



Ministry of Public Works
Republic of Indonesia

The Study on the Integrated Regional Development Plan for the Northern Part of Sumatra

Final Report

Vol. III
Sectoral Analyses

March 1990

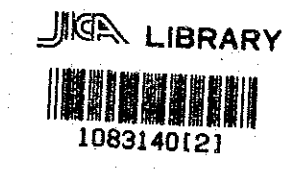
Japan International Cooperation Agency



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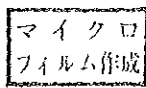


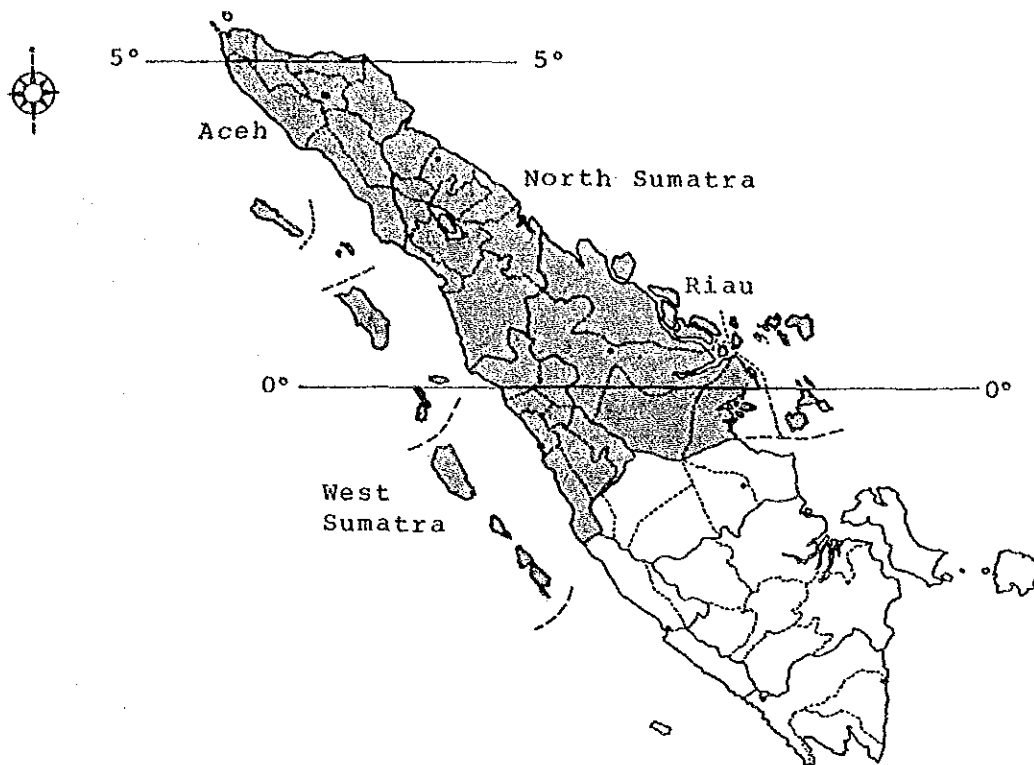
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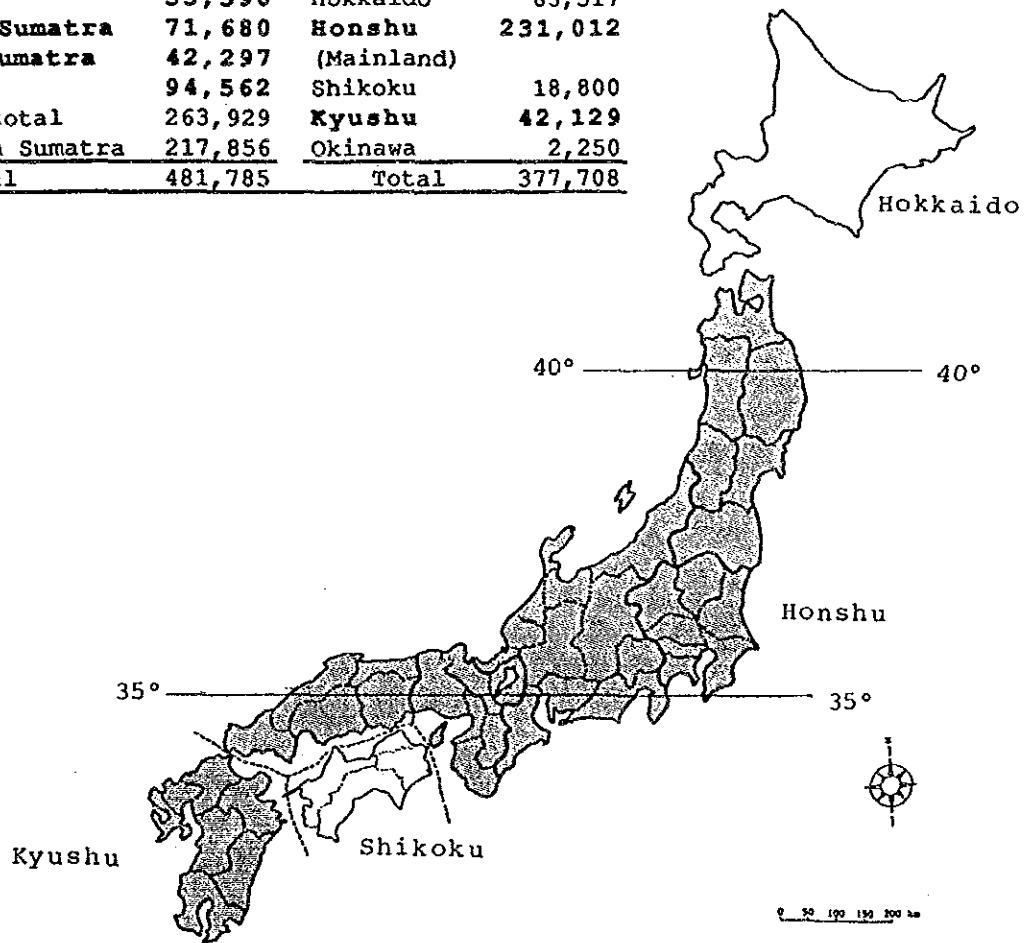
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Comparison of Land Area: Sumatra and Japan

Sumatra (km ²)		Japan (km ²)	
Aceh	55,390	Hokkaido	83,517
North Sumatra	71,680	Honshu	231,012
West Sumatra	42,297	(Mainland)	
Riau	94,562	Shikoku	18,800
Subtotal	263,929	Kyushu	42,129
Southern Sumatra	217,856	Okinawa	2,250
Total	481,785	Total	377,708



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ABBREVIATIONS

AAC	Annual Allowable Cut
AARD	Agency for Agricultural Research and Development
AATE	Agency for Agricultural Training and Education
ADB	Asian Development Bank
ADP	Area Development Program
AGRARIA	Badan Pertanahan Nasional
APBD	Anggaran Pendapatan dan Belanja Daerah
APBN	Anggaran Pendapatan dan Belanja Negara
ASEAN	Association of Southeast Asian Nations
BANGDA	Pembangunan Daerah
BANGDES	Pembangunan Desa
BAPPEDA	Badan Perencanaan Pembangunan Daerah
BAPPENAS	Badan Perencanaan Pembangunan Nasional
BBN	Bea Balik Nama
BHN	Basic human needs
BIPIK	Small-scale Industry Development Guidance
BKPM	Badan Koordinasi Penanaman Modal
BKPMD	Badan Koordinasi Penanaman Modal Daerah
BMG	Institute of Meteorology and Geophysics
BNA	Basic Needs Approach
BOE	Barreles of Oil Equivalent
BPAM	Water supply management unit
BPLPs	Tourism Development and Training Schools
BPPI	Marine Fishery Development Center
BPPT	Agency for the Assessment and Application of Technology
BPS	Biro Pusat Statistik
BUTSI	Badan Urusan Tenaga Sukarela Indonesia
CAD/CAM	Computer Aided Design/Computer Aided Manufacturing
CIDA	Canadian International Development Agency
CNG	Compressed Natural Gas
CPUE	Catch per Unit Effort
CRIFC	Central Research Institute for Food Crops
CV	Central Valley Area
DAS	Daerhd Aliran Sungai
DB	Directorate of Coal
DBM	Dinas Bina Marga
DDC	District Development Center
DEG	Directorate of Environmental Geology
DGCK	Directorate General of Cipta Karya
DGENE	Directorate General of Electric Power and New Energy
DGF	Directorate General of Fisheries
DGH	Directorate General of Highways
DGLC	Directorate General of Land Communication
DGSC	Directorate General of Sea Communications
DGT	Directorate General of Tourism
DGWRD	Directorate General for Water Resources Development
DJA	Direktorat Jendral Agraria
DJPU	Direktorat Jenderal Perhubungan Udara
DPEB	Direktorat Pengembangan Energi Baru
DPMA	Institute of Hydraulic Engineering
DPP	Dewan Pimpinan Pusat
DPU	Departemen Pekerjaan Umum
EC	The European Community
EEZ	Exclusive Economic Zone
EP	Eastern Plateu Area
ESCAP	Economic and Social Commission for Asia and the Pacific
Ex-Im Bank	Export-Import Bank
F/S	Feasibility Study
FAD	Fish Aggregating Device
FAO	Food and Agriculture Organization
FETC	Forestry Education and Training Center

FRDC	Forest Research and Development Center
GBHN	Garis-garis Besan Haluan Negara
GDP	Gross domestic product
GOI	Government of Indonesia
GRDP	Gross Regional Domestic Product
GTZ	Gesellschaft fur Technische Zusammenarbeit
HPH	Hak Pengusahaan Hutan (forest concession)
HPHH	Forest concession of short term and small scale
HPPS	Hydro Power Potentials Study
HRD	Human Resources Development
HTI	Hutan Tanaman Industri
IBRD	International Bank for Reconstruction and Development
ICOR	Incremental Capital Output Ratio
IDC	Interprovincial Development Center
IDCJ	International Development Center of Japan
IDEP	Integrated Development Program
IFPRI	International Food Policy Research Institute
IGGI	Inter-Governmental Group on Indonesia
IIMI	International Irrigation Management Institute
IKK	Ibu Kota Kecamatan
ILOR	Incremental labor-output ratio
ILS	Instrument Landing System
IMCE	Inter-ministerial Committee on Electrification
IMF	International Monetary Fund
IMTCE	Inter-ministerial Technical Committee on Energy
INPRES	Instruksi Presiden
INTAM	Tambak intensification
IPEDA	Iuran Pembangunan Daerah
IRR	Internal Rate of Return
ITU	International Telecommunication Union
IUIDP	Integrated Urban Infrastructure Development Program
JAIDO	Japan International Development Organization
JICA	Japan International Cooperation Agency
KADIN	Indonesian Chamber of Commerce and Industry
KBOE	Thousand Barrels of Oil Equivalent
KIK	Small investment credit
KIP	Kampung Improvement Programme
KLH	Kependudukan dan Lingkungan Hidup
KMKP	Permanent working capital credit
KPD	Rural development extension worker
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
LSC	Local Service Center
MIGA	Multilateral Investment Guarantee Agency
MITI	Ministry of International Trade and Industry
MMBOE	Million Barrels of Oil Equivalent
MME	Ministry of Mines and Energy
MMSCFD	Million Standard Cubic Feet Per Day
MOA	Ministry of Agriculture
MSY	Maximum Sustainable Yield
MUDP	Medan Urban Development Project
NAIEs	Newly Agro-industrializing Economies
NDC	National Development Center
NEDO	New Energy and Industrial Technology Development Organization
NES	Nucleus Estate Scheme
NG	Natural Gas
NGO	Non-governmental Organization
NIEs	Newly Industrializing Economies
NRER	New and Renewable Energy Resources
NUDS	The National Urban Development Strategy Project
NWC	North Western Coast Area
O&M	Operation and maintenance
ODA	Official Development Assistance

OECF	Overseas Economic Cooperation Fund
OMR	Operaion, Maintenance and Repair
OPMC	Outside Plant Maintenance Center
P3KT	Program Peningkatan Perbaikan Kampung Terpadu
PDAM	Perusahaan Daerah Air Minum
PDC	Provincial Development Center
PDP	Provincial Development Program
PELNI	Pelayaran Nasional Indonesia
PEMDA	Pemerintah Daerah
PERUMTEL	Perusahaan Umum Telekomunikasi
PHPA	Pelesterian Hutan dan Perlindungan Alam
PIR	Perkebunan Inti Rakyat
PJKA	Perusahaan Jawatan Kereta Api
PKB	Pajak Kendaraan Bermotor
PLN	Perusahaan Listrik Negara
PMUs	Project Management Units
POSTEL	Ministry of Tourism, Post and Telecommunication
PPI	Provincial fish landing center
PPW	Proyek Pengembangan Wilayah
PSB	P.T. Perikanan Samudra Besar
PUSDATA	Pusat Pengolahan Data
PUSIDO	Pusat Informasi dan Dokumentasi
RDC	Regional Development Center
RE	Rural Electrification
RSE	Remote Sensing Engineering Project
SATUGAS	Satuan Tugas
SBK	Small satellite station
SDM	Directorate of Mineral Resources
SKDP	Sambungan Komunikasi Data Packet (Packet Data Communication Systems)
SLDD	Subscriber long distance dialing
STDP	Smallholder Tree Crops Development Project
SUA	Strategic Urban Areas
SWC	South Western Coast Area
TDMA	Time Division Multiple Access
TEU	Twenty-foot Equivalent Unit
TGHK	Tata guna hutan kesepakatan (concensus on Forest Land Use)
TK.I.	Tingkat I (level I)
TPI	Forest management system
U.K.	United Kingdom
U.S.A.	United States of America
UNCHS	United Nations Centre for Human Settlements
UNDP	United Nations Development Programme
UPPI	Provincial level marine fisheries development unit
US	United States
USAID	United States Agency for International Development
USSR	Union of Soviet Socialist Republics
VROM	Direktorat Perumahan Negeri (Pemerintahan) Belanda
WMTC	Watershed Management Technology Center

I. AGRICULTURE

A. Present Situation and Development Potentials

1. Introduction

1. Two major distinguishing characteristics of agriculture in the Region are the overwhelming importance of rice in the production of food crops and the similar importance of estate crops, especially tree crops. The former characteristic is seen in the existence of an appreciable regional surplus of rice and a generally higher level of per capita consumption of rice compared with other parts of the country. The latter characteristic is especially seen in the large contribution to the country's exports of oil palm and rubber products.

2. The other aspects of the regional agriculture generally lack distinguishing characteristics other than the relative absence of development. Partly as a corollary to the primacy of rice, the production of palawija crops are generally very small, especially compared with the situation in Java. The livestock subsector in the Region as a whole does not show significantly different characteristics relative to the national picture, and the same applies to horticultural production. To put it rather simplistically, in contrast to a limited number of estate crops which are geared to export and to rice whose production has strong orientation toward regional autarchy in most parts of the country, agricultural and livestock production in the Region are not yet effectively connected to market prospects, especially national and international market demands.

2. Food Crop Subsector

3. In order to clarify the overall framework for agricultural development, it is necessary to consider some salient characteristics of the Region's agriculture. The most important characteristic of the food crop subsector is the apparent supremacy of rice in both consumption and production patterns in the Region, as shown in Tables 1 and 2. Taken as a whole, the Region devotes about 80% of the total harvested area of major food crops to rice. It has significantly less areas allocated to maize and cassava, and with the exception of Aceh, also soybean, compared with Southern Sumatra and Java. This is probably correlated to the higher proportion of per capita rice consumption in the Region. Coupled with much less population pressure on agricultural land (especially wetland), palawija (secondary) crops like maize and cassava are apparently not as important as staple food as in Java or Southern Sumatra.

4. As shown in Table 3, the four provinces have a total rice production of 4.9 million tons (dry unhusked rice) in three-year average during 1985-87, of which over 95% are from the wetland. The growth of production during the 1980/82 and the 1985/87 average was 5.1% per annum, significantly higher than the national figure of 3.4%. If the national average per capita consumption of 137kg in milled rice is applied to the Region, the demand for the single year of 1986 is estimated to be about 4.5 million tons in terms of dry unhusked rice. This indicates an estimated surplus of some 400,000 tons (Table 4).

5. The autarchic nature of rice production in the Region can be seen in Table 4. Of 22 development areas (excluding Medan included in Kab. Deli Serdang, south Aceh islands included in Aceh Barat and

Table 1. Distribution of Harvested Area by Major Food Crop 1986 (Unit: %)

	Wetland Rice	Dryland Rice	Maize	Cassava	Sweet Potato	Soybean	Peanut
Acch	66	2	3	2	1	22	4
North Sumatra	71	11	8	3	2	3	2
West Sumatra	85	3	3	2	1	4	2
Riau	54	26	7	3	1	7	2
Total Region	71	9	6	2	1	9	2
Southern Sumatra	50	15	14	7	1	11	2
Java	54	4	21	8	1	8	4

Sources: BPS, Production of Cereals in Indonesia 1986.

Table 2. Weekly Per Capita Consumption of Selected Food Crops 1987 (Unit: g)

	Rice	Maize		Cassava		Sweet Potato
		Fresh	Dry	Fresh	Dry	
Aceh	2791	5	1	120	1	27
North Sumatra	2428	6	4	439	1	189
West Sumatra	2612	10	3	96	3	70
Riau	2079	16	3	137	2	44
Indonesia	2060	37	160	262	46	124
Central Java	1836	12	246	357	65	124
East Java	1562	34	405	205	94	93
West Java	1562	30	6	190	-	74
Lampung	2182	79	100	268	252	51

Source: BPS, pengeluaran untuk Konsumsi Penduduk Indonesia per Provinsi 1987

Table 3 Rice Production by Province

	Average 1980-82	Average 1981-83	Average 1982-84	Average 1983-85	Average 84-86	Average 1985-87	Annual Growth % 1981-84	Annual Growth % 1984-86	Annual Growth % 1981-86
Total Rice									
Production (1000mt):									
Aceh	789.6	882.6	922.4	922.4	953.4	978.6	5.32	3.00	4.38
N. Sum.	1697.6	1776.6	2001.2	2001.2	2079.6	2178.6	5.64	4.34	5.12
W. Sum.	1070.8	1151.4	1341.5	1341.5	1384.7	1418.9	7.80	2.84	5.79
Riau	268.8	294.6	329.1	329.1	343.9	326.0	6.98	-0.47	3.94
Region	3826.8	4105.3	4594.1	4594.1	4761.6	4902.1	6.28	3.30	5.08
Indonesia	33583.7	34443.4	35674.4	37490.8	38965.4	39612.6	3.74	2.79	3.36
Harvested Area (1000ha):									
Aceh	244.2	260.9	264.9	264.9	271.3	270.9	2.75	1.13	2.10
N. Sum.	559.9	556.2	582.4	582.4	592.6	617.2	1.32	2.94	1.97
W. Sum.	292.9	301.8	333.1	333.1	340.3	343.2	4.37	1.51	3.22
Riau	127.9	132.2	139.3	139.3	143.5	133.9	2.88	-1.95	0.92
Region	1224.9	1251.0	1319.7	1319.7	1347.7	1365.2	2.51	1.71	2.19
Indonesia	8988.5	9075.5	9304.8	9609.4	9884.8	9937.8	2.25	1.69	2.03
Yield (kg/ha) :									
Aceh	3233	3383	3482	3482	3514	3612	2.50	1.85	2.24
N. Sum.	3032	3194	3436	3436	3509	3530	4.26	1.36	3.09
W. Sum.	3656	3815	4028	4028	4069	4134	3.28	1.31	2.49
Riau	2101	2229	2362	2362	2397	2434	3.98	1.51	2.99
Region	3124	3281	3481	3481	3533	3591	3.67	1.56	2.82
Indonesia	3736	3795	3834	3901	3942	3986	1.45	1.08	1.30
Wetland Rice									
Production (1000mt):									
Aceh	771.4	861.8	887.8	903.1	937.5	964.6	5.39	3.35	4.57
N. Sum.	1521.9	1600.4	1715.6	1820.9	1911.4	2014.4	6.16	5.18	5.77
W. Sum.	1056.9	1133.3	1238.3	1319.8	1362.4	1394.7	7.69	2.80	5.70
Riau	207.1	223.2	242.5	254.1	271.8	253.2	7.07	-0.18	4.11
Region	3557.3	3818.6	4084.2	4297.9	4483.2	4627.0	6.51	3.76	5.40
Indonesia	31775.6	32535.0	33695.7	35446.3	36928.1	37578.9	3.71	2.96	3.41
Harvested Area (1000ha):									
Aceh	232.6	248.4	254.0	254.0	262.4	263.1	2.98	1.79	2.50
N. Sum.	456.0	458.7	491.8	491.8	509.2	533.6	2.55	4.16	3.20
W. Sum.	284.3	291.5	322.0	322.0	329.2	331.4	4.23	1.45	3.11
Riau	83.6	84.2	87.6	87.6	92.8	86.6	1.57	-0.59	0.70
Region	1056.5	1082.9	1155.3	1155.3	1193.5	1214.7	3.03	2.54	2.83
Indonesia	7872.6	7929.8	8135.5	8429.9	8730.3	8813.3	2.31	2.25	2.28
Yield (kg/ha) :									
Aceh	3317	3469	3496	3556	3573	3666	2.35	1.54	2.02
N. Sum.	3338	3489	3488	3703	3754	3775	3.52	0.98	2.49
W. Sum.	3717	3887	3846	4099	4139	4209	3.32	1.33	2.52
Riau	2477	2651	2768	2901	2930	2925	5.41	0.42	3.38
Region	3367	3526	3535	3720	3756	3809	3.38	1.19	2.50
Indonesia	4036	4103	4142	4205	4230	4264	1.37	0.70	1.10

Note: Production in dry unhusked rice.

Sources: BPS, Production of Cereals in Indonesia, 1986 and 1987.
BPS, Statistical Yearbook of Indonesia, 1980-85.

