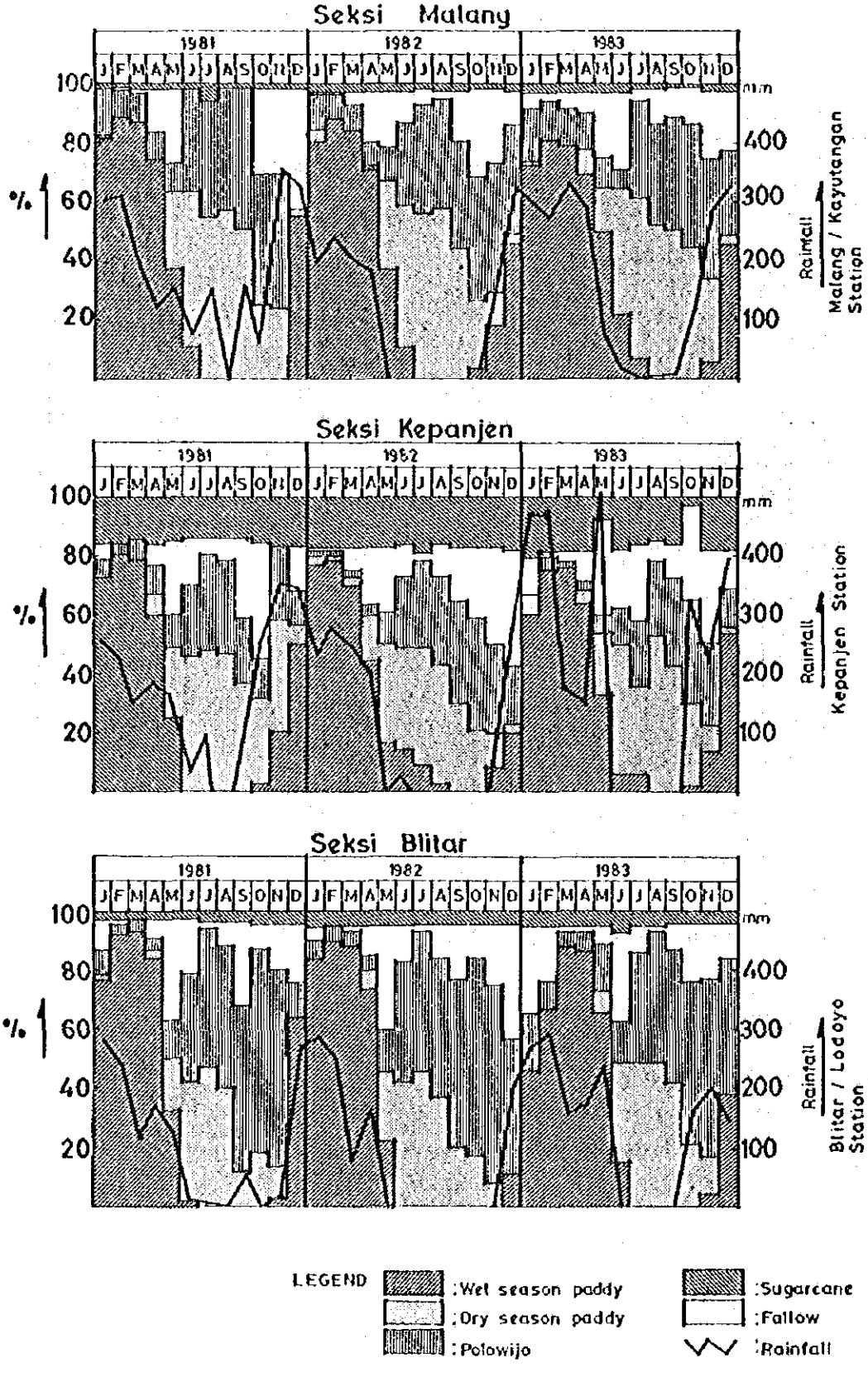

Fig. 1 (1) MONTHLY CROPPING STATUS

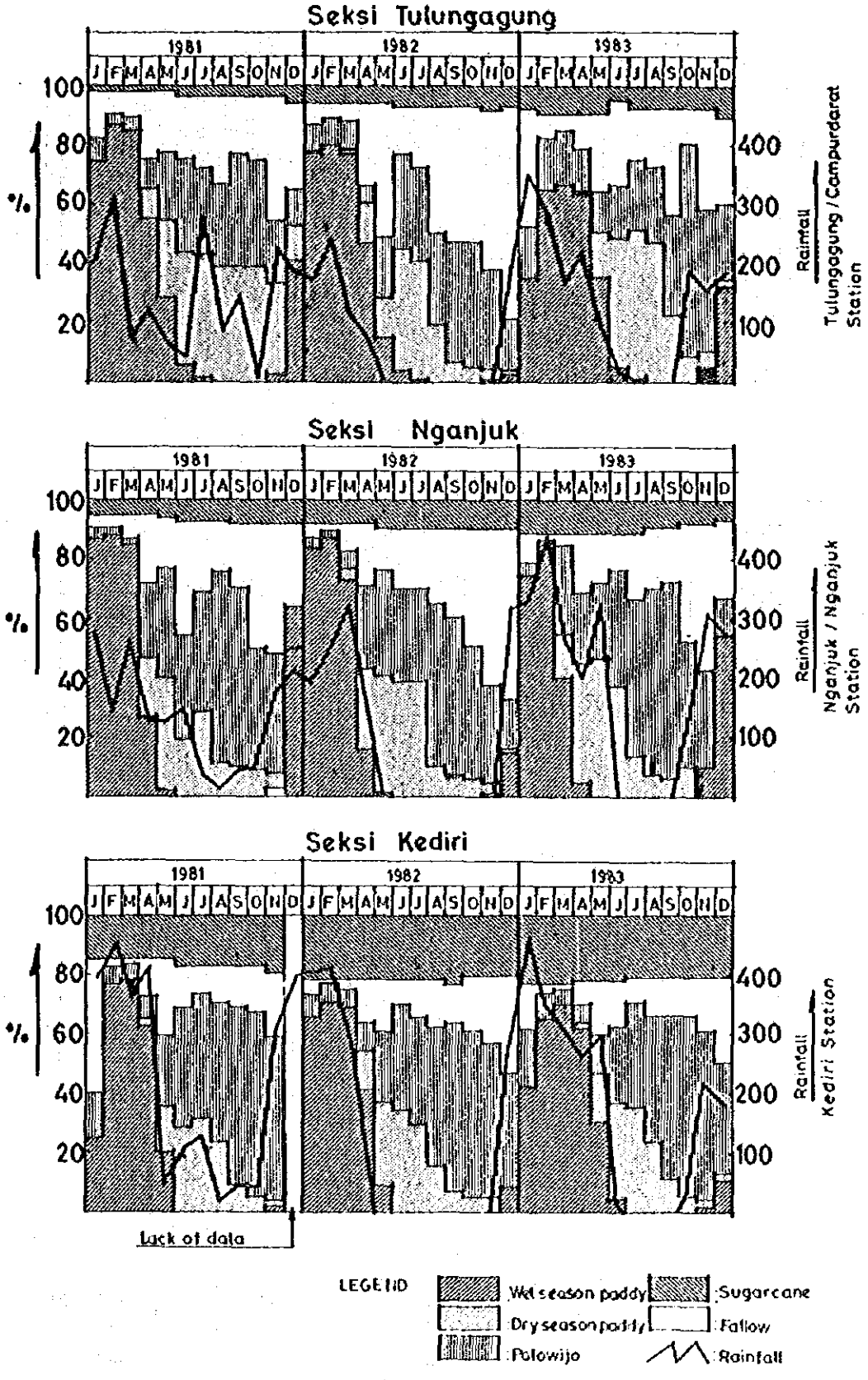

Fig. 1 (2) MONTHLY CROPPING STATUS

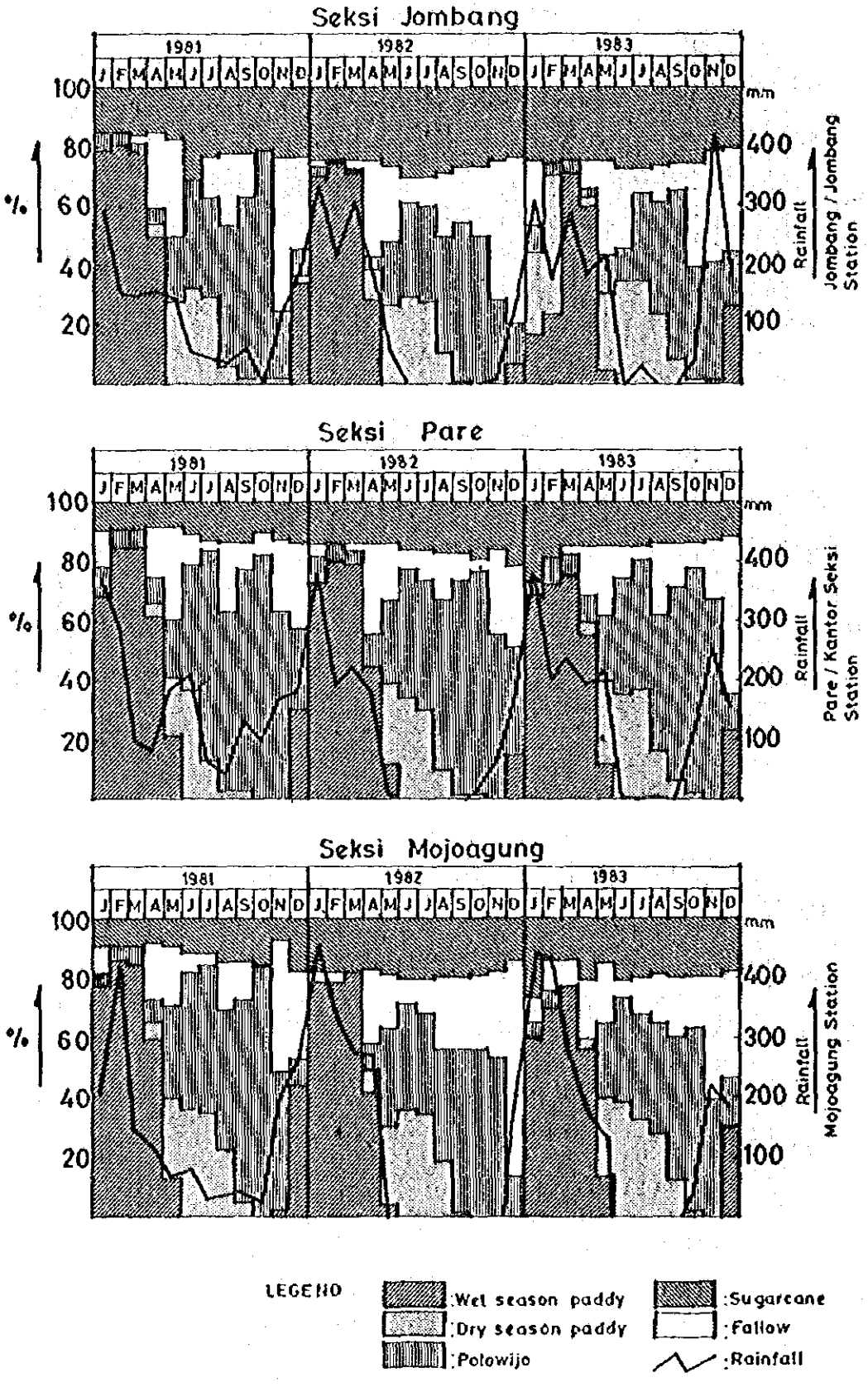

Fig. 1 (3) MONTHLY CROPPING STATUS

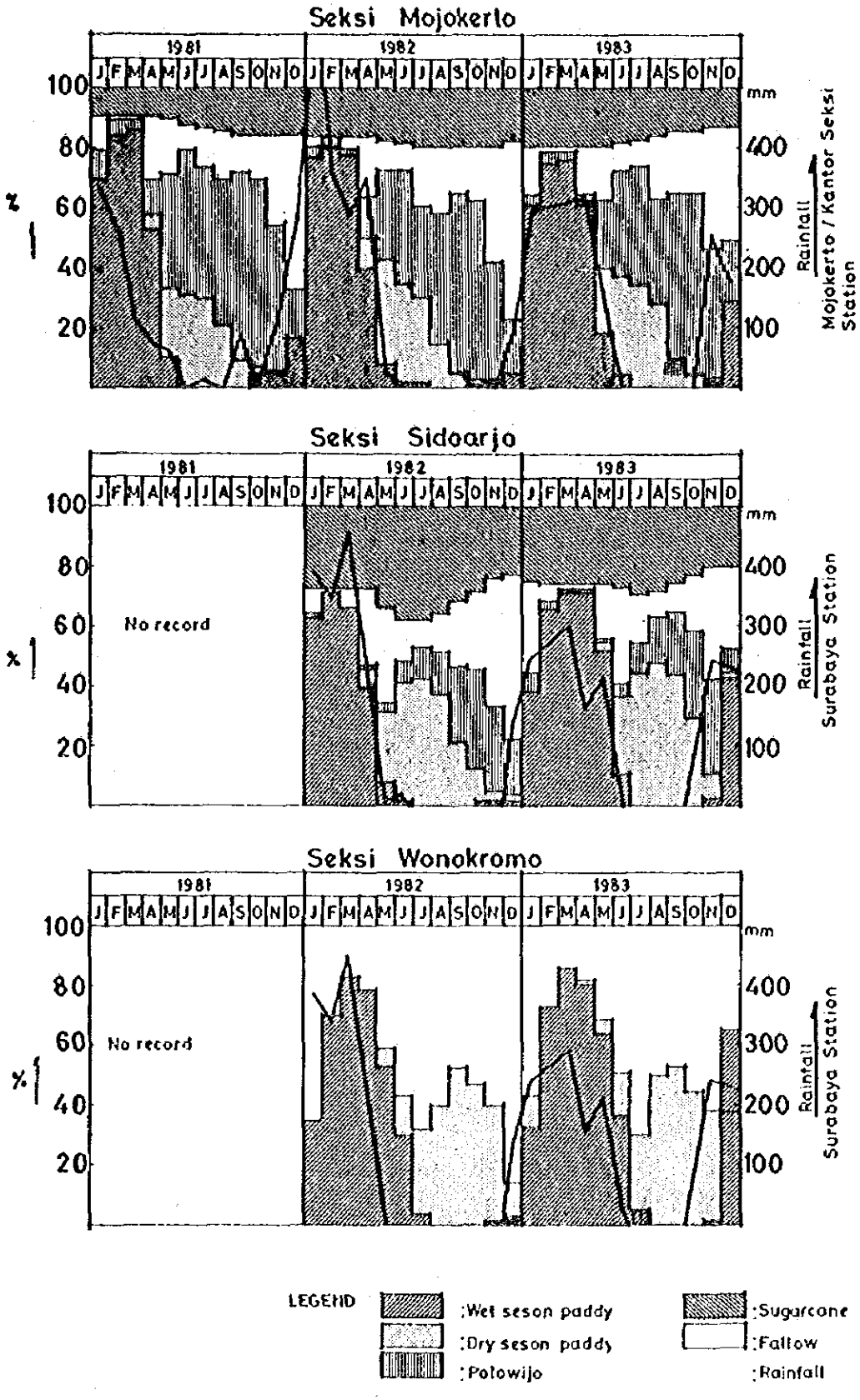

Fig. 1 (4) MONTHLY CROPPING STATUS

NOTE AI-3

YIELD AND CROP PRODUCTION

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Note AI - 3 YIELD AND CROP PRODUCTION

Harvested area, unit yield and production of major crops such as paddy, maize, soybean, ground nut, cassave, and sugarcane for years from 1980 to 1983 are listed as following sequence.

Table	1	Paddy
Table	2	Maize
Table	3	Ground nut
Table	4	Peanut
Table	5	Cassava
Table	6	Sugarcane

Table 1 (1) HARVESTED AREA OF LOW LAND PADDY IN KABUPATENS RELATED TO THE BRANTAS BASIN.

(Unit : ha)

REGION OF ORIGIN (KABUPATEN & KODYA)	1980	1981	1982	1983	AVERAGE
KABUPATEN					
1. Malang	70,197	76,322	67,052	66,205	69,944
2. Blitar	46,605	47,987	45,235	47,091	46,730
3. Tulungagung	24,237	29,662	25,790	25,362	26,263
4. Trenggalek	14,669	18,296	14,468	15,889	15,831
5. Kediri	58,758	59,815	58,820	60,797	59,148
6. Nganjuk	52,848	55,694	52,147	54,128	53,704
7. Jombang	57,046	57,866	54,055	54,470	55,859
8. Mojokerto	43,188	43,724	41,674	43,556	43,036
9. Sidoarjo	41,232	41,073	37,685	36,098	39,022
10. Kodya Surabaya	9,302	8,912	6,848	7,430	8,123
Total	418,082	439,351	403,774	411,026	417,660

Source : Jawa Timur Dalam Angka, 1980, 1981, 1982 and 1983

Remarks: Source of other tables up to Table 5 (3) is also the same source as that mentioned above.

Table : 1 (2) UNIT YIELD OF LOW LAND PADDY IN KABUPATEN RELATED TO THE BRANTAS BASIN.

(Unit : ton/ha, dry Paddy)

REGION OF ORIGIN (KABUPATEN & KODYA)	1980	1981	1982	1983	AVERAGE
KABUPATEN					
1. Malang	5.17	5.19	5.55	5.72	5.3
2. Blitar	5.05	5.20	5.56	5.79	5.3
3. Tulungagung	4.60	4.72	4.80	4.91	4.7
4. Trenggalek	4.94	4.98	5.16	5.10	5.0
5. Kediri	5.23	5.35	5.36	5.97	5.4
6. Nganjuk	5.06	5.32	5.47	5.61	5.4
7. Jombang	5.57	5.53	5.63	5.95	5.7
8. Mojokerto	5.27	5.40	5.67	5.56	5.4
9. Sidoarjo	5.59	5.39	5.59	5.74	5.5
10. Kodya Surabaya	5.76	3.83	4.08	4.26	3.9
Average	5.22	5.09	5.29	5.46	5.2

Tale : 1 (3) TOTAL PRODUKCTION OF LOW LAND PADDY IN KABUPATENS RELATED TO THE BRANTAS BASIN.

(Unit : Ton/Dry Paddy)

REGION OF ORIGIN (KABUPATEN & KODYA)	1980	1981	1982	1983	AVERAGE
KABUPATEN					
1. Malang	362,918.49	396,111.18	372,138.60	378,692.60	377,465
2. Blitar	235,355.25	249,532.4	251,506.60	272,656.89.	252,262
3. Tulungagung	111,490.20	140,004.64	123,792.00	124,036.42	124,831
4. Trenggalek	72,464.86	91,114.08	74,645.08	81,033.90	79,816
5. Kediri	307,304.34	320,010.25	314,687.00	360,598.09	325,740
6. Nganjuk	267,410.88	296,292.68	294,109.08	303,658.08	290,367
7. Jombang	317,746.22	319,998.98	304,329.65	324,096.50	316,542
8. Mojokerto	227,600.76	236,109.60	236,291.58	242,171.36	235,543
9. Sidoarjo	230,486.88	221,383.47	210,659.15	207,202.52	217,433
KODYA					
10. Ko. Surabaya	34,975.52	34,132.96	27,939.84	31,651.80	32,174
Total	2,132,778	2,270,557	2,182,159	2,294,146	2,292,172

Tabel 2 (1) HARVESVED AREA OF MAIZE IN KABUPATENS RELATED TO THE BRANTAS BASIN

(Unit : ha)

Region of Origin (Kabupaten & Kodya)	1980	1981	1982	1983	Average
Kabupaten					
1. Malang	83,939	90,964	77,605	89,513	85,505
2. Blitar	23,498	27,615	16,786	21,364	22,316
3. Tulungagung	14,594	11,700	9,822	14,363	12,620
4. Trenggalek	8,384	8,247	3,522	7,309	6,866
5. Kediri	43,144	41,353	35,968	49,110	42,394
6. Nganjuk	21,164	22,522	17,004	21,089	20,445
7. Jombang	19,465	20,839	13,542	19,194	18,260
8. Mojokerto	18,976	20,696	11,766	15,216	16,689
9. Sidoarjo	2,672	2,393	1,516	1,830	2,078
10. Ko. Surabaya	603	1,629	811	708	938
Total	236,439	247,958	188,342	239,696	228,111

Tabel 2 (2) UNIT YIELD OF MAIZE IN KABUPATENS RELATED TO THE BRANTAS BASIN.

