Table 8.2 Number of Connections and Water Consumption Served by Tuguegarao Water District in 1985

Item	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Total	Average
Number of Connections											
- Residential	589	591	601	585	611	696	861	934	1,007	6,475	719.4
- Commercial	377	374	374	360	377	376	389	405	417	3,449	383.2
- Industrial	2	2	2	2	2	3	4	4	4	25	2.8
- Municipal	8	8	8	7	7	7	7	6	7	65	7.2
- Total	976	975	985	954	997	1,082	1,261	1,349	1,435	10,014	1,112.6
Consumption (m^3/month)											
- Residential	9,616	9,867	8,627	7,794	9,676	15,586	16,536	21,185	22,206	121,093	13,455
- Commercial	8,768	8,723	7,680	6,672	7,195	10,365	10,273	12,301	13,836	85,813	9,535
- Industrial	23	108	95	103	96	204	261	337	305	1,532	170
- Municipal	89	100	150	115	229	631	568	560	731	3,173	353
- Total	18,496	18,798	16,552	14,864	17,196	26,786	27,638	34,383	37,078	211,611	23,513
Consumption Per Consumer Unit (l/day/unit)											
- Residential	526	597	463	444	511	746	620	732	735	5,374	597.1
- Commercial	750	833	662	618	616	919	852	980	1,106	7,336	815.1
- Industrial	370	1,929	1,532	1,717	1,548	2,267	2,104	2,718	2,542	16,727	1,858.6
- Municipal	559	446	403	548	1,055	3,005	2,617	3,010	3,481	14,924	1,658.2

Source: EC-103

Table 8.3 Criteria for Water Demand Projection

Item	1985	1990	1995	2000	2005
Unit Consumption					
Domestic Water (l/capita/day)					
Level I	30	30	30	30	30
Level II	60	60	60	60	60
Level III	100	105	110	115	120
Trade Establishment (m^3/establishment/day)	1.0	1.25	1.5	1.75	2.0
Other Facility					
School (m^3/unit/day)	1.0	1.25	1.5	1.75	2.0
Hospital (m^3/unit/day)	3.0	3.25	3.5	3.75	4.0
Others (Office etc.) (m^3/unit/day)	2.0	2.25	2.5	2.75	3.0
Construction (m^3/day/GVA(₱10^6 at 1972 prices))	31	31	31	31	31
Other Industries (m^3/day/GVA(₱10^6 at 1972 prices))	763	743	723	703	684
Service Factor for Domestic Demand (%)					
Rural : Level I	44	47	50	53	50
Level II	16	28	30	32	35
Level III	40	25	20	15	15
Urban : Level I	50	25	0	0	0
Level II	25	25	25	0	0
Level III	25	50	75	100	100
Existing Waterworks					
Capacity (10^3 m^3/day)	52.4	58.1/1	-	-	-
Loss Rate (%)	35	32.5	30	27.5	25

Note : /1 Existing capacity plus expansion plan
Sources: EC-376 and EC-379 to EC-387

Table 8.4 Projected Water Demand by Munincipality

(Unit : m³/day)

Province	1985	1990	1995	2000	2005
Cagayan	31,632	42,232	54,545	84,155	122,525
Ifugao	6,790	8,823	10,997	15,707	21,854
Isabela	63,518	88,306	119,444	196,047	302,122
Kalinga-Apayao	8,950	12,429	16,899	28,212	44,866
Nueva-Vizcaya	18,803	26,788	37,207	63,429	100,648
Quirino	6,973	10,124	14,267	24,400	38,921
Mountain Province	4,266	5,268	6,141	7,793	9,820
Aurora	331	439	538	647	754
Total	141,261	194,410	260,038	420,390	641,511

Table 8.5 Projected Water Demand by Sector

(Unit : m³/day)

Sector	1985	1990	1995	2000	2005
Domestic	82,465	111,495	143,504	179,761	211,343
Services & Public	17,258	23,722	31,307	39,872	49,182
Industrial	41,538	59,193	85,227	200,757	380,986
Total	141,261	194,410	260,038	420,390	641,511

Table 8.6 Projected Source Water Requirement by Supply Block

(Unit : m³/day)

Block Number	1985	1990	1995	2000	2005
Block 1	11,236	15,650	21,150	34,548	52,901
Block 2	6,977	9,157	11,596	17,324	25,116
Block 3	21,951	30,530	41,557	70,164	109,081
Block 4	9,550	12,132	14,981	22,095	31,517
Block 5	14,901	20,113	26,387	41,954	62,569
Block 6	9,143	12,470	16,539	26,658	40,069
Block 7	12,664	17,185	22,853	37,570	57,222
Block 8	13,568	18,578	24,947	41,661	63,997
Block 9	14,465	19,269	24,911	38,751	57,041
Block 10	10,445	13,072	15,711	21,665	29,139
Block 11	6,563	7,804	8,773	10,749	13,093
Block 12	12,911	17,676	23,746	39,757	61,168
Block 13	6,159	7,868	9,627	13,474	18,447
Block 14	4,359	5,531	6,642	8,488	10,801
Block 15	10,947	14,994	20,308	34,669	55,174
Block 16	2,823	3,420	3,833	4,243	4,647
Block 17	12,290	16,306	21,333	35,336	52,911
Block 18	13,075	16,622	20,216	28,208	37,972
Block 19	7,528	9,497	11,426	15,557	20,580
Block 20	15,772	20,142	24,947	36,974	51,904
Total (m³/day)	217,325	288,015	371,484	579,848	855,349
Total (t/sec)	2.52	3.33	4.30	6.71	9.90

Table 8.7 Projected Source Water Requirement by Sector

(Unit : m³/day)

Sector	1985	1990	1995	2000	2005
Domestic	126,869	165,178	205,006	247,946	281,791
Services & Public	26,551	35,144	44,725	54,996	65,577
Industrial	63,905	87,693	121,753	276,906	507,981
Total	217,325	288,015	371,484	579,848	855,349

Table 9.1 Results of First Screening

	NO.	NAME OF DAM	SUB-BASIN	RIVER	(A) CATCHMENT AREA (sq.km)	(B) DAM HEIGHT (m)	CREST ELEVATION (EL.m)	HWL (EL.m)	SEDIMENT LEVEL (EL.m)	RIVERBED ELEVATION (EL.m)	GROSS STORAGE (Mcm)	(C) EFFECTIVE STORAGE (Mcm)	SEDIMENT STORAGE (Mcm)	(D) ENHANCEMENT VOLUME (Mcm)	STORAGE (1) (C)/(D)	EFFICIENCY (2) (1)*(A) /1000	EFFICIENCY (3) (2)*(B) /1000	SE(1) >60	SE(2) >40	SE(2) >5	HYDRO HIGH HEAD SCHEME	SELECTED DAMSITES	REMARKS
	1	Dusmon	Dusmon	Dusmon	112	54	153	145	122	104	145	128	17	1.4	91.4	10.2	0.5	o				o	
x △	2	Tanudan	Chico	Tanudan	370	150	445	440	385	300	295	239	56	7.3	32.7	12.1	1.8						
	3	Chico No.5	Chico	Chico	3354	55	105	100	98	55	885	782	503	4.5	36.0	120.7	6.6		o	o			Discarded due to difficult compensation
	4	Chico No.4	Chico	Chico	1410	166	456	451	398	295	740	529	211	18.2	29.1	41.0	6.8		o	o			
	5	Chico No.3	Chico	Chico	920	70	565	560	500	500	43	-	135	1.7	-	-	-					o	
	6	Chico No.2	Chico	Chico	720	167	832	827	756	670	560	452	108	10.2	44.3	31.0	5.3			•	o	o	
	7	Chico No.1	Chico	Chico	371	166	1021	1018	957	860	219	163	56	10.1	16.1	6.0	1.0						
	8	Chico-Malitz	Chico	Chico	1090	135	305	300	236	175	2120	1822	298	37.7	48.3	96.1	13.0		o	•		•	
x	9	Pasil	Chico	Pasil	244	150	780	785	756	645	70	33	37	8.3	4.0	1.0	0.2						
x x	10	Mataing	Chico	Mataing	855	70	90	85	47	25	900	800	100	2.2	363.6	238.2	16.7	•	o	•		o	Subject to compensation for an intake weir
x	11	Bobusanan	Chico	Bobusanan	105	75	180	175	164	110	49	20	29	1.5	13.3	2.0	0.2						
	12	Pinukuk	Chico	Saltan	858	92	162	157	106	75	1150	1022	128	5.6	182.5	156.2	14.4	o	o	o		o	Subject to land compensation
	13	Saltan	Chico	Saltan	406	130	340	335	278	215	305	244	61	7.4	33.0	13.4	1.7						
	14	Babacn	Chico	Babacn	253	120	240	235	160	125	340	302	38	3.8	79.5	20.1	2.4	o				•	
x	15	Ditac	Pared	Pared	805	40	80	55	38	25	950	840	104	1.1	769.1	534.5	21.4	•	•	•		•	Subject to land compensation
	16	Pared	Pared	Pared	110	30	142	137	95	87	150	133	17	5.8	26.6	2.9	0.2						
	17	Dadac	Pared	Dadac	74	51	94	89	62	48	100	89	11	3.8	24.7	1.5	0.1						
	18	Paraaca	Pared	Paraaca	64	75	200	195	155	130	88	78	10	2.1	37.1	2.4	0.2						
x	19	Azzugaddan	Tuzuegaraa	Tuzuegaraa	441	55	85	80	52	35	448	382	66	1.2	318.3	140.4	7.7	•	o	o		•	Subject to geological condition
	20	Tuzuegaraa	Tuzuegaraa	Tuzuegaraa	220	130	200	195	127	75	306	287	35	7.7	36.7	7.6	1.0						
	21	Natutud	Tuzuegaraa	Natutud	81	85	180	155	113	80	110	95	12	1.7	57.8	4.7	0.4						
	22	Pinaceauaan	Pinaceauaan	Pinaceauaan	115	131	237	232	181	111	155	138	17	8.4	16.4	1.9	0.3						
	23	Tuaauial	Tuaauial	Tuaauial	165	127	252	247	181	139	223	198	25	7.0	28.3	4.7	0.6						
x	24	Siffu No.1(A)	Siffu-Mallig	Siffu	658	65	125	120	91	65	540	442	98	1.7	260.6	170.6	11.1	•	•	•		o)	One deaaite to be aelected conaidering
	24'	Siffu No.1(B)	Siffu-Mallig	Siffu	625	50	130	125	108	78	335	241	94	1.8	133.9	83.8	5.0	o	•	o		o)	aeological condition
	25	Siffu No.2	Siffu-Mallig	Siffu	387	113	275	270	210	187	680	425	55	4.5	94.4	34.6	4.0	o				o	
	26	Mallig No.1	Siffu-Mallig	Mallig	435	77	150	145	101	78	580	525	55	2.6	201.9	88.0	6.6	o	o	o		o	
	27	Mallig No.2	Siffu-Mallig	Mallig	262	60	165	160	131	110	498	444	54	1.9	444.8	160.7	9.6	o	o	o		o	
	28	Ilaaan No.1	Ilaaan	Ilaaan	1350	89	160	155	137	98	628	425	203	3.6	118.1	159.4	11.2	•	•	•		o	
	29	Ilaaan No.2	Ilaaan	Ilaaan	878	122	265	260	178	140	1125	994	131	10.9	81.2	79.9	10.0	o	o	o		o	
	30	Ilaaan No.3	Ilaaan	Ilaaan	366	130	495	490	424	370	480	425	55	13.8	30.8	11.3	1.5						
	31	Abuan No.1	Ilaaan	Abuan	474	120	183	178	107	58	640	569	71	9.9	57.5	27.3	3.3						
	32	Abuan No.2	Ilaaan	Abuan	271	121	285	280	210	180	362	321	41	6.8	47.2	12.8	1.5						
x	33	Dinabuaaan	Ilaaan	Dinabuaaan	652	65	105	100	72	45	608	508	98	4.4	115.5	75.3	4.9	o	•			o	
	34	Catalaaaan	Ilaaan	Catalaaaan	235	107	215	210	155	113	320	285	35	4.5	63.3	14.9	1.6	o				o	
	35	Tao-tao No.1	Naaat	Tao-tao	84	38	140	135	128	107	26	18	10	0.3	53.3	3.4	0.1						
	36	Tao-tao No.2	Naaat	Tao-tao	75	44	280	275	265	241	25	17	11	0.5	34.0	2.6	0.1						
	37	Allalt No.1(A)	Naaat	Allalt	559	125	315	310	243	185	740	656	84	7.1	92.4	51.7	6.5						
x	37'	Allalt No.1(B)	Naaat	Allalt	517	95	325	320	290	235	279	201	78	2.8	77.3	40.0	3.8	o	•	•		o)	*Allalt No. 1 (A) is selected on the basis
	38	Allalt No.2	Naaat	Allalt	431	142	415	410	340	278	570	505	65	10.4	48.6	20.8	3.0	o	•				of higher storage efficiency
	39	Ibulao No.1	Naaat	Ibulao	595	125	380	375	310	260	650	561	89	33.1	16.9	10.1	1.3						
	40	Ibulao No.2	Naaat	Ibulao	598	150	600	595	551	455	180	101	79	10.0	10.1	4.0	0.6						
	41	Natuao No.1	Naaat	Natuao	556	133	530	525	502	492	157	75	82	8.1	9.3	5.1	0.7				•	o	Hydropower project with high head thru long headrace tunnel
	42	Natuao No.2	Naaat	Natuao	220	150	795	790	724	650	180	157	23	11.4	13.8	3.0	0.5						
	43	Sta.Cruz No.1	Naaat	Sto. Cruz	87	144	735	730	658	596	88	78	10	12.0	8.5	0.4	0.1						
	44	Sta.Cruz No.2	Naaat	Sta. Cruz	62	103	680	675	617	582	88	88	9	3.2	17.5	1.1	0.1						
	45	Baaay	Naaat	Baaay	37	87	455	450	418	393	35	29	6	2.3	12.6	0.5	0.0						
	46	Naraaa	Naaat	Naraaa	51	83	628	623	574	550	88	80	8	5.4	11.7	0.8	0.0						
x	47	Caaayan No.1	Upper Caaayan	Caaayan	2384(1214)	55	185	180	128	115	958	774	182	1.2	845.0	783.0	43.1	•	•	•		•	Subject to land compensation and geological condition
x	48	Caaayan No.2	Upper Caaayan	Caaayan	1631 (481)	80	245	240	208	170	383	311	72	3.1	100.3	43.2	3.9	•	•			•	Subject to geological condition
	49	Caaaaaa	Upper Caaayan	Caaayan	1150 (1)	191	432	428.5	310	248	2300	2127	173	28.9	73.6	84.6	16.2	o	•	•	•	•	Tranabaaia diveraion achaaa
	50	Addalac(A)	Upper Caaayan	Addalac	884 (587)	50	187	182	137	113	240	182	58	2.0	82.8	56.3	3.4	o	•			•	
x	50'	Addalac(B)	Upper Caaayan	Addalac	821 (244)	47	187	182	159	125	65	13	52	1.3	10.0	8.2	0.4					o	
	51	Dilduyon	Upper Caaayan	Dilduyon	477	109	653	648	610	540	578	507	72	4.2	81.0	39.0	4.3	•			•	o	Hydropower project with high head thru long headrace tunnel
	52	Dibulaan	Upper Caaayan	Dibulaan	150	150	385	350	295	240	182	158	24	16.3	15.3	2.4	0.4				•	o	Tranabaaia diveraion achaaa

NOTES: (1) : Maaaaa dacaite aaaaa found out in this study.
(2) : Catchment areas in parenthesis of Caaayan No.1 (47) and Caaayan No. 2 (48) are excluded those of Caaaaaaa.
(3) : Catchment area in parenthesis of Addalac (A) (50) and Addalac (B)(50') are excluded those of Dilduyon

Table 9.2 Results of Second Screening

NO.		NAME OF DAM	C.A. (sq.km)	IRRIGATION EFFICIENCY (US$ /y/cu.m)	CLASS	POWER GENERATION EFFICIENCY (US$ /y/cu.m)	CLASS	FLOOD CONTROL EFFICIENCY (1) (US$ /y/cu.m)	CLASS	FLOOD CONTROL EFFICIENCY (2) (US$ /y/cu.m)	CLASS	COMPENSATION NUMBER OF BUILDINGS IN RESERVOIR	ACCESSIBILITY LENGTH OF ACCESS ROAD (km)	GELOGICAL CONDITION	SELECTED DAMSITE /1	REMARKS
1	1	Dumoon	112	1.58	B	0.60	C	0.10	C	0.52	C	40	18	Conglomerate,Sandstone		Low efficiencies,thought possible for irrigation.
2	4	Chico No.4	1410	0.58	C	3.37	A	0.59	C	2.70	C	300	0	Sandstone,Mudstone	oo	High efficiency for power generation.Topo maps available.
3	6	Chico No.2	720	0.89	C	0.35	A	0.91	C	2.86	C	230	0	Basic volcanics	o	High efficiency for power generation.
4	8	Chico-Mallig	1990	0.92	C	1.64	C	0.53	C	2.74	C	860	0	Sandstone/Shale		Low efficiencies
5	10	Matalag	655	5.90	A	3.65	A	0.58	C	2.89	C	2150	0	Conglomerate,Sandstone		High efficiencies, but difficult due to compensation.
6	12	Pinukpuk	856	3.04	A	3.05	B	1.12	B	4.41	B	1050	0	Conglomerate,Sandstone	o	Effective for each purpose.
7	14	Babaca	253	1.70	B	2.05	B	0.87	C	4.74	B	470	11	Conglomerate,Sandstone		Postponed for future development.
8	15	Bitag	695	11.20	A	3.05	B	3.06	A	4.23	B	3900	0	Sandstone		High efficiencies, but difficult due to compensation.
9	19	Aggugaddan	441	8.08	A	3.30	A	2.54	A	5.73	A	750	13	Limestone weathered		High efficiencies, but foundation consists of weathered lime-stone,hence more geological survey needed.
10	24	Siffu No.1(A)	858	4.31	A	2.89	B	3.27	A	8.45	A	80	7	Pebble-conglomerate	o	High efficiencies for each purpose.
11	24'	Siffu No.1(B)	626	2.68	A	2.70	B	2.00	B	4.84	B	80	15	Sandstone,Shale		Siffu No.1(B) is discarded in favor of (A) due to lower efficiency.
12	25	Siffu No.2	387	1.39	B	1.45	C	1.21	B	3.29	B	40	40	Volcanic rocks		Postponed for future development.
13	26	Mallig No.1	436	2.37	B	1.62	C	1.79	B	5.58	A	100	8	Conglomerate,Sandstone		Postponed for future development.
14	27	Mallig No.2	362	6.68	A	2.82	B	3.72	A	11.73	A	100	12	Sandstone,Shale	o	High efficiencies for each purpose.
15	28	Ilagan No.1	1350	2.36	B	4.57	A	3.13	A	5.07	A	40	27	Meta-Andesite,Diorite	o	High efficiencies for each purpose.
16	29	Ilagan No.2	876	1.57	B	1.89	B	2.02	B	2.80	C	0	41	Meta-Andesite,Agglomerate		Postponed for future development.
17	33	Disabungan	652	1.89	B	1.57	C	1.50	B	2.20	C	270	5	Granodiorite,Sandstone	o	Flood control will be expected.
18	34	Catalangan	235	1.02	C	1.13	C	0.87	C	0.87	C	20	19	Andesite,Phyoclastics		Low efficiencies.
19	37	Alisit No.1(A)	559	1.40	B	1.57	C	1.25	B	4.77	B	0	25	Andesite,Agglomerate	o	Alternative for irrigation and water supply in case Magat storage is partly allocated for flood control.
20	41	Matuno No.1	550	0.19	C	3.79	A	0.29	C	1.10	C	0	8	Conglomerate	oo	High efficiency for power generation.Topo maps available.
21	47	Cagayan No.1	2384 (1214)	12.90	A	8.35	A	12.32	A	34.95	A	1440	22	Limestone (Calisa-)	o	High efficiencies. Compensation problem can probably be set-tled.
22	48	Cagayan NO.2	1631 (481)	2.01	B	2.17	B	2.04	B	5.61	A	0	50	Limestone (Sicalao-)	o	High efficiencies. Alternative in case compensation problem in Cagayan No. 1 cannot be settled.
23	49	Casecnan	1150	1.18	C	2.96	B	1.18	B	2.88	C	120	80	Agglomerate	oo	Definite design on-going by NIA. Topo maps available.
24	50	Addalao(A)	864 (387)	1.26	B	3.19	B	1.45	B	3.37	B	0	25	Agglomerate	o	Effective for each purpose.
25	51	Diduyon	477	1.35	B	9.58	A	0.98	C	1.98	C	0	55	Agglomerate,Andesite	oo	High efficiency for power generation.Topo maps available.
26	52	Dibuluan	159	0.29	C	0.77	C	0.14	C	0.73	C	0	28	Metasediments		Low efficiencies.

NOTE : /1 : oo .... Feasibility Study completed.

Table 9.3 Result of Geological Survey

Dam Name	Geology	Geological Age	Strike/Dip	Hardness/Weathering	Fault, Fracture Zone
Pinukpuk	conglomerate, sandstone	Upper Miocene	N30°E/30°SE	soft-partly hard	-
Chico No.4/1	sandstone,shale, siltstone	Upper Miocene	N60°W/70°NE	hard-medium/moderately weathered (upland)	fault is present at the abutment
Chico No.2/1	basic volcanics (basalt-spilite, diabase)	Cretaceous-Paleogene	-	generally very hard	-
Siffu No.1	pebble-conglomerate	Pliocene	strike: N-S dip: 30°E	soft/moderately to highly weathered	active structure inferred may be no problem
Mallig No.2	sandstone with conglomerate, mudstone	Upper Miocene	N10°/60°E	soft-medium/moderately weathered	-
Ilagan No.1	meta-ancesite, diorite	Cretaceous-Paleogene	-	very hard-medium/slightly altered	-
Disabungan	sandstone, andesite granodiorite	Cretaceous-Paleogene/Pliocene	almost horizontal (sandstone)	very soft, highly (upland)/hard (river bank)	-
Alimit No.1	agglomerate, andesite	Cretaceous-Paleogene	N50-60°W/50°NE	generally hard/slightly-moderately weathered	-
Matuno No.1/1	conglomerate, sandstone	Middle Miocene	strike: E-W, dip: 30-40°N	hard/moderately weathered	-
Cagayan No.1	limestone (Callao-)	Upper Miocene	strike: N-S dip: 7-8°W	hard/slightly-moderately with solutive texture	-
Cagayan No.2	limestone (Sicalao-)	Middle Miocene	strike: NE-SW dip: 10°NW	hard-medium/moderately weathered	-
Casecnan/1	agglomerate	Upper Oligocene	strike: NE-SW dip: 20-30°N	hard, massive	sheared zone, consolidated
Addalam	agglomerate	Oligocene	N60°W/10°SW	med.-very hard/slightly-highly weathered (right)	-
Diduyon/1	agglomerate, andesite	Oligocene	N35-50°NE/25-35°E	hard/generally fresh	fault right bank
Dibuluan	metasediments	Cretaceous-Paleogene	strike: NE-SW dip: NW	medium hard/moderately weathered	-

Note; /1: Source, Feasibility or Pre-Feasibility Report of Each Projects

Table 9.4 Proposed Construction Material

(from surface inspection)

Number	Dam Name	Location	Material	Description	Class
1	Pinukpuk	2 km upstream river bed	sand, gravel	including cobble-boulder, hard	A
2	Siffu No. 1	0.8 km downstream both banks	conglomerate sand-stone (preocene) End Teriary	very loose, moderately weathered	B
3	Mallig No. 2	*2.5 km SW right bank	sandstone, mud-stone (End Tertiary)	moderately-highly weathered soft rock	C
		**11 km NW (Chico River Channel)	sand, gravel	including cobble-boulder, hard	A
4	Ilagan No. 1	2 km downstream and 5 km upstream river bed	sand, gravel	including cobble-boulder, hard	A
5	Disabungan	1 km upstream right bank	andesite etc. (metavolcanics) (Not to be specified)	moderately weathered soft rock	B
6	Alimit No. 1	1-2 km upstream right bank	agglomerate (cretaceous)	slightly-moderately weathered	A
7	Cagayan No. 1	3-5 km upstream river bed	sand, gravel	including cobble-boulder, hard	A
8	Cagayan No. 2	0.5-3 km upstream river bed	sand, gravel	including cobble-boulder, hard	A
9	Addalam	4 km SW both banks (upstream)	agglomerate (cretaceous)	slightly-moderately weathered	A

Notes: * and ** means alternative plan each other

Class - A: fresh-moderately weathered hard rock
- B: moderately weathered soft rock
- C: moderately-highly weathered soft rock

Table 9.5 Land Use and Number of Buildings in Reservoir Area

Name of Dam	Elevation (El.m)	Land Use (ha)				No. of Buildings (Nos.)
		Paddy	Agri-culture	Residen-tial	Others /1	
Pinukpuk	70	0	0	0	38	0
	80	8	26	0	336	113
	90	48	164	0	494	225
	100	76	272	0	692	470
	110	76	302	0	1,050	712
	120	76	314	0	1,420	965
	130	76	326	0	1,842	1,215
Siffu No.1	70	0	0	0	50	0
	80	0	30	0	180	25
	90	10	120	0	420	119
	100	40	240	0	700	219
	110	170	400	0	1,070	440
	120	340	590	0	1,610	492
	130	430	690	0	2,270	660
Mallig No.2	110	0	0	0	10	0
	120	0	10	0	70	0
	130	10	60	0	290	84
	140	30	150	0	630	198
	150	100	220	0	1,040	332
	160	140	270	0	1,560	409
	170	190	290	0	2,310	540
Disabungan	60	0	0	0	30	0
	70	0	160	0	210	79
	80	50	320	0	510	311
	90	70	410	0	860	531
	100	90	540	0	1,350	727
	110	100	640	0	2,030	881
Ilagan No.1	110	0	0	0	70	0
	120	0	50	0	250	2
	130	0	130	0	480	90
	140	0	210	0	890	267
	150	0	260	0	1,270	376
	160	0	270	0	1,820	415
	170	0	280	0	2,850	436

(to be continued)

(Continuation)

Name of Dam	Elevation (El.m)	Land Use (ha)				No. of Buildings (Nos.)
		Paddy	Agri-culture	Residen-tial	Others/1	
Addalam/2	120	0	0	0	199	0
	140	0	140	0	325	0
	160	0	320	0	766	0
	180	0	550	0	1,303	0
	200	0	740	0	1,774	0
	220	0	990	0	2,386	0
Cagayan No.1	120	0	0	0	20	0
	130	0	10	0	110	0
	135	0	50	0	300	0
	140	0	340	0	650	4
	145	20	840	10	1,090	230
	150	100	1,180	40	1,840	1,586
	160	240	1,430	60	3,310	3,458
	170	470	1,600	80	4,890	5,282
Cagayan No.2	180	0	0	0	50	0
	190	0	20	0	140	13
	200	0	100	0	290	38
	210	0	130	0	420	92
	220	0	160	0	560	173
	230	0	170	0	820	238
	240	0	180	0	1,220	288
	250	0	190	0	1,500	315
Alimit No.1/2	200	0	0	0	37	0
	220	0	0	0	166	0
	240	0	0	0	334	0
	260	0	0	0	652	0
	280	10	0	0	1,019	0
	300	50	0	0	1,394	0
	320	116	0	0	2,090	0
	340	186	0	0	2,777	0
	360	271	0	0	3,177	0

Notws; /1: Include forest and grass land
/2: Data source,MAF Region II's investigation.
Other site are estimated on the basis of the topographic map in a scale of 1 to 25,000.

Table 9.6 Results of Screening for Small Dam Project

No.	Name of Dam	River	C.A. (km^2)	Annual Rainfall (mm)	Available Water (MCM) /1	Riverbed Elevation (El.m)	Possible Max. Elevation (El.m)	Sediment Level (El.m)	MWL (El.m)	Dam Crest (El.m)	Sediment Storage ($10^6 m^3$)	Effect. Storage ($10^6 m^3$)	Gross Storage ($10^6 m^3$)	Dam Height (m)	Dam Volume ($10^6 m^3$)	Storage Efficiency	Selected Damsites	Remarks (Dam height is decided by following limit.)
1	Guising		5.3	2,100	3.74	45	72+	55.5	67	72	0.20	1.10	1.30	30	0.246	4.5		Maximum dam height (30 m).
2	Bulagao		17.3	2,100	12.21	37	60	46.3	55	60	0.65	2.05	2.70	26	0.160	12.8		Topographical condition.
3	San Luis		6.2	2,000	4.17	46	60	50.5	55	60	0.23	0.97	1.20	17	0.117	8.3		Topographical condition.
4	Asassi	Asassi	6.0	2,900	5.85	19	46+	22.8	41	46	0.22	4.68	4.90	30	0.504	9.1		Maximum dam height (30 m).
5	Nabialan	Afusing	6.7	2,000	4.50	17	50	41.5	45	50	0.25	0.95	1.20	16	0.137	6.9		Topographical condition.
6	Magogod		11.4	3,000	11.49	28	55+	35.0	50	55	0.43	2.87	3.30	30	0.332	8.6		Maximum dam height (30 m).
7	Manalo		26.9	2,900	26.21	25	52+	45.5	47	52	1.01	0.19	1.20	30	0.164	1.2		Maximum dam height (30 m).
8	Marohbod		21.0	2,800	19.76	25	52+	32.0	47	52	0.79	5.81	6.60	30	0.619	9.4		Maximum dam height (30 m).
9	Sta. Barbara		22.1	2,800	20.79	26	53+	38.6	48	53	0.83	2.17	3.00	30	0.281	7.7		Maximum dam height (30 m).
10	Bayo		7.5	2,600	6.55	27	50	33.0	45	50	0.28	2.72	3.00	26	0.295	9.2		Topographical condition.
11	San Juan		3.8	2,000	2.55	76	100	81.0	90	95	0.14	2.55	2.69	22	0.250	10.3		Hydrological condition.
12	Liwan Norte		6.0	2,000	4.03	59	70	61.5	65	70	0.23	0.57	0.80	14	0.025	22.8	*	Topographical condition.
13	Kinama		8.1	2,000	5.94	79	106+	87.5	101	106	0.30	1.80	2.10	30	0.187	9.6		Maximum dam height (30 m).
14	Liwan West		5.1	2,000	3.43	99	126+	106.1	121	126	0.19	1.91	2.10	30	0.276	6.9		Maximum dam height (30 m).
15	Santor		11.3	2,000	7.56	80	100	85.3	95	100	0.42	4.88	5.30	23	0.163	29.9	*	Topographical condition.
16	Maglatac 1	Paculagu	76.3	2,000	51.27	56	83+	70	78	83	2.86	6.84	9.70	30	0.263	26.0	*	Maximum dam height (30 m).
17	Maglatac 2	Paculagu	51.2	2,000	34.41	75	102+	87.5	97	102	1.92	8.08	10.00	30	0.386	20.9		Maximum dam height (30 m).
18	Minagbag		8.9	2,000	5.98	120	140	129.4	135	140	0.13	0.77	1.10	23	0.270	2.9		Topographical condition.
19	Laguinday		15.9	2,000	10.68	90	117+	98.0	112	117	0.60	6.40	7.00	30	0.596	10.7		Maximum dam height (30 m).
20	Bubug		4.9	2,000	3.29	68	95+	75.3	90	95	0.18	3.29	3.47	30	0.430	7.7		Max. dam height & hydro. condition.
21	San Vicente		11.6	2,300	8.96	40	67+	47.0	62	67	0.44	8.16	8.60	30	0.774	10.5		Maximum dam height (30 m).
22	Sto. Rosario		5.8	2,000	3.90	65	90	69.5	81	86	0.22	3.90	4.12	24	0.394	9.9		Hydrological condition.
23	Maui		4.2	2,000	2.82	78	100	80.3	95	100	0.16	2.82	2.98	25	0.250	11.3		Topo. & hydrological condition.
24	Carmencita	Calinauan	5.0	2,000	3.36	85	110	92.0	105	110	0.19	3.36	3.55	28	0.500	6.7		Topo. & hydrological condition.
25	Miguel		3.1	2,000	2.08	50	70	54.0	65	70	0.12	2.08	2.20	23	0.314	6.6		Topographical condition.
26	Mangga		14.3	2,000	9.61	90	100	93.6	95	100	0.54	0.46	1.00	13	0.090	5.1		Maximum dam height (30 m).
27	Malalao		8.8	2,000	5.91	117	144+	123.5	139	144	0.33	3.47	3.80	30	0.228	15.2		Maximum dam height (30 m).
28	Turod		33.0	2,000	22.18	73	100+	82.0	95	100	1.24	6.96	8.20	30	0.423	16.5		Maximum dam height (30 m).
29	Rang-ayan 1		15.1	2,000	10.15	77	104+	92.0	99	104	0.57	0.73	1.30	30	0.117	6.2		Maximum dam height (30 m).
30	Rang-ayan 2		9.7	2,000	6.52	135	162+	146.5	157	162	0.36	2.14	2.50	30	0.151	14.2		Maximum dam height (30 m).
31	Sinamar		5.1	2,000	3.43	90	117+	95.0	112	117	0.19	2.61	2.80	30	0.445	5.9		Maximum dam height (30 m).
32	San Rafael	Cabanayan	6.0	2,000	4.03	88	115+	97.2	110	115	0.23	1.17	1.40	30	0.177	7.1		Maximum dam height (30 m).
33	Matuxalem	Barambam	20.2	2,000	13.57	88	115+	96.8	110	115	0.76	5.44	6.20	30	0.274	19.9		Maximum dam height (30 m).
34	Eden		13.5	2,000	9.07	95	122+	106.3	117	122	0.51	3.79	4.30	30	0.176	21.5		Maximum dam height (30 m).
35	Mapapi	Mapapi	12.8	2,000	8.60	95	122+	103.0	117	122	0.48	5.72	6.20	30	0.304	18.8		Maximum dam height (30 m).
36	Mangcuram	Manga	10.3	2,000	6.92	36	50	41.0	45	50	0.39	1.61	2.00	15	0.116	13.9		Topographical condition.
37	Pasa		17.9	2,900	17.44	90	117+	104.5	112	117	0.67	1.13	1.80	30	0.222	5.1		Maximum dam height (30 m).
38	Fuyo		6.0	2,700	5.44	66	90	71.0	84	89	0.23	5.44	5.67	26	0.507	10.7		Hydrological condition.
39	Yehan		10.7	2,300	8.27	47	70	52.0	64	69	0.40	8.27	8.67	25	0.424	19.5		Hydrological condition.
40	San Francisco		11.4	2,600	9.96	65	80	68.0	75	80	0.43	6.07	6.50	18	0.126	48.2	*	Topographical condition.
41	Songsong		14.8	2,700	10.44	30	50	39.1	45	50	0.56	2.54	3.10	23	0.113	22.5		Topographical condition.
42	Cuihang		20.8	2,100	14.68	38	60	45.0	55	60	0.78	10.02	10.80	25	0.510	19.6		Topographical condition.
43	Bagong		22.9	2,000	15.39	45	60	51.1	55	60	0.86	2.84	3.70	18	0.103	27.6	*	Topographical condition.
44	Sta. Maria		30.6	2,300	23.65	55	80	60.0	74	79	1.15	23.65	24.80	27	0.267	88.6	*	Hydrological condition.
45	Calaocan	Madalao	26.8	2,200	19.81	62	90	68.0	79	84	1.01	19.81	20.82	25	0.271	72.6	*	Hydrological condition.
46	Bannawag		14.3	2,100	24.20	57	70	61.4	65	70	1.29	0.81	2.10	16	0.058	14.0		Topographical condition.
47	Linglingay		15.6	2,000	10.48	55	70	57.5	65	70	0.59	6.11	6.70	18	0.116	52.7	*	Topographical condition.
48	Colorado	Sinalugan	63.9	2,100	45.09	60	87+	67.0	82	87	2.40	45.09	47.49	30	0.505	89.3	*	Max. dam height & hydro. condition.
49	Lourdes	Sto. Nino	12.7	2,000	8.53	49	60	52.7	55	60	0.48	0.62	1.10	14	0.040	15.5		Topographical condition.
50	Salvacion	Macaluat	54.1	2,000	36.36	67	80	77.6	75	80	2.03	0						No effective storage
51	San Felipe		11.9	2,000	8.00	79	90	82.8	85	90	0.45	0.95	1.40	14	0.082	11.6		Topographical condition.
52	Sacradal		14.8	2,000	9.95	65	80	71.0	75	80	0.56	2.04	2.60	18	0.112	18.2		Topographical condition.
53	San Sebastian		9.0	2,000	6.05	85	100	89.0	95	100	0.34	2.46	2.80	18	0.130	18.9		Topographical condition.
54	Bello	Diarao	42.5	2,200	31.42	118	145+	127.0	140	145	1.59	12.71	14.30	30	0.303	42.0	*	Maximum dam height (30 m).
55	Fermin		4.4	2,000	2.96	87	100	90.8	95	100	0.17	1.33	1.50	16	0.094	14.1		Topographical condition.
56	San Marcos		13.2	2,000	8.87	88	115+	97.3	110	115	0.50	4.30	4.80	30	0.199	21.6		Maximum dam height (30 m).