Table 4 Estimated Regional Supply and Demand 1986
(In 1000 tons of unhusked rice)

Development Areas	Production			Estimated Demand (A)	Sufficiency (%)	Estimated Demand (B)	Sufficiency (%)
	Wetland	Dryland	Total				
1. Aceh Besar			97.0	93.5	103.7	93.7	103.5
2. Northern Aceh			465.7	306.3	152.0	307.0	151.7
Pidie			155.5	90.6	171.6	90.8	171.2
Aceh Utara			270.2	173.9	155.4	174.3	155.1
Aceh Tengah			40.0	41.8	95.6	41.9	95.4
3. Aceh Timur			154.8	124.9	124.0	125.1	123.7
4. Aceh Tenggara			77.4	42.2	183.2	42.3	182.8
5. Aceh Barat 1)			132.1	80.2	164.8	80.3	164.4
6. Aceh Selatan			96.8	74.3	130.3	74.5	130.0
(Total Aceh)	1023.8	15.0	1038.8	721.4	144.0	723.0	143.7
9. East Coast N. Sum.	1254.0	41.8	1295.8	1557.1	83.2	1560.6	83.0
Langkat	182.1	2.4	184.5	182.6	101.0	183.0	100.8
Deli Serdang 2)	429.5	10.1	439.6	778.4	56.5	780.2	56.3
Simalungun	277.6	15.4	293.0	233.1	125.7	233.6	125.4
Asahan	189.6	10.8	200.4	213.7	93.8	214.2	93.6
Labuhan Batu	175.2	3.1	178.3	149.2	119.5	149.6	119.2
10. Karo Highlands	76.6	64.1	140.7	122.1	115.2	122.4	114.9
Karo	35.0	38.1	73.1	57.4	127.4	57.5	127.1
Dairi	41.6	26.0	67.6	64.7	104.4	64.9	104.2
11. Tapanuli Utara	202.5	14.3	216.8	169.9	127.6	170.3	127.3
12. West Coast Tapanuli	295.7	2.8	298.5	268.4	111.2	269.1	110.9
Tapanuli Tengah	69.1	0.4	69.5	61.1	113.7	61.3	113.4
Tapanuli Selatan	226.6	2.4	229.0	207.3	110.5	207.8	110.2
13. Nias	84.6	31.3	115.9	128.8	90.0	129.1	89.8
(Total North Sum.)	1913.3	154.3	2067.6	2246.4	92.0	2251.4	91.8
14. Central West Sum.	598.6	0.9	599.5	449.6	133.3	450.6	133.0
Tanah Datar	183.8	0.1	183.9	89.3	206.0	89.5	205.5
Padang Pariaman 3)	236.8	0.0	236.8	247.4	95.7	247.9	95.5
Agam	178.0	0.8	178.8	113.0	158.3	113.2	157.9
15. Pasaman	165.1	7.3	172.4	97.4	177.0	97.6	176.6
16. Lima Puluh Koto	175.6	1.2	176.8	89.6	197.4	89.8	196.9
17. Southeast W. Sum.	297.1	14.9	312.0	171.2	182.3	171.5	181.9
Solok	213.3	0.3	213.6	103.4	206.6	103.6	206.1
Sawah/Sijunjung	83.8	14.6	98.4	67.8	145.2	67.9	144.9
18. Pesisir Selatan	161.4	0.1	161.5	84.4	191.4	84.6	191.0
(Total West Sum.)	1397.8	24.4	1422.3	892.2	159.4	894.2	159.1
20. Kampar	54.2	42.4	96.6	172.1	56.1	172.5	56.0
21. Bengkalis	76.7	13.7	90.4	166.2	54.4	166.6	54.3
22. Indragiri Hulu	29.7	14.1	43.8	69.9	62.6	70.1	62.5
23. Indragiri Hilir	131.3	3.5	134.8	99.7	135.1	100.0	134.8
24. Riau Islands	0.4	0.0	0.4	109.8	0.4	110.1	0.4
(Total Riau)	292.3	73.7	366.0	617.8	59.2	619.2	59.1
Total Region	4627.2	267.4	4894.6	4477.8	109.3	4487.9	109.1

Sources: BPS, Production Cereals in Indonesia 1986.

BPS, Statistical Year Book of Indonesia 1986.

Notes: Demand (A) is based on per capita consumption of 143kg in milled rice and the conversion rate of 68% from unhusked rice; Demand (B) is based on 137kg and 65%. The other conversion factors (such as wastes and feed use) are the same, being taken from the Food Balance Sheet in Indonesia 1985, as prepared by BPS.

1) including "7. Aceh Islands", 2) including "8. Medan", 3) including "19. Mentawai Islands."

western islands included in Padang Pariaman), only six areas, two in North Sumatra and four in Riau, are estimated to have deficits.

6. The Region's estimated self-sufficiency in rice is based on a relatively extensive manner of utilizing the available wetland area. Compared with Java, the Region is characterized by the lower rice-cropping intensity, the lower percentage of irrigated wetland, and the higher percentage of simple and village irrigation systems which are generally inadequate to control water intake and drainage. Coupled with generally less fertile soil conditions, and the lower coverage of various intensification programs, the Region's average rice yield remains relatively low (Table 5). However, the exception of West Sumatra must be duly noted for its similarity to Java.

Table 5. Utilization of Wetland 1986

	Wetland Area (1000 ha)	% of Rice Double- Cropped	% of Irrig.	% of Simple Systems	Rice- Cropping Intensity	Average Paddy Yield(t/ha)
Aceh	323.9	21.3	45.6	79.7	0.87	3.6
North Sumatra	518.2	38.7	47.8	61.7	0.98	3.8
West Sumatra	224.2	66.6	70.7	57.3	1.49	4.2
Riau	178.5	9.7	7.5	90.9	0.55	2.9
Total Region	1224.8	35.1	45.6	65.8	1.00	3.8
Southern Sum. Region	749.3	22.3	32.2	44.7	1.00	4.0
Java	3444.5	59.7	72.0	26.3	1.45	4.7
Indonesia	7769.1	42.1	54.0	38.5	1.14	4.2

Sources: BPS, Land Area by Utilization 1986.

BPS, Production of Cereals in Indonesia 1986.

7. The current much lesser importance of palawija crops in the Region is probably related to the readily available supply of rice which reduces the regional demand for supplementary staples, the much greater importance of estate crops as sources of cash income, and the Region's insufficient integration into wider domestic markets outside the Region. However, as seen in Table 6, some major palawija crops show notably rapid growth in recent years, granted that such growth has been primarily due to the initial low level of production.

8. In addition, it must be mentioned that such growth has a tendency of local concentration in the four provinces. For instance, two kabupatens of Karo and Simalungun in North Sumatra Province account for three-fourths of the total regional production of maize, while two kabupatens of Aceh Utara and Aceh Timur produce two-thirds of the regional output of soybean. This appears to be correlated with easier access to urban and/or wider markets, among other factors.

Table 6. Production of Major Palawija Crops

	1982	1983	1984	1985	1986	1987	Annual Growth
MAIZE							
Production (1000mt):							
Aceh	4.8	5.0	6.9	7.7	17.8	17.4	25.9
N. Sum.	65.9	77.2	64.3	90.7	109.4	140.7	15.2
W. Sum.	9.7	12.1	11.0	14.2	19.4	22.2	16.6
Riau	15.7	35.7	9.8	17.4	20.8	20.8	5.6
Region	96.0	129.9	92.0	130.1	167.3	201.1	14.8
Harvested Area (1000ha):							
Aceh	3.9	3.9	5.5	3.2	13.1	12.2	23.0
N. Sum.	37.4	42.7	33.8	46.9	58.9	63.8	10.7
W. Sum.	5.9	6.9	6.4	8.0	11.2	11.4	13.3
Riau	14.0	26.7	7.5	11.7	12.9	11.0	-4.7
Region	61.1	80.2	53.2	69.9	96.1	98.4	9.5
SOYBEAN							
Production (1000mt):							
Aceh	20.3	32.4	43.9	51.3	91.3	102.4	32.4
N. Sum.	2.5	4.2	6.8	10.1	20.3	28.0	48.3
W. Sum.	0.9	1.5	2.6	7.4	15.2	17.8	58.7
Riau	1.0	2.5	1.7	4.0	9.9	7.6	41.1
Region	24.7	40.6	55.0	72.8	136.6	155.7	36.8
Harvested Area (1000ha):							
Aceh	25.7	35.6	44.8	53.4	96.0	101.1	27.4
N. Sum.	3.0	4.4	8.1	11.4	22.0	26.0	43.4
W. Sum.	1.4	2.3	3.2	9.0	16.7	18.4	51.2
Riau	1.7	3.3	2.4	5.0	12.0	9.1	33.6
Region	31.8	45.7	58.4	78.8	146.7	154.6	31.6
PEANUT							
Production (1000mt):							
Aceh	7.8	10.7	13.8	12.4	21.0	16.3	14.8
N. Sum.	13.3	10.7	13.2	15.5	15.0	20.1	8.3
W. Sum.	6.4	7.1	6.8	9.7	12.6	10.8	10.6
Riau	2.1	3.3	1.9	2.4	4.2	4.1	13.5
Region	29.6	31.8	35.7	39.9	52.8	51.4	11.0
Harvested Area (1000ha):							
Aceh	9.0	10.4	13.7	11.9	17.4	14.1	9.0
N. Sum.	11.8	10.4	11.8	13.1	12.2	19.0	9.6
W. Sum.	6.9	7.7	6.8	8.3	9.9	9.9	7.2
Riau	3.4	3.4	1.9	2.4	4.2	4.0	3.0
Region	31.1	31.8	34.3	35.7	43.7	46.9	8.2
CASSAVA							
Production (1000mt):							
Aceh	43.8	50.6	69.9	61.3	96.0	81.4	12.4
N. Sum.	250.4	231.7	256.0	230.1	247.4	245.2	-0.4
W. Sum.	58.4	65.8	83.5	82.4	82.6	108.1	12.3
Riau	60.6	79.8	78.7	69.2	68.5	84.2	6.6
Region	413.2	427.9	488.0	443.0	494.5	518.8	4.6
Harvested Area (1000ha):							
Aceh	3.9	4.7	6.8	5.6	8.2	7.0	11.4
N. Sum.	23.2	20.9	21.9	19.0	19.8	20.8	-2.2
W. Sum.	5.0	5.5	6.7	6.9	6.4	8.5	10.8
Riau	7.2	7.5	6.6	6.2	5.9	6.9	-0.8
Region	39.3	38.6	42.0	37.8	40.2	43.2	1.9
SWEET POTATO							
Production (1000mt):							
Aceh	14.1	17.3	23.1	20.2	21.7	21.4	8.3
N. Sum.	140.4	133.8	147.5	138.0	131.9	129.8	-1.6
W. Sum.	16.8	18.8	26.9	25.6	26.0	40.0	17.3
Riau	11.3	17.8	15.0	16.6	16.2	19.8	11.1
Region	182.7	187.7	212.6	200.4	153.6	211.0	2.9
Harvested Area (1000ha):							
Aceh	1.6	1.9	2.7	2.3	2.3	2.2	6.2
N. Sum.	17.1	16.3	15.9	14.8	14.3	13.7	-4.5
W. Sum.	1.9	2.0	2.7	2.7	3.0	3.9	14.2
Riau	2.2	2.4	2.1	2.2	2.1	2.5	3.2
Region	22.9	22.7	23.4	22.0	16.6	22.4	-0.4

Sources: Dalam Angka 1986 and 1987 of Four Provinces.

9. Some aspects of the relative importance of rice, on the one hand, and the other annual crops (including palawija and horticultural crops), on the other, vis-a-vis tree/estate crops can be seen in the composition of cropped agricultural land per farming household, as shown in Table 7. According to the agricultural census of 1983, the percentage of the wetland area in the total cropped area is largest in West Sumatra where the average farm size is the smallest among the four provinces. The larger average dryland (or upland) area used for annual crops are generally correlated with the smaller area of wetland available for rice production as in Riau Province.

10. In addition, the average dryland area used for annual crops generally appears to be larger than the area for tree/estate crops, where the average farm size is relatively small as found in West Sumatra. The rough correlation between the average farm size and the importance of dryland planted to annual crops relative to tree/estate crops is found among those smallholders who operate agricultural land of less than 1 ha (or roughly, less than the provincial average) in Aceh and North Sumatra Provinces.

11. Judging from the census data, the correlation seems to reflect, in locational terms, the characteristics of those areas where physical characteristics of the terrains constrain the expansion of agricultural land and/or wetland, such as the Gayo, Karo, and Minang Highlands. More or less similar situations are found in the areas of transmigration where the availability of wetland is (yet) limited. This indicates the growing need and importance of non-rice annual crops in smallholder agriculture in the Region. Moreover, the existence of shifting cultivation, which probably accounts for a substantial part of dryland area planted to arable crops in such areas, requires farming, or land use, systems which are sound from the viewpoint of environmental conservation.

3. Tree/Estate Crop Subsector

12. The tree/estate crops have always been extremely important in the Region not only for large-scale estates but also for smallholders. According to the agricultural land use survey of 1986, the Region is reported to have 24.3 million ha under large-scale state and private estates, which is nearly twice as large as the total wetland area. The Region's share in the national total amounts to 30%. Among the four provinces, North Sumatra has the largest estate area, accounting for 47% of the Region's total, followed by Riau (28%), Aceh (14%) and West Sumatra (11%).

13. In terms of the planted area by the estates, rubber and oil palm are the most important in the Region, totalling 282,000 ha and 410,000 ha respectively (Table 8). In terms of production, the Region's estates account for 63% of dry rubber and 94% of palm oil of the national total in 1986. Over the past decade of 1976 - 1986, estate production of these crops in Indonesia grew 3.6% for rubber and 11.5% for palm oil per annum. Although the planted area of cocoa in Indonesia is yet very small, the Region's estates also account for 50% of the national production. Because of the low initial level of production, the growth of cocoa beans in Indonesia has been even more rapid than palm oil, recording over 22% per annum over the same period.

14. Compared with rubber, oil palm and cocoa, the shares of the Region's estates in other estate crops are generally smaller, amounting to 20% for tea, and 15% in sugarcane in terms of production. Among the four provinces, North Sumatra has the overwhelming shares of the

Table 7. Average Farm Size and Composition of Cropped Land 1983

	(Unit: ha)						
	Irrigated Wetland	Total Wetland	Annual Crops Dryland	Estate Crops Dryland	Total Dryland	Total Cropped Land	Of which, Wetland (%)
1. Aceh Besar	0.13	0.40	0.08	0.29	0.37	0.76	52.3
2. Northern Aceh	0.26	0.36	0.19	0.26	0.45	0.81	44.5
Pidie	0.40	0.44	0.05	0.11	0.16	0.60	72.9
Aceh Utara	0.17	0.33	0.20	0.19	0.39	0.72	45.8
Aceh Tengah	0.27	0.30	0.44	0.80	1.24	1.54	19.2
3. Aceh Timur	0.08	0.43	0.29	0.33	0.61	1.04	41.4
4. Aceh Tenggara	0.41	0.51	0.09	0.25	0.33	0.84	60.5
5. Aceh Barat	0.14	0.77	0.09	0.67	0.76	1.53	50.4
6. Aceh Selatan	0.04	0.25	0.16	0.37	0.53	0.78	32.6
TOTAL ACEH	0.19	0.42	0.17	0.33	0.50	0.93	45.7
9. East Coast North Sum.	0.15	0.41	0.26	0.22	0.48	0.89	46.3
Langkat	0.07	0.42	0.33	0.29	0.62	1.03	40.3
Deli Serdang	0.20	0.38	0.23	0.13	0.36	0.74	51.2
Simalungun	0.27	0.29	0.33	0.09	0.42	0.71	41.0
Asahan	0.14	0.46	0.23	0.18	0.41	0.87	53.0
Labuhan Batu	0.03	0.59	0.21	0.50	0.71	1.30	45.4
10. Karo Highlands	0.11	0.14	0.51	0.22	0.73	0.86	16.0
Karo	0.11	0.15	0.68	0.10	0.78	0.94	16.5
Dariri	0.12	0.12	0.34	0.33	0.67	0.79	15.3
11. Tapanuli Utara	0.21	0.26	0.22	0.21	0.42	0.69	38.4
12. West Coast Tapanuli	0.23	0.37	0.11	0.36	0.47	0.84	43.8
Tapanuli Tengah	0.17	0.36	0.09	0.37	0.47	0.82	43.3
Tapanuli Selatan	0.25	0.37	0.12	0.35	0.47	0.84	43.9
13. Nias	0.05	0.24	0.35	0.53	0.88	1.12	21.7
TOTAL NORTH SUM.	0.16	0.35	0.26	0.27	0.53	0.87	39.5
14. Central West Sum.	0.26	0.37	0.20	0.17	0.36	0.73	50.4
Tanah Datar	0.31	0.39	0.22	0.12	0.33	0.72	53.8
Padang Pariaman	0.21	0.38	0.26	0.28	0.54	0.92	41.2
Agam	0.27	0.34	0.11	0.09	0.21	0.55	62.4
15. Pasaman	0.32	0.41	0.17	0.20	0.38	0.79	52.1
16. Lima Puluh Koto	0.25	0.40	0.19	0.09	0.28	0.68	59.0
17. Southeast West Sum.	0.28	0.41	0.29	0.18	0.47	0.89	46.5
Solok	0.34	0.44	0.28	0.13	0.41	0.86	51.9
Sawahl./Sijunjung	0.19	0.36	0.32	0.25	0.57	0.93	38.6
18. Pesisir Selatan	0.19	0.36	0.10	0.09	0.19	0.55	65.0
TOTAL WEST SUM.	0.27	0.39	0.21	0.16	0.36	0.75	51.7
20. Kampar	0.05	0.17	0.82	0.93	1.75	1.93	9.1
21. Bengkalis	0.00	0.22	0.60	1.08	1.68	1.90	11.5
22. Indragiri Hulu	0.02	0.22	0.53	1.04	1.57	1.79	12.2
23. Indragiri Hilir	0.00	0.84	0.26	2.20	2.46	3.30	25.4
24. Riau Islands	0.01	0.06	0.57	2.11	2.68	2.74	2.1
TOTAL RIAU	0.02	0.31	0.59	1.33	1.92	2.23	13.8
REGIONAL TOTAL	0.18	0.37	0.27	0.37	0.63	1.00	36.6

Source: BPS, Agricultural Census 1983.

Table 8. Area and Production of Major Tree/Estate Crops (1986)

		(Unit: 000 ha or tons)						
		Aceh	North Sumatra	West Sumatra	Riau	Region	National Total	Share of Region(%)
Rubber								
Planted Area	Estate	26.4	232.5	3.3	20.1	282.3	507.4	55.6
	Smallholder	44.1	319.3	64.8	310.1	738.3	2366.2	31.2
	Total	70.5	551.8	68.1	330.2	1020.6	2873.6	35.5
Prod.:dry rubber	Estate	5.9	213.4	1.1	1.1	221.4	350.0	63.3
	Smallholder	12.6	166.7	36.4	72.9	288.5	763.2	37.8
	Total	18.5	380.0	37.4	73.9	509.9	1113.1	45.8
Oil Palm								
Planted Area	Estate	43.2	321.7	6.7	37.3	409.0	476.9	85.8
	Smallholder	2.0	47.2	4.2	26.2	79.5	129.9	61.2
	Total	45.2	368.9	10.9	63.5	488.5	606.8	80.5
Prod.:palm oil	Estate	91.6	1116.8	2.2	64.5	1275.1	1350.7	94.4
Cocoa								
Planted Area	Estate	0.2	14.7	0.0	0.0	14.9	45.6	32.6
	Smallholder	0.6	2.6	0.8	0.3	4.2	58.6	7.2
	Total	0.8	17.2	0.8	0.3	19.1	104.2	18.3
Prod.:dry beans	Estate	0.0	11.7	0.0	0.0	11.7	23.3	50.2
	Smallholder	0.0	0.3	0.0	0.0	0.4	11.8	3.0
	Total	0.0	12.0	0.0	0.0	12.1	24.1	50.0
Tea								
Planted Area	Estate	0.0	10.6	0.4	0.0	11.0	71.9	15.3
	Smallholder	0.0	0.0	0.3	0.0	0.3	54.4	0.5
	Total	0.0	19.1	0.7	0.0	19.7	126.3	15.6
Prod.:dry leaves	Estate	0.0	19.1	0.3	0.0	19.4	98.4	19.7
	Smallholder	0.0	0.0	0.2	0.0	0.2	31.1	0.5
	Total	0.0	19.1	0.4	0.0	19.5	129.5	15.1
Coconut								
Planted Area	Estate	0.0	5.4	0.0	2.2	7.7	56.0	13.8
	Smallholder	97.9	137.4	75.0	291.0	601.3	3056.6	19.7
	Total	97.9	142.9	75.0	293.2	609.0	3112.5	19.6
Prod.:copra equiv.	Estate	0.0	3.3	0.0	0.2	3.5	24.4	14.3
	Smallholder	64.3	84.9	60.3	154.8	364.3	1950.3	18.7
	Total	64.3	88.2	60.3	155.0	367.8	1974.6	18.6
Coffee								
Planted Area	Estate	0.0	0.0	0.1	0.0	0.2	46.3	0.4
	Smallholder	59.9	46.4	20.5	10.5	137.2	888.9	15.4
	Total	59.9	46.5	20.6	10.5	137.4	935.2	14.7
Prod.:dry beans	Estate	0.0	0.0	0.1	0.0	0.1	27.2	0.3
	Smallholder	29.2	32.2	8.1	4.9	74.4	329.6	22.6
	Total	29.2	32.2	8.2	4.9	74.5	356.8	20.9
Clove								
Planted Area	Smallholder	39.9	24.6	15.4	14.6	74.5	679.3	11.0
Prod.:dry fouli	Smallholder	5.0	2.3	0.8	0.6	8.6	50.6	17.1
Nutmeg								
Planted Area	Smallholder	5.1	0.2	2.1	0.0	7.4	63.1	11.7
Prod.:dry beans/fouli	Smallholder	2.0	0.1	0.8	0.0	3.0	15.1	19.6
Cinnamon								
Planted Area	Smallholder	0.0	4.5	21.1	0.2	25.9	71.5	36.3
Prod.:dry bark	Smallholder	0.0	1.0	14.3	0.0	15.3	21.0	73.0
Candlenut								
Planted Area	Smallholder	5.8	4.2	0.0	0.0	10.0	84.7	11.8
Prod.:	Smallholder	5.9	4.5	0.0	0.0	10.4	28.9	35.9
Arocanut								
Planted Area	Smallholder	13.4	0.3	0.4	0.0	14.2	87.9	16.2
Prod.:	Smallholder	9.4	0.1	0.3	0.0	9.8	20.7	47.3
Sugarcane								
Planted Area	Estate	2.5	10.8	0.0	0.0	13.3	87.2	15.2
	Smallholder	0.0	5.8	9.5	0.4	15.7	238.5	6.6
	Total	2.5	16.6	9.5	0.4	29.0	325.7	8.9
Prod.:brown sugar	Estate	8.0	58.6	0.0	0.0	66.7	447.0	14.9
	Smallholder	0.0	30.5	18.8	0.3	49.5	1567.6	3.2
	Total	8.0	89.1	18.8	0.3	116.2	2014.6	5.8
Tobacco								
Planted Area	Estate	0.0	2.8	0.0	0.0	2.8	5.3	53.2
	Smallholder	6.0	0.4	1.0	0.0	7.4	193.6	3.8
	Total	6.0	3.2	1.0	0.0	10.2	198.8	5.2
Prod.:dry leaves	Estate	0.0	2.2	0.0	0.0	2.2	4.9	45.1
	Smallholder	3.3	0.2	0.4	0.0	3.9	96.3	4.1
	Total	3.3	2.4	0.4	0.0	6.1	101.2	6.1
Total Area of Estates		338.8	1132.9	264.7	690.9	2427.3	8036.3	30.2
Smallholder Estate Crop Area(1983)		113.4	230.7	67.4	262.8	674.3		

Sources: Data from I Data from Direktorat Jenderal Perkebunan
BPS, Land Area by Utilization in Outer Java 1986
BPS, Agricultural Census 1983

planted areas, accounting for 82% of rubber, 78% of oil palm, and nearly 100% of cocoa and tea.

15. Tree or estate crops are also very important for small farmers in the Region. According to the agricultural census of 1983, smallholders possessed 674,000 ha planted to tree/estate crops, of which Riau accounted for 39%, followed by North Sumatra (34%), Aceh (17%) and West Sumatra (10%). As shown in Table 7, the average holding per farming household was largest in Riau (1.33 ha), followed by Aceh (0.37 ha), North Sumatra (0.27 ha) and West Sumatra (0.16 ha).

16. As shown in Table 8, two most important tree/estate crops for smallholders are rubber and coconut, estimated to total 740,000 ha and 600,000 ha respectively in the Region. Among the four provinces, Riau and North Sumatra have large shares in terms of the planted areas, together accounting for 85% for rubber and 70% for coconut in the Region. Although much less extensive in planted area, coffee is also important as one of the smallholder tree crops. The largest planted area is located in Aceh, closely followed by North Sumatra, and the two provinces together account for 82%.

