3.3 Sedimentation and Water Quality

3.3.1 Sedimentation

Measurements on sedimentation were carried out three (3) times on June 23, 1987. However, such data are still insufficient for the derivation of the relationship between discharge and sediment volume.

The sediment volume at the intake site is estimated on the basis of the surface denudation rate taking the study results of Batang Ai and Bakun Hydroelectric Projects into considerations.

The denudation rates for the above projects are 1.0 mm per annum for the former and 0.5 mm per annum for the latter. Those correspond to annual sediment deposit volume of 1.25 million m^3 and 7.60 million m^3, respectively.

The denudation rate of 1.0 mm per annum is adopted for the intake site, namely, the annual sediment volume flowing through the intake is estimated at 0.19 million m^3.

3.3.2 Water quality

Water quality of the Limbang River was analysed by the Agricultural Department in April 1974. A typical example of the chemical composition in fresh water is given in Table III-17. Furthermore, water quality tests are also carried out in this study.

3.4 Right of Way in Water Use

There is no habitant in the Medamit River basin upstream from the Medamit-2 site. Uppermost location of habitants is about 8.5 km downstream from the intake site, where people utilize river water for their drinking. Mandatory release of 0.5 m^3/sec would be required for ensuring their drinking water, if water of the Medamit River is diverted to the Limbang River for power generation. Furthermore, the Medamit River is not used for the transport of logged timber.

Table III - 1 List of Meteorological Gauging Station

No	Name of Station	Location Latitude	Location Longitude	Altitude (a.m.s.l.)	Recording period
1	Kuching aerodrome	01° 29'N	110° 20'E	21.7	1954-1986
2	Sibu aerodrome	02° 20'N	111° 50'E	7.5	1968-1986
3	Bintulu aerodrome	03° 12'N	113° 02'E	3.1	1968-1986
4	Miri aerodrome	04° 20'N	113° 59'E	17.0	1968-1986

Table III - 2 Annual Rainfall Depth at Representative Stations

(Unit:mm)

Year	Rainfall Gauging Station		
	Kuching	Kapit	Ukong
1950	3,951		
1951	3,873		
1952	4,404		
1953	4,220		
1954	3,884		
1955	4,677		
1956	3,529	3,405	
1957	3,861	3,004	
1958	3,722	3,000	
1959	3,553	3,808	
1960	3,872	4,025	
1961	4,160	4,022	
1962	4,516	3,237	
1963	4,909	3,767	4,402
1964	4,792	3,535	4,374
1965	3,329	3,659	4,362
1966	3,696	4,529	3,804
1967	3,654	3,630	4,201
1968	4,441	3,706	5,150
1969	4,277	3,672	3,729
1970	4,262	4,714	3,592
1971	4,988	4,353	3,609
1972	3,099	3,178	3,801
1973	4,521	4,571	4,327
1974	3,325	3,479	4,395
1975	4,520	3,574	4,022
1976	3,770	3,151	3,268
1977	5,296	2,870	3,549
1978	4,236	3,558	3,533
1979	4,365	3,901	3,839
1980	4,651	4,633	4,519
1981	3,869	3,224	3,668
1982	3,327	4,473	3,252
1983	4,118	4,021	3,616
1984	4,488	4,170	4,469
1985	3,772	3,500	3,424
1986	4,264	3.530	3,122
Maximum	5,296	4,714	5,150
Minimum	3,099	2,870	3,122
Average	4,104	3,739	3,903

Table III - 3 Monthly Rainfall Depth at Lubok Lalang

(Unit : mm)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1963	846.7	463.6	367.0	188.7	406.0	238.5	279.5	362.1	308.1	382.5	376.8	356.8	4576.3
1964	286.5	282.9	310.9	507.6	360.0	341.5	585.5	270.8	494.1	429.6	532.6	387.2	4789.1
1965	449.4	385.2	490.8	474.5	491.0	253.8	234.6	309.1	287.4	464.0	470.8	470.8	4781.3
1966	328.9	264.5	350.1	369.9	260.8	299.5	298.8	441.5	264.5	418.9	464.8	661.5	4423.7
1967	428.3	470.0	304.4	354.0	331.7	387.0	287.3	221.9	405.6	551.9	424.9	511.0	4677.9
1968	508.2	385.6	510.9	455.7	467.4	484.5	407.3	360.2	388.9	565.7	304.1	447.9	5286.3
1969	325.8	384.9	309.7	266.3	393.2	327.8	308.6	441.7	236.4	523.2	443.8	414.5	4375.8
1970	452.1	242.5	387.7	309.3	413.5	319.3	263.0	296.6	371.9	394.8	443.0	393.9	4287.6
1971	319.6	415.7	278.2	238.0	322.8	254.5	214.9	465.8	436.7	504.5	411.2	437.1	4298.9
1972	556.4	299.8	343.1	544.0	280.7	311.0	213.1	241.1	321.7	401.2	596.4	313.3	4422.0
1973	195.7	211.8	348.7	570.6	404.1	491.6	376.9	326.2	551.0	363.1	382.5	536.7	4758.8
1974	487.9	477.2	328.9	374.1	345.8	295.5	394.6	373.1	597.9	341.0	387.9	398.4	4802.4
1975	609.0	259.6	289.7	268.9	476.8	342.8	375.0	295.1	436.4	342.8	412.1	455.4	4563.4
1976	507.5	353.2	268.3	289.5	354.8	296.3	250.5	307.5	207.4	487.1	384.1	374.5	4080.5
1977	440.8	165.6	444.7	297.5	363.8	402.9	300.6	244.0	251.8	393.8	566.7	388.0	4260.1
1978	534.6	225.3	287.5	280.8	467.5	354.5	382.4	278.8	345.3	311.2	392.4	389.5	4250.0
1979	214.0	273.0	434.0	403.0	160.0	669.0	505.0	246.0	389.0	570.0	613.0	351.0	4827.0
1980	515.0	179.0	145.0	462.0	363.0	205.0	417.0	538.0	298.0	408.0	638.0	636.0	4804.0
1981	499.0	347.0	333.0	311.0	675.0	184.0	177.0	113.0	352.0	306.0	652.0	346.0	4295.0
1982	427.0	313.0	173.0	481.0	362.0	358.0	187.0	305.0	328.0	435.0	343.0	519.0	4231.0
1983	409.0	153.9	147.4	191.8	468.4	345.0	230.6	439.1	390.7	220.9	443.7	667.9	4108.4
1984	643.5	465.1	353.4	454.2	629.5	326.4	304.3	243.4	327.2	557.7	381.4	303.9	4990.0
1985	316.6	94.6	395.2	365.1	637.7	81.5	227.5	202.9	322.8	477.8	334.5	295.2	3751.4
1986	422.8	148.0	389.6	586.3	247.1	356.8	163.2	304.1	281.5	725.0	251.1	172.7	4048.2
AVE.	446.8	302.5	333.0	376.8	403.4	330.3	307.7	317.8	358.1	440.7	443.8	426.2	4487.0

Table III - 4 Generated Daily Discharge at Intake Site in 1984

(Unit : cms)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	15.8	16.0	10.6	9.8	8.8	77.6	8.6	7.7	14.0	6.6	8.2	17.6
2	12.0	12.8	9.7	8.5	16.9	33.2	10.0	7.4	12.7	61.8	7.8	16.7
3	9.2	12.0	9.0	9.1	25.2	23.9	8.9	7.2	8.9	121.8	7.6	12.4
4	13.0	20.1	8.3	8.1	16.8	25.6	7.8	6.9	7.3	58.2	7.5	10.9
5	22.0	14.1	8.1	14.9	20.7	18.3	7.5	6.8	6.8	81.9	7.4	10.2
6	15.1	10.5	7.9	15.9	29.6	22.6	7.4	6.5	7.9	30.5	7.3	10.0
7	16.3	51.8	7.8	15.8	38.2	15.0	8.4	6.3	9.7	22.5	7.9	9.9
8	17.3	69.8	7.6	15.6	42.2	11.1	10.1	6.1	20.0	18.4	9.0	9.0
9	35.9	26.3	7.5	15.5	24.2	9.6	12.9	6.0	26.7	16.4	11.4	9.3
10	20.6	16.7	9.3	50.5	23.7	9.3	10.3	5.8	30.8	15.3	85.6	54.0
11	14.2	10.8	11.9	26.3	22.1	23.3	11.2	5.6	33.2	17.8	28.3	28.3
12	10.4	8.9	14.2	19.4	15.9	14.2	10.0	5.5	34.4	20.7	18.0	17.3
13	35.9	9.6	10.4	14.2	14.3	11.2	9.2	5.5	22.5	13.6	11.0	11.7
14	19.3	20.0	8.7	68.2	26.1	19.0	19.9	5.5	16.0	10.0	10.5	9.7
15	36.2	17.4	7.7	23.6	18.4	83.2	18.0	5.4	11.9	8.5	9.4	8.5
16	28.2	12.7	7.9	25.4	17.6	37.5	11.8	5.4	22.7	8.3	8.4	26.6
17	31.3	54.4	18.5	17.6	20.0	22.5	9.4	5.3	14.3	8.0	7.8	15.3
18	22.6	21.4	31.5	34.1	14.9	14.3	9.9	5.3	9.9	7.8	7.6	27.7
19	17.3	23.9	18.1	24.6	11.6	10.2	12.6	5.3	10.8	7.6	14.2	17.0
20	12.6	16.1	65.4	16.7	9.8	9.3	12.1	5.2	18.2	7.9	10.3	14.1
21	9.7	15.8	24.9	11.9	8.9	9.1	18.8	5.2	16.0	9.1	15.3	10.4
22	25.0	12.1	17.3	10.1	8.7	8.8	50.6	32.7	11.6	9.7	14.9	10.0
23	29.6	10.4	27.4	19.8	11.5	8.5	20.9	22.8	9.4	17.0	10.2	8.7
24	113.1	23.2	17.5	23.1	10.0	8.3	13.6	68.9	8.3	28.8	11.3	8.1
25	83.4	15.8	13.1	16.3	10.2	8.1	9.5	22.7	7.8	17.1	9.2	7.9
26	34.3	12.9	10.1	12.1	15.9	7.9	9.0	22.5	7.6	15.5	8.2	7.7
27	21.8	33.9	9.2	10.1	14.1	7.6	10.5	13.5	7.4	11.5	35.1	7.4
28	14.2	18.2	9.4	9.4	25.2	9.3	9.9	8.4	7.1	10.0	17.9	7.1
29	35.2	12.8	8.7	9.6	51.4	8.3	8.7	8.1	6.8	21.6	11.8	6.9
30	33.3		8.0	9.6	62.2	7.7	8.1	6.9	6.7	14.6	13.8	6.8
31	21.1		12.1		29.5		7.9	6.7		10.1		6.7
Average	26.6	20.7	14.1	18.9	21.4	19.2	12.4	10.9	14.2	22.9	14.4	13.7

ANNUAL AVERAGE = 17.4 cms

Table III - 5 Generated Daily Discharge at Intake Site in 1985

(Unit : cms)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	6.4	6.8	4.8	8.7	8.3	25.8	4.8	5.7	19.9	21.1	35.4	32.7
2	6.3	6.7	5.6	9.2	7.4	16.4	4.8	5.5	12.4	12.8	21.5	27.1
3	6.3	6.6	4.9	36.4	6.7	11.0	4.8	5.2	7.4	8.9	14.4	21.8
4	6.6	6.5	7.9	27.2	6.6	9.0	4.7	5.0	6.6	15.5	9.4	21.0
5	18.2	6.4	17.5	18.9	6.5	22.3	4.7	4.8	5.7	19.0	8.7	60.7
6	62.5	6.4	12.7	19.9	6.6	16.3	4.7	4.7	5.6	21.0	7.8	36.7
7	21.6	6.3	8.7	21.0	11.0	12.0	4.7	4.7	5.5	22.1	7.5	23.4
8	23.4	6.3	6.5	21.8	17.7	11.1	4.7	4.5	5.4	22.8	8.2	16.0
9	14.4	6.2	5.6	22.4	21.6	9.5	4.6	4.4	5.4	13.9	8.8	11.2
10	10.2	6.2	5.6	15.2	23.8	8.4	4.6	4.3	8.7	11.0	9.1	9.2
11	8.1	6.2	5.4	9.9	20.0	8.2	4.6	4.3	7.0	9.0	9.4	11.9
12	7.3	6.2	5.2	7.7	12.3	7.9	4.7	4.3	6.3	7.5	10.0	9.5
13	7.1	6.1	5.0	7.5	10.9	7.6	4.7	4.3	5.5	6.9	9.4	9.0
14	7.0	6.0	13.1	7.3	64.8	7.2	4.8	4.3	5.4	6.8	9.9	8.0
15	6.7	6.1	7.8	8.9	52.5	7.0	4.7	4.2	5.3	6.7	12.3	7.8
16	6.4	6.1	6.9	25.7	23.1	6.7	4.8	4.2	5.3	6.6	10.7	8.3
17	6.2	6.0	5.5	24.6	18.4	6.6	13.7	4.2	8.0	6.4	9.3	11.3
18	6.0	6.0	5.4	14.8	20.2	6.4	8.3	4.1	6.1	6.2	8.3	9.5
19	13.0	5.9	5.3	9.4	17.8	6.2	7.9	4.1	6.6	6.1	7.3	9.4
20	17.1	5.8	5.3	8.3	13.9	5.9	8.4	4.8	6.3	6.6	6.9	8.2
21	11.4	5.6	5.6	8.0	44.6	5.7	16.5	4.4	6.1	12.4	6.7	7.2
22	20.8	5.4	15.9	7.2	27.5	5.5	10.8	4.8	19.7	21.5	6.6	7.0
23	12.7	5.2	49.9	7.4	26.6	5.3	22.0	4.2	13.9	13.9	6.5	6.9
24	8.8	5.2	75.8	7.1	20.1	5.1	23.0	4.2	37.2	15.7	6.4	6.7
25	7.4	5.2	36.1	7.8	14.2	4.9	13.5	7.1	20.8	10.9	6.3	6.6
26	16.4	5.2	26.3	7.0	21.6	4.9	8.2	12.9	13.5	9.5	6.2	6.9
27	13.7	5.1	19.0	6.8	38.2	4.9	6.3	7.6	8.4	7.6	27.5	7.7
28	12.1	4.9	14.1	13.8	75.2	4.9	6.2	5.7	13.6	25.4	14.1	8.3
29	8.8		9.0	9.1	36.3	4.9	6.1	8.5	27.3	28.5	9.2	7.8
30	7.2		8.1	7.7	31.3	4.8	6.0	10.3	23.1	50.0	100.8	6.8
31	6.9		7.7		28.8		5.9	42.7		88.4		6.5
Average	12.5	5.9	13.3	13.6	23.7	8.7	7.7	6.6	10.9	16.8	13.8	13.9

ANNUAL AVERAGE = 12.3 cms

Table III - 6 Generated Daily Discharge at Intake Site in 1986

(Unit : cms)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	6.4	10.1	6.6	9.2	138.7	17.4	5.7	9.5	7.7	8.0	28.4	14.3
2	6.3	7.9	5.7	17.6	34.6	19.7	5.7	10.7	11.0	11.6	30.5	8.9
3	6.2	7.7	5.6	17.1	20.9	21.0	5.7	11.4	15.9	16.4	29.4	7.9
4	6.1	7.4	5.5	38.5	15.3	21.8	5.6	7.5	9.9	22.9	18.1	17.6
5	6.0	7.1	5.4	24.7	18.4	22.3	5.5	6.4	7.3	37.8	14.8	13.3
6	5.9	6.9	5.3	19.5	13.9	22.6	5.4	6.0	6.3	33.7	10.6	10.6
7	5.8	6.6	5.3	16.2	19.1	13.7	5.2	5.5	6.1	34.2	9.9	8.1
8	5.7	6.3	5.3	14.4	23.5	10.8	5.0	5.5	6.1	34.6	9.7	6.8
9	5.6	6.2	7.1	13.6	26.3	9.0	4.8	5.5	10.5	34.9	9.7	6.7
10	5.5	6.2	9.8	9.8	17.8	17.5	4.7	5.4	17.1	43.2	9.7	6.7
11	5.5	7.1	7.2	74.1	14.4	25.8	4.7	5.2	18.1	102.3	9.2	6.6
12	5.4	8.5	5.8	28.4	10.0	15.4	4.7	5.0	17.1	35.2	15.0	6.5
13	5.4	10.6	5.6	69.9	8.1	80.5	4.6	5.2	19.6	26.6	10.4	6.4
14	5.4	8.1	6.7	35.0	7.9	36.7	4.6	6.5	12.0	42.3	9.2	6.3
15	5.4	6.6	9.3	22.9	7.7	22.2	4.6	20.0	8.0	21.6	7.8	6.2
16	14.6	6.3	7.8	14.5	7.4	22.2	4.6	55.9	7.9	13.8	7.7	6.1
17	15.9	6.2	33.7	10.8	7.1	22.0	4.6	19.7	7.3	9.6	7.5	6.0
18	9.8	6.1	22.8	9.5	7.8	20.8	4.6	17.1	7.1	8.5	7.3	12.0
19	7.0	6.1	23.1	8.3	7.5	13.3	4.5	14.4	6.5	8.2	7.1	9.6
20	5.9	5.9	17.6	8.1	6.9	9.8	4.5	12.2	6.3	13.5	6.9	8.5
21	5.8	5.8	12.6	7.9	6.8	8.1	5.2	8.2	6.2	13.5	6.8	7.8
22	66.0	5.7	30.4	7.8	6.7	7.9	4.6	7.0	6.0	9.9	6.6	6.5
23	50.6	5.5	19.7	7.9	6.4	7.7	4.6	11.5	5.8	9.7	6.4	6.2
24	41.8	5.3	12.2	7.9	6.3	7.6	4.6	8.2	6.2	14.4	6.2	6.1
25	26.2	5.1	8.2	10.5	6.0	7.3	5.9	8.5	5.7	9.9	6.1	6.1
26	31.8	18.3	9.2	8.8	5.8	7.0	4.9	7.4	5.7	8.3	6.0	6.0
27	19.2	11.3	38.1	8.0	5.5	6.7	5.2	6.9	7.6	9.3	7.1	5.9
28	45.5	8.6	23.2	7.8	5.4	6.4	4.9	6.3	21.8	88.4	9.8	5.8
29	43.0		26.7	8.0	5.4	6.2	4.9	6.2	15.0	27.1	16.5	5.8
30	25.7		17.3	7.2	8.4	5.9	4.8	6.1	11.3	31.0	24.1	5.7
31	16.6		11.1		13.4		10.9	6.6		69.2		5.7
Average	16.5	7.5	13.2	18.1	15.8	17.2	5.2	10.2	10.0	27.4	11.8	7.8

ANNUAL AVERAGE = 13.4 cms

Table III - 7 Frequency Analysis of Rainfall Depth

(Unit:mm)

STORM DURATION (DAYS)	RETURN PERIOD (YEAR) 2	5	10	20	50	100	200
A. Gumbel method							
1	72	94	108	122	139	152	165
2	100	130	149	168	192	210	229
3	122	164	192	219	253	279	305
5	161	211	245	277	319	350	381
B. Iwai method							
1	73	94	108	122	139	152	165
2	100	130	149	168	192	210	229
3	124	154	171	187	207	220	234
5	163	110	223	245	272	292	312
C. Log-Pearson Type-III method							
1	72	91	103	115	130	142	154
2	98	123	141	159	184	205	227
3	116	147	173	203	251	293	342
5	154	193	225	259	312	356	407

Table III - 8 Heavy Rainfall Data at Kuching

No	Period From	To	Amount (mm)
(1)	Jan. 8, 1971	Jan. 9, 1971	355
(2)	Jun. 22, 1972	Jun. 23, 1972	247
(3)	Dec. 24, 1973	Dec. 25, 1973	198
(4)	Dec. 28, 1975	Dec. 29, 1975	193

Table III - 9 Ratio of Every 3-hour Rainfall Depth to 1-day Rainfall Depth

Duration (hr)	Accumulated (%)	Ratio (%)
0 - 3	9.7	9.7
3 - 6	24.4	14.7
6 - 9	40.0	15.6
9 - 12	60.5	20.5
12 - 15	82.3	21.8
15 - 18	89.5	7.2
18 - 21	95.3	5.8
21 - 24	100.0	4.7

Table III - 10 Design Rainfall

(Unit:mm)

RETURN PERIOD (YEARS)	DURATION (HRS) 3	6	9	12	15	18	21	24	TOTAL
2	12	18	19	25	27	9	7	6	123
5	15	22	23	31	33	11	9	7	150
10	16	25	26	34	37	12	10	8	168
20	18	27	29	38	41	13	11	9	186
50	20	31	32	43	45	15	12	10	208
100	22	33	35	46	49	16	13	11	225
200	23	36	38	50	53	17	14	11	242

Table III - 11 Loss Rate adopted in Malaysia

Project	Location	Catchment Area (sq.km)	Loss Rate (mm/hr)
Klang Gates Dam	P. Malaysia	74	5.1
Jor Dam	"	123	7.2
Batang Ai	Sarawak	1,200	3.0
Pergau Dam	P. Malaysia	1,290	2.5
Temengor Dam	"	3,400	2.5
Kenyir Dam	"	4,580	2.5
Bakun	Sarawak	14,750	4.0

Table III - 12 Probable Peak Discharge and Flood Volume

CATCHMENT AREA (km^2)	RETURN PERIOD (years)	FLOOD VOLUME ($10^6 m$)	PEAK DISCHARGE (m^3/sec)	SPECIFIC DISCHARGE ($m^3/sec/km^2$)
	2	12.0	277	1.5
	5	16.6	361	1.9
	10	19.8	417	2.2
186	20	23.1	473	2.5
	50	27.1	542	2.9
	100	30.2	595	3.2
	200	33.3	648	3.5

Table III - 13 Annual Maximum Peak Discharge at Nanga Medamit

Year	Peak Discharge (m^3/sec)	Specific Discharge (m^3/sec/km^2)
1966	771	0.274
1967	909	0.324
1968	922	0.328
1969	869	0.309
1970	926	0.330
1971	1,204	0.428
1972	858	0.305
1973	1,047	0.373
1974	1,028	0.366
1975	1,059	0.377
1976	1,035	0.368
1977	1,520	0.541
1978	782	0.278
1979	955	0.340
1980	788	0.280
1981	877	0.312
1982	745	0.265
1983	771	0.274
1984	879	0.313

Note : Catchment area at Nanga Medamit is 2,810 km^2.

