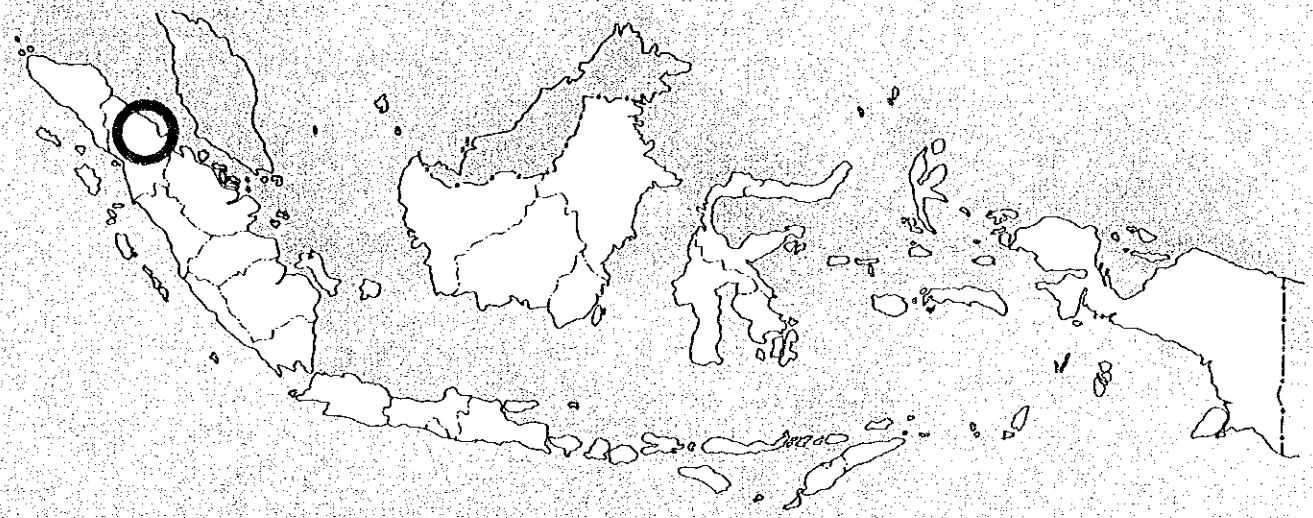
MASTER PLAN STUDY ON LOWER ASAHAN RIVER BASIN DEVELOPMENT

Volume 1

Main Report



July 1990

REPUBLIC OF INDONESIA
MINISTRY OF PUBLIC WORKS
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT

MASTER PLAN STUDY ON LOWER ASAHAN RIVER BASIN DEVELOPMENT

Volume 1

Main Report

July 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

LIST OF REPORTS

Volume 1 Main Report

Volume 2 Flood Control Plan (Part-I study)
(Reprinted from previous Interim Report submitted in October 1985)

Volume 3 Agricultural Development Plan
(Stage 1 of Part-II study)

Volume 4 In-depth Study on the Silau-Bunut Rehabilitation Irrigation Project
(Stage 2 of Part-II study)

PREFACE

In response to a request from the Government of the Republic of Indonesia, the Japanese Government decided to conduct a Master Plan Study for the Lower Asahan River Basin Development Project and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Indonesia a Part-I survey team headed by Mr. Makoto Tsuda, Nippon Koei Co, Ltd. twice from October, 1984 to October, 1985, and a Part-II survey team headed by Mr. Yasuhiko Kunihiro, Nippon Koei Co, Ltd. three times from June, 1989 to March, 1990.

The team held discussions with the concerned officials of the Government of Indonesia, and conducted field surveys. After the team returned to Japan, further studies were made and the present report was prepared.

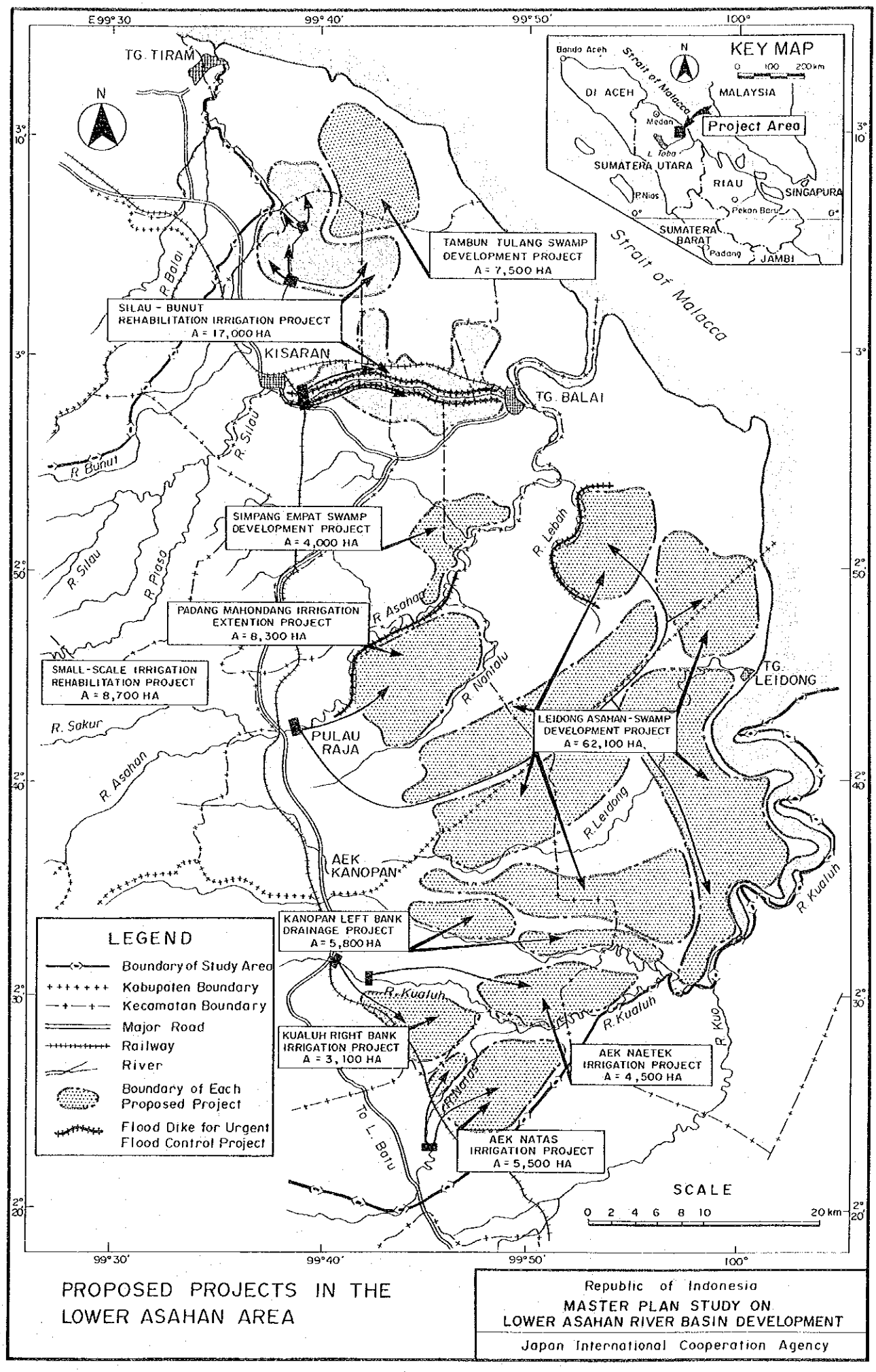
I hope that this report will contribute to the promotion of the Project and to the enhancement of friendly relations between our two countries.

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

July, 1990

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

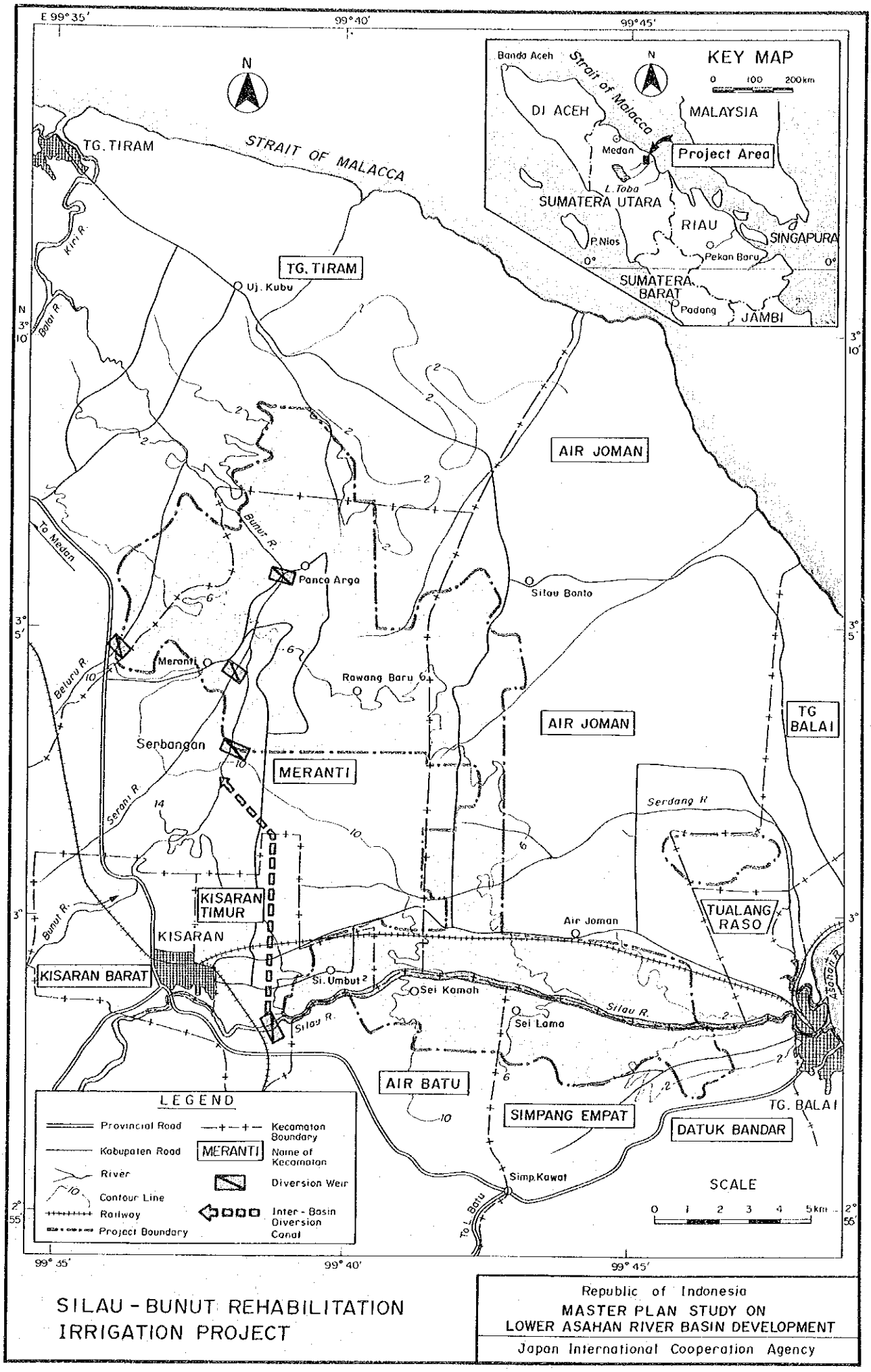


PROPOSED PROJECTS IN THE LOWER ASAHAN AREA

Republic of Indonesia

MASTER PLAN STUDY ON LOWER ASAHAN RIVER BASIN DEVELOPMENT

Japan International Cooperation Agency



SILAU - BUNUT REHABILITATION IRRIGATION PROJECT

Republic of Indonesia
MASTER PLAN STUDY ON
LOWER ASAHAN RIVER BASIN DEVELOPMENT
Japan International Cooperation Agency

SUMMARY

1. Objective of the Study

The objective of the Study has been to prepare a master plan on the lower Asahan river basin development covering the period up to the year 2005 from the viewpoint of such long-range policies as raising productivity, creating employment opportunities, promoting transmigration and improving living standards in the region.

2. Performance of the Study

The Study was carried out in accordance with the Scope of Work agreed on July 27, 1984 between the Japan International Cooperation Agency (JICA) and the Directorate General of Water Resources Development (DGWRD), Ministry of Public Works, the Government of the Republic of Indonesia. The Study was conducted in two parts, Part-I and Part-II.

The aim of the Part-I study was to: (i) establish the basic direction for land and water resources development; (ii) formulate a master plan for flood mitigation in the low-lying areas in the Asahan and adjacent river basins; and (iii) conduct a feasibility study for the most urgent flood control projects. The Part-I study was commenced in October 1984 and completed in September 1985. The results of the Part-I study were compiled in the Interim Report and submitted to DGWRD in October 1985.

The Government of Indonesia commenced the detailed design for the most urgent flood control projects in March 1988 in accordance with recommendations of the Part-I study and completed the works in June 1989. This detailed design was performed by the Directorate of Rivers, DGWRD with a financial assistance from OECF, Japan. The objective rivers for the Urgent Flood Control Project are the Asahan river, the Silau river, and the Lebah river.

The Part-II study was carried out mainly to establish the agricultural development master plan, in line with the flood control master plan proposed in the Part-I study. However the Part-II study was postponed for about four years and was started in June 1989. The Part-II study was done stagewise. Preparation of the master plan for agricultural development including the priority sequence of the projects was finished by the end of September. The highest priority project was selected in the master plan. The in-depth study for the selected project was commenced in October 1989 and finished by the end of March, 1990.

This report presents the results of the whole study in four volumes as follows;

Volume 1	*Main Report*
Volume 2	*Flood Control Plan (Part-I study)*
Volume 3	*Agricultural Development Plan (Stage 1 of Part-II study)*
Volume 4	*In-depth Study on the Silau-Bunut Rehabilitation Irrigation Project (Stage 2 of Part-II study)*

3. Study Area

The study area is located in the east-central part of North Sumatra province, at 150 km southeast of Medan, the capital of the province. The study area has four main river basins. The annual rainfall is about 1,500 to 3,500 mm. The study area enjoys ample water resources, but suffers from floods.

The population in the study area is about 860,000 in 1987. The main industry in the study area is agriculture, especially rice and tree crops. The land resources in the study area have been well utilized for agriculture, except for the virgin swamp of about 100,000 ha.

The study area has some of the lowest agricultural productivity in North Sumatra province. The unit yield of paddy is low due to natural

disasters and poor farming technology. The present cropping intensity is low and the farm size per farm household is less than one ha, so that the farmers' economy remains at the subsistence level. It is necessary to raise farmers' income levels through enhancement of agriculture, especially through rice production.

In the study area, provision of social infrastructures has only been concentrated in urban areas and is less in the rural areas. These are the constraints against economic development in rural areas.

4. Flood Control Plan

The flood control master plan in the study area covers four major rivers, the Bunut, the Silau, the Asahan and the Kualuh including the Kanopan. After a study of flood discharge, past flood damage and the economy of flood mitigation, a criterion of a 30-year design flood was adopted for the formulation of flood control plans in the master plan.

The proposed flood control plans for the Bunut, the Silau and the Kualuh rivers comprise construction of dikes and excavation of river channels. For Asahan river a combination of channel improvement and a provision of a retarding basin was proposed. The flood control works proposed in the master plan are: (i) 34 km channel improvement for the Bunut river; (ii) 40 km channel improvement for the Asahan river; (iii) 18 km dike construction for the Lebah river; (iv) 22 km channel improvement for the Silau river; and (v) the 46 km dike construction for the Kualuh river.

Construction cost of the proposed flood control projects is estimated at Rp.12,600 million for the Bunut, Rp.63,500 million for the Asahan and Silau and Rp.20,500 million for the Kualuh at 1985 price. The flood control benefit is estimated at Rp.1,840 million for the Bunut, Rp.11,700 million for the Asahan and Silau and Rp.3,100 million for the Kualuh. The estimated economic internal rate of return is 11.9 % for the Bunut, 14.3 % for the Asahan and Silau and 12.3 % for the Kualuh.

Following the master plan, a feasibility study of the flood control project for the downstream reaches of the Asahan and the Silau rivers was carried out in order to make an urgent flood control plan to meet the urgent need to mitigate vast and frequent flood damage which occurs in the area. A criterion of 10-year design flood was adopted in the plan based on the analysis on an economic viability for the plan.

In this urgent flood control project it is proposed that 57 km of the river channel of the Asahan and the Silau rivers be improved. The proposed improvement works include: (i) construction of a dike 19 km long on the right bank of the Asahan, (ii) construction of a dike 18 km long on the right bank of the Lebah for a retarding basin, and (iii) channel improvement for 19 km in the Silau by excavation of the channel and construction of dikes on both banks to secure 10-year flood flows.

