedimentation inflow into the new reservoir due to human use of trees;
- Spiritual fear among religious believer in view of submergence of the altar;
- Moral pressure of resettlers, and discord between settlers and habitants who have lived in the place where resettlers will be made to settle as the lands in the proposed reservoir area are expropriated in the Pelangan project area; and,
- Deterioration of the living environment owing to the change of atmosphere circumstances during construction stage in the Aik Beta project area.

The countermeasures to eliminate these environmental impacts are:

- To establish an effective watershed management rule to protect the vegetation in the catchment area;
- To shift the altar to the place which will be decided in cooperation with believer;
- To ensure social and economic bases which are equivalent or better situation for resettlers, to train regarding shifted economic activities and to give chances to participate a meeting and hearing regarding implementation of the project; and,
- To exact the appropriate consideration for the activities such as daily safety control and transportation management by contractors under the control of client.

Primary information necessary for environmental assessment to be made on the Indonesian rule is compiled in Attachment of this Volume 4.

10.5 Contribution to Women in Development

With provision of permanent water source facilities, women and children in the Pelangan, Fatukmetang and Mataiyang project areas can be quite free from their daily hard job to carry their domestic water at the average distance of 150 m to 1.5 km. As a result, women will be able to utilize the saved time for improving their activities in relation to not only agriculture and livestock but also small business and cottage industry. Since housewives in all

the project areas manage their family budgets, increasing family's income would encourage women in investing surplus in improvement and diversification of their economic activities.

11. CONCLUSION AND RECOMMENDATIONS

11.1 Conclusion

On the basis of categorization of 157 candidate schemes for the Study, a total of 10 Embung projects is selected representing different categories made on the basis of the present condition of irrigation water intake facility and farming system in the project areas well as the intention of inhabitants to the future use of storage water to be newly created by constructing Embung. Paying special attention to two types of development approach such as supply-oriented and demand-oriented types, the optimization study is conducted to determine the optimum development scale of each representative Embung as shown below.

Optimum Development Scale of Representative Schemes

Project	Type	Dan Height (m)	Effective Storage Capacity ('000 m^3)	Water Supply
Lokok Meniris	Supply-oriented	20.0	165	Irrigation
Pelangan	Demand-oriented	29.5	5,040	Irrigation and domestic
Montong Krarak	Supply-oriented	12.0	62	Irrigation
Aik Beta	Supply-oriented	25.0	309	Irrigation
Tiu Tui	Demand-oriented	19.5	3,962	Irrigation and livestock
Penyempeng	Demand-oriented	39.0	7,200	Irrigation
Ncoha II	Demand-oriented	25.0	1,024	Irrigation
Ntonggu II	Supply-oriented	17.0	1,159	Irrigation and livestock
Fatukmetang	Demand-oriented	19.0	840	Irrigation, domestic and livestock
Mataiyang	Demand-oriented	20.0	1,832	Irrigation and domestic

The dam types, irrigation area and required investment cost for the representative Embung projects are summarized below.

Investment Cost for Representative Embungs

Project	Dam Type	Investment Cost (Rp. mill.)	Net Irrigation Area (ha)	No. of Beneficiary Inhabitants (person)	No. of Beneficiary Livestock (eqiv. head)
Lokok Meniris	Zoned embankment	4,766	44	-	-
Pelangan	Zoned embankment	23,648	248	4,800	-
Montong Krarak	Masonry gravity	2,773	44	-	-
Aik Beta	Masonry gravity	16,736	84	-	-
Tiu Tui	Zoned embankment	10,919	331	-	7,145
Penyempeng	Zoned embankment	25,301	350	-	-
Ncoha II	Zoned embankment	15,531	154	-	-
Ntonggu II	Homogeneous embankment	11,229	187	-	423
Fatukmetang	Homogeneous embankment	18,999	57	700	736
Mataiyang	Zoned embankment	18,494	450	5,300	-

The results of feasibility study reveal:

- From the viewpoints of topography or availability of water resources at the proposed site, the Lokok Meniris, Montong Krarak and Aik Beta Embung projects

are not recommendable for project implementation, while the Ntonggu II and Fatukmetang Embung projects are not feasible due to limited runoff from catchment area and irrigable land resources, respectively. The remaining five Embung projects are technically sound;

- From the economic viewpoints, the Tiu Tui Embung project is feasible, while the Pelangan, Penyempeng, Ncoha II and Mataiyang Embung projects are marginally feasible and the rest are not economical; and,

- From the social viewpoints, the Pelangan, Tiu Tui and Mataiyang Embung projects are recommendable for public investment in implementation, but the Ntonggu II and Fatukmetang Embung projects are not recommendable due to very low investment efficiency.

The results of feasibility study on the 10 representative Embung schemes are to be employed as raw materials in formulating mid - and long-term development program of Embung in NTB and NTT. Further, the methodology, procedure, and results are to be fully reflected in the Guideline.

11.2 Recommendations

In the intensification of the farming system to the target level with the cropping intensity up to 300%, it is recommended to improve farming practices and on-farm irrigation water management skills of the beneficiary farmers through strengthening of agricultural extension services and water management training programs.

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The Study on The Embung Development Project in East Nusa Tenggara and West Nusa Tenggara

Feasibility Study on Ten Embung Development Projects

Tables

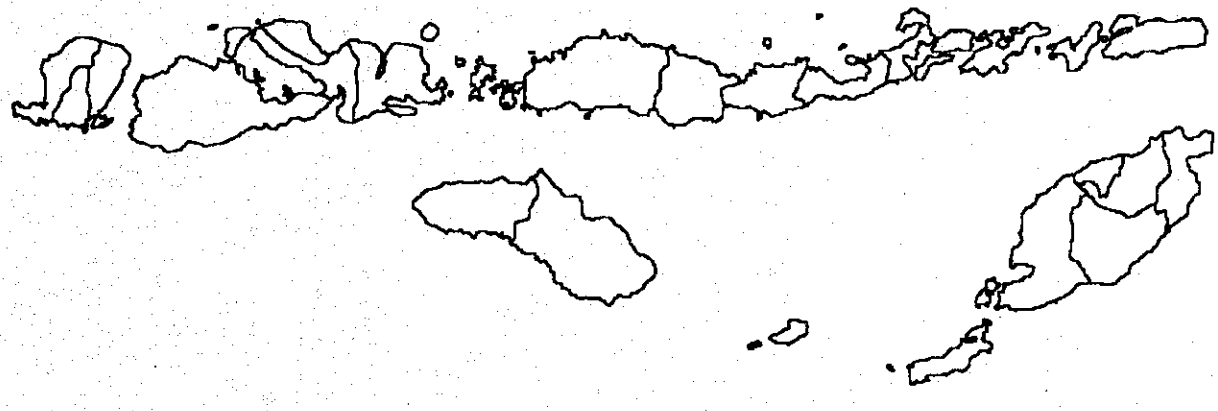


Table 1.1 Actual Results of Field Survey Entrusted to Local Consultants

	Unit	Lokok Meniris	Pelangan	Montong Krarak	Aik Beta	Tiu Tui	Penyempeng	Ncoha II	Ntonggu II	Fatukmetang	Mataiyang	Total
Topographic Survey												
Scale 1/500	ha	7	20	5	12	8	15	6	12	20	20	125
Scale 1/5000	ha	227	550	250	350	500	400	350	450	200	450	3,727
Geological Survey												
Core Boring	m	70	105	60	50	70	70	70	70	70	65	700
Standard Penetration Test	Nos.	-	18	-	-	3	2	7	16	43	4	93
Field Permeability Test	Nos.	14	21	12	10	14	10	14	14	14	13	136
Soil Test	Nos.	-	2	-	-	2	2	2	2	4		14
Rock Test	Nos.	2	2	2	2	2	2	2	2	2	2	20
Material Survey												
Test Pit	Nos.	5	5	4	5	5	4	5	5	4	4	46
Sample for Laboratory Test	Nos.	7	7	5	7	7	6	7	7	6	5	64
Soil Survey												
Sample for Soil Survey	Nos.	9	9	9	9	9	9	9	9	9	9	90
Farm Economy Survey												
Sample farm households	Nos.	15	15	15	15	15	15	15	15	15	15	150
Water Quality Test		2	2	2	2	2	2	2	2	2	2	20
Water Samples	Nos.											

Table 3.1 Present Domestic and Livestock Water Source Facilities in 10 Representative Project Areas

Project Area	No. of Inhabitants	No. of Livestock	Pumped Well	Hand Pump Well	Big Dug Well	Small Dug Well	Water Basin	Irrigation Canal	Spring	River
Lokok Meniris	977	1,506			x		xx	x/w		
Pelangan	3,649	6,360			x/w					x/w
Montong Krarak	3,977	397			xx	xx	xx		x	w
Aik Beta	1,660	353					xx			xx/ww
Tiu Tui	3,477	7,000		x/w						w
Penyempeng	3,258	1,080		xx			xx			xx/ww
Ncoha II	2,274	291	x			x				w
Ntonggu II	2,307	595	x			x/w				w
Fatukmetang	572	511				x/w				
Mataiyang	4,076*	1,141							xx	ww

Remarks : x ; Drinking water source with water shortage period
xx ; Drinking water source without water shortage period
w ; Livestock water source with water shortage period
ww ; Livestock water source without water shortage period

Table 3.2 Summary of Survey on Farmers' Economy in Ten Beneficiary Areas

	Item	Unit	Lokok Meniris	Pelangan	Montong Krarak	Aik Beta	Tiu Tui	Penyempeng	Ncoha II	Ntonggu II	Fatukmetang	Mataiyang
1	Average of Respon't Age		43	38	50	43	51	44	43	39	43	45
2	No. of Family Member		M-2/F-2	M-2/F-2	M-2/F-3	M-2/F-3	M-2/F-2	M-2/F-2	M-2/F-3	M-2/F-2	M-1/F-2	M-1/F-2
3	No. of Respon't with Side Job		6	7	6	11	7	7	13	13	10	6
4	Own Farmland	ha	0.87	1.10	0.84	1.68	5.15	2.01	2.10	1.33	1.56	2.23
	Rented Farmland	ha	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.00	0.00
	Yield Division	ha	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00
	(Paddy field)	ha	0.95	0.88	0.74	0.41	2.44	1.14	1.13	0.98	0.00	1.08
5	Cropped Area	ha	2.12	1.90	1.49	1.94	4.99	2.60	2.21	2.72	1.22	1.99
	(Paddy)	ha	0.77	1.14	0.69	0.25	2.09	1.18	0.59	1.15	0.00	1.35
	(Palawija)	ha	1.35	0.76	0.80	1.68	2.87	1.43	1.62	1.57	1.22	0.63
	(Others)	ha	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.01
6	Cow/Buffalo	head	3	3	0	0	11	2	5	2	2	3
	Horse	head	0	0	0	0	2	1	0	0	0	1
	Goat/Sheep	head	1	0	1	2	0	0	1	2	1	1
	Pig	head	0	1	0	0	0	0	0	0	3	3
	Chicken/Duck	head	25	18	4	2	2	3	8	10	2	15
7	Gross Income	Rp.'000/yr	3,229.2	2,370.1	2,340.9	2,610.9	4,039.2	2,324.4	2,532.7	3,503.4	1,065.1	1,779.4
	(Production)	Rp.'000/yr	2,561.2	992.2	2,181.2	2,040.3	3,444.6	1,918.4	1,618.0	2,296.5	350.7	1,099.4
	(Livestock)	Rp.'000/yr	269.3	287.2	0.0	13.3	353.3	46.0	139.0	49.3	61.7	99.3
	(Side job)	Rp.'000/yr	398.7	1,090.7	159.7	557.3	241.3	360.0	775.7	1,157.6	652.7	580.7
8	Expenditure	Rp.'000/yr	1,681.6	1,535.2	3,287.0	2,644.4	3,242.9	2,260.0	2,684.2	2,854.4	880.5	1,224.4
	(Food/drink)	Rp.'000/yr	838.6	677.4	1,616.6	1,144.3	1,124.7	955.7	1,067.0	1,338.3	490.0	517.9
	(Living)	Rp.'000/yr	260.4	377.2	467.9	368.6	702.9	590.5	598.3	534.6	276.5	424.6
	(Education)	Rp.'000/yr	35.7	108.4	320.5	701.9	291.0	190.0	351.7	278.4	76.3	161.6
	(Production)	Rp.'000/yr	546.9	372.2	882.0	429.6	1,124.3	523.8	667.2	703.1	37.7	120.3
9	Surplus/Deficit	Rp.'000/yr	1,547.6	834.9	-946.1	-33.5	796.3	64.4	-151.5	649.0	184.6	555.0
10	Saving	Rp.'000/yr	0.0	0.0	129.3	0.0	78.0	0.0	150.8	54.7	0.0	0.0

Source : JICA Study Team

Note : All figures are temporary and yet cross-checked.

Table 4.1 Alternative Cropping Pattern for 10 Representative Project Areas

Unit : %

Project Area	Alternative Pattern	Wet Season		Dry Season			
				1st Crop		2nd Crop	
		Crop	Share	Crop	Share	Crop	Share
Lokok Meniris	C-12	Paddy	100	Paddy	max	-	-
	C-21	Paddy	100	Soybean	100	-	-
	C-22	Paddy	100	Soybean	100	Red onion	max
	C-22	Paddy	100	Soybean	50	Mungbean	max/2
				Mungbean	50	Red onion	max/2
Pelangan	C-12	Paddy	100	Paddy	max	Mungbean	50
	C-21	Paddy	100	Soybean	100	Red onion	50
	C-22	Paddy	100	Soybean	50	Red onion	max/2
				Mungbean	50	Tomato	max/2
	C-23	Paddy	100	Paddy	max	Mungbean	max
Montong Krarak	B-21	Paddy	100	Soybean	50	-	-
				Tobacco	50	-	-
Aik Beta	A-21	Paddy	100	Soybean	50	-	-
				Tobacco	50	-	-
	A-22	Paddy	100	Tobacco	max	Mungbean	max
Tiu Tui	A-12	Paddy	100	Paddy	100	-	-
	A-21	Paddy	100	Soybean	50	-	-
				Mungbean	50	-	-
	A-23	Paddy	100	Paddy	100	Mungbean	max
Penyempeng	C-12	Paddy	100	Paddy	100	-	-
	C-21	Paddy	100	Soybean	100	-	-
	C-22	Paddy	100	Soybean	max	Mungbean	max/2
						Red onion	max/2
	C-23	Paddy	100	Paddy	100	Mungbean	max
Ncoha II	B-12	Paddy	100	Paddy	max	-	-
	B-21	Paddy	100	Mungbean	max	-	-
	B-22	Paddy	100	Mungbean	max	Red onion	max
Ntonggu II	C-12	Paddy	100	Paddy	100	-	-
	C-22	Paddy	100	Mungbean	max	Tomato	max/3
						Cabbage	max/3
						Red onion	max/3
Fatukmetang	A-11	Paddy	100	-	-	-	-
	A-21	Paddy	100	Mungbean	max/2	-	-
				Red onion	max/2	-	-
	A-52			Mango			100
Mataiyang	A-21	Paddy	100	Soybean	50	-	-
				Mungbean	50	-	-
	A-22	Paddy	100	Soybean	max/2	Mungbean	max
				Mungbean	max/2		

