

- Division boxes for inhabitants are arranged based on the water demand in the beneficiary area, water conveyance distance between a division box and its users' houses and topographic condition of a site for constructing a division box. The designed capacity of division box for inhabitants is 6,000 lit to cover daily water demand of 100 persons.
- Related structures of pipelines such as check valves, air valves and blowoffs are set taking into account the topographic condition along and the layout of pipeline system; and,
- High Density PVC pipes are used for the water supply in due consideration of the safety against unexpected high pressure to the pipes, the steep and undulating topographic condition and the easiness to get the materials in Indonesia.

The design discharge of pipeline is decided on the basis of the unit water demand of inhabitants as well as projected population of inhabitants for the beneficiary area.

Main features of the pipeline system are summarized below.

Main Features of the Pipeline System

Facilities	Quantities
Pipeline (Dia. 150 mm)	0.10 km

5.4 Preliminary Design of O&M Road

No all weathered road is available in and around the Embung site. It is therefore planned to provide O&M road to the dam site aiming at smooth undertaking of O&M works after completion of the Embung. Main features are summarized below.

Main Features of O&M Road

Item	Unit	Quantities
Required length	km	0.60
Width	m	7.0
Pavement		Gravel

6. EMBUNG CONSTRUCTION PLAN

6.1 Construction Schedule

(1) Basic condition

All the construction works will be carried out by a local contractor selected by local competitive bidding.

The construction plan is based on the mode of construction and the target schedule of construction works as well as local conditions such as availability of construction labor, material and equipment, as well as weather and topographic conditions of the construction site.

It is assumed that 200 working days per year are available for conducting the earthfill embankment works, 270 days per year for the filter and rock embankment works and 300 days per year for concreting works in view of the daily rainfall distribution in the Project area. For each working day, 8-hour shift is applied.

(2) Construction schedule

The overall construction schedule is determined as shown in Figure 6.1 taking into account the necessary time of detailed design, bidding procedure including the time of tender evaluation and award of the contract. The major points of construction schedule are described below.

1) Mobilization and preparation works

Immediately after received the "Notice to Proceed", the contractor would commence the mobilization of the construction equipment and key staffs to the site from beginning of November in the first year. Following the above, preparatory works would be commenced at the Project site.

2) Setting out and excavation works

During the mobilization, setting out of all the structures would be commenced by the contractor at the Project site. Construction of temporary access roads such as access to the borrow area and access to major structural sites shall be started by using equipment available at the Project site. The excavation works for the river diversion tunnel and the main dam would be commenced at the beginning of March in the second year.

3) Concrete work of river diversion tunnel

Concrete work of the river diversion tunnel will be commenced in August, in the second year and completed in March in the third year.

4) Main dam embankment

After the river water is switched into the river diversion tunnel at April in the third year, the embankment works of the main dam will be done in two dry seasons of the third and fourth years.

5) Spillway and water supply system

Excavation of the spillway will be commenced in September in the second year and completed in July in the third year. The concrete work of the spillway will

be done for 14 months from August in the third year to September in the fourth year. At the time of the plug in the river diversion tunnel, steel pipe with a diameter of 450 mm will be installed from the plug portion to the valve house through the river diversion tunnel. Construction of the valve house will be completed in dry season in the fourth year.

6) Commencement of reservoir water impounding

Commencement of the reservoir water impounding will be done at the beginning of October in the fourth year after completion of the main dam embankment and spillway construction. Considering the rainfall in November and December in the fourth year, the Mataiyang reservoir would be quite full and the water could be supplied from the reservoir to the water users from January in the fifth year.

7) Water distribution system

Construction works for the water distribution system will be executed in parallel with the Embung construction works by using mainly manpower because those work quantities are not so much. The construction works shall be completed by the end of December in the fourth year, before supplying the reservoir water to the beneficiary area.

6.2 Construction Plan of Embung

(1) Preparatory works

The preparatory works consist of preparation of temporary buildings, construction plant and repair shop, arrangement power and water supply systems as well as communication system, construction of access and haul roads, and so on. All of these works will be conducted from November in the first year to February in the second year.

1) Temporary buildings and yards

The temporary buildings required for the construction would include office, quarters, workshop, warehouse and storage yards. These temporary buildings will be built by the contractor.

2) Water and power supply

The water required for the construction works and the daily use in the construction camp is planned to be taken from the rivers or springs near the Embung site or the wells drilled in the contractor's yard.

The electric power for the construction camp is planned to be supplied by the contractor's diesel generators.

(2) River diversion works

The river flow will be released through the river diversion tunnel during the third and fourth year, and therefore the river diversion tunnel will be constructed at the right abutment of the main dam.

After completion of the main dam embankment and the spillway around the end of September in the fourth year, the river diversion tunnel shall be closed by the closing gate and plugged by the concrete using concrete pump.

(3) Main dam works

Following the foundation excavation and completion of the river diversion tunnel, the dam embankment will be commenced at the beginning of April, in the third year. Considering a total embankment volume of 190,000 m³ and the dry season of 13 months until the end of September in the fourth year, the daily embankment volume is to be 600 m³ which is quarried from the borrow area around the Embung construction site.

(4) Spillway construction

Excavation of the spillway will be scheduled to be performed about 11 months in the second and third year. Most of the excavated materials from the spillway may be used for the main dam embankment so that the excavated material will be stocked on the designated area.

After completion of the spillway excavation, concrete works for the weir and chuteway will be commenced. Before starting the reservoir water impounding at the beginning of October in the fourth year, major concrete works of the spillway shall be completed in order to release the flood discharge in the following wet season.

(5) Water supply system

Inlet structure of the water supply system will be constructed at the inlet portion of the river diversion tunnel, during the dry season in the fourth year. Steel pipe with a diameter of 450 mm is installed in the plug portion of the river diversion tunnel just closing point between the dam axis and the tunnel. The steel pipe will be connected from the plug portion to the valve house located immediately downstream of the main dam. Construction of the valve house and the installation of the steel pipe will be completed before the reservoir water reaches to F.S.L. of El. 594.0 around the end of December in the fourth year.

6.3 Construction Plan of Irrigation, Water Distribution Facilities and O&M Road

Since the construction of irrigation facilities, water distribution facilities and O&M road is rather small in work quantities and the sites are scattering in the beneficiary area in comparison with the Embung construction works, almost all the works except earth works for irrigation canal and road will be basically executed by man power. Earth works for the irrigation canal and road such as clearing, stripping, excavation and embankment works will be executed by using heavy construction equipment including bulldozer, excavator, compactor, and so on. All of these works will be executed in parallel with the Embung construction works.

6.4 Institutional Arrangement for Project Implementation

(1) Responsible organization for Project implementation

In the course of Project implementation, DPUP of NTT, after getting approval from DGWRD, will direct the PKSA Flores-Sumba Project Office to commence undertaking of detailed investigation and design works of the Mataiyang Embung. These works will be done by the Survey Section as well as the Technical Program and Design Section of the said Project Office. Based on the cost estimate, DPUP of NTT will disburse budget for land acquisition and construction of Embung and related facilities to the Project Office using development budget allocated from the Central Government. Before starting construction

work, land acquisition work will be carried out by the Construction Implementation Section of the Project Office. Supervision of construction works, being entrusted to a contractor through tendering, will be the responsibility of the Construction Implementation Section of the Project Office.

(2) Technical resources input

In due consideration of the current availability of engineers and technical staff as well as the annual development target in the PKSA Flores-Sumba Project Office, it is necessary to utilize technical resources outside the Project Office to the maximum extent for enabling the Project Office to realize its target. In this connection, undertaking of detailed investigation and design works for the Mataiyang Embung need to be entrusted to consultants aiming to secure smooth implementation of the Project in accordance with the implementation program made by the Project Office.

(3) Organization for O&M

After completing all of the Project works for Mataiyang Embung, DPUP of NTT will submit its completion report to the Minister for Public Works through DGWRD and therefrom the notice of Project completion will be transferred to the Minister for Home Affairs. After receiving the Minister's direction, the Governor of NTT Province will order DPUP of NTT to take a necessary action for O&M of the said Project facilities. Following this, DPUP of NTT will direct its Provincial O&M Project Office to arrange O&M works and disburse the Provincial Government's budget to DPUP Kabupaten Sumba Timur Office.

(4) Water User's Association (P3A)

In the Project area, no P3A has been established. It is therefore necessitated to organize the beneficiary farmers for establishing P3A and to train them by using training materials and modules prepared by the Water User Training Program under DGWRD.

7. COST ESTIMATE

7.1 Basic Assumption of Cost Estimate

Project cost of the proposed works for developing the Mataiyang Embung is estimated on the basis of assumptions as follows :

- All the civil works of the Project will be executed on the contract basis. Contractor(s) will be selected through the competitive bidding;
- Project cost includes the physical contingency of 15% of the construction costs in view of the preliminary nature of the estimate. The price contingency of 20% is also included in the cost estimate taking into account the recent price escalation of construction materials in Indonesia;
- The associated costs to be financed by the Government, such as the cost for strengthening the extension services, facilities of the Water Users' Association and improvement of the social infrastructures except for those included in the proposed Project works, are not included in the cost estimate;
- The direct construction cost is estimated based on the calculated work quantities of the Project works and unit prices of the works. The unit prices of the works are estimated based on the current prices in NTB as of October 1994 and the data collected from the on-going projects in NTT and NTB. The basic prices for construction works include delivery cost of construction materials to the Project site;
- The contract tax, which is a value added tax imposed by the government at a rate of 10% against the total contract cost, is included in the estimate of the Project cost;
- Engineering service cost for the consultants in conducting detailed design and construction supervision is estimated based on such assumption as 15% of direct construction cost;
- Administration cost consists of PRWS's staff salary for construction management, vehicle running cost and other related cost only for the Project implementation. Administration cost is estimated at around 5% of the direct construction cost with reference to the recent other project costs in NTT and NTB;
- Land acquisition cost including the purchase of the Embung site, reservoir area, borrow areas, and land of pipe line, irrigation canal and permanent structures and is estimated at 0.5 % of the direct construction cost taking into consideration the present condition of the Project area based on the survey results under the Study; and,
- The currency for cost estimate is expressed in Indonesian Rupiah (Rp.) since all construction materials are available in Indonesia and the payment for construction works will be executed with Indonesian Rupiah.

7.2 Construction Cost

The Project cost, as an initial investment by the Project, is composed of direct construction cost, administration cost, engineering service cost, physical contingency,

contract tax, land acquisition cost and price contingency. The total Project cost for constructing the Mataiyang Embung is estimated at Rp. 18,498 million as shown in Table 7.1. Detail of direct construction cost estimated based on the calculated work quantities of the proposed Project works and unit prices of the works is shown in Table 7.2 together with work quantities of the main work items and unit prices.

The total Project cost for constructing the Mataiyang Embung is summarized below.

Summary of Project Cost for Mataiyang Embung

Unit : Rp. Million

Item	Project cost
I. Direct construction cost	10,155
1.1 Preparatory works	484
1.2 Embung construction	8,472
1.3 Irrigation facilities	1,159
1.4 Domestic water supply	4
1.5 Operation & maintenance road	36
II. Administration cost	508
III. Engineering services	1,523
IV. Physical contingencies	1,828
V. Contract tax	1,351
VI. Land acquisition	51
VII. Price contingency	3,083
Grand Total	18,498

7.3 Operation and Maintenance Cost

The O&M costs consist of salaries of O&M staff, cost for maintaining the Project facilities, material and labor cost for repairing works, and running cost of Project facilities. The annual O&M costs are estimated at Rp. 92.5 million, which is equivalent to 0.5 % of the Project cost.

8. PROJECT JUSTIFICATION

8.1 Satisfaction of BHN

The benefit of domestic water supply to 5,300 beneficiary inhabitants in Lewa/Paku Village and the town area of Lewa could be indicated as the value of water and the investment amount to each beneficiary inhabitant. If the total amount of direct construction cost is defined as the total amount of investment for the construction of Mataiyang Embung, this investment amount could be allocated to the investment in domestic water supply according to the proportion of annual domestic water demand against the total annual water demand. Then, the value of water can be estimated by dividing the sum of allocated amount of direct construction cost of Embung and the whole amount of domestic water supply system by the annual domestic water demand, while the investment amount to each beneficiary inhabitant can be given by dividing the said sum by the total number of domestic water users.

The direct construction cost is broken down into the cost for Embung construction, dam O&M road and preparatory works of Rp. 8,991 million, irrigation facilities of Rp. 1,159 million and domestic water supply system of Rp. 2 million. The total number of beneficiary inhabitants is 5,300 persons. The annual water demand is 0.175 MCM for domestic use and 5.04 MCM for irrigation use, totaling 5,215 MCM. The direct construction cost is allocated as shown below.

Allocation of Direct Construction Cost

Item	Unit	Total demand	Domestic water	Livestock water	Irrigation water
Annual water demand	'000 m ³	5,215	175	0	5,040
Direct construction cost	Million Rp.	10,152	304	0	9,848

Thus, the benefit of domestic water supply is indicated by the value of water of Rp. 1,737/m³ and also the investment amount to the respective beneficiary inhabitants of Rp. 57,358/person.

8.2 Economic Consideration

(1) Economic cost

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

When the financial cost is converted to the economic cost, the contract tax, land acquisition cost and price contingency are fully excepted. In this Study, only the purchasing cost of consumables and goods appropriated in the administration cost is to be converted to the economic administration cost, as the normal payment to civil servants is principally appropriated in the operation budget of the Government. As the construction cost of dam and engineering cost estimated include some allowance to cover additional cost for expatriates, 50% of the engineering cost is to be converted to the economic cost in order to make the estimated cost equal to the level of local cost.

The economic cost converted and its annual disbursement schedule are shown in Table 8.1.

(2) Economic benefit

The irrigation benefits of the Project are principally derived from increased crop production attributable to stable irrigation water supply, full utilization of available farm land resources and optimum farm input supply. Table 8.2 gives financial and economic prices of farm inputs and outputs estimated for major islands. Based on the proposed quantity of farm inputs, anticipated crop yield and economic farm gate prices, the economic crop budget is estimated as shown in Table 8.3.

