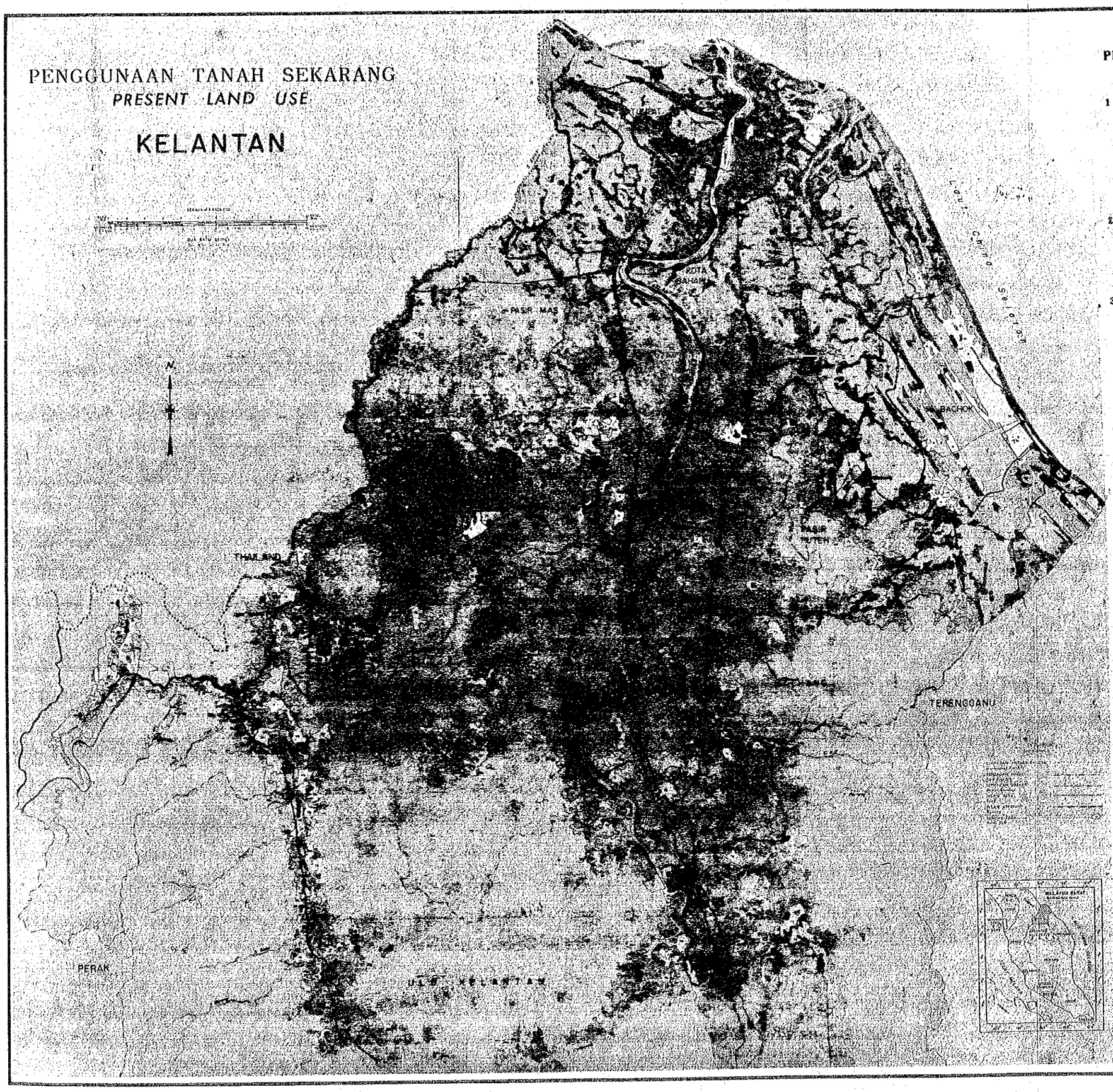
PENGGUNAAN TANAH SEKARANG
PRESENT LAND USE

KELANTAN



PETUNJUK PENGELASAN PENGGUNAAN TANAH
LAND USE CLASSIFICATION LEGEND

1 KAWASAN TEMPAT TINGGAL DAN KAWASAN BERKAITAN BUKAN PERTANIAN
Settlements and Associated Non-Agricultural Areas

- KAWASAN BANDARAN DAN YANG BERKAITAN
  Urban and Associated Areas
- KAWASAN BANGUNAN LADANG DAN YANG BERKAITAN
  Estate Buildings and Associated Areas
- KAWASAN LOMBONG BIJIH TIMAH
  Tin Mining Areas
- KAWASAN LOMBONG BAHAN-BAHAN GALIAN
  Other Mining Areas
- HAK LALUAN TALIAN LETRIK
  Power Line Right of Way

2 KAWASAN PERKEBUNAN
Horticultural Lands

- PERKEBUNAN CAMPUR
  Mixed Horticulture
- PERKEBUNAN SAYUR-SAYUR DAN BENDA-BENDA MAKANAN
  Market Gardening
- PUSAT PERCUBAAN PERTANIAN
  Agricultural Stations

3 POKOK, PALMA DAN LAIN-LAIN TANAMAN KEKAL
Tree, Palm and Other Permanent Crops

- GETAH
  Rubber
- KELAPA SAWIT
  Oil Palm
- KELAPA
  Coconut
- NENAS
  Pineapple
- TEH
  Tea
- KOPI
  Coffee
- KOKO
  Cocoa
- LADA HITAM
  Pepper
- TEBU
  Sugarcane
- DUSUN/CAMBUTAN/DURIAN/LIMAU/CENGKIH/PALA/DLL
  Orchards (Rambutan, Durian, Limau, Cloves, Nutmeg, etc.)
- KEMBIA
  Jaggery
- PISANG
  Bananas
- KOLAM IKAN DAN LEMBAYUNG (KAMBANG ATAU KELADI BUNTING)
  Fish and Kyabok Ponds
- PINANG
  Arecanut

4 KAWASAN TANAMAN
Cropland

- PADI
  Paddy
- PELBAGAI TANAMAN
  Diversified Crops
- PENANAMAN BERPINDAH-PINDAH
  Shifting Cultivation

5 PADANG TERNAK KEKAL YANG DIPERBAIKI
Improved Permanent Pasture

- PADANG TERNAK KEKAL YANG DIPERBAIKI
  Improved Permanent Pasture

6 PADANG RUMPUT
Grasslands

- LALANG, PADANG TERNAK YANG TERSISA DAN/ATAU PADANG RUMPUT SEMAK
  Lalang, Unimproved Grass Pasture and/or Scrub-Grassland
- TAPAK-TAPAK HASSAN BERUMPUT DAN TANAH-TANAH RUNTUH
  Open Covered Eroded Scars and Landslides

7 KAWASAN HUTAN
Forest Land

- HUTAN
  Forest
- SEMAK
  Scrub
- CERANG BARU/RU
  Newly Cleared Land

8 HUTAN-HUTAN PAYA DAN BUYAU
Swamps, Marshlands and Wetland Forests

- TERMASUK KEKAU, NIPAH, GELAM DAN LAIN-LAIN KUMPULAN HUTAN BUYAU
  Including Mangrove, Nipah, Gelam and Other Wetland Forest Associations

9 KAWASAN YANG TIDAK DIUSAHAKAN
Unused Land

- KAWASAN YANG TIDAK DIUSAHAKAN
  Unused Land

Fig.IV.2.2

Present Land Use (1/2)

GOVERNMENT OF MALAYSIA
STUDY
ON
KELANTAN RIVER BASIN - WIDE FLOOD MITIGATION
JAPAN INTERNATIONAL COOPERATION AGENCY

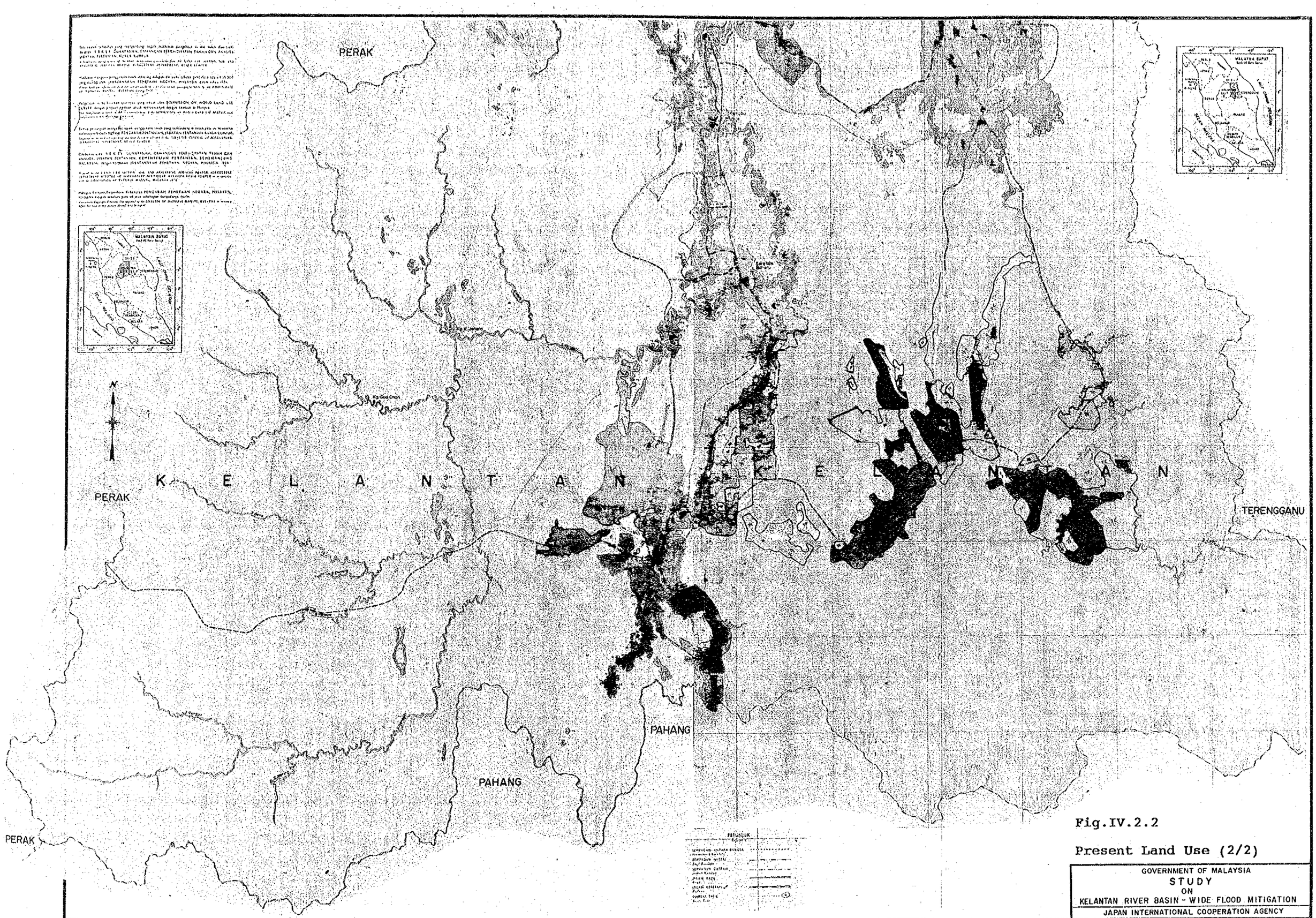


Fig.IV.2.2

Present Land Use (2/2)