The construction cost of the urgent flood control project is estimated at Rp.36,500 million at 1985 price. The average annual benefit is estimated at about Rp.5,100 million. The estimated economic internal rate of return of the project is 12.4 % which indicates that the project is economically feasible.

Based on the results of the feasibility study, the Government of Indonesia decided as a matter of urgency to carry out detailed design for "the Lower Asahan River Flood Control Project". This was completed in June 1989.

5. *Agricultural Development Plan*

The agricultural development master plan in the study area was formulated in line with the flood control master plan. Based on the evaluation of the land and water resources development potential in the study area, the potential area for agricultural development in the study area was evaluated to be 178,700 ha in gross consisting of existing paddy fields of 68,200 ha, virgin swamp area of 107,700 ha, and unused dry lands of 2,800 ha.

The agricultural development master plan was formulated with the objectives of: (i) raising farmers' income levels through enhancement of agricultural production, especially in rice by efficient use of land and water resources in the study area; and (ii) contributing to the regional need to achieve self-sufficiency in rice in North Sumatra province.

To realize the objectives mentioned above, irrigation, drainage and swamp development projects were formulated on the basis of the following basic considerations to: (i) assure double cropping of paddy per year by the maximum use of available water resources for irrigation; (ii) introduce an inter-basin water transfer system from the Silau to the Bunut river basins for efficient use of water resources; (iii) develop swamp lands for paddy cultivation; (iv) develop swamp lands for oil palm cultivation where the irrigation water is not available or the soil is deep peat soil; and (v) upgrade social infrastructures in rural areas, especially rural road networks.

Through an evaluation of development potential and the considera-tions above, the following ten (10) projects have been formulated in the study area:

(1) Silau-Bunut rehabilitation irrigation project
(2) Padang Mahondang irrigation extension project
(3) Kanopan left bank drainage improvement project
(4) Small-scale irrigation package project
(5) Aek Natas irrigation project
(6) Aek Naetek irrigation project
(7) Kualuh right bank irrigation project
(8) Tambun Tulang swamp development project
(9) Simpang Empat swamp development project
(10) Leidong-Asahan swamp development project

To evaluate the proposed ten projects and to determine priority ranking to select a project for urgent implementation, three criteria were applied: (i) the economic internal rate of return for the project should be higher; (ii) construction cost per ha should be lower; and (iii)

the number of beneficiaries should be greater. As a result, the Silau-Bunut rehabilita-tion irrigation project was selected as the highest priority project, followed by the Padang Mahondang irrigation extension project.

The target for increase of rice production in the study area is proposed to be 10 % of the provincial target of paddy production increase (1.2 million tons) in the year 2005. To meet the target, the Silau-Bunut rehabilitation irrigation project and the Padang Mahondang irrigation extension project were proposed to be implemented by the year 2005.

In the official meeting held on October 9, 1989, it was decided that the in-depth study (feasibility level) on the Silau-Bunut rehabilitation irrigation project should be undertaken.

6. *In-depth Study on the the Silau-Bunut Rehabilitation Irrigation Project*

The project area lies in the northwest of the lower Asahan river basin about 150 km southeast of Medan. Based on the assessment of drainability, water source, soil condition, land use condition and irrigability, the project area is delineated to be 14,300 ha in gross with net paddy field of 10,300 ha.

The main constraints for agricultural development in the project area are: (i) frequent inundation of the downstream reaches of the Silau and the Bunut river; (ii) low provision level of irrigation facilities and deterioration/malfunction of the existing irrigation and drainage facilities; (iii) absolute shortage of available water during the dry season in the Bunut river; and (iv) lack of proper water management. As a result, the present unit yield of crops is low and the annual cropping intensity is only about 120 %.

The agricultural development plan for the Silau-Bunut rehabilitation irrigation project was formulated in line with objectives

and strategy proposed in the overall agricultural development plan in the lower Asahan river basin. Double cropping of paddy per year under proper irrigated farming is proposed.

The proposed project works consist of:

(i) construction of an integrated diversion weir on the Silau;
(ii) construction of a 8.3 km inter-basin water transfer canal from the Silau to the Bunut;
(iii) reha-bilitation of 3 existing weirs on the Bunut;
(iv) 60 km rehabilitation and 110 km new construction of irrigation canals;
(v) rehabilitation/new construction of drainage canals of 180 km long;
(vi) construction of farm road network of 350 km long;
(vii) construction of Bunut flood dike of 34 km long;
(viii) construction of on-farm facilities for about 9,500 ha;
(ix) land reclamation for coconut fields of 670 ha in net;
(x) construction of agri-business quarter at 70 sites;
(xi) procurement of O&M equipment; and
(xii) provision of training for O&M staff and farmers.

The project works are planned to be implemented in about 7 years including detailed design and pre-construction arrangement for 2.5 years. The total project cost is estimated at Rp.157,310 million consisting of Rp.57,270 million for the local currency portion and Rp.100,040 million (US$ 56.5 million) for the foreign currency portion.

When the project is in the full operation, 109,300 tons of paddy will be produced annually. The irrigation benefit at the full development stage is estimated at Rp.15,600 million. The flood control benefit is estimated at Rp.7,970 million. The negative benefit which is expected to accrue on the cultivated land to be acquired for the construction of project works is estimated at Rp.665 million.

The economic internal rate of return of the project is estimated to be 13.2 % assuming a useful life of 50 years. The sensitivity test for

possible adverse changes in the future indicates that economic viability of the project is rather insensitive. It is concluded that the project is not only technically sound but also economically feasible.

Financial analysis of the project was made by analysis of the farm budget of typical farmers and preparation of a cash flow statement for repayment of the project cost. It is expected that the net reserve or capacity to pay for the farmers ranges from Rp.1.0 million to Rp.3.2 million. These net reserves will provide incentives to the farmers in the project area. Since no financial revenue is expected from the project, the Government should annually subsidize about Rp.8,000 to 10,000 million for loan repayment, loan service fee and O&M cost during the repayment period.

In addition to direct project benefits, various positive or negative socio-economic impacts are expected from implementation of the project. There are 17 project impacts predicted. Of these, the main positive impacts will be the increase in employment opportunities, the increase in farmer's income, the improved living standards of farmers, the increase of rice production and foreign exchange saving, and the betterment of sanitation.

The main negative impacts are impacts during the construction stage such as speculation in land, land acquisition, loss of agricultural production,etc. It is concluded that these predicted negative impacts would not be serious to the local people in the project area.

7. Recommendations

The Silau-Bunut rehabilitation irrigation project is technically sound and economically feasible. This project will provide substantial and sustainable socio-economic benefits not only within the project area but also for the region and nation as a whole. Thus, it is recommended that this project be implemented as early as possible in parallel with the implementation of the flood control project for the Silau for which the detailed design has already been completed.

Following the flood control project for the Asahan river and the Silau-Bunut rehabilitation irrigation project, a feasibility study on the Padang Mahondang irrigation extension project will be initiated so as to meet the requirement of completing its development by the target year of 2005.

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TABLES

FIGURES

GLOSSARY OF TERMS AND ABBREVIATIONS

BAPPEDA	-	Badan Perencanaan Pembangunan Daerah (Provincial Development Planning Board)
BAPPENAS	-	Badan Perencanaan Pembanguanan Nasional (National Development Planning Board)
BIMAS	-	Bimbingan Massal
BPP	-	Balai Penyuluhan Pertanian (Rural Extension Center)
BRI	-	Bank Rakyat Indonesia (People's Bank of Indonesia)
BRIUD	-	Bank Rakyat Indonesia Unit Desa (Village branch of BRI)
Bupati	-	District Chief, Head of Kabupaten
Cabang Dinas	-	PU Seksi, (Administrative area for irrigation with the PU-Wilayah)
Camat	-	Sub-district Chief, Head of Kecamatan
CRIFC	-	Central Research Institute for Food Crops
CS	-	Construction supervision
Desa	-	Village or group of small villages
DGFCA	-	Director General of Food Crops Agriculture, Ministry of Agriculture
DGWRD	-	Directorate General of Water Resources Development, Ministry of Public Works
DIP	-	Project Implementation Budget
DOI	-	Directorate of Irrigation
DPU	-	Departemen Pekerjaan Umum (Ministry of Public Works)
FC	-	Foreign currency
E/S	-	Engineering services
FY	-	Fiscal year (April 1 to March 31)
GDP	-	Gross Domestic Product

GOI	-	Government of Indonesia
Golongan	-	Division of an irrigation area in order to phase planting and reduce peak water demand
Gotong royong	-	Mutual self help assistance
HYV	-	High yielding variety
IBRD	-	International Bank for Reconstruction and Development (World Bank)
ICB	-	International competitive bidding
IGGI	-	Inter-governmental Group on Indonesia
INMAS	-	Intensifikasi Massal (massive intensification for self sufficiency in food)
INSUS	-	Intensifikasi Khusus (special intensification program)
ISSP	-	Irrigaiton Sub-Sector Project
JICA	-	Japan International Cooperation Agency
Julu	-	Official responsible for the day-to-day operation of an irrigation area, generally no greater than 1,000 ha
Kabupaten	-	District (sub-division of province)
Kecamatan	-	Sub-district within the Kabupaten
KUD	-	Koperasi Unit Desa (village unit co-operative)
KUPEDES	-	Kredit Umum Pedesaan (general rural credit program)
KUT	-	Kredit Usaha Tani
LC	-	Local currency
LCB	-	Local competitive bidding
LP3ES	-	Lembaga Penelitian Pendidikan dan Penuangan, Ekonomi dan Social (Institute of Research, Education & Information for Social & Economy)
LS	-	Lump sum
M & E	-	Monitoring and evaluation

MCM	-	Million cubic meter (10^6 m^3)
M/M	-	Man-months
OECF	-	The Overseas Economic Cooperation Fund, Japan
O&M	-	Operation and maintenance
PBME	-	Project benefit monitoring and evaluation
Pengamat	-	Water distribution supervisor
Polowijo	-	All annual crops other than rice, sugar or vegetables grown on wet paddy land
PMF	-	Probable maximum flood
PMP	-	Probable maximum precipitation
PPA	-	Penjaga Pintu Air (Gate operator)
PPK	-	Penyuluhan Pertanian Kecamatan (Agricultural officer in Kecamatan)
PPL	-	Penyuluh Pertanian Lapangan (Field extension worker)
PPM	-	Penyuluh Pertanian Madya (agricultural extension supervisor)
PPS	-	Penyuluh Pertanian Spesialis (Subject matter specialist)
P2AT	-	Proyek Pengembangan Air Tanah (Groundwater Development Project)
P3A	-	Perkumpulan Petani Pemakai Air (Water User's Association)
P3A Union	-	Water User's Association Union
P3SA	-	Proyek Pengembangan dan Penyelidikan Sumber-sumber Air (Water Resources Development and Planning Project)
Rp.	-	Indonesian Rupiah
PTT	-	Soil Research Center, Bogor
PU	-	Pekerjaan Umum (Ministry of Public Works)
PUD	-	Pekerjaan Umum Daerah/PU Kabupaten (Public Works Service of District)

Sawah	-	Wet rice field
SCF	-	Standard conversion factor
S/W	-	Scope of Work
TA	-	Technical Assistance
TOR	-	Terms of reference
Ulu-ulu	-	An employee of the P3A responsible for O & M of the tertiary unit (Water master)
UNDP	-	United Nations Development Program
Waker	-	Assistant to the Juru stationed at the main river offtake
WKPP	-	Wilayah Kerja Penyuluh Pertanian (working area of field extension worker)
WUA	-	Water User Association
WUAO	-	Water User Association Organizer

CONVERSION FACTORS

	Metric to Imperial			Imperial to Metric		
Length	1 cm	=	0.349 inch	1 inch	=	2.54 cm
	1 m	=	3.28 feet	1 foot	=	30.48 cm
	1 km	=	0.621 mile	1 mile	=	1.609 km
Area	1 m^2	=	10.76 sq.ft	1 sq.ft	=	0.0929 m^2
	1 ha	=	2.471 acres	1 acre	=	0.4047 ha
	1 km^2	=	0.386 sq.mile	1 sq.mile	=	2.59 km^2
Volume	1 lit	=	0.22 gal (imp)	1 gal (imp)	=	4.55 lit
	1 m^3	=	35.3 cu.ft	1 cu.ft	=	28.32 lit
	1 MCM	=	1 x 10^6 m^3			
		=	811 acre-ft	1 acre-ft	=	1,233.5 m^3
Weight	1 kg	=	2.20 lb	1 lb	=	0.4536 kg
	1 ton	=	0.984 long ton	1 long ton	=	1.016 ton
Derived	1 m^3/sec	=	35.3 cusec	1 cusec	=	0.0283 m^3/sec
Measures		=	19.0 mgd	1 mgd	=	0.0526 m^3/sec
	1 ton/ha	=	891 lb/acre	1 lb/acre	=	1.12 kg/ha

Temperatire

°C = (°F - 32) x 5/9 °F = 1.8 x °C + 32

CURRENCY EQUIVALENT

(as of late 1989)

US$ 1 = Rp.1,770

1. INTRODUCTION

1.1 Authority

This final report for Master Plan Study on Lower Asahan River Basin Development (the Study) was prepared in accordance with the Scope of Work agreed on July 27, 1984 between the Japan International Cooperation Agency (JICA) and the Directorate General of Water Resources Development (DGWRD), Ministry of Public Works, the Government of the Republic of Indonesia.

The Study was conducted in two parts, Part-I study and Part-II study. This report presents the results of the whole study in four volumes as follows;

volume 1	Main Report
volume 2	Flood Control Plan (Part-I study)
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volume 4	In-depth Study on the Silau-Bunut Rehabilitation Irrigation Project (Stage 2 of Part-II study)

1.2 Project History

The Government of Indonesia has made every endeavor to promote economic development since the first five year development plan in 1968/69 and has given highest priority to rural and regional development including an agricultural development, especially for attainment of self-sufficiency of foodstuff.

The objective area of the Study is located in the lower Asahan river basin, about 150 km southeast of Medan, the capital of North Sumatra province. The study area comprises four main river basins: the Bunut, the Silau, the Asahan and the Kualuh. Of these, the Asahan river originating from Lake Toba is the largest river, having a stable base flow of about 100 m^3/sec throughout a year under regulation by the Asahan

Hydropower Development Project. However, flood damage is still caused occasionally along the downstream reaches of all of these rivers. These floods have greatly hampered agricultural development in these reaches in spite of the large development potential of land and water resources in the basin. This has accordingly depressed the local economy.

To solve these constraints in the lower Asahan river basin, the Government recognized an urgent need to prepare a comprehensive land and water resources development plan in the basin. The Government of Indonesia requested to the Government of Japan to execute a technical cooperation for a master plan study in the lower Asahan river basin.

In response to this request, the Government of Japan sent the preliminary study team of JICA headed by Mr. Kazuto Nakazawa to Indonesia. The Scope of Work for the Study was agreed between JICA and DGWRD on July 27, 1984.

1.3 Objectives of the Study

The objective of the Study was to prepare a master plan on the lower Asahan river basin development covering the period up to the year 2005 from the viewpoint of such long-range policies as raising productivity, creating employment opportunities, promoting transmigration and improving living standards in the region. The study area will cover the lower Asahan river basin of about 6,000 km^2.

1.4 Performance of the Study

1.4.1 Part-I study

The Part-I study was carried out from October 1984 to September 1985. The JICA study team first identified the basic direction for land and water resources development in the study area, and formulated a

long-term flood control plans for the Asahan, the Silau, the Bunut, the Kualuh and the Kanopan rivers. In the plan the 30-year design flood was adopted based on the results of the comparative economic study with a scale of design flood.

This was followed by a feasibility study of the flood control project in the downstream reaches of the Asahan and the Silau rivers, where vast and frequent damage has occurred. This was carried out as the most urgent flood control project. The criterion of a 10-year design flood was adopted in the plan based on analysis of the economic viability of the plan.

In addition, a study on regulation of Lake Toba was carried out to obtain a possible solution to satisfy the requirements of both flood control and efficient water utilization. Seasonal water level control and discharge control together with improved operation of the existing regulating dam were recommended.

The results of the Part-I study were compiled in the Interim Report and submitted to DGWRD in October, 1985 and summarized in volume 2 in this final report.

1.4.2 Part-II study

The Part-II study was commenced in June, 1989, to formulate an agricultural development master plan in line with the flood control projects. Ten agricultural development projects were identified and a priority sequence for these projects was determined. The Silau-Bunut rehabilitation irrigation project was selected as the highest priority project among them. All the results were compiled in the Progress Report III which was submitted to DGWRD at the beginning of October,1989. The content of the agricultural development master plan was agreed between JICA and DGWRD at the official meeting held on October 9,1989.

