

On the other hand, households in rural area are still using kerosene lamps for lighting. The percentage of households using electricity as a fuel for cooking and boiling drinking water is very small and estimated at below 1% in the study area. Most of households are still using wood or charcoal (78%) or kerosene (21%) for domestic fuel.

1.4.5 Transmigration

After independence, the transmigration program was carried out by the Government under the responsibility of Ministry of Manpower, Transmigration and Co-operatives. Since the reorganization in April 1983, the Ministry of Transmigration undertakes this program.

The objectives of transmigration programs are the following:
1) enhancing level of living, 2) regional development, 3) balanced population distribution, 4) development equity, 5) utilization of natural resources and human resources, 6) national unity, and 7) strengthening to security and defense.

Sumatra island is the biggest receiver of immigrants among others. But it differs widely province by province as shown in Table C-31. Among eight provinces, the net annual migration in two provinces: North Sumatra and West Sumatra indicates minus, i.e. - 0.22% to total population for the former and - 0.36% for the latter, respectively. This means that in those provinces, there were more flowing-out peoples than those of flowing-in. In case of North Sumatra, the southwestern part of the Province is producing many migrants to the neighboring provinces and outer islands.

Number of household resettled in North Sumatra Province amounted to 972 in 1982 and 8,111 in 1983, corresponding to 4,447 and 36,244 migrants, respectively. Their original provinces and Kabupatens in 1983 are Jawa timur (28.7%), Jawa Tengah (22.9%), Jawa Barat (19.1%), Yogyakarta (3.8%), Jakarta (0.6%) and Tapanuli Selatan in the North Sumatra Province (24.9%). Although the proportion of general

transmigration to Sumatra island amounted to 57% of the total migration in Indonesia, that to North Sumatra accounted for only 1% in 1981 (See Table C-32). Most of immigrants are entering into South Sumatra.

In the study area (Kabupaten Labuhan Batu), there exists only one systematic transmigration area (Aek Naetek: 2,100 ha) where 700 families were resettled under Government program from 1972 to 1979. As to the future transmigration program in the study area, the expansion of Aek Naetek is envisaged during the Repelita IV.

In the same Kabupaten outside of the study area, the following two transmigration programs are planned to be realized during the Repelita IV.

<u>Location</u>	<u>Area (ha)</u>	<u>No. of families to be resettled</u>
1) Pulau Rakyat	5,000	1,250
2) Bandar Pulau Pekan	2,000	500

The plan specifies that each transmigrant family will be provided with 2 ha of land including 0.25 ha for homelot, 0.75 ha for upland field and 1 ha for paddy field at the time of transmigration. In addition, each family will receive, free of charge, the farming inputs such as rice seeds, fertilizers, pesticides, etc., and be provided with subsistence support consisting of provision of rice, salt fish, cooking oil, sugar, kerosene and so on. After construction of the infrastructure in the area, education and family planning services will be also provided.

As the results of land use study implied, the study area has almost no room to accept transmigrants except development of swampy areas.

1.4.6 Socio-Cultural Features

Indonesia is a country of tremendous diversity in terms of culture and this has an important effect upon the socio-economic structure.

In parallel with the national language of "Indonesia", sixteen (16) main dialects are still spoken in Sumatra, together with many sub-dialects. In the two Kabupatens comprising the study area, linguistic (or tribal) groups consist of Java (44%), Batak (27%), Melayu (22%), Minangkabau (2%), Bajar (2%), Aceh (1%) and others (2%).

As to the religion, five are legally recognized in Indonesia, namely Islam, Christian (Protestant), Catholic, Hindu and Buddhist. The religion of North Sumatra Province is predominantly Islam, as well as that of the whole Indonesia. Admitting this fact, the region is characterized by the influence of christianism which is mainly believed by the Bataks; Bataks are also distinguished in five sub-tribes according to their sub-dialects: Tapanuli, Simalungun, Karo, Dairi and Mandailing.

The percentage of population by religion in the study area (in 1980) is the following: 1) Islam (83.34%), 2) Catholic (1.37%), 3) Christian (11.88%), 4) Hindu (0.06%) and 5) Buddha (3.35%), as shown in Table C-33. As the study area is located far away from the homeland of Bataks around Lake Toba, the percentage of Christians (Protestant & Catholics) in the study area is not large (about 13%) compared with that in North Sumatra Province accounting for nearly 30% of the total population.

In this connection, 21.7% of Christian in Kabupaten Labuhan Batu mean that this area received a number of transmigrants from the region of Bataks.

In the study area, most of families immigrated from Java and other regions of Sumatra are living in still keeping the traditional social customs (Adat) of their origins. Therefore, the society of the area shows a variety even in harmony in terms of faith, rites, heritage and so on.

As for the traditional mutual aid "Gotong Royong" practised in Indonesia, it is limited in the study area to the construction and repair of the local public structures such as roads, bridges, mosque, etc. and this valuable system seems not yet fully exploited for the rural development.

1.4.7 Social Affairs

(a) Education

In the North Sumatra Province, as well as in the whole Indonesia, the percentage of population 10 years and over who are not being school continues to decline. Accordingly, illiteracy rate of population aged 10 years and over is decreasing from 23.5% in 1971 to 8.9% in 1981. The rate of decrease for rural areas (from 26.7% to 10.3%) is higher than that for urban areas (from 9.3% to 5.0%) in the same period, as shown in the following table:

Percentage of Illiterate Population Aged 10 Years and Over in Indonesia and North Sumatra Province

Region	(%)								
	U r b a n			R u r a l			T o t a l		
	1971	1980	1981	1971	1980	1981	1971	1980	1981
Indonesia	21.67	14.47	13.15	43.03	33.15	30.81	39.03	28.34	26.66
North Sumatra	9.33	7.05	5.03	26.66	18.88	10.30	23.54	15.70	8.86

Source: Welfare indicators 1983.

Enrollment ratio of the primary school is increasing from 68% in 1971 to 87% in 1980. Table C-34 shows the number of elementary school children (7-12 years old) and illiteracy in the study area, Kabupatens/Kotamadya concerned, North Sumatra Province and Indonesia. The rate of children currently in elementary school in the area is 84.8% in 1980. This percentage is slightly higher than that of the national average (83.5%), but below that of North Sumatra Province (87.8%).

Illiterate ratio of population (7-12 years old) consisting of those who never attended and gave up elementary school in the study area accounted for 15.2% in 1980, while that of North Sumatra Province was 12.1%. It is noticed that the illiterate ratio is small in the urban area, as shown in percentages of Tanjung Balai (4.7%) and Kisaran (8.3%). It may suggest that the low education level in the rural area is basically due to the economic condition of families which generally obliges them to the least expenses for education and medical cares.

(b) Sanitation and health

Table C-35 shows the number of major health facilities and the rates of population to their numbers in Kabupatens/Kotamadya concerned and North Sumatra Province. Number of public (state and private) and give birth hospitals in North Sumatra Province is 122 with the bed capacity of 10,027 in 1983.

In the area related to the study, there exist 9 public hospitals and 1 give birth hospital. Total number of beds of those hospitals amounts to 1,380, corresponding to 1,039 persons for one bed. From this table, it can be said that the numbers of health facilities and doctors are extremely short in both Kabupatens Asahan and Labuhan Batu and the uneven distribution of basic public services favors urban dwellers.

Morbidity rate in North Sumatra Province was 3.34 percent, and this is lower than 3.83% of Sumatra island and 4.06% of national level. Regarding the infant mortality, the situation is actually much better than that of the preceding decade. Infant mortality rate per 1,000 persons in North Sumatra Province decreased from 112 in 1971 to 89 in 1980. This figure in 1980 is also below the averages of Sumatra island (93) and whole Indonesia (105).

As to the daily per capita consumption (in 1980) of calory and protein in the North Sumatra Province, it is higher than the national average (100). But, the ratio (113.9) of daily per capita consumption of calory remains at the Sumatra island's average (113.4) while that of protein (114.7) is slightly higher than its average (100).

2. Basic Direction of Socio-Economic Development

2.1 Characteristics of the Study Area

Based on the synthetical analysis of the data collected and results of interview survey, socio-economic conditions of the region were clarified and its main characteristics were put into relief, as summarized as follows:

(A) Natural Conditions Given

Natural conditions of the region are good by and large and there is no major natural constraints for the regional development except frequent damages caused by habitual floods.

As one of the key features determining socio-economic conditions of the region, there is a fact that about 30% of the study area covered with swamps undeveloped. As to the natural resources in the study area comprising arable land, water, forest, fishery, etc., their potentials are confirmed to be relatively large, except for minerals. However almost all land area has been already utilized due to high population pressure except swampy areas. It is therefore required to develop this area under the following basic direction:

- 1) Intensive development to increase the productivity of the existing cultivated lands.
- 2) Extensive development of swampy areas unused.
- 3) Development of agro-based and aqua-based industries in long range program to absorb surplus labor to be increased by population increase.

The intensive development for increasing the land productivity is urgently required to raise the income level of the comparatively poor small farmers and absorb the increase of farming population. This will require the land protection from the frequent flood damages on one hand and improvement of existing irrigation facilities and the extension of irrigated land.

The extensive development of swampy areas has also high priority for absorbing the future population increase even within the study area.

Following the above development, development of some kinds of agro-based industries and aquaculture-based industries will be required to increase employment opportunities in a long range view.

The detailed plan will be made clear later after all detailed engineering and economic surveys are completed.

(B) Social Infrastructures

According to the statistics, the level of social structures and services in North Sumatra Province, such as road, water supply, electricity, education facilities, etc. is, as a whole, higher than that of other provinces in Sumatra island. This is due to the boosting effects of Medan, the biggest city in Sumatra (ranked the 4th in Indonesia).

In other areas than Medan, most of social infrastructures and basic social services are concentrated in the urban areas (especially in Kisaran and Tanjung Balai) with high disparities to the rural areas, resulting in flow-out of rural population.

Consequently, from the point of view of urban-rural equity, the future development and investment shall put a considerable stress on the rural areas to compensate the existing great gaps.

(C) Social Conditions

Reflecting the socio-cultural diversity in the region, the study area also presents a variety in terms of religion, tribe, dialect, custom, etc.

Although Islam (83.3%) is a predominant religion in the study area, Christians (13.3%) and Buddhist (3.4%) are found there with the

relatively high percentages, compared with those in the whole Indonesia. The christianism and buddhism, despite of their small shares, characterize the socio-economic conditions of the area.

Besides, it is noticed from the socio-economic standpoint that most of families resettled are living in still keeping their ancestral mode of life, based on the traditional social customs (Adat) of their origins. Accordingly, the traditional mutual aid "Gotong Royong" is practised only in communities of the same tribe. The spirit of Gotong Royong shall be encouraged even among different communities through some project works for which working together.

(D) Economic Conditions

Agriculture is the mainstay of the region. The key feature of the region in this sector resides in the shares of area and production of perennial crops such as oil palm, rubber, coconut, etc. The percentage of plantation areas accounts for 27% of the study area, whereas that of cultivated lands (paddy, upland crops and mixed) is only 13%.

In addition the present insufficient irrigation facilities cause low yield per ha being threatened by adverse weather, drought and frequent floods. If the existing paddy fields are much improved under perennial irrigation, the local deficit of rice will be well solved. Such intensive development of the existing paddy yields shall have high priority for production increase and raising of income of small farmers.

While, livestock raising is not an important source of income in the study area. From the spatial and climatic viewpoints, it will remain incidental to the farm management and to some extent in local market.

In the study area comprising vast plantations, the main industries are related to the processing of the primary products such as palm oil, rubber, coconut and so on.

As to GRDP and regional income of the area concerned, their growth rates are higher than provincial, Medan and national averages. It is however noticed that there exist large disparities between urban-rural areas and between wealthy farmers and small farmers.

(E) Human Resources

The percentage of net migration in Sumatra island is the highest among those of all Indonesian islands. Nevertheless, net migration rate of North Sumatra Province indicates - 0.22%. This migratory loss means that the Province is contrarily producing migrants to the neighboring cities, provinces and the outer islands.

This tendency is also observed in the study area by its low average growth rate of population (1.2%). In addition to the outflows of population due to inter-provincial migration, rural-urban migration has been accelerating also in the area. Kotamadya Tanjung Balai with the population density of 22,534 persons/km² in 1983 is the striking case.

The total population within the study area is estimated to exceed 1 million in 2005, even using the low average growth rate from 1980 to 1983. If the natural increase rate of around 2.3% is taken, the total population in the study area will reach 1.3 million in the year of 2005. Those increases, 500,000 persons or about 100,000 families can hardly be absorbed only by agricultural development, hence some small scale industries related with agriculture and aquaculture will be required in a long range.

2.2 Socio-Economic Problems & Constraints

From the socio-economic viewpoints, the present major problems and constraints for the regional development are pointed out as follows:

- (A) From a spatial viewpoint, land to be exploited is limited to the wild land consisting of swamps and forests. For acquisition of develop land, time-consuming process and colossal funds are needed.

- (B) As to the volume of available water from river, there seems to be no problem. But, a huge investment is required for the reclamation of swamp areas through flood control, drainage, etc.
- (C) The Asahan project is not yet bestowing favors on the study area in power supply. For the regional development in the area, stable power supply is indispensable.
- (D) Except provincial and Kabupaten & Kotamadya roads, the conditions of the roads are extremely poor in the rural area. The improvement of these roads should be carried out from the viewpoint of regional development aiming at reducing the disparities between urban and rural areas. Agricultural development shall pay much attention to plan public roads along canals.
- (E) For the primary products, especially agricultural and fishery products, storage facilities and marketing system are insufficient. Those facilities shall be developed in a long range program in relation with the industrial development.

2.3 Basic Direction to Desirable Future Socio-Economic Frame

Taking into due consideration the regional characteristics, the above mentioned problems and constraints and the national policy, the basic direction of the desirable future socio-economic frame for the regional development can be determined in the following ways:

- (A) Flood control and drainage of the undeveloped areas classified as swamps in order to promote optimum water and land resources development of the study area has the first priority.
- (B) Intensive agricultural development aiming at regional foodgrain self-sufficiency shall be made for improving income, employment and nutrition levels.

- (C) In a long range view to absorb future surplus labor force, agro-based and aqua-based small scale industries shall be studied and planned in future.
- (D) Development of rural economic infrastructure such as roads, water supply, electricity, etc., shall be taken into consideration in any project to be implemented in order to mitigate the rural-urban migration.

Table C-1 Percentage Distribution of GDP at Constant Market Prices, 1971-1982

(%)

Economic Sectors	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Agriculture, forestry and fishery	44.0	40.8	40.1	38.7	36.8	36.1	33.6	32.8	32.0	30.7	29.8	29.8
Mining	9.9	11.1	12.3	11.8	10.9	11.7	12.1	11.0	10.3	9.3	8.9	7.6
Manufacturing	8.8	9.3	9.6	10.4	11.1	11.4	11.9	12.9	13.7	15.3	15.6	15.4
Electricity, gas & water	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.9
Construction	3.0	3.7	3.9	4.4	4.8	4.7	5.2	5.5	5.5	5.7	6.0	6.2
Transport & communication	3.8	3.8	3.8	4.0	4.0	4.2	4.9	5.4	5.5	5.4	5.6	5.8
Other Services	30.1	30.9	29.8	30.2	31.9	31.3	31.7	31.8	32.3	32.9	33.4	34.3
Gross Domestic Product	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source : Based on data of Central Bureau of Statistics.

Table C-2 Export and Import of Major Commodities in Indonesia,
1978/79 - 1982/83

(% in value)

Commodities	1978/79	1979/80	1980/81	1981/82	1982/83
<u>Export</u>					
Petroleum & Products	63.9	56.9	65.1	72.2	69.0
Wood	8.5	11.5	7.7	3.5	2.8
Rubber	6.2	6.0	4.9	3.3	2.7
Coffee	4.2	3.9	2.7	1.4	1.5
Tin Ore	2.5	2.6	2.1	1.8	1.7
Others	14.7	19.1	17.5	17.8	22.3
Total	100.0	100.0	100.0	100.0	100.0
<u>Import</u>					
Crude Petroleum & Products	8.7	11.0	16.1	13.0	21.0
Machinery	10.3	10.5	11.1	8.0	10.4
Rice	8.8	8.3	6.4	1.6	0.6
Fertilizer	0.9	0.8	0.7	2.0	0.9
Cement	0.4	0.2	0.4	0.3	0.3
Others	70.9	69.2	65.3	75.1	66.8
Total	100.0	100.0	100.0	100.0	100.0

Source : Economic Survey on Indonesia, Asian Development Bank,
December 1983.

Table C-3 Indonesia Imports of Rice (Milled Rice), 1965 - 1984

Calendar Year	Production	Total Import (millions of m.t.)	Percentage World Imports (%)	Rank among Rice Importer
1965	10.24	0.24	2.5	7
1970	13.14	0.96	12.2	2
1975	15.18	0.67	8.8	1
1980	20.16	2.00	16.8	1
1981	22.29	0.48	3.8	5
1982	23.19	0.30	2.7	10
1983	23.97	1.16	9.6	1
1984 ^{/1}	24.72	0.50	4.3	5

Remarks : ^{/1} Estimates

Source : Bulletin of Indonesian Economic Studies, Vol. XX No. 2,
August 1984.

Table C-4 Sectoral Percentage Breakdown of Development Budget

Sector	Repelita III	Repelita IV
Agriculture and irrigation	14.0	12.7
Industry	5.4	5.5
Mining and energy	13.5	15.4
Transport and tourism	15.5	12.6
Trade and cooperatives	0.9	1.2
Manpower and transmigration	5.7	5.8
Regional development	9.8	6.8
Religion	0.7	0.7
Education and youth affairs	10.4	14.7
Health and family planning	3.8	4.5
Housing	2.4	3.8
Law	0.9	0.8
Defence and Security	6.8	6.7
Information	0.7	0.6
Science and technology	2.0	2.2
Government apparatus	2.6	1.3
Business Development	1.7	2.2
Environment	3.2	2.5
Total	100.0	100.0

Source : Repelita III and IV documents

Table C-5 Gross Regional Domestic Product of North Sumatra Province by Industry at Constant 1975 Market Prices and Its Percentage Distribution

		(Unit : Billion Rupiahs)							
No.	Industrial Origin	1975	1976	1977	1978	1979	1980	1981	1982/1
1.	Agriculture	279.8 (45.03)	311.1 (45.89)	322.0 (42.78)	347.7 (41.68)	390.4 (43.34)	414.4 (42.37)	431.7 (40.90)	464.4 (41.31)
2.	Mining & Quarrying	0.3 (0.05)	0.4 (0.06)	1.0 (0.13)	1.2 (0.14)	1.6 (0.18)	1.7 (0.17)	1.7 (0.16)	2.2 (0.20)
3.	Manufacturing	43.3 (6.97)	46.3 (6.83)	52.9 (7.03)	61.0 (7.31)	63.0 (7.00)	66.0 (6.75)	73.6 (6.97)	80.2 (7.13)
4.	Construction	19.6 (3.15)	20.0 (2.95)	48.7 (6.47)	51.4 (6.16)	53.2 (5.90)	58.6 (5.99)	64.3 (6.09)	50.2 (4.47)
5.	Electricity & Water Supply	3.0 (0.48)	3.6 (0.53)	4.1 (0.54)	5.3 (0.64)	6.8 (0.75)	10.0 (1.02)	11.0 (1.04)	12.2 (1.08)
6.	Trade, Hotel & Restaurant	110.5 (17.79)	119.2 (17.59)	124.6 (16.56)	141.6 (16.97)	150.4 (16.70)	157.6 (16.11)	164.7 (15.61)	173.2 (15.41)
7.	Transportation & Communication	61.9 (9.96)	67.2 (9.91)	69.9 (9.29)	79.1 (9.48)	83.6 (9.28)	102.4 (10.47)	119.7 (11.34)	133.2 (11.85)
8.	Banking & Other Financial Insti- tution	10.0 (1.61)	10.6 (1.56)	11.2 (1.49)	16.3 (1.95)	16.3 (1.81)	20.1 (2.06)	26.7 (2.53)	35.0 (3.11)
9.	Ownership of Dwelling	28.0 (4.51)	28.8 (4.25)	29.7 (3.95)	30.5 (3.66)	31.6 (3.51)	32.6 (3.33)	33.1 (3.14)	33.6 (2.99)
10.	Administration & Defence	47.9 (7.71)	50.3 (7.42)	66.5 (8.84)	76.6 (9.18)	79.2 (8.79)	85.2 (8.71)	97.2 (9.21)	107.5 (9.56)
11.	Services	17.0 (2.74)	20.4 (3.01)	22.0 (2.92)	23.6 (2.83)	24.7 (2.74)	29.5 (3.02)	31.8 (3.01)	32.5 (2.89)
GRDP		621.3 (100.0)	677.9 (100.0)	752.6 (100.0)	834.3 (100.0)	900.8 (100.0)	978.1 (100.0)	1,055.5 (100.0)	1,124.2 (100.0)
GRDP Index ^{/2}		-	109.1	111.0	110.9	108.0	108.6	107.9	106.5

Remarks : /1 Preliminary figures

/2 Previous Year = 100.0

Source : Pendapatan Regional, Propinsi Sumatera Utara, Tahun 1975-1982

Table C-6 Provincial Economic Indicators, 1980
(Indonesia = 100)

Island/ Province	Land area	Population	Labor force	GDP / ¹	GDP / ¹ per capita
<u>SUMATRA</u>	<u>24.7</u>	<u>19.0</u>	<u>19.9</u>	<u>31.4</u>	<u>164.7</u>
D.I. Aceh	2.9	1.8	1.6	3.4	192.5 ^{/2}
* North Sumatra	3.7	5.7	5.7	6.0	105.8
West Sumatra	2.6	2.3	2.1	1.6	70.7
Riau	4.9	1.5	1.3	11.6	790.4 ^{/2}
Jambi	2.4	1.0	0.9	0.9	89.2
South Sumatra	5.4	3.1	3.1	5.4	170.7 ^{/2}
Bengkulu	1.7	0.5	0.5	0.4	67.4
Lampung	1.1	3.1	2.9	2.1	65.3
<u>J A V A</u>	<u>6.9</u>	<u>61.9</u>	<u>64.1</u>	<u>47.1</u>	<u>75.8</u> ^{/2}
<u>KALIMANTAN</u>	<u>28.1</u>	<u>4.6</u>	<u>4.9</u>	<u>10.2</u>	<u>24.0</u>
<u>SULAWESI</u>	<u>9.8</u>	<u>7.0</u>	<u>7.0</u>	<u>5.3</u>	<u>74.5</u>
<u>OTHERS</u>	<u>30.5</u>	<u>7.5</u>	<u>7.1</u>	<u>6.0</u>	<u>84.0</u>
INDONESIA TOTAL	100.0	100.0	100.0	100.0	

Remarks : ^{/1} 1979 current prices.

^{/2} Those Provinces include very high weights of crude oil or gas production.

Source : Central Bureau of Statistics and World Bank estimates.

Table C-7 Export Commodities of Belawan Port, 1976 - 1982

No.	Commodities	(unit : ton)						
		1976	1977	1978	1979	1980	1981	1982
1.	Palm Oil	403,096(42.3)	426,740(44.2)	403,525(41.0)	457,255(40.0)	422,802(36.1)	197,586(22.7)	292,817(29.2)
2.	Rubber	267,836(28.1)	273,904(28.3)	289,745(29.4)	309,082(27.0)	338,233(28.9)	321,063(36.9)	311,704(31.1)
3.	Palm Kernel	57,397(6.0)	52,447(5.4)	48,887(5.0)	74,671(6.5)	70,636(6.0)	59,095(6.8)	59,564 (5.9)
4.	Latex	61,433(6.5)	60,488(6.3)	53,660(5.4)	51,271(4.5)	63,465(5.4)	46,057(5.3)	58,446 (5.8)
5.	Vegetables	25,821(2.7)	21,018(2.2)	16,122(1.7)	31,945(2.8)	36,465(3.1)	38,244(4.4)	39,100 (3.9)
6.	Copra Chips	50,654(5.3)	45,250(4.7)	53,260(5.4)	46,492(4.1)	61,758(5.3)	37,215(4.3)	47,361 (4.7)
7.	Coffee	18,722(2.0)	22,580(2.3)	29,780(3.0)	33,309(2.9)	36,674(3.1)	36,398(4.2)	40,002 (4.0)
8.	Sawn wood	- (0.0)	1,743(0.2)	2,884(0.3)	35,929(3.2)	32,455(2.8)	31,235(3.6)	44,121 (4.4)
9.	Plywood	- (0.0)	- (0.0)	1,035(0.1)	11,359(1.0)	8,263(0.7)	25,641(2.9)	15,014 (1.5)
10.	Tea	13,750(1.4)	15,584(1.6)	18,095(1.8)	20,166(1.8)	17,420(1.5)	21,784(2.5)	16,512 (1.7)
11.	Forest Products	7,281(0.8)	8,657(0.9)	10,117(1.0)	17,519(1.5)	13,245(1.1)	16,178(1.8)	19,072 (1.9)
12.	Tobacco	2,846(0.3)	2,652(0.3)	2,726(0.3)	2,428(0.2)	3,006(0.3)	2,500(0.3)	2,500 (0.3)
13.	Others	44,335(4.6)	35,303(3.6)	54,962(5.6)	51,635(4.5)	66,431(5.7)	37,887(4.3)	56,552 (5.6)
T o t a l		953,771(100.0)	966,366(100.0)	984,798(100.0)	1143,061(100.0)	1170,829(100.0)	870,883(100.0)	1002,550(100.0)
		(91%)	(83%)	(84%)	(98%)	(Index 100)	(74%)	(86%)

Source : Year Book 1984, Province of North Sumatra.