Table III-14 Frequency Analysis for Annual Maximum Peak Discharge at Nanga Medamit

(Unit:m^3/sec)

Return Period (years)	Method			Adopted
	Gumbel	Iwai	LP TypeIII	
200	1,756	1,733	1,775	1,760
100	1,638	1,605	1,620	1,640
50	1,519	1,482	1,477	1,520
20	1,361	1,325	1,300	1,360
10	1,238	1,209	1,176	1,240
5	1,111	1,093	1,057	1,110
2	918	930	898	920

Table III - 15 Probable Flood Volume at Nanga Medamit

(Unit:$10^6 m^3$)

Duration (days)	Return Period (years)						
	2	5	10	20	50	100	200
1	68.9	87.5	93.5	99.2	106.6	112.2	115.4
2	126.0	159.3	169.5	179.4	192.0	201.7	207.0
3	175.2	220.8	234.6	247.8	264.6	277.6	284.9
5	252.3	319.7	340.9	360.7	387.1	406.5	417.7
7	325.8	411.9	437.9	463.3	495.3	520.1	534.0
10	419.0	522.7	550.4	594.4	611.7	637.6	652.3
15	536.5	679.1	723.2	765.9	820.4	860.5	883.9

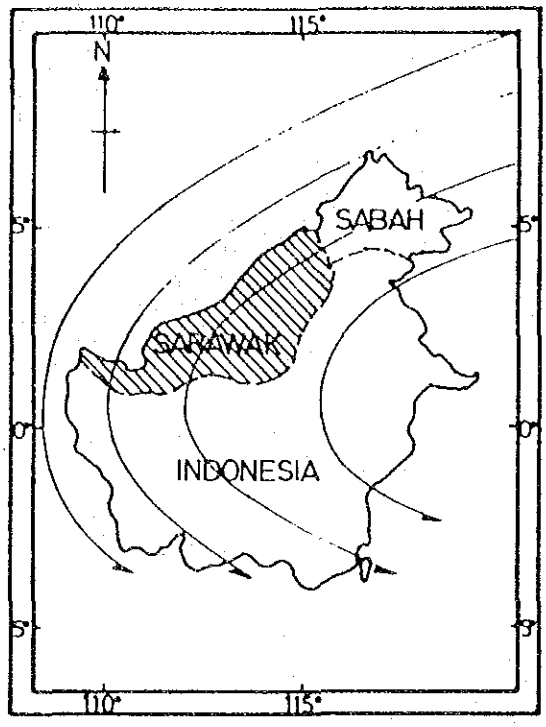
Table III - 16 Probable Peak Discharge at Powerhouse Site

Return Period (years)	Nanga Medamit		C	Powerhouse Site	
	Q	q		Q'	Qadopt
200	1,760	0.625	18.013	1,492	1,500
100	1,640	0.582	16.785	1,391	1,400
50	1,520	0.540	15.557	1,289	1,300
20	1,360	0.483	13.919	1,153	1,150
10	1,240	0.440	12.691	1,051	1,050
5	1,110	0.394	11.360	941	940
2	920	0.327	9.416	780	780

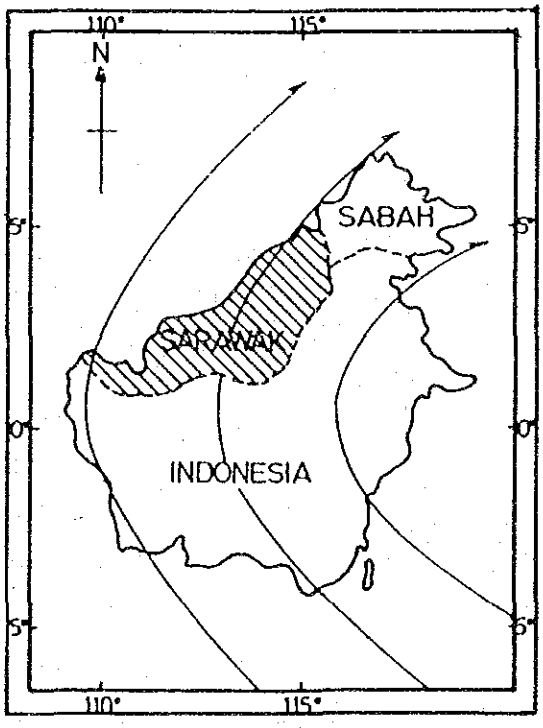
Note : Q : probable peak discharge (m^3/sec)
q : specific discharge (m^3/sec/km^2)
C : coefficient at Creager's equation
Q' : probable peak discharge (m^3/sec)
Qadopt : adopted value (m^3/sec)

Table III-17 Typical Composition of Fresh Water in Limbang River

Description	Unit	Value
PH		7.2
Conductivity	pemkos/cm	35
Cl	ppm	1.0
SO_4	ppm	10.0
Ca	meq/l	0.10
Mg	"	0.20
Na	"	0.14
K	"	0.01



Rainy Season



Dry Season

Fig. III - 1 Prevailing Patterns of Monsoons

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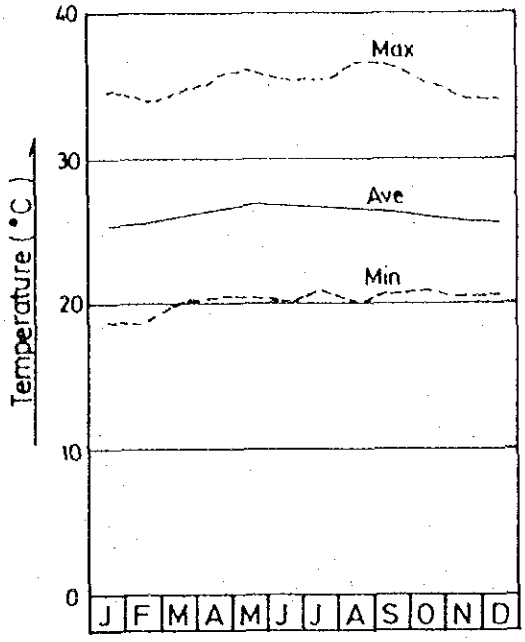
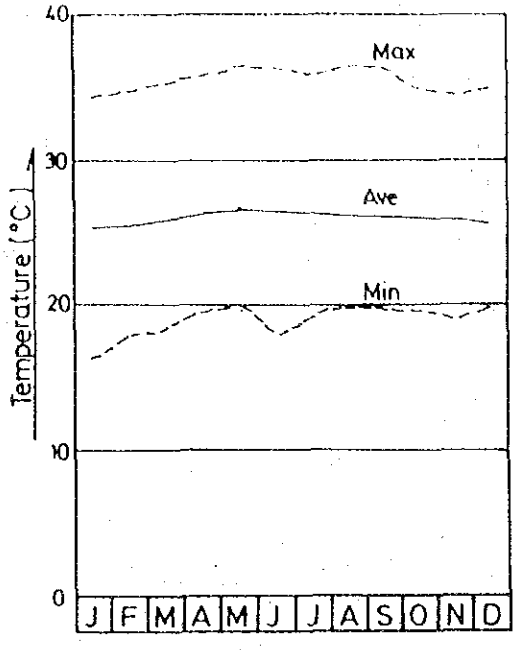


KUCHING
(1968 - 1981)



SIBU
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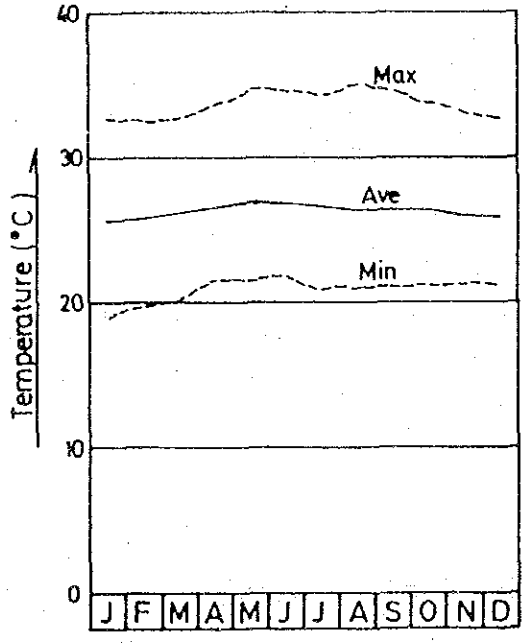

BINTULU
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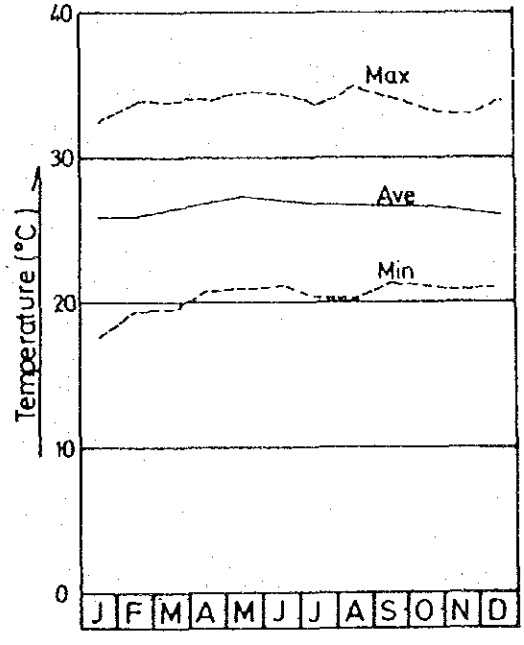

MIRI
(1968 - 1981)

Fig. III - 2 Monthly Mean, Maximum and Minimum Temperatures

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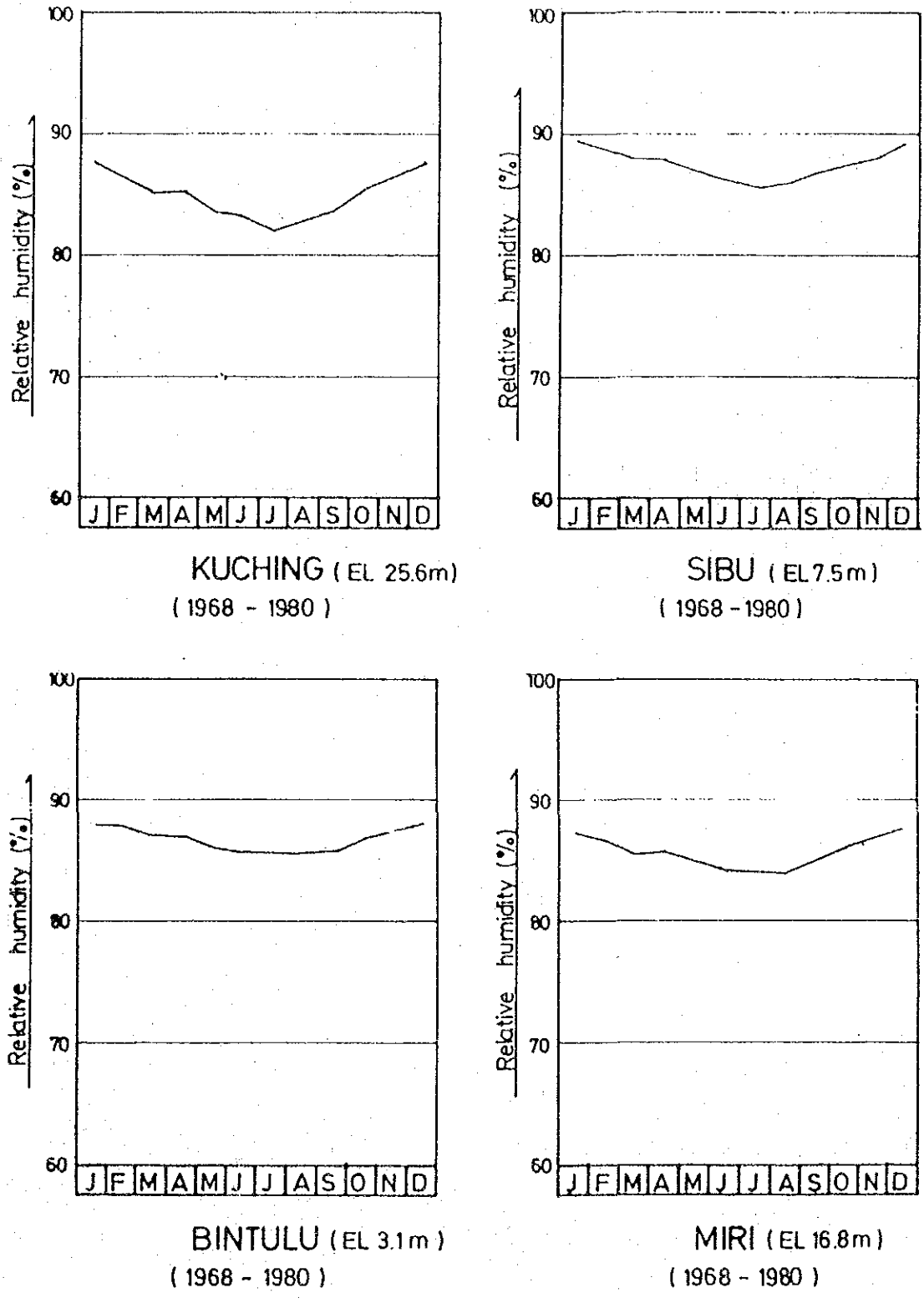

Fig. III - 3 Monthly Mean Relative Humidity

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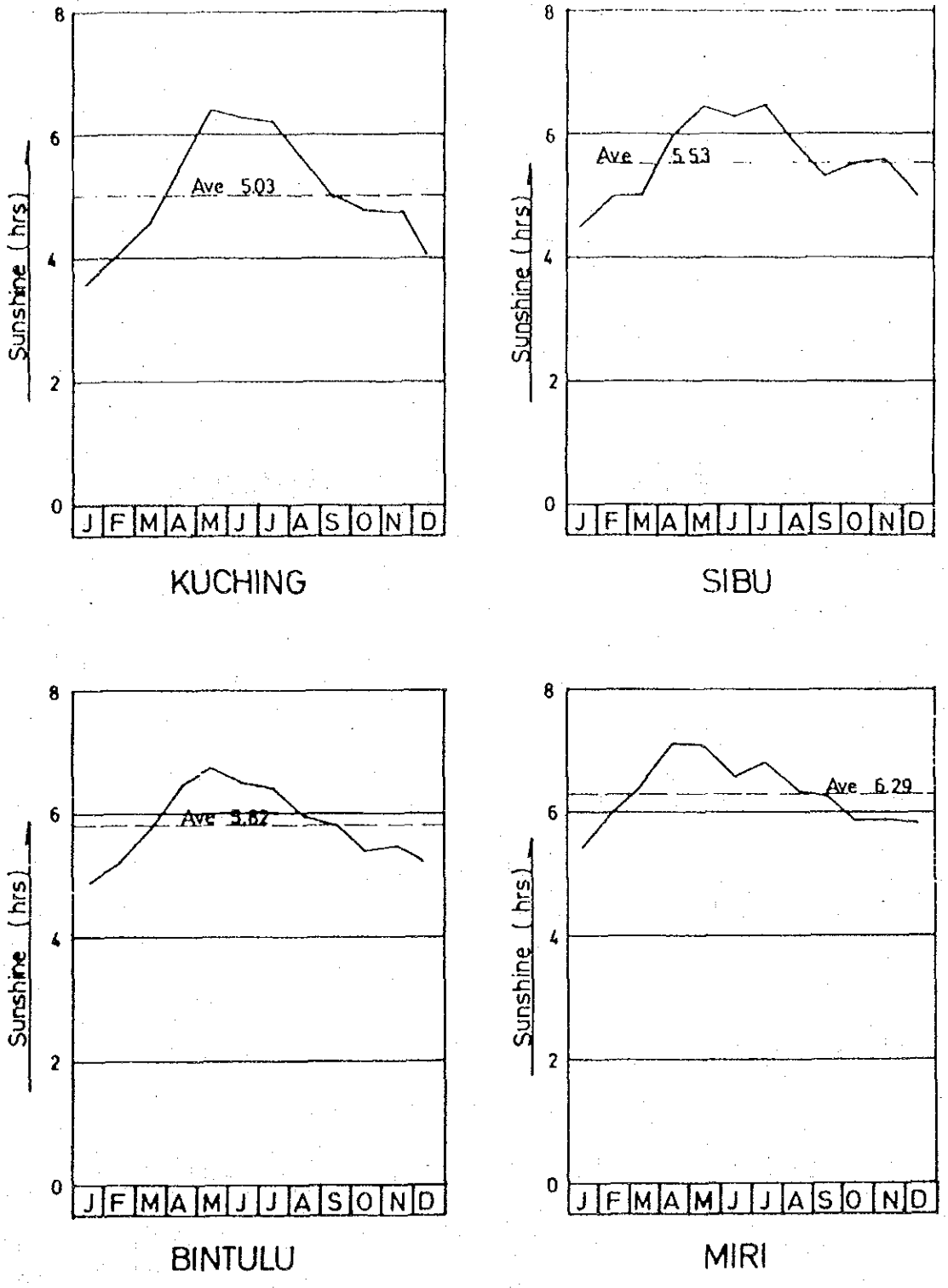

Fig. III - 4 Mean Monthly Patterns of Sunshine Hour

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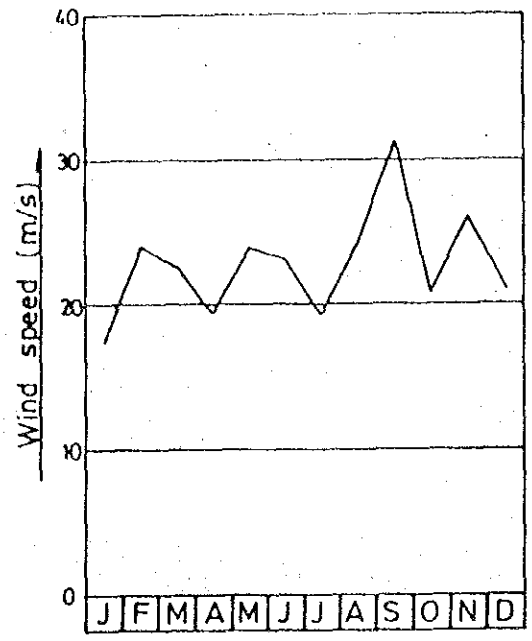
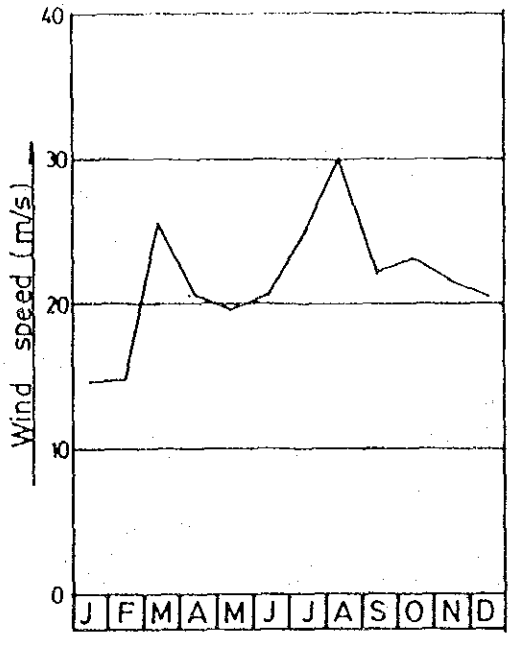
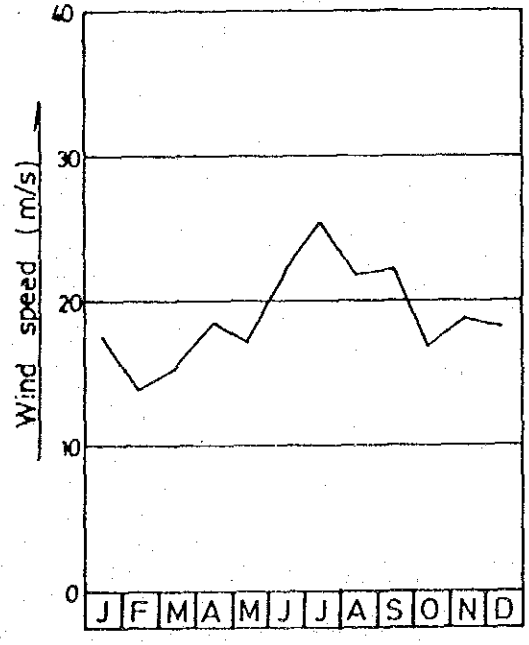


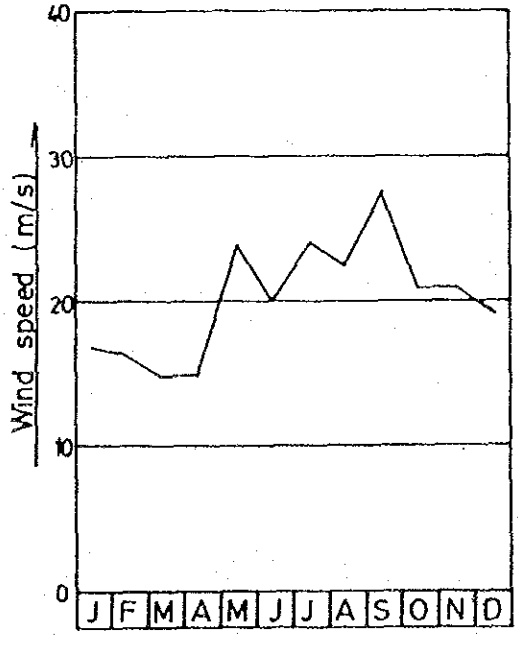
KUCHING
(1964 - 1981)



SIBU
(1964 - 1981)



BINTULU
(1964 - 1981)



MIRI
(1964 - 1981)

Fig. III - 5 Monthly Maximum Surface Wind Speed

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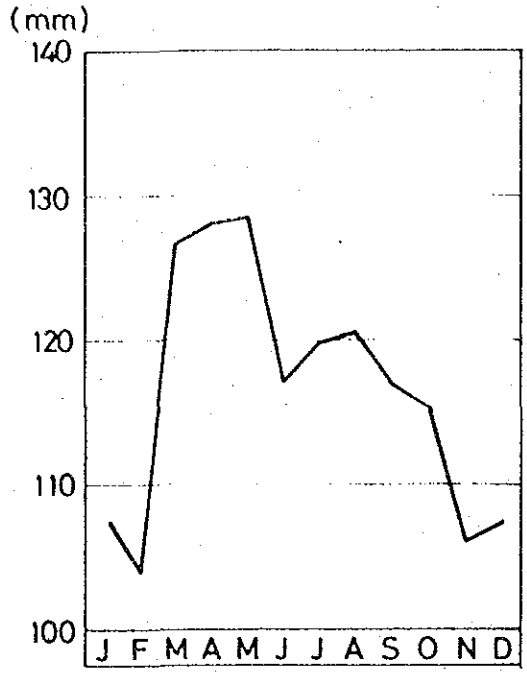
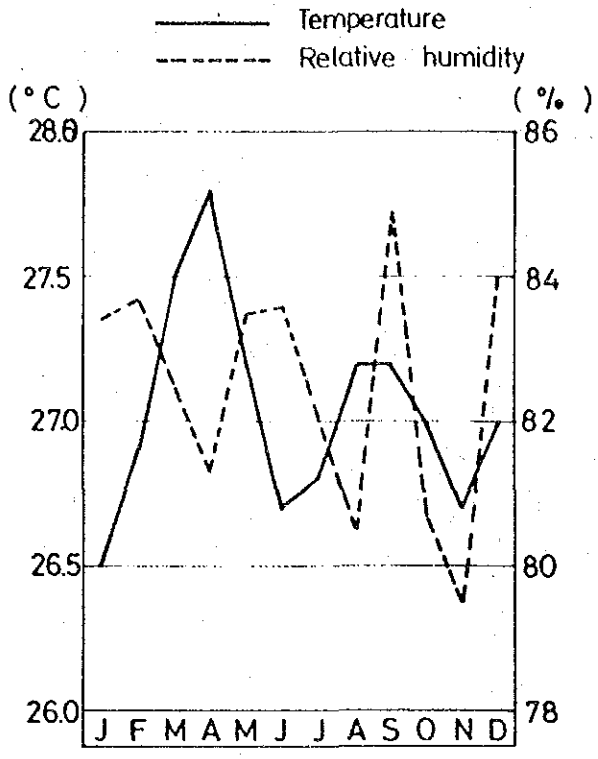
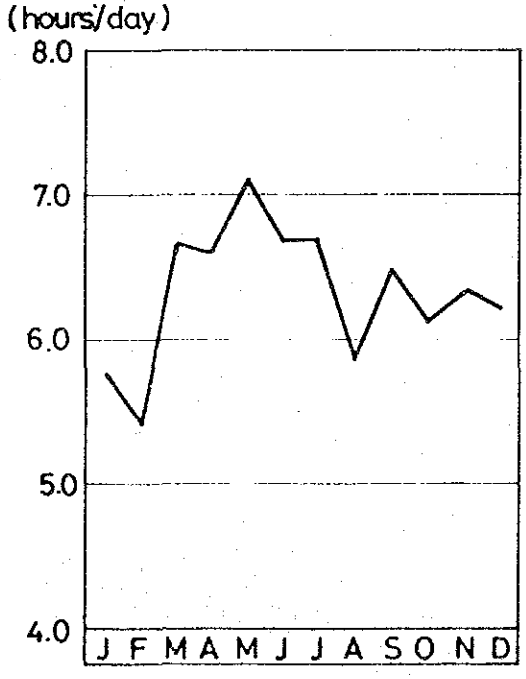