(Unit : ton/ha)

Region of Origin (Kabupaten & Kodya)	1980	1981	1982	1983	Average
Kabupaten					
1. Malang	1.76	1.73	1.09	1.96	1.84
2. Blitar	1.36	1.45	1.35	1.48	1.41
3. Tulungagung	1.93	2.03	2.02	2.06	2.01
4. Trenggalek	1.91	2.04	1.96	2.21	2.03
5. Kediri	2.18	2.45	2.66	3.23	2.71
6. Nganjuk	2.12	2.98	3.07	3.08	2.81
7. Jombang	1.52	1.45	1.44	2.24	1.66
8. Mojokerto	1.00	1.39	1.10	1.47	1.24
9. Sidoarjo	0.98	0.90	1.03	1.31	1.04
10. Ko. Surabaya	0.56	0.60	0.6	0.67	0.61
Average	1.53	1.70	1.63	1.97	1.74

Table : 2 (3) TOTAL PRODUCTION OF MAIZE IN KABUPATENS RELATED TO THE BRANTAS BASIN

(Unit : ton)

Region of Origin (Kabupaten & Kodya)	1980	1981	1982	1983	Average
Kabupaten					
1, Malang	147,732.64	157,367.72	146,673.45	175,445.48	156,80
2. Blitar	32,192.26	40,041.75	22,661.10	31,618.72	31,62
3. Tulungagung	28,166.42	23,751.00	19,840.44	30,617.78	25,59
4. Trenggalek	16,013.44	16,823.88	6,903.12	16.152.89	13,97
5. Kediri	106,997.12	101,069.85	95,674.88	158,625.30	115,53
6. Nganjuk	54,395.91	67,115.56	52.032.24	64.954.12	59,62
7. Jombang	29,197.50	30,216.55	19,500.48	42.994.56	30,47
8. Mojokerto	18,976.00	28,767.44	12,942.60	22,367.52	20,75
9. Sidoarjo	2,404.80	2,063.70	1,561.48	2,697.30	2,10
10. Ko.Surabaya	343.71	977.40	494.71	474.36	57
Total	436,420	468,195	378,285	545,948	457,06

Table 3 (1) HARVESTED AREA OF SOYBEANS IN KABUPATEN RELATED TO THE BRANTAS BASIN

(Unit : ha)

REGION OF ORIGIN (KABUPATEN & KODYA)	1980	1981	1982	1983	AVERAGE
KABUPATEN					
1. Malang	5,614	4,081	3,708	3,175	4,744
2. Blitar	8,978	9,558	6,572	7,256	8,091
3. Tulungagung	2,573	1,821	1,833	1,648	1,969
4. Trenggalek	8,413	8,170	6,012	4,835	6,858
5. Kediri	6,988	8,573	7,933	6,295	7,447
6. Nganjuk	21,050	24,350	23,424	22,805	22,907
7. Jombang	23,540	22,881	17,768	15,728	19,979
8. Mojokerto	11,327	12,061	10,532	10,198	11,030
9. Sidoarjo	2,875	2,401	1,392	1,071	1,935
KODYA					
10. Ko. Surabaya	57	5	9	2	18
Total	91,415	93,901	79,183	73,011	84,978

Table 3 (2) UNIT YIELD OF SOYBEANS IN KABUPATENS
RELATED TO THE BRANTAS BASIN

(Unit : ton/ha)

REGION OF ORIGIN (KABUPATEN & KODYA)	1980	1981	1982	1983	AVERAGE
1. Malang	0.68	0.63	0.69	0.72	0.68
2. Blitar	0.58	0.59	0.60	0.58	0.59
3. Tulungagung	0.65	0.71	0.75	0.74	0.71
4. Trenggalek	0.52	0.61	0.64	0.73	0.63
5. Kediri	0.78	0.74	0.80	0.83	0.79
6. Nganjuk	0.76	0.79	0.75	0.85	0.80
7. Jombang	0.82	0.80	0.81	0.84	0.82
8. Mojokerto	0.72	0.87	0.82	0.94	0.84
9. Sidoarjo	0.85	0.83	0.94	0.89	0.88
KODYA					
10. Ko.Surabaya	0.56	0.63	0.62	0.60	0.60
Average	0.69	0.72	0.74	0.77	0.73

Table 3 (3) TOTAL PRODUCTION OF SOYBEANS IN KABUPATENS RELATED TO THE BRANTAS BASIN

(Unit : ton)

REGION OF ORIGIN (KABUPATEN & KODYA)	1980	1981	1982	1983	AVERAGE
KABUPATEN					
1. Malang	5,815.48	2,571.03	2,558.52	2,286.00	2,808
2. Blitar	5,207.24	5,639.22	3,943.20	4,208.48	4,749
3. Trenggalek	1,672.45	1,292.91	1,374.75	1,219.52	1,389
4. Tulungagung	4,874.76	4,983.70	3,847.68	3,529.55	4.183
5. Kediri	5,450.64	6,349.02	6,846.40	5,224.85	5,841
6. Nganjuk	15,998.00	19,286.50	18,504.96	19,394.25	18,281
7. Jombang	19,302,85	18,304.80	14,392.08	13,211.52	16,302
8. Mojokerto	8,155.44	10,493.07	8,636.24	9,586.12	9,218
9. Sidoarjo	2,443.75	1,992.83	1,308.48	953.19	1,674
KODYA					
10. Ko.Surabaya	31.92	3.15	5.58	1.2	10
Total	68,952	70,916	61,412	59,614	64,455

Table 4 (1) HARVESTED AREA OF GROUND NUTS IN KABUPATENS RELATED TO THE BRANTAS BASIN

(Unit : ha)

REGION OF ORIGIN (KABUPATEN & KODYA)	1980	1981	1982	1983	AVERAGE
KABUPATEN					
1. Malang	3,189	3,934	2,475	2,620	3.055
2. Blitar	12,567	12,291	11,119	9,508	11.321
3. Tulungagung	4,925	4,096	3,393	3,579	3,993
4. Trenggalek	1,233	1,359	1,003	1,632	1,307
5. Kediri	4,856	4,867	5,227	3,171	4,539
6. Nganjuk	2,019	1,644	1,367	1,626	1,626
7. Jombang	2,811	2,430	2,679	2,447	2,592
8. Mojokerto	3,930	2,030	2,586	2,723	2,817
9. Sidoarjo	204	106	111	89	128
KODYA					
10. Ko.Surabaya	132	213	182	52	145
Total	35,866	32,970	30,142	27,446	31,523

Table 4 (2) UNIT YIELD OF GROUND NUTS IN KABUPATENS
RELATED TO THE BRANTAS BASIN

(Unit : Ton/ha)

REGION OF ORIGIN (KABUPATEN & KODYA)	1980	1981	1982	1983	AVERAGE
KABUPATEN					
1. Malang	0.79	0.75	0.73	0.75	0.76
2. Blitar	0.56	0.58	0.59	0.58	0.58
3. Tulungagung	0.79	0.82	0.82	0.84	0.82
4. Trenggalek	0.59	0.64	0.60	0.79	0.66
5. Kediri	0.90	0.91	1.01	1.08	0.98
6. Nganjuk	0.77	0.83	0.85	0.94	0.85
7. Jombang	0.93	0.99	0.99	0.99	0.98
8. Mojokerto	0.72	0.87	0.80	0.79	0.80
9. Sidoarjo	0.88	0.77	0.82	0.82	0.82
KODYA					
10.Ko.Surabaya	0.47	0.44	0.53	0.56	0.50
Average	0.74	0.76	0.77	0.81	0.78

Table 4 (3) TOTAL PRODUCTION OF GROUND NUTS IN KABUPATENS RELATED TO THE BRANTAS BASIN

(Unit : Ton)

REGION OF ORIGIN (KABUPATEN & KODYA)	1980	1981	1982	1983	AVERAGE
KABUPATEN					
1. Malang	2,579.31	2,950.50	1,806.75	1,965.00	2.310
2. Blitar	6,925.52	7,128.78	6.560.21	5,514.64	6,532
3. Tulungagung	3,874.95	3,358.72	2,782.26	3,006.36	3,255
4. Trenggalek	727.47	869.76	601.80	1,289.28	872
5. Kediri	4,365.00	4,428.97	5,279.27	5,424.68	4,374
6. Nganjuk	2,554.63	1,364.52	1,161.95	1,528.44	1,402
7. Jombang	2,614.23	2,405.70	2,652.21	2,422.53	2,523
8. Mojokerto	2,839.60	2,766.10	2,068.80	2,151.17	2,204
9. Sidoarjo	179.52	81.62	910.02	72.98	311
KODYA					
10. Ko.Surabaya	62.04	93.72	96.46	29.12	70
Total	26,722	25,448	23,920	23,404	23,853

Table 5 (1) HARVESTED AREA OF CASSAVA IN KABUPATENS
RELATED TO THE BRANTAS BASIN

(Unit : ha)

REGION OF ORIGIN (KABUPATEN & KODYA)	1980	1981	1982	1983	AVERAGE
KABUPATEN					
1. Malang	25,954	25,594	22,570	23,794	24,478
2. Blitar	16,350	16,983	13,297	12,698	15,825
3. Tulungagung	9,164	8,145	6,743	7,438	7,873
4. Trenggalek	21,637	19,941	18,292	19,313	19,796
5. Kediri	13,678	11,957	11,744	14,738	12,879
6. Nganjuk	6,655	6,327	6,024	6,729	6,434
7. Jombang	4,293	4,100	4,855	3,285	4,133
8. Mojokerto	5,367	5,179	4,283	2,842	4,418
9. Sidoarjo	519	457	437	430	461
KOTAMADYA					
10. Ko.Surabaya	135	192	228	169	181
Total	103,752	98,695	88,473	91,436	94,478

Table 5 (2) UNIT YIELD OF CASSAVA IN KABUPATENS
RELATED TO THE BRANTAS BASIN

(Unit : Ton/ha)

REGION OF ORIGIN (KABUPATEN & KODYA)	1980	1981	1982	1983	AVERAGE
KABUPATEN					
1. Malang	15.60	16.27	16.75	15.29	15.98
2. Blitar	7.50	7.85	8.21	8.47	8.01
3. Tulungagung	7.62	8.25	8.46	8.98	8.33
4. Trenggalek	9.52	9.52	9.48	9.80	9.58
5. Kediri	16.14	17.60	18.59	21.06	18.35
6. Nganjuk	8.23	9.47	8.47	9.15	8.83
7. Jombang	10.57	9.97	11.22	14.51	11.57
8. Mojokerto	12.83	12.76	12.35	12.71	12.66
9. Sidoarjo	9.29	8.18	8.98	9.05	8.88
KOTAMADYA					
10. Ko.Surabaya	4.78	4.78	4.85	5.00	4.85
AVERAGE	10.21	10.47	10.74	11.40	10.70

Table 5 (3) TOTAL PRODUCTION OF CASSAVA IN
KABUPATENS RELATED TO THE BRANTAS BASIN

(Unit : Ton)

REGION OF ORIGIN (KABUPATEN & KODYA)	1980	1981	1982	1983	AVERAGE
KABUPATEN					
1. Malang	412,409.06	416,414.38	378,047.50	363,810.26	392,670
2. Blitar	122,625.00	133,081.05	142,008.37	107,552.06	126,317
3. Tulungagung	69,829.68	67,196.25	57,045.78	66,793.24	65,216
4. Trenggalek	205,984.24	189,838.32	173,408.16	189,267.40	189,624
5. Kediri	220,762.92	210,443.20	207,166.96	310,382.28	237,188
6. Nganjuk	54,770.70	59,916.69	51,023.28	61,570.35	56,820
7. Jombang	45,377.01	38,827.00	54,473.10	47,665.35	46,586
8. Mojokerto	68,858.61	66,084.04	52,895.05	36,121.82	55,990
9. Sidoarjo	4,821.51	3,738.26	3,924.26	3,891.50	4,094
KOTAMADYA					
10. Ko.Surabaya	615.30	917.76	1,105.80	845.00	878
Total	1,206,054	1,186,457	1,121,098	1,187,899	1,175,383

Table 6 (1) AVERAGE HARVESTED AREA, UNIT YIELD AND PRODUCTION OF SUGARCANE FROM 1981 to 1982

NAME OF SUGAR MILLS	HARVESTED AREA	UNIT YIELD OF CANE	TOTAL PRODUCTION OF CANE	TOTAL SUGAR	MILLING RATE
	(ha)	(ton/ha)	(10^3 ton)	(10^3 ton)	(%)
MALANG					
(1) Kebonagung	9,892	55	547.1	46.0	8.4
(2) Krebet Baru	13,354	66	882.4	73.6	8.3
SIDOARJO					
(1) Tjandi	3,241	78	251.8	19.7	7.8
(2) Krembung	2,295	84	192.6	15.1	7.8
(3) Tulangan	2,453	85	208.0	17.6	8.5
(4) Watutulis	3,166	81	257.9	20.9	8.1
(5) Krian	1,944	93	180.9	14.8	8.2
MOJOKERTO					
(1) Gempolkerep	8,034	78	625.2	59.0	9.4
JOMBANG					
(1) Cukir	4,697	84	369.7	38.1	9.6
(2) Jombang Baru	2,953	85	249.9	21.2	8.5
KEDIRI					
(1) Mojopanggung	3,585	69	248.3	20.7	8.3
(2) Ngadirejo	4,235	80	338.3	29.2	8.6
(3) Pesantren	7,375	88	647	65.5	0.1
NGANJUK					
(1) Mrican	4,558	81	369.6	30.9	8.4
(2) Lestari	4,415	79	347.5	28.0	8.1
T O T A L	76,197	75	5,743.2	500.3	8.7

Source : AI 07

Table 6 (2) HARVESTED AREA, UNIT YIELD AND PRODUCTION OF SUGARCANE IN 1981

NAME OF SUGAR MILLING	HARVESTED AREA	UNIT YIELD OF CANE	TOTAL PRODUCTION OF CANE	TOTAL SUGAR	MILLING RATE
	(ha)	(ton/ha)	(10^3/ton)	(10^3 ton)	(%)
MALANG					
(1) Kebonagung	9,073	55	496.1	45.6	9.2
(2) Krebet Baru	11,683	67	782.7	72.3	9.2
SIDOARJO					
(1) Tjandi	3,311	76	252.8	22.1	8.7
(2) Krembung	2,321	83	191.6	16.5	8.6
(3) Tulangan	2,488	81	202.0	18.5	9.2
(4) Watutulis	2,935	85	248.2	23.0	9.3
(5) Krian	1,980	90	177.3	16.0	9.0
MOJOKERTO					
(1) Gempol kerep	7,510	77	581.3	59.7	10.3
JOMBANG					
(1) Cukir	4,441	82	362.4	39.3	10.8
(2) Jombang Baru	2,600	80	207.6	19.4	9.3
KEDIRI					
(1) Mojopanggung	2,854	63	178.4	16.6	9.3
(2) Ngadirejo	4,058	79	318.7	31.5	9.9
(3) Pesantren	6,384	87	557.6	63.3	11.4
NGANJUK					
(1) Mrican	4,252	79	334.3	31.4	9.4
(2) Lestari	4,336	77	336.8	30.9	9.2
T O T A L	70,326	75	5,230.9	506.0	9.7

Source : AI 07

Table 6 (3) HARVESTED AREA, UNIT YIELD AND PRODUCTION OF SUGARCANE IN 1982

NAME SUGAR MILLS	HARVESTED AREA	UNIT YIELD OF CANE	TOTAL PRODUCTION OF CANE	TOTAL SUGAR	MILLING RATE
	(ha)	(ton/ha)	(10^3 ton)	(10^3 ton)	(%)
MALANG					
(1) Kebonagung	10,711	56	598.1	46.3	7.7
(2) Krebet Baru	15.024	65.4	482.1	74.8	7.6
SIDOARJO					
(1) Tjandi	3,171	79	250.8	17.3	6.9
(2) Krembung	2,269	85	193.6	13.7	7.1
(3) Tulangan	2,418	88	213.9	16.6	7.7
(4) Watutulis	3,397	79	267.6	18.7	7.0
(5) Krian	1,907	97	184.5	13.5	7.3
MOJOKERTO					
(1) Gempol kerep	8,557	78	669.0	58.3	8.7
JOMBANG					
(1) Cukir	4,953	87	430.9	36.9	8.6
(2) Jombang Baru	3,306	88	292.2	23.0	7.9
KEDIRI					
(1) Mojopanggung	4,315	74	318.1	24.7	7.8
(2) Ngadirejo	4,411	81	357.9	26.9	7.5
(3) Pesantren	8,366	88	736.4	67.6	9.2
NGANJUK					
(1) Mrican	4,864	83	404.9	30.4	7.5
(2) Lestari	4,494	80	358.1	25.0	7.0
T O T A L	82,163	76	6,262.1	493.7	7.9

Source : AI 07

NOTE AI-4

INVENTORY OF IRRIGATION FACILITIES, CLASSIFICATION OF IRRIGATION AREA, AND INTAKE DISCHARGE

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Note AI - 4 Inventry of Irrigation Facilities Classification of Irrigation Area, and Intake Discharge

Table 1 shows the inventry of irrigation facilities summarized from Buku Pintar Daerah Irrigasi P.U. Sept. 1982 obatained from the Irrigation service Surabaya. According to the Table, the Irrigation canal density is 10 m/ha on an average in the basin. About 14% of total length of canal are provided with lining which is mostly made of wet stone masonry.

Large scale irrigation systems are mainly located along the Brantas river and depend on the water stored in the Karangkates reservoir in the dry season. They are Molek, Lodoyo, Warujayeng-Kertosono, Turi-Tunggorono, Porong and Mangetan systems. Besides, the Widas system serves to the Widas north area of 8,600 ha with the Water stored in the Bening reservoir.

The head intakes for Molek, Lodoyo, Porong, Mangetan and Widas functions well. The head intakes for Warujayeng and Turi-Tunggorono are more or less deteriorated and suffer from the sedimentation. These intakes have been planned to be reconstructed in the near future by the Irrigation Service.
As for the canal and the related structures, Lodoyo area has a sophisticated irrigation system and the canal density reaches 80 m/ha or more which is the highest among the irrigation units together with the functional new structures. Next are the Porong, Mangetan, Widas and Molek areas. The canal density is around 42 m/ha to 26 m/ha and the related structures relatively function well. The Warujayeng and Turi-Tunggorono areas have poor canal systems and structures except some limited areas. The canal density are 14 m/ha and 10 m/ha, respectively in accordance with the data Buku Pintar, Sept. 1982 obtained from the Irrigation Service.

As for the small irrigation systems, the most of them rely on small tributaries. The irrigation areas are generally served by a small diversion and poor canals. In the most of the irrigation units, the canal density is less than 50 m/ha.
Table 2 and Table 3 show the areas by clasification of technical, semi-technical and non-technical system in every irrigation sections and every irrigation systems fed from the Brantas river and the Surabaya river, respectively. The summary of which is shown below.

(Year : 1983)

Name of Daerah	Technical %	Semi-technical %	Non-technical %
Malang *	63 (52)	18 (11)	19 (37)
Kediri	66 (59)	13 (14)	21 (27)
Jombang	87 (82)	0 (0)	13 (18)
Mojokerto	76 (67)	17 (22)	7 (11)
Average	72 (65)	12 (11)	16 (24)

* Excluding seksi Kasri and Pasuruan which are outside of Brantas river basin.
Figures in parentheses are in 1972, derived from Master Plan, 1973.

The technical irrigation area covers only 72% of all the irrigation area, while about 95% of the irrigation area fed from the Brantas river or Surabaya river is technical area.

During a last decade, the technical area increased by 7%. On the contrary, the non-technical area decreased by 8%. It indicates that the 8% of the total area were upgraded, however the irrigation facilities in old technical areas have substantially been fallen into the semi-technical level owing to insufficient maintenance.

Intake discharge records for the areas fed from the Brantas river are compiled in Table 4.