Table C-8 Basic Figures of the Study Area

Kabupaten/ Kotamadya	Area (km ²)	Area (whole) Concerned (km ²)	Rate to Total Area (%)	Rate to Whole Kabupaten Kotamadya (%)	No. of Kecamatans/ Daerah	No. of Desa
Asahan	4,681	4,042.6	65.96	86	13	155
Labuhan Batu	9,323	2,085.0	34.01	22	3	40
Tanjung Balai	1.9	1.9	0.03	100	2	4
Total	14,005.9	6,129.5	100.0	-	18	199

Source : Ref. Tables 2.12 and 2.13

Table C-9 Population in Study Area, Kabupaten & Kotamadya Concerned, North Sumatra, Sumatra and Indonesia in 1971 - 1983

Region	Area (km ²)	P o p u l a t i o n			Average Growth Rate of Population per Annum (%)		Population Density per km ²	
		1971	1980	1983	1971-1980	1980-1983	1980	1983
Indonesia	1,919,443	119,208,229	147,490,298	158,082,700	2.4	2.3	77	82
Sumatra	473,606	20,808,148	28,016,160	30,928,500	3.4	3.3	59	65
North Sumatra	70,787	6,621,831	8,360,894	9,023,520	2.6	2.5	119	127
<u>Kabupaten/Kotamadya Concerned (Whole)</u>								
Kab. Asahan	4,681	593,584	774,980	800,069	3.0	1.1	166	171
Kab. Labuhan Batu	9,323	360,153	547,171	591,275	4.8	2.6	59	65
Kodya Tanjung Balai	1.9	33,535	41,776	42,814	2.5	0.8	21,987	22,534
Total	14,005.9	987,272	1,363,927	1,434,158	3.7	1.7	97	102
<u>Study Area</u>								
Kab. Asahan	4,043	426,934	582,299	603,405	3.5	1.2	144	149
Kab. Labuhan Batu	2,085	94,049	147,282	152,659	5.2	1.2	71	73
Kodya Tanjung Balai	1.9	33,535	41,776	42,814	2.5	0.8	21,987	22,534
Total	6,129.9	554,518	771,357	798,878	3.7	1.2	126	130

Source : Sensus Penduduk 1971; Penduduk Propinsi Sumatera Utara Menurut Kabupaten/Kotamadya dan Kecamatan, 1980; Year Book 1984; Statistik Indonesia 1983.

Table C-10 Population Distribution by Kecamatan/Daerah
in the Study Area in 1980 and 1983

Kecamatan/ Kotamadya	Area (km ²)	Population /1		Average Growth Rate per Annum(%) 1980-1983	Population Density per Km ² in 1983
		1980	1983		
<u>Kab. Asahan</u>					
1. Kota Kisaran Barat	33.0		52,120		1,581
2. Kota Kisaran Timur	38.9	126,323	36,247	140,823 3.6	931
3. Meranti	285.0		52,456		184
4. Tanjung Tiram	283.7	68,608	68,818	0.1	243
5. Buntu Pane	435.5	48,702	49,456	6.5	114
6. Bandar Pasir Mandoge	651.0	14,143	16,955	6.1	26
7. Air Joman	155.0	38,866	40,081	1.0	259
8. Tanjung Balai	154.0	61,524	61,888	0.2	402
9. Sei Kepayang	464.0	36,308	36,622	0.2	79
10. Simpang Empat	184.8	33,950	34,882	0.9	189
11. Air Batu	190.7	57,122	52,169	-3.0	274
12. Pulau Rakyat	432.0	62,219	65,258	1.6	151
13. Bandar Pulau	735.0	34,534	36,453	1.9	50
Total (or average)	4,042.6	582,299	603,405	1.2	149
<u>Kab. Lab. Batu</u>					
1. Kualuh Hulu	982.0	90,760	95,164	1.6	97
2. Kualuh Hilir / ²	484.0	29,243	29,314	0.1	61
3. Aek Natas / ²	619.0	27,279	28,181	1.1	46
Total (or average)	2,085.0	147,282	152,659	1.2	73
<u>Kotamadya Tg. Balai</u>					
1. Tg. Balai Kota I	0.5	8,804	9,031	0.8	18,062
2. Tg. Balai Kota II	0.6	15,905	15,919	0.03	26,532
3. Tg. Balai Kota III	0.3	7,605	7,996	1.7	26,653
4. Tg. Balai Kota IV	0.5	9,462	9,868	1.4	19,736
Total (or average)	1.9	41,776	42,814	0.8	22,534
Grand Total :	6,129.5	771,357	798,878	1.2	130

Remarks : /1 Decrease or discrepancy in population is due to the reorganization of administrative division in April 1983.

/2 As to the area and population of two Kecamatan in Labuhan Batu, 2/3 of those are included respectively in the study area.

Source : "Rambate Rataraya", Bergotong-royong untuk membangun (Kab. Asahan 1984) ; Penduduk Kabupaten Asahan 1980; Asahan Dalam Angka, Tahun 1981; Labuhan Batu Dalam Angka 1981 - 1983; Penduduk Kabupaten Labuhan Batu 1983; Penduduk Kabupaten Labuhan Batu 1980; Daerah Kotamadya Tk.II Tanjung Balai Dalam Angka Tahun 1979/1980; Kotamadya Tanjung Balai Dalam Angka 1983.

Table C-11 Number of Households in Study Area, Kabupaten & Kotamadya Concerned, North Sumatra, Sumatra and Indonesia in 1980 or 1983

Region	Population	Number of Households	Average Population per Household
(1980)			
Indonesia	147,490,298	30,263,273	4.9
Sumatra	28,016,160	5,375,688	5.2
North Sumatra	8,360,894	1,548,323	5.4
(1983)			
<u>Kabupaten/Kotamadya Concerned (Whole)</u>			
Kabupaten Asahan	800,069	150,210	5.3
Kab.Labuhan Batu	591,275	116,112	5.1
Kodya Tg.Balai	42,814	7,478	5.7
Total	1,434,158	273,800	5.2
<u>Study Area</u>			
Kabupaten Asahan	603,405	112,694	5.4
Kab.Labuhan Batu	152,659	29,174	5.2
Kodya Tg.Balai	42,814	7,478	5.7
Total	798,878	149,346	5.3

Source : " Rambate Rataraya ", Bergotong Royong Untuk Membangun, Kabupaten Asahan 1984; Penduduk Kabupaten Labuhan Batu 1983; Kotamadya Tanjung Balai Dalam Angka 1983, Statistik Indonesia 1983.

Table C-12 Population Distribution Ratio Between Urban and Rural Areas in 1980

Region	Ratio (%)	
	Urban	Rural
Indonesia	22.4	77.6
Sumatra	19.4	80.6
North Sumatra	26.0	74.0
<u>Kabupaten & Kotamadya (Whole) Concerned</u>		
Kab. Asahan	10.3	89.7
Kab. Labuhan Batu	11.0	89.0
Kodya Tanjung Balai	100.0	0.0
Total Average	15.3	84.7
<u>Study Area</u>		
Kab. Asahan	12.4	87.6
Kab. Labuhan Batu	12.6	87.4
Kodya Tanjung Balai	100.0	0.0
Total Average	17.2	82.8

Source : penduduk Kabupaten Asahan 1980; Penduduk Kabupaten Labuhan Batu 1980;
penduduk Propinsi Sumatera Utara menurut Kabupaten/Kotamadya dan
Kecamatan 1980.

Table C-13 Population Distribution by Age and Sex in 1980

Age Group	Male		Female		Total	
	Number	%	Number	%	Number	%
<u>Indonesia</u>						
0 - 4	10,555,575	14.4	10,163,963	13.7	20,719,538	14.1
5 - 9	10,817,738	14.8	10,410,441	14.1	21,228,179	14.4
10 - 14	9,403,612	12.8	8,765,011	11.8	18,168,623	12.3
15 - 24	13,433,455	18.4	15,027,980	20.3	28,461,435	19.3
25 - 49	20,973,173	28.6	21,408,258	28.9	42,381,431	28.8
50 and over	8,051,397	11.0	8,321,220	11.2	16,372,617	11.1
<u>Total</u>	<u>73,234,950</u>	<u>100.0</u>	<u>74,096,873</u>	<u>100.0</u>	<u>147,331,823</u>	<u>100.0</u>
<u>North Sumatra</u>						
0 - 4	680,765	16.3	641,520	15.4	1,322,285	15.8
5 - 9	658,934	15.7	628,923	15.1	1,287,857	15.4
10 - 14	596,701	14.2	563,008	13.5	1,159,709	13.9
15 - 24	830,237	19.8	904,417	21.8	1,734,654	20.8
25 - 49	996,907	23.8	1,007,738	24.2	2,004,645	24.0
50 and over	426,839	10.2	414,961	10.0	841,800	10.1
<u>Total</u>	<u>4,190,383</u>	<u>100.0</u>	<u>4,160,569</u>	<u>100.0</u>	<u>8,350,950</u>	<u>100.0</u>
<u>Study Area</u>						
0 - 4	66,075	17.0	62,024	16.2	128,099	16.6
5 - 9	62,474	16.0	60,532	15.9	123,006	16.0
10 - 14	54,379	14.0	51,608	13.5	105,987	13.7
15 - 24	75,190	19.3	82,012	21.5	157,202	20.4
25 - 49	90,710	23.3	91,406	23.9	182,116	23.6
50 and over	40,701	10.4	34,246	9.0	74,947	9.7
<u>Total</u>	<u>389,529</u>	<u>100.0</u>	<u>381,828</u>	<u>100.0</u>	<u>771,357</u>	<u>100.0</u>

Source : Penduduk Kabupaten Asahan 1980; Penduduk Kabupaten Labuhan Batu 1980.

Table C-14 Harvested Area, Production and Yield of Paddy and Second Crops by Kinds in the Area Related to the Study and North Sumatra Province, 1982 - 1983

No. Kinds of Crops	Harvested Area (ha)		Yield Rate (t/ha)		Production (ton)	
	1982	1983	1982	1983	1982	1983
<u>Kabupaten Asahan</u>						
1. Wet land paddy	55,935	36,779	4.3	2.4	239,179	88,109
2. Dry land paddy	11,279	6,817	2.6	1.9	29,444	13,125
3. Maize	2,539	2,770	1.8	2.6	4,456	7,134
4. Cassava	1,281	1,025	11.9	17.8	13,950	17,237
5. Sweet potatoes	180	391	1.3	1.2	2,275	4,824
6. Peanuts	232	178	1.0	1.0	231	178
7. Soyabeans	450	634	0.8	0.7	344	456
8. Small green pea	281	237	1.0	0.9	276	221
<u>Kabupaten Labuhan Batu</u>						
1. Wet land paddy	57,714	51,107	3.1	3.2	181,367	163,831
2. Dry land paddy	5,574	2,261	1.1	1.5	11,672	3,541
3. Maize	1,011	401	1.9	1.3	1,967	516
4. Cassava	275	198	9.3	12.5	2,548	2,474
5. Sweet potatoes	35	50	8.4	8.5	295	426
6. Peanuts	58	45	1.1	1.3	65	58
7. Soyabeans	158	166	1.1	1.1	172	178
8. Small green pea	76	49	1.3	1.2	102	60
<u>North Sumatra Province</u>						
1. Wet land paddy	489,957	413,678	4.0	3.6	1,976,920	1,477,763
2. Dry land paddy	91,096	81,376	2.2	2.2	202,536	182,530
3. Maize	44,075	45,573	2.3	2.5	101,408	113,924
4. Cassava	21,867	25,029	15.4	14.0	337,596	350,231
5. Sweet potatoes	16,705	17,540	9.3	9.2	155,523	161,650
6. Peanuts	11,181	10,752	1.5	1.5	17,109	16,497
7. Soyabeans	3,294	4,316	1.0	1.1	3,437	4,812
8. Small green pea	2,823	2,738	0.9	0.9	2,428	2,437

Source : Sumatera Utara Dalam Angka 1982 & 1983.

Table C-15 Production Costs of Estates' Commodities in North Sumatra Province, 1975 - 1980

No.	Commodities	Y e a r					Average annual increase rate (%) 1975 - 1980	
		1975	1976	1977	1978	1979		1980
(Rupiah/Kg)								
1.	Ruber	244.6 (-)	245.8 (100.5)	282.6 (115.0)	325.0 (115.0)	400.5 (123.2)	453.1 (113.1)	13.4
2.	Palm Oil	145.4 (-)	155.4 (106.9)	172.3 (110.9)	195.3 (113.3)	207.5 (106.2)	306.1 (147.5)	17.0
3.	Palm Kernel	121.8 (-)	125.5 (103.0)	143.9 (114.7)	144.3 (100.3)	214.6 (148.7)	218.7 (101.9)	13.7
4.	Tea	435.4 (-)	450.3 (103.4)	485.2 (107.8)	478.0 (98.5)	489.3 (102.4)	871.9 (178.2)	18.6
5.	Cocoa	333.3 (-)	430.0 (129.0)	464.0 (107.9)	635.5 (137.0)	701.9 (110.4)	1,445.3 (205.9)	38.0
6.	Tobacco	3,379.3 (-)	3,379.3 (100.0)	3,203.6 (94.8)	3,346.0 (104.4)	3,380.5 (101.0)	3,379.3 (99.9)	1.5

Source : Pendapatan Regional, Propinsi Sumatera Utara

Tahun 1975 s/d 1980.

Table C-16 Values, Volumes and Prices of Main Perennial Crops
(1975/76 - 1982/83)

Value : In US \$ million
Volume : In thousands of tons
Price : US \$/ton

Export Commodities	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
<u>Rubber</u>								
Value	381	577	608	774	1,101	1,078	770	614
Volume	846	892	873	928	1,015	954	881	877
Price	450	647	697	834	1,084	1,130	874	701
<u>Palm oil</u>								
Value	142	147	202	221	257	178	79	103
Volume	417	415	438	415	440	376	182	315
Price	341	354	461	533	584	473	433	327
<u>Palm kernel</u>								
Value	4	4	5	2	12	7	4	1
Volume	41	30	25	6	33	30	21	5
Price	98	140	218	333	364	233	195	189
<u>Copra cake</u>								
Value	29	36	33	34	52	46	32	38
Volume	363	375	301	323	354	390	300	367
Price	80	96	111	105	146	118	108	104
<u>Coffee</u>								
Value	112	330	626	508	715	588	343	368
Volume	142	143	179	232	238	232	218	238
Price	789	2,308	3,496	2,190	3,004	2,534	1,573	1,521
<u>Tea</u>								
Value	50	64	120	98	91	97	94	116
Volume	61	64	60	65	69	77	88	68
Price	820	996	2,007	1,508	1,319	1,260	1,075	1,714
<u>Tobacco</u>								
Value	40	41	59	58	60	69	49	37
Volume	23	21	27	27	24	31	26	19
Price	1,576	1,954	2,194	2,130	2,500	2,226	1,856	1,947

Source : Bank Indonesia Policies and Prospects for Economic growth and Transformation, Document of the World Bank, April 26, 1984.

Table C-17 Planted Area of Estates & Smallholders by Type of
Plants in North Sumatra Province, 1983

No.	Type of Plants	A r e a (H a)					(Unit : ha)			
		Productive		Others / 1		T o t a l	Grand Total	Proportion (%)		
		Estates / S.Holders	Estates / S.Holders	Estates / S.Holders	Estates & S.Holders				Estates/S.Holders	
1.	Rubber	162,392	190,930	73,233	77,877	235,625 (40.8)	268,807 (52.3)	504,432 (46.3)	46.7	53.3
2.	Oil palm	218,444	1,919	84,980	35,018	303,424 (52.6)	36,937 (7.2)	340,361 (31.2)	89.1	10.9
3.	Coconut	2,725	78,600	1,735	37,683	4,460 (0.8)	116,283 (22.6)	120,743 (11.1)	3.7	96.3
4.	Coffee	153	25,298	84	12,746	237 (0.0)	38,044 (7.4)	38,281 (3.5)	0.6	99.4
5.	Clove	-	7,371	20	11,868	20 (0.0)	19,239 (3.8)	19,259 (1.8)	0.1	99.9
6	Benzoin	-	12,835	-	9,263	-	22,098 (4.3)	22,098 (2.0)	0.0	100.0
7.	Tea	12,525	-	181	-	12,706 (2.2)	-	12,706 (1.2)	100.0	0.0
8.	Cocoa	7,338	61	4,489	273	11,827 (2.1)	334 (0.1)	12,161 (1.1)	97.3	2.7
9.	Casia vera	-	2,125	-	4,114	-	6,239 (1.2)	6,239 (0.6)	0.0	100.0
10.	Tobacco	3,332	478	-	-	3,332 (0.6)	478 (0.1)	3,810 (0.3)	87.5	12.5
11.	Candlenut	-	2,240	-	743	- (0.0)	2,983 (0.6)	2,983 (0.3)	0.0	100.0
12.	Sugar cane	5,268	297	-	210	5,268 (0.9)	507 (0.1)	5,775 (0.5)	91.2	8.8
13.	Others	-	1,017	-	596	- (0.0)	1,613 (0.3)	1,613 (0.1)	0.0	100.0
Total		412,177	323,171	164,722	190,391	576,899 (100.0)	513,562 (100.0)	1,090,461 (100.0)	52.9	47.1

Remarks : / 1 Others include the areas of "not yet productive", "Un-productive" and "seed pot"

Source : Sumatera Utara Dalam Angka 1982.

Table C-18 Production of Estate & Smallholders by Type of Plants
in North Sumatra Province, 1982 & 1983

No.	Type of Plants	Production (ton)					Proportion (%) in 1983	
		Estate		Small Holders			Estate	Small Holders
		1982	1983	1982	1983	Total		
1.	Rubber	193,210	210,456	96,350	105,791	289,560	66.5	33.5
2.	Palm oil & Palm products	3,687,229	3,750,005	1,270	3,986	3,688,499	99.9	0.1
3.	Coconut	2,723	2,716	60,310	66,815	63,033	3.9	96.1
4.	Coffee	182	57	13,292	14,370	13,474	0.4	99.6
5.	Glove	-	-	1,376	1,043	1,376	0.0	100.0
6.	Benzoin	-	-	6,608	3,684	6,608	0.0	100.0
7.	Tea	20,554	22,502	-	-	20,564	100.0	0.0
8.	Cocoa	5,869	6,801	2	23	5,871	99.7	0.3
9.	Casia Vera	-	-	1,081	1,133	1,081	0.0	100.0
10.	Tobacco	2,493	2,424	196	246	2,689	90.8	9.2
11.	Candlenut	-	-	2,140	2,798	2,140	0.0	100.0
12.	Sugar cane	-	47,295	328	330	328	99.3	0.7
13.	Others	-	-	202	247	202	0.0	100.0
Total		3,912,270	4,042,256	183,155	200,466	4,095,425	95.3	4.7

Source : Sumatera Utara Dalam Angka 1982/1983

Table C-19 Planted Area and Production of Smallholders by Type of Plants in Kabupatens Concerned and Study Area, 1982

No.	Type of Plants	Asahan		Labuhan Batu		Total	
		Planted Area(ha)	Production (ton)	Planted Area(ha)	Production (ton)	Planted Area(ha)	Production (ton)
Kabupatens Concerned (Whole)							
1.	Rubber	8,600(16.3)	2,286	47,600(79.4)	16,862	56,200(49.8)	19,148
2.	Coconut	41,710(78.9)	19,659	5,964(9.9)	3,386	47,674(42.3)	23,045
3.	Oil palm	620(1.2)	482	4,052(6.8)	2,153	4,672(4.1)	2,635
4.	Coffee	713(1.3)	76	423(0.7)	77	1,136(1.0)	153
5.	Clove	672(1.3)	16	1,183(2.0)	10	1,855(1.6)	26
6.	Nutmeg	-(0.0)	-	165(0.3)	7	165(0.1)	7
7.	Tobacco	65(0.1)	21	-	-	65(0.1)	21
8.	Sugar cane	87(0.2)	13	201(0.3)	14	288(0.3)	27
9.	Cinnamon	71(0.1)	-	365(0.6)	28	436(0.4)	28
10.	Cocoa	221(0.4)	-	-(0.0)	-	221(0.2)	-
11.	Candlenut	83(0.2)	6	-(0.0)	-	83(0.1)	6
12.	Benzoin	-(0.0)	-	-(0.0)	-	-(0.0)	-
13.	Aromatic herb	-(0.0)	-	-(0.0)	-	-(0.0)	-
14.	Pepper	-(0.0)	-	(0.0)	-	-(0.0)	-
Total							
	Planted Area	52,842(100.0)		59,953(100.0)		112,795(100.0)	
Study Area							
1.	Rubber	8,033(16.6)	2,104	6,114(77.3)	1,598	14,147(25.1)	3,702
2.	Coconut	38,215(79.0)	18,119	1,171(14.8)	656	39,386(70.0)	18,775
3.	Oil palm	593(1.3)	467	201(2.5)	90	794(1.4)	557
4.	Coffee	689(1.4)	72	101(1.3)	19	790(1.4)	91
5.	Clove	488(1.0)	11	197(2.5)	2	685(1.2)	13
6.	Nutmeg	-(0.0)	-	3(0.1)	-	3(0.0)	-
7.	Tobacco	40(0.1)	13	-	-	40(0.1)	13
8.	Sugar cane	58(0.1)	9	43(0.5)	3	101(0.2)	12
9.	Cinnamon	51(0.1)	-	-(0.0)	-	51(0.1)	-
10.	Cocoa	113(0.2)	-	-(0.0)	-	113(0.2)	-
11.	Candlenut	80(0.2)	6	80(1.0)	6	160(0.3)	12
12.	Cassia vera	-(0.0)	-	-(0.0)	-	-(0.0)	-
13.	Sugar palm	-(0.0)	-	-(0.0)	-	-(0.0)	-
Total							
	Planted Area	48,360(100.0)		7,910(100.0)		56,270(100.0)	

Source : Dinas Perkebunan Sumatera Utara.

