TABLES

Table 1 AREA BY DIVISION AND POPULATION DENSITY IN SABAH

Division/District	Area (km^2)	Population 1980	Population Density
Perdalaman Division	18,162	183,672	10.11
Beaufort	1,739	37,126	21.35
Kuala Penyu	473	13,193	27.89
Sipitan	2,762	12,360	4.48
Tenom	2,347	27,772	11.83
Pensiangan	6,034	8,288	1.37
Keningau	3,315	43,476	13.11
Tanbunan	1,396	15,004	10.75
Labuan	96	26,453	275.55
Kudat Division	4,599	87,285	18.98
Kudat	1,000	41,872	41.87
Kota Marudu	1,000	28,249	28.25
Pitas	2,599	17,164	6.60
West Coast Division	7,859	321,670	42.39
Ranau	2,922	31,118	10.65
Kota Belud	1,414	46,727	33.05
Tuaran	1,176	49,821	42.36
Kota Kinabalu	350	112,758	322.17
Penampang	498	39,338	78.99
Papar	1,229	41,908	34.10
Tawau Division	14,365	232,432	16.18
Tawau	6,246	121,736	19.49
Lahad Datu	6,984	54,212	7.76
Semporna	1,135	56,484	49.77
Sandakan Division	29,167	177,549	6.09
Sandakan	2,292	118,417	51.67
Kinabatangan	10,360	26,656	1.45
Labuk & Sugut	8,515	32,476	3.81
Sabah State Total	73,882	1,002,608	13.57

Source; (1) The present land use of the west coast residency, 1970 area is converted by 1 acre = 0.40468 ha = 0.004046880 km^2

(2) 1980 population and housing census of Malaysia, preliminary field count summary

Table 2 AREA BY DIVISION AND POPULATION DENSITY IN SARAWAK

Division/District	Area (km^2)	Population 1980	Population Density
First Division	8,899	465,339	52.29
Lundu	1,813	22,412	12.36
Bau	883	32,921	37.28
Kuching	2,463	305,719	124.12
Serian	2,038	67,011	32.88
Simunjan	1,702	37,276	21.90
Second Division	10,273	165,349	16.10
Simanggang	4,406	68,405	15.53
Lubok Antu	2,339	20,539	8.78
Saribas	1,865	41,001	21.98
Kalaka	1,663	35,404	21.29
Third Division	12,887	221,822	17.21
Sibu	3,406	134,786	39.57
Kanowit	2,253	28,879	12.82
Mukah	5,019	35,831	7.14
Oya/Dalat	2,209	22,326	10.11
Fourth Division	38,943	210,759	5.41
Bintulu	11,844	58,296	4.92
Miri	5,027	99,470	19.79
Baram	22,072	52,993	2.40
Fifth Division	7,790	45,961	5.90
Limbang	3,978	25,909	6.51
Lawas	3,812	20,052	5.26
Sixth Division	6,721	118,062	17.57
Sarikei	1,715	43,199	25.19
Binatang	1,085	29,946	27.60
Matu/Daro	1,292	16,928	13.10
Julau	2,629	27,989	10.65
Seventh Division	38,935	67,461	1.73
Kapit	15,597	38,345	2.46
Song	3,934	16,887	4.29
Belaga	19,404	12,229	0.63
Sarawak State Total	124,448	1,294,753	10.40

Source; (1) Annual statistical bulletin, Sarawak 1979

(2) 1980 population and housing census of Malaysia, preliminary field count summary

Table 3 CORRESPONDENCE BETWEEN BASIN AND ADMINISTRATIVE DIVISION IN THE STATE OF SABAH (1/2)

Basin No.	Name of Basin	Catchment Area (km^2)	Administrative Division	
			Residency	District
201	Pensiangan	5,971	Interior	Pensiangan (100), Tenom (3) & Keningau (2)
202	Serudong	1,308	Tawau	Pensiangan (4) & Tawau (18)
203	Kalabakan	1,371	Tawau	Tawau (22)
204	Brantian	741	Tawau	Tawau (12)
205	Umas Umas	553	Tawau	Tawau (9)
206	Merutai Besar	558	Tawau	Tawau (9)
207	Tawau	888	Tawau	Tawau (14)
208	Kalumpang	2,792	Tawau	Tawau (16), Lahad Datu (13) & Semporna (100)
209	Silibukan	2,714	Tawau Sandakan	Lahad Datu (33) Kinabatangan (1)
210	Segama	5,558	Tawau Sandakan	Lahad Datu (54) Kinabatangan (8)
211	Kinabatangan	16,581	Interior Sandakan	Kiningau (13) Sandakan (5), Kinabatangan (88) & Lubak & Sugut (6)
212	Segalid	2,335	Sandakan	Sandakan (93) & Kinabatangan (2)
213	Labuk	6,829	Interior Sandakan West Coast	Tambunan (40) Sandakan (2), Kinabatangan (0.5) & Labuk & Sugut (52) Ranau (63)
214	Sugut	3,094	Sandakan West Coast	Labuk & Sugut (24) Ranau (37)
215	Paitan	1,474	Sandakan	Labuk & Sugut (18)
216	Bengkoka	1,943	Kudat	Kota Marudu (24) & Pitas (97)
217	Bongan	2,191	Kudat	Kudat (100), Kota Marudu (76) & Pitas (3)
218	Kadamaian	1,386	West Coast	Kota Belud (100)
219	Tuaran	1,219	West Coast	Tuaran (100) & Kota Kinabalu (15)
220	Putatan	629	West Coast	Kota Kinabalu (85), Penampang (55) & Papar (6)
221	Papar	805	West Coast	Penampang (45) & Papar (48)

Remarks; (1): Figures expressed in percentage in parentheses show the proportion of district area shared by each river basin.

Table 4 CORRESPONDENCE BETWEEN BASIN AND ADMINISTRATIVE DIVISION IN THE STATE OF SABAH (2/2)

Basin No.	Name of Basin	Catchment Area (km^2)	Administrative Division	
			Residency	District
222	Kimanis	572	West Coast	Papar (46)
223	Membakut	736	Interior	Beaufort (36) & Kuala Penyu (24)
224	Padas	9,180	Interior	Beaufort (37), Kuala Penyu (76), Sipitant (70), Tenom (97), Keningau (85) & Tambunan (60)
			Sandakan	Kinabatangan (0.5)
225	Labuan	91	Interior	Labuan (100)
226	Lakutan	1,291	Interior	Beaufort (27) & Sipitang (30)
	Total	72,810		

Remarks; (1): The area of small islands totalling 901 km^2 is excluded from the Study.

(2): Figures expressed in percentage in parentheses show the proportion of district area shared by each river basin.

Table 5 CORRESPONDENCE BETWEEN BASIN AND ADMINISTRATIVE DIVISION IN THE STATE OF SARAWAK

Basin No.	Name of Basin	Catchment Area (km^2)	Administrative Division	
			Division	District
227	Lawas	1,070	Fifth	Lawas (28)
228	Trusan	2,742	Fifth	Lawas (72)
229	Limbang	3,978	Fifth	Limbang (100)
230	Baram	22,325	Fourth	Baram (100) & Miri (5)
231	Miri	788	Fourth	Miri (16)
232	Sibuti	935	Fourth	Miri (19)
233	Niah	1,345	Fourth	Miri (27)
234	Suai	1,440	Fourth	Miri (29)
235	Similajau	1,268	Fourth	Miri (4) & Bintulu (9)
236	Kemena	5,834	Fourth	Bintulu (49)
237	Tatau	5,008	Fourth	Bintulu (42)
238	Balingian	2,457	Third	Mukah (49)
239	Mukah	2,562	Third	Mukah (51)
240	Oya	2,209	Third	Oya Dalat (100)
241	Rajang	51,315	Third	Sibu (100) & Kanowit (100)
			Sixth	Sarikei (100), Binatang (100), Julau (100) & Matu/Daro (100)
			Seventh	Kapit (100), Song (100) & Belaga (100)
242	Kerian	1,663	Second	Kalaka (100)
243	Saribas	1,865	Second	Saribas (100)
244	Lupar	6,745	Second	Sri Aman (100) & Lubok Antu (100)
245	Sadong	3,688	First	Kuching (2), Serian (97) & Simunjan (98)
246	Sarawak	3,398	First	Bau (100), Kuching (98), Serian (3) & Simunjan (2)
247	Kayan	1,808	First	Lundu (100)
	Total	124,448		

Remarks; Figures expressed in percentage in parentheses show the proportion of district area shared by each river basin.

Table 6 RIVER CHARACTERISTICS (1/41)

201	Pensiangan
Estuary	Flows to Kalimantan Indonesia, territory
Salt Water Intrusion	No salt water intrusion because inland river.
Flood	Damage to agirculture crop reported on Jan. 1981 flood.

Table 7 RIVER CHARACTERISTICS (2/41)

203	Kalabakan
River Morphology	Moderate meanders at upstream of Kalabakan town.
Estuary	River branchs off at the eastuary with several streams.

Table 8 RIVER CHARACTERISTICS (3/41)

207	Tawau
River Morphology	No heavy meanders exist.
Flood	Flood damage on Jan. 1981 reported. Flash flood due to poor urban drainage occurred in Tawau town.

Table 9 RIVER CHARACTERISTICS (4/41)

208	Kalumpan
River Morphology	No heavy meandering exists.
Flood	Flood damage to crops on Jan. 1981 reported.

Table 10 RIVER CHARACTERISTICS (5/41)

209	Silibukan
River Morphology	Meanding and bank erosion are not serious problem.
Estuary	No problem exists.
Sediment	No sediment problem exists.
Salt Water Intrusion	Salt water intrudes up to existing water supply intake at S.Sepagaya. Frequency is one week per year in dry season.
Flood	Flooded Lahad Datu down town due to poor drainage and because the town level is at sea level.
Other Items	A dam for water supply dam is to be teudered within 1981. Active storage of the dam is planned to be 4.1x10 m .

Table 11 RIVER CHARACTERISTICS (6/41)

210	Segama
River Morphology	Meanders exist in the whole reaches.
Salt Water Intrusion	No survey data available.
Flood	Flood damage to crops on Jan. 1981 reported. Other severe flood reported in 1963, 1965, 1968 and 1971. Flood damaged the plantation discouraged further continuation of plantation.
Other Items	Trials to grow annual crops using machines were hampered by drainage problems and discontinued.

Table 12 RIVER CHARACTERISTICS (7/46)

211 Kinabatangan

River Morphology	Remarkable meanding in the middle and the lower reaches. Bank erosion is still active at the concave of river.
Estuary	Sand dune along river makes the haul distance of timber vessels longer.
Sediment	Water contains much mud and fine sand. Sediment yeild of 2oom /km /y is adopted.
Salt Water Intrusion	No survey data available, but water reached at least 50 km from the river mouth. Tidal back water effect was reported at Lamag.
Flood	Recent big flood occurred in 1963, 1968 and 1971. Flood of Jan. 1981 is also one of the biggest ones. Narrow stretch at Sukau caused flooding
Other Items	Transportation and hauling of goods and timber heavily rely on river. Navigation through river is frequent. Intensive study on this river is now carrying out by JICA

Table 13 RIVER CHARACTERISTICS (8/41)

212 Segaliud

River Morphology	River regime seems generally in stable.
Sediment	Sg. Api was badly silted up.
Flood	Flash flood in Sandakan reported due to poor drainage.
Other Items	Sg. Api improvement is proposed.

Table 14 RIVER CHARACTERISTICS (9/41)

213	Labuk	
River Morphology		No active meandering/erosion reported.
Flood		Minor flood damage in Jan. 1981 reported.
Other Items		Multipurpose river development scheme proposed by UN expert in 1964.

Table 15 RIVER CHARACTERISTICS (10/41)

214	Sugut	
River Morphology		Meanders exist in the middle and lower reaches, but no active meandering/erosion reported.
Flood		No flood damage exists.
Other Items		There is no road connecting major towns, so river is used as means of transportation and navigation.

Table 16 RIVER CHARACTERISTICS (11/41)

216	Bengkoka	
River Morphology		Meanderings exist in the lower reaches but seems not serious.
Estuary		No sand bar exists.
Sediment		No silting problem exists.
Other Items		Irrigation development under IBRD fund is under study.

Table 17 RIVER CHARACTERISTICS (12/41)

217 Bongan

River Morphology	Rivers are no stable. Meandering/bank erosions assaulted houses, padi and irrigation facilities.
Estuary	River mouths are silted up but it seems not affect much to fishermen since activity become less.
Sediment	S. Bandau, S. Bongon are silted up because of sediment yielded banked erosion and development of road.
Salt Water Intrusion	S. Langkong, S. Bandau used for domestic water supply observed salt water intrusion. But the salt water intrusion does not affect padi field.
Flood	Severest flood Jan.1981, town ..ooded 2',12 hr associated with high tide. Estimated damage amounted M$121,000. In all houses in Kampongs, ethe floors are more or less elevated.
Other Items	Sand arresting work be incorporated for the proposed mitigation plan under 4MP. In S. Bandau, measure against aggradation of river bed be considered at just downstream of the confluence of S. Bandau and S. Tuaran. Sand and gravel for donstruction purpose are extracted from S. Bandau.

Table 18 RIVER CHARACTERISTICS (13/41)

218 Kadaimaian

River Morphology	Bank erosions threaten houses and crop feild, river bed is not stable.
Estuary	River mouth is shifting towards south-west due to sea current.
Sediment	Sediment situation is deteriorated at S. Kadamayan blue to road construction.
Salt Water Intrusion	S. Bira-Biraan is affected by salt water intrusion. Tidal gate at S. Bira-Biraan is under planning.
Flood	Flood assaulted mainly irrigation scheme. Flood damage on Jan. 1981 amounted M$130,000 to irrigation scheme and crops.
Other Items	Adjustment of river gradient by means of sabo dam at Kg.Rangalau or upstream of the irrigation intake be considered.

Table 19 RIVER CHARACTERISTICS (14/41)

219	Tuaran
River Morphology	Meandering in the lower reach. Bank erosions in Sg. Tuaran threaten the riverain area.
Sediment	Some irrigation intake silted up.
Flood	Floods assaulted crops and irrigation scheme.

Table 20 RIVER CHARACTERISTICS (15/41)

220	Putatan
Flood	Floods occur due to areas low lying, poor drainage and rivers under-sized and subjected to tidal influence.
Other Items	S.Talipok downstream of the main road bridge has recently been canalised by the DID, thus relieving the surrounding areas from flooding of the river.

Table 21 RIVER CHARACTERISTICS (16/41)

221	Papar
River Morphology	Meandering and bank erosions are active in the lower reach.
Flood	After short-cut the rooped portion of downstream of Papar town, flood is limited in local area.
Other Items	Flood mitigation project is proposed under 4MP at Sg. Padawan.

Table 22 RIVER CHARACTERISTICS (17/41)

222 Kimanis

River Morphology	Remarkable meanderings exist in S. Kimanis and S. Bongawan.
Estuary	Sand dunes developed at the right bank due to sea current.
Flood	At S. Kimanis, flood assaulted Kampong area. Bongawan town was affected by flood.
Other Items	Flood mitigation by means of floodway is proposed under 4MP.

Table 23 RIVER CHARACTERISTICS (18/41)

223 Membakut

River Morphology	Meanderings exist in the downstream and middle reach.
Flood	Loggs clog. the river, which deteriorates the flood.

Table 24 RIVER CHARACTERISTICS (19/41)

224 Padas

River Morphology	Heavy meanderings exist in the downstream reach and upstream of the confluence of S. Padas and S. Pegalan. Banks are eroded near Beaufort. DOA's Pumping station at Cocoa Reserch Station, Tenom was washed away due to bank erosion.
Sediment	Bolders and gravel are deposited at the river bed, which accelerates bank erosion.
Salt Water Intrusion	Salt water intrusion has not investigated yet. The most downstream intake is just downstream of Beaufort town.
Flood	Beaufort town was innundated by the flood of Jan. 1981. Flood duration was 2 weeks. A part of Tenom town was also innundated.
Other Items	Tenom-Pangi hydropower project is under construction. Sg. Sook regulation dam for firm-up Tenom Pangi scheme is proposed.

Table 25 RIVER CHARACTERISTICS (20/41)

226	Lakutan	
River Morphology		Remarkable meanderings exist in the downstream reach.
Flood		Flood assaulted irrigation schemes.

Table 26 RIVER CHARACTERISTICS (21/41)

227	Lawas	
River Morphology		Meanderings exists in the lower reach of the river.
Salt Water Intrusion		Salt water reaches Kpg. Pangeleh. 29.5 km from the eastary.
Flood		Severe flood 1963 Jan.16 flood depth 2 ft at airfield,2 days duration. Flooding along riverine villages and in the alluvial plain.