Table 1 INVENTORY OF IRRIGATION FACILITIES

Description	Unit	Malang	Kepanjen	Kediri	Nganjuk	Tulungagung	Blitar
1. Irrigation area	Ha	16,712	28,294	29,660	39,069	34,268	34,986
2. Reservoir							
1. Dam	Nos	0	0	0	4	0	0
2. Closing dike	Nos	0	0	0	0	0	0
3. Intake structure							
1. Spring	Nos	65	163	194	81	477	314
2. Free intake	Nos	77	109	98	126	0	239
3. Pump well	Nos	0	0	26	0	0	0
4. Intake weir	Nos	65	48	141	34	42	328
4. Irrigation facilities							
1. Turnout	Nos	139	235	272	570	201	157
2. Drop	Nos	7	145	16	16	1	16
3. Aqueduct	Nos	10	10	21	22	20	12
4. Syphon	Nos	2	1	11	33	15	25
5. Culvert	Nos	2	30	17	92	37	0
6. Spillway	Nos	37	15	6	9	6	5
7. Canal with lining	Km	36.546	39.975	0	0	2.300	81.767
8. Canal without lining	Km	46.329	146.412	58.364	305.985	78.644	16.765
5. Drain and flood dike							
1. Drain canal with lining	Km	0.600	0.050	0	0	0	0
2. Drain canal without lining	Km	0	4.950	0	209.228	20.649	41.138
3. Flood dike	Km	0	0.650	5.177	61.557	9.601	81.419

Description	Unit	Jombang	Mojoagung	Pare	Mojokerto	Sidoarjo	Wonokromo	Grand Total
1. Irrigation area	Ha	24,264	23,389	19,298	32,024	31,601	2,979	316,544
2. Reservoir								
1. Dam	Nos	0	0	2	1	4	0	11
2. Closing dike	Nos	0	0	0	0	29	0	29
3. Intake structure								
1. Spring	Nos	0	40	158	121	6	0	1,619
2. Free intake	Nos	48	179	75	164	2	11	1,128
3. Pump well	Nos	0	5	35	0	0	0	66
4. Intake weir	Nos	28	43	92	65	4	4	914
4. Irrigation facilities								
1. Turnout	Nos	298	596	397	762	1,580	157	5,364
2. Drop	Nos	27	32	2	5	0	0	267
3. Aqueduct	Nos	14	23	7	32	27	6	204
4. Syphon	Nos	23	7	10	10	9	2	148
5. Culvert	Nos	7	30	15	12	48	11	301
6. Spillway	Nos	16	7	4	37	3	1	146
7. Canal with lining	Km	49.933	2.462	18.639	77.654	126.412	15.185	447.933
8. Canal without lining	Km	282.496	413.998	162.800	395.279	744.703	65.905	2,717.682
5. Drain and flood dike								
1. Drain canal with lining	Km	86.070	0	0	0.940	2.009	0	89.669
2. Drain canal without lining	Km	0	100.123	0	80.885	533.427	82.750	1,073.150
3. Flood dike	Km	47.277	83.618	60.660	115.200	115.200	13.700	475.759

Source : AI-52

Table 2 IRRIGATION AREA CLASSIFIED BY TECHNICAL, SEMI-TECHNICAL AND NON-TECHNICAL CATEGORIES

(Unit : ha)

NAME OF WILAYAH	IRRIGATION SECTION	TECHNICAL IRRIGATION AREA	SEMI TECHNICAL AREA	NON TECHNICAL AREA	TOTAL
MALANG	1. Kasri *)	15,007	2,947	3,746	21,700
	2. Malang	13,072	1,692	1,948	16,712
	3. Kepanjen	15,325	6,531	6,438	28,294
	4. Pasuruan *)	10,528	5,548	5,392	21,468
KEDIRI	1. Blitar	21,556	4,901	8,529	34,986
	2. Tulungagung	18,227	7,332	8,709	34,268
	3. Kediri	18,000	3,432	8,228	29,660
	4. Nganjuk	33,786	1,535	3,748	39,069
JOMBANG	1. P a r e	17,323	0	1,975	19,298
	2. Jombang	19,349	0	4,915	24,264
	3. Mojoagung	21,428	0	1,961	23,389
MOJOKERTO	1. Mojokerto	18,116	9,356	4,552	32,024
	2. Sidoarjo	30,497	1,104	0	31,601
	3. Wonokromo	1,715	1,264	0	2,979
T O T A L		253,929	45,642	60,141	359,712
		(70,6%)	(12.7%)	(16.7%)	(100.0%)
BRANTAS BASIN		228,394	37,147	51,003	316,544
		(72.2%)	(11.7%)	(16.1%)	(100.0%)

Source : AI 51 and AI 52

*) Outside of Brantas Basin

Table 3 IRRIGATION AREA OF WHICH IRRIGATION WATER IS TAKEN FROM THE MAIN BRANTAS RIVER AND THE SURABAYA RIVER

	NAME OF IRR. AREA	TECHNICAL AREA	SEMI TECHNICAL AREA	NON TECHNICAL AREA	TOTAL
(1)	Irr.Water from the K.Brantas				
	K.Brantas Atas	1,005	732	2	1,739
	K.Brantas Bawah	1,799	429	143	2,371
	Molek	3,991	0	0	3,991
	Lodoyo	12,706	0	0	12,706
	Besuk	539	0	0	539
	Warujayeng/ Kertosono	12,827	0	0	12,827
	T u r i	855	0	320	1,175
	Tunggorono	8,398	0	0	8,398
	Bunder	97	0	178	275
	Jatimlerek	563	0	238	801
	Gottan	188	0	491	679
	Bebekan	228	0	0	228
	Keboan	12	0	0	12
	Watespinggir	374	0	0	374
	Ngares	1,803	0	0	1,803
	Losari	665	0	0	665
	Jatikulon	11	464	144	619
	Mangetan	17,197	0	0	17,197
	Kemlaten	1,006	0	0	1,006
	Porong	12,294	40	0	12,334
	TOTAL	76,558	1,665	1,516	79,739
	Proportional (%)	(96 %)	(2.1 %)	(1.9 %)	(100.0%)
(2)	Irr.Water from the K.Surabaya				
	Karah	38	8	0	46
	Rowo Wiyung	0	398	0	398
	Gunung Lari	658	72	0	730
	Kali Bokor	254	182	0	436
	Jeblokan	268	200	0	468
	Simowau	94	82	0	176
	Kebonagung	363	322	0	685
	Jambangan	50	0	0	50
	TOTAL	1,725	1,264	0	2,989
	Proportional (%)	(57.7%)	(42.3%)	0	(100.0%)
	GRAND TOTAL	78,283	2,929	1,516	82,728
	Proportional (%)	(94.6 %)	(3.5 %)	(1.8 %)	(100.0%)

Source : AI 53, 54, 55, 56

TABLE 4(1) 10 - DAY DISCHARGE AT IRRIGATION INTAKE

Year : 1982 Unit : m^3/s

Month		Molek	Kodoyo	Mricen	Banjar Sari	Besuk	Kedung Kudi	Pengkol	Turi	Tunggo rono	Bunder	Jatin lerek	Cottan	Bebeken	Yates Pinggir	Ngares	Losari	Jati Kulon	Lengkong	Kem-leten	Mange tan	Po-rong	To-tal
Jan.	1	-	9.00	11.50	1.54	0.32	0.15	0.08	0.70	8.30	0.20	0.60	0.50	0.10	0.40	1.70	1.00	0.4	0.4	0.9	30.4	20.8	-
	2	-	9.00	11.90	1.66	0.32	0.15	0.08	0.70	9.60	0.20	0.70	0.60	0.10	0.40	1.60	0.50	0.4	0.6	1.0	31.2	23.5	-
	3	-	9.00	11.30	1.85	0.32	0.15	0.08	0.80	8.70	0.20	0.60	0.40	0.10	0.30	1.50	0.60	0.4	0.4	0.9	33.9	22.7	-
Feb.	1	-	9.00	10.50	1.76	0.32	0.15	0.08	0.80	9.00	0.10	0.60	0.50	0.10	0.30	1.40	0.60	0.4	0.4	0.9	39.8	28.8	-
	2	-	9.00	9.50	1.57	0.32	0.15	0.08	1.00	8.60	0.20	0.60	0.50	0.10	0.30	1.40	0.60	0.4	6.2	0.8	36.8	25.6	-
	3	-	9.00	9.30	1.86	0.32	0.15	0.08	0.90	8.80	0.20	0.60	0.40	0.10	0.30	1.40	0.60	0.4	0.3	0.6	31.8	20.8	-
Mar.	1	-	9.00	8.80	1.78	0.32	0.15	0.08	0.90	9.20	0.20	0.70	0.50	0.10	0.30	1.40	0.60	0.4	0.3	0.6	30.8	20.0	-
	2	-	9.00	9.20	1.57	0.32	0.15	0.08	1.20	6.80	0.20	0.60	0.50	0.10	0.30	1.40	0.60	0.4	-.3	0.6	25.8	18.8	-
	3	-	9.00	6.70	1.49	0.32	0.15	0.08	0.90	6.80	0.10	0.50	0.40	0.10	0.30	1.30	0.50	0.4	0.3	0.6	27.6	19.3	-
Apr.	1	-	9.00	8.30	1.53	0.32	0.15	0.08	0.40	7.70	0.10	0.30	0.20	0.10	0.30	1.30	0.30	0.3	0.3	0.6	30.4	19.7	-
	2	-	9.00	10.20	1.86	0.32	0.50	0.08	0.20	5.90	0.10	0.30	0.10	0.10	0.30	1.10	0.20	0.3	0.3	0.4	21.3	14.3	-
	3	-	9.00	10.90	1.67	0.32	0.65	0.08	0.50	4.20	0.10	0.40	0.10	0.10	0.10	0.60	0.20	0.3	0.3	0.5	25.2	17.4	-
May	1	-	9.00	8.40	1.49	0.32	0.65	0.08	0.60	7.70	0.10	0.50	0.20	0.10	0.10	0.20	0.10	0.3	0.3	0.6	31.6	21.7	-
	2	-	9.00	7.80	1.49	0.32	0.66	0.08	0.70	7.60	0.30	0.80	0.20	0.10	0.10	0.10	0.10	0.3	0.3	0.6	31.2	21.3	-
	3	-	9.00	6.90	1.29	0.32	0.66	0.08	0.70	7.20	0.40	0.70	0.20	0.10	0.10	0.10	0.10	0.3	0.3	0.4	29.2	19.3	-
Jun.	1	5.40	9.00	8.60	1.33	0.09	0.63	0.09	0.60	6.10	0.20	0.70	0.20	0.10	0.10	0.10	0.10	0.3	0.3	0.4	24.4	19.0	77.74
	2	5.30	9.00	8.90	1.21	0.09	0.63	0.09	0.60	5.40	0.20	0.50	0.20	0.10	0.10	0.10	0.10	0.3	0.3	0.4	24.9	15.7	74.12
	3	5.30	9.00	8.10	1.20	0.09	0.63	0.09	0.60	5.10	0.20	0.50	0.20	0.10	0.10	0.20	0.10	0.3	0.3	0.2	22.8	14.1	69.21
Jul.	1	5.50	7.60	6.70	0.92	0.09	0.63	0.09	0.60	5.90	0.20	0.40	0.20	0.10	0.10	0.20	0.10	0.3	0.3	0.2	21.0	12.2	63.33
	2	5.50	6.00	6.90	0.52	0.08	0.65	0.09	0.50	4.80	0.30	0.70	0.20	0.10	0.10	0.20	0.10	0.3	0.3	0.2	18.0	11.8	57.34
	3	5.60	6.00	7.50	0.52	0.09	0.65	0.09	0.60	7.80	0.20	0.50	0.20	0.10	0.10	0.10	0.10	0.3	0.3	0.4	24.9	19.0	75.05
Aug.	1	5.20	6.00	7.00	0.52	0.08	0.65	0.09	0.60	5.20	0.20	0.30	0.20	0.10	0.10	0.20	0.10	0.	0.	0.2	17.3	11.5	55.54
	2	4.60	6.00	6.80	0.52	0.08	0.65	0.09	0.60	5.10	0.20	0.30	0.20	0.10	0.10	0.20	0.10	0.2	0.2	0.2	17.3	11.7	55.24
	3	4.30	6.00	6.90	0.52	0.08	0.65	0.09	0.40	4.80	0.20	0.30	0.20	0.10	0.10	0.20	0.10	0.3	0.3	0.3	17.1	11.3	54.24
Sep.	1	3.90	6.00	6.90	0.52	0.08	0.65	0.09	0.20	4.10	0.20	0.30	0.20	0.10	0.10	0.20	0.10	0.8	0.3	0.2	12.4	8.1	44.94
	2	3.90	6.00	6.80	0.52	0.08	0.65	0.09	0.30	4.80	0.20	0.30	0.20	0.10	0.10	0.20	0.10	0.3	0.3	0.2	11.7	8.4	45.24
	3	4.20	6.00	6.80	0.52	0.08	0.65	0.09	0.20	3.50	0.20	0.30	0.20	0.10	0.10	0.20	0.10	0.3	0.3	0.3	12.3	8.6	45.04
Oct.	1	3.70	6.00	6.90	0.52	0.08	0.65	0.09	0.20	3.50	0.20	0.30	0.20	0.10	0.10	0.20	0.10	0.3	0.3	0.3	12.2	9.1	45.04
	2	3.40	6.00	7.00	0.52	0.08	0.65	0.09	0.10	1.30	0.20	0.30	0.20	0.10	0.10	0.20	0.10	0.3	0.3	0.2	12.4	9.0	42.54
	3	3.30	6.00	6.60	0.52	0.09	0.65	0.09	0.20	3.20	0.20	0.30	0.20	0.10	0.10	0.20	0.10	0.3	0.3	0.1	12.4	8.3	42.54
Nov.	1	3.60	6.00	6.40	0.52	0.08	0.65	0.09	0.20	2.90	0.20	0.30	0.20	0.10	0.10	0.20	0.10	0.3	0.1	0.1	11.3	7.5	43.24
	2	4.00	6.00	6.60	0.52	0.08	0.65	0.09	0.20	3.30	0.20	0.30	0.20	0.10	0.10	0.20	0.10	0.3	0.3	0.1	12.1	8.1	43.54
	3	3.80	6.00	6.10	0.52	0.08	0.65	0.09	0.20	3.50	0.20	0.10	0.20	0.10	0.10	0.20	0.10	0.3	0.1	0.	7.7	4.8	34.84
Dec.	1	-	6.00	5.20	0.52	0.08	0.65	0.09	0.20	3.20	0.20	0.20	0.10	0.10	0.10	0.20	0.10	0.3	0.3	0.1	8.7	6.6	-
	2	-	6.00	10.00	0.52	0.08	0.65	0.09	0.20	3.90	0.20	0.50	0.20	0.10	0.10	0.20	0.10	0.3	0.3	0.4	26.6	19.6	-
	3	-	6.00	12.90	0.52	0.08	0.65	0.09	0.50	4.80	0.30	1.10	0.50	0.10	0.10	0.20	0.10	0.3	0.3	0.3	32.0	22.6	-

TABLE 4 (2) 10-DAY DISCHARGE AT IRRIGATION INTAKE

Year: 1983 (Unit: m^3/s)

Month	Molek	Lodoyo	Mrican	Banjar seri	Bendo	Padung Kudi	Pacoltol	Teri	Tanggo rono	Bender	Jatim lerek	Gottan	Bebekan	Wates Pinggir	Ngares	Lossari	Jati Kulon	Leng koog	Kan laten	Mange tan	Porong	Total
Jan.1	-	6.00	13.20	1.39	0.08	0.15	0.09	0.60	6.70	0.30	0.90	0.40	0.10	0.10	0.50	0.20	0.40	0.40	0.60	32.0	22.6	-
2	-	6.00	13.20	1.19	0.08	0.15	0.09	0.80	7.60	0.30	1.10	0.60	0.10	0.10	0.80	0.50	0.30	0.30	0.50	30.3	21.6	-
3	-	6.00	13.20	1.32	0.08	0.15	0.09	0.80	7.50	0.30	0.90	0.60	0.10	0.10	0.80	0.50	0.30	0.30	0.50	27.7	19.7	-
Feb.1	-	7.53	13.50	1.19	0.08	0.15	0.09	0.80	8.40	0.30	0.80	0.50	0.20	0.30	1.00	0.50	0.50	0.50	0.50	30.1	21.7	-
2	-	8.00	13.40	1.22	0.08	0.15	0.09	0.80	9.00	0.30	0.80	0.50	0.10	0.20	0.90	0.50	0.40	0.50	0.50	27.4	20.2	-
3	-	6.84	13.50	1.28	0.08	0.15	0.09	0.80	9.30	0.30	0.80	0.50	0.10	0.20	0.90	0.50	0.50	0.50	0.50	30.9	22.9	-
Mar.1	-	9.00	13.30	1.30	0.08	0.15	0.09	0.50	9.00	0.30	0.80	0.50	0.10	0.20	0.90	0.40	0.40	0.50	0.20	31.6	24.6	-
2	-	9.00	13.20	1.35	0.08	0.15	0.09	0.50	8.40	0.30	0.80	0.50	0.10	0.20	0.90	0.40	0.30	0.40	0.50	27.3	21.2	-
3	-	9.00	12.60	1.26	0.08	0.15	0.09	0.50	8.30	0.30	0.70	0.50	0.10	0.20	1.00	0.40	0.40	0.60	0.60	33.6	26.1	-
Apr.1	-	9.00	10.70	1.16	0.08	0.45	0.09	0.50	6.80	0.20	0.50	0.40	0.10	0.20	1.00	0.40	0.40	0.20	0.20	14.4	11.0	-
2	-	9.00	11.00	1.25	0.08	0.65	0.09	0.50	6.40	0.10	0.30	0.30	0.10	0.20	1.00	0.40	0.40	0.20	0.20	12.3	9.2	-
3	-	9.00	9.60	1.18	0.08	0.17	0.09	0.50	6.20	0.10	0.10	0.10	0.10	0.20	0.80	0.40	0.40	0.40	0.40	24.2	18.0	-
May 1	-	9.00	9.70	1.26	0.08	0.65	0.09	0.50	7.80	0.30	0.70	0.10	0.10	0.10	0.70	0.30	0.30	0.40	0.40	24.9	18.6	-
2	-	9.00	9.70	1.08	0.08	0.65	0.09	0.50	7.60	0.40	1.10	0.10	0.10	0.10	0.50	0.20	0.30	0.40	0.40	22.2	17.9	-
3	-	9.00	9.80	1.09	0.08	0.65	0.09	0.50	7.50	0.30	1.10	0.10	0.10	0.10	0.40	0.10	0.50	0.40	0.40	21.2	17.4	-
Jun.1	6.10	9.00	9.90	1.09	0.08	0.65	0.09	0.50	7.80	0.30	0.80	0.10	0.10	0.10	0.40	0.10	0.10	0.40	0.40	25.5	18.9	82.41
2	5.80	9.00	10.80	1.07	0.08	0.65	0.09	0.60	7.70	0.30	0.90	0.20	0.10	0.10	0.40	0.10	0.60	0.40	0.40	26.0	19.3	84.59
3	5.40	9.00	10.90	1.00	0.08	0.65	0.09	0.60	8.00	0.20	0.70	0.40	0.10	0.10	0.30	0.10	0.50	0.40	0.40	27.0	19.2	85.12
Jul.1	5.50	9.00	10.30	0.46	0.08	0.65	0.09	0.80	8.90	0.20	0.70	0.30	0.10	0.10	0.10	0.10	0.50	0.40	0.40	27.0	19.2	84.88
2	5.50	9.00	8.20	0.46	0.08	0.65	0.09	0.70	7.20	0.20	0.60	0.20	0.10	0.10	0.40	0.10	0.	0.30	0.30	25.6	18.4	78.18
3	4.90	9.00	7.00	0.46	0.08	0.65	0.09	0.70	4.90	0.20	0.70	0.20	0.10	0.10	0.20	0.10	0.40	0.20	0.20	19.9	13.2	63.28
Aug.1	3.80	8.40	10.60	0.46	0.15	0.65	0.15	0.70	3.90	0.20	0.70	0.10	0.10	0.10	0.20	0.10	0.30	0.20	0.20	16.7	10.6	58.31
2	3.90	8.00	8.30	0.53	0.61	0.61	0.61	0.50	3.50	0.30	0.60	0.20	0.10	0.10	0.20	0.10	0.30	0.10	0.20	16.8	11.3	56.88
3	3.60	8.00	7.50	1.00	0.12	0.12	0.12	0.40	3.10	0.10	0.70	0.20	0.10	0.10	0.20	0.10	0.30	0.10	0.20	15.5	10.7	57.26
Sep.1	3.20	8.00	8.10	0.76	0.21	0.61	0.15	0.30	3.00	0.10	0.40	0.20	0.10	0.10	0.10	0.10	0.40	0.10	0.20	15.2	9.9	51.13
2	3.30	8.00	7.20	0.68	0.20	0.61	0.15	0.20	2.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.20	0.10	0.20	12.0	9.6	45.24
3	3.50	8.00	6.60	0.49	0.20	0.61	0.15	0.30	2.30	0.10	0.10	0.30	0.10	0.10	0.10	0.10	0.20	0.10	0.20	11.4	9.1	44.25
Oct.1	3.40	8.00	7.60	0.53	0.20	0.61	0.15	0.30	2.00	0.10	0.10	0.30	0.10	0.10	0.10	0.10	0.20	0.20	0.20	12.6	10.3	47.19
2	5.00	7.50	7.50	0.52	0.25	0.61	0.20	0.10	1.00	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.20	15.8	12.8	52.38
3	4.10	6.50	7.60	0.95	0.25	0.61	0.20	0.10	0.30	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.30	0.20	0.20	20.4	16.5	58.91
Nov.1	-	6.50	9.30	0.88	0.25	0.61	0.20	0.30	2.50	0.10	0.10	0.20	0.10	0.10	0.10	0.10	0.40	0.20	0.20	22.3	17.9	-
2	-	6.50	10.20	0.95	0.25	0.61	0.20	0.40	3.00	0.10	0.50	0.40	0.10	0.10	0.20	0.10	0.50	0.30	0.40	25.8	18.4	-
3	-	6.50	11.70	1.21	0.25	0.61	0.20	0.50	5.00	0.40	1.00	0.60	0.10	0.10	0.20	0.10	0.40	0.30	0.40	25.3	18.6	-
Dec.1	-	6.50	11.00	1.17	0.20	0.60	0.15	0.50	5.20	0.60	1.60	0.90	0.20	0.10	0.40	0.10	0.40	0.40	0.50	29.5	22.1	-
2	-	7.50	11.40	1.34	0.28	0.60	0.20	1.00	6.20	0.50	1.40	0.80	0.20	0.10	0.40	0.10	0.30	0.40	0.50	32.0	23.1	-
3	-	8.00	11.90	1.18	0.27	0.60	0.20	1.00	7.50	0.40	1.10	0.70	0.20	0.10	0.60	0.10	0.50	0.40	0.60	27.6	22.5	-

NOTE AI-5

EXISTING IRRIGATION PROJECT

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Note AI-5 Existing Irrigation Project

There are six major irrigation projets in the basin. These are;
Lodoyo Irrigation Project
Wonorejo Dam and Irrigation Project
Tugu Dam and Irrigation Project
Wuru-Turi Irrigation Project
East Java Irrigation Project
East Java Groundwater Irrigation Project

1. Lodoyo Irrigation Project

The Project area is located in Kabupaten Blitar. Out of total irrigation area of about 15,200 ha, 14,400 ha have been already completed as of March 1984. The Project is to be completed in December 1985. The main canal and secondary canals are 31.7 km and 129 km long, respectively.