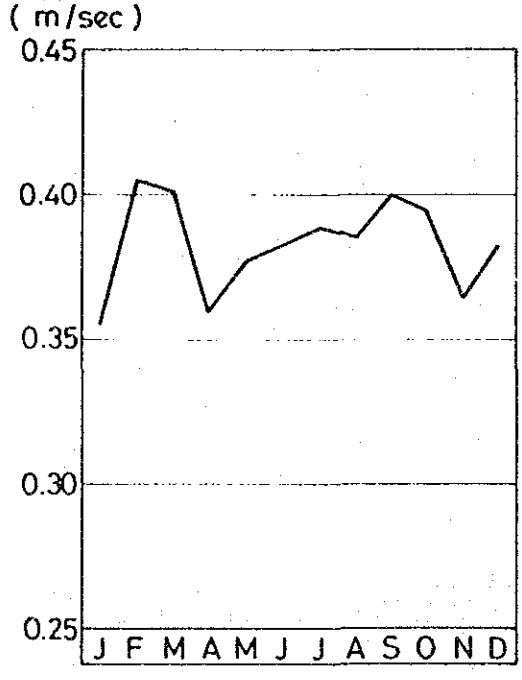
EVAPORATION



TEMPERATURE AND
RELATIVE HUMIDITY



SUNSHINE HOUR



SURFACE WIND VELOCITY

Fig.III- 6 Meteorological Data at Ukong

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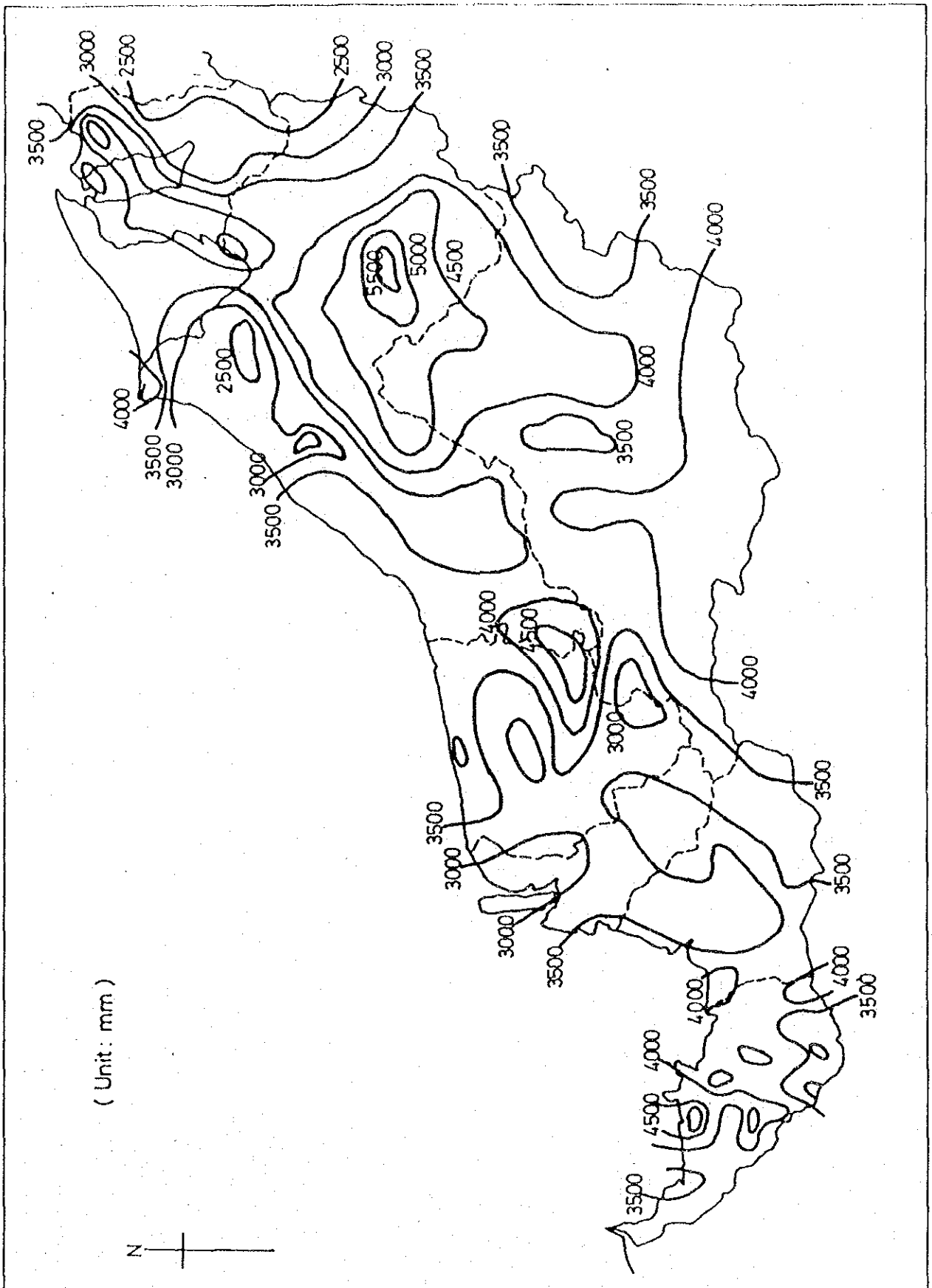

Fig. III - 7 Isohyetal Map of Mean Annual Rainfall

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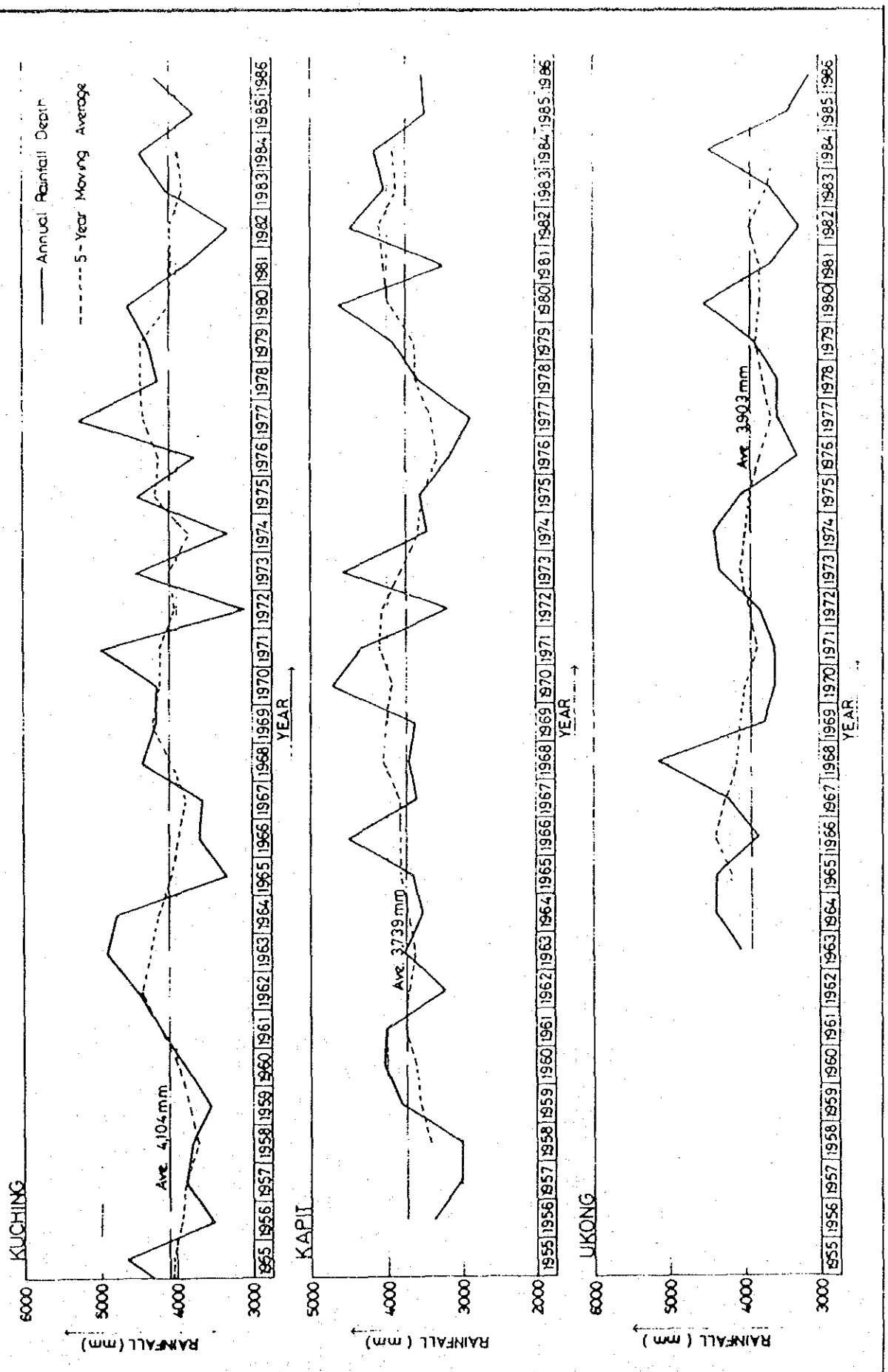

Fig. III - 8 Annual Rainfall Depth at Representative Stations

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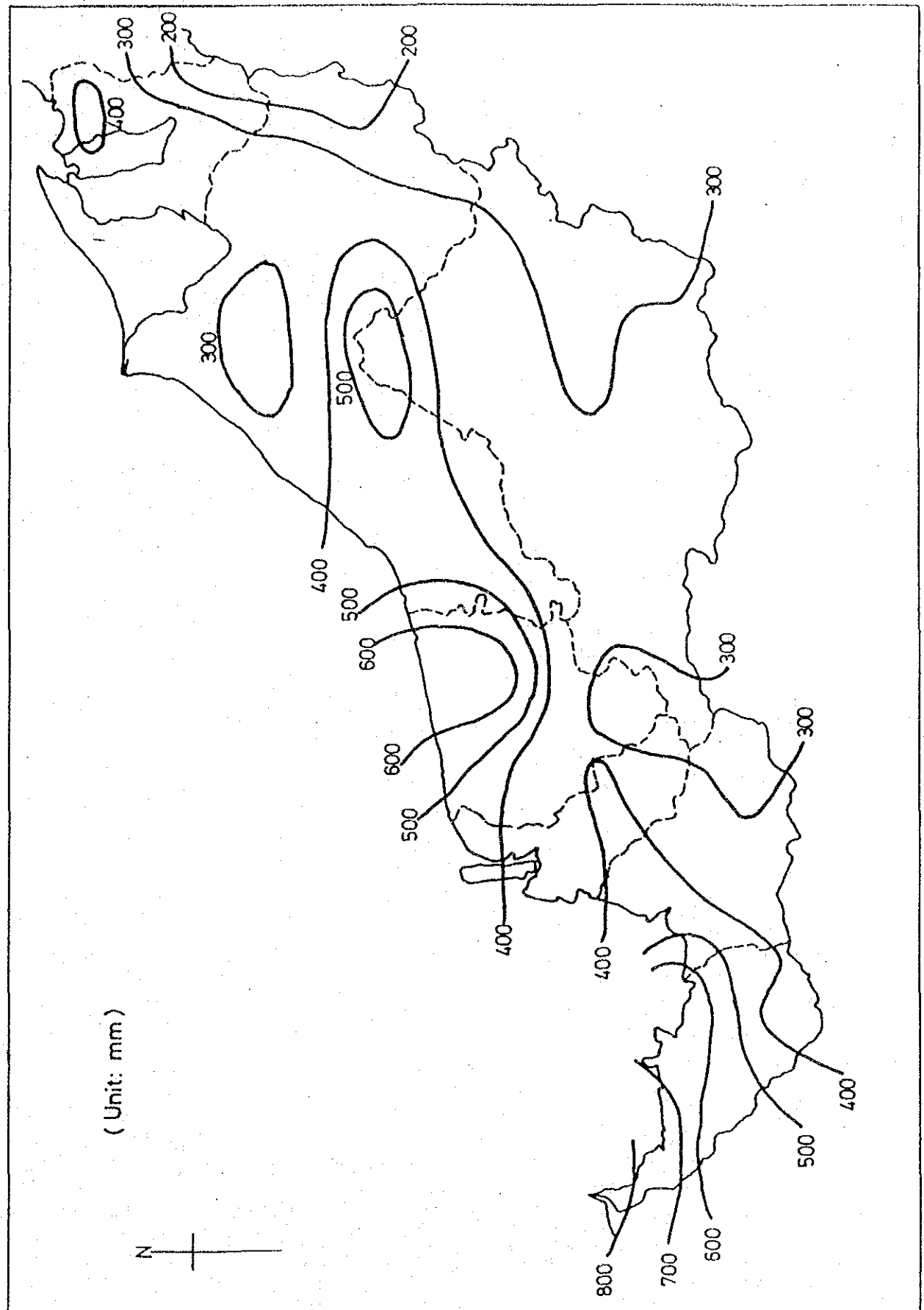

Fig. III - 9 Isohyetal Map of Monthly Mean Rainfall (January)

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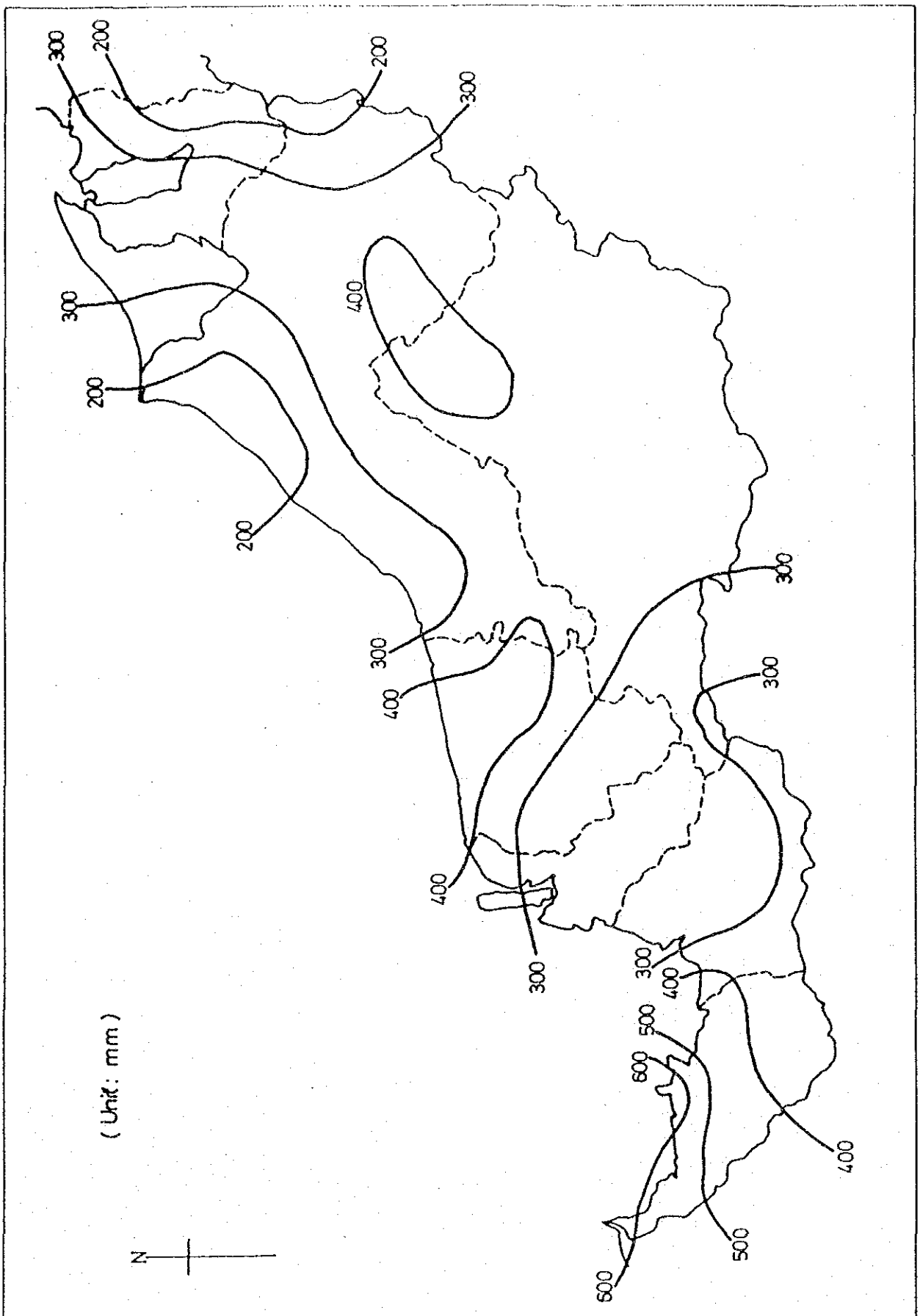

Fig. III - 10 Isohyetal Map of Monthly Mean Rainfall (February)

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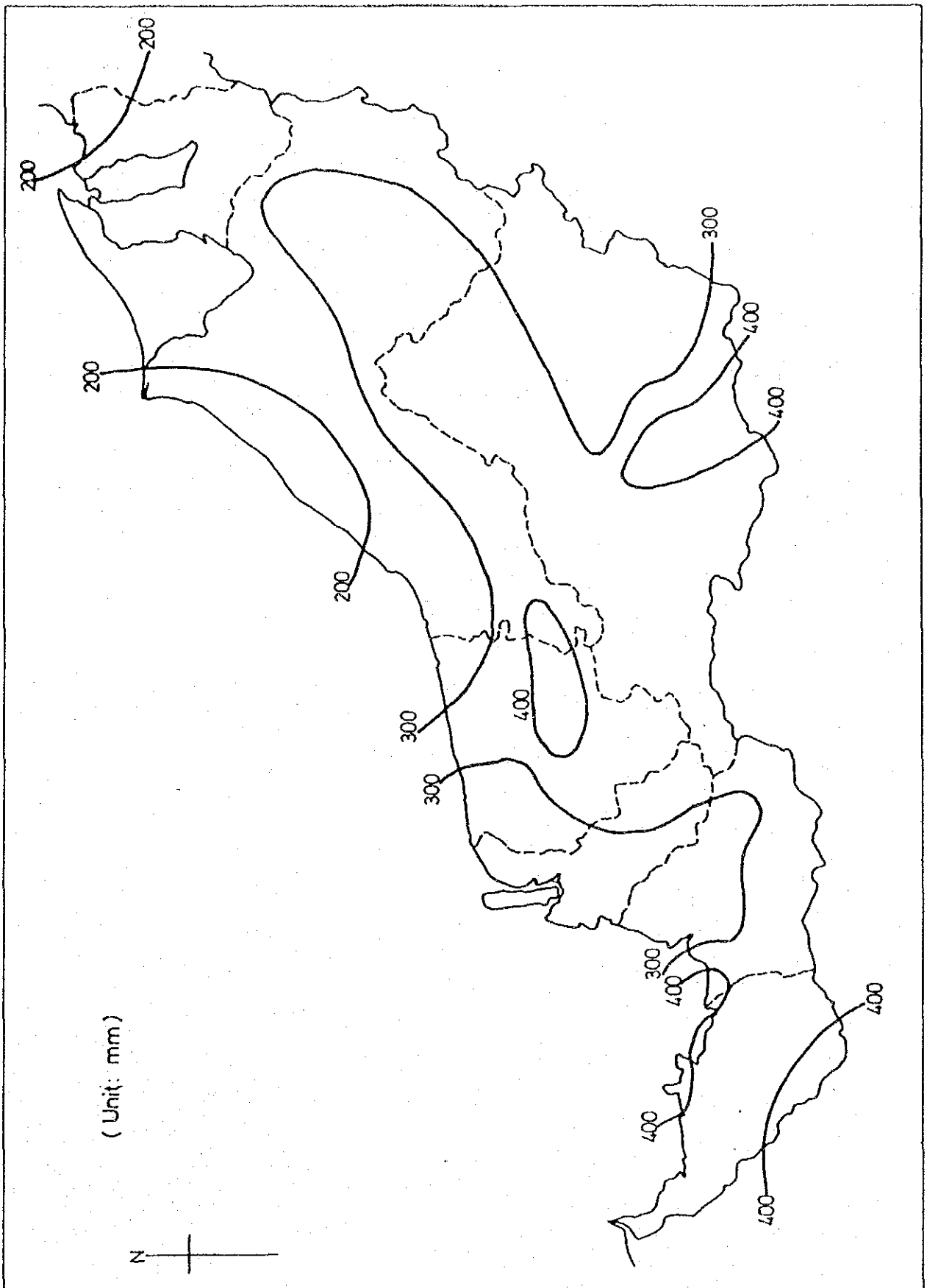

Fig. III - 11 Isohyetal Map of Monthly Mean Rainfall (March)