17. In addition, there are a variety of other tree/estate crops predominantly grown by smallholders, such as clove, nutmeg, and cinnamon. Although relatively minor compared with rubber, coconut and coffee in regional terms, these tree crops are just as important as sources of income for smallholders in certain parts of the Region.

18. Although very extensive in aggregate planted areas, the smallholder tree crops are generally characterized by low productivity and quality and stagnant growth. The typical case is rubber. As shown in Table 8, the planted area of smallholder rubber is more than twice as large as that of estates, but its dry rubber production accounts for only 56% of the regional total. Trees are mostly aged and of low genetic potential, and coupled with poor maintenance and inappropriate tapping methods, the yields are said to be very low at around 620 kg/ha compared with the agronomic potential of 2000 - 3000 kg of improved varieties. The large area is often left untapped when the price is depressed, and the growth of smallholder rubber during 1976 - 1986 was only 2.2% compared with 3.6% of estate production. Coconut oil is the preferred edible oil in Indonesia, but the production of coconut increased by 2.5% per annum during the same period, while palm oil grew at more than 12%, replacing a large chunk of domestic consumption partly because of the government regulation. Poor knowledge of maintenance, production, and processing techniques among smallholders is common in other tree crops such as coffee and clove.

4. Livestock Subsector

19. The livestock subsector in Indonesia is relatively small, accounting for about 10% of the agricultural GDP. The Region's livestock population density is larger than national average in buffalo (Aceh), pig (W. Sumatra) and broiler (N. Sumatra and Riau). According to the 1983 agricultural census, the combined population of larger livestock (cattle, buffaloes and horses) in Indonesia was about 12 million, but relative to some 18.6 million farming households, the ratio is 0.64 head per household, and relative to "controlled" agricultural land, the ratio is 0.67 head per ha (Table 9).

20. The situation is similar in the Region which had a combined larger livestock population of 1.1 million. The regional ratios to farming households (2 million) and agricultural land (2.4 million ha) are a little lower than the national average. However, there are

notable variations among the four provinces. Namely, Aceh has significantly higher ratios, while the ratios of Riau and North Sumatra are a half, or less than a half, of the national averages.

21. The average size of herds or flocks per farm household in the Region as a whole is small and not much different from the national average. Among the four provinces, West Sumatra has relatively small herds of cattle and buffaloes than the other three provinces, but the difference does not amount to much. The average holding of broilers/layers per household, for which some commercial undertakings have been developing, is larger in North Sumatra (250) and Riau (300), but a little less than 30 in Aceh and 140 in West Sumatra.

22. There are similar provincial differences in the distribution of livestock and poultry in 1987 (Table 10). Aceh has relatively large populations of cattle and buffaloes, while North Sumatra has much smaller populations of these large ruminants but the largest populations of pigs and broilers/layers. Riau has the sizable population of broilers relative to other sources of meat.

23. The Region's production of meat and eggs is estimated to be about 178,000 tons and 69,000 tons in 1987. Annual growth over 1983 - 1987 in the Region was 19.1% for meat, which was more than twice as high as in Java and Indonesia as whole, and 8.9% for eggs which was significantly lower than in Java and Indonesia as a whole. The rapid growth of meat in the Region has been due to the increase of pork and broiler meat. In contrast, the growth rate of beef production has been a low 2.6% in comparison with the national rate of 3.7%. The lower growth of egg production in the Region has been due to the slower growth of egg production from layers as opposed to native chickens. In Java, eggs from layers increased at a little over 15% per year, compared with 4.6% in the Region.

24. The annual per capita production in the Region of 10.8 kg for meat and 3.5 kg for eggs is higher than the national average and the average in Java (4.7 kg and 2.7 kg). This is chiefly because of the higher production of pork, broiler meat and other livestock meat excluding beef. The Region's per capita beef production of 0.69 kg was roughly one half of the national average. The higher per capita egg production in the Region was primarily because of the large production of duck eggs. In the absence of information on consumption, these per capita production figures might be taken as indicative of the higher consumption of local animal foods in the Region. The results of the consumption survey in 1987 at least show higher consumption figures of meat and eggs in West Sumatra relative to the national average.

5. Development Potentials

25. As shown in Table 11, the land utilization survey in 1987 reports that the Region has 1.3 million ha of wetland, of which a little less than 40%, or 500,000 ha, is equipped with some forms of irrigation. Furthermore, 40% of the irrigated area is under technical and semi-technical systems. According to the survey, roughly 70% of irrigated wetland and 34% of total wetland can be used for double-cropping (or more) of rice. Relative to the total planted area of wetland paddy, the actual cropping intensity was only 100%.

26. Supposing that the regional average yield of wetland paddy increase to the present national average of 4.3 tons by the year 2008, a net increase of a little over 300,000 ha in harvested area would ensure the maintenance of the Region's self-sufficiency in rice. The existence of 300,000 ha under simple irrigation systems and over

Table 9. Selected Indicators of Livestock Subsectors (1983)

	Acch	North Sum	West Sum.	Riau	Region	Indonesia
Population of Larger Livestock (1000 heads)	383	322	312	62	1079	11958
No. per farming households	1.1	0.3	0.6	0.2	0.5	0.6
No. per ha of agricultural land	1.0	0.3	0.8	0.1	0.4	0.7
No. per ha of wetland	2.8	1.0	1.9	0.9	1.6	2.2
Average size of herd or flock						
Cattle	3.3	2.8	1.7	2.7	2.4	2.2
Buffalo	2.6	2.4	1.7	3.0	2.3	2.6
Pig	2.3	2.5	7.4	6.0	2.7	2.9
Goat/sheep	5.4	4.5	2.5	4.4	4.3	3.3
Layer/broiler	28.7	252.9	136.9	303.3	178.1	131.5

Source: BPS, Agricultural Census 1983, Series A4.

Table 10. Livestock Population and Production and Consumption of Livestock Products (1987)

	Acch	North Sum	West Sum.	Riau	Region	Indonesia
Population (1000 heads)						
Dairy cattle	0	5.6	2.3	0	7.9	225.4
Cattle	408.5	160.8	354.1	65.7	989.1	9616.2
Buffalo	469.6	187.7	172.9	37.5	867.6	3287.3
Pig	9.3	1249.1	23.0	35.5	1316.8	6214.859
Goat/sheep	471.0	377.1	222.5	137.5	1208.0	15378.9
Layer	141.1	2080.1	1629.4	519.9	4370.5	38687.8
Broiler	66.8	2126.8		2177.2	4370.8	19196.6
Native chicken	8094.5	9982.4	2177.2	2325.5	22579.6	162990.9
Meat production (1000 t)						
Beef	5.3	3.6	5.2	0.8	14.8	235.2
Buffalo meat	1.5	4.3	3.3	2.2	11.3	48.8
Pork	0.3	44.0	1.7	4.4	50.3	158.8
Goat meat	3.2	4.4	2.0	0.3	9.8	93.5
Subtotal livestock meat	31.0	56.5	12.2	7.6	107.2	537.4
Broiler meat	0	18.4	0	18.9	37.3	174.8
Subtotal poultry meat	10.0	30.3	8.5	21.7	70.5	389.5
Total meat	41.0	87.0	20.7	29.3	177.9	926.9
Layer eggs	0.9	13.5	10.6	3.4	28.4	300.4
Total eggs	18.6	23.9	20.3	5.9	68.7	494.6
Per capita production (kg/year)						
Livestock meat	9.9	5.7	3.2	2.8	5.5	3.1
Poultry meat	3.2	3.1	2.2	8.0	3.6	2.3
Eggs	5.9	2.4	5.3	2.2	3.5	2.9
Per capita consumption (g/week)						
Meat	38	31	54	37		46
Eggs	56	61	85	118		62

Sources: Direktorat Jenderal Perternakan, Statistical Book on Livestock 1988
BPS, Pengeluaran untuk Konsumsi Penduduk Indonesia per Provinsi 1987

Table 11. Land Use in Northern Sumatra Region 1987

(Unit: 1000 ha)

	Total			Total			Shift. Cultiv.	Total Unused Dryland
	Wetland	Irrig. Area	Simple Irrig.	Used Dryland	Estates	Perm. Used Dryland		
1. Aceh Besar	31	6	4	108	19	41	21	39
2. Northern Aceh	115	48	33	516	119	177	104	81
Pidie	37	15	9	105	8	47	3	41
Aceh Utara	65	30	20	235	16	92	63	30
Aceh Tengah	13	3	3	176	95	39	39	10
3. Aceh Timur	57	6	3	241	102	54	22	30
4. Aceh Tenggara	23	5	5	56	38	11	5	10
5. Aceh Barat	49	7	1	118	31	38	9	84
6. Aceh Selatan	40	21	18	132	43	31	22	179
TOTAL ACEH	315	94	63	1170	351	352	184	424
8. Medan	5	0	0	12	0	1	1	0
9. East Coast North Sum.	366	131	52	1483	890	252	118	189
Langkat	62	7	3	367	170	40	40	21
Deli Serdang	101	52	23	218	131	63	10	6
Simalungun	50	45	13	250	137	54	47	33
Asahan	55	16	6	290	151	74	7	4
Labuhan Batu	98	12	8	358	302	20	14	125
10. Karo Highlands	23	22	17	116	11	35	57	57
Karo	13	12	7	61	4	12	38	34
Dariri	10	10	10	56	7	23	18	23
11. Tapanuli Utara	55	50	44	185	73	46	26	173
12. Southern Tapanuli	98	58	45	202	139	31	12	258
Tapanuli Tengah	14	8	5	64	44	13	4	17
Tapanuli Selatan	84	50	39	138	95	18	8	241
13. Nias	21	4	3	233	63	129	27	31
TOTAL NORTH SUMATRA	568	266	163	2230	1176	494	241	707
14. Central West Sum.	92	52	21	242	78	90	41	30
Tanah Datar	25	8	4	51	3	28	12	3
Padang Pariaman	37	22	8	126	57	40	14	7
Agam	30	22	9	65	17	22	15	21
15. Pasaman	30	16	4	164	64	48	41	32
16. Lima Puluh Koto	26	18	13	67	12	34	3	35
17. Southeast West Sum.	50	26	12	200	84	59	23	52
Solok	34	21	10	93	41	27	12	39
Sawahl./Sijunjung	16	5	2	107	43	32	11	13
18. Pesisir Selatan	26	12	5	106	34	49	13	14
TOTAL WEST SUMATRA	224	124	55	779	272	279	121	162
20. Kampar	28	7	5	454	222	91	83	187
21. Bengkalis	45	0	0	652	283	195	24	85
22. Indragiri Hulu	25	2	2	248	181	31	7	32
23. Indragiri Hilir	93	5	5	199	0	146	4	85
24. Riau Islands	2	0	0	148	80	23	4	229
TOTAL RIAU	193	14	12	1700	766	487	122	617
REGIONAL TOTAL	1301	497	293	5879	2565	1612	668	1910

Notes: 1. Used dryland consists of home gardens, estates, permanently cropped land (tree and annual crops), and shifting cultivation.
 2. Unused dryland consists of temporary fallow and grassland, and excludes communal and private forests and unused swamps.

Source: BPS, Land Area Utilization in Outer Java 1987

800,000 ha of unirrigated wetland implies the Region's capacity of producing a sizable surplus through the turn of the next century. To put it differently, the appropriate scale of investments in irrigation facilities during the next twenty years should depend not so much on the availability of land but the prospects of domestic demand for rice outside the Region.

27. With respect to dryland (or upland), the same survey records that three more or less permanently utilized land categories of house gardens, estates and permanently used dryland (consists of kebun, or tree crop areas, and tegal, or permanently used upland fields) total 5.8 million ha, or four times the total wetland. Excluding swamps and communal forests, the under-utilized dryland areas comprising three categories of shifting cultivation, temporary fallow and grassland total 2.6 million ha.

28. Granted that all of the existing dryland areas with varying degrees of utilization are not suitable for sustainable agricultural development, their vast availability and the diversity of agro-climatic conditions in the Region indicate large development potentials, such as tree/estate crops, arable crops and animal husbandry.

29. With respect to the natural conditions, the most important constraint in Sumatra Island as a whole is soil suitability, because rainfalls are generally abundant and well-distributed. The soil survey and mapping of Sumatra are underway by the Soil Research Institute of Bogor, but not yet released. According to the available information, the two commonest soil types are said to be red-yellow podosols and swamp soils (organosols and humic gley soils), respectively covering 47% and 22 % of the total land area of Sumatra.¹ More fertile soil types of andosols, alluvial soils and latosols together account for about 30% (Figure 1). Nonetheless, in so far as appropriate corrective measures and environmentally sustainable land utilization techniques are developed and employed, the sizable part of the Region's vast dryland areas can be successfully harnessed for diversified agricultural production including irrigation development.

B. Development Strategy

1. Development Issues

30. In the last 15 years or so, the agricultural sector played an important role in realizing Indonesia's major development objectives, such as GDP growth, employment generation, food security and nutrition improvement, and the balance of payment improvements. Especially noteworthy was the increased rice production, which culminated in the achievement of self-sufficiency in 1984, and was the leading factor to generate the substantial secular GDP growth (1974 - 1984) of 4.5% per annum in the food crops subsector, and that of 3.8% in the agricultural sector as a whole.

31. However, the recent trend after 1984 indicates that it is unrealistic, and unwarranted, to expect the similarly favorable rice-based performance of the food crop sub-sector over the next decade and beyond. Undoubtedly, it is crucial to maintain the self-sufficiency in rice in the years to come, but the required long-term growth of rice output will be paced along with the expected population increase, and

¹ Ulrich Scholz, The Natural Regions of Sumatra and their Agricultural Production Pattern: A Regional Analysis, vol. I, 1983.



Figure 1. Distribution of Main Soil Types (Part)

Source: U. Scholz, *The Natural Regions of Sumatra and Their Agricultural Pattern: A Regional Analysis, Vol. II: Maps, 1983, Map 5: The Main Soil Types of Sumatra*

will be significantly lower than the annual growth of 5.4% in rice output achieved during 1974 - 84.

32. The future growth of the agricultural sector must be generated, without sacrificing the past achievements in rice production, through diversification which will effectively serve to improve the productivity and the income of farmers and fisherman, to expand agriculture-related industrial and business opportunities and employment, to ensure better national nutrition and food sufficiency, and to boost non-oil exports.

33. Important issues for the future agricultural development in the Region can be phrased as follows:

- (i) How far and how best the Region can contribute to the maintenance of rice self-sufficiency in particular, and of food self-sufficiency with better nutritional balance, in general.
- (ii) What kinds and manners of diversification would be appropriate and/or advantageous for the Region in order to (a) generate income and employment opportunities mainly but not only for rural population and (b) achieve more efficient resource allocations from the viewpoint of the production growth and the balance of payments improvement.

34. These issues must be carefully examined by taking into consideration the following four factors. The first is the fact that Java has almost exhausted its capacity to generate additional employment opportunities in agriculture. This is best illustrated by the preponderance in Java provinces of farming households which control less than 0.5 ha of agricultural land (ranging from 60% - 65%, compared with 18% - 39% in the Region) and by the observation that some 20,000 - 30,000 ha of paddy harvested area is annually lost due to growing urbanization and industrialization in Java. This implies that agriculture in the Outer Islands will have to contribute to growth and employment generation much more than before.

35. The second factor is the significant on-going changes in government policy which directly and indirectly affect the future agricultural development. The general theme of the changes is the lessening of government intervention and the increased reliance on the private sector initiatives and market mechanisms. Specifically in relation to the agricultural sector, among the agenda are elimination or gradual reduction of subsidization on inputs and production credit, reassessment and readjustment of price policy on major agricultural commodities, sharing of operation and maintenance costs of irrigation, or direct management of small systems, by farmers and local government, and so forth. Moreover, the macro policy stance for increasing deregulation and privatization in other sectors will also have an important bearing on agriculture, especially stimulating the private sector investments in commercial agriculture.

36. The third factor is the obvious inadequacy of institutional supports to expedite the so-called diversification. To limit the discussion only to "horizontal" diversification, basic and applied research efforts and extension services on non-rice arable crops are yet insufficient to generate and impart suitable production technologies for the majority of small farmers. Moreover, there is a question of considerable marketing risks which small farmers have to shoulder even if some suitable technologies for diversification should be made available.

37. The fourth factor is the necessity of environmental conservation, which is considered as one of the most important policy objectives in the present Pelita V period. Specifically in relation to the agricultural sector, this issue is basic to realize sustainable growth in its subsectors, such as fisheries and forestry as well as cultivation of crops.

2. National Strategies for Agricultural Development

38. The People's Consultative Assembly in March 1988 designated the agricultural sector as having the highest development priority during Pelita V. It says: "Agricultural development, which includes production of food and commercial crops (estates), fisheries, cattle and poultry breeding and farming and forestry, is designed to promote the growth of advanced, efficient and viable agriculture. It aims to increase the yields and quality of production and the income of farmers and fishermen, to expand employment and business opportunities, to support industrial development and to boost exports. The processes of diversification, intensification, extensification and rehabilitation should be implemented in an integrated and proportionate way, having due regard for the soil, water and climatic conditions with a view to the preservation of natural resources and the living environment."¹

39. The Team generally supports the above strategy, with the following observations. Self-sufficiency in rice achieved in 1984 experienced a setback in 1987 and 1988 when production was reportedly affected by the unfavorable weather. Undoubtedly, Indonesia is now in a much better position to cope with this setback than a decade ago. In the medium and the long term, however, the country is required to maintain its self-sufficiency in rice more efficiently, by, *inter alia*, reducing the fertilizer subsidies, and adjusting price and technology policies pertaining to rice and other food crops more in line with international market trends.

40. Indonesia should make every effort to expedite agricultural diversification in conjunction with sustained rice self-sufficiency for three major reasons. Firstly, more balanced food self-sufficiency including palawija crops, tree crops, livestock, fish, vegetables and fruits will have to be considered along with expected income growth and nutritional improvement. Secondly, rice mono-cropping as a policy target is riskier from the view point of farm revenues. Thirdly, agricultural diversification takes long time and requires well-prepared research work and extension services, and thus the action must be taken immediately.

41. The intensification strategy should continue not only for rice but also for dryland crops and estate crops, especially of the smallholder sector, as part of the diversification drive. Appropriate technology of irrigation for diversified crops should be developed to sustain land and water productivity with minimum operation, maintenance and repair cost. Emphasis on extensification will be reduced partly because of the fiscal constraints and partly because of the environmental consideration. In this regard, new major irrigation development will be substantially cut down especially in Java where the bulk of investments have already been directed. However, the areal expansion of export-oriented tree crops, especially by large-scale government and private estates, will be encouraged in Outer Islands.

¹ Ministry of Information, Decrees of the People's Consultative Assembly of the Republic of Indonesia, March 1988, p.47.

42. The priority for rehabilitation is to consolidate the progresses and to remedy the shortfalls created during the past development plans. The most notable policy focus will be on upgrading the efficiency of the already existing irrigation systems and plantings of tree crops through the improvement of operation and maintenance. The recent experiences have proved that the rehabilitated irrigation projects will require another rehabilitation in less than a decade due to poor operation and maintenance. Thus, the most cost effective method in a long run should be sought among various alternatives concerning rehabilitation, improvement, operation, maintenance and repair of a project.

43. Considering the national long-term objective of creating a cost-efficient economy, the strategic priorities mentioned above are not simply expediciencies necessitated by the current budget and foreign exchange constraints, but are expected to have continued relevance beyond the current Fifth Five-Year Development Plan.

3. Strategies for the Region

44. On the basis of the major characteristics mentioned in the preceding section, the broad framework of development will consist of (i) the maintenance of regional rice self-sufficiency, and possibly, of some surplus to supply to other parts of the country in the long term, (ii) the productivity improvement and selective areal expansion of tree/estate crops, (iii) the promotion of selective diversification, most notably, into major palawija crops (maize, cassava and oil seeds), higher-altitude horticulture, selected tropical fruits, and animal husbandry (mainly ruminants).

3.1. Rice

45. The total demand for rice in the Region is projected to increase from an estimated 4.68 million tons (in dry unhusked rice) in 1988 to 6.86 million in the year 2008 (Table 12), growing 2.3% per annum during 1988-98, and 1.6% during 1998-2008. Provincial breakdowns indicate that in West Sumatra the present level of production will more than satisfy the expected provincial demand in 2008.

46. In order to meet the regional demand, the output of rice will have to increase at the average rate of 1.5% per annum during 1988-2008, or 1.8% in the first decade and 1.2% in the second. Assuming that the contribution of dryland rice to total production would remain approximately the same through 2008, and that the regional average yield of wetland rice would grow from 3.8 tons per ha in 1986 to 4.3 tons, the harvested area of wetland rice will have to be expanded to a little over 1.6 million ha by the year 2008, a net addition of some 400,000 ha.

47. Supposing that the reported annual reduction of rice harvested areas continue in Java and that the significant slowdown in recent years of yield improvement in Java suggests the limits of the currently available technological packages of cultivators and other production inputs, the Region may have to maintain its surplus in order to feed the growing population in other parts of the country, most notably the southern Sumatra region. However, considering the facts that the country has already passed the stage where the rice output must be increased at all costs and that self-sufficiency is now not the issue of rice alone but of food in general of better nutritional standards, the target for surplus in the Region with regard to rice will have to be weighed carefully from the prospects of income-

Table 12. Estimated Demand and Production of Rice by Province
(in dry unhusked rice)

	1986	1988	1993	1998	2008	Annual Growth Rates(%)		
						1988-93	1993-98	98-2008
Estimated Demand (1000 tons)								
Aceh	723.0	755.2	864.8	976.0	1152.7	2.7	2.4	1.7
North Sum.	2251.4	2366.2	2669.2	2980.0	3524.5	2.4	2.2	1.7
West Sum.	894.2	899.0	956.6	1007.1	1050.1	1.2	1.0	0.4
Riau	619.2	660.6	778.0	903.7	1132.4	3.3	3.0	2.3
Total Region	4487.9	4681.1	5268.7	5866.8	6859.7	2.4	2.2	1.6
Estimated Wetland Production (1000 tons)								
Aceh	1023.7	1069.6	1193.6	1349.9	1567.0	2.2	2.5	1.5
North Sum.	1913.3	2010.9	2276.7	2572.9	3068.0	2.5	2.5	1.8
West Sum.	1397.8	1454.8	1607.7	1740.1	1818.0	2.0	1.6	0.4
Riau	292.3	307.8	356.5	421.8	586.7	3.0	3.4	3.4
Total Region	4627.2	4843.2	5434.5	6084.7	7039.7	2.3	2.3	1.5
Estimated Dryland Production (1000 tons)								
Total Region	267.8	272.5	285.4	294.6	309.7	0.9	0.6	0.5
Total Production	4895.0	5115.7	5719.9	6379.3	7349.4	2.3	2.2	1.4
Estimated Surplus	407.1	434.6	451.2	512.5	489.7	0.8	2.6	-0.5
Estimated Yields of Wetland Rice (tons/ha)								
Aceh	3.64	3.66	3.75	3.87	4.17	0.5	0.6	0.7
North Sum.	3.78	3.84	3.97	4.10	4.33	0.7	0.7	0.5
West Sum.	4.18	4.21	4.31	4.38	4.45	0.5	0.3	0.2
Riau	2.95	2.98	3.07	3.18	3.48	0.6	0.7	0.9
Total Region	3.79	3.83	3.94	4.05	4.28	0.6	0.6	0.5
Estimated Harvested Area on Wetland (1000 ha)								
Aceh	281.2	292.1	317.9	349.0	375.9	1.7	0.9	0.7
North Sum.	505.9	524.3	573.3	627.2	708.0	1.8	1.8	1.2
West Sum.	334.4	345.6	373.0	397.3	408.5	1.5	1.3	0.3
Riau	99.0	103.2	116.0	132.5	168.5	2.4	2.7	2.4
Total Region	1220.5	1264.2	1379.7	1502.6	1646.1	1.8	1.7	0.9

Note: The demand for 1986 and 1988 is based on per capita consumption in milled rice of 137kg. The consumption is assumed to increase to 143kg in 1998 and then to decline to 140kg in 2008. The supply for 1986 and 1988 is based on the recently revised milling rate of 65%, which is assumed to improve to 68% in 2008. The other conversion factors are taken from the Food Balance Sheet in Indonesia 1986 and applied to the entire period.

generating opportunities for small farmers. In the light of these considerations, the Team recommends that the Region should continue to be a rice-surplus (about 7%) area.

