JAPAN INTERNATIONAL COOPERATION AGENCY

Directorate General of Water Resources Development
Ministry of Public Works
The Republic of Indonesia

BASIC DESIGN STUDY REPORT
ON
THE RESERVOIR (EMBUNG) DEVELOPMENT PROJECT
IN
EAST NUSA TENGGARA
IN
THE REPUBLIC OF INDONESIA

January 1995

Nippon Koei Co., Ltd.

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Preface

In response to a request from the Government of Republic of Indonesia, the Government of Japan decided to conduct a basic design study on the Reservoir (Embung) Development Project in East Nusa Tenggara and entrusted the study to the Japan International Cooperation Agency (JICA).

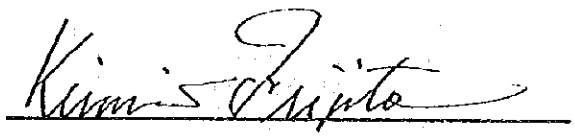
JICA sent to Indonesia a study team headed by Mr. Akira NAKAMURA, First Basic Design Study Division, Grant Aid Study & Design Department of JICA and constituted by members of Nippon Koei Co., Ltd., from November 16 to 25, 1994.

Prior to their sending to Indonesia, the team carried out an additional study in Japan to supplement the result of the Interim Report on the Draft Master Plan Report by the JICA Study on the Embung Development Project in East Nusa Tenggara and West Nusa Tenggara and prepared a Draft Basic Design Report. After discussion on the draft report with the officials concerned of the Republic of Indonesia, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Indonesia for their close cooperation extended to the team.

January 1995



Kimio Fujita
President
Japan International Cooperation Agency

January 1995

Mr. Kimio Fujita
President
Japan International Cooperation Agency

Letter of Transmittal

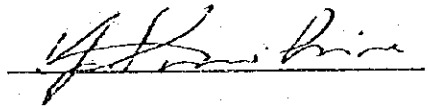
We are pleased to submit to you the basic design study report on the Reservoir (Embung) Development Project in East Nusa Tenggara in the Republic of Indonesia.

This study was conducted by Nippon Koei Co., Ltd., under a contract to JICA, during the period of October 17, 1994 to January 31, 1995. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Indonesia and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, the Ministry of Foreign Affairs, and the Ministry of Agriculture, Forestry, and Fisheries. We would also like to express our gratitude to the officials concerned of the Directorate General of Water Resources Development, the Ministry of Public Works, the JICA Indonesia office and the Embassy of Japan in Indonesia for their cooperation and assistance throughout our field survey.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

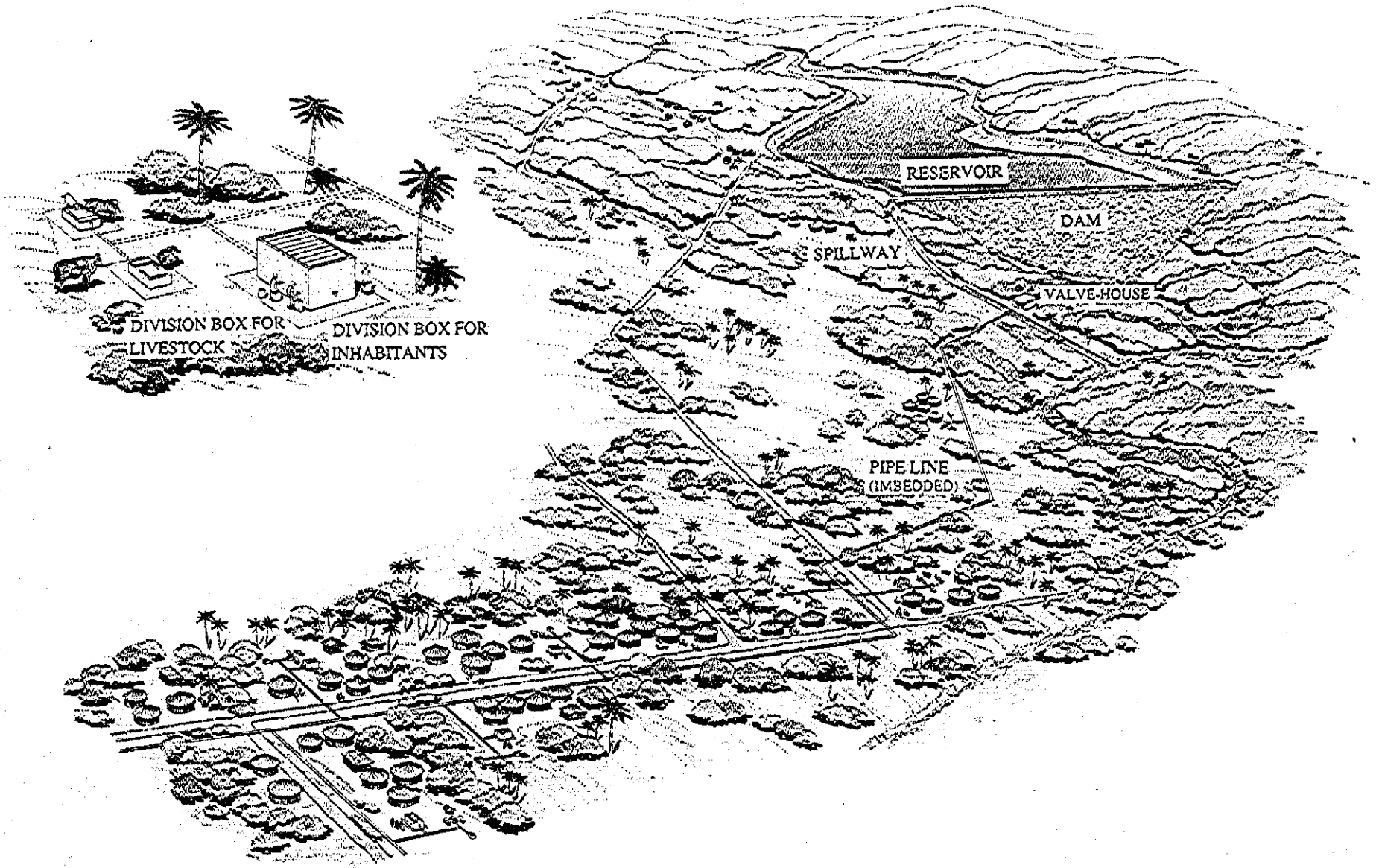


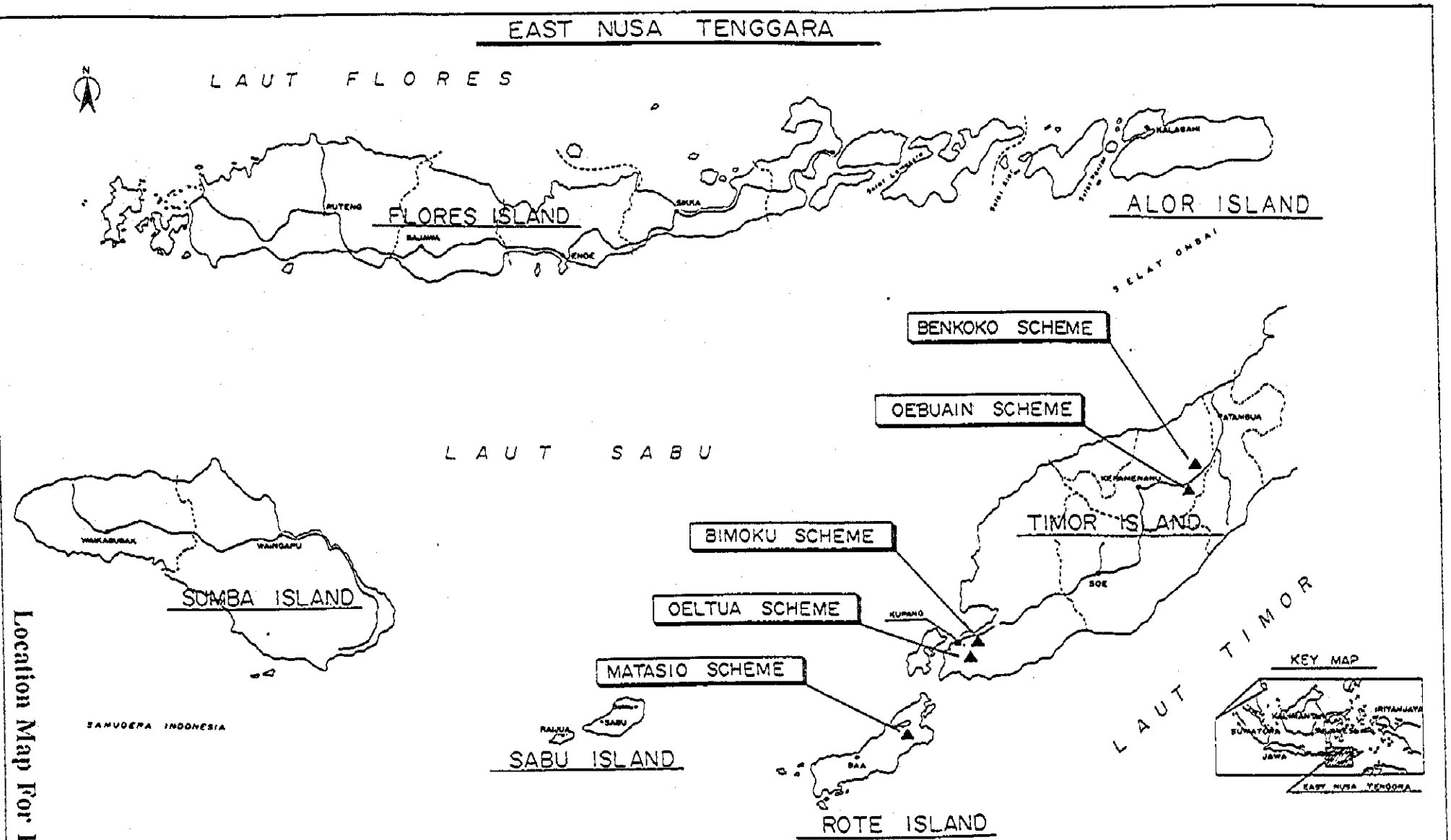
Dr. Yasuhiko KUNIHIRO

Project Manager,
Basic Design Study Team on
the Reservoir (Embung)
Development Project
in East Nusa Tenggara
in the Republic of Indonesia

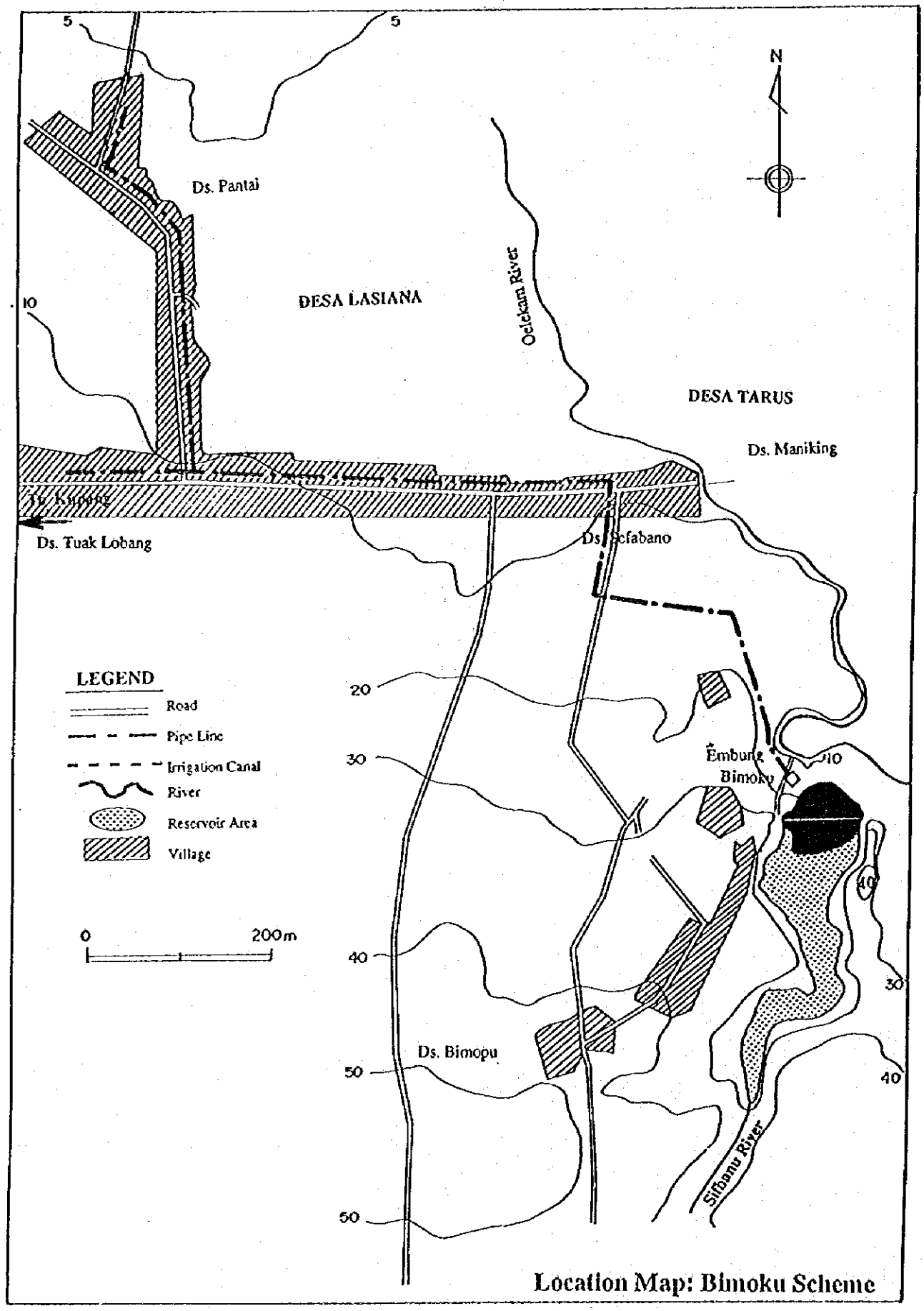
Nippon Koei Co., Ltd.