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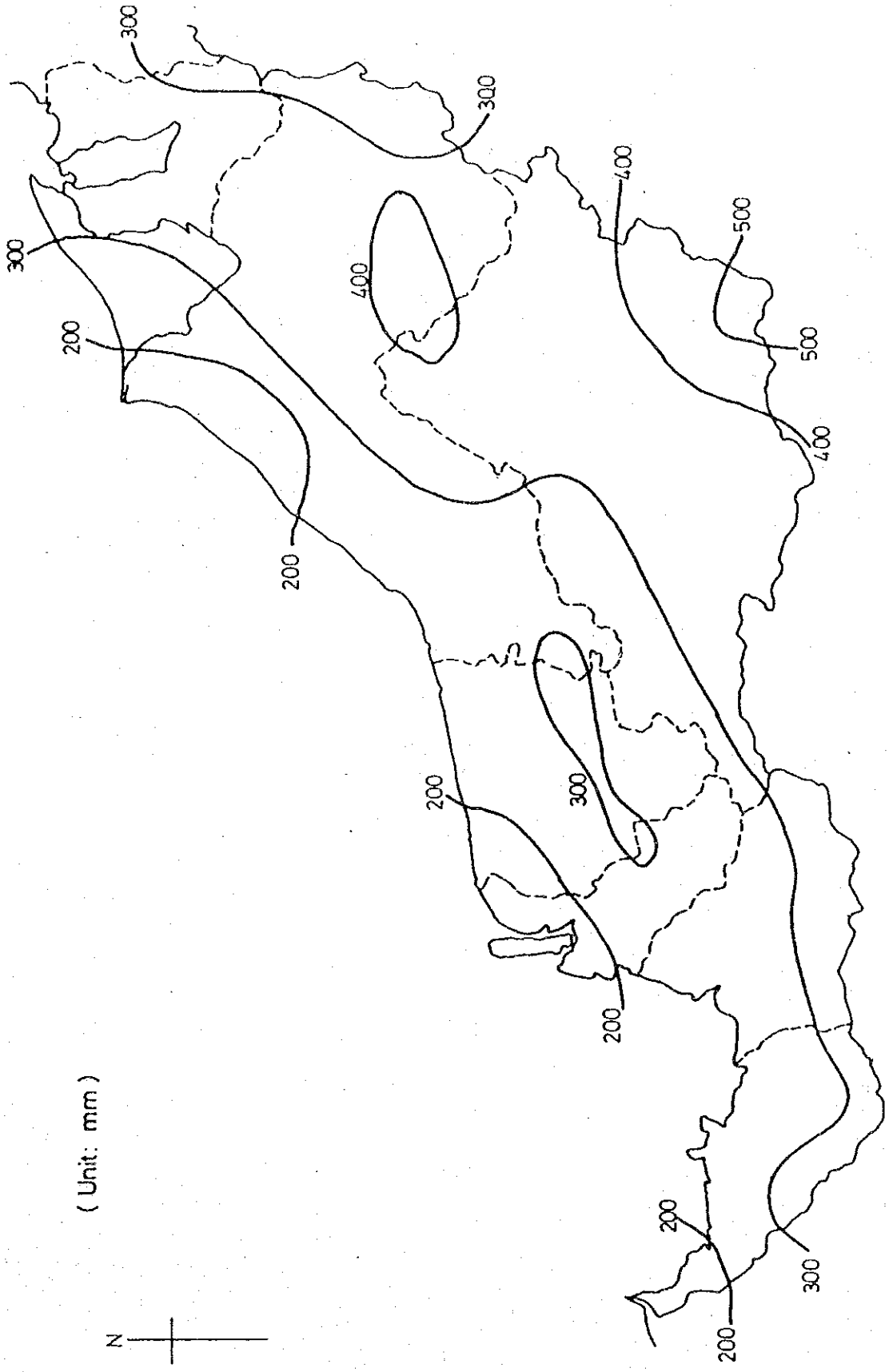

Fig. III - 12 Isohyetal Map of Monthly Mean Rainfall (April)

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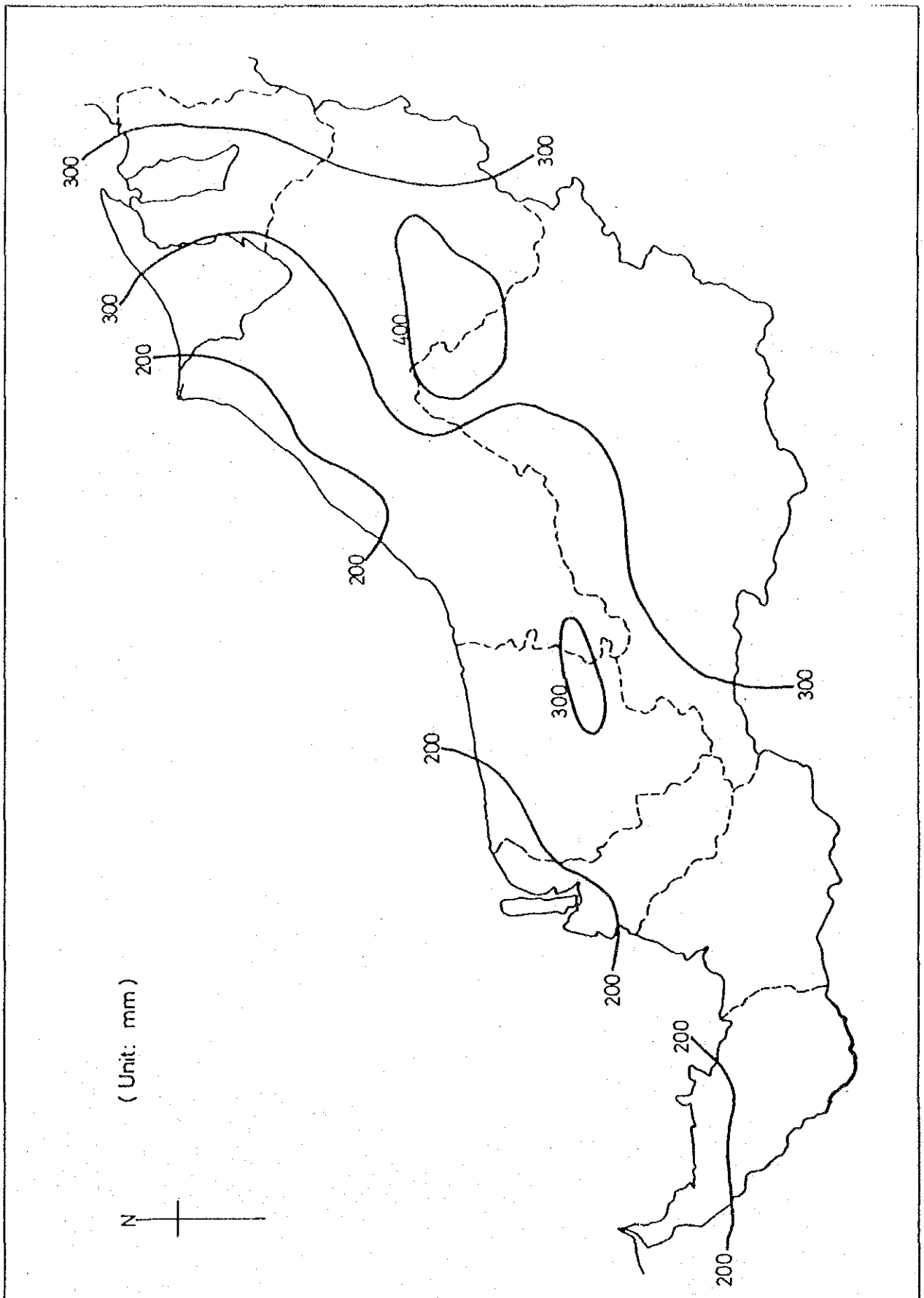

Fig. III - 13 Isohyetal Map of Monthly Mean Rainfall (May)

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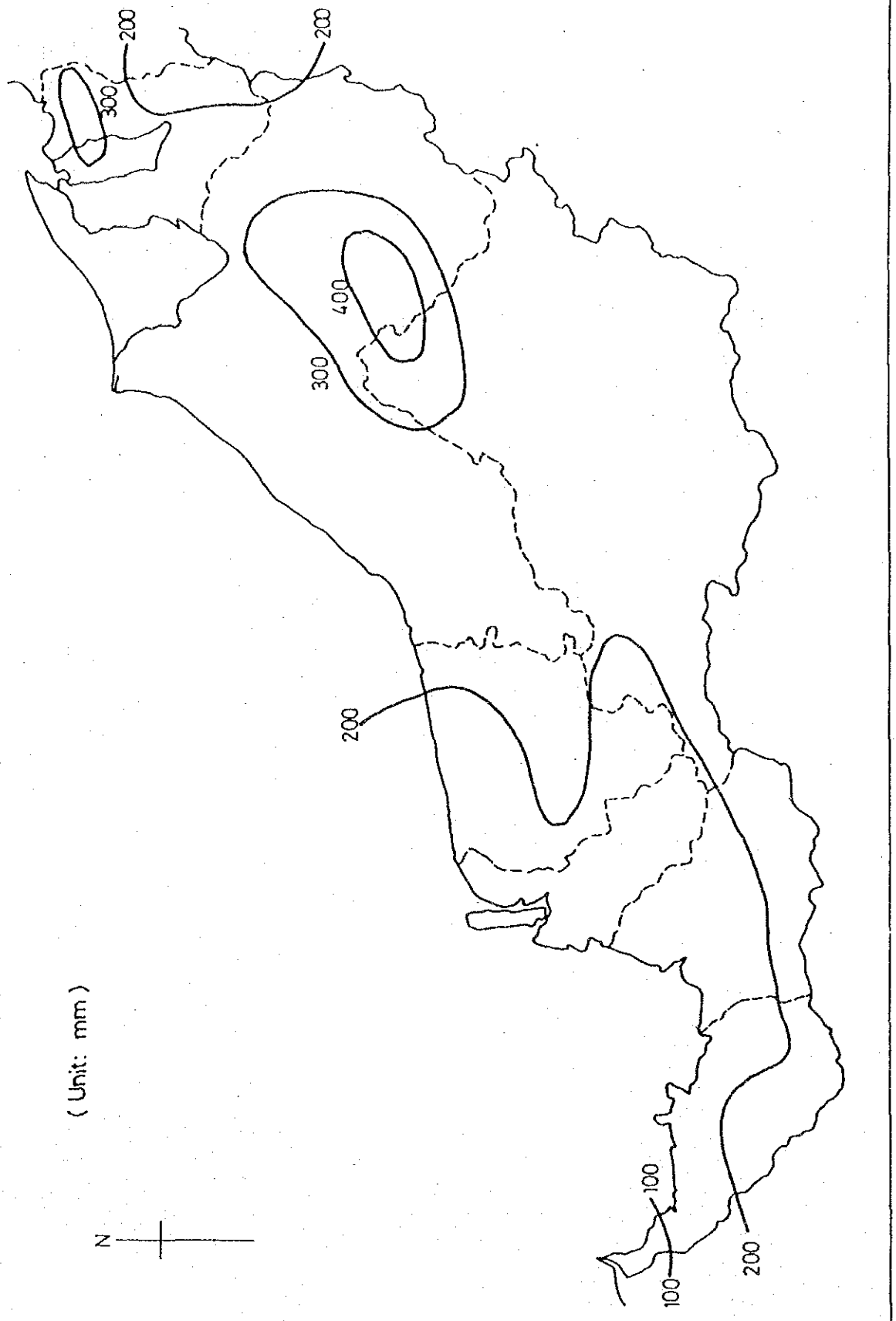

Fig. III - 14 Isohyetal Map of Monthly Mean Rainfall (June)

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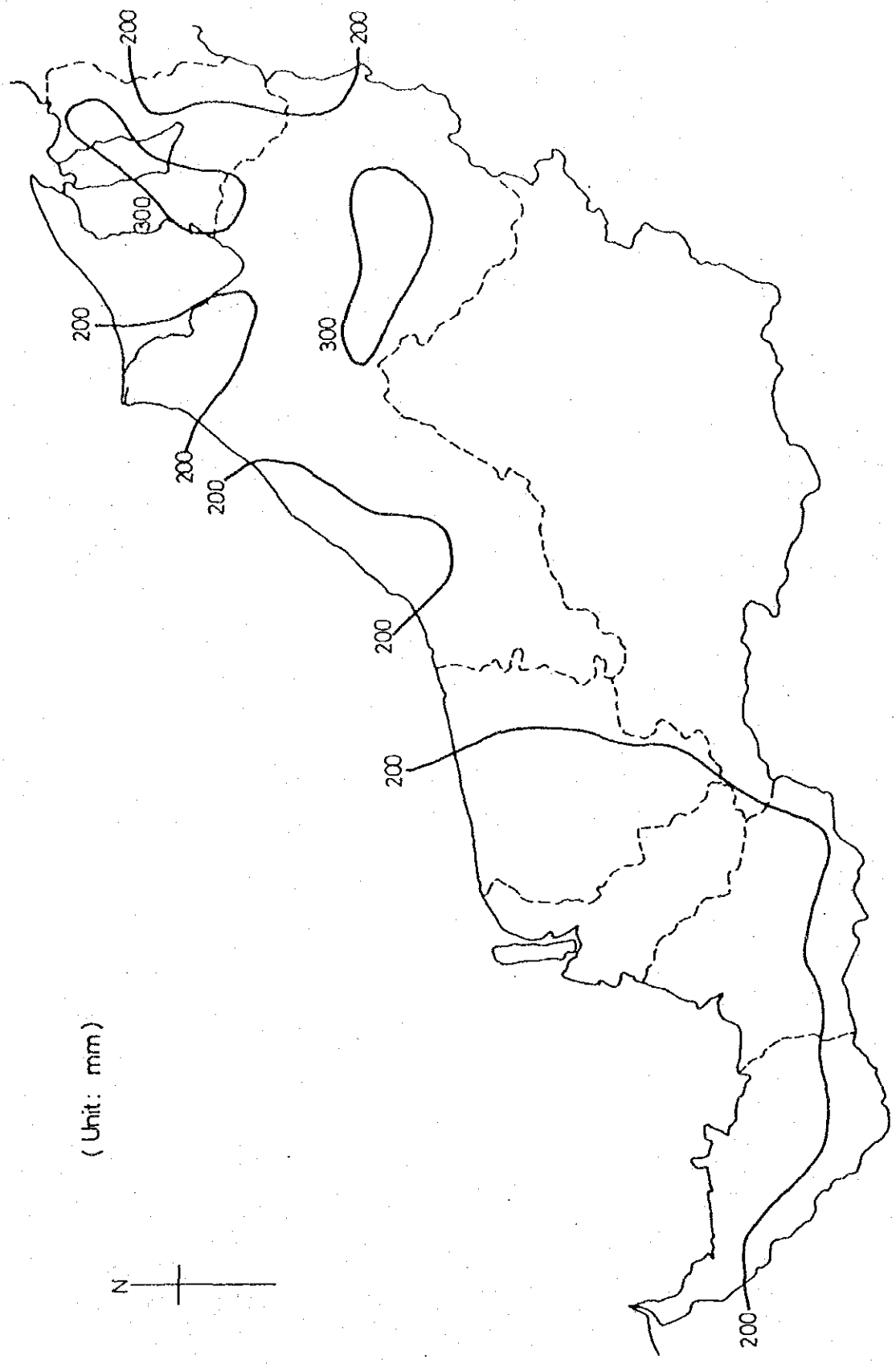

Fig. III - 15 Isohyetal Map of Monthly Mean Rainfall (July)

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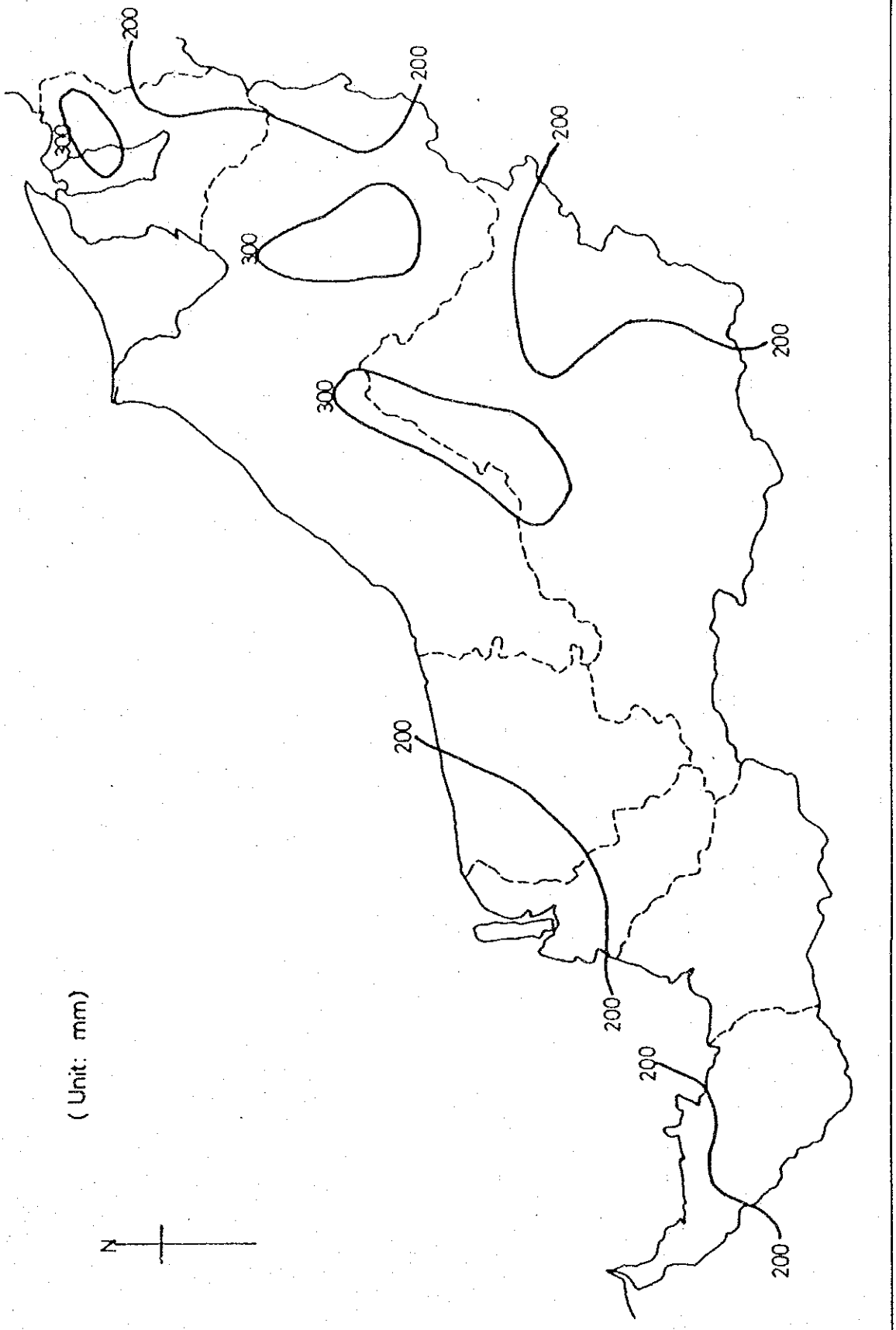

Fig. III - 16 Isohyetal Map of Monthly Mean Rainfall (August)

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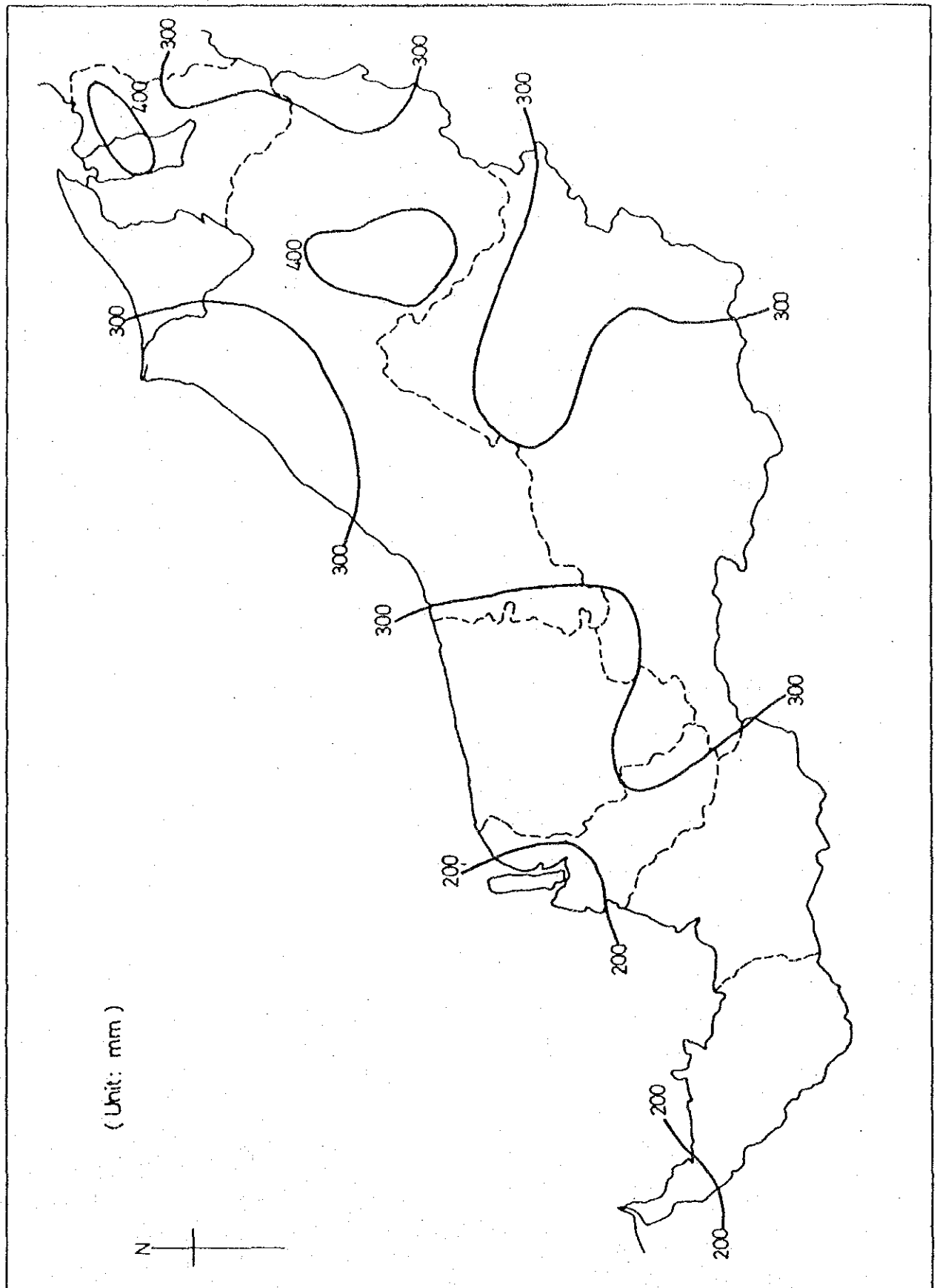

Fig. III - 17 Isohyetal Map of Monthly Mean Rainfall (September)

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JAPAN INTERNATIONAL COOPERATION AGENCY

