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Japan International
Cooperation Agency
(JICA)

Directorate General of
Water Resources Development,
Ministry of Public Works

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

Final Report
(Volume 5)

Guideline

May 1995

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(SMALL SCALE IMPOUNDING POND DEVELOPMENT PROJECT)
IN
EAST NUSA TENGGARA AND WEST NUSA TENGGARA
IN
THE REPUBLIC OF INDONESIA

FINAL REPORT

VOLUME 5

Guideline

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1. INTRODUCTION

1.1 Introduction

This is the Final Report prepared in accordance with the Scope of Work on the Study on the Embung Development Project in West Nusa Tenggara (NTB) and East Nusa Tenggara (NTT) in the Republic of Indonesia (the Study) agreed upon between the Directorate General of Water Resources Development (DGWRD) of the Ministry of Public Works and Japan International Cooperation Agency (JICA) on October 15, 1993. The Final Report Volume 5 presents Guideline which is prepared as a general tool for assessing Embung development potential from the technical, economical and social viewpoints to clarify development needs and priority.

1.2 The Purpose and Users of Guideline

This guideline is prepared in a form for the purpose of serving technical knowledge and advice that enable users to step in the right direction of Embung development plan formulation in water shortage areas prevailing in the both Provinces of NTB and NTT. The expected users are engineers and technicians concerned with Embung development in the Provincial Public Works Services (DPUP), NTB and NTT.

In the course of preparing this Guideline, special attention has been paid to extract the essence of the existing methodology and procedures used for formulating water source facility development plans in Indonesia and to put it to the test for the purpose of designing the Guideline for practical use. For testing, a series of feasibility study was carried out for 16 cases representing different types of Embung selected from a total of 157 candidates which the both DPUPs took up for the Study. All the important outputs from these feasibility study are fully fed back to the Guideline. Aiming to establish a practical tool meeting requirements of staff involved in Embung development, any comment on this Guideline is welcome and will be incorporated into the final version of Guideline.

1.3 Definition of Embung

Resulting from the said feasibility study on 16 representative cases, it is clarified that, if Embung exceeds 15 m in dam height, practice of foundation treatment works at the same standard of large dam is indispensable to every Embung because of particular condition of geology in NTB and NTT. Another clarification is that, if Embung has large pocket area at its site, it is desirable to increase the total storage capacity of Embung to the maximum extent within the upper limit of Embung height taking into account investment efficiency. From these viewpoints, the difference of definition between Embung and dam in this Guideline is made as shown below.

Difference of definition between Embung and dam

Total Storage Capacity	Dam Height	
	Up to 15.0 m	Above 15.0 m
Up to 1.0 MCM	Embung	Dam
Above 1.0 MCM	Embung	Dam

Thus, this Guideline can be applied to the above two cases of which height from the river bed is 15.0 m and below and location is NTB and NTT only.

1.4 Scope of Guideline

The Guideline consists of three parts:

- General procedure and notable points in formulating Embung development plan;
- Identification and investigation of potential Embung; and,
- Assessment of Embung development potential and Embung formulation of development plan.

The first part gives users technical directions and advice which can be referred to check focal points for development plan formulation corresponding to different stages of Embung development. The second part describes important issues to which users have to paid their attention in undertaking identification and investigation of potential Embung. The third part presents the key points to assess development potential of Embung which is identified, already planned or already designed but not implemented yet.

As the Guideline covers issues concerning identification to planning stages, an additional guideline for design, construction management, and operation and maintenance will be able to be prepared on the basis of actual results and new findings to be obtained from the urgent implementation of five Embung in NTT under the GOJ's grant aid.

2. GENERAL PROCEDURE AND FOCAL POINTS OF EMBUNG DEVELOPMENT PLAN FORMULATION

2.1 Confirmation of Maturity of Embung Development Plan

Figure 2.1 illustrates the general procedure to formulate a development plan of Embung from the initial stage in which no identification study has been completed yet to the final stage in which a development plan or design work has been already completed. In talking about development of any Embung, therefore, it is necessitated to confirm the project maturity level of each Embung as the first step of the general procedure. The focal points are to confirm and classify the maturity of Embung development plan according to the following four levels:

- Identification study not yet completed : This indicates that everybody is aware of Embung development needs, but no information on Embung development potential is available;
- Identification study completed : This means that potential Embung site has been identified, but no plan about how to develop identified Embung is formulated;
- Formulation of development plan completed : This indicates that Embung development plan has been already formulated by DPUP but this plan needs to be confirmed in line with the concept of this Guideline; and,
- Design completed : This means that implementation of Embung development needs to be promoted based on the DPUPs' design already made but its design concepts need to be reconfirmed whether the design is in line with the planning concept of this Guideline.

After confirming the maturity level of Embung development plan, users are able to go to the next step of this planning procedure. The focal points of the planning procedure are described in the following sections.

2.2 Focal Points for Identification and Categorization of Embung

In case that no potential Embung site has been identified yet, the identification study coupled with inventory survey has to be conducted and the focal points are:

- To confirm the purpose of Embung through interview to village committee members, heads of villages and key personnel of local governments;
- To check water source focusing upon whether the water source river of the potential Embung and the existing water intake facilities is same or different; and,
- To carry out an inventory survey for collecting basic information on potential Embung site and beneficiary area.

The next step is to categorize potential Embung which is found through this identification study or has been already identified by the previous survey. The main purpose of categorization is to enable users to prepare Embung development plan matching with the future

water use pattern of beneficiary inhabitants. The concept of categorization coincides with the above three focal points.

Concerning Embung previously identified, it is required to confirm the availability of exact information on these issues before categorization of Embung. If there are not enough data and information, immediate undertaking of additional inventory survey is required.

All the data and information collected through the inventory survey are arranged and interpreted for classifying Embung by specific features. This classification is used as supplemental materials for categorization of Embung. The categorization result is able to give users the definite direction towards the goal in formulating Embung development plan.

2.3 Focal Points for Formulation of Development Plan

The current economic status of NTB and NTT are still left behind that of other provinces due to insufficient fulfillment of basic human needs (BHN), slow pace of poverty alleviation and less concerns about a balanced investment to regional development. In harmony with the national policy to correct this economic imbalance, the development concept aims to improve the present condition of social and economic infrastructures with the highest priority so as to meet BHN and to increase agricultural outputs.

The focal points to formulate Embung development plan as follows:

- To put the first priority to supply irrigation water and the second to domestic and livestock water in NTB, whereas the first priority to meet BHN followed by irrigation water supply in NTT taking into account inhabitants' needs for and intention to the future use of new water source facilities;
- To project the future water demand for irrigation, domestic and livestock use at the 15th year from starting the project taking into account useful life of Embung;
- To examine development potential of Embung from the technical viewpoints;
- To determine the optimum development scale of Embung;
- To make preliminary design and cost estimate; and,
- To conduct project justification from the viewpoints of economic soundness, social satisfaction and environmental impact.

2.4 Focal Points for Review of Previous Development Plan

There are many cases of which Embung development plans have been previously made depending on insufficient and unreliable data and information resulting in many discrepancies among the important planning issues. Correction of contradiction in Embung development plan is indispensable before conducting design works. The focal points to review the previous development plan are as follows:

- Catchment area vis-a-vis runoff at Embung site;
- Runoff vis-a-vis storage capacity of reservoir;
- Storage capacity vis-a-vis irrigation command area; and,
- Topographic and geological condition vis-a-vis Embung type.

2.5 Focal Points for Estimate of Project Benefit

Direct benefits attributable to development of new water resources by constructing Embung in NTB and NTT are derived from supply of domestic, livestock and irrigation water to inhabitants who have been suffering from chronic water shortage problems. The estimate of project benefit is the basic tool required to justify the economic viability of Embung development. In due consideration of social importance to provide new water sources to the water shortage areas in NTB and NTT, it is also indispensable to assess the expected socio-economic impact of domestic and livestock water supply. The focal points to estimate project benefit are as follows:

- Value of domestic water and investment amount to beneficiary inhabitants;
- Quantification of effect of livestock water supply; and,
- Estimate of economic value of irrigation benefit.

2.6 Focal Points for Justification of Project Implementation

The implementation of Embung development is generally justified from the economic viewpoint. In NTB and NTT, however, it is indispensable to justify the needs for implementation of Embung from the viewpoint of meeting BHN prior to the economic justification. The focal points to justify the implementation of Embung development are as below:

- The purpose of Embung development is demarcated according to inhabitants' intention to the future use of new water source facility;
- The original development scale of Embung is reconfirmed taking into account the topographic, geological and hydrological limitation; and,
- The original irrigation command area of Embung is reassessed after the review of the original development scale.

3 INVESTIGATION FOR IDENTIFICATION OF POTENTIAL EMBUNG

3.1 Interview to Village Communities

In the initial stage of investigation for finding potential Embung sites, it is prerequisite to carry out an interviews to villagers, key village community members, and heads of villages and local governments aiming to confirm their needs to solve water shortage problems, correct their own ideas about potential development sites of new water source facilities including Embung and confirm their intention to the future use of new water source facilities. The interview is conducted by means of face-to-face question system.

3.2 Site Reconnaissance Survey

At the same time of interview, undertaking of reconnaissance survey is required to confirm potential Embung sites which are suggested through interviews in village committees. Special attention is paid to topographic shape, surface runoff of the water source river and surface geology in conducting reconnaissance survey. As no topographic map (1/25,000) is usually available, it is required to prepare a sketch map to plot the location of village, potential Embung site, access road, river and springs, irrigation area and other remarkable landmarks after reconnaissance survey.

3.3 Inventory Survey

An inventory survey is conducted for the promising site for Embung development which is found through the identification study consisting of the interview and site reconnaissance survey. The purpose of the inventory survey is to correct data and information as the basic planning materials. The main items of the inventory survey are as follows:

- Number of beneficiary inhabitants and livestock;
- Drinking water source facilities coupled with water availability, water quality, location and distance from houses and number of users by water source facility;
- Livestock water sources coupled with water availability, location, distance and number of animals by water source;
- Acreage of farm land and present land use;
- Prevailing crops, cropping patterns, farming practices and crop production;
- Available irrigation facilities and irrigation water sources;
- Inhabitants intention to their future farming system; and,
- Present condition of catchment area, potential Embung reservoir area and potential Embung site, river channel, river bed and other related issues.

3.4 Arrangement of Information on Embung

As for Embung previously identified and some already planned, the availability of the above-mentioned items of information is checked. If there are not enough data and information, immediate undertaking of additional inventory survey is required.

All the data and information collected through the inventory survey are arranged and interpreted for classifying Embung by specific features as follows:

- Maturity of Embung development plans is classified into three groups, namely planning and design completed, survey and planning completed, and survey and planning incompleted;
- Catchment areas at potential Embung sites are classified into four groups, namely less than 5 km^2, 5.1 to 10.0 km^2, 10.1 to 15.0 km^2, 15.1 to 20.0 km^2 and more than 20.1 km^2;
- Embankment type is classified into three groups, namely homogeneous embankment dam, zoned embankment dam and masonry gravity dam;
- Dam height is classified into four groups, namely lower than 5.0 m, 5.1 to 10.0 m, 10.1 to 15.0 m and higher than 15.1 m;
- Embankment volume is classified into six groups, namely less than 20,000 m^3, 20,000 to 40,000 m^3, 40,000 to 60,000 m^3, 60,000 to 80,000 m^3, 80,000 to 100,000 m^3 and more than 100,000 m^3;
- Total storage capacity of Embung is classified into six groups, namely less than 0.2 MCM, 0.2 to 0.4 MCM, 0.4 to 0.6 MCM, 0.6 to 0.8 MCM, 0.8 to 1.0 MCM and more than 1.0 MCM; and,
- Irrigation command areas is classified into six groups, namely less than 50 ha, 51 to 100 ha, 101 to 200 ha, 201 to 500 ha and more than 501 ha.

3.5 Categorization

The categorization criteria is established to classify the present situation of farming system and irrigation water source facilities as well as the future utilization of storage water.

