CHAPTER XVIII

INUNDATIONS DUE TO POSSIBLE FLOODS FROM EXISTING GUNUNGSARI DAM

1. General.

In every rainy season, water of the Brantas river diverted into the Surabaja river. Hence, the water level of the Surabaja river is always kept high and the discharge hydrograph of the Marmojo river is flattened due to the lasting backwater of the Surabaja river. But in future, Mlirip sluice and Gedek sluice are to be shut during the floods of the Brantas not to divert flood water from the Brantas. Accordingly the lower basin of the Marmojo river is expected to be released from habitual inundation. On the other hand, the discharge hydrographs of the Marmojo and the Surabaja rivers will be sharpened or the discharge will increase rapidly from ordinary one to the peak. Therefore, the manual operation of gates of Gunungsari dam may not be able to follow the rapid increase of discharge and may have to be abandoned halfway.

In this chapter, the flood damages which may be caused by the manual operation of gates and the effectiveness of motorization of gate operation are discussed.

2. Location and Structure of Gunungsari Dam.

Gunungsari dam is located about 2.7 km upstream of Wonokromo sluice. Plan and cross sections of the dam and its upstream reaches are shown in Fig. 1. Closely upstream of the dam, Gunungsari canal diverges from the Surabaja river through Gunungsari syphon. Downstream of the dam, the Kedurus river which runs in parallel with the Surabaja river joins with it. On the right and left-side banks there exist roads. The elevation of the left road is 5.6 m SHVP which is the same as that of the pier crown of Gunungsari dam. On the left side of the road, the Kedurus river flows at the foot of Gunungsari hill.

Gunungsari dam has two locks, two stop-log gates and nine needle gates. Among them, one lock and four needle gates on the right hand are closed and out of use, as shown in Fig. 2.

3. Discharge Hydrograph of the Surabaja River.

(1) Average rainfall over the drainage area.

There exist 9 rain-gage stations in the drainage area upstream of Gunungsari dam. Daily rainfalls at five return periods were calculated and shown in Table 1. The average value of the daily rainfalls at the nine stations for each return period was taken as the average daily rainfall over the drainage area upstream of the dam. The results are also shown in Table 1.

Fig.1 Surabaja River Around the Gunungsari Dam

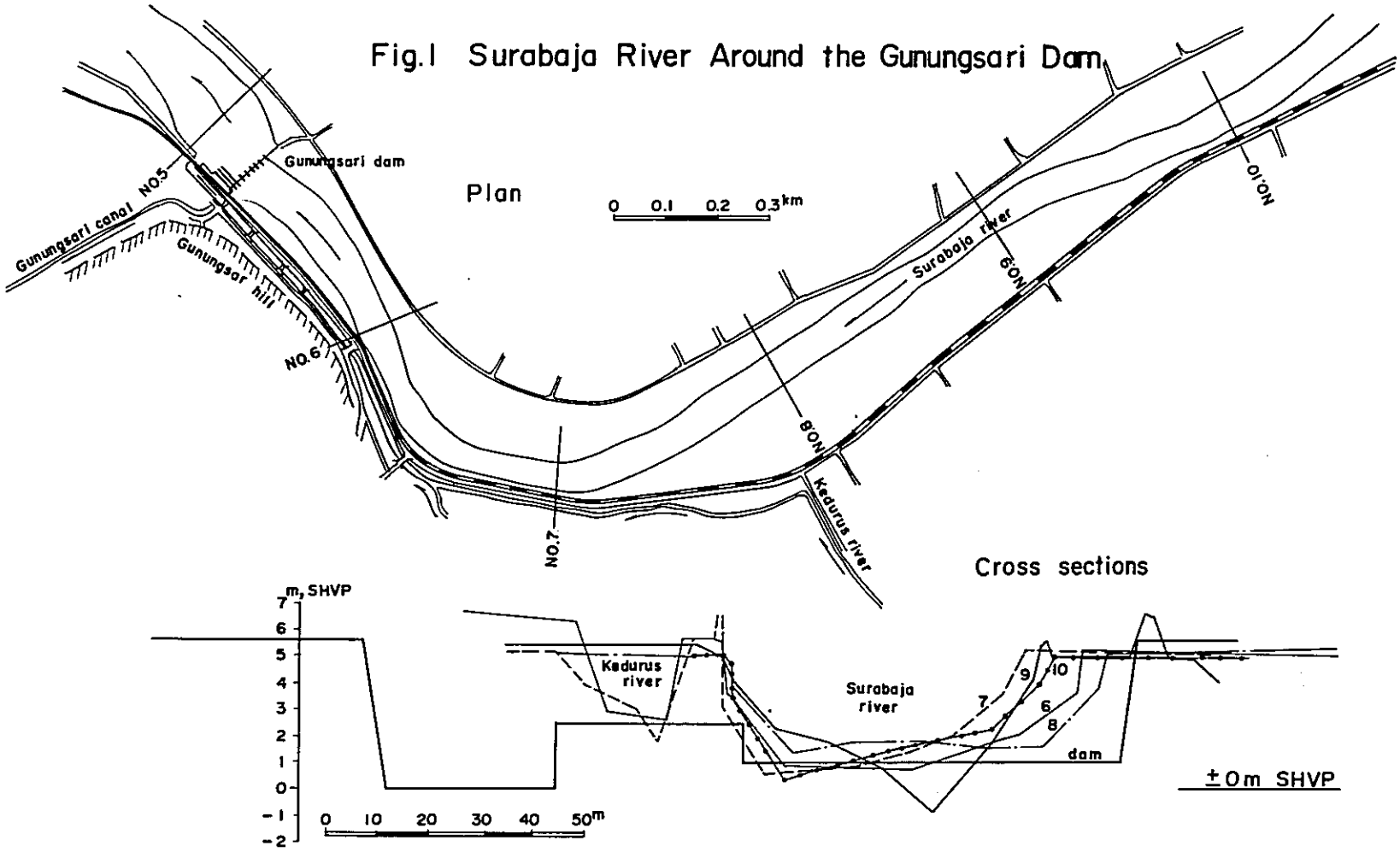
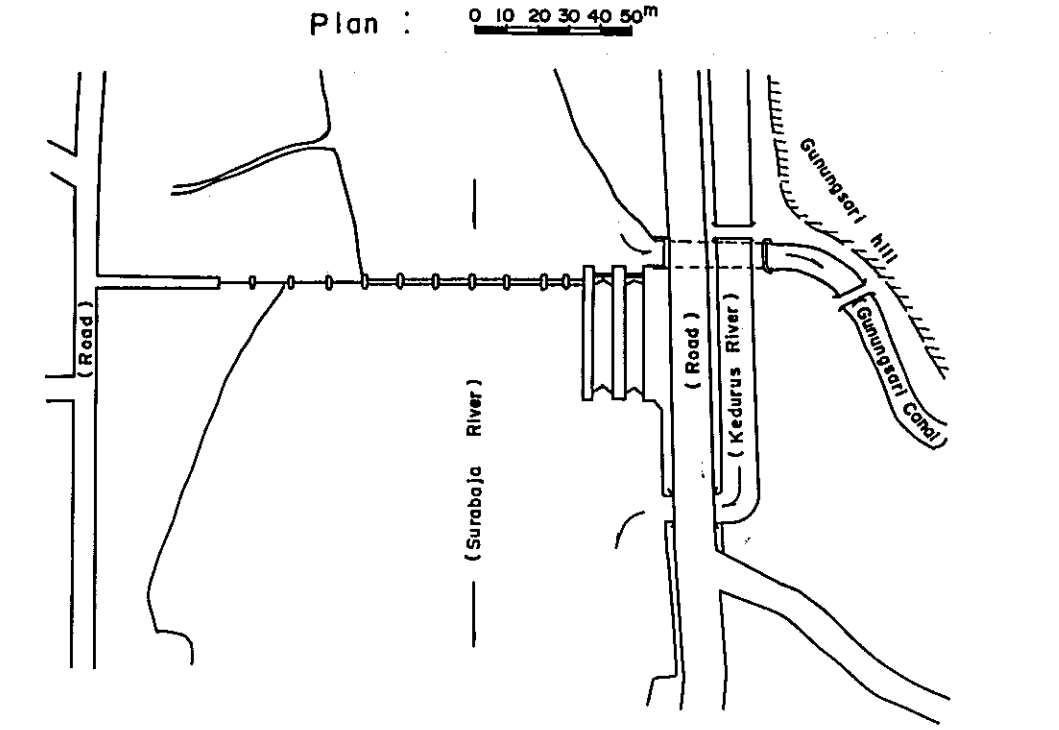


Fig.2 Gunungsari Dam



Elevation

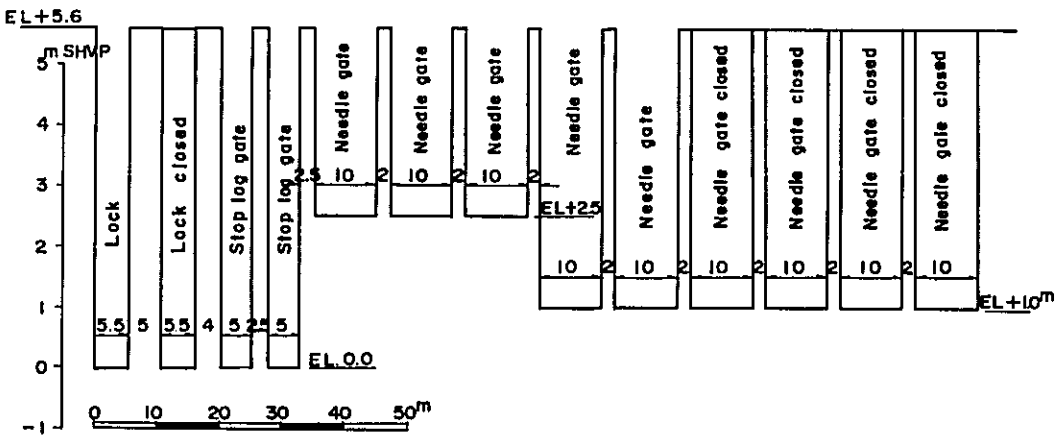


Table 1 Average Daily Rainfall Upstream of Gunungsari Dam

(unit: mm)

Return period (years)			50	20	10	5	2
Rain gage station	12	Tandjung	140.0	129.3	120.6	110.7	94.1
	11	Kabuh	154.7	143.2	133.7	123.0	104.8
	18	Djatisari	142.5	129.8	119.5	108.1	89.2
	10	Tapen	145.6	132.9	122.6	111.2	92.2
	15	Gedek	121.3	110.4	101.5	91.7	75.5
	17	Terusan	192.3	166.7	146.8	125.9	93.8
	13	Wringinanom	153.8	142.3	132.7	122.0	103.9
	14	Krikilan	191.0	168.2	150.3	131.1	101.0
	7	Gunungsari	181.6	162.1	146.5	129.6	102.6
Average			158.1	142.8	130.5	117.0	95.2

(2) Peak discharge.

Peak discharge at Gunungsari dam was estimated as a sum of discharge from the drainage area except the Watudakon-river basin, say Q_{Gpeak}, and that from the Watudakon-river, say Q_{Wpeak}.

Q_{Gpeak} was calculated by the following equation which has already been studied in Chapter XII.

$$Q_{Gpeak} = K\sqrt{A_G} \qquad (A_G = 403.7 \text{ km}^2)$$

where A_G is the drainage area upstream of Gunungsari dam except the Watudakon-river basin and K is a constant which is to be determined by the peak discharge at a return period at Mernung dam, say Q_{Mer}, and drainage area upstream of Mernung dam, say A_{Mer}.

$$K = Q_{Mer}/\sqrt{A_{Mer}} \qquad (A_{Mer} = 155.1 \text{ km}^2)$$

Q_{Wpeak} was taken as 60 m^3/s which is the upper limit of discharge passing through Watudakon syphon.

The results of calculation are shown in Table 2

Table 2 Peak Discharge at Gunungsari Dam.

Return period (years)	At Mernung dam		Q_{Gpeak}	Q_{Wpeak}	Peak discharge
	Q_{Mer} (m^3/s)	K-value	(m^3/s)	(m^3/s)	(m^3/s)
50	190	15.26	307	60	367
20	166	13.33	268	60	328
10	149	11.97	240	60	300
5	130	10.44	210	60	270
2	101	8.11	163	60	223

(3) Time of concentration.

Time of concentration at Gunungsari dam was estimated for 50-year flood and 2-year flood according to the following way.

a. For the reaches from the upper end to Pekunden: Kraven's table was used.

b. For the reaches from Pekunden to Merunung dam: mean velocity obtained by uniform-flow calculation was used.

c. For the reaches from Mernung dam to Gunungsari dam: mean velocity obtained by nonuniform-flow calculation was used.

Calculation of concentration times for 50 and 20-year floods are shown in Table 3. Concentration times for other return periods were estimated according to the results mentioned above.

Table 3 Time of Concentration

Point on the river	Distance (km)	50-year flood			20-year flood			Velocity calculation method
		Velocity (m/s)	Time (hr)	Time of concentration (hr)	Velocity (m/s)	Time (hr)	Time of concentration (hr)	
Upper end				0			0	
Pekunden	19.72	3.0	1.83	1.83	3.0	1.83	1.83	Kraven
Patemon	7.18	2.21	0.90	2.73	1.99	1.00	2.83	uniform flow
Merunung dam	5.02	1.78	0.78	3.51	1.59	0.88	3.71	"
Berat-kuron	6.21	1.45	1.19	4.70	1.00	1.73	5.44	nonuniform flow
Klubuk	7.81	1.27	1.71	6.41	1.03	2.11	7.55	"
Sidogede	6.15	1.15	1.49	7.90	0.99	1.73	9.28	"
Gunungsari dam	33.25	1.30	7.11	15.01	1.04	8.88	18.16	"

Return Period (years)	50	20	10	5	2
Time of concentration (hr)	15.0	15.8	16.5	17.2	18.2

(4) Discharge hydrograph.

Discharge hydrographs at Gunungsari dam were obtained superposing the discharge hydrographs of the drainage area except the Watudakon-river basin, Q_G and the Watudakon river basin, Q_W as shown in Fig. 3.

The discharge hydrograph Q_G was estimated as follows:

a. Total volume of discharge hydrograph, V for each return period was calculated as follows:

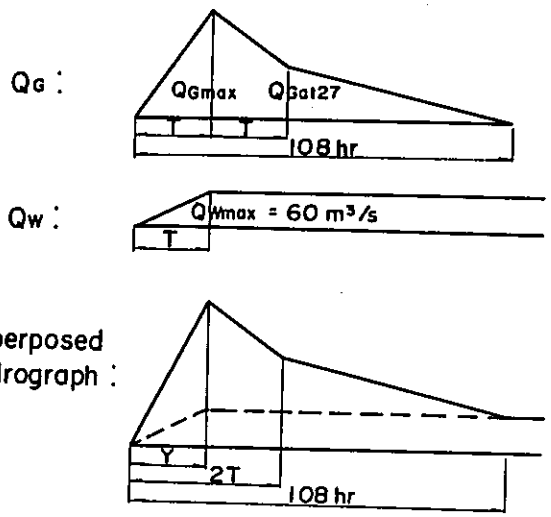


Fig. 3

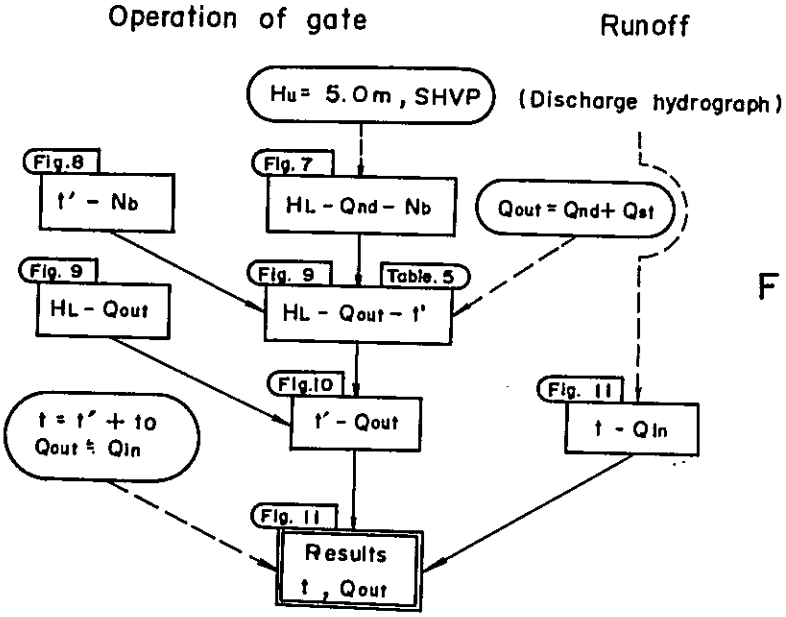


Fig. 6

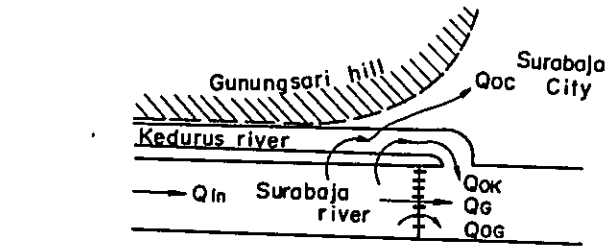


Fig. 12

$$V = fRA_G$$

where f = runoff coefficient assumed at 0.8,
R = average daily rainfall over the drainage area upstream of Gunungsari dam,
A_G= drainage area upstream of the dam = 403.7 km^2.

b. Duration of flood was determined at 108 hrs or 4.5 days after some considerations.

c. Discharges at t = 0 and t = 108 hrs are zero.

d. Peak discharge occurs at t = T or at the time of concentration.

e. Discharge at t = 2T was determined so that the total volume of the hydrograph might be the same as that calculated from rainfall, V.

The discharge hydrograph of the Watudakon, Q_W was estimated as follows:

a. Discharge at t = 0 is zero.

b. Discharge at t = T or at the time of concentration is 60 m^3/s.

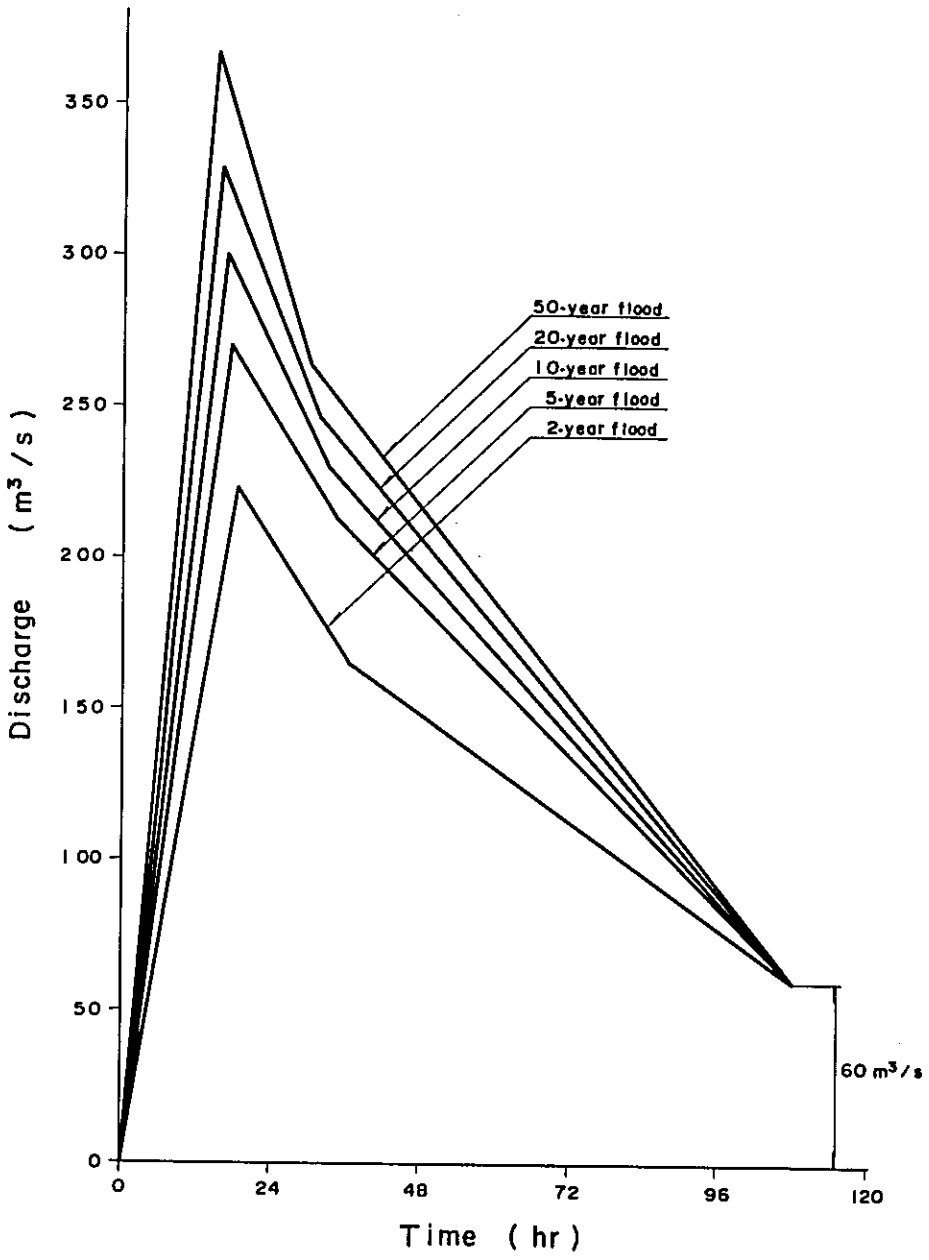
c. Discharge at t > T was assumed to be constant, i.e. Q_W = 60 m^3/s.

The results of estimation for each return period are shown in Table 4 and Fig. 4.

Table 4 Discharge Hydrograph for Each Return Period

Return period (years)		Total volume of discharge for Q_G ($\times 10^6 m^3$)	Total volume of discharge for Q_W ($\times 10^6 m^3$)	t = 0 Q_G (m^3/s)	t = 0 Q_W (m^3/s)	t = T Q_G (m^3/s)	t = T Q_W (m^3/s)	t = 2T Q_G (m^3/s)	t = 2T Q_W (m^3/s)	t = 108hr. Q_G (m^3/s)	t = 108hr. Q_W (m^3/s)
50	for Q_G, Q_W	51.07	21.71	0	0	307	60	203	60	0	60
	Sum	72.78		0		367		263		60	
20	for Q_G, Q_W	46.12	21.62	0	0	268	60	186	60	0	60
	Sum	67.74		0		328		246		60	
10	for Q_G, Q_W	42.15	21.55	0	0	240	60	169	60	0	60
	Sum	63.70		0		300		229		60	
5	for Q_G, Q_W	37.79	21.47	0	0	210	60	152	60	0	60
	Sum	59.26		0		270		212		60	
2	for Q_G, Q_W	30.75	21.36	0	0	163	60	104	60	0	60
	Sum	52.11		0		223		164		60	

Fig.4 Discharge Hydrograph at Gunungsari Dam



4. Time and Discharge when the Gate Operation have come to be abandoned.

Some operation records of stop logs and needles in the rainy season are shown in Fig. 5, which indicates that stop logs are operated against long-period variation of discharge and needles are operated to adjust the discharge variation of short-period. There are 100 needles in a gate and they are devided into 6 groups which are called "buka". Therefore, 1 buka comprizes 16 or 17 needles and needles are operated by the buka.

If the operation of gate is not quick enough and the increase of the carrying capacity of the dam is less than that of flood discharge, the water level upstream of the dam will rise and come to make it dangerous to continue the operation work. In this section, we calculate the time and the discharge through the dam when the operation of gate have come to be abandoned because of dangerous high water level.

(1) Condition of calculation.

i. Initial condition: Number of stop logs and needles which have been removed for ordinary discharge are

2 logs for each of 2 stop-log gates, and 1 buka among 5 needle gates.

ii. It is assumed that the operation work is abandoned, when the water level upstream of the dam reaches 5.0 m SHVP which is 0.6 m lower than the pier-crown of the dam.

iii. It is assumed that only needle gates are operated to release flood discharge, stop logs are not operated, and lock is closed.

(2) Method of calculation.

Calculation of time and discharge when the gate operation came to be abandoned was carried out according to the flow chart shown in Fig. 6.

Notation is as follows:

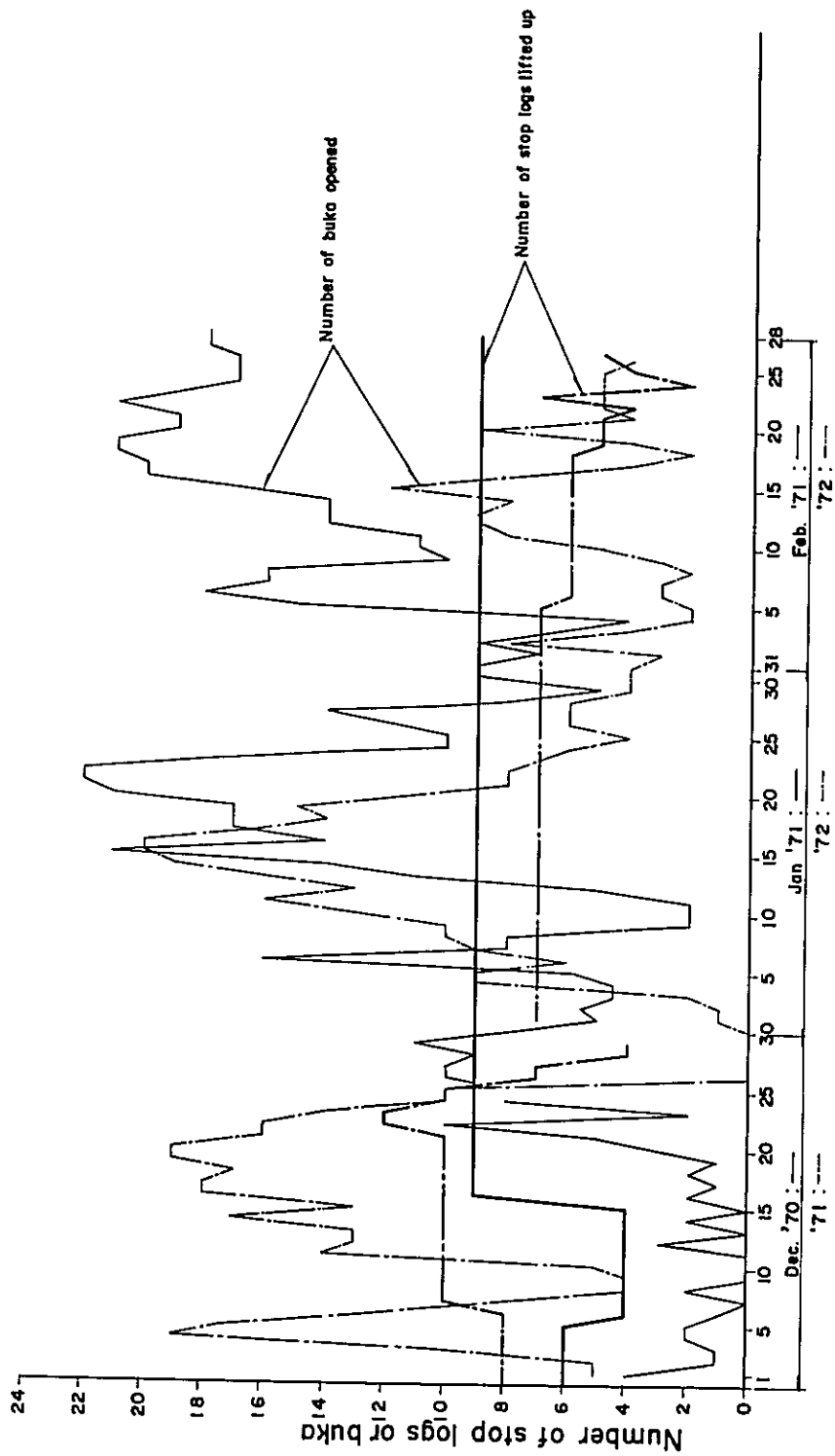
H_u = water level upstream of the dam (m, SHVP),
H_L = water level downstream of the dam (m, SHVP),
Q_{nd} = discharge through needle gates (m^3/s),
Q_{st} = discharge through stop-log gates (m^3/s),
Q_{out} = total discharge through gates = $Q_{nd} + Q_{st}$ (m^3/s),
N_b = number of buka opened (buka),
t' = time from the begining of operation work (hr),
t_o = time from the begining of runoff to the begining of operation work (hr),
t = time from the begining of runoff = $t' + t_o$ (hr),
Q_{in} = discharge from the drainage area upstream of Gunungsari dam (m^3/s).

(3) Calculation.

i. $H_2 - Q_{nd} - N_b$

Discharges through needle gates at H_u = 5.0m, SHVP were calculated for the following cases by Kindsvater-Carter-Tracy's method of calculation for flow through constriction.

Fig.5 Operation Record of Stop Logs and Needles in the Rainy Season



※ 1 buka = 16 or 17 needles
1 gate = 6 buka = 100needles

H_L = 3.2, 3.5, 4.0, 4.5 and 5.0 m, SHVP
N_b = 1, 2, 3 and 4 buka

The results are shown in Fig. 7.

ii. $t' - N_b$

It is reported that it takes 5 min. to remove one needle from the gate, which means that 1.38 hr are necessary to open 1 buka. Therefore, number of buka (N_b) are expressed as follows:

$$N_b = 0.72\ t' + 1$$

This equation is also shown in Fig. 8.

iii. Q_{st}

Discharges through stop log gates were calculated by Rehback's formula for free overflow.

$$Q_{st} = CBh_1^{3/2}$$

$$C = 1.785 + 0.237\ \frac{h_1}{D}$$

where C = coefficient of discharge,
B = width of the wier,
h_1= overflow depth,
D = depth of the wier.

Each gate has 15 stop logs of which thickness is 0.3 m. Elevation of gate bottom, H_Z is 0 m, SHVP and water level upstream of the dam, H_u is 5.0 m, SHVP. Thus, D = 0.3m x 13 logs = 3.9m, h_1 = 5.0 - 3.9 = 1.1m and B = 5m x 2 gates = 10m. If the water level downstream of the dam H_L is lower than 4.5m, SHVP, h_2/h_1 is less than 2/3 and the flow over the wier is considered to be free overflow, where h_2 is the water depth downstream of the dam. Therefore

$$C = 1.785 + 0.237\frac{h_1}{D} = 1.852$$

$$Q_{st} = CBh_1^{3/2} = 21.38\ m^3/s$$

iv. $H_L - Q_{out} - t'$

Q_{out} for the following cases were calculated making use of the results mentioned above,

H_L = 3.2, 3.5, 4.0 and 4.5 m, SHVP
t' = 0, 3, 6, 9, 12, 15 and 18 hr.

The results of the calculation are shown in Table 5 and Fig. 9.

v. $H_L - Q_{out}$

Stage-discharge relation at tailwater of the dam was obtained by non-uniform flow calculation for the reaches from Djagir dam to Gunungsari dam taking the water level upstream of Djagir dam as 3.2 m, SHVP which is always kept for the purpose of water-intake. The results are also shown in Fig. 9.

Fig.7 HL-Qnd-Nb Curve for Hu=5.0m, SHVP

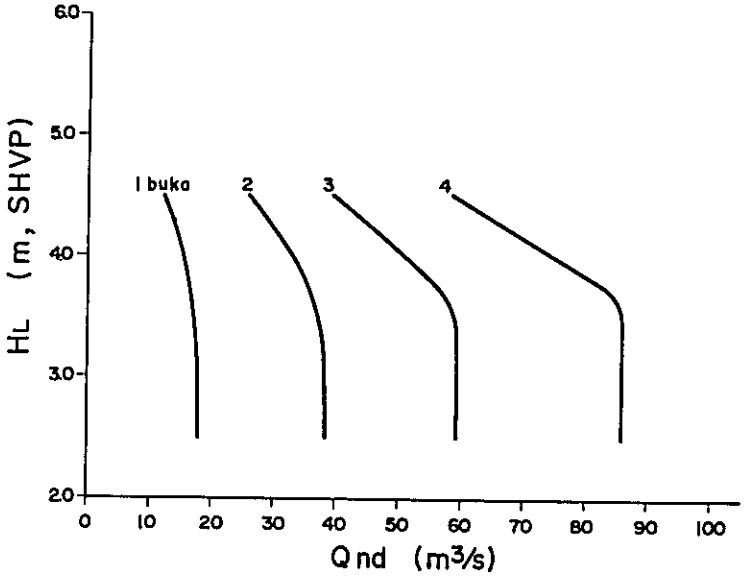


Fig.8 t'-Nb Curve

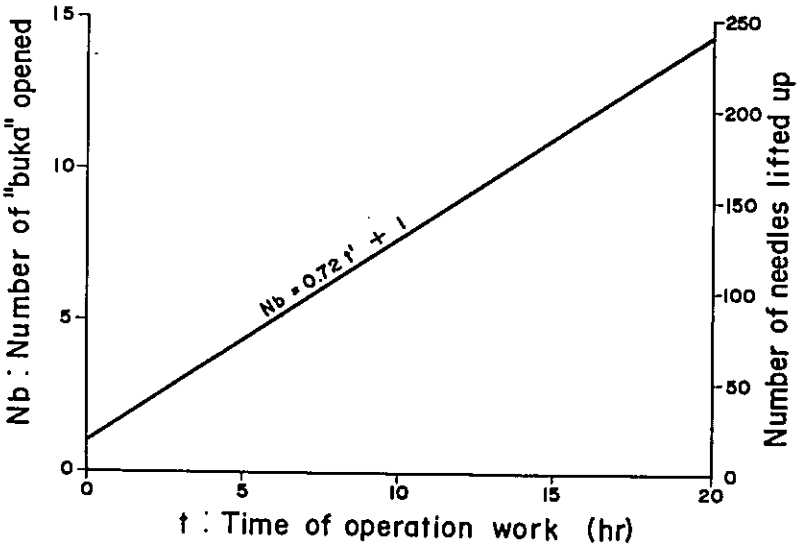


Fig.9 H_L – Qout – t' Curve and H_L – Qout Curve

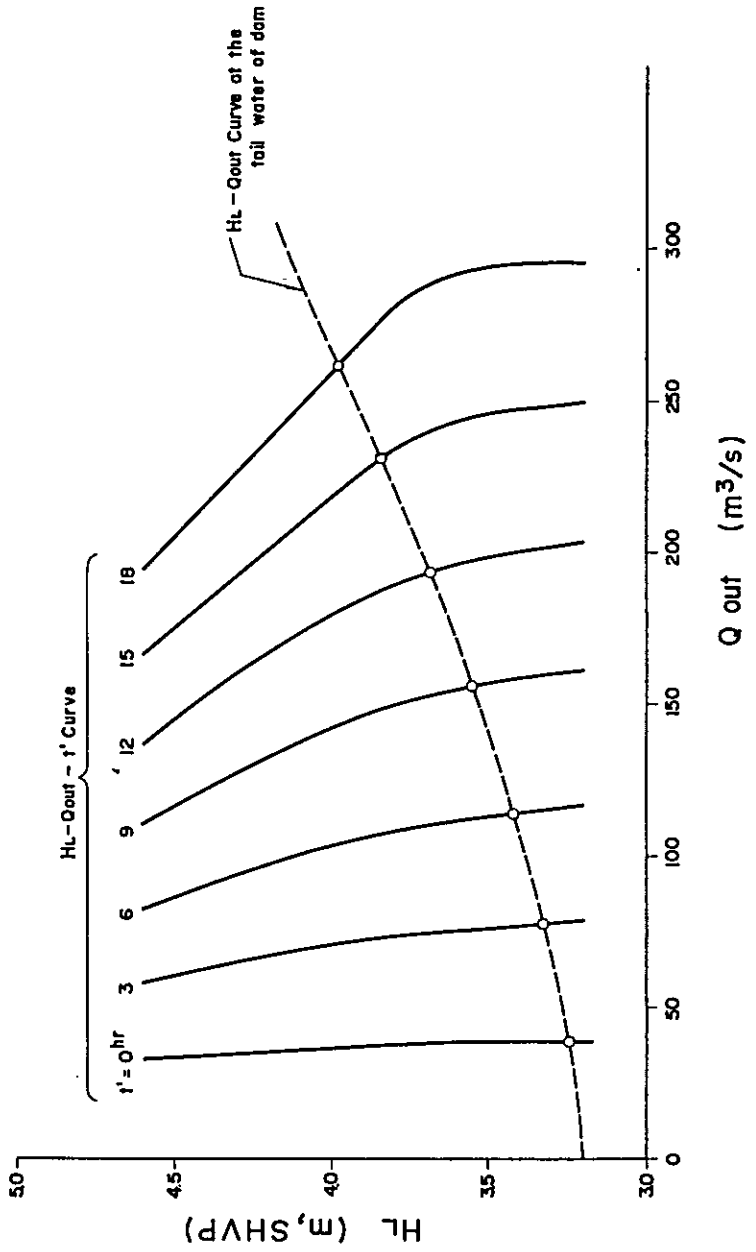


Table 5 Calculation of Discharge Through the Dam for Each Time of Operation Work

t' (hr)	N_b (buka)	Contents (buka x gate)	Discharge (m^3/s)			
			H_L=4.5 (m,SHVP)	H_L=4.0 (m,SHVP)	H_L=3.5 (m,SHVP)	H_L=3.2 (m,SHVP)
0	1.0	1 x 1	12.1	15.3	17.0	17.8
		Q_{out}	33.5	36.7	38.4	39.2
3	3.2	1 x 3	36.3	45.9	51.0	53.4
		0.2 x 1	2.4	3.1	3.4	3.6
		Q_{out}	60.1	70.4	75.8	78.4
6	5.3	1.3 x 1	16.3	21.0	23.0	24.0
		1 x 4	48.4	61.2	68.0	71.2
		Q_{out}	86.1	103.6	112.4	116.6
9	7.5	2 x 2	51.6	65.6	74.0	76.0
		1.5 x 1	19.0	24.0	27.0	28.0
		1 x 2	12.1	15.3	17.0	17.8
		Q_{out}	116.2	141.6	156.4	161.0
12	9.6	2 x 4	103.2	131.2	148.0	152.0
		1.6 x 1	20.5	26.0	29.0	30.0
		Q_{out}	145.1	178.6	198.4	203.4
15	11.8	3 x 1	39.5	51.0	58.8	59.0
		2.8 x 1	36.8	47.5	54.3	55.0
		2 x 3	77.4	98.4	111.0	114.0
		Q_{out}	175.1	218.3	245.5	249.4
18	14.0	3 x 4	158.0	204.0	235.2	236.0
		2 x 1	25.8	32.8	37.0	38.0
		Q_{out}	205.2	258.2	293.6	295.4

* Discharge through stop log gate(21.4 m^3/s) is included in Q_{out}.

vi. $t' - Q_{out}$ and $t - Q_{in}$

Fig. 9 shows the graphical solutions of the simultaneous equations of H_L-Q_{out}-t' curve and H_L-Q_{out} curve. From this figure, $t' - Q_{out}$ curve was obtained as the solution, which is shown in Fig. 10. This curve indicates the increase of carrying capacity of the dam according to the lapse of operation time.

On the other hand, discharge hydrograph shown in Fig. 11 indicates the increase of inflow according to the lapse of time.

vii. Results.

Thus, the time t and the discharge through the dam Q_{out} when the gate operation have come to be abandoned were calculated as a solution of the simultaneous equations of t'-Q_{out} and t-Q_{in} supposing $Q_{in} \fallingdotseq Q_{out}$ at H_u = 5.0 m, SHVP and t_o = 0.9, 1.0, 1.2, 1.4 and 1.8 hr for 50, 20, 10, 5 and 2-year floods respectively. The results are as follows:

Return Period	Q_{out}(m^3/s)	t (hr)	total buka
50 year flood	56	2.4	2.7
20 year flood	66	3.2	3.3
10 year flood	75	4.2	4.0
5 year flood	108	7.0	6.0
2 year flood	Manual operation is quick enough for 2-year flood		

5. Discharges of Floods Running into the City Area.

When the water level upstream of the dam has reached 5.0 m, SHVP and the operation of gates is stopped, the water begins to overtop the piers and further the left-side road when H_u has reached 5.6 m, SHVP. Finally, the discharge from drainage area upstream of Gunungsari dam, Q_{in} comes to be devided into the following four parts when H_u is higher than 5.6 m, SHVP.

Q_G = discharge passing through the gates at H_u = 5.6 m, SHVP
Q_{OG} = discharge which flows over the top of piers
Q_{OK} = discharge which, flowing over the left-side road, runs into the downstream reach of the Surabaja river through the Kedurus river
Q_{OC} = discharge which, flowing over the left-side road and the Kedurus river, runs into the Surabaja city area. (see Fig. 12).

(1) Discharge through gates, Q_G.

Discharge through the gates at H_u = 5.6 m, SHVP was calculated by Kindsvader-Carter-Tracy's method and stage-discharge curve at the tail water of the dam. The results are as follows:

Return Period	50 yr	20 yr	10 yr	5 yr
Q_G (m^3/s)	101	114	130	174

Fig. 10 $t'-Q_{out}$ Curve

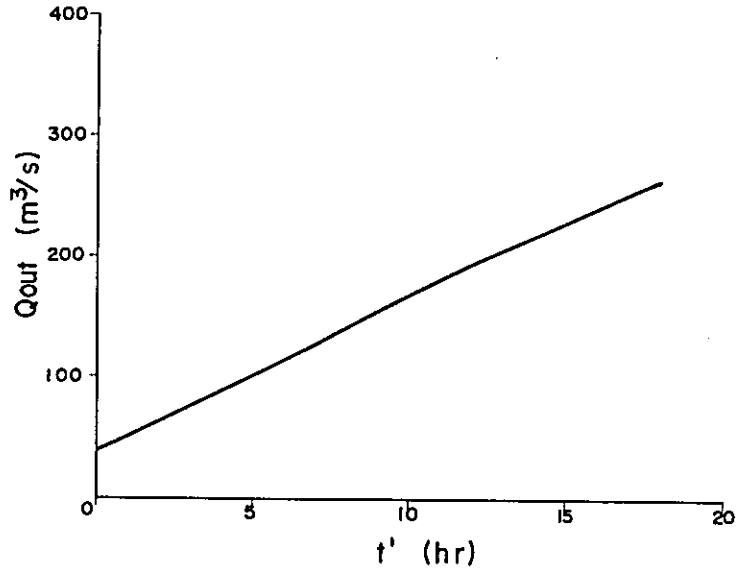
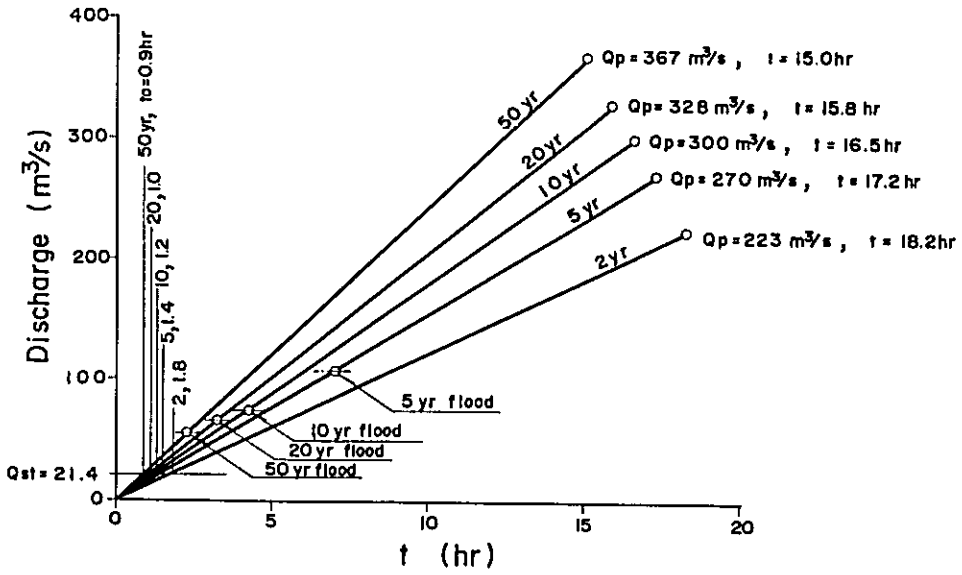


Fig. 11 $t-Q_{in}$ Curve



(2) Discharge through the Kedurus river, Q_{OK}.

Discharge which flows into the Surabaja river through the Kedurus river was calculated for 5.6 m, SHVP of water level in the Kedurus river by Kindsvader-Carter-Tracy's method, considering the loss of head due to the piers of culvert and the water level downstream of the dam. As a result, Q_{OK} = 52 m^3/s for 50, 20, 10 and 5-year floods.

(3) Discharge which flows over the top of piers of the dam, Q_{OG} and discharge which runs into the city area, Q_{OC}.

The ratio of Q_{OG} and Q_{OC} was estimated assuming that Q_{OG} was a flow over the sharp edged wier and Q_{OC} was an uniform flow of n = 0.1 and I = 1/120 for unit width, taking account the width of the dam and the width between the Kedurus river and Gunungsari dam. This is shown below.

Discharge	① Ratio of width	② Ratio of discharge for unit width	① x ②	Q_{OG}:Q_{OC} in percentage
Q_{OG}	3.0	2.2	6.6	87
Q_{OC}	1.0	1.0	1.0	13

Therefore, discharge which runs into the Surabaja city area is estimated as follows:

Return period	① Q_{in}	② Q_G	③ Q_{OK}	④ ① -(②+③)	⑤ Q_{OG}	⑥ Q_{OC}
50 year	367	101	52	214	186	28
20 year	328	114	52	161	140	21
10 year	300	130	52	118	103	15
5 year	270	174	52	44	38	6

The discharge hydrograph of the flow which runs into the Surabaja city area for each return period is shown in Fig. 13. Total volume of the hydrograph is as follows,

Return period (years)	50	20	10	5
Total volume ($x10^6 m^3$)	2.678	1.766	1.041	0.169

6. Flooding in Surabaja city.

The water which has overflowed left-side road and the Kedurus river runs into Surabaja city and flows mainly on the streats toward lower part of the city. Finally the water pours into the sea. The course of the flood flow was assumed as shown in Fig. 14 and flow was calculated as unsteady flow under the following conditions;

a. Cases of flood: Flood flows at 50, 20 and 10-year return periods were taken. It was found by some trial computation, that five-year flood would not cause practical damage.

b. Boundary condition: Water level at the lowest end was assumed to be constant at 10 cm in depth.

Fig. 13 Discharge Hydrograph which Runs in to City Area

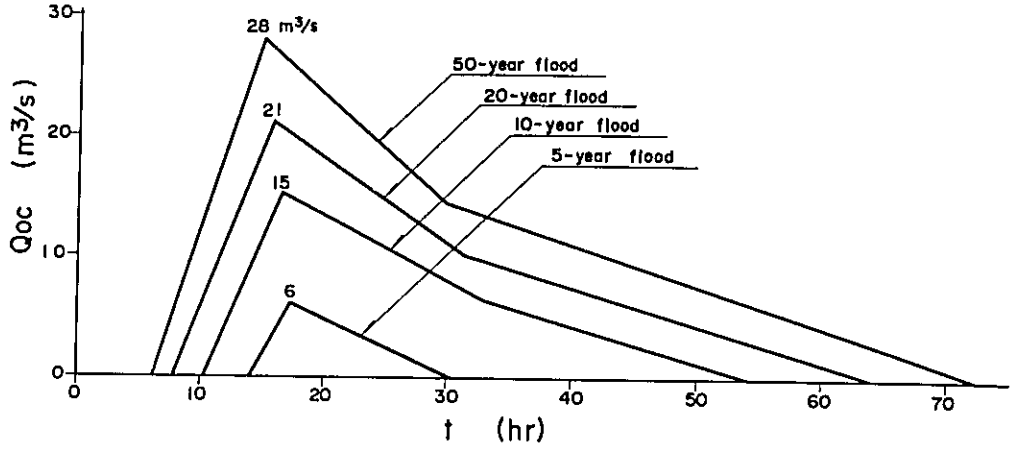


Fig. 15 Maximum Water Level due to Flood Flow

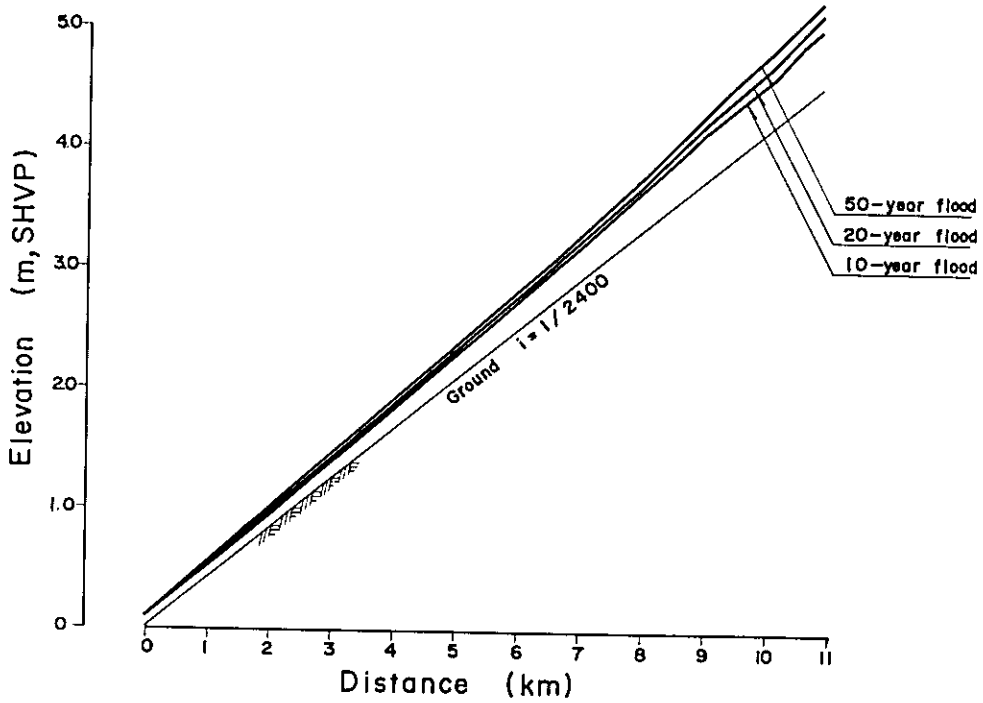


Fig. 14 Course of Flood Flow

c. Initial condition: Initial condition of discharge at each section was taken constant as 5.6, 5.1 and 6.2 m^3/s for 50, 20 and 10-year flood respectively. Initial condition of water level at each section was given according to nonuniform flow calculation for discharges méntioned above.

d. Interval of sections Δx was taken as 500 m and interval of time for calculation Δt was taken as 5 min.

e. Manning's coefficient of roughness n was assumed at 0.1 and average ground slope i was taken as 1/2400. Ratio of effective width of flow to whole flooding width was assumed at 40% according to aero-photographs.

The calculations gave the maximum water level at each section as shown in Fig. 15.

CHAPTER XIX

REDUCTION OF INUNDATION DUE TO IMPROVEMENT OF THE MAS RIVER

This chapter deals with the case of Darmo Subbasin as an example.

Even though the areal net of the drainage system in the Darmo Subbasin should not be improved, the condition of drainage ought to be improved so much if the Mas river is improved so as to have a larger carrying capacity, because the increase of carrying capacity of the Mas river means the lowering of the water level which will exert a good effect upon the drainage condition of the subbasin. In this chapter, reduction of inundation in the subbasin due to the improvement of the Mas river is studied. The bases of the study are as follows:

a. The present conditions of the subbasin and the Mas river have been making it impossible to drain the runoff from the subbasin without any inundation. That is, the difference between the runoff hydrograph when the Mas river as well as the subbasin would have been improved under the condition of f = 0.6 and the runoff hydrograph when they are left as they are is causing the inundation in the present subbasin of f = 0.4.

b. If the Mas river is improved, the drainage of the subbasin will also be improved so much. However, an inundation will still remain in the subbasin in accordance with the difference of improvement between the two conditions of drainage of the subbasin f = 0.4 and f = 0.6.

c. The method of calculation of runoff which is used here is the same as in Chapter XI.

d. Runoffs were calculated for the three cases, improved state (f = 0.6), present state (f = 0.4), and the Mas river alone improved (f = 0.4). Each of them was calculated for three cases of 10-year, 5-year, and 2-year storms.

e. Notations are as follows:

f = runoff coefficient of peak discharge, 0.4 for the existing basin and 0.6 for the improved basin,

w_1 = propagation velocity in the 300 m-channel mentioned in Chapter XI, m/s,

w_2 = propagation velocity in the 2500m-channel mentioned in Chapter XI, m/s,

T_o = inlet time; 8 min for the improved basin, but 24 min was assumed for the existing basin,

T_c = concentration time, min,

r = rainfall intensity, mm/hr; estimated for T_c using Fig. 8 in Chapter VIII,

Q = peak discharge, m^3/s; calculated by the rational formula,

R = daily rainfall, mm; from Table 4 in Chapter VIII,

F = coefficient of total runoff; this value was taken as 0.8 according to the study in Chapter XIV,

V = total volume of runoff, m^3; = FRA,

A = area of the basin, m^2; 2.25 km^2 in this case,

T = duration of runoff, min,

w_{2m} = propagation velocity in the existing 2500m-channel when the Mas river has been improved, m/s,

ΔT_1 = shortening of propagation time in the existing 2500m-channel due to the channel improvement of the Mas river, min; this value was obtained by trial computation,

ΔT_2 = shortening of propagation time in the reaches of the Mas river which concern the Darmo subbasin due to the channel improvement of the Mas river, min; this value was also obtained by trial computation,

ΔV_p = volume of storage or inundation due to the difference of the two hydrographs, hydrograph in the improved state of the basin and hydrograph in the present state of the basin, m^3,

ΔV_m = volume of storage or inundation due to the difference of the two hydrographs, hydrograph in the improved state of the basin and hydrograph in the improved state of the Mas river, m^3,

a = area of inundation, m^2; the value in the present state of the basin was surveyed in the field and the value in the improved state of the Mas river was assumed on the basis of the above value,

d = average depth of submergence, m; = $\Delta V/a$.

