Japan International Cooperation Agency (JICA)

Directorate General of Water Resources Development, Ministry of Public Works

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

Final Report
(Volume 2)

Master Plan Study Report

May 1995

NIPPON KOEI CO., LTD.

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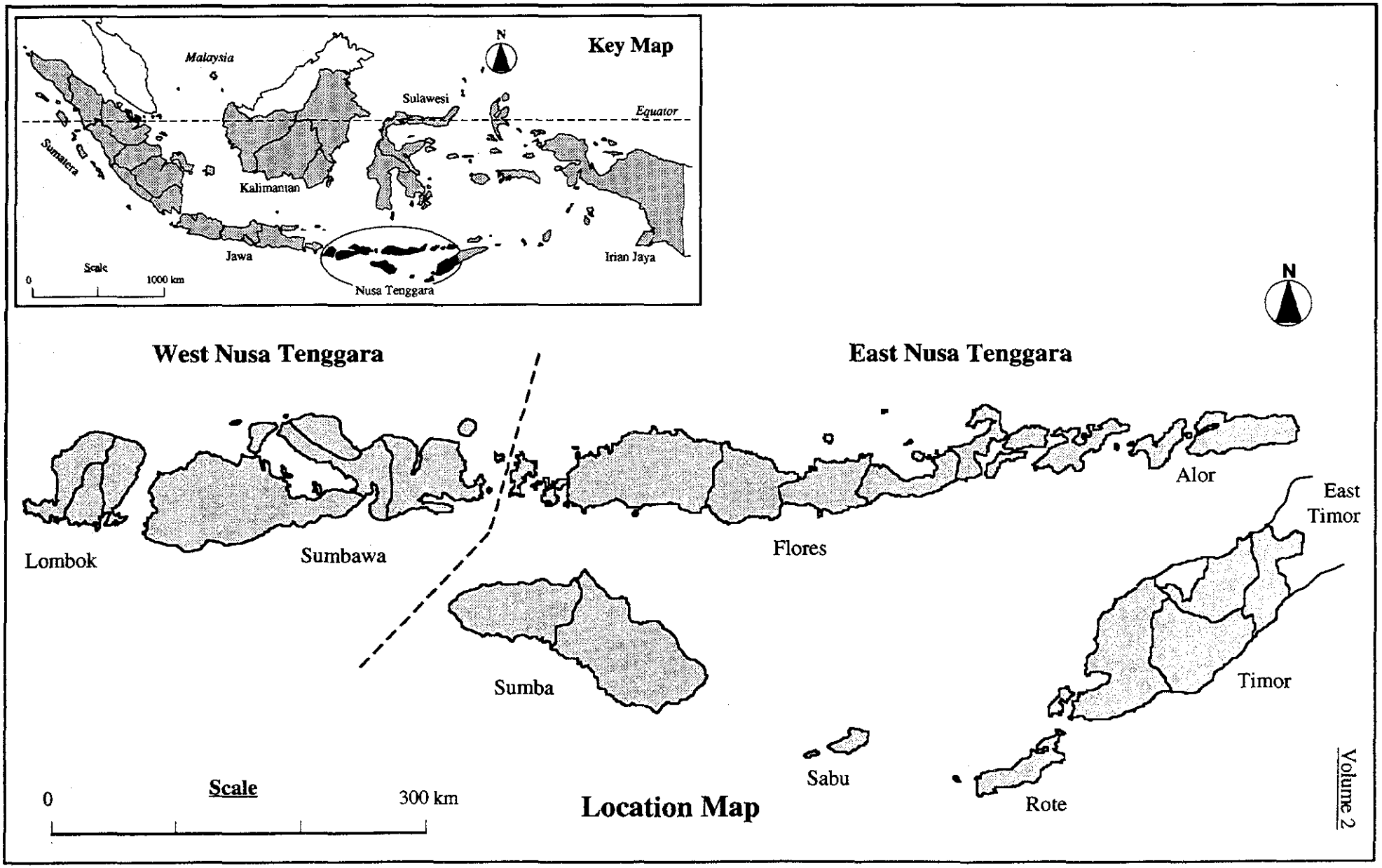
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Location Map
Volume 2

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 2

Master Plan Report

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1. INTRODUCTION

This Final Report is prepared in accordance with the Scope of Work for the Study on the Embung Development Project in East Nusa Tenggara (NTB) and West 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 the Japan International Cooperation Agency (JICA) on October 15, 1993. The local term of Embung is defined as a small scale impounding pond.

1.1 Background of the Study

The alleviation of poverty and the correction of imbalance in the development status among regions have been the main target of policy issues since the Pelita V (Fifth Five Year Development Plan for 1989/90 to 1993/94) was launched. Both NTB and NTT are the least developed regions in the country in economic terms. Per capita gross regional domestic product (GRDP) is as low as or less than 40% of the national average, with NTB ranked 25th and NTT last among a total of 27 provinces.

This low per capita GRDP is attributed to low productivity in the agricultural sector which is the main supporter of economic activities in these two provinces. Lack of rainfall is the fatal constraint hindering the improvement of agricultural productivity. In particular, water shortages in the dry season cause serious problems for agricultural and livestock production and livelihood in rural areas. Aiming to make the most of the limited water resources, small Embungs have been constructed for domestic, livestock and irrigation water use in the NTB and NTT Provinces.

The Government of Indonesia (GOI), considering the importance of the maximum utilization of limited water resources through construction of Embung as an effective measure to develop the rural economy in the NTB and NTT Provinces, requested the Government of Japan (GOJ) in May 1993 to extend technical cooperation for undertaking a feasibility study on the Embung Development Project. At the same time, GOI also requested GOJ to provide grant aid for constructing six Embungs near Kupang in NTT.

As GOJ had regarded this request to construct six Embungs as a candidate grant aid project for its 1994 fiscal year, GOJ decided to conduct the development study in response to these two requests. A preliminary study was thus conducted by JICA in October 1993, and the Scope of Work (S/W) for the Study was agreed upon between the JICA preliminary study team and DGWRD. In accordance with the agreed S/W attached to this Volume 2 Report as Appendix A, JICA started the Study from January 1994.

1.2 Study Objectives and Area

The objectives of the Study are:

- To prepare a master plan in order to formulate a development plan on existing and potential Embung development schemes in the Study area;
- To conduct a feasibility study for the priority Embung development schemes which will be selected by the master plan; and
- To carry out technology transfer to the Indonesian counterpart personnel in the course of the Study.

The Study area covers the two Provinces of NTB and NTT located in the eastern part of Indonesia.

1.3 Study Performance

For the execution of the Study covering a total period of 17 months, JICA organized a study team (the Study Team) consisting of 10 experts and the Indonesia side assigned 17 counterparts. The list of members of the Study Team and Indonesian counterparts is shown in Table 1.1.

The Study was undertaken in two phases and three stages as follows and its overall flow is illustrated in Figure 1.1:

- Phase I Stage 1 Study was conducted in Indonesia and Japan from January 25 to May 31, 1994 to collect data and information, to undertake field investigations, to examine basic human needs in connection with Embung development, to select six Embungs for feasibility studies, and to prepare an Inception Report and a Progress Report (I);
- Phase I Stage 2 Study was performed in Indonesia and Japan from June 1 to August 31, 1994 to collect additional data and information, to assess technical feasibility of six Embungs selected as candidates for urgent project implementation under the GOI grant aid program, to conduct categorization study as a part of the master plan study, to select 10 representative Embungs for Phase II Study and to prepare an Interim Report; and,
- Phase II Study was undertaken in Indonesia and Japan from September 21, 1994 to March 31, 1995 to make a full feasibility study on 10 representative Embungs, to formulate a master plan for mid- and long-term action programs of Embung development in NTB and NTT, to establish fundamental guidelines for Embung development, and to prepare a Progress Report and a Draft Final Report.

Several discussion meetings were held as listed below between DGWRD and the Study Team in the course of the Study and all the minutes of meeting are attached to this Volume 2 Report as Appendix B:

- Consulting Meeting organized by the Directorate of Irrigation II, DGWRD on February 7, 1994 to explain and discuss the contents of the Inception Report;
- First Coordinating Committee organized by the Directorate of Irrigation II, DGWRD on June 20, 1994 to explain and discuss the contents of the Progress Report (I);
- Second Coordinating Committee organized by the Directorate of Technical Guidance, DGWRD on September 28, 1994 to explain and discuss the contents of the Interim Report;
- Third Coordinating Committee organized by the Directorate of Technical Guidance, DGWRD on December 7, 1994 to explain and discuss the contents of the Progress Report (II); and,
- Fourth Coordinating Committee organized by the Directorate of Technical Guidance, DGWRD on March 22, 1995 to explain and discuss the contents of the Draft Final Report.

In addition, the Study Team had meetings with the Provincial Governments of NTB and NTT in order to explain the results of the Study and to exchange views with officials from various agencies. In NTB, five meetings were held on February 8, April 27, June 9, September 22, December 1, 1994, and March 20, 1995, while in NTT on February 14, April 21, June 18, September 26, December 5, 1994, and March 15, 1995. These meetings were organized by either the Provincial Development and Planning Agency (BAPPEDA) or the Water Resources Services (PRWS) of each Provincial Government.

1.4 Organization of the Report

The Final Report consists of ten volumes:

Volume 1	Executive Summary
Volume 2	Master Plan Report
Volume 3	Feasibility Study Report on Urgent Development of Six Embung Schemes
Volume 4	Feasibility Study Report on Representative Embung Schemes
Volume 5	Guideline for Embung Development
Volume 6	Feasibility Study Report on Urgent Development of Six Embung Schemes (Annexes)
Volume 7	Feasibility Study Report on Urgent Development of Six Embung Schemes (Drawings)
Volume 8	Feasibility Study Report on Representative Embung Schemes in Lombok Island in West Nusa Tenggara
Volume 9	Feasibility Study Report on Representative Embung Schemes in Sumbawa Island in West Nusa Tenggara
Volume 10	Feasibility Study Report on Representative Embung Schemes in East Nusa Tenggara

The Final Report describes the summary of all outputs from the Study in Volume 1, and the current socio-economic situation and water resources utilization in rural areas, the needs and directions for water resources development and the medium- and long-term action

Volume 2

programs of Embung development for the NTB and NTT Provinces in Volume 2. Further, it presents the results of the technical examination of six Embungs selected as candidates for urgent project implementation under the GOJ's grant aid in Volume 3 (detail are given in Volumes 6 and 7), and the full feasibility study on 10 representative Embungs in Volume 4 (details are given in Volumes 8, 9, and 10). Fundamental guidelines in carrying out site investigations, plan formulation, facility design, project evaluation, and operation and maintenance in the development of Embungs are compiled in Volume 5.

2. BACKGROUND

2.1 Policy Background

The economic development strategy of the GOI has placed strong emphasis on rural and regional development including intervention in key areas of the agricultural sectors. The strategy has aimed to enhance food production, especially rice, for meeting strong and growing domestic demand, to increase rural employment opportunity and to achieve balanced regional development. Through the First to Fourth National Development Plans (Pelita I to Pelita IV), the rice production had been greatly increased from 18 million tons in 1969 to 41 million tons in 1988. Self-sufficiency in rice was achieved in 1984.

Under this situation, Pelita V was launched in April 1989 with targets such as: (1) to raise living standards and improve the well-being of the whole of the people more evenly and equitably; and (2) to lay a solid foundation for subsequent development. To achieve these targets, priority was given to economic development, placing emphasis on agriculture and industry. The agriculture development policy in Pelita V was; (1) to improve the quality of food production and to sustain stable self-sufficiency in food, (2) to increase agricultural production for meeting export demand, raw materials for local manufacturing industry and feed for animal raising and fish culture, (3) to improve productivity in the agriculture and value added of farm products, (4) to raise the income level of farmers, and (5) to promote rural development and environmental conservation. In line with this policy, the followings were promoted as the most important strategies:

- Diversification of farm and processed products aiming to improve national nutrition and farm household economy;
- Intensification through improvement of farm input use and farming practices for utilization of local resources and to uplift land productivity to the maximum extent;
- Extensification of the production basis emphasizing expansion of farm land in the eastern part of Indonesia; and,
- Rehabilitation of agricultural resources focusing upon the betterment of existing irrigation facilities, recovery of idle farm land, and renewal of estate crops.

For the first four years of Pelita V, paddy planted area increased at the average rate of 2.3% per annum and paddy yield rose by at 1.4% resulting in a paddy production increase of 3.4%. Due to the conversion of productive paddy fields into urban and industrial areas in Jawa, however, paddy production slightly declined to 48 million tons in 1993, the last year of Pelita V. The per capita rice consumption ratio has tended to rise in rural areas as the staple food of farmers has shifted to rice with their increasing household income level. The target to rehabilitate irrigation facilities covering 1.1 million ha was realized, but in terms of new

irrigation development and swamp improvement the actual results were below the targets of 0.5 million ha and 0.4 million ha, respectively.

Despite of the successful achievements made in the First Long Term Development (PJPT I, 1969/1970 to 1993/1994), there are still a number of problems left unsolved. As considerable and ceaseless efforts are needed to overcome these problems, the Second Long Term Development (PJPT II, 1994/1995 to 2018/2019) is directed towards the attainment of: (1) the developed quality of the man and society with an equal level of life to other nations; and (2) a self-reliant society through enhancement of the quality of the human resources, decrease in dependability on foreign financing resources, development of ability to be self-sufficient for essential needs, and the provision of economic capability to endure global economic jolts. Development programs in PJPT II are based on the Trilogy of Development concept, that is, high economic growth, attainment of equal distribution of development gains, and supported by sustainable and dynamic national stability as shown in Table 2.1.

Under Pelita VI (1994/1995 to 1998/1999) in line with PJPT II, the development of the agricultural sector is directed towards maintaining food crop production at a self-sufficiency level, enhancing job opportunities and raising farm labor productivity, increasing exports of farm products, improving and extending agricultural supporting institutions, and eradicating poverty. To achieve these targets, five fundamental programs and three supporting programs are taken up in Pelita VI. The former comprise a food production increase program, new job opportunity enhancement and labor productivity improvement program, an export-oriented farm products development program, an institutional development program, and an agricultural production increase and diversification program. While, the latter consist of an agricultural education, training and publication program, an agricultural research and development program, and an immigration promotion program.

The development targets for the water resources and irrigation sector under Pelita VI are: (1) development and conservation of water resources for the purpose of enabling the irrigation system to function continuously and to provide irrigation water permanently; (2) proper land resources and watershed management to maintain fertile farm land and constant run off; and (3) water pollution controls to keep living environments clean. The development programs of this sector are summarized in Table 2.2.

The targets of cooperative activities in Pelita VI are directed to improve the quality of human resources participating in rural cooperatives so as to raise cooperative management ability, to promote participation of members in cooperative activities, to support development and utilization of appropriate technology, to introduce cooperative reforms aiming at sound capital structure, to strengthen horizontally and vertically the integrated cooperative business network, and to develop institutional activities of cooperative. During the period of Pelita

VI, the total number of village cooperatives (KUD) and non-village cooperatives (non-KUD) will increase from 8,596 to 9,458 and participants will increase from 13.5 million to 16.6 million. Further, 2,700 KUDs will be newly upgraded to self-sustainable management level in addition to 2,300 KUDs currently self-sustained.

2.2 Socio-economic Background

Indonesia has a total area of 1.92 million km^2 of which low land paddy field shares 4.4% or some 84,000 km^2. In 1992, the harvested area of paddy was 111,000 km^2 in total with a cropping intensity of 132%, production of 48.24 million tons, and an average yield of 4.35 tons/ha.

Through Pelita V, the total GDP at 1983 constant market prices increased from Rp. 99,981 billion in 1988 to Rp. 139,707 billion in 1993, an annual average growth rate of 7.9%. The shares of the agricultural, livestock, forestry, and fisheries sectors as well as the petroleum and gas sector in the total GDP declined by 3.6% and 3.1%, respectively, for this period resulting from the remarkable growth of the manufacturing industries sector with its share increasing from 13.6% to 16.9%. Table 2.3 shows GDP by sector for the period of Pelita V.

According to the past Population Census, the total population was 119. 2 million in 1971, 147.5 million in 1980 and 179.4 million in 1990, and the annual growth rate was 2.32% for the period of 1971-1980 and 1.98% for the period of 1980-1990. The number of households was 30.4 million in 1980 and 39.7 million in 1990 with the average household size of 4.9 and 4.5 persons, respectively. In PJPT II, the projected growth rate of population in the future is 1.5% for 1998 and 0.88% for 2018. The projected population is 189. 1 million for 1993, 204.1 million for 1998, 233.6 million for 2008, and 258.2 million for 2018.

In 1993, population aged 10 years and over was 143.8 million. Those who are economically active amount to 81.4 million comprising working people of 79.2 million and people looking for work of 2.2 million, while the remaining 62.4 million are not economically active and attend school, engage in house keeping, and others. The agriculture sector has contributed much to employment absorption and employs 46% of the total workforce as at 1993.

The change in labor productivity by sector between 1985 and 1993 is shown in Table 2.4. Reflecting the small share in GDP and large share in employment, the labor productivity of the agricultural sector for 1992 is lower at a value of Rp. 0.5 million/labor at 1983 constant market prices, while the average productivity of all sectors is Rp. 1.4 million/labor. This low productivity mainly results from the lower income of the agricultural sector.

The actual Government receipts in 1992/1993 were Rp. 58.17 billion consisting of oil and gas receipts of Rp. 15.33 million, tax and duty receipts of Rp. 32.12 million, and development receipts of Rp. 10.72 billion. On the other hand, actual Government routine expenditures amounted to Rp. 34.03 billion including subsidies to local Governments of Rp. 5.28 billion and debt repayment of Rp. 15.22 billion, and actual Government development expenditures totaled Rp. 24.14 billion including project aids of Rp. 10.20 billion, and development subsidies to local Governments of Rp. 1.85 billion. The actual Government receipts and expenditures for the period of Pelita V are summarized in Table 2.5.

According to the 1992 National Socio Economic Survey, sources of drinking water and those shares in total households in the country are piped water of 14.7%, pumped water of 10.5%, sheltered well water of 31.1%, unsheltered well water of 21.2%, sheltered spring water of 6.7%, unsheltered spring water of 7.2%, river water of 5.6%, rain water of 2.1%, and other water sources of 0.9%.

3. CURRENT SITUATION OF THE STUDY AREA

3.1 General Background

Under Pelita I to IV, the early achievement of self-sufficiency in rice has been recognized as the main development issue of the agricultural sector. To realize the national self-sufficiency of rice, the priority of public investment was given to the implementation of large scale land and irrigation development projects in Jawa as well as a part of Sumatra and Sulawesi. Despite the successful achievement resulting from this agricultural development policy, such problems have been brought about as (1) imbalance of development among regions, (2) insufficiency of diversification of crops considering the locality of the area, (3) lack of effective countermeasures for development of small and medium scale irrigation schemes.

Among 27 provinces in Indonesia, NTB and NTT failed to achieve self-sufficiency in rice because of their remote location coupled with low potential for land and water resources development mainly caused by a drier climate than other parts of Indonesia. In 1991, thus, per capita GRDP excluding oil and its products at current market prices was Rp. 461,000 for NTB and Rp. 404,000 for NTT ranked 25th and last, respectively as shown in Table 3.1. Aiming to improve the lower productivity of the agricultural sector and living standards of urban and rural inhabitants, therefore, the "Poverty Alleviation" and the "Development of the Eastern Part of the Indonesia" were taken up as the main development target components under Pelita V. This principle is maintained in Repelita VI.

In the light of this Government development policy, various technical support projects are ongoing in NTB and NTT seconded by donor agencies including the World Bank (WB), Asian Development Bank (ADB), Overseas Economic Cooperation Fund, Japan (OECF), United States Agency for International Development (USAID), Canadian International Development Agency (CIDA), and Australian Development Assistance Bureau (ADAB) as well as JICA. Major foreign aid projects are listed in Table 3.2.

As at 1993, the Province (Propinsi) of NTB administratively totals one Municipality (Kotamadya), six Regencies (Kabupaten), 59 Districts (Kecamatan) and 524 Villages (Desa), while the Province of NTT comprises 12 Kabupatens, one Administrative City (Kota Administrasi), 114 Kecamatans, and 1,743 Desas. Table 3.3 indicates the number of Kecamatans and Desas for each Kabupaten.

3.2 Natural Circumstances

3.2.1 Physiography

The Study Area is situated between 8°10' and 11°15' south latitude and 115°46' and 125°10' east longitude. It consists of 614 small to medium sized islands, of which 48 belong to NTB and 566 to NTT. About 70 islands in all are inhabited. The major islands are Lombok and Sumbawa in NTB, and Flores, Sumba and Timor in NTT. The total land area is 67,503 km^2 occupying 3.5% of the country's territory and comprising 20,153.1 km^2 for NTB and 47,349.9 km^2 for NTT.

These islands form two distinct arcs. One is the Inner Island Arc including Lombok and Sumbawa islands in NTB and Flores, Lomblen, and Alor islands in NTT, while the other is the Outer Island Arc including Sumba, Sabu, Rote, and Timor islands in NTT. The islands on the Inner Island Arc are volcanic in origin; some volcanoes are still active, others dormant or extinct. Most of the volcanoes display classical conical outlines featured by precipitous upper slopes, gentler but slashed middle slopes by deep ravines, and the almost level foot slope fans broaden out. Those on the Outer Island Arc are formed by uplifted marine sediments and coral reefs with geographic characteristics of barren limestone plains and sparse savannahs.

The physiographic features of the five major islands are summarized below:

- Lombok has a the bonnet-like shape. Its northern part is dominated by a high ridge of volcanic cones, while its south-western part is formed by coastal hills. The highest peak is Mt. Rinjani with an elevation of 3,775 m above sea level. From the northern ridge, four major rivers flow north and seven flow south. The south central fans on the ridge's foot slope are the main agricultural zone. The land area is 4,738.7 km^2. Flat and very gentle land of less than 8% in slope occupies 46% of the island;

- Sumbawa has a long east-west stretch and a narrow north-south width. Capes, a peninsular, and deeply cut bays form a crooked and broken coast-line. The highest peak is Mt. Tambora of 2,851 m. The rivers characteristically have small catchment areas with rather steep slopes. The terrain is rough and mountainous, but coastal plains on alluvial fans and river terraces, inland valleys, and the lower volcanic slopes, occupying about 18% in all of the island's area of 15,414.4 km^2, are flat to gentle in land slope and used for agriculture;

- Flores is longer in the east-west stretch, narrower in the north-south width and has a rather simple coast line. The younger volcanoes lie to the south of the islands, about 10 are active or recently active in geological terms. The highest peak is Mt. Ranakah of 2,400 m. Short and steep rivers very quickly drop down after leaving the watersheds. Coastal plains are usually formed by narrow strips. The land area is 14,231.0 km^2. Flat and very gentle land of less than 8% in slope is limited to only 11% of the whole area;

- Sumba is the fourth largest island, with a little bit shorter in the northwest-southeast stretch, narrower in the northeast to southwest width, and simple in

shape. The southeast is of lower mountainous areas, while much of the interior is made up of a plateau, separated by deep valleys and scattered hills. The highest peak is Mt. Wangga Meti of 1,225 m. The land area is 11,040.0 km^2. Land gradient is flat to gentle occupying 42% of the island; and,

- Timor is the largest among the islands east of Bali with a land area of 29,268.9 km^2, the southwestern half of which is a part of NTT's territory of 14,394.9 km^2. It stretches along a southwest to northeast axis. In NTT, the highest peak is Mt. Mutis of 2,427 m and 12 major rivers flow southeast or northwest from the central highlands which are composed of gravel and coral limestone. Rote an island of in rugged rock formations is to the southwest of Timor and has lower hills rising and falling in gentle slopes. Only 13% of the western part of Timor is flat to gentle in land slope.

3.2.2 Geology

Geologically, the Inner Island Arc is of volcanic origin and mainly underlain by volcanic and sedimentary rocks of younger age, while the Outer Island Arc is characterized by recent coral limestone and sedimentary rocks of old age. Major rocks found in NTB and NTT are alluvium, coral limestone, limestone, sedimentary rock of the Tertiary/Quaternary, volcanic rock of the Pre-Quaternary, and volcanic products of the Quaternary. Other minor rocks include terrace deposits (gravel and sand), claystone of "Bobonaro Complex", sedimentary rock of the Pre-Tertiary, volcanic lava of the Quaternary, metamorphic rock and ultrabasic rock, granite, and intrusive rock. Figures 3.1 to 3.5 depict the distribution of these rocks and the geological features in each major island are outlined below:

- Lombok is broadly underlain by volcanic rocks among which lava of the Quaternary predominates in the north central part of the island and breccia of the Quaternary encompasses the lava zone. The volcanic rock of the Pre-Quaternary occupies the southern part of the island with minor areas underlain by limestone, sedimentary rock of the Tertiary/Quaternary, and intrusive rock;

- Sumbawa is predominantly underlain by volcanic rock of the Pre-Quaternary in the south coast side of the island and that of the Quaternary including andesitic lava and breccia in the north coast side. Intrusive rock and coral limestone are distributed in a part of the western mountain and north central coast, respectively;

- Flores is mainly underlain by volcanic rocks, particularly lava, of the Quaternary followed by those of the Pre-Quaternary. Along the north coast, mountain slopes are limitedly underlain by sedimentary rocks such as sandstone of the Tertiary and limestone. Coastal terrace and alluvium are made of unconsolidated deposits;

- Sumba is mainly underlain by limestone of the early to late age of the Tertiary in the northwest half of the island and sedimentary rocks of the Tertiary such as sandstone and claystone in the southeastern half. Coral limestone of the Quaternary predominates in the northeast coastal area, while volcanic rocks composed of lava and breccia of the Tertiary are predominant in the southwest coastal area; and,

- West Timor is characterized by widespread distribution of coral limestone and the Bobonaro Complex which is the geological formation peculiar to the northwest part of west Timor and composed of claystone with a great mass of rocks of the Pre-Tertiary. The coral limestone is porous and high in permeability and dominates the

southeast part of west Timor and islands like Rote. West Timor is also interspersed with sedimentary rocks of the Pre-Tertiary consisting of chart, shale sandstone, limestone, metamorphic, and ultra basic rocks.