The Silau-Bunut rehabilitation irrigation project (the Project), was selected in the master plan as the highest priority project, and the in-depth study (feasibility study level) on the Project have been performed. The results of the in-depth study were compiled in Volume 4 in this draft final report.

1.5 Acknowledgement

In undertaking the Study, the study team received great support and cooperation from the departments and agencies concerned of the Government of Indonesia relating to the various aspects covered by the Study. The contribution to the Study by the officials concerned who have provided information and data, participated in discussion, given valuable advice and provided other forms of assistance to the Study are gratefully acknowledged. The study team would like to acknowledge particularly DPU North Sumatra province for day-to-day support, guidance and coordination for the Study. Heartfelt gratitude is also extended to the members of DGWRD in Jakarta who have given advice in performing the Study.

2. BACKGROUND

Economic development in Indonesia is closely linked with price trends in the international oil market. Indonesia's gross domestic product grew at an average annual rate of 8.1 % during the 1970's. Since the early 1980's, the economy of Indonesia has been stagnant and deteriorated in 1985/86 due to a sharp drop of international oil market prices. To improve the economic condition, the Government of Indonesia devised a series of countermeasures which include devaluation of domestic currency, acceleration of non-oil export, encouragement of direct foreign investment and a drastic cut in the financial budget. Through execution of such countermeasures, the Indonesian economy has been recovering gradually.

The Government's economic development strategy places strong emphasis on rural and regional development and includes intervention in key areas of the agricultural sector. The aim of this has been to enhance food production, especially of rice, to meet increasing domestic demand, to provide rural employment, and to achieve balanced regional development.

During Pelita I and II, the main emphasis was placed on increasing of rice production. More than half of the agricultural sector development expenditure was given to rehabilitation and expansion of irrigation facility with the aim of increasing rice production. During Pelita III and IV, emphasis has been widened to include intensification programs for other crops.

Through the performance of sectorial development from Pelita I to Pelita IV, the rice production has been greatly increased. Paddy production increased from 18 million tons in 1969 to 41 million tons in 1988. Self-sufficiency in rice was realized in 1985. Since then, there has been, however, no substantial increase in annual paddy production in Indonesia, mainly due to conversion of highly productive paddy fields into urban and industrial areas in Java, the home of the leading

producers of rice in Indonesia. Thus, domestic paddy demand has gradually gained upon domestic production.

Under such situation Pelita V started from April 1989. The targets of Pelita V are to: (i) raise living standards, to enlighten the mind and improve the well-being of the whole of the people more evenly and equitably; and (ii) lay a solid foundation for subsequent development.

To achieve the above targets, priority is given to economic development, putting emphasis on agriculture and industry. Sustainment of self-sufficiency in rice is one of the most important policies in the agricultural sector.

For this purpose, Pelita V includes an irrigation sub-sector development program which consist of: (i) a program for rehabilitation and maintenance of the existing irrigation/drainage systems; (ii) a program for construction of new irrigation systems; and (iii) a program for swamp area development.

Since Pelita III, the Government has gradually shifted irrigation development emphasis to the outer islands. In Pelita V, the Government gives high priority to irrigation development in the outer islands.

North Sumatra province is one of the most promising provinces for irrigation development in the outer islands. Agriculture is the main source of employment in the province, accounting for 35 % of gross regional domestic product. Despite excellent water resources, however, agricultural production, and in particular production of food crops, has been far below its potential. This is mainly due to frequent flood damage, the poor condition of the existing irrigation systems, shortage of irrigation water, inadequacy of O&M, etc. Thus, North Sumatra province is a region of rice shortage and for which a considerable amount of rice has been imported from other provinces.

The study area is located in the Kabupatens of Asahan and Labuhan Batu which provide about 10 % of the total rice production in North Sumatra province. The study area is blessed with rich water and land resources. Despite such excellent resources, increasing agricultural production in the study area has been hindered by: (i) occasional inundation in the low-lying area along the downstream reaches of rivers; (ii) lack of irrigation systems; (iii) poor conditions of the existing irrigation systems; and so on.

The above circumstances indicate an urgent need to raise the level of regional domestic production by socio-economic development. The ever-increasing population means that there is an ever more pressing need for job opportunities and to raise living conditions as well.

3. STUDY AREA AND DEVELOPMENT POTENTIAL

3.1 The Study Area

The study area is located in the Kabupatens of Asahan and Labuhan Batu in the east-central part of North Sumatra province. The study area is located 150 km southeast of Medan, the capital of the province as shown in Fig. 3-1. The administrative boundary in the study area is shown in Fig. 3-2. The population in the study area is about 860,000, which corresponds to 8.7 % of the total population in the province of about 9.9 million in 1987.

The climate in the study area is of the tropical monsoon type. The annual mean temperature is about 26°C throughout a year. Annual rainfall is about 1,500 to 2,500 mm on the lower plain of the study area and about 2,500 to 3,500 mm to the west towards the mountains as shown in Fig. 3-3. The wet season is from September to December. However, the distinction of seasons is not clear due to some rainfall during the dry season as shown in Fig. 3-4.

The study area has four main river basins, the Bunut, the Silau, the Asahan and the Kualuh river basins from north to south. The Bunut river is a tributary of the Kiri river. The Silau river is the largest tributary of the Asahan river joining at Tanjung Balai, as shown in Fig. 31. The hydrological features of these main rivers are as follows:

Features		Bunut	Silau	Asahan	Kualuh
Catchment area	(km^2)	621	1,180	6,863	3,820
River length	(km)	59	124	152	198
River gradient		1/2,230	1/1,550	1/5,810	1/29,000
Annual mean discharge	(m^3/s)	23	73	233	202
Runoff coefficient		0.50	0.70	0.55	0.65

The runoff of these rivers is characterized by moderate annual fluctuation and high runoff coefficients. The low flow occurs during the

period from June to September. Floods are common on all rivers in the study area. Major floods were recorded in 1975, 1977, 1982 and 1984. The season of flood is usually from October to January and in May.

Among the rivers in the study area, the Asahan river is the largest river originating from Lake Toba with surface area of 1,100 km^2. The low flow in the Asahan river has been increased to about 100 m^3/sec throughout a year owing to regulation by the Asahan Hydropower Development Project since February 1981. However, the peak flood discharge in the Asahan river downstream has not been reduced and flood damages have been caused occasionally. For other rivers, floods are also the main constraints for agricultural development in the area downstream.

The main industry in the study area is agriculture, especially rice and tree crops. In the study area the number of farm households is about 60 % of total households. Some 80 % of total manpower is engaged in the agricultural sector. The land resources in the study area have been well utilized for agriculture, rationally matching with natural conditions, except for the huge swamp and swampy areas covering about 100,000 ha which remain unused. The present land use in the study area is shown in Fig. 3-5.

Agricultural productivity in the study area is one of the lowest in North Sumatra province. The unit yield of paddy is low, and rice production is severely affected and unstable due to natural disasters which accrue from droughts, pests and diseases as well as floods.

Irrigated paddy fields are quite limited in the study area, about 85 % of the existing paddy fields of 68,000 ha being rainfed. Even in the existing irrigation schemes as shown in Fig. 3-6, irrigable areas for dry season paddy are limited due to shortage of available water and/or an insufficient intake water level in the river during the dry season.

The present cropping intensity in the study area is quite low. Furthermore, the farm size per farm household is as small as less than one ha, so that the farmers' economy remains at the subsistence level.

It is necessary to raise farmers' income levels through enhancement of agriculture, especially through rice production.

Social infrastructures such as roads, water supply, electricity, sanitation and health services in the study area have been provided mainly in urban areas such as Kisaran and Tanjung Balai. Such infrastructures in the rural areas are less developed.

3.2 Development Potential

3.2.1 Development potential of land resources

Land resources in the study area of about 6,000 km^2 are assessed from the viewpoint of the possibility of establishing profitable irrigated agriculture. Assessment of land resources for irrigation development is examined by two factors: (i) present land use conditions; and (ii) land capability. Present land use in the study area is shown in Fig. 3-5 and is estimated as follows:

Category		Area (ha)	Proportion (%)
1. Settlement land		9,080	1.5
2. Agricultural land			
2.1	Paddy fields	68,190	11.5
2.2	Upland fields	38,220	6.4
2.3	Coconut estates	43,230	7.3
2.4	Rubber estates	107,610	18.1
2.5	Oil palm estates	58,400	9.8
	Sub-total	315,650	53.1
3. Unused land			
3.1	Forest (dry land)	158,440	26.6
3.2	Swamp (bush)	22,550	3.8
3.3	Swamp (mostly forest)	85,180	14.3
	Sub-total	266,170	44.7
4. Others		4,100	0.7
Total		595,000	100.0

Rubber and oil palm estates have been developed mainly in the hilly area and in the lower end of the hilly area. Coconut estates extend over the flat low land and over the sand dune belt along the coast. Upland fields are scattered in the hilly area on a small scale. Most of the paddy fields are developed in the flat low land and on the fringe of the swamp areas. Forest lands extend over the hilly and mountainous land.

The forest land should be reserved as it is for land and water conservation as well as for the supply of cattle feed and fire wood for local inhabitants. Since upland crop cultivated areas have been developed on the hilly areas, small scale irrigation development of these lands is not practical.

Present land use in the study area has already been properly established and there is no necessity to change the present land use pattern. The possible area for agricultural development is, therefore, selected within the existing paddy areas (68,200 ha), swamp area (107,700 ha) and some unused dry land (2,800 ha). According to the land capability assessment, all the land selected is suitable either for paddy cultivation or for oil palm planting. Thus the maximum potential area for agricultural development in the study area becomes 178,700 ha.

3.2.2 Development potential of water resources

To assess the development potential of water resources in the study area, the minimum available discharge for irrigation has been estimated by deducting the maintenance flow from the 5-year low flow during the cropping season. The river maintenance flow is taken to be equal to the monthly mean discharge of 90 % in probability of non-exceedance. Based on a water balance study as shown in Volume 3 of the final report, the total available discharge for irrigation development in the study area is estimated to be about 60 m^3/sec.

Water resources in the study area are, in general, abundant and their development potential is very high. However, there is a regional imbalance between water demand and supply. The present water shortage in the Bunut river basin is especially serious. In the Silau river basin, however, the water resources are ample compared with the limitation in horizontal expansion of irrigated areas.

To solve the water shortage in the Bunut river basin, an inter-basin diversion from the Silau to the Bunut river has been studied. According to a survey, the most promising site for diversion would be 600 m downstream of railway bridge near Kisaran. The maximum water withdrawal by the Silau-Bunut inter-basin diversion should be determined so as to sustain the river maintenance flow of 26 m^3/sec at the diversion site. Since the 5-year low flow at the diversion site is estimated at about 44 m^3/sec, the available maximum discharge for an inter-basin diversion is estimated to be about 8 m^3/sec.

3.2.3 Development potential for agriculture

Optimum utilization of development potential of land and water resources in the study area was investigated in line with the development objectives and strategy mentioned already. In the study area, the frontier of new land resource development exists extensively in the swamp or swampy areas presently unused. If proper drainage and irrigation facilities are provided, these areas would become promising agricultural areas in future.

From the macroscopic viewpoint of land resources, the net area for development is estimated at 125,000 ha, converting the gross area of 178,700 ha by a conversion factor of 0.7. The total net irrigable area is estimated to be about 58,000 ha under full utilization of the available discharge of 60 m^3/sec. Therefore, it is necessary to encourage non-irrigated agricultural development of about 67,000 ha in the study area.

3.3 Basic Direction of Land and Water Resources Development

The study area is blessed with rich land and water resources. From the viewpoint of efficiency of investment and its social and economic effects, it is recommended to develop land and water resources giving priority on the agricultural development.

The socio-economic survey clarified that the small farmers depending on mainly paddy cropping on their small lands, are much suffered from low incomes. In order to absorb future increasing population the land productivity of those paddy fields should first be raised. It will contribute to raise family income level and to achieve the self-sufficiency of rice in this area.

The first priority of development in the study area shall be given to protect those existing paddy fields from frequent damage by floods. Hence, the long-term and urgent flood control plans are necessary to be established prior to the formulation of agricultural development plans.

The second priority shall be put on the rehabilitation or improvement of the existing irrigation and drainage facilities. The third priority will be given to extension of irrigated lands including swamp and swampy land unused.

4. FLOOD CONTROL PLAN (PART-I STUDY)

4.1 Needs for Flood Control

The study area is blessed with ample land and water resources for agricultural development. The elevated land in the study area have been developed as tree crop estates such as oil palm and rubber. On the other hand, cultivation of paddy has been concentrated in the low-lying areas along the river stretches and swamp fringes, where occasional floods and inundation occur.

The lower areas of the Asahan and Silau rivers have often suffered from flood damages. In recent 8 years from 1977 to 1984, large floods occurred 6 times in the Asahan river and 8 times in the Silau river. To make matters worse, the cultivated land has been expanded even in such low-lying areas surrounding the existing swamps. The social and economic damages by flooding are increasing in these areas. Especially in January 1984, a large flood caused an inundation on agricultural lands of about 2,100 ha and damages of about 560 houses along the downstream reaches of the Asahan river. Due to such serious flood damages the local people in the basin have been depressed in their economy. The area between Kisaran and Tanjung Balai along the Silau river is the most developed zone in the study area. This fact emphasizes the importance of flood mitigation in the downstream reaches of the Silau river.

The effort to construct flood protection dikes has been given by DPU for many years. However, the existing flood control facilities are not enough to mitigate even the 10-year probable flood.

In the study area, floods have been one of the most serious factors to hamper an agricultural and regional development in these river basins downstream in spite of a large development potential of land and water resources in the low-lying areas. The local people have been depressed in their economy under such situation. Under the

circumstances, it has been recognized that the formulation of a long-term and urgent flood control plans would be prerequisite for agricultural and regional developments in the study area.

4.2 Long-term Flood Control Plan

(1) Planning concept

The study area suffers from occasional floods. To promote agricultural and regional developments in the study area, formulation of an overall flood control plan is prerequisite. The basic concepts for formulation of a long-term flood control plan are to:

(i) determine the optimum design flood discharge;
(ii) enhance potential areas for future development efficiently; and
(iii) achieve a low-cost solution to flood mitigation.

(2) Objective rivers for flood control plan

The long-term flood control plan is formulated by a comparative study of alternative schemes. The recommended plan is formulated aiming to prevent flood damages not only in the existing developed lands but also in adjacent lands for future development.

The length of stretches of objective rivers for the flood control planning is 218 km in total comprising 37 km for the Bunut, 62 km for the Asahan, 22 km for the Silau, 84 km for the Kualuh, and 13 km for the Kanopan rivers.

(3) Proposed flood control method

The following methods are considered for the long-term flood control planning.

Upper basin: - flood regulation by reservoir.
Lower basin: - flood diversion by floodway
- flood retardation by retarding basin
- flood prevention by channel improvement.

Flood control method in the upper basin

Appropriate dam site at Parhitean in the upstream reaches of the Asahan river was taken up by PLN as the Asahan No.3 Hydropower Project. A feasibility study on this project was conducted by JICA in 1982, and the detailed design was completed by PLN in 1987.

The proposed dam has a possibility of flood regulation. The flood control effect of this dam will reduce about 20% of the peak flood discharge of 1,360 m^3/sec at Pulau Raja which includes the maximum flood release of 400 m^3/sec from the upstream regulating dam. So that, it is recommended to consider a flood control effect at this dam in the long-term flood control plan.

Flood control method in the lower basin

In most of downstream reaches of the rivers, the existing flow capacity is not enough except for the stretches from Tanjung Balai to the river-mouth of the Asahan river and from Teluk Binjai to the river-mouth of the Kualuh river. Flood control methods proposed are as follows:

(a) Bunut river

A construction of a 22 km floodway from Serbangan intake to the Strait of Malacca was considered, but not recommended due to low economic efficiency. Channel improvement by means of construction of dikes and excavation of channel were recommended.

(b) Asahan river

A 30 km floodway from Pulau Raja to the estuary of the Kualuh river was considered, but not recommended due to low economic efficiency.
The recommended plan is a combination of channel improvement by diking and a retarding basin of 95 km^2 at the right bank of the Asahan river between the confluences of the Nantalu and Lebah rivers. To protect the existing Lebah scheme from raising water level in a retarding basin during flood, a dike along the right bank of the Lebah river is required.

(c) Silau river

Channel improvement is only the conceivable method in the lower reaches of the Silau river due to topographic conditions.