The results of calculation are shown in Tables 1 and 2 and the obtained hydrographs for 10-year, 5-year, and 2-year storms are shown in Figs. 1 to 3.

Table 1 Runoff from the Darmo Subbasin

	10-yr storm	5-yr storm	2-yr storm
Improved state			
f	0.60	0.60	0.60
w_1	0.30	0.30	0.17
w_2	0.50	0.50	0.25
T_o	8	8	8
T_c	108	108	204
r	55	44	19
Q	20	16	7
R	156	140	109
F	0.80	0.80	0.80
V	281×10^3	252×10^3	196×10^3
T	468	525	934
Present state			
f	0.40	0.40	0.40
w_1	0.16	0.15	0.10
w_2	0.27	0.25	0.20
T_o	24	24	24
T_c	210	224	282
r	32	24	15
Q	8	6	4
V	281×10^3	252×10^3	196×10^3
T	1171	1400	1635
The Mas river improved			
f	0.40	0.40	0.40
w_{2m}	0.40	0.37	0.27
ΔT_1	50	54	53.7
ΔT_2	16	16	2.4
T_c	140	154	226
r	44	33	17.5
Q	11	8.3	4.5
V	281×10^3	252×10^3	196×10^3
T	852	1012	1453

Table 2 Average Submergence Depth

	10-yr storm	5-yr storm	2-yr storm
Present state			
ΔV_p	147,420	133,875	63,180
a	300,000	280,000	250,000
d	0.49	0.48	0.25
The Mas river improved			
ΔV_m	99,072	92,043	46,980
a	260,000	250,000	200,000
d	0.38	0.37	0.23

Fig. 1 10-yr Discharge Hydrograph

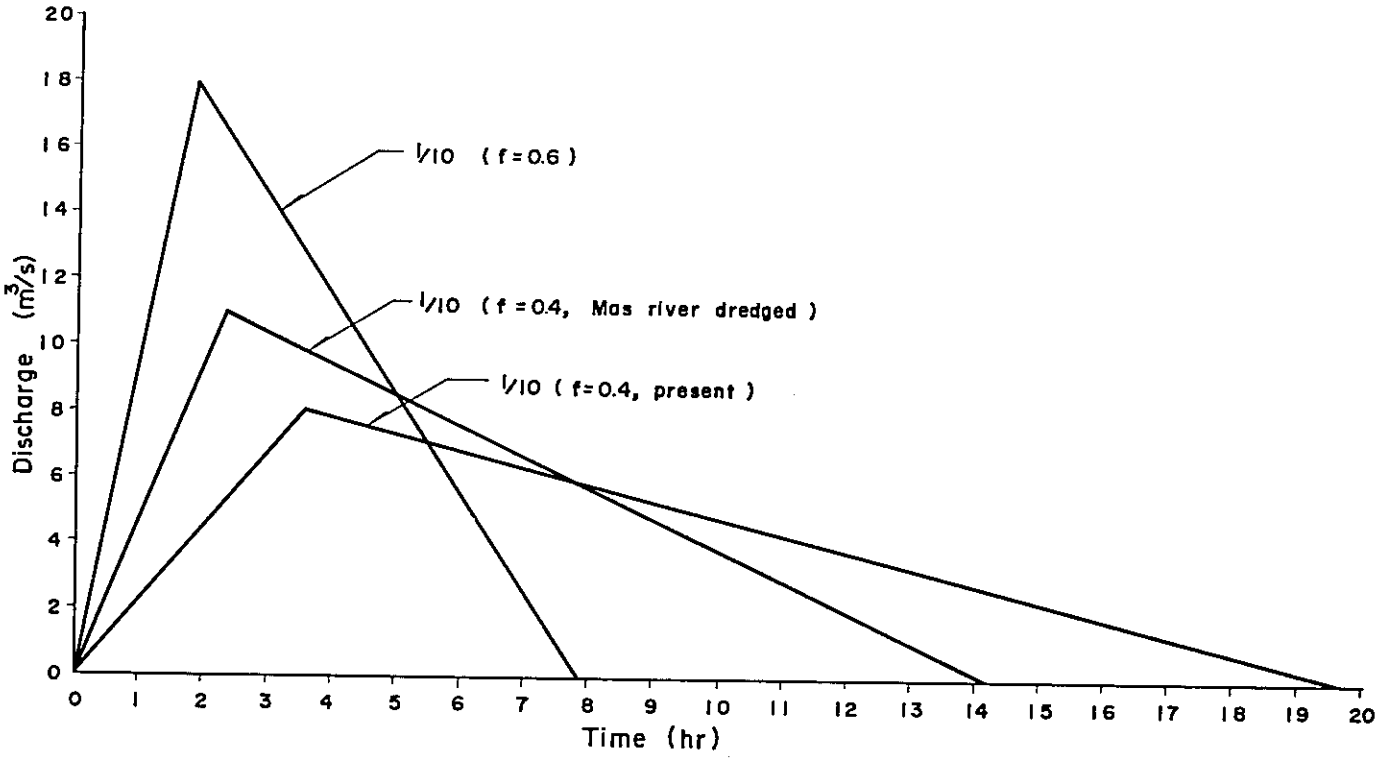


Fig. 2 5-yr Discharge Hydrograph

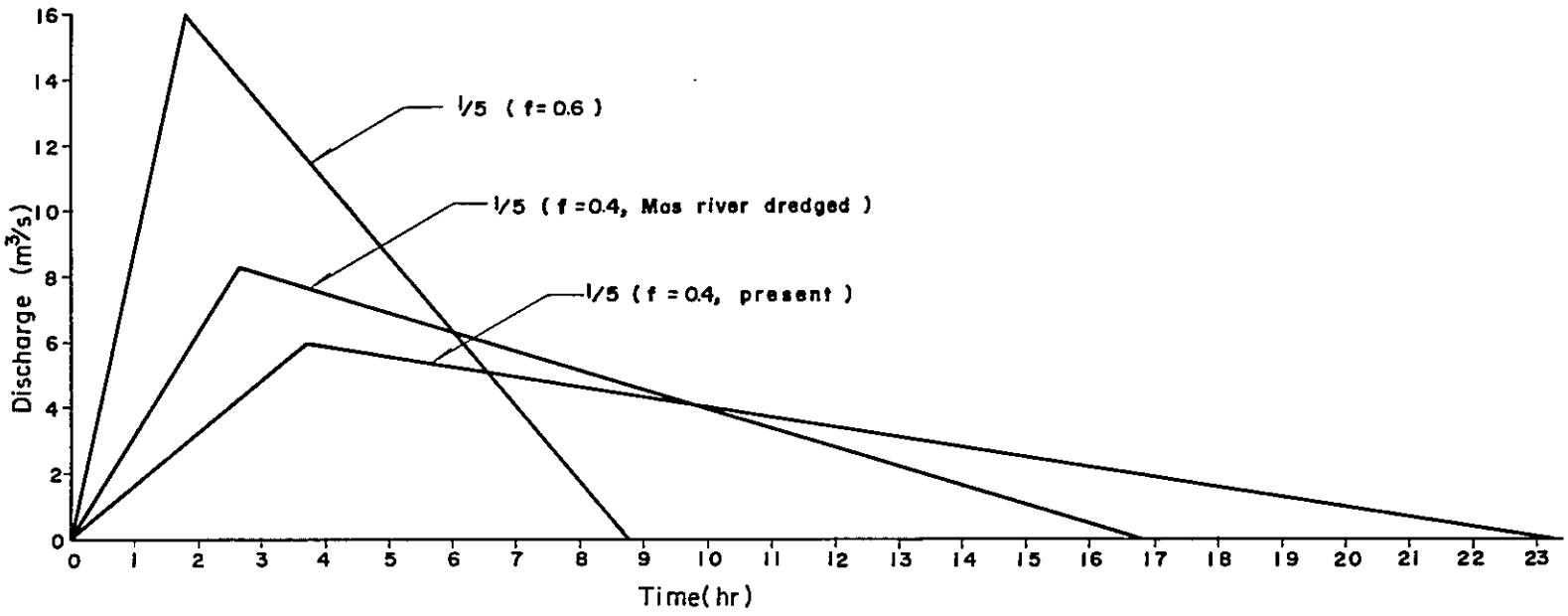
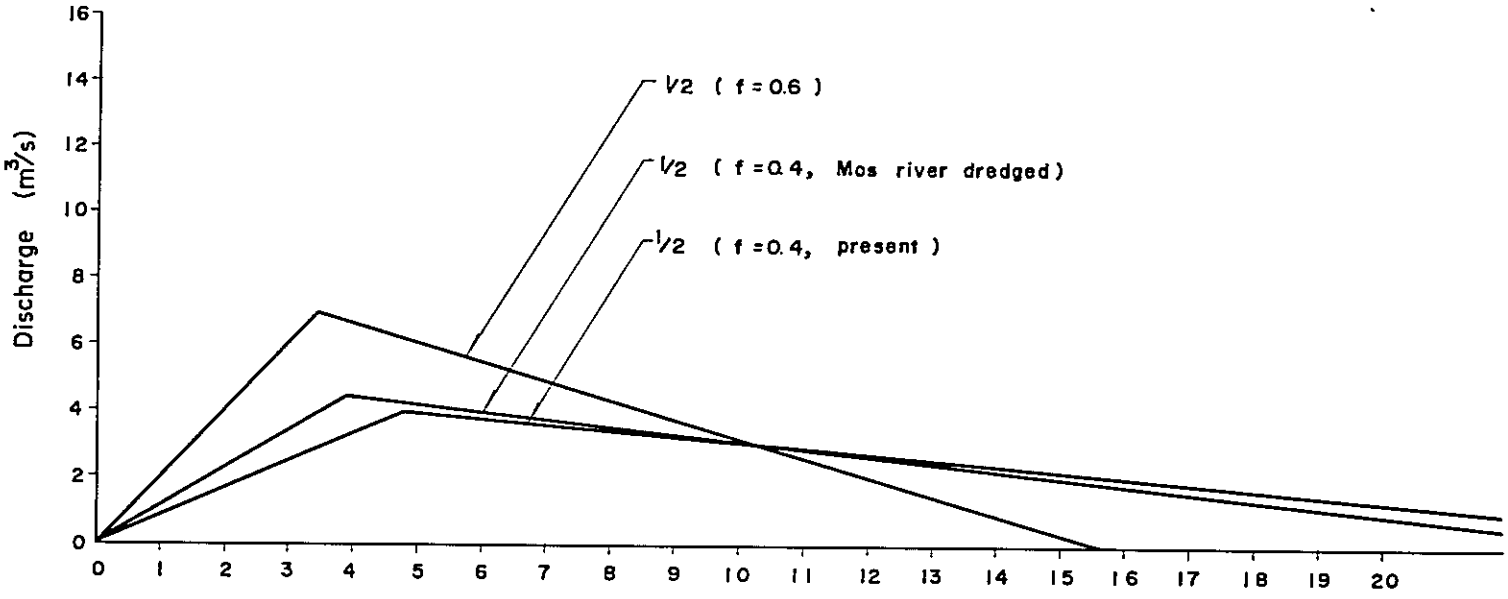


Fig. 3 2-yr Discharge Hydrograph



CHAPTER XX

POPULATION FORECASTING

In accordance with the city planning, established by the Team City Master Plan, the future population of Surabaja urban area is expected to reach roughly 4.8 million by 1990. The prediction might be based upon the facts and assumptions that; (1) the annual population growth rate of 6% will remain same in future, (2) the form of government and the political, economical and social organization and institutions of the country will occur. remain substantially unchanged, (3) no allout war, internal revolution, nation-wide devastation, epidemic or other disaster will occur, (4) no large-scale epidemic, destruction by military action, fire, earthquake, or other disaster will occur in the area, (5) the past populations in the city are, 1,285,810 in 1968, 1,409,363 in 1969, 1,518,352 in 1970 and 1,622,256 in 1971 respectively.

Although the future population is roughly estimated at 4.8 million, the prediction is calculated from data obtained from only the last four years from 1968 through 1971 and the result may possibly to deviate from the predicted figures, in other words, envelope of probable future population prediction may become so wide that the error will also be great from the statistical viewpoint. Therefore, other trials have also been conducted in order to reach better agreement.

1. Mathematical Method.

(1) $P_n = P_o + n \cdot q$ (1)

where P_n = population of nth year from the base,
P_o = present or base year population,
n = number of years from the base year,
q = averaged number of annual increase of population,

then

$$P_n = 1,622,256 + 19 \times \frac{1,622,256 - 1,285,810}{3}$$

$$= 3,753,081 \quad \text{Say } 3,750,000$$

(2) $P_n = aX + b$ (2)

where P_n = population for the forecast year,
X = number of years from the base year,
a, b = constants may be obtained by the least square method,

then, using the above statistical figures we obtained the following;

$a = 111,833$

$b = 1,403,024$

$P_n = 111,833X + 1,403,024$

For 1990, $X = 21$ is substituted, then,

$P_n = 3,751,517$ Say 3,750,000

(3) $P_n = P_t(1 + r)^n$ (3)

where $r = \left(\frac{P_o}{P_t}\right)^{\frac{1}{t}} - 1 = \left(\frac{1,622,256}{1,285,810}\right)^{\frac{1}{4}} - 1$

$= 0.0598$ Say 0.06

then

$P_n = 1,622,256\ (1 + 0.06)^{19}$

$= 4,908,900$ Say,4,900,000

(4) $P_n = P_o + A_n^a$ (4)

where A,a = constants to be obtained by the least squares,
n = number of the years from the first year of the data,
P_n = index of the population at nth year to the base year.

Table 1

Year	Population	P_n
1968	1,285,810	79.26
1969	1,409,363	86.88
1970	1,518,352	93.60
1971	1,622,256	100.00

Using the above statistical figures and the least square method, we obtain an equation as

$$P_n = 79.26 + 7.6194 \cdot n^{0.9115}$$

for the year of 1990, 22 may be substituted to n, then,

$$P_n = 79.26 + 7.6194 \times 16.74 = 203.81$$

therefore, the population in 1990 is

$1,622,256 \times 2.03819 = 3,306,320$ Say 3,300,000

(5) Logistic Curve.

$$P_n = \frac{K}{1 + e^{a-bx}}$$

where P_n = population at time x,
x = number of the years from the base year,
e = base of Napierian logarithms,
(2.7182 ...)
K = ultimate population,
4,800,000 after the Team City Master Plan,
a,b= constants,

the equation (5) may be expressed by the least square method as follows:

$$P_n = \frac{4,800,000}{1 + e^{0.7763-0.1106x}} \quad (6)$$

The population in 1990 will be

$$P_n = \frac{4,800,000}{1 + e^{-1.4357}} = 3,877,953 \qquad \text{Say } 3,880,000$$

2. Other Method.

The study on the future agricultural development indicates that even in the year of 1990, considerable farm land will remain in the interior of city area where the city planning designated as either residential, industrial or recreational zones etc. The study expects that reduction of the farm land from the present condition is nearly 900 ha by the year, which means that nearly 6,900 ha of the farm land area will occupy in the city planning area even in twenty years later.

The reducted farm land of 900 ha may be converted into the city area, and if we assume an average population density at 200 persons/ha, a total population expected to inhabit in this area will be; 200 x 900 = 180,000 persons. Although the overall annual population growth rate is given approximately as 6%, such accurate compositions of the increment as the ratio of births, deaths and migration is not given. An average annual population growth rate of the whole Indonesia is reported to have been 3%, and it may be safe to assume that the city's annual population growth rate other than migration is 3%. Then the total population in 1990 is estimated at

$$P = 1,622,256\ (1 + 0.03)^{19} + 180,000$$
$$\fallingdotseq 3,025,000$$

3. Conclusions.

Although several methods have been mathematically presented, population forecasting is essentially a matter of judgment and are subject to a wide variety of disrupting influences that may affect their reliability and require the use of a large number of assumptions in their preparation. Although the forecasting of the future population has been conducted by several different ways, no same result has been obtained. The results are summerized in Table 2. At the same time, populations for the years from 1971 through 1992 have also been calculated and illustrated in Fig. 1.

Table 2 Population Forecast for 1990

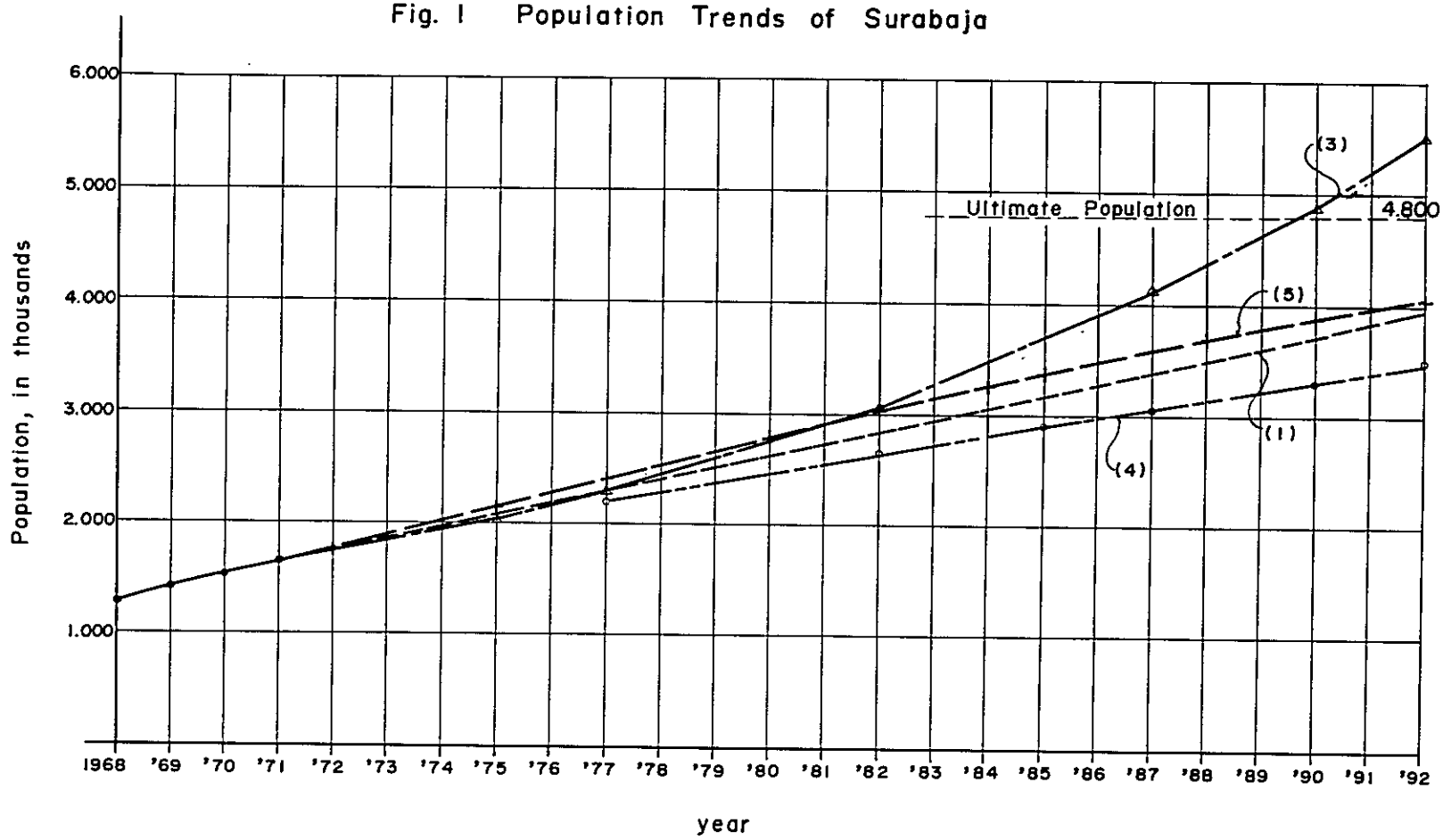
Equation	Population in 1990
$P_n = P_o + n \cdot q$	3,750,000
$P_n = aX + b$	3,750,000
$P_n = P_o(1 + r)^n$	4,900,000
$P_n = P_o + A_n^a$	3,300,000
$P_n = \frac{K}{1 + e^{a-bx}}$	3,880,000
$P_n = P_o(1 + r)^n + A$	3,025,000

Taking these results of the computation and circumstances in the city into account, we may use the figure of 3,750,000 as a population of the city in 1990. Populations for the years, 1972, 1977, 1982, 1987 and 1992 are also forecast by using the equation (1) and given in Table 3.

Table 3

Year	1972	1977	1982	1987	1992
Population	1,735,000	2,296,000	2,856,000	3,417,000	3,978,000

Fig. 1 Population Trends of Surabaja



CHAPTER XXI

STATISTICS ON HOUSEHOLD WATER USE

1. Number of Households Served by Municipal Water Supply System.

MONTH	HOUSES SERVED			
	1968	1969	1970	1971
JANUARY	44,773	44,735	45,833	47,180
FEBRUARY	43,870	44,854	45,910	47,249
MARCH	43,944	44,915	45,968	47,391
APRIL	44,042	44,982	46,026	47,477
MAY	44,131	45,043	46,092	47,616
JUNE	44,261	45,103	46,263	47,732
JULY	44,374	45,149	46,382	47,877
AUGUST	44,421	45,214	46,502	48,065
SEPTEMBER	44,484	45,335	46,452	48,199
OCTOBER	44,592	45,486	46,835	
NOVEMBER	44,658	45,579	46,952	
DECEMBER	44,732	45,678	47,047	
AVERAGE	44,356	45,174	46,371	47,643

2. Quantity of Water Spent.

MONTH	QUANTITY OF WATER CONSUMES (m^3/month)			
	1968	1969	1970	1971
JANUARY	2,995,451	3,370,346	3,498,419	3,828,922
FEBRUARY	2,853,086	3,058,523	3,356,802	3,404,320
MARCH	3,095,568	3,078,784	3,666,408	3,874,619
APRIL	3,021,390	3,218,820	3,602,527	4,215,927
MAY	3,114,046	3,463,320	3,788,777	3,868,482
JUNE	3,184,618	3,316,411	3,713,591	3,756,827
JULY	3,405,021	3,559,309	3,856,820	3,839,840
AUGUST	3,329,023	3,487,833	3,857,179	3,853,599
SEPTEMBER	3,210,540	3,364,191	3,779,469	3,787,021
OCTOBER	3,327,181	3,486,576	3,581,912	
NOVEMBER	3,196,537	3,367,819	3,563,044	
DECEMBER	3,347,758	3,428,314	3,785,376	
TOTAL	38,080,219	40,201,246	44,171,941	34,429,557
AVERAGE	3,173,352	3,350,104	3,680,995	3,825,506

3. Electricity Consumed by Water Supply System

MONTH	USE OF ELECTRIC POWER (KWH)			
	1968	1969	1970	1971
JANUARY	714,218	853,044	855,808	901,254
FEBRUARY	767,334	779,508	770,220	786,922.8
MARCH	691,812	806,570	863,856	911,271.6
APRIL	726,406	805,894	855,284	867,550
MAY	653,684	846,804	894,000	889,750
JUNE	804,946	751,984	874,792	888,599.6
JULY	813,864	868,266	907,052	909,471
AUGUST	827,890	875,264	814,628	916,640.4
SEPTEMBER	793,578	854,560	883,744	894,137.4
OCTOBER	815,736	872,176	897,178	
NOVEMBER	781,286	857,214	849,330	
DECEMBER	828,238	860,348	882,668	
TOTAL	9,218,982	10,031,634	10,437,740	

4. Average Water Consumption Rate per each Family.

MONTH	1968 l/day/house	1969 l/day/house	1970 l/day/house	1971 l/day/house
JANUARY	2,240	2,430	2,462	2,617
FEBRUARY	2,240	2,351	2,611	2,484
MARCH	2,270	2,211	2,573	2,637
APRIL	2,280	2,385	2,609	2,959
MAY	2,270	2,480	2,651	2,623
JUNE	2,398	2,450	2,675	2,587
JULY	2,475	2,541	2,682	2,586
AUGUST	2,417	2,488	2,675	2,619
SEPTEMBER	2,405	2,473	2,700	
OCTOBER	2,406	2,472	2,467	
NOVEMBER	2,385	2,462	2,529	
DECEMBER	2,414	2,452	2,595	

5. Water Quality of River.

(1) Name of the river: The Surabaja river, at Gunungsari.

Authority: Labolatory of Petro Kimia, Gresik.

Chemical composition of raw water:

a. pH		--- 7 - 7.7	
b. Turbidity		--- 300 - 15,000	ppm
c. Total hardness as $CaCo_3$		--- 100 - 150	ppm
d. Alkalinity as $CaCo_3$	P	--- 0	
	M	--- 100 - 120	"
e. Chloride as $CaCo_3$		--- 15 - 25	"
f. Sulphate as $CaCo_3$		--- 26	
g. Organic matters ($KMnO_4$ number)		--- 18.63	

Chemical composition of purified water:

a. pH		--- 9 - 9.5	ppm
b. Turbidity		--- 1	"
c. Total hardness as $CaCo_3$		--- 70 - 100	"
d. Alkalinity as $CaCo_3$	P	--- 20	"
	M	--- 70	"
e. Sulphate as $CaCo_3$		--- 100	"
f. Chloride as $CaCo_3$		--- 15 - 25	"

Chemicals used for purification:

a. Aluminum Sulphate
b. Calcium Hyphochlorite
c. Lime

(2) Name of the river: The Pegirian, at Gembong bridge.

Authority: The Japanese Survey Team for the Surabaja river.

Date: 17th January, 1972.

Temperature: Atom-32 degress C, Water-28 degrees C.

Result of analysis:

a. Hardness as Calcium	--- 110	ppm
b. Total Hardness	--- 150	ppm
c. Hydrogen Sulfide	--- 0.2	"
d. Ammonia	--- more than 5	ppm

CHAPTER XXII

IRRIGATION WATER REQUIREMENT

1. Average Values of 7-Crop-Year Records.

Average values of crop-growing areas in each crop and in each irrigation block are shown in Tables 1-1 to 1-9, and, for reference, the values in Brantas Delta is also shown in Table 1-10.

2. Calculation of Monthly Growing Ratio and Average Plant Height of Crop.

Areal average growing ratio and plant height of paddy in each irrigation block have be calculated using Fig. 3-1 in the main report which indicates the relationship between relative growth of rice plant and rice plant height. The results of calculation are shown in Tables 2-1 to 2-24, and, for reference, those of Brantas Delta are shown in Tables 2-25 to 2-28.

3. Calculation of Field Delivery Water Requirements and Diversion Water Requirements in Each Irrigation Block.

Seed bed water requirements of paddy are shown in Tables 3-1 to 3-5.

Monthly transplanting area and puddling water requirements are shown in Tables 3-6 to 3-10.

Field delivery water requirements both for paddy and for polowidjo are given in Tables 3-11 to 3-16.

Field delivery water requirements and diversion water requirements are given in Tables 3-17 to 3-25.

4. Irrigation Water Distribution.

Irrigation water distribution under the control of Wonokromo Section during the period from 1964 to 1970 is shown in Tables 4-1 to 4-8.

Table 1-1 Growing area by crop in hectare

Irrigation Block: SIMOWAU W-1
A = 387 ha

Average of 7 yrs (1964 to 1970)

		Rainy season paddy		Dry season paddy Regulated		Dry season paddy non-Regulated		Polowidjo	Fallow	Others	Total
		Seed bed	Growing	Seed bed	Growing	Seed bed	Growing				
Oct.	ha	2	2	0	3	0	93	7	277	3	387
	%	0.5	0.5	0	0.8	0	24.0	1.8	71.6	0.8	100.0
Nov.	ha	11	15	0	0	0	37	3	294	27	387
	%	2.8	3.9	0	0	0	9.6	0.8	76.0	6.9	100.0
Dec.	ha	13	89	0	0	0	16	0	212	57	387
	%	3.4	23.0	0	0	0	4.1	0	54.8	14.7	100.0
Jan.	ha	16	189	0	0	0	4	0	121	57	387
	%	4.2	48.8	0	0	0	1.0	0	31.3	14.7	100.0
Feb.	ha	7	256	0	0	0	0	0	75	49	387
	%	1.8	66.1	0	0	0	0	0	19.4	12.7	100.0
Mar.	ha	2	291	0	0	0	0	0	71	23	387
	%	0.5	75.2	0	0	0	0	0	18.4	5.9	100.0
Apr.	ha	0	267	2	2	2	1	0	98	15	387
	%	0	69.0	0.5	0.5	0.5	0.3	0	25.3	3.9	100.0
May	ha	0	184	3	17	7	12	1	136	27	387
	%	0	47.5	0.8	4.4	1.8	3.1	0.3	35.1	7.0	100.0
Jun.	ha	0	64	0	33	5	89	4	164	28	387
	%	0	16.5	0	8.5	1.3	23.0	1.0	42.4	7.3	100.0
Jul.	ha	0	18	0	34	3	130	9	163	30	387
	%	0	4.7	0	8.8	0.8	33.6	2.3	42.1	7.7	100.0
Aug.	ha	0	3	0	34	1	144	10	165	30	387
	%	0	0.8	0	8.8	0.3	37.2	2.6	42.6	7.7	100.0
Sep.	ha	0	0	0	17	0	120	9	210	31	387
	%	0	0	0	4.4	0	31.0	2.3	54.3	8.0	100.0

Note: Basic data (yearly records) are "Daftar Pertanaman" of Sekisi Wonokromo, Brantas, East Java Provincial Irrigation Service.

Table 1-2 Growing area by crop in hectare

Irrigation Block: KEBONAGUNG W-2
A = 1.511 ha

Average of 7 yrs (1964 to 1970)

		Rainy season paddy		Dry season paddy Regulated		Dry season paddy non-Regulated		Polowidjo	Fallow	Others	Total
		Seed bed	Growing	Seed bed	Growing	Seed bed	Growing				
Oct.	ha	0	0	0	276	1	709	16	506	3	1,511
	%	0	0	0	18.3	0.1	46.9	1.0	33.5	0.2	100.0
Nov.	ha	15	8	0	220	0	522	20	654	72	1,511
	%	1.0	0.5	0	14.6	0	34.5	1.3	43.3	4.8	100.0
Dec.	ha	50	77	0	141	0	324	21	710	188	1,511
	%	5.3	5.1	0	9.3	0	21.4	1.4	47.0	12.5	100.0
Jan.	ha	74	332	0	52	0	101	20	534	398	1,511
	%	4.9	22.0	0	3.4	0	6.7	1.3	35.3	26.4	100.0
Feb.	ha	44	899	0	2	0	6	20	378	162	1,511
	%	2.9	59.5	0	0.1	0	0.4	1.3	25.0	10.8	100.0
Mar.	ha	13	1,327	0	0	0	0	19	62	90	1,511
	%	0.9	87.8	0	0	0	0	1.3	4.1	5.9	100.0
Apr.	ha	0	1,415	1	0	0	0	20	69	6	1,511
	%	0	93.6	0.1	0	0	0	1.3	4.6	0.4	100.0
May	ha	0	1,137	14	5	5	1	18	268	63	1,511
	%	0	75.2	0.9	0.3	0.3	0.1	1.2	17.8	4.2	100.0
Jun.	ha	0	756	17	54	20	47	12	447	158	1,511
	%	0	50.0	1.1	3.6	1.3	3.1	0.8	29.6	10.5	100.0
Jul.	ha	0	245	16	166	31	200	20	603	230	1,511
	%	0	16.2	1.1	11.0	2.1	13.2	1.3	39.9	15.2	100.0
Aug.	ha	0	18	5	305	16	559	18	484	106	1,511
	%	0	1.2	0.3	20.2	1.1	37.0	1.2	32.0	7.0	100.0
Sep.	ha	1	0	0	353	3	723	17	392	22	1,511
	%	0.1	0	0	23.4	0.2	47.8	1.1	26.0	1.4	100.0

Note: Basic data (yearly records) are "Daftar Pertanaman" of Sekisi Wonokromo, Brantas, East Java Provincial Irrigation Service.

Table 1-3 Growing area by crop in hectare

Irrigation Block: DJAMBANGAN W-3
A = 62 ha

Average of 7yrs (1964 to 1970)

		Rainy season paddy		Dry season paddy Regulated		Dry season paddy non-Regulated		Polowidjo	Fallow	Others	Total
		Seed bed	Growing	Seed bed	Growing	Seed bed	Growing				
Oct.	ha	0	0	0	14	0	23	3	19	3	62
	%	0	0	0	22.6	0	37.1	4.8	30.6	4.9	100.0
Nov.	ha	2	1	0	9	0	15	2	19	14	62
	%	3.2	1.6	0	14.5	0	24.2	3.2	30.7	22.6	100.0
Dec.	ha	2	24	0	7	0	14	1	6	8	62
	%	3.2	38.7	0	11.3	0	22.6	1.6	9.7	12.9	100.0
Jan.	ha	2	35	0	1	0	2	1	10	11	62
	%	3.2	56.5	0	1.6	0	3.2	1.6	16.1	17.8	100.0
Feb.	ha	1	45	0	0	0	0	1	4	11	62
	%	1.6	72.6	0	0	0	0	1.6	6.4	17.8	100.0
Mar.	ha	0	50	0	0	0	0	0	2	10	62
	%	0	80.7	0	0	0	0	0	3.2	16.1	100.0
Apr.	ha	0	41	0	0	0	0	0	12	9	62
	%	0	66.1	0	0	0	0	0	19.4	14.5	100.0
May	ha	0	20	2	3	1	0	0	16	20	62
	%	0	32.3	3.2	4.8	1.6	0	0	25.8	32.3	100.0
Jun.	ha	0	9	1	21	1	4	0	12	14	62
	%	0	14.5	1.6	33.9	1.6	6.5	0	19.3	22.6	100.0
Jul.	ha	0	0	1	27	1	17	2	7	7	62
	%	0	0	1.6	43.6	1.6	27.4	3.2	11.3	11.3	100.0
Aug.	ha	0	0	0	31	0	22	3	1	5	62
	%	0	0	0	50.0	0	35.5	4.8	1.6	8.1	100.0
Sep.	ha	0	0	0	31	0	26	3	1	1	62
	%	0	0	0	50.0	0	41.9	4.9	1.6	1.6	100.0

Note: Basic data (yearly records) are "Daftar Pertanaman" of Sekisi Wonokromo, Brantas, East Java Provincial Irrigation Service.

Table 1-4 Growing area by crop in hectare

Irrigation Block: KARAH W-4
A = 129 ha

Average of 7 yrs (1964 to 1970)

		Rainy season paddy		Dry season paddy Regulated		Dry season paddy non-Regulated		Polowidjo	Fallow	Others	Total
		Seed bed	Growing	Seed bed	Growing	Seed bed	Growing				
Oct.	ha	1	0	0	36	0	51	0	34	7	129
	%	0.8	0	0	27.9	0	39.5	0	26.4	5.4	100.0
Nov.	ha	4	8	0	21	0	33	0	37	26	129
	%	3.1	6.2	0	16.3	0	25.6	0	28.7	20.1	100.0
Dec.	ha	4	44	0	14	0	20	0	19	28	129
	%	3.1	34.1	0	10.9	0	15.5	0	14.7	21.7	100.0
Jan.	ha	5	68	0	2	0	5	0	20	29	129
	%	3.9	52.7	0	1.6	0	3.9	0	15.5	22.4	100.0
Feb.	ha	3	102	0	0	0	0	0	16	8	129
	%	2.3	79.1	0	0	0	0	0	12.4	6.2	100.0
Mar.	ha	1	122	0	0	0	0	0	3	3	129
	%	0.8	94.6	0	0	0	0	0	2.3	2.3	100.0
Apr.	ha	0	105	1	0	0	0	0	23	0	129
	%	0	81.4	0.8	0	0	0	0	17.8	0	100.0
May	ha	0	66	3	8	1	0	0	25	26	129
	%	0	51.1	2.3	6.2	0.8	0	0	19.4	20.2	100.0
Jun.	ha	0	22	1	44	2	13	15	17	15	129
	%	0	17.0	0.8	34.1	1.6	10.1	11.6	13.2	11.6	100.0
Jul.	ha	0	3	1	55	1	28	3	21	17	129
	%	0	2.3	0.8	42.6	0.8	21.7	2.3	16.3	13.2	100.0
Aug.	ha	0	0	1	65	1	40	0	10	12	129
	%	0	0	0.8	50.4	0.8	31.0	0	7.7	9.3	100.0
Sep.	ha	0	0	0	65	0	55	0	7	2	129
	%	0	0	0	50.4	0	42.6	0	5.4	1.6	100.0

Note: Basic data (yearly records) are "Daftar Pertanaman" of Sekisi Wonokromo, Brantas, East Java Provincial Irrigation Service.

Table 1-5 Growing area by crop in hectare

Irrigation Block: ROWOWIJUNG W-5
A = 430 ha

Average of 7 yrs (1964 to 1970)

		Rainy season paddy		Dry season paddy Regulated		Dry season paddy non-Regulated		Polowidjo	Fallow	Others	Total
		Seed bed	Growing	Seed bed	Growing	Seed bed	Growing				
Oct.	ha.	0	0	0	6	0	9	17	393	5	430
	%	0	0	0	1.4	0	2.1	4.0	91.4	1.1	100.0
Nov.	ha	15	2	0	0	0	0	13	366	34	430
	%	3.5	0.5	0	0	0	0	3.0	85.1	7.9	100.0
Dec.	ha	26	80	0	0	0	0	6	216	102	430
	%	0.1	18.6	0	0	0	0	1.4	50.2	23.7	100.0
Jan.	ha	10	293	0	0	0	0	0	61	66	430
	%	2.3	68.1	0	0	0	0	0	14.2	15.4	100.0
Feb.	ha	2	357	0	0	0	0	0	56	15	430
	%	0.5	83.0	0	0	0	0	0	13.0	3.5	100.0
Mar.	ha	0	395	0	0	0	0	0	34	1	430
	%	0	91.9	0	0	0	0	0	7.9	0.2	100.0
Apr.	ha	0	361	1	0	0	0	0	64	4	430
	%	0	84.0	0.2	0	0	0	0	14.9	0.9	100.0
May	ha	0	224	1	4	2	4	0	186	9	430
	%	0	52.1	0.2	0.9	0.5	0.9	0	43.3	2.1	100.0
Jun.	ha	0	53	1	13	2	35	7	308	11	430
	%	0	12.3	0.2	3.0	0.5	8.2	1.6	71.6	2.6	100.0
Jul.	ha	0	5	0	20	0	51	12	342	0	430
	%	0	1.2	0	4.7	0	11.8	2.8	79.5	0	100.0
Aug.	ha	0	0	0	20	0	46	14	349	1	430
	%	0	0	0	4.7	0	10.7	3.3	81.1	0.2	100.0
Sep.	ha	0	0	0	15	0	31	15	369	0	430
	%	0	0	0	3.5	0	7.2	3.5	85.8	0	100.0

Note: Basic data (yearly records) are "Daftar Pertanaman" of Sekisi Wonokromo, Brantas, East Java Provincial Irrigation Service.

Table 1-6 Growing area by crop in hectare

Irrigation Block: GUNUNGSARI W-6
A = 1,293 ha

Average of 7 yrs (1964 to 1970)

		Rainy season paddy		Dry season paddy Regulated		Dry season paddy non-Regulated		Polowidjo	Fallow	Others	Total
		Seed bed	Growing	Seed bed	Growing	Seed bed	Growing				
Oct.	ha	0	0	0	18	0	54	0	1,216	5	1,293
	%	0	0	0	1.4	0	4.2	0	94.0	0.4	100.0
Nov.	ha	7	0	0	7	0	9	3	1,226	41	1,293
	%	0.5	0	0	0.5	0	0.7	0.2	94.9	3.2	100.0
Dec.	ha	44	54	0	2	0	3	3	1,034	153	1,293
	%	3.4	4.2	0	0.2	0	0.2	0.2	80.0	11.8	100.0
Jan.	ha	68	448	0	0	0	0	1	449	327	1,293
	%	5.3	34.6	0	0	0	0	0.1	34.7	25.3	100.0
Feb.	ha	11	1,173	0	0	0	0	2	23	84	1,293
	%	0.8	90.7	0	0	0	0	0.2	1.8	6.5	100.0
Mar.	ha	0	1,286	0	0	0	0	1	0	6	1,293
	%	0	99.4	0	0	0	0	0.1	0	0.5	100.0
Apr.	ha	0	1,281	0	0	0	0	1	0	10	1,293
	%	0	99.1	0	0	0	0	0.1	0	0.8	100.0
May	ha	0	1,002	0	0	0	4	1	270	16	1,293
	%	0	77.5	0	0	0	0.3	0.1	20.9	1.2	100.0
Jun.	ha	0	199	0	0	1	24	2	1,045	22	1,293
	%	0	15.4	0	0	0.1	1.8	0.2	80.8	1.7	100.0
Jul.	ha	0	0	1	0	6	58	11	1,194	23	1,293
	%	0	0	0.1	0	0.5	4.5	0.8	92.3	1.8	100.0
Aug.	ha	0	0	0	0	0	81	7	1,195	10	1,293
	%	0	0	0	0	0	6.3	0.5	92.4	0.8	100.0
Sep.	ha	0	0	0	0	0	59	2	1,212	20	1,293
	%	0	0	0	0	0	4.6	0.2	93.7	1.5	100.0

Note: Basic data (yearly records) are "Daftar Pertanaman" of Sekisi Wonokromo, Brantas, East Java Provincial Irrigation Service.

Table 1-7 Growing area by crop in hectare

Irrigation Block: KALIBOKOR W-7
A = 1,109 ha

Average of 7 yrs (1964 to 1970)

		Rainy season paddy		Dry season paddy Regulated		Dry season paddy Non-Regulated		Polowidjo	Fallow	Others	Total
		Seed bed	Growing	Seed bed	Growing	Seed bed	Growing				
Oct.	ha	5	0	0	326	0	95	0	677	6	1,109
	%	0.5	0	0	29.4	0	8.6	0	61.0	0.5	100.0
Nov.	ha	40	7	0	110	0	29	0	734	189	1,109
	%	3.6	0.6	0	9.9	0	2.6	0	66.2	47.1	100.0
Dec.	ha	210	241	0	4	0	1	0	445	208	1,109
	%	18.9	21.7	0	0.4	0	0.1	0	40.1	18.8	100.0
Jan.	ha	69	731	0	0	0	0	0	151	158	1,109
	%	6.2	65.9	0	0	0	0	0	13.6	14.3	100.0
Feb.	ha	6	1,035	0	0	0	0	0	0	68	1,109
	%	0.5	93.3	0	0	0	0	0	0	6.1	100.0
Mar.	ha	0	1,107	0	0	0	0	0	0	2	1,109
	%	0	99.8	0	0	0	0	0	0	0.2	100.0
Apr.	ha	0	898	1	0	0	0	0	137	73	1,109
	%	0	81.0	0.1	0	0	0	0	12.4	6.5	100.0
May	ha	0	443	19	4	0	1	0	521	121	1,109
	%	0	39.9	1.7	0.4	0	0.1	0	47.0	10.9	100.0
Jun.	ha	0	40	36	137	0	15	0	621	261	1,109
	%	0	3.6	3.2	12.4	0	1.3	0	56.0	23.5	100.0
Jul.	ha	0	0	14	376	2	45	0	560	112	1,109
	%	0	0	1.3	33.9	0.2	4.1	0	50.4	10.1	100.0
Aug.	ha	0	0	0	489	0	136	0	479	5	1,109
	%	0	0	0	44.1	0	12.3	0	43.2	0.4	100.0
Sep.	ha	0	0	0	482	0	106	0	518	3	1,109
	%	0	0	0	43.5	0	9.5	0	46.7	0.3	100.0

Note: Basic data (yearly records) are "Daftar Pertanaman" of Sekisi Wonokromo, Brantas, East Java Provincial Irrigation Service.

Table 1-8 Growing area by crop in hectare

Irrigation Block: DJEBLOKAN W-8
A = 1,808 ha

Average of 7 yrs (1964 to 1970)

		Rainy season paddy		Dry season paddy Regulated		Dry season paddy non-Regulated		Polowidjo	Fallow	Others	Total
		Seed bed	Growing	Seed bed	Growing	Seed bed	Growing				
Oct.	ha	5	0	0	316	0	286	0	1,121	80	1,808
	%	0.3	0	0	17.5	0	15.8	0	62.0	4.4	100.0
Nov.	ha	77	7	0	28	0	29	0	1,331	336	1,808
	%	4.3	0.4	0	1.5	0	1.6	0	73.6	18.6	100.0
Dec.	ha	107	339	0	0	0	0	0	666	696	1,808
	%	5.9	18.8	0	0	0	0	0	36.8	38.5	100.0
Jan.	ha	48	1,124	0	0	0	0	0	171	465	1,808
	%	2.9	62.2	0	0	0	0	0	9.4	25.9	100.0
Feb.	ha	8	1,275	0	0	0	0	0	20	505	1,808
	%	0.5	90.5	0	0	0	0	0	1.1	27.9	100.0
Mar.	ha	0	1,796	0	0	0	0	0	9	3	1,808
	%	99.3	99.3	0	0	0	0	0	0.5	0.2	100.0
Apr.	ha	0	1,577	2	0	0	0	0	170	59	1,808
	%	0	87.2	0.1	0	0	0	0	9.4	3.3	100.0
May	ha	0	671	22	6	0	0	0	837	272	1,808
	%	0	37.1	1.2	0.3	0	0	0	46.3	15.1	100.0
Jun.	ha	0	79	40	144	16	32	0	1,232	265	1,808
	%	0	4.4	2.2	8.0	0.9	1.8	0	68.1	14.6	100.0
Jul.	ha	0	4	15	407	12	253	0	833	284	1,808
	%	0	0.2	0.8	22.5	0.7	14.0	0	46.1	15.7	100.0
Aug.	ha	0	0	0	504	0	388	0	897	19	1,808
	%	0	0	0	27.9	0	21.5	0	49.6	1.0	100.0
Sep.	ha	0	0	0	497	0	407	0	904	0	1,808
	%	0	0	0	27.5	0	22.5	0	50.0	0	100.0

Note: Basic data (yearly records) are "Daftar Pertanaman" of Sekisi Wonokromo, Brantas, East Java Provincial Irrigation Service.

Table 1-9 Growing area by crop in hectare

Irrigation Block: GROMPOL S-1
A = 227 ha

Average of 7 yrs (1964 to 1970)

		Rainy season paddy		Dry season paddy Regulated		Dry season paddy non-Regulated		Polowidjo	Fallow	Tobacco	Others	Total
		Seed bed	Growing	Seed bed	Growing	Seed bed	Growing					
Oct.	ha	0	0	0	0	0	0	16	167	44	0	227
	%	0	0	0	0	0	0	7.0	73.6	19.4	0	100.0
Nov.	ha	5	0	0	0	0	0	0	216	5	1	227
	%	2.2	0	0	0	0	0	0	95.1	2.2	0.5	100.0
Dec.	ha	19	1	0	0	0	0	0	201	0	6	227
	%	8.4	0.5	0	0	0	0	0	88.5	0	2.6	100.0
Jan.	ha	12	106	0	0	0	0	0	87	0	22	227
	%	5.3	46.7	0	0	0	0	0	38.3	0	9.7	100.0
Feb.	ha	1	222	0	0	0	0	0	3	0	1	227
	%	0.5	97.8	0	0	0	0	0	1.3	0	0.4	100.0
Mar.	ha	0	227	0	0	0	0	0	0	0	0	227
	%	0	100.0	0	0	0	0	0	0	0	0	100.0
Apr.	ha	0	223	0	0	0	0	0	4	0	0	227
	%	0	98.2	0	0	0	0	0	1.8	0	0	100.0
May	ha	0	112	0	0	0	0	14	97	3	1	227
	%	0	49.3	0	0	0	0	6.2	42.7	1.3	0.5	100.0
Jun.	ha	0	2	0	0	0	0	60	121	44	0	227
	%	0	0.9	0	0	0	0	26.4	53.3	19.4	0	100.0
Jul.	ha	0	0	0	0	0	0	80	89	57	1	227
	%	0	0	0	0	0	0	35.2	39.2	25.1	0.5	100.0
Aug.	ha	0	0	0	0	0	0	73	99	55	0	227
	%	0	0	0	0	0	0	32.2	43.6	24.2	0	100.0
Sep.	ha	0	0	0	0	0	0	44	129	54	0	227
	%	0	0	0	0	0	0	19.4	56.8	23.8	0	100.0

Note: Basic data (yearly records) are "Daftar Pertanaman" of Sekisi Wonokromo, Brantas, East Java Provincial Irrigation Service.

Table 1-10 Growing area by crop in hectare

Irrigation Block: BRANTS DELTA
A = 32,360 ha

Average of 8 yrs (1962 to 1969)

		Rainy season paddy		Dry season paddy Regulated		Dry season paddy non-Regulated		Sugar Cane						
								Seeding & Seedling	Field			Polowidjo	Fallow	Others	Total
		Seed bed	Growing	Seed bed	Growing	Seed bed	Growing		New	Old	Total				
Oct.	ha	31	0	0	3,895	1	2,705	132	0	5,085	5,085	11,911	7,514	1,086	32,360
	%	0.1	0	0	12.0	0	8.4	0.4	0	15.7	15.7	36.8	23.2	3.4	100
Nov.	ha	785	255	0	752	0	638	327	0	5,085	5,085	6,718	15,131	2,669	32,360
	%	2.4	0.8	0	2.3	0	2.0	1.0	0	15.7	15.7	20.8	46.8	8.2	100
Dec.	ha	1,504	6,329	0	114	0	187	448	0	5,085	5,085	1,333	11,121	6,239	32,360
	%	4.6	19.6	0	0.4	0	0.6	1.4	0	15.7	15.7	4.1	34.4	19.2	100
Jan.	ha	585	19,712	0	1	0	25	535	0	5,085	5,085	224	3,111	3,082	32,360
	%	1.8	60.9	0	0	0	0.1	1.7	0	15.7	15.7	0.7	9.6	9.5	100
Feb.	ha	116	25,082	0	0	0	4	552	0	5,085	5,085	141	611	769	32,360
	%	0.4	77.5	0	0	0	0	1.7	0	15.7	15.7	0.4	1.9	2.4	100
Mar.	ha	9	25,970	0	0	0	0	571	0	5,085	5,085	133	318	274	32,360
	%	0	80.3	0	0	0	0	1.8	0	15.7	15.7	0.4	1.0	0.8	100
Apr.	ha	0	22,253	19	2	24	3	580	1	4,909	4,910	386	3,635	548	32,360
	%	0	68.7	0.1	0	0.1	0	1.8	0	15.2	15.2	1.2	11.2	1.7	100
May	ha	0	8,822	361	269	224	187	581	153	3,772	3,925	3,668	10,378	3,945	32,360
	%	0	27.3	1.1	0.8	0.7	0.6	1.8	0.5	11.7	12.1	11.3	32.0	12.2	100
Jun.	ha	0	1,510	355	3,553	167	2,499	567	1,926	2,183	4,109	7,360	6,247	5,993	32,360
	%	0	4.7	1.1	11.0	0.5	7.7	1.8	6.0	6.7	12.7	22.7	19.3	18.5	100
Jul.	ha	0	168	80	6,869	66	4,564	461	4,231	706	4,937	9,553	2,615	3,047	32,360
	%	0	0.5	0.2	21.2	0.2	14.1	1.4	13.0	2.2	15.3	29.5	8.1	9.4	100
Aug.	ha	0	4	8	7,504	16	5,286	218	5,010	39	5,049	11,567	1,772	929	32,360
	%	0	0	0	23.2	0	16.3	0.7	15.5	0.1	15.6	35.8	5.5	2.9	100
Sep.	ha	0	0	4	7,116	7	5,062	93	5,080	0	5,080	12,986	1,721	291	32,360
	%	0	0	0	22.0	0	15.7	0.3	15.7	0	15.7	40.1	5.3	0.9	100

Note: Basic data (yearly records) are "Daftar Pertanaman" of Seksi Sidoardjo Brantas East Java Provincial Irrigation Service.