Table 27 RIVER CHARACTERISTICS (22/41)

228	Trusan	
River Morphology		Heavy meanderings exist in the lower reach. Paddy field and rubber plantation area seem to be eroded.
Salt Water Intrusion		Salt water reaches Kpg. Kamis Pasir 29.5 km from the Estuary.
Flood		Severe flood 1963 Jan. 16. Flood depth 3 1/2′ for 2 days at Surdar Bazaar and 4 1/2′ for 3 days at Trusan Bazaar. Flood occur along riverine villages and alluvial plain.

Table 28 RIVER CHARACTERISTICS (23/41)

229 Limbang

River Morphology	Heavy meandering exists in the lower reach. Narrow Cross-section of Sg. Limbang (in the middle reachs) results to a higher flood depth during flooding in the settlement adjacent to the river.
Salt Water	Tidal reach is between Kg. Telahak and Kg. Epai 40 km from the estuary.
Flood	Severe flood at Ukong between Jan.14 and 23 (1963). Depth of flood 12′. Flood depth of 8′ at Batu Danan during the period. Flood occurred along Penderuan Road and also along riverine villages and alluvial plains.

Table 29 RIVER CHARACTERISTICS (24/41)

230 Baram

River Morphology	Heavy meanderings exists in the lower reach. Marudi town is reported to be in danger because of bank erosion. Banks are eroded by floods. Tidal fluctuation and inland naviagtion boats.
Estuary	Estuary cloggings are reported.
Sediment	Sediment yeild seems large from aerial view.
Salt Water Intrusion	Salt water reaches Kpg. Maro 156 km from Estuary.
Flood	Flood occurred along the low laying plains. Severe flood being at Marudi on 23th Jan. 1963, depth 8 1/4′, 27 days duration. Flood occurred along riverine villages mainly Long Lamo & Long Teru, flood depth 11′ and 2′ respectively.
Other Items	river bank protection is proposed and being studied by JKR.

Table 30 RIVER CHARACTERISTICS (25/41)

231 Miri

River Morphology	No heavy meanders. Stable bank being formed by hard ground. The estuary moved to south-west may deteriorate the flood problem.
Estuary	Huge sand dune is developed at the estuary, on which oil refinary quarters locate. River dredging is reported to excise every year.
Salt Water Intrusion	Salt water reaches Long Palai 22.5 km from Estuary.
Flood	Flood occurred mainly along the coast line with severe flood at Lutong PS. on 19th Jan. 1963, depth 3′, 9 days duration. Flood also occurred on other long laying plain and riverine villages.

Table 31 RIVER CHARACTERISTICS (26/41)

232 Sibuti

River Morphology	No heavy meanderings exist. Gentle river gradient due to estuary movement caused by sea current may deteriorate flood situation for Bekenu town.
Estuary	River mouth seems to be moving to south-west by sea current.
Sediment	Sediment yeild seems large judging from aerial survey.
Salt Water Intrusion	Salt water reaches Bekenu 21.5 km from Estruary.
Flood	Severe flood at Kuala Sibuti & Bekenu, flood depth 3′ and 8 1/2′ respectively. Duration of 14 days flooding at Bekenu i.c between 8th Jan. and 22rd Jan.1963. Flooding near coastline and riverine villages.
Other Items	Relatively large scale irrigation by pumping often assaulted by flood.

Table 32 RIVER CHARACTERISTICS (27/41)

233 Niah

River Morphology	Heavy meanderings exist in the lower reach but seems no damage to property because less developed.
Sediment	No detailed survey so far but possively high yeild from aerial survey.
Salt Water Intrusion	Salt water reaches Batu Niah 32 km from Estuary.
Flood	Flooding at low laying areas &long rivers.

Table 33 RIVER CHARACTERISTICS (28/41)

234 Niah

River Morphology	Heavy meandering exists in the lower reach.
Salt Water Intrusion	Salt water reaches till the Confluence of Sg. Legang 58 km from Estuary.
Flood	Flooding at low laying areas near the Coast.

Table 34 RIVER CHARACTERISTICS (29/41)

235 Similajau

River Morphology	Only minor menaders, generally river regime seems stable.
Salt Water Intrusion	Salt Water reaches till 10 km from Estuary to Confluence of Sg. Siod.
Flood	No flood reported except for floods at swampy area.

Table 35 RIVER CHARACTERISTICS (30/41)

236 Kemena

River Morphology	Only minor meanderings, the banks are generally stable.
Estuary	No major problem reported.
Sediment	Possibly high yeild from aerial survey due to logging operation and development.
Salt Water Intrusion	Salt water reaches till timber station at R. Engki, 57 km from Estuary.
Flood	Flood occurred along the riverine villages and towns mainly Bintulu,Sebauh,Pandan and Lavang, with a depth of 1 3/4′, 2′, 5 3/4′ respectively. A duration of 30 days at Sebauh and 31 days at Pandan. Flooding between Jan. 7th and 7th Feb. 1963.

Table 36 RIVER CHARACTERISTICS (31/41)

237 Tatau

River Morphology	River regime seems stable. Bank erosions seem of minor scale.
Sediment	Salt water reaches till confluence of Sungai Biban 44 km from Estuary.
Flood	Severe flood at Tatau Bazaar, depth 15′. Flooding along riverine villages and alluvial plain.

Table 37 RIVER CHARACTERISTICS (32/41)

238 Balingian

River Morphology	Heavy meanderings exist in the lower and middle reaches.
Sediment	Possibly high yeild from aerial survey.
Salt Water Intrusion	Salt water reaches Confluence of Sg.Pelagau 103 km from estuary.
Flood	Flood at swampy areas along the river.

Table 38 RIVER CHARACTERISTICS (33/411

239 Mukah

River Morphology	Heavy meanderings exist in the lower and middle reaches.
Estuary	No problems reported.
Sediment	Comparatively low yield from aerial survey.
Salt Water Intrusion	Salt water reaches till R. Kudang 82 km from Estuary.
Flood	Flood along river and low laying area near coast.

Table 39 RIVER CHARACTERISTICS (34/41)

240 Oya

River Morphology	Heavy meanderings exist in the lower and middle reaches.
Estuary	River mouth clogging may be anticipated due to littoral drift.
Sediment	River water contains much silt from aerial survey.
Salt Water Intrusion	Salt water reaches T. Kebang Pek 96 km from Estuary.
Flood	Flood along the riverine village and swampy areas.

Table 40 RIVER CHARACTERISTICS (45/41)

241 Rajang

River Morphology	Heavy meanderings exist in the lower reach. Banks are eroded by flood, tidal fluctuation and inland navigation boats. Rivers trifurcated at downstream of Sibu play as floodways.
Estuary	No problems reported.
Sediment	Sand and gravels are extracted for construction purposes. No silting-up problems reported so far.
Salt Water Intrusion	Salt water reaches until R. Patah 238 km from Estuary.
Flood	Severe flood at Sibu 1 1/2′ depth, duration 31 days. Flood along riverline villages and low laying plain near the Coast and also roads.
Other Items	Pelagas and Balu hydropower schemes are proposed at the middle reach. No flood control storage is allotted.

Table 41 RIVER CHARACTERISTICS (36/41)

242	Kerian
River Morphology	Heavy meanderings exist in the lower reach. Banks are eroded by flood and tidal fluctuation.
Estuary	No problems exist.
Sediment	Salt water reaches till Sg. Malupa (N. Malupa), 78 km from Estuary.
Salt Water Intrusion	Tidal water reaches at Kaki Wong far upstream of the Sibu road.

Table 42 RIVER CHARACTERISTICS (37/41)

243	Saribas
River Morphology	Heavy meanderings exist in the lower and middle reaches.
Estuary	No problem arises.
Sediment	No problem reported.
Salt Water Intrusion	Salt water reaches Engkeranji 105 km from Estuary.
Flood	No serious problem arises in Betong town.

Table 43 RIVER CHARACTERISTICS (38/41)

244	Lupar
River Morphology	Heavy meanderings exist in the middle reach downstream of Engkilli town.
Estuary	No problem exists.
Salt Water Intrusion	Salt water reachs until Confluence of Sg. Klampu 130 km from Estuary.
Flood	Engkilli town is likely affected by flood but of minor scale.
Other Items	Btg. Ai hydropower scheme is under construction.

Table 44 RIVER CHARACTERISTICS (39/41)

245	Sadong
River Morphology	Heavy meanderings exist in the lower and middle reaches.
Estuary	No problem exists.
Salt Water Intrusion	Salt water reaches until confluence of Sg. Sebengkong 75 km from estuary.
Flood	Flooding at low laying plain near the coast. Flooding at specific town like Simunjau and Seriar depth 2′ and 5′ respectively.
Other Items	Simunjau town was resettled because of bank erosion. Two flood control dams were proposed to mitigate floods at upstream of Btg. Kayan and Sg. Kedup.

Table 45 RIVER CHARACTERISTICS (40/41)

246	Sarawak
River Morphology	Meanderings exist in the middle reach but of local and minor scale. Narrow Cross section of Sg. Sarawak near Batu Kitang results in higher flood depths.
Estuary	No problem reported.
Salt Water Intrusion	Salt water reaches until Ngiru 69.5 km from Estuary.
Flood	Flooding along riverine villages and towns mainly and towns mainly Kuching, Bau, Batu Kitang, Siniawan, Buso, with depth of 3′, 9′, 13′, 13′, 17′ respectively. Flooding between 25th and 31st Jan. 1963. Flood also occur along the Kuching Serian Road.
Other Items	Bungo flood control dam scheme was proposed at the upstream of Sg.Sarawak Kiri. Samarahan irrigation scheme was proposed in the downstream of Btg. Samarahan.

Table 46 RIVER CHARACTERISTICS (41/41)

247	Kayan
River Morphology	Heavy meanderings exist in the lower and middle reaches.
Estuary	No problem exists.
Sediment	Salt water reaches until Tg. Batu Bajamban, 64 km from Estuary.
Flood	Flood along riverine villages, towns and roads, depth 3 1/2' along Lundu/Serayan Road (Sebiris bridge)

Table 47 FLOODS IN SABAH AND SARAWAK (1/2)

State	1963	1964	1965
Sabah	-	-	-
Sarawak	Severe flood in First, Third, Fourth and Fifth Division between Jan.-Feb. Duration ranges from 1 week to 4 weeks. Reached 20 feet in First Division. In Second Division, flood lasted one day.	Severe flood in Kuching District in February 4 feet deep and December 5 feet. Roads were damaged. Bau District 2 people died. Flood lasted 2 days.	-

State	1966	1967	1968
Sabah	Minor flood at Jesselton and Keningau Districts. Damage estimated M$300,000.	Major flood at west coast in Penampang District and normal flood in the east coast.	-
Sarawak	Flood at Sibuti in March lasted one week. Flash flood in Kanowit, Kapit, Tekalit and Nangsa Nasam.	Minor flood in Begak, Titiakar, Tebera, Serayan and Sepau Rivers in First Division.	Minor flood. No damage.

State	1969	1970	1971
Sabah	Minor floods throughout the state.	Floods affected 17,000 acres of padi and jungle areas.	-
Sarawak	Minor flood. Damage negligible.	Flood occurring in First Division. 2 days Depth 1 - 10 feet. Roads were damaged.	-

Table 48 FLOODS IN SABAH AND SARAWAK (2/2)

State	1972	1973	1974
Sabah	Minor flood in Beaufort and Papar Districts. No damage.	-	Flood in Kudat, Bandau, Kota Belud, Tuaran, Sandakan and Beaufort districts in February. Irrigation works damaged M$600,000. Flood again in October at Beaufort and Kota Kinabalu.
Sarawak	-	-	-

State	1975	1976	1977
Sabah	Several floods occurred. Total damage to irrigation and drainage amounted to M$500,000.	Severe flood at Labuk/Kinabatangan basins. 13 people died minor flood in Beaufort, Kota Marudu and Kota Kinabalu crops, livestock and roads damaged.	Severe flood at Kota Belud, Kota Marudu, Beaufort, Sandakan, Labuk/Sugut, Kinabatangan districts. 1000 evacuees from Kota Marudu, 250 from Sandakan, 2 deaths Damaged roads, crops livestock property. Irrigation works M$900,000.
Sarawak	Floods in Bintulu and other areas minor damage.	Severe flood in Kuching, Bau, and Serian districts. Sixth and seventh Division also affected. Damaged property and crops.	Flood in Kuching, Serian, and Bintulu districts. Severe flood in Lawas lasted 4 days 2-12 feet. 16 houses and other properties destroyed. 5 deaths. Bintulu 4 feet deep and lasted 15 days.

State	1978	1979
Sabah	Minor flood in Kota Belud and Sandakan districts.	Minor flood in west coast on Oct. 7 due to severe rain storm.
Sarawak	Severe flood in Kuching/Bau district January to February 2-3 feet deep. Severe flood in Baram and Bintulu districts in December lasted 3 days.	Minor flood in Kuching and Serian districts. Severe flood in Miri and Baram districts on June 20. 538 evacuees. Depth varies from 6-17 feet.

Table 49 FLOOD AREA STATISTICS BY BASIN (1/9)

Basin No.	201	207	210	211
State	Sabah			
River Basin	Pensiangan	Tawau	Segama	Kinabatangan
Basin Catchment (km2)	5,971	888	5,558	16,581
Land Use (km2)				
Urban Area	0.25	3.00	0.53	2.63
Mining	-	-	-	-
Mixed Horticulture	0.78	0.25	2.89	5.56
Rubbr	-	1.00	-	2.38
Oil Palm	-	3.13	9.13	-
Coconuts	-	10.13	0.25	1.75
Other Crops	-	-	-	-
Padi	2.62	-	0.63	2.69
Pasture/Grassland	3.67	0.13	-	1.13
Forest Land	60.01	-	146.56	194.26
Swamp	-	0.50	96.15	821.30
Unused Land	-	-	-	-
Total Flood Area	67.32	18.13	256.12	1031.70
No. of Persons Affected by Flood (thousand)	1.0	5.9	4.9	5.6
Estimated Damages:				
Damage in Past Flood (thou. M. $)	41	678	618	677
Annual Average Damage (thou. M. $)	15	260	238	260
Average Depth (m)				3
Flood Duration (day)				14
Flood Event				1981
Return Period				14
Station (St.No)			Wlu Kuamut (29)	
Non-flooding Discharge Q (m3/s)				939
Non-flooding Discharge R.P.(yr)				1.1
Flood Event (for Danrage Estinate) Q(m3/s)				8235

Table 50 FLOOD AREA STATISTICS BY BASIN (2/9)

Basin No.	212	213	214	216
State	Sabah			
River Basin	Segalid	Labuk	Sugut	Bengkaka
Basin Catchment (km2)	2,335	6,829	3,094	1,943
Land Use (km2)				
Urban Area	1.75	0.75	0.13	0.17
Mining	-	-	-	-
Mixed Horticulture	1.88	5.95	0.31	0.63
Rubber	3.63	-	-	-
Oil Palm	-	0.95	-	-
Coconuts	0.44	0.31	-	6.57
Other Crops	-	1.53	-	-
Padi	-	3.94	0.70	-
Pasture/Grassland	0.16	-	-	-
Forest Land	1.79	197.39	70.20	4.16
Swamp	-	48.55	90.64	32.58
Unused Land	-	-	-	-
Total Flood Area	9.04	259.37	161.97	44.10
No. of Persons Affected by Flood (thousand)	6.3	4.2	0.3	0.4
Estimated Damages:				
Damages in Past Flood (M$)	593	122	14	21
Annual Average Damage (M$)	228	42	4	5
Flood Event		1963		
Return Period		16		
Station (St.No.)		Tombolor(25)		
Non-flooding Discharge Q(m3/s)		1486		
Non-flooding Discharge R.P.(yr)		1.3		
Flood Event (for Damage Estimate) Q(m3/s)		4225		

Table 51 FLOOD AREA STATISTICS BY BASIN (3/9)