Table 4.2 Future Farm Input and Farm Labour Requirements

Item		Q'ty of Unit	NTB Paddy (Irrigated) Wet S'n	NTB Paddy (Irrigated) Dry S'n	NTB Soybean (Irri.) Dry Season	NTB Soybean (Rain.) Dry Season	NTB Mungbean (Irri.) Dry Season	NTB Mungbean (Rain.) Dry Season	NTB Onion (Irri.) Dry S'n	NTT Tobacco (Irri.) Dry Season	NTT Tobacco (Rain.) Dry Season	NTT Paddy (Irri.) Wet S'n	NTT Soybean (Irri.) Dry S'n	NTT M'gbean (Irri.) Dry S'n	NTT Onion (Irri.) Dry S'n
Seed															
Paddy	Certified	kg	25	25	0	0	0	0	0	0	0	25	0	0	0
	Own	kg	0	0	0	0	0	0	0	0	0	0	0	0	0
Soybean	Certified	kg	0	0	20	20	0	0	0	0	0	0	20	0	0
	Own	kg	0	0	20	20	0	0	0	0	0	0	20	0	0
Mungbean	Certified	kg	0	0	0	0	10	10	0	0	0	0	0	10	0
	Own	kg	0	0	0	0	20	20	0	0	0	0	0	20	0
Red onion	Certified	kg	0	0	0	0	0	0	2,000	0.1	0.1	0	0	0	2,000
Fertiliser															
Urea		kg	300	300	50	40	75	60	300	250	200	200	50	50	300
TSP		kg	100	100	100	80	100	80	200	200	160	100	100	100	200
KCl		kg	50	50	50	40	50	40	100	100	80	50	50	50	100
Agro-chemicals															
Insecticide	Lquid	lit	2.0	1.0	2.0	1.5	2.0	2.0	10.0	0.0	0.0	2.0	2.0	2.0	10.0
	Powder	kg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rodenticide		kg	2.0	2.0	1.0	0.5	1.0	1.0	3.0	0.0	0.0	2.0	1.0	1.0	3.0
Labor															
Family		md	172	167	70	60	80	80	151	100	80	172	70	80	151
Hired		md	13	13	0	0	0	0	99	0	0	13	0	0	99
Draft Animal															
Family		ad	20	20	10	10	10	10	20	10	10	20	10	10	20
Tractor		ha	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 4.3 Anticipated Crop Yield in10 Representative Project Areas

Unit : ton/ha

Project Area	Project Status	Wet Season				Dry Season			
		Rainfed		Irrigated		Rainfed		Irrigated	
		Crop	Yield	Crop	Yield	Crop	Yield	Crop	Yield
Lokok Meniris	With	-	-	Paddy	4.50	Soybean	1.10	-	-
						Mungbean	0.95	-	-
	Without	Paddy	2.00	-	-	-	-	-	-
Pelangan	With	-	-	Paddy	4.50	-	-	Paddy	4.50
								Mungbean	1.20
								Red onion	7.50
	Without	Paddy	2.00	Paddy	3.00	Mungbean	0.50	-	-
		Maize	1.30	-	-	-	-	-	-
Montong Krarak	With	-	-	Paddy	4.50	Soybean	1.10	-	-
						Tobacco	3.20	-	-
	Without	Paddy	2.00	-	-	-	-	-	-
Aik Beta	With	-	-	Paddy	4.50	Mungbean	0.95	Mungbean	1.20
						Tobacco	3.20	Tobacco	4.00
	Without	Paddy	2.00	-	-	Tobacco	1.60	-	-
		Maize	1.30	-	-	-	-	-	-
Tiu Tui	With	-	-	Paddy	4.50	-	-	Soybean	1.40
								Mungbean	1.20
								Red onion	7.50
	Without	Paddy	2.00	Paddy	3.00	Soybean	0.60	-	-
		Soybean	0.90	-	-	-	-	-	-
Penyempeng	With	-	-	Paddy	4.50	-	-	Paddy	4.50
								Mungbean	1.20
								Red onion	7.50
	Without	Paddy	2.00	Paddy	3.00	Paddy	1.80	-	-
		Soybean	0.90	-	-	-	-	-	-
Ncoha II	With	-	-	Paddy	4.50	-	-	Mungbean	1.20
								Red onion	7.50
	Without	Paddy	2.00	Paddy	3.00	Mungbean	0.50	-	-
Ntonggu II	With			Paddy	4.50	Mungbean	0.95	Mungbean	1.20
	Without	Paddy	2.00	Paddy	3.00	Soybean	0.60	-	-
Fatukmetang	With	-	-	Paddy	4.00	-	-	Mungbean	1.10
								Red onion	7.50
	Without	Fallow	0.00	-	-	-	-	-	-
Mataiyang	With	-	-	Paddy	4.00	-	-	Soybean	1.20
								Mungbean	1.00
	Without	Paddy	1.50	Paddy	2.20	-	-	-	-
		Maize	0.80	-	-	-	-	-	-

Table 4.4 Annual Unit Diversion Water Requirement

Unit : cubic m/ha

Project Area	Alternative Pattern	Wet Season		Dry Season			
				1st Crop		2nd Crop	
		Crop	UWR*	Crop	UWR*	Crop	UWR*
Lokok Meniris	C-12	Paddy	7,910	Paddy	16,130	-	-
	C-21	Paddy	7,910	Soybean	6,040	-	-
	C-22	Paddy	7,910	Soybean	6,040	Red onion	4,900
	C-22	Paddy	7,910	Soybean	6,040	Mungbean	4,630
				Mungbean	3,320	Red onion	4,900
Pelangan	C-12	Paddy	11,470	Paddy	15,250	Mungbean	2,840
	C-21	Paddy	11,470	Soybean	4,980	Red onion	2,930
	C-22	Paddy	11,470	Soybean	4,980	Red onion	2,930
				Mungbean	2,490	Tomato	6,170
	C-23	Paddy	11,470	Paddy	15,250	Mungbean	2,840
Montong Krarak	B-21	Paddy	11,330	Soybean	5,370	-	-
				Tobacco	5,060	-	-
Aik Beta	A-21	Paddy	10,550	Soybean	6,950	-	-
				Tobacco	6,610	-	-
	A-22	Paddy	10,550	Tobacco	6,610	Mungbean	3,600
Tiu Tui	A-12	Paddy	8,330	Paddy	15,430	-	-
	A-21	Paddy	8,330	Soybean	5,030	-	-
				Mungbean	2,770	-	-
	A-23	Paddy	8,330	Paddy	15,430	Mungbean	3,250
Penyempeng	C-12	Paddy	8,330	Paddy	15,430	-	-
	C-21	Paddy	8,330	Soybean	5,030	-	-
	C-22	Paddy	8,330	Soybean	5,030	Mungbean	3,250
						Red onion	3,380
	C-23	Paddy	8,330	Paddy	15,430	Mungbean	3,250
Ncoha II	B-12	Paddy	8,750	Paddy	14,800	-	-
	B-21	Paddy	8,750	Mungbean	2,620	-	-
	B-22	Paddy	8,750	Mungbean	2,620	Red onion	2,570
Ntonggu II	C-12	Paddy	8,750	Paddy	14,800	-	-
	C-22	Paddy	8,750	Mungbean	2,620	Tomato	5,780
						Cabbage	4,150
						Red onion	2,570
Fatukmetang	A-11	Paddy	9,330	-	-	-	-
	A-21	Paddy	9,330	Mungbean	3,880	-	-
				Red onion	4,310	-	-
	A-52			Mango			19,860
Mataiyang	A-21	Paddy	6,020	Soybean	4430	-	-
				Mungbean	1890	-	-
	A-22	Paddy	6,020	Soybean	4430	Mungbean	2,010
				Mungbean	1890		

Remarks : UWR* ; Unit irrigation water requirement

Table 6.1 Results of Simulation for 10 Representative Project Areas

Unit : ha

Project Area	Alternative Pattern	Dam Height (m)	TSC* ('000 cu.m)	Wet Season		Dry Season			
						1st Crop		2nd Crop	
				Crop	NPI**	Crop	NPI**	Crop	NPI**
Lokok Meniris	C-12	20.0	250	Paddy	44	Paddy	0	-	-
	C-21			Paddy	44	Soybean	0	-	-
	C-22-1			Paddy	44	Soybean	0	Red onion	0
	C-22-2			Paddy	44	Soybean	0	Mungbean	0
						Mungbean	0	Red onion	0
Pelangan	C-12	23.0	2,400	Paddy	248	Paddy	90	-	-
		29.0	4,650	Paddy	248	Paddy	248	-	-
	C-21	23.0	2,400	Paddy	248	Soybean	248	-	-
	C-22	23.0	2,400	Paddy	248	Soybean	248	Red onion	54
								Tomato	54
		25.0	3,250	Paddy	248	Soybean	248	Red onion	124
								Tomato	124
	C-23	23.0	2,400	Paddy	248	Paddy	75	Mungbean	75
		30.0	5,600	Paddy	248	Paddy	248	Mungbean	248
Montong Krarak	B-21	12.0	125	Paddy	44	Soybean	0	-	-
						Tobacco	0	-	-
Aik Beta	A-21	25.0	570	Paddy	57	Soybean	8	-	-
						Tobacco	8	-	-
	A-22	25.0	570	Paddy	57	Tobacco	11	Mungbean	11
Tiu Tui	A-12	16.0	2,325	Paddy	331	Paddy	83	-	-
		19.5	4,300	Paddy	331	Paddy	205	-	-
	A-21	16.0	2,325	Paddy	331	Soybean	165.5	-	-
						Mungbean	165.5	-	-
	A-22	16.0	2,325	Paddy	331	Soybean	90	Mungbean	180
						Mungbean	90	-	-
		19.5	4,300	Paddy	331	Soybean	165.5	Mungbean	331
						Mungbean	165.5	-	-
	A-23	16.0	2,325	Paddy	331	Paddy	70	Mungbean	35
								Red onion	35
		19.5	4,300	Paddy	331	Paddy	175	Mungbean	87.5
								Red onion	87.5
Penyempeng	C-12	28.0	3,100	Paddy	350	Paddy	115	-	-
		38.0	6,700	Paddy	350	Paddy	350	-	-
	C-21	28.0	3,100	Paddy	350	Soybean	350	-	-
	C-22	28.0	3,100	Paddy	350	Soybean	220	Mungbean	110
								Red onion	110
		32.0	4,200	Paddy	350	Soybean	350	Mungbean	175
								Red onion	175
	C-23	28.0	3,100	Paddy	350	Paddy	95	Mungbean	95
		40.0	7,750	Paddy	350	Paddy	350	Mungbean	350
Ncoha II	B-12	22.0	860	Paddy	157	Paddy	30	-	-
		25.0	1,220	Paddy	157	Paddy	54	-	-
	B-21	22.0	860	Paddy	157	Mungbean	157	-	-
	B-22	22.0	860	Paddy	157	Mungbean	95	Red onion	95
		25.0	1,220	Paddy	157	Mungbean	157	Red onion	157
Ntonggu II	C-12	17.0	1,270	Paddy	0	Paddy	0	-	-
	C-22	17.0	1,270	Paddy	0	Mungbean	0	Tomato	0
								Cabbage	0
								Red onion	0
	C-21	17.0	1,270	Paddy	187	Mungbean	65	-	-
Fatukmetang	A-11	15.0	380	Paddy	57	-	-	-	-
	A-21	15.0	380	Paddy	57	Mungbean	7	-	-
						Red onion	7	-	-
		18.0	760	Paddy	57	Mungbean	28.5	-	-
						Red onion	28.5	-	-
	A-52	20.0	1,050			Mango			55
Mataiyang	A-21	20.0	2,160	Paddy	450	Soybean	225	-	-
						Mungbean	225	-	-
	A-22	20.0	2,160	Paddy	450	Soybean	225	Mungbean	450
						Mungbean	225	-	-

Remarks : TSC* ; Total storage capacity of Embung
NPI** ; Net possible irrigation area

Table 6.2 Proposed Cropping Pattern for 10 Representative Project Areas

Unit : %

Project Area	Project Status	Wet Season			Dry Season					
					1st Cropping			2nd Cropping		
		Crop	Watering	Share	Crop	Watering	Share	Crop	Watering	Share
Lokok Meniris	With	Paddy	Irrigated	100	Soybean	Rainfed	50	-	-	-
		-	-	-	Mungbean	Rainfed	50	-	-	-
	Without	Paddy	Rainfed	100	-	-	-	-	-	-
Pelangan	With	Paddy	Irrigated	100	Paddy	Irrigated	100	Mungbean	Irrigated	50
		-	-	-	-	-	-	Red onion	Irrigated	50
	Without	Paddy	Irrigated	35	Mungbean	Rainfed	10	-	-	-
		Paddy	Rainfed	52	-	-	-	-	-	-
		Maize	Rainfed	1	-	-	-	-	-	-
		Fallow	-	12	-	-	-	-	-	-
Montong Krarak	With	Paddy	Irrigated	100	Soybean	Rainfed	50	-	-	-
		-	-	-	Tobacco	Rainfed	50	-	-	-
	Without	Paddy	Rainfed	100	-	-	-	-	-	-
Aik Beta	With	Paddy	Irrigated	100	Mungbean	Irrigated	13	-	-	-
		-	-	-	Tobacco	Irrigated	13	-	-	-
		-	-	-	Mungbean	Rainfed	37	-	-	-
		-	-	-	Tobacco	Rainfed	37	-	-	-
	Without	Paddy	Rainfed	69	Tobacco	Rainfed	18	-	-	-
		Maize	Rainfed	31	-	-	-	-	-	-
Tiu Tui	With	Paddy	Irrigated	100	Soybean	Irrigated	50	Mungbean	Irrigated	50
		-	-	-	Mungbean	Irrigated	50	Red onion	Irrigated	50
	Without	Paddy	Irrigated	10	Soybean	Rainfed	3	-	-	-
		Paddy	Rainfed	83	-	-	-	-	-	-
		Soybean	Rainfed	7	-	-	-	-	-	-
Penyempeng	With	Paddy	Irrigated	100	Paddy	Irrigated	100	Mungbean	Irrigated	50
		-	-	-	-	-	-	Red onion	Irrigated	50
	Without	Paddy	Irrigated	24	Paddy	Rainfed	24	-	-	-
		Paddy	Rainfed	39	-	-	-	-	-	-
		Soybean	Rainfed	37	-	-	-	-	-	-
Ncoha II	With	Paddy	Irrigated	100	Mungbean	Irrigated	50	-	-	-
		-	-	-	Red onion	Irrigated	50	-	-	-
	Without	Paddy	Irrigated	26	Mungbean	Rainfed	13	-	-	-
		Paddy	Rainfed	74	-	-	-	-	-	-
Ntonggu II	With	Paddy	Irrigated	100	Mungbean	Irrigated	35	-	-	-
		-	-	-	Mungbean	Rainfed	65	-	-	-
	Without	Paddy	Irrigated	65	Soybean	Rainfed	5	-	-	-
		Paddy	Rainfed	35	-	-	-	-	-	-
Fatukmetang	With	Paddy	Irrigated	100	Mungbean	Irrigated	50	-	-	-
		-	-	-	Red onion	Irrigated	50	-	-	-
	Without	Fallow		100	-	-	-	-	-	-
Mataiyang	With	Paddy	Irrigated	100	Soybean	Irrigated	50	Mungbean	Irrigated	50
		-	-	-	Mungbean	Irrigated	50	Soybean	Irrigated	50
	Without	Paddy	Irrigated	13	-	-	-	-	-	-
		Paddy	Rainfed	84	-	-	-	-	-	-
		Maize	Rainfed	3	-	-	-	-	-	-