48. The projected production of rice in the Region shown in Table 12 is only indicative, and based on the following general assumptions.

- (i) The surplus of the Region would remain within the range of 400,000 - 500,000 tons (dry unhusked rice) and be supplied mainly to the southern Sumatra region (currently estimated to have a deficit of over 400,000 tons) and to a lesser extent to urban centers in Java.
- (ii) The self-sufficiency would be maintained in the Region as a whole, and not in each of the four provinces, although two currently deficit provinces (Riau and North Sumatra) would increase their respective production at higher rates than the other surplus provinces.
- (iii) The expected increase of production would be largely from wetland rice, and the production of dryland rice would remain in the range of 4% - 5% of the total production.
- (iv) The average yield of wetland rice in the Region will increase from the present 3.8 tons per ha to 4.3 tons in 2008, which is equivalent to the present national average. West Sumatra, which has the highest yield in the Region, would increase it to the level equivalent to the present average yield of Java.
- (v) The assumed gain in yield is set somewhat conservatively compared with the past achievement in Java, in view of the expected reduction of input subsidization and the generally lower soil fertility in Sumatra than in Java. Another assumption is that the emphasis of domestic demand would shift from more rice to better taste, influencing the breeding of new varieties.

49. The results show that the level of self-sufficiency would improve slightly in two deficit provinces: from 85% in 1986 to 87% in 2008 in North Sumatra and from 47% to 52% in Riau. Of the two surplus provinces, West Sumatra would raise its self-sufficiency from 156% to 178%, with the surplus increasing from 500,000 tons to over 800,000 tons, because of its advantageous position relative to the external demand. Approximately 50% of its surplus would be directed outside the Region. Aceh would increase its surplus from 300,000 tons to 400,000 tons, but the level of self-sufficiency will decline somewhat from 140% to 136%. With this surplus, Aceh and North Sumatra combined would maintain the self-sufficiency in rice.

50. In order to produce the indicative target, the harvested area of wetland will have to be expanded from 1.2 million ha in 1986 to 1.6 million in 2008, an increase of 425,000 ha. Two thirds of the expansion would be needed during the first decade of 1988-98. Supposing that the expansion be made by improving the existing irrigation facilities (chiefly single-cropped simple and village systems) and by developing technical and semi-technical systems on un-irrigated wetland, the scale of irrigation development would be about 24,000 ha per annum during the first decade and 14,000 ha during the second decade.

51. Location of irrigation development will have to ensure a certain degree of local self-sufficiency, partly because rice is cultivated by small farmers with strong subsistence orientation, and

partly because the transportation network is not yet adequately and evenly provided in rural areas of the Region to allow specialization of crop production by area or location.

52. Assuming that the current levels of rice production would remain the same, thirty-two kabupatens in the Region can be classified into four categories: those with deficits, including 100% self-sufficiency (twelve kabupatens), those with marginal surpluses of 25% or less which would be lost due to population increases within the next ten years (seven kabupatens), those with substantial surpluses of 60% or more which would meet the local demand through the next twenty years (eight kabupatens), and the remainder with moderate surpluses between the second and the third category (five Kabupatens) (Figure 2).

53. Excluding three kabupatens which include provincial capitals (Aceh Besar, Deli Serdang and Padang Pariaman), four deficit kabupatens of Nias, Kampar, Indragiri Hulu and Bengkalis need be given higher priority in the development of irrigation primarily in order to improve local food security. These kabupatens are isolated, or consist of isolated communities, and their existing wetland is generally characterized by the low percentage of irrigated areas, predominance of simple or village systems, if any, low cropping intensity and relatively large dryland rice areas, as shown in Table 13.

54. Except for geographical isolation, more or less similar situations are found in the remaining deficit kabupatens (Langkat, Asahan, Dairi and Aceh Tengah), and most of the marginal surplus kabupatens (Aceh Timur, Labuhan Batu, Tapanuli Selatan, Karo, and Tapanuli Utara). These kabupatens need be given priority in irrigation development, although it must be pointed out that irrigation development is already underway in some of these kabupatens.

55. In addition to ensuring a safe degree of local food security, irrigation development must consider market prospects from the standpoint of increased income generation for small rice farmers, by evaluating the access to urban and other promising markets outside the Region and moreover, the comparative advantage of rice production relative to other crops. This question is especially relevant to the areas with moderate to substantial surpluses shown in Figure 2. Before mid-1990s, it would be necessary to reorient the policy framework of rice production in the Region from the viewpoint of efficient regional and local specialization. One option is to produce a larger paddy surplus of about 1 million tons, by investing more on irrigation development in suitable places. However, in view of the present national objective of agricultural diversification, more emphasis might be placed on exploring the prospects of the palawija crop diversification for much of the single-cropped, or "sleeping" land in simple systems or in rainfed wetland areas.

3.2. Other Arable Crops

56. The existing cultivation of palawija and horticultural crops in the Region, as elsewhere in Indonesia, takes diverse forms on the actual smallholder farm level in accordance with the varying local environmental conditions, dominant cropping systems, and other socio-economic characteristics of small-scale farming. The available planting materials and technology packages are yet extremely inadequate to cope with this diversity. Furthermore, the marketing systems of palawija and horticultural crops which are poorly developed and often unreliable do not offer adequate incentives for farmers to adopt better seeds and improved farming practices.

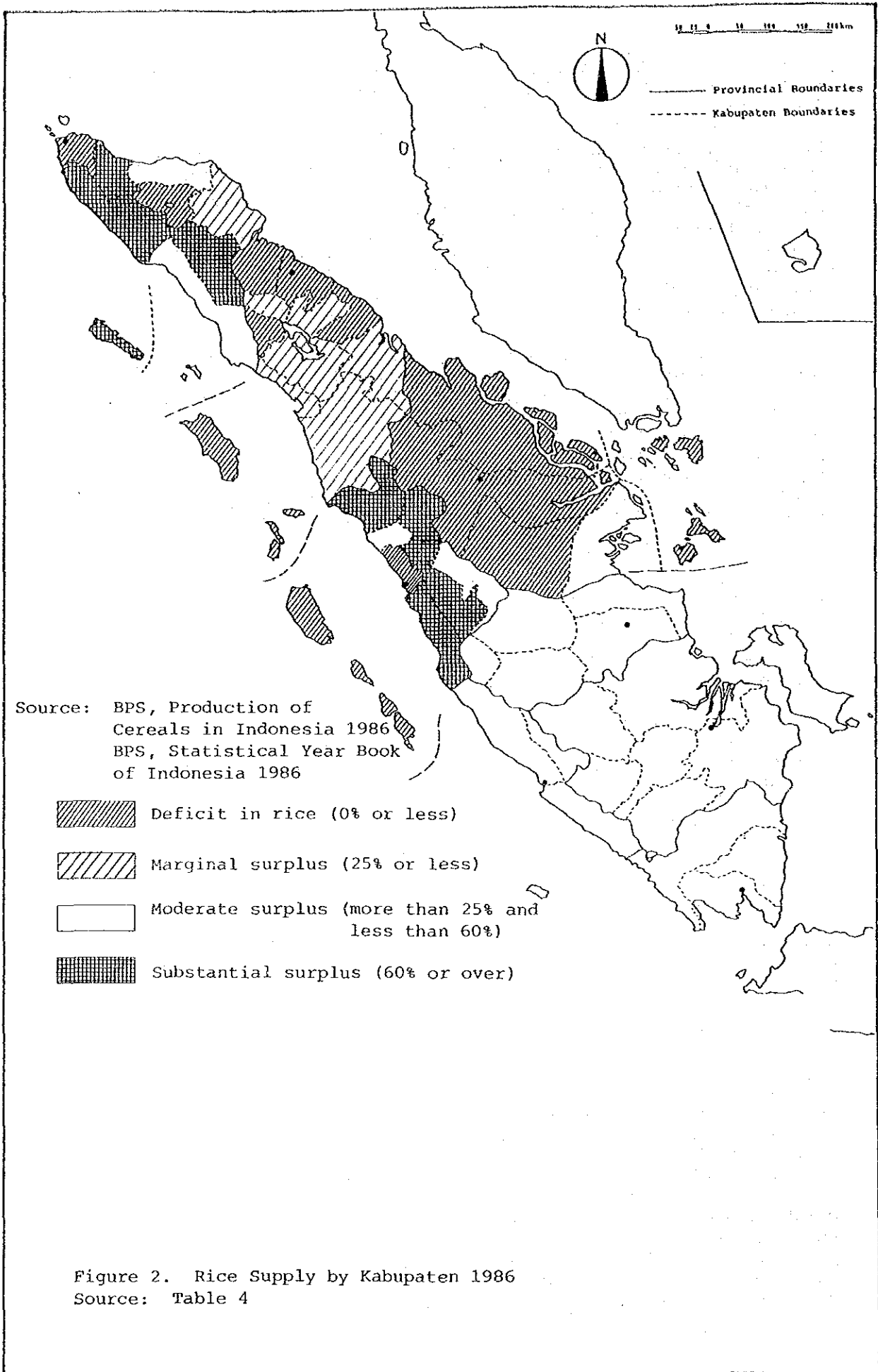


Table 13. Selected Indicators of Food Crop Subsector by Kabupaten (1986)

	Wetland		Irrigated wetland			Harv. Area of Dryland Paddy	Harvested Area of Palawija ¹⁾				Harvested Area of Horticulture ²⁾		
	Total Area	Paddy Cropping Intensity	Total Area	% of Wetland	% of Simple Systems		Total Area	% of roots	% of oil-seeds	% of Maize	Total Area	% of Group A	% of Group B
Aceh Besar	30.0	0.88	8.6	28.7	77.1	0.2	1.8	40.1	34.2	12.2	3.1	5.8	94.2
Pidie	35.2	1.16	32.3	91.6	83.1	7.0	10.7	5.4	83.5	5.2	5.2	9.3	90.7
Aceh Utara	60.4	1.20	27.2	45.1	68.6	37.5	71.9	4.5	83.0	11.5	7.0	0.3	99.7
Aceh Tengah	12.9	0.95	12.9	99.9	100.0	2.5	3.3	11.1	67.0	21.9	5.0	18.6	81.4
Aceh Timur	50.4	0.87	8.4	16.6	42.5	3.6	30.1	11.4	81.9	4.5	17.7	0.4	99.6
Aceh Tenggara	22.4	0.89	22.4	99.7	95.5	12.0	1.1	34.6	38.2	16.7	2.5	15.2	84.8
Aceh Barat	49.1	0.78	10.3	20.9	46.8	2.8	4.5	6.5	85.6	3.2	2.9	0.7	99.3
Aceh Selatan	63.5	0.44	25.8	40.6	90.0	14.2	7.9	10.6	68.1	17.1	5.1	5.3	94.7
Total Aceh	323.9	0.87	147.8	45.6	79.8	82.1	131.3	7.5	80.5	9.7	48.7	4.9	95.1
Langkat	56.2	0.96	6.1	10.9	41.5	14.2	17.3	4.7	65.8	26.8	3.6	0.0	100.0
Deli Serdang	95.4	1.16	51.2	53.7	44.4	80.7	11.7	24.6	24.8	41.3	7.9	3.5	96.5
Simalungun	49.9	1.24	42.3	84.8	36.2	82.0	20.9	14.3	15.0	68.8	6.5	35.8	64.2
Asahan	56.4	0.99	15.6	27.7	38.0	58.1	7.6	16.6	28.9	49.5	3.0	6.4	93.6
Labuhan Batu	88.3	0.57	12.3	13.9	73.8	15.1	1.8	33.1	32.5	30.6	1.0	0.0	100.0
Karo	12.4	0.73	11.8	95.4	68.2	180.0	26.5	0.1	6.8	92.5	11.0	50.2	49.8
Dairi	9.3	1.21	9.3	100.0	100.0	140.5	7.3	7.2	72.6	20.3	1.2	34.0	66.0
Tapanuli Utara	54.2	0.97	50.3	92.9	86.5	71.4	11.6	58.7	33.6	7.0	5.9	44.9	55.1
Tapa. Tengah	14.6	1.31	9.9	67.8	56.1	2.5	0.8	62.1	23.5	9.2	1.1	0.0	100.0
Tapa. Selatan	67.8	0.79	35.5	52.4	79.7	12.6	5.6	17.8	47.8	18.4	4.3	4.0	96.0
Nias	13.7	1.99	3.2	23.5	69.2	171.3	19.6	85.5	0.4	13.7	1.9	2.0	98.0
Total North Sum.	518.1	0.98	247.6	47.8	61.7	798.2	130.6	26.1	26.1	45.0	47.5	24.4	75.6
Tanah Datar	25.3	1.53	17.9	70.5	78.6	0.9	6.4	23.5	36.2	37.9	6.8	24.0	76.0
Padang Pariaman	37.3	1.66	25.9	69.5	46.2	0.1	4.2	28.8	47.8	20.5	5.5	0.2	99.8
Agam	29.5	1.39	22.5	76.2	40.8	4.7	6.7	32.8	29.2	35.9	4.5	20.5	79.5
Pasaman	30.5	1.37	20.6	67.5	46.6	43.5	15.4	5.1	70.6	16.4	5.4	0.9	99.1
Lima Puluh Koto	26.3	1.55	18.1	68.9	76.7	10.7	4.8	16.1	23.3	60.6	2.8	5.8	94.2
Solok	33.7	1.54	28.8	85.5	60.4	1.4	4.1	23.2	51.9	22.5	7.9	67.2	32.8
Saw./Sijunjung	16.0	1.32	8.0	49.6	66.4	75.2	11.8	9.4	76.4	8.7	2.1	0.0	100.0
Pesisir Selatan	25.6	1.45	16.7	65.4	56.6	0.8	4.4	18.6	56.5	12.8	1.5	2.5	97.5
Total West Sum.	224.4	1.49	158.6	70.7	57.3	137.3	57.9	16.2	55.2	23.6	36.5	22.2	77.8
Kampar	26.8	0.60	6.8	25.5	83.0	269.0	20.5	9.7	51.0	29.9	8.6	0.3	99.7
Bengkalis	35.0	0.79	0.0	0	0	88.3	4.5	58.4	19.3	19.1	8.5	0.6	99.4
Indragiri Hulu	19.4	0.44	1.4	7.3	100.0	102.3	7.4	19.1	52.7	19.0	3.6	0.1	99.9
Indragiri Hilir	94.2	0.49	5.0	5.3	100.0	29.0	9.0	13.8	10.3	73.6	3.2	1.5	98.5
Riau Islands	3.1	0.05	0.1	2.4	65.8	0.5	1.1	58.9	18.3	22.8	0.5	11.5	88.5
Total Riau	178.6	0.55	13.3	7.5	91.1	489.0	42.5	18.6	38.5	35.9	24.4	0.8	99.2
Total Region	1245.0	0.98	567.3	45.6	65.9	1506.5	362.3	16.9	51.9	27.7	157.1	14.2	85.8

- Notes:
- 1) The total area of six major palawija crops (maize, cassava, sweet potato, soybean, peanut, and mung bean. Root crops consist of cassava and sweet potato, and oilseeds of soybean and peanut.
 - 2) The total area of eighteen vegetables in the production statistics. Group A consists of eight vegetables chiefly grown in higher-altitude areas, and Group B the remaining ten.
 - 3) The wetland area for Nias in the same survey series conducted in 1985 and 1987 is 20,838 ha and 20,701 ha. If there were some error in tabulation in 1986, the cropping intensity would have been about 1.33.

Sources: BPS, Land Area by Utilization in Outer Java 1986
 BPS, Production of Vegetables and Fruits in Indonesia 1986
 BPS, Production of Cereals in Indonesia 1986.

57. Although of lesser significance compared with other parts of the country, the production of some palawija crops has shown rapid growth in a limited number of locations, such as soybean along the eastern coast of Aceh and maize in the areas relatively close to the metropolitan Medan in North Sumatra. As seen in table 13, there are some appreciable provincial differences in the relative sizes of harvested areas among major palawija crops. Aceh shows the dominance of oilseeds (soybean along the east coast and peanut along the west coast), while maize seems to be most important in North Sumatra with oilseeds and root crops each having an equal share of the remaining area. In West Sumatra and Riau, oilseeds have the largest area followed by maize.

58. Palawija crops are generally important in higher altitude or hilly areas, such as Simalungun, Karo and Tapanuli Utara in North Sumatra, Lima Puluh Koto, Solok, Tanah Datar and Agam in West Sumatra, and in many newly opened transmigration communities in the four provinces, in both of which dryland annual crop farming is relatively important for cash income as well as subsistence. In addition to sometimes difficult terrains, disadvantages in produce transportation, and lack of access to support services, there is a danger of erosion in mountain-type red-yellow podosolic soils. In other words, these areas need some form of integrated farming system approaches, rather than the standard extension services, to overcome the local constraints and improve the income opportunities for farmers.

59. In the current five-year development plan, target growth rates of production for four major palawija crops and vegetables and fruits are set higher for Outer Islands compared with Java (Table 14). Granted that the increased production of palawija and horticultural crops at the present moment involves much more risks than rice for small farmers because of the inadequate integration of inter-regional, or even intra-regional markets. But this implies an even greater need of taking early measures for sustainable diversification.

Table 14. Target Annual Growth Rates for Selected Palawija and Horticultural Crops 1988 - 1993

(Unit: %)

	Java	Outer Islands	Indonesia
Maize	1.45	5.1%	2.56
Soybean	1.55	4.52	2.69
Peanut	2.28	7.44	4.06
Cassava	1.88	4.53	2.84
Sweet potato	1.52	2.78	2.28
Vegetables	3.05	5.28	3.89
Fruits	5.30	5.29	5.29

Source: Information from Direktorat Jendral Pertanian Tanaman Pangan, as of Feb. 1988.

60. The strategy for palawija crops in the Region would emphasize maize, cassava, soybean and peanut, primarily because of the domestic demand prospects. By taking into account the framework of the current development plan, the production of four major palawija crops for the

Region is roughly estimated in Table 15. The estimated accelerating growth of their production would largely depend on the concomitant growth of livestock/poultry raising, better marketing arrangement, and processing industries, on the one hand, and the supply of locally suitable planting materials and more intensive extension services, on the other.

61. It will be necessary to promote the second (or third) cropping after paddy on wetland and the development of dryland farming

Table 15. Estimated Production of Major Palawija Crops
(Unit:1000 tons)

	1987	1993	1998	2008	Annual Growth(%)	
					1987-98	98-2008
Maize:						
North Sumatra	141	155	194	300	2.9	4.4
Other Prov.	60	97	116	180	6.2	4.5
Riau	21	38	39	60	5.8	4.5
Aceh	17	29	38	60	7.8	4.5
West Sumatra	22	30	39	60	5.1	4.5
Total Region	201	252	310	480	4.0	4.5
Soybean :						
Aceh	102	112	138	205	2.8	3.0
Other Prov.	54	75	101	175	6.1	5.6
North Sumatra	28	39	55	95	6.3	5.6
West Sumatra	18	20	25	43	3.1	5.6
Riau	8	16	21	37	9.6	6.0
Total Region	156	187	239	380	4.0	4.8
Peanut:						
North Sumatra	20	27	35	60	5.3	5.4
Aceh	16	21	28	48	4.9	5.6
West Sumatra	11	14	18	30	4.6	5.4
Riau	4	4	5	7	1.2	4.4
Total Region	51	66	86	145	4.8	5.4
Cassava:						
North Sumatra	245	248	295	450	1.7	4.3
West Sumatra	108	141	178	270	4.7	4.3
Aceh	81	77	84	110	0.2	2.8
Riau	84	117	150	230	5.4	4.4
Total Region	518	583	707	1,060	2.9	4.1

Source: Figures for 1987 and 1993 are taken from Departemen Pertanian, Peta Produksi dan Pengembangan Sektor Pertanian Dalam Replita V, Feb. 1989. Figures for 1998 and 2008 are estimated by the Team.

systems. The former requires the support to self-help efforts among local farmers in wetland improvement, including better drainage and land preparation methods. The latter would require the development of environmentally sustainable land utilization methods. The location for palawija crop promotion would be more selective than rice. The proximity and/or good transportation access to the major urban centers in the Region and to a lesser extent outside markets would be important. The

priority of dryland farming development will have to be given initially to transmigration and other newly opening areas.

62. With respect to horticultural crops, priority need be given to areas of higher altitudes, especially already existing production centers like Karo and Simalungun in North Sumatra, and the central highlands of West Sumatra and Aceh (Table 13). The market prospects in urban centers outside the Region and in the neighboring countries are also generally promising, but in view of perishability of crops, volatile price movements and quality control requirements, among others, it will be essential to organize effective marketing channels, to provide basic post-harvest infrastructure like terminal facilities for collection, grading, packaging, storage and shipping, in addition to strengthening the on-going market information system development. For other areas, the location-specific strategy should be devised on the basis of local market prospects as part of the diversification drive on wetland and dryland areas. This need be supported by the strengthening of public programs and private enterprises for better seed multiplication and distribution on the provincial level.

63. Lastly, there appears to be a variety of opportunities in horticulture in higher-altitude areas for the private sector investments. Small farmers are usually encumbered by too many technical and socio-economic constraints difficult to overcome by themselves, but the private sector investors can open up the Region's horizons of agricultural development, as shown by the market- and/or export-oriented vegetable and flower seed farms established in North and West Sumatra, and eventually serve as nuclei for diffusion to small farmers.

3.3. Tree/Estate Crops

64. With respect to tree/estate crops, it is a truism to consider this subsector as one of the focuses of future development efforts in the Region. Compared with the "horizontal" diversification involving non-rice arable crops, which would require some forms of integrated development of "vertical" diversification (i.e., the establishment of processing/manufacturing outlets and/or effective marketing mechanisms), at least two dominant estate crops, rubber and oil palm, are obviously much less burdened in the vertical dimension of diversification because of the existence of large estates in the Region.

65. During the last two development plans, Indonesia implemented large-scale planting and replanting programs through rehabilitation of public estates and establishment of many project management units for smallholders. Especially notable has been the expansion of the oil palm area, which increased some 370,000 ha during the fourth development plan. Stimulated by the on-going deregulation to encourage private investments, the production of palm oil and palm kernel oil will assuredly increase at a substantial rate during the present development plan and beyond.