The criteria to classify the present farming system is established as follows, focusing upon the level of irrigated cropping:

- Type a : fallow, rainfed cropping on dry upland, single cropping of rainfed wet paddy or single cropping of irrigated paddy to a partial extent, having the cropping intensity of up to 100%;
- Type b : single cropping of irrigated paddy fully for the wet season and rainfed Palawija crops partly to fully for the dry season, having the cropping of more than 100%; and,

- Type c : two cropping of the wet season paddy and the dry season Palawija crops partly to fully under irrigated condition, double cropping of irrigated paddy, single cropping of the wet season paddy and double cropping of the dry season Palawija crops under irrigated condition, or double cropping of irrigated paddy coupled with the dry season Palawija crops under either irrigated or rainfed condition, having the cropping intensity of 200% to 300%.

The criteria to classify the present status of irrigation water source facilities is set up as below, taking into account the location of water intake facility:

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

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

- Type 1 : Permanent source of irrigation, domestic and livestock water;
- Type 2 : Permanent source of irrigation and livestock water;
- Type 3 : Permanent source of irrigation and domestic water;
- Type 4 : Permanent source of irrigation water; and,
- Type 5 : Permanent source of domestic and livestock water or one of these two purposes.

4 FORMULATION OF EMBUNG DEVELOPMENT PLAN

4.1 Assessment of Future Water Demand

4.1.1 Land resources availability

(1) Land resources assessment

Basic land resources assessment shall be carried out for the anticipated beneficiary area of potential Embung. In the land resources assessment, the following survey works shall be required for the planning:

- Identification of beneficiary area

Primary confirmation of the beneficiary area based on the existing topographic maps and/or air photographs at about 1:50,000 scale.

Field reconnaissance at and around the beneficiary area.

- Topographic maps

Preparation of topographic maps of the anticipated beneficiary area at a scale of about 1:5,000.

- Soil survey

Soil profile survey on the soil test pits made every 25 to 50 ha of the beneficiary area.

Soil laboratory tests on standard analysis items for the samples taken from the about 3 representative soil pits.

As the primary target of the Embung development planning is on irrigation development, land suitability assessment shall be done on the above survey results. The evaluation items are as follows and the suitability criteria is mentioned in Table 4.1.

- Temperature regime (annual average temperature)
- Water availability (dry months, average annual rainfall)
- Rooting conditions (soil drainage class, soil texture, rooting depth)
- Nutrient retention (cation exchange capacity (CEC), pH)
- Nutrient availability (total N, available P_2O_5, available K_2O)
- Toxicity (salinity (EC))
- Terrain (slope, surface stoniness, rock outcrops)

It is preferable for irrigation development plan of Embung that the farmland and convertible land to farmland, which are suitable for wet paddy and Palawija crops cultivation, extend at 50 ha or more.

The conversion rate to net irrigable area is set to be 0.9 for the existing irrigated and rainfed paddy field and 0.8 for dry upland field, estate crop field and fallow land.

(2) Land use survey

The irrigation-oriented Embung development schemes can be classified into the following three categories.

Category A	Rainfed farming as irrigation facilities have not been provided yet or already been available but not functioning.
Category B	Irrigated farming to some extent of the designed level caused by unstable condition of water supply and/or low level of irrigation facilities.
Category C	Irrigated farming to the full extent of the design level with further possibility of extending irrigation area and/or increasing crop intensity if water resources can be regulated.

The present land use map of the beneficiary area shall be prepared by topographic map and field reconnaissance. Then, the land potential for irrigation development shall be examined by the land suitability assessment results. The results of the land use survey can be tabulated by category in the following table.

Present Land Status	Land Classification		Category A	Category B	Category C
Irrigated field			No	Yes	Yes
Area by land use					
Paddy field				ha	ha
Upland				ha	ha
Tree crops				ha	ha
Non-irrigated field			Yes/No	Yes/No	Yes/No
Area by land use					
Paddy field			ha	ha	ha
Upland			ha	ha	ha
Tree crops			ha	ha	ha
Convertible land			Yes/No	Yes/No	Yes/No
Paddy	->	Upland	ha	ha	ha
Paddy	->	Tree crops	ha	ha	ha
Upland	->	Paddy	ha	ha	ha
Upland	->	Tree crops	ha	ha	ha
Tree crops	->	Paddy	ha	ha	ha
Tree crops	->	Upland	ha	ha	ha
New irrigable area			Yes/No	Yes/No	Yes/No
Area by suitable land use					
Paddy field			ha	ha	ha
Upland			ha	ha	ha
Tree crops			ha	ha	ha

(3) Cropping survey

The dominant cropping patterns in the beneficiary area are studied based on the present land use condition. The survey method is of interviews to beneficiary farmers chosen by random sampling. The number of the sample farmers is about 10 % of total.

The cropping patterns can be coded as shown below.

Island Group		Status		Category		Cropping Pattern
LM	Lombok	PR	Present	A	11	Paddy
SM	Sumbawa	WO	Without project	B	12	Paddy - Paddy
FR	Flores	WP	With project	C	13	Paddy - Paddy - Paddy
SB	Sumba				21	Paddy - Palawija
TR	Timor				22	Paddy - Palawija - Palawija
					23	Paddy - Paddy - Palawija
					31	Palawija
					32	Palawija - Palawija
					33	Palawija - Palawija - Palawija
					41	Shifting cultivation
					51	Perennial crops (cash crops)
					52	Perennial crops (fruits)

The typical present cropping patterns by major island are shown in Table 4.2. The cropping pattern of potential Embung beneficiary area is classified into a case similar to the survey results. The future cropping pattern under the conditions of "With- and Without-project" is estimated from the same table.

4.1.2 Irrigated farming development

(1) Cropping pattern

The main items to select crops and to determine cropping pattern are as follows:

- Physical conditions include meteorological conditions focusing the wet season period and soil conditions paying special attention to soil texture and drainability;
- Social and economic conditions cover farm-gate prices of products, suitability of crops for the regional social customs and marketability and trafficability of products; and,
- Present farming practices and farming method include farmers' experience for the crops and easiness of farming practices.

(2) Farm inputs

Amounts and applying methods of seeds, fertilizer and agro-chemicals for major crops is considered on the basis of regional recommendation by extension service institution, data of agricultural researches, and similar irrigation projects. Proper application amounts of fertilizer

and agro-chemicals for high yielding rice varieties is examined carefully, because the varieties generally demand large amount of fertilizer and agro-chemicals.

(3) Farm labor requirement

The present labor requirement is investigated on the basis of farm budget survey or statistical data on labor requirement for crop production. The future labor requirement for improved cropping systems is examined on the basis of present labor requirement and additional labor requirement by proposed farming practices. In the case of intensive rotation cropping pattern with high yielding rice varieties newly introduced, labor requirements for the farm management increase largely. Accordingly, labor balance is examined to confirm the availability of family and hired labors in the beneficiary area at the peak season of farm operation.

(4) Farming practice

The following items are considered in the examination of farming practices and farm management schedule:

- Suitable period for farming practices will be limited by introducing irrigation farming;
- Available periods of plowing and harvesting will be limited due to the intensive cropping system;
- Kind and quantity of farming practices will be increase by increasing of dry season crops and planted area; and,
- Insect damage will be increase by irrigation farming and increasing of fertilizer application.

It is necessary that farming practices are improved from by-hand to by-animal, from by-animal to mechanization, or from by-hand to mechanization levels due to the necessity of intensive work performance in the limited period and emancipation from hard work on farm. Lift-upping of efficiency and accuracy in farm operation is important. In the future farming practice and schedule the following items need to be examined for introduction of agricultural machinery:

- Profitability of mechanization;
- Availability of proper kinds and capacities of agricultural machinery;
- Easiness of machinery operation;
- Availability of enough manual for operation and maintenance;
- Availability of enough after-services and spare part supply; and,

- Availability of procurement fund.

(5) Anticipate crop yield

The target crop yield is anticipated on the following consideration:

- Soil conditions, farmers' experience and farming techniques for the crops, varieties, and present unit yield in the beneficiary area;
- National guideline, date of research institutes, and yields of the demonstration farms; and,
- Target yields of the similar projects.

Anticipated yield of each crop is determined comparing with farming techniques, present and proposed, which consist of certified seeds introduction, fertilizer application, insect control, irrigation, water control and so on. Increase in unit yield is determined throughout consideration of increase impacts of yield.

(6) Agricultural extension services

Intensification of various supporting services need to achieve to target crop yield. The following agricultural extension services are included into the future irrigation development plan:

- Farming technique level of farmers;
- Farming technique level of progressive farmers in the project area;
- Organization of farmers for extension, which includes a progressive farmer; and
- Substance of technical transfer and its timing.

(7) Agricultural input and credit supply

As the supply of agricultural inputs and distribution of agricultural credit play an important role in promoting intensification of irrigated farming, the following items are checked to estimate the input and credit demand:

- Kind and quantity of inputs required for intensive farming;
- Present economic situation of farmers;
- Availability of fund for agricultural credit; and,
- Credit program by KUD.

4.1.3 Population projection for inhabitants and livestock

The future population in the beneficiary area of Embung is projected by referring to "Projection of Population for Kabupaten/Kotamadya in Indonesia 1990-2000" prepared by National Statistic Bureau and the Second Long Term Development Plan (PJPT II).

The future livestock population in the beneficiary area is projected taking into account the actual growth rate of each livestock in the both NTB and NTT Provinces during the Pelita V period.

4.1.4 Water demand projection

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

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

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

The irrigation water demand is estimated for unit irrigation area of one hectare on the semi-monthly base taking into account crop consumptive use, evapotranspiration, crop coefficient, effective rainfall and irrigation efficiency both for paddy and Palawija crop as well as land preparation water, layer replacement and percolation loss only for paddy. For calculation of the irrigation diversion requirement, the standards quoted in "Irrigation Design Standard, KP-01" by DGWRD.

4.2 Assessment of Embung Development Potential

4.2.1 Water resources availability

(1) Catchment yield

The rainfall stations with rainfall records continuing 15 to 36 years are selected. The rainfall data are converted to the catchment rainfall by use of an isohyet map. Less than 20 mm of half monthly rainfall is ignored for estimation. A run-off coefficient adopted is 0.30 - 0.40 considering the characteristics of each catchment area and available hydrological analysis data in NTB and NTT.

(2) Floods

The flood analysis is made to determine the design discharge of the structures, such as spillway, diversion tunnel, and so on. Taking availability of the flood record and size of the catchment area into account, the rational formula is adopted to estimate the flood discharge in the study. The formula is;

$$Q = 0.2778 \, f \, r \, A$$

where, Q : Peak discharge (m^3/s)
f : Runoff coefficient
r : Average rainfall intensity within time of concentration (mm/hr)
A : Catchment area (km)

1) Design rainfall

Design rainfall is estimated by the Log Pearson Type III method is adopted, which is widely used in NTB and NTT areas.

2) Design flood

Following formula is the Ruziha's formula to estimate the flood travel time:

$$T = L/V$$
$$V = 72(H/L)^{0.6}$$

where, T : Flood travel time (hr)
L : Horizontally projected length of river course (km)
H : Difference of elevation (m)
V : Velocity of flood (km/hr)

The rainfall intensity within concentration time of the flood is estimated by an empirical formula prepared by Dr. Mononobe as follows:

$$r = (R_{24}/24) \times (24/T)^{2/3}$$

where; r : Maximum average rainfall intensity within concentration time (mm/hr)
R_{24} : Daily rainfall (mm)
T : Time of concentration (hr)

The runoff coefficient is estimated at 0.8 considering the condition of the catchment area.

(3) Sediment load

As no data on sediment load is available for each source river, the sedimentation rate is assumed to be 0.4 - 0.5 mm/km^2/year for potential Embung taking into account the characteristics of catchment areas and referring to the previous study on "Sumbawa Water Resources Development".

4.2.2 Topographic condition

The following base maps are prepared:

- Area map, 1:1,000 to 1:2,000 in scale, showing reservoir, its surrounding area, and borrow area; and,
- Site map, 1:200 to 1:500 in scale, for Embung site area.

Interpretation of aerial photographs are effective for getting general information on land form and geological structure.