3.2.3 Climate

In general, both Provinces are the driest part of Indonesia, but the climate varies with the location of the east-west stretch between islands and the elevation within the same island. The wet season, generally starting from December and lasting to March, is caused by the northwest monsoon of which winds from the Java Sea bring moisture-laden air particularly to the north-facing mountain slopes of all islands. The mean annual rainfall is also widely varied ranging from 700 to 3,000 mm between and within the islands. Throughout the islands, the average sunshine hours are 4 to 5 hrs/day during the wet season and increase to 7 to 8 hrs/day in the dry season, and the mean annual temperature ranges from 26°C at sea level to 15°C at mountains of 2,000 m in height. Winds are stronger from June to September and calm from December to March with the average wind velocity of 9 to 14 km/hr along the coast of the Inner Island Arc and 24 to 27 km/hr along the coast of the Outer Island Arc.

The rainfall pattern peculiar to the five major islands is summarized below and the average monthly rainfall data are shown in the following table:

- In Lombok, the wet season lasts seven months from October in the northwestern part and is one month shorter in the southeast starting from November. Based on the isohyetal map, the annual rainfall is estimated to be 1,900 mm for the entire island, and about 700 to 1,100 mm for the narrow fringe area along the southwest to northeast coast;

- In Sumbawa, the wet season starts from October in the eastern and middle parts and November in the western part, ending in April throughout the island. Mean annual rainfall is 1,300 mm in lowland areas, while it increases to 2,500 mm and more in high mountains;

- In Flores, the wet season is about six months from October to April in coastal areas and the mean annual rainfall varies between 900 and 1,200 mm. The wet months in highlands above El. 500 m end in May and mean annual rainfall increases to 2,500 mm;

- In Sumba with an absence of high mountains, the eastern part of the island is a drought prone region with a mean annual rainfall of less than 1,000 mm. This low rainfall is often concentrated in a very short period, although the wet season lasts five months. Mean annual rainfall tends to increase to 1,300 mm in the western part; and,

- In west Timor, the wet season is usually four months starting from November at the earliest usually December, and lasting to March and sometimes April. Mean annual rainfall is around 1,400 mm from the east coast to the interior of the island.

Average Monthly Rainfall in Major Islands

Unit : mm

Major Island	Lombok	Sumbawa	Flores	Sumba	West Timor
Jan.	298	282	314	316	255
Feb.	248	255	273	285	244
Mar.	216	255	273	285	244
Apr.	102	110	149	167	97
May	84	70	91	103	82
June	60	44	61	54	55
July	40	29	39	38	38
Aug.	27	14	22	37	11
Sept.	28	17	37	37	6
Oct.	65	48	76	85	29
Nov.	134	125	151	151	98
Dec.	242	241	264	266	204
Annual	1,544	1,452	1,718	1,799	1,310

Source : Annual Seasonal Rainfall in Indonesia, DGWRD

3.2.4 Hydrology

Rivers, springs, and lakes are the main usable water resources in NTB and NTT. Most rivers have small watersheds and dry up during the later part of the dry season due to particular rainfall patterns in this area. There are 46 rivers with catchment areas of more than 200 km^2. Although the major supply for irrigation is being diverted from perennial rivers in each main island, dams and Embungs have recently been developed mainly in Lombok and Sumbawa. Further, small scale Embungs have been constructed for a more reliable water source for domestic use throughout the islands.

The characteristics of the river system in each island are summarized below:

- In Lombok, there are 46 rivers with the area assigned to river basins totaling 3,839 km^2 or 81% of the whole area. The largest river is the Dodokan flowing with a catchment area of 563 km^2 followed by the Babak and Renggung rivers having a catchment area of more than 200 km^2. From the more humid northwest region to the rain poor central Lombok, two interbasin transfers, Jangkok-Babak High Level Diversion and Jurang Sate canal, divert water to the existing Batujai reservoir;

- In Sumbawa, the majority of the 41 rivers in the central and eastern parts of the island are short and run in steeply sloping channels to the nearest coast, while most of the 81 rivers in the western part are generally longer. Of 122 rivers, the Beh is the largest with a catchment area of 1,372 km^2. Another five rivers have a catchment area of more than 200 km^2. These are the Taliwang and Moyo in the western part, the Rora in the central part, and the Ncangakai and Pelaparado in the eastern part;

- In Flores, there are 286 rivers most of which are strongly affected by the rainfall pattern and dry up quickly after the dry season starts. A total of 215 rivers flow in small islands such as Solor, Adonara, Lembata, Pantar, and Alor, forming a stretch of islands next to Flores. Among these rivers, the largest is the Ai Sissa in Flores and its catchment area is 1,179 km^2. Rivers with a catchment area of more than 400 km^2 are the Waso, Jamal, Moke/Manggarai, Rea, and Buntal in Flores. Those having a catchment area of more than 200 km^2 are the Nae, Dondo/Ria, Nede, Meseh, and Bema rivers in Flores and the Anail river in Alor;

- In Sumba, there are 122 rivers of which 42 flow in the western part of the island which receive more rainfall than the eastern part. The largest river is the Kambaniru in the eastern part and its catchment area is 1,104 km^2. Major rivers flowing in the eastern part are the Kadahang with a catchment area of 419 km^2 and the Mondu, Tidas, Kadumbul, Nggongi, Rende, Rambangaru, Kawangu, and Watumbaka having a catchment area of more than 200 km^2. Those in the western part are the Polapare, Kalada, Wonokaka, Palameda, and Bondokodi rivers with a catchment area of more than 200 km^2; and,

- In west Timor including Sabu and Rote, there are 142 rivers most of which commonly dry up during the dry season due to the small size of their watershed and poor vegetation. Some perennial rivers may also carry less than 1% of the maximum flows during the dry season. The largest river is the Benain with a catchment area of 3,354 km^2 followed by the Mina having a catchment area is 2,008 km^2. Rivers with a catchment area of more than 400 km^2 are the Bilomi/Tono, Nungkurus, Muke, and Tarmanu, while those having a catchment area of more than 200 km^2 are the Mena, Nuelbessi, Sitoto, Tomutu, and Fail.

3.2.5 Soils

Soil conditions in NTB and NTT are very heterogeneous and there are considerable differences between islands. Accordingly, those suitable for agricultural development vary widely. Most soil orders are represented by Entisols, Inceptisols, Alfisols, Ultisols, and Vertisols. Agricultural soils on the Outer Island Arc tend to be less fertile and more drought prone than those on the volcanic Inner Island Arc. Expansion of farm land in NTB and NTT is usually restricted by the shallow depth of soils and/or steepness of the land. This is particular in Sumbawa and Flores where small pockets of deeper agricultural soils are separated by large expanses of rugged volcanic terrain.

Dominant features of agricultural soils on each island are briefly described below:

- In Lombok, agricultural soils are largely sandy loam, sandy clay, loam, and clay loam in soil texture. Organic matter and nitrogen contents are generally very low to low, while the available phosphorus content is high to very high, resulting in poor soil fertility. As the presence of exchangeable cations is moderate to high, soil pH value is generally on the high side. Because of coarse soil texture, small water holding capacity, and high infiltration rate, many unirrigated soils experience water shortages in the dry season;

- In Sumbawa, soil texture widely ranges from clay to loamy sand. Soil fertility is moderate to low due to the very low organic matter content and very low available phosphorus. The presence of exchangeable cations varies among soil orders and thus soil pH values range between 6.5 and 7.9;

- In Flores, soils are generally clay to clay loam in soil texture and low in organic matter, nitrogen and available phosphorus contents. The presence of exchangeable cations varies widely and soil pH values are slightly acid to neutral. Soils extending over alluvial valleys, young volcanic plains of the interior and north coast colluvial plain are fertile and highly productive, but in other parts of the island productivity is limited due to low fertility;

- In Sumba, soils are generally featured with low soil fertility and water retention capacity. Organic matter and nitrogen contents are low to moderate and the available phosphorus content is moderate to low. Soil pH values widely range from rather alkaline to acid; and,

- In west Timor, soil fertility is poor throughout the island. Most soils are of medium to fine texture and become sticky when wet but very firm after drying. Soils on uplifted marine sediments are very shallow in effective soil depth. Organic matter and phosphrus contents broadly range from very low to high, and nitrogen content is low to moderate. The presence of exchangeable cations varies between high and moderate, while soil pH values are neutral to slightly alkaline.

3.2.6 Vegetation and land use

Natural vegetation, especially forests, in the past were closely related to soil conditions in both Provinces. Productive dense forests extended over deep loamy soils, while shrub forests covered the steep and shallow volcanic soil areas and fire climax savannah was common in upland marine clay soil areas. Shifting cultivation and human settlement have seriously affected this nature of the vegetative cover. Therefore, the existing forest areas or forest-designated areas have reduced to 41% of the total land area of NTB and 21% of NTT, while grassland accounts for 2% of NTB and 19% of NTT. In NTB and NTT, designated land conservation areas cover 2,657 km^2 in all, comprising 950 km^2 for nature reservations, 516 km^2 for wildlife reservations, 561 km^2 for national parks, 102 km^2 for recreational parks, and 529 km^2 for hunting parks.

The salient features of vegetation and land use in each island are shown in Table 3.4 and Figures 3.6 to 3.10 and summarized below:

Land Use Condition in Major Islands as at 1993

Unit : km^2

Major Island	Lombok	Sumbawa	Flores and Alor	Sumba	West Timor
Farmland	2,604	4,885	4,984	2,104	3,306
Shifting Area	338	174	629	316	461
Grass land	12	340	2,470	3,305	2,061
Fallow land	85	671	2,202	1,108	1,613
Forest	1,184	7,085	4,331	2,287	5,910
Others	516	2,259	5,281	1,932	3,050
Total land	4,739	15,414	19,897	11,052	16,401

Source : Bureaus of Statistics in NTB and NTT

- In Lombok, 444 km^2 or 9.4% of the island is designated as land conservation areas which consist of 413 km^2 of national parks and 30 km^2 of recreation parks;

- In Sumbawa, the land conservation area covers 926 km^2 or 6.0% of the island including 251 km^2 of nature reservations, 117 km^2 of wildlife reservations, 36 km^2 of recreation parks, and 523 km^2 of hunting parks;

- In Flores, conservation areas occupy 703 km^2 or 3.5% of the island comprising 528 km^2 of nature reservations, 140 km^2 of national parks, and 35 km^2 of recreation parks;

- In Sumba, 242 km^2 or 2.2% of the island is demarcated as wildlife reservations; and,

- In west Timor, the land conservation area amounts to 342 km^2 and shares 2.1% of the western part of the island. These include 171 km^2 of nature reservations, 157 km^2 wildlife reservations, 8 km^2 of a national park, 1 km^2 of a recreation park and 6 km^2 of a hunting park.

3.3 Socio-economy

3.3.1 Demography

The total population in 1993 was 3,504,006 in NTB and 3,357,099 in NTT. The growth rate of population was 2.36% for the period 1971 to 1980 and 2.15% for the period 1981 to 1990 in NTB, higher than the nation's average of 2.32% and 1.98%, respectively. On the other hand, that of NTT was 1.95% in the 1970's and 1.79% in the 1980's, both below the national growth rates. The population density in 1993 was 174 person/km^2 in NTB and 71 person/km^2 in NTT. The total number of households in 1993 was about 783,900 in NTB and 634,313 in NTT. The average household size in 1993 was 4.5 in NTB and 5.3 in NTT. The religious background of inhabitants is clearly distinguished into predominant Islamic in NTB and Christians forming a sociological majority in NTT.

The number of school attendants in NTB as at 1993 was 519,609 pupils to 2,780 primary schools, 81,151 pupils to 242 junior high schools, and 50,578 pupils to 143 various senior high schools. In addition, 5,775 students were registered at the State University in Mataram and another 11,819 students were studying in 18 private universities. That in NTT as at 1993 was 573,894 pupils to 3,901 primary schools, 101,687 pupils to 523 junior high schools and 54,184 pupils to 195 various senior high schools. In addition, 5,057 students were registered at the State University in Kupang and another 8,712 students are studying in 11 private universities and colleges.

The demographic data by major islands are shown in Table 3.5 and summarized below.

Demographic Conditions in Major Islands as at 1993

Major Island		Lombok	Sumbawa	Flores*	Sumba	West Timor
Total population	person	2,494,588	1,009,418	1,607,587	461,630	1,287,882
Working population	person	1,839,312	751,270	1,230,203	332,880	952,223
Total household**	number	574,800	209,100	296,375	78,975	258,963
Population density	pers./km^2	526	65	81	42	78
Average household size	person	4.3	4.8	5.4	5.8	5.0

Remarks : * ; Including Solor, Adonara, Lembata, Pantar and Alor islands
** ; Estimated figures in terms of household number in Lombok and Sumbawa
Source : Bureaus of Statistics in NTB and NTT

3.3.2 Employment

As at 1993, the share of the working age population being 10 years old and over against the total population was 74% of the total population in NTB and 75% in NTT. The economically active population not including school attendants and housewives accounted for 63% of the working population in NTB and 68% in NTT. In the both Provinces, 99% of the economically active population are working and the rest are looking for job opportunities.

Out of the working population, 62% in NTB and 78% in NTT are engaged in agriculture, forestry, hunting, and fishery. Other major sectors providing job opportunities in NTB are wholesale trade, retail trade, restaurants, and hotels absorbing 14% of the working population, public services sharing 9%, and the manufacturing industry accounting for 8%. While in NTT, the second main sector is public services with a share of 8% followed by the manufacturing sector occupying 7% of the working population.

3.3.3 Transmigration

Up to date, both Provinces have played a minor role in involvement in the national transmigration program due to limited water resources and a lack of sizable land resources. Instead, special attention has been paid to resettlement of farmers from mountainous areas to lowlands within the islands and in Sulawesi and Kalimantan aiming to prevent further deterioration of the forests by their practice of shifting cultivation. In 1993, local migrants totaled 404 families with 1,680 persons resettled within NTB and 230 families with 1,053 persons within NTT, while transmigrants to Kalimantan, Sulawesi, and Irian Jaya totaled 1,744 families with 6,578 persons from NTB and 783 families with 3,270 persons from NTT.

3.3.4 Social infrastructures

The major communication infrastructures available in NTB comprise three airports, three ferry routes, five seaports, and 14,585 telephone users. In NTT, there are 14 airports, 11 seaports, and 9,840 telephone users. Electricity produced in 1993 was 162 MWh in NTB and 103 MWh in NTT, while that sold was 126 MWh in NTB and 95 MWh in NTT.

The total length of existing roads in NTB is 5,367 km consisting of 3,200 km of asphalt road, 569 km of gravel road, and 1,599 km of earth road, while that in NTT is 14,081 km being composed of 4,209 km of asphalt road, 3,182 km of gravel road, and 6,690 km of earth road. The road density per 100 km^2 is 26.6 km in NTB and 29.7 km in NTT, being higher than the national average of 15 km. Table 3.6 shows the road length by condition in each major island. The number of vehicles registered as at 1993 amounted to 8,520

passenger cars, 11,263 trucks, 2,380 buses, and 66,072 motor cycles in NTB, and 4,119 passenger cars, 8,869 trucks, 4,535 buses, and 30,421 motor cycles in NTT.

In NTB, a total of 298,614 arrival and departure passengers, 2,084 tons of unloaded cargoes, baggage and parcels, and 2,004 tons of loaded ones were carried by 19,247 flights landed and taken off at three airports in 1993. Further, a total of 2,236,572 passengers embarked and disembarked, 19,635 heads of animal loaded and unloaded, and 1,120,912 tons of cargoes were loaded and unloaded from ships which visited five sea ports.

In NTT, a total of 283,198 arrival and departure passengers, 2,731 tons of unloaded cargoes, baggage and parcels, and 2,158 tons of loaded ones was carried by 18,824 flights landed and taken off at 14 airports in 1993. Further, a total of 692,175 passengers embarked and disembarked, 57,095 heads of animal loaded and unloaded, and 1,002,621 tons of cargoes loaded and unloaded was shipped by 6,743 ships and sailing crafts which visited 11 sea ports.

The performance of air and sea communications in 1993 by major islands is summarized as shown below.

Incoming and Outgoing Passengers and Cargoes by Air and Sea in Major Islands for 1993

Major Island		Lombok	Sumbawa	Flores*	Sumba	West Timor
Airport	number	1	2	8	2	4
Seaport	number	2	3	6	2	3
Arrival air passenger	person	125,339	17,397	41,668	13,924	82,170
Disembarked sea passenger	person	770,620	364,857	256,114	23,020	67,905
Air cargo**						
Unloaded	ton	1,758	326	878	255	1,598
Loaded	ton	1,803	201	546	199	1,413
Sea cargo						
Unloaded	ton	554,751	205,267	271,941	82,021	421,543
Loaded	ton	256,115	104,779	86,263	12,496	128,357

Remarks : * ; Including Alor island.
** ; Including baggage and parcels.
Sources : Bureaus of Statistics in NTB and NTT

3.3.5 Sanitation

According to the 1992 National Socio-economic Survey on sanitation facilities, 33.4% of 132,352 urban households in NTB used private toilet with septic tank, 11.0% use shared toilets with septic tanks, 6.8% use private toilets without septic tanks, 2.4% use shared toilets without septic tanks, 5.3% use public toilets, 35.5% use rivers, and 5.6% use holes and others. While, 5.1% of 656,003 rural households were users of private toilet with septic tanks, 3.1% of shared toilets with septic tanks, 2.5% of private toilets without septic tanks,

1.0% of shared toilets without septic tanks, 1.1% of public toilets, 48.2% of ponds and rivers, and 39.0% of holes and others.

In NTT, 44.3% of 69,632 urban households on use private toilets with septic tanks, 9.4% use shared toilets with septic tanks, 27.5% use private toilets without septic tanks, 8.2% use shared toilets without septic tanks, 2.0% use public toilets, 0.2% use rivers, and 8.4% use holes and others. On the other hand, 8.8% of 568,320 rural households were users of private toilets with septic tanks, 2.0% of shared toilets with septic tanks, 40.7% of private toilets without septic tanks, 9.7% of shared toilets without septic tanks, 0.7% on public toilets, 1.1% on ponds and rivers, and 37.0% on holes and others.

3.4 Agriculture, Livestock and Fisheries

3.4.1 Farmland

The present condition of farmland use features rice cultivation on wet paddy fields in NTB and maize planting on dry upland as well as shifting cultivation in NTT. In addition, grassland supports the livestock industry which plays a predominant role in the agricultural sector in NTT. As at 1993, the total farmland area including wet paddy field, dry upland field, fruit tree field, and estate crop field was 7,488 km^2 occupying 37.2% of the landmass in NTB and 10,394 km^2 or 22.0% in NTT. Due mainly to uncertain rainfall patterns and traditional land use patterns specified by shifting cultivation, there exists a temporary fallow land of 756 km^2 in NTB, apart from the farmland. On the contrary, a total of 4,924 km^2 is left fallow in NTT.

The farmland use by major island is presented in Table 3.7 and summarized below.

Agricultural Land Use on Major Islands as at 1993

Unit : '000 ha

Major Island	Lombok	Sumbawa	Flores	Sumba	West Timor
Farmland	260.4	488.5	498.4	210.4	330.6
Wet paddy field	121.9	79.1	48.2	42.9	38.6
Dry upland field	35.0	370.3	180.0	45.4	162.9
Fruit tree field	10.8	5.7	14.4	15.2	31.9
Estate crop field	92.7	33.4	255.8	106.9	97.2
Shifting cultivation area	33.8	17.4	62.9	31.6	46.1
Fallow land	8.5	67.1	220.2	110.9	161.3
Grassland	1.2	34.1	247.0	330.5	206.1

Source : Bureaus of Statistics in NTB and NTT, and Provincial Agriculture Services, NTT

3.4.2 Predominant crops

High yielding varieties of wet paddy are grown on wet paddy fields, while dry paddy cultivation using traditional varieties is predominant in dry uplands and shifting cultivation areas. Palawija crops grown as the second crop on wet paddy fields for the dry season are

mainly pulse crops such as soybean, mungbean, and groundnut. Maize and cassava are common food crops grown on dry upland fields and sweet potato is also planted to some extent. Chili, red onion, and tomato are planted as cash crops on dry upland fields and also as Palawija crops on wet paddy fields.

Estate crops consist of annual crops represented by tobacco and cotton and permanent crops predominated by coconut and cashew followed by coffee and kapok. In NTT, planting of candle nut and areca palm is popular as the second important estate crop. Wide varieties of fruits are cultured in Lombok island, including pineapple, banana, rose apple, jack fruit, papaya and mango. In other major islands in NTB and NTT, common fruits are orange, pineapple, jack fruit and mango.

3.4.3 Paddy cultivation

Improved rice varieties have been broadly used by farmers in NTB, but traditional varieties still remain in upland paddy cultivation areas as well as a considerable part of wet paddy planting areas under rainfed conditions in NTT. Land preparation is done using draft animals in NTB and Flores. In other islands in NTT, it depends on manual work or the traditional animal trampling system. Transplanting method is common and a seedbed of 500 m^2 is required for transplanting seedlings to wet paddy fields of 1 ha. Urea of 200 to 300 kg/ha and triple super phosphate of 50 to 100 kg/ha are split three times when fertilizing. Dosages in NTB are relatively high compared with those in NTT. Due mainly to a lack of knowledge, cash and equipment, pesticide dosage is generally very low. Harvesting is done using sickle and hand threshing by beating against a frame is also common.

The total cropped area of wet paddy in 1993 was around 164,500 ha on Lombok Island and 107,400 ha on Sumbawa in NTB and 49,200 ha on Flores and Alor, 16,800 ha on Sumba and 17,700 ha on Timor in NTT. As Palawija crops are grown on wet paddy fields under irrigated or rainfed conditions during the dry season in NTB, the total planted area was 19,200 ha on Lombok and 17,000 ha on Sumbawa. On the contrary, Palawija crops on wet paddy fields are usually grown during the wet season instead of wet paddy with a total planted area of 4,100 ha on Flores and Alor, 10,100 ha on Sumba, and 4,100 ha on Timor. Further, idle paddy fields broadly prevail in NTT totaling 6,700 ha on Flores and Alor, 16,000 ha on Sumba, and 17,300 ha on Timor. The cropping intensity on wet paddy fields in 1993 was 151% on Lombok, 157% on Sumbawa, 110% on Flores and Alor, 63% on Sumba, and 56% on Timor as shown in Table 3.8.

3.4.4 Upland crop cultivation

Maize is one of the important staple food crops other than rice particularly in NTT, while it is a supplemental food crop in NTB. It is normally grown in upland crop fields

under rainfed conditions and sometimes intercropped with groundnuts, mungbean or upland rice. Cassava is planted for food security purposes in NTT. Soybean is a very popular Palawija crop in NTB and is grown reflecting food preferences in NTT. Mungbean is a single upland crop with minor importance in NTB, but it is more popular compared with soybean in NTT. Groundnut is grown as a Palawija crop in Lombok and interplanted with maize on dry upland fields in west Timor. All farming practices from land preparation to harvesting are done manually. Seeds are normally local varieties and a little fertilizer is applied. Tables 3.9 and 3.10 present planted areas of major dry upland crops and are summarized below.

Major Upland Crop Planted Areas on Major Islands as at 1993

Unit : ha

Major Island	Lombok	Sumbawa	Flores	Sumba	West Timor
Dryland paddy	5,453	13,443	38,198	9,432	10,357
Maize	13,643	12,652	69,748	25,405	111,380
Cassava	8,422	2,781	31,305	10,995	30,116
Sweet potatoes	3,128	800	5,896	1,255	4,963
Soybean	52,884	77,045	3,154	236	547
Groundnut	14,855	5,065	2,687	723	4,114

Source : Bureaus of Statistics in NTB and NTT, and Provincial Agriculture Services, NTT

3.4.5 Estate crop cultivation

Estate crops grown in NTB are represented by coconut, cashew, and tobacco, while those in NTT consist of coconut, cashew, candle nut, and coffee. Among these, coconut is the most important, especially in coastal areas producing copra. Coffee cultivation is limited to Flores and Sumba in NTT. Under the dry weather conditions in NTB and NTT, planting of cashew nut and candle nut is popular for checking erosion, though it has not functioned as a source of cash income due to low yields. Tobacco is grown in Lombok as a palawija crop on wet paddy fields sometimes receiving irrigation water. Fruit tree planting predominates in NTT represented by mango and orange. Planted areas of estate and fruit crops in 1993 are summarized below.

