

section will provide the basic information in determining the priority areas of protection from floods dealing in Annex VIII, Study on Flood Mitigation Plan.

Fig. V.4.2 depicts seven districts of Kota Bharu, Tumpat, Pasir Mas, Bachok, Machang, Tanah Merah and Kuala Krai in the study area. These seven districts include 48 sub-districts, which are the minimum unit to estimate flood damages.

4.3 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. Table V.4.1 shows the land use of the Kelantan State by district as of 1988. Judging from this, 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.

Table V.4.2 shows 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). 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 livestock is also estimated by multiplying the damage rate of livestock 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.4.3.

4.4 Establishment of Asset Distribution

The acreage and number of assets given in Table V.4.3 were first of all 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. It is noted that elevation reading of assets by one metre was made by interpolating a two-metre contour interval of the topographic maps.

Following are assumed for measuring and counting the distribution of assets:

- Since 1 to 25,000 scale topographic maps with a 15-metre contour interval are not contoured with a two-metre interval in the areas for the 28 km long river stretches between Temangan and Kuala Krai (refer to Chapter 3 of Annex I, Topographic Survey), the distribution of assets in these areas is basically measured and counted by evenly dividing the contour interval of 15-metre. However, some adjustments are given based on site survey.
- The topographic maps with a scale of 1 to 25,000 show the acreage of paddy and rubber. Since these maps were prepared before 1967, the acreage of paddy and rubber by each contour in the present condition is estimated by multiplying the increase rate of total acreage in a sub-district from 1967 to present by the acreage given by each contour in 1967.
- A sub-district (refer to Fig. V.4.2) is a minimum unit to summarize the acreage of assets.
- The planted areas of oil palm and tobacco are not shown on the 1 to 25,000 scale topographic maps, since those were rarely planted when the maps were prepared. Since tobacco is mainly cultivated together with paddy in the flat land and the plantation of oil palm spreads on the areas with undulation like rubber, the distribution of tobacco and oil palm by ground height is assumed to proportion to that of paddy and rubber by elevation in a sub-district, respectively.
- The distribution of industrial, commercial and service establishment and public institutions by ground height is assumed to proportion to population or the number of residential houses measured from the maps by elevation in a sub-district.

4.5 Preliminary Study on Socio-economic Condition in the Probable Inundation Area

The socio-economic activities in the probable inundation area are in prosperity along the Kelantan River with four major towns of Kota Bharu, Pasir Mas, Tanah Merah and Kuala Krai as a centre of activities, resulting in the concentration of population in these four towns including surrounding areas. Economic activities in these urban areas include the industrial, commercial and service sectors. The number of building and establishment in these sectors was already given by sub-district or by river stretch in Table V.4.3.

On the other hand, the rural areas in the probable

inundation area are sparsely populated, and people in these rural areas are engaged in agriculture. Main crops cultivated are represented by paddy, tobacco, rubber and oil palm. Paddy field spreads over almost all the districts, but the coastal regions of Kota Bharu, Tumpat, Pasir Mas and Bachok districts overwhelm other districts in planting area. On the other hand, rubber and oil palm are extensively planted in Pasir Mas district as well as Machang, Tanah Merah and Kuala Krai districts in the upstream areas of the Kelantan River.

4.5.1 Basic socio-economic conditions

Population in the probable inundation area was projected by sub-district for the period from present to year 2010 with an interval of 5 years as given in Table V.4.4, while Tables V.4.5 and V.4.6 show the results of projection for the population density and number of houses in the probable inundation area.

The number of industrial, and commercial and service establishments is forecasted as summarized in Tables V.4.7 and V.4.8 respectively, while social amenities such as medical, educational, religious and administrative institutions are estimated to increase as given in Table V.4.9 to V.4.12, respectively. Further details are discussed in Annex IV, Socio-economy.

4.5.2 Agro-economic conditions

The increase of cultivating and planting areas for four major crops of paddy, tobacco, rubber and oil palm was projected in the probable inundation area by sub-district for the period from present to year 2010 with an interval of 5 years as given in Tables V.4.13 to V.4.16.

4.6 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.

4.6.1 Unit value of assets

(1) Unit value for agricultural 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.4.17 to V.4.20, 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 ($=1,322.85 \times 0.85 + 1,234.85 \times 0.1 + 1,338.5 \times 0.05$) by taking the weighted average of production costs varied by varieties and planting methods as given in Table V.4.21. The production cost of tobacco is given in Table V.4.22. 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.4.23 and V.4.24 respectively by assuming the economic life of 25 years for those trees.

(2) Unit value for non-agricultural assets

The unit value of residential houses, and industrial, commercial and service establishments, which are non-agricultural assets, is estimated in Table V.4.25 by referring to the results of interview at the Department of Public Works (JKR), Kelantan. Table V.4.26 shows the increase of unit value for the non-agricultural assets by year 2010.

4.6.2 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.4.27 and V.4.28 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.4.29 and V.4.30 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.4.31 by referring to National Water Resources Study, Malaysia and Regional Water Resources Study of South Johor.

5. PROBABLE FLOOD DAMAGE

5.1 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 km² as delineated in Fig.V.5.1, whilst 870 km² for the 1983-pattern flood with a 13-year return period as given in Fig.V.5.2 and 1,050 km² for the 1967-pattern flood with a 50-year return period as given in Fig.V.5.3.

Table V.5.1 summarizes the estimate for the flood water level and flooding duration of three selected floods. 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 was also determined based on the flooding duration obtained from site interview and respective flood reports.

5.2 Probable Flood Damage

5.2.1 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, the areas of crops planted with the seasonal variation are for paddy and tobacco. Shown in Fig.V.5.4 are the cropping calendar of paddy and tobacco and the frequency of flood peak discharges beyond 5,000 m³/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 as given in Table V.5.3.

(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 considering the following condition:

Shown in Table V.2.6 are the recorded damages of infrastructures in the flood reports. These values, however, do not correspond to the magnitudes of recorded floods. Furthermore, the recorded damage does not cover the full range of flood damage. Whilst the in-depth survey of flood damage carried out in past in and around the Kelantan River basin as given in Table V.5.4 shows the ratio of damage to the infrastructures ranging from 30% to 50%. In this Study, the ratio of 30% in minimum was adopted.

(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 as given in Table V.5.4. The ratio of 30% on an average to the direct damage was regarded as the indirect damage.

5.2.2 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.5.5 and V.5.6 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 thier return periods. Since none of damage is caused 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.5.7. The probable flood damage was estimated to be 243 million M\$ for a scale of 50-year return period.

REFERENCES

1. Flood Reports (10) DID/Kelantan Dec. 1965/Jan. 1966, Jan. 1967, Nov. 1969, Dec. 1973, Dec. 1974/Jan. 1975, Nov./Dec. 1981, Dec. 1982, Dec. 1983, Dec. 1984, Nov./Dec. 1986
2. National Water Resources Study, Malaysia, Sectoral Report, Vol.5 River Conditions, Oct. 1982, JICA
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Vol.1 Hydrology Chapter 12 Kelantan Flood Plain,
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Table V.2.1 List of Flood Reports

Calender Year	Annual Max. Discharge at Guillemard Bridge (cms)	Flood Report	Remarks
1965	6,170	Dec.1965/Jan.1966 *	
1966	16,000	Jan.1967 **	50-year return period
1967	8,280		
1968	1,700		
1969	6,650	Nov.1969	
1970	8,800		
1971	5,550		
1972	10,260		
1973	11,130	Dec.1973	
1974	4,490	Dec.1974/Jan.1975	
1975	5,247		
1976	2,610		
1977	2,525		
1978	3,291		
1979	10,400		
1980	1,711		
1981	2,028	Nov./Dec.1981	
1982	7,172	Dec.1982	
1983	12,007	Dec.1983	13-year return period
1984	7,744	Dec.1984	
1985	1,722		
1986	6,901	Nov./Dec.1986	3-year return period

Source: Flood Report, DID/Kelantan

Note: * Flood Report, Dec.1965/Jan.1966 is the first compilation.
 ** Flood Report of Jan.1967-flood compiles the flood event
 from Dec.1966 to Jan.1967.

Table V.2.2 Inundation Area by January 1967 Flood

District	Administrative Area (sq.km) (1)	Inundation Area (sq.km) (2)	(%) (2)/(1)
Kota Bharu	402.4	383	95
Tumpat	181.3	177	98
Pasir Mas	645.2	609	94
Bachok	278.9	271	97
Pasir Puteh	425.6	404	95
Machang	530.2	-	-
Tanah Merah	798.4	-	-
Kuala Krai	2,273.1	-	-
Jeli	1,324.1	-	-
Gua Musang	8,180.9	-	-
Total	15,040.1	2,979	20

Source: Flood Report - January 1967 flood DID/Kelantan

Note: Inundation areas shown in the above table are assumed on basis of the flood map of Jan.1967-flood.

Table V.2.3 Flood Data of December 1967 Flood (1/2)

River Basin	Location	Max. Flood Water Level (El.m)	Date/Time	Ground Level (El.m)	Water Depth (m)	Flooding Duration (days)	Cause of Flooding	Remarks
Sg.Kelantan	Bradley Steps (Kuala Krai Town)	31.7 (104')	6 Jan.'67/morning					5,000 people were evacuated to Hospital Hill.
Sg.Kelantan	Bukit Panau		6 Jan.'67				Overflow from Sg.Kelantan/ Sg.Kusial	Flood water entered Sg.Lemal basin. First major overspill from Sg.Kelantan.
Sg.Kelantan	Guillemard Bridge	22.3 (73.2')	6 Jan.'67/8am					
Sg.Kelantan	To'Uban Headworks	12.8 (42')	6 Jan.'67				Overflow from Sg.Lemal.	
Sg.Kelantan	Repek Pump House	9.9 (32.6')	6 Jan.'67				Overflow from Sg.Lemal.	Flood water flowed towards Sg.Golok via Lubok Batil.
Sg.Kelantan	Pasir Mas Town		6 Jan.'67		1.2 (4')		Overflow from Sg.Kelantan near Sg.Lemal Pump House.	Second major overspill from Sg.Kelantan. 5,000 victims in town and its surrounding areas were evacuated.
Sg.Kelantan	Sg.Raja Gali Area		6 Jan.'67				Overflow from Sg.Kelantan/ Sg.Raja Gali.	Third major overspill from Sg.Kelantan occurred between the Sultan Yahya Petra Bridge and Palekbang enormous damage to railway, road and irrigation canal.
Sg.Kelantan	Kg.Mata Ayer	17.6 (57.6')	6 Jan.'67				Overflow from Sg.Kelantan.	
Sg.Kelantan	Kembu Pump House	16.5' (54.1')	6 Jan.'67				Overflow from Sg.Kelantan.	
Sg.Kelantan	Ketereh Police Station	12.6 (41.3')	6 Jan.'67				Overflow from Sg.Kelantan.	
Sg.Kelantan	Salor Pump House	12.6 (41.2')	5 Jan.'67/9pm				Overflow from Sg.Kelantan.	
Sg.Kelantan	Pasir Mas Pump House	10.2 (33.4')	5 Jan.'67/10pm				Overflow from Sg.Kelantan.	
Sg.Kelantan	Kota Bharu Custom	5.2 (20.4')	6 Jan.'67				Overflow from Sg.Kelantan.	
Sg.Kelantan	Sg.Baung Bridge	4.7 (15.6')	6 Jan.'67				Overflow from Sg.Kelantan.	

Table V.2.3 Flood Data of December 1967 Flood (2/2)

River Basin	Location	Max. Flood Water Level (El.m)	Date/Time	Ground Level (El.m)	Water Depth (m)	Flooding Duration (days)	Causes of Flooding	Remarks
Sg. Pergau	Kg. Batu Melintang		4 Jan. '67		11.4 (37'6")	21	Water rise of Sg. Pergau	Kg. Batu Melintang, Jeli, Lubok Bungor, Kuala Belah were all inundated. 2-3 days evacuation.
Sg. Nenggiri	Bertan		4 Jan. '67/evening		8.5 (28')		No inundation	
Sg. Galas	Dabong		5 Jan. '67/morning		19.4 (63'7")			2,500 persons of Kg. Dabong, Kuala Gris, Kemubu were evacuated to Bukit Dabong.
Sg. Lebir	Manek Urai		5 Jan. '67/morning		15.3 (50'1")			500 persons evacuated, 125 houses swept away.
Sg. Kemasin	Sg. Kemasin Basin						Overflow from Sg. Kelantan	Severe losses to crops, live stock and properties in Kota Bharu and Bachok Districts.
Sg. Semerak	Pasir Puteh Town	4.3 (14.2')	6 Jan. '67		2.7 (9')		Overflow from Sg. Semerak	8,500 civilian were evacuated.
Sg. Golok	Rantau Panjang	10.4 (34.1')	5 Jan. '67		1.7 (5'6")		Overflow from Sg. Golok	Since Dec. 1966, Sg. Golok and its tributaries like Sg. Kemai and Sg. Meranti were already in spate and caused flooding in the districts along the rivers.
Sg. Golok	Kuala Jambu Police Station	4.7 (15.5')	5 Jan. '67		4.3 (14')		Overflow from Sg. Golok	
Sg. Golok	Kg. Lubok Stoi				2.7 (9')		Overflow from Sg. Golok	

Source: Flood Report December 1967, DID/Kelantan

Note: Sg. is an abbreviation for Sungai meaning River.
Kg. is an abbreviation for Kampung meaning Village.

Table V.2.4 Flood Data of December 1983 Flood (1/2)

River Basin	Location	Max. Flood Water Level (El.m)	Date/Time	Ground Level (El.m)	Water Depth (m)	Flooding Duration (days)	Cause of Flooding	Remarks
Sg.Kelantan	Kuala Krai Town	29.97 (98.3')	4 Dec.'83/8pm	28.5	1.5	2.5	Overspill from Sg.Kelantan	2 phases of heavy rainfall 1st to 15th December 1st to 8th 1st stage 11th to 14th 2nd stage - more serious damage
Sg.Kelantan	Kuala Krai Area				5	14	Overspill from Sg.Kelantan and its tributaries like Sg.Kenor, Durian and Nal	
Sg.Kelantan	Tanah Merah				1-4	2-6	Overspill from Sg.Kelantan, Sg.Kusial	
Sg.Kelantan	Guillemard Bridge	20.89	7 Dec.'83/5am		0.5-5	2-7	Overspill from Sg.Sat,Bagan and Kemubu	
Sg.Kelantan	Machang	11.87			1-1.5	7	Overspill from Sg.Kelantan and its tributaries	
Sg.Kelantan	Pasir Mas Town				1.5-2	4-6	Overspill from Sg.Kelantan	
Sg.Kelantan	Tumpat	6.28	7 Dec.'83/4pm		0.5-1.5	5-7	Overspill from Sg.Kelantan and its Sg.Keladi	
Sg.Kemasin	Peringat	5.43	28 Nov.'83/10pm		1		Overflow from Sg.Kemasin and its tributaries (Sg.Peringat and Rusa)	
Sg.Kemasin	Kg.Jelawat				1.2-1.5		Overflow from Sg.Kemasin and its tributaries (Sg.Peringat and Rusa)	
Sg.Kemasin	Kg.Rusa				1.2-1.5		Overflow from Sg.Kemasin and its tributaries (Sg.Peringat and Rusa)	
Sg.Kemasin	Kg.Kusu				1.2-1.5	14	Overflow from Sg.Kemasin and its tributaries (Sg.Peringat and Rusa)	

Table V.2.4 Flood Data of December 1983 Flood (2/2)

River Basin	Location	Max. Flood Water Level (El.m)	Date/Time	Ground Level (El.m)	Water Depth (m)	Flooding Duration (days)	Cause of Flooding	Remarks
Sg.Semerak	Pasir Puteh Town	3.43	14 Dec. '83/5pm		1.7		Overflow from Sg.Semerak and its tributaries (Sg.Belida, Rasau and Gall)	
Sg.Semerak	Kg.Telosan				1-2	7-8	Overflow from Sg.Semerak and its tributaries (Sg.Belida, Rasau and Gall)	17.5 sq.km area damaged by flood
Sg.Semerak	Other kg.				1-2		Overflow from Sg.Semerak and its tributaries (Sg.Belida, Rasau and Gall)	
Sg.Golok	Rantau Panjang	10.04	5 Dec. '83/8pm		1.5-3	3-8	Overspill from Sg.Golok and its tributaries (Sg.Lanas, Manal,Jedok,Buluh and Jagor)	
Sg.Golok	Tanah Merah District						Overspill from Sg.Golok and its tributaries (Sg.Lachang, Rengas and Tasek Saru)	
Sg.Golok	Pasir Mas District				0.5-2	12-14	Overspill from Sg.Golok and Lemal	
Sg.Golok	Pasir Mas District/ Lemal Area				1-2	5-7	Overspill from Sg.Golok and its tributaries (Sg.Kuala Jambu, Mentua and Meranti)	

Source: Flood Report December 1983 Flood DID/Kelantan

Note: Sg. is an abbreviation for Sungai meaning River.