Table C-20 Number of Livestock by Kinds in Kabupaten & Kotamadya Related to the Study and
North Sumatra Province, 1982 - 1983

No. Kinds of Livestock	Kab. Asahan		Kab. Lab. Batu		Kodya. Tg. Balai		North Sumatra Province	
	1982	1983	Index (1982=100)	1982	1983	Index (1982=100)	1982	1983
1. Cow	10,160	10,838	(106.7)	2,409	4,860	(201.7)	-	-
2. Buffalo	5,295	4,477	(84.6)	332	726	(218.7)	-	-
3. Horse	-	41	(41.0)	29	5	(17.2)	-	-
4. Milking cow	-	713	(713.0)	-	138	(138.0)	-	-
5. Goat	69,507	78,708	(113.2)	28,750	60,499	(210.4)	-	16
6. Sheep	6,171	6,757	(109.5)	283	1,137	(401.8)	-	-
7. Pig	33,400	15,239	(45.6)	14,302	10,165	(71.1)	-	276
8. Imported chicken	39,842	59,195	(148.6)	23,326	6,453	(27.7)	-	520
9. Domestic chicken	639,420	557,403	(87.2)	387,145	404,149	(104.4)	-	3,983
10. Duck manila	174,994	86,255	(49.3)	79,157	62,802	(79.3)	-	29
							1,265,865	725,676
							(1982=100)	(1982=100)

Source : Sumatera Utara Dalam Angka 1982 & 1983

Table C-21 Fishery Production in the Area Related to the Study and
North Sumatra Province, 1982 & 1983

(Unit : ton)

Region	Sea Fishery		Inland Fishery		Total	
	1982	1983 (1982=100) Index	1982	1983 (1982=100) Index	1982	1983 (1982=100) Index
<u>Kabupaten/Kotamadya Concerned</u>						
Asahan	57,581	48,927 (85.0)	1,556	1,526 (98.1)	59,137	50,453 (85.3)
Labuhan Batu	19,657	17,609 (89.6)	616	648 (105.2)	20,273	18,257 (90.1)
Tanjung Balai	14,693	13,783 (93.8)	-	(-)	14,693	13,783 (93.8)
Total	91,931	80,319 (87.4)	2,172	2,174 (100.1)	94,103	82,493 (87.7)
Whole Province	167,612	140,078 (83.6)	10,307	14,347 (139.2)	177,919	154,425 (86.8)

Source : Sumatera Utara Dalam Angka 1982 & 1983

Table C-22 Inland Fishery Production in the Area Related to the Study and
North Sumatra Province, 1982 - 1983

(Unit : ton)

Region	Fish Farming/Source				Open Water/Source				Total	
	Dam	Pond	Rice field	Fresh water	River	Lake	Swamp	Others		
<u>Kabupaten/Kotamadya Concerned</u>										
Asahan	1982	-	20.9	-	-	695.2	23.0	816.6	-	1,555.7
	1983	-	58.5	-	-	807.1	47.7	612.5	-	1,525.8
Labuhan Batu	1982	-	24.5	3.5	-	588.0	-	-	-	616.0
	1983	-	30.6	-	-	383.2	-	234.3	-	648.1
Tanjung Balai	1982	-	-	-	-	-	-	-	-	-
	1983	-	-	-	-	-	-	-	-	-
Total	1982	-	45.4	3.5	-	1,283.2	23.0	816.6	-	2,171.7
	1983	-	89.1	-	-	1,150.3	47.7	846.8	-	2,173.9
Whole Province	1982	352.9	1,899.4	3,307.0	-	2,763.2	389.5	1,447.7	147.6	10,307.3
	1983	424.2	2,035.2	6,826.8	-	2,614.5	420.4	1,791.7	138.9	14,251.7

Source : Sumatera Utara Dalam Angka, 1982 & 1983

Table C-23

Number of Existing Industries by Type and Their Production in

Kabupaten Asahan, 1980 - 1983

No. Type of Industries	1980			1981			1982			1983			Remarks on Production
	Nbr. of Establish- ments	Produc- tion	Nbr. of Establish- ments	Produc- tion	Nbr. of Establish- ments	Produc- tion	Nbr. of Establish- ments	Produc- tion	Nbr. of Establish- ments	Produc- tion	Nbr. of Establish- ments	Produc- tion	
1. Brick	727	112,480	727	221,071	729	779,929	789	787,985	in 1,000 pieces				
2. Handicraft	2,449	61,350	2,449	65,150	2,465	77,573	2,452	65,956	in piece				
3. Blacksmith	14	9,250	14	9,250	15	10,560	25	15,296	- "				
4. Saw Mill	38	28,670	38	28,750	41	28,600	38	28,536	in ton				
5. Rice Mill	306	-	306	-	310	-	310	-					
6. Food and Soft Drink	190	-	190	-	198	-	223	-					
7. Workshop	66	106,890	66	109,968	76	129,990	126	185,408	in piece				
8. Ice	4	46,395	4	46,389	4	46,400	4	47,904	in ton				
9. Palm and coconut oil refinery	20	9,488	39	9,962	40	10,796	40	11,652	in ton				
10. Clothes	460	9,456	676	13,835	781	20,420	781	15,847	in piece				
Total Number of Establishments	4,274		4,509		4,659		4,788						
Index (1980 = 100)	(-)		(105.5)		(109.0)		(112.0)						

Source : BAPPEDA DATI II ASAHAN

Table C-24 GDP of Indonesia and GRDP of North Sumatra, Medan and Kabupaten/Kotamadya Concerned, 1975 - 1981

Region	1975	1976	1977	1978	1979	1980	1981	Average annual growth rate(%) 1975-1980
A. At Current Prices								
Indonesia	12,643 (-)	15,467 (122.3) ¹	19,033 (123.1)	22,746 (119.5)	32,025 (140.8)	45,446 (141.9)	54,027 (118.9)	27.8
North Sumatra Province	621.3 (-)	764.6 (123.1)	955.0 (124.9)	1,194.0 (125.0)	1,549.4 (129.8)	2,053.9 (132.6)	2,403.9 (117.0)	25.4
Medan	143.6 (-)	175.8 (122.4)	202.5 (115.2)	257.3 (127.1)	328.8 (127.8)	462.8 (140.8)	548.4 (118.5)	25.3
Kabupaten/Kotamadya Concerned								
Asahan	61.9 (-)	73.3 (118.4)	96.9 (132.2)	138.4 (142.8)	155.7 (112.5)	203.1 (130.4)	262.3 (129.1)	27.0
Labuhan Batu	46.5 (-)	59.9 (128.8)	70.8 (118.2)	89.4 (126.3)	110.7 (123.8)	154.5 (139.6)	178.4 (115.5)	25.4
Tanjung Balai	4.6 (-)	5.6 (121.7)	6.4 (114.3)	8.6 (134.4)	8.9 (103.5)	12.7 (142.7)	15.8 (124.4)	23.5
B. Constant 1975 Prices								
Indonesia	12,642.5 (-)	13,513.1 (106.9)	14,697.1 (108.8)	15,711.7 (106.9)	16,550.8 (105.3)	18,148.1 (109.7)	-	7.5 ¹
North Sumatra Province	621.3 (-)	677.9 (109.1)	752.6 (111.0)	834.3 (110.9)	900.8 (108.0)	978.1 (108.0)	1,055.5 (107.9)	9.3
Medan	143.6 (-)	154.2 (107.4)	161.6 (104.8)	189.6 (117.3)	196.8 (103.8)	221.9 (112.8)	241.6 (108.9)	9.2
Kabupaten/Kotamadya Concerned								
Asahan	61.9 (-)	66.3 (107.1)	80.6 (121.6)	99.6 (123.6)	95.4 (95.8)	101.9 (106.8)	121.5 (119.2)	12.3
Labuhan Batu	46.5 (-)	53.0 (114.0)	55.9 (105.5)	62.2 (111.3)	65.3 (105.0)	76.4 (117.0)	83.0 (108.6)	10.2
Tanjung Balai	4.6 (-)	5.0 (108.7)	5.2 (104.0)	6.5 (125.0)	5.8 (89.2)	6.7 (115.5)	8.0 (119.4)	10.1

Remarks : /1 Figures in parentheses show growth rates against previous year (= 100.0)

Source : Sumatera Utara Dalam Angka 1983; Pendapatan Regional, Propinsi Sumatera Utara 1975 - 1981

Table C-25 Shares and Average Annual Growth Rates of GRDP by Industrial Origin at Constant 1975 Prices, 1975 - 1981

No.	Industrial Origin	Asahan			Labuhan Batu			Tanjung Balai		
		Share		Average Annual growth rate 1975-1981	Share		Average Annual growth rate 1975-1981	Share		Average Annual growth rate 1975-1981
		1975	1981		1975	1981		1975	1981	
1.	Agriculture	67.9	63.6	10.8	64.10	63.5	10.0	39.0	35.3	7.8
2.	Mining & Quarrying	0.1	0.2	39.0	0.05	0.1	39.6	0.1	0.3	55.0
3.	Manufacturing	7.1	3.9	1.5	8.88	9.1	10.6	2.9	2.6	7.1
4.	Construction	3.4	12.9	61.1	0.91	1.1	14.9	2.0	1.6	5.6
5.	Electricity, Gas & Water Supply	0.1	0.2	27.7	0.08	0.3	42.2	1.6	2.4	18.6
6.	Trade, Hotel & Restaurant	8.1	5.4	4.4	8.89	8.0	8.2	8.0	8.5	10.7
7.	Transportation & Communication	3.1	3.4	14.4	5.81	6.8	13.4	23.8	28.8	13.5
8.	Banking & Other Financial Institution	0.6	0.9	21.3	0.49	1.1	32.9	4.3	5.1	13.2
9.	Ownership of Dwelling	3.4	2.0	2.5	3.57	2.6	4.1	5.0	3.3	2.5
10.	Administration & Defence	3.8	5.2	19.5	5.15	5.0	9.6	11.2	9.9	7.4
11.	Services	2.4	2.3	11.1	2.07	2.4	13.4	2.1	2.2	10.8
Whole Industries		100.0	100.0	12.1	100.00	100.0	10.2	100.0	100.0	9.7

Source : Pendapatan Regional Kabupaten dan Kotamadya Propinsi Sumatera Utara, 1975 - 1981.

Table C-26 National and Regional Incomes per Capita, 1975 - 1981

(Unit : Rp.)							Average annual growth rate(%) 1975-1981
Region	1975	1976	1977	1978	1979	1980	
A. At Current Prices							
Indonesia	82,286 (-)	99,758 (121.2)	118,793 (119.1)	136,554 (115.0)	183,046 (134.0)	253,372 (138.4)	25.5 ^{1/1}
North Sumatra Province	85,097 (-)	102,049 (119.9)	124,239 (121.7)	151,439 (121.9)	191,639 (126.5)	247,743 (129.3)	22.2
Medan	139,103 (-)	162,835 (117.1)	180,836 (111.1)	215,228 (119.0)	259,432 (120.5)	338,436 (130.5)	18.7
Kabupaten/Kotamadya Concerned							
Asahan	92,867 (-)	106,747 (114.9)	137,210 (128.5)	190,519 (138.9)	208,464 (109.4)	264,007 (126.6)	24.0
Labuhan Batu	109,380 (-)	134,687 (123.1)	152,171 (113.0)	183,811 (120.8)	217,479 (118.3)	284,784 (130.9)	19.4
Tanjung Balai	126,196 (-)	149,545 (118.5)	168,404 (112.6)	218,219 (129.6)	222,297 (101.9)	304,972 (137.2)	20.3
B. At Constant 1975 Prices							
Indonesia	82,286 (-)	86,102 (104.6)	91,277 (106.0)	94,605 (103.6)	96,369 (101.9)	102,026 (105.9)	4.4
North Sumatra Province	85,097 (-)	90,477 (106.3)	97,908 (108.2)	105,808 (108.1)	111,416 (105.3)	117,973 (105.9)	6.5
Medan	139,103 (-)	142,811 (102.7)	144,292 (101.0)	158,626 (109.9)	155,257 (97.9)	162,310 (104.5)	3.5
Kabupaten/Kotamadya Concerned							
Asahan	92,867 (-)	96,647 (104.1)	114,081 (118.0)	137,057 (120.1)	127,776 (93.2)	132,522 (103.7)	9.1
Labuhan Batu	109,380 (-)	119,254 (109.0)	120,169 (100.8)	127,756 (106.3)	128,348 (100.5)	140,804 (109.7)	5.0
Tanjung Balai	126,196 (-)	134,371 (106.5)	137,195 (108.7)	166,491 (121.3)	143,302 (86.1)	160,739 (112.2)	8.2

Remarks : 1/ Average 1975 - 1980

2/ Figures in parentheses show growth rates against previous year (= 100.00)

Source : Sumatera Utara Dalam Angka 1983; Pendapatan Regional
Propinsi Sumatera Utara 1979-1981

Table C-27 Road Conditions in North Sumatra Province and
Kabupaten/Kotamadya Concerned in 1983

Status	Kabupaten Asahan	Kabupaten Lab. Batu	Kotamadya Tg. Balai	Kab./Kodya Total	North Sumatra Province
1. Length of Roads (Km)					
State	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	793 (5.7)
Provincial	272 (35.0)	266 (32.0)	0 (0.0)	538 (32.6)	2,544 (18.3)
Kab./Kodya	505 (65.0)	566 (68.0)	39 (100.0)	1,110 (67.4)	10,589 (76.0)
Total	777 (100.0)	832 (100.0)	39 (100.0)	1,648 (100.0)	13,926 (100.0)
2. Surface Types of Kab./Kodya Roads					
Asphalted	78 (15.5)	171 (30.2)	31 (79.5)	280 (25.2)	3,406 (32.2)
Gravelled	140 (27.7)	37 (6.5)	4 (10.3)	181 (16.3)	3,021 (28.5)
Others	287 (56.8)	354 (62.6)	4 (10.2)	645 (58.1)	3,412 (32.2)
Non asphalted	0 (0.0)	4 (0.7)	0 (0.0)	4 (0.4)	750 (7.1)
Total	505 (100.0)	566 (100.0)	39 (100.0)	1,110 (100.0)	10,589 (100.0)
3. Conditions of Kab./Kodya Roads					
Good	354 (70.1)	152 (26.9)	0 (0.0)	506 (45.6)	2,946 (27.8)
Sufficient	105 (20.8)	307 (54.2)	35 (89.7)	447 (40.3)	3,492 (33.0)
Bad	33 (6.5)	96 (17.0)	4 (10.3)	133 (12.0)	1,577 (14.9)
Very bad	13 (2.6)	11 (1.9)	0 (0.0)	24 (2.1)	2,575 (24.3)
Total	505 (100.0)	566 (100.0)	39 (100.0)	1,110 (100.0)	10,590 (100.0)

Remarks : Figures in parentheses show the ratios to the total.

Source : Sumatera Utara Dalam Angka 1983

Table C-28 Percentage of Households Holding Television and Radio
Sets in North Sumatra Province, 1981/1982

Facility	Urban Area		Rural Area		Total (Urban + Rural)		
	Yes	No	Yes	No	Yes	No	Total
Television	51.9	48.1	10.8	89.2	20.9	79.1	100.0
Radio	66.6	33.4	47.0	53.0	51.8	48.2	100.0

Source : Keterangan Kesejahteraan, Sosial Anak,
Sumatera Utara, 1981/1982.

Table C-29 Percentage of Households in Urban and Rural Areas by
Source of Drinking Water in North Sumatra Province,
Sumatra and Indonesia, 1981/1982

Source	% of Households				
	North Sumatra Province			Sumatra ^{/1}	Indonesia ^{/1}
	Urban	Rural	Total	Total	Total
Pipe	33.1	2.0	9.7	7.1	7.4
Pump	2.8	0.6	1.1	1.4	4.2
Well	59.6	58.5	58.8	58.3	59.5
Spring	2.4	16.5	13.0	10.1	14.6
River	1.0	14.7	11.3	16.8	8.6
Rain	0.0	0.2	0.2	3.5	1.5
Others	1.1	7.5	5.9	2.8	4.2
Total (%)	100.0	100.0	100.0	100.0	100.0

Remarks : ^{/1} Figures in 1981

Source : Keterangan Kesejahteraan, Sosial Anak,
Sumatera Utara, 1981/1982.

Table C-30 Percentage of Households in Urban and Rural Areas
by Type of Lighting in North Sumatra Province and
Indonesia, 1981/1982

Lighting	% of Households		Total
	Urban	Rural	
<u>North Sumatra Province</u>			
Electricity	60.6	12.6	24.4
Kerosene lamp	12.9	41.3	34.3
Kerosene pressure lamp	25.8	42.5	38.4
Others	0.7	3.6	2.9
Total (%)	100.0	100.0	100.0
<u>Indonesia</u> ^{/1}			
Electricity	48.8	5.4	14.5
Kerosene	50.8	93.1	84.5
Others	0.5	1.5	1.3

Remarks : ^{/1} Figures in 1980

Source : Keterangan Kesejahteraan, Sosial Anak
Sumatera Utara, 1981/1982; Welfare
Indicators, 1983.

Table C-31 Estimates of Net Migration and Natural Increase 1971 - 1980
(in percent per annum)

Province	Growth rate	Net migration	Natural increase
<u>JAVA</u>	<u>2.04</u>	<u>- 0.14</u>	<u>2.18</u>
<u>KALIMANTAN</u>	<u>2.99</u>	<u>0.61</u>	<u>2.38</u>
<u>SULAWESI</u>	<u>2.20</u>	<u>0.11</u>	<u>2.09</u>
<u>EASTERN ISLANDS</u>	<u>2.05</u>	<u>0.09</u>	<u>1.98</u>
<u>SUMATRA</u>	<u>3.34</u>	<u>0.76</u>	<u>2.58</u>
- Aceh	2.93	0.17	2.72
- North Sumatra	2.60	- 0.22	2.82
- West Sumatra	2.21	- 0.36	2.57
- Riau	3.11	0.37	2.74
- Jambi	4.07	0.99	3.08
- South Sumatra	3.32	0.37	2.95
- Bengkulu	4.39	1.31	3.08
- Lampung	5.77	2.04	3.73
TOTAL INDONESIA	2.33	0.00	2.33

Source : Indonesia Policies and Prospects for Economic Growth
and Transformation, Document of the World Bank,
April 26, 1984.

Table C-32 . General Transmigration by Region and Province
in Sumatra Island, 1981

Region / Province	Transmigration		
	Families	Persons	(%)
Sumatra	51,473	202,687	(56.7)
1. North Sumatra	954	3,738	(1.0)
2. West Sumatra	742	2,892	(0.8)
3. D. I. Aceh	3,783	14,541	(4.1)
4. Riau	12,938	50,327	(14.1)
5. Jambi	4,067	16,479	(4.6)
6. South Sumatra	25,530	102,095	(28.6)
7. Bengkulu	2,105	8,499	(2.4)
8. Lampung	1,354	4,116	(1.1)
Kalimantan	19,783	78,405	(21.9)
Sulawesi	14,325	57,060	(16.0)
Maluku	2,050	8,645	(2.4)
Irian Jaya	2,712	10,656	(3.0)
Total	90,343	357,453	(100.0)

Source : Statistical Yearbook of Indonesia, 1983.

Table C-33 Percentage of Population by Religion in the Study Area, Kabupaten & Kotamadya, North Sumatra and Indonesia, 1980

Region	Religion					Total
	Islam	Catholi- cism	Christianism (Protestant)	Hindu- ism	Bud- dhism	
<u>Study Area</u>						
Kab. Asahan	87.38	1.06	9.55	0.07	1.94	100.00
Kab. Lab. Batu	74.08	2.65	21.74	0.02	1.51	100.00
Kodya Tg. Balai	59.81	0.98	9.60	0.14	29.47	100.00
Total	83.34	1.37	11.88	0.06	3.35	100.00
<u>Kabupaten & Kotamadya Concerned (Whole)</u>						
Kab. Asahan	85.47	1.60	11.16	0.05	1.72	100.00
Kab. Lab. Batu	83.51	1.58	12.80	0.01	2.10	100.00
Kodya Tg. Balai	59.81	0.98	9.60	0.14	29.47	100.00
Total	83.89	1.58	11.77	0.04	2.72	100.00
North Sumatra	62.45	4.4	28.95	0.2	4.0	100.00
Indonesia ^{/1}	87.1	3.0	5.8	2.0	0.9	100.00 ^{/2}

Remarks : ^{/1} Percentage of Indonesia is based on the statistics in 1980 and includes Timor and Irian Jaya.

^{/2} In addition to five religions, 1.2 % of others is included in the total percentage.

Source : Penduduk Propinsi, Sumatra Utara Menurut Kecamatan 1980; Penduduk Propinsi Sumatra Utara Menurut Kabupaten/Kotamadya, 1980; Statistical Yearbook of Indonesia 1983.

Table C-34 Number of Elementary School Children and Illiterate Population in the Study Area, Kab. & Kodya Concerned, North Sumatra and Indonesia in 1980

Area	Population 7 - 12 Years (%)				Illiterate Population	
	Total	Currently in school	No longer in school	Never attended school	(7-12 years old)	%
<u>Study Area</u>						
Asahan	109,117 (100.0)	92,250 (84.5)	5,341 (4.9)	11,526 (10.6)	16,867	15.5
Kisaran	23,160 (100.0)	21,230 (91.7)	501 (2.1)	1,429 (6.2)	1,930	8.3
Other Kecamatan	85,957 (100.0)	71,020 (82.6)	4,840 (5.6)	10,097 (11.8)	14,937	17.4
Lab.Batu	26,629 (100.0)	22,124 (83.1)	1,422 (5.3)	3,083 (11.6)	4,505	16.9
Tg.Balai	6,815 (100.0)	6,509 (95.5)	88 (1.3)	218 (3.2)	306	4.7
Total	142,561 (100.0)	120,883 (84.8)	6,851 (4.8)	14,827 (10.4)	21,678	15.2
<u>Kab. & Kodya Concerned (Whole)</u>						
Asahan	144,891 (100.0)	128,286 (88.5)	6,688 (4.6)	14,917 (10.3)	21,605	14.9
Lab.Batu	102,043 (100.0)	80,991 (79.4)	6,607 (6.5)	14,445 (14.1)	21,052	20.6
Tg.Balai	6,815 (100.0)	6,509 (95.5)	88 (1.3)	218 (3.2)	306	4.7
Total	253,749 (100.0)	210,786 (83.1)	13,383 (5.3)	29,580 (11.6)	42,963	16.9
North Sumatra	1,518,721 (100.0)	1,334,287 (87.8)	57,453 (3.8)	126,981 (8.4)	184,434	12.1
Indonesia	24,291,587 (100.0)	20,293,565 (83.5)	(16.5)		3,998,022	16.5

Source : Statistical Yearbook of Indonesia; Penduduk Propinsi Sumatera Utara Menurut Kabupaten & Kotamadya 1980; Penduduk Propinsi Sumatera Utara Menurut Kecamatan 1980.

Table C-35 Number of Major Health Facilities and Their Accommodating Ratios in Kabupaten/Kotamadya Concerned, Medan and North Sumatra Province, 1983

Kab./Kotadya & Province	Public & Give birth hospitals	Bed Capacity of hospitals	Public health centers and Mother & child's clinics	State Doctor (general physician)	Nurse	Midwife
Asahan Population: 800,069	4 (200,017)	796 (1,005)	92 (8,696)	19 (42,109)	114 (7,018)	72 (11,112)
Labuhan Batu Population: 591,275	4 (147,819)	499 (11,85)	89 (6,644)	10 (59,128)	81 (7,300)	43 (13,751)
Tanjung Balai Population: 42,814	2 (21,407)	85 (504)	8 (5,352)	3 (14,271)	13 (3,293)	17 (2,518)
Total Population: 1,434,158	10 (143,416)	1,380 (1,039)	189 (7,588)	32 (44,817)	208 (6,895)	132 (10,865)
Medan Population: 1,495,615	49 (30,523)	3,290 (455)	57 (26,239)	46 (32,513)	141 (10,607)	205 (7,296)
North Sumatra Population: 9,023,520	122 (73,963)	10,027 (900)	1,228 (63,347)	232 (38,894)	1,487 (6,068)	1,363 (6,620)

Remarks : Figures in parentheses show population per hospital, bed, health center, clinic, doctor, nurse and midwife.

Source : Sumatera Utara Dalam Angka 1983.

APPENDIX D AGRICULTURE AND IRRIGATION

APPENDIX D: AGRICULTURE AND IRRIGATION

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1. Agriculture and Social Conditions

Basic agricultural and social data in the study area are shown in Table D-1. Administration map is shown in Fig. D-1. Total population in the Study area is about 828,000 as of December 1983. The population density averages about 130 persons/sq.km, ranging from 26 persons/sq.km in Kec. Bandar Pasir Mandoge to 1,580 persons/sq.km in Kec. Kota Kisaran Barat with the exception of 22,500 persons/sq.km in Tanjung Balai city. The population density in the study area is same as that of the whole North Sumatra Province (127 persons/sq.km). Population growth rate in the study area is estimated at 3.7% per annum during the period from 1971 to 1980. It decreases to 1.2% per annum from 1980 to 1983. The detailed information of population is filed in each village or often in Kecamatans. Within limited survey period, detailed data on population were collected for five Kecamatans as follows;

	Population in 1982	Variation of Population				Population in 1983
		Birth	Moved in	Death	Moved out	
<u>Kab. Asahan</u>						
(1) Buntu Pane	49,134	417	36	114	17	49,456
	(100.00)	(0.85)	(0.07)	(0.23)	(0.03)	(100.66)
(2) Bandar Pulau	35,540	530	616	145	88	36,453
	(100.00)	(1.49)	(1.73)	(0.41)	(0.25)	(102.56)
<u>Kab. Lab. Bat</u>						
(1) Kualuh Hulu	92,390	728	3,428	470	912	95,164
	(100.00)	(0.78)	(3.71)	(0.51)	(0.99)	(102.99)
(2) Kualuh Hilir	44,896	191	846	127	1,835	43,971
	(100.00)	(0.43)	(1.88)	(0.28)	(4.09)	(97.94)
(3) Aek Natas	41,967	474	277	162	285	42,271
	(100.00)	(1.13)	(0.66)	(0.39)	(0.68)	(100.72)

Remarks : () indicates growth rate to 1982

Though these data cover about 30 percent of total population in the study area, the above table presents the tentative conclusions as follows:

- i) Natural population growth rate is not so high (0.43 to 1.49% per annum), which reflects decreasing population growth rate.
- ii) Movement of population from the study area to other area and vice versa varies widely depending on locations.

