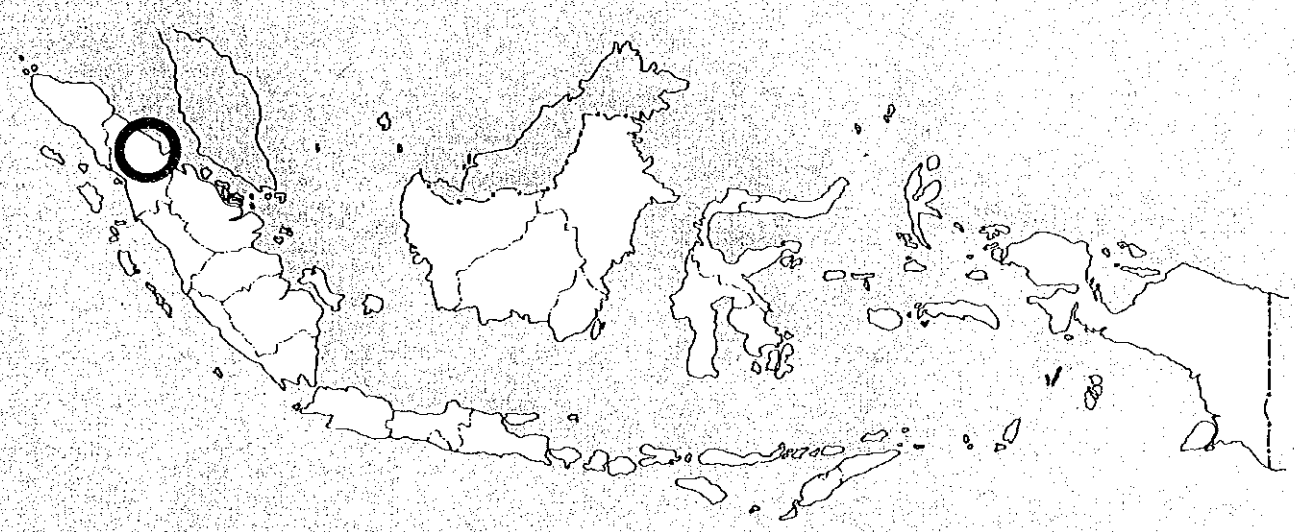
MASTER PLAN STUDY ON LOWER ASAHAN RIVER BASIN DEVELOPMENT

Volume 3

Agricultural Development Plan



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 3

Agricultural Development Plan

July 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

LIST OF REPORTS

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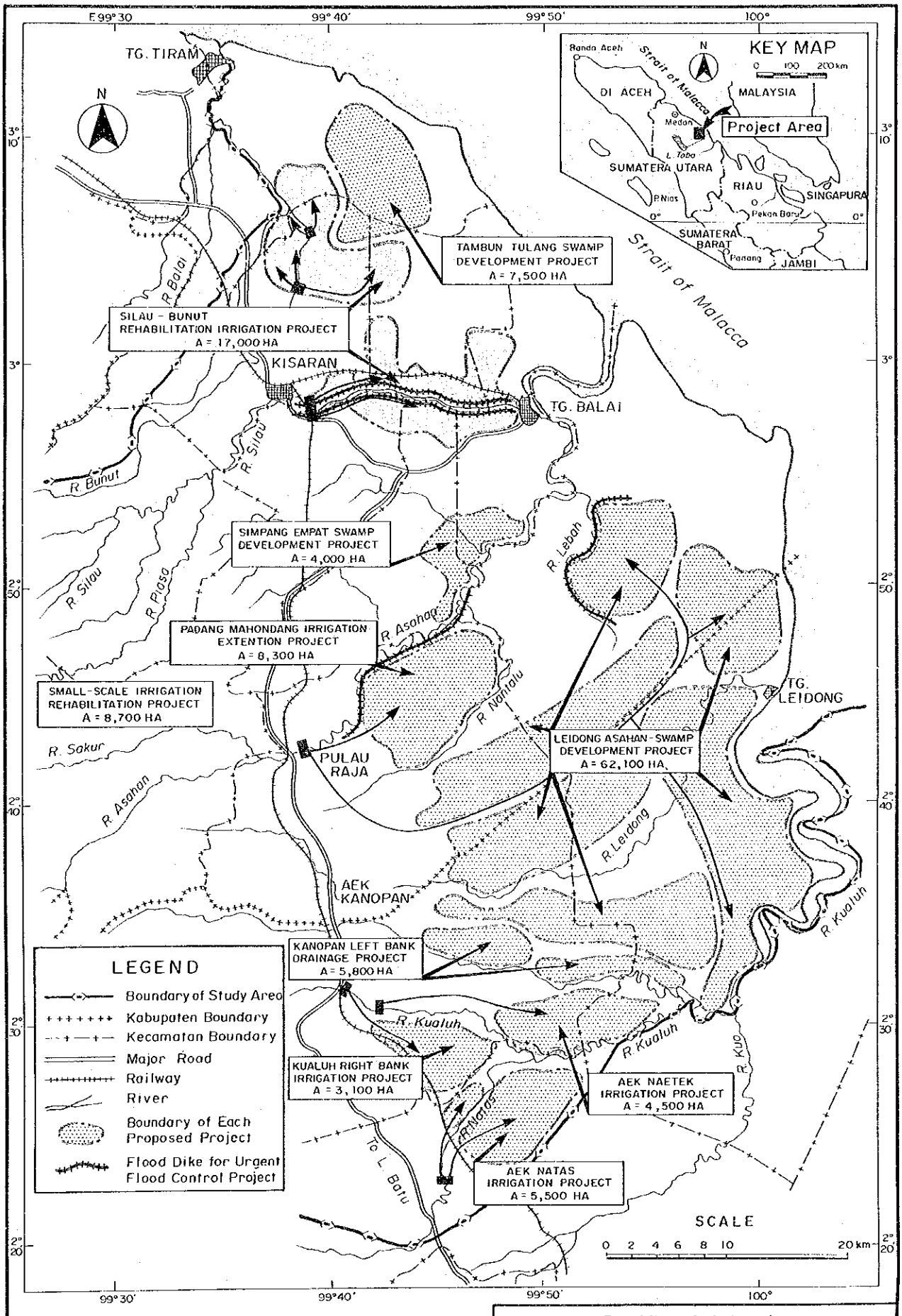

PROPOSED PROJECTS IN THE LOWER ASAHAN AREA

Republic of Indonesia

MASTER PLAN STUDY ON LOWER ASAHAN RIVER BASIN DEVELOPMENT

Japan International Cooperation Agency

MASTER PLAN STUDY
ON
LOWER ASAHAN RIVER BASIN DEVELOPMENT

(VOLUME 3)

AGRICULTURAL DEVELOPMENT PLAN
(Stage I of Part-II study)

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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. AGRICULTURAL BACKGROUND

Agriculture plays a dominant role in the Indonesia economy sharing about 24% of gross domestic product (GDP) and contributing about 55% of the employment, and 56% of non-oil exports in 1985. Some two-third of rural and 10% of the urban households depend on agriculture for their livelihood. Of the some 57 million ha in the country suitable for agriculture, about 23.5 million ha is under cultivation, of which about 5.3 million ha is irrigated.

The Government's economic development strategy places strong emphasis on rural and regional development and includes intervention in key areas of 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 (1969/70 - 1978/79), the main emphasis was placed on increase 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 (1979/80 - 1988/89), emphasis has been widened to include intensification programs for other crops.

Through the performance of sectoral 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 the annual paddy production in Indonesia, mainly due to conversion of high-productive paddy fields into urban and industrial area in Java where is the leading producer 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 the Pelita V are to: (a) raise the living standard, enlighten the mind and improve the well-being of the whole of the people more evenly and equitably; and (b) lay a solid foundation of subsequent development stage.

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

For this purpose, Pelita V presents irrigation sub-sector development program which consist of: (a) program for rehabilitation and maintenance of existing irrigation/drainage systems (775,000 ha); (b) program for construction of new irrigation systems (500,000 ha); and (c) program for swamp area developments (444,200 ha).

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

North Sumatra province is one of the most prospective province for irrigation development in the outer islands. Agriculture is the major source of employment in the province, accounting for 35% of gross regional domestic product (GRDP). Despite excellent water resources, however, agricultural production, in particular, production of food crops, has been far below its potential. This is mainly due to frequent flood damages, the poor condition of the existing irrigation systems, shortage of irrigation water, inadequacy of O&M, etc. Thus, North Sumatra province is the region of rice shortage. In the region considerable amount of rice has been imported from other provinces as well as from foreign countries.

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 much blessed with rich water and

land resources. Despite such excellent resources, increasing agricultural production in the study area has been hindered by frequent inundation of the low flat area along the downstream reaches, lack of irrigation system, the poor conditions of the existing irrigation systems, etc.

Furthermore, there is no large scale industry in the study area because there are no underground mineral resources and the electric power supply in the area is poor. The major towns such as Kisaran and Tanjung Balai are supplied with electricity by isolated diesel generators.

The above circumstances show an urgent need for the raising of the level of regional domestic production by socio-economic development in addition to other measures. The ever-increasing population, not only naturally but also by transmigration, means that there is a more pressing need to job opportunities and to stabilize living conditions as well.

Major economic indicators in Indonesia, province and kabupatens concerned are presented in Tables B-1 to B-6.

2. STUDY AREA

2.1 Administration

The study area, covering the lower Asahan river basin of about 6,000 km^2 including a part of the Kualuh and Kiri river basins, is administratively located within the jurisdictions of two districts (Kabupatens) in North Sumatra province, Asahan and Labuhan Batu, and the municipality (Kotamadya) of Tanjung Balai. Further, the districts in the study area are divided into 13 sub-districts (Kecamatans) for the Kabupaten Asahan and 3 Kecamatans for the Kabupaten Labuhan Batu. The number of villages (Desas) in the study area is 208 comprising 159 villages in Asahan and 49 villages in Labuhhan Batu. The administrative boundary in the study area is shown in Fig. 2-1.

Major towns within the study area are Kisaran (capital of the Kabupaten Asahan) and the Kotamadya Tanjung Balai, located about 150 km southeast of Medan, the capital of North Sumatra Province.

2.2 Topography

The study area lies in the central part of North Sumatra province facing the Strait of Malacca running in the direction from northwest to southeast. The topography of the study area is broadly divided into four zones almost parallel to the coast line, namely (a) steep mountain area rising from about El. 100 m to approximately El. 1,500 m in elevation and mostly covered by natural and secondary forests, (b) low undulating hills or terace extending between about El. 15 m and El. 100 m, (c) wide and flat alluvial plain below El. 15 m and including lower swampy areas, and (d) coastal sand dune or coastal sand bar of 2 or 3 km in width along the coast.

Four major rivers dissecting this study area rise in the steep mountain area and flow down generally in northeast direction. The low

hilly zone is mostly planted with rubber and oil palm. Also the national highway and railway pass along the hilly area or its foot-hills. Major towns and villages have developed along highway and secondary roads branching off the highway. These secondary roads are usually gravel paved but not jeepable in the rainy season.

The low alluvial plain is mostly covered with paddy fields or upland fields on its higher area but lower areas are predominantly mangrove swamp or forest. The low-lying areas suffer from frequent floods, but even the fringes of the swamps are now being gradually settled by farmers under the high population pressure.

The sand dunes along the coast are used for coconut plantations and some cultivation. Sand dunes hinder the drainage from swamps to the sea, so that flood water in the swamps has to be drained through river channels. The coastal marginal area affected by tides are mostly covered by mangrove.

2.3 Climate

The study area lies in the tropical monsoon zone between 2 and 3 degrees North Latitude and 99 and 100 degrees East Longitude. The annual average temperature along the coast is about 26°C with very little seasonal variation ranging from the maximum 32°C to the minimum 22°C.