GOVERNMENT OF MALAYSIA
STUDY
ON
KELANTAN RIVER BASIN - WIDE FLOOD MITIGATION
JAPAN INTERNATIONAL COOPERATION AGENCY

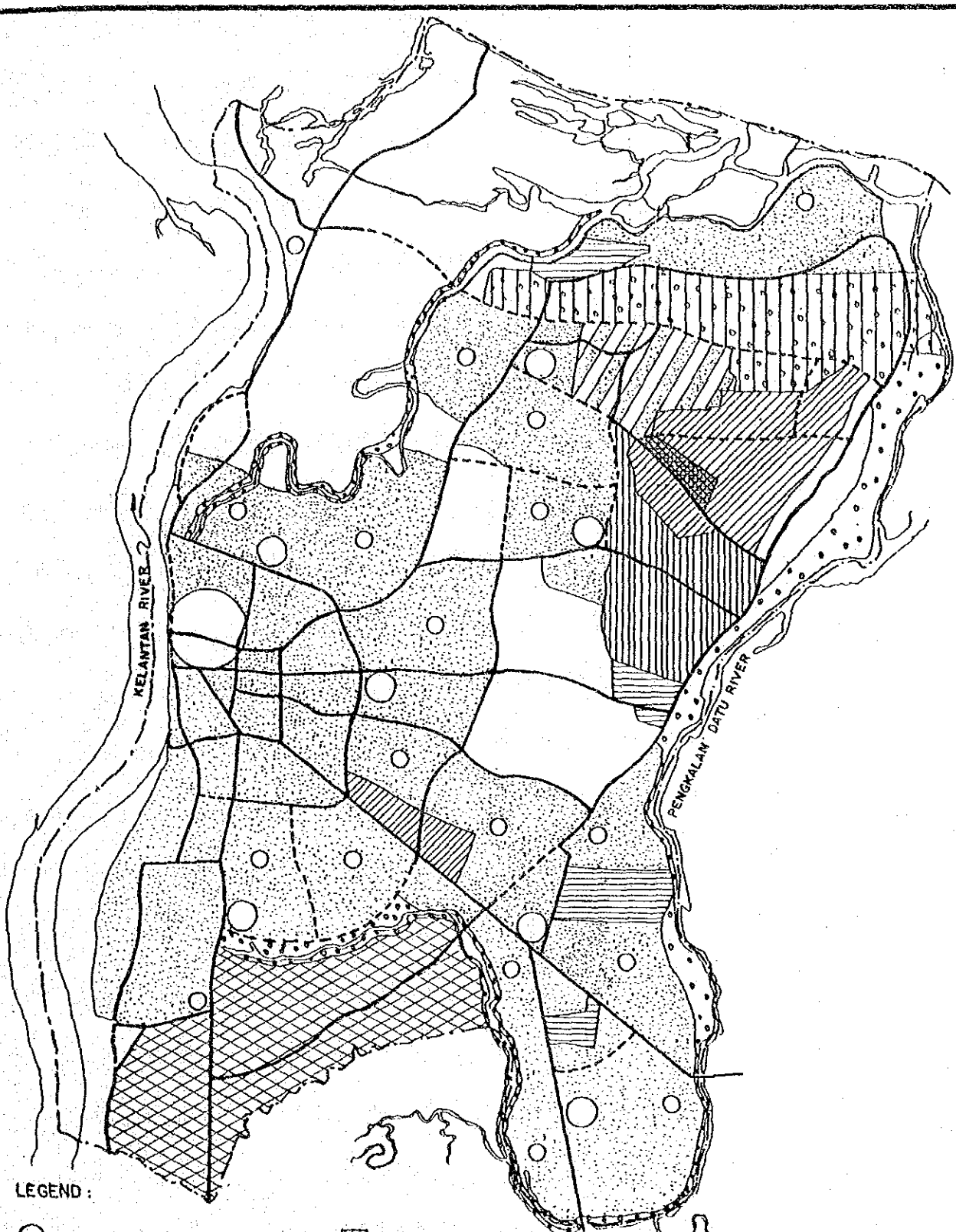


Fig.IV.3.1

Development Plan of Majilis Perbandaran Kota Bharu

GOVERNMENT OF MALAYSIA
STUDY
ON
KELANTAN RIVER BASIN - WIDE FLOOD MITIGATION
JAPAN INTERNATIONAL COOPERATION AGENCY

ANNEX V

FLOOD DAMAGE STUDY

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V. FLOOD DAMAGE STUDY

1. INTRODUCTION

A comprehensive flood damage study to estimate the damage for probable floods was discussed in Annex V of Supporting Report for Master Plan Study based on the past floods with various scales. Furthermore, the damage caused by the flood occurred on November 1988 was estimated for endorsing the accuracy of damage assessed for probable floods. It was confirmed that the result of flood damage study on 1988 flood almost coincides with that studied in Master Plan.

This Annex summarizes the result of flood damage study discussed in Annex V of Supporting Report for Master Plan Study. The flood damage discussed in this Annex will provide the benefit in assessing the viability of the flood mitigation plan combined with the Kemubu and Lebir dam schemes and river improvement. Further discussions on flood damage are referred to Annex V of Supporting Report for Master Plan Study.

2. PROCEDURE TO ESTIMATE PROBABLE FLOOD DAMAGE

The estimate of flood damage for probable floods was based on the floods occurred on 1967, 1983 and 1986 with the recurrence interval of some 50, 13 and 3 years, respectively.

The procedure to estimate damages for probable floods is as follows:

- The extent of inundation area of floods in 1967, 1983 and 1986 is first of all confirmed with topographic maps and hearing at sites. The study area in this flood damage study defined as the probable inundation area is delineated based on the inundation area of 1967-flood.

- The properties in the probable inundation area are estimated by counting the number and value of various assets. The number and unit value of assets as well as the increase rate of assets in future are based on the results of socio-economic studies. The damage rate, which shows a relationship between degree of damages, and depth and duration of flooding, is referred to past studies.

- Probable flood damages are assessed by multiplying the damage rate by the value of assets in the inundation areas of probable floods. The probable damages so estimated are classified into agricultural, non-agricultural and indirect damages.

3. PROBABLE INUNDATION AREA AND FLOOD DAMAGE VALUE

3.1 Probable Inundation Area

Rainstorms occurred in January, 1967 caused an overflow of the Kelantan and its adjacent rivers including tributaries, resulting in inundation of the entire coastal area of the Kelantan State. According to the Flood Report of January 1967 flood, the inundation area spreads over 3,000 km^2 which is equivalent to 20% of the Kelantan State area. Fig. V.3.1 delineates the inundation area in 1967 flood.

The delineation of probable inundation area for the estimate of probable flood damages is based on the flood map for the 1967 flood referring to 1983 and 1986 floods as well as the assumptions and conditions mentioned below:

- Upstream areas of Kuala Krai in the Kelantan River

  According to the Flood Report of 1967-flood, inundation took place even in the upstream areas of Kuala Krai (Ulu Kelantan), however, damages in these areas were as small as 1.0% of total damages. Due to this, these areas are excluded from the area to estimate flood damages in this study. Thus, damages for probable floods are estimated for the Kelantan River basin extended in the downstream reaches of Kuala Krai.

- The boundary between the Kelantan and Golok rivers

  It can be presumed from the map for 1967-flood that flood water overflowed from the Kelantan River came up to the right bank of the Golok River. A boundary to divide the flood prone areas between the Kelantan and Golok rivers is however drawn using a railway running between Tanah Merah and Pasir Mas and a highway between Repek and Tumpat (refer to Fig. V.3.2).

- The boundary between the Kelantan and Semerak rivers

  A low mountain running towards the north from Machang to Bukit Mak Lipah and a low ridge running towards the northeast from Gunong Timor to the coast through Jelawat show a divide between the Kelantan and Semerak river basins except a paddy area between Melor and Gunong Timor. A highway running between Melor and Jelawat through the paddy area is used as the boundary to divide the flood prone areas between the Kelantan and Semerak rivers based on the results of the interview at sites.

- The boundary between the Kelantan and Kemasin rivers

  Overflow from the Kelantan River in 1967-flood swept over the entire Kemasin River basin. Thus, the entire Kemasin River basin is counted as the flood prone area of the Kelantan River.

Fig. V.3.2 prepared on basis of the assumptions and conditions mentioned above as well as the inundation map of 1967-flood (refer to Fig. V.3.1) delineates the maximum extent of inundation area for the 50-year probable flood caused by flooding

of the Kelantan River; that is, this maximum extent of inundation area is defined as the survey area of the flood damage study.

3.2 Procedure to Estimate Flood Damage Value

3.2.1 General

Identification of assets in the inundation area is performed to obtain the basis to estimate flood damages. The increase of assets in future is projected based on the number and value of assets identified.

Since the number and value of assets in the inundation area have been surveyed and projected for the time period from present to year 2010 in Annex IV, Socio-economic Study of Part I, those estimated figures are applied in this study. On the other hand, the flood damage rate used in estimating the flood damage value of each asset is basically referred to the values actually applied in the past studies of Malaysia. The value of assets is expressed by the price in year 1988.

The evaluation of assets necessary for estimating probable flood damages discussed in the subsequent Chapter 4 is carried out by the following procedure:

- Identification of urban and rural areas in the probable inundation area divided by river stretch
- Identification of assets in the probable inundation area
- Estimation of asset distribution
- Preliminary study of socio-economic condition in the probable inundation area
- Estimation of present and future unit value of assets, and damage rate.

3.2.2 Identification of urban and rural areas in the probable inundation area

Four major towns of Kota Bharu, Pasir Mas, Tanah Merah and Kuala Krai are developed at the riverside in the downstream reaches of the Kelantan River, i.e. in the study area. Sub-districts (Daerah) where those four towns are located including neighbouring sub-districts are relatively well populated. These four populated ares are thus defined as the urban areas in this study, while the remaining parts in the study area are called the rural areas.

Considering the location of four major towns mentioned above and the place of tributaries flowing into the Kelantan River, a 100 km long river stretch of the Kelantan River from Kuala Krai to the estuary is divided into twelve sections, which are named KL1, KL2, ..., Kl12 toward the upstream reaches from the estuary

as shown in Fig. V.3.3.

The sections so divided into twelve will be the base for the estimate of flood damages, and the flood damages estimated by section will provide the basic information in determining the priority areas of protection from floods.

3.2.3 Identification of assets in the probable inundation area

Assets vulnerable to floods are classified into two in the probable inundation area; agricultural and non-agricultural assets. According to the land use of the Kelantan State by district as of 1988, major crops planted are paddy, oil palm, rubber and tobacco, sharing more than 80% of total agricultural area, followed by coffee, maize, fruit and so forth.

As the results of prediction by year 2010 for the land use in the whole of the Kelantan State (refer to Section 3.4 of Annex IV, Socio-economy of Part I), four major crops of paddy, oil palm, rubber and tobacco are dominant by sharing 85% of total agricultural area in year 2010. The crops to share remaining 15% are vegetable, maize, fruit and so forth. Damages for the four major crops of paddy, tobacco, oil palm and rubber are estimated by counting acreage of them in the probable inundation area. On the other hand, damages for other crops such as vegetable, maize, fruit and so forth are estimated by multiplying the damage rate of these crops to paddy, which is referred to past studies, by the damage of paddy. The damage to livestocks is also estimated by multiplying the damage rate of livestocks to crops, which is referred to past studies. Thus, a total damage in the agricultural assets is computed by adding all the damages estimated above.

On the other hand, items to be raised as non-agricultural assets are residential houses including household effects, industrial, commercial and service establishments including building, equipment, inventory stocks, and public institutions such as hospitals, schools, mosques and government offices including building and equipment. Furthermore, infrastructures such as roads, bridges, irrigation facilities and so on are also estimated as the assets vulnerable to floods. The acreage of four major agricultural crops as well as the number of houses and establishment in the probable inundation area is summarized in Table V.3.1. Furthermore, the increase of those agricultural and non-agricultural assets was projected for the period from present to year 2010 with an interval of 5 years. Further details are referred to Annex V of Supporting Report for Master Plan Study.