66. In the current fifth development plan, the annual growth rates for production of palm oil, rubber and coconut are targetted at about 12%, 4.3% and 6.7% per annum. Two beverage crops of coffee and tea are expected to grow at 7.3% and 5.8% respectively, while cocoa, an emerging estate crop in the Region, is projected to increase at 20.6% a year. Growth rates set for planted areas are substantially lower than production targets; 6.1% for oil palm, 8.0% for cocoa, 3.6% for rubber and 2.8% for coconut. This partly comes from the fiscal austerity and partly from the much greater emphasis placed on OMR improvements in public estates in order to consolidate the efficiency of the rapidly expanded tree crop areas.

67. The areal expansion is expected to come from private sector investments in large estates and from smallholders. Especially in relation to the latter group, the emphasis is placed on nucleus estate and smallholder development, or NES/PIR programs (mainly oil palm and rubber), and self-reliant (swadaya) smallholders which involve less government financing and manpower than those covered by the programs of project management units (PMUs).

68. By taking into account the production targets for the four provinces during the current development plan, rough projections are made for three major tree crops grown in the Region. As shown in Table 16, oil palm is expected to grow most dynamically. In terms of crude palm oil, the regional production is expected to increase from 1.4 million tons in 1987 to over 4 million tons in 2008, or by a little less than 10% per annum during the first decade and by 1.3% during the second. In order to expedite the increased private sector investments, it will be important to proceed with further deregulation efforts concerning the price system and other government interventions in palm oil processing and trade, relaxation of NES/PIR-related restrictions and so forth.

Table 16. Estimated Production of Palm Oil, Rubber and Coconut

(Unit:1000 tons)

	1987	1993	1998	2008	Annual Growth (%)	
					1987-98	98-2008
Palm Oil:						
North Sumatra	1,224	1,921	2,070	2,200	4.9	0.6
Other Prov.	170	1,148	1,705	2,100	23.3	2.1
Riau	71	662	973	1,190	26.9	2.0
Aceh	96	234	361	450	12.8	2.2
West Sumatra	3	252	371	460	55.0	2.2
Total Region	1,393	3,069	3,775	4,300	9.8	1.3
Rubber:						
North Sumatra	367	544	662	800	5.5	1.9
Other Prov.	144	176	235	310	14.5	2.8
Riau	187	199	130	182	3.7	3.5
Aceh	18	24	39	43	7.3	3.5
West Sumatra	39	53	66	85	4.9	4.9
	2.7					
Total Region	511	720	897	1,110	5.2	2.3
Copra:						
Riau	159	226	280	415	5.3	4.0
North Sumatra	88	106	128	190	3.5	4.2
Aceh	64	83	104	155	4.5	4.0
West Sumatra	62	70	82	120	2.6	4.0
Total Region	373	485	594	880	4.3	4.0

Source: Figures for 1987 and 1993 are taken from Departemen Pertanian, Peta Produksi dan Pengembangan Sektor Pertanian Dalam Replita V, Feb. 1989. Figures for 1998 and 2008 are estimated by Team.

69. The growth of the planted area would be more rapid in three provinces other than North Sumatra, and by 2008 the combined production of Riau, West Sumatra and Aceh which accounted for only 12% of the regional total in 1987, would roughly equal that of North Sumatra. Over twenty years, some 640,000 ha would be added to 560,000 ha recorded for 1987. Assuming 0.24 person per ha, the expansion of this scale is expected to generate some 150,000 direct permanent employment as well as contributing to the regional income and export expansion. The distribution of the planted area in the year 2008 would be roughly estimated as follows.

	Planted Area
North Sumatra	550,000 ha
Riau	350,000
West Sumatra	150,000
Aceh	150,000
Region	1,200,000

70. Most of the already approved concessions for private investments are located in the relatively under-developed areas of the four provinces, such as South Tapanuli, west coast kabupaten of Aceh, South Sijunjung and Pasaman of West Sumatra as well as in Riau excluding Indragiri Hilir and Riau Islands. With the growth of palm oil production along the west coast, it would become necessary to upgrade port facilities at appropriate locations.

71. The expected growth of rubber would be moderate at 5.2% during the first decade and 2.3% during the second, because the world demand would be unlikely to be dynamic, compared with palm oil. The production of coconut in copra equivalent would grow by 4.3% per annum during the first decade and 4.0% during the second. The growth of Riau is the highest because of the existence of a large-scale oil mill in Indragiri Hilir with a new plant soon to be added adjunct to a newly planted hybrid coconut estate.

72. From the viewpoint of equity, an important issue is in the smallholder sector which is generally characterized by low productivity, low-quality output, and slower than expected response to replanting or planting schemes. Such characteristics have understandable reasons: that tree crops have longer gestation periods, and especially replanting means a loss of important cash income, and that efforts at quality improvements are often not rewarded sufficiently by corresponding increases in producer prices, among others. There are dire needs to step up efforts to expedite the productivity improvement, mainly by rehabilitating the already existing extensive areas under smallholder rubber, coconut, coffee and other tree/estate crops and upgrading field extension services on estate crops.

73. According to the agricultural census of 1983, rubber, coconut and coffee, and to a lesser degree clove as well, are grown by smallholders in every kabupaten of the four provinces, but major producing areas are discernible from Figure 3. From the standpoint of balanced regional growth, smallholder programs for rehabilitation and new planting need to emphasize under-developed areas. In the case of rubber, Tapanuli Selatan, Nias, Indragiri Hulu, Kampar, Pasaman, Sijunjung and the east coast of Aceh would be important. For coconut, rehabilitation will be necessary in Indragiri Hilir, where coconut is yet practically the only income-generating crop, and Nias, while organized new planting schemes would be suitable along underdeveloped west coastal areas of the Region, such as West Aceh, Tapanuli Tengah and Selatan, and Pesisir Selatan. In this regard, it will be important to

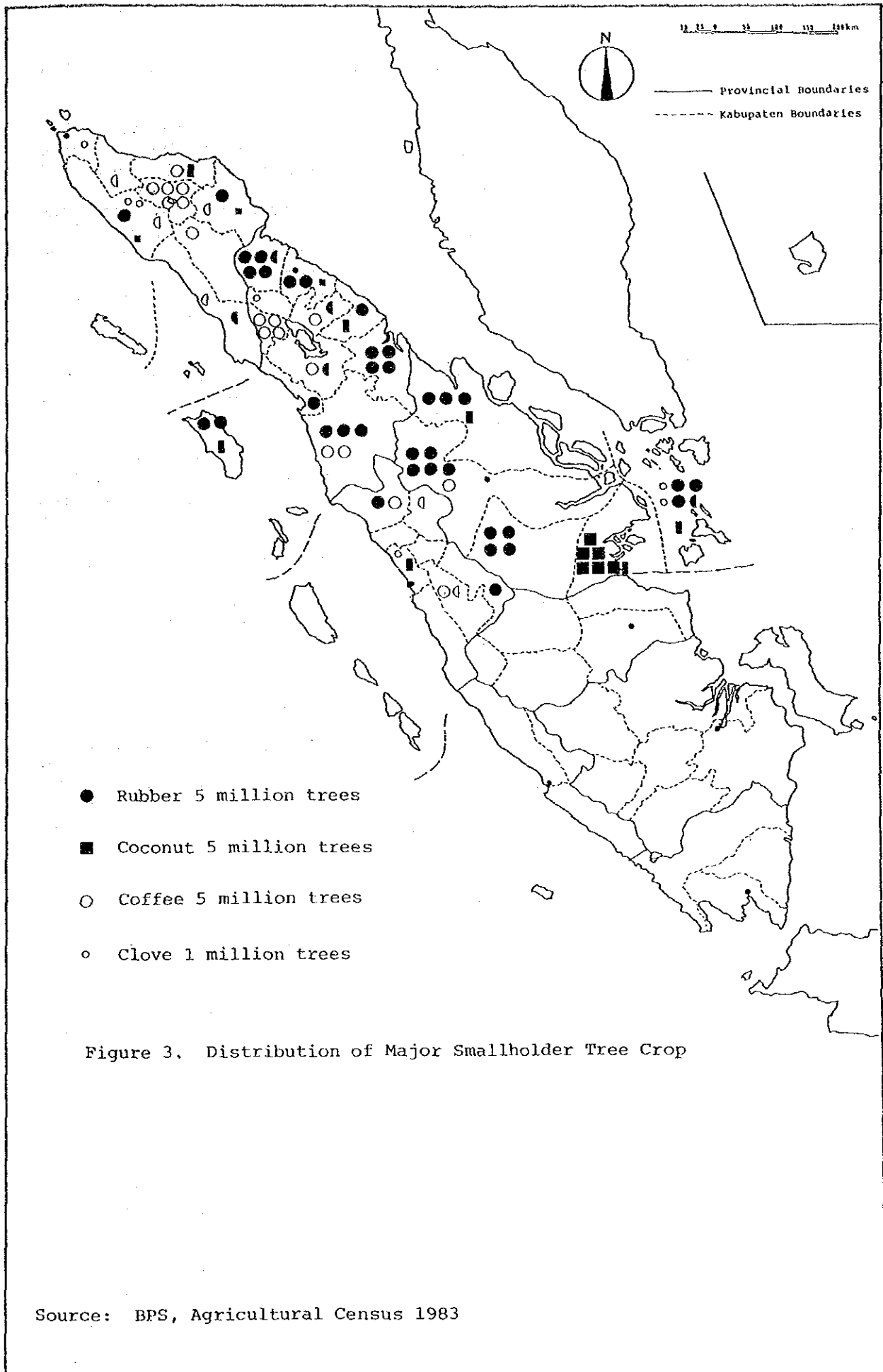


Figure 3. Distribution of Major Smallholder Tree Crop

Source: BPS, Agricultural Census 1983

encourage the establishment of new oil mills, because coconut oil is a preferred edible oil in Indonesia.

74. For coffee, the prospects of international markets are rather limited, and therefore the emphasis need be placed selectively on the quality improvement. Priority should be given to the rehabilitation of major producing areas of arabica coffee with the altitude of over 1,000m where quality beans can be produced, such as Aceh Tengah, the area around Muarosipongi in Tapanuli Selatan and Solok. Generally speaking, the improvement of the smallholders' harvest and post-harvest practices is urgently necessary to improve their cash income from coffee.

3.4. Livestock and Poultry

75. The national goals for the livestock subsector are to increase production mostly for domestic consumption and nutritional improvement, and to increase the population of large ruminants as draft animals and as sources of manure for supporting the production of various crops. In the current five-year development plan, the domestic consumption of meat and eggs in Indonesia is estimated to grow at 6.0% and 5.7% per annum. With respect to meat, the consumption of poultry meat is expected a higher growth of 7.9% compared with 4.7% projected for livestock meat. The target growth rates of production are set at about 7% per annum for meat and 8% for eggs, including some export growth (pigs and goats, beef, broiler meat, and eggs). The policy for the regional dimension of such production increase seems to be that each region/island will increase its output to raise the level of per capita consumption. For export prospects, the Region is especially slated for commercial farms/ranches to produce pigs, broilers, and possibly beef cattle and goats/sheep.

76. In line with the national goals, the production of livestock/poultry products would be increased in the Region, chiefly to satisfy the growing demand in major urban centers, but partly for exports to the neighboring countries. Assuming that the per capita consumption estimated by the General Directorate of Livestock for 1993 continue to grow at 4% per annum through 2008, the total demand in the Region would increase to some 370,000 tons for meat and 140,000 tons for eggs, or at annual growth rates of over 6% (Table 17).

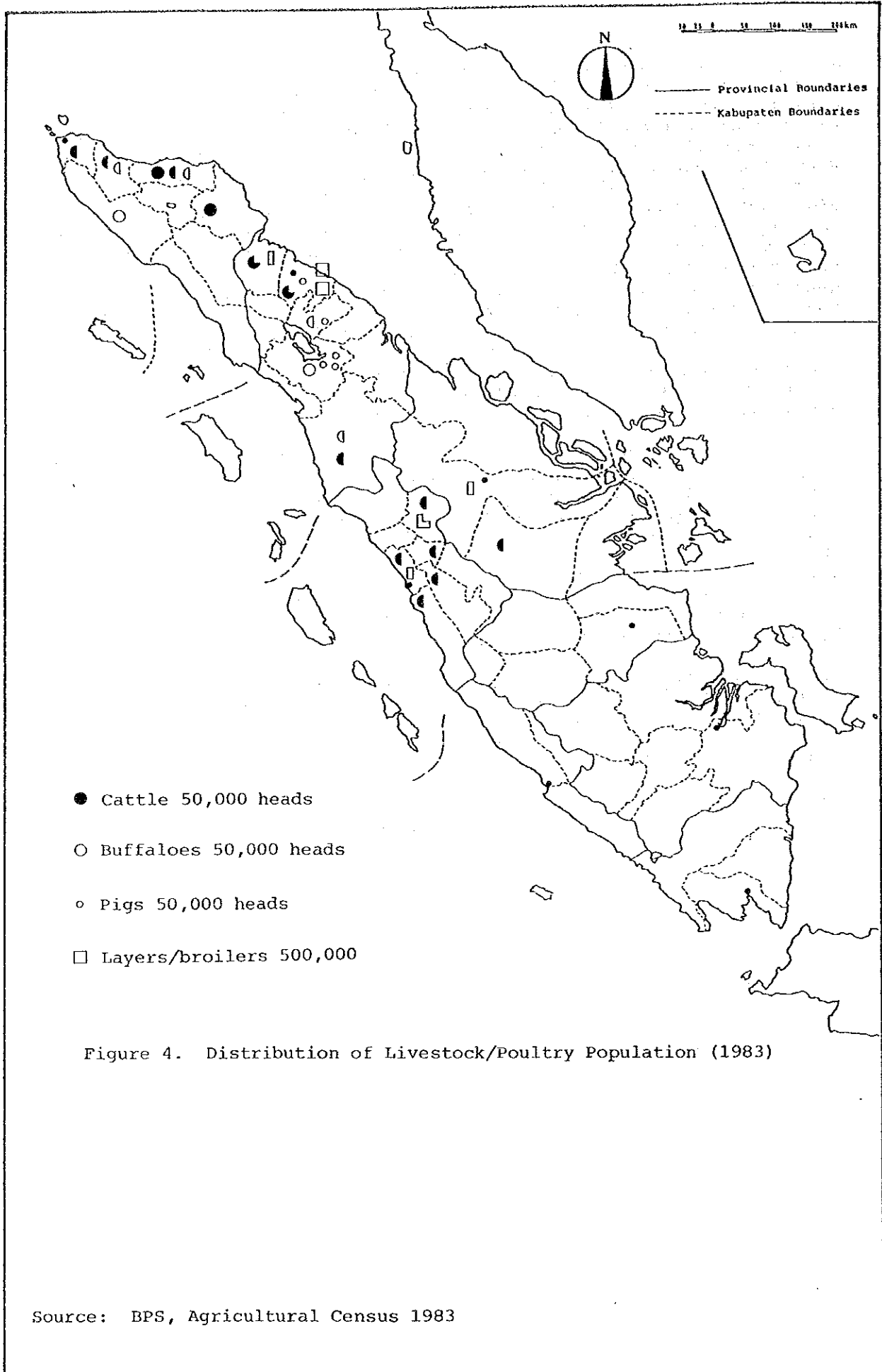
Table 17. Estimated Consumption of Meat and Eggs

	1988	1993	1998	2008	(Unit: 1000t)	
					Annual Growth(%)	
					1988-98	98-2008
Meat						
Aceh	18.0	24.8	33.9	62.6	6.5	6.3
North Sumatra	56.4	76.6	103.5	191.5	6.3	6.3
West Sumatra	21.4	27.4	35.0	57.1	5.0	5.0
Riau	15.7	22.3	31.4	61.5	7.2	7.0
Total Region	111.5	151.1	203.8	372.7	6.2	6.2
Eggs						
Aceh	6.7	9.2	12.4	23.2	6.4	6.5
North Sumatra	20.9	28.4	37.8	71.1	6.1	6.5
West Sumatra	8.0	10.2	12.8	21.2	4.9	5.2
Riau	5.8	8.3	11.5	22.8	7.0	7.1
Total Region	41.4	56.1	74.4	138.4	6.0	6.4
Per capita consumption(kg/year)						
Meat	5.58	6.79	8.26	12.23	4.0	4.0
Eggs	2.07	2.52	3.07	4.54	4.0	4.0

Sources: Based on the Team's population estimates and per capita consumption estimates for 1993 by General Directorate of Livestock.

77. The distribution of large ruminants (cattle and buffaloes), pigs and layers/broilers in the Region according to the agricultural census of 1983 is shown on Figure 4. Layers/broilers (as opposed to native chickens) had larger presence in urbanized areas such as the east coast area of North Sumatra and the central area of West Sumatra and Riau from Padang through Pekanbaru, while the cattle population was larger along the east coast areas of Aceh through Medan and the central highlands of West Sumatra. However, the average small farmers in the Region as well as elsewhere in the country are encumbered by a variety of constraints, and livestock/poultry raising is generally considered as one of the important but subsidiary sources of cash income. They are generally not oriented to meat production, and larger livestock are economically more valuable as draft animals in addition to being sources of animal protein. Therefore, in order to facilitate the sustained increase of production to satisfy the growing demand, it would be necessary to strengthen the yet relatively weak extension services for small farmers, especially on animal/poultry nutrition and health, and to encourage private sector investments.

78. Because of the relatively extensive utilization of wetland as well as dryland in the Region compared with Java, and of the relative absence of agricultural laborers, there is a definite need to increase the number of draft animals in order to harness the large potentials of agricultural intensification, extensification and diversification. At the same time, the availability of vast grassland and partially wooded land in the Region are especially suitable for semi-extensive and extensive types of cattle raising for meat production. Commercial cattle raising could be managed by the private investors or communally by groups of local villagers. This calls for the strengthening of extension services for improved livestock management such as nutrition and disease control, on the one hand, and the provision of better infrastructure for handling livestock products such as slaughtering, dairy processing and cold storage facilities, on the other. It would be useful to establish pilot ranches to demonstrate the improved nutrition and disease control, grassland management, and feed grains and forage crop production.



II. FISHERY

A. Present Situation and Development Potential

1. Present Situation

1.1. General

79. The fishery sector in the Region not only plays a substantial role in supplying fish as a major animal protein source to the population in the Region, but also contributes to the regional economy through increasing export of fishery products. Fish production grew at an annual rate of about 5.9% between 1981 and 1987 and the value of fish exports increased by 13.1% over the same period (Tables 18 and 19. Tables and Figures are all located at the end of this Chapter).

80. Total fish export in the Region in 1987 was 29,536 tons which accounted for 94% of whole Sumatra or 22% of national total, while import was only 4,017 tons or 6% of whole Indonesia. The export volume of the Region has been increasing at over 10% per annum during last 7 years. The major export commodities are fresh/chilled fish (9,329 tons), frozen shrimp (6,208 tons), fresh/chilled shrimp (2,145 tons), and crabs (1,906 tons). Almost all fishes are exported from North Sumatra or Riau provinces, and their major destinations are Singapore (16,201 tons or 65% of Indonesia's total fish export to Singapore) and Malaysia (5,070 tons or 99% of same). The Region has a close trade relation with these two countries.

81. Based on the information obtained during the field surveys, it seems that about 10,000 tons of fresh fish are annually distributed from the Region to the southern part of Sumatra, mainly Jambi and Bengkulu, while about 10,000 tons of dried marine fish (30,000 tons in wet weight, Ikan Asin) might be sent to Java from coastal area of Riau (Figure 5). The Region's per capita fish consumption in 1987 is estimated at about 23 - 25 kg, which is over 1.5 times larger than the national average (Table 20). Like elsewhere in Indonesia, about a half of fish is utilized fresh in the Region, but in Riau province, salted/dried fish production is larger in volume than fresh fish.

1.2. Fishing Activities

82. About 88% of total fish production in the Region is accounted for by the marine fishery. The major production area is the east coast of Sumatra. It faces Malacca Straits, which abound in rich nutrient supplied by a number of rivers of both Sumatra and Malay Peninsula. The area also has good access to the markets. Thus fishing activities are concentrated and more developed in this area, with both fish catch and number of fishermen therein almost three times larger than in the western part of Sumatra. The motorization rate of fishing boats is also higher in the Malacca Straits side (44%). In the western side, it is only 25% which is below the national average of 31% (Table 21). The western side, however, has a vast reserve of under-exploited fish resources.

83. Inland fishery is conducted at or near the subsistence level in the Region, where traditional methods of catching fishes in rivers, swamps and lakes still prevail. Although statistics show that inland fishery production accounts only for about 23,800 mt or 4.6% of total fish catch in the Region, actual catch may reach 2 - 3 times of that. This is because many fishes are self-consumed in rural areas. The most productive in the Region with respect to this sub-sector is Riau, where

vast areas of swamps and rivers exists. There are four large-scale lakes in the Region, namely, Lake Toba (North Sumatra), Lake Laut Tawar (Aceh), Lake Singkarak and Lake Mamniau (West Sumatra). In these lakes, however, no particular fishery resource management program is conducted based on the stock assessment and limnological survey.

1.3. Fish Resources

84. According to the estimate of the potential fish stock calculated by the Directorate General of Fisheries (DGF) in 1983, the fish resources in the Region have not been fully exploited. Exceptions are shrimps and skipjack whose production has been stagnating in recent years (Table 22). Resource exploitation levels in the Malacca Straits have almost reached to their potential levels, and it is noted that a further increase in fishing activity therein, particularly in the narrower part of the straits, may cause resource depression. In addition, the actual catch may be larger than indicated by the statistical record, since some of the fish caught in Malacca Straits are directly sold to buyers from Singapore and Malaysia on the sea.

85. By contrast, it is reported that there is an under-exploited tuna resource within the 200-mile EEZ off the western to northern coasts of Sumatra. The resource scale, however, is rather small, compared with those identified in the eastern part of Indonesia. In addition, both pelagic and demersal fish resources are also valuable but remain largely untouched in the offshore of the west coast and South China Sea (Table 23), although some foreign vessels are operated therein.

1.4. Aquaculture

86. Aquaculture production in the Region was 37,343 mt in 1986 which accounted for 10.8% of the national total. Since aquaculture is more commercially oriented, its production is much larger in terms of value than in volume. In 1986, it was 7.6% in quantity of the total fish production in the Region but 28.2% in value.

87. Brackishwater pond (tambak) culture has a long history in Aceh Province and has been expanded from north to south along east coast. The pond area in Aceh now totals approximately 29,700 ha (about 95.4% of the total tambak area in the Region or 12.5% of the national total). In 1986 Aceh produced 22,095 mt of shrimps and fishes (mainly milkfish), which represented over 90% of the total tambak production in the Region. The culture system is generally traditional, only some ponds operated by enterprises are adopting intensive method (Only 178 ha or 0.6% of tambaks are intensive in Aceh and 222 ha or 19.9% in North Sumatra). The per hectare annual yield in 1986 was 745 kg in Aceh and 1,484 kg in North Sumatra (Table 24), but in intensive culture ponds the production has already reached to over 10 tons/ha/crop (20 tons/ha/year). Almost all tambaks are located in the east coast of Sumatra because of its easy access to the market and better infrastructures.

88. The tambak intensification (INTAM) programs are under way in Aceh, with provision and rehabilitation of water canals. Currently only about 5,000 ha of tambak (in Aceh Timur) out of a total 30,000 ha tambaks are under intensification with financial support under IBRD's Fisheries Support Services project. The extensification of tambaks (increase of areas) is also planned by the Government (Target under Repelita IV was 100,000 ha in whole country), but due mainly to lack of budget, the detailed survey of potential areas has not sufficiently conducted at moment (The current status of survey on potential tambak areas is described in Table 25).