4.2.3 Geological condition

(1) Preparation for geological investigation

Geological conditions of potential Embung site, reservoir area and borrow area is clarified using collected data, field survey and necessary laboratory tests.

Previous geological data is collected before commencement of survey. Outline of geologic structure for the potential Embung area is studied from the geological maps of Geological Research And Development Center, 1:250,000 in scale.

(2) Surface geological survey

The surface geological survey is carried out in regard to rock and soil faces and their characteristics.

- Geological maps using area map and site map is examined; and
- Embung axis is selected.

(3) Sub-surface geological survey

Drilling survey, at least three bore holes along the Embung axis, is required. These three holes are at both sides of the river and river bed. Drilling survey is core drilling. Standard penetration test utilizing boreholes is required every 1.0 m.

Standard drilling depth is not less than 2/3 of the Embung height. In principle, boreholes are drilled up to bed rock for 5.0 m at least.

Field permeability test shall be performed utilizing boreholes every 5.0 m. The test methods needs to be lugeon test, open-end constant head test or others. In case of encountering soft fine soil, undisturbed sampling is taken using thin-walled sampler.

Soil test shall be performed for clarification of soil characteristics, physical test for SRT samples and physical and mechanical test for undisturbed samples.

(4) Report

The survey report shall be submitted including following items:

- Location map;
- Physiography;
- Site geology;
- Reservoir geology;
- Drilling log;
- Photographs of survey, core, etc.;
- Laboratory test results; and,
- Geological mapping

Geological maps using area map and site map is performed in view of surface geological survey and drilling results. Geological profile shall be 1:200 to 1:500 in vertical scale and same scale or within 5 times in horizontal scale. The profile should indicates drilling logs, rock and soil classification, permeability results and ground water level, etc.

4.2.4 Embankment material availability

Items of construction material investigation are as follows:

- Deposit condition and available volume, engineering classification, and physical and mechanical properties of materials in the reservoir and at dam site, particularly excavated materials from spillway site;
- Selection of borrow area of core material;
- Selection of borrow area contact clay material; and,
- Selection of borrow area of filters, concrete aggregates and riprap materials.

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The location and quantity of deposits for construction materials in each site are presented in the report.

The followings are test items and quantity of dam including test of soft foundation.

Material	Test Item
Contact clay	Gs, Wf, LL, PL, SP
Core	Gs, Wf, LL, PL, SP, rd, K, ϕ and C,Cd
Random	Gs, Wf, LL, PL, SP
Filter	Gs, SP, WG, K
Concrete Aggregate	Gg, Sp, WG, LA, Sb, LW
Riprap	Gg, WG, Sb
Soft found-dation of dam	Undisturbed sample Gs, Wf, LL, PL, SP, rd, K, ϕ and C,Cd

Legends :

Symbol	Test Item	Symbol	Test Item
Gs	Specific gravity of soil	Wf	Field water content
LL	Liquid limit	PL	Plastic limit
SP	Grain size analysis	Gg	Specific gravity of gravel
WG	Moisture absorption ratio	LA	Los Angeles rattler
Sb	Stability	LW	Loss by washing
rd	Compaction	K	Permeability
ϕ &C	Shearing	Cd	Consolidation

Note :

(a) In case of semi-pervious to impervious material, the non-dry preparation and non-cyclic use shall be applied for compaction test, permeability test, shearing test and consolidation test.

(b) Compaction test energy is based on : EC=5.625 kg.cm./cm3.

EC=(WxHxNxL)/V (kg.cm/cm3)

where, W : Rammer weight; 2.5kg
H : Rammer drop height; 30cm
N : Number of drops per layer; 30times
L : Number of layers; 3 layers
V : Mold volume; 1,000cm3

(c) Shearing test : The shearing test shall be carried out by triaxial compression test, and test conditions be U-U test and C-U test.

(d) Conditions of sample : The sample conditions for permeability test and triaxial compression test.

4.3 Embung Development Plan

4.3.1 Optimization of maximum development scale

(1) Purpose of optimization study

In order to determine the optimum development scale of each Embung, special attention is paid to two types of Embung indicating orientation of optimization. The one is water supply

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

A simulation model of reservoir operation is employed as the basic tool for determining the optimum development scale of Embung. In carrying out the simulation on the half monthly basis, alternative cropping patterns are referred to and attention is paid to:

- Inflow to reservoir;
- Water losses from the reservoir caused by evaporation;
- Flow of water over the spillway;
- Outflow needed for domestic water;
- Outflow needed for livestock water;
- Outflow needed for irrigation water;
- Volume of water in the reservoir at the beginning of the simulation period; and,
- Volume of water in the reservoir at the end of the simulation period.

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

(2) Cases for comparison

In order to determine the optimum development scale of potential Embung to supply irrigation water, at least two or three alternative cropping patterns are established for comparing development scale of Embung with irrigation benefit.

(3) Methodology

The simulation equation is as follows:

$$W_2 = W_1 + I - L - Sp - O_D - O_L - O_I$$

where, I : inflow to reservoir at the half monthly period (m^3)
L : water losses from the reservoir caused by evaporation during the half monthly period (m^3)
Sp : flow of water over the spillway during the half monthly period (m^3)
O_D : outflow needed for domestic water during the half monthly period (m^3)
O_L : outflow needed for Livestock water during the half monthly period (m^3)
O_I : outflow needed for Irrigation water during the half monthly period (m^3)
W_1 : volume of water in the reservoir at the beginning of the half monthly period (m^3)
W_2 : volume of water in the reservoir at the end of the half monthly period (m^3)

1) Inflow

If there is no gauging station on the water source river, discharge is generated from rainfall of the nearest station.

2) Reservoir storage curve

Reservoir storage curve with surface area is in relation to the elevation at the proposed Embung site.

3) Losses

Evaporation from inundation area can be estimated as "1.1 x ETo" indicating "open water evaporation", which is employed in the Design Criteria KP-1.

4) Spill out discharge from reservoir

Spill out discharge id considered if there is any excess storage which exceed the maximum storage capacity of dam. The probability that the spill out comes in the wet season is set at about 80 %.

5) Water Demand

The annual water demand for the domestic water and livestock are estimated on the basis of the projected population of inhabitants and livestock in the beneficiary area.

As for the irrigation water demand, the maximum irrigable area for the both wet and dry seasons are taken up.

To meet 80 % dependability of irrigation water, reservoir capacity will be determined.

Priority of water use is set as follows:

a) Domestic water
b) Livestock water
c) Irrigation water in wet season
d) Irrigation water in dry season

6) Water level of reservoir

Minimum water level is estimated considering sedimentation volume for 25 years and 0.5 m allowance.

Maximum water level for the simulation is equal to the crest elevation of spillway.

Probable maximum high water level is set according to topography.

(4) Optimum development scale

In case of supply oriented type of Embung with either topographic or hydrological limitation, the optimum development scale coincides with the maximum scale within the upper limit of determining factor.

In case of demand oriented type of Embung with no limitation in terms of topography and hydrology, the optimum development scale coincides with the development scale which makes the irrigation benefit maximum and the investment minimum.

4.3.2 Delineation of beneficiary area

The beneficiary area of each Embung is finally delineated according to the optimum development scale of each Embung. In case of the supply-oriented type of Embung, the beneficiary area is delineated from the irrigable land resources available in the whole irrigable area up to the maximum limit of irrigation area. While, the beneficiary area of the demand-oriented type of Embung coincides with the maximum irrigable area.

4.3.3 Embung development plan

Following the results of the examination on the development potential of Embung and the optimization study on the development scale of Embung, the development plan of each Embung is formulated. In harmony with the foundation strength and the availability of embankment materials at Embung site, dam types applied are selected from zoned embankment dam, masonry gravity dam and homogeneous embankment dam. Foundation treatment methods applied are also chosen from grout or cut-off method according to the foundation treatment requirement. Seepage protection work for the reservoir area is practiced by applying earth blanket method if necessary.

4.4 Preliminary Design

4.4.1 Selection of Embung site

(1) Adaptability to development purpose

The damsite need to be as near as possible to the benefit area and have a sufficient catchment area (including indirect catchment) to fulfill the development objective. In case of

direct diversion of water from the dam, the location of the dam must be selected so that water can be conveyed to the benefit area by gravity flow.

(2) Adverse environmental impacts

Even if the damsite seems preferable from engineering viewpoints, the scale of land acquisition and compensation, and influence to farm land, forest, villages, road, fisheries, cultural assets, natural monuments, ecological relationship, etc. must be carefully examined.

In the preparation of the land acquisition and compensation program for the submerged area, resttlement of households and regional development around the dam site and reservoir must also be considered.

(3) Relationship with other long term development plans

The proposed project must be integrated with the existing projects and future development around the dam site and reservoir must also be considered.

(4) Dam engineering

Dam foundation and the subsurface condition of reservoir area possess, required water tightness and strength, and is sufficiently safe against sliding failure or seepage failure.

The location of the spillway, outlet works, construction of accesstemporary facilities, and embankment material must be examined carefully.

4.4.2 Selection of embankment type

Embankment type shall be selected through the examination on the following items:

- Condition of Embung foundation;
- Quantity and quality of available embankment materials including excavated materials from spillway and other structure sites;
- Easiness of construction; and,
- Embung scale.

The above explanation is made only for fill type dams since most of the Embung scheme have formulated with fill type dams. However, concrete type dam may be considered upon the following conditions:

- Embung foundation is of rock with enough bearing capacity for concrete dam;

- Embung site is located at narrow riverbed with steep slope and embankment volume is considered to be very small;
- Construction materials for concrete aggregate is available; and,
- Construction cost of spillway in fill type dam is considered expensive.

4.4.3 Basic consideration in design

The basic principles in Embung design are to ensure envisaged Embung functions including storage of water, control of river water intake of water and other requirements for safe and efficient dam operation and management.

In addition, safety of Embung body, appurtenant facilities reservoir and natural ground around the reservoir should be ensured during and after completion of construction.

Embung is constructed in conformity with the natural and social environments in the surrounding area and the environmental impacts of dam construction shall carefully be studies to prevent adverse effects, Furthermore, the both construction and O & M costs should be economized as much as possible.

4.4.4 Main features of Embung and reservoir

(1) Feature of reservoir

Feature of reservoir which is main factor for determining dam height is in principle composed of the following capacities:

- Inactive or dead storage capacity;
- Active storage capacity;
- Surcharge volume; and,
- Total storage capacity.

Inactive or dead storage capacity is decided by adding the storage volume for inland fishery, etc., if required, to the estimated sediment volume.

Active storage capacity means the required storage volume determined by water balance study.

Surcharge volume is calculated through flood routing analysis against inflow design flood and shall be kept above full water levels.

Total storage capacity is the total storage volume of inactive or dead storage capacity and active storage capacity.

(2) Feature of Embung

Feature of dam shall be formed with the followings:

- Design flood discharge and maximum water level;
- Full supply level or high water level;
- Minimum operation level;
- Freeboard;
- Embung crest elevation;
- Embung height;
- Extra banking; and,
- Width of Embung crest.

The design flood discharge should be determined on the basis of meteo-hydrological investigations and analysis. the maximum water surface elevation is defined as the maximum reservoir water level when the design flood discharge occurs at the full supply level in the reservoir.

The full supply level or high water level shall be maximum level of water stored by the dam for the purpose of the project.

The minimum operation level shall correspond to the water level for inactive or dead storage.

Freeboard which is one of the elements for deciding the dam crest elevation shall be determined by the following equation :

$$Hf=0.05h+1.0(m)$$

Hf : Height of freeboard (m)
h : Height from river bed to design flood level (Max. water level)

Dam crest elevation shall be decided by the following equation :

Dam crest elevation (DEL)=Max. water level + Hf

Dam height is regarded as the maximum difference height between the dam crest elevation and the top of the dam foundation after stripping, not considering the excavation depth if core trench.

Extra banking shall be considered against settlement of dam embankment. Thickness of extra bankind shall be estimated at 1 to 2% of dam height.