Bird's-eye View

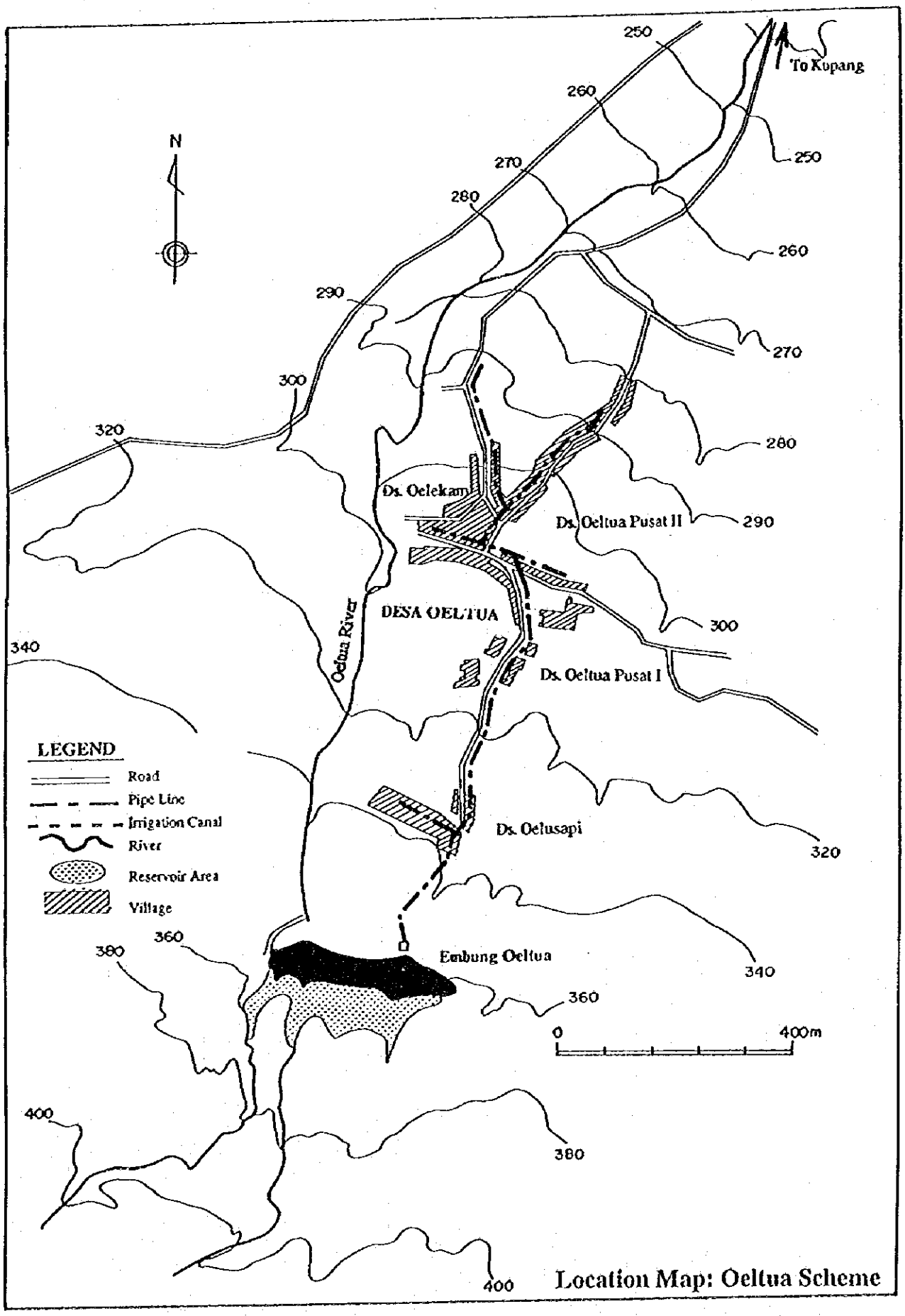




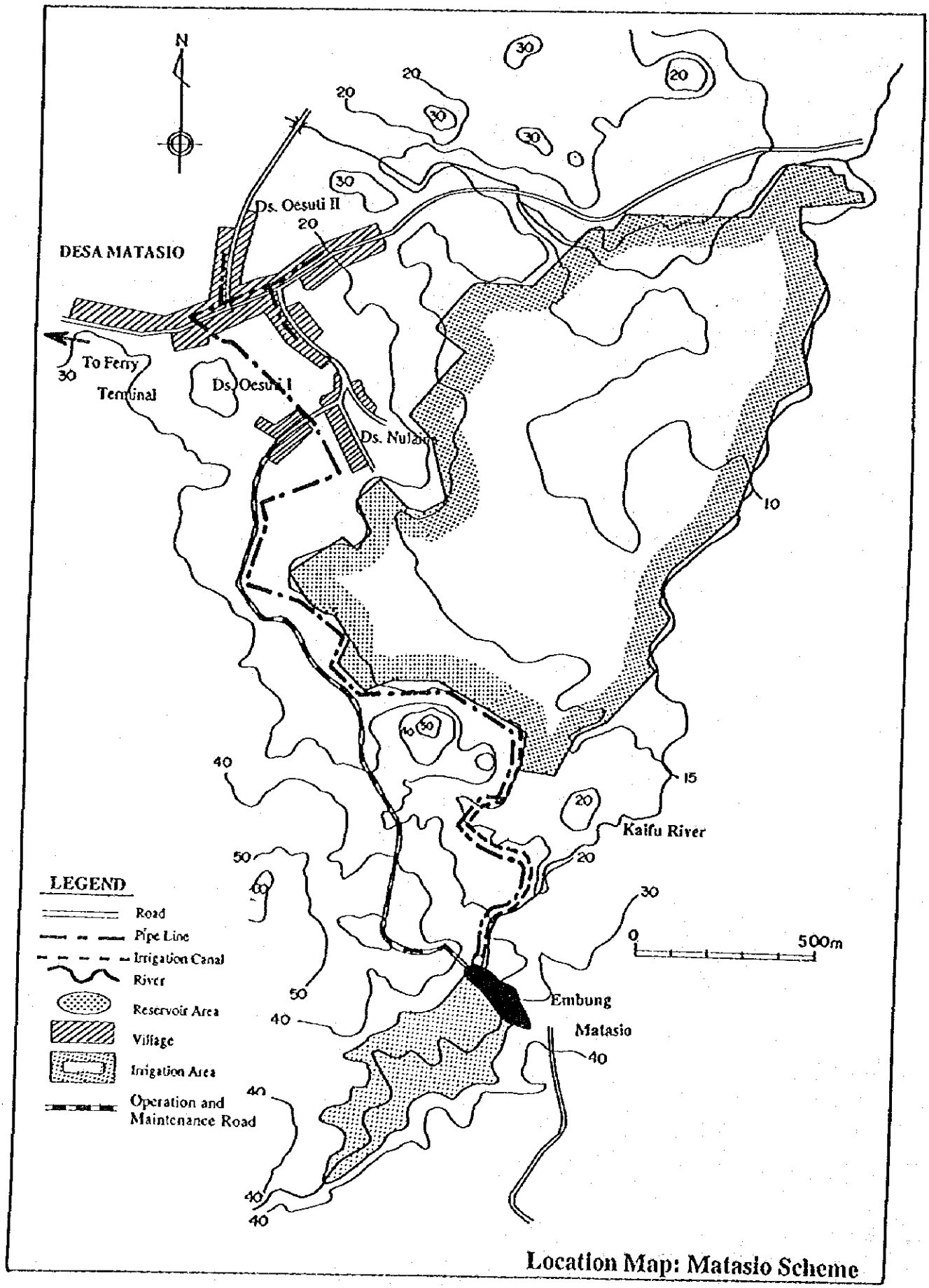
Location Map For Project Site



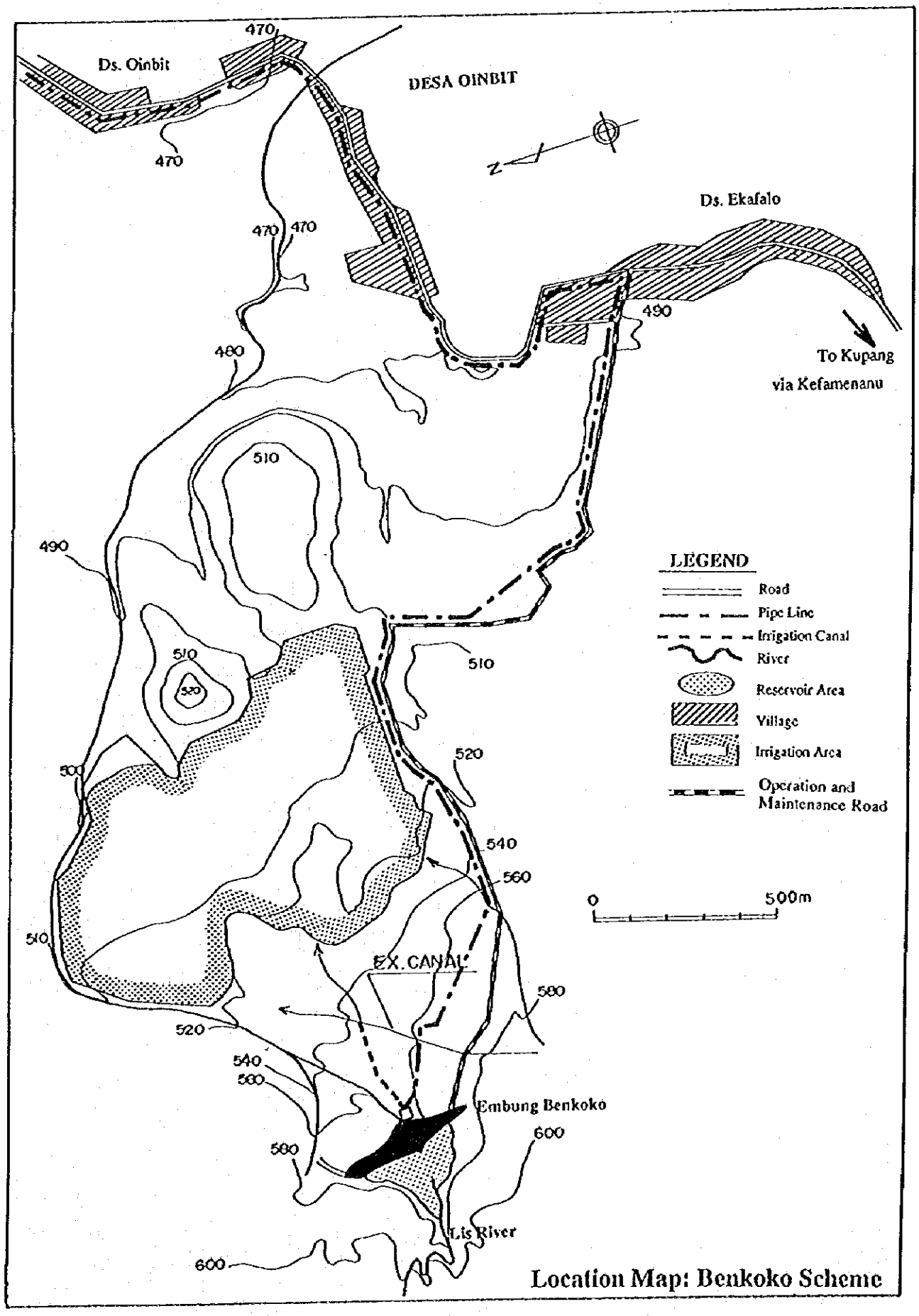
Location Map: Bimoku Scheme

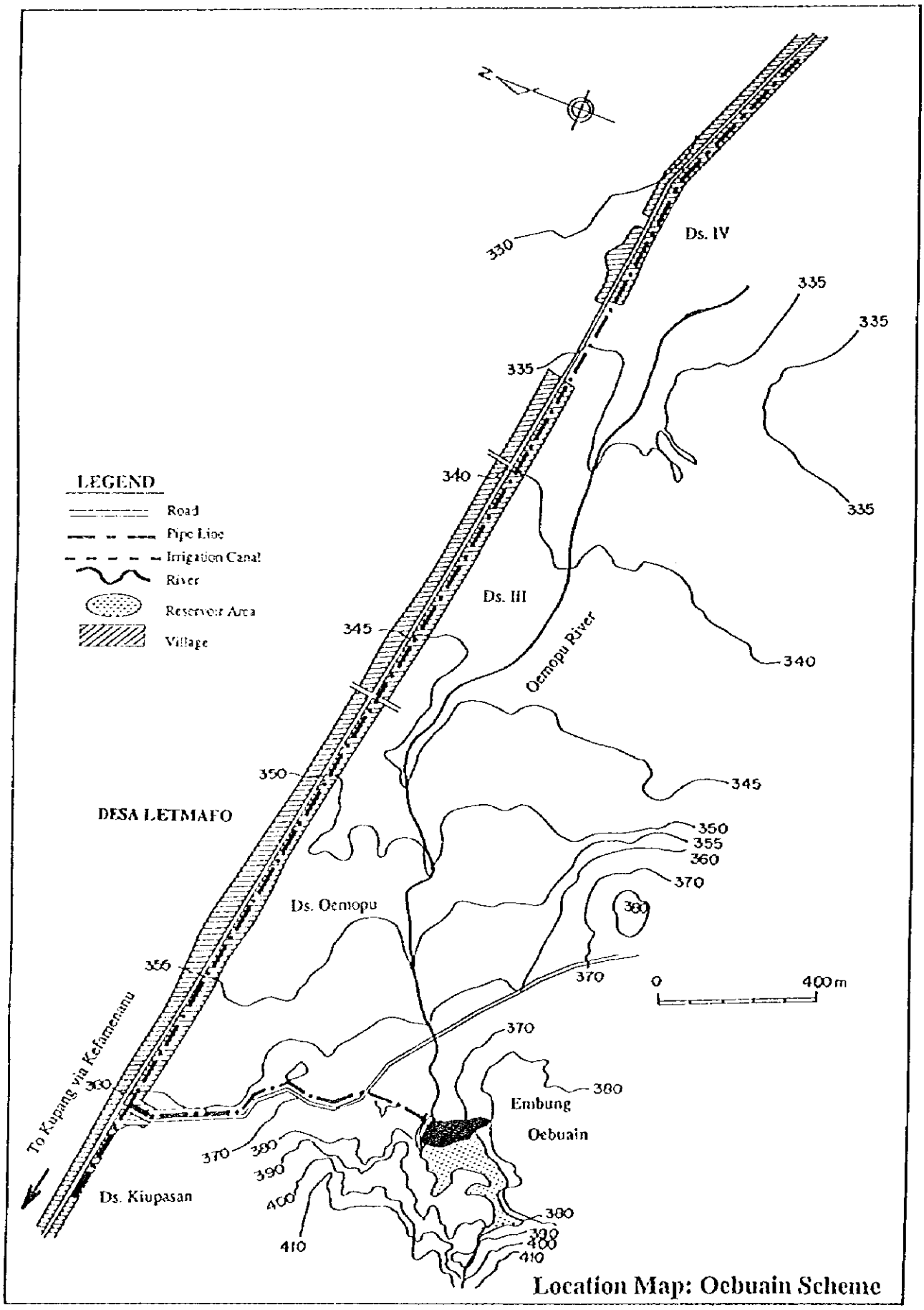


Location Map: Oeltua Scheme



Location Map: Matasio Scheme


Ds. Oinbit
DESA OINBIT
Ds. Ekafalo
To Kupang
via Kefamenanu
LEGEND
Road
Pipe Line
Irrigation Canal
River
Reservoir Area
Village
Irrigation Area
Operation and
Maintenance Road
0
500m
EX. CANAL
Embung Benkoko
Lis River
Location Map: Benkoko Scheme


N
LEGEND
Road
Pipe Line
Irrigation Canal
River
Reservoir Area
Village
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410
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Ds. IV
Ds. III
Oemopu River
DESA LETMAFO
Ds. Oemopu
Ds. Kiupasan
To Kupang via Kefamenanu
Embung
Oebuain
0
400 m
Location Map: Oebuain Scheme

Summary

Under Pelita I to IV, the development of the NTB and NTT provinces has remained separated from development on a the national level because of their remote location coupled with their small potential for development since their climates are drier than any other part of Indonesia. In 1990, the Gross Regional Domestic Product (GRDP) at the current market price was Rp. 1,290 billion for NTB and Rp. 1,172 billion for NTT. The per capita GRDP was Rp. 385,000 for NTB and Rp. 361,000 for NTT, which are ranked 25th and 27th, respectively, among the 27 provinces of the country. In order to improve the low productivity of the agricultural sector and living standards of the urban and rural inhabitants, the "Poverty Alleviation" and "Development of the Eastern Part of Indonesia" were adopted as the main components of the development targets under Pelita V. This principle is maintained in Pelita VI (1993/94 to 1998/99).

In order to reduce chronic and serious water shortage problems caused limited rainfall and seasonally available discharge in most rivers, the Provincial Irrigation Services (PRIS) of NTT has constructed 13 irrigation Embungs and 92 small Embungs. In the development of small Embungs, the Government of Australia granted technical guidance, construction equipment, and office and workshop facilities for five years from 1984.

However, no water resources development projects have been realized under special geological condition. Water sources for domestic and livestock purposes in each Project Area consist of public water basins, tanks, springs, and wells. All water sources, except for springs, dry up for part or the whole dry season. If the water sources dry up, the inhabitants of an area are usually provided with drinking water by public water tankers.

The Government of Indonesia (GOI), taking into account the importance of the maximum utilization of limited water resources through the construction of Embungs which is an effective measure for developing NTT and NTB, requested the Government of Japan (GOJ) in May 1993 to extend technical cooperation for undertaking a feasibility study on the Embung Development Project. At the same time, GOI also requested GOJ to provide grant aid for the construction of six Embungs near Kupang in NTT. GOJ decided to conduct the development study in response to these two requests. The preliminary study was therefore conducted by the Japan International Cooperation Agency (JICA) in October 1993, and the Scope of Work (S/W) for the Study was agreed upon between the JICA preliminary Study Team and the Directorate general of Water Resources Development (DGWRD). In accordance with the agreed S/W, JICA organized the Study Team and began the Study in January 1994.

Under the Phase I Study, the technical feasibility and project justification study was carried out in order to examine the development potential of six Embungs where GOI requested GOJ to provide grant aid for their urgent implementation. The six proposed Embungs are Bimoku, Oeltua, and Tasiepah located near Kupang, which is the provincial capital of NTT, Benkoko and Oebuain situated in the eastern part of the West Timor, and Matasio in Rote island which lies west of the Timor island.

The results of the study were reported to GOI as the Interim Report of the Project in the presence of the JICA mission in September, 1994. The minutes of meeting between the leader of the JICA mission and the representative of GOI was signed to confirm the basic components of the requested grant project. In addition to the minutes, both sides understood the necessity for further studies to be carried out on the Tasiepah Project in order to utilize the water resources fully.

The mission was sent to Indonesia between November 16 and 25 to explain the Draft Report on Basic Design and to discuss supplementary studies in the Interim Report.

Although the technical feasibility has been almost completed through the Master Plan Study on the Embung Development Project, further study on the operation and maintenance after completion of the requested projects, especially on sanitary engineering aspects and that as Japanese Grant Project are required.

Outline of the Project are shown below:

Item	Unit	Bimoku	Oeltua	Benkoko	Oebuain	Matasio
Reservoir						
Catchment area	km^2	0.2	0.8	2.3	0.8	5.0
Dam height	m	14.0	12.0	19.5	12.0	11.0
Crest length	m	90.0	340.0	413.0	180.0	297.0
Reservoir area	m^2	13,200	25,750	38,800	21,000	160,000
Effective storage capacity	m^3	51,250	81,200	170,000	58,800	445,000
Embankment volume	m^3	31,000	200,000	221,000	80,000	110,000
Design flood discharge of the spillway	m^3 /s	18	48	49	21	33
Crest width of the spillway	m	6.2	8.7	12.4	7.3	9.1
Design discharge	lit/s	1.27	1.8	0.95	1.46	0.56
Domestic water						
Total length of pipeline	km	1.47	1.63	5.40	4.22	4.04
Total number of related facilities	nos.	24	58	46	39	23
Design discharge	lit/s			50		100
Irrigation inlet box	Nos.			1		1
Concrete flume type canals	km			0.3		1.0
Irrigation diversion box	nos.			3		1

The implementation of the Project is divided into the following two Stages

The first stage : Construction of the Benkoko and Oebuain Reservoir
The second stage : Construction of the Bimoku, Oeltua and Matasio Reservoirs

The objective of the Project, which is in line with Basic Human Needs (BHN), is to improve people's living standards. Furthermore the beneficiaries of the Project have had no opportunity to receive any benefits from the Development Policy up until now.

GOI can operate and maintain facilities using its own finances, human power, and technology. The objective of the Project is in line with achieving the objectives of the mid-term and long-term Development Plan.

The Project is defined as a non profitable Project and are suitable model for BHN fulfillment. Under the Project there are no effects on environmental aspects and no detrimental effects on water quality.

Thus, the Project will be completed under the regulations of the Japanese Grant Aid Policy.