The acreage and number of assets given in Table V.3.1 were measured and counted by one metre in elevation using 1 to 25,000 scale topographic maps with a two-metre contour interval newly contoured in this study. The aim of this work is to grasp the relationship between the area-depth-duration and distribution of assets.

3.2.4 Estimate of present and future unit value of assets and damage rate

The unit value of assets and their damage rate are estimated for assessing the flood damage of assets counted and measured in the probable inundation area in a monetary term. The unit price of assets is expressed in the price level of year 1988. The flood damage rate is obtained from the relationship between water depth and duration in flooding.

(1) Unit value of assets

Agricultural damages are classified into two losses; one is the loss of yield of crops and the other is loss of production due to mortalities of crops by flood. The unit values for the yield of paddy, tobacco, rubber and oil palm are given in Tables V.3.2 to V.3.5, respectively. The conversion rates of 3.2 and 8.5 ton/ha are applied to estimate the farm-gate prices of rice and tobacco per hectare, respectively, while the unit yield of rubber and oil palm varies by age of trees.

The production cost of paddy is estimated at M$1,317 per hectare, while M$4,011 per hectare for Tobacco. The accumulative production costs of rubber and oil palm, which are perennial trees, consist of initial and maintenance costs, which are estimated as given in Tables V.3.6 and V.3.7 respectively by assuming the economic life of 25 years for those trees.

The unit value of residential houses, and industrial, commercial and service establishments, which are non-agricultural assets, is estimated in Table V.3.8 by referring to the results of interview at the Department of Public Works (JKR), Kelantan. Table V.3.9 shows the increase of unit value for the non-agricultural assets by year 2010.

(2) Damage rate of assets

The damage rate for agricultural and non-agricultural damages was estimated by referring to the past studies in Malaysia. Tables V.3.10 and V.3.11 show the damage rate of paddy and tobacco, while the damage rates for rubber and oil palm include not only the ones for production losses, but also for yield losses. Tables V.3.12 and V.3.13 show the damage rates for the yield and production of rubber and oil palm including unit values. It is noted that the damage rates for rubber and oil palm are referred to the monitoring survey of damages for 1982-83 and February/March 1984-floods occurred in the Batu Pahat River basin of the Johor State under Western Johor Agricultural Development Project.

The damage rate of non-agricultural assets is estimated as given in Table V.3.14 by referring to National Water Resources Study, Malaysia and Regional Water Resources Study of South Johor.

4. PROBABLE FLOOD DAMAGE

4.1 Inundation Area - Flood Water Level - Flooding Duration Relationship

The inundation area, flood water level and flooding duration of 1967, 1983 and 1986-pattern flood were confirmed based on site interview by referring to the respective flood reports for estimating probable flood damages. The inundated area of 1986-pattern flood with a 3-year return period extended to 510 km^2 as delineated in Fig. V.4.1, whilst 870 km^2 for the 1983-pattern flood with a 13-year return period as given in Fig. V.4.2 and 1,050 km^2 for the 1967-pattern flood with a 50-year return period as given in Fig. V.4.3.

Flood water level was estimated by adding the ground level read from the 1 to 6,360 scale topographic maps to the flood water depth obtained from site interview and respective flood reports. The flooding duration obtained from site interview and respective flood reports.

4.2 Probable Flood Damage

4.2.1 Items to evaluate the damage

Probable flood damage of 1967, 1983 and 1986-flood was evaluated on the following three items; that is,

(i) Agricultural damage

In the State of Kelantan, paddy and tobacco are planted with the seasonal variation. Shown in Fig. 4.4 are the cropping calendar of paddy and tobacco and the frequency of flood peak discharges beyond 5,000 m^3/sec at Guillemard Bridge. Since the relatively high flood frequency of 72% was recorded on December, the damages of paddy and tobacco are assumed on the basis of the area planted on December. As for the planted areas of rubber and oil palm, they are constant throughout the year.

The damages for other crops except above major crops were evaluated multiplying the rate of damages of other crops to the damages of paddy. The rate of damages of other crops was estimated at 20% on an arithmetic average from the records in the flood reports as enumerated below:

(Unit : thousand M$)

Crop	Flood Report		
	1967-flood	1982-flood	1986-flood
Paddy	13,762	182	631
Tobacco	-	-	40
Rubber	7.5	3.6	5
Oil Palm	-	-	7
Others	574	65	118
Others/Paddy	4%	36%	19%

Remarks : A price level is set at recorded year.

Whilst the damages of livestocks were evaluated based on those magnitudes recorded in the flood reports taking the probability of flood into considerations.

(ii) Non-agricultural damage

The damage of infrastructures such as roads, bridges, irrigation facilities, electric power facilities, water supply facilities and other public facilities was evaluated at the ratio of 30% to the damages of houses and buildings. This ratio is based on the in-depth survey of flood damage carried out in past in and around the Kelantan River basin, showing the ratio of damage to the infrastructures ranging from 30% to 50%.

(iii) Indirect damage

As well as the evaluation of non-agricultural damage, the indirect damage such as the suspension of production, trade, transportation and communications, and costs for rescue and relief activities was evaluated on the basis of the in-depth survey of flood damage. The ratio of 30% on an average to the direct damage was regarded as the indirect damage.

4.2.2 Probable flood damage

Submerged assets and flood damages at a price level of 1988 for the magnitude of selected floods were estimated as given in Tables V.4.11 and V.4.12 under the aforementioned assumptions respectively. The probable flood damages for various return periods of 5, 10, 15 and 20 years were interpolated on the basis of the relationship between the damages of selected floods and their return periods. Since none of damage is cause by the flood with the probability of once in two years, the annual mean flood damage exceeding the level of 2-year probability was estimated under the socio-economic conditions in 1988 as given in Table V.4.7. The probable flood damage was estimated to be 243 million M$ for a scale of 50-year return period.

Table V.3.1 Assets in Probable Inundation Area Corresponding to 50-Year Return Period in 1988 (1/2)

	District	Sub-district	Administrative Area (ha)	Agricultural Land Use (ha)				Non-Agricultural Assets (Nos)						
				Paddy Area	Tobacco Area	Rubber Area	Oil Palm Area	Residential House	Industrial Establishment	Commercial & Service Establishment	Public Establishment			
											Medical	Educational	Religious	Administrative
KL 1	Kota Bharu	Badang	475	84	5	0	0	690	4	52	1	2	1	2
	Tumpat	S.Pinang	680	128	7	0	0	836	1	23	1	3	1	1
	Sub-total		1,155	212	12	0	0	1,526	5	75	2	5	2	3
KL 2	Kota Bharu	Badang	2,050	170	22	10	0	2,960	20	226	3	5	5	5
	Tumpat	S.Pinang	1,513	285	16	5	0	1,389	2	49	3	4	3	3
	Sub-total		3,563	455	38	15	0	4,349	22	275	6	9	8	8
KL 3	Kota Bharu	Badang	460	85	5	22	0	658	4	51	1	2	2	2
		Bandar Kota Bharu	1,087	0	0	30	0	7,317	47	558	2	26	14	15
		Kota	1,707	365	0	405	0	4,858	31	371	2	4	9	12
		Panji	2,456	673	23	272	0	8,982	58	685	1	3	17	21
		Kemumin	2,248	604	66	4	0	3,904	28	298	2	9	7	9
		Lundang	2,127	711	0	414	0	9,900	63	755	5	9	18	21
		Sering	2,278	406	48	74	0	2,863	9	102	3	7	5	6
	Bachok	Mentuan	3,989	1,570	906	30	0	3,475	3	124	7	12	10	6
	Tumpat	S.Pinang	843	159	8	37	0	564	2	28	2	3	2	2
		Kebakat	1,533	730	73	20	0	2,180	4	78	1	1	5	6
		Wakaf Bharu	2,554	875	11	270	0	4,392	7	157	4	12	10	9
		Terbok	2,673	1,315	133	23	0	2,363	4	85	1	2	5	6
		Tumpat	2,330	1,138	188	1	0	3,127	5	110	8	5	6	6
		Peng.Kubor	784	258	36	11	0	2,190	5	74	5	5	5	6
		Jal.Besar	3,347	1,620	122	38	0	1,863	3	67	2	1	4	3
	Sub-total		30,416	10,509	1,619	1,651	0	58,636	273	3,543	46	101	119	130
KL 4	Kota Bharu	Pendek	2,242	1,180	8	420	0	2,481	7	89	2	5	4	6
		Limbat	1,722	580	0	476	0	1,322	4	47	2	12	2	3
		Salor	790	387	0	74	0	755	3	27	1	2	1	1
		Banggu	3,073	1,263	3	601	0	3,047	9	109	1	4	5	6
	Bachok	Tg.Pauh	1,585	603	379	25	0	1,220	1	44	1	1	4	3
		Perupok	1,737	682	619	21	0	2,861	3	102	4	10	8	6
	Pasir Mas	Kubang Sepat	2,248	940	38	226	0	2,250	3	80	1	3	6	3
		Bunut Susu	3,791	1,920	10	407	0	2,323	3	83	3	6	6	3
		Kubang Gadong	1,610	530	86	203	15	1,203	2	43	1	2	5	3
	Sub-total		18,798	8,085	1,143	2,453	15	17,462	35	624	16	45	41	34
KL 5	Kota Bharu	Salor	605	332	0	55	0	566	2	20	1	2	1	1
	Pasir Mas	Kubang Gadong	1,590	527	85	203	14	1,202	3	43	1	1	5	3
		Pasir Mas	1,985	1,145	0	142	0	4,372	6	156	6	17	12	9
		Alor Pasir	533	189	124	117	0	451	1	9	1	1	1	1
		Gual Periok	545	354	265	121	444	692	1	20	1	1	1	1
		Kuala Lemal	1,623	762	223	195	21	463	2	60	2	2	4	2
	Sub-total		6,881	3,309	697	833	479	7,746	15	308	12	24	24	17

Table V.3.1 Assets in Probable Inundation Area of 50-Year Return Period in 1988 (2/2)

	District	Sub-district	Administrative Area (ha)	Agricultural Land Use (ha)				Non-Agricultural Assets (Nos)						
				Paddy Area	Tobacco Area	Rubber Area	Oil Palm Area	Residential House	Industrial Establishment	Commercial & Service Establishment	Public Establishment			
											Medical	Educational	Religious	Administrative
KL 6	Kota Bharu	Salor	780	386	0	54	0	565	1	20	0	1	1	1
		Beta	2,325	1,170	0	512	0	1,610	5	58	1	5	3	3
		Pangkal Kalong	4,865	1,725	51	2,128	0	5,999	18	215	5	3	10	12
		Kadok	2,837	1,505	0	603	0	2,826	8	101	4	4	5	6
		Peringat	4,263	1,930	3	1,088	0	3,140	9	112	2	5	5	6
	Bachok	Bekelam	2,297	1,354	35	175	0	1,458	1	52	1	1	4	3
		G.Barat	635	756	4	125	0	1,024	1	36	1	2	3	2
		G.Timor	1,073	255	30	255	0	1,103	1	24	2	2	2	2
		Repek	1,340	575	246	39	0	1,343	2	62	2	2	4	2
	Pasir Mas	Kangkong	2,855	2,991	110	572	80	1,509	3	82	2	5	7	5
		Chetok	4,127	1,554	330	1,583	0	2,003	3	83	8	6	7	3
	Sub-total		27,397	14,201	809	7,134	80	22,580	52	845	28	36	51	45
KL 7	Machang	Pulai Chondong	2,340	810	53	602	22	697	5	70	4	9	5	5
		Labok	1,577	242	12	437	3	878	3	25	1	2	2	2
	Tanah Merah	Kusial	1,955	1,084	94	1,094	88	1,070	4	48	2	2	4	3
	Sub-total		5,872	2,136	159	2,133	113	2,645	12	143	7	13	11	10
KL 8	Machang	Pangkal Meleret	3,259	992	0	447	0	974	3	39	2	2	2	3
		Panyit	119	61	1	22	0	83	1	3	0	0	1	1
		Ulu Sat	396	86	3	90	0	450	1	8	0	0	1	1
	Tanah Merah	Kusial	1,987	30	3	270	20	4,026	11	171	3	8	12	12
		Ulu Kusial	1,430	1,324	19	231	0	255	1	7	0	1	1	1
	Sub-total		7,191	2,493	26	1,060	20	5,788	17	228	5	11	17	18
KL 9	Machang	Temangan	1,167	42	2	491	72	745	2	23	3	4	2	2
		Panyit	68	61	0	10	0	0	0	0	0	0	0	0
	Tanah Merah	Ulu Kusial	427	80	0	57	0	1,868	4	47	1	2	3	3
		Sokor	622	0	0	968	0	271	1	12	1	1	1	1
	Sub-total		2,284	183	2	1,526	72	2,884	7	82	5	7	6	6
KL 10	Machang	Temangan	465	49	2	490	72	248	1	8	1	2	1	1
	Kuala Krai	Batu Mengkebang	845	0	0	480	0	915	4	36	0	1	2	2
	Tanah Merah	Sokor	488	56	0	969	0	271	0	12	1	2	0	1
	Sub-total		1,798	105	2	1,939	72	1,434	5	56	2	5	3	4
KL 11	Kuala Krai	Batu Mengkebang	3,231	0	0	1,845	0	915	6	36	0	1	3	2
	Sub-total		3,231	0	0	1,845	0	915	6	36	0	1	3	2
KL 12	Kuala Krai	Batu Mengkebang	1,721	207	3	980	0	7,320	43	292	3	5	20	20
	Sub-total		1,721	207	3	980	0	7,320	43	292	3	5	20	20
	Total		110,307	41,895	4,510	21,569	851	133,285	492	6,507	132	262	305	297