Major Estate Crop Planted Areas on Major Islands as at 1993

Unit : ha

Major Island	Lombok	Sumbawa	Flores	Sumba	West Timor
Coconut	48,946	13,841	29,360	19,980	23,686
Coffee	4,658	3,516	13,523	5,007	1,703
Cocoa	2,284	506	9,886	795	1,275
Cashew	15,000	9,840	42,955	9,184	8,490
Candle nut	-	-	22,740	2,013	25,199
Tobacco	9,123	226	639	625	0

Source : Bureaus of Statistics in NTB and NTT, and Provincial Agriculture Services, NTT

Shifting cultivation is practiced in NTB to a limited extent and in NTT broadly. As farmers are keen to reduce the fallow period and to make the cultivation period longer, they

pay no attention to soil conservation. Shifting cultivation is the major cause of soil degradation and deforestation in NTT.

3.4.6 Crop production

As shown in Table 3.11, paddy production in NTB for 1993 amounted to 1,218,500 tons being broken down into wetland paddy of 731,500 tons and upland paddy of 8,400 tons on Lombok Island, and wetland paddy of 415,600 tons and upland paddy of 31,500 tons on Sumbawa. In NTT, the total production of paddy for 1993 was 377,600 tons with the breakdown of wetland paddy of 160,100 tons and upland paddy of 70,700 tons on Flores and Alor, wetland paddy of 52,400 tons and upland paddy of 19,500 tons on Sumba, and wetland paddy of 53,700 tons and upland paddy of 21,200 tons on Timor.

The 1993 production records of dry upland and estate crops are summarized below.

Major Upland Crop Production on Major Islands as at 1993

Unit : ton

Major Island	Lombok	Sumbawa	Flores	Sumba	West Timor
Maize	26,958	24,692	118,890	53,840	198,220
Cassava	95,542	28,922	307,860	108,668	294,951
Sweet potatoes	37,095	8,996	45,574	11,085	46,616
Soybean	55,056	77,696	3,045	223	437
Groundnut	16,420	5,733	2,137	571	3,077

Source : Bureaus of Statistics in NTB and NTT, and Provincial Agriculture Services, NTT

3.4.7 Livestock

Sumba and Timor in NTT have traditionally played an important role in functioning as cattle feeder stock areas for other regions in Indonesia because the drier climate of the Outer Arc islands adversely affects rainfed agriculture. To meet the increasing demand of beef meat in Jakarta and Surabaya, the livestock sub-sector in these two islands is playing a new role in supplying live cattle to these domestic markets. On the contrary, cattle in NTB and Flores are mainly used as draft animals for the land preparation. As shown in Table 3.12 and below, the number of animals by kind varies according to the natural circumstances and the inhabitants' religious background particular to the respective main islands.

Livestock Population on Major Islands as at 1993

Unit : head

Major Island	Lombok	Sumbawa	Flores	Sumba	West Timor
Cow	275,827	133,124	160,713	51,311	555,680
Buffalo	50,564	161,832	68,558	88,006	30,541
Horse	22,641	55,820	70,269	55,619	44,291
Goat and sheep	193,394	94,294	285,417	33,710	330,898
Pig	21,823	602	679,914	223,939	549,705
Domestic hen	3,660,000	836,000	3,426,830	1,093,830	1,905,505
Layer	146,524	25,325	82,444	-	513,468
Duck	440,085	61,117	141,015	587	25,841

Source : Bureaus of Statistics in NTB and NTT, and Provincial Agriculture Services, NTT

A free grazing system is widely employed in NTT and the availability of foodstuffs reduces sharply in quantity and quality during the dry season. In addition, a shortage of drinking water occurring from September to November results in loss of the weight the animals gained during the preceding wet season. Overgrazing in areas near drinking water sources causes severe deterioration of the environment.

To meet increasing demand for meat in local markets, the slaughtered number of livestock has increased year by year. Table 3.13 shows the slaughtered number of livestock by Kabupaten in 1992. In NTB, chilled and frozen meats are marketed, while in NTT raw meat is sold in shops and open markets because of a lack of cold storage and transportation system.

3.4.8 Inland fisheries

The fishery sub-sector in NTB and NTT principally depends on coastal fishery which is still very primitive and traditional. As shown in Table 3.14, the sea fish catch in 1993 was 77,800 tons or 89% of the total fish catch in NTB and 62,200 tons or 99% in NTT. In other words, the importance of inland fisheries is very low in NTB and Sumba, while it is negligible in other islands of NTT. In Lombok, fresh water fish cultivation is done in open water, fresh water ponds, and wetlands. Brackish water fish cultivation predominates in Sumbawa. Fresh water fishes are fed in open water in Sumba.

3.4.9 Land tenure and farm size

The 1983 Agricultural Census indicates that 40% of the total farm households owns 42% of the whole farm land in NTB, while 44% of the total farm households shares 29% of the farm land in NTT. In terms of the size of farm land operated by one farm household, 43% of the total farm households cultivate farm land of less than 0.5 ha followed by the farm size of 0.5 to 0.99 ha sharing 24%, and 1.0 to 1.99 ha accounting for 18% in NTB. On the contrary, the majority is of farm households operating farm land of 0.5 to 0.99 ha and 1.0 to 1.99 ha each sharing 31% followed by farm households with farm size of less than 0.5 ha.

3.4.10 Agricultural supporting services

Although agricultural extension service networks are under reorganization, extension agents at Provincial and Kabupaten levels have been fairly well staffed and equipped. The total number of extension workers as at 1992 was 1,075 in NTB and 1,240 in NTT, both including extension workers at Kecamatan and Desa levels, belonging to specialized agricultural extension agents and as middle cadres for agricultural extension. At present, field level extension agents are still insufficient to provide farmers with proper services.

Most farmers use high yielding variety seeds of fourth, fifth, or older generations because they do not want to spend money on seeds to save as much as cash possible, although they can buy new high-quality seeds at subsidized prices.

Village Unit Cooperatives (KUD) are responsible for the distribution of fertilizers and pesticides to paddy farmers. Actually, timely and efficient distribution of these farm inputs is not realized due to a lack of facilities and managerial skills in most KUDs. This situation forces farmers to buy farm inputs at higher prices from middlemen. Another function of KUD as middlemen between farmers and relevant agencies is to buy rice for the Dolog, rice buying agent, and to distribute agricultural credit for the Indonesia People's Bank (BRI). Similar to farm input distribution, KUD's performance in carrying out these services is far below the expected level. The total number of KUD is 152 in NTB and 150 in NTT. These KUDs are classified into three groups according to activities and performance of services as shown in Table 3.15.

To distribute seedlings of estate crops and fruits, five nurseries in NTB and six in NTT are currently operated by responsible agencies for estate crops, reforestation, and land rehabilitation, but these capacities are limited. The major species supplied by these nurseries include candlenut, tamarind, sugar palm, jack fruit, mango, citrus, avocado, and cashew nut.

Supporting services for the livestock sub-sector consist of extension, veterinary care, livestock markets, and slaughterhouses. In NTB, there are three Animal Health Centers in Lombok and nine in Sumbawa, while no systematic veterinary service network has been established yet in NTT. There are 13 normal weekly markets in Lombok and three in Timor, playing an important role in trading cattle. A total of 55 slaughterhouses in NTB and 14 in NTT is run by the Government and private sector.

3.4.11 Institutions and organizations

Responsible agencies for water resources and irrigation development in the project areas are the Provincial Water Resources Services (Sub Dinas Pengairan) of the Provincial Public Works Services (DPUP) in the respective Provinces of NTB and NTT. Both DPUPs

are principally controlled by the Governors of the Provincial Governments and also directed by DGWRD of the Ministry of Public Works through its Provincial Office (Kanwil) in terms of technical issues and development budgets. Under DPUPs, several project offices are established to undertake project implementation as well as operation and maintenance of project facilities. Of these, water resources development and watershed management works are the responsibility of Lombok and Sumbawa Water Resources Development and Conservation Project Offices (PPKSA) under DPUP NTB, and Timor and Flores-Sumba Water Resources Development and Conservation Project Offices (PPKSA) and Project Office for Provincial Embung Development in Kabupaten Kupang under DPUP NTT. Construction of new irrigation facilities and rehabilitation of the existing ones in NTB are the obligations of Lombok Irrigation Project Office, Sumbawa Irrigation Project Office and Provincial Project Office for Rehabilitation and Upgrading of Irrigation. These works in NTT are the responsibilities of Timor-Sumba Irrigation Project Office and Flores Irrigation Project Office. Operation and maintenance works of all the existing facilities are conducted by Provincial Project Office for Operation and Maintenance under DPUP in each Province.

Agricultural extension services are under the direct responsibility of the Ministry of Agriculture and the Provincial Agricultural Services (PRAS) of NTB and NTT and further supported by the Ministry of Home Affairs and the Governor Office.

The provincial level organization which has responsibility for all activities regarding the coordination and preparation of regional development is BAPPEDA with a direct reporting line to the Governor.

3.5 Regional and Farm Economy

3.5.1 Manufacturing industries

Apart from the primary industry sector which comprise agriculture, livestock, fisheries, forestry, and mining and the public services sector, the manufacturing sector is contributing a considerable extent to the rural economy of NTB and NTT. In 1993, 37,925 establishments were active in NTB, comprising 14 large and medium scale manufacturing enterprises, 2,921 small scale ones, and 34,925 handicraft clusters. In NTT, 26,332 active establishments were classified into large and medium scales of 26, small scales of 333, and handicraft clusters of 25,973.

More than half the large and medium scale industries in NTB consist of basic chemical industries, while in NTT the wood manufacturing industry predominates. In regard to small scale industries in NTB and NTT, outputs from food, beverages, and tobacco account for more than 60% of the gross output in terms of value.

3.5.2 Regional economy

In 1992, GRDP amounted to Rp. 1,870 billion at current market prices and increased by Rp. 298 billion from the previous year in NTB and Rp. 1,632 billion at current market prices increasing by Rp. 236 million from 1991 in NTT. These GRDP at current market prices were converted to Rp. 954 billion at 1983 constant prices in NTB and Rp. 822 billion at 1983 constant prices in NTT. The contribution of the agricultural sector to the 1992 GRDP at 1983 constant prices was 47.6% in NTB and 49.7% in NTT, more than twice of the nation's average of 18.5%. Both Provinces shared 3.70% of Indonesia's population and 3.55% of the country's land area, while the total GRDP of NTB and NTT contributed only 1.54% at 1992 current market prices and 1.64% at 1983 constant prices to the Gross Domestic Product (GDP), excluding oil and its products.

Regarding the regional economy of the five main islands in 1991, the main contributor to GRDP of all the main islands is the agricultural sector, seconded by the trade and tourism sector in Lombok and the public service sector in other islands.

- In Lombok, GRDP was Rp. 573 billion at 1983 constant prices, 46.6% originated from the agricultural sector;
- In Sumbawa, GRDP was Rp. 306 billion at 1983 constant prices, and almost 52.3% originated from the agricultural sector;
- In Flores, GRDP was Rp. 327 billion at 1983 constant prices, and the agricultural sector contributed 56.6% of the GRDP;
- In Sumba, GRDP at 1983 constant prices amounted to Rp. 105 billion, and the agricultural sector's contribution accounted for 60.6%; and,
- In west Timor, GRDP was Rp. 316 billion at 1983 constant prices, 39.2% of which was born from the agricultural sector. In contrast with lower contributions by the agricultural and industrial sectors, 19.0% of GRDP originated from the public sector.

3.5.3 Poverty level

According to the nation-wide study to identify poor villages made by the Central Bureau of Statistics in 1993, 593 Desas were categorized as "Desa Miskin (poor village)" among 2,317 Desas in NTB and NTT. A breakdown by the main islands is summarized below.

- In Lombok, 53 Desas are recognized as poor villages and account for 19.7% of 269 Desas. The estimated 1991 per capita GRDP at 1983 constant market prices is Rp. 238,000;
- In Sumbawa, poor villages amount to 72 and share 22.9% of the total Desas of 314. The estimated 1991 per capita GRDP at 1983 constant market prices is Rp. 317,000;
- In Flores, there are 234 poor villages occupying 26.8% of 873 Desas. The 1991 per capita GRDP at 1983 constant market prices was Rp. 235,000;

- In Sumba, the number of poor villages is 53, accounting for 23.6% of the whole 225 Desas. The 1991 per capita GRDP at 1983 constant market prices is Rp. 235,000; and,

- In the west Timor, there are 181 poor villages, the largest share of 28.5% of the whole Desas of 636 among the five main islands. The 1991 per capita GRDP at 1983 constant market prices is Rp. 220,000.

4. AGRICULTURAL RESOURCES DEVELOPMENT NEEDS

4.1 Present Resource Utilization

4.1.1 Domestic water use

(1) Urban water supply

According to the 1992 National Socio-economic Survey, 30.6% of the total urban households of 132,352 in NTB relied on pipe for their drinking water source, 10.4% on pump, 55.2% on protected and unprotected wells, 3.5% on protected and unprotected springs, and 0.3% on river, while 58.4% of 69,632 urban households in NTT got drinking water from pipe, 0.4% from pump, 32.6% from wells, 8.0% from springs, 0.4% from river, and 0.2% from others. Particular features of bathing and cloth washing water sources for urban households are the decline in the share of pipe to 19.4% and an increase in river to 8.5% in NTB and the same tendency but not as drastically in NTT.

In order to distribute piped water to urban customers, state-owned water supply companies, six in NTB and 12 in NTT, operate. Each company is responsible for purification and distribution of drinking water as well as collection of water charges. Its total production capacity is 717 lit/sec in potential and 500 lit/sec effective for NTB and 548 lit/sec in potential and 442 lit/sec effective for NTT. Water sources of these companies comprise four rivers, one lake, five wells, and one miscellaneous in NTB as well as four rivers, 10 wells, and one artesian well in NTT.

To purify raw water, water companies usually put chemicals in their plants. The actual consumption of input materials in 1992 was 45 tons aluminum, 14.0 tons of potash, and less than 1.0 ton of soda ash and others in NTB and 24.0 tons of aluminum, 2.0 tons of potash, 18.0 tons of lime and others in NTT. The cost of aluminum was Rp. 803/kg in NTB and Rp. 746/kg in NTT, while potash was Rp. 4,073/kg in NTB and Rp. 4,396/kg in NTT. The unit cost of clean water distributed in 1992 was Rp. 95.6/lit in NTB and Rp. 59.5/lit in NTT, while the unit net value of water distributed was Rp. 132.8/lit in NTB and Rp. 204.2/lit in NTT.

During the last five years, the total volume of water distribution has increased year by year from 1988 to 1992 with an increase in urban population and per capita water consumption as shown below.

Piped Water Consumption Volume in NTB and NTT from 1988 to 1992

Unit : '000 m^3

Province	1988	1989	1990	1991	1992	1993
NTB	5,875	5,678	6,094	7,497	12,178	9,203
NTT	6,626	7,344	7,962	8,077	8,635	9,839

Source : Bureau of Statistics, NTB and NTT

The following show numbers of urban customers, water consumption volume and value of water consumed in urban areas of major islands in 1993.

Urban Water Distribution on Major Islands in 1993

Item	Unit	Lombok	Sumbawa	Flores	Sumba	Timor
No. of customers	number	20,713	15,510	14,236	4,044	13,597
Consumption volume	'000 m^3	6,716	2,487	3,081	1,495	5,264
Value of water	million Rp.	1,609	919	1,127	309	1,565

Source : Bureau of Statistics, NTB and NTT

(2) Rural water supply

The 1992 National Socio-economic Survey reveals that 10.3% of 656,003 rural households in NTB obtained their drinking water from pipe, 12.9% from pump, 54.6% from wells, 16.9% from springs, 4.0% from river, 1.1% from rain and 0.2% from others, while 15.0% of 568,320 rural households in NTT were users of pipe, 3.6% of pump, 26.9% of wells, 37.9% of springs, 15.4% of river, 1.1% of rain and 0.1% of others. In rural areas of NTB and NTB, some households switched their bathing and cloth washing water sources to river and the proportion went up to 20.0%. In NTT, rural household people depending on springs and rivers for their water sources are usually forced to spend their productive time fetching their drinking water from distance of about 1 km or more.

Though there is no record in terms of per capita water consumption in rural areas, various studies previously made give their estimated per capita water consumption, ranging from 10 to 40 litters per day where piped water supply systems are available.

(3) Livestock water supply

Drinking water sources for livestock in NTB and NTT are mainly rivers and irrigation canals for free grazing cattle and wells and springs for tied and stall fed animals. In addition, bathing water is also required for feeding buffaloes. Specific records of actual unit water consumption for the respective kinds of livestock are also not available, but it is considered that there is not a big difference of water consumption between human being and cows and buffaloes in the water shortage areas of NTB and NTT. The annual consumption is estimated

to be around 17 MCM in NTB and 32 MCM in NTT if drinking water resources are available everyday.

4.1.2 Irrigation water use

In NTB and NTT, there is no remarkable river basin with ample surface runoff and discharge. Irrigation water sources in Lombok have been developed by constructing an inter-basin transfer canal, dam and Embung in addition to diversion weirs of surface runoff. In Sumbawa as well as other islands of NTT, irrigation water sources have been developed by applying a surface water diversion system and recently introducing a water storage system such as dams and Embungs. In NTB, as shown in Table 4.1, 80% of the total irrigation command area of 148,996 ha relies on river flow diverted through weirs, while the remaining 20% is irrigated by impounded water of Embungs and dams. In NTT, 90% of the total command area is provided with irrigation water through weirs, while the remaining 10% comes from groundwater or spring water and the impounded water of Embungs.

There are 270 irrigation projects under operation in NTB as shown in Table 4.2 and Figure 4.1 and 134 irrigation projects under operation in NTT as shown in Table 4.3 and Figure 4.2. In general, irrigation facilities are in rather well developed conditions in the south foothills of Mt. Rinjani in Lombok resulting in the significant utilization of water resources. On the other hand, the majority of irrigation projects on other islands can utilize river discharge or groundwater for only a limited period every year because most water source rivers dry up from May to October.

4.1.3 Features of existing irrigation projects

(1) Irrigation projects in Lombok

In Lombok, there are 191 irrigation projects with a total command area of 107,036 ha. The average size is 560 ha and the irrigation area of 46 projects is below 200 ha. To date, implementation of irrigation projects has been mostly concentrated into the south foothills of Mt. Rinjani, using the rather ample water and land resources. While, only several irrigation projects have been developed in the northern part of the island due to limited flat and gently sloped land and low rainfall. Apart from the new development of the irrigation system, rehabilitation of the existing projects is a main concern in Lombok. Of the total irrigation area, 80% is commanded by weirs, while the remaining 20% is served by Batujai dam, 45 Embungs managed by DPUP, and 218 small Desa Embungs rehabilitated by DPUP. As for the irrigation facility level, 29% of the total command area is technical and the rest is semi-technical. The present condition of irrigation projects by Kabupaten is summarized below.

Present Condition of Irrigation Projects in Lombok

Kabupaten	Lombok Barat	Lombok Tengah	Lombok Timur	Total
No. of Project	36	52	103	191
Total Command Area (ha)	18,875	47,377	40,784	107,036 (100%)
Command Area by Water Source Facility (ha)				
-Weir	18,875	33,691	32,540	85,106 (80%)
-Embung / Dam	0	13,686	8,244	21,930 (20%)
Irrigation Area by Facility Level				
-Technical	10,891	18,091	2,059	31,041 (29%)
-Semi-Technical	7,984	29,286	38,725	75,995 (71%)
-Non Technical	0	0	0	0

Source : DPUP in NTB

(2) Irrigation projects in Sumbawa

In Sumbawa, 79 irrigation projects are under operation commanding 41,960 ha. The average size is 531 ha and the irrigation area of 16 projects is below 200 ha. The existing projects are distributed mainly in the western and eastern parts of the island. As the majority of water source rivers are not perennial, irrigation is limited to the wet season only. Moreover the locations of arable land do not match the places with potential water resources. Out of the whole irrigation area, 81% takes irrigation water from rivers through weirs, while 19% is provided with impounded water from Mamak dam and 15 Embungs newly developed by DPUP. The irrigation facility level varies widely, classifying 32% as technical, 49% as semi-technical, and 19% as non-technical. The present condition of irrigation projects by Kabupaten is summarized below.

Present Condition of Irrigation Projects in Sumbawa

Kabupaten	Sumbawa	Dompu	Bima	Total
No. of Project	31	11	37	79
Total Command Area (ha)	19,823	8,845	13,292	41,960 (100%)
Command Area by Water Source Facility (ha)				
-Weir	15,025	8,445	10,345	33,815 (81%)
-Embung / Dam	4,798	400	2,947	8,145 (19%)
Irrigation Area by Facility Level (ha)				
-Technical	7,427	6,037	0	13,464 (32%)
-Semi-Technical	9.506	2,808	8,387	20,701 (49%)
-Non Technical	2,890	0	4,905	7,795 (19%)

Source : DPUP in NTB

(3) Irrigation projects in Flores and Alor

In Flores, there are 58 irrigation projects covering 44,066 ha. The average size is 760 ha and the irrigation area of 14 projects is below 200 ha. Almost half of the projects are located in the western part of the island reflecting the rainfall pattern. Since the majority of water source rivers dry up during the dry season, irrigation water supply is limited to the wet season only. Of the whole irrigation command area, 94% diverts irrigation water from rivers through weirs, while 5% uses spring water and 1% gets impounded water from three

Embungs newly developed by DPUP. The irrigation facility level varies widely, classifying 43% as technical, 5% as semi-technical and 52% as non-technical. The present condition of irrigation projects by Kabupaten is summarized below.

Present Condition of Projects in Flores

Kabupaten	Flores Timur	Sikka	Ende	Ngada	Manggarai	Alor	Total
No. of Project	6	8	2	12	26	4	58
Total Command Area (ha)	2,661	1,717	1,135	9,450	28,243	860	44,066 (100%)
Command Area by Water Source Facility (ha)							
-Weir	2,661	1,415	1,135	6,985	28,243	815	41,254 (94%)
-Embung	0	302	0	0	0	45	347 (1%)
-Spring	0	0	0	2,465	0	0	2,465 (5%)
Irrigation Area by Facility Level (ha)							
-Technical	1,087	1,048	1,135	7,132	8,630	45	19,077 (43%)
-Semi-Technical	1,046	669	0	0	513	0	2,228 (5%)
-Non Technical	528	0	0	2,318	19,100	815	22,761 (52%)

Source : DPUP in NTT

(4) Irrigation projects in Sumba

There are 29 irrigation projects with a total command area of 15,524 ha and an average size of 535 ha. The locations of the projects are scattered throughout the island. The majority of water source rivers dry up during the dry season and irrigation water is supplied during the wet season only. Of the whole irrigation area, 90% takes irrigation water from rivers through weirs, while 3% is provided with impounded water from two Embungs newly developed by DPUP and 7% is irrigated by groundwater. The irrigation facility level varies widely, classifying 32% as technical, 11% as semi-technical, and 57% as non-technical. The present condition of irrigation projects by Kabupaten is summarized below.

Present Condition of Irrigation Projects in Sumba

Kabupaten	Sumba Barat	Sumba Timur	Total
No. of Project	16	13	29
Total Command Area (ha)	6,326	9,198	15,524 (100%)
Command Area by Water Source Facility (ha)			
-Weir	5,268	8,701	13,969 (90%)
-Embungs	0	497	497 (3%)
-Groundwater	1,058	0	1,058 (7%)
Irrigation Area by Facility Level (ha)			
-Technical	1,910	3,123	5,033 (32%)
-Semi-Technical	1,745	0	1,745 (11%)
-Non Technical	2,671	6,075	8,746 (57%)

Source : DPUP in NTT

(5) Irrigation projects in West Timor

In the western part of Timor as well as Rote and Sabu islands, there are 46 irrigation projects of which the total command area is 14,352 ha and an average size of 312 ha. Out of 46 irrigation projects, one is in Sabu and six are in Rote, while the rest are distributed

throughout West Timor. Since the majority of water source rivers dry up in the dry season, irrigation water is supplied in the wet season paddy only. Of the whole irrigation area, 80% diverts irrigation water from rivers through weirs, while 18% is provided with impounded water from eight Embungs newly developed by DPUP in Sabu and Rote and 2% is irrigated by groundwater. The irrigation facility level is rather simple, classifying 23% as technical, 23% as semi-technical and 54% as non-technical. The present condition of irrigation projects by Kabupaten is summarized below.