Table 7.1 Main Features of Embungs

Item		Lombok Island				Sumbawa Island				Timor Island	Sumba Island
		(1) Lokok Meniris	(2) Pelangan	(3) Montong Krarak	(4) Aik Beta	(5) Tiu Tui	(6) Penyempeng	(7) Ncoha II	(8) Ntonggu II	(9) Faukmetang	(10) Mataiyang
I. Reservoir											
- Catchment Area	km2	7.4	46.0	5.4	22.4	21.2	41.1	12.6	6.2	4.0	19.1
- Reservoir Area	km2	0.05	0.58	0.04	0.08	0.64	0.55	0.13	0.23	0.17	0.30
- Full Supply Level	EL	EL.86.70	EL.41.00	EL.205.00	EL.219.00	EL.32.20	EL.83.00	EL.49.00	EL.66.00	EL.50.00	EL.594.00
- Minimum Operation Level	EL	EL.82.10	EL.26.80	EL.202.90	EL.213.90	EL.22.10	EL.60.00	EL.36.90	EL.58.30	EL.41.50	EL.585.50
- Total Storage Capacity	m3	281,000	5,700,000	125,000	570,000	4,300,000	7,750,000	1,220,000	1,270,000	920,000	2,160,000
- Dead Storage Capacity	m3	116,000	660,000	63,000	261,000	338,000	550,000	196,000	111,000	80,000	328,000
- Effective Storage Capacity	m3	165,000	5,040,000	62,000	309,000	3,962,000	7,200,000	1,024,000	1,159,000	840,000	1,832,000
II. Main Dam											
- TYpe of Dam		Zone Type	Zone Type	Masonry Gravity	Masonry Gravity	Zone Type	Zone Type	Zone Type	Homo-Earthfill	Homo-Earthfill	Zone Type
- Height from River Bed	m	20.0	29.5	12.0	25.0	19.5	39.0	25.0	17.0	19.0	20.0
- Crest Elevation	EL	EL.90.00	EL. 45.50	EL207.00	EL.223.00	EL.36.00	EL.87.50	EL.52.00	EL.70.00	EL. 54.00	El. 598.00
- Crest Length	m	200.0	360.0	210.0	470.0	230.0	360.0	400.0	260.0	370.0	240.0
- Crest Width	m	7.0	9.0	4.0	5.0	7.0	10.0	7.0	7.0	7.0	7.0
- Upstream Slope		1 : 2.5	1 : 2.5	1 : 0.5	1 : 0.5	1 : 2.5	1 : 2.5	1 : 2.5	1 : 4.0	1 : 4.0	1 : 2.5
- Downstream Slope		1 : 2.0	1 : 2.0	1 : 1.0	1 : 1.0	1 : 2.0	1 : 2.0	1 : 2.0	1 : 3.5	1 : 3.5	1 : 2.0
III. Spillway											
- Design Flood (100 years)	m3	159.0	522.0	35.0	330.0	323.0	411.0	107.0	106.0	77.0	231.0
- Type		Side Cahannl	Side Channel	Overflow weir	Overflow weir	Side Channel	Side Channel	Side Channel	Side Channel	Side Channel	Side Channel
- Width of Overflow Weir	m	40.0	73.0	35.0	53.0	52.0	85.0	50.0	20.0	13.0	38.0
- Width of Throughway	m	10.0	15.0	-	-	10.0	15.0	10.0	20.0	13.0	15.0
- Lengh of Throughway	m	141.5	223.0	-	-	140.0	305.0	360.0	160.0	210.0	140.0
IV. River Diversion											
- Design Flood (5 years in dry season	m3	40.0	280.0	24.0	192.0	184.0	234.0	73.0	73.0	44.0	164.0
- Type		Diversion Tunnel	Open channel	By-pass conduit	By-pass conduit	Open channel	Diversion Tunnel	Open channel	Open channel	Open channel	Diversion Tunnel
- Size		D=2.6 m	20*5 m	1.5*1.5 m	2.0*2.0 m	15*4 m	D=5.0 m	10*4 m	10*4 m	D=3.0 m	D=3.0 m
- Length	m	62.5	300.0	15.0	30.0	200.0	430.0	250.0	170.0	120.0	140.0
V. Outlet works											
- Design discharge	Lit	60.0	500.0	60.0	110.0	350.0	900.0	160.0	200.0	70.0	400.0
- Size		D=160 mm	D=500 mm	D=160 mm	D=250 mm	D=400 mm	D=620 mm	D=260 mm	D=300 mm	D=160 mm	D=450 mm
VI. Foundation Treatment											
- Condition		Rock	Weathered Rock	Rock	Rock	Weathered Rock	Rock	Rock	Weathered Rock	Weathered Rock	Rock
- Treatment Method		Grout	Grout	-	-	Cut-off	Grout	Cut-off	Cut-off	Cut-off	Grout

Table 7.2 Main Features of Water Distribution Facilities

Item		Pelangan	Fakukmetang	Mataiyang
Annual Water demand	1000 m3/year	174.60	28.70	153.20
Design discharge	lit./sec	5.50	0.90	4.90
Required length of pipes				
Dia. 150 mm	km	7.50		0.10
Dia. 75 mm	km		3.90	
Total	km	7.50	3.90	0.10
Required related facilities				
Check valve	Nos.	4	1	
Air valve	Nos.	4		
Blow off	Nos.	3	2	
Division box for inhabitants	Nos.	38	22	
Division box for livestock	Nos.		22	
Total	Nos.	49	47	0

Table 7.3 Main Features of Irrigation Facilities

Item		Lombok				Sumbawa				Timor	Sumba
		Lokok Menins	Pelangan	Montong Karak	Aik Beta	Tiu Tui	Penyempeng	Ncoha II	Ntonggu II	Fatuknetiang	Mataiyang
- Irrigation inlet box	Nos.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
- Canal Length											
- Canal Type		Masonry flume	Masonry	Masonry flume	Concrete flume	Masonry	Masonry	Masonry	Masonry	Concrete flume	Masonry
- Canal to be newly constructed	km	1.80	-	-	5.50	1.20	8.20	3.00	5.40	2.20	11.00
- Canal to be rehabilitated	km	1.80	11.70	2.96	-	3.50	1.10	1.20	-	-	-
- Numbers of Structures											
- Turnout	Nos.	1		1	2	1	3	3	2		2
- Siphon	Nos.						1	1	1		3
- Aqueduct						1			1		
- Cross Drain	Nos.	1						1	1	4	2
- Irrigation Division Box	Nos.	15			43	22	82	29	54	22	110
- Livestock Division Box	Nos.					5			14		
Total		17	0	1	45	29	86	34	73	26	117

Table 9.1 Summary of Project Cost

Item	Lombok				Sumbawa				Timor	Sumba
	Lokok Meniris	Pelangan	Montong Krarak	Aik Beta	Tiu Tui	Penyempeng	Ncoha II	Ntonggo II	Fatukmetang	Mataiyang
I. Direct Construction Cost	2,617	12,982	1,472	9,188	5,994	13,889	8,526	6,165	10,430	10,155
1.1 Preparatory Works	125	618	70	438	285	661	406	294	497	484
1.2 Dam Construction										
1) Main dam	895	6,713	1,118	7,586	2,836	6,030	4,251	2,471	5,529	2,178
2) Spillway	1,085	3,857	0	0	2,146	3,036	2,846	2,428	2,951	3,696
3) Diversion Tunnel	83	0	0	0	0	1,063	0	0	0	265
4) Seepage protection works	0	0	0	0	0	0	0	0	0	1,228
5) Miscellaneous	206	1,057	112	759	498	1,519	710	490	848	1,105
Sub-total of 1.2	2,269	11,627	1,230	8,345	5,480	11,648	7,807	5,389	9,328	8,472
1.3 Irrigation Facilities	190	114	163	405	229	1,477	313	425	187	1,159
1.4 Domestic Water Supply	0	623	0	0	0	0	0	0	284	4
1.5 Dam Operation and Maintenance Road	33	0	9	0	0	103	0	57	134	36
II. Administration Cost	131	649	74	459	300	694	426	308	521	508
III. Engineering Services	392	1,947	221	1,378	899	2,083	1,279	925	1,564	1,523
Sub-total of I, II & III	3,140	15,579	1,767	11,025	7,193	16,667	10,231	7,397	12,516	12,185
IV. Physical Contingency	471	2,337	265	1,654	1,079	2,500	1,535	1,110	1,877	1,828
Sub-total of I, II, II, & IV	3,611	17,915	2,031	12,679	8,272	19,167	11,766	8,507	14,393	14,013
V. Contract Tax	348	1,727	196	1,222	797	1,847	1,134	820	1,387	1,351
VI. Land Acquisition Cost	13	65	7	46	30	69	43	31	52	51
Sub-total I, II, III, IV, V & VI	3,972	19,707	2,235	13,947	9,100	21,084	12,942	9,358	15,832	15,415
VII. Price Contingency	794	3,941	447	2,789	1,820	4,217	2,588	1,872	3,166	3,083
GRAND TOTAL	4,766	23,648	2,682	16,736	10,919	25,301	15,531	11,229	18,999	18,498

Table 10.1 Economic Construction Costs and Annual Disbursement Schedule

(Unit : Rp. million)

Item	SCF	Lokok Meniris	Pelangan	Montong Krarak	Aik Beta	Tiu Tui	Penyempeng	Ncoha II	Ntonggu II	Fatukmetang	Mataiyang
1 Direct Construction Cost		1,711	8,466	968	5,985	3,902	8,783	5,549	4,029	6,804	6,425
1) Preparatory Works	0.71	89	439	52	311	202	469	288	209	353	343
2) Dam Construction											
- Main dam	0.71	635	4,766	794	5,386	2,013	4,281	3,018	1,754	3,926	1,546
- Spillway	0.71	770	2,738	0	0	1,524	2,156	2,021	1,724	2,095	2,624
- Diversion tunnel	0.71	59	0	0	0	0	755	0	0	0	188
- Seepage protection works	0.71	0	0	0	0	0	0	0	0	0	872
Sub-total		1,464	7,504	794	5,386	3,537	7,192	5,039	3,478	6,021	5,230
3) Irrigation Facilities	0.71	135	81	116	288	163	1,049	222	302	133	823
4) Domestic Water Supply System	0.71	0	442	0	0	0	0	0	0	202	3
5) Dam O & M Road	0.71	23	0	6	0	0	73	0	40	95	26
2 Administration Cost	0.90	118	584	68	413	270	625	383	277	469	457
3 Engineering Services	0.90	163	805	95	569	371	501	528	383	647	607
4 Physical Contingency		257	1,270	150	898	585	1,317	833	598	1,021	964
Total		2,249	11,125	1,281	7,865	5,128	11,226	7,293	5,287	8,941	8,453
5 Annual Disbursement of Cost											
1st year		135	591	112	417	272	537	386	281	475	392
2nd year		2,114	4,733	1,169	3,818	2,119	2,498	3,049	2,146	3,830	1,422
3rd year		0	5,801	0	3,630	2,737	4,223	3,858	2,860	4,636	3,183
4th year		0	0	0	0	0	4,302	0	0	0	3,456

Note : Standard Conversion Factors (SFC). Source ; Pedoman Pengamatan dan Evaluasi Proyek-Proyek Pengairan, Direktorato Jeneral Pengairan, 1985.

Table 10.2 Economic Price Structures of Paddy

	Item	Nation		Region			
		Operation	US$/ton	Lombok Rp./kg	Sumbawa Rp./kg	Flores & Sumba Rp./kg	West Timor Rp./kg
Import Parity							
1	Export price, FOB Bangkok, 2005 *1						
	(1990 constant price) *2		267				
2	Adjusted to 1994 constant price	x 1.0603	283				
3	Quality adjusment	x 0.9	255				
4	Freight and insurance						
	(Bangkok-Surabaya)	+	35				
5	CIF Surabaya		290				
6	Convert to Rupiah *3	x 2,160		626.4	626.4	626.4	626.4
7	Port handling, storage and losses	x 0.05 +		31.3	31.3	31.3	31.3
8	Transportation (Port to wholesaler at Surabaya)	+		25.0	30.0	35.0	40.0
9	Ex-wholesaler (Surabaya)			682.7	687.7	692.7	697.7
10	Handling and transportation						
	(Wholesaler to project area)	-		6.0	7.5	9.0	10.5
11	Ex-mill price			676.7	680.2	683.7	687.2
12	Conversion to paddy	x 0.68		460.2	462.5	464.9	467.3
13	By-products						
	(Rice bran : 20% of paddy x Rp.100/kg)	+		20.0	20.0	20.0	20.0
14	Milling charge	-		15.0	15.0	15.0	15.0
15	Local transportation (Farm to mill)	-		6.0	7.5	9.0	10.5
16	Economic farm gate price			459.2	460.0	460.9	461.8
	(Rounded)			459.0	460.0	461.0	462.0
Export Parity							
1	Thai 5% broken, FOB Bangkok, 2005 *1						
	(1990 constant price) *2		267				
2	Adjusted to 1994 constant price	x 1.0603	283				
3	Quality adjusment	x 0.9	255				
4	Freight and insurance						
	(Bangkok-Surabaya)						
5	CIF Surabaya		255				
6	Convert to Rupiah *3	x 2,160		550.8	550.8	550.8	550.8
7	Port handling, storage and losses	x 0.05 -		27.5	27.5	27.5	27.5
8	Transportation (Port to wholesaler at Surabaya)	-		25.0	30.0	35.0	40.0
9	Ex-wholesaler (Surabaya)			498.3	493.3	488.3	483.3
10	Handling and transportation						
	(Wholesaler to project area)	-		6.0	7.5	9.0	10.5
11	Ex-mill price			492.3	485.8	479.3	472.8
12	Conversion to paddy	x 0.68		334.7	330.3	325.9	321.5
13	By-products						
	(Rice bran : 20% of paddy x Rp.100/kg)	+		20.0	20.0	20.0	20.0
14	Milling charge	-		15.0	15.0	15.0	15.0
15	Local transportation (Farm to mill)	-		6.0	7.5	9.0	10.5
16	Economic farm gate price			333.7	327.8	321.9	316.0
	(Rounded)			334.0	328.0	322.0	316.0
	Average economic farm gate price of import and export parity			397.0	394.0	392.0	389.0

Remarks : *1 : Projected price in 2005 at 1990 constant price

Source : The World Bank, Commodity Markets and the Developing Countries - A World Bank Quarterly, August 1994

*2 : Thai, white, milled, 5% broken, government standard, Board of Trade-posted price, FOB Bangkok

*3 : Exchange rate : US$ 1.00 = Rp. 2,160

Table 10.3 Economic Price Structures of Maize

	Item	Nation		Region			
		Operation	US$/ton	Lombok Rp./kg	Sumbawa Rp./kg	Flores & Sumba Rp./kg	West Timor Rp./kg
Import Parity							
1	Export price, FOB Gulf ports, 2005 *1						
	(1990 constant price) *2		90				
2	Adjusted to 1994 constant price	x 1.0603	95				
3	Freight and insurance						
	(Gulf ports-Surabaya)	+	40				
4	CIF Surabaya		135				
5	Convert to Rupiah *3	x 2.160		292.5	292.5	292.5	292.5
6	Port handling, storage and losses	x 0.05 +		14.6	14.6	14.6	14.6
7	Transportation (Port to wholesaler at Surabaya)	+		5.5	5.5	5.5	5.5
8	Ex-wholesaler (Surabaya)			312.6	312.6	312.6	312.6
9	Handling and transportation						
	(Surabaya to local wholesaler)	-		20.0	25.0	30.0	35.0
10	Ex-local wholesaler price						
11	Local transportation and handling losses	-		12.0	12.0	12.0	12.0
12	Economic farm gate price			280.6	275.6	270.6	265.6
	(Rounded)			281.0	276.0	271.0	266.0
Export Parity							
1	Export price, FOB Gulf ports, 2005 *1						
	(1990) constant price) *2		90				
2	Adjusted to 1994 constant price	x 1.0603	95				
3	Freight and insurance						
	(Gulf ports-Surabaya)						
4	CIF Surabaya		95				
5	Convert to Rupiah *3	x 2,160		206.1	206.1	206.1	206.1
6	Port handling, storage and losses	x 0.05 -		10.3	10.3	10.3	10.3
7	Transportation (Port to wholesaler at Surabaya)	-		5.5	5.5	5.5	5.5
8	Ex-wholesaler (Surabaya)			190.3	190.3	190.3	190.3
9	Handling and transportation						
	(Surabaya to local-wholesaler)	-		20.0	25.0	30.0	35.0
10	Ex-local wholesaler price						
11	Local transportation and handling losses	-		12.0	12.0	12.0	12.0
12	Economic farm gate price			158.3	153.3	148.3	143.3
	(Rounded)			158.0	153.0	148.0	143.0
	Average economic farm gate price of import and export parity			220.0	215.0	210.0	205.0

Remarks : *1 ; Projected price in 2005 at 1990 constant price

Source : The World Bank, Commodity Markets and the Developing Countries - A World Bank Quarterly, August 1994

*2 : US, No. 2, yellow, FOB Gulf ports

*3 : Exchange rate : US$ 1.00 = Rp. 2,160

Table 10.4 Economic Price Structures of Palawija Crops (1/2)