Table V.3.2 Economic Price of Rice (For Import)

(Unit : M$/ton)

Item	1988	2000	2005	2010
1. Export Price of Thai 5% Brokens, FOB Bangkok	650	748	763	778
2. Grade Adjustment (less 10%)	-65	-75	-76	-77
3. Ocean Freight & Insurance	75	75	75	75
4. CIF at Port Klang	660	748	762	776
5. Port Handling	22	22	22	22
6. Transportation from Klang to Kota Bharu	92	92	92	92
7. Wholesale Price, Kota Bharu	774	862	876	890
8. Transportation, KADA Area to Kota Bharu	-4	-4	-4	-4
9. Ex-mill Price, KADA Area	770	858	872	886
10. Paddy Equivalent, KADA Area	501	558	567	576
11. Milling Cost	-44	-44	-44	-44
12. Farm-gate Price	457	514	523	532

Source: The Lebir Dam Project, JICA and Half-Yearly Revision of Commodity Price Forecasts, Feb. 1988, World Bank.

Table V.3.3 Economic Price of Tobacco (For Import)

(Unit : M$/ton)

Item	1988	2000	2005	2010
1. Import Price at Kuala Lumpur	20,000	24,683	24,722	24,761
2. Quality Adjustment	-7,700	-9,503	-9,518	-9,533
3. Transportation to Kota Bharu	100	100	100	100
4. Market Price at Kota Bharu	12,400	15,280	15,304	15,328
5. Green Leaves Equivalent	1,240	1,528	1,530	1,532
6. Processing Cost	-558	-558	-558	-558
7. Farm Gate Price of Green Leaves	682	970	972	974

Source: National Tobacco Board, Kelantan and Half-Yearly Revision of Commodity Price Forecasts Fed. 1988, World Bank.

Table V.3.4 Unit Yield Price of Rubber

Crop Age (Year)	Unit Yield Price (M$/ton)	Unit Yield (ton/ha)	Unit Yield Value (M$/ha)
1-6	-	-	-
7	2,510.00	0.60	1,506.00
8	2,510.00	0.80	2,008.00
9	2,510.00	0.96	2,409.60
10	2,510.00	1.05	2,635.50
11	2,510.00	1.10	2,761.00
12	2,510.00	1.30	3,263.00
13	2,510.00	1.45	3,639.50
14	2,510.00	1.55	3,890.50
15	2,510.00	1.55	3,890.50
16	2,510.00	1.65	4,141.50
17	2,510.00	1.70	4,267.00
18	2,510.00	1.60	4,016.00
19	2,510.00	1.65	4,141.50
20	2,510.00	1.60	4,016.00
21	2,510.00	1.60	4,016.00
22	2,510.00	1.60	4,016.00
23	2,510.00	1.60	4,016.00
24	2,510.00	1.60	4,016.00
25	2,510.00	1.60	4,016.00
Average		1.40	3,508.72

Source: Interview with FELCRA, Kelantan

Table V.3.5 Unit Yield Price of Oil Palm

Crop Age (Year)	Unit Yield Price (M$/ton)	Unit Yield (ton/ha)	Unit Yield Price (M$/ha)
1-3	-	-	-
4	132.80	4.70	623.63
5	164.40	11.86	1,950.37
6	186.30	18.04	3,361.32
7	203.10	21.26	4,317.00
8	209.20	22.74	4,756.90
9	209.20	23.73	4,963.72
10	209.20	24.22	5,067.13
11	209.20	23.97	5,015.42
12	209.20	23.48	4,912.01
13	209.20	22.99	4,808.60
14	209.20	22.24	4,653.48
15	209.20	21.75	4,550.07
16	204.10	21.26	4,338.26
17	204.10	20.76	4,237.37
18	204.10	20.27	4,136.48
19	204.10	19.77	4,035.59
20	204.10	19.28	3,934.70
21	204.10	18.78	3,833.81
22	204.10	18.78	3,833.81
23	204.10	18.78	3,833.81
24	204.10	18.78	3,833.81
25	204.10	18.78	3,833.81
Average	200.05	19.83	4,037.78

Source: Farm Budgets 1987, Kelantan SEPU, Malaysia FELCRA

Note: Price of palm oil and seed are assumed to be 1020 M$/ton, 500 M$/ton, respectively at the price level of 1 July,1988. FFB means Fresh Fruit Bunch.

Table V.3.6 Production Cost of Rubber

Year	Cost (M$ / ha)				
	Labour	Materials	Machinery/ Equipment	Total	Accumulative
1				3,109.0	3,109.0
2				893.8	4,002.8
3				758.6	4,761.4
4				677.5	5,438.9
5				688.5	6,127.4
6				1,329.2	7,456.6
7				867.2	8,323.8
8				910.2	9,234.0
9				910.2	10,144.2
10				946.2	11,090.2
11				970.2	12,060.2
12				1,086.2	13,146.2
13				1,130.2	14,276.4
14				1,130.2	15,406.6
15				1,200.2	16,606.8
16				1,200.2	17,807.0
17				1,200.2	19,007.2
18				1,120.2	20,127.4
19				1,120.2	21,247.6
20				1,120.2	22,367.8
21				958.2	23,326.0
22				958.2	24,284.2
23				868.2	25,152.4
24				868.2	26,020.6
25				868.2	26,888.8

Source: Farm Budgets 1987, Kelantan SEPU, Malaysia

Note: Economic Life is 25 years.

Table V.3.7 Production Cost of Oil Palm

Year	Cost (M$/ha)				
	Labour	Materials	Machinery/ Equipment	Total	Accumulative
1				2,750.20	2,750.20
2				640.35	3,390.55
3				1,007.80	4,398.35
4				1,114.65	5,513.00
5				1,008.15	6,521.15
6				1,189.40	7,710.55
7				1,214.40	8,924.95
8				1,214.40	10,139.35
9				1,214.40	11,353.75
10				1,204.00	12,557.75
11				1,204.00	13,761.75
12				1,204.00	14,965.75
13				1,204.00	16,169.75
14				1,204.00	17,373.75
15				1,204.00	18,577.75
16				1,038.40	19,686.15
17				1,038.40	20,794.55
18				1,038.40	21,902.95
19				1,038.40	23,011.35
20				1,038.40	24,119.75
21				1,038.40	25,158.15
22				1,038.40	26,196.55
23				1,038.40	27,234.95
24				1,038.40	28,273.35
25				1,038.40	29,311.75

Source: Farm Budgets 1987, Kelantan SEPU, Malaysia

Note: Economic Life is 25 years.

Table V.3.8 Unit Value of Assets (Non-Agriculture)

Asset Item	Unit Value
1. House	(M$/Unit)
(1) Private House in Urban Area	27,000
House	18,000
Household Effects	9,000
(2) Private House in Rural Area	17,900
House	11,900
Household Effects	6,000

Note: Assumptions
Average number of occupants is 5.
The number of household effects is 50% of that of a house

2. Industrial Establishment	(M$/Unit)
Building*	137,000
Equipment**	274,000
Inventory Stock***	164,910
Total	575,910

Note: Assumptions
Average number of workers is 25.
*Standard size of a building is 1,000 sm.
**2 x (building value)
***M$ 824,567(output)/ 5(turnover)

3. Commercial and Service Establishment	(M$/Unit)
Building	21,530
Equipment	21,540
Inventory Stock	36,000
Total	79,070

Note: Assumptions
Average number of workers is 5.
*Standard size of a building is 135 sm.
**1 x (building value)
***M$ 180,000(sales)/ 5(turnover)

4. Public Institutions (M$/Unit)

	Medical	Educational	Religious	Administrative
Building*	19,910	191,730	77,510	549,620
Equipment	9,950**	95,870**	15,500***	274,810**
Total	29,860	287,600	93,010	824,430

Note: Assumptions
*Standard size of a building
Medical- 145 sm. Educational- 1,618 sm.
Religious- 515 sm. Administrative- 2,050 sm.
**50% of building value
***20% of building value

Source: Public Works Department (JKR), Kelantan

Note: Price level in 1988
The value of a house or building shown in the above table is assumed 50% of that of a new house or building.

Table V.3.9 Forecast of Unit Value of Assets (Non-Agriculture)

Asset Item	Unit Value (M$/unit)			
	1988	2000	2005	2010
1. Private House				
in Urban Area	27,000	40,946	48,397	57,204
in Rural Area	17,900	27,150	32,092	37,933
2. Industrial Establishment	575,910	821,110	951,891	1,103,502
3. Commercial and Service Establishment	79,070	119,011	139,987	164,660
4. Public Institutions				
(1) Medical	29,860	45,292	53,533	63,273
(2) Educational	287,600	439,278	519,208	613,682
(3) Religious	93,010	141,082	166,753	197,095
(4) Administrative	824,430	1,250,531	1,478,077	1,747,027

Source: Public Works Development (JKR)

Note : (1) The increase rate of unit value in future stage is estimated at 3.4% based on 6% of increase rate of GDP and 2.5% of growth rate of population.
(2) Unit value of private house includes value for household effects.