Table 2-1

Calculation of Monthly Growing Ratio and Average Plant Height

Rainy Season Paddy

Irrigation Block: Simowau w-1
A = 387 ha

Area Planted Ha		Month											
		O	N	D	J	F	M	A	M	J	J	A	S
2	A	0.17	0.33	0.50	0.67	0.83	1.00						
	B	0.34	0.66	1.00	1.34	1.66	2.00						
13	A		0.20	0.40	0.60	0.80	1.00						
	B		2.60	5.20	7.80	10.40	13.00						
9	A			0.25	0.50	0.75	1.00						
	B			2.25	4.50	7.50	9.00						
65	A			0.20	0.40	0.60	0.80	1.00					
	B			13.00	26.00	39.0	52.00	65.00					
18	A				0.25	0.50	0.75	1.00					
	B				4.50	9.00	13.50	18.00					
82	A				0.20	0.40	0.60	0.80	1.00				
	B				16.40	32.80	49.20	65.60	82.00				
38	A					0.25	0.50	0.75	1.00				
	B					9.50	19.00	28.50	38.00				
29	A					0.20	0.40	0.60	0.80	1.00			
	B					0.58	11.60	17.40	23.20	29.00			
17	A						0.25	0.50	0.75	1.00			
	B						4.25	8.50	12.75	17.00			
15	A						0.20	0.40	0.60	0.80	1.00		
	B						3.00	6.00	9.00	12.00	15.00		
3	A						0.17	0.33	0.50	0.67	0.83	1.00	
	B						0.51	0.99	1.50	2.01	2.49	3.00	
Total Area		2	15	89	189	256	291	267	184	64	18	3	
ΣB		0.34	3.26	21.45	60.54	110.44	177.06	209.99	166.45	60.01	17.49	3.00	
A.A.G.R. ΣB/Total Area		0.17	0.22	0.25	0.32	0.43	0.61	0.79	0.90	0.94	0.97	1.00	
A.P.H. m		0.25	0.35	0.43	0.59	0.81	1.11	1.24	1.25	1.25	1.25	1.25	

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H. : Average Plant Height

Remarks:
A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 2-2

Calculation of Monthly Growing Ratio and Average Plant Height

Dry Season Paddy
Regulated

Irrigation Block: Simowau w-1
A = 387 ha

Area Planted Ha		Month A	M	J	J	A	S	O	N	D	J	F
2	A	0.20	0.40	0.60	0.80	1.00						
	B	0.40	0.80	1.20	1.80	2.00						
15	A		0.25	0.50	0.75	1.00						
	B		3.75	7.50	11.60	15.00						
14	A			0.25	0.50	0.75	1.00					
	B			3.50	7.00	10.50	14.00					
2	A			0.20	0.40	0.60	0.80	1.00				
	B			0.40	0.80	1.20	1.60	2.00				
1	A				0.25	0.50	0.75	1.00				
	B				0.25	0.50	0.75	1.00				
Total Area		2	17	33	34	34	17	3	0			
ΣB		0.40	4.55	12.60	21.35	29.20	16.35	3.00	0			
A.A.G.R. ΣB/Total Area		0.20	0.27	0.38	0.63	0.86	0.96	1.00	0			
A.P.H. m		0.30	0.48	0.70	1.13	1.25	1.25	1.25	0			

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H. : Average Plant Height

Remarks: A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 2-3

Calculation of Monthly Growing Ratio and Average Plant Height

Dry Season Paddy
Non-Regulated

Irrigation Block: Simowau w-1
A = 387 ha

Area Planted Ha		Month										
		A	M	J	J	A	S	O	N	D	J	F
1	A	0.20	0.40	0.60	0.80	1.00						
	B	0.20	0.40	0.60	0.80	1.00						
11	A		0.25	0.50	0.75	1.00						
	B		2.75	5.50	8.25	11.00						
31	A			0.33	0.66	1.00						
	B			10.23	20.46	31.00						
24	A			0.25	0.50	0.75	1.00					
	B			6.00	12.00	18.00	24.00					
22	A			0.20	0.40	0.60	0.80	1.00				
	B			4.40	8.80	13.20	17.60	22.00				
34	A				0.25	0.50	0.75	1.00				
	B				8.50	17.00	25.50	34.00				
7	A				0.20	0.40	0.60	0.80	1.00			
	B				1.40	2.80	4.20	5.60	7.00			
14	A					0.25	0.50	0.75	1.00			
	B					3.50	7.00	10.50	14.00			
12	A							0.33	0.66	1.00		
	B							3.96	7.92	12.00		
4	A							0.25	0.50	0.75	1.00	
	B							1.00	2.00	3.00	4.00	
Total Area		1	12	89	130	144	120	93	37	16	4	0
ΣB		0.20	3.15	26.73	60.21	97.50	78.30	77.06	30.92	16.00	4.00	0
A.A.G.R. ΣB/Total Area		0.20	0.26	0.30	0.46	0.68	0.66	0.83	0.84	0.94	1.00	0
A.P.H. m		0.30	0.45	0.55	0.87	1.18	1.15	1.25	1.25	1.25	1.25	0

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H.: Average Plant Height

Remarks:
A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 2-4

Calculation of Monthly Growing Ratio and Average Plant Height

Rainy Season Paddy

Irrigation Block: Kebonagung w-2
A = 1,511 ha

Area Planted Ha		Month											
		O	N	D	J	F	M	A	M	J	J	A	S
8	A		0.17	0.33	0.50	0.67	0.83	1.00					
	B		1.36	2.64	4.00	5.36	6.41	8.00					
69	A			0.20	0.40	0.60	0.80	1.00					
	B			13.80	27.60	41.40	55.20	69.00					
2 01	A				0.25	0.50	0.75	1.00					
	B				50.25	100.50	150.75	201.00					
54	A				0.20	0.40	0.60	0.80	1.00				
	B				10.80	21.60	32.40	43.20	54.00				
327	A					0.25	0.50	0.75	1.00				
	B					81.75	163.50	245.25	327.00				
240	A					0.20	0.40	0.60	0.80	1.00			
	B					48.00	96.00	144.00	192.00	240.00			
2 71	A						0.25	0.50	0.75	1.00			
	B						67.75	135.50	203.25	271.00			
157	A						0.20	0.40	0.60	0.80	1.00		
	B						31.40	62.8	94.20	125.60	157.00		
70	A							0.25	0.50	0.75	1.00		
	B							17.50	35.00	52.50	70.00		
18	A							0.20	0.40	0.60	0.80	1.00	
	B							3.60	7.20	10.80	14.40	18.00	
Total Area		0	8	77	332	899	1,327	1,415	1,137	756	245	18	0
ΣB		0	1.36	16.44	92.65	298.61	603.64	929.85	912.65	699.90	241.40	18.00	0
A.A.G.R. ΣB/Total Area		0	0.17	0.21	0.28	0.33	0.45	0.66	0.80	0.93	0.99	1.00	0
A.P.H. m		0	0.25	0.33	0.50	0.61	0.85	1.16	1.25	1.25	1.25	1.25	0

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H. : Average Plant Height

Remarks:
A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 2-5

Calculation of Monthly Growing Ratio and Average Plant Height

Dry Season Paddy
Regulated

Irrigation Block: Kebonagung w-2
A = 1,511 ha

Area Planted Ha		Month										
		A	M	J	J	A	S	O	N	D	J	F
5	A		0.20	0.40	0.60	0.80	1.00					
	B		1.00	2.00	3.00	4.00	5.00					
49	A			0.25	0.50	0.75	1.00					
	B			12.25	24.50	36.75	49.00					
23	A				0.33	0.67	1.00					
	B				7.59	15.41	23.00					
56	A				0.25	0.50	0.75	1.00				
	B				14.00	28.00	42.00	56.00				
33	A				0.20	0.40	0.60	0.80	1.00			
	B				6.60	13.20	19.80	26.40	33.00			
46	A					0.25	0.50	0.75	1.00			
	B					11.50	23.00	34.50	46.00			
89	A					0.20	0.40	0.60	0.80	1.00		
	B					17.80	35.60	53.40	71.20	89.00		
4	A					0.17	0.33	0.50	0.67	0.83	1.00	
	B					0.68	1.32	2.00	2.68	3.32	4.00	
46	A						0.20	0.40	0.60	0.80	1.00	
	B						9.20	18.40	27.60	36.80	46.00	
2	A						0.17	0.33	0.50	0.67	0.83	1.00
	B						0.34	0.66	1.00	1.34	1.66	2.00
Total Area		0	5	54	166	305	353	276	220	141	52	2
ΣB		0	1.00	14.25	55.69	127.34	208.26	191.36	181.48	130.46	51.66	2.00
A.A.G.R. ΣB/Total Area		0	0.20	0.26	0.34	0.42	0.59	0.69	0.82	0.93	0.99	1.00
A.P.H. m		0	0.30	0.45	0.63	0.79	1.09	1.19	1.25	1.25	1.25	1.25

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H. : Average Plant Height

Remarks:
A: Growing Ratio
B: Weighted Growing Ratio
B - A x Area

Table 2-6

Calculation of Monthly Growing Ratio and Average Plant Height

Dry Season Paddy
Non-Regulated

Irrigation Block: Kebonagung w-2
A = 1,511 ha

Area Planted Ha		Month A	M	J	J	A	S	O	N	D	J	F
1	A		0.20	0.40	0.60	0.80	1.00					
	B		0.20	0.40	0.60	0.80	1.00					
13	A			0.25	0.50	0.75	1.00					
	B			3.25	6.50	9.75	13.00					
33	A			0.20	0.40	0.60	0.80	1.00				
	B			6.60	13.20	19.80	26.40	33.00				
153	A				0.25	0.50	0.75	1.00				
	B				38.25	76.50	114.75	153.00				
1	A					0.33	0.67	1.00				
	B					0.33	0.67	1.00				
198	A					0.25	0.50	0.75	1.00			
	B					49.50	99.00	148.50	198.00			
160	A					0.20	0.40	0.60	0.80	1.00		
	B					32.00	64.00	96.00	128.00	160.00		
63	A						0.25	0.50	0.75	1.00		
	B						15.75	31.50	47.25	63.00		
95	A						0.20	0.40	0.60	0.80	1.00	
	B						19.00	38.00	57.00	76.00	95.00	
6	A						0.17	0.33	0.50	0.67	0.83	1.00
	B						1.02	1.98	3.00	4.02	4.98	6.00
Total Area		0	1	47	200	559	723	709	522	324	101	6
ΣB		0	0.20	10.25	58.55	188.68	354.59	502.98	433.25	303.02	99.98	6.00
A.A.G.R.		0	0.20	0.22	0.29	0.34	0.49	0.71	0.83	0.94	0.99	1.00
A.P.H. m		0	0.30	0.35	0.53	0.63	0.93	1.21	1.25	1.25	1.25	0

Note: A.A.G.R.: Areal Average Growing Ratio
.AP.H. : Average Plant Height

Remarks:
A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 2-7

Calculation of Monthly Growing Ratio and Average Plant Height

Rainy Season Paddy

Irrigation Block: Djambangan w-3
A = 62 ha

Area Planted Ha		Month O	N	D	J	F	M	A	M	J	J	A
1	A		0.20	0.40	0.60	0.80	1.00					
	B		0.20	0.40	0.60	0.80	1.00					
8	A			0.25	0.50	0.75	1.00					
	B			2.00	4.00	6.00	8.00					
15	A			0.20	0.40	0.60	0.80	1.00				
	B			3.00	6.00	9.00	12.00	15.00				
6	A				0.25	0.50	0.75	1.00				
	B				1.50	3.00	4.50	6.00				
5	A				0.20	0.40	0.60	0.80	1.00			
	B				1.00	2.00	3.00	4.00	5.00			
6	A					0.25	0.50	0.75	1.00			
	B					1.50	3.00	4.50	6.00			
4	A					0.20	0.40	0.60	0.80	1.00		
	B					0.80	1.60	2.40	3.20	4.00		
5	A						0.25	0.50	0.75	1.00		
	B						1.25	2.50	3.75	5.00		
Total Area		0	1	24	35	45	50	41	20	9	0	0
ΣB		0	0.20	5.40	13.10	23.10	34.35	34.40	17.95	9.00	0	0
A.A.G.R. ΣB/Total Area		0	0.20	0.23	0.37	0.51	0.69	0.84	0.90	1.00	0	0
A.P.H. m		0	0.30	0.38	0.69	0.96	1.19	1.25	1.25	1.25	0	0

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H. : Average Plant Height

Remarks: A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 2-8

Calculation of Monthly Growing Ratio and Average Plant Height

Dry Season Paddy
Regulated

Irrigation Block: Djambangan w-3
A = 62 ha

Area Planted Ha		Month										
		A	M	J	J	A	S	O	N	D	J	F
3	A		0.25	0.50	0.75	1.00						
	B		0.75	1.50	2.25	3.00						
17	A			0.25	0.50	0.75	1.00					
	B			4.25	8.50	12.75	17.00					
1	A			0.20	0.40	0.60	0.80	1.00				
	B			0.20	0.40	0.60	0.80	1.00				
4	A				0.25	0.50	0.75	1.00				
	B				1.00	2.00	3.00	4.00				
2	A				0.20	0.40	0.60	0.80	1.00			
	B				0.40	0.80	1.20	1.60	2.00			
4	A					0.20	0.40	0.60	0.80	1.00		
	B					0.80	1.60	2.40	3.20	4.00		
2	A						0.25	0.50	0.75	1.00		
	B						0.50	1.00	1.50	2.00		
1	A						0.20	0.40	0.60	0.80	1.00	
	B						0.20	0.40	0.60	0.80	1.00	
Total Area		0	3	21	27	31	31	14	9	7	1	0
ΣB		0	0.75	5.95	12.55	19.95	24.30	10.40	7.30	6.80	1.00	0
A.A.G.R. ΣB/Total Area		0	0.25	0.28	0.46	0.64	0.78	0.74	0.81	0.97	1.00	0
A.P.H. m		0	0.42	0.50	0.87	1.14	1.24	1.22	1.25	1.25	1.25	0

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H. : Average Plant Height

Remarks: A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 2-9

Calculation of Monthly Growing Ratio and Average Plant Height

Dry Season Paddy
Non-Regulated

Irrigation Block: Djambangan w-3
A = 62 ha

Area Planted Ha		Month A	M	J	J	A	S	O	N	D	J	F
3	A			0.25	0.50	0.75	1.00					
	B			0.75	1.50	2.25	3.00					
1	A			0.20	0.40	0.60	0.80	1.00				
	B			0.20	0.40	0.60	0.80	1.00				
7	A				0.25	0.50	0.75	1.00				
	B				1.75	3.50	5.25	7.00				
1	A				0.20	0.40	0.60	0.80	1.00			
	B				0.20	0.40	0.60	0.80	1.00			
5	A				0.17	0.33	0.50	0.67	0.83	1.00		
	B				0.85	1.65	2.50	3.35	4.15	5.00		
5	A					0.20	0.40	0.60	0.80	1.00		
	B					1.00	2.00	3.00	4.00	5.00		
2	A						0.25	0.50	0.75	1.00		
	B						0.50	1.00	1.50	2.00		
2	A						0.20	0.40	0.60	0.80	1.00	
	B						0.40	0.80	1.20	1.60	2.00	
Total Area		0	0	4	17	22	26	23	15	14	2	0
ΣB		0	0	0.95	4.70	9.40	15.05	16.95	11.85	13.60	2.00	0
A.A.G.R. ΣB/Total Area		0	0	0.24	0.28	0.43	0.58	0.74	0.79	0.97	1.00	0
A.P.H. m		0	0	0.40	0.50	0.81	1.08	1.22	1.24	1.25	1.25	0

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H. : Average Plant Height

Remarks: A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 2-10

Calculation of Monthly Growing Ratio and Average Plant Height

Rainy Season Paddy

Irrigation Block: Karah w-4
A = 129 ha

Area Planted Ha		Month O	N	D	J	F	M	A	M	J	J	A
8	A		0.20	0.40	0.60	0.80	1.00					
	B		1.60	3.20	4.80	6.40	8.00					
12	A			0.25	0.50	0.75	1.00					
	B			3.00	6.00	9.00	12.00					
24	A			0.20	0.40	0.60	0.80	1.00				
	B			4.80	9.60	14.40	19.20	24.00				
12	A				0.25	0.50	0.75	1.00				
	B				3.00	6.00	9.00	12.00				
12	A				0.20	0.40	0.60	0.80	1.00			
	B				2.40	4.80	7.20	9.60	12.00			
32	A					0.25	0.50	0.75	1.00			
	B					8.00	16.00	24.00	32.00			
2	A					0.20	0.40	0.60	0.80	1.00		
	B					0.40	0.80	1.20	1.60	2.00		
17	A						0.25	0.50	0.75	1.00		
	B						4.25	8.50	12.75	17.00		
3	A						0.20	0.40	0.60	0.80	1.00	
	B						0.60	1.20	1.80	2.40	3.00	
Total Area		0	8	44	68	102	122	105	66	22	3	0
ΣB		0	1.60	11.00	25.80	49.00	77.05	80.50	60.15	21.40	3.00	0
A.A.G.R. ΣB/Total Area		0	0.20	0.25	0.38	0.48	0.63	0.77	0.91	0.97	1.00	0
A.P.H. m		0	0.30	0.42	0.70	0.91	1.13	1.23	1.25	1.25	1.25	0

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H. : Average Plant Height

Remarks: A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 2-11

Calculation of Monthly Growing Ratio and Average Plant Height

Dry Season Paddy
Regulated

Irrigation Block: Karah w-4
A = 129 Ha

Area Planted Ha		Month										
		A	M	J	J	A	S	O	N	D	J	F
8	A		0.20	0.40	0.60	0.80	1.00					
	B		1.60	3.20	4.80	6.40	8.00					
21	A			0.25	0.50	0.75	1.00					
	B			5.25	10.50	15.75	21.00					
15	A			0.20	0.40	0.60	0.80	1.00				
	B			3.00	6.00	9.00	12.00	15.00				
7	A				0.20	0.40	0.60	0.80	1.00			
	B				1.40	2.80	4.20	5.60	7.00			
4	A				0.17	0.33	0.50	0.67	0.83	1.00		
	B				0.68	1.32	2.00	2.68	3.32	4.00		
8	A					0.20	0.40	0.60	0.80	1.00		
	B					1.60	3.20	4.80	6.40	8.00		
2	A					0.17	0.33	0.50	0.67	0.83	1.00	
	B					0.34	0.66	1.00	1.34	1.66	2.00	
Total Area		0	8	44	55	65	65	36	21	14	2	0
ΣB		0	1.60	11.45	23.38	37.21	51.06	29.08	18.06	13.66	2.00	0
A.A.G.R. ΣB/Total Area		0	0.20	0.26	0.43	0.57	0.79	0.81	0.86	0.98	1.00	0
A.P.H. m		0	0.30	0.45	0.80	1.06	1.24	1.25	1.25	1.25	1.25	0

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H. : Average Plant Height

Remarks: A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 2-12

Calculation of Monthly Growing Ratio and Average Plant Height

Dry Season Paddy
Non-Regulated

Irrigation Block: Karah w-4
A = 129 ha

Area Planted Ha		Month										
		A	M	J	J	A	S	O	N	D	J	F
4	A			0.25	0.50	0.75	1.00					
	B			1.00	2.00	3.00	4.00					
9	A			0.20	0.40	0.60	0.80	1.00				
	B			1.80	3.60	5.40	7.20	9.00				
9	A				0.25	0.50	0.75	1.00				
	B				2.25	4.50	6.75	9.00				
6	A				0.20	0.40	0.60	0.80	1.00			
	B				1.20	2.40	3.60	4.80	6.00			
7	A					0.25	0.50	0.75	1.00			
	B					1.75	3.50	5.25	7.00			
5	A					0.20	0.40	0.60	0.80	1.00		
	B					1.00	2.00	3.00	4.00	5.00		
10	A						0.25	0.50	0.75	1.00		
	B						2.50	5.00	7.50	10.00		
5	A						0.20	0.40	0.60	0.80	1.00	
	B						1.00	2.00	3.00	4.00	5.00	
Total Area		0	0	13	28	40	55	51	33	20	5	0
ΣB		0	0	2.80	9.05	18.05	30.55	38.05	27.50	19.00	5.00	0
A.A.G.R. ΣB/Total Area		0	0	0.22	0.32	0.45	0.56	0.75	0.83	0.95	1.00	0
A.P.H. m		0	0	0.35	0.59	0.85	1.04	1.22	1.25	1.25	1.25	0

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H. : Average Plant Height

Remarks: A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 2-13

Calculation of Monthly Growing Ratio and Average Plant Height

Rainy Season Paddy

Irrigation Block: Rowowijung w-5
A = 430 ha

Area Planted Ha		Month O	N	D	J	F	M	A	M	J	J	A
2	A	0.20	0.40	0.60	0.80	1.00						
	B	0.40	0.80	1.20	1.60	2.00						
46	A		0.25	0.50	0.75	1.00						
	B		11.50	23.00	34.50	46.00						
32	A		0.20	0.40	0.60	0.80	1.00					
	B		6.40	12.80	19.20	25.60	32.00					
122	A			0.25	0.50	0.75	1.00					
	B			30.50	61.00	91.50	122.00					
91	A			0.20	0.40	0.60	0.80	1.00				
	B			18.20	36.40	54.60	72.80	91.00				
49	A				0.25	0.50	0.75	1.00				
	B				12.25	24.50	36.75	49.00				
15	A				0.20	0.40	0.60	0.80	1.00			
	B				3.00	6.00	9.00	12.00	15.00			
33	A					0.25	0.50	0.75	1.00			
	B					8.25	16.50	24.75	33.00			
5	A					0.20	0.40	0.60	0.80	1.00		
	B					1.00	2.00	3.00	4.00	5.00		
Total Area		2	80	293	357	395	361	224	53	5	0	0
ΣB		0.40	18.70	85.70	167.95	259.45	291.05	179.75	52.00	5.00	0	0
A.A.G.R. ΣB/Total Area		0.20	0.23	0.29	0.47	0.66	0.81	0.80	0.98	1.00	0	0
A.P.H. m		0.30	0.38	0.53	0.89	1.16	1.25	1.25	1.25	1.25	0	0

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H. : Average Plant Height

Remarks:
A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 2-14

Calculation of Monthly Growing Ratio and Average Plant Height

Dry Season Paddy
Regulated

Irrigation Block: Rowowijung w-5
A = 430 ha

Area Planted Ha		Month										
		A	M	J	J	A	S	O	N	D	J	F
4	A		0.25	0.50	0.75	1.00						
	B		1.00	2.00	3.00	4.00						
1	A			0.33	0.67	1.00						
	B			0.33	0.67	1.00						
8	A			0.25	0.50	0.75	1.00					
	B			2.00	4.00	6.00	8.00					
1	A				0.33	0.67	1.00					
	B				0.33	0.67	1.00					
6	A				0.25	0.50	0.75	1.00				
	B				1.50	3.00	4.50	6.00				
Total Area		0	4	13	20	20	15	6	0	0	0	0
ΣB		0	1.00	4.33	9.50	14.67	13.50	6.00	0	0	0	0
A.A.G.R. ΣB/Total Area		0	0.25	0.33	0.48	0.73	0.90	1.00	0	0	0	0
A.P.H. m		0	0.43	0.61	0.91	1.21	1.25	1.25	0	0	0	0

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H. : Average Plant Height

Remarks: A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 2-15

Calculation of Monthly Growing Ratio and Average Plant Height

Dry Season Paddy
Non-Regulated

Irrigation Block: Rowowijung
A = 430 ha

Area Planted Ha		Month										
		A	M	J	J	A	S	O	N	D	J	F
4	A		0.33	0.67	1.00							
	B		1.32	2.68	4.00							
16	A			0.33	0.67	1.00						
	B			5.28	10.72	16.00						
15	A			0.25	0.50	0.75	1.00					
	B			3.75	7.50	11.25	15.00					
7	A				0.33	0.67	1.00					
	B				2.31	4.69	7.00					
9	A				0.25	0.50	0.75	1.00				
	B				2.25	4.50	6.75	9.00				
Total Area		0	4	35	51	46	31	9	0	0	0	0
ΣB		0	1.32	11.71	26.78	36.44	28.75	9.00	0	0	0	0
A.A.G.R. ΣB/Total Area		0	0.33	0.33	0.53	0.79	0.93	1.00	0	0	0	0
A.P.H. m		0	0.61	0.61	1.00	1.19	1.25	1.25	0	0	0	0

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H. : Average Plant Height

Remarks: A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 2-16

Calculation of Monthly Growing Ratio and Average Plant Height

Rainy Season Paddy

Irrigation Block: Gunungsari w-6
A = 1,293 ha

Area Planted Ha		Month										
		O	N	D	J	F	M	A	M	J	J	A
5	A			0.25	0.50	0.75	1.00					
	B			1.25	2.50	3.75	5.00					
49	A			0.20	0.40	0.60	0.80	1.00				
	B			9.80	19.60	29.40	39.2	49.00				
230	A				0.25	0.50	0.75	1.00				
	B				57.50	115.00	172.50	230.00				
164	A				0.20	0.40	0.60	0.80	1.00			
	B				32.80	65.60	98.40	131.20	164.00			
639	A					0.25	0.50	0.75	1.00			
	B					159.75	319.50	479.25	639.00			
86	A					0.20	0.40	0.60	0.80	1.00		
	B					17.20	34.40	51.60	68.80	86.00		
113	A						0.25	0.50	0.75	1.00		
	B						28.25	56.50	84.75	113.00		
Total Area		0	0	54	448	1,173	1,286	1,281	1,002	199	0	0
ΣB		0	0	11.05	112.40	390.70	697.25	997.55	956.55	199.0	0	0
A.A.G.R. ΣB/Total Area		0	0	0.20	0.25	0.33	0.54	0.78	0.95	1.00	0	0
A.P.H. m		0	0	0.30	0.43	0.61	1.01	1.24	1.25	1.25	0	0

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H. : Average Plant Height

Remarks: A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 2-17

Calculation of Monthly Growing Ratio and Average Plant Height

Dry Season Paddy
Non-Regulated

Irrigation Block: Gunungsari W-6
A = 1,293 ha

Area Planted Ha		Month										
		A	M	J	J	A	S	O	N	D	J	F
4	A		0.25	0.50	0.75	1.00						
	B		1.00	2.00	3.00	4.00						
18	A			0.33	0.67	1.00						
	B			5.94	12.42	18.00						
2	A			0.25	0.50	0.75	1.00					
	B			0.50	1.00	1.50	2.00					
3	A				0.33	0.67	1.00					
	B				0.99	2.01	3.00					
31	A				0.25	0.50	0.75	1.00				
	B				7.75	15.50	23.25	31.00				
14	A					0.33	0.67	1.00				
	B					4.62	9.38	14.00				
6	A					0.25	0.50	0.75	1.00			
	B					1.50	3.00	4.50	6.00			
3	A					0.20	0.40	0.60	0.80	1.00		
	B					0.60	1.20	1.80	2.40	3.00		
Total Area		0	4	24	58	81	59	54	9	3	0	0
ΣB		0	1.00	8.44	25.16	47.73	41.83	51.30	8.40	3.00	0	0
A.A.G.R. ΣB/Total Area		0	0.25	0.35	0.43	0.59	0.71	0.95	0.93	1.00	0	0
A.P.H. m		0	0.43	0.65	0.80	1.09	1.21	1.25	1.25	1.25	0	0

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H. : Average Plant Height

Remarks: A: Growing Ratio
B: WeighTed Growing Ratio
B = A x Area

Table 2-18

Calculation of Monthly Growing Ratio and Average Plant Height

Rainy Season Paddy

Irrigation Block: Kalibokor W-7
A = 1,109 ha

Area Planted Ha		Month										
		O	N	D	J	F	M	A	M	J	J	A
7	A		0.20	0.40	0.60	0.80	1.00					
	B		1.40	2.80	4.20	5.60	7.00					
202	A			0.25	0.50	0.75	1.00					
	B			50.50	101.0	151.50	202.00					
32	A			0.20	0.40	0.60	0.80	1.00				
	B			6.40	12.80	19.20	25.60	32.00				
423	A				0.25	0.50	0.75	1.00				
	B				105.75	211.50	317.25	423.00				
67	A				0.20	0.40	0.60	0.80	1.00			
	B				13.40	26.80	40.20	53.60	67.00			
304	A					0.25	0.50	0.75	1.00			
	B					76.00	152.00	228.00	304.00			
32	A						0.33	0.67	1.00			
	B						10.56	21.44	32.00			
40	A						0.25	0.50	0.75	1.00		
	B						10.00	20.00	30.00	40.00		
Total Area		0	7	241	731	1,035	1,107	898	443	40	0	0
ΣB		0	1.40	59.70	237.15	490.60	764.61	778.04	433.00	40.00	0	0
A.A.G.R. ΣB/Total Area		0	0.20	0.25	0.32	0.47	0.69	0.87	0.98	1.00	0	0
A.P.H. m		0	0.30	0.43	0.58	0.89	1.19	1.25	1.25	1.25	0	0

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H. : Average Plant Height

Remarks: A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 2-19

Calculation of Monthly Growing Ratio and Average Plant Height

Dry Season Paddy
Regulated

Irrigation Block: Kalibokor w-7
A = 1,109 ha

Area Planted Ha		Month										
		A	M	J	J	A	S	O	N	D	J	F
4	A		0.25	0.50	0.75	1.00						
	B		1.00	2.00	3.00	4.00						
3	A			0.33	0.67	1.00						
	B			0.49	2.01	3.00						
130	A			0.25	0.50	0.75	1.00					
	B			32.50	65.00	97.50	130.00					
26	A				0.33	0.67	1.00					
	B				8.58	17.42	26.00					
213	A				0.25	0.50	0.75	1.00				
	B				53.25	106.50	159.75	213.00				
3	A					0.33	0.67	1.00				
	B					0.99	2.01	3.00				
106	A					0.25	0.50	0.75	1.00			
	B					26.50	53.00	79.50	106.00			
4	A					0.20	0.40	0.60	0.80	1.00		
	B					0.80	1.60	2.40	3.00	4.00		
Total Area		0	4	137	376	489	482	326	110	4	0	0
ΣB		0	1.00	35.49	131.84	256.71	372.36	297.90	109.20	4.00	0	0
A.A.G.R. ΣB/Total Area		0	0.25	0.26	0.35	0.52	0.77	0.91	0.99	1.00	0	0
A P.H. m		0	0.43	0.45	0.65	0.98	1.23	1.25	1.25	1.25	0	0

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H. : Average Plant Height

Remarks: A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 2-20

Calculation of Monthly Growing Ratio and Average Plant Height

Dry Season Paddy
Non-Regulated

Irrigation Block: Kalibobeor w-7
A = 1,109 ha

Area Planted Ha		Month										
		A	M	J	J	A	S	O	N	D	J	F
1	A		0.25	0.50	0.75	1.00						
	B		0.25	0.50	0.75	1.00						
14	A			0.33	0.67	1.00						
	B			4.62	9.38	14.00						
26	A				0.33	0.67	1.00					
	B				8.58	17.42	26.00					
4	A				0.25	0.50	0.75	1.00				
	B				1.00	2.00	3.00	4.00				
62	A					0.33	0.67	1.00				
	B					20.46	41.54	62.00				
28	A					0.25	0.50	0.75	1.00			
	B					7.00	14.00	21.00	28.00			
1	A					0.20	0.40	0.60	0.80	1.00		
	B					02.0	0.40	0.60	0.80	1.00		
Total Area		0	1	15	45	136	121	95	29	1	0	0
ΣB		0	0.25	5.12	19.71	62.08	84.94	87.60	28.80	1.00	0	0
A.A.G.R. ΣB/Total Area		0	0.25	0.34	0.44	0.46	0.70	0.92	0.99	1.00	0	0
A.P.H. m		0	0.43	0.63	0.82	0.87	1.20	1.25	1.25	1.25	0	0

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H.: Average Plant Height

Remarks: A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 2-21

Calculation of Growing Ratio and Average Plant Height

Rainy Season Paddy

Irrigation Block: Djeblokan w-8
A = 1,808 ha

Area Planted Ha		Month										
		O	N	D	J	F	M	A	M	J	J	A
7	A		0.20	0.40	0.60	0.80	1.00					
	B		1.40	2.80	4.20	5.60	7.00					
212	A			0.25	0.50	0.75	1.00					
	B			53.00	106.00	159.00	212.00					
120	A			0.20	0.40	0.60	0.80	1.00				
	B			24.00	48.00	72.00	96.00	120.00				
785	A				0.25	0.50	0.75	1.00				
	B				196.25	392.5	588.75	785.00				
1	A					0.33	0.69	1.00				
	B					0.33	0.67	1.00				
150	A					0.25	0.50	0.75	1.00			
	B					37.50	75.00	112.50	150.00			
442	A						0.33	0.67	1.00			
	B						145.86	296.14	442.00			
75	A						0.25	0.50	0.75	1.00		
	B						18.75	37.50	56.25	75.00		
4	A						0.20	0.40	0.60	0.80	1.00	
	B						0.80	1.60	2.40	3.20	4.00	
Total Area		0	7	339	1,124	1,275	1,796	1,577	671	79	4	0
ΣB		0	1.40	79.80	354.45	666.93	1,144.83	1,367.60	650.65	78.20	4.00	0
A.A.G.R. ΣB/Total Area		0	0.20	0.23	0.32	0.52	0.64	0.87	0.97	0.99	1.00	0
A.P.H. m		0	0.30	0.37	0.58	0.98	1.14	1.25	1.25	1.25	1.25	0

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H. : Average Plant Height

Remarks: A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 2-22

Calculation of Growing Ratio and Average Plant Height

Dry Season Paddy
Regulated

Irrigation Block: Djeblokan w-8
A = 1,808 ha

Area Planted Ha		Month										
		A	M	J	J	A	S	O	N	D	J	F
6	A		0.25	0.50	0.75	1.00						
	B		1.50	3.00	4.50	6.00						
1	A			0.33	0.67	1.00						
	B			0.33	0.67	1.00						
137	A			0.25	0.50	0.75	1.00					
	B			34.25	68.50	102.75	137.00					
44	A				0.33	0.67	1.00					
	B				14.52	29.48	44.00					
219	A				0.25	0.50	0.75	1.00				
	B				54.75	109.50	164.25	219.00				
69	A					0.33	0.67	1.00				
	B					22.77	46.23	69.00				
28	A					0.25	0.50	0.75	1.00			
	B					7.00	14.00	21.00	28.00			
Total Area		0	6	144	407	504	497	316	28	0	0	0
ΣB		0	1.50	37.58	142.94	278.50	405.48	240.69	28.00	0	0	0
A.A.G.R.		0	0.25	0.26	0.35	0.55	0.82	0.76	1.00	0	0	0
A.P.H.	m	0	0.43	0.45	0.65	1.02	1.25	1.25	1.25	0	0	0

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H. : Average Plant Height

Remarks: A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 2-23

Calculation of Growing Ratio and Average Plant Height

Dry Season Paddy
Non-Regulated

Irrigation Block: Djeblokan w-8
A = 1,808 ha

Area Planted Ha		Month										
		A	M	J	J	A	S	O	N	D	J	F
32	A			0.25	0.50	0.75	1.00					
	B			8.00	16.00	24.00	32.00					
89	A				0.33	0.67	1.00					
	B				29.37	59.63	89.00					
132	A				0.25	0.50	0.75	1.00				
	B				33.00	66.00	99.00	132.00				
125	A					0.33	0.67	1.00				
	B					41.25	83.75	125.00				
10	A					0.25	0.50	0.75	1.00			
	B					2.50	5.00	7.50	10.00			
19	A						0.33	0.67	1.00			
	B						6.27	12.73	19.00			
Total Area		0	0	32	253	388	407	286	29	0	0	0
ΣB		0	0	8.00	78.37	193.88	315.02	277.23	29.00	0	0	0
A.A.G.R. ΣB/Total Area		0	0	0.25	0.30	0.50	0.77	0.97	1.00	0	0	0
A.P.H. m		0	0	0.43	0.55	0.95	1.24	1.25	1.25	0	0	0

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H. : Average Plant Height

Remarks: A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 2-24

Calculation of Growing Ratio and Average Plant Height

Rainy Season Paddy

Irrigation Block: Grompol S-1
A = 227 ha

Area Planted Ha		Month O	N	D	J	F	M	A	M	J	J	A
1	A			0.25	0.50	0.75	1.00					
	B			0.25	0.50	0.75	1.00					
3	A				0.33	0.67	1.00					
	B				0.99	2.01	3.00					
102	A				0.25	0.50	0.75	1.00				
	B				25.50	51.00	76.50	102.00				
9	A					0.33	0.67	1.00				
	B					2.97	6.03	9.00				
107	A					0.25	0.50	0.75	1.00			
	B					26.75	53.50	80.25	107.00			
3	A						0.33	0.67	1.00			
	B						0.99	2.01	3.00			
2	A						0.25	0.50	0.75	1.00		
	B						0.50	1.00	1.50	2.00		
Total Area		0	0	1	106	222	227	223	112	2	0	0
ΣB		0	0	0.25	26.99	83.48	141.62	194.26	111.50	2.00	0	0
A.A.G.R. ΣB/Total Area		0	0	0.25	0.25	0.38	0.62	0.87	1.00	1.00	0	0
A.P.H. m		0	0	0.43	0.43	0.70	1.12	1.25	1.25	1.25	0	0

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H. : Average Plant Height

Remarks: A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 2-25

Calculation of Monthly Growing Ratio and Average Plant Height

Rainy Season Paddy

Irrigation Block: Brantas Delta
A = 32,360

Area Planted Ha		Month											
		O	N	D	J	F	M	A	M	J	J	A	S
255	A		0.20	0.40	0.60	0.80	1.00						
	B		51.0	102.0	153.0	204.0	255.0						
3,462	A			0.25	0.50	0.75	1.00						
	B			865.5	1,731.0	2,596.5	3,462.0						
2,612	A			0.20	0.40	0.60	0.80	1.00					
	B			522.4	1,044.8	1,567.2	2,089.6	2,612.0					
10,819	A				0.25	0.50	0.75	1.00					
	B				2,704.5	5,409.5	8,114.3	10,819.0					
2,564	A				0.20	0.40	0.60	0.80	1.00				
	B				512.8	1,025.6	1,538.4	2,051.2	2,564.0				
4,748	A					0.25	0.50	0.75	1.00				
	B					1,187.0	2,374.0	3,561.0	4,748.0				
622	A					0.20	0.40	0.60	0.80	1.00			
	B					124.4	248.8	373.2	497.6	622.0			
720	A						0.25	0.50	0.75	1.00			
	B						180.0	360.0	540.0	720.0			
164	A						0.20	0.40	0.60	0.80	1.00		
	B						32.8	65.6	98.4	131.2	164.0		
4	A						0.17	0.33	0.50	0.67	0.83	1.00	
	B						0.7	1.3	2.0	2.7	3.3	4.0	
Total Area		0	255	6,329	19,712	25,082	25,970	22,253	8,822	1,510	168	4	0
ΣB		0	51.0	1,489.9	6,146.1	12,114.2	18,295.6	19,843.3	8,450.0	1,475.9	167.3	4.0	0
A.A.G.R.		0	0.20	0.24	0.31	0.48	0.70	0.89	0.96	0.98	1.00	1.00	0
A.P.H, m		0	0.30	0.40	0.57	0.91	1.20	1.25	1.25	1.25	1.25	1.25	0

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H. : Average Plant Height

Remarks:
A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 2-26

Calculation of Monthly Growing Ratio and Average Plant Height

Dry Season Paddy
Regulated

Irrigation Block: Brantas Delta
A = 32,360

Area Planted Ha		Month										
		A	M	J	J	A	S	O	N	D	J	F
2	A	0.20	0.40	0.60	0.80	1.00						
	B	0.40	0.80	1.20	1.60	2.00						
267	A		0.25	0.50	0.75	1.00						
	B		66.75	133.50	202.25	267.00						
119	A			0.33	0.67	1.00						
	B			39.27	79.73	119.00						
3,165	A			0.25	0.50	0.75	1.00					
	B			791.25	1,582.50	2,373.75	3,165.00					
56	A				0.33	0.67	1.00					
	B				18.48	37.52	56.00					
3,143	A				0.25	0.50	0.75	1.00				
	B				785.75	1,571.5	2,357.25	3,143.00				
117	A				0.20	0.40	0.60	0.80	1.00			
	B				23.40	46.80	70.20	93.60	117.00			
521	A					0.25	0.50	0.75	1.00			
	B					130.25	260.50	390.75	521.00			
113	A					0.20	0.40	0.60	0.80	1.00		
	B					22.60	45.20	67.80	90.40	113.00		
1	A					0.17	0.33	0.50	0.67	0.83	1.00	
	B					0.17	0.33	0.50	0.67	0.83	1.00	
Total Area		2	269	3,533	6,869	7,504	7,116	3,895	752	114	1	0
ΣB		0.40	67.55	965.22	2,691.71	4,570.59	5,943.98	3,695.65	729.07	113.83	1.00	0
A.A.G.R. ΣB/Total Area		0.20	0.25	0.27	0.39	0.61	0.84	0.95	0.97	1.00	0	0
A.P.H. m		0.30	0.43	0.48	0.73	1.11	1.25	1.25	1.25	1.25	1.25	0

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H.: Average Plant Height

Remarks:
A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 2-27

Calculation of Monthly Growing Ratio and Average Plant Height

Dry Season Paddy
Non-Regulated

Irrigation Block: Brantas Delta
A = 32,360 ha

Area Planted Ha		Month A	M	J	J	A	S	O	N	D	J	F	M
3	A	0.20	0.40	0.60	0.80	1.00							
	B	0.60	1.20	1.80	2.40	3.00							
184	A		0.25	0.50	0.75	1.00							
	B		46.00	92.00	138.00	184.00							
41	A			0.33	0.67	1.00							
	B			13.53	27.47	41.00							
2,271	A			0.25	0.50	0.75	1.00						
	B			567.75	1,135.50	1,703.25	2,271.00						
86	A				0.33	0.67	1.00						
	B				28.38	57.62	86.00						
1,979	A				0.25	0.50	0.75	1.00					
	B				494.75	989.50	1,484.25	1,979.00					
88	A					0.33	0.67	1.00					
	B					29.04	58.96	88.00					
451	A					0.25	0.50	0.75	1.00				
	B					112.75	225.50	338.75	451.00				
162	A					0.20	0.40	0.60	0.80	1.00			
	B					32.40	64.80	97.20	129.60	162.00			
21	A					0.17	0.33	0.50	0.67	0.83	1.00		
	B					3.57	6.93	10.50	14.07	17.43	21.00		
4	A						0.17	0.33	0.50	0.67	0.83	1.00	
	B						0.68	1.32	2.00	2.68	3.32	4.00	
Total Area		3	187	2,499	4,564	5,286	5,062	2,705	638	187	25	4	0
ΣB		0.60	47.12	675.08	1,826.5	3,155.63	4,198.12	2,514.27	596.67	182.11	24.32	4.00	0
A.A.G.R. ΣB/Total Area		0.20	0.25	0.27	0.40	0.60	0.83	0.93	0.94	0.97	0.97	1.00	0
A.P.H. m		0.30	0.43	0.47	0.75	1.10	1.25	1.25	1.25	1.25	1.25	1.25	0

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H. : Average Plant Height

Remarks:
A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 2-28 Calculation of Monthly Growing Ratio and Average Plant Height

Sugar Cane — Brantas Delta A = 32,360 ha

Area Planted Ha		Month A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S
1	A	0	0.09	0.18	0.27	0.36	0.45	0.55	0.64	0.73	0.82	0.91	1.00						
	B	0	0.09	0.18	0.27	0.36	0.45	0.55	0.64	0.73	0.82	0.91	1.00						
152	A		0	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00						
	B		0	15.20	30.40	45.60	60.80	76.00	91.20	106.40	121.60	136.80	152.0						
23	A			0	0.11	0.22	0.33	0.44	0.55	0.67	0.78	0.89	1.00						
	B			0	2.53	5.06	7.59	10.12	12.65	15.41	17.94	20.47	23.00						
1,137	A			0	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00					
	B			0	113.70	227.40	341.10	454.80	568.50	682.20	795.90	909.60	1,023.3	1,137.0					
613	A			0	0.09	0.18	0.27	0.36	0.45	0.55	0.64	0.73	0.82	0.91	1.00				
	B			0	55.17	110.34	165.51	220.68	275.85	337.15	392.32	447.49	502.66	557.83	613.00				
976	A				0	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00				
	B				0	97.60	195.20	292.80	390.40	488.00	585.60	683.20	780.80	878.40	976.00				
1,329	A				0	0.09	0.18	0.27	0.36	0.45	0.55	0.64	0.73	0.82	0.91	1.00			
	B				0	119.61	239.22	358.83	478.44	598.05	730.98	850.56	970.17	1,089.78	1,209.39	1,329.00			
148	A					0	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00			
	B					0	14.80	29.60	44.40	59.20	74.00	88.80	103.6	118.40	133.20	148.00			
631	A					0	0.09	0.18	0.27	0.36	0.45	0.55	0.64	0.73	0.82	0.91	1.00		
	B					0	56.79	113.58	170.37	227.16	283.95	347.05	403.84	460.63	517.42	574.21	631.0		
36	A						0	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00		
	B						0	3.60	7.20	10.80	14.40	18.00	21.60	25.20	28.80	32.40	36.00		
34	A						0	0.09	0.18	0.27	0.36	0.45	0.55	0.64	0.73	0.82	0.91	1.00	
	B						0	3.06	6.12	9.18	12.24	15.30	18.70	21.76	24.82	27.88	30.94	34.00	
5	A							0	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	
	B							0	0.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	
Total Area		1	153	1,926	4,231	5,010	5,080	5,085	5,085	5,085	5,085	5,085	5,085	4,909	3,772	2,183	706	39	0
ΣB		0	0.09	15.38	202.07	605.97	1,081.46	1,563.62	2,046.27	2,535.28	3,031.22	3,520.18	4,003.17	4,292.0	3,506.13	2,116.49	702.44	39.00	0
		4,292/ 4,910	3506.22/ 3,925	2130.87/ 4,109	904.51/ 4,937	644.97/ 5,049													
A.A.G.R.		0.87	0.89	0.52	0.18	0.13	0.21	0.31	0.40	0.50	0.60	0.69	0.79						
A.P.H. m		2.74	2.78	1.40	0.48	0.42	0.54	0.76	1.00	1.30	1.60	2.26	2.57						

Note: A.A.G.R.: Areal Average Growing Ratio
A.P.H. : Average Plant Height

Remarks:
A: Growing Ratio
B: Weighted Growing Ratio
B = A x Area

Table 3-1 Seed Bed Water Requirements of Paddy

			Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
W-1	Area	Ha	2	11	13	16	7	2	-	-	-	-	-	-
	Unit Rate	lit/s	2.02	2.06	2.02	2.02	2.14	2.02	-	-	-	-	-	-
R.P	Requirements	lit/s	4.0	22.7	26.3	32.3	15.0	4.0	-	-	-	-	-	-
	Area	Ha	-	-	-	-	-	-	2	3	-	-	-	-
D.P.R	Unit Rate	lit/s	-	-	-	-	-	-	1.67	1.65	-	-	-	-
	Requirements	lit/s	-	-	-	-	-	-	3.3	5.0	-	-	-	-
D.P.N.R.	Area	Ha	-	-	-	-	-	-	2	7	5	3	1	-
	Unit Rate	lit/s	-	-	-	-	-	-	1.67	1.65	1.67	1.65	1.65	-
	Requirements	lit/s	-	-	-	-	-	-	3.3	11.6	8.4	5.0	1.7	-
W-2	Area	Ha	-	15	50	74	44	13	-	-	-	-	-	-
	Unit Rate	lit/s	-	2.06	2.02	2.02	2.14	2.02	-	-	-	-	-	-
R.P	Requirements	lit/s	-	30.9	10.1	149.5	94.2	26.3	-	-	-	-	-	-
	Area	Ha	-	-	-	-	-	-	1	14	17	16	5	-
D.P.R	Unit Rate	lit/s	-	-	-	-	-	-	1.67	1.65	1.67	1.65	1.65	-
	Requirements	lit/s	-	-	-	-	-	-	1.7	23.1	28.4	26.4	8.3	-
D.P.N.R.	Area	Ha	1	-	-	-	-	-	-	5	20	31	16	3
	Unit Rate	lit/s	1.65	-	-	-	-	-	-	1.65	1.67	1.65	1.65	1.67
	Requirements	lit/s	1.7	-	-	-	-	-	-	8.3	33.4	51.2	26.4	5.0

Note R.P. : Rainy Season Paddy
D.P.R. : Dry Season Paddy Regulated
D.P.N.R. : Dry Season Paddy Non Regulated

Table 3-2 Seed Bed Water Requirements of Paddy

			Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
W-3	Area	Ha	-	2	2	2	1	-	-	-	-	-	-	-
	Unit Rate	lit/s	-	2.06	2.02	2.02	2.14	-	-	-	-	-	-	-
R.P	Requirements	lit/s	-	4.1	4.0	4.0	2.1	-	-	-	-	-	-	-
	Area	Ha	-	-	-	-	-	-	-	2	1	1	-	-
D.P.R	Unit Rate	lit/s	-	-	-	-	-	-	-	1.65	1.67	1.65	-	-
	Requirements	lit/s	-	-	-	-	-	-	-	3.3	1.7	1.7	-	-
D.P.N.R.	Area	Ha	-	-	-	-	-	-	-	1	1	1	-	-
	Unit Rate	lit/s	-	-	-	-	-	-	-	1.65	1.67	1.65	-	-
	Requirements	lit/s	-	-	-	-	-	-	-	1.7	1.7	1.7	-	-
W-4	Area	Ha	1	4	4	5	3	1	-	-	-	-	-	-
	Unit Rate	lit/s	2.02	2.06	2.02	2.02	2.14	2.02	-	-	-	-	-	-
R.P	Requirements	lit/s	2.0	8.2	8.1	10.1	6.4	2.0	-	-	-	-	-	-
	Area	Ha	-	-	-	-	-	-	1	3	1	1	1	-
D.P.R.	Unit Rate	lit/s	-	-	-	-	-	-	1.67	1.65	1.67	1.65	1.65	-
	Requirements	lit/s	-	-	-	-	-	-	1.7	5.0	1.7	1.7	1.7	-
D.P.N.R.	Area	Ha	-	-	-	-	-	-	-	1	2	1	1	-
	Unit Rate	lit/s	-	-	-	-	-	-	-	1.65	1.67	1.65	1.65	-
	Requirements	lit/s	-	-	-	-	-	-	-	1.7	3.3	1.7	1.7	-

Note R.P. : Rainy Season Paddy
D.P.R. : Dry Season Paddy Regulated
D.P.N.R. : Dry Season Paddy Non Regulated

Table 3-3 Seed Bed Water Requirements of Paddy

			Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
W-5	Area	Ha	-	15	26	10	2	-	-	-	-	-	-	-
	Unit Rate	lit/s	-	2.06	2.02	2.02	2.14	-	-	-	-	-	-	-
R.P	Requirements	lit/s	-	30.9	52.5	20.2	4.3	-	-	-	-	-	-	-
	Area	Ha	-	-	-	-	-	-	1	1	1	-	-	-
D.P.R	Unit Rate	lit/s	-	-	-	-	-	-	1.67	1.65	1.67	-	-	-
	Requirements	lit/s	-	-	-	-	-	-	1.7	1.7	1.7	-	-	-
D.P.N.R.	Area	Ha	-	-	-	-	-	-	-	2	2	-	-	-
	Unit Rate	lit/s	-	-	-	-	-	-	-	1.65	1.67	-	-	-
	Requirements	lit/s	-	-	-	-	-	-	-	3.3	3.3	-	-	-
W-6	Area	Ha	-	7	44	68	11	-	-	-	-	-	-	-
	Unit Rate	lit/s	-	2.06	2.02	2.14	2.14	-	-	-	-	-	-	-
R.P	Requirements	lit/s	-	14.4	88.9	145.5	23.5	-	-	-	-	-	-	-
	Area	Ha	-	-	-	-	-	-	-	-	-	-	-	-
D.P.R	Unit Rate	lit/s	-	-	-	-	-	-	-	-	-	-	-	-
	Requirements	lit/s	-	-	-	-	-	-	-	-	-	-	-	-
D.P.N.R.	Area	Ha	-	-	-	-	-	-	-	-	1	6	-	-
	Unit Rate	lit/s	-	-	-	-	-	-	-	-	1.67	1.65	-	-
	Requirements	lit/s	-	-	-	-	-	-	-	-	1.7	9.9	-	-

