7．非施設的方策に対する提言

7.1　概　　要

洪水予警報、洪水危険地区区分、土地利用制限等による非施設的方策は通常施設的方策が経済的に見合わない場合や施設的方策の補足手段として洪水が起りやすい地区に対して用いられる。クランタン川流域の洪水が起りやすい地区のすべてがダム及び河川改修による構造物対策により守られる計画になっているので、非施設的方策は本治水計画において考慮する必要はないと考えられる。

一方高床式による家屋の洪水防御策もクランタン川の常襲氾濫地区内で個々に実施されている。洪水発生頻度及びダム及び河川改修工事実施への早期要請等を勘案すると高床式家屋の建設も流域内の洪水防御の一手段と考えられる。

一方施設的方策が実施されたとしても計画洪水規模以上の洪水の発生も考えられ、このためこれら施設的方策を補足する意味で洪水予警報システムの導入が必要となろう。既存の洪水予警報システムは1971に導入され1986年に更新されている。さらに充実したシステム構築のため既存システムの改良が必要と考えられる。

7.2　非施設的方策に対する提言

クランタン川流域に導入されている洪水予警報システムは遠隔装置化された水位雨量計より成る。現在システムは6地点のテレメーター化された雨量計にもとづいてなされているが、より多くの雨量計をより適切に配置することにより、より適格な洪水予測が可能となるので、ネンギリ川流域にもう一つ遠隔装置つき雨量計を設置することが推奨される。ダムが上流域に建設された場合、既存の洪水予警報モデルを修正することが必要であり、洪水予測を容易ならしめるためにダムに遠隔装置つき水位計と雨量計を設置することが望まれる。

現在コタバルのＤＩＤ事務所で実施されている洪水予警報活動は水文スタッフにより行なわれ、クアラルンプールの予警報センターでバックアップされている。ＤＩＤにおけるデータ処理及び地域分散化を容易にするためにマイクロコンピュータをベースとしたシステムを現在のシステムに導入する事が提案される。

付　表

表 2.1 クランタン州の人口

Item	1970	Annual Growth	1980	Annual Growth	1988 1/
State of Kelantan	690,800 (100.0%)	2.6%	893,800 (100.0%)	2.5%	1,091,756 (100.0%)
Bachok	62,593 (9.1%)	2.1%	76,991 (8.6%)	2.0%	90,549 (8.3%)
Kota Bharu	209,210 (30.3%)	3.2%	286,742 (32.1%)	2.8%	357,995 (32.8%)
Machang	51,977 (7.5%)	1.5%	60,436 (6.8%)	1.5%	67,930 (6.2%)
Pasir Mas	101,354 (14.7%)	2.0%	123,026 (13.8%)	1.9%	142,867 (13.1%)
Pasir Puteh	71,608 (10.4%)	1.6%	84,317 (9.4%)	1.6%	95,536 (8.8%)
Tanah Merah	49,318 (7.1%)	2.7%	64,568 (7.2%)	2.7%	79,942 (7.3%)
Jeli	14,477 (2.1%)	5.3%	24,321 (2.7%)	5.4%	37,120 (3.4%)
Tumpat	73,533 (10.6%)	2.0%	89,516 (10.0%)	2.0%	104,492 (9.6%)
Gua Masang	12,578 (1.8%)	4.4%	19,349 (2.2%)	4.8%	28,198 (2.6%)
Kuala Krai	44,152 (6.4%)	3.9%	64,534 (7.2%)	3.8%	87,127 (8.0%)
MPKB	127,290 (18.4%)	3.5%	179,307 (20.1%)	2.9%	224,719 (20.6%)

Note : 1) 1/ = Estimate
2) Figures for 1970 are adjusted figures based on Population Census.
3) Figures in parentheses are shares by District.

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

表 2.2 ギルマード橋における年最大洪水ピーク流量

No.	Year	Peak Discharge (cms)	No.	Year	Peak Discharge (cms)
1	1941	2,030	24	1964	1,610
2	1942	11,480	25	1965	6,170
3	1943	4,630	26	1966	16,000
4	1944	5,230	27	1967	8,280
5	1945	12,850	28	1968	1,700
6	1946	3,970	29	1969	6,650
7	1947	13,580	30	1970	8,800
8	1948	3,420	31	1971	5,550
9	1949	7,050	32	1972	10,260
10	1950	8,090	33	1973	11,130
11	1951	2,600	34	1974	4,490
12	1952	1,970	35	1975	5,247
13	1953	4,060	36	1976	2,610
14	1954	4,550	37	1977	2,525
15	1955	2,310	38	1978	3,291
16	1956	2,580	39	1979	10,400
17	1957	6,050	40	1980	1,711
18	1958	1,500	41	1981	2,028
19	1959	3,440	42	1982	7,172
20	1960	3,610	43	1983	12,007
21	1961	2,700	44	1984	7,744
22	1962	3,410	45	1985	1,722
23	1963	2,790	46	1986	6,901

Note : Data from 1941 to 1974 --- "The Kelantan River Basin Study (ENEX)", 1977

Data from 1975 to 1986 ---- Observed data by D.I.D.

表 2.3 クランタン川の既存橋梁

No.	Name	Road/ Railway	River	Distance from the estuary	Dimensions, m			Administration office	Year of construction	Remarks
					Length	Width	Lowest El. of girder			
1	Sultan Yahya Petra	Road	Kelantan	13	840.2	12.2	8.2	JKR	1963	
2	Pasir Mas	Road	Kelantan	28	633.0	12.5	15.3	JKR	1989	Under construction
3	Tanah Merah	Road	Kelantan	63	630.0	9.0	24.9	JKR	1987	
4	Guillemard	Railway	Kelantan	65	619.5	3.0	23.8	Railway Dept.	1924	
5	Manek Urai	Railway	Lebir	121	330.0	3.0	-	Railway Dept.	1928	TBM:El.117.751 m
6	Lalok	Road	Lebir	132	166.0	9.0	52.7	JKR	1982	
7	Kemubu	Railway	Galas	147	240.0	3.0	-	Railway Dept.	1930	TBM:El.142.670 m
8	Bertam	Railway	Nenggiri	174	210.0	3.0	66.7	Railway Dept.	1931	TBM:El.220.072 m

表 2.4 クランタン川の既存ポンプ施設

No.	Name	Location from Pasir Mas	Left/right bank	Features			Administration office	Year of construction	Remarks
				No. of pumps	Capacity, cms	Intake design level, m			
1	Kemubu	18 km upstream	Right	5	10.8	5.4	KADA	1971	Extension up to 37.2 cms
2	Salor	4 km upstream	Right	2	1.7	2.4	KADA	1948	
3	Lemal	2 km upstream	Left	4	18.3	1.6	KADA	1963	
4	Pasir Mas	3 km upstream	Left	3	4.3	(1.9) 1/	KADA	1956	
5	Tanah Merah		Left	2	0.3		JKR	1984	Water supply
6	Pasir Mas		Left		0.3		JKR	1983	"

Note: 1/ A figure in the parentheses shows the low level.

表　3.1　既設のかんがい面積及びかんがい用水の需要量

Irrigation Scheme	Irrigation Area (ha)	Annual Peak Demand (cms)	Monthly Demand during Off Season				
			Mar. (cms)	Apr. (cms)	May (cms)	Jun. (cms)	Jul. (cms)
Kemubu	19,200	43.3	38.1	43.3	26.4	23.0	23.3
Salor	890	2.2	1.8	2.2	1.2	1.2	1.1
Lemal	9,805	22.1	19.5	22.1	13.5	13.5	11.9
Pasir Mas	1,905	4.3	3.8	4.3	2.6	2.6	2.3
	31,800	71.9	63.2	71.9	43.7	40.3	38.6

Source: "KADA II Improvement Project, 1982"

表 3.2 かんがい用ポンプの最大揚水量

Pumping Station	Year of Completion	Controlled by	Original Design Capacity (cms)	Present Available Capacity (cms)	Projected Capacity (cms)
(1) Kemubu (Old)	1971	KADA	28.3	10.8	10.8
(2) Salor	1948	KADA	2.0	1.7	2.0
(3) Lemal	1963	KADA	18.3	18.3	24.0
(4) Pasir Mas	1956	KADA	4.3	3.4	6.0
(5) Kemubu (New) 1/	1990	DID/KADA	37.2	-	37.2
(6) Others				-	4.0-5.0

Source: Interview from "Mechanical Division of KADA" and "Kemasin-Semerak Project Office, DID".

Note: 1/ The pumping station is being implemented by DID and will be maintained by KADA after its completion.

Present total available capacity : 35 cms
Total capacity projected in 1990 : 80 cms
Total capacity projected for the period 2000 to 2005 : 85 cms

表　3. 3　　かんがい地区への水供給記録

Year	Off-season		Main-season	
	Area Irrigated ('000 ha)	Percentage to Whole Irrigable Area (%)	Area Irrigated ('000 ha)	Percentage to Whole Irrigable Area (%)
1975	22.3	70	28.0	88
1976	21.7	68	22.4	70
1977	25.4	80	26.0	82
1978	25.7	81	23.0	72
1979	21.3	67	21.0	66
1980	21.4	67	22.3	70
1981	19.1	60	16.2	51
1982	18.1	57	21.6	68
1983	18.8	59	41.3	13
1984	24.2	76	19.7	62

Source: KADA Statistical Digest

表 3.4 家庭用水及び工業用水に対する最大供給量

Water Source	District for Water Supply	Name of Supply System	Maximum Capacity (Mld)	Year of Commission
Kelantan River	(1) Pasir Mas	Kg.Kelar	22.70	1983
	(2) Tanah Merah and Machang	Tanah Merah	20.43	1984
	Total		43.13	
Ground Water	(1) Kota Bharu	Kg.Puteh	25.06	1935
		K.Krian	12.00	1935
		P.Geng	1.00	1976
		Tg.Mas	9.08	1978
		P.Chepa	3.27	1950
	(2) Tumpat	Wakaf Baru	18.16	1984
	(3) Bachok	Kg.Chap	2.27	1978
		Kg.Jelawat	0.82	1978
	(4) Pasir Mas	R.Panjang	0.74	1978
	Total		72.40	
Others	(1) Pasir Puteh	Wakaf Bunut	18.16	1983
	(2) Tanah Merah	Air Lanas	0.50	1980
	Total		18.66	
	Grand Total		134.19	

Source: "Water Supply in Northern Kelantan, 1986"

表 3.5 家庭用水の使用量

Item	Unit	Actual Results 1980	Actual Results 1985
(1) Average Supplied Water			
from Kelantan River	Mld	0	24
from Ground water,etc.	Mld	39	52
Total		39	76
(2) Average Consumed Water	Mld	20	Data Not Available
(3) Served Population	'000 people	147	230
(4) Coverage of Public Water Supply	%	19.5	25.6
(5) Supply Loss ((1) - (2)/(1))	%	48.7	Data Not Available
(6) Per Capita Consumption ((2)/(3))	l/day.person	137	Data Not Available

Source: "Water Supply in Northern Kelantan, 1986" and "Kelantan Development Statistics, 1987".

Note: The present use of domestic water is estimated for the lower reaches of Kelantan River covering the districts of Kota Bharu, Tumpat, Pasir Mas, Tanah Merah, Machang, Bachok and Pasir Puteh.