The study area is affected by the northeast monsoon from the China Sea in September through December and southwest monsoon from the Indian Ocean in March through May. The main rainy season begins on the coast facing the Strait of Malacca with richest rain in October and it reaches the coast of Indian Ocean after one or one and a half months. The secondary rainy season, however, begins on Indian Ocean side. However, due to the existance of a mountain range over 2,000 m high to the west of the study area, the influence of monsoon is weakened and the study area can receive considerable rainfall even in the dry season, though this cannot be relied upon. There are no severe

dry months. Monthly distribution of rainfall at representative stations in the study area is shown in Fig. 2-2.

The 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. 2-3. In general the water resource in the study area is ample. Detailed description of the rainfall condition and its characteristics are tabulated in Section 1.2 of Appendix 3-A.

Relative humidity is as high as 88% on average with 90% in the highest month and 87% in the lowest. Wind velocity is as weak as 0.2 m/s on annual average with very little seasonal variation. Sunshine is generally short, due to the many rainy days, more than 15 days in a month during the rainy season. Climatological conditions are presented in Section 1.1 of Appendix 3-A.

2.4 Rivers and Runoff

(1) River system

On the low-lying plain of the study area, there are four main river basins, the Bunut, the Silau, the Asahan, and the Kualuh river basins from north to south. Of these, the Asahan river originating from Lake Toba (surface area: 1,100 km^2) is the largest river, having a stable base discharge of about 100 m^3/s throughout a year owing to regulation by the Asahan hydropower development projects completed downstream of Lake Toba. The Bunut river is a tributary of the Kiri river flowing northword. The Silau river is the largest tributary of the Asahan joining at Tanjung Balai. The location of these rivers and river stations are shown in Fig. 2-4 and main features of river basins and channels are shown in Table A-18.

The hydrological features of main rivers in the study area 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 runoff	(MCM)	730	2,310	7,360	6,370
Annual mean discharge	(m^3/s)	23	73	233	202
5-year drought discharge	(m^3/s)	13	39	149	94
Runnoff coefficient	($m^3/s/km^2$)	0.50	0.70	0.55	0.65

(2) River runoff

The runoff of rivers in the study area is characterized by moderate annual fluctuation and high runoff coefficients. The annual mean specific discharge of the large rivers such as the Silau and the Kualuh rivers is more than 0.05 $m^3/s/km^2$, and for the Asahan 0.034 $m^3/s/km^2$. The annual runoff coefficient of these rivers is relatively high. It is in a range between 0.5 and 0.8. The runoff in the small river basins such as the Bunut river is, however, smaller due to lower runoff rate. Distribution of monthly runoff is shown in Fig. 2-5. The low flow occurs during the period from June to September. Detailed conditions of river runoff are shown in Section 1.3 of Appendix 3-A.

(3) Flood

The flood discharge in the rivers in the study area is relatively large due to the high rainfall intensity and relatively steep river bed gradients. Major floods have been recorded in 1973, 1977, 1979 and 1984 (refer to Table A-36). Large floods occuring in the study area have included:

Date of Occurrence	Name of River	Gauging Station	Basin ave. 2-day Rainfall (mm)	Peak Discharge (m^3/s)	Specific Discharge ($m^3/s/km^2$)
1984. 1	Asahan	Pulau Raja	63	521	0.76
1973.12	Silau	Kisaran	122	800	0.76
1984. 1	Kualuh	Polo Dogom	38	674	0.60

The inundated area and houses damaged by the above flood in the Asahan is estimated at about 2,110 ha of agricultural land and 562 houses. For the Silau river, the maximum flood above caused damage by inundation to 5, 760 ha of agricultural land and 7,300 houses.

The probable flood discharges were estimated by applying the storage function method to the past flood data and the estimated probable rainfalls (refer to Section 2.1 of Appendix 3-A). The 10-year probable floods and possible damages by inundation are estimated as shown in the next page.

Features		Bunut	Silau	Asahan	Kualuh
Gauging site		Bunut Highway	Kisaran	Pulau Raja	Polo Dogom
Catchment area	(km^2)	115	1,050	4,486	1,116
10-year peak flood runoff	(m^3/s)	70	565	1,000	880
Possible inundation area					
Houses	(nos)	1,710	7,364	1,387	1,498
Paddy area	(ha)	2,280	4,686	4,866	6,785
Upland crop area	(ha)	296	220	876	345

Flood damages are high in Asahan and Silau. The average annual damages that would be caused by the 10-year flood in Asahan and Silau are estimated to be Rp.5 billion in 1989 and Rp.12 billion in 2005. A flood mitigation plan would be required prior to water resources development for irrigation in the basin.

(4) Water quality and sedimentation

From water quality analyses, the quality of water in rivers originating from the mountain range is all within tolerable limits and suitable for irrigation as shown in Tables A--34 and A-35.

The total annual sediment yield in the Silau and the Asahan river basin ranges between 500 and 550 m^3 /km^2 , out of which the specific sediment of riverbed materials is about 260 m^3 /km^2 for the Asahan river and about 400 m^3 /km^2 for the Silau river. The above sediment

production is considered to be attributable mainly to sheet erosion of the ground surface of the mountains and hilly area.

(5) Tide and sea water intrusion

The range of the tidal fluctuation of the Strait of Malacca is high to moderate. Tidal fluctuation estimated at the estuary of the Asahan river is abut 2.2 meter under normal condition and 4.4 m at the maximum. At Kuala Tanjung it is 1.5 m and 3.2 m, respectively. Due to the tide effects, certain parts of the low-lying areas near the sea coast in the study area suffer from poor drainage (refer to Section 1.4 of Appendix 3-A).

In 1989 sea water intrusion was observed by the Study team in several rivers at the spring tide during low flow. The results show that the possible maximum distance of intrusion is about 6 km in the Asahan, 12 km in the Leidong and 10 km in the Bunut rivers (Refer to tables and figures in Section 1.5 of Appendix 3-A). Existing intakes for domestic water supply and irrigation are located far upstream of the end point of possible sea water intrusion and, therefore, there are no problems for river water use at present.

2.5 Geology

Basement rocks exposed in the mountain area are composed of acidic volcanic rocks. The low hilly area is widely covered by thick laterite ranging from 5 to 10 m underlain by soft white tuff which is derived from the Toba volcanic eruptions and partially interbedded with thin sand and gravel layers dipping slightly northeastward.

The alluvial plain deposits mostly consist of fine silty to clayey soils interbedded by thin sandy soil layers and organic soil layers. These have been transported from the acidic volcanic rocks, tuff and laterite of the hinterland.

The coastal sand dunes or sand bars are mostly composed of coarse to fine sand of volcanic native glass or hard quartz particles derived from ignimbrite.

2.6 Soils

According to the criteria prepared by the Center for Soil Research of Indonesia, the soils in the study area have been classified into 10 soil units; including (a) partly ripened poorly drained low land soils, (b) unripened poorly drained low land soils, (c) coastal swamp soils, (d) fine textured alluvial soils, (e) coarse to fine textured alluvial soils, (f) moderately deep organic soils, (g) deep organic soils, (h) flat volcanic tuff soils, (i) gently sloping volcanic tuff soils, and (j) steep mountain soils. Distribution of these soils is illustrated in Fig. 2-6, and indicated in Table B-7.

Both the soils (a) and (b) are extensively distributed in the flat to swampy low land along the coastal line. These are fine-textured, poorly to very poorly drained soils with deep effective soil depth. Soil reaction is strongly to very strongly acid. The land covered with these soils are extensively used for rice cultivation and coconut farm. Considerably high productive rice farming is expected under proper irrigation development in these soils. The soil (c) are distributed along the coastal line in the study area and seldomely used. The soils are fine-textured, poorly drained, very strongly to excessively acid soils.

The soil (d) is covering flat alluvial valleys along rivers. The soils are fine textured, imperfectly to poorly drained soils with deep effective soil depth. Soil reaction is strong to very strong acid. The area distributed with the soils are used for rice cultivation and potential for irrigated nice farming is considered to be high. Distribution of the soil (e) is limited to the northern part of the study are. The soils are coarse to fine-textured, moderately drained soils and predominantly used for tree crop production.

The soils (f) and (g) are found in unused swampy areas in the study area. The depth of the peat layer is in the range of 0.5 to 2 m for (f) and more than 2 m for (g). The peat is well decomposed and classified as sapric. The soil (f) is poorly to very poorly drained with moderate to excessive acidity. The soil (g) are very poorly drained, excessively acid. Both the soils could be developed for oil palm production if the drainage condition is improved.

The soils (h) and (i) are soils derived from volcanic tuff deposits and extensively distributed in upland area in the study area. The flat volcanic tuff soils are in flat plains and fans, the gently sloping type is in gently slooping foot slopes of the Toba Tuff. The former is moderately coarse to fine and moderately to well drained, and the later is moderately coarse to fine and well drained, in general. Both the soils are intensively used for tree crop production. The soil (j) is distributed in mountain area and is limited in the study area. The effective soil depth is generally deep.

The land capability classification of the potential area for agricultural development in the study area (178,690 ha) is made for paddy, upland and tree crop cultivation. Criteria for land classification is shown in Table B-8. Four land classes are applied; S1 (suitable), S2 (moderately suitable), S3 (marginally suitable) and N (not suitable). As a result, majority of land in the potential area are classified in the S2 class both for rice farming and tree crop cultivation. The distribution and proportional extent of land by land class are shown below. Details are shown in Table B-7.

Land Class	Land Use					
	Rice Farming		Tree Crop Production		Upland Crop Farming	
	Area	%	Area	%	Area	%
S1 (Suitable)	-	-	-	-	-	-
S2 (Moderately suitable)	111,740	62.5	124,790	69.8	29,370	16.4
S3 (Marginally suitable)	66,950	37.5	48,130	26.9	143,550	80.3
N (Not suitable)	-	-	5,770	3.2	5,770	3.2
Total	178,690	100	178,690	100	178,690	100

2.7 Present Land Use

Use of lands in the study area has been developed to reflecting the soil conditions and topography. The present land use map in the study area was prepared as shown in Fig. 2-7 based on analysis of the latest aerial photographs and ground verification in 1989. The present land use in the study area is summarized in the following page.

	Category	Area (ha)	Percentage (%)
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 estate	43,230	7.3
	2.4 Rubber estate	107,610	18.1
	2.5 Oil palm estate	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

The paddy fields occupy only about 12% of the total land area and are mostly found on low-lying land. Upland fields are planted with cassava, maize, various kinds of pulses, and vegetables.

The three major estate crops, rubber, oil palm and coconut, occupy about 35% of the whole area, of which rubber estates still occupy 18%. Coconut estate are gradually being turned into to paddy fields.

Swamp forest and swampy bush occupy about 18% of the whole area. The difficult access due to boggy ground and frequent floods and hard living conditions inhibit human settlement. However, the recent

high population pressure is obliging local people to intrude into the fringes of those swamps.

2.8 Population

In 1987, the study area supported a population of some 859,000 consisting of 665,000 in Kab. Asahan, 150,000 in Kab. Labuhan Batu and 44,000 in Tanjung Balai. The population in the study area is about 9% of the total of the Province. The annual average growth rate for the period of 1980/1987 was 2.1% per annum.

The population density in the study area is about 134 persons/km^2 on average but unevenly distributed, ranging from 1,572 persons/km^2 in Kechamatan Kota Kisaran Barat to 34 persons/km^2 in Kechamatan Bandar Pasir Mandoge. The urban population in the Study area was 15.3% in 1987. This figure is below the national average of 22.4% and the North Sumatra Province average of 26%.

The total number of households in the study area was about 163,000 in 1987 with an average family size estimated at 5.2, which is slightly higher than the national average of 4.9, but lower than that of the province of 5.4. Among them 95,000 are farm households occupying 60% of the total households.

The detailed data on population in the study area and the area concerned are presented in Tables B-9 to B-14.

2.9 Land Tenure and Holdings

According to the Agricultural Census in 1983, the land tenurial status in the study area is 73.7% by land owners, 17.7% by tenant and 8.6% by partial land owners as indicated in Table B-15.

The distribution of farm land by holding size in the study area is shown Table B-16 and summarized in the following table.