89. The development of shrimp hatcheries both in numbers and technical level in the Region during recent 2 years is remarkable. At present there are 26 shrimp hatcheries (including 3 hatcheries under construction) in the Region with a total capacity of over 360 million pieces of shrimp fry per year. The actual production is roughly estimated about 50% of the capacity (Table 26). The potential of wild shrimp fry is estimated by DGF at approximately 190 million pieces in the Malacca Straits side and 8 million pieces in the west coast. Out of that, about 90 million pieces were collected in the east coast of Aceh in 1987 for stocking into tambaks. Along with the intensification of tambaks, the demand for shrimp fry has been increasing. As for milkfish, all necessary fry, available only in the east coast of Aceh in the Region, are collected from natural water (the number of fry collected in 1986 was 33 million while available wild stock is estimated at approximately 530 million).

90. Freshwater as well as tambak aquaculture has a long history especially in Java. In the Region, about 8,200 ha of ponds (kolam) and 14,100 ha of paddy fields (sawah) are utilized for freshwater fish culture. Kolams are concentrated in West Sumatra (some 7,800 ha or over 70% of the regional total), while sawah culture is scattered in both North Sumatra and West Sumatra. The size of farms is small with an average pond area of 0.09 ha for kolam and 1.53 ha for sawah. Typical cultured species are carps and tilapia. The yield per hectare varies greatly among the provinces, with an average of 1,330 kg/ha for kolam and 133 kg/ha for sawah (Table 27). As for cage culture, at present, only about 800 cages are operated in Lake Toba mainly rearing carps. There are 47 freshwater fish hatcheries in the Region (three are provincial based station and the others are sub-stations) where about 34 million pieces of fish fry were produced in 1985 to support the small-scale fish farmers in the Region (Table 28).

91. Mariculture activities are basically conducted on the experimental basis in the Region. Marine fish cage culture and seaweed raft culture have recently started by private farmers/companies. Shellfish culture is still under experimental stage (Table 29).

1.5. Fisheries Infrastructure

92. In the Region, there are 5 national fishing ports, i.e., Belawan, Lampullo, P. Telo, Sikakap and Tarempa. The fishing port at Bungus (West Sumatra) has completed in 1988. There are 31 provincial fish landing centers (PPIs) equipped only with basic facilities and generally without an ice plant. Most of the PPIs are located in the east coast of Sumatra (Figure 6) especially in North Sumatra. In 1985 fish landing at these public facilities was 115,822 mt or only 28% of total marine fish catch in the Region (Table 30). Over 70% fishes are landed at private fish landing piers (Tangkahan) or directly sold to middlemen on sea. In this aspect, it can be said that most of public fishing ports including PPIs are not well used by fishermen. This is because of that: a) most of fishermen have tight relation with private fish dealers (mainly Tangkahan owners), b) the location of some PPIs are not convenient for fishermen due to no fish buyers and a difficult access to the landing pier, and c) the port facilities are not suitable for private fish dealers to utilize. Only in West Sumatra where has a few number of Tangkahan the fish auction is partly taken place at public fishing ports (about 15% of total fish landing in the province), while in other provinces fish are marketed by price bargaining.

93. Current fish marketing methods in most areas do not appear to be constrained by lack of ice, although distribution of ice may not be sufficient in some remote areas. Out of 19 cold storages including 5 owned by 2 government enterprises (P.T. Perikanan Samudra Besar and

P.T. Karya Mina) in the Region, 18 are located in the east coast of Sumatra (mostly in North Sumatra) where yields a large quantity of shrimps for export. Riau records the largest shrimp catch, but it is mostly ice-packed and transported directly to Singapore and Malaysia, and some are frozen but small size of shrimps dominate. In 1988 three canning plants exist in the Region all locating in Medan and another 2 factories are under construction (Table 31).

1.6. On-going Development Projects

94. The on-going fisheries related development projects are shown in Figure 7. More projects are carried out in the east coast of Sumatra than west coast.

2. Development Potential

2.1. Maximum Exploitation and Utilization of Coastal Fish Resources in the 12-Mile Territorial Water

95. Fisheries resources along the west coast of Sumatra are still under-exploited due mainly to low fishing population, low income level of fishermen, and difficult market accessibility.

96. Strengthening of Extension Services: Lowering of catch per unit effort (CPUE) at Malacca Straits in near future may induce the natural movement of fishing grounds therefrom to the north and west coast of Sumatra. This trend has already been observed in some area. However, in order to accelerate such movement, it is necessary to make utmost effort to provide with the sufficient information on fishing in the west coast to the fishermen in Malacca Straits. The special appeal should be made to owners of Tangkahans and/or boats, who has a enough financial source to increase number of fishing boats and has market channels.

97. Increase of Fishermen's Income: One of major constraints to expand the fishing capacity relies on the fishermen's low income level which makes difficult them to invest for enlargement of fishing boat and gear. It is important to generate additional income sources for fishermen with a minimum investment. Fish aggregating device (FAD) will be a unique gear to increase fish catch per unit effort of fishermen, which will result in increase of their income. The introduction of mariculture is an other way to generate fishermen's additional income with a low investment and a family manpower.

98. Introduction of New Fishing Gear: The present fishing gears used for catching tuna, skipjack and eastern little tuna are mainly trolling, hook-and-lining, purse seining, and drift gill netting, thus the catching volume of coastal tuna-like fish is till low. Small-scale tuna long-line fishing will be prospective to introduce in the Region.

99. Follow-up of Sumatra Fisheries Development Project (ADB): The captioned project, which was completed in 1988, included the supply of 42 fishing boats (20 purse seiners and 22 multi-purpose boats), various kinds of fishing gears and outboard engines for canoes, and the construction of Bungus fishing port and rehabilitation of 3 existing fishing ports (P. Telo, Sikakap and Tiku) in West Sumatra Province. The similar projects will be effective to intensify the fishing activities in other areas of west coast of Sumatra, e.g., North Sumatra and Aceh. For this activity, fishermen not only from west coast but also from east coast of Sumatra should be invited.

2.2. Development of Offshore Fishery in the 200-mile EEZ

100. As shown in Table 23, the DGF estimated that there are rich pelagic and demersal fish resources within the 200-mile EEZ off west of Sumatra (238,700 mt/year) and in the South China Sea (488,900 mt), which are largely untouched by Indonesian fishing boats (Some foreign vessels such as Thai purse seiners and Korean/Taiwanese tuna long-liners are operated under agreement with Indonesian side). In order to meet the increasing demand mainly for the Region's own consumption in 2008, it is essential to develop these resources gradually at latest from 1993. There are several proposals for joint fishing with Indonesian companies basically with leasing of the existing Sabang fishing complex owned by P.T. Perikanan Samudra Besar (PSB, a government enterprise) which facilities have been idling for over 10 years since all PSB's tuna fishing boats moved to Benoua (Bali). Due to the limited data on offshore fishery resources, however, immediate commencement of fishing activities seems to be risky. Thus, it is recommended to collect and review all available data including those from foreign vessels, to make a trial operation, and to identify the most suitable fishing methods, scale, grounds and seasons. Concurrently, it is necessary to train local fishermen for offshore fishing so that they will be employed even for a temporary period by any fishing vessels.

2.3. Development of Aquaculture

101. The development of aquaculture is essential in the Region not only to increase the foreign currency earnings mainly from export of shrimps but also to increase the small-scale fishermen's income and to provide new jobs especially for fishermen in the Malacca Straits.

2.3.1. Brackishwater Pond (Tambak) Culture

102. Shrimp production has especially bright prospects. The future increase in shrimp production in the Region, however, would largely depends on cultured shrimp from tambak since the catch of wild shrimps has been stagnant in the Region. This trend has been already seen from the past record, and the contribution rate of the Region's tambak shrimps to the national total has been increasing from 7.0% in 1982 to 16.3% in 1986. As for black tiger shrimp *Penaeus monodon*, which is major species for Indonesia tambak culture, its increase is much larger from 5.7% to 27.8% (Table 31). Thus, it can be said that the Region's shrimp production from tambak will be placed in very important position not only for earning of the Region's income but also for taking leadership of the country's shrimp export.

103. Extensification (Increase of Area): According to the DGF's estimate in 1984, about 78,000 ha in the Region (mostly along the east coast) are identified as potential areas which would be suitable for tambak development. However, these figures are mainly estimated based on the data from Department of Forestry and Department of Agraria, and of which only some 10,000 ha have been actually identified through field reconnaissance (Table 25). In this context, first it is necessary to review the existing survey records and to make a detailed survey for selecting priority areas. Due consideration must be given to natural environmental conditions, socio-economic aspects and physical infrastructure. Possible areas for tambak culture are usually remote areas without sufficient supporting facilities such as shrimp fry and feed supply and market channels. Therefore, tambak extensification should be tackled along the line similar to the NES (Nucleus Estates and Smallholders) approach. For this purpose, the nucleus whichever private enterprise or cooperatives, should be strengthened in both managerial and financial capabilities.

104. Intensification (Increase of Yield per Unit Area): Tambak intensification programs are on-going in Aceh for some small-scale farmers (about 5,000 ha in Aceh Timur) under the IBRD's Fisheries Support Service Project, with construction/rehabilitation of water canals. The extension of similar projects will be required for the remaining 25,000 ha along the east coast of Aceh Province. Shortage of shrimp fry and feed (animal protein source) may be a critical factor which constrains the intensification in Indonesia. Shrimp fry are very expensive in Indonesia (Rp.25 - 30/pc. for PL20) compared with other countries, and so is the feed imported from Taiwan (Rp.2,000 - 2,100/kg).

105. The current number of black tiger shrimp fry stocked in the Region's tambak can be estimated at approximately 280 million pieces. The source of fry distributed to the Region might be 134 million from the Region's own hatcheries, 90 million from wild collected in the Region, and the remaining from other regions' hatcheries and naturally introduced. With intensification of the existing tambaks, the required number of fry will increase year by year. It is estimated that over 1 billion pieces of shrimp fry will be required in future for the introduction of shrimp fry (10,000 pcs/ha) into the currently non-stocking ponds (13,850 ha) and for semi-intensification (stocking density 40,000 pcs/ha) of the existing shrimp monoculture extensive ponds (about 7,710 ha) does not stock any fry starts to shrimp extensive monoculture (10,000 pcs/ha). The current maximum supply level of shrimp fry in the Region accounts for only 550 million pieces per year including 360 million from the Region's hatcheries and wild fry availability 190 million. Thus, over 3 times of the existing hatchery capacity will be required only for achievement of intensification scheme.

106. With semi-intensification of tambaks, the feeding practice will be required to supplement the natural productivity of ponds. The intensive ponds which will be mainly operated by the enterprises will also require much more feeds. Although it is possible to import the formulated pellet feeds from foreign countries such as Taiwan, the current price is very high as well as local feed (produced by CV. Mabar Shrimp Feed at Medan, Rp.1,650 - 1,700/kg), which makes difficult small-scale farmers to purchase such expensive feeds. In order to survive even if the world shrimp market crisis occurs in future, it is necessary to produce the shrimp at cheaper price as possible. In this context, it is important to establish appropriate local feed production system at low cost since the feed cost will be main factor largely concern to total production cost. Since the total banning of trawl fishery in Indonesia in 1980, the raw materials to be used as animal protein source for shrimp feed is quite limited and the waste which come from processing plants is also not large in volume due to their limited number. One of ideas to overcome this situation in the Region is to utilize the unidentified fishes categorized to "other fishes" in the statistics which catch is quite large in Malacca Straits (along the coast of North Sumatra and Riau) and are mainly processed into salted/dried fish (Ikan Asin) at present. Ikan Asin is important shape of fish supply in this country, but it had better use them for fish meal production from cost viewpoint. In Bagan Siapiapi buy raw materials at price of Rp.70/kg from fishermen and sell products at price of Rp.300/kg (production cost: $(Rp.70/kg \times 2) + Rp.90$ (for salt) = Rp.230/kg) in Java, while price of fish meal in the Region is about Rp.400/kg (production cost: $Rp.70/kg \times 4.5 = Rp.315/kg$).

107. Along the line with the approach for NES tambak development as the afore-described, namely, "to generate the enterprises so as to be eligible for NES projects", such aquaculture supporting facilities as hatchery, feed plant and cold storage should be developed.

108. The currently on-going Fisheries Industry Credit Project in Indonesia (ADB) is covering the construction and rehabilitation/expansion of fisheries facilities including production facilities (fishing vessels, aquaculture ponds, etc.) and supporting facilities (hatchery, cold storage, processing plant, shipyard etc.) with supply of sub-loans to fisheries-related enterprises. Although some of enterprises will be financed under this project, it seems to be difficult to implement because the scope of credit is too wide without any particular area development programs. It will be necessary to prepare appropriate investment plans which will meet the actual demand and potential.

2.3.2. Mariculture Development

109. Mariculture activities will be emphasized mainly to generate the small-scale fishermen's additional income. The Region has a vast area suitable for several kinds of mariculture, e.g. marine fish cage culture, seaweed raft culture and shellfish culture.

110. Marine fish cage culture: While domestic markets for such marine fishes as grouper and rabbitfish are very limited in Indonesia except in the seafood restaurants, those species are preferred and highly valued as alive condition in the Chinese markets (Rp.10,000 - 12,000/kg for E. tauvina, Rp.25,000 - 27,000/kg for P. leopardus, and Rp.40,000/kg (only during Chinese new year) for Siganus with egg). The Riau archipelago which is close to Singapore is suitable location in terms of easy access to the market and good natural environment. The detailed location of potential areas has been already selected in the AARD/DGF's previous survey. The required fish seeds must be obtained from natural water, since artificial fingerling production of these species is still under experiment. The availability of feed (mainly sardine) seems to be limited and its price is rather expensive (about Rp.500 - 1,000/kg at Tanjung Pinang market). Although feed and seed may be critical factors to constrain the development of cage culture in this region, fishermen will be able to select some smaller size of these species for stocking into net cage as well as some low valued fishes for feeding. The actual number of cages should be carefully determined based on the hearing from fishermen on composition of their daily fish catch.

111. Seaweed culture: According to the DGF's estimate there are about 3,100 ha of potential areas suitable for seaweed culture in the Region, and of which about 84% of areas for Eucheuma raft culture in coastal water and the remaining for Gracilaria culture in tambak (Table 17). Since the tambak in the Region has higher potential for shrimp culture and its is also a heavy burden for fishermen to have tambak for seaweed culture, Eucheuma raft culture will be emphasized in the Region. Eucheuma can be processed to extract Carragenan which can be utilized as materials for chemical and food industries.

112. Eucheuma is usually cultured in areas having clean seawater mainly in coral reef. The priority areas for this culture will be in the bays of north to west coast of Sumatra and Riau archipelago where strong wave by monsoon can be avoided throughout years, harviborous fishes are limited, and preferably some corals are developed. The spats of seaweed are available at Pulau Seribu and Lampung at cost of Rp.100 - 500/kg. The current selling price is approx. Rp.1,000/kg. At present one seaweed processing plant (capacity: 240 tons/year of finished product weight) is available in Medan (P.T. INDOKING ANEKA AGAR-AGAR), and another one in Batam (Riau).

113. Shellfish Culture: In the coastal areas of Riau and southern part of east coast of North Sumatra, several economically important shellfish species such as oyster (Crassostrea cucullata), green mussel (Perna viridis) and bloody cockle (Anadara granosa) are identified. Experiment has been made only for culture of oyster, green mussel and some pearl employing a floating hanging method. The experiments for shellfish culture using stake method and bloody cockle propagation should be also conducted at several possible areas not only for extension of such technology to small-scale fishermen but also for managing coastal water in sound manner at earliest time.

2.4. Development of Lake Fisheries

114. Freshwater fish is an important source of animal protein for local people in the Region, particularly for the peoples living in mountainous areas. In the Region, there are 4 large lakes locating in the mountain, e.g., Lake Toba (North Sumatra), Lake Laut Tawar (Aceh), Lake Singkarak and Lake Mamniau (West Sumatra). The natural productivity in these lakes seem to be decreasing in recent years because of a deforestation especially in Lake Toba, no particular fish resource management program conducted, and so on. Since these lakes have a great potential for cage culture of freshwater fishes as well as capture fishery, the certain limnological study and stock assessment should be made, and based on that results the appropriate fishery resource management program should be implemented in consideration of effective utilization of water resources not only for fishery but also for other purposes, e.g. irrigation, tourism, hydro power generation.

2.5. Strengthening of Fisheries Education and Research

115. Fisheries Education: Fisheries education and training in the Region are mainly carried out by three fisheries high-schools (Banda Aceh, Parliaman and Dumai) and one fisheries training center (Belawan), under the Agency for Agricultural Training and Education (AATE). Academic education on fisheries are provided by some universities. The education and training facilities, however, seems not to be sufficient. For the future development of fisheries, particularly offshore fishing, coastal aquaculture and fish processing, it is recommended to improve facilities of the existing high-schools.

116. Fisheries Research: At present, there are two DGF's sub-centers for development of aquaculture in the Region, e.g. Brackishwater Aquaculture Development Sub-Center in Ujong Batee (Aceh) and Mariculture Development Sub-Center in Tg. Pinang (Riau), and in addition there is one AARD's coastal aquaculture research sub-station in Tanjung Pinang (Riau). As for marine fisheries, there is a Marine Fisheries Development Center only in Semarang (Central Java) without having any sub-centers. In order to develop marine fisheries in the west coast of Sumatra, it is recommended to establish one marine fishery development sub-center in Sumatra.

3. Development Targets and Strategy

117. As mentioned earlier, per capita fish consumption in the Region has been relatively high compared with the national average. In 1987 it was about 23 kg which exceeded the target (18 kg/capita/year) proposed by the National Nutritional Workshop as well as the target (20 kg/capita/year) set out in the REPELITA V. As long as the required volume of fish is supplied at present price structure of fish and meat/egg/milk to the regional market, this relatively high level consumption would last in future. Due to the long distance to densely populated areas such as Java and Bali and the local price level almost

as high as in Java, it seems difficult to transfer fishes thereto from the economic viewpoint. Although some of fresh fish are marketed to the southern part of Sumatra (mainly Jambi and Bengkulu), due to the low population therein those markets would not be large to expect as future potential market areas. In these contexts, the fish produced in the Region continue to play a substantial role not only for regional consumption but also for direct export to or via neighboring countries like Singapore, Malaysia and so on.

118. Accordingly, it will be essential to increase fish production steadily, first to keep pace with the increasing population, and, second to increase export earnings in this Region. Based on the assumption that the Region's demand for fish will continue to increase along with an population increase and an per capita fish consumption of 23 kg, and the Region's fish export will increase at an increase rate 10%, the total fish demands in 1993 and 2008 are estimated about 600,000 tons and 960,000 tons respectively (Table 35).

119. As shown in Table 22, fisheries resource exploitation rate is still low (67%) in the west coast of Sumatra, but quite high (102%) in the Malacca Straits. In order to meet demand for fishes (605,000 tons) in 1993, it is necessary first to fully exploit and effectively utilize the coastal fish resources (total potential stock: 523,000 tons/year including tuna and skipjack), and second to increase production from inland fishery and aquaculture (to cover the remaining demand: 82,000 tons). Although there is a largely untouched offshore fisheries resources in the 200-mile EEZ, the priority development should be paid to the coastal fishery and aquaculture, since for offshore fishery development, it takes a time for preparatory arrangements which are also to be urgently tackled on. In 2008 the fish demand including export may reach to 960,000 tons per year. It is essential to exploit the offshore fish resources to meet the increasing demand. The fish production targets to be achieved by each province in the Region are given in Table 36 and the expected fish distribution model in 2008 is shown in Figure 8.

4. Projects Identified

120. Based on the following selection criteria the projects to be required in fisheries sector were identified. The long-list of Identified projects and profiles of some short-listed projects are given in Volume IV.

- (i) Unexploited fish resource development
- (ii) Export-oriented fish production
- (iii) Fish market development in remote areas
- (iv) Cooperations strengthening in remote areas
- (v) Upgrading of small-scale fishermen
- (vi) Extension of possible government support

5. Fisheries Sector in IDEP

5.1. Northern Aceh IDEP (P-1)

121. This Area plays an important role as a production and collecting base of shrimps in the east coast of Aceh. With establishment of a better transportation channel from west to east coasts and development of coastal fishery in the west, most fishes will be transported to Lhokseumawe. Furthermore, upon the development of deep-sea fishery having a base in Sabang, those catches are also expected to move to Lhokseumawe for processing and export. In these points of view, the Area should be developed as a fish processing center as well as an export base in Aceh Province. In 2008 Lhokseumawe may overcome Medan in processing and export capacities.

5.2. West Aceh IDEP (P-2)

122. Meulaboh will be developed as a main fish supply base in the west coast of Aceh, distributing fishes mainly to Lhokseumawe. In the west coast of Sumatra, three fishing ports, namely, Lampullo, Sibolga and Padang will serve as offshore fishing bases in future. In West Aceh, as well as South Aceh, therefore, the development of coastal fishery is emphasized with improvement of fishery infrastructure and marketing. Particularly, as a first step of development, purse seine fishing with fish aggregating device (FAD) will be appropriate.

5.3. Metropolitan Medan IDEP (P-3)

123. The area between Medan and Belawan will continue to play an important role as a fish collecting and processing center not only in North Sumatra Province but also in the whole area of northern part of Sumatra. Due to high domestic fish demand in the Area, however, it is indispensable to expand fish collecting capacity along with establishment of better transportation system from producing areas, particularly, those from west coasts of Aceh and North Sumatra.

5.4. West Coast Tapanuli IDEP (P-4)

124. Sibolga will play an essential role as a major fish collecting and supply base in the Province, for distributing fishes from west to east coast. The development of offshore fishery based on Sibolga is indispensable for satisfying the future regional fish demand, while coastal fishing villages such as Barus, Bataban and Natal should be emphasized with coastal fishery development including improvement of fishery infrastructure and marketing. Particularly, purse seine fishing with fish aggregating device (FAD) seems to be prospective in this area.

5.5. Nias Island IDEP (P-5)

125. Upon the improvement of fish marketing and transportation system between Nias Island and Sumatra main island, this Area will play a substantial role to supply fishes to main island. By effectively utilizing potentials of comparatively large fishing manpower and rich fisheries resources around the island, Nias has an high advantage to develop fisheries sector. The strategy of fisheries development is, first to upgrade artisanal fishermen, with provision of adequate fishing gear and technique through training, and, second to improve fish marketing facilities including landing place. In particular, the Area is close to tuna fishing ground so that small-scale tuna fishery development will be prospective.

5.6. Minang Highlands IDEP (P-6)

126. This Area has been historically developed in freshwater fish pond culture achieving a highest yield. It is expected that freshwater fish culture in this area will be further developed as a fish production center of West Sumatra which will be able to supply fishes not only to the province but also to Pekanbaru (Riau).

5.7. South Sijunjung IDEP (P-7)

127. In this Area the development of freshwater fish culture will be also emphasized taking advantage of well irrigated areas with strengthening of fish fry production and distribution system.

5.8. Mentawai Islands IDEP (P-8)

128. Due to very limited number of fishermen and their traditional level of fishing gear and technique, it will take a time to exploit rich fisheries resources around islands. First, it is necessary to expand their fishing capability by providing with appropriate fishing gear as well as development of new fish processing technique in order to make up a difficulty of fish marketing due to the primitive inter-island transportation.