Table V.3.10 Flood Damage Rate of Paddy

Irrigated Paddy

(Unit: %)

Flood Duration (days)	Water Depth of Flooding		
	Less than 0.5 m	0.5 - 1.0 m	More than 1.0 m
1 - 2	30	33	60
3 - 4	37	40	80
5 - 6	40	43	86
longer than 7	45	49	96

Source: National Water Resources Study, Malaysia
Perlis-Kedah-Pulau Pinang Regional Water Resources Study
Vol.5 Annex H. Flood Mitigation Plan, October 1983

National Water Resources Study, Malaysia
Sectional Report Vol.5 River Conditions, October 1982

Rainfed Paddy

(Unit: %)

Flood Duration (days)	Water Depth of Flooding		
	Less than 0.5 m	0.5 - 1.0 m	More than 1.0 m
1 - 2	27	30	54
3 - 4	33	36	72
5 - 6	36	39	77
longer than 7	41	44	86

Source: National Water Resources Study, Malaysia
Perlis-Kedah-Pulau Pinang Regional Water Resources Study
Vol.5 Annex H. Flood Mitigation Plan, October 1983

National Water Resources Study, Malaysia
Sectoral Report Vol.5 River Conditions, October 1982

Table V.3.11 Flood Damage Rate of Tobacco

Flood Duration (days)	Flood Damage Rate (%)
1	50
2	75
longer than 3	100

Source: Interview with National Tobbcco Board, Kelantan

Table V.3.12 Unit Value and Flood Damage Rate for Mortality of Rubber and Oil Palm

Crop Item	Age of Crop (Year)	Value if Killed (M$/ha) (1)	Flood Duration shorter than 14 days Kill Factor (2)	Flood Duration shorter than 14 days Loss (M$/ha) (1)x(2)	Flood Duration longer than 14 days Kill Factor (3)	Flood Duration longer than 14 days Loss (M$/ha) (1)x(3)
Rubber	1	3,109	0.95	2,954	1.00	3,109
	2	4,003	0.85	3,403	0.95	3,803
	3	4,761	0.40	1,904	0.60	2,857
	4	5,439	0.30	1,632	0.50	2,720
	5	6,127	0.20	1,225	0.20	1,225
	6	7,457	0.10	746	0.20	1,491
	7	8,324	0.10	832	0.20	1,665
	8	9,234	0.05	462	0.10	923
	9	10,144	0.05	507	0.10	1,014
	10	11,090	0.05	555	0.10	1,109
	11	12,060	0.00	0	0.05	603
	12-25	-	0.00	0	0.00	0
	Average			569		821
Oil Palm	1	2,750	0.95	2,613	1.00	2,750
	2	3,390	0.65	2,204	0.85	2,882
	3	4,398	0.30	1,319	0.60	2,639
	4	5,513	0.20	1,103	0.30	1,654
	5	6,521	0.20	1,304	0.30	1,956
	6	7,710	0.10	771	0.20	1,542
	7	8,925	0.05	446	0.20	1,785
	8	10,139	0.05	507	0.20	2,028
	9	11,354	0.05	568	0.10	1,135
	10	12,558	0.00	0	0.10	1,256
	11	13,762	0.00	0	0.05	688
	12-25	-	0.00	0	0.00	0
	Average			433		813

Source: National Water Resources Study, Malaysia, Regional Water Resources Study of South Johor, Dec. 1985
Farm Budget, Kelantan SEPU Nov.1987

Note: The average value of loss by flood is assumed to be the sum of the total loss per hectare at each year of crop age divided by the total number of years considered. It also assumes to be a mean distribution of crops of all ages in the crop field.

Table V.3.13 Unit Value and Flood Damage Rate for Production Losses of Rubber and Oil Palm

Crop Item	Age of Crop (Year)	Unit Value (M$/ha) (1)	Flood Duration shoter than 14 days: Flood Damage Rate (2)	Flood Duration shoter than 14 days: Loss of Yield (M$/ha) (1)x(2)	Flood Duration longer than 14 days: Flood Damage Rate (3)	Flood Duration longer than 14 days: Loss of Yield (M$/ha) (1)x(3)
Rubber	1 - 6	0	-	0	-	0
	7	1,506	0.045	68	0.080	120
	8 - 10	2,352	0.048	113	0.090	212
	11 - 25	3,738	0.050	187	0.100	374
	Average			128		131
Oil Palm	1 - 3	0	-	0	-	0
	4	624	0.080	50	0.210	131
	5	1,950	0.040	78	0.140	273
	6 - 9	4,350	0.050	218	0.080	348
	10 - 11	5,041	0.050	252	0.090	454
	12 - 25	4,344	0.050	217	0.100	434
	Average			182		351

Source: National Water Resources Study, Malaysia, Regional Water Resources Study of South Johor, Dec. 1985
Farm Budget, Kelantan SEPU Nov.1987

Note: The average value of loss by flood is assumed to be the sum of the total loss per hectare at each year of crop age divided by the total number of years considered. It also assumes to be a mean distribution of crops of all ages in the crop field.

Table V.3.14 Flood Damage Rate of Non-Agricultural Asset

Inundation Depth Above Floor Level (m)	Damage Factor
Below Floor level	0.03
Less than 0.5 m	0.05
0.5 to 1.0 m	0.07
1.0 to 2.0 m	0.11
2.0 to 3.0 m	0.15
More than 3 m	0.22

Source: National Water Resources Study, Malaysia
Oct. 1982, Sectoral Report Vol.5, Oct.1982

National Water Resources Study, Malaysia
Regional Water Resources Study of South Johor,
Vol.5 Annex G. Flood Mitigation Plan, Dec. 1985

Table V.4.1 Assets Affected in the Probable Inundation Area in 1988 (1/2)

River Stretch No.	Affected Population (persons)			Paddy (ha)			Tobacco (ha)			Rubber (ha)			Oil Palm (ha)			Residential House (No.)			Public Building (No.)		
	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year
KL. 1	35	70	385	32	65	65	2	5	5	0	0	0	0	0	0	7	14	77	0	0	3
KL. 2	120	4,635	6,945	138	187	269	13	23	31	4	7	11	0	0	0	24	927	1,389	0	38	76
KL. 3	49,230	93,345	108,680	3,826	5,448	6,025	520	1,196	1,294	724	949	1,183	0	0	0	9,846	18,669	21,736	430	773	899
KL. 4	11,780	38,785	47,205	1,910	3,212	4,561	238	411	882	1,233	1,895	2,309	5	11	15	2,356	7,757	9,441	61	228	331
KL. 5	6,300	10,050	13,650	818	1,681	1,955	295	511	565	402	744	796	258	476	479	1,260	2,010	2,730	31	82	124
KL. 6	5,345	22,125	27,480	2,896	5,551	7,541	205	485	645	500	1,910	4,338	13	73	79	1,069	4,425	5,496	28	132	190
KL. 7	965	6,945	7,660	413	974	1,152	19	100	118	475	1,363	1,609	26	64	74	193	1,389	1,532	8	88	98
KL. 8	2,420	7,260	10,970	776	1,391	1,496	9	21	21	294	976	1,059	6	19	21	484	1,452	2,194	14	52	71
KL. 9	1,305	6,460	7,175	40	94	110	1	2	2	254	1,522	1,526	15	72	72	261	1,292	1,435	7	37	42
KL. 10	510	2,510	2,885	38	63	63	2	2	2	895	1,579	1,939	44	72	72	102	502	577	2	26	29
KL. 11	0	460	765	0	0	0	0	0	0	0	1,383	1,845	0	0	0	0	92	153	0	2	5
KL. 12	0	8,235	13,910	0	124	124	0	2	2	0	980	980	0	0	0	0	1,647	2,782	0	57	89
Total	78,010	200,880	247,710	10,886	18,789	23,362	1,304	2,756	3,567	4,781	13,308	17,595	367	787	812	15,602	40,176	49,542	581	1,515	1,957

Note: The number of population affected is assumed by multiplying the number of residential houses shown above by 5 of average number of occupants per house.

Table V.4.1 Assets Affected in the Probable Inundation Area in 2010 (2/2)

River Stretch No.	Population to be affected (persons)			Paddy (ha)			Tobacco (ha)			Rubber (ha)			Oil Palm (ha)			Residential House (No.)			Public Building (No.)		
	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year
KL. 1	58	116	641	37	75	75	2	5	5	0	0	0	0	0	0	12	23	128	0	0	5
KL. 2	200	7,713	11,556	159	215	311	13	23	31	5	8	13	0	0	0	40	1,543	2,311	0	63	126
KL. 3	81,919	155,326	180,844	4,415	6,287	6,953	520	1,196	1,294	848	1,112	1,386	0	0	0	16,384	31,065	36,169	716	1,286	1,496
KL. 4	19,602	64,538	78,549	2,205	3,707	5,264	238	411	882	1,444	2,220	2,705	12	27	37	3,920	12,908	15,710	102	379	551
KL. 5	10,483	16,723	22,714	944	1,939	2,257	295	511	565	471	872	932	629	1,160	1,167	2,097	3,345	4,543	52	136	206
KL. 6	8,894	36,816	45,727	3,342	6,406	8,702	205	485	645	586	2,237	5,082	32	178	193	1,779	7,363	9,145	47	220	316
KL. 7	1,606	11,556	12,746	477	1,124	1,329	19	100	118	556	1,597	1,885	63	156	180	321	2,311	2,549	13	146	163
KL. 8	4,027	12,081	18,254	895	1,605	1,726	9	21	21	344	1,143	1,241	15	46	51	805	2,415	3,651	23	87	118
KL. 9	2,172	10,749	11,939	46	108	127	1	2	2	298	1,783	1,788	37	175	175	434	2,150	2,388	12	62	70
KL. 10	849	4,177	4,801	44	73	73	2	2	2	1,048	1,850	2,271	107	175	175	170	835	960	3	43	48
KL. 11	0	765	1,273	0	0	0	0	0	0	0	1,620	2,161	0	0	0	0	153	255	0	3	8
KL. 12	0	13,703	23,146	0	143	143	0	2	2	0	1,148	1,148	0	0	0	0	2,741	4,629	0	95	148
Total	129,809	334,264	412,189	12,563	21,683	26,959	1,304	2,756	3,567	5,601	15,590	20,612	894	1,918	1,979	25,962	66,853	82,438	967	2,521	3,256

Note: The number of population to be affected is assumed by multiplying the number of residential houses shown above by 5 of average number of occupants per house.

Table V.4.2 Probable Flood Damage (3 Patterns) (1988) (1/6)

(Unit: Thousand M$)

River Stretch No.	Direct Damage									Indirect Damage (C)			Total (A)+(B)+(C)		
	(A) Agriculture			(B) Non-agriculture											
	(1)			(2) House/Building			(3) Infrastracture								
	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year
KL 1	39	89	105	7	13	79	2	4	24	14	32	62	63	137	269
KL 2	203	441	720	26	892	1,789	8	268	537	71	480	914	308	2,081	3,960
KL 3	6,838	16,341	22,092	13,591	25,723	36,197	4,077	7,717	10,859	7,352	14,934	20,745	31,858	64,716	89,893
KL 4	3,596	8,338	16,394	2,112	7,966	13,118	634	2,390	3,935	1,903	5,608	10,034	8,244	24,302	43,481
KL 5	2,701	6,596	9,153	1,282	2,989	5,225	385	897	1,568	1,310	3,145	4,784	5,678	13,627	20,729
KL 6	3,705	10,711	22,058	947	4,574	6,817	284	1,372	2,045	1,481	4,997	9,276	6,417	21,654	40,196
KL 7	786	2,744	3,964	244	3,007	3,586	73	902	1,076	331	1,996	2,588	1,434	8,650	11,214
KL 8	1,061	3,030	4,005	553	2,693	3,560	166	808	1,068	534	1,959	2,590	2,313	8,491	11,222
KL 9	233	1,382	1,613	291	2,097	2,215	87	629	665	183	1,232	1,348	795	5,341	5,840
KL 10	724	1,399	1,893	130	1,186	1,416	39	356	425	268	882	1,120	1,160	3,823	4,853
KL 11	0	1,080	1,620	0	84	185	0	25	56	0	357	558	1	1,546	2,419
KL 12	0	962	1,114	3	2,584	4,370	1	775	1,311	1	1,296	2,039	5	5,618	8,834
Total	19,886	53,114	84,730	19,185	53,807	78,557	5,756	16,142	23,567	13,447	36,919	56,056	58,272	159,981	242,910

Table V.4.2 Agricultural Flood Damage (3 Pattern) (1988) (2/6)

(Unit: Thousand M$)