Farm size distribution (ha)	Proportional percentage (%)	Accumulated percentage (%)
Below 0.09	9.8	9.8
0.1 - 0.49	25.6	35.4
0.5 - 0.99	20.4	55.8
1.0 - 1.99	23.7	79.5
2.0 - 2.99	11.1	90.6
Above 3.0	9.4	100.0

The average holding size in the study area is estimated to be 0.8 ha.

2.10 Present Agriculture

(1) Cropping pattern and cropping intensity

Major food crops cultivated in the study area are paddy, followed by upland rice, maize, cassava, soybeans, sweet potato, mongo beans and peanuts. Major estate crops include oil palm, coconut and rubber. Detailed data on planted/harvested area, production of major crops in the study area and concerned area are presented in Tables B-17 to B-23.

Monthly planted area by proportion of paddy, the most important and extensively cultivated food crop, is calculated for recent five years from 1984 as indicated below:

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Monthly planted area by proportion (%)	7.1	0.4	0.0	0.8	5.0	4.1	5.0	2.2	5.1	11.0	30.7	28.6
				| ←	dry season		→ |		|←	wet season	→|

As shown in the table, paddy in the study area is planted at the onset of the monsoon, generally in September to December. Harvest is carried out from January to March. Cultivation of dry season paddy is generally practiced in the irrigated paddy field. Cropping season is from May-July to August-November.

Upland rice is planted during the period of 4 months from July to October and harvested from Decemeber to March. Other crops such as maize, cassava, sweet potato, peanuts, soybeans and mongo beans are planted throughout a year.

Cropping patterns in the study area are generally corresponding to land conditions and can be categorized into the following six (6) patterns according to the same.

Condition of Land	Prevailing Cropping Pattern
Irrigated land in flat low land	Double cropping of irrigated paddy1/
Irrigated land in narrow valley bottom	Double cropping of irrigated paddy1/
Rainfed land in flat low land & swamp	Single cropping of wet season paddy (local variety)2/
Rainfed land in narrow valley bottom	Single cropping of wet season paddy (HYV)3/
Flat to gently sloping upland (rainfed)	Double cropping of upland crops
Flat to gently sloping upland (rainfed)	Cultivation of estate crops

1/ : Cropping intensity is not so high.
2/ : Cultivation of local variety is prevailing.
3/ : Cultivation of high yielding variety is practiced.

Cropping intensities of irrigated and rainfed paddy field in the study area are calculated on the basis of the data obtained at agricultural offices in Kecamatan as indicated in Table B-24. The figures are not inconsistent with the findings of field survey. Accordingly, the present cropping intensity of irrigated paddy field is estimated to be 160% and the same of rainfed paddy field is to be 100%.

(2) Farming practices

Paddy is cultivated by transplanting method in the study area. The nursery preparation of paddy is done at the onset of the monsoon in about 1/20 to 1/25 of the paddy fields. The amount of seeds is estimated at 40 to 60 kg/ha. The nursery period is about 20 to 30 days. Land preparation is usually done once or twice by draft animal and/or manpower, and not commonly by tractors. Weeding is done once or twice depending on availability of labour. Harvesting is carried out by sickle. The ani-ani system is not practiced except for swampy paddy field. Harvested rice is usually sold without drying to brokers or other buyer when weather conditions during harvest are favorable. While, drying of harvested rice in rainy season is usually done in the house yard and along roadsides. Drying is often poorly done and empty grains are not properly separated from the bulk produce. This causes a rather low quality of paddy. Total labour requirement for paddy farming activities is estimated at about 140 to 160 man-days per crop as shown in Table B-25.

Farming activities for crops other than paddy are fully dependent on manpower from seeding to harvesting. Application of fertilizer and agro-chemicals is limited in the study area in general.

Details of farming practices prevailing in the study area identified through farm economic survey are presented in Table B-26.

(3) Farm inputs

Application of improved seed varieties of rice in the study area is done in the irrigated field and part of rainfed field. Major improved varieties are IR-46, IR-56, IR-64, Bah Bolon and Cimandiri. Their growing period ranges from 95 to 145 days. Major local varieties are Ramos, Ceredek, Sikapal, etc., of which the growing period is about 5 to 6 months.

(Unit: kg/ha)

Condition of Land	Urea	TSP	KCl
Irrigated land in flat lowland	174	134	53
Irrigated land in narrow valley bottom	163	112	37
Rainfed land in flat lowland & swamp	33	28	5
Rainfed land in narrow valley bottom	110	88	18

Details are presented in Table B-26.

(4) Unit yields

Unit yield of paddy is estimated examining the results of cutting survey of Provincial Statistic Office and the results of questionnaire survey conducted during the field survey.

Unit yields of paddy in Kb. Asahan and Kb. Labuhan Batu by type of intensification reported by the same office are presented in Tables B-17 and B-18 in detail and summarized as follows;

(Unit: ton/ha)

Type of Intensification	Kb. Asahan						Kb. Labuhan Batu						Both Kbs. Avg. 1983-87
	'83	'84	'85	'86	'87	Avg.	'83	'84	'85	'86	'87	Avg.	
Special	4.0	4.3	4.6	4.4	4.5	4.4	4.4	4.0	4.4	3.7	4.0	4.1	4.2
General	2.5	3.8	3.4	3.3	3.5	3.3	3.1	3.2	3.0	3.2	3.4	3.2	3.2
Non	1.3	2.5	2.2	1.9	2.3	2.0	2.1	2.2	2.2	1.9	2.4	2.2	2.1

As shown in the above table, the yield level of paddy is clearly different among the types of intensification.

Similarly, the differences of paddy yields corresponding to field conditions are identified through the said questionnaire survey as shown below;

(Unit: t/ha)

Condition of Land	1986/87 Wet	1986/87 Dry	1987/88 Wet	1987/88 Dry	1988/89 Wet	1988/89 Dry	Average Wet	Average Dry
Irrigated land in flat low land	3.9	3.7	3.9	3.6	4.0	3.5	3.9	3.6
Irrigated land in narrow valley bottom	3.4	3.2	3.4	3.1	3.4	3.3	3.4	3.2
Rainfed land in flat low land & swamp	1.9	-	2.0	-	1.7	-	1.9	-
Rainfed land in narrow valley bottom	2.4	-	2.6	-	2.3	-	2.4	-

An average rates of fertilizer application of sample farmers selected from each land types are indicated in the previous section (3) and the level of intensification corresponding to fertilization rate in each land type is as shown below:

Condition of Land	Level of Intensification 1/
Irrigated land in flat low land	Packet B/C
Irrigated land in narrow valley bottom	Packet A
Rainfed land in flat low land & swamp	-
Rainfed land in narrow valley bottom	General intensification

1/: Level of intensification corresponding to fertilization rate.

On the basis of the above study, present yield level of paddy in each land type is estimated as follows;

Condition of Land	Unit Yield (t/ha) 1/
Irrigated land in flat low land	4.0
Irrigated land in narrow valley bottom	3.5
Rainfed land in flat low land & swamp	2.0
Rainfed land in narrow valley bottom	2.5

1/: Average yield of paddy in North Sumatra Province is 3.7 t/ha.

Unit yields of other food crops in the study area are presented in Tables B-17 to B-23 and summarized hereunder.

(Unit: ton/ha)

Type of Crop	Study Area	N. Sumatra Province
Maize	1.9	2.2
Cassava	13.7	31.6
Sweet potato	10.8	9.3
Peanuts	1.1	1.3
Soybeans	1.2	1.0
Mongobeans	0.9	0.9

As indicated above, the unit yield of paddy in the study area is low. Furthermore the unit yield of paddy has not always increased within the last five years. Furthermore yield of paddy considerably differs from location to location depending on field conditions. It also alters from year to year depending on pest and diseases. Unit yields of crops other than paddy seem to be reasonable from the standpoint of present farming practices.

Constraints which hampered increasing the unit yields of paddy and its production are considered from the technical viewpoints as follows:

(a) low level of fertilizer application;

(b) small percentage of certified seed among the privailing improved varieties;

(c) infection and considerable damage by pests, diseases and rats;

(d) damage by flood and poor drainage; and

(e) water shortage in dry season and low percentage of coverage by irrigation system or malfunction of the existing system.

2.11 Existing Irrigation and Drainage System

(1) Existing irrigation system

The history of irrigation in the study area is relatively short. In former time main focus for agricultural development in the study area was placed on tree crop plantation such as oil palm, rubber and coconuts. Paddy schemes in the study area have been developed only in these 20 years by DPU North Sumatra province and district public service offices of Kabupaten in the area.

Paddy schemes in the study area consist of two types, irrigation and controlled drainage schemes. Most irrigation schemes in the study area are gravity irrigation type diverting irrigation water from the Bunut, the Silau, the Asahan, and the Kualuh rivers. A total commanding area of main irrigation systems, so called the potential irrigation area by DPU, is 13,100 ha in 1988. Among these areas, an actually irrigated area is estimated at about 9,000 ha (70% of potential irrigation area) mainly due to insuficient irrigation networks. Controlled drainage schemes are common in the low-lying area in the Kualuh river basin. The location of existing irrigation and controlled drainage schemes managed by DPU is shown in Fig. 2-8. The areas of DPU schemes are presented in Table C-2 and these are summarized by river basin as below.

(Unit: ha)

River Basin	Irrigation Scheme		Drainage Scheme	Total
	Potential Area	Irrigared Area		
Bunut	4,400	4,080	5,000	9,400
Silau	4,100	3,100	0	4,100
Asahan	3,500	1,300	3,200	6,700
Kualuh	1,100	550	21,800	22,900
Total	13,100	9,030	30,000	43,100

The biggest rice bowl in the study area is the Bunut - Silau area with a irrigated paddy area of about 7,200 ha. In the study area the positive irrigation facilities have been provided for only 9,030 ha, or

13% of the total paddy area of 68,000 ha in the study area. This low rate of coverage with irrigation systems seems to be one of the reasons of the low unit yield of paddy in the study area.

Irrigation schemes in the Bunut river basin are relatively well maintained. However, the irrigable area for dry season paddy is quite limited due to water shortage during dry months. On the other hand, existing irrigation schemes in the lower Silau area suffer from water shortage due to the low intake water level in the Silau river, though the river discharge during dry months is abundant.

Among 25 irrigation schemes in the study area, there exist 5 technical irrigation schemes of 3,900 ha in total (refer to Table C-3). In general, the existing irrigation facilities in the study area are in poor condition or mal-functional. Many of them require urgent repair and improvement.

(2) Present water management

The water management for irrigation schemes has not been executed properly due to lack of trained irrigation service staff, no provision of measuring device, and insufficient budget for the work. As a result, there is neither established water management procedure nor operation records of water management. Organization of irrigation service offices of DPU North Sumatera Province is shown in Table C-9.

Though water users' associations of beneficiaries have been organized in each village level by the local government, no significant activities has been executed. It is required to strengthen the organization of irrigation service office as well as water users' association.

The present density of irrigation canals in the study area is 9 m/ha on average ranging from 2 m/ha to 40 m/ha. Tertiary canals have been provided only for 2 irrigation schemes (1,000 ha in total). The present density of existing canals is too low to execute adequate water management. Furthermore, the number of control structures in

the existing schemes seems to be insufficient. To achieve the desirable level of water management in the near future, provision of a tertiary canal network and suitable control structures with measuring devices is necessary (refer to Tables C-3 to C-6).

(3) Existing drainage system

Controlled drainage schemes are defined as paddy schemes without irrigation facilities maintained by DPU. These schemes are located in a low-lying areas and usually provided with main and secondary drainage canals and flood protection dikes. In the lower Kualuh river basin, there are many controlled drainage schemes with flood dikes as shown in Table C-2. Though drainage canals have been provided in these area, only 2 control gates have been equipped. The related structures of the drainage canals are bridges, culverts and flap gates.

(4) Existing flood control facilities

All the four major rivers have had earth dikes, namely 14 km for the Bunut, 35 km for the Silau, 18 km for the Asahan, and 29 km for the Kualuh rivers. Generally those dikes have a crest width of 2 to 3.5 m and a height of 1 to 4 m, with side slopes of 1:1 to 1:2 on each sides. Those embankments are often destroyed by floods once a year or every two years due to their low flood carrying capacity (refer to Section 1.2 of Appendix 3-C).