5.9. Rokan Basin IDEP (P-9)

129. Freshwater fish culture in this Area will be developed along with settlement programs both for local population and transmigrants. The freshwater fishes will be possible to culture as a second product of food-crop farms.

5.10. Indragiri River IDEP (P-10)

130. This area has an extensive potential for development of swamp where brackishwater shrimps and freshwater fish cultures are highly prospective. In order to supplement the recent stagnant level of capture fishery both in coastal and inland waters due to natural fish stock depression, which are mainly caused by intensive fishing and flood control, aquaculture development will be indispensable in this area. In addition, shellfish culture should be introduced in terms of coastal water management, and optimum level of development of coastal mangrove swamp in harmony with environmental conservation will be emphasized.

5.11. Riau Islands IDEP (P-11)

131. This Area is an ideal location for development of mariculture including marine fish cage culture, seaweed culture and shellfish culture. The Area will continue to contribute to export of fishes to and/or via Singapore. The South China Sea, which is a huge water area having rich fisheries resources, will be exploited with participation of private enterprises including those from overseas countries, but most of catch may be landed at areas other than Riau Province, e.g., Pontianak (West Kalimantan), Singapore, Jakarta, Bangkok, from geographical viewpoints.

6. High Priority Projects

132. The following projects are proposed as high priority projects, and the Guidelines for Implementation therefor which included in the IDEP areas are presented in the IDEP Report.

6.1. Marine Fishery Development Sub-Center Project (A-32)

133. Although Marine Fishery Development Center (BPPI) in Semarang (Central Java) was established for the purpose of upgrading small-scale fishermen through development of fishing gear and method and training in collaboration with provincial-level marine fisheries development units (UPPI), the capacity is not enough to cover whole Indonesia and the extension of technology seems to be not efficient because of limited facilities in each UPPI. In the course of development of both coastal and offshore fisheries in the west coast of Sumatra, where rich fisheries resources are still undeveloped mainly due to lack of fishing technique, however, the establishment of proposed facilities in Sibolga (North Sumatra) which will act as a sub-center of BPPI Semarang and their covering area will be whole Sumatra particularly the west coast are indispensable.

6.2. Small-Scale Fishery Development Project (A-16, A-34, A-49)

134. In order to meet the increasing demand for fishes both in domestic and export markets, it is largely expected to increase the Region's fish production. As fisheries resource level has already reached to the maximum sustainable yield (MSY) in the Malacca straits, the increase of fish production should be mainly from the west coast where the fisheries resources are still underexploited. Based on the demand projection prepared by the Team, it is necessary, first to develop coastal fishery in the west coast upto its MSY level by 1993. For doing so, the following activities are focused.

- (i) Artificial reef installation and purse seine fishing development (west coast of Sumatra main island).
- (ii) Improvement of small-scale fishery infrastructure and marketing/processing along with cooperatives strengthening. (Whole western part of Sumatra including islands).
- (iii) Motorization of canoes and small-scale tuna fishery development. (Western islands of Sumatra including Nias and Mentawai)

135. Particularly in the 4 IDEP areas in the west coast Sumatra, namely, West Aceh, West Coast Tapanuli, Nias Island and Mentawai Islands, the implementation of this project is highly recommended.

6.3. Mariculture Development Project (A-35, A-62)

136. Riau province has a close relation with bordering countries; Singapore and Malaysia, on commercial activities. As for fisheries it is largely contributed to the regional economy through export of fishes to those countries. Due to highly exploited coastal waters of the Malacca Straits, the further increase of export may have to depend on aquaculture production. The Riau archipelago and Indragiri swamp in particular are prospective areas for aquaculture development taking advantage of a close location to Singapore. Thus, in these areas, the participation of some private enterprises can be expected. In order to promote aquaculture in sound manner as well as to encourage private sector's investment, however, it is necessary to provide possible government support especially to small-scale fishermen/farmers who may

be left behind the development. The proposed components of the Project are as follows:

- (i) Mariculture development
 - Establishment of marine fish hatchery (Batam)
 - Marine fish fry collecting & nursing system (Senayang)
 - Organization of seaweed culture farmers group as a plasma under NES approach (Senayang)

- (ii) Brackishwater aquaculture development
 - Resettlement of land-less fishermen into brackishwater shrimp farms (Indragiri Hilir)
 - Establishment of freshwater giant prawn hatchery (Singkep)
 - Introduction of freshwater prawn culture for land-owned rice farmers in irrigated area (Indragiri Hilir)

- (iii) Coastal water management by means of introduction of shellfish culture (Indragiri Hilir)

Table 18. Total Fish Production (1981 - 1987)

Year	(in MT)					
	Aceh	North Sumatra	West Sumatra	Riau	Total	National Share
1981	56,465	141,101	31,771	141,305	370,642	19.4
1982	54,687	147,003	32,767	127,843	362,300	18.1
1983	62,857	163,276	35,176	152,976	414,285	18.7
1984	56,257	192,598	39,523	145,904	434,282	19.2
1985	88,971	177,581	39,130	159,556	465,238	19.4
1986	93,795	183,985	47,805	163,278	488,863	19.4
1987	103,401	198,270	53,020	169,180	523,871	19.6
Annual Increase Rate (%)	10.7	5.8	8.7	3.1	5.9	

Source: Directorate General of Fisheries (DGF).

Table 19. Total Fish Export (1981 - 1987)

Year	(FOB in US\$1,000)					
	Aceh	North Sumatra	West Sumatra	Riau	Total	National Share
1981	1,642	23,976	109	2,070	27,797	12.3
1982	2,281	24,757	18	2,225	29,281	11.7
1983	1,735	32,151	55	2,560	36,501	14.2
1984	1,736	25,364	27	3,393	30,520	12.3
1985	2,137	29,116	69	3,463	34,785	13.4
1986	3,041	48,597	124	4,240	56,002	15.0
1987	8,055	66,052	82	5,754	79,943	16.8
Annual Increase Rate (%)	30.4	18.4	-	18.6	16.3	

Source: Directorate General of Fisheries (DGF).

Table 20. Per Capita Fish Consumption (1986)

	Aceh	North Sumatra	West Sumatra	Riau	Total	Sumatra	Indonesia
Production							
- marine fishery	78,103	186,079	39,097	156,745	460,024	612,653	2,017,350
- inland fishery	1,884	5,847	4,205	11,911	23,847	74,042	276,291
- aquaculture	23,414	6,344	9,718	524	40,000	48,089	376,772
Total catch	103,401	198,270	53,020	169,180	523,891	734,784	2,670,413
Export (mt)	667	17,269	34	11,566	29,536	31,471	140,378
Import (mt)	9	2,924	0	1,084	4,017	4,018	65,371
Regional consumption	102,743	183,925	52,986	158,698	498,352	707,331	2,595,406
Inter-provincial movement/*	(-3,000)	(10,000)	(-)	(-47,000)	(-40,000)	(10,000)	
Provincial Consumption	(99,743)	(193,925)	(52,986)	(141,698)	458,352	(717,331)	2,595,406
Population (1,000 persons)	3,225	10,104	3,839	2,821	19,989	35,720	174,825
P.C. Fish Consumption (kg/capita/yr)	31.9 (30.9)	18.2 (19.2)	13.8 (13.8)	56.3 (39.6)	24.9 (22.9)	19.8 (20.1)	14.8

Remarks: * Volume os estimated based on field surveys.

Source: Directorate General of Fisheries (DGF).

Table 21. Comparison of Marine Fishery Status Between West Coast and Malacca Straits Sides (1987)

	Fish catch		No. of fishermen				No. of fishing boats					
	volume (MT)	share (%)	(1,000 persons)		share (%)		Non-power		Outboard eng.		Inboard eng.	
			Full	Part	Total		units	share	units	share	units	share
West Coast	(120,833)	(26.3)	(76)	(26)	(102)	(34.8)	(16,450)	(39.1)	(3,188)	(63.1)	(2,337)	(11.5)
- Aceh	36,910	8.1	24	9	33	11.3	5,242	12.5	913	18.1	744	3.7
- N. Sumatra	44,826	9.7	22	8	30	10.2	6,317	15.0	702	13.9	1,196	5.9
- W. Sumatra	39,097	8.5	30	9	39	13.3	4,891	11.6	1,573	31.1	397	1.9
Percentage of motorization							74.9		14.5		10.6	
Malacca St.	(339,191)	(73.7)	(148)	(43)	(191)	(65.2)	(25,612)	(60.9)	(1,865)	(36.9)	(17,915)	(88.5)
- Aceh	41,193	8.9	21	4	25	8.5	2,152	5.1	1,268	25.1	927	4.6
- N. Sumatra	141,253	30.7	87	25	112	38.2	11,191	26.6	35	0.7	10,465	51.7
- Riau	156,745	34.1	40	14	54	18.5	12,269	29.2	562	11.1	6,523	32.2
Percentage of motorization							56.4		4.1		39.5	

Source: Directorate General of Fisheries

Table 22. Marine Fish Catch and Potential Resources

A. Western Water of Sumatra

	Actual Catch (MT)						Potential stock (MT/year)	Water region (T or E)	Exploitation rate (%)
	1982	1983	1984	1985	1986	1987			
Pelagic fish	47,443	53,730	57,070	58,643	62,710	72,646	110,900	T	66
Demersal fish	12,030	15,108	18,837	18,489	23,953	26,635	50,400	T	53
Tuna	2,468	1,865	2,285	2,318	2,936	4,859	12,800	T & E	38
Skipjack	5,375	5,911	6,522	6,903	6,901	7,102	6,100	T & E	116
Shrimp	2,043	3,030	1,638	3,119	1,997	2,821	900	T	313
Others	11,049	7,455	8,436	5,767	12,769	13,902	(10,000)	T	-
Total	80,408	87,099	94,788	95,239	111,266	128,126	(191,100)		67

B. Malacca Straits

	Actual Catch (MT)						Potential stock (MT/year)	Water region (T or E)	Exploitation rate (%)
	1982	1983	1984	1985	1986	1987			
Pelagic fish	101,660	117,706	74,306	98,925	102,349	100,843	126,500	T	81
Demersal fish	40,401	48,486	49,384	49,831	54,617	60,883	78,300	T	78
Tuna	1,413	267	151	1,512	1,411	2,272	4,800	T & E	47
Skipjack	1,472	983	816	2,600	1,612	1,985	2,300	T & E	86
Shrimp	39,703	44,310	38,185	39,246	41,087	54,109	20,000	T	270
Others	92,165	114,058	133,889	123,832	123,670	119,099	(100,000)	T	-
Total	276,814	325,810	296,731	315,946	324,746	339,191	(331,900)		102

Note: a) Actual catch volumes in Malacca Straits include those caught in the South China Sea (landed at Riau only).

b) T: 12-mile territorial water E: 200-mile Exclusive Economic Zone (EEZ)

c) Figures in parenthesis are estimated by the Team.

Source: Directorate General of Fisheries

Table 23. Potential Fish Stock in Offshore (200-mile EEZ)

	(in MT)	
	West Coast of Sumatra	South China Sea
Pelagic fish	132,600	195,000
Demersal fish	106,100	293,900

Source: Directorate General of Fisheries (DGF).

Table 24. Comparison of Brackishwater Aquaculture by Province (1986)

	Aceh	North Sumatra	West Sumatra	Riau	Total
Tambak Area (ha)	(29,677)	(1,118)	-	(155)	(30,950)
- intensive	178	222	-	-	400
- extensive	29,499	896	-	155	30,550
No. of households	13,762	429	-	73	14,264
Average pond size (ha)	2.2	2.6	-	2.1	2.2
Production (MT/year)	(22,095)	(1,659)	(-)	(32)	(23,786)
- shrimp	6,862	829	-	10	7,701
- milkfish	12,537	256	-	-	12,793
- others	2,696	574	-	22	3,292
Average yield (kg/ha/year)	745	1,484	-	206	736

Source: Directorate General of Fisheries

Table 25. Status of Survey on Potential Tambak Areas

Province	Potential Area (ha)		Current Status
	East coast	West coast	
Aceh	10,000 (17,000)	-	- 3,200 ha (Aceh Timur) was preliminary surveyed in 1987 has already approved by Dept. of Forestry and Dept. of Agraria for tambak development (Of which 500 ha will be developed under ADB project). - Potential areal survey on west coast was recently done by the University of Syiah Kuala (in Banda Aceh) and report is under preparation as of July 1989.
N. Sumatra	9,500	2,500	- A total of 7,020 ha (6,280 ha in east coast and 740 ha in west coast) have already been surveyed in 1985/86, and the following areas were recommended as priority areas for tambak development. Kab. Langkat : 2,850 ha (Of which 500 ha will be developed under ADB project) Kab. Deli Serdang : 2,100 ha (Of which 500 ha will be developed under ADB project) Kab. Asahan : 1,000 ha Kab. Tapanuli Tengah: 440 ha
W. Sumatra	-	2,000	- Preliminary survey was conducted in 1984/85 for areas of about 1,000 ha, but not including priority area survey.
Riau	54,000 (20,000)	-	- No survey conducted. (Area was identified based on mangrove areas)
Total	73,500 (49,500)	4,500	

Note: Figure in parenthesis shows the estimate by Dinas Perikanan.

Source: Directorate General of Fisheries (DGF).

Table 26. Shrimp Hatcheries in the Region (1988)

Prov.	District	Name of Hatchery	Production capacity (mil. pcs/yr)	Actual production (mil. pcs/yr)	
Aceh	Aceh Besar	Shrimp Sub-Center (SSU)	40	2	
		Ulhelhe Station	2	2	
		*)ADB Shrimp hatchery	40	-	
		PT. Brama Sakti Pertiwi	5	5	
		H. Abudussalam Ibrahim	20	2	
		PT. Karuniya Mas Perdana	40	10	
		*)PT. Bangun Tambak Persada	40	-	
		*)PT. Ladong	20	-	
		Aceh Pidie	PT. Kuala Berabo	40	30
		Aceh Utara	PT. Amaranda Brata	40	20
			CV. Mon Klaya	10	3
			PT. Udita Mina	40	30
			Toko Asia	2	1
			PT. Mahari Lestari	40	30
	PT. Matang Speng Raya	20	10		
	Haji Jafar	3	3		
North Deli		PT. Antaso	5	5	
Sumatra	Serdang	PT. Hartono	40	30	
Riau	Riau	PT. Hari Baik	5	5	
	Kapalauan				
Total			360	134	

- Note: a) Hatcheries with mark *) are under construction or planning as of June 1988.
 b) According to Dinas Perikanan Riau and North Sumatra, there are 5 shrimp hatcheries in Batam Is. (Riau) and also 5 in Deli Serdang (North Sumatra), but capacity is unknown.
 c) The size of shrimp fry produced is PL15-20.

Source: Directorate General of Fisheries
 Dinas Perikanan Daerah Tingkat I Propinsi Aceh

Table 27. Comparison of Freshwater Aquaculture by Province

A. Freshwater Pond (Kolam)

	Aceh	North Sumatra	West Sumatra	Riau	Total
Kolam Area (ha)	706	3,335	4,140	78	8,259
No. of households	1,601	7,677	74,715	3,882	87,875
Average pond size (ha)	0.44	0.43	0.06	0.02	0.09
Production (MT/year)	740	2,022	7,826	397	10,985
Average yield (kg/ha/year)	1,048	606	1,890	5,090	1,330

B. Paddy Field (Sawah)

	Aceh	North Sumatra	West Sumatra	Riau	Total
Sawah Area (ha)	668	12,284	1,084	-	14,036
No. of households	760	7,281	1,141	-	9,131
Average sawah size (ha)	0.88	1.69	0.95	-	1.53
Production (MT/year)	303	1,298	971	-	2,572
Average yield (kg/ha/year)	454	106	895	-	183

Source: Directorate General of Fisheries

Table 28. Freshwater Fish Hatcheries in the Region

Province	No. of Fish Hatchery			Seed Production in 1985 (1,000 pcs)
	Station	Sub-Station	Total	
Aceh	1	3	4	8,600
North Sumatra	1	27	28	21,019
West Sumatra	1	11	12	4,375
Riau	-	3	3	79
Total	3	44	47	34,073

Source: Directorate General of Fisheries

Table 29. Current Status of Mariculture Experiment in the Region

Type of Culture	Species	Status
Marine Fish cage culture	grouper (<u>Epinephelus tauvina</u>) " (<u>Plectropomus leopardus</u>) rabbitfish (<u>Siganus canaliculatus</u>)	- There are 50 farmers engaging in cage culture having 2 - 20 cages/farmer in Riau archipelago. - AARD/DGF experiment with 24 cages in progress in Pulau Bintang (Riau).
Seaweed raft culture	<u>Eucheuma cottoni</u>	- DGF's experiment in progress (started 1987) with 20 rafts in Sibolga (North Sumatra). - Some private firms' trial operation in progress with 300 rafts at Desa Carocoh Tarusan (West Sumatra), 16 farmers in Sibolga (North Sumatra), and 30 farmers in Tanjung Pinang (Riau) under NES system.
Shellfish culture	pearl oyster (<u>Pinctada spp.</u>) oyster (<u>Crassostrea cucullata</u>) gastropoda (<u>Strombus kanasiium</u>)	- Oyster culture using hanging method not yet succeeded, but it is highly prospective in Kec. Moro (Riau archipelago).

Source: Mariculture Research Sub-Station, Agency for Agriculture Research and Development (AARD) Seafarming Sub-Center Riau Tg. Pinang, Directorate General of Fisheries (DGF) (Prepared based on hearing during field survey)

Table 30. Comparison of Fish Landing by Fishing Port (1985)

A. National Fishing Port

Province	Location	Fish Landing (MT/year)	Proportion to Total Provincial Fish Landing (%)
Aceh	Lampullo	2,463	3.8
North Sumatra	Belawan	16,949	10.3
	Sibolga P. Telo	573	0.3
West Sumatra	Sikakap	24	0.1
Riau	Tarempa	4,516	3.1
Sub-Total		24,525	6.1

B. Provincial Fish Landing Centers (PPIs)

Province	No. of PPIs	Fish Landing (MT/year)	Proportion to Total Provincial Fish Landing (%)
Aceh	5	15,666	24.5
North Sumatra	17	71,262	43.4
West Sumatra	5	2,058	7.3
Riau	10	2,311	1.6
Sub-Total		91,297	22.6
Total	43	115,822	28.7

Notes: a) Fish landing capacity of national fishing port;
B-class: Belawan - over 13,250 MT/year
C-class: Others - over 7,300 MT/year
b) Sibolga Fishing Port is now under tendering for construction as of August 1989.
c) Number of PPIs includes only those which were constructed with central governmental support.

Source: Directorate General of Fisheries

Table 31. Marketing Infrastructure

A. Ice Plant (1985)

Province	No. of Plants	Daily Capacity (MT/24 hrs)
Aceh	7	185
North Sumatra	24	958
West Sumatra	5	210
Riau	89	729
Total	125	2,082

Note: Ice is mainly used for fisheries use.

B. Fish/Shrimp Cold Storages (1988)

Province	Location	No. of Plants	Freezing capacity (MT/day)	Cold Store Capacity (MT)
Aceh	Lhokseumawe	2	4.0	1,000
	*Sabang	1	5.0	900
North Sumatra	Medan	8	49.5	2,210
	Tg. Balai	1	12.0	140
	Sibolga	1	3.0	100
West Sumatra	-	-	-	-
Riau	Bagan Siapiapi	2	4.5	80
	*Tg. Pinang	1	5.0	50
	*Singkap	1	5.0	50
	*Sungai Bela	1	5.0	50
	*Tg. B. Kalimun	1	5.0	50
Total		19	98.0	4,630

Note: Location with mark * are owned by government enterprises and which plants are for frozen fish use (These facilities are under leasing to private sector, and will be liquidated near future). Others are private factories mainly producing frozen shrimps.

C. Fish Canning Plant (1988)

Province	Name of Enterprise	Daily Capacity (MT/day)	Major Products
North Sumatra	PT. Bintang Maya Canning	6	fish
	PT. Medan Canning	-	crab/clam
	PT. Button	-	fish

Source: Directorate General of Fisheries
(modified based on the findings at field survey)

Table 32. Change of Shrimp production in the Region

A. Shrimp Production from Tambak Culture

Province	Black Tiger					Shrimp Total				
	1982	1983	1984	1985	1986	1982	1983	1984	1985	1986
Aceh	469	504	1,028	2,484	4,697	2,052	2,047	2,545	5,506	6,862
North Sumatra	22	10	22	278	247	58	48	56	806	829
West Sumatra	-	-	-	-	-	-	-	-	-	-
Riau	6	5	6	10	2	24	19	23	20	10
Total	497	519	1,056	2,772	4,946	2,134	2,114	2,624	6,332	7,701
Country Total	8,783	7,550	10,318	13,068	17,812	30,602	27,595	31,989	37,399	47,217
Proportion to country total (%)	5.7	6.9	10.2	21.2	27.8	7.0	7.7	8.2	16.9	16.3

B. Shrimp Production from Marine Capture Fishery

Province	Black Tiger					Shrimp Total				
	1982	1983	1984	1985	1986	1982	1983	1984	1985	1986
Aceh	110	244	109	465	515	1,046	3,436	1,831	4,033	3,647
North Sumatra	1,315	957	982	737	831	18,045	17,337	15,324	12,310	12,901
West Sumatra	55	28	42	42	53	576	396	486	511	625
Riau	4,608	2,297	4,902	3,719	3,773	21,938	26,075	22,046	25,345	25,646
Total	6,088	3,526	6,035	4,963	5,172	41,605	47,244	39,687	42,199	42,819
Country Total	10,068	10,726	14,209	10,481	13,863	100,495	111,384	101,428	107,190	115,584
Proportion to country total (%)	60.5	32.9	42.5	47.4	37.3	41.4	42.5	39.1	39.4	37.0

Source: Directorate General of Fisheries

Table 33. Current Shrimp Fry Distribution and its Future Demand (Estimate)

Type of Culture	Current Status			Future Demand with Intesification		
	Tambak area (ha)	Shrimp fry stocking density (pcs/ha)	Total No. of fry (mil. pcs)	Type of improvement	Shrimp fry stocking density (pcs/ha)	Total No. of fry required (mil. pcs)
Non fry stocking	13,850	-	-	(shrimp monoculture) or (Semi-intesification)	10,000 40,000	277 1,108
Stocking						
a) Shrimp monoculture				(Semi-intensification)	40,000	617
- extensive	7,710	10,000	154			
- semi-intensive		40,000				
- intensive	400	100,000 up	80	same as left	100,000 up	80
b) Milkfish monoculture				same as left	-	-
- extensive	4,490	-				
c) Polyculture (shrimp + milkfish)	4,500	5,000	45	same as left	5,000	45
Total	30,950		279			1,019 - 1,850

Note: a) The above estimated number of shrimp fry (current status) can be also calculated from production volume of black tiger with the following formula.

$$(\text{Production of black tiger shrimp}) \div (\text{Average size of shrimp}) \div (\text{Survival rate of shrimps})$$

$$4,946,000 \text{ kg} \div 0.04 \text{ kg/pc} \div 45\% = 275 \text{ million pcs.}$$

b) The number of culture cycles is 2 times per year for shrimp culture.