Notes: /1 : Potential water to be stored.

Table 9.7 Results of Screening for Pond Scheme

Item		Pond 1 (Carmencita)	Pond 2	Pond 3	Pond 4
Catchment Area, at Intake	(km^2)	16.0	4.2	2.9	2.4
at Pond	(km^2)	0.8	0.4	0.3	0.7
Annual Rainfall	(mm)	2,000	2,000	2,000	2,000
Potential Water to be stored	(10^6m^3)	11.29	3.09	2.15	2.08
Ground Elevation	(El.m)	45	55	75	82
Possible Maximum Elevation	(El.m)	60	70	90	100
Sediment Level	(El.m)	48	58	80	85
HWL.	(El.m)	57	67	87	97
Dam Crest	(El.m)	60	70	90	100
Sediment Storage Volume	(10^6m^3)	0.06	0.03	0.02	0.04
Effective Storage Volume	(10^6m^3)	1.34	0.51	0.35	0.84
Gross Storage Volume	(10^6m^3)	1.40	0.54	0.37	0.88
Dam Height	(m)	18	18	18	21
Dam Volume	(10^6m^3)	0.117	0.085	0.072	0.125
Length of Intake Channel	(m)	900	500	800	1,200
Storage Efficiency (1)		11.5	6.0	4.9	6.7
Storage Efficiency (2)		1,490	1,020	440	700
Selected Pond		*			

Table 9.8 Priority Ranking for Proposed Small Dam

Name of Sites	With Irrigation Development				Without Irrigation Development			
	Net Present Value/1 (₱x10⁶)	Benefit Cost Ratio	EIRR (%)	Priority Ranking	Net Present Value/1 (₱x10⁶)	Benefit Cost Ratio	EIRR (%)	Priority Ranking
Liwan Norte	4.3	1.11	11.8	2	7.6	1.22	13.8	3
Santor	13.6	1.17	12.6	1	18.7	1.35	16.5	1
Maglatac 1	-24.4	0.81	7.1	7	4.7	1.07	11.1	5
San Francisco	0.4	1.01	10.1	5	-2.5	0.89	8.1	6
Bagong	-0.7	0.99	9.8	6	7.7	1.22	14.0	2
Linglingay	3.6	1.07	11.1	3	4.7	1.12	12.5	4
Bello	5.8	1.06	10.8	4	-9.9	0.70	5.1	7
Carmencita Pond	0.7	1.02	10.3		9.9	1.44	18.6	

Note: /1; Discount Rate ... 10% per annum

Table 9.9 Unit Price for Dam Construction

(Unit: Pesos)

Item	Unit	F.C.	L.C.	Total
New road	km	825,000	675,000	1,500,000
Road improvement	km	165,000	135,000	300,000
Bridge	m	22,500	27,500	50,000
Excavation, common	m^3	35	30	65
rock	m^3	120	90	210
tunnel	m^3	740	300	1,040
shaft	m^3	820	320	1,140
Embankment, core & earth	m^3	65	45	110
filter	m^3	95	75	170
rock	m^3	110	80	190
riprap	m^3	160	120	280
Concrete, dam	m^3	820	600	1,420
spillway & tailrace	m^3	910	890	1,800
powerhouse	m^3	950	950	1,900
tunnel	m^3	1,080	1,010	2,090
plug & anchor block	m^3	870	840	1,710
other structure	m^3	1,010	990	2,000
Grout, curtain	m	1,310	590	1,900
blanket or consoli.	m	910	510	1,420
Reinforcement bar	ton	10,450	4,750	15,200
Steel support	ton	12,350	8,550	20,900
Metal works, valve	ton	188,100	20,900	209,000
intake gate	ton	116,280	12,920	129,200
other gate	ton	109,440	12,160	121,600
trash rack	ton	76,950	8,550	85,500
penstock	ton	68,400	7,600	76,000

Table 10.1 1/5 Probable Annual Water Deficit at Balance Point

Unit: $x10^6m^3$/year

Balance Point	Annual Deficit 1985 Demand	1990 Demand	1995 Demand	2000 Demand	2005 Demand
1					
2					
3					
4					
5					
6			2 (80)	2 (80)	2 (80)
7			2 (78)	5 (78)	6 (78)
8				75 (82)	75 (82)
9			2 (78)	7 (78)	11 (78)
10					
11					87 (84)
12					
13		27 (75)	27 (75)	53 (75)	146 (75)
14					
15					
16					
17					
18					
19					
20					
21	2 (83)	2 (83)	2 (83)	2 (83)	2 (83)
22	3 (83)	3 (83)	3 (83)	3 (83)	3 (83)
23	40 (80)	139 (80)	139 (80)	139 (80)	139 (80)
24					
25					
26	15 (78)	17 (83)	18 (83)	19 (83)	20 (83)
27	4 (78)	4 (78)	5 (78)	5 (78)	6 (78)
28					
29					
30			650 (75)	650 (75)	650 (75)
31	2 (78)	2 (80)	55 (78)	55 (78)	55 (78)
32			7 (74)	7 (74)	8 (74)
33	7 (78)	7 (78)	7 (78)	7 (78)	5 (78)
34		10 (78)	10 (78)	10 (78)	10 (78)
35					
36					
37					
38					
39					
40					
41					
42	6 (63)	6 (63)	6 (63)	6 (63)	14 (78)
43					
44	14 (78)	13 (78)	13 (78)	13 (78)	38 (69)
45					
46	16 (80)	16 (80)	16 (80)	17 (80)	25 (80)
47			8 (78)	25 (81)	37 (69)
48			7 (78)	23 (78)	34 (69)

Note; Figures in parentheses are the years when 1/5 probable deficits occur.

Table 11.1 Allocated Dam Cost and Total Cost

(Unit: ₱ x 10^6)

Item	Dummon	Paranan	Zinundungan	Mallig No.2	Siffu No.1	Alimit No.1	Matuno No.1
I. Allocated Dam Cost							
Irrigation	354.56	355.46	226.13	1,188.68	-	-	578.28
Hydropower	35.49	47.10	83.64	-	245.06	589.12	2,023.20
Flood Control	-	-	-	388.48	304.15	978.22	-
Water Supply	-	-	-	-	-	80.47	53.68
Irrigation /1	-	-	-	-	286.05	137.70	239.12
Water Supply /1	-	-	-	-	109.56	51.86	92.72
Sub-Total of I	390.05	402.56	309.77	1,577.16	944.82	1,837.37	2,987.00
II. Specific Cost							
Irrigation	34.37	26.41	66.59	2,138.09	-	-	783.07
Hydropower	24.96	22.01	41.70	-	112.41	199.73	2,085.00
Sub-Total of II	59.33	48.42	108.29	2,138.09	112.41	199.73	2,868.07
III. Total	449.38	450.98	418.06	3,715.25	1,057.23	2,037.10	5,855.07

Note: /1 ; Supplement of Magat dam

Table 11.2 Assumed Cost Disbursement

(Unit: Mill. Pesos)

Item	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
I. MULTIPURPOSE PROJECT																				
1. Matiig Project				44.87	281.51	748.07	905.79	1,016.20	718.82											3,715.26
2. Sifu Project				31.72	158.58	264.31	338.31	264.31												1,057.23
3. Matuno Project						152.16	507.20	937.26	1,348.64	1,566.00	1,342.41									6,856.07
4. Ailmit Project											61.10	305.57	509.28	651.67	509.28					2,037.10
																			Sub-Total	12,664.66
II. FLOOD CONTROL PROJECT																				
1. Tuguegarao Dike				27.60	131.70	131.70	131.70	131.70												554.40
2. Magapit (Nassiping Left,NLL)					49.00	232.30	232.30	232.30	232.30											978.20
3. Bank Protection		53.30	53.90	53.90	53.90	53.90	53.90	53.90	53.90	53.90	53.90	53.90	53.90	53.90	53.90	53.90	53.90	53.90	53.90	969.60
4. Cabagan Dike										15.50	72.80	72.80	72.80	72.80						306.70
5. Magapit (Nassiping Right,NLR)										147.70	312.10	312.10	312.10	312.10	312.10	312.10	312.10	312.10	312.10	2,956.60
																			Sub-Total	5,765.50
III. IRRIGATION PROJECT																				
1. Pinacanauan RIS			1.85	21.16																23.01
2. Dabubu RIP			5.64	46.81	46.72															99.07
3. Lututan IP											7.80	88.29	87.85							183.94
4. Solana IS											2.92	35.10	35.10							73.12
5. Gappal IP											19.79	88.08	259.24	238.96						606.07
6. Ragan IP													7.00	79.75	79.39					166.14
7. Tuguegarao IP													4.15	47.64	47.46					99.25
8. Alcala Amulung West IP														13.59	128.52	166.15	125.41			433.77
9. Bagao IS														21.23	85.97	182.61	161.27			450.98
10. Dummon RIS															20.75	84.38	182.50	161.75		449.38
11. Tumauini IS																	20.74	178.93	178.73	378.40
12. Zinundungan IEP																17.57	73.19	172.55	154.75	418.06
13. Magat O & M Improvement		157.75	352.95	234.71	183.46	131.13														1,060.00
																			Sub-Total	4,441.19
IV. HYDROPOWER																				
1. Ibulao									16.53	82.65	137.75	176.32	137.75							551.00
2. Tanudan												19.38	96.90	161.50	206.72	161.50				646.00
3. Diduyon															1,069.78	1,337.22	2,674.44	2,674.44	1,158.92	8,914.80
																			Sub-Total	10,111.80
Total	0.00	211.05	414.24	460.77	904.87	1,713.57	2,169.20	2,635.67	2,369.59	1,867.75	2,010.57	1,151.54	1,676.07	1,653.34	2,513.97	2,315.33	3,603.55	3,563.67	1,858.40	32,983.15
V. PROJECT COST BY SECTOR																				
1. Flood Control	0.00	53.30	53.90	90.62	291.87	552.21	612.35	618.26	383.32	217.10	468.15	585.53	683.36	751.82	610.56	366.00	366.00	366.00	366.00	7,436.56
2. Irrigation	0.00	157.75	360.34	359.43	559.38	946.74	1,031.64	1,186.56	1,055.94	540.95	477.20	251.98	460.65	484.13	412.86	404.61	489.67	441.94	259.61	9,925.58
3. Hydropower	0.00	0.00	0.00	10.72	53.62	212.62	525.21	828.85	930.33	1,109.70	1,065.22	314.03	431.86	417.39	1,490.55	1,544.72	2,747.88	2,745.73	1,202.79	15,621.22

FIGURES

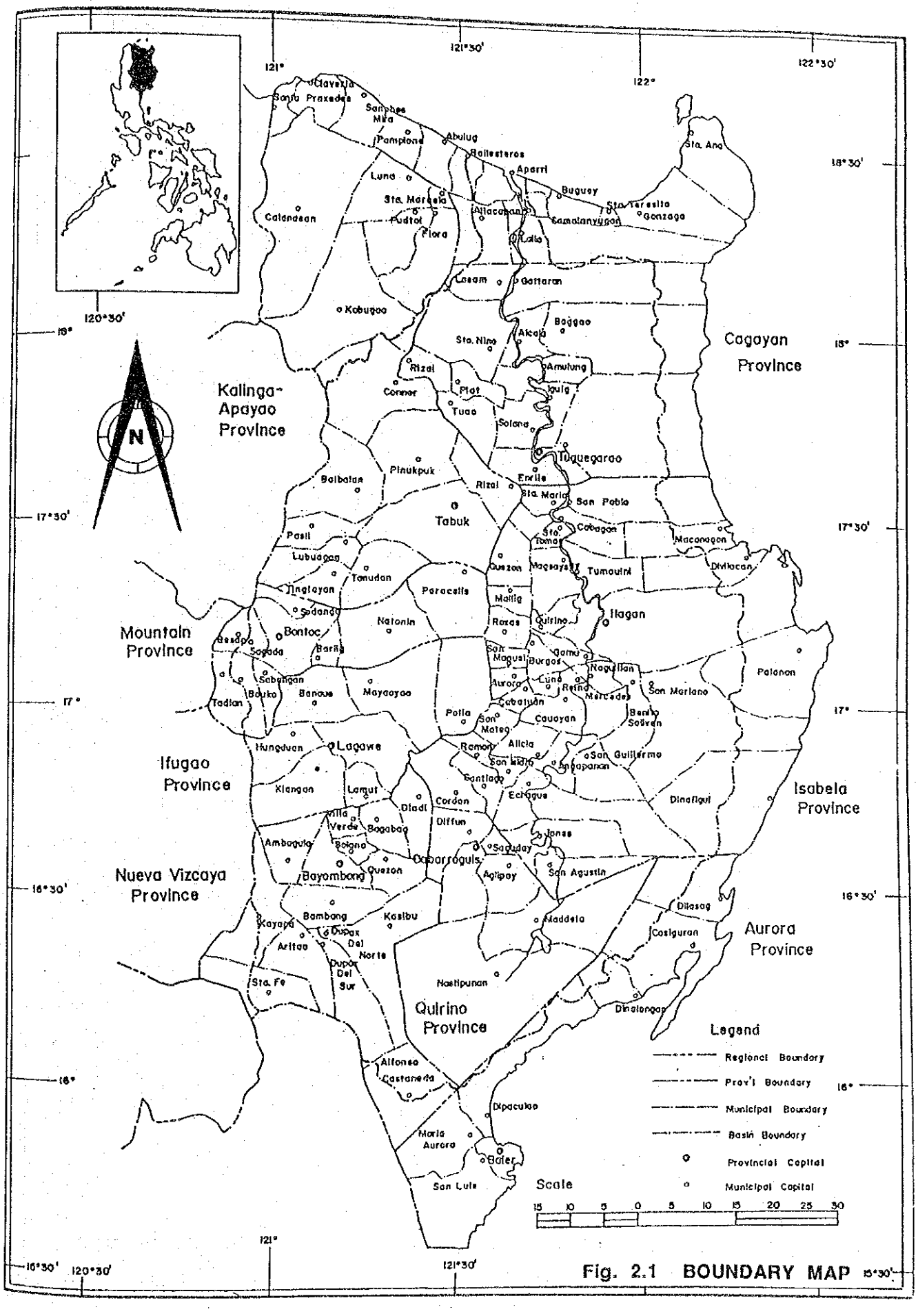


Fig. 2.1 **BOUNDARY MAP**

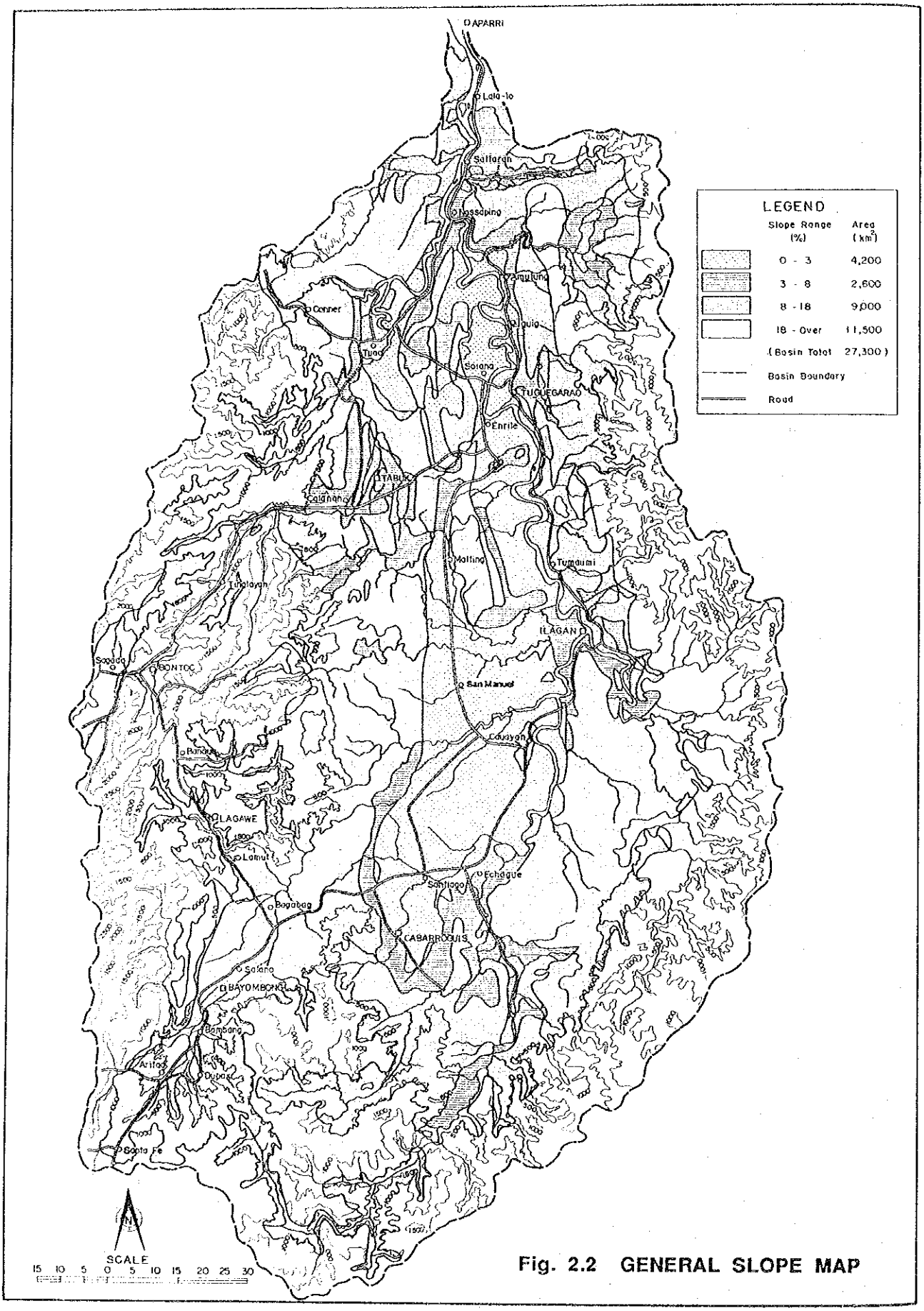


Fig. 2.2 GENERAL SLOPE MAP

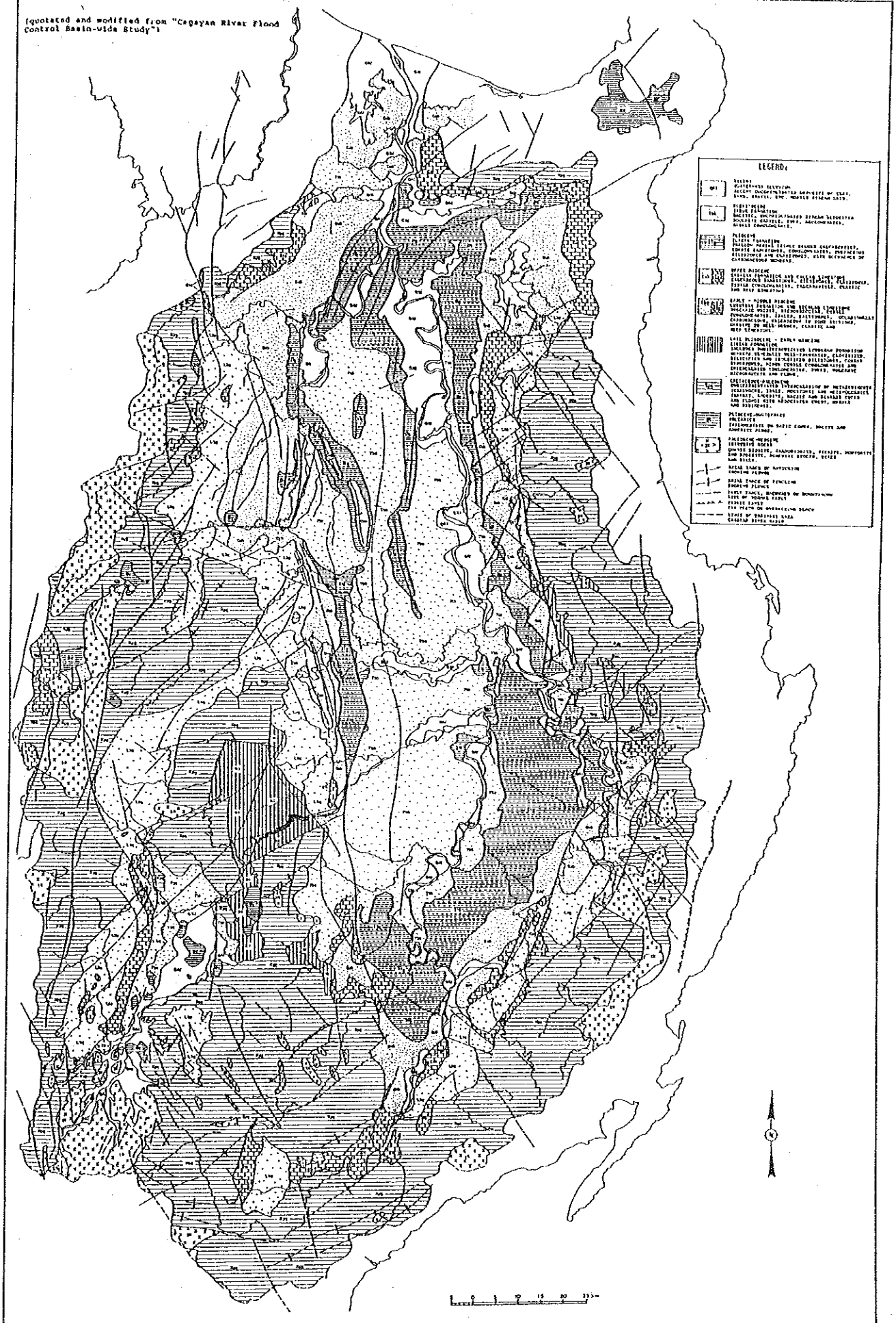


Fig. 2.3 GEOLOGICAL MAP OF CAGAYAN RIVER BASIN

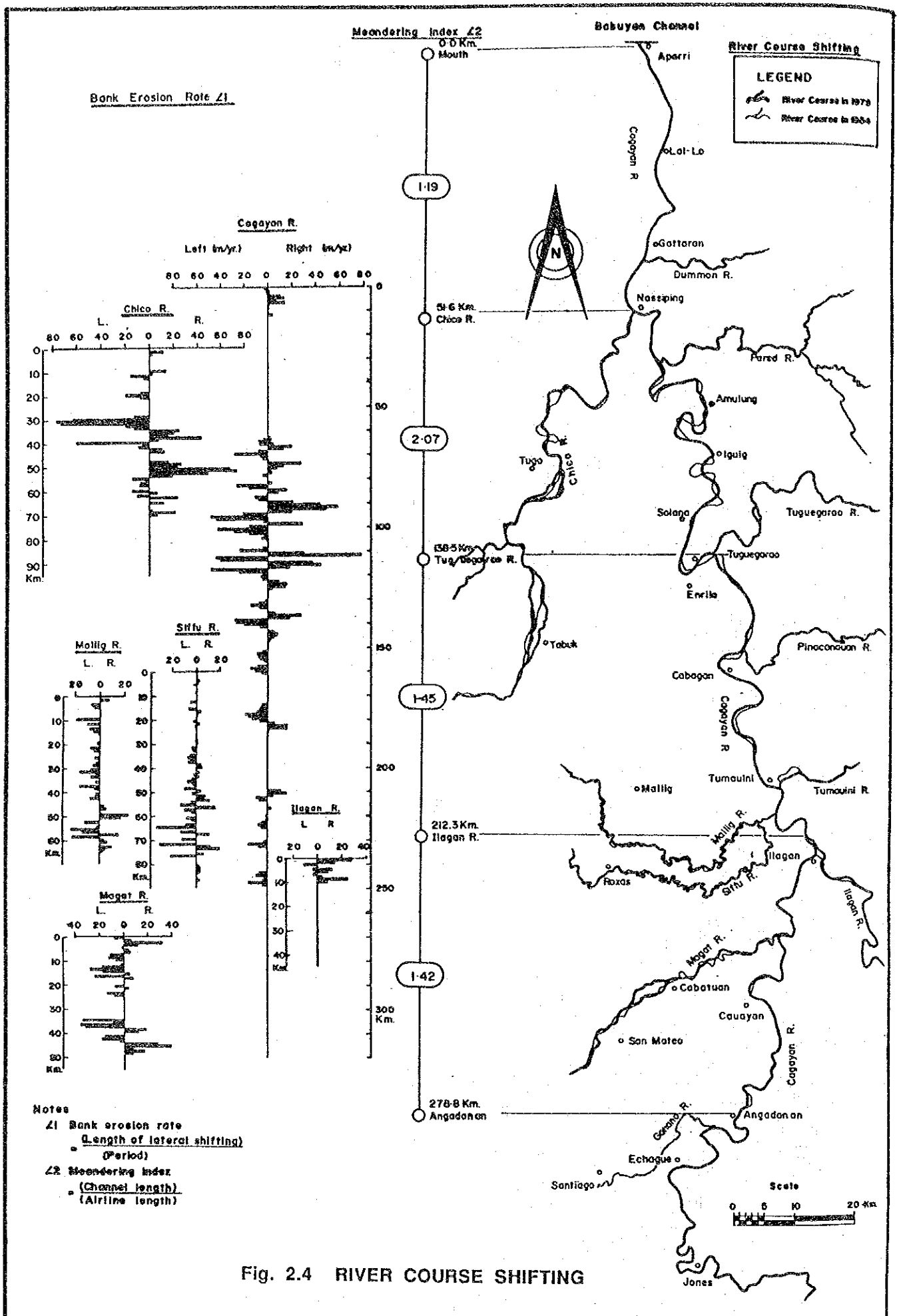


Fig. 2.4 RIVER COURSE SHIFTING

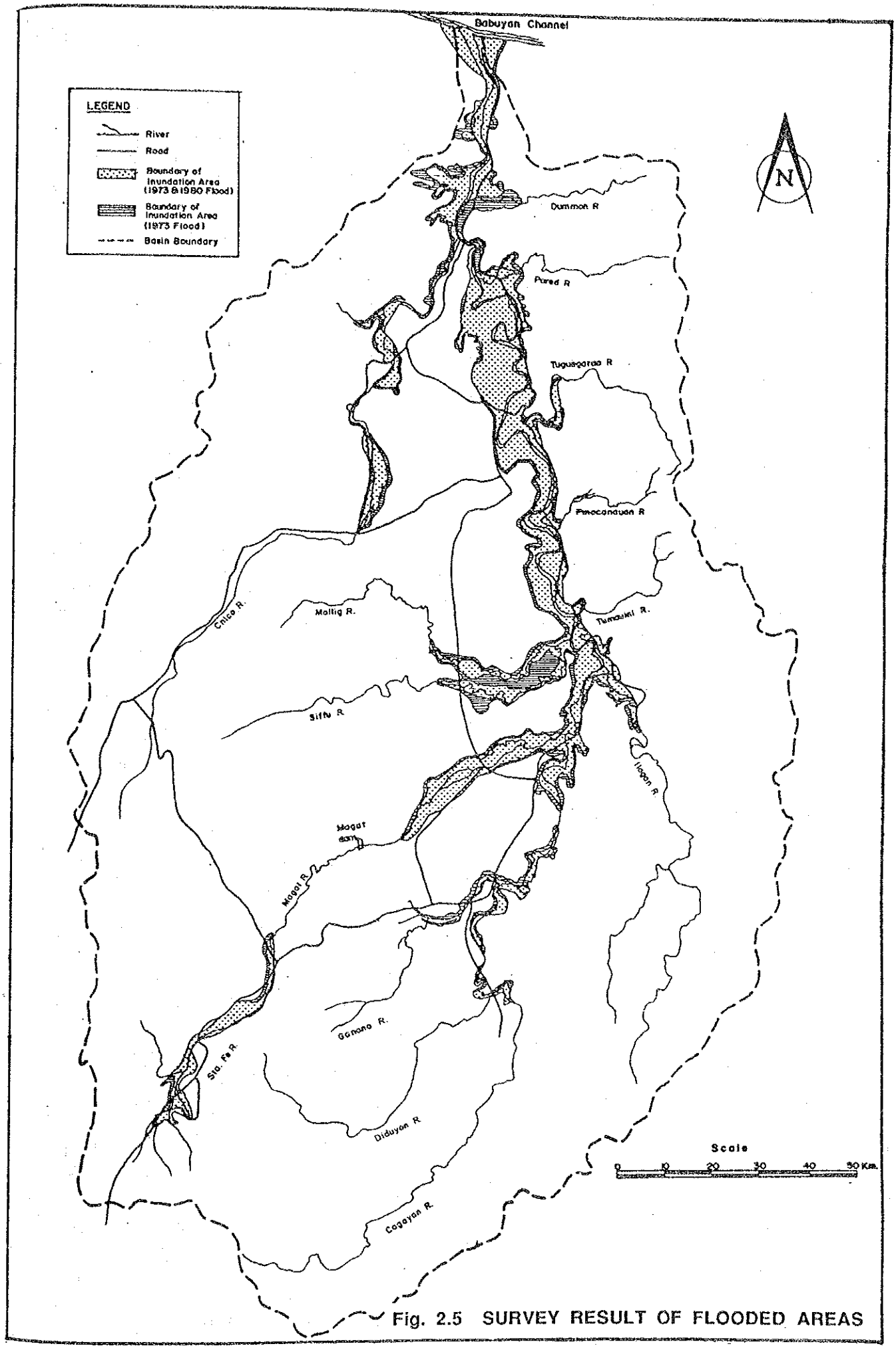


Fig. 2.5 SURVEY RESULT OF FLOODED AREAS

Streamflow Gauging Station

No.	Station Name	No.	Station Name	No.	Station Name
1	Aparri	41	Palattao	67	Baybayog
2	Maddatero	42	Supang	68	Rosario
3	Caloyauan	43	Minanga	69	Tungngod
4	Centro, Camalaniugan	44	Disulap	70	Careb
5	Simay	45	Caipilan	71	Balilling
6	Poblacion, Gattaran	46	Dipatlo	72	Beti
7	Calaoagan	47	Oscariz	73	Ilut
8	Nassiping	48	Dulao	74	Aurora east
9	Tupang	49	Cabulay	75	Gamis
10	Calantac	50	Hapid	76	Jones
11	Asassi	51	Camandag		
12	Escalta	52	Pangal		
13	Anguiray	53	Panang		
14	Centro, Iguig	54	Guinatvin		
15	Baya	55	Bante		
16	Pangul	56	Manamtam		
17	Centro, Solana	57	Kamamasi		
18	Larion Alto	58	Minuri		
19	Pinukpuk	59	Dabubu		
20	Calaggaman	60	NPC Lamut		
21	Namabbalan	61	Bato		
22	Ligtig Gawaan	62	Dippadiw		
23	Naneng	63	Pingkian		
24	Abbot	64	Taan		
25	Pasonglao	65	Ponggo		
26	Baba-atan	66	Bangag		
27	Patac				
28	Abut				
29	Antagan				
30	Ampawilen				
31	Anabet				
32	Tomiangan				
33	Pattacan				
34	Toad				
35	Basao				
36	Ambato				
37	Casile				
38	Maligaya				
39	Muñoz				
40	Malalam				