2.12 Marketing and Processing

The Government interventions in the market of agricultural products have concentrated in rice by the National Logistics Agency (BULOG) at the national level and Regional Logistics Depot (DOLOG) at the province level. BULOG has been able to defend the floor price procuring up to about 10% of total production through the village cooperatives (KUDs).

North Sumatra province is the region of rice shortage. DOLOG in North Sumatra province has procured rice from other provinces, mainly from Java and foreign countries. The actual procured amount of rice in North Sumatra province ranges from 33,000 tons in 1984/85 at minimum and 245,000 tons in 1986/87 at maximum since 1970's. The movement of rice in North Sumatra Province is indicated in Table 4-1.

The marketing of rice from the farmers to consumers in the study area comprises four channels such as through (a) KUD, (b) broker at village level, (c) local millers and (d) local market. Among them broker at village level and local millers are the main channels in the study area. The general rice marketing flow is illustrated in Fig. B-1.

The price of rice is generally controlled by DOLOG. The support price is shown in Table B-29. In general when the market price is down under the floor price, DOLOG purchases the marketed rice and when the price is over the ceiling price, DOLOG sell its stock. DOLOG also handle with upland crops of which government support price is shown in Table B-29. Retail price of major farm inputs and outputs in the study area is shown in Table B-30.

DOLOG in North Sumatra province owns 52 warehouses having 121,000 tons in capacity. Of them about 10% for the number and 5% for capacity are shared in the study area. The number and capacity of warehouse in the province are indicated in Table B-27.

The number of rice mills in the study area is about 300 as shown in Table B-28. Supposing that an average milling capacity for each mill is 700 tons/year, the total milling capacity is estimated to be 210,000 tons/year in the study area which is considered to be sufficient for the present output.

2.13 Agricultural Support Services

(1) Mass Guidance Agricultural Intensificatin Program (BIMAS Program)

BIMAS Program is one of the strongest administrative supporting services for agricultural development in Indonesia. Since 1968, when the first trial of BIMAS Program was implemented, the Program has been steadly developed in whole country and the program itself has been modified and improved year by year. The latest program is super group guidance intensification program so called SUPRA INSUS Program implemented in the selected several Provinces since 1987.

The SUPRA INSUS Program in North Sumatra Province was commenced since 1988/89 wet season paddy cultivation in five kabupatens including Kabupaten Asahan.

Present BIMAS Program implemented in North Sumatra Province is INMUM, INSUS and SUPRA INSUS. INMUM is applied for individual farmers and INSUS is applied for farmer groups. SUPRA INSUS is applied for several farmer groups under the same large irrigation system with average irrigated paddy field of 25,000 ha.

For successful implementation, BIMAS Committee chaired by Governor and BIMAS Daily Executive Committee chaired by Chief of Regional Agriculture Office are organized at Provincial level. At Kabupaten, Kecamatan and Village level, each BIMAS Coordination Committee chaired by head of respective administration, e.i. Bupati, Camat and Lurah respectively, is also organized for strong support of implementation of BIMAS Program.

(2) Agricultural Extension Service

One of the strongest supporting arm for implementation of BIMAS Program is agricultural extension service.

Agricultural extension service in Indonesia is supported by the central government, Ministry of Agriculture. Budget and personnel management of extension service in whole Indonesia is carried out under the responsibility of Secretariat of BIMAS Committee. Recommendation and guidance of technical practices are prepared by Director General of Food Crop Agriculture on food crops, Director General of Livestock on animal husbandry, Director General of Estate Crops on estate crops and Director General of Fisheries on fishery respectively. Extension methods and training for extension workers are under the responsibility of Agency for Agriculture Education, Training and Extension.

For smooth operation of extension service, Forum on Agricultural Extension Coordination is organized among above mentioned authorities concerned.

In the Provincial level, Provincial Secretariat of BIMAS Committee is incharge of budget arrangement and personnel management of agricultural extension service in the Province. Recommendatin and guidance of technical practices are prepared by respective Service Office of Province under the coordination of Regional Agriculture Office in the Province.

In the Kabupaten level, Kabupaten BIMAS Office which is directly under the control of Provincial Secretariat of BIMAS Committee is incharge of budget arrangement and personnel management of extension service in the Kabupaten including Rural Extension Centers (BPP).

Recommendation and guidance of technical practices are prepared by respective Service Offices of Kabupaten under the technical guidance of respective Service Office of Province. In general, the chief of Kabupaten Food Crops Agriculture Service Office is appointed as the chairman of BIMAS Daily Execution Coordination Committee of Kabupaten and the chairman of Forum on Agricultural Extension Coordination in Kabupaten simultaneously.

Agricultural extension staffs are consisting of three kinds, i.e. Subject-matter Specialist (PPS), Subject-sector Supervisor (PPUP) and Field Extension Worker (PPL). PPUP is divided to four sectors, i.e. food crops, livestock, estate crops and fishery and stationed at Rural Extension Center (BPP) with covering whole BPP area. PPL is also stationed in BPP but assigned one working area (WKPP).

Number of PPS in North Sumatra Province is 73 in 1989, of which 24 PPS are working at provincial level offices such as Provincial BIMAS Secretariate Office, North Sumatra Province Food Crops Agriculture Service Office, Livestock Service Office, Estate Crops Service Office, Fisheries Service Office and Agricultural Information Center. In Kabupaten level, 49 PPS are appointed, an average of 3 PPS in each kabupaten.

Number of PPUP and PPL in the Province is 1,743 in total in 1989, of which 159 or 9% are working in Asahan Kabupaten. There are 9 BPP in Asahan Kabupaten and 8 BPP in Labuhan Batu.

Daily activities of extension worker are carried out under the training and visit (TV) system. Technical information is mostly decided by recommended technology packages A, B, C and D under BIMAS Program. The packages are mostly consisting of production technique. Post harvest technology, farm mechanization technique and farm management methods including marketing business are not sufficiently provided.

In addition to daily activities, extension worker is requested to attend to BIMAS Daily Execution Coordination Committee (POSKO) at farmer group level as technical supervisor held once two weeks. PPL is also appointed as an advisor of P3A in the working area.

(3) Research and extension services

Reserach into agriculture, especially food crops, is centralised and undertaken by the Central Research Institute for Food Crops

(CRIFC), Bogor in West Java. Under the supervision of CRIFC, there are at present six branch research stations for food crops.

Agricultural research in North Sumatra province is covered by SARIF station at Sukarami. The main activities of the station are to execute experimental work under the instruction and supervision of the Central Station at Bogor and to collect information from extension services on the technical problems associated with the farming practices of local farmers. In addition to the experimental work, the station produces the foundation seeds of newly recommended varieties of food crops such as rice, maize, soybeans, peanuts and mongobeans.

In order to carryout adaptability test for new recommended agricultural technique, Agricultural Development Center (ADC) was intended to be established in each province, but it is not realized yet in North Sumatra Province. Therefore, at present, Rural Extension Centers (BPP) are the bases of extension services and responsible for adaptation test of new recommended agricultural techniques and dissemination of such information and training of key farmers.

(4) Seed multiplication

Present recommended varieties of paddy by Intensification Program in North Sumatra are IR 46, IR 64, Bah Bolon and Bah Butong for low land paddy. Total certified paddy seed production in North Sumatra was 1,223 ton in 1988 and 1,476 ton in 1989, of which more than 95% of certified paddy seeds were produced by North Sumatra Branch of Sang Hyang Seri seed company (SHS).

North Sumatra Branch of SHS seed company has three seed processing units (UPB), of which one UPB is located in Kabupaten Asahan. Each UPB selects joint working farmer groups for seed multiplication providing stock seeds of recommended varieties together with technical guidance.

After processing with 5 kg vinyl pack, the extension seeds are distributed to farmers through KUD, PT Pertani and appointed distributors in each kabupaten.

(5) Agricultural credits

The Indonesian Peoples' Bank (BRI) is the state bank specializing in agricultural credit covering the whole country. Before 1985, credit was extended to the farmers through the BRI under the BIMAS package system which decided the size of loans based on the conditions in each region and the possible cropping seasons. The BIMAS credit for paddy production was a short term loan over a period of 7 months with a monthly interest rate of 1%. In 1981, the Government strengthened the BIMAS credit by introducing INSUS intensification program through the farmers group system. Each INSUS area should be more than 25 ha and should have irrigation facilities owned by a group of farmers who are eager to improve their farms.

In 1985, the BIMAS package system has been replaced by other credit systems as follows:

(a) A continuation of the BIMAS credit which uses the free credit system through a reliable KUD as an intensification credit channel, whereby the farmer can get a loan which is not limited by a package, and is therefore according only to their requirements.

(b) "Kupedes" credit (General credit for rural area). It can be utilised by farmers if a reliable KUD is not available. Kupedes credit has been extended through the BRI village units since May 1984 for farmers who have more than 1.0 ha of sawah and more than 2.0 ha of upland. The loan amount of the credit can be between Rp. 25,000 and Rp. 1,000,000 for investment and operational purposes with an interest rate of 1% to 2% depending on certain conditions.

(c) "KIK" and "KMKP" credit (Small Investment Credit) is a Government credit program especially for small investments which in the case of agricultural activities has in the last four years been applied to land development programs where new paddy fields are to be constructed.

Among 208 villages in the study area, the percentage of villages which credit facility was given in 1986 is about 27% for BIMAS, 17% for KIK, and 10% for KMKP as indicated in Table B-31.

(5) Cooperatives

The existing BUUD/KUD cooperative system is the one of the principal farmer's cooperatives in the study area. The major activity of these organization is to purchase the farm products directly from farmers and to sell them to DOLOG. Another role of BUUD/KUD is to supply necessary farm inputs such as seeds, fertilizers, agro-chemicals, etc. Incidentally, the KUD has also dealt with BIMAS/INMAS credits since 1982/83. In the study area, out of 208 villages, 37 or 18% of the total number had established BUUD/KUD by the end of 1986 as shown in Tables B-32 and B-33.

There are 38 water user's associations (P3A) in the study area, which is equivalent to 18% of the number of villages (208) as indicated in Table B-34. However the activities of these organizations are not fully running yet. Operation and maintenance of the existing intake facilities are carried out partially by each foreman by own way at present. There is no record concerned with daily discharge, distributed area as well as planting calender in any intake places.

2.14 Transmigration

Since independence, transmigration has been encouraged by the Government under the responsibility of the Ministry of Manpower, Transmigration and Co-operatives aiming at (a) enhancing living standards, (b) regional development, (c) balancing population

distribution, (d) development equity, (e) utilization of natural resources and human resources, (f) national unity, and (g) strengthening security and defence. Since the reorganization in 1983, the Ministry of Transmigration has been undertaking this program.

Sumatra island is the biggest receiver of immigrants of all, indeed 57% of the total migration in Indonesia. Most of immigrants, however, have settled in South Sumatra. In North Sumatra province sixteen transmigration projects have been implemented during the period from pre-Pelita to Pelita IV as shown in detail in TAble B-35. About 12,000 families or 56,000 people were settled in five Kabupatens such as Langkat, L. Batu, Tapanuli Selatan, Tapanuli Tengah and Dairi.

In the study area, there is only one systematic transmigration area (Aek Naetek: 2,100 ha) where 700 families were resettled under the Government program from 1973/74 to 1974/75. The Government has formulated transmigration programs in North Sumatra in Pelita V. Target of the programs is to settle 13,700 families in 98,000 ha which are located in four Kabupatens such as Tapanuli Selatan, Tapanuli Tengah, Tapanuli Utara and Labuhan Batu. These programs, however, do not cover the study area.

As a results of the land use study described earlier, it is clear that the study area has almost no room to accept transmigrants except by development of swampy areas.