Note R.P. : Rainy Season Paddy
D.P.R. : Dry Season Paddy Regulated
D.P.N.R. : Dry Season Paddy Non Regulated

Table 3-4 Seed Bed Water Requirements of Paddy

			Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
W-7	Area	Ha	5	40	210	69	6	-	-	-	-	-	-	-
	Unit Rate	lit/s	2.02	2.06	2.02	2.14	2.02	-	-	-	-	-	-	-
R.P	Requirements	lit/s	10.1	82.4	424.2	147.7	12.1	-	-	-	-	-	-	-
	Area	Ha	-	-	-	-	-	-	1	19	36	14	-	-
D.P.R	Unit Rate	lit/s	-	-	-	-	-	-	1.67	1.65	1.67	1.65	-	-
	Requirements	lit/s	-	-	-	-	-	-	1.7	31.4	60.1	23.1	-	-
D.P.N.R	Area	Ha	-	-	-	-	-	-	-	-	-	2	-	-
	Unit Rate	lit/s	-	-	-	-	-	-	-	-	-	16.5	-	-
	Requirements	lit/s	-	-	-	-	-	-	-	-	-	3.3	-	-
W-8	Area	Ha	5	77	107	48	8	-	-	-	-	-	-	-
	Unit Rate	lit/s	2.02	2.06	2.02	2.14	2.02	-	-	-	-	-	-	-
R.P	Requirements	lit/s	10.1	158.6	216.1	102.7	16.2	-	-	-	-	-	-	-
	Area	Ha	-	-	-	-	-	-	2	22	40	15	-	-
D.P.R	Unit Rate	lit/s	-	-	-	-	-	-	1.67	1.65	1.67	1.65	-	-
	Requirements	lit/s	-	-	-	-	-	-	3.3	36.3	66.8	24.8	-	-
D.P.N.R	Area	Ha	-	-	-	-	-	-	-	-	1.6	12	-	-
	Unit Rate	lit/s	-	-	-	-	-	-	-	-	1.67	1.65	-	-
	Requirements	lit/s	-	-	-	-	-	-	-	-	26.7	19.8	-	-

Note R.P. : Rainy Season Paddy , D.P.R. : Dry Season Paddy Regulated , D.P.N.R. : Dry Season Paddy Non Regulated

Table 3-5 Seed Bed Water Requirements of Paddy

			Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
S-1	Area	Ha	-	5	19	12	1	-	-	-	-	-	-	-
	Unit Rate	lit/s	-	2.06	2.02	2.02	2.14	-	-	-	-	-	-	-
R.P	Requirements	lit/s	-	10.3	38.4	24.2	2.1	-	-	-	-	-	-	-

Table 3-6 Transplanting Area(Monthly) and Puddling Water Requirements

			Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
W-1	Area	Ha	2	13	74	100	67	35	-	-	-	-	-	-
R.P	Unit Rate	lit/s	0.93	0.96	0.93	0.93	1.03	0.93	-	-	-	-	-	-
	Requirements	lit/s	1.9	12.5	68.8	93.0	69.0	32.6	-	-	-	-	-	-
D.P.R.	Area	Ha	-	-	-	-	-	-	2	15	16	1	-	-
	Unit Rate	lit/s	-	-	-	-	-	-	0.58	0.56	0.58	0.56	-	-
	Requirements	lit/s	-	-	-	-	-	-	1.2	8.4	9.3	0.6	-	-
D.P.N.R.	Area	Ha	16	-	-	-	-	-	1	11	77	41	14	-
	Unit Rate	lit/s	0.56	-	-	-	-	-	0.58	0.56	0.58	0.56	0.56	-
	Requirements	lit/s	9.0	-	-	-	-	-	0.6	6.2	44.7	23.0	7.8	-
W-2	Area	Ha	-	8	69	255	567	428	88	-	-	-	-	-
R.P	Unit Rate	lit/s	-	0.96	0.93	0.93	1.03	0.93	0.96	-	-	-	-	-
	Requirements	lit/s	-	7.7	64.2	237.2	584.0	398.0	84.5	-	-	-	-	-
D.P.R.	Area	Ha	-	-	-	-	-	-	-	5	49	112	139	48
	Unit Rate	lit/s	-	-	-	-	-	-	-	0.56	0.58	0.56	0.56	0.58
	Requirements	lit/s	-	-	-	-	-	-	-	2.8	28.4	62.7	77.8	27.8
D.P.N.R.	Area	Ha	-	-	-	-	-	-	-	1	46	153	359	164
	Unit Rate	lit/s	-	-	-	-	-	-	-	0.56	0.58	0.56	0.56	0.58
	Requirements	lit/s	-	-	-	-	-	-	-	0.6	26.7	85.7	201.0	95.1

Note R.P. : Rainy Season Paddy
D.P.R. : Dry Season Paddy Regulated
D.P.N.R. : Dry Season Paddy Non Regulated

Table 3-7 Transplanting Area(monthly) and Puddling Water Requirements

			Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
W-3	Area	Ha	-	1	23	11	10	5	-	-	-	-	-	-
	Unit Rate	lit/s	-	0.96	0.93	0.93	1.03	0.93	-	-	-	-	-	-
R.P	Requirements	lit/s	-	1.0	21.4	10.2	10.3	4.7	-	-	-	-	-	-
	Area	Ha	-	-	-	-	-	-	-	3	18	6	4	3
D.P.R.	Unit Rate	lit/s	-	-	-	-	-	-	-	0.58	0.56	0.58	0.56	0.58
	Requirements	lit/s	-	-	-	-	-	-	-	1.7	10.1	3.5	2.2	1.7
	Area	Ha	-	-	-	-	-	-	-	-	4	13	5	4
D.P.N.R.	Unit Rate	lit/s	-	-	-	-	-	-	-	-	0.56	0.58	0.56	0.58
	Requirements	lit/s	-	-	-	-	-	-	-	-	2.2	7.5	2.8	2.3
W-4	Area	Ha	-	8	36	24	34	20	-	-	-	-	-	-
	Unit Rate	lit/s	-	0.96	0.93	0.93	1.03	0.93	-	-	-	-	-	-
R.P	Requirements	lit/s	-	7.7	33.5	22.3	35.0	18.6	-	-	-	-	-	-
	Area	Ha	-	-	-	-	-	-	-	8	36	11	10	-
D.P.R.	Unit Rate	lit/s	-	-	-	-	-	-	-	0.58	0.56	0.58	0.56	-
	Requirements	lit/s	-	-	-	-	-	-	-	4.6	20.2	6.4	5.6	-
	Area	Ha	-	-	-	-	-	-	-	-	13	15	12	15
D.P.N.R.	Unit Rate	lit/s	-	-	-	-	-	-	-	-	0.56	0.58	0.56	0.58
	Requirements	lit/s	-	-	-	-	-	-	-	-	7.3	8.7	6.7	8.7

Note R.P. : Rainy Season Paddy
D.P.R.: Dry Season Paddy Regulated
D.P.N.R. : Dry Season Paddy Non Regulated

Table 3-8 Transplanting Area(Monthly) and Puddling Water Requirements

			Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
W-5	Area	Ha	2	78	213	64	38	-	-	-	-	-	-	-
	Unit Rate	lit/s	0.93	0.96	0.93	0.93	1.03	-	-	-	-	-	-	-
R.P	Requirements	lit/s	1.9	74.9	198.1	59.5	39.1	-	-	-	-	-	-	-
	Area	Ha	-	-	-	-	-	-	-	4	9	7	-	-
D.P.R.	Unit Rate	lit/s	-	-	-	-	-	-	-	0.56	0.58	0.56	-	-
	Requirements	lit/s	-	-	-	-	-	-	-	2.2	5.2	3.9	-	-
	Area	Ha	-	-	-	-	-	-	-	4	31	13	-	-
D.P.N.R.	Unit Rate	lit/s	-	-	-	-	-	-	-	0.56	0.58	0.56	-	-
	Requiremnts	lit/s	-	-	-	-	-	-	-	2.2	18.0	7.3	-	-
W-6	Area	Ha	-	-	54	394	725	113	-	-	-	-	-	-
	Unit Rate	lit/s	-	-	0.93	0.93	1.03	0.93	-	-	-	-	-	-
R.P	Requirements	lit/s	-	-	50.2	366.4	746.8	105.1	-	-	-	-	-	-
	Area	Ha	-	-	-	-	-	-	-	4	20	34	23	-
D.P.R.	Unit Rate	lit/s	-	-	-	-	-	-	-	0.56	0,58	0.56	0.56	-
	Requirements	lit/s	-	-	-	-	-	-	-	2.2	11.6	19.6	12.9	-
	Area	Ha	-	-	-	-	-	-	-	-	-	-	-	-
D.P.N.R.	Unit Rate	lit/s	-	-	-	-	-	-	-	-	-	-	-	-
	Requirements	lit/s	-	-	-	-	-	-	-	-	-	-	-	-

Note R.P. : Rainy Season Paddy
D.P.R. : Dry Season Paddy Regulated
D.P.N.R : Dry Season Paddy Non Regulated

Table 3-9 Transplanting Area(Monthly) and Puddling Water Requirements

			Oct.	Non.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
W-7	Area	Ha	-	7	234	490	304	72	-	-	-	-	-	-
	Unit Rate	lit/s	-	0.96	0.93	0.93	1.03	0.93	-	-	-	-	-	-
R.P	Requirements	lit/s	-	6.7	217.6	455.7	313.1	67.0	-	-	-	-	-	-
	Area	Ha	-	-	-	-	-	-	-	4	133	239	113	-
D.P.R.	Unit Rate	lit/s	-	-	-	-	-	-	-	0.56	0.58	0.56	0.56	-
	Requirements	lit/s	-	-	-	-	-	-	-	2.2	77.1	133.8	63.3	-
	Area	Ha	-	-	-	-	-	-	-	1	14	30	91	-
D.P.N.R.	Unit Rate	lit/s	-	-	-	-	-	-	-	0.56	0.58	0.56	0.56	-
	Requirements	lit/s	-	-	-	-	-	-	-	0.6	8.1	16.8	51.0	-
W-8	Area	Ha	-	7	332	785	151	521	-	-	-	-	-	-
	Unit Rate	lit/s	-	0.96	0.93	0.93	1.03	0.93	-	-	-	-	-	-
R.P	Requirements	lit/s	-	0.7	308.8	730.1	155.5	484.5	-	-	-	-	-	-
D.P.R.	Area	Ha	-	-	-	-	-	-	-	6	138	263	97	-
	Unit Rate	lit/s	-	-	-	-	-	-	-	0.56	0.58	0.56	0.56	-
	Requirements	lit/s	-	-	-	-	-	-	-	3.4	80.0	147.3	54.3	-
	Area	Ha	-	-	-	-	-	-	-	-	32	221	135	19
D.P.N.R.	Unit Rate	lit/s	-	-	-	-	-	-	-	-	0.58	0.56	0.56	0.58
	Requirements	lit/s	-	-	-	-	-	-	-	-	18.6	123.8	75.6	11.0

Note R.P. : Rainy Season Paddy
D.P.R. : Dry Season Paddy Regulated
D.P.N.R. : Dry Season Paddy Non Regulated

Table 3-10 Transplanting Area (Monthly) and Puddling Water Requirements

			Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
S-1	Area	Ha	-	-	1	105	116	5	-	-	-	-	-	-
	Unit Rate	lit/s	-	-	0.93	0.93	1.03	0.93	-	-	-	-	-	-
	Requirements	lit/s	-	-	0.9	97.7	119.5	4.7	-	-	-	-	-	-

Table 3-11 Field Delivery Water Requirements of Paddy

			Oct.	Non.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
W-1	Area	Ha	2	15	89	189	256	291	267	184	64	18	3	-
	Growing Ratio	%	0.17	0.22	0.25	0.32	0.43	0.61	0.79	0.90	0.94	0.97	1.00	-
R.P	Unit Rate	lit/s	0.90	1.00	1.00	1.00	1.20	1.10	1.10	0.85	0.85	0.85	0.85	-
	Requirements	lit/s	1.8	15.0	89.0	189.0	307.2	320.1	293.7	156.4	54.4	15.3	2.6	-
	Area	Ha	3	-	-	-	-	-	2	17	33	34	34	17
D.P.R.	Growing Ratio	%	1.00	-	-	-	-	-	0.20	0.27	0.38	0.63	0.86	0.96
	Unit Rage	lit/s	0.85	-	-	-	-	-	0.90	1.00	1.00	1.10	0.85	0.85
	Requirements	lit/s	2.6	-	-	-	-	-	1.8	17.0	33.0	37.4	28.9	14.5
D.P.N.R.	Area	Ha	93	39	16	4	-	-	1	12	89	130	144	120
	Growing Ratio	%	0.83	0.84	0.94	1.00	-	-	0.20	0.26	0.30	0.46	0.68	0.65
	Unit Rate	lit/s	0.85	0.85	0.85	0.85	-	-	0.90	1.00	1.00	1.20	1.10	1.10
	Requirements	lit/s	79.1	31.5	13.6	3.4	-	-	0.9	12.0	89.0	156.0	158.4	132.0
W-2	Area	Ha	-	8	77	332	899	1,327	1,415	1,137	756	245	18	-
	Growing Ratio	%	-	0.17	0.21	0.28	0.33	0.45	0.66	0.80	0.93	0.99	1.00	-
R.P	Unit Rate	lit/s	-	0.90	1.00	1.00	1.00	1.20	1.10	0.85	0.85	0.85	0.85	-
	Requirements	lit/s	-	7.2	77.0	332.0	899.0	1592.4	1556.5	996.5	642.6	288.3	15.3	-
D.P.R.	Area	Ha	276	220	141	52	2	-	-	5	54	166	305	353
	Growing Ratio	%	0.69	0.82	0.93	0.99	1.00	-	-	0.20	0.26	0.34	0.42	0.59
	Unit Rate	lit/s	1.10	0.85	0.85	0.85	0.85	-	-	0.90	1.00	1.00	1.20	1.20
	Requirements	lit/s	303.6	187.0	119.9	44.2	1.7	-	-	4.5	54.0	166.0	366.0	423.6
D.P.N.R.	Area	Ha	709	522	324	101	6	-	-	1	47	200	559	723
	Growing Ratio	%	0.71	0.83	0.94	0.99	1.00	-	-	0.20	0.22	0.29	0.34	0.49
	Unit Rate	lit/s	1.10	0.85	0.85	0.85	0.85	-	-	0.90	1.00	1.00	1.00	1.20
	Requirements	lit/s	779.9	443.7	275.4	85.9	5.1	-	-	0.9	47.0	200.0	559.0	868.0

Note R.P. : Rainy Season Paddy, D.P.R. : Dry Season Paddy Regulated , D.P.N.R. : Dry Season Paddy Non Regulated

Table 3-12 Field Delivery Water Requirements of Paddy

			Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
W-3	Area	Ha	-	1	24	35	45	50	41	20	9	-	-	-
	Growing Ratio	%	-	0.20	0.23	0.37	0.51	0.69	0.84	0.90	1.00	-	-	-
R.P	Unit Rate	lit/s	-	0.90	1.00	1.00	1.20	1.10	0.85	0.85	0.85	-	-	-
	Requirements	lit/s	-	0.9	24.0	35.0	54.0	55.0	34.9	17.0	7.7	-	-	-
	Area	Ha	14	9	7	1	-	-	-	3	21	27	31	31
D.P.R.	Growing Ratio	%	0.74	0.81	0.97	1.00	-	-	-	0.25	0.28	0.46	0.64	0.78
	Unit Rate	lit/s	1.10	0.85	0.85	0.85	-	-	-	1.00	1.00	1.20	1.10	1.10
	Requirements	lit/s	15.4	7.7	6.0	0.9	-	-	-	3.0	21.0	32.4	34.1	34.1
D.P.N.R.	Area	Ha	23	15	4	2	-	-	-	-	4	17	22	2.6
	Growing Ratio	%	0.74	0.79	0.97	1.00	-	-	-	-	0.24	0.28	0.43	0.58
	Unit Rate	lit/s	1.10	1.10	0.85	0.85	-	-	-	-	1.00	1.00	1.20	1.20
	Requirements	lit/s	25.3	16.5	3.4	1.7	-	-	-	-	4.0	17.0	26.4	3.2
W-4	Area	Ha	-	8	44	68	102	122	105	66	22	3	-	-
	Growing Ratio	%	-	0.20	0.25	0.38	0.48	0.63	0.77	0.91	0.97	1.00	-	-
R.P	Unit Rate	lit/s	-	0.90	1.00	1.00	1.20	1.10	1.10	0.85	0.85	0.85	-	-
	Requirements	lit/s	-	7.2	44.0	68.0	122.4	134.2	115.5	56.1	18.7	2.6	-	-
D.P.R.	Area	Ha	36	21	14	2	-	-	-	8	44	55	65	65
	Growing Ratio	%	0.81	0.86	0.98	1.00	-	-	-	0.20	0.26	0.43	0.57	0.79
	Unit Rate	lit/s	0.85	0.85	0.85	0.85	-	-	-	0.90	1.00	1.20	1.20	1.10
	Requirements	lit/s	30.6	17.9	11.9	1.7	-	-	-	7.2	44.0	66.0	78.0	71.5
D.P.N.R.	Area	Ha	51	33	20	5	-	-	-	-	13	28	40	55
	Growing Ratio	%	0.75	0.83	0.95	1.00	-	-	-	-	0.22	0.32	0.45	0.56
	Unit Rate	lit/s	1.10	0.85	0.85	0.85	-	-	-	-	1.00	1.00	1.20	1.20
	Requirements	lit/s	56.1	28.1	17.0	4.3	-	-	-	-	13.0	28.0	48.0	66.0

Note R.P. : Rainy Season Paddy , D.P.R. : Dry Season Paddy Regulated , D.P.N.R. , Dry Season Paddy Non Regulated

Table 3-13 Field Delivery Water Requirements of Paddy

			Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
W-5	Area	Ha	2	80	293	357	395	361	224	53	5	-	-	-
	Growing Ratio	%	0.20	0.23	0.29	0.47	0.66	0.81	0.80	0.91	1.00	-	-	-
R.P	Unit Rate	lit/s	0.90	1.-0	1.00	1.20	1.10	0.85	1.10	0.85	0.85	-	-	-
	Requirements	lit/s	1.8	80.0	293.0	428.4	434.5	306.9	246.4	45.1	4.3	-	-	-
D.P.R.	Area	Ha	6	-	-	-	-	-	-	4	13	20	20	15
	Growing Ratio	%	1.00	-	-	-	-	-	-	0.25	0.33	0.48	0.73	0.90
	Unit Rate	lit/s	0.85	-	-	-	-	-	-	1.00	1.00	1.20	1.10	0.85
	Requirements	lit/s	5.1	-	-	-	-	-	-	4.0	13.0	24.0	22.0	12.8
D.P.N.R.	Area	Ha	9	-	-	-	-	-	-	4	35	51	46	31
	Growing Ratio	%	1.00	-	-	-	-	-	-	0.33	0.33	0.53	0.79	0.93
	Unit Rate	lit/s	0.85	-	-	-	-	-	-	1.00	1.00	1.20	1.10	0.85
	Requirements	lit/s	7.7	-	-	-	-	-	-	4.0	35.0	61.2	50.6	26.4
W-6	Area	Ha	-	-	54	448	1,173	1,286	1,281	1,002	199	-	-	-
	Growing Ratio	%	-	-	0.20	0.25	0.33	0.54	0.78	0.95	1.00	-	-	-
R.P.	Unit Rate	lit/s	-	-	0.90	1.00	1.00	1.20	1.10	0.85	0.85	-	-	-
	Requirements	lit/s	-	-	48.6	448.0	1,173	1543.2	1409.1	851.7	169.2	-	-	-
	Area	Ha	54	9	3	-	-	-	-	4	28	58	81	59
D.P.R.	Growing Ratio	%	0.95	0.93	1.00	-	-	-	-	0.25	0.35	0.43	0.59	0.71
	Unit Rate	lit/s	0.85	0.85	0.85	-	-	-	-	1.00	1.00	1.20	1.20	1.10
	Requirements	lit/s	45.9	7.7	2.6	-	-	-	-	4.0	28.0	69.6	97.2	64.9
D.P.N.R.	Area	Ha	-	-	-	-	-	-	-	-	-	-	-	-
	Growing Ratio	%	-	-	-	-	-	-	-	-	-	-	-	-
	Unit Rate	lit/s	-	-	-	-	-	-	-	-	-	-	-	-
	Requirements	lit/s	-	-	-	-	-	-	-	-	-	-	-	-

Note R.P. : Rainy Season Paddy , D.P.R. : Dry Season Paddy Regulated , D.P.N.R. : Dry Season Paddy Non Regulated

Table 3-14 Field Delivery Water Requirements of Paddy

			Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
W-7	Area	Ha	-	7	241	731	1,035	1,107	898	443	40	-	-	-
	Growing Ratio	%	-	0.20	0.25	0.32	0.47	0.69	0.87	0.98	1.00	-	-	-
R.P.	Unit Rate	lit/s	-	0.90	1.00	1.00	1.20	1.10	0.85	0.85	0.85	-	-	-
	Requirements	lit/s	-	6.3	241.0	731.0	1242.0	1217.7	763.3	376.6	34.0	-	-	-
D.P.R.	Area	Ha	326	110	4	-	-	-	-	4	137	376	489	482
	Growing Ratio	%	0.91	0.99	1.00	-	-	-	-	0.25	0.26	0.35	0.52	0.77
	Unit Rate	lit/s	0.85	0.85	0.85	-	-	-	-	1.00	1.00	1.00	1.20	1.10
	Requirements	lit/s	277.1	93.5	3.4	-	-	-	-	4.0	137.0	376.0	586.8	530.2
D.P.N.R.	Area	Ha	95	29	1	-	-	-	-	1	15	45	136	121
	Growing Ratio	%	0.92	0.99	1.00	-	-	-	-	0.25	0.34	0.44	0.46	0.70
	Unit Rate	lit/s	0.85	0.85	0.85	-	-	-	-	1.00	1.00	1.20	1.20	1.10
	Requirements	lit/s	80.8	24.7	0.9	-	-	-	-	1.0	15.0	54.0	163.2	133.1
W-8	Area	Ha	-	7	339	1,124	1,275	1,796	1,577	671	79	4	-	-
	Growing Ratio	%	-	0.20	0.23	0.32	0.52	0.64	0.87	0.97	0.99	1.00	-	-
	Unit Rate	lit/s	-	0.90	1.00	1.00	1.20	1.10	0.85	0.85	0.85	0.85	-	-
R.P.	Requirements	lit/s	-	6.3	339.0	1124.0	1530.0	1975.6	1340.5	570.4	67.2	3.4	-	-
D.P.R.	Area	Ha	316	28	-	-	-	-	-	6	144	407	504	497
	Growing Ratio	%	0.76	1.00	-	-	-	-	-	0.25	0.26	0.35	0.55	0.82
	Unit Rate	lit/s	1.10	0.85	-	-	-	-	-	1.00	1.00	1.00	1.20	0.85
	Requirements	lit/s	347.6	23.8	-	-	-	-	-	6.0	144.0	407.0	604.8	422.5
D.P.N.R.	Area	Ha	286	29	-	-	-	-	-	-	32	253	388	407
	Growing Ratio	%	0.97	1.00	-	-	-	-	-	-	0.25	0.30	0.50	0.77
	Unit Rate	lit/s	0.85	0.85	-	-	-	-	-	-	1.00	1.00	1.20	1.10
	Requirements	lit/s	243.1	24.7	-	-	-	-	-	-	32.0	253.0	465.6	447.7

Note R.P. : Rainy Season Paddy, D.P.R. : Dry Season Paddy Regulated , D.P.N.R. : Dry Season Paddy Non Regulated

Table 3-15 Field Delivery Water Requirements of Paddy

			Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
S-1	Area	Ha	-	-	1	106	222	227	223	112	2	-	-	-
R.P.	Growing Ratio	%	-	-	0.25	0.25	0.38	0.62	0.87	1.00	1.00	-	-	-
	Unit Rate	lit/s	-	-	1.00	1.00	1.00	1.10	0.85	0.85	0.85	-	-	-
	Requirements	lit/s	-	-	1.0	106.0	222.0	249.7	189.6	95.2	1.70	-	-	-

Note R.P. : Rainy Season Paddy

Table 3-16 Field Delivery Water Requirements of Polowidjo

Unit Rate: 0.5 lit/s/ha

			Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
W-1	Area	Ha	7	3	-	-	-	-	-	1	4	9	10	9
	Requirements	lit/s	3.5	1.5	-	-	-	-	-	0.5	2.0	4.5	5.0	4.5
W-2	Area	Ha	16	20	21	20	20	19	20	18	12	20	18	17
	Requirements	lit/s	8.0	10.0	10.5	10.0	10.0	9.5	10.0	9.0	6.0	10.0	9.0	8.5
W-3	Area	Ha	3	2	1	1	1	-	-	-	-	2	3	3
	Requirements	lit/s	1.5	1.0	0.5	0.5	0.5	-	-	-	-	1.0	1.5	1.5
W-4	Area	Ha	-	-	-	-	-	-	-	-	15	3	-	-
	Requirements	lit/s	-	-	-	-	-	-	-	-	7.5	1.5	-	-
W-5	Area	Ha	17	13	6	-	-	-	-	-	7	12	14	15
	Requirements	lit/s	8.5	6.5	3.0	-	-	-	-	-	3.5	6.0	7.0	7.5
W-6	Area	Ha	-	3	3	1	2	1	1	1	2	11	7	2
	Requirements	lit/s	-	1.5	1.5	0.5	1.0	0.5	0.5	0.5	1.0	5.5	3.5	1.0
W-7	Area	Ha	-	-	-	-	-	-	-	-	-	-	-	-
W-8	Requirements	lit/s	-	-	-	-	-	-	-	-	-	-	-	-
S-1	Area	Ha	16	-	-	-	-	-	-	14	60	80	73	44
	Requirements	lit/s	8.0	-	-	-	-	-	-	7.0	30.0	40.0	36.5	22.0

Table 3-17 Field Delivery Water Requirements and Diversion Water Requirements Irrigation Block : Simowau A=387ha W-1

	Rainy Season Paddy		Dry Season Paddy Regulated		Dry Season Paddy Non Regulated		Polowidjo		Total Field Delivery Water Requirements			Diversion Water Requirements
	Growing Area	Amount	Growing Area	Amount	Growing Area	Amount	Growing Area	Amount	Growing Area	Rate	Amount	
	ha	lit/s	ha	lit/s	ha	lit/s	ha	lit/s	ha	lit/s/ha	lit/s	m^3/s
Oct.	4	7.7	-	-	93	88.1	7	3.5	104	0.96	99.3	0.14
Nov.	26	50.2	-	-	37	31.5	3	1.5	66	1.26	83.2	0.12
Dec.	102	184.1	-	-	16	13.6	-	-	118	1.68	197.7	0.28
Jan.	205	314.3	-	-	4	3.4	-	-	209	1.52	317.7	0.45
Feb.	263	391.2	-	-	-	-	-	-	263	1.45	391.2	0.56
Mar.	293	356.7	-	-	-	-	-	-	293	1.22	356.7	0.51
Apr.	267	293.7	4	6.5	3	4.8	-	-	274	1.11	305.0	0.44
May	184	156.4	20	30.4	19	29.8	1	0.5	224	0.97	217.1	0.31
Jun.	64	54.4	33	42.3	94	142.1	4	2.0	195	1.23	240.8	0.34
Jul.	18	15.3	34	38.0	133	184.0	9	4.5	194	1.72	241.8	0.35
Aug.	3	2.6	34	28.9	145	167.9	10	5.0	192	1.06	204.4	0.29
Sep.	-	-	17	14.5	120	132.0	9	4.5	146	1.03	151.0	0.22

Note: Growing Area of Paddy : The sum of growing area of seed bed and paddy field in Table 1-1
Amount in paddy : The sum of evapotranspiration of paddy and deep percolation and puddling water requirements.

Table 3-18 Field Delivery Water Requirements and Diversion Water Requirements Irrigation Block : Kebonagung A=1,511 ha W-2

	Rainy Season Paddy		Dry Season Paddy Regulated		Dry Season Paddy Non Regulated		Polowidjo		Total Field Delivery Water Requirements			Diversion Water Requirements
	Growing Area	Amount	Growing Area	Amount	Growing Area	Amount	Growing Area	Amount	Growing Area	Rate	Amount	
	ha	lit/s	ha	lit/s	ha	lit/s	ha	lit/s	ha	lit/s/ha	lit/s	m^3/s
Oct.	-	-	276	303.6	710	781.6	16	8.0	1,002	1.09	1,093.2	1.56
Nov.	23	45.8	220	187.0	522	443.7	20	10.0	785	0.87	686.5	0.98
Dec.	127	151.3	141	119.9	324	275.4	21	10.5	613	0.91	557.1	0.80
Jan.	406	718.7	52	44.2	101	85.9	20	10.0	579	1.48	858.8	1.23
Feb.	943	1,577.2	2	1.7	6	5.1	20	10.0	971	1.64	1,594.0	2.28
Mar.	1,340	2,016.7	-	-	-	-	19	9.5	1,359	1.49	2,026.2	2.90
Apr.	1,415	1,641.0	1	1.7	-	-	20	10.0	1,436	1.09	1,562.7	2.23
May	1,137	996.5	19	30.4	6	9.8	18	9.0	1,180	0.89	1,045.7	1.49
Jun.	756	642.6	71	110.8	67	107.1	12	6.0	906	0.96	866.5	1.24
Jul.	245	208.3	182	255.1	231	336.9	20	10.0	678	1.20	810.3	1.16
Aug.	18	15.3	310	452.1	575	786.4	18	9.0	921	1.37	1,263.8	1.80
Sep.	-	-	353	451.4	726	968.1	17	8.5	1,096	1.30	1,428.0	2.04

Note: Growing Area of Paddy : The sum of growing area of seed bed and paddy field in Table 1-2
Amount in paddy : The sum of evapotranspiration of paddy and deep percolation and puddling water requirements.

Table 3-19 Field Delivery Water Requirements and Diversion Water Requirements Irrigation Block: Djambangan A=62ha W-3

	Rainy Season Paddy		Dry Season Paddy Regulated		Dry Season Paddy Non Regulated		Plowidjo		Total Field Delivery Water Requirements			Diversion Water Requirements
	Growing Area	Amount	Growing Area	Amount	Growing Area	Amount	Growing Area	Amount	Growing Area	Rate	Amount	
	ha	lit/s	ha	lit/s	ha	lit/s	ha	lit/s	ha	lit/s/ha	lit/s	m^3/s
Oct.	-	-	14	15.4	23	25.3	3	1.5	40	1.06	42.2	0.06
Nov.	3	6.0	9	7.7	15	16.5	2	1.0	29	1.08	31.2	0.04
Dec.	26	49.4	7	6.0	4	3.4	1	0.5	38	1.56	59.3	0.08
Jan.	37	49.2	1	0.9	2	1.7	1	0.5	41	1.28	52.3	0.07
Feb.	46	66.4	-	-	-	-	1	0.5	47	1.42	66.9	0.10
Mar.	50	59.7	-	-	-	-	-	-	50	1.19	59.7	0.09
Apr.	41	34.9	-	-	-	-	-	-	41	0.85	34.9	0.05
May	20	17.0	5	8.0	1	1.7	-	-	26	1.03	26.7	0.04
Jun.	9	7.7	22	32.8	5	7.9	-	-	36	1.34	48.4	0.07
Jul.	-	-	28	37.6	18	26.2	2	1.0	48	1.35	64.8	0.09
Aug.	-	-	31	36.3	22	29.2	3	1.5	56	1.20	67.0	0.10
Sep.	-	-	31	35.8	26	33.5	3	1.5	60	1.18	70.8	0.10

Note: Growing Area of Paddy : The sum of growing area of seed bed and paddy field in Table 1-3
Amount in paddy : The sum of evapotranspiration of paddy and deep percolation and puddling water requirements.

Table 3-20 Field Delivery Water Requirements and Diversion Water Requirements Irrigation Block : Karah A=129ha W-4

	Rainy Season Paddy		Dry Season Paddy Regulated		Dry Season Paddy Non Regulated		Polowidjo		Total Field Delivery Water Requirements			Diversion Water Requirements
	Growing Area	Amount	Growing Area	Amount	Growing Area	Amount	Growing Area	Amount	Growing Area	Rate	Amount	
	ha	lit/s	ha	lit/s	ha	lit/s	ha	lit/s	ha	lit/s/ha	lit/s	m^3/s
Oct.	1	2.0	36	30.6	51	56.1	-	-	88	1.01	88.7	0.13
Nov.	12	23.1	21	17.9	33	28.1	-	-	66	1.05	69.1	0.10
Dec.	48	85.6	14	11.9	20	17.0	-	-	82	1.40	114.5	0.16
Jan.	73	100.4	2	1.7	5	4.3	-	-	80	1.33	106.4	0.15
Feb.	105	163.8	-	-	-	-	-	-	105	1.56	163.8	0.23
Mar.	123	154.8	-	-	-	-	-	-	123	1.26	154.8	0.22
Apr.	105	115.5	1	1.7	-	-	-	-	106	1.11	117.2	0.17
May	66	56.1	11	16.8	1	1.9	-	-	78	0.96	74.6	0.11
Jun.	22	18.7	45	65.9	15	23.6	-	-	82	1.32	108.2	0.15
Jul.	3	2.6	56	74.1	29	38.4	15	7.5	103	1.19	122.6	0.18
Aug.	-	-	65	85.3	41	56.4	3	1.5	109	1.31	143.2	0.20
Sep.	-	-	65	71.5	55	74.7	-	-	120	1.22	146.2	0.21

Note: Growing Area of Paddy : The sum of growing area of seed bed and paddy field in Table 1-4
Amount in paddy : The sum of evapotranspiration of paddy and deep percolation and puddling water requirements.

Table 3-21 Field Delivery Water Requirements and Diversion Water Requirements — Irrigation Block : Rowowijung A=430ha W-5

	Rainy Season Paddy		Dry Season Paddy Regulated		Dry Season Paddy Non Regulated		Polowidjo		Total Field Delivery Water Requirements			Diversion Water Requirements
	Growing Area	Amount	Growing Area	Amount	Growing Area	Amount	Growing Area	Amount	Growing Area	Rate	Amount	
	ha	lit/s	ha	lit/s	ha	lit/s	ha	lit/s	ha	lit/s/ha	lit/s	m^3/s
Oct.	2	3.7	6	5.1	9	7.7	17	8.5	34	0.74	25.0	0.04
Nov.	95	185.8	-	-	-	-	13	6.5	108	1.78	192.3	0.27
Dec.	319	543.6	-	-	-	-	6	3.0	325	1.68	546.6	0.78
Jan.	367	508.1	-	-	-	-	-	-	367	1.38	508.1	0.73
Feb.	397	477.9	-	-	-	-	-	-	397	1.20	477.9	0.68
Mar.	361	307.0	-	-	-	-	-	-	361	0.85	307.0	0.44
Apr.	224	246.4	1	1.7	-	-	-	-	225	1.10	248.1	0.35
May	53	45.1	5	7.9	6	9.5	-	-	64	0.98	62.5	0.09
Jun.	5	4.3	14	19.9	3.7	56.3	7	3.5	63	1.33	84.0	0.12
Jul.	-	-	20	27.9	51	68.5	12	6.0	83	1.23	102.4	0.15
Aug.	-	-	20	22.0	46	50.6	14	7.0	80	1.00	79.6	0.11
Sep.	-	-	15	12.8	31	26.4	15	7.5	61	0.77	46.7	0.07

Note: Growing Area of Paddy : The sum of growing area of seed bed and paddy field in Table 1-5
Amount in paddy : The sum of evapotranspiration of paddy and deep percolation and puddling water requirements.

Table 3-22 Field Delivery Water Requirements and Diversion Water Requirements — Irrigation Block : Gunungsari A=1,293 ha W-6

	Rainy Season Paddy		Dry Season Paddy Regulated		Dry Season Paddy Non Regulated		Polowidjo		Total Field Delivery Water Requirements			Diversion Water Requirements
	Growing Area	Amount	Growing Area	Amount	Growing Area	Amount	Growing Area	Amount	Growing Area	Rate	Amount	
	ha	lit/s	ha	lit/s	ha	lit/s	ha	lit/s	ha	lit/s/ha	lit/s	m^3/s
Oct.	-	-	54	45.9	-	-	-	-	54	0.85	45.9	0.07
Nov.	7	14.4	9	7.7	-	-	3	1.5	19	1.24	23.6	0.03
Dec.	98	187.7	3	2.6	-	-	3	1.5	104	1.84	191.8	0.27
Jan.	516	959.9	-	-	-	-	1	0.5	517	1.86	960.4	1.37
Feb.	1,184	1,943.3	-	-	-	-	2	1.0	1,186	1.64	1,944.3	2.78
Mar.	1,286	1,648.3	-	-	-	-	1	0.5	1,287	1.28	1,648.8	2.36
Apr.	1,281	1,409.1	-	-	-	-	1	0.5	1,282	1.10	1,409.6	2.01
May	1,002	851.7	4	6.2	-	-	1	0.5	1,007	0.85	858.4	1.23
Jun.	199	169.2	28	39.6	1	1.7	2	1.0	230	0.92	211.5	0.30
Jul.	-	-	58	88.6	6	9.9	11	5.5	75	1.39	104.0	0.15
Aug.	-	-	81	110.1	-	-	7	3.5	88	1.29	113.6	0.16
Sep.	-	-	59	64.9	-	-	2	1.0	61	1.08	65.9	0.09

Note: Growing Area of Paddy : The sum of growing area of seed bed and paddy field in Table 1-6
Amount in paddy : The sum of evapotranspiration of paddy and deep percolation and puddling water requirements.

Table 3-23 Field Delivery Water Requirements and Diversion Water Requirements Irrigation Block : Kalibakor A=1,109 ha W-7

	Rainy Season Paddy		Dry Season Paddy Regulated		Dry Season Paddy Non Regulated		Polowidjo		Total Field Delivery Water Requirements			Diversion Water Requirements
	Growing Area	Amount	Growing Area	Amount	Growing Area	Amount	Growing Area	Amount	Growing Area	Rate	Amount	
	ha	lit/s	ha	lit/s	ha	lit/s	ha	lit/s	ha	lit/s/ha	lit/s	m^3/s
Oct.	5	10.1	326	277.1	95	80.8	-	-	426	0.86	368.0	0.53
Nov.	47	95.4	110	93.5	29	24.7	-	-	186	1.15	213.6	0.31
Dec.	451	882.8	4	3.4	1	0.9	-	-	456	1.95	887.1	1.27
Jan.	800	1,334.4	-	-	-	-	-	-	800	1.68	1,344.4	1.92
Feb.	1,041	1,567.2	-	-	-	-	-	-	1,041	1.51	1,567.2	2.24
Mar.	1,107	1,284.7	-	-	-	-	-	-	1,107	1.16	1,284.7	1.84
Apr.	898	763.3	1	1.7	-	-	-	-	899	0.85	765.0	1.09
May	443	376.6	23	37.6	2	1.6	-	-	468	0.89	415.8	0.59
Jun.	40	34.0	173	274.2	15	23.1	-	-	228	1.45	331.3	0.47
Jul.	-	-	390	532.9	47	74.1	-	-	437	1.39	607.0	0.87
Aug.	-	-	489	650.1	136	214.2	-	-	625	1.38	864.3	1.24
Sep.	-	-	482	530.2	121	133.1	-	-	603	1.10	663.3	0.95

Note: Growing Area of Paddy : The sum of growing area of seed bed and paddy field in Table 1-7
Amount in paddy : The sum of evapotranspiration of paddy and deep percolation and pudding water requirements.

Table 3-24 Field Delivery Water Requirements and Diversion Water Requirements Irrigation Block : Djeblokan A=1,808ha W-8

	Rainy Season Paddy		Dry Season Paddy Regulated		Dry Season Paddy Non Regulated		Polowidjo		Total Field Delivery Water Requirements			Diversion Water Requirements
	Growing Area	Amount	Growing Area	Amount	Growing Area	Amount	Growing Area	Amount	Growing Area	Rate	Amount	
	ha	lit/s	ha	lit/s	ha	lit/s	ha	lit/s	ha	lit/s/ha	lit/s	m^3/s
Oct.	5	10.1	316	347.6	286	243.1	-	-	607	0.99	600.8	0.86
Nov.	84	171.6	28	23.8	29	24.7	-	-	141	1.56	220.1	0.31
Dec.	446	863.9	-	-	-	-	-	-	446	1.94	863.9	1.23
Jan.	1,172	1,956.8	-	-	-	-	-	-	1,172	1.67	1,956.8	2.80
Feb.	1,283	1,701.7	-	-	-	-	-	-	1,283	1.33	1,701.7	2.43
Mar.	1,796	2,460.1	-	-	-	-	-	-	1,796	1.37	2,460.1	3.52
Apr.	1,577	1,340.5	2	3.3	-	-	-	-	1,579	0.85	1,343.8	1.92
May	671	570.4	28	45.7	-	-	-	-	699	0.88	616.1	0.88
Jun.	79	67.2	184	290.8	48	77.3	-	-	311	1.40	435.3	0.65
Jul.	4	3.4	422	579.1	265	396.6	-	-	691	1.42	979.1	1.40
Aug.	-	-	504	659.1	388	541.2	-	-	892	1.35	1,200.3	1.72
Sep.	-	-	497	422.0	407	458.7	-	-	904	0.97	881.7	1.26

Note: Growing Area of Paddy : The sum of growing area of seed bed and paddy field in Table 1-8
Amount in paddy : The sum of evapotranspiration of paddy and deep percolation and puddling water requirements.

Table 3-25 Field Delivery Water Requirements and Diversion Water Requirements Irrigation Block : Grompol A= 227 ha S-1

	Rainy Season Paddy		Dry Season Paddy Regulated		Dry Season Paddy Non Regulated		Polowidjo		Total Field Delivery Water Requirements			Diversion Water Requirements
	Growing Area	Amount	Growing Area	Amount	Growing Area	Amount	Growing Area	Amount	Growing Area	Rate	Amount	
	ha	lit/s	ha	lit/s	ha	lit/s	ha	lit/s	ha	lit/s/ha	lit/s	m^3/s
Oct.	-	-	-	-	-	-	16	8.0	16	0.50	8.0	0.01
Nov.	5	10.3	-	-	-	-	-	-	5	2.06	10.3	0.01
Dec.	20	40.3	-	-	-	-	-	-	20	2.02	40.3	0.06
Jan.	118	227.9	-	-	-	-	-	-	118	1.93	227.9	0.33
Feb.	223	343.6	-	-	-	-	-	-	223	1.54	343.6	0.49
Mar.	227	254.4	-	-	-	-	-	-	227	1.12	254.4	0.36
Apr.	223	189.6	-	-	-	-	-	-	223	0.85	189.6	0.27
May	112	95.2	-	-	-	-	14	7.0	126	0.81	102.2	0.15
Jun.	2	1.7	-	-	-	-	60	30.0	62	0.51	31.7	0.05
Jul.	-	-	-	-	-	-	80	40.0	80	0.50	40.0	0.06
Aug.	-	-	-	-	-	-	73	36.5	73	0.50	36.5	0.05
Sep.	-	-	-	-	-	-	44	22.0	44	0.50	22.0	0.03

Note: Growing Area of Paddy : The sum of growing area of seed bed and paddy field in Table 1-9

Amount in paddy : The sum of evapotranspiration of paddy and deep percolation and puddling water requirements.

Table 4-1 Irrigation Water Distribution

Wonokromo Section (W-1, W-2, W-3, W-4
W-5, W-6, W-7, W-8)

		lit/sec								
		1964	1965	1966	1967	1968	1969	1970	Average	Monthly Average
Oct.	F	4,123	1,702	3,448	2,875	3,819	2,830	3,636	3,204	m^3/sec
	M	5,348	1,258	2,884	2,950	3,778	3,136	4,671	3,432	3.32
	L	4,648	1,258	2,670	2,539	3,807	3,550	4,671	3,306	
Nov.	F	5,933	1,708	4,733	2,502	4,607	5,800	6,717	4,571	
	M	7,686	2,153	6,176	2,514	5,373	3,052	6,717	4,810	4.82
	L	8,620	2,544	6,031	3,133	4,990	3,357	6,518	5,075	
Dec.	F	9,971	2,568	6,690	3,989	5,883	4,616	5,809	5,647	
	M	9,581	3,355	7,431	4,760	6,648	4,838	5,804	6,060	5.97
	L	10,068	3,402	6,737	6,457	6,930	4,726	5,021	6,192	
Jan.	F	11,267	5,759	7,163	7,615	7,421	4,746	5,813	7,112	
	M	11,824	8,077	9,953	7,653	8,648	4,900	6,766	8,260	7.88
	L	11,614	7,939	10,490	7,209	8,753	5,062	6,796	8,266	
Feb.	F	11,814	8,743	10,284	7,666	8,329	5,634	5,902	8,339	
	M	12,773	10,777	9,758	8,231	8,280	5,718	6,271	8,830	8.51
	L	11,222	11,204	7,739	8,291	8,645	5,421	5,954	8,354	
Mar.	F	11,563	11,806	7,571	8,883	8,711	5,481	6,058	8,582	
	M	10,386	11,369	7,621	9,447	8,711	5,584	6,054	8,453	8.49
	L	11,202	10,692	7,650	8,603	8,464	5,584	6,804	8,428	
Apr.	F	10,681	9,919	7,600	8,723	8,429	5,659	6,804	8,259	
	M	10,418	9,967	7,532	8,993	8,239	5,460	6,804	8,202	8.20
	L	9,999	10,342	7,326	8,818	8,014	5,595	6,804	8,128	
May	F	8,025	10,498	6,963	8,728	7,527	5,634	6,804	7,740	
	M	7,716	9,056	6,821	8,470	7,169	5,634	6,804	7,381	7.40
	L	8,316	10,488	4,959	7,234	5,961	5,765	6,652	7,053	
Jun.	F	7,611	9,076	4,267	7,208	5,491	5,817	6,652	6,875	
	M	6,649	9,485	4,768	6,700	5,204	6,388	6,652	6,578	6.33
	L	3,705	6,927	5,574	5,181	5,044	5,595	6,652	5,525	
Jul.	F	3,975	5,206	4,823	4,825	4,054	5,074	6,652	4,944	
	M	3,553	3,954	3,673	4,014	4,236	5,074	6,652	4,451	4.60
	L	4,099	2,601	3,475	4,261	3,860	5,799	6,652	4,392	
Aug.	F	2,952	1,999	3,255	3,887	3,629	5,795	5,786	3,901	
	M	2,497	1,800	2,865	3,989	4,049	5,795	5,686	3,812	3.81
	L	2,239	1,580	2,974	3,715	3,880	5,795	5,686	3,696	
Sep.	F	1,969	1,624	3,417	3,802	3,883	5,795	4,885	3,625	
	M	1,712	2,188	2,834	3,953	3,654	4,739	5,957	3,720	3.56
	L	1,712	2,274	2,966	3,917	3,264	4,536	4,468	3,305	

Table 4-2 Irrigation Water Distribution

1964

		lit/sec								
		W-1	W-2	W-3	W-4	W-5	W-6	W-7	W-8	Total
Oct.	F	86	502	72	222	63	193	1,362	1,623	4,123
	M	86	1,322	72	221	334	222	1,362	1,729	5,348
	L	72	660	36	111	193	251	1,597	1,729	4,648
Nov.	F	220	1,325	72	222	660	556	1,309	1,569	5,933
	M	325	1,373	72	222	879	1,309	1,572	1,934	7,686
	L	485	1,463	96	252	1,047	2,049	1,412	1,816	8,620
Dec.	F	480	1,955	127	263	1,336	2,528	1,556	1,726	9,971
	M	701	1,769	97	360	1,067	2,420	1,419	1,748	9,581
	L	725	2,059	116	311	860	2,767	1,428	1,802	10,068
Jan.	F	711	2,729	163	388	682	3,377	1,414	1,803	11,267
	M	893	3,156	184	407	844	3,122	1,414	1,804	11,824
	L	950	3,757	194	470	844	2,181	1,414	1,804	11,614
Feb.	F	965	3,982	189	438	844	2,178	1,414	1,804	11,814
	M	1,001	3,999	61	385	844	3,276	1,414	1,803	12,773
	L	945	3,838	147	327	844	1,907	1,414	1,800	11,222
Mar.	F	933	4,259	138	311	844	1,907	1,414	1,757	11,563
	M	909	3,064	138	311	844	1,907	1,414	1,799	10,386
	L	878	3,911	138	311	844	1,907	1,414	1,799	11,202
Apr.	F	763	3,519	138	311	830	1,907	1,414	1,799	10,681
	M	845	3,580	138	246	808	1,588	1,414	1,799	10,418
	L	838	3,573	138	223	466	1,548	1,414	1,799	9,999
May	F	818	2,559	138	311	370	616	1,414	1,799	8,025
	M	608	2,838	110	250	205	492	1,414	1,799	7,716
	L	751	3,311	132	397	69	352	1,461	1,843	8,316
Jun.	F	698	3,001	120	274	64	192	1,461	1,821	7,611
	M	644	2,251	41	282	64	85	1,461	1,821	6,649
	L	-	1,021	17	63	-	-	1,105	1,499	3,705
Jul.	F	212	935	36	125	17	46	1,105	1,499	3,975
	M	158	1,020	48	120	35	61	840	1,271	3,553
	L	258	1,329	97	213	69	22	840	1,271	4,099
Aug.	F	85	780	57	98	44	12	732	1,144	2,952
	M	77	682	40	104	22	9	518	1,045	2,497
	L	65	701	28	54	-	9	404	978	2,239
Sep.	F	32	471	24	55	-	5	404	978	1,969
	M	-	293	-	37	-	-	404	978	1,712
	L	-	293	-	37	-	-	404	978	1,712

W-1 Simowau W-2 Kebonagung W-3 Djambangan W-4 Karah
W-5 Rowowijung W-6 Gunungsari W-7 Kalibokor W-8 Djeblokan

Table 4-3 Irrigation Water Distribution

1965

		lit/sec								
		W-1	W-2	W-3	W-4	W-5	W-6	W-7	W-8	Total
Oct.	F	-	293	-	27	-	-	404	978	1,702
	M	-	176	-	27	-	-	321	734	1,258
	L	-	176	-	27	-	-	321	734	1,258
Nov.	F	-	86	16	22	-	-	518	1,066	1,708
	M	-	86	16	22	-	-	428	1,601	2,153
	L	-	586	32	44	-	-	551	1,331	2,544
Dec.	F	-	577	32	37	37	-	456	1,429	2,568
	M	-	1,187	67	142	266	-	715	978	3,355
	L	242	1,096	67	142	266	-	502	1,087	3,402
Jan.	F	410	1,105	63	144	575	1,235	863	1,364	5,759
	M	795	960	53	206	834	2,293	1,333	1,603	8,077
	L	940	1,460	81	230	830	1,334	1,498	1,566	7,939
Feb.	F	1,097	1,712	110	299	740	1,732	1,498	1,555	8,743
	M	1,110	3,172	157	332	985	1,828	1,621	1,572	10,777
	L	1,004	3,717	179	335	985	1,837	1,721	1,426	11,204
Mar.	F	1,022	4,299	172	382	833	1,698	1,731	1,669	11,806
	M	1,022	4,020	138	338	789	1,589	1,731	1,742	11,369
	L	906	3,862	138	312	789	1,589	1,573	1,523	10,692
Apr.	F	865	3,130	138	312	789	1,589	1,573	1,523	9,919
	M	782	3,559	138	312	789	1,589	1,385	1,413	9,967
	L	782	3,559	138	312	789	1,589	1,572	1,601	10,342
May	F	782	3,559	138	312	789	1,589	1,549	1,780	10,498
	M	782	3,555	138	312	789	1,167	1,549	1,780	9,056
	L	782	2,546	131	312	711	2,677	1,549	1,780	10,488
Jun.	F	765	3,440	120	311	547	526	1,533	1,734	9,076
	M	1,966	3,299	125	285	221	556	1,384	1,649	9,485
	L	591	2,869	81	241	111	50	1,369	1,615	6,927
Jul.	F	332	1,747	26	114	25	10	1,343	1,609	5,206
	M	83	1,159	28	77	4	-	1,238	1,365	3,954
	L	13	809	24	36	8	24	842	845	2,601
Aug.	F	35	558	35	82	8	31	595	655	1,999
	M	27	462	36	86	8	31	595	600	1,800
	L	15	461	28	43	8	28	595	402	1,580
Sep.	F	22	437	36	97	12	28	595	397	1,624
	M	37	883	55	146	20	50	595	402	2,188
	L	37	884	55	143	20	50	595	490	2,274