The width of dam crest shall be determined considering the minimum required width for construction and utilization as road after construction, etc. The recommended width is as follows :

$$W \geq 0.2xH + 3.0$$

where

W : width of dam crest (m)

H : dam height (m)

4.4.5 Design of Embung embankment

(1) General

Fill dam has the advantage in utilization of almost all kinds of materials in the vicinity of the dam site. It shall be planned to use excavated materials from spillway, dam foundation outlet works and borrow materials in the reservoir area, in order to minimize construction cost and increase reservoir capacity.

(2) Zoning of embankment

Zoning for fill dam shall be determined considering characteristics of embankment mateials available at the site.

In order to determine zoning plan, characteristics of embankment materials available at the site shall be grasped. The zoning shall be done so as to avoid sudden change of characteristics of materials. In case of sudden change transition zone such as filter shall be placed between both zones.

4.4.6 Stability analysis

(1) Study cases if sliding failure

Study cases and condition are as shown below.

Case	Water level in reservoir	design seismic factor (%)	safety factor
1	Empty (after construction)	0	Fs > 1.5
		50	Fs > 1.2
2	Full Supply level	0	Fs > 1.5
		100	Fs > 1.2
3	Rapid drawdown; Minimum operation level	0	Fs > 1.5
		50	Fs > 1.2

1) Case 1: Pore pressure during the construction remains. Stress indication is total stress.

2) Case 2: Seepage flows in steady condition at full supply level. Stress indication is effective stress.

3) Case 3: Water level suddenly drops from full supply level to minimum operation level, and pore pressure remains. Stress indications is effective stress.

The "Slip Circle Method" is one of the stability analysis to determine the safety factor represented by the ratio of the sum of sliding moment to the sum of resistance moment. The calculation is executed in relation to the center of slip circle for each slice.

1) For total stress analysis; using parameters (c, ϕ) for case 1 :

$$Fs = \frac{\Sigma\{cxl + (N - Ne)\tan\phi\}}{\Sigma(T + Te)}$$

2) For effective stress analysis; using parameters (c, ϕ)

$$Fs = \frac{\Sigma\{c' xl + (N - U - Ne)\tan\phi'\}}{\Sigma(T + Te)}$$

where,

Fs : Safety factor
c, c' : Cohesion of material on sliding surface of each slice
c : for total stress analysis
c' : for effective stress analysis
ϕ, ϕ' : Angle of shear resistance of material on sliding surface of each slice

ϕ : for total stress analysis
ϕ' : for effective stress analysis

l	:	Length of a sliding surface of each slide
N	:	Normal load acting on sliding surface of each slide
T	:	Tangential seismic load acting on sliding surface of each slice
Te	:	Tangential seismic load acting on sliding surface of each slice
Ne	:	Normal seismic load acting on sliding surface of each slice
U	:	Pore pressure acting on sliding surface of each slice (Resultant of the pore water pressure due to seepage)

With regard to the dam to be constructed on soft foundation and slakable surface foundation, study on a safety factor is necessary for sliding moment acting through the foundation and along the contact plane respectively.

Design seismic coefficient shall be determined in accordance with the location and foundation of dam. Seismic coefficient varies depending on the geological structures of the site, for instance, seismic force in soil ground is expected to be intensified compared with the rock ground.

The following seismic coefficient is recommended for the Embung scheme.

Zone	for Embung Scheme	in Japan*
Strong seismic zone :	Kh ≥ 0.15	Kh = 0.15
Medium seismic zone :	Kh ≥ 0.12	Kh = 0.12 - 0.15

Note; *:

referred to the "Deign Criteria for Land Improvement Projects", 1981, the Ministry of Agriculture, Forestry and Fisheries, Japan.

4.4.7 Outlet works

(1) General

Design discharge of outlet works shall be determined based on the dishing discharge required for the following purposes:

- Irrigation;
- Mini-hydropower;
- Water supply;
- Service discharge for existing water rights on maintenance flow;
- Diversion of flood during construction; and,
- Emergency release.

(2) Layout of outlet works

There are in general four types of intake portion; inclined intake structure, intake tower, drop inlet and bottom intake structure.

The type of intake portion shall be determined taking the following into consideration:

- condition to be purpose (control of discharge);
- available water depth;
- design discharge; and
- handed over to project area.

Intake tower or inclined intake structure is favorably adopted to dams of which the available water depth is high or the control of discharge is necessary.

Intake portion shall be designed taking into consideration the following items:

- Intake portion shall be located outside of the toe of dam embankment.

- The sill of intake portion shall be located at equal or lower than the minimum operation level (MOL).

- Transhrack shall be installed.

- It is recommended that simple facilities for getting water from the inactive or dead storage zone be installed in case of an emergency like extraordinary drought.

- Inclined intake structure shall be located on stable foundation.

- Intake tower shall have the facility to go to tower deck such as access bridge or ladder.

The conduit of diversion works shall be used as that on? outlet works after construction. The use of conduit varies according to the conduit size (D) for diversion and the calculated conduit size (É≥) for outlet works as illustrated below.

in case of $D \geq \phi$

in case of $D \leq \phi$

The conduit shall be constructed on stable foundation. The shape of conduit is recommended to be circular since circular section is structurally stable against high inner/outer pressure. The conduit shall be lined with the following materials especially in case of Type B.

- For zoned earthfill type dam;
- Portion before core zone; concrete
- Portion from core zone; steel
- For homogeneous earthfill type dam; steel

The control portion shall be located outside of toe of the dam embankment. Some sets of control gate/valve shall be installed order to allow releasing the wide range of discharge. Each set must have main and sub-gate/valve for its maintenance or replacement. Location of gate/valve at the control portion shall be determined taking the following into consideration:

- Accessibility to gate/valve;
- Sufficient space for constructing energy dissipator against jet flow just after gate/valve; and
- Utilization of water, etc.

Energy dissipator shall be designed just after the gate/valve to convey water smoothly into main canal. Water measurement facility shall be installed after the controlling portion to measure the released discharge.

For reference, some illustrations for recommendable control section are presented.

4.4.8 Diversion works during construction

(1) Design diversion flood

Magnitude of design diversion flood shall be determined on the basis of construction period as follows:

Construction period*	Design diversion flood**
one dry season or one relative dry season	- 5 to 10-year flood during construction period
1 year - 2 year	- 5 to 10-year flood

Note; *: Construction period for river portion of dam embankment

**: Magnitude of design diversion flood shall be determined taking into account the extent of damages to the downstream area, damages to embankment and delay of construction.

(2) Diversion methods

Typical diversion methods are classified as follows:

- Tunnel type;
- Conduit type; and
- Open channel type (using natural river).

Tunnel type shall be avoided from viewpoint of construction cost in the SWIM projects. The conduit installed for the outlet works shall be mainly used in parallel with the natural open channel as illustrated below.

(3) Size of conduit

As for hydraulic conditions and determination of conduit size, the required size of conduit shall be calculated under the free-flow condition based on the design diversion flood. The calculated size may be larger than the required size for releasing the design discharge for irrigation, mini-hydropower and water supply.

Sill elevation of conduit shall be determined based on the design hydraulic gradient, low water level and various conditions during construction.

Crest elevation of cofferdam shall be determined based on the design water level for diversion works and appropriate height of freeboard.

4.5 Construction Plan, Construction Schedule and Cost Estimate

4.5.1 Construction plan

(1) Preparatory works

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

(2) River diversion works

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

(3) Main dam works (fill dam type)

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

(4) Spillway construction works (fill dam type)

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

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

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

(6) Outlet works

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

4.5.2 Construction schedule

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

- All the construction works are carried out by contractor(s) selected through the competitive bidding(s);
- The construction plan is formulated taking into account the mode of construction, the completion target of construction works, the site, weather and topographic conditions, the availability of laborers, construction materials and equipment, and so on. The mechanized construction method is principally adopted and supplemented by ordinary construction method locally practiced;

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

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

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

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

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

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

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

4.5.3 Cost estimate

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

- All the civil works of the Project are performed by contractor(s), selected through the competitive bidding, on the contract basis;

- For physical contingency, 15% of the total amount of direct construction, administration and engineering costs is appropriated, while 10 % of the total cost is added as price contingency;

- The direct construction cost is estimated on the basis of work quantities of the proposed construction works and unit price of each work item. The unit price is estimated for each work item taking into account the market price as of June 1994 and referring to data collected from the on-going projects in NTT. The unit price includes delivery cost of construction materials and equipment to the Project site;

- For engineering service cost to cover detailed design and construction supervision works by consultants, around 15 % of the direct construction cost is appropriated;
- For the contract tax as a value added tax imposed by the GOI, around 10 % of the total contract cost is appropriated;
- Administration cost covers staff salary and office running cost of PRIS's responsible section to manage the Project works. Taking into account the actual condition of on-going projects in NTT, around 5 % of the direct construction cost is appropriated;
- Land acquisition cost is estimated to be 0.5 % of the direct construction cost. The both administration and land acquisition costs need to be borne from the budget of the Indonesian side;
- The Project cost estimated excludes other associated costs necessary for strengthening extension services, organizing water users' association, improving social infrastructures and so on because these costs have to be arranged by the Indonesian side; and,
- The currency used for the cost estimate is Indonesian Rupiah (Rp.).

4.6 Environmental Impact Assessment

4.6.1. Outline of environmental impact assessment

The environmental impact assessment on the Embung development is important for smooth project implementation and sustainable operation. As for Embung development, significant environmental impacts and impact toward off-site area of the project have not been recognized because of almost small scale . In order to recognize negative impact and to be reflected the countermeasures in the project as rapidly as possible, the effective works in the limited staff and duration is required. This guideline shows the procedure and approach of the assessment and keys on the assessment. The procedure, criteria and forms are based on "Guidelines for the arrangement and selecting of environmental impact analysis" issued by Ministry of Public Works.

4.6.2 Procedure and methods of environmental impact assessment

Environmental impacts of Embung development are assessed according to the following procedure:

- to identify the scope (scale and extent) of environmental impact assessment;
- to collect the information and data concerning around Project area;
- to choose environmental issues in due consideration of the project components and demarcation of places where environmental issues occur;
- to collect the information and data concerning chosen environmental issues;
- to identify actual environmental aspects and impacts;

- to asses potential environmental aspects and impacts, both positive and negative;
- to suggest mitigatory measures against negative environmental impacts; and,
- to appreciate residual negative impact with mitigatory measures and to suggest alternative plan in case of being inevitable impacts.

The main elements of approach of the environmental impact assessment for the Embung development comprise screening, followed by scoping, environmental impact assessment. The screening means to determine whether the project requires, if necessary, how scale and extent, after the procedure, criteria and forms shown on "Guidelines for the arrangement and selecting of environmental impact analysis" issued by Ministry of Public Works are recognized. The scoping means to consider environmental issues of which aspects will cause significant environmental impacts The environmental impacts assessment means to define the overall goal of the environmental management through field study, followed by analysis of actual and potential impacts, consideration of mitigatory measures, suggestion of alternative.

The relation between procedure and approach of the environmental impact assessment for the Embung development are shown in Table 4.3. Then, Table 4.4 explains the matrix between project components and environmental issues for selection of the environmental issues, and Table 4.5 shows the matrix of environmental issues and environmental impacts for assessment.

4.6.3 Keys on the assessment

(1) Physical environment

1) Land

In the Embung project, it shall be stressed to study present soil and land conditions and environmental impacts in the catchment area, considering the impacts on impounding area. However, it is not easy to assess their issues in the short duration because it is difficult to get maps and information required in order to analyze their current status, such as aerial photograph, topographical map, soil map, land use map, and slope grade classification map. Therefore, the present social activities, production activities and land use in the catchment area shall be studied as much as possible, then potential impacts of construction of Embung shall be anticipated. If the activities induced inflow of earth and sand or toxic materials into reservoir are recognized, it is necessary to carry out detailed investigation about them.

2) Water

The river flow subjected to Embung plan and the availability of the surface water shall be studied for environmental component of water . The utilization of the river water will

change with positive impacts in many cases of installation of the Embung on the river. As for groundwater, it is not easy to correctly assess in the short duration because being provided continual data for level and quality and/or hydro-geological map is rare case. Although groundwater conditions have received no negative impacts in past Embung projects, in case of the irrigation-oriented Embung development of relatively large scale in the area, where domestic water depends on tube wells, geological and groundwater survey shall be carried out.