Total households in the study area amount to 155,000 as of 1983. An average family size is 5.3, ranging from 4.7 in Kecamatan Kualuh Hilir to 6.4 in Kodya Tanjung Balai II. Total farm households are about 88,500 or 57% of total households.

Available labor force in the study area amounts to 419,300 persons or 51% of total population. Sectoral available labor force is summarized below: Details are shown in Table D-2.

	Population	Proportional percent (%)
Farmers	212,900	51
Fisheries men	47,800	11
Merchants/traders	24,600	6
Laborers	83,000	20
Others	51,000	12
Total	419,300	100

Supposing that total population of farmers and laborers is available for agricultural farming activities, available monthly labor force is calculated at 8,877,000 man-days per month./1. On the other hand, total labor requirement for present farming activities is estimated as shown in the following table:

$$/1 : (212,900 + 83,000) \times 30 \text{ days}$$

(1,000 man-day/month)

	Major Crops/1	Other Crops/3	Estate Crops/3	Total labor requirement	Available labor force	Balance
Jan.	1,485	149	1,475	3,109	8,877	5,768
Feb.	1,352	135	1,475	2,962	8,877	5,768
Mar.	1,304	130	1,475	2,909	8,877	5,968
Apr.	532	53	1,475	2,060	8,877	6,817
May.	420	42	1,475	1,937	8,877	6,940
Jun.	269	27	1,475	1,771	8,877	7,106
Jul.	497	50	1,475	2,022	8,877	6,855
Aug.	698	70	1,475	2,243	8,877	6,634
Sep.	1,198	120	1,475	2,793	8,877	6,084
Oct.	1,505	151	1,475	3,131	8,877	5,746
Nov.	2,032	203	1,475	3,710	8,877	5,167
Dec.	1,509	151	1,475	3,135	8,877	5,742

/1 : Including paddy, upland rice, maize, peanuts, soybeans, cassave and sweet potato. (Detailed calculation is shown in Tables D-3 to D-5).

/2 : Labor requirement of other crops is estimated at 10% of that of major crops.

/3 : Total estate crop area x 0.4 man-days/ha x one month (122,900 ha x 0.4 x 30).

Present monthly labor requirement for farming activities ranges from $1,771 \times 10^3$ man-days at the minimum to $3,710 \times 10^3$ man-days at the maximum. It is tentatively concluded that only about 20 to 40% of total available labor force in agricultural sector is used for farming activities as a whole in the study area leaving 60 to 80% surplus.

With respect to land tenurial status, no reliable data in 1983 are available. According to the Agricultural Census in 1980, land tenurial status in the study area is reported as follows:

Tenurial status	%
Land owner	73.7
Tenant	17.7
Partly land owner	8.6

The table indicates that more than 70% of total farm households are owner operators. It is believed that these tenurial status are not so much changed as of 1983. Details of tenurial status in the study area are shown in Table D-6. The distribution pattern of farm size of farmers in the study area in 1983 is shown in Table D-7 and summarized below:

Farm size (ha)	Proportional percent(%)	Accumulated proportion percent(%)
Below 0.05	6.0	6.0
0.05 - 0.09	3.8	9.8
0.10 - 0.24	12.0	21.8
0.25 - 0.49	13.9	35.7
0.50 - 0.75	13.3	49.0
0.75 - 0.99	6.8	55.8
1.00 - 1.99	23.7	79.5
2.00 - 2.99	11.1	90.6
Above 3.00	9.4	100.0
Total	100.0	

As shown in the above table, 50% of total farm households occupy less than 0.75 ha, 40% for 0.75 ha to 2.00 ha and 10% for above 2 ha in farm size. Based on the table, an average farm size in the study area is roughly estimated at about 0.8 ha.

Rental fee of paddy field in the study area is about Rp. 80,000 to 120,000/ha/year.

2. Soil Conditions

There is no detailed information with respect to soils in the study area with the exception of the following reconnaissance soil survey data.

- i) Soil Map of The World with soil map on a scale of 1/5,000,000 which was prepared by FAO-UNESCO in 1979;
- ii) Soil Map in North Sumatra Province on a scale of 1/500,000 prepared by RISPA in 1979 which is based on the soil survey carried out by Soil Research Institute in Bogor in 1970; and
- iii) Soil Survey on the Lebah River basin in Kab. Asahan with soil map on a scale of 1/167,000 which was conducted by North Sumatra University in 1978.

Among them, Soil Map of The World is considered to be the most useful reference to understand soil conditions in the study area, though accurate land assesement is not possible. According to the Soil Map of The World, there exist five major soil groups in the study area: (a) Dystric Histosols, (b) Dystric Fluvisols, (c) Humic Gleysols, (d) Ferric Acrisols, and (e) Orthic Acrisols.

Dystric Histosols extend over the swampy area with flat to slightly depressed concave topography which are favourable for accumulation of organic matter and plant debris. These soils are extended mainly in the lowest swamp with an elevation of less than about 4 m which is enclosed by the Asahan river and the Kualuh river. Based on the result of field reconnaissance, depth of peats (Histic horizon) varies widely depending on location. There is a tendency that depth of peats increases toward the lower area. Though some part of the swamp covered with these soils are in use for paddy field and coconut yard, most swamp areas remain unused under primary swamp forest. Main constraints for the reclamation of these soils are : (a) high subsidence ater drainage, (b) locally, slight decomposition of organic materials, (c) low bearing capacity and poor rooting capacity, (d) rapid oxidation/decomposition of organic materials after drainage,

and (e) irreversible shrinkage. However many of these constraints will be solved if groundwater level is kept at proper level. With such care, oil palm,, rubber, coconuts, pineapples, root crops and vegetables can be expected to be grown. The depth of peats will be the most important factor to assess land capability of these soils for future agricultural development.

Dystric Fluvisols occupy the flat, partly undulating, low-lying land along the coastal line. Sometimes undulating microrelief occurs. These soils are fine textured and poorly to very poorly drained. Soil reaction is slightly to strongly acid. At present the land with these soils are partly utilized for paddy and coconut. Drainage control is essential for the successful utilization of these soils. Under proper water control these soils may be cultivated for a wide range of crops such as food crops, fruit and industrial crop with moderate applications of fertilizer.

Humic Gleysols occupy the swampy land in the kualuh river basin where is enclosed by Dystric Histosols in the lower elevated portion and Ferric/Orthic Acrisols in the higher elevated portion. Their macrorelief is predominantly flat. They are mostly waterlogged and inundated for a long period, although they partly dry up to some depth during dry spells. These soils are fine textured and poorly to very poorly drained. Soil reaction is generally strongly acid. At present the land covered with these soils are partly used for paddy cultivation. Proper water control is the key for successful utilization of these soils. In addition to paddy, pineapples, cassava, oil palm and rubber will be grown if drainage condition is improved.

Ferric Acrisols and Orthic Acrisols occupy the higher elevated land with undulating topography. These soils have a low organic matter content, and are moderately well to well drained. At present the land covered with these soils is utilized mostly by rubber and oil palm cultivation with careful management. The distribution of the major soils in and around the study area is illustrated in Fig. D-2.

As will be mentioned in the next section, land potentials for the future agricultural development exist in the vast swampy area of about 140,000 ha. Most of such lands are covered with Dystric Histosols and Dystric Fluvisols. Further the report of the Soil of the World indicates existence of Thionic Fluvisols (so-called potential acid sulphate soils) in a part of the area with mapping units; Dystric Fluvisols associated with Dystric Histosols and Humic Gleysols associated with Dystric Fluvisols.

Based on review of the existing soil data and results of field reconnaissance, soil conditions in the study area and recommendation of future soil survey work are tentatively concluded from the standpoint of agricultural development as follows:

- i) Dystric Histosols and Dystric Fluvisols are major soils in the swampy land to be newly reclaimed for the future agricultural development. Some part of the land has Thionic Fluvisols; potential acid sulphate soils.
- ii) It can be expected to develop the swamp land with proper farm management in general.
- iii) The existing soil data are insufficient to assess the land capability and soil characteristics properly for agricultural development planning. The soil survey in the study area is essential, especially for the swamp land.
- iv) The soil survey work will be carried out as follows:
 - a) Survey area : about 100,000 ha the swampy area except for coastal swamp.
 - b) Soil profile density : one pit/1,000 ha
 - c) Specific identification : (1) distribution of organic soils and depth of peat.

- (2) distribution of potential acid sulphate soils and depth to acid sulphate soils.
- (3) soil salinity
- (4) stage of physical ripening of a soil (N-value).

3. Cropping Pattern and Farming Practice

Cropping pattern prevailing in the study area is analyzed based on the results of field reconnaissance and review of the previous reports: (i) Statistik Pertanian Tanaman Pangan Per Kecamatan di Propinsi Dati. I Sumatra Utara, (ii) office file on monthly basis-planted/harvested area in Kab. Asahan and Lab. Batu and (iii) Register Kab. Tentang Tanaman Palawija.

Major crops cultivated in the study area are paddy, followed by upland rice, maize, cassava, soybeans, sweet potato, mongo beans and peanuts. To identify present cropping pattern, planted area of each major crop in the study area is calculated by monthly basis for recent three years from 1981. The results are as shown in Table D-8.

As shown in Table D-8, paddy in the study area is planted at the onset of monsoon, generally September to December. Harvest is carried out from February to April. Upland rice is planted during the period of four months from July to October and harvested from December to March. Other crops such as maize, cassava, sweet potato, peanuts, soybeans and mongo beans are planted throughout a year.

As far as seed varieties are concerned, Agricultural Service has made every endeavour to expand application of improved varieties. At present, application of improved seed varieties of rice in the study area is estimated at about 60% of total seed volume as shown in Table D-9. Major improved varieties are IR-46, IR-56, Bah Bolonn, Cimandiri, Krueng Aceh, Kelara and Mahakam. Their growing period ranges from 95 to 145 days. Major local varieties are Ceredek, Sikapal, Sikodok, Pangkal Pinang, Ramos, etc., of which growing period is about 4 to 6 months. Major varieties of palawija crops are local varieties with the exception of :

Maize : Arjuna, Metro, Hybric C1 and Harapan
 Soybeans : Sokon, Willis and Orba
 Peanuts : Gajah

Characteristics of seeds for major crops are summarized in Table D-10.

With respect to farming practice, the nursery preparation of paddy is done at the onset of the monsoon in the area of about 1/20 to 1/25 of paddy field. Amount of seeds is estimated at 25 to 30 kg/ha. Nursery period is about 20 to 30 days. Land preparation is usually done by draft animal and/or man power, and not common by tractors. The field is prepared once or twice depending on the density of the vegetation cover. Transplanting method is spread over the most of the study area and direct sowing method is not common. Weeding is done once or twice depending on availability of labor. Farm inputs such as fertilizers and agro-chemicals are principally distributed to farmers through intensification programme of BIMAS and INMAS. Since paddy field under intensification programme is about 50% of the total paddy field, it is estimated that about a half of farmers in the study area uses fertilizers and agro-chemicals. Dosage of farm inputs is estimated on the basis of the report of "Pernyataana Program Peningkatan Produksi Tanaman Pangan Kab. Dati II Asahan". The estimated dosage for paddy under intensification programme is shown below.

(Unit: kg/ha)

	11980/81	1981/82	1982/83	1983/84
Urea	81.1	46.4	170.5	32.5
T S P	50.1	23.7	19.0	19.3
Z A	-	12.1	8.7	4.8
KCl	1.8	6.4	8.4	3.5
Insecticide	1.5	2.4	4.6	6.4
Rodenticide	-	0.4	0.3	0.3

Dosage of the farm inputs is very low, which is one of the constraints to hinder increasing unit yield. The major reasons of low dosage of farm inputs are considered as follows;

- i) Farmers in the study area cannot buy fertilizers and agrochemicals due to low capacity to pay
- ii) Paddy field with irrigation and drainage facilities which make it possible to increase rice production by effective application of farm inputs is small.
- iii) KUD, one of the agencies of farm inputs distribution, does not always function effectively.

Harvest is carried out by sickle and ani-ani system is not common. Drying of harvested rice 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 labor requirement for paddy farming activities is estimated at about 160 to 180 man-days per crop.

As far as farming practice of other crops is concerned, farming activity from seeding to harvesting is carried out by man power. No application of fertilizer and agro-chemicals is practiced in the study area in general.

4. Unit Yield and Agricultural Production

Unit yield and production of major crops in the study area are estimated as an average value for recent five years between 1979 and 1983. For its estimation "Statistik Pertanian Tanaman Pangan Per Kecamatan di Propinsi Dati I Sumatera Utara" was used.

Unit yield and total productions of major crops in the study area are shown in Table D-11 and summarized below;

	Unit yield (ton/ha)	Production (ton)
Paddy	2.9 (3.6)*	184,000 (1,776,000)*
Upland rice	1.8 (1.8)*	27,000 (199,000)*
Maize	1.9 (2.3)*	5,000 (93,000)*
Cassava	12.3 (10.5)*	12,000 (262,000)*
Sweet potato	12.2 (6.7)*	3,000 (136,000)*
Peanuts	1.0 (1.2)*	300 (15,000)*
Soybeans	1.1 (1.2)*	800 (8,500)*
Mongo beans	1.2 (0.9)*	400 (3,400)*

* average unit yield and production between 1979 and 1983 in North Sumatra Province

As shown in the above table, unit yield of paddy is quite low. Furthermore unit yield of paddy has not increased for recent five years according to the result of past trend analyses (see Table D-12). Unit yields of crops other than paddy seem to be reasonable from the standpoint of present farming practices.

Constraints which have hampered increasing unit yield of paddy and its production are considered from the technical viewpoint as follows:

- i) Low level fertilizer application
- ii) Though about 60% of total rice seeds is the improved varieties, only 6% are certified seed.
- iii) As shown in Table D-13 considerable infection and damage by pest, diseases and rat have been found.
- iv) Damage by flood and poor drainage
- v) More than 80% of the total paddy field are under rainfed.

In addition to major crops for foodstuff, unit yield and production of estate crops are estimated based on Data Statistik Tanaman Perkebunan and office file of PTP Wilayah.

Estate crops in the study area are produced by PTP and small holder systems. Major crops are oil palm, followed by coconut, rubber, coffee, etc. The unit yield and production of these crops in 1983 are shown in Tables D-14 to D-16 and are summarized as below.

	PTP**		Small holder		Total
	Unit Yield (t/ha)	Total Production (t)	Unit Yield (t/ha)	Total Production (t)	Production (t)
Oil palm	18	403,600	1.7	700	404,300
Coconut	*	*	0.8	20,300	20,300
Rubber	1.3	19,800	0.4	4,800	24,600
Coffee	*	*	0.3	100	100
Clove	*	*	0.1	13	13
Sugarcane	*	*	0.3	20	20

* : data not yet available

** : private not included

Under small holder system, application of fertilizers and agrochemicals is not practiced in general. On the other hand PTP carries out careful management. Its design of farm inputs is shown below.

	Oil Palm	Rubber
N (kg/tree/year)	3	0.5
P (kg/tree/year)	2	0.25
K (kg/tree/year)	3	-
Mg (kg/tree/year)	1	-
Herbicide (l/ha)	8	8

5. Irrigation and Drainage

5.1 Present condition of paddy schemes

(1) Paddy scheme area in Kabupaten Asahan

Paddy schemes in the study area have been developed steadily in these 15 years by DPU North Sumatra Province and Asahan Kabupaten Office. Paddy schemes in the study area can be divided into two types, i.e. irrigation scheme and controlled drainage scheme. The controlled drainage scheme is defined as the scheme to improve drainage condition in the paddy field by providing drainage canal network and/or flood (or tide) protection dike with control gate (generally automatic or flap gate). In this section, benefited area by irrigation and controlled drainage schemes is called as the paddy schemes area.

In February 1985, 23 paddy schemes are in operation in the study area comprising 18 irrigation schemes and 5 controlled drainage schemes as listed in Table D-17. Location of paddy schemes is shown in Fig. D-4. The biggest rice bowl in the study area is really the lower Bunut area, north of Kisaran, with a paddy scheme area of 11,214 ha by grouping 7 DPU schemes into one area. Among them, existing irrigated area is estimated to be 2,882 ha, or 26% of the total paddy scheme area. Dry season paddy can be planted for the area of only about 870 ha due to insufficient available discharge in the Bunut river. Rainfed paddy area has been expanded northeastward in this area as shown in Fig. D-3.

The second biggest rice bowl is the lower Silau area, east of Kisaran, with a paddy scheme area of 3,743 ha by grouping 7 irrigation schemes into one area. Irrigation area in the lower Silau area is 1,882 ha, or 50% of total irrigation scheme area. Irrigation water supply for dry season paddy in this area is quite limited (about 560 ha only) due to decrease of intake water level at the existing free intakes on the Silau river although available discharge in the Silau river is enough. At present only one pumping station for irrigation is in operation in the Silau river as shown in Fig. D-5.

Other paddy schemes in Kabupaten Asahana are scattered into 5 Kecamatan. Of them, Padang Mahondang scheme of 3,231 ha and Sei Lebah scheme of 6,550 ha are suffering from flood problem caused by the Asahan river due to their location. Flood control of the Asahan river has high priority for further development of these schemes.

(2) Paddy schemes area in Kabupaten Labuhan Batu

Control drainage scheme is common in this area. To increase paddy production in the existing paddy area being located along the Kualuh river and its tributaries, dikes and drainage canals have been provided progressively by DPW. In March 1985, an area of 6,500 ha along the Kualuh river is benefited by control drainage schemes, though drainage improvement in these schemes seems to be incomplete yet. Existing 3 irrigation schemes (203 to 510 ha in size) in this area are scattered in the elevated area along the Kisaran - Rantau Prapat highway. These irrigation schemes can provide dry season irrigation water for only one third of each irrigable area due to small size of the catchment area at the intake site. Two irrigation schemes (450 and 250 ha) is under construction in the similar location of existing irrigation schemes as shown in Table D-17 and Fig. D-4.

(3) Present condition of existing facilities

Inventory of intake structures, canals and dikes in the existing paddy schemes in the study area is summarized in Table D-18 and D-19. Location of intake is shown in Fig. D-4. Intake structures located on big rivers such as the Asahan and Silau rivers are free intake type (without weir) and, therefore, only a part of available discharge in these rivers can be taken into the scheme area during dry season. Most free intakes are suffering from silt accumulation in the inlet channel from the river. In general, intake gates of most irrigation schemes (constructed in 1970's) are deteriorated and are waiting for rehabilitation. Furthermore, lack of measuring device of discharge at the intake makes the water control difficult.

Existing irrigation canal in the study area is of earth. According to the field reconnaissance, present maintenance of irrigation canals seems to be generally in proper level. Irrigation canal density in the existing irrigation schemes averages to be 19 m/ha ranging from 2.5 m/ha to 110.6 m/ha as shown in Table D-20. Only 3 irrigation schemes have been provided tertiary canals. Excluding the schemes with tertiary system, the average canal density is estimated to be 15 m/ha, which is too low to execute adequate water management. Furthermore, number of control structures in the existing irrigation schemes seems to be insufficient. To achieve the desirable water management in the near future, provision of tertiary canal network and suitable control structures with measuring device is very necessary.

(4) Present operation and maintenance of paddy schemes

Operation and maintenance (O&M) for existing DPU paddy schemes is executed by the direct control of the chief of DPU Irrigation Section Office. Kabupaten Asahana and Labuhan Batu are divided into 4 and 5 sector, respectively, for O&M purpose. O&M of existing schemes in each sector is executed by sector chief who is controlled by DPU Section chief. In the study area, 2 sector chiefs in Kabupaten Asahan and Labuhan Batu, respectively, are in charge of O&M for existing schemes. Permanent staffs of gate keepers/labours are directly executing O&M works covering 330 ha per person on an average in the study area. Number of O&M staffs seems to be insufficient for better O&M works.

Average annual O&M cost for paddy schemes in recent 3 years in Kabupaten Asahana is estimated to be only Rp. 520 per ha, which seems to be insufficient to maintain irrigation and drainage networks in good condition.

In case of Kabupaten Asahan, paddy schemes have been implemented and maintained by two organizations independently, i.e. DPU Irrigation Section Asahan and Asahan Kabupaten Office. Overlapping of development plans made by these offices were found. For further development in this area, adequate coordination between these two organizations is desirable.

(5) Problems found in the existing paddy schemes

Problems and constraints in the existing paddy schemes found through the field reconnaissance, analysis of collected data, and discussions with DPU officials are preliminarily listed below. Further collection of information and detailed field reconnaissance in Part II stage will reveal existing problems and constraints more specifically.

- (a) The Padang Mahondang scheme and Sei Lebah scheme located in the Asahan river basin are suffering from flood dproblem.
- (b) In the existing irrigation schemes in the lower Bunut area, irrigable area for dry season paddy is quite limited due to shortage of available water in the Bunut River.
- (c) In the existing irrigation schemes in the lower Silau area, irrigable area for dry season paddy is limited due to insufficient water level at the free intakes during dry season.
- (d) Most of all paddy schemes in the study area, provision of canal network is insufficient. Poor drainage condition seems to be one of the reasons of low productivity of paddy.
- (e) In most existing irrigation schemes, tertiary canal and measuring device are not provided yet. Lack of these facilities seems to be one of the reasons of present poor water management.
- (f) Farm roads are absolutely insufficient. Especially, accessibility in and around the existing control drainage schemes is terribly poor.
- (g) To achieve good O&M for existing schemes, present number of O&M staffs and budget is too small.
- (h) Many existing intakes and canal structures constructed in 1970's are partly deterioratd already, especially gates.
- (i) Much closer coordination between DPU Irrigation Section Asahana and Asahan Kabupaten Office is desired.

- (j) Data and information on existing paddy schemes are often different by source. Boundary of existing paddy schemes is generally not clear. Such situation causes difficulty to grasp the exact condition of existing schemes.

5.2 Present water utilization in the existing irrigation schemes (provisional estimate)

(1) Climate in the Study area

General

Climate in the study area is humid tropical type. Due to low latitude (2°30' - 3°15'N) and low elevation in the study area, mean temperature is as high as 26.4°C on an annual average with little seasonal fluctuation (25.7 - 26.8°C) as shown in Table D-21. The climate in the study area is influenced by its location. The study area is located in the east of mountain range in Sumatra (Bukit Barisan). In the eastward of the study area, mountain ranges in Peninsular Malaysia is located. These two mountain ranges make weak the influence of monsoon to the study area, or there is no clear dry season. Rainy season may be from August to December as shown in Fig. D-5. However about 45% of annual rainfall falls during dry season as shown in Table D-22. Sunshine duration in the study area is only 49%, which is one of the lowest figure in Sumatra (Ref. D 14). Mean relative humidity is about 88% through a year.

Rainfall

Average annual rainfall in the study area ranges from 1,600 mm in the northern part of the lower Bunut area to over 3,500 mm in the western corner of the study area as shown in Fig. D-5. Annual rainfall in the low-lying area (lower than 25 m a.m.s.l.) in the study area increases southward. The control drainage schemes located along the Kuala Lumpur river receive rainfall of about 2,000 - 2,500 mm a year.

(2) Estimation of irrigation water requirement

Present irrigation water requirement was provisionally estimated using present cropping pattern, existing irrigable area and calculation method proposed by PROSIDA. Procedure and assumptions applied to the estimation are listed below.

(a) Equation for estimation:

$$ET = ETo \times kc$$

$$IWR = (LP + ET + P - ER)/IE$$

where; ET = Evapotranspiration (mm/d)

ETo = Potential evapotranspiration (mm/d)

kc = Crop coefficient

IWR = Irrigation water requirement (mm/d)

LP = Land preparation requirement (mm/d)

P = Percolation rate (mm/d)

ER = Effective rainfall (mm/d)

IE = Irrigation efficiency (%)

(b) ETo : PROSIDA method is adopted using climatic data at Sei Dadap station. Daily ETo value is estimated by monthly as shown in Table D-21.