2. Wonorejo Dam and Irrigation Project

The Project area is located in Tulungagung. The detailed design of the Project was started in September 1983 and completed by October 1984. Rehabiltation and extension of irrigation and drainage facilities will serve 6,420 ha, and provision of pumped irrigation facilities will serve 1,120 ha.

3. Tugu Dam and Irrigation Project

The Project area is located in Trenggalek. Pre-feasibility study was conducted in 1984. The irrigation area of 4,500 ha is expected to be served by the proposed Tugu reservoir.

4. Waru-Turi Irrigation Project

The Project area is located astride the Brantas middle reaches; the left is Warujayeng area and the rigth is Papar-Peterongan area and Turi-Tunggorono area.

The Warujayeng and Turi-Tunggorono sub-projects are under detail design stage together with a gated barrage so-called Waru-Turi Barrage and the Papar-Peterongan sub-project is under feasibility study stage at present.

Net irrigation area is about 38,000 ha comprising 13,600 ha of Warujayeng area, 14,600 ha of Papar-Peterongan area and 9,900 ha of Turi-Tunggorono area.

The Project is composed of the construction of a new barrage accross the Brantas river at a few kms downstream of Kediri city, primary canals originating the barrage for Papar-Peterongan and Turi-Tunggorono areas and connecting canals between the barrage to the existing primary canals of Warujayeng area together with the rehabilitation and upgrading of existing irrigation and drainage systems and flood control works.

The barrage construction would involve several uncertain factors which probably cause serious problems in view of river morphology as well as the operation of the barrage. Among others, the most serious problem which could be anticipated upon the barrage construction might be the sediment.

According to the records, Mt. Kelud has erupted once in 15 years on an average and the last eruption in 1951 and 1966, river bed in the middle and then lower Brantas rose up by several meters, of which the accumulation effect of the sediment lasted for about five years. When such eruptions would occur, in order to eliminate the danger of flood the Waru-Turi barrage would be obliged to be fully opened for a long period to drain the sediment so as to restore the discharge capacity of the river.

In such occasion, the irrigation intakes of the barrage would encounter the difficulty to take irrigation water to meet the irrigation water requirement for a long period if the design intake water level is set at high elevation.

Taking the above into account, the barrage is expected to be carefully designed.

5. East Java Irrigation Project

The East Java Irrigation Project is divided into two sub-project; East Java Rehabilitation Project and East Java O & M Project.

The East Java Rehabilitation Project covers most of the existing irrigation areas in the Brantas river basin except Lodoyo area, Waru-Turi areas and Brantas delta. The Project principally aims to restore the irrigation system to the original design requirements. The irrigation areas are divided into three ranks generally in Dinas Pengairan level. Total projects area is about 180,000 ha, of which 50,000 ha is selected as first priority area. At present 12,000 ha for main system and 5,300 ha of tertiary development have already been rehabilitated and 50,000 ha is scheduled to be completed by the end of 1988.

The Project area overlaps with the Wonorejo Project, East Java Groundwater Project and Papar-Peterongan Project which is sub-project of Waru-Turi Project. Accordingly, adjusment is needed among the Projects.

The East Java O & M Project covers the whole irrigation area controlled by the Irrigation Service of East Java. Under the O & M Project, new operation and maintenance systems are being applied.

6. East Java Groundwater Development Project.

About 150 wells serving about 6,000 ha of irrigation area have been developed and the groundwater exploitation is still more continued by P2AT at present. To make further development, the East Java Groundwater Development Project was formulated.

Through the project study, an area of 30,000 ha was tentatively identified for the future development area in the Brantas basin which is composed of Mojokerto zone of 18,000 ha, Kediri-Nganjuk zone of 9,000 ha and Blitar zone 3,000 ha.
Out of 30,000 ha, 5,200 ha in Mojokerto zone and 4,900 ha in Kediri-Nganjuk zone have been tentatively proposed as first priority area.

NOTE AI-6

SELECTION OF AREA TO BE DEVELOPED

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Note AI-6 Selection of Area to be Developed

1. Selection Procedure

The selection of the areas to be developed is conducted taking into account the on-going and studied projects in accordance with the following procedure.

First, the low cropping intensity areas are identified by examining of all the irrigation areas in the Brantas basin. The cropping intensity is a good indicator of water availability and of agricultural activities. The low cropping intensity areas are generally judged to be less-developed area.

Second, the areas taken up by the on-going or studied projects except East Java Irrigation Project (EJIP) and East Java Groundwater Development Project (EJGDP) are excluded from the objective area of future development.

Third, the areas taken up by EJIP as a first priority area or having no additional water availability are left to EJIP.

Fourth, among the screened areas, the areas expected to be developed with the groundwater exploitation by EJGDP and to have no availability of surface water are left to EJGDP.

2. Selection of Area

The low cropping intensity areas are :

- Widas extension area
- Trenggalek area
- Batu area upper Malang
- Beng area along the left bank of Brantas river
- Middle area between Blitar and Kediri
- Southern area of Mojokerto city
- Gottan - Losari intake area fed from Brantas river
- Lesti Left bank area.

Among these areas, the Widas extension area, the Beng area, Gottan - Losari area and the Lesti left bank area are selected as conceivable project areas according to the following considerations.

The Widas extension area is located at the outside of developed areas and there is no industries in the area. The most of the inhabitants are relying on the poor agricultural activities. The agricultural land is expected to be developed with water to be created by the construction of reservoir dams.

The Trenggalek area where is far from the big cities and main trunk road, is located at the inner part of the Brantas basin. Considering such situations, the Trenggalek will be left as an agricultural producing area. However, this area is at present taken as an objective area to

developed by Tugu Dam and Irrigation Project which is under the pre-feasibility study stage with technical assistance loan from ADB for detailed design of Tulungagung II Stage Development.

The Batu area is located at the most upstream of the Brantas river and a tourist resort with cool climate and favored with spring water. By the cool climate and ample spring water, they are producing vegetables such as carrot, cabbage, chinese cabbage, tomato, cucumber, etc. instead of rice and also there are more employment opportunities in the tourism than the other areas.

The Beng area has the same situation as the Widas extension area. The most of the people are relying on the poor agricultural activities owing to the poor water availability. However, the water resources of the Beng river has not been fully exploited yet. The area is expected to be developed with the provision of a reservoir on the Beng river.

The middle area between Blitar and Kediri and the southern area of Mojokerto city are taken up by the Irrigation Service as a first priority area to be rehabilitated and upgraded. The latter area is taken up by the P2AT.

The Gottan - Losari area for which water is delivered from the Brantas river through small intakes suffers from the water shortage.

The Lesti left area is located far from the major cities and almost isolated with the developed area due to the poor traffic measures. There is least other employment opportunity than agriculture. The Lesti river, however, has abundant base flow even in the dry season.

NOTE AI-7

PRESENT CONDITION OF SELECTED AREA

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Note AI-7 Present Condition of Selected Area

1. Widas Extension Area

The Widas extension area is located in the northern part along the Widas river adjacent to the downatream side of the previous Widas Project area. The topography is gently sloping downward from the northwest to the south-easth with altitudes ranging from EL. 60 m to EL. 40 m. The project area is covered with fine alluvials. The gross acreage of the project area is about 3,040 ha consisting of paddy field of 2,280 ha, upland field of 80 ha and homestead and others of 680 ha.

The Project area belongs to the Kabupaten Nganjuk and covers the Kecamatan Gondang and Lengkong. The population density is estimated to be 4.5 persons/ha which is fairly less than the average of the Kabupaten Nganjuk. There is no industry in the area. The most of the inhabitants are relying on the poor agricultural activities.

The project area is covered with the two irrigation units, namely Tretes and Ketandan. The main water sources of the project area are small streams originating from the Kedung ridge and flowing to the Widas river. Irrigation water is taken by means of simple run-off river type weirs and conveyed to the fields through unlined poor canals or directly field plot to plot. The small streams are easily dried up in the dry season and the irrigation in the dry season is limited to quite small areas. Even in the wet season, the base-flow of small streams is not sufficient to the water requirement of the wet season paddy. As a result, the water flooding at storm time is used for irrigation.

Major crops grown in the area are paddy in the wet season and soybean, peanut, maize and tobacco in the dry season. The cropping patterns are almost same as those in the Brantas river basin; the wet season paddy is planted in December to January and harvested in April and May, then upon the harvesting, polowijo crop I is planted. In some lowlying land polowijo crop II is planted immediately after the polowijo crop I. Dry season paddy cropping is considerably limited in lowlying land due to the severe shortage of irrigation water. The cropping intensities are 0.83 in paddy plus sugarcane and 1.78 in total. The cultivated area, the unit yield of crops and the crop production are shown in Table 1. In this table, the unit yield of paddy are modified according to the DOLOG standard of clean dry paddy by multiplying the unit yield records obtained from agricultural service office by conversion factor of 0.80, since the records of the unit yield are always expressed in terms of rough dry paddy with the moisture content of 20 % or more and 8 % to 10 % impurities, while the DOLOG standard of clean dry paddy is defined as 14 % of moisture content and less than 3% impurities.

2. Beng Area

The Beng area is located at the north of Ploso city along the

Kedung ridge in the north and bordered in the Marmoyo river in the south. The topography is gently sloping downsward from north-west to south-east with altitudes ranging from EL. 40 m to EL. 25 m. The gross acreage is 4,180 ha consisting of the paddy field of 3,090 ha, upland field of 280 ha and homestead and others of 810 ha.

The project area belongs to the Kabupaten Jombang and covers the Kecamatan Plandakan, Kabuh and Kudu. The population density is estimated at about 4 persons/ha which is fairly less than the average of the Kabupaten Jombang. The most of peopel are relying on the poor agricultural activities owing to the poor water availaility.

The project area is covered with the irrigation unit, so-called, Luar Brantas. About halves are technical area and non-technical area. No semi-technical area is in the Luar Brantas. The area irrigated by the Beng river is only 275 ha at present. Most of the project area relies on rainfall and small streams flowing from the Kedung ridge as well as the widas extension area. The irrigation system is very poor.

Major crops grown in the area are paddy in the wet season and tobacco, maize and soybean in the dry season. The cropping pattern is almost the same as that of the Widas extension area. In the dry season, tobacco accounts for 37% of total cropping area. Cropping intensities are 0.97 in paddy plus sugarcane and 1.85 in total. The cultivated area of each crop, unit yield of crops and crop production are shown in Table 1. The unit yield of paddy is modified as aforementioned.

3. Gottan-Losari Area

The Gottan-Losari area is located along the left bank of the Brantas river nearly from Ploso city to Mojokerto city. The area is slender along the Brantas river. The area is adjacent to the Beng area in the northern side through the Marmoyo river. The area is very flat with altitude of about 25 m to 17 m. The gross acreage is about 6,850 ha consisting of paddy field of 4,240 ha and homestead and others of 2,610 ha.

The area belongs to the Kabupaten Jombang in the upstream half and the Kabupaten Mojokerto in the downstream half. The population density is estimated to be 13 persons per ha which is fairly higher than the averages of both Kabupatens.

The area takes irrigation water from the Brantas river through small intakes or pumps installed along the left bank of the Brantas river. The following table shows the areal distribution of irrigation area according to the intakes and the type of intakes.

Name of Intake	Irrigation Area (ha)	Type of Intake
Gottan	679	Wooden gate
Bebekan	228	Wooden gate
Keboan	12	Wooden gate
Wates Pinggir	374	Pump
Ngares I + II	1,803	Pump (Ngares I) Steel gate (Ngares II)
Sidoringin	477	Steel gate
Losari	665	Steel gate
Total	4,238	

Source : AI - 5

The water level of the Brantas river is lowered in the dry season less than the ground surface elevation of the most of the irrigation area. Thus, the intake and canal system can not supply the irrigation water to the fields. Actually the Keboan intake to the Losari intake can not take river water due to the lower water level of the Brantas river than the sill elevation of these intakes. Further the Gottan, Bebekan and Keboan intakes have deteriorated or have been broken more or less in the gates.

Sedimentation in the existing canal system is also one of serious problems. These intakes have no sediment ponds. Farmers lift up the sediment deposit in the canal system before the onset of the wet season.

Under the irrigation conditions mentioned above, the paddy cultivations is limited in the wet season. Sugarcane cropping prevails in the area. The cropping area of sugarcane accounts for 33 % of the total cultivated area. The main crops grown in the dry season are maize and soybeans.

Cropping intensities are 0.97 in paddy plus sugarcane and 1.75 only in total. The cultivated area, unit yield of crop production are shown in Table 1.

4. Lesti Left Area

The Lesti left area is located far from the major cities and almost isolated with the developed area due to the poor traffic measures. There is least other employement opportunity than agriculture. The Lesti river, however, has abundant base flow even in the dry season.

The Lesti left area is slender and long along the left bank of the Lesti river and divided into several blocks by the small tributaries of the Lesti river. The topography of the project area is steep downward from the hilly area located in the south of the project area to the Lesti river with the average slope of around 2% and the altitude

ranging from EL. 342m and EL. 290m above sea level and from 25 m to 30 m above the Lesti river. The gross acreage is about 4,300 ha consisting of the upland field of about 2,450 ha and homestead and others of 1,850 ha.

No irrigation systems are available in the most of the area. Upland crops such as maize, cassava, soybean and sugarcane are planted relying on the rainfall water and the water of small streams and springs. The cropping intensity is roughly estimated to be 0.95 in total. The cultivated area and the crop production are shown in Table 1. The unit yield shown in Table 1 is the average of the Kabupaten Malang, however, the actual unit yield in this area is assumed to be lower than the average considering the actual condition of the area.

5. Widas South Area

The Widas south area extends the northern plain from the foot of the Mt. Wilis. The project area borders the Warujayeng area in the eastern side through the Kedungsoko river and the previous Widas project area in the norther side through Ulo river. The both rivers are major tributaries of the Widas river.

The topography is gently sloping downsward to the north-east with altitudes ranging from EL. 85 m to EL. 40 m. The gross acreage is about 9,400 ha consisting of paddy field of 6,600 ha and homestead and others of 2,800 ha.

The area belongs to the Kabupaten Nganjuk and is the most developed area in this Kabupaten as well as the Warujayeng area. The population density is bigger than the average of the Kabupaten Nganjuk.

The Project area is covered with three irrigation units such as Kedungpedet, Kuncir and Kedungsoko controlled by the Seksi Irrigasi Nganjuk. The main water sources are the river water of the Kuncir river, the Kuncir Kiri river and the Bodor river. These rivers serve with perenial streams. The water is taken by means of runoff-river type weir and conveyed to the fields by small canals. The existing canal length is about 90 km in the project area according to the data obtained from the Irrigation Service, however, the actual canal length is securely more than that, since many small distributaries are provided by farmers themselves. The most of the canals are earthen canal and only about 13 km is lined with wet masonry. Many canals have been deteriorated. Many measuring devices have not worked well or not provided at small diversion points.

At present, groundwater irrigation project is being carried out by P2AT. This development aims to irrigate the irrigation area of about 2,600 ha. East Java Irrigation Project also aims to rehabilitate the irrigation facilities in the most of the areas as first priority or second priority area.

The area is a main granary store in the Kabupaten Nganjuk and extensively serves the crop production of paddy, soybeans, maize, ground nuts and sugarcane. The total cropping intensities reach to 1.32 in paddy plus sugarcane and 2.16 in total. The cropping pattern and the intensity are almost the same as those of the area fed directly from the Brantas river.

The cultivated area of each crop unit yield and crop production are shown in Table 1.

Table 1 CULTIVATED AREA, UNIT YIELD AND CROP PRODUCTION OF FUTURE PROJECT AREA AT PRESENT

Kind of Crop	Cultivated Area (ha)	Unit Yield (ton/ha)	Crop Production (ton)
(1) Widas Extension Area			
Wet Season paddy	1,930)	4,3	9,030
Dry season paddy	170)		
Soybean	880	0.78	686
Ground nut	315	0.85	268
Maize	270	2.8	256
Tobacco	450	-	-
(2) Beng Area			
Wet season paddy	2,380)	4.3	12,000
Dry season paddy	410)		
Soybean	620	0.82	508
Ground nut	190	0.98	186
Maize	680	1.66	1,145
Sugar-cane	320	84	26,880
Tobacco	1,320	-	-
(3) Gottan-Losari Area			
Wet season paddy	2,690)	4.2	12,390
Dry season paddy	260)		
Soybean	1,260	0.83	1,046
Ground nut	280	0.89	249
Maize	1,640	1.45	2,378
Sugar-cane	1,200	81	97,200
(4) Widas South Area			
Wet season paddy	5,890)	4.3	33,020
Dry season paddy	1,790)		
Soybean	2,060	0.78	1,610
Ground nut	1,540	0.85	1,310
Maize	1,700	2.8	4,760
Sugar-cane	620	79	48,980
(5) Lesti Left Area			
Soybean	315	0.68	214
Ground nut	63	0.76	48
Maize	1,650	1.84	3,040
Sugar-cane	200	66	13,200
Cassava	250	-	-

Source : AI-05 for Cultivated area
NOTE AI-3 for Unit Yield

Remarks : Unit yield is Kabupaten Average

NOTE AI-8

FUTURE LAND USE, TARGET YIELD AND PRODUCTION IN SELECTED AREA

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Note AI-8 Future Land Use, Target Yield and Production in Selected Area

1. Future Land Use

Except the Lesti left area, the major crops are paddy in the wet season and paddy, soybean, peanut and maize in the dry season as well as the present cropping pattern of the well-developed area in the Brantas river basin. In the Widas extension area, the Beng area and the Gottan-Losari area, the dry season paddy cropping is realised upto about one-third the irrigation area so as to attain the average level of the Brantas river basin and the acreages of polowijo crops are remarkably increased. The tobacco cultivated in the Beng area is replaced with useful crops.

In the Widas south area, the cropping intensity of the dry season paddy is proposed to be 100 %. The polowijo crops are maintained nearly with the present acreage without irrigation water supply as well as present condition due to the insufficient storage capacity of the reservoir planned on the Kuncir river.

As for the Lesti left area, a tripple cropping of polowijo crops is proposed because of no paddy field at present and of disadvantage to be reclaimed to paddy field from the economic view point in such a steep gradient area of around 2% on an average.

Based on the proposed cropping patterns and their intensities the future land use of the project areas is estimated as follows.

Unit : ha

Area	Wet Season paddy	Dry Season paddy	Soybean	Peanut	Maize	Sugarcane
Widas extension	2,250	750	1,500	1,500	750	-
Beng	2,800	1,000	1,800	1,800	1,000	350
Gottan-Losari	2,800	1,000	1,800	1,800	1,000	1,200
Lesti left bank	-	-	2,000	2,000	2,000	200
Widas south	5,500	5,000	2,000	1,800	1,700	650

2. Anticipated yield and production

The anticipated yields of paddy and polowijo crops are estimated in view of the recent achievements attained from well-irrigated area in the Brantas river basin.

In the estimation of present crop yield of paddy, the data obtained from agricultural service offices are always expressed in terms of rough dried paddy with moisture of 20% or more and 8 to 10% impurities.

(Refer to AI-58 of reference). On the other hand DOLOG, standard of dried clean paddy is defined as 14% of moisture and less than 3% purities.

Since in agricultural planning and the evaluation of the project, unit yield of paddy is always followed by DOLOG standard, present unit yield of paddy mentioned above is to be converted to meet the DOLOG. Standard by the conversion factor of 0.80 is adopted by taking into account the difference of moisture content and impurities.

The unit yield of paddy attained in the Brantas river basin is arround 5.5 tons/ha as rough dry paddy in Kabupatens as previously shown in Note AI-3 and in some of the Kecamatans, the unit yield over 7 tons/ha as rough dry paddy has been attained. These high yields correspond to 4.5 tons/ha to 5.5 tons/ha of clean dry paddy to meet the DOLOG standard.

Also, according to the data of C.R.I.A Bogor No. 30, the experimental farms in various agricultural stations get the unit yield of 7.0 tons/ha or more in 14 % moisture content. Based on these data, the target yield of paddy is conservatively estimated at 5.5 tons/ha as clean dry paddy.

The unit yields of soybean , peanut, maize and sugarcane attained in recent years are already stated Note AI-3 in the Kabupaten level. The followings are high unit yield attained in the Kabupatens.

Crop	Unit yield (ton/ha)	Kabupaten	Year
Soybean	1.1	Pasuruan	1983
	1.0	Pasuruan	1982
Peanut	1.2	Pasuruan	1983
	1.1	Pasuruan	1983
Maize	3.2	Nganjuk	1983
	3.1	Kediri	1983
Sugar-cane	97	Sidoarjo (Krian)/1	1982
	88	Kediri (Pesantren)/1	1981

/1 : Figure in parenthesis is name of sugar mill

In the unit yields are taken from the limitted area such as Kecamatan level or Desa level in which no hazards occur, the unit yields certainly increase.

Taking the above into account, the target yields of upland crops are tentatively estimated as follows.

Soybean	1.4 ton/ha
Peanut	1.5 ton/ha
Maize	3.5 ton/ha
Sugarcane	110 ton/ha

NOTE AI-9

BENEFIT ESTIMATE OF FUTURE PROJECTS

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Note AI-9 Benefit Estimate of Future Projects

The prices of crops and fertilizer are estimated by use of the 1990 price at 1984 constant price converted from 1981 constant price forecasted in the IBRD report 1982. Labour and animal cost are estimated based on the Wonorejo Irrigation Project. Table 1 shows the economic price estimated.