表 3.6 1985年におけるクランタン州の工業用水需要

Type of Industry	Value of 1/ Industrial Output (Mil.M$)	Unit Water Use 2/ per Industrial Output (l/day/M$)	Potential Water Demand (Mld)
Rubber Manufacture	69.2	0.085	5.88
Food/Tobacco	33.2	0.080	2.66
Chemicals	11.5	0.150	1.73
Wood Product	105.5	0.015	1.58
Textiles	31.3	0.075	2.35
Non-Metal	10.2	0.070	0.71
Basic Metal	0.8	0.050	0.04
Machinery	30.0	0.020	0.60
Publishing	4.3	0.010	0.04
Miscellaneous	4.2	0.050	0.21
Total	300.2		15.80

Note: 1/ Estimated based on the publishment of Department of Statistics, Malaysia.

2/ Estimated from the results of sumpling survey carried out by JICA Study Team for "National Water Resources Study, Malaysia 1982".

表　3.7　　工業団地への最大供給量

Name of Estate	District	Water Source	Max.Capacity (Mld)
Pengkalan Chepa I	Kota Bharu	Ground Water	4.5
Pengkalan Chepa II	Kota Bharu	Ground Water	2.4
Tanah Merah	Tanah Merah	Kelantan River	20.9
Jeli	Kuala Krai	Kelantan River	2.0
Kemubu	Kuala Krai	Kelantan River	0.1
Gua Musang	Gua Musang	Kelantan River	0.1
Total			30.0

Source: "Kelantan Development Statistics, 1987"

表 3.8 将来かんがい面積及びその需要量

Year	Cumulate Irrigable Area (ha)	Cumulate Annual Peak Demand (cms)	Irrigation Scheme to be Developed											
			Name of Irrigation Scheme	Irrigable Area (ha)	Off Season Demand					Main Season Demand				
					Mar. (cms)	Apr. (cms)	May (cms)	Jun. (cms)	Jul. (cms)	Sep. (cms)	Oct. (cms)	Nov. (cms)	Dec. (cms)	Jan. (cms)
1990	35,697	72.7	Kemubu	19,200	38.1	43.3	26.4	23.0	23.3	8.3	14.3	3.1	13.2	21.5
			Salor	890	1.8	2.2	1.2	1.2	1.1	0.4	0.7	0.1	0.6	1.0
			Lemal	9,805	19.5	22.1	13.5	13.5	11.9	4.2	7.3	1.6	6.7	11.0
			Pasir Mas	1,905	3.8	4.3	2.6	2.6	2.3	0.8	1.4	0.3	1.3	2.1
			Bendang Jah	120	0.3	0.3	0.2	0.2	0.2	0.1	1.0	0.0	0.9	0.2
			Kemasin	3,775	0.7	0.5	5.4	4.2	2.7	-	-	-	-	-
			Total	35,697	64.2	72.7	49.3	44.7	41.5	13.8	24.7	5.1	22.7	35.8
1995	46,382	81.4	Semerak	7,745	1.6	1.7	10.4	10.4	5.1	-	-	-	-	-
			Ulu Lemal	2,130	4.5	5.1	3.1	2.7	2.8	1.0	1.7	0.4	1.6	2.5
			Bagan II	810	1.7	1.9	2.4	2.1	1.0	0.4	0.6	0.1	0.6	1.0
			Total	10,685	7.8	8.7	15.9	15.2	8.9	1.4	2.3	0.5	2.2	3.5
2000 to 2010	50,002	84.6	Others	3,620	1.6	3.2	1.7	1.7	1.5	0.5	0.9	0.1	1.7	1.6

Source: (1) "KADA II Improvement Project, 1982"
(2) "Kemasin-Semerak Integrated Rural Development Project, 1979"
(3) "Water Supply Study in Northern Kelantan, 1986"
(4) Interview from Kemasin-Semerak Project Office.

表　3.9　将来家庭用水・工業用水需要量（1／2）

Item	Unit	Actual	Projected 1990	1995	2000	2005	2010
I. Domestic water		(As of 1980)					
(1) Population 1/	'000 people	850	1075	1205	1348	1505	1680
(2) Coverage of Water Supply	%	19.5	80	90	100	100	100
(3) Per Capita Demand Excluding Supply Loss	l/day	137	200	210	220	230	240
(4) Supply Loss	%	48.7		30.0	30.0	30.0	30.0
(5) Per Capita Demand Including Supply Loss	l/day	265	286	300	314	329	343
(6) Water Demand							
- Gross (1)x(2)x(5)	Mld	44	246	325	423	495	576
- from Kelantan River 2/	Mld	-	155	234	332	404	485
II. Industrial Water		(As of 1985)					
(1) Annual Growth rate 1/ of GDP	%	6.25 (1986-1990)	(..................6.0..................) (1991-2010)				
(2) Percentage of Industrial 1/ Product to GDP	%	12.9	13.9	14.1	14.4	14.7	14.7
(3) Growth Rate of Industrial Product		1.0	1.5	2.0	2.7	3.7	5.0
(4) Water Demand							
- Gross (Demand in 1980)x(4)	Mld	16	24	32	43	59	80
- from Kelantan River	Mld	16	24	32	43	59	80

- to be continued

表　3.9　　将来家庭用水・工業用水需要量（2／2）

Item	Unit	Actual	Projected				
			1990	1995	2000	2005	2010
III. Domestic and Industrial Water Demand							
- Gross	Mld		270	357	466	554	656
- from Kelantan River	Mld		159	266	375	463	565

Notes: 1/ Estimated on the basis of "Population and Housing Census, 1980 and the projections given in "Kelantan Regional and Township Development Project, 1987".

2/ Water demand from Kelantan River is estimated by subtracting the maximum supply capacity of ground water as of 1985 from the gross water demand.

表　3.10　クランタン川の総水需要量

Item	Demand (cms)
1. Present Max. Supply Capacity (in 1985)	
(1) Domestic and Industrial Water	0.5
(2) Irrigation Water	35.0
(3) River Maintenance Flow	70.0
(4) Total	105.5
2. Demand in 1990	
(1) Domestic Water	1.8
(2) Industrial Water	0.3
(3) Irrigation Water	72.7
(4) River Maintenance Flow	70.0
(5) Total	144.8
3. Demand in 2000	
(1) Domestic Water	3.8
(2) Industrial Water	0.5
(3) Irrigation Water	84.6
(4) River Maintenance Water	70.0
(5) Total	158.9
4. Demand in 2010	
(1) Domestic Water	5.6
(2) Industrial Water	0.9
(3) Irrigation Water	84.6
(4) River Maintenance Flow	70.0
(5) Total	161.1

表　3.11　　1991年における総電力設備容量

Type of Station	Installed Capacity (MW)
1. Hydro Power Station	
(1) Sultan Yussuf (Jor)	100
(2) Sultan Idris (Woh)	150
(3) Chenderoh	40
(4) Bersia	72
(5) Kenering	120
(6) Temengor	348
(7) Kenyir	400
(8) Sungai Pia	64
Sub-total	1294
2. Thermal Power Station	
(1) Gas Turbine	1427
(2) Steam Oil	405
(3) Steam Coal	600
(4) Combined Cycle	1173
Sub-total	3605
Grand Total	4899

表 3.12 電力系統における総電力需要量

Year	Annual Generation (TWH)	System Peak Load (MW)
1986	13.236	2268
1990	17.520	2984
1995	24.495	4142
2000	33.449	5615
2005	44.952	7546

Notes: 1/ Demand in 1986 is actual value.

2/ Demand from 1995 to 2005 is forecasted by NEB.

表 3.13 水力発電計画の概要（1／2）

Dam	Description	Unit	Alternative							
Lebir	NHWL	EL.m	65	70	75	80	85	90		
	LWL	EL.m	56	59	61	70	75	81		
	Live Storage Volume	MCM	460	678	1192	1192	1645	1645		
	TWL	EL.m	27	27	27	27	27	27		
	Firm Discharge	cms	55	65	75	75	80	80		
	Max. Discharge	cms	220	260	300	300	320	320		
	Install Capacity	MW	67	87	112	126	147	162		
	Dependable Capacity	MW	59	73	88	110	130	149		
	Firm Energy	GWH/yr.	145	188	242	272	318	349		
	Secondary Energy	GWH/yr.	93	91	80	87	76	81		
	Total Energy	GWH/yr.	238	279	322	359	394	430		
Dabong	NHWL	EL.m	54	56	58	60	62	64	66	67
	LWL	EL.m	48	48	47	52	52	55	58	58
	Live Storage Volume	MCM	407	640	910	916	1213	1213	1213	1524
	TWL	EL.m	26	26	26	26	26	26	26	26
	Firm Discharge	cms	160	180	200	200	220	220	220	240
	Max. Discharge	cms	640	720	800	800	880	880	880	960
	Install Capacity	MW	144	171	200	215	246	261	275	303
	Dependable Capacity	MW	137	158	172	193	218	235	250	269
	Firm Energy	GWH/yr.	310	370	432	464	531	564	595	654
	Secondary Energy	GWH/yr.	317	309	295	312	293	307	322	289
	Total Energy	GWH/yr.	627	679	727	776	824	871	917	942

Note: NHWL; Normal High Water Level
LWL; Low water Level
TWL; Tailrace Water Level

- to be continued

表 3.13 水力発電計画の概要（２／２）

Dam	Description	Unit	Alternative					
Nenggiri	NHWL	EL.m	135	140	145	150	155	160
	LWL	EL.m	130	136	140	146	150	155
	Live Storage Volume	MCM	253	253	344	344	442	546
	TWL	EL.m	65.5	65.5	65.5	65.5	65.5	65.5
	Firm Discharge	cms	75	75	80	80	85	90
	Max. Discharge	cms	300	300	320	320	340	360
	Install Capacity	MW	175	188	213	227	255	284
	Dependable Capacity	MW	168	182	206	221	249	277
	Firm Energy	GWH/yr.	378	405	461	490	550	613
	Secondary Energy	GWH/yr.	205	218	204	215	196	176
	Total Energy	GWH/yr.	583	623	665	705	746	789

Note: NHWL; Normal High Water Level
LWL; Low water Level
TWL; Tailrace Water Level

表　3.14　　代替火力の概要

Alternative No.	Composition of Thermal Plant	Plant Factor	Unit Fix. Cost (M$/KW.YR)	Unit Var. Cost (M$/KWH.YR)
(1)	Gas Turbine + Combined Cycle (GT) (CC)	0.1 (GT) 0.7 (CC)	70.782 109.211	0.054 0.041
(2)	Gas Turbine + Steam Coal (GT) (SC)	0.1 (GT) 0.7 (SC)	70.782 215.114	0.054 0.026
(3)	Gas Turbine + Steam Oil (GT) (SO)	0.1 (GT) 0.7 (SO)	70.782 148.245	0.054 0.062
(4)	Gas Turbine (GT)	0.25	70.782	0.054
(5)	Combined Cycle (CC)	0.25	109.211	0.041