3) Atmosphere

An impact in a short time and limited area during Embung construction shall be concerned regarding air pollution in atmosphere component. This impact shall be subjected only in case of the construction of relatively large dam body or the living circumstances near the construction site.

(2) Biological environment

1) Flora and Fauna

In Nusa Tenggara, only 4 species of birds are recognized as the endemic flora and fauna. The territory, ecology and reason of the decreasing in number are not clear yet. Therefore, in case that there exist dense forests or swamps suitable for birds' nest in the impounding area, such ecological conditions shall be carefully considered in the planning. As for Embung plans in the land conservation area or its adjacent area, further information such as local connection between conservation area and project area is required. If any suspicions, opinions of the competent authorities shall be required. The present vegetation and human intervention in the impounding area as well as the catchment area shall be studied as much as possible.

(3) Social environment

1) Social Surroundings

The transfer of dwellings and/or farmlands and health/sanitation are main points in social situation in the project area. As for the transfer, the alternative land at the equivalent or better economical and social basis compared as submerged land shall be provided and ensured. Besides, with respect to health/sanitation, it is possible to get the data and information for surrounding in national health center (PUSKESMAS) and sub-national health center (SUB-PUSKESMAS), for project area in rural health and sanitation center which is almost set up in Village office.

2) Social Activity

The present agricultural production, animal husbandry reforestation and domestic water supply in the project area shall be deeply studied and assessed because these issues are directly affected the Embung project. Domestic water use survey shall be carried out on not only water resource but also regulation and custom on water use.

3) Economy

The income and employment of the beneficiaries shall be basically studied. The negative impacts on their economic situation have never observed in the existing Embung schemes.

4) Culture

The religious facilities and monuments of Islam, Hindu and Christian require transfer if they or their access will be submerged by the Embung construction. The transfer plan of them shall be carefully studied because it is historically and mentally sensitive matter for the inhabitants.

4.7 Review of Previous Embung Development Plan

4.7.1 Catchment vis-a-vis runoff

The relationship between the catchment area and runoff at the Embung site is examined by comparison the estimated runoff with the catchment area. If the runoff estimated in the development plan is too high compared with the catchment area, it has to be reduced to the appropriate level which is estimated taking into account the basin rainfall information.

In case that the runoff estimated in the development plan is too low compared with the catchment area, it is considered that this Embung has limited availability of water resources. Accordingly, the planned Embung of the both cases are defined as "supply-oriented" type. The development scale of Embung should be in line with the revised runoff for the former case and the original runoff for the latter case.

4.7.2 Runoff vis-a-vis storage capacity

In reviewing the relationship between the runoff and storage capacity of the planned Embung, the runoff is firstly reviewed on the above procedure. Then, this relationship is checked focusing upon whether the total storage capacity of planned Embung is too large or

small in comparing with the reviewed runoff. If too large, the total storage capacity of the original plan is reduced to the level matching with the runoff. The planned Embung is defined as "supply-oriented" type.

If too small, it is considered that the total storage capacity of the planned Embung is limited by topographic condition. In other words, there is no possibility of constructing higher Embung than the original plan. The planned Embung is defined as "supply-oriented" type. The implementation of the planned Embung is promoted according to the original plan without any change in the total storage capacity.

4.7.3 Storage capacity vis-a-vis irrigation area

The relationship between the total storage capacity and the designed irrigation command area of the planned Embung is reviewed from the viewpoint of irrigation water supply capacity of the reservoir of planned Embung. Prior to review this relationship, the above two relationships are checked and, if necessary, the both irrigation command area and total storage capacity of the original development plan is revised according to the scale down resulting from the above reviews.

If the irrigation command area of the either original or revised plan is too large compared with the irrigation water supply capacity of the reservoir, the irrigation command area is reduced in line with the effective storage capacity of the planned Embung. In this case, the planned Embung is defined as "supply-oriented type".

The original or revised irrigation command area is too small in comparison with the reservoir capacity, the planned Embung is defined as "demand-oriented type". It is considered that the original or revised irrigation command area is adjusted to the maximum limitation of available farmland resources. In other words, there is no more possibility of expanding irrigation area within the beneficiary area.

4.7.4 Topography and geology vis-a-vis embankment type of Embung

In reviewing the relationship between the embankment type and the topographic and geological conditions, it is required to refer to general information on topographic and geological condition at the site of the planned Embung. The embankment type of the original plan is reviewed in comparison with the height and foundation condition of the planned Embung. Additional attention is paid to the availability and kind of embankment materials near the site of the planned Embung.

5. EVALUATION OF PROJECT BENEFIT

5.1 Definition of Water Supply Benefits

The definition of water supply benefits is as follows:

- Domestic water supply benefits are attributed to save the time for fetching water from distant water sources and to reduce health problems or morbidity. It is however hard to quantify such types of benefit;
- Livestock water supply benefit is derived from saving time to bring draft animal fed under open yard feeding system to places where water is available, and to carry water from places where water is available to inhabitants' houses. It is also hard to quantify these benefits; and,
- Irrigation water supply benefits are born from increased crop production under stable irrigated condition coupled with full utilization of available farm land resources and optimum use of farm inputs. This benefit is quantified with increment net production value which is obtained by estimating surplus of the both net production values under the condition of "With Project" and "Without Project".

5.2 Socio-economic Impact

The benefit of domestic water supply is to be indicated as the value of water and the investment amount to each beneficiary inhabitant. These two indicators are estimated on the following procedure:

- The total amount of direct construction cost is taken up as the total amount of investment for the construction of the proposed Embung;
- This investment amount is allocated to the investment in domestic water supply according to the proportion of annual domestic water demand against the total annual water demand;
- The value of water is estimated by dividing the sum of allocated amount of direct construction cost for the proposed Embung and whole amount of domestic water supply system by the annual domestic water demand; and,
- The investment amount to each beneficiary inhabitant is estimated by dividing the above-mentioned sum by the total number of domestic water users.

5.3 Livestock Supporting Impact

The benefit of livestock water supply is indicated as the net value of additionally increasing cattle weight, either cow or buffalo, attributable to stabilized livestock water supply condition. This net value is estimated on the basis of the following assumption:

- Additional increase in weight of a cow or buffalo aged 1.5 to 2 years old is 0.6 kg/day from the initial weight of 200 kg during four months of the dry season as a result of stable supply of livestock water;
- Unit values are Rp.2,500/kg for the both initial and increasing weights, Rp. 490,000/head for the overall feeding cost and Rp. 24,000/head for by-products;

- Conversion rate to equivalent head of cow is 1.0 for buffalo and horse, 0.125 for goat and sheep, 0.15 for pig and 0.015 for poultry. In Sumbawa, the conversion rate of 1.5 is applied to buffalo as bathing water is additionally required; and
- Formula to estimate the net value is as follows:

$$NV = \{UV\ (IW + AW) - FC + BV\} \times EC$$

where,
NV : Net value (Rp.)
UV : Unit value (Rp./kg)
IW : Initial weight (kg/head)
AW : Additional increase in weight (kg/head)
FC : Feeding cost (Rp./head)
BV : Value of by-products (Rp./head)
EC : Equivalent head of cow (head)

5.4 Irrigation Benefit

(1) Economic cost

The financial costs are to be converted into the economic costs by applying the following economic conversion factors established by DGWRD in 1985. Next, the annual disbursement schedule is made on the basis of economic cost.

- 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;
- 1.00 for O&M equipment and replacement cost; and,
- Contract tax, land acquisition cost and price contingency are not converted to economic cost.

(2) Economic benefit

The irrigation benefit of the project is principally derived from increased crop production attributable to stable irrigation water supply, full utilization of available farm land resources and optimum farm input supply. The irrigation benefit is indicated by the surplus of the both net production values under the condition of "With Project" and "Without Project".

The net production value is estimated on the basis of the anticipated crop yield, and economic farm gate prices of farm inputs and outputs. The economic farm gate prices of farm inputs and outputs are decided taking into account economic price structures of paddy, maize, Palawija crops and fertilizers. The samples of estimating economic price structures are

compiled in Table 6.1 for paddy, Table 6.2 for maize, Table 6.3 for mungbean and soybeans, Table 6.4 for red onion and tobacco, and Table 6.5 for fertilizers. The economic farm gate prices are to be renewed at least once a year by referring to the latest issue of World Bank's report on "Commodity Markets and the Developing Countries".

The increment net production value is estimated in the following manner:

- The economic crop budgets for the both cases of "With Project" and "Without Project" conditions are estimated based on the farm inputs quantity, anticipated crop yield and economic farm gate prices;
- The total net production values for the both cases are calculated through multiplying cropped areas by economic crop budgets;
- The annual net incremental benefit is estimated by deducting the total net production value of "Without Project" from that of "With Project";
- The annual net increment benefit accrues from the first year when irrigation water is released from Embung and attain to the full value at the fifth year. The increasing rate is 60% in the first year, 70% in the second year, 80% in the third year, 90% in the fourth year and 100% from the fifth year and onward; and,
- The value of production foregone is estimated under the same condition of "Without Project" if some crop cultivation areas are submerged in the reservoir area of Embung. The value of production foregone deducts from the annual net increment benefit during the first five years as farmers translocated from reservoir area need the same period to recover their production on newly allocated farm land. The value of production foregone reduces by 10% every year taking into account progress of crop production recovery.

(3) Economic evaluation

The economic evaluation is made on the basis of cost benefit analysis method. The evaluation period is 25 years taking into account life period of Embung. The cash flow table is prepared. The present values of cost and benefit of every year are estimated by multiplying by discounting rate of 8%. This discount rate matches with assessment of public investment efficiency in Indonesia. The benefit-cost ratio (B/C) is calculated by dividing the total present value of benefit by the total present value of cost.

(4) Farm budget analysis

The purpose of farm budget analysis is to clarify the effect of irrigation water supply to beneficiary farm households' economy. This effect is quantified by making comparison of the net on-farm incomes before and after irrigation water supply from Embung. The net on-farm income is estimated on the basis of a unit farm size of 1.0 ha and financial prices. The procedure is as follows:

- The financial farm gate prices of farm inputs and outputs are decided taking into account prevailing local market prices;

- The financial crop budget is estimated by using the financial farm gate prices;
- The proportion of planted area of each crop coincides with the cropping pattern;
- The total net production values for two cases before and after irrigation water supply from Embung are calculated through multiplying the proportional planted area by financial crop budgets; and,
- The surplus between two total net production values indicates the financial impact to household economy of beneficiary inhabitants.

6. JUSTIFICATION OF PROJECT IMPLEMENTATION

6.1 Demarcation of Development Purpose

The development scale of Embung is justified from the combination of four development purposes and two development types. The development purposes coincide with the categories of future use of new water source facility as follows:

- Irrigation water supply exclusive;
- Irrigation water supply prior to BHN (domestic and livestock) water supply;
- BHN (domestic and livestock) water supply prior to irrigation water supply; and,
- BHN (domestic and livestock) water supply exclusive.

The development type consists of supply-oriented type and demand-oriented type. The definition of development type is as follows:

- Supply-oriented type of which Embung development scale is principally decided by topographic or hydrological limitation; and,
- Demand-oriented type of which development scale is principally decided by water demand in beneficiary area.

The implementation of Embung development is justified for each combination of four development purposes and two development types on the following procedures to be described in Sections 5.2 and 5.3.

6.2 Irrigation Development Oriented Type

(1) Irrigation water supply exclusive type

The implementation of irrigation water supply exclusive type Embung is justified by the economic viability. If there are no topographic, geological and hydrological limitations, the identified Embung is put in the group of irrigation-oriented cum demand-oriented type. The identified Embung with B/C ratio of more than 1.0 is taken up in the candidate list for high priority implementation without any revision of the original development plan of Embung and irrigation system.

The identified Embung with limitation of either topographic shape or water availability at the potential Embung site is grouped as irrigation-oriented cum supply-oriented type. The Embung development scale is reduced in line with the upper limit of topographic shape or water availability. If the revised development plan has B/C ratio of more than 1.0, the identified Embung is taken up in the candidate list for high priority implementation.