Kg. is an abbreviation for Kampung meaning Village.

Table V.2.5 Flood Data of December 1986 Flood

River Basin	Location	Max. Flood Water Level (El.m)	Date/Time	Ground Water Level (El.m)	Water Depth (m)	Flooding Duration (days)	Cause of Flooding	Remarks
Sg.Kelantan	Kuala Krai Town	26.15	1 Dec.'86/6pm				No Inundation	
Sg.Kelantan	Guillemard Bridge	18.12	2 Dec.'86/1am				No Inundation	
Sg.Kelantan	Kota Bharu	5.70	2 Dec.'86/8am					
Sg.Kemasin	Peringat	5.78	28 Nov.'86/10pm					
Sg.Semerak	Pasir Puteh	3.39	30 Nov.'86/3pm					
Sg.Golok	Rantau Panjang	10.10	30 Nov.'86/7pm					

Source: Flood Report December 1986, DID/Kelantan

Note: Sg. is an abbreviation for Sungai meaning River.

Kg. is an abbreviation for Kampung meaning Village.

Table V.2.6 Actual Flood Damage Records by Jan. 1967,
Dec. 1983 and Dec. 1986 Floods

Item	Damage Value (Thousand M\$)		
	Jan. 1967	Dec. 1983	Dec. 1986
Inundation Evacuees (persons)	125,000	29,108	4,757
Agriculture			
Paddy	13,762	2,376	631
Tobacco	?	?	40
Rubber	8	154	5
Fruits	37	109	?
Vegetable	328	394	88
Others	208	466	37
Livestock	?	435	?
Sub-total	14,343	3,934	801
Non-Agricultural			
Residential House	?	963	?
Public Building	410	?	?
Road/Bridge	1,516	6,453	5,176
Railways	?	*	?
Irrigation Facilit	?	*	?
Electricity/Teleco	86	*	120
Water supply	?	*	?
Sub-total	2,012	7,416	5,296
Total	16,355 (30,000)	11,350	6,096

Source: Flood Reports, Jan. 1967, Dec. 1983, Dec. 1986 DID/Kelantan

Note: -Damage values shown in the above table are indicated at price level of each year.
 -Damage values in the parentheses indicate the grand total of flood damage reported in the Flood Report of Jan. 1967-flood.
 * Included in the damage to road/bridge above.

Table V.4.1 Land Use by District, Kelantan 1988

(Unit : ha)

Item	District	Kota Bharu	Tumpat	Pasir Mas	Bachok	Pasir Puteh	Machang	Tanah Merah	Kuala Krai	Jeli	Gua Musang	Total	Z
1. Urban and Associated Areas		2,381	183	373	96	377	364	387	888	97	219	5,365	
2. Agricultural Areas		32,935	14,832	41,608	18,534	26,745	25,725	43,443	47,488	10,390	58,883	320,583	100
Paddy		13,356	7,655	16,527	8,566	11,225	6,221	5,340	485	1,241	432	71,248	21
Tobacco		(232)	(809)	(1,373)	(3,140)	(2,136)	(182)	(165)	(10)	(172)	-	(8,219)	3
Rubber		7,242	447	15,008	1,389	5,939	15,240	26,002	41,510	5,654	10,982	129,413	34
Oil Palm		0	0	1,192	0	241	471	9,870	876	2,912	45,699	61,261	31
Others*		12,137	6,730	8,881	8,579	9,340	3,793	2,231	4,617	593	1,770	58,661	11
3. Grasslands		1,287	234	1,992	3,368	2,377	947	456	1,310	761	4,714	17,446	
4. Swamps		1,611	1,756	8,829	4,923	4,765	688	159	456	265	1,641	25,093	
5. Forest and Others		2,028	1,122	11,714	972	8,300	25,298	35,398	177,163	120,894	752,633	1,135,522	
Total		40,242	18,127	64,516	27,893	42,564	53,022	79,843	227,305	132,407	818,090	1,504,009	

Source: Department of Agriculture, KADA, RISDA, FELCRA, FELDA, KESEDAR, SEPUL

Note: Parentheses shown in the above table indicate tobacco planting area. Planting areas of tobacco are excluded from the total area of agriculture area because tobacco is planted mainly in paddy areas.

* Others consist of horticulture, permanent crops (coffee, etc.), annual crops (maize, etc.), fruits and other minor cultivation, pasture reserves.

Table V.4.2 Land Use Forecast, Kelantan

Item	(Unit : ha)					
	1988	(%)	2000	(%)	2005	(%)
1. Urban and Associated Areas	5,365	0.4	7,003	0.5	7,825	0.5
2. Agricultural Areas	320,583	21.3	384,935	25.6	411,902	27.4
Paddy	71,248	(22)	77,248	(20)	79,750	(19)
Tobacco	8,219	(2)	8,219	(2)	8,219	(2)
Rubber	129,413	(39)	141,497	(36)	146,416	(35)
Oil Palm	61,261	(19)	102,637	(26)	119,877	(29)
Others*	58,661	(18)	63,553	(16)	65,859	(15)
3. Grasslands	17,446	1.1	16,354	1.1	15,920	1.0
4. Swamps	25,093	1.7	24,406	1.6	24,126	1.6
5. Forest and Others	1,135,522	75.5	1,071,311	71.2	1,044,204	69.4
Total	1,504,009	100.0	1,504,009	100.0	1,504,009	100.0

Source: Department of Agriculture, KADA, RISDA, FELCRA, FELDA, KESEDAR, SEPU

Note: Parentheses shown in the above table indicate the percentage of each crop area to the total of agricultural area.

* Others consist of horticulture, permanent crops (coffee of 0.01%, etc.), annual crops (maize of 0.8%, etc.), etc.), fruits of 2.7% and other minor cultivation and pasture reserves of 0.3%.

Table V.4.3 Assets in Probable Inundation Area corresponding to 50-Year Return Period in 1988

Table V.4.3 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	Medical	Educational	Religious Administrative
KL 1 Kota Bharu	Badang	65	188	7	0	0	698	4	22	1	2	2
	Tumpat	60	128	12	0	0	838	1	23	1	1	1
	Sub-total	1,155	312	19	0	0	1,526	5	45	2	3	3
KL 2 Kota Bharu	Badang	2,050	170	22	10	0	2,960	20	226	3	3	3
	Tumpat	1,513	285	16	15	0	1,389	22	79	3	3	3
	Sub-total	3,563	455	38	25	0	4,349	42	305	6	6	6
KL 3 Kota Bharu	Badang Kota Bharu	60	85	5	22	0	658	4	51	1	1	1
	Kuala	1,707	365	0	30	0	7,317	47	371	26	26	26
	Pantai	2,456	873	23	405	0	4,858	31	371	33	33	33
	Kemamin	2,248	604	66	272	0	8,982	58	685	33	33	33
	Lundang	2,177	711	0	414	0	3,900	28	752	33	33	33
	Sering	2,228	406	48	30	0	3,900	6	1,023	33	33	33
	Merituan	2,989	1,370	906	30	0	3,775	33	1,428	13	13	13
	2-Finang	1,823	320	71	20	0	2,390	27	1,577	13	13	13
	Sebak Bharu	1,252	825	133	223	0	2,390	27	1,577	13	13	13
	Techok	2,633	1,115	133	118	0	2,390	27	1,577	13	13	13
	Tumpat	2,330	1,138	133	118	0	2,390	27	1,577	13	13	13
	Peng-Kubor	3,747	1,820	122	138	0	58,836	273	1,030	10	10	10
	Jai-Besar	3,416	10,509	1,519	1,551	0	58,836	273	3,593	10	10	10
KL 4 Kota Bharu	Pendek	2,222	1,180	8	420	0	2,481	7	89	3	3	3
	Limbak	1,772	387	0	476	0	2,481	7	89	3	3	3
	Salor	3,033	1,363	0	774	0	3,755	7	277	3	3	3
Bachok	Banggu	1,535	603	373	601	0	3,047	13	109	1	1	1
	Tg. Pahuh	1,772	682	619	225	0	3,220	13	144	1	1	1
	Perupok	2,228	840	38	226	0	3,220	13	180	1	1	1
	Kubang Sepat	1,772	1,200	38	203	0	3,220	13	180	1	1	1
	Kurut Sulu	1,772	1,200	38	203	0	3,220	13	180	1	1	1
Pasir Mas	Kubang Gadong	1,772	8,085	1,143	2,453	13	27,462	35	624	45	45	45
	Sub-total	18,758	33,277	1,143	2,453	13	27,462	35	624	45	45	45
KL 5 Kota Bharu	Salor	605	337	0	55	0	566	2	20	2	2	2
	Kubang Gadong	1,595	527	85	205	14	1,202	2	43	1	1	1
	Pasir Mas	1,595	1,145	124	142	0	4,372	2	156	1	1	1
	Alor Pasir	1,595	1,145	124	142	0	4,372	2	156	1	1	1
	Gual Perlok	1,595	1,145	124	142	43	4,372	2	20	1	1	1
	Kuala Lemal	1,595	1,145	124	142	43	4,372	2	20	1	1	1
Sub-total		6,881	3,206	697	1,833	478	7,746	15	308	12	12	12

Table V.4.3 Assets in Probable Inundation Area corresponding to 50-Year Return Period in 1988

Table V.4.3 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 Educational Religious Administrative
KL 6	Kota Bharu	780	386	0	54	0	55	1	0	1
	Beta	2,325	1,170	0	512	0	1,500	1	0	1
	Pangkal Kalong	4,865	1,725	51	2,128	0	1,999	18	215	1
	Kadok	2,837	1,105	0	603	0	2,836	10	112	1
	Peringat	4,263	1,330	3	1,088	0	3,140	9	112	1
Bachok	Bekelan	2,897	1,334	35	1,75	0	1,458	1	52	1
	C. Barat	1,835	426	4	125	0	1,024	1	36	1
	C. Timur	1,875	272	20	255	0	1,103	1	24	1
	Kedondong	2,849	2,091	170	572	0	1,303	1	622	1
	Chetok	4,127	2,874	330	1,562	80	2,303	1	822	1
KL 7	Sub-total	27,397	14,201	809	7,334	80	22,500	52	843	38
	Machang	2,340	810	53	602	22	697	5	70	4
	Labok	1,577	242	12	437	3	828	3	25	2
	Kusial	1,955	1,084	194	1,084	88	1,070	4	48	2
	Sub-total	5,872	2,136	159	2,133	113	2,645	12	143	13
KL 8	Machang	3,259	992	0	447	0	974	3	39	2
	Pangkal Meleret	3,068	821	1	22	0	823	1	3	1
	Ulu St.	1,387	30	3	270	20	4,286	1	17	1
	Kusial	1,830	1,324	19	231	20	5,788	17	228	17
	Sub-total	7,531	2,393	28	1,860	20	11,788	24	368	21
KL 9	Machang	1,167	42	2	491	72	745	2	23	4
	Temangan	68	61	0	10	0	0	0	0	0
	Panyit	427	80	0	57	0	1,869	4	47	2
	Ulu Kusial	2,222	183	0	968	0	2,271	1	122	1
	Sokor	2,284	183	2	1,326	72	2,884	1	82	1
KL 10	Sub-total	465	49	2	490	72	248	1	8	2
	Machang	845	0	0	480	0	915	1	36	1
	Kuala Krai	488	56	0	969	0	271	0	38	1
	Batu Mengkebang	1,798	105	2	1,939	72	1,434	5	56	3
	Sub-total	3,231	0	0	1,845	0	915	6	36	3
KL 11	Sub-total	3,231	0	0	1,845	0	915	6	36	3
	Kuala Krai	1,721	207	3	980	0	7,320	43	292	20
	Batu Mengkebang	1,721	207	3	980	0	7,320	43	292	20
	Sub-total	110,307	41,895	4,510	21,569	851	133,285	492	6,507	305
	Total									

Table V.4.4 Population Forecast in the
Probable Inundation Area, Kelantan

		(Unit : persons)			
Administrative Division		1988	2000	2005	2010
Kota Bharu	Badang	24,655	34,337	39,439	45,073
	Bandar Kota Bharu	41,869	58,652	66,976	76,099
	Kota	27,801	40,094	46,343	53,298
	Panji	51,402	74,999	87,110	100,671
	Kemumin	22,338	31,658	36,328	41,478
	Lundang	56,654	83,628	97,603	113,344
	Banggu	16,131	22,351	25,410	28,743
	Beta	8,524	10,761	11,769	12,807
	Kadok	14,962	19,627	21,811	24,117
	Limbat	7,001	8,379	8,962	9,538
	Pangkal Kalong	31,759	51,337	62,235	75,069
	Pendek	13,133	17,166	19,047	21,028
	Peringat	16,623	19,946	21,357	22,753
	Salor	9,985	11,571	12,211	12,822
	Sering	15,158	18,680	20,225	21,788
Sub-total		357,995	503,186	576,826	658,629
Bachok	Bekelam	7,720	8,271	8,447	8,584
	Gunong Timor	5,838	7,188	7,766	8,348
	Gunong Barat	5,423	6,515	6,980	7,441
	Perupok	15,143	17,356	18,231	19,054
	Repek	7,110	8,367	8,886	9,391
	Mentuan	18,395	24,428	27,285	30,324
	Tg. Pauh	6,460	8,218	9,016	9,842
	Sub-total	66,089	80,343	86,611	92,984
Tumpat	Jal Besar	9,860	11,880	12,742	13,598
	Kebakat	11,539	14,358	15,609	16,884
	Pengkalan Kubor	11,596	15,721	17,711	19,854
	Sg. Pinang	14,763	16,589	17,284	17,918
	Terbok	12,509	15,757	17,217	18,718
	Tumpat	17,029	17,464	17,515	17,478
	Wakaf Bharu	23,248	31,136	34,901	38,926
	Sub-total	100,544	122,905	132,979	143,377
Pasir Mas	Alor Pasir	2,394	2,815	2,989	3,158
	Bunut Susu	12,295	14,030	14,711	15,348
	Chetok	10,609	12,349	13,057	13,737
	Gual Periook	3,857	4,068	4,128	4,167
	Kangkong	7,981	9,155	9,620	10,058
	Kuala Lemal	2,453	3,031	3,286	3,545
	Kubang Gadong	12,736	15,774	17,114	18,476
	Kubang Sepat	11,911	14,393	15,457	16,517
	Pasir Mas	23,145	28,430	30,740	33,072
	Sub-total	87,381	104,043	111,101	118,076
Machang	Labok	4,650	5,034	5,164	5,270
	Panyit	437	482	498	513
	Pulai Chondong	3,686	4,112	4,271	4,414
	Pang. Meleret	5,158	5,373	5,424	5,448
	Temangan	5,255	5,480	5,535	5,563
	Ulu Sat	2,361	3,072	3,402	3,749
	Sub-total	21,548	23,553	24,294	24,956
Tanah Merah	Kusial	26,975	34,421	37,812	41,330
	Ulu Kusial	11,246	13,488	14,440	15,380
	Sokor	2,869	3,783	4,213	4,668
	Sub-total	41,090	51,692	56,465	61,379
Kuala Krai	Batu Mengkebang	48,438	70,403	81,143	93,054
	Sub-total	48,438	70,403	81,143	93,054
Total		723,085	956,125	1,069,419	1,192,455

Sources: 5th. Malaysia Plan for Kelantan and Population Census,
1970 and 1980

Table V.4.5 Population Density Forecast in the
Probable Inundation Area, Kelantan