	Item	Nation			Region			
		Operation	US$/ton	Rp./kg	Lombok Rp./kg	Sumbawa Rp./kg	Flores & Sumba Rp./kg	West Timor Rp./kg
Mungbeans								
1	Import price, CIF Jakarta *1		427					
2	Adjusted to 1994 constant price	x 1.00	427					
3	Convert to Rupiah *2	x 2,160		922.3				
4	Port handling, storage and losses	x 0.05 +		46.1				
5	Transportation							
	(Port to wholesaler at Jakarta)	+		5.5				
6	Ex-wholesaler price (Jakarta)			973.9				
7	Transportation							
	(Jakarta to local wholesaler)	-			25.0	30.0	35.0	40.0
8	Port handling and storage							
	(Local wholesaler)	-			11.0	11.0	11.0	11.0
9	Handling and transportation							
	(Local wholesaler to project area)	-			20.0	20.0	20.0	20.0
10	Local transport and handling losses	-			12.0	12.0	12.0	12.0
11	Economic farm gate price				905.9	900.9	895.9	890.9
	(Rounded)				906.0	901.0	896.0	890.0
Soybeans								
1	Export price, FOB Rotterdam *3		247					
2	Adjusted to 1994 constant price	x 1.0603	262					
3	Freight and insurance							
	(Rotterdam-Surabaya)	+	35					
4	CIF Surabaya		297					
5	Convert to Rupiah *2	x 2,160		641.3				
6	Port handling, storage and losses	x 0.05 +		32.1				
7	Transport to wholesaler							
	(Port to wholesaler at Surabaya)	+		5.5				
8	Ex-wholesaler price (Surabaya)			678.9				
9	Handling and transportation							
	(Wholesaler to project area)	-			20.0	25.0	30.0	35.0
10	Local transport and handling losses	-			12.0	12.0	12.0	12.0
11	Economic farm gate price				646.9	641.9	636.9	631.9
	(Rounded)				647.0	642.0	637.0	632.0

Remarks : *1 : Estimated on the basis of CIF Jakarta prices for the last five years

*2 : US$ 1.00 = Rp. 2,160

*3 : Projected price in 2005 at 1990 constant price

Table 10.4 Economic Price Structures of Palawija Crops (2/2)

	Item	Nation			Region			
		Operation	US$/ton	Rp./kg	Lombok Rp./kg	Sumbawa Rp./kg	Flores & Sumba Rp./kg	West Timor Rp./kg
Red Onion								
1	*Import price, CIF Jakarta *1*		338					
2	Adjusted to 1994 constant price	x 1.00	338					
3	Convert to Rupiah *2	x 2,160		730.1				
4	Port handling, storage and losses	x 0.05 +		36.5				
5	Transportation							
	(Port to wholesaler at Jakarta)	+		5.5				
6	Ex-wholesaler price (Jakarta)			772.1				
7	Transportation							
	(Jakarta to local wholesaler)	-			25.0	30.0	35.0	40.0
8	Port handling and storage							
	(Local wholesaler)	-			11.0	11.0	11.0	11.0
9	Handling and transportation							
	(Local wholesaler to project area)	-			20.0	20.0	20.0	20.0
10	Local transport and handling losses	-			12.0	12.0	12.0	12.0
11	Economic farm gate price				704.1	699.1	694.1	689.1
	(Rounded)				704.0	699.0	694.0	689.0
Tobacco								
1	Export price, FOB Bombay *3		1,725					
2	Adjusted to 1994 constant price	x 1.0603	1,829					
3	Freight and insurance							
	(Bombay-Surabaya)	+	35					
4	CIF Surabaya		1,864					
5	Convert to Rupiah *2	x 2,160		4,026.3				
6	Port handling, storage and losses	x 0.05 +		201.3				
7	Transport to wholesaler							
	(Port to wholesaler at Surabaya)	+		15.0				
8	Ex-wholesaler price (Surabaya)			4,242.6				
9	Handling and transportation							
	(Wholesaler to project area)	-			50.0	60.0	70.0	80.0
10	Local transport and handling losses	-			12.0	12.0	12.0	12.0
11	Economic farm gate price (fermented leaf)				4,180.6	4,170.6	4,160.6	4,150.6
12	Economic farm gate price (fresh leaf)				522.6	521.3	520.0	518.8
	(Rounded)				522.0	521.0	520.0	519.0

Remarks : *1 : Estimated on the basis of CIF Jakarta prices for the last five years

*2 : US$ 1.00 = Rp. 2,160

*3 : Projected price in 2005 at 1990 constant price

Table 10.5 Economic Price Structures of Fertilizer

	Item	Nation		Region			
		Operation	US$/ton	Lombok Rp./kg	Sumbawa Rp./kg	Flores & Sumba Rp./kg	West Timor Rp./kg
Urea							
1	Export price FOB Europe, bagged *1		140				
2	Adjusted to 1994 constant price	x 1.0603	148				
3	Transport premium	+	15				
4	CIF Palembang		163				
5	Conversion to Rupiah *2	x 2,160		353.0	353.0	353.0	353.0
6	Transportation to Surabaya	+		8.0	8.0	8.0	8.0
7	Port handling, storage and losses	+		23.0	23.0	23.0	23.0
8	Handling and transportation to project area	+		30.0	35.0	40.0	45.0
9	Economic price of bagged urea at farm gate			414.0	419.0	424.0	429.0
	(Rounded)			414.0	419.0	424.0	429.0
TSP							
1	Export price, FOB US Gulf, bulk *1		129				
2	Adjusted to 1994 constant price	x 1.0603	137				
3	Freight and insurance (US Gulf-Surabaya)	+	55				
4	CIF Surabaya		192				
5	Conversion to Rupiah *2	x 2,160		414.2	414.2	414.2	414.2
6	Port handling, storage and losses	+		30.0	35.0	40.0	45.0
7	Bagging at Surabaya	+		12.0	12.0	12.0	12.0
8	Handling and transportation to project area	+		30.0	30.0	30.0	30.0
9	Economic cprice of bagged TSP at farm gate			486.2	491.2	496.2	501.2
	(Rounded)			486.0	491.0	496.0	501.0
Potassium Chloride (KCl)							
1	Export price, FOB, Vancouver, bulk *1		103				
2	Adjusted to 1994 constant price	x 1.0603	109				
3	Freight and insurance (Vancouver-Surabaya)	+	50				
4	CIF Surabaya		159				
5	Conversion to Rupiah *2	x 2,160		343.9	343.9	343.9	343.9
6	Port handling, storage and losses	+		30.0	35.0	40.0	45.0
7	Bagging at Surabaya	+		12.0	12.0	12.0	12.0
8	Handling and transportation to project area	+		30.0	30.0	30.0	30.0
9	Economic price of bagged KCl at farm gate			415.9	420.9	425.9	430.9
	(Rounded)			416.0	421.0	426.0	431.0

Remarks : *1 ; Projected price in 2005 at 1994 constant price

Source : The World Bank, Commodity Markets and the Developing Countries, A World Bank Quarterly, August 1994

*2 ; US$ 1.00 = Rp. 2,160

Table 10.6 Financial and Economic Prices of Farm Inputs and Outputs

Item		Unit	Lombok		Sumbawa		Flores & Sumba		West Timor	
			Financial Price *1	Economic Price *2	Financial Price *1	Economic Price *2	Financial Price *1	Economic Price *2	Financial Price *1	Economic Price *2
1 Farm Products										
Paddy *3		kg	280	397	260	394	325	392	325	389
Maize *3		kg	200	220	200	215	200	210	200	205
Soybeans *3		kg	900	647	900	642	900	637	900	632
Mungbeans *3		kg	1,000	906	1,000	901	1,000	896	1,000	890
Red onion *4		kg	900	704	800	699	1,500	694	1,500	689
Tobacco *5		kg	900	522	900	521	900	520	900	519
2 Seeds										
Paddy	Certified	kg	605	605	605	605	537	605	537	605
	Own	kg	-	325	-	325	-	325	-	325
Maize	Certified	kg	922	922	922	922	533	922	533	922
	Own	kg	-	297	-	297	-	297	-	297
Soybeans	Certified	kg	617	617	617	617	810	617	810	617
	Own	kg	-	606	-	606	-	606	-	606
Mungbeans	Certified	kg	1,383	1,383	1,383	1,383	1,170	1,383	1,170	1,383
	Own	kg	-	893	-	893	-	893	-	893
Red onion		kg	850	850	850	850	850	850	850	850
Tobacco		kg	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
3 Fertilisers										
Urea		kg	350	414	350	419	350	424	350	429
TSP		kg	400	486	400	491	400	496	400	501
KCl		kg	400	416	400	421	400	426	400	431
4 Agro-chemicals										
Insecticides	Liquid type	lit	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
	Powder type	kg	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Rodenticides		kg	5,500	5,500	5,500	5,500	5,500	5,500	5,500	5,500
5 Labour										
Hired labour *6		man-day	3,000	2,250	2,500	1,875	2,000	1,500	2,000	1,500
Family labour		man-day	-	2,250	-	1,875	-	1,500	-	1,500
6 Draft Animal										
Hired		head-day	6,000	6,000	5,000	5,000	5,000	5,000	5,000	5,000
Own		head-day	-	6,000	-	5,000	-	5,000	-	5,000
7 Farm Machinery										
Tractor		ha	250,000	250,000	200,000	200,000	200,000	200,000	200,000	200,000

Remarks : *1 : As of 1994

*2 : Projected prices in 2005 at 1994 constant prices

*3 : Dry grain

*4 : Fresh

*5 : Fresh leaves

*6 : Economic conversionfactor is 0.75.

Table 10.7 Economic Crop Budget per Ha

Unit : Rp./ha

Crop	Crop Season	Watering Condition	Without Project			With Project		
			Gross Production Value	Production Cost	Net Production Value	Gross Production Value	Production Cost	Net Production Value
1 Lombok								
1) Paddy	Wet	Rainfed	794,000	339,150	454,850	-	-	-
	Wet	Irrigated	1,191,000	640,410	550,590	1,786,500	775,975	1,010,525
	Dry	Irrigated	-	-	-	1,786,500	754,725	1,031,775
2) Maize	Wet	Rainfed	286,000	157,550	128,450	-	-	-
3) Soybean	Dry	Rainfed	-	-	-	711,700	309,290	402,410
	Dry	Irrigated	-	-	-	905,800	357,560	548,240
4) Mungbean	Dry	Rainfed	453,000	165,985	287,015	860,700	377,550	483,150
	Dry	Irrigated	-	-	-	1,087,200	397,640	689,560
5) Red onion	Dry	Irrigated	-	-	-	5,280,000	2,762,000	2,518,000
6) Tobacco	Dry	Rainfed	835,200	250,400	584,800	1,670,400	436,340	1,234,060
	Dry	Irrigated	-	-	-	2,088,000	529,800	1,558,200
2 Sumbawa								
1) Paddy	Wet	Rainfed	788,000	302,025	485,975	-	-	-
	Wet	Irrigated	1,182,000	569,585	612,415	1,773,000	688,850	1,084,150
	Dry	Rainfed	709,200	292,650	416,550	-	-	-
	Dry	Irrigated	-	-	-	1,773,000	669,475	1,103,525
2) Soybean	Wet	Rainfed	577,800	166,775	411,025	-	-	-
	Dry	Rainfed	385,200	98,290	286,910	-	-	-
	Dry	Irrigated	-	-	-	898,800	322,310	576,490
3) Mungbean	Dry	Rainfed	450,500	108,625	341,875	855,950	338,450	517,500
	Dry	Irrigated	-	-	-	1,081,200	358,765	722,435
4) Red onion	Dry	Irrigated	-	-	-	5,242,500	2,651,250	2,591,250
3 West Timor								
1) Paddy	Dry	Irrigated	-	-	-	1,556,000	581,075	974,925
2) Mungbean	Dry	Irrigated	-	-	-	979,000	320,290	658,710
3) Red onion	Dry	Irrigated	-	-	-	5,167,500	2,563,500	2,604,000
4 Flores & Sumba								
1) Paddy	Wet	Rainfed	588,000	253,700	334,300	-	-	-
	Wet	Irrigated	862,400	421,170	441,230	1,568,000	579,325	988,675
2) Maize	Wet	Rainfed	509,600	107,900	401,700	-	-	-
3) Soybean	Dry	Irrigated	-	-	-	764,400	318,120	446,280
4) Mungbean	Dry	Irrigated	-	-	-	896,000	319,290	576,710

Table 10.8 Increment Net Production Value

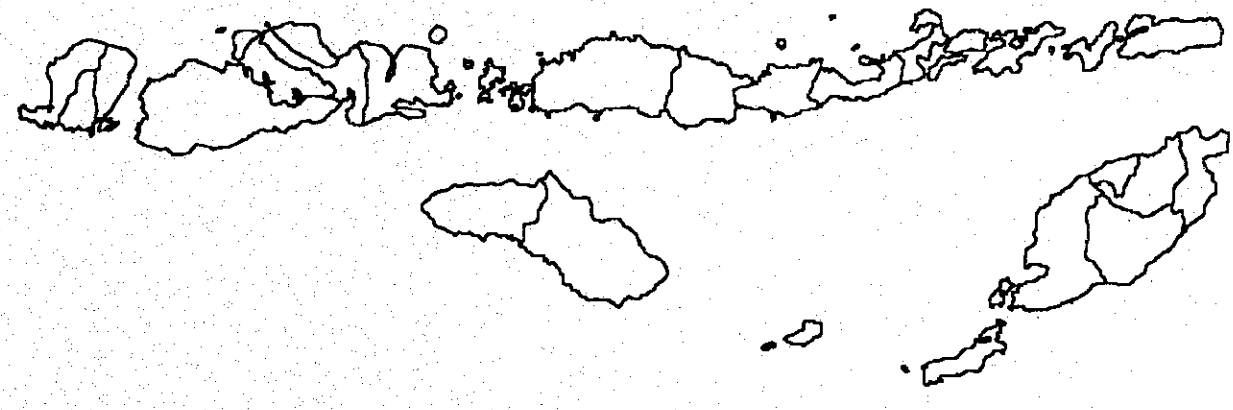
Crop	Crop Season	Watering Condition	Without Project: Lokok Meniris	Pelangan	Montong Krarak	Aik Beta	Tiu Tui	Penyempeng	Ncoha II	Ntonggu II	Farukmetang	Mataiyang	With Project: Lokok Meniris	Pelangan	Montong Krarak	Aik Beta	Tiu Tui	Penyempeng	Ncoha II	Ntonggu II	Farukmetang	Mataiyang
1 Harvested Area (ha)																						
1) Paddy	Wet	Irrigated	-	86.0	-	-	33.0	86.0	40.0	122.0	-	57.0	44.0	248.0	44.0	84.0	331.0	350.0	157.0	187.0	57.0	450.0
	Wet	Rainfed	44.0	130.0	44.0	58.0	274.0	135.0	117.0	65.0	-	380.0	-	-	-	-	-	-	-	-	-	-
	Dry	Irrigated	-	-	-	-	-	-	-	-	-	-	-	248.0	-	-	-	350.0	-	-	-	-
	Dry	Rainfed	-	-	-	-	-	86.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2) Maize	Wet	Rainfed	-	3.0	-	26.0	-	-	-	-	-	13.0	-	-	-	-	-	-	-	-	-	-
3) Soybean	Wet	Rainfed	-	-	-	-	24.0	129.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Dry	Irrigated	-	-	-	-	-	-	-	-	-	-	-	-	-	-	165.5	-	-	-	-	450.0
	Dry	Rainfed	-	-	-	-	10.0	-	-	10.0	-	-	22.0	-	22.0	-	-	-	-	-	-	-
4) Mungbean	Dry	Irrigated	-	-	-	-	-	-	-	-	-	-	-	124.0	-	11.0	331.0	175.0	157.0	65.0	28.5	450.0
	Dry	Rainfed	-	26.0	-	-	-	-	20.0	-	-	-	22.0	-	-	31.0	-	-	-	122.0	-	-
5) Red onion	Dry	Irrigated	-	-	-	-	-	-	-	-	-	-	-	124.0	-	-	165.5	175.0	157.0	-	28.5	-
6) Tobacco	Dry	Irrigated	-	-	-	-	-	-	-	-	-	-	-	-	-	11.0	-	-	-	-	-	-
	Dry	Rainfed	-	-	-	15.0	-	-	-	-	-	-	-	-	22.0	31.0	-	-	-	-	-	-
7) Fallow			-	29.0	-	-	-	-	-	-	57.0	-	-	-	-	-	-	-	-	-	-	-
2 Unit Net Production Value (Rp.'000/ha)																						
1) Paddy	Wet	Irrigated	-	550.6	-	-	612.4	612.4	612.4	612.4	-	441.2	1,010.5	1,010.5	1,010.5	1,010.5	1,084.2	1,084.2	1,084.2	1,084.2	974.9	988.7
	Wet	Rainfed	454.9	454.9	454.9	454.9	486.0	486.0	486.0	486.0	-	334.3	-	-	-	-	-	-	-	-	-	-
	Dry	Irrigated	-	-	-	-	-	-	-	-	-	-	-	1,031.8	-	-	-	1103.5	-	-	-	-
	Dry	Rainfed	-	-	-	-	-	416.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2) Maize	Wet	Rainfed	-	128.5	-	128.5	-	-	-	-	-	401.7	-	-	-	-	-	-	-	-	-	-
3) Soybean	Wet	Rainfed	-	-	-	-	411.0	411.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Dry	Irrigated	-	-	-	-	-	-	-	-	-	-	-	-	-	-	576.5	-	-	-	-	446.3
	Dry	Rainfed	-	-	-	-	286.9	-	-	286.9	-	-	402.4	-	402.4	-	-	-	-	-	-	-
4) Mungbean	Dry	Irrigated	-	-	-	-	-	-	-	-	-	-	-	690.0	-	690.0	722.4	722.4	722.4	722.4	658.7	576.7
	Dry	Rainfed	-	287.0	-	-	-	-	341.9	-	-	-	483.2	-	-	483.2	-	-	-	517.5	-	-
5) Red onion	Dry	Irrigated	-	-	-	-	-	-	-	-	-	-	-	2,518.0	-	-	2,591.3	2,591.3	2,591.3	-	2,604.0	-
6) Tobacco	Dry	Irrigated	-	-	-	-	-	-	-	-	-	-	-	-	-	1,558.2	-	-	-	-	-	-
	Dry	Rainfed	-	-	-	584.8	-	-	-	-	-	-	-	-	1,234.1	1,234.1	-	-	-	-	-	-
7) Fallow			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3 Net Production Value (000 Rp.)																						
1) Paddy	Wet	Irrigated	-	47,352	-	-	20,209	52,666	24,496	74,713	-	25,148	44,462	250,604	44,462	84,882	358,870	379,470	170,219	202,745	55,569	444,915
	Wet	Rainfed	20,016	59,137	20,016	26,384	133,164	65,610	56,862	31,590	-	127,034	-	-	-	-	-	-	-	-	-	-
	Dry	Irrigated	-	-	-	-	-	-	-	-	-	-	-	255,886	-	-	-	386,225	-	-	-	-
	Dry	Rainfed	-	-	-	-	-	35,828	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2) Maize	Wet	Rainfed	-	386	-	3,341	-	-	-	-	-	5,222	-	-	-	-	-	-	-	-	-	-
3) Soybean	Wet	Rainfed	-	-	-	-	9,864	53,019	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Dry	Irrigated	-	-	-	-	-	-	-	-	-	-	-	-	-	-	95,411	-	-	-	-	200,835
	Dry	Rainfed	-	-	-	-	2,869	-	-	2,869	-	-	8,853	-	8,853	-	-	-	-	-	-	-
4) Mungbean	Dry	Irrigated	-	-	-	-	-	-	-	-	-	-	-	85,560	-	7,590	239,114	126,420	113,417	46,956	18,773	259,515
	Dry	Rainfed	-	7,462	-	-	-	-	6,838	-	-	-	10,630	-	-	14,979	-	-	-	63,135	-	-
5) Red onion	Dry	Irrigated	-	-	-	-	-	-	-	-	-	-	-	312,232	-	-	428,860	453,478	406,834	-	74,214	-
6) Tobacco	Dry	Irrigated	-	-	-	-	-	-	-	-	-	-	-	-	-	17,140	-	-	-	-	-	-
	Dry	Rainfed	-	-	-	8,772	-	-	-	-	-	-	-	-	27,150	38,257	-	-	-	-	-	-
7) Fallow			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total			20,016	114,336	20,016	38,497	166,106	207,123	88,196	109,172	0	157,405	63,945	904,282	80,465	162,849	1,122,256	1,345,593	690,470	312,836	148,556	905,265
4 Incremental Amount (Million Rp.)													43.9	789.9	60.4	124.4	956.1	1,138.5	602.3	203.7	148.6	747.9