表　3.15　代替火力の建設費

Plant Type	Item	Unit	Value
Steam Oil	1. Installation Cost	M$/KW	2116
	2. Fix. O/M Cost	M$/KW	7.3
	3. Var. O/M Cost	M$/KWH	0.002
	4. Fuel Cost		
	(1) Buying Price	M$/t	437
	(2) Calorific Value	Kcal/l	9700
	(3) Equivalent Price	M$/Mcal	0.045
	(4) Heat Rate	Kcal/KWH	2400
	(5) Standard Cost	M$/KWH	0.108
Steam Coal	1. Installation Cost	M$/KW	1800
	2. Fix. O/M Cost	M$/KW	23.0
	3. Var. O/M Cost	M$/KWH	0.001
	4. Fuel Cost		
	(1) Buying Price	M$/t	114
	(2) Calorific Value	Kcal/l	6500
	(3) Equivalent Price	M$/Mcal	0.018
	(4) Heat Rate	Kcal/KWH	2500
	(5) Standard Cost	M$/KWH	0.045
Combined Cycle	1. Installation Cost	M$/KW	1541
	2. Fix. O/M Cost	M$/KW	13.8
	3. Var. O/M Cost	M$/KWH	0.002
	4. Fuel Cost		
	(1) Buying Price	M$/MBTU	7.8
	(2) Equivalent Price	MS/Mcal	0.031
	(3) Heat Rate	Kcal/KWH	2300
	(4) Standard Cost	M$/KWH	0.071
Gas Turbine	1. Installation Cost	M$/KW	1000
	2. Fix. O/M Cost	M$/KW	0.96
	3. Var. O/M Cost	M$/KWH	0.003
	4. Fuel Cost		
	(1) Buying Price	M$/MBTU	7.8
	(2) Equivalent Price	M$/Mcal	0.031
	(3) Heat Rate	Kcal/KWH	3000
	(4) Standard Cost	M$/KWH	0.093

表　3.16　　代替火力の特性

Item	Thermal Power: Steam Oil	Steam Coal	Combined Cycle	Gas Turbine	Hydro Power
Life Time (yr.)	25	25	20	15	50
Construction Time (yr.)	5	5	3	2	7
Transmission Loss (%)	3.0	3.0	1.0	1.0	5.0
Forced Outage (%)	15.0	15.0	10.0	20.0	0.5
Auxiliary Power Use (%)	5.0	7.0	2.0	2.0	0.5
Overhaul (%)	15.0	15.0	10.0	10.0	1.0
Annual Investment Rate during Construction Period (%)					
Year 1	-	-	-	-	5
2	-	-	-	-	10
3	5	5	-	-	25
4	25	25	-	-	25
5	40	40	10	-	20
6	20	20	70	40	10
7	10	10	20	60	5

表 3.17 水力発電計画の便益

Dam	Normal High Water Level (EL.m)	Dependable Capacity (MW)	Average Annual Energy (GWH)	Benefit Derived from Corresponding Cost of Thermal Plant	
				Alter. 1/ No.	Annual 2/ Benefit (Mil.M$/yr)
Lebir	90	149	430	1	35.16
	85	130	394	1	31.53
	80	110	359	1	27.85
	75	88	322	1	23.87
	70	73	279	1	20.34
	65	59	238	1	17.01
Dabong	67	269	942	1	71.03
	66	250	917	1	67.90
	64	235	871	1	64.24
	62	218	824	1	60.32
	60	193	776	1	55.53
	58	172	727	1	51.10
	56	158	679	1	47.45
	54	137	627	1	42.89
Nenggiri	160	277	789	1	64.88
	155	249	746	1	60.00
	150	221	705	1	55.21
	145	206	665	1	51.82
	140	182	623	1	47.40
	135	168	583	1	44.12

Notes: 1/ Alternative No.1: Gas Turbine + Combined Cycle,
Alternative No.2: Gas Turbine + Steam Coal,
Alternative No.3: Gas Turbine + Steam Oil,
Alternative No.4: Gas Turbine,
Alternative No.5: Combined Cycle.

2/ Assuming discount rate of 10%.

表　3.18　米の生産価格

(Unit : M$/ton)

Item	Price in 1988
1. Export Price of Thai 5% Brokens, FOB Bangkok	650
2. Grade Adjustment (less 10%)	-65
3. Ocean Freight & Insurance	75
4. CIF at Port Klang	660
5. Port Handling	22
6. Transportation from Klang to Kota Bharu	92
7. Wholesale Price, Kota Bharu	774
8. Transportation, KADA Area to Kota Bharu	-4
9. Ex-mill Price, KADA Area	770
10. Paddy Equivalent, KADA Area	501
11. Milling Cost	-44
12. Farm-gate Price	457

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

表 3.19 米の生産費用

Description	Unit	Production Type A	Production Type B	Production Type C
1. Mechanical working Item		Land Prep.	Land Prep./ Harvesting	Land Prep./ Harvesting
2. Planting method		Trans-planting	Trans-planting	Direct Seeding
3. Harvesting time	day	150	130-140	130-140
4. Area in percentage to entire paddy cropping area	%	85	10	5
5. Production cost				
5-1 Land preparation	M$/ha	228.00	225.00	330.00
5-2 Field levelling	M$/ha	-	-	20.00
5-3 Planting	M$/ha	292.50	300.00	70.00
5-4 Manuring	M$/ha	222.80	222.80	204.70
5-5 Pest/Disease control	M$/ha	122.25	122.25	312.00
5-6 Harvesting	M$/ha	425.00	333.00	370.00
5-7 Land tax	M$/ha	6.80	6.80	6.80
5-8 Irrigation fee	M$/ha	25.00	25.00	25.00
5-9 Total	M$/ha	1,322.35	1,234.85	1,338.50

Average Production Cost = M$ 1,314.4/ha
((4) x (5))

Source : Farm Budgets 1987, Kelantan SEPU, Malaysia

表 3.20 かんがい計画の便益

Dam Development Case		Reduction of Annual Deficit (cms)	Increment of Irrigation Area (ha)	Increment of Paddy Production (Mil.M$/year)	Annual 1/ Average Benefit (Mil.M$/year)
Dam Location	Firm Discharge (cms)				
Lebir	55	5.6	2,750	0.91	0.51
	60	6.2	3,044	1.01	0.57
	65	6.8	3,339	1.10	0.62
	70	7.3	3,584	1.19	0.65
	75	7.6	3,732	1.23	0.69
	80	7.9	3,879	1.28	0.72
Dabong	160	8.5	4,174	1.38	0.78
	180	8.5	4,174	1.38	0.78
	200	8.5	4,174	1.38	0.78
	220	8.5	4,174	1.38	0.78
	240	8.5	4,174	1.38	0.78
Nenggiri	75	7.7	3,781	1.25	0.70
	80	8.0	3,928	1.30	0.73
	85	8.2	4,026	1.33	0.75
	90	8.3	4,075	1.35	0.76

Note : 1/ Assuming discount rate of 10%, the benefit was calculated in terms of the annual average value for a 57-year period covering the dam construction period of 7 years and the dam project life of 50 years.

表 3.21 ダム計画の建設費

Dam	NHWL, El.m	Dam crest El.,m	Installed capacity, MW	Plant discharge, m^3/sec	Investment cost, million M$			
					Dam	Power	Relocation	Total
Lebir	65.0	78.2	67.0	220.0	232.5	131.0	103.5	467.0
	70.0	82.7	87.0	260.0	260.0	155.0	130.5	545.5
	75.0	86.8	112.0	300.0	276.5	179.0	159.0	614.5
	80.0	91.1	126.0	300.0	291.9	204.1	190.1	686.1
Dabong	54.0	69.6	160.0	720.0	59.0	356.8	264.4	680.2
	56.0	71.1	187.0	800.0	64.2	370.8	265.6	700.6
	58.0	72.7	201.0	800.0	70.4	384.2	267.0	721.6
	60.0	74.5	214.0	800.0	77.8	396.0	268.2	742.0
	62.0	76.4	246.0	880.0	83.8	407.6	269.5	760.9
	64.0	78.2	262.0	880.0	88.7	418.7	270.5	777.9
	66.0	78.5	296.0	960.0	89.7	428.9	270.6	789.2
	66.7	80.0	302.0	960.0	94.2	431.7	270.9	796.8
Nenggiri	135.0	151.3	175.0	300.0	251.2	234.0	15.1	500.7
	140.0	155.4	188.0	300.0	263.8	241.4	15.1	520.7
	145.0	159.7	213.0	320.0	280.2	268.4	15.1	564.1
	150.0	164.1	227.0	320.0	299.1	274.5	15.1	589.1
	155.0	168.4	255.0	340.0	318.9	288.1	15.1	622.5
	157.0	169.0	275.0	360.0	353.6	292.6	15.1	661.8

表 3.22 ダム計画の経済評価

Dam	Normal High Water Level (EL.m)	Firm Dis-charge (cms)	Depend-able Capacity (MW)	Average Annual Energy (GWH)	Cost for Dam Development: Investment Cost (Mil.M$)	O/M 1/ Cost (Mil.M$/yr)	Annual 2/ Cost (Mil.M$/yr)	Benefit from Dam Development: Hydro-power 2/ (Mil.M$/yr)	Irrigation Supply 2/ (Mil.M$/yr)	Total (Mil.M$/yr)	(B)/(C) Ratio	Net Benefit (B)-(C) 2/ (Mil.M$/yr)	EIRR (%)
Lebir	80	75	110	359	733.6	1.64	41.88	27.85	0.89	28.74	0.59	-20.14	5.30
	75	75	88	322	648.3	1.46	43.20	23.87	0.89	24.76	0.57	-18.44	5.15
	70	65	73	279	570.2	1.13	37.92	20.34	0.75	21.09	0.56	-16.83	4.97
	65	55	59	238	488.5	0.87	32.44	17.01	0.56	17.57	0.54	-14.87	4.82
Dabang	66.7	240	272	935	857.8	3.93	58.19	71.02	1.16	72.18	1.24	13.99	12.78
	66	240	264	918	850.1	3.85	57.64	69.41	1.16	70.57	1.22	12.93	12.59
	64	220	236	870	838.4	3.41	56.65	64.30	1.16	65.46	1.16	8.81	11.77
	62	220	217	822	821.2	3.20	55.42	60.13	1.16	61.29	1.11	5.87	11.20
	60	200	194	773	802.2	2.78	53.96	55.49	1.16	56.65	1.05	2.69	10.56
	58	200	179	728	781.7	2.61	52.53	51.88	1.16	53.04	1.01	0.51	10.11
	56	200	162	680	760.6	2.43	51.06	47.91	1.16	49.07	0.96	-1.98	9.57
	54	180	149	633	739.8	2.08	49.51	44.42	1.16	45.58	0.92	-3.94	9.11
Neng-giri	157	90	266	762	670.2	3.58	45.72	62.50	1.06	63.56	1.39	17.84	14.64
	155	85	249	746	657.8	3.32	44.78	60.00	1.02	61.02	1.36	16.25	14.28
	150	80	221	705	611.7	2.95	41.57	55.21	0.98	56.19	1.35	14.62	14.11
	145	80	206	665	581.1	2.77	39.47	51.82	0.98	52.80	1.34	13.33	13.94
	140	75	182	623	534.0	2.44	36.22	47.40	0.92	48.32	1.33	12.10	13.87
	135	75	168	583	499.5	2.28	33.88	44.12	0.92	45.04	1.33	11.16	13.81

Notes: 1/ O/M Cost = Firm Capacity (MW) x 13(M$/KW.year)
2/ Assuming discount rate of 10%