The annual net incremental benefit is thus estimated to be Rp. 747.9 million. This increment benefit will accrue from the first year when irrigation water can be released from the Mataiyang Embung. Taking the present agricultural situation and farmers capability into account, it is assumed that five years are needed as the build-up period to attain the anticipated crop yield level. In the proposed reservoir area, there will be no production foregone in the proposed reservoir area by constructing the proposed Mataiyang Embung.

(3) Economic evaluation

The economic internal rate of return (EIRR) is examine as shown in Table 8.4 on costs and benefits as at August 1994. The result of economic analysis shows that EIRR is 5.5%, but the proposed Mataiyang Embung Project would still have a significant positive impact on the development of the economically depressed area within Sumba island as it can be expected to increase paddy production by 1,105 tons or 2.6 times and to enhance cash income source by introducing irrigated cultivation of Palawija crops twice a year. Also, the pressing BHN in Desa Lewa/Paku and Lewa town can be met by constant supply of clean domestic water to 5,300 inhabitants even in the dry season.

(4) Farm budget analysis

With the implementation of Mataiyang Embung Project, the net on-farm income of farmers holding a unit farm size of 1.0 ha can be expected to increase by Rp. 2,499,400/year from Rp. 431,000/year under the "Without Project" condition with the cropping intensity of 100% to Rp. 2,930,400/year under the "With Project" condition with the cropping intensity of 300% as shown in Table 8.5 and below. Such improvement of farm budget would give much incentive for farmers to make further investment in improvement of their living standard and also could increase their payment capacity enabling beneficiary farmers to pay irrigation water charge to some extent.

Farm Budget for Unit Farm Size of 1 Ha

Crop	Watering Condition	Without Project		With Project	
		Crop Intensity (%)	Income (Rp.)	Crop Intensity (%)	Income (Rp.)
Paddy	Wet/Rainfed	84.4	341,609	-	-
	Wet/Irrigated	12.7	69,818	100.0	1,097,875
Soybean	Dry/Irrigated	-	-	100.0	949,340
Mungbean	Wet/Rainfed	2.9	19,577	-	-
	Dry/Irrigated	-	-	100.0	883,170
Total		100.0	431,004	300.0	2,930,385

8.3 Environmental Impact Assessment

Environmental impact assessment for the Project is carried out in consideration of the development objectives of the Project.

(1) Environmental features of the Project area

The principal features of human and physical environment in the Mataiyang Project area are summarized as below.

Environmental Features in the Mataiyang Project Area

Item	Description
1. Human Environment	
Social intention	Insufficiency of reliable water sources and facilities for irrigation water and domestic use
Human use	Use of water led by pipeline from spring and well water (shortage in the dry season)
Economic activities	Cultivation of irrigated and rainfed paddy and dry upland crop, and livestock farming
Health and sanitation	Prevalence of waterborne intestinal diseases
2. Physical environment	
Geology/land	Limestone of Neogene
Surface/ground water	Perennial spring water is observed
Endemic fauna and flora	None
3. Others	
	None

(2) Environmental impact assessment

The results of environmental impact assessment reveal that there exist no negative impacts by Embung development in this Project area.

(3) Primary information of environmental assessment

To support environmental analysis presentation for this Project implementation on the Indonesian rule, primary information on environmental assessment is compiled in the Attachment to the Volume 4

8.4 Contribution to Women in Development

With provision of permanent water source facilities, women and children of 206 families can be quite free from their daily hard job to carry their domestic water at the average distance of 1.5 km. As a result, women will be able to utilize the saved time for improving their activities in relation to not only agriculture and livestock but also small business. Since housewives in the Project area manage their family budgets, increasing farmer's income would encourage women in investing surplus in improvement and diversification of their economic activities.

9. CONCLUSION AND RECOMMENDATIONS

9.1 Conclusion

On the basis of categorization of 157 candidate schemes for the Study, the Mataiyang Embung scheme is selected representing a typical sample scheme of which potential beneficiary area has its irrigation water intake on the source river of the proposed Embung, mainly rainfed farming system with small irrigation area and inhabitants' demand for further use of irrigation and domestic water. The proposed Mataiyang Embung site has physically irrigable land resources of 450 ha in net and the annual discharge of 15.1 MCM from its catchment area of 19.1 km². A total of 5,300 inhabitants projected for the year of 2008 needs additional water source facilities to solve their water shortage problem during the dry season.

As there is no limitation in the topographic condition and the availability of water resources, the future water demand for irrigation and domestic use in the beneficiary area is the determining factor in the optimization of development scale. To cover the physically irrigable area by gravity method and the domestic water demand of inhabitants to the maximum extent, the dam height of Mataiyang Embung is thus set to be 20.0 m with the total and effective storage capacities of 2.16 and 1.83 MCM, respectively. Under such condition, it can be expected to practice irrigated cropping of the wet season paddy followed by double cropping of irrigated Palawija crops for the dry season and to meet increasing domestic water demand of 5,300 inhabitants in the beneficiary area.

The structural components are main dam, spillway, diversion tunnel, seepage protection works and dam O&M road as well as irrigation and domestic water distribution systems. The zoned embankment dam is constructed with the crest length of 240 m, embankment volume of 189,000 m³ and side-channel typed spillway having design flood discharge of 231 m³/sec and overflow weir width of 38 m. The required investment cost amounts to Rp. 18.5 billion of which direct construction cost is estimated to be 10.2 billion.

The results of feasibility study reveal that construction of the candidate Embung at the proposed site is technically sound but economically marginal because construction cost of spillway is higher than that of main dam due to hydrological features on Sumba island. The increasing domestic water demand of 5,300 inhabitants in the Project area could be fully met by creating a new clean water source through construction of the proposed Mataiyang Embung. Therefore, such type of Embung is worth implementing from the socio-economic viewpoints.

9.2 Recommendations

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

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

***Feasibility Study on
Matayang Embung Development Project***

Tables

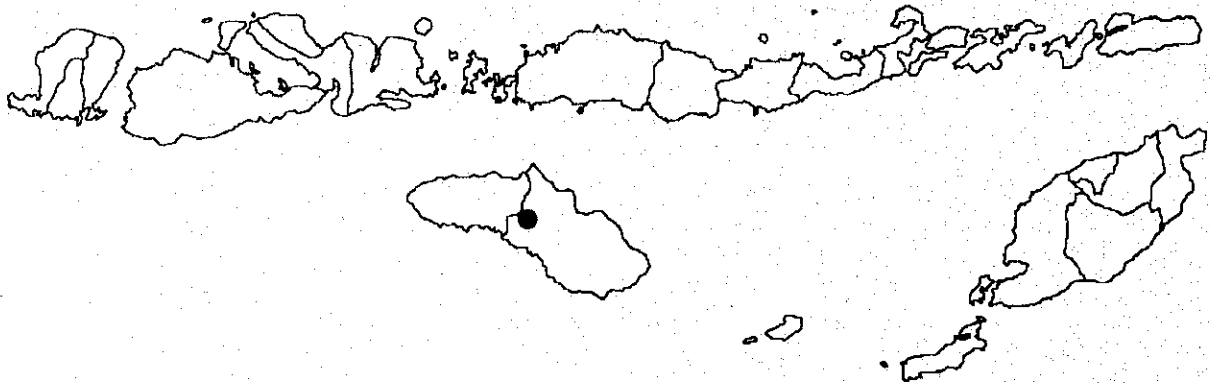


Table 1.1 Rainfall Record in Waikabubak

Station Number Station Name Location Elevation	Year												Annual Daily Max	
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.		Total
460 Wai Kabubak 09° 38'S/119° 26'E 360 m														
1951	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1952	368	231	334	100	41	0	0	9	33	149	459	601	2,325	77
1953	204	262	256	121	320	-	-	-	-	-	-	-	2,108	95
1954	516	154	98	350	140	31	5	114	39	124	135	402	3,524	160
1955	512	572	193	280	164	380	298	42	0	162	536	385	2,806	100
1956	904	237	75	413	71	120	127	62	6	221	235	335	2,209	78
1957	220	641	231	221	119	6	167	0	0	0	0	139	291	215
1958	50	339	352	157	137	107	50	-	0	51	131	291	-	142
1959	367	-	-	650	247	89	0	0	0	-	-	-	2,422	138
1960	514	331	232	275	346	0	12	5	18	160	310	219	2,422	85
1961	470	439	215	279	-	11	4	0	41	81	224	204	2,354	110
1962	335	491	182	299	77	145	127	35	0	61	58	544	2,201	144
1963	430	360	327	291	147	0	0	6	25	161	127	327	2,491	110
1964	427	304	242	120	183	50	2	78	21	279	454	351	2,491	110
1965	427	401	477	47	20	34	0	0	3	36	-	324	1,979	82
1966	121	231	466	105	22	126	0	0	48	285	229	346	2,223	114
1967	547	287	432	249	0	0	0	0	40	25	131	512	3,022	82
1968	547	239	383	127	320	193	165	45	82	78	260	583	1,849	140
1969	230	296	356	222	168	0	14	34	186	72	68	203	2,087	115
1970	396	197	352	160	135	0	0	0	121	113	232	381	2,705	123
1971	336	279	545	112	354	7	52	14	82	170	526	228	1,748	135
1972	127	297	530	115	60	0	0	0	0	80	129	410	1,748	105
1973	617	327	486	423	388	9	0	15	404	99	235	327	3,330	136
1974	616	489	389	193	188	29	4	22	136	233	278	269	2,846	83
1975	140	488	420	199	212	38	16	51	74	352	391	87	1,748	68
1976	127	297	530	115	60	0	0	0	0	80	129	410	1,748	68
1977	371	341	162	129	204	-	0	8	23	0	-	-	-	-
1978	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1979	79	-	329	197	277	82	64	-	-	124	173	503	2,469	-
1980	539	384	109	367	57	0	7	36	4	97	394	475	-	-
1981	462	145	159	382	-	-	-	-	-	-	-	-	-	-
1982	-	392	-	-	-	-	-	-	-	-	-	-	-	-
1983	170	396	310	139	43	17	0	11	22	244	-	-	-	-
1984	348	-	-	-	-	-	-	-	-	290	-	-	-	-
1985	87	468	194	185	102	181	30	-	-	-	-	-	-	-
Mean	363	344	312	227	159	59	39	23	54	137	248	367	2,424	-

Source : Repprot

Table 1.2 Climate in Waingapu

Station: Waingapu
 Island : Sumba
 Kabupaten : Sumba Timur

Latitude : 09 39 S
 Longitude : 120 16 E
 Elevation : 10 m

Description	Unit	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Average	Year
Average daily maximum temperature	C	31.9	31.5	31.4	31.7	31.6	31.2	30.9	31.3	31.8	32.7	32.8	32.0	31.7	1972 - 1979
Average daily minimum temperature	C	22.3	22.1	22.2	21.2	20.6	19.5	18.5	18.7	20.4	21.3	22.1	22.3	20.9	1972 - 1979
Mean daily temperature	C	27.1	26.8	26.8	26.5	26.1	25.4	24.7	25.0	26.1	27.0	27.5	27.2	26.4	1972 - 1979
Mean daily relative humidity	%	79.0	81.0	81.0	78.0	77.0	75.0	72.0	71.0	71.0	70.0	72.0	77.0	75.3	1972 - 1979
Mean daily wind run over 24 hours	km/day	254.0	235.0	223.0	267.0	306.0	334.0	350.0	339.0	326.0	317.0	286.0	229.0	288.8	1972 - 1979
Wind speed at time of observation	m/s	2.7	2.7	2.6	3.1	3.5	3.9	4.1	3.9	3.8	3.7	3.3	2.7	3.3	1972 - 1979
Mean daily observed bright sunshine	hr/month	158.0	144.0	133.0	177.0	214.0	159.0	192.0	214.0	216.0	245.0	201.0	136.0	2,189.0	1972 - 1979
Mean daily observed bright sunshine	hr/day	5.1	5.1	4.3	5.9	6.9	5.3	6.2	6.9	7.2	7.9	6.7	4.4	6.0	1972 - 1979
Mean daily maximum possible sunshine	hr/day	12.6	12.5	12.2	11.9	11.7	11.6	11.6	11.8	12.1	12.3	12.6	12.7	12.1	1972 - 1979
Mean Solar Radiation	mm/day	16.4	16.3	15.7	14.4	13.0	12.3	12.6	13.7	15.0	16.0	16.2	16.5	14.8	1972 - 1979

Source : Repprot (Nusatenggara, Maluku, Timor Timur) Annex 3

Table 1.3 Typical Soil Profile in the Mataiyang Project Area

Profile No.:	4	
Soil Classification:	Ustic Endoaquerts	
Physiography:	Alluvial fan	
Topography:	Almost flat (< 3 %)	
Land Use/Vegetation:	Paddy field	
Parent material:	Calcareous rock	
Drainage:	Poor to moderate	
Groundwater Table:	> 7 m	
Permeability:	Slow (0.25 cm/hr)	
Land Morphology:	Cracking 5 - 55 cm width, 60 cm depth	
Horizon	Depth (cm)	Description
Ap	0 - 26	Brownish grey (10YR 5/1, dry); clay; angular blocky; coarse, very strong structure; sticky, plastic, extremely hard consistency; many, medium root; many micropore, few meso and macropore; gradual, smooth horizon boundary
Bw1	26 - 56	Brownish grey (10YR 5/1, moist); silty clay; angular blocky, medium, strong structure; sticky, plastic, firm consistency; slacken side, few, small-medium root; few micropore; gradual, wavy horizon boundary
Bw2	56 - 100	Black (10YR 1.7/1, moist); clay; angular blocky, medium, moderate structure; very sticky, very plastic, firm consistency

Source: Soil survey carried out by the local consultant under supervision of the JICA Study Team