River Stretch No.	Crops												Non-crops						Sub-total		
	Paddy			Tobacco			Rubber			Oil Palm			Others			Livestock					
	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year
KL 1	19	42	45	15	29	29	0	0	0	0	0	0	4	8	9	2	10	22	39	89	105
KL 2	80	214	319	96	132	181	3	5	8	0	0	0	16	43	64	8	47	149	203	441	720
KL 3	2,936	5,833	7,673	2,548	6,929	7,501	504	662	825	0	0	0	587	1,167	1,535	263	1,751	4,559	6,838	16,341	22,092
KL 4	1,435	3,245	5,234	873	2,223	5,112	860	1,321	1,609	3	7	9	287	649	1,047	138	893	3,383	3,596	8,338	16,394
KL 5	496	1,763	2,617	1,563	2,963	3,275	280	518	554	159	293	295	99	353	523	104	707	1,889	2,701	6,596	9,153
KL 6	1,967	4,895	8,910	845	2,313	3,741	349	1,331	3,024	8	45	49	393	979	1,782	142	1,148	4,552	3,705	10,711	22,058
KL 7	304	982	1,392	44	283	309	331	950	1,121	16	39	46	61	196	278	30	294	818	786	2,744	3,964
KL 8	640	1,583	1,926	43	113	116	205	681	738	4	12	13	128	317	385	41	325	826	1,061	3,030	4,005
KL 9	30	100	134	2	10	11	177	1,061	1,064	9	43	44	6	20	27	9	148	333	233	1,382	1,613
KL 10	31	79	80	9	10	11	623	1,101	1,351	27	43	44	6	16	16	28	150	391	724	1,399	1,893
KL 11	0	0	0	0	0	0	0	964	1,286	0	0	0	0	0	0	0	116	334	0	1,080	1,620
KL 12	0	136	156	0	13	14	0	683	683	0	0	0	0	27	31	0	103	230	0	962	1,114
Total	7,938	18,872	28,486	6,038	15,018	20,300	3,332	9,277	12,263	226	482	500	1,588	3,774	5,697	765	5,691	17,484	19,886	53,114	84,730

Table V.4.2 Non-agricultural Flood Damage (3 Pattern) (1988) (3/6)

(Unit:Thousand M$)

River Stretch No.	House Residential			Industrial			Commercial			Medical			Educational			Religious			Administrative			Sub-total		
	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year
KL 1	4	8	41	0	0	9	2	3	18	0	0	0	0	1	3	0	0	0	0	1	7	7	13	79
KL 2	14	519	1,020	1	96	233	8	181	322	0	1	4	1	26	56	0	7	16	2	62	138	26	892	1,789
KL 3	8,955	17,291	25,318	1,296	2,159	2,705	2,159	3,729	4,763	12	29	40	210	476	646	94	202	270	865	1,837	2,455	13,591	25,723	36,197
KL 4	1,400	5,282	8,724	126	484	820	301	1,052	1,696	3	12	19	73	342	571	25	94	152	184	700	1,136	2,112	7,966	13,118
KL 5	890	1,986	3,526	69	190	314	164	388	686	3	8	13	36	96	159	16	44	73	104	277	454	1,282	2,989	5,225
KL 6	635	3,069	4,583	34	236	391	158	668	935	2	9	13	19	123	192	13	60	88	86	409	615	947	4,574	6,817
KL 7	124	1,500	1,851	26	323	380	45	514	595	1	11	12	14	205	222	4	49	58	30	405	468	244	3,007	3,586
KL 8	364	1,856	2,423	40	188	257	71	283	378	1	3	4	11	54	74	6	29	41	60	280	383	553	2,693	3,560
KL 9	173	1,464	1,541	25	152	161	41	224	237	1	4	4	16	56	63	4	20	21	31	177	188	291	2,097	2,215
KL 10	72	702	843	8	43	64	17	159	183	1	6	6	13	109	123	1	6	8	18	161	189	130	1,186	1,416
KL 11	0	49	106	0	14	35	0	12	22	0	0	0	0	1	3	0	1	3	0	7	16	0	84	185
KL 12	0	1,778	3,024	0	316	506	3	237	434	0	1	2	0	18	30	0	24	38	0	210	336	3	2,584	4,370
Total	12,631	35,504	53,000	1,625	4,201	5,875	2,969	7,450	10,269	23	84	117	393	1,507	2,142	163	536	768	1,380	4,526	6,385	19,185	53,807	78,557

Table V.4.2 Probable Flood Damage (3 Patterns) (2010) (4/6)

(Unit: Thousand M$)

River Stretch No.	Direct Damage									Indirect Damage			Total		
	(A) Agriculture			(B) Non-agriculture						(C)			(A)+(B)+(C)		
	(1)			(2) House/Building			(3) Infrastracture								
	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year
KL 1	62	141	166	17	31	229	5	9	69	25	55	139	109	236	603
KL 2	315	700	1,145	68	2,746	5,545	20	824	1,664	121	1,281	2,506	525	5,550	10,860
KL 3	10,547	25,112	34,197	44,807	82,039	117,230	13,442	24,612	35,169	20,639	39,529	55,979	89,435	171,291	242,575
KL 4	5,404	12,704	24,993	6,278	23,815	39,271	1,883	7,145	11,781	4,070	13,099	22,814	17,635	56,762	98,859
KL 5	4,173	10,331	14,416	3,421	7,754	13,984	1,026	2,326	4,195	2,586	6,123	9,778	11,207	26,534	42,373
KL 6	5,841	16,704	34,170	2,791	13,791	20,793	837	4,137	6,238	2,841	10,390	18,360	12,310	45,022	79,562
KL 7	1,118	4,250	6,176	567	7,160	8,733	170	2,148	2,620	557	4,067	5,259	2,412	17,625	22,787
KL 8	1,495	4,241	5,624	1,498	7,551	9,990	449	2,265	2,997	1,033	4,217	5,583	4,475	18,274	24,194
KL 9	309	1,798	2,102	773	5,879	6,183	232	1,764	1,885	394	2,832	3,042	1,708	12,273	13,181
KL 10	942	1,811	2,424	320	3,158	3,773	96	947	1,132	407	1,775	2,199	1,765	7,691	9,528
KL 11	0	1,317	1,977	1	266	587	0	80	176	0	499	822	2	2,162	3,562
KL 12	0	1,221	1,418	11	9,903	16,751	3	2,971	5,025	4	4,229	6,958	18	18,324	30,153
Total	30,206	80,329	128,808	60,551	164,093	243,069	18,165	49,228	72,921	32,677	88,095	133,439	141,599	381,745	578,238

Table V.4.2 Agricultural Flood Damage (3 Pattern) (2010) (5/6)

(Unit: Thousand M$)

River Stretch No.	Crops												Non-crops			Sub-total		
	Paddy			Tobacco			Rubber			Oil Palm			Others			Livestock					
	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year
KL 1	32	70	75	21	42	42	0	0	0	0	0	0	6	14	15	2	15	34	62	141	166
KL 2	135	359	535	138	188	258	3	6	9	0	0	0	27	72	107	12	75	236	315	700	1,145
KL 3	4,906	9,765	12,852	3,639	9,896	10,712	615	807	1,006	0	0	0	981	1,953	2,570	406	2,691	7,057	10,547	25,112	34,197
KL 4	2,409	5,448	8,789	1,247	3,175	7,301	1,049	1,611	1,963	9	19	25	482	1,090	1,758	208	1,361	5,157	5,404	12,704	24,993
KL 5	833	2,960	4,395	2,232	4,231	4,677	342	632	676	439	809	814	167	592	879	161	1,107	2,975	4,173	10,331	14,416
KL 6	3,302	8,220	14,962	1,207	3,302	5,342	425	1,624	3,689	22	124	134	660	1,644	2,992	225	1,790	7,051	5,841	16,704	34,170
KL 7	442	1,428	2,026	97	813	976	404	1,159	1,368	44	109	126	88	286	405	43	455	1,274	1,118	4,250	6,176
KL 8	931	2,303	2,802	62	161	165	250	830	900	8	32	36	186	461	560	57	454	1,160	1,495	4,241	5,624
KL 9	44	146	195	3	14	14	216	1,294	1,298	25	122	122	9	29	39	12	193	434	309	1,798	2,102
KL 10	46	115	116	15	14	14	761	1,343	1,649	75	122	122	9	23	23	36	194	500	942	1,811	2,424
KL 11	0	0	0	0	0	0	0	1,176	1,569	0	0	0	0	0	0	0	141	408	0	1,317	1,977
KL 12	0	198	227	0	20	20	0	833	833	0	0	0	0	40	45	0	131	293	0	1,221	1,418
Total	13,080	31,012	46,974	8,661	21,856	29,521	4,065	11,315	14,960	622	1,337	1,379	2,616	6,202	9,395	1,162	8,607	26,579	30,206	80,329	128,808

Table V.4.2 Non-agricultural Flood Damage (3 Pattern) (2010) (6/6)

(Unit:Thousand M$)

River Stretch No.	House Residential			Industrial			Commercial			Medical			Educational			Religious			Administrative			Sub-total		
	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year	3-year	13-year	50-year
KL 1	12	24	155	0	1	17	4	5	36	0	0	0	0	1	6	0	0	1	0	1	14	17	31	229
KL 2	43	1,936	3,879	2	196	475	16	399	712	0	4	8	2	58	126	0	15	35	4	138	310	68	2,746	5,545
KL 3	34,846	63,915	93,932	2,608	4,332	5,406	4,722	8,137	10,344	24	65	88	471	1,062	1,439	211	448	596	1,925	4,080	5,424	44,807	82,039	117,230
KL 4	4,806	18,259	30,178	241	927	1,571	628	2,191	3,533	6	26	41	155	730	1,219	53	199	322	389	1,483	2,407	6,278	23,815	39,271
KL 5	2,605	5,707	10,442	134	358	610	345	797	1,447	7	17	29	76	204	345	33	92	157	222	579	975	3,421	7,754	13,984
KL 6	2,144	10,675	16,169	66	451	750	329	1,390	1,948	4	19	27	40	263	411	27	127	185	181	866	1,303	2,791	13,791	20,793
KL 7	324	4,051	5,150	49	618	729	93	1,070	1,239	2	23	26	29	436	474	7	104	123	63	858	992	567	7,160	8,733
KL 8	1,088	5,733	7,521	81	379	521	156	622	828	1	6	7	26	122	167	13	65	91	132	625	855	1,498	7,551	9,990
KL 9	525	4,576	4,793	48	290	307	87	467	496	2	8	10	35	120	133	7	42	45	68	375	400	773	5,879	6,183
KL 10	199	2,148	2,580	15	82	123	36	330	381	1	12	13	27	232	262	3	13	19	39	341	395	320	3,158	3,773
KL 11	0	198	428	0	26	66	1	24	46	0	0	0	0	2	6	0	2	6	0	14	35	1	266	587
KL 12	0	8,045	13,689	0	681	1,085	11	554	1,013	0	2	5	0	44	69	0	57	91	0	500	799	11	9,903	16,751
Total	46,592	125,288	188,896	3,245	8,341	11,660	6,428	15,986	22,022	48	181	254	861	3,273	4,658	354	1,164	1,670	3,024	9,860	13,910	60,551	164,093	243,069

Table V.4.3 Probable Flood Damage (Without Project)

Return Period	Annual Mean Probability Exceedance	Annual Mean Probability of Return	Probable Flood Damage (Million M$)	Mean Flood Damage (Million M$)	Annual Mean Flood Damage (Million M$)	Accumulative Annual Mean Flood Damage (Million M$)
2	0.500	-	0	-	-	-
3	0.333	0.167	58.27	29.14	4.86	4.86
5	0.200	0.133	100.50	79.39	10.58	15.44
10	0.100	0.100	148.00	124.25	12.43	27.87
13	0.077	0.023	159.98	153.99	3.55	31.42
20	0.050	0.027	188.00	173.99	4.68	36.10
50	0.020	0.030	242.91	215.46	6.46	42.57