Farm input requirement without project condition are estimated through interview survey of officers in Agricultural service offices and refined according to the existing projects (Refer to Note AI-2). Farm input requirement with project condition is formed based on the standard input requirement of BIMAS program.

Table 2 and 3 shows the crop production cost without and with projects.

Table 4 shows the primary profit per hectare, without and with project conditions.

Table 5 shows the net incremental value with project.

Table 1 ECONOMIC PRICE

	Unit	Economic Price
Paddy	Rp/ton	241,000
Maize	Rp/ton	160,000
Soybeans	Rp/ton	346,000
Peanuts	Rp/ton	567,000
Sugar-cane	Rp/ton	24,000
Seed		
Paddy	Rp/kg	241
Maize	Rp/kg	160
Soybeans	Rp/kg	346
Peanuts	Rp/kg	567
Sugar-stalk	Rp/stalk	5.6
Urea	Rp/kg	253
TSP	Rp/kg	231
ZA	Rp/kg	253
Agro-chemical	Rp/kg	6,500
Animal power	Rp/kg	1,800
Labor cost	Rp/kg	600

Note : Unit price of 1990 in 1984 constant price forcasted by IBRD (Report 1982). Animal and labor costs, estimated based on Wonorejo Project.

Table 2 CROP PRODUCTION COST WITHOUT PROJECT CONDITION

	Paddy			Soybean			Middle		
	Amount	Unit Price (Rp)	Cost ($x10^3$Rp)	Amount	Unit Price (Rp)	Cost ($x10^3$Rp)	Amount	Unit Price (Rp)	Cost ($x10^3$Rp)
Seed (kg/ha)	30	241	7.2	50	346	17.3	30	160	4.8
Fertilizer									
Urea (kg/ha)	200	253	50.6	50	253	12.7	100	253	25.3
TSP (kg/ha)	50	231	11.6	75	231	17.3	50	231	11.5
Agro-chemical(ℓ/ha)	4	6,500	26.0	1	6,500	6.5	2	6,500	13.0
Animal Power (animal day)	8	1,800	14.4	-	-	-	4	1,800	7.2
Labour cost(man day)	210	500	105.0	80	500	40.0	72	500	36.0
Miscellaneous			21.9			9.4			9.1
Total production cost			236.3			103.2			106.9
			≒ 236			≒ 103			≒ 107

	Peanut			Sugar-cane		
	Amount	Unit Price (Rp)	Cost ($x10^3$Rp)	Amount	Unit Price (Rp)	Cost (10^3Rp)
Seed (kg/ha)	70	567	39.7	22.500	5.6	126.0
Fertilizer						
Urea (kg/ha)	70	253	17.7	450	253	113.9
TSP (kg/ha)	80	231	18.5	150	231	34.7
Agro-chemical(ℓ/ha)	1	6,500	6.5	30	6,500	195.0
Animal power (animal day)	-	-	-	-	-	-
Labour cost (man day)	98	500	49.0	840	500	420.0
Miscellaneous			13.1			89.0
Total production cost			144.5			978.6
			≒145			≒ 979

Source : Amounts are estimated through Interview survey for officers in Agricultural service offices and AI-83

Table 3 CROP PRODUCTION COST WITH PROJECT CONDITION

	Paddy			Soybean			Maize		
	Amount	Unit Price (Rp)	Cost ($x10^3$ Rp)	Amount	Unit Price (Rp)	Cost ($x10^3$ Rp)	Amount	Unit Price (Rp)	Cost ($x10^3$ Rp)
Seed (kg/ha)	24	241	6.0	40	346	13.8	30	160	4.8
Fertilizer									
Urea (kg/ha)	250	253	63.3	50	253	12.7	300	253	75.9
TSP (kg/ha)	100	231	23.1	100	231	23.1	50	231	11.6
Agro-chemical (ℓ/ha)	6	6,500	39.0	2	6,500	13.0	3	6,500	19.5
Animal Power (animal day)	8	1,800	14.4	4	1,800	7.2	4	1,800	7.2
Labour cost(man day)	250	500	125.0	85	500	42.5	85	500	42.5
Miscellaneous			27.1			10.9			16.5
Total production cost			297.9			123.2			178.0

	Peanut			Sugar-cane		
	Amount	Unit Price (Rp)	Cost ($x10^3$ Rp)	Amount	Unit Price (Rp)	Cost ($x10^3$ Rp)
Seed (kg/ha)/(Stalk)	60	567	34.0	22,500	5.6	126
Fertilizer						
Urea (kg/ha)	80	253	20.2	700	253	177.1
TSP (kg/ha)	100	231	23.1	150	231	34.7
Agrochemical (ℓ/ha)	2	6,500	13.0	40	6,500	260.0
Animal Power (animal day)	4	1,800	7.2	-	-	-
Labour cost (man day)	115	500	57.5	940	500	470
Miscellaneous			15.4			107.2
Total production cost			170.4			1,175.0

Table 4 PRIMARY PROFIT PER HECTARE

	Paddy	Soybean	Maize	Peanut	Sugar-cane
I.Without Project Condition					
1. Widas Extension Area					
Gross Income					
Unit yield (ton/ha)	4.3	0.78	2.8	0.85	-
Unit price(10^3Rp/ton)	241	346	160	567	-
Gross Income(10^3Rp/ha)	1,036	270	448	482	-
Production Cost(x10^3Rp/ha)	236	103	107	145	
Primary Profit(x10^3Rp/ha)	800	167	341	337	-
2. Beng Area					
Gross Income					
Unit Yield (ton/ha)	4.3	0.82	1.66	0.98	84
Unit Price(x10^3Rp/ton)	241	346	160	567	24
Gross Income(x10^3Rp/ha)	1,036	284	266	556	
Production cost(x10^3/Rp/ha)	236	103	107	145	979
Primary Profit(x10^3Rp/ha)	800	181	159	411	1,037
3. Gottan Losari Area					
Gross Income					
Unit yield (ton/ha)	4.2	0.83	1.45	0.89	81
Unit Price(x10^3Rp/ton)	241	346	160	567	24
Gross Income (x10^3Rp/ha)	1,012	287	232	505	1,944
Production cost (x10/Rp/ha)	236	103	107	145	979
Primary Profit ($x10^3$Rp/ha)	776	184	125	360	965
4. Widas south Area					
Gross Income					
Unit yield(ton/ha)	4.3	0.78	2.8	0.85	79
Unit price(x10^3Rp/ton)	241	346	160	567	24
Gross Income(x10^3Rp/ha)	1,036	270	448	482	1,896

Table 5 PRIMARY PROFIT PER HECTARE

	Paddy	Soybean	Maize	Peanut	Sugar-cane
Production Cost ($x10^3$Rp/ha)	236	103	107	145	979
Primary Profit($x10^3$Rp/ha)	800	167	341	337	917
5. Lesti left bank area					
Gross Income					
Unit yield (ton/ha)	-	0.68	1.84	0.76	66
Unit Price($x10^3$Rp/ton)	-	346	160	567	24
Gross income($x10^3$Rp/ha)	-	235	294	431	1,584
Production cost ($x10^3$Rp/ha)	-	103	107	145	979
Primary Profit($x10^3$Rp/ha)	-	132	187	286	605
II. With Project Condition					
Gross Income					
Unit yield (ton/ha)	5.5	1.4	3.5	1.5	110
Unit price($x10^3$Rp/ton)	241	346	160	567	24
Gross income($x10^3$Rp/ha)	1,325	484	480	850	2,640
Production Cost($x10^3$Rp/ha)	297	123	178	170	1,175
Primary Profit($x10^3$Rp/ha)	1,028	361	382	680	1,465

Unit Price: Projected price of 1990 in 1984 constant price forcasted by IBRD (Report 1982)
US$ ≒ 1.0 = Rp.1,030.

Table · 6 NET INCREMENTAL VALUE

Unit x 10^3Rp

	Without Project Condition			With Project Condition			Net Increment
	Net Profit	Area	Net Value	Net Profit	Area	Net Value	Value
Widas Extension							
Paddy	800	2,100	1,680,000	1,028	3,000	3,084,000	1,404,000
Soybean	167	880	146,960	361	1,500	341,500	394,540
Peanut	338	315	106,470	680	1,500	1,020,000	913,53
Maize	341	720/1	245,520	382	750	286,500	40,980
							2,754,050
Beng Area							
Paddy	800	2,790	2,232,000	1,028	3,800	3,906,400	1,674,400
Soybean	181	1,170/1	211,770	361	1,800	649,800	438,030
Peanut	411	360/1	147,960	680	1,800	1,224,000	1,076,040
Maize	159	1,282/1	203,838	382	1,000	382,000	178,162
Sugar-cane	1,037	320	331,840	1,465	350	512,750	331,327
							3,697,959
Gottan-Losari Area							
Paddy	776	2,950	2,289,200	1,028	3,800	3,906,400	1,617,200
Soybean	184	1,260	231,840	361	1,800	649,800	417,960
Peanut	360	280	100,800	680	1,800	1,224,000	1,123,200
Maize	125	1,640	205,000	382	1,000	382,000	177,000
Sugar-cane	965	1,200	1,158,000	1,465	1,200	1,758,000	600,000
							3,935,360
Lesti							
Paddy	132	315	41,580	361	2,000	722,000	680,420
Peanut	286	63	18,020	680	2,000	1,360,000	1,341,980
Maize	187	1,650	308,550	382	2,000	764,000	455,450
Sugar-cane	605	200	121,000	1,465	200	293,000	172,000
							2,649,850
Widas South Area							
Paddy	800	7,680	6,144,000	1,028	10,500	10,794,000	4,650,000
Soybean	167	2,060	344,020	167	2,000	334,000	-10,020
Peanut	338	1,540	520,520	338	1,800	608,400	87,880
Maize	341	1,700	579,700	341	1,700	579,700	0
Sugar-cane	917	620	568,540	1,465	650	952,250	383,710
							5,111,570

/1 : Including tobacco planting area

NOTE AI-10

PROPOSED IRRIGATION SYSTEM IN WIDAS EXTENSION AREA

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Note AI-10 Proposed Irrigation System in Widas Extension Area

1. Water balance calculation

The proposed irrigation area is shown in Fig.1. The net irrigation areas is 2,250 ha from the land resources. The water resources available for the project area are the water storage in the dam to be provided in the Kedungwarak river and the Semantok river.

To clarify the scale of exploitation of water resources for irrigation or to confirm the aerial scale of 2,250 ha of the irrigation area from the view point of the water resources, the water balance calculation is made on the basis of the river runoff estimated by the Tank Model method and the irrigation requirement estimated according to the proposed cropping pattern.

The catchment area of the Kedungwarak dam is only 32 km^2 and the mean annual runoff of the Kedungwarak river is estimated to be 0,68 m^3/sec on an average. The water resources are not sufficient to cover the total irrigation water requirement of 2,250 ha. However, since the storage efficiency of the Kedungwarak dam is considerably higher than that of the Semantok dam, the water resources of the Kedungwarak river is expected to be exploited at the maximum possible extent and the uncovered irrigation area by the Kedungwarak dam is planned to be irrigated by the Semantok dam.

As the results of the water balance calculation, the Kedungwarak dam scheme can cover the irrigation area of only 950 ha in the proposed cropping pattern and the required storage to guarantee the irrigation in the drought year of 80 % dependability is to be 28.0 x 10^6 m^3 which is estimated by Gumbel method. The irrigation water requirement, the estimated runoff of the river and the water balance calculation are shown in Table 1, 2 and 3. Calculation criteria of irrigation water requirement is stated in Note AI-17. Estimation method of runoff is stated in Section 3.2.

If the proposed cropping pattern is changed to extend the cropping intensity of dry season paddy from the 30 % to 100 %, the irrigation area of only 720 ha can be covered by the Kedungwarak dam scheme.

The Semantok dam is conceived to cover the remaining area of 1,300 ha for the proposed cropping pattern. The irrigation requirement in this case is shown in Table 1. The required storage to guarantee the irrigation in a drought year of 80 % dependability is 17 x 10^6 m^3 estimated by Gumbel method. The estimated runoff and water balance calculation is shown in Table 4 and 5, respectively.

2. Primary features of Kedungwarak dam and Semantok dam

The stage-storage capacity curves of both dam reservoirs are drawn

in Fig.2 and 3. According to these curves, the necessary dam height to store the required amount of water is decided and the preliminary design is made in line with the design condition stated in Section 3.7. Principal features are as follows.

	Kedungwarak Dam	Semantok Dam
Location	On Kedungwarak river, 12 km from the confluence with the Widas river	On Semantok river, 10 km from the confluence with the Widas river
Catchment area	32 km^2	61 km^2
Average runoff	0,68 m^3/sec	1.5 m^3/sec
High water level	EL.164.5 m	EL. 89.8 m
Low water level	EL.152 m	EL. 80 m
Gross storage	31.5 x $10^6 m^3$	20.5 x $10^6 m^3$
Effective storage	28.0 x $10^6 m^3$	16.9 x $10^6 m^3$
Dam type	Homogeneous earthfill	Homogeneous earthfill
Dam height	26 m	36.3 m
Upstream slope	1 : 3.5	1 : 3.5
Downstream slope	1 : 3.0	1 : 3.0
Dam volume	140 x $10^3 m^3$	2,700 x $10^3 m^3$
Spillway type	Side channel	Center flow concrete gravity

3. Irrigation system

The irrigation system layout is made by use of 1 to 50,000 scale topographic maps and 1 to 10,000 scale aero photographs.

Major works of irrigation facilities are as follows.

Main canal 1/

Type	:	Trapezoid lined with wet stone masonry
Length	:	9.5 km
Base width	:	2.2 m - 1,0 m
Canal Heihgt	:	1.6 m - 1.5 m
Side slope	:	1 : 1.5
Bank width	:	1.5m
Lining	:	Wet masonry 0.3 m in thickness

Inspection Road along Main Canal

Length	:	7 km
Total width	:	6 m
Effective width	:	3 m
Metalling	:	Sand and stone, 0.3 m in thickness

Secondary Canal

Total length	:	17 km
Base width	:	0.6 m - 1.0 m
Canal height	:	0.8 m - 1.0 m
Side slope	:	1 : 1
Bank width	:	0.6 - 1.0 m in one side, 3.6 - 4.0 m in another side.
Lining	:	Wet masonry, 0.2 m in thickness

Tertiary Development

Canal density	:	50 m/ha
Canal type	:	Trapezoidal eath type

Structures related to Main Canal

Bridge	:	5 nos
Drain culvert	:	5 nos
Diversion	:	5 nos
Spillway	:	3 nos

1/ : Including connecting canals from Semantok Dam and Gondang Dam.

Table 1 IRRIGATION WATER REQUIREMENT
IN WIDAS EXTENTION PROJECT

Unit x 10^3Rp.

Month	Ten Day	WSP /1	DSP /2	Polo-wijo	Total	K.Warak Dam Scheme	Semantok Dam Scheme
	1	0.35	0	0	0.35	0.15	0.20
Jan.	2	1.92	0	0	1.92	0.81	1.11
	3	0	0	0	0	0	0
	1	0	0.03	0	0.03	0.01	0.02
Feb.	2	0	0.04	0	0.04	0.02	0.02
	3	0.39	0.57	0	0.96	0.41	0.55
	1	0.07	0.59	0	0.66	0.28	0.38
Mar.	2	0	0.97	0.01	0.98	0.41	0.57
	3	0	1.36	0.51	1.87	0.89	1.08
	1	0	0.94	0.55	1.49	0.63	0.86
Apr.	2	0	1.07	0.96	2.03	0.86	1.17
	3	0	0.50	0	0.50	0.21	0.29
	1	0	1.06	1.11	2.17	0.92	1.25
May	2	0	0.99	0.92	1.91	0.81	1.10
	3	0	1.04	0.82	1.86	0.79	1.07
	1	0	0.21	0	0.21	0.09	0.12
June	2	0	0.60	0.27	0.87	0.37	0.50
	3	0	0.28	0.02	0.30	0.13	0.17
	1	0	0.12	0.24	0.36	0.15	0.21
July	2	0	0	0.45	0.45	0.19	0.26
	3	0	0	0.75	0.75	0.32	0.43
	1	0	0	1.22	1.22	0.52	0.70
Aug.	2	0	0	1.54	1.54	0.65	0.89
	3	0	0	1.81	1.81	0.76	1.05
	1	0	0	2.30	2.30	0.97	1.33
Sep.	2	0	0	2.23	2.23	0.94	1.29
	3	0	0	1.70	1.70	0.72	0.98
	1	0.09	0	1.11	1.20	0.51	0.69
Oct.	2	0.12	0	0.57	0.69	0.29	0.40
	3	1.96	0	0.15	2.11	0.89	1.22
	1	2.74	0	0	2.74	1.16	1.58
Nov.	2	3.47	0	0	3.47	1.47	2.00
	3	3.35	0	0	3.35	1.41	1.94
	1	2.08	0	0	2.08	0.88	1.20
Dec.	2	0.82	0	0	0.82	0.35	0.47
	3	0	0	0	0	0	0

/1 : Wet season paddy

/2 : Dry season paddy

Table 2(1) ESTIMATED RUNOFF OF K. KEDUNGKARAK

(Unit: 10^6 m^3)

Month		1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
Jan.	1st	0.74	1.61	1.33	1.25	2.18	0.18	0.54	0.89	2.28	1.91
	2nd	0.28	0.73	0.48	1.60	1.04	1.08	0.57	1.80	1.70	1.30
	3rd	1.27	0.25	0.51	1.62	0.82	1.74	1.27	1.30	0.66	0.52
Feb.	1st	2.19	0.13	0.23	2.47	0.74	1.38	1.72	1.03	1.13	1.00
	2nd	1.36	0.09	1.54	2.53	0.33	2.77	0.97	1.98	0.95	3.22
	3rd	0.52	0.10	2.37	2.07	0.21	2.17	1.65	2.40	0.88	4.98
Mar.	1st	2.98	0.07	1.55	0.75	1.27	0.61	3.08	1.01	0.96	2.88
	2nd	2.19	0.33	1.29	0.97	2.45	1.25	4.50	0.85	1.22	1.64
	3rd	2.04	0.14	0.55	1.20	2.60	0.81	2.82	1.20	1.00	1.55
Apr.	1st	1.67	0.72	0.32	1.67	3.10	0.65	2.47	0.72	0.39	0.99
	2nd	1.21	0.36	0.19	2.31	1.57	0.34	1.19	0.36	0.17	0.66
	3rd	0.42	0.16	0.11	1.65	0.67	0.38	1.41	0.25	0.10	0.76
May	1st	0.63	0.10	0.08	0.58	0.97	0.17	1.11	1.41	2.74	2.44
	2nd	0.25	0.08	0.07	0.23	0.77	0.10	0.46	1.21	1.79	3.50
	3rd	0.30	0.07	0.06	0.11	0.57	0.07	0.19	0.90	0.57	2.11
Jun.	1st	0.40	0.07	0.08	0.08	0.25	0.07	0.11	1.04	0.24	1.40
	2nd	0.38	0.07	0.07	0.07	0.13	0.07	0.08	0.37	0.12	0.49
	3rd	0.17	0.07	0.07	0.07	0.09	0.07	0.07	0.16	0.08	0.20
Jul.	1st	0.11	0.07	0.07	0.07	0.57	0.07	0.07	0.10	0.07	0.11
	2nd	0.08	0.07	0.07	0.07	0.51	0.07	0.07	0.08	0.07	0.08
	3rd	0.07	0.06	0.06	0.06	0.20	0.06	0.06	0.06	0.06	0.06
Aug.	1st	0.07	0.07	0.07	0.07	0.12	0.07	0.06	0.07	0.06	0.07
	2nd	0.07	0.07	0.07	0.07	0.08	0.07	0.06	0.07	0.06	0.07
	3rd	0.07	0.06	0.06	0.06	0.07	0.06	0.06	0.06	0.06	0.06
Sep.	1st	0.07	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06
	2nd	0.07	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06
	3rd	0.07	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06
Oct.	1st	0.27	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06
	2nd	0.13	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06
	3rd	0.08	0.06	0.06	0.06	0.06	0.06	0.06	1.25	0.06	0.06
Nov.	1st	0.74	0.07	0.07	0.06	0.51	0.07	0.08	0.75	0.06	0.06
	2nd	0.27	0.07	0.07	0.06	0.33	0.06	0.09	0.98	0.06	0.08
	3rd	0.20	0.07	0.13	0.06	0.41	0.08	0.62	0.38	0.06	0.83
Dec.	1st	0.11	0.07	1.70	1.20	0.63	0.07	0.37	0.19	0.06	1.39
	2nd	0.08	0.34	1.86	0.63	1.13	1.19	0.16	2.14	0.65	1.06
	3rd	1.65	0.86	1.63	2.17	0.38	1.23	0.74	0.99	2.23	0.52
Mean	1st	0.64	0.20	0.47	0.72	0.69	0.48	0.75	0.73	0.57	1.00

Table 2(2) ESTIMATED RUNOFF OF K. KEDUNGARAK

(Unit: 10^6 m^3)