Volume 4

The Study on The Embung Development Project in East Nusa Tenggara and West Nusa Tenggara

Feasibility Study on Ten Embung Development Projects

Figures



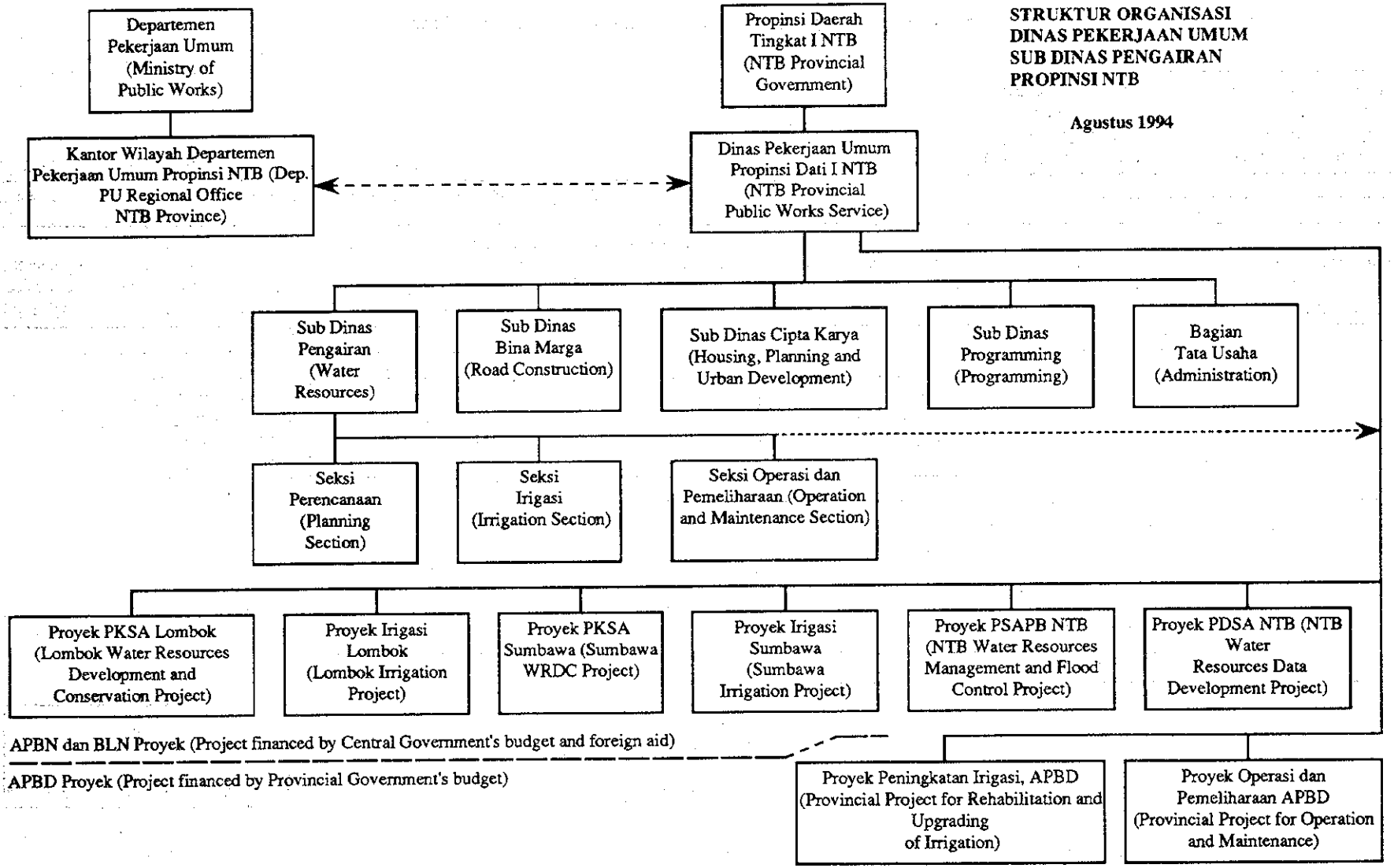


Figure 3.1 Present Organization Chart of PRWS, NTB

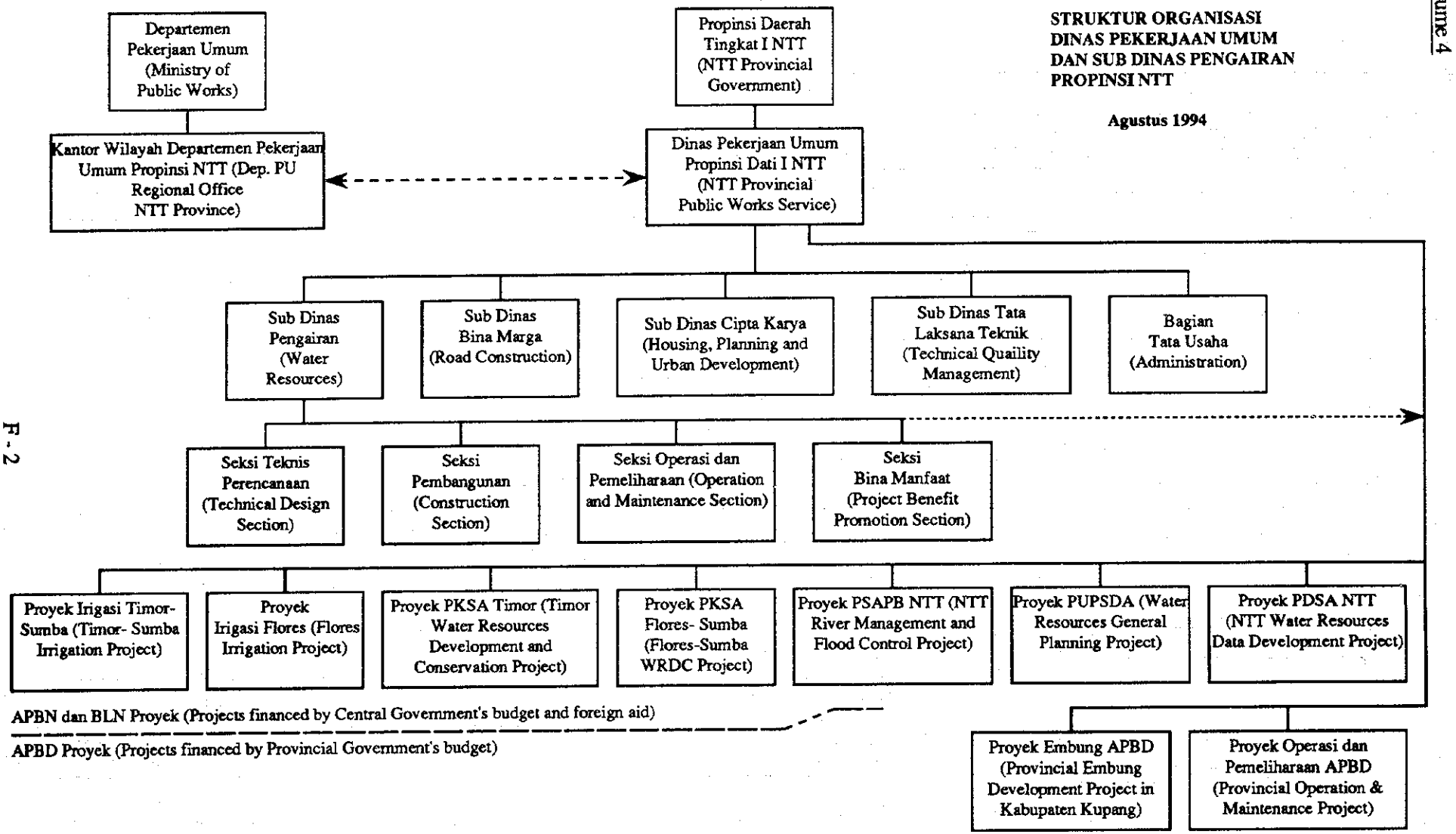


Figure 3.2 Present Organization Chart of PRWS, NTT

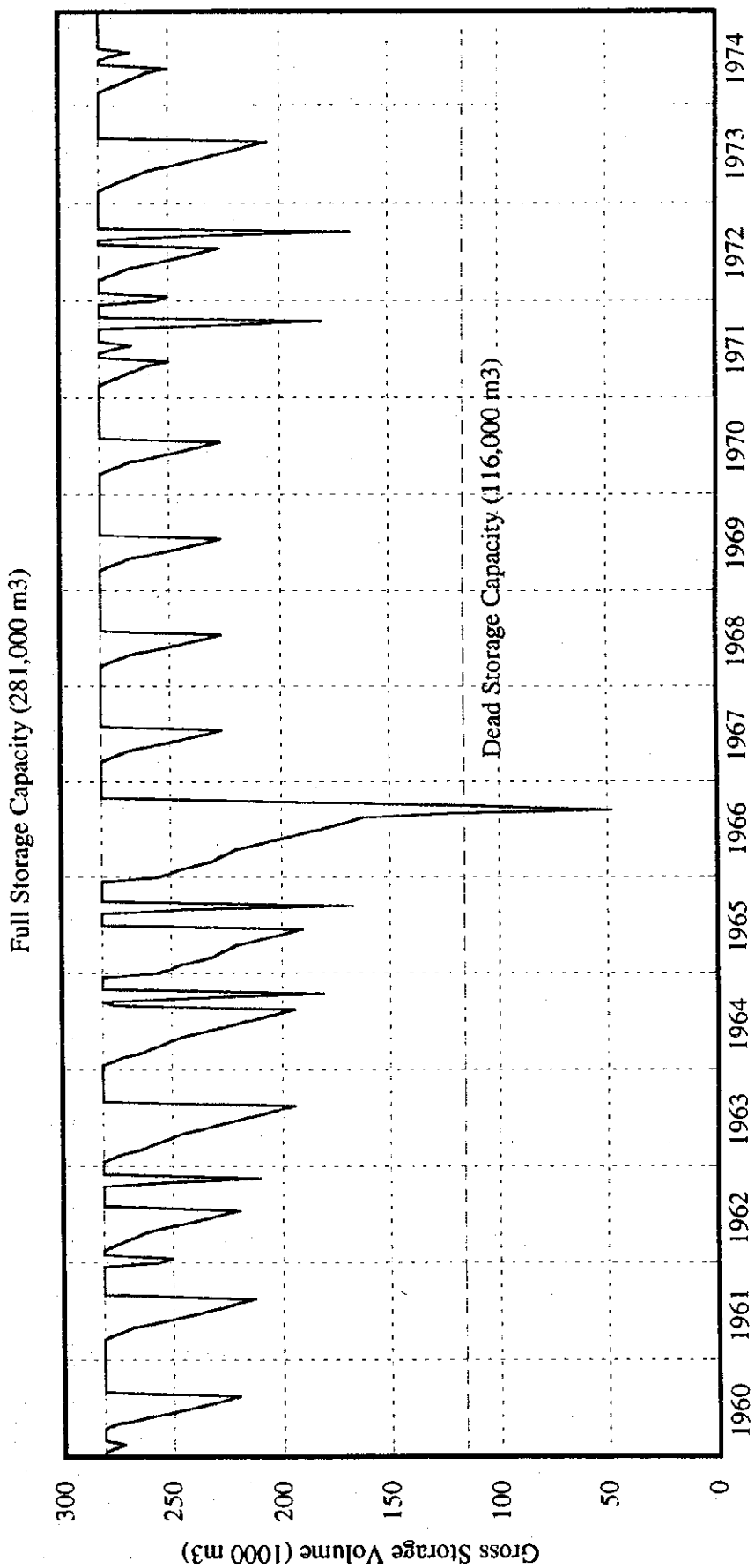


Figure 6.1 Result of Reservoir Operation in Lokok Meniris Embung