Present Condition of Irrigation Projects in West Timor, Rote and Sabu

Kabupaten	Kupang	TTS	TTU	Belu	Total
Nos. of Project	15	7	14	10	46
Total Command Area (ha)	6,168	1,791	5,261	1,132	14,352 (100%)
Command Area by Water Source (ha)					
-Weir	3,613	1,791	5,111	1,042	11,557 (80%)
-Embung	2,548	0	0	0	2,548 (18%)
-Groundwater	7	0	150	90	247 (2%)
Irrigation Area by Facility Level (ha)					
-Technical	2,788	37	400	90	3,315 (23%)
-Semi-Technical	2,207	0	920	196	3,323 (23%)
-Non Technical	1,173	1,754	3,941	846	7,714 (54%)

Source : DPUP in NTT

4.2 Land Resource Potential

The land area suitable for agricultural use in each main island of NTB and NTT is estimated by referring to the Regional Physical Planning Program for Transmigration Report (RePPProt). As shown in Table 4.4, a total of 143,900 ha or 32% of the land area in Lombok is suitable to conditionally suitable for growing wet paddy. On the contrary, less than 6% of the land area is suitable to conditionally suitable for wet paddy cultivation in the other islands. The suitable land resources available are 91,300 ha in Sumbawa, 93,900 ha in Flores, 55,600 ha in Sumba, and 77,800 ha in the western part of Timor. The land suitable maps are given in Figures 4.3 to 4.7.

Coupled with better rainfall conditions in Lombok, about 85% of the suitable to conditionally suitable land is used for growing wet paddy as shown in Table 4.5. In contrast, the utilization ratio of the available land resources for wet paddy cultivation in other islands is considerably lower due mainly to a lack of stable irrigation water sources. The estimated utilization ratio is 55% for Sumbawa, 46% for Flores, 43% for Sumba, and 3% for West Timor.

The land area suitable to conditionally suitable for growing dry upland crops amounts to 325,600 ha in NTB and 557,800 ha in NTT. The actual utilization ratio of these land resources is however very low if the shifting cultivation area is excluded, which is 9% in NTB and 7% in NTT. Especially in Sumba, 27% of the land area is suitable to conditionally

suitable for dry upland crop cultivation, while less than 1% of these land resources is grown with dry upland crops. The land area suitable to conditionally suitable for pasture and livestock grazing accounts for 28% in NTB and 39% in NTT with the highest share of 68% in West Timor.

The potential land resources available for future extension of agricultural land are quite limited to 600 ha in Lombok, but the potential increase in other islands is 30,300 ha in Sumbawa, 33,600 ha in Flores, 24,100 ha in Sumba, and 61,200 ha in West Timor. This availability of land resources is closely related to climate and soil variations in the eastern part of NTB and the whole of NTT.

4.3 Water Resources Development Needs

According to "The Poor Village Identification Survey" conducted by Central Bureau of Statistics in 1993, around 60% of 1,743 villages in NTT are distributed in dry weather zones where an insufficient supply of domestic and livestock water is common due to chronic water shortages. Targeting these villages, DPUP of NTT has a long-term plan to construct a small scale Embung every 100 households as a domestic and livestock water supply source with the final goal of developing Embungs at 2,700 sites throughout the Province.

In NTB and NTT, there are not many possibilities of generating jobs in economic sectors other than agriculture so that farmers intend to use their farm land more intensively to raise their incomes. To do so, they are eager for all year-round irrigation water source facilities and also anxious to change their common time-consuming patterns carrying drinking water and removing cattle in order to gain more farm income.

To meet basic human needs (BHN) and increase agricultural production aiming to correct gaps in regional development, it is indispensable to solve the water shortage problems caused by the fact that available surface runoff of the respective river basins has not been fully utilized.

4.4 Water Demand

4.4.1 Domestic water demand

The future population for 2000 projected by NTB and NTT Provincial Governments is shown in Table 4.6. According to this projection, the total population will be 1.79 million in 1995 and 1.92 million in 2000 in NTB, and 3.52 million in 1995 and 3.86 million in 2000 in NTT.

The new target set up under Pelita VI is to increase the supply of raw water for drinking purposes in the urban areas and fast growing areas by 150 liters per day per person

from the present target of 60 liters per day per person. Taking into account this new target, the minimum water supply amount to rural inhabitants is anticipated to increase to 60 liters per day per person by 1995 in NTB and by 2000 in NTT. The future domestic water consumption level in rural areas of NTB after 2000 is assumed to be 80 lit/day/capita with an additional public water demand of 30 lit/day for 10% of the projected population and unaccounted-for demand at equivalent to 20% of the total water demand. That for rural areas in NTT is assumed to be set 70 lit/day/capita including public water demand and unaccounted-for demand.

The annual raw water demand for domestic use is estimated to be at least 80.2 MCM for 1995 and 85.8 MCM for 2000 in NTB, and 58.8 MCM for 1995 and 84.6 MCM for 2000 in NTT. In the long run, the annual raw water demand for domestic, municipal, and industrial use will increase to 138.6 MCM in NTB and 121.1 MCM in NTT by 2020 citing "The Study for Formulation of Irrigation Development Program in the Republic of Indonesia".

4.4.2 Livestock water demand

The annual increasing rate of livestock is anticipated to follow the actual rates of NTB and NTT for the period of Pelita V. Livestock water demand is 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 the buffalo's bathing is considered to be 20 lit/day/head in NTB. The future livestock water demand for 2000 is estimated to be 20.6 MCM in NTB and 38.7 MCM in NTT at the maximum supply level. In the long term period, the livestock water demand will go up to 21.6 MCM in NTB and 33.6 MCM in NTT by 2020 citing "The Study for Formulation of Irrigation Development Program in the Republic of Indonesia".

4.4.3 Irrigation water demand

Aiming to estimate the future irrigation water demand in each main island of NTB and NTT, the typical cropping patterns are made as shown in Table 4.7 in due consideration of the existing cropping patterns representing the agricultural background in the main islands and the patterns planned and formulated in various study reports previously prepared. Under the Study, the future irrigation water demand is calculated for a unit irrigation area of 100 ha based on the above cropping patterns and meteorological conditions of each island. In estimating irrigation water demand, special attention is paid to such factors as crop consumptive use, evapotranspiration, crop coefficient, land preparation water, layer replacement water, percolation loss, effective rainfall, irrigation efficiency, and the irrigation area.

The monthly irrigation water diversion requirements for a unit area of 100 ha are calculated for each main island on the basis of a typical cropping pattern and summarized below.

Diversion Requirement for Each Island

Unit : mm/month per 100 ha

Island	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Lombok	142	127	141	134	127	116	124	136	149	166	151	142	1,655
Sumbawa	133	124	128	133	135	127	139	154	163	176	160	147	1,719
Timor	146	122	139	145	147	140	149	162	171	181	167	150	1,819
Flores	143	128	144	148	136	129	143	160	177	187	184	157	1,836
Sumba	152	132	136	138	138	121	135	150	162	186	170	147	1,767

Citing "The Study for Formulation of Irrigation Development Program in the Republic of Indonesia", the projected irrigation area will be 97,600 ha in NTB by 2005 and 66,700 ha in NTT by 2020. The future irrigation water demand in 2020 is estimated to be 3,179 MCM in NTB and 2,018 MCM in NTT.

4.5 Overview of Previous water Resources Development

4.5.1 Existing dams

In NTB, there are four dams; Batujai and Pengga in Lombok and Mamak and Tiu Kulit in Sumbawa all of which were constructed for the purpose of creating new irrigation water sources. The salient features of these dams are summarized below.

Salient Features of Existing Dams in NTB

Item	Unit	Batujai	Pengga	Mamak	Tiu Kulit
Catchment area	km^2	169	310	101	54
Dam type		Earthfill	Earthfill	Rockfill	Rockfill
Dam height	m	16.0	33.5	41.0	31.7
Crest length	m	1,300	1,235	550	419
Dam volume	m^3	130,000	550,000	712,000	562,000
Effective storage capacity	MCM	25.0	27.0	30.0	10.0
Irrigation command area	ha	3,350	3,585	5,173	1,800

Source ; DPUP, NTB

4.5.2 Existing Embungs in NTB

Embung is a local term that originated in Lombok island, meaning an artificial small scale impounding pond used for irrigation purpose. Rainfall pattern in this area is featured by uneven distribution of annual rainfall and unpredictable interruptions of rainfall sometimes for several weeks during the wet season. This rainfall pattern which is peculiar to Lombok causes a lack of irrigation water sources not only for the dry season but also the wet season and makes crop harvests unstable and poor. To overcome this problem, the villagers in South Lombok constructed many small scale Embungs and have used them as reservoirs to collect rain water during the wet season and to save the surplus water for the following dry

season. There are two types of Embungs constructed formerly by the villagers themselves as below:

- Embung Rakyat (Individual Embung) was constructed by an individual villager with a height of 2.0 to 3.0 m and a reservoir area of 0.2 to 0.5 ha. This type of Embung profits only the owner himself; and,
- Embung Desa (Village Embung) was constructed by one group of people coordinated by the village. Many Embungs have been rehabilitated and managed by DPUP since 1980, because this type has profited many farmers as a public facility of the village.

In addition, DPUP of NTB has made an effort to develop Embungs since 1980 in line with GOI's policy for optimizing the limited water resources and for increasing agricultural and livestock production as well as public prosperity. Based on this concept, the following two patterns of Embung development have been executed in NTB aiming to increase the cropping intensity and to guarantee the success of the harvest of the wet season paddy;

- Rehabilitation works of the old Embung to increase function; and,
- Development of the new Embungs to be constructed for both places where an irrigation system is already available and not yet available.

In NTB, there are 296 Embungs constructed or rehabilitated by PRIS as shown in Tables 4.8 to 4.10 and summarized below. Among the 296 Embungs, the entire rehabilitated and village Embungs are concentrated in Lombok. A total of 15 newly constructed Embungs are located in Sumbawa and the rest are in Lombok.

Numbers of Existing Embung in NTB

	Lombok	Sumbawa	Total
Newly constructed Embung	18	15	33
Rehabilitated Embung	45	-	45
Desa Embung	218	-	218

Source : Pembangunan Irigasi Embung NTB

4.5.3 Existing Embungs in NTT

In NTT, most inhabitants living in rural areas and even some urbanized zones always suffer from chronic and serious water shortage problems due to similar rainfall patterns as NTB. The majority of rivers have small catchment areas with a limited forest coverage caused by prevailing shifting cultivation The river flows commonly fluctuate to a considerable extent and sometimes occur only in flood time. In Sumba and Timor, the geological condition featured by uplifted coral limestone also limits developing a large size water source facility.

Under these conditions, an Embung development program has been implemented in NTT since 1981 placing top priority on upgrading the living standard of rural people. The following two types of Embungs have been executed by DPUP of NTT:

Irrigation Embungs mainly for supporting irrigated agriculture with a rather large storage capacity of around 250,000 to 1,000,000 m^3; and,

Small Embungs with a storage capacity of 10,000 to 30,000 m^3 mainly for supplying domestic water to villagers, their livestock and crops grown in home-yards.

The development of small Embungs was executed under a five-year cooperation plan from the Government of Australia an the Integrated Area Development Project/NTT-IADP (1983/84-1988/89). The Government of Australia supported this development through the provision of technology, construction equipment, and office and workshop facilities. While all activities for construction of irrigation Embungs have been done by DPUP of NTT with overall support of GOI.

In NTT, there are 105 Embungs of which eight are located in West Timor, Rote, and Sabu for irrigation use and 92 are distributed throughout the western part of Timor for domestic use. In Flores and Sumba, five Embungs have been constructed for the purpose of supplying irrigation water as shown in Tables 4.8, 4.11 and 4.12 and summarized below.

Numbers of Existing Embungs in NTT

	Timor	Flores	Sumba	Total
Irrigation Embung	8	3	2	13
Small Embung	92	-	-	92

Source : Pembangunan Irigasi Embung NTT

4.6 Water Resources Development Constraints and Concepts

4.6.1 Development constraints

The present constraints against social upgrading and economic development in rural areas of NTB and NTT are featured by the condition that available surface runoff of rivers have not been fully utilized. The reason is that all the intake weirs available on the source river can divert only the wet season discharge, because either the water levels at the weir sites fall below the designed intake levels or the available discharge is very limited during the dry season. Due to this, utilization of all the source rivers can not be expected unless countermeasures to regulate the wet season runoff are practiced.

4.6.2 Development concepts

The current economic status of NTB and NTT are still lower than other provinces due to insufficient fulfillment of BHN, slow pace of poverty alleviation, and less concerns about a balanced investment for regional development. In harmony with the national policy to

correct this economic imbalance, the development concept aims to improve the present condition of the social and economic infrastructures with the highest priority so as to meet BHN and to increase agricultural outputs. Among others, it is very important to pay special attention solving irrigation, domestic, and livestock water shortage problems which have originated from the insufficient use of potential water resources in the respective river basins.

4.6.3 Development targets

The main targets of water resource development under Pelita VI are; (1) to support fulfillment of the national food demand, (2) to support an increase in agricultural products, (3) to support improvement of energy product diversification, (4) to support creation of a feasible environment condition, (5) to support development equity, and (6) to grade up human resources in the water resource development.

The objectives for agricultural development under Repelita VI are:

- To improve the quality of agricultural human resources and the income of farmers and fishermen through agricultural diversification, optimization of resources, application of sustainable agriculture technology, and promotion to add value to agricultural production;
- To improve nutrition quality through diversification of food production and consumption;
- To encourage the provision of employment opportunities in rural areas through generation of interrelated economic activities among the sub-system of agribusiness; and,
- To promote the growth of export earnings through production of industrial crops and increase the value of export commodities.

4.6.4 Development strategies

To attain the targets of water resource development, the major strategies of Pelita VI are:

- Continuous development and management of water resources to fulfill the equal, fair and efficient water resource allocation target;
- Improvement of quality, extension of scope, and increase in service reliability of water resource infrastructures in the development of water resources;
- Increase in opportunity for water users to participate in the development and management of water resource infrastructures related to such sectors as raw water supply, human settlement, hydroelectric generation, fishery, recreation, and so on; and,
- Application of proper technology in the development of water resources.

To achieve the objectives of agricultural development, the basic strategy under Pelita VI is directed toward sustainable and efficient agriculture by means of (1) development of agricultural diversification and intensification, (2) improvement of agricultural resources rehabilitation and (3) development of economic democracy in the agricultural sector.

4.7 Potential Embungs

Aiming to fulfill irrigation water demand and to supply raw water for domestic use to rural areas, it can be considered a very useful countermeasure to develop the limited water resources by constructing Embung in NTB and NTT where water shortages are common and adversely affect the living circumstance of inhabitants in rural areas.

The DPUPs of NTB and NTT have carried out their own investigations to identify potential sites suitable for construction Embungs. In addition, the DPUPs requested village chiefs to signify their intention of mitigating water shortage problems and to find possible sites for the development of Embungs. Available information on around 3,000 potential Embungs, however, vary widely in terms of quantity and quality because the respective Embungs are in different stages of development in NTB and NTT.

4.8 Investment in Embung Development under Pelita VI

During the period of Pelita VI, DPUP of NTB is planning to invest Rp. 52.6 billion in the development of 17 Embung schemes for irrigation water supply and another 17 for irrigation, domestic, and livestock water supply on Lombok Island as well as 31 for irrigation water supply and seven for multiple water supply on Sumbawa Island.

For the period of Pelita VI, DPUP of NTT is considering to invest Rp. 119.5 billion in the development of 200 Embung schemes in total, comprising eight for irrigation water supply and 84 small scale Embung schemes for domestic and livestock water supply on Timor and Rote Islands as well as 20 for irrigation water supply and 88 for domestic and livestock water supply on Flores, Alor, and Sumba Islands.

5. ASSESSMENT OF EMBUNG DEVELOPMENT POTENTIAL

5.1 Inventory Survey

5.1.1 Candidate schemes for the Study

The DPUPs of NTB and NTT selected 157 candidate Embung development schemes in total for the Study based on their previous identification studies of Embungs and taking into account the maturity of Embung development plans and the urgency of implementing Embung development. As the 157 candidate Embung schemes include 27 existing Embung schemes which need to be rehabilitated, the objective schemes of the Study are limited to 130 potential Embung development schemes. The following shows the distribution of 157 candidate schemes by island.

Distribution of Selected and Candidate Schemes by Island

Island	No. of Schemes Selected by DPUP	No. of Existing Schemes	No. of Candidates for the Study
Lombok	64	14	50
Sumbawa	41	0	41
NTB	105	14	91
Flores	9	2	7
Pantar & Alor	8	0	8
Sumba	5	2	3
Sabu & Rote	15	9	6
Timor	15	0	15
NTT	52	13	39
Total	157	27	130

5.1.2 Inventory survey on candidate schemes

All the available information given by the DPUPs of NTB and NTT are extracted from their previous identification, investigation, and study works. Taking into account the wide variation in quantity and quality of this information, however, the inventory survey was conducted two times under the Study for the purpose of reconfirming the reliability of basic planning materials of the 130 candidate schemes in collaboration with the DPUPs and the Indonesian consulting firm. In performing the inventory survey, special attention was paid to: the number of beneficiary inhabitants and livestock; prevailing crops, cropping patterns, farming practices, and crop production; future farming plans in the beneficiary irrigation areas; catchment areas and the designed storage capacity of Embungs; and so on.

5.1.3 Information obtained from inventory survey

The major items of information for basic planning materials are: maturity of Embung development plans; catchment areas at potential Embung sites; embankment type, dam

height, embankment volume, and total storage capacity of Embungs; and irrigation command areas. Table 5.1 shows the maturity of development plans for each candidate Embung with additional information on its location; the summary is given below.

Classification of Candidate Embung by Maturity of Plan

Major Island	Planning and Design Completed	Survey and Planning Completed	Survey and Planning Incompleted	Total
Lombok	2*	3	45	50
Sumbawa	3	6	31	40
NTB	5	9	76	90
Flores & Sumba	3	16	0	19
Timor	1	17	3	21
NTT	4	33	3	40
Total	9	42	79	130

Remarks : * ; Design work only

The candidate schemes are classified into three embankment types, homogeneous embankment dam, zoned embankment dam, and masonry gravity dam, as shown below.

Classification of Candidate Embung by Embankment Type

Major Island	Homogeneous Embankment Dam	Zoned Embankment Dam	Masonry Gravity Dam	Total
Lombok	18	10	22	50
Sumbawa	36	3	1	40
NTB	54	13	23	90
Flores & Sumba	16	1	2	19
Timor	21	0	0	21
NTT	37	1	2	40
Total	91	14	25	130

The candidate schemes are classified into four groups by dam height, lower than 5.0 m, 5.1 to 10.0 m, 10.1 to 15.0 m, and higher than 15.1 m, as given below.

Classification of Candidate Embung by Dam Height

Major Island	Up to 5.0 m	5.1 to 10.0 m	10.1 to 15.0 m	Above 15.1 m	Total
Lombok	8	23	16	3	50
Sumbawa	0	10	23	7	40
NTB	8	33	39	10	90
Flores & Sumba	4	12	2	1	19
Timor	2	7	9	3	21
NTT	6	19	11	4	40
Total	14	52	50	14	130

The candidate schemes are classified into six groups on the basis of embankment volume, 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, for earthfill type Embungs, and less than 2,000 m^3, 2,000 to 4,000 m^3, 4,000 to 6,000 m^3, 6,000 to 8,000 m^3, 8,000 to 10,000 m^3,

and more than 10,000 m^3, for masonry type Embungs, respectively, as presented below. These three summaries for the respective candidate schemes are presented in Table 5.2.

Classification of Candidate Embung by Embankment Volume (Earthfill Type Embung)

Major Island	Up to 10,000 m3	20,000 to 40,000 m3	40,000 to 60,000 m3	60,000 to 80,000 m3	80,000 to 100,000 m3	Above 100,000 m3	Total
Lombok	21	2	2	2	0	1	28
Sumbawa	2	9	11	5	3	9	39
NTB	23	11	13	7	3	10	67
Flores & Sumba	10	2	2	2	0	1	17
Timor	8	5	0	1	0	7	21
NTT	8	5	0	1	0	7	21
Total	41	18	15	10	3	18	105

Classification of Candidate Embung by Embankment Volume (Masonry Type Embung)

Major Island	Up to 1,000 m3	2,000 to 4,000 m3	4,000 to 6,000 m3	6,000 to 8,000 m3	8,000 to 10,000 m3	Above 10,000 m3	Total
Lombok	5	8	4	4	0	1	22
Sumbawa	0	0	0	1	0	0	1
NTB	5	8	4	5	0	1	23
Flores & Sumba	0	2	0	0	0	0	2
Timor	0	0	0	0	0	0	0
NTT	0	2	0	0	0	0	2
Total	5	10	4	5	0	1	25

The candidate schemes are classified into five groups taking into account the catchment area at the potential site, 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, as shown below.

Classification of Candidate Embung by Catchment Area

Major Island	Up to 5.0 km^2	5.1 to 10.0 km^2	10.1 to 15.0 km^2	15.1 to 20.0 km^2	Above 20.1 km^2	Total
Lombok	36	8	3	0	3	50
Sumbawa	16	14	4	1	5	40
NTB	52	22	7	1	8	90
Flores & Sumba	15	1	0	3	0	19
Timor	15	1	1	1	3	21
NTT	30	2	1	4	3	40
Total	82	24	8	5	11	130

The candidate schemes are classified into six groups based on the total storage capacity of the reservoir; 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, as shown below.

Classification of Candidate Embung by Total Storage Capacity

Major Island	Up to 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	Above 1.0 MCM	Total
Lombok	16	18	8	3	0	5	50
Sumbawa	2	13	10	2	2	11	40
NTB	18	31	18	5	2	16	90
Flores & Sumba	10	4	2	2	0	1	19
Timor	11	4	2	1	1	2	21
NTT	21	8	4	3	1	3	40
Total	39	39	22	8	3	19	130

The candidate schemes are classified into five groups on the basis of their irrigation command area; less than 50 ha, 51 to 100 ha, 101 to 200 ha, 201 to 500 ha and more than 501 ha, as presented below. These three summaries for the respective candidate schemes are presented in Table 5.3.

Classification of Candidate Embung by Irrigation Command Area

Major Island	Up to 50 ha	51 to 100 ha	101 to 200 ha	201 to 500 ha	Above 501 ha	Total
Lombok	21	11	8	9	1	50
Sumbawa	3	6	15	11	5	40
NTB	24	17	23	20	6	90
Flores & Sumba	8	10	0	1	0	19
Timor	11	3	5	2	0	21
NTT	19	13	5	3	0	40
Total	43	30	28	23	6	130

5.2 Categorization of Candidate Embung Schemes

5.2.1 Purpose of and criteria for categorization

The results of the inventory survey reveal that the salient features of the 130 candidate schemes vary widely in the development scale and storage water use plan. It is therefore indispensable to discover common key factors closely related to the assessment of development potential and formulation of a development plan for each candidate Embung in a systematic and well-organized manner. In line with this point, three kinds of information were taken up as the said key factors through a review of the inventory survey results. These are the present condition of the farming system, the existing irrigation water source facilities, and the inhabitants' needs for future water use in each candidate scheme area. For the respective factors, several categories are established and employed in grouping the 130 candidate schemes. The purpose of categorization is to select typical samples among the candidates aiming at an assessment of water resources development potential through undertaking a feasibility study from technical, economical, and social viewpoints.

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 intensity of more than 100%; and,

- Type c : two croppings of wet season paddy and the dry season Palawija crops partly to fully under irrigated conditions, double cropping of irrigated paddy, single cropping of wet season paddy, and double cropping of dry season Palawija crops under irrigated conditions, or double cropping of irrigated paddy coupled with dry season Palawija crops under either irrigated or rainfed conditions, 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 the 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 a 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 for the future use of the 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.

5.2.2 Result of categorization

The 130 candidate schemes are categorized on the basis of the present farming system and the result is summarized below.

Categorization of Candidate Embung by Present Farming System

Major Island	a	b	c	Total
Lombok	20	5	25	50
Sumbawa	14	3	23	40
NTB	34	8	48	90
Flores & Sumba	18	0	1	19
Timor	17	3	1	21
NTT	35	3	2	40
Total	69	11	50	130

The candidate schemes are categorized on the basis of the present status of irrigation water source facilities and the result is summarized below.

Categorization of Candidate Embung by Existing Irrigation Water Source Facilities

Major Island	A	B	C	Total
Lombok	19	9	22	50
Sumbawa	14	19	7	40
NTB	33	28	29	90
Flores & Sumba	17	2	0	19
Timor	15	6	0	21
NTT	32	8	0	40
Total	65	36	29	130

The candidate schemes are categorized on the basis of the inhabitants' intention for the future use of new water source facilities and the result is summarized below.

Classification of Candidate Embung by Dam Height

Major Island	1	2	3	4	5	Total
Lombok	2	4	25	19	0	50
Sumbawa	0	6	0	34	0	40
NTB	2	10	25	53	0	90
Flores & Sumba	9	0	9	1	0	19
Timor	16	0	2	0	3	21
NTT	25	0	11	1	3	40
Total	27	10	36	54	3	130

Table 5.4 indicates the categorization result based on the combination of three key factors. In NTB, a total of 90 candidate Embung schemes are categorized into 16 combinations, while in NTT 40 candidates are categorized into 10 combinations.