Sediment / Water Quality

No.	Station Name
1	Calaoagan
2	Asassi
3	Escalta
4	Larion Alto
5	Ligtig Gawaan
6	Pasonglao
7	Antagan
8	Casile
9	Muñoz
10	Malalam(Alinguigan)
11	Palattao
12	Minanga
13	Oscariz
14	Magat Damsite
15	Dulao
16	Cabulay
17	Lamut
18	Hapid (Tupaya)
19	Camandag
20	Guinatvin
21	Bante
22	Minuri
23	Dabubu
24	Bato
25	Dippadiw
26	Pingkian
27	Bangag
28	Baybayog
29	Rosario
30	Tungngod
31	Careb
32	Balilling
33	Beti
34	Ilut
35	Aurora East
36	Gamis
37	Jones
38	Maddela
39	Conwao
40	Gabong
41	Dakgan
42	Bagabag

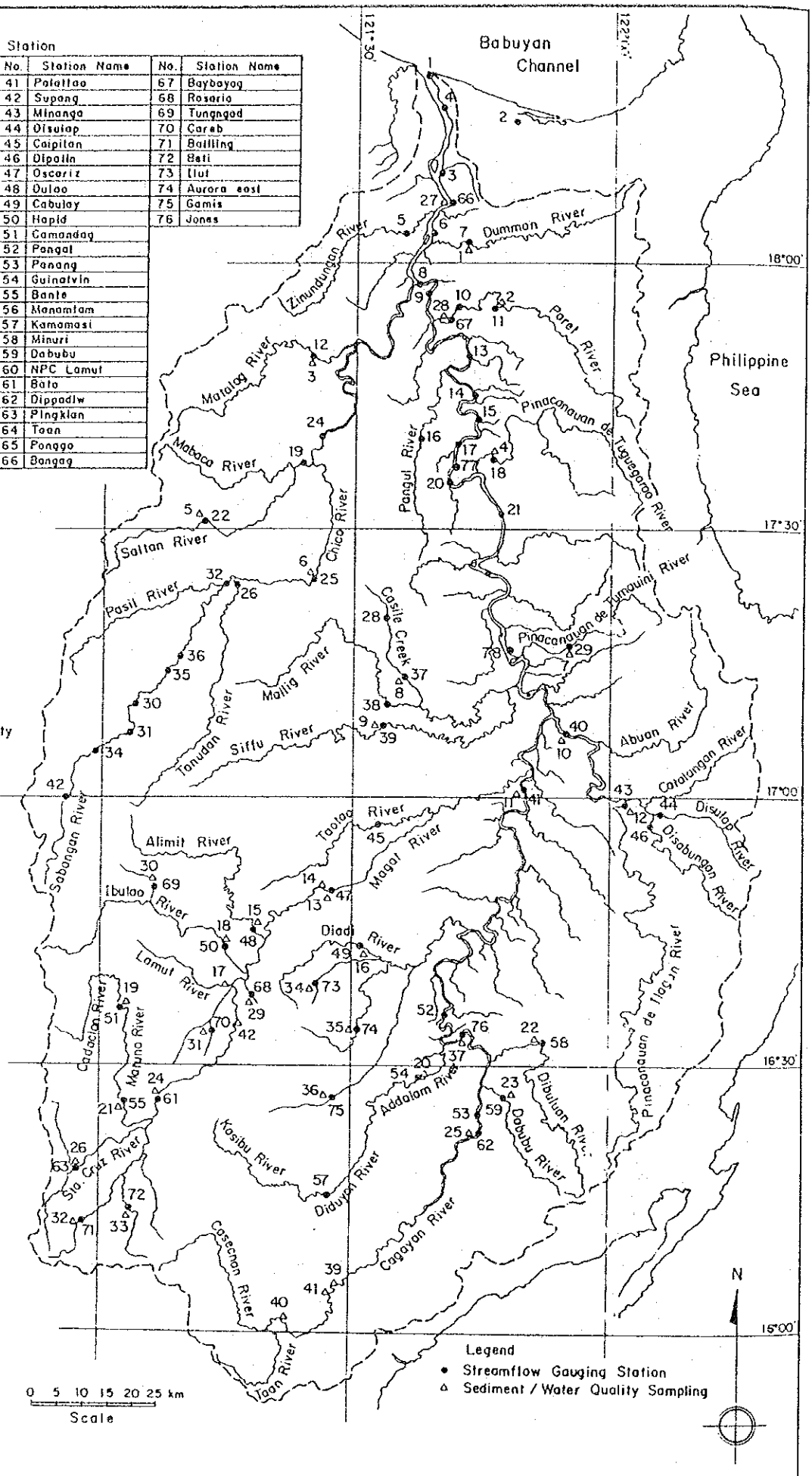


Fig. 3.1 LOCATION OF HYDROLOGICAL STATIONS

Climatological Station

No.	Station Name	No.	Station Name
1	Aparri	10	Wacal
2	Tuguegarao	11	Bontoc
3	Echague	12	Bayombong
4	Santo Domingo	13	Hapid
5	Baretbet	14	Malasin
6	Allmanao R.	15	San Isidro
7	Consuelo		
8	Baligatan		
9	Lagawe		

Rainfall Gauging Station

No.	Station Name
1	Aparri
2	Lal-lo
3	Agguneian
4	Bitag Grande
5	Imurung
6	Bauan
7	Tuao
8	Tuguegarao
9	Bagabba
10	Pinukpuk
11	Salegseg
12	Tomiangan
13	Naneng
14	Guilguiia
15	Tumauini
16	Cabagan
17	Lubuagan
18	Basao
19	Ilagan
20	Sanga-an
21	Bontoc
22	Barlig
23	Bauko
24	Reina Mercedes
25	Mt. Polis
26	Mt. Data
27	Namuldilan
28	Lagawe
29	Nayon
30	Echague
31	Diadi
32	Solano
33	Bayombong
34	Barat
35	Dupax
36	Malico
37	Imugan
38	Consuelo
39	Gabong
40	Dakgan
41	Casigurar
42	Taan
43	Upper Casecnan
44	Aurora
45	Aritao
46	Kayapa
47	Wacal
48	Banti
49	Conwap
50	Dippadiw
51	Tabayong
52	Lias
53	San Francisco
54	Cabarroguis
55	Hapid, Lamut
56	Baretbet
57	Baligatan
58	Poblacion Lagawe
59	Sto Domingo
60	Kasibu
61	Kamamosi
62	Biyoy
63	Alayan
64	Packet

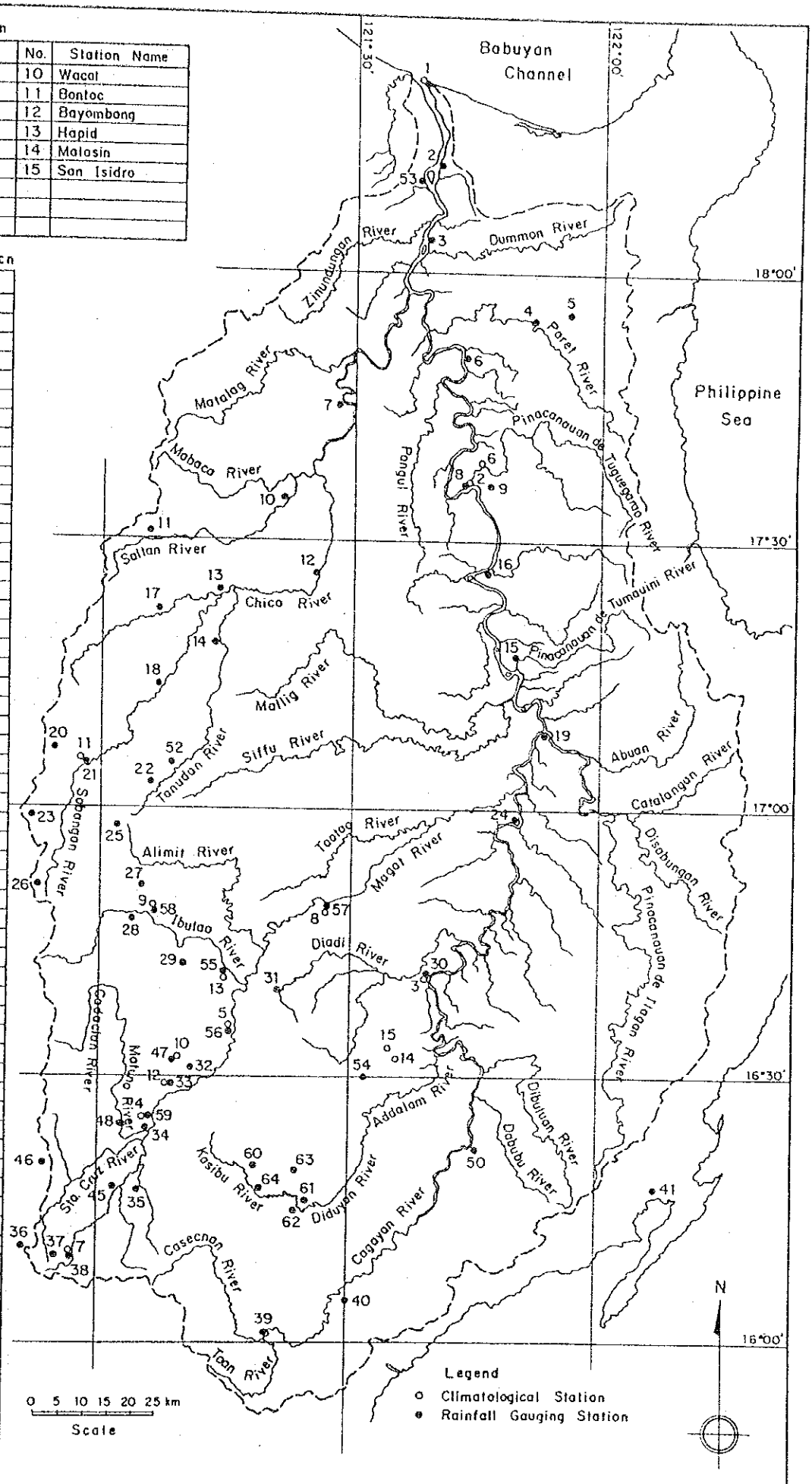
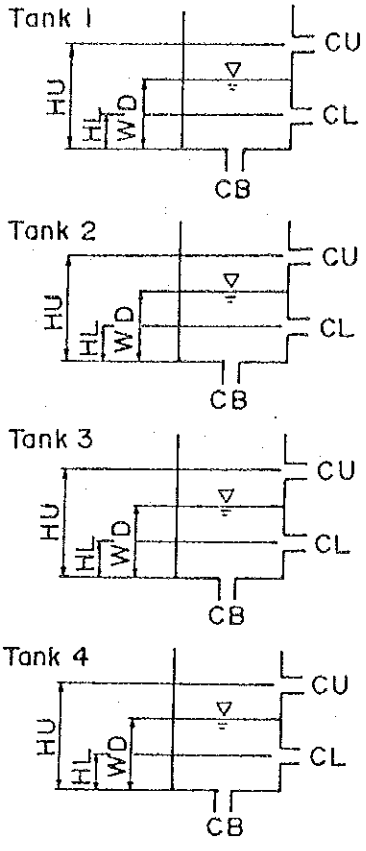


Fig. 3.2 LOCATION OF METEOROLOGICAL STATIONS



CU : Coefficient of upper hole

CL : Coefficient of lower hole

CB : Coefficient of bottom hole

HU : Height of upper hole (mm)

HL : Height of lower hole (mm)

WD : Initial water depth (mm)

Dulao				
	Tank 1	Tank 2	Tank 3	Tank 4
CU	0.35	0.04	0.02	0.0
CL	0.08	0.02	0.015	0.01
CB	0.25	0.12	0.06	0.001
HU	60	30	5	0
HL	10	10	0	0
WD	40	100	200	800

Minanga				
	Tank 1	Tank 2	Tank 3	Tank 4
CU	0.25	0.03	0.02	0.0
CL	0.10	0.02	0.015	0.014
CB	0.35	0.12	0.09	0.001
HU	60	30	10	0
HL	30	10	0	0
WD	50	150	150	600

Larion Alto				
	Tank 1	Tank 2	Tank 3	Tank 4
CU	0.30	0.07	0.03	0.0
CL	0.10	0.03	0.01	0.01
CB	0.30	0.09	0.05	0.001
HU	50	30	10	0
HL	10	10	0	0
WD	20	200	200	700

Ampawilen				
	Tank 1	Tank 2	Tank 3	Tank 4
CU	0.35	0.05	0.03	0.0
CL	0.12	0.03	0.02	0.01
CB	0.25	0.10	0.06	0.001
HU	60	30	5	0
HL	20	10	0	0
WD	10	100	200	700

Guinalvin				
	Tank 1	Tank 2	Tank 3	Tank 4
CU	0.35	0.05	0.02	0.0
CL	0.10	0.03	0.01	0.01
CB	0.35	0.15	0.07	0.001
HU	50	30	5	0
HL	10	10	0	0
WD	40	200	200	700

Pinukpuk				
	Tank 1	Tank 2	Tank 3	Tank 4
CU	0.30	0.08	0.02	0.0
CL	0.10	0.05	0.015	0.014
CB	0.30	0.15	0.12	0.001
HU	50	30	5	0
HL	10	10	0	0
WD	20	100	100	700

Fig. 3.3 TANK MODEL AND CALIBRATED COEFFICIENT

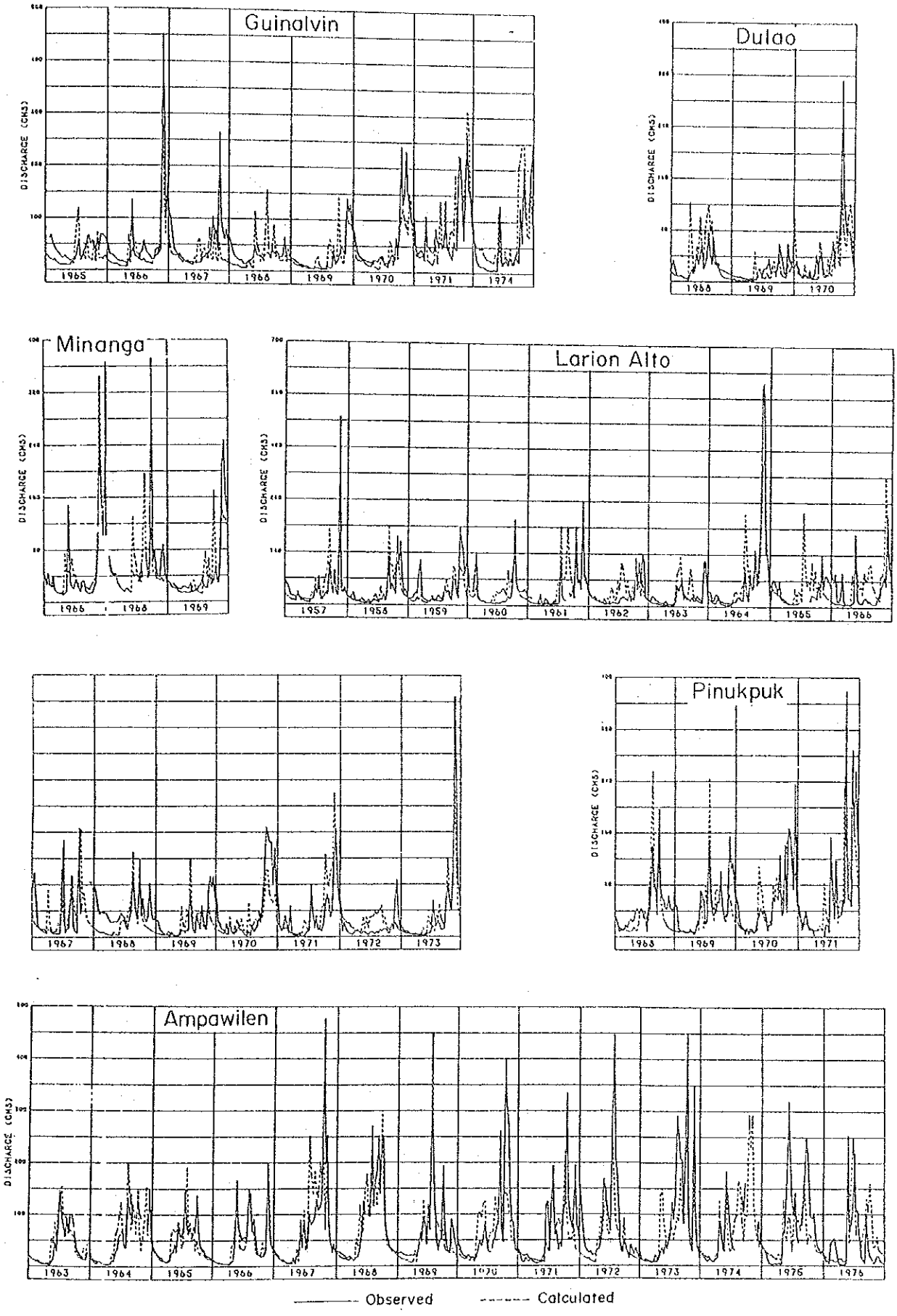


Fig. 3.4 OBSERVED AND CALCULATED RUNOFF HYDROGRAPH

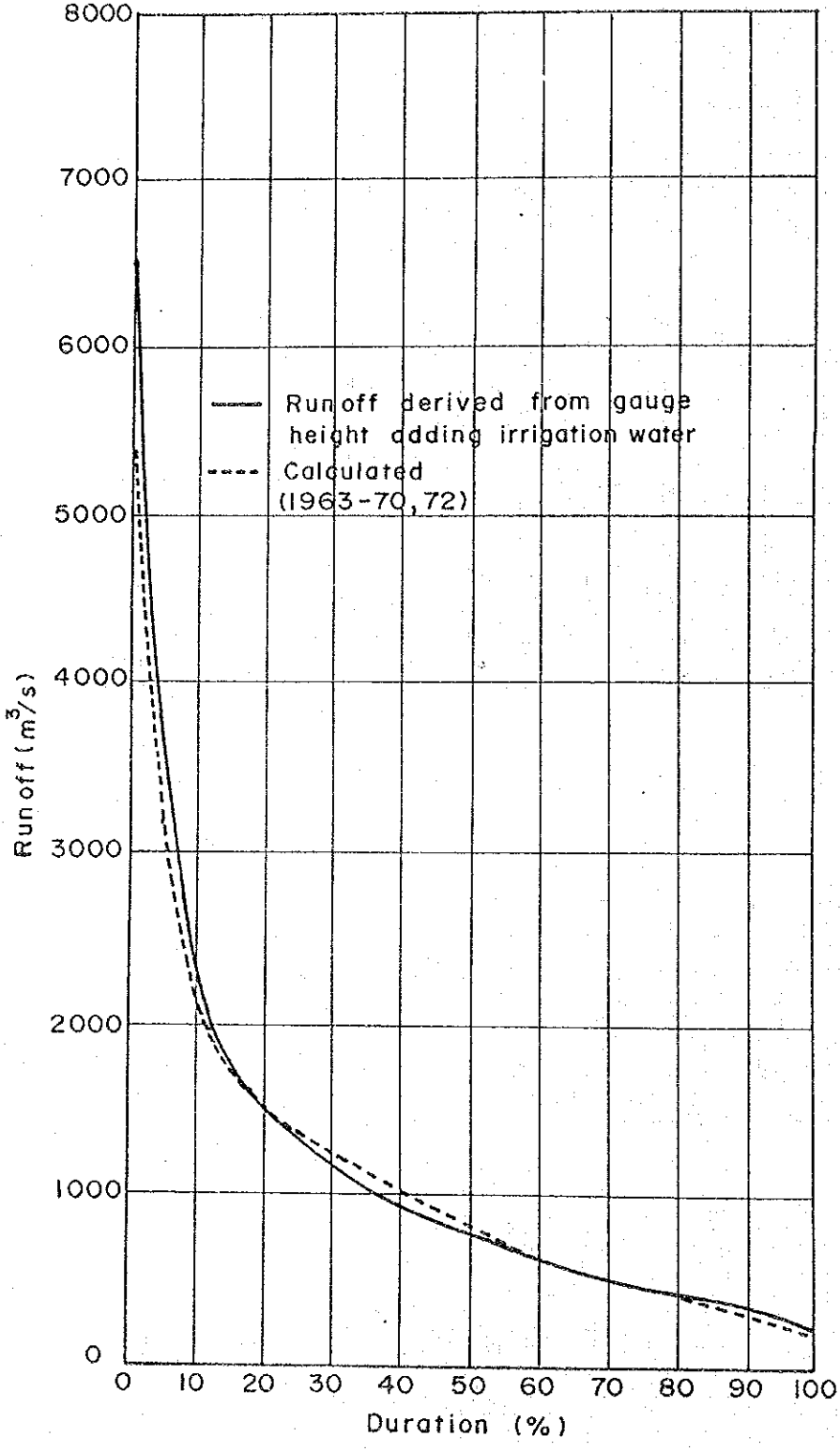


Fig. 3.5 FLOW DURATION CURVE AT NASSIPING

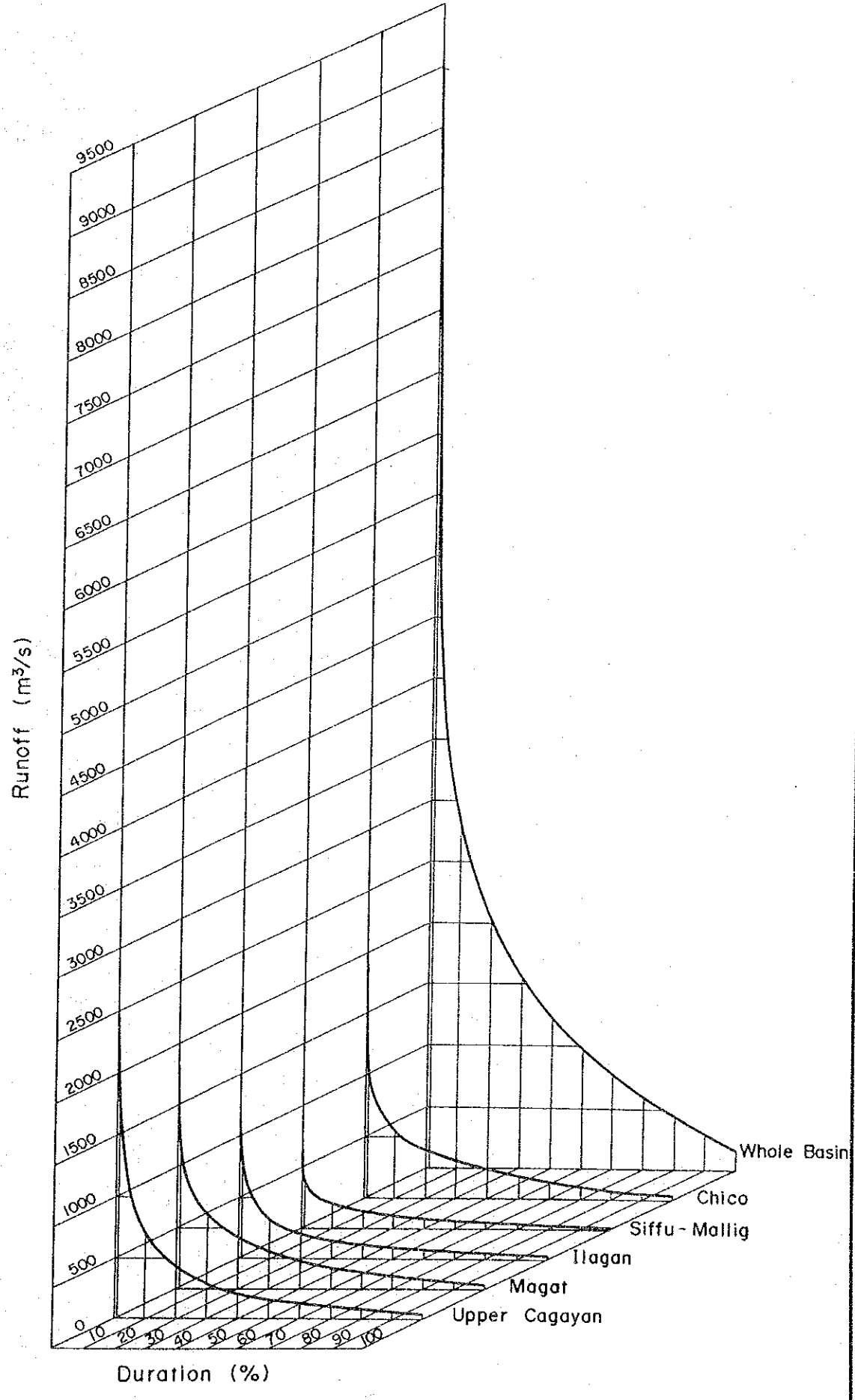


Fig. 3.6 DURATION CURVE OF ESTIMATED 10-DAY RUNOFF (1963-1984)

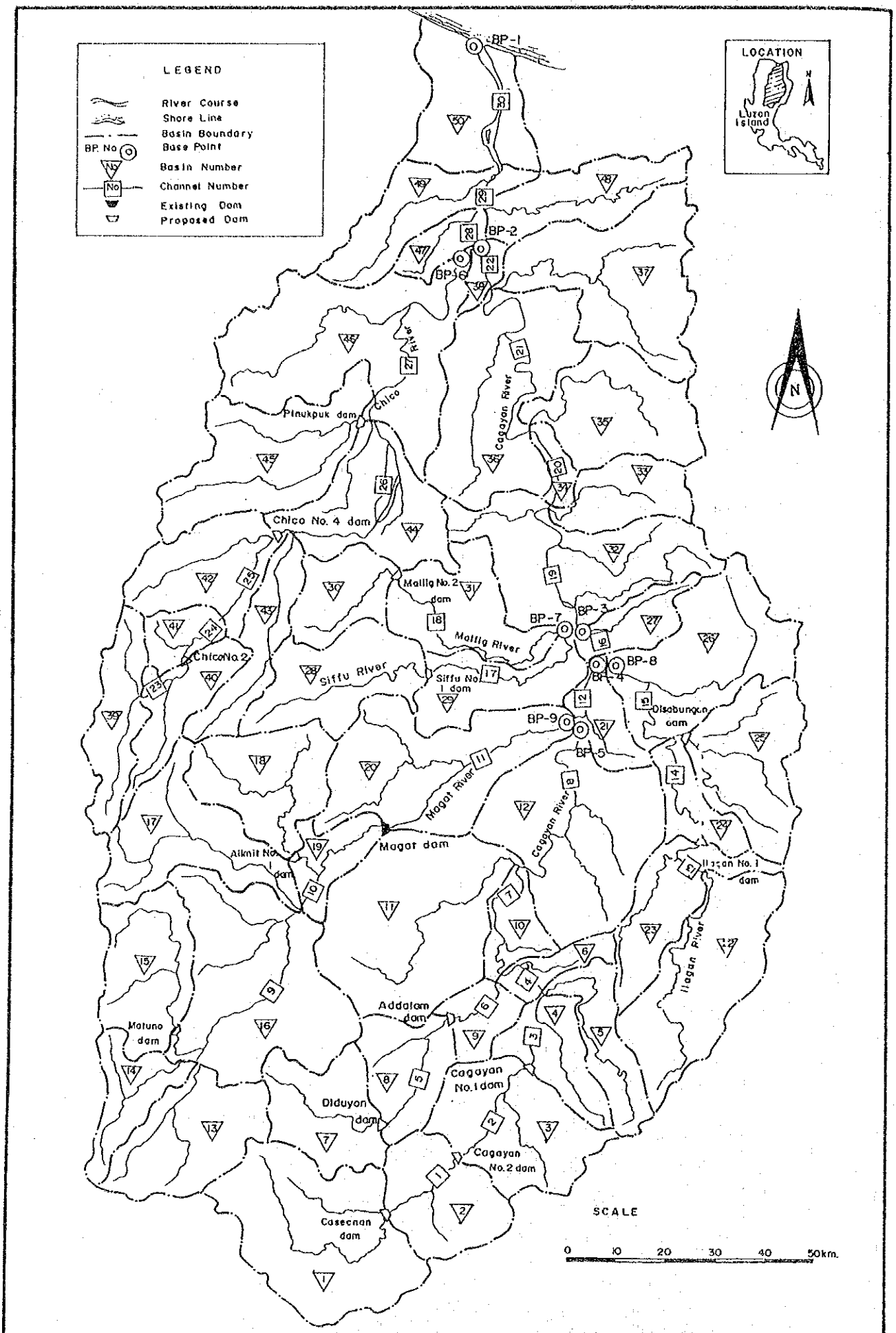
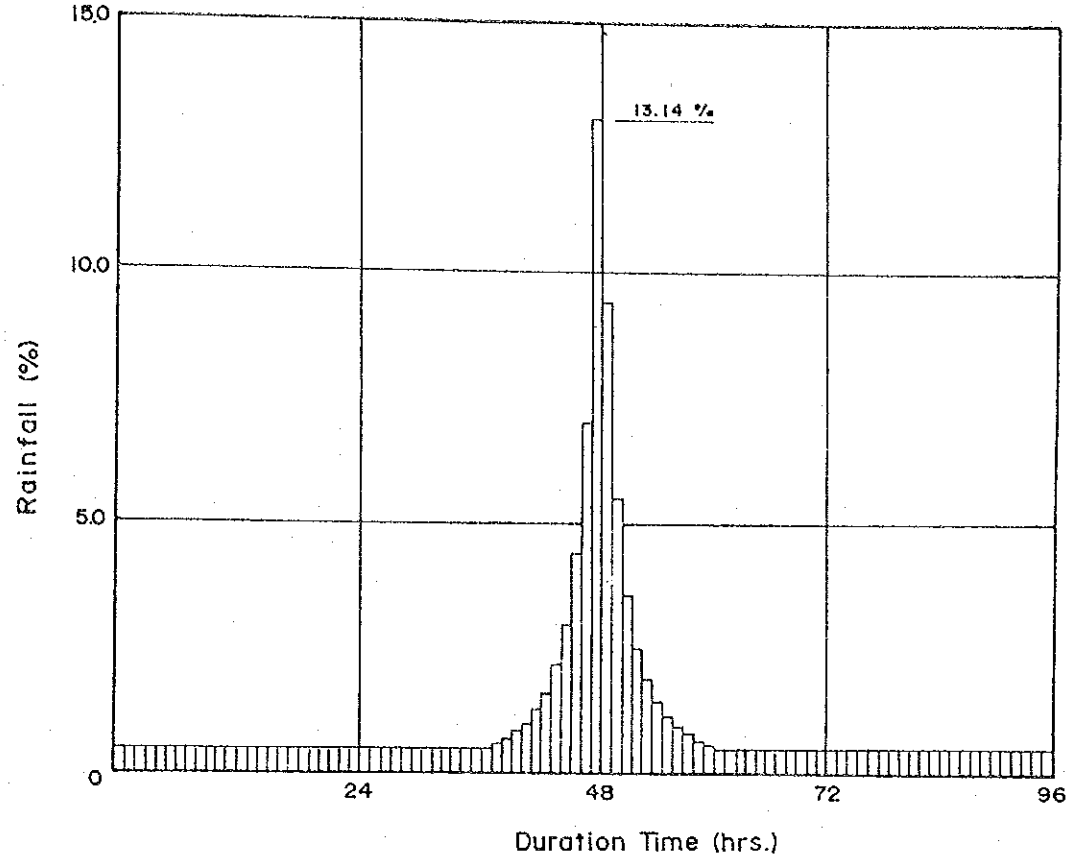