		(Unit : persons/sq.km)			
Administrative Division		1988	2000	2005	2010
Kota Bharu	Badang	826	1,157	1,321	1,501
	Bandar Kota Bharu	3,852	5,396	6,162	7,002
	Kota	1,629	2,349	2,715	3,122
	Panji	2,093	3,084	3,547	4,059
	Kemumin	994	1,408	1,616	1,845
	Lundang	2,664	3,932	4,589	5,329
	Banggu	524	727	826	934
	Beta	366	462	506	551
	Kadok	527	691	768	849
	Limbati	406	486	520	554
	Pangkal Kalong	479	774	939	1,133
	Pendek	585	765	849	938
	Peringat	381	458	490	522
	Salor	459	532	561	589
	Sering	665	820	887	955
	Average	1,097	1,536	1,753	1,992
Bachok	Bekelam	323	346	353	358
	Gunong Timor	544	667	721	775
	Gunong Barat	854	1,026	1,099	1,172
	Perupok	871	999	1,049	1,096
	Repek	531	624	663	701
	Mentuan	461	612	684	761
	Tg.Pauh	407	518	568	620
	Average	570	685	734	783
Tumpat	Jal Besar	294	354	380	406
	Kebakat	752	936	1,018	1,102
	Pengkalan Kubor	1,479	2,005	2,259	2,532
	Sg.Pinang	486	546	569	590
	Terbok	467	589	644	701
	Tumpat	689	707	709	707
	Wakaf Bharu	910	1,219	1,366	1,523
	Average	725	908	992	1,080
Pasir Mas	Alor Pasir	449	528	561	592
	Bunut Susu	324	370	388	405
	Chetok	257	299	316	333
	Gual Periook	708	746	757	765
	Kangkong	280	321	337	352
	Kuala Lemal	155	192	208	225
	Kubang Gadong	113	140	152	164
	Kubang Sepat	529	640	687	734
	Pasir Mas	1,165	1,432	1,548	1,665
	Average	442	519	551	582
Machang	Labok	141	152	156	159
	Panyit	234	258	267	274
	Pulai Chondong	158	176	183	189
	Pang.Meleret	158	165	166	167
	Temangan	322	336	339	341
	Ulu Sat	596	776	859	947
	Average	268	310	328	346
Tanah Merah	Kusial	684	873	959	1,048
	Ulu Kusial	606	726	778	828
	Sokor	258	341	380	421
	Average	516	647	705	766
Kuala Krai	Batu Mengkebang	978	1,401	1,614	1,851
	Average	978	1,401	1,614	1,851
	Average	657	858	954	1,057

Sources: 5th Malaysia Plan for Kelantan,
Population Census 1970 & 1980,
and Agricultural Development.

Table V.4.6 Forecast of Number of Houses in the
Probable Inundation Area, Kelantan

(Unit: Nos)

Administrative Division		1988	2000	2005	2010
Kota Bharu	Badang	4,308	6,035	6,892	7,871
	Bandar Kota Bharu	7,317	10,250	11,704	13,364
	Kota	4,858	7,006	8,099	9,363
	Panji	8,982	13,106	15,222	17,680
	Kemumin	3,904	5,532	6,368	7,330
	Lundang	9,900	14,614	17,056	19,906
	Banggu	3,047	4,222	4,800	5,457
	Beta	1,610	2,033	2,223	2,431
	Kadok	2,826	3,708	4,120	4,578
	Limbati	1,322	1,583	1,693	1,811
	Pangkal Kalong	5,999	9,698	11,757	14,253
	Pendek	2,481	3,243	3,598	3,992
	Peringat	3,140	3,768	4,035	4,321
	Salor	1,886	2,186	2,307	2,435
	Sering	2,863	3,529	3,821	4,137
	Sub-total	64,443	90,513	103,695	118,928
Bachok	Bekelam	1,458	1,562	1,596	1,631
	Gunong Timor	1,103	1,352	1,461	1,577
	Gunong Barat	1,024	1,230	1,318	1,412
	Perupok	2,861	3,279	3,444	3,617
	Repek	1,343	1,587	1,686	1,791
	Mentuan	3,475	4,615	6,164	8,233
	Tg. Pauh	1,220	1,552	1,703	1,869
	Sub-total	12,484	15,177	17,371	20,129
Tumpat	Jal Besar	1,863	2,244	2,407	2,582
	Kebakat	2,180	2,712	2,949	3,207
	Pengkalan Kubor	2,190	2,969	3,345	3,769
	Sg. Pinang	2,789	3,134	3,265	3,401
	Terbok	2,363	2,977	3,252	3,552
	Tumpat	3,127	3,299	3,309	3,319
	Wakaf Bharu	4,392	5,882	6,593	7,390
	Sub-total	18,904	23,217	25,120	27,220
Pasir Mas	Alor Pasir	451	531	564	599
	Bunut Susu	2,323	2,650	2,779	2,914
	Chetok	2,003	2,332	2,465	2,606
	Gual Periok	692	730	741	752
	Kangkong	1,509	1,731	1,819	1,912
	Kuala Lemal	463	572	620	672
	Kubang Gadong	2,405	2,978	3,231	3,506
	Kubang Sepat	2,250	2,719	2,920	3,136
	Pasir Mas	4,372	5,371	5,807	6,278
	Sub-total	16,468	19,613	20,946	22,376
Machang	Labok	878	950	974	999
	Panyit	83	92	95	98
	Pulai Chondong	697	778	808	839
	Pang. Meleret	974	1,015	1,024	1,034
	Temangan	993	1,036	1,046	1,057
	Ulu Sat	450	585	648	717
	Sub-total	4,075	4,455	4,595	4,743
Tanah Merah	Kusial	5,096	6,502	7,149	7,861
	Ulu Kusial	2,123	2,547	2,727	2,919
	Sokor	542	715	796	887
	Sub-total	7,761	9,764	10,672	11,667
Kuala Krai	Batu Mengkebang	9,150	13,102	15,101	17,405
	Sub-total	9,150	13,102	15,101	17,405
Total		133,285	175,841	197,500	222,468

Sources: Housing Census 1980 & Kota Bharu Urban Development Studies

Table V.4.7 Forecast of Number of Industrial Establishments
in the Probable Inundation Area, Kelantan

(Unit: Nos)

Administrative Division		1988	2000	2005	2010
Kota Bharu	Badang	28	38	43	49
	Bandar Kota Bharu	47	65	74	84
	Kota	31	44	51	59
	Panji	58	83	96	111
	Kemumin	28	35	40	46
	Lundang	63	93	107	123
	Banggu	9	13	15	17
	Beta	5	7	8	9
	Kadok	8	12	14	16
	Limbati	4	6	6	6
	Pangkal Kalong	18	25	29	34
	Pendek	7	10	12	14
	Peringat	9	13	15	17
	Salor	6	8	9	10
	Sering	9	12	14	16
	Sub-total	330	464	533	612
Bachok	Bekelam	1	2	2	2
	Gunong Timor	1	2	2	2
	Gunong Barat	1	1	2	2
	Perupok	3	4	5	6
	Repek	2	3	3	3
	Mentuan	3	5	6	7
	Tg. Pauh	1	1	2	4
	Sub-total	12	18	21	26
Tumpat	Jal. Besar	3	4	5	6
	Kebakat	4	5	6	7
	Pengkalan Kubor	5	7	8	9
	Sg. Pinang	5	6	7	8
	Terbok	4	5	6	7
	Tumpat	5	7	9	12
	Wakaf Bharu	7	10	12	14
	Sub-total	33	44	53	64
Pasir Mas	Alor Pasir	1	2	2	2
	Bunut Susu	3	4	5	6
	Chetok	3	4	5	6
	Gual Periok	1	2	2	2
	Kangkong	3	5	5	4
	Kuala Lemal	2	3	4	5
	Kubang Gadong	5	7	8	9
	Kubang Sepat	3	4	5	6
	Pasir Mas	6	8	9	10
	Sub-total	27	39	45	51
Machang	Labok	3	4	5	5
	Panyit	1	2	2	2
	Pulai Chondong	5	7	8	8
	Pang. Meleret	3	5	5	6
	Temangan	3	4	4	4
	Ulu Sat	1	1	2	2
	Sub-total	16	22	25	28
Tanah Merah	Kusial	15	21	24	28
	Ulu Kusial	5	7	8	9
	Sokor	1	1	2	2
	Sub-total	21	30	34	39
Kuala Krai	Batu Mengkebang	53	75	86	99
	Sub-total	53	75	86	99
Total		492	692	797	920

Sources: SEPU, MPKB & Kelantan Development Statistics, 1987

Table V.4.8 Forecast of Number of Commercial & Service Establishments
in the Probable Inundation Area, Kelantan

(Unit: Nos)

Administrative Division		1988	2000	2005	2010
Kota Bharu	Badang	329	460	526	601
	Bandar Kota Bharu	558	782	893	1,020
	Kota	371	535	618	714
	Panji	685	1,000	1,162	1,350
	Kemumin	298	422	484	555
	Lundang	755	1,115	1,301	1,518
	Banggu	109	151	172	196
	Beta	58	73	80	88
	Kadok	101	133	147	162
	Limbati	47	57	61	65
	Pangkal Kalong	215	347	421	511
	Pendek	89	116	129	143
	Peringat	112	135	144	154
	Salor	67	78	83	88
	Sering	102	126	137	149
	Sub-total	3,896	5,530	6,358	7,315
Bachok	Bekelam	52	56	57	58
	Gunong Timor	24	29	32	34
	Gunong Barat	36	43	46	49
	Perupok	102	117	123	129
	Repek	62	73	78	83
	Mentuan	124	165	184	205
	Tg. Pauh	44	56	61	66
	Sub-total	444	539	580	625
Tumpat	Jal Besar	67	80	86	92
	Kebakat	78	97	105	114
	Pengkalan Kubor	74	100	113	127
	Sg. Pinang	100	112	117	122
	Terbok	85	106	116	127
	Tumpat	110	113	113	113
	Wakaf Bharu	157	210	236	265
	Sub-total	671	818	886	960
Pasir Mas	Alor Pasir	9	11	11	12
	Bunut Susu	83	95	99	103
	Chetok	83	97	102	107
	Gual Periok	20	21	22	22
	Kangkong	82	94	86	79
	Kuala Lemal	60	74	65	58
	Kubang Gadong	86	107	116	125
	Kubang Sepat	80	97	104	112
	Pasir Mas	156	192	208	225
	Sub-total	659	788	813	843
Machang	Labok	25	27	28	28
	Panyit	3	3	3	4
	Pulai Chondong	70	78	92	109
	Pang. Meleret	39	40	40	40
	Temangan	31	33	33	33
	Ulu Sat	8	10	12	13
	Sub-total	176	191	208	226
Tanah Merah	Kusial	219	280	306	336
	Ulu Kusial	54	65	69	74
	Sokor	24	31	35	39
	Sub-total	297	376	411	449
Kuala Krai	Batu Mengkebang	364	521	600	691
	Sub-total	364	521	600	691
Total		6,507	8,762	9,855	11,110

Sources: MPKB, SEPU & Kota Bharu Urban Development Studies

Table V.4.9 Forecast of Number of Medical Institutions
in the Probable Inundation Area, Kelantan

		(Unit: Nos)			
Administrative Division		1988	2000	2005	2010
Kota Bharu	Badang	5	7	8	9
	Bandar Kota Bharu	2	3	3	3
	Kota	2	3	3	3
	Panji	1	1	2	4
	Kemumin	2	3	3	3
	Lundang	5	7	9	12
	Banggu	1	1	1	1
	Beta	1	1	1	1
	Kadok	4	5	6	7
	Limbak	2	2	3	5
	Pangkal Kalong	5	8	10	13
	Pendek	2	3	3	3
	Peringat	2	2	3	5
	Salor	2	2	2	2
	Sering	3	4	4	4
	Sub-total	39	52	61	73
Bachok	Bekelam	1	1	1	1
	Gunong Timor	2	2	3	3
	Gunong Barat	1	1	2	4
	Perupok	4	5	5	5
	Repek	2	2	2	2
	Mentuan	7	9	10	11
	Tg. Pauh	1	1	1	1
	Sub-total	18	21	24	27
Tumpat	Jal Besar	2	2	3	5
	Kebakat	1	1	1	1
	Pengkalan Kubor	5	6	8	10
	Sg. Pinang	6	7	7	7
	Terbok	1	1	1	1
	Tumpat	8	8	8	8
	Wakaf Bharu	4	5	6	7
	Sub-total	27	30	34	39
Pasir Mas	Alor Pasir	1	1	1	1
	Bunut Susu	3	3	4	5
	Chetok	8	9	10	11
	Gual Periok	1	1	1	1
	Kangkong	2	2	2	2
	Kuala Lemal	2	2	3	5
	Kubang Gadong	2	2	3	5
	Kubang Sepat	1	1	1	1
	Pasir Mas	6	7	8	9
	Sub-total	26	28	33	40
Machang	Labok	1	1	1	1
	Panyit	0	0	1	1
	Pulai Chondong	4	4	5	6
	Pang. Meleret	2	2	2	2
	Temangan	4	5	5	5
	Ulu Sat	0	1	1	1
	Sub-total	11	13	15	16
Tanah Merah	Kusial	5	6	7	8
	Ulu Kusial	1	1	1	1
	Sokor	2	3	3	3
	Sub-total	8	10	11	12
Kuala Krai	Batu Mengkebang	3	4	5	6
	Sub-total	3	4	5	6
Total		132	158	183	214

Source: Public Works Department (JKR), Kelantan

Table V.4.10 Forecast of Number of Educational Institutions
in the Probable Inundation Area, Kelantan

(Unit: Nos)

Administrative Division		1988	2000	2005	2010
Kota Bharu	Badang	9	13	14	15
	Bandar Kota Bharu	26	37	43	50
	Kota	4	6	7	8
	Panji	3	4	5	6
	Kemumin	9	13	15	17
	Lundang	9	13	16	20
	Banggu	4	6	6	6
	Beta	5	6	7	8
	Kadok	4	5	6	7
	Limbati	12	14	15	16
	Pangkal Kalong	3	5	6	7
	Pendek	5	7	7	7
	Peringat	5	6	6	6
	Salor	5	6	6	6
	Sering	7	9	9	9
	Sub-total	110	150	168	189
Bachok	Bekelam	1	1	1	1
	Gunong Timor	2	3	3	3
	Gunong Barat	2	3	3	3
	Perupok	10	11	12	13
	Repek	2	2	2	2
	Mentuan	12	16	18	20
	Tg. Pauh	1	2	2	2
	Sub-total	30	37	40	43
Tumpat	Jal Besar	1	1	1	1
	Kebakat	1	1	1	1
	Pengkalan Kubor	5	7	8	9
	Sg. Pinang	10	11	12	13
	Terbok	2	3	3	3
	Tumpat	5	5	5	5
	Wakaf Bharu	12	16	18	20
	Sub-total	36	44	48	52
Pasir Mas	Alor Pasir	1	1	1	1
	Bunut Susu	6	7	7	7
	Chetok	6	7	7	7
	Gual Periok	1	1	1	1
	Kangkong	5	6	6	6
	Kuala Lemal	2	3	3	3
	Kubang Gadong	3	4	4	4
	Kubang Sepat	3	4	4	4
	Pasir Mas	17	21	23	25
	Sub-total	44	54	56	58
Machang	Labok	2	2	2	2
	Panyit	0	0	1	1
	Pulai Chondong	9	10	11	12
	Pang. Meleret	2	2	2	2
	Temangan	6	6	6	6
	Ulu Sat	0	1	1	1
	Sub-total	19	21	23	24
Tanah Merah	Kusial	10	13	14	15
	Ulu Kusial	3	4	4	4
	Sokor	3	4	4	4
	Sub-total	16	21	22	23
Kuala Krai	Batu Mengkebang	7	10	12	14
	Sub-total	7	10	12	14
Total		262	337	369	404

Source: Public Works Department (JKR), Kelantan

Table V.4.11 Forecast of Number of Religious Institutions
in the Probable Inundation Area, Kelantan

(Unit: Nos)