It is concluded that the implementation of the Project would be suitable for Japan's grant aid because the Project will not only secure BHN of villagers but also significantly contribute to the targets of Repelita VI. Furthermore, there will be no problems with the O&M of the Project, since DGWRD has sufficient funds, manpower, and engineering know-how.

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Chapter 1 Background of the Project

1-1 Background of the Project

Under Pelita I to IV, the development of the NTB and NTT provinces of has remained separate from the development on a national level because of their remote location coupled with their little potential for development since their climate are drier than any other part of Indonesia. In 1990, the Gross Regional Domestic Product (GRDP) at the current market price was Rp. 1,290 billion for NTB and Rp. 1,172 billion for NTT. The per capita GRDP was Rp. 385,000 for NTB and Rp. 361,000 for NTT which are ranked 25th and 27th, respectively, among the 27 provinces of the country. In order to improve the low productivity of the agricultural sector and living standards of the urban and rural inhabitants, the "Poverty Alleviation" and the "Development of Eastern Part of the Indonesia" were adopted as the main components of development targets under Pelita V. This principle is maintained in Pelita VI (1993/94 to 1998/99).

The Government of Indonesia (GOI) taking into account the importance of the maximum utilization of limited water resources through the construction of small-scale impounding ponds called Embungs which is an effective measure for developing the East Nusa Tenggara (NTT) and West Nusa Tenggara (NTB) provinces, requested the Government of Japan (GOJ) in May 1993 to extend technical cooperation for undertaking a feasibility study on the Embung Development Project. At the same time, GOI also requested GOJ to provide grant aid for the construction of six Embungs in NTT. In response to these two requests, GOJ decided to conduct the development study. In the preliminary study carried out in October 1993, the Scope of Work for "the Study on the Embung Development Project in NTB and NTT in the Republic of Indonesia" (the Study) was agreed upon between the Japan International Cooperation Agency (JICA) and the Directorate General of Water Resources Development (DGWRD). The Study (hereinafter refer to as the Master Plan Study) has been undertaking since January 1994.

Under the Phase I Study of the Master Plan Study, the technical feasibility and project justification study was carried out in order to examine the development potential of six Embungs where GOI requested the GOJ to provide grant aid for their urgent implementation. The six proposed Embungs are Bimoku, Oeltua, and Tasiepah located near Kupang, which is the provincial capital of NTT, Benkoko and Oebuain situated in the eastern part of West Timor, and Matasio in Rote island which lies west of the Timor island.

The surveyed results of this Master Plan Study were prepared as the Interim Report on the Study on the Embung Development Project in East Nusa Tenggara and West Nusa

Tenggara. The Consultative Meeting organized by the Directorate of Technical Guidance, DGWRD was held on September 1994 in the presence of the JICA Mission, and the Report was basically accepted by the Indonesian side. The JICA Mission held a series of discussions with the officials concerned of DGWRD in Jakarta regarding the six Embungs and both parties confirmed the basic components of the five Resrvoirs (Embungs), except Tasiepah, to be the scope of Japan's Grant Aid. With regard to the Tasiepah Embung, the implementation of an additional feasibility study focusing upon dam construction is recommended in order to supply impounded water to the surrounding areas for irrigation and urban water use, since the maximum utilization of limited water resources is prerequisite for the upgrading social infrastructures so as to satisfy BHN and increasing agricultural production in order to accelerate regional economic development in NTT.

1-2 Outline of the Request and Main Components

In order to reduce chronic and serious water shortage problems caused by limited rainfall and seasonally available discharge in most rivers, the PRIS of NTT has constructed 13 irrigation Embungs at other islands except the Timor island (the average height : 8.8 m and the average storage capacity : 708,900 m3) and 92 small Embungs on the Timor island (the average height : 7.2 m and the average storage capacity : 16,930 m3). In the development of small Embungs, the Government of Australia granted technical guidance, construction equipment, and office and workshop facilities for five years from 1984 and PRIS helped beneficiaries to construct Embungs.

Due to some weak points in geological condition derived from the presence of coral limestone in the western part of the Timor island, the technical know-how for the construction of higher Embungs has not yet been accumulated in the public and private sectors in NTT. Water sources for domestic and livestock uses in each requested Project Area consist of: public water basins, tanks, and wells and private wells in Bimoku; public and private wells and springs in Oeltua; and public wells and springs in Benkoko, Oebuain, and Matasio. All water sources except for dry up for a part of or the entire dry season. When water sources dry up, inhabitants are usually provided with drinking water by public water tankers.

It is necessary for the inhabitants of each Project Area to meet basic human needs by improving their living conditions, paying special attention to water shortage problems cause by the lack of perennial water sources. In addition, the inhabitants are eager to obtain a sufficient water supply for maintaining their livestock, which is their source of nutrition and cash income. Thus GOI requested grant aid from GOJ in order to overcome these problems.

1-3 Project and Program of Other Donors

In NTT, there are 40 rivers which are longer than 30 km, while 37 rivers have catchment areas larger than 200 km^2. Owing to these small catchment area where the area covered by forests is small, the wet season is short, and the rainfall pattern is not uniform, river flow is large fluctuations occur in all rivers, a majority of which also completely dry up in the dry season. The existing hydrological observation network covers a limited number of river basins, therefore it is very difficult to fully comprehend the hydrological characteristics.

In relation to the above background, technical and financial assistance is continually being provided for PRIS (Sub-Dinas Pengairan) of NTT by the "Water Sector Technical Cooperation Fund (WSTCF) Program" which was signed by the GOI and the Government of Canada in November 1988 and funded by the Canadian International Development Agency (CIDA). This Project aims to establish a system for the simple and easy assessment of water availability. Its goal is to formulate an approach and methodology for assessing water availability of small and medium size river basins for the development of water resources projects, including small and medium-scale irrigation projects and for other water uses such as domestic and industrial water supplies.

With the Australian Government's provision of technology, construction equipment, and office and workshop facilities, PRIS of NTT constructed 92 simple and small scale Embungs with a dam height lower than 10 m in order to create domestic water supply sources in Timor island during the period of 1983/84 to 1988/89.

The Asian Development Bank has been carrying out a master plan study for the development of integrated water resources on the Flores island under its technical assistance program, from June 1993. Following the master plan study, a feasibility study is ongoing for two selected schemes; one is the rehabilitation of the existing irrigation scheme and the other is the construction of a small Embung for supplying domestic and livestock water. Furthermore, the Bank is preparing the Eastern Islands Groundwater Development Project and the Eastern Islands Rainfed Agriculture Development Project.

IBRD is considering to provide a loan for the Eastern Island Development I to overcome poverty as recommended in the Review Report on the Agricultural Sector in Indonesia in 1992.

The Small Scale Irrigation Management Project (SSIMP) commenced in December 1990 with the financial assistance of the Overseas Economic Cooperation Fund (OECF), Japan, under the cofinancing program between OECF and the United States Agency for

International Development (USAID), and was completed in 1994. Under SSIMP, a groundwater irrigation development subproject was realized in the Oesao-Priti Plain on the Timor island.

Chapter 2 Outline of the Project

2-1 Objectives of the Project

Although the technical feasibility has been almost completed through the Master Plan Study on the Embung Development Project, further study on the operation and maintenance after completion of the requested projects, especially on sanitary engineering aspects and that as Japanese Grant Project are required. The objective of this Project is to clarify these aspects.

2-2 Study and Examination on the Request

In the five Projects Areas, it is common for a total of 8,621 inhabitants to carry water an average distance of 1,780 m from the available water sources to their homes during the wet season and for almost 50 % of the inhabitants to receive the minimum volume of water from public tankers for their own use during the dry season when all the water sources dry up . Such water shortages have resulted in infectious diseases occurring and have damaged their health. Furthermore, it has prevented farmers' from introducing improved crop production systems and expanding or constructing irrigation facilities.

It is necessary for the inhabitants of each Project Area to meet basic human needs by improving their living conditions, paying special attention to water shortage problems caused by the lack of perennial water sources. In addition, the inhabitants are eager to obtain a sufficient water supply for maintaining their livestock, which is their source of nutrition and cash income.

The available land suitable for agricultural use amounts to 1,775 ha in the five Project Areas. Of these, sizable wet paddy fields, which are located in the downstream area of the proposed Embungs, cover 10 ha in Bimoku, 70 ha in Benkoko and 140 ha in Matasio. In Bimoku, however, there is no potential water resources development on the scale necessary for meeting the irrigation water demand. If irrigation water can be secured fully, the irrigable land resources in Benkoko and Matasio will be utilized by practicing the following proposed cropping patterns:

Project Area		Wet Season Crop Growing Period	Dry Season Crop Growing Period
Benkoko	(Paddy field)	Paddy Dec. 5 to May 15	Red onions June 1 to Aug. 30
	(Upland)	Corn/beans (Rainfed)	Red onions June 1 to Aug. 30
Matasio	(Paddy field)	Paddy Dec. 5 to May 15	Maize May 16 to Sept. 25
			Beans May 16 to Sept. 5

At present, the estimated per capita domestic water consumption is about 25 lit/day on an average in the six Project Areas, which is far below the regional levels of 123 lit/day for NTT and 144 lit/day for Kabupaten Kupang. The future water demand comprizes domestic water for the inhabitants and livestock in the six Project Areas and irrigation water in Tasiepah, Benkoko, and Matasio. In the draft Pelita VI (1993/94 to 1998/99), the Provincial Government of NTT has set various goals for meeting the basic human needs by 1998. In terms of the domestic and livestock water supply, the target is set at 60 lit/day/capita for rural people and 40 lit/day /head for cows.

In comparison with the present levels of water consumption and taking into consideration the limited availability of water resources in the six Project Areas, the target year for reaching the above water supply levels is set at 2003/04, the last year of Pelita VII, under the Study. In addition, the above per capita water supply target of 60 lit/day will include drinking, bathing, defecating, washing, gardening, and leakage water. The future population of the inhabitants and livestock in the target year are estimated by the Study in accordance with the projected population growth rates calculated by the Provincial Statistic and Livestock Offices.

With regard to the daily amount of water consumption by livestock other than cows, the unit water requirement assumed in "The Study for Formulation of Irrigation Development Program in the Republic of Indonesia" is employed; 40 lit/head/day for buffaloes, 5 lit/head/day for sheep/goats, 6 lit/head/day for pigs, 0.6 lit/head/day for poultry, and 40 lit/head/day for horse.

Irrigation water demand is estimated by referring to the standard quoted in the "Irrigation Design Standard, KP-01" of DGWRD. For estimating the annual unit diversion requirement of irrigation water, the proposed cropping pattern, crop consumptive uses, evapotranspiration, crop coefficient, effective rainfall, and irrigation efficiency are taken into consideration for wet paddy and palawija crops. Further, more land preparation, layer water demand, and percolation loss are taken in account by the wet paddy crop.

The details of the water demand calculation for each Project are presented in the Interim Report of the Draft Master Plan Report (Part Two) Annex 1 to Annex 6.

(1) Domestic Water Demand

The future population for the target year 2003/04 is forecasted for each Project Area. The future water demand is calculated by multiplying the target per capita water supply amount by the forecasted population. The forecasted population and the annual water demand amount

which are 9,546 persons and 209,057 m^3, respectively, in the six Project Areas are broken down as shown below:

Project Area	Projected Population (person)	Projected Water Demand (m^3/year)
Bimoku	3,019	66,116
Oeltua	2,077	45,486
Benkoko	1,773	38,829
Oebuain	2,101	46,012
Matasio	576	12,614

(2) Livestock Water Demand

The future livestock population for the target year 2003/04 is forecasted for each Project Area. The future water demand amount is calculated by multiplying the target unit water supply requirement by the forecasted livestock population. The forecasted livestock water demand for the target year 2003/04 amounts to 54,454 m^3 in the Project Area and is broken down as shown below:

Project Area	Forecasted Livestock Population					Forecasted Livestock Water Demand (m^3/year)
	Cow/Buffalo (head)	Horse (head)	Goat/Sheep (head)	Pig (head)	Chicken/Duck (head)	
Bimoku	455	31	376	756	1,361	9,735
Oeltua	627	7	21	752	2,384	11,464
Benkoko	936	361	371	868	1,104	21,756
Oebuain	317	14	63	529	1,286	6,388
Matasio	200	7	582	481	285	5,201

(3) Irrigation Water Demand

The annual unit diversion requirement of irrigation water for Benkoko and Matasio is summarized below:

Project Area	Crop	Annual Unit Diversion Requirement (m^3/ha)
Benkoko	Paddy	10,930
	Red onion	3,090
Matasio	Paddy	10,010
	Maize	8,920
	Beans	6,370

2-3 Project Description

2-3-1 Execution Agency and Operational Structure

On a national level, DGWRD of the Ministry of Public Works (PU) is responsible for managing overall water resources development for the whole country. On a provincial level, PRIS of the Provincial Department of Public Works (DPUP), which is under the direct control of the Governor, is the principal organization responsible for water resources planning and design and for system operation and maintenance. A Regional Office of PU (Kanwil PU) is established in each Province and is responsible for maintaining coordination between PU and DPUP, and for providing support and assistance to the Provincial Services, as well as planning and implementing national projects.

In NTT, there are four provincial service offices; Irrigation (Pengairan), Road/Bridge (Bina Marga), Water Supply/Building (Cipta Karya), and Equipment (Peralatan). In the case of the domestic water supply to urban and rural areas in NTT, PRIS is responsible for creating raw water sources and the Cipta Karya has to treat and distribute water to end users.

The structure of PRIS is composed of a general administrative unit and three technical sections for design, construction, and operation and maintenance (O&M). Under the direct management of the chief of PRIS, there are five functional sections established for the specific activities. Of these, Embung development is handled by the Timor Water Resource Construction and Conservation Project Office (Proyek PKSA Timor) and Flores-Sumba Water Resources Construction and Conservation Project Office (Proyek PKSA Flores-Sumba). The former controls the Central Government's financing and Embung Development Project Office (Embung APBDI) in case of he Provincial Government's financing. After completion of Embungs, O&M works are transferred to O&M Section. The present organization chart of PRIS is shown in Figure 2.1.

In the implementation of the package program of the five Reservoir Development Projects, it is proposed that PRIS be in charge of all the financial arrangements for the implementation of the Indonesian program

2-3-2 Plan of Operation

As mentioned in 2-1, Objectives of the Project, further studies on operation and maintenance after the completion of the requested projects, especially on sanitary engineering aspects, and the Japanese Grant Project, are required to be carried out.

To clarify these aspects the following studies have been carried out:

1) Proper scale and methods of domestic water supply facilities from sanitary engineering aspects.
2) Reassessment of Japanese Grant Aid regarding design, implementation program, and required machines and materials described in the Interim Report .
3) Estimation of cost borne by the Indonesian side.
4) Operation and maintenance plan

2-3-3 Natural Condition of the Project Sites

(1) Location and Topography

Of the five reservoir development projects, the Bimoku site is located in the Kupang Tengah Sub-district (Kecamatan), Oeltua site in the Kupang Timur Sub-district, Benkoko and Oebuain sites in the Insana Sub-district in the easternmost part of NTT, and Matasio site in the Rote Timur Sub-district on Rote island. The location of each site is shown below:

Reservoir	Island	Direction and Distance from Kupang (km)	Coordinates of the Site		Village (Desa)
			East Longitude	South Latitude	
Bimoku	Timor	East : 12	123°41'43"	10°08'50"	Lasiana, Tarus
Oeltua	Timor	East : 20	123°40'51"	10°13'56"	Oeltua
Benkoko	Timor	Northeast : 155	124°44'28"	9°22'45"	Oinbit
Oebuain	Timor	Northeast : 140	124°36'33"	9°26'30"	Letmafo
Matasio	Rote	Southwest : 50	123°29'18"	10°37'60"	Matasio

(2) Climate and Hydrology

In each Project Area, the wet season usually starts in late November and ends in early April. The rainfall pattern is specified by concentrated heavy rains which occur two or three times during the wet season. The average annual rainfall varies from 1,000 mm in the Benkoko and Oebuain sites to 1,190 mm in the Matasio site and 1,470 mm in the remaining two sites. The maximum 24 hours rainfall record is 58 mm in the Benkoko and Oebuain sites, 120 mm in the Matasio site and 120 mm in the other sites. The following indicates climatic features of each Project Area:

Reservoir	Mean Annual Temperature (°C)	Mean Relative Humidity (%)	Mean daily Sunshine (hrs)		Average Wind Velocity(km/hr)
			Wet Season	Dry Season	
Bimoku	27.4	72.8	4 to 5	7 to 8	0.4
Oeltua	27.4	72.8	4 to 5	7 to 8	0.4
Benkoko	25.4	87.0	4 to 5	7 to 8	2.0
Oebuain	25.4	87.0	4 to 5	7 to 8	2.0
Matasio	27.4	72.8	4 to 5	7 to 8	0.4

The water source river of each reservoir site is listed below. There are no gauging stations on the respective rivers. The river resume reflects the monthly rainfall pattern. Due to deforestation occurring in the catchment area of each river, sedimentation on the river bed is common along the river.

Reservoir	Source River	River System	Catchment Area (km^2)
Bimoku	Sifbanu	Oelekam	0.20
Oeltua	Oeltua	Oelekam	0.82
Benkoko	Lis	Maubesi	2.30
Oebuain	Oemopu	Maubesi	0.80
Matasio	Kaifu	Kaifu	5.00

(3) Geology

Among the five Project Areas, the Bimoku and Oeltua Reservoir sites are underlain by siltstone called Noele Formation of the Tertiary and Coralline limestone, terrace deposits and recent river deposits of the Quaternary. The Coralline limestone is highly porous and is composed of sandy limestone and coral limestone. Benkoko and Oebuain sites are underlain by claystone called Bobonaro Complex of the Tertiary and thick debris of the Quaternary being composed of coral limestone, alluvial terrace deposits and recent river deposits. The Matasio site is underlain by Bobonaro Complex, terrace deposits, and coral limestone. Table 2.1 presents the comparisons made between the respective geological formations.