表 3.23 ダボンダムに水没する村落

Name of Town / Kampung	Population	Number of Households		
		Farming	Non-Farming	Total
A. Dabong Dam (Jeli District)				
1. Kg. Tunku Abdul Rahman Kuala Balah	2,645	503	26	529
2. Kg. Bukit Tok Ali (Dusun Manal)	608	128	7	135
3. Kg. Bukit Jering	1,527	239	18	257
4. Kg. Jerimbong	580	96	4	100
5. Kg. Tebing Timbah	186	48	6	54
6. Kg. Bukit Selai	334	64	3	67
7. Kg. Kubur Datu	816	157	9	166
8. Kg. Jaber	190	49	3	52
9. Kg. Lubok Bongor	1,057	193	22	215
10. Kg. Renyut	141	30	2	32
11. Kg. Chegar Bedil	229	43	3	46
12. Kg. Pasir Dusun	527	98	5	103
13. Kg. Teluk Bayu	132	24	2	26
14. Kg. Belahat	381	68	8	76
15. Kg. Berdang	684	120	14	134
Total	10,037	1,860	132	1,992
B. Dabong Dam (Kuala Krai District)				
1. Kg. Biak	200	50	-	50
2. Kg. Kl pergau	120	30	-	30
3. Kg. Kandek	533	100	33	133
4. Kg. Jewang	240	50	10	60
5. Kg. Rambai	50	12	-	12
6. Kg. Stong	53	10	7	17
7. Kg. Kl Mahligai	84	21	-	21
8. Kg. Serasa	90	22	-	22
9. Kg. Pulai Layak	18	5	-	5
10. Kg. Sg. Suda	13	4	-	4
11. Kg. Dabong	2,000	350	150	500
12. Kg. Kemubu	1,017	200	55	255
Total	4,418	854	255	1,109

Source: Jeli Distric office, Kuala Krai District office and Orang Asli Department (JHEOA), Kelantan

表 5.1 ダム計画の洪水調節効果 'e Dams

(Unit : cms)

Case	Scheme	Peak Cut Ratio 1/			Peak Discharge at Guillemard Bridge	
					20-year	50-year
1	Without structures 2/	-			13,437	16,369
2	R/I 3/ 4/	-			14,350	17,420
3	Nenggiri + R/I	100			13,367	16,175
4	- do -	90			13,394	16,206
5	- do -	80			13,435	16,254
6	- do -	76	5/		13,456	16,299
7	Kemubu + R/I	40			11,609	13,936
8	- do -	30			11,689	14,136
9	- do -	20			12,118	14,719
10	- do -	15	5/		12,500	15,185
11	Lower Pergau + R/I	30			12,801	15,627
12	- do -	20			12,971	15,879
13	- do -	10			13,399	16,314
14	- do -	9	5/		13,433	16,348
15	Dabong + R/I	80			8,459	10,586
16	- do -	70			8,545	10,683
17	- do -	60			8,655	10,802
18	- do -	59	5/		8,988	11,079
19	Lebir + R/I	70			10,190	12,442
20	- do -	60			10,606	12,580
21	- do -	50			10,648	12,817
22	- do -	37	5/		10,661	13,213
23	Lebir + Nenggiri + R/I	70	100	6/	10,021	11,592
24	- do -	60	90		10,157	11,999
25	- do -	50	80		10,238	12,088
26	- do -	37	76		10,249	12,101
27	Lebir + Kemubu + R/I	70	40		8,429	9,948
28	- do -	60	30		8,456	10,063
29	- do -	50	20		8,789	10,732
30	- do -	37	15		8,896	11,334
31	Lebir + Dabong + R/I	70	80		4,936	6,066
32	- do -	60	70		5,224	6,429
33	- do -	50	60		5,486	6,745
34	- do -	37	59		6,000	7,466

Notes : 1/ Peak-cut ratio = Peak outflow from the spillway for flood mitigation / peak inflow

2/ Flood discharge in natural condition

3/ R/I means river improvement

4/ Inundated flow between Kuala Krai and Guillemard Bridge is confined in the river channel.

5/ An ordinary overflow weir for flood mitigation is not provided to the spillway for the case with the lowest peak-cut ratio of each dam scheme; that is, the flood mitigation to the downstream reaches is only expected with the overflow weir for PMF.

6/ The peak-cut ratio of the Lebir dam scheme is shown in the first column, while the second column for the Nenggiri dam scheme.

表 5.2 余水吐の概要

Scheme	50-yr peak discharge (cms)	Peak Cut Ratio (%)	Dam type	Dam Crest Elevation (El;m)	NHWL 1/ (El;m)	Spillway for flood mitigation, m: SWL 1/	Width (a)	Height (b)	Spillway for DF, m 1/: DFWL 1/	Width (c)
		100	Rockfill	169.0	150.7	158.6	-	7.9	166.0	75.0
Nenggiri	4,668	90	Rockfill	169.0	152.9	158.8	17.0	5.9	166.0	75.0
	(1984)	80	Rockfill	169.0	155.0	159.5	50.0	4.5	166.0	75.0
		76	Rockfill	169.0	157.0	-	-	-	166.0	75.0
		40	Concrete Gravity	82.0	53.0	3/ 70.8	20.0	17.8	80.0	100.0
Kemubu	4,943	30	Concrete Gravity	82.0	58.4	71.4	37.0	13.0	80.0	100.0
2/	(1983)	20	Concrete Gravity	82.0	63.0	72.5	70.0	9.5	80.0	100.0
		15	Concrete Gravity	82.0	65.7	-	-	-	80.0	100.0
		80	Concrete Gravity	80.0	62.4	73.1	25.0	10.7	78.0	100.0
Dabong	8,431	70	Concrete Gravity	80.0	64.1	73.7	45.0	9.6	78.0	100.0
	(1983)	60	Concrete Gravity	80.0	65.6	74.2	70.0	8.6	78.0	100.0
		59	Concrete Gravity	80.0	66.7	-	-	-	78.0	100.0
		70	Rockfill	91.1	76.3	84.2	40.0	7.9	87.6	150.0
Lebir	5,561	60	Rockfill	91.1	77.9	84.5	70.0	6.6	87.6	150.0
	(1983)	50	Rockfill	91.1	79.6	84.7	120.0	5.1	87.6	150.0
		37	Rockfill	91.1	80.0	-	-	-	87.6	150.0

Note : 1/ DF : Spillway Design Flood, NHWL : Normal High Water Level
SWL : Surcharge Water Level, DFWL : Design Flood Water Level
2/ The Kemubu project is developed as a single purpose project of flood mitigation.
3/ The crest elevation of spillway for flood mitigation

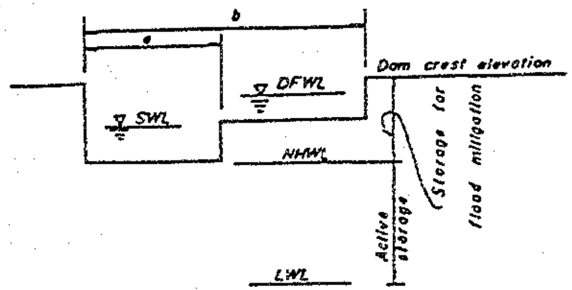

表　5.3　　水資源開発を含めた組合せ案の建設費（1／2）

Combination	Peak cut ratio	Dam Project 1/ Dam	Power	Relocation	Total	River improvement R/I	Compensation	Total	Grand Total
1. R/I only	-	-	-	-	-	751	132	883	883.0
2. Nenggiri + R/I	100	353.6	278.0	49.5	647.1	707	125	832	1,479.1
	90	353.6	284.5	49.5	653.6	708	125	833	1,486.6
	80	353.6	290.8	49.5	659.9	710	125	835	1,494.9
	76	353.6	297.0	49.5	666.1	713	126	839	1,505.1
3. Kemubu + R/I	40	84.9	-	54.7	139.6	626	111	737	876.6
	30	84.9	-	54.7	139.6	634	112	746	885.6
	20	84.9	-	54.7	139.6	655	116	771	910.6
	15	84.9	-	54.7	139.6	671	119	790	929.6
4. Dabong + R/I	80	94.2	410.1	270.9	775.2	481	85	566	1,341.2
	70	94.2	419.3	270.9	784.4	485	86	571	1,355.4
	60	94.2	427.0	270.9	792.1	499	88	587	1,379.1
	59	94.2	431.7	270.9	796.8	510	90	600	1,396.8
5. Lebir + R/I	70	291.9	184.7	190.1	666.7	570	101	671	1,337.7
	60	291.9	193.1	190.1	675.1	576	102	678	1,353.1
	50	291.9	202.0	190.1	684.0	586	103	689	1,373.0
	37	291.9	204.1	190.1	686.1	599	106	705	1,391.1
6. Lebir + Nenggiri + R/I	70 100	645.5	462.7	205.6	1,313.8	530	93	623	1,936.8
	60 90	645.5	477.6	205.6	1,328.7	555	98	653	1,981.7
	50 80	645.5	492.8	205.6	1,343.9	557	98	655	1,998.9
	37 76	645.5	501.1	205.6	1,352.2	558	98	656	2,008.2

Cost, million M$

表　5. 3　水資源開発を含めた組合せ案の建設費（2／2）

Combination	Peak cut ratio	Cost, million M$ Dam Project 1/ Dam	Power	Relocation	Total	River improvement R/I	Compensation	Total	Grand Total
7. Lebir + Kemubu + R/I	70 15	376.8	184.7	244.8	806.3	445	78	523	1,329.3
	60 20	376.8	193.1	244.8	814.7	450	80	530	1,344.7
	50 30	376.8	202.0	244.8	823.6	490	86	576	1,399.6
	37 40	376.8	204.1	244.8	825.7	521	92	613	1,438.7
8. Lebir + Dabong + R/I	70 80	386.1	594.8	461.0	1,441.9	156	28	184	1,625.9
	60 70	386.1	612.4	461.0	1,459.5	184	33	217	1,676.5
	50 60	386.1	629.0	461.0	1,476.1	210	37	247	1,723.1
	37 59	386.1	635.8	461.0	1,482.9	269	48	317	1,799.9

Note : 1/ The specific cost of flood mitigation is as follows:
M$ 132.0 million for Nenggiri
M$ 193.0 million for Dabong
M$ 191.0 million for Lebir

表　5.4　　組合せ案の費用配分スケジュール

(Unit : million M$)

Combination Plan	Malaysia Plan																			
	5 th		6 th					7 th					8 th					9 th		
	'89	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	2000	'01	'02	'03	'04	'05	'06	'07	'08
1. R/I only						45.8	45.8	45.8	45.8	45.8	45.8	45.8	45.8	45.8	45.8	45.8	45.8	45.8	45.8	45.8
2. Nenggiri + R/I					33.5	124.5	225.1	225.1	191.5	124.5	90.9	57.4	57.4	57.4	57.4	57.4	57.4			
3. Kemubu + R/I						83.9	129.1	99.0	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8	53.8			
4. Dabong + R/I						94.1	136.9	265.5	265.5	222.6	136.9	94.1	51.2	51.2						
5. Lebir + R/I					36.7	117.2	227.3	227.3	190.6	117.2	80.5	43.8	43.8	43.8	43.8	43.8	43.8			
6. Lebir + Nenggiri + R/I					36.7	125.9	236.0	236.0	199.3	125.9	122.7	119.6	220.2	220.2	186.6	67.1	33.5			
7. Lebir + Kemubu + R/I					36.7	115.2	225.3	225.3	188.6	115.2	78.5	71.9	117.1	87.0	41.8					
8. Lebir + Dabong + R/I					36.7	103.1	213.2	213.2	176.5	103.1	109.3	115.4	214.3	214.3	171.4	85.7	42.9			