Basin No.	217	218	219	220
State	Sabah			
River Basin	Bongan	Kadamaian	Tuaran	Putatan
Basin Catchment (km2)	2,191	1,386	1,219	629
Land Use (km2)				
Urban Area	0.90	0.70	-	1.06
Mining	-	-	-	-
Mixed Horticulture	16.90	18.65	5.85	0.88
Rubber	16.90	1.05	8.35	3.38
Oil Palm	-	-	-	-
Coconuts	24.60	0.45	0.40	-
Other Crops	-	-	-	-
Padi	19.10	24.45	4.75	1.75
Pasture/Glassland	16.75	8.60	0.60	-
Forest Land	91.50	3.05	2.10	-
Swamp	182.10	4.90	11.95	-
Unused Land	-	0.90	0.75	-
Total Flood Area	368.75	62.75	34.75	7.06
No.of Persons Affected by Flood (thousand)	21.4	9.3	4.2	7.2
Estimated Damages:				
Damages in Past Flood (M$)	556	2,352	401	653
Annual Average Damage (M$)	794	406	140	237
Average Depth (m)	0.6	1	1	
Flood Duration	7	7	7	
Flood Event	1977	1977	1975	
Return Period	12	17	14	
Station (St.No.)	Simpagas (22)	Bridge No2 (42)	Malangang (40)	
Non-flooding Discharge Q(m3/s)	306	764	739	
Non-flooding Discharge R.P.(yr)	3	5.7	1.4	
Flood Event (for Damage Estimate) Q(m3/s)	798	1219	1918	

Table 52 FLOOD AREA STATISTICS BY BASIN (4/9)

Basin No.	221	222	224	
State	Sabah			
River Basin	Papar	Kimanis	Padas	Sabah Total
Basin Catchment (km3)	805	572	9,180	59,181
Land Use (km2)				
Urban Area	0.60	0.60	1.13	14.20
Mining	-	-	-	0.00
Mixed Horticulture	6.80	-	4.22	71.53
Rubber	1.40	4.00	114.88	156.97
Oil Palm	-	-	1.10	14.30
Coconuts	-	-	0.94	45.83
Other Crops	-	-	6.15	7.68
Padi	7.75	2.25	10.65	81.28
Pasture/Glassland	1.15	1.75	6.41	40.34
Forest Land	1.75	2.10	152.13	926.38
Swamp	2.60	2.25	54.78	1348.30
Unused Land	0.70	0.75	-	3.10
Total Flood Area	22.75	13.70	352.38	2709.91
No. of Persons Affected by Flood (thousand)	6.8	1.3	4.8	83.6
Estimated Damages:				
Damages in Past Flood (M$)	873	250	835	8,684
Annual Average Damage (M$)	317	95	309	3,350
Average Depth (m)	1		0.6	
Flood Duration (day)	1		14	
Flood Event	1967		1981	
Return Period	16		14	
Station (St.No.)	Kaiduan(38)		Tenom Lama(35)	
Non-flooding Discharge Q(m3/s)	-		747	
Non-flooding Discharge R.P.(yr)	1.0		1.2	
Flood Event (for Damage Estimate) Q(m3/s)	1176		2401	

Table 53 FLOOD AREA STATISTICS BY BASIN (5/9)

Basin No.	227	228	229	230
State	Sarawak			
River Basin	Lawas	Trusan	Limbang	Baram
Basin Catchment (km2)	1,070	2,742	3,978	22,325
Land Use (km2)				
Urban Area	0.6	0.9	0.4	2.5
Mining	-	-	-	-
Mixed Horticulture	1.25	0.4	0.55	1.25
Rubber	0.80	5.10	12.00	46.25
Oil Palm	-	-	2.75	-
Coconuts	1.10	2.75	0.60	-
Other Crops	-	1.05	2.55	2.35
Padi	3.00	105.05	190.10	797.75
Pasture/Grassland	0.75	4.25	4.75	59.35
Forest Land	-	33.10	37.65	1896.55
Swamp	26.50	33.90	10.40	1679.35
Unused Land	-	-	-	6.00
Total Flood Area	34.00	186.50	261.75	4491.35
No. of Persons Affected by Flood (thousand)	0.3	0.8	2.8	7.7
Estimated Damages:				
Damage in Past Flood (M$)	15	267	1362	1915
Annual Average Damage (M$)	5	96	379	619
Average Depth (m)				2.4
Flood Duration (day)				27
Flood Event				1979
Return Period				15
Station (St.No)			Mendamit(1)	L.Terawan(2)
Non-flooding Discharge Q(m3/s)			1605	815
Non-flooding Discharge R.P.(yr)			1.8	1.5
Flood Event (for Damage Estimate) Q(m3/s)			1948	993

Table 54 FLOOD AREA STATISTICS BY BASIN (6/9)

Basin No.	231	232	233	234
State	Sarawak			
River Basin	Miri	Sibuti	Niah	Suai
Basin Catchment (km2)	788	935	1,345	1,440
Land Use (km2)				
Urban Area	6.60	-	1.75	-
Mining	-	-	-	-
Mixed Horticulture	6.50	0.50	-	-
Rubber	24.00	5.25	2.25	-
Oil Palm	-	-	62.25	-
Coconuts	2.25	2.00	1.00	-
Other Crops	9.50	2.75	4.65	0.75
Padi	118.30	114.60	204.10	29.00
Pasture/Grassland	16.75	5.50	4.50	1.25
Forest Land	46.75	44.00	54.75	9.35
Swamp	443.15	39.50	144.45	171.40
Unused Land	-	-	-	-
Total Flood Area	673.80	214.10	479.70	211.75
No. of Persons Affected by Flood (thousand)	20.7	2.5	4.9	0.3
Estimated Damages:				
Damages in Past Flood (M$)	1871	616	699	50
Annual Average Damage (M$)	604	200	226	16
Flood Event				
Return Period				
Station (St.No.)				
Non-flooding Discharge Q(m3/s)				
Non-flooding Drischarge R.P.(yr)				
Flood Event (for Damage Estinate) Q(m3/s)				

Table 55 FLOOD AREA STATISTICS BY BASIN (7/9)

Basin No.	235	236	237	238
State	Sabah			
River Basin	Similajau	Kemena	Tatau	Balingian
Catchment Area	1,268	5,834	5,008	2,457
Land Use (km2)				
Urban Area	-	4.15	-	-
Mining	-	-	-	-
Mixed Horticulture	-	1.40	0.60	-
Rubber	-	30.90	-	-
Oil Palm	-	-	-	-
Coconuts	-	0.80	0.75	-
Other Crops	-	8.00	-	8.90
Padi	0.5	446.70	393.20	1
Pasture/Glassland	-	16.85	37.40	17.60
Forest Land	-	140.20	117.40	-
Swamp	16.5	235.85	149.10	80.3
Unused Land	-	-	-	-
Total Flood Area	17.0	884.85	698.45	107.80
No. of Persons Affected by Flood (thousand)	-	17.6	5.2	-
Estimated Damages:				
Damages in Past Flood (M$)	1	1942	155	89
Annual Average Damage (M$)	-	747	59	34
Average Depth (m)		0.6		
Flood Duration		67		
Flood Event		1967		
Return Period		14		
Station (St.No)		Sebiu (7)		
Non-flooding Discharge Q(m3/s)		36		
Non-flooding Discharge R.P.(yr)		1.1		
Flood Event (for Damage Estimate) Q (m3/s)		157		

Table 56 FLOOD AREA STATISTICS BY BASIN (8/9)

Basin No.	239	240	241	245
State	Sabah			
River Basin	Mukah	Oya	Rajang	Sadong
Basin Catchment (km3)	2,562	2,209	51,315	3,668
Land Use (km2)				
Urban Area	2.25	-	12.50	0.90
Mining	-	-	-	-
Mixed Horticulture	2	0.60	26.75	0.50
Rubber	4.75	11.10	341.70	-
Oil Plam	-	-	-	-
Coconuts	0.25	-	-	49.20
Other Crops	40.00	50.3	35.50	-
Padi	37.60	113.45	492.50	15.25
Pasture/Glassland	4.65	3.50	39.00	6.25
Forest Land	62.70	4.85	4.75	-
Swamp	25.50	213.10	482.40	23.60
Unused Land	-	-	-	-
Total Flood Area	179.70	396.90	1435.10	95.70
No.of Persons Affected by Flood (thousand)	1.80	0.80	24.3	0.9
Estimated Damages:				
Damages in Past Flood (M$)	520	619	5695	96
Annual Average Damage (M$)	200	238	2205	34
Average Depth (m)			0.45	
Flood Duration (day)			31	
Flood Event			1969	
Return Period			15	
Station (St.No)			Kapit (14)	
Non-flooding Discharge Q (m3/s)			-	
Non-flooding Discharge R.P(yr)			1.0	
Flood Event (for Damage Estimate) Q(m3/s)			10038	

Table 57 FLOOD AREA STATISTICS BY BASIN (9/9)

Basin No.	246	247	Sarawak Total
State	Sabah		
River Basin	Sarawak	Kayan	
Basin Catchment (km2)	3,398	1,838	114,200
Land Use (km2)			
Urban Area	6.65	1.80	41
Mining	-	-	-
Mixed Horticulture	9.30	1.35	52.95
Rubber	90.50	12.85	587.45
Oil Palm	-	-	65
Coconuts	63.85	6.05	130.6
Other Crops	6.15	0.45	172.9
Padi	171.05	67.45	3300.6
Pasture/Grassland	22.75	6.00	251.1
Forest Land	16.10	60.95	2529.1
Swamp	59.50	23.15	3857.65
Unused Land	0.25	-	6.25
Total Flood Area	446.10	180.05	10994.60
No. of Persons Affected by Flood (thousand)	40.9	1.5	133.0
Estimated Damages:			
Damage in Past Floods (M$)	6984	167	23063
Annual Average Damage (M$)	2854	68	8584
Average Depth (m)	3.9		
Flood Duration (day)	6		
Flood Event	1975		
Return Period	12		
Station (St.No)	K.Git (19)		
Non-flooding Discharge Q (m3/s)	-		
Non-flooding Discharge R.P.(yr)	1.0		
Flood Event (for Damage Estimate) Q (m3/s)	880		

Table 58 URBANIZATION RATIO IN SABAH

Residency/District	District Population (person)	Town in District	Town Population (person)	Urbanization Ratio (%)
Interior Residency	183,672			
Beaufort	37,126	Beaufort	3,886	11
Kuala Penyu	13,193			
Sipitang	12,360			
Tenom	27,772	Tenom	4,438	16
Pensiangan	8,288			
Keningau	43,476	Keningau	4,686	11
Tambunan	15,004			
Labuan	26,453	Labuan	13,660	52
Kudat Residency	87,285			
Kudat	41,872	Kudat	11,977	27
Kota Marudu	28,249			
Pitas	17,164			
West Coast Residency	321,678			
Ranau	31,118	Ranau	5,082	16
Kota Belud	46,727	Kota Belud	5,198	11
Tuaran	49,821	Tuaran	4,777	10
Kota Kinabalu	112,758	Kota Kinabalu	65,153	58
Penampang	39,338			
Papar	41,908	Papar	5,784	14
Tawau Residency	232,432			
Tawau	121,736	Tawau	49,548	41
Lahad Datu	54,212	Lahad Datu	18,096	33
Semporna	56,484	Semporna	6,084	11
Sandakan Residency	177,549			
Sandakan	118,417	Sandakan	80,827	68
Kinabatangan	26,656			
Labuk & Sugut	32,476			

Remarks; Population in district is extracted from 1980, population and housing census preliminary field count. Population in town of 1980 is the figure estimated by EPU for 4MP. Urbanization ratio is town population over district population. Those which have no town population and urban areas are given in land use map, 10% of district population is assumed to reside urban area for the estimation of people in the flood area.

Table 59 URBANIZATION RATIO IN SARAWAK

Division	District Population (person)	Town in District	Town Population (person)	Urbanization Ratio (%)
First Division	465,339			
Lundu	22,412	Lundu	2,467	11
Bau	32,921	Bau	2,403	7
Kuching	305,719	Kuching Municipality	75,342	25
Serian	67,011	Serian	4,075	6
Simunjan	37,276	Simunjan		
Second Division	165,349			
Simanggang	68,405	Simanggang	4,687	7
Lubok Antu	20,539	Lubok Antu		
Saribas	41,001	Betong	1,940	5
Kalaka	35,404	Saratok	1,114	3
Third Division	221,822			
Sibu	134,786	Sibu	88,163	65
Kanowit	28,879	Kanowit	1,648	57
Mukah	35,831	Mukah	1,745	5
Oya/Dalat	22,326			
Fourth Division	210,759			
Bintulu	58,296	Bintulu	8,807	15
Miri	99,470	Miri	54,606	55
Baram	52,993	Marudi	6,475	12
Fifth Division	45,961			
Limbang	25,909	Limbang	8,346	32
Lawas	20,052	Lawas	853	4
Sixth Division	118,062			
Sarikei	43,199	Sarikei	12,988	30
Binatang	29,946	Binatang	4,719	16
Matu/Daro	16,928			
Julau	27,980			
Seventh Division	67,461			
Kapit	38,345	Kapit	3,410	9
Song	16,887			
Belaga	12,229			

Remarks; Population in district is extracted from 1980, population and housing census preliminary field count. Population in town of 1980 is the figures estimated by EPU for 4MP. Urbanization ratio is town population over district population. Those which have no town population and urban areas are given in land use map, 5% of district population is assumed to reside in urban area for the estimated of people in the flood area.

Table 60 POPULATION DENSITY IN LAND USE CATEGORIES, SABAH

Unit: person/km^2

Residency/District	Urban Population Density	Rural Population Density in Horticulture	Tree crop	Crop land
Interior Residency	2,029	852	80	178
Beaufort	1,408	594	48	290
Kuala Penyu	3,472	613	67	265
Sipitang	1,224	732	81	147
Tenom	2,452	1,089	44	216
Pensiangan	3,070	925	-	73
Keningau	1,003	1,453	161	185
Tambunan	1,613	792	286	76
Labuan	3,672	867	143	582
Kudat Residency	3,712	1,264	79	101
Kudat	5,054	1,202	75	96
Kota Marudu	1,587	1,362	86	109
Pitas	5,721	1,242	78	99
West Coast Residency	4,580	950	109	168
Ranau	1,300	608	757	75
Kota Belud	2,363	544	398	112
Tuaran	2,654	835	69	163
Kota Kinabalu	8,111	3,756	100	902
Penampang	1,788	1,576	131	267
Papar	3,882	1,010	62	180
Tawau Residency	3,012	2,881	79	4,723
Tawau	3,606	2,392	65	15,039
Lahad Datu	2,279	1,790	62	1,806
Semporna	2,173	10,678	161	5,727
Sandakan Residency	3,693	816	89	297
Sandakan	5,874	721	68	2,610
Kinabatangan	519	1,052	168	256
Labuk & Sugut	708	806	89	148

Remarks; Population of district is extracted from 1980 Population and housing census preliminary field count. Areas of each land use category are from the present land use of Sabah 1970. Horticulture area includes mixed horticulture, market gardening and agricultural stations in land use category. Tree crop area includes rubber, oil palm, coconuts, coffee, cocoa, pepper, fibre crops, bananas, orchards, fish and hyacinth ponds. Crop land includes paddy, diversified crops and shifting cultivation. It is assumed that one-half of rural people defined as district population less urban population reside in horticultural area. One-half of the rest reside in each remaining land use category.

Table 61 POPULATION DENSITY IN LAND USE CATEGORIES, SARAWAK

Unit: person/km^2

Division/District	Urban Population Density	Rural Population Density in		
		Horticulture	Tree crop	Crop land
First Division	1,645	1,073	199	52
Lundu	732	168	140	18
Bau	843	164	109	28
Kuching	1,853	3,358	282	123
Serian	1,600	222	169	27
Simunjan	375	145	132	47
Second Division	1,084	336	174	14
Simanggang	905	320	179	17
Lubok Antu	1,848	554	157	6
Saribas	7,462	204	206	19
Kalaka	538	-	148	17
Third Division	3,579	1,556	100	12
Sibu	4,863	1,926	32	8
Kanowit	796	319	179	10
Mukah	421	503	284	23
Oya/Dalat	720	216	166	11
Fourth Division	2,646	1,499	175	18
Bintulu	2,127	2,540	628	101
Miri	2,739	1,346	470	106
Baram	2,779	2,490	81	8
Fifth Division	1,870	968	204	14
Limbang	3,222	3,210	152	10
Lawas	366	124	281	20
Sixth Division	1,789	537	121	14
Sarikei	3,854	2,997	111	17
Binatang	1,300	156	88	25
Matu/Daro	251	326	136	26
Julau	1,794	-	186	7
Seventh Division	1,251	1,402	400	7
Kapit	1,196	3,935	364	8
Song	1,083	325	362	6
Belaga	2,352	183,435	715	5

Remarks; Population of district is extracted from 1980 Population and housing census preliminary field count. Areas of each land use category are from Planimetric Measurement of Land Use Map - Sarawak 1976. Tree crop includes rubber, oil palm coconut, pepper and sago. Crop land includes wet paddy and shifting cultivation. Assuming that population in horticulture area is 30% of urban population. One-half of the rest of people in the district assumed to reside in tree crop area and crop land respectively.