2.15 Existing Rural Infrastructure

(1) Transportation

The main transport network in the study area consists of a national highway, provincial asphalt-paved roads and the provincial gravel-paved roads. The national highway traverses the study area from north to south connecting Kisaran with Medan in the north and Rantau Prapat, capital of Kabupaten Labuhan Batu, in the south.

In the study area, there is a road network of 2,061 km in total, comprizing 538 km of provincial roads and 1,523 km of Kabupaten/Kotamadya roads as indicated in Table B-36. Of these, about a half are paved with asphalt or gravel, and remaining half just earthen. Most earthen roads are considerably dilapidated due to insufficient maintenance. After heavy rainfall, most of them are not even jeepable.

Navigation is another important means of transport in the study area. Especially the Leidong and the low-lying areas in the Kualuh river basin are well networked by local navigation system. There is a regular transport services from Tanjung Balai to Leidong town by speed boat (Table B-37).

(2) Domestic water supply

In the study area, piped water supplies are available only for the cities of Kisaran and Tanjung Balai and their vicinities (Table B-38). Water sources for cities of Kisaran and Tanjung Balai are the Silau and the Asahan rivers, respectively. In 1989, the State Water Company provides services for only 7 villages in the study area. Of the 208 villages in the study area, 155 villages are wholly dependent for their potable water on local shallow wells (Table B-39). For 7 villages located on the east side of the Asahan swamp, no groundwater is available and, therefore, rain water is stored and used for drinking. Water shortages often occur during the dry months.

(3) Electricity supply

Of the 163,000 households in the study area, 53,330 are provided with electricity services, 31,300 by PLN and 22,030 by non-PLN services. The electrification ratio in the study area is, therefore, estimated at 32.7%. The available number of non-PLN generators are 542 in the study area. In the lower Bunut area, an electrification project is on-going to improve the poor electrification level. Details are explained in Table B-40.

(4) Health

Health and medical facilities in the study area are summarized in Table B-41. There are 8 hospitals, 62 maternity hospitals, and 73 clinics served by 66 medical doctors and 837 nurses. There also exist 31 public health centers and 410 family planning clinics. In Kisaran a general hospital is available. The villagers living in the study area are well served by these medical facilities.

(5) Education

Public education is composed of primary school, lower secondary school and higher secondary school. In the study area, there are 716 primary schools, 26 lower secondary school and 8 higher secondary schools. Furthermore, there are 4 universities/colleges in the study area, 2 in Kisaran and 2 in Tanjung Balai (Table B-42). The education facilities in the study area are well arranged.

(6) Communications

Inter-district communications by post and telegraph are available in the study area. Post offices are available one for each district capital. Telephone services are limited to the cities of Kisaran and Tanjung Balai and to some villages located along the national highway. An inventory of communication facilities in the area is presented in Table B-43.

3. DEVELOPMENT POTENTIAL

3.1 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 to establish profitable irrigated agriculture. Assessment of land resources for irrigation development is examined by two factors: (a) present land use conditions, and (b) land capability. As mentioned in Section 2.7, the present land use in the study area is as follows.

Category		Area (ha)	Percentage (%)
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 hilly area. Coconut estates extends over the flat low land and the sand dune belt along the coast. Upland field is scattered in the hilly area on a small scale. Most of the paddy field is developed on the flat low land and 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 fields 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 Development Potential of Water Resources

(1) General

Water resources in the study area are, in general, abundant and their development potential is very high. However, there is regional imbalance between water demand and supply. For example, water availability during the dry season in the Bunut river basin is not sufficient to cover the irrigable paddy areas downstream. On the other hand, water resources in the adjacent basins, the Silau and the Asahan, are far in excess of water use at present. To grasp the development potential of water resources in the study area, assessment of available river runoff based on hydrological study was made.

(2) Low flow in the river basin

For irrigation planning in Indonesia, the risk level of water shortage of once in 5-year probability is generally accepted. The 5-year low flow during the paddy cropping season was estimated at the possible intake site downstream based on available discharge records and analysis. The result of the analysis is summarized below and details of low-flow analysis is presented in Chapter 3 of Appendix 3-A.

Item		Bunut	Silau	Asahan	Kualuh	Natas
Catchment area	(km^2)	115	1,050	4,486	1,116	530
Annual mean flow	(m^3/s)	4.3	65	153	59	28
5-year low flow	(m^3/s)	3.0	44	111	24	21

Available river discharge for irrigation can be estimated by deducting the maintenance flow from the 5-year low flow during the cropping season. The maintenance flow is estimated in the succeeding sub-section.

(3) River maintenance flow

The river maintenance flow is the minimum discharge which is required to maintain water depth, flow velocity, water quality, channel stability, the aquatic eco-system and scenery to the extent necessary for navigation, fish catch, operation and maintenance of intakes, maintenance of river facilities, sea water repulsion, prevention of estuary clogging, preservation of riparian land and people's amenity.

The river maintenance flow is the indicator of the allowable limit of water withdrawal from the river, to be considered in allocating and developing water resources. Increased water withdrawal should not be allowed, if it is expected to impair the river maintenance flow frequently. In principle, the river maintenance flow is determined to be equal to the monthly mean discharge of 90% in probability of exceedance. Probable monthly drought discharges of the rivers are tabulated in Tables A-52 and A-53. For the Bunut river, however, the maintenance flow is not considered because all available discharge during dry months has been fully utilized for many years and there are no problems downstream.

(4) Possibility of inter-basin diversion

The available water resources in the Bunut river basin are insufficient during dry season. Only a part of the irrigable area in the basin can receive irrigation water during dry months. To solve the

water shortage problem, an inter-basin water diversion from the Silau to the Bunut river has been planned by PU North Sumatra. The proposed diversion site is 17 km upstream of Kisaran where the distance between the two rivers is about 4 km (Ref. to Fig. C-4). In 1983, PU North Sumatra carried out a survey and preliminary planning to confirm the possibility of this idea. The elevation of the river bed of the Silau at the diversion site is 6 m higher than that of the Bunut river. The sediment flow in the Silau river during dry season is quite low. Furthermore, the construction cost of an intake and a diversion canal seems to be not high owing to the topography and geology at the site. The proposed plan is, therefore, quite promising if there are no adverse effects downstream.

The maximum water withdrawal by the Silau-Bunut inter-basin water diversion should be determined so as not to cause adverse effects on environmental quality downstream. The amount of discharge is estimated so as to sustain the river maintenance flow of 29.9 m^3/s at the diversion site on the Silau river. The 5-year low flow and the river maintenance flow at Kisaran is estimated at 44.2 m^3/s and 29.9 m^3/s, respectively. Since the water demand downstream is estimated at 7.2 m^3/s, the available discharge for an inter-basin water diversion is calculated to be 7.1 m^3/s (= 44.2 - 29.9 - 7.2).

(5) Possibility of increase of base flow

After the completion and full operation of the No. 2 Asahan hydropower development project in 1983, the runoff in the Asahan river downstream has been regulated and the base flow was augumented to about 110 m^3/s. No. 3 Asahan hydropower development project has now been proposed. After completion of this project, runoff downstream will become more steady throughout a year and the available discharge downstream will be increased still further. However the influence of this project is not taken into account in this study due to uncertainity over implementation timing and the operation rule to be applied.

(6) Available water resources for irrigation development

Available water resources for irrigation development in the study area are preliminarily estimated as shown below:

(unit: m^3/s)

Item	Bunut	Silau	Asahan	Kualuh	Natas
1) 5-year low flow	3.3	44.2	110.7	27.5	20.7
2) Maintenance flow	0	29.9	81.5	24.4	10.9
3) Inter-basin transfer	+ 7.1	- 7.1	-	-	-
4) Available flow (1-2+3+4)	10.4	7.2	29.2	3.1	9.8

As shown in the above table, water resources available in the study area under 5-year drought condition is estimated to be 59.7 m^3/s.

3.3 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. 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/s. Therefore, it is necessary to encourage non-irrigated agricultural development of about 67,000 ha in the study area.

4. AGRICULTURAL DEVELOPMENT PLANS

4.1 Development Needs

North Sumatra province has suffered a shortage of rice for many years. Rice has had to be imported from other provinces as well as from foreign countries as shown in the following figures for rice imports in recent years:

Year	Imported from Foreign Countries (ton)	Imported from Other Provinces (ton)
1985/86	-	159,350
1986/87	25,560	219,920
1987/88	44,860	158,650
1988/89	-	75,700

The total population in North Sumatra province was estimated to be about 9.9 million in 1987. The population in 2005, the target year of the master plan is estimated at about 13.6 million (Table B-44). Demand of rice in the target year is forecast to be about 3.6 million tons of paddy. On the other hand, production of rice in the target year will be only 2.4 million tons of paddy if new irrigation and/or drainage projects are not implemented during the period up to the target year. This would leave a shortage of 1.2 million tons as paddy. It is, therefore, recommended in the master plan that development priority be given to increasing rice production in North Sumatra province.

The study area is administered by the Kabupatens Asahan and Labuhan Batu. The mainstay of its economy is agriculture based on rice and estate crop cultivation. About 60% of households are farm households, and about 80% of the total labor force is engaged in agriculture and related activities. Present land use patterns are well characterized by excellent utilization of the given natural conditions.

Almost all land has been fully utilized except for swamp land of about 108,000 ha.

However the study area has some of the lowest agricultural productivity in North Sumatra province, especially in rice. Unit yields of paddy are low, and rice production is severely affected by natural disasters which accrue from droughts, pests and diseases, floods, etc. About 85% of existing paddy fields are rainfed. Even in the existing irrigation systems, the irrigated areas for dry season paddy are quite limited due to the shortage of available water and/or insufficient water levels at free intakes during the dry season. As a result, cropping intensity in the study area is low.

Furthermore the farm size per farm household is as small as less than one ha, so that farmers' economy remains at the subsistence level. It is necessary to raise farmers' incomes through enhancement of agriculture, especially of rice production.

In the study area, provision of social infrastructures including roads, water supply, electricity, sanitation and health services has been concentrated on urban areas such as Kisaran and Tanjung Balai. Such infrastructures in the rural areas are less developed, especially in the southeastern part of the study area: Leidong coastal area and lower Kualuh area. The road network in such areas and road conditions connecting the rural areas with urban areas are very poor, which hampers smooth transport of agricultural products to Tanjung Balai and Kisaran which are the centers of agricultural marketing. This is one of the major constraints to economic development in the rural areas. From the viewpoint of urban-rural equity, the future development and investment in the rural areas is also considered.

4.2 Objectives and Strategy for Development

The preliminary assessment of development needs for the study area indicates that agricultural development should aim:

(a) to maximize the potential agricultural benefits through efficient use of the available land and water resources,

(b) to increase rice production for self-sufficiency of rice in North Sumatra province, and

(c) to upgrade the present depressed living standards of the farmers in the study area.

In order to maximize the potential agricultural benefits, special attention has been paid on (a) swamp development and (b) water resources development through inter-basin transfer of available water sources. Introduction of oil palm cultivation in newly developed swamp land which has deep peat soils will be considered from the standpoint of low cost of development, crop adaptability for peat soils and climatological suitability.

For the purpose of increasing rice production, it is necessary (a) to increase the unit yields of paddy, (b) to increase the annual cropping intensity of paddy in the existing paddy fields, and (c) to increase the area of paddy fields.

To increase the unit yield of paddy, improved irrigation farming should be introduced. To increase cropping intensity and the area of paddy fields, the following measures are essential; (a) rehabilitation and improvement of existing irrigation and/or drainage systems, (b) water resources development through inter-basin diversion of available water sources, (c) provision of irrigation and drainage facilities to rainfed paddy field and, (d) land reclamation of swamp land. From the viewpoint of the economy, it is considered that agricultural development, particularly irrigation development of the existing cultivated land, should have the highest priority for raising land productivity.

In addition to increasing rice production, urban-rural equity in the study area be realized not only through implementation of

irrigation/drainage systems but also through upgrading the social infrastructure with emphasis on the rural road system.

4.3 Agricultural Development Plan

4.3.1 Proposed land use

Implementation of irrigation, drainage and swamp development projects will provide the basis for increasing the unit yields of crops and production. After implementation of these projects, land use in the study area will change considerably as follows.