Administrative Division		1988	2000	2005	2010
Kota Bharu	Badang	8	11	13	15
	Bandar Kota Bharu	14	19	22	25
	Kota	9	13	15	17
	Panji	17	25	28	31
	Kemumin	7	10	12	14
	Lundang	18	28	32	37
	Banggu	5	7	8	9
	Beta	3	4	4	4
	Kadok	5	6	7	8
	Limbat	2	3	3	3
	Pangkal Kalong	10	17	20	24
	Pendek	4	6	6	6
	Peringat	5	7	7	7
	Salor	3	4	4	4
	Sering	5	6	7	8
	Sub-total	115	166	188	213
Bachok	Bekelam	4	5	5	5
	Gunong Timor	2	2	3	3
	Gunong Barat	3	4	4	4
	Perupok	8	10	10	10
	Repek	4	5	5	6
	Mentuan	10	13	15	17
	Tg.Pauh	4	5	5	5
	Sub-total	35	44	47	51
Tumpat	Jal Besar	4	5	5	5
	Kebakat	5	6	6	6
	Pengkalan Kubor	5	8	8	8
	Sg.Pinang	6	7	7	7
	Terbok	5	6	7	8
	Tumpat	6	6	6	6
	Wakaf Bharu	10	13	14	15
	Sub-total	41	51	53	55
Pasir Mas	Alor Pasir	1	1	1	1
	Bunut Susu	6	7	8	9
	Chetok	7	8	8	8
	Gual Periok	1	1	1	1
	Kangkong	7	9	10	11
	Kuala Lemal	4	5	6	7
	Kubang Gadong	10	13	14	15
	Kubang Sepat	6	8	8	8
	Pasir Mas	12	15	16	17
	Sub-total	54	67	72	76
Machang	Labok	2	2	3	4
	Panyit	1	1	1	1
	Pulai Chondong	5	6	6	6
	Pang.Meleret	2	2	2	2
	Temangan	3	3	3	3
	Ulu Sat	1	2	2	2
	Sub-total	14	16	17	18
Tanah Merah	Kusial	16	20	22	24
	Ulu Kusial	4	5	5	6
	Sokor	1	2	3	5
	Sub-total	21	27	30	35
Kuala Krai	Batu Mengkebang	25	36	42	49
	Sub-total	25	36	42	49
Total		305	407	449	497

Source: Religious Department, Kelantan

Table V.4.12 Forecast of Number of Administrative Institutions
in the Probable Inundation Area, Kelantan

		(Unit: Nos)			
Administrative Division		1988	2000	2005	2010
Kota Bharu	Badang	9	12	15	19
	Bandar Kota Bharu	15	24	27	30
	Kota	12	15	18	22
	Panji	21	30	33	36
	Kemumin	9	12	15	19
	Lundang	21	33	36	39
	Banggu	6	9	9	9
	Beta	3	3	6	12
	Kadok	6	9	9	9
	Limbati	3	3	3	3
	Pangkal Kalong	12	21	24	27
	Pendek	6	6	6	6
	Peringat	6	9	9	9
	Salor	3	3	6	12
	Sering	6	6	9	14
	Sub-total	138	195	225	260
Bachok	Bekelam	3	3	3	3
	Gunong Timor	2	3	3	3
	Gunong Barat	2	2	2	2
	Perupok	6	6	6	6
	Repek	2	4	4	4
	Mentuan	6	9	12	16
	Tg.Pauh	3	3	3	3
	Sub-total	24	30	33	36
Tumpat	Jal Besar	3	6	6	6
	Kebakat	6	6	6	6
	Pengkalan Kubor	6	9	9	9
	Sg. Pinang	6	6	6	6
	Terbok	6	6	6	6
	Tumpat	6	6	6	6
	Wakaf Bharu	9	12	15	19
	Sub-total	42	51	54	57
Pasir Mas	Alor Pasir	1	1	1	1
	Bunut Susu	3	6	6	6
	Chetok	3	6	6	6
	Gual Periook	1	1	1	1
	Kangkong	5	5	5	5
	Kuala Lemal	2	2	2	2
	Kubang Gadong	6	9	9	9
	Kubang Sepat	3	6	6	6
	Pasir Mas	9	9	9	9
	Sub-total	33	45	45	45
Machang	Labok	2	2	2	2
	Panyit	1	1	1	1
	Pulai Chondong	5	5	5	5
	Pang.Meleret	3	3	3	3
	Temangan	3	3	3	3
	Ulu Sat	1	1	2	2
	Sub-total	15	15	16	16
Tanah Merah	Kusial	15	18	21	25
	Ulu Kusial	4	5	5	5
	Sokor	2	2	2	2
	Sub-total	21	25	28	32
Kuala Krai	Batu Mengkebang	24	33	39	46
	Sub-total	24	33	39	46
Total		297	395	440	492

Source: Public Works Department (JKR), Kelantan

Table V.4.13 Forecast of Paddy Acreage in the
Probable Inundation Area, Kelantan

		(Unit: ha)			
Administrative Division		1988	2000	2005	2010
Kota Bharu	Badang	339	368	379	391
	Bandar Kota Bharu	0	0	0	0
	Kota	365	396	409	421
	Panji	673	730	753	777
	Kemumin	604	655	676	697
	Lundang	711	771	796	821
	Banggu	1,263	1,369	1,414	1,458
	Beta	1,170	1,269	1,310	1,351
	Kadok	1,505	1,632	1,685	1,737
	Limbat	580	629	649	670
	Pangkal Kalong	1,725	1,870	1,931	1,991
	Pendek	1,180	1,279	1,321	1,362
	Peringat	1,930	2,093	2,160	2,228
	Salor	1,105	1,198	1,237	1,276
	Sering	406	440	454	469
	Sub-total	13,556	14,697	15,173	15,649
Bachok	Bekelam	1,355	1,469	1,517	1,564
	Gunong Timor	255	276	285	294
	Gunong Barat	756	820	846	873
	Perupok	682	739	763	787
	Repek	575	623	644	664
	Mentuan	1,570	1,702	1,757	1,812
	Tg. Pauh	603	654	675	696
	Sub-total	5,796	6,284	6,487	6,691
Tumpat	Jal Besar	1,620	1,756	1,813	1,870
	Kebakat	730	791	817	843
	Pengkalan Kubor	257	279	288	297
	Sg. Pinang	572	620	640	660
	Terbok	1,315	1,426	1,472	1,518
	Tumpat	1,138	1,234	1,274	1,314
	Wakaf Bharu	875	949	979	1,010
	Sub-total	6,507	7,055	7,283	7,512
Pasir Mas	Alor Pasir	189	205	212	218
	Bunut Susu	1,920	2,082	2,149	2,216
	Chetok	1,554	1,685	1,739	1,794
	Gual Periok	354	384	396	409
	Kangkong	2,991	3,243	3,348	3,453
	Kuala Lemal	762	826	853	880
	Kubang Gadong	1,057	1,146	1,183	1,220
	Kubang Sepat	940	1,019	1,052	1,085
	Pasir Mas	1,145	1,241	1,282	1,322
	Sub-total	10,912	11,831	12,214	12,597
Machang	Labok	242	242	242	242
	Panyit	122	122	122	122
	Pulai Chondong	810	810	810	810
	Pang. Meleret	992	992	992	992
	Temangan	91	91	91	91
	Ulu Sat	86	86	86	86
	Sub-total	2,343	2,343	2,343	2,343
Tanah Merah	Kusial	1,114	1,114	1,114	1,114
	Ulu Kusial	1,404	1,404	1,404	1,404
	Sokor	56	56	56	56
	Sub-total	2,574	2,574	2,574	2,574
Kuala Krai	Batu Mengkebang	207	207	207	207
	Sub-total	207	207	207	207
Total		41,895	44,991	46,282	47,572

Source: Agricultural Department and KADA, Kelantan

Table V.4.14 Forecast of Tobacco Acreage in the Probable Inundation Area, Kelantan

		(Unit: ha)			
Administrative Division		1988	2000	2005	2010
Kota Bharu	Badang	32	32	32	32
	Bandar Kota Bharu	-	-	-	-
	Kota	-	-	-	-
	Panji	23	23	23	23
	Kemumin	66	66	66	66
	Lundang	-	-	-	-
	Banggu	3	3	3	3
	Beta	-	-	-	-
	Kadok	-	-	-	-
	Limbati	-	-	-	-
	Pangkal Kalong	51	51	51	51
	Pendek	8	8	8	8
	Peringat	3	3	3	3
	Salor	-	-	-	-
	Sering	48	48	48	48
	Sub-total	234	234	234	234
Bachok	Bekelam	35	35	35	35
	Gunong Timor	30	30	30	30
	Gunong Barat	4	4	4	4
	Perupok	619	619	619	619
	Repek	246	246	246	246
	Mentuan	906	906	906	906
	Tg. Pauh	379	379	379	379
	Sub-total	2,219	2,219	2,219	2,219
Tumpat	Jal Besar	122	122	122	122
	Kebakat	73	73	73	73
	Pengkalan Kubor	36	36	36	36
	Sg. Pinang	31	31	31	31
	Terbok	133	133	133	133
	Tumpat	188	188	188	188
	Wakaf Bharu	11	11	11	11
	Sub-total	594	594	594	594
Pasir Mas	Alor Pasir	124	124	124	124
	Bunut Susu	10	10	10	10
	Chetok	330	330	330	330
	Gual Periok	265	265	265	265
	Kangkong	110	110	110	110
	Kuala Lemal	223	223	223	223
	Kubang Gadong	171	171	171	171
	Kubang Sepat	38	38	38	38
	Pasir Mas	-	-	-	-
	Sub-total	1,271	1,271	1,271	1,271
Machang	Labok	12	12	12	12
	Panyit	1	1	1	1
	Pulai Chondong	53	53	53	53
	Pang. Meleret	-	-	-	-
	Temangan	4	4	4	4
	Ulu Sat	3	3	3	3
	Sub-total	73	73	73	73
Tanah Merah	Kusial	97	97	97	97
	Ulu Kusial	19	19	19	19
	Sokor	-	-	-	-
	Sub-total	116	116	116	116
Kuala Krai	Batu Mengkebang	3	3	3	3
	Sub-total	3	3	3	3
Total		4,510	4,510	4,510	4,510

Source: National Tobacco Board, Kelantan

Table V.4.15 Forecast of Rubber Acreage in the
Probable Inundation Area, Kelantan

		(Unit: ha)			
Administrative Division		1988	2000	2005	2010
Kota Bharu	Badang	32	35	36	37
	Bandar Kota Bharu	30	33	34	35
	Kota	405	443	459	476
	Panji	272	298	308	318
	Kemumin	4	4	4	4
	Lundang	414	452	468	485
	Banggu	601	657	680	704
	Beta	512	559	579	600
	Kadok	603	659	683	708
	Limbati	476	520	539	559
	Pangkal Kalong	2,128	2,325	2,408	2,494
	Pendek	420	459	475	492
	Peringat	1,088	1,189	1,231	1,274
	Salor	183	200	207	214
	Sering	74	81	84	87
	Sub-total	7,242	7,914	8,195	8,486
Bachok	Bekelam	175	192	198	204
	Gunong Timor	255	278	288	299
	Gunong Barat	125	137	142	147
	Perupok	21	23	23	23
	Repek	39	43	44	45
	Mentuan	30	33	34	35
	Tg. Pauh	25	27	28	29
	Sub-total	670	733	757	782
Tumpat	Jal Besar	38	42	43	44
	Kebakat	20	22	22	22
	Pengkalan Kubor	11	12	12	12
	Sg. Pinang	42	46	48	50
	Terbok	23	26	27	28
	Tumpat	1	1	1	1
	Wakaf Bharu	270	295	305	315
	Sub-total	405	444	458	472
Pasir Mas	Alor Pasir	117	128	132	137
	Bunut Susu	407	445	461	478
	Chetok	1,583	1,730	1,791	1,855
	Gual Periok	121	132	137	142
	Kangkong	572	625	647	670
	Kuala Lemal	195	213	221	229
	Kubang Gadong	406	443	459	476
	Kubang Sepat	226	247	256	265
	Pasir Mas	142	155	161	167
	Sub-total	3,769	4,118	4,265	4,417
Machang	Labok	437	477	494	512
	Panyit	32	35	36	37
	Pulai Chondong	602	658	681	705
	Pang. Meleret	447	488	506	524
	Temangan	981	1,072	1,110	1,149
	Ulu Sat	90	99	102	106
	Sub-total	2,589	2,829	2,929	3,033
Tanah Merah	Kusial	1,364	1,491	1,543	1,598
	Ulu Kusial	288	315	326	337
	Sokor	1,937	2,117	2,191	2,268
	Sub-total	3,589	3,922	4,060	4,203
Kuala Krai	Batu Mengkebang	3,305	3,612	3,739	3,871
	Sub-total	3,305	3,612	3,739	3,871
Total		21,569	23,571	24,404	25,266

Source: RISDA, Kelantan

Table V.4.16 Forecast of Oil Palm Acreage in the
Probable Inundation Area, Kelantan

(Unit: ha)

Administrative Division		1988	2000	2005	2010
Kota Bharu	Badang	-	-	-	-
	Bandar Kota Bharu	-	-	-	-
	Kota	-	-	-	-
	Panji	-	-	-	-
	Kemumin	-	-	-	-
	Lundang	-	-	-	-
	Banggu	-	-	-	-
	Beta	-	-	-	-
	Kadok	-	-	-	-
	Limbati	-	-	-	-
	Pangkal Kalong	-	-	-	-
	Pendek	-	-	-	-
	Peringat	-	-	-	-
	Salor	-	-	-	-
	Sering	-	-	-	-
	Sub-total	-	-	-	-
Bachok	Bekelam	-	-	-	-
	Gunong Timor	-	-	-	-
	Gunong Barat	-	-	-	-
	Perupok	-	-	-	-
	Repek	-	-	-	-
	Mentuan	-	-	-	-
	Tg. Pauh	-	-	-	-
	Sub-total	-	-	-	-
Tumpat	Jal Besar	-	-	-	-
	Kebakat	-	-	-	-
	Pengkalan Kubor	-	-	-	-
	Sg. Pinang	-	-	-	-
	Terbok	-	-	-	-
	Tumpat	-	-	-	-
	Wakaf Bharu	-	-	-	-
	Sub-total	-	-	-	-
Pasir Mas	Alor Pasir	-	-	-	-
	Bunut Susu	-	-	-	-
	Chetok	-	-	-	-
	Gual Periok	444	816	971	1,155
	Kangkong	80	149	177	210
	Kuala Lemal	21	40	48	58
	Kubang Gadong	29	51	60	71
	Kubang Sepat	-	-	-	-
	Pasir Mas	-	-	-	-
	Sub-total	574	1,056	1,256	1,494
Machang	Labok	3	4	5	6
	Panyit	-	-	-	-
	Pulai Chondong	22	33	38	44
	Pang. Meleret	-	-	-	-
	Temangan	144	219	250	285
	Ulu Sat	-	-	-	-
	Sub-total	169	256	293	335
Tanah Merah	Kusial	108	180	210	245
	Ulu Kusial	-	-	-	-
	Sokor	-	-	-	-
	Sub-total	108	180	210	245
Kuala Krai	Batu Mengkebang	-	-	-	-
	Sub-total	-	-	-	-
Total		851	1,492	1,759	2,074

Source: FELCRA, FELDA and KESEDAR, Kelantan

Table V.4.17 Economic Price of Rice (For Import)

Item	(Unit : M\$/ton)			
	1988	2000	2005	2010
1. Export Price of Thai 5% Broken, 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.4.18 Economic Price of Tobacco (For Import)

Item	(Unit : M\$/ton)			
	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.4.19 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.4.20 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.4.21 Production Cost of Paddy (1/3)

Item	Cost (M\$/ha)			Total Cost
	Labour	Materials	Machinery/ Equipment	
Land Preparation	-	-	228	228
Planting	270	22.5	-	292.5
Manuring	30	192.8	-	222.8
Pest & Disease Control	70	47.75	4.5	122.25
Harvesting	400	20	5	425
Land Tax	-	-	-	6.8
Irrigation Fee	-	-	-	25
Total				1,322.35

Source: Farm Budgets 1987, Kelantan SEPU, Malaysia.

Note: Transplanting,
Harvesting Time 150 days.
This planting way is applied for 85 percent field of the
total paddy area.

Table V.4.21 Production Cost of Paddy (2/3)

Item	Cost (M\$/ha)			Total Cost
	Labour	Materials	Machinery/ Equipment	
Land Preparation	-	-	225	225
Planting	270	30	-	300
Manuring	30	192.8	-	222.8
Pest & Disease Control	70	47.75	4.5	122.25
Harvesting	-	18	315	333
Land Tax	-	-	-	6.8
Irrigation Fee	-	-	-	25
Total				1,234.85

Source: Farm Budgets 1987, Kelantan SEPU, Malaysia.