Table 62 COMPARISON OF FLOOD DAMAGE DERIVED FROM OTHER DATA

Basin No.	Basin Name	River Catch-ment	People Affected (10^3 persons) (extracted from) Raw Data	Sarawak DID	Popu-lation Map	Popula-tion Density	Flood Damage (M$10 x 3) (extracted from) Raw Data	Computed
211	Kinabatangan	16,755	-	-	-	5.6	713.7	418
213	Labuk	6,829	300/1	-	-	6.3	-	-
214	Sugut	3,094	1,000/1	-	-	-	-	-
216	Bengkoka	1,866	-	-	-	-	368	-
217	Bongan	2,126	-	-	-	19.8	1,768	809
218	Kadamaian	1,336	-	-	-	9.3	688.1	2,356
219	Tuaran	1,247	-	-	-	4.2	265	404
221	Papar	805	-	-	-	6.8	430.6	874
222	Kimanis	607	-	-	-	1.3	-	250
224	Padas	9,180	-	-	-	7.4	2,174.6	531
227	Lawas	1,080	-/2	-/3	3.17	0.3	-	22
228	Trusan	2,768	40	1.0	6.57	0.8	-	267
229	Limbang	3,920	-	8.7	7.84	2.8	-	995
230	Baram	22,325	23.6	17.7	34.77	7.2	-	760
231	Miri	788	6.0	22.1	41.66	20.7	-	1,932
232	Sibuti	935	-		8.23	2.5	-	381
233	Niah	1,345	-	3.3	8.71	4.9	-	674
234	Suai	1,440	-		1.50	0.3	-	46
236	Kemena	6,000	-	2.7	20.33	17.6	-	2,270
237	Tatau	5,150	-	7.0	9.58	5.2	-	216
238	Balingian	2,518	-	1.4	2.85	0.002	-	89
239	Mukah	2,625	N.A.	2.2	15.43	1.8	-	520
240	Oya	2,005	N.A.	1.1	17.02	0.8	-	620
241	Rajang	51,053	N.A.	12.0	145.79	75.3	-	5,915
245	Sadong	3,645	-	6.7	13.77	0.9	-	96
246	Sarawak	3,358	2.0	60.0	45.75	40.9	-	7,242
247	Kayan	1,838	-	1.1	9.97	1.5	-	168

Remarks; /1: Extracted from DID Sabah's internal paper
/2: Hydrological year book, Sarawak 1962-63
/3: Data supplied by DID Sarawak, assuming that 10 to 50% of people affected by floods.

Table 63 NUMBER OF PERSONS PER HOUSEHOLD (1/2)

State/District	Population 1980 (person)	Living Quarters 1980 (nos.)	Average No. of Persons per Household
Sabah			
Beaufort	37,126	6,988	5.3
Kuala Penyu	13,193	2,870	4.6
Sipitang	12,360	2,684	4.6
Tenom	27,772	5,667	4.9
Pensiangan	8,288	1,464	5.7
Keningau	43,476	9,341	4.65
Tambunan	15,004	2,727	5.5
Labuan	26,453	5,549	4.8
Kudat	41,872	8,034	5.2
Kota Marudu	28,249	6,517	4.3
Pitas	17,164	3,744	4.6
Ranau	31,110	8,003	3.9
Kota Belud	46,727	8,929	5.2
Tuaran	49,821	9,214	5.4
Kota Kinabalu	112,758	19,825	5.7
Penampang	39,338	6,812	5.8
Papar	41,908	8,262	5.1
Tawau	121,736	23,382	5.2
Lahad Datu	54,212	9,881	5.5
Semporna	56,484	7,924	7.1
Sandakan	118,417	19,935	5.9
Kinabatangan	26,656	4,354	6.1
Labuk & Sugut	32,476	6,584	4.9
Total/Average	1,002,600	188,690	5.31

Source; 1980 Population and Housing Census of Malaysia
Preliminary Field Count Summary

Table 64 NUMBER OF PERSONS PER HOUSEHOLD (2/2)

State/District	Population 1980 (person)	Living Quarters 1980 (nos.)	Average No. of Persons of Household
Sarawak			
Lundu	22,412	4,048	5.5
Bau	32,921	6,062	5.4
Kuching	305,719	51,576	5.9
Serian	67,011	11,273	5.9
Simunjan	32,276	6,915	4.7
Simanggang	68,405	14,025	4.9
Lubok Antu	20,539	4,026	5.1
Saribas	41,001	7,790	5.3
Kalaka	35,404	6,675	5.3
Sibu	134,786	22,673	5.9
Kanowit	28,879	5,303	5.4
Mukah	35,831	6,718	5.3
Oya Dalat	22,326	4,311	5.2
Bintulu	58,296	10,407	5.6
Miri	99,470	21,017	4.7
Baram	52,993	8,813	6.0
Limbang	25,909	4,399	5.9
Lawas	20,052	3,271	6.1
Sarikei	43,199	7,810	5.5
Binatang	29,946	5,334	5.6
Mato Daro	16,928	2,749	6.2
Julau	27,989	5,091	5.5
Kapit	38,345	6,516	5.9
Song	16,887	2,880	5.9
Belaga	12,229	1,682	7.3
Total/Average	1,294,753	231,364	5.60

Source; 1980 Population and Housing Census of Malaysia
Preliminary Field Count Summary

Table 65 PROPORTION OF WET PADI AREA IN SABAH

Unit: km^2

Residency/ District	Total Crop Land Area	Wet Padi Area	Other Crops Land Area	Percentage of Wet Padi (%)
Interior				
Beaufort	28.7	27.7	1	96.5
Kuala Penyu	11.2	9.9	1.3	88.4
Sipitang	18.9	9.1	9.8	48.2
Tenom	27.0	9.8	17.2	36.3
Pensiangan	25.4	0	25.4	0
Keningau	52.5	38.5	14.0	73.3
Tambunan	44.3	30.8	5.8	69.5
Labuan	5.5	5.4	0.1	98.2
Kudat	174.9	33.8	141.1	19.3
Kudat	-	-	-	-
Kota Marudu	-	-	-	-
Pitas	-	-	-	-
West Coast				
Ranau	86.9	20.7	66.2	23.8
Kota Belud	92.7	64.3	28.4	69.4
Tuaran	69.2	35.5	33.7	51.3
Kota Kinabalu	13.2	11.7	1.5	88.6
Penampang	33.2	30.6	2.6	92.2
Papar	50.4	47.2	3.2	93.7
Tawau				
Tawau	1.2	0	1.2	0
Lahad Datu	5.0	0.1	4.9	2
Semporna	2.2	0	2.2	0
Sandakan				
Sandakan	3.6	0	3.6	0
Kinabatangan	23.4	0.1	23.3	0.4
Labuk/Sugut	49.5	0.4	49.1	0.8

Source; The present land use of Sabah, 1970

Table 66 PROPORTION OF WET PADI AREA IN SARAWAK

Division/ District	Total Crop Land Area	Wet Padi Area	Other Crops Land Area	Percentage of Wet Padi
				(%)
First Division				
Lundu	538.2	7.3	530.9	1.4
Bau	541.1	5.7	535.4	1.1
Kuching	842.5	20.2	822.3	2.4
Serian	1,126.5	11.4	1,115.3	1.0
Simunjan	380.7	28.0	352.7	7.4
Second Division				
Simanggang	1,801.6	64.8	1,736.8	3.6
Lubok	1,564.9	4.9	1,560.0	0.3
Saribas	1,007.5	48.7	958.8	4.8
Kalaka	1,006.7	18.6	988.1	1.8
Third Division				
Sibu	1,203.1	13.5	1,189.6	1.1
Kanowit	1,369.3	1.8	1,367.5	0.1
Mukah	1,358.7	21.5	1,337.2	1.6
Oya/Dalat	908.6	0.8	907.8	0.08
Fourth Division				
Bintulu	2,145.0	10.9	2,134.1	0.5
Miri	1,044.3	33.7	1,010.6	3.2
Baram	2,942.0	20.7	2,921.3	0.7
Fifth Division				
Limbang	783.0	47.1	735.9	6.0
Lawas	472.7	22.3	450.4	4.7
Sixth Division				
Sarikei	780.1	4.1	77.6	0.5
Binatang	470.0	25.4	444.6	5.4
Matu/Daro	306.9	7.3	299.6	2.4
Julau	1,761.5	0	1,761.5	0
Seventh Division				
Kapit	2,237.0	2.1	2,234.9	0.09
Song	1,235.7	0.3	1,235.4	0.02
Belaga	1,092.2	0	1,092.2	0

Source; Planimetric measurement of land use map - Sarawak 1976

Table 67 AREA DAMAGE FACTORS

Crop	Paddy	Coconut	Other Crops
Damage Factor (%)	100	80	50

Housing/Properties	Urban	Rural		
		Horti.	Rubber	Paddy
Damage Factor (%)	50	80	30	10

Table 68 MORTALITY OF IMMATURE RUBBER TREES UP TO 3-YEAR OLD

Flood Duration (Days)	Flood Depth (cm)	Mortality (Percentage)
7	25	5
14	25	15
21	25	60
28	25	100

Source; Ref. 22

Table 69 MORTALITY OF IMMATURE PALM TREES UP TO 3-YEAR OLD - (OIL PALMS/COCONUTS PALMS)

Flood Duration (Days)	Flood Depth (cm)	Mortality (Percentage)
7	25	10
14	25	20
21	25	70
28	25	100

Remarks; Mortality of oil palms assumed to be same as for coconuts palms. (Conservative assumption in terms of damageability).

Source; Ref. 22

Table 70 MORTALITY OF IMMATURE TREES UP TO 3-YEAR OLD UNDER CATEGORY OF OTHER PERMANENT CROPS

Flood Duration (Days)	Flood Depth (cm)	Mortality (Percentage)
4	25	10
8	25	25
12	25	60
16	25	100

Remarks; Majorities included in this category are fruit trees, cocoa, sugarcane, coffee, pineapples.
Mortality rates represented by fruit crops.

Source; Ref. 22

Table 71 FLOOD DAMAGE FACTORS OF MIXED HORTICULTURES

Flood Duration (Day)	4	8	12	16	20
Damage Factor (%)	10	25	50	75	100

Source; Damage - flood duration relationship extracted from Fig. A.14 in Vol. 2 of Ref. 23.

Table 72 BUILDINGS/PROPERTIES DAMAGE FACTORS

Flood Depth (m)	Damage Factor
Below Floor Level	0.03
0.5 m above Floor Level	0.05
1.0 m above Floor Level	0.07
2.0 m above Floor Level	0.11
3.0 m above Floor Level	0.15
More than 3 m above Floor Level	0.22

Table 73 FLOOD DAMAGE FACTORS - PADI

Unit: %

Inundation Depth (m)	Duration (day)	Region A (Booting-Heading Period) Short-term/ Irrigated	Region A (Booting-Heading Period) Long-term/ Rainfed	Region B (Heading-Ripening Period) Short-term/ Irrigated	Region B (Heading-Ripening Period) Long-term/ Rainfed
Plant Height (cm)		80-100	90-110	100-120	110-130
Less than 0.5 m	1-2	30	27	3	3
	3-4	37	33	8	7
	5-6	40	36	11	10
	7 over	45	41	12	11
0.5-0.9 m	1-2	33	30	5	5
	3-4	40	36	17	15
	5-6	43	39	24	22
	7 over	49	44	25	23
1.0 m over	1-2	60	54	11	10
	3-4	80	72	35	32
	5-6	86	77	45	41
	7 over	96	86	48	43

Remarks; (1) Main flood season:

Region A (Sarawak): Booting/heading period (Main season)
Region B (Sabah) : Heading/ripening period (Irrig. off season)

(2) Above weighted average damage rates were calculated taking into account the duration and damageability at respective growing stages. Growing period is assumed as below.

- Booting stage : 30% of total growing period
- Heading time : 10% of total growing period
- Ripening stage: 30% of total growing period

(3) Damage rates for long-term varieties assumed to be 90% of that for short-term varieties.

Table 74 FLOOD DAMAGE FACTOR OF PADI BY GROWING STAGE

Item		Booting Stage	Heading Stage	Ripening Stage
Relative Growth	(%)	60-75	80-90	90-100
Flooding Depth up to 50% Plant Height	1 - 2 days	37	8	2
	3 - 4 days	42	22	4
	5 - 6 days	45	25	6
	7 days over	50	28	6
Flooding Depth up to 75% Plant Height	1 - 2 days	40	10	4
	3 - 4 days	46	23	15
	5 - 6 days	49	26	23
	7 days over	55*	30*	23
Complete Submergence	1 - 2 days	70*	30*	5
	3 - 4 days	80*	80*	20
	5 - 6 days	85*	90*	30
	7 days over	95*	100*	30

Remarks; (1) Assumption of padi varieties:
Short-stem varieties (e.g. Mehsmi, Mat Candu) planted in irrigated area. Long-stem varieties (e.g. Serendah Kuning) planted in non-irrigated area.

(2) *: Almost coincide with assumptions in Kelantan River Basin Study - Main Report, Annex 1, page 87.

Source; SJ 21

Table 75 PADI AREA BY BASIN IN SABAH

Unit: ha

Basin No.	Total Wet Paddy Area	Rainfed	Irrigation	Percentage (%) Irrigated	Percentage (%) Rainfed
201	0	-	-	-	-
202	0	-	-	-	-
203	0	-	-	-	-
204	0	-	-	-	-
205	0	-	-	-	-
206	0	-	-	-	-
207	101	101	-	-	-
208	0	-	-	-	-
209	0	-	-	-	-
210	0	-	-	-	-
211	45	45	-	0	-
212	20	20	-	0	-
213	2,510	0	2,510	100	-
214	1,068	0	1,068	100	-
215	0	0	0	0	-
216	430	192	238	55	45
217	3,767	1,626	2,141	57	43
218	5,818	376	5,442	94	6
219	2,842	858	1,984	70	30
220	4,614	2,792	1,822	39	61
221	2,748	0	2,748	100	0
222	1,303	1,243	60	5	95
223	838	693	145	17	83
224	6,090	3,873	2,217	36	64
225	568	568	0	0	100
226	838	433	405	48	52
Total	33,600	12,820	20,780	62	38

Source; Sectoral Report SF

Table 76 PADDY AREA BY BASIN IN SARAWAK

Unit: ha

Basin No.	Total Wet Paddy Area	Rainfed	Irrigation	Percentage (%) Irrigated	Percentage (%) Rainfed
227	596	596	0	0	100
228	2,115	2,115	0	0	100
229	1,845	1,626	219	12	88
230	4,654	4,492	162	3	97
231	400	272	128	32	68
232	1,939	1,191	748	39	61
233	150	150	0	0	100
234	0	0	0	0	100
235	0	0	0	0	100
236	3,800	3,691	109	3	97
237	223	223	0	0	100
238	315	315	0	0	100
239	1,900	1,900	0	0	100
240	1,233	1,233	0	0	100
241	16,507	14,982	1,525	9	91
242	5,569	5,338	231	4	96
243	3,875	3,571	304	8	92
244	13,964	12,179	1,785	13	87
245	5,978	5,620	358	6	94
246	4,919	4,660	259	5	95
247	1,417	1,223	194	14	86
Total	71,399	65,377	6,022	8	92

Remarks; Paddy yield in irrigated is deemed to be the same as the one in rainfed for the flood damage estimate.

Source; Sectoral Report Vol. 5, Part 2

Table 77 WIDTH OF HIGH-WATER CHANNEL

Design Discharge (m^3/s)	Width (m)	Levees of Earth Embankment	
		Freeboard (m)	Width (m)
300	40 - 60	0.7	3
500	60 - 80	0.8	3
1,000	90 - 120	1.0	4
2,000	160 - 220	1.0	4
5,000	350 - 450	1.2	5

Table 78 CHANNEL IMPROVEMENT COST (PER KM)

Unit: M10^6/km

Design Flood (m^3/s)	Longitudinal Gradient						
	1/500	1/1000	1/2000	1/3000	1/5000	1/10,000	1/20,000
50	0.26	0.29	0.34	0.36	0.40	-	-
100	0.33	0.37	0.43	0.47	0.51	-	-
200	0.34	0.42	0.53	0.55	0.59	0.75	1.20
300	0.42	0.47	0.54	0.58	0.73	0.87	1.32
500	0.61	0.64	0.81	0.87	0.97	1.20	1.79
1,000	0.73	0.84	0.97	1.07	1.25	1.51	2.22
2,000	1.00	1.08	1.44	1.58	1.87	2.29	3.67
3,000	1.22	1.38	1.76	1.95	2.28	2.79	3.93
5,000	1.66	1.98	2.40	2.66	3.10	3.81	4.42
10,000	2.53	3.03	3.63	4.09	4.75	5.91	6.34
20,000	3.81	4.22	5.34	5.96	7.02	8.83	11.28

Remarks; (1) Cost for other discharges/gradient to be interpolated.