5.3 Feedback of Feasibility Study Results

5.3.1 Selection of representative schemes

Aiming to establish a new standard for assessment of Embung development potential, a feasibility study is conducted for sample cases representing the respective combinations of 11 categories of three factors. From the 130 candidate Embung schemes, a total of 16 sample schemes are selected for the feasibility study including six schemes taken up for urgent

project implementation. The list of 16 sample schemes with representing categories and locations is shown below.

List of Representative Schemes Selected for the Feasibility Study

Category	Project	Province	Regency (Kabupaten)
10 Representative Schemes			
a-A-1	Fatukmetang	NTT	Belu
a-A-4	Aik Beta	NTB	Lombok Timur
a-B-3	Mataiyang	NTT	Sumba Timur
b-B-2	Tiu Tui	NTB	Sumbawa
b-B-3	Montong Krarak	NTB	Lombok Timur
b-B-4	Ncoha II	NTB	Bima
c-B-2	Ntonggu II	NTB	Bima
c-B-3	Pelangan	NTB	Lombok Barat
c-B-4	Penyempeng	NTB	Sumbawa
c-C-3	Lokok Meniris	NTB	Lombok Barat
6 Urgent Development Schemes			
5	Bimoku	NTT	Kupang
	Oeltua	NTT	Kupang
	Oebuain	NTT	Timor Tengah Utara
a-A-3	Matasio	NTT	Kupang
b-B-1	Tasiepah	NTT	Kupang
b-C-1	Benkoko	NTT	Timor Tengah Utara

5.3.2 Feedback of feasibility study results

The results of the feasibility study on the six urgent development schemes are described in Volume 3 of this Final Report and those on the 10 representative schemes in Volume 4. Among the various outputs obtained though the feasibility studies, some are to be fed back to be employed as decision-making tools in the preliminary assessment of the development potential of the remaining 114 candidate Embung schemes. The outputs to be fed back are: (1) the relationship between catchment area and runoff; (2) the relationship between runoff and total storage capacity of the Embung; (3) the relationship between total storage capacity and irrigable area; (4) the selection of embankment type in relation to topographic and geological conditions; (5) the unit construction cost on the basis of embankment type and volume; and (6) the economic crop budget . The unit construction cost and economic crop budget are presented in Tables 5.5 and 5.6, respectively.

5.4 Assessment of Embung Development Potential

5.4.1 Procedure of development potential assessment

To assess the development potential of each candidate Embung from technical, economical and social viewpoints, the following procedure is applied.

- To decide the factor that determines the development scale of the Embung attention must be paid to the following two types:

  Supply-oriented type : The Embung development scale is principally decided by topographic or hydrological limitations; and,

  Demand-oriented type: The development scale is principally decided by water demand in the beneficiary area of the Embung.

- To scale down the irrigation area of the supply-oriented Embung according to the estimated runoff at the proposed Embung site.

- To estimate the benefit-cost ratio (B/C) at the discount rate of 8% and then examine the possibility of project implementation based on the following steps:

  An Embung with B/C ratio of more than 1.0 can be implemented without any revision of the original development plan;

  An demand-oriented Embung with B/C ratio of less than 1.0 needs to be reassessed on the basis of the beneficiary inhabitants' intention for the future water use in the following manner;

  To revise the dry season cropping pattern for increasing the irrigation benefit if the irrigation water is secured for the dry season, and then re-estimate B/C ratio,

  In case the re-estimated B/C ratio is more than 1.0, project implementation is recommendable with revision of the original cropping pattern for the dry season,

  In the case of an Embung supplying irrigation water only if the re-estimated B/C ratio is less than 1.0 or there is no possibility of revising the original cropping pattern for the dry season, Embung development for irrigation purposes is not recommendable, and,

  In the case of an Embung supplying both irrigation and domestic and/or livestock water if the re-estimated B/C ratio is less than 1.0, project implementation is recommendable for meeting basic human needs (BHN) primarily and irrigation water demand secondly by utilizing surplus storage water.

  Supply-oriented Embungs with domestic and/or livestock water demand in the beneficiary area need to be implemented meet BHN; and

  Supply-oriented Embungs with only irrigation water demand in the beneficiary area and in case the B/C ratio is less than 1.0, are not necessary for Embung development.

5.4.2 Assessment of development scale

Focal points needed to assess the development scale of candidate schemes on the pre-feasibility level are the three relationships between (1) catchment area and runoff, (2) runoff and total storage capacity of the Embung, and (3) total storage capacity and irrigable area.

The first relationship needs to compare the estimated runoff on the basis of the catchment area. If the estimated runoff is considered to be too high compared with the catchment area, it has to be reduced to an appropriate level which is estimated taking into account the basin rainfall information. In case the estimated runoff is too low, it is considered the candidate has a limited availability of water resources. Accordingly, candidate schemes of these both cases are defined as "supply-oriented" type. The development scale should be in line with the revised runoff for candidates of the former case and the original runoff for candidates of the latter case.

After fixing the runoff of each candidate scheme, the second relationship is to be checked to establish if the total storage capacity planned is too large or small. If it is too large, the original plan of the total storage capacity should be matched with the runoff. On the other hand, if it is smaller, the topographic limitations have to be considered when constructing a higher Embung than the original plan. This case is also defined as "supply-oriented". The development scale should be in line with the original plan of the total storage capacity.

The third relationship is confirmed in terms of the irrigable area from the viewpoint of the irrigation water supply capacity expected according to the total storage capacity of the Embung. If the development scale is revised in the above examination, the beneficiary irrigation command area is rearranged in harmony with the storage capacity of the candidate scheme. In case the original irrigable area is too small in comparison with the expected water supply capacity of the candidate Embung it is defined as "demand-oriented type" and its development scale is adjusted to the maximum limitation of available farmland resources. Table 5.7 shows the revised irrigation command area and cropped area of the respective candidates.

5.4.3 Assessment of embankment type and construction cost

By referring to the general information on topographic and geological conditions at the candidate Embung site, the original embankment type is reconfirmed. The investment requirement is estimated on the basis of the examined development scale with a preliminarily estimated quantity of the construction works and a unit construction cost derived from the feasibility study.

The preliminarily estimated construction cost of 114 candidate schemes is shown in Table 5.8.

5.4.4 Assessment of development benefit

The irrigation benefit is defined as the increment net production value by deducting the gross production value under the "Without Project" condition from that under the "With Project" condition. Taking into account the examination result of the development scale and based on the economic crop budget derived from the feasibility study, the gross production values of both cases are estimated as shown in Table 5.9.

5.4.5 Preliminary feasibility assessment for candidate schemes

The economic evaluation of 114 candidate schemes is made by estimating the benefit-cost ratio (B/C) at the discount rate of 8% to assess the possibility of Embung development based on the procedure described in Sub-section 5.4.1. The evaluation result is given in Table 5.10. Figures 5.1 to 5.5 depict the assessment results of Embung development potential on 114 candidate schemes. The summary of assessment is presented below.

Result of Development Potential Assessment from Economic Viewpoints

Type	B/C Ratio	Water Use	No. of Scheme	Re-estimated B/C > 1.0
Supply-oriented			22	
	> 1.0		6	
	< 1.0		16	
		Irrigation, livestock and domestic	8	
		Irrigation and domestic	6	
		Irrigation	2	
Demand-oriented			92	
	> 1.0		60	
	< 1.0		32	
		Irrigation, livestock and domestic	10	0
		Irrigation and livestock	2	1
		Irrigation and domestic	6	2
		Irrigation	14	11

5.5 Selection of High Development Potential Embungs

From the results of the Embung development potential assessment on 114 candidate schemes, it can be judged that the project implementation is recommendable for 80 schemes comprising six supply-oriented schemes and 74 demand-oriented schemes including 14 schemes with a re-estimated B/C ratio of more than 1.0. Out of the remaining 34 candidate schemes, it is necessary to implement 29 schemes to primarily meet BHN in each beneficiary area, while the other five schemes for the exclusive use of irrigation water need to be developed by constructing or rehabilitating intake weirs instead of Embung on the water source river. Adding the results of the feasibility study on the 16 schemes, implementation of Embung development is recommendable for 82 schemes to supply irrigation water exclusively and prior to BHN, and 39 schemes to supply domestic and/or livestock water prior to irrigation water, while Embung development is not recommendable for the

remaining nine schemes because of beneficiary inhabitants' water use pattern limited to irrigation, a small irrigation area, and a very low investment efficiency. For these cases, it is recommended to secure irrigation water using a smaller amount of investment by the rehabilitation, improvement, and construction of intake weirs.

6. FORMULATION OF EMBUNG DEVELOPMENT PLAN

6.1 Provisional Definition of Embung

In NTB and NTT, it is indispensable to practice foundation treatment works at the same standard of a large dam if the Embung exceeds 15 m in dam height due to particular conditions of the geology. On the other hand, it is desirable to raise the upper limit of total storage capacity of the Embung to the maximum extent in regard to investment efficiency considering the availability of potential Embung sites with large pockets at even if the dam height is low. Taking into account these two factors, Embungs are provisionally defined as dams with a maximum height of 15 m and a maximum total storage capacity of 1.0 million m^3. These Embungs are therefore upgraded to dams.

Among the 130 candidate schemes, there are 14 schemes with dams over 15 m and 19 schemes with a total storage capacity beyond 1.0 million m^3. A total of nine schemes exceed these two upper limitations. Of these, the following eight schemes are recommendable for implementation as dams. The remaining Ncoha II scheme, 25.0 m in dam height and 1.22 MCM in the total storage capacity, needs to change its development approach to the rehabilitation and upgrade of the existing intake weir and canal network instead of constructing storage facility in due consideration of its investment efficiency.

List of Candidate Schemes Upgraded to Dams

Water Supply Purpose	Project	Island	Dam Height (m)	Total Storage Capacity (MCM)
Irrigation water only	Gapit	Sumbawa	18.0	10.35
	Terusa	Sumbawa	18.0	2.40
	Penyempeng	Sumbawa	39.0	1.22
Irrigation water prior	Tiu Tui	Sumbawa	19.5	4.30
Irrigation water sub	Pelangan	Lombok	29.5	5.70
	Ntonggu II	Sumbawa	17.0	1.27
	Mataiyang	Sumba	20.0	2.16
	Tasiepah	Timor	26.0	2.50

Note : The maximum development potential of Tasiepah dam is 36.0 m in dam height and 7.60 MCM in the total storage capacity.

6.2 Investment Requirement

Excluding the five candidate schemes for urgent implementation, eight candidate schemes have been upgraded to dam development, nine candidate schemes have been changed to alternative water source facilities, and the investment in implementing 108 Embungs amounts to Rp. 274.6 billion of which the breakdown is Rp. 218.6 billion for NTB and 56.0 billion for NTT as shown below. Further, the annual O&M cost required of Embungs and their related facilities is Rp. 1.1 billion for NTB and 0.3 billion for NTT. In comparison with the investment in Embung development projects projected by the both NTB

and NTT DPUPs for Pelita VI (1993/1994 to 1998/1999), the required investment in the above is equivalent to an annual amount for 21 years in NTB and three years in NTT.

Required Investment in Embung Development

Type	Water Supply	NTB		NTT	
		Scheme (No.)	Amount (billion Rp.)	Scheme (No.)	Amount (billion Rp.)
Supply-oriented					
	Irrigation prior	4	10.7	2	2.8
	BHN prior	1	1.8	13	22.0
Demand-oriented					
	Irrigation prior	67	202.5	5	10.2
	BHN prior	4	3.6	12	21.0
Total		76	218.6	32	56.0

The required investment in eight dams amounts to Rp. 166.0 billion which is broken down as Rp. 124.8 billion for six dams in NTB and Rp. 41.2 billion for two dams in NTT.

6.3 Implementation Program for Embung Development

6.3.1 Short-term action program

Resulting from the feasibility study on the six candidate Embungs in NTT, urgent implementation of the Bimoku, Oeltua, Benkoko, Oebuain, and Benkoko schemes can be justified technically as well as socially and socio-economically desirable. In due consideration of the inhabitants' requirement and the necessity of practicing new Embung construction methods, therefore, a short-term action program is formed by the urgent implementation of these five schemes under the GOJ's grant aid.

6.3.2 Mid- and long-term action plan

As the NTB DPUP has lined up Embung development schemes in its program for Pelita VI, the new investment in 76 candidate schemes will have to be commenced for 20 years from Pelita VII and onward. If the whole implementation period needs to be shortened to 15 years, the annual amount of investment will have to increase by about 40%. In NTT, it is desirable to carry out detailed investigation, planning and design works of 32 candidate schemes within the Pelita VI period and then to complete construction works during the period of Pelita VII. In parallel with the development of these 32 candidate schemes, a long-term implementation program of 2,700 small scale Embung projects will have to be decided.

The investment fund for the implementation of the candidate Embung schemes purposing irrigation water supply, both exclusive and prior, and indicating a B/C ratio of more than 1.0, is expected from the national development budget and/or foreign aids. In this case, a part of the loan repayment will have to be born from the irrigation water charge from beneficiary water users. On the other hand, the whole amount of the investment in

implementing the candidate Embung schemes for supplying domestic and/or livestock water prior to irrigation water needs to be covered with a grant from the Central Government because of the low economic soundness indicated by the B/C ratio of less than 1.0. In the case of Embungs which meet only BHN and have a B/C ratio of less than 1.0, the investment is expected to be fully supported by the Provincial Government.

Apart from implementation of the candidate Embung schemes, special attention has to be paid for the early promotion of eight candidate schemes upgraded to the development scale of dams for the next steps according to the maturity of each development plan because water resources development potential using dams is very limited in NTB and NTT. In conformity with this background situation, the investment in construction of these eight dams can be considered as an important component of the mid-and long-term action program for water resources development in NTB and NTT.

6.4 Supporting Arrangements for Embung Development

In order to ensure realization of the investment target , it is a prerequisite to strengthen both DPUPs' function and capability of planning, design, implementation, and operation and maintenance of the Embung projects. Furthermore, it is indispensable to make necessary arrangements of the ordinary budget of the Departments of Agriculture and DPUPs in NTB and NTT to provide intensive extension services and on-farm water management training to beneficiary farmers when the project planning works commence. In addition, it is necessary to ensure farmers' access to cooperative and credit services to support intensive irrigation farming with the provision of farm inputs and working capital.

7. IMPACT OF EMBUNG DEVELOPMENT

7.1 BHN Satisfaction Impact

Out of the 108 candidate Embung schemes for the future implementation, a total of 30 schemes will be developed aiming to supply domestic and livestock water prior to irrigation water supply and another 31 schemes will be developed for the purpose of supplying irrigation water primarily and domestic and/or livestock water secondly. It is assumed that the effective storage capacity is equivalent to 80% of the total storage capacity on an average and each 10% of the effective storage capacity is allocated to domestic and livestock water use. From this assumption, the prospected supply capacity of domestic and livestock water can be obtained as shown below. Based on the unit domestic and livestock water requirements for 2010, the annual domestic water demand is estimated to be 36.4 m3/person for NTB and 25.6 m3/person for NTT, while the annual livestock water demand is estimated to be 14.6 m3/cow-head for Lombok, Flores-Sumba and Timor and 21.9 m3/cow-head for Sumbawa. Accordingly, the expected number of beneficiary inhabitants amounts to approximately 21,600 persons in NTB and 29,200 persons in NTT as indicated below, while the equivalent head of beneficiary cows are expected to be around 47,300 in NTB and about 42,100 in NTT if all of 61 candidate schemes are completed.

Prospected Beneficiary Inhabitants and Livestock

Item	Unit	Lombok	Sumbawa	Flores-Sumba	Timor
Water Use Type 3	No.	20	-	8	-
ESC	'000 m^3	6,903	-	1,304	-
Inhabitants	person	18,987	-	5,105	-
Water Use Type 1	No.	2	-	9	14
ESC	'000 m^3	964	-	2,162	3,987
Inhabitants	person	2,652	-	8,463	15,605
Cows	cow-head	6,603	-	14,811	27,310
Water Use Type 2	No.	4	4	-	-
ESC	'000 m^3	455	8,220	-	-
Cows	cow-head	3,116	37,534	-	-

Remarks : ESC ; Total of effective storage capacity

7.2 Economic Development Impact

Through implementation of the 108 candidate Embung schemes in the future, irrigated cropping areas will be expected to change in the following manner.

Change in Cropped Area in Beneficiary Irrigation Areas

Unit : ha

Crop	Crop Season	Watering	Lombok	Sumbawa	Flores-Sumba	Timor
Paddy	Wet	Rainfed	- 2,759	- 3,927	- 553	- 689
		Irrigated	+4,573	+6,396	+1,213	+1,361
	Dry	Irrigated	+353	+3,179	0	0
Maize	Wet	Rainfed	- 1,621	- 1,971	- 712	- 517
	Dry	Rainfed	- 57	-	-	-
		Irrigated	+50	-	+121	+200
Cassava	Wet	Rainfed	-	-	-	- 114
Soybean	Dry	Rainfed	- 1,239	+704	-	-
		Irrigated	+3,490	+1,725	-	-
Mungbean	Dry	Rainfed	-	+180	- 95	-
		Irrigated	-	+599	+376	- 18
Groundnut	Dry	Rainfed	- 30	-	-	-
		Irrigated	+391	+265	+60	+120
Onion	Dry	Irrigated	+14	+160	-	-
Garlic	Dry	Irrigated	+74	-	-	-
Tobacco	Dry	Irrigated	+97	+125	-	-

The economic impact of the implementation of Embung development can be indicated by the increase in crop production. The anticipated production increase in major crops are summarized as follows:

- In Lombok, the expected production increase is mainly paddy by around 16,700 tons followed by soybean by about 2,700 tons;
- In Sumbawa, the increase in paddy production is expected to be a remarkable 43,100 tons and an additional production increase of soybean of around 2,500 tons;
- In Flores-Sumba, the future production outputs can be expected to increase by around 4,000 tons of paddy; and,
- In Timor, the main food crop output will change from maize to paddy. The prospected increase in paddy production is estimated to be about 4,400 tons.

7.3 Woman in Development

With the provision of permanent water source facilities after construction of Embungs in NTB and NTT, women and children in rural areas where water shortage problems are common can be free from their daily job of carrying domestic water great distances. As a result, women will be able to utilize this time for improving their activities in relation not only to agriculture and livestock production but also cash-income activities in small business and cottage industries. Since housewives in all the candidate scheme areas manage their family budgets, increasing the family income would encourage women in investing the surplus in the improvement and diversification of their income sources.

7.4 Environmental Impact

The results of the environmental impact assessment conducted in the 16 feasibility studies reveal that development activities of Embung in NTB and NTT would have no residual negative impacts on the natural environment and living circumstances of the inhabitants. The following negative impacts are expected in some areas:

- Acceleration of soil erosion in the catchment area and a further increase in sedimentation inflow into the new reservoir due to cultivation of trees; and,
- Moral pressure from resettlers, and discord between settlers and habitants when resettlers will be made to settle if their lands in the reservoir area of candidate scheme are expropriated.

The countermeasures to eliminate these environmental impacts are:

- To establish an effective watershed management rule to protect the vegetation in the catchment area; and,
- To ensure social and economic bases which are equivalent or better for resettlers, to offer training regarding the shifted economic activities and to allow participation in meetings and hearings regarding implementation of the project.

8. CONCLUSION AND RECOMMENDATIONS

8.1 Conclusion

This present Study assessed the development potential of 157 candidate Embung schemes requested by both DPUPs of NTB and NTT. As the requested schemes include 27 existing Embungs for which some rehabilitation works are required, the Study is concentrated on the remaining 130 new Embung development schemes in line with the Study objectives. In the course of the Study, a total of 16 schemes were selected for carrying out a feasibility study aiming to examine the development potential from technical, economical, social, and environmental viewpoints. By referring to the results of these feasibility studies, the development potential of 114 candidate schemes is also assessed in the same manner as the said feasibility study but on a pre-feasibility basis.

It is concluded that the required investment in development of the 108 candidate Embung schemes amounts to Rp. 218.6 billion for NTB and 56.0 billion for NTT as shown below. The remaining 22 candidate schemes are comprised of five in NTT for implementing urgently by GOJ's grant aid, eight for upgrading to dam development schemes, and nine for arranging alternative water source facilities. In addition, the investment for implementing the eight dams is estimated to be Rp. 124.8 billion for six dams in NTB and Rp. 41.2 billion for two dams in NTT.

Investment Requirements for Embung Development in NTB and NTT

Type	Water Supply	NTB		NTT	
		Scheme (No.)	Amount (billion Rp.)	Scheme (No.)	Amount (billion Rp.)
Supply-oriented					
	Irrigation prior	4	10.7	2	2.8
	BHN prior	1	1.8	13	22.0
Demand-oriented					
	Irrigation prior	67	202.5	5	10.2
	BHN prior	4	3.6	12	21.0
Total		76	218.6	32	56.0

8.2 Recommendations

It is recommended that the NTB DPUP will start its investment in the implementation of 76 candidate Embung schemes from the beginning of Pelita VII and last for 20 years. If there is a strong necessity for accelerating the implementation of the Embung development to attain target within 15 years, it is recommended to increase the annual investment amount by about 40%.

The NTT DPUP is advised to carry out its detailed investigation, planning, and design works of 32 candidate schemes within the Pelita VI period and then to complete construction works during the period of Pelita VII. In parallel with the development of these 32 candidate schemes, it is also advised to formulate a concrete program as soon as possible for the purpose of implementing 2,700 small scale Embung schemes on a long-term basis.