Annual Mean Flood Damage = 42.6 Million M$

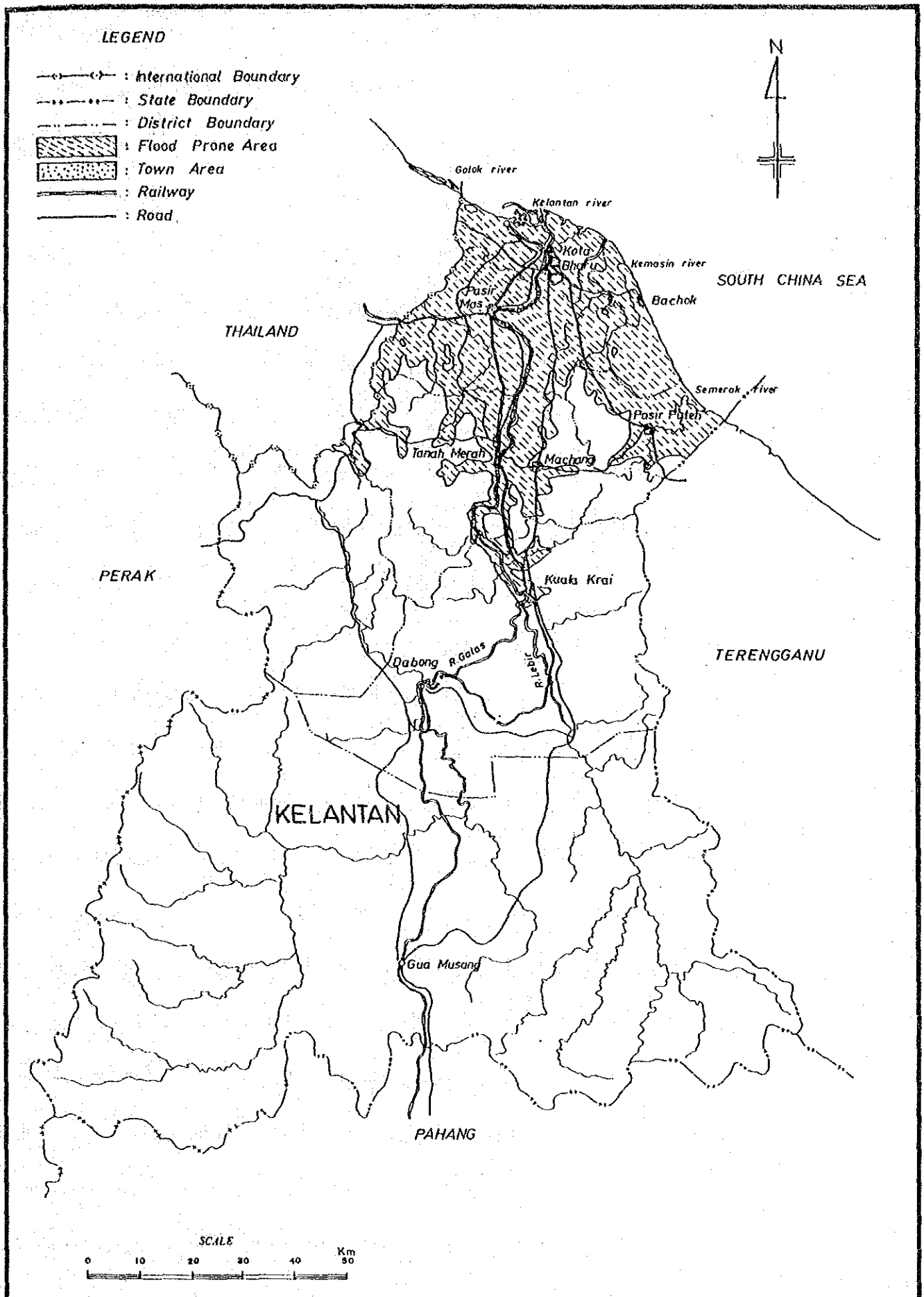

Fig.V.3.1

Flooded Area by January 1967 Flood

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STUDY
ON
KELANTAN RIVER BASIN - WIDE FLOOD MITIGATION
JAPAN INTERNATIONAL COOPERATION AGENCY

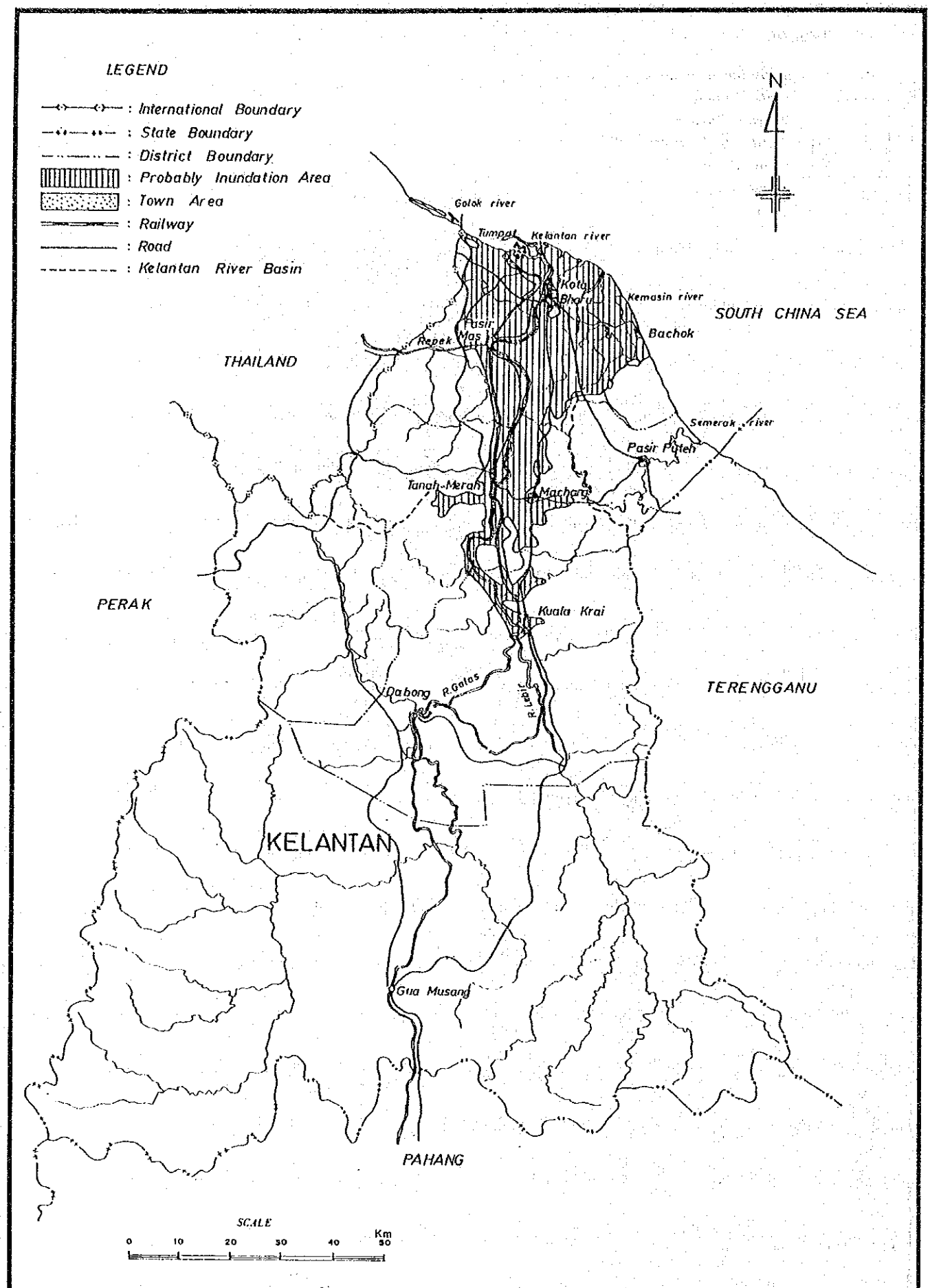

Fig.V.3.2

Probable Inundation Area

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JAPAN INTERNATIONAL COOPERATION AGENCY

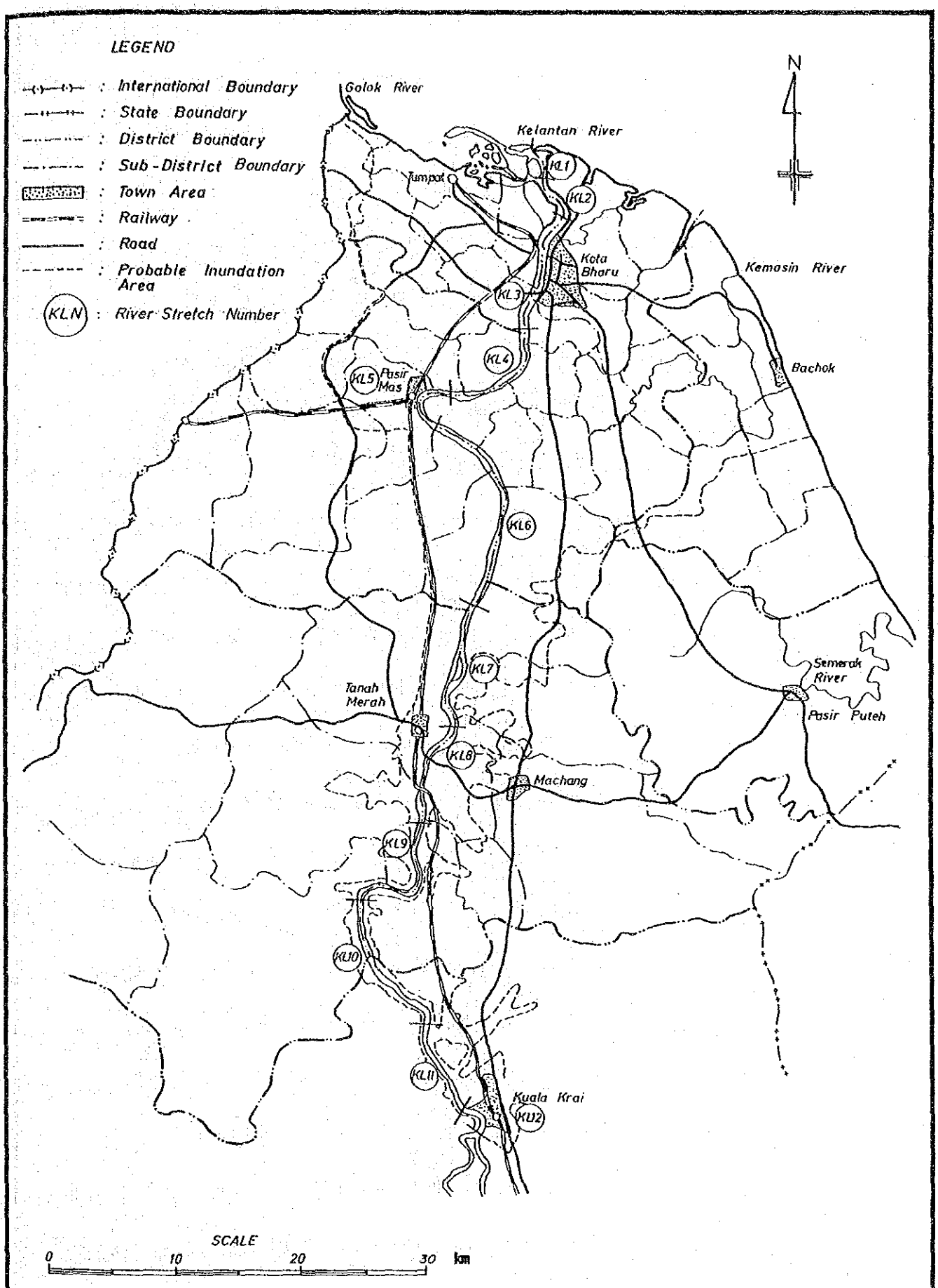

Fig.V.3.3

Division of River Stretches

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JAPAN INTERNATIONAL COOPERATION AGENCY