(c) kc : PROSIDA method is adopted (Table D-23)

(d) ET : (see Table D-23)

(e) P : A rate of 1 mm/day is assumed

(f) LP : duration of land preparation is assumed to be 30 days. Saturation and water layer establishment requirement is assumed to be 200 mm. LP is estimated to be 9.4 mm/d for rainy season paddy and 9.6 mm/d for dry season paddy (Ref. D 17).

(g) ER : During land preparation, 70% of monthly rainfall is assumed to be effective. After transplanting, 40% of monthly rainfall is assumed to be effective.

(h) IE : Overall irrigation efficiency of 60% is assumed.

- (i) Nursery requirement : It is assumed that this requirement is to be a part of LP.
- (j) Rainfall data : For estimation of ER, 1/5 year low rainfall and average monthly rainfall are applied.
Representative stations selected are as follows.
- (i) Asahan : Serbangan (Station No. 6.22)
- (ii) Labuhan Batu : Labuhan Haji (Station No. 7.10)
- (k) Growing period of paddy: 130 days is assumed.

Unit irrigation water requirement was estimated as shown in Table D-23 and summarized below.

Item	Rainy Season Paddy	Dry Season Paddy	Unit: ha Total
<u>Kabupaten Asahan</u>			
1/5 year low rainfall	816	1,153	1,969
Average rainfall	705	1,083	1,788
<u>Kabupaten L. Batu</u>			
1/5 year low rainfall	592	958	1,550
Average rainfall	484	879	1,363

Present annual water utilization for irrigation purpose in the study area was estimated at 77 million cu.m per year in the year of 1 in 5 year low rainfall and 68 million cu.m per year in the year of average rainfall. Monthly figures by Kecamatan and by area are summarized in Table D-24.

5.3 Necessity of new gauging stations

To make realistic plan for the future agricultural development in the study area, the following gauging stations should be established as soon as possible.

- (1) Rainfall stations : In the south and east of the lower Asahan swamp, no rainfall station is located. Absolute lack of rainfall records in such a huge area makes the study accuracy poor. At least, 3 new rainfall stations should be established. Recommended locations for new stations are (a) Tg. Leidong, (b) Proyek Transmigrasi Aek Nauli, and (c) Sidare-dalu (Pasar No.1)
- (2) Water level gauging station in swamp area : To make development plan for swamp areas, records of river water level in and around the swamp area are quite important. It is recommended to establish water level gauging stations in Kualuh river, Leidong river, Lebah river, and Nantalu river.

Table D-1 Total Population, Total Household, Average Family Size, and Total Household of Farmer in 1983

	Total Population (1)	Total Household (2)	Average Family Size (3)	Total Household of Farmer (4)	Percent of Farmers per Total Household (5)
<u>Kab. Asahan</u>	603,405	112,694	5.4	69,058	61.3
1.Kota Kisaran B	52,120	9,138	5.7	921	10.1
2.Kota Kisaran T	36,247	5,406	6.7	508	9.4
3.Meranti	52,456	9,599	5.5	6,752	70.3
4.Tj.Tiram	68,818	13,187	5.2	8,859	67.2
5.Buntu Pane	49,456	9,537	5.2	7,701	80.7
6.Bandar Pasir Mandoge	16,955	3,214	5.3	2,205	68.6
7.Air Joman	40,081	7,244	5.5	7,390	*
8.Tj.Balai	61,888	12,287	5.0	5,312	43.2
9.Sei Kepayang	36,622	6,933	5.3	4,802	69.3
10.Simpang Empat	34,882	6,584	5.4	4,230	64.2
11.Air Batu	52,169	9,387	5.6	6,693	71.3
12.Pulau Rakyat	65,258	12,988	5.0	8,544	65.8
13.Bandar Pulau	36,453	7,190	5.1	5,141	71.5
<u>Kab. Lab. Batu</u>	181,406	35,136	5.2	23,777	67.7
1.Kualuh Hulu	95,164	17,249	5.5	10,907	63.2
2.Kualuh Hilir	43,971	9,367	4.7	7,400	79.0
3.Aek Natas	42,271	8,520	5.0	5,470	64.2
<u>Kotamadya Tj. Balai</u>	42,814	7,478	5.7	1,656	22.1
1. I	9,031	1,421	6.4		
2. II	15,919	2,727	5.8		
3. III	7,996	1,574	5.1		
4. IV	9,868	1,756	5.6		
<u>Project Area</u>	827,625	155,308	5.3	94,491	60.8
All Kab. Asahan	800,069	150,210	5.3	97,920	65.2
All Kab.Lab.Batu	591,275	116,112	5.1	80,027	68.9
North Sumatra Province	8,360,894	1,548,323	5.4	1,006,221	65.0
Indonesia					

Sources : A15, A19, A20, A22

Table D-2 Population Classified by Occupation in
The Study Area in 1983

	Farmer	Fisheries men	Merchant	Labor	Others ₂	Total
Kab. Asahan ^{/1}	(162,704)	(33,109)	(16,525)	(62,461)	(36,553)	(311,352)
1. Kota Kisaran B	4,302	263	4,816	10,062	2,126	
2. Kota Kisaran T	2,929	50	1,790	2,552	5,224	
3. Meranti	5,979	0	285	2,993	1,023	
4. Tj. Tiram	33,995	11,261	4,455	13,911	5,196	
5. Buntu Pane	14,455	28	317	4,873	744	
6. Bandar Pasir Mandoge	3,128	0	62	3,391	207	
7. Air Joman	24,133	154	590	705	600	
8. Tj. Balai	7,437	20,172	1,852	1,658	2,263	
9. Sei Kepayang	12,778	687	674	195	12,491	
10. Simpang Empat	13,357	203	249	1,635	600	
11. Air Batu	16,773	258	516	5,419	2,839	
12. Pulau Rakyat	17,788	33	449	8,902	2,038	
13. Bandar Pulau	5,650	0	470	6,165	1,202	
Kab. Lab. Batu ^{/2}	(48,914)	(9,953)	(4,968)	(18,778)	(10,989)	
1. Kualuh Hulu						
2. Kualuh Hilir						
3. Aek Natas						
Kotamadya Tj. Balai ^{/3}	(1,264)	(4,775)	(3,140)	(1,734)	(3,493)	
1. I	60	352	64	720	847	
2. II	393	1,614	1,930	810	1,662	
3. III	173	530	283	16	534	
4. IV	638	2,279	863	188	450	
Project Area	212,882	47,837	24,633	82,973	51,035	419,360
(%)	51	11	6	20	12	100
All Kab. Asahan(%)	55	10	5	18	12	100
All Kab. Lab. Batu	-	-	-	-	-	-

^{/1} : Source : A78

^{/2} : Estimated value

^{/3} : Source : A15

Table D-3 Estimate of Total Labor Requirement
for Major Crops in The Study Area

	(10 ³ man-days/month)							
	Paddy	Upland rice	Maize	Peanuts	Soybeans Mongo	Cassava	Sweet potato	Total
Jan.	1,257	186	31	2	4	4	1	1,485
Feb.	1,174	137	23	2	5	9	2	1,352
Mar.	1,198	61	34	1	5	4	1	1,304
Apr.	487	9	18	2	6	8	2	532
May	378	0	22	2	6	6	6	420
Jun.	230	0	21	2	5	6	5	269
Jul.	216	236	24	3	5	10	3	497
Aug.	359	300	22	2	4	6	5	698
Sep.	906	262	16	2	4	6	2	1,198
Oct.	1,279	194	22	2	3	5	0	1,505
Nov.	1,865	129	21	2	3	10	2	2,032
Dec.	1,250	233	15	1	3	6	1	1,509

Table D-4 Average Monthly Basis Planted Area
of Major Crops between 1981 and 1983
in The Project Area

	(ha)							
	Paddy	Upland rice	Cassava	Maize	Sweet potato	Peanuts	Soybeans	Mongo beans
Jan.	3,604	0	69	614	21	37	128	32
Feb.	1,136	0	69	242	16	23	116	45
Mar.	384	0	54	191	22	23	56	35
Apr.	627	0	158	239	32	26	39	32
May	2,448	0	73	391	113	19	184	39
Jun.	1,870	0	58	212	27	18	10	19
Jul.	1,978	4,377	203	162	13	27	2	8
Aug.	3,618	5,005	70	397	16	12	21	10
Sep.	9,935	3,549	51	164	16	21	8	22
Oct.	14,278	1,733	60	127	13	10	2	7
Nov.	20,473	250	72	274	15	37	45	17
Dec.	7,618	0	58	188	13	7	12	7

Source : A 71A, A 80, A 100 and A 101

Table D-5 Present Labor Requirement for Major Crop cultivation per ha in The Study Area

Kind of Crop	(man-days)					Total labor requirement
	Seed bed	Land preparation	Planting	Maintenance	Harvest	
Paddy	3	46	21	36	50	156
Upland rice	0	38	16	31	34	119
Maize	0	19	8	26	30	83
Peanuts	0	32	25	25	26	108
Soybeans	0	33	12	30	18	93
Cassava	0	25	10	34	35	104
Tomato	2	20	50	113	50	235
Shallot	0	85	32	98	46	261

Source : A89

Table D-6 Tenurial Status of Farm Land Clasified
by Farm Size. (1/3)

	Below 0.25 ha			Total
	Land-owner	Tenant	Partly land owner	
<u>Kab. Asahan</u>	12,173	3,993	585	16,751
1. Kota Kisaran B				
2. Kota Kisaran T	2,322	523	40	2,885
3. Meranti				
4. Tj. Tiram	1,202	402	110	1,714
5. Buntu Pane	1,720	579	12	2,311
6. Bandar Pasir Mandoge	37	14	3	54
7. Air Joman	1,220	511	80	1,811
8. Tj. Balai	296	80	103	479
9. Sei Kepayang	344	47	9	400
10. Simpang Empat	513	375	36	924
11. Air Batu	2,186	614	62	2,862
12. Pulau Rakyat	1,850	440	98	2,388
13. Bandar Pulau	483	408	32	923
<u>Kab. Lab. Batu</u>	2,151	1,074	233	3,458
1. Kualuh Hulu	1,582	831	138	2,551
2. Kualuh Hilir	50	52	14	116
3. Aek Natas	519	191	81	791
<u>Kotamadya Tj. Balai</u>	93	37	8	138
1. I				
2. II				
3. III				
4. IV				
<u>Project Area</u>	14,417	5,104	826	20,347
All Kab. Asahan	17,340	6,205	806	24,351
All Kab. Lab. Batu	8,205	2,967	547	11,719
N. Sumatra Province	192,960	74,824	21,370	289,154
Indonesia				

Source : A5 and A6

Table D-6 Tenurial Status of Farm Land Classified by Farm Size (2/3)

	(No. of household)			
	0.25 ha - 0.50			Total
	Land-owner	Tenant	Partly land owner	
<u>Kab. Asahan</u>	10,695	3,934	1,357	15,986
1. Kota Kisaran B				
2. Kota Kisaran T	1,967	635	220	2,822
3. Meranti				
4. Tj. Tiram	853	361	115	1,329
5. Buntu Pane	1,286	442	64	1,792
6. Bandar Pasir Mandoge	18	24	0	42
7. Air Joman	1,072	365	296	1,729
8. Tj. Balai	461	508	145	1,114
9. Sei Kepayang	546	204	32	782
10. Simpang Empat	591	381	69	1,041
11. Air Batu	1,609	376	249	2,234
12. Pulau Rakyat	1,927	389	108	2,424
13. Bandar Pulau	365	249	59	673
<u>Kab. Lab. Batu</u>	2,351	1,692	457	4,500
1. Kualuh Hulu	1,564	941	325	2,830
2. Kualuh Hilir	190	454	67	711
3. Aek Natas	597	297	65	959
<u>Kotamadya Tj. Balai</u>	86	17	1	104
1. I				
2. II				
3. III				
4. IV				
<u>Project Area</u>	13,132	5,643	1,815	20,590
All Kab. Asahan	15,586	5,777	1,902	23,265
All Kab. Lab. Batu	7,658	4,430	905	12,993
N. Sumatra Province	167,716	58,821	31,473	258,010
Indonesia				

Source : A5 and A6

Table D-6 Tenurial Status of Farm Land Classified by Farm Size (3/3)

	(No. of household)			
	Over 0.50 ha			Total
	Land-owner	Tenant	Partly land owner	
<u>Kab. Asahan</u>	26,641	3,472	3,488	33,601
1. Kota Kisaran B				
2. Kota Kisaran T	2,484	390	717	3,591
3. Meranti				
4. Tj. Tiram	3,502	499	469	4,470
5. Buntu Pane	2,221	158	163	2,542
6. Bandar Pasir Mandoge	1,046	48	27	1,121
7. Air Joman	2,082	315	302	2,699
8. Tj. Balai	1,665	330	271	2,266
9. Sei Kepayang	3,144	770	485	4,449
10. Simpang Empat	1,914	349	224	2,487
11. Air Batu	2,175	170	319	2,664
12. Pulau Rakyat	3,847	141	285	4,273
13. Bandar Pulau	2,511	302	226	3,039
<u>Kab. Lab. Batu</u>	12,184	1,729	1,687	15,600
1. Kualuh Hulu	6,739	572	1,018	8,329
2. Kualuh Hilir	3,534	858	300	4,692
3. Aek Natas	1,911	299	369	2,579
<u>Kotamadya Tj. Balai</u>	353	29	14	396
1. I				
2. II				
3. III				
4. IV				
<u>Project Area</u>	39,178	5,230	5,189	49,597
All Kab. Asahan	33,746	4,362	4,884	42,992
All Kab. Lab. Batu	40,499	6,770	4,908	52,177
N. Sumatra Province	279,605	36,663	49,147	365,415
Indonesia				

Source : A5 and A6

Table D-7 Distribution of Farm Size in the Study Area in 1983

	Farm Size (ha)										Total
	below 0.05	0.05 0.09	0.10 0.24	0.25 0.49	0.50 0.74	0.75 0.99	1.00 1.99	2.00 2.99	over 3.00		
Kab. Asahan Proportional %	4,415 (6.4)	2,990 (4.3)	9,317 (13.5)	10,470 (15.2)	9,801 (14.2)	5,164 (7.5)	15,321 (22.2)	6,175 (8.9)	5,405 (7.8)	69,058 (100.0)	
1. Kota Kisaran B	44	103	333	275	78	44	39	5	0	921	
2. Kota Kisaran T	9	18	108	162	108	32	72	4	0	508	
3. Meranti	388	352	1,255	1,239	1,137	607	1,433	275	66	6,752	
4. Tj. Tiram	719	275	969	1,199	1,127	658	2,280	1,010	622	8,859	
5. Buntu Pane	203	364	1,414	1,825	1,134	603	1,357	421	380	7,701	
6. Bandar Pasir Mandoge	59	83	113	270	279	93	539	387	382	2,205	
7. Air Joman	250	219	939	1,117	1,183	724	1,622	734	602	7,390	
8. Tj. Balai	1,598	167	245	304	637	274	1,029	529	529	5,312	
9. Sei Kepyayang	435	165	99	231	374	143	1,199	924	1,232	4,802	
10. Simpang Empat	65	110	475	585	700	400	1,235	365	295	4,230	
11. Air Batu	181	274	1,308	1,274	1,103	573	1,421	343	216	6,693	
12. Pulau Rakyat	163	427	1,651	1,714	1,507	778	1,805	331	168	8,544	
13. Bandar Pulau	301	433	413	275	434	235	1,290	847	913	5,141	
Kab. Labuhan Batu Proportional %	538 (2.3)	539 (2.3)	1,980 (8.3)	2,614 (11.0)	2,667 (11.2)	1,187 (5.0)	6,845 (28.8)	4,069 (17.1)	3,338 (14.0)	23,777 (100.0)	
1. Kualuh Hulu	212	313	1,558	1,908	1,134	530	2,623	1,394	1,235	10,907	
2. Kualuh Hilir	51	36	97	296	643	362	2,242	2,015	1,658	7,400	
3. Aek Natas	275	190	325	410	890	295	1,980	660	445	3,470	
Kotamadya Tj. Balai	679	41	21	67	93	68	255	234	198	(1,656)	
1. I											
2. II											
3. III											
4. IV											
Project Area Proportional %	5,632 (6.0)	3,570 (3.8)	11,318 (12.0)	13,151 (13.9)	12,561 (13.3)	6,419 (6.8)	22,421 (23.7)	10,478 (11.1)	8,941 (6.4)	94,491 100.0	
All Kab. Asahan	7.4	5.4	14.8	15.9	14.6	7.5	20.7	7.5	6.2	100.0	
All Kab. Labuhan Batu	3.7	4.2	8.4	10.0	12.1	5.2	28.6	15.5	12.3	100.00	
N. Sumatra Province	5.1	4.6	13.3	16.9	16.3	8.2	22.6	7.8	5.2	100.00	
Indonesia											

Source : A22

Table D-8 Average Monthly Basis-Planted Area of Major Crops between 1981 and 1983

(unit : ha)

	Paddy fields paddy	Upland rice	Maize	Cassava	Sweet potato	Peanuts	Soybeans	Mango beans	Total
Jan.	3,604 (5.3)	0	614 (19.2)	69 (6.9)	21 (6.6)	37 (14.3)	128 (20.5)	32 (11.7)	901
Feb.	1,136 (1.7)	0	242 (7.6)	69 (6.9)	16 (5.0)	23 (8.8)	116 (18.6)	45 (16.5)	511
Mar.	384 (0.6)	0	191 (6.0)	54 (5.4)	22 (6.9)	23 (8.8)	56 (9.0)	35 (12.8)	381
Apr.	627 (0.9)	0	239 (7.5)	158 (15.9)	32 (10.1)	26 (10.0)	39 (6.3)	32 (11.7)	526
May	2,448 (3.6)	0	341 (10.9)	73 (7.3)	113 (35.6)	19 (7.3)	184 (29.5)	39 (14.3)	819
Jun.	1,870 (2.8)	0	212 (6.6)	58 (5.8)	27 (8.5)	18 (6.9)	10 (1.6)	19 (7.0)	344
Jul.	1,978 (2.9)	4,377 (29.3)	162 (5.1)	203 (20.4)	13 (4.1)	27 (10.4)	3 (0.5)	8 (2.9)	4,793
Aug.	3,618 (5.3)	5,005 (33.6)	397 (12.4)	70 (7.0)	16 (5.0)	12 (4.6)	21 (3.4)	10 (3.7)	5,531
Sep.	9,935 (14.6)	3,549 (23.8)	164 (5.1)	51 (5.1)	16 (5.0)	21 (8.1)	8 (1.3)	22 (8.1)	3,831
Oct.	14,278 (21.0)	1,733 (11.6)	127 (4.0)	60 (6.0)	13 (4.1)	10 (3.8)	2 (0.3)	7 (2.6)	1,952
Nov.	20,473 (30.1)	250 (1.7)	274 (8.6)	72 (7.2)	15 (5.0)	37 (14.3)	45 (6.7)	17 (6.1)	710
Dec.	7,618 (11.2)	0	188 (7.2)	58 (6.1)	13 (4.1)	7 (2.7)	12 (2.3)	7 (2.6)	285
	67,969 (100.0)	14,914 (100.0)	3,201 (100.0)	995 (100.0)	317 (100.0)	260 (100.0)	624 (100.0)	273 (100.0)	20,584

Source : A 71A, A 80, A 100 and A 101

() indicates proportional percent

Table D-9 Rice varieties used in Kab. Asahan during period
from 1979/80 to 1983/84

	(%)				
	1979/80	1980/81	1981/81	1982/83	1983/84
Improved varieties	42.6	58.87	59.14	58.29	62.01
i) certified	3.56	1.93	4.12	4.45	6.05
ii) not certified	39.20	56.94	55.02	53.84	55.96
Local varieties	57.24	41.13	40.86	41.71	37.99
Total	100.00	100.00	100.00	100.00	100.00

Source : A79

Table D-10 Characteristics of Crop Varieties in
The Study Area

(A) Paddy

Name of variety	Growing period	Height	Weight of 1000 grain	Content of amilase
	(day)	(cm)	(gram)	(%)
<u>(i) Improved Varieties</u>				
IR - 42	135 - 145	90 - 105	21 - 23	27
IR - 46	125 - 130	90 - 110	26	28
IR - 56	110 - 115	85	25	26
Bah Bolon	120 - 125	75 - 85	24	25
Cimandiri	135 - 145	100 - 115	25 - 26	21
Krueng Aceh	125 - 135	100 - 105	28	24
Kelara	95 - 110	115 - 125	24	27
Mahakam	130 - 140	100 - 110	26 - 27	25.4
<u>(ii) Local Varieties</u>				
Ceredek	-	-	-	-
Sikapal	-	-	-	-
Sikodok	4 - 6 months	-	-	-
Pangkal Pinang	-	-	-	-
Ramos	4 - 6 months	-	-	-

(B) Palawija Crops

Name of variety	Growing period	Period up to flowering	Height	Weight of 1,000 grains
	(days)	(days)	(cm)	(gram)
<u>Improved Varieties</u>				
<u>Maize</u>				
Arjuna	85 - 90	55	-	275
Metro	-	-	-	-
Hybrid C1	95 - 100	58	-	317
Harapan B	105 - 110	60	-	261
<u>Soybeans</u>				
Sokon	68 - 75	32	72 - 76	106
Wilis	88	39	40 - 50	100
Orba	85	35	60	130 - 145
<u>Peanuts</u>				
Gajah	100	-	-	-

Source : A84, A85, A108, A109 and A110.