表 5.5 組合せ案の経済比較

Case	Scheme	Peak-cut ratio, %		EIRR %
1.	R/I	-		5.34
2.	Nenggiri + R/I	100		9.91
3.	- do -	90		10.33
4.	- do -	80		10.53
5.	- do -	76		10.87
6.	Kemubu + R/I	40		4.44
7.	- do -	30		4.38
8.	- do -	20		4.22
9.	- do -	15		4.06
10.	Dabong + R/I	80		11.01
11.	- do -	70		11.31
12.	- do -	60		11.78
13.	- do -	59		11.93
14.	Lebir + R/I	70		6.11
15.	- do -	60		6.20
16.	- do -	50		6.29
17.	- do -	37		6.27
18.	Lebir + Nenggiri + R/I	70	100	9.24
19.	- do -	60	90	9.49
20.	- do -	50	80	9.66
21.	- do -	37	76	9.89
22.	Lebir + Kemubu + R/I	70	15	5.55
23.	- do -	60	20	6.06
24.	- do -	50	30	6.32
25.	- do -	37	40	6.34
26.	Lebir + Dabong + R/I	70	80	11.08
27.	- do -	60	70	11.19
28.	- do -	50	60	11.37
29.	- do -	37	59	11.19

表　6.1　　ダムと余水吐の規模の関係

Storage Dam	Catchment Area (sq.km)	Scale	Riverbed El. (m)	Spillway Width (m)	Dimension (El;m)			Dam Height (m)	Storage (MCM)		Peak Discharge (cms)		Peakcut Ratio (%)
					NHWL	DFWL	Dam Crest		at NHWL	at DFWL	Inflow 1/	Outflow	
Nenggiri	3,690	Maximum	61	75	157.0	166.0	169.0	108.0	3,101	4,213	4,668	1,120	76
		Medium		75	126.0	141.0	144.0	83.0	899	1,686	4,668	2,087	55
		Minimum		75	95.0	115.0	119.0	58.0	152	532	4,668	3,552	24
Kemubu	5,630	Maximum	36	100	65.7	80.0	82.0	46.0	726	2,163	4,943	4,184	15.4
		Medium		100	59.6	75.7	77.7	41.7	352	1,461	4,943	4,215	14.7
		Minimum		100	55.0	71.4	73.4	37.4	250	1,139	4,943	4,389	11
Dabong	7,480	Maximum	22	100	66.7	78.0	80.0	58.0	3,707	6,631	8,431	3,457	59
		Medium		85	54.8	69.0	71.0	49.0	1,532	4,294	8,431	4,768	43
		Minimum		70	40.0	60.0	62.0	40.0	307	2,121	8,431	6,319	25
Lebir	2,480	Maximum	30	150	80.0	87.6	91.1	61.1	2,393	3,917	5,561	3,503	37
		Medium		150	63.3	73.2	76.7	46.7	726	1,563	5,561	4,942	11
		Minimum		150	47.0	58.8	62.3	32.3	102	463	5,561	5,322	4

Note : 1/ Peak discharge of 50-year probable flood.

表 6.2 貯水ダムの治水効果

Storage Dam	Catchment Area (km2)	Scale	Spillway Width (m)	Peak Discharge (cms) Inflow 1/	Peak Discharge (cms) Outflow	Peakcut Ratio (%)	Peak Discharge at Guillemard Bridge (cms)
Nenggiri	3,690	Maximum	75	4,668	1,120	76	16,299 (1,121)
		Medium	75	4,668	2,087	55	16,550 (870)
		Minimum	75	4,668	3,552	24	16,890 (530)
Kemubu	5,630	Maximum	100	4,943	4,184	15.4	15,185 (2,235)
		Medium	100	4,943	4,215	14.7	15,279 (2,141)
		Minimum	100	4,943	4,389	11	15,802 (1,618)
Dabong	7,480	Maximum	100	8,431	3,457	59	11,079 (6,341)
		Medium	85	8,431	4,768	43	12,334 (5,086)
		Minimum	70	8,431	6,319	25	13,602 (3,818)
Lebir	2,480	Maximum	150	5,561	3,503	37	13,213 (4,207)
		Medium	150	5,561	4,942	11	15,265 (2,155)
		Minimum	150	5,561	5,322	4	16,257 (1,163)

Note : 1/ Peak discharge of 50-year probable flood.
2/ Parenthesized figures are obtained by subtracting peak discharge at Guillemard Bridge from that of river improvement only. (17,420 cms)

表　6.3　　ダム組合せ案の治水効果

No.	Combination	Peak Discharge at Guillemard Bridge (cms)
1	R/I only	17,420
2	Ds	13,602
3	Dm	12,334
4	Dl	11,079
5	Ls	16,257
6	Lm	15,265
7	Ll	13,213
8	Ns	16,890
9	Nm	16,550
10	Nl	16,229
11	Ks	15,802
12	Km	15,279
13	Kl	15,185
14	Ds + Ls	13,033
15	Dm + Ls	11,765
16	Dl + Ls	10,510
17	Ds + Lm	12,014
18	Dm + Lm	10,746
19	Dl + Lm	9,491
20	Ds + Ll	9,989
21	Dm + Ll	8,721
22	Dl + Ll	7,466
23	Ds + Ls + Ns	11,928
24	Ds + Lm + Ns	11,648
25	Ds + Ll + Ns	11,327
26	Ds + Ls + Nm	10,926
27	Ds + Lm + Nm	10,656
28	Ds + Ll + Nm	10,335
29	Ds + Ls + Nl	8,874
30	Ds + Lm + Nl	8,604
31	Ds + Ll + Nl	8,283
32	Ks + Ls	13,768
33	Km + Ls	13,245
34	Kl + Ls	13,151
35	Ks + Lm	12,776
36	Km + Lm	12,253
37	Kl + Lm	12,159
38	Ks + Ll	10,724
39	Km + Ll	10,201
40	Kl + Ll	10,107
41	Ns + Ls	15,736
42	Nm + Ls	15,466
43	Nl + Ls	15,145
44	Ns + Lm	14,744
45	Nm + Lm	14,474
46	Nl + Lm	14,153
47	Ns + Ll	12,692
48	Nm + Ll	12,422
49	Nl + Ll	12,101

Remarks ; Dam scheme　D : Dabong　N : Nenggiri
　　　　　　　　　　L : Lebir　K : Kemubu

Dam scale　l : maximum　m : medium
　　　　　　s : minimum

表 6.4 ダム組合せ案の建設費及び社会的影響度の大きさ

No.	Combination	CONSTRUCTION COST (million M$)						SOCIAL IMPACT																				
		Dam				R/I	Total	Dabong							Lebir					Nenggiri		Kemubu					R/I	
		Dabong	Lebir	Nenggiri	Kemubu			H(nos) (1)	P(ha)	OP(ha)	RP(ha)	F(ha)	R(km)	PR(km)	H(nos) (2)	OP(ha)	RP(ha)	F(ha)	PR(km)	H(nos) (3)	F(ha)	H(nos) (4)	OP(ha)	RP(ha)	F(ha)	R(km)	H(nos) (5)	B(n
1	R/I only					883	883																				800	
2	Ds + R/I	445				726	1,171	4,800	40	390	5,580	4,110	30	26													800	
3	Dm + R/I	555				668	1,223	6,100	40	540	6,090	6,030	35	44													800	
4	Dl + R/I	745				603	1,348	7,300	40	1,400	9,850	11,230	55	57													770	
5	Ls + R/I		220			838	1,058								90	2,100	1,200	2,300									800	
6	Lm + R/I		351			798	1,149								140	5,400	2,900	4,600									800	
7	Ll + R/I		611			708	1,319								165	11,800	5,300	8,600	5								800	
8	Ns + R/I			106		862	968													320	1,600						800	
9	Nm + R/I			246		848	1,094													510	6,100						800	
10	Nl + R/I			403		835	1,238													640	13,900						800	
11	Ks + R/I				139	819	958															1,000	180	790	1,910	16	800	
12	Km + R/I				189	798	987															1,200	560	1,660	3,780	23	800	
13	Kl + R/I				246	793	1,039															1,295	1,160	2,990	6,600	28	800	
14	Ds + Ls + R/I	445	220			698	1,363	4,800	40	390	5,580	4,110	30	26	90	2,100	1,200	2,300									800	
15	Dm + Ls + R/I	555	220			638	1,413	6,100	40	540	6,090	6,030	35	44	90	2,100	1,200	2,300									780	
16	Dl + Ls + R/I	745	220			563	1,528	7,300	40	1,400	9,850	11,230	55	57	90	2,100	1,200	2,300									770	
17	Ds + Lm + R/I	445	351			652	1,448	4,800	40	390	5,580	4,110	30	26	140	5,400	2,900	4,600									800	
18	Dm + Lm + R/I	555	351			580	1,486	6,100	40	540	6,090	6,030	35	44	140	5,400	2,900	4,600									770	
19	Dl + Lm + R/I	745	351			492	1,568	7,300	40	1,400	9,850	11,230	55	57	140	5,400	2,900	4,600									750	
20	Ds + Ll + R/I	445	611			529	1,585	4,800	40	390	5,580	4,110	30	26	165	11,800	5,300	8,600	5								760	
21	Dm + Ll + R/I	555	611			428	1,594	6,100	40	540	6,090	6,030	35	44	165	11,800	5,300	8,600	5								740	
22	Dl + Ll + R/I	745	611			318	1,674	7,300	40	1,400	9,850	11,230	55	57	165	11,800	5,300	8,600	5								670	
23	Ds + Ls + Ns + R/I	445	220	106		647	1,418	4,800	40	390	5,580	4,110	30	26	90	2,100	1,200	2,300		320	1,600						800	
24	Ds + Lm + Ns + R/I	445	351	106		634	1,536	4,800	40	390	5,580	4,110	30	26	140	5,400	2,900	4,600		320	1,600						790	
25	Ds + Ll + Ns + R/I	445	611	106		613	1,775	4,800	40	390	5,580	4,110	30	26	165	11,800	5,300	8,600	5	320	1,600						780	
26	Ds + Ls + Nm + R/I	445	220	246		590	1,501	4,800	40	390	5,580	4,110	30	26	90	2,100	1,200	2,300		510	6,100						770	
27	Ds + Lm + Nm + R/I	445	351	246		573	1,615	4,800	40	390	5,580	4,110	30	26	140	5,400	2,900	4,600		510	6,100						770	
28	Ds + Ll + Nm + R/I	445	611	246		555	1,857	4,800	40	390	5,580	4,110	30	26	165	11,800	5,300	8,600	5	510	6,100						760	
29	Ds + Ls + Nl + R/I	445	220	403		443	1,511	4,800	40	390	5,580	4,110	30	26	90	2,100	1,200	2,300		640	13,900						740	
30	Ds + Lm + Nl + R/I	445	351	403		420	1,619	4,800	40	390	5,580	4,110	30	26	140	5,400	2,900	4,600		640	13,900						730	
31	Ds + Ll + Nl + R/I	445	611	403		393	1,852	4,800	40	390	5,580	4,110	30	26	165	11,800	5,300	8,600	5	640	13,900						720	
32	Ks + Ls + R/I		220		139	732	1,091								90	2,100	1,200	2,300				1,000	180	790	1,910	16	800	
33	Km + Ls + R/I		220		189	710	1,119								90	2,100	1,200	2,300				1,200	560	1,660	3,780	23	800	
34	Kl + Ls + R/I		220		246	705	1,171								90	2,100	1,200	2,300				1,295	1,160	2,990	6,600	28	800	
35	Ks + Lm + R/I		351		139	688	1,178								140	5,400	2,900	4,600				1,000	180	790	1,910	16	800	
36	Km + Lm + R/I		351		189	665	1,205								140	5,400	2,900	4,600				1,200	560	1,660	3,780	23	800	
37	Kl + Lm + R/I		351		246	658	1,255								140	5,400	2,900	4,600				1,295	1,160	2,990	6,600	28	800	
38	Ks + Ll + R/I		611		139	577	1,327								165	11,800	5,300	8,600	5			1,000	180	790	1,910	16	770	
39	Km + Ll + R/I		611		189	540	1,340								165	11,800	5,300	8,600	5			1,200	560	1,660	3,780	23	760	
40	Kl + Ll + R/I		611		246	537	1,394								165	11,800	5,300	8,600	5			1,295	1,160	2,990	6,600	28	760	
41	Ns + Ls + R/I		220	106		816	1,142								90	2,100	1,200	2,300		320	1,600						800	
42	Nm + Ls + R/I		220	246		805	1,271								90	2,100	1,200	2,300		510	6,100						800	
43	Nl + Ls + R/I		220	403		792	1,415								90	2,100	1,200	2,300		640	13,900						800	
44	Ns + Lm + R/I		351	106		775	1,232								140	5,400	2,900	4,600		320	1,600						800	
45	Nm + Lm + R/I		351	246		764	1,361								140	5,400	2,900	4,600		510	6,100						800	
46	Nl + Lm + R/I		351	403		748	1,502								140	5,400	2,900	4,600		640	13,900						800	
47	Ns + Ll + R/I		611	106		684	1,401								165	11,800	5,300	8,600	5	320	1,600						800	
48	Nm + Ll + R/I		611	246		670	1,527								165	11,800	5,300	8,600	5	510	6,100						800	
49	Nl + Ll + R/I		611	403		655	1,669								165	11,800	5,300	8,600	5	640	13,900						800	