(d) Kualuh river

Channel improvement is only the conceivable method in the lower reaches of the Kualuh and Kanopan rivers due to topographic conditions.

(4) Design flood discharge

After a study on flood discharge, past flood damages and the economy of flood mitigation, a criterion of the 30-year design flood was adopted for formulation of a long-term flood control plan.

The design flood discharge for the proposed long-term plan is 300 m^3/sec for the Bunut downstream, 1,100 m^3/sec for the Asahan river at Pulau Raja, 950 m^3/sec for the Silau river at Kisaran and 1,050 m^3/sec for the Kualuh at the national highway as illustrated in Fig. 4-1.

(5) Proposed development plan

The flood control works to meet the 30-year design flood were planned and evaluated from the economic viewpoint. The proposed long-term flood control plans for each river basin are shown in Fig. 4-2, and are summarized below.

Bunut river

The proposed flood control works for the Bunut river are: (i) 34 km channel improvement including a part of the Kiri river of 7 km; and (ii) construction of drainage culverts.

Asahan river

The proposed works for the Asahan river are: (i) 40 km channel improvement by diking in the downstream reach from Pulau Raja, (ii) construction of 18 km dike on the right bank of the Lebah river to protect the existing paddy scheme from fluctuating water level in the proposed retarding basin of 95 km^2; and (iii) provision of 13 drainage culverts.

Silau river

The proposed works for the Silau river are: (i) 22 km channel improvement downstream of Kisaran by channel excavation and diking on both river banks; (ii) provision of 6 drainage culverts; and (iii) reconstruction of 5 existing irrigation intakes.

Kualuh river

The proposed works for the Kualuh river are: (i) 33 km channel improvement by diking between the confluence with the Kanopan river and the national highway bridge, (ii) provision of 9 drainage culverts; and (iii) reconstruction of the existing irrigation intake. For the Kanopan river, the proposed works are: (i) 13 km channel improvement by diking; and (ii) provision of 8 drainage culverts.

(6) Costs, benefits and evaluation

Construction costs (financial cost) for the proposed long-term flood control plans are preliminarily estimated at Rp.12,600 million for the Bunut, Rp.63,500 million for the Asahan and Silau, and Rp.20,500 million for the Kualuh at 1985 price.

The flood control benefits comprise flood damage reduction benefit and land enhancement benefit (6,500 ha in the Asahan and 4,800 ha in the Kualuh). The expected benefits under future condition in 2005 are estimated at Rp.1,840 million for the Bunut, Rp.11,700 million for the Asahan and Silau and Rp.3,100 million for the Kualuh at 1985 price.

Based on the estimate of economic construction cost and benefits, the economic internal rate of return (EIRR) for the long-term flood control plan is calculated assuming the project life of 50 years. EIRR is estimated at 11.9 % for the Bunut, 14.3 % for the Asahan and Silau, and 12.3 % for the Kualuh.

The Asahan and the Silau river basins were selected for a feasibility study on urgent flood control project to meet the strong needs for flood mitigation and owing to the highest economic efficiency among rivers in the study area.

4.3 Urgent Flood Control Project

(1) Design flood discharge

For the urgent flood control plan, a criterion of the 10-year design flood is proposed through an analysis of cost-benefit efficiency comparing other risk levels of floods.

(2) Proposed development plan

For the Asahan river, a combination of channel improvement and utilization of a retarding basin have been proposed. For the Silau river, flood problem area is concentrated in the area along the stretches downstream of Kisaran, as shown in Fig. 4-2.

The proposed works include: (i) construction of a 19 km dike on the right bank of the Asahan; (ii) construction of a 18 km dike on the right bank of the Lebah river to protect the existing paddy scheme from fluctuating water level in the proposed retarding basin; and (iii) a 19 km channel improvement for the Silau river from Kisaran to Tanjung Balai by excavation of the channel and construction of dikes on both banks.

(3) Cost, benefit and evaluation

The construction cost of the project is estimated at Rp.36,500 million at 1985 prices. The average annual benefit is estimated at about Rp.5,100 million, comprising a flood damage reduction benefit of Rp.4,600 million and land enhancement benefit of Rp.500 million. The estimated economic internal rate of return of the project is 12.4 % which indicates that the project is economically feasible.

(4) Follow-up of the Project

The Government of Indonesia commenced the detailed design for the urgent flood control project for the Asahan and Silau in March 1988 in accordance with recommendations of the Part-I study. The detailed design was performed by the Directorate of Rivers, DGWRD with a financial assistance from OECF. This was completed in June 1989.

Financial arrangement for implementation of this project is not finalized yet. It is desirable to implement the channel improvement works for the Silau river in line with implementation of the agricultural

development project, the "Silau-Bunut Rehabilitation Irrigation Project", to be proposed in this report.

4.4 Regulation of Lake Toba

In addition to flood control planning, a study on regulation of Lake Toba was carried out to obtain a possible solution to satisfy the requirements for both flood control and efficient water utilization for hydropower generation. The recommendable seasonal water level control and discharge control together with improved operation of the existing regulating dam was recommended in detail as shown in Chapter 6 in Volume 2 of the draft final report.

4.5 Impact of Proposed Plan on Environment

Following the basic development policies recommended, the study area will be developed stepwise: first for provision of flood control measures to prevent flood damages along the rivers, and secondary by agricultural development.

The proposed flood control project will reduce the area affected by inundation. It would contribute to reducing infection from water-based diseases. The proposed roads along the dikes to be constructed will serve local inhabitants for easy traffic and transportation.

In the study area, the malaria mosquitoes living in the study area belong to the special species, called as Anopheles Sundaicus, which lays their eggs only to the semi-saline water. This malaria infection is not increased in the fresh water. In the flood control plan, no deep dredging of river beds in the downstream reaches is planned to avoid increase of the semi-saline water. Irrigation networks will have no problem on malaria infection.

5. AGRICULTURAL DEVELOPMENT PLANS (PART-II STUDY)

5.1 Needs for Agricultural Development

The main crops cultivated in the study area are tree crops such as oil palms, rubber and coconuts. They have been cultivated for many years on dry land with good drainage conditions in the estates. On the other hand, paddy cultivation has been restricted to low-lying areas along the main rivers and in swampy areas, where frequent floods or inundations occur.

Paddy production in the study area has been left far below its potential mainly due to: (i) insufficient infrastructures such as flood protection dikes and irrigation and drainage facilities; (ii) shortage of irrigation water; and (iii) poor water and farm managements. Consequently, the income level of farmers in the study area is quite low. Furthermore, the existing rural infrastructures are very poor. It is recognized that there is a pressing need for agricultural and rural development in the study area.

North Sumatra province is a region of rice shortage. At present a considerable amount of rice has to be imported from other provinces as summarized in Table 5-1. The total population in the province was about 9.9 million as of 1987, and is projected to be increased to 13.6 million by the year 2005. Demand for rice in 2005 is forecast to be about 3.6 million tons of paddy (2.1 million tons of rice). By contrast the present production of rice is 2.4 million tons of paddy and it is predicted that a 1.2 million tons shortage of paddy in the province will occur by the year 2005 as estimated in Table 5-2.

It is, therefore, important to place a development priority on increasing provincial rice production. The study area has a big potentiality to contribute significantly to achieve self-sufficiency in rice in North Sumatra province by increasing paddy production.

5.2 Objectives and Strategy for Agricultural Development

Reflecting the development needs and the national development policy, the following objectives for agricultural development in the study area have been set up for the master plan to.

(a) raise farmer's income level through enhancement of agriculture, especially in rice production, by efficient utilization of the land and water development potential in the area; and

(b) contribute to the regional need to increase rice production with the aim of achieving self-sufficiency in rice in North Sumatra province.

To realize these objectives, the following development strategy is proposed for the formulation of individual plans.

(a) Development of unused swamp lands and development of water resources including an inter-basin water diversion plan will be encouraged. For the new development in swamp areas with deep peat soil, introduction of oil palm cultivation will be considered from the viewpoints of low cost development, crop adaptability for peat soils and climatic suitability;

(b) To raise rice production, necessary measures have been proposed aiming to: (i) increase unit yield of paddy; (ii) increase the annual cropping intensity of paddy in the existing paddy field; and (iii) expand the area of paddy fields by provision of irrigation and drainage facilities on rainfed paddy fields and land reclamation of swamp land; and

(c) Urban-rural equity in the study area needs to be realized not only through implementation of irrigation and drainage systems but also by upgrading of social infrastructures, especially the rural road system.

5.3 Formulation of Overall Development Plans

5.3.1 Identification of projects

Individual projects for agricultural development have been formulated based on the assessment of land and water resources and the proposed long-term flood control plan in line with the development objectives and strategy proposed. The following ten projects have been formulated as promising development ideas.

(i) Silau-Bunut rehabilitation irrigation project
(ii) Padang Mahondang irrigation extension project
(iii) Kanopan left bank drainage improvement project
(iv) Small-scale irrigation package project
(v) Aek Natas irrigation project
(vi) Aek Naetek irrigation project
(vii) Kualuh right bank irrigation project
(viii) Tambun Tulang swamp development project
(ix) Simpang Empat swamp development project
(x) Leidong-Asahan swamp development project

The main features of each project are summarized in Table 5-3. Type of development, gross and net areas of these conceivable projects are summarized as follows.

(Unit: ha)

Project No.	Project Name	Type	Command Area: Gross Area	Command Area: Net Area: Upgrading and Improvement	Command Area: Net Area: Newly Reclaimed	Command Area: Net Area: Total
PJT-1	Silau-Bunut	I	17,000	14,300	0	14,300
PJT-2	Tambun Tulang	C/D	7,500	4,100	1,700	5,800
PJT-3	Simpang Empat	C/D	4,000	0	2,800	2,800
PJT-4	Pd. Mahondang	I	8,300	2,200	4,000	6,200
PJT-5	Leidong Asahan	I & S/W	62,100	15,900	29,700	45,600
PJT-6	Kanopan Left	C/D	5,800	2,000	2,300	4,300
PJT-7	Aek Natas	I	5,500	2,700	1,500	4,200
PJT-8	Kualuh Right	I	3,100	2,000	400	2,400
PJT-9	Aek Naetek	I	4,500	2,400	1,100	3,500
PJT-10	Small Scale	I	8,700	7,200	0	7,200
	Total		126,500	52,800	43,500	96,300

Note: I = Irrigation project, C/D = Controlled drainage project, S/W = Swamp development

Among these conceivable projects, the Silau-Bunut rehabilitation irrigation project and the Small-scale irrigation rehabilitation package project are of the rehabilitation or upgrading type without new reclamation of virgin swamp. All the project areas, except for the Simpang Empat project, include the irrigation and/or drainage facilities in part or whole of the command areas. It should, therefore, be recognized that these projects are generally not new developments but rather rehabilitation, upgrading and expansion of the existing systems.

In total, the net area of development would be 54,600 ha for irrigation, 12,900 ha for controlled drainage, and 28,800 ha for oil palms. The total development area of 96,300 ha would be equivalent to 77 % of the net land development potential of 125,000 ha. The net irrigation area of 54,600 ha is equivalent to 94 % of the net irrigable area of 58,000 ha which is presumed from available water resources of 60 m^3/sec. It should be noted that the above ten projects have been formulated to utilize available land and water resources to their maximum extent.

5.3.2 Selection of priority projects

For the purpose of evaluating the proposed projects and to select the priority projects for urgent implementation among them, three evaluation criteria have been applied. The first criterion is the level of economic feasibility expressed by the economic internal rate of return (EIRR). The second one is the magnitude of initial investment expressed by construction cost in US Dollars per ha. The third one is the distribution of benefits expressed by the number of beneficiaries.

Reflecting the importance of each indicator, weighted points are given to each category: (x 3) for the first, (x 2) for the second and (x 1) for the third. The evaluation criteria applied are as follows:

Criteria	Unit	Grade	Points	Magnitude
Economic feasibility	EIRR	A (High)	6	above 12%
		B (Medium)	4	12% - 10%
		C (Low)	0	10% - 8%
		D (Very low)	-2	less than 8%
Investment cost per ha	US$/ha	A (Low)	4	below 3,000
		B (Medium)	2	3,000 - 6,000
		C (High)	0	6,000 - 9,000
		D (Very high)	-2	above 9,000
Number of beneficiaries	persons	A (High)	2	above 50,000
		B (Medium)	1	50,000 - 10,000
		C (Low)	0	below 10,000

Based on the figures summarized in the table above, the points for each criterion are given. The priority ranking has been given to each project following the order of points. When the points of some projects are same, priority is given to the project with higher EIRR. The total points and the priority ranking are estimated as follows:

Indicator	PJT -1	PJT -2	PJT -3	PJT -4	PJT -5	PJT -6	PJT -7	PJT -8	PJT -9	PJT -10
Economic feasibility	6	0	0	6	0	4	4	4	4	4
Investment cost per ha	2	4	2	2	-2	4	2	0	0	2
No. of beneficiaries	2	1	1	1	2	1	1	1	1	1
Total points	10	5	3	9	0	9	7	5	5	7
Priority ranking	**1**	**8**	**9**	**2**	**10**	**3**	**5**	**7**	**6**	**4**

The result shows that the Silau-Bunut rehabilitation irrigation project has the highest priority and the Padang Mahondang project next. These projects are in the same location as the site selected for the Urgent Flood Control Project.

5.3.3 Overall implementation schedule

The implementation schedule of these projects is determined so as to meet the increasing demand of paddy towards the year 2005. The target for increase of rice production in the study area is proposed to be 10 % of the provincial target of paddy production increase with respect to the present share of rice production and harvested area of paddy in the study area. This target for rice production is considered to be the minimum level for the study area.

Figure 5-1 illustrates the relationship between the increase in rice production through implementation of the projects and the trend in demand for paddy. To meet the minimum target (10 % share), the Silau-Bunut and Padang Mahondang projects should be implemented by the target year of 2005.

When the higher target (to achieve 15 % share) is applied, four projects including the Silau-Bunut, the Padang Mahondang, the Kanopan Left and Small-scale shall be completed by the year 2005, if a huge amount of their investment costs is realized. Taking the present

investment policy into consideration, the above minimum share is recommendable as a practical target.

5.4 In-depth Study on the Silau-Bunut Rehabilitation Irrigation Project

5.4.1 General

The overall agricultural development plan was discussed between DGWRD and JICA at a meeting held on 9 October 1989, and it was decided to proceed an in-depth study (feasibility study level) of the Silau-Bunut rehabilitation irrigation project.

The field survey for the in-depth study was commenced immediately after the said meeting and finished at the end of December 1989. During this period, further detailed survey and investigations have been conducted to elaborate the original plan proposed in the overall development study. The difference in the accuracy of surveys and the features of development plans between the overall development study and the in-depth study are summarized in Table 5-4.

5.4.2 The Project area

Administratively, the project area is located fully or partly within the jurisdiction of 26 Desas and 8 Kecamatans in Kabupaten Asahan, North Sumatra province. The population of the all villages related to the project area is estimated at 133,400 consisting of the total households of 24,400 in 1987. An average population density is estimated to be 263 persons/km^2. An average family size is estimated at 5.5. It is estimated that some 60 % of the total households is engaged in agriculture and its related activities. With respect to tenurial status, about 70 % of the farmers seems to be shared by land owner operators. Farm holding size is more or less one ha on an average.

The climate in the project area is of the tropical monsoon type. The daily mean temperature is about 25°C throughout a year. The annual rainfall is about 1,670 mm. The annual rainfall in the dry year with 80 % dependability is estimated at about 1,460 mm. The rainy season is from September to December.

The water sources in the project area depend on the Bunut and the Silau rivers. The 10-year drought discharge is estimated to be 1.8 m^3/sec for the Bunut and 26.0 m^3/sec for the Silau river. These discharges are regarded as the maintenance flow for each river required at the bridges on the national road.

The present land use in the project area consists of 75 % for paddy fields, 15 % for coconut land and 10 % for other uses. All the lands in the project area except for non-agricultural land are suitable for irrigation farming of paddy based on the criteria defined by the Soil Research Center (PTT) with some modification.

The area having irrigation and/or drainage facilities is 4,830 ha in the project area. The existing irrigation facilities consist of 52 canals of 194 km in total length and about 230 related structures. A considerable portion of the facilities are not properly functioned due to damages and some defects of the facilities. Only about 40 % of the area of 4,830 ha is double cropped a year as illustrated in Fig. 5-2.

The main causes of such poor irrigation conditions are: (i) malfunction of all the existing diversion weir with free intake type; (ii) improper alignment of irrigation canal; (iii) absolute shortage of river discharge in the Bunut river; (iv) low provision level and deterioration of irrigation facilities; and (v) lack of water management activities. Furthermore, the downstream of the Silau and Bunut rivers suffered from seasonal flooding and poor drainage condition due to low provision level of drainage networks and less capacity and high elevation of bed of drainage canals.