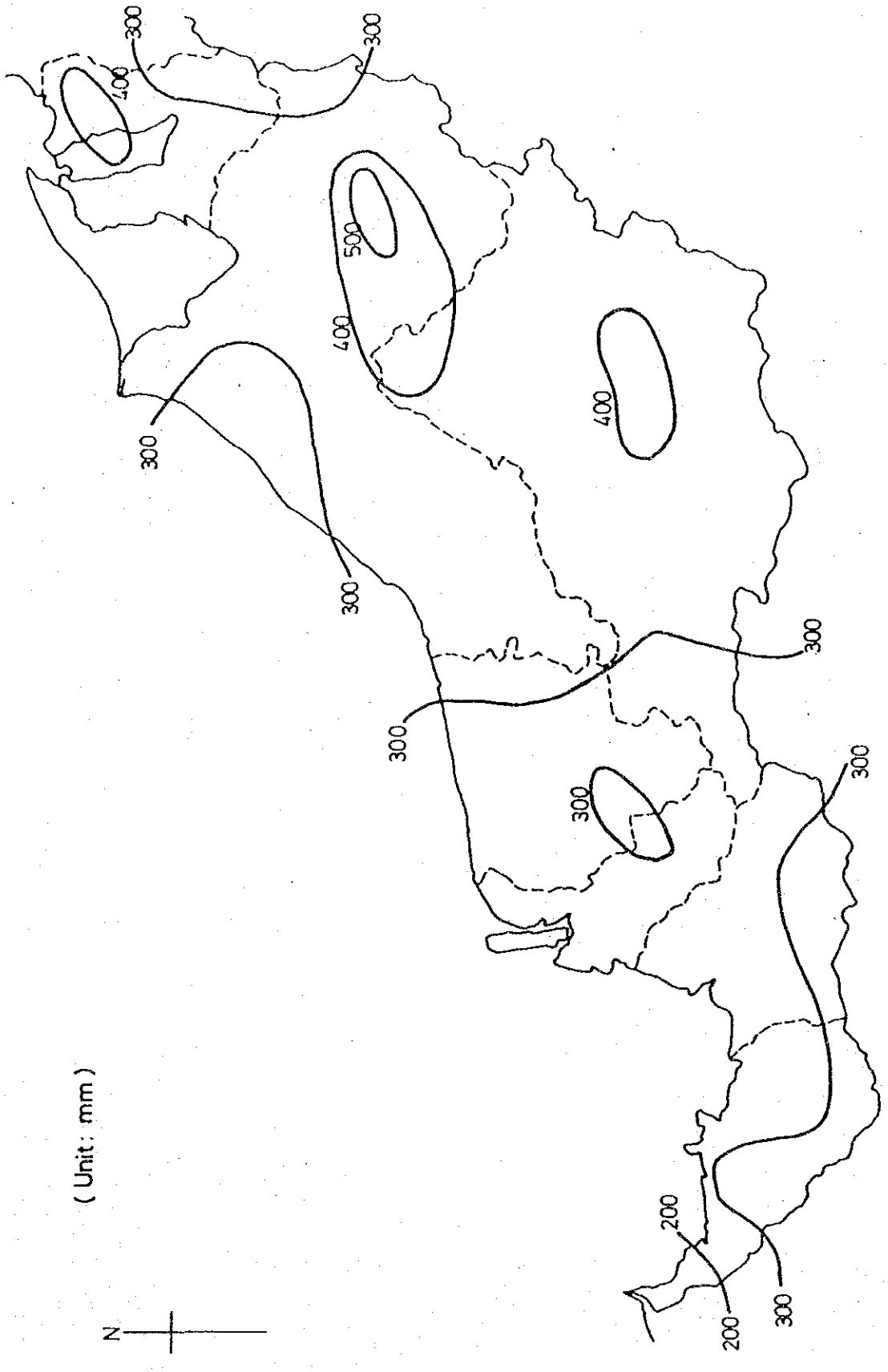

Fig. III - 18 Isohyetal Map of Monthly Mean Rainfall (October)

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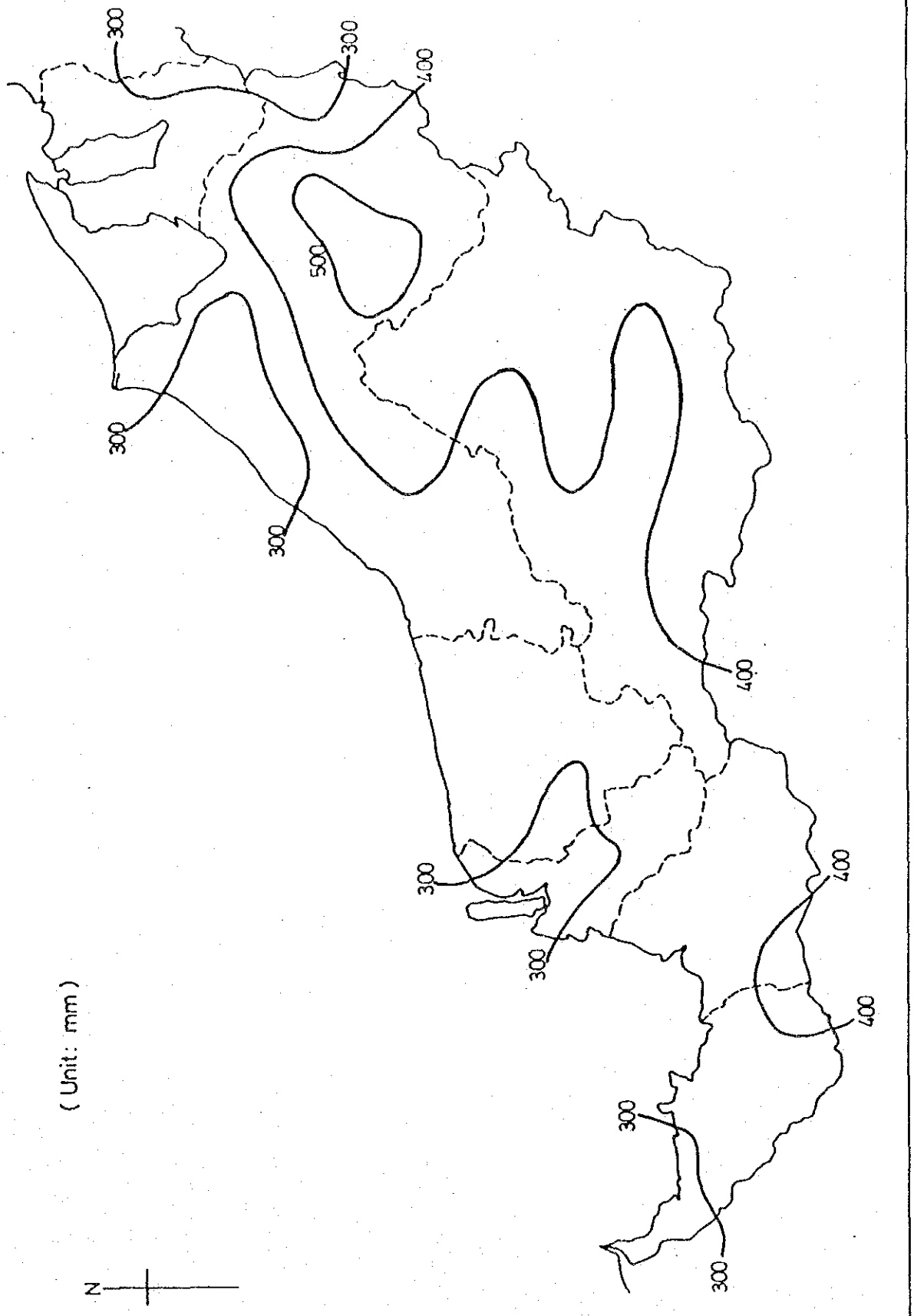

Fig. III - 19 Isohyetal Map of Monthly Mean Rainfall (November)

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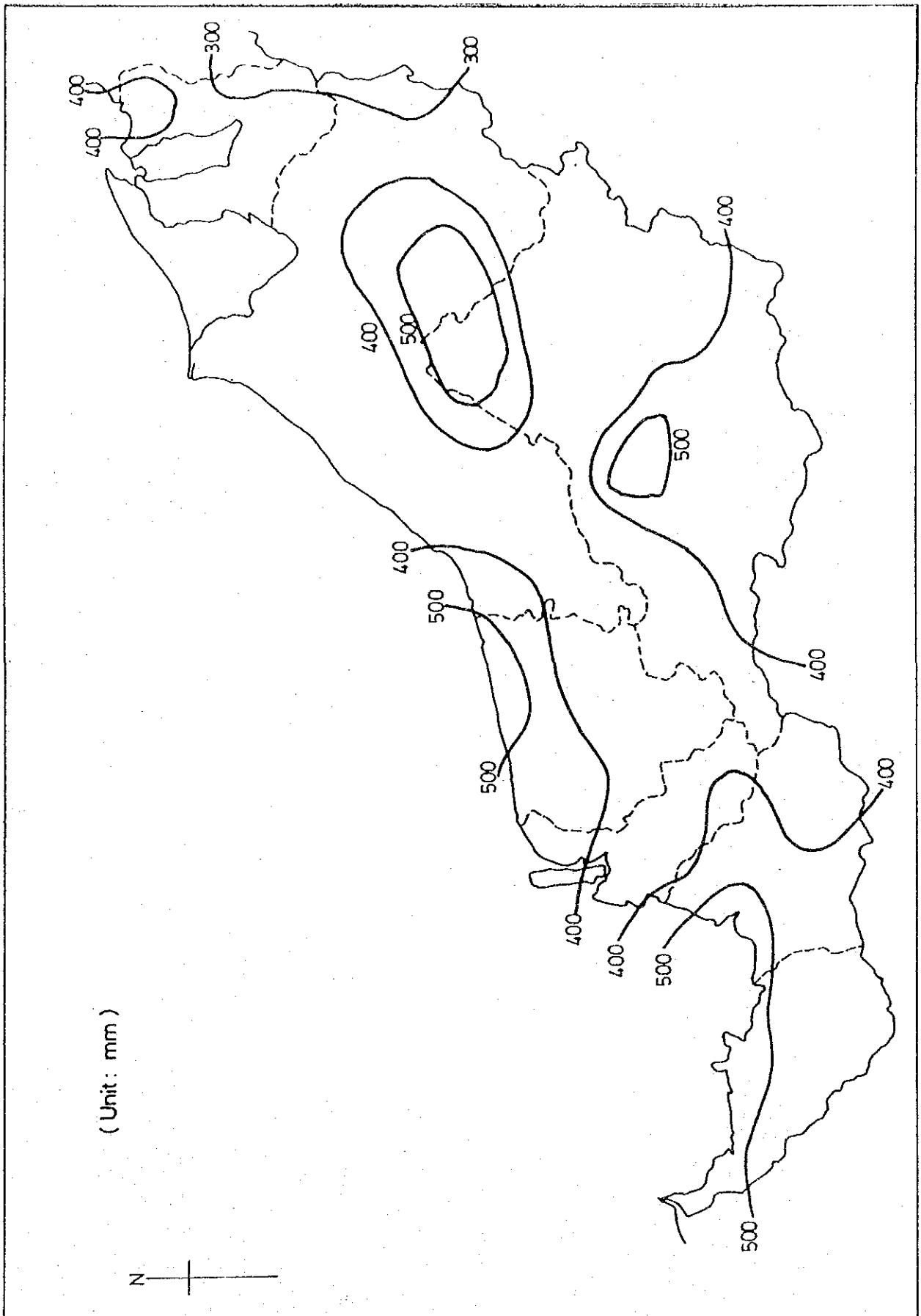

Fig. III - 20 Isohyetal Map of Monthly Mean Rainfall (December)

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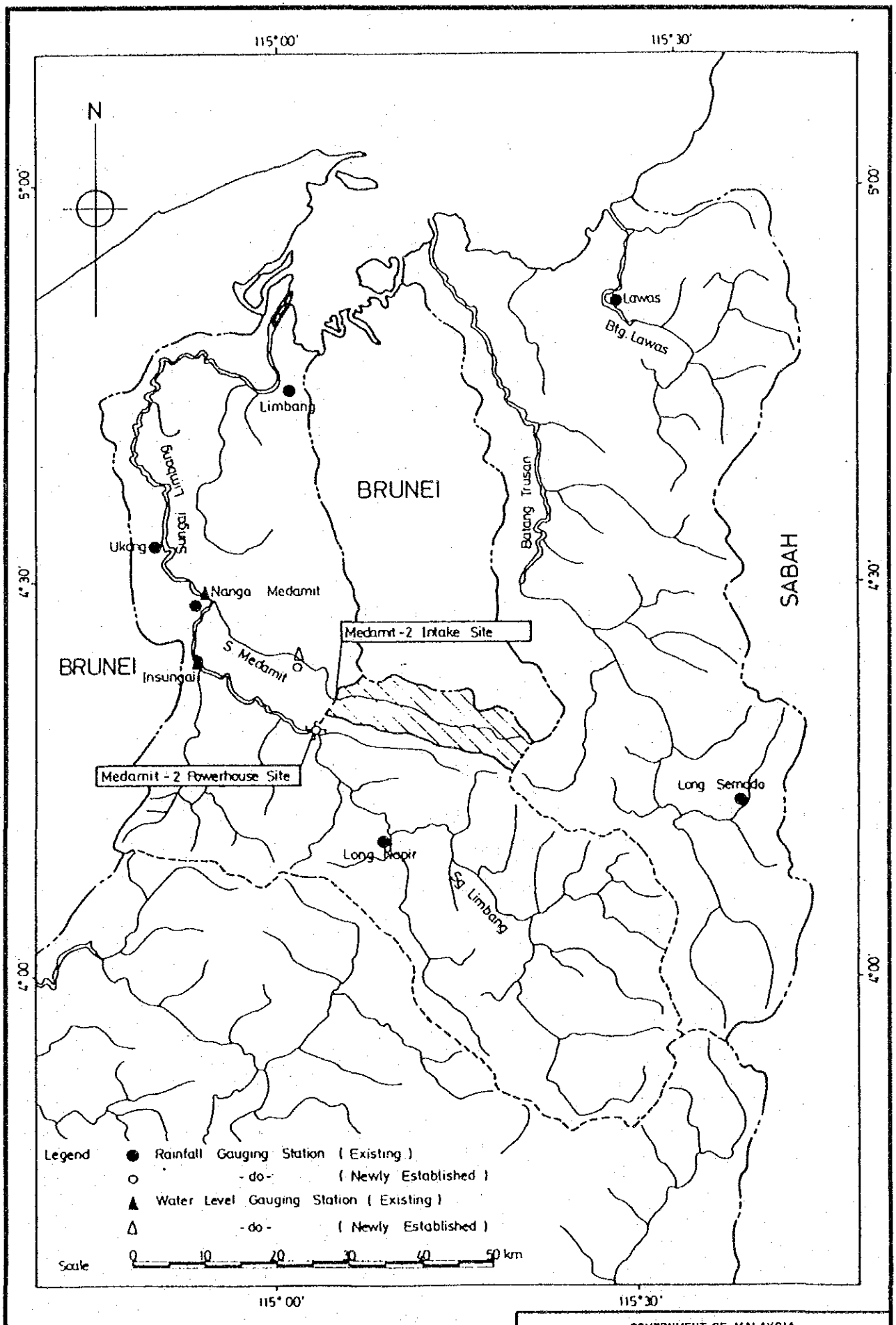

Fig. III - 21 Location Map of Project Site

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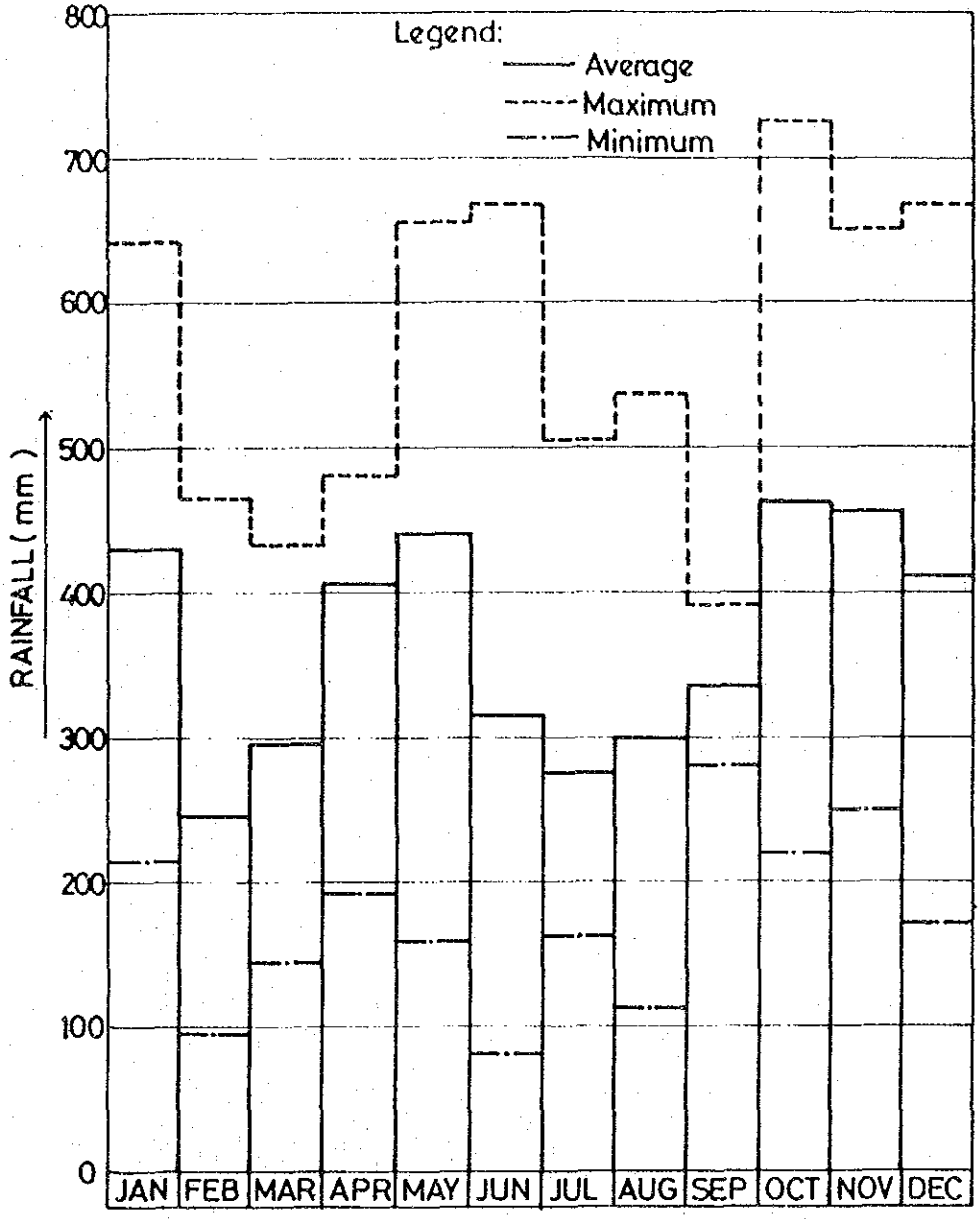

Fig. III - 22 Monthly Mean, Maximum and Minimum Rainfall Depth at Lubok Lalang

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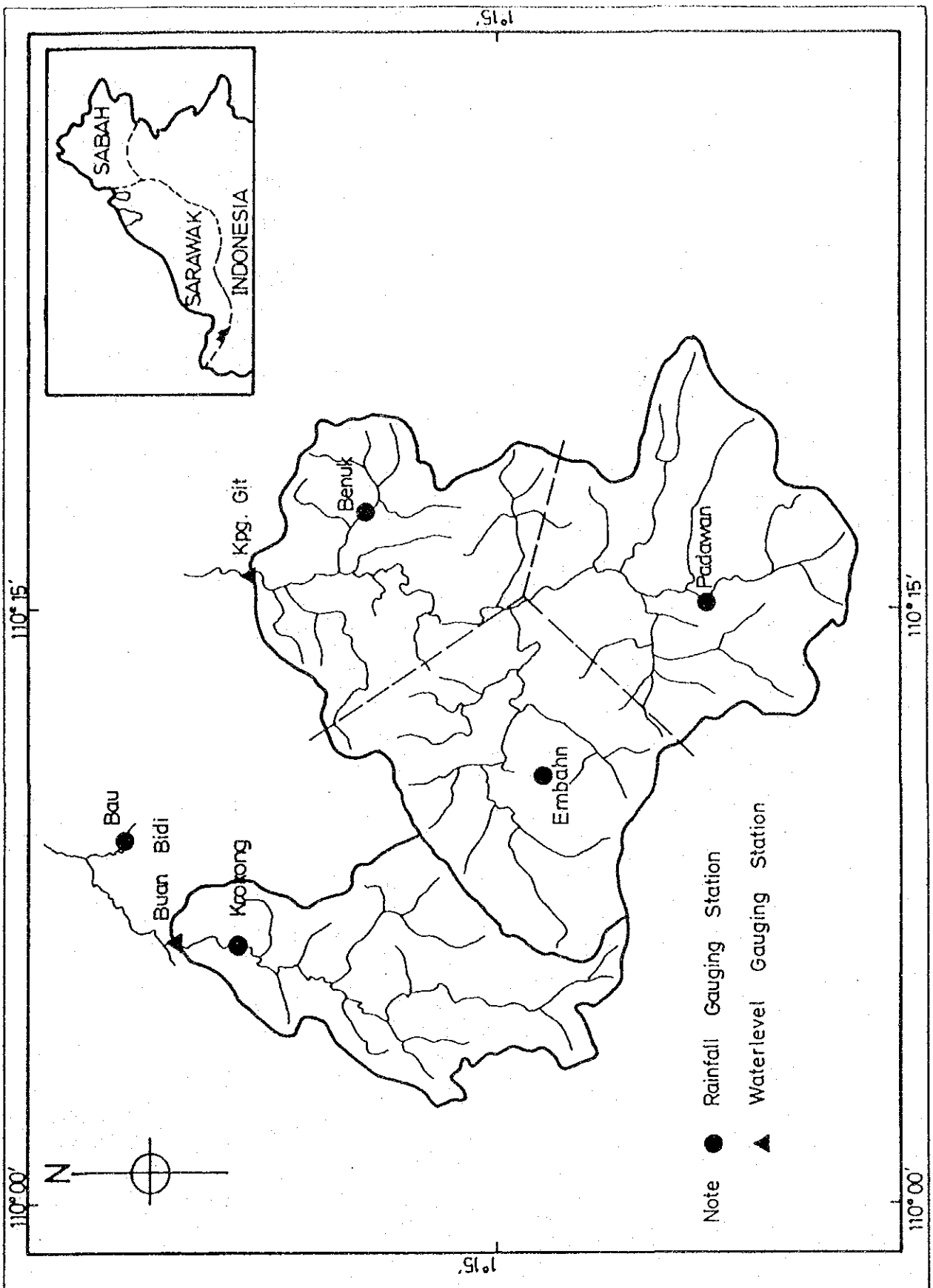

Fig. III - 23 Location Map of Rainfall and Waterlevel Gauging Stations

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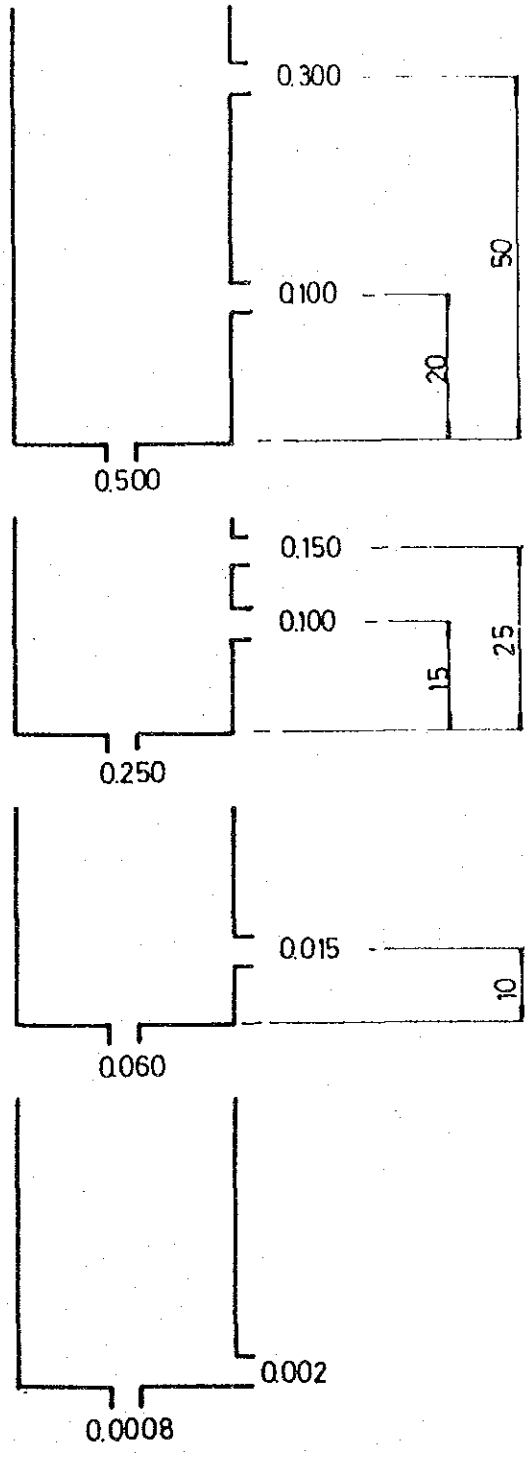