(4) Soils and Land Use

Soils of the cultivated and cultivable land of each Project Area are silty to sandy clay in Bimoku and Oeltua, silty clay to silty clay loam in Benkoko, sandy clay to sandy in Oebuain, and clay to silty clay in Matasio. Soils in the Benkoko and Matasio areas become sticky when wet and very firm when dried. Due to the large presence of exchangeable cations, the soil reaction is slightly alkaline. The response to the application of fertilizers is high because of poor soil fertility caused by the lack of organic matter in the topsoil.

The present land use for agricultural purposes in the five Project Areas is summarized below. In addition, most inhabitants grow vegetables and tree crops in a small area of their home yard for their home consumption purposes.

Project Area	Wet Paddy Field (ha)	Dry Upland (ha)	Estate Crop Field (ha)	Grassland and Idle Land (ha)	Total (ha)
Bimoku	10	276	0	0	276
Oeltua	7	95	175	105	382
Benkoko	237	390	40	11	678
Oebuain	150	229	7	70	456
Matasio	140	25	10	120	295

2-3-4 Social Conditions of the Project Site

(1) Demographic Condition

The demographic conditions of each Project Area in 1993 is presented below. The ethnic condition is: heterogeneous and originating from the native Timor in the Bimoku site; dominated by natives Timor and mixed with a few people from Rote, Sabu, and Belu in the Oeltua site; a majority are natives of Timor with few a people from Belu in the Benkoko and Oebuain sites; and heterogeneous and originating from Rote in the Matasio site. The majority of inhabitants are Protestant and engage in agricultural activities. The average education attained is a primary school grade.

Project Area	Total Population	Number of Households	Average Family Size
Bimoku	2,392	576	4.2
Oeltua	1,645	332	4.9
Benkoko	1,779	356	5.0
Oebuain	1,500	278	5.4
Matasio	1,305	116	4.2

(2) Domestic Water Supply

The existing water sources for domestic and livestock uses in the five Project Areas consist of: public water basins, tanks and wells and private wells in Bimoku; public and private wells and springs in Oeltua; and public wells and springs in Benkoko, Oebuain, and Matasio. All water sources except for springs dry up for part of or the entire dry season. When water source dry up, inhabitants are usually provided with drinking water by public water tankers. The average walking distance from water sources is 36 m in Bimoku, 500 m in Oeltua, 6,500 m in Benkoko, 1,560 m in Oebuain and 135 m in Matasio. Table 2.2 shows the present situation of domestic water uses in each Project Area.

(3) Social Infrastructure

Access from Kupang, the Provincial capital of NTT, to the five Project Areas is obtained through the trans-Timor road leading to Dili in the Timor Timur Province and extending to Bimoku, Oeltua, Benkoko, and Oebuain. Access is obtained to Matasio by a ferry service which connects Kupang to Rote island. Rural electricity supply is available in Bimoku, and Oeltua. In each Project Area, no hospitals are available, but community health sub -centers and health integrated posts were established in order to provide inhabitants with the minimum health care services.

Most of the rural people have no facilities for bathing, defecating, and washing inside their houses. Instead, they use river water for bathing and washing purposes, as well as for providing drinking water for their livestock. In addition, they have private outside toilet or use public toilets. Under these circumstances, they are often suffering from various waterborne diseases.

(4) Agriculture and Livestock

In the six Project Areas, available farmland resources have not been fully utilized due mainly to the short wet season and lack of irrigation water sources. The predominant crops in the six Project Areas are maize and cassava followed by paddy and beans. These crops are grown under rainfed conditions during the wet season. The planted areas and the amount of the major crops producted are shown in Table 2.3.

Normally, the wet paddy field is prepared by animal-drawn ploughs and harrows. The high yielding rice variety IR 64 is commonly used, while little fertilizer is usually applied. No serious plant pests are reported under hot and dry weather conditions, and if necessary, farmers use insecticides. Harvesting is carried out principally by the family labor force and if necessary additional labors hired. Farming practices for growing dry upland crops are very simple and primitive with direct sowing being carried out harrowed fields and no application of fertilizers.

The livestock population in each Project Area in 1993 is summarized below.

Project Area	Cows and Buffaloes	Horses	Goats and Sheep	Pigs	Chickens and Ducks
Bimoku	350	27	257	471	719
Oeltua	484	7	14	469	1,260
Benkoko	725	312	255	542	584
Oebuain	244	12	43	330	679
Matasio	159	6	400	300	150

(5) Irrigation

Irrigation facilities are available in the Benkoko and Matasio areas. In Benkoko and Matasio springs are the irrigation water sources. In Benkoko, the net irrigation area of 70 ha is commanded by the existing system which draws spring water through pipeline and open channel. In Matasio, farmers use spring water for irrigating their wet paddy fields using simple irrigation methods.

(6) Agro-economy

Agricultural extension services are provided for farmers by field extension workers belonging to the existing rural extension centers. Due to the limited operational budget, however, farmers have usually less frequent access to extension service activities. Farmers are organized into Agricultural Cooperative (KUD). But KUD's branches in each Project Area are not very active at present, therefore farmers buy their necessary farm inputs from local markets or merchant shops. Agricultural credits are available in the service network of the Indonesian People's Bank (Bank Rakyat Indonesia/BRI) which offers short-term credits to cover one crop season and a mid-term credit for five years to support farmers' small investments. The outstanding bank credits in NTT amounted to Rp. 165,226 million in total in 1992, comprizing investment credit of 14 %, capital investment of 71 %, and consumption investment of 15 %. Of the total bank credit, 61 % was lent to customers in the Timor and Rote islands, including small enterprises whose share was 12 %.

The food produced in the six Project Areas is consumed by the farmers' themselves and partly sold to local markets or middlemen in Kupang if the farmers need cash. The present condition of the farmers' home economy clarified through the agro-economy survey conducted under the Study, is summarized below. Among the 58 respondents, 23 farm households manage to keep their family budgets in the black, while the finances of the families in the other 35 farm households have been straitened. Usually these families make up their deficits by receiving allowance from relatives and family members or extra cash by working away from home.

Project Area	Average Annual Income (Rp. '000)	Average Annual Expenditure (Rp. '000)	Surplus or Deficit (Rp. '000)
Bimoku	1,564	1,883	-319
Oeltua	877	1,220	-313
Benkoko	1,302	1,154	148
Oebuain	827	1,034	-207
Matasio	1,222	1,521	-299

2-3-5 Operation and Maintenance Plan

After the completion of the five proposed reservoirs, the O&M section of PRIS is responsible for operating and managing the reservoirs, as well as water intakes and distribution facilities. Among the various management works to be carried out by this section, the operation of the reservoir is the main function and needs to be conducted on the basis of the operation rule to be established. In order to operate and maintain the project facilities effectively according to the above rule, it is a prerequisite that the capability of the O&M staff and the level of the O&M equipment.

With regard to the maintenance of the water distribution and irrigation facilities, it is proposed that PRIS organize people so that they will participate in routine works such as the cleaning of water division boxes, clearing of animal excreta around the water division boxes, repairing of fences along the reservoir, and so on.

Chapter 3 Basic Design

3-1 Design Policy on Reservoir Development

(1) Topographic Condition

The original sites identified through the previous identification studies carried out by PRIS of NTT are reconfirmed to be appropriate. The shape and width of the valley and topographically maximum height of each reservoir site are shown below:

Reservoir	Shape of the Valley	Width of the Valley (m)	Topographically Maximum Height (m)
Bimoku	Rather deep/narrow	90	14.0
Oeltua	Shallow/wide	350	12.0
Benkoko	Rather deep/wide	400	19.5
Oebuain	Rather deep/rather wide	200	20.0
Matasio	Deep/wide	300	17.0

(2) Geological Condition

The geological investigation conducted under the Master Plan Study consists of core drilling, a field permeability test, a standard penetration test, and an unconfined compression test. Table 3.1 shows the engineering geological features of each reservoir site and detailed information concerning these features is presented in Annex 1 to Annex 6 (except Annex 3, these are hereinafter referred to as the Annexes).

The coefficient of permeability of the foundation rocks varies from 2.8×10^{-5} to 9.8×10^{-6} for Noele Formation, 4.3×10^{-4} to 3.8×10^{-6} for Coralline limestone, 2.2×10^{-5} to 7.1×10^{-7} for Bobonaro Complex and 6.9×10^{-2} to 2.4×10^{-7} for debris. These permeability values reveal that ordinary to special care against seepage or the leakage of water from the reservoir through the dam foundations or the abutments is taken into consideration in the design of the foundations. The results of the standard penetration and unconfined compression tests also suggests that the type of dam should be determined.

In each reservoir area, no major fault or landslide are recognized in the field. It is however envisaged that water leakage occurs through bedding rocks with heterogeneous permeability. Therefore, careful consideration is required in order to introduce effective countermeasures to water leakage.

(3) Availability of Embankment Materials

The PRIS of NTT carried out the first construction material survey in and around each reservoir site in 1992, in order to check the availability of embankment and concrete aggregate materials. The second material survey under the Study was performed to clarify the quantity and quality of embankment materials by field test pitting and laboratory testing. As presented in the Annexes, the results of the tests show that soils in and around each reservoir area are suitable for the embankment materials.

In consideration of the results of the above soil mechanical investigations, the borrow area for obtaining earth materials is selected in the reservoir area of each reservoir. Additional borrow areas selected are hilltops along the Bimoku reservoir, hill slopes downstream of the Oeltua Reservoir, and the downstream riverbed of the Oebuain and Matasio Reservoirs.

The sites selected for obtaining sand and gravel materials for the filter of the dam embankment and concrete aggregates are the N. Pulti and Takari rivers for the Bimoku site, Kasmuti and Baun rivers for the Oeltua site, Noelmina and Maubesi rivers for the Benkoko site, Maubesi and Noel Mina rivers for the Oebuain site, and the seashore for the Matasio site.

(4) Availability of Water Resources

1) Catchment yield

Since no discharge records are available for the water source river, runoff at each reservoir site is estimated using the rainfall records near each site: the Penfui rainfall station near the Bimoku, Oeltua sites; the Kefamenanu rainfall station near the Benkoko and Oebuain site; and the Namodale rainfall station near the Matasio site. These rainfall stations possess rainfall records covering a period of 10 to 28 years, which are used to estimate catchment rainfall. The runoff coefficient of 0.30 was adopted taking into account the characteristics of each catchment area and available hydrological analysis data for the Timor island. The details of the estimated half monthly discharge are presented in Annexes and are summarized below:

Reservoir	Catchment	Mean Monthly Discharge ('000 m^3)											
	Area (km^2)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Bimoku	0.20	24	22	13	4	1	1	1	0	0	0	6	14	86
Oeltua	0.82	99	90	53	15	5	3	2	0	1	2	25	58	353
Benkoko	2.30	167	164	126	72	66	37	37	27	33	39	70	140	978
Oebuain	0.80	41	49	48	35	16	14	4	4	0	2	5	15	233
Matasio	5.00	431	356	429	30	74	17	8	7	0	0	74	284	1,710

2) Floods

To determine the design discharge of the structures, a flood analysis was carried out by adopting the rational formula in consideration of the availability of flood records and the size of the catchment area under the Study. The details of this analysis are presented in Annex 1 to Annex 6. The estimated probable flood for each reservoir is summarized below:

	Return Period						
Reservoir	1 in 2 years	1 in 5 years	1 in 10 years	1 in 20 years	1 in 50 years	1 in 100 years	1 in 200 years
	Probable Flood (m^3/s)						
Bimoku	5	7	9	11	15	18	21
Oeltua	13	20	25	31	40	48	57
Benkoko	19	26	31	36	43	49	56
Oebuain	8	11	13	15	18	21	24
Matasio	20	24	26	28	31	33	34

3) Sediment load

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

4) Water quality

The results of the investigation carried out on the water quality of the source water in June 1994 by the Master Plan Study showed that the water quality does not meet the requirement on Coliform tinja contents defined by the Regulation of Health Department of GOI as summarized below:

cf. Abstract of the Rule Issued by the Health Minister of The Republic of Indonesia Pertaining to the Conditions and Water Quality Control.

Chapter - One : General Specifications, Article 1
The water defined in this rule consists of the following :
c. Clean water is commonly employed for daily uses fulfilling the health needs and shall be boiled before drinking.

Chapter - Two : Conditions
1. The water quality shall fulfills the health conditions covering the microbiological, physical, chemical and raidioactive conditions.
2. The conditions above mentioned in subsection (1) can be seen in the appendixes I, II, III, and IV of this rule.

September 3, 1990

APPENDIX II
List of Clean Water Quality Requirements

No.	Parameter	Unit	Required Max. Limit
C. Micro Biology			
1.	Coliform tinja	/100ml	50
2.	Total Coliform	/100ml	10

Thus the distributed water in each division box on its completion shall be tested and be certified by the local authority concerned on its fulfillment of the regulation.

3-2 Reservoir Development Plan

(1) Optimization of the Development Scale

In order to determine the optimum development scale of each reservoir, the operation of the reservoir is simulated at alternative dam heights. In carrying out the simulation on the half monthly basis, attention is paid to; (i) inflow into the reservoir , (ii) water losses from the reservoir caused by evaporation, (iii) flow of water over the spillway, (iv) outflow needed for domestic purposes, (v) outflow needed for livestock purposes, (vi) outflow needed for irrigation purposes, (vii) volume of water in the reservoir at the beginning of the simulation period, and (viii) volume of water in the reservoir at the end of the simulation period. The simulation model is presented in detail in the Annexes.

Priority is given to the domestic water demand followed by the livestock water demand and then irrigation water demand. The reservoir capacity will have 100 % dependability in order to meet the domestic and livestock water demand, and 80 % dependability for the irrigation water demand. It is assumed that the minimum water level is 0.50 m above the lowest water level needed for ensuring sedimentation volume for 25 years in the reservoir, while the maximum water level is equal to the crest elevation of the spillway.

The consequence elated to the operation of the reservoir of each reservoir are presented in Figures 3.1 to 3.5. The optimum development scale is determined as described below:

- Bimoku : It is impossible for the reservoir water level to return to the full water level during the wet season if the dam height is higher than 14.0 m. Accordingly, the optimum development scale is set up at the maximum dam height of 14.0 m with an effective storage capacity of 51,250 m^3. However, this effective storage capacity can meet the domestic water demand only.

- Oeltua : It is impossible for the reservoir water level to return to the full water level during the wet season if the dam height is higher than 11.5 m. Accordingly, the optimum development scale is set at the maximum dam height of 11.5 m with an effective storage capacity of 81,200 m^3. This effective storage capacity can meet the domestic and livestock water demand.

- Benkoko : If the reservoir is developed to meet the domestic and livestock water demand only, the minimum dam height will be 12.5 m with an effective storage capacity of 10,000 m^3. To utilize the available land resources, the height of the dam needs to be raised to at least 16.5 m for irrigating wet paddy fields of 35 ha and for growing the wet season paddy and the dry season palawija crops. Since

the available water resources are sufficient for increasing the planted area of the dry season palawija crop, the optimum development scale is set up at the dam height of 19.5 m with an effective storage capacity of 170,000 m^3.

- Oebuain : It is impossible for the reservoir water level to return to the full water level during the wet season if the dam height is higher than 12.0 m. Accordingly, the optimum development scale is set up at the maximum dam height of 12.0 m with an effective storage capacity of 58,800 m^3. This effective storage capacity can meet the domestic and livestock water demand.

- Matasio : If the reservoir is developed to meet the domestic and livestock water demand only, the minimum dam height will be 10.0 m with an effective storage capacity of 315,000 m^3. In this case, surplus water can cover the irrigation water demand for irrigating wet paddy fields of 40 ha during the wet season. It is impossible for the reservoir water level to return to the full water level during the wet season if the dam height is higher than 11.0 m. Accordingly, the optimum development scale is set at the maximum dam height of 11.0 m with an effective storage capacity of 445,000 m^3. The irrigated paddy fields can be increased to 75 ha in the wet season.

(2) Delineation of the Beneficial Area

According to the optimum development scale of each reservoir, the beneficiary areas can finally be delineated. Through this delineation, first priority is given to basic human needs, by providing the beneficiary people with domestic and livestock water and, if surplus water is available through the operation of the reservoir , second priority is given to the utilization of the remaining storage water for irrigation purpose. Due to the limited effective storage capacity of the Bimoku Reservoir, a part of the Project Area is delineated as the beneficiary area and the beneficial inhabitants are provided with domestic water only. In consideration of the service areas of the existing water distribution system in Benkoko, a part of the Project Area is commanded by the proposed water distribution system. The number of beneficial inhabitants and livestock and the area to be irrigated in the five Project Areas are summarized below.

Project	Inhabitants	Livestock (head)					Irrigated Area (ha)	
Area	(person)	Cow/Buffalo	Horse	Goat/Sheep	Pig	Chicken/Duck	Wet Season	Dry Season
Bimoku	1,825	0	0	0	0	0	0	0
Oeltua	2,077	627	7	21	752	2,384	0	0
Benkoko	935	456	118	235	289	711	35	70
Oebuain	1,773	317	14	63	529	1,268	0	0
Matasio	576	200	7	582	481	285	75	0

(3) Reservoir Development Plan

Following the results of the examination of the reservoir development potential and the optimization study of the reservoir development scale, the proposed development plan for each reservoir was formulated. In terms of the dam type, a homogeneous earthfill type was applied

taking into account strength of the foundation and the availability of embankment materials. Regarding the proposed countermeasures to the leakage of water from the reservoirs, except for Matasio, it is proposed that an earth blanket for covering the reservoir areas of Bimoku, Oeltua, Benkoko, and Oebuain be adopted in order to maintain the water tightness of the permeable layer in the reservoirs.