As for the identified Embung of demand-oriented type with B/C ratio of less than 1.0, the dry season cropping pattern is revised for increasing irrigation benefit within the maximum limitation of irrigation water available for the dry season. The economic viability of the revised cropping pattern is checked by calculating B/C ratio. If re-estimated B/C ratio is more than 1.0, the implementation of identified Embung is justifiable. The identified Embung is taken up in the candidate list for high priority implementation.

As for the identified Embung of either demand-oriented or supply-oriented type with re-estimated B/C ratio of less than 1.0 or no possibility of revising the original cropping pattern for the dry season, the implementation of identified Embung is not justifiable.

(2) Irrigation water supply prior to BHN water supply type

If there are no topographic, geological and hydrological limitations, the identified Embung is put in the group of irrigation-oriented cum demand-oriented type. The identified Embung with B/C ratio of more than 1.0 is taken up in the candidate list for high priority implementation without any revision of the original development plan of Embung, irrigation system and BHN water distribution system.

The identified Embung with limitation of either topographic shape or water availability at the potential Embung site is grouped as irrigation-oriented cum supply-oriented type. The development scale is reduced in line with the upper limit of topographic shape or water availability. If the revised development plan has B/C ratio of more than 1.0, the identified Embung is taken up in the candidate list for high priority implementation for irrigation and BHN water supply purposes.

As for the identified Embung of demand-oriented type with B/C ratio of less than 1.0, the dry season cropping pattern is revised for increasing irrigation benefit within the maximum limitation of irrigation water available for the dry season. The economic viability of the revised cropping pattern is checked by calculating B/C ratio. If re-estimated B/C ratio is more than 1.0, the implementation of identified Embung is justifiable. The identified Embung is taken up in the candidate list for high priority implementation for irrigation and BHN water supply purposes.

As for the identified Embung of either demand-oriented or supply-oriented type with re-estimated B/C ratio of less than 1.0 or no possibility of revising the original cropping pattern for the dry season, the implementation of identified Embung is considered from the viewpoint of BHN water supply. This type of Embung is transferred to BHN-oriented group for further assessment of development needs and possibility.

6.3 Basic Human Needs Oriented Type

(1) BHN water supply exclusive type

The implementation of BHN water supply exclusive type Embung is justified by the technical soundness. If there are no topographic, geological and hydrological limitations, the identified Embung is put in the group of BHN-oriented cum demand-oriented type and taken up in the candidate list for immediate implementation.

The identified Embung with limitation of either topographic shape or water availability at the potential Embung site is grouped as BHN-oriented cum supply-oriented type. The development scale is reduced in line with the upper limit of topographic shape or water availability. If the revised development plan is technically sound, the implementation of identified Embung is justifiable putting the second priority.

In case that the identified Embung has geological limitation at the embankment site and in the reservoir, technical assessment has to be made to clarify the possibility of overcoming geological weak points by applying a suitable foundation treatment method. If practice of any foundation treatment method is technically possible, the required foundation treatment cost is compared with embankment cost. The justification criteria for implementation of Embung development is established as follows:

- The development of identified Embung of which foundation treatment cost is less than the embankment cost is justifiable with the lowest priority for implementation. In this case, the identified Embung without topographic and hydrological limitations is grouped into BHN-oriented cum demand-oriented type. The identified Embung with either topographic or hydrological limitation is grouped into BHN-oriented cum supply-oriented type and its development scale is reduced according to the limitation.; and,
- The development of identified Embung of which foundation treatment cost is more than the embankment cost is out of consideration.

(2) BHN water supply prior to irrigation water supply type

This type of identified Embung is originally planned to be developed for the purpose of supplying irrigation water prior to BHN water. As its economic viability is below the level of justification for implementation of Embung development, however, the identified Embung is transferred to this type. The water of identified Embung is distributed to beneficiary inhabitants for meeting their domestic and/or livestock demand and next irrigation water demand if excess water is available.

If there are no topographic, geological and hydrological limitations, the identified Embung is put in the group of BHN-oriented cum demand-oriented type and taken up in the candidate list for immediate implementation.

The identified Embung with limitation of either topographic shape or water availability at the potential Embung site is grouped as BHN-oriented cum supply-oriented type. The development scale is reduced in line with the upper limit of topographic shape or water availability. If the revised development plan is technically sound, the implementation of identified Embung is justifiable putting the second priority.

In case that the identified Embung has geological limitation at the embankment site and in the reservoir, technical assessment has to be made to clarify the possibility of overcoming geological weak points by applying a suitable foundation treatment method. If practice of any foundation treatment method is technically possible, the required foundation treatment cost is compared with embankment cost. The justification criteria for implementation of Embung development is established as follows:

- The development of identified Embung of which foundation treatment cost is less than the embankment cost is justifiable with the lowest priority for implementation. In this case, the identified Embung without topographic and hydrological limitations is grouped into BHN-oriented cum demand-oriented type. The identified Embung with either topographic or hydrological limitation is grouped into BHN-oriented cum supply-oriented type and its development scale is reduced according to the limitation.; and,

- The development of identified Embung of which foundation treatment cost is more than the embankment cost is out of consideration.

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

Guideline

Tables

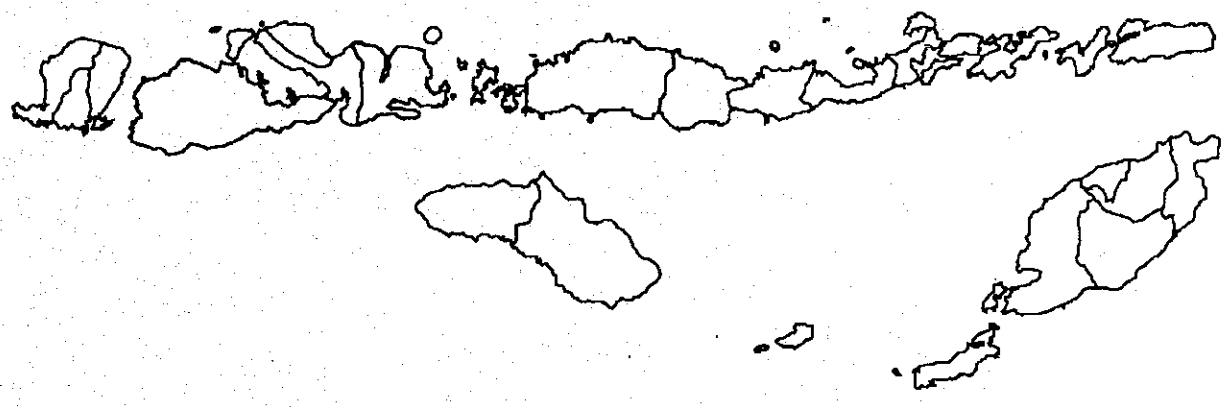


Table 4.1 General Land Suitability Rating (1/3)

(1) Wetland Rice

		Land Suitability Class			
		S1	S2	S3	N
t	Temperature Regime				
	1 Annual average temperature (C)	25 - 29	30 - 32 24 - 22	33 - 35 21 - 18	> 35 < 18
w	Water Availability				
	1 Dry months (< 75 mm)	0 - 3	3.1 - 9	9.1 - 9.5	> 9.5
	2 Average annual rainfall (mm)	> 1500	1200 - 1500	800 - 1200	< 800
r	Rooting Conditions				
	1 Soil drainage class	somewhat poor, *moderately well*	very poor, *poor*	well	somewhat *excessive*, excessive
	2 Soil texture (surface soil)	sandy clay loam, silt loam, silt, clay loam	sandy loam, loam, silty clay laom, silty clay,	loamy sand, massive clay	gravels, sands
	3 Rooting depth (cm)	> 50	41 - 50	20 - 40	< 20
f	Nutrient Retention				
	1 CEC (me/100g, subsoil)	> medium	low	very low	
	2 pH (surface soil)	5.5 - 7.0	7.1 - 8.0 5.4 - 4.5	8.1 - 8.5 4.6 - 4.0	>8.5 < 4.0
n	Nutrient Availability				
	1 Total N (surface soil)	> medium	low	very low	
	2 Available P2O5 (surface soil)	very high	high	medium - low	very low
	3 Available K2O (surface soil)	> medium	low	very low	
x	Toxicity				
	1 Salinity (mmhos/cm, subsoil)	< 3	3.1 - 5	5.1 - 8	> 8
s	Terrain				
	1 Slope (%)	0 - 3	3.1 - 5	5.1 - 8	> 8
	2 Surface stoniness	0.00			> 1
	3 Rock outcrops	0.00		1.00	> 2

Source: Reconnaissance Land Resource Surveys, 1:250,000 scale Atlas Format Resources, CSR/FAO Staff, 1983

Table 4.1 General Land Suitability Rating (2/3)

(2) Maize

		Land Suitability Class			
		S1	S2	S3	N
t	Temperature Regime				
	1 Annual average temperature (C)	20 - 26	27- 30	31 - 32	> 30
				20 - 18	< 18
w	Water Availability				
	1 Dry months (< 75 mm)	34341.00	34523.00	34555.00	> 9
	2 Average annual rainfall (mm)	> 1200	1200 - 900	900 - 600	< 600
r	Rooting Conditions				
	1 Soil drainage class	moderately well, well	somewhat poor	poor, somewhat excessive	very poor, excessive
	2 Soil texture (surface soil)	loam, sandy clay, loam silt loam, silt, clay loam, silty clay	sandy loam, sandy clay	loamy sand, silty clay, structured clay	gravels, sands, massive clay
	3 Rooting depth (cm)	> 60	40 - 59	20 - 39	< 20
f	Nutrient Retention				
	1 CEC (me/100g, subsoil)	> medium	low	very low	
	2 pH (surface soil)	6.0 - 7.0	7.1 - 7.5	7.6 - 8.5	> 8.5
			5.9 - 5.5	5.4 - 5.0	< 5.0
n	Nutrient Availability				
	1 Total N (surface soil)	> medium	low	very low	
	2 Available P2O5 (surface soil)	very high	high	medium - low	very low
	3 Available K2O (surface soil)	> medium	low	very low	
x	Toxicity				
	1 Salinity (mmhos/cm, subsoil)	< 2	34369.00	34432.00	> 8
s	Terrain				
	1 Slope (%)	0 - 5	34469.00	15 - 20	> 20
	2 Surface stoniness	0.00		1.00	> 2
	3 Rock outcrops	0.00		1.00	> 2

Source: Reconnaissance Land Resource Surveys, 1:250,000 scale Atlas Format Resources, CSR/FAO Staff, 1983

Table 4.1 General Land Suitability Rating (3/3)

(3) Soybean

		Land Suitability Class			
		S1	S2	S3	N
t	Temperature Regime				
	1 Annual average temperature (C)	23 - 28	29 - 30 22 - 20	31 - 32 19 - 18	> 32 < 18
w	Water Availability				
	1 Dry months (< 75 mm)	3 - 7.5	7.6 - 8.5	8.6 - 9.5	> 9.5
	2 Average annual rainfall (mm)	1000 - 1500	1500 - 2500 1000 - 700	2500 - 3500 700 - 500	> 3500 < 500
r	Rooting Conditions				
	1 Soil drainage class	moderately well, well	somewhat excessive	poor, somewhat poor	very poor, excessive
	2 Soil texture (surface soil)	loam, sandy clay loam, silt loam, silt, clay loam, silty clay	sandy loam, sandy clay	loamy sand, silty clay, structured clay	gravels, sands, massive clay
	3 Rooting depth (cm)	> 50	30 - 49	15 - 29	< 15
f	Nutrient Retention				
	1 CEC (me/100g, subsoil)	> medium	low	very low	
	2 pH (surface soil)	6.0 - 7.0	7.1 - 7.5 5.9 - 5.5	7.6 - 8.5 5.4 - 5.0	> 8.5 < 5.0
n	Nutrient Availability				
	1 Total N (surface soil)	> medium	low	very low	
	2 Available P2O5 (surface soil)	> high	medium	low - very low	
	3 Available K2O (surface soil)	> very low			
x	Toxicity				
	1 Salinity (mmhos/cm, subsoil)	< 2.5	2.5 - 4	34432.00	> 8
s	Terrain				
	1 Slope (%)	0 - 5	34469.00	15 - 20	> 20
	2 Surface stoniness	0.00		1.00	> 2
	3 Rock outcrops	0.00		1.00	> 2