Table D-11 Major Agricultural Crop Yield and
Production in The Study Area (1/2)

YEAR	HA(ha)	TP(t)	UY(t/ha)
(A) Paddy			
1979	56,968	165,434	2.9
1980	61,431	175,281	2.9
1981	66,698	212,159	3.2
1982	70,405	234,009	3.3
1983	55,754	131,409	2.4
Average	62,251	183,658	2.9
(B) Upland Rice			
1979	13,708	27,801	2.0
1980	15,116	24,731	1.6
1981	16,158	29,185	1.8
1982	16,816	32,040	1.9
1983	13,247	22,957	1.7
Average	15,009	27,343	1.8
(C) Maize			
1979	2,170	3,012	1.4
1980	2,301	3,984	1.7
1981	2,661	3,127	1.2
1982	2,807	6,162	2.2
1983	2,715	4,832	2.9
Average	2,531	4,832	1.9
(D) Cassava			
1979	705	6,764	9.6
1980	1,182	13,990	11.8
1981	1,591	21,191	13.3
1982	724	9,541	13.2
1983	549	7,487	13.6
Average	950	11,795	12.3
(E) Sweet Potato			
1979	214	2,064	9.7
1980	245	3,517	14.4
1981	172	2,096	12.2
1982	153	1,866	12.2
1983	363	4,573	12.6
Average	229	2,823	12.2
(F) Peanuts			
1979	444	580	1.3
1980	321	314	1.0
1981	300	231	0.8
1982	258	233	0.9
1983	243	255	1.0
Average	313	323	1.0

to be continued

Table D-11 Major Agricultural Crop Yield and Production in the
Study Area (2/2)

YEAR	HA(ha)	TP(t)	UY(t/ha)
(G) Soybeans			
1979	704	752	1.1
1980	600	515	0.9
1981	304	229	0.8
1982	304	285	0.9
1983	764	633	0.8
Average	535	483	0.9
(H) Mongo beans			
1979	312	371	1.2
1980	379	312	0.8
1981	308	245	0.8
1982	209	211	1.0
1983	256	260	1.0
Average	293	280	1.0

Source : A 71A, A 71B, A 71C and A 72

TP : Total Production

UY : Unit Yield

HA : Harvested Area

Table D-12

Past Trend of Unit Yield of Major Crops and Relationship between Total Production and Unit Yield, and Harvested Area and Total Production in The Study Area During the Period of 1977 to 1983

COMMODITY	FUNCTION/ r^2		COEFFICIENT r^2 ($Y = A + Bx$)	
	$Y = A.e^{bx}$	$Y = A + Bx$	TP/UY	HA/TP
Paddy	$A = 8.17 \times 10^{21}$ $b = -0.02$ $r^2 = 0.1$	$A = 121.8$ $B = -0.06$ $r^2 = 0.07$	0.94	0.94
Upland rice	$A = 2.71 \times 10^{13}$ $b = -0.02$ $r^2 = 0.08$	$A = 61.2$ $B = -0.03$ $r^2 = 0.09$	0.45	0.63
Maize	$A = 0.00$ $b = -0.17$ $r^2 = 0.59$	$A = -691.5$ $B = 0.35$ $r^2 = 0.66$	0.97	0.44
Cassava	$A = 3.23 \times 10^{-69}$ $b = 0.08$ $r^2 = 0.78$	$A = -1,850$ $B = 0.94$ $r^2 = 0.80$	0.13	0.96
Sweet potato	$A = 2.18 \times 10^{-30}$ $b = 0.04$ $r^2 = 0.16$	$A = -700.9$ $B = 0.36$ $r^2 = 0.12$	0.27	0.90
Peanuts	$A = 1.60 \times 10^{54}$ $b = -0.06$ $r^2 = 0.31$	$A = 139.7$ $B = -0.07$ $r^2 = 0.35$	0.89	0.90
Soybeans	$A = 5.58 \times 10^{54}$ $b = -0.06$ $r^2 = 0.60$	$A = 119.8$ $B = -0.06$ $r^2 = 0.6$	0.34	0.91
Mongo beans	$A = 1.42 \times 10^{12}$ $b = -0.01$ $r^2 = 0.02$	$A = 40.6$ $B = -0.02$ $r^2 = 0.04$	0.20	0.43

Y : Unit yield
X : Year
B : Growth Rate of Unit yield per year
TP : Total Production
UY : Unit Yield
HA : Harvested area

Table D-13 Area Damaged by Pest, Diseases and Rat in Paddy Field in Kab. Asahan (1979 - 1983)

	(ha)				
	1979	1980	1981	1982	1983
Plant hopper	5 (1,400)	6 (1,623)	8 (2,590)	294 (10,335)	6,493 (31,768)
Rat	710 (2,468)	794 (1,280)	937 (1,900)	439 (1,212)	44 (1,262)
Stem borer (Scirpophaga innotata Wlk)	0 (158)	0 (215)	0 (1,117)	0 (469)	0 (0)
Kepinding Tanah (Scotinophara vermiculata voll)	10 (147)	0 (13)	0 (9)	0 (0)	0 (0)
Walang Sangit (Leptocorisa oratorius F)	0 (454)	0 (293)	3 (354)	7 (210)	0 (0)
Hama Putih (Nymphula depunctalis Guen)	0 (1,214)	0 (682)	0 (2,051)	0 (1,326)	12 (176)
Blast	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Other	144 (149)	5 (10)	0 (0)	3 (34)	1,672 (3,715)
Total	(6,170)	(4,116)	(8,021)	(13,586)	(36,921)

() means area affected by pest, diseases and rat

Source : A 79

Table D-14 Planted Area, Harvested Area, Production, and Unit Yield of Oil Palm in PTP in The Study Area

				1983
Name of Estate and No. of PTP	Planted Area (Ha)	Harvested Area (Ha)	Production (ton)	Unit Yield (ton/ha)
<u>Kabupaten Asahan</u>				
1. Sei Dadap (PTP.V)	1,893	1,824	39,356	22
2. Sei Silau (PTP.V)	1,571	1,571	35,365	23
3. Pulau Mandi (PTP.V)	1,569	1,569	23,435	15
4. Huta Padang (PTP.V)	1,991	931	4,956	5
5. Ambalutu Sei Kapas (PTP.V)	2,296	2,296	30,691	13
6. Air Batu (PTP VI)	6,443	4,696	91,284	19
7. Pulau Raja (PTP VI)	4,480	4,189	81,689	14
8. Teluk Dalam (PTP VI)	4,503	4,330	90,000	21
<u>Kabupaten Labuhan Batu</u>				
1. Adian Torop (PTP.III)	17,021	853	6,824	8
2. Sungai Daun (PTP IV)	7,698	-	-	-
<hr/>				
Project Area	49,465	22,259	403,600	18
<hr/>				
All Kabupaten Asahan	27,059	23,129	422,990	18
<hr/>				
All Kabupaten Labuhan Batu	76,005	24,608	387,185	16

Remark : Oil Palm's Production is in FFB Fruits Fresh Bunch Unit

Table D-15 Planted Area, Harvested Area, Production and
Unit Yield of Rubber in PTP in The Study Area

Name of Estate and No. of PTP in the area	Planted Area (Ha)	Harvested Area (Ha)	Production (Ha)	1983
				Unit Yield (ton/Ha)
<u>Kabupaten Asahan</u>				
1. Bandar Pulau (PTP III)	3,756	2,688	3,383	1.3
2. Bandar Slamet (PTP III)				
3. Sei Dadap (PTP V)	2,733	2,728	3,903	1.4
4. Sei Silau (PTP V)	3,587	3,581	4,946	1.4
5. Pulau Mandi (PTP V)	1,255	1,255	1,600	1.3
6. Ambalutu Sei Kapas (PTP V)	715	640	991	1.5
7. Kuta Padang (PTP V)	1,848	192	264	1.4
<u>Kabupaten Labuhan Batu</u>				
1. Membang Muda (PTP III)	3,023	1,927	2,300	1.2
2. Labuhan Haji (PTP III)	3,358	1,860	2,458	1.3
3. Adian Torop (PTP III)	1,979	-	-	-
Project Area	22,254	14,871	19,845	1.3
All Kab. Asahan	13,894	11,084	15,087	1.4
All Kab. Lab. Batu	23,121	11,891	14,316	1.2

Remark : Rubber's Production is in latex plus compo

Table D-16 Planted Area, Harvested Area, Production and Unit Yield of Major Estate Crops in Small Holder System in The Study Area in 1983

	Planted Area (ha)	Harvested Area (ha)	Production (ton)	Unit Yield (ton/ha)
Oil palm	4,911	440	739	1.7
Rubber	16,125	12,264	4,811	0.4
Coconut	39,910	25,824	20,312	0.8
Clove	713	90	13,2	0.1
Coffee	867	377	117	0.3
Sugar cane	97	57	19	0.3

Source : Data Statistik Tanaman Perkebunan 1983,
Dinas Perkebunan Pemda Dati I Sumatera Utara.

Table D-17 Inventory of DPU Paddy Schemes in the Study Area

No.	Name of Scheme	Kecamatan	Type of Scheme	Present Status	Scheme Area (ha)	Existing Paddy Area (ha)		Water Source
						Total	Irrigable Dry Season	
AS - 1	Setbangan	Meranti	I	Exist.	2,333	2,014	1,832	550 R. Bunut
2	Panca Arga	Meranti	I	"	750	750	750	225 R. Bunut
3	Tambun Tulang	Meranti	C/D	"	6,800	6,800	-	-
4	Silo Bonto	Air Joman	C/D	"	3,231	750	-	-
5	Tinggi Raja	Buntu Pane	I	"	163	153	109	33 R. Piasa
6	Sei Silau	Air Batu/S. Empat	I	"	1,315	1,006	856	257 R. Silau
7	Desa Gajah	Tg. Tiram	C/D	"	600	600	-	-
8	Rawa Sei Lebah	Sei Kepayang	C/D	"	4,000	4,000	-	-
9	Sijambi	Tg. Balai	I	"	250	176	156	47 R. Silau
10	Padang Mahondang	Pulau Rakyat	I	"	3,231	2,231	557	167 R. Asahan
11	Bandar Saleh	Simpang Empat	I	"	250	250	250	75 R. Silau
12	Sei Beluru	Meranti	I	"	150	150	150	45 R. Bunut
13	Sei Serani	Meranti	I	"	150	150	150	45 R. Bunut
14	Rawa Mahondang	Pulau Rakyat	C/D	Plan	3,000	-	-	-
15	Sampat Kotak	Tg. Balai	C/D	"	1,300	476	-	-
16	Simpang Empat	Simpang Empat	C/D	"	1,050	800	-	-
AX - 1	Siambut-Umbut	Kisaran Timur/S. Empat	I	Exist.	1,001	495	325	98 R. Silau
2	Pulau Bargot	Buntu Pane	I	"	220	135	135	41
3	Perdamasan	Pulau Rakyat	I	"	90	85	50	15
4	Kapias Batu VIII	Tg. Balai	I	"	358	231	80	24
5	Tasik Malaya	Air Joman	I	"	1,490	1,490	170	51 R. Silau
6	Sei Hessa	S. Empat/Tg. Balai	I	"	666	666	238	71 R. Hessa
7	Narjanji Aceh	Bandar Pulau	I	"	229	147	90	27
8	Sei Lebah	Sei Kepayang	C/D	"	4,245	2,550	50	15 R. Lebah
9	Binjai Serbangan	Air Joman	I	"	95	95	45	14 R. Silau
10	Bandar Poban	Pulau Rakyat	I	"	150	150	40	12 R. Kuasan
IS - 1	Sinar Toba	Kualuh Hulu	I	Exist.	600	510	305	92 R. Simangalam
2	Gunting Saga	Kualuh Hulu	I	"	450	302	302	100 R. Kualuh
3	Sono Martini	Kualuh Hulu/Hilir	C/D	"	8,000	2,000	-	-
4	Sukopi-Kopi	Kualuh Hulu	I	"	336	203	152	46 R. Kanopan
5	Tapian Nauli	Aek Natas	C/D	"	1,500	1,000	-	-
6	Suka Sari	Kualuh Hulu	C/D	"	800	300	-	-
7	Aek Natas	Aek Natas	C/D	"	4,500	3,200	-	-
8	Aek Naetek	Kualuh Hulu/Hilir	C/D	"	4,500	-	-	-
9	Siamporik	Kualuh Hulu	I	U/C	600	450	450	150
10	Bandar Lama	"	I	U/C	400	250	250	100
11	Suka Ramai	"	I	Design	1,500	-	1,050	300
12	Aek Leidong	"	I	Plan	13,800	2,500	-	-
13	Pulau Dagom	Kualuh Hulu/Hilir	I	"	1,000	600	-	-

Note : I = Irrigation, C/D = Control drainage, Exist. = Existing, U/C = Under Construction

Table D-18 Inventory of Existing Intake Structure in DPU

Paddy Scheme

Code No.	Name of Scheme	Paddy Area (ha)	Irrigation Area (ha)	Type of Scheme	Water Source	Intake Discharge (m ³ /s)	Size of Weir (m)		Intake Gate No. Size (m x m)
							Length	Height	
AS - 1	Serbanan	2,014	1,832	I	R. Bunut	2.97	15.00	2.50	5 1.00 x 1.00
2	Panca Arga	750	750	I	R. Bunut	0.75	18.70	2.16	1 1.20 x 1.00
3	Tambun Tulang	6,800	-	C/D	-	-	-	-	-
4	Silo Bonto	750	-	C/D	-	-	-	-	-
5	Tinggi Raja	153	109	I	R. Piassa	0.34	-	-	-
6	Sei Silau	1,006	856	I	R. Silau	1.93	-	-	2 1.00 x 1.00
7	Desa Cajah	600	-	C/D	-	-	-	-	3 1.20 x 1.00
8	Rawa Sei Lebah	4,000	-	C/D	-	-	-	-	-
9	Siambi	176	156	I	R. Silau	1.13	-	-	-
10	Padang Mahondang	3,231	557	I	R. Asahan	1.50	-	-	3 1.20 x 1.00
11	Bandar Saleh	250	250	I	R. Silau	0.80	-	-	2 1.20 x 1.00
12	Sei Beluru	150	150	I	R. Bunut	0.40	18.00	2.50	1 0.80 x 0.60
13	Sei Serani	150	150	I	R. Bunut	0.40	18.00	-	1 1.00 x 0.80
AX - 1	Siambut-umbut	495	325	I	R. Silau	1.50	-	-	3 1.00 x 2.00
2	Pulau Bargot	135	135	I	R. Kianga	0.64	-	-	2 0.80 x 1.00
3	Pardamaran	85	50	I	R. Piring	0.02	-	-	1 0.80 x 1.00
4	Kapias Batu VIII	231	80	I	R. Pekan-Pekan	0.20	-	-	1 1.00 x 1.25
5	Tasik Malaya	1,490	170	I	R. Silau	2.60	-	-	4 1.30 x 1.50
6	Sei Hessa	666	238	I	R. Suka Raja	0.63	12.00	1.50	2 1.00 x 1.25
7	Marjanji Aceh	147	90	I	Dam	0.20	-	-	-
8	Sei Lebah	2,550	50	C/D(I)	R. Lebah	0.05	-	-	-
9	Binjai Serbangan	95	45	I	R. Silau	0.05	-	-	-
10	Bandar Pohar	150	40	I	R. Kuasan	0.40	8.00	1.00	2 1.00 x 1.00
LBT - 1	Sinar Toba	510	305	I	R. Simangalam	1.50	15.00	3.00	2 0.70 x 0.80
2	Gunting Saga	302	302	I	R. Kulauh	0.90	6.00	1.50	1 1.00 x 1.00
3	Sono Martini	1,000	-	C/D	-	-	-	-	-
4	Sikopi-Kopi	203	152	I	R. Londut	0.40	13.00	1.80	2 1.00 x 1.50
5	Tapien Nauli	1,000	-	C/D	-	-	-	-	-
6	Suka Sari	300	-	C/D	-	-	-	-	-
7	Aek Natas	3,200	-	C/D	-	-	-	-	-
8	Aek Naetek	4,500	-	C/D	-	-	-	-	-

Table D-19 Inventory of Existing Canal and Dike in DPU
Paddy Scheme

Code No.	Name of Scheme	Paddy Area (ha)	Irrigation Area (ha)	Type of Scheme	Irrigation Canal Length (m)			Drainage Canal Length (m)		Dike Length (m)
					Main	Secondary	Tertiary	Main	Field	
AS - 1	Serbangan	2,014	1,832	I	4,483	21,087	-	16,065	3,995	6,000
2	Panca Aрга	750	750	I	1,205	1,845	-	-	1,050	5,000
3	Tambun Tulang	6,800	-	C/D	-	-	-	16,000	-	-
4	Silo Bonto	750	-	C/D	-	-	-	15,315	-	3,350
5	Tinggi Raja	153	109	I	410	5,326	1,910	472	-	125
6	Sei Silau	1,006	856	I	1,665	20,410	-	11,860	-	9,800
7	Desa Cajah	600	-	C/D	-	-	-	3,350	-	-
8	Rawa Sei Lebah	4,000	-	C/D	-	-	-	6,000	-	-
9	SiJambi	176	156	I	1,125	3,930	13,330	18,815	-	6,050
10	Padang Mahondang	3,231	557	I	850	11,508	-	15,950	-	9,000
11	Bandar Saleh	250	250	I	-	1,650	-	3,415	-	-
12	Sei Beluru	150	150	I	3,700	-	-	-	-	-
13	Sei Serani	150	150	I	6,288	-	-	-	-	-
AK - 1	Siambut-Dmbut	495	325	I	7,250	4,690	-	-	-	-
2	Pulau Barget	135	135	I	3,800	-	-	-	-	-
3	Pardamaran	95	50	I	3,500	-	-	-	-	-
4	Kapias Batu VIII	231	80	I	7,500	3,000	-	-	-	-
5	Tasik Malaya	1,490	170	I	6,000	800	-	-	-	12,000
6	Sei Hessa	666	238	I	12,000	6,800	-	-	-	-
7	Marjanji Aceh	147	90	I	4,822	-	-	-	-	-
8	Sei Lebah	2,550	50	C/D	1,200	-	-	-	-	-
9	Binjai Serbangan	95	45	I	5,000	-	-	-	-	-
10	Bandar Pohan	150	40	I	3,000	-	-	-	-	-
IBT - 1	Sinar Toba	510	305	I	1,350	5,500	5,000	9,500	-	10,500
2	Cunting Saga	302	302	I	-	3,450	-	11,500	-	-
3	Sono Martini	1,000	-	C/D	-	-	-	44,600	-	-
4	Sikopi-Kopi	203	152	I	900	7,481	-	2,300	-	5,750
5	Tapian Nauli	1,000	-	C/D	-	-	-	-	-	-
6	Suka Sari	300	-	C/D	-	-	-	-	-	-
7	Aek Natas	3,200	-	C/D	-	-	-	4,000	-	3,185
8	Aek Naetek	4,500	-	C/D	-	-	-	4,800	-	21,000

Table D-20 Canal Density of Existing Irrigation Schemes

No.	Name of Scheme	Irrigation Area (ha)	Length of Canal (km) ^{/1}	Canal Density (m/ha)
AS - 1	Serbangan	1,832	21.09	11.5
2	Panca Arga	750	1.85	2.5
5	Tinggi Raja	109	5.33	48.9 ^{/2}
6	Sei Silau	856	20.41	23.8
9	Sijambi	156	17.26	110.6 ^{/2}
10	Padang Mahondang	557	11.51	20.7
11	Bandar Saleh	250	1.65	6.6
AK	1 Siumbut-Umbut	325	4.69	14.4
4	Kapias Batu VIII	80	3.00	37.5
5	Tasik Malaya	170	0.80	4.7
6	Sei Hessa	238	6.80	28.6
LBT - 1	Sinar Toba	305	10.50	34.4 ^{/2}
2	Gunting Saga	302	3.45	11.4
4	Sikopi-Kopi	152	7.48	49.2
Total/Average		<u>6,082</u>	<u>115.82</u>	<u>19.0</u>

Remarks ; ^{/1} = Total length of secondary and tertiary canals
^{/2} = Tertiary canal has already provided

Table D-21 Average Monthly Climatic Data at Sei Dadap Station

Month	Mean Temperature (°C)	Relative Humidity (%)	Sunshine Duration (%)	/1	Wind Speed (m/s)	ETo (mm/d)	
						Penman (FAO)	PROSIDA
Jan.	25.7	89	42		0.2	3.2	3.6
Feb.	26.0	88	48		0.3	3.6	4.0
Mar.	26.3	88	50		0.3	3.7	4.2
Apr.	26.7	88	53		0.3	3.8	4.3
May	26.8	87	54		0.3	3.7	4.3
June	26.8	87	57		0.3	3.6	4.3
July	26.5	87	56		0.3	3.6	4.2
Aug.	26.3	88	54		0.3	3.7	4.2
Sep.	26.2	89	48		0.3	3.6	4.1
Oct.	26.2	89	43		0.2	3.4	3.9
Nov.	26.2	90	43		0.2	3.3	3.8
Dec.	26.0	89	37		0.2	3.0	3.5
<u>Mean</u>	<u>26.4</u>	<u>88</u>	<u>49</u>		<u>0.3</u>	<u>3.5</u>	<u>4.0</u>

Remarks : ETo = Potential evapotranspiration

Source : /1 = Ref. D 14 (Bunut)

Table D-22 Average Monthly Rainfall of Representative Rainfall Stations in the Study Area

No.	Name of Station	Unit = mm(%)												
		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
5.09	Tanah Datar	81 (5.1)	85 (5.4)	82 (5.2)	93 (5.9)	98 (6.2)	104 (6.5)	137 (8.6)	159 (10.0)	212 (13.4)	232 (14.9)	169 (10.6)	131 (8.2)	1,588 (100.0)
6.22	Serbangan	96 (5.3)	92 (5.1)	80 (4.5)	107 (6.0)	119 (6.6)	118 (6.6)	152 (8.5)	157 (8.7)	213 (11.9)	290 (16.1)	200 (11.1)	172 (9.6)	1,796 (100.0)
6.26	Teluk Mants	108 (5.7)	86 (4.5)	99 (5.2)	123 (6.5)	156 (8.2)	124 (6.5)	139 (7.3)	170 (9.0)	257 (13.5)	263 (13.9)	205 (10.8)	167 (8.9)	1,897 (100.0)
6.17	Pulau Mandi	123 (5.1)	105 (4.4)	123 (5.1)	155 (6.5)	195 (8.2)	172 (7.2)	185 (7.7)	226 (9.5)	306 (12.8)	327 (13.7)	267 (11.2)	206 (8.6)	2,390 (100.0)
6.16	Pulau Raja	132 (5.3)	104 (4.2)	112 (4.5)	165 (6.7)	213 (8.6)	177 (7.1)	178 (7.2)	233 (9.4)	301 (12.1)	371 (15.1)	265 (10.7)	230 (9.3)	2,481 (100.0)
7.10	Labuhan Haji	152 (5.8)	112 (4.2)	155 (5.9)	176 (6.7)	208 (7.9)	176 (6.7)	193 (7.3)	240 (9.1)	324 (12.3)	347 (13.2)	308 (11.7)	242 (9.2)	2,633 (100.0)
6.07	Gunung Melayu	152 (5.7)	117 (4.4)	146 (5.5)	169 (6.4)	229 (8.6)	193 (7.3)	185 (7.0)	249 (9.4)	290 (10.9)	383 (14.4)	300 (11.3)	240 (9.1)	2,653 (100.0)
6.02	Aek Tarum	188 (6.2)	154 (5.1)	204 (6.7)	209 (6.9)	255 (8.4)	225 (7.4)	223 (7.3)	219 (7.2)	326 (10.7)	376 (12.3)	359 (11.8)	304 (10.0)	3,042 (100.0)

Table D-23 Provincial Estimation of Irrigation Water Requirement

Unit : mm/d (lit/s/ha)												
	J	F	M	A	M	J	J	A	S	O	N	D
<u>Rainfall</u>												
<u>1. Asahan</u>												
1/5 low rainfall	2.6	2.8	2.2	3.0	3.2	3.3	4.1	4.3	6.0	7.9	5.6	4.6
Average rainfall	3.1	3.3	2.6	3.6	3.8	3.9	4.9	5.1	7.1	9.4	6.7	5.5
<u>2. Lab. Batu</u>												
1/5 low rainfall	4.2	3.5	4.3	5.1	5.8	5.1	5.4	6.7	9.4	9.7	8.9	6.8
Average rainfall	4.9	4.0	5.0	5.9	6.7	5.9	6.2	7.7	10.8	11.2	10.3	7.8
<u>Calculation of Gross Field Requirement</u>												
ET ₀	3.6	4.0	4.2	4.3	4.3	4.3	4.2	4.2	4.1	3.9	3.8	3.5
K _c	1.24				1.2	1.4	1.24				1.2	1.4
ET	4.5				5.2	6.0	5.2				4.6	4.9
LP												
P	1.0				1.0	1.0	1.0			9.4	1.0	1.0
GFR	5.5	-	-	9.6	6.2	7.0	6.2	-	-	9.4	5.6	5.9
<u>Calculation of IWR</u>												
<u>Asahan (1/5 low rainfall)</u>												
ER	1.0			2.1	1.3	1.3	1.6			5.5	2.2	1.8
IWR	7.5			12.5	8.2	9.5	7.7			6.5	5.7	6.8
	(0.87)			(1.45)	(0.95)	(1.10)	(0.89)			(0.75)	(0.66)	(0.79)
<u>Asahan (Average rainfall)</u>												
ER	1.2			2.5	1.5	1.6	2.0			6.6	2.7	2.2
IWR	7.2			11.8	7.8	9.0	7.0			4.7	4.8	6.2
	(0.83)			(1.37)	(0.90)	(1.04)	(0.81)			(0.54)	(0.56)	(0.72)
<u>Lab. Batu (1/5 low rainfall)</u>												
ER	1.7			3.5	2.3	2.0	2.2			6.8	3.6	2.7
IWR	6.3			10.0	6.5	8.3	6.7			4.3	3.3	5.3
	(0.73)			(1.16)	(0.75)	(0.96)	(0.78)			(0.50)	(0.38)	(0.61)
<u>Lab. Batu (Average rainfall)</u>												
ER	2.0			4.1	2.7	2.4	2.5			7.8	4.1	3.1
IWR	5.8			9.2	5.8	7.7	6.2			2.7	2.5	4.7
	(0.67)			(1.06)	(0.67)	(0.89)	(0.72)			(0.31)	(0.29)	(0.54)