3-3 Basic Plan

(1) Preliminary Design of the Reservoirs

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

Preliminary design works for each reservoir are carried out based on the following basic concepts and procedures:

1) Freeboard

The freeboard of reservoir 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 is 5 % of the distance between the river bed and the designed flood level with an allowance of 1.0 m.

2) Stability of the dam slope

The upstream and downstream embankment slopes of the main dam are determined base on the result of the stability analysis. The required minimum safety factor for the stability of all the embankments is 1.2. The seismic coefficient of 0.15 is applied to the calculation under the F.S.L. condition of reservoirs. This coefficient is determined taking into account the designed seismic coefficient applied to reservoirs and irrigation projects in NTT. A slip circle method is used for the stability analysis. The basic concept of this method is to check whether the resisting moment of the force along the presumed slip circle line exceeds the driving moment caused by gravity and seismic forces or not.

3) Horizontal filter drain and toe rock drain

In order to reduce seepage line within the dam body under the F.S.L. condition, a horizontal filter drain (drainage mattress) and a toe rock drain are provided below the dam body and the toe portion of the main dam.

4) River diversion during construction

In the dry season, river diversion works are required during the embankment works of the main dam of all reservoirs. The design discharge of river diversion works is determined based on the flood discharge with a return period of 1 in 5 years during the dry season from May to November. Rivers can be effectively and economically constructed by providing a random-filled cofferdam and utilizing one or two lanes of concrete conduits.

5) Spillway

A spillway is planned to be provided on the right or left abutment of each reservoir. The spillway is composed of an overflow weir, a throughway, a chuteway, and a downstream channel. The non-gated overflow weir is designed to cope with the inflow design flood determined for 100-year probable flood. If necessary, a bridge will be built over the throughway of the spillway.

6) Outlet works

Outlet works are provided in order to release the impounded water to the downstream beneficiaries for domestic and irrigation uses. These works comprize an intake structure, a pipe line, and a valve house. The intake structure is located above the sediment deposition level of each reservoir. Fixed trash racks are provided on the intake structure. Cast iron pipes connect the intake structure to the valve house and run along the river diversion conduits. The valve house is constructed near the downstream toe of each reservoir and comprizes a check valve and a flow meter for controlling the released water.

7) Leakage protection works

There are several different kinds of leakage protection works such as rubber sheet facing works, concrete facing works, earth blanket work and so on, which have been carried out in order to protect the reservoir area from water leakage. A leakage protection method is selected for each reservoir taking into careful consideration the construction costs required for leakage protection works, construction methods for leakage protection works, topographic, geological and soil mechanical conditions in the reservoir area, socio-economic conditions around the reservoirs, and so on. The leakage protection works applied to each reservoir are summarized below:

- Bimoku, Oeltua, Benkoko and Oebuain : Soils in the reservoir area can be used as blanket materials for protection against leakage. Earth blankets with a thickness of 2.0 m will be constructed throughout the whole reservoir area.

The Main features of the five reservoirs are shown in Table 3.2 and summarized below:

Item	Unit	Bimoku	Oeltua	Benkoko	Oebuain	Matasio
Catchment area	km^2	0.2	0.8	2.3	0.8	5.0
Dam height	m	14.0	12.0	19.5	12.0	11.0
Crest length	m	90.0	340.0	413.0	180.0	297.0
Reservoir area	m^2	13,200	25,750	38,800	21,000	160,000
Effective storage capacity	m^3	51,250	81,200	170,000	58,800	445,000
Embankment volume	m^3	31,000	200,000	221,000	80,000	110,000
Design flood discharge of the spillway	m^3/s	18	48	49	21	33
Crest width of the spillway	m	6.2	8.7	12.4	7.3	9.1

(2) Preliminary Design of the O&M Road for Reservoir

In the Bimoku, Oeltua, and Oebuain Reservoir sites the access roads are in good condition. However, in and around the Benkoko and Matasio Reservoir sites the roads have been weathered. Therefore, it is planned that after the completion of the reservoirs O & M roads to these sites will be provided for the implementation of the O & M works. The main features are summarized below:

Item	Unit	Benkoko	Matasio
Required length	km	3.20	2.00
Width	m	4.0	4.0
Pavement		Gravel	Gravel
Cross drain	nos.	8	5

(3) Preliminary Design of the Water Distribution Facilities

Preliminary design for each water distribution system was carried out based on the following basic concepts:

- Distribution facilities to the beneficiary areas are laid out taking into consideration the effective storage capacity of each reservoir, topographic condition of each Project area, village boundary and the existing water supply facilities.
- Water demand of inhabitants and livestock is fully reflected in the preliminary design of pipelines and the layout of division boxes in the beneficiary areas.
- Pipeline systems with pressure flows are adopted by the water distribution network from each reservoir to its beneficiary area. Pipes are laid along the existing roads as far as possible from the viewpoint of easy O&M of the pipeline system. Pipes are laid underground at a depth of 50 cm.
- Division boxes for inhabitants are arranged based on the demand for water in each beneficiary area, water conveyance distance between a division box and its users'

house, and topographic condition of a site for the construction of a division box. The designed capacity of a division box for inhabitants is 6,000 liters which covers a daily water demand of 100 persons.

- Division box for livestock are planned in different areas away from the division boxes for inhabitants in order to reduce the risk of water contamination and damage to the inhabitants division boxes, and so on. The designed capacity of a division box for livestock is 900 liters which covers the daily water demand of 22 cows.

- Pipelines related structures such as check valves, air valves, and blowoffs are set taking into account topographic conditions along and layout of each pipeline system.

- In consideration of safety against unexpected high pressure, steep and undulating topographic conditions, and the convenience of purchasing materials in Indonesia, High Density PVC pipes are used for supplying water.

The design discharge of pipelines is estimated based on the basis of the unit water demand of inhabitants and livestock, as well as the projected inhabitants and livestock population of the beneficiary area of each reservoir. The main features of the pipeline system are summarized below:

Item	Unit	Bimoku	Oeltua	Benkoko	Oebuain	Matasio
Design discharge	lit/s	1.27	1.80	0.95	1.46	0.56
Total length of pipeline	km	1.47	1.63	5.40	4.22	4.04
Total number of related facilities	Nos.	24	58	46	39	23

(4) Preliminary Design of the Irrigation Facilities

The main components of the water distribution facilities in the beneficiary irrigation areas of the Benkoko and Matasio Reservoirs are irrigation inlet boxes, concrete flume type canals, aqueducts, cross drains and irrigation division boxes.

Preliminary design for the irrigation facilities was carried out based on the following basic concepts:

- Irrigation canals are laid from the outlet of each reservoir to the head of the beneficiary irrigation areas by open channels as much as possible from an economical viewpoint.

- Canal alignment for gravity irrigation systems is designed in harmony with the present environmental circumstances.

- On-farm irrigation service facilities in the beneficiary areas will be improved or upgraded by beneficiary farmers themselves.

The main features of the irrigation water distribution system are shown in Table 3.3 and summarized below:

Item	Unit	Benkoko	Matasio
Design discharge	lit/s	50	100
Irrigation inlet boxes	nos.	1	1
Concrete flume type canals	km	0.3	1.0
Irrigation diversion boxes	nos.	3	1

3-4 Implementation Plan

The executing body of the Project is DGWRD as described in Chapter 2. The Project works financed by Japan's grant aid will be carried out by a Japanese contractor selected through competitive bidding, and construction supervision will be undertaken by the Japanese consultant engaged in the basic design study. Construction will be carried out under the cooperation of DGWRD and other related government agencies, as well as the water users' associations, who are the beneficiaries of the Project.

Except for some special materials most of the necessary construction materials will be procured in Indonesia. The construction equipment required will in principle be procured from Japan.

The construction plan is formulated taking into account the mode of construction, completion target of the construction works, site, weather and topographic conditions, availability of laborers, construction materials and equipment, and so on. The mechanized construction method is principally adopted and supplemented by ordinary construction methods practiced locally as shown below:

- It is assumed that in every year, 200 working days are suitable 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. In every working day an 8-hour shift is required and

- The embankment works for the main dam are carried out during the dry season only and are completed before the end of this dry season in order to secure the quality and profitability of the construction works.

3-4-1 Reservoir Construction Plan

In order to secure the smooth implementation of the Project, it is planned that reservoir construction works be carried out using heavy equipment. The proposed construction plan for the major construction items is described in general as follows:

(1) Preparatory works

The preparatory works consist of the preparation of temporary buildings, construction plant, repair shops, power supply system, water supply system and communication system, construction of access and haul roads, and so on. The temporary buildings comprize offices, living quarters, workshops, warehouses and storage yards. For each reservoir, the required floor space for temporary buildings is 1,200 m^2 for every 15 staff and 100 laborers, and the required land area for temporary buildings and yards is 2,500 m^2.

(2) River diversion works

To release river flow in the dry season, during which the embankment works of the main dam are being carried out, a river diversion conduit is laid under the excavated foundation of the main dam. Considering the proposed location of the outlet works and the topographic conditions of the site, a river diversion conduit is arranged either to the left or right bank side of the river. After the completion of the embankment works of the main dam, the whole length of the river diversion conduit will be plugged using concrete.

(3) Main dam works

Following the completion of the foundation excavation works and river diversion conduit arrangement, the embankment works of the main dam start as soon as possible so that these works are completed before the end of the dry season. The excavation of embankment materials from the borrow areas is carried out by 21-ton class bulldozers. The excavated materials are then loaded by 1.2-m^3 wheel loader and hauled to the embankment site by 11-ton dump trucks. At the site, the embankment materials are spread by a 21-ton bulldozer into a layer 20 cm thick and then compacted by a 10-ton class tire roller.

Riprap placement works are simultaneously undertaken with the embankment works of the main dam. Rock materials are placed by a 0.6-m^3 backhoe, and large voids are filled with smaller rock fragments. Riprap protection works are carried out manually according to the designed slope and thickness.

(4) Spillway construction works

After the completion of the preparatory works, the excavation of a spillway is carried out by a 21-ton bulldozer for the flat portion and a 1.2-m^3 backhoe for the steep slope chuteway portion. Concrete placing works for the spillway structures are carried out using a 20-ton class truck crane with a 1.0-m^3 concrete bucket and a concrete pump with a capacity of 20m^3/hr. Major concrete works need to be completed before starting to impound water in the reservoir in order that the flood discharge is released in the next wet season.

(5) Outlet works

Outlet works are carried out in order 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 the valve house. The cast iron pipe is connected to the check valve and flow meter in the valve house.

(6) Protection works against leakage

Earth blanket works as a proposed protection measure against leakage are undertaken for all reservoirs except for the Matasio. An earth blanket with a thickness of 2.0 m is carpeted up to F.S.L. of the reservoir area. The ground of the reservoir area is loosened using a 21-ton bulldozer and a 3.7-m motor grader. The foundation of the earth blanket is graded and trimmed smoothly using a 11-ton bulldozer and a 3.7-m motor grader. Earth blanket materials are selected from the reservoir area or the borrow area. The quality of the soils in the field are checked and trial embankment works are undertaken at the site. Qualified earth blanket materials are compacted using a 21-ton bulldozer and a 10-ton tire roller.

(7) Construction materials and equipment

The required quantities of the major construction materials for each reservoir are summarized below:

Materials	Unit	Bimoku	Oeltua	Benkoko	Oebuain	Matasio
Earthfill material						
- Main dam	m^3	30,000	200,000	221,000	80,000	110,000
- Blanket	m^3	34,000	68,000	102,000	56,000	0
Filter material						
- Horizontal drain	m^3	1,500	11,500	20,000	5,000	11,000
- Riprap portion	m^3	800	2,500	2,900	900	1,800
Rock material						
- Riprap protection	m^3	1,700	5,500	7,800	2,400	4,800
- Toe rock fill	m^3	1,000	2,500	3,100	1,100	2,200
Concrete						
- Cement	ton	600	760	950	380	660
- Reinforcement bars	ton	50	65	66	22	43
- Aggregates	m^3	1,500	2,000	2,400	1,000	1,700

The required amount of the main construction equipment and plant for the six reservoirs is shown in Table 3.4.

3-4-2 Construction Plan for Water Distribution and Irrigation Facilities

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

3-4-3 Construction and Supervisory Plan

(1) Detailed design and tender works

Prior to the implementation of the Project, the topo-survey, investigation, detailed design and tender works will be carried out. Immediately after the conclusion of the Exchange of Notes (E/N), on agreement for the consulting services will be concluded with DGWRD. Then the consultant will start the detailed design after discussions have been held with DGWRD. In the field investigation at the detailed design stage, discussions will be held with DGWRD concerning the design and implementation schedule. DGWRD is requested to obtain the land required for the construction of the Project facilities, arrange the temporary construction office, and fulfill other requirements prior to the commencement of the Project.

The tender drawings and the tender documents for the civil works will be prepared as the Tender Documents.

The tender for the selection of the civil works contractor will take place after the approval of the tendering process by DGWRD. The first step will be the prequalification

tender, for which a notice will be published on behalf of DGWRD, in the major daily newspapers regarding the construction business and economy in Japan.

The prequalification documents will be distributed by the consultant to the tenderers who have expressed interest in the tender. The tender documents will be distributed by the consultant to the prequalified tenderers.

The tenders will be received by the consultant and opened in the presence of the representatives of DGWRD. Immediately after they are opened, the tenders will be evaluated by the consultant in collaboration with these representatives. In line with the evaluation result's the draft contract will be prepared by the consultant.

(2) Construction supervision

After the conclusion of the civil works contract, the consultant will clarify the construction methods and the construction time schedule for the civil works through discussions held with the contractor. After construction has begun, the consultant's resident engineer will supervise construction and regularly report the work progress, problems encountered, and countermeasures, if any, to both JICA Indonesia Office and DGWRD. He will also coordinate all the agencies concerned with the Project, including the contractor, in order to the Project be implemented smoothly.

Since the careful implementation of the reservoirs is a prerequisite of the Project, a work control engineer will be assigned in addition to the resident engineer. Furthermore, a few engineers will be dispatched for a short period of time to supervise special construction works. Under this arrangement, construction supervision will assure the timely completion of the Project in accordance with the scheduled progress rate and the required work quality.

The scope of construction supervision is outlined below:

(a) Assistance in and advice with the civil works contract

Tenderers prequalification evaluation, tender evaluation, assistance in contract awarding, and witnessing the signing of the contract.

(b) Checking and approval of the construction drawings

Checking and approval of the construction drawings, application for commencement of the works, samples of materials, specifications of equipment etc., submitted by the contractor.

(c) Construction progress and quality control

Guidance with and checking of the construction plan and time schedule, work progress and quality, necessary inspections of the construction methods.

(d) Approval of payments to the contractor

Checking and evaluating of the performance of the works necessary for the issuance of the payment certificates and completion certificate to the contractor.

(e) Report on the progress of construction

Regular reporting to and discussing with DGWRD and agencies concerned of GOJ on the progress of construction.

(f) Handing-over of the completed facilities

Attending the handing-over of the completed facilities to DGWRD after confirmed the completion of the works and the fulfillment of the contract have been.

3-4-4 Implementation schedule

The implementation of the Project is divided into the following two Stages:

The first stage : Construction of the Benkoko, and Oebuain Reservoirs
The second stage : Construction of the Bimoku, Oeltua, and Matasio Reservoirs

The tentative implementation schedule of the Project is given in Figure 3.6.

3-4-5 Procurement Plan

Required quantities of the major construction materials for each reservoir are summarized below.

Materials	Unit	Bimoku	Oeltua	Benkoko	Oebuain	Matasio
Earthfill material						
- Main dam	m3	30,000	200,000	221,000	80,000	110,000
- Blanket	m3	34,000	68,000	102,000	56,000	0
Filter material						
- Horizontal drain	m3	1,500	11,500	20,000	5,000	11,000
- Rip rap portion	m3	800	2,500	2,900	900	1,800
Rock material						
- Riprap protection	m3	1,700	5,500	7,800	2,400	4,800
- Toe rock fill	m3	1,000	2,500	3,100	1,100	2,200
Concrete						
- Cement	ton	600	760	950	380	660
- Reinforcement bars	ton	50	65	66	22	43
- Aggregates	m3	1,500	2,000	2,400	1,000	1,700

3-4-6 Scope of Work

The Indonesian Government shall obtain the required space for realization of the project and have a duty to operate and maintain the completed facilities properly.

Chapter 4 Project Evaluation and Conclusion

4-1 Project Evaluation

Present Conditions and Problems	Countermeasures	Extent of Benefits
1. No water resources development projects have been realized under special geological conditions. Water sources for domestic and livestock uses in each Project Area consist of public water basins, tanks, springs, and wells. All water sources, except for springs, dry up for a part of or the whole the dry season. If the water sources dry up, the inhabitants of an area usually provided with drinking water by public water tankers.	In order to obtain a secure domestic water supply, reservoirs will be constructed using the maximum water resources and pipeline systems with terminal tanks will be set up to villages.	The technology involving the construction of water supply systems in bottlenecked areas is transferred to the engineers concerned. Comparing the beneficiaries of the Project (about 10,000 persons in total at the year of 2004), it might be said that the expensive investment at the unit base will be required. However, this project can be realized by overcoming the weak geological condition at the project site with advanced technology.
2. The average walking distance for carrying water from the sources is 36 m in Bimoku, 500 m in Oeltua, 6,500 m in Benkoko, 1,560 m in Oebuain, and 135 m in Matasio.	One terminal tank for 100 villagers will be provided.	Sometimes women and children in the five Project Areas are released from their daily hard job of carry their domestic water at the average distance of 1,780 m. As a result, women will be able to designate this saved time to other activities related to not only agriculture and livestock but also small business and cottage industries. An increase in the family's income would encourage women to use the surplus income improving the above and diversify their income sources.
3. Inhabitants have no facilities for bathing, defecating, and washing their houses. Instead, they are using river water for bathing and washing purposes, as well as for providing drinking water for their livestock. Under such circumstances, they often suffer from various waterborne diseases.	Supplied water is secured as clean water by GOI rule.	Sanitary conditions in the villages have improved.