(2) Single cross section for discharges less than 200 m^3/s. Composite section for others.

(3) Basic unit prices used for the estimation above (contingencies and engineering cost not included):

- Clearing & Stripping (m^2) M$0.4
- Excavation-machine (m^3) M$3.0
- Embankment-excavated (m^3) M$2.0
- Embankment-borrowed (m^3) M$6.0
- Levee road pavement (m^2) M$8.0
- Revetment (m^2) M$25.0
- Sod facing (m^2) M$2.5

Table 79 CONSTRUCTION COST OF BYPASS FLOODWAY - PER KM

Unit: M$10^6/km

Design Capacity (m^3/s)	Longitudinal Gradient					
	1/500	1/1000	1/2000	1/3000	1/5000	1/10,000
300	0.68	0.76	0.88	0.96	1.20	1.40
500	0.84	0.98	1.36	1.39	1.54	1.94
1,000	1.19	1.40	1.62	1.82	2.15	2.61
2,000	1.66	1.90	2.48	3.29	3.29	3.93
3,000	2.04	2.42	3.06	3.77	4.08	4.87
5,000	2.79	3.44	4.22	4.74	5.54	6.75
10,000	4.25	5.34	6.49	7.39	8.55	10.77

Remarks; Single cross section for discharge of less than 200 m^3/s. Composite section for others.

Table 80 CONSTRUCTION COST OF POLDER

Unit: M$10^6

Item	Estimated Cost
Polder Dyke:	
- Height 1 m	0.21/km
- " 2 m	0.40/km
- " 3 m	0.51/km
- " 4 m	0.70/km
- " 5 m	0.95/km
Internal Drainage System:	
- Urban land	0.007/ha
- Paddy land	0.003/ha
Pumping Facilities:	
- Capacity 1 m^3/s	0.6/station
- " 2 m^3/s	0.8/station
- " 4 m^3/s	1.3/station
- " 6 m^3/s	1.8/station
- " 8 m^3/s	2.2/stat
- " 10 m^3/s	2.6/stat

Table 81 UNIT PRICES FOR ESTIMATION OF DAM CONSTRUCTION COST

Class of Dam (in Embankment Volume)	Unit Price ($M\$/m^3$)
Less than 500,000 m^3	73
500,000 - 2,000,000	60
More than 2,000,000	50

Remarks; Above represents prices for construction of rockfill dam.

Table 82 LAND PROCUREMENT AND RESETTLEMENT COSTS

Compensation on Land ($M\$10^6/km^2$)

Irrigated paddy	2.5	Urban area Class S	100
Rainfed paddy	1.5	Urban area Class A	10
Tree crop field Class A	1.5	Urban area Class B	5
Tree crop field Class B	1.0	Village area Class A	5
Tree crop field Class C	0.5	Village area Class B	1
Forest Class A	0.5		
Forest Class B	0.1		

Resettlement ($M\$10^3$/household)

Urban	30	Rural	10

Table 83 UNIT COST FOR NON-STRUCTURAL MEASURES

Unit: M$10^3

Item	Estimated Cost
1. Restriction of Development	
1) Management office expenditures (per 100 families of flood area/1)	
- Personnel cost (per year)	
Engineer	0.5 persons x 36 = 18
Asst. Engineer	1 person x 25 = 25
Overseer	1 person x 20 = 20
Assistant incl. Clerks	6 persons x 30 = 180
Others	2 persons x 3 = 6
Sub-total	10.5 persons = 249
- Building, equipment and other expenditures	
100% of personnel cost	251
Total cost per year	500
2) Flood risk mapping (per 100 km^2/2)	20
2. Resettlement Plan	
Resettlement cost (per family)	
- Resettlement	100
- Procurement of land in resettled area	1
3. Flood Proofing	
Subsidy to household (per household)	5

Remarks; /1: only for lands presently in use, excl. unused lands such as swamp, forest

/2: for total flood area incl. swamp, forest, etc.

Table 84 UNIT COST FOR TELEMETRIC FLOOD FORECASTING SYSTEM INSTALLATIONS

Item	Equipment Cost (M$10^3/no)	Cost including Installation* (M$10^3/no)
Rain-gauge station	32	70
Stream-gauge station	36	86
Repeater station	78	170
Receiving station	290	570

Remarks; *: excluding contingencies (30%) and engineering cost (10%)

In addition, cost for operation guidance to be assumed at approximately 20% of above.

Table 85 OPERATION AND MAINTENANCE COSTS

Work Item	Annual O&M Cost (% to Initial Cost)	Service Life (year)
Channel/levee	2	50
Bypass floodway	2	50
Polder	2	-
- Civil works	-	50
- Pumps & equipment	-	20/1
Flood control dam	0.5	50
Flood forecasting system	10	10/2
Dredger	7	10/1

Remarks; /1: Replacement at end of service life

/2: Ditto. Possibility of replacement due to system remodelling taken into account.

Table 86 RIVER IMPROVEMENT PLAN (1/8)
WITHOUT DAM/FLOODWAY

State:Sabah

Unit: Million M$ for cost

St'h No.	Location	Impr. Le'th (km)	Des'n Flood (cms)	Lon'l Grad.	Con' Cost	Ann'l Cost	Da'g Red'n	B-C
Basin 201 Pensiangan								
1		21	3237	1/422	31.03	2.24	0.20	-2.04
2		26	2195	1/190	18.55	1.31	0.18	-1.13
3		28	1322	1/2417	39.00	2.92	0.13	-2.79
101		17	1555	1/490	18.59	1.38	0.08	-1.30
Basin 207 Tawau								
1		9	827	1/738	7.95	0.59	0.76	+0.17
Basin 210 Segama								
1		47	8067	1/10279	288.78	21.54	0.93	-20.61
2		33	7135	1/5413	157.23	11.63	0.75	-10.88
3		40	6598	1/5249	179.32	13.29	1.00	-12.29
4		8	6159	1/1312	24.13	1.77	0.33	-1.44
Basin 213 Labuk								
1		27	8113	1/6014	144.70	10.74	0.64	-10.10
2		14	7058	1/3062	57.53	4.23	0.28	-3.95
3		26	6789	1/947	79.45	5.78	0.50	-5.28
4		36	6153	1/1088	105.80	7.75	0.64	-7.11
5		17	5538	1/499	39.53	2.89	0.25	-2.64
101		15	2802	1/1230	27.12	1.98	0.19	-1.79
Basin 214 Sugut								
1		44	6153	1/7217	203.41	15.15	0	-
2		31	5957	1/10170	155.70	11.64	-0.04	-11.68
3		8	5439	1/2624	26.13	1.94	0	-
4		24	5258	1/3937	84.78	6.32	0	-
5		20	4574	1/468	37.79	2.77	0	-

Remarks: * Stretches in other state

Table 87 RIVER IMPROVEMENT PLAN (2/8)
WITHOUT DAM/FLOODWAY

State:Sabah

Unit: Million M$ for cost

St'h No.	Location	Impr. Le'th (km)	Des'n Flood (cms)	Lon'l Grad.	Con' Cost	Ann'l Cost	Da'g Red'n	B-C
Basin 216 Bengkoka								
1		20	2902	1/2187	44.03	3.25	0	-
2		6	2704	1/1640	11.68	0.85	0	-
Basin 217 Langkon								
1		6	754	1/3937	7.42	0.55	0.01	-0.54
2		3	297	1/298	0.97	0.07	0.01	-0.06
3		2	274	1/46	0.20	0.01	0.03	0.02
101		5	618	1/431	3.39	0.25	0.04	-0.21
102		3	580	1/112	0.87	0.06	0.09	0.03
Basin 217 Bongan								
1		11	1872	1/1804	17.31	1.29	0.13	-1.16
2		9	1857	1/738	11.05	0.82	0.18	-0.64
Basin 217 Kota Marudu								
1		10	1322	1/1093	11.27	0.83	0.08	-0.75
2		5	1272	1/328	3.53	0.25	0.07	-0.18
3		5	1185	1/86	1.55	0.10	0.03	-0.07
Basin 217 Tandek								
1		8	978	1/3749	10.68	0.80	0.16	-0.64
2		6	858	1/820	5.92	0.44	0.18	-0.26
Total		227			0.00	47.47		
Basin 218 Kadamaian								
1		15	2841	1/2034	33.31	2.45	0.29	-2.16
2		2	2614	1/1640	4.79	0.35	0.03	-0.32
101		8	1566	1/1049	9.54	0.71	0.04	-0.67

Remarks: * Stretches in other state

Table 88 RIVER IMPROVEMENT PLAN (3/8)
WITHOUT DAM/FLOODWAY

State:Sabah

Unit: Million M$ for cost

St'h No.	Location	Impr. Le'th (km)	Des'n Flood (cms)	Lon'l Grad.	Con' Cost	Ann'l Cost	Da'g Red'n	B-C
Basin 219 Tuaran								
1		13	2977	1/1777	27.25	2.00	0.28	-1.72
2		9	2534	1/1736	17.37	1.27	0.09	-1.18
101		4	1050	1/504	3.63	0.26	0.01	-0.25
Basin 220 Putatan								
1		12	797	1/1574	11.98	0.89	1.07	0.18
2		10	709	1/1312	9.17	0.68	0.02	-0.66
Basin 221 Papar								
1		17	1695	1/1093	21.25	1.58	0.34	-1.24
2		12	1602	1/1036	14.40	1.07	0.	-
Basin 222 Kimanis								
1		15	913	1/1093	14.76	1.10	0.05	-1.05
2		2	602	1/1312	1.69	0.12	0.	-
Basin 222 Bongwan								
1		15	908	1/1406	15.38	1.14	0.17	-0.97
Basin 223 Membakut								
1		17	816	1/2230	18.91	1.41	0.04	-1.37
2		8	744	1/1749	8.07	0.60	0.02	-0.58

Remarks: * Stretches in other state

Table 89 RIVER IMPROVEMENT PLAN (4/8)
WITHOUT DAM/FLOODWAY

State:Sabah

Unit: Million M$ for cost

St'h No.	Location	Impr. Le'th (km)	Des'n Flood (cms)	Lon'l Grad.	Con' Cost	Ann'l Cost	Da'g Red'n	B-C
Basin 224 Padas								
1		52	4678	1/4265	173.83	12.99	0.65	-12.34
2		16	4433	1/6561	58.36	4.37	0.27	-4.10
3		45	2574	1/1203	78.41	5.72	0.58	-5.14
201		27	2907	1/942	46.84	3.42	0.36	-3.06
203		8	1800	1/238	5.36	0.38	0.06	-0.32
204		25	1756	1/507	29.30	2.17	0.15	-2.02
2021		9	1658	1/124	3.89	0.27	0.02	-0.25
Total		343			0.00	45.06		

Remarks: * Stretches in other state

Table 90 RIVER IMPROVEMENT PLAN (5/8)
WITHOUT DAM/FLOODWAY

State:Sarawak

Unit: Million M$ for cost

St'h No.	Location	Impr. Le'th (km)	Des'n Flood (cms)	Lon'l Grad.	Con' Cost	Ann'l Cost	Da'g Red'n	B-C
Basin 227 Lawas								
1		18	2010	1/1596	28.16	2.01	0.01	-2.00
Basin 228 Trusan								
1		57	5538	1/2010	177.53	12.43	0.08	-12.35
Basin 229 Limbang								
1		89	7144	1/9124	491.43	34.78	1.06	-33.72
2		18	5999	1/3937	69.66	4.90	0.57	-4.33
Basin 230 Baram								
1		76	21693	1/41557	1586.70	117.05	0.12	-116.93
2		41	21368	1/22419	607.34	44.12	0.68	-43.44
3		158	18575	1/1851	995.77	67.77	0.21	-67.56
101		91	4135	1/7281	327.34	23.61	0.06	-23.55
201		166	6999	1/6723	826.08	57.95	0.	-
301		23	8862	1/4438	117.95	8.29	0.01	-8.28
302		15	8440	1/2460	64.44	4.45	0.	-
303		37	6885	1/5057	169.77	11.85	0.	-
Basin 231 Miri								
1		10	2545	1/2187	20.74	1.42	2.71	+1.29
2		22	2439	1/2887	47.04	3.27	0.62	-2.65
Basin 232 Sibuti								
1		16	2766	1/2282	34.75	2.40	0.13	-2.27
2		11	2579	1/2004	22.59	1.55	0.18	-1.37

Remarks: * Stretches in other state

Table 91 RIVER IMPROVEMENT PLAN (6/8)
WITHOUT DAM/FLOODWAY

State:Sarawak

Unit: Million M$ for cost

St'h No.	Location	Impr. Le'th (km)	Des'n Flood (cms)	Lon'l Grad.	Con' Cost	Ann'l Cost	Da'g Red'n	B-C
Basin 233 Niah								
1		19	3617	1/4452	55.85	3.97	0.13	-3.84
2		11	3261	1/4511	30.72	2.17	0.34	-1.83
3		22	2920	1/4811	59.31	4.19	0.04	-4.15
Basin 234 Suai								
1		35	3778	1/6754	117.14	8.41	0.01	-8.40
2		5	3444	1/820	9.48	0.64	0.01	-0.63
Basin 236 Kemena								
1		30	9216	1/4279	156.07	10.99	0.40	-10.59
2		15	8443	1/4101	73.14	5.12	0.19	-4.93
3		58	7744	1/3883	264.47	18.39	0.34	-18.05
Basin 237 Tatau								
1		28	8182	1/4834	140.35	9.85	0.03	-9.82
2		35	7836	1/5468	176.32	12.38	0.03	-12.35
201		32	4092	1/4772	102.89	7.36	0.01	-7.35
211		28	4474	1/3167	84.47	6.02	0.01	-6.01
212		43	3962	1/6717	147.66	10.62	0.02	-10.60
Basin 238 Baling								
1		55	4975	1/3759	184.83	13.27	0.04	-13.23
Basin 239 Mukah								
1		41	5403	1/5173	159.49	11.42	0.24	-11.18
2		36	4415	1/3374	109.21	7.78	0.01	-7.77

Remarks: * Stretches in other state

Table 92 RIVER IMPROVEMENT PLAN (7/8)
WITHOUT DAM/FLOODWAY

State:Sarawak

Unit: Million M$ for cost

St'h No.	Location	Impr. Le'th (km)	Des'n Flood (cms)	Lon'l Grad.	Con' Cost	Ann'l Cost	Da'g Red'n	B-C
Basin 240 Oya								
1		69	4650	1/4192	228.44	16.39	0.28	-16.11
2		22	3757	1/4811	67.62	4.82	0.02	-4.80
Basin 241 Rajang								
1		81	33921	1/8572	1300.12	93.22	2.19	-91.03
2		72	33493	1/9448	1079.42	77.08	0.13	-76.95
3		47	31231	1/254	218.00	13.22	0.28	-12.94
201		65	6121	1/7616	303.85	21.64	0.37	-21.27
Basin 241 Matu								
1		21	598	1/3444	23.10	1.74	0.12	-1.62
101		24	450	1/7874	28.39	2.14		
Basin 245 Sadong								
1		84	6385	1/19802	496.77	37.16	1.41	-35.75
Basin 246 Samarahan								
1		25	2748	1/4824	65.61	4.87	1.42	-3.45
2		4	1491	1/1312	4.97	0.37	0.03	-0.34
201		17	770	1/3983	21.26	1.59	0.17	-1.42
Basin 246 Samarahan								
1		36	3942	1/6216	120.89	9.03	3.01	-6.02
101		18	2516	1/4921	45.73	3.39	0.82	-2.57
102		11	2291	1/880	16.20	1.18	1.33	+0.15
103		19	1428	1/402	16.52	1.21	0.16	-1.05
111		7	2045	1/5741	16.04	1.20	0.04	-1.16
112		26	1966	1/1640	40.56	3.02	0.22	-2.80

Remarks: * Stretches in other state

Table 93 RIVER IMPROVEMENT PLAN (8/8)
WITHOUT DAM/FLOODWAY

State:Sarawak

Unit: Million M$ for cost

St'h No.	Location	Impr. Le'th (km)	Des'n Flood (cms)	Lon'l Grad.	Con' Cost	Ann'l Cost	Da'g Red'n	B-C
Basin 247 Kayan								
1		15	2764	1/2734	33.84	2.50	0.32	-2.18
2		17	2570	1/4101	42.41	3.14	0.20	-2.94
Basin 247 Kayan								
1		9	1124	1/1736	10.61	0.79	0.07	-0.72
Total		334			0.00	73.40		