Fig. III - 24 Tank Model for Kpg. Git

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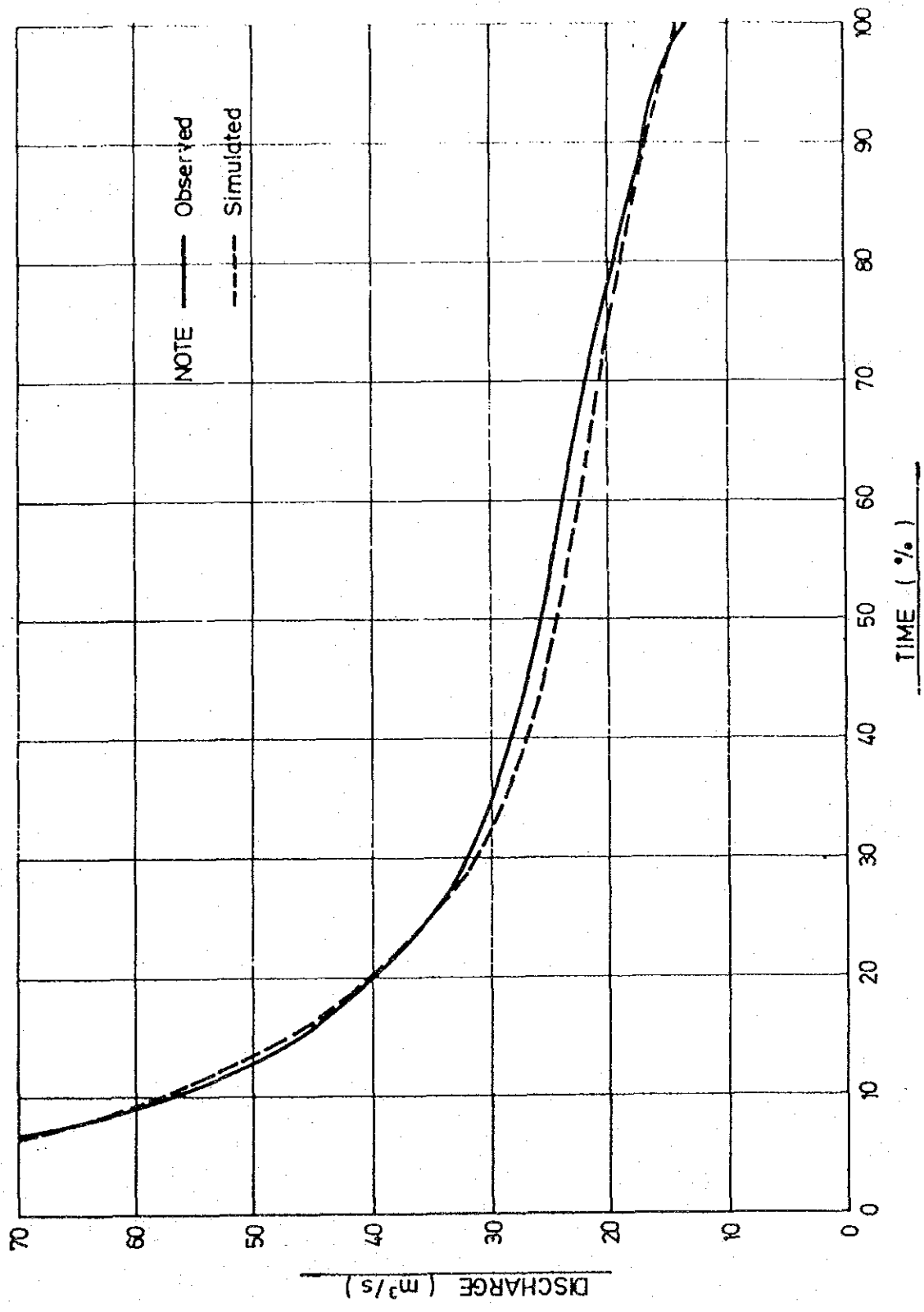

Fig. III - 25 Average Flow Duration Curve at Kpg. Git

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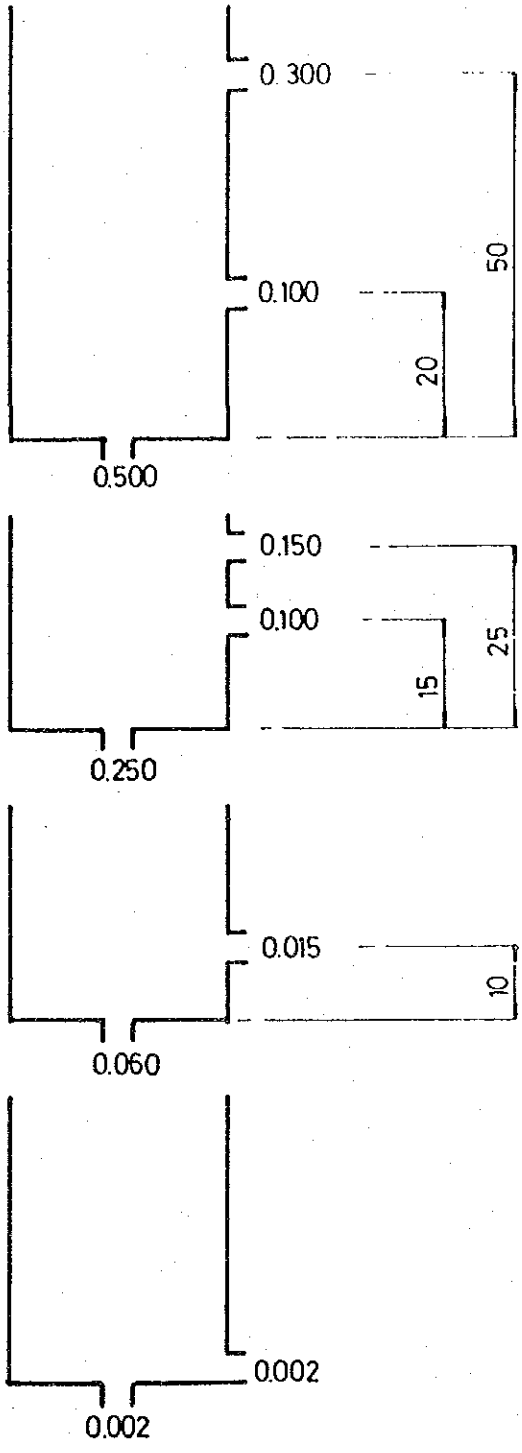

Fig. III - 26 Tank Model for Buan Bidi

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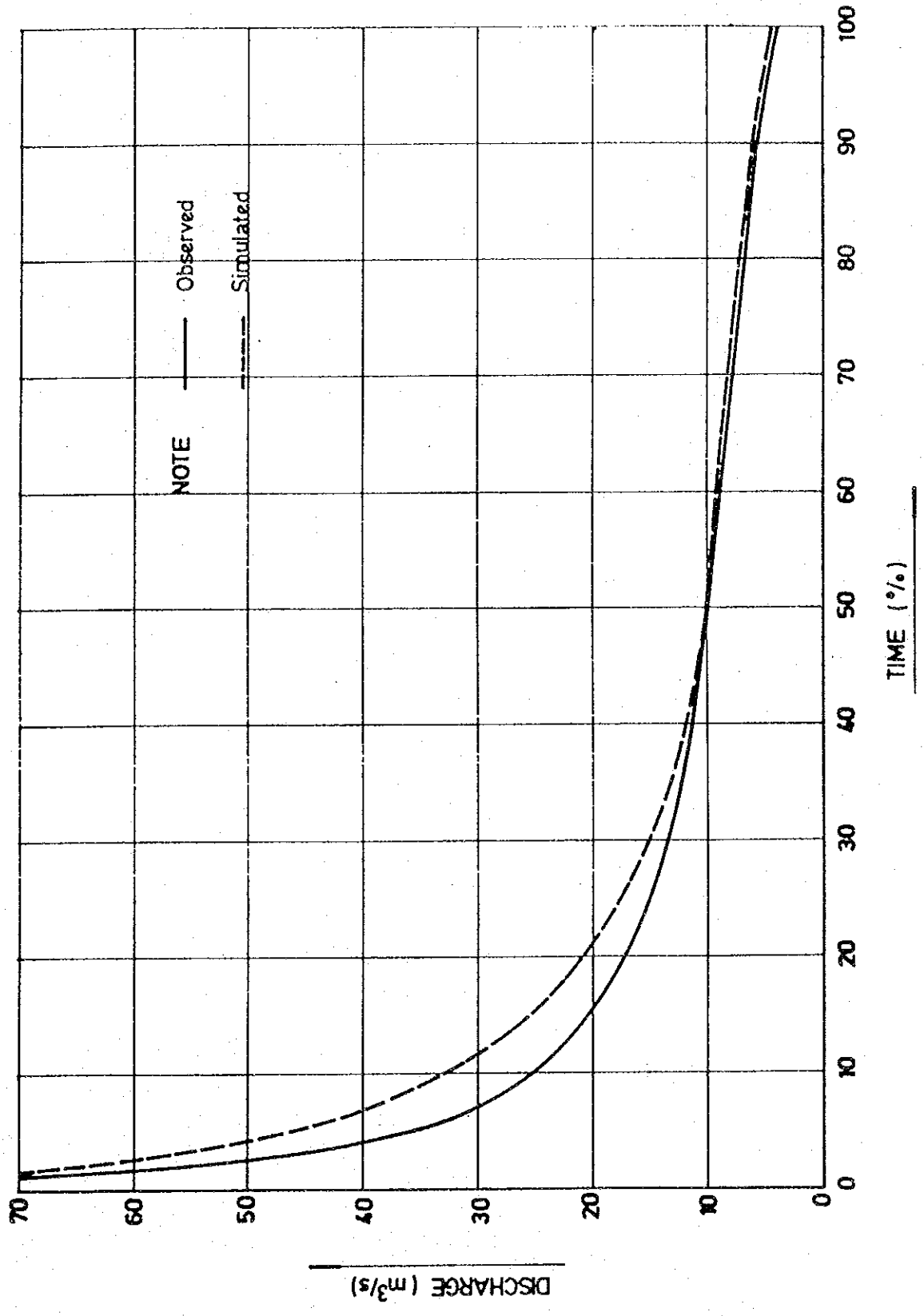

Fig. III - 27 Average Flow Duration Curve at Buan Bidi

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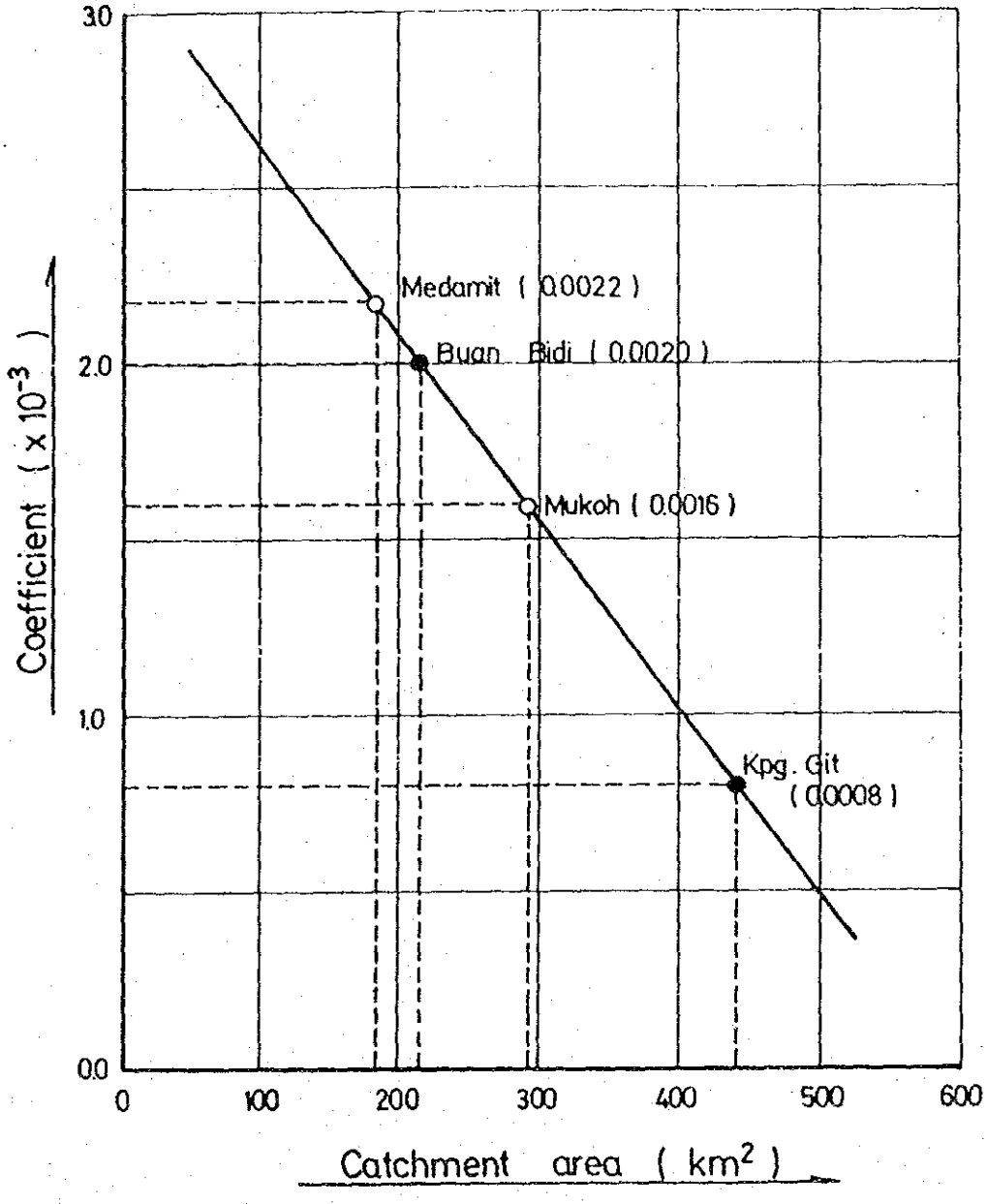

Fig. III - 28 Relationship between Catchment Area and Coefficient of Tank Model

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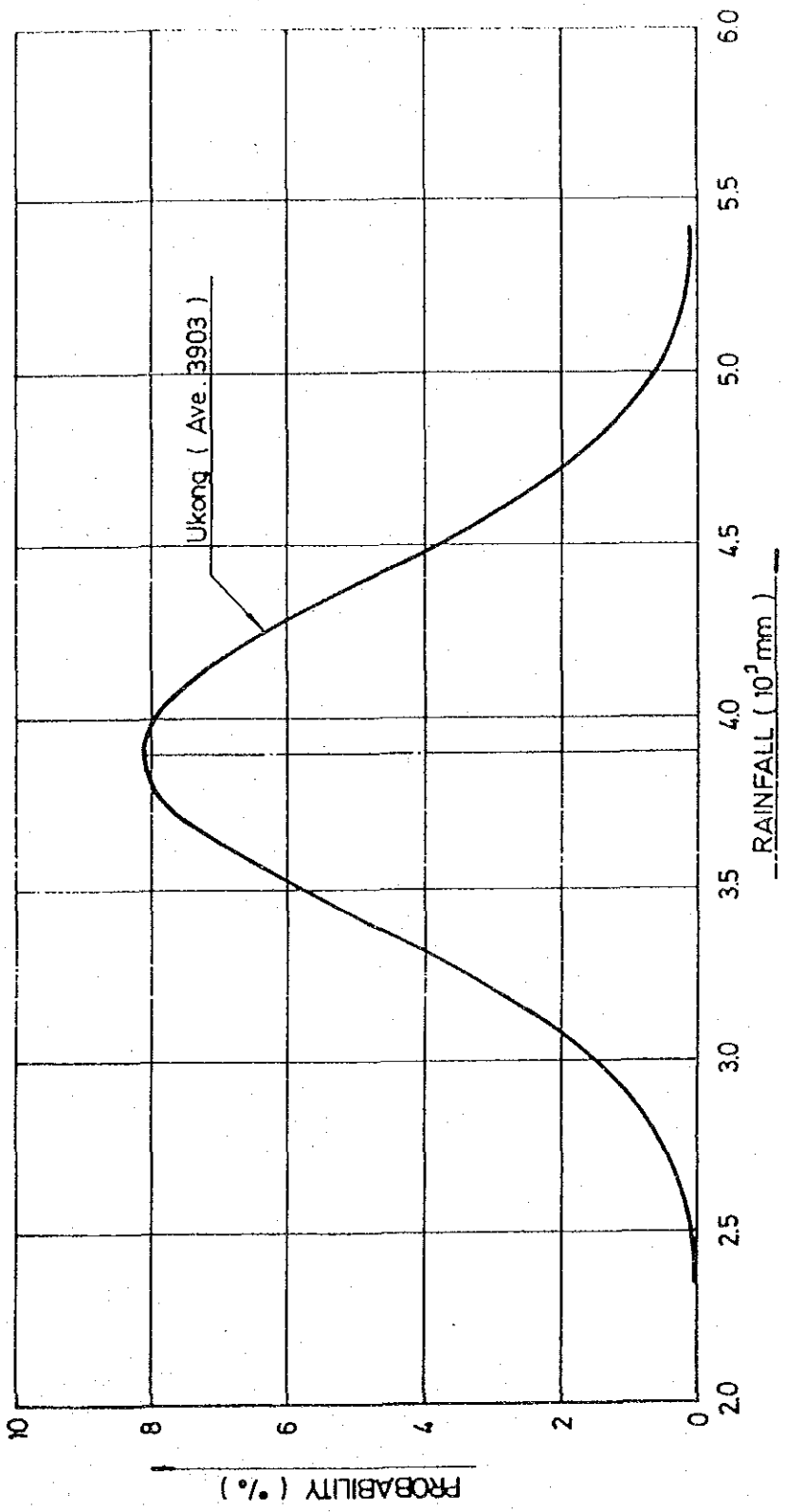

Fig. III - 29 Normal Distribution Curve of Annual Rainfall Depth at Ukong

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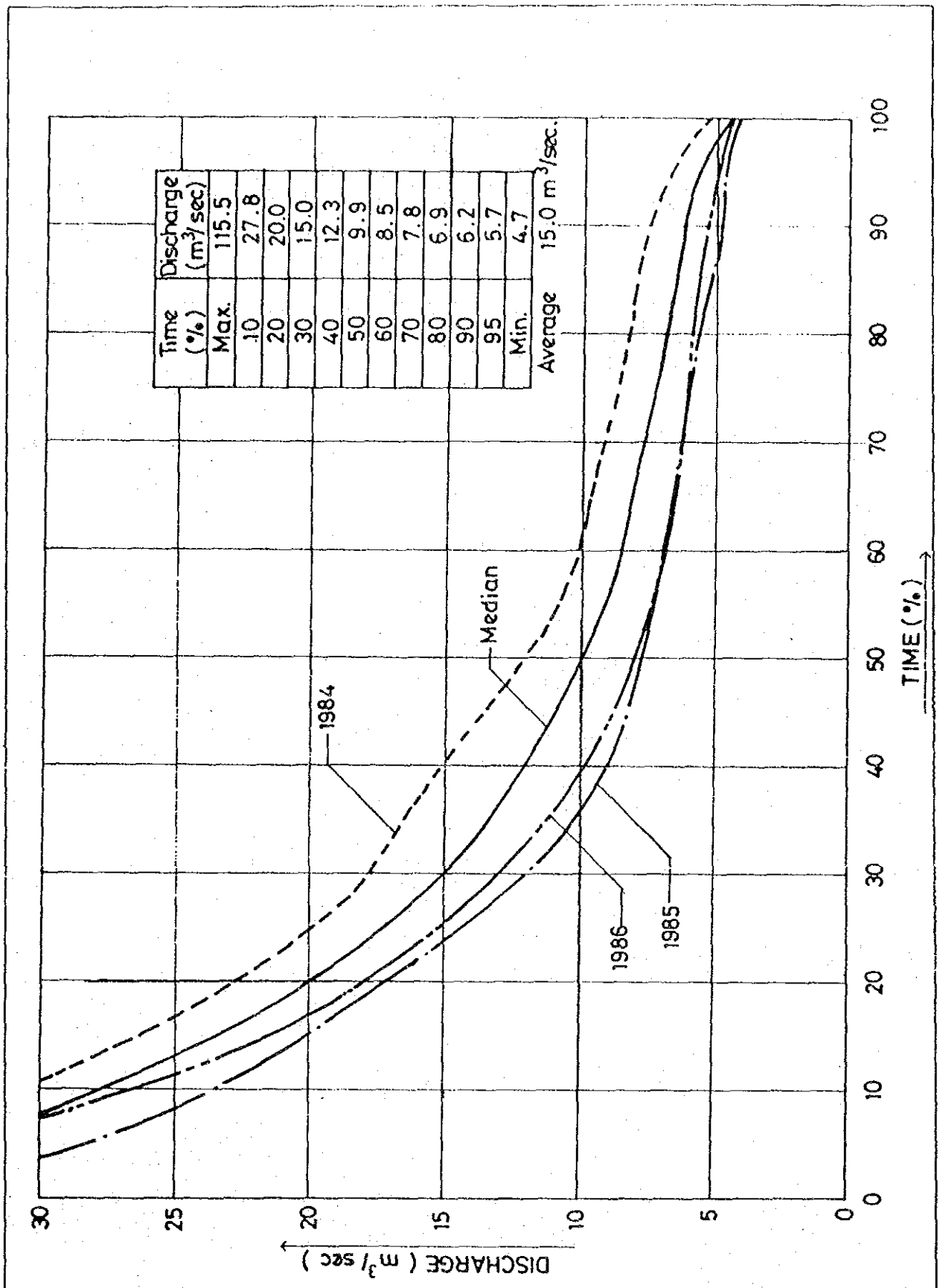