Present Conditions and Problems	Countermeasures	Extent of Benefits
4. In the five Project Areas, available farmland resources have not been fully utilized due mainly to the short wet season and lack of irrigation water sources.	Irrigation facilities are provided at Bimoku and Matasio with sufficient water resources.	Farmers incentive to upgrade their productivity will be realized.

4-2 Justification of the Project Implementation

(1) Spreaded beneficiaries of the project have had no opportunities to receive any benefits of Development Policy.

(2) The objective of the Project which is in line with BHN, is to improve people's living standards.

(3) GOI can operate and maintain facilities using their own finances, human power, and technology.

(4) The objective of the Project is in line with achieving the objectives of the Mid-term and the Long-term Development Plan.

(5) The Project is defined as a non profitable one and as a suitable model for BHN fulfillment.

(6) Under the Project there are no effects on environmental aspects and no detrimental effects on water quality.

(7) The Project will be completed under the regulations of the Japanese Grant Aid Policy.

4-3 Conclusion

It is concluded that the implementation of the Project would be suitable for Japan's grant aid, because the Project will not only secure BHN of villagers but also significantly contribute to the targets of Repelita VI. Furthermore, there will be no problems with O&M of the Project, since DGWRD has sufficient funds, manpower, and engineering know-how.

Tables

Table 2.1 Main Features of Geological Formation

Name of Stratum	Reservoir Site	Rock Facies	Consolidation	Color	Characteristics	Engineering Geological Features	Standard Penetration N-value	Coefficient of Permeability cm/s
Bobonaro Complex	Benkoko Oebuain Matasio	Claystone to Claystone with exotic blocks (crystalline limestone and calcarious shale)	Soft rock (hard rock for exotic blocks)	Dark grey to dark red	Chaotic rock formed of olistostrome originated from submarine landslide deposits	No water leakage and foundation problem	10 to 50	6.1 x 10-5 to 2.4 x 10-7
Nocle Formation	Bimoku Oeltua	Siltstone	Soft rock	Whitish grey	Sandy marl interdedded with sandstone, conglomerate and tuff	No water leakage and foundation problem	19 to 50	2.8 x 10-5 to 2.3 x 10-6
Coralline Limestone	Bimoku Oeltua	Coral limestone	Medium hard rock	Milky white to yellowish white	Highly porous and mederately hard rock formed of raised coral reef	Water leakage problem	16 to 50	5.8 x 10-3 to 1.1 x 10-5
	Matasio	Sandy limestone	Soft rock	Milky white to yellowish white	Secondary deposit distributed under coral limestone	Wide variation of permeability with water leakage problem in limited part of layer	12 to 50	4.3 x 10-4 to 3.8 x 10-6
Debris	Benkoko Oebuain	Soils with gravel	Sediments	Dark brown to brownish grey	Secondary deposits overlying the Bobonaro Formation and formed of mud flow	Wide variation of permeability with water leakage problem in limited part of layer	10 to 50	6.9 x 10-2 to 2.4 x 10-7

Table 2.2 Present Domestic and Livestock Water Uses

Type of Water Source	Unit	Bimoku	Oeltua	Benkoko	Oebuain	Matasio
Public Water Basin and Tank						
No. of facility	Nos.	5 (2*)	1	-	-	3
No. of users	person	569	1,159	-	-	338
	family	123	262	-	-	80
Average distance	m	33	590	-	-	250
No. of livestock	head	36	0	-	-	0
Public Well and Grant Well						
No. of facility	Nos.	5 (1*)	2*	14	5	-
No. of users	person	78	209	1,779	218	-
	family	18	42	356	39	-
Average distance	m	47	250	35	34	-
No. of livestock	head**	119	88	1,159	91	-
Pipeline to Public Water Tank and Water Faucet***						
No. of facility	Nos.	1***	-	1	1	-
No. of users	person	4	-	<1,779>	207	-
	family	1	-	<356>	40	-
No. of livestock	head**	2	-	0	-	-
Private Well						
No. of facility	Nos.	214*	14*	-	-	2 & <3>
No. of users	person	1,234	135	-	-	83/<96>
	family	310	27	-	-	20/<22>
Average distance	m	16	42	-	-	10/<15>
No. of livestock	head**	206	0	-	-	0/<0>
Spring and Artesian Well***						
No. of facility	Nos.	-	-	26	5	-
No. of users	person	-	-	<1,779>	255	-
	family	-	-	<356>	48	-
Average distance	m	-	-	7,040	985	-
No. of livestock	head**	-	-	<1,159>	230	247
River						
No. of facility	Nos.	1	-	-	-	14
No. of users	person	106	-	-	-	0
	family	32	-	-	-	0
Average distance	m	100	-	-	-	6
No. of livestock	head**	132	552	-	<321>	0
No Specific Water Source, and Water suppied by Public Tanker or taken from River/Spring***						
No. of users	person	291	142	-	820***	67***
	family	65	28	-	151***	16***
No. of livestock	head**	0	0	-	0	0

Remarks : * ; Water source destroyed, dried up during the dry season or contaminated by mud water during the wet season.

** ; All livestock are converted to number of cow according to unit water consumption rate.

*** ; Indicating numbers of facilities and users in the Project Area.

Source : JICA Water Use Survey

Table 2.3 Present Cultivation Area and Crop Productions

Crop	Unit	Bimoku	Oeltua	Benkoko	Oebuain	Matasio
Cultivable land	ha	286	277	667	386	175
Cropped Area						
Wet paddy						
- Irrigated	ha	0	7	0	0	0
- Raifed (Wet season)	ha	10	0	152	0	60
- Raifed (Dry season)	ha	0	0	52	25	0
Maize	ha	276	75	365	220	3
Groundnut	ha	0	15	0	5	0
Mungbean	ha	0	0	0	4	0
Cassava	ha	0	5	15	0	0
Tuber crops	ha	0	0	0	215	0
Coconut	ha	0	0	0	7	10
Total cropped area	ha	286	102	584	476	73
Cropping Intensity	%	100	37	88	123	42
Yield						
Wet paddy						
- Irrigated	ton/ha	-	1.70	-	-	-
- Raifed (Wet season)	ton/ha	1.50	-	1.20	-	2.25
- Raifed (Dry season)	ton/ha	-	-	1.50	1.70	-
Maize	ton/ha	0.40	1.40	2.40	1.10	2.00
Groundnut	ton/ha	-	1.00		0.75	-
Mungbean	ton/ha	-	-	-	0.80	-
Cassava	ton/ha	-	4.00	4.60	-	-
Tuber crops	ton/ha	-	-	-	8.00	-
Crop Production						
Wet paddy						
- Irrigated	ton	0	12	0	0	0
- Raifed (Wet season)	ton	15	0	182	0	14
- Raifed (Dry season)	ton	0	0	78	43	0
Upland paddy	ton	0	0	0	0	0
Maize	ton	110	105	876	242	6
Groundnut	ton	0	15	0	4	0
Mungbean	ton	0		0	3	0
Cassava	ton	0	20	69	0	0
Tuber crops	ton	0	0	0	1,720	0

Source : JICA Agro-economy Survey

Table 3.1 Engineering Geology of Each Reservoir Site

Site	Foundation	N - Value	Permeability (cm/sec)	Problem
Bimoku	Noele Formation; Siltstone	19～50	2.8 x 10-5 ～9.8 x 10-6	None
	Coralline limestone; sandy limestone	12～50	7.4 x 10-5 ～1.6 x 10-5	Minor Water Leakage
Oeltua	Coralline limestone; sandy limestone	11～50	4.3 x 10-4 ～3.8 x 10-6	Water Leakage
Benkoko	Bobonaro Complex; claystone	14～50	2.2 x 10-5 ～2.4 x 10-7	None
	Debris; soil with gravel	10～41	6.9 x 10-2 ～2.4 x 10-7	Water Leakage
Oebuain	Bobonaro Complex; claystone	16～46	3.8 x 10-5 ～8.5 x 10-7	None
	Debris; soil with gravel	36～50	8.4 x 10-3 ～2.2 x 10-5	Water Leakage
Matasio	Bobonaro Complex; claystone	10～49	6.1 x 10-5 ～7.1 x 10-7	None
	Coralline limestone; coral limestone	16～48	1.1 x 10-5	Major Water Leakage

Table 3.2 Main Features of the Reservoir

Item	Unit	Embung				
		Bimoku	Oeltua	Benkoko	Oebuain	Matasio
Reservoir						
- Catchment area	km2	0.20	0.82	2.30	0.80	5.00
- Full supply level (F.S.L.)	El.	24.00	362.50	576.00	375.00	32.00
- Minimum operation level (M.O.L)	El.	16.50	357.80	568.00	371.00	27.30
- Effective storage capacity	m3	51,250	81,200	170,000	58,000	445,000
- Dead storage capacity	m3	3,750	12,800	34,000	13,200	85,000
- Gross strage capacity	m3	55,000	94,000	204,000	72,000	530,000
- Sediment deposition level	El.	16.00	357.20	567.40	370.40	26.80
Main dam (homogeneous earthfill)						
- Height above river bed	m	14.00	12.00	19.50	12.00	11.00
- Crest elevation	El.	27.00	366.00	579.50	378.00	35.00
- Crest length	m	90.00	340.00	413.00	180.00	297.00
- Crest width	m	7.00	6.00	7.00	6.00	6.00
- Upstream slope		1:3.5	1:4.0	1:3.5	1:4.0	1:4.0
- Downstream slope		1:3.0	1:3.0	1:3.0	1:3.0	1:3.0
- Total embankment volume	m3	31,000	200,000	221,000	80,000	110,000
Spillway						
- Design flood (1/100)	m3/s	20.00	50.00	50.00	21.00	33.00
- Type		Non gated overflow	Non gated overflow	Non gated overflow	Non gated overflow	Non gated overflow
- Crest elevation of overflow weir	El.	24.00	362.50	576.00	375.00	32.00
- Width of overflow weir	m	6.20	8.70	12.40	7.30	9.10
- Discharge capacity	m3/s	20.00	20.00	50.00	21.00	33.00
- Length	m	89.00	107.00	132.00	95.00	120.00
River diversion						
- Design flood (1/5 year in dry season)	m3/s	2.00	5.50	15.70	6.70	7.00
- Conduit, Box culvert (B*H*Nos.)	m	-	-	-	-	-
Pipe culvert (Dia. * Nos.)	mm	900 x 1	1,100 x 1	1,200 x 2	1,200 x 1	1,200 x 2
Outlet works						
- Inlet structure	m	1.0 x 1.0	1.0 x 1.0	1.0 x 1.0	1.0 x 1.0	1.0 x 1.0
- Pipe diameter	mm	40.00	50.00	200.00	65.00	300.00
Leakage protection works						
- Type		Earth Blanket	Earth Blanket	Earth Blanket	Earth Blanket	-
- Covering area	El.	24.00	362.50	576.00	375.00	-
	m2	13000.00	25000.00	39000.00	21000.00	-
- Thickness	m	2.00	2.00	2.00	2.00	-

Table 3.3 Main Features of the Irrigation Facilities

Benkoko	Matasio
- Valve house : 1 No. (including in the facilities for Embung) - Irrigation inlet box : 1 No. - Concrete flume type canal with a base width of 0.5 m : Approx. 330 m - Cross drain : 1 No. - Irrigation division box : 3 Nos.	- Valve house : 1 No. (including in the facilities for Embung) - Irrigation inlet box : 1 No. - Concrete flume type canal with a base width of 0.5 m : Approx. 1.0 km - Aqueduct : 1 No. - Cross drain : 3 Nos. - Irrigation division box : 1 No.

Table 3.4 Minimum Amount of Construction Equipment

(Required for Each Embung Construction)

	Equipment	Capacity	Minimum Number of Equipment
1.	Bulldozer	21 ton	2
2.	Wheel loader	1.2 m3	1
3.	Backhoe	1.2 m3	2
4.	Backhoe	0.6 m3	3
5.	Dump truck	11 ton	12
6.	Dump truck	7 ton	3
7.	Tyre roller	10 ton	1
8.	Motor grader	3.7 m	1
9.	Water tanker (Sprinkler)	6 kl	1
10.	Leg drill	2.8 m3/min	2
11.	Sinker	3.3 m3/min	2
12.	Air compressor	14 m3/min	1
13.	Batching plant	0.75 m3*1	1
14.	Agitator	3.2 m3	2
15.	Concrete bucket	1.0 m3	2
16.	Concrete vibrator	-	3
17.	Track crane	20 ton	1
18.	Water pump, Dia 200 mm	3.7 kw	2
19.	Welder	300 A	2
20.	Diesel generator	80 KVA	2
21.	Truck	7 ton	4
22.	Truck with crane	6 ton	1
23.	Pickup car	-	4
24.	Jeep	-	4
25.	Concrete pump	20 m3/hr	1