W-1 Simowau W-2 Kebonagung W-3 Djambangan W-4 Karah
W-5 Rowowijung W-6 Gunungsari W-7 Kalibokor W-8 Djeblokan

Table 4-4 Irrigation Water Distribution

1966

		lit/sec								
		W-1	W-2	W-3	W-4	W-5	W-6	W-7	W-8	Total
Oct.	F	74	1,465	92	240	29	43	754	751	3,448
	M	48	1,175	71	193	60	14	754	569	2,884
	L	35	880	27	149	60	11	754	754	2,670
Nov.	F	89	1,209	71	193	93	683	908	1,487	4,733
	M	215	1,559	85	218	569	904	1,062	1,564	6,176
	L	299	1,282	71	181	633	980	1,172	1,413	6,031
Dec.	F	359	1,424	70	186	822	1,256	1,172	1,401	6,690
	M	524	1,612	148	239	920	1,465	1,172	1,401	7,431
	L	480	1,729	116	188	708	1,144	959	1,413	6,737
Jan.	F	626	1,835	120	259	663	1,288	959	1,413	7,163
	M	907	2,587	170	331	990	2,153	1,171	1,644	9,953
	L	899	3,787	179	390	507	1,912	1,172	1,644	10,490
Feb.	F	636	3,772	189	446	507	1,912	1,201	1,621	10,284
	M	855	3,423	169	350	507	1,912	1,053	1,489	9,758
	L	468	2,931	136	271	412	979	1,053	1,489	7,739
Mar.	F	468	2,801	110	249	422	979	1,053	1,489	7,571
	M	468	2,851	110	249	422	979	1,053	1,489	7,621
	L	468	2,882	110	249	420	979	1,053	1,489	7,650
Apr.	F	468	2,867	110	249	421	979	1,022	1,484	7,600
	M	468	2,840	110	249	380	979	1,022	1,484	7,532
	L	442	2,840	110	249	256	747	1,022	1,660	7,326
May	F	427	2,626	83	249	183	720	1,015	1,660	6,963
	M	410	2,795	83	249	183	605	1,015	1,633	6,821
	L	247	1,219	68	216	128	433	1,015	1,633	4,959
Jun.	F	168	1,548	41	118	60	230	770	1,332	4,267
	M	154	2,142	50	147	99	100	771	1,305	4,768
	L	180	2,600	80	218	120	250	794	1,332	5,574
Jul.	F	116	2,209	65	164	115	28	794	1,332	4,823
	M	90	1,129	49	103	86	90	794	1,332	3,673
	L	79	1,115	49	106	-	-	794	1,332	3,475
Aug.	F	82	890	49	105	-	-	797	1,332	3,255
	M	-	611	41	87	-	-	794	1,332	2,865
	L	-	857	40	85	-	-	726	1,266	2,974
Sep.	F	-	714	41	70	-	-	726	1,866	3,417
	M	-	714	41	87	-	-	726	1,266	2,834
	L	-	714	41	87	-	-	726	1,398	2,966

W-1 Simowau W-2 Kebonagung W-3 Djambangan W-4 Karah
W-5 Rowowijung W-6 Gunungsari W-7 Kalibokor W-8 Djeblokan

1967 Table 4-5 Irrigation Water Distribution

lit/sec

		W-1	W-2	W-3	W-4	W-5	W-6	W-7	W-8	Total
Oct.	F	-	713	41	86	-	-	716	1,319	2,875
	M	-	713	37	86	-	-	716	1,398	2,950
	L	-	425	-	-	-	-	716	1,398	2,539
Nov.	F	-	388	-	-	-	-	716	1,398	2,502
	M	23	329	12	36	-	-	716	1,398	2,514
	L	60	802	45	94	-	156	605	1,371	3,133
Dec.	F	136	647	89	162	166	408	814	1,567	3,989
	M	273	1,070	103	169	248	516	814	1,567	4,760
	L	441	1,594	124	241	500	1,176	814	1,567	6,457
Jan.	F	551	1,961	122	274	649	1,677	814	1,567	7,615
	M	582	1,970	124	239	429	1,928	814	1,567	7,653
	L	513	1,871	116	219	358	1,553	877	1,722	7,209
Feb.	F	510	2,433	82	199	314	1,590	972	1,566	7,666
	M	590	2,614	97	217	369	1,806	972	1,566	8,231
	L	547	2,751	97	217	369	1,806	973	1,532	8,292
Mar.	F	549	3,033	97	217	522	1,906	1,027	1,532	8,883
	M	547	3,305	97	217	536	1,906	1,087	1,752	9,447
	L	543	2,852	97	217	536	1,906	966	1,486	8,603
Apr.	F	554	2,852	97	217	536	1,906	986	1,575	8,723
	M	541	2,852	97	217	529	1,906	1,098	1,753	8,993
	L	541	2,840	81	192	464	1,850	1,097	1,753	8,818
May	F	461	2,741	77	179	502	1,782	1,135	1,751	8,728
	M	421	2,750	80	154	502	1,679	1,133	1,751	8,470
	L	334	2,379	43	86	391	1,133	1,134	1,734	7,234
Jun.	F	262	2,403	53	101	384	1,143	1,135	1,727	7,208
	M	173	2,287	56	108	511	719	1,134	1,712	6,700
	L	130	1,904	57	140	70	27	1,168	1,685	5,181
Jul.	F	80	1,886	57	132	84	27	1,042	1,517	4,825
	M	80	971	57	132	84	27	1,079	1,584	4,014
	L	80	956	57	132	84	27	1,079	1,846	4,261
Aug.	F	78	992	57	133	84	27	1,079	1,437	3,887
	M	78	1,094	57	133	84	27	1,079	1,437	3,989
	L	73	1,135	57	133	84	27	1,079	1,127	3,715
Sep.	F	54	1,007	41	126	44	14	1,079	1,437	3,802
	M	61	1,135	57	124	59	-	1,083	1,434	3,953
	L	55	1,135	57	133	50	-	1,083	1,404	3,917

W-1 Simowau W-2 Kebonagung W-3 Djambangan W-4 Karah
W-5 Rowowijung W-6 Gunungsari W-7 Kalibokor W-8 Djeblokan

Table 4-6 Irrigation Water Distribution
1968

lit/sec

		W-1	W-2	W-3	W-4	W-5	W-6	W-7	W-8	Total
Oct.	F	57	1,095	39	107	34	-	1,083	1,404	3,819
	M	106	1,010	29	67	21	-	1,080	1,465	3,778
	L	117	963	43	78	61	-	1,080	1,465	3,807
Nov.	F	421	1,137	68	156	280	-	1,080	1,465	4,607
	M	492	1,702	68	156	410	-	1,080	1,465	5,373
	L	395	1,449	98	201	461	-	951	1,435	4,990
Dec.	F	654	1,702	129	323	589	-	1,051	1,435	5,883
	M	656	1,841	97	208	682	624	1,051	1,489	6,648
	L	601	2,142	97	218	718	614	1,051	1,489	6,930
Jan.	F	588	2,608	97	173	726	689	1,051	1,489	7,421
	M	566	2,996	97	218	685	1,730	958	1,398	8,648
	L	578	2,955	97	218	623	1,936	948	1,398	8,753
Feb.	F	546	2,545	97	218	420	1,910	1,051	1,542	8,329
	M	546	2,545	97	218	523	1,910	1,050	1,391	8,280
	L	546	2,860	97	218	573	1,910	1,050	1,391	8,645
Mar.	F	546	2,860	97	218	573	1,910	1,051	1,456	8,711
	M	546	2,806	97	218	573	1,910	1,051	1,456	8,711
	L	521	2,854	97	218	573	1,910	1,051	1,456	8,464
Apr.	F	486	2,844	59	181	567	1,855	978	1,459	8,429
	M	361	2,816	65	138	567	1,855	978	1,459	8,239
	L	352	2,701	59	129	518	1,818	978	1,459	8,014
May	F	300	2,552	19	89	427	1,610	1,071	1,459	7,527
	M	214	2,263	32	103	389	1,631	1,078	1,459	7,169
	L	164	1,969	41	81	337	871	1,008	1,490	5,961
Jun.	F	221	1,893	50	129	285	275	999	1,639	5,491
	M	186	1,792	48	124	168	243	1,008	1,635	5,204
	L	185	1,783	57	126	101	149	1,008	1,635	5,044
Jul.	F	208	916	57	126	145	81	908	1,613	4,054
	M	285	1,041	49	108	76	66	1,008	1,603	4,236
	L	195	942	49	108	48	71	1,008	1,439	3,860
Aug.	F	195	909	49	108	48	71	1,008	1,241	3,629
	M	190	1,627	49	108	48	71	1,018	938	4,049
	L	177	1,369	49	108	45	71	1,018	1,043	3,880
Sep.	F	177	1,369	49	108	48	71	1,018	1,043	3,883
	M	111	1,226	49	108	48	60	1,018	1,043	3,654
	L	36	924	23	58	42	20	1,018	1,143	3,264

W-1 Simowau W-2 Kebonagung W-3 Djambangan W-4 Karah
W-5 Rowowijung W-6 Gunungsari W-7 Kalibokor W-8 Djeblokan

Table 4-7

1969 Irrigation Water Distribution

		lit/sec								
		W-1	W-2	W-3	W-4	W-5	W-6	W-7	W-8	Total
Oct.	F	33	616	-	-	20	-	1,018	1,143	2,830
	M	121	738	28	67	21	-	1,018	1,143	3,136
	L	422	731	44	112	80	-	1,018	1,143	3,550
Nov.	F	722	1,152	300	744	300	-	978	1,604	5,800
	M	110	446	21	50	30	-	1,008	1,387	3,052
	L	131	372	90	212	50	43	976	1,483	3,357
Dec.	F	342	1,393	64	145	180	33	976	1,483	4,616
	M	434	1,511	64	266	180	33	881	1,469	4,838
	L	434	1,511	64	145	180	43	881	1,468	4,726
Jan.	F	434	1,511	64	145	180	48	981	1,468	4,746
	M	434	1,511	64	145	180	48	979	1,539	4,900
	L	434	1,511	64	145	180	109	982	1,637	5,062
Feb.	F	434	1,511	64	143	180	651	979	1,672	5,634
	M	456	1,511	64	145	180	651	979	1,732	5,718
	L	456	1,511	64	145	150	651	983	1,461	5,421
Mar.	F	456	1,511	64	145	210	651	983	1,461	5,481
	M	456	1,511	64	145	210	651	981	1,566	5,584
	L	456	1,511	64	145	210	651	981	1,566	5,584
Apr.	F	456	1,511	64	145	210	651	981	1,641	5,659
	M	456	1,511	64	145	150	651	981	1,502	5,460
	L	456	1,511	64	145	150	651	980	1,638	5,595
May	F	456	1,511	64	145	200	640	980	1,638	5,634
	M	456	1,511	64	145	250	640	980	1,638	5,634
	L	466	1,538	62	153	200	666	1,008	1,672	5,765
Jun.	F	466	1,538	64	153	250	666	1,008	1,672	5,817
	M	666	1,845	120	242	280	555	1,008	1,672	6,388
	L	466	1,538	64	153	250	444	1,008	1,672	5,595
Jul.	F	466	1,314	64	153	175	222	1,008	1,672	5,074
	M	466	1,314	64	153	175	222	1,008	1,672	5,074
	L	666	1,621	120	239	250	222	1,008	1,673	5,799
Aug.	F	666	1,621	120	235	250	222	1,008	1,673	5,795
	M	666	1,621	120	235	250	222	1,008	1,673	5,795
	L	666	1,621	120	235	250	222	1,008	1,673	5,795
Sep.	F	666	1,621	120	235	250	222	1,008	1,673	5,795
	M	492	1,204	90	180	-	165	935	1,673	4,739
	L	492	1,204	90	180	-	165	935	1,470	4,536

W-1 Simowau W-2 Kebonagung W-3 Djambangan W-4 Karah
W-5 Rowowijung W-6 Gunungsari W-7 Kalibokor W-8 Djeblokan

Table 4-8

1970 Irrigation Water Distribution

		lit/sec								
		W-1	W-2	W-3	W-4	W-5	W-6	W-7	W-8	Total
Oct.	F	592	1,204	90	180	-	165	935	470	3,636
	M	494	1,200	90	180	150	165	935	1,457	4,671
	L	494	1,200	90	180	150	165	935	1,457	4,671
Nov.	F	716	1,368	280	1,418	200	326	980	1,429	6,717
	M	716	1,368	280	1,418	200	326	980	1,429	6,717
	L	716	1,368	280	435	200	980	980	1,559	6,518
Dec.	F	716	1,368	285	435	200	326	980	1,499	5,809
	M	716	1,368	280	435	200	326	980	1,499	5,804
	L	716	1,368	280	435	200	-	972	1,050	5,021
Jan.	F	1,036	1,368	280	469	200	-	946	1,514	5,813
	M	864	1,368	280	435	305	652	948	1,914	6,766
	L	864	1,368	280	435	305	652	948	1,944	6,796
Feb.	F	868	1,368	280	435	350	652	948	1,001	5,902
	M	868	1,520	280	652	350	652	948	1,001	6,271
	L	868	1,520	280	335	350	652	948	1,001	5,954
Mar.	F	868	1,520	280	435	350	656	948	1,001	6,058
	M	868	1,520	280	435	350	652	948	1,001	6,054
	L	868	1,520	280	469	350	720	947	1,650	6,804
Apr.	F	868	1,520	280	469	350	720	947	1,650	6,804
	M	868	1,520	280	469	350	720	947	1,650	6,804
	L	868	1,520	280	469	350	720	947	1,650	6,804
May	F	868	1,520	280	469	350	720	947	1,650	6,804
	M	868	1,520	280	469	350	720	947	1,650	6,804
	L	868	1,520	280	435	300	652	947	1,650	6,652
Jun.	F	868	1,520	280	435	300	652	947	1,650	6,652
	M	868	1,520	280	435	300	652	947	1,650	6,652
	L	868	1,520	280	435	300	652	947	1,650	6,652
Jul.	F	868	1,520	280	435	300	652	947	1,650	6,652
	M	868	1,522	280	435	300	652	947	1,650	6,652
	L	868	1,522	280	435	300	652	947	1,650	6,652
Aug.	F	600	1,522	200	500	250	526	937	1,251	5,786
	M	600	1,522	200	400	250	526	937	1,251	5,686
	L	600	1,522	200	400	250	526	937	1,251	5,686
Sep.	F	500	1,000	150	300	200	350	998	1,387	4,885
	M	500	1,522	-	300	250	1,000	998	1,387	5,957
	L	-	1,600	-	272	192	-	1,008	1,396	4,468

W-1 Simowau W-2 Kebonagung W-3 Djambangan W-4 Karah
W-5 Rowowijung W-6 Gunungsari W-7 Kalibokor W-8 Djeblokan

CHAPTER XXIII

MEASUREMENT OF WATER LEVEL AND SALINITY IN WELLS

1. Base Points for Measurement.

Fixed base points were set on the brims of wells for the convenience of measuring water level of wells, marks were put on them with ink, and wrote the number of well on the brim, as shown in Fig. 1.

As for the base points for measurement of river water level, proper fixed points (concrete structure or iron pipe) were selected mainly near the middle part of bridges for the convenience of measurement.

Levelings were conducted on these base points and their elevations were expressed by SHVP.

2. Measurement of Water Level.

Water level of well was measured getting away from the time during or just after shower in order to avoid the influence of rainfall upon water level of well.

In order to make as much simultaneous measurement as possible, low tide hours were chosen because of less variation of tide level during the measurement and the measurement of water level was finished in as short period as possible (about 1 to 1.5 hours) mobilizing many people.

Water level of well was measured by hanging down a weight from the base point on the brim vertically into the well and took memos of measurement time, cleanness of water, and special remarks around the well.

The measurement of water level was made every hour during twelve hours in the day time between one low tide and the next. One measure was stationed to each well for hourly measurement of water level. And the measurement of water level and temperature was made at depths of 0.3D, 0.6D and 0.9D from the water surface, where D is water depth of a well.

3. Measurement of Salinity of Well Water.

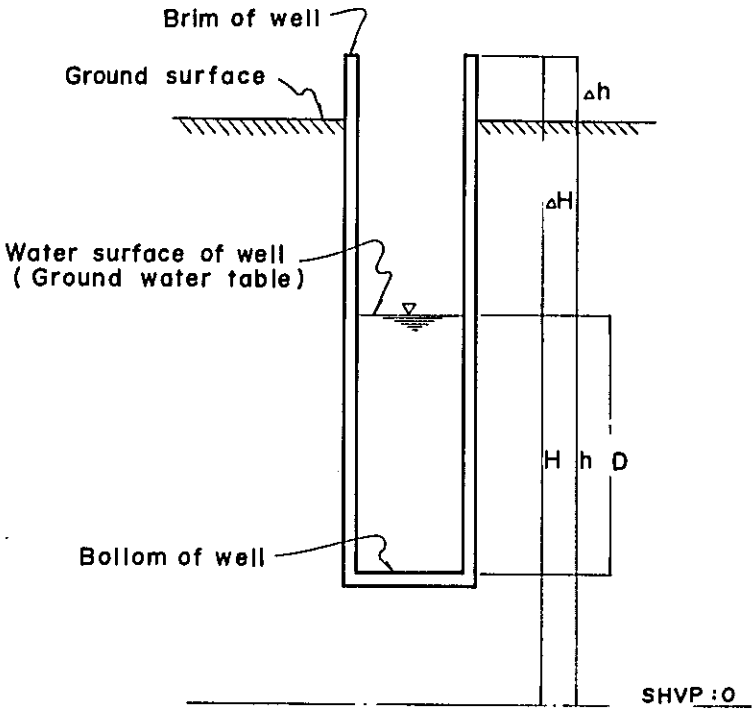
Salinity concentration of well water was measured by another team which moved around by car carrying an electric conductivity meter. The car patroled the selected five wells taking a specified course and measured salinity at least three times in one well during the said twelve hours of water level measurement.

In case well water was drawn up during the said measurement period, the time and water levels before and after the drawing up were measured beside the specified hourly measurement.

4. Measured values.

Measured values of water levels of wells were arranged as soon as possible after finishing measurement and listed in a form mentioned later.

Fig. 1


Brim of well
Ground surface
Δh
ΔH
Water surface of well
(Ground water table)
H
h
D
Bollom of well
SHVP : 0

Contour maps of ground water table were made expressed in meter above or below SHVP.

For the said five wells, the measured values of salinity were arranged in a form mentioned later and vertical distribution of salinity concentration were figured.

Elevation of Bench Mark or Brim of Well (in m, SHVP)

bench mark or wells	result of leveling	another result of leveling	number of turning point	adjustment	elevation adjusted
KP1	3.050	3.050	0		3.050
R1	2.809		9		2.815
R2	1.934		26		1.953
R4	2.025		42		2.055
R3	2.236		50		2.272
KP3	2.927	2.971	60	+ 0.044	2.971
KP4	3.158	3.158	0		3.158
R6	3.032		9		3.027
R5	2.747		12		2.737
R7	1.447		29		1.422
R8	2.169		32		2.142
R10	1.913		44		1.875
KP6	3.367	3.326	47	- 0.041	3.326
R9	3.280		48		3.239
KP9	3.654	3.654	0		3.654
R11	2.881		7		2.874
R12	1.943		21		1.922
R13	1.832		31		1.801
R14	2.879		41		2.838
KP10	1.359	1.311	45	- 0.048	1.311
P12	2.572	2.572	0		2.572
R15	2.380		6		2.391
R17	2.279		17		2.310
R16	1.832		31		1.889
KP13	2.714	2.742	15	+ 0.028	2.742
P1	3.004		16		3.033
M7	3.108		16		3.137
KP15	1.978	1.978	0		1.978
R18	1.318		6		1.317
R19	1.324		17		1.322
R20	1.507		28		1.504
P2	2.410		18		2.408
KP17	1.685	1.682	27	- 0.003	1.682
R21	2.588		31		2.585
KP18	2.550	2.550	0		2.550
R24	2.182		11		2.182
P3	1.632		20		1.633
R23	2.080		26		2.081
R22	1.751		45		1.753
R20	1.501	1.504	57	+ 0.003	1.504

KPi : bench mark of K. Mas

KP1	3.050	3.050	0		3.050
L1	4.431		3		4.432
L2	2.639		10		2.649
L3	3.681		12		3.694
L6	2.741		17		2.760
L5	2.762		22		2.786
L4	2.837		34		2.894
P3	2.931	2.971	36	+ 0.040	2.971
KP6	3.326	3.326	0		3.326
L7	3.780		8		2.774
L8	1.747		21		1.732
L9	2.231		34		2.207
L13	2.421		45		2.390
L17	1.236		52		1.200
L16	1.393		68		1.345
TB	1.905		71		1.853
L12	3.026		74		2.974
L10	2.507		77		2.453
KP8	2.772	2.710	85	- 0.062	2.710
L11	2.849		88		2.785
KP9	3.724	3.654	0	- 0.070	3.654
L14	2.945		4		2.878
L15	2.135		14		2.076
TB	1.905	1.853	23	- 0.052	1.853
KP12	2.572	2.572	0		2.572
L18	1.849		5		1.849
L19	2.323		16		2.323
L20	0.989		29		0.989
L21	1.267		45		1.267
KP15	1.978	1.978	52	0	1.978
KP17	1.682	1.682	0	0	1.682
L22	3.358		10	0.004	3.354
L23	1.192		25	0.011	1.181
L24	0.987		35	0.015	0.972
L25	1.036		50	0.022	1.014
L27	0.954		56	0.025	0.929
L26	1.792		63	0.028	1.764
M10	2.113	2.083	68	0.030	2.083

TB : temporary bench mark

Table 2-1 Result of Ground-Water Table Measurement

Measured on Jan. 7, 1972

Well	Location	Elevation (m, SHVP)					Time of measurement	Color of water	used or not	Note
		Well brim	Ground-water table ΔH	Ground-water table H	Ground surface Δh	Ground surface h				
R1	Djl. Ngagelredjo Kidul 25	2.815	1.61	1.205	0.65	2.165	9:30	clean	used	salty
R2	" Bratang III 102	1.953	0.88	1.073	0.67	1.283	9:45	"	"	"
R3	" Ngageldjaja Selatan 18	2.272	2.45	-0.178	0.82	1.452	10:10	"	"	3 m from canal
R4	" Ngageldjaja Selatan 54	2.055	0.82	1.235	0.63	1.425	10:10	"	"	near canal
R5	" Putjangan 9/89	2.737	1.31	1.427	0.64	2.097	10:20	"	"	
R6	" Kali Bokor II/20	3.027	1.34	1.687	0.47	2.557	10:30	"	"	
R7	" Manjar Dukuh 4	1.422	1.02	0.402	0.55	0.872	10:45	"	"	10 m from canal
R8	" Kertodjaja 98	2.142	1.31	0.832	0.58	1.562	9:55	"	"	
R9	" Raja Gubeng 80	3.239	0.68	2.559	0.08	3.159	10:06	"	"	
R10	" Karang Menur 6	1.875	0.95	0.925	0.79	1.085	9:47	"	"	near little pond
R11	" Nias	2.874	1.23	1.644	0.30	2.574	10:12	"	"	
R12	" Erlangga 4	1.922	1.08	0.842	0.54	1.382	9:40	rather clean	"	near small canal
R13	" Kedung Tarukan G7/3	1.801	1.11	0.691	0.70	1.001	9:30	clean	"	
R14	" Gubeng Podjok 9	2.838	1.66	1.178	0.40	2.438	10:20	"	"	
R15	" Diaksa Agung Suprapto 9	2.391	1.27	1.121	0.53	1.861	10:23	"	not used	
R16	" Djolotundo 1	1.889	0.78	1.109	0.28	1.609	10:00	not so clean	used	between drains
R17	" Kusuma Brangsa 21	2.310	1.94	0.370	1.03	1.307	10:13	clean	"	
R18	" Nakam Peneleh 40	1.317	0.60	0.717	0.20	1.117	10:48	"	"	
R19	" Kalisari G1(Pabr Tjoklot)	1.322	0.94	0.382	0.16	1.162	10:32	"	"	
R20	" Ngaglik 27 (P.T.P.N.)	1.504	0.77	0.734	0.40	1.104	9:45	"	"	
R21	" Semut Baru 23	2.585	2.47	0.115	0.28	2.305	10:08	"	"	
R22	" Kapasan 123	1.753	1.39	0.363	0.68	1.073	9:30	"	"	4 m from drain
R23	" Kapason 169	2.081	1.36	0.721	0.68	1.401	10:46	"	"	
R24	" Bibis III/1	2.182	2.01	0.172	0.86	1.322	9:54	"	"	

L1	Djl.	Marmojo 6A	4.432	2.05	2.382	0.49	3.942	9:42	clean	used	
L2	"	Tjipunegara 20	2.649	1.38	1.269	0.72	1.929	9:51	"	"	
L3	"	Bengawan 49	3.694	1.33	2.364	1.12	2.574	10:05	"	not used	
L4	"	Dinojo G8 muka no 3	2.874	0.84	2.034	0.50	2.374	9:30	"	used	
L5	"	Dr Wahidin 44	2.786	1.40	1.386	0.39	2.396	10:18	rather clean	not used	
L6	"	Prapantja 30	2.760	0.81	1.950	0.53	2.230	10:13	clean	used	
L7	"	Pedjadjaran 3	3.774	2.22	1.554	0.73	3.044	10:00	"	"	
L8	"	Imam Bondjol 4	1.732	1.91	-0.178	0.30	1.432	9:40	"	"	1 m from canal
L9	"	Kmp Malangkulon IV/6	2.207	1.54	0.667	0.60	1.607	9:45	"	"	
L10	"	Embong Blimbing	2.453	0.75	1.703	0.40	2.053	10:20	"	"	
L11	"	Kajun(Knt Imigrasi)	2.785	0.88	1.905	0.50	2.285	10:10	"	"	
L12	"	Mawar 19	2.974	1.36	1.614	0.85	2.124	10:26	not clean	not used	2 m from canal
L13	"	Raja Ardjuna 156	2.390	1.35	1.040	0.62	1.770	9:25	clean	used	
L14	"	Embong Kenongo 53	2.878	1.90	0.987	1.03	1.848	9:30	"	"	10 m from drain
L15	"	Taman Apsari 69	2.076	1.51	0.566	0.61	1.466	9:36	"	"	
L16	"	Surabaja IV/56	1.345	0.60	0.745	0.22	1.125	9:44	not clean	not used	0.5 m from drain
L17	"	Raja Ardjuna 75	1.200	0.70	0.500	0.16	1.040	10:00	rather clean	used	
L18	"	Genteng Tjandiredjo 3	1.849	1.82	0.029	0.68	1.169	10:40	clean	"	
L19	"	Praban Wetan III/5	2.323	2.18	0.143	0.99	1.333	10:20	"	"	
L20	"	Kranggan 108	0.989	1.04	-0.051	0.51	0.479	10:08	"	"	
L21	"	Penghela 29	1.267	0.54	0.727	0.00	1.267	9:30	"	"	
L22	"	Djohar 29	3.354	2.83	0.524	0.70	2.654	9:40	"	"	
L23	"	Dupak 28	1.181	1.19	-0.009	0.96	0.221	9:46	"	"	
L24	"	Dupak 150	0.972	1.44	-0.468	0.65	0.322	10:00	"	"	2 m from drain
L25	"	Parangkusumo 34	1.014	1.16	-0.146	0.73	0.284	10:27	"	"	
L26	"	Niagu (Asrama Polisi)	1.764	1.29	0.474	1.08	0.684	9:38	"	"	
L27	"	Kremb Makam 27	0.929	1.32	-0.391	0.68	0.349	10:29	"	"	

Table 2-2 Result of Water-Level Measurement

Measured on Jan. 7, 1972

Point	Location	Elevation of mark on bridge or sluice	Water-level of river		Time of measure-ment	Color of water	Note
			ΔH	W.L.			
M1	Wonokromo Sluice(up stream)	5.200	1.731	3.469	9:30	brown	
M1'	" " (down stream)	5.200	2.723	2.477	9:30	"	
M2	Djembatan Dinojo	5.605	3.408	2.197	9:40	"	
M3	" Kajun	4.145	2.076	2.069	9:50	"	
M4	Gubeng Sluice (up stream)	2.607	0.596	2.011	9:55	"	
M4'	" " (down stream)	2.607	2.490	0.117	9:55	"	
M5	Djembatan Simpang	5.063	5.018	0.045	10.00	"	
M6	" Ondomohen	3.148	3.501	-0.353	10:10	"	
M7	" Patuk	3.137	3.500	-0.363	9:33	"	v ≒ 0.4 m/sec
M8	" Peneleh	3.110	3.700	-0.590	10:40	"	0.5
M9	" Kebonrodjo	2.867	4.415	-1.548	10:30	"	
M10	" Merah	2.083	3.950	-1.867	10:00	"	0.4
P1	Pintu air Ngemplak(down stream)	3.033	2.135	0.898	9:30	"	0.0
P2	Djembatan Kalianjar	2.408	2.800	-0.392	9.38	"	0.1
P3	" Kapasan	1.633	2.430	-0.797	10:15	"	0.5

M1, ..., M10 : Points for measurement of water-level of the Mas river
P1, ..., P2 : Points for measurement of water-level of the Pegirian river
ΔH : Difference between elevation of mark on bridge or sluice and water-level of river (in m)
W.L. : Water-level (in m, SHVP)

Table 3-1 Result of Ground-Water Table Measurement

Measured on Jan. 8, 1972

Well	Location	Elevation (m, SHVP)					Time of measurement	Color of water	used or not	Note
		Well brim	Ground-water table ΔH	Ground-water table H	Ground surface Δh	Ground surface h				
R1	Djl. Ngageredjo Kidul 25	2.815	1.66	1.155	0.65	2.165	9:30	clean	used	salty
R2	" Brantang III 102	1.953	0.96	0.993	0.67	1.283	9:45	"	"	"
R3	" Ngageldjaja Selatan 18	2.272	2.48	-0.208	0.82	1.452	10:10	"	"	"
R4	" Ngageldjaja Selatan 54	2.055	0.65	1.405	0.63	1.425	10:00	"	"	"
R5	" Putjangan 9/89	2.737	1.35	1.387	0.64	2.097	10:30	"	"	"
R6	" Kali Bokor II/20	3.027	1.42	2.607	0.47	2.557	10:20	"	"	
R7	" Manjar Dukuh 4	1.422	1.06	0.362	0.55	0.872	10:45	"	"	10 m from canal
R8	" Kertodjaja 98	2.142	1.33	0.812	0.58	1.562	9:50	"	"	
R9	" Raja Gubeng 80	3.239	0.71	2.529	0.08	1.159	9:57	"	"	
R10	" Karang Menur 6	1.875	0.99	0.885	0.79	1.085	9:42	"	"	near little pond
R11	" Nias	2.874	1.24	1.634	0.30	2.574	10:05	"	"	
R12	" Erlangga 4	1.922	1.12	0.802	0.54	1.382	9:36	rather clean	"	near small canal
R13	" Kedung Taruhan G7/3	1.801	1.11	0.691	0.70	1.001	9:30	clean	"	
R14	" Gubeng Podjok 9	2.838	1.66	1.178	0.40	2.438	10:10	"	"	
R15	" Djaksa Agung Suprapto 9	2.391	1.30	1.091	0.53	1.861	10:14	"	not used	
R16	" Djolotundo 1	1.889	0.83	1.059	0.28	1.609	9:57	not so clean	used	between drains
R17	" Kusuma Brangsa 21	2.310	1.98	0.330	1.03	1.280	10:07	clean	"	
R18	" Makam Peneleh 40	1.317	0.62	0.697	0.20	1.117	10:27	"	"	
R19	" Kalisari G1(Pabr Tjoklot)	1.322	0.99	0.332	0.16	1.162	10:20	"	"	
R20	" Ngaglik 27(P.T.P.N.)	1.504	0.81	0.694	0.40	1.104	9:45	"	"	
R21	" Semut Saru 23	2.585	2.49	0.095	0.28	2.305	10:08	"	"	
R22	" Kapasan 123	1.753	1.40	0.353	0.68	1.073	10:46	"	"	4 m from drain
R23	" Kapasan 169	2.081	1.63	0.451	0.68	1.401	10:24	"	"	
R24	" Bibis III/1	2.182	2.08	0.102	0.86	1.322	9:54	"	"	

L1	Djl.	Marmojo 6A	4.432	1.96	2.472	0.49	3.942	9:42	clean	used	
L2	"	Tjipunegara 20	2.649	1.52	1.129	0.72	1.929	9:51	"	"	
L3	"	Bengawan 49	3.694	1.40	2.294	1.12	2.574	10:05	"	not used	
L4	"	Dinojo G8 muka no 3	2.874	0.90	1.874	0.50	2.374	9:30	"	used	
L5	"	Dr Wahidin 44	2.786	1.42	1.366	0.39	2.396	10:18	rather clean	not used	
L6	"	Prapantja 30	2.760	0.84	1.920	0.53	2.290	10:30	clean	used	
L7	"	Pedjadjaran 3	3.774	2.25	1.524	0.73	3.044	10:00	"	"	
L8	"	Imam Bondjol 4	1.732	2.04	-0.308	0.30	1.432	9:40	"	"	1 m from canal
L9	"	Kmp Malangkulon IV/6	2.207	1.67	0.537	0.60	1.609	9:45	"	"	
L10	"	Embong Blimbing	2.453	0.76	1.693	0.40	2.053	10:20	"	"	
L11	"	Kajun(Knt Imigrasi)	2.785	0.92	1.865	0.50	2.285	10:10	"	"	
L12	"	Mawar 19	2.974	1.39	1.584	0.85	2.124	10:25	not clean	not used	2 m from canal
L13	"	Raja Ardjuna 156	2.390	1.43	1.960	0.62	1.770	9:25	clean	used	
L14	"	Embong Kenongo 53	2.878	1.94	0.938	1.03	1.848	9:30	"	"	10 m from drain
L15	"	Taman Apsari 69	2.076	1.30	0.776	0.61	1.466	9:38	"	"	
L16	"	Surabaja IV/56	1.345	0.61	0.735	0.22	1.125	9:50	not clean	not used	0.5 m from drain
L17	"	Raja Ardjuna 75	1.200	0.76	0.540	0.16	1.040	10:00	rather clean	used	
L18	"	Genteng Tjandiredjo 3	1.849	1.81	0.039	0.68	1.169	10:25	clean	"	
L19	"	Praban Wetan III/5	2.323	2.26	0.063	0.99	1.333	10:15	"	"	
L20	"	Kranggan 108	0.989	1.07	-0.081	0.51	0.479	10:05	"	"	
L21	"	Penghela 29	1.267	0.60	0.667	0.00	1.267	10:38	"	"	
L22	"	Djohar 29	3.354	2.85	0.504	0.70	2.654	9:30	"	"	
L23	"	Dupak 28	1.181	0.96	0.221	0.96	0.221	10:13	"	"	
L24	"	Dupak 150	0.972	1.48	-0.452	0.65	0.322	10:03	"	"	2 m from drain
L25	"	Parangkusumo 34	1.014	1.20	-0.186	0.73	0.284	9:44	"	"	
L26	"	Niagu (Asrama Polisi)	1.764	1.40	+0.364	1.08	1.684	9:38	"	"	
L27	"	Kremb Makam 27	0.929	1.31	-0.381	0.68	0.249	9:50	"	"	

Table 3-2 Result of Water-Level Measurement

Measured on Jan. 8, 1972

Point	Location	Elevation of mark on bridge or sluice	Water-level of river		Time of measure-ment	Color of water	Note
			ΔH	W.L.			
M1	Wonokromo Sluice(up stream)	5.200	1.913	3.287	9:30		
M1'	" " (down stream)	5.200	2.798	2.402	9:30		
M2	Djembatan Dinojo	5.605	3.432	2.173	9:40		
M3	" Kajun	4.145	2.094	2.051	9:50		
M4	Gubeng Sluice (up stream)	2.607	0.600	2.007	9:55		
M4'	" " (down stream)	2.607	2.450	0.157	9:55		
M5	Djembatan Simpang	5.063	4.980	0.083	10:00		
M6	" Ondomohen	3.148	3.474	-0.326	10:05		
M7	" Patuk	3.137	3.450	-0.313	9:45		v ≒ 0.3 m/s
M8	" Peneleh	3.110	3.650	-0.540	9:30		0.4
M9	" Kebonrodjo	2.867	4.350	-1.483	10:09		0.5
M10	" Merah	2.083	3.920	-1.837	10:00		0.3
P1	Pintu air Ngemplak(down stream)	3.033	2.165	0.868	9:47		0.0
P2	Djembatan Kalianjar	2.408	2.810	-0.402	9:52		0.25
P3	" Kapasan	1.633	2.470	-0.837	10:17		0.2

M1, ..., M10, : Points for measurement of water-level of the Mas river
P1, ..., P3 : Points for measurement of water-level of the Pegirian river
ΔH : Difference between elevation of mark on bridge or sluice and water-level of river (in m)
W.L. : Water-level (in m, SHVP)

Table 4 Hourly Measurement of Ground-Water Table

Feb. 18, 1972

Time	L10 (EL. 2.453)		L11 (EL. 2.785)		L14 (EL. 2.878)		L15 (EL. 2.076)		L18 (EL. 1.849)	
	ΔH	H	ΔH	H	ΔH	H	ΔH	H	ΔH	H
7:00	1.215	1.238	0.99	1.795	2.12	0.758	1.78	0.296	2.25	-0.401
8:00	1.340	1.113	0.99	1.795	2.13	0.748	1.62	0.456	2.12	-0.271
9:00	1.120	1.333	0.99	1.795	2.13	0.748	1.45	0.626	2.88	-0.231
10:00	1.010	1.403	0.99	1.795	2.13	0.748	1.52	0.556	2.065	-0.216
11:00	0.99	1.463	0.99	1.795	2.13	0.748	1.45	0.626	2.21	-0.361
12:00	0.98	1.473	0.99	1.795	2.125	0.753	1.46	0.616	2.10	-0.251
13:00	1.040	1.413	1.02	1.765	2.125	0.753	1.47	0.606	2.06	-0.211
14:00	1.010	1.443	1.01	1.775	2.19	0.688	1.43	0.646	2.09	-0.241
15:00	1.050	1.403	1.01	1.775	2.145	0.733	1.49	0.586	2.25	-0.401
16:00	1.00	1.453	1.00	1.785	2.14	0.738	1.60	0.476	2.075	-0.226
17:00	0.99	1.463	0.99	1.795	2.14	0.738	1.81	0.266	2.045	-0.196
18:00	0.99	1.463	1.00	1.795	2.14	0.738	1.88	0.196	2.11	-0.261

Water-level of well before and after drawing up or record of drawing up

Time	ΔH	H	Time	ΔH	H	Time	ΔH	H	Time	ΔH	H	Time	ΔH	H
7:40	1.09	1.363	10:10	1.01	1.775	7:10	draw					7:00	draw	
7:52	1.44	1.013	16:20	1.81	1.775	13:15	draw					8:00	draw	
8:06	1.24	1.213	17:15	1.00	1.785							9:00		
8:10	1.31	1.143										10:00	draw	
12:08	0.96	1.495										11:00		
12:10	1.16	1.293										13:00	draw	
14:42	1.00	1.453										14:00		
14:45	1.06	1.393										14:00	draw	
												15:00		

no record of drawing up

Table 5 Measurement of Electrical Conductivity and Temperature

Measured on Feb. 18, 1972

Well	Depth of well water D (m)	Time	Elect Conductivity ($\times 10^2\Omega$) 0.3D	0.6D	0.9D	Temperature Surface	Bottom
L10	3.85	7:30	8.5	8.49	8.47	27.54°C	27.50°C
		10:25			7.80		27.60°C
		13:25			7.80		27.60°C
		18:00	7.75	7.70	7.60	27.19°C	27.10°C
L11	2.40	8:00	12.20	12.10	12.00	27.40°C	27.30°C
		10:40			11.40		27.40°C
		13:33			11.20		27.45°C
		18:15	11.5	11.3	11.20	27.60°C	27.60°C
L14	1.15	8:30	14.20	13.80	12.80	28.22°C	28.20°C
		10:50			10.85		28.22°C
		13:49			10.30		28.30°C
		18:30	10.1	10.5	10.60	28.40°C	28.50°C
L15	3.82	8:45	8.50	8.10	5.50	27.98°C	27.94°C
		11:00			5.15		28.05°C
		14.03			5.50		28.15°C
		18:55	7.8	8.10	5.60	28.20°C	28.10°C
L18	2.31	9:15	8.30	8.10	7.70	27.40°C	27.50°C
		11:20			7.50		27.40°C
		14:30			7.60		27.40°C
		19:25	8.4	8.0	7.4	27.40°C	27.40°C

Note : For example, 0.3D means a depth measured downwards from the water surface of a well.

Table 6 Concentration of NaCl and Temperature

Well	Depth of well water D (m)	Time	Elect conductivity (ppm 10^2) 0.3D	0.6D	0.9D	Temperature Surface	Bottom	Note
L10	3.85	7:30	5.60	5.64	5.65	27.54°C	27.50°C	
		10:25			6.05		27.60°C	
		13:25			6.05		27.60°C	
		18:00	6.20	6.22	6.30	27.19°C	27.10°C	
L11	2.40	8:00	3.82	3.86	3.87	27.40°C	27.50°C	
		10:40			4.10		27.40°C	
		13.33			4.20		27.45°C	
		18:15	4.10	4.18	4.20	27.60°C	27.60°C	
L14	1.15	8:30	3.24	3.40	3.62	28.22°C	28.20°C	
		10:50			4.26		28.22°C	
		13.49			4.60		28.30°C	
		18:30	4.65	4.45	4.40	28.40°C	28.30°C	
L15	3.82	8:45	5.60	5.80	8.60	27.98°C	27.94°C	
		11:00			9.20		28.05°C	
		14:03			8.60		28.15°C	
		18:55	6.05	5.80	8.20	28.20°C	28.10°C	
L18	2.31	9:15	5.8	5.8	6.30	27.40°C	27.30°C	
		11:20			6.32		27.40°C	
		14:30			6.31		27.40°C	
		19:25	5.80	5.90	6.40	27.40°C	27.40°C	

CHAPTER XXIV

ECONOMIC ANALYSIS OF DAMAGES DUE TO INUNDATIONS

1. Scope of Survey.

Field survey for data collection on socio-economy was carried out by the Japanese experts and their Indonesian counterparts for more than two months at Surabaja and its surrounding areas.

The survey area, as shown in Fig. 1, stretches over twenty-seven Ketjamatans which have a total area of 87,000 ha including all the areas for the Surabaja river improvement project composed of such five improvement works as the Marmojo river, the Surabaja/Wonokromo river, the Mas river, Morokrembangan Boezem and Sea dike works.

Field survey was carried out principally aiming at collection of the following socio-economic data to be used for the estimation of amount of damage caused by inundation.

a. Land use:

   Areas of residential, commercial, industrial, agricultural and public (river, road, railroad, etc.) uses.

b. Population and number of households.

c. Number of houses:

   number of residences, farmhouses, shops, factories, offices, schools, etc.

d. Valuation of properties:

   valuation of properties such as building and household effects, goods stocked at shops, and industrial goods and raw materials stocked at factories.

e. Information on agricultural products:

   cultivated and planted area, yield, unit price, and production cost.

f. Information on public facilities:

   locations, kinds and sizes of major structures.

g. Information on damages caused by inundations.

h. Others.

2. Data.

Data collection were carried out according to the following two ways,

Table 1 Population and Land Use

No.	Name of Ketjamatan	Population		Area (ha)														
		Total	Density (per ha)	Total	Residential (1)	Industrial (2)	Commercial (3)	Public (4)	(1)+(2)+(3)+(4)	Irrigated paddy	Upland paddy	Upland crop	Fish-pond & salt	Forest	River	Road	Rail road	Vacant
1	Krembangan	142,909	125	1,143	546	119	244	56	965	30	0	0	66	0	5	23	4	50
2	Pabean/ Tjantian	38,748	281	138	38	33	31	10	112	0	0	0	0	0	2	6	2	16
3	Simokerto	101,755	407	250	146	16	27	15	204	7	0	0	0	0	2	11	21	5
4	Bubutan	174,481	352	495	236	53	48	26	363	19	0	0	46	0	12	22	19	14
5	Genteng	92,533	275	337	194	18	53	26	291	0	0	0	0	0	15	13	3	15
6	Gubeng	131,382	188	700	405	22	3	8	438	233	0	0	0	0	14	8	2	5
7	Tambaksari	130,147	183	712	241	8	11	9	269	420	0	0	0	0	3	9	4	7
8	Sawahan	187,981	320	587	296	50	117	39	502	67	0	0	0	0	4	12	1	1
9	Tegalsari	91,131	260	350	276	11	31	16	334	0	0	0	0	0	2	9	4	1
10	Wonokromo	210,669	165	1,273	809	191	18	30	1,048	115	0	7	0	0	40	31	12	20
11	Sukolilo	46,409	11	4,161	360	27	5	10	402	2,292	91	567	680	5	58	23	0	43
12	Rungkut	21,481	8	2,543	227	1	1	14	243	1,202	0	771	219	0	46	11	0	51
13	Wonotjolo	40,628	14	2,825	503	75	1	110	689	997	0	983	0	1	20	18	16	101
14	Karangpilang	69,878	12	5,670	448	26	17	22	513	2,807	1,764	481	0	0	50	28	3	24
15	Tandes	41,823	6	7,259	321	5	26	26	378	2,100	947	455	3,251	11	43	12	20	42
16	Semampir	100,301	136	735	436	29	12	10	487	130	0	5	45	0	13	8	2	45
	Sub total	1,622,256	56	29,778	5,482	684	645	427	7,238	10,419	2,802	3,269	4,307	17	329	244	113	440
17	Driaredjo	30,867	3	11,589	1,343	5	0	20	1,368	4,096	3,070	2,291	0	656	54	41	1	12
18	Wringinanon	32,132	3	12,524	1,351	2	0	11	1,364	5,414	3,619	1,990	0	59	55	10	0	13
19	Waru	31,208	11	2,730	567	31	2	55	655	1,289	75	27	531	0	30	13	5	105
20	Taman	51,175	18	2,895	781	14	16	37	848	1,771	141	0	0	0	80	23	32	0
21	Tarik	34,715	10	3,465	934	10	13	40	997	2,181	61	0	0	0	180	33	4	9
22	Balongbendo	34,113	11	3,131	785	106	0	84	975	1,746	211	0	0	0	141	53	4	1
23	Krian	48,645	17	2,944	873	4	20	37	934	1,859	17	0	0	5	77	30	19	3
24	Djetis	36,251	7	5,181	1,075	2	2	9	1,088	1,876	1,236	814	0	45	95	21	0	6
25	Gedeg	34,284	13	2,616	735	15	0	43	793	1,524	86	0	0	0	169	37	0	7
26	Kemlagi	36,905	11	3,407	770	0	0	89	859	1,799	212	452	0	6	21	2	0	56
27	Kudu	37,860	6	6,245	822	0	0	8	830	2,391	249	221	0	2,516	33	5	0	0
	Total	2,030,411	24	86,770	15,518	873	698	860	17,949	36,365	11,779	9,064	4,838	3,304	1,264	512	178	652

Table 2 Number of Houses

No.	Name of Ketjamatan	Residence	Governmental office	School	Hospital	Shop	Factory	Total
1	Krembangan	23,547	45	85	11	2,904	23	26,615
2	Pabean/ Tjantian	12,715	9	35	3	492	127	13,381
3	Simokerto	12,817	14	54	4	950	61	13,900
4	Bubutan	14,809	12	87	13	9,800	7	24,728
5	Genteng	9,710	25	19	3	856	1	10,614
6	Gubeng	19,682	19	56	3	136	39	19,935
7	Tambaksari	13,296	10	62	1	182	19	13,570
8	Sawahan	25,505	12	136	1	1,880	110	27,644
9	Tegalsari	13,194	9	19	3	500	-	13,725
10	Wonokromo	30,011	26	126	2	276	59	30,500
11	Sukolilo	10,256	10	26	2	84	27	10,405
12	Rungkut	4,737	6	13	2	16	-	4,774
13	Wonotjolo	8,131	3	28	-	250	3	8,415
14	Karangpilang	13,043	14	26	2	430	13	13,528
15	Tandes	7,415	49	31	9	116	5	7,625
16	Semampir	13,891	10	43	4	34	18	14,000
	Sub total	232,759	273	846	63	18,906	512	253,359
17	Driaredjo	6,162	5	20	1	118	6	6,312
18	Wringinanon	6,498	9	24	1	110	-	6,642
19	Waru	5,814	6	32	1	144	7	6,004
20	Taman	9,569	10	40	5	254	5	9,883
21	Tarik	6,847	7	36	1	204	5	7,100
22	Balongbendo	6,770	5	31	1	34	7	6,848
23	Krian	9,409	9	33	3	162	1	9,617
24	Djetis	6,976	8	21	4	106	17	7,132
25	Gedeg	6,661	7	32	2	46	22	6,770
26	Kemlagi	7,151	1	7	1	70	-	7,230
27	Kudu	8,399	12	19	2	72	-	8,504
	Total	313,015	352	1,141	85	20,226	582	335,401

a. collection of socio-economic data possessed by the authorities concerned, such as Dinas Pengairan, Dinas Pertanian, Kotamadya Surabaja, Kabupatens and Ketjamatans in East Java Province,

b. direct survey by members of the study team: valuation of properties such as buildings, household effects, and goods stocked at shops and factories, and rate of damages caused by inundations to these properties.

Some of the data collected from the above authorities were arranged and summerized under each Ketjamatan as shown in Tables 1 and 2. Detail statistics of agricultural productions and their prices in East Java and the Surabaja city area are shown in Tables 5 through 20 at the end of this Chapter.

3. Properties and Their Damages due to Inundations.

(1) Properties.

1) Building and household effects.

It is hard to say that the data which are shown in Tables 1 and 2 are quite sufficient from the viewpoint of accuracy for numerical computation for estimation of amount of properties damaged by inundation.

In order to cover the above defect, the project area was divided into a number of meshes of one square kilometer as shown in Fig. 1, and properties contained in each mesh were estimated making use of aerophotographs and land-use maps on the basis of the data in every Ketjamatan which are shown in Tables 1 and 2.

Data on properties in each mesh were arranged in the form of punched cards as input data to a computer for calculation of inundation damage and other purposes. These data are not listed in the present report because of being enormous.

On the other hand, average amount of valuation of building and household effects per house, as shown in Table 3, have been obtained as one of results of field survey.

In calculating inundation damages, valuation of properties classified according to height above floor level is required in order to make a reasonable estimation of damages by submergence depth. Accordingly, the valuation of household effects was made by the 0.50 m from floor level to the height of 3.00 m. The results are shown in Fig. 2 in the ratio(%) to the average amount of valuation of household effects per house.

Every point on the figure was obtained as an average value of the data sampled by height. These results were used for the determination of the rate of inundation damages which are explained in the succeeding section.