Fig. 3.7 BASIN DIVISION IN THE CAGAYAN RIVER SYSTEM



t (hr)	Rainfall (%)	t (hr)	Rainfall (%)	t (hr)	Rainfall (%)	t (hr)	Rainfall (%)
1	0.48	25	0.48	49	9.38	73	0.48
2	0.48	26	0.48	50	5.47	74	0.48
3	0.48	27	0.49	51	3.58	75	0.48
4	0.48	28	0.49	52	2.52	76	0.48
5	0.48	29	0.49	53	1.88	77	0.48
6	0.48	30	0.49	54	1.45	78	0.48
7	0.48	31	0.49	55	1.15	79	0.48
8	0.48	32	0.49	56	0.94	80	0.48
9	0.48	33	0.49	57	0.78	81	0.48
10	0.48	34	0.49	58	0.66	82	0.48
11	0.48	35	0.49	59	0.56	83	0.48
12	0.48	36	0.49	60	0.49	84	0.48
13	0.48	37	0.52	61	0.49	85	0.48
14	0.48	38	0.61	62	0.49	86	0.48
15	0.48	39	0.71	63	0.49	87	0.48
16	0.48	40	0.85	64	0.49	88	0.48
17	0.48	41	1.04	65	0.49	89	0.48
18	0.48	42	1.29	66	0.49	90	0.48
19	0.48	43	1.64	67	0.49	91	0.48
20	0.48	44	2.17	68	0.49	92	0.48
21	0.48	45	2.99	69	0.49	93	0.48
22	0.48	46	4.38	70	0.49	94	0.48
23	0.48	47	7.04	71	0.48	95	0.48
24	0.48	48	13.14	72	0.48	96	0.48

Fig. 3.8 HOURLY RAINFALL DISTRIBUTION

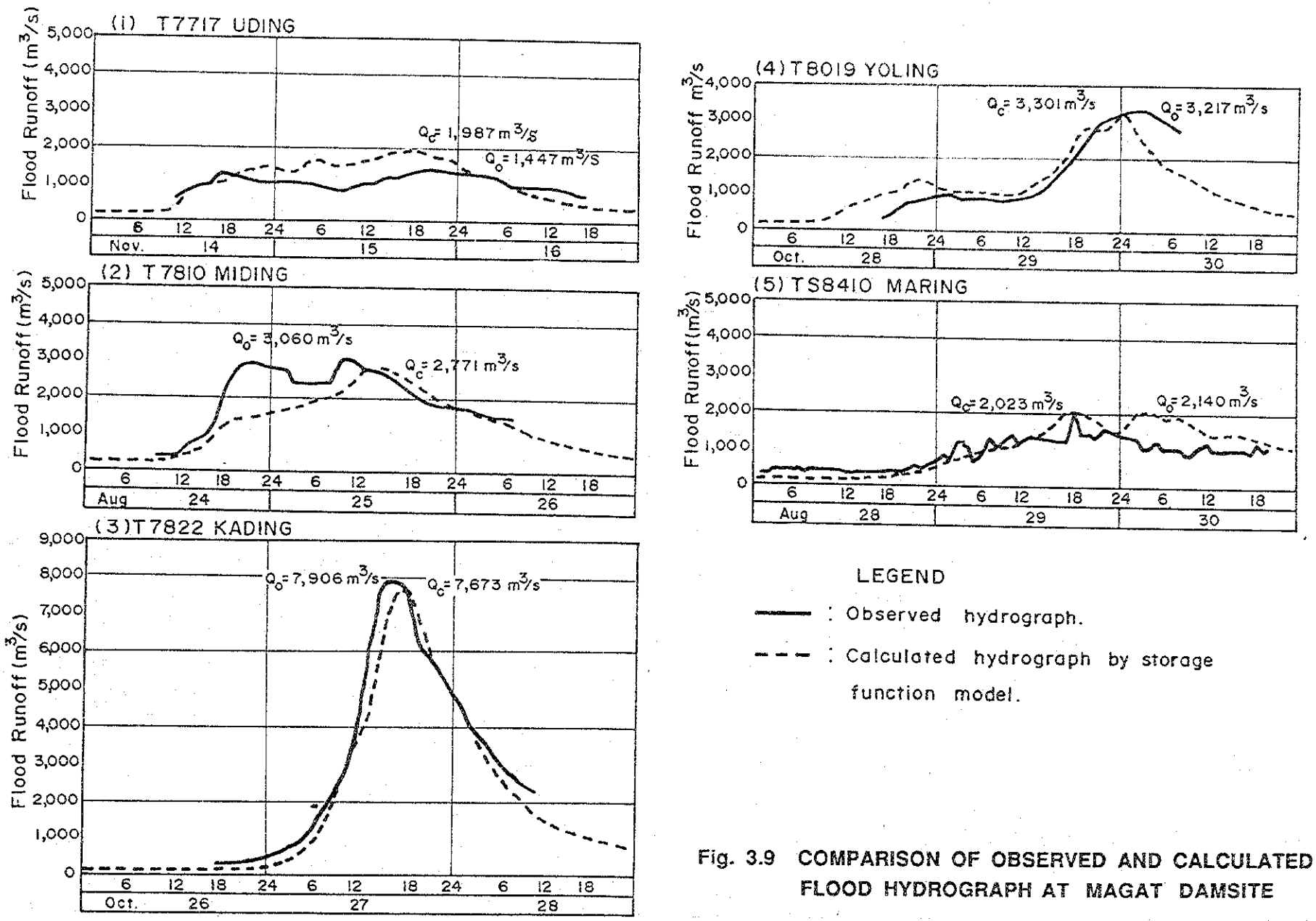
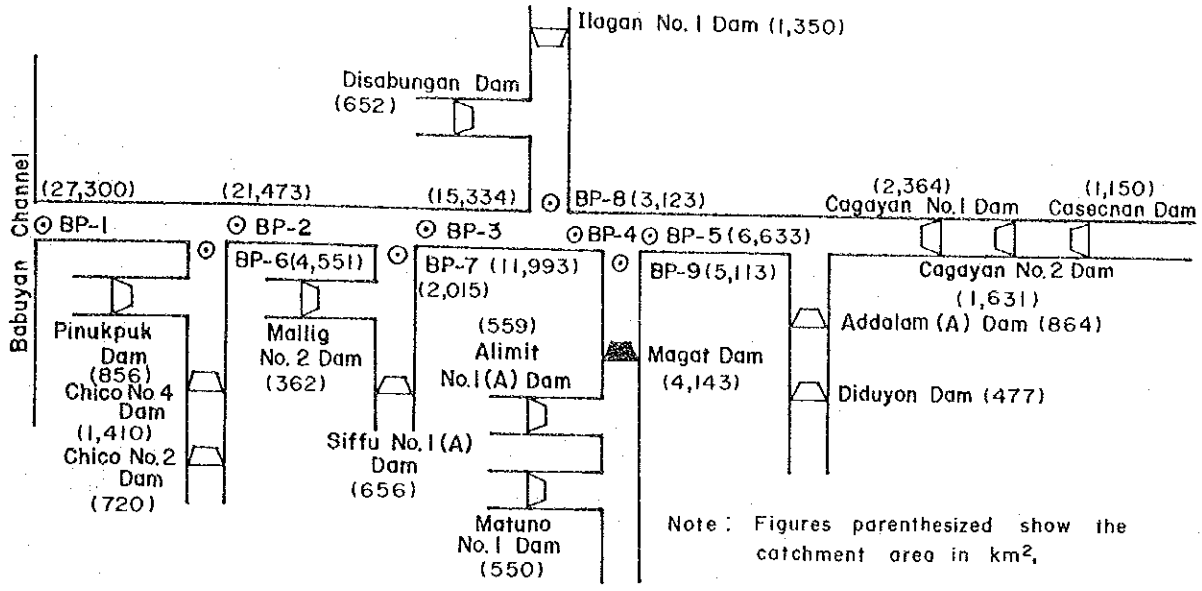


Fig. 3.9 COMPARISON OF OBSERVED AND CALCULATED FLOOD HYDROGRAPH AT MAGAT DAMSITE



Unit: m^3/s

	Base Point	1/2	1/5	1/10	1/25	1/50	1/100	1/200	1/1,000	1/10,000
Probable Flood Peak (1-day)	Casecnan	3,600	5,800	7,500	9,700	14,500	20,700	26,000	42,000	72,800
	Cagayan No.2	3,800	5,800	7,300	9,200	13,500	19,400	24,000	38,000	65,900
	Cagayan No.1	2,500	4,500	6,200	8,500	12,500	17,200	22,000	34,000	59,400
	Diduyon	1,300	2,000	2,600	3,700	5,200	7,500	9,500	14,500	25,000
	Addalam (A)	600	1,300	1,900	2,900	4,200	5,650	7,500	13,000	24,550
	Matuno No.1	750	1,050	1,300	1,550	1,800	2,050	2,300	3,000	4,150
	Alimit No.1 (A)	450	700	850	1,100	1,350	1,650	2,000	3,200	5,750
	Magat	-	-	-	-	-	-	-	-	-
	Ilagan No.1	1,750	3,200	4,300	6,350	7,600	8,950	11,500	17,000	28,050
	Disabungan	1,050	1,900	2,700	3,800	5,400	7,600	9,200	14,000	24,750
	Siffu No.1 (A)	400	700	950	1,300	1,600	1,950	2,500	4,000	7,100
	Mallig No.2	300	400	600	800	950	1,100	1,400	2,200	3,950
	Chico No.2	850	1,350	1,750	2,300	2,850	3,550	4,000	5,300	9,250
	Chico No.4	800	1,450	2,000	2,750	3,600	4,500	5,400	7,800	12,250
	Pinukpuk	700	1,200	1,600	2,200	2,700	3,150	4,000	6,300	10,700
Without Magat Dam	Base point No.1	6,200	9,900	12,000	15,700	18,100	21,400			
	Base point No.2	5,800	9,400	11,500	15,300	17,700	21,000			
	Base point No.3	6,100	10,300	12,900	17,700	20,900	25,300			
	Base point No.4	5,400	9,300	11,600	16,200	19,300	23,500			
	Base point No.5	3,300	5,900	7,200	10,100	12,500	14,700			
	Base point No.6	2,000	3,000	3,800	5,200	7,500	8,700			
	Base point No.7	1,200	1,600	2,000	2,700	3,000	3,300			
	Base point No.8	2,000	3,400	4,700	6,700	7,600	9,400			
	Base point No.9	2,700	4,500	6,000	7,200	9,500	10,600			
With Magat Dam	Base point No.1	6,200	9,700	11,600	15,000	17,300	20,300			
	Base point No.2	5,700	9,300	11,200	14,600	16,900	19,900			
	Base point No.3	6,100	9,800	12,000	16,100	19,000	22,600			
	Base point No.4	5,500	9,000	10,900	14,700	17,600	21,000			
	Base point No.5	3,300	5,900	7,200	10,100	12,500	14,700			
	Base point No.6	2,000	3,000	3,800	5,200	7,500	8,700			
	Base point No.7	1,200	1,600	2,000	2,700	3,000	3,300			
	Base point No.8	2,000	3,400	4,700	6,700	7,600	9,400			
	Base point No.9	2,500	3,500	4,300	5,000	6,300	7,000			

Fig. 3.10 PROBABLE FLOOD PEAK RUNOFF DISTRIBUTION UNDER THE PRESENT RIVER CONDITION

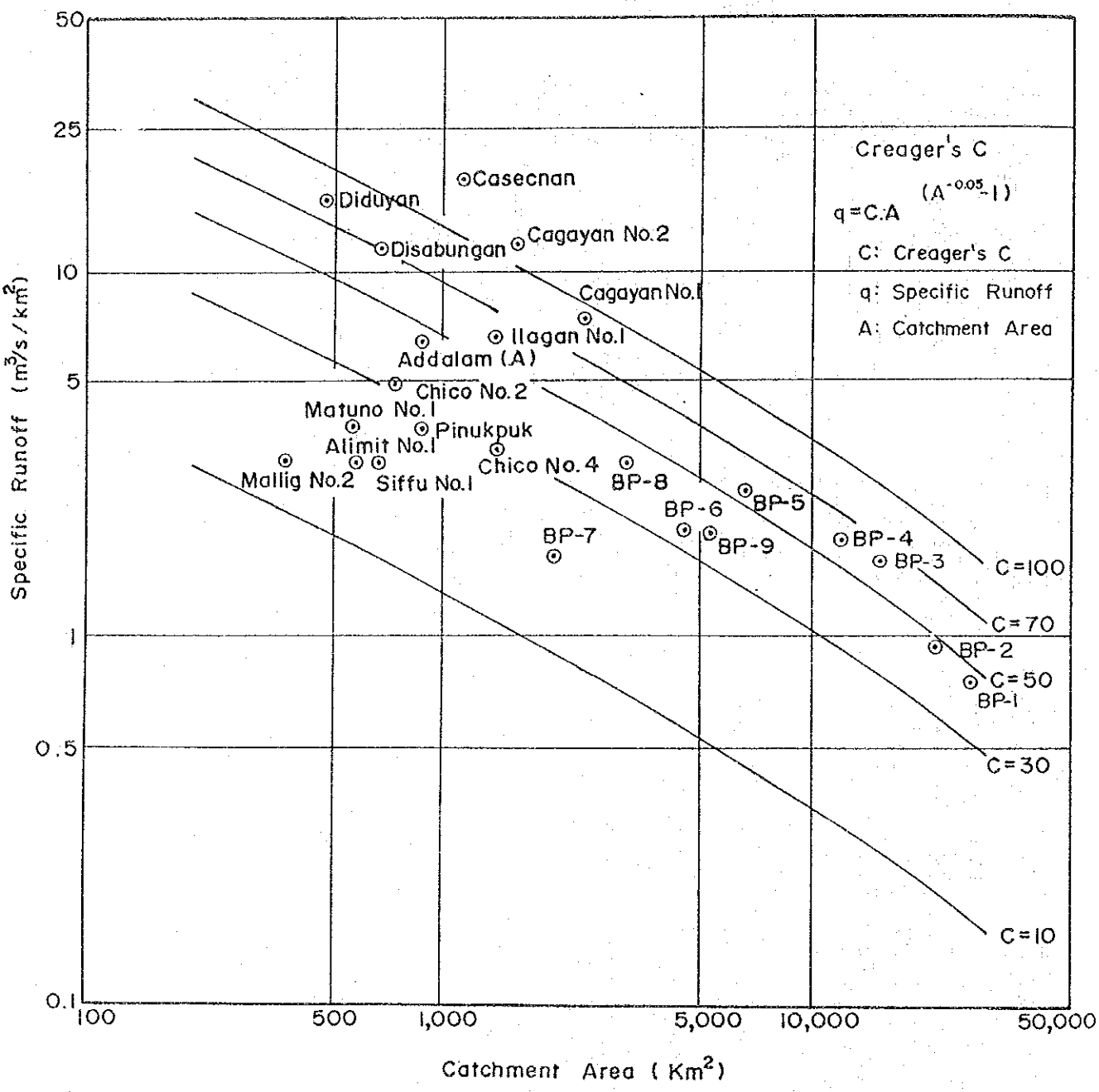
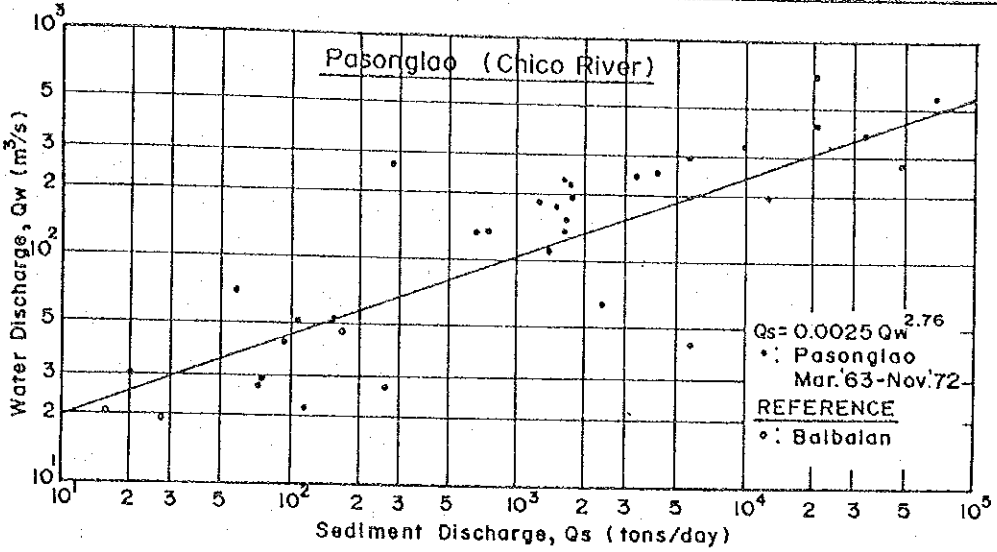
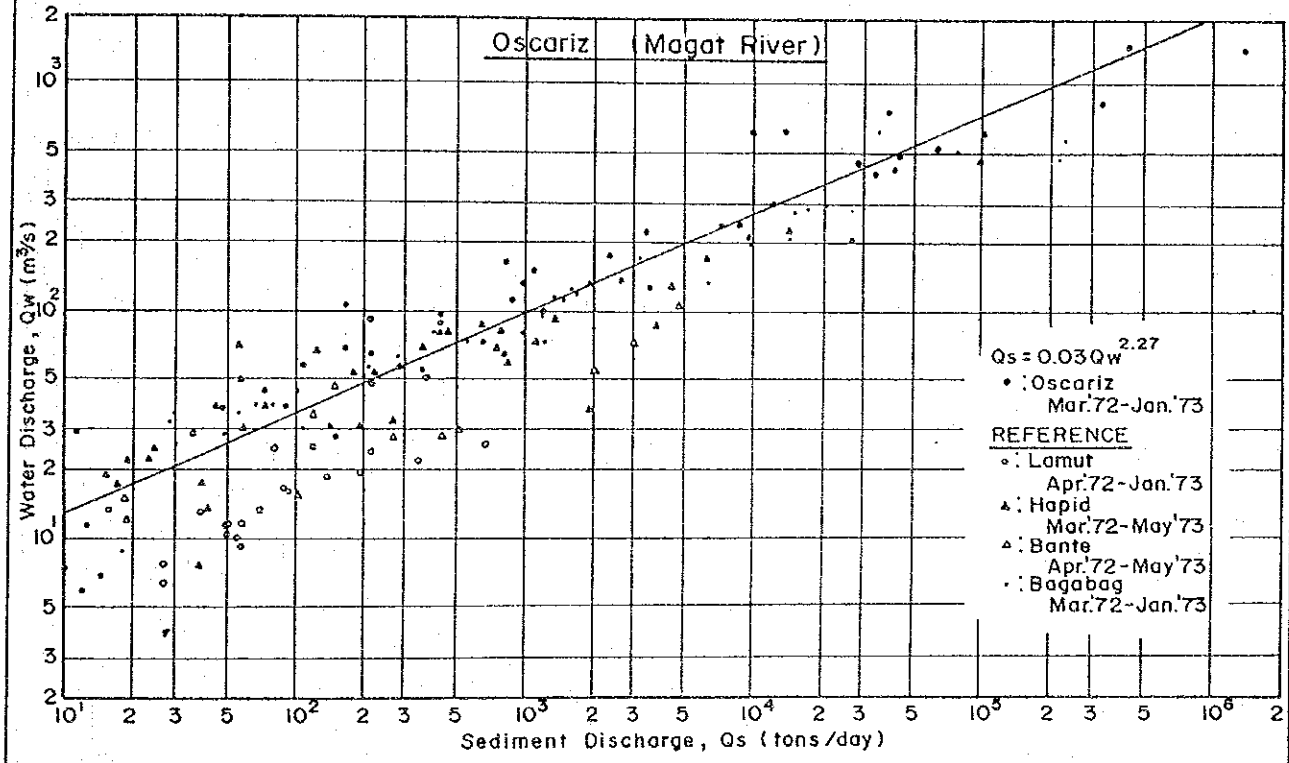


Fig. 3.11 SPECIFIC FLOOD PEAK RUNOFF (100-YR)