Month		1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	Mean
Jan.	1st	0.74	1.55	1.27	1.13	3.39	3.98	0.08	2.42	1.12	2.52	1.55
	2nd	0.91	2.38	1.16	0.89	3.12	2.49	1.17	1.56	0.90	2.40	1.37
	3rd	0.40	1.56	0.37	1.30	2.24	2.38	1.21	1.84	0.58	1.83	1.18
Feb.	1st	1.70	2.51	0.17	1.81	2.05	1.56	0.69	1.50	1.30	2.09	1.37
	2nd	1.12	1.71	0.17	1.16	2.50	0.63	0.53	1.02	1.07	1.67	1.36
	3rd	1.31	1.79	2.13	0.54	1.84	2.05	1.78	0.59	1.39	4.35	1.75
Mar.	1st	1.76	1.40	3.82	0.24	1.11	1.35	1.46	1.12	1.38	2.60	1.59
	2nd	1.45	0.80	3.14	0.27	1.06	1.37	1.71	0.70	2.21	2.20	1.58
	3rd	0.88	1.79	1.29	1.11	0.37	1.12	1.35	1.10	1.49	1.73	1.30
Apr.	1st	0.93	2.25	0.88	1.59	0.19	1.66	1.18	0.98	0.82	1.82	1.25
	2nd	1.96	2.71	0.32	0.60	0.11	2.76	1.11	0.43	0.45	1.31	0.99
	3rd	0.88	2.62	0.15	0.66	0.08	2.14	0.60	0.38	0.88	0.88	0.75
May	1st	0.96	1.86	0.09	0.25	0.07	2.58	0.23	1.34	0.32	1.25	0.95
	2nd	1.38	0.92	0.08	0.12	0.07	1.46	0.12	0.53	0.15	1.91	0.76
	3rd	0.51	0.31	0.06	0.08	0.06	0.62	0.08	0.19	0.08	1.76	0.43
Jun.	1st	0.22	0.15	0.07	0.27	0.55	1.48	0.07	0.11	0.07	0.79	0.37
	2nd	0.12	0.10	0.07	0.13	0.21	0.61	0.07	0.08	0.07	0.29	0.18
	3rd	0.08	0.08	0.07	0.10	0.11	0.24	0.06	0.71	0.07	0.14	0.13
Jul.	1st	0.07	0.07	0.07	0.08	0.34	0.12	0.06	0.21	0.07	0.09	0.12
	2nd	0.07	0.07	0.07	0.07	0.15	0.08	0.06	0.13	0.06	0.07	0.10
	3rd	0.06	0.06	0.06	0.06	0.08	0.07	0.06	0.08	0.06	0.06	0.07
Aug.	1st	0.32	0.07	0.07	0.07	0.07	0.07	0.06	0.07	0.06	0.07	0.08
	2nd	0.14	0.07	0.07	0.07	0.07	0.07	0.06	0.07	0.06	0.06	0.07
	3rd	0.08	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Sep.	1st	0.07	0.07	0.06	0.06	0.06	0.07	0.06	0.06	0.06	0.06	0.06
	2nd	0.09	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
	3rd	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Oct.	1st	0.20	0.78	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.11
	2nd	0.11	0.28	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.39	0.09
	3rd	0.25	0.87	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.22	0.17
Nov.	1st	0.13	0.52	0.22	0.06	0.08	0.06	0.06	0.06	0.06	1.25	0.24
	2nd	0.60	0.60	0.11	0.06	0.10	0.06	0.50	0.56	0.06	0.77	0.27
	3rd	0.41	1.07	1.83	0.61	0.07	0.06	3.73	0.79	0.06	1.64	0.65
Dec.	1st	2.06	2.11	1.78	0.78	1.13	0.06	4.08	0.88	0.06	1.19	0.99
	2nd	2.55	1.14	0.82	0.66	1.29	0.06	2.85	0.50	0.58	0.41	1.00
	3rd	1.64	0.37	0.32	2.51	4.61	0.06	2.98	0.86	1.93	2.06	1.48
Mean	1st	0.72	0.96	0.58	0.49	0.76	0.88	0.78	0.59	0.50	1.11	0.68

Table -3(1) STORAGE REQUIREMENT OF KEDUNGWARAK RESERVOIR

(Unit: 10^6 m^3)

Month		1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
Jan.	1st	0.00	8.72	23.01	28.80	25.84	26.09	31.21	27.86	24.25	26.84
	2nd	0.54	8.88	23.39	28.21	25.73	25.94	31.50	27.10	23.57	26.50
	3rd	0.00	8.73	23.00	26.76	25.04	24.38	30.39	25.95	23.04	26.11
Feb.	1st	0.00	8.72	22.89	24.72	24.50	23.28	29.00	25.16	22.15	25.34
	2nd	0.00	8.74	21.67	22.64	24.32	20.99	28.27	23.55	21.44	22.66
	3rd	0.00	9.06	20.22	21.43	24.55	19.70	27.38	22.08	21.15	19.18
Mar.	1st	0.00	9.93	19.21	21.11	23.78	19.50	25.05	21.54	20.65	17.02
	2nd	0.00	9.48	18.53	20.71	22.11	18.87	21.60	21.25	20.04	16.05
	3rd	0.00	10.20	18.86	20.41	20.48	18.94	19.76	20.95	19.93	15.42
Apr.	1st	0.00	10.21	19.21	19.60	18.43	19.01	18.26	20.96	20.22	15.19
	2nd	0.00	10.72	19.88	18.61	17.91	19.55	18.06	21.48	20.91	15.45
	3rd	0.00	10.85	20.05	17.45	17.60	19.49	17.11	21.53	21.09	15.06
May	1st	0.33	11.65	20.86	17.83	17.64	20.22	17.03	21.19	19.60	13.84
	2nd	0.90	12.37	21.59	18.42	17.76	20.92	17.42	20.93	18.84	11.60
	3rd	1.46	13.15	22.38	19.16	18.06	21.70	18.09	20.92	19.15	10.44
June	1st	1.28	13.25	22.47	19.26	18.01	21.80	18.16	20.19	19.10	9.39
	2nd	1.36	13.59	22.82	19.60	18.31	22.15	18.49	20.28	19.41	9.38
	3rd	1.41	13.73	22.96	19.74	18.43	22.29	18.63	20.34	19.54	9.40
July	1st	1.53	13.89	23.11	19.89	18.15	22.44	18.79	20.47	19.69	9.52
	2nd	1.71	14.08	23.30	20.08	17.96	22.63	18.98	20.65	19.88	9.71
	3rd	2.05	14.42	23.64	20.43	18.17	22.97	19.32	20.99	20.22	10.05
Aug.	1st	2.52	14.90	24.12	20.90	18.60	23.45	19.80	21.46	20.71	10.52
	2nd	3.11	15.48	24.71	21.49	19.18	24.04	20.40	22.05	21.30	11.11
	3rd	3.86	16.24	25.47	22.25	19.93	24.80	21.16	22.81	22.06	11.87
Sep.	1st	4.72	17.11	26.33	23.11	20.79	25.67	22.03	23.69	22.94	12.74
	2nd	5.56	17.95	27.17	23.95	21.63	26.52	22.88	24.53	23.78	13.59
	3rd	6.21	18.59	27.82	24.60	22.28	27.17	23.54	25.19	24.44	14.25
Oct.	1st	6.50	19.06	28.28	25.07	22.75	27.65	24.01	25.66	24.91	14.72
	2nd	6.73	19.34	28.56	25.34	23.02	27.93	24.30	25.95	25.20	15.01
	3rd	7.59	20.22	29.44	26.23	23.91	28.82	25.18	25.70	26.08	15.89
Nov.	1st	8.04	21.25	30.47	27.26	24.56	29.85	26.20	26.14	27.12	16.93
	2nd	9.17	22.54	31.77	28.57	25.63	31.15	27.48	26.65	28.42	18.22
	3rd	10.30	23.79	32.96	29.82	26.58	32.39	28.25	27.63	29.68	18.80
Dec.	1st	11.05	24.57	32.34	29.63	26.88	33.17	28.77	28.31	30.47	18.45
	2nd	11.37	24.67	31.12	29.48	26.29	32.53	29.03	26.85	30.30	17.92
	3rd	9.90	23.95	29.67	27.51	26.03	31.46	28.42	26.00	28.28	17.52

Table 3(2) STORAGE REQUIREMENT OF KEDUNGMARAK RESERVOIR

(Unit: 10^6 m^3)

Month		1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Jan.	1st	17.10	14.12	5.10	10.02	12.97	8.78	11.38	5.06	8.49	11.80
	2nd	17.10	12.85	4.88	10.03	11.06	7.42	11.16	4.50	8.50	10.51
	3rd	16.81	11.46	4.63	8.89	9.03	5.25	10.10	2.85	8.04	8.86
Feb.	1st	15.44	9.39	4.58	7.43	7.35	4.00	9.60	1.65	7.01	7.15
	2nd	14.58	8.02	4.53	6.53	5.30	3.56	9.25	0.87	6.19	5.81
	3rd	13.95	7.02	3.27	6.50	4.26	2.36	8.26	0.81	5.51	2.83
Mar.	1st	12.76	6.14	0.30	6.62	3.63	1.52	7.33	0.17	4.21	0.91
	2nd	11.95	5.89	0.00	6.83	3.16	0.78	6.29	0.00	2.74	0.00
	3rd	11.96	5.03	0.00	6.62	3.65	0.56	5.85	0.00	2.17	0.00
Apr.	1st	11.79	3.72	0.00	5.88	4.12	0.00	5.47	0.00	2.10	0.00
	2nd	10.92	2.21	0.55	6.19	4.85	0.00	5.34	0.45	2.54	0.00
	3rd	10.43	0.21	0.69	5.89	5.05	0.00	5.09	0.39	2.04	0.00
May	1st	10.48	0.00	1.49	6.55	5.87	0.00	5.77	0.12	2.65	0.00
	2nd	10.08	0.00	2.21	7.24	6.60	0.00	6.45	0.44	3.30	0.00
	3rd	10.44	0.55	3.00	8.01	7.39	0.25	7.22	1.11	4.07	0.00
June	1st	10.41	0.58	3.10	7.94	7.07	0.00	7.32	1.18	4.18	0.00
	2nd	10.71	0.90	3.44	8.23	7.30	0.00	7.67	1.52	4.52	0.15
	3rd	10.84	1.03	3.58	8.34	7.40	0.00	7.82	1.10	4.66	0.23
July	1st	11.00	1.19	3.74	8.49	7.33	0.11	7.98	1.08	4.82	0.37
	2nd	11.19	1.38	3.93	8.68	7.45	0.29	8.18	1.22	5.02	0.56
	3rd	11.53	1.72	4.27	9.02	7.77	0.62	8.52	1.55	5.36	0.90
Aug.	1st	11.79	2.19	4.75	9.50	8.24	1.10	9.01	2.02	5.84	1.37
	2nd	12.32	2.78	5.33	10.08	8.83	1.68	9.60	2.61	6.44	1.97
	3rd	13.06	3.54	6.09	10.85	9.59	2.44	10.36	3.37	7.20	2.73
Sep.	1st	13.92	4.40	6.97	11.72	10.46	3.31	11.23	4.24	8.07	3.60
	2nd	14.74	5.24	7.81	12.56	11.31	4.16	12.08	5.09	8.92	4.45
	3rd	15.39	5.89	8.47	13.22	11.97	4.81	12.74	5.74	9.58	5.11
Oct.	1st	15.74	5.74	8.95	13.70	12.44	5.29	13.21	6.22	10.05	5.58
	2nd	15.99	5.84	9.23	13.98	12.73	5.57	13.50	6.50	10.34	5.58
	3rd	16.69	5.95	10.11	14.87	13.61	6.46	14.38	7.39	11.22	6.31
Nov.	1st	17.67	6.59	11.01	15.90	14.63	7.49	15.42	8.43	12.26	6.32
	2nd	18.50	7.43	12.27	17.21	15.90	8.80	16.34	9.30	13.56	7.01
	3rd	19.45	7.81	12.00	17.98	17.15	10.05	14.43	9.92	14.81	6.90
Dec.	1st	18.52	6.83	11.31	18.16	17.02	10.85	11.75	10.01	15.61	6.72
	2nd	16.71	6.24	10.99	17.98	16.29	11.18	9.67	9.96	15.50	6.75
	3rd	15.24	5.98	10.78	15.69	12.00	11.22	6.94	9.24	13.76	4.89

Table 4(1) ESTIMATED RUNOFF OF K. SEMANTOK

(Unit: 10^6 m^3)

Month		1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
Jan.	1st	1.68	3.64	3.01	2.82	4.92	0.40	1.21	2.02	5.16	4.32
	2nd	0.63	1.64	1.09	3.62	2.36	2.43	1.28	4.07	3.85	2.93
	3rd	2.87	0.56	1.15	3.66	1.86	3.93	2.86	2.93	1.49	1.18
Feb.	1st	4.96	0.30	0.52	5.58	1.66	3.12	3.88	2.33	2.55	2.26
	2nd	3.07	0.21	3.49	5.73	0.74	6.25	2.20	4.47	2.14	7.27
	3rd	1.18	0.22	5.35	4.67	0.47	4.91	3.73	5.42	2.00	11.24
Mar.	1st	6.74	0.17	3.50	1.70	2.86	1.38	6.96	2.28	2.18	6.51
	2nd	4.96	0.76	2.91	2.18	5.55	2.82	10.16	1.92	2.75	3.72
	3rd	4.60	0.31	1.24	2.71	5.86	1.84	6.37	2.71	2.26	3.50
Apr.	1st	3.78	1.63	0.72	3.77	7.00	1.46	5.58	1.63	0.87	2.25
	2nd	2.74	0.81	0.42	4.78	3.55	0.77	2.68	0.81	0.38	1.49
	3rd	0.95	0.36	0.25	3.72	1.52	0.86	3.18	0.57	0.22	1.71
May	1st	1.43	0.22	0.19	1.30	2.18	0.38	2.51	3.18	6.18	5.52
	2nd	0.56	0.18	0.17	0.51	1.74	0.23	1.03	2.74	4.03	7.90
	3rd	0.68	0.15	0.14	0.24	1.29	0.16	0.43	2.04	1.28	4.78
June	1st	0.90	0.16	0.19	0.19	0.57	0.16	0.26	2.36	0.53	3.16
	2nd	0.86	0.16	0.16	0.16	0.29	0.15	0.19	0.84	0.27	1.10
	3rd	0.39	0.16	0.16	0.16	0.20	0.15	0.16	0.37	0.19	0.45
July	1st	0.24	0.16	0.15	0.15	1.28	0.15	0.15	0.22	0.16	0.25
	2nd	0.19	0.16	0.15	0.15	1.15	0.15	0.15	0.17	0.15	0.18
	3rd	0.16	0.14	0.14	0.14	0.46	0.13	0.13	0.14	0.13	0.14
Aug.	1st	0.17	0.16	0.15	0.15	0.26	0.15	0.15	0.15	0.15	0.15
	2nd	0.17	0.16	0.15	0.15	0.19	0.15	0.15	0.15	0.15	0.15
	3rd	0.15	0.14	0.14	0.14	0.15	0.13	0.13	0.13	0.13	0.13
Sep.	1st	0.16	0.16	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
	2nd	0.16	0.16	0.15	0.15	0.15	0.15	0.14	0.15	0.14	0.14
	3rd	0.16	0.16	0.15	0.15	0.15	0.15	0.14	0.15	0.14	0.14
Oct.	1st	0.62	0.16	0.15	0.15	0.15	0.15	0.14	0.14	0.14	0.14
	2nd	0.30	0.15	0.15	0.15	0.15	0.15	0.14	0.14	0.14	0.14
	3rd	0.19	0.14	0.14	0.13	0.13	0.14	0.13	2.83	0.13	0.13
Nov.	1st	1.67	0.15	0.15	0.15	1.15	0.15	0.18	1.69	0.14	0.14
	2nd	0.62	0.15	0.15	0.15	0.75	0.15	0.20	2.20	0.14	0.18
	3rd	0.46	0.15	0.30	0.15	0.93	0.19	1.40	0.87	0.14	1.89
Dec.	1st	0.25	0.16	3.85	2.71	1.42	0.16	0.84	0.43	0.14	3.15
	2nd	0.19	0.76	4.18	1.42	2.55	2.69	0.37	4.83	1.46	2.40
	3rd	3.73	1.93	3.65	4.90	0.86	2.79	1.68	2.23	5.03	1.18
Mean	1st	1.46	0.46	1.07	1.63	1.57	1.09	1.69	1.65	1.30	2.27

Table 4(2) ESTIMATE RUNOFF OF K. SEMANTOK

(Unit: 10^6 m^3)

Month		1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	Mean
Jan.	1st	1.68	3.50	2.88	2.55	7.67	9.00	0.14	5.47	2.52	5.70	3.51
	2nd	2.05	5.38	2.63	2.01	7.04	5.63	2.64	3.54	2.04	5.43	3.11
	3rd	0.91	3.51	0.83	2.93	5.06	5.39	2.73	4.17	1.32	4.13	2.67
Feb.	1st	3.84	5.68	0.39	4.09	4.63	3.53	1.57	3.39	2.94	4.71	3.09
	2nd	2.52	3.87	0.38	2.62	5.66	1.42	1.19	2.31	2.42	3.78	3.08
	3rd	2.97	4.03	4.82	1.22	4.16	4.62	4.01	1.33	3.15	9.83	3.96
Mar.	1st	3.97	3.16	8.64	0.55	2.51	3.04	3.30	2.53	4.25	5.87	3.60
	2nd	3.28	1.80	7.09	0.62	2.38	3.09	3.86	1.59	5.00	4.98	3.57
	3rd	1.99	4.05	2.93	2.50	0.83	2.53	3.05	2.48	3.36	3.92	2.95
Apr.	1st	2.10	5.08	1.99	3.60	0.42	3.76	2.66	2.22	1.86	4.11	2.82
	2nd	4.43	6.11	0.72	1.36	0.24	6.25	2.51	0.93	1.02	2.97	2.25
	3rd	2.00	5.93	0.33	1.48	0.18	4.84	1.35	0.66	1.98	1.98	1.71
May	1st	2.16	4.19	0.21	0.56	0.16	5.84	0.52	3.04	0.71	2.83	2.16
	2nd	3.12	2.07	0.17	0.28	0.15	3.31	0.27	1.19	0.33	4.31	1.71
	3rd	1.15	0.70	0.14	0.18	0.13	1.40	0.17	0.43	0.19	3.99	0.98
Jun.	1st	0.50	0.35	0.15	0.62	1.24	3.34	0.16	0.25	0.17	1.79	0.65
	2nd	0.26	0.22	0.15	0.30	0.48	1.38	0.15	0.18	0.15	0.66	0.40
	3rd	0.19	0.17	0.15	0.23	0.25	0.54	0.15	1.61	0.15	0.31	0.30
Jul.	1st	0.16	0.16	0.15	0.17	0.76	0.28	0.15	0.61	0.15	0.20	0.28
	2nd	0.15	0.15	0.15	0.16	0.34	0.19	0.14	0.30	0.15	0.17	0.22
	3rd	0.14	0.14	0.13	0.14	0.19	0.15	0.13	0.18	0.13	0.14	0.15
Aug.	1st	0.73	0.15	0.15	0.15	0.16	0.15	0.14	0.16	0.15	0.15	0.18
	2nd	0.33	0.15	0.15	0.15	0.15	0.15	0.14	0.15	0.15	0.15	0.16
	3rd	0.18	0.14	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Sep.	1st	0.16	0.15	0.15	0.15	0.15	0.15	0.14	0.15	0.14	0.15	0.15
	2nd	0.20	0.15	0.15	0.15	0.14	0.15	0.14	0.14	0.14	0.15	0.15
	3rd	0.16	0.15	0.15	0.15	0.14	0.15	0.14	0.14	0.14	0.14	0.14
Oct.	1st	0.44	1.75	0.15	0.15	0.14	0.15	0.14	0.14	0.14	0.14	0.26
	2nd	0.24	0.63	0.15	0.14	0.14	0.15	0.14	0.14	0.14	0.88	0.21
	3rd	0.57	1.97	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.50	0.40
Nov.	1st	0.30	1.18	0.49	0.14	0.18	0.15	0.14	0.14	0.14	2.83	0.56
	2nd	1.36	1.35	0.25	0.14	0.22	0.14	1.13	1.26	0.14	1.75	0.62
	3rd	0.93	2.41	4.13	1.37	0.17	0.14	8.43	1.77	0.14	3.69	1.48
Dec.	1st	4.64	4.76	4.01	1.75	2.55	0.14	9.22	1.99	0.14	2.69	2.25
	2nd	5.76	2.59	1.85	1.50	2.92	0.14	6.43	1.12	1.31	0.92	2.27
	3rd	3.71	0.85	0.73	5.68	10.41	0.13	6.72	1.94	4.37	4.66	3.36
Mean	1st	1.64	2.18	1.32	1.11	1.72	1.99	1.78	1.33	1.15	2.52	1.55