Volume 2

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

Master Plan Report

Tables

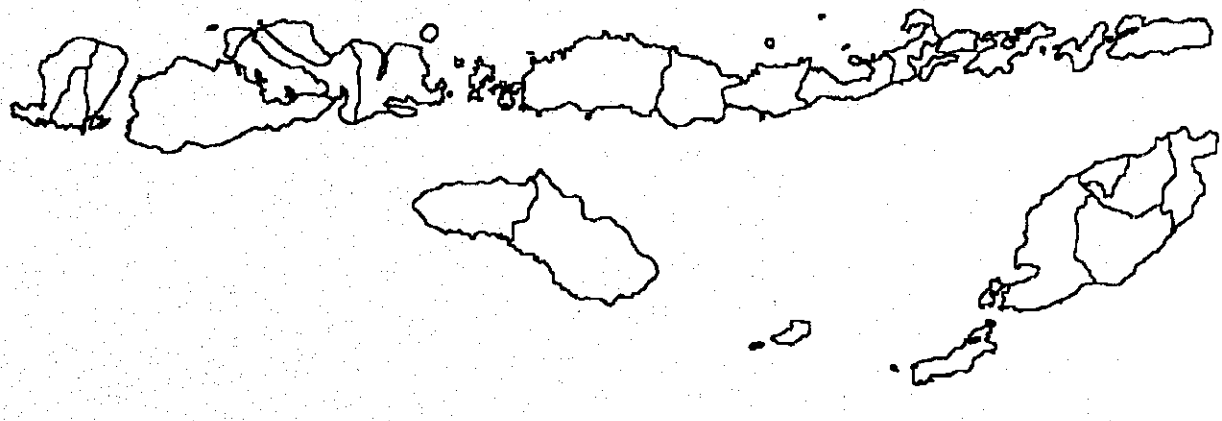

Table 1.1 Member List of JICA Study Team and Indonesian Counterparts

	Name	Expertism
	JICA Study Team	
1	Dr. Yasuhiko KUNIHIRO	Leader / Regional Development Plan
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3	Takuya IGAWA	Meteorology and Hydrology
4	Mitsuo NISHIYA	Soil and Land Use
5	Hiroyuki FUNAOKA	Topography and Geology
6	Hiroshi YASUDA	Agriculture / Livestock / Agriculture Supporting Services
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9	Kiyunobu KOTANI	Water Impoundment and Soil Mechanics
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6	Anang Muchlis	Agriculture and Agro-economy
7	Zaenal Arifin	Soil Mechanics
8	Moh. Mubasir	Structural Design
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1	Ir. J. H. Manu Dima	Coordination
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10	Karolus Poltje Pani	Water Impoundment
11	Pahlawan Perang, BE	Construction Plan

Table 2.1 Projected Macro Socio-economic Indicator for PJPT II

Item	Pelita V	Pelita VI	Pelita VII	Pelita VIII	Pelita IX	Pelita X
1. National Production						
GDP Growth Rate (%)	6.4	6.2	6.6	7.1	7.8	8.7
Agriculture	2.1	3.4	3.5	3.5	3.5	3.5
Industry	10.0	9.2	9.4	9.4	9.1	8.7
Non-oil and gas	11.0	10.3	10.2	10.0	9.5	9.0
Other sectors	6.9	6.0	6.3	6.8	8.0	9.5
2. Population (the last year of each period)						
Total Population (million)	189.1	204.4	219.4	233.6	246.5	258.2
Annual Average Increase Rate (%)	1.7	1.6	1.4	1.3	1.1	0.9
3. Per Capita GDP						
1989 Constant Price (Rp. million)	1.18	1.47	1.89	2.50	3.45	4.99
1989 Constant Price (US$)	685	776	984	1,303	1,797	2,603
4. Labor Force						
Economically Active Population						
Total (million)	81.3	93.1	105.7	118.5	130.8	142.8
Growth rate (%)	3.1	2.8	2.6	2.3	2.0	1.8
Sectoral Distribution of Labor Force (million)						
Total	78.8	90.8	103.1	115.8	128.2	139.9
Agriculture	38.0	39.9	41.1	41.6	41.0	39.8
Industry	9.9	13.0	16.4	20.1	24.4	28.9
Others	30.9	37.9	45.6	54.1	62.8	71.2
Labor Force Participation Rate (%)	55.9	57.7	57.9	59.5	61.1	62.1
Average Unemployment Rate (%)	3.2	2.7	2.5	2.3	2.2	2.0
Labor Productivity						
US$/person	1,670	1,774	2,120	2,654	3,491	4,839
Growth rate (%)	3.3	3.3	3.9	4.6	5.7	6.8

Remarks : * ; Those who are 10 years old and over and also work or look for work opportunity.
** ; Ratio of economically active population to working age population (10 years and over)
Source : BAPPENAS

Table 2.2 Development Program of Irrigation and Water Resources Sub-sector for Pelita VI

Item	Unit	1994/95	1995/96	1996/97	1997/98	1998/99	Total
1 Dam Rehabilitation	No.	3	0	1	1	1	6
2 Reservoir Construction	No.	4	0	0	0	1	5
3 Large Embung Construction	No.	30	50	70	90	120	360
4 O&M of Rivers	km	2,750	2,750	2,750	2,750	2,750	-
5 Lake Maintenance	No.	3	6	10	15	20	-
6 O&M of Dams and Dikes	No.	36	36	40	40	40	-
7 River Improvement and Management	km	370	370	370	370	370	1,850
8 O&M of Irrigation Networks	1,000 ha	5,900	6,000	6,100	6,200	6,300	-
Main canal	1,000 km	114	114	114	116	116	-
Second canal	1,000 km	160	160	160	163	163	-
9 Irrigation Network Improvement	1,000 ha	140	100	120	160	180	700
Main canal	km	350	300	330	880	940	2,800
Second canal	km	690	600	640	1,985	2,450	6,365
Embung rehabilitation	No.	290	250	270	700	870	2,380
10 Irrigation Network Development	1,000 ha	100	80	90	110	120	500
Embung	No.	45	40	43	59	63	250
Main canal	km	270	230	254	635	761	2,150
Second canal	km	655	610	630	1,240	1,140	4,275
Tertiary	km	3,850	3,600	4,200	8,900	9,940	30,490
11 Swampland Develoment and Management	1,000 ha	134	100	120	154	162	670
Main canal	km	120	110	115	123	132	600
Second canal	km	300	240	265	338	357	1,500
Multipurpose	km	20	20	20	20	20	100
12 Pond Construction	1,000 ha	6	4	5	7	8	30
Main canal	km	94	86	90	99	101	470
13 Coastal Area Improvement	km	6	6	9	9	10	40

Source : Bina Program, DGWRD

Table 2.3 Gross Domestic Product by Industrial Origin for Pelita V

Unit : Rp. billion at 1983 constant market prices

Industrial Origin	1989	1990	1991*	1992**	1993***
1. Agriculture, Livestock, Forestry and Fisheries	21,917.8	22,356.9	22,714.8	24,225.5	24,569.3
a. Farm food crops	13,488.7	13,558.2	13,484.2	14,526.7	14,355.9
b. Farm non food crops	2,867.9	2,980.5	3,129.9	3,276.4	3,456.9
c. Estate crops	681.3	743.1	794.1	834.8	893.8
d. Livestock and products	2,243.7	2,327.7	2,468.3	2,664.5	2,813.5
e. Forestry	973.8	1,002.7	1,002.9	980.4	996.6
f. Fisheries	1,662.4	1,744.7	1,835.4	1,942.7	2,052.6
2. Mining and Quarrying	16,663.8	17,531.7	19,317.0	18,957.7	19,370.3
a. Crude petroleum and natural gas	15,390.7	16,029.5	17,512.6	16,719.2	16,666.5
b. Other mining and quarrying	1,273.1	1,502.2	1,804.4	2,238.5	2,703.8
3. Manufacturing Industries	19,855.7	22,336.9	24,585.0	26,963.6	29,484.4
a. Manufacturing without petroleum and gas	15,180.6	17,149.6	19,015.2	21,098.6	23,544.3
b. Petroleum refinery	990.0	1,094.2	1,136.7	1,202.3	1,186.8
c. Liquefied natural gas	3,685.1	4,093.1	4,433.1	4,662.7	4,753.3
4. Electricity, Gas and Water Supply	615.6	725.7	842.8	928.2	1,022.3
5. Construction	5,878.0	6,672.9	7,423.7	8,223.6	9,222.5
6. Trade, Hotels and Restaurants	17,338.1	18,568.6	19,576.2	21,009.1	22,850.1
a. Wholesale and retail trade	14,446.8	15,425.3	16,213.5	17,405.8	18,968.8
b. Hotels and restaurants	2,891.3	3,143.3	3,362.7	3,603.3	3,881.3
7. Transportation and Communication	5,811.5	6,367.9	6,869.4	7,554.9	8,302.2
a. Transportation	5,151.3	5,596.4	6,002.7	6,601.3	7,192.1
b. Communication	660.2	771.5	866.7	953.6	1,110.1
8. Banking and Other financial Intermedics	4,290.7	4,893.8	5,535.1	6,255.7	7,069.6
9. Ownership of Dwelling	2,877.7	2,998.8	3,119.7	3,249.3	3,411.1
10. Public Administration and Defence	8,396.9	8,783.3	9,052.1	9,320.0	9,508.8
11. Services	3,790.8	3,980.8	4,189.4	4,497.2	4,896.5
Gross Domestic Product	107,436.6	115,217.3	123,225.2	131,184.8	139,707.1
Gross Domestic Product (Without Petroleum and Gas)	87,370.8	94,000.5	100,142.8	108,600.6	117,100.5

Remarks : * ; Preliminary figures
** ; Very preliminary figures
*** ; Very-very preliminary figures

Table 2.4 Change in Labor Productivity by Sector

Sector	1985			1990			1993			Growth Rate	
	GDP by Sector Rp. billion	Working Population Pers. '000	Labor Productivity Rp.'000/ person	GDP by Sector Rp. billion	Working Population Pers. '000	Labor Productivity Rp.'000/ person	GDP by Sector Rp. million	Working Population Pers. '000	Labor Productivity Rp.'000/ person	1985 to 1990 %	1990 to 1993 %
1. Agriculture, Livestock, Forestry and Fisheries	19,302	34,162	565	22,605	42,378	533	24,569	40,072	613	-1.2	4.8
2. Mining and Quarrying	13,962	375	37,256	17,538	528	33,203	19,370	653	29,663	-2.3	-3.7
3. Manufacturing Industries	10,049	4,337	2,317	22,277	7,693	2,896	29,484	8,784	3,357	4.6	5.1
4. Electricity, Gas and Water Supply	595	115	5,177	726	135	5,388	1,022	172	5,942	0.8	3.3
5. Construction	4,544	2,112	2,151	6,715	2,060	3,261	9,223	2,810	3,282	8.7	0.2
6. Trade, Hotel and Restaurant	12,283	9,256	1,327	18,645	11,067	1,685	22,850	12,508	1,827	4.9	2.7
7. Transportation and Communication	4,597	2,006	2,291	6,392	2,313	2,764	8,302	2,931	2,832	3.8	0.8
8. Banking, Other Financial Intermediaries and Services	5,721	474	12,058	8,769	606	14,461	11,966	703	17,021	3.7	5.6
9. Public Administration and Defence	6,439	4,431	1,453	8,783	9,070	968	9,509	10,566	900	-7.8	-2.4
Total and Average	77,490	57,269	1,353	112,448	75,851	1,482	136,295	79,199	1,721	1.8	5.1

Source : Statistik Indonesia, 1986, 1991 and 1993

Table 2.5 Actual Government Receipts and Expenditures for Pelita V Period

Unit : Rp. billion

Item	1989/1990	1990/1991	1991/1992	1992/1993	1993/1994*
RECEIPTS	38,169	49,451	51,994	58,168	27,224
A. Routine Receipts	28,740	39,546	41,585	47,452	23,079
1. Oil and Gas Receipts	11,252	17,712	15,039	15,330	7,019
2. Non Oil and Gas Receipts	17,488	21,834	26,546	32,122	16,060
1) Income tax	5,488	6,755	9,580	11,913	6,115
2) VAT**	5,837	7,463	8,926	10,714	5,372
3) Import duties	1,587	2,486	2,133	2,652	1,384
4) Excises duties	1,477	1,917	2,223	2,381	1,129
5) Export tax	171	44	19	8	7
6) Others tax	276	243	303	360	136
7) Land tax/Taxes on Land and Building	590	811	875	1,101	583
8) Non tax receipts	2,062	2,115	2,487	2,993	1,077
9) Other oil receipts	-	-	-	-	257
B. Development Receipts	9,429	9,905	10,409	10,716	4,145
1. Program Aid	1,007	1,397	1,563	512	-
2. Project Aid	8,422	8,508	8,846	10,204	4,145
EXPENDITURES	38,165	49,451	51,991	58,166	27,221
A. Routine Expenditures	24,331	29,998	30,227	34,031	17,895
1. Personnel Expenditures	6,201	7,054	8,102	9,466	6,234
2. Material Expenditures	1,702	1,830	2,373	2,870	1,269
3. Subsidies to Regions	3,566	4,236	4,834	5,283	3,345
4. Debt Repayment	11,939	13,395	13,434	15,217	6,855
1) Internal debt	149	250	251	275	117
2) External debt	11,790	13,145	13,183	14,942	6,738
5. Others	923	3,483	1,484	1,195	192
B. Development Expenditures	13,834	19,453	21,764	24,135	9,326
1. Department/Institutions	2,509	4,854	5,971	7,858	2,546
2. Development Subisidy to villages	112	181	250	327	299
3. Development Subisidy to Regencies	270	392	583	825	377
4. Development Subisidy to Provinces	324	486	573	701	340
5. Development of Primary Schools	100	374	521	655	180
6. Facilities/Public Health Central	122	193	269	320	151
7. Infrastructure Development	294	679	972	1,225	422
8. Subsidies to Reconstruction and Development of Market	3	3	2	1	1
9. Subsidies for Regreening and Reforestation	16	33	75	95	77
10. Land Tax/Taxes on Land and Building	478	657	708	891	515
11. Fertilizer Subsidies	278	265	302	175	-
12. Government Capital Participation	141	323	470	150	75
13. Others	765	505	722	708	198
14. Project Aid	8,422	8,508	8,846	10,204	4,145
16. Reserves	0	2,000	1,500	0	0

Remarks : * ; First half year of 193/1994

** ; Value added tax on goods and services and tax on the sale of luxuries goods

Source : Statistik Indonesia 1993

Table 3.1 GRDP Excluding Oil and Its Products by Province in 1991

Province	GRDP* at Current Market Prices (Rp. billion)	GRDP* at 1983 Constant Prices (Rp. billion)	Per Capita GRDP* at Current Market Prices (Rp. '000)	Per Capita GRDP* at 1983 Constant Prices (Rp. '000)	Growth Rate of GRDP* at 1983 Constant Prices (%)	Growth Rate of Per Capita GRDP* at 1983 Constant Prices (%)
D.I. Aceh	3,349	1,880	943	529	6.04	1.09
Sumatra Utara	11,725	6,177	1,130	595	7.67	5.72
Sumatra Barat	3,766	1,955	932	484	6.67	5.02
Riau	3,327	1,825	980	537	10.41	6.05
Jambi	1,505	844	731	410	3.93	0.73
Sumatra Selatan	6,837	3,997	1,069	625	6.85	3.86
Bengkulu	944	498	779	411	8.21	3.86
Lampung	3,642	2,011	597	330	4.77	2.28
D.K.I. Jakarta	26,051	14,709	3,112	1,757	7.64	5.33
Jawa Barat	33,315	16,797	928	468	7.42	4.95
Jawa Tengah	23,390	11,773	815	410	6.61	5.62
D.I. Yogyakarta	2,201	1,141	754	391	5.19	4.84
Jawa Timur	34,052	17,913	1,042	548	7.10	6.20
Kalimantan Barat	3,240	1,679	990	513	6.61	3.86
Kalimantan Tengah	1,635	844	1,142	589	9.25	5.19
Kalimantan Selatan	2,689	1,434	1,021	545	6.51	4.31
Kalimantan Timur	4,968	2,509	2,574	1,300	7.30	2.85
Sulawesi Utara	1,732	1,046	685	413	9.23	6.49
Sulawesi Tengah	1,097	635	630	365	9.34	6.29
Sulawesi Selatan	5,283	3,062	750	434	9.96	8.43
Sulawesi Tenggara	976	598	707	434	13.81	10.01
Bali	3,503	1,737	1,251	620	8.29	7.03
Nusa Tenggara Barat	1,573	879	461	258	7.42	5.39
Nusa Tenggara Timur	1,332	748	404	227	5.72	4.09
Maluku	1,731	907	934	489	6.88	4.29
Irian Jaya	1,867	921	1,082	533	11.19	4.57
Timor Timur	328	155	431	203	10.41	7.45
Indonesia	192,956	100,194	1,064	552	6.59	4.70

Source : Statistik Indonesia, 1993

Table 3.2 List of Foreign Aid Programs and Projects in NTB and NTT

Area and Major Islands	Sub-sector	Financing sources	Project/Program Title	Stage
Lombok	Water Resources and Irrigation	ADB	Pengga Dam Irrigation Project	Complted in 1994
	Water Resources and Irrigation	ADB	Pandanduri Swangi Dam Irrigation Project	To be commenced in 1995
Sumbawa	Water Resources and Irrigation	ADB	Mamak Dam Irrigation Project	Complted in 1993
	Water Resources and Irrigation	USAID/OECF	Tiu Kulit Dam Irrigation Sub-Project	Complted in 1994
Flores	Water Resources and Irrigation	ADB	Integrated Water Resources in Flore Island	Complted in 1994
West Timor	Water Resources and Irrigation	ADB	Nusa Tenggara Agricultural Development Project	Complted in 1994
	Water Resources and Irrigation	CIDA	Water Resources Development Service	Scheduled to continue to1995
	Water Resources and Irrigation	AIDAB	Integrated Area Development Project	Completed in 1991
	Water Resources and Irrigation	USAID/OECF	Oesao Groudnwater Irrigation Sub-Project	Complted in 1994

Source : Annual Reports of Sub Dinas Pengairan and Dinas Pertanian, NTB and NTT

Table 3.3 Administration Division

Unit : number

Province/ Island/ Kabupaten	Kabupaten Capital	Kota	Kecamatan	Perwk. Kacamatan	Desa
NTB					
Lombok		0	31	32	237
Lombok Barat	Mataram	0	9	0	60
Lombok Tengah	Praya	0	9	5	81
Lombok Timur	Selong	0	10	4	96
Kodya Mataram	Mataram	0	3	23	0
Sumbawa		0	28	27	287
Sumbawa	Sumbawa Besar	0	14	6	122
Dompu	Dompu	0	4	9	34
Bima	Bima	0	10	12	131
NTB sub-total		0	59	59	524
NTT					
Flores		0	54	26	876
Manggarai	Ruteng	0	11	6	255
Ngada	Bajawa	0	9	2	137
Ende	Ende	0	7	5	103
Sikka	Maumere	0	8	3	90
Flores Timur	Larantuka	0	13	7	233
Alor	Kalabahi	0	6	3	58
Sumba		0	16	8	225
Sumba Barat	Waikabubak	0	8	7	125
Sumba Timur	Waingapu	0	8	1	100
Timor		1	44	13	642
Kupang	Kupang	1	21	0	275
Timur Tengah Selatan	So'g	0	9	6	170
Timur Tengah Utara	Kefameanu	0	6	3	115
Belu	Atambua	0	8	4	82
NTT sub-total		1	114	47	1,743
Total		1	173	106	2,267

Source : Statistik Penggunaan Lahan & Alat-Alat Pertanian, NTB, 1993
Laporan Luas Lahan Menurut Penggunaannya Kabupaten Dati II SE-NTT, Tahun 1993

Table 3.4 General Land Use in 1993

Unit : ha

Province/ Island/ Kabupaten	Agricultural Land	Shifting Cultivation Area	Grass land	Forest	Temporally Fallow Land	Others	Total Land Area
NTB							
Lombok	260,365	33,792	1,175	118,447	8,539	51,552	473,870
Lombok Barat	94,416	29,624	165	38,640	25	7,680	170,550
Lombok Tengah	79,013	0	915	22,334	8,514	31,989	142,765
Lombok Timur	86,936	4,168	95	57,473	0	11,883	160,555
Sumbawa	488,490	17,406	34,053	708,469	67,085	225,942	1,541,445
Sumbawa	267,891	8,841	11,944	369,733	42,615	148,276	849,300
Dompu	83,482	2,579	5,081	83,940	7,558	49,815	232,455
Bima	137,117	5,986	17,028	254,796	16,912	27,851	459,690
NTB sub-total	748,855	51,198	35,228	826,916	75,624	277,494	2,015,315
NTT							
Flores	498,435	62,869	246,990	433,077	220,221	528,068	1,989,660
Manggarai	207,054	23,327	133,668	151,614	81,709	116,268	713,640
Ngada	49,227	8,346	56,257	86,079	29,236	74,645	303,790
Ende	44,873	4,915	11,963	30,940	17,217	94,752	204,660
Sikka	83,071	3,584	24,614	17,534	12,555	31,832	173,190
Flores Timur	62,607	11,051	13,394	76,400	38,710	105,758	307,920
Alor	51,603	11,646	7,094	70,510	40,794	104,813	286,460
Sumba	210,369	31,645	330,480	228,745	110,849	193,152	1,105,240
Sumba Barat	133,672	9,540	92,913	70,866	33,418	64,781	405,190
Sumba Timur	76,697	22,105	237,567	157,879	77,431	128,371	700,050
West Timor	330,611	46,057	206,079	591,027	161,335	304,981	1,640,090
Kupang	116,526	23,037	83,832	232,010	80,696	197,759	733,860
Timur Tengah Selatan	99,961	6,858	72,316	184,932	15,701	14,932	394,700
Timur Tengah Utara	27,129	10,796	38,559	134,407	21,999	34,080	266,970
Belu	86,995	5,366	11,372	39,678	42,939	58,210	244,560
NTT sub-total	1,039,415	140,571	783,549	1,252,849	492,405	1,026,201	4,734,990
Total	1,788,270	191,769	818,777	2,079,765	568,029	1,303,695	6,750,305

Source : Dalam Angka, 1993, NTB and NTT
Data-Data Pemdukung Usulan Program/Proyek Subsektor Tanaman Pangan Propinsi NTT, 1993

Table 3.5 Population by Kabupaten in NTB and NTT as at 1993

Province/ Island/ Kabupaten	Total Population ('000 person)	Population Density (person/km2)	Total Household (number)	Average Family Member per Household (person/family)
NTB				
Lombok	2,494.6	526.4		
Lombok Barat	905.0	530.5		
Lombok Tengah	697.0	488.1		
Lombok Timur	892.6	555.8		
Sumbawa	1,009.4	214.8		
Sumbawa	385.9	45.4		
Dompu	158.8	68.3		
Bima	464.7	101.1		
NTB sub-total	3,504.0	741.2		
NTT				
Flores	1,607.7	80.8	296,286	5.4
Manggarai	521.0	73.1	89,954	5.8
Ngada	201.6	66.4	34,806	5.8
Ende	221.8	108.4	40,936	5.4
Sikka	247.6	143.0	46,124	5.4
Flores Timur	268.1	87.1	54,678	4.9
Alor	147.6	51.5	29,788	5.0
Sumba	461.6	41.7	78,975	5.8
Sumba Barat	302.2	74.9	49,702	6.1
Sumba Timur	159.4	22.8	29,273	5.4
Timor	1,287.9	78.5	258,963	5.0
Kupang	537.0	73.2	109,323	4.9
Timur Tengah Selatar	357.9	90.7	71,360	5.0
Timur Tengah Utara	170.4	63.8	34,456	4.9
Belu	222.6	91.0	43,824	5.1
NTT sub-total	3,357.2	70.2	634,224	5.3
Total	6,861.2	49.7		

Source : NTB Dalam Angka 1993
NTT Dalam Angka 1993

Table 3.6 Length of Road by condition in 1993

Unit : km

Province/ Island/ Kabupaten	Good	Moderate	Damaged	Badly Damaged	Total
NTB					
Lombok	1,015	0	1,429	268	2,712
Lombok Barat	713	0	132	205	1,050
Lombok Tengah	156	0	574	63	793
Lombok Timur	146	0	723	0	869
Sumbawa	1,235	0	364	1,056	2,655
Sumbawa	615	0	92	367	1,074
Dompu	256	0	101	177	534
Bima	364	0	171	512	1,047
NTB sub-total	2,250	0	1,793	1,324	5,367
NTT					
Flores	2,017	225	4,753	-	6,995
Manggarai	516	58	1,390	-	1,964
Ngada	371	52	771	-	1,194
Ende	278	46	412	-	736
Sikka	340	0	772	-	1,112
Flores Timur	336	57	732	-	1,125
Alor	176	12	676	-	864
Sumba	665	135	1,525	-	2,325
Sumba Barat	354	0	777	-	1,131
Sumba Timur	311	135	748	-	1,194
Timor	1,359	321	3,081	-	4,761
Kupang	462	216	1,165	-	1,843
Timur Tengah Selatan	332	62	942	-	1,336
Timur Tengah Utara	309	28	477	-	814
Belu	256	15	497	-	768
NTT sub-total	4,041	681	9,359	-	14,081
Total	6,291	681	11,152	-	18,124

Source : NTB dalam Angka, 1993
NTT Dalam Angka, 1993

Table 3.7 Agricultural Land Use in 1993

Unit : ha

Province/ Island/ Kabupaten	Wetland	Dry Upland	Fruit Tree Area	Estate Crop Area	Farmland Sub-total	Shifting Cultivation Area	Grass land	Forest	Temporally Fallow Land	Others	Total Land Area
NTB											
Lombok	121,878	35,017	10,750	92,720	260,365	33,792	1,175	118,447	8,539	51,552	473,870
Lombok Barat	23,281	25,450	6,148	39,537	94,416	29,624	165	38,640	25	7,680	170,550
Lombok Tengah	51,531	5,049	1,674	20,759	79,013	0	915	22,334	8,514	31,989	142,765
Lombok Timur	47,066	4,518	2,928	32,424	86,936	4,168	95	57,473	0	11,883	160,555
Sumbawa	79,097	370,260	5,726	33,407	488,490	17,406	34,053	708,469	67,085	225,942	1,541,445
Sumbawa	37,949	213,890	1,465	14,587	267,891	8,841	11,944	369,733	42,615	148,276	849,300
Dompu	13,545	56,996	3,098	9,843	83,482	2,579	5,081	83,940	7,558	49,815	232,455
Bima	27,603	99,374	1,163	8,977	137,117	5,986	17,028	254,796	16,912	27,851	459,690
NTB sub-total	200,975	405,277	16,476	126,127	748,855	51,198	35,228	826,916	75,624	277,494	2,015,315
NTT											
Flores	48,227	180,007	14,378	255,823	498,435	62,869	246,990	433,077	220,221	528,068	1,989,660
Manggarai	26,395	85,317	3,355	91,987	207,054	23,327	133,668	151,614	81,709	116,268	713,640
Ngada	8,434	10,538	2,231	28,024	49,227	8,346	56,257	86,079	29,236	74,645	303,790
Ende	6,223	14,265	1,920	22,465	44,873	4,915	11,963	30,940	17,217	94,752	204,660
Sikka	2,148	27,123	2,077	51,723	83,071	3,584	24,614	17,534	12,555	31,832	173,190
Flores Timur	2,018	15,444	2,270	42,875	62,607	11,051	13,394	76,400	38,710	105,758	307,920
Alor	3,009	27,320	2,525	18,749	51,603	11,646	7,094	70,510	40,794	104,813	286,460
Sumba	42,881	45,429	15,140	106,919	210,369	31,645	330,480	228,745	110,849	193,152	1,105,240
Sumba Barat	18,672	23,934	7,481	83,585	133,672	9,540	92,913	70,866	33,418	64,781	405,190
Sumba Timur	24,209	21,495	7,659	23,334	76,697	22,105	237,567	157,879	77,431	128,371	700,050
West Timor	38,607	162,918	31,883	97,203	330,611	46,057	206,079	591,027	161,335	304,981	1,640,090
Kupang	21,081	50,833	15,563	29,049	116,526	23,037	83,832	232,010	80,696	197,759	733,860
Timur Tengah Selatan	4,693	52,441	9,025	33,802	99,961	6,858	72,316	184,932	15,701	14,932	394,700
Timur Tengah Utara	4,191	9,478	730	12,730	27,129	10,796	38,559	134,407	21,999	34,080	266,970
Belu	8,642	50,166	6,565	21,622	86,995	5,366	11,372	39,678	42,939	58,210	244,560
NTT sub-total	129,715	388,354	61,401	459,945	1,039,415	140,571	783,549	1,252,849	492,405	1,026,201	4,734,990
Total	330,690	793,631	77,877	586,072	1,788,270	191,769	818,777	2,079,765	568,029	1,303,695	6,750,305