Remarks: * Stretches in other state

Table 94 BYPASS FLOODWAY PLAN

State: Sarawak

Unit: Mil. M. Dollars

St'h No.	Name/ Lacation of Floodway	Len'h	Design Flood (cms)	Long' Grad.	Const. Cost	Ann'l Cost	Damage Red'n	B-C
Basin 210	Segama	12	5850	1/600	46.35	3.73	0.33	-3.40
Basin 231	Miri	4.5	2130	1/700	10.66	0.45	0.73	+0.28
Basin 232	Subuti	4	1990	1/500	8.74	0.70	0.16	-0.54

Table 95 FLOOD PROTECTION BY POLDER

State:

Unit: Thou. M. Dollars

St'h No.	Name/ Lacation of Floodway	Area Bunded	Population Protected (2000)	Const. Cost	Ann'l Cost	Damage Red'n	B-C
Basin 230	Baram	4.0	2840	3452	148	605	+457
Basin 233	Niah	3.25	2081	749	33	403	+370
Basin 247	Kayan	6.25	732	6184	265	346	+81

Table 96 PRINCIPAL FEATURES OF FLOOD CONTROL DAM EXAMINED (1/2)

Basin No.	Dam Name	Catchment Area (km^2)	Required Flood Storage (10^6 m^3)	Dam Fill Volume (10^6 m^3)	Efficiency Physical	Efficiency Control (mm)	Catch-ment (%)
201	Tagul	449	42.5	1.3	35	94	9
201	Sibungo	530	47.2	1.9	27	89	10
201	Pensiangan	5,106	205.8	1.1	241	40	100
201	Sumatalun	384	38.4	1.9	22	100	8
201	Sapulut	2,594	131.9	0.5	342	50	51
202	Serudong	441	119.1	16.9	7	270	40
203	Kalabakan 1	310	94.7	2.8	35	305	23
203	Kalabakan 2	295	91.6	9.9	9	310	22
203	Kalabakan 3	278	88.1	0.3	282	317	20
204	Brantian 1	478	125.5	1.4	95	262	82
204	Brantian 2	436	118.4	2.2	57	271	75
204	Brantian 3	120	51.0	2.6	19	425	21
205	Umas-umas 1	208	73.0	2.9	26	350	38
205	Umas-umas 2	171	64.3	4.6	14	375	31
206	Merutai 1	192	69.3	1.0	71	360	47
206	Merutai 2	86	41.1	0.5	89	477	21
207	Tawau	38	24.0	5.1	4	639	28
207	Kinabutan	23	17.7	2.8	6	756	49
207	Balung 1	47	27.6	2.7	10	593	17
207	Balung 2	20	15.8	0.2	70	12	7
210	Segama 2	671	156.8	3.0	55	233	14
210	Danum	257	83.7	1.0	85	326	5
211	Kuamut 2	2,686	390.8	1.6	271	145	17
211	Kuamut 3	1,971	318.5	3.7	95	161	12
211	Kuamut 4	1,408	255.2	17.7	397	181	9
211	Kuamut 5	945	196.2	5.7	36	207	6
211	Kuamut 6	381	108.4	15.6	7	284	2
211	Imabak	360	104.4	4.2	25	289	2
211	Sinoa	171	64.2	0.5	123	375	1
211	Labau	977	200.6	14.2	15	205	6
211	Pingas	264	85.3	15.6	56	323	2
211	Milian 1	3,390	455.8	5.0	98	134	21
211	Milian 2	1,262	237.4	4.9	51	188	8
211	Pinangah	1,205	230.3	0.6	419	191	7
211	Balar	10,730	983.0	0.3	647	92	67
211	Tongod	216	74.8	2.8	28	346	1
212	Babakong	36	23.5	0.2	127	647	8
213	Telupid Lower	2,480	395.5	3.0	130	149	50
213	Telupid Upper	2,443	391.5	3.5	112	150	49
213	Mounod	99	45.1	0.2	196	454	33
214	Sugut 1	2,111	354.4	1.1	318	158	69
214	Mirau	685	159.0	1.6	107	232	22
215	Kolombuon 1	34	22.5	1.4	16	663	3
216	Bengkoka 1	515	131.9	2.8	50	256	54
216	Bengkoka 2	347	101.0	8.8	12	293	36
216	Nibang	55	30.8	1.0	33	559	58
217	Langkon	41	25.4	1.9	14	620	32
217	Bandau	101	45.6	6.1	8	451	36
217	Tuaran	87	41.3	6.6	6	478	31
217	Kinaram 2	38	24.2	16.5	2	637	8
218	Perataran	40	24.8	10.9	2	628	4
218	Wariu	123	51.9	1.5	4	421	13
218	Kadamaian	139	56.2	7.0	8	404	15

Table 97 PRINCIPAL FEATURES OF FLOOD CONTROL DAM EXAMINED (2/2)

Basin No.	Dam Name	Catchment Area (km^2)	Required Flood Storage (10^6 m^3)	Dam Fill Volume (10^6 m^3)	Efficiency Physical	Efficiency Control (mm)	Catch-ment (%)
219	Tuaran 1	711	162.8	2.1	79	229	72
219	Tuaran 2	568	140.6	6.6	22	248	57
219	Tuaran 3	451	121.0	5.9	21	268	46
219	Tuaran 4	213	74.2	2.1	36	348	22
219	Tuaran 5	120	51.1	6.0	8	425	12
219	Tuaran 6	98	44.8	6.7	7	456	10
219	Mulau 1	202	71.6	1.9	39	355	20
219	Mulau 2	178	65.9	3.5	19	370	18
220	Moyog 1	114	30.6	2.6	12	268	46
220	Moyog 2	53	18.8	2.9	66	355	22
220	Tempangoa	19	9.0	0.8	12	516	8
221	Papar 1	353	63.1	1.5	44	179	44
221	Papar 2	288	55.3	3.1	19	192	36
221	Papar 3	221	46.7	4.6	11	211	27
221	Gramatoi	83	25.0	3.2	8	301	10
221	Mandalipau	101	28.3	2.6	11	281	13
222	Besanon 1	61	20.6	1.0	20	337	20
222	Besanon 2	47	17.4	0.8	23	371	15
222	Kimanis	63	20.9	1.2	18	333	21
222	Bongawan	40	15.6	1.6	10	395	13
222	Puas	44	16.7	1.3	13	380	14
223	Membakut 1	164	38.6	0.1	286	235	64
223	Membakut 2	128	33.0	0.3	124	251	50
223	Membakut 4	37	14.8	1.3	12	406	14
224	Padas 1	1,935	109.0	6.2	21	56	21
224	Padas 2	1,171	78.7	4.4	20	67	13
224	Maligan	575	49.8	2.1	26	87	6
224	Telekosong 1	821	62.6	2.9	25	76	9
224	Telekosong 2	624	52.5	3.9	15	84	7
229	Limbang 2	2,430	365.2	0.9	443	150	62
236	Segan	20	15.9	2.1	6	799	1
236	Pandan 1	436	118.1	0.4	297	271	7
236	Pandan 2	128	58.2	0.2	229	414	2
236	Pandan 3	47	27.9	0.5	54	588	1
236	Tubau	158	61.0	0.8	77	385	3
236	Pesu 1	110	48.2	1.2	41	437	2
236	Pesu 2	39	24.4	6.9	4	633	1
236	Pasai	29	20.3	0.3	76	699	1
236	Sebrau	48	28.2	0.2	138	584	1
244	Lemanak 1	183	23.9	0.5	49	131	3
244	Lemanak 2	141	20.3	0.5	43	144	2
244	Kumpong	72	34.4	0.2	82	184	1
244	Batangai 3	220	26.9	0.6	45	122	3
245	Kayan 2	29	20.3	2.2	10	670	1
245	Kedup 2	51	29.2	0.3	91	573	2
245	Kayan 1	425	120.4	0.7	182	273	12
245	Kedup 1	300	95.5	0.1	679	308	9
246	Semadang	25	18.6	0.3	55	734	1
246	Tebia	50	28.8	0.5	61	578	2
246	Bengoh	126	52.5	0.2	240	417	4
246	Giam	294	91.3	1.9	50	310	9
246	P. Batu	101	45.5	0.5	97	450	3
247	Kayan 1	128	53.2	0.1	439	414	15
247	Kayan 2	20	15.7	0.6	27	804	2

Table 98 RIVER IMPROVEMENT PLAN (1/5)
WITH FLOOD CONTROL DAM

State:Sabah

Unit: Million M$ for cost

St'h No.	Location	Impr. Le'th (km)	Des'n Flood (cms)	Lon'l Grad.	Con' Cost	Ann'l Cost	Da'g Red'n	B-C
Basin 201 Pensiangan								
1		21	2114	1/423	23.84	4.81	0.00	-4.81
2		26	756	1/191	10.21	2.05	0.00	-2.05
3		28	1322	1/2417	39.00	7.94	0.02	-7.92
101		17	1291	1/491	17.05	3.46	0.00	-3.46
	Supulut Dam				29.80	2.05		
	Sibungo Dam				137.73	9.56		
Basin 207 Tawau								
1		9	708	1/738	7.56	30.87	0.66	-30.15
	Tawau Dam				436.80	30.31		
Basin 210 Segama								
1		47	7287	1/10280	271.59	30.51	0.00	-30.51
2		33	6290	1/5413	143.90	16.13	0.09	-16.02
3		40	5706	1/5249	161.87	18.19	0.27	-17.86
4		8	5224	1/1312	21.32	2.38	0.18	-2.16
	Segama 2 Dam				254.73	17.67		
	Danum Dam				72.14	5.01		
Basin 213 Labuk								
1		27	5811	1/6015	116.38	15.11	0.09	-15.00
2		14	4430	1/3062	41.69	5.41	0.00	-5.41
3		26	4050	1/948	55.05	7.10	0.01	-7.09
4		36	3067	1/1089	66.94	8.61	0.07	-8.54
5		17	1866	1/499	20.71	2.68	0.03	-2.65
101		15	2802	1/1230	27.12	3.48	0.04	-3.44
	Telupid U Dam				225.18	18.15		

Remarks: Annual cost herein includes the cost of dam allocated according to reduction of design flood discharge.

Table 99 RIVER IMPROVEMENT PLAN (2/5)
WITH FLOOD CONTROL DAM

State:Sabah

Unit: Million M$ for cost

St'h No.	Location	Impr. Le'th (km)	Des'n Flood (cms)	Lon'l Grad.	Con' Cost	Ann'l Cost	Da'g Red'n	B-C
Basin 214 Sugut								
1		44	3694	1/7217	147.95	13.38	0.00	-13.38
2		31	3407	1/10170	110.95	10.18	0.01	-10.17
3		8	2574	1/2624	17.29	1.64	0.00	-1.64
4		24	2240	1/3937	52.47	5.26	0.00	-5.26
5		20	4574	1/468	37.81	2.77	0.00	-2.77
Sugut 1 Dam					85.65	5.92		
Basin 216 Bengkoka								
1		20	2037	1/2187	35.40	4.26	-0.01	-4.25
2		6	1780	1/1640	8.83	1.19	0.00	-1.19
Bengkoka 1 Dam					31.05	2.15		
Basin 217 Langkon								
1		6	615	1/3937	6.88	5.71	0.00	-5.71
2		3	297	1/298	0.97	0.80	0.00	-0.80
3		2	274	1/46	0.20	0.16	0.03	-0.13
101		5	618	1/432	3.39	2.81	0.00	-2.81
102		3	427	1/113	0.71	0.59	0.07	-0.51
Langkon Dam					132.78	9.21		
Basin 217 Bongan								
1		11	1801	1/1804	16.90	61.06	0.07	-60.99
2		9	1786	1/738	10.83	39.12	0.12	-39.00
Kinaran 2 Dam					1414.44	98.15		
Basin 217 Kota Marudo								
1		10	1110	1/1093	10.59	4.70	0.05	-4.64
2		5	1055	1/328	3.27	1.75	0.06	-1.68
3		5	956	1/86	1.42	0.87	0.01	-0.86
Tuaran Dam					89.40	6.20		

Remarks: Annual cost herein includes the cost of dam allocated according to reduction of design flood discharge.

Table 100 RIVER IMPROVEMENT PLAN (3/5)
WITH FLOOD CONTROL DAM

State:Sabah

Unit: Million M$ for cost

St'h No.	Location	Impr. Le'th (km)	Des'n Flood (cms)	Lon'l Grad.	Con' Cost	Ann'l Cost	Da'g Red'n	B-C
Basin 218 Kadamaian								
1		15	2657	1/2034	32.33	10.21		
2		2	2614	1/1640	4.79	0.35		
101		8	1293	1/1049	8.86	6.14		
	Marui Dam				191.91	13.31		
Basin 219 Tuaran								
1		13	297	1/1777	7.99	20.91	0.14	-20.77
2		9	253	1/1737	5.35	14.00	0.00	-14.00
101		4	105	1/505	1.50	3.92	0.00	-3.92
	Tuaran 1 Dam				185.44	12.86		
	Tuaran 4 Dam				181.61	12.60		
	Mulau 1 Dam				133.67	9.28		
Basin 220 Putatan								
1		12	615	1/1575	10.72	9.77	0.52	-9.14
2		10	490	1/1312	7.69	7.01	0.00	-7.01
	Moyon 1 Dam				222.04	15.41		
Basin 221 Papar								
1		17	1301	1/1094	19.05	5.95	0.31	-5.64
2		12	1190	1/1036	12.88	4.02	0.00	-4.02
	Papar 1 Dam				109.70	7.61		
Basin 222 Kimanis								
1		15	823	1/1094	14.15	5.74	0.00	-5.74
2		2	481	1/1312	1.52	0.61	0.00	-0.61
	Besanon 1 Dam				74.78	5.19		

Remarks: Annual cost herein includes the cost of dam allocated according to reduction of design flood discharge.

Table 101 RIVER IMPROVEMENT PLAN (4/5)
WITH FLOOD CONTROL DAM

State:Sabah

Unit: Million M$ for cost

St'h No.	Location	Impr. Le'th (km)	Des'n Flood (cms)	Lon'l Grad.	Con' Cost	Ann'l Cost	Da'g Red'n	B-C
Basin 222 Bongawan								
1		15	844	1/1406	14.91	7.73	0.12	-7.61
Puas Dam					95.46	6.62		
Basin 223 Membakut								
1		17	81	1/2231	7.85	1.81	0.00	-1.81
2		8	74	1/1750	3.38	0.77	0.00	-0.77
Menbakut 1 Dam					8.84	0.61		
Menbakut 2 Dam					16.24	1.13		
Basin 224 Padas								
1		52	3863	1/4265	156.32	40.48	0.12	-40.36
2		16	3583	1/6562	51.59	13.37	0.10	-13.27
3		45	1093	1/1204	48.82	12.63	0.12	-12.51
201		27	2907	1/942	46.84	12.06	0.08	-11.98
203		8	1800	1/239	5.36	1.37	0.02	-1.35
204		25	1756	1/507	29.30	7.57	0.04	-7.53
2021		9	1658	1/125	3.90	0.99	0.00	-0.99
Padas 1 Dam					528.09	36.64		
Padas 2 Dam					381.50	26.47		

Remarks: Annual cost herein includes the cost of dam allocated according to reduction of design flood discharge.

Table 102 RIVER IMPROVEMENT PLAN (5/5)
WITH FLOOD CONTROL DAM

State:Sarawak

Unit: Million M$ for cost

St'h No.	Location	Impr. Le'th (km)	Des'n Flood (cms)	Lon'l Grad.	Con' Cost	Ann'l Cost	Da'g Red'n	B-C
Basin 229 Limbang								
1		89	5459	1/9124	406.74	34.11	0.39	-1.73
2		18	4037	1/3937	54.11	4.70	0.37	-1.65
Limbang 2 Dam					62.28	4.30		
Basin 236 Kemena								
1		30	8577	1/4279	149.35	15.08	0.36	-14.72
2		15	7768	1/4101	69.50	7.00	0.17	-6.83
3		58	7522	1/3883	259.44	26.12	0.31	-25.81
Pandan 1 Dam					25.84	1.78		
Pandan 2 Dam					14.96	1.03		
Pesu 1 Dam					85.54	5.93		
Tubau Dam					59.15	4.11		
Basin 245 Sadong								
1		84	5685	1/19802	463.97	38.58	0.00	-38.58
Kedup 1 Dam					11.28	0.77		
Kayan 1 Dam					42.04	2.98		
Basin 246 Sarawak								
1		36	3788	1/6216	118.17	9.19	2.74	-5.87
101		18	2516	1/4921	45.73	3.39	0.75	-2.48
102		11	2291	1/880	16.20	1.18	1.21	-0.28
103		19	1428	1/402	16.51	1.22	0.15	-1.04
111		7	1812	1/5741	14.83	1.27	0.04	-1.22
112		26	1727	1/1640	37.61	3.20	0.11	-3.07
Bengoh Dam					13.41	0.92		
Bain 247 Kayan								
1		15	2569	1/2734	32.68	2.66	0.15	-2.51
2		17	2366	1/4101	40.27	3.30	0.02	-3.28
Kayan 1 Dam					7.89	0.56		

Remarks: Annual cost herein includes the cost of dam allocated according to reduction of design flood discharge.