Furthermore, the farm roads as well as rural roads in the project area are in poor conditions. The road network connecting the rural

area with the urban area is poor, which hampers the transportation of agricultural products to the central crop markets such as Tanjung Balai and Kisaran.

Under such situation the farmers in the project area can not apply proper farming with appropriate amount of farm inputs. Paddy production is severely affected and unstable due to natural disasters which accrue from droughts, pests and diseases, floods, etc. The unit yield of paddy is low and ranges from 3.7 tons/ha in the irrigated area to 1.1 tons/ha in the low-lying rainfed land with cultivation of local rice variety. In addition, cropped area for the dry season paddy are limited to only 20 % of the project area due to the constraints of irrigation systems themselves and water sources as mentioned above.

As a result, the present cropping intensity in the project area is as low as about 120 %. The farm size per farm household is as small as about one ha . The farmer's economy except for the farmers growing HYV in the irrigated land remains at the subsistence level. It is necessary to raise farmer's income levels through enhancement of agriculture, especially through rice production.

With respect to agricultural support systems,especially farmers organizations such as KUD, P3A and farmers groups, these organizations do not function properly. The main problems are the low rate of participant in KUD, ineffective water management of P3A and shortage of self-determination for joint activities of the farmers groups. It is essential to improve not only irrigation and drainage systems but also the present agricultural support systems.

5.4.3 Agricultural development plan

Proper irrigation and drainage systems would be provided in order to establish a base for increasing unit yield of crops and production. After the implementation of the project, all the land will become the paddy fields having a year round-irrigation system. The present land use conditions will change the figures as shown in Table

5-5. Some coconut lands under low productivity are proposed to be converted into paddy fields reflecting the strong request of the farmers in the project area.

Double cropping of paddy per year is proposed. The introduction of upland crops in the dry season is not adopted because of soil acidity, pests and diseases and the farmer's reluctance to cultivation of upland crops. The cropping pattern is proposed as shown in Fig. 5-3 based on the study on climatic factors, plant physiological features, farming practices, water balance, drainage conditions, and water management aspects. An overall cropping intensity in the future with project condition will be expected to become 200 % per annum.

Proper farming practices are expected to be practiced after the implementation of the project. High yielding and/or improved rice varieties will be introduced. Proper amount of fertilizer and chemicals will be applied through proper irrigation farming.

The unit yield of paddy with project condition has been estimated on the basis of information supplied by the Department of Agriculture in North Sumatra province as well as the yield on well-irrigated land in and around the project area. The anticipated unit yields are summarized below. And incremental paddy production is estimated at about 74,000 tons in the whole project area.

(Unit: ton/ha)

Categories of present paddy field	with project		without project	
	wet	dry	wet	dry
Irrigated land (I)	5.5	5.5	4.0	4.0
Irrigated land (II)	5.5	5.5	4.0	2.8
Rainfed(HYV)	5.5	5.5	2.8	-
Rainfed(Local)	5.0	5.0	1.5	-
Coconut field	5.0	5.0	-	-

5.4.4 Irrigation and drainage development plan

(1) Planning concept

The irrigation and drainage plan have been formulated to realize profitable irrigated agriculture giving serious attention to: (i) cost-effective development and full utilization of available water resources; (ii) harmonization with environment to avoid adverse effects; (iii) proper design of canal layout following the existing systems and irrigation blocks at the maximum extent; and (iv) harmonization with existing development plans and ideas proposed by the Government.

The basic concept of project formulation is to divert surplus water in the Silau river to the Bunut river basin by inter-basin diversion canal to develop irrigated paddy area in the lower Bunut area. On the Silau river, an integrated headworks is proposed. At present, the intake water level of the existing free-intakes on the Silau river is not sufficient during the dry season. Furthermore, the intake water level is predicted to be lowered due to: (i) canalization of the Silau river and construction of dikes under the Urgent Flood Control Project; and (ii) decrease in low flow by inter-basin diversion. These points support the necessity for construction of an integrated headworks. The proposed integrated headworks would consist of a weir and intake structures on each bank.

(2) Water requirements and irrigable area

The irrigation water requirements for paddy have been estimated respecting DGWRD's planning guideline. Consumptive use of water is estimated by the modified Penman method proposed by FAO. A percolation rate of 2 mm/day is applied. The effective rainfall is estimated based on the 5-year low rainfall in the project area. The overall irrigation efficiency is assumed to be 60 %. The diversion requirement used for the design is estimated at 1.67 lit/sec/ha.

Since an idea of the inter-basin water diversion is of realistic, the available water resources for the project have been evaluated by integrating the Silau and the Bunut river basins. The water balance study shows that a net area of 11,000 ha in the project area can be irrigated under low flow condition of 80% dependability.

The areas below El. 2 m in the Bunut and the Silau river basins are excluded from the project area due to difficulty of economic drainage. Some coconut fields of 670 ha are included in the project area. The total net irrigable area is planned to be 10,300 ha.

(3) Proposed irrigation and drainage systems

The planning and preliminary design of the irrigation and drainage facilities are made based on the detailed topographic map on a scale of 1:5,000 and the national base map on a scale of 1:50,000. The supplemental topographic surveys for the alternative route of the inter-basin diversion canal and external drains in the lower Bunut area are made for the design. The geo-technical data and information for the proposed Silau integrated headworks are taken from the investigation results of the Lower Asahan River Flood Control Project by DGWRD.

The main project works proposed are:

(i) construction of an inter-basin diversion canal between the Silau and the Bunut;
(ii) construction of an integrated headworks on the Silau river;
(iii) construction of a connection canals from the integrated headworks to the existing free intake points;
(iv) rehabilitation and upgrading of existing irrigation and drainage facilities;
(v) extension of irrigation and drainage canals;
(vi) construction of farm road network;
(vii) on-farm development;
(viii) reclamation of new farm land of 670 ha in coconut fields in the Silau area;

(ix) construction of a flood protection dike along the Bunut river of 34 km long; and

(x) construction of agri-business quarters at 70 sites for enhancement of the agricultural activities by farmers.

Proposed irrigation and drainage systems are illustrated in Fig. 5-4. The principal features of proposed project works are summarized in Table 5-6. The fundamental points on the proposed systems and their features are as follows.

Tertiary block

To realize proper water management and equitable water distribution, the average size of a tertiary block is determined at 60 ha. The net irrigable area of 10,300 ha is divided into 270 tertiary blocks dividing the area by existing village boundaries and physical boundaries such as roads and canals.

Integrated headworks on the Silau river

The existing four free intakes on the Silau river is proposed to be integrated into a headworks for ensuring the intake water level. New integrated headworks on the Silau river is planned to be constructed at 600 m downstream of the railway bridge near Kisaran as shown in Fig. 5-5.

The movable type weir is proposed for the integrated headworks in order to avoid adverse effects (back water inundation during flood) by the construction of the weir near Kisaran. Through the comparative study, rubber tube weir has been recommended because of: (i) suitability to weak foundation; (ii) reliability of easy and safe operation during flood; (iii) low construction cost; and (iv) low maintenance cost.

Inter-basin diversion canal

To transfer an excess water in the Silau river to the Bunut area, an inter-basin diversion canal is proposed. The diversion canal route has

been studied comparing alternative sites by evaluating viewpoints of easy operation and maintenance and economic efficiency The selected canal route is from the proposed integrated headworks to 2 km upstream of the existing Serbangan weir on the Bunut river. The canal is 8.3 km long with a flow capacity of 7.4 m^3/sec.

Irrigation canals

The irrigation system of the project is a single system diverting water at the integrated headworks on the Silau river supplemented by river flow of the Bunut river. The proposed irrigation system consists of 6 sub-systems, 2 in the Silau river basin and 4 in the Bunut river basin, following the existing irrigation systems. The proposed irrigation system consists of 170 km long canals and about 340 related structures.

Drainage canals

The unit drainage requirement is determined to be 5.1 lit/sec/ha so as to drain 5-year 3-day consecutive storm rainfall of 172 mm within 3 days following DGWRD's criteria. The proposed length of drainage canals is 180 km in total comprising new drains of 98 km and rehabilitation of 82 km. Related structures are about 160 in total. To maintain a drainability in the low-lying areas in the project area, 3 existing main drains connecting the low-lying area with the Strait of Malacca would be rehabilitated and, furthermore, tidal control gates be provided at the mouth of each main drain to avoid sea water intrusion.

Farm roads

Inspection roads of 340 km in total length are proposed along the proposed canals in the project. Macadam/gravel pavement is proposed for roads along the main and secondary irrigation canals and main drainage canals. In addition, a 10-km main trunk road (5 m wide asphalt-paved) between Meranti and Pasar XI/Air Joman is proposed to improve the accessibility in the Bunut area.

On-farm development

Of the total project area of 10,300 ha, an area of 9,510 ha has no on-farm facilities such as tertiary/quaternary irrigation and drainage canals, inspection roads and related structures. These facilities are quite necessary to realize profitable agriculture.

Planning and design of on-farm development have been made following DGWRD's Irrigation Design Standards. Design concept for on-farm facilities are to: (i) minimize the change of existing farm plot and existing ditches; (ii) allow plot-to-plot irrigation supply within 5 consecutive plots; and (iii) supply water by a quaternary canal to a group farmers consisting of 12 or less farmers.

(4) Flood control facilities

The master planning for flood control and a feasibility study on the urgent flood control project in the Asahan and the Silau rivers have been made in the Part-I study. Following the proposed plan, the detailed design for urgent flood control project was carried out by the Directorate General of River, DGWRD with a financial assistance of OECF. The design was completed in June 1989. The proposed works for the flood control in the Silau river are the improvement of river course of 19 km long between Kisaran and Tanjung Balai by constructing dikes on both banks and an excavation of the existing low water channel.

Flood control plan for the Bunut river has been made following a master plan proposed in the Part-I study. The plan aims to mitigate a 10-year flood by constructing dikes of 34 km long and by dredging the existing river channel as shown in Fig. 5-6.

(5) Operation and Maintenance plan

The operation and maintenance (O&M) works are important activities to realize project objectives. They include daily water management of irrigation water to secure the irrigation schedule, and a periodic maintenance of the project facilities. An O&M office would be established in Kisaran under jurisdiction of Provincial Irrigation Service of North Sumatra.

The water management will be undertaken by both operation section of the O&M office and the ditch tenders belonging to the farmers' water users' associations. The former will be responsible for operation of the major irrigation facilities down to turnout at the head of tertiary irrigation canal, while the latter will be responsible for operation and water management within respective tertiary blocks.

5.4.5 Development plan for farmer's organization

Farmer's organization is one of the most important functions for successful implementation of the project. However, the present farmer's organizations in the project area are inactive in general. In order to improve such activities of the farmer's organizations, improvement of physical and socio-economic infrastructures is quite essential.

Improvement of the physical infrastructures will be done by construction of the facilities for the irrigation, drainage and flood control. Improvement of socio-economic infrastructure will be made step by step and spot by spot by farmers themselves with growing their consciousness on cooperating activities. Development of individual farmer's consciousness and better experiences on cooperating activities among farmers in daily small scale activities is the prerequisite for realization of large scale effective farmer's organization. Therefore, the effort in the project should initially be concentrated to the farmer groups and P3A for their development. After that, development

activities will be expanded to promote KUD when majority of the farmers will become to pay keen attention to KUD.

An initial step of the activities in the Project will include: (i) reorganization of P3A; (ii) adjustment of farmer group; and (iii) construction of agri-business quarter.

The present P3A should be adjusted to reorganize so that one P3A union covers new irrigation blocks with about 200 ha on an average. The estimated number of P3A will amount to about 50 in the whole project area. The necessary staff for these P3As are 100 of Ulu-ulu and 400 of Ili-ili in total. Together with reorganization of P3As, present farmer groups should be adjusted to cover new irrigation blocks by one farmer group or farmer group union to facilitate farmer's joint activities on daily farm operation and post harvest and marketing activities. Also, the farmers in the present rainfed paddy field will be organized.

An agri-business quarter is planned to be constructed at the density of one per about 150 ha in the project area. The number of the quarter is estimated at 70 in total. One quarter has area of 0.2 ha with meeting rooms, conventional field depot for farm input and output,and sun-drying concrete yard. In the future, the quarter will have function of rice processing including rice mill unit and garage of farm machinery by farmer group.

5.4.6 Training program

In the framework of reinforcing institutional aspects, quality improvement of the O&M staff of the project office, the extension workers and farmers in the project area is one of the important factors to realize proper level of efficiency and effectiveness of the irrigation and drainage system.

The objective trainees are 608 in total number consisting of 38 O&M staff of the project area, 20 extension workers, 50 chairman of

P3A, 100 Ulu-ulu and 400 Ili-ili. The necessary number of trainers are estimated at 19 .

The training method to be used in the program would include: (i) lectures and field practices; (ii) workshop; and (iii) field visit. The training modules and materials to be used will include: (i) trainer's handbook; (ii) training modules; and (iii) trainer/trainee note and practical exercises.

The training period is planned to be two weeks for O&M staff and extension workers, and one week for the farmers. All the training programs will be finished during 1995/96.

5.4.7 Cost estimate

The project cost is estimated on the basis of preliminary design of the project facilities with the following assumptions:

(a) Unit prices for materials, equipment and labour applied to the present estimate are based on the current prices as of late 1989.
(b) The exchange rate used in the cost estimate is as follows.
US$ 1.0 = Rp.1,770
(c) Construction works are assumed to be executed on contract basis.
(d) Physical contingency is assumed to be 15 % for direct construction costs.
(e) Price escalation is estimated based on proposed implementation schedule by applying the following annual inflation rates:
- 8 % per annum for local currency portion.
- 3 % per annum for foreign currency portion
(f) Value added tax (PPN) is estimated at 10 % of the sum of direct construction costs including physical contingency.

The project cost comprises cost for detailed design, land acquisition cost, direct construction cost, procurement cost of O&M equipment, engineering service, administration cost and training cost. The direct construction cost consists of preparatory works, integrated weir work, rehabilitation works of weirs, irrigation and drainage works, on-farm works, farm roads works, agri-business quarters and flood dike on the Bunut river.

The project cost is estimated at Rp.157,300 million consisting of Rp.57,300 million of local currency portion and US$ 56.5 million (Rp.100,000 million equivalent) of foreign currency portion as shown in Table 5-7.

The annual O&M cost for the Project is assumed to be 1 % of the direct construction cost. The annual O&M costs for the main facilities (irrigation, drainage and road network; excluding on-farm facilities) and flood control works are estimated to be Rp.54,400/ha (or US$30/ha) and Rp.14,000/ha (or US$8/ha), respectively, which will be provided by the government. On the other hand, the O&M costs for the on-farm facilities and agri-business quarters are estimated at Rp.16,400/ha (or US$9/ha), which are assumed to be born by farmers. The annual total O&M costs is estimated at Rp.84,800/ha (or US$47/ha).

Some of the facilities proposed will have lives shorter than the useful life of the Project (50 years). The replacement cost of these facilities is adopted on the basis of their useful life such as 30 year for integrated headworks, 25 years for gates and 20 years for O&M equipment.

5.4.8 Project implementation and organization

(1) Project implementation

The project works are planned to be implemented in about 7 years including 2.5 years for project preparatory work such as detailed

design, implementing program, financial arrangement and pre-construction arrangement as shown in Fig. 5-7.

The project works are planned to be constructed by two packages; the Silau system and the Bunut system. Since the flood control works of the Silau river under the "Lower Asahan River Flood Control Project" proposed by Directorate of River, DPU, will be completed in 1994/95, earlier completion of the Silau system is planned so as to obtain irrigation benefit as soon as possible. Also the construction of the inter-basin works from the Silau to the Bunut is set out earlier than the other civil works, so as to obtain irrigation benefit as early as possible. The construction period of these works will require about 1.5 years. The construction of canal works and on-farm works will be carried out for 4 years from 1993/94 to 1996/97. The area to be irrigated will increase from 1994/95 and will attain the maximum area in 1997/98.

(2) Project organization

The Directorate of Irrigation, DGWRD, will become the executing agency for the proposed Silau-Bunut rehabilitation irrigation project. It will be responsible for design, construction of the project works and supervision for the project. The director of Irrigation I will be responsible for an overall execution of the proposed project,who will coordinate activities of all relevant governmental agencies in connection with implementation of the project.

The project execution office will be established at Kisaran. A project manager of the project will manage all field works in the project execution office, assisted by three divisions. The proposed organization chart for the project construction office is illustrated in Fig. 5-8.