(Unit: ha)

	Present Condition	With Project Condition Development Area	
		Gross	Net
Irrigated paddy fields	9,940	73,070	54,380
Rainfed paddy fields	58,250	17,300	12,880 (1)
Unused uplands	2,770	-	-
Oil palm fields	0	41,140	28,670
Swamps	107,730	57,180	82,630 (2)
Total	178,690	178,690	178,690

Note: (1) Control drainage project without irrigation water supply
(2) Including land for facilities of the systems, retarding basin, new settlement areas, etc. in addition to swamp lands.

4.3.2 Proposed cropping patterns

In due consideration of needs and basic strategy for agricultural development of the project, paddy and oil palm are selected as the main crops in the framework of future cropping pattern.

The possibility of introducing upland crops in the dry season has been examined, however soil acidity and farmer's reluctance to upland crop cultivation during the dry season due to pest attacks present great difficulties. Accordingly upland crop cultivation is not proposed.

The proposed cropping patterns has been framed to take into consideration the following conditions; (a) climatic condition, (b) availability of irrigation water, (c) plant physiological features, (d) soil conditions (e) maintenance of the systems and (f) socio-economic conditions.

Double cropping of paddy is planned if irrigation water is available. Double cropping of paddy would be practiced in irrigation development projects, but only single cropping in controlled drainage projects. Oil palm is planned to be planted in the swamp area development which will extend over the Asahan swamp having deep peat soils.

Wet season paddy is planted from September to November and is harvested from January to March. The staggering period is designed to be 1.5 months. Dry season paddy is planted from March to May and is harvested from July to September. Plantphysiologically sunshine hour is an important factor in attaining a higher yield of paddy and required for increasing the photosynthetic efficiency of rice plant. Critical growth periods in terms of sunlight requirements are about 15 days just before heading and about 25 days just after heading, so the framework of the cropping calender of paddy is designed so as to get sunny weather as much as possible. Furthermore, the period between the end of harvesting and the beginning of planting is designed to be more than half a month to prevent damage from pests, diseases and rats.

With respect to oil palms, planting will be timed to coincide with the wet seasons.

The proposed cropping patterns are illustrated in Fig. 4-1. The target cropping intensity for the projects is shown below.

Project	Development Area (ha)	Paddy (ha)		Oil Palm (ha)	Intensity (%)
		Wet Season	Dry Season		
Silan-Bunut	14,295	14,295	14,295	0	200
Tambung Tulang*	5,755	5,755	0	0	100
S. Empat*	2,800	2,800	0	0	100
Pd. Mahondang	6,185	6,185	6,185	0	200
Leidong-Asahan	45,470	16,800	16,800	28,670	137
Kanopan Left*	4,320	4,320	0	0	100
Aek Natas	4,190	4,190	4,190	0	200
Kualuh Right	2,425	2,425	2,425	0	200
Aek Naetek	3,450	3,450	3,450	0	200
Small-Scale	7,038	7,038	5,240**	0	174
Total	95,928	67,258	52,585	28,670	155

Note: * Control drainage project

** Double cropping of rice is envisaged for the existing small-scale irrigated valley bottom area and 170% of cropping of rice per year is planned for new small-scale irrigation in the valley bottom area.

4.3.3 Proposed farming practices

Proper farming practice is the most essential factor for realizing full exploitation of the agricultural potential in the area. For the purpose high yielding and/or improved varieties will be introduced. Proper amount of fertilizer and chemicals will be applied through proper farming practices with project conditions. It is, however, expected that there will be no substantial changes in farming practices and farm input for future without project conditions. The future farming practices are proposed in Table B-45 and farm inputs per ha with and without project conditions are shown in Tables B-46 and B-47.

The labour requirement per ha with and without project conditions are shown in Table B-48.

Assuming that land preparation work is performed in three weeks and harvesting/processing is in two weeks in a farm, the peak demand period for labour force is harvesting time.

Per farm base labour balance study for paddy farming at the peak labour demand period of harvesting time is shown in the following table.

With project condition (Unit: mandays)

	Irrigated Paddy in Low Land		Newly Irrigated Area & Irrigated Area in Valley Bottom			Rainfed Area	
Farm size (ha)	0.5	1.0	0.5	1.0	2.0	1.0	2.0
Labour requirement for harvesting/processing	22.5	45	20	40	80	40	80
Available labour force/farm	30	30	30	30	30	30	30
Balance	+7.5	-15	+10	-10	-50	-10	-50

1/ : Assumed future available labour force/farm is 2.5.
2 weeks x 6 working days/week x 2.5 = 30

Without project condition (Unit: mandays)

	Irrigated Paddy in Low Land		Irrigated Paddy in Valley Bottom		Rainfed Paddy in Low Land		Rainfed Paddy in Valley Bottom		Upland Crop	
Farm size (ha)	0.5	1.0	0.5	1.0	1.0	2.0	0.5	1.0	0.5	1.0
Labour requirement for harvesting/processing	20	40	20	40	30	60	17.5	35	12.5	25
Available labour force[1/] for the period/farm	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4
Balance	+6.4	-13.6	+6.4	-13.6	-3.6	-33.6	+8.9	-8.6	+13.9	+1.4

1/: Assumed available labour force/farm is 2.2
2 weeks x 6 working day/week x 2.2 labour force/farm = 26.4

The labour shortages during high demand period could be solved by hiring labour and/or mutual cooperation among villagers as currently practiced. However, in newly reclaimed areas, transmigration project will be necessary to cope with the labour problems.

Total labour demand per year for paddy and oil palm production with and without projects conditions in the proposed project areas are estimated in Tables B-49 and B-50, summarized as shown in the following table. The incremental labour demand at the full development stage is estimated at about 12.4 million mandays.

(Unit: 1,000 mandays)

	Without Project	With 1/ Project	Incremental Labour Demand
Irrigated area	2,048	15,851	13,803
Rainfed area	6,158	2,189	-3,969
Oil palm farm	-	2,592	2,592
Total	8,206	20,632	12,426

1/: labour demand at the full development stage.

4.3.4 Anticipated yields and production

The present crop yield is low, mainly because of the shortage of irrigation water. This means that farmers in the study area cannot introduce improved farming methods because of lack of water or the unstable supply of water. substantial increase of crop production is not expected without improvement in irrigation conditions.

Introduction of improved and advanced irrigation farming, however, will help raise the present low yield of crops year by year under with project condition. The estimate of the future yield of crops has been made 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 study area. The anticipated unit yields and production at the full development stage are summarized below:

Unit Yields

(Unit: ton/ha)

		With Project	Without Project
(1)	Paddy		
	Irrigated lowland	5.5	4.0
	Irrigated valley bottom land	5.0	3.5
	Rainfed (low land)		2.0
	Rainfed (valley bottom land)		2.5
	Control drainage area	4.0	
(2)	Oil Palm	22 1/	0

1/: Fresh fruit bunch, yield of 9-30 years after planting, average yield from the 5th to 8th years after planting is estimated to be 12 t/ha.

Production

(Unit: ton)

	Development Area	Production		Incremental Production
		Wit h Project Condition	Without Project Condition	
Paddy				
Silan-Bunut	14,295	149,900	59,100	90,800
Tambung Tulang*	5,755	23,000	8,100	14,900
S. Empat*	2,800	11,200	0	11,200
Pd. Mahondang	6,185	62,900	9,900	53,000
Leidong-Asahan	16,800	168,100	32,100	136,000
Kanopan Left*	4,320	17,300	4,200	13,100
Aek Natas	4,190	41,900	6,000	35,900
Kualuh Right	2,425	24,300	4,100	20,200
Aek Naetek	3,450	34,500	4,800	29,700
Small-Scale	7,038	61,400	20,800	40,600
Total	67,258	594,500	149,100	445,400
Oil Palm				
Leidong-Asahan	28,670	630,700	0	630,700

Note: * control drainage

4.3.5 Marketing and price prospects

North Sumatra province is a region of rice shortage at present. The amount of rice which was imported from the other provinces and the foreign countries is shown in Table 4-1. The amount of imported rice differs from year to year depending on the year, ranging from 75,700 tons to 245,500 tons during a recent four year.

It is expected that all the rice produced in the projects will be marketed in North Sumatra province. The demand for rice in North Sumatra province in future is estimated as follows, with further details in Table 4-2:

Year	Population (10^3 persons)	Demand (10^3 tons of Paddy)
1990	10,541	294
1995	11,551	556
2000	12,567	926
2005	13,605	1,207
2010	14,656	1,487
2015	15,789	1,788
2020	17,009	2,114

If all the projects are implemented, incremental paddy production will be about 450,000 tons. Thus all the paddy produced in the projects will be absorbed by the regional market.

The oil palm production will be marketed for both domestic use and export.

The prospective prices of farm outputs and inputs are based on the World Bank document on "the price prospects for major commodities (1988-2000)." Prices at the farm gate prices are estimated as follows. Details are shown in Tables B-51 to B-53.

	(Rp/ton)
Paddy	300,000
Oil palm	99,800-132,500
Urea	448,000
TSP	517,000
KCL	326,000

4.3.6 Crop budgets and irrigation benefits

Irrigation benefits to be expected are defined as the difference between the primary profits from crops as between future with project and without project conditions. On the basis of the estimated production cost and gross income, the primary profit for each crop per ha is calculated both on future with and without project condition as shown in Table B-54 and B-55. In terms of economic value, the primary profit of each crop per ha is summarized in the following table.

Without project conditions (paddy)

(Unit: Rp/ha)

	Irrigated Low Land	Irrigated Valley Bottom	Rainfed Low Land	Rainfed Valley Bottom
Gross income	1,200,000	1,050,000	600,000	750,000
Production cost	479,121	417,940	269,365	343,472
Primary profit	720,879	632,060	330,635	406,428

With project conditions (paddy and oil palm)

(Unit: Rp/ha)

	Irrigated Low Land	New Irrigated and Irrigated Valley Bottom	Control Drainage	Oil Palm
Gross income	1,650,000	1,500,000	1,200,000	2,915,000
Production cost	557,950	550,450	431,500	922,950
Primary profit	1,092,050	949,550	768,500	1,992,050

Applying the primary profit per crop estimated to crop area, total primary profit accrued from agricultural production for the project is estimated both without and with project conditions. Based on this result, irrigation benefit is calculated.

The irrigation benefit will be expected to reach the target in the 3rd year for the irrigated low land and in the 4th year for newly irrigated areas, irrigated valley bottom areas and control drainage areas after completion of irrigation and drainage facilities. The fields of oil palm are expected to increase year by year and reach the target yield in and after the 9th year. The irrigation and drainage area will be also developed stepwise. The irrigation benefit at the full development stage is estimated as follows. Details are shown in Table 4-3.

Project	Total Irrigation Benefit (Million Rp.)
Silan-Bunut	18,691
Tambung Tulang	3,088
S. Empat	2,153
Pd. Mahondang	10,303
Leidong-Asahan	83,999
Kanopan Left	2,639
Aek Natas	6,973
Kualuh Right	3,932
Aek Naetek	5,761
Small-Scale	8,023

4.3.7 Farm economy

After implementation of the irrigation projects, the projects will provide bases for the introduction of improved irrigation farming through year round stable irrigation. As a result, increase of unit yield of paddy and cropping intensity will be expected. Paddy yield is anticipated to increased to 5.0 - 5.5 tons per ha. Cropping intensity under with project condition will increase to 200% from about 160% in the existing irrigated area and from about 100% in rainfed area under without project condition. In drainage control project, paddy yield of

4.0 tons per ha is expected through the introduction of fairly intensive farming system and improvement of land drainability. In addition, the development of smallholder's oil palm farm envisaged in the swamp development project will present greater opportunities both in stable income earning and self-employment to landless farmers.

Farm budget analyses of typical farmers are made by examining the incremental income expressed by the difference of net return from objective crops in future with and without project conditions. In the analyses, it is assumed that no significant increase of farm income will be expected in the future without project condition.