Table 1.4 Results of Soil Laboratory Test in the Mataiyang Project Area

Soil Layer Pit	Texture		Permeability (cm/hr)	pH (H ₂ O)	pH (KCl)	Organic matter	Total N (%)	Ava. P (ppm)	CEC (me/100g)	Ex. Na (me/100g)	Ex. Ca (me/100g)	Ex. K (me/100g)	Ex. Mg (me/100g)	Base Saturation (%)	EC (mS/cm)		
	Sand (%)	Silt (%)														Clay (%)	
6	Ap	32.3	21.4	46.3	0.4	7.1	6.5	3.85	0.03	1.78	34.34	0.59	20.28	0.14	0.13	62	0.52
	Bw1	39.1	17.9	42.6	0.2	7.1	5.8	0.30	0.04	1.88	36.40	0.31	23.41	0.13	0.14	66	0.76
	Bw2	36.1	15.7	48.2		7.2	6.2	2.01	0.04	1.97	38.57	0.38	20.17	0.10	0.07	54	0.16
8	Ap	33.4	18.3	48.3	0.1	6.9	5.6	5.31	0.04	2.04	38.81	0.20	20.71	0.31	0.16	55	0.22
	Bw1	38.9	19.5	41.6	0.3	7.2	6.5	2.16	0.03	1.87	35.92	0.40	20.81	0.23	0.20	60	0.24
	Bw2	28.5	27.3	44.2		7.4	6.8	0.73	0.03	2.00	24.86	0.44	19.04	0.22	0.20	80	0.24
13	A1	37.0	20.5	42.5	1.5	6.7	5.5	4.29	0.04	1.69	35.11	0.31	17.04	0.25	0.25	51	0.10
	Bw1	37.8	21.2	41.0	0.1	6.7	5.5	0.53	0.04	2.09	28.17	0.34	18.03	0.21	0.10	66	0.12
	Bw2	34.9	23.3	41.9		7.0	6.3	1.32	0.03	1.99	37.52	0.15	31.74	0.15	0.14	86	0.22

Source: Soil survey carried out by the local contractor under supervision of the JICA Team

Table 1.5 Soil Classification in the Mataiyang Project Area

Land Unit	Description	Physiography		Topography		Potential Suitability			Area	
						Paddy	Soybean	Maize	(ha)	(%)
I	Ustic Endoaquerts deep; very fine clay; neutral; high CEC; slow-very slow permeability; poor-moderate drainage	Alluvial fan	Flat (0-3%)	S1	S3	S3			280	37%
II	Ustic Haplusterts fine loam-very fine clay; neutral; high CEC; slightly slow permeability; well drainage	Alluvial fan	Flat (0-2%)	S1	S2/S3	S1/S3			344	45%
III	Chromic Haplusterts very fine clay; neutral; high CEC; slightly slow permeability; poor- moderate drainage	Alluvial fan	Flat (0-2%)	S1	S3	S3			36	5%
#	Unclassified								97	13%
	Total								757	100%

Source: Soil survey carried out by the local consultant under supervision of the JICA Team

Table 1.6 Summary of Farm Household Economic Survey in the Mataiyang Project Area

Item	Unit	Respond't No. 1	Respond't No. 2	Respond't No. 3	Respond't No. 4	Respond't No. 5	Respond't No. 6	Respond't No. 7	Respond't No. 8	Respond't No. 9	Respond't No. 10	Respond't No. 11	Respond't No. 12	Respond't No. 13	Respond't No. 14	Respond't No. 15	Average
1 Sex and Age		Male 80	Male 26	Male 35	Male 36	Male 30	Male 62	Male 29	Male 70	Male 58	Male 32	Male 67	Male 32	Male 36	Male 49	Male 40	Male 45
2 No. of Family Member		M-1/F-1	M-0/F-2	M-0/F-5	M-2/F-2	M-0/F-1	M-0/F-1	M-1/F-2	M-0/F-1	M-2/F-3	M-2/F-1	M-1/F-2	M-2/F-1	M-1/F-4	M-3/F-3	M-3/F-1	M-1/F-2
3 Type of Side Job		Business	None	None	None	None	Civil Sv.	Worker	None	None	None	None	None	None	None	None	None
4 Own Farmland	ha	2.00	2.50	0.60	2.50	1.10	2.50	1.60	1.00	6.00	2.50	2.70	1.60	3.70	2.00	1.10	2.23
Reined Farmland	ha	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Yield Division	ha	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(Paddy field)	ha	1.50	2.00	0.00	1.00	0.50	1.00	1.00	0.25	4.00	1.00	0.50	0.50	3.00	0.00	0.00	1.08
5 Cropped Area	ha	1.90	2.60	0.50	1.50	1.00	2.00	1.50	0.85	5.00	1.50	2.50	1.50	3.50	3.00	1.00	1.99
(Paddy)	ha	1.50	2.00	0.00	1.00	0.50	1.00	1.00	0.25	4.00	1.00	0.50	0.50	3.00	3.00	1.00	1.35
(Palawija)	ha	0.30	0.60	0.50	0.50	0.50	1.00	0.50	0.60	1.00	0.50	2.00	1.00	0.50	0.00	0.00	0.63
(Others)	ha	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
6 Cow/Bufalo	head	0	0	0	0	0	29	12	7	4	0	0	0	0	0	0	3
Horse	head	0	0	0	0	0	7	12	0	3	0	0	0	0	0	0	1
Goat/Sheep	head	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	1
Pig	head	1	5	2	2	4	2	6	0	2	1	2	0	2	5	7	3
Chicken/Duck	head	2	5	4	8	9	15	7	25	38	10	17	23	31	11	16	15
Gross Income	Rp. '000/yr.	2,950.0	625.0	140.0	560.0	380.0	4,495.0	2,480.0	365.5	4,900.0	3,200.0	1,095.0	545.0	1,890.0	2,200.0	865.0	1,779.4
(Crop)	Rp. '000/yr.	1,090.0	625.0	140.0	560.0	380.0	1,295.0	780.0	165.5	3,100.0	800.0	1,045.0	545.0	1,890.0	1,750.0	525.0	979.4
(Livestock)	Rp. '000/yr.	0.0	0.0	0.0	0.0	0.0	1,100.0	100.0	200.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	99.3
(Side job)	Rp. '000/yr.	1,860.0	0.0	0.0	0.0	0.0	2,100.0	1,600.0	0.0	0.0	2,400.0	0.0	0.0	0.0	450.0	300.0	580.7
(Miscellaneous)	Rp. '000/yr.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,800.0	0.0	0.0	0.0	0.0	0.0	0.0	120.00
8 Expenditure	Rp. '000/yr.	644.0	740.7	628.2	788.1	528.3	2,903.6	2,682.0	493.1	2,358.0	1,483.0	883.6	866.6	1,342.5	1,118.0	906.0	1,224.4
(Food/drink)	Rp. '000/yr.	366.0	464.4	367.2	462.0	289.2	636.0	504.0	228.0	780.0	666.0	522.0	522.0	708.0	696.0	558.0	517.9
(Living)	Rp. '000/yr.	152.0	229.2	249.0	300.5	224.0	376.0	1,997.0	211.0	887.0	619.0	126.1	126.1	309.0	320.0	243.0	424.6
(Education)	Rp. '000/yr.	0.0	0.0	0.0	0.0	0.0	1,800.0	0.0	0.0	360.0	0.0	60.0	96.0	36.0	36.0	36.0	161.6
(Production)	Rp. '000/yr.	126.0	47.1	12.0	25.6	15.1	91.6	181.0	54.1	331.0	198.0	175.5	122.5	289.5	66.0	69.0	120.3
9 Surplus/Deficit	Rp. '000/yr.	2,306.0	-115.7	-488.2	-228.1	-148.3	1,591.4	-202.0	-127.6	2,542.0	1,717.0	211.4	-321.6	547.5	1,082.0	-41.0	555.0
10 Saving	Rp. '000/yr.	0.0	0.0	0.0	0.0	0.0	300.0	0.0	0.0	500.0	0.0	0.0	0.0	0.0	0.0	0.0	53.3

Source: JICA Agro-economy Survey

Table 2.1 Estimated Evapotranspiration in Mataiyang Project

Site : Mataiyang
 Meteorological Station : Waingapu

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
T mean	27.10	26.80	26.80	26.50	26.10	25.40	24.70	25.00	26.10	27.00	27.50	27.20
RH mean	79.00	81.00	81.00	78.00	77.00	75.00	72.00	71.00	71.00	70.00	72.00	77.00
U km/day	254.00	235.00	223.00	267.00	306.00	334.00	350.00	339.00	326.00	317.00	286.00	229.00
ea	35.70	35.07	35.07	34.44	33.60	32.27	30.94	31.51	33.60	35.49	36.54	35.91
RH/100	0.79	0.81	0.81	0.78	0.77	0.75	0.72	0.71	0.71	0.70	0.72	0.77
ed	28.20	28.41	28.41	26.86	25.87	24.20	22.28	22.37	23.86	24.84	26.31	27.65
(ea-ed)	7.50	6.66	6.66	7.58	7.73	8.07	8.66	9.14	9.74	10.65	10.23	8.26
f(u)	0.96	0.90	0.87	0.99	1.10	1.17	1.22	1.19	1.15	1.13	1.04	0.89
(1-W)	0.24	0.24	0.24	0.25	0.25	0.26	0.26	0.26	0.25	0.24	0.24	0.24
(1-W)f(u)(ea-ed)	1.72	1.46	1.41	1.85	2.12	2.43	2.78	2.83	2.80	2.89	2.52	1.75
Ra	16.40	16.30	15.50	14.20	12.80	12.00	12.40	13.50	14.80	15.90	16.20	16.20
n	5.10	5.10	4.30	5.90	6.90	5.30	6.20	6.90	7.20	7.90	6.70	4.40
N	12.60	12.40	12.10	11.80	11.60	11.50	11.60	11.80	12.00	12.30	12.60	12.70
(0.25+0.50n/N)	0.45	0.46	0.43	0.50	0.55	0.48	0.52	0.54	0.55	0.57	0.52	0.42
Rs	7.42	7.43	6.63	7.10	7.01	5.77	6.41	7.32	8.14	9.08	8.36	6.86
Rns	5.94	5.94	5.30	5.68	5.61	4.61	5.13	5.86	6.51	7.26	6.69	5.49
f(T)	16.10	16.06	16.06	15.98	15.90	15.75	15.55	15.65	15.90	16.10	16.18	16.14
f(ed)	0.10	0.10	0.10	0.11	0.11	0.12	0.13	0.13	0.12	0.12	0.11	0.10
f(n/N)	0.46	0.47	0.42	0.55	0.64	0.51	0.58	0.63	0.64	0.68	0.58	0.41
Rnl=f(T)f(ed)f(n/N)	0.76	0.76	0.68	0.95	1.13	0.97	1.16	1.26	1.23	1.27	1.03	0.69
Rn =Rns-Rnl	5.17	5.18	4.62	4.73	4.47	3.64	3.97	4.60	5.28	5.99	5.65	4.79
W	0.76	0.76	0.76	0.75	0.75	0.74	0.74	0.74	0.75	0.76	0.76	0.76
W Rn	3.93	3.92	3.50	3.57	3.35	2.71	2.92	3.40	3.96	4.55	4.32	3.65
c	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Eto	6.22	5.92	5.40	5.96	6.02	5.65	6.27	6.85	7.44	8.18	7.52	5.94

Source : JICA Study Team estimation by Modified Penman Method based on the meteorological data at Waingapu station

Table 2.2 Effective Rainfall in Mataiyang Project

Site : Mataiyang

Meteorological Station : Waikabubak

Month	Evapotranspiration (ETo) [1] (mm)	Average Rainfall		Annual-base Dependable Rainfall [4] (mm)	Effective Rainfall	
		[2] (mm)	[3] (%)		Paddy [5] (mm)	Palawija [6] (mm)
January	193	377	15.6%	317	222	147
February	166	358	14.8%	301	211	138
March	167	325	13.4%	273	191	138
April	179	236	9.7%	198	139	141
May	187	165	6.8%	139	97	106
June	169	61	2.5%	51	36	41
July	194	41	1.7%	34	24	29
August	212	23	0.9%	19	14	17
September	223	56	2.3%	47	33	42
October	254	142	5.9%	119	84	100
November	226	258	10.6%	217	152	159
December	184	382	15.8%	321	225	144
Total	2,354	2,424	100.0%	2,037	1426	1203

Note ;

- [1] : Estimated by Modified Penman Method based on Waingapu station
 [2] : Rainfall data in station compiled by DPU (1952-1985)
 [3] : Percentage of monthly rainfall to annual rainfall, calculated from column [2]
 [4] : 2,037 mm (Calculated 80 % dependable annual rainfall) x [3]
 [5] : [4] x 0.70
 [6] : Derived by USDA SCS Method introduced by Design Criteria KP-01, where effective storage is assumed 75 mm

Source ; JICA Study Team estimation based on the rainfall data at the Waikabubak station

Table 2.3 Irrigation Water Requirement in Mataiyang Project (1/2)

Site : **Mataiyang**
Crops : **Wet Season Paddy**

Item	Jan.		Feb.		Mar.		Apr.		May		Jun.		Jul.		Aug.		Sep.		Oct.		Nov.		Dec.		Annual
	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	
I. Evapotranspiration (Eto)	6.22	6.22	5.92	5.92	5.40	5.40	5.96	5.94	6.02	6.02	5.65	5.65	6.27	6.27	6.85	6.85	7.44	7.44	8.18	8.18	7.52	7.52	5.94	5.94	2,354
mm/day	93	100	83	83	81	86	89	89	90	96	85	85	94	100	103	110	112	112	123	131	113	113	89	95	
mm																									
II. Wet Season Paddy																									
(1) Proposed cropping pattern / Crop coefficient																									
- WP-1	1.10	1.10	1.05	1.05	1.05	0.95	0.95	0.00																	
- WP-2	1.10	1.10	1.05	1.05	1.05	0.95	0.95	0.00																	
- WP-3	1.10	1.10	1.10	1.10	1.05	1.05	0.95	0.00																	
(2) Crop consumptive use (Etc)																									
- WP-1	103	109	87	87	77	0	0	0																	463
- WP-2		109	91	87	85	82	0	0																	455
- WP-3			91	91	85	91	85	0																	443
(3) Land preparation (LR)																									
- WP-1																									413
- WP-2																									416
- WP-3																									419
(4) Percolation																									
- WP-1	30	32	28	28	30	32	30	30																	
- WP-2		32	28	28	30	32	30	30																	
- WP-3			28	28	30	32	30	30																	
(5) Water layer replacement (RW)																									
- WP-1		50	50	50	50	50	50	50																	
- WP-2			50	50	50	50	50	50																	
- WP-3																									
(6) Effective rainfall (ER)																									
	107	115	106	105	92	99	70	69	47	50	18	18	12	12	7	7	16	17	41	43	76	76	109	116	1,428
(7) Field water requirement																									
- WP-1	26	76	9	60	15	0	0	0																	374
- WP-2	96	26	63	10	73	15	0	0																	381
- WP-3	96	101	13	64	23	74	45	0																	416
(8) Diversion requirement																									
	112	105	44	69	57	46	23	0																	600
	1,120	1,050	440	690	570	460	230	0																	6,020

Source : JICA Study Team estimate based on the meteorological data at the Waingapu and the Waikabubak station.