Source : JICA Study Team estimate

Figures

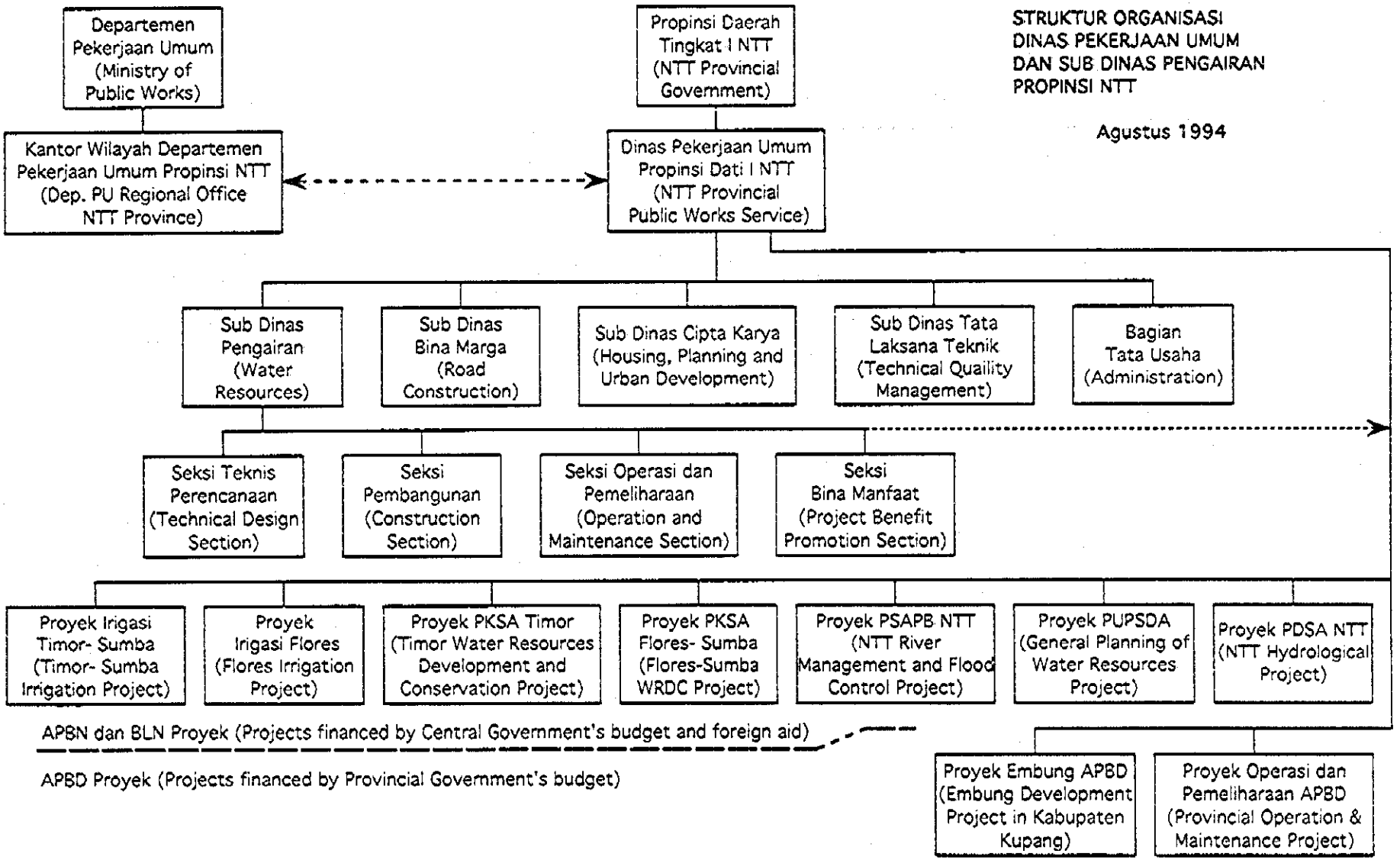

Figure 2.1 Present Organization of PRIS

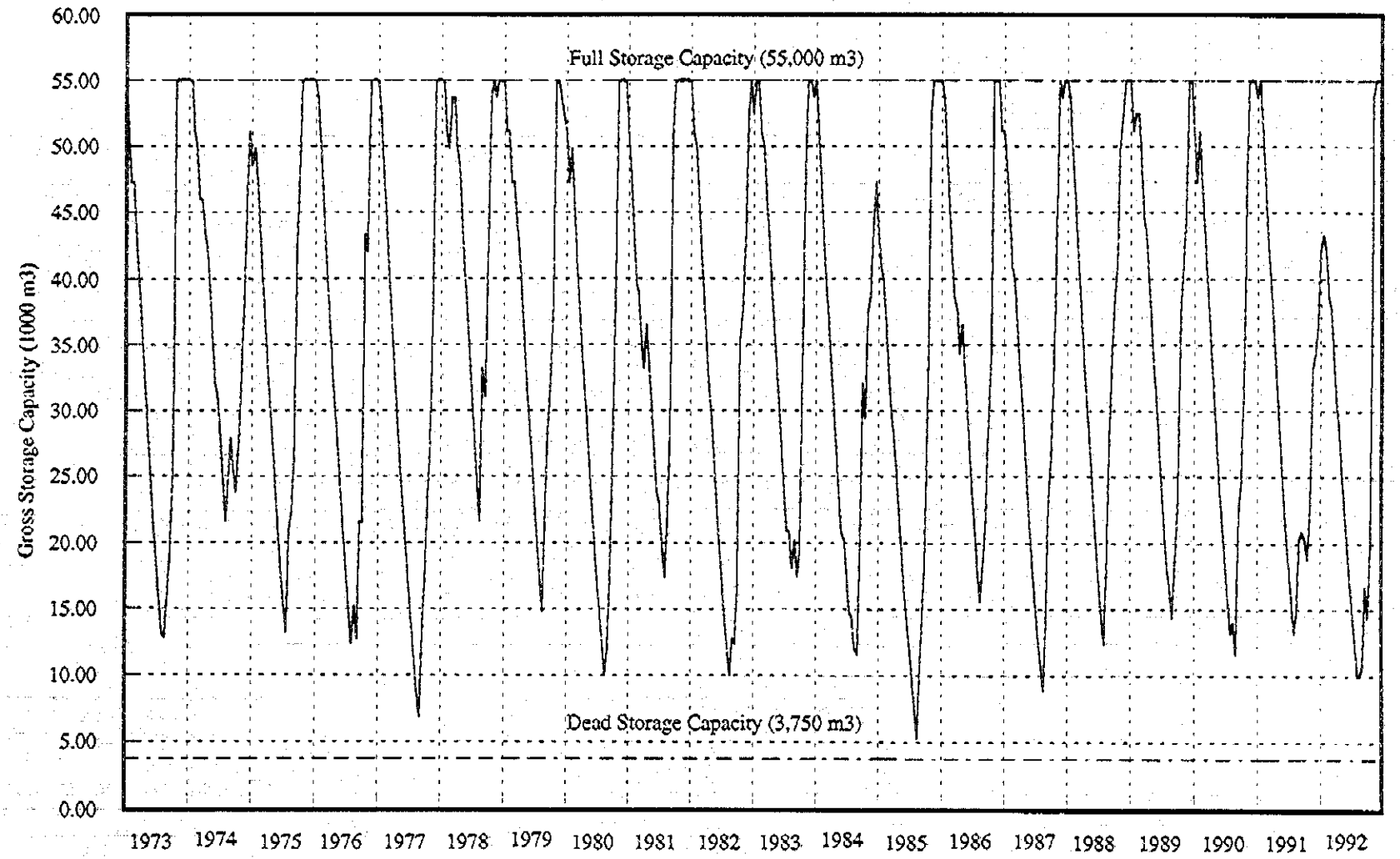

Figure 3.1 Reservoir Operation at Bimoku

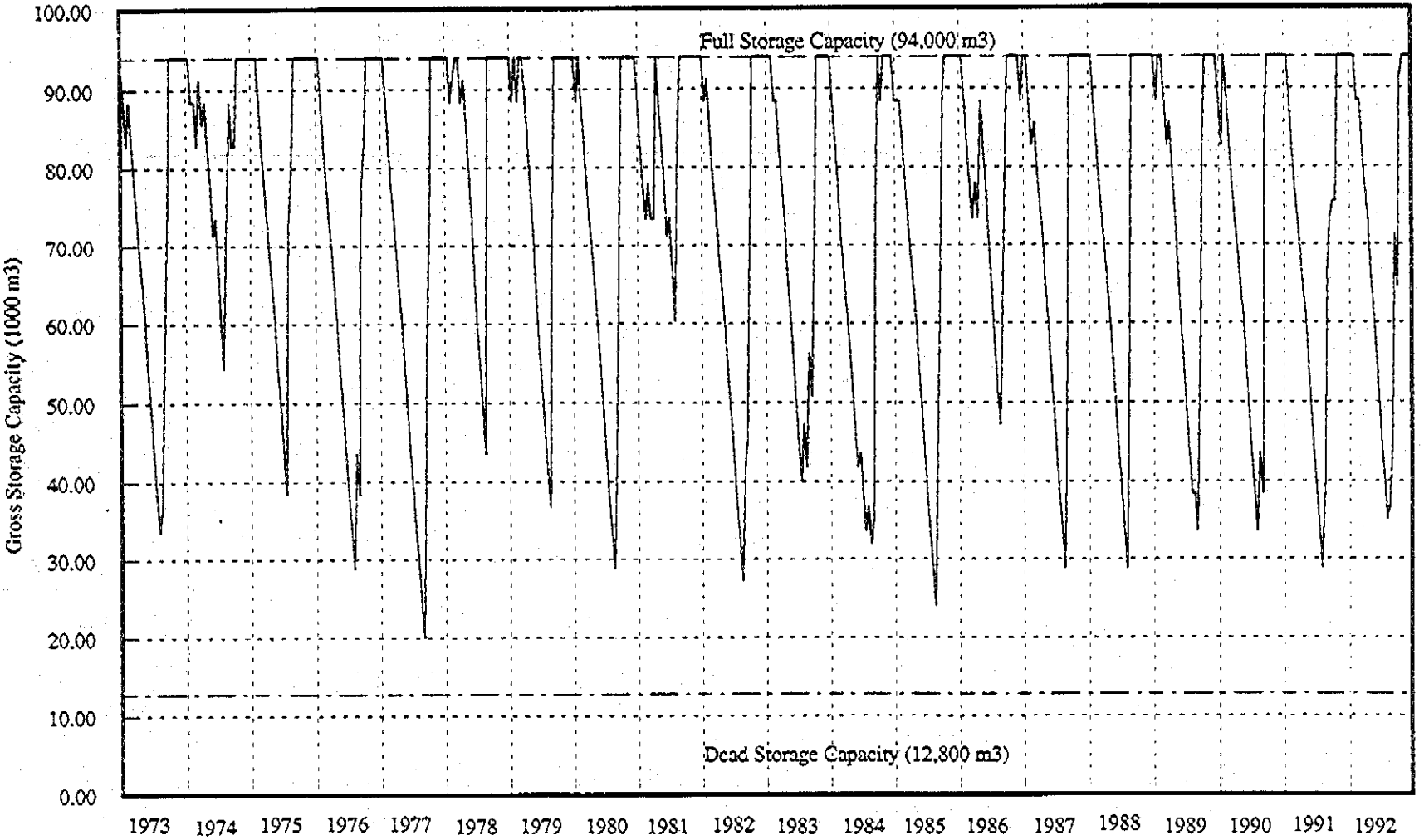

Figure 3.2 Reservoir Operation at Oeltua

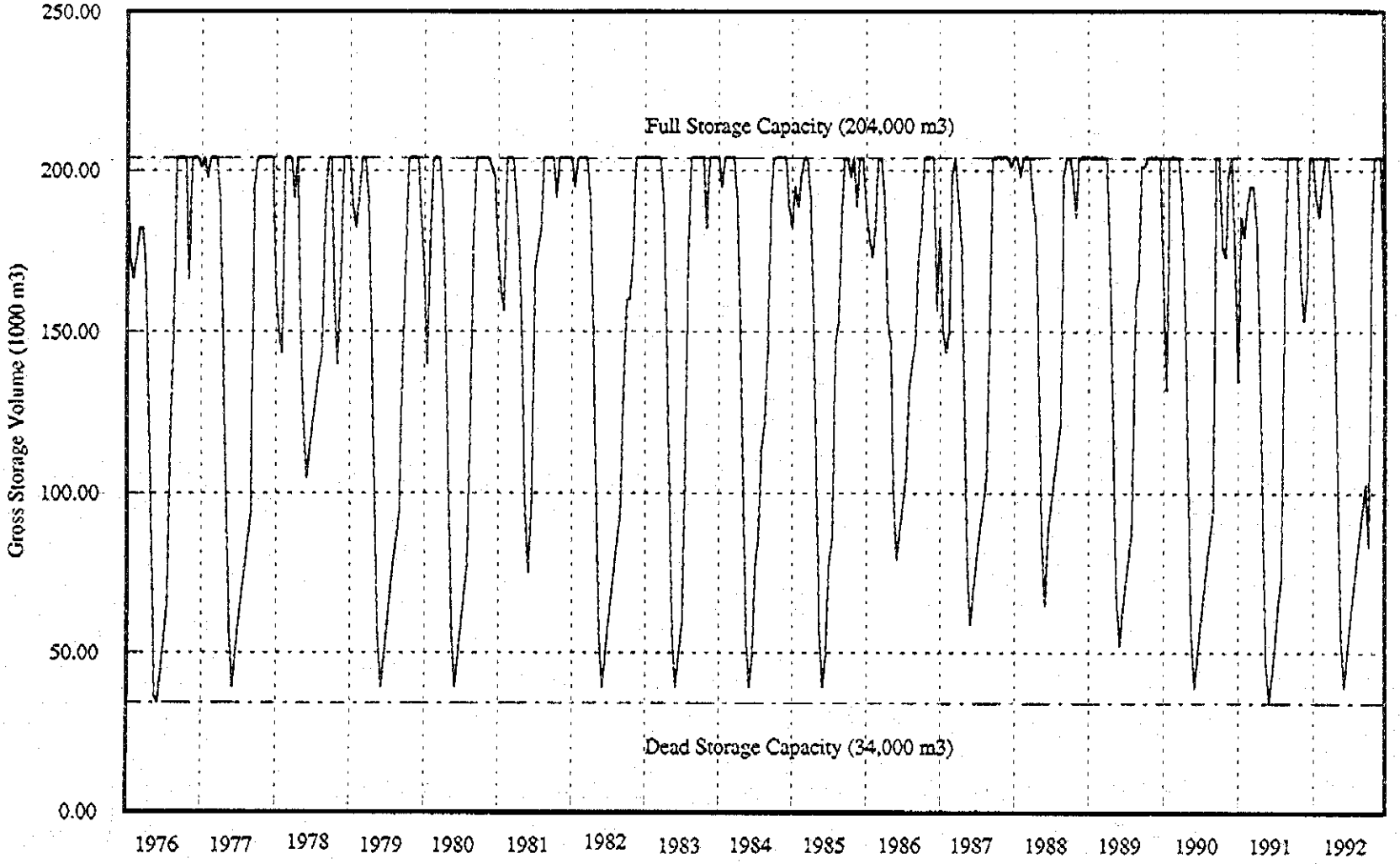

Figure 3.3 Reservoir Operation at Benkoko

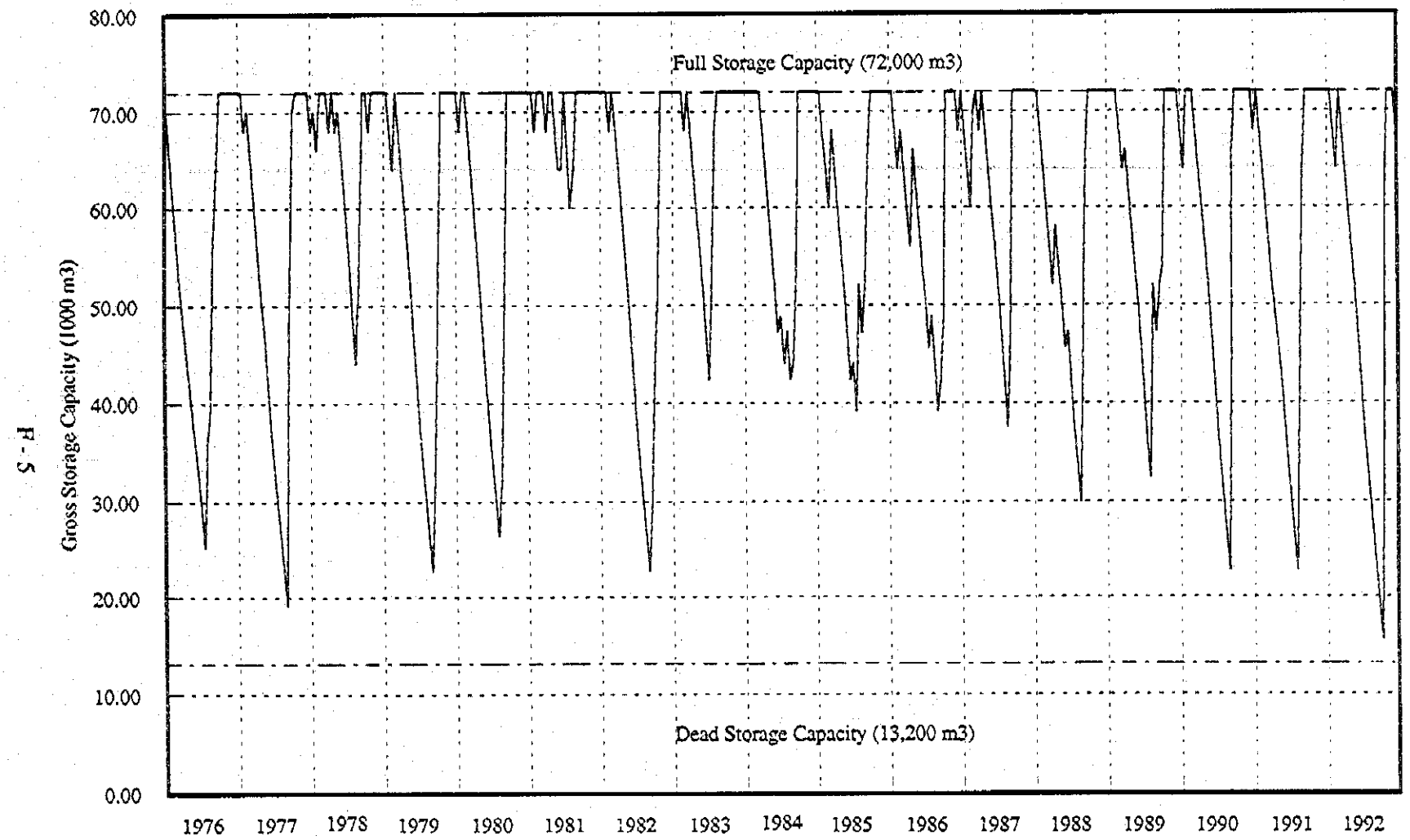

Figure 3.4 Reservoir Operation at Oebuain

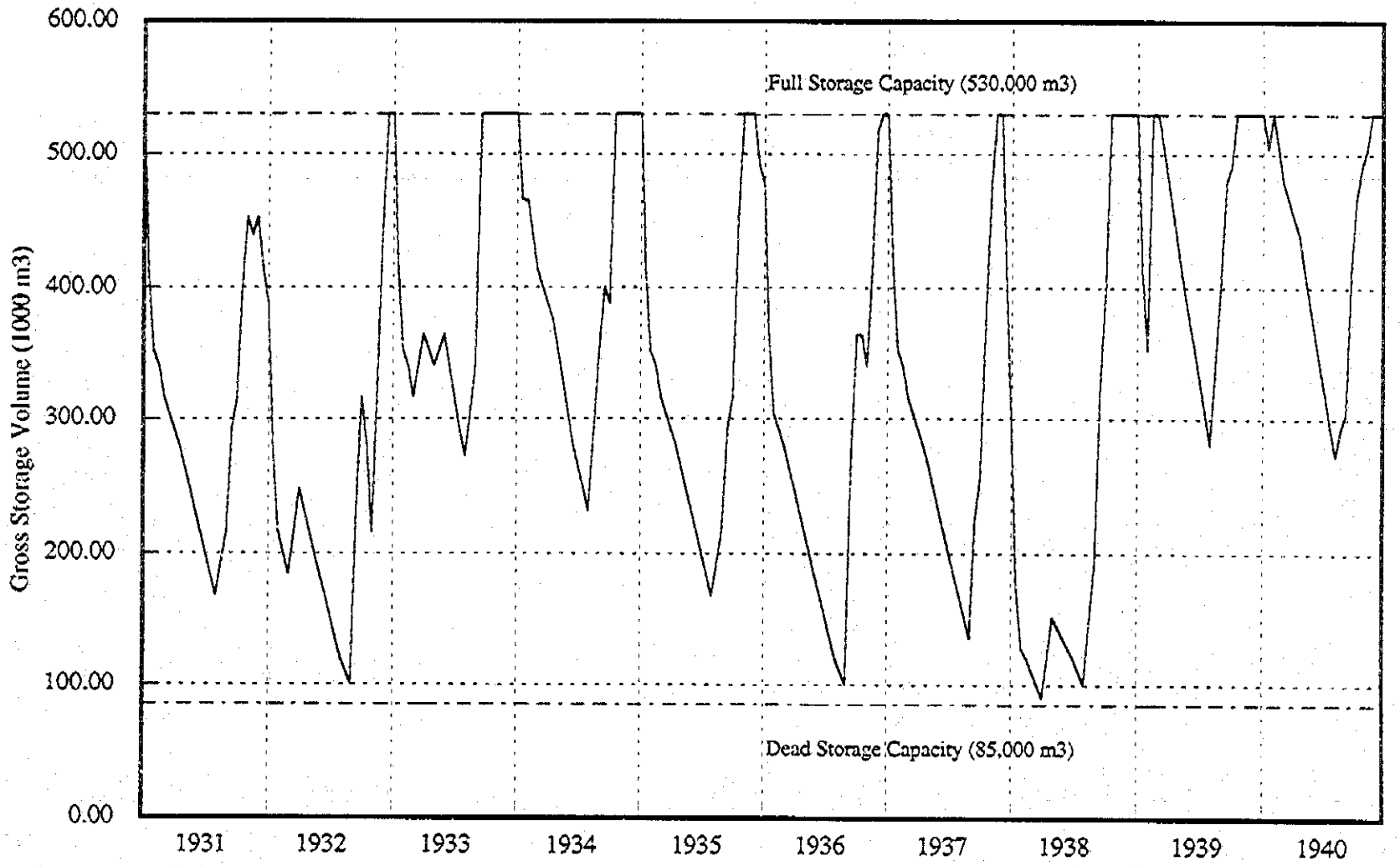

Figure 3.5 Reservoir Operation at Matasio

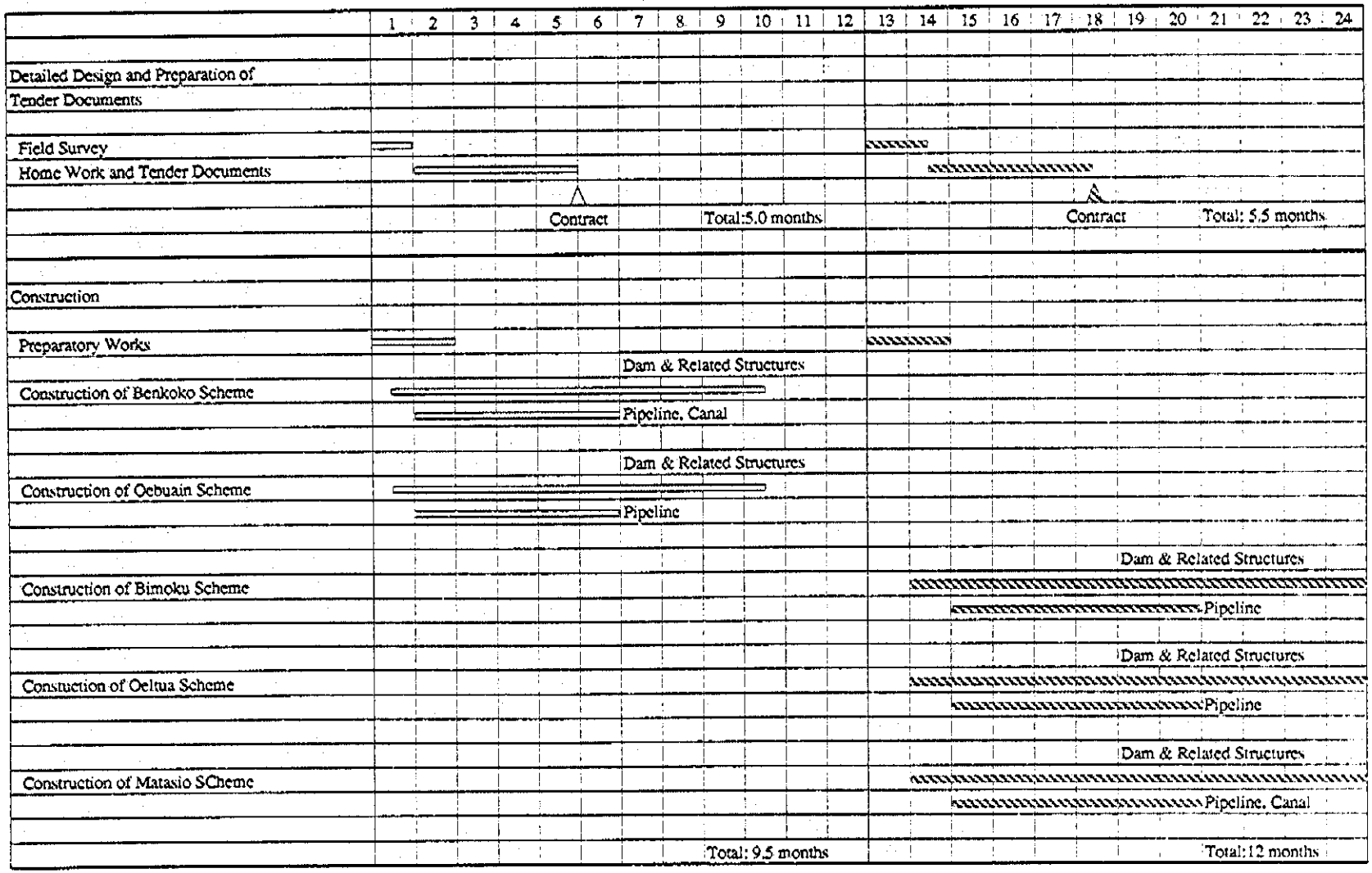

Fig. 3.6 Tentative Implementation Schedule of the Project

Appendix

Appendix 1. Member List of Survey Team

(1)	Leader / Grant Aid	Akira NAKAMURA	First Basic Design Division, Grant Aid Study & Design Department, JICA
(2)	Chief Consultant	Yasuhiko KUNIHIRO	Nippon Koei Co., Ltd.
(3)	Facility Design / Cost Estimation	Shigeyuki TANAKA	Nippon Koei Co., Ltd.

Appendix 2. Survey Schedule

	Date	Day	Journey	Activity
1	11/16	Wed.	Tokyo - Denpasar	Trip
2	/17	Thu.	Denpasar - Kupang	Courtesy call to agencies
3	/18	Fri.	Kupang	Meeting on the report
4	/19	Sat.	Kupang	Data collection
5	/20	Sun.	Kupang - Jakarta	Trip
6	/21	Mon.	Jakarta	Meeting on the report
7	/22	Tue.	Jakarta-Tokyo (Nakamura) Jakarta (Kunihiro, Tanaka)	Signing the M/D, Reporting to EOJ & JICA
8	/23	Wed.	Jakarta (Kunihiro, Tanaka)	Data collection
9	/24	Thu.	Jakarta-Tokyo (Tanaka) Jakarta (Kunihiro)	Data collection
10	/25	Fri.	Jakarta (Kunihiro)	Join to Master Plan Study

Appendix 3. Member List of Party Concerned in Indonesia

Embassy of Japan	Kenichi KAWAMOTO	Ist Secretary
JICA Indonesia Office	Director Okazaki	
	Shishido in charge	

DGWRD, Ministry of Public Works

Director Genral	Ir. Sparmono
Director of Programming Guidance	Ir. Djoko Sarjono
Director of Technical Guidance	Ir. M.Hardjono
Sub.Dit Foreign Aid, D.P.G.	Drs. S.Hadiwijono
Sub.Dit Irrigation, D.T.G.	Ir. R.Zainuddin

Coordinating Members of NTT

1	Ketua Pappeda Tingkat I NTT	Drs. T.I.Therik
2	Kepala Kanwil Dep. PU Prop NTT	Ir. RTS Harjono
3	Kepala Dinas PU Prop. Dati I NTT	Ir. Frankie Tayu
4	Kepala Sub Dinas Pengairan DPU Prop Dati I NTT	Ir. Joseph Heru Marsudi Dlpl. HE
5	Kepala Kanwil Pertanian Prop. NTT	Ir. A.P.Hutabarat
6	Kepala Kanwil Kehutanan Prop. NTT	Ir. Toga Sialagan
7	Kepala Sub Dinas Cipta Karya DPU Prop. Dati I NTT	Ir. Jamin H
8	Kepala Sub Dinas Bina Marga DPU Prop. Dati I NTT	Dr. Piter D. Rebo
9	Kepala Dinas Pertanian Prop. Dati. I NTT	Ir. Umbu Purawoha
10	Kepala Dinas Keternakan Prop. Dati I NTT	Ir. E. Th. Sakar
11	Kepala Dinas Kehutanan Prop. Dati I NTT	Ir. Ilianto Boedimar
12	Kepala Dinas Perkebunan Prop. Dati I NTT	Ir. Domi Ndarung
13	Kepala Badan Pertanahan Nasional Prop. NTT	Drs.Soeprapto Hadimoelyono
14	Kasie. Pelaksanaan Sub Dinas Pengairan DPU Prop. Dati I NTT	Tj. R.Y.Halundaka, BE
15	Kasie. Perencanaan Sub Dinas Pengairan DPU Prop. Dati I NTT	Ir. Didik Kresnohadi
16	Pimpro P2KSA Flores Sumba	Ir. Herry Oematan
17	Pimpro P2KSA Timor	Ir. Joppy H. Manu Dima
18	Bappeda Bidang Physik	Drs. P.J.Radyo Poro
19	Bappeda Bidang Physik	Drs. Jack Djobo

Appendix 4. Minutes of Discussion

MINUTES OF DISCUSSIONS

ON

THE BASIC DESIGN STUDY

ON

THE EMBUNG DEVELOPMENT PROJECT

IN

EAST NUSA TENGGARA

IN

THE REPUBLIC OF INDONESIA

(CONSULTATION ON DRAFT REPORT)

The Japan International Coopeation Agency (JICA) has been conducting the Basic Design Study on the Embung Development Project in East Nusa Tenggara (hereinafter referred to as "the Project") and has prepared the draft report of the study.

In order to explain and discuss the contents of the draft report, JICA sent to Indonesia a study team headed by Mr. Akira Nakamura, First Basic Design Study Division, Grant Aid Study & Design Department, JICA, in November 16 to 25, 1994.

As a result of discussions, both parties confirmed the main items described on the attached sheets.

JAKARTA, November 22, 1994

MR. AKIRA NAKAMURA
LEADER
DRAFT REPORT EXPLANATION
TEAM JICA

MR. DJOKO S. SARDJONO
DIRECTOR OF PLANNING AND
PROGRAMMING
DIRECTORATE GENERAL OF WATER
RESOURCES DEVELOPMENT
MINISTRY OF PUBLIC WORKS

ATTACHMENT

1. Components of Draft Report

The Government of Indonesia has agreed and accepted in principle the components of the Draft Report proposed by the team.

2. Japan's Grant Aid System

1) The Government of Indonesia has understood the system of Japanese Grant Aid Programme explained by the team.

2) The Government of Indonesia will take the neccesary measures described in Annex- I for smooth implementation of the Project on condition that the Grant Aid assistance by the Government of Japan is extended to the Project.

3. Further schedule

1) JICA will make a final report in accordance with the confirmed items, and send it to the Government of Indonesia by the end of January, 1995.

4. Other Relevant Issue

1) The Government of Indonesia will complete land acquisition for the Project before June, 1995.

Annex I : Necessary measures to be taken by the Government of Indonesia in case Japan's Grant Aid is extended.

1. To secure the site for the Project.

2. To clear, level and reclaim the site before commencement of construction.

3. To provide the land for a temporary site office, warehouse and stock yard during implementation of the project

4. To provide necessary facilities for the Project such as electricity, water supply, drainage, and other incidental facilities which will not be covered by the Grant.

5. To bear commissions to the Japanese foreign exchange bank for the banking services based upon the Banking Arrangement.

6. To exempt taxes and to take necessary measures for customs clearance of the materials and equipment brought for the project at the port of disembarkation.

7. To accord Japanese Nationals whose services may be required in connection with the supply of products and the services under the verified contract such facilities as may be necessary for their entry into Indonesia and stay therein for the performance of their work.

8. To maintain and use properly and effectively the facilities constructed and equipment purchased under the Grant.

9. To bear all expenses other than those to be borne by the Grant, necessary for construction of the facilities.

Annex II : Japan's Grant Aid System

1. Japan's Grant Aid Procedures

The Japan's Grant Aid program is extended in the following procedure.

At the first step, a request made by the Government of the recipient country is examined and studied by the Government of Japan(the Ministry of Foreign Affairs) to make sure of the project's appropriateness for Grant Aid. If it is confirmed that the project has the high priority, the Government of Japan instructs the Japan International Cooperation Agency (JICA) to conduct the Study.

At the second step, the Basic Design Study is conducted by JICA under the contract with Japanese consulting firm.