Fig. 1 The Surabaja City and Its Surrounding Areas

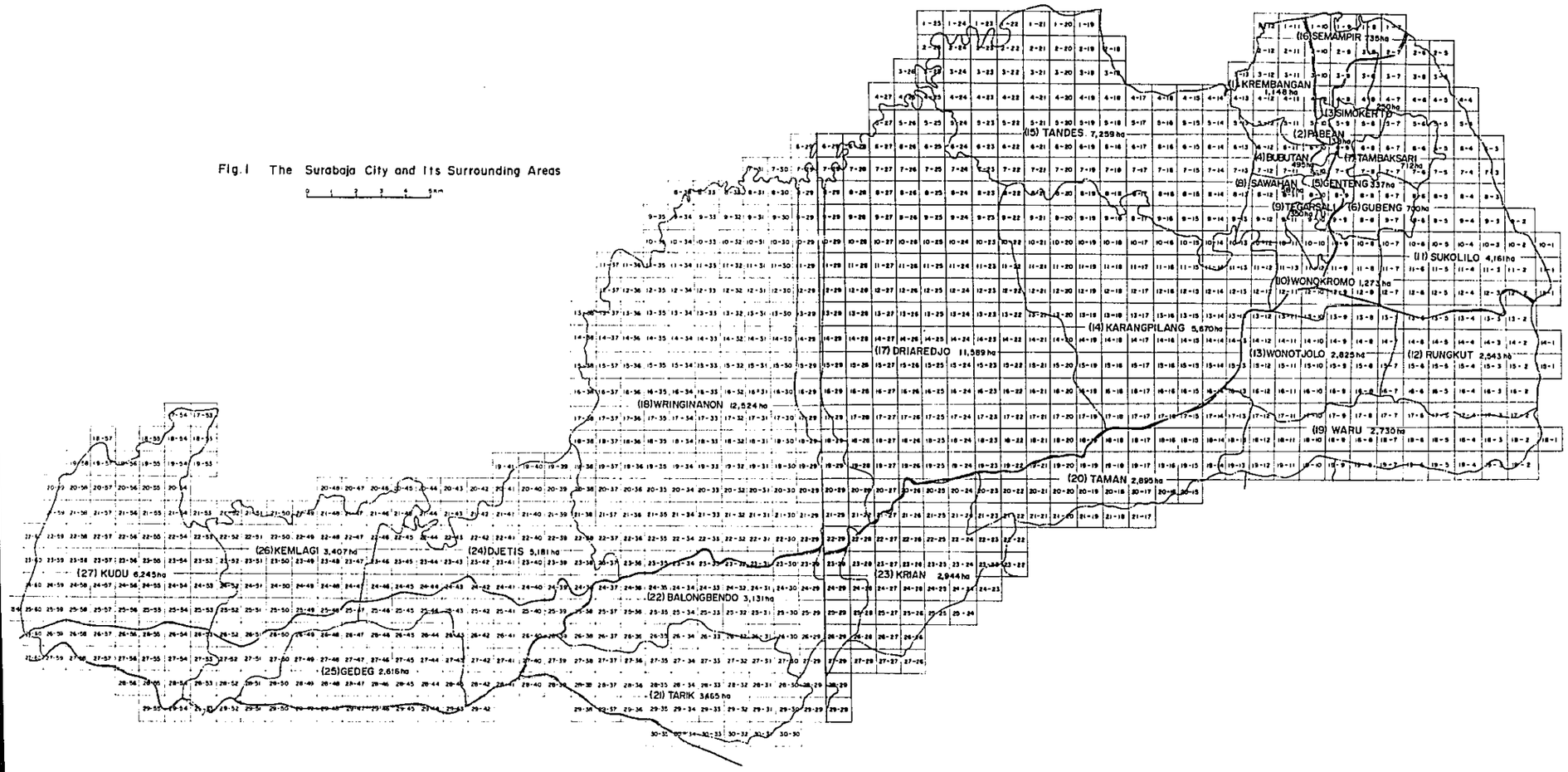
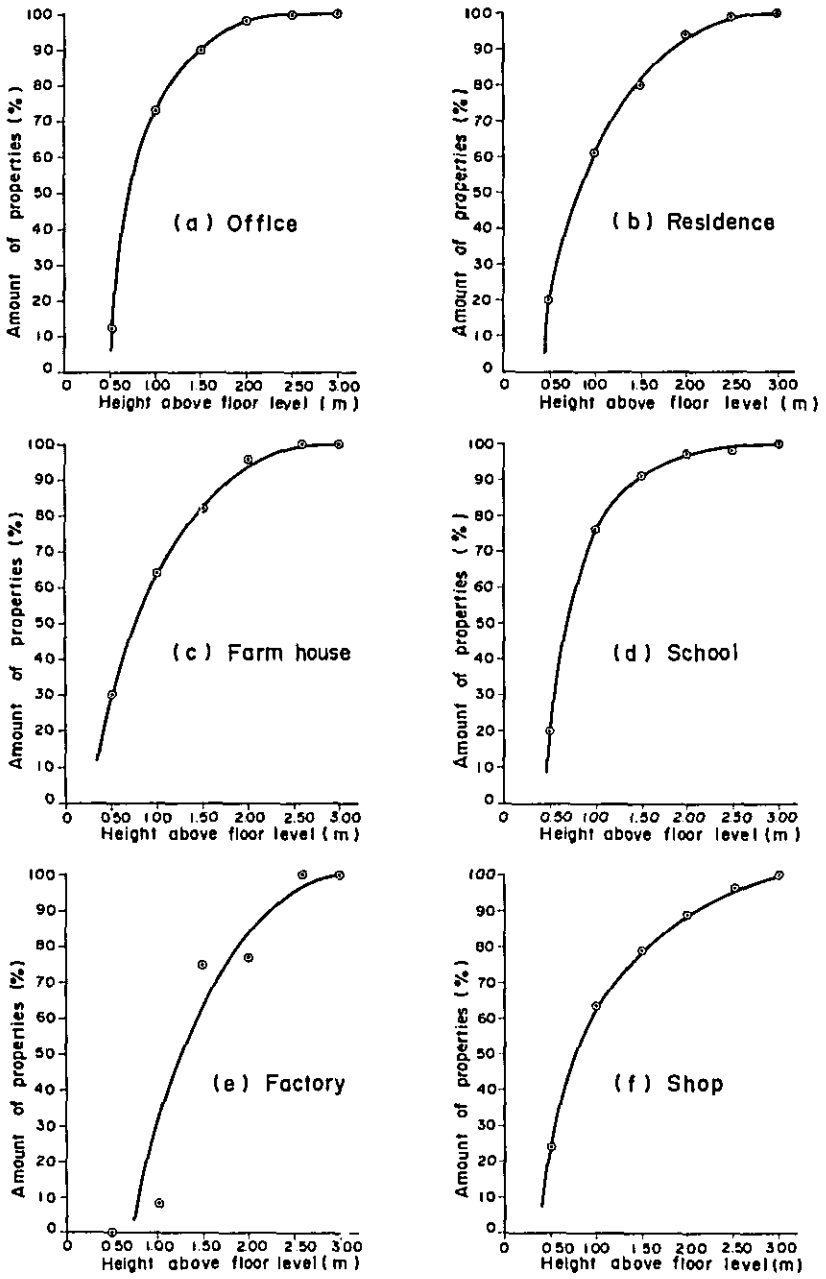


Table 3 Average Amount of Valuation of Properties

Kind		Number of sampling	Average amount of valuation of properties		
			Building (Rp)	Household effects(Rp)	Total (Rp)
Office		15	2,020,000	760,000	2,780,000
Residence		41			
	high class	10	9,850,000	4,680,000	14,530,000
	middle class	21	1,850,000	480,000	2,330,000
	low class	10	170,000	40,000	210,000
Farm house		14	430,000	100,000	530,000
School		6	3,500,000	460,000	3,960,000
Factory		2	3,300,000	1,800,000	5,100,000
Shop		97	440,000	800,000	1,240,000
	Furniture	5	570,000	500,000	1,070,000
	Agricultural products	12	200,000	310,000	510,000
	Gold	3	1,700,000	3,100,000	4,800,000
	Textiles	5	260,000	1,880,000	2,140,000
	Restaurant	5	500,000	120,000	620,000
	General	13	330,000	510,000	840,000
	Food	11	360,000	380,000	740,000
	Construction materials	4	310,000	740,000	1,050,000
	Electric	3	250,000	430,000	680,000
	Book	5	110,000	180,000	290,000
	Watch	2	530,000	5,330,000	5,860,000
	Paint	3	300,000	370,000	670,000
	Part of bicycle	7	960,000	1,540,000	2,500,000
	Bag	4	430,000	280,000	710,000
	Shoes	5	650,000	1,360,000	2,010,000
	Photostudio	3	260,000	460,000	720,000
	Hardware	2	500,000	1,090,000	1,590,000
	Dragstore	5	450,000	470,000	920,000
Total		175	-	-	

Note: Data were gathered by the randum sampling method.

Fig. 2 Amount of Valuation of Household Effects Classified According to Height above Floor Level



2) Planted crops in farm land.

Data on monthly planted areas and rates of growth of major crops in the present project area were collected from East Java Provincial Irrigation Office, Ketjamatans and other authorities concerned.

Fig. 3 shows the rate of monthly average planted area to cultivated area for each crop in the said twenty-seven Ketjamatans for the last three years from 1969 to 1971.

As evident on the figure, planted area of sugar cane scarcely varies throughout a year, while those of crops such as paddy, corn, peanuts and soybeans vary remarkably by the season.

As generally known, rice planting has two seasons, rainy season from December to March and dry season from May to September. Rainy-season paddy is more beneficial than dry-sean one in unit yield per ha and also has more planted area than the latter, as shown in Table 3 of Chapter I, Part 1. Further, it is seen from the above Table 3 that production of rainy-season paddy is nearly 50 % of that of major food crops in the present area.

From the facts described above, it may be expected that if damage due to inundation occurrs in the present area, the damage will be larger in the rainy season from December to March throughout a year. This is also obvious from the records of damages which were collected by the Fact Finding Mission and the records of rainfall depths in the Surabaja city and its surrounding areas described later on.

The rate of growth of crops as well as their planted area are required for the estimation of inundation damages. In Japan, the rate of growth of paddy is easily estimated, because the four seasons in the year are clearly distinguished. However, seasons of rice planting in Indonesia are not quite clear, since it is situated in a tropical zone.

For such reason, we have tried to examine the monthly rate of growth of paddy and sugar cane in the present project area on the basis of the data collected. This study is explained in detail in Chapter XXII, Part 4.

(2) Damage due to inundation.

1) Inundation damages in the past year.

According to the report on the survey made by the Fact Finding Mission in March 1971, the Surabaja city and its surrounding areas have suffered from damages due to inundation several times a year in the past ten years.

Inundation area extends over eleven Ketjamatans; Simokerto, Sukolilo, Wonotjolo, Rungkut, Karangpilang, Sawahan, Tandes, Djetis, Gedeg, Kemlagi and Kudu. It was recorded that the maximum depth of submergence reached about 1.6 m, its duration was about six days, and the total area inundated ranged from 1,000 ha to 2,000 ha and the amount of damage was estimated at about 20 million Rupiah on the average.

Further, frequency of occurence of damages due to inundations in each month for the past ten years has been examined from the said records, and the results are shown in Fig. 4.

Fig.3 Planted Area of Major Crops on the Average of the Last Three Years (1969-1971)

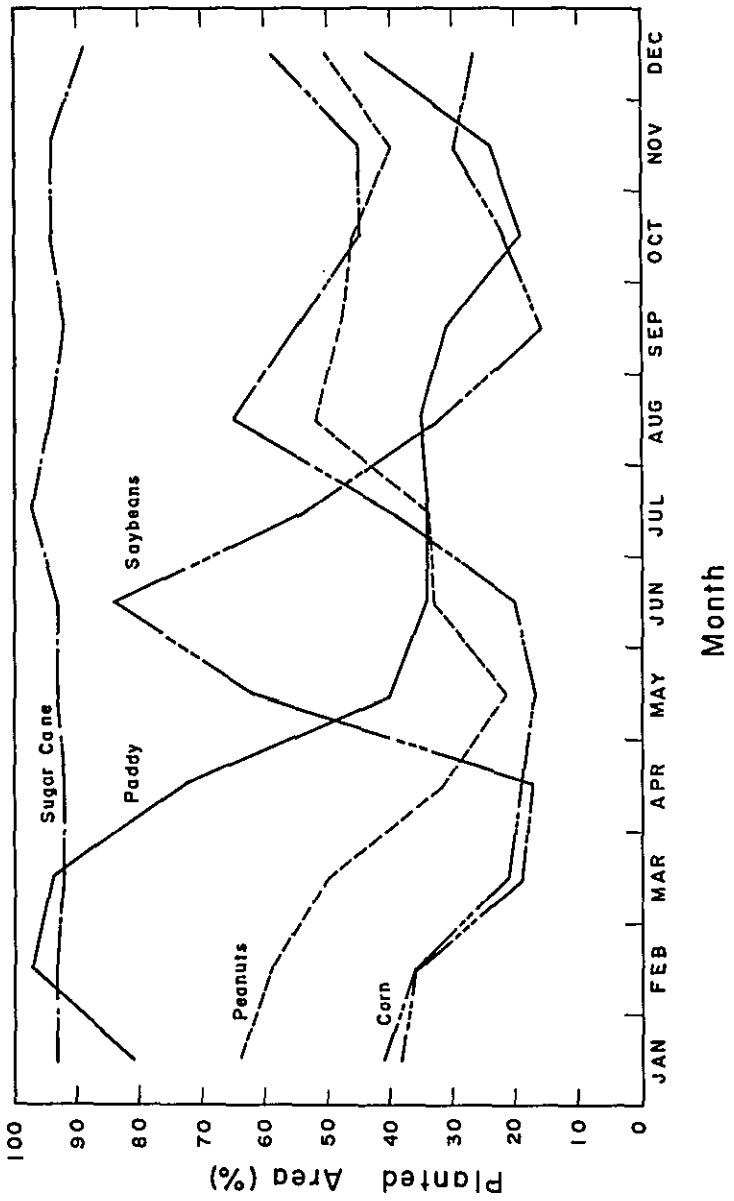
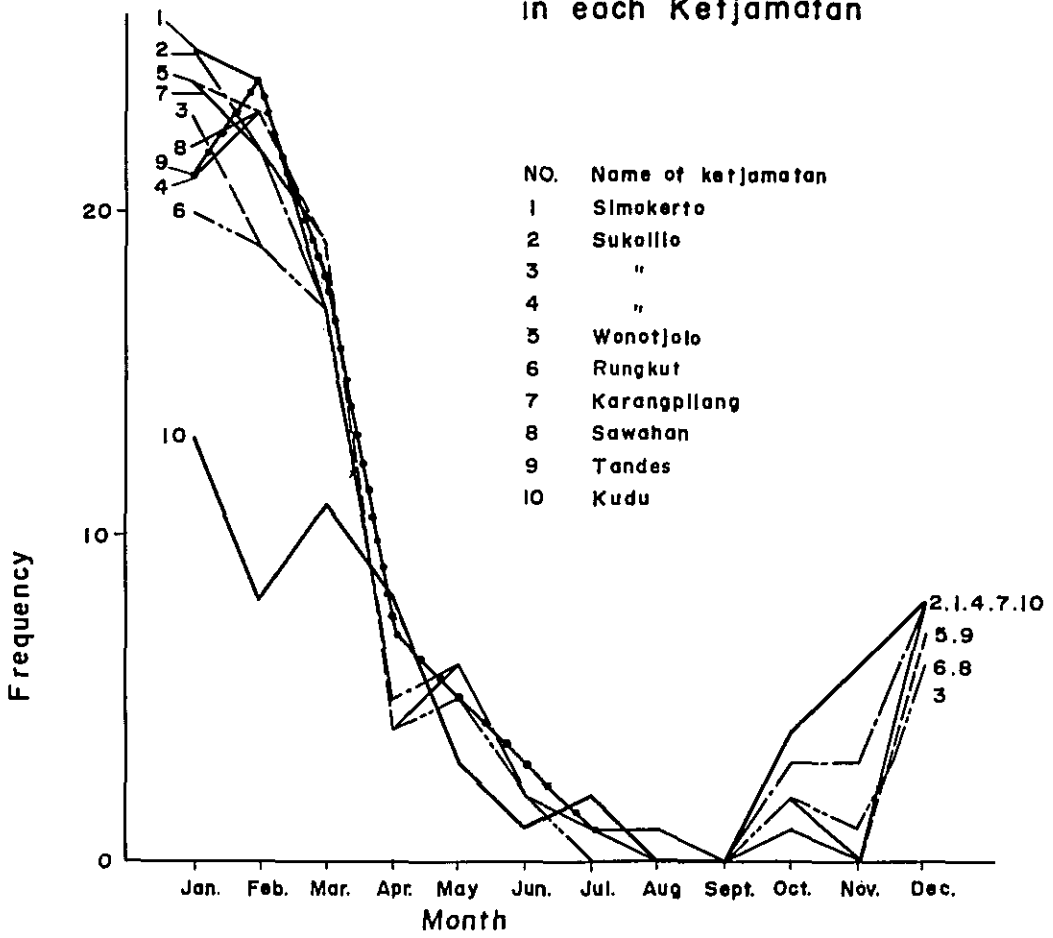
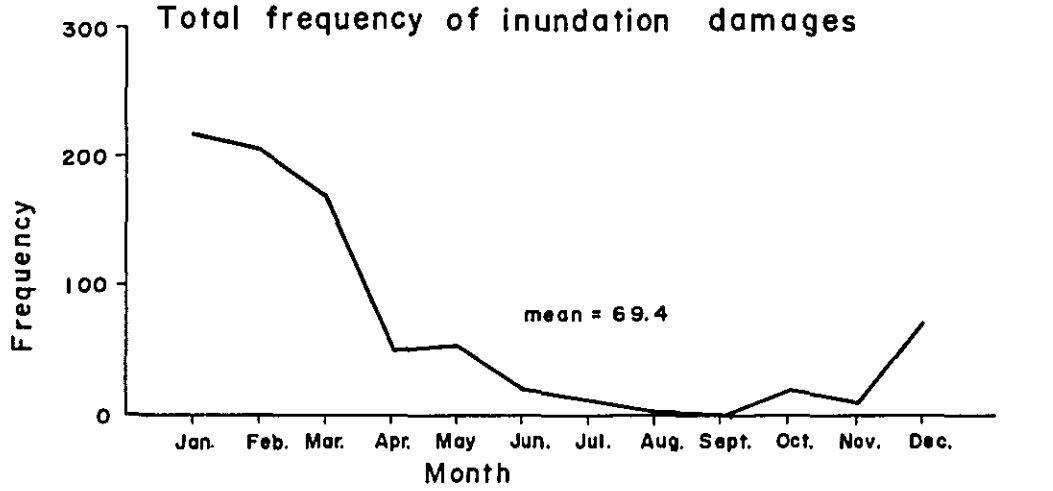


Fig. 4 Frequency of inundation damages in each Ketjamatan





It is seen from the figure that inundation damages in the present area have concentrated on the period from January through March in the year.

On the other hand, the heavy daily rainfall in each month was examined from the rainfall records of the seven rain-gage stations in the Surabaja city and its surrounding areas in the past twenty-one years from 1951 to 1971.

As an example, Fig. 5 shows frequency of occurence of rainfall depths of over 77 mm in the above period. It is obvious from the figure that the frequency of occurence of the heavy rainfall from January to March are far high compared with those of other months. And that, it is found that this result agrees well with frequency of occurence of damages due to inundations which are shown in Fig. 4.

Furthermore, the area of planted crops is largest and the crops are well grown in the period from January to March as mentioned previously, namely the farm land has the greatest value in the period of the year. Accordingly, most of great damages due to inundations will surely occur during the said period.

2) Rates of inundation damage to building and household effects.

Analysis of rate of inundation damage was made for the reasonable estimation of the amount of damage due to inundation by setting a standard value of the rate of damage.

The rates of damage were determined as to three kinds of properties; building, household effects and planted crops. The rates of damage to household effects and goods were classified into five kinds; household effects of office, residence, farmhouse and school, and goods stocked at shops. The rate of damage to buildings was determined without classifying their kinds.

Fig. 6 shows relations between submergence depths and rates of damages. Rates of inundation damages were given by the 0.50 m from floor level to the height of 3.00 m similarly to the case of valuation of properties mentioned above.

The points on the figure were given as average values of data sampled by height. Convex-upwards increase-curves were obtained by smoothing these points, as shown in Fig. 6.

As seen from the figure, the ratio of the damage to the submergence depth takes relatively large values in lower depth and the rate of increase gradually decreases with the increase of submergence depth. These facts are common to all of rates of damages to household effects. And that they are approximately similar to those studied in Japan.

3) Rates of damages to planted crops.

Damages to planted crops caused by floods may be estimated principally from four factors; submergence depth, duration, velocity of flow and rate of growth of crops.

Experiments on the influence of the above four factors upon inundation damage to planted crops have been conducted by the Agricultural Experiment Stations of the Ministry of Agriculture and Forestry and other authorities concerned in Japan. Results of these experiments are being used for the

Fig. 5 Frequency Distribution of Rainfall

(According to data of which rainfall depth is deeper than 77mm from 1951 to 1971)

Line	Station NO.	Station Name
———	NO. 1	Gubeng
—·—	NO. 4	Keptih
—·· —	NO. 7	Gunungsari
– – – –	NO. 10	Tapen
———	NO. 12	Tandjung
—●—●—	NO. 13	Wringinanom
—·—·—	NO. 14	KrtKlan

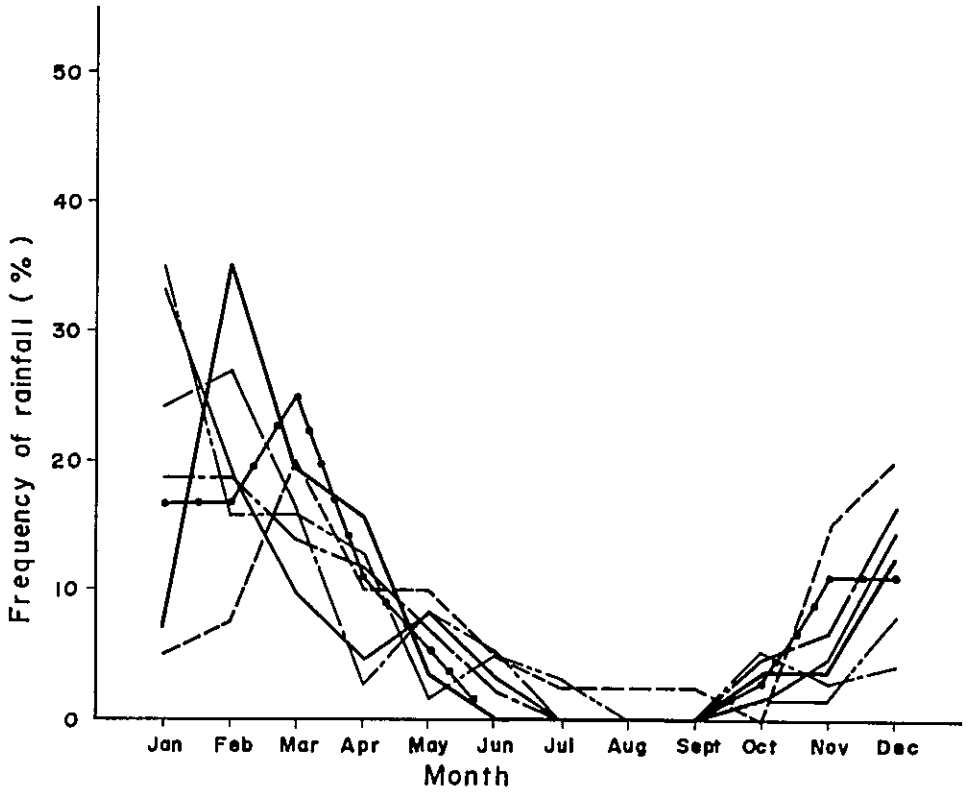
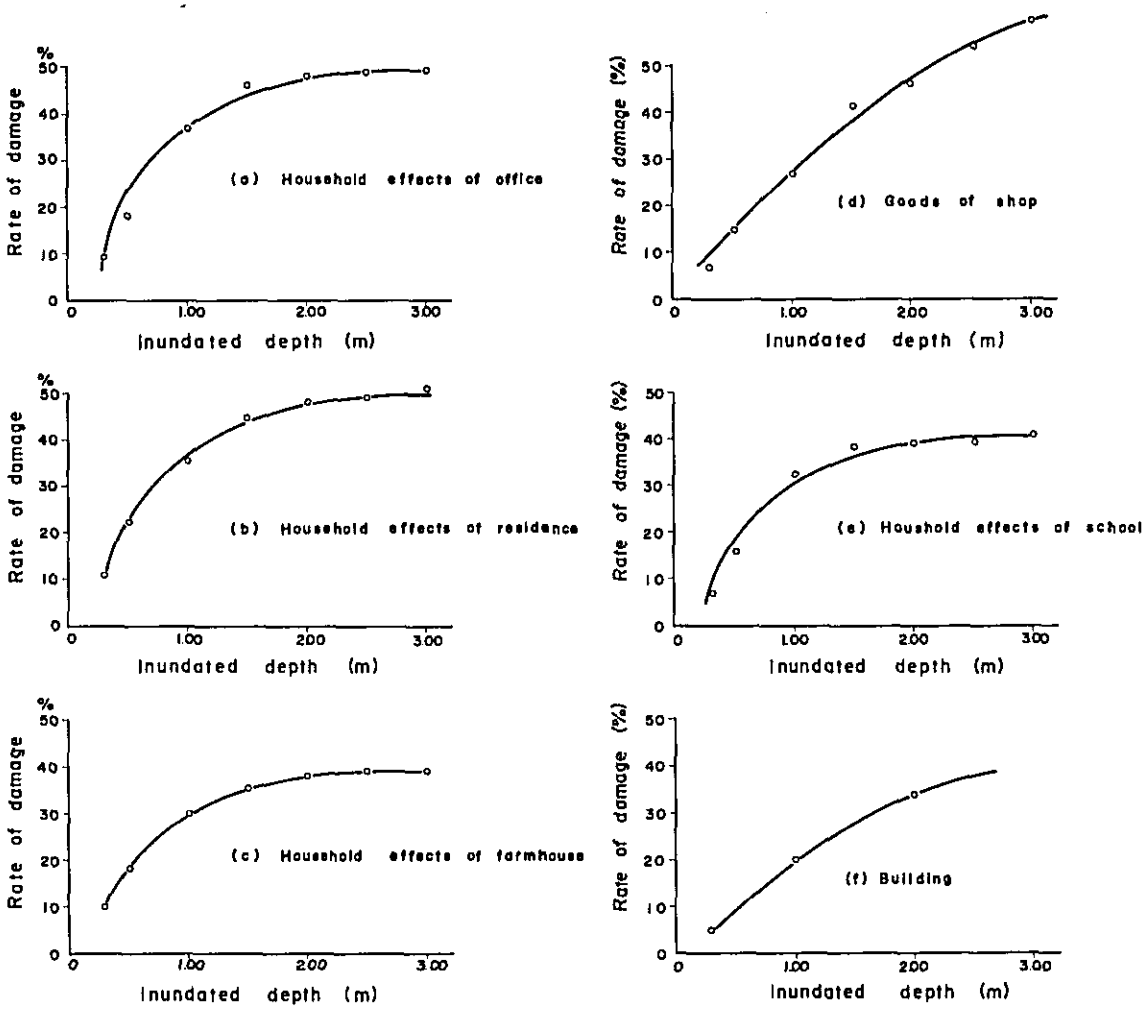


Fig. 6 Rate of Damage Caused by Inundation



estimation of flood damages in Japan.

Those results, however, are not applicable to the present case without any modification, because there are differences in climatic conditions and kinds of crops between Japan and Indonesia. Therefore, the rate of damage to paddy was newly studied on the basis of experimental data in Japan and the results of experiments made by Dr. S. Matsushima in Malaysia in 1968. The result is shown in Table 4 and Fig. 7.

As for other crops such as maize, cassava, peanuts, and soybeans, since their roots are not so trong against water, it is expected that they suffer from more damage than paddy under the same condition of inundation. However, it is very hard at least for the present to grasp exactly the amount of submergence damage to them.

(3) Calculation of inundation damage.

1) Preparation for calculation.

The following data were prepared as input data to the computer.

a. Stage hydrographs (H-T curve).

Stage hydrographs at several return periods of floods were prepared for the conditions before and after the four improvement works such as the Marmojo river, the Surabaja/Wonokromo river, the Mas river and sea-dike works. For the sea dike, however, two kinds of stage hydrographs were given; one of them concerns the possible breaks on the dike and the other concerns the devastation of the flap gates.

b. Properties contained in inundated area.

Number of houses and planted area comprized in each mesh in inundated area were prepared.

Number of houses were classified according to their kinds such as office, residence, farmhouse, shop, factory and school making use of the aerophotographs. In case kinds of houses were not clear on the aerophotograph, classification was made in proportion to number of houses which were classified in Table 2.

Figures which are shown in Table 3 were used for the valuation of building and household effects. Cultivated area in each mesh was measured using the both of aerophotographs and land use maps. Monthly planted area of paddy out of the above cultivated one and monthly height of growth of paddy were given as shown in Tables 2-1 through 2-28 of Chapter XXII, Part 4.

Tables 5 through 17 and Tables 18 through 20 which are shown at the end of this chapter were taken as unit yield per ha and unit price for the estimation of inundation damages to crops. However, the price of paddy alone was given at Rp 15 per kg in dry stalked paddy.

c. Ground height.

Average ground height in each mesh was measured on topographic maps.

Fig. 7 Rice Plants Height vs. Relative Growth

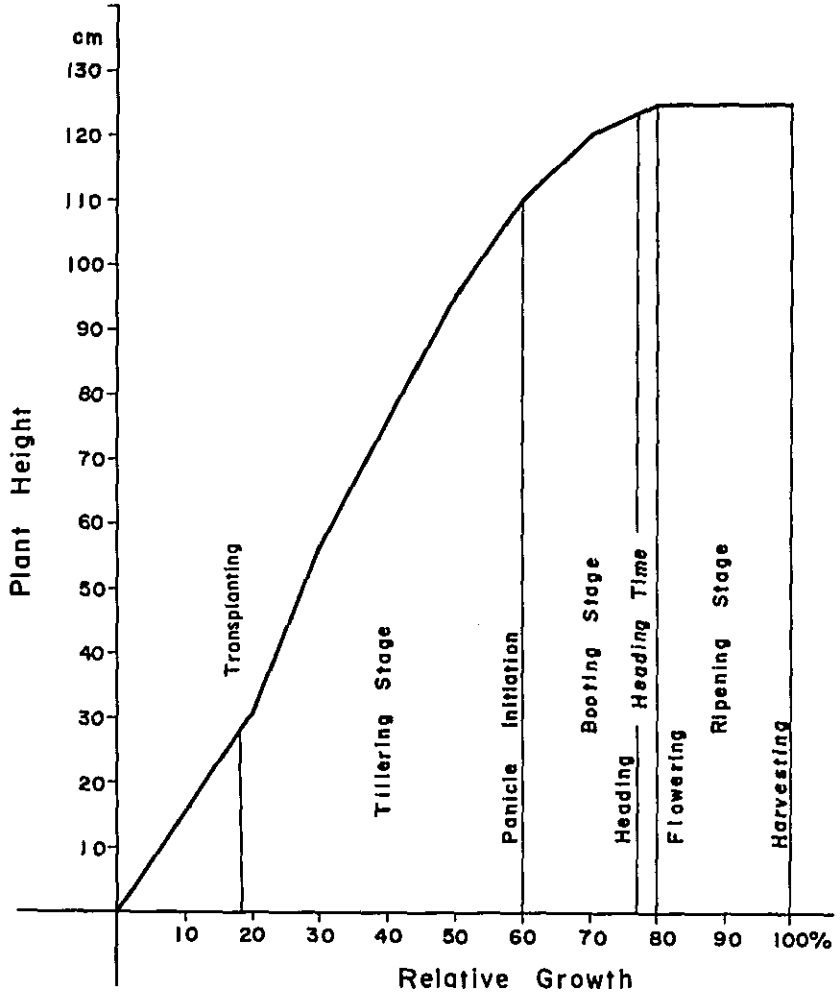


Table 4
Percentage of Decrease in Yield

		Tillering Stage	Booting Stage	Heading time	Ripening Stage
	days	0 to 59 %	60 to 76 %	77 to 79 %	80 to 100 %
Overhead Flooding	1 to 2	10	70	30	5
	3 to 4	20	80	80	20
	5 to 6	30	85	90	30
	over 7	35	95	100	30
Inundation Upto 75 % Plant Height	1 to 2	6	40	10	4
	3 to 4	9	46	23	15
	5 to 6	14	49	26	23
	over 7	16	55	30	23
Inundation Upto 50 % Plant Height	1 to 2	4	37	8	2
	3 to 4	9	42	22	4
	5 to 6	13	45	25	6
	over 7	15	50	28	6

(d) Rate of damage.

As described already, Fig. 6 and Table 4 were adopted as standard values of rates of damage to building, household effects, and planted paddy.

2) Process of calculation.

(a) Depth of submergence.

Submergence depths were calculated in each square mesh using the both of the stage hydrograph and the ground height.

(b) *Rate of damage.*

The rate of damage corresponding to a submergence depth calculated at (a) was read on the standard table of rates of damages to submergence depths which was already stored in the computer.

(c) Calculation of amount of damage.

Amount of inundation damage in a mesh was calculated by the following equation,

$$g = \sum_{i=1}^{\ell} B_i(P_{1i}d_{1i} + P_{2i}d_{2i}) + \sum_{j=1}^{m} L_j r_j Y_j P_{3j} d_{3j} \qquad (1)$$

where g = amount of damage,
B = number of houses classified by their kind,
P_1 = average valuation of building per house,
P_2 = average valuation of household effects per house,
d_1 = rate of damage to building,
d_2 = rate of damage to household effects,
L = cultivated area,
r = *ratio of area of a planted crop to cultivated area,*
Y = unit yield of a crop per ha,
P_3 = price of a crop,
d_3 = rate of damage to a planted crop,
i = number of kinds of houses,
j = number of kinds of planted crops.

The amount of damage in all the inundated area was obtained by $G = \sum_{k=1}^{n} g_k$, where k denotes number of meshes in the inundated area.

The above calculation was made for each return period of floods. Accordingly, the amount of the average annual flood damage was given by the following equation,

$$D = \frac{1}{2} \sum_{i=1}^{s} (P_{i-1} - P_i)(G_{i-1} + G_i) \qquad (2)$$

where = probability density function,
$P_{i-1} - P_i$ = probability of occurence of floods between $(i-1)$th and ith,
G = amount of flood damage at a return period,
i = *number of return periods.*

The results of calculation of amount of inundation damages are shown in Chapter IX of Part 2.

Table 5 Seasonal Production of Paddy in East Java

Item		Rainy Season				Dry Season	Total
		R	Gr	Ga	Total	Go	
1966							
Area	ha	846,749	53,369	160,682	1,060,800	73,914	1,084,714
Production	ton	2,623,416	95,202	490,068	3,208,686	121,595	3,330,281
Yield	ton/ha	3.10	1.78	3.05	3.02	1.65	3.07
1967							
Area	ha	870,649	45,830	163,350	1,079,829	71,450	1,151,279
Production	ton	2,699,813	66,855	441,644	3,208,312	95,902	3,304,214
Yield	ton/ha	3.10	1.46	2.70	2.97	1.34	2.87
1968							
Area	ha	860,278	41,060	232,346	1,133,684	75,582	1,209,266
Production	ton	3,349,200	101,066	828,484	4,278,750	125,635	4,404,385
Yield	ton/ha	3.89	2.46	3.57	3.77	1.66	3.64
1969							
Area	ha	906,501	37,841	210,269	1,154,611	68,129	1,222,740
Production	ton	3,377,862	84,590	740,620	4,203,072	109,245	4,312,317
Yield	ton/ha	3.73	2.24	3.52	3.64	1.60	3.53
1970							
Area	ha	888,222	51,456	189,101	1,128,779	63,752	1,192,531
Production	ton	3,381,917	139,095	756,778	4,277,789	110,121	4,387,911
Yield	ton/ha	3.81	2.70	4.00	3.79	1.73	3.68

Note: R : Rainy season paddy (Rendengan)
Gr: Paddy cultured under a dry condition of the field initially after direct seeding and a wet condition in succession (Gogorantja)
Ga: Dry season paddy (Gadu)
Go: Upland rice (Gogo)

Production is given in dry stalk paddy (Padikering Gudang)

Table 6 Production of Paddy in East Java in 1970 and 1971

Territory	1970					1971				
	Harvested Area ha	Production qul	Yield qul/ha	Reserve for Seed qul	Food Production qul	Harvested Area ha	Production qul	Yield qul/ha	Reserve for Seed qul	Feed Production qul
Kares. A. Surabaja	172,866	6,939,838	40.15	87,321	6,852,517	177,212	7,298,392	41.18	88,606	7,209,789
1. Komad. Surabaja	11,645	405,496	34.83	6,089	399,407	12,506	514,742	41.16	6,253	508,489
2. Kab. Surabaja	41,246	1,380,634	33.47	20,892	1,359,742	41,288	1,081,299	26.19	20,644	1,060,655
3. Kab. Sidoardjo	35,617	1,773,732	49.80	17,898	1,755,834	38,248	2,132,622	55.76	19,124	2,113,498
4. Kab. Modjokerto	38,565	1,569,695	40.70	19,453	1,550,242	38,874	1,715,266	44.12	19,437	1,695,829
5. Kab. Djombang	45,795	1,810,281	39.53	22,989	1,787,292	46,296	1,854,463	40.06	23,146	1,831,315
B. Kares. Bodjonegro	185,157	4,535,415	24.49	95,626	4,439,789	185,662	4,542,101	24.46	92,831	4,449,270
C. Kares. Madium	171,327	5,526,290	32.26	85,952	5,440,338	178,780	6,270,004	35.07	89,390	6,180,614
D. Kares. Koduri	160,141	5,641,461	35.23	82,610	5,558,851	169,724	7,440,624	43.84	84,862	7,355,762
E. Kares. Malang	195,057	8,369,298	42.91	97,901	8,271,397	204,617	9,604,464	46.94	102,308	9,502,156
F. Kares. Besuki	229,384	10,972,439	47,83	114,750	10,857,689	257,694	14,002,780	54.34	128,847	13,873,933
G. Kares. Madura	78,599	1,894,336	24.10	40,273	1,854,093	84,636	1,918,090	22.66	42,318	1,875,772
East Java	1,192,531	43,879,107	36.79	604,433	43,274,674	1,258,325	51,076,455	40.59	629,162	50,447,293

Note: 1. The figure of December in 1971 are estimated
2. The production is given in dry stalk paddy (padi kering gudang)
3. qul = 100 kgs, Kares = Residency, Komad = city, Kab. = Regency

Source: Laporan Tabunan 1970, 1971, Dinas Pertanian Rakjat Propinsi Djawa Timur

Table 7 Production of Maize in East Java in 1970 and 1971

Territory	1970 Harvested Area ha	1970 Production qul	1970 Yield qul/ha	1970 Reserve for Seed qul	1970 Feed Production qul	1971 Harvested Area ha	1971 Production qul	1971 Yield for qul/ha	1971 Reserve for Seed qul	1971 Food Production qul
Kares. A. Surabaja	92,271	537,405	5.82	28,574	508,831	99,543	592,949	5.96	29,864	563,085
1. Komad. Surabaja	2,019	8,654	4.29	718	7,936	2,925	12,397	4.24	878	11,519
2. Kab. Surabaja	32,207	130,526	4.05	10,268	128,258	37,013	187,480	5.07	11,104	176,376
3. Kab. Sidoardgo	3,121	24,701	7.91	986	23,715	3,245	27,746	8.55	974	26,772
4. Kab. Modjokerto	24,600	172,953	7.03	7,420	165,533	23,998	162,804	6.84	7,199	155,605
5. Kab. Djombanq	30,324	192,571	6.35	9,182	183,389	32,362	202,522	6.26	9,709	192,813
B. Kares. Bodjonegro	234,798	1,422,445	6.06	78,694	1,343,751	170,922	927,628	5.43	51,277	876,351
C. Kares. Madium	108,767	642,434	5.91	32,906	609,528	70,641	414,759	5.87	21,192	393,567
D. Kares. Keduri	113,521	1,161,536	10.23	35,189	1,126,347	94,891	1,140,310	12.02	28,468	1,111,848
E. Kares. Malang	279,121	1,899,291	6.80	84,004	1,815,287	268,457	2,012,450	7.50	80,537	1,931,913
F. Kares. Besuki	238,670	1,980,880	8.30	72,774	1,908,136	204,849	1,880,180	9.18	61,454	1,818,726
G. Kares. Madura	255,091	1,105,648	4.33	79,076	1,026,572	270,591	1,357,699	5.02	81,176	1,276,523
East Java	1,322,239	8,749,639	6.62	411,187	8,338,452	1,179,894	8,325,975	7.06	353,968	7,972,007

Note: 1. The figures of December in 1971 are estimated
2. The production is given in dry grain (Pipilan Kering)
3. qul = 100 kgs, Kares = Residency, Komad = city, Kab. = Regency

Source: Laporan Tabunan 1970, 1971, Dinas Pertanian Rakjat Propinsi Djawa Timur

Table 8 Production of Sweet Potatoes in East Java in 1970 and 1971

Territory	1970					1971				
	Harvested Area ha	Production qul	Yield qul/ha	Reserve for Seed qul	Food Production qul	Harvested Area ha	Production qul	Yield qul/ha	Reserve for Seed qul	Food Production qul
A. Kares. Surabaja	7,137	486,545	68.17	-	486,545	5,989	392,682	65.57	-	392,682
1. Komad. Surabaja	316	13,931	44.09	-	13,931	209	6,963	33.32	-	6,963
2. Kab. Surabaja	1,205	53,132	44.09	-	53,132	744	31,423	42.24	-	31,423
3. Kab. Sidoardjo	576	86,400	150.00	-	86,400	545	79,732	146.30	-	79,732
4. Kab. Modjokerto	1,913	149,677	78.24	-	149,677	1,657	104,374	62.99	-	104,374
5. Kab. Djombang	3,127	183,405	58.65	-	183,405	2,834	170,190	60.05	-	170,190
B. Kares. Bodjonogro	8,365	357,503	42.74	-	357,503	6,575	268,103	40.78	-	268,103
C. Kares. Madian	6,558	335,884	51.22	-	335,884	6,457	309,344	47.91	-	309,344
D. Kares. Keduri	7,360	389,910	52.98	-	389,910	6,640	393,753	59.30	-	393,753
E. Kares. Malang	6,170	438,780	71.12	-	438,780	6,376	482,546	75.68	-	482,546
F. Kares. Besuki	8,267	828,531	100.22	-	828,531	7,344	730,251	99.44	-	730,251
G. Kares. Madura	19,582	464,150	23.70	-	464,150	22,331	563,672	25.24	-	563,672
East Java	63,439	3,310,303	52.18	-	3,310,303	61,712	3,140,351	50.89	-	3,140,351

Note: 1. The figures of December in 1971 are estimated
2. The production is given in wet weight (Ubi basah)
3. qul = 100 kgs, Kares = Residency, Komad = city, Kab. = Regency

Source: Laporan Tabunan 1970, 1971, Dinas Pertanian Rakjat Propinsi Djawa Timur

Table 9 Production of Cassava in East Java in 1970 and 1971

Territory	1970					1971				
	Harvested Area ha	Production qul	Yield qul/ha	Reserve for Seed qul	Food Production qul	Harvested Area ha	Production qul	Yield qul/ha	Reserve for Seed qul	Food Production qul
A. Kares. Surabaja	25,849	1,749,351	67.68	-	1,749,351	25,029	1,655,381	66.14	-	1,655,381
1. Komad. Surabaja	1,510	62,427	41.34	-	62,427	1,024	51,685	50.47	-	51,685
2. Kab. Surabaja	8,916	409,337	45.91	-	409,337	8,941	396,763	44.38	-	396,763
3. Kab. Sidoardjo	916	91,600	100.00	-	91,600	807	80,117	99.28	-	80,117
4. Kab. Modjokerto	5,656	629,859	111.36	-	629,859	4,959	532,408	107.36	-	532,408
5. Kab. Djombang	8,851	556,128	62.83	-	556,128	9,298	59,408	6.39	-	59,408
B. Kares. Bodjonegro	44,860	2,162,008	48.19	-	2,162,008	46,082	2,201,587	47.78	-	2,201,587
C. Kares. Madium	123,751	5,852,538	47.29	-	5,852,538	125,250	5,563,860	44.42	-	5,563,860
D. Kares. Koduri	62,702	4,947,720	78.91	-	4,947,720	66,358	4,761,109	71.75	-	4,761,109
E. Kares. Malang	47,255	4,388,679	92.87	-	4,388,679	49,472	4,726,023	95.53	-	4,726,023
F. Kares. Besuki	34,386	4,181,475	121.60	-	4,181,475	33,462	4,536,466	135.57	-	4,536,466
G. Kares. Madura	111,488	5,755,384	51.62	-	5,755,384	115,242	6,104,754	52.97	-	6,104,754
East Java	450,291	29,037,155	64.49	-	29,037,155	460,895	29,549,180	64.11	-	29,549,180

Note: 1. The figures of December in 1971 are estimated
2. The production is given in wet weight (Ubi basah)
3. qul = 100 kgs, Kares = Residency, Komad = city, Kab. = Regency

Source: Laporan Tabunan 1970, 1971, Dinas Pertanian Rakjat Propinsi Djawa Timur

Table 10 Production of Peanuts in East Java in 1970 and 1971

Territory	1970					1971				
	Harvested Area ha	Production qul	Yield qul/ha	Reserve for Seed qul	Food Production qul	Harvested Area ha	Production qul	Yield qul/ha	Reserve for Seed qul	Food Production qul
Kares. A. Surabaja	19,640	141,329	7.20	15,716	125,613	19,013	129,337	6.80	15,210	114,217
1. Komad. Surabaja	242	275	1.14	194	81	388	1,471	3.79	310	1,161
2. Kab. Surabaja	7,401	43,433	5.87	5,921	37,512	6,279	35,136	5.60	5,023	30,113
3. Kab. Sidoardjo	122	1,220	10.00	98	1,122	162	1,599	9.87	130	1,469
4. Kab. Modjokerto	7,575	61,613	8.13	6,063	55,550	7,504	56,719	7.56	6,003	50,716
5. Kab. Djombang	4,296	34,788	8.10	3,440	31,348	4,680	34,412	7.35	3,744	30,668
B. Kares. Bodjonegro	28,349	159,373	5.62	22,800	136,573	26,719	134,256	5.02	21,375	112,881
C. Kares. Madium	8,722	42,713	4.90	7,030	35,683	8,430	40,199	4.78	6,744	33,455
D. Kares. Keduri	25,853	180,274	6.97	20,696	159,578	26,683	182,333	6.83	21,347	160,986
E. Kares. Malang	12,595	84,625	6.72	10,081	74,544	16,994	124,068	7.30	13,595	110,473
F. Kares. Besuki	13,576	101,422	7.47	10,861	90,561	15,257	113,588	7.44	12,205	101,383
G. Kares. Madura	23,770	99,505	4.19	19,531	79,974	21,969	103,469	4.71	17,575	85,894
East Java	132,505	809,241	6.11	106,715	702,526	135,065	827,250	6.12	108,051	719,199

Note: 1. The figures of December in 1971 are estimated
2. The production is given in dry grain husked (Wose kering)
3. qul = 100 kgs, Kares = Residency, Komad = city, Kab. = Regency

Source: Laporan Tabunan 1970, 1971, Dinas Pertanian Rakjat Propinsi Djawa Timur

Table 11 Production of Soybean in East Java in 1970 and 1971

Territory	1970					1971				
	Harvested Area ha	Production qul	Yield qul/ha	Reserve for Seed qul	Food Production qul	Harvested Area ha	Production qul	Yield qul/ha	Reserve for Seed qul	Food Production qul
A. Kares. Surabaja	39,083	220,190	5.63	19,608	200,582	34,804	202,210	5.81	17,402	184,808
1. Komad. Surabaja	-	-	-	-	-	3	5	1.67	2	3
2. Kab. Surabaja	3,371	15,894	4.71	1,686	14,208	2,207	10,747	4.87	1,104	9,643
3. Kab. Sidoardjo	5,900	53,076	9.00	2,999	50,077	4,812	53,425	11.10	2,406	51,019
4. Kab. Modjokerto	8,512	45,103	5.30	4,260	40,843	6,669	37,334	5.60	3,334	34,000
5. Kab. Djombang	21,300	106,117	4.98	10,663	95,454	21,113	100,699	4.77	10,556	90,143
B. Kares. Bodjonegro	30,714	136,555	4.45	15,677	120,878	35,845	171,999	4.80	17,922	154,077
C. Kares. Madium	63,952	294,220	4.60	32,343	261,877	66,785	337,203	5.05	33,391	303,812
D. Kares. Keduri	58,279	329,503	5.65	29,381	300,122	52,320	313,068	5.98	26,159	286,909
E. Kares. Malang	74,142	387,649	5.23	37,222	350,427	77,767	404,084	5.20	38,885	365,199
F. Kares. Besuki	122,578	847,381	6.91	61,337	786,044	121,712	879,202	7.22	60,856	818,346
G. Kares. Madura	2,261	8,417	3.72	1,132	7,285	2,044	8,489	4.15	1,022	7,467
East Java	391,009	2,223,915	5.69	196,700	2,027,215	391,277	2,316,255	5.92	195,637	2,120,618

Note: 1. The figures of December in 1971 are estimated
2. The production is given in dry grain husked (Wose kering)
3. qul = 100 kgs, Kares = Residency, Komad = city, Kab. = Regency

Source: Laporan Tabunan 1970, 1971, Dinas Pertanian Rakjat Propinsi Djawa Timur

Table 12 Production of Paddy in Surabaja City Area

Rainy Season Paddy

Ketjamatan	Harvested Area in Ha					
	1965	1966	1967	1968	1969	1970
Wonotjolo	904	932	873	874	941	942
Sukolilo	1,734	1,732	1,524	1,526	1,831	1,834
Rungkut	715	743	527	528	632	723
Tandes	579	621	568	569	653	672
Karang Pilang	1,289	1,267	1,163	1,164	1,524	1,573
Total	5,221	5,295	4,655	4,661	5,581	5,744

Ketjamatan	Production in ton and yield in ton/ha					
	1965	1966	1967	1968	1969	1970
Wonotjolo	3,425.43 3.79	3,564.43 3.82	2,821.00 3.23	3,426.00 3.92	3,624.23 3.85	3,515.32 3.73
Sukolilo	6,421.00 3.95	6,312.43 3.64	5,413.41 3.55	5,683.43 3.72	7,543.14 4.11	7,325.12 3.99
Rungkut	2,514.72 3.52	2,617.24 3.52	1,722.43 3.27	1,832.37 3.47	2,542.32 4.02	3,214.32 4.45
Tandes	1,925.00 3.32	2,143.32 3.45	1,621.34 2.85	1,743.63 3.06	2,432.23 3.72	3,135.23 4.70
Karang pilang	4,318.43 3.35	4,934.29 3.89	3,614.41 3.11	3,974.48 3.41	6,432.24 4.22	6,321.24 4.01
Total	18,604.58 3.56	19,571.71 3.70	15,192.59 3.26	16,659.91 3.57	22,565.16 4.04	23,611.23 4.11

Note: Production is of dry paddy without stem of 16 % moisture content

Source: Dinas Pertanian Rakjat Kotamadya Surabaja

Table 13 Production of Paddy in Surabaja City Area

Dry Season Paddy

Ketjamatan	Harvest Area in Ha					
	1965	1966	1967	1968	1969	1970
Wonotjolo	701	773	712	732	739	734
Sukolilo	1,456	1,482	1,308	1,312	1,479	1,476
Rungkut	517	509	443	443	493	402
Tandes	408	391	377	376	432	413
Karang pilang	987	998	862	878	1,161	1,112
Total	4,069	4,153	3,072	3,741	4,303	4,137

Ketjamatan	Production in ton and yield in ton/ha					
	1965	1966	1967	1968	1969	1970
Wonotjolo	2,505.47	2,633.10	2,223.20	2,028.00	2,093.33	3,212.26
	3.57	3.41	3.14	2.77	3.92	4.38
Sukolilo	4,061.00	4,390.19	3,712.09	4,090.23	4,145.15	4,743.01
	2.78	2.96	2.83	3.12	2.80	3.21
Rungkut	1,726.18	1,987.08	1,313.33	1,484.11	1,953.13	1,418.44
	3.34	3.90	2.96	3.35	3.96	3.53
Tandes	1,493.00	1,497.22	1,294.27	1,448.11	1,918.34	1,349.31
	3.66	3.83	3.43	3.85	4.44	3.27
Karang pilang	3,622.64	3,616.33	3,195.31	3,275.26	3,908.32	4,243.12
	3.67	3.62	3.71	3.73	3.37	3.81
Total	13,408.29	14,123.92	11,738.20	12,325.71	14,828.27	14,966.13
	3.30	3.40	3.17	3.29	3.45	3.62

Note: Production is of dry paddy without stem of 16 % moisture content

Source: Dinas Pertanian Rakjat Kotamadya

Table 14 Production of Maize in Surabaja City Area

No. Ketjamatan	Harvested Area in Ha						Production in Ton and Yield in Ton/ha					
	65	66	67	68	69	70	65	66	67	68	69	70
1. Tandes	256	319	275	292	320	344	114.43 0.45	142.59 0.45	122.93 0.45	130.52 0.45	143.04 0.45	140.67 0.41
2. Karang pilang	789	694	549	779	772	679	285.62 0.36	251.23 0.36	198.74 0.36	281.10 0.36	279.46 0.36	256.66 0.38
Total	1,045	1,013	824	1,071	1,092	1,023	400.05 0.38	393.82 0.39	321.67 0.39	411.62 0.38	422.50 0.39	397.33 0.39

Source: Dinas Pertanian Rakjat Kotamadya Surabaja

Table 15 Production of Sweet Potatoes in Surabaja City Area

No. Ketjamatan	Harvested Area in Ha						Production in Ton and Yield in Ton/ha					
	65	66	67	68	69	70	65	66	67	68	69	70
1. Tandes	13	9	3	12	4	6	41.6 3.2	28.8 3.2	9.6 3.2	38.4 3.2	12.8 3.2	18 3.0
2. Karang pilang	94	78	106	219	211	310	357.2 3.8	316.4 4.1	402.8 3.8	832.2 3.8	801.8 3.8	1,294.25 4.2
3. Rungkut	8	9	1	4	3	-	27.2 3.4	33.6 3.7	3.4 3.4	13.6 3.4	10.2 3.4	-
Total	115	96	110	235	218	316	426.0 3.70	378.8 3.95	415.8 3.78	884.2 3.76	824.8 3.78	1,312.25 4.15

Source: Dinas Pertanian Rakjat Kotamadya Surabaja

Table 16 Production of Cassava in Surabaja City Area

No. Ketjamatan	Harvested Area in Ha						Production in Ton and Yield in Ton/ha					
	65	66	67	68	69	70	65	66	67	68	69	70
1. Tandes	382	357	192	498	525	555	2,062.8 5.40	1,927.6 5.40	1,036.8 5.40	2,639.4 5.30	2,835 5.40	2,997 5.40
2. Karang pilong	691	574	492	616	824	945	2,773.83 4.01	2,321.12 4.04	2,001.96 4.07	2,544.08 4.13	3,303.12 4.01	3,902.85 4.13
Total	1,073	931	684	1,114	1,349	1,500	4,863.63 4.51	4,248.72 4.56	3,038.76 4.44	5,183.48 4.65	6,138.12 4.55	6,899.85 4.60

Source: Dinas Pertanian Rakjat Kotamadya Surabaja

Table 17 Production of Peanuts in Surabaja City Area

No. Ketjamatan	Harvested Area in Ha						Production in quintal and yield in qul/ha					
	65	66	67	68	69	70	65	66	67	68	69	70
1. Tandes	35	29	34	27	36	-	122.5 3.5	87 3.0	119 3.5	91.8 3.4	126 3.5	-
2. Karang pilang	194	263	186	234	203	242	368.64 1.9	495.48 1.9	364.56 2.0	458.68 2.0	483.32 2.4	467.06 1.93
Total	229	292	220	261	239	242	491.14 2.1	582.48 2.0	483.56 2.2	550.48 2.1	609.32 2.5	467.06 1.9

Source: Dinas Pertanian Rakjat Kotamadya Surabaja

Table 18 Price List of Agricultural Products in 1971

Rp./Kg

No.	Products	Farmer level	Merchant level	Consumer level			
				Village market	Ketjamatan market	Regency market	Province market
1.	Sub-Yaponica paddy	17	19	-	-	-	-
2.	Sub-Indica paddy	16	16	-	-	-	-
3.	Polished Rice 1	-	-	47.5	47.5	45	45
4.	Polished Rice II	-	-	45	45	42.5	42.5
5.	Polished Rice by hand I	35	37.5	42.5	42.5	42.5	42.5
6.	Polished Rice by hand II	32.5	35	40	40	40	40
7.	Grain Maize	20	21.5	23	23	25	25
8.	Maize with stem (dried)	-	-	-	-	-	-
9.	Grain Peanut	80	82.5	82.5	85	90	90
10.	Peanut with shell	28	30	35	35	40	40
11.	Green bean	-	-	-	-	-	80
12.	Red bean	-	-	-	-	-	50
13.	Cassava	5	6	7.5	9	10	10
14.	Sweet potato	5	6	7.5	9	10	10
15.	Tapioca powder	-	-	-	-	-	40
16.	Potato	-	-	-	-	-	50
17.	Cabbage	-	-	-	-	-	20
18.	Tomato	20	22.5	25	30	40	50
19.	Red onion	-	-	-	-	-	100
20.	White onion	-	-	-	-	-	250
21.	Pepper	60	65	70	75	80	80
22.	Green long beans	22.5	24	28	30	35	40

Source: Dinas Pertanian Rakjat Kotamaya Surabaja

Table 19 Price List of Livestock Products in 1971

No.	Products	Farmer level	Merchant level	Price Rp...../kg./liter			
				Village market	Ketjamatan market	Regency market	Province market
1.	Chicken-egg	10	11	11	12	12.5	12.5
2.	Duck-egg	12.5	12.5	13	13	15	15
3.	Cow meat I	-	-	-	-	270	270
4.	Cow meat II	-	-	-	-	260	260
5.	Chicken-meat	240	245	240	240	250	250
6.	Pig-meat	-	-	-	-	300	300
7.	Cow milk	60	-	-	-	70	70
8.	Salted fish	-	-	210	200	200	200

Source: Dinas Pertanian Rakjat Kotamadyo Surabaja

Table 20 Average Retail Prices of Agricultural Products in the Markets (Wonokromo, Genteng and Pabean) of Surabaja City in 1970.