The farm budget of typical farmers in both with and without project conditions are summarized in the following table and details are shown in Table B-56.

Farm Income/With & Without Project Condition[1/]

(Unit: Rp. 000)

	Irrigation Development Projects Present Land Use Category				
	Irrigated Paddy Low Land	Irrigated Paddy Valley Bottom	Rainfed Paddy Low Land	Rainfed Paddy Valley Bottom	Swamp
Farm size (ha)	0.5	0.5	1.0	0.5	1.0
Farm income (without project condition)	719.6	670.6	552.7	298.4	0
Farm income (with project condition)	1,280.1	1,145.1	2,290..2	971.5	2,290.2
Incremental income	560.5	474.5	1,737.5	673.1	2,290.2

	Drainage Control/Swamp Development Projects Present Land Use Category		
	Rainfed Paddy Low Land	Swamp[2/] (Paddy)	Swamp[2/] (Oil Palm)
Farm size (ha)	1.0	1.0	2.0
Farm income (without project condition)	552.7	0.0	0.0
Farm income (with project condition)	979.9	979.9	2,498.4
Incremental income	427.2	979.9	2,498.4

1/ : Farm income from objective crops, without costing labour cost.
2/ : Newly reclamated land and crops proposed to produce.

As shown in the table, considerable to drastic increase of farm income is expected in all projects proposed in the present study.

4.4 Irrigation and Drainage Development Plan

4.4.1 General

Based on assessment of the development potential of the land and water resources of the study area, possible plans for irrigation, drainage and swamp area development has been formulated in line with the development strategy set up in Section 4.2.

To formulate possible area development projects, all related factors such as agricultural conditions, topography, soils and land suitability, present land use, available irrigation water sources, risks of flooding, topography, present irrigation and drainage conditions, as well as socio-economic situations have been taking into account. Of these, the most crucial points are as follows.

(a) Land suitability;

(b) Available water resources for irrigation development without provision of artificial reservoir on the rivers and farm pond;

(c) Irrigability and drainability by means of gravity system;

(d) Existing and future flood control measures such as dikes; and

(e) Relationship to existing development plans and proposals prepared by the Government of Indonesia (Ref. to Chapter 2 of Appendix 3-C).

The major relevant data and information such as topography, soil mechanics, sediment and Lower Asahan river flood control project for planning and preliminary design of the proposed facilities are presented in Section 7 of Appendix 3-C.

4.4.2 Irrigation water requirements

In the present study, the irrigation water suppy is considered only for paddy. The irrigation water requirements have been estimated in accordance with a planning guideline prepared by DGWRD. Consumptive use of water has been estimated on the basis of the modified Penman method proposed by FAO. A percolation rate of 2 mm/day is applied for paddy. The water requirement for land preparation for paddy is assumed to be 200 mm. The effective rainfall is based on the 5-year low rainfall at representative rainfall stations. The overall irrigation efficiency is assumed to be 60%.

The irrigation water requirements for paddy by river basin have been calculated as shown below:

Basin	Peak water Requirement (lit/s/ha)	Seasonal Water Requirement	
		Wet Weason (mm/crop)	Dry Season (mm/crop)
Bunut & Silau	1.49	774	789
Asahan	1.38	712	715
Kualuh	1.30	704	722
Natas	1.44	633	738

4.4.3 Maximum irrigable area

To grasp the possible maximum scale of irrigation development by basin, the water supply and demand balance was examined based on available 5-year low flows and unit water requirements for double cropping of paddy as shown in Table C-15. The results of this estimation are summarized below and details are shown in Table C-16.

River	Maximum Irrigable Area (ha)
Bunut	2,200
Silau	11,800
Asahan	23,000
Kualuh	6,600
Natas	6,800
Minor rivers	7,600
Total	58,000

As shown in the above table, a total area of 58,000 ha could be irrigated in the study area. For the Silau river basin, the possible scale of development is much larger than the available land resources in the basin. The excess water in the Silau river should be used effectively if an inter-basin water diversion plan is possible.

4.5 Proposed Area Development Projects

4.5.1 Project identification

Based on the assessment of land and water resources development potential and in line with development strategy, the following ten(10) irrigation, drainage and swamp area development projects have been identified.

1) Silau-Bunut River Basin Integrated Rehabilitation Irrigation Project
2) Tambung Tulang Swamp Development Project
3) Simpang Empat Swamp Development Project
4) Padang Mahondang Irrigation Extension Project
5) Leidong and Asahan Swamp Development Project
6) Kanopan Left Bank Drainage Improvement Project
7) Aek Natas Irrigation Project
8) Kualuh Right Bank Irrigation Project
9) Aek Naetek Irrigation Project
10) Small-scale Irrigation Rehabilitation Package Project

The type of project and proposed command areas by category for each project are as shown below:

(Unit: ha)

Project		Type of Project	Project Area			
			Gross Area	Net Area		
				Upgrading and Improvement	Newly Reclaimed	Total
1.	Silau-Bunut	I	17,000	13,200	1,100	14,300
2.	Tambung Tulang	C/D	7,500	4,100	1,700	5,800
3.	Simpang Empat	C/D	4,000	0	2,800	2,800
4.	Pd. Mahondang	I	8,300	2,200	4,000	6,200
5.	Leidong - Asahan	I	62,100	15,900	29,700	45,600
6.	Kanopan Left	C/D	5,800	2,000	2,300	4,300
7.	Aek Natas	I	5,500	2,700	1,500	4,300
8.	Kualuh Right	I	3,100	2,000	400	2,400
9.	Aek Naetek	I	4,500	2,400	1,100	3,500
10.	Small Scale	I	8,700	7,200	0	7,200
	Total		126,500	51,700	44,600	96,300

Note: I = Irrigation project , C/D = Controlled drainage project

As shown in the above table, the net area totals 96,300 ha, of which 44,600 ha will be newly reclaimed from virgin swamp land.

As regards the flood protection work, the dikes proposed in Part I study are supplemented by new dikes for the irrigation development as shown in Section 4.1 of Appendix 3-C. The design flood discharge with 30-year return period for design of river structures are shown in Table A-41.

The main features of each project are summarized in Table 4-4. Detailed information on each project is summarized in the form of the "Project Description Sheet" in the Appendix 3-D of this report, which contains the following items for each project.

Contents of Project Description Sheet

I. Summary
II. Present Conditions of the Project Area
III. Main Constraints of the Area
IV. Proposed development Plan
V. Project Cost Estimate (Financial Cost)
VI. Implementation Schedule
VII. Project Evaluation
Project System Map

General features of proposed projects are briefely explained in the succeeding Sub-sections.

4.5.2 Silau-Bunut river basin integrated rehabilitation irrigation project

The project area, covering 14,300 ha net, extends over the alluvial plain both in the lower Bunut river and the lower Silau river. The area includes 12 irrigation schemes managed by DPU in the area. Although the area is relatively well developed as compared with other areas, the area suffers from water shortage in dry seasons and flood damage in wet seasons.

The basic idea of the project formulation is to divert surplus water in the Silau river to the Bunut river by inter-basin diversion channel to develop irrigated paddy area in the lower Bunut area. As already discussed in Section 3.2, the available discharge from the Silau river by the inter-basin diversion is estimated to be 7.1 m^3/s.

On the Silau river, an integrated headworks is proposed. At present, the intake water level is not sufficient during the dry season. Furthermore, the intake water level will be lowered due to (a) canalization of the Silau river and construction of dikes under the Urgent Flood Control Project, and (b) decrease in low flow by inter-basin diversion. These points support the necessity for construction an integrated headworks. The proposed integrated headworks would consist of a weir and intake structures on each bank.

The main project works proposed are (a) construction of an inter-basin diversion system between the Silau and the Bunut (Ref. to Fig. C-6), (b) construction of an integrated headworks on the Silau river (Ref. to Table C-19 and Fig. C-5), (c) construction of a connection canal from the integrated headworks to the existing free intake points, (d) rehabilitation of existing irrigation and drainage facilities, (e) extension of irrigation and drainage canals of 255 km, (f) construction of farm road network of 660 km, (g) on-farm development for 13,200 ha, (h) reclamation of new farm land of 1,100 ha, and contruction of a flood protection dike 56 km long.

4.5.3 Tambung Tulang swamp development project

The project area, covering 5,800 ha net, is located in the northern part of the Bunut river system. The area extends over very flat low-lying swampy area. The water level of the existing drainage canals is subject to tidal influence from the Strait of Malacca, which affects drainage in the area. Since no river exists, water for agricultural development depends on rainfall and use of drainage water from the Bunut irrigation systems. At present, there is a controlled drainage scheme in the area. The main constraints existing in the area are poor drainage and accessibility due to poor drainage networks and roads.

The main facilities to be provided by the project would be (a) drainage canal network of 144 km and tidal gates, (b) farm road network of 144 km, (c) on-farm development for 5,800 ha, and (d) land reclamation of 1,700 ha.

4.5.4 Simpang Empat swamp development project

The project area, covering 2,800 ha net, is located on the left bank of the Asahan river. The project area is divided into two areas by the Sukuraja river, a small tributary of the Asahan. Most of the project area is a virgin swamp and no agricultural activity exists since the area suffers from seasonal flooding of the Asahan river. It is expected that the area can be utilized for profitable agriculture if the proposed flood protection plan proposed in Part-I Study realized.

No water source for irrigation for the project is available since all the available water of the Sukaraja river is diverted to irrigation areas upstream. The main project works proposed are (a) construction of a drainage canal network of 70 km with control gates, (b) construction of a flood protection dike 30 km long, (c) land reclamation work for 2,800 ha, and (d) construction of a farm road network of 70 km in total.

4.5.5 Padang Mahondang irrigation extension project

The project area, covering 6,200 ha net, is situated to the east of Pulau Raja city. The area is bounded by the Asahan river to the north, the Nantal river to the east and south, and an oil palm plantation to the west. Most of the area extends over a very flat alluvial plain along the Asahan river. At present, there is one irrigation scheme. The scheme covers irrigated paddy fields of 1,000 ha, rainfed paddy fields of about 1,100 ha, swamp areas of about 3,400 ha, and unused uplands of 600 ha.

The project area of 8,300 ha gross was determined after taking into account the available water for irrigation from the Asahan river and the land resource to the east of the existing paddy fields. The east area (Nantal Swamp) will be flood-free after river improvement works. The detailed design of the river improvement work was completed in June 1989.

This project was formulated on the basis of (a) augmentation of irrigation water supply to the area by constructing a new diversion structure on the Asahan river which would be located upstream of the existing one, (b) rehabilitation and extension of existing irrigation and drainage networks, (c) reclamation of a swamp area, (d) construction of a flood protection dike against the 10-year flood, and (e) provision of farm road networks.

The main project works are (a) construction of a free intake structure on the Asahan river, (b) rehabilitation of existing canal and construction of a new canal network including extension of existing canals, 216 km in total, (c) rehabilitation and new construction of drainage canals, 150 km in total, (d) construction of a flood protection

dike 29 km long, (e) land reclamation of 4,000 ha in swamp, (f) on-farm development for 6,200 ha, and (g) construction of a farm road network of 367 km.

4.5.6 Leidong - Asahan swamp development project

The aim of the project is to develop rainfed paddy areas for paddy and virgin swamp for oil palm production on a large scale by utilizing the land and water resources potential on much as possible. The basic concepts for formulation of the project has been (a) to divert water from the Asahan river to the Leidong area where there are extensive existing rainfed paddy areas, (b) to provide irrigation and drainage networks for the existing rainfed paddy fields, (c) to develop virgin land in the Asahan swamp area for oil palm plantation, and (d) to the improve transportation network in the coastal area.

The project area, covering an area of 45,600 ha net, is situated towards the center of the study area. The area is bounded broadly by the Strait of Malacca to the east, the Asahan river to the north, the Kualuh river to the south, and existing oil palm plantation area to the west. The project area consists of two sub-areas. One is the existing rainfed paddy area of about 23,000 ha gross extending along the coastal line and the other is swampy forest land of about 37,000 ha in the Asahan swamp. The Asahan swamp area is covered by deep organic soils (peat)..