Table 34. Potential Areas for Seaweed Culture

Province	Potential area (ha)	Coastal (%)	Tambak (%)	Remarks
Aceh	500	63	37	Coastal: for <u>Eucheuma</u> culture
North Sumatra	600	85	15	
West Sumatra	500	70	30	Tambak: for <u>Gracilaria</u> culture
Riau	1,500	95	5	
Total	3,100	84	16	

Source: Directorate General of Fisheries

Table 35. Fish Demand Projection

(1) Region's consumption

Year	Required Volume (1,000 MT)				
	1988	1993	1998	2003	2008
a) Aceh	74.2	84.1	94.4	105.5	117.8
b) N. Sumatra	232.4	259.5	288.3	320.9	360.1
c) W. Sumatra	88.3	93.0	97.4	102.2	107.3
d) Riau	64.9	75.6	87.4	100.7	115.7
Region Total	459.7	512.3	567.5	629.3	700.9

(2) Export

Year	Required Volume (1,000 MT)				
	1988	1993	1998	2003	2008
a) Foreign countries	29.5	47.5	76.5	123.2	198.4
b) Southern Sumatra	10.0	11.9	13.9	15.9	17.7
c) Java	30.0	33.0	35.9	38.6	41.7
Export Total	69.5	92.4	126.3	177.7	257.3

(3) Total Demand

Year	Required Volume (1,000 MT)				
	1988	1993	1998	2003	2008
Total Demand	529.2	604.7	693.8	807.0	958.2

Table 36. Fish Production Targets

(1) Aceh

Year	Target Volume (1,000 MT)				
	1988	1993	1998	2003	2008
Marine (East)	41.2	45.0	48.7	52.5	56.2
Marine (West)	36.9	54.0	73.5	93.0	112.5
Inland fishery	1.9	1.9	1.9	1.9	1.9
Aquaculture	23.4	33.7	43.3	53.9	65.6
Total	103.4	134.6	167.4	201.3	236.2

(2) North Sumatra

Year	Target Volume (1,000 MT)				
	1988	1993	1998	2003	2008
Marine (East)	141.3	145.1	148.8	152.6	156.3
Marine (West)	44.8	65.6	89.3	113.0	136.7
Inland fishery	5.8	5.8	5.8	--	5.8
Aquaculture	6.3	11.7	17.0	22.4	27.9
Total	198.3	228.2	260.9	293.8	326.7

(3) West Sumatra

Year	Target Volume (1,000 MT)				
	1988	1993	1998	2003	2008
Marine (West)	39.1	57.2	77.8	98.4	119.0
Inland fishery	4.2	4.2	4.2	4.2	4.2
Aquaculture	9.7	11.1	12.9	15.1	18.0
Total	53.0	72.5	94.9	117.7	141.2

(4) Riau

Year	Target Volume (1,000 MT)				
	1988	1993	1998	2003	2008
Marine (East)	156.7	160.4	164.2	167.9	171.6
Inland fishery	11.9	11.9	11.9	11.9	11.9
Aquaculture	0.5	0.7	3.6	10.4	32.9
Total	169.2	173.0	179.1	190.2	216.4

(5) Region's Total

Year	Target Volume (1,000 MT)				
	1988	1993	1998	2003	2008
Marine (East)	339.2	350.5	361.7	373.0	384.1
Marine (West)	120.8	176.8	240.6	304.4	368.2
Inland fishery	23.8	23.8	23.8	23.8	23.8
Aquaculture	40.0	66.2	66.2	86.3	104.4
Total	523.8	608.3	702.3	803.0	920.5

Assumptions:

- a) The exploitation of offshore fisheries resources will be commenced from 1994, and will be completed in 2008.
- b) The maximum rate of exploitation of potential fish stock (both coastal and offshore) in the Region will be the level of 80% of MSY estimated by DGF.
- c) The resources in the South China Sea are not accounted for because catch therefrom may be landed to the areas other than the Study Region.
- d) Inland fishery production will not increase because of establishment of irrigation and flood control systems in future.
- e) Aquaculture production will be increased both from brackishwater and freshwater culture. As for brackishwater culture, the production targets are set up based on the potential areas and increment of yield (See Table 37), while freshwater culture production will increase just only to meet the increasing population.

Table 37. Brackishwater Shrimp Demand & Production Targets

A. Demand

(unit: MT)

Year	1988	1993	1998	2003	2008
Export/*1 (cultured)	13,800 (6,900)	22,200 (15,300)	35,800 (28,900)	57,600 (50,700)	92,800 (85,900)
Domestic/*2 (cultured)	36,700 (800)	40,900 (5,000)	45,300 (9,400)	50,200 (14,300)	55,900 (20,000)
Total (cultured)	50,500 (7,700)	62,900 (20,300)	81,100 (38,300)	107,800 (65,000)	148,700 (105,900)

B. Production (from tambak only)/*3

(unit: MT)

	1988	1993	1998	2003	2008
<u>Tambak area/*4</u>					
- Aceh	29,677	32,200	34,700	37,200	39,700
- N. Sumatra	1,118	4,100	7,100	10,100	13,100
- W. Sumatra	--	250	750	1,250	2,000
- Riau	155	650	3,150	8,150	20,150
<u>Average yield/*5</u>					
- Aceh	745	1,000	1,200	1,400	1,600
- N. Sumatra	1,485	1,600	1,800	2,000	2,200
- W. Sumatra	--	1,000	1,200	1,400	1,600
- Riau	206	400	600	800	1,000
<u>Production</u>					
- Aceh	22,095	32,200	41,640	52,080	63,520
- N. Sumatra	1,659	6,560	12,780	20,200	28,820
- W. Sumatra	--	250	900	1,750	3,200
- Riau	32	260	1,890	6,520	20,150
<u>Total</u>	(23,786)	(39,270)	(57,210)	(80,550)	(115,690)
- Shrimps	7,701	21,340	37,350	58,520	91,260
- Milkfish/*6	12,793	14,260	15,790	17,520	19,510
- Others/*6	3,293	3,670	4,070	4,510	4,920

Remarks/*1 : Based on 10 % annual growth (1982 - 87 average)

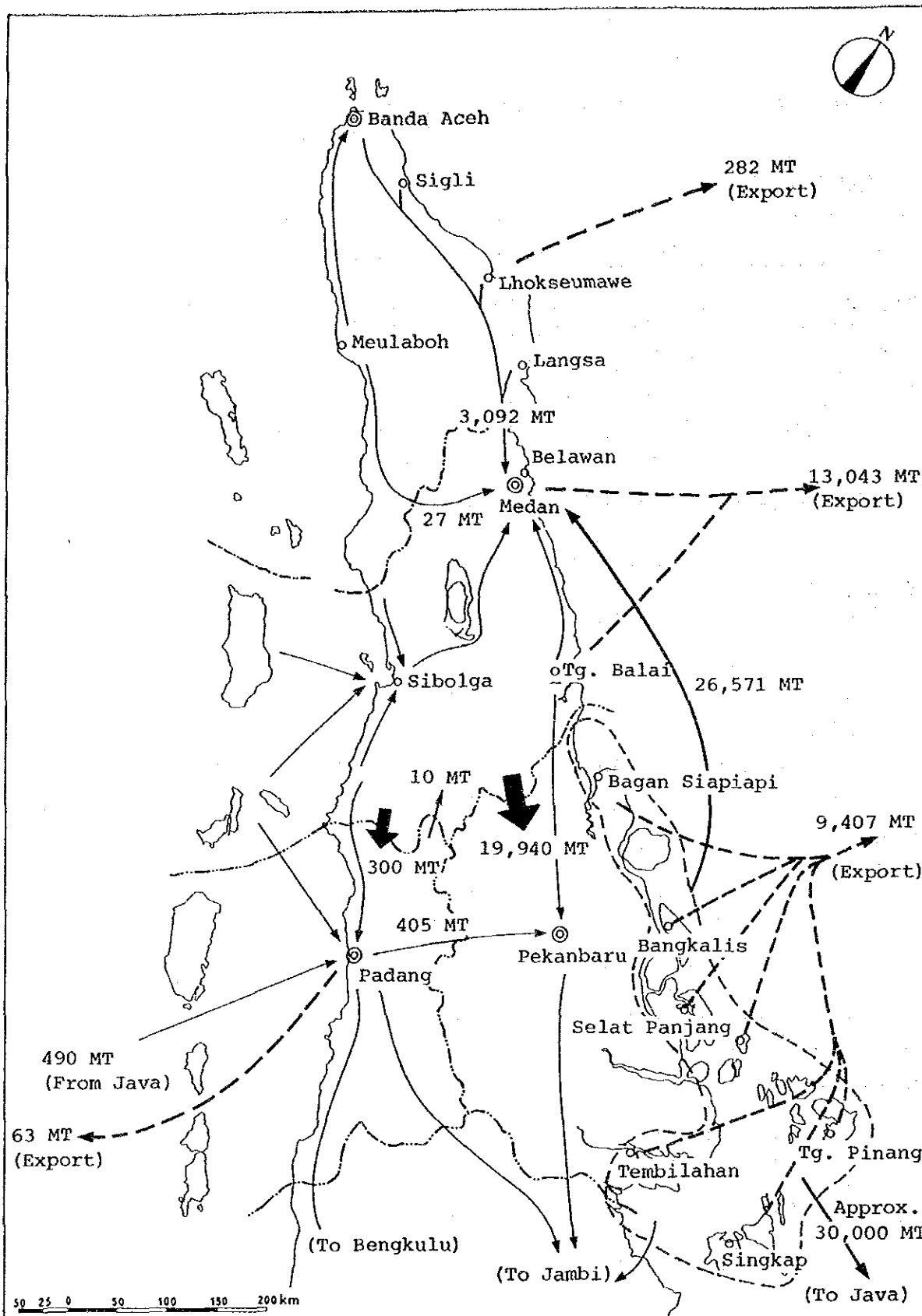
/*2 : Based on population increase.

/*3 : Production from capture fishery at stagnant level.

/*4 : Based on increase upto estimated potential areas by 2008.

/*5 : Based on increase by intensification (rehabilitation of pond and canals)

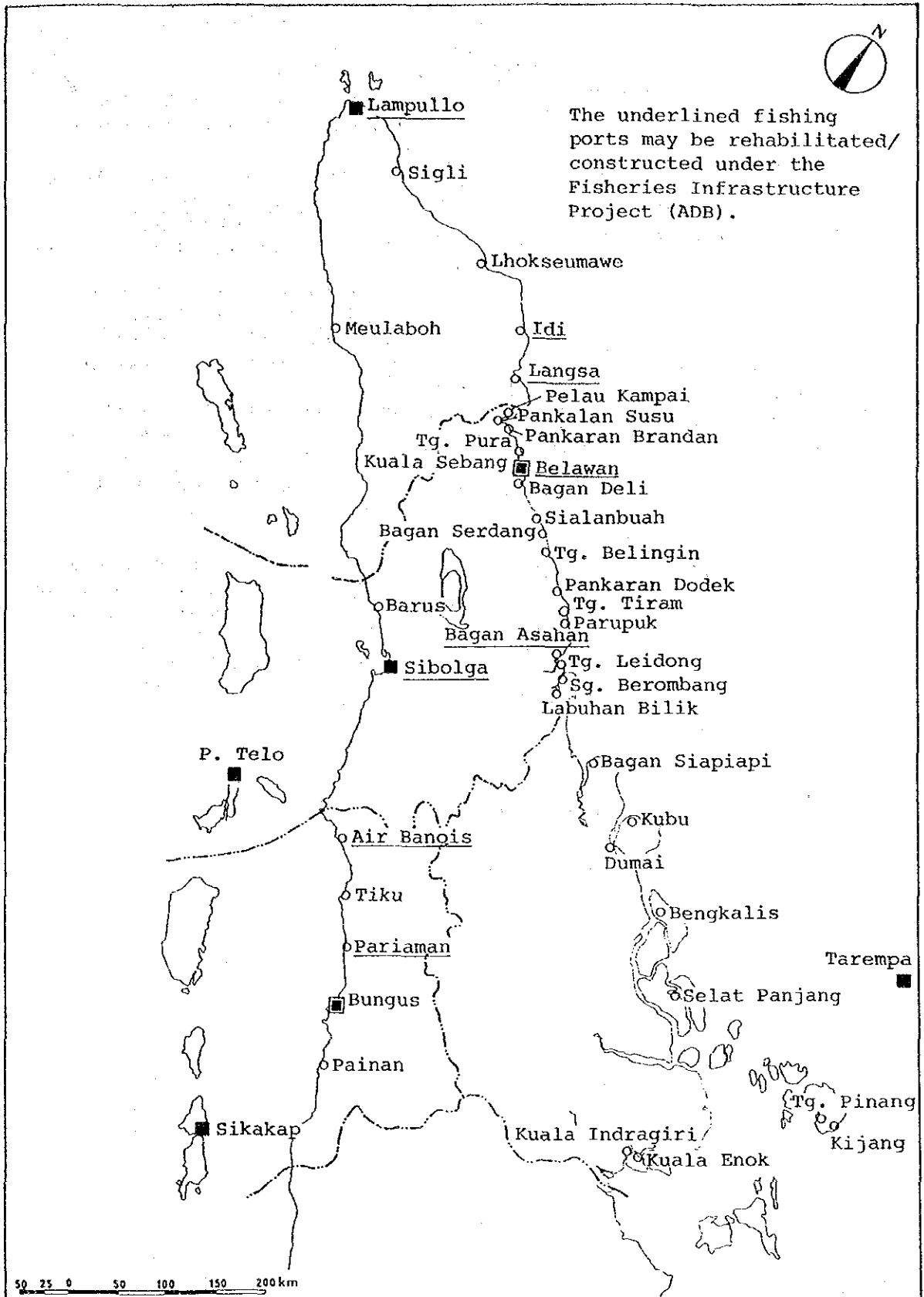
/*6 : Based on population increase (Assumed Production equal to estimated demand)



LEGEND:
 Figure shows the volume of fishes transferred based on 1986 data.

FIG. 5
 FISH DISTRIBUTION IN THE STUDY REGION

THE STUDY ON THE INTEGRATED REGIONAL DEVELOPMENT PLAN FOR THE NORTHERN PART OF SUMATERA



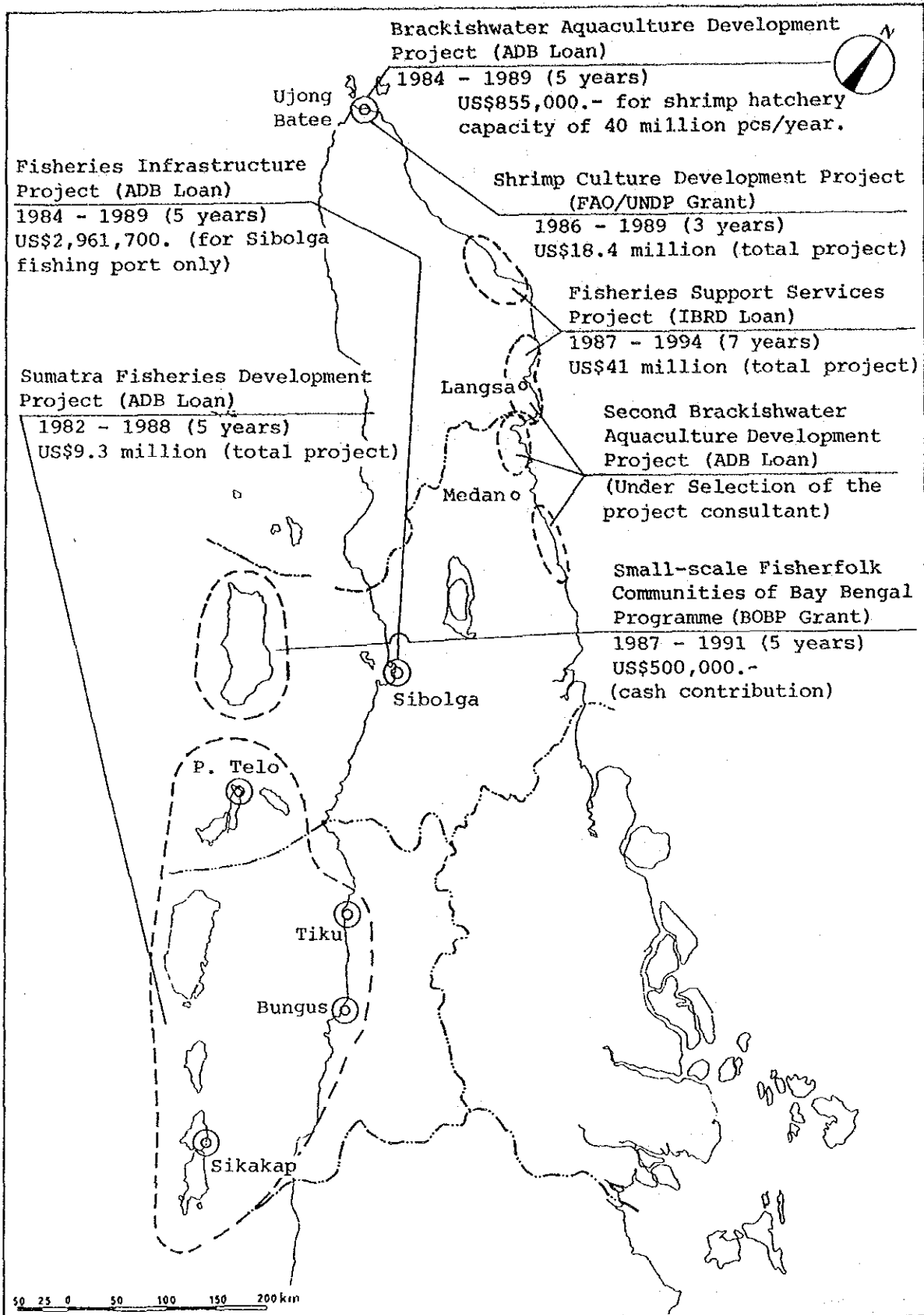
LEGEND:

- National Fishing Port (B-class)
- National Fishing Port (C-class)
- Provincial Fish Landing Center (PPIs)

FIG. 6

LOCATION OF FISHING PORTS
AND FISH LANDING CENTERS

THE STUDY ON THE INTEGRATED REGIONAL
DEVELOPMENT PLAN FOR
THE NORTHERN PART OF SUMATERA



Brackishwater Aquaculture Development Project (ADB Loan)

1984 - 1989 (5 years)

US\$855,000.- for shrimp hatchery capacity of 40 million pcs/year.

Fisheries Infrastructure Project (ADB Loan)

1984 - 1989 (5 years)

US\$2,961,700. (for Sibolga fishing port only)

Shrimp Culture Development Project (FAO/UNDP Grant)

1986 - 1989 (3 years)

US\$18.4 million (total project)

Fisheries Support Services Project (IBRD Loan)

1987 - 1994 (7 years)

US\$41 million (total project)

Sumatra Fisheries Development Project (ADB Loan)

1982 - 1988 (5 years)

US\$9.3 million (total project)

Second Brackishwater Aquaculture Development Project (ADB Loan)

(Under Selection of the project consultant)

Small-scale Fisherfolk Communities of Bay Bengal Programme (BOBP Grant)

1987 - 1991 (5 years)

US\$500,000.- (cash contribution)

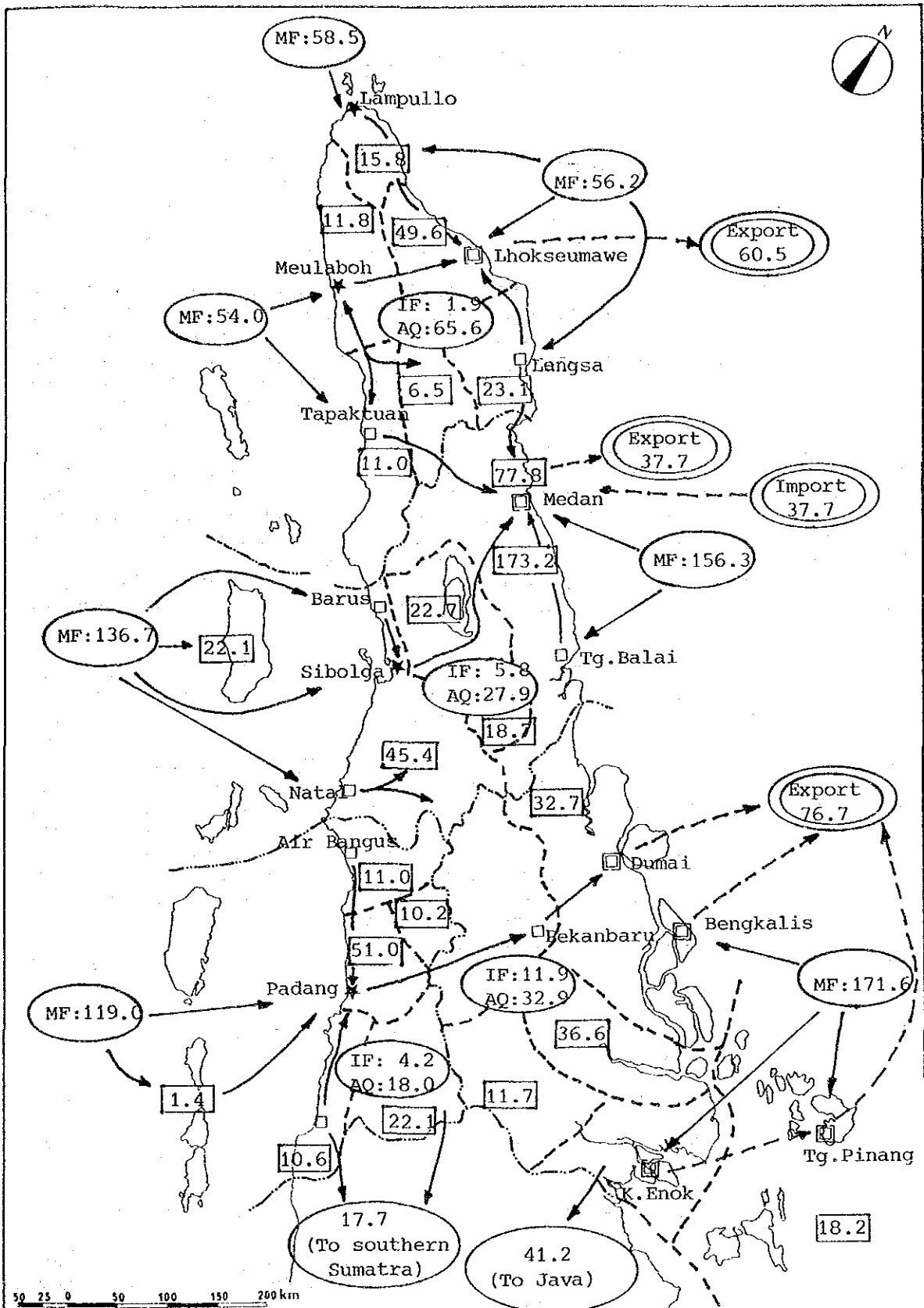
50 25 0 50 100 150 200 km

LEGEND :

FIG. 7

ON-GOING PROJECT SUMMARY
IN THE FISHERY SECTOR

THE STUDY ON THE INTEGRATED REGIONAL
DEVELOPMENT PLAN FOR
THE NORTHERN PART OF SUMATERA



LEGEND : (Unit: 1,000 tons)
 MF: Marine fishery production
 IF: Inland fishery production
 AQ: Aquaculture production
 □: Regional consumption
 ◻: Main center for fish processing and export
 ★: Main fish collecting & supply base
 ---: Boundaries of development area

FIG. 8.
 Expected Fish Distribution
 in the Region (2008)

THE STUDY ON THE INTEGRATED REGIONAL
 DEVELOPMENT PLAN FOR
 THE NORTHERN PART OF SUMATERA