Remarks ; Dam Scheme D : Dabong L : Lebir N : Nenggiri K : Kemubu
Dam Scale s : small m : medium l : large
Compensation H : houses P : Paddy OP : Oil palm RP : Rubber R : Railway PR : Public road F : Forest B : Bridge
EIRR F.M. : Flood mitigation P.G. : Power generation

表 6.4 ダム組合せ案の建設費及び社会的影響度の大きさ

CTION COST (million M$)				SOCIAL IMPACT																								ORDER				EIRR	
Dam				Dabong							Lebir					Nenggiri		Kemubu					R/I		(A) Total for H (nos) (1)-(4)	(B) Total for H (nos) (1)-(5)	Total for Plant. (ha)	(C) Const. Cost	(D) Social Impact for(A)	(E) Social Impact for(B)	Total (C)+(E)	F.M. (%)	F.M. & P.G. (%)
Nenggiri	Kemubu	R/I	Total	H(nos) (1)	P(ha)	OP(ha)	RP(ha)	F(ha)	R(km)	PR(km)	H(nos) (2)	OP(ha)	RP(ha)	F(ha)	PR(km)	H(nos) (3)	F(ha)	H(nos) (4)	OP(ha)	RP(ha)	F(ha)	R(km)	H(nos) (5)	B(nos)									
		883	883																				800	3	0	800		1		1	2	4.5	
		726	1,171	4,800	40	390	5,580	4,110	30	26													800	2	4,800	5600	5,970	13	28	29	42	2.6	
		668	1,223	6,100	40	540	6,090	6,030	35	44													800	2	6,100	6900	6,630	16	41	42	58	2.3	4.8
		603	1,348	7,300	40	1,400	9,850	11,230	55	57													770	1	7,300	8070	11,250	24	45	46	70	1.9	9.1
		838	1,058								90	2,100	1,200	2,300									800	3	90	890	3,300	6	1	2	8	3.2	
		798	1,149								140	5,400	2,900	4,600									800	3	140	940	8,300	11	2	3	14	2.8	3.7
		708	1,319								165	11,800	5,300	8,600	5								800	2	165	965	17,100	21	3	4	25	2.0	5.6
106		862	968													320	1,600						800	3	320	1120		3	4	5	8	3.8	
246		848	1,094													510	6,100						800	3	510	1310		8	8	9	17	3.1	6.1
403		835	1,238													640	13,900						800	3	640	1440		18	10	11	29	2.2	10.2
	139	819	958															1,000	180	790	1,910	16	800	3	1,000	1800	970	2	16	17	19	3.8	
	189	798	987															1,200	560	1,660	3,780	23	800	3	1,200	2000	2,220	4	20	21	25	3.6	
	246	793	1,039															1,295	1,160	2,990	6,600	28	800	3	1,295	2095	4,150	5	22	23	28	3.3	
		698	1,363	4,800	40	390	5,580	4,110	30	26	90	2,100	1,200	2,300									800	2	4,890	5690	9,270	26	29	30	56	1.8	
		638	1,413	6,100	40	540	6,090	6,030	35	44	90	2,100	1,200	2,300									780	1	6,190	6970	9,930	29	42	43	72	1.7	3.5
		563	1,528	7,300	40	1,400	9,850	11,230	55	57	90	2,100	1,200	2,300									770	1	7,390	8160	14,550	38	47	48	86	1.4	7.9
		652	1,448	4,800	40	390	5,580	4,110	30	26	140	5,400	2,900	4,600									800	2	4,940	5740	14,270	32	31	31	63	1.8	2.6
		580	1,486	6,100	40	540	6,090	6,030	35	44	140	5,400	2,900	4,600									770	1	6,240	7010	14,930	33	44	45	78	1.7	4.0
		492	1,588	7,300	40	1,400	9,850	11,230	55	57	140	5,400	2,900	4,600									750	1	7,440	8190	19,550	41	48	49	90	1.4	8.0
		529	1,585	4,800	40	390	5,580	4,110	30	26	165	11,800	5,300	8,600	5								760	1	4,965	5725	23,070	40	30	32	72	1.7	4.4
		428	1,594	6,100	40	540	6,090	6,030	35	44	165	11,800	5,300	8,600	5								740	1	6,265	7005	23,730	42	43	44	86	1.3	5.7
		318	1,674	7,300	40	1,400	9,850	11,230	55	57	165	11,800	5,300	8,600	5								670	1	7,465	8135	28,350	46	46	47	93	1.1	9.0
106		647	1,418	4,800	40	390	5,580	4,110	30	26	90	2,100	1,200	2,300		320	1,600						800	1	5,210	6010	9,270	31	32	33	64	1.7	
106		634	1,536	4,800	40	390	5,580	4,110	30	26	140	5,400	2,900	4,600		320	1,600						790	1	5,260	6050	14,270	39	33	34	73	1.6	2.1
106		613	1,775	4,800	40	390	5,580	4,110	30	26	165	11,800	5,300	8,600	5	320	1,600						780	1	5,285	6065	23,070	47	34	35	82	0.7	3.8
246		590	1,501	4,800	40	390	5,580	4,110	30	26	90	2,100	1,200	2,300		510	6,100						770	1	5,400	6170	9,270	34	35	36	70	1.6	3.9
246		573	1,615	4,800	40	390	5,580	4,110	30	26	140	5,400	2,900	4,600		510	6,100						770	1	5,450	6220	14,270	43	36	37	80	1.4	4.0
246		555	1,857	4,800	40	390	5,580	4,110	30	26	165	11,800	5,300	8,600	5	510	6,100						760	1	5,475	6235	23,070	49	37	38	87	0.6	5.1
403		443	1,511	4,800	40	390	5,580	4,110	30	26	90	2,100	1,200	2,300		640	13,900						740	1	5,530	6270	9,270	36	38	39	75	1.6	6.8
403		420	1,619	4,800	40	390	5,580	4,110	30	26	140	5,400	2,900	4,600		640	13,900						730	1	5,580	6310	14,270	44	39	40	84	1.4	7.4
403		393	1,852	4,800	40	390	5,580	4,110	30	26	165	11,800	5,300	8,600	5	640	13,900						720	1	5,605	6325	23,070	48	40	41	89	0.6	7.8
	139	732	1,091								90	2,100	1,200	2,300				1,000	180	790	1,910	16	800	2	1,090	1890	4,270	7	17	18	25	3.0	
	189	710	1,119								90	2,100	1,200	2,300				1,200	560	1,660	3,780	23	800	2	1,290	2090	5,520	9	21	22	31	2.9	
	246	705	1,171								90	2,100	1,200	2,300				1,295	1,160	2,990	6,600	28	800	2	1,385	2185	7,450	12	25	26	38	2.7	
	139	688	1,178								140	5,400	2,900	4,600				1,000	180	790	1,910	16	800	2	1,140	1940	9,270	14	19	20	34	2.8	3.6
	189	665	1,205								140	5,400	2,900	4,600				1,200	560	1,660	3,780	23	800	2	1,340	2140	10,520	15	24	25	40	2.7	3.3
	246	658	1,255								140	5,400	2,900	4,600				1,295	1,160	2,990	6,600	28	800	2	1,435	2235	12,450	19	27	28	47	2.5	3.3
	139	577	1,327								165	11,800	5,300	8,600	5			1,000	180	790	1,910	16	770	1	1,165	1935	18,070	22	18	19	41	2.1	5.7
	189	540	1,340								165	11,800	5,300	8,600	5			1,200	560	1,660	3,780	23	760	1	1,365	2125	19,320	23	23	24	47	1.9	5.5
	246	537	1,394								165	11,800	5,300	8,600	5			1,295	1,160	2,990	6,600	28	760	1	1,460	2220	21,250	27	26	27	54	1.9	5.6
106		816	1,142								90	2,100	1,200	2,300		320	1,600						800	3	410	1210	3,300	10	5	6	16	2.7	
246		805	1,271								90	2,100	1,200	2,300		510	6,100						800	3	600	1400	3,300	20	9	10	30	2.2	5.1
403		792	1,415								90	2,100	1,200	2,300		640	13,900						800	3	730	1530	3,300	30	13	14	44	1.6	9.2
106		775	1,232								140	5,400	2,900	4,600		320	1,600						800	3	460	1260	8,300	17	6	7	24	2.5	3.4
246		764	1,361								140	5,400	2,900	4,600		510	6,100						800	3	650	1450	8,300	25	11	12	37	2.0	5.1
403		748	1,502								140	5,400	2,900	4,600		640	13,900						800	3	780	1580	8,300	35	14	15	50	1.5	8.3
106		684	1,401								165	11,800	5,300	8,600	5	320	1,600						800	2	485	1285	17,100	28	7	8	36	1.8	5.3
246		670	1,527								165	11,800	5,300	8,600	5	510	6,100						800	2	675	1475	17,100	37	12	13	50	1.4	6.4
403		655	1,669								165	11,800	5,300	8,600	5	640	13,900						800	2	805	1605	17,100	45	15	16	61	0.9	8.9

L : Lebir N : Nenggiri K : Kemubu
m : medium l : large
P : Paddy OP : Oil palm RP : Rubber R : Railway PR : Public road F : Forest B : Bridge
d mitigation P.G. : Power generation

表　6.5　洪水ピーク流量の基本構想を満す組合せ案

No.	Combination	Peak discharge at Guillemard Bridge, m^3/sec	Households to be submerged, nos
1	Dl + Ls	10,510	6,190
2	Dm + Lm	10,746	6,240
3	Dl + Lm	9,491	7,440
4	Ds + Ll	9,989	4,965
5	Dm + Ll	8,721	6,265
6	Dl + Ll	7,466	7,465
7	Ds + Ls + Nm	10,926	5,400
8	Ds + Lm + Nm	10,656	5,450
9	Ds + Ll + Nm	10,335	5,475
10	Ds + Ls + Nl	8,874	5,530
11	Ds + Lm + Nl	8,604	5,580
12	Ds + Ll + Nl	8,283	5,605
13	Ks + Ll	10,724	1,165
14	Km + Ll	10,201	1,365
15	Kl + Ll	10,107	1,460

Remarks : Dam scheme D : Dabong L : Lebir
K : Kemubu N : Nenggiri
Dam scale l : maximum m : medium s : minimum

表 6.6 ギルマード橋地点での治水効果

(Unit : m^3/sec)

Case	Combination	Probability				
		1/5	1/10	1/20	1/30	1/50
1.	Natural condition	8,680	11,430	13,470	14,770	16,370
2.	R/I only 1/	9,190	12,100	14,350	15,760	17,420
3.	Lebir + R/I	6,860	8,840	10,520	11,530	12,910
4.	Kemubu + R/I	8,630	11,440	13,180	14,290	15,800
5.	Lebir + Kemubu + R/I	6,260	8,060	9,270	9,940	10,650

Note : 1/ Flood discharge inundated at the reaches between Kuala Krai and Guillemard Bridge is confined in the river channel by river improvement.