Rupiah

	Unit	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1. Polished Rice I (Beras Gil. I)	1 kg	50	53	46	40	39	42	42	43	43	44	44	45
2. Polished Rice II (Beras Gil. II)	1 kg	49	50	44	39	38	40	40	41	41	42	43	44
3. Polished Rice I by Man power (Beras Tmb II)	1 kg	48	49	43	38	37	40	40	40	40	42	41	43
4. Polished Rice II by Man power (Beras Tmb II)	1 kg	47	48	40	37	35	38	38	39	39	40	40	42.5
5. Dry Grain Maize (Djag. Pip. Kr.)	1 kg	26	25	25	25	24	24	24	26	26	26	26	25
6. Dry Mash Maize (Djag. Beras)	1 kg	28	27	27	27	26	26	26	28	28	28	29	26
7. Cassava (Ketela Pohon)	1 kg	10	10	10	10	10	10	10	10	10	10	12	10
8. Sweet Potatoes (Ketela rambat)	1 kg	10	10	9	10	10	10	10	10	10	10	11	10
9. Tapioka	1 kg	45	45	47	45	50	45	45	45	45	50	50	45
10. Ground Nuts Unshelled (Katjang tanah)	1 kg	90	95	95	90	95	90	100	95	100	95	90	70
11. Ground nuts shelled (Katjang glond)	1 kg	55	55	-	-	45	45	50	-	55	50	60	-
12. Small green peas (Katjang idjo)	1 kg	65	65	65	70	70	65	70	70	70	70	65	60
13. String bean (Katjang pandjang)	1 kg	20	22.5	22	20	20	25	25	25	25	10	25	20
14. Onion (Bawang mera)	1 kg	35	35	35	40	50	50	55	45	30	30	35	50
15. Garlic (Bawang Putih)	1 kg	350	350	350	350	300	350	350	350	300	275	270	325
16. Potatoes (Kentang)	1 kg	40	45	30	35	35	35	50	45	35	35	40	55
17. Carrot (Wortel)	1 kg	35	40	35	25	30	30	45	40	30	30	35	35
18. Dried Cassava (Gaplek)	1 kg	17	17	17	17	17	17	17	17	17	17	17	17
19. Soy beans (Katjang Kedele)	1 kg	70	65	65	65	70	65	67	70	60	70	60	50
20. Coffee (Kopi)	1 kg	200	200	200	200	200	200	200	200	200	200	200	225
21. Red Pepper (Lombok besar)	1 kg	50	50	35	55	50	60	60	45	60	50	35	40
22. Chili Pepper (Lombok ketjil)	1 kg	35	35	30	45	40	40	40	35	85	40	40	50
23. Cabbage (Kobis)	1 kg	20	30	30	25	25	25	25	25	25	25	25	30
24. Tomatoes (Tomat)	1 kg	30	35	50	35	35	40	45	35	25	20	25	60
25. Pumpkin (Labu pandj.)	1 kg	20	25	25	20	20	20	20	20	22	20	20	20
26. Egg plant (Terung besar)	1 kg	10	10	10	10	10	10	10	10	10	10	10	10
27. Sesame (Widjen)	1 kg	120	120	120	120	125	125	120	125	127	128	128	130
28. Coconuts (Kelapa)	1 butir	25	25	22.5	25	25	25	25	25	25	25	30	35
29. Coconuts oil (Minjak Kelapa)	1 kg	80	80	80	75	80	80	80	80	75	75	85	100
30. Granulated sugar (Gula pasir)	1 kg	70	70	60	67	70	75	70	70	60	70	85	95
31. Red sugar (Gula Merah)	1 kg	50	50	50	50	50	50	55	50	40	45	50	55
32. Beef (Daging Sapi)	1 kg	200	200	200	200	200	200	200	200	200	200	200	270
33. Chicken (Ajam)	1 butir	275	250	275	250	250	250	250	255	250	275	275	300
34. Hen's egg (Telur ajam)	1 butir	12	13	13	13	13	13	13	12.5	12.5	12.5	14	14
35. Duck's egg (Telur itik)	1 butir	13	13	12	13.5	13.5	13.5	13.5	13.5	13.5	13.5	15	13
36. Salted fish (Ikan asin)	1 kg	125	125	120	125	125	125	125	125	125	125	125	130
37. Fish for Canning (Ikan pindang)	1 kg	35	32.5	25	40	37	35	35	35	30	30	35	35
38. Fresh fish (Ikan Basah)	1 kg	110	110	100	110	100	100	110	110	100	110	110	110
39. Charcoal (Arang)	1 kg	20	20	20	20	20	20	20	20	20	20	20	20
40. Petroleum (Minjak Tanah)	1 lit	14	14	15	13	15	13	14	14	14	15	15	14

Source: Page G.20 & G.21 of Laporan Tahunan 1970, Propinsi Djawa Timur

CHAPTER XXV

ESTIMATION OF AMOUNT OF LOSSES ON AGRICULTURAL PRODUCTION RESULTING FROM DESTRUCTION OF EXISTING GUNUNGSARI DAM

If the existing Gunungsari dam should be destroyed completely due to the superannuation, the irrigation area would suffer serious damage to the agricultural production. The beneficial area under the present irrigation system would be unable to receive any Surabaja river water and would be obliged to result in rainfed farming.

Then the amount of losses due to the destruction of existing Gunungsari dam is simply presumed as the difference between irrigation farming and rainfed one.

However, the main irrigation canals in the each irrigation block under the Gunungsari irrigation system also have deteriorated and the rehabilitation works have been being required.

Some portion of the said amount of losses should be allocated to the benefit owing to the rehabilitation works of the main irrigation canals.

In this meaning it is assumed that the amount of losses obtained from the maximum irrigation acreage possible under the present capacity of the canals is equivalent to the benefit of new Gunungsari dam.

The loss amount corresponding to decreased capacity of the main canals is reserved for the benefit resulting from the future rehabilitation works of the main irrigation canals.

Estimation of the amount of losses is described in the following paragraphs in due order.

1. Beneficial Area (Irrigation Area).

Total beneficial area of Gunungsari dam is 3,812 ha at present (exactly in 1971) and each irrigation block has an independent intake along the Surabaja river.

Detail of the beneficial area is as below;

Right Bank Block	Area (ha)
Simowau (w-1)	387
Kebonagung (w-2)	1,511
Djambangan (w-3)	62
Karah (w-4)	129
Total	2,089

Left Bank Block	Area (ha)
Rowowijung (w-5)	430
Gunungsari (w-6)	1,293
Total	1,723
Grand-Total	3,812

The beneficial area during future 50 years was derived from the Table of Prospective Irrigation Area in Surabaja City by calculation in direct proportion of the acreage. (Ratio = 3,812/6,729 = 0.567)

2. Harvest Area under Crop in the Beneficial Area.

From the data collected at the East Java Irrigation Service, the average value of the 7-year of the harvest area under crop have been derived as follows:

Harvest Area Throughout a Year

Irrigation block	Beneficial area (ha)	Rainy season paddy (ha)	Dry season paddy Regulated (ha)	Dry season paddy Non-regulated (ha)	Polowidjo (ha)x(times)=(ha)
w-1	387	291	34	160	6 x 2 = 12
w-2	1,511	1,415	353	723	18 x 3 = 54
w-3	62	50	34	26	2 x 2 = 4
w-4	129	122	65	55	9 x 1 = 9
w-5	430	395	20	51	12 x 2 = 24
w-6	1,293	1,286	-	81	3 x 4 = 12
			506	1,096	
Total	3,812	3,559	1,602		115
Percentage	100	93.4	42.0		3.0

Note : Growth period of Polowidjo is regarded as 4 months.

Source : Tables of Calculation of Monthly Growth Ratio and Average plant height in Chapter of Irrigation Water Requirements.

Expected harvest area under crop in the future is basically calculated in accordance with the percentage of the above Table after the examination from the points of the water requirements and the capacity of the irrigation system as described in the following paragraphs.

3. Distributed Irrigation Water thru Existing Irrigation Facilities at Present Condition.

According to the collected data, the distributed irrigation water was recently decreased too much. It seems that main reasons are the deterioration of the function of Gunungsari dam and each irrigation canal. The latest records of intake to the irrigation area as of 1970 are as follows. These values were considered as the present capacity of the irrigation system.

Present Capacity of Irrigation System

unit : cu.m/sec

Month	Irrigation block W-1	W-2	W-3	W-4	W-5	W-6	Total
Oct.	0.53	1.20	0.09	0.18	0.15	0.17	2.32
Nov.	0.72	1.37	0.28	1.09	0.20	0.54	4.20
Dec.	0.72	1.37	0.28	0.44	0.20	0.33	3.34
Jan.	0.92	1.37	0.28	0.45	0.27	0.65	3.94
Feb.	0.87	1.47	0.28	0.47	0.35	0.65	4.09
Mar.	0.87	1.52	0.28	0.45	0.35	0.68	4.15
Apr.	0.87	1.52	0.28	0.47	0.35	0.72	4.21
May	0.87	1.52	0.28	0.46	0.33	0.69	4.15
June	0.87	1.52	0.28	0.44	0.30	0.65	4.06
July	0.87	1.52	0.28	0.44	0.30	0.65	4.06
Aug.	0.60	1.52	0.20	0.43	0.25	0.53	3.53
Sept.	0.50	1.37	0.15	0.29	0.21	0.68	3.20

4. Diversion Water Requirement for Each Irrigation Block.

According to the study on the irrigation water requirements in another chapter, the optimum irrigation water requirements for the above cropping were found as follows.

Diversion Water Requirements by Irrigation Block

unit : cu.m/sec

Month	Irrigation block W-1	W-2	W-3	W-4	W-5	W-6	Total
Oct.	0.14	1.56	0.06	0.13	0.04	0.07	2.00
Nov.	0.12	0.98	0.04	0.10	0.27	0.03	1.54
Dec.	0.28	0.80	0.08	0.16	0.78	0.27	2.37
Jan.	0.45	1.23	0.07	0.15	0.73	1.37	4.00
Feb.	0.56	2.28	0.10	0.23	0.68	2.78	6.63
Mar.	0.51	2.90	0.09	0.22	0.44	2.36	6.52
Apr.	0.44	2.23	0.05	0.17	0.35	2.01	5.25
May	0.31	1.49	0.04	0.11	0.09	1.23	3.27
June	0.34	1.24	0.07	0.15	0.12	0.30	2.22
July	0.35	1.16	0.09	0.18	0.15	0.15	2.08
Aug.	0.29	1.80	0.10	0.20	0.11	0.16	2.66
Sept.	0.22	2.04	0.10	0.21	0.07	0.09	2.73

5. Comparison between Present Capacity of the Irrigation System and Diversion Water Requirements.

From the comparison of the figures in the previous two paragraphs, it can be said that under the existing conditions the shortage of water supply is occuring only in the rainy season from January to April and in the other months irrigation water is sufficient. In other words, the deterioration of the irrigation system affects the cultivation of rainy season paddy only but not of dry season paddy and polowidjo.

Surplus or Shortage of Irrigation Water Supply Capacity

unit : cu.m/sec

Month	Present capacity A	Diversion water requirements B	Difference C = A - B (+)	(-)
Oct.	2.32	2.00	0.32	-
Nov.	4.20	1.54	2.66	-
Dec.	3.34	2.37	0.97	-
Jan.	3.90	4.00	-	0.10
Feb.	4.09	6.63	-	2.54
Mar.	4.15	6.52	-	2.37
Apr.	4.21	5.25	-	1.04
May	4.16	3.27	0.89	-
June	4.06	2.22	1.84	-
July	4.06	2.08	1.98	-
Aug.	3.53	2.66	0.89	-
Sept.	3.20	2.73	0.47	-

Especially the critical month is February, and the maximum acreage of irrigation possible in the rainy season is about 60 percent of the all beneficial area. If the water intake capacity is 4.09 cu.m/sec in February, only 2,352 ha can be expected to receive irrigation benefit, and the acreage of the rainy season paddy is calculated at 2,197 hectares as below.

$$\frac{4.09 \times 3,812}{6.63} = 2,352 \text{ ha} \qquad 2,352 \times 0.934 = 2,197 \text{ ha}$$

In the future, the beneficial area itself will be decreased. However, in the year which the acreage is above 2,352 ha, 2,197 ha of the rainy season paddy can be irrigated sufficiently.

6. *Amount of Losses on Agricultural Production.*

If the existing Gunungsari dam should lose all the functions owing to the superannuation, the existing irrigation area would be unable to receive any Surabaja river water throughout a year. This means that the irrigation area must be turned to a rainfed farming area.

From this point, the amount of losses on agricultural production will be considered naturally as the difference between the present and a rainfed farming production levels.

On the basis of statistics* collected at the field survey time, the amount of losses per hectare under crop is estimated as below:

(a) Rainy season paddy

	Yield		Unit price		Net income ratio	Rp/ha
Irrigated ...	3.74 t/ha**	x	19 Rp/kg	x	0.35	= 24,871

* Statistics : Production Record of Surabaja City,
Production of 10-yr average of East Java Province

Rainfed	2.05 t/ha***	x	15 Rp/kg	x	0.00	= 0
** 5-yr average (1965-1969) of Rendengan					Difference	= 24,871
***10-yr average (1960-1969) of Gogorantjah					Loss(Rounded)	= 24,000

(b) Dry season paddy

	Yield		Unit price		Net income ratio	Rp/ha
Irrigated ...	3.39 t/ha*	x	19 Rp/kg	x	0.35	= 22,544
Rainfed	1.50 t/ha**	x	15 Rp/kg	x	0.00	= 0
* 5-yr average (1965-1969) of Gadu					Difference	= 22,544
**10-yr average (1960-1969) of Gogo					Loss(Rounded)	= 22,000

(c) Pollowidjo

Irrigated (Net income)	7,000 Rp/ha
Rainfed	5,000
Difference	2,000
Loss	2,000

Note : Unit price, Dry stalk paddy; 15 Rp/kg, Dry paddy; 19 Rp/kg

7. Calculation of Amount of Losses on Agricultural Production.

Using the figures described in the above, the loss calculation were made for the future 50 years according to the decreasing tendency of the beneficial area as shown in the following tables.

Table 1 Calculation of Amount of Losses on Agricultural Production in the Gunungsari Irrigation System (in case that the beneficial area will decrease after the straight line formula)

N	Year	Beneficial Area (ha)	Water Req't in Feb. (cu.m/s)	Expected Harvest Area			Expected Amount of Losses			
				Rainy Season Paddy (ha)	Dry Season Paddy (ha)	Polo-widjo (ha)	Rainy Season Paddy (1000Rp)	Dry Season Paddy (1000Rp)	Polo-widjo (1000Rp)	Total (1000Rp)
1	1973	3,797	6.61	2,197	1,595	114	52,728	35,090	228	88,046
2	74	3,788	6.59	2,197	1,591	114	52,728	35,002	228	87,958
3	75	3,779	6.58	2,197	1,587	113	52,728	34,914	226	87,868
4	76	3,770	6.56	2,197	1,583	113	52,728	34,826	226	87,780
5	77	3,761	6.54	2,197	1,580	113	52,728	34,760	226	87,714
6	78	3,752	6.53	2,197	1,576	113	52,728	34,672	226	87,626
7	79	3,743	6.51	2,197	1,572	112	52,728	34,584	224	87,536
8	80	3,734	6.50	2,197	1,568	112	52,728	34,496	224	87,448
9	81	3,725	6.48	2,197	1,565	112	52,728	34,430	224	87,382
10	82	3,716	6.47	2,197	1,561	111	52,728	34,342	222	87,292
11	1983	3,707	6.45	2,197	1,557	111	52,728	34,254	222	87,204
12	84	3,699	6.44	2,197	1,554	111	52,728	34,188	222	87,138
13	85	3,689	6.42	2,197	1,549	111	52,728	34,078	222	87,028
14	86	3,680	6.40	2,197	1,546	110	52,728	34,012	220	86,960
15	87	3,671	6.39	2,197	1,542	110	52,728	33,924	220	86,872
16	88	3,662	6.37	2,197	1,538	110	52,728	33,836	220	86,784
17	89	3,654	6.36	2,197	1,535	110	52,728	33,770	220	86,718
18	90	3,645	6.34	2,197	1,531	109	52,728	33,682	218	86,628
19	91	3,636	6.33	2,197	1,527	109	52,728	33,594	218	86,540
20	92	3,627	6.31	2,197	1,523	109	52,728	33,506	218	86,452
21	1993	3,617	6.29	2,197	1,519	109	52,728	33,418	218	86,364
22	94	3,609	6.28	2,197	1,516	108	52,728	33,352	216	86,296
23	95	3,600	6.26	2,197	1,512	108	52,728	33,264	216	86,208
24	96	3,591	6.25	2,197	1,508	108	52,728	33,176	216	86,120
25	97	3,583	6.23	2,197	1,505	107	52,728	33,110	214	86,052
26	98	3,573	6.22	2,197	1,501	107	52,728	33,022	214	85,964
27	99	3,564	6.20	2,197	1,497	107	52,728	32,934	214	85,876
28	2000	3,555	6.19	2,197	1,493	107	52,728	32,846	214	85,788
29	01	3,546	6.17	2,197	1,489	106	52,728	32,758	212	85,698
30	02	3,537	6.15	2,197	1,486	106	52,728	32,692	212	85,632
31	2003	3,528	6.14	2,197	1,482	106	52,728	32,604	212	85,544
32	04	3,519	6.12	2,197	1,478	106	52,728	32,516	212	85,456
33	05	3,501	6.09	2,197	1,470	105	52,728	32,340	210	85,278
34	06	3,492	6.08	2,197	1,467	105	52,728	32,274	210	85,212
35	07	3,483	6.06	2,197	1,463	104	52,728	32,186	208	85,122
36	08	3,475	6.05	2,197	1,460	104	52,728	32,120	208	85,056
37	09	3,466	6.03	2,197	1,456	104	52,728	32,032	208	84,968
38	10	3,456	6.01	2,197	1,452	104	52,728	31,944	208	84,880
39	11	3,447	6.00	2,197	1,448	103	52,728	31,856	206	84,790
40	12	3,438	5.98	2,197	1,444	103	52,728	31,768	206	84,702
41	2013	3,430	5.97	2,197	1,441	103	52,728	31,702	206	84,636
42	14	3,421	5.95	2,197	1,437	103	52,728	31,614	206	84,548
43	15	3,412	5.94	2,197	1,433	102	52,728	31,526	204	84,458
44	16	3,403	5.92	2,197	1,429	102	52,728	31,438	204	84,370
45	17	3,393	5.90	2,197	1,425	102	52,728	31,350	204	84,262
46	18	3,385	5.89	2,197	1,422	102	52,728	31,284	204	84,196
47	19	3,376	5.87	2,197	1,418	101	52,728	31,108	202	84,126
48	20	3,367	5.86	2,197	1,414	101	52,728	31,108	202	84,038
49	21	3,358	5.84	2,197	1,410	101	52,728	31,020	202	83,950
50	22	3,349	5.83	2,197	1,407	100	52,728	30,954	200	83,882

Table 2 Calculation of Amount of Losses on Agricultural Production in the Gunungsari Irrigation System (in case that the beneficial area will decrease after the exponencial curve formula)

N	Year	Beneficial Area (ha)	Water Req't in Feb. (cu.m/s)	Expected Harvest Area			Expected Amount of Losses			
				Rainy Season Paddy (ha)	Dry Season Paddy (ha)	Polo-widjo (ha)	Rainy Season Paddy (1000Rp)	Dry Season Paddy (1000Rp)	Polo-widjo (1000Rp)	Total (1000Rp)
1	1973	3,788	6.59	2,197	1,591	114	52,728	35,002	228	87,958
2	74	3,775	6.57	2,197	1,586	113	52,728	34,892	226	87,846
3	75	3,760	6.54	2,197	1,579	113	52,728	34,738	226	87,692
4	76	3,744	6.51	2,197	1,572	112	52,728	34,584	224	87,536
5	77	3,727	6.48	2,197	1,565	112	52,728	34,430	224	87,382
6	78	3,712	6.46	2,197	1,559	111	52,728	34,298	222	87,248
7	79	3,689	6.42	2,197	1,549	111	52,728	34,078	222	87,028
8	80	3,667	6.38	2,197	1,540	110	52,728	33,880	220	86,828
9	81	3,645	6.34	2,197	1,531	109	52,728	33,682	218	86,628
10	82	3,620	6.30	2,197	1,520	109	52,728	33,440	218	86,386
11	1983	3,594	6.25	2,197	1,509	108	52,728	33,198	216	86,142
12	84	3,567	6.21	2,197	1,498	107	52,728	32,956	214	85,898
13	85	3,535	6.15	2,197	1,485	106	52,728	32,670	212	85,690
14	86	3,502	6.09	2,197	1,471	105	52,728	32,362	210	85,300
15	87	3,466	6.03	2,197	1,456	104	52,728	32,032	208	84,968
16	88	3,428	5.96	2,197	1,440	103	52,728	31,680	206	84,614
17	89	3,388	5.90	2,197	1,423	102	52,728	31,306	204	84,238
18	90	3,344	5.82	2,197	1,404	100	52,728	30,888	200	83,816
19	91	3,296	5.74	2,197	1,384	99	52,728	30,448	198	83,374
20	92	3,246	5.65	2,197	1,363	97	52,728	29,986	194	82,908
21	1993	3,191	5.55	2,197	1,340	96	52,728	29,480	192	82,400
22	94	3,132	5.45	2,197	1,315	94	52,728	28,930	188	81,846
23	95	3,068	5.34	2,197	1,289	92	52,728	28,358	184	81,270
24	96	3,001	5.22	2,197	1,260	90	52,728	27,720	180	80,628
25	97	2,926	5.09	2,197	1,229	88	52,728	27,038	176	79,942
26	98	2,847	4.95	2,197	1,196	85	52,728	26,312	170	79,210
27	99	2,762	4.81	2,197	1,160	83	52,728	25,520	166	78,414
28	2000	2,671	4.65	2,197	1,122	80	52,728	24,684	160	77,572
29	01	2,573	4.48	2,197	1,081	77	52,728	23,782	154	76,664
30	02	2,468	4.29	2,197	1,037	74	52,728	22,814	148	75,690
31	2003	2,354	4.10	2,197	984	71	52,728	21,648	142	74,518
32	04	2,231	3.88	2,084	937	67	50,016	20,614	134	70,764
33	05	2,100	3.65	1,961	882	63	47,064	19,404	126	66,594
34	06	1,958	3.41	1,829	822	59	43,896	18,084	118	62,098
35	07	1,805	3.14	1,686	758	54	40,464	16,676	108	57,248
36	08	1,617	2.81	1,510	679	49	36,240	14,938	98	51,276
37	09	1,466	2.55	1,369	616	44	32,856	13,552	88	46,496
38	10	1,277	2.22	1,193	536	38	28,632	11,792	76	40,500
39	11	1,072	1.87	1,001	450	32	24,024	9,900	64	33,988
40	12	853	1.49	797	358	26	19,128	7,876	52	27,056
41	2013	617	1.07	576	259	19	13,824	5,698	38	19,560
42	14	130	0.23	121	55	4	2,904	1,210	8	4,122
43	15	90	0.16	84	38	3	2,016	836	6	2,858
44	16	0	0	0	0	0	0	0	0	0
45	17	0	0	0	0	0	0	0	0	0
46	18	0	0	0	0	0	0	0	0	0
47	19	0	0	0	0	0	0	0	0	0
48	20	0	0	0	0	0	0	0	0	0
49	21	0	0	0	0	0	0	0	0	0
50	22	0	0	0	0	0	0	0	0	0

CHAPTER XXVI

INNUNDATION OF THE MARMOJO RIVER BASIN

1. Examination of Inundations of the Marmojo River.

Basin with and without Flood Diversion from the Brantas River through the Gedeg and Mlirip Sluices.

(1) Discharges of each river and inundation of the Marmojo river basin when the Brantas flood discharge is divided.

The records about inundation of the Marmojo river basin due to the flood which took place in 1959 under the present controlling method that diverts a part of the Brantas flood discharge through the Gedeg and Mlirip sluices are shown in Fig. 1. Also the water levels at the Gedeg and Mlirip sluices, Mernung dam and Perning and the discharges at these points calculated from the stage-discharge curves aforementioned are shown in Fig. 2 respectively with solid lines. Using the results given in Fig. 2, the discharge of the Marmojo river after receiving that of the Gedeg river has been estimated roughly on the two assumptions - one that such discharge is the sum of discharge at the Mernung dam point and that of the Gedeg river, and another that it is the discharge at the Perning point from which the discharge at the Mlirip point and that of the Watudakon river presumed to be a fixed discharge of 70 m^3/sec are deducted. The results of estimations by these two methods are shown in Fig. 2; the discharge curves closely resemble one another though there is a time lag of about ten hours and there seems to be a good relatively between respective discharges. Therefore, it seems that the discharges at various points and the discharge of the Marmojo river after receiving that of the Gedeg river (here, the average of the discharges estimated by the above two methods) are reliable to analysis. Though some questionable points are noted in the records, comparison between the duration of inundation in both basins of the Wonoaju and the Bekutjuk rivers and the discharge hydrograph at Perning, between the duration of inundation in the Pendjalinwakul river basin and the discharge hydrograph of the Gedeg river, and between the duration of inundation in the upper Marmojo basin and the discharge hydrograph of the Marmojo river after joining the Gedeg river indicates that the drainage of landside water in each basin is impossible due to the backwater effects of the large discharges in the respective stem river.

Taking into consideration the above points, the discharges probable to cause any inundation have been estimated roughly for various districts. From this, it seems that an inundation will take place when the discharge of Perning point exceeds about 350 m^3/sec for the Wonoaju and Bukutjuk districts, that of the Gedeg river about 60 m^3/sec for the Pendjalinwakul district and that of the Marmojo river after receiving that of the Gedeg river about 100 m^3/sec for the Marmojo district.

(2) Estimation of discharge and inundation of the Marmojo river basin at the time of flood in 1959 if no diversion of flood discharge had been made.

If no diversion of flood of the Brantas river had been made through the Gedeg and Mlirip sluices for the flood in 1959, the discharges at various points would have been as shown in Fig. 2. It is seen from the Figure that

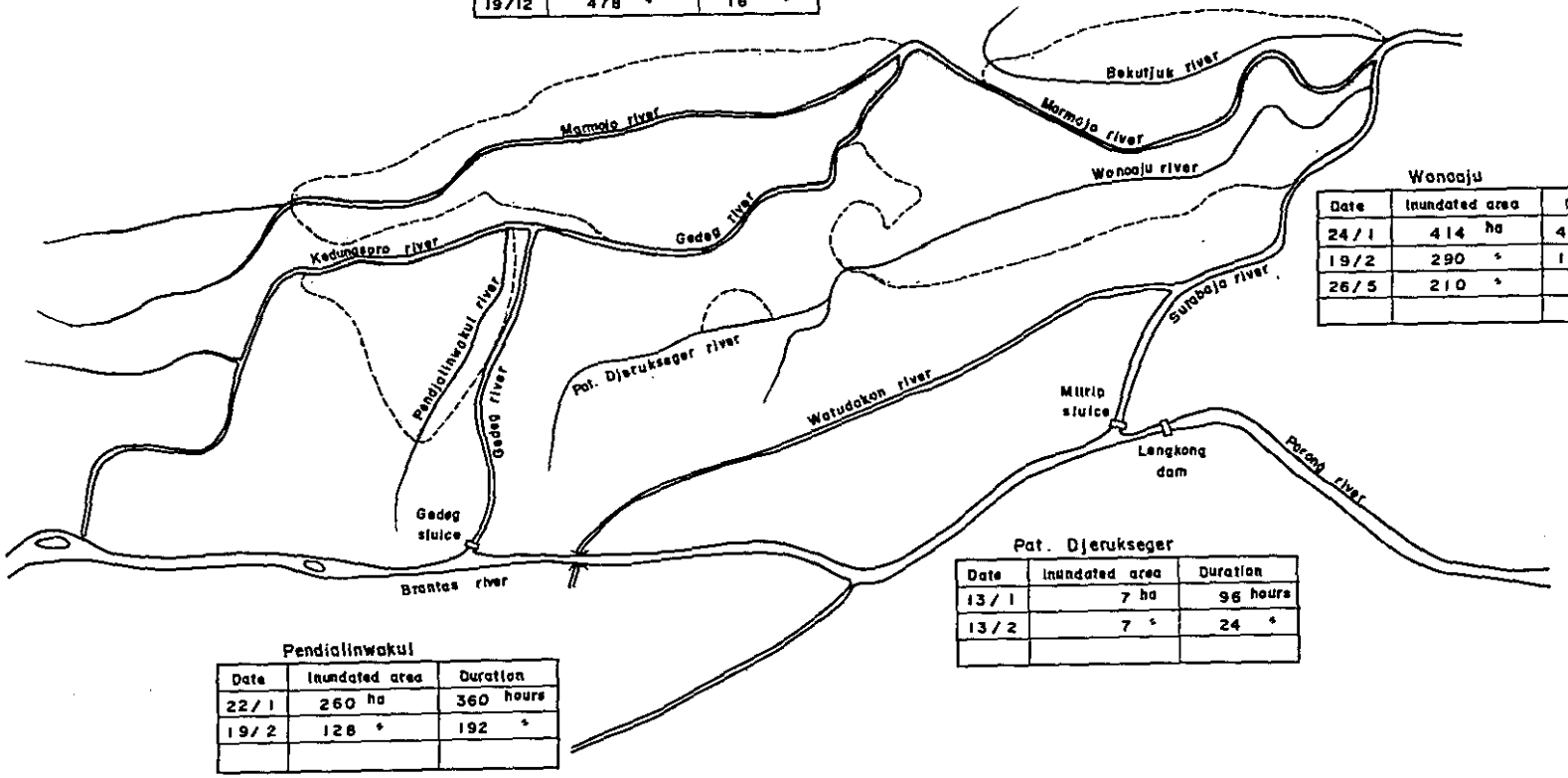
Fig. 1 Inundation of the Marmojo River in 1959

Marmojo

Date	Inundated area	Duration
16/1	380 ha	144 hours
17/2	175 "	120 "
21/3	889 "	24 "
19/12	478 "	16 "

Bekutjuk

Date	Inundated area	Duration
31/1	322 ha	168 hours
19/2	322 "	192 "
26/5	80 "	96 "



Wonoaju

Date	Inundated area	Duration
24/1	414 ha	408 hours
19/2	290 "	192 "
26/5	210 "	96 "

Pat. Djerukseger

Date	Inundated area	Duration
13/1	7 ha	96 hours
13/2	7 "	24 "

Pendialinwakul

Date	Inundated area	Duration
22/1	260 ha	360 hours
19/2	128 "	192 "

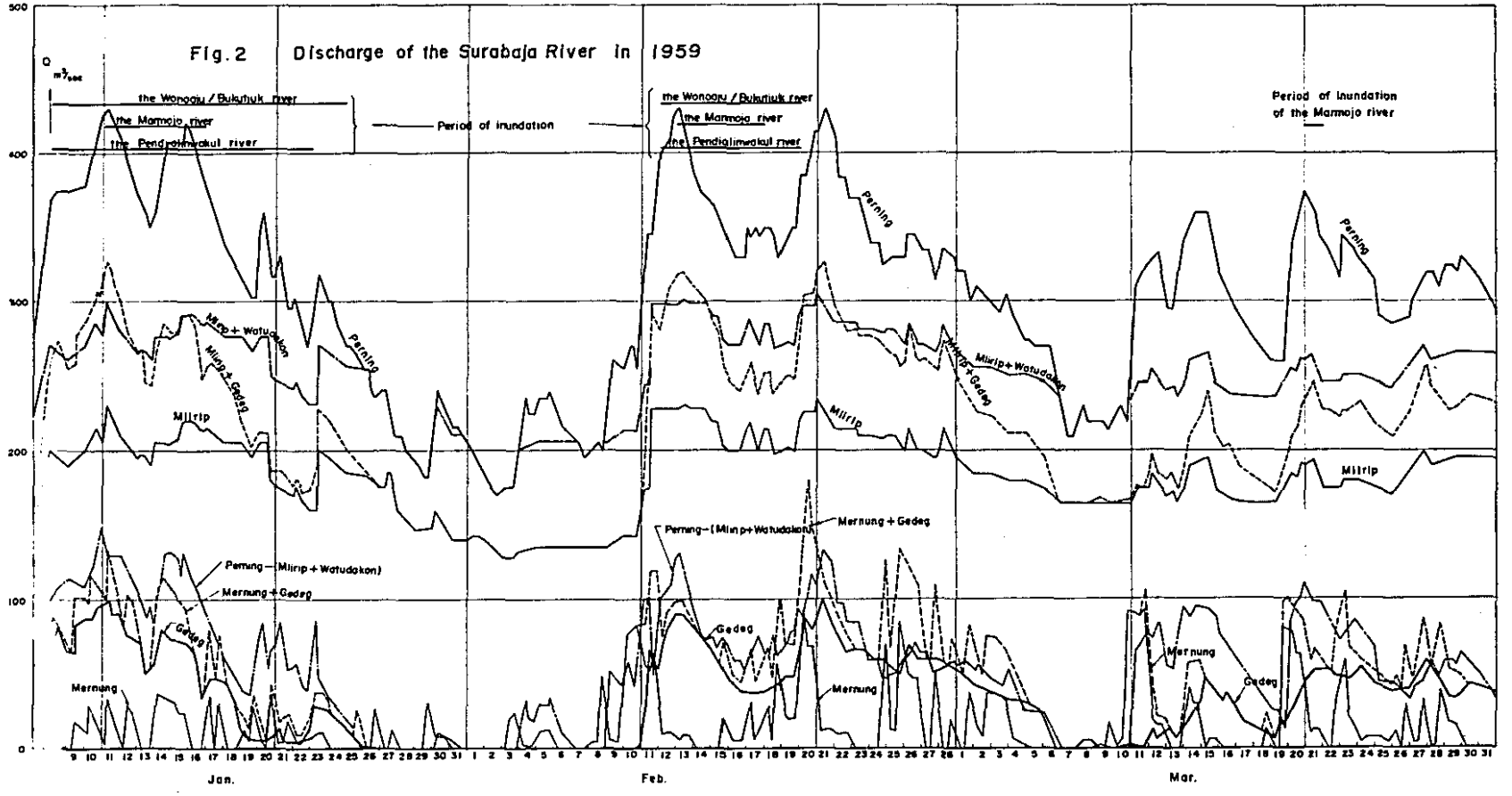


Fig. 2 Discharge of the Surabaja River in 1959
Q m³/sec
the Wonogiri / Bulukituk river
the Marmoja river
the Pendjalinwakul river
Period of inundation
Period of inundation of the Marmoja river
Perning
Mirip + Watudakon
Mirip + Gedeg
Mirip
Perning – (Mirip + Watudakon)
Mernung + Gedeg
Gedeg
Mernung
Jan.
Feb.
Mar.

no inundation would have taken place in the Wonoaju and Bukutjuk districts because of the discharge at the Perning point being about 200 m^3/sec; that the discharge of the Gedeg river would be nearly nil causing no inundation of the Pendjalinwakul district; and that the discharge of the Marmojo river after receiving that of the Gedeg river would be less than 100 m^3/sec, so any inundation would not have taken place in the Marmojo district.

Thus, it is believed that any inundation of the Marmojo river basin due to the flood in 1959 would not have taken place if the flood of the Brantas river were not diverted through the Gedeg and Mlirip sluices. If the practice of diverting the Brantas flood is ceased, it is likely that any inundation of the Marmojo river will almost be avoided and even if any inundation should take place it will be of very short duration.

2. Flooding of Upper Part of the Marmojo River Upstream of the Confluence with the Gedeg River and Improvement of that Part.

(1) Stage-discharge curve at typical profile on the existing river channel.

The plan of upper part of the Marmojo river upstream from the confluence with the Gedeg river and the no. of profiles for which the calculations are made are shown in Fig. 3. For these five typical profiles numbered I to V, the respective cross sections have been supposed to be as shown in Fig. 4 on the basis of topographical map, and the Manning's coefficient of roughness, n, of the Marmojo river has been assumed at 0.03 to calculate the discharges and stages by the Manning's mean velocity formula; the relations between them are shown in Table 1 and Fig. 5.

Fig. 3 Inundation of Upper Basin of the Marmojo River

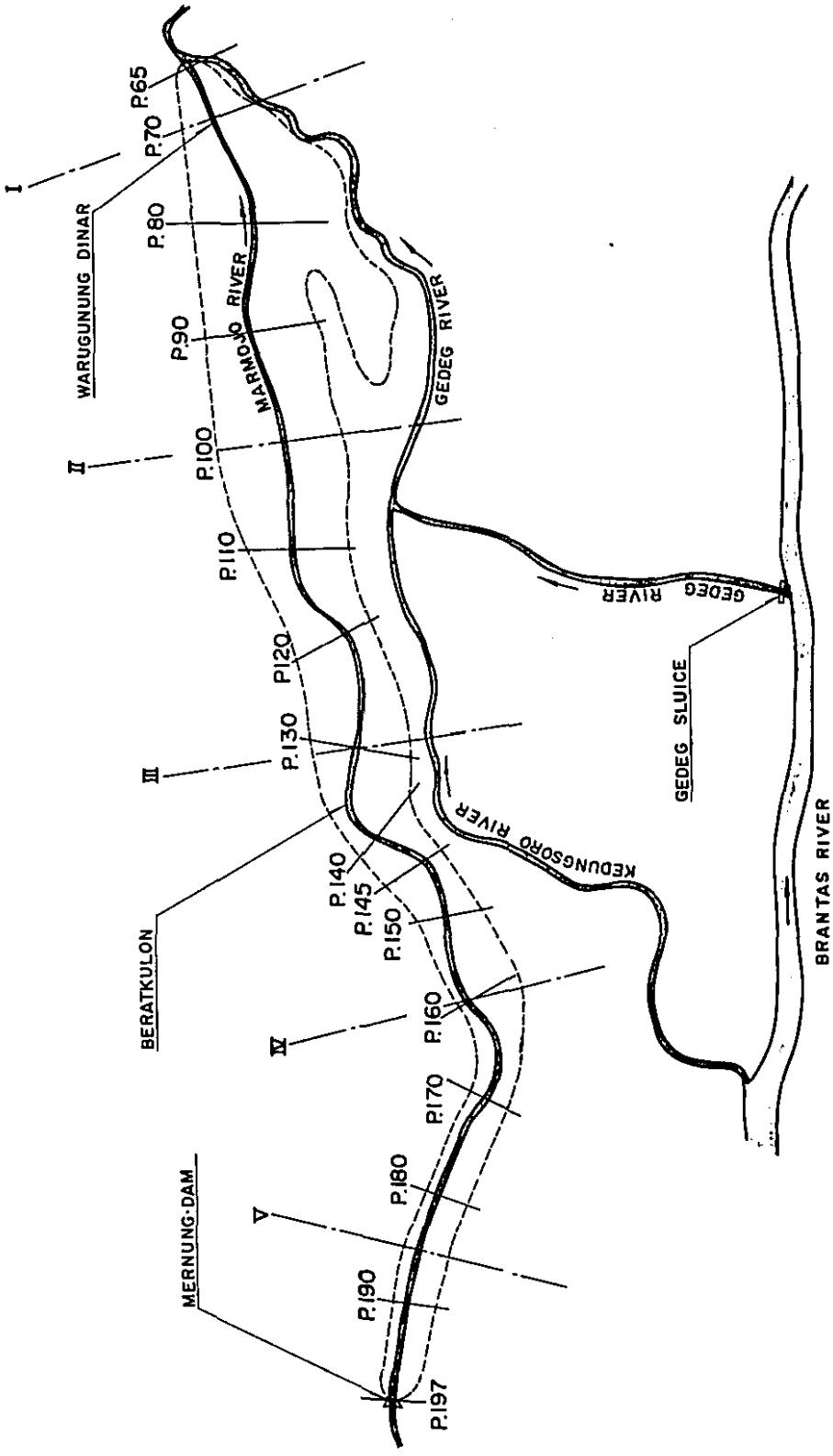


Fig. 4 Lateral Profile of the Mormojo River

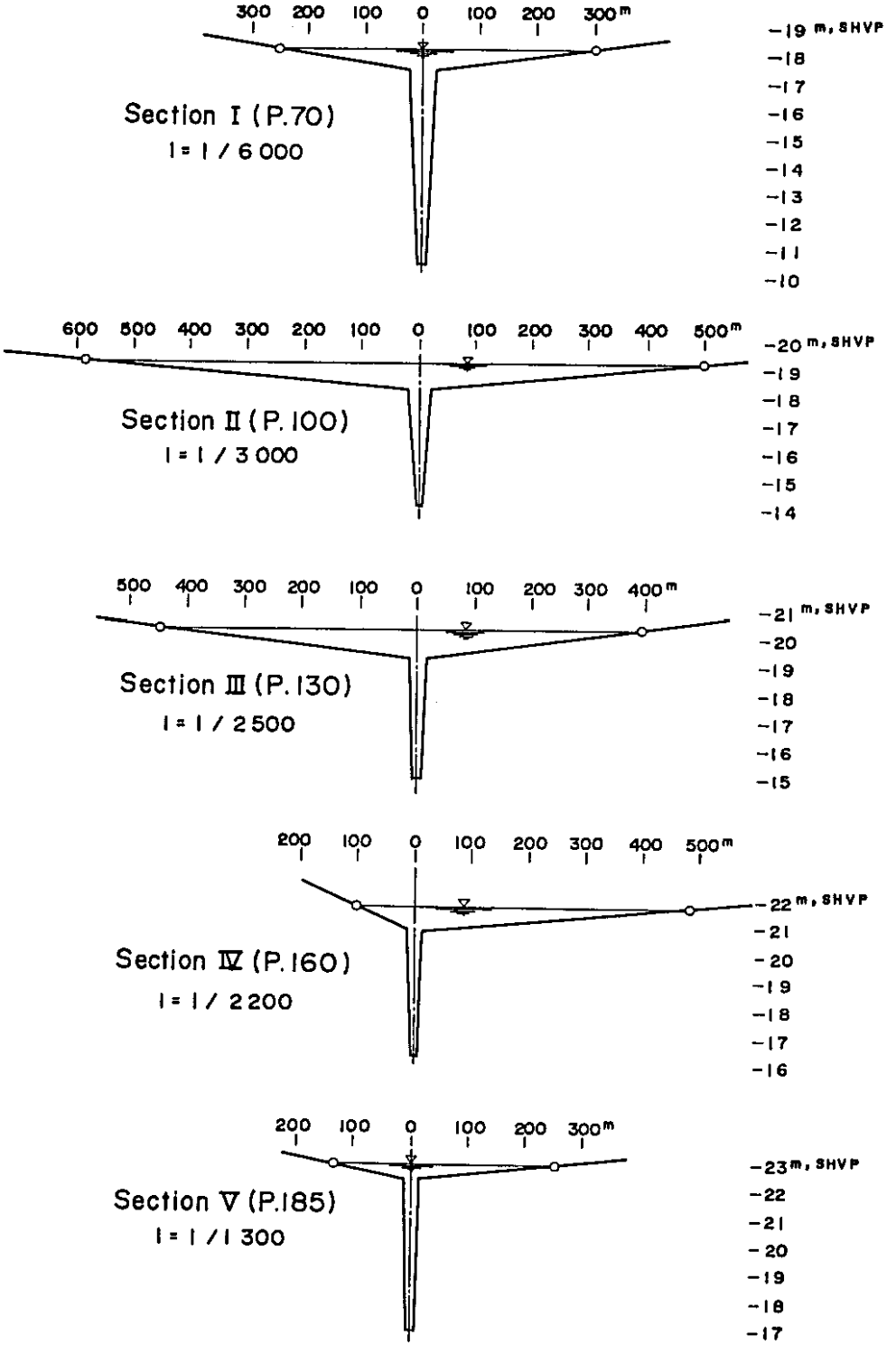


Fig. 5 Stage-Discharge Curve

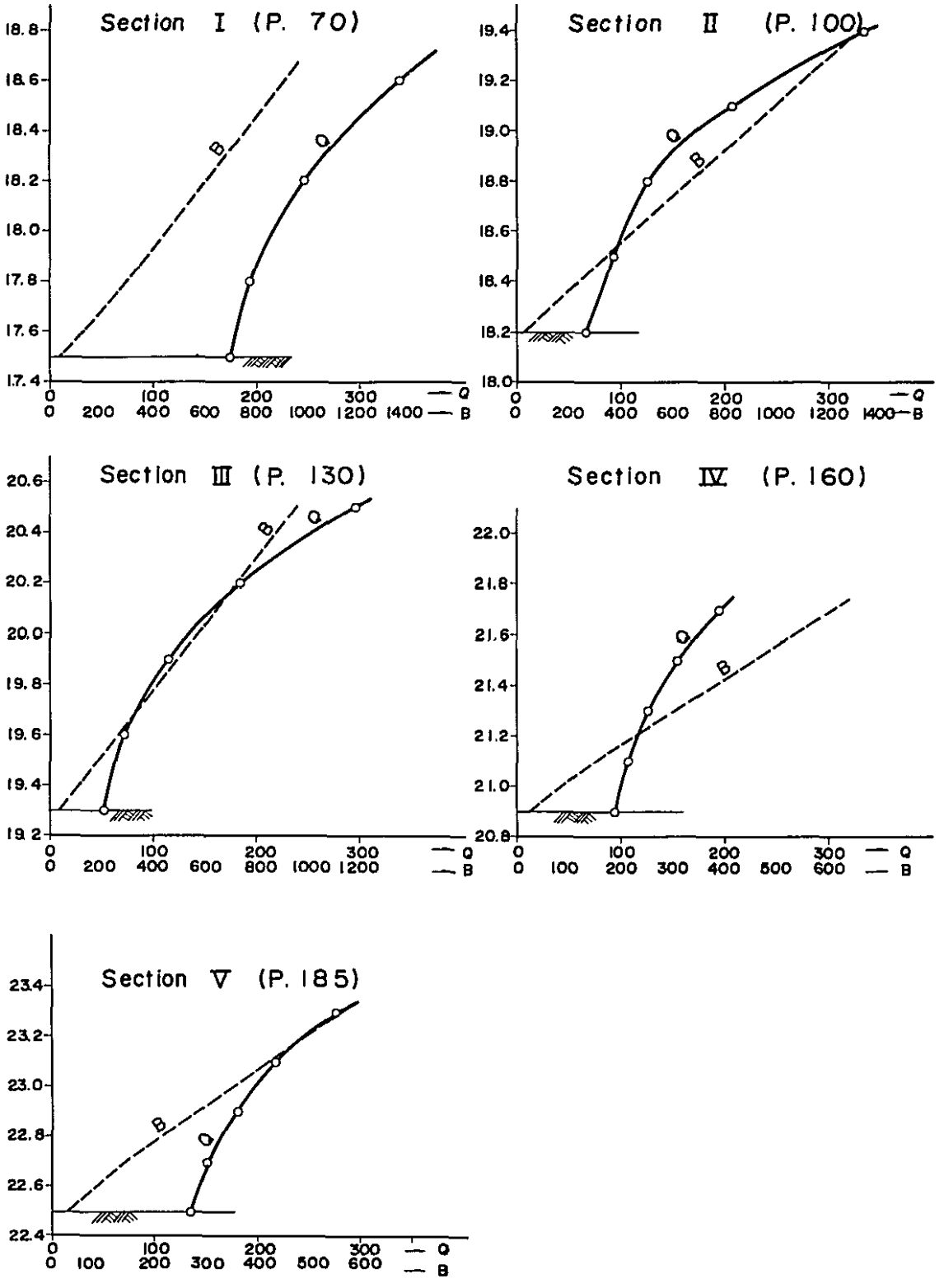


Table 1 Calculation of H-Q for Respective Profiles

Section No.	H.	(I) $I^{1/2}$	River channel (1/n=1/0.03=33.333) A_1	R_1	$R_1^{2/3}$	Q_1	Protected low-land (1/n=1/0.05=20.) A_2	R_2	$R_2^{2/3}$	Q_2	$Q=Q_1+Q_2$
		(1/6,000)	m^2	m		m^3/s	m^2	m		m^3/s	m^3/s
	17.5	0.0129	185	3.25	2.194	174.					174.
	17.8	"	196	3.44	2.279	192.	45.	0.1495	0.282	3.3	195.
I	18.2	"	211	3.71	2.397	216.	225.	0.374	0.519	30.1	246.
	18.6	"	226	3.97	2.507	243.	525.	0.582	0.697	94.5	338.
	19.0	"	240	4.22	2.611	269.	945.	0.785	0.851	207.0	476.
		(1/3,000)									
	18.2	0.01825	75	1.73	1.441	66.					66.
	18.5	"	86	1.98	1.577	88.	50.	0.151	0.284	5.2	93.
II	18.8	"	96	2.21	1.697	99.	178.	0.269	0.417	27.1	126.
	19.1	"	107	2.47	1.827	119.	425.	0.429	0.569	88.3	207.
	19.4	"	117	2.70	1.939	138.	772.	0.583	0.698	196.5	335.
		(1/2,500)									
	19.3	0.020	61	1.425	1.266	52.					52.
	19.6	"	72	1.68	1.416	68.	39.	0.150	0.282	4.4	72.
III	19.9	"	83	1.94	1.558	87.	152.	0.31	0.458	28.0	115.
	20.2	"	94	2.195	1.689	106.	333.	0.461	0.597	80.0	186.
	20.5	"	105	2.455	1.820	127.	584.	0.613	0.722	169.0	296.
		(1/2,200)									
	20.9	0.0213	78	2.29	1.737	96.					96.
	21.1	"	83	2.44	1.812	107.	15.	0.10	0.215	1.4	108.
IV	21.3	"	88	2.59	1.886	118.	60.	0.199	0.341	8.7	127.
	21.5	"	93	2.73	1.953	129.	135.	0.299	0.447	25.7	155.
	21.7	"	98	2.88	2.024	141.	240.	0.399	0.542	55.4	196.
		(1/1,300)									
	22.5	0.0285	88	2.045	1.611	135.					135.
	22.7	"	94	2.18	1.681	150.	14.	0.10	0.215	1.7	152.
V	22.9	"	101	2.35	1.768	170.	56.	0.199	0.341	10.9	181.
	23.1	"	107	2.49	1.837	186.	126.	0.30	0.448	32.2	218.
	23.3	"	114	2.65	1.915	208.	224.	0.399	0.542	69.1	277.