Table 5(1) STORAGE REQUIREMENT OF SEMANTOK DAM

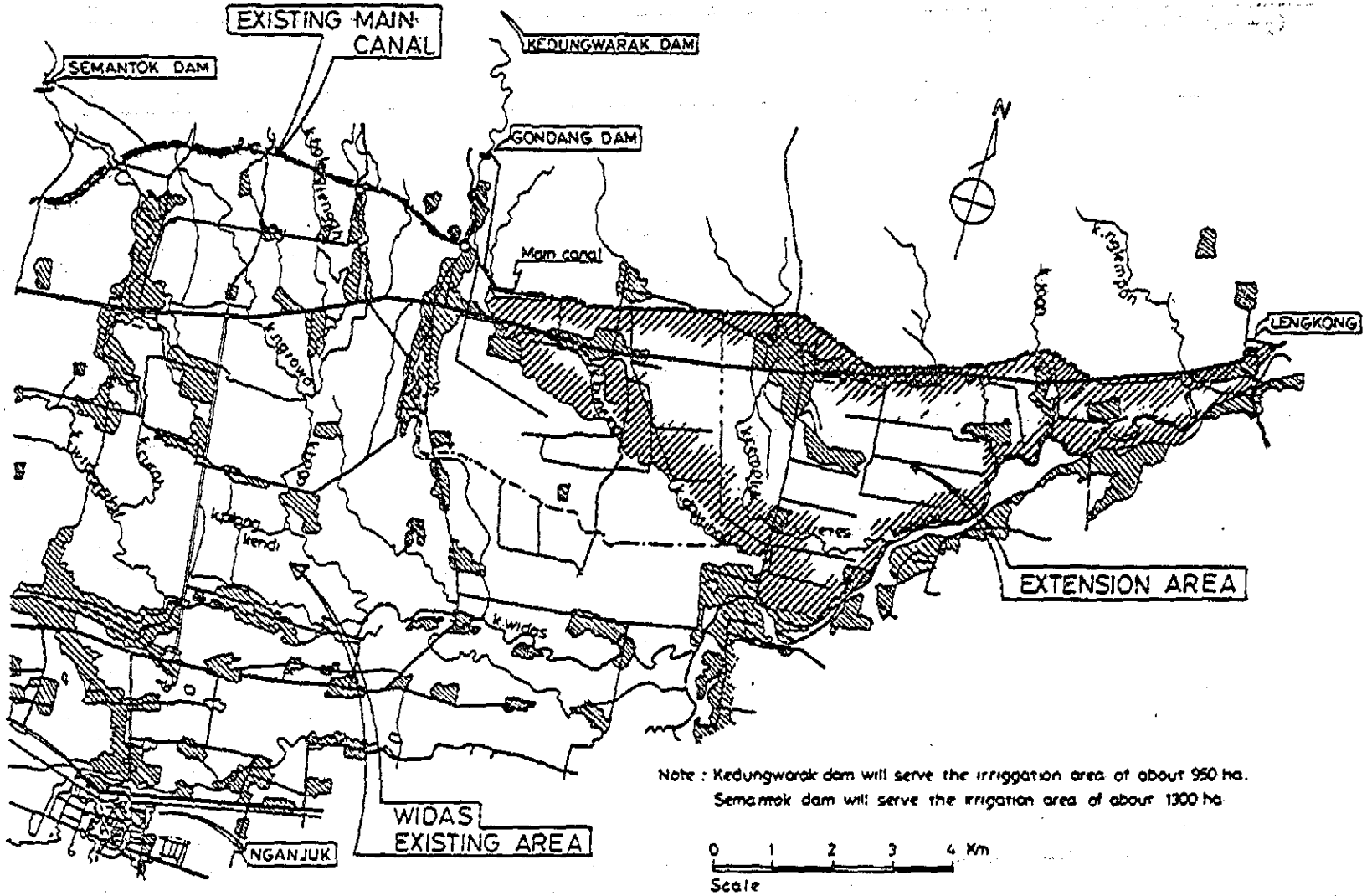
(Unit: 10^6 m^3)

Month	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
Jan. 1st	0.00	4.76	17.47	11.00	4.06	7.10	11.53	10.29	0.00	5.04
2nd	0.50	4.39	17.59	8.92	3.06	6.04	11.47	7.82	0.00	3.55
3rd	0.00	3.95	16.59	5.54	1.39	2.40	8.85	5.13	0.00	2.53
Feb. 1st	0.00	3.80	16.24	0.82	0.06	0.00	5.60	3.22	0.00	0.68
2nd	0.00	3.72	13.33	0.00	0.00	0.00	3.80	0.00	0.00	0.00
3rd	0.00	4.05	9.68	0.00	0.13	0.00	1.41	0.00	0.00	0.00
Mar. 1st	0.00	4.32	7.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2nd	0.00	4.24	5.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3rd	0.00	5.07	5.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apr. 1st	0.00	4.49	5.28	0.00	0.00	0.00	0.00	0.00	0.07	0.00
2nd	0.00	4.89	6.02	0.00	0.00	0.43	0.00	0.39	0.84	0.00
3rd	0.00	4.91	6.14	0.00	0.00	0.02	0.00	0.24	0.99	0.00
May 1st	0.00	5.89	7.14	0.04	0.00	0.86	0.00	0.00	0.00	0.00
2nd	0.55	6.77	8.03	0.63	0.00	1.70	0.14	0.00	0.00	0.00
3rd	1.01	7.74	9.01	1.52	0.00	2.66	0.85	0.00	0.00	0.00
June 1st	0.43	7.79	9.04	1.54	0.00	2.71	0.81	0.00	0.00	0.00
2nd	0.20	8.17	9.42	1.92	0.26	3.10	1.16	0.00	0.28	0.00
3rd	0.10	8.27	9.51	2.02	0.32	3.20	1.26	0.00	0.35	0.00
July 1st	0.16	8.40	9.65	2.16	0.00	3.34	1.40	0.07	0.48	0.05
2nd	0.31	8.57	9.83	2.34	0.00	3.52	1.58	0.24	0.66	0.20
3rd	0.66	8.94	10.20	2.71	0.06	3.90	1.96	0.61	1.04	0.57
Aug. 1st	1.20	9.49	10.76	3.27	0.53	4.46	2.52	1.17	1.60	1.13
2nd	1.91	10.21	11.49	4.00	1.22	5.19	3.25	1.89	2.33	1.86
3rd	2.86	11.17	12.45	4.96	2.17	6.16	4.22	2.86	3.30	2.83
Sep. 1st	3.96	12.27	13.55	6.06	3.28	7.26	5.32	3.97	4.40	3.94
2nd	5.02	13.33	14.63	7.13	4.35	8.34	6.40	5.04	5.48	5.02
3rd	5.81	14.13	15.43	7.94	5.15	9.14	7.21	5.85	6.30	5.83
Oct. 1st	5.96	14.67	15.98	8.49	5.70	9.69	7.76	6.41	6.86	6.39
2nd	6.13	14.97	16.28	8.79	6.01	9.99	8.09	6.72	7.17	6.70
3rd	7.21	16.09	17.41	9.92	7.14	11.12	9.22	5.28	8.30	7.83
Nov. 1st	7.22	17.42	18.73	11.25	7.59	12.44	10.51	5.27	9.63	9.16
2nd	8.50	19.10	20.41	12.93	8.76	14.12	12.16	5.19	11.32	10.82
3rd	9.86	20.73	21.92	14.56	9.72	15.72	12.71	6.20	12.96	10.95
Dec. 1st	10.77	21.72	19.71	13.35	9.62	16.71	13.11	6.95	13.97	9.35
2nd	11.10	21.56	16.58	12.61	7.91	14.87	13.28	3.27	13.20	7.77
3rd	7.65	19.82	13.18	8.05	7.18	12.32	11.78	1.25	8.51	6.74

Table 5(2) STORAGE REQUIREMENT OF SEMANTOK DAM

(Unit: 10^6 m^3)

Month	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Jan. 1st	5.55	0.00	0.00	6.68	1.00	0.00	13.83	0.00	5.18	7.04
2nd	4.83	0.00	0.00	5.99	0.00	0.00	12.66	0.00	4.46	3.39
3rd	4.06	0.00	0.00	3.30	0.00	0.00	10.16	0.00	3.30	0.00
Feb. 1st	0.84	0.00	0.00	0.00	0.00	0.00	8.91	0.00	0.87	0.00
2nd	0.00	0.00	0.00	0.00	0.00	0.00	7.98	0.00	0.00	0.00
3rd	0.00	0.00	0.00	0.00	0.00	0.00	5.37	0.00	0.00	0.00
Mar. 1st	0.00	0.00	0.00	0.00	0.00	0.00	2.93	0.00	0.00	0.00
2nd	0.00	0.00	0.00	0.04	0.00	0.00	0.18	0.00	0.00	0.00
3rd	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00
Apr. 1st	0.00	0.00	0.00	0.00	0.79	0.00	0.00	0.00	0.00	0.00
2nd	0.00	0.00	0.47	0.00	1.68	0.00	0.00	0.25	0.21	0.00
3rd	0.00	0.00	0.52	0.00	1.87	0.00	0.00	0.00	0.00	0.00
May 1st	0.00	0.00	1.51	0.68	2.89	0.00	0.71	0.00	0.55	0.00
2nd	0.00	0.00	2.40	1.47	3.80	0.00	1.52	0.00	1.30	0.00
3rd	0.01	0.44	3.38	2.41	4.79	0.00	2.47	0.71	2.23	0.00
June 1st	0.00	0.33	3.44	2.07	3.91	0.00	2.52	0.68	2.27	0.00
2nd	0.29	0.66	3.83	2.33	4.01	0.00	2.91	1.04	2.66	0.00
3rd	0.36	0.74	3.93	2.36	4.03	0.00	3.01	0.00	2.77	0.00
July 1st	0.49	0.87	4.07	2.48	3.64	0.02	3.15	0.00	2.90	0.09
2nd	0.67	1.06	4.25	2.66	3.66	0.17	3.34	0.05	3.09	0.25
3rd	1.04	1.43	4.63	3.03	3.98	0.53	3.72	0.38	3.47	0.62
Aug. 1st	1.10	1.99	5.19	3.59	4.53	1.09	4.29	0.93	4.03	1.19
2nd	1.67	2.71	5.92	4.31	5.26	1.82	5.02	1.66	4.75	1.91
3rd	2.59	3.67	6.89	5.28	6.23	2.79	5.99	2.63	5.72	2.88
Sep. 1st	3.69	4.78	7.99	6.39	7.33	3.89	7.11	3.73	6.84	3.99
2nd	4.72	5.85	9.06	7.46	8.41	4.96	8.19	4.81	7.92	5.06
3rd	5.51	6.65	9.87	8.26	9.23	5.77	9.00	5.63	8.73	5.87
Oct. 1st	5.81	5.82	10.42	8.82	9.79	6.32	9.56	6.19	9.29	6.43
2nd	6.04	5.71	10.72	9.13	10.10	6.62	9.87	6.50	9.60	6.10
3rd	6.75	5.09	11.85	10.26	11.23	7.75	11.00	7.63	10.73	6.88
Nov. 1st	7.94	5.53	12.88	11.59	12.53	9.07	12.33	8.96	12.06	5.89
2nd	8.58	6.17	14.48	13.28	14.15	10.77	13.17	9.69	13.76	6.19
3rd	9.54	5.85	12.67	13.86	15.77	12.41	7.65	9.92	15.40	4.77
Dec. 1st	6.66	2.87	10.33	13.47	14.69	13.41	0.81	9.32	16.40	3.57
2nd	2.17	1.12	9.23	12.67	12.66	13.78	0.00	8.85	15.76	3.26
3rd	0.00	0.41	8.63	7.37	2.86	13.76	0.00	7.10	11.70	0.00



Note : Kedungwarak dam will serve the irrigation area of about 950 ha.
Semantok dam will serve the irrigation area of about 1300 ha.

Fig : 1 GENERAL PLAN OF WIDAS EXTENSION AREA

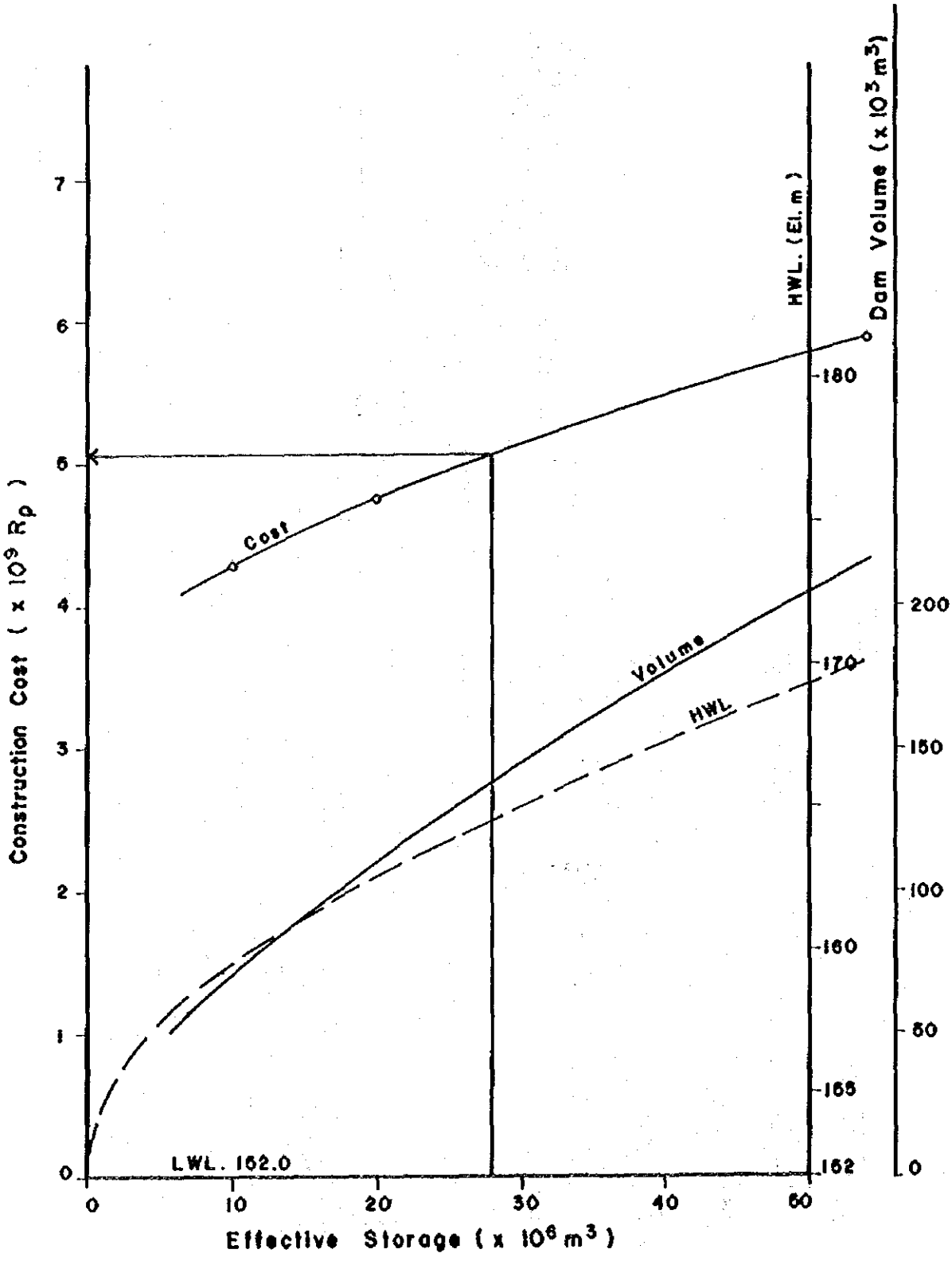


Fig. 2 RELATION BETWEEN EFFECTIVE STORAGE AND CONSTRUCTION COST OF KEDUNGWARAK DAM.

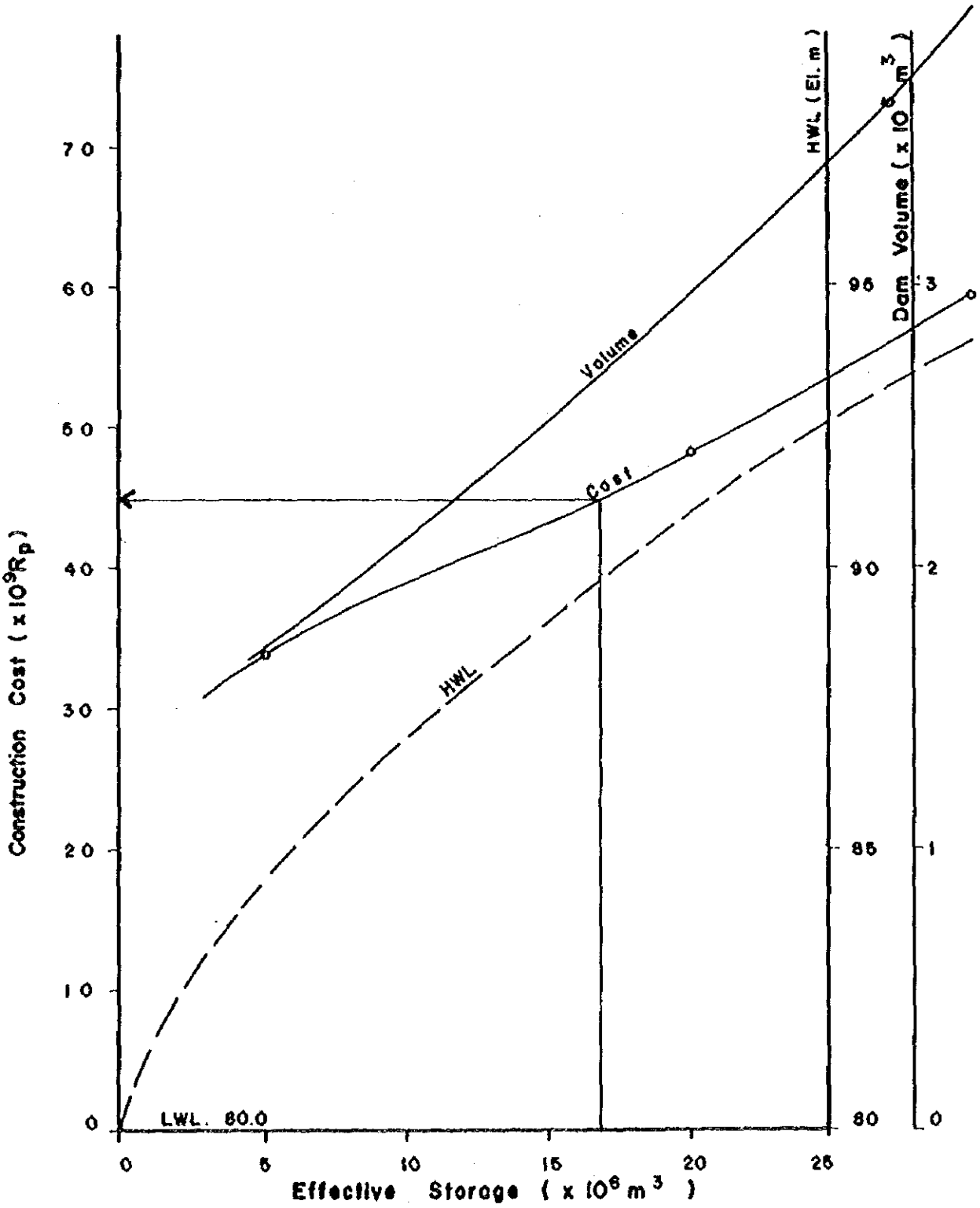


Fig. 3 RELATION BETWEEN EFFECTIVE STORAGE AND CONSTRUCTION COST OF SEMANTOK DAM.

NOTE AI-11

PROPOSED IRRIGATION SYSTEM OF BENG IRRIGATION AREA

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NOTE AI-11 Proposed Irrigation System of Beng Irrigation Area

1. Water balance calculation

The net irrigation area is 3,200 ha. The water resources available for the Beng Irrigation area are natural flow and water stored in the reservoir proposed in the upstream of the Beng river.

To clarify the scale of exploitation of water resources for irrigation, the water balance calculation is made.

The catchment area at the proposed dam site is 132 km^2 and average runoff is 3.7 m^3/sec. While the mean annual irrigation water requirement is 2.0 m^3/sec (see Table 1). Thus the runoff is totally enough to cover the water requirement. However, as shown in Table 2, the runoff in the dry season is quite small compared with the water requirement (see Table 1). As the result of the water balance calculation, the storage of irrigation water to guarantee the irrigation in the drought year of 80% dependability is estimated to be 30.6 x 10^6 m^3. The detail calculation results are shown in Table 3. Calculation criteria is reffered to Note AI-17.Runoff estimate method is stated in Section 3.2

2. Beng Dam

The Beng dam is conceived for domestic and industrial water supply together with irrigation water supply. The development scheme is stated in Section 3.7.

3. Irrigation system

Irrigation layout is made by use of 1 to 50,000 scale topographic maps and 1 to 10,000 scale aerophotographs.

The primary features of irrigation facilities are approximately as follows.

Headworks	
Weir, type	: Run-off river type
width	: 25 m
length	: 52 m including downstream protection
height	: 3.0 m
Sandflushing gates	: 3.5 m wide, and 3.5 m high x 2 gates
Intake gates	: 2.0 m wide and 2.0 m high x 2 gates
	: 0.5 m wide and 0.5 m high x 1 gate
Sandflushing pond	: Wet stone masonry
Ability	: Catching fine sand of 2.0 mm particle size
Length	: 60 m
Depth	: 2 m
Width	: 10 m

Main canal

Type	: Trapezoid, lined with wet stone masonry
Length	: 14.5 km
Base width	: 2.5 m - 4.0 m
Canal height	: 1.5 m - 1.7 m
Side slope	: 1 : 1.5
Bank width	: 1.5 m
Lining	: Wet masonry, 0.3 m in thickness

Inspection Road along Main Canal

Length	: 14.5 km
Total width	: 6 m
Effective width	: 3 m
Metalling	: Sand and gravel, 0.3 m in thickness

Secondary Canals

Type	: Trapezoid lines with wet stone masonry
Total length	: 21 km
Base width	: 0.6 - 1.0 m
Height	: 0.8 - 1.0 m
Side slope	: 1 : 1
Bank width	: 0.6 - 0.1 m in one side, 3.6 - 4.0 m in other side
Lining	: Wet masonry 0.2 m in thickness

Tertiary development

Canal density	: 50 m/ha
Canal type	: Trapezoidal earth type

Major Structures related to Main Canal (Irrigation area only)

Bridge	: 14 nos
Drain culvert	: 6 nos
Syphon	: 4 nos
Diversion	: 11 nos
Spillway	: 3 nos

Table 1 IRRIGATION WATER REQUIREMENT
IN BENG IRRIGATION PROJECT

Year : 1969 Unit : m3/sec.