Table 2.3 Irrigation Water Requirement in Mataiyang Project (2/2)

Site Crops :	Mataiyang Palawija (1), (2), (3) & (4) : Mungbeans and Soybeans												Annual																
	Month (days)		Jan.		Feb.		Mar.		Apr.		May			Jun.		Jul.		Aug.		Sep.		Oct.		Nov.		Dec.			
	1	2	1	2	1	2	1	2	1	2	1	2		1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
I. Evapotranspiration (Eto) mm/day mm	6.22 95	6.22 100	5.92 83	5.92 83	5.40 81	5.40 86	5.96 89	5.96 89	6.02 96	5.65 85	5.65 85	6.27 94	6.27 100	6.85 103	6.85 110	7.44 112	7.44 112	8.18 123	8.18 131	7.52 113	7.52 113	8.18 113	8.18 113	7.52 113	7.52 113	5.94 89	5.94 95	2,354	
II. Palawija(1), (2) : Mungbeans and Soybeans (1) Proposed cropping pattern / Crop coefficient(Kc) - Pwj(1)-1 - Pwj(1)-2 - Pwj(1)-3																													
(2) Crop consumptive use(Etc) - Pwj(1)-1 - Pwj(1)-2 - Pwj(1)-3																													
(3) Effective rainfall (ER)	71	76	69	69	67	71	71	70	55	21	20	14	15	8	9	21	21	48	52	79	80	70	74	1,202					
(4) Field water requirement - Pwj(1)-1 - Pwj(1)-2 - Pwj(1)-3																													
(5) Diversion requirement																													
III. Palawija (3), (4) : Soybeans and Mungbeans (1) Proposed cropping pattern / Crop coefficient(Kc) - Pwj(2),(3)-1 - Pwj(2),(3)-2 - Pwj(2),(3)-3																													
(2) Crop consumptive use(Etc) - Pwj(2),(3)-1 - Pwj(2),(3)-2 - Pwj(2),(3)-3																													
(3) Effective rainfall (ER)	71	76	69	69	67	71	71	70	55	21	20	14	15	8	9	21	21	48	52	79	80	70	74	1,202					
(4) Field water requirement - Pwj(2),(3)-1 - Pwj(2),(3)-2 - Pwj(2),(3)-3																													
(5) Diversion requirement																													

Source : JICA Study Team estimate based on the meteorological data at the Waingapu and the Waikabubak station

Table 3.1 Estimated Catchment Rainfall in Mataiyang Embung Site

year	Jan		Feb		Mar.		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Annual
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
	Unit : mm																								
1962	168	168	246	246	91	91	150	150	39	39	73	73	64	64	18	18	0	0	31	31	29	29	272	272	2,362
1963	215	215	180	180	164	164	146	146	74	74	0	0	0	0	3	3	13	13	81	81	64	64	164	164	2,208
1964	214	214	152	152	121	121	60	60	92	92	25	25	1	1	39	39	11	11	140	140	217	217	176	176	2,496
1965	214	214	201	201	239	239	24	24	10	10	17	17	0	0	0	0	2	2	18	18	31	31	162	162	1,836
1966	61	61	116	116	233	233	53	53	11	11	63	63	0	0	0	0	24	24	143	143	115	115	173	173	1,984
1967	274	274	144	144	216	216	125	125	0	0	0	0	0	0	0	0	20	20	13	13	66	66	256	256	2,228
1968	274	274	120	120	192	192	64	64	160	160	97	97	83	83	23	23	41	41	39	39	130	130	292	292	3,030
1969	115	115	148	148	178	178	111	111	84	84	0	0	7	7	17	17	93	93	36	36	34	34	102	102	1,850
1970	198	198	99	99	176	176	80	80	68	68	0	0	0	0	0	0	61	61	57	57	116	116	191	191	2,092
1971	168	168	140	140	273	273	56	56	177	177	4	4	26	26	7	7	41	41	85	85	263	263	114	114	2,708
1972	64	64	149	149	265	265	58	58	30	30	0	0	0	0	0	0	0	0	40	40	65	65	205	205	1,752
1973	309	309	164	164	243	243	212	212	194	194	5	5	0	0	8	8	202	202	50	50	118	118	164	164	3,338
1974	308	308	245	245	195	195	97	97	94	94	15	15	2	2	11	11	68	68	117	117	139	139	135	135	2,852
1975	70	70	244	244	210	210	100	100	106	106	19	19	8	8	26	26	37	37	176	176	196	196	44	44	2,472
1976	64	64	149	149	265	265	58	58	30	30	4	4	1	1	0	0	0	0	40	40	65	65	205	205	1,754
1977	186	186	171	171	81	81	65	65	102	102	4	4	0	0	4	4	12	12	0	0	37	37	179	179	1,682
Mean	181	181	167	167	196	196	91	91	79	79	20	20	12	12	10	10	39	39	67	67	105	105	177	177	2,290

Table 3.2 Estimated Discharge at Mataiyang Embung Site

Unit : 1000 m³

Year	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Annual	
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II		
1962	1,123	1,123	1,645	1,645	608	608	1,003	1,003	261	261	488	488	428	428	0	0	0	0	207	207	194	194	1,818	1,818	15,550	
1963	1,437	1,437	1,203	1,203	1,096	1,096	976	976	495	495	0	0	0	0	0	0	0	0	541	541	428	428	1,096	1,096	14,544	
1964	1,431	1,431	1,016	1,016	809	809	401	401	615	615	167	167	0	0	261	261	0	0	936	936	1,451	1,451	1,177	1,177	16,528	
1965	1,431	1,431	1,344	1,344	1,598	1,598	1,600	1,600	0	0	0	0	0	0	0	0	0	0	0	0	207	207	1,083	1,083	11,646	
1966	408	408	775	775	1,558	1,558	354	354	0	0	421	421	0	0	0	0	0	160	956	956	769	769	1,157	1,157	13,116	
1967	1,832	1,832	963	963	1,444	1,444	836	836	0	0	0	0	0	0	0	0	0	0	0	0	441	441	1,711	1,711	14,454	
1968	1,832	1,832	802	802	1,284	1,284	428	428	1,070	1,070	648	648	555	555	154	154	274	274	274	261	261	869	869	1,952	1,952	20,258
1969	769	769	989	989	1,190	1,190	742	742	562	562	0	0	0	0	0	0	622	622	408	381	381	775	775	682	682	12,048
1970	1,324	1,324	662	662	1,177	1,177	535	535	455	455	0	0	0	0	0	0	274	274	408	381	381	775	775	1,277	1,277	13,988
1971	1,123	1,123	936	936	1,825	1,825	374	374	1,183	1,183	0	0	174	174	0	0	0	0	0	568	568	1,758	1,758	762	762	17,954
1972	428	428	996	996	1,772	1,772	388	388	201	201	0	0	0	0	0	0	0	0	0	267	267	435	435	1,370	1,370	11,714
1973	2,066	2,066	1,096	1,096	1,624	1,624	1,417	1,417	1,297	1,297	0	0	0	0	0	0	1,350	1,350	455	334	334	789	789	1,096	1,096	22,138
1974	2,059	2,059	1,638	1,638	1,304	1,304	648	648	628	628	0	0	0	0	0	0	455	455	455	782	782	929	929	902	902	18,690
1975	468	468	1,631	1,631	1,404	1,404	669	669	709	709	0	0	0	0	174	174	247	247	247	1,177	1,177	1,310	1,310	294	294	16,166
1976	428	428	996	996	1,772	1,772	388	388	201	201	0	0	0	0	0	0	0	0	0	267	267	435	435	1,370	1,370	11,714
1977	1,243	1,243	1,143	1,143	541	541	435	435	682	682	0	0	0	0	0	0	0	0	0	0	247	247	1,197	1,197	10,976	
Mean	1,213	1,213	1,115	1,115	1,313	1,313	610	610	522	522	108	108	72	72	37	37	237	237	432	432	704	704	1,184	1,184	15,093	
	2,425		2,229		2,626		1,219		1,045		216		145		74		474		865		1,408		2,368			

Table 3.3 Probable Flood Discharge at Mataiyang Embung Site

Characteristics of the catchment area		19.10							
Catchment Area (km ²)		200							
Elevation at Dam Site (1) (m)		500							
Maximum elevation in the catchment area (2) (m)		300							
Height (3)=(2)-(1) (h)		6,000							
Length of Catchment Area (1) (m)		11.93							
Flow velocity W2 (km/hr)		0.50							
Time of concentration T2 (hrs)									
Probable Flood Discharge									
Return Period (years)		2	5	10	20	50	100	200	
Rainfall (mm/day)		111	134	149	162	178	189	201	
Rainfall intensity within the time of concentration (mm)		32	39	43	47	51	54	58	
Probable Flood Discharge (m ³ /s)		136	164	182	198	217	231	246	
Specific Discharge (m ³ /s/km ²)		7	9	10	10	11	12	13	

To estimate design rainfall, the Log Pearson III method is adopted. The rational method is adopted for estimation of the design flood discharge. C = 0.8 is used to estimate designed flood discharge by the rational method.

Table 3.4 Result of Water Quality Test in Mataiyang Project

DESCRIPTION	UNIT	1	2	3	4	Max. Limit of B Class by GR. NO. 20/1990
		Upstream of proposed embung	Embung Site	downstream of proposed embung		
I. PHYSICS						
1 Temperature	C	25.50	26.00	27.00		Normal water temperature
2 Dissolved solid matter	mg/liter	354.00	127.00	251.00		1000
3 Electric Conductivity	umhos/cm	482.00	170.00	342.00		
II. CHEMISTRY						
<i>a. Unorganic chemistry</i>						
1 Mercury	mg/liter	0.00	0.00	0.00		0.001
2 Ammonia	mg/liter	0.00	0.00	0.00		0.5
3 Aroenic	mg/liter	0.00	0.00	0.00		0.05
4 Barium	mg/liter	-	-	-		5
5 Ferro	mg/liter	0.00	0.00	0.00		1
6 Fluoride	mg/liter	1.80	1.70	1.90		1.5
7 Cadmium	mg/liter	0.00	0.00	0.00		0.005
8 Chloride	mg/liter	14.20	14.20	10.60		600
9 Chromium, valense-6	mg/liter	0.00	0.00	0.00		0.05
10 Manganese	mg/liter	0.00	0.00	0.00		0.5
11 Nitrate, N	mg/liter	0.00	0.00	0.00		10
12 Nitric, N	mg/liter	0.00	0.00	0.00		1
13 Dissolved Oxygen	mg/liter	6.31	6.49	6.49		*
14 pH	-	7.00	7.00	7.40		5-9
15 Selenium	mg/liter	-	-	-		0.01
16 Zinc	mg/liter	0.00	0.00	0.00		5
17 Cyanide	mg/liter	0.00	0.00	0.00		0.1
18 Sulphate	mg/liter	19.00	16.50	15.10		400
19 Sulfide, H2S	mg/liter	0.00	0.00	0.00		0.1
20 Copper	mg/liter	0.00	0.00	0.00		1
21 Lead	mg/liter	0.00	0.00	0.00		0.1
<i>b. Organic Chemistry</i>						
1 Aldrin and Dieldrin	mg/liter	0.00	0.00	0.00		0.017
2 Chlordane	mg/liter	0.00	0.00	0.00		0.003
3 DDT	mg/liter	0.00	0.00	0.00		0.042
4 Endrine	mg/liter	0.00	0.00	0.00		0.001
5 Fenol	mg/liter	0.00	0.00	0.00		0.001
6 Heptachlor and Heptachlor Epoxide	mg/liter	-	-	-		0.018
7 Carbon Clorofom Ektrakt	mg/liter	-	-	-		0.5
8 Lindane	mg/liter	0.00	0.00	0.00		0.056
9 Methoxychlor	mg/liter	-	-	-		0.035
10 Oil and Fat	mg/liter	0.00	0.00	0.00		Nil
11 Organofosphate and Carbomate	mg/liter	0.00	0.00	0.00		0.1
12 PCB	mg/liter	-	-	-		Nil
13 Senyawa atife biru (Sulfaktan)	mg/liter	0.00	0.00	0.00		0.5
14 Toxaphene	mg/liter	0.00	0.00	0.00		0.005
III MICRO BIOLOGY						
1 Coliform tinja	per 100 ml	240	920	540		2,000
2 Total Coliform	per 100 ml	240	920	540		10,000

NOTE:

* = The water level shall be more than or equal to 6.

mg = miligram

ml = Milimeter

Bq = Bequerel

Heavy metals are classified into dissolved matter.