After the completion of the project facilities, all the project works will be transferred to DPU, North Sumatra province which will carry

out operation and maintenance of the project facilities. The proposed organization chart for the project O&M office is illustrated in Fig. 5-9.

5.4.9 Project justification

(1) Economic evaluation

The economic evaluation for the project was made by adopting the following basic assumptions:

(a) The economic useful life of the project is 50 years;
(b) All prices are expressed in constant late 1989 prices;
(c) The exchange rate of US$ 1.00 = Rp.1,770 is applied throughout;
(d) A standard conversion factor of 0.8 is applied to the price of non-traded goods and services;
(e) The transfer payments such as contract tax, interest, etc. are excluded from the project cost for the economic analysis;
(f) The economic prices of tradable agricultural inputs and outputs are estimated on the basis of IBRD projections of world market prices for 1995; and
(g) Shadow price factor of 0.6 is applied to farm labor and unskilled labor.

The expected economic benefit comprises: (i) irrigation benefit; (ii) flood control benefit: and (iii) negative benefit.

Irrigation benefit to be expected is defined as the difference of primary profit from crops between future with project and without project conditions. The irrigation benefit will be expected to increase year by year and reach the full benefit in and after 3 years after the completion of the projects. Annual irrigation benefit at the full development stage is estimated at Rp.15,597 million as indicated in Table 5-8.

The flood control benefit is expressed as flood damage reduction by the implementation of the flood control works for the Silau and the Bunut rivers. The flood damage consists of direct flood damages, indirect flood damages and intangible flood damages. In the evaluation, direct and indirect flood damages are considered to be benefit. The annual flood damage reduction is estimated at Rp.7,969 million consisting of Rp.1,489 million for the Bunut river basin and Rp.6,480 million for the Silau river basin.

Negative benefit is the loss of benefit which is expected to accrue on the cultivated land to be acquired for the construction of irrigation and drainage canals and levees for the flood control project. The total negative benefit annually expected is estimated at Rp.639 million.

The economic project costs comprise not only the cost for irrigation, drainage and road networks but also the cost for flood control facilities at Silau and Bunut rivers. It is estimated by taking account of transfer payment, shadow price for unskilled labor and a standard conversion factor for non-tradable goods within the financial project cost as shown in Table 5-9. The economic project cost is estimated at Rp.148,400 million.

The economic internal rate of return is calculated on the basis of the cost and benefit flow as shown in Table 5-10. The internal rate of return of the project is 13.2 %.

A sensitivity analysis is carried out to evaluate the soundness of the project against possible adverse change in the future in the following factors: (i) cost overrun by 10 %; and (ii) reduction of irrigation benefit by 10 % due to unexpected decrease in forecast price. The results are presented below.

Case		EIIR (%)
Original EIRR		13.2
Case 1;	cost overrun by 10%	12.0
Case 2;	reduction of irrigation benefit by 10%	12.4
Case 3;	combined effect of case 1 and case 2	11.3

From the above results, the project could be justified economically. The sensitivity analysis indicates that the economic viability of the project is rather insensitive to the possible adverse changes.

(2) Financial analysis

Financial analysis of the project is made by analysis of the typical farm budgets and an assessment for repayment of the project cost. After the completion of the project, increase of unit yield of paddy and cropping intensity will be much expected. So farm income is expected to increase considerably. As a result, net reserve or capacity to pay for typical farmers will also increase as follows:

	irrigated (HYV)	rainfed (HYV)	rainfed (Local)
Average land holding size (ha)	1.1	0.8	1.9
Capacity to pay (Rp.1,000)			
with project condition	1,759	979	3,230
without project condition	1,240	-154	447
increase	519	1,133	2,783

These net reserves will offer incentive to the farmers in the project area. The project would be justified from the farmer's viewpoint.

Since no financial revenue is expected from the project, the Government should subsidize about Rp.8 to 10 billion per annum comprising loan repayment, loan interrest, and operation, maintenance and replacement (OMR) costs during the project life of 30 years. A financial cash flow statement is shown in Table 5-11.

5.4.10 Environmental assessment

In addition to the direct benefits, various positive or negative environmental and/or socio-economic impacts are expected from the implementation of the project.

The positive impacts expected by the implementation of the project would be as follows:

(i) increase of job opportunity,
(ii) increase of rice production and foreign exchanges saving,
(iii) increase in farmer's income and raising of living standards,
(iv) improvement of marketing,
(v) improvement of sanitation,
(vi) improvement of rural communication, and
(vii) effects by cultural innovation.

The conceivable negative impacts on social and environmental aspects are listed below.

(i) speculation of land
(ii) social conflict of land acquisition
(iii) loss of agricultural land
(iv) loss of agricultural crop production during construction
(v) traffic jam, accident, and damage of existing road
(vi) noise and air pollution
(vii) soil erosion
(viii) increase of turbidity in river water
(ix) social conflict between people in the project area and that from outside
(x) adverse effects by use of agricultural chemicals

Detailed description of the social and environmental impacts and recommendations to avoid negative impacts to be predicted are given in Table 5-12. It is concluded that the negative impacts to be predicted would not be serious to the local people in the project area.

Tables

Table 5-1 Movement of Rice in North Sumatra Province

(Unit: ton)

Year	Import	Rice Movement to North Sumatra Province			Rice Movement from North Sumatra Province			Balance
		Rice from Other Province through Dolog	Rice from Other Province through Private Sector	Total Amount	To Other Province through Dolog	To Other Province through Private Sector	Total Amount	
1974/75	116,139	0	n.a.	116,139	n.a.	n.a.	0	116,139
1975/76	121,290	0	n.a.	121,290	n.a.	n.a.	0	121,290
1976/77	155,979	0	n.a.	155,979	n.a.	n.a.	0	155,979
1977/78	188,200	0	n.a.	188,200	5,750	n.a.	5,750	182,450
1978/79	90,508	0	n.a.	90,508	5,800	n.a.	5,800	84,708
1979/80	124,502	32,300	n.a.	156,802	350	n.a.	350	153,302
1980/81	56,421	105,689	n.a.	162,110	2,850	n.a.	2,850	159,260
1981/82	42,202	150,000	n.a.	192,202	2,250	n.a.	2,250	189,952
1982/83	0	47,700	n.a.	47,700	2,550	n.a.	2,550	45,150
1983/84	183,724	55,285	n.a.	239,009	500	n.a.	500	238,509
1984/85	4,750	28,500	n.a.	33,250	n.a.	n.a.	0	33,250
1985/86	0	155,358	3,991	159,349	n.a.	n.a.	0	159,349
1986/87	25,561	154,285	65,638	245,484	n.a.	n.a.	0	245,484
1987/88	44,858	95,811	65,337	206,006	2500	n.a.	2,500	203,506
1988/89	0	75,700	n.a.	75,700	n.a.	n.a.	0	75,700

Table 5-2 Demand Projection of Paddy in North Sumatra Province

(1,000 ton)

Year	Population (000) (1)	Percapita Consumption (kg/year)	Total Paddy Consumption (2)	Waste, Feed and Seed (3)	Total Demand of Paddy	Supply of Paddy (4)	Requirement in North Sumatra	Requirement in the Study Area (5)	Requirement in the Study Area (6)
1990	10,541	145	2,425	291	2,716	2,422	294	44	29
1995	11,551	145	2,659	319	2,978	2,422	556	83	56
2000	12,567	150	2,992	359	3,351	2,422	929	139	93
2005	13,605	150	3,240	389	3,629	2,422	1,207	181	121
2010	14,656	150	3,490	419	3,909	2,422	1,487	223	149
2015	15,789	150	3,759	451	4,210	2,422	1,788	268	179
2020	17,009	150	4,050	486	4,536	2,422	2,114	317	211

Remarks:

(1) Population growth rate is assumed as follows;
Figures in 1990 and 1995 are figures estimated by Bureau of central statistic office
1995/2000: 1.7% per year
2000/2005: 1.6% per year
2005/2020: 1.5% per year

(2) Conversion rate of paddy to rice = 1:0.63

(3) Feed requirement: 2% of total demand
Seed requirement: 1.3% of total demand
Waste for paddy: 5.4% of total demand
Waste for rice: 2.5% of consumption of rice

(4) Total production of paddy in North Sumatra province, 1988

(5) Requirement in North Sumatra x 15%

(6) Requirement in North Sumatra x 10%

Table 5-3 Main Features of Proposed Projects

Description	PJT-1 Silau-Bunut	PJT-2 Tambun Tulang	PJT-3 Simpang Empat	PJT-4 Padang Mahondang	PJT-5 Leidong Asahan	PJT-6 Kanopan Left	PJT-7 Aek Natas	PJT-8 Kualuh Right	PJT-9 Aek Naetek	PJT-10 Small Scale
1 Project area										
(1) Gross area (ha)	17,000	7,500	4,000	8,300	62,100	5,800	5,500	3,100	4,500	8,700
(2) Net area (ha)	14,300	5,800	2,800	6,200	45,600	4,300	4,200	2,400	3,500	7,200
2 Type of Project	I	C/D, S/W	C/D, S/W	I & S/W	I & S/W	C/D, S/W	I & S/W	I	I & S/W	I
3 Agricultural Development Plan										
(1) Cropping Pattern	P/P	P	P	P/P	P/P, O/P	P	P/P	P/P	P/P	P/P
(2) Cropping Intensity (%)	200	100	100	200	137	100	200	200	200	174
(3) Annual incremental production of paddy (ton/year)	90,800	14,900	11,200	53,000	136,000	13,100	35,900	20,200	29,700	40,600
4 Proposed Project Works										
(1) Irrigation canals (km)	406	0	0	216	773	0	147	85	121	205
(2) Drainage canals (km)	255	144	70	51	1,136	85	86	61	86	152
(3) Flood dikes (km)	56	0	30	29	29	11	16	19	43	0
(4) On-farm facilities (ha)	13,222	5,755	2,800	6,185	45,500	4,300	4,190	2,400	3,450	7,040
(5) Land reclamation (ha)	1,065	1,715	2,800	4,015	29,640	2,260	1,490	385	1,050	20
5 Project Cost (Rp. billion) *	205	31	26	99	657	26	64	41	59	77
6 Implementation Period (years)**	7	5	5	6	16	5	5	5	5	6
7 Economic Evaluation										
(1) EIRR (%)	13.2	9.9	9.6	12.2	8.5	11.3	11.2	10.1	11.3	11.5
(2) B/C ratio at 10 % intrest	1.32	0.99	0.96	1.21	0.80	1.14	1.12	1.01	1.13	1.03
8 Possible number of transmigrator (families)	0	1,700	2,800	3,400	15,200	2,200	1,200	300	1,000	0

Remarks:

Type of project:
- I : Irrigation and drainage development
- C/D : Controlled drainage development
- SW : Swamp area development

Cropping Pattern:
- P/P : Double cropping of paddy
- P : Single cropping of paddy
- O/P : Oil palm plantation

* : Price contingency is not included.

**: Period includes further study, design, fund arrangement, and construction works.

Table 5-4 Comparison Between Master Plan Study and In-depth Study (1/2)

No	Item	Master Plan Study	In-Depth Study	Description (Main reason of change or confirmed matter)
1	**Employed data and information**			
1.1	Topographic map	1/50,000 (CI = 25 m)	1/5,000 (CI = 1.0 m)	New detailed map was available for the in-depth study.
1.2	Available water resources	Monthly basis river discharge	10-day basis river discharge	Shorter term river runoff discharges of the Silau and Bunut were estimated.
1.3	Soil map	Existing survey data and field reconnaissance	S=1/50,000 map based on the soil survey	Soil survey was conducted by the DGWRD under supervision of the Team.
1.4	Existing irr.and drain facilities	Inventory list of Irrigation Service Offices	Inventory survey by the Team	Status of existing irrigation and drainage conditions were investigated in the field.
1.5	Irrigation and drainage conditions	Interview results to the Irrigation Service Offices	Interview survey to the village chives and farmers by the Team	Information taken from District Irrigation Service Offices of PU was confirmed and/or modified based on the field investigation.
1.6	Tidal effect	Existing data and information	Field investigation and interview survey	Field investigation as well as interview survey are conducted to clarify the tidal reach and degree of tidal amplitude
1.7	Present land use condition	S=1/50,000 map and aerophoto	S=1/5,000 map and field investigations	Land use condition is clarified based on the map of S=1/5,000 and field investigations
1.8	Present cropping season & pattern	Existing data by kecamatan & questionnaire	Existing data by desa, field survey & questionnaire	In depth field investigation and interview survey were conducted in the project area to identify the pattern.
1.9	Farming practices	Existing data by kecamatan & questionnaire	Field survey & questionnaire	In depth field investigation and interview survey were conducted in the project area to identify the present status.
1.10	Crop yield	Existing data & interview	Questionnaire, yield survey & field survey	Questionnaire by type of cropping pattern and rice yield survey were conducted aiming at estimating present yield.
1.11	Farm economy	Questionnaire & existing data	3 questionnaire survey in the project area	Questionnaire by type of cropping pattern and in depth farm socio- economic survey such as coconut farmer's intention on land use change from coconut field into irrigated paddy field, and tenurial status of farm land.
1.12	Supporting services	Existing data by kecamatan	Interview, field survey on services	Actual situations and problems are identified through in-depth survey.

Table 5-4 Comparison Between Master Plan Study and In-depth Study (2/2)

No	Item	Master Plan Study	In-Depth Study	Description (Main reason of change or confirmed matter)
2	**Demarcation of the Project Area**			
	2.1 Development concept	Increase of paddy production by introducing double cropping of paddy per year	Same as left	No change
	2.2 Project area	17,000 ha in gross 14,300 ha in net	14,300 ha in gross 10,300 ha in net	(Land use) Paddy field area clarified by the detailed land use study was applied. Convertion of some coconut field to irrigated paddy field was planned. (Drainability and relation with swamp development) The low-lying land below EL.2 m was excluded for poor drainability. (Soil conditions) Deep organic soil zones were excluded based on the land suitability classification. (Water resource) Water resources are available enough for the Project according to the water balance study taking into account the river maintenance flow, and conjunctive use of the river flow of the Silau and Bunut.
	2.3 Proposed cropping pattern	Double cropping of paddy	Same as left	Formulated based on climatic conditions, the results of water balance and drainage study, present cropping pattern, etc. Slightly revised in order to avoid adverse effects of inundation on seedling and young plant
3	**Project Works**			
	3.1 Type of the Silau Integrated weir	Movable gate (rubber tube weir) is tentatively proposed	Rubber tube weir was selected.	Fixed type weir will cause aggradation of the river bed. Due to the decrease of the river flow capacity, flood damage to the Kisaran city is anticipated. No stable intake of irrigation water is expected by the free intake method. Rubber tube weir was selected through comparative study on movable weirs
	3.2 Inter-basin work	Inter-basin site on the Silau river at Prapat Janji, 20 km upstream Kisaran (Alt-1)	Alternative inter-basin plan from the Silau Integrated weir, was additionally studied as Alt-2	Plan of Alt-2 was selected based on the comparative studies on O & M works, construction cost, river hydraulics, etc.
	3.3 Irrigation and drainage canals			
	Irri. canals	400 km	170 km	Project area was reduced from 17,000 ha to 14,300 ha. Canal length was estimated based on preliminary layout of canals taking into account the full utilization of existing canals. The existing irrigation and drainage canals of about 140 km in total will be rehabilitated and upgraded under the project
	Drain. canals	250 km	180 km	
4	Institutional and training aspects	-	Recommendation of enhancement plan	- Training of O & M staff, farmers. - Construction of agri-business quarter which has function of meeting room, storage of farm input and output, drying yard, rice processing center, etc.

Table 5-5 Land Use Plan

(unit : ha)

Present land use	Land Use Plan						
	Paddy field (net)		Coconut field	Up-land field	Housing yard	Others	Total
	Irrigated	Rainfed					
1. Paddy field	9630	-	-	-	-	1,070 *	10700
(1) Irrigated **	(1,480)	-	(-)	(-)	(-)		(1,640)
(2) Rainfed	(8,150)	-	(-)	(-)	(-)		(9,060)
2. Coconut field	670	-	1400	-	-	80 *	2150
3. Upland field	-	-	-	240	-	-	240
4. Housing yard	-	-	-	-	810	-	810
5. Others	-	-	-	-	-	400	400
Total	10300	0	1400	240	810	1550	14300

Remarks:

1) Coconut field of 750 ha is converted into irrigated paddy field.
2) * ; Land used for additional canals and roads.
3) ** ; Paddy field irrigated throughout a year (Grade I condition) only.