Source : Dalam Angka, 1993, NTB and NTT
Data-Data Pemdukung Usulan Program/Proyek Subsektor Tanaman Pangan Propinsi NTT, 1993

Table 3.8 Cropped Area and Cropping Intensity on Wet Paddy Field

Unit : ha

Province/ Island/ Kabupaten	Total Area of Wet Paddy Field	Fallow Area of Paddy Field for Wet Season	Irrigated Wet Season Paddy Planted Area	Rainfed Wet Season Paddy Planted Area	Irrigated Dry Season Paddy Planted Area	Rainfed Dry Season Paddy Planted Area	Total Planted Area of Wet Paddy	Rainfed Wet Season Palawija Planted Area	Rainfed Dry Season Palawija Planted Area	Total Planted Area	Cropping Intensity (%)
NTB											
Lombok	121,878	0	99,141	22,737	42,630	0	164,508	0	19,206	183,714	151
Lombok Barat	23,281	0	20,982	2,299	17,272	0	40,553	0	2,369	42,922	184
Lombok Tengah	51,531	0	31,679	19,852	15,876	0	67,407	0	7,547	74,954	145
Lombok Timur	47,066	0	46,480	586	9,482	0	56,548	0	9,290	65,838	140
Sumbawa	79,097	190	62,181	16,726	28,523	0	107,430	0	16,951	124,381	157
Sumbawa	37,949	0	28,419	9,530	11,174	0	49,123	0	9,944	59,067	156
Dompu	13,545	190	11,357	1,998	7,662	0	21,017	0	2,139	23,156	171
Bima	27,603	0	22,405	5,198	9,687	0	37,290	0	4,868	42,158	153
NTB sub-total	200,975	190	161,322	39,463	71,153	0	271,938	0	36,157	308,095	153
NTT											
Flores	48,227	6,687	29,245	10,145	9,828	0	49,218	4,062	0	53,280	110
Manggarai	26,395	0	17,593	8,802	8,128	0	34,523	0	0	34,523	131
Ngada	8,434	2,305	4,986	1,143	1,650	0	7,779	0	0	7,779	92
Ende	6,223	91	4,419	0	0	0	4,419	3,625	0	8,044	129
Sikka	2,148	305	1,643	200	50	0	1,893	0	0	1,893	88
Flores Timur	2,018	1,300	391	0	0	0	391	327	0	718	36
Alor	3,009	2,686	213	0	0	0	213	110	0	323	11
Sumba	42,881	16,000	16,804	0	0	0	16,804	10,077	0	26,881	63
Sumba Barat	18,672	3,488	10,595	0	0	0	10,595	4,589	0	15,184	81
Sumba Timur	24,209	12,512	6,209	0	0	0	6,209	5,488	0	11,697	48
West Timor	38,607	17,316	16,695	493	3	481	17,672	4,103	0	21,775	56
Kupang	21,081	4,991	12,107	0	0	0	12,107	3,983	0	16,090	76
Timur Tengah Selatan	4,693	3,049	1,627	17	3	0	1,647	0	0	1,647	35
Timur Tengah Utara	4,191	2,745	1,244	202	0	481	1,927	0	0	1,927	46
Belu	8,642	6,531	1,717	274	0	0	1,991	120	0	2,111	24
NTT sub-total	129,715	40,003	62,744	10,638	9,831	481	83,694	18,242	0	101,936	79
Total	330,690	40,193	224,066	50,101	80,984	481	355,632	18,242	36,157	410,031	124

Source : Dalam Angka, 1993, NTB and NTT

Table 3.9 Maize and Cassava Production in 1993

Province/ Island/ Kabupaten	Maize			Cassava		
	Harvested Area (ha)	Yield (ton/ha)	Production (ton)	Harvested Area (ha)	Yield (ton/ha)	Production (ton)
NTB						
Lombok	13,643	1.98	26,958	8,422	11.34	95,542
Lombok Barat	6,434	1.84	11,831	5,792	11.74	67,998
Lombok Tengah	2,719	1.94	5,274	1,671	10.34	17,278
Lombok Timur	4,490	2.19	9,853	959	10.70	10,266
Sumbawa	12,652	1.95	24,692	2,781	10.40	28,922
Sumbawa	4,403	2.06	9,092	926	10.46	9,686
Dompu	1,816	1.43	2,589	167	9.64	1,610
Bima	6,433	2.02	13,011	1,688	10.44	17,626
NTB sub-total	26,295	1.96	51,650	11,203	11.11	124,464
NTT						
Flores	69,748	1.70	118,890	31,305	9.83	307,860
Manggarai	16,450	2.11	34,677	10,976	10.21	112,021
Ngada	8,796	1.92	16,888	2,833	11.68	33,098
Ende	8,637	1.36	11,764	6,540	10.22	66,813
Sikka	11,873	1.62	19,213	3,704	9.70	35,936
Flores Timur	14,653	1.53	22,470	3,958	10.21	40,403
Alor	9,339	1.49	13,878	3,294	5.95	19,589
Sumba	25,405	2.12	53,840	10,995	9.88	108,668
Sumba Barat	16,088	2.12	34,107	8,629	10.10	87,118
Sumba Timur	9,317	2.12	19,733	2,366	9.11	21,550
Timor	111,380	1.78	198,220	30,116	9.79	294,951
Kupang	18,892	2.08	39,371	3,107	8.22	25,533
Timur Tengah Selatan	51,068	1.57	79,972	16,940	10.20	172,720
Timur Tengah Utara	16,041	1.78	28,601	6,784	9.29	63,023
Belu	25,379	1.98	50,276	3,285	10.25	33,675
NTT sub-total	206,533	1.80	370,950	72,416	9.82	711,479
Total	232,828	1.82	422,600	83,619	10.00	835,943

Source : NTB Dalam Angka, 1993
NTT Dalam Angka, 1993

Table 3.10 Groundnut and Soybean Production in 1993

Province/ Island/ Kabupaten	Groundnut			Soybean		
	Harvested Area (ha)	Yield (ton/ha)	Production (ton)	Harvested Area (ha)	Yield (ton/ha)	Production (ton)
NTB						
Lombok	14,855	1.11	16,420	52,884	1.04	55,056
Lombok Barat	8,769	1.10	9,646	14,121	1.02	14,347
Lombok Tengah	4,302	1.08	4,663	30,453	1.07	32,524
Lombok Timur	1,784	1.18	2,111	8,310	0.98	8,185
Sumbawa	5,065	1.13	5,733	77,045	1.01	77,696
Sumbawa	1,928	1.11	2,144	31,038	1.03	31,845
Dompu	1,082	1.01	1,098	12,576	0.99	12,438
Bima	2,055	1.21	2,491	33,431	1.00	33,413
NTB sub-total	19,920	1.11	22,153	129,929	1.02	132,752
NTT						
Flores	2,687	0.80	2,137	3,154	0.97	3,045
Manggarai	366	0.81	295	1,044	0.97	1,015
Ngada	235	0.88	206	1,825	1.00	1,820
Ende	276	0.76	211	175	0.70	123
Sikka	814	0.88	716	5	0.80	4
Flores Timur	902	0.67	606	64	0.78	50
Alor	94	1.10	103	41	0.80	33
Sumba	723	0.79	571	236	0.94	223
Sumba Barat	140	0.90	126	186	0.94	175
Sumba Timur	583	0.76	445	50	0.96	48
Timor	4,114	0.75	3,077	547	0.80	437
Kupang	2,203	0.71	1,569	103	0.82	84
Timur Tengah Selatan	443	0.78	346	314	0.78	246
Timur Tengah Utara	772	0.74	573	50	0.76	38
Belu	696	0.85	589	80	0.86	69
NTT sub-total	7,524	0.77	5,785	3,937	0.94	3,705
Total	27,444	1.02	27,938	133,866	1.02	136,457

Source : NTB Dalam Angka, 1993
NTT Dalam Angka, 1993

Table 3.11 Paddy Production in 1993

Province/ Island/ Kabupaten	Wetland			Dry Upland		
	Harvested Area (ha)	Paddy Yield (ton/ha)	Paddy Production (ton)	Harvested Area (ha)	Paddy Yield (ton/ha)	Paddy Production (ton)
NTB						
Lombok	160,055	4.57	731,480	4,453	1.89	8,410
Lombok Barat	38,113	4.61	175,793	2,440	1.75	4,266
Lombok Tengah	66,901	4.37	292,027	506	2.00	1,012
Lombok Timur	55,041	4.79	263,660	1,507	2.08	3,132
Sumbawa	92,987	4.47	415,555	14,443	2.18	31,481
Sumbawa	41,472	4.67	193,819	7,651	2.27	17,346
Dompu	17,018	3.78	64,293	3,999	2.05	8,178
Bima	34,497	4.56	157,443	2,793	2.13	5,957
NTB sub-total	253,042	4.53	1,147,035	18,896	2.11	39,891
NTT						
Flores	49,218	3.25	160,162	38,198	1.85	70,651
Manggarai	34,523	3.40	117,206	9,256	2.15	19,873
Ngada	7,779	3.04	23,648	4,208	2.14	8,997
Ende	4,419	2.81	12,426	5,930	1.63	9,660
Sikka	1,893	2.71	5,128	6,979	1.65	11,529
Flores Timur	391	2.97	1,161	6,924	1.66	11,515
Alor	213	2.78	593	4,901	1.85	9,077
Sumba	16,804	3.12	52,373	9,432	2.07	19,546
Sumba Barat	10,595	3.19	33,777	6,495	2.18	14,133
Sumba Timur	6,209	3.00	18,596	2,937	1.84	5,413
Timor	17,672	3.04	53,657	10,357	2.04	21,176
Kupang	12,107	3.17	38,331	5,526	2.14	11,842
Timur Tengah Selatan	1,647	2.74	4,514	200	1.68	335
Timur Tengah Utara	1,927	2.91	5,600	4,187	1.97	8,253
Belu	1,991	2.62	5,212	444	1.68	746
NTT sub-total	83,694	3.18	266,192	57,987	1.92	111,373
Total	336,736	4.20	1,413,227	76,883	1.97	151,264

Source : NTB Dalam Angka, 1993
NTT Dalam Angka, 1993

Table 3.12 Livestock Population in 1993

Unit : head

Province/ Island/ Kabupaten	Cow	Buffaloes	Hoarse	Goat/ Sheep	Pig	Domestic Hens	Layer	Duck/ Manila Duck
NTB								
Lombok	275,827	50,564	22,641	193,394	21,823	3,660,000	146,524	440,085
Lombok Barat	87,500	8,750	8,040	33,560	21,200	875,000	56,800	41,000
Lombok Tengah	89,912	30,066	5,393	61,983	623	1,518,000	41,879	247,835
Lombok Timur	98,415	11,748	9,208	97,851	0	1,267,000	47,845	151,250
Sumbawa	133,124	161,832	55,820	94,294	602	836,000	25,325	61,117
Sumbawa	52,874	103,782	40,070	20,989	557	334,000	5,650	19,192
Dompu	22,500	17,050	4,700	16,155	0	146,000	16,200	11,925
Bima	57,750	41,000	11,050	57,150	45	356,000	3,475	30,000
NTB sub-total	408,951	212,396	78,461	287,688	22,425	4,496,000	171,849	501,202
NTT								
Flores	52,520	50,481	55,254	227,447	572,912	2,996,688	77,112	95,279
Manggarai	11,884	32,549	17,012	18,347	122,923	359,599	0	5,005
Ngada	19,217	14,515	12,945	24,831	96,531	267,765	7,551	897
Ende	6,240	2,822	5,377	17,062	75,292	1,392,132	27,745	40,442
Sikka	6,439	550	14,051	54,202	157,455	308,970	17,799	23,972
Flores Timur	3,073	45	5,176	90,426	89,372	448,010	19,828	18,577
Alor	5,667	0	693	22,579	31,339	220,212	4,189	6,386
Sumba	51,311	88,006	55,618	33,710	223,939	1,093,830	0	587
Sumba Barat	10,033	50,792	19,963	19,626	152,668	594,470	0	0
Sumba Timur	41,278	37,214	35,655	14,084	71,271	499,360	0	587
Timor	663,873	48,618	59,307	388,868	656,707	2,335,647	518,800	71,577
Kupang	220,068	25,786	16,677	243,425	300,362	1,346,133	496,859	12,421
Timur Tengah Selatan	224,234	2,602	18,515	72,757	181,240	453,614	3,036	5,528
Timur Tengah Utara	111,378	2,153	9,099	14,716	68,103	105,758	13,573	7,892
Belu	108,193	18,077	15,016	57,970	107,002	430,142	5,332	45,736
NTT sub-total	767,704	187,105	170,179	650,025	1,453,558	6,426,165	595,912	167,443
Total	1,176,655	399,501	248,640	937,713	1,475,983	10,922,165	767,761	668,645

Source : NTB Dalam Angka, 1993
NTT Dalam Angka, 1993

Table 3.13 Number of Livestock Slaughtered

Unit : head

Province/ Island/ Kabupaten	Cow	Buffaloes	Goat	Sheep	Pig
NTB					
Lombok	24,399	2,259	2,121	587	6,687
Lombok Barat	16,127	877	1,580	436	6,673
Lombok Tengah	1,945	527	8	5	0
Lombok Timur	6,327	855	533	146	14
Sumbawa	5,673	3,667	3,941	6	0
Sumbawa	2,654	1,707	1,261	0	0
Dompu	1,756	1,189	1,075	0	0
Bima	1,263	771	1,605	6	0
NTB sub-total	30,072	5,926	6,062	593	6,687
NTT					
Flores	2,621	356	9,535	23	18,245
Manggarai	235	153	297	0	7,458
Ngada	632	47	298	1	931
Ende	792	45	1,095	0	1,118
Sikka	629	111	428	0	502
Flores Timur	197	0	6,949	22	7,651
Alor	136	0	468	0	585
Sumba	552	60	1,642	0	467
Sumba Barat	165	59	0	0	0
Sumba Timur	387	1	1,642	0	467
Timor	11,711	90	1,614	0	6,672
Kupang	7,404	2	1,477	0	3,702
Timur Tengah Selatan	1,130	5	0	0	496
Timur Tengah Utara	1,050	44	137	0	419
Belu	2,127	39	0	0	2,055
NTT sub-total	14,884	506	12,791	23	25,384
Total	44,956	6,432	18,853	616	32,071

Source : NTB dalam Angka, 1993
NTT Dalam Angka, 1993

Table 3.14 Fisheries Production in 1993

Unit : ton

Province/ Island/ Kabupaten	Sea Fisheries	Inland Fisheries					Grand Total
		Open Water	Brackish Water Pond	Fresh Water Pond	Wetland	Total	
NTB							
Lombok	22,415	1,527	1,465	1,085	766	4,843	27,258
Lombok Barat	10,997	385	1,083	759	506	2,733	13,730
Lombok Tengah	962	860	66	113	113	1,152	2,114
Lombok Timur	10,456	282	316	213	147	958	11,414
Sumbawa	42,292	254	4,788	96	54	5,192	47,484
Sumbawa	19,030	242	772	87	53	1,154	20,184
Dompu	5,908	0	537	3	1	541	6,449
Bima	17,354	12	3,479	6	0	3,497	20,851
NTB sub-total	64,707	1,781	6,253	1,181	820	10,035	74,742
NTT							
Flores	31,886	30	18	33	14	95	31,981
Manggarai	6,020	15	3	12	9	39	6,059
Ngada	3,980	15	14	14	5	48	4,028
Ende	6,625	0	0	6	0	6	6,631
Sikka	5,237	0	0	0	0	0	5,237
Flores Timur	6,426	0	0	0	0	0	6,426
Alor	3,598	0	1	1	0	2	3,600
Sumba	6,475	332	15	42	7	396	6,871
Sumba Barat	1,393	127	0	16	7	150	1,543
Sumba Timur	5,082	205	15	26	0	246	5,328
Timor	23,827	122	119	62	0	303	24,130
Kupang	20,399	101	80	53	0	234	20,633
Timur Tengah Selatan	43	9	1	5	0	15	58
Timur Tengah Utara	93	11	28	4	0	43	136
Belu	3,292	1	10	0	0	11	3,303
NTT sub-total	62,188	484	152	137	21	794	62,982
Total	126,895	2,265	6,405	1,318	841	10,829	137,724

Source : NTB Dalam Angka, 1993
NTT Dalam Angka, 1993

Table 3.15 Number and Classification of KUD

Unit : number

Province/ Island/ Kabupaten	Class A	Class B	Class C	Not Classed	Un-classed	Total
NTB						
Lombok	33	23	21	0	0	77
Lombok Barat	11	7	3	0	0	21
Lombok Tengah	9	7	13	0	0	29
Lombok Timur	13	9	5	0	0	27
Sumbawa	17	28	28	0	0	73
Sumbawa	6	14	7	0	0	27
Dompu	7	3	9	0	0	19
Bima	4	11	12	0	0	27
Province	0	1	1	0	0	2
NTB sub-total	50	52	50	0	0	152
NTT						
Flores	59	6	0	3	0	68
Manggarai	9	5	0	3	0	17
Ngada	9	0	0	0	0	9
Ende	8	1	0	0	0	9
Sikka	10	0	0	0	0	10
Flores Timur	14	0	0	0	0	14
Alor	9	0	0	0	0	9
Sumba	13	8	0	0	0	21
Sumba Barat	5	8	0	0	0	13
Sumba Timur	8	0	0	0	0	8
Timor	37	17	1	3	3	61
Kupang	11	9	0	0	1	21
Timur Tengah Selatan	6	7	1	0	1	15
Timur Tengah Utara	8	0	0	3	0	11
Belu	12	1	0	0	1	14
Province	0	0	0	0	0	0
NTT sub-total	109	31	1	6	3	150
Total	159	83	51	6	3	302

Source : Laporan Tahunan Tahun NTB, 1992
NTT Kanwil Koperasi

Table 4.1 Main Existing Irrigation Project in Nusa Tenggara

Item \ Island		NTB			NTT				Total
		Lombok	Sumbawa	NTB Total	Timor	Flores	Sumba	NTT Total	
Total Area	(ha)	107,036	41,960	148,996	14,352	44,066	15,524	73,942	222,938
		100%	100%	100%	100%	100%	100%	100%	100%
(Water Source)									
- Weir / Free intake	(ha)	85,106	33,815	118,921	11,557	41,254	13,969	66,780	185,701
		80%	81%	80%	81%	94%	90%	90%	83%
- Embung / Dam	(ha)	21,930	8,145	30,075	2,548	347	497	3,392	33,467
		20%	19%	20%	18%	1%	3%	5%	15%
- Ground Water , /Spring	(ha)	0	0	0	247	2,465	1,058	3,770	3,770
		0%	0%	0%	2%	6%	7%	5%	2%
(Irrigation Grade)									
- Technical	(ha)	31,041	13,464	44,505	3,315	19,077	5,033	27,425	71,930
		29%	32%	30%	23%	43%	32%	37%	32%
- Semi-technical	(ha)	75,995	20,701	96,696	3,323	2,228	1,745	7,296	103,992
		71%	49%	65%	23%	5%	11%	10%	47%
- Non-technical	(ha)	0	7,795	7,795	7,714	22,761	8,746	39,221	47,016
		0%	19%	5%	54%	52%	56%	53%	21%

Source : PRIS in NTB and NTB

Table 4.2 Main Existing Irrigation Project in NTB (1/ 6)

LOMBOK - LOMBOK BARAT

No.	Project Name	Location		Irrigation Area (ha)	Water Source	Irrigation Grade	Crops
		Kabupateng	Kecamatang				
1	MATARAM	LOBAR	Mataram	540	W	S	Paddy/Paddy/Palawija
2	PAMOTAN	LOBAR	Mataram	265	W	S	Paddy/Paddy/Palawija
3	U N U S	LOBAR	Mataram	596	W	S	Paddy/Paddy/Palawija
4	PESONGORAN	LOBAR	Mataram	242	W	S	Paddy/Paddy/Palawija
5	SINDANGGILA	LOBAR	BAYAN	496	W	S	Paddy/Paddy/Palawija
6	SOPAK	LOBAR	BAYAN	407	W	S	Paddy/Paddy/Palawija
7	LOLOAN	LOBAR	BAYAN	500	W	S	Paddy/Paddy/Palawija
8	BATU RAKIT	LOBAR	BAYAN	190	W	S	Paddy/Palawija
9	SAMBIK JENGKEL	LOBAR	BAYAN	245	W	S	Paddy/Paddy/Palawija
10	SANTONG	LOBAR	TANJUNG	1323	W	T	Paddy/Paddy/Palawija
11	BAGIK KEMBAR	LOBAR	TANJUNG	565	W	T	Paddy/Palawija
12	REMPEK	LOBAR	TANJUNG	197	W	T	Paddy/Palawija
13	PEKATAN	LOBAR	TANJUNG	853	W	T	Paddy
14	MENGGALA	LOBAR	TANJUNG	135	W	T	Paddy/Paddy/Palawija
15	BENTEK	LOBAR	TANJUNG	14	W	S	Paddy/Paddy/Palawija
16	SANDIK	LOBAR	G.SARI	356	W	S	Paddy/Paddy/Palawija
17	GEGUTU	LOBAR	G.SARI	207	W	S	Paddy/Paddy/Palawija
18	PENIMBUNG	LOBAR	G.SARI	472	W	S	Paddy/Paddy/Palawija
19	MENJELI	LOBAR	G.SARI	169	W	S	Paddy/Paddy/Palawija
20	REPUK PANCOR	LOBAR	G.SARI	299	W	S	Paddy/Paddy/Palawija
21	TEMBELOK	LOBAR	G.SARI	211	W	S	Paddy/Paddy/Palawija
22	KELUNCING	LOBAR	G.SARI	548	W	S	Paddy/Paddy/Palawija
23	JUWET	LOBAR	G.SARI	456	W	S	Paddy/Paddy/Palawija
24	BERTAIS	LOBAR	NARMADA	163	W	S	Paddy/Paddy/Palawija
25	DASAN TERENG	LOBAR	NARMADA	220	W	S	Paddy/Paddy/Palawija
26	MENCONGAK	LOBAR	NARMADA	253	W	S	Paddy/Paddy/Palawija
27	NYURBAYE	LOBAR	NARMADA	449	W	S	Paddy/Paddy/Palawija
28	MONTANG	LOBAR	NARMADA	178	W	S	Paddy/Paddy/Palawija
29	SESAOT	LOBAR	NARMADA	1270	W	T	Paddy/Paddy/Palawija
30	KERU	LOBAR	NARMADA	844	W	T	Paddy/Paddy/Palawija
31	GEBONG	LOBAR	KEDIRI	4510	W	T	Paddy/Paddy/Palawija
32	DATAR	LOBAR	KEDIRI	634	W	T	Paddy/Paddy/Palawija
33	BATU RITI	LOBAR	KEDIRI	560	W	T	Paddy/Paddy/Palawija
34	BUM TOPENG	LOBAR	KEDIRI	191	W	S	Paddy/Paddy/Palawija
35	PESONGORAN KRP.	LOBAR	KEDIRI	209	W	S	Paddy/Paddy/Palawija
36	PELANGAN	LOBAR	KEDIRI	108	W	S	Paddy/Paddy/Palawija

Total Area (ha)	18,875
(Water Source)	
-Weir / free Intake (ha)	18,875
-Embung / Dam (ha)	0
(Irrigation Grade)	
-Technical (ha)	10,891
-Semi-technical (ha)	7,984
-Non technical (ha)	0

Note : (Water Source)
W : Weir / Free Intake
E : Embung / Dam
(Irrigation Grade)
T : Technical
S : Semi-technical
N : Non technical

Table 4.2 Main Existing Irrigation Project in NTB (2/6)