The main project works proposed are (a) construction of a headworks on the Asahan river and a conveyance canal of about 40 km long to the coastal area, (b) construction of irrigation canal networks of 773 km, (c) construction of drainage canal networks of 1,136 km, (d) land reclamation of swamp area of 30,000 ha, (e) on-farm development for irrigated paddy fields of 19,600 ha, (f) construction of a flood protection dike 29 km long along the Lebah river, and (g) construction of a farm road network of 1,910 km in total length.

4.5.7 Kanopan left bank drainage project

The project area, covering an area of 4,300 ha net, is situated on the left bank of the Kanopan river, a tributary of the Kualuh river. The project area comprises two controlled drainage schemes, Sukarame-Sukasari scheme and Sono-Martani scheme. Most of the area extends over a flat swampy area of the Kanopen river. The water level in the river along the Sano-Martani scheme is subject to tidal influence from the Strait of Malacca, which affects drainage in the scheme area. At present, there is no irrigation network. The existing drainage canal network is malfunctioning due to poor canal density, no central drainage gate, etc.

The drought discharge of the Kanopan river is very small. It is estimated at only 2-3 m^3/s. Irrigation activity on the river depends on the tidal fluctuation of the river. Land use trends towards crop diversification from rainfed paddy to oil palm plantation. The area is usually seasonally inundated due to lack of a river dike and poor drainage.

The main project works proposed are (a) extension of the drainage canals by 85 km, (b) reclamation of swamp area of 2,300 ha, (c) on-farm development for 4,300 ha, (d) construction of a flood protection dike 11 km long, and (e) construction of a farm road network of 85 km.

4.5.8 Aek Natas irrigation project

The project area, covering an area of 4,200 ha net, is located on the both sides of the Natas river, a tributary of the Kualuh river. The area is bounded by the Kualuh river to the north, the Pamanke river to the east and south. Most of the area extends over very flat alluvial and swampy plain along the Natas and the Kualuh rivers.

At present, there are rainfed paddy fields of about 3,400 ha. The area is divided into two areas by the Natas river and these two areas are under command of the district irrigation service of Labuhan Batu. Since

no irrigation canal system is provided yet, the area is defined as a controlled drainage scheme.

The main project works proposed are (a) construction of a headworks on the Natas river, (b) construction of a new irrigation canal network 147 km long, (c) rehabilitation of existing drainage canals 86 km long, (d) on-farm development for4,300 ha, (e) construction of 16 km of flood protection dike, and (e) construction of a farm road network of 233 km.

4.5.9 Kualuh right bank irrigation project

The project area, covering an area of 2,400 ha net, is located on the right bank of the Kualuh river, downstream of the provincial road. Most of the area extends over the very flat alluvial plain along the Kualuh river. There are rainfed paddy fields of about 2,000 ha. At present no irrigation and drainage facilities exist. The irrigation water will be supplied by diverting water from the Kualuh river, in order to overcome the existing water shortage.

The main project works proposed are (a) construction of a headworks on the Kualuh river, (b) construction of new irrigation canal network, (c) on-farm development for 2,400 ha, and (e) construction of new farm roads of 207 km.

4.5.10 Aek Naetek irrigation project

The project aims at upgrading the paddy productivity of the existing controlled drainage scheme by providing irrigation water diverted from the Kualuh river by gravity. The project area is 3,450 ha in net extending on a swampy alluvial plain with tidal effects to the downstream of the Kualuh river. Due to malfunctioning of the existing drainage control facilities, paddy areas have been affected by seasonal floods/ inundation and poor drainability.

The main project works proposed are (a) construction of a headworks on the Kualuh river located at about 5 km downstream of the

provincial road, (b) construction of a new irrigation canal network of 121 km, (c) rehabilitation and extension of existing drainage canals of 86 km, (d) on-farm development for 3,500 ha, (e) construction of a flood protection dike 17 km long, and (f) construction of a farm road network of 207 km.

4.5.11 Small-scale irrigation rehabilitation package project

This project is a package project gathering 11 existing irrigation schemes and 5 rainfed paddy areas of more than 500 ha each located to the west of the national highway, and covering a total net area of 7,200 ha. The development concept is to enhance the productivity of existing paddy areas through rehabilitation of existing facilities and provision of new facilities with farmers' participation.

The main project works proposed are (a) rehabilitation of existing irrigation and drainage canals of 53 km, (b) provision of new canals of 305 km, (c) on-farm development for 7,200 ha, (d) upgrading of farm roads of 358 km in total.

4.6 Cost Estimate

Construction costs for proposed project works are estimated on the basis of the following conditions:

a) All the civil works of the project will be executed on the contract basis. Contractors will be selected through international competitive bidding.

b) The physical contingency is assumed to be 30% of the direct construction cost; and

c) Exchange rate used for the estimate is US$1.00 = Rp.1,770 as of August 1989.

The unit prices are described based on those for similar works quoted in recent engineer's estimates such as for the "Detailed Design of Lower Asahan River Basin Flood Control Project", by DGWRD in 1989,

Balu Bolon Irrigation Project in 1989, and Ular Irrigation Project in 1989. The unit prices for main items used in the cost estimate are shown in Table C-22.

The direct construction cost is estimated based on the calculated work quantities of the proposed project works including the land reclamation costs. The breakdown of direct construction costs of proposed projects are shown in Table C-23.

The operation and maintenance (O&M) costs will consist of salaries of O&M staff, cost of maintaining the project facilities, materials and labour costs for repair works, and running costs of project facilities. The annual O&M costs have been assumed at 1.0% of the direct construction cost.

5. PROJECT ASSESSMENT AND PRIORITY SEQUENCE

5.1 General

Individual projects for agricultural development have been formulated based on the assessment of land and water resources in line with the development objectives and strategy proposed. Ten projects have been formulated as promising development projects from engineering viewpoints as listed below.

(1) Silau-Bunut River Basin Integrated Rehabilitation Irrigation Project (PJT-1)

(2) Tambung Tulang Swamp Development Project (PJT-2)

(3) Simpang Empat Swamp Development Project (PJT-3)

(4) Padang Mahondang Irrigation Extension Project (PJT-4)

(5) Leidong-Asahan Swamp Development Project (PJT-5)

(6) Kanopan Left Bank Drainage Improvement Project (PJT-6)

(7) Aek Natas Irrigation Project (PJT-7)

(8) Kualuh Right Bank Irrigation Project (PJT-8)

(9) Aek Naetek Irrigation Project (PJT-9)

(10) Small-scale Irrigation Rehabilitation Package Project (PJT-10)

For selecting the priority project(s), evaluation of each project was first made from an economc viewpoint. Then the priority sequence for implementation is determined by applying an evaluation criteria taking various aspects into account. The assumption and procedure applied for the evaluation are described hereunder.

5.2 Economic Evaluation

The economic evaluation for the formulated 10 projects is made by adopting the following basic assumptions;

(1) The economic useful life of the project is 50 years.

(2) All prices are expressed in constant 1989 prices.

(3) The exchange rate of US$1.00 = Rp. 1,770 is applied.

(4) The economic construction costs are estimated by applying the standard conversion factor (0.8) to the financial construction costs.

(5) Economic prices of agricultural outputs and inputs is estimated on the basis of IBRD projections of world market prices for 1995 in constant 1989 terms.

(6) Unskilled labor (farm labor) is priced by applying labor shadow price factor of 0.6.

Following these assumptions, the economic internal rate of return (EIRR) has been calculated as shown in Table 4-4.

5.3 Priority Sequence for the Development

For the purpose of evaluating the ten 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 Economic Internal Rate of Return (EIRR). The second is the magnitude of initial investment expressed as construction cost per ha. The third 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 as applied are shown below:

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 and the total points 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 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 priority ranking thus evaluated is shown below:

Project Sequence	Project
1	Silau-Bunut River Basin Integrated Rehabilitation Irrigation Project
2	Padang Mahondang Irrigation Extension Project
3	Kanopan Left Bank Drainage Improvement Project
4	Small-scale Irrigation Rehabilitation Package Project
5	Aek Natas Irrigation Project
6	Aek Naetek Irrigation Project
7	Kualuh Right Bank Irrigation Project
8	Tambung Tulang Swamp Development project
9	Simpang Empat Swamp Development Project
10	Leidong-Asahan Swamp Development Project

The result shows that the Silau-Bunut project should have 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.

5.4 Implementation Schedule

The implementation schedule for these projects will be determined so as to meet the increasing demand for paddy in the future.

Target for increase of rice production in the study area is set so as to supply 10% of the total rice demand of North Sumatra province taking into account the study area's share for the province with respect to present production and harvested area. This target for rice production is considered to be the minimum level for the study area.

The incremental rice production from each project and the demand for rice in North Sumatra province are shown in Sub-sections 4.3.4 and 4.3.5, respectively. Based on these supply and demand of rice so projected, the relationship between the increase in rice production

through implementation of the projects and the trend in demand for rice in North Sumatra province up to the year 2020 is illustrated in Fig. 5.1. To meet the increased demand for rice, implementation of the proposed project should be staggered following the priority sequence for the development.

To meet the minimum target (10% share), it is recognized in the long range plan that four projects such as the Silau-Bunut (PJT-1), the Padang Mahondang (PJT-4), the Kanopan Left (PJT-6) and the Small-scale (PJT-10) projects should be implemented by the end of the year 2020. On the other hand the Silau-Bunut and Padang Mahondang projects should be implemented by the target year of 2005 in the short range plan. Assuming a gradual increase in paddy productivity after completion of the project, a feasibility study on the Silau-Bunut project should be initiated as soon as possible.

If the higher target (to achieve 15% share) is applied, the above four projects would have to be completed by the year 2005, which would require huge investment costs. In view of the present investment policy of Indonesia, the above minimum target (10% share) is recommended as a practical target.

5.5 Project Impacts

In addition to the direct benefits assessed in the economic evaluation, various secondary and intangible benefit and/or favourable socio-economic impacts are expected from the implementation of the projects. The main socio-economic impacts expected to accrue from the Silau-Bunut and Padang Mahondang projects are presented as follows;

(1) Increase of employment opportunity

It is estimated that the projects will generate employment opportunities totalling about 1.5 million man-days of unskilled labours during the construction period for the Silau-Bunut project, and 0.8 million man-days for the Padang Mahondang project. Most of the

manpower will be supplied by farmers in the study area. Furthermore, employees will be able to gain relevant experience and skills in various working fields. This experiences will be valuable later in O&M work by the farmers. In addition, the projects will create a demand for farm labor due to the increased farming activities from intensive use of the land. The annual incremental farm labor requirement is estimated at 1.6 million man-days for the Silau-Bunut project and 1.3 million man-days for the Padang Mahondang project.

(2) Increase in rice production and foreign exchange saving

The projects will provide incremental paddy production of 90,800 tons for the Silau-Bunut project and 53,000 tons for the Padang Mahondang project which will play an important role in self-sufficiency in rice in North Sumatra province. The incremental production will bring in total annual foreign exchange savings of about Rp. 27.2 billion equivalent for the Silau-Bunut project and Rp. 15.9 billion equivalent for the Padang Mahondang project.

Furthermore the increase in such rice production will be profitable to rice millers and merchants with respect to processing and marketing costs.

(3) Increase in farmer's income

Farmer's incomes will be expected to improve considerably due to production increase of rice. Their incomes from rice farming will become about or more than twice the present level, which will provide motivation in improvement of living standards of farmers as well as of the regional economy.

(4) Improvement of local transportation

Local transportation will be much improved by the construction of O&M roads. These road systems will not only enhance economic activities but will also contribute to inter-regional accessibility and communication.

(5) Use of fertilizer and chemicals

After the implementation of the projects, improved irrigation farming practices will be followed by the farmers. The dosage of fertilizer and agro-chemicals will increase. The use of fertilizers and agro-chemicals will be carefully made under the guidance of Department of Agriculture and would thus involve minimal environment impact.

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Tables

Table 4-1 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 4-2 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%