Fig. III - 30 Simulated Flow Duration Curve at Intake Site

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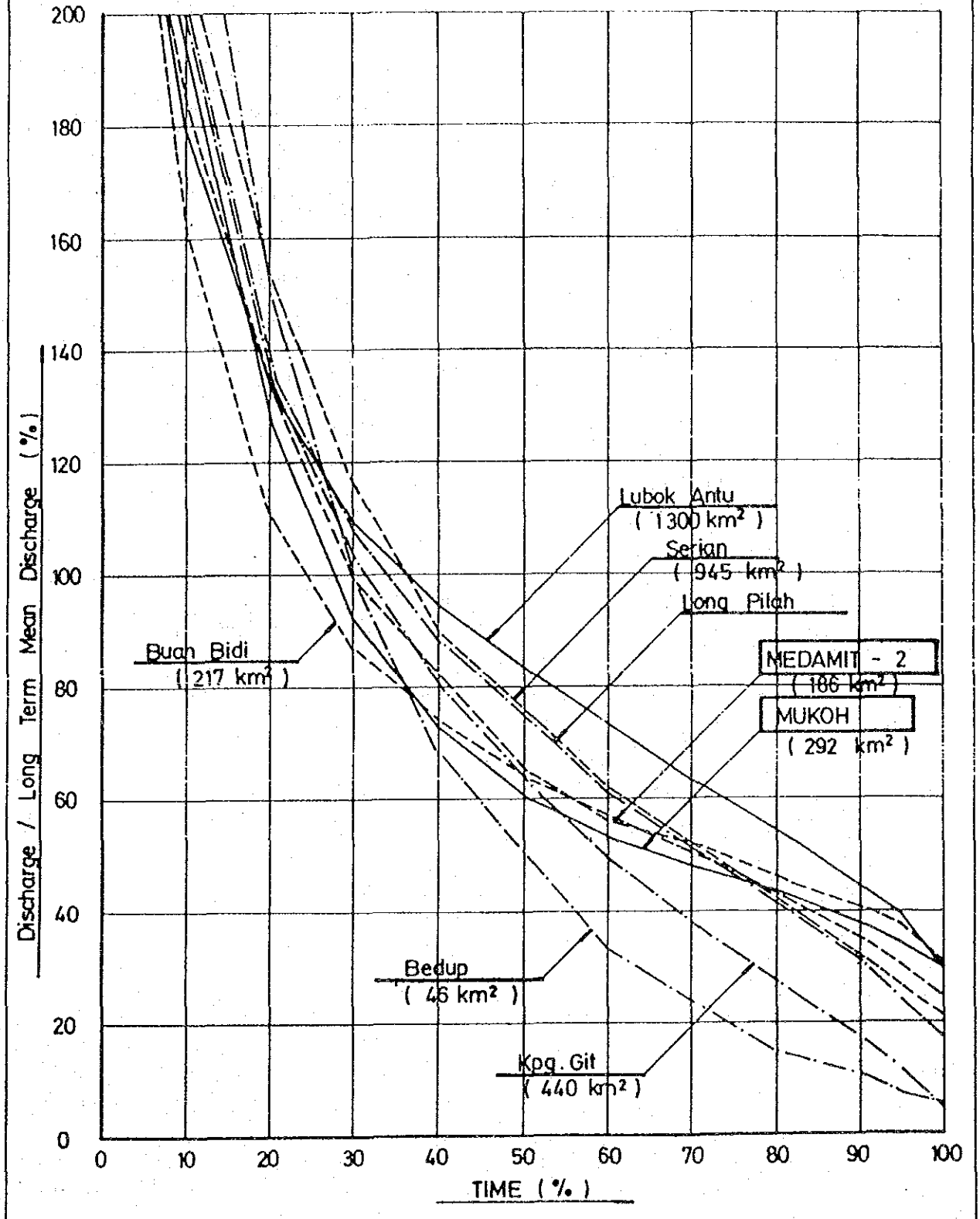

Fig. III - 31 Flow Duration Curve at Representative Station having Relatively Small Catchment Area

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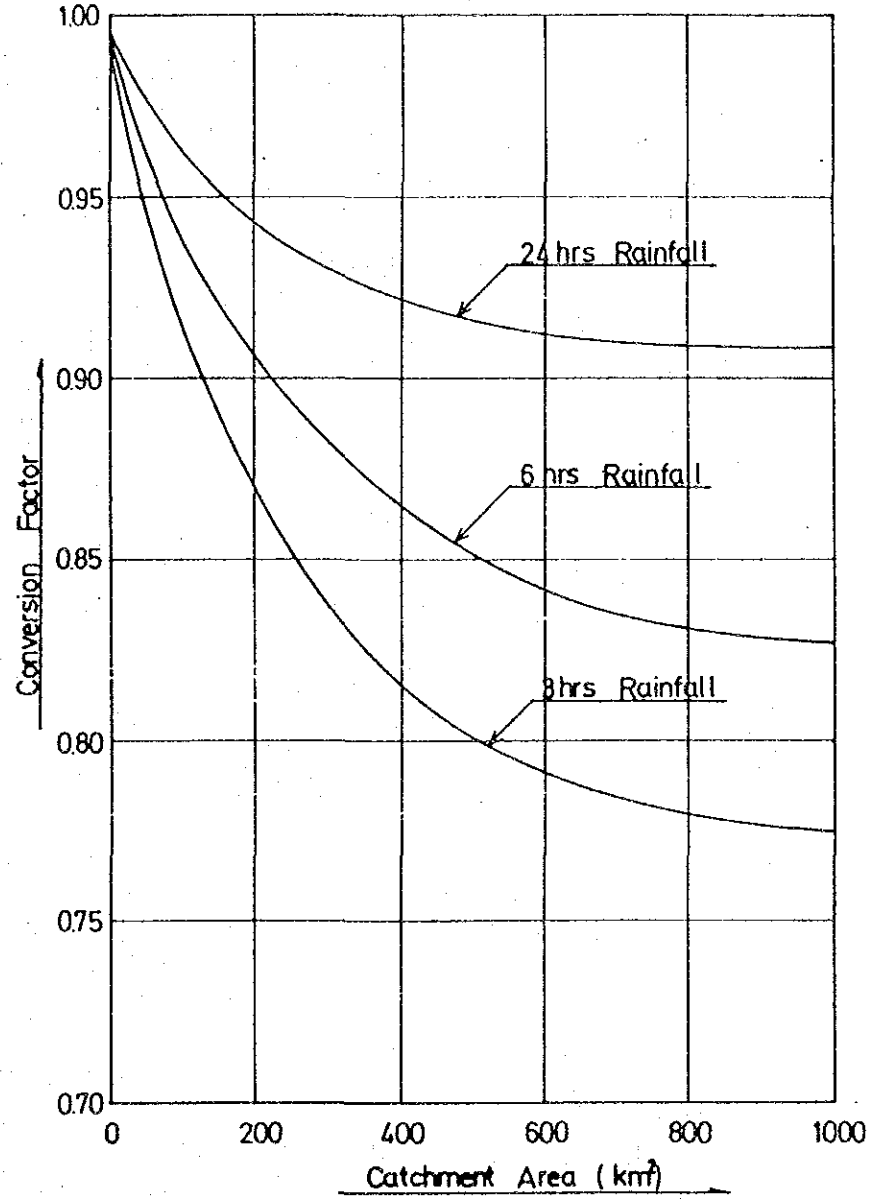

Fig. III - 32 Conversion Factor of Point Rainfall

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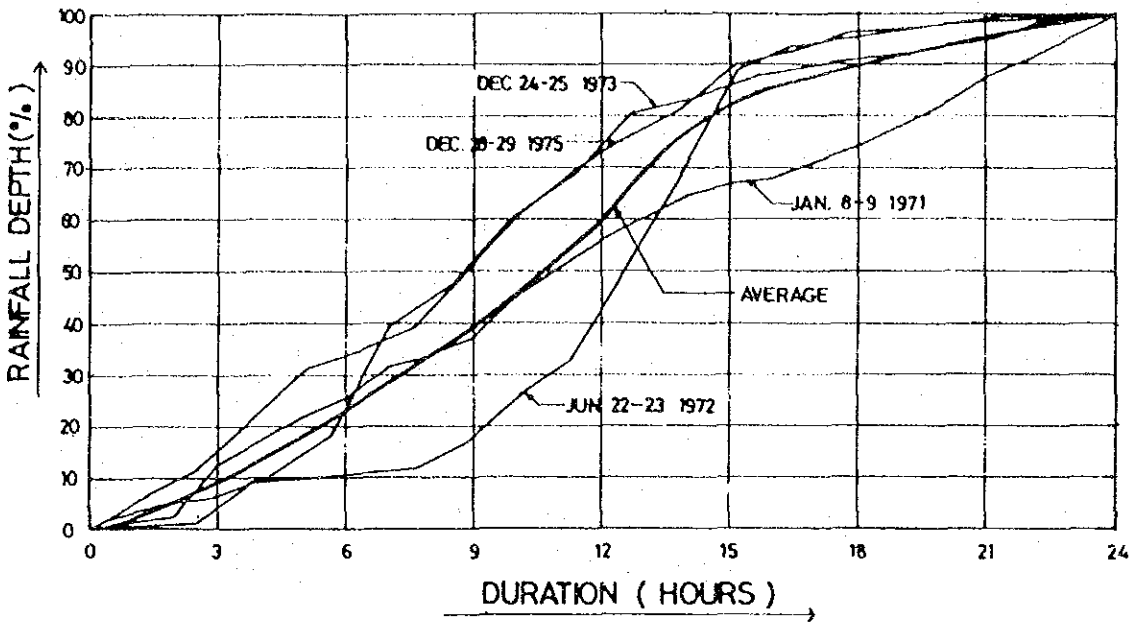

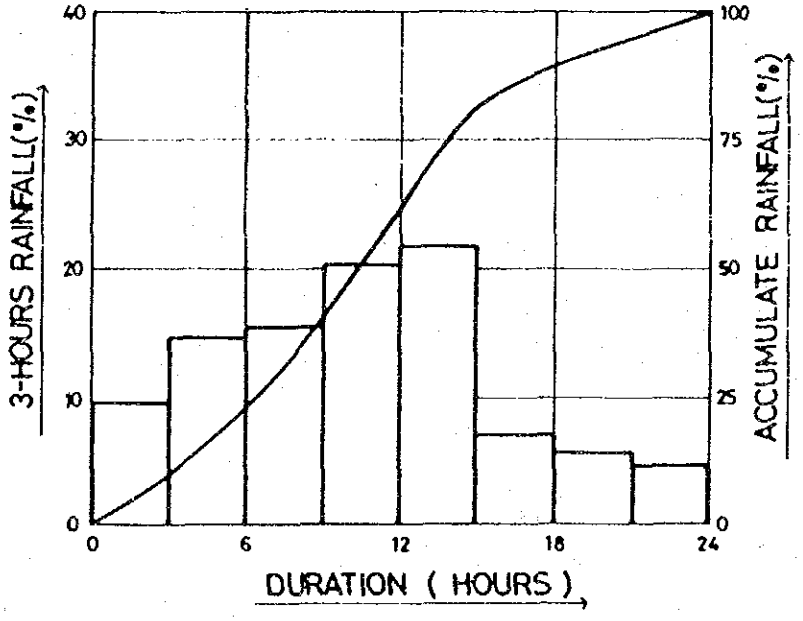

Fig. III - 33 Average Hourly Rainfall Distribution Pattern

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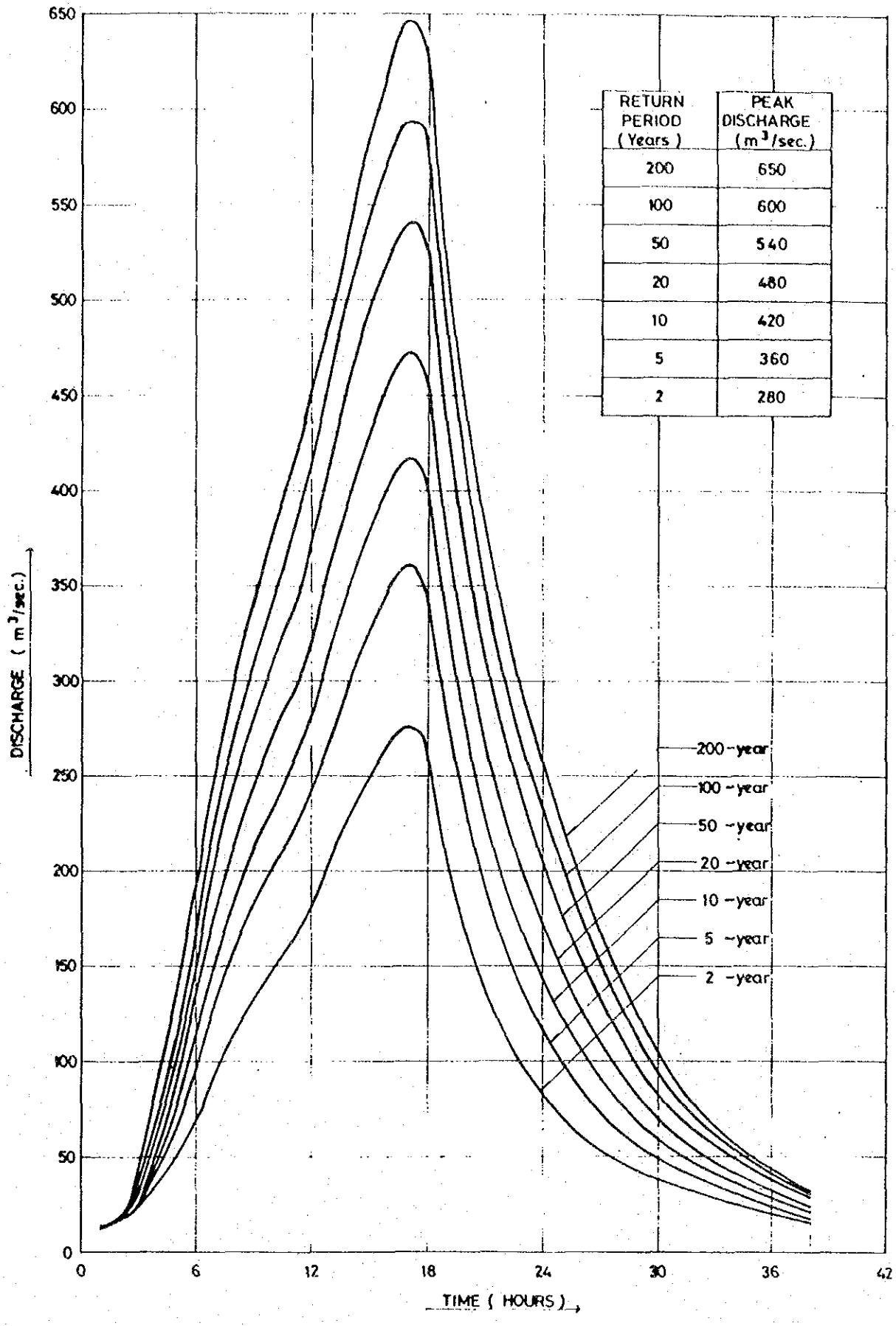

RETURN PERIOD (Years)	PEAK DISCHARGE (m^3/sec.)
200	650
100	600
50	540
20	480
10	420
5	360
2	280

Fig. III - 34 Probable Flood Hydrographs at Intake Site

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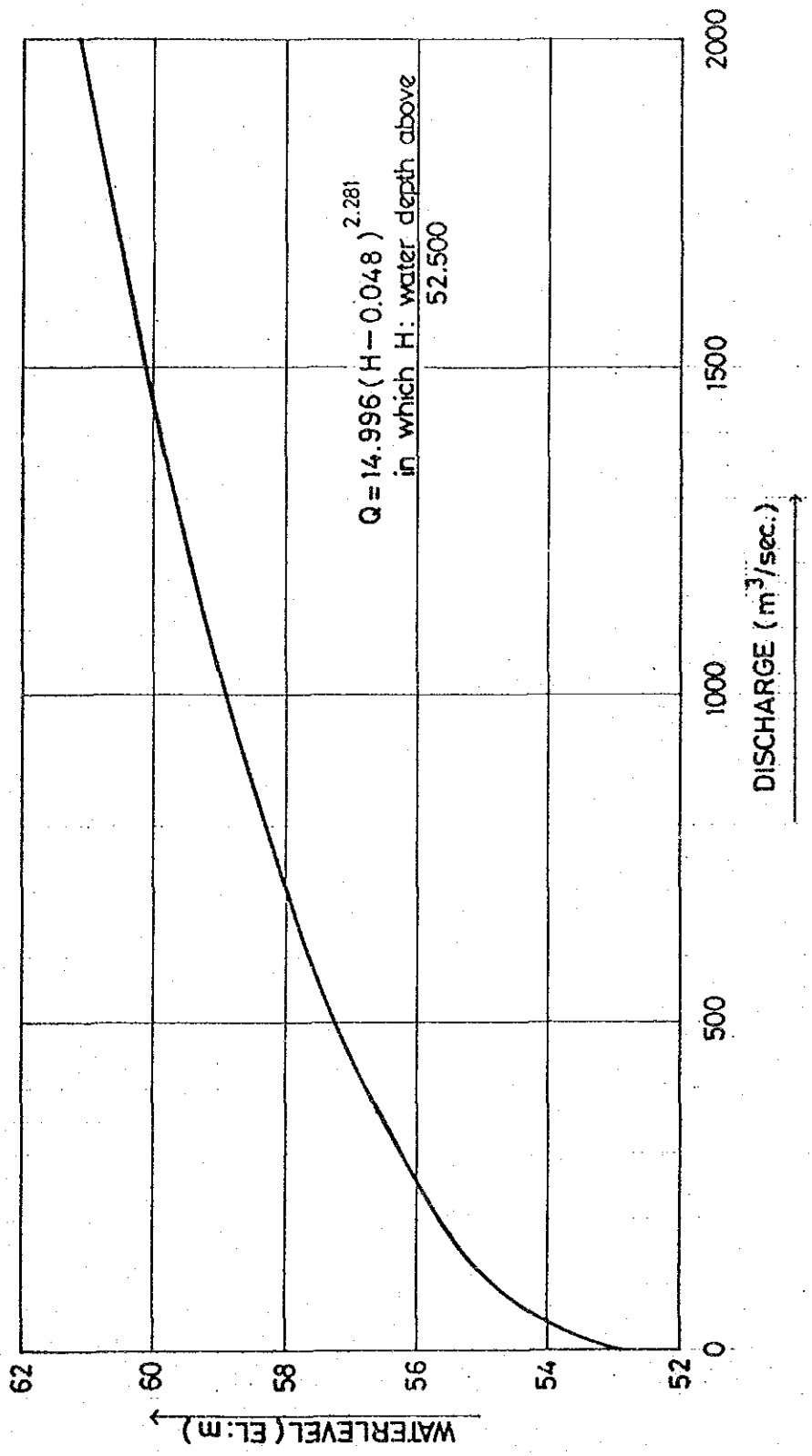

Fig. III - 35 Rating Curve at Powerhouse Site

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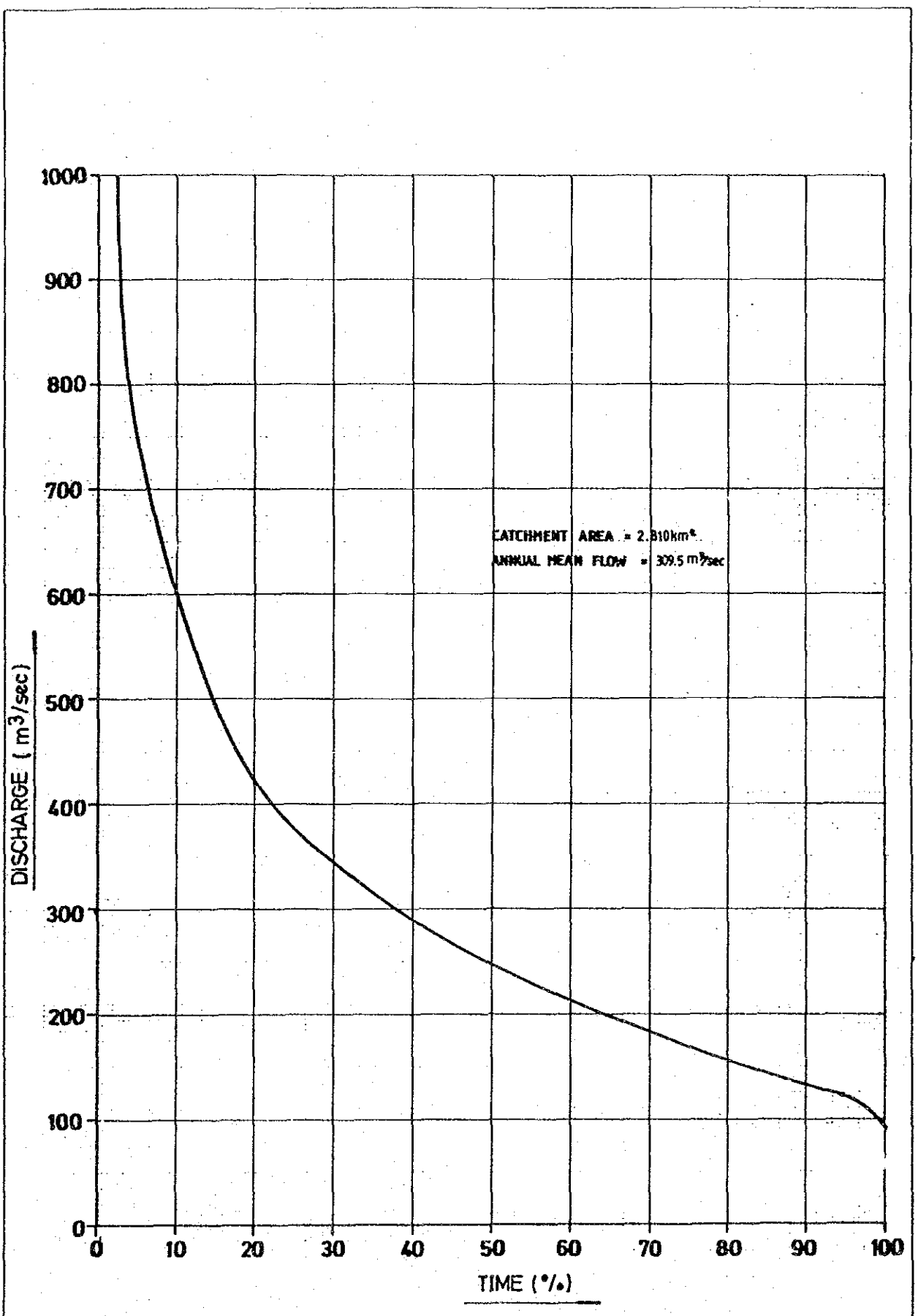