Source : JICA's Water Quality Test

Table 7.1 Summary of Construction Cost in Mataiyang Project

Scheme : Mataiyang	
Item	Amount (Rp. million)
I. Direct Construction Cost	
1.1 Preparatory Works	484
1.2 Embung Construction	
1) Main dam	2,178
2) Spillway	3,696
3) Diversion Tunnel	265
4) Seepage protection works	1,228
5) Miscellaneous	1,105
Sub-total of 1.2	8,472
1.3 Irrigation Facilities	1,159
1.4 Domestic Water Supply	4
1.5 Embung Operation and Maintenance Road	36
Sub-total of I.	10,155
II. Administration Cost	508
III. Engineering Services	1,523
Sub-total of I, II & III	12,185
IV. Physical Contingency	1,828
Sub-total of I, II, III, & IV	14,013
V. Contract Tax	1,351
VI. Land Acquisition Cost	51
Sub-total I, II, III, IV, V & VI	15,415
VII. Price Contingency	3,083
GRAND TOTAL	18,498

Table 7.2 Direct Construction Cost in Mataiyang Project (1/2)

Item	Unit	Unit Price Rp.	Quantity	Total 1000 Rp.
I. Dam				
1. Main Dam				
1.1 Earth/stone works				
1) Clearing	m2	400	15,600	6,240
2) Excavation, common	m3	3,500	4,400	15,400
, weathered rock	m3	7,500	56,200	421,500
, rock	m3	11,500	1,900	21,850
3) Embankment, impervious soil	m3	8,000	35,500	284,000
, filter	m3	12,000	17,600	211,200
, transition	m3	12,000	24,500	294,000
, random material	m3	6,000	110,800	664,800
4) Stone masonry	m3	80,000	0	0
5) Rip-rap protection	m3	15,000	4,700	70,500
1.2 Grouting	m	71,000	1,200	85,200
1.3 Other miscellaneous works				103,735
Sub-total of 1.				2,178,425
2. Spillway				
2.1 Earth works				
1) Clearing	m2	400	12,600	5,040
2) Excavation, common soil	m3	3,500	9,200	32,200
, weathered rock	m3	7,500	118,300	887,250
, rock	m3	11,500	3,900	44,850
3) Backfill	m3	5,200	6,300	32,760
2.2 Concrete works				
1) Concrete - A	m3	250,000	500	125,000
2) Concrete - B	m3	170,000	9,460	1,608,200
3) Reinforcement bar	ton	1,500,000	25	37,500
4) Form	m2	15,000	49,800	747,000
2.3 Other miscellaneous works	L.S			175,990
Sub-total of 2.				3,695,790
3. Diversion Tunnel				
3.1 Earth works				
1) Clearing	m2	400	2,100	840
2) Excavation	m3	11,500	5,800	66,700
3) Backfill	m3	5,200	0	0
3.2 Concrete works				
1) Concrete - A	m3	250,000	430	107,500
2) Concrete - B	m3	170,000	0	0
3) Reinforcement bar	ton	1,500,000	22	33,000
4) Form	m2	15,000	2,200	33,000
3.3 Other miscellaneous works	L.S			24,104
Sub-total of 3.				265,144
4. Seepage protection works				1,227,872
5. Miscellaneous & Others				1,105,085
Total - I.				8,472,315

Table 7.2 Direct Construction Cost in Mataiyang Project (2/2)

Item	Unit	Unit Price Rp.	Quantity	Total 1000 Rp.
II. Irrigation Facilities				
1. Canal works (including the rehabilitation works)				
1.1 Earth works				
1) Clearing	m2	400	77,900	31,160
2) Excavation	m3	5,000	10,900	54,500
3) Embankment	m3	6,300	16,200	102,060
1.2 Stone masonry	m3	80,000	9,200	736,000
Sub-total of 1.				923,720
2. Related structures				
2.1 Turnout	nos.	2,540,000	2	5,080
2.2 Syphon	nos.	5,500,000	3	16,500
2.3 Aqueduct		5,975,000	0	0
2.3 Cross drain	nos.	4,700,000	2	9,400
2.4 Irrigation division box	nos.	900,000	110	99,000
2.5 Division box for livestock		1,170,000		
Sub-total of 2.				129,980
3. Miscellaneous & Others				
				L.S
Total - II				1,159,070
III. Domestic Water Supply				
1. Pipe line				
1.1 Earth works				
1) Clearing	m2	400	100	40
2) Excavation	m3	5,000	70	350
3) Backfill	m3	5,200	60	312
1.2 Pipe line setting works				
1) Dia 75 mm	m	13,300	0	0
2) Dia 150 mm	m	33,200	100	3,320
Sub-total of 2.				4,022
2. Miscellaneous & Others				
				L.S
Total - III.				4,424
IV. Dam Operation and Maintenance Road				
1. Road Works				
1.1 Earth works				
1) Clearing	m2	400	5,500	2,200
2) Excavation	m3	5,000	800	4,000
3) Embankment	m3	6,300	2,300	14,490
4) Pavement (lime stone)	m3	15,000	800	12,000
2. Miscellaneous and others				
				L.S
Total - IV				35,959
GRAND TOTAL				9,671,768

Table 8.1 Economic Construction Costs and Annual Disbursement Schedule

Mataiyang Project		(Unit : Rp. million)					
	Item	SCF	Total cost	1st year	2nd year	3rd year	4th year
1	Direct Construction Cost		6,425	172	1,065	2,482	2,706
	1) Preparatory Works	0.71	343	172	171	0	0
	2) Dam Construction						
	- Main dam	0.71	1,546	0	308	619	619
	- Spillway	0.71	2,624	0	262	1,050	1,312
	- Diversion tunnel	0.71	188	0	150	38	0
	- Seepage protection works	0.71	872	0	174	349	349
	Sub-total		5,230	0	894	2,056	2,280
	3) Irrigation Facilities	0.71	823	0	0	412	411
	4) Domestic Water Supply System	0.71	3	0	0	1	2
	5) Dam O & M Road	0.71	26	0	0	13	13
2	Administration Cost	0.90	457	12	76	177	192
3	Engineering Services	0.90	607	182	121	152	152
4	Physical Contingency		964	26	160	372	406
	Total		8,453	392	1,422	3,183	3,456

Note : Standard Conversion Factors (SFC). Source : Pedoman Pengamatan dan Evaluasi Proyek-Proyek Pengairan, Direktorat Jenderal Pengairan, 1985

Table 8.2 Financial and Economic Prices of Farm Inputs and Outputs in NTT

Item	Unit	Flores & Sumba		West Timor		
		Financial Price *1	Economic Price *2	Financial Price *1	Economic Price *2	
1 Farm Products						
Paddy *3	kg	325	392	325	389	
Maize *3	kg	200	210	200	205	
Mungbeans *3	kg	1,000	896	1,000	890	
Soybeans *3	kg	900	637	900	632	
Red onion *4	kg	1,500	694	1,500	689	
Tobacco *5	kg	900	520	900	519	
2 Seeds						
Paddy	Certified	kg	537	605	537	605
	Own	kg	-	325	-	325
Maize	Certified	kg	533	922	533	922
	Own	kg	-	297	-	297
Mungbeans	Certified	kg	1,170	1,383	1,170	1,383
	Own	kg	-	893	-	893
Soybeans	Certified	kg	810	617	810	617
	Own	kg	-	606	-	606
Red onion		kg	850	850	850	850
Tobacco		kg	25,000	25,000	25,000	25,000
3 Fertilisers						
Urea		kg	350	424	350	429
TSP		kg	400	496	400	501
KCl		kg	400	426	400	431
4 Agro-chemicals						
Insecticides	Liquid type	lit	10,000	10,000	10,000	10,000
	Powder type	kg	3,000	3,000	3,000	3,000
Rodenticides		kg	5,500	5,500	5,500	5,500
5 Labour						
Hired labour *6		man-day	2,000	1,500	2,000	1,500
Family labour		man-day	-	1,500	-	1,500
6 Draft Animal						
Hired		head-day	5,000	5,000	5,000	5,000
Own		head-day	-	5,000	-	5,000
7 Farm Machinery						
Tractor		ha	200,000	200,000	200,000	200,000

Remarks : *1 : As of 1994

*2 : Projected prices in 2005 at 1994 constant prices

*3 : Dry grain

*4 : Fresh

*5 : Fresh leaves

*6 : Economic conversion factor is 0.75.

Table 8.3 Economic Crop Budget per Ha

Item	Qty of Unit	Value (Rp.)	Without Project				With Project							
			Paddy (Irrigated) Qty	Paddy (Irrigated) Amt (Rp.)	Maize (Rainfed) Qty	Maize (Rainfed) Amt (Rp.)	Paddy (Irrigated) Qty	Paddy (Irrigated) Amt (Rp.)	Soybean (Irrigated) Qty	Soybean (Irrigated) Amt (Rp.)	Mungbean (Irrigated) Qty	Mungbean (Irrigated) Amt (Rp.)		
1 Gross Production Value														
Paddy	kg	392	2,200	862,400	1,500	588,000	0	0	4,000	1,568,000	0	0	0	0
Soybean	kg	637	0	0	0	509,600	0	0	1,200	764,400	0	0	0	0
Mungbean	kg	896	0	0	0	0	0	0	0	0	0	1,000	896,000	0
Red onion	kg	694	0	0	0	0	0	0	0	0	0	0	0	0
2 Production Cost														
Seed														
Paddy	kg	605	50	30,250	0	0	0	0	25	15,125	0	0	0	0
	Certified													
	Own	325	0	0	50	16,250	0	0	0	0	0	0	0	0
Soybean	kg	617	0	0	0	0	6,170	0	0	0	0	0	0	0
	Certified													
	Own	606	0	0	0	0	18,180	0	0	0	0	0	0	0
Mungbean	kg	1,383	0	0	0	0	0	0	0	0	0	20	27,660	10
	Certified													
	Own	893	0	0	0	0	0	0	0	0	0	20	17,860	20
Red onion	kg	850	0	0	0	0	0	0	0	0	0	0	0	0
	Certified													
Fertiliser														
Urea	kg	424	120	50,880	100	42,400	25	10,600	200	84,800	50	21,200	50	21,200
TSP	kg	496	60	29,760	50	24,800	50	24,800	100	49,600	100	49,600	100	49,600
KCI	kg	426	30	12,780	0	0	25	10,650	50	21,300	50	21,300	50	21,300
Agro-chemicals														
Insecticide	lit	10,000	2.0	20,000	0.5	5,000	0.0	0	2.0	20,000	2.0	20,000	2.0	20,000
Rodenticide	kg	3,000	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Liquid	5,500	2.0	11,000	0.5	2,750	0.0	0	2.0	11,000	1.0	5,500	1.0	5,500
	Powder													
Labor														
Family	md	1,500	98	147,000	65	97,500	25	37,500	172	258,000	70	105,000	80	120,000
Hired	md	1,500	13	19,500	10	15,000	0	0	13	19,500	0	0	0	0
Draft Animal														
Family	ad	5,000	20	100,000	10	50,000	0	0	20	100,000	10	50,000	10	50,000
Hired	ad	5,000	0	0	0	0	0	0	0	0	0	0	0	0
Tractor	ha	200,000	0	0	0	0	0	0	0	0	0	0	0	0
Total production cost				421,170		253,700		107,900		579,325		318,120		319,290
3 Net Production Value				441,230		334,300		401,700		988,675		446,280		576,710

Table 8.4 Economic Costs and Benefits Flow

Mataiyang Project								Unit : Million Rp.
Year	Cost				Benefit		Increment	
	Capital	Replace	O&M	Total	Irrigation	Negative		Total
1.	392	0	0	392	0	0	0	-392
2.	1,422	0	0	1,422	0	0	0	-1,422
3.	3,183	0	0	3,183	0	0	0	-3,183
4.	3,456	0	0	3,456	0	0	0	-3,456
5.	0	0	34	34	449	0	449	415
6.	0	0	34	34	524	0	524	490
7.	0	0	34	34	598	0	598	564
8.	0	0	34	34	673	0	673	639
9.	0	0	34	34	748	0	748	714
10.	0	0	34	34	748	0	748	714
11.	0	0	34	34	748	0	748	714
12.	0	0	34	34	748	0	748	714
13.	0	0	34	34	748	0	748	714
14.	0	0	34	34	748	0	748	714
15.	0	0	34	34	748	0	748	714
16.	0	0	34	34	748	0	748	714
17.	0	0	34	34	748	0	748	714
18.	0	0	34	34	748	0	748	714
19.	0	0	34	34	748	0	748	714
20.	0	0	34	34	748	0	748	714
21.	0	0	34	34	748	0	748	714
22.	0	0	34	34	748	0	748	714
23.	0	0	34	34	748	0	748	714
24.	0	0	34	34	748	0	748	714
25.	0	0	34	34	748	0	748	714
26.	0	0	34	34	748	0	748	714
27.	0	0	34	34	748	0	748	714
28.	0	0	34	34	748	0	748	714
29.	0	0	34	34	748	0	748	714