Source: Reconnaissance Land Resource Surveys, 1:250,000 scale Atlas Format Resources, CSR/FAO Staff, 1983

Table 4.2 Cropping Pattern (1/5)
Lombok

Case	Code	Wet Season	Dry Season (I)		Dry Season (II)	
Lombok (A-1)	LM-PR-A-11	Paddy	100%	-	-	
	LM-WO-A-11	Paddy	100%	-	-	
	LM-WP-A-21	Paddy	100%	Soybean;	70%	-
				Peanut	30%	
Lombok (A-2)	LM-PR-A-11	Paddy	100%	-	-	
	LM-WO-A-11	Paddy	100%	-	-	
	LM-WP-A-21	Paddy	100%	Mungbean;	50%	-
				Tomato, Tobacco, Onion	50%	
Lombok (A-3)	LM-PR-A-11	Paddy	100%	-	-	
	LM-WO-A-11	Paddy	100%	-	-	
	LM-WP-A-21	Paddy	100%	Soybean;	70%	Mungbean; 25%
	LM-WP-A-22			Peanut	30%	Tomato, Tobacco, Onion 25%
Lombok (B-1)	LM-PR-B-11	Paddy	100%	-	-	
	LM-WO-B-11	Paddy	100%	-	-	
	LM-WP-B-21	Paddy	100%	Soybean, Peanut;	50%	-
				Tomato, Tobacco, Onion	50%	
Lombok (B-2)	LM-PR-B-11	Paddy	100%	-	-	
	LM-WO-B-11	Paddy	100%	-	-	
	LM-WP-B-21	Paddy	100%	Soybean, Peanut;	50%	Mungbean; 25%
	LM-WP-B-22			Mungbean	50%	Tomato, Tobacco, Onion 25%
Lombok (B-3)	LM-PR-B-11	Paddy	100%	Soybean, Peanut;	25%	-
	LM-PR-B-21			Mungbean	25%	
	LM-WO-B-11	Paddy	100%	Soybean, Peanut;	25%	-
	LM-WO-B-21			Mungbean	25%	
	LM-WP-B-21	Paddy	100%	Soybean, Peanut;	50%	Mungbean; 25%
	LM-WP-B-22			Mungbean	50%	Tomato, Tobacco, Onion 25%
Lombok (B-4)	LM-PR-B-11	Paddy	100%	Soybean, Peanut;	25%	-
	LM-PR-B-21			Mungbean	25%	
	LM-WO-B-11	Paddy	100%	Soybean, Peanut;	25%	-
	LM-WO-B-21			Mungbean	25%	
	LM-WP-B-22	Paddy	100%	Soybean, Peanut;	50%	Mungbean; 50%
				Tomato, Tobacco, Onion	50%	Soybean, Peanut 50%
Lombok (C-1)	LM-PR-C-21	Paddy	100%	Soybean, Peanut;	50%	-
				Mungbean	50%	
	LM-WO-C-21	Paddy	100%	Soybean, Peanut;	50%	-
				Mungbean	50%	
	LM-WP-C-22	Paddy	100%	Soybean, Peanut;	50%	Mungbean; 50%
				Mungbean	50%	Tomato, Tobacco, Onion 50%
Lombok (C-2)	LM-PR-C-21	Paddy	100%	Soybean, Peanut;	50%	-
				Mungbean	50%	
	LM-WO-C-21	Paddy	100%	Soybean, Peanut;	50%	-
				Mungbean	50%	
	LM-WP-C-22	Paddy	100%	Soybean, Peanut;	50%	Mungbean; 50%
				Tomato, Tobacco, Onion	50%	Soybean, Peanut 50%
Lombok (C-3)	LM-PR-C-12	Paddy	100%	Paddy	100%	-
	LM-WO-C-12	Paddy	100%	Paddy	100%	-
	LM-WP-C-23	Paddy	100%	Paddy	100%	Soybean, Peanut; 50%
						Tomato, Tobacco, Onion 50%

Table 4.2 Cropping Pattern (2/5)
Sumbawa

Case	Code	Wet Season		Dry Season (I)		Dry Season (II)	
Sumbawa (A-1)	SM-PR-A-11	Paddy	100%	-	-		
	SM-WO-A-11	Paddy	100%	-	-		
	SM-WP-A-21	Paddy	100%	Soybean;	50%	-	
				Mungbean	50%		
Sumbawa (A-2)	SM-PR-A-11	Paddy	100%	-	-		
	SM-WO-A-11	Paddy	100%	-	-		
	SM-WP-A-21	Paddy	100%	Mungbean;	50%	-	
				Vegetable (Onion)	50%		
Sumbawa (B-1)	SM-PR-B-11	Paddy	100%	-	-		
	SM-WO-B-11	Paddy	100%	-	-		
	SM-WP-B-21	Paddy	100%	Soybean, Peanut;	50%	-	
				Mungbean	50%		
Sumbawa (B-2)	SM-PR-B-11	Paddy	100%	-	-		
	SM-WO-B-11	Paddy	100%	-	-		
	LM-WP-A-21	Paddy	100%	Soybean;	70%	-	
				Peanut	30%		
Sumbawa (B-3)	SM-PR-B-21	Paddy	100%	Soybean;	70%	-	
				Mungbean	30%		
	SM-WO-B-21	Paddy	100%	Soybean;	70%	-	
				Mungbean	30%		
	LM-WP-A-21	Paddy	100%	Soybean;	70%	-	
				Peanut	30%		
Sumbawa (C-1)	SM-PR-C-21	Paddy	100%	Soybean;	70%	-	
				Mungbean	30%		
	SM-WO-C-21	Paddy	100%	Soybean;	70%	-	
				Mungbean	30%		
	LM-WP-A-21	Paddy	100%	Soybean;	70%	-	
				Peanut	30%		
Sumbawa (C-2)	SM-PR-C-21	Paddy	100%	Soybean;	70%	-	
				Mungbean	30%		
	SM-WO-C-21	Paddy	100%	Soybean;	70%	-	
				Mungbean	30%		
	LM-WP-A-21	Paddy	100%	Soybean;	70%	-	
				Peanut	30%		
Sumbawa (C-3)	SM-PR-C-12	Paddy	100%	Paddy	100%	-	
	SM-WO-C-12	Paddy	100%	Paddy	100%	-	
	SM-WP-C-22	Paddy	100%	Paddy	100%	Mungbean;	50%
						Vegetable (Onion)	50%

Table 4.2 Cropping Pattern (3/5)
Flores

Case	Code	Wet Season		Dry Season (I)		Dry Season (II)	
Flores (A-1)	FR-PR-A-11	Paddy	100%	-	-		
	FR-WO-A-11	Paddy	100%	-	-		
	FR-WP-A-21	Paddy	100%	Mungbean;	50%	-	
				Soybean	50%		
Flores (A-2)	FR-PR-A-31	Maize;	70%	-	-		
		Cassava	30%				
	FR-WO-A-31	Maize;	70%	-	-		
		Cassava	30%				
	FR-WP-A-11	Paddy	100%	-	-		
Flores (B-1)	FR-PR-B-11	Paddy	100%	-	-		
	FR-WO-B-11	Paddy	100%	-	-		
	FR-WP-B-21	Paddy	100%	Mungbean;	25%	-	
				Soybean	25%		
Flores (C-1)	FR-PR-C-21	Paddy	100%	Mungbean;	50%	-	
				Soybean	50%		
	FR-WO-C-21	Paddy	100%	Mungbean;	50%	-	
				Soybean	50%		
	FR-WP-C-22	Paddy	100%	Soybean, Peanut	100%	Mungbean	100%

Table 4.2 Cropping Pattern (4/5)
Sumba

Case	Code	Wet Season		Dry Season (I)		Dry Season (II)	
Sumba (A-1)	SB-PR-A-11	Paddy	100%	-	-		
	SB-WO-A-11	Paddy	100%	-	-		
	SB-WP-A-21	Paddy	100%	Mungbean; Peanit	60% 40%	-	
Sumba (A-2)	SB-PR-A-31	Maize; Cassava	70% 30%	-	-		
	SB-WO-A-31	Maize; Cassava	70% 30%	-	-		
	SB-WP-A-11	Paddy	100%	-	-		
Sumba (B-1)	SB-PR-B-11	Paddy	100%	-	-		
	SB-WO-B-11	Paddy	100%	-	-		
	SB-WP-B-21	Paddy	100%	Mungbean	100%	-	
Sumba (C-1)	SB-PR-C-21	Paddy	100%	Mungbean	100%	-	
	SB-WO-C-21	Paddy	100%	Mungbean	100%	-	
	SB-WP-C-22	Paddy	100%	Peanut	100%	Mungbean	100%

Table 4.2 Cropping Pattern (5/5)
Timor

Case	Code	Wet Season		Dry Season (I)		Dry Season (II)	
Timor (A-1)	TR-PR-A-11	Paddy	100%	-	-		
	TR-WO-A-11	Paddy	100%	-	-		
	TR-WP-A-21	Paddy	100%	Mungbean; Peanit	60% 40%	-	
Timor (A-2)	TR-PR-A-31	Maize; Cassava	70% 30%	-	-		
	TR-WO-A-31	Maize; Cassava	70% 30%	-	-		
	TR-WP-A-11	Paddy	100%	-	-		
Timor (A-3)	TR-PR-A-31	Maize; Cassava	70% 30%	-	-		
	TR-WO-A-31	Maize; Cassava	70% 30%	-	-		
	TR-WP-A-52	Orange	100%	Orange	100%	Orange	100%
Timor (A-4)	TR-PR-A-31	Maize; Cassava	70% 30%	-	-		
	TR-WO-A-31	Maize; Cassava	70% 30%	-	-		
	TR-WP-A-52	Mango	100%	Mango	100%	Mango	100%
Timor (B-1)	TR-PR-B-11	Paddy	100%	-	-		
	TR-WO-B-11	Paddy	100%	-	-		
	TR-WP-B-21	Paddy	100%	Mungbean; Peanit	60% 40%	-	
Timor (C-1)	TR-PR-C-21	Paddy	100%	Maize; Mungbean	50% 50%	-	
	TR-WO-C-21	Paddy	100%	Maize; Mungbean	50% 50%	-	
	TR-WP-C-21	Paddy	100%	Mungbean; Peanut	60% 40%	-	

Table 4.3 Process and Approach for Environmental Impact Assessment

PROCESS	APPROACH	COMPONENT / ISSUE	PLACE
1. Identification of the scope for environmental impact assessment	· Recognizance of guidelines for the arrangement and selecting of environmental impact analysis by the Ministry of Public Works	· -	-
2. Data collection and analysis around Project area	· Preparation of table to identify environmental features	· Human environment — Social needs, Human use, Economic, Health and sanitation · Physical environment — Geology, Surface/ groundwater, Endemic fauna and flora · Others	the whole the whole the whole
3. Selection of environmental issues in dı consideration of the project components and demarcation of places where environmental issues occur	· Preparation of scoping list to choice environmental issues and places	· Physical environment · Biotic environment · Human environment (Selection from issues listed in Table 2.2)	cf. Table 2.2 cf. Table 2.2 cf. Table 2.2
4. Collecting of data and information concerning selected environmental issues	· Carrying out of the study	· Field reconnaissance · Field hearing survey	the whole Proposed beneficial area
5. Identification of actual environmental aspects and impacts	· Preparation of table for environmental impact assessment	· Physical environment · Biotic environment · Human environment (selected environmental issues)	Selected places where environmental issues occur
6. Assessment of potential environmenta aspects and impacts	· ditto	· ditto	Places where environmental impacts occur
7. Consideration of mitigatory measures against negative environmental impacts	· ditto	· potential negative impact recognized by assessment	ditto
8. Appreciation of residual negative impact and suggestion of alternative plan in case of being inevitable impacts with mitigatory measures	· Environmental impact assessment	· ditto	ditto