Table 5-6 Main Features of Proposed Project Works

Item	Description
1. Location	Noth-east of Kisaran, 150 km from Medan, North Sumatra Province
2. Water resources	Conjunctive use of Silau and Bunut river flows
3. Project Command Area	
(1) Gross area	14,300 ha
(2) Net irrigation area	10,300 ha
4. Agricultural Development Plan	
(1) Cropping pattern	Double crop of paddy per year
(2) Cropping intensity	200%
(3) Annual incremental paddy production	74,000 ton/year
5. Proposed Project Work	
(1) Water resource facilities	
(i) Construction of Silau integrated weir	Rubber tube type movable weir on the Silau river
(ii) Construction of inter-basin diversion canal	Diversion canal from the Silau to the Bunut river (L= 8.3 km)
(iii) Rehabilitation of existing weirs on Bunut river	3 weirs of Serbangan, Panca Arga and Buluru
(2) Rehabilitation and construction of irrigaiton canals	49 canals of 170 km in total (Rehabilitation : 60 km, New construction ; 110 km)
(3) Rehabilitation and construction of drainage canals	48 canals of 180 km in total (Rehabilitation : 82 km, New construction ; 98 km)
(4) Construction of farm road network	354 km in total(New roads)
(5) Construction of Bunut flood dike	Construction of earth dike and dredging of river bed for 34 km
(6) Construction of on-farm facilities	9,510 ha (area of 790 ha has been developed)
(7) Land reclamation	670 ha from coconuts field to paddy fields in Silau system
(8) Construction of agri-business quarter	70 sites (each has drying yard and building in 2,000 sq-m land)
(9) Procurement of O&M equipment	Operation vehicles, maintenance equipment, etc.
(10) Training program for O&M staff and farmers	Nos. of trainees : Government staff ; 58 , Farmers ; 550
6. Project Cost *	
(1) Construction cost (Rp. million)	100,426 (US$ 5,500/ha)
(2) Other costs (Rp. million)	31,635
(3) Total (Rp. million)	132,061
7. Project Fund Requirement	
(1) Foreign currency portion (US$ 1,000)	56,520
(2) Local currency portion (Rp. million)	57,271
(3) Total cost (Rp. million)	157,311
8. Implementation Program	
(1) Implementation period	
(i) Detailed design and pre-construction management	2.5 years
(ii) Construction period	4.5 years
(iii) Total period	7 years
(2) Execution agency	DGWRD, DPU (Project office will be established)
9. Economic Evaluation **	
(1) Economic capital costs (Rp. million)	148,432
(2) Annual economic benefit (Rp. million)	22,901
(3) Economic Internal Rate of Return (%)	13.2 %
(4) Benefit-Cost (B/C) ratio (at 12 % discount rate)	1.10
(5) Benefit minus Cost (B-C) ratio (at 12 % discount rate)	Rp. 9,580 million

Remarks:
1. Conversion rate : US$ 1.0 = Rp. 1,770
2. Price escalation ratio : Foreign currency ; 3% / year, Local currency ; 8 % /year

*: The cost does not include a price contingency

**: The economic evaluation is made based on the costs and benefits of the Project and Silau flood control works by DGWRD

Table 5-7 Summary of Project Cost

	Item	Foreign Currency (US $1,000)	Local currency (Rp. million)	Total (Rp. million)	Remarks
I	DETAILED DESIGN	2,418	1,834	6,113	(7 % of Item III-1 & 2)
II	LAND ACQUISITION				
	1 Silau Area	0	950	950	
	(0) Bunut Area	0	1,550	1,550	
	Total for Item II	0	2,500	2,500	
III	CONSTRUCTION COST				
	1 Direct Cost for Irrigation Development				
	(1) Silau River System (4,250 ha)				
	1) General items	1,082	850	2,766	(9%)
	2) Silau integrated weir	2,959	1,125	6,363	(20%)
	3) Irrigation canal system	3,509	2,302	8,513	(27%)
	4) Drainage canal system	1,081	895	2,809	(9%)
	5) Farm road network	1,463	1,100	3,689	(12%)
	6) On-farm development	1,811	2,151	5,356	(17%)
	7) Agri. business quarter	644	413	1,552	(5%)
	Sub-total (1)	12,549	8,836	31,047	(100%)
	(2) Bunut River System (6,050 ha)				
	1) General items	1,839	1,578	4,834	(12%)
	2) Rehabilitation of weirs	634	406	1,528	(4%)
	4) Inter-basin canal	791	816	2,216	(5%)
	5) Irrigation canal system	3,170	2,045	7,656	(18%)
	6) Drainage canal system	4,067	3,591	10,790	(26%)
	7) Farm road network	1,912	1,445	4,829	(12%)
	8) On-farm development	2,636	3,080	7,745	(18%)
	9) Agri. business quarter	965	619	2,328	(6%)
	Sub-total (2)	16,015	13,579 0	41,926	(100%)
	Total for Item III-1	**28,564**	**22,415 0**	**72,973**	**US $ 4,003 /ha**
	2 Direct Cost for Bunut Flood Dikes	5,975	3,779	14,354	US $ 787 /ha
	Total for Items III-1 & 2	**34,539**	**26,194 0**	**87,327**	**US $ 4,790 /ha**
	3 Contingency				
	(1) Physical Contingency	5,181	3,929	13,099	(15 % of Item III-1)
	(2) Price Contingency	6,139	14,384	25,250	(F/C : 3 % /year) (L/C : 8 % /year)
	Total for Item III-2	11,320	18,313 0	38,349	
	4 Total for Items III-1, 2 & 3	**45,859**	**44,507 0**	**125,676**	
	5 Tax on Civil Works (VAT)	3,972	3,012	10,043	(10 % of Item III-3)
	Total for Item III	**49,830**	**47,520 0**	**135,719**	
IV	O&M EQUIPMENT	817	66	1,513	
V	ENGINEERING SERVICE	3,454	2,619	8,733	(10 % of Items III -1 & 2)
VI	ADMINISTRATION COST	0	2,620	2,620	(3 % of Items III-1 & 2)
VII	TRAINING PROGRAM	0	113	113	
	GRAND TOTAL	**56,520**	**57,271**	**157,311**	

(Conversion rate : US $ 1.0 = Rp. 1,770)

Table 5-8 Irrigation Benefit at Full development Stage

Item	With Project Condition (1)	Without Project Condition (2)	Incremental (1) - (2)
Paddy cropping area by present land use (ha)			
Wet season			
Paddy			
Irrigation	2,790	2,790	0
Rained (HYV)	3,490	3,490	0
Rained (Local variety)	3,350	3,350	0
Coconut	670	670	0
Total	10,300	10,300	0
Dry season			
Paddy			
Irrigation	1,480	1,480	0
Rainfed (in irrigation area)	1,310	460	850
Rainfed (HYV)	3,490	-	3,490
Rainfed (Local variety)	3,350	-	3,350
Coconut	670	-	670
Total	10,300	1,940	8,360
Profit per ha by present land use (Rp.'000/ha)			
Paddy			
Irrigation (Wet & dry seasons)	1,092	744	
Rainfed (in irrigation area)	1,092	460	
Rainfed (HYV)	1,092	429	
Rainfed (Local variety)	950	194	
Coconut	950	330	
Total profit by present land use (Rp.million)			
Paddy			
Irrigation (Wet season)	3,047	2,076	971
Irrigation (dry season)	1,616	1,101	515
Rainfed (in irrigation area)	1,431	212	1,219
Rainfed (HYV)	7,622	1,497	6,125
Rainfed (Local variety)	6,365	650	5,715
Coconut	1,273	221	1,052
Total	21,354	5,757	15,597
Annual incremental benefit per ha (Rp. '000/ha)			1,514

Table 5-9 Economic Project Cost

	Item	Local Currency (Rp. million)	Foreign Currency (US $1,000)	Total (Rp. million)
I	Detailed Design (7 % of Item III-1)	1,254	2,418	5,533
II	Land Acquisition			
	1) Silau area	760	0	760
	2) Bunut area	1,168	0	1,168
	Total of Item II	1,928	0	1,928
III	Construction Cost			
	1 Direct Cost			
	1) Silau River System	6,075	12,549	28,286
	2) Bunut River System	11,836	21,990	50,758
	Total of Item III-1	17,911	34,538	79,044
	2 Physical Contingency (15 % of Item III-1)	2,687	5,181	11,857
	Total of Item III	20,598	39,719	90,901
IV	Procurement of O&M Equip.	53	1,706	3,073
V	Engineering Service (10 % of total cost of Item III -1)	2,230	3,454	8,343
VI	Administration Cost (3 % of total cost of Item III-1)	2,112	0	2,112
VII	Training Program	90	0	90
VIII	Silau Flood Dike	10,262	15,886	38,380
	TOTAL	38,527	63,183	150,361

Note: Conversio rate : US $ 1.0 = Rp. 1,770

Table 5-10 Economic Cash Flow

(Unit:Rp.million)

No.	Year	Costs				Benefits				
		Irrigation	Flood (Silau)	OMR	Total	Irrigation	Flood	Negative (Irri,)	Negative (Flood)	Total
1	1990	1,087	2,419		3,506					0
2	1991	4,446	5,652		10,098				-32	-32
3	1992	12,808	11,305		24,113				-65	-65
4	1993	26,037	11,305		37,342		3,240	-187	-97	2,956
5	1994	25,197	9,421	430	35,048	3,079	4,536	-339	-97	7,179
6	1995	25,947		800	26,747	6,613	7,671	-491	-97	13,696
7	1996	12,808		1,040	13,848	10,973	7,969	-568	-97	18,277
8	1997			1,170	1,170	13,914	7,969	-568	-97	21,218
9	1998			1,170	1,170	15,170	7,969	-568	-97	22,474
10	1999			1,170	1,170	15,594	7,969	-568	-97	22,898
11	2000			1,170	1,170	15,594	7,969	-568	-97	22,898
12	2001			1,170	1,170	15,594	7,969	-568	-97	22,898
13	2002			1,170	1,170	15,594	7,969	-568	-97	22,898
14	2003			1,170	1,170	15,594	7,969	-568	-97	22,898
15	2004			1,170	1,170	15,594	7,969	-568	-97	22,898
16	2005			1,170	1,170	15,594	7,969	-568	-97	22,898
17	2006			1,170	1,170	15,594	7,969	-568	-97	22,898
18	2007			1,170	1,170	15,594	7,969	-568	-97	22,898
19	2008			1,170	1,170	15,594	7,969	-568	-97	22,898
20	2009			1,170	1,170	15,594	7,969	-568	-97	22,898
21	2010			1,170	1,170	15,594	7,969	-568	-97	22,898
22	2011			1,170	1,170	15,594	7,969	-568	-97	22,898
23	2012			1,170	1,170	15,594	7,969	-568	-97	22,898
24	2013			1,170	1,170	15,594	7,969	-568	-97	22,898
25	2014			1,170	1,170	15,594	7,969	-568	-97	22,898
26	2015			1,952	1,952	15,594	7,969	-568	-97	22,898
27	2016			1,952	1,952	15,594	7,969	-568	-97	22,898
28	2017			1,561	1,561	15,594	7,969	-568	-97	22,898
29	2018			1,170	1,170	15,594	7,969	-568	-97	22,898
30	2019			1,170	1,170	15,594	7,969	-568	-97	22,898
31	2020			1,170	1,170	15,594	7,969	-568	-97	22,898
32	2021			1,170	1,170	15,594	7,969	-568	-97	22,898
33	2022			1,170	1,170	15,594	7,969	-568	-97	22,898
34	2023			1,170	1,170	15,594	7,969	-568	-97	22,898
35	2024			5,159	5,159	15,594	7,969	-568	-97	22,898
36	2025			1,170	1,170	15,594	7,969	-568	-97	22,898
37	2026			1,170	1,170	15,594	7,969	-568	-97	22,898
38	2027			1,170	1,170	15,594	7,969	-568	-97	22,898
39	2028			1,170	1,170	15,594	7,969	-568	-97	22,898
40	2029			1,170	1,170	15,594	7,969	-568	-97	22,898
41	2030			1,170	1,170	15,594	7,969	-568	-97	22,898
42	2031			1,170	1,170	15,594	7,969	-568	-97	22,898
43	2032			1,170	1,170	15,594	7,969	-568	-97	22,898
44	2033			1,170	1,170	15,594	7,969	-568	-97	22,898
45	2034			1,170	1,170	15,594	7,969	-568	-97	22,898
46	2035			1,170	1,170	15,594	7,969	-568	-97	22,898
47	2036			1,952	1,952	15,594	7,969	-568	-97	22,898
48	2037			1,952	1,952	15,594	7,969	-568	-97	22,898
49	2038			1,561	1,561	15,594	7,969	-568	-97	22,898
50	2039			1,170	1,170	15,594	7,969	-568	-97	22,898

Table 5-11 Financial Cash Flow Statement

(Unit : Rp. Million)

Year	Year in Order	Cash Outflow						Cash Inflow						
		Project Cost	O &M Cost	Peplacement Cost	Loan Interest	Loan Repayment	Total Outflow(A)	Foreign Loan	Government Budget	Government Subsidy	Water Charge	Total Inflow(B)	Balance (B)-(A)	Accumulated Loan
1990	1	3,723	0	0	25	0	3,748	1,013	2,710	25	0	3,748	0	1,013
1991	2	5,110	0	0	131	0	5,241	4,231	879	131	0	5,241	0	5,244
1992	3	16,890	0	0	468	0	17,358	13,477	3,413	468	0	17,358	0	18,720
1993	4	35,691	0	0	1,196	0	36,887	29,118	6,573	1,196	0	36,887	0	47,839
1994	5	36,354	329	0	1,937	0	38,620	29,631	6,723	2,266	0	38,620	0	77,470
1995	6	38,975	597	0	2,732	0	42,304	31,799	7,176	3,329	0	42,304	0	109,269
1996	7	20,568	864	0	3,146	0	24,578	16,576	3,992	4,010	0	24,578	0	125,844
1997	8	0	1,000	0	3,146	0	4,146	0	0	4,146	0	4,146	0	125,844
1998	9	0	1,000	0	3,146	0	4,146	0	0	4,146	0	4,146	0	125,844
1999	10	0	1,000	0	3,146	0	4,146	0	0	4,146	0	4,146	0	125,844
2000	11	0	1,000	0	2,989	6,292	10,281	0	0	10,281	0	10,281	0	119,552
2001	12	0	1,000	0	2,832	6,292	10,124	0	0	10,124	0	10,124	0	113,260
2002	13	0	1,000	0	2,674	6,292	9,966	0	0	9,966	0	9,966	0	106,968
2003	14	0	1,000	0	2,517	6,292	9,809	0	0	9,809	0	9,809	0	100,676
2004	15	0	1,000	0	2,360	6,292	9,652	0	0	9,652	0	9,652	0	94,384
2005	16	0	1,000	0	2,202	6,292	9,495	0	0	9,495	0	9,495	0	88,092
2006	17	0	1,000	0	2,045	6,292	9,337	0	0	9,337	0	9,337	0	81,800
2007	18	0	1,000	0	1,888	6,292	9,180	0	0	9,180	0	9,180	0	75,508
2008	19	0	1,000	0	1,730	6,292	9,023	0	0	9,023	0	9,023	0	69,216
2009	20	0	1,000	0	1,573	6,292	8,865	0	0	8,865	0	8,865	0	62,924
2010	21	0	1,000	0	1,416	6,292	8,708	0	0	8,708	0	8,708	0	56,632
2011	22	0	1,000	0	1,259	6,292	8,551	0	0	8,551	0	8,551	0	50,340
2012	23	0	1,000	0	1,101	6,292	8,393	0	0	8,393	0	8,393	0	44,048
2013	24	0	1,000	0	944	6,292	8,236	0	0	8,236	0	8,236	0	37,756
2014	25	0	1,000	0	787	6,292	8,079	0	0	8,079	0	8,079	0	31,464
2015	26	0	1,000	702	629	6,292	8,624	0	0	8,624	0	8,624	0	25,172
2016	27	0	1,000	702	472	6,292	8,466	0	0	8,466	0	8,466	0	18,880
2017	28	0	1,000	603	315	6,292	8,210	0	0	8,210	0	8,210	0	12,588
2018	29	0	1,000	0	157	6,292	7,450	0	0	7,450	0	7,450	0	6,296
2019	30	0	1,000	0	0	6,292	7,292	0	0	7,292	0	7,292	0	0
										0		0		
Total		157,311	24,790	2,007	48,962	125,844	358,914	125,844	31,467	201,603	0	358,914	0	

Remarks:

Foreign Loan: Annual interest of 2.5% for repayment period of 30 years including 10-year grace period.