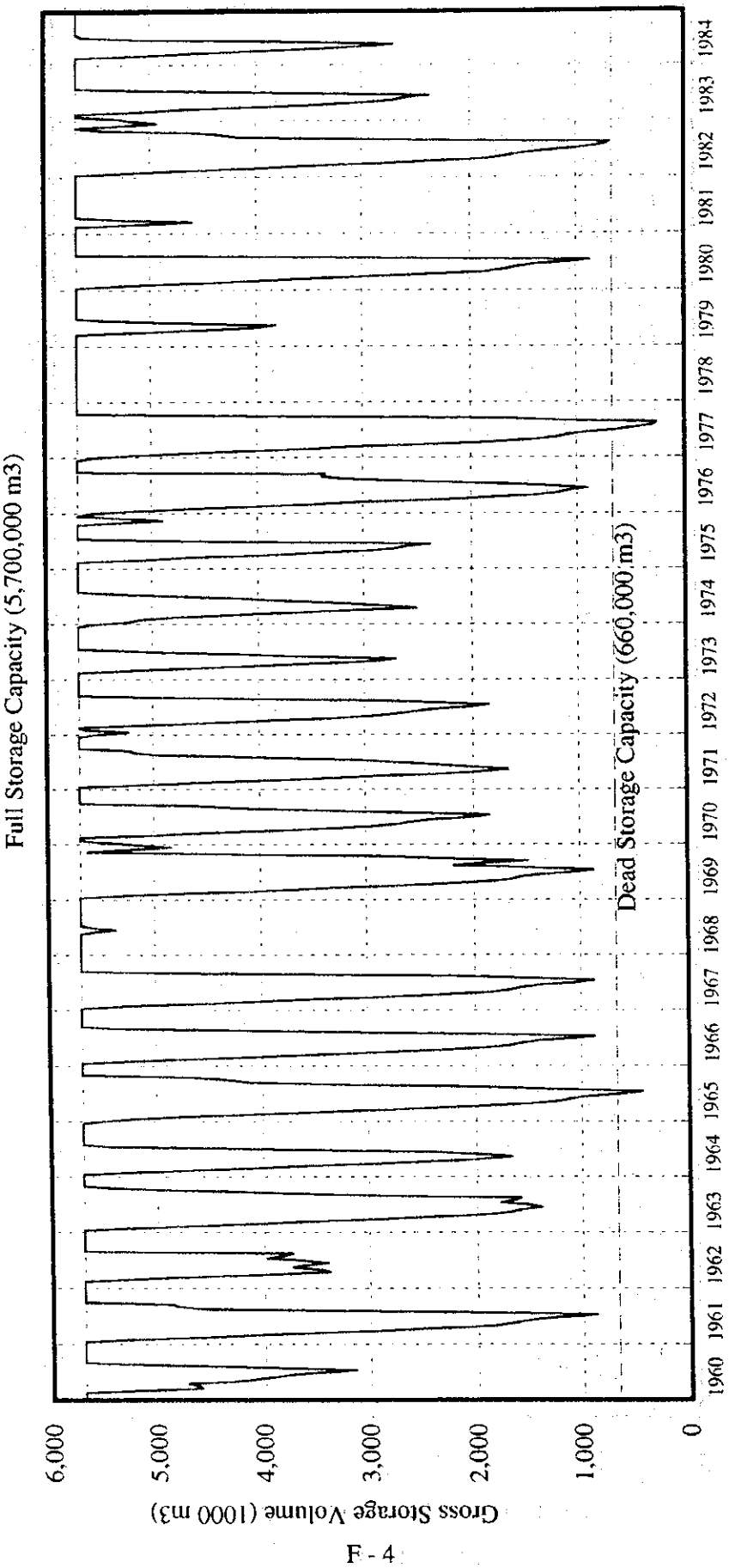


Figure 6.2 Result of Reservoir Operation in Pelangan Embung

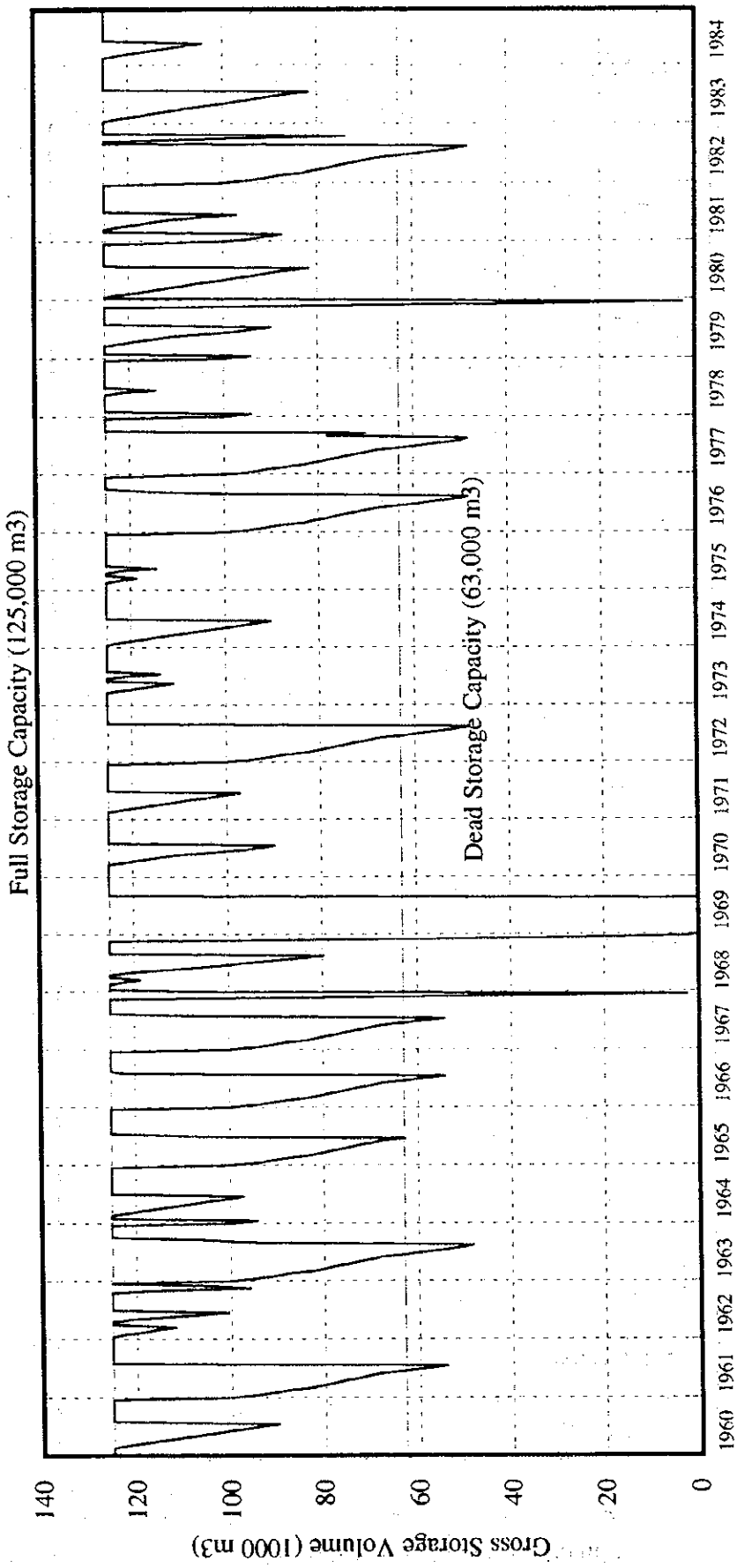


Figure 6.3 Result of Reservoir Operation in Montong Krarak Embung

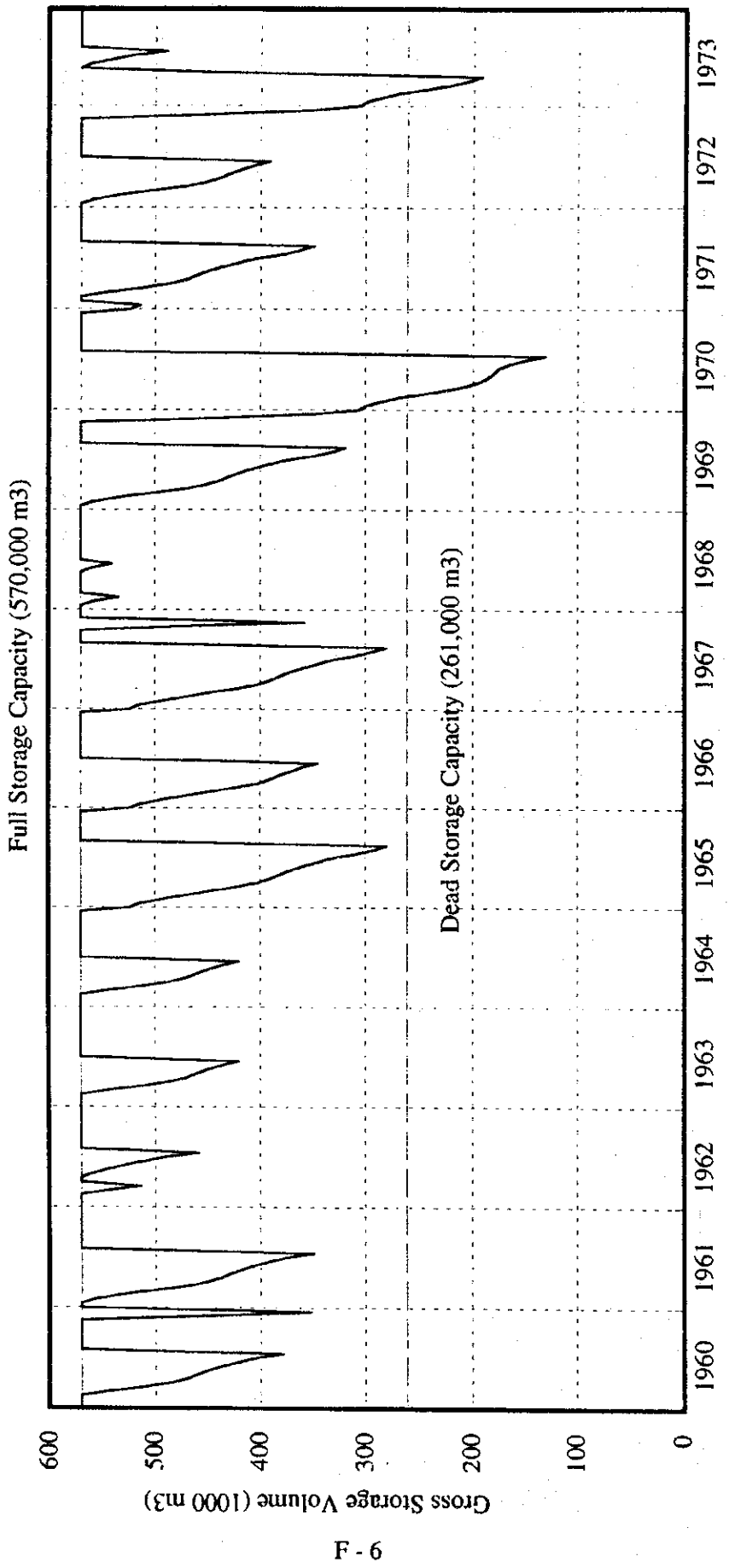


Figure 6.4 Result of Reservoir Operation in Aik Beta Embung

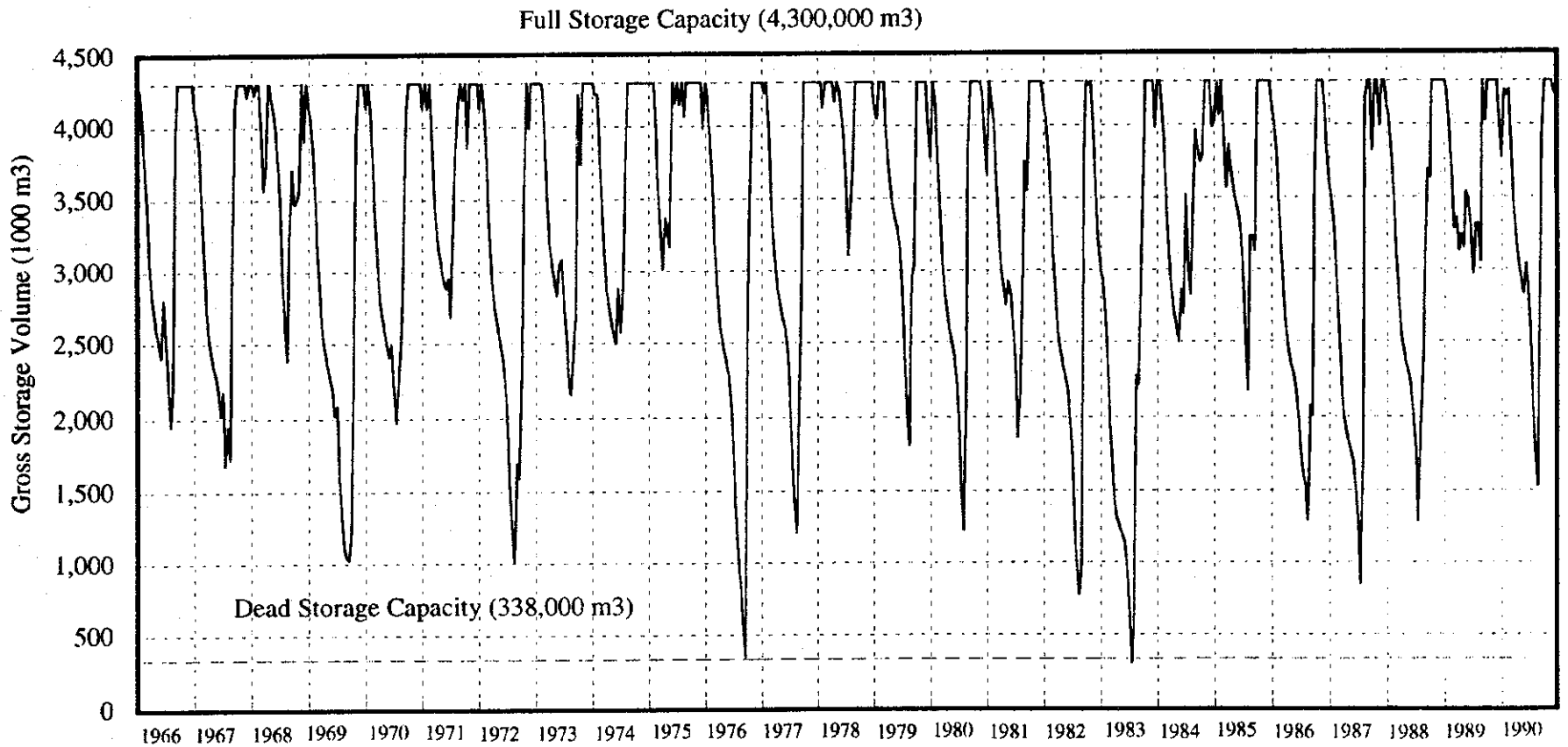


Figure 6.5 Result of Reservoir Operation in Tiu Tui Embung

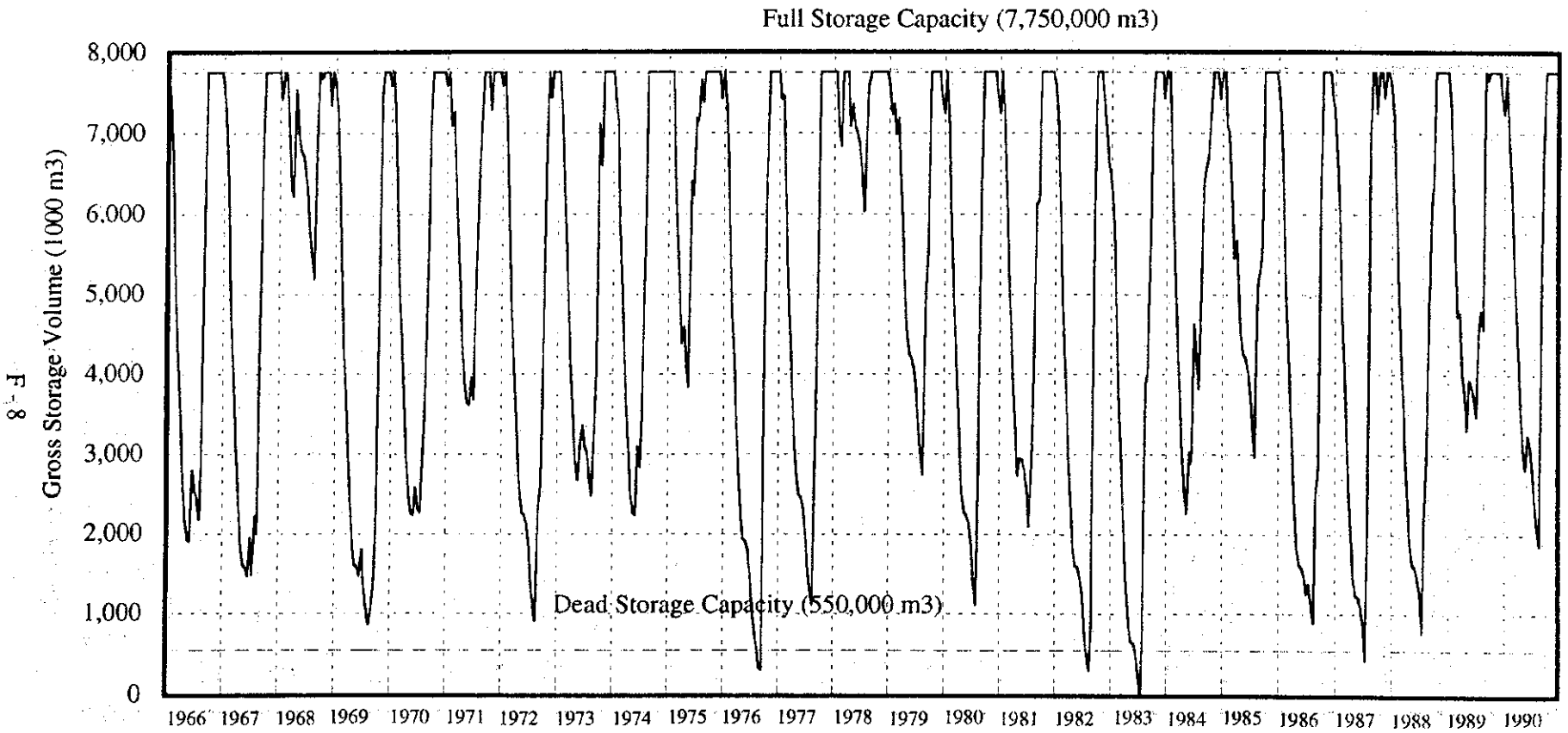