表 6.7 河川改修工事実施のための河道区分

River stretches	Urban/ Rural	Distance, km (A)	Area, km^2	Population, persons	Population density, persons/km^2	Annual potential damage (50-year flood), 10^6 M$ (B)	(B)/(A) (10^6M$/km)
Left bank							
DL1	Rural	25.0	239.1	130,084	544	8.70	0.348
DL2	Urban	5.0	62.8 (19.9)	38,217 (23,145)	609 (1,166)	3.81 (0.80)	0.762
DL3	Rural	18.0	69.8	18,590	266	1.38	0.077
DL4	Rural	11.0	19.6	5,665	290	0.95	0.086
DL5	Urban	9.0	34.2	31,206	912	1.53	0.170
DL6	Rural	33.0	31.5	6,508	207	1.34	0.041
Right bank							
DR1	Rural	6.5	25.3	20,965	829	0.33	0.051
DR2	Urban	9.5	163.5 (10.9)	237,317 (41,869)	1,451 (3,852)	12.38 (9.54)	1.303
DR3	Rural	19.0	174.2	94,681	544	5.06	0.266
DR4	Rural	11.0	124.8	67,806	543	2.47	0.225
DR5	Rural	52.0	141.2	43,943	311	3.51	0.068
DR6	Urban	3.0	17.2	38,750	2,252	1.11	0.370

Note: Figures in parentheses show the information in the township area excluding the out-skirts.

表　6.8　　クランタン川治水計画案の事業費配分スケジュール

Unit : Million M$

	Malaysia Plan																			
				6th				7th					8th					9th		
emes	'91	'92	'93	'94	'95	'96	'97	'98	'99	2000	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10
er Improvement																				
an area			31.7	23.5	23.5	23.5	16.2	16.2	15.2	15.2										
al area			39.4	11.5	11.5	11.5	18.9	18.9	19.9	19.9	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0
Schemes																				
ir			117.3	57.5	71.1	84.7	112.0	57.5												
ubu																	69.6	51.2	52.7	52.0
			188.4	92.5	106.1	119.7	147.1	92.6	35.1	35.1	26.0	26.0	26.0	26.0	26.0	26.0	95.6	77.2	78.7	78.0
each Malaysian Plan				387.0				429.6					130.0					355.6		