Note: Transplanting,
Harvesting Time 130 - 140 days.
This planting way is applied for 10 percent field of the
total paddy area.

Table V.4.21 Production Cost of Paddy (3/3)

Item	Cost (M\$/ha)			Total
	Labour	Materials	Machinery/ Equipment	
Land Preparation	-	-	330	330
Field Levelling	20	-	-	20
Planting/Broadcasting	30	40	-	70
Manuring	20	184.7	-	204.7
Pest and Disease Control	110	197.5	4.5	312
Harvesting	-	20	350	370
Land Tax	-	-	-	6.8
Irrigation Rates	-	-	-	25
Total				1,338.5

Source: Farm Budgets 1987, Kelantan SEPU, Malaysia.

Note: Direct Seeding
Harvesting Time 130 - 140 days
This planting way is applied for 5 percent field of the total paddy area.

Table V.4.22 Production Cost of Tobacco

Item	Cost (M\$/ha)			
	Labour	Materials	Machinery/ Equipment	Total Cost
1. Nursery	268	67.7	57	392.7
Seedbed Preparation	15	-	25	40
Shade Construction	12	45	-	57
Sowing	4	2	-	6
Watering	150	-	12	162
Fertilizing	15	14	-	29
Pest Control	10	6.7	20	36.7
Weeding	22	-	-	22
General Maintenance	40	-	-	40
2. Potting	830	151.7	6	987.7
Potting Bed Preparation	60	-	-	60
Shade Construction	140	45	-	185
Filling Polythene Bags with Soil Mixture	180	80	-	260
Transplanting into Polythene Bags	140	-	-	140
Fertilizing	30	10	-	40
Watering	100	-	6	106
Pest & Disease Control	10	6.7	-	16.7
Leaf Pruning/Clipping	90	10	-	100
Hardening	10	-	-	10
General Maintenance	70	-	-	70
3. Field Operation	2,010	560	36	2,631
Bed Construction	235	-	-	235
Holing and Planting	340	-	-	340
Fertilizing	150	400	-	550
Pest Control	250	160	-	410
Watering	170	-	36	206
Soil Loosening	300	-	-	300
Weeding	75	-	-	75
Topping and Desuckering	160	-	-	160
Harvesting	250	-	-	250
Field Cleaning	80	-	-	80
Land Tax	-	-	-	25
Total				4,011.40

Source: Farm Budgets 1987, Kelantan SEPU, Malaysia.

Note: 100-day Season.

Table V.4.23 Production Cost of Rubber

Year	Cost (M\$/ha)			Total	Accumulative
	Labour	Materials	Machinery/ Equipment		
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.4.24 Production Cost of Oil Palm

Year	Cost (M\$/ha)			
	Labour	Materials	Machinery/ Equipment	Total
1				2,750.20
2				640.35
3				1,007.80
4				1,114.65
5				1,008.15
6				1,189.40
7				1,214.40
8				1,214.40
9				1,214.40
10				1,204.00
11				1,204.00
12				1,204.00
13				1,204.00
14				1,204.00
15				1,204.00
16				1,038.40
17				1,038.40
18				1,038.40
19				1,038.40
20				1,038.40
21				1,038.40
22				1,038.40
23				1,038.40
24				1,038.40
25				1,038.40

Source: Farm Budgets 1987, Kelantan SEPU, Malaysia

Note: Economic Life is 25 years.

Table V.4.25 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.4.26 Forecast of Unit Value of Assets (Non-Agriculture)

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

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.4.27 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.4.28 Flood Damage Rate of Tobacco

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

Source: Interview with National Tobacco Board, Kelantan

Table V.4.29 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		Flood Duration longer than 14 days	
			Kill Factor	Loss (M\$/ha) (1)x(2)	Kill Factor	Loss (M\$/ha) (1)x(3)
			(2)	(1)x(2)	(3)	(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 the years considered. It also assumes to be a mean distribution of crops of all ages in the crop field.

Table V.4.30 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 shorter than 14 days		Flood Duration longer than 14 days	
			Flood Damage Rate (2)	Loss of Yield (M\$/ha) (1)x(2)	Flood Damage Rate (3)	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.4.31 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.5.1 Assumed Flood Water Level and Flooding Duration
of the Probable Floods** (1/2)

River Stretch	District	Sub-District	1986-type Flood (3-Year)		1983-type Flood (13-Year)		1967-type Flood (50-Year)	
			Flood Water Level (EL.m)	Flooding Duration (Days)	Flood Water Level (EL.m)	Flooding Duration (Days)	Flood Water Level (EL.m)	Flooding Duration (Days)
KL 1	Kota Bharu Tumpat	Badang	0.5	9	1	14	1	14
		Sg.Pinang	0.5	3	1	5	1	14
KL 2	Kota Bharu Tumpat	Badang	1	6	2	7	3	10
		Sg.Pinang	1	3	2	5	3	7
KL 3	Kota Bharu Bachok Tumpat	Badang	3	6	5	7	6	7
		Bandar Kota Bharu	4	0	5	5	6	6
		Kota	5	1	6	2	7	3
		Panji	3	3	5	3	6	5
		Kemumin	2	1	3	3	4	5
		Lundang	5	3	5	5	7	7
		Sering	2	2	4	3	5	4
		Mentuan	2	1	3	4	4	7
		Sg.Pinang	2	3	3	5	4	7
		Kebakat	3	1	4	4	5	7
		Wakaf Bharu	5	2	7	3	8	3
		Terbok	3	3	4	5	5	7
		Tumpat	1	3	2	3	3	3
		Peng.Kubor	3	1	4	3	5	7
		Jal.Besar	3	2	4	7	5	7
KL 4	Kota Bharu	Pendek	6	3	8	4	9	6
		Limbat	5	2	6	5	8	7
		Salor	9	2	10	2	11	3
		Banggu	4	2	5	5	6	7
		Tg.Pauh	2	1	3	4	4	7
	Bachok	Perupok	1	1	2	2	3	4
	Pasir Mas	Kubang Sepat	6	3	8	3	9	4
		Bunut Susu	4	2	5	5	7	6
		Kubang Gadong	4	2	6	3	9	6
KL 5	Kota Bharu Pasir Mas	Salor	9	1	11	2	12	5
		Kubang Gadong	4	2	6	3	9	7
		Pasir Mas	5	2	8	4	10	7
		Alor Pasir	5	2	6	4	7	6
		Gual Perlok	8	2	9	3	11	7
		Kuala Lemal	10	2	11	5	12	7

Table V.5.1 Assumed Flood Water Level and Flooding Duration of the Probable Floods

River	District	Sub-District	1986-type Flood (3-Year)		1983-type Flood (13-Year)		1967-type Flood (50-Year)	
			Flood Water Level (EL.m)	Flooding Duration (Days)	Flood Water Level (EL.m)	Flooding Duration (Days)	Flood Water Level (EL.m)	Flooding Duration (Days)
KL 6	Kota Bharu	Salor	9	1	11	2	12	7
		Beta	9	1	10	3	12	6
		Pangkal Kalong	10	1	12	2	14	3
	Bachok	Kadok	8	1	9	2	10	5
		Peringat	6	2	7	3	8	5
		Bekelam	4	2	5	5	6	7
		G. Barat	6	3	7	5	9	7
		G. Timor	4	2	5	4	6	6
		Repek	2	1	3	4	4	7
	Pasir Mas	Kangkong	11	2	12	5	13	7
		Chetok	12	1	13	1	15	3
KL 7	Machang	Pulai Chondong	14	1	16	3	17	5
		Labok	15	1	17	2	18	4
	Tanah Merah	Kusial	14	1	17	3	18	7
KL 8	Machang	Pang. Meleret	16	1	20	4	22	3
		Panyit	19	4	22	6	24	6
		Ulu Sat	19	1	22	2	25	2
	Tanah Merah	Kusial	14	1	20	2	21	5
		Ulu Kusial	17	2	21	6	22	7
KL 9	Machang	Temangan	18	1	23	4	24	5
		Panyit	19	1	22	4	24	5
	Tanah Merah	Ulu Kusial	18	1	22	4	24	5
		Sokor	20	2	23	6	25	6
KL 10	Machang	Temangan	21	3	25	6	27	6
	Kuala Krai	Batu Mengkebang	23	3	27	7	30	10
	Tanah Merah	Sokor	21	2	25	6	27	6
KL 11	Kuala Krai	Batu Mengkebang	25	2	29	5	31	6
KL 12	Kuala Krai	Batu Mengkebang	26	2	30	5	31	6

Table V.5.2 Annual Planted Area of Paddy

Paddy Planted Area (1970 - 1985)				(Unit : ha)			
Year	Planted Area						
	Main-season	%	Off-season	%	Total	%	
1970	65,115		10,652		75,767		
1971	64,518		7,182		71,700		
1972	65,946		17,270		83,216		
1973	70,336		21,017		91,353		
1974	65,741		23,122		88,863		
1975	67,161		27,317		94,478		
1976	66,410		24,165		90,575		
1977	59,762		27,441		87,203		
1978	66,490		26,552		93,042		
1979	62,543		27,017		89,560		
1980	58,916		19,377		78,293		
1983	46,934		19,407		66,341		
1984	24,951		25,559		50,510		
1985	33,189		24,413		57,602		
Average	58,429	73	21,464	27	79,893	100	

Source: Kelantan Development Statistics, Kelantan SEPU Nov. 1987

Paddy Planted Area (1983 - 1985)				(Unit : ha)			
Year	Planted Area						
	Main-season	%	Off-season	%	Total	%	
KADA 1983	21,550		18,721		40,271		
KADA 1984	4,091		22,136		26,227		
KADA 1985	20,051		21,183		41,234		
Average	15,231		20,680		35,911		
Outside KADA 1983	25,384		686		26,070		
Outside KADA 1984	20,860		3,423		24,283		
Outside KADA 1985	13,138		3,230		16,368		
Average	19,794		2,446		22,240		
Total 1983	46,934	71	19,407	29	66,341	100	
Total 1984	24,951	49	25,559	51	50,510	100	
Total 1985	33,189	58	24,413	42	57,602	100	
Average	35,025	60	23,126	40	58,151	100	

Source: Kelantan Development Statistics, Kelantan SEPU Nov. 1987

Table V.5.3 Flood Damage to Livestock and Forecast Number of Livestock

Flood Damage to Livestock in Past Flood Events, Kelantan				
Items	Jan.1967-flood	Dec.1983-flood	Dec.1982-flood	
	Estimated* Flood Report	Flood Report	Flood Report	
	(50-year Return Period)	(13-year Return Period)	(3-year Return Period)	
(1)Livestock Damage	6,390	435	10	
(Thousand M\$)				
(2)Crop Damage	24,850	3,499	255	
(Thousand M\$)				
(1)/(2)	0.26	0.12	0.04	
Price Level Year	1976	1983	1982	

Source: Flood Reports, Jan.1967, Dec.1982, Dec.1983, DID/Kelantan

Note: *Government of Malaysia, The Kelantan River Basin Study, Main Report, Annex 1, ENNEX 1977

Forecast Number of Cattle and Buffalos in the Probable Inundation Area

District	1988	2000	2005	2010
Kota Bharu	16,348	18,421	19,362	20,351
Bachok	10,167	11,458	12,041	12,654
Tumpat	13,821	15,574	16,368	17,202
Pasir Mas	14,347	16,166	18,831	23,207
Machang	3,291	3,708	3,897	4,096
Tanah Merah	1,140	1,285	1,350	1,419
Kuala Krai	507	571	600	631
Total	59,621	67,183	72,449	79,560

Source: FELCRA, Kelantan

Table V.5.4 Flood Damages in Past Major Floods, Malaysia

(Unit: Thousand M\$)

Items	Kelantan		Pahang		Pahang	
	Jan. 1967	Damage (Z)	Jan. 1971	Damage (Z)	Jan. 1971	Damage (Z)
Rural Industries						
Crops	24,850		6,000		4,000	1,600
Livestock	6,390		200		40	10
Forests	-		20		-	-
Fisheries	-		40		5	-
Sub-total	31,240 (40)		6,260 (21)		4,045 (30)	1,610 (29)
Structures/Properties						
House/Building	17,708	(66)	11,380	(73)	4,065	1,360 (59)
Infrastructures	9,287	(34)	4,200	(27)	1,270	620 (31)
Sub-total	26,995 (34)	(100)	15,580 (53)	(100)	5,335 (39)	1,980 (36)(100)
Indirect Damages						
Activities/Interrupted	12,305		6,600		3,530	1,615
Rescue/Relief	8,350		1,200		600	300
Sub-total	20,655 (26)		7,800 (26)		4,130 (31)	1,915 (35)
Total	78,890 (100)		29,640 (100)		13,510 (100)	5,505 (100)
(Price Level)	(1976)		(1974)		(1974)	(1974)

Sources: National Water Resources Study, Malaysia, Sectoral Report Vol.5, Oct. 1982
Government of Malaysia, The Kelantan River Basin Study, Main Report, Annex 1, ENEX 1977

Table V.5.5 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
XL. 1	35	70	385	32	65	65	2	5	5	0	0	0	0	0	0	7	14	77	0	0	3
XL. 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
XL. 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
XL. 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
XL. 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
XL. 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
XL. 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
XL. 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
XL. 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
XL. 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
XL. 11	0	460	765	0	0	0	0	0	0	0	1,383	1,845	0	0	0	0	92	153	0	2	5
XL. 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.5.5 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	53	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	2,416	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.5.6 Probable Flood Damage (3 Patterns)

(Unit: Thousand \$)

River Stretch	Direct Damage					Indirect Damage					Total				
	(A) Agriculture					(B) Non-agriculture					(C)				
	(1)					(2) House/Building					(3) Infrastructure				
	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
No.															
KL 1	39	89	105	7	13	79	2	4	24	14	32	62	63	137	269
KL 2	203	441	720	26	892	1,788	8	268	536	71	480	913	308	2,081	3,958
KL 3	6,838	16,341	22,092	13,590	25,723	36,199	4,077	7,717	10,860	7,352	14,934	20,745	31,857	64,716	89,896
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	1,281	2,987	5,225	384	896	1,568	1,310	3,144	4,784	5,676	13,623	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	2,694	3,560	166	808	1,068	534	1,960	2,590	2,313	8,492	11,222
KL 9	233	1,382	1,613	291	2,097	2,216	87	629	665	183	1,232	1,348	795	5,341	5,841
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	4,368	1	775	1,310	1	1,296	2,038	5	5,617	8,830
Total	19,886	53,114	84,730	19,183	53,806	78,557	5,755	16,142	23,567	13,447	36,919	56,056	58,272	159,981	242,910

Table V.5.6 Probable Flood Damage (3 Patterns)

(Unit: Thousand MS)

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		
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	1,568	3,774	5,697	765	5,691	17,484	19,886	53,114	84,730

Table V.5.6 Probable Flood Damage (3 Patterns)

(Unit: Thousand MS)

River Stretch	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					
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	4	8	41	0	0	0	3	18	0	0	0	1	3	0	0	0	1	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	892	1,788	
KL 3	8,955	17,291	25,318	1,295	2,158	2,705	2,159	3,729	4,763	11	29	40	210	476	646	94	202	270	865	1,837	2,455	13,590	25,723	36,159
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	1,135	2,112	7,966	13,118
KL 5	890	1,985	3,526	69	190	314	164	388	686	3	8	13	36	96	159	16	44	73	104	277	454	1,281	2,967	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	1,858	2,423	40	188	257	71	283	378	1	3	4	11	54	74	6	29	41	60	280	383	553	2,694	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	2,216
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	4,368
Total	12,631	35,504	53,000	1,625	4,201	5,875	2,969	7,450	10,269	23	84	117	393	1,506	2,142	163	535	768	1,380	4,526	6,385	19,183	53,806	78,557

(Unit: Thousand Rs.)