EIRR = 5.5 %

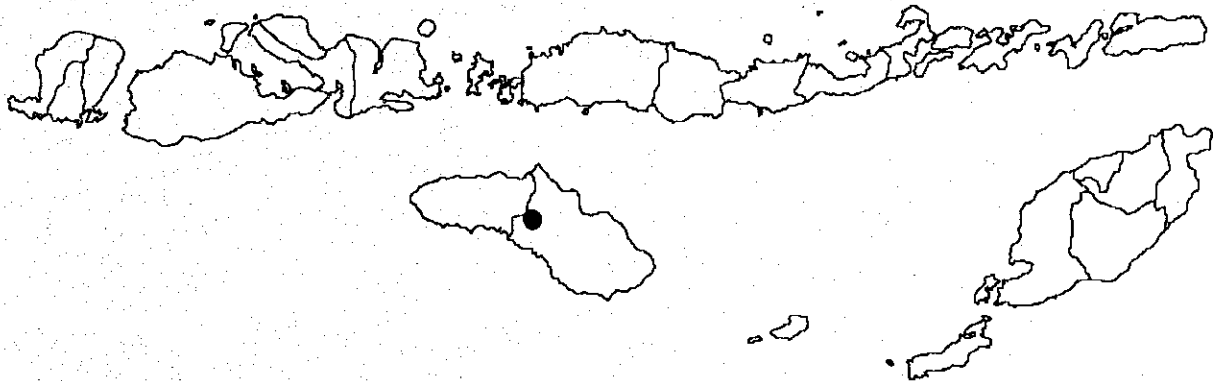
Table 8.5 Financial Crop Budget per Ha

Item	Q'ty of Unit	Value (Rp.)	Without Project				With Project							
			Paddy (Irrigated) Q'ty	Paddy (Irrigated) Amt (Rp.)	Maize (Rainfed) Q'ty	Maize (Rainfed) Amt (Rp.)	Paddy (Irrigated) Q'ty	Paddy (Irrigated) Amt (Rp.)	Soybean (Irrigated) Q'ty	Soybean (Irrigated) Amt (Rp.)	Mungbean (Irrigated) Q'ty	Mungbean (Irrigated) Amt (Rp.)		
1 Gross Production Value														
Paddy	kg	325	2,200	715,000	1,500	487,500	0	0	4,000	1,300,000	0	0	0	0
Soybean	kg	900	0	0	0	800	720,000	0	0	0	1,200	1,080,000	0	0
Mungbean	kg	1,000	0	0	0	0	0	0	0	0	0	0	1,000	1,000,000
Red onion	kg	1,500	0	0	0	0	0	0	0	0	0	0	0	0
2 Production Cost														
Seed														
Paddy	kg	605	50	30,250	0	0	0	0	25	15,125	0	0	0	0
	kg	0	0	0	50	0	0	0	0	0	0	0	0	0
Soybean	kg	617	0	0	0	10	6,170	0	0	0	0	0	0	0
	kg	0	0	0	0	30	0	0	0	0	0	0	0	0
Mungbean	kg	1,383	0	0	0	0	0	0	0	0	0	20	27,660	10
	kg	0	0	0	0	0	0	0	0	0	0	20	0	20
Red onion	kg	850	0	0	0	0	0	0	0	0	0	0	0	0
Fertiliser														
Urea	kg	350	120	42,000	100	35,000	25	8,750	200	70,000	50	17,500	50	17,500
TSP	kg	400	60	24,000	50	20,000	50	20,000	100	40,000	100	40,000	100	40,000
KCl	kg	400	30	12,000	0	0	25	10,000	50	20,000	50	20,000	50	20,000
Agro-chemicals														
Insecticide	lit	10,000	2.0	20,000	0.5	5,000	0.0	0	2.0	20,000	2.0	20,000	2.0	20,000
Rodenticide	kg	3,000	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	kg	5,500	2.0	11,000	0.5	2,750	0.0	0	2.0	11,000	1.0	5,500	1.0	5,500
Labor														
Family	md	0	98	0	65	0	25	0	172	0	70	0	80	0
Hired	md	2,000	13	26,000	10	20,000	0	0	13	26,000	0	0	0	0
Draft Animal														
Family	ad	0	20	0	10	0	0	0	20	0	10	0	10	0
Hired	ad	5,000	0	0	0	0	0	0	0	0	0	0	0	0
Tractor	ha	200,000	0	0	0	0	0	0	0	0	0	0	0	0
Total production cost				165,250		82,750		44,920		202,125		130,660		116,830
3 Net Production Value				549,750		404,750		675,080		1,097,875		949,340		883,170

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

***Feasibility Study on
Mataiyang Embung Development Project***

Figures





Legend (Present Land Use/Soils)

Present Land Use		Soils	
PI	Paddy Field, Irrigated	I	
PR	Paddy Field, Rainfed	II	
U	Upland	III	
T	Tree Crops	#	
B	Bush/Scrub/Grassland		
R	Residential		
C	Cemetery		
O	Others		

▲ No	Soil Test Pit with Sampling
△ No	Soil Test Pit without Sampling
---	Boundary of Beneficiary Area

0 100 200 400 600 800 1000m
SCALE 1:20,000

Figure 1.1 Present Land Use and Soils (Mataiyang)

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

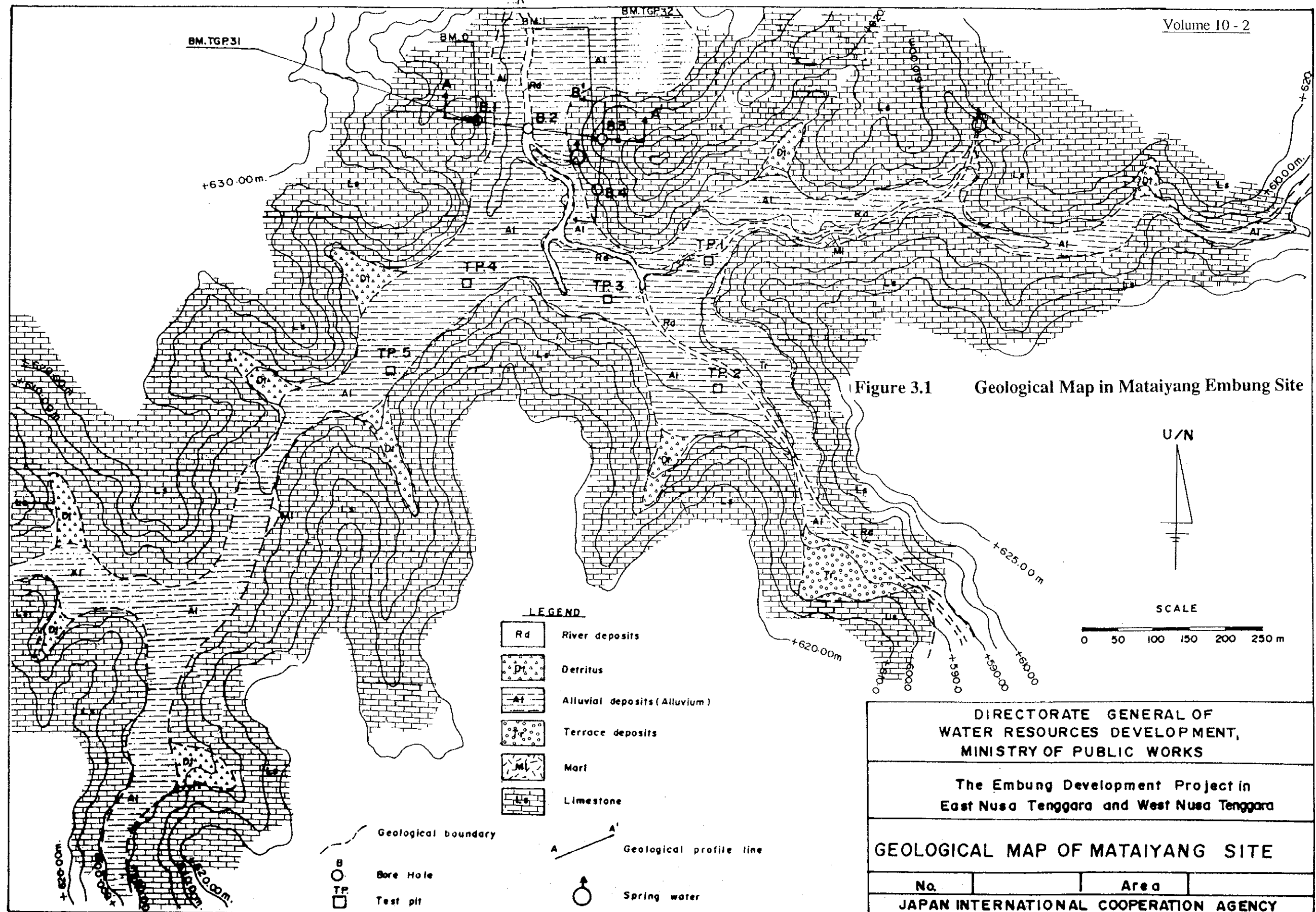
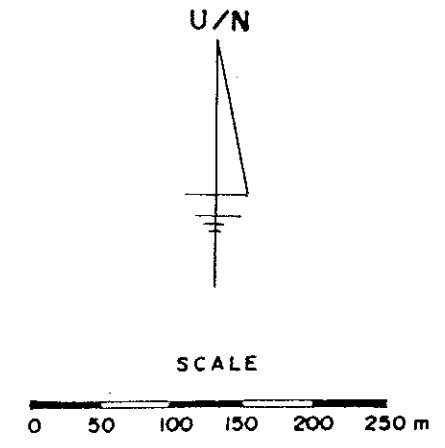


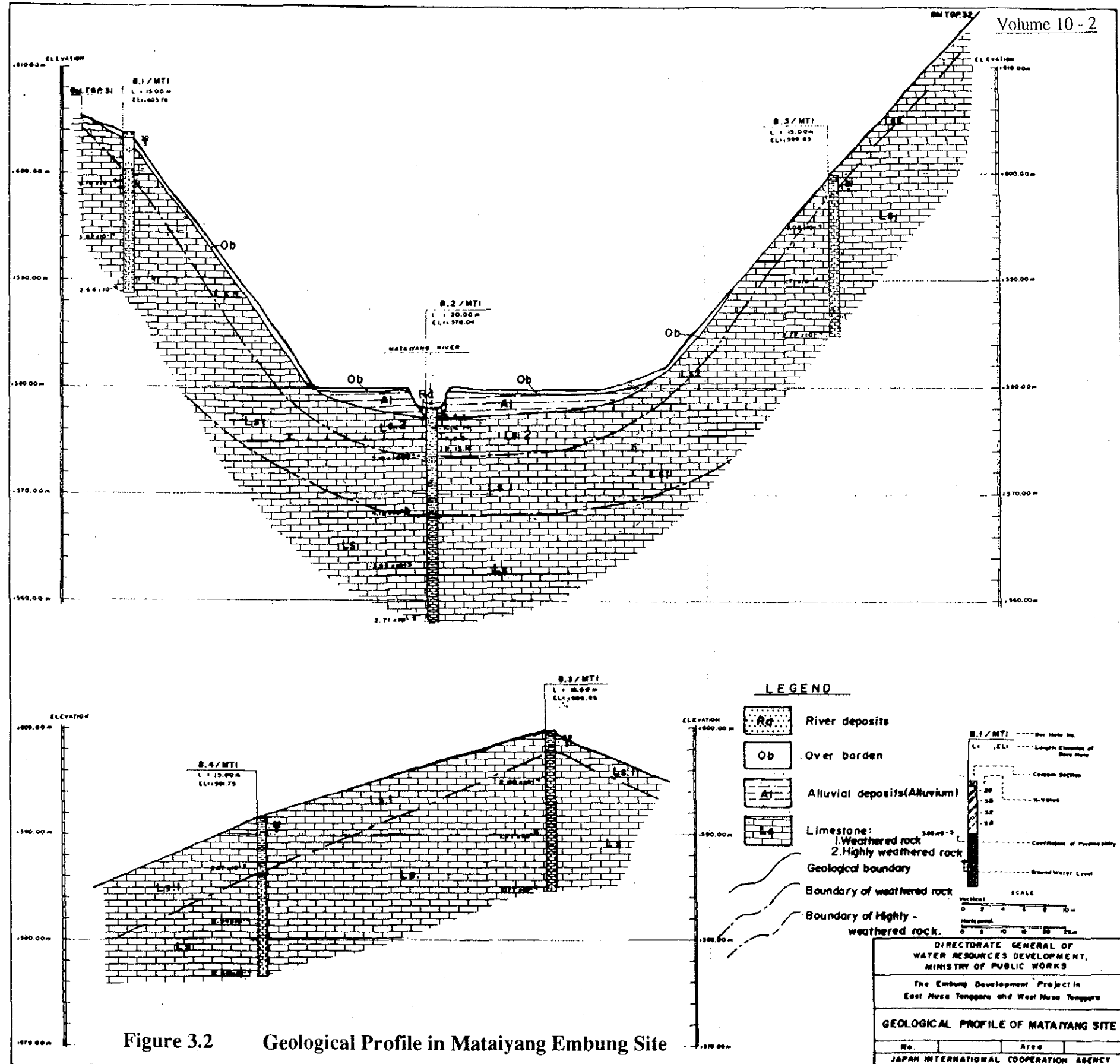
Figure 3.1 Geological Map in Mataiyang Embung Site

- LEGEND**
- Rd River deposits
 - Dt Detritus
 - Al Alluvial deposits (Alluvium)
 - Td Terrace deposits
 - Ml Marl
 - Ls Limestone

- Geological boundary
- Bore Hole
- Test pit
- Geological profile line
- Spring water



DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT, MINISTRY OF PUBLIC WORKS			
The Embung Development Project in East Nusa Tenggara and West Nusa Tenggara			
GEOLOGICAL MAP OF MATAIYANG SITE			
No.		Area	
JAPAN INTERNATIONAL COOPERATION AGENCY			