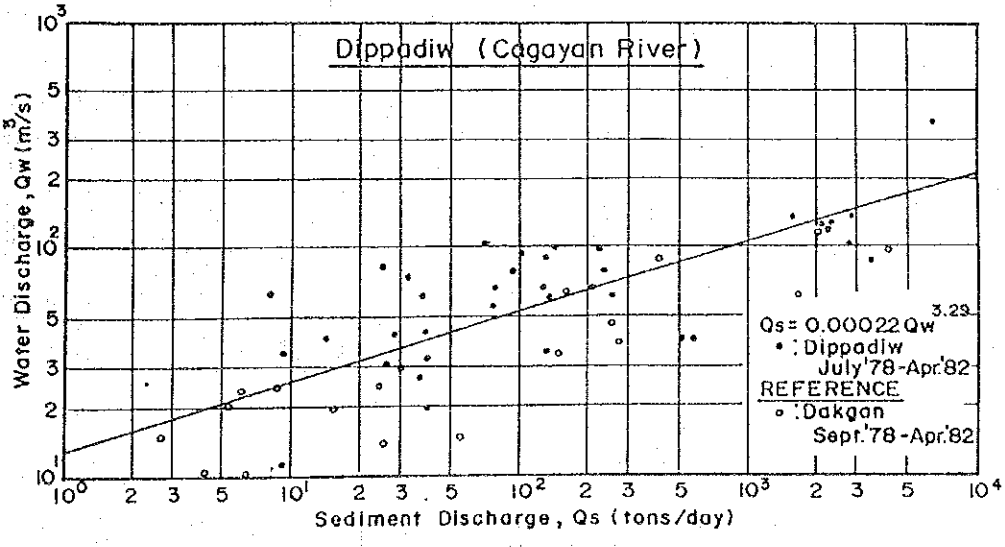


Fig. 3.12 SEDIMENT RATING CURVE IN THE CAGAYAN RIVER

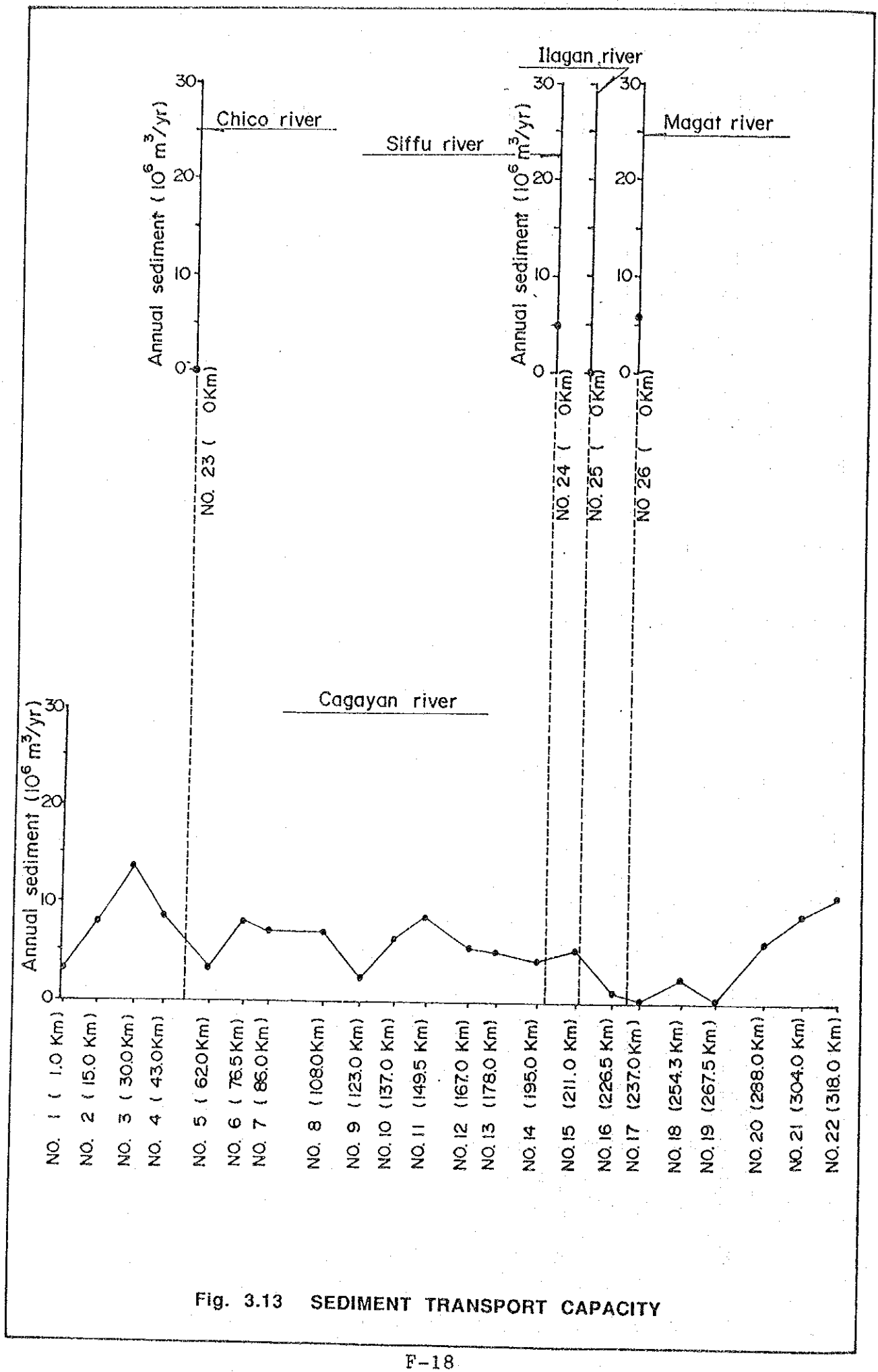


Fig. 3.13 SEDIMENT TRANSPORT CAPACITY

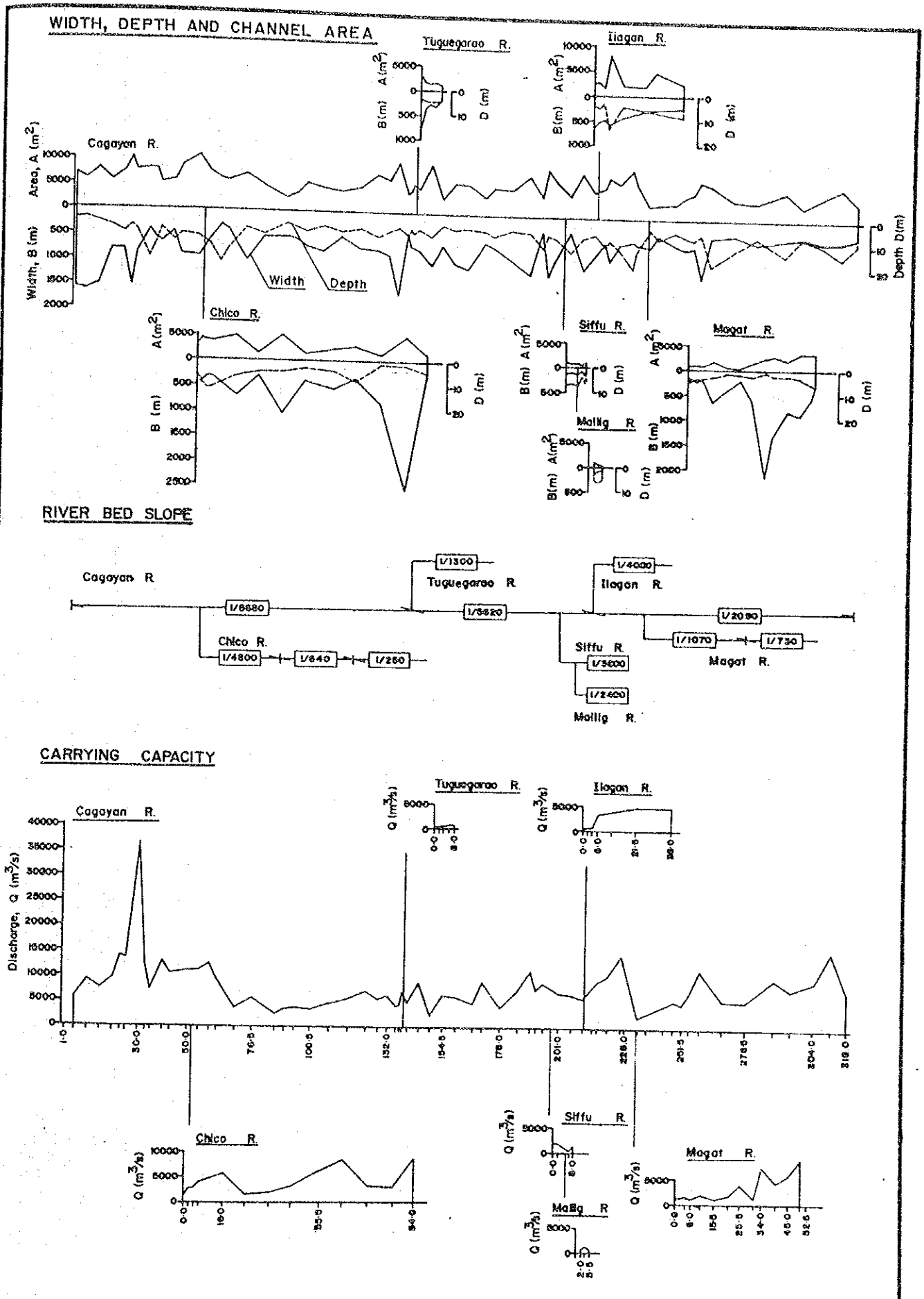


Fig. 5.1 CHARACTERISTICS OF EXISTING RIVER CHANNELS

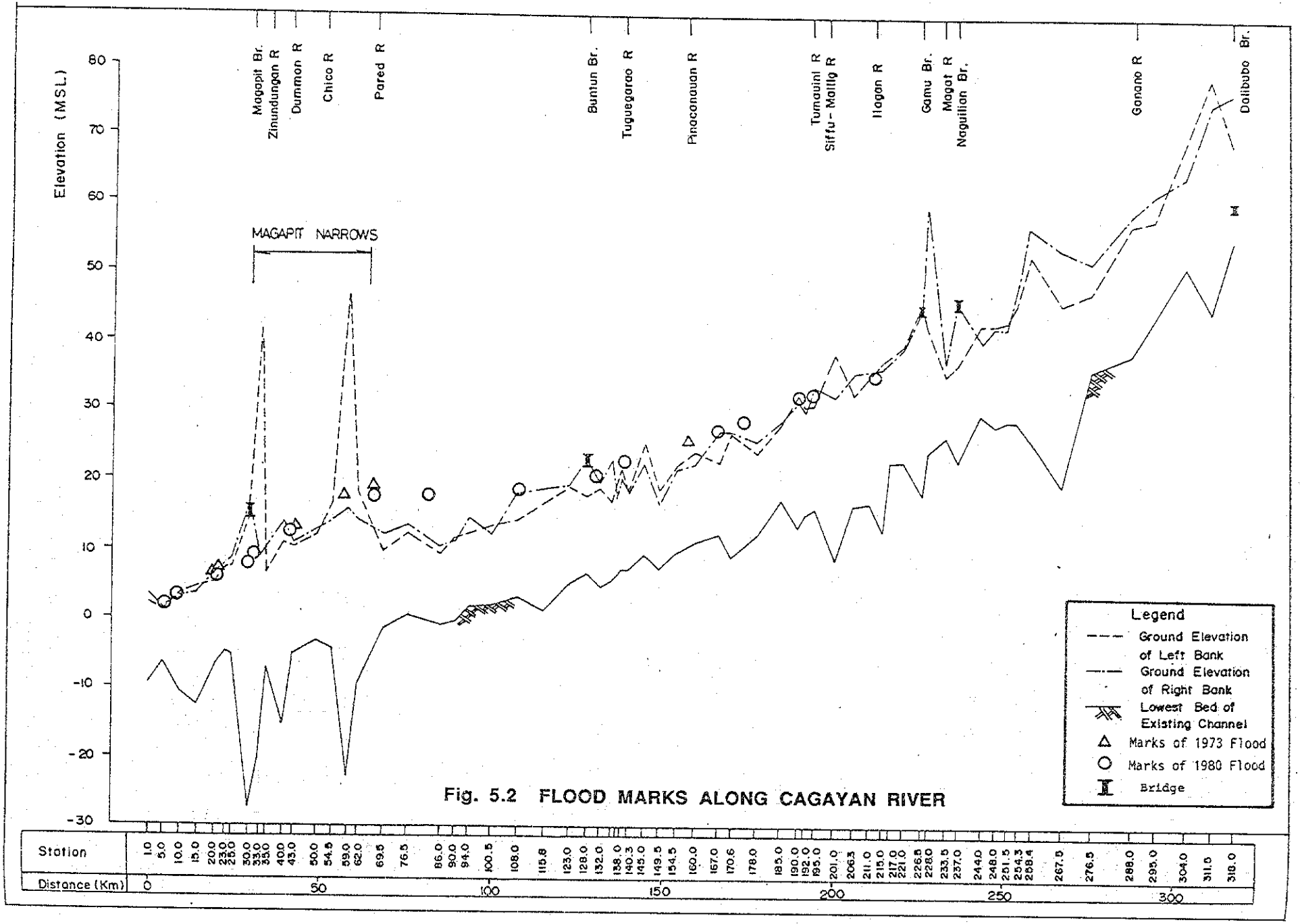


Fig. 5.2 FLOOD MARKS ALONG CAGAYAN RIVER

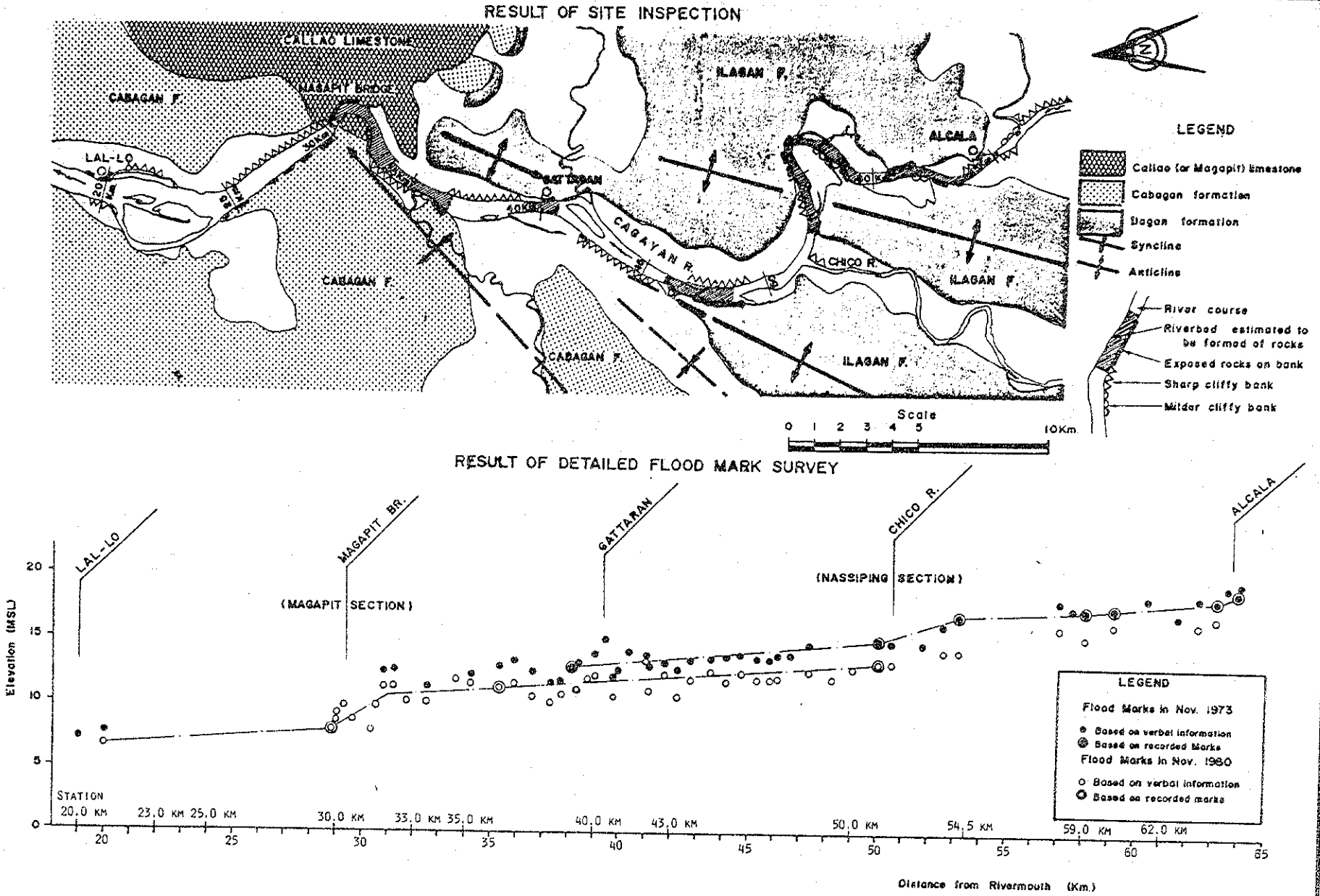


Fig. 5.3 CONDITION OF MAGAPIT NARROWS

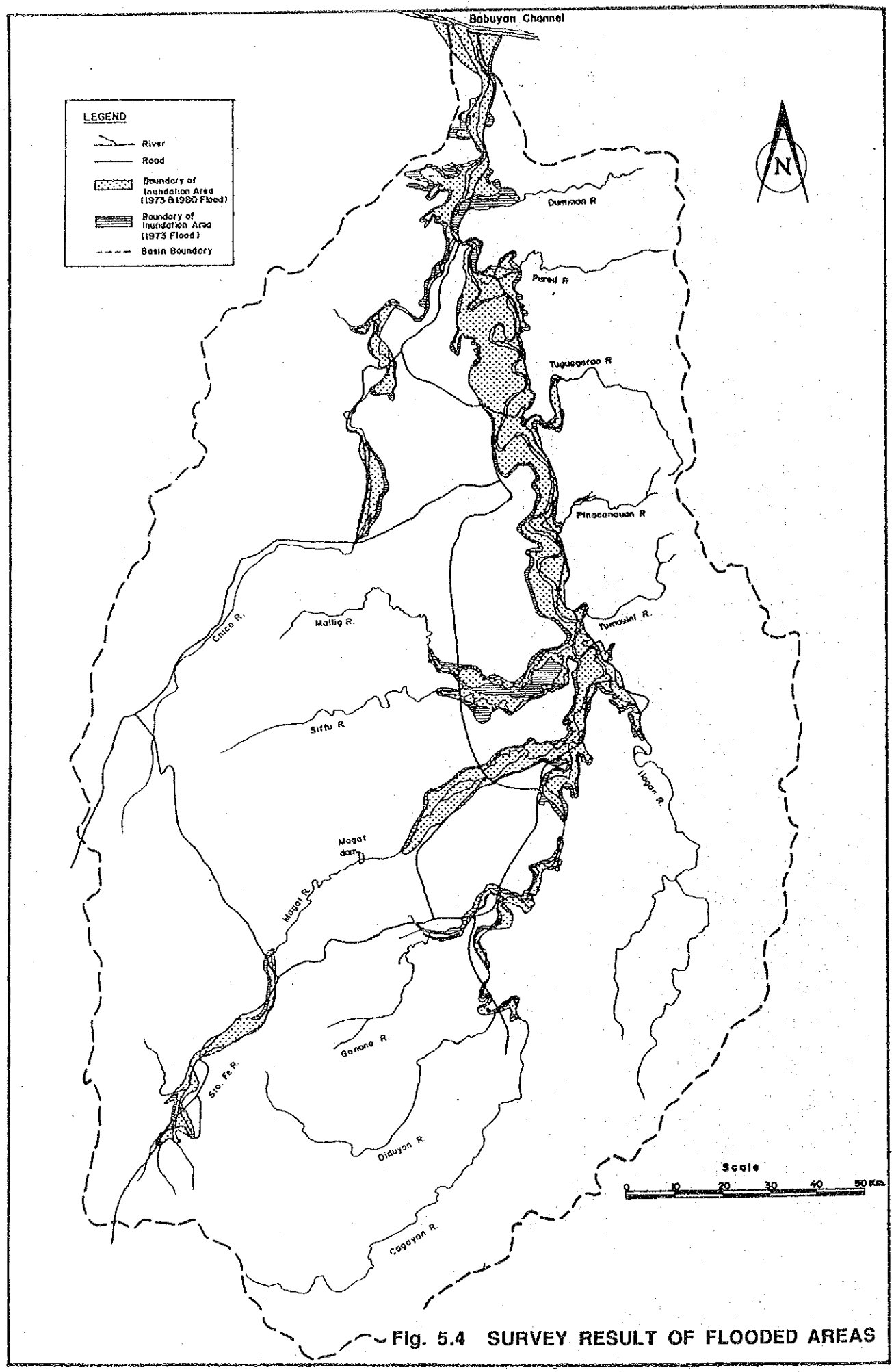


Fig. 5.4 SURVEY RESULT OF FLOODED AREAS

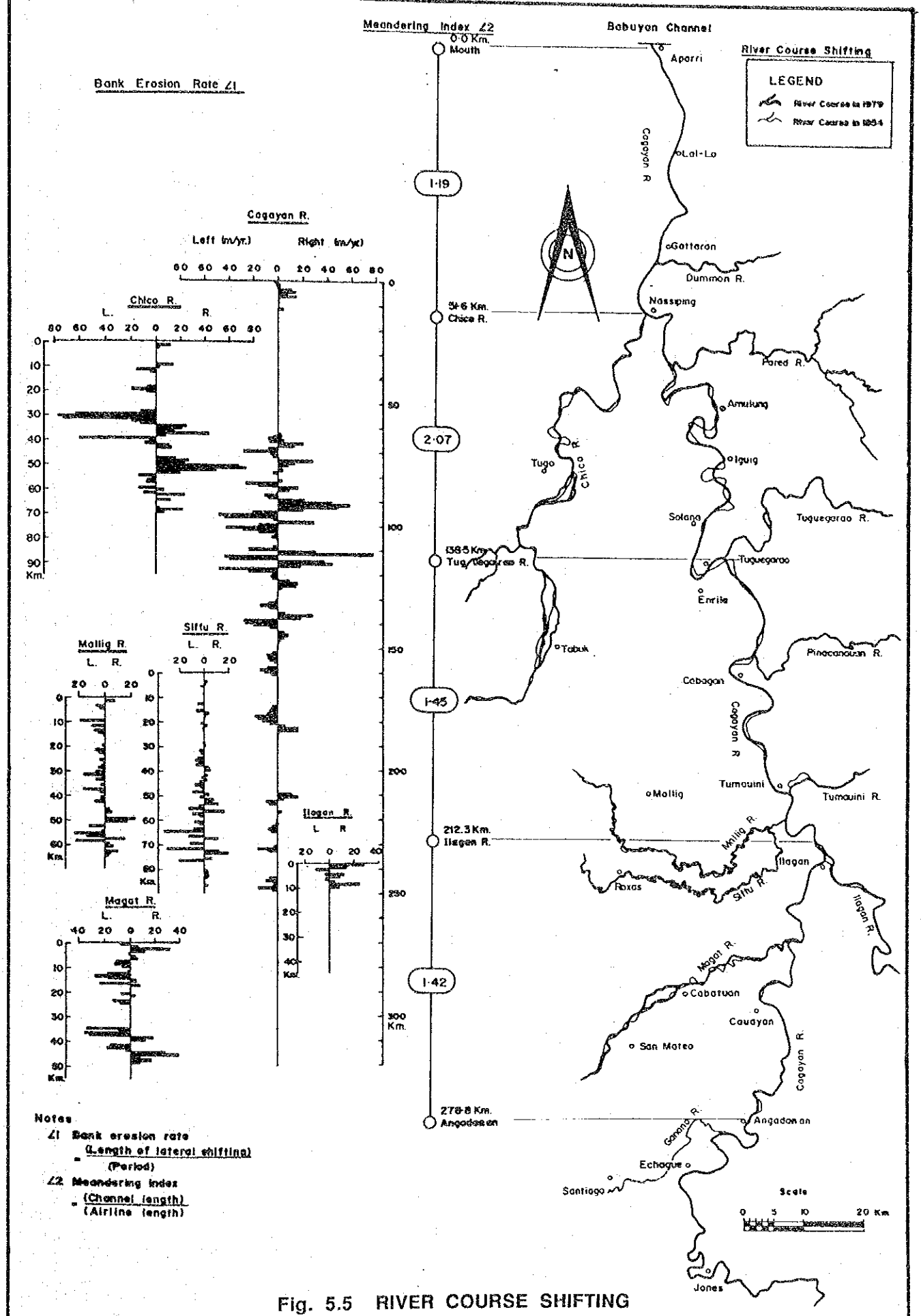


Fig. 5.5 RIVER COURSE SHIFTING

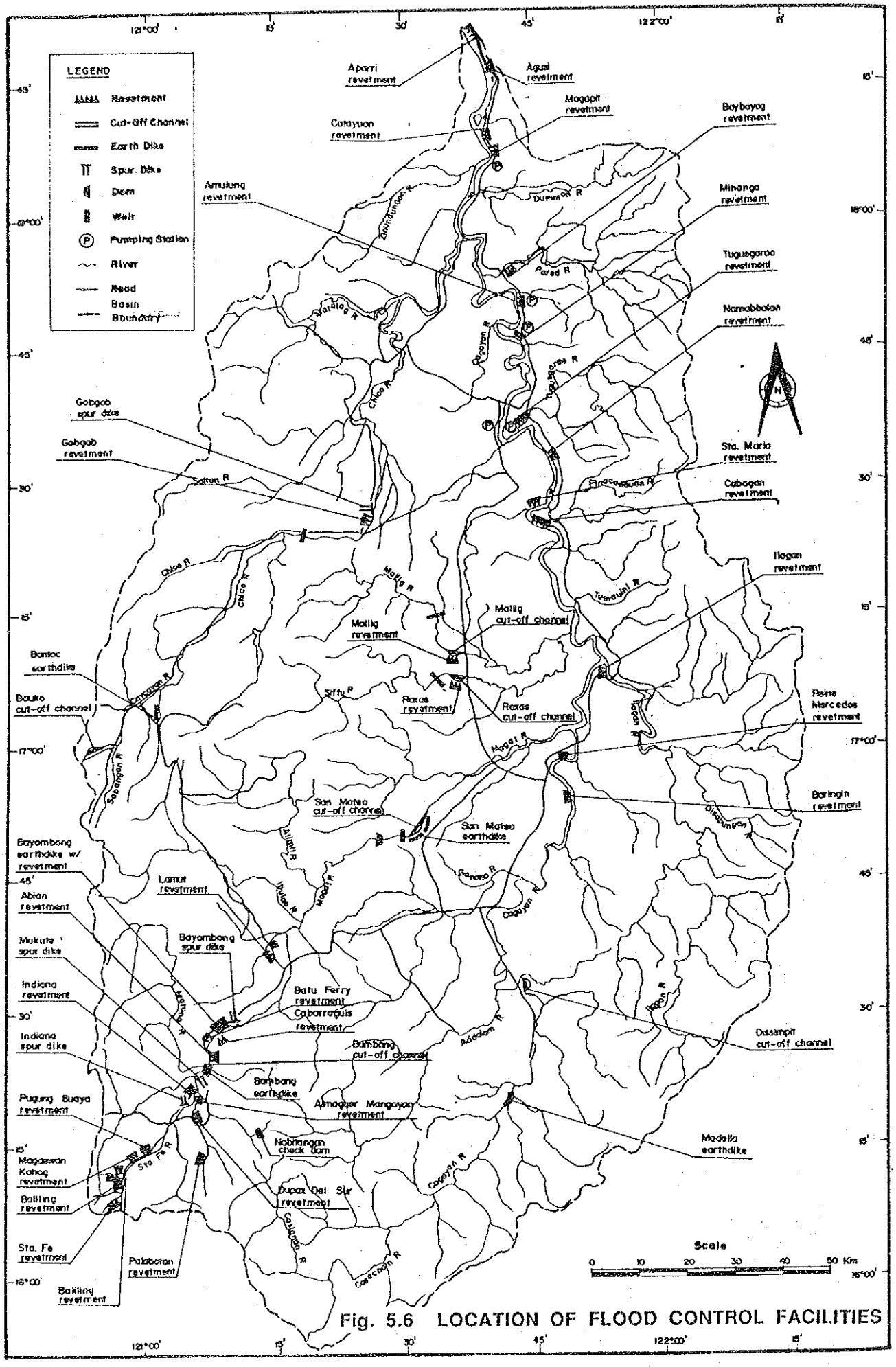


Fig. 5.6 LOCATION OF FLOOD CONTROL FACILITIES

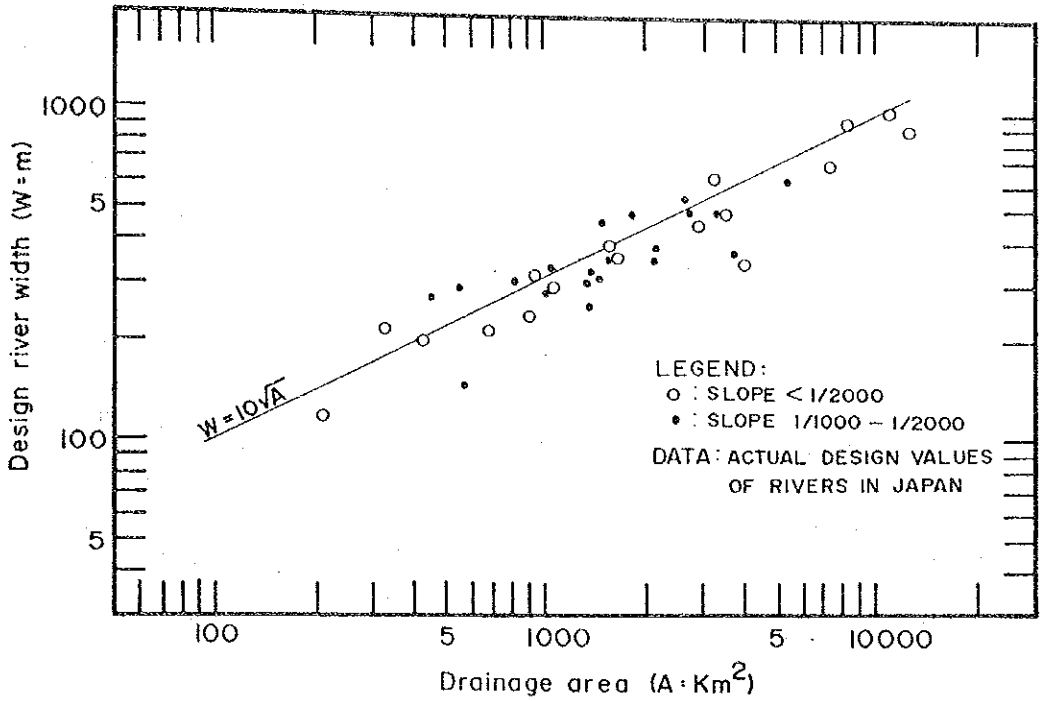
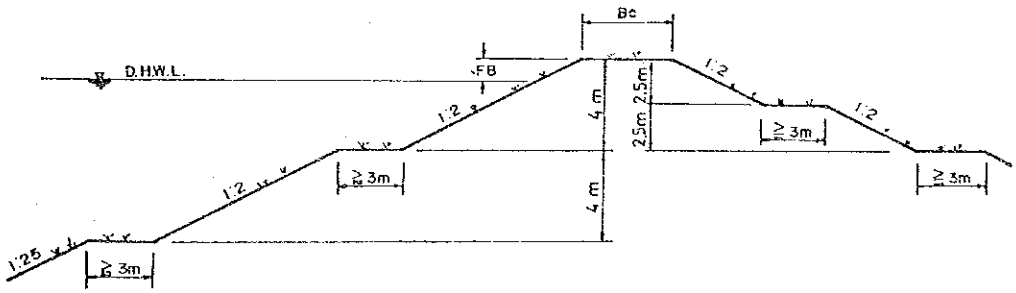


Fig. 5.7 RELATIONSHIP BETWEEN DESIGN RIVER WIDTH AND DRAINAGE AREA



Design Discharge Q (m/3)	Free-board FB (m) not less than	Crown width Bc (m) not less than
< 200	0.6	3
200 to 500	0.8	3
500 to 2,000	1.0	4
2,000 to 5,000	1.2	5
5,000 to 10,000	1.5	6
10,000 <	2.0	7