Table 103 SELECTION OF ALTERNATIVE (1/4)

Unit: Thou. M Dollars

Stre'h	Averege Annual Damage	Population (2000)	Flood area Total	Flood area Paddy	Benefit less Cost (B-C) Structural Measure: Channel improv. SC	Bypass Flood-way SF	Dam with Channel improv. SD	Polder SP	Non-structural Measure: Rest-rict of Devel. NM	Land Use Change NR	Flood Proof-ing NP	Selected Plan Alt. F1	Alt. F2	Alt. F3
		(person)	(sq.km)											
Basin 201 Pensiagan														
1	0.	0.	0.	0.	-2.04	0.	-4.81	0.	0.	0.	0.	-	-	-
2	0.	0.	37.	0.	-1.13	0.	-2.05	0.	-0.06	0.	0.	-	-	-
3	43.	1006.	16.	0.	-2.79	0.	-7.92	0.	-0.02	-1.49	-0.21	-	-	-
101	6.	298.	10.	0.	-1.30	0.	-3.40	0.	-0.02	-0.44	-0.05	-	-	-
102	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	-	-	-
201	0.	0.	4.	0.	0.	0.	0.	0.	-0.01	0.	0.	-	-	-
Basin 207 Tawau														
1	1896.	17089.	18.	0.	0.17	0.17	-6.99	0.	0.19	-11.67	-4.31	SF	SF	SF
Basin 210 Segama														
1	0.	0.	105.	0.	-20.61	0.	-30.51	0.	-0.17	0.	0.	-	-	-
2	151.	1131.	62.	0.	-10.88	-8.03	-16.04	0.	-0.09	-1.58	-0.52	-	-	-
3	435.	3161.	78.	0.	-12.29	-23.09	-17.92	0.	-0.10	-4.42	-1.50	SC	-	-
4	298.	2767.	10.	0.	-1.44	0.	-2.20	0.	0.	-3.83	-1.07	SC	-	-
Basin 213 Labuk														
1	246.	2098.	54.	0.	-10.10	0.	-15.02	0.	-0.09	-4.54	-1.37	-	-	-
2	2.	0.	32.	0.	-3.95	0.	-5.41	0.	-0.05	-0.02	-0.02	-	-	-
3	23.	434.	39.	0.	-5.28	0.	-7.09	0.	-0.06	-0.79	-0.13	-	-	-
4	175.	1923.	52.	0.	-7.11	0.	-8.54	0.	-0.08	-3.80	-0.93	-	-	-
5	77.	387.	56.	0.	-2.64	0.	-2.65	0.	-0.09	-1.01	-0.42	-	-	-
101	0.	0.	26.	0.	-1.79	0.	-3.44	0.	-0.04	-3.35	-0.46	SC	-	-
Basin 214 Sugut														
1	0.	0.	91.	0.	-15.15	0.	-13.38	0.	-0.15	0.	0.	-	-	-
2	12.	282.	50.	0.	-11.68	0.	-10.17	0.	-0.08	-0.46	-0.06	-	-	-
3	0.	5.	12.	0.	-1.94	0.	-1.64	0.	-0.02	-0.01	0.	-	-	-
4	0.	8.	9.	0.	-6.32	0.	-5.26	0.	-0.02	-0.01	0.	-	-	-
5	0.	0.	0.	0.	-2.77	0.	-2.77	0.	0.	0.	0.	-	-	-
Basin 216 Bengkoka														
1	18.	562.	41.	0.	-3.246	0.	-4.25	0.	-0.07	-0.95	-0.13	-	-	-
2	1.	0.	3.	0.	-0.85	0.	-1.19	0.	-0.01	-0.01	-0.01	-	-	-
Basin 217 Langkon														
1	0.	0.	6.	0.	-0.54	0.	-5.71	0.	-0.02	0.	0.	-	-	-
2	0.	0.	8.	0.	-0.06	0.	-0.80	0.	-0.02	0.	0.	-	-	-
3	95.	2691.	7.	0.	0.02	0.	-0.13	0.	-0.01	-1.95	-0.35	SC	SC	SC
101	3.	0.	16.	0.	-0.21	0.	-2.81	0.	-0.05	-0.04	-0.01	-	-	-
102	341.	31.	25.	0.	0.03	0.	-0.51	0.	-0.04	-16.82	-1.25	SC	SC	SC
Basin 217 Bongan														
1	339.	2436.	42.	0.	-1.16	0.	-60.99	0.	-0.09	-16.25	-1.58	SC	SC	-
2	536.	4315.	49.	0.	-0.64	0.	-39.00	0.	-0.10	-28.83	-2.67	SC	SC	-
Basin 217 Kota Murudu														
1	177.	1901.	12.	0.	-0.75	0.	-4.64	0.	-0.02	-12.29	-1.02	SC	SC	-
2	237.	2169.	30.	0.	-0.18	0.	-1.68	0.	-0.07	-14.40	-1.24	SC	SC	-
3	49.	88.	27.	0.	-0.07	0.	-0.86	0.	-0.07	-0.65	-0.17	-	-	-
Basin 217 Tandek														
1	452.	4412.	66.	0.	-0.64	0.	0.	0.	-0.15	-29.31	-2.46	SC	SC	-
2	997.	4432.	110.	0.	-0.26	0.	0.	0.	-0.24	-29.90	-3.63	SC	SC	-

Table 104 SELECTION OF ALTERNATIVE (2/4)

Unit: Thou. M Dollars

Stre'h	Averege Annual Damage	Population (2000)	Flood area Total	Flood area Paddy	Benefit less Cost (B-C) Structural Measure: Channel improv. SC	Bypass Flood-way SF	Dam with Channel improv. SD	Polder SP	Non-structural Measure: Rest-rict of Devel. NM	Land Use Change NR	Flood Proof-ing NP	Selected Plan Alt. F1	Alt. F2	Alt. F3
		(person)	(sq.km)											
Basin 218 Kadamaian														
1	617.	12962.	63.	0.	-2.16	0.	-10.05	0.	-0.08	-19.25	-4.68	SC	SC	-
2	0.	0.	0.	0.	-0.32	0.	0.35	0.	0.	0.	0.	-	-	-
101	0.	0.	0.	0.	-0.67	0.	-6.14	0.	0.	0.	0.	-	-	-
Basin 219 Tuaran														
1	313.	4809.	35.	0.	-1.72	0.	-4.01	0.	-0.02	-8.62	-2.00	SC	-	-
2	0.	0.	0.	0.	-1.18	0.	-2.60	0.	0.	0.	0.	-	-	-
101	0.	0.	0.	0.	-0.25	0.	-2.51	0.	0.	0.	0.	-	-	-
Basin 220 Putatan														
1	885.	21473.	7.	0.	0.18	0.	-9.77	0.	-0.01	0.	0.	SC	SC	SC
2	0.	0.	0.	0.	-0.66	0.	-7.01	0.	0.	0.	0.	-	-	-
Basin 221 Papar														
1	718.	28453.	23.	0.	-1.24	0.	-1.54	0.	0.07	-14.15	-3.96	SC	-	-
2	0.	0.	0.	0.	-1.07	0.	-0.51	0.	0.	0.	0.	-	-	-
Basin 222 Kimanis														
1	0.	0.	0.	0.	-1.05	0.	-5.74	0.	0.	0.	0.	-	-	-
2	0.	0.	0.	0.	-0.12	0.	-0.61	0.	0.	0.	0.	-	-	-
Basin 222 Bongwan														
1	271.	1396.	14.	0.	-0.97	0.	-7.61	0.	0.01	-2.29	-1.06	SC	-	-
Basin 223 Menbakut														
1	0.	0.	0.	0.	-1.37	0.	-1.81	0.	0.	0.	0.	-	-	-
2	0.	0.	0.	0.	-0.58	0.	-0.77	0.	0.	0.	0.	-	-	-
Basin 224 Padas														
1	199.	950.	110.	0.	-12.34	0.	-40.36	0.	-0.18	-2.42	-1.58	-	-	-
2	148.	1861.	87.	0.	-4.10	0.	-13.27	0.	-0.14	-3.36	-0.92	SC	-	-
3	161.	1060.	40.	0.	-5.14	0.	-12.51	0.	-0.07	-2.42	-1.18	-	-	-
201	121.	820.	38.	0.	-3.06	0.	-11.98	0.	-0.07	-1.89	-0.95	-	-	-
202	0.	0.	18.	0.	0.	0.	0.	0.	-0.03	0.	0.	-	-	-
203	28.	130.	10.	0.	-0.32	0.	-1.35	0.	-0.02	-0.37	-0.24	-	-	-
204	78.	976.	22.	0.	-2.02	0.	-7.53	0.	-0.04	-1.74	-0.68	-	-	-
2021	2.	118.	27.	0.	-0.25	0.	-0.99	0.	-0.04	-0.18	-0.01	-	-	-
Basin 226 Lakutan														
1	0.	0.	0.	0.	0.	0.	0.	-0.64	0.	0.	0.	-	-	-
State Total	10,150.	128,270.	1,697.	0.										

Table 105 SELECTION OF ALTERNATIVE (3/4)

Unit: Thou. M Dollars

Stre'h	Averege Annual Damage	Population (2000)	Flood area Total	Flood area Paddy	Benefit less Cost (B-C) Structural Measure: Channel improv. SC	Bypass Flood-way SF	Dam with Channel improv. SD	Polder SP	Non-structural Measure: Rest-rict of Devel. NM	Land Use Change NR	Flood Proof-ing NP	Selected Plan Alt. F1	Alt. F2	Alt. F3
		(person)	(sq.km)											
Basin 227 Lawas														
1	16.	400.	34.	0.	-2.00	0.	0.	0.	-0.06	-0.64	-0.12	SC	-	-
Basin 228 Trusan														
1	131.	1092.	184.	0.	-12.35	0.	0.	0.	-0.27	-1.95	-0.98	SC	-	-
2	1.	6.	3.	0.	0.	0.	0.	0.	0.	-0.02	-0.02	-	-	-
Basin 229 Limbang														
1	968.	4800.	174.	0.	-33.72	0.	-33.72	0.	-0.13	-9.36	-7.29	SC	-	-
2	1140.	319.	88.	0.	-4.33	0.	-4.33	0.	-0.10	-2.49	-2.67	SC	-	-
Basin 230 Baram														
1	245.	2006.	472.	0.	-116.93	0.	0.	0.	-0.75	-1.45	-0.74	SC	-	-
2	1355.	7893.	407.	0.	-43.44	0.	0.	0.45	-0.58	-10.98	-4.96	SC	-	SP
3	381.	2118.	1539.	0.	-67.56	0.	0.	0.	-2.47	-3.31	-1.89	SC	-	-
101	142.	570.	1083.	0.	-23.55	0.	0.	0.	-1.75	-1.21	-0.94	-	-	-
201	87.	373.	843.	0.	-57.95	0.	0.	0.	-1.37	-0.74	-0.60	-	-	-
301	9.	41.	147.	0.	-8.28	0.	0.	0.	-0.24	-0.07	-0.06	-	-	-
302	0.	0.	0.	0.	-4.45	0.	0.	0.	0.	0.	0.	-	-	-
303	0.	0.	0.	0.	-11.85	0.	0.	0.	0.	0.	0.	-	-	-
Basin 231 Miri														
1	374.	3068.	48.	0.	1.29	0.28	0.	0.	-0.03	-2.02	-0.96	SF	SF	SF
2	1825.	24871.	494.	0.	-2.65	0.	0.	0.	-0.57	-21.36	-5.30	SF	SF	SF
1	2799.	19740.	132.	0.	0.	0.	0.	0.	0.15	-16.74	-6.82	-	-	-
Basin 232 Sibuti														
1	289.	1625.	102.	0.	-2.27	-9.53	0.	0.	-0.13	-1.53	-1.12	SC	-	-
2	411.	2687.	88.	0.	-1.37	0.	0.	0.	-0.10	-2.41	-1.41	SC	-	-
1	202.	1418.	24.	0.	0.	0.	0.	0.	-0.02	-0.65	-1.24	-	-	-
Basin 233 Niah														
1	292.	2760.	187.	0.	-3.84	0.	0.	0.37	-0.29	-2.47	-1.01	SC	SP	SP
2	773.	7154.	166.	0.	-1.83	0.	0.	0.	-0.22	-6.55	-2.80	SC	-	-
3	79.	1257.	125.	0.	-4.15	0.	0.	0.	-0.20	-1.21	-0.50	SC	-	-
Basin 234 Suai														
1	26.	461.	184.	0.	-8.40	0.	0.	0.	-0.30	-0.41	-0.15	SC	-	-
2	15.	243.	27.	0.	-0.63	0.	0.	0.	-0.04	-0.23	-0.10	SC	-	-
Basin 236 Kemena														
1	934.	16585.	178.	0.	-10.59	0.	-14.72	0.	-0.22	-14.91	-4.19	SC	SC	-
2	392.	5567.	113.	0.	-4.93	0.	-6.83	0.	-0.16	-8.90	-2.53	SC	-	-
3	672.	8514.	593.	0.	-18.05	0.	-25.81	0.	-0.88	-13.58	-4.80	SC	-	-
Basin 237 Tatau														
1	59.	2097.	198.	0.	-9.82	0.	0.	0.	-0.32	-3.09	-0.40	SC	-	-
2	45.	1953.	166.	0.	-12.35	0.	0.	0.	-0.27	-2.82	-0.32	SC	-	-
201	11.	510.	99.	0.	-7.35	0.	0.	0.	-0.16	-0.74	-0.08	SC	-	-
211	18.	884.	80.	0.	-6.01	0.	0.	0.	-0.13	-1.28	-0.14	SC	-	-
212	35.	1601.	155.	0.	-10.60	0.	0.	0.	-0.25	-2.31	-0.26	SC	-	-
Basin 238 Baling														
1	80.	3.	108.	0.	-13.23	0.	0.	0.	-0.16	-0.35	-0.56	-	-	-

Table 106 SELECTION OF ALTERNATIVE (4/4)

Unit: Thou. M Dollars

Stre'n	Averege Annual Damage	Population (2000)	Flood area Total	Flood area Paddy	Benefit less Cost (B-C) Structural Measure: Channel improv. SC	Bypass Flood-way SF	Dam with Channel improv. SD	Polder SP	Non-structural Measure: Rest-rict of Devel. NM	Land Use Change NR	Flood Proof-ing NP	Selected Plan Alt. F1	Alt. F2	Alt. F3
		(person)	(sq.km)											
Basin 239 Mukah														
1	392.	2234.	128.	0.	-11.18	0.	0.	0.	-0.19	-4.73	-2.94	SC	-	-
2	13.	175.	52.	0.	-7.77	0.	0.	0.	-0.09	-0.35	-0.15	-	-	-
Basin 240 Oya														
1	437.	912.	345.	0.	-16.11	0.	0.	0.	-0.55	-3.50	-3.59	SC	-	-
2	25.	141.	52.	0.	-4.80	0.	0.	0.	-0.09	-0.34	-0.20	-	-	-
Basin 241 Rajang														
1	239.	2554.	339.	0.	-91.03	0.	0.	0.	-0.53	-4.82	-1.76	SC	-	-
2	7154.	27862.	523.	0.	-76.95	0.	0.	0.	-0.55	-100.00	-35.45	SC	-	-
3	245.	2726.	149.	0.	-12.94	0.	0.	0.	-0.18	-5.24	-1.77	SC	-	-
201	528.	776.	198.	0.	-21.27	0.	0.	0.	-0.35	-4.00	-3.93	-	-	-
Basin 241 Matu														
1	941.	9349.	226.	0.	-1.62	0.	0.	0.	-0.37	-4.50	-16.27	SC	SC	-
2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	-	-	-
Basin 245 Sadong														
1	429.	1131.	96.	0.	-35.75	0.	-38.58	0.	-0.12	-3.18	-1.90	-	-	-
Basin 246 Samarahan														
1	3013.	10154.	178.	0.	-3.45	0.	0.	0.	0.02	-14.94	-9.60	SC	SC	-
2	34.	70.	2.	0.	-0.34	0.	0.	0.	0.	-0.18	-0.13	SC	-	-
201	327.	687.	20.	0.	-1.42	0.	0.	0.	0.	-1.78	-1.31	SC	-	-
Basin 246 Sarawak														
1	7804.	27032.	56.	0.	-6.02	0.	-5.82	0.	0.79	-37.60	-20.97	SD	SD	-
101	2086.	8295.	56.	0.	-2.57	0.	-2.48	-	0.13	-12.03	-6.16	SD	SD	-
102	3424.	14262.	65.	0.	0.15	0.	0.28	-0.87	0.27	-20.16	-9.78	SD	SD	-
103	425.	1227.	36.	0.	-1.05	0.	-1.04	0.	-0.01	-2.43	-1.60	SD	SD	-
111	104.	288.	7.	0.	-1.16	0.	-1.22	0.	0.	-0.59	-0.39	SC	SC	-
112	297.	813.	27.	0.	-2.80	0.	-3.07	0.	-0.01	-1.70	-1.14	SC	SC	-
Basin 247 Kayan														
1	297.	923.	81.	0.	-2.18	0.	-2.48	0.08	-0.19	-2.88	-1.93	SC	-	SP
2	41.	457.	54.	0.	-2.94	0.	-3.28	0.	-0.08	-0.69	-0.21	SC	-	-
Basin 247 Serayan														
1	83.	709.	45.	0.	-0.72	0.	0.	0.	-0.07	-1.05	-0.32	SC	-	-
State Total	42,144.	235,393.	10,976.	0.										