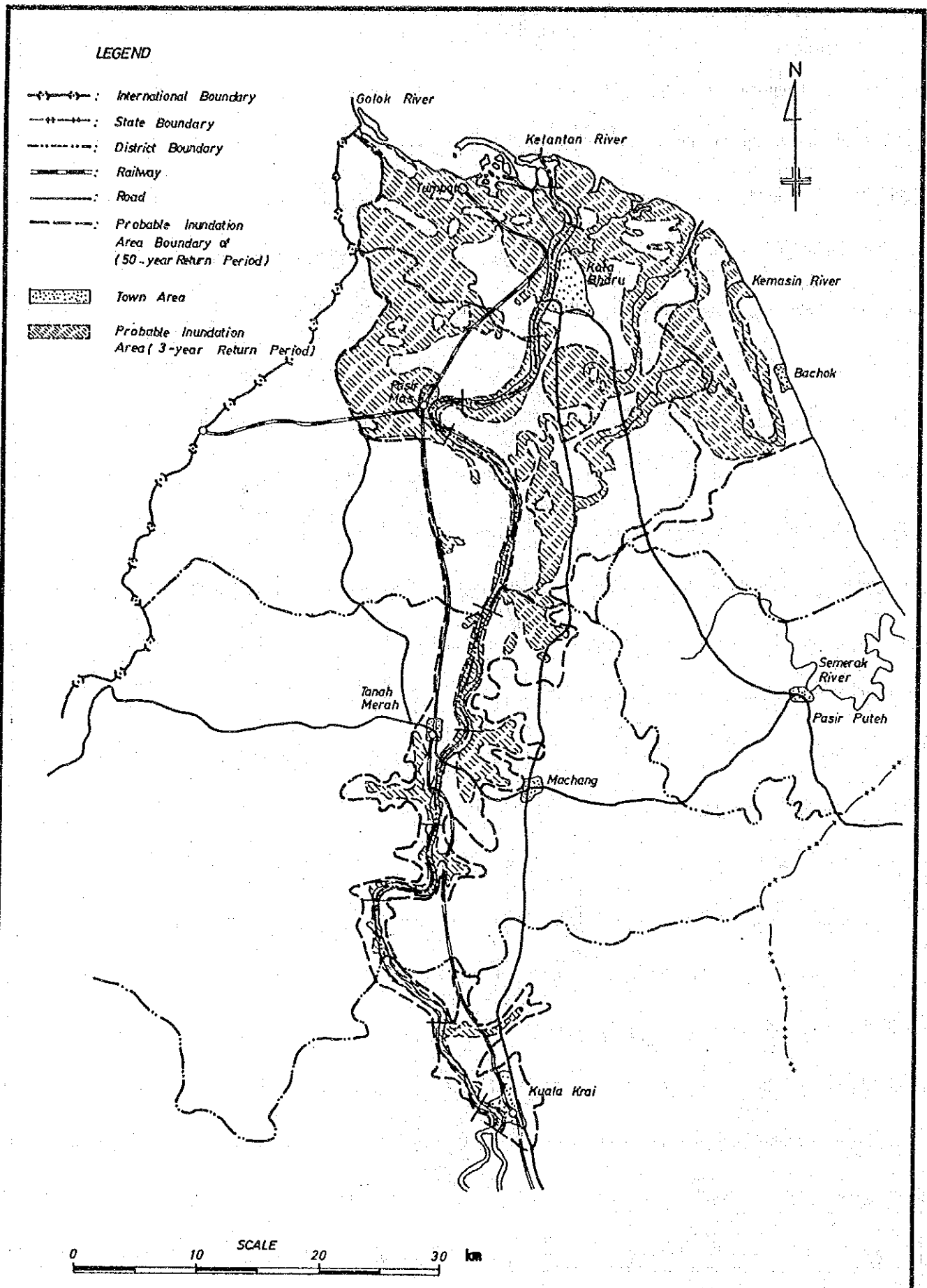

Fig.V.4.1

Probable Inundation Area (3-year Probable Flood)

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JAPAN INTERNATIONAL COOPERATION AGENCY

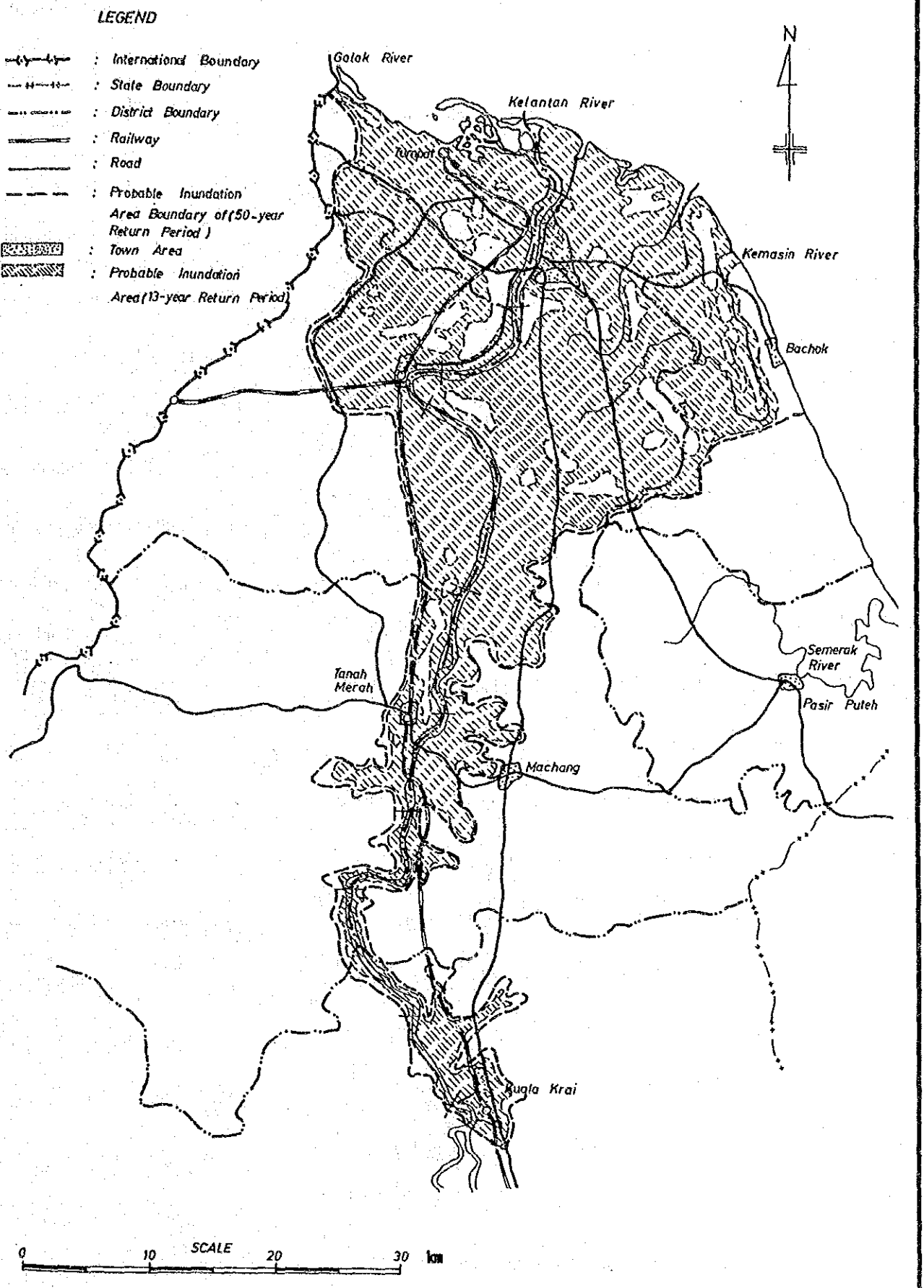

Fig.V.4.2

Probable Inundation Area (13-year Probable Flood)

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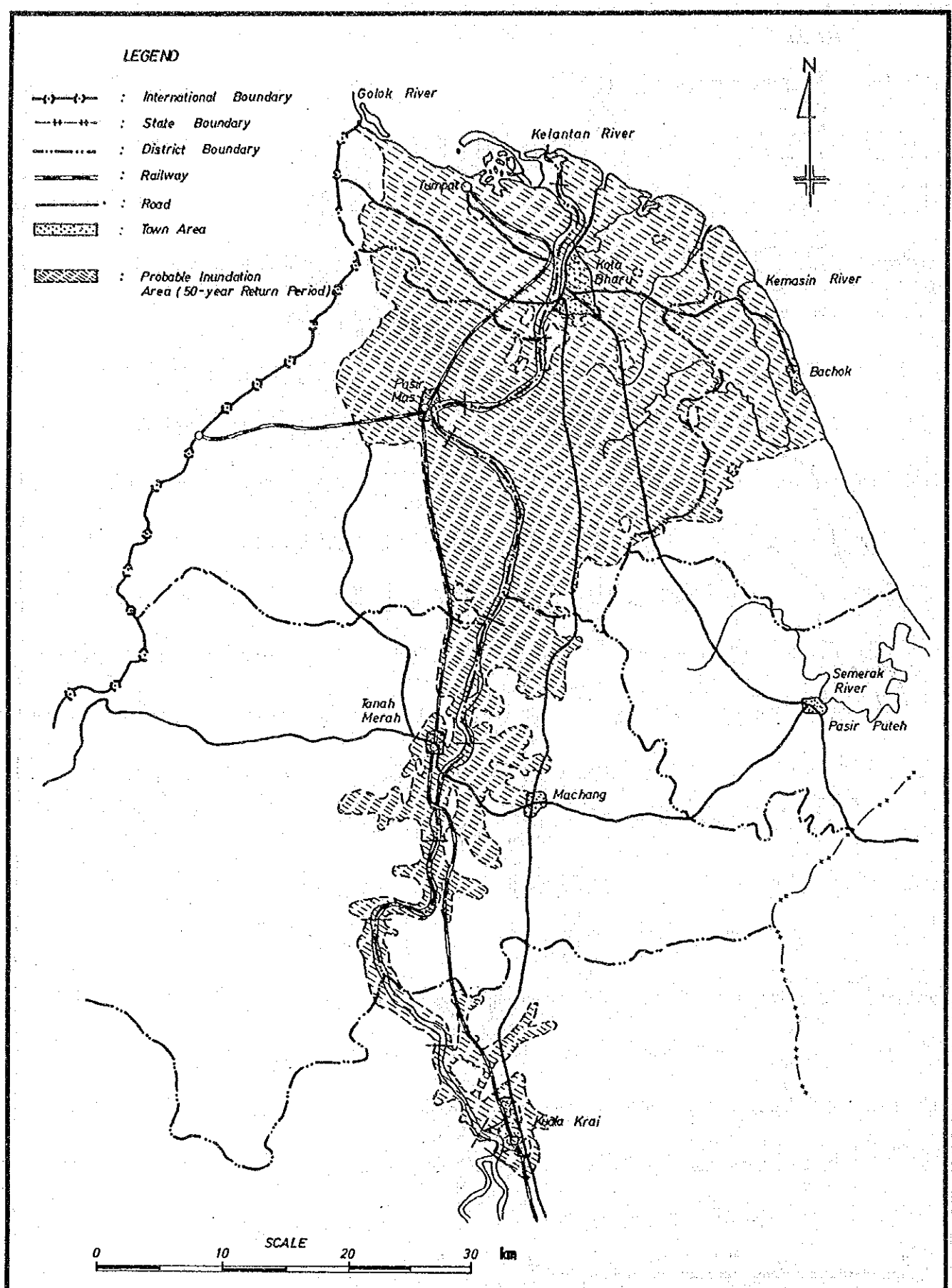

Fig.V.4.3

Probable Inundation Area (50-year Probable Flood)

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