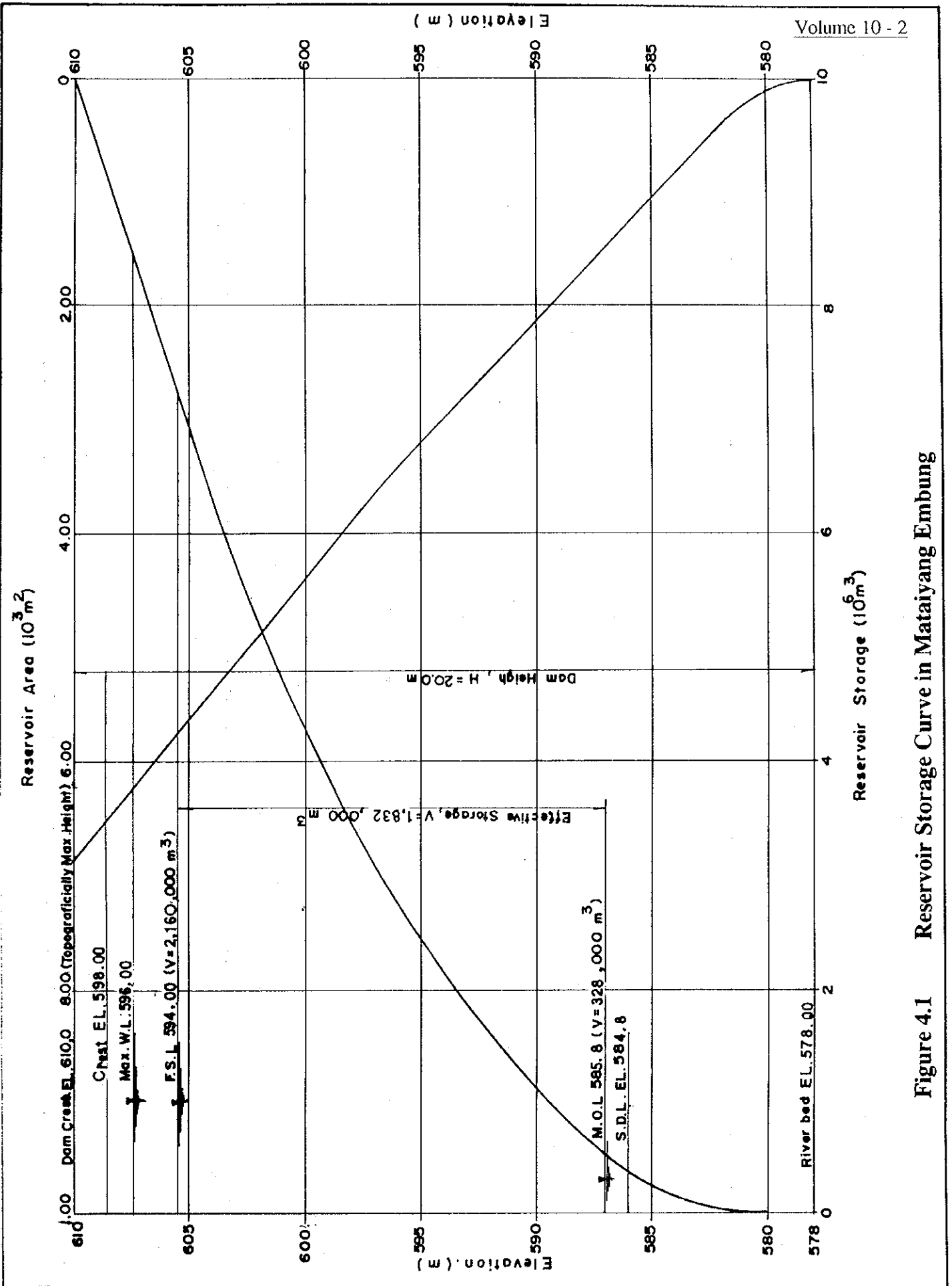


Figure 4.1 Reservoir Storage Curve in Mataiyang Embung

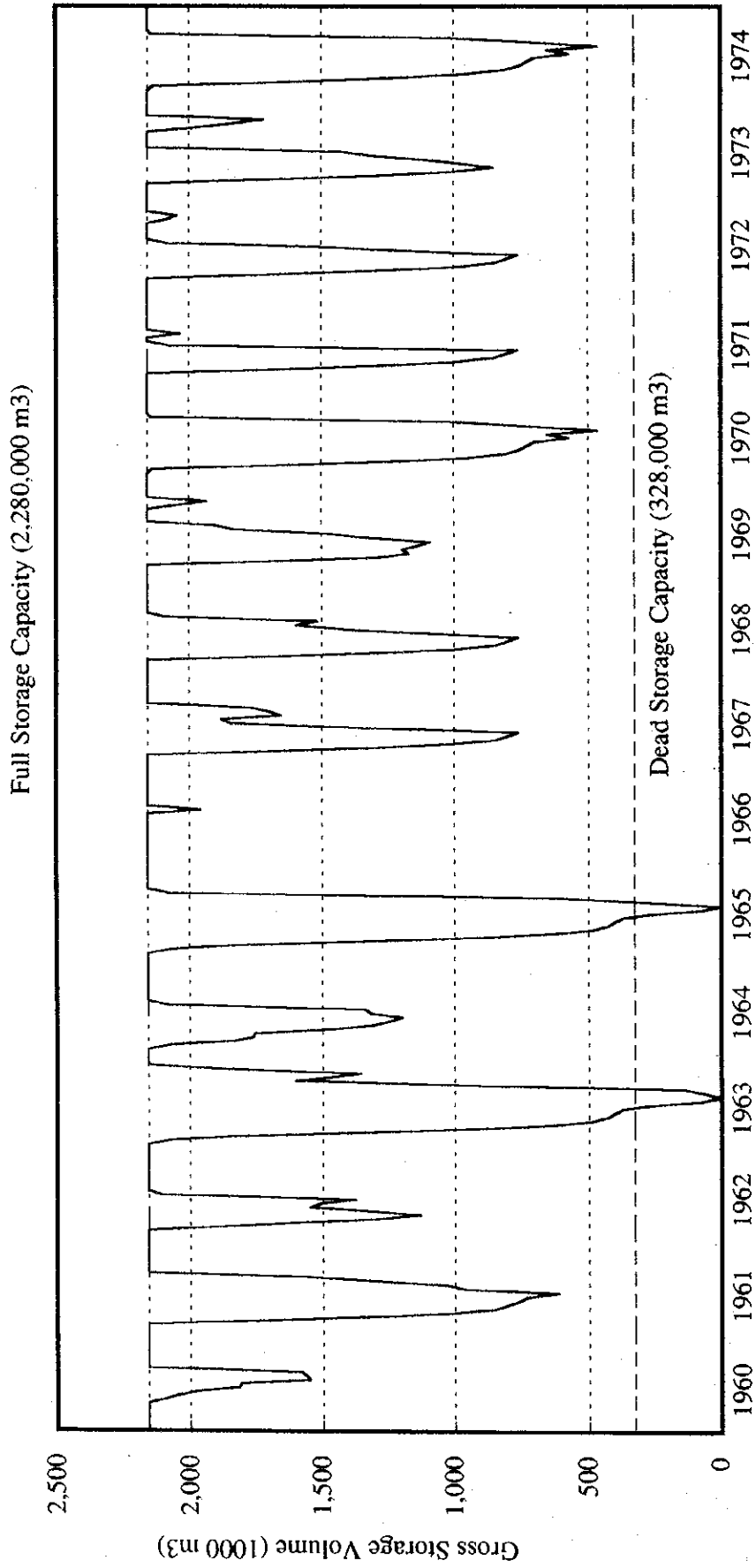


Figure 4.2 Result of Reservoir Operation in Mataiyang Embung

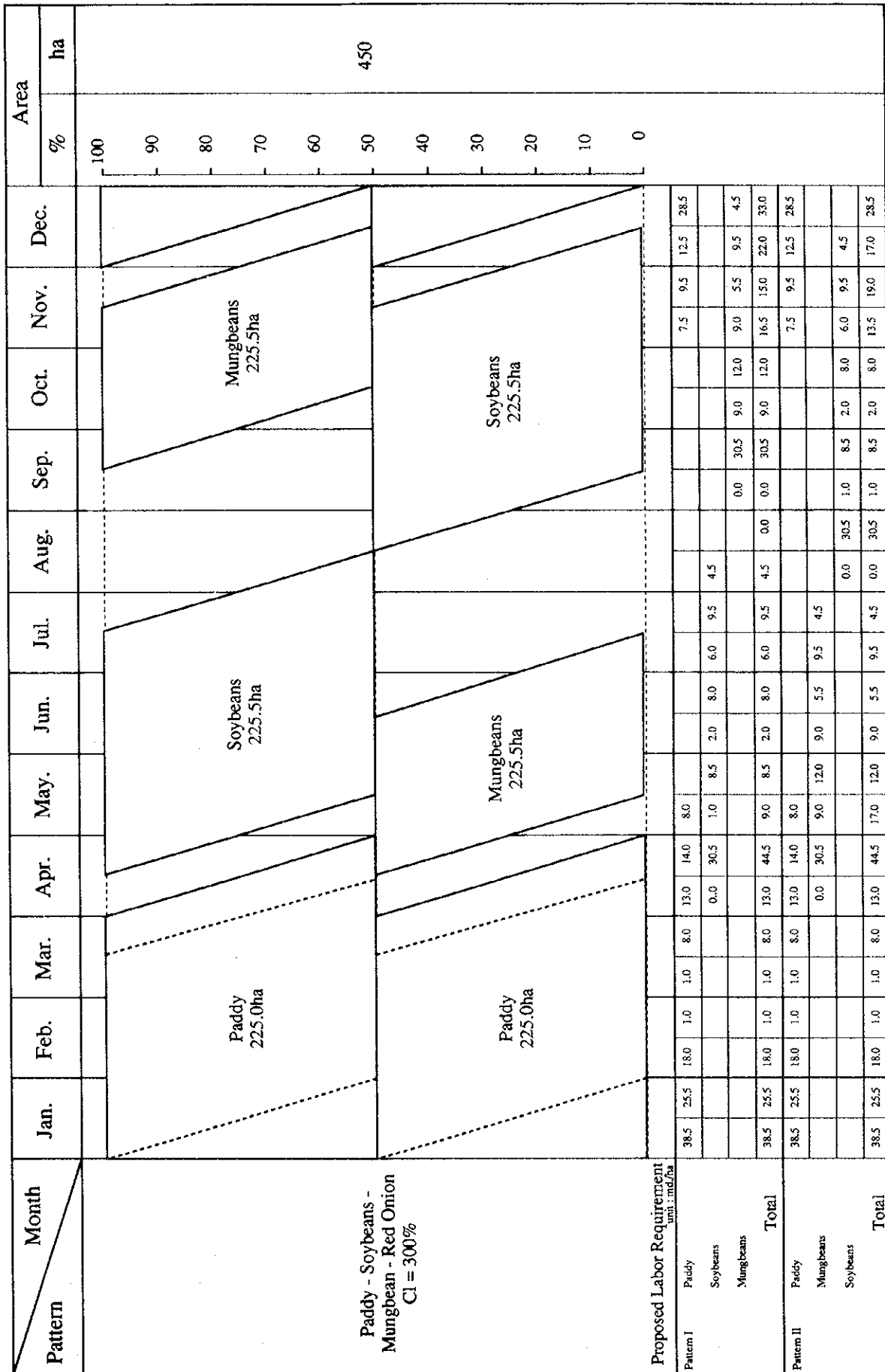
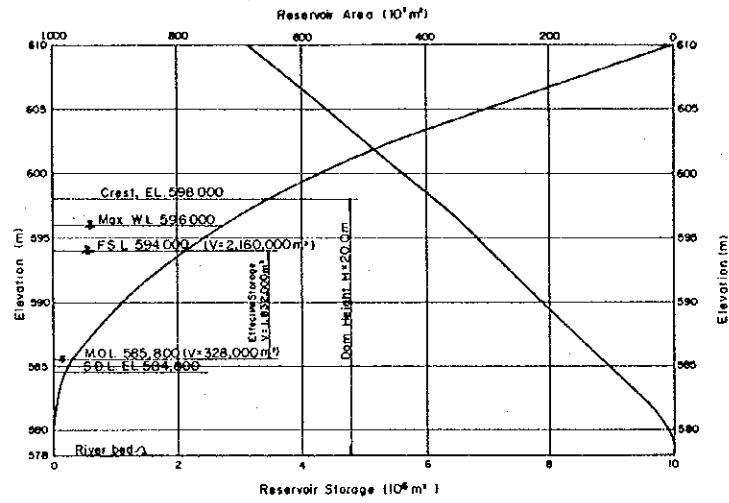
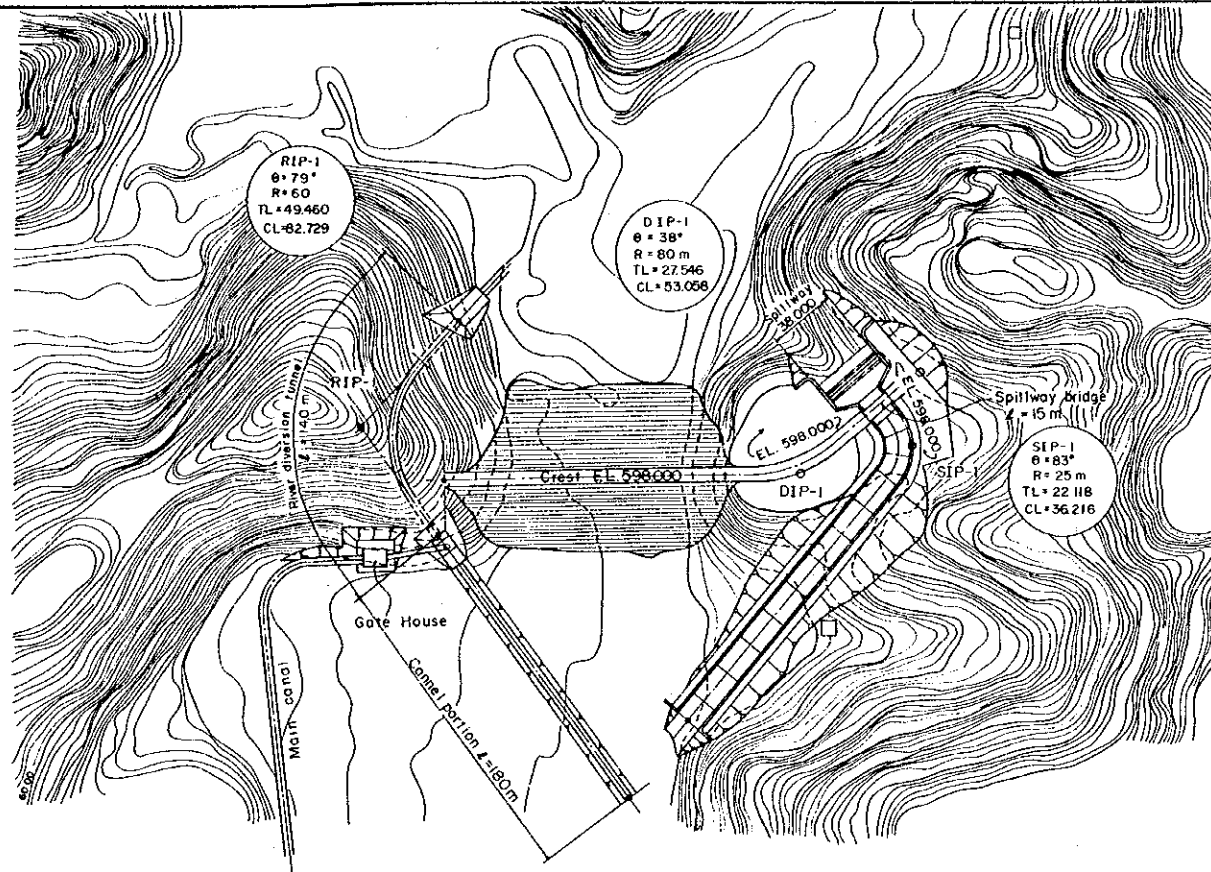