V - 68

(Unit: Thousand US\$)

V - 69

Table V.5.6 Probable Flood Damage (3 Patterns)

(Unit: Thousand \$)

River Stretch	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	35	0	0	0	1	6	0	0	0	1	0	1	14	17	31	229
KL 2	43	1,936	3,879	2	196	475	15	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	10,422	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	1,396	1,948	4	19	27	40	263	411	27	127	185	181	886	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	282	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	8,065	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	1,570	3,024	9,860	13,910	60,551	154,093	243,069

Table V.5.7 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\$

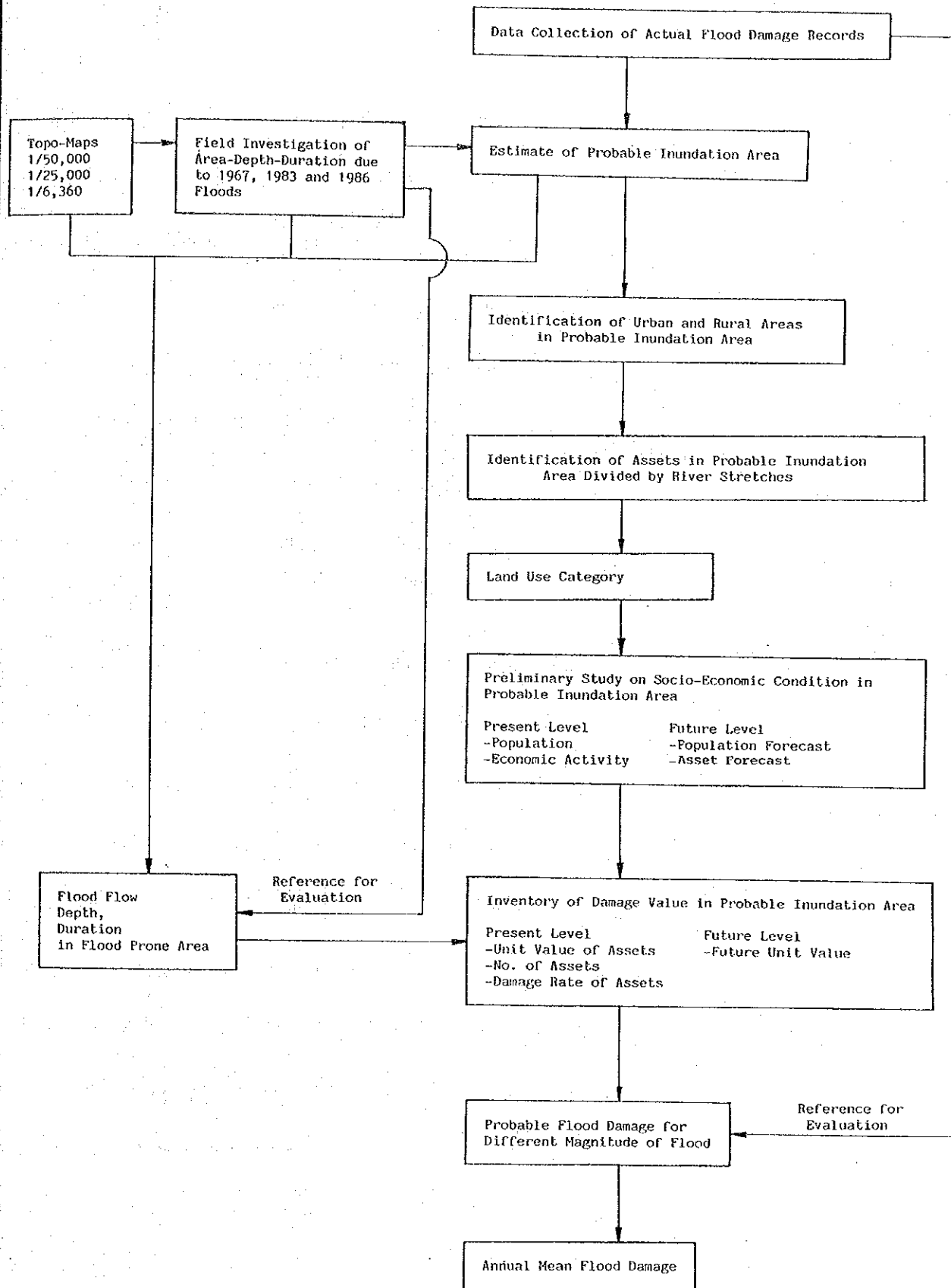


Fig.V.1.1

Flow Chart of Flood Damage Study

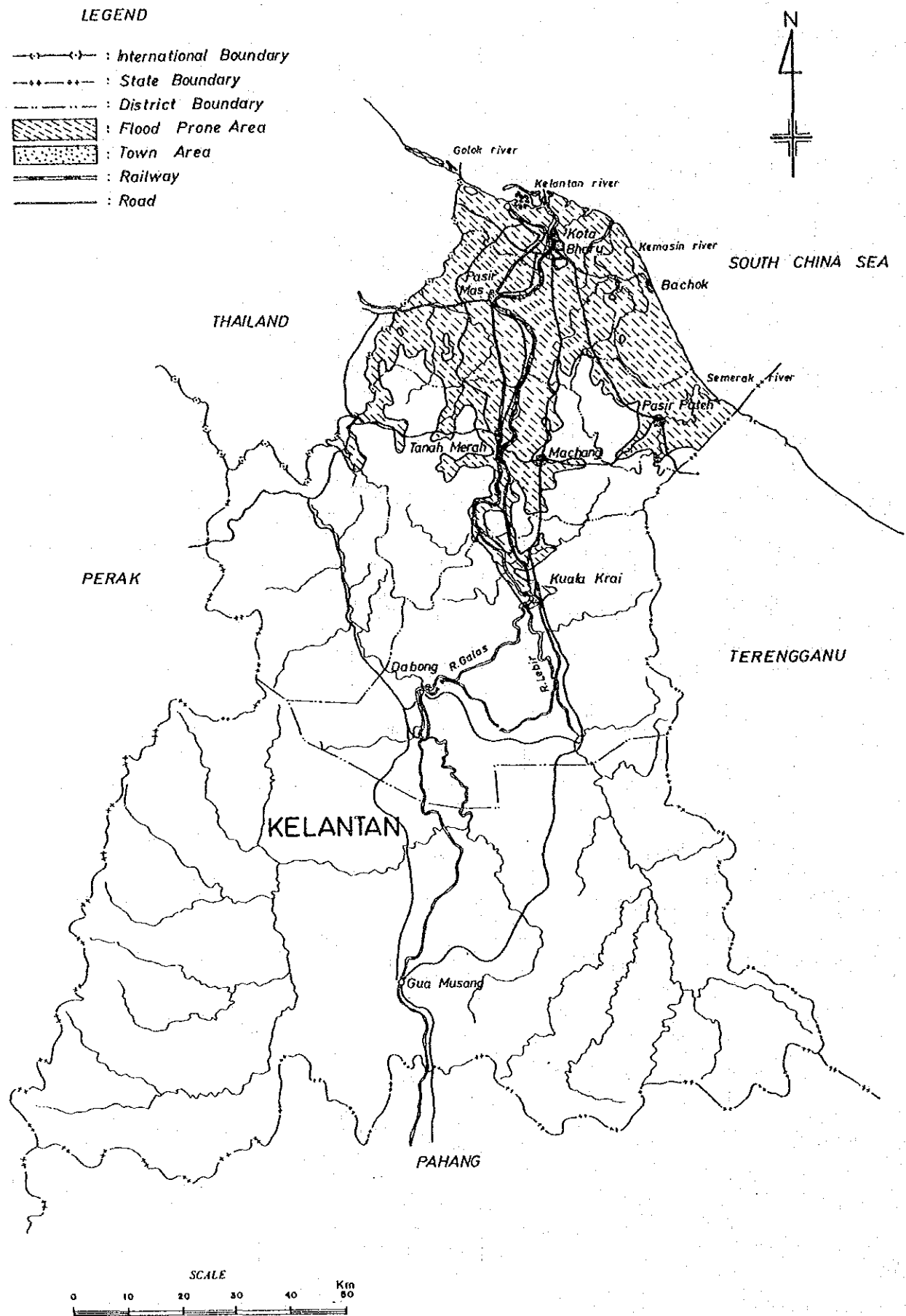
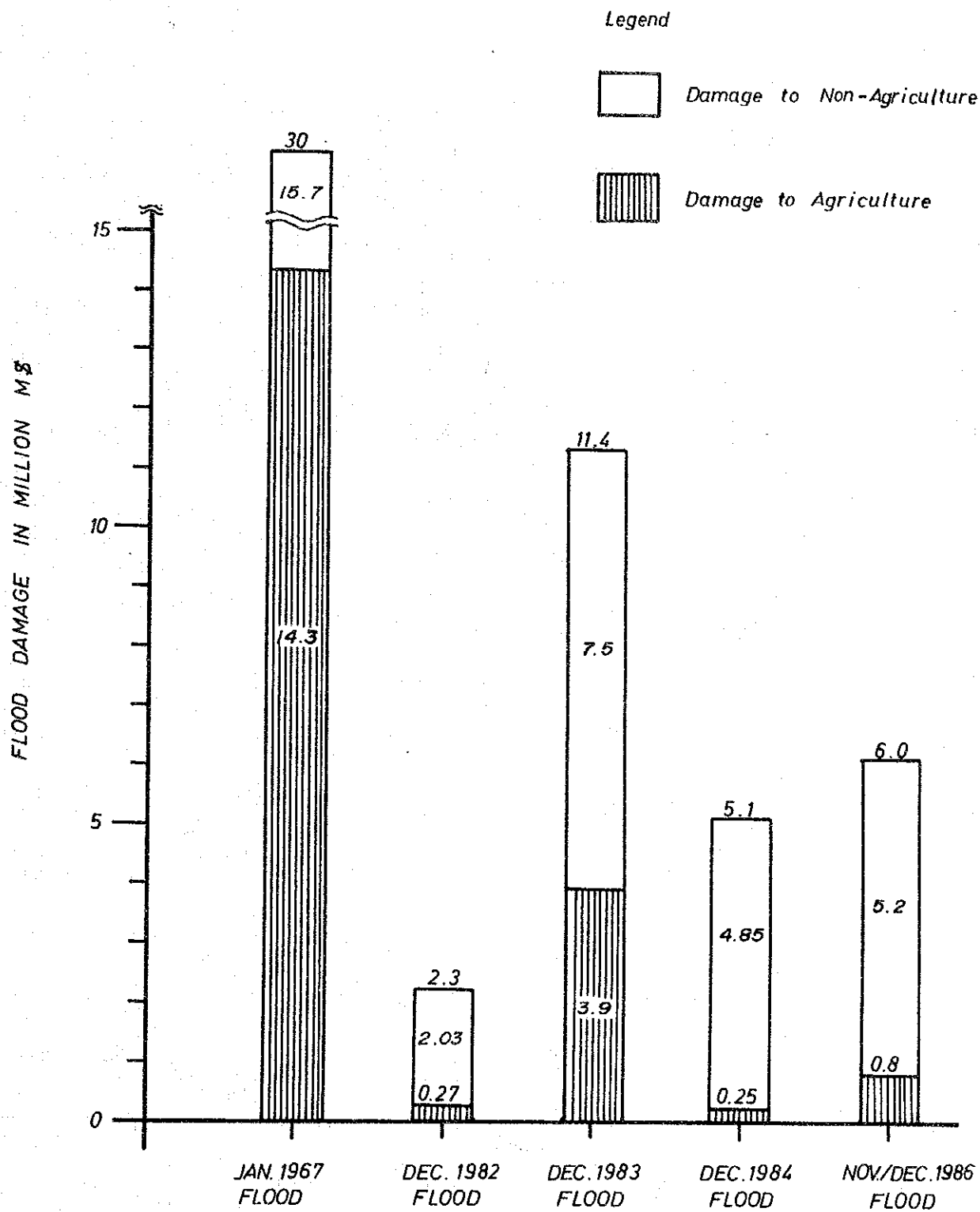


Fig.V.2.1

Flooded Area by January 1967 Flood

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



Source : Flood Reports, DID / Kelantan

Note : Damage values shown are indicated at price level of each year.

Fig.V.2.2

Actual Flood Damage Records

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

LEGEND

- +---+--- : International Boundary
- +--- : State Boundary
- +--- : District Boundary
- +--- : Sub-District Boundary
- [Stippled Area] : Town Area
- == : Railway
- : Road
- - - : Probable Inundation Area
- (KLN) : River Stretch Number

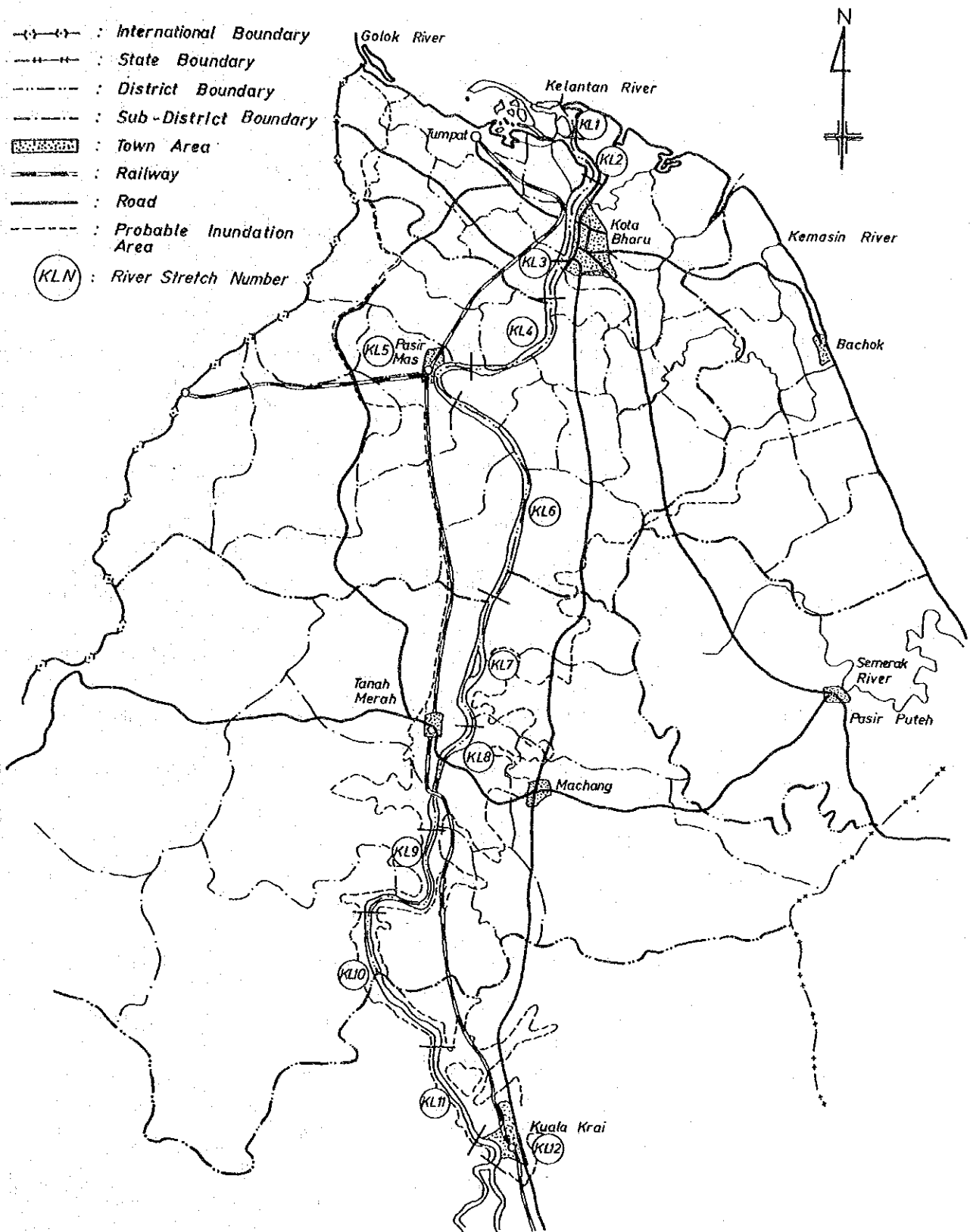
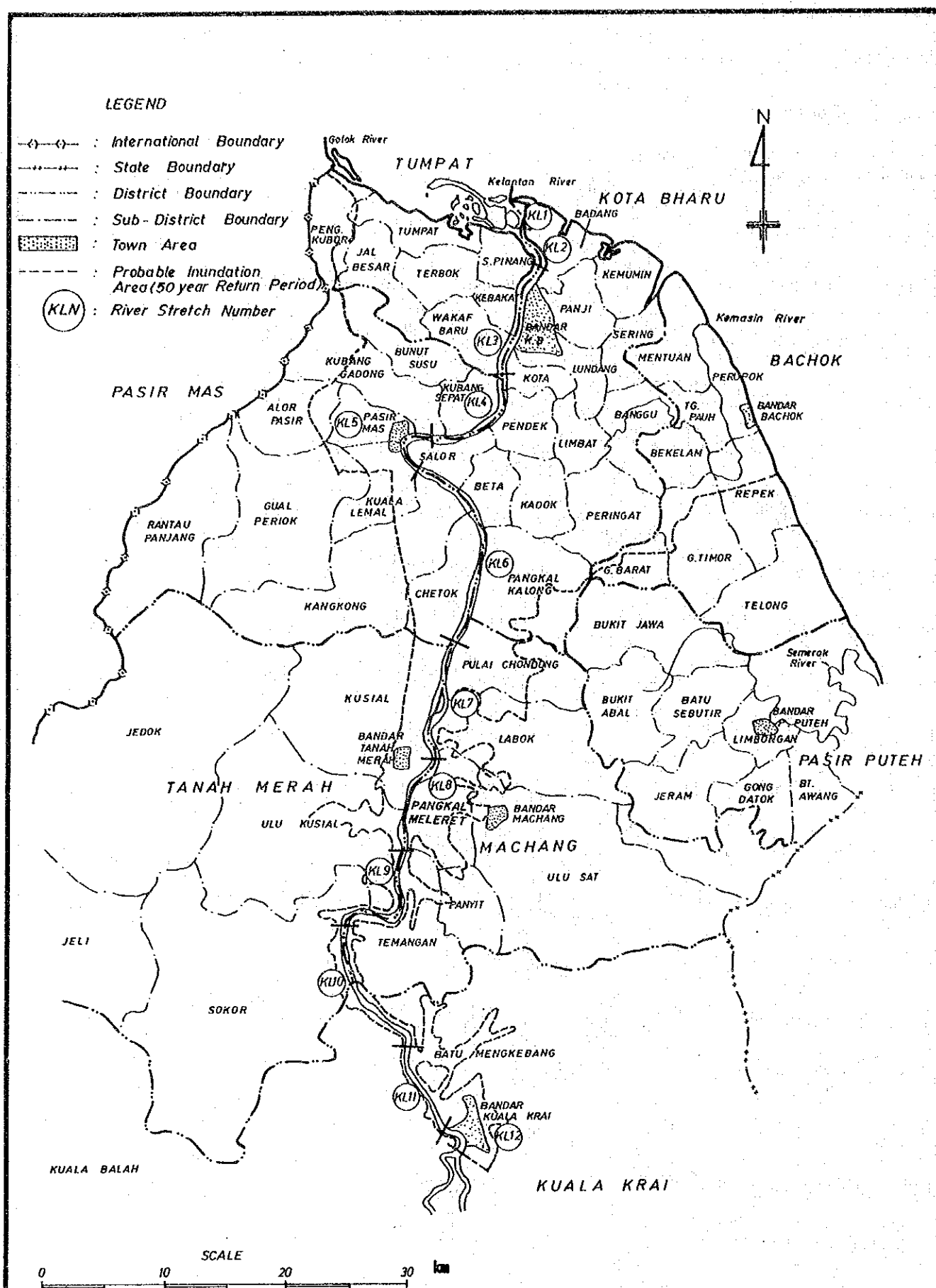