(2) Probable flood and flooding of upper part of the Marmojo river.

The discharge distribution in the probable flood of the Marmojo river is shown in Table 2.

Table 2 Probable Flood at Various Points of the Marmojo River

(unit : m^3/s)

Point \ Flood probability (years)	1.05	2.0	5.	10.	20.	50.
Merunung - Beratkulon	63	101	130	149	166	190
Beratkulon - Warugungdinar	78	125	161	184	205	235
Wargungdinar - Klubuk	84	135	174	199	222	254

For these probable floods the water level and widths of water surface at respective typical profiles have been found from Fig. 5, which are shown in Table 3.

Table 3 Inundation Water Level and Width in Each Probable Flood of the Marmojo River

Section No.	Flood level; width of water surface \ Flood probability (years)	1.05	2	5	10	20	50
I	Level (m, SHVP)	-	-	-	17.86	18.05	18.24
	Width (m)	-	-	-	340.	490.	640.
II	Level (m, SHVP)	18.33	18.80	18.96	19.04	19.09	19.18
	Width (m)	160.	660.	840.	930.	980.	1080.
III	Level (m, SHVP)	19.66	19.91	20.11	20.20	20.27	20.35
	Width (m)	310.	500.	650.	720.	780.	840.
IV	Level (m, SHVP)	-	21.00	21.33	21.46	21.56	21.67
	Width (m)	-	70.	320.	420.	500.	580.
V	Level (m, SHVP)	-	-	-	22.67	22.80	22.96
	Width (m)	-	-	-	120.	210.	320.

The supposed inundation map for the 20-year flood is as shown in Fig. 3 and the longitudinal profile of such inundation is shown in Fig. 6.

(3) Water level in improved river channel.

If the improved sections of the Marmojo river are as shown in Fig. 7, the results of hydraulic calculation and the quantities of the works of excavation and embankment are as shown in Tables 4 and 5.

Fig 6 Water Level of the Marmoja River

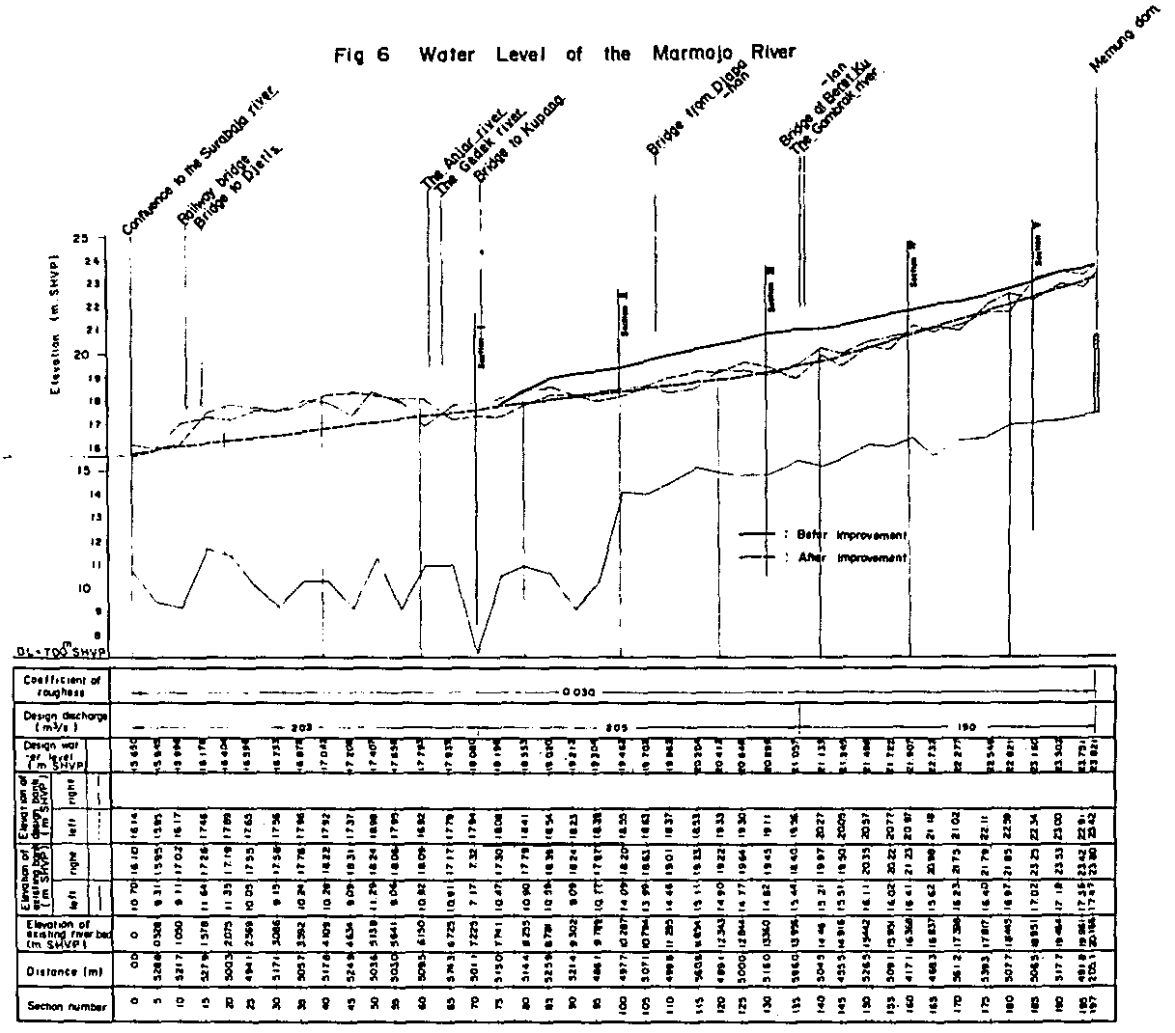


Fig. 7 Improved Cross-Section of the Marmojo River

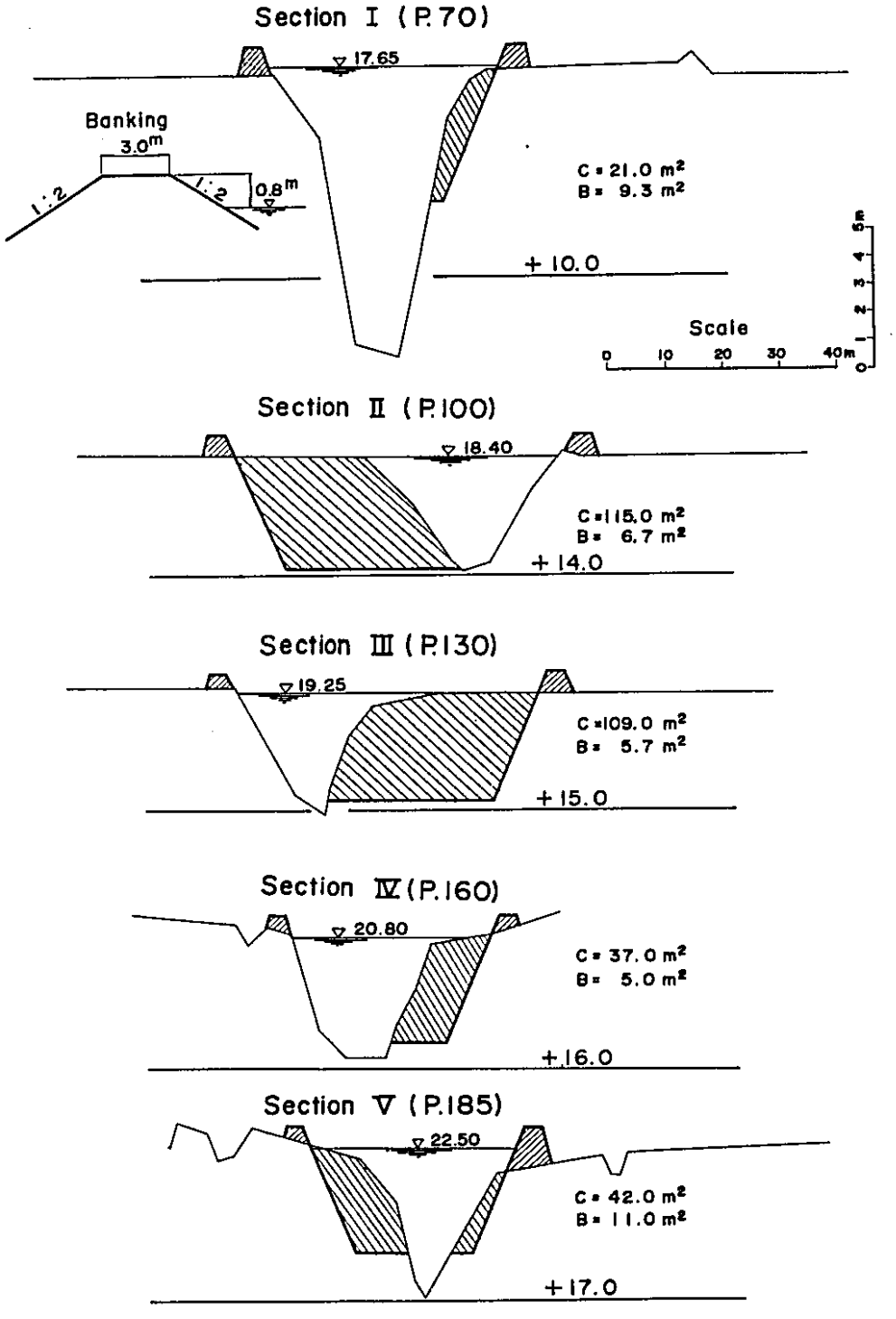


Table 4 Stage and discharge of improved river calculated by the mean velocity formula

Section No.	H (m,SHVP)	I	A (m^2)	R (m)	$R^{2/3}$	$I^{1/2}/n$	Q (m^3/s)	Design discharge (m^3/s)
I	17.65	1/4,000	210	3.44	2.279	0.527	252	222
II	18.40	1/4,000	196	3.00	2.080	0.527	215	205
III	19.25	1/2,500	170	2.80	1.987	0.667	225	205
IV	20.80	1/1,500	110	2.50	1.842	0.860	174	166
V	22.50	1/1,500	115	2.25	1.717	0.860	170	166

Table 5 Quantity of earth excavated and embanked

Section No.	Length of section	Excavation			Embankment		
		Cross sectional area	Average area	Quantity of earth	Cross sectional area	Average area	Quantity of earth
I	0m	21.0m^2	m^2	m^3	9.3m^2	m^2	m^3
II	3,000	115.0	68.	204,000	6.7	8.0	24,000
III	3,000	109.0	112.	336,000	5.7	6.2	18,600
IV	3,000	37.0	73.	219,000	5.0	5.35	16,050
V	3,700	42.0	39.5	146,150	11.0	8.0	29,600
Total				903,150			88,250

(4) Construction costs and amount of flood damages.

The construction costs for the improvement of the river channel are estimated roughly as floows:

Excavation :	903.150 m^3 @ Rp 365	Rp 329,649,750
Embankment :	88,250 m^3 @ Rp 420	Rp 37,065,000
Other works:	suit	Rp 33,284,250
Total		Rp 400,000,000

As the damages due to the flooding of the existing river channel is estimated at about Rp 10,000,000 on the annual average, the above works to prevent any flooding will not be feasible economically.

PART 5

DATA LIST

CHAPTER I

DATA ON HYDROLOGY

1. Rainfall. file No.

(1) Terms on the raingage station HY-3

1) Station name : Gubeng/Kedungtjowek/Larangan/Keputih /Kebonagung/Wonoredjo/Gunungsari/ Banjuurip/Semimi/Tapen/Kabuh/Tandjung/ Wringinanom/Krikilan/Gedeg/Wonokromo/ Kedung/Terusan/Djatisari

2) Terms : station name/type of raingage/year of start/ managing office/elevation of station site/ gaging time of daily rainfall/period of daily rainfall data/period of hourly rainfall data

(2) Location map of raingage stations

a. Fig. 1.1 General orientation inundated area in connection with Surabaja river project PL-2
b. On the raingage station in the Brantas river basin PL-6

(3) Daily rainfall

a. Gubeng station : 1950(Jan.) - 1971(Dec.)
i) 1950(Jan.) - 1970(Dec.) HY-1
ii) 1971(Jan. - Dec.) HY-3

b. Kedungtjowek station : 1950(Jan.) - 1971(Dec.)
i) 1950(Jan.) - 1970(Dec.) HY-1
ii) 1971(Jan. - Dec.) HY-3

c. Larangan station : 1950(Jan.) - 1971(Dec.)
i) 1950(Jan.) - 1970(Dec.) HY-1
ii) 1971(Jan. - Dec.) HY-3

d. Keputih station : 1950(Jan.) - 1971(Dec.)
i) 1950(Jan.) - 1970(Dec.) HY-1
ii) 1971(Jan. - Dec.) HY-3

e. Kebonagung station : 1950(Jan.) - 1971(Dec.)
i) 1950(Jan.) - 1970(Dec.) HY-1
ii) 1971(Jan. - Dec.) HY-3

f. Wonoredjo station : 1950(Jan.) - 1971(Dec.)
i) 1950(Jan.) - 1970(Dec.) HY-1
ii) 1971(Jan. - Dec.) HY-3

g. Gunungsari station : 1950(Jan.) - 1971(Dec.)
i) 1950(Jan.) - 1970(Dec.) HY-1
ii) 1971(Jan. - Dec.) HY-3

h. Banjuurip station : 1950(Jan.) - 1971(Dec.)
   i) 1950(Jan.) - 1970(Dec.) HY-1
   ii) 1971(Jan. - Dec.) HY-3

i. Semimi station : 1950(Jan.) - 1971(Dec.)
   i) 1950(Jan.) - 1970(Dec.) HY-1
   ii) 1971(Jan. - Dec.) HY-3

j. Tapen station : 1950(Jan.) - 1971(Dec.)
   i) 1950(Jan. - Dec.), 1970(Jan. - Dec.) HY-2
   ii) 1951(Jan.)-1965(Dec.), 1967(Jan.)-1969(Dec.) HY-1
   iii) 1966(Jan. - Dec.), 1971(Jan. - Dec.) HY-3

k. Kabuh station : 1950(Jan.) - 1971(Dec.)
   i) 1950(Jan. - Dec.), 1970(Jan. - Dec.) HY-2
   ii) 1951(Jan.)-1965(Dec.), 1967(Jan.)-1969(Dec.) HY-1
   iii) 1966(Jan. - Dec.), 1971(Jan. - Dec.) HY-3

l. Tandjung station : 1950(Jan.) - 1971(Dec.)
   i) 1950(Jan. - Dec.), 1970(Jan. - Dec.) HY-2
   ii) 1951(Jan.)-1965(Dec.), 1968(Jan.)-1969(Dec.) HY-1
   iii) 1966(Jan.)-1967(Dec.), 1971(Jan. - Dec.) HY-3

m. Wringinanom station : 1950(Jan.) - 1971(Dec.)
   i) 1950(Jan.)-1951(Dec.), 1970(Jan. - Dec.) HY-2
   ii) 1952(Jan.) - 1969(Dec.) HY-1
   iii) 1971(Jan. - Dec.) HY-3

n. Krikilan station : 1950(Jan.) - 1971(Dec.)
   i) 1950(Jan.)-1952(Dec.), 1957(Jan.)-1959(Dec.), 1970(Jan. - Dec.) HY-2
   ii) 1953(Jan.)-1956(Dec.), 1960(Jan.)-1969(Dec.) HY-1
   iii) 1971(Jan. - Dec.) HY-3

o. Gedeg station : 1958(Jan.) - 1971(Dec.) HY-3

p. Surabaja station : 1962(Jan.) - 1971(Dec.) HY-3

q. Terusan station : 1950(Jan.) - 1971(Dec.) HY-3

r. Djatisari station : 1950(Jan. - Dec.), 2603?, 2604?. 1956(Apr.) - 1971(Dec.) HY-3

s. Wonokromo station : 1971(Jan.) - 1972(Feb.) HY-3

t. Kedung station : 1971(Jan. - Dec.) HY-3

u. Djombang station : 1950(Jan.) - 1965(Dec.) 1967(Jan.) - 1970(Dec.) HY-3

(4) Diagram of :

a. Fig. 5.1 Rainfall (1950 - 1970)
b. Fig. 5.2 Mean of monthly total discharge (1950 - 1970)
c. Fig. 5.3 Max. & min. discharge (1948 - 1970)

(5) Copies of records of recording raingage HY-4

a. *Surabaja station* : 1962(Jan.) - 1972(Feb.)
   i) 1962(Jan.) - 1971(Dec.); storm of which daily rainfall is larger than 50mm.
   ii) 1972(Jan. - Feb.); every storm

b. Wonokromo station : 1971(Jan.) - 1972(Feb.)
   i) 1971(Jan.)-1972(Jan.); storm of which daily rainfall is larger than 50mm.
   ii) 1972(Feb.); every storm

2. Water Level and Tide Level

(1) Water level

Data marked * show daily water level records and rests are records taken more than three times a day

a. Kedungsoro : 1949(Nov.)-1962(Oct.), 1964(Jan. - Dec.), 1966(Feb.)-1971(Dec.)

	i) 1949(Nov.) - 1953(Jan.)	HY-7
*	ii) 1953(Jan.) - 1960(Dec.)	HY-6
	iii) 1953(Feb.) - 1956(Apr.)	HY-8
	iv) 1956(May) - 1957(Dec.)	HY-9
	v) 1958(Jan.) - 1959(Dec.)	HY-10
	vi) 1960(Jan. - Dec.)	HY-11
	vii) 1961(Jan. - Dec.)	HY-12
	viii) 1962(Jan. - Dec.)	HY-13
	ix) 1964(Jan. - Dec.)	HY-14
	x) 1966(Feb.) - 1971(Oct.)	HY-15
*	xi) 1971(Jan. - Dec.)	HY-5

b. Gedeg : 1949(Nov.)-1962(Dec.), 1964(Jan. - Dec.), 1966(Feb. - Aug.), 1966(Dec.)-1968(Dec.), 1969(Apr.)-1971(Dec.)

i) 1949(Nov.) - 1953(Jan.)	HY-7
ii) 1953(Jan.) - 1960(Dec.)	HY-6
iii) 1953(Feb. - Aug.), 1953(Dec.) - 1956(Apr.)	HY-8
iv) 1956(May) - 1957(Dec.)	HY-9
v) 1958(Jan.) - 1959(Dec.)	HY-10
vi) 1960(Jan. - Dec.)	HY-11
vii) 1961(Jan. - Dec.)	HY-12
viii) 1962(Jan. - Dec.)	HY-13
ix) 1964(Jan. - Dec.)	HY-14
x) 1966(Feb. - Aug.), 1966(Dec.)-1968(Dec.), 1969(Apr.) - 1971(Oct.)	HY-15
xi) 1971(Jan. - Dec.)	HY-5

c. Terusan : 1949(Nov.) - 1971(Dec.)

i) 1949(Nov.) - 1953(Jan.)	HY-7
ii) 1953(Jan.) - 1960(Dec.)	HY-6
iii) 1953(Feb.) - 1957(Dec.)	HY-8
iv) 1956(May) - 1957(Dec.)	HY-9
v) 1958(Jan.) - 1959(Dec.)	HY-10
vi) 1960(Jan. - Dec.)	HY-11
vii) 1960(Oct.) - 1971(Dec.)	HY-5
viii) 1961(Jan. - Dec.)	HY-12
ix) 1962(Jan. - Dec.)	HY-13

x) 1964(Jan. - Dec.)	HY-14
xi) 1966(Dec.)-1967(Mar.), 1968(Mar.), 1971(Jan.-Mar.)	HY-15
xii) 1971(Jan. - Dec.)	HY-16
d. Djabon : 1950(Jan.) - 1971(Dec.)	
* i) 1950(Jan.) - 1970(Dec.)	HY-2
* ii) 1969(Jul. & Nov.), 1970(Mar. Jun. & Jul.); some supplements of i)	HY-3
* iii) 1951(Feb.)-1953(Apr.), 1960(Oct.)-1971(Dec.)	HY-5
* iv) 1953(Jan.) - 1960(Dec.)	HY-6
e. Kepadjaran : 1950(Jan.) - 1971(Dec.)	
* i) 1950(Jan.) - 1970(Dec.)	HY-2
* ii) 1951(Feb.)-1953(Apr.), 1960(Oct.)-1971(Dec.)	HY-5
* iii) 1953(Jan.) - 1960(Dec.)	HY-6
f. Lengkong : 1950(Feb.) - 1962(Dec.), 1964(Jan.-Dec.) 1970(Sep.) - 1971(Dec.)	
i) 1950(Feb.) - 1953(Jan.)	HY-7
ii) 1953(Feb.) - 1956(Apr.)	HY-8
iii) 1956(May) - 1957(Dec.)	HY-9
iv) 1958(Jan.) - 1959(Dec.)	HY-10
v) 1960(Jan. - Dec.)	HY-11
vi) 1961(Jan. - Dec.)	HY-12
vii) 1962(Jan. - Dec.)	HY-13
viii) 1964(Jan. - Dec.)	HY-14
ix) 1970(Sep.) - 1971(Dec.)	HY-16
g. Mlirip : 1950(Jan.) - 1971(Dec.)	
i) 1950(Jan.) - 1971(Dec.)	HY-2
ii) 1969(Jun. & Nov.), 1970(Mar., Jun. & Jul.); some supplements of i)	HY-3
iii) 1950(Feb.) - 1953(Jan.)	HY-7
iv) 1951(Feb.)-1953(Apr.), 1960(Oct.)-1971(Dec.)	HY-5
v) 1953(Jan.) - 1960(Dec.)	HY-6
vi) 1953(Feb.) - 1956(Apr.)	HY-8
vii) 1956(May) - 1957(Dec.)	HY-9
viii) 1958(Jan.) - 1959(Dec.)	HY-10
ix) 1960(Jan. - Dec.)	HY-11
x) 1961(Jan. - Dec.)	HY-12
xi) 1962(Jan. - Dec.)	HY-13
xii) 1964(Jan. - Dec.)	HY-14
xiii) 1970(Sep.) - 1971(Dec.)	HY-16
h. Perning : 1950(Jan.) - 1971(Dec.)	
i) 1950(Jan.) - 1970(Dec.)	HY-2
ii) 1969(Jul. & Nov.), 1970(Mar., Jun. & Jul.); some supplements of i)	HY-3
iii) 1950(Feb.) - 1953(Jan.)	HY-7
iv) 1951(Feb.)-1953(Apr.), 1960(Oct.)-1971(Dec.)	HY-5
v) 1953(Jan.) - 1960(Dec.)	HY-6
vi) 1953(Feb.) - 1956(Apr.)	HY-8
vii) 1956(May) - 1957(Dec.)	HY-9
viii) 1958(Jan.) - 1959(Dec.)	HY-10
ix) 1960(Jan. - Dec.)	HY-11
x) 1961(Jan. - Dec.)	HY-12
xi) 1962(Jan. - Dec.)	HY-13

xii) 1964(Jan. - Dec.) HY-14
xiii) 1970(Sep.) - 1971(Dec.) HY-16

i. Gunungsari dam : HY-18
i) upstream; 1965(Jan.) - 1972(Feb.)
ii) downstream; 1965(Jan.) - 1972(Feb.)

j. Djagir dam : HY-18
i) upstream; 1966(Apr.) - 1971(Dec.)
ii) downstream; 1966(Apr.)-1967(Dec.),
1969(Jan.)-1971(Dec.)

k. Wonokromo dam : HY-18
i) upstream; 1966(Apr.) - 1970(Dec.)
ii) downstream; 1966(Apr.)-1966(Dec.),
1968(Jan.)-1969(Dec.)

l. Gubeng dam : HY-18
i) upstream; 1966(Apr.) - 1971(Dec.)
ii) downstream; 1966(Apr.)-1967(Dec.),
1969(Jan.)-1971(Dec.)

m. Mernung : 1949(Nov.)-1962(Jun.), 1964(Jan. - Apr.)
1966(Jan.)-1971(Oct.)
i) 1949(Nov.) - 1953(Jan.) HY-7
ii) 1953(Feb.) - 1956(Apr.) HY-8
iii) 1956(May) - 1957(Dec.) HY-9
iv) 1958(Jan.) - 1959(Dec.) HY-10
v) 1960(Jan. - Dec.) HY-11
vi) 1961(Jan. - Dec.) HY-12
vii) 1962(Jan. - Jun.) HY-13
viii) 1964(Jan. - Apr.) HY-14
ix) 1966(Jan. - Aug.), 1960(Dec.)-1971(Oct.) HY-15
x) 1966(Jul.) - 1970(Mar.) HY-18

n. L.Lengkong : 1951(Feb.) - 1971(Dec.)
* i) 1951(Feb.)-1953(Apr.), 1960(Oct.)-1971(Dec.) HY-5
* ii) 1953(Jan.)-1960(Dec.) HY-6

o. Kedungsumur : 1953(Jan.) - 1971(Dec.)
* i) 1953(Jan.) - 1960(Dec.) HY-6
* ii) 1960(Oct.) - 1971(Dec.) HY-5

p. L.Djatikulon : 1953(Jan.) - 1971(Dec.)
* i) 1953(Jan.) - 1960(Dec.) HY-6
* ii) 1960(Oct.) or 1963(Sept.) - 1971(Dec.) HY-5

q. Voor K. : 1953(Jan.) - 1960(Dec.)
1968(Jan.) - 1971(Dec.)
* i) 1953(Jan.) - 1960(Dec.) HY-6
* ii) 1968(Jan.) - 1971(Dec.) HY-5

r. Mangetan K. : 1951(Feb.) - 1971(Dec.)
* i) 1951(Feb.)-1953(Apr.), 1960(Oct.)-1971(Dec.) HY-5
* ii) 1953(Jan.)-1960(Dec.) HY-6
*iii) 1969(Jul. & Nov.), 1970(Jun. & Jul.) HY-3

s. Porong K. : 1951(Feb.)-1971(Dec.)

* i) 1951(Feb.)-1953(Apr.), 1960(Oct.)-1971(Dec.) HY-5
* ii) 1953(Jan.)-1960(Dec.) HY-6
*iii) 1969(Jul. & Nov.), 1970(Jun. & Jul.) HY-3

t. L.Kemlaten : 1951(Feb.) - 1971(Dec.)
* i) 1951(Feb.)-1953(Apr.), 1960(Oct.)-1971(Dec.) HY-5
* ii) 1953(Jan.)-1960(Dec.) HY-6

u. Kediri/Kertosono/Kedunggabus/Ploso/Tapen/Kesamben/ Ngramee/Kenongo/Porrong/Permisan/Pendjwakul : some records are kept in Hy-7 ~ 16

(2) Hourly tide level record

a. Morokrembangan boezem gate (inside and outside of gate) HY-17
i) period : 1964(Dec. 21) - 1972(Feb. 29)
ii) lack of data : 1965(Jan. 1-10), 1966(Aug. 22-Sep. 20), 1970(Jul. 1-20)

b. Surabaja Harbor
i) period : 1966(Jan.) - 1972(Mar.)
ii) lack of data : 1967(Mar. - May)
1969(Jan. - Dec.)

3. Discharge

(1) Daily discharge

a. Djabon : 1950(Jan.) - 1971(Dec.)
i) 1950(Jan.) - 1965(Dec.)
1967(Jan.) - 1970(Oct.) HY-1
ii) 1966(Jan. - Dec.) HY-2
iii) 1969(Nov.), 1970(Mar., Jun., Jul., Nov. & Dec.) ; some supplements of (1) & (2) HY-3
iv) 1951(Feb.)-1953(Apr.), 1960(Oct.)-1971(Dec.) HY-5
v) 1953(Jan.) - 1960(Dec.) HY-6

b. Kepandjaran : 1950(Jan.) - 1971(Dec.)
i) 1950(Jan.)-1965(Dec.), 1967(Jan.)-1970(Oct.) HY-1
ii) 1966(Jan. - Dec.) HY-2
iii) 1951(Feb.)-1953(Apr.), 1960(Oct.)-1971(Dec.) HY-5
iv) 1953(Jan.) - 1960(Dec.) HY-6

c. Mlirip : 1950(Jan.) - 1971(Dec.)
i) 1950(Jan.)-1965(Dec.), 1967(Jan.)-1970(Oct.) HY-1
ii) 1966(Jan. - Dec.) HY-2
iii) 1969(Jun. & Nov.), 1970(Mar., Jun., Jul., Nov. & Dec.) HY-3
iv) 1951(Feb.)-1953(Apr.), 1960(Oct.)-1971(Dec.) HY-5
v) 1953(Jan.) - 1960(Dec.) HY-6

d. Perning : 1950(Jan.) - 1971(Dec.)
i) 1950(Jan.)-1965(Dec.)., 1967(Jan.)-1970(Oct.) HY-1
ii) 1966(Jan. - Dec.) HY-2
iii) 1969(Nov.), 1970(Mar., Jun., Jul., Nov., & Dec.): some supplements of (1) & (2) HY-3
iv) 1951(Feb.)-1953(Apr.), 1960(Oct.)-1971(Dec.) HY-5
v) 1953(Jan.) - 1960(Dec.) HY-6

e. Mangetan K. : 1951(Feb.) - 1971(Dec.)
  i) 1951(Feb.)-1953(Apr.), 1960(Oct.)-1971(Dec.) HY-5
  ii) 1953(Jan.) - 1960(Dec.) HY-6
  iii) 1969(Jul. & Nov.), 1970(Mar., Jun., July., Nov. & Dec.) HY-3

f. Porong K. : 1951(Feb.) - 1971(Dec.)
  i) 1951(Feb.)-1953(Apr.), 1960(Oct.)-1971(Dec.) HY-5
  ii) 1953(Jan.) - 1960(Dec.) HY-6
  iii) 1969(Nov.), 1970(Mar., Jun., Jul., Nov., & Dec.) HY-3

g. L.Kemlaten : 1951(Feb.) - 1971(Dec.)
  i) 1951(Feb.)-1953(Apr.), 1960(Oct.)-1971(Dec.) HY-5
  ii) 1953(Jan.) - 1960(Dec.) HY-6

h. L.Lengkong : 1951(Feb.) - 1971(Dec.)
  i) 1951(Feb.)-1953(Apr.), 1960(Oct.)-1971(Dec.) HY-5
  ii) 1953(Jan.) - 1960(Dec.) HY-6

i. Kedungsumur : 1953(Jan.) - 1971(Dec.)
  i) 1953(Jan.) - 1960(Dec.) HY-6
  ii) 1960(Oct.) - 1971(Dec.) HY-5

j. L.Djatikulon : 1953(Jan.) - 1971(Dec.)
  i) 1953(Jan.) - 1960(Dec.) HY-6
  ii) 1960(Oct.) or 1963(Sep.)-1971(Dec.) HY-5

k. Voor K. : 1953(Jan.)-1960(Jan.), 1968(Jan.)-1971(Dec.)
  i) 1953(Jan.) - 1960(Dec.) HY-6
  ii) 1968(Jan.) - 1971(Dec.) HY-5

(2) Measurement and calculation records of discharge at Djabon and Mlirip HY-18

1) stations : Djabon/Mlirip

2) period : 1966(Jan. - May, Jul. - Nov.)
1969(Feb.) - 1972(Feb.)

(3) Operation records of stop logs of dam and sluice

a. Gedeg sluice : 1953(Feb.) - 1962(Dec.), 1964(Jan.-Dec.)
  i) 1953(Feb.) - 1956(Apr.) HY-8
  ii) 1956(May) - 1957(Dec.) HY-9
  iii) 1958(Jan.) - 1959(Dec.) HY-10
  iv) 1960(Jan. - Dec.) HY-11
  v) 1961(Jan. - Dec.) HY-12
  vi) 1962(Jan. - Dec.) HY-13
  vii) 1964(Jan. - Dec.) HY-14

b. Mlirip : 1953(Feb.)-1962(Dec.), 1964(Jan. - Dec.)
1970(Sep.)-1971(Dec.)
  i) 1953(Feb.) - 1956(Apr.) HY-8
  ii) 1956(May) - 1957(Dec.) HY-9
  iii) 1958(Jan.) - 1959(Dec.) HY-10
  iv) 1960(Jan. - Dec.) HY-11
  v) 1961(Jan. - Dec.) HY-12
  vi) 1962(Jan. - Dec.) HY-13
  vii) 1964(Jan. - Dec.) HY-14
  viii) 1970(Sep.) - 1971(Dec.) HY-16

c. Lengkong dam : 1953(Feb.)-1962(Dec.), 1964(Jan.-Dec.)
1969(Feb. - Jun.), 1970(Feb. - Mar.,
May, Sep. - Dec.), 1971(Jan. - Jun.,
Nov. - Dec.), 1972(Jan. - Feb.)

(1)	1953(Feb.) - 1956(Apr.)	HY-8
(2)	1956(May) - 1957(Dec.)	HY-9
(3)	1958(Jan.) - 1959(Dec.)	HY-10
(4)	1960(Jan. - Dec.)	HY-11
(5)	1961(Jan. - Dec.)	HY-12
(6)	1962(Jan. - Dec.)	HY-13
(7)	1964(Jan. - Dec.)	HY-14
(8)	1970(Sep.) - 1971(Dec.)	HY-16
(9)	1969(Feb. - Jun.), 1970(Feb. - Mar., May, Nov. - Dec.), 1971(Jan. - Jun., Nov. - Dec.) 1972 (Jan. - Feb.)	HY-18

d. Mernung dam : 1957(Feb.)-1961(Dec.)
1966(Oct.)-1970(Mar.)

(1)	1957(Mar.) - 1957(Dec.)	HY-9
(2)	1958(Jan.) - 1959(Dec.)	HY-10
(3)	1960(Jan. - Dec.)	HY-11
(4)	1961(Jan. - Dec.)	HY-12
(5)	1966(Oct.) - 1970(Mar.)	HY-18

e. Gunungsari dam : 1970(Dec.) - 1972(Feb.) HY-18

f. Djagir dam : 1971(Jan. - Dec.) HY-18

(4) Rating curve at Djabon, Kepadjaran, Mlirip and Perning PL-6

4. Meteorological Data HY-3

(1) Station name : Statiun Meteorologie dan Geofisika
Surabaja

(2) Contents :

1) summary of climatological data for the period;
i) period : 1956 - 1965
ii) terms : temperature (max., min. and mean)/
relative humidity (max., min. and mean)/
prev. wind direction and wind velocity/
sun-shine/rainfall

2) daily record:
i) period : 1962 - 1971
ii) terms : temperature (max. and min.)/humidity
(max. and min.)/type of cloud/wind
direction and wind velocity/atmospheric
pressure (max. and min.)/rainfall.

CHAPTER II

DATA REQUIRED FOR RIVER PLANNING

1. Topographic Map.

file No.

(1) Topographic maps (scale 1/50000) collected in Japan

(2) Topographic maps (scale 1/50000) collected in Indonesia

(3) Topographic maps of Surabaja City : scale 1/10000 PL-1

(4) Topographic maps of Surabaja City : scale 1/5000 PL-1

2. Aero-Photograph.

3. Result of Survey.

(1) Surabaja river

a. laterial profile with outline of plan and longitudinal profile surveyed in 1970; PL-2
   i) lateral profile : scale 1/200
   ii) plan : scale 1/10000
   iii) longitudinal profile : scale H = 1/5000
   V = 1/200

b. longitudinal profile downstream of Gunungsari dam surveyed in 1938 : scale H = 1/5000 V = 1/50 PL-4

c. Plan of the Surabaja river surveyed in Dutch time: scale 1/5000, 1/2000, 1/1000 PL-8

(2) Mas river

a. lateral profile with outline of plan and longitudinal profile surveyed in 1970; PL-2
   i) lateral profile : scale 1/200
   ii) plan : scale 1/10000
   iii) longitudinal profile : scale H = 1/5000 V = 1/200

b. longitudinal profile surveyed in 1937 : scale H = 1/20000 V = 1/100 PL-4

c. Plan of the Mas river surveyed in Dutch time: scale 1/1000 PL-8

(3) Wonokromo river

lateral profile with outline of plan and longitudinal profile surveyed in 1970; PL-2
   i) lateral profile : scale 1/400
   ii) plan : scale 1/10000
   iii) longitudinal profile : scale H = 1/10000
   V = 1/200

(4) Pegirian river

a. plan which indicates the sections of lateral profile : scale 1/20000 — PL-4

b. lateral profile surveyed in 1972 : scale 1/100 — PL-4

c. plan and lateral profile for dredging works : — PL-4

(5) Marmojo river

a. plan, longitudinal and lateral profile surveyed in 1971; — PL-3
   i) plan : scale 1/20000, 1/2000
   ii) plan of the major structure : scale 1/500
   iii) longitudinal profile : scale H = 1/5000, V = 1/100
   iv) lateral profile : scale 1/200

b. plan, longitudinal and lateral profile surveyed in 1972; — PL-9
   i) plan : scale 1/2000
   ii) longitudinal profile : scale H = 1/5000, V = 1/50
   iii) lateral profile : scale H = 1/50, V = 1/200

(6) Kedungsoro and Gedeg river

plan, longitudinal and lateral profile surveyed in 1971; — PL-10
   i) plan : scale 1/2000
   ii) longitudinal profile : scale H = 1/2000, V = 1/100
   iii) lateral profile : scale 1/200

(7) Porong river

plan and lateral profile surveyed in 1972; — PL-4
   i) plan : scale 1/60
   ii) lateral profile : scale H = 1/500, V = 1/100

(8) Brantas river

plan and lateral profile surveyed in 1971; (Lengkong → Kedungsoro); — PL-13
   i) plan : scale 1/2000
   ii) lateral profile : scale H = 1/500, V = 1/50

(9) Gunungsari Canal

plan, longitudinal and lateral profile surveyed in 1972; — PL-11
   i) plan : scale 1/500
   ii) longitudinal profile : scale H = 1/10000, V = 1/100
   iii) lateral profile : scale 1/100

(10) Wonoaju river

plan, longitudinal and lateral profile surveyed in 1969; — PL-4

i) plan : scale 1/5000
ii) longitudinal profile : scale H = 1/10000
V = 1/100
iii) lateral profile : scale 1/100

(11) Morokrembangan boezem

plan, longitudinal and lateral profile surveyed in 1971; PL-4
i) plan with contour line : scale 1/5000
ii) longitudinal profile : scale H = 1/5000
V = 1/200
iii) lateral profile : scale 1/500

(12) Sea dike

plan, longitudinal and lateral profile surveyed in 1971; PL-12
i) plan : scale 1/50000, 1/20000, 1/5000
ii) longitudinal profile : scale H = 1/2000
V = 1/100
iii) lateral profile : scale
major section H = 1/1000, V = 1/50
minor section 1/200

(13) Ajino-moto factory

plan surveyed in 1969 : scale 1/1000 PL-4

4. Other Maps.

(1) Peta Propinsi Djawa-Timur (Map of East Java Prov.): sacle 1/500000 PL-5

(2) Peta Geologi Propinsi Djawa-Timur (Geologic Map of East Java Prov.): scale 1/500000

(3) Peta Daerah Pengairan Seksi Wonokromo (Map of Irrigation Area in Seksi Wonokromo): scale 1/50000 PL-5

(4) Peta Daerah Pengairan Seksi Wonokromo (Map of Irrigation Area in Seksi Modjokerto): scale 1/50000 PL-5

(5) Peta Delta Sidoardjo, Daerah Pengairan Seksi Sidoardjo (Map of Irrigation Area in Seksi Sidoardjo): scale 1/50000 PL-5

(6) Irrigatie Afdeeling "Brantas", Ressort Mantri Gedeg (Map of Irrigation Area in Mantri Gedek): scale 1/20000 PL-5

(7) Pomp Stations Der Suikerfabriek Gempolkerep (Pump Station of Gempolkerep Sugar Factory): scale 1/50000 PL-5

(8) Peta Wonokromo, Daerah Pengairan Seksi Wonokromo (Map of Irrigation Area in Seksi Wonokromo): scale 1/20000 PL-5

(9) Pendjagaan Tankis K. Brantas (Watching of the dike of the Brantas river): scale 1/100000

(10) Peta Kotamadya Surabaja (Map of Surabaja City): scale 1/40000 PL-5

(11) Data-data, Dinas Pengairan Daerah "Brantas" (Data, Dinas Pengairan Daerah Brantas) PL-5

1) Baku Sawah (Luas D.P.) (Rice field)
1A) Areal Sawah (Rice field)
2) Sawah Tadah Hudjan, Tambak, Hutan (Rice field by rainfall, weir, wood)
3) Sumber-waduk (Well, spring)
4) Waduk-waduk (Reservoir)
5) Tanah Pembelian Zaman Djepang/Belanda (Commercial area in Japan/Dutch time)
6) Daerah Inundasi (Inundated area)
7) Tempat Stasiun Hudhan (Rain gage station)
8) Tempat Peilschaal (Stream gaging station)
9) Tempat Drijfvak
10) Tempat Djadjagan (Sounding station)
11) Pendjagaan Tangkis (Watching the dike)
11A) Tempat (Pos) Pendjagaan Bandjir (Watching station of flood)
12) Pompa-pompa Tetap (Settling pumps)
13) Tempat-tempat Pesawat Tilpon (Place of telephon)
14) Tempat-tempat Djuru Pengairan+Tjamat (Place of irrigation expert and subdistrict head)
15) Pengambilan Air Oleh Pabrik-pabrik/Perusahaan (Use of water by factories and offices)
16) Areal Pabrik Gula (Area of sugar factory)
17) Pandjang Tangkis (Length of dike)
18) Adanja Bangun-bangunan Pengairan Menurut Legger (Existing irrigation facilities)
18A) Dam Besar dan Lain-lain (Large weir etc.)
19) Gedung-gedung (Structures)
20) Tinggi djembatan/Peilschaal Menurut SHVP (Elevation of bridge and staff gage in SHVP)
21) Garis Sempadan (Waterrooilijn) (Alignment)
22) Garis Normaal (Normal line)
23) Lomba Desa TH : 1970

5. Inundation Area.

(1) Inundated area & depth by each flood and its contents together with Fig. 1.1 and Fig. 1.2 HY-1, PL-2

a. Fig. 1.1 Map of general orientation inundated area in connection with Surabaja river project : (scale 1/50000)
b. Fig. 1.2 Map of inundated area of Surabaja municiple: (scale 1/20000)

(2) Bandjiran dalam Daerah Pengairan Seksi Wonokromo dalam bulan Djanuari dan Pebruari th. 1958 dengan peta bandjiran Tath. 1958 (Flood in Jan. and Feb., 1958 in irrigation area of seksi-Wonokromo with inundation map) : scale 1/50000 PL-6

(3) Bandjiran dalam Daerah Pengairan Seksi Modjokerto dalam bulan Djanuari, Pebruari, Maret, Mei dan Desember 1959 dengan Peta bandjiran th. 1960 (Flood in Jan. Feb., Mar., May and Dec., 1959 in irrigation area of seksi Modjokerto with inundation map): scale 1/50000 PL-6

(4) Bandjiran dalam Daerah Pengairan Seksi Modjokerto dalam bulan Djanuari, Pebruari and Maret th. 1960 (Flood in Jan., Feb. and Mar., 1960 in irrigation area of Seksi Modjokerto with inundation map) PL-6

6. Construction Cost.

7. Other Data Required for River Planning.

(1) Radiotelephon system of the Brantas river, the Porong river and the Surabaja river PL-6

(2) Tabulation of coef. of run-off

(3) Example of designing - 1 : Perbaikan Inlat Karah dan Djambangan dengan Salurannja (Improvement of Karah Inlet and Djambangan Channel) PL-6

(4) Example of designing - 2 : Perbaikan tangkis Kanan K Surabaja di Kebonagung (Improvement of Right dike of the Surabaja river at Kebonagung) PL-6

(5) Beberapa Masalah : beserta aspek jang timbul dan ada dalam rangka serta Usaha meng-kota-kan Ketjamatan TANDES kota madya Surabaja : oleh M. Maskoep. (Probelems which exist and come appear in master plan on urbanizing of Ketjamatan TANDES, Surabaja City) PL-6

(6) Some pamphlets on P.N.BARATA PL-6

(7) Regulations concerning river PL-6

a. Peraturan Perairan Umum (Reguration of general water works)
b. Het Algemeen Waterreglement (Regulation of water works)
c. Peraturan Perairan Daerah Djawa Timur (Regulation of water works in East Jawa Area)
d. Provinciale Voorschriften van Oost-Java (Provincial regulation of water works in East Java)
e. Algemeen Waterreglement 1936 dan Provinciaal Waterreglement Oost-Java (Water regulation in 1936 and provincial water regulation in East Java)
f. Tentang Pekerdjaan Pengairan (On the irrigation works)

(8) Survey result on bed load and suspended load of the Brantas river PL-6

8. Surveying, Measurement and Analysis

(1) Surveying;
   i) lateral profile of the Mas river and the Surabaja river
   ii) elevation of dam, sluice, intake and pump station
   iii) leveling (Lengkong — Mlirip sluice)

(2) Ground water survey making use of wells PL-7

(3) On the method of discharge measurement of DPPDT PL-7

(4) Measurement of coef. of roughness PL-7

(5) Measurement of suspended load PL-7

(6) Analysis of bed materials PL-7

(7) Analysis on runoff in the Marmojo river basin PL-7

CHAPTER III

DATA ON RIVER-STRUCTURE AND PUMP-STATION

1. General.

(1) River-structure

i) Dimension of river facilities attached to Fig. 2	HY-1
Fig. 2 : Map of river facilities (scale 1/50000)	PL-2
ii) List of bridges	ST-1
iii) Location map of bridges	ST-1
iv) Short description on dams, sluices and gates	ST-2
v) Location map of dams, sluices and gates	ST-2

(2) Pump-station

i) Investigation of drainage pump-station attached to Fig. 3	HY-1
Fig. 3 : Skelton map of river & canal and places of pump-station (scale 1/50000)	PL-2
ii) Short description on pump-stations	ST-2
iii) Location map of pump-stations	ST-2

2. Design Drawing.

(1) Bridges ST-1

i) Bridges over the Surabaja river : Legundi/ Sepandjang/Wonokromo bridge and bridge for water supply pipe just upstream of Wonokromo bridge
ii) Bridges over the Wonokromo river : list of members of Nginden bridge
iii) Bridges over the Mas river: Dinojo/Sonokembang/ Gubeng/Sindunegara/Ketabang/Patuk/Plampitan (or Peneieh)/Bibis/Merah bridge
iv) Bridges over the Pegirian river : Kalianjar/ Gembong/Tjantian/Gali/Pegirian bridge

(2) Dams, sluices and gates ST-2

i) Mlirip sluice
ii) Gunungsari dam
iii) Wonokromo sluice
iv) Djagir dam
v) Gubeng dam
vi) Lengkong dam
vii) Gedek sluice
viii) Gate of Morokrembangan boezem
ix) Gate of the Pegirian river : Pegirian/ Djatipurwo gate
x) New Lengkong dam

(3)	Intakes	ST-2
(4)	Syphons : Krikilan/Gunungsari/Watudakon syphon	ST-2
(5)	Pump-stations : Gunungsari/Darmo/Kupang/Keptran/ Darmohusodo/Kalikepiting/Ngemplak/ Simolawang/Pesapen pump-station	ST-2

CHAPTER IV

OTHER DATA

1. Data on Drainage in Town Area.

(1) Water supply of industry and factory with allowance
Dinas Pengairan — HY-1

(2) Land use map (Year 1967) : scale 1/20000 — PL-2

(3) Land use map programme of government : scale 1/20000 — PL-2

(4) Interim report on drainage and sewerage planning for urban area of Surabaja City — PL-7

2. Data on Agriculture.

(1) Land use maps of the Surabaja river basin including Surabaja City (scale 1/50000)

(2) Laporan tahunan, 1970, Dinas Pertanian Rakjat, Propinsi Djawa Timur (Annual Report, 1970)

(3) Agricultural statistic of East Java for ten years from 1960 to 1969

(4) Bimas jang disempurnakan, seri II Manteri Penjuluhan Nomor 10, 1970, A.I.C.

(5) Statistic of planted area of agricultural products in Surabaja City from 1964 to 1970.

3. Data on Socio-Economy.

(1) Population and estates in inundated area attached to Fig. 1.1 and 1.2 — HY-1

i) Fig. 1.1 Map of general orientation of inundated area in connection with Surabaja river project: scale 1/50000 — PL-2

ii) Fig. 1.2 Map of inundated area in Surabaja : scale 1/20000 — PL-2

(2) Houses along the Surabaja river, Mas river, Wonokromo canal and Pegirian canal — HY-1

(3) Property every block (Ketjamatan) in inundated area

(4) Cost of damage of property on every block (Ketjamatan) in inundated area — HY-1

(5) Statistics of each Ketjamatan

1) Name of Ketjamatan : Krembangan(S)/Pabean Tjantian(S)/Simokerto(S)/Bubutan(S)/Genteng(S)/ Gubeng(S)/Tambaksari(S)/Sawahan(S)/Tegalsari(S)/ Wonokromo(S)/Sukolilo(S)/Rungkut(S)/Wonotjolo(S)/ Karang Pilang(S)/Tandes(S)/Semampir(S)/Drijoredjo (s)/Wringinanom(s)/Waru(si)/Taman(si)/Tarik(si)/ Balongbendo(si)/Krian(si)/Djetis(M)/Gedeg(M)/Kemlagi(M)/ Kudu(D)

Note : (S) : Kotamadya Surabaja
(s) : Kabupaten Surabaja
(si) : Kabupaten Sidoardjo
(M) : Kabupaten Modjokerto
(D) : Kabupaten Djombang

2) Terms : total area/population for six years from 1966 to 1971/number of house and household from 1966 to 1971/ area of land for residential, commercial, industrial, agricultural and public use/number of such public facility as governmental office, school, hospital, bridge etc./number of shop and factory/monthly planted area (ha) of agricultural products during the last three(3) years/annual harvested area (ha) and agricultural production (ton) from 1966 to 1971/number of livestock from 1966 to 1971.

(6) Observation value of hourly traffic volume on main roads in Surabaja city in 1966 and 1969.

(7) Number of holding cars classified according to their kind in Surabaja city in 1972.

(8) Monthly market price of the major goods from 1966 to 1971.

(9) Adanja kedjadian bentjana dalam bandjir di Daerah Kabupaten Modjokerto th. 1968 s/d 1971, Kabupaten Modjokerto. (Damage caused by flood in Kabupaten Modjokerto from 1968 to 1971)

(10) Daftar recapitulasi serangan, Bentjana-bandjir dari aliran sungai Marmojo dalam daerah Kabupaten Modjokerto dari tabun tahun 1966 s/d 1972. (Table of damage caused by flood of the Marmojo river in Kabupaten Modjokerto from 1966 to 1972)

(11) Data obtained from field survey

a. Number of residences, farmhouses, offices, schools and shops of which properties were surveyed
b. Terms of survey;
i) Amount of household effects and goods classified according to height above floor surface of residence, farmhouse, office, school and shop.
ii) Construction cost of building mentioned above.
iii) Total amount of goods in stock at shop.