Fig. III - 36 Average Flow Duration Curve at Nanga Medamit

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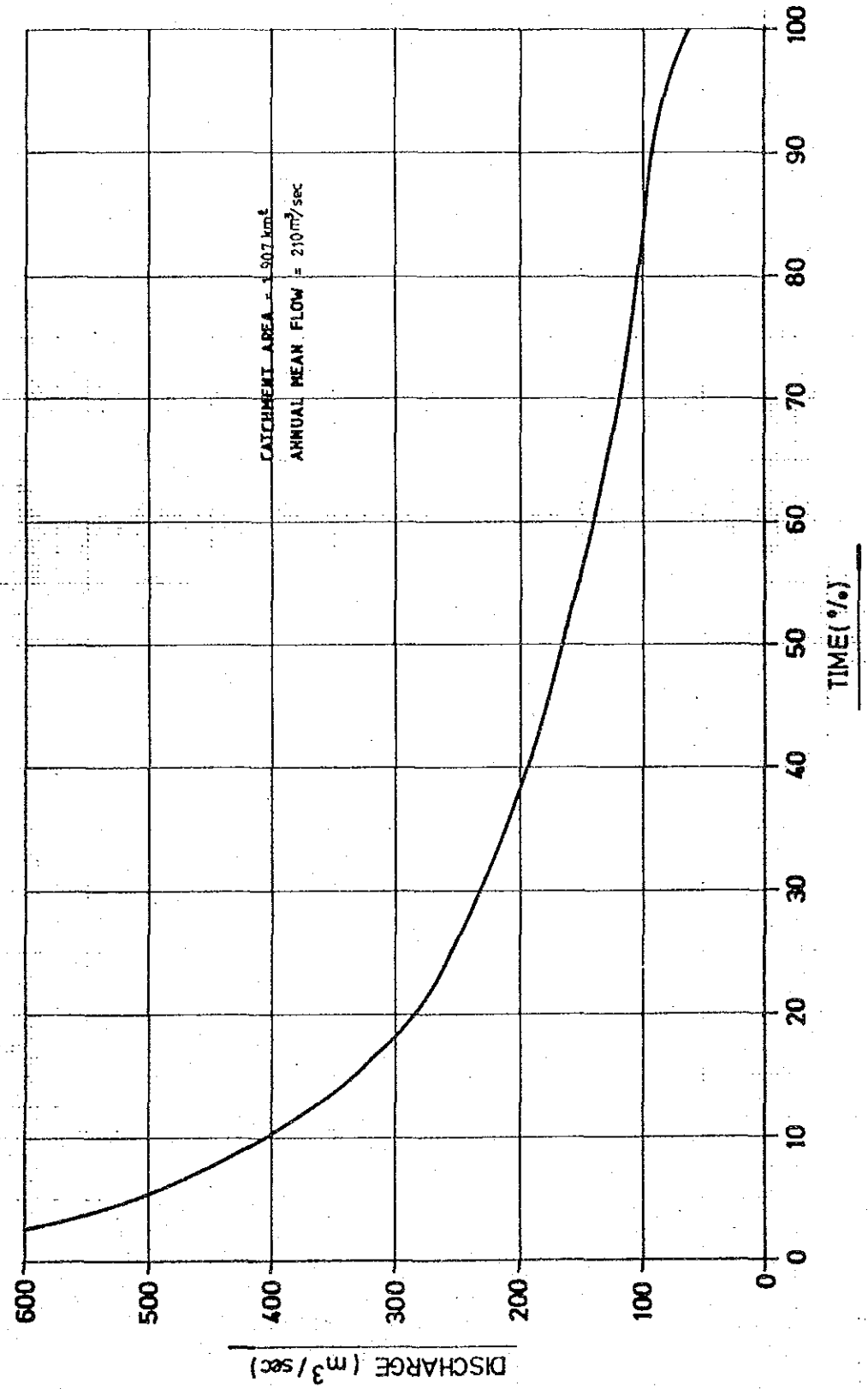

Fig. III - 37 Average Flow Duration Curve at Powerhouse Site

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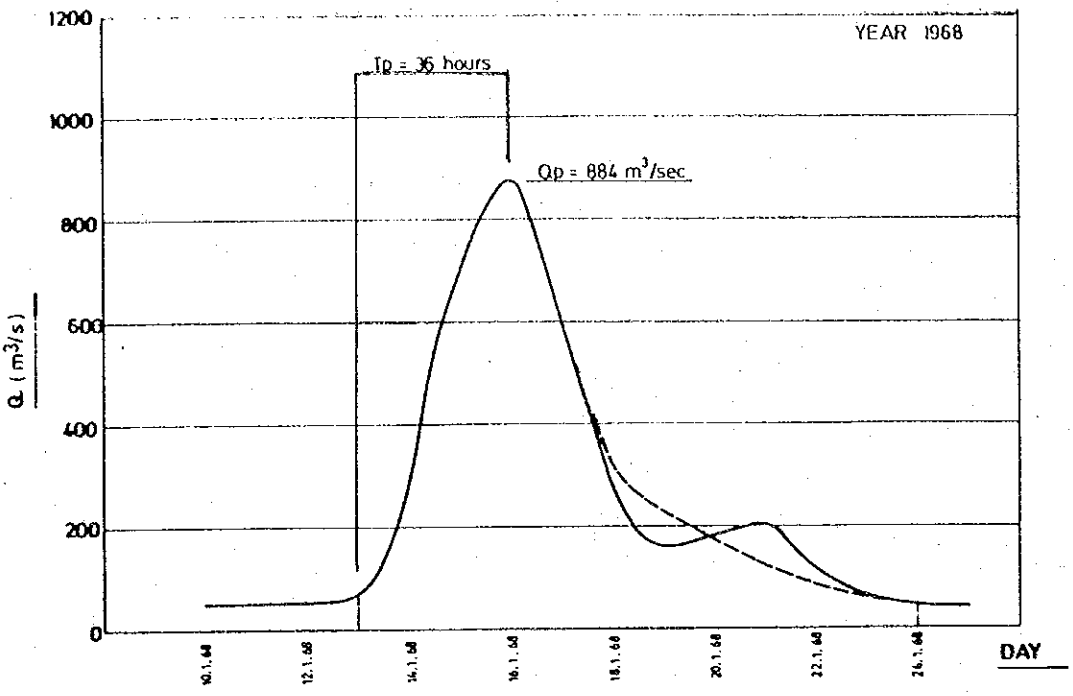

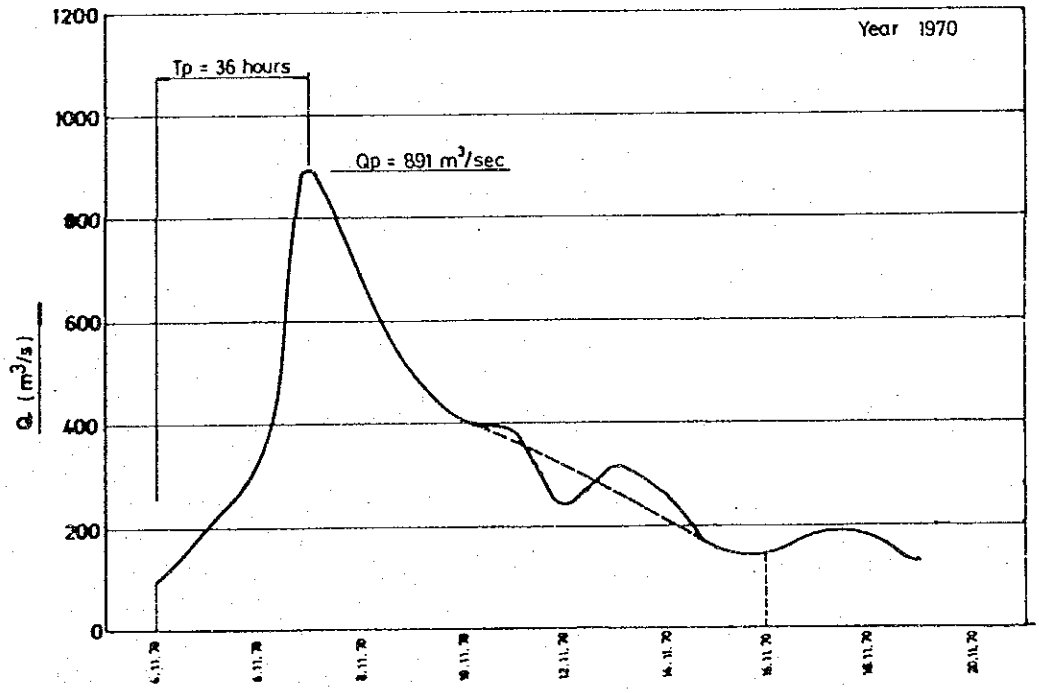

Fig. III - 38 Recorded Flood Hydrograph at Nanga Medamit (1)

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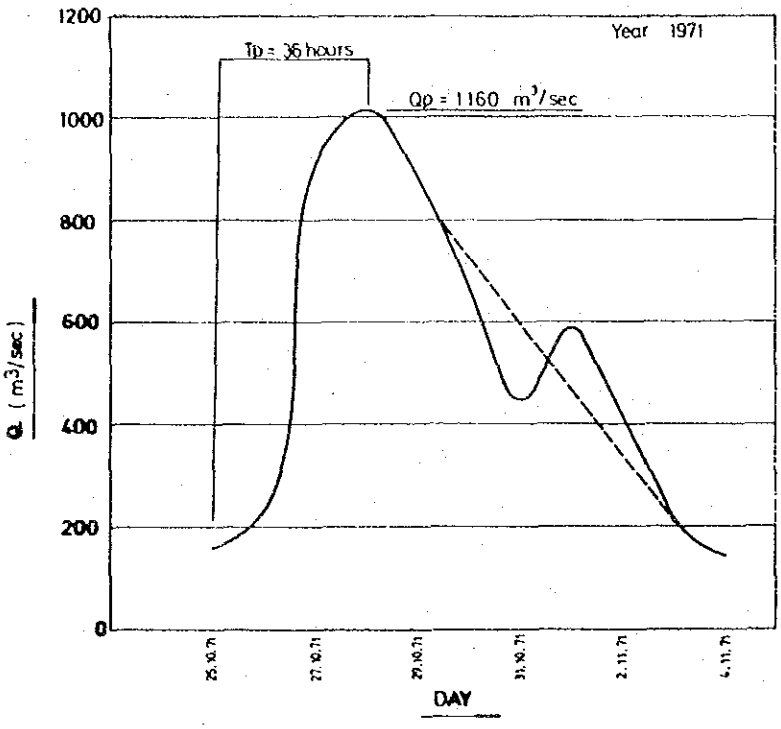

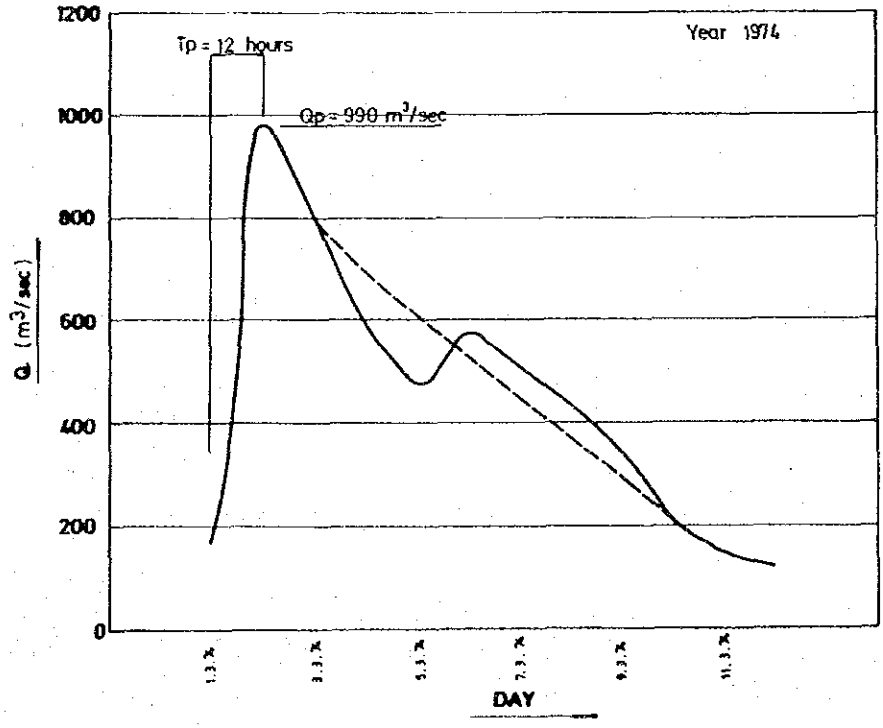

Fig. III - 39 Recorded Flood Hydrograph at Nanga Medamit (2)

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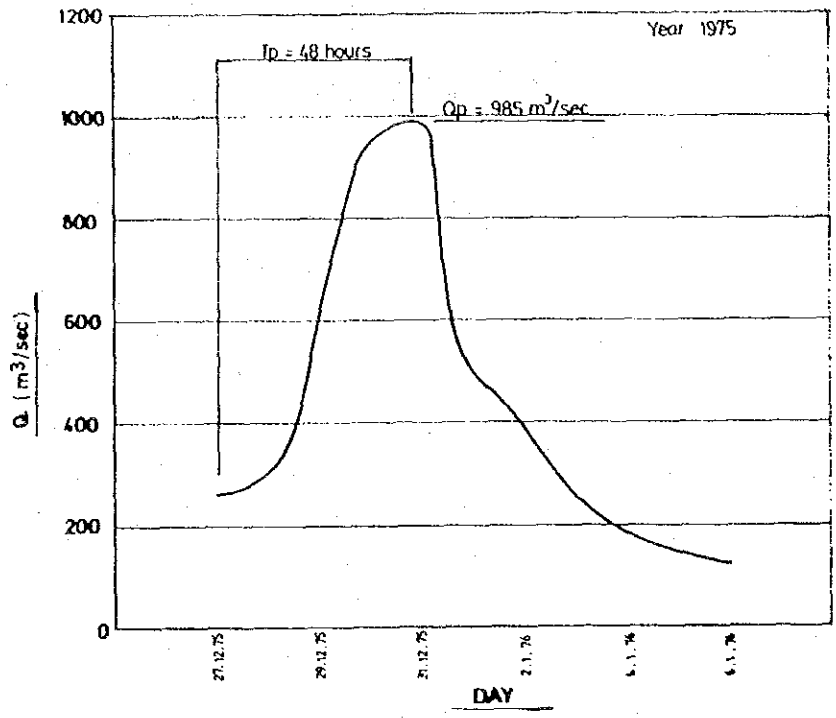

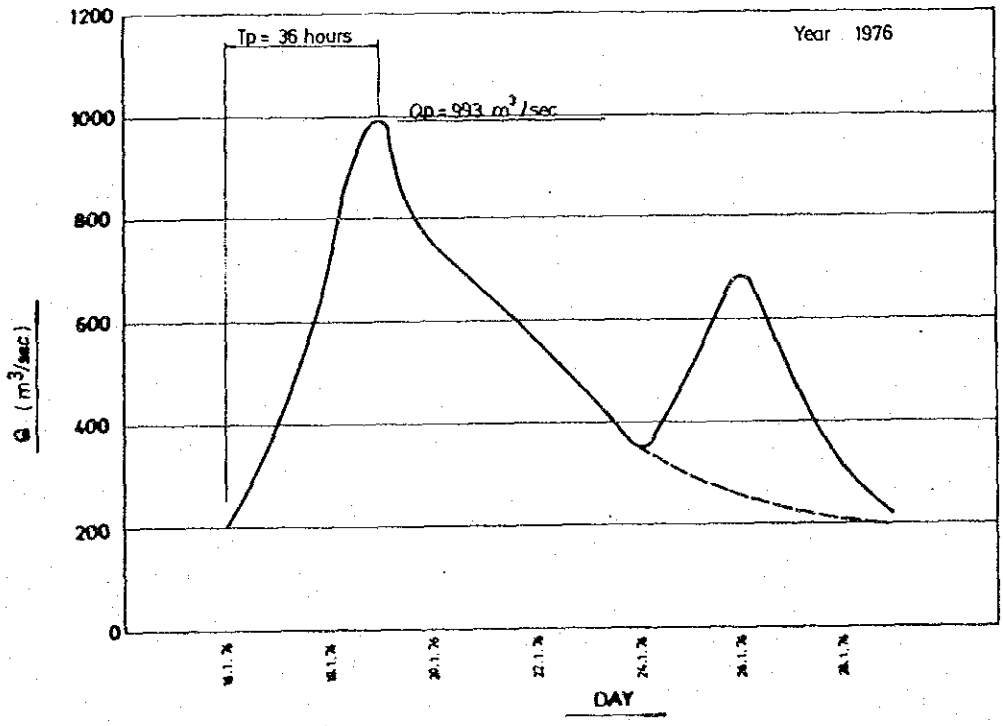

Fig. III - 40 Recorded Flood Hydrograph at Nanga Medamit (3)

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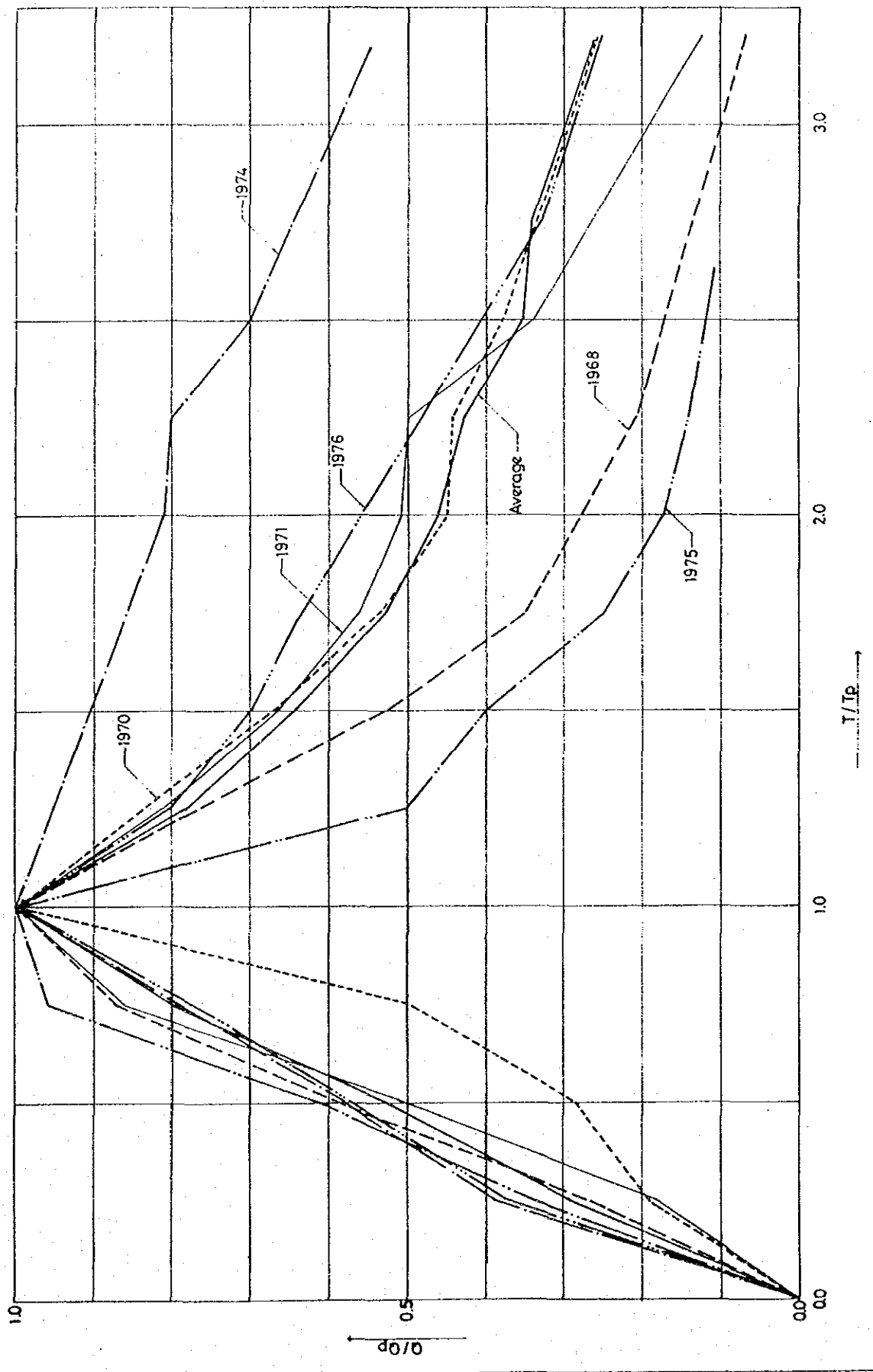

Fig. III - 41 Simplified Dimensionless Flood Hydrograph

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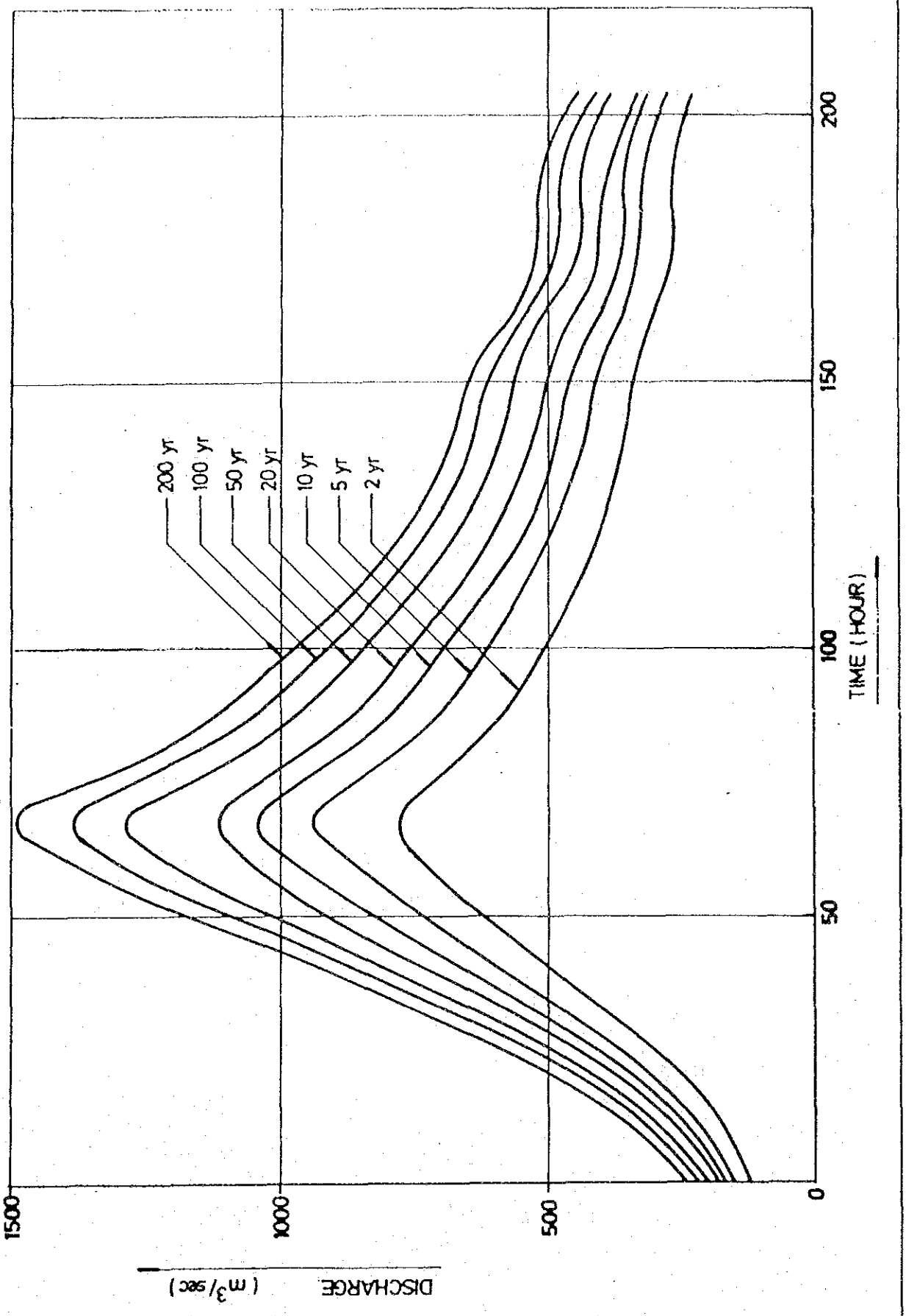

Fig. III - 42 Probable Flood Hydrograph at Powerhouse Site

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