Fig.V.4.1

Division of River Stretches

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LEGEND

- +---+--- : International Boundary
- +---+--- : State Boundary
- +---+--- : District Boundary
- +---+--- : Railway
- +---+--- : Road
- +---+--- : Probable Inundation Area Boundary of (50-year Return Period)



Town Area



Probable Inundation Area (3-year Return Period)

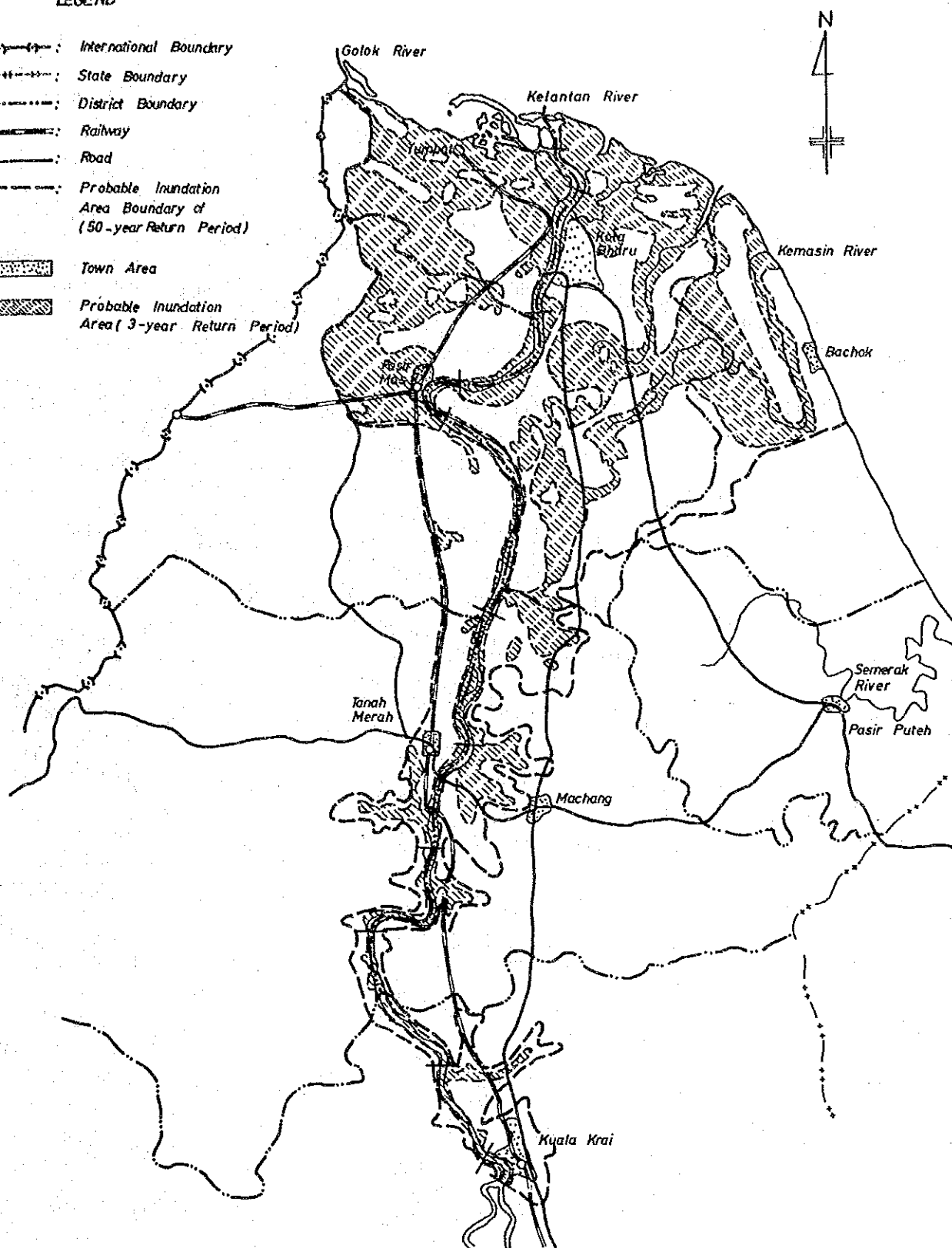


Fig.V.5.1

Probable Inundation Area
(3-year Probable Flood)

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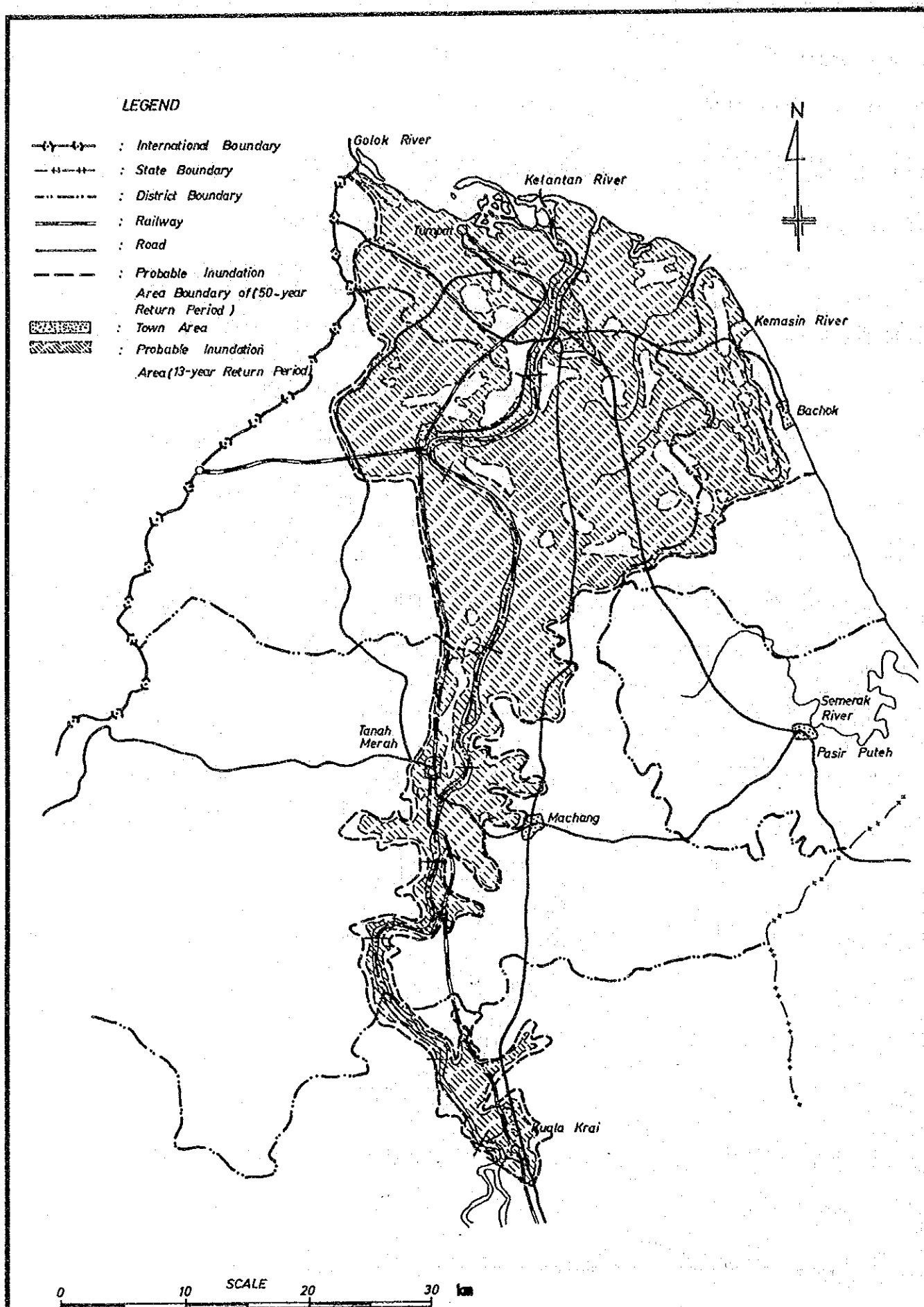
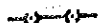





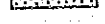


Fig.V.5.2

**Probable Inundation Area
(13-year Probable Flood)**

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LEGEND

-  : International Boundary
-  : State Boundary
-  : District Boundary
-  : Railway
-  : Road
-  : Town Area
-  : Probable Inundation Area (50-year Return Period)

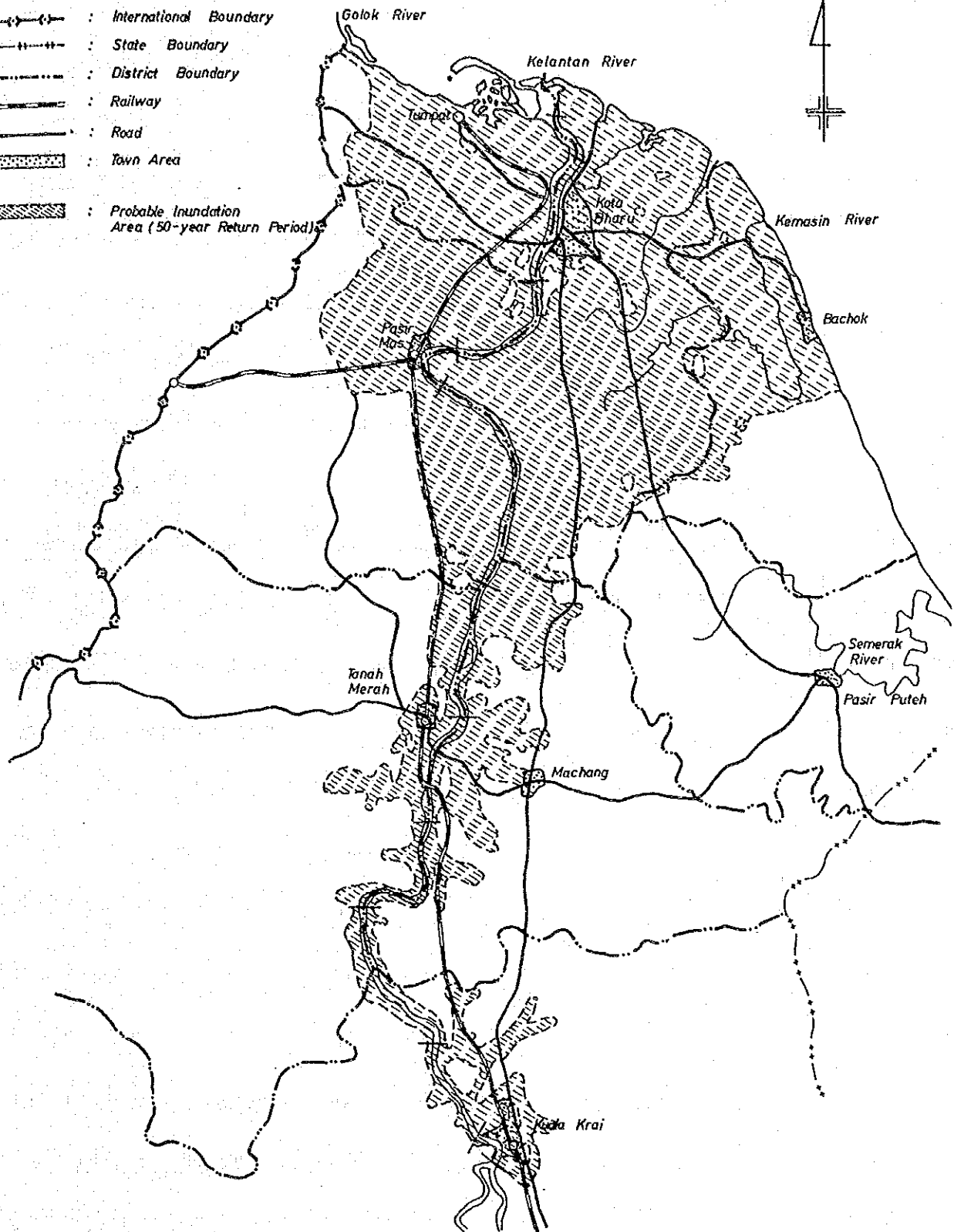


Fig.V.5.3

Probable Inundation Area
(50-year Probable Flood)

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Paddy

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cropping Calendar	Main-Season			Off-season					Main-season			
Planted Area (%)	100	50		50	100			100	50	50	100	100

Tobacco

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cropping Calendar	Season-II										Season-II	
	Season-I									Season-I		
Total Planted Area (%)	100	85		70						30	65	100

Flood Frequency

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(%)	11.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.3	72.1

Source : "Paddy Production and Area", KADA
 "Basic Agriculture Statistics", Agriculture Department of Kelantan
 "Kelantan Development Statistics, Nov.1987"
 "Kelantan Tobacco Statistics, 1987", National Tobacco Board

Note : Percentage of planted area for seasons I and II to total tobacco planted area are 30% and 70%, respectively.