Remarks : GFR = ET + LP + P

Table D-24 Present Water Utilization for Irrigation
in the Study Area

Unit : 10 ⁶ m ³						
	Bunut	Silau	Asahan Others	Total	Labuhan Batu	Total
1. Irrigation Area (ha)						
Rainy S. Paddy	2,882	1,882	1,269	6,033	759	6,792
Dry S. Paddy	865	566	381	1,812	238	2,050
2. Irrigation Water Requirement (1/5 year low rainfall)						
Rainy S. Paddy						
Oct.	5.8	3.8	2.6	12.2	1.0	13.2
Nov.	4.9	3.2	2.2	10.3	0.8	11.1
Dec.	6.1	4.0	2.7	12.8	1.2	14.0
Jan.	6.7	4.4	3.0	14.1	1.5	15.6
(Sub-Total)	(23.5)	(15.4)	(10.5)	(49.4)	(4.5)	(53.9)
Dry S. Paddy						
Apr.	3.2	2.1	1.4	6.7	0.7	7.4
May	2.2	1.4	1.0	4.6	0.5	5.1
June	2.5	1.6	1.1	5.2	0.6	5.8
July	2.1	1.4	0.9	4.4	0.5	4.9
(Sub-Total)	(10.0)	(6.5)	(4.4)	(20.9)	(2.3)	(23.2)
Total	<u>33.5</u>	<u>21.9</u>	<u>14.9</u>	<u>70.3</u>	<u>6.8</u>	<u>77.1</u>
3. Irrigation Water Requirement (Average rainfall)						
Rainy S. Paddy						
Oct.	4.2	2.7	1.8	8.7	0.6	9.3
Nov.	4.2	2.7	1.8	8.7	0.6	9.3
Dec.	5.5	3.6	2.4	11.5	1.1	12.6
Jan.	6.4	4.2	2.8	13.4	1.4	14.8
(Sub-Total)	(20.3)	(13.2)	(8.8)	(42.3)	(3.7)	(46.0)
Dry S. Paddy						
Apr.	3.1	2.0	1.3	6.4	0.7	7.1
May	2.1	1.4	0.9	4.4	0.4	4.8
June	2.3	1.5	1.0	4.8	0.5	5.3
July	1.9	1.2	0.8	3.9	0.5	4.4
(Sub-Total)	(9.4)	(6.1)	(4.0)	(19.5)	(2.1)	(21.6)
Total	<u>29.7</u>	<u>19.3</u>	<u>12.8</u>	<u>61.8</u>	<u>5.8</u>	<u>67.6</u>

Fig.D-1 Administrative Division in the Study Area

No.	Kabupaten	Kecamatan
A-1	Asahan	Kota Kisaran Barat
A-2	"	Kota Kisaran Timur
A-3	"	Meranti
A-4	"	Tanjung Ilir
A-5	"	Buntu Pane
A-6	"	Bandar Pasir Mandage
A-7	"	Air Joman
A-8	"	Tanjung Balai
A-9	"	Sel Kepayang
A-10	"	Simpang Empat
A-11	"	Air Batu
A-12	"	Pulau Rakyat
A-13	"	Bandar Pulau
LB-1	Labuhan Batu	Kualuh Hulu
LB-2	"	Kualuh Hilir
LB-3	"	Aek Natas

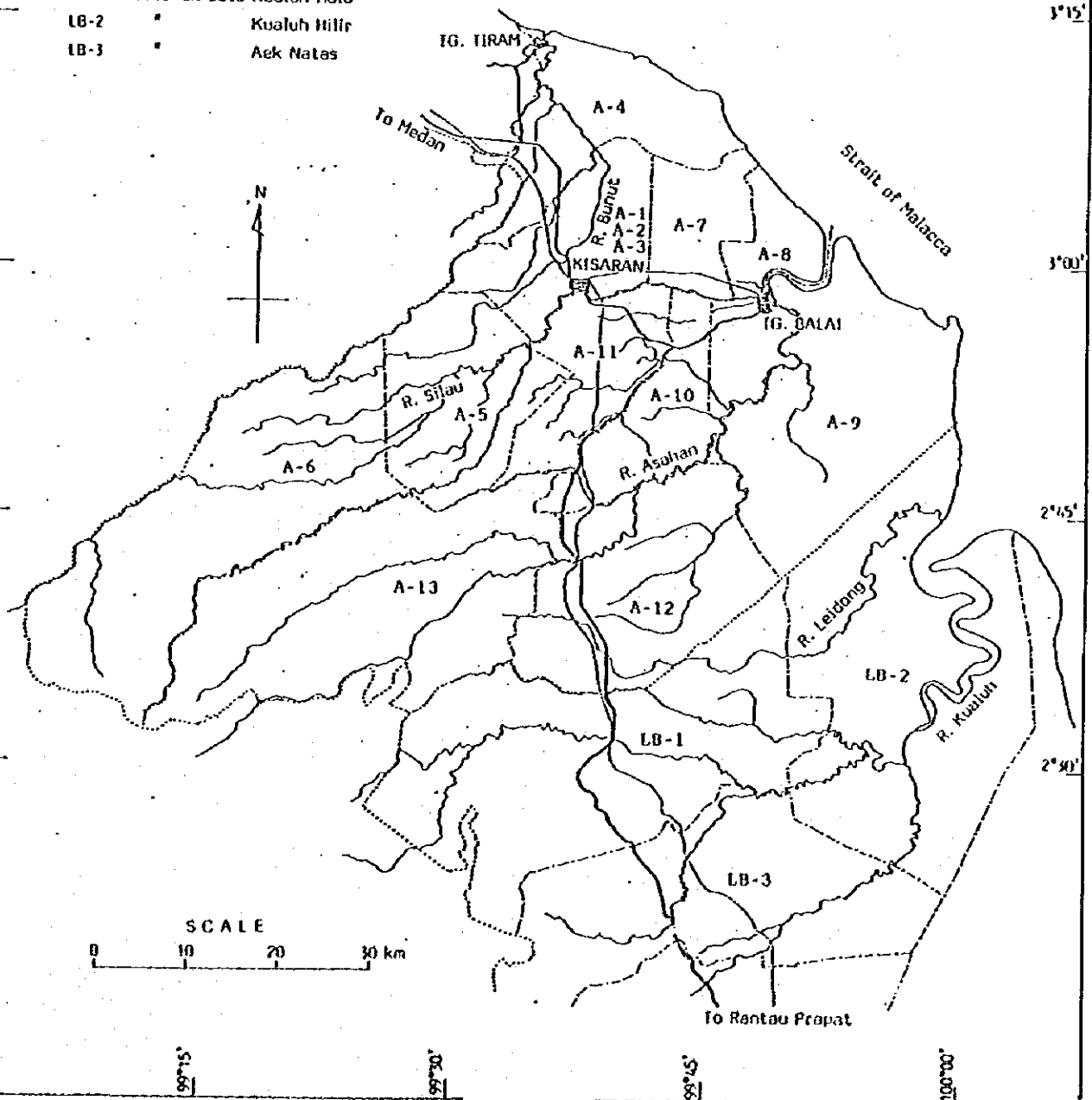
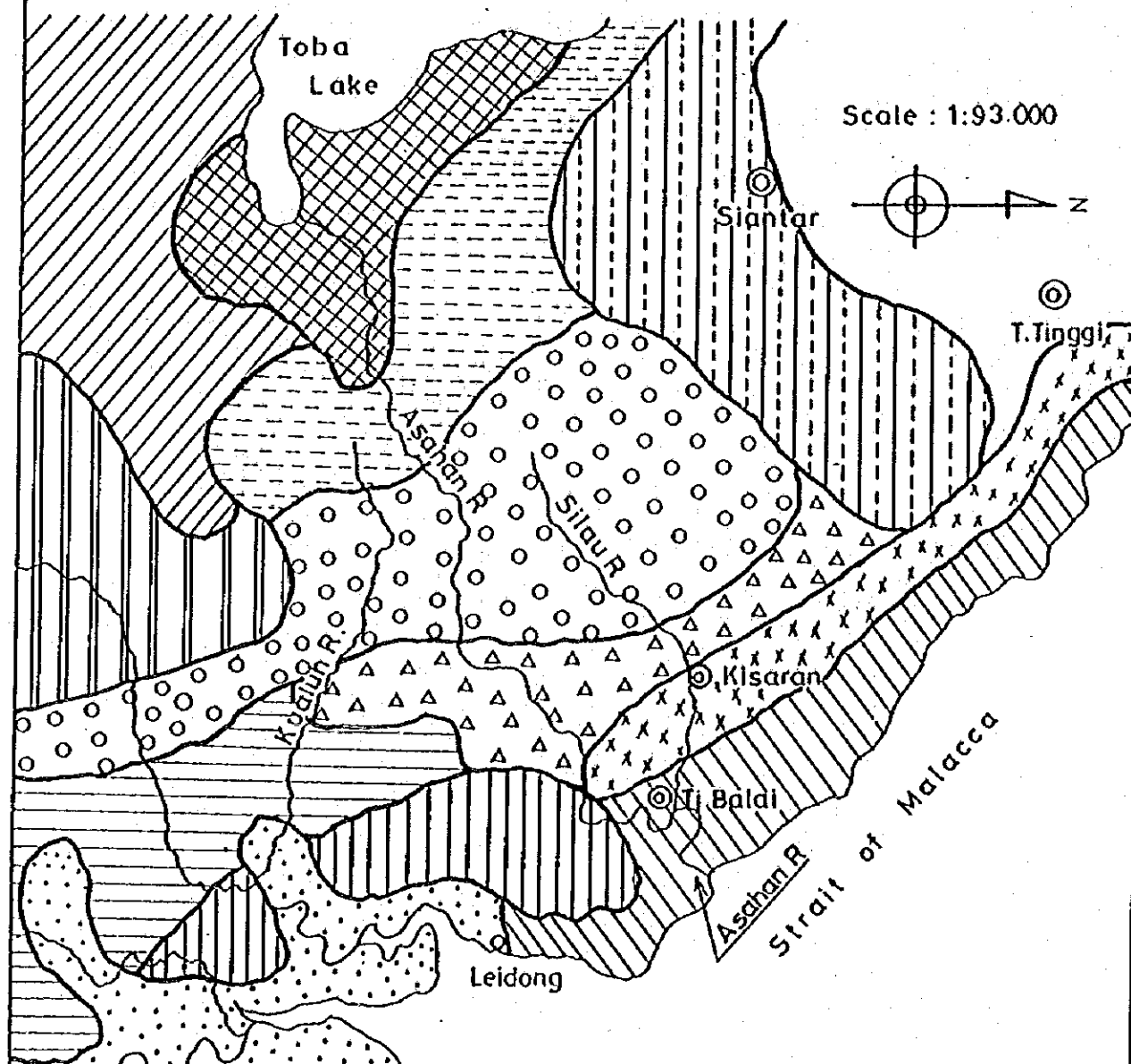


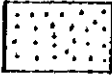
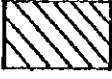
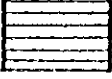
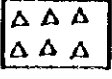


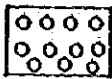
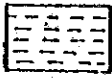




Fig.D-2 Soil Map in and around The Study Area



Mapping Unit:

-  Dystric Fluvisols associated with Dystric Histosols.
-  Dystric Fluvisols associated with Dystric Cambisols.
-  Dystric Histosols associated with Humic Gleysols.
-  Dystric Fluvisols associated with Dystric Gleysols.
-  Humic Gleysols associated with Dystric Fluvisols.
-  Ferric Acrisols associated with Gleyic Acrisols and Dystric Histosols.

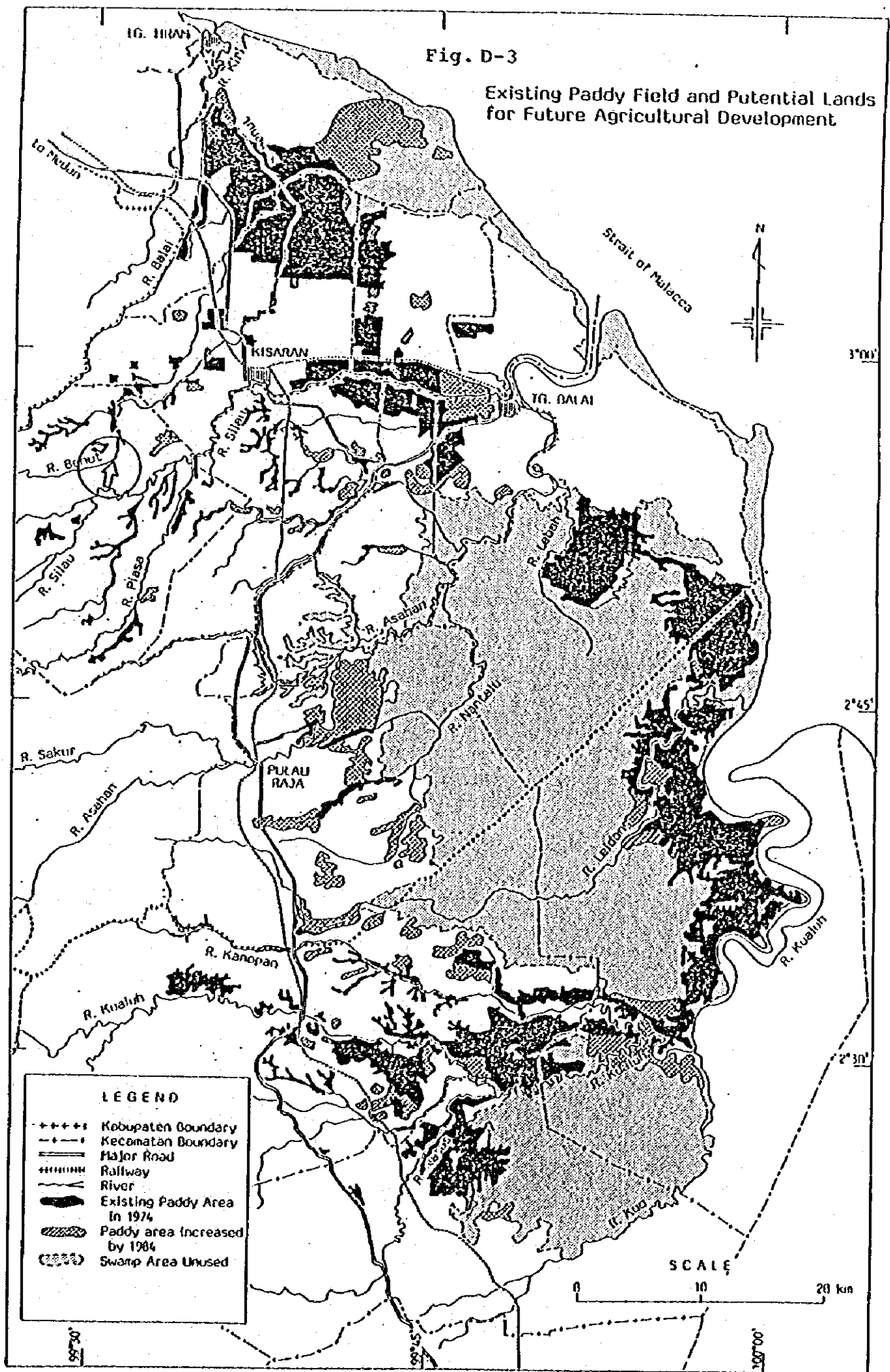
Mapping Unit:

-  Orthic Acrisols.
-  Orthic Acrisols associated with Humic Acrisols and Dystric Cambisols.
-  Humic Acrisols.
-  Humic Acrisols associated with Lithosols.
-  Dystric Cambisols associated with Orthic Acrisols.
-  Dystric Cambisols associated with Rankers and Dystric Cambisols.

Source FAO - UNESCO Soil Map of The World.

Fig. D-3

Existing Paddy Field and Potential Lands
for Future Agricultural Development



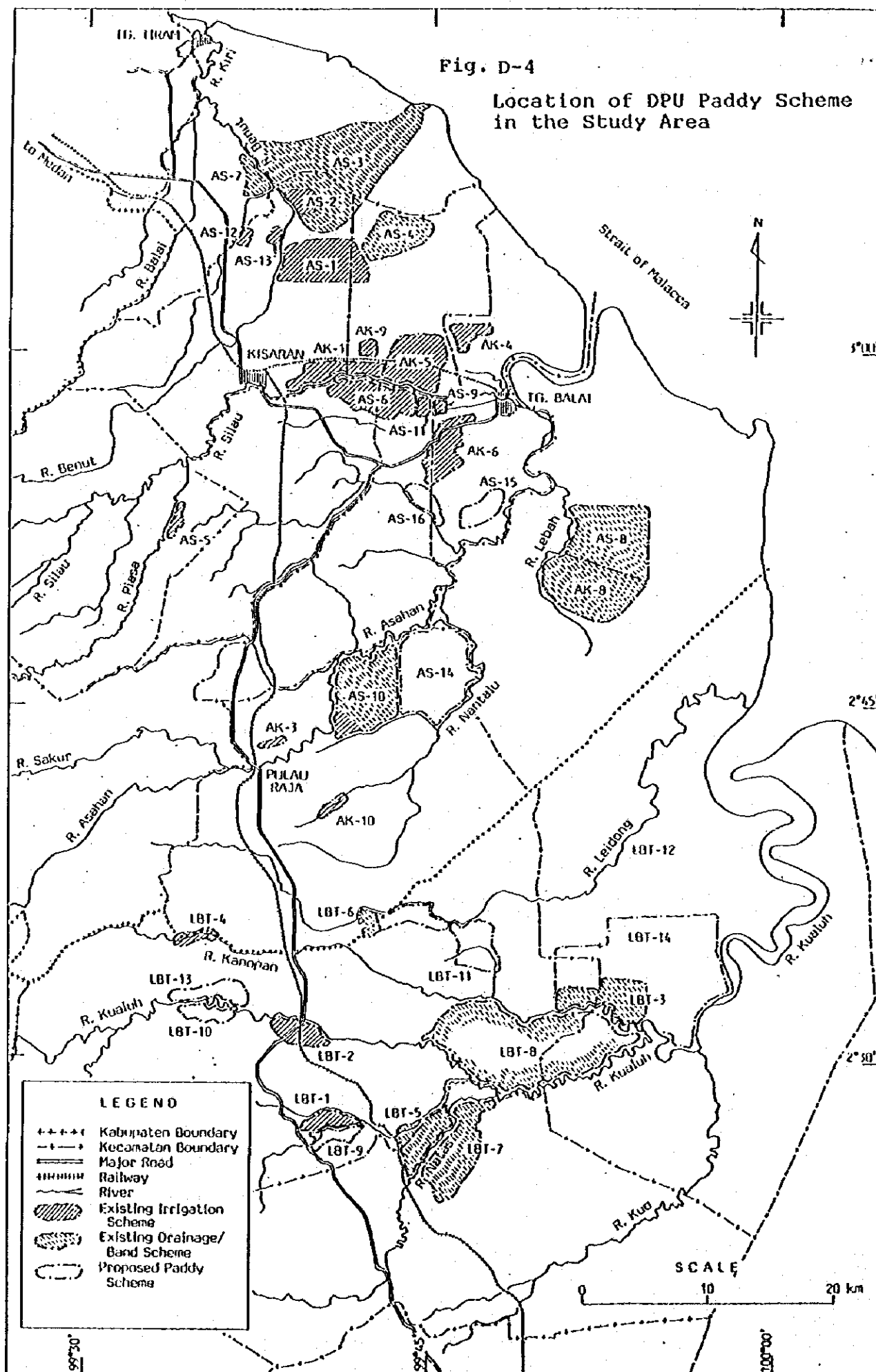


Fig. D-5

Location of Existing Intake
in the Study Area

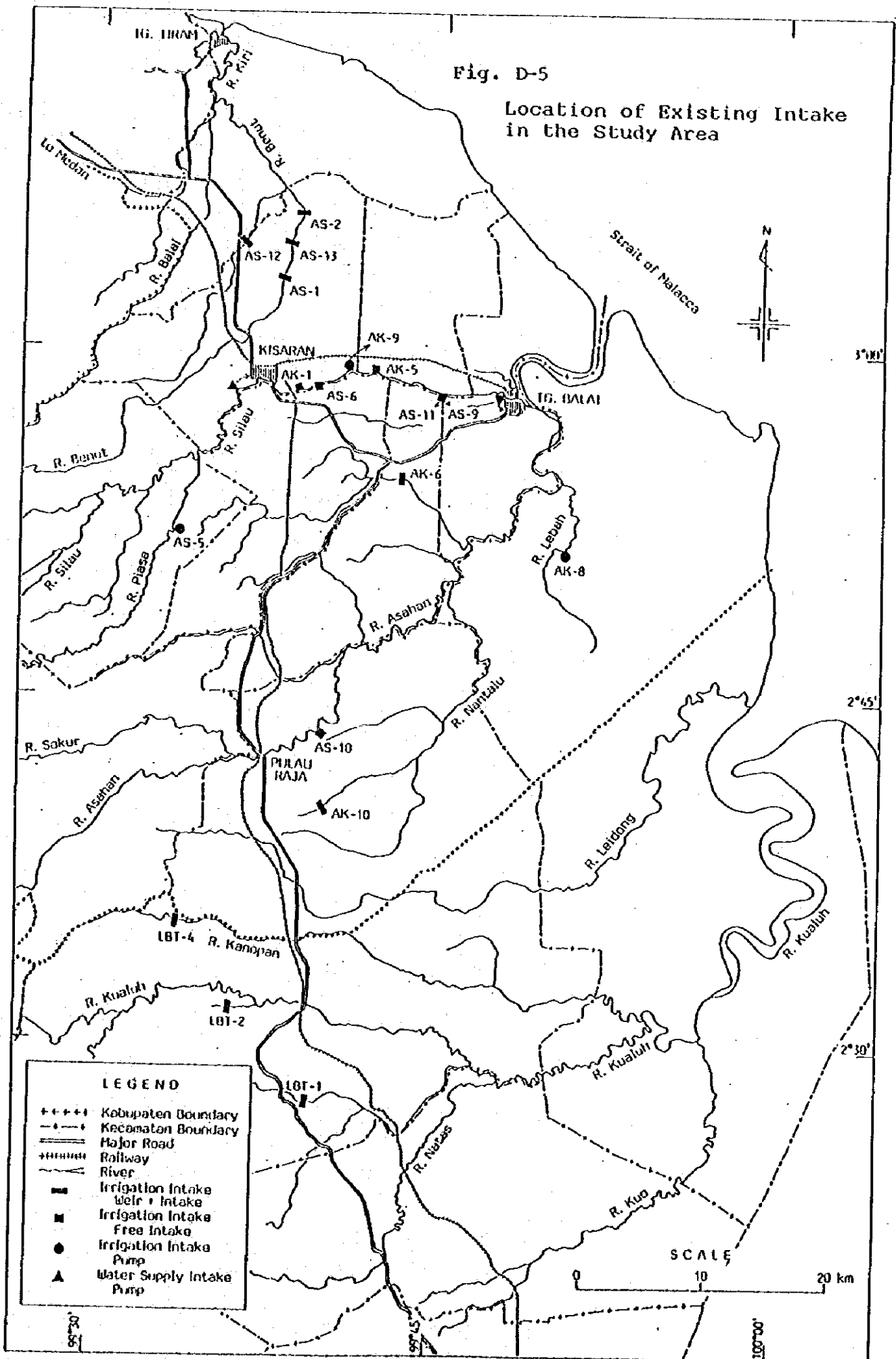
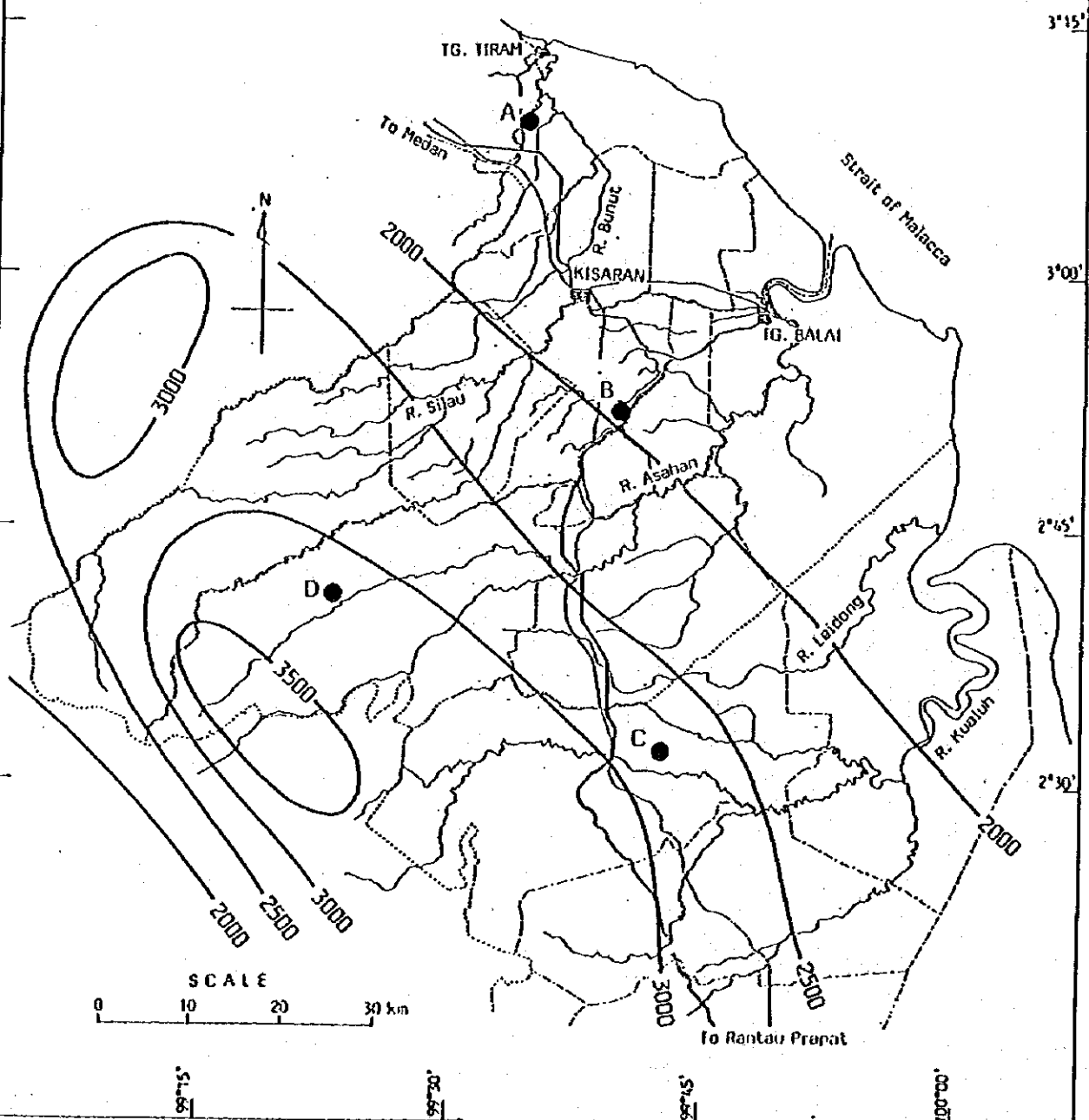
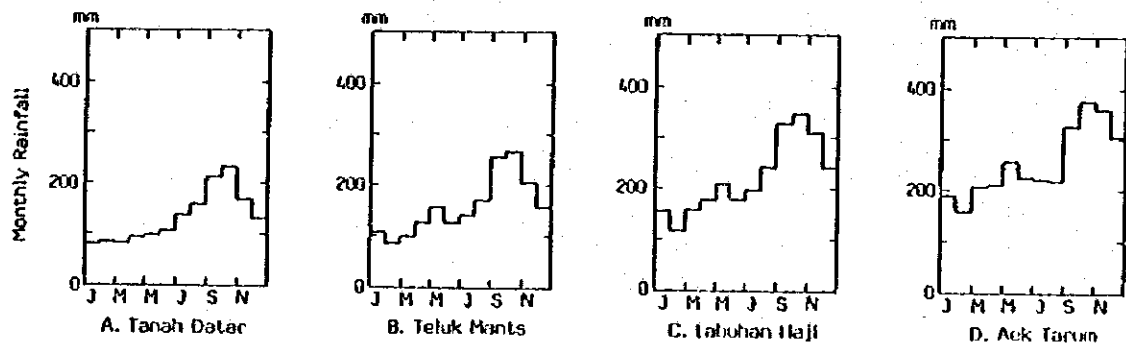