LOMBOK - LOMBOK TENGAH

No.	Project Name	Location		Irrigation Area (ha)	Water Source	Irrigation Grade	Crops
		Kabupateng	Kecamatang				
1	JURANG SATE	LOTENG	Pringgararata	4095	W	T	Paddy/Paddy/Palawija
			Puyung	6584	W	T	Paddy/Paddy/Palawija
2	BILE KERE	Loteng/Lobar	Pringgarata	380	W	T	Paddy/Paddy/Palawija
3	SIDEMEN	LOTENG	Mantang	613	W	S	Paddy/Paddy/Palawija
4	BENJOR	LOTENG	Mantang	188	W	S	Paddy/Paddy/Palawija
5	BRAMBANG	LOTENG	Mantang	195	W	S	Paddy/Paddy/Palawija
6	MESONE	LOTENG	Mantang	80	W	S	Paddy/Paddy/Palawija
7	WADUK WAO	LOTENG	Mantang	400	E	S	Paddy/Paddy/Palawija
8	GEDE BONGOH	LOTENG	Mantang	2644	W	S	Paddy/Paddy/Palawija
9	JENGGUAR	LOTENG	Mantang	293	W	S	Paddy/Paddy/Palawija
10	NEREDEP	LOTENG	Kopang	222	E	S	Paddy/Paddy/Palawija
11	TELAGA	LOTENG	Kopang	316	W	S	Paddy/Paddy/Palawija
12	PAOK RENGGA	LOTENG	Kopang	413	W	S	Paddy/Paddy/Palawija
13	BISOK BOKAH	Loteng/Lotim	Kopang	1218	E	S	Paddy/Paddy/Palawija
14	OTAK DESA	LOTENG	Kopang	300	W	S	Paddy/Paddy/Palawija
15	PAOK DENGKOL	LOTENG	Kopang	300	W	S	Paddy/Paddy/Palawija
16	GULE LIAT	LOTENG	Kopang	210	W	S	Paddy/Paddy/Palawija
17	RENGGUNG	LOTENG	Kopang	1692	W	S	Paddy/Paddy/Palawija
18	TAIN PETUK	LOTENG	Kopang	387	W	S	Paddy/Paddy/Palawija
19	MUNCAN	LOTENG	Kopang	324	W	S	Paddy/Paddy/Palawija
20	BENGAK	LOTENG	Jana pria	157	E	S	Paddy/Paddy
21	DANA SARI	LOTENG	Jana pria	210	E	S	Paddy
22	EMB.KUANG SAMPI	LOTENG	Jana pria	91	E	S	Paddy
23	LENDANG TELAGE	LOTENG	Jana pria	136	E	S	Paddy
24	JEBAK	LOTENG	Jana pria	99	E	S	Paddy
25	EGUSI	LOTENG	Jana pria	45	E	S	Paddy
26	PENYABUK	LOTENG	Jana pria	94	E	S	Paddy
27	EMBUNG BRENGE	LOTENG	Jana pria	350	E	S	Paddy
28	JONGKOR	LOTENG	Jana pria	15	E	S	Paddy
29	EMBUNG PAJERUK	LOTENG	Jana pria	63	E	S	Paddy
30	MELATI I	LOTENG	Jana pria	35	E	S	Paddy
31	EMB.MELATI II	LOTENG	Jana pria	25	E	S	Paddy
32	TASIK ASIK	LOTENG	Jana pria	25	E	S	Paddy
33	PEROK	LOTENG	Jana pria	35	E	S	Paddy
34	LOANG MAKE	LOTENG	Jana pria	100	E	S	Paddy
35	PELAPAK	LOTENG	Jana pria	621	W	S	Paddy
36	KATON	LOTENG	Sengkerang	3720	W	S	Paddy/Palawija
37	MUJUR I	LOTENG	Sengkerang	1175	W	S	Paddy/Palawija
38	TIBU NANGKA	LOTENG	Sengkerang	1800	W	S	Paddy/Paddy/Palawija
39	EMB. PARE	Loteng/Lotim	Sengkerang	244	W	S	Paddy/Palawija
40	PARUNG	LOTENG	Mujur	5593	E	S	Paddy/Palawija
41	MUJUR II	LOTENG	Mujur	3500	W	S	Paddy/Palawija
42	EMB.PENGKENIT	LOTENG	Mujur	300	E	S	Paddy/Palawija
43	EMB. GABAK	LOTENG	Mujur	250	E	S	Paddy/Palawija
44	EMB. TANTIH	LOTENG	Mujur	200	E	S	Paddy
45	EMB. GUA	LOTENG	Mujur	82	E	S	Paddy/Palawija
46	EMB. SEPIT	LOTENG	Mujur	175	E	S	Paddy/Paddy/Palawija
47	BATUJAI	Loteng/Lobar	Batujai	3560	E	T	Paddy/Paddy/Palawija
48	SURABAYA	LOTENG	Penujak	2839	W	T	Paddy/Palawija
49	BOMBAS	LOTENG	Penujak	206	E	S	Paddy
50	RUTUS	Loteng/Lotim	Jana pria	633	W	T	Paddy
51	WARENG	LOTENG	Mantang	80	W	S	Paddy/Palawija
52	SEPAKEK	LOTENG	Mantang	65	W	S	Paddy/Paddy/Palawija

Total Area (ha)	47,377
(Water Source)	
-Weir / Free intake (ha)	33,691
-Embung / Dam (ha)	13,686
(Irrigation Grade)	
-Technical (ha)	18,091
-Semi-technical (ha)	29,286
-Non technical (ha)	0

Note : (Water Source)
W : Weir / Free Intake
E : Embung / Dam
(Irrigation Grade)
T : Technical
S : Semi-technical
N : Non technical

Source : PRIS in NTB

Table 4.2 Main Existing Irrigation Project in NTB (3/6)

LOMBOK - LOMBOK TIMUR (1/2)

No.	Project Name	Location		Irrigation Area (ha)	Water Reource	Irrigation grade	Crops
		Kabupateng	Kecamatang				
1	PELAPAK	LOTIM	Sepit	1321	W	S	Paddy
2	GEGE I	LOTIM	Terara	67	W	S	Paddy/Paddy/Palawija
3	SELAK EAT	LOTIM	Terara	171	W	S	Paddy/Paddy/Palawija
4	TETE KOPONG	LOTIM	Terara	305	W	S	Paddy/Paddy/Palawija
5	TEMUSIK	LOTIM	Terara	654	W	S	Paddy/Paddy/Palawija
6	CAMIK	LOTIM	Terara	313	W	S	Paddy/Paddy/Palawija
7	TERARA	LOTIM	Terara	277	W	S	Paddy/Paddy/Palawija
8	MARE	LOTIM	Terara	471	E	S	Paddy/Paddy/Palawija
9	KANDONG	LOTIM	Terara	389	E	S	Paddy/Palawija
10	RUTUS	LOTIM	Terara	1040	W	T	Paddy/Palawija
11	PELOLAT	LOTIM	Terara	297	W	S	Paddy/Paddy/Palawija
12	TEMILING	LOTIM	Terara	233	W	S	Paddy/Paddy/Palawija
13	JOGOK	LOTIM	Terara	599	W	S	Paddy/Palawija
14	PUNGKANG	LOTIM	Terara	315	E	S	Paddy/Palawija
15	PANDAN DURI	LOTIM	Sepit	2720	E	S	Paddy
16	SUANGI	LOTIM	Sepit	2604	E	S	Paddy
17	TUNDAK	LOTIM	Sepit	729	E	S	Paddy
18	PENENDEN	LOTIM	Sepit	868	W	S	Paddy
19	PELAMBIK	LOTIM	Sepit	467	W	S	Paddy
20	PARA	LOTIM	Sepit	300	W	S	Paddy
21	BILA REMONG	LOTIM	Sepit	300	W	S	Paddy
22	BANGKA	LOTIM	Sakra	265	W	S	Paddy/Paddy/Palawija
23	BOROK LELET	LOTIM	Sakra	576	W	S	Paddy/Paddy/Palawija
24	JIMSA	LOTIM	Sakra	111	W	S	Paddy/Paddy/Palawija
25	KANGKEK LEPANG	LOTIM	Sakra	233	W	S	Paddy/Palawija
26	REBAN TALAT	LOTIM	Sakra	213	W	S	Paddy/Palawija
27	SAKRA	LOTIM	Sakra	1859	W	S	Paddy/Palawija
28	RUNGKANG	LOTIM	Sakra	686	W	S	Paddy/Paddy/Palawija
29	SIKUR	LOTIM	Sakra	800	W	S	Paddy/Paddy/Palawija
30	ENDUT	LOTIM	Sakra	230	W	S	Paddy/Paddy/Palawija
31	SADAR	LOTIM	Sakra	281	W	S	Paddy/Paddy/Palawija
32	PERESAK SIREN	LOTIM	Sakra	167	W	S	Paddy
33	LENTING	LOTIM	Sakra	220	W	S	Paddy
34	KUANG DEREK	LOTIM	Sakra	252	W	S	Paddy
35	MONTONG TANGI	LOTIM	Sakra	305	W	T	Paddy
36	KONDAK	LOTIM	Sakra	508	W	S	Paddy
37	REBAN WARU	LOTIM	Sakra	204	W	S	Paddy
38	Surabaya Lepak	LOTIM	Sakra	199	W	S	Paddy
39	TOJANG	LOTIM	Selong	136	W	S	Paddy/Paddy/Palawija
40	KERUAK	LOTIM	Selong	130	W	S	Paddy/Paddy/Palawija
41	RUGAH	LOTIM	Selong	69	W	S	Paddy/Paddy/Palawija
42	AIK ANYAR	LOTIM	Selong	215	W	S	Paddy/Palawija/Palawija
43	BEREMBUN	LOTIM	Selong	166	E	S	Paddy/Palawija/Palawija
44	SEMBA	LOTIM	Selong	360	W	S	Paddy/Palawija/Palawija
45	Dasan Lekong	LOTIM	Selong	213	W	T	Paddy/Palawija/Palawija
46	SANGKON	LOTIM	Selong	52	W	S	Paddy/Paddy/Palawija
47	REBAN TEBU	LOTIM	Selong	121	W	T	Paddy/Palawija/Palawija
48	BELEONG	LOTIM	Selong	290	W	S	Paddy/Paddy/Palawija
49	LEDANG	LOTIM	Selong	265	W	S	Paddy/Palawija/Palawija
50	Bagik Longgik	LOTIM	Selong	201	W	S	Paddy/Palawija/Palawija
51	ESOT	LOTIM	Selong	231	W	S	Paddy/Palawija/Palawija
52	PENEDE Ia	LOTIM	Selong	65	W	S	Paddy/Palawija/Palawija
53	PENEDE II	LOTIM	Selong	200	W	S	Paddy/Palawija/Palawija
54	Damar jengkang	LOTIM	Selong	40	W	S	Paddy/Paddy/Palawija
55	AMBUNG	LOTIM	Selong	100	W	S	Paddy/Paddy/Palawija
56	JANTUK	LOTIM	Selong	216	W	S	Paddy/Palawija/Palawija
57	PENGADANGAN	LOTIM	Lenek	380	W	T	Paddy/Paddy/Palawija
58	TEMPASAN	LOTIM	Lenek	300	W	S	Paddy/Paddy/Palawija
59	Pringga Sela	LOTIM	Lenek	640	W	S	Paddy/Paddy/Palawija
60	TEBABAN	LOTIM	Lenek	270	W	S	Paddy/Paddy/Palawija
61	Paok Pondong	LOTIM	Lenek	129	W	S	Paddy/Paddy/Palawija
62	Bagik Tungka	LOTIM	Lenek	250	W	S	Paddy/Paddy/Palawija
63	Loang Gali	LOTIM	Lenek	170	W	S	Paddy/Paddy/Palawija
64	Batu Malang	LOTIM	Lenek	514	W	S	Paddy/Paddy/Palawija
65	As Malang	LOTIM	Lenek	254	W	S	Paddy/Paddy/Palawija
66	PELENENG	LOTIM	Lenek	302	W	S	Paddy/Paddy/Palawija
67	IJOBALIT	LOTIM	Lenek	25	W	S	Paddy/Paddy/Palawija
68	ANJANI	LOTIM	Lenek	315	W	S	Paddy/Paddy/Palawija
69	KERONGKONG	LOTIM	Lenek	669	W	S	Paddy/Paddy/Palawija

Source : PRIS in NTB

Table 4.2 Main Existing Irrigation Project in NTB (4/6)

LOMBOK - LOMBOK TIMUR (2/2)

No.	Project Name	Location		Irrigation Area (ha)	Water Reource	Irrigation grade	Crops
		Kabupateng	Kecamatang				
70	GAPUK	LOTIM	Lenek	458	W	S	Paddy/Paddy/Palawija
71	MAMBEN	LOTIM	Wanasaba	496	W	S	Paddy/Paddy/Palawija
72	KUKUSAN	LOTIM	Wanasaba	2864	W	S	Paddy/Palawija/Palawija
73	RENGA	LOTIM	Wanasaba	305	W	S	Paddy/Paddy/Palawija
74	Paok Dangka	LOTIM	Wanasaba	259	W	S	Paddy/Paddy/Palawija
75	BEBIDAS	LOTIM	Wanasaba	288	W	S	Paddy/Paddy/Palawija
76	Lokak Bau	LOTIM	Wanasaba	331	W	S	Paddy/Palawija/Palawija
77	Suntalangu	LOTIM	Wanasaba	160	E	S	Paddy/Palawija/Palawija
78	WD. Kembar	LOTIM	Wanasaba	367	E	S	Paddy/Palawija/Palawija
79	SONGGEN	LOTIM	Wanasaba	328	W	S	Paddy/Paddy/Palawija
80	KEDATUK	LOTIM	Wanasaba	176	W	S	Paddy/Paddy/Palawija
81	SAMBELIA	LOTIM	Sambalia	1665	W	S	Paddy/Palawija/Palawija
82	BELANTING	LOTIM	Sambalia	886	W	S	Paddy/Palawija/Palawija
83	Lendang Tinggi	LOTIM	Sambalia	215	W	S	Paddy
84	Lendang Guar	LOTIM	Sambalia	243	W	S	Paddy
85	Timba Gading	LOTIM	Sambalia	415	W	S	Paddy/Palawija
86	Obel-obel	LOTIM	Sambalia	364	W	S	Paddy/Palawija/Palawija
87	GEGE II	LOTIM	Terara	159	W	S	Paddy/Palawija/Palawija
88	GEGE III	LOTIM	Terara	146	W	S	Paddy/Palawija/Palawija
89	GN. PAOK	LOTIM	Terara	98	E	S	Paddy/Paddy/Palawija
90	LEKAK	LOTIM	Terara	80	W	S	Paddy/Palawija/Palawija
91	BANGLE	LOTIM	Terara	45	W	S	Paddy/Paddy/Palawija
92	SUNDI	LOTIM	Terara	50	W	S	Paddy/Palawija/Palawija
93	TRIDAYA	LOTIM	Terara	138	E	S	Paddy/Palawija/Palawija
94	PENGGEK	LOTIM	Terara	75	E	S	Paddy/Palawija
95	BANOK	LOTIM	Terara	12	E	S	Paddy/Palawija
96	KEPAK	LOTIM	Sakra	88	W	S	Paddy/Palawija
97	Udang Karapan	LOTIM	Selong	35	W	S	Paddy/Palawija/Palawija
98	Ganang	LOTIM	Selong	147	W	S	Paddy/Palawija/Palawija
99	Peneda Ib	LOTIM	Selong	221	W	S	Paddy/Palawija/Palawija
100	Tibu Pandan	LOTIM	Wanasaba	300	W	S	Paddy/Paddy/Palawija
101	Padanara	LOTIM	Wanasaba	163	W	S	Paddy/Palawija/Palawija
102	BANDAR	LOTIM	Wanasaba	80	W	S	Paddy/Palawija/Palawija
103	LEMBAK	LOTIM	Wanasaba	290	W	S	Paddy/Paddy/Palawija

Total	Area (ha)	40,784
	(Water Source)	
	-Weir / Free intake (ha)	32,540
	-Embung / Dam (ha)	8,244
	(Irrigation Grade)	
	-Technical (ha)	2,059
	-Semi-technical (ha)	38,725
	-Non technical (ha)	0

Note : (Water Source)
W : Weir / Free Intake
E : Embung / Dam
(Irrigation Grade)
T : Technical
S : Semi-technical
N : Non technical

Source : PRIS in NTB

Table 4.2 Main Existing Irrigation Project in NTB (5/6)

SUMBAWA - SUMBAWA

No.	Project Name	Location		Irrigation Area (ha)	Water Source	Irrigation Grade	Crops
		Kabupaten	Kecamatan				
1	AIK PUTIK	Sumbawa	Utan Rhee	195	W	S	Paddy/Palawija
2	TARUSAN	Sumbawa	Utan Rhee	343	W	S	Paddy/Palawija/Palawija
3	Beringin Sila	Sumbawa	Utan Rhee	1086	W	S	Paddy/Palawija/Palawija
4	Juru Mapin	Sumbawa	ALAS	286	W	S	Paddy/Palawija
5	TARUSA I	Sumbawa	ALAS	240	W	S	Paddy/Palawija
6	MARENTEH	Sumbawa	ALAS	333	W	S	Paddy/Palawija
7	Penringganis	Sumbawa	ALAS	560	W	S	Paddy/Palawija/Palawija
8	LEKONG	Sumbawa	ALAS	389	W	N	Paddy/Palawija/Palawija
9	Timu Bulu	Sumbawa	ALAS	612	W	N	Paddy/Palawija
10	Timu Kawa	Sumbawa	Taliwang	650	W	S	Paddy/Palawija/Palawija
11	Reban Batu	Sumbawa	Taliwang	365	W	S	Paddy
12	Kalimantong I	Sumbawa	Taliwang	1501	W	S	Paddy/Palawija/Palawija
13	Kalimantong II	Sumbawa	Taliwang	250	W	N	Paddy
14	Elang Desa	Sumbawa	Taliwang	316	W	S	Paddy/Palawija/Palawija
15	Plampo'o	Sumbawa	Taliwang	316	W	S	Paddy/Palawija
16	PUNGKA	Sumbawa	M o y o	185	W	S	Paddy/Paddy/Palawija
17	A J I	Sumbawa	M o y o	574	W	S	Paddy/Paddy/Palawija
18	M O Y O	Sumbawa	M o y o	621	W	S	Paddy/Paddy
19	KAKIANG	Sumbawa	M o y o	1289	W	T	Paddy/Palawija/Palawija
20	PUNGKIT	Sumbawa	Lape Lopok	1340	W	T	Paddy/Palawija/Palawija
21	M A M A K	Sumbawa	Lape Lopok	3899	E	T	Paddy/Palawija/Palawija
22	KWANG RAKO	Sumbawa	Lape Lopok	500	W	N	Paddy/Palawija
23	PEMASAR	Sumbawa	Empang	320	W	N	Paddy/Palawija
24	MARONGE	Sumbawa	Empang	819	W	N	Paddy
25	BRANG KOLONG	Sumbawa	Empang	175	W	S	Paddy
26	EMBUNG MUER	Sumbawa	Empang	287	E	T	Paddy/Palawija/Palawija
27	EMBUNG SELANTEL	Sumbawa	Empang	612	E	T	Paddy/Palawija/Palawija
28	SEJARI	Sumbawa	Empang	110	W	S	Paddy/Palawija/Palawija
29	U S A R	Sumbawa	Empang	800	W	S	Paddy/Palawija
30	P A R I A	Sumbawa	Empang	272	W	S	Paddy/Palawija/Palawija
31	SEMANGI	Sumbawa	Empang	578	W	S	Paddy/Palawija/Palawija

Total Area (ha)	19,823
(Water Source)	
-Weir / Free intake (ha)	15,025
-Embung / Dam (ha)	4,798
(Irrigation Grade)	
-Technical (ha)	7,427
-Semi-technical (ha)	9,506
-Non technical (ha)	2,890

Note : (Water Source)
W : Weir / Free Intake
E : Embung / Dam
(Irrigation Grade)
T : Technical
S : Semi-technical
N : Non technical

Source : PRIS in NTB

SUMBAWA -DOMPU

No.	Project Name	Location		Irrigation Area (ha)	Water Source	Irrgation Grade	Crops
		Kabupateng	Kecamatang				
1	K A T U A	DOMPU	Dompu Timur	1009	W	T	Paddy/Paddy/Palawija
2	RAHALAYU	DOMPU	Dompu Timur	500	W	T	Paddy/Paddy/Palawija
3	SAKOLO	DOMPU	Dompu Timur	330	W	T	Paddy/Paddy/Palawija
4	L A J U	DOMPU	Dompu Timur	1002	W	T	Paddy/Palawija/Palawija
5	B A K A	DOMPU	Dompu Timur	2440	W	T	Paddy/Palawija/Palawija
6	NAE KEMPO	DOMPU	Dompu Timur	510	W	S	Paddy/Palawija/Palawija
7	PATULA	DOMPU	Dompu Timur	342	W	T	Paddy/Palawija/Palawija
8	KADINDI	DOMPU	Dompu Timur	1260	W	S	Paddy/Palawija/Palawija
9	SANGGOPA	DOMPU	Dompu Timur	400	E	S	Paddy/Palawija/Palawija
10	LAE RANGGO	DOMPU	Dompu Timur	638	W	S	Paddy/Palawija/Palawija
11	SAMBANA	DOMPU	Dompu Timur	414	W	T	Paddy/Palawija/Palawija

Total Area (ha)	8,845
(Water Source)	
-Weir / Free intake (ha)	8,445
-Embung / Dam (ha)	400
(Irrigation Grade)	
-Technical (ha)	6,037
-Semi-technical (ha)	2,808
-Non technical (ha)	0

Note : (Water Source)
W : Weir / Free Intake
E : Embung / Dam
(Irrigation Grade)
T : Technical
S : Semi-technical
N : Non technical

Source : PRIS in NTB

Table 4.2 Main Existing Irrigation Project in NTB (6/6)

SUMBAWA - BIMA

No.	Project Name	Location		Irrigation Area (ha)	Water Source	Irrgation Grade	Crops
		Kabupateng	Kecamatang				
1	RORA KECIL	B I M A	B o l o	170	W	S	Pady/Palawija 2x
2	MADA PANGGA	B I M A	B o l o	400	W	S	Pady/Palawija 2x
3	MORI RADE	B I M A	B o l o	307	W	S	Pady/Palawija 2x
4	L E B O	B I M A	B o l o	117	W	S	Pady/Palawija 2x
5	NCANGAKAI	B I M A	B o l o	725	W	S	Pady/Palawija 2x
6	N C O H A	B I M A	B o l o	334	W	S	Pady/Palawija 2x
7	NDANO RANGGA	B I M A	B o l o	275	W	S	Pady/Palawija 2x
8	DIWU TANGIRI	B I M A	B o l o	300	W	N	Pady/Palawija 2x
9	OIKAWA	B I M A	B o l o	42	W	N	Pady/Palawija 2x
10	BONTOKAPE	B I M A	B o l o	505	W	N	Pady/Palawija 2x
11	SORI MONCA	B I M A	B o l o	150	W	N	Pady/Palawija 2x
12	TALOKO	B I M A	B o l o	341	W	S	Pady/Palawija 2x
13	PELA CEMPAKA	B I M A	W o h a	337	W	S	Pady/Palawija 2x
14	S I E	B I M A	W o h a	181	W	N	Pady/Palawija 2x
15	PARADO	B I M A	W o h a	1040	W	S	Pady/Palawija 2x
16	KALATE	B I M A	W o h a	968	W	S	Pady/Palawija 1x
17	TONGGONDOA	B I M A	W o h a	672	W	N	Pady/Palawija 2x
18	L E K A	B I M A	W o h a	350	W	N	Pady/Palawija 2x
19	KARANU NTONGGU	B I M A	W o h a	566	W	N	Pady/Palawija 2x
20	EMBUNG ROI	B I M A	Rasa Nae	803	E	S	Pady/Palawija 2x
21	RONTU	B I M A	Rasa Nae	273	W	S	Pady/Palawija 2x
22	NUNGGA	B I M A	Rasa Nae	241	W	S	Pady/Palawija 2x
23	S A L O	B I M A	Rasa Nae	53	W	S	Pady/Palawija 2x
24	SATAMPA	B I M A	Rasa Nae	33	W	N	Pady/Palawija 2x
25	D A D I	B I M A	Rasa Nae	78	W	N	Pady/Palawija 1x
26	KENCINTOBO	B I M A	Rasa Nae	160	W	N	Pady/Palawija 2x
27	SANGGA	B I M A	Rasa Nae	50	E	N	Pady/Palawija 2x
28	NGGARO RANGGA	B I M A	Rasa Nae	150	E	N	Pady/Palawija 1x
29	RABA PONDA	B I M A	Rasa Nae	130	E	N	Pady/Palawija 2x
30	D O D U	B I M A	Rasa Nae	225	E	N	Pady/Palawija 2x
31	NAE WERA	B I M A	S a p e	436	E	N	Pady/Palawija 2x
32	S A R I	B I M A	S a p e	475	E	N	Pady/Palawija 2x
33	S A P E	B I M A	S a p e	678	E	S	Pady/Palawija 2x
34	W U W U	B I M A	S a p e	302	W	N	Pady/Palawija 2x
35	S U M I	B I M A	S a p e	725	W	S	Pady/Palawija 2x
36	SAMBU	B I M A	S a p e	100	W	N	Pady/Palawija 1x
37	DIWUSADUNDU	B I M A	S a p e	600	W	S	Pady/Palawija 2x

Total	Area (ha)	13,292
	(Water Source)	
	-Weir / Free intake (ha)	10,345
	-Embung / Dam (ha)	2,947
	(Irrigation Grade)	
	-Technical (ha)	0
	-Semi-technical (ha)	8,387
	-Non technical (ha)	4,905

Note : (Water Source)
W : Weir / Free Intake
E : Embung / Dam
(Irrigation Grade)
T : Technical
S : Semi-technical
N : Non technical

Source : PRIS in NTB