Table 4.4 Matrix between Project Component and Environment Component

Environmental Component/Issue	Places Environmental Issues Occur	Correlation between Embung construction	Project Component: Domestic water supply	Livestock water supply	Irrigation water supply
1. Physical Environment Impacts					
(1) Land					
1) Land use	Catchment area	○	◎	◎	○
2) Land desertification	Catchment area	○	×	×	×
3) Soil erosion	Catchment area	○	○	○	◎
4) Soil contamination	Catchment area	×	◎	◎	○
(2) Water	Catchment area				
1) River hydrology	River and riverbed	○	◎	◎	◎
2) River morphology	Riverside	○	×	○	×
3) Flooding	River and riverbed	○	×	×	×
	Riverside	○	×	×	×
4) Surface water availability	Beneficial area	◎	◎	◎	◎
5) Surface water quality	River and riverbed	△	◎	○	○
6) Groundwater levels	Beneficial area	△	○	○	○
7) Groundwater quality	Beneficial area	×	○	○	○
(3) Atmosphere					
1) Dust, Odor, Noise	Embung and reservoir area planned	◎	×	×	×
2. Biotic Environment Impacts					
(1) Fauna					
1) Fauna community/habitats	Embung and reservoir area planned	◎	×	×	×
2) Flora community/habitats	Embung and reservoir area planned	◎	×	×	×
3) Forests/trees	Embung and reservoir area planned	◎	×	×	×
3. Human					
(1) Social					
1) Human carrying capacity	Beneficial area	×	×	×	◎
2) Resettlement	Beneficial area	◎	×	×	△
3) Settlement	Beneficial area	◎	×	×	△
4) Population growth	Beneficial area	×	○	×	○
5) Demographic structure	Beneficial area	×	×	×	○
6) Social equity	Beneficial area	×	◎	×	○
7) Social attitude	Beneficial area	×	◎	×	○
8) Social cohesion	Beneficial area	◎	○	×	○
9) Health	Beneficial area	×	◎	○	△
(2) Human use					
1) Cultivation	Beneficial area	×	×	×	◎
2) Livestock	Beneficial area	×	×	◎	×
3) Fisheries	River and riverbed	△	×	×	△
	other than beneficial	△	×	×	△
4) Afforestation	Catchment area	◎	×	×	×
	Embung and reservoir area planned	◎	×	×	×
5) Domestic water supply	Beneficial area	○	◎	○	×
(3) Economic					
1) Income	Beneficial area	×	×	○	◎
2) Employment	Beneficial area	×	×	△	◎
(4) Cultural					
1) Historic/archaeological sites	River and riverbed	◎	×	×	×
	Beneficial area	◎	×	×	◎
2) Lifestyle (quality of life)	Beneficial area	×	◎	◎	◎

◎: closely related ○: normally related △: Occasionally related ×: scarcely related

Table 4. 5 Matrix between Environmental Issues and Impacts

Environmental Issue	Places it	Land use	Land desertification	Soil erosion	Soil contamination	River hydrology	River morphology	Flooding	Surface water availability	Surface water quality	Groundwater levels	Groundwater quality	Dust, Odor, Noise	Fauna community/habitats	Flora community/habitats	Forests/trees	Human carrying capacity	Resettlement	Settlement	Population growth	Demographic structure	Social equity	Social attitude	Social cohesion	Health	Cultivation	Livestock	Fisheries	Afforestation	Domestic water supply	Income	Employment	Historic/archaeological sites	Lifestyle (quality of life)
1. Physical Environment Impacts																																		
(1) Land																																		
1) Land use	Catchment			○						○				○	○	○		△	△										◎					
2) Land desertification	Catchment			○												○													○					
3) Soil erosion	Catchment							○																										
4) Soil contamination	Catchment									○														○						○				
(2) Water	Catchment																																	
1) River hydrology	River and riverbed						○	○																				△						
2) River morphology	Riverside							○																										
3) Flooding	River and riverbed						○																											
	Riverside						○																											
4) Surface water availability	Beneficial area					△	△				△									△		△	△		△	◎	◎	○		◎				
5) Surface water quality	River and riverbed																								△	◎	◎	○		◎				
6) Groundwater levels	Beneficial area																									△	△			○				
7) Groundwater quality	Beneficial area																								△					○				
(3) Atmosphere																																		
1) Dust, Odor, Noise	Embung and reservoir area																								○									
2. Biotic Environment Impacts																																		
(1) Fauna																																		
1) Fauna community/ habitats	Embung and reservoir area													※																				
2) Flora community/ habitats	Embung and reservoir area														※																			
3) Forests/trees	Embung and reservoir area			◎												※																		
3. Human																																		
(1) Social																																		
1) Human carrying capacity	Beneficial area																			△	△					○						◎		△
2) Resettlement	Beneficial area																																	
3) Settlement	Beneficial area																					○	◎	○										
4) Population growth	Beneficial area																○	△				△			◎					◎		○		○
5) Demographic structure	Beneficial area																																	
6) Social equity	Beneficial area																						◎											
7) Social attitude	Beneficial area																					◎												
8) Social cohesion	Beneficial area																					◎												
9) Health	Beneficial area																			◎	◎													
(2) Human use																																		
1) Cultivation	Beneficial area																			◎											◎	◎		◎
2) Livestock	Beneficial area						◎								◎															△	◎			
3) Fisheries	River and riverbed																								○						◎	△		
	Downstream area other than beneficial area																															△		
4) Afforestation	Catchment		○	○				○																										
	Embung and reservoir area		○	○																														
5) Domestic water supply	Beneficial area																								◎									◎
(3) Economic																																		
1) Income	Beneficial area																◎															○		◎
2) Employment	Beneficial area																			○	○										◎			○
(4) Cultural																																		
1) Historic/ archaeological sites	River and riverbed																							◎										
	Beneficial area																																	
2) Lifestyle (quality of life)	Beneficial area																								◎									◎

◎: closely related ○: normally related △: occasionally related ※: Others

Table 6.1 Sample Calculation for Economic Price Structures of Paddy

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

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

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

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

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

Table 6.2 Sample Calculation for Economic Price Structures of Maize

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

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

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

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

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

Table 6.3 Sample Calculation for Economic Price Structures of Mungbeans and Soybeans

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

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

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

*3 ; Projected price in 2005 at 1990 constant price

Table 6.4 Sample Calculation for Economic Price Structures of Red Onion and Tobacco

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

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

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

*3 ; Projected price in 2005 at 1990 constant price

Table 6.5 Sample Calculation for Economic Price Structures of Fertilizer

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

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

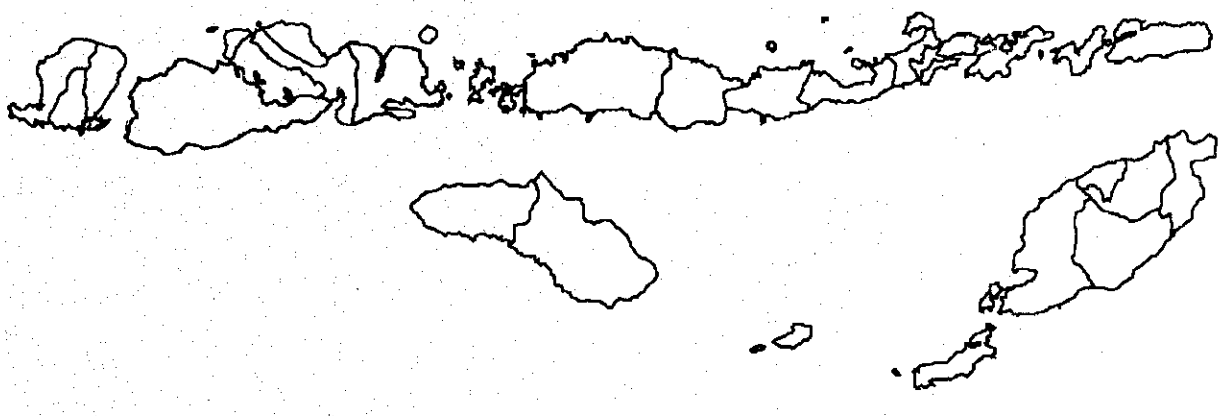
Source : The World Bank, Commodity Markets and the Developing Countries, A World Bank Quarterly, August 1994

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

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

Guideline

Figures



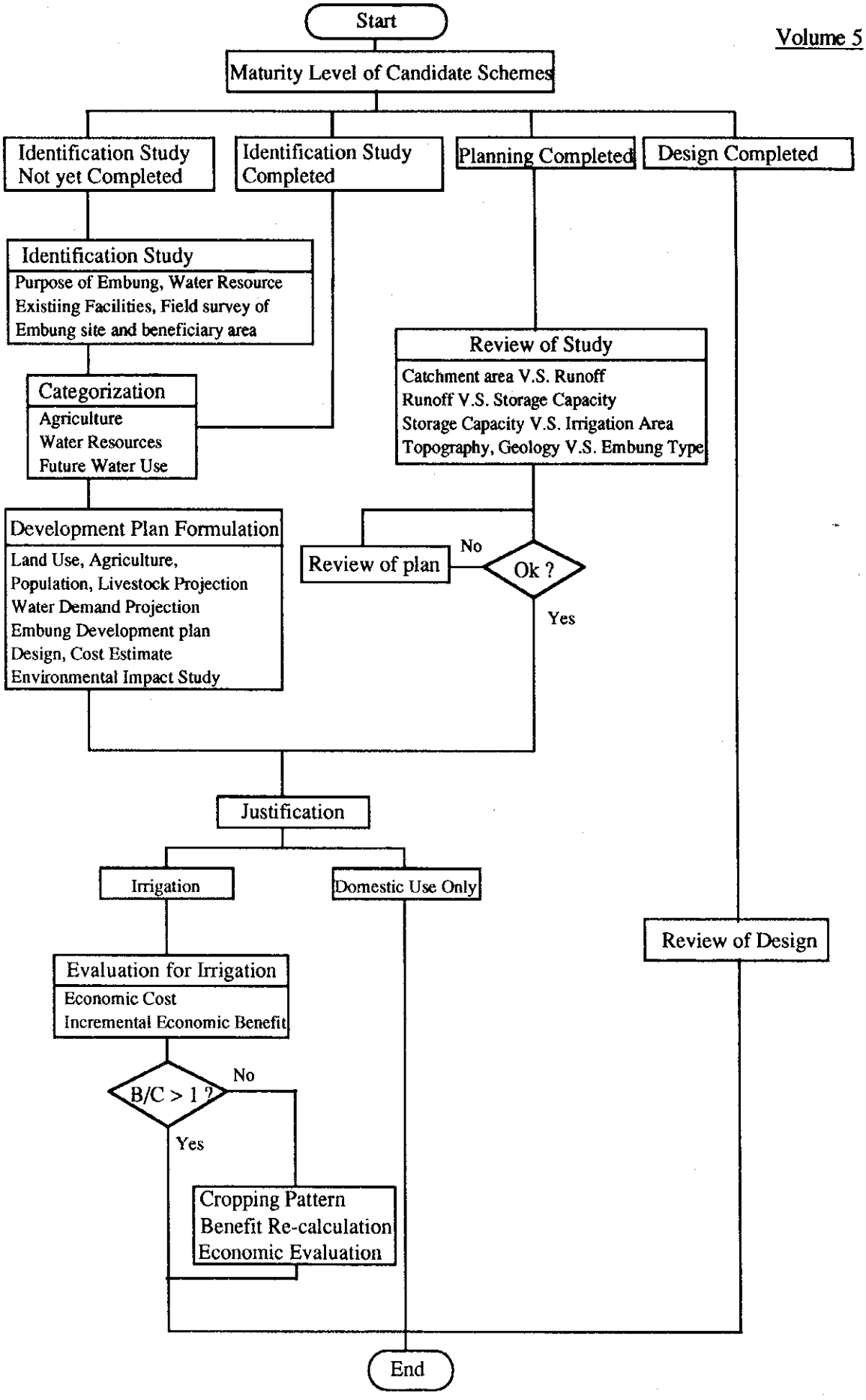


Figure 2.1 Basic Flow of Guideline for Investigation and Planning

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