Fig. 5.8 STANDARD DIKE SECTION

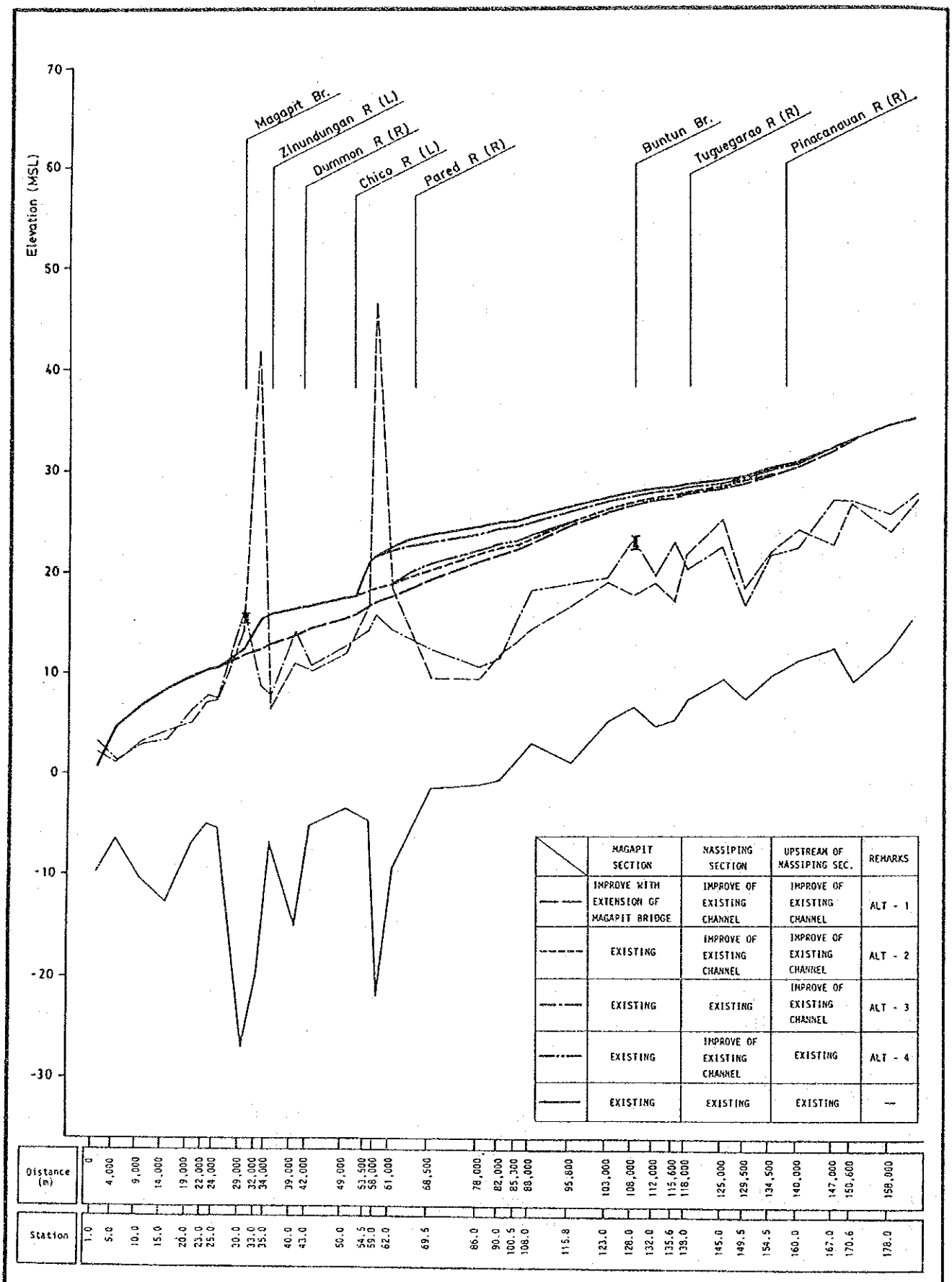


Fig. 5.9 LONGITUDINAL PROFILE FOR MAGAPIT NARROW IMPROVEMENT

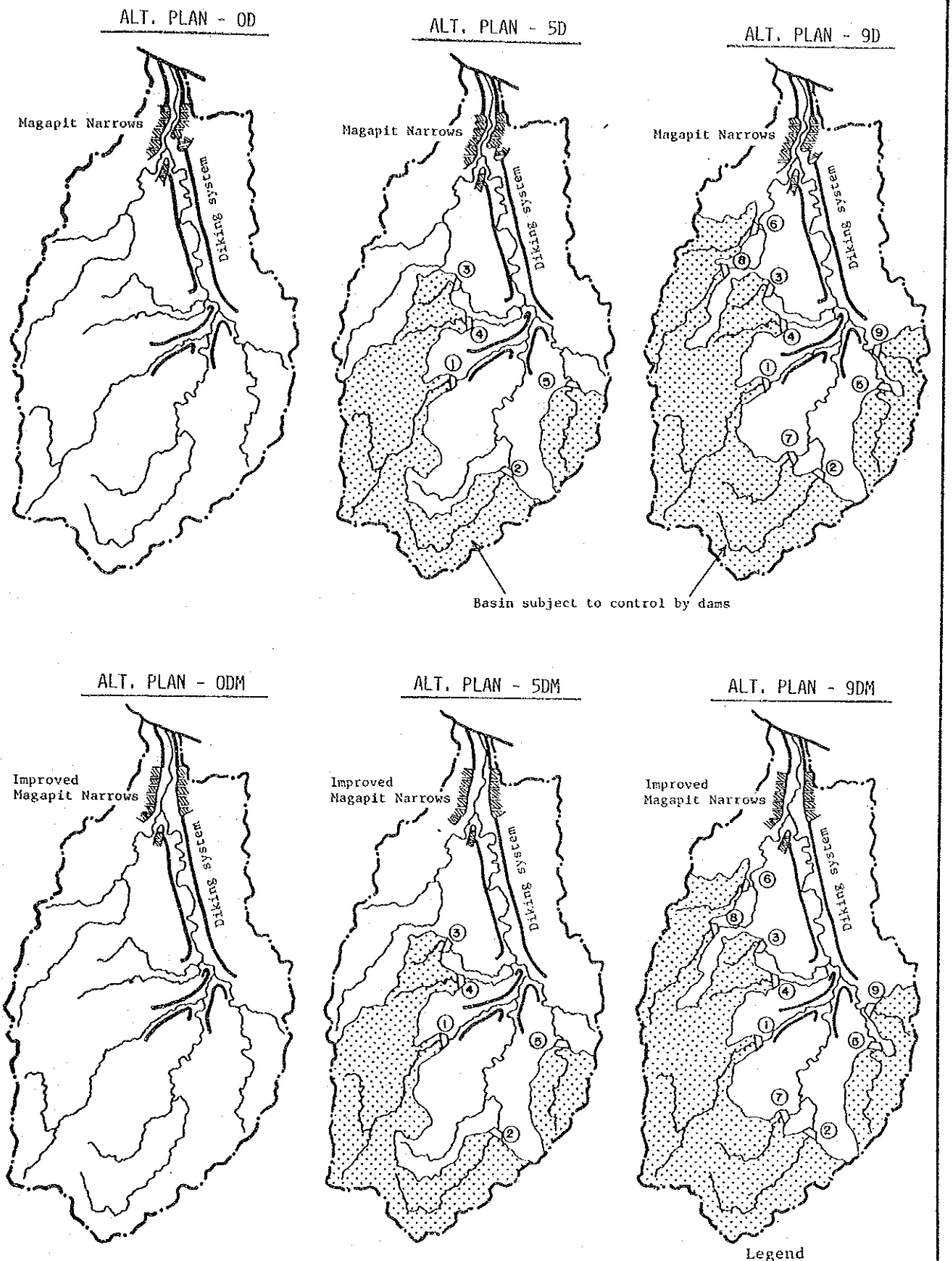


Fig. 5.10 ALTERNATIVE FLOOD CONTROL FRAMEWORK PLANS

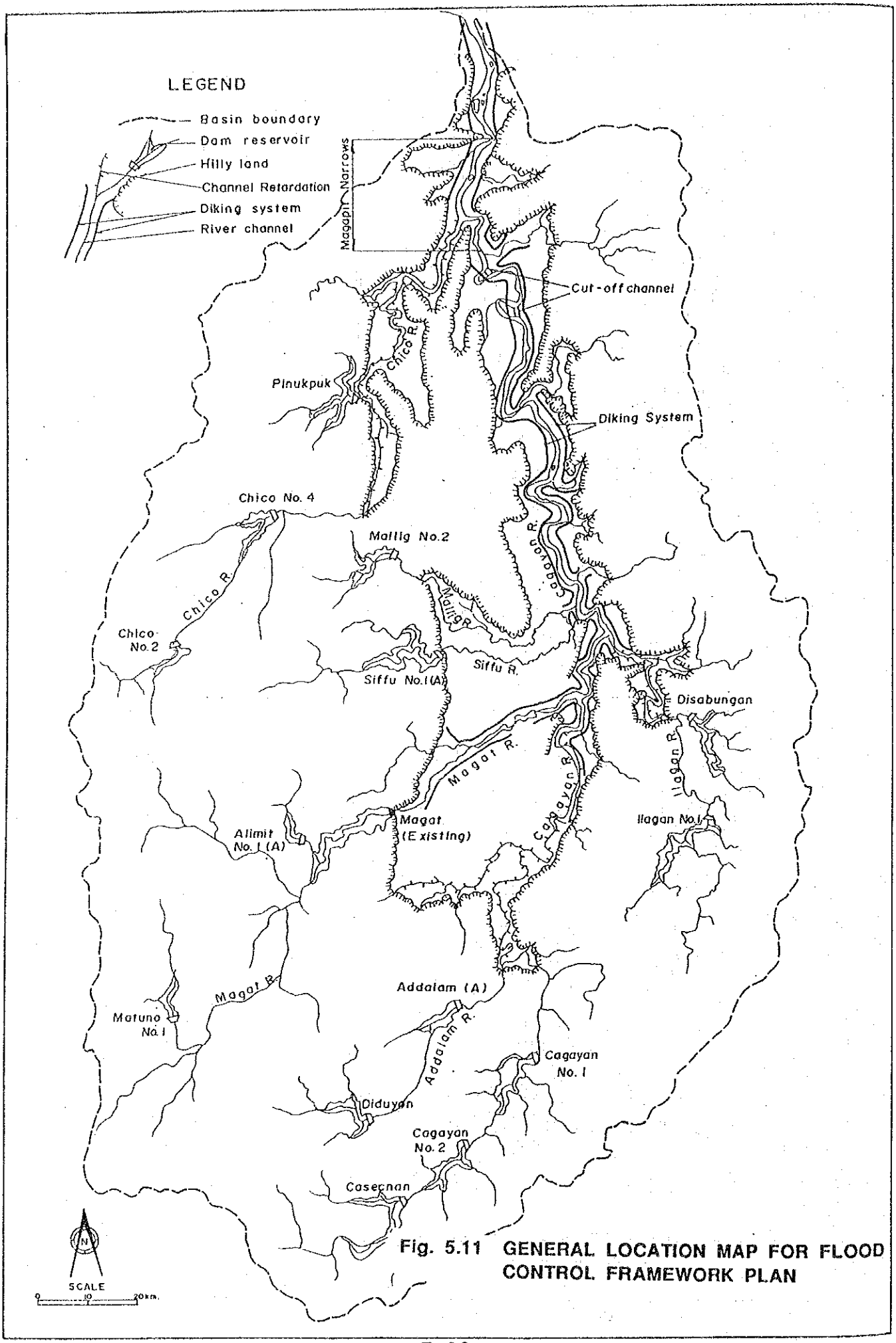


Fig. 5.11 GENERAL LOCATION MAP FOR FLOOD CONTROL FRAMEWORK PLAN

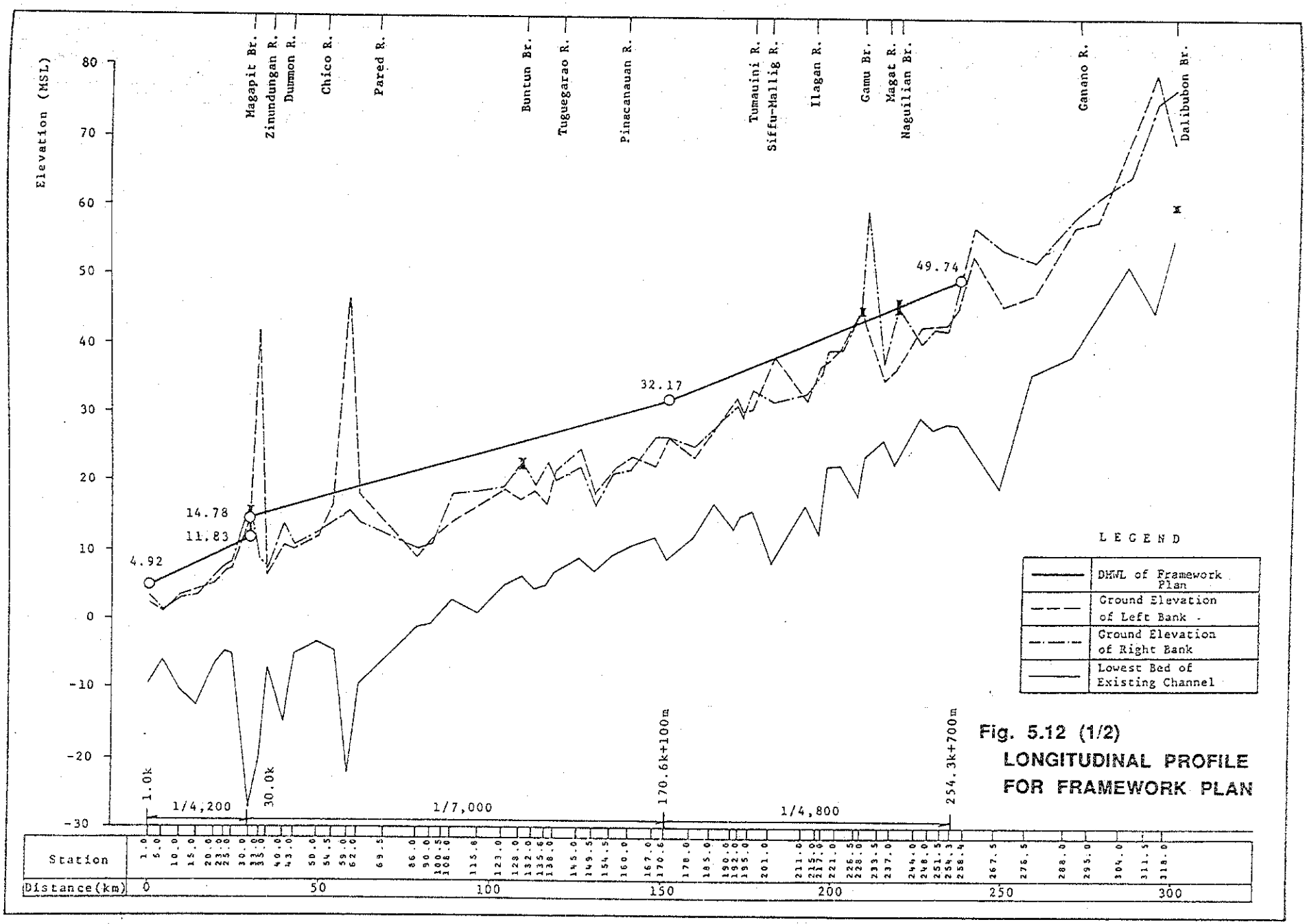
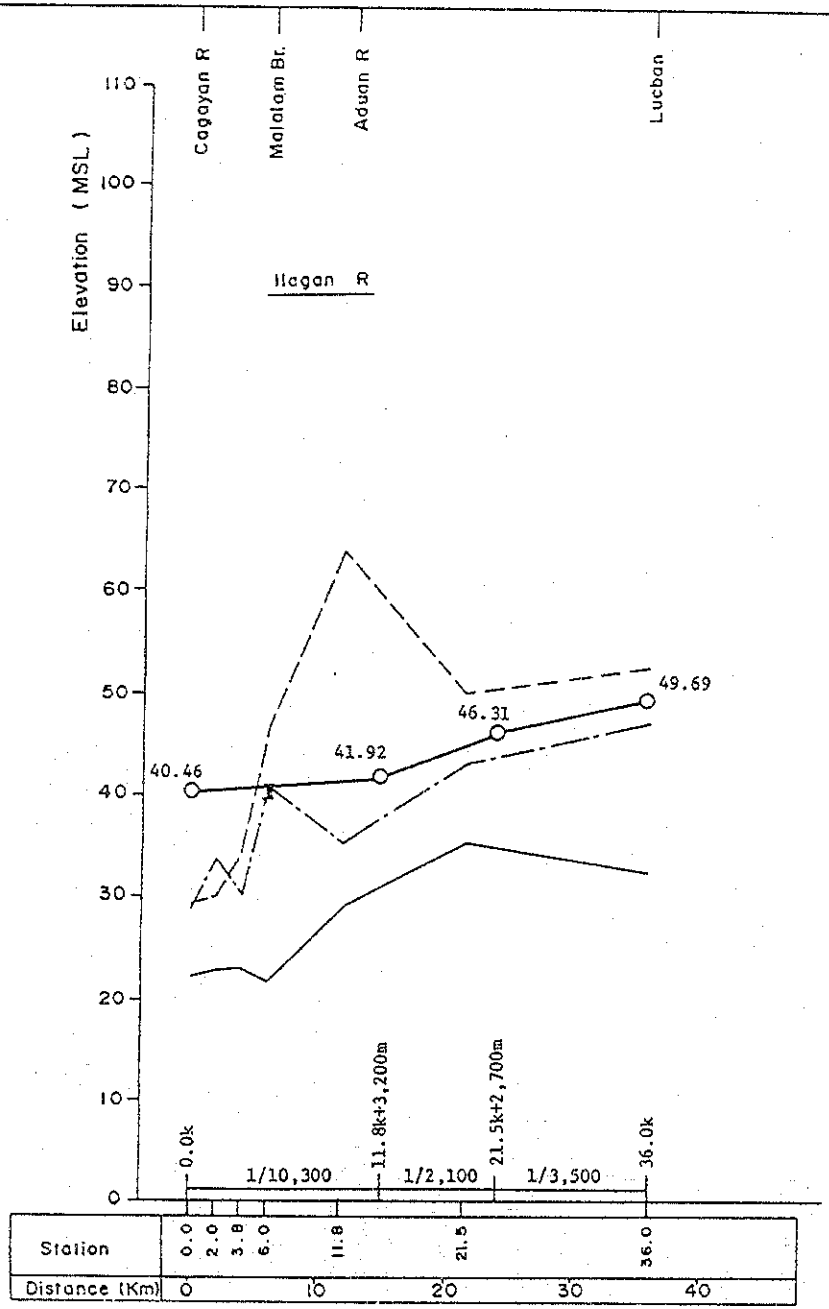


Fig. 5.12 (1/2)
LONGITUDINAL PROFILE
FOR FRAMEWORK PLAN



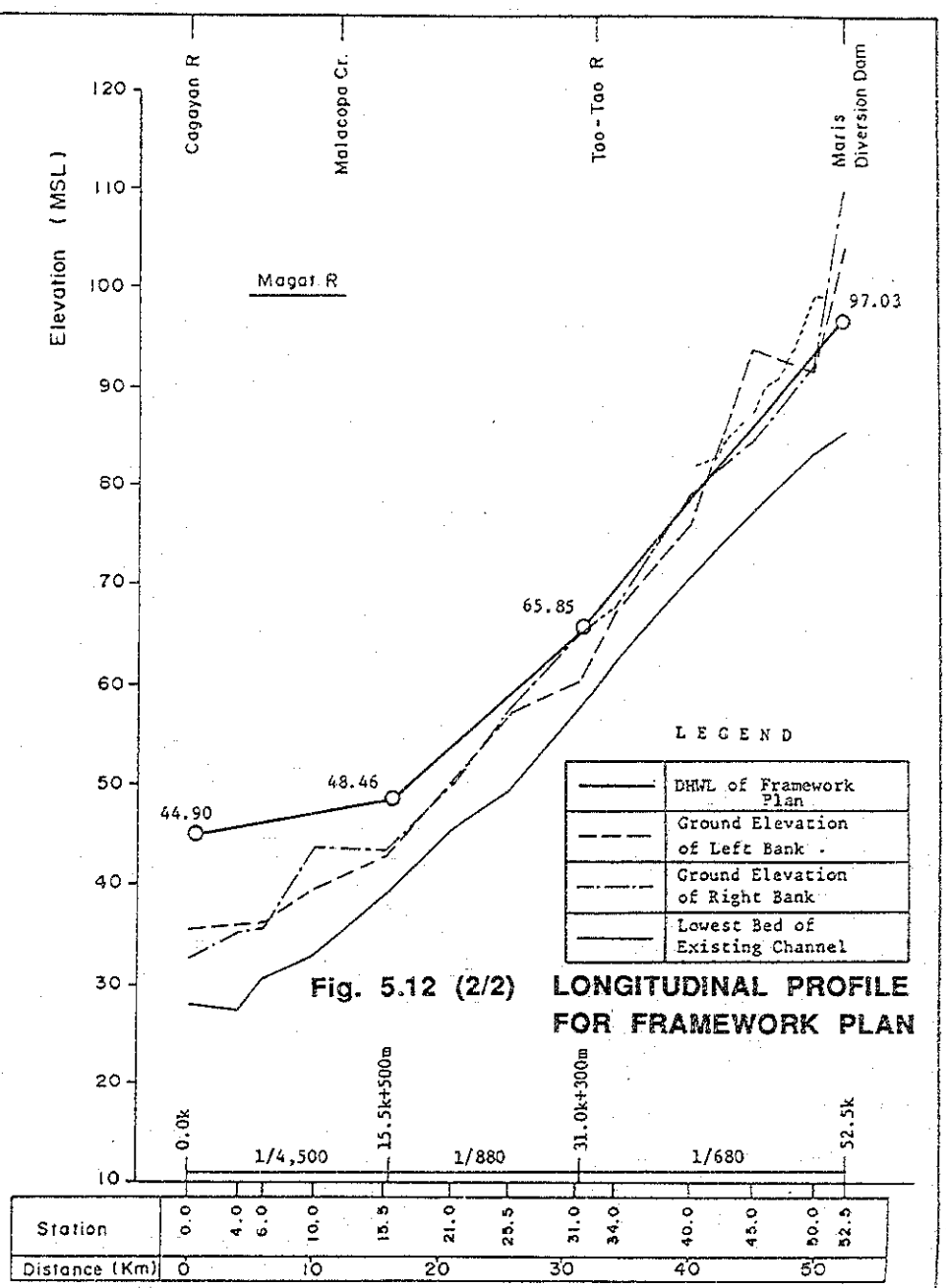


Fig. 5.12 (2/2) LONGITUDINAL PROFILE FOR FRAMEWORK PLAN

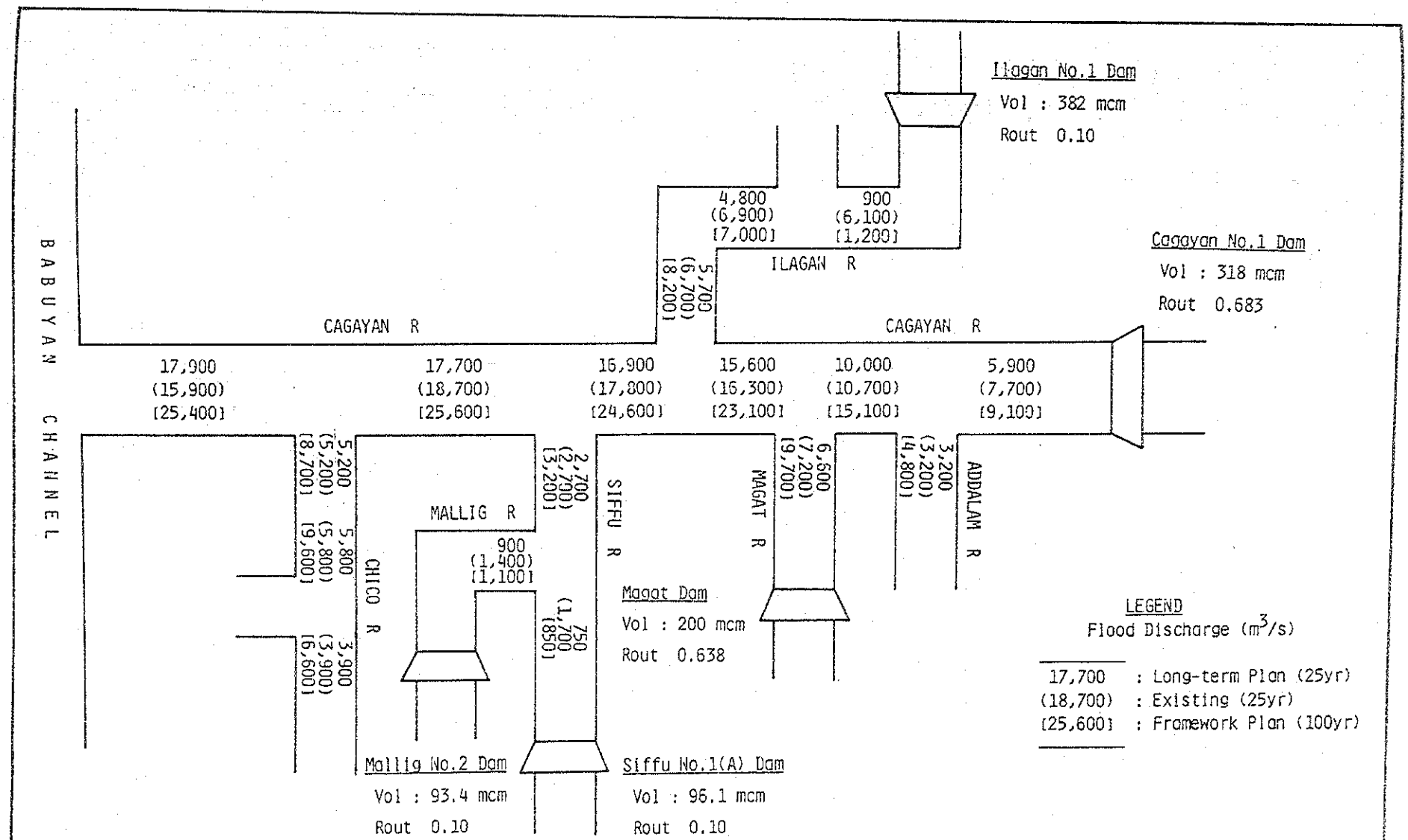


Fig. 5.13 DESIGN DISCHARGE FOR LONG-TERM PLAN

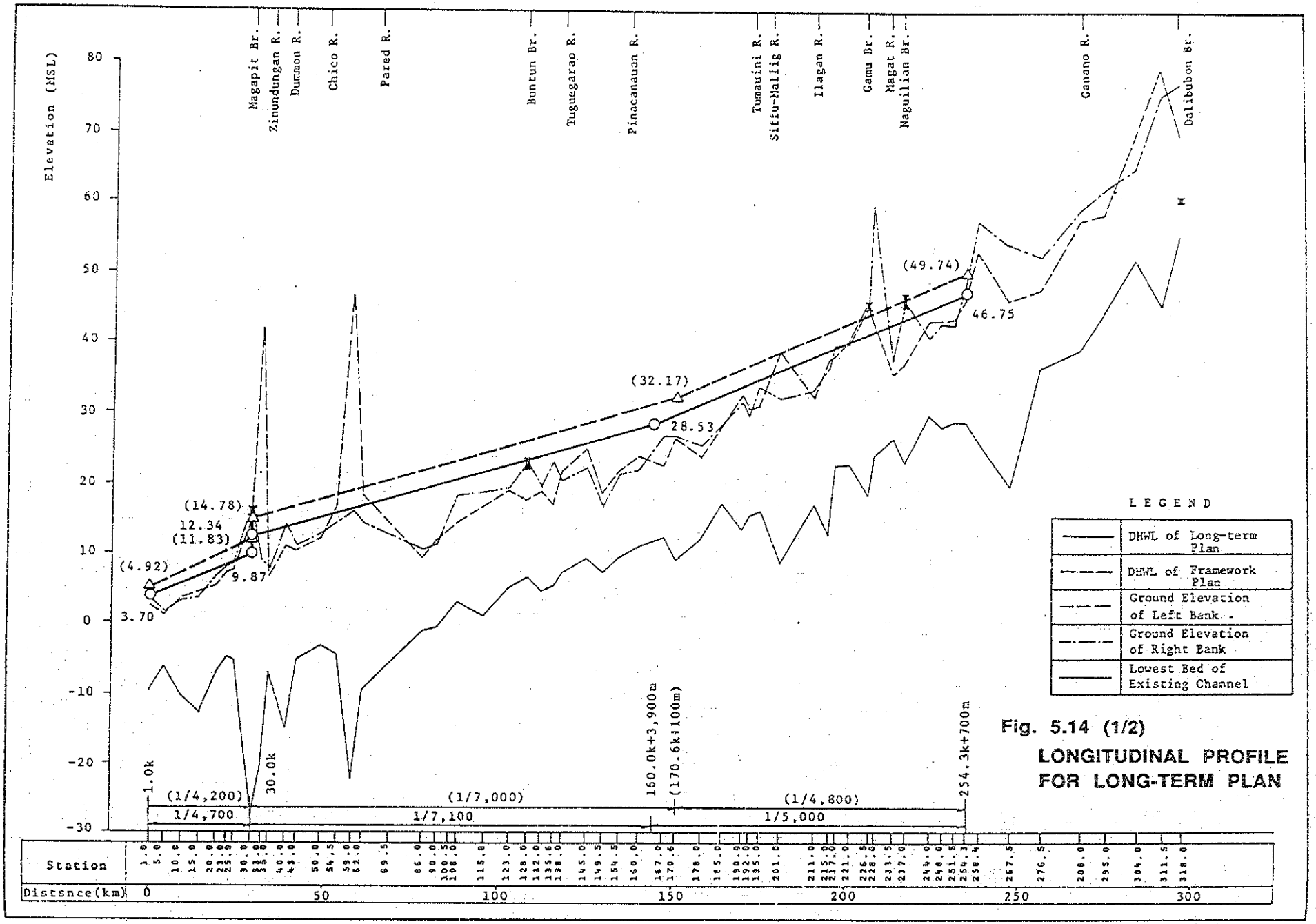
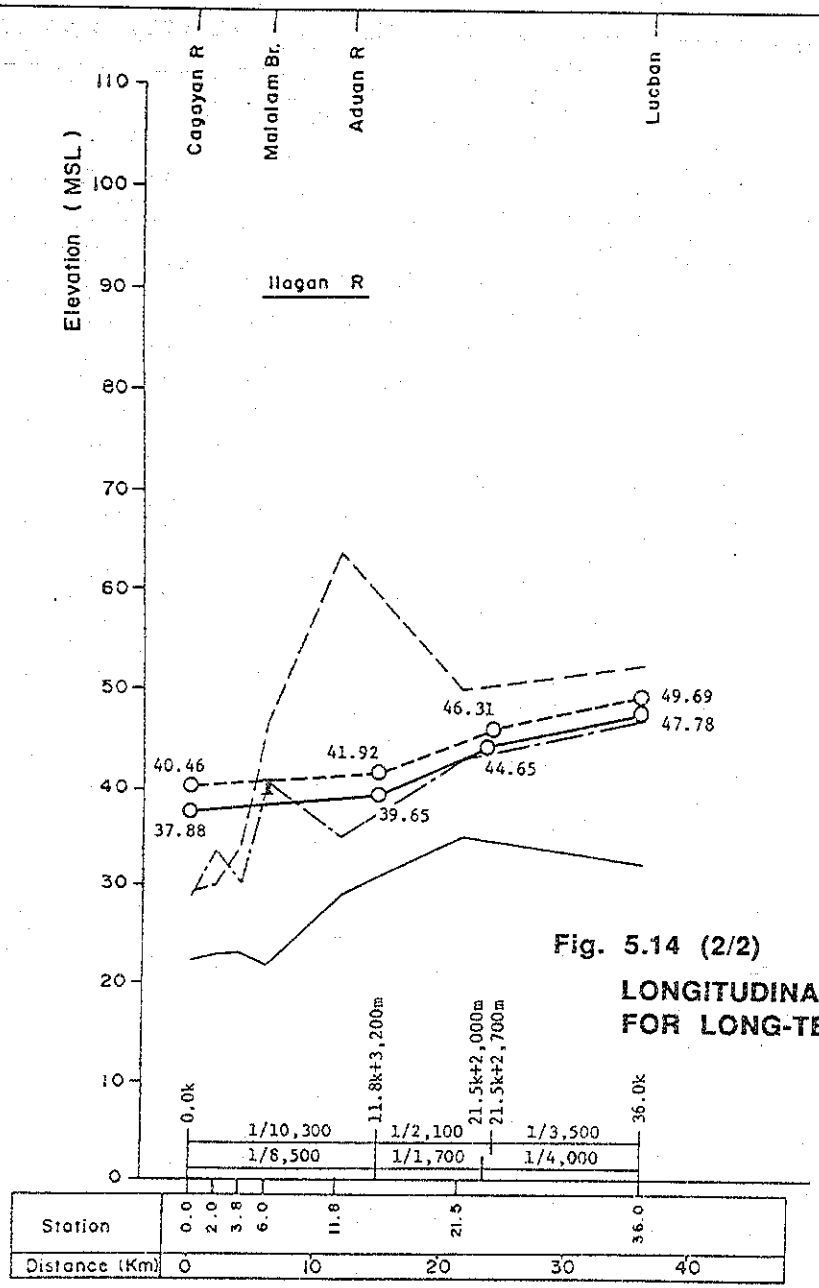


Fig. 5.14 (1/2)

LONGITUDINAL PROFILE FOR LONG-TERM PLAN



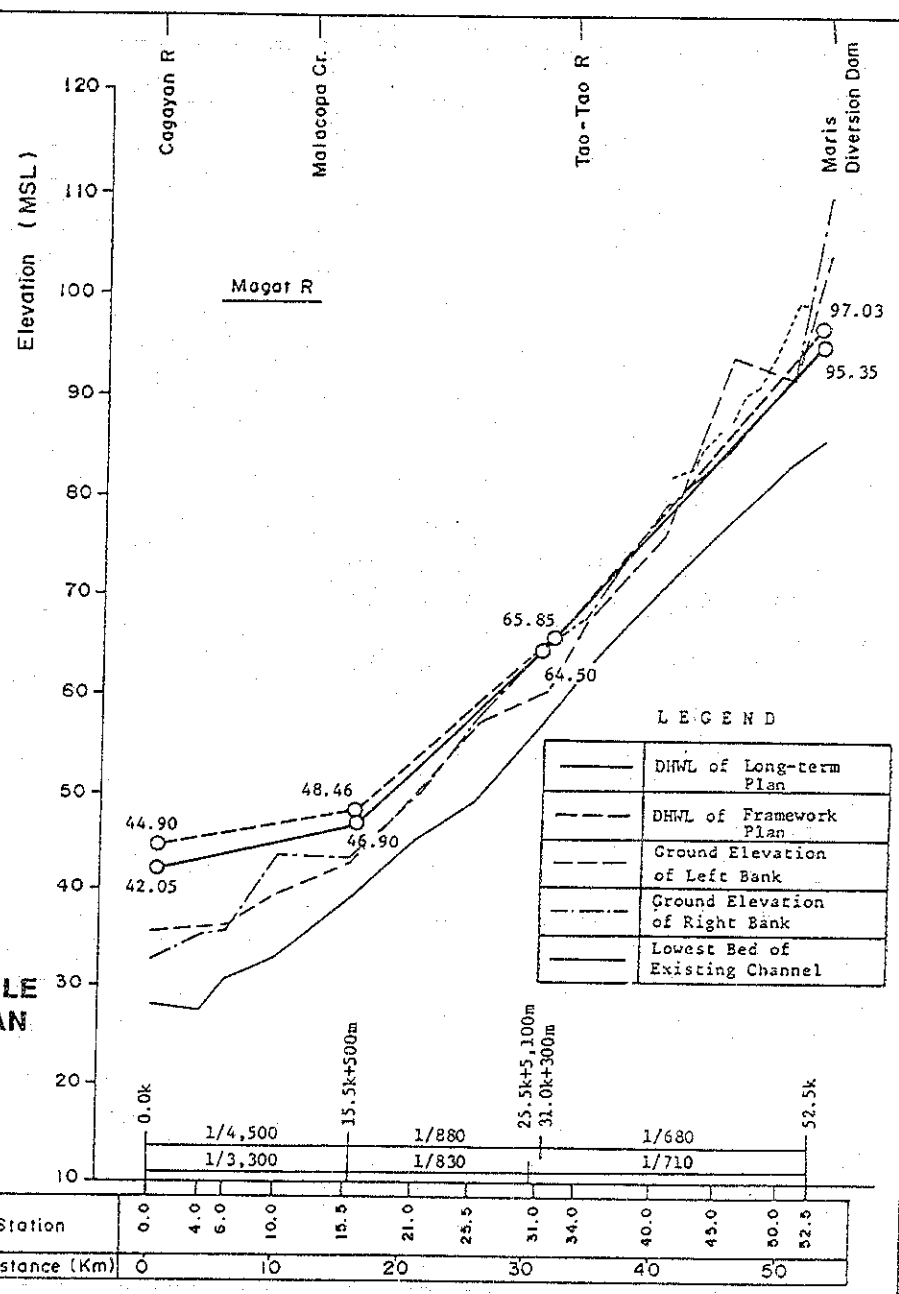


Fig. 5.14 (2/2)

LONGITUDINAL PROFILE FOR LONG-TERM PLAN

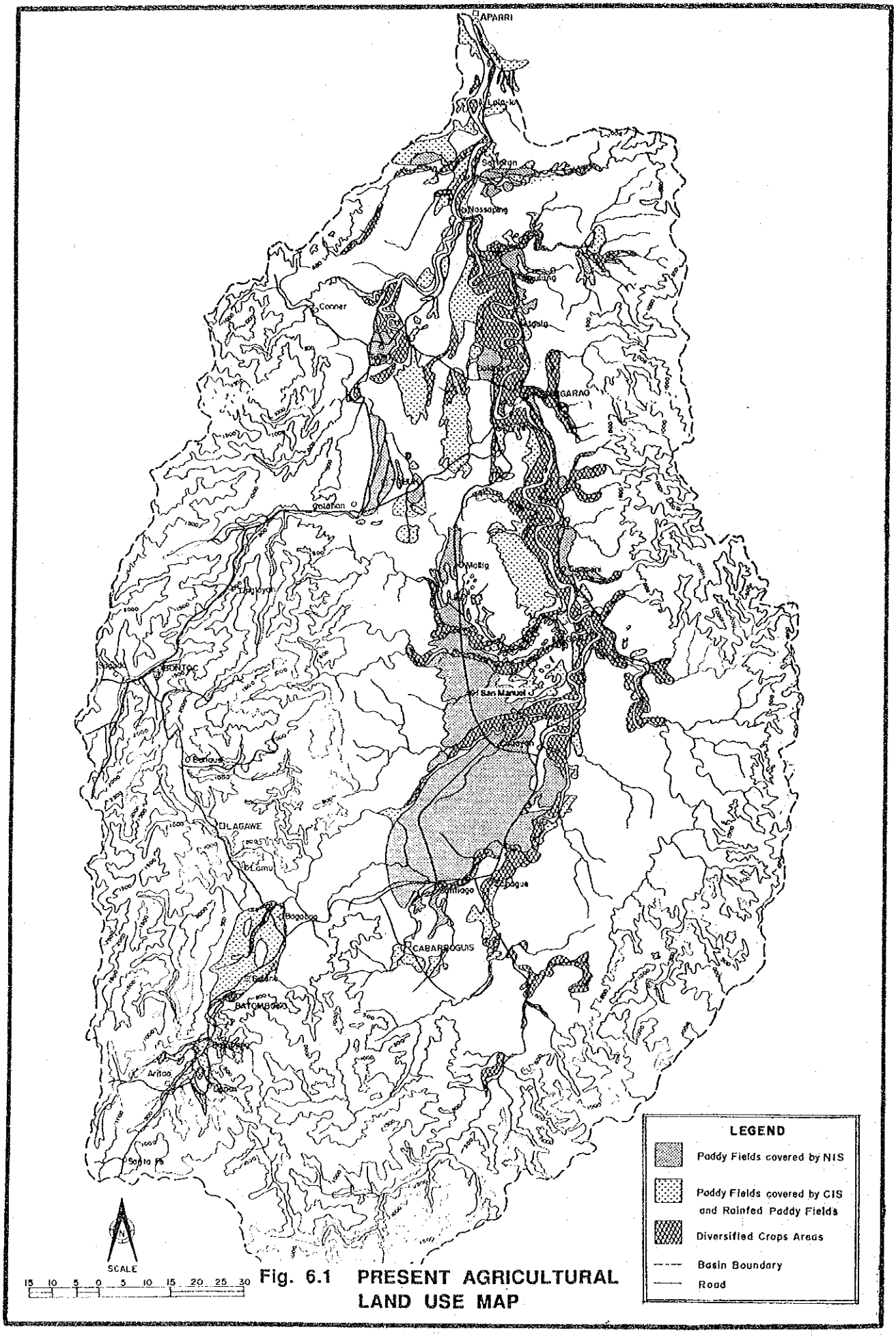


Fig. 6.1 PRESENT AGRICULTURAL LAND USE MAP

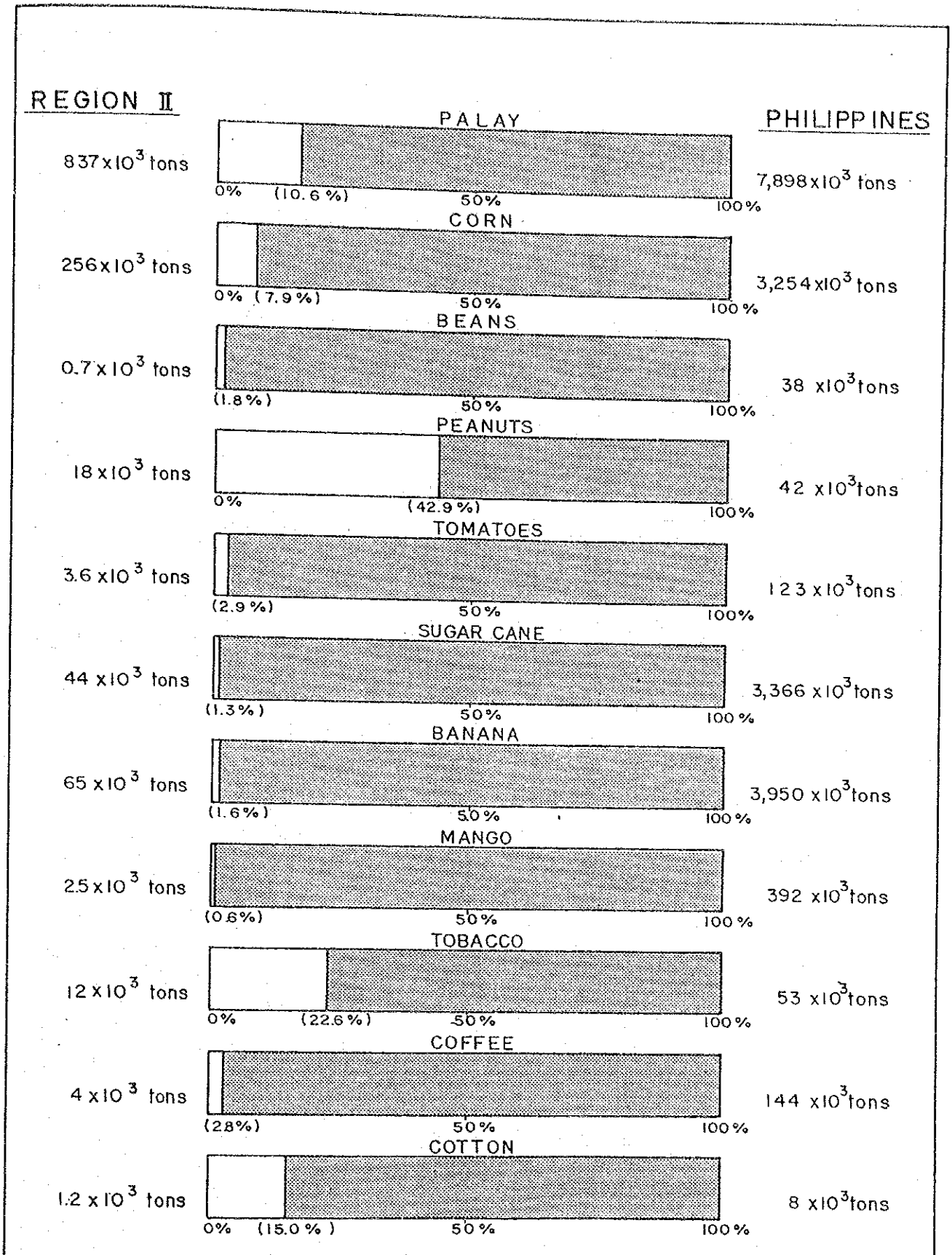


Fig. 6.2 PRESENT CROP PRODUCTIONS OF REGION II (1982-1984 AVERAGE)