Table 5-12 Project Impacts (1/2)

Impact to be predicted	Pre-Construction	Stage Construction	Operation & Maintenance	Remarks
(1) speculation of land	*			In the project, it will become necessary to acquire the land of about 1,400 ha for the construction of irrigation and drainage canals, dikes and related structures. It is predicted that investors from the outside of the project area speculate in land buying for profit. To minimize such negative impacts, it is proposed that a specific regulation against selling and purchasing land within the project area should be enacted. And the regulation will be put in force only for the period of project implementation stage.
(2) loss of agricultural land		*		It is estimated that 1,070 ha of paddy field and 375 ha of coconut field are lost due to construction of project facilities. These lands should be compensated by the project.
(3) social conflict of land acquisition		*		It is predicted that problems of acquisition and compensation for the land occur because of a small farmhold size of the beneficiaries in the project area. To minimize such negative impacts, detailed design of the project facilities should be done so as to minimize area for compensation. In addition the project execution organization should institute a coordination committee with the local governments such as village chieves, Camats, Bupatis and the authorities concerned through which better understanding for the project by the farmers in the project area should be realized.
(4) loss of agricultural crop production		*		A construction of the improvement and rehabilitation of the existing irrigation systems is planned to be carried out during the dry season. It is predicted that some loss of agricultural crop production in the dry season will be brought about due breaking cropping by the construction. An appropriate construction schedule and methods such as half-closure diversion methods should be applied to for minimizing the loss.
(5) trafic jam, accident and damage against existing roads		*		A lot of the heavy equipment such as heavy truck, dump truck, bulldozer, backhoe,ete are planned to be utilized for the construction of the project facilities. Traffic jam, traffic accidents and damage against the existing roads will be considered. Compensation cost for the roads to be damaged is budgeted in the project cost.
(6) noise and air pollution		*		During the construction period, problems on noise and air pollution accrued from the construction may occur, but small.
(7) soil erosion		*		Since good soil materials are not found in the project area, borrow pit sites is to be at the undulating elevated lands located in the north of the project area. A great deal of soil materials will be excavated at the sites and sheet soil erosion is considered. Erosion control measures such as terrace structures, vegetative coverage, etc, will be needed for prevention against soil erosion.
(8) increase of turbidity in river water and unstable supply of bathing and washing water for local people		*		The excavation and dredging of the river channel of the Silau and Bunut rivers will affect turbidity of river water and increase it. This fact may give a negative impact against living organisms such as fishes especially cultured in the cages, plankton,etc. A unstable water supply to the people in the downstream which will be accrued from the construction of the integrated diversion weir in the Sulau river is planned to be minimized through an application of half-closure diversion method.
(9) social conflict between people in the project area and from the outside area		*		Labor requirement of the unskilled laborers is estimated at 4.2 million man-days during the construction period. So considerable portion of such laborers will be dependent on the laborers from the outside of the project area. Under such situation social conflict may occur between the laborers in terms of competition of seeking jobs and their different behaviour. A settlement of project workers should be placed in the particular location to prevent such problems.

Table 5-12 Project Impacts (2/2)

Impact to be predicted	Pre-Construction	Stage Construction	Operation & Maintenance	Remarks
(10) cultural inovation		*		Skilled workers necessary for the project may be from the outside of the project area. These people will give technical knowledge and cultural inovation to the local people through the project work.
(11) increase of job opportunity		*	*	It is estimated that the project will generate employment opportunities totalling about 4.2 million man-days of unskilled labors during the construction period. In addition the project creates a demand for farm labor requirement accrued from increased farming activities due to intensive use of the land. The incremental farm labor requirement is estimated at 1.6 million man-days annually. The ratio of labor absorbed in farming activities to total available labor force will be expected to increase from 30 % at present condition to about 60 % in the project condition. Furthermore the increase of rice production under project condition will generate an additional employment opprotunity of rice millers and merchants.
(12) change of land use and increase of rice production			*	At the full development stage, present land use pattern having 9,630 ha of the existing paddy field and 670 ha of coconut field will change into all the irrigated paddy field. It is expected that incremental paddy production of about 74,000 tons will be genearated. These incremental product will play an important role in self-sufficiency in rice in North Sumatra province. The incremantal production will bring in total annual foreign exchange savings of about Rp.22.2 billion equivalent.
(13) increase in farmer's income and raising of living standard			*	Farmer's income will be expected to improve considerably due to production increase of rice. Their incomes will become about twice the present level or more, which will provide motivation in improvement of living standard of farmers as well as of the regional economy.
(14) betterment of marketing			*	The project will provide about 350 km of roads including connection road with provincial and Kabupaten roads. Under such situation easy transportation of farm inputs and outputs is realized. Reduction of their marketing costs is also expected.
(15) betterment of sanitation			*	The conditions of the drainage and flooding in the project area are much improved by the construction of about 230 km of the drainage canals and river channel improvement. By these improvements, malaria, filariasis and various kinds of skin diseases will be expected to be significantly decreased will be reduced.
(16) betterment and easy communication			*	Through improvement of road network in the project area, easy and better communication among communities will be realized.
(17) use of agricultural chemicals			*	After the implementation of the projects,improved irrigation farming practices will be followed by the farmers. At the full development stage, total amount of chemicals is forcasted to become 2.3 times of that of the present use,which results from not increase of dosage/ha but expansion of cropping area. At present the chemicals used in the project area is low in toxicity. The selection and practice of these chemicals have been carefully made and guided by Department of Agriculture. It is recommended for the project office to monitor kind of chmicals and their amounts.

Figures

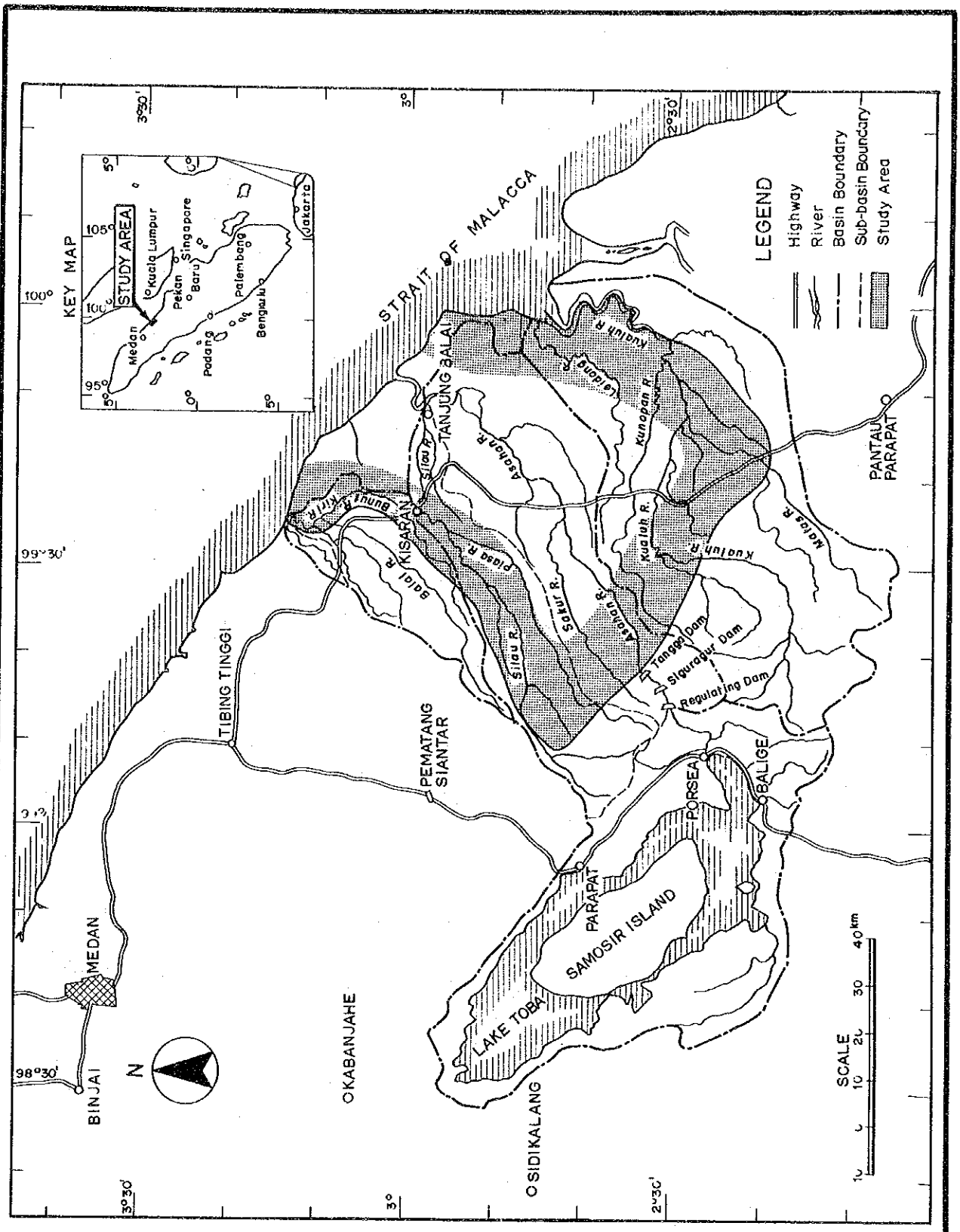

Fig. 3-1

Location of the Study Area

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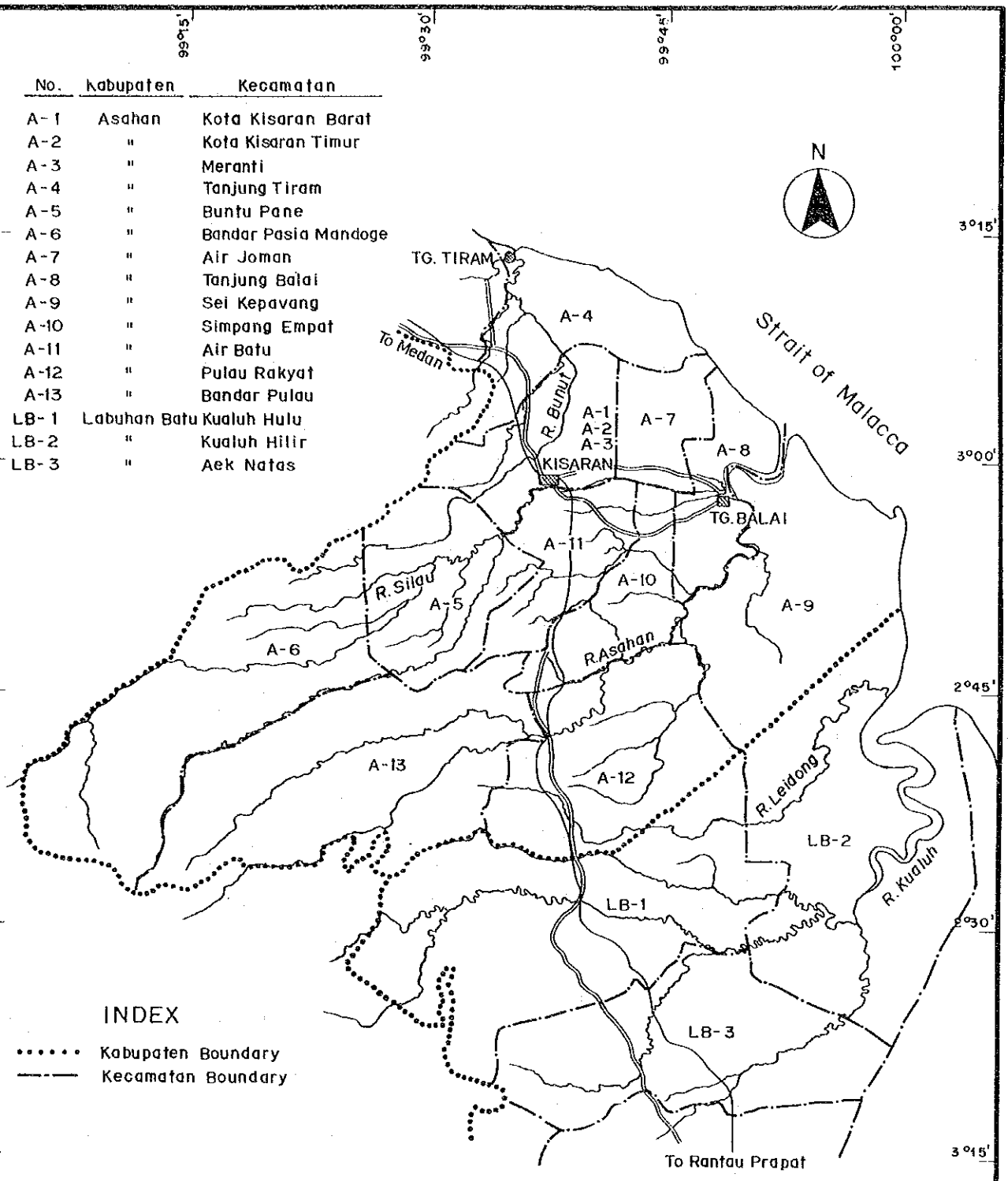

Fig. 3-2
Administrative Boundary

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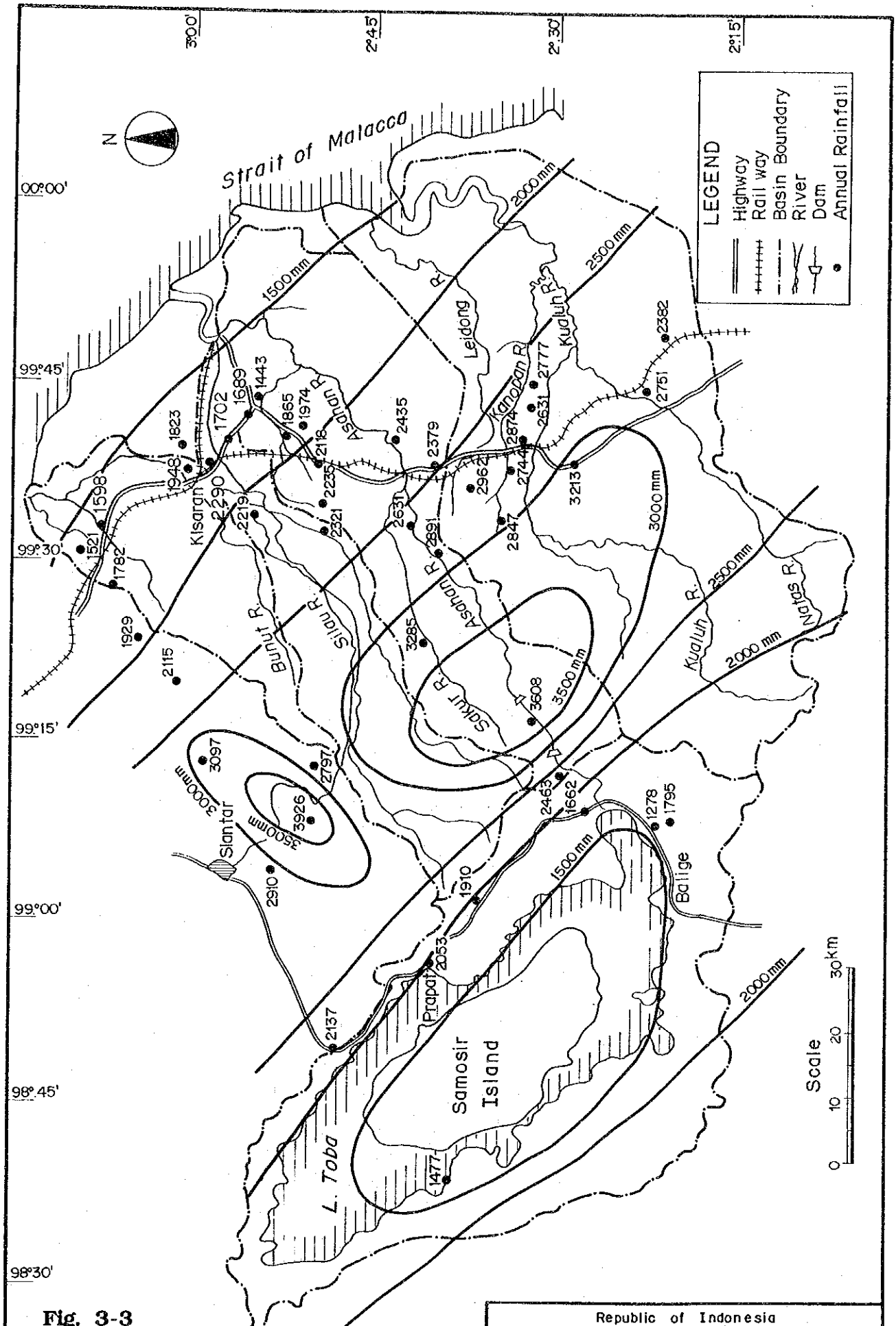

Fig. 3-3
Isohyet and Rainfall Stations

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