At the third step, the Government of Japan appraises whether or not the project is suitable for Japan's Grant Aid based on the Basic Design Study report presented by JICA and proceeds to get approval for the implementation of Grant Aid from the Cabinet.

At the fourth step, when the implementation of Grant Aid is approved by the Cabinet, an Exchange of Notes is signed by both Governments. By the signing of the E/N, the official commitment of assistance to the recipient country is made, and the execution of Grant Aid begins.

In the course of implementation procedures, JICA will assist the recipient country in terms of the procedures of tender, contract and others.

2. Contents of the Study

1) Contents of the Study

The purpose of the Study(the Basic Design Study) conducted by JICA, is to provide a basic document necessary for the appraisal by the Government of Japan for the project's viability for Japan's Grant Aid. The contents of the Study are as follows:

a) to confirm the background and objectives of the request, the effects of the Project and the maintenance ability of the recipient country,

b) to examine and assess the technical and economic viability of the Project,

c) to confirm the basic concept of the plan through discussions with the recipient country,

d) to make a general layout and design and to estimate the cost of the Project and a schedule required for implementing the construction.

The contents of the original request are not necessarily approved as the scope of the Grant Aid as it is. The scope of the cooperation is decided in consideration of the Japan's Grant Aid scheme.

Since Japan's Grant Aid is aiming at assisting the recipient country's efforts at self-reliance, the Government of Japan requests the Government of the recipient country to take necessary measures in the implementation of the Project. Those undertakings must be guaranteed by the Government of the recipient country including those of which are not within the jurisdiction of the implementing organization. Those undertakings are confirmed in the Minutes of Discussions.

2) Selection of Consultants

For the smooth implementation of the study, JICA selects a consultant among those consultants who register to JICA by evaluating proposals submitted by those consultans. The selected consultant carries out the Basic Design Study and prepares a report based upon the terms of reference made by JICA.

At the stage of implementation after the Exchange of Notes, for concluding the contract regarding the Detailed Design and Construction Supervision of the Project between a consultant and the recipient country, JICA recommends the same consultant which participated in the Basic Design Study to the recipient country in order to maintain the technical consistency between the Basic Design Study and the Detailed Design as well as to avoid undue delay caused by the selection of a new consultant.

3. Japan's Grant Aid Scheme

1) What is Grant Aid ?

Grant Aid is financial assistance extended to a recipient country for the procurement of equipment, facilities, materials, and services needed for

their economic and social development without requiring any repayment. In principle, it is not extended in the form of payment in kind, such as of equipment or facilities or materials, procured by the Government of Japan but in the form of a funds supply, in accordance with relevant laws and regulations of Japan.

2) Exchange of Notes(E/N)
Japan's Grant Aid is extended in accordance with the Exchange of Notes (E/N) between both Govenments, in which the Objectives of the Project, Period, Conditions and Amount of the Grant etc. are confirmed.

3) Japan's Grant Aid is implemented under the single budget system.
Accordingly, each project, from the commitment to the recipient country (signing of E/N) to final payment through contract, must, in principle, be completed within one year. But in fact, exception to this fiscal rule is admitted in the case of a delay in construction due to weather conditions and other unavoidable circumstances. In such cases, implementation of the commitment can be carried over to the next fiscal year with an agreement between both Governments.

4) Grant Aid is used properly and exclusively for the purchase of the products, in principle, of Japan or the recipient country and the services of the Japanese or the recipient country's nationals. The term "Japanese nationals" means Japanese physical persons or Japanese juridical persons controlled by Japanese physical persons.

When both Governments deem it necessary, the Grant Aid may be used for the purchase of the products or services of the third country(other than Japan or the recipient country).

However in terms of the principle of the Grant Aid, the Prime contractors, that is the Consultant, Contractor and Procurement firm, necessary for the implementation of the Grant are limited to "Japanese nationals".

5) Necessity of the "Verification"
The Govenment of the recipient country or its designated authority concludes the contracts with Japanese nationals in Japanese yen, those contracts shall be verified by the Government of Japan. The "Verification" is necessary because the source of Grant Aid is the taxes of Japanese nationals.

6) Undertaikings required to the Government of the recipient country
In the implementation of Grant Aid, the recipient country is required to undertake the necessary measures. (See Annex I .)

7) "Proper Use"
The recipient country is required to maintain and use the facilities constructed and equipment purchased under Grant Aid properly and effectively and to assign the necessary staff for operation and maintenance of them as well as to bear all the expenses other than those to be borne by Grant Aid.

8) "Re-export"
The products purchased under the Grant Aid shall not be re-exported from the recipient country.

9) Banking Arrangement(B/A)
a) The Government of the recipient country or its designated authority shall open an account in the name of the Government of the recipient country in an authorized foreign exchange bank in Japan(hereinafter referred to as "the Bank"). The Government of Japan will execute Grant Aid by making payments in Japanese yen to cover the obligation incurred by the Government of the recipient country or its designated authority under the contracts verified.

b) The payments will be made when payment requests are presented by the Bank to the Government of Japan under an Authorization to Pay issued by the Government of the recipient country or its designated authority.

Appendix 5. Cost Estimation borne by the Government of Indonesia

The required O&M expenditure on five reservoirs and related facilities will be borne by Provincial Government without any heavy burden. The amount of expenditure will be Rp. 10million including salary for aditional five drivers and other O&M expense.