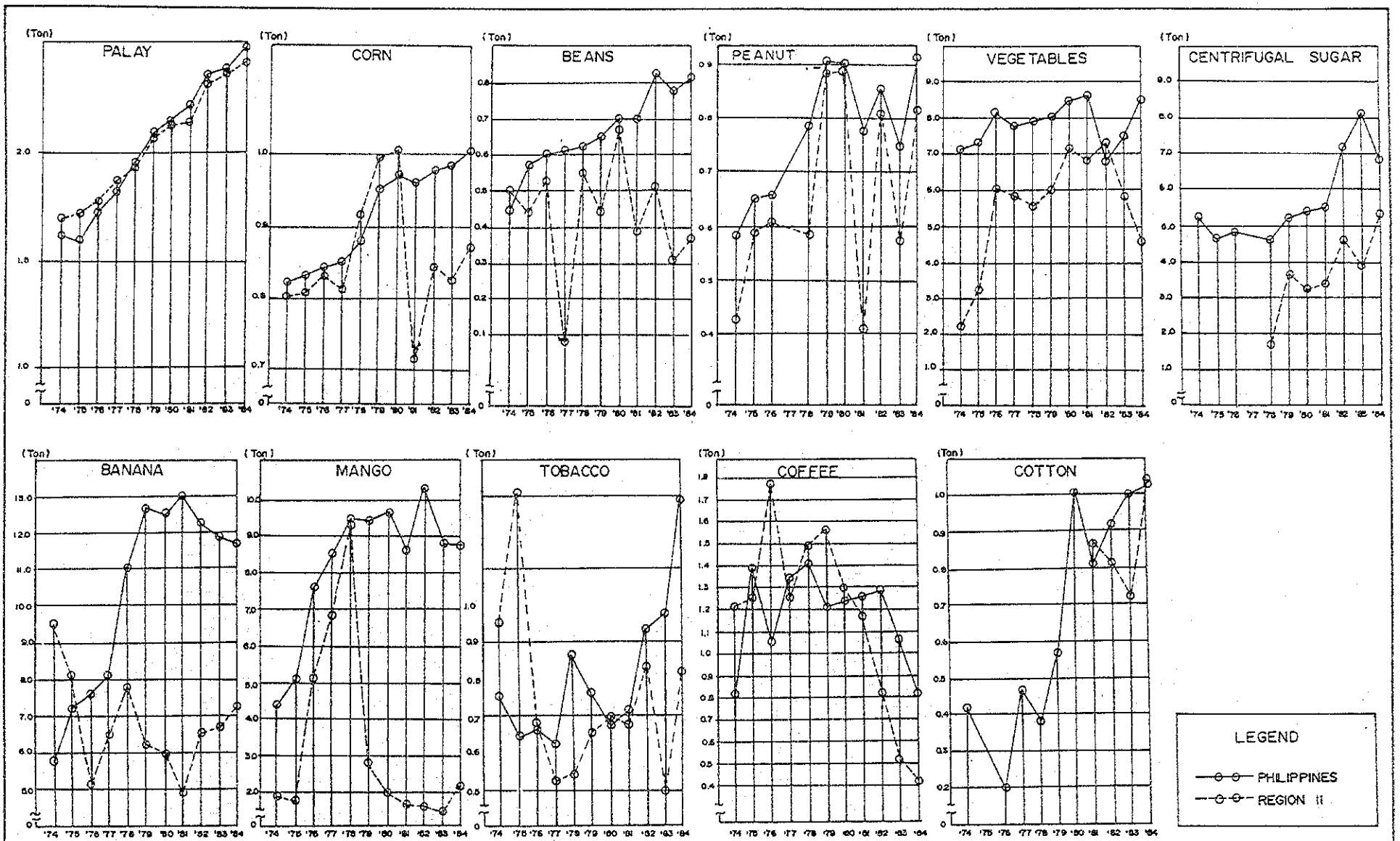


Fig. 6.3 AVERAGE CROP YIELD PER HA (1974-1984)

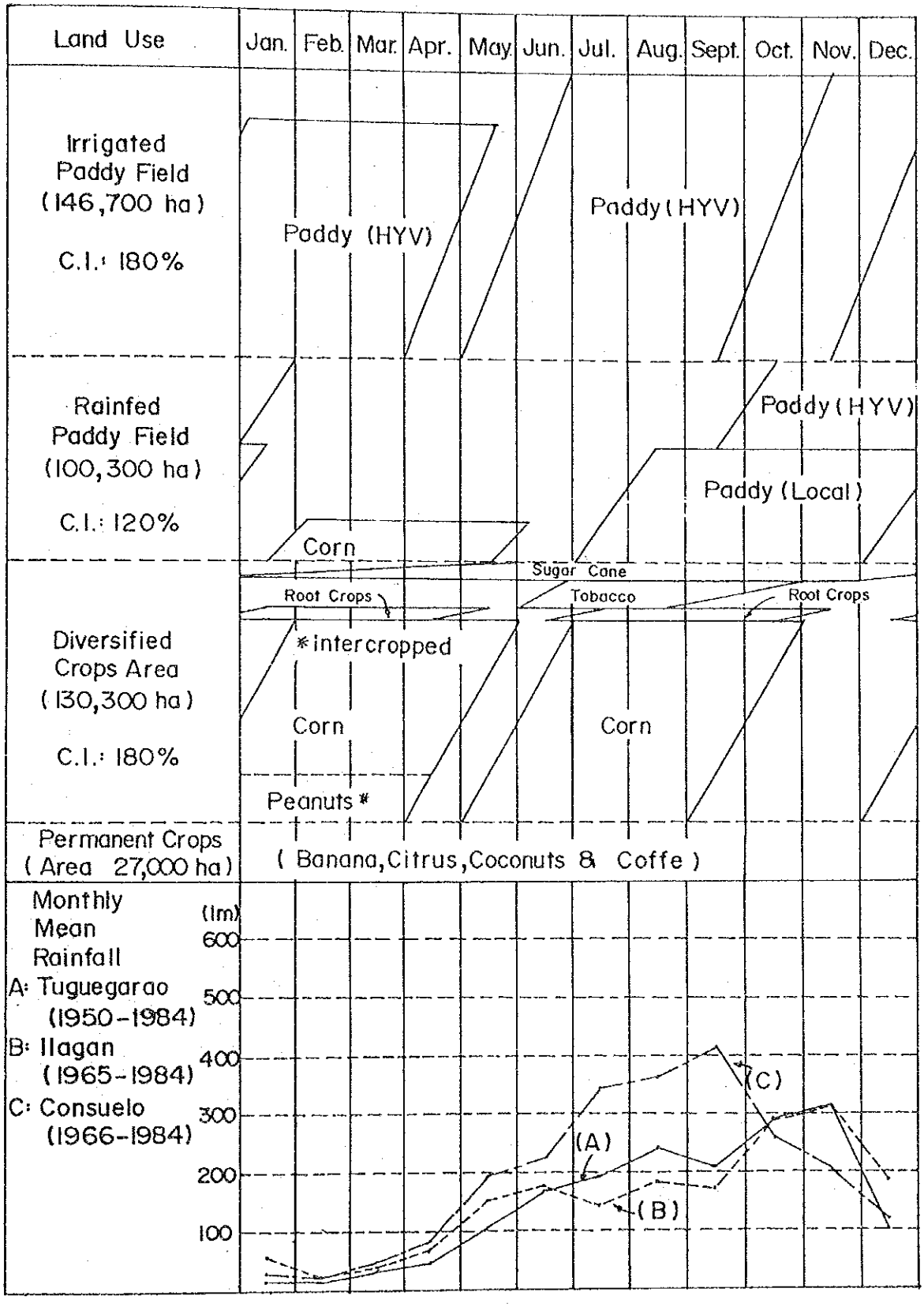


Fig. 6.4 PRESENT CROPPING PATTERN IN CAGAYAN RIVER BASIN

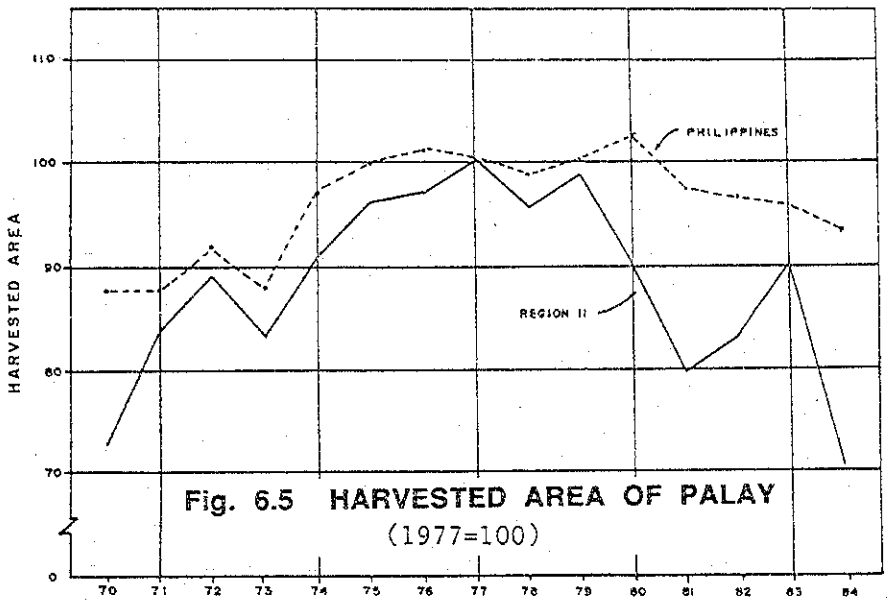


Fig. 6.5 HARVESTED AREA OF PALAY
(1977=100)

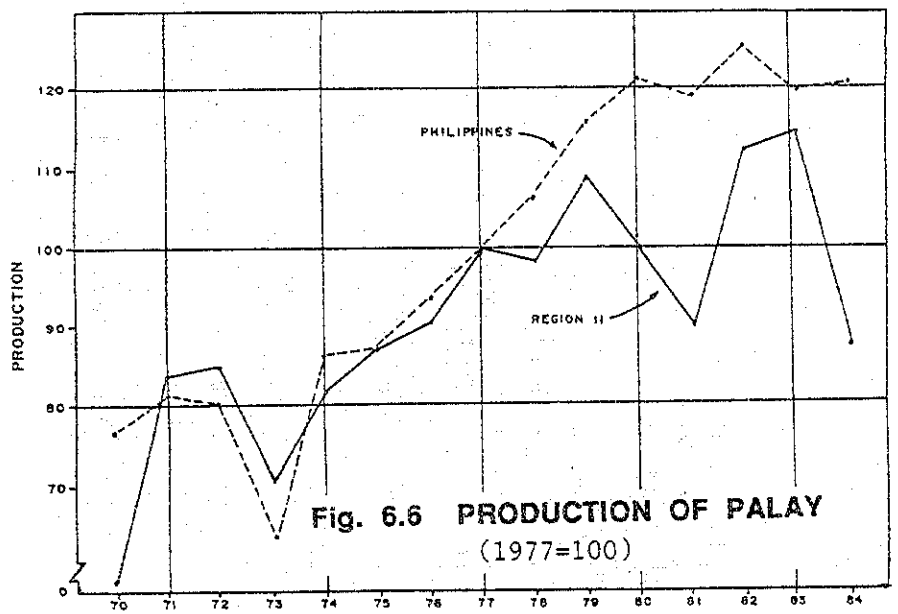


Fig. 6.6 PRODUCTION OF PALAY
(1977=100)

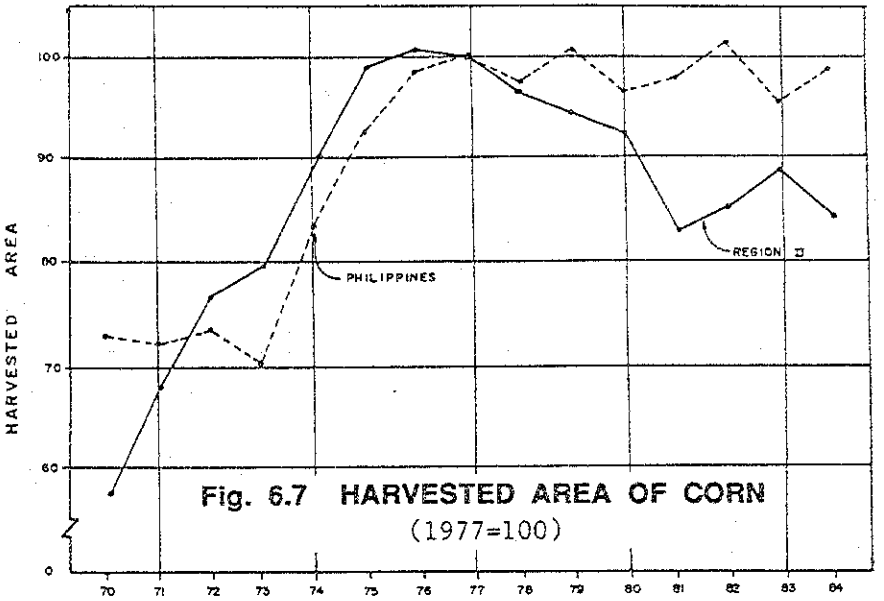


Fig. 6.7 HARVESTED AREA OF CORN
(1977=100)

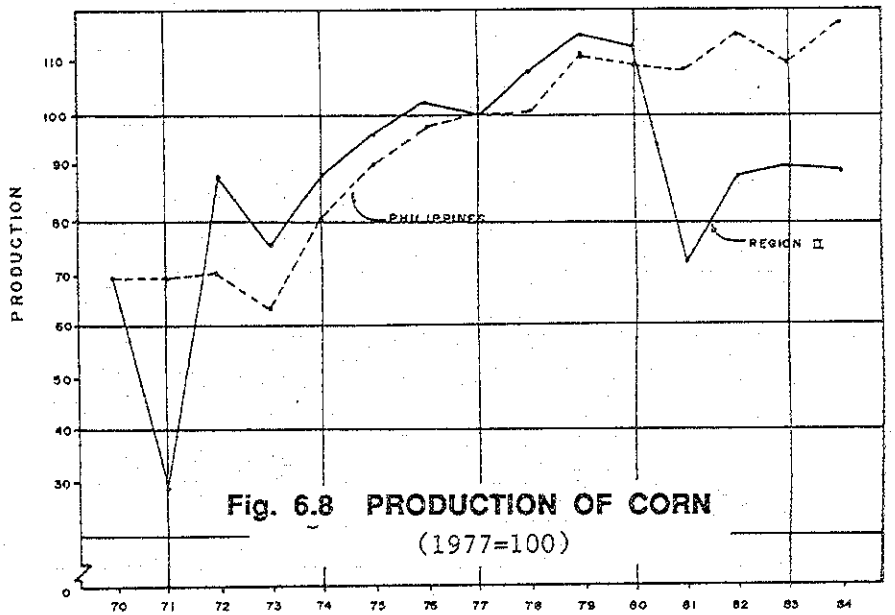


Fig. 6.8 PRODUCTION OF CORN
(1977=100)