付　図

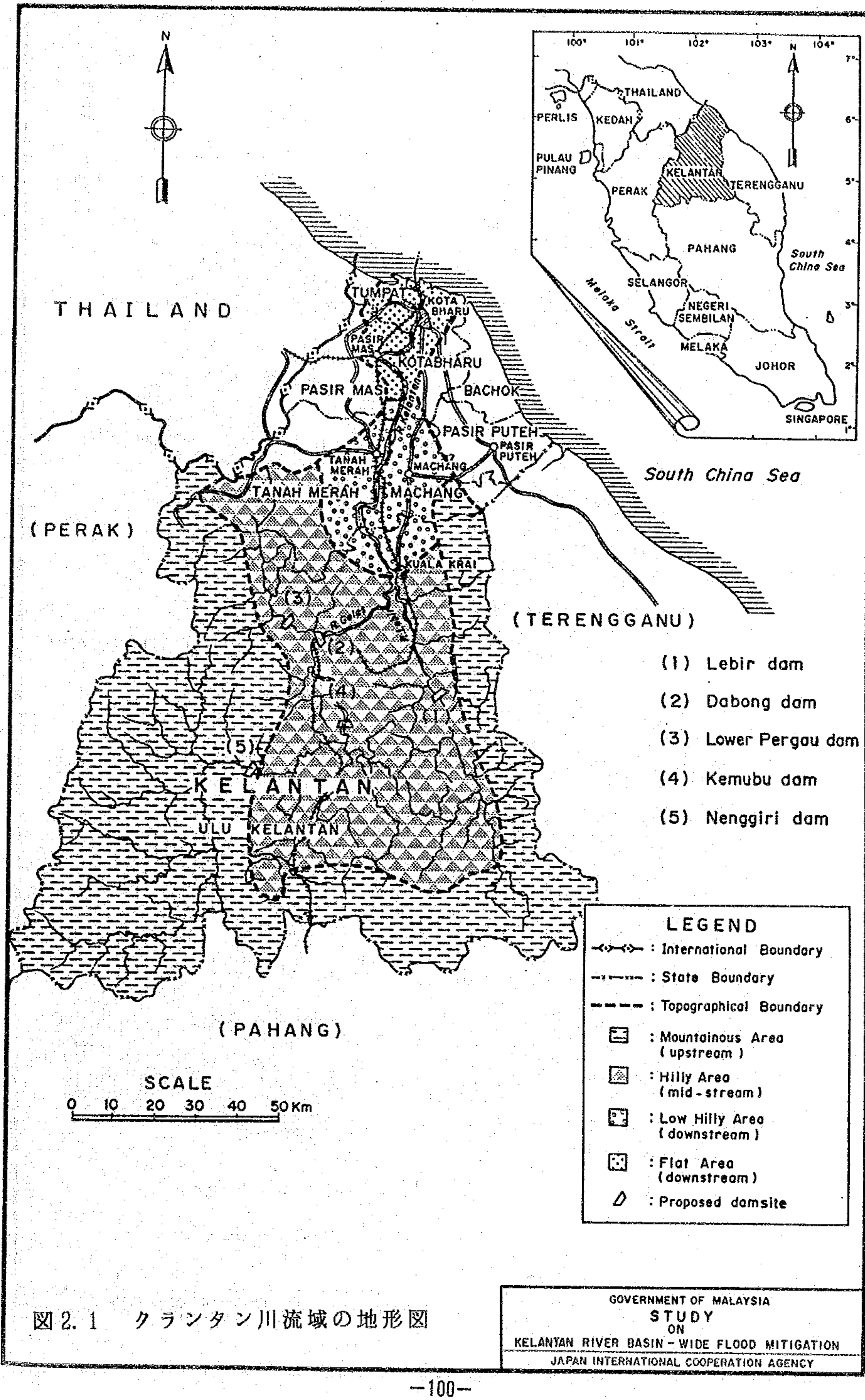

図2.1　クランタン川流域の地形図

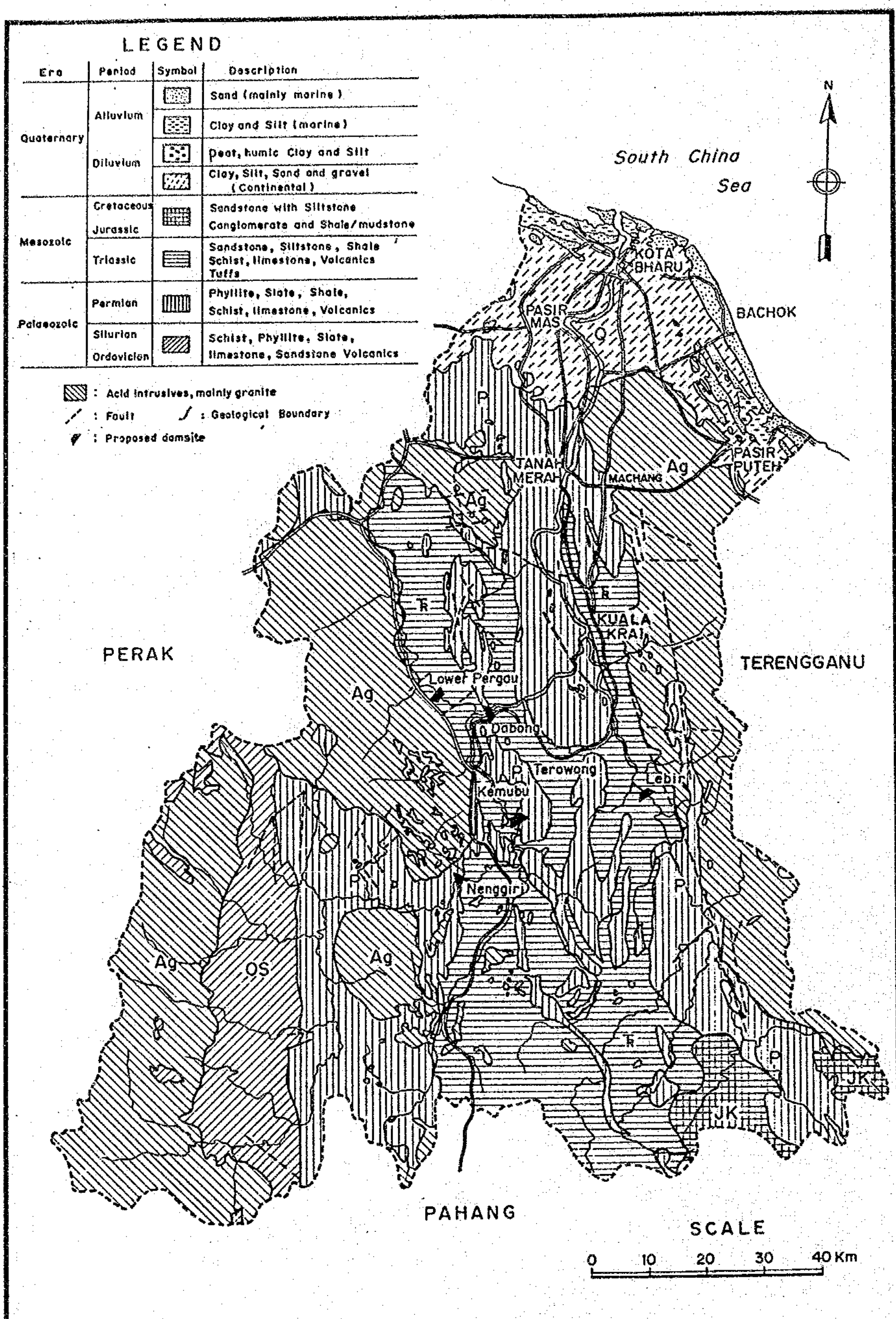

図2.2　クランタン川流域の地質図

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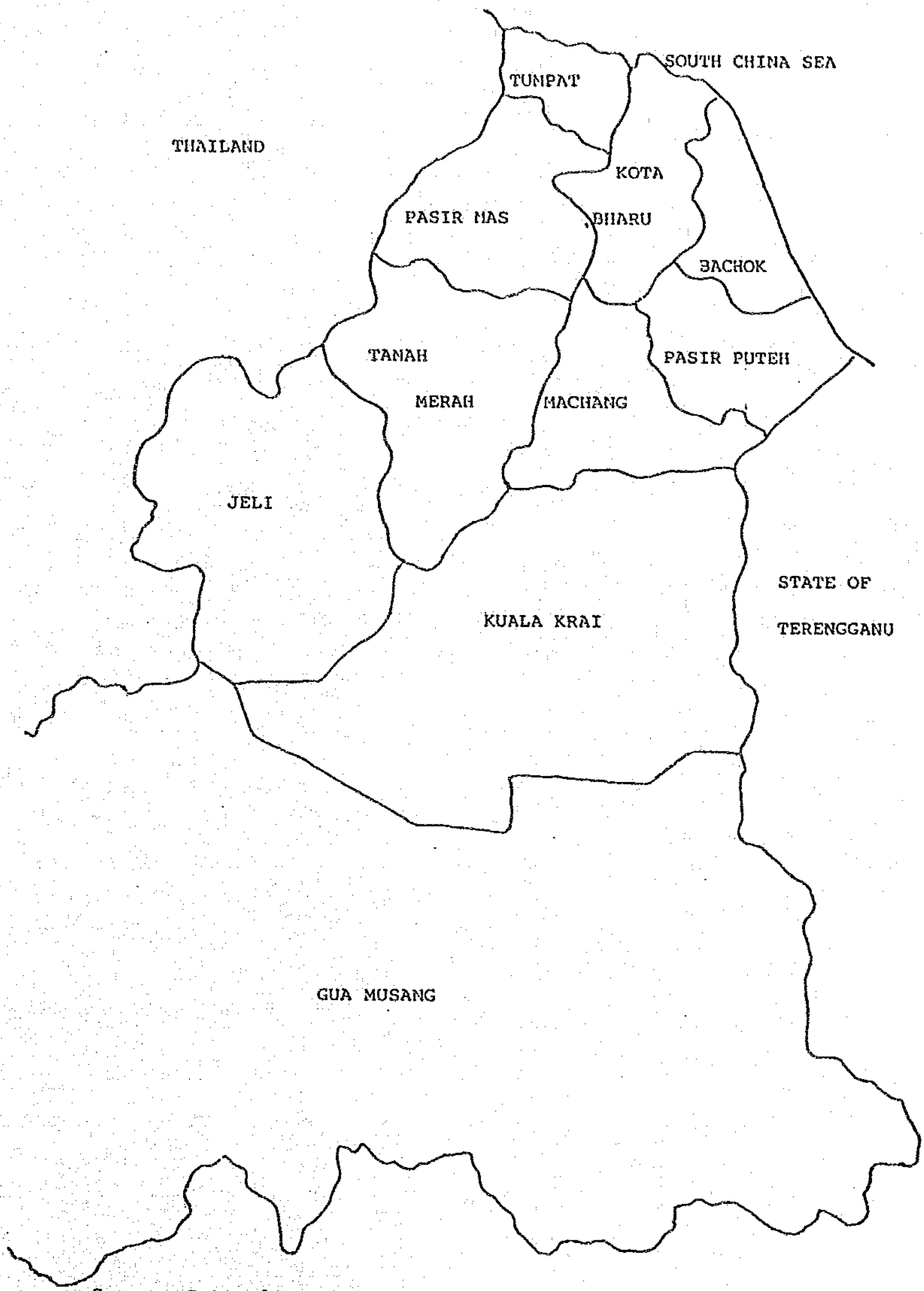

Source: Dpt. of Town & Country
Planning, Kelantan

図2.3　クランタン州の行政区分

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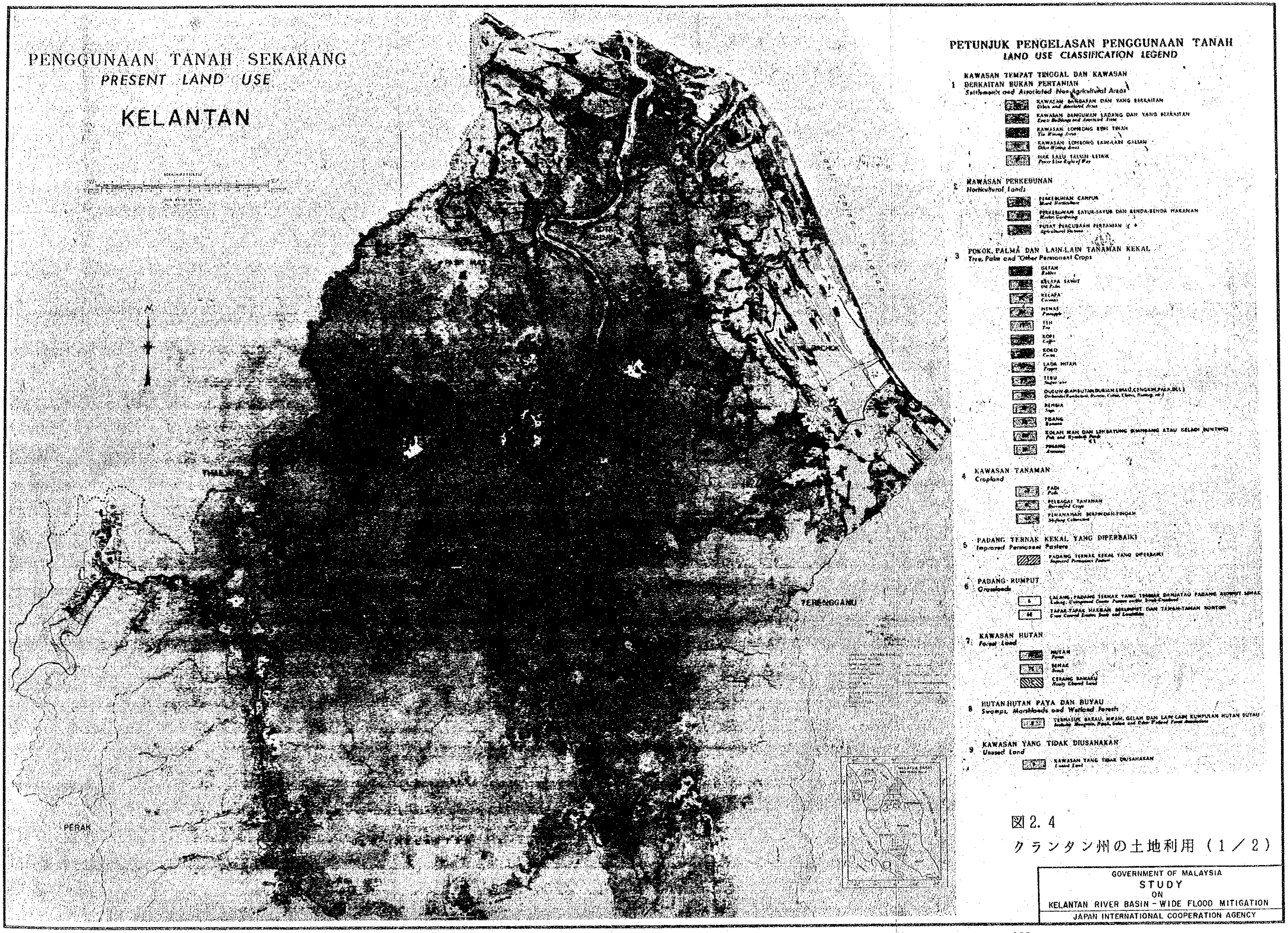

図2.4
クランタン州の土地利用（1／2）

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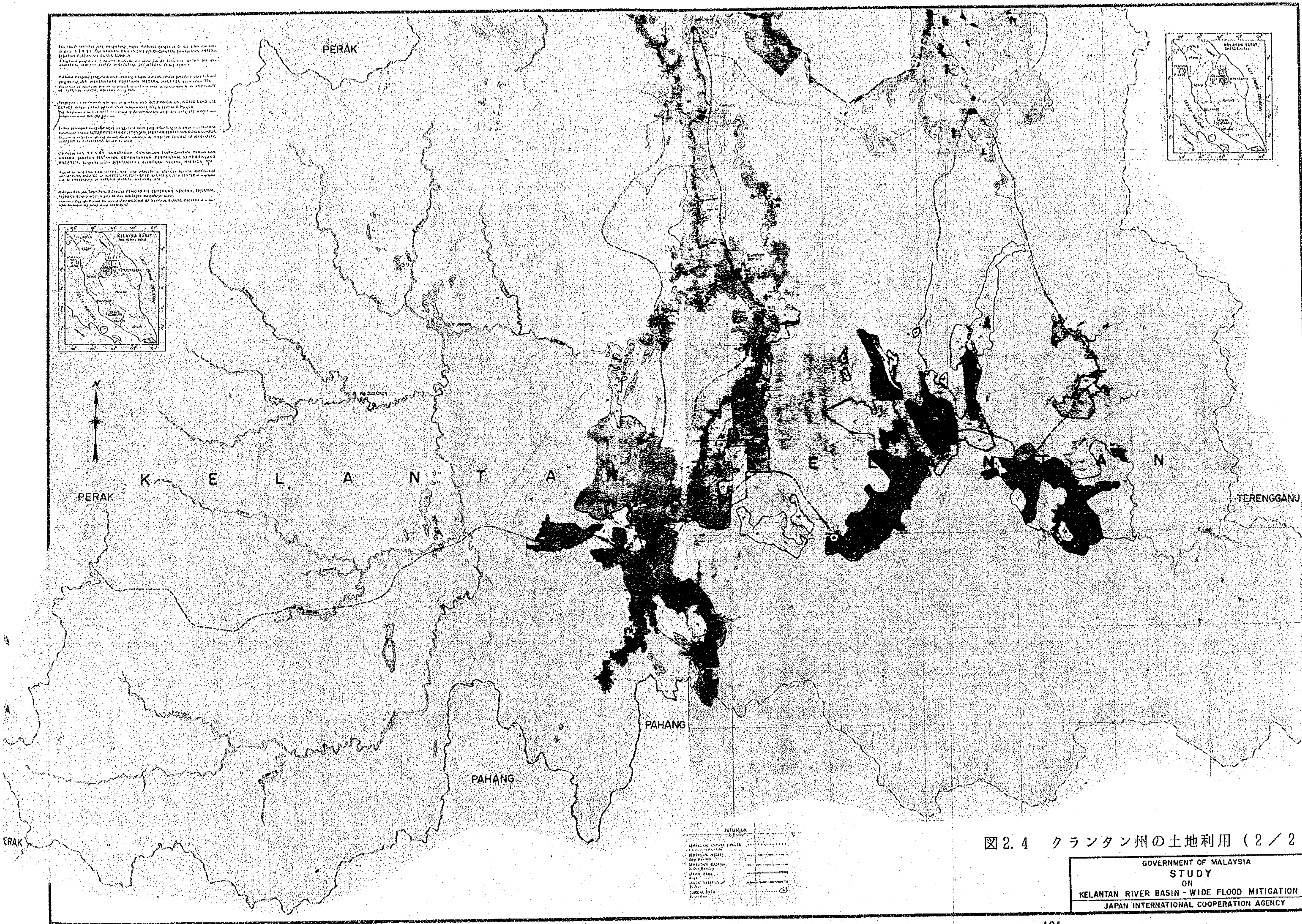

図2.4　クランタン州の土地利用（2／2）

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