Figure 6.6 Result of Reservoir Operation in Penyempeng Embung

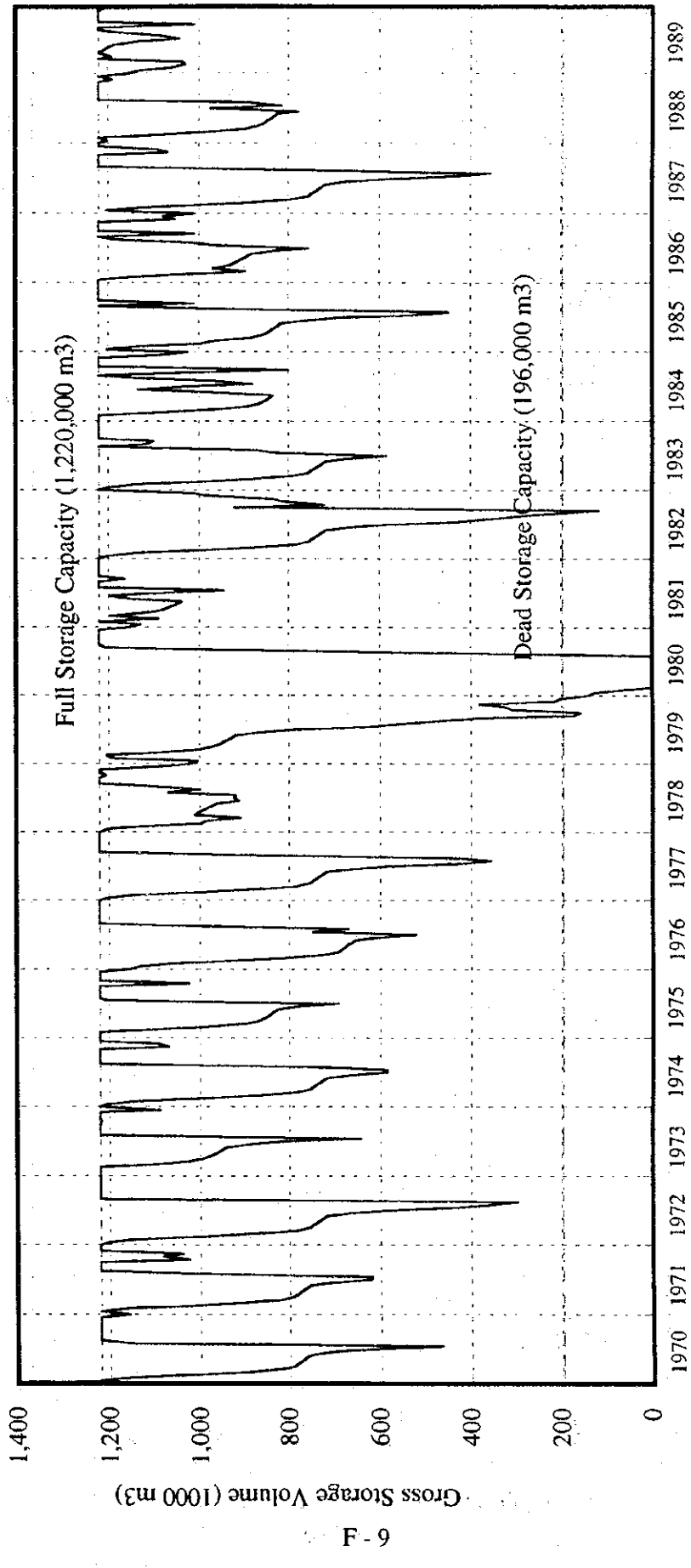


Figure 6.7 Result of Reservoir Operation in Ncoha II Embung

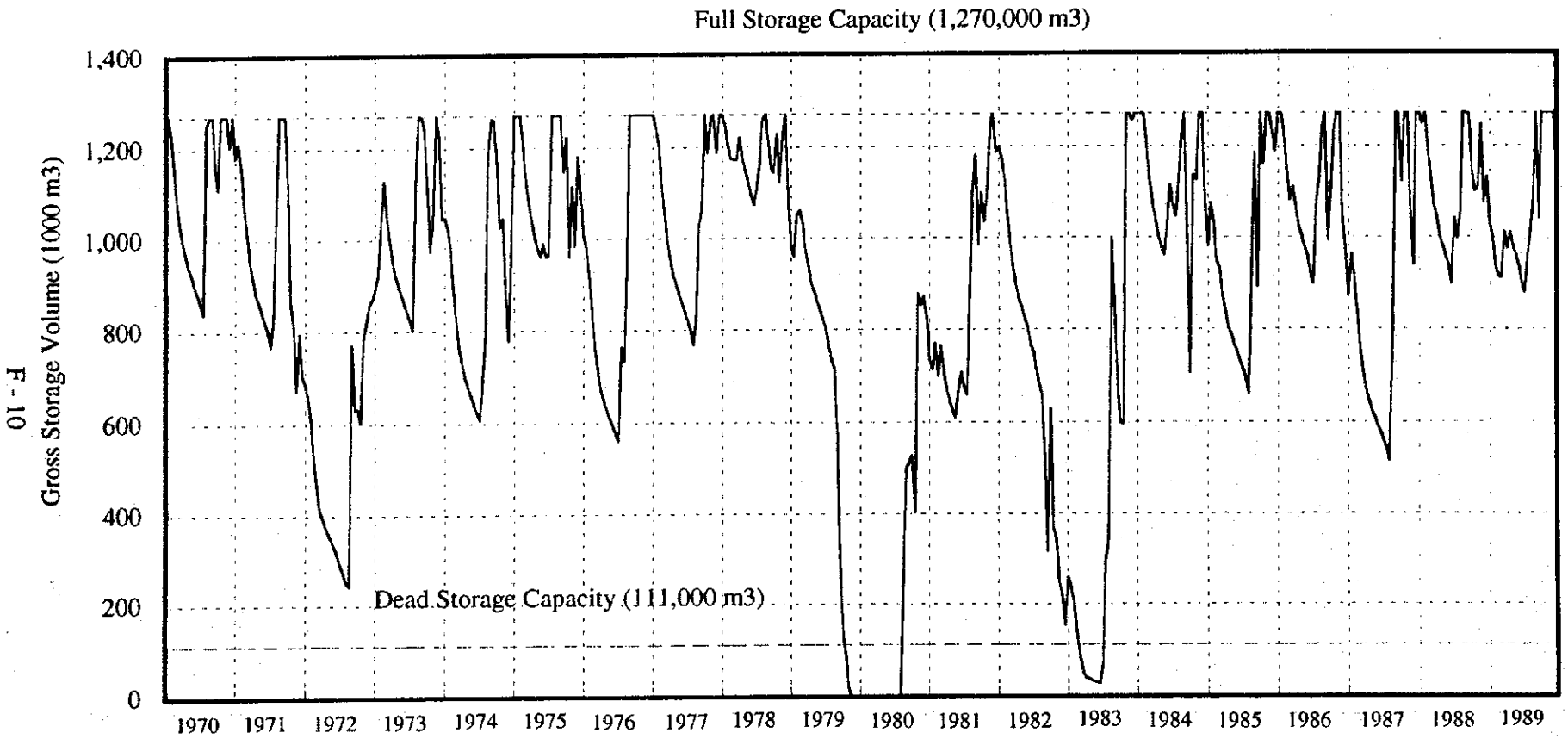


Figure 6.8 Result of Reservoir Operation in Ntonggu II Embung

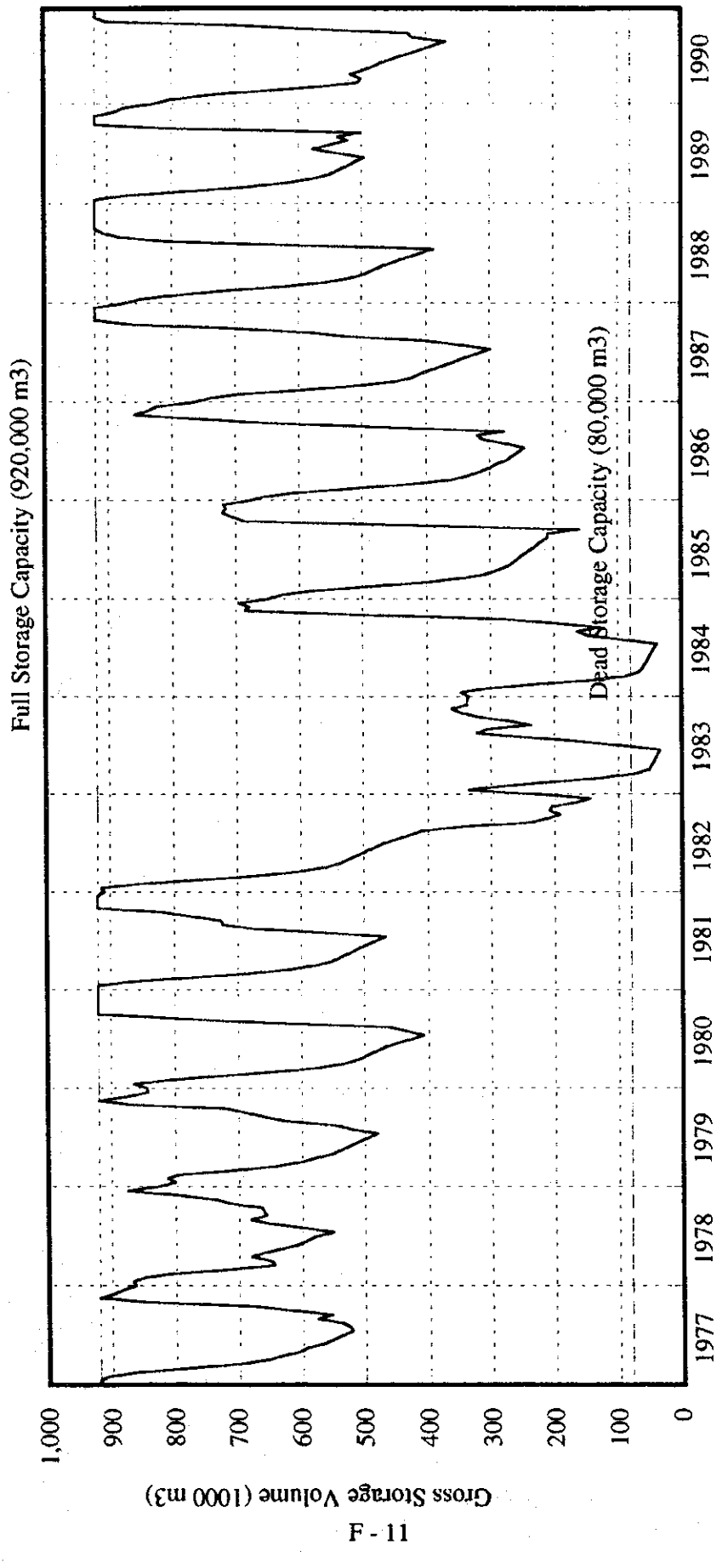


Figure 6.9 Result of Reservoir Operation in Fatukmetang Embung

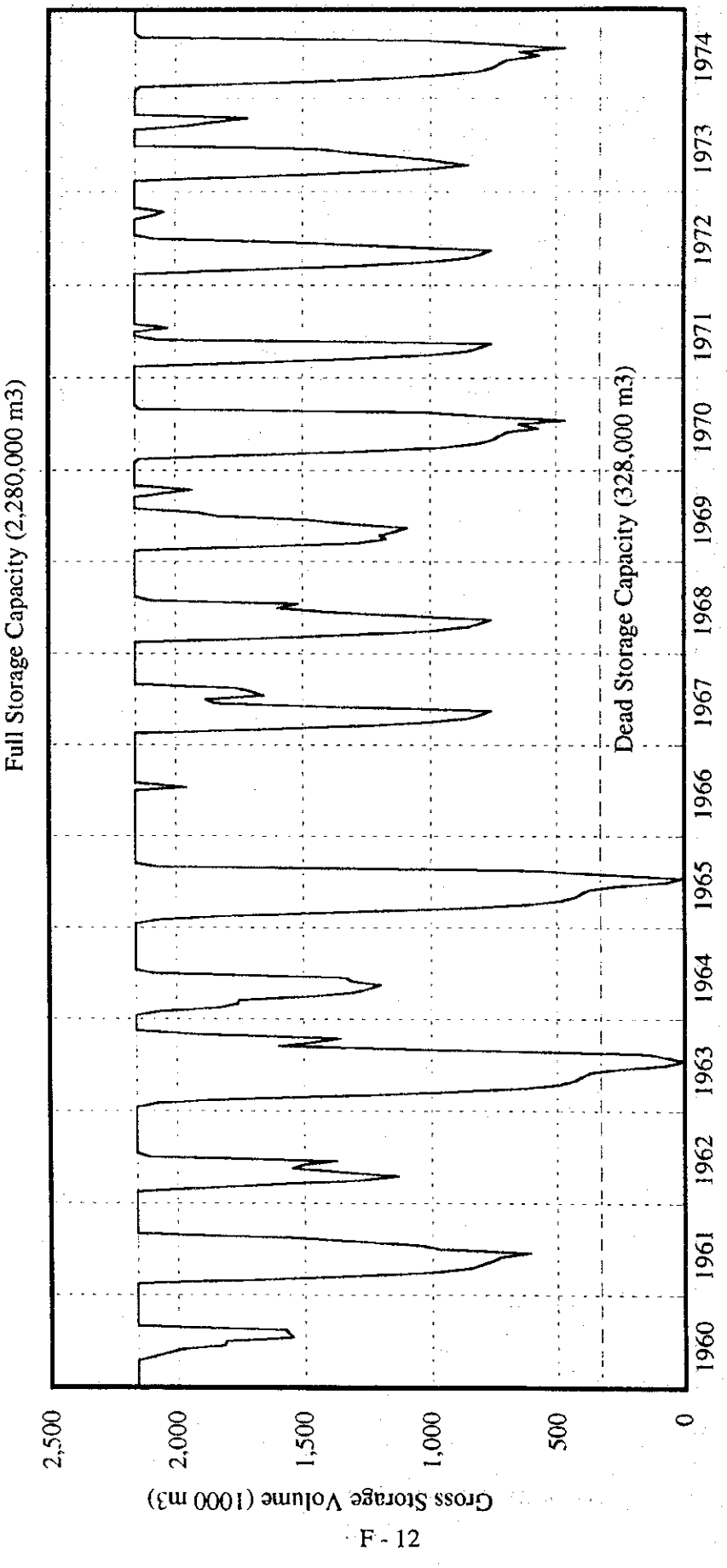
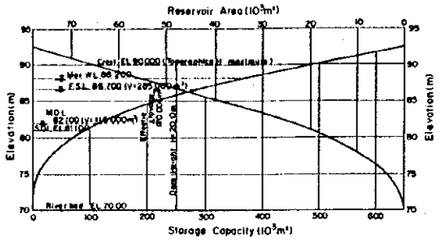
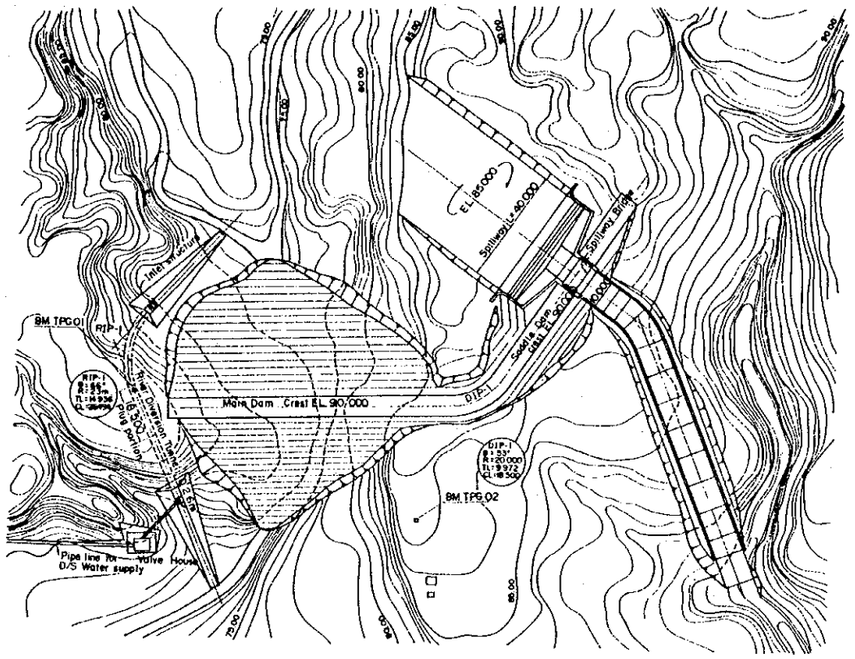