Fig.V.5.4

Cropping Calendars for Paddy and Tobacco

ANNEX VI

REVIEW AND UPDATING

OF

WATER RESOURCES DEVELOPMENT PLAN

TABLE OF CONTENTS

	Page
1. INTRODUCTION	VI-1
2. EXISTING WATER USE OF THE KELANTAN RIVER	VI-2
2.1 Irrigation Water Use	VI-2
2.2 Domestic and Industrial Water Use	VI-2
2.2.1 Maximum supply capacity	VI-2
2.2.2 Daily average use of domestic water	VI-3
2.2.3 Potential use of industrial water	VI-3
2.2.4 Total amount of present domestic and industrial water use	VI-4
3. FUTURE WATER DEMAND OF THE KELANTAN RIVER	VI-5
3.1 Irrigation Water Demand	VI-5
3.2 Domestic and Industrial Water Demand	VI-6
3.2.1 Domestic water demand	VI-6
3.2.2 Industrial water demand	VI-7
3.3 River Maintenance Flow	VI-7
3.3.1 General	VI-7
3.3.2 Simulation model of salt water wedge	VI-8
3.3.3 Required discharge for river maintenance flow	VI-10
3.4 Total Water Demand	VI-11

	Page
4. WATER DEMAND AND SUPPLY BALANCE	VI-12
4.1 General	VI-12
4.2 Probable Minimum Discharge of the Kelantan River	VI-12
4.2.1 Probable minimum discharge without dam development scheme	VI-12
4.2.2 Probable minimum discharge with dam development scheme	VI-13
4.3 Water Deficit	VI-13
5. HYDROPOWER POTENTIAL IN THE KELANTAN RIVER BASIN	VI-16
5.1 Power Demand	VI-16
5.2 Storage Dam Schemes	VI-16
5.3 Methodology for the Estimate of Hydropower Potential	VI-16
5.4. Estimated Hydropower Potential	VI-20
5.5 Effect on Temporary Use of Flood Control Space for Hydropower Generation	VI-20
6. ECONOMIC EVALUATION	VI-22
6.1 Yielding Benefits	VI-22
6.1.1 Hydropower benefit	VI-22
6.1.2 Irrigation benefit	VI-22
6.2 Construction Costs	VI-23
6.3 Economic Evaluation	VI-24

Page

7. ENGINEERING STUDIES FOR DAM AND RELATED STRUCTURES ...	VI-26
7.1 Lebir Dam Scheme	VI-26
7.2 Dabong Dam Scheme	VI-26
7.3 Nenggiri Dam Scheme	VI-27
7.4 Kemubu Dam Scheme	VI-27
7.5 Lower Pergau Dam Scheme	VI-27

REFERENCES

APPENDIX

LIST OF TABLES

Table No.	Title	Page
VI.2.1	Present Irrigable Area and Maximum Irrigation Water Demand for the Kelantan River	VI-30
VI.2.2	Maximum Capacity of Pumping Stations for Irrigation on the Kelantan River	VI-31
VI.2.3	Record of Past Irrigated Area	VI-32
VI.2.4	Maximum Supply Capacity for Domestic and Industrial Water	VI-33
VI.2.5	Present Use of Domestic Water	VI-34
VI.2.6	Industrial Water Demand in Kelantan State as of 1985	VI-35
VI.2.7	Maximum Supply Capacity for Major Industrial Estates in Kelantan State	VI-36
VI.3.1	Future Irrigable Area and Irrigation Water Demand for the Kelantan River	VI-37
VI.3.2	Future Domestic and Industrial Water Demand	VI-38
VI.3.3	Relationship between River Flow Discharge and Length of Salt Water Wedge	VI-39
VI.3.4	Results of Simulation for Salt Water Intrusion	VI-40
VI.3.5	Gross Water Demand for the Kelantan River	VI-41
VI.4.1	Semiannual and Annual Minimum Discharges at Guillemard Bridge	VI-42
VI.4.2	Probable Minimum Discharges of Five-day Average Natural Flow at Guillemard Bridge	VI-43
VI.4.3	Monthly Distribution of Semiannual Minimum Discharge at Guillemard Bridge	VI-44
VI.4.4	Annual Average Deficit of Water Demand	VI-45
VI.5.1	Installed Capacity of National Grid Network Projected in 1991	VI-46
VI.5.2	Demand Forecast for National Grid Network	VI-47
VI.5.3	Historical Record of Annual Rainfall and Run-off Discharge Observed at Key Gauging Stations	VI-48

LIST OF TABLES

Table No.	Title	Page
VI.5.4	Alternative Plan for Hydropower Generation (1/2)	VI-49
VI.5.4	Alternative Plan for Hydropower Generation (2/2)	VI-50
VI.5.5	Effect on Temporary Use of Flood Control Space for Hydropower Generation	VI-51
VI.6.1	Configuration of Alternative Thermal Power Station	VI-52
VI.6.2	Unit Cost of Thermal Power Plant	VI-53
VI.6.3	Comparative Characteristics of Power Plant	VI-54
VI.6.4	Economic Benefit of Hydropower Generation	VI-55
VI.6.5	Economic Farm Gate Price of Paddy	VI-56
VI.6.6	Production Cost of Paddy	VI-57
VI.6.7	Economic Benefit of Irrigation Water Supply	VI-58
VI.6.8	Dam Investment Cost for the Purpose of Water Resources Development	VI-59
VI.6.9	Economic Evaluation of Alternative Dam Schemes for Water Resources Development	VI-60

LIST OF FIGURES

Fig.No.	Title	Page
VI.2.1	Location of Pumping Stations and Irrigation Area	VI-61
VI.3.1	Result of Previous Salt Water Wedge Measurement	VI-62
VI.3.2	Characteristic of Interfacial Resistance Coefficient	VI-63
VI.3.3	Concept of Simulation Model for Salt Water Wedge	VI-64
VI.4.1	Distribution of Annual Minimum Discharges at Guillemard Bridge (Without Dam)	VI-65
VI.4.2	Probable Minimum Discharges at Guillemard Bridge (With and Without Dam)	VI-66
VI.5.1	National Grid Network of Power Supply	VI-69
VI.5.2	Relation between Firm Discharge and Required Storage Volume	VI-70
VI.5.3	Relation between Firm Discharge and Low Water Level for Power Generation	VI-71
VI.5.4	Average Annual Energy Generated by Alternative Normal High Water Level	VI-72
VI.7.1	Location Map of Lebir Dam	VI-73
VI.7.2	Reservoir Area, Lebir Dam	VI-74
VI.7.3	Re-planned Highway Route between Chiku and Kuala Brang	VI-75
VI.7.4	Storage Capacity, Lebir dam	VI-76
VI.7.5	Proposed Development Plan of the Lebir Dam Scheme	VI-77
VI.7.6	Location Map of Dabong Dam	VI-79
VI.7.7	Railway, Plan and Profile	VI-80
VI.7.8	Reservoir Area, Dabong Dam	VI-81
VI.7.9	Storage Capacity, Dabong Dam	VI-82
VI.7.10	Proposed Development Plan of the Dabong Dam Scheme	VI-83

LIST OF FIGURES

Fig.No.	Title	Page
VI.7.11	Location Map of Nenggiri Dam	VI-84
VI.7.12	Reservoir Area, Nenggiri Dam	VI-85
VI.7.13	Storage Capacity, Nenggiri Dam	VI-86
VI.7.14	Proposed Development Plan of the Nenggiri Dam Scheme	VI-87
VI.7.15	Location Map of Kemubu Dam	VI-89
VI.7.16	Proposed Route of Railway around the Pass between Kemubu and Bertam	VI-90
VI.7.17	Storage Capacity, Kemubu Dam	VI-91
VI.7.18	Proposed Development Plan for the Kemubu Dam Scheme	VI-92
VI.7.19	Location Map of Lower Pergau Dam	VI-93
VI.7.20	Storage Capacity, Lower Pergau Dam	VI-94

VI. REVIEW AND UPDATING OF WATER RESOURCES DEVELOPMENT PLAN

1. INTRODUCTION

The study objectives are mainly divided into following two aspects:

- (1) To review and update the previous plans for water use of the Kelantan River so as to determine the optimum reservoir scale for water resources development, and
- (2) To identify the potential damsites in the Kelantan River basin and carry out the engineering studies for dam structures.

The water resources development plan aims at searching water supply sources to cope with the incremental water demand in the target year of 2010, and also developing the hydropower potential to meet the growing electric power demand. In this connection, following were discussed in this Annex VI; (1) the present and future water demand of the Kelantan River, (2) the water demand and supply balance assuming subject to "without and with dam development scheme", and (3) the hydropower potential at the proposed three dam sites, Lebir, Dabong and Nenggiri.

Based on the above discussion, the study formed a conclusion on the optimum dam development scheme which is available to meet the water demand in 2010 and can provide the greatest benefit for hydropower generation. The results of study are finally incorporated into the overall plan of multi-purpose dam projects which include the functions of flood mitigation as well as water supply and hydropower generation.

2. EXISTING WATER USE OF THE KELANTAN RIVER

2.1 Irrigation Water Use

Water of the Kelantan River is at present used for four major irrigation schemes, i.e. Kemubu, Salor, Lemal and Pasir Mas, all of which stretch out in the lower reaches of the Kelantan River as shown in Fig. VI.2.1. These major irrigation schemes were developed by DID from 1951 to 1973 to increase the yield by double paddy cropping. Operation and maintenance were transferred to KADA after completion. The present irrigable areas for these schemes sum up to about 31,800 ha which requires about 72 m³/sec in maximum water use to realize the entire double cropping as shown in Table VI.2.1.

The water abstraction fully depends on the existing four pumping stations, all of which are located along the reaches downstream from Guillemard Bridge as illustrated in Fig. VI.2.1. The maximum capacity of the pumping stations was originally designed to be 52.9 m³/sec in total as shown in Table VI.2.2. However, due to the over-age pumping facilities, the pumping capacity has considerably decreased. According to the recent pump tests carried out by KADA, the present available capacity is estimated at about 35 m³/sec as referred to Table VI.2.2.

At present, the main season crop is usually planted in October/November and harvested by the end of March, while the off season crop is planted in April/May and harvested by September. Peak water demand required for the Kelantan River as a source occurs in May/June. Since the maximum irrigation demand is much larger than the existing available pumping capacity, the actual irrigated area has been limited within 60 to 70% of the total irrigable area both for main and off seasons as given in Table VI.2.3. Thereby, KADA implements the renovation of the existing pumping facilities as well as other irrigation facilities so as to realise the double cropping irrigation for the whole irrigable area by the end of 1990.

2.2 Domestic and Industrial Water Use

2.2.1 Maximum supply capacity

Groundwater was a sole water source for public supply system in the State of Kelantan by 1982. Thereafter, the Kelantan River and other surface flows were sought as water sources to solve the quantitative and qualitative restriction of the groundwater use and to cope with the rapid increment of domestic and industrial water demand.

The present maximum demand sums up to about 134 Mld in the lower reaches of the Kelantan River covering the districts of Kota Bharu, Tumpat, Pasir Mas, Machang, Bachok, Pasir Puteh and Kuala Krai. The said maximum demand is met by the groundwater (72 Mld), the Kelantan River (43 Mld) and other surface flows (19 Mld) as shown in Table VI.2.4.

Water from the Kelantan River is abstracted from two existing pumping stations; one located at Kg. Kelar in Pasir Mas district with its pumping capacity of 22.70 Mld and the other at Sg. Kelantan in Tanah Merah district with its capacity of 20.43 Mld. These pumping stations are located along the Kelantan River downstream from Guillemard Bridge as illustrated in Fig. VI.2.1.

2.2.2 Daily average use of domestic water

The enlargement of maximum supply capacity starting from 1982 could increase the daily average domestic water supply from 39 Mld in 1980 to 76 Mld in 1985 as shown in Table VI.2.5. Daily average domestic water supply in 1985 corresponds to about 57% of maximum supply capacity. It is herein noted that the share of supply from the Kelantan River was nil in 1980 but increased to 24 Mld equivalent to 32% of total average supply in 1985.

With the increment of daily average water supply, the population covered by the public water supply system has expanded from 147,000 (coverage rate of 19.5% to total population) in 1980 to 230,000 (coverage rate of 25.6%) in 1985. In this connection, the per capita consumption rate is estimated at 137 l/day.person in 1980. The values in recent years would be higher, but could not be assessed due to lack of available data (refer to Table VI.2.5).

The estimated per capita consumption in 1980 is deemed to be rather low compared with the usual consumption rate of some 200 l/day.person. This low consumption rate will be attributed to the high supply loss as estimated at 48.7% in Table VI.2.5 and the inadequately small supply capacity before 1982. It is however anticipated that the supply loss is gradually reduced and that the per capita consumption rate increases from 1982 onward due to the recent high supply capacity system.

2.2.3 Potential use of industrial water

The potential use of industrial water in 1985 was estimated on the basis of following available information:

- The state gross industrial output as of 1985 expressed in monetary value, and
- Water use rate required to unit industrial output which was cited from the results of sampling survey carried out in the National Water Resources Study, 1982.

As shown in Table VI.2.6, the actual industrial output amounted to about M\$300 million in 1985. The corresponding potential water use in 1985 is estimated at 16 Mld.

Judging from the water supply system enlarged after 1982, most of present and future industrial water will be taken from the Kelantan River. In fact, as shown in Table VI.2.7, there are

five major industrial estates in the State of Kelantan and the considerable part of their water use is projected to rely on the Kelantan River water.

2.2.4 Total amount of present domestic and industrial water use

Domestic and industrial water use is computed at about 92 Mld on an average in 1985; 76 Mld for domestic water use and 16 Mld for industrial water use. The said daily average water use corresponds to about 70% of the maximum supply capacity.

Water sources for the daily average use are classified as follows:

- The Kelantan River: 24 Mld for domestic water use and 16 Mld for industrial water use, and
- Other sources; 52 Mld.

As estimated above, the present water use taken from the Kelantan River is to be about 40 Mld which corresponds to about 90% of the maximum supply capacity abstracted from the Kelantan River.

3. FUTURE WATER DEMAND OF THE KELANTAN RIVER

3.1 Irrigation Water Demand

The future irrigation water demand for the source of Kelantan River is estimated in accordance with phasing development programmes of irrigation schemes. Thereby, the phasing development programmes are preliminarily assumed on the basis of the interview with the agencies concerned such as KADA and Kemasin-Semerak Project office, DID as well as the review on the previous study reports such as "KADA II Improvement Project, 1982" and "Kemasin-Semerak Integrated Rural Development Project, 1979". It is estimated as shown in Table VI.3.1 that the irrigation demand will increase from the present maximum use of 35 m³/sec to the peak demand of 85 m³/sec in 2010. It is herein noted that the future peak demand is assumed to occur on April from the result of the various study reports. The double cropping area of about 50,000 ha will be irrigated with maximum supply of 85 m³/sec in 2010 as referred in Table VI.3.1.

The development programmes herein assumed are enumerated as below:

(1) Improvement of existing KADA irrigation areas

The existing irrigable area of 31,800 ha will be entirely used for double paddy cropping by the end of 1990 by improving existing irrigation facilities. In this connection, KADA is executing the plan to either replace or rehabilitate the existing pumping facilities so as to increase the total pumping capacity from the present 35 m³/sec to about 43 m³/sec as referred to Table VI.2.2. Furthermore, a new pumping station with its capacity of about 37 m³/sec is to be constructed by DID in 1990 near the existing Kemubu pumping station. Accordingly, the total pumping capacity will reach about 80 m³/sec by 1990.

The peak water demand for the entire double cropping will be 72 m³/sec which comes out on April by assuming that a 40-day presaturation period starts on March 11th (refer to "KADA II Improvement Project").

(2) Kemasin irrigation scheme

The Kemasin irrigation scheme is currently being implemented under "Kemasin-Semerak Integrated Rural Development Project" and to be completed by 1990. The area of 3,775 ha in the scheme is irrigated by taking the Kelantan River water from the new Kemubu pumping station during the off season. The peak water demand is to be 5.4 m³/sec which comes out on May (refer to "Kemasin-Semerak Integrated Rural Development Project").

(3) Semerak irrigation scheme

Succeeding to the Kemasin irrigation scheme, the Semerak