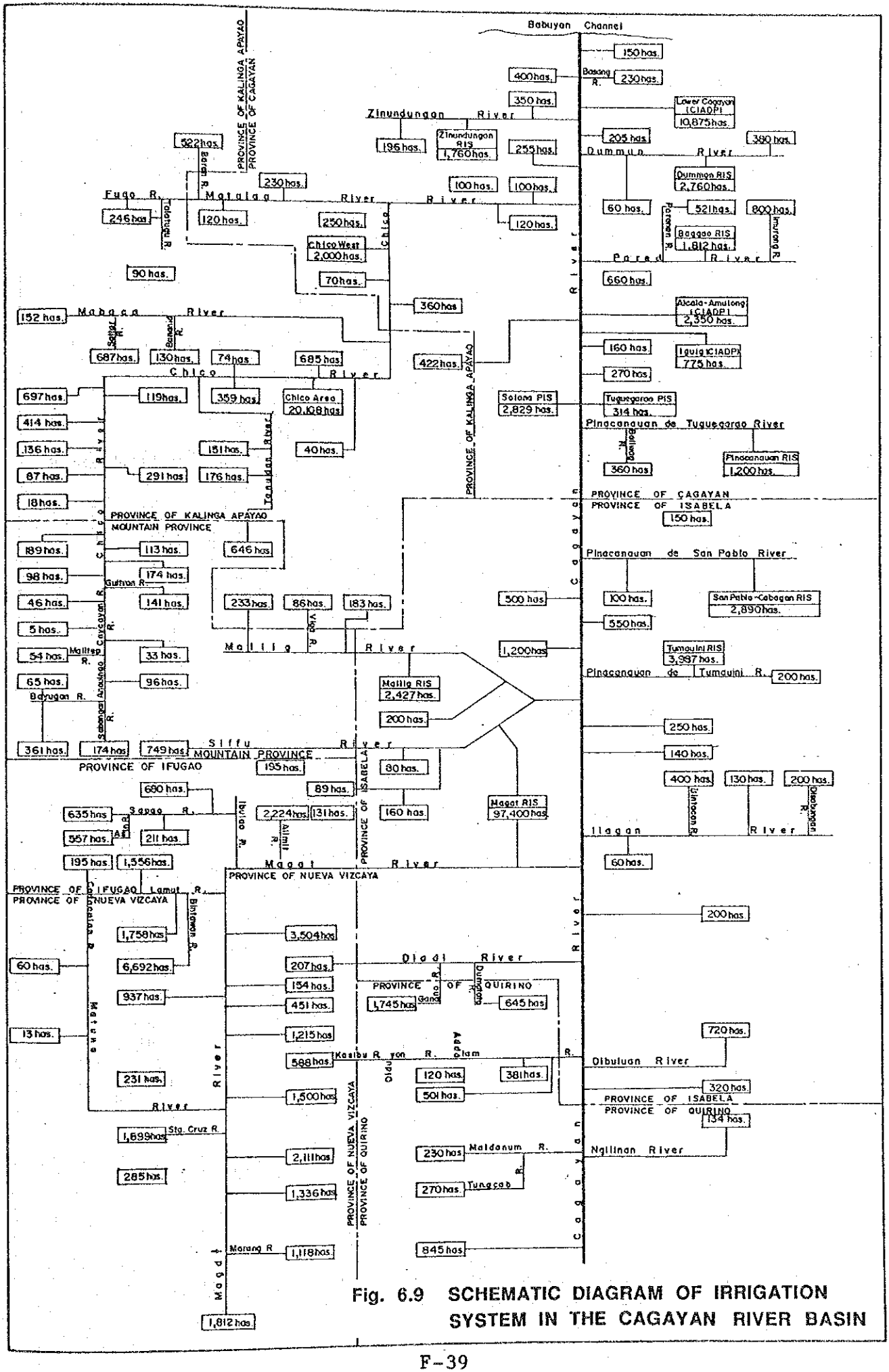


Fig. 6.9 SCHEMATIC DIAGRAM OF IRRIGATION SYSTEM IN THE CAGAYAN RIVER BASIN

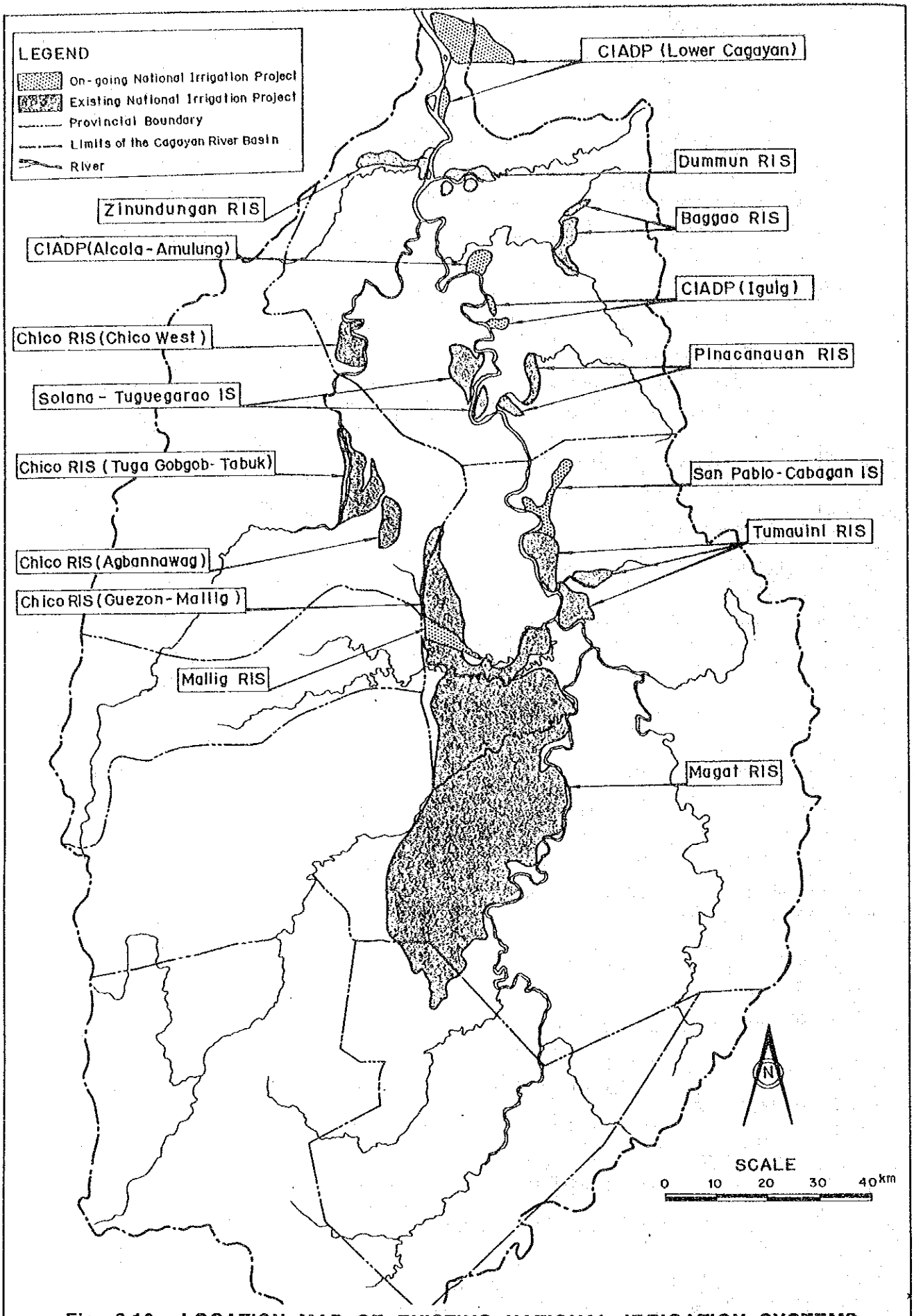


Fig. 6.10 LOCATION MAP OF EXISTING NATIONAL IRRIGATION SYSTEMS AND ON-GOING IRRIGATION PROJECTS

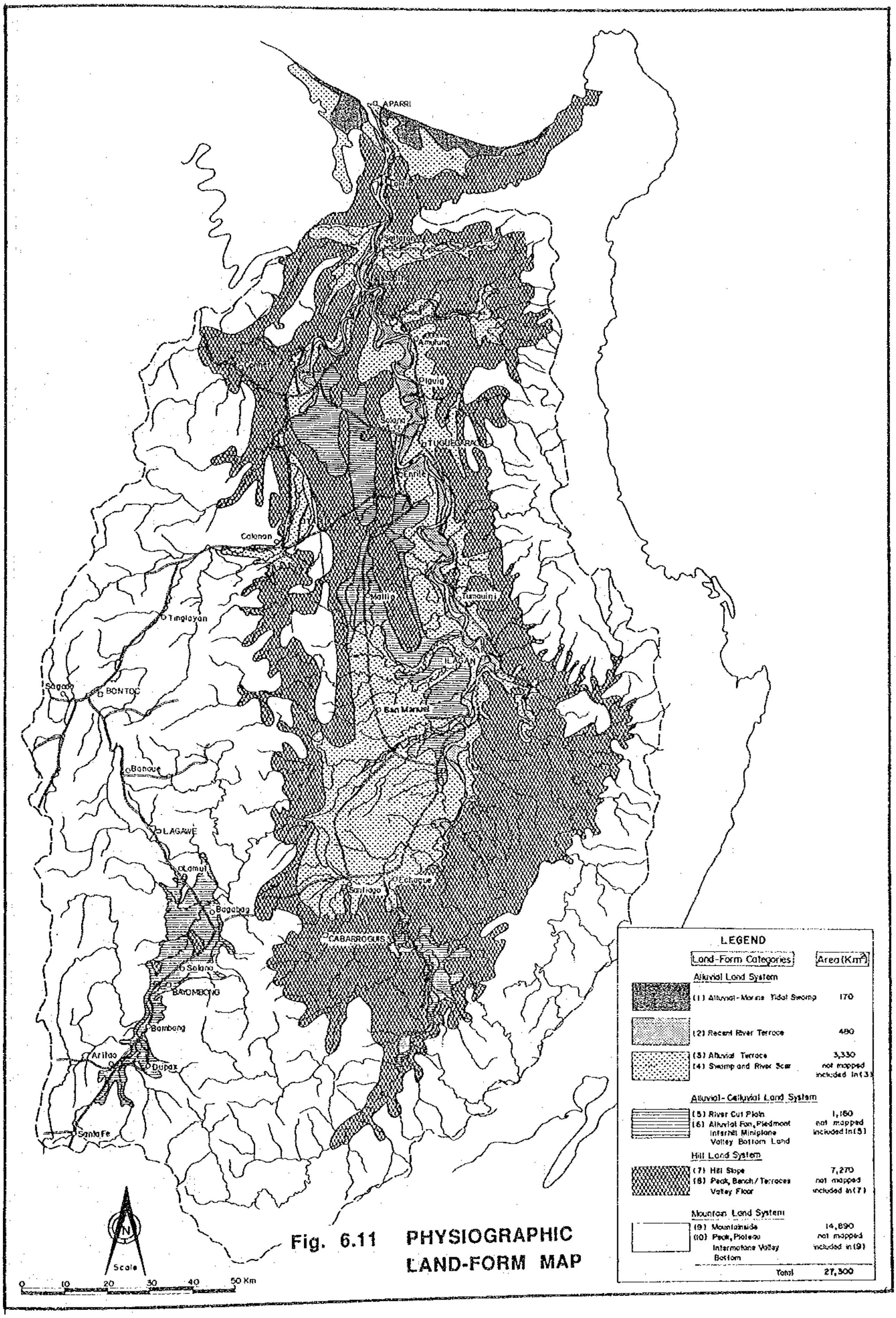


Fig. 6.11 PHYSIOGRAPHIC LAND-FORM MAP

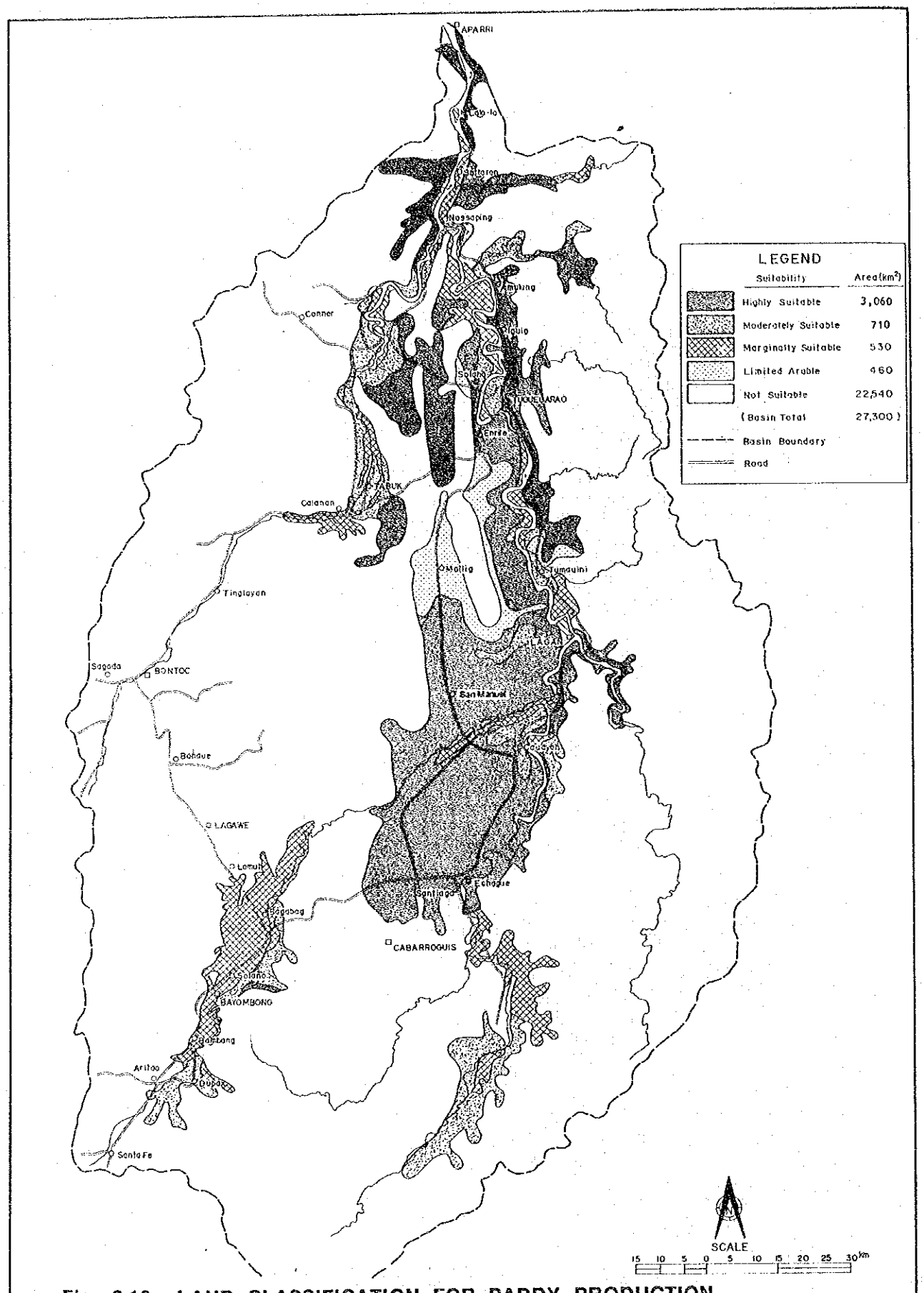


Fig. 6.12 LAND CLASSIFICATION FOR PADDY PRODUCTION

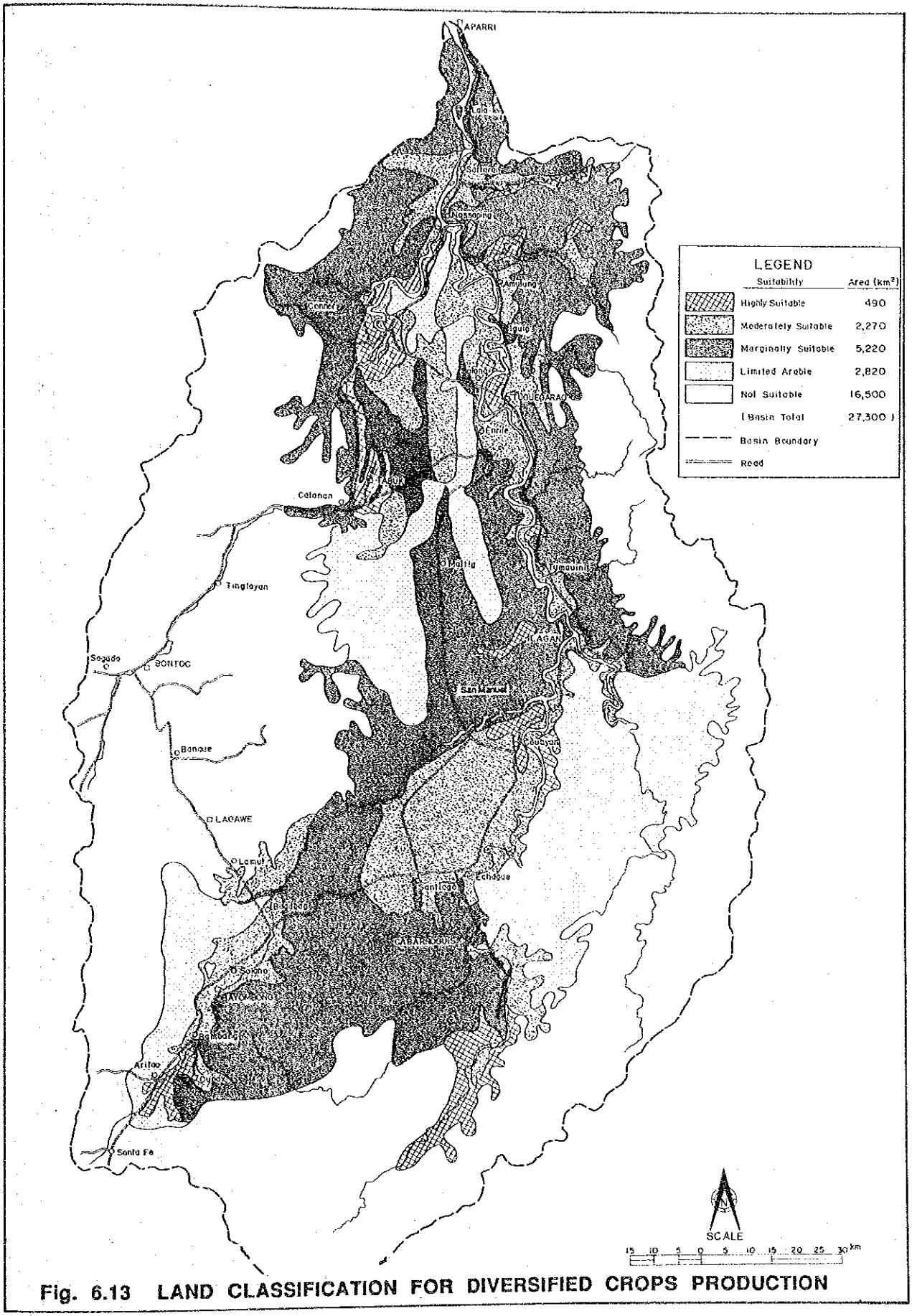
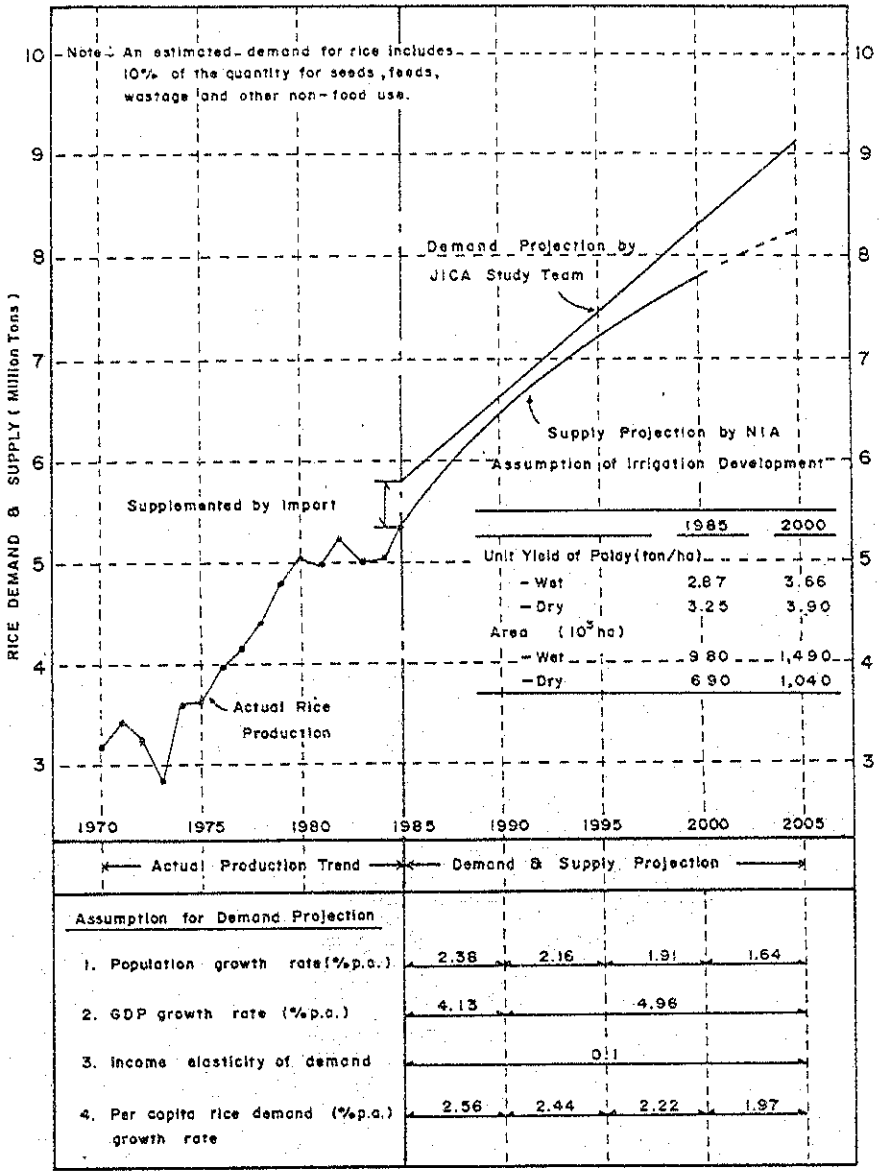
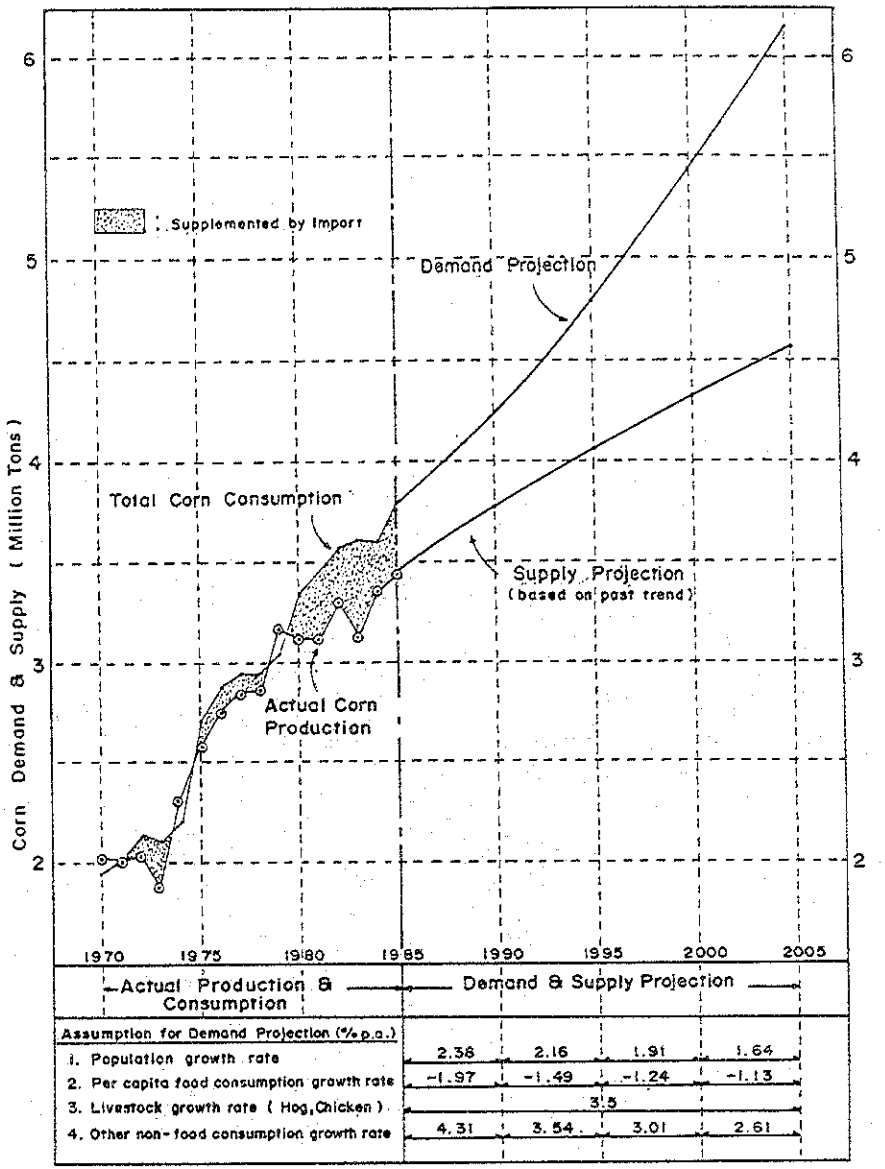


Fig. 6.13 LAND CLASSIFICATION FOR DIVERSIFIED CROPS PRODUCTION



DEMAND AND SUPPLY PROJECTION FOR RICE

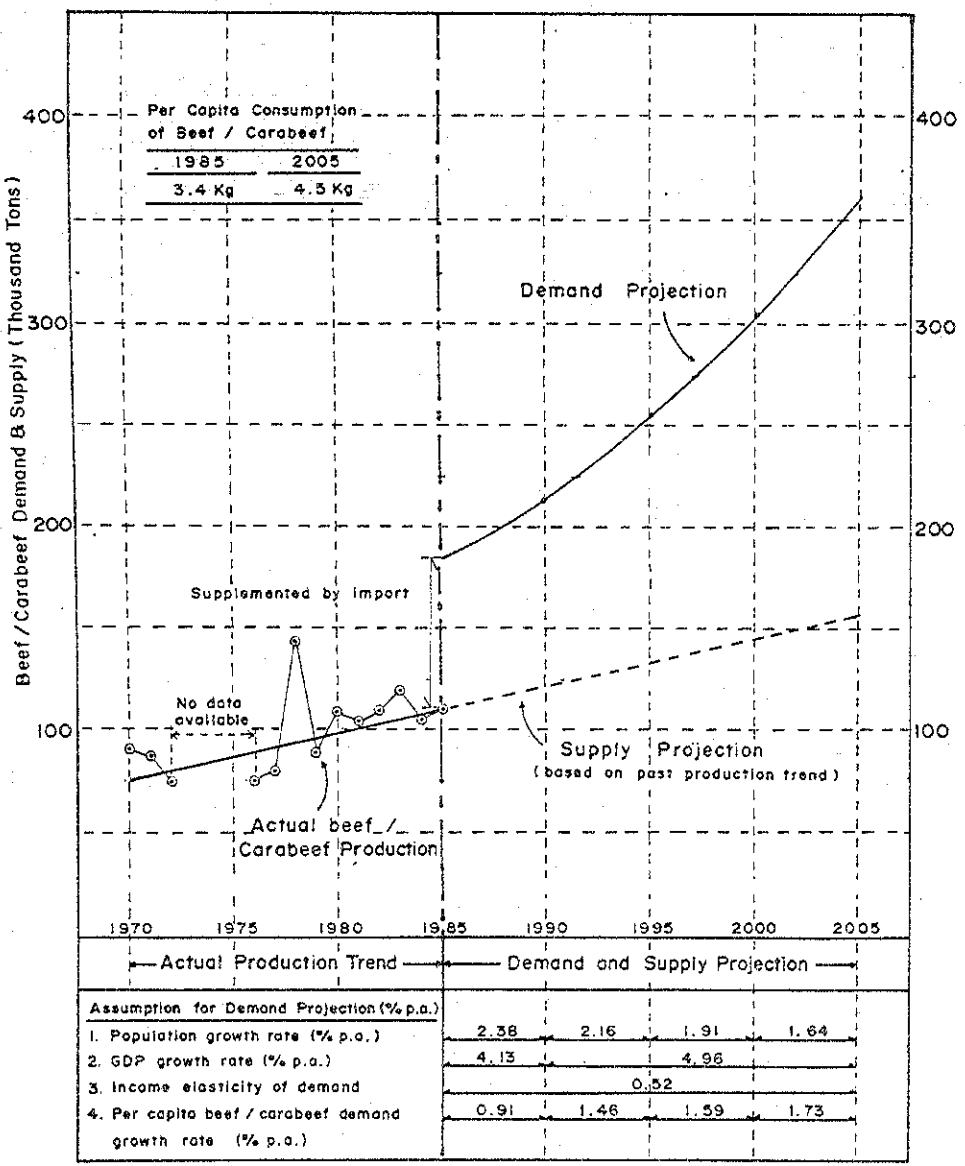


DEMAND AND SUPPLY PROJECTION FOR CORN

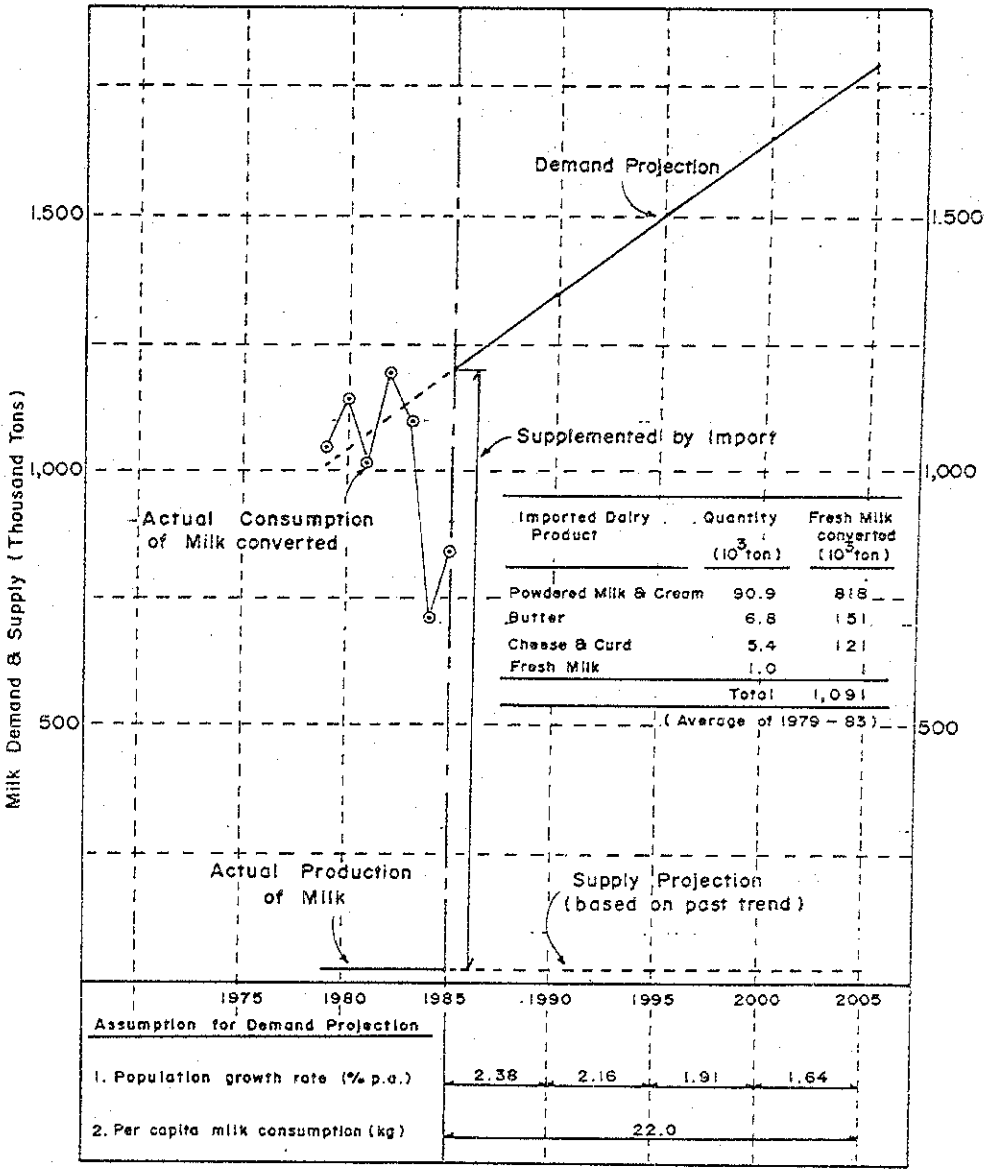
Fig. 6.14 DEMAND AND SUPPLY PROJECTIONS FOR MAJOR AGRICULTURAL COMMODITIES IN THE PHILIPPINES

(to be continued)

(continuation)



DEMAND AND SUPPLY PROJECTION FOR BEEF/CARABEEF



DEMAND AND SUPPLY PROJECTION FOR MILK

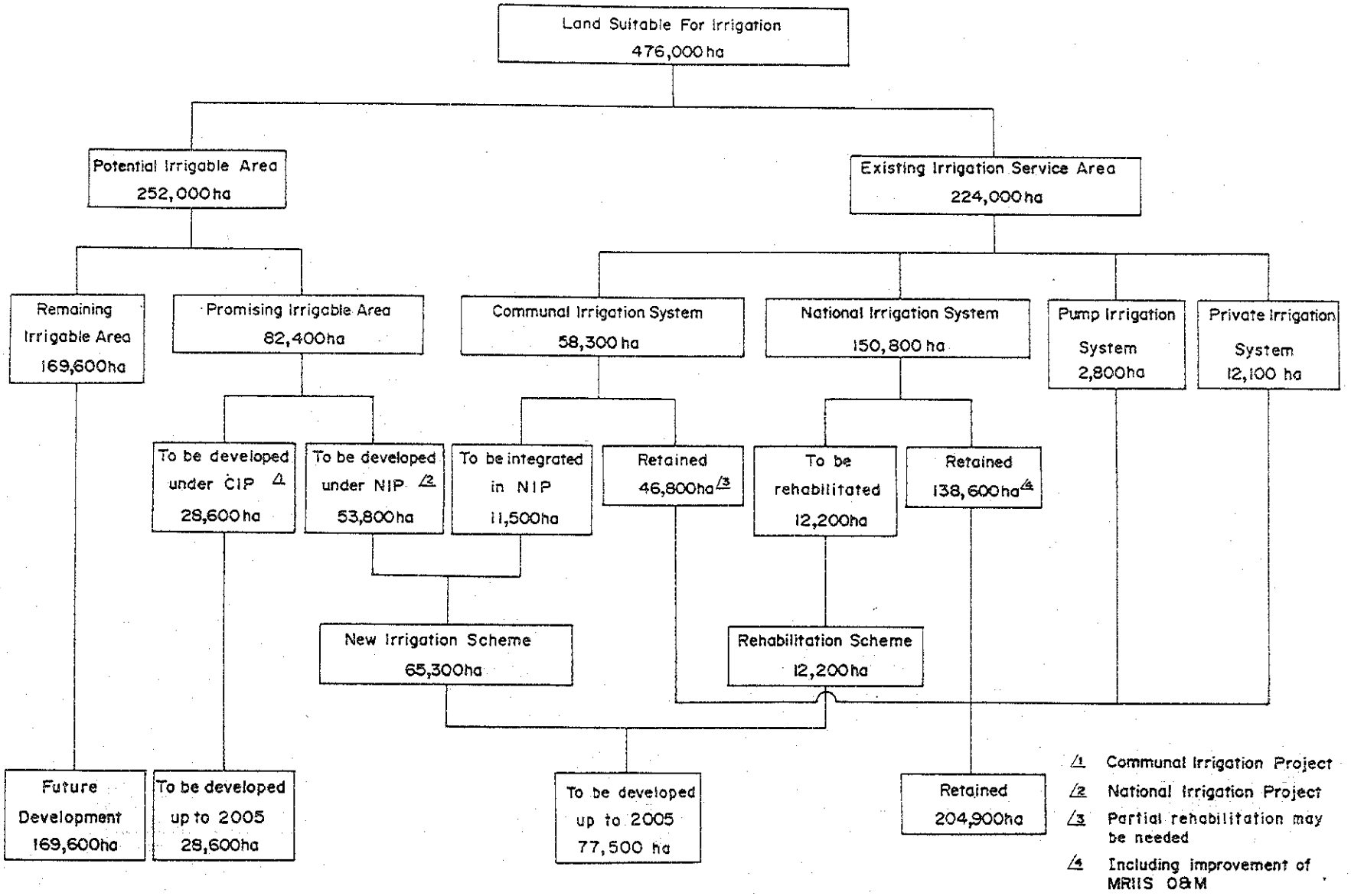


Fig. 6.15 CLASSIFICATION OF IRRIGABLE AREA

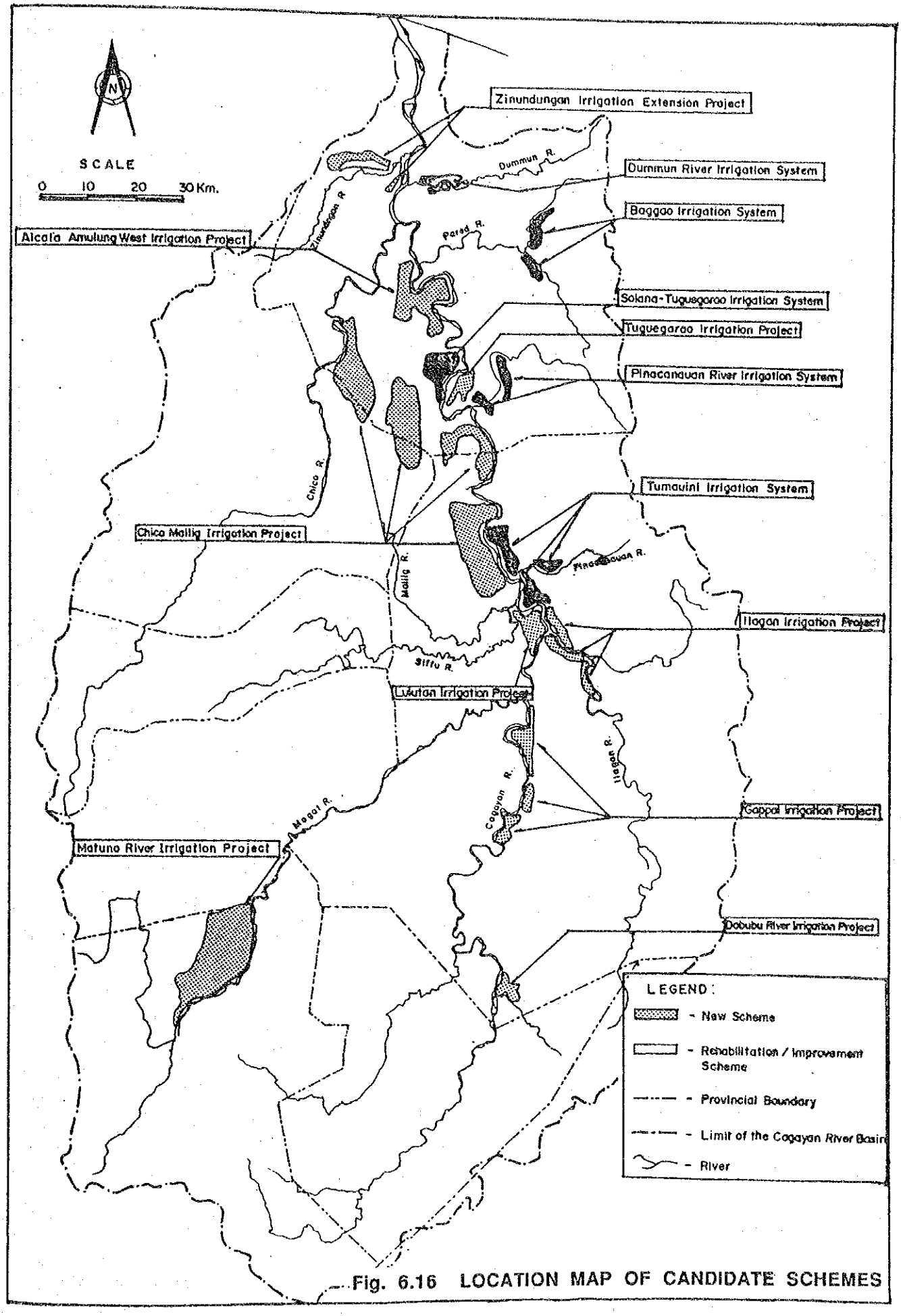


Fig. 6.16 LOCATION MAP OF CANDIDATE SCHEMES

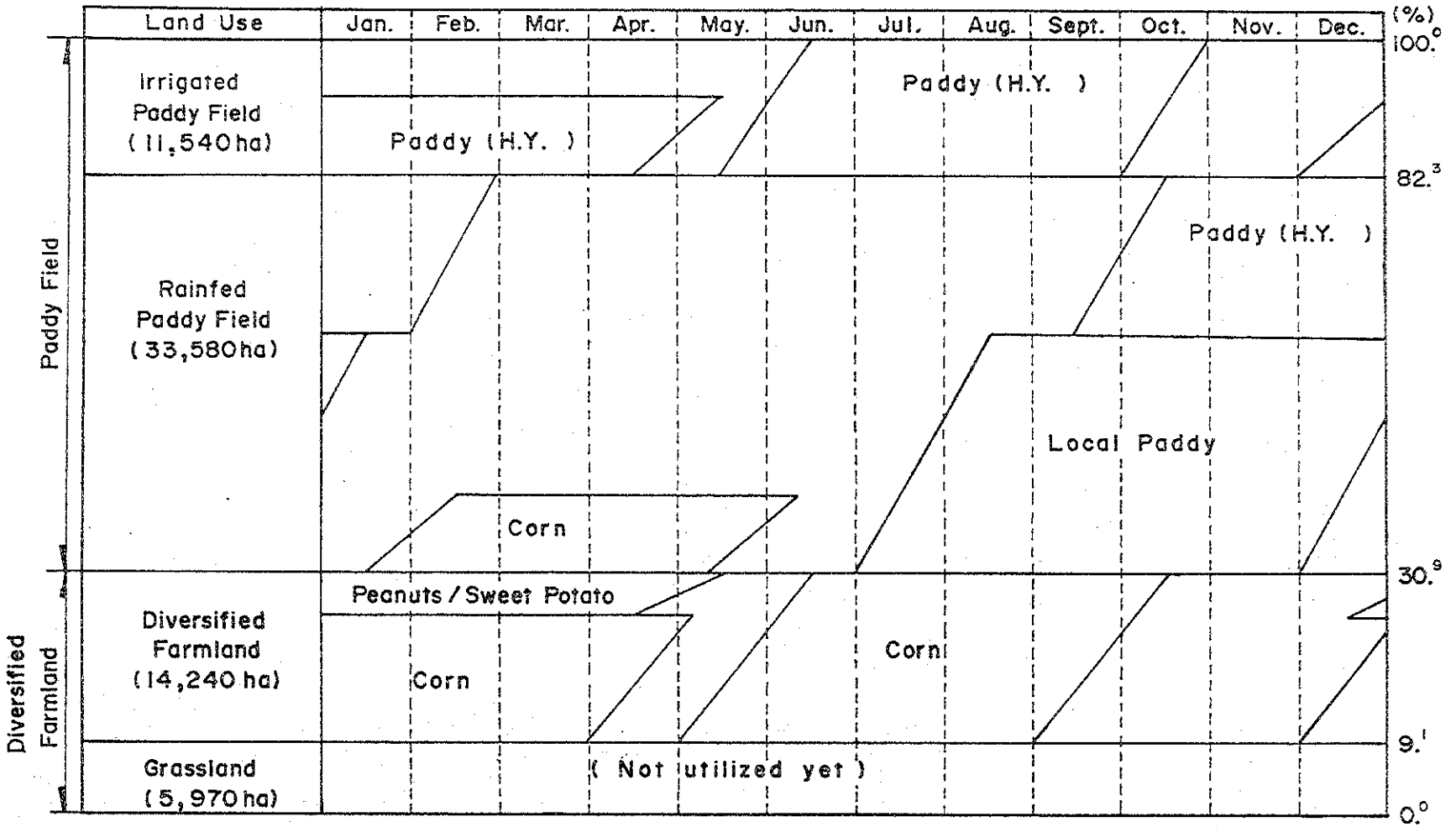


Fig. 6.17 PRESENT CROPPING PATTERN IN NEW IRRIGATION SCHEMES

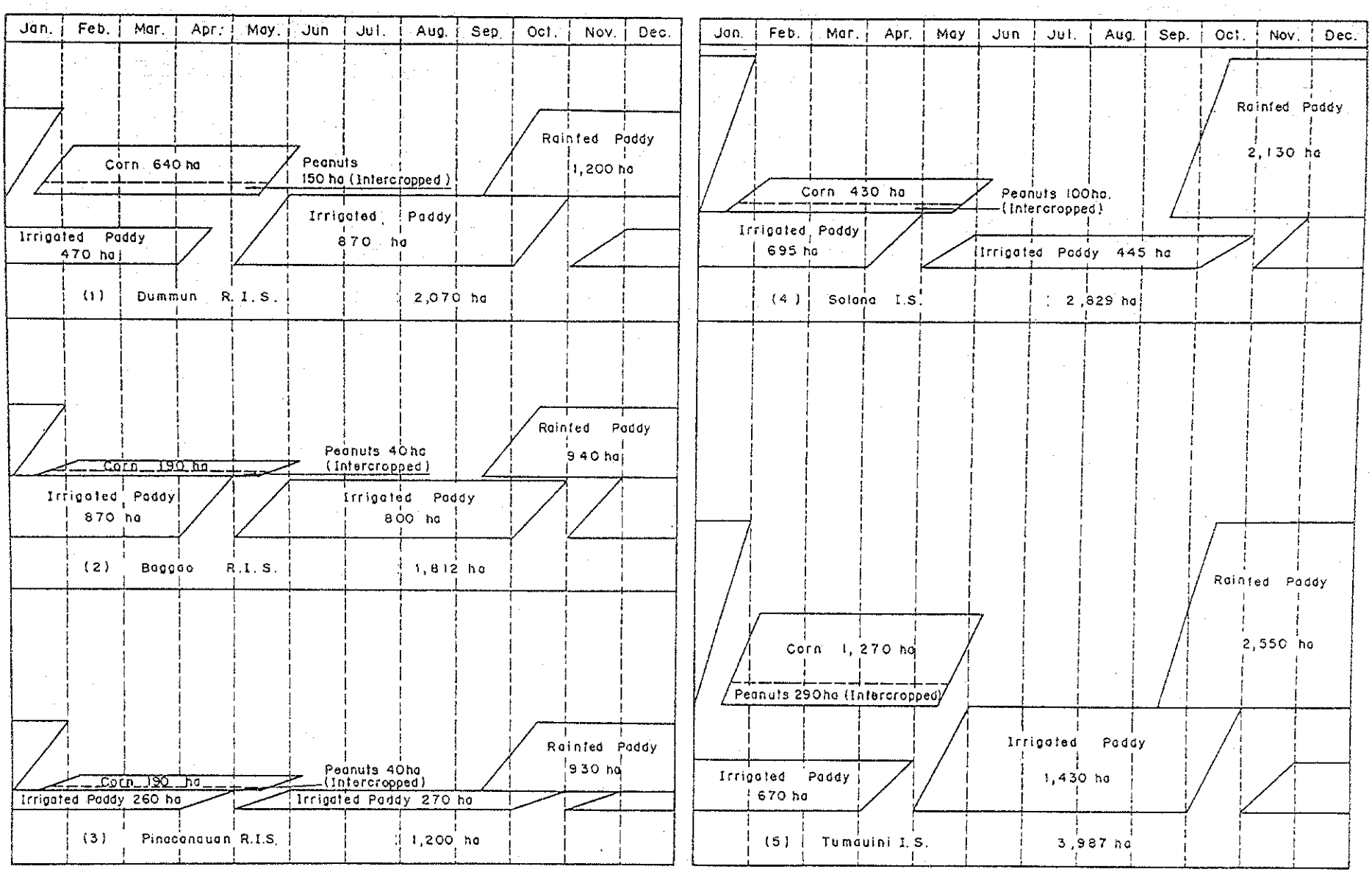


Fig. 6.18 PRESENT CROPPING PATTERN IN REHABILITATION/IMPROVEMENT SCHEMES