Figure 6.10 Result of Reservoir Operation in Mataiyang Embung

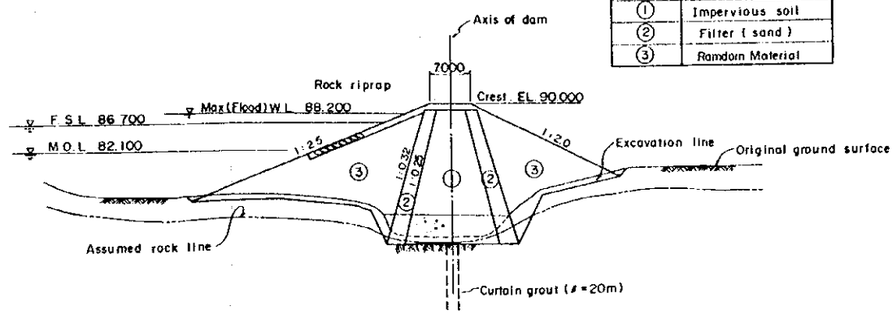


RESERVOIR STORAGE CURVE AT LOKOK MENIRIS



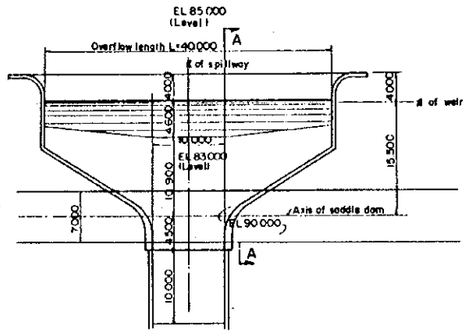
PLAN Scale A

Zone	Materials
①	Impervious soil
②	Filter (sand)
③	Ramdom Material



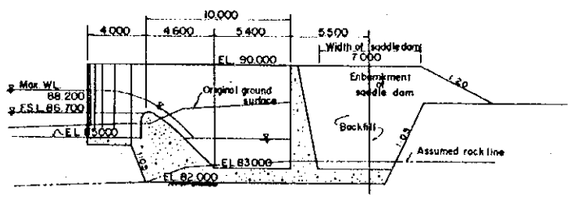
MAXIMUM CROSS SECTION

Scale B



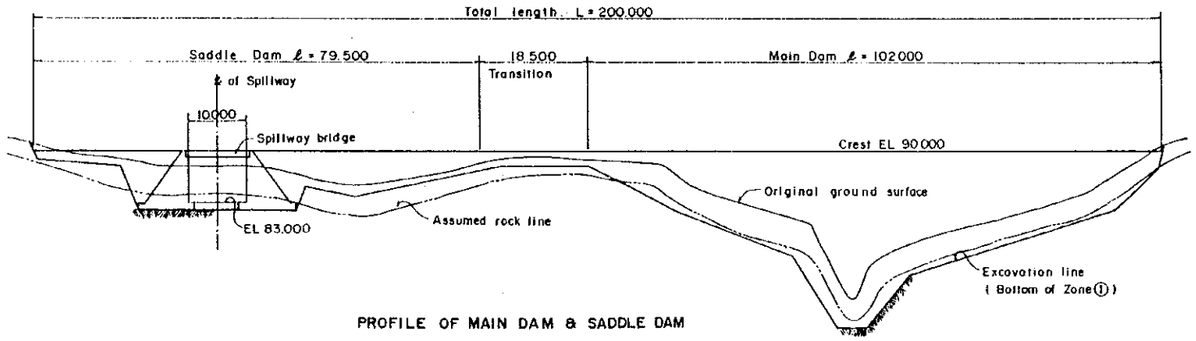
DETAIL OF OVERFLOW WEIR

Scale C



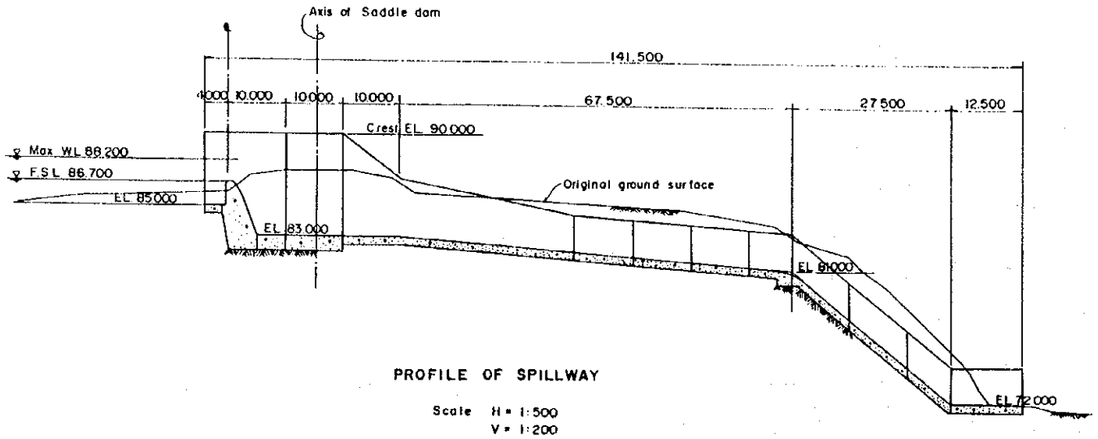
SECTION A-A

Scale D



PROFILE OF MAIN DAM & SADDLE DAM

Scale H = 1:500
V = 1:400



PROFILE OF SPILLWAY

Scale H = 1:500
V = 1:200

Scale A 0 20 40 60 80 100m

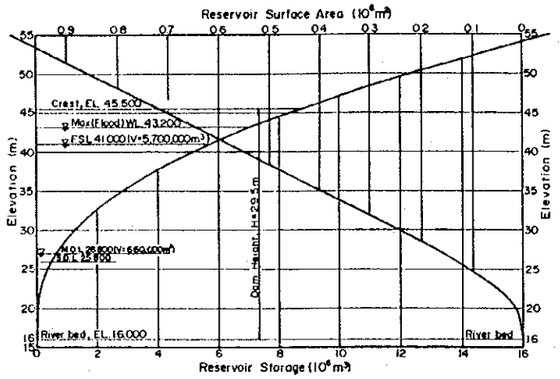
Scale B 0 10 20 30 40 50m

Scale C 0 10 20 30 40m

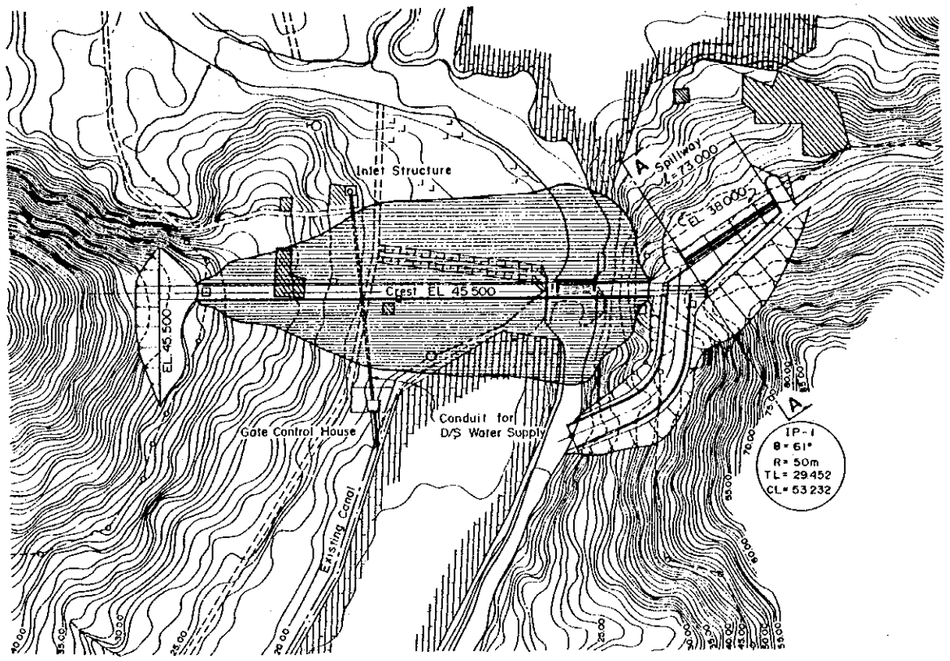
Scale D 0 5 10 15 20m

Figure 6.11 General Plan of Lokok Meniris Embung

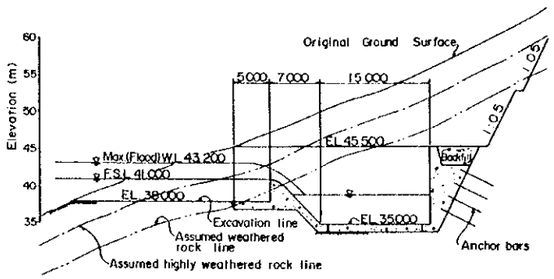
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT, MINISTRY OF PUBLIC WORKS	
The Embung Development Project in East Nusa Tenggara and West Nusa Tenggara	
GENERAL PLAN OF LOKOK MENIRIS EMBUNG	
No.	Area
JAPAN INTERNATIONAL COOPERATION AGENCY	



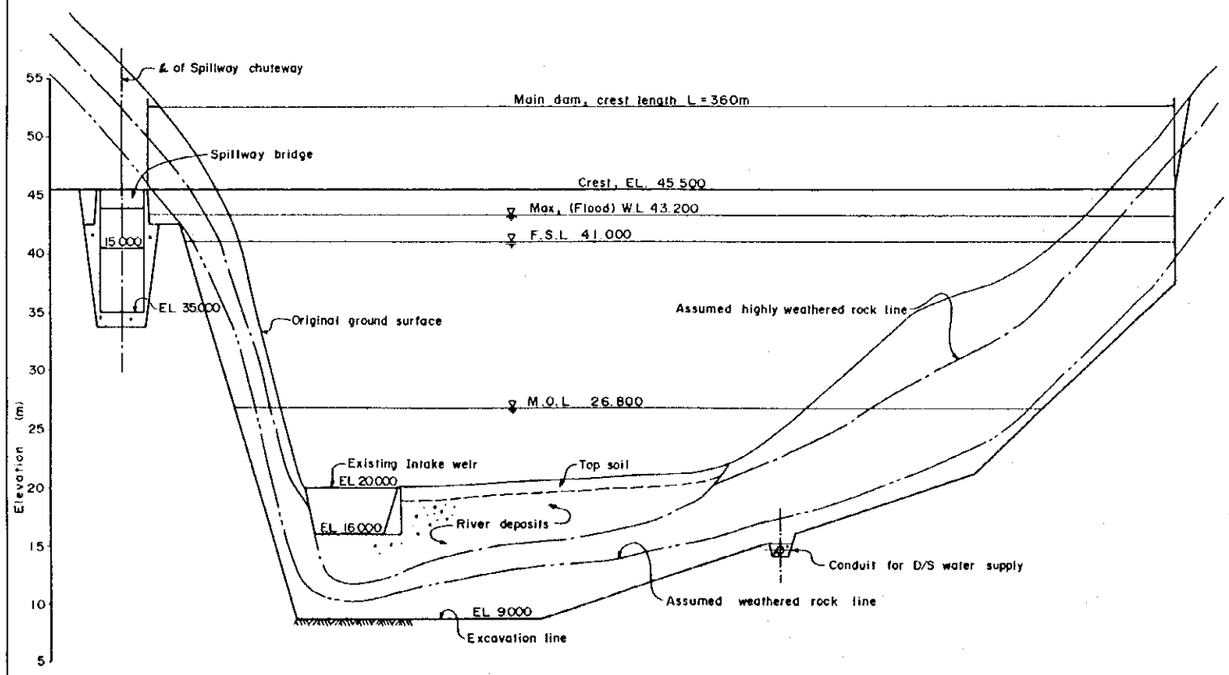
RESERVOIR STORAGE CURVE AT PELANGAN



PLAN Scale A

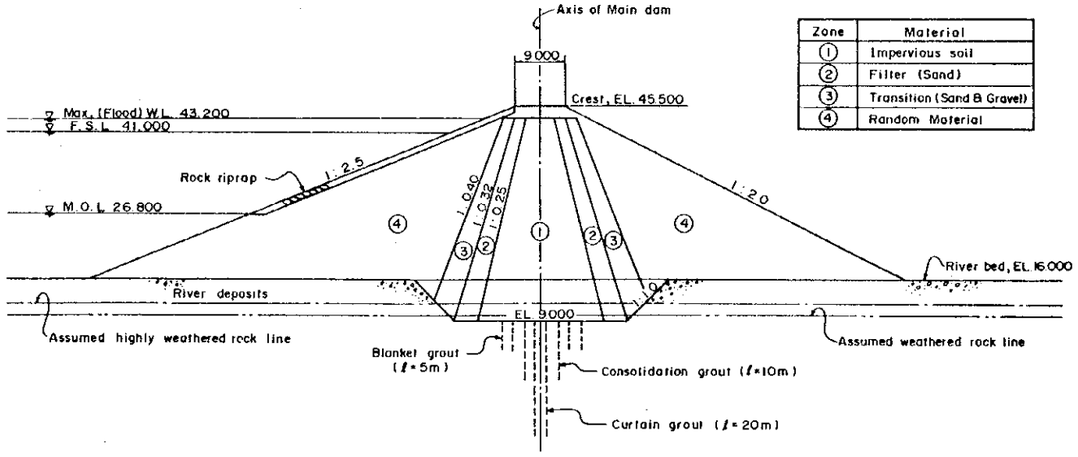


SECTION A–A
Scale C



Note : Grouts (Curtain, Consolidation, Blanket) are not shown.

PROFILE OF MAIN DAM
Scale : H = 1 : 1.000
V = 1 : 250



Zone	Material
①	Impervious soil
②	Filter (Sand)
③	Transition (Sand & Gravel)
④	Random Material

MAXIMUM CROSS SECTION OF MAIN DAM
Scale B

Scale A 0 50 100 150 200m
Scale B 0 10 20 30 40 50m
Scale C 0 10 20 30 40m

Figure 6.12 General Plan of Pelangan Embung

DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT, MINISTRY OF PUBLIC WORKS	
The Embung Development Project in East Nusa Tenggara and West Nusa Tenggara	
GENERAL PLAN OF PELANGAN EMBUNG	
No.	Area
JAPAN INTERNATIONAL COOPERATION AGENCY	