Table 107 PROPOSED FLOOD FORECASTING AND WARNING SYSTEM IN SABAH

Unit: M10^6

Basin No.	River Basin	People Rel'ved by F/F (10^3)	Construction Cost	Construction Period
207	Tawau	8.5	2.41	1990 - 1995
210	Segama	3.5	4.12	1996 - 2000
211	Kinabatangan	4.3	4.22	1981 - 1985
217	Bongan	12.7	3.01	1986 - 1990
218	Kadamaian	6.5	2.21	1991 - 1995
221	Papar	14.2	2.07	1986 - 1990
224	Padas	3.0	5.38	1996 - 2000
	Total	52.7	28.10	

Table 108 PROPOSED FLOOD FORECASTING AND WARNING SYSTEM IN SARAWAK

Unit: M10^6

Basin No.	Basin	People Rel'ved by F/F (10^3)	Construction Cost	Construction Period
229	Limbang	2.6	3.56	7MP
230	Baram	6.0	9.83	5MP
231	Miri	14.0	2.27	6MP
233	Niah	5.0	2.55	7MP
236	Kemena	11.1	4.09	6MP
237	Tatau	2.7	3.81	7MP
241	Rajang	16.6	19.88	6MP
245	Sadong	5.0	2.66	4MP
246	Sarawak	22.9	3.43	5MP
	Total	85.9	52.08	

Table 109 PUBLIC DEVELOPMENT EXPENDITURE FOR ALT. F 1

Unit: Mil. M Dollars

B'n No.	Basin Name	4MP	5MP	6MP	7MP	Total
	SABAH					
207	Tawau	0.00	7.96	0.00	0.00	7.96
210	Segama	0.00	0.00	0.00	24.13	24.13
213	Labuk	0.00	0.00	0.00	27.13	27.13
217	Bongan	0.00	31.63	28.37	0.00	60.00
218	Kadamaian	0.00	0.00	0.00	33.31	33.31
219	Tuaran	0.00	0.00	27.26	0.00	27.26
220	Putatan	0.00	11.98	0.00	0.00	11.98
221	Papar	0.00	0.00	21.26	0.00	21.26
222	Kimanis	0.00	0.00	15.38	0.00	15.38
224	Padas	0.00	0.00	0.00	58.37	58.37
	Flood forecasting	4.22	5.08	4.62	9.50	23.42
		(4.22)	(56.65)	(96.89)	(152.44)	(310.20)
	SARAWAK					
230	Baram	0.00	607.34	0.00	0.00	607.34
231	Miri	0.00	10.66	0.00	0.00	10.66
232	Sibuti	0.00	0.00	0.00	57.35	57.35
233	Niah	0.00	0.75	0.00	90.03	90.78
236	Kemena	0.00	0.00	156.07	337.61	493.68
237	Tatau	0.00	0.00	0.00	316.69	316.69
241	Rajang	0.00	0.00	1079.42	1541.23	2620.65
246	Sarawak	0.00	0.00	13.41	314.68	328.09
247	Kayan	0.00	16.79	0.00	0.00	16.79
	Flood forecasting	2.66	13.26	26.24	9.92	52.08
		(2.66)	(648.80)	(1275.14)	(2667.51)	(4594.11)
	Total	6.88	705.45	1372.03	2819.94	4904.31

Remarks: Population,GRP growth followed Case 1 (High growth).

Table 110 ANNUAL RECURRENT EXPENDITURE FOR ALT. F 1

Unit: Mil. M Dollars

B'n No.	Basin Name	4MP	5MP	6MP	7MP	Total
	SABAH					
207	Tawau	0.00	0.00	0.75	0.75	1.50
210	Segama	0.00	0.00	0.00	0.00	0.00
213	Labuk	0.00	0.00	0.00	0.00	0.00
217	Bongan	0.00	0.00	2.92	5.57	8.49
218	Kadamaian	0.00	0.00	0.00	0.00	0.00
219	Tuaran	0.00	0.00	0.00	2.45	2.45
220	Putatan	0.00	0.00	1.10	1.10	2.20
221	Papar	0.00	0.00	0.00	2.00	2.00
222	Kimanis	0.00	0.00	0.00	1.45	1.45
224	Padas	0.00	0.00	0.00	0.00	0.00
	Flood forecasting	0.00	2.11	2.54	2.31	6.96
		(0.00)	(2.11)	(7318)	(15.63)	(25.05)
	SARAWAK					
230	Baram	0.00	0.00	60.75	60.75	121.50
231	Miri	0.00	0.00	0.95	0.95	1.90
232	Sibuti	0.00	0.00	0.00	0.00	0.00
233	Niah	0.00	0.00	0.75	0.75	1.50
236	Kemena	0.00	0.00	0.00	15.60	15.60
237	Tatau	0.00	0.00	0.00	0.00	0.00
241	Rajang	0.00	0.00	0.00	107.95	107.95
246	Sarawak	0.00	0.00	0.00	3.36	3.36
247	Kayan	0.00	0.00	1.62	1.62	3.24
	Flood forecasting	0.00	1.33	6.63	13.12	21.08
		(0.00)	(1.33)	(70.71)	(204.10)	(276.13)
	Total	0.00	3.44	78.01	219.73	301.18

Remarks: Population,GRP growth followed Case 1 (High growth).

Table 111 PUBLIC DEVELOPMENT EXPENDITURE FOR ALT. F2

Unit: Mil. M Dollars

B'n No.	Basin Name	4MP	5MP	6MP	7MP	Total
	SABAH					
207	Tawau	0.00	0.00	7.96	0.00	7.96
217	Bongan	22.15	27.63	11.05	0.00	60.83
218	Kadamaian	0.00	0.00	0.00	33.31	33.31
220	Putatan	0.00	0.00	11.98	0.00	11.98
	Flood forecasting	4.22	5.08	4.62	9.50	23.42
		(26.37)	(32.71)	(35.61)	(42.81)	(137.50)
	SARAWAK					
229	Limbang	-	-	-	-	-
231	Miri	0.00	10.66	0.00	0.00	10.66
233	Niah	0.00	0.00	0.00	0.75	0.75
236	Kemena	0.00	0.00	156.07	0.00	156.07
241	Rajang	0.00	0.00	0.00	23.10	23.10
246	Sarawak	0.00	0.00	13.41	314.68	328.09
	Flood forecasting	2.66	13.26	26.24	9.92	52.08
		(2.66)	(23.92)	(195.72)	(348.45)	(570.75)
	Total	(29.03)	(56.63)	(231.33)	(391.26)	(708.25)

Table 112 ANNUAL RECURRENT EXPENDITURE FOR ALT. F 2

Unit: Mil. M Dollars

B'n No.	Basin Name	4MP	5MP	6MP	7MP	Total
	SABAH					
207	Tawau	0.00	0.00	0.00	0.75	0.75
217	Bongan	0.00	2.20	5.00	6.10	13.30
218	Kadamaian					
220	Putatan					
	Flood forecasting	0.00	2.11	2.54	2.31	6.96
		(0.00)	(4.31)	(7.54)	(9.16)	(21.01)
	SARAWAK					
229	Limbang	-	-	-	-	-
231	Miri	0.00	0.00	0.95	0.95	1.90
233	Niah	-	-	-	-	-
236	Kemena	0.00	0.00	0.00	15.60	15.60
241	Rajang	-	-	-	-	-
246	Sarawak	0.00	0.00	0.00	0.35	0.35
	Flood forecasting	0.00	1.33	6.63	13.12	21.08
		(0.00)	(1.33)	(7.58)	(30.02)	(38.93)
	Total	0.00	5.64	15.12	39.18	59.94

Remarks: Population,GRP growth followed Case 1 (High growth).
Project cost of Limbang flood mitigation project be borne by the Irrigation sector.

Table 115 GOVERNMENT PERSONNEL REQUIREMENT

Unit: person

	Engineer	Tech. Assist.	Techni-cian	Others	Adm. Staff	Consult.
Structural Measures						
Government staff during construction						
Annual constr. cost less than M$2.5 x 10^6	2	3	4	10	1	1
2.5 - 5	3	4	10	12	1	2
5 - 10	5	6	15	14	2	3
10 - 15	7	8	20	18	2	4
15 - 20	10	10	30	20	3	6
20 - 30	15	15	35	25	4	8
30 - 50	20	20	40	30	6	10
50 - 75	25	25	50	40	7	12
75 - 100	30	30	60	45	8	15
Operation and maintenance staff						
Part of staff during construction to be remained as O&M staff	5%	10%	10%	10%	10%	0

Table 116 MAN-POWER REQUIREMENT

Unit: Person

State: Sabah

		4MP	5MP	6MP	7MP
Alt. F1					
Constr.	Engineer	0	9	16	20
	T.Assis'	0	16	26	31
	Techni'n	0	23	50	60
	Others	0	34	52	58
	Total G. staff	0	82	144	169
	Consultants	0	5	10	12
O&M	Engineer	0	0	3	7
	T.Assis'	0	0	6	14
	Techni'n	0	0	4	10
	Others	0	0	4	12
	Total G. staff	0	0	17	43
Alt. F2					
Constr.	Engineer	3	5	6	5
	T.Assis'	5	8	12	8
	Techni'n	10	15	12	15
	Others	12	14	30	14
	Total G. staff	30	42	60	42
	Consultants	2	3	3	3
O&M	Engineer	0	1	2	5
	T.Assis'	0	2	4	10
	Techni'n	0	1	3	6
	Others	0	2	4	7
	Total G. staff	0	6	13	28
Alt. F3					
Constr.	Engineer	0	2	2	2
	T.Assis'	0	4	4	4
	Techni'n	0	4	4	4
	Others	0	10	10	10
	Total G. staff	0	20	20	20
	Consultants	0	1	1	1
O&M	Engineer	0	0	1	2
	T.Assis'	0	0	2	4
	Techni'n	0	0	1	2
	Others	0	0	1	2
	Total G. staff	0	0	5	10

Table 117 MAN-POWER REQUIREMENT

Unit: Person

State: Sarawak

		4MP	5MP	6MP	7MP
Alt. F1					
Constr.	Engineer	0	37	53	122
	T.Assis'	0	51	69	157
	Techni'n	0	78	110	260
	Others	0	77	87	203
	Total G. staff	0	243	319	742
	Consultants	0	19	27	61
O&M	Engineer	0	0	5	9
	T.Assis'	0	0	10	19
	Techni'n	0	0	9	20
	Others	0	0	9	19
	Total G. staff	0	0	33	67
Alt. F2					
Constr.	Engineer	2	0	23	30
	T.Assis'	4	0	31	41
	Techni'n	4	0	50	64
	Others	10	0	42	62
	Total G. staff	20	0	146	197
	Consultants	1	0	12	15
O&M	Engineer	0	1	1	3
	T.Assis'	0	2	2	7
	Techni'n	0	1	1	6
	Others	0	1	1	6
	Total G. staff	0	5	5	22
Alt. F3					
Constr.	Engineer	0	4	2	2
	T.Assis'	0	8	4	4
	Techni'n	0	8	4	4
	Others	0	20	10	10
	Total G. staff	0	40	20	20
	Consultants	0	2	1	1
O&M	Engineer	0	0	2	3
	T.Assis'	0	0	4	6
	Techni'n	0	0	2	3
	Others	0	0	2	3
	Total G. staff	0	0	10	15

Table 118 BENEFICIAL AND ADVERSE EFFECTS OF FLOOD MITIGATION ALTERNATIVES IN SABAH

Item		Alternative F1	F2	F3
1. National Economic Development				
1.1 Economic Benefit				
Damage reduction in 2000/1	(M$10^6)	2.6	3.5	1.0
1.2 Economic Cost				
Flood mitigation work	(M$10^6)	7.6	4.0	0.5
1.3 EIRR	(%)	2.6	7.1	13.4
2. Environmental Quality				
2.1 Beneficial Effect				
Length of improved river stretch	(km)	173	84	17
2.2 Adverse Effect				
3. Social Well-Being				
3.1 Beneficial Effect				
Number of protected people by proposed facilities in 2000	(10^3)	116	77	42
Population served by proposed flood warning system in 2000	(10^3)	53	53	53
Area relieved from flood hazards	(km^2)	598	403	81
3.2 Adverse Effect				
Number of people to be removed for construction of facilities	(10^3)	-	9	-

Remarks; /1: High growth rates of per capita GDP and population are applied for annual average damage estimate at 2000 condition.

Table 119 BENEFICIAL AND ADVERSE EFFECTS OF FLOOD MITIGATION ALTERNATIVES IN SARAWAK

Item		Alternative F1	F2	F3
1. National Economic Development				
1.1 Economic Benefit				
Damage reduction in 2000/1	($M\$10^6$)	10.9	7.7	2.0
1.2 Economic Cost				
Flood mitigation work	($M\$10^6$)	114.5	12.0	0.6
1.3 EIRR	(%)	-	5.7	20.7
2. Environmental Quality				
2.1 Beneficial Effect				
Length of improved river stretch	(km)	639	193	-
2.2 Adverse Effect		-	-	-
3. Social Well-Being				
3.1 Beneficial Effect				
Number of protected people by proposed facilities in 2000	(10^3)	260	117	32
Population served by proposed flood warning system in 2000	(10^3)	86	86	86
Area relieved from flood hazards	(km^2)	4,379	1,414	585
3.2 Adverse Effect				
Number of people to be removed for construction of facilities	(10^3)	-	4	-

Remarks; /1: High growth rates of per capita GDP and population are applied for annual average damage estimate at 2000 condition.

Table 120 RECOMMENDED FLOOD MITIGATION PLAN IN SABAH

Basin No.	Basin	Improved River Length (km)	Bypass Floodway (km)	Protected Population (10^3)	Protected Area (km^2)
By 1990					
217	Bongan	47	-	21	269
By 2000					
207	Tawau	-	3	17	18
217	Bongan	56	-	25	315
218	Kadamaian	16	-	13	63
220	Putatan	12	-	22	7
	Total	84	3	77	403

Remarks; Protected population: in 2000

Table 121 RECOMMENDED FLOOD MITIGATION PLAN IN SARAWAK

Basin No.	Basin	Improved River Length (km)	Floodway (km)	Dam (nos)	Polder (nos)	Protected Population (10^3)	Protected Area (km^2)
By 1990							
229	Limbang	-	-	1	-	5.1	262
231	Miri	-	5	-	-	27.9	542
	Total	-	5	1	-	33.0	804
By 2000							
229	Limbang	-	-	1	-	5.1	262
231	Miri	-	5	-	-	27.9	542
233	Niah	-	-	-	1	0.9	3
236	Kemena	30	-	-	-	16.6	178
241	Rajang	21	-	-	-	9.3	266
246	Sarawak	142	-	1	-	62.1	425
	Total	193	5	2	1	121.9	1,676