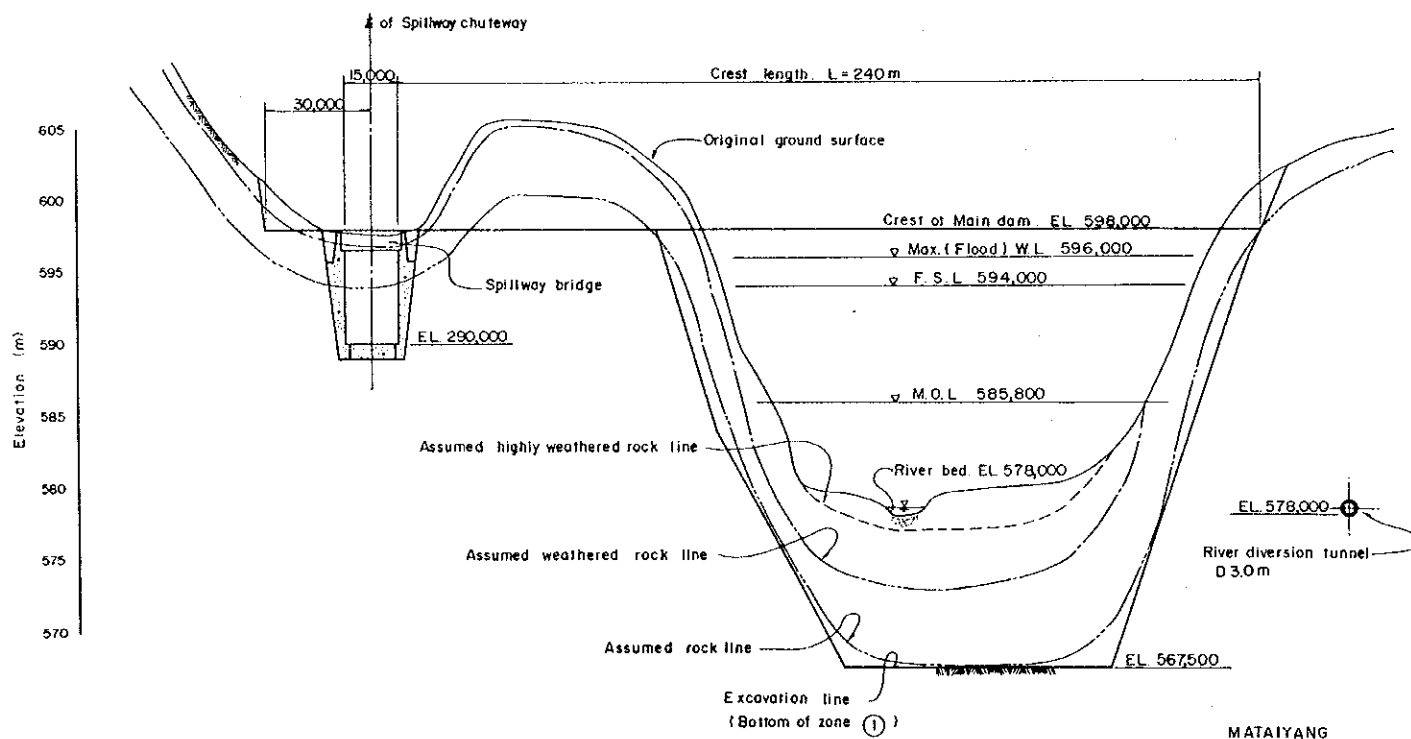
Figure 4.3 Proposed Cropping Pattern for Mayaiyang Project



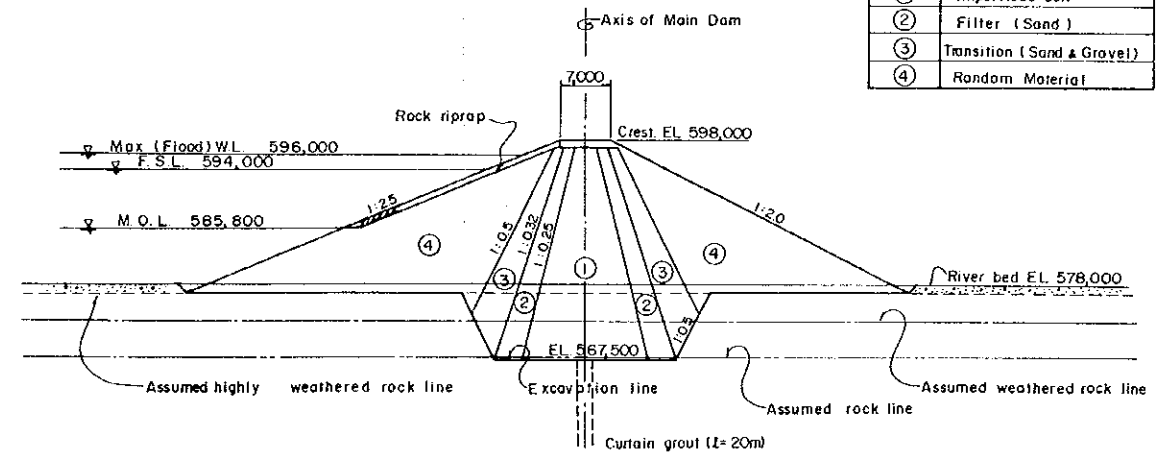
RESERVOIR STORAGE CURVE AT MATAIYANG



PLAN Scale A



PROFILE OF MAIN DAM
Scale: H = 1:1,000
V = 1:250



MAXIMUM CROSS SECTION OF MAIN DAM
Scale B

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

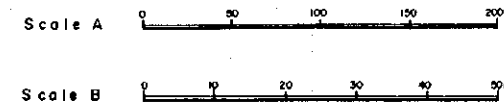


Figure 4.4 General Plan of Mataiyang Embung

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

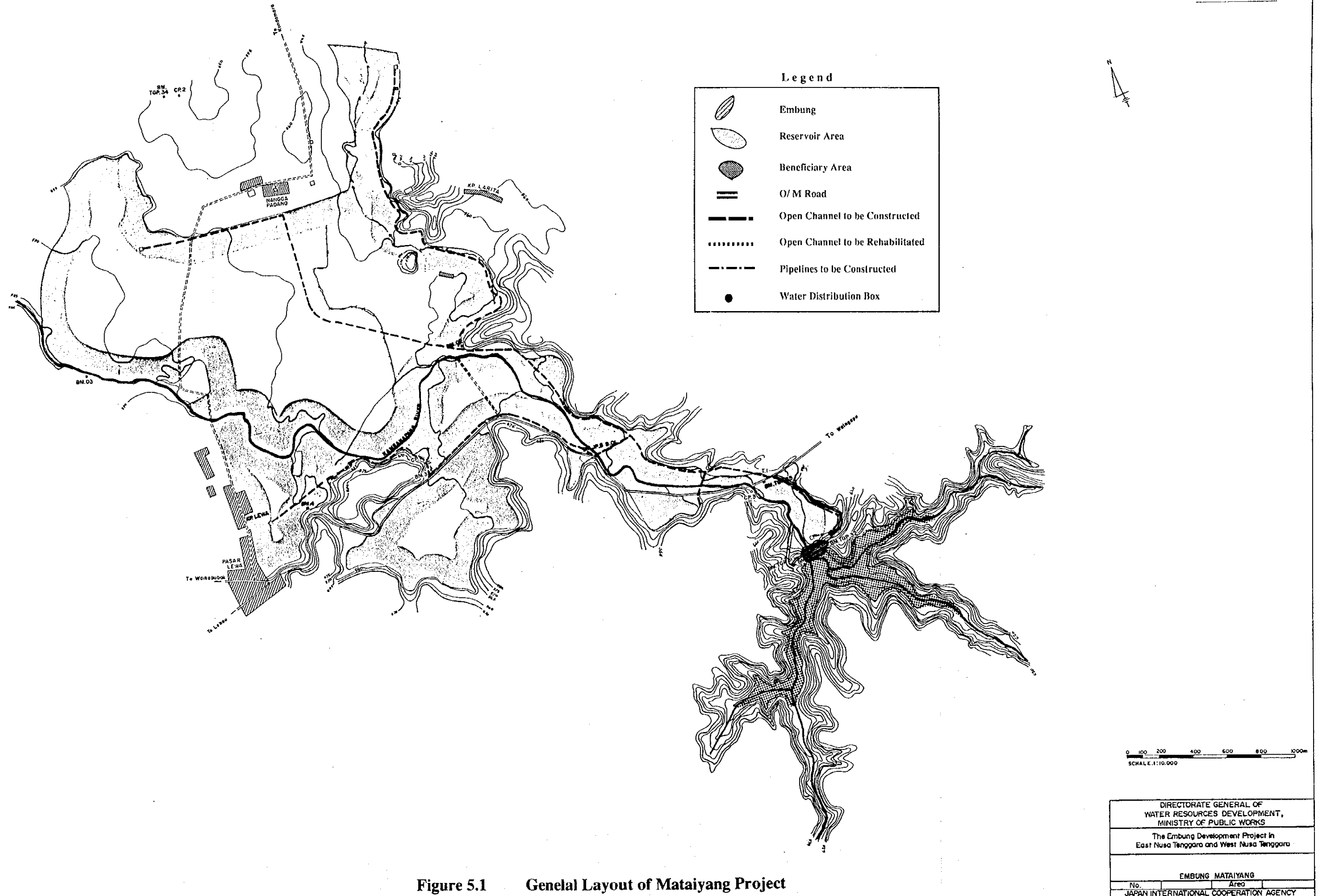


Figure 5.1 Genel Layout of Mataiyang Project

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

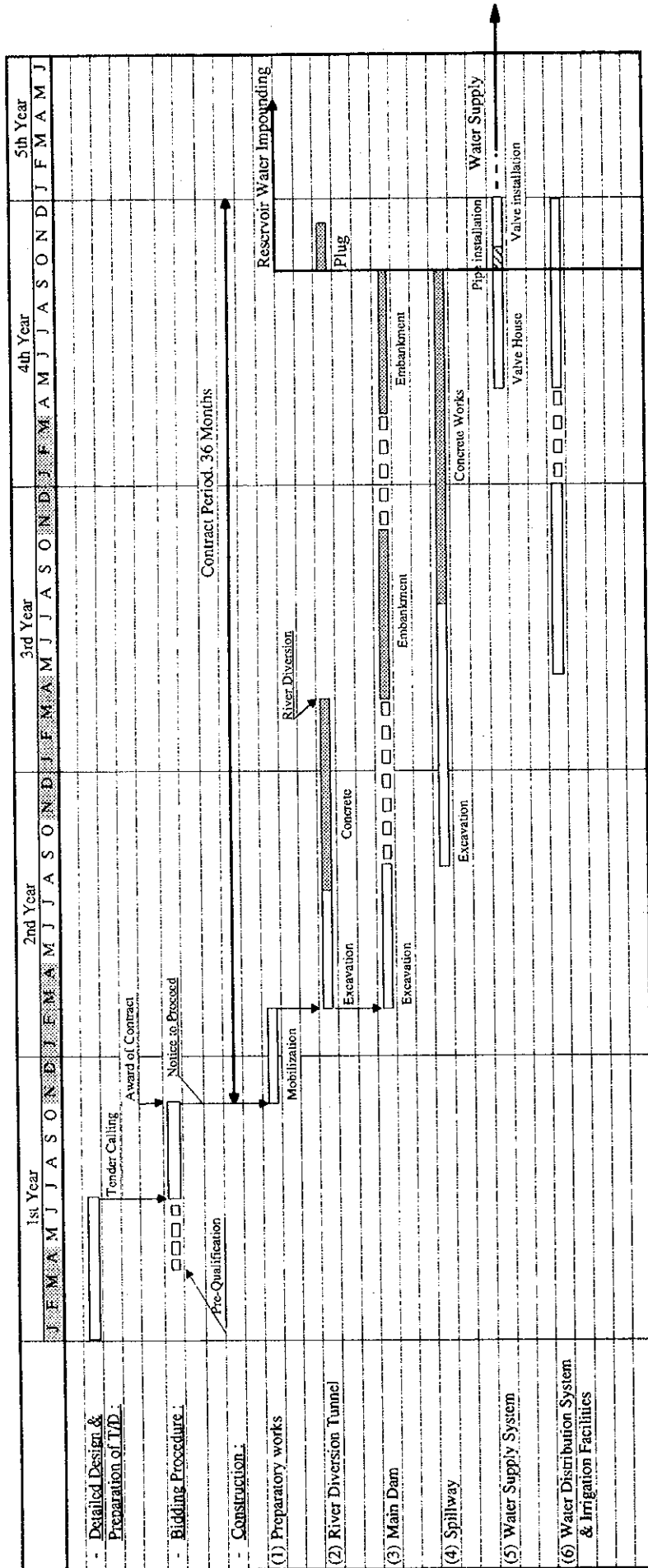


Figure 6.1 Construction Time Schedule for Mataiyang Project

JICA