Fig. D-6 Distribution of Monthly Rainfall and Annual Isohyet in the Study Area



APPENDIX E SEDIMENTATION

APPENDIX E: SEDIMENTATION

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1. General

(1) Background Information

The general background information in regard to the river sedimentation of the area is summarized as follows. Refer to Table E-1 and Figs. E-1 to E-4.

(A) Hydrology

The mean annual rainfall is about 2,000 mm in the alluvial plain area and increases to some 3,500 mm in the mountain area. That of Lake Toba remains under 2,000 mm. There exist the rainy and dry seasons in the area, but the river flow never dry up even in the dry season. According to the observation data, the mean discharge of Silau river, Asahan river and Kualuh river are respectively $64 \text{ m}^3/\text{s}$ ($5.9 \text{ m}^3/\text{s}/100 \text{ km}^2$) at Kisaran, $149 \text{ m}^3/\text{s}$ ($3.3 \text{ m}^3/\text{s}/100 \text{ km}^2$) at Pulau Raja and $61 \text{ m}^3/\text{s}$ ($5.5 \text{ m}^3/\text{s}/100 \text{ km}^2$) at Pulo Dogom.

(B) River System

Bunut river has catchment area of 868 km^2 and it's mean basin slope is about $1/190$. Silau river: $1,201 \text{ km}^2$ (at Tg. Balai), $1/70$; Asahan river: $5,702 \text{ km}^2$ (at Tg. Balai), $1/100$; and Kualuh river: $3,900 \text{ km}^2$ (at river mouth), $1/120$.

(C) Topography, Surface Geology and Land Use

The study area is topographically classified into three areas: mountain area (over El 100 m), hill area (El 100 m - El 15 m) and alluvial plain area (under El 15 m). The mountain area is mostly covered by forest on the weathered tertiary volcanic rocks, the hill area by oil palm and rubber trees on laterite underlain by soft white tuff, and the alluvial plain area by paddy fields and coconut trees or swamp bush on fine silty soils. Except the Bunut river which has no mountain area, the other river (Silau, Asahan and Kualuh river) basins are composed of these three areas.

(2) Present Conditions on Sedimentation

Relating to the sediment production and its transportation in the area, the field survey, hearing from officials concerned and inhabitants, interpretation of Landsat imagery (June 8, 1984) and so on revealed the followings.

(A) Sediment Production or Erosion

There are no large scale mountain break and land slide in the watershed. The sediment materials are considered to be produced by the sheet erosion in the mountain and hill area. The amount of the sheet erosion may be changed depending on the human activities such as renewal of plantation and slash-and-burn agriculture.

Judging from the facts that the renewal interval of plantation is 20 to 30 years and the replanting period is about one year, in several percents of the total plantation area on the annual mean, the amount of sheet erosion may increase. But they take much care of soil conservation, employing such measures as small dike (Tanggul or Benteng), planting of grasses (also used as soil-fertilizer) and contour ploughing and planting.

(B) Lake Toba

As almost all the sediment materials which are produced in the Lake Toba catchment area deposit themselves into the lake, pure water is flowing into the Asahan river. Therefore, some 65 % of the total catchment area of the Asahan river is not concerned in supply of sediment materials to the Asahan river.

(C) Sediment Transportation Regime

Judging from the grain size distribution of the river bed materials, water-surface slope and water depth, the sediment materials must be transported as bed-load and suspended-load even in the low water flow. There seems to be no such high density sediment flow as debris flow or mud flow.

(D) Silau River

In the Silau river, especially downstream of Kisaran, the river bed fluctuation shows a tendency of gradual aggradation. Owing to the river bed aggradation the flow area of river channel becomes smaller and the recent flood overflowed the right bank and inflicted some damages to the downstream areas. The sediment production rate seems to be higher.

(E) Asahan River and Others

Due to the sediment deposition at the river mouth of the Asahan river, water depth has decreased and the navigation of big ship is becoming difficult even in high tide. In the upper reaches of Asahan river and other rivers, sedimentation seems to be not a serious problem.

2. Sedimentation of Silau and Asahan River

The annual sediment runoff and river bed fluctuation were estimated for the following river reaches where the urgent flood control plan is prepared.

- Silau River:

From Kisaran to the confluence with the Asahan river.

- Asahan River:

From the Pulau Raja to the confluence with the Silau river.

(1) Modeling

For sedimentation study of the Silau and Asahan rivers, the basin can be divided as follows. (Refer to Fig. E-4.)

Silau River:

Zone - S1: Mountain and hill area, upstream of Kisaran, 1,050 km², primary sediment production and transportation occurs.

Zone - S2: Alluvial plain area, downstream of Kisaran to the confluence at Asahan R. (Tg. Balai), 151 km², little sediment production, sediment transportation zone.

Asahan River:

- Zone - A0: Lake Toba catchment area, 3,674 km², no sedimentation (for river bed material).
- Zone - A1: Mountain and hill area between Regulating dam and Pulau Raja, 812 km², primary sediment production and transportation occurs.
- Zone - A2: Alluvial plain area including swamp between Pulau Raja and Tg. Balai, 1,216 km², little sediment production, sediment transportation zone.
- Zone - A3: Estuary between Tg. Balai and the sea, sediment transportation to the sea occurs by both river flow and tidal flow.

(2) River Conditions

The river conditions of the Silau between Kisaran and Tanjung Balai (Zone - S2) and of the Asahan between Pulau Raja and Tanjung Balai (Zone - A2), are summarized as follows. (Refer to Figs. E-5 to E-9)

(A) Channel Geomorphology

The river length, mean width and mean river bed slope of the Silau Zone - S2 are respectively 22 km, 125 m and 1/1,700. Those of the Asahan River Zone - A2 (from Pulau Raja to the confluence with the Lebah River, Zone - A21) are respectively 58 km, 75 m and 1/6,000. As to the rest reaches up to Tanjung Balai in Zone - A2 (Zone - A22), the river length is 11 km, the river width becomes wider in the downstream reaches and 600 m at Tanjung Balai, and the river bed slope is nearly level.

(B) Flow and Sediment Discharge Capacity

The flow capacity of Zone - S2 is 800 m³/s at Kisaran and becomes smaller in the lower reaches to 150 m³/s near Tanjung Balai. That of Zone - A2 is 1,300 m³/s at Pulau Raja and 200 m³/s - 450 m³/s through the lower reaches.

The sediment discharge capacity of flow discharge $100 \text{ m}^3/\text{s}$ is $10^{-1} - 10^{-3} \text{ m}^3/\text{s}$ in Zone - S2, $10^{-1} - 10^{-4} \text{ m}^3/\text{s}$ in Zone - A21 and $10^{-2} - 10^{-7} \text{ m}^3/\text{s}$ in Zone - A22. In sediment discharge capacity, Zone - S2 of the Silau river is larger than Zone - A2. That in Zone - A22 of the lower reaches of the Asahan river is very small because of the wide river width.

(C) River Bed Materials

In Zone - S2 of the Silau river and Zone - A2 of the Asahan river, the river bed materials is almost uniform sand (uniformity coefficient = 1.5) and its mean grain size is 0.7 mm in Zone - S2 and 0.5 mm in Zone - A2. For each zone, there is little difference in grain size distribution between the upper and lower reaches. The specific gravity of these sands is around 2.60 gr/cm^3 .

(D) Regime of River bed and Sediment Transportation

Judging from the river bed materials and hydraulic data, the river bed regime (or form of river bed roughness) must be ripple, and the sediment transportation regime (or form of sediment transportation) is a mixed type with suspended load and bed load.

(3) Sediment Runoff and River Bed Fluctuation

(A) Reference Points

For Zone - S2 of the Silau river, the reference points of sediment inflow and outflow are respectively Kisaran and the confluence with the Asahan River at Tanjung Balai.

For Zone - A2 of the Asahan River, the reference point of sediment inflow is Pulau Raja and that of sediment outflow is set at the confluence with the Lebah river because the sediment discharge capacity by river flow is obviously small due to wide river width and the sediment transportation supposed to be controlled by tidal flow in the river reaches between that point and Tanjung Balai.

(B) Sediment Discharge Formula

Considering the form of sediment transportation (for both zone, river bed materials are carried in the form of suspended load and bed load), Brown Formula of Eq. 1 that is suitable for this type of sediment transportation form is applied as shown below.

$$\phi B = 10 \phi^{2.5} \quad \text{-----} \quad 1$$

(Brown Formula)

where,

$$\phi B = \frac{qB}{\sqrt{Sgdm}}$$

(non-dimentional sediment discharge)

$$\phi = \frac{U_*^2}{Sgdm} = \frac{RIe}{Sdm}$$

(non-dimentional tractive force)

qB : sediment discharge per unit width

S : specific gravity of sediment grain in fluid

g : acceleration of gravity

dm : mean grain diameter

U_* : friction velocity

$$U_* = \sqrt{\frac{T_0}{\rho}} = \sqrt{gRIe}$$

T_0 : tractive force

ρ : dencity of fluid

R : hydraulic radius

I_e : energy slope of flow

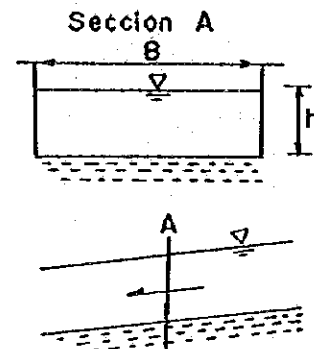
Eq. 1 is written as Eq. 2 and 3

$$\frac{qB}{\sqrt{Sgdm}} = 10 \left(\frac{RIe}{Sdm} \right)^{2.5} \quad \text{-----} \quad 2$$

$$qB = C (RIe)^{2.5} \quad C = \frac{10 \cdot g^{0.5}}{S^{2.5} dm} \quad \text{-----} \quad 3$$

Total sediment discharge of river section (QB) is obtained from Eq. 4

$$QB = B \cdot qB \quad \text{-----} \quad 4$$



Using Eq. 3 , Eq. 4 can be re-written as Eq. 5

$$QB = C' (R I_e)^{2.5} \quad C' = \frac{10 B g^{0.5}}{S^2 d m} \quad \text{-----} 5$$

From Manning formula (Eq. 6), energy slope of flow (I_e) is obtained as Eq. 7 .

$$V = \frac{1}{n} R^{2/3} I_e^{1/2} \quad \text{-----} 6$$

$$\text{where,} \quad I_e = \frac{V^2 n^2}{R^{4/3}} \quad \text{-----} 7$$

n : Manning roughness coefficient

By substituting Eq. 7 into Eq. 5 , Eq. 5 is rearranged as Eq. 8 .

$$QB = \frac{10.9 \cdot B \cdot V \cdot n^5}{S^2 d m R^{5/6}} \quad \text{-----} 8$$

Here, if the constant values: $g = 9.8 \text{ m/s}^2$, $S = 1.6$, $d = 0.7 \text{ mm}$ (for Silau river) and 0.5 mm (for Asahan river) are given, Eq. 8 can be written as Eq. 9

$$QB = C \frac{B (V \cdot n)^5}{R^{5/6}} \quad \left. \begin{array}{l} C = 17,459 \text{ for Silau R.} \\ 24,475 \text{ for Asahan R.} \end{array} \right\} \quad \text{-----} 9$$

(C) Sediment Discharge Rating Curves

Two kinds of sediment discharge rating curve are established as shown below (Refer to Figs. E-10 and E-11). The one is the rating curve for wash load that is prepared on the basis of the existing and new sampling data. The other is the rating curve for river bed materials that is prepared on the basis of the hydraulic data and the above mentioned formula.

- Sediment Discharge Rating Curve for Wash Load -

$$Q_{sw} = 1.0 \times 10^{-6} \times Q^2 \quad (\text{for Silau river at Kisaran})$$

$$Q_{sw} = 2.5 \times 10^{-7} \times Q^2 \quad (\text{for Asahan river at Pulau Raja})$$

where,

Q_{sw} : sediment discharge of wash load (m^3/s)

Q : flow discharge (m^3/s)

- Sediment Discharge Rating Curve for River Bed Materials -
(Silau river)

$$Q_s = 4.867 \times 10^{-5} \times Q^{1.343} \quad (\text{sediment inflow at Kisaran})$$

$$Q_s = 3.519 \times 10^{-7} \times Q^{2.421} \quad (Q \leq 150 \text{ m}^3/\text{s}) \quad \text{sediment out-} \\ \text{flow at Tanjung} \\ \text{Balai}$$

$$Q_s = 6.527 \times 10^{-2} \quad (Q > 150 \text{ m}^3/\text{s})$$

(Asahan river)

$$Q_s = 1.340 \times 10^{-6} \times Q^{1.685} \quad (\text{sediment inflow at Pulau Raja})$$

$$Q_s = 5.373 \times 10^{-10} \times Q^{3.073} \quad (Q \leq 350 \text{ m}^3/\text{s}) \quad \text{sediment out-} \\ \text{flow at} \\ \text{confluence} \\ \text{with Lebah R.}$$

$$Q_s = 3.533 \times 10^{-2} \quad (Q > 350 \text{ m}^3/\text{s})$$

where,

Q_s : sediment discharge of river bed materials

- (D) Estimation of Sediment Runoff and River Bed Fluctuation
Using the above mentioned rating curves and annual mean discharge (shown in Fig. E-1), sediment inflow and outflow are estimated for Zone - S2 of the Silau river and Zone - A22 of the Asahan river. The river bed fluctuation is also estimated by the following equation on the assumption that the annual sediment balance estimated be equivalent to the change of river bed height (Refer to Tables E-2 to E-4).

$$Z = \frac{\Delta Q_s}{B \cdot \Delta X \cdot (1 - \lambda)} \times \Delta t$$

where,

ΔZ : annual mean fluctuation of river bed

ΔQ_s : annual sediment balance

B : mean river width

ΔX : total river length

λ : void ratio (= 0.4)

Δt : time (= one year)

The results of estimation are as follows.

= Annual Sediment Balance =

Silau River (Kisaran - Tg. Balai)

(1) Flow	: $2,003 \times 10^6 \text{ m}^3$
(2) Wash Load Inflow	: $156 \times 10^3 \text{ m}^3$ (78 ppm)
(3) River Bed Materials Inflow	: $423 \times 10^3 \text{ m}^3$ (211 ppm)
(4) Total Sediment Inflow	: $579 \times 10^3 \text{ m}^3$ (289 ppm)
(5) River Bed Materials Outflow	: $324 \times 10^3 \text{ m}^3$
(6) Balance of River Bed Materials:	$99 \times 10^3 \text{ m}^3$
(7) River Bed Fluctuation	: 6.0 cm

Asahan River (Pulau Raja - Lebah R.)

(1) Flow	: $4,695 \times 10^6 \text{ m}^3$
(2) Wash Load Inflow	: $202 \times 10^3 \text{ m}^3$ (43 ppm)
(3) River Bed Materials Inflow	: $210 \times 10^3 \text{ m}^3$ (45 ppm)
(4) Total Sediment Inflow	: $412 \times 10^3 \text{ m}^3$ (88 ppm)
(5) River Bed Materials Outflow	: $197 \times 10^3 \text{ m}^3$
(6) Balance of River Bed Materials:	$13 \times 10^3 \text{ m}^3$
(7) River Bed Fluctuation	: 0.5 cm

= Specific Sediment Yield (S.S.Y.) =

Silau river (at Kisaran, 1,050 km²)

(1) S.S.Y. of Wash Load	: $149 \text{ m}^3/\text{km}^2/\text{year}$
(2) S.S.Y. of River Bed Materials	: $403 \text{ m}^3/\text{km}^2/\text{year}$
(3) Total S.S.Y.	: $552 \text{ m}^3/\text{km}^2/\text{year}$

Asahan river (at Pulau Raja, 812 km² excl. Lake Toba
catchment area)

(1) S.S.Y. of Wash Load	: $249 \text{ m}^3/\text{km}^2/\text{year}$
(2) S.S.Y. of River Bed Materials	: $259 \text{ m}^3/\text{km}^2/\text{year}$
(3) Total S.S.Y.	: $508 \text{ m}^3/\text{km}^2/\text{year}$

3. Conclusion and Recommendation

(1) Present Conditions on Sedimentation

In the Silau river between Kisaran and Tanjung Balai, the river bed fluctuation shows a tendency of gradual aggradation. Because of this, section area of river channel becomes smaller and the flood has recently overflowed the right bank and given some damages in the downstream areas. Due to the sedimentation at the mouth of the Asahan river, water depth has decreased and the navigation of big ship is becoming difficult even in the high tide time.

(2) Sediment Production

There are no large scale mountain break and land slide in the watershed. The most sediments which are supplied into the river channel are considered to be produced by the sheet erosion mainly in the mountain and hill area. According to the estimation of sediment runoff, the specific total sediment yield is $500 - 550 \text{ m}^3/\text{km}^2/\text{year}$. The specific sediment of river bed materials is about $400 \text{ m}^3/\text{km}^2/\text{year}$ for the Silau river and about $260 \text{ m}^3/\text{km}^2/\text{year}$ for the Asahan river. The value of the Silau river is 1.5 times larger than that of the Asahan river.

(3) Sediment Deposition

The annual sediment runoff of river bed materials is $423 \times 10^3 \text{ m}^3$ at Kisaran and $324 \times 10^3 \text{ m}^3$ at Tanjung Balai in the Silau river. The annual balance is deposition of $99 \times 10^3 \text{ m}^3$ and mean river bed aggradation of 6 cm/year. In the Asahan river, the amount of annual sediment runoff at Pulau Raja and the confluence with the tributary Lebah river, are $210 \times 10^3 \text{ m}^3$ and $197 \times 10^3 \text{ m}^3$ respectively. The annual balance is deposition of $13 \times 10^3 \text{ m}^3$ and aggradation of 0.5 cm/year. These values are smaller than those of the Silau river. However, in the lower reaches between confluence of Lebah river and the river mouth, the river width becomes wider and the capacity of sediment transportation is very small. Through these reaches sediments seem to be carried by tidal flow.

(4) Recommendation for Flood Control Plan

In the Silau river, the sediment runoff and river bed aggradation are larger in comparison with other rivers. If the sedimentation of the Silau river remains within this extent, stable river course will be established by designing appropriate cross section and longitudinal section of the river. However, in the case that extensive and new plantation development in the upperstream areas would be planned, it is recommended that the possible measure of check dam to reduce sediment runoff should be studied in the planning.

Table E-1 General Information of Sedimentation for Objective Rivers

Rivers				
Items	Asahan	Silau	Kualuh	Bunut
Catchment Area (km ²)	6,903.5 (at T. Balai inc. Silau R.) 5,702.1 (at T. Balai exc. Silau R.) 3,674.0 (Toba Lake Catchment area)	1,201.4 (at T. Balai	3,909.4	867.5 (Upstream from Kiri Kiri. R.)
River length (km)	139 (Sakur R.)	124	198	81
Watershed Height (EL.m)	1,450	1,800	1,700	420
Mean Basin Slope	0.0104 (1/100)	0.0145 (1/70)	0.0086 (1/120)	0.0052 (1/190)
River Bed Materials	Through the alluvial plain, river bed materials are uniform sand.			
Hydrology	Mean annual rainfall is about 2,000 mm in the alluvial plain area, but increased up to some 3,500 mm in the mountain area.			
Geology	Mountain area : tertiary volcanic rocks Low hilly area: laterite underlain by soft white tuff Alluvial plain: fine silty soils			
Land Use	Mountain area : mostly forest Low hilly area: oil palm and rubber plantation Alluvial plain: paddy field, coconut plantation, bush and swamp.			

Table E-2 Annual sediment Runoff Volume at Kisaran

Sediment	Discharge Range	Mean (m ³ /s) Discharge	Rating Curve	Days	Sediment Volume (10 ³ m ³)
Wash Load	0 - 50m ³ /s	39.53	Q _{sw} = 1.0x10 ⁻⁶ Q ²	143.57	19.4
	50 - 100	67.45		181.25	71.2
	100 - 150	117.53		32.98	39.4
	150 - 200	166.28		4.89	11.7
	200 - 250	217.93		1.41	5.8
	250 - 300	280.47		0.58	3.9
	300 - 350	311.30		0.08	0.7
	350 - 400	381.60		0.08	1.0
	400 - 450	415.30		0.08	1.2
	450 - 500	457.40		0.08	1.4
< Total>		(64)	-	365	155.7
Suspended Load and Bed Load	0 - 50m ³ /s	39.53	Q _s = 4.867x10 ⁻⁵ xQ ^{1.343}	143.57	84.2
	50 - 100	67.45		181.25	218.0
	100 - 150	117.53		32.98	83.6
	150 - 200	166.28		4.89	19.8
	200 - 250	217.93		1.41	8.2
	250 - 300	280.47		0.58	4.7
	300 - 350	311.30		0.08	0.8
	350 - 400	381.60		0.08	1.0
	400 - 450	415.30		0.08	1.1
	450 - 500	457.40		0.08	1.3
< Total>		(64)	-	365	422.7
< Ground Total>				365	578.4