Month	Ten-Day	WSP /1	DSP/2	UDSP	Sub-Total	Sugar-cane	Polo-wijo	Sub-Total	Total
Jan	1	4.01	0		4.01	0.28	0	0.28	4.29
	2	4.11	0		4.11	0.28	0	0.28	4.39
	3	4.17	0		4.17	0.28	0	0.28	4.45
Feb	1	4.29	0		4.29	0.29	0	0.29	4.58
	2	0	0.03		0.03	0	0	0	0.03
	3	0	0.05		0.05	0	0	0	0.05
Mar	1	1.28	0.60		1.88	0.01	0	0.01	1.89
	2	0	0.56		0.56	0	0	0	0.56
	3	0	0.55		0.55	0	0	0	0.55
Apr	1	0.23	1.12		1.35	0.10	0	0.10	1.45
	2	0	1.71		1.71	0.25	0.48	0.73	2.44
	3	0	1.37		1.37	0.24	0.74	0.98	2.35
May	1	0	0.79		0.79	0.19	0.87	1.06	1.85
	2	0	0.82		0.82	0.17	1.04	1.21	2.03
	3	0	0.84		0.84	0.15	1.17	1.32	2.16
Jun	1	0	0.47		0.47	0.04	0.48	0.52	0.99
	2	0	0.78		0.78	0.12	0.93	1.05	1.83
	3	0	0.67		0.67	0.11	0.70	0.81	1.48
Jul	1	0	0.56		0.56	0.11	0.51	0.62	1.18
	2	0	0.39		0.39	0.11	0.33	0.44	0.83
	3	0	0.22		0.22	0.11	0.29	0.40	0.62
Aug	1	0	0.08		0.08	0.13	0.47	0.60	0.68
	2	0	0		0	0.13	0.80	0.93	0.93
	3	0	0		0	0.14	1.22	1.36	1.36
Sep	1	0	0		0	0.17	1.85	2.02	2.02
	2	0	0		0	0.20	2.19	2.39	2.39
	3	0	0		0	0.22	2.48	2.70	2.70
Oct	1	0	0		0	0.25	2.57	2.82	2.82
	2	0.09	0		0.09	0.27	2.11	2.38	2.47
	3	0.11	0		0.11	0.28	1.58	1.86	1.97
Nov	1	1.91	0		1.91	0.27	0.97	1.24	3.15
	2	2.68	0		2.68	0.28	0.50	0.78	3.46
	3	3.47	0		3.47	0.29	0.13	0.42	3.89
Dec	1	2.49	0		2.49	0	0	0	2.49
	2	1.44	0		1.44	0	0	0	1.44
	3	1.15	0		1.15	0	0	0	1.15

/1 : Wet season paddy

/2 : Dry season paddy

Table 2(1) ESTIMATE RUNOFF OF K. BENG

(Unit: 10^6 m^3)

Month		1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
Jan.	1st	5.53	2.17	13.86	3.52	10.89	0.85	6.50	8.71	9.36	8.47
	2nd	5.93	0.99	12.61	9.37	7.59	0.89	6.14	19.16	10.56	8.31
	3rd	8.96	4.97	13.63	9.47	5.86	4.89	13.98	16.80	5.71	6.34
Feb.	1st	12.45	8.63	10.53	6.88	10.55	6.34	17.20	16.51	6.78	7.71
	2nd	9.62	9.93	17.42	9.33	11.86	15.11	14.20	15.30	5.37	10.55
	3rd	5.17	10.46	21.23	9.13	15.67	12.96	9.59	16.01	2.22	11.95
Mar.	1st	11.79	6.76	15.53	2.60	16.41	10.46	10.63	6.19	1.87	13.88
	2nd	12.07	8.51	14.43	3.19	10.49	10.12	20.02	4.56	1.78	8.56
	3rd	13.55	5.52	9.78	6.32	17.00	12.96	10.28	7.03	3.93	7.43
Apr.	1st	10.21	10.64	5.57	3.72	20.93	8.69	8.76	6.65	1.57	9.02
	2nd	5.81	4.95	2.50	1.40	11.64	3.61	3.12	5.50	0.82	12.09
	3rd	2.17	1.78	2.12	0.76	5.43	1.37	3.01	1.93	0.51	11.93
May	1st	4.44	0.82	0.93	0.49	5.84	0.74	2.00	4.09	0.51	15.97
	2nd	2.24	0.51	0.55	0.40	7.35	0.49	0.88	4.75	0.40	11.03
	3rd	0.88	0.38	0.39	0.33	5.37	0.63	0.48	10.96	0.33	9.99
Jun.	1st	2.86	0.38	0.44	0.36	8.95	0.47	0.41	11.71	0.35	5.17
	2nd	3.32	0.37	0.39	0.35	7.25	0.39	0.37	5.11	0.35	1.85
	3rd	1.28	0.37	0.37	0.35	5.13	0.36	0.36	3.08	0.35	0.82
Jul.	1st	1.87	0.36	0.36	0.35	1.94	0.35	0.35	1.20	0.35	0.51
	2nd	0.86	0.36	0.36	0.35	7.33	0.35	0.35	0.63	0.34	0.40
	3rd	0.48	0.33	0.32	0.32	5.70	0.32	0.31	0.40	0.31	0.33
Aug.	1st	0.42	0.36	0.36	0.35	2.45	0.35	0.34	0.38	0.34	0.35
	2nd	0.38	0.36	0.35	0.35	1.01	0.35	0.34	0.36	0.34	0.35
	3rd	0.33	0.33	0.32	0.31	0.52	0.32	0.31	0.32	0.31	0.31
Sep.	1st	0.36	0.36	0.35	0.34	0.42	0.35	0.34	0.35	0.34	0.34
	2nd	0.36	0.36	0.35	0.34	0.38	0.35	0.34	0.34	0.34	0.34
	3rd	0.36	0.36	0.35	0.34	0.36	0.35	0.34	0.34	0.34	0.34
Oct.	1st	3.20	0.36	0.47	0.34	0.35	0.34	0.34	0.34	0.34	0.34
	2nd	5.37	0.36	3.35	0.34	0.35	0.34	0.34	0.34	0.34	0.34
	3rd	2.92	0.32	1.15	0.31	0.32	0.31	0.31	4.77	0.31	0.31
Nov.	1st	6.32	0.35	0.63	0.34	3.70	0.34	0.34	4.60	0.34	0.34
	2nd	4.77	0.35	0.43	0.34	2.47	0.34	0.46	6.19	0.34	3.49
	3rd	3.33	0.35	1.66	0.34	2.69	0.34	4.91	4.72	3.39	1.42
Dec.	1st	1.55	3.16	1.50	3.76	3.22	1.90	1.84	5.99	7.83	4.08
	2nd	1.29	9.85	0.71	5.73	3.81	6.70	0.82	18.66	9.88	4.45
	3rd	1.34	10.78	0.42	9.94	1.71	6.10	5.08	11.17	9.54	4.35
Mean	1st	4.27	2.97	4.32	2.56	6.19	3.14	4.03	6.25	2.44	5.09

Table 2(2) ESTIMATED RUNOFF OF K. BENG

(Unit: 10^6 m^3)

Month		1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	Mean
Jan.	1st	2.63	6.79	7.03	2.88	12.62	9.47	0.35	4.51	10.05	12.25	6.92
	2nd	1.82	10.57	5.57	4.22	12.57	8.77	2.57	1.64	4.28	7.89	7.07
	3rd	0.79	13.06	2.33	4.42	9.37	7.30	5.59	2.96	1.66	5.53	7.19
Feb.	1st	11.46	20.24	2.55	11.75	16.56	7.25	3.29	3.96	8.49	4.70	9.69
	2nd	10.09	15.50	2.72	8.23	13.00	4.08	3.91	5.83	7.44	2.39	9.59
	3rd	16.92	13.82	3.58	5.39	14.52	9.04	10.39	8.94	7.33	10.65	10.74
Mar.	1st	14.50	13.42	8.50	3.11	9.93	6.94	5.28	14.13	4.69	15.81	9.63
	2nd	10.12	12.35	11.46	11.46	7.65	2.91	4.78	7.40	6.81	12.41	9.05
	3rd	6.83	13.27	10.71	13.74	4.06	3.36	2.30	2.38	4.35	10.07	8.24
Apr.	1st	7.02	12.78	6.94	16.47	1.71	3.21	1.04	2.31	4.58	7.58	7.47
	2nd	12.71	16.73	6.36	10.49	2.34	8.42	5.03	1.07	2.91	2.73	6.01
	3rd	6.80	13.77	3.62	4.04	0.98	4.31	6.05	0.59	1.15	5.23	3.87
May	1st	2.46	10.27	1.38	1.86	0.56	4.96	2.16	0.72	0.61	3.72	3.22
	2nd	1.01	8.24	0.69	2.01	0.43	1.84	0.92	1.24	0.44	1.49	2.34
	3rd	0.51	2.65	0.43	1.57	0.35	1.57	0.48	0.58	0.35	2.44	2.03
Jun.	1st	0.42	1.16	0.40	0.81	0.37	1.20	0.41	0.44	0.36	1.08	1.88
	2nd	0.37	0.62	0.37	0.51	0.36	0.64	0.37	0.38	0.35	0.58	1.21
	3rd	0.36	0.44	0.36	0.42	0.38	0.46	0.36	0.64	0.35	0.42	0.83
Jul.	1st	0.35	0.38	0.36	0.38	0.52	0.40	0.35	0.54	0.35	0.37	0.58
	2nd	0.35	0.36	0.36	0.37	3.55	0.37	0.35	0.41	0.34	0.35	0.90
	3rd	0.31	0.32	0.33	0.33	1.21	0.33	0.32	0.33	0.31	0.31	0.64
Aug.	1st	3.54	0.35	0.36	0.36	0.65	0.36	0.35	0.35	0.34	0.34	0.63
	2nd	1.31	0.35	0.36	0.36	0.45	0.36	0.35	0.35	0.34	0.34	0.43
	3rd	3.19	0.32	0.32	0.32	0.35	0.32	0.31	0.31	0.31	0.31	0.47
Sep.	1st	2.46	0.35	0.35	0.36	0.36	0.36	0.35	0.34	0.34	0.34	0.45
	2nd	1.00	2.51	0.35	0.36	0.36	0.35	0.34	0.34	0.34	0.34	0.48
	3rd	0.55	1.01	0.35	0.35	0.35	0.35	0.34	0.34	0.34	0.34	0.39
Oct.	1st	6.14	3.43	0.35	0.35	0.35	0.35	0.34	0.34	0.34	0.34	0.93
	2nd	2.77	4.27	0.35	0.35	0.35	0.35	0.34	0.34	0.34	0.34	1.06
	3rd	0.99	7.51	0.87	0.32	0.32	0.32	0.31	0.31	0.31	0.30	1.12
Nov.	1st	0.57	12.08	0.59	0.35	0.35	0.35	0.34	0.34	0.34	2.94	1.77
	2nd	0.41	7.32	1.44	0.35	0.35	0.35	0.76	2.47	0.34	2.99	1.79
	3rd	6.20	8.82	0.69	5.33	0.35	0.35	6.61	1.50	0.34	10.03	3.16
Dec.	1st	13.46	11.96	6.69	8.48	3.69	0.35	12.90	5.81	0.33	9.11	5.38
	2nd	9.57	9.79	3.80	7.57	8.10	0.35	6.83	10.23	2.98	3.41	6.32
	3rd	6.22	7.09	1.36	8.35	5.28	0.32	4.00	7.64	6.74	1.66	5.45
Mean	1st	4.61	7.33	2.61	3.83	3.74	2.55	2.52	2.55	2.26	3.92	3.86

Table 3(1) STORAGE REQUIREMENT OF BENG DAM

(Unit: 10^6 m^3)

Month	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
Jan. 1st	0.00	3.07	3.89	26.65	12.74	12.65	17.05	17.05	0.00	6.22
2nd	0.00	6.01	0.00	22.34	9.98	15.67	15.54	4.29	0.00	2.83
3rd	0.00	5.52	0.00	17.57	8.64	15.25	6.48	0.00	0.00	1.04
Feb. 1st	0.00	2.02	0.00	15.59	3.48	13.73	0.00	0.00	0.00	0.00
2nd	0.00	0.00	0.00	7.55	0.00	0.70	0.00	0.00	0.00	0.00
3rd	0.00	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00
Mar. 1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apr. 1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2nd	0.00	0.00	0.00	0.89	0.00	0.00	0.00	0.00	1.39	0.00
3rd	0.15	0.49	0.19	2.27	0.00	0.84	0.00	0.36	2.98	0.00
May 1st	0.00	1.38	0.99	3.44	0.00	1.80	0.00	0.00	4.14	0.00
2nd	0.00	2.69	2.27	4.85	0.00	3.13	0.99	0.00	5.55	0.00
3rd	1.21	4.38	3.95	6.59	0.00	4.59	2.59	0.00	7.29	0.00
June 1st	0.00	4.91	4.42	7.13	0.00	5.03	3.09	0.00	7.84	0.00
2nd	0.00	6.17	5.67	8.41	0.00	6.28	4.35	0.00	9.12	0.00
3rd	0.17	7.13	6.63	9.39	0.00	7.25	5.32	0.00	10.10	0.57
July 1st	0.00	7.84	7.34	10.11	0.00	7.96	6.03	0.00	10.81	1.14
2nd	0.00	8.24	7.74	10.52	0.00	8.38	6.45	0.17	11.24	1.52
3rd	0.13	8.52	8.03	10.81	0.00	8.66	6.74	0.38	11.53	1.79
Aug. 1st	0.35	8.80	8.30	11.09	0.00	8.95	7.04	0.64	11.83	2.08
2nd	0.83	9.29	8.81	11.59	0.00	9.45	7.55	1.13	12.34	2.58
3rd	1.81	10.27	9.79	12.59	0.79	10.44	8.54	2.12	13.33	3.58
Sep. 1st	3.24	11.70	11.24	14.04	2.18	11.88	9.99	3.56	14.79	5.03
2nd	4.99	13.46	13.00	15.81	3.91	13.64	11.77	5.33	16.56	6.80
3rd	7.02	15.48	15.03	17.85	5.93	15.67	13.81	7.37	18.60	8.84
Oct. 1st	6.69	17.60	17.06	19.99	8.07	17.82	15.95	9.51	20.74	10.98
2nd	4.18	19.43	16.30	21.84	9.90	19.66	17.79	11.35	22.58	12.82
3rd	3.28	20.99	17.08	23.41	11.47	21.23	19.37	8.69	24.16	14.40
Nov. 1st	0.54	23.41	19.26	25.84	10.99	23.66	21.79	7.44	26.58	16.83
2nd	0.00	26.10	21.87	28.54	11.85	26.36	24.39	5.08	29.28	16.80
3rd	0.48	29.16	23.80	31.60	12.89	29.43	23.50	4.36	29.71	18.93
Dec. 1st	1.29	28.58	24.66	30.51	12.25	29.94	24.07	1.34	25.10	17.56
2nd	1.42	21.31	25.29	26.80	10.21	23.66	24.60	0.00	17.81	14.96
3rd	1.24	12.16	25.98	18.45	9.67	18.96	20.87	0.00	9.83	11.92

Table 3(2) STORAGE REQUIREMENT OF BENG DAM

(Unit: 10^6 m^3)

Month		1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Jan.	1st	13.35	0.00	0.00	21.41	0.00	11.02	31.46	13.26	5.84	18.59
	2nd	15.57	0.00	0.00	21.56	0.00	7.24	33.03	15.63	5.94	15.57
	3rd	19.05	0.00	2.01	21.58	0.00	4.53	31.95	17.05	8.40	14.54
Feb.	1st	13.11	0.00	3.76	15.39	0.00	2.22	33.07	17.59	5.02	14.44
	2nd	4.42	0.00	1.44	8.30	0.00	0.00	29.71	12.57	0.00	12.40
	3rd	0.00	0.00	0.00	4.15	0.00	0.00	21.67	5.66	0.00	4.16
Mar.	1st	0.00	0.00	0.00	3.10	0.00	0.00	18.74	0.00	0.00	0.00
	2nd	0.00	0.00	0.00	0.00	0.00	0.00	15.10	0.00	0.00	0.00
	3rd	0.00	0.00	0.00	0.00	0.00	0.00	13.44	0.00	0.00	0.00
Apr.	1st	0.00	0.00	0.00	0.00	0.00	0.00	13.80	0.00	0.00	0.00
	2nd	0.00	0.00	0.00	0.00	0.08	0.00	11.56	1.18	0.00	0.00
	3rd	0.00	0.00	0.00	0.00	1.27	0.00	8.36	2.70	1.03	0.00
May	1st	0.00	0.00	0.40	0.00	2.38	0.00	8.10	3.68	2.10	0.00
	2nd	0.88	0.00	1.56	0.01	3.76	0.16	9.05	4.36	3.48	0.46
	3rd	2.44	0.00	3.20	0.57	5.48	0.72	10.65	5.86	5.20	0.20
June	1st	2.94	0.00	3.71	0.73	6.02	0.54	11.15	6.34	5.74	0.12
	2nd	4.20	1.04	4.97	1.87	7.29	1.57	12.41	7.59	7.02	1.20
	3rd	5.17	1.94	5.94	2.78	8.24	2.45	13.38	8.31	8.00	2.11
July	1st	5.88	2.63	6.65	3.48	8.81	3.12	14.10	8.87	8.71	2.81
	2nd	6.30	3.04	7.06	3.87	6.46	3.52	14.51	9.23	9.14	3.23
	3rd	6.59	3.32	7.33	4.15	5.90	3.79	14.80	9.51	9.43	3.52
Aug.	1st	4.12	3.61	7.61	4.43	5.92	4.07	15.08	9.79	9.73	3.82
	2nd	3.79	4.11	8.10	4.92	6.34	4.56	15.59	10.29	10.24	4.33
	3rd	2.05	5.10	9.09	5.91	7.30	5.55	16.58	11.29	11.23	5.32
Sep.	1st	1.67	6.54	10.53	7.34	8.73	6.99	18.03	12.74	12.68	6.78
	2nd	2.87	6.44	12.29	9.09	10.49	8.75	19.80	14.51	14.46	8.55
	3rd	4.73	7.90	14.33	11.13	12.52	10.78	21.84	16.55	16.49	10.59
Oct.	1st	1.86	7.37	16.46	13.26	14.65	12.91	23.98	18.69	18.64	12.73
	2nd	1.60	5.81	18.29	15.09	16.48	14.75	25.82	20.53	20.48	14.57
	3rd	2.54	0.55	19.34	16.66	18.05	16.31	27.40	22.11	22.06	16.16
Nov.	1st	4.77	0.00	21.55	19.08	20.47	18.73	29.82	24.54	24.48	16.34
	2nd	7.40	0.00	23.29	21.77	23.16	21.42	32.16	25.39	27.18	16.74
	3rd	5.40	0.00	26.06	20.52	26.22	24.48	29.81	27.46	30.25	11.44
Dec.	1st	0.00	0.00	22.43	15.35	25.18	26.33	20.81	24.59	32.11	5.72
	2nd	0.00	0.00	20.39	10.05	19.42	27.27	16.16	17.00	30.78	4.02
	3rd	0.00	0.00	20.19	3.21	15.50	28.06	13.45	10.83	25.47	3.53

NOTE AI-12

PROPOSED IRRIGATION SYSTEM OF GOTTAN-LOSARI AREA

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NOTE AI-12 Proposed Irrigation System of Gottan-Losari Area

The irrigation canal system is made on 1 to 50,000 scale topographic maps.

The water source is the Brantas river. The water will be taken through the intake gates when the Brantas river water level is sufficiently higher than the field elevations and be taken by low lift pumps when the Brantas river water level lowers.

The pumping stations are proposed at the Gottan intake, the Ngares intake and the Losari intake. Respective commanding irrigation areas are about 1,280 ha, 2,280 ha and 660 ha. The water lifted up at these pumping stations are conveyed through the connecting canals to the existing secondary and tertiary canals.

The maximum unit water requirement is 1.4 ℓ/s/ha. (See Table 1).

The pumps will be vertical shaft axial-flow pump and the lifted head is estimated to be about 2 m. Major works of the Gottan-Losari Irrigation Project are approximately as follows.

Pump Stations	: 3 stations in Gottan, Ngares and Losari
Pump type	: Vertical shaft axial-flow pump
Head	: about 2 m
Installed capacity of Pump	: 1,0 m^3/sec in Gottan, 1.8 m^3/sec in Ngares, 0.6 m^3/sec in LOsari
Nos of pump	: 2 pumps in Gottan, 3 pumps in Ngares, one pump in Losari
Main and secondary canals	: Rehabilitation of most of sections
Type	: Trapezoid, lines with wet stone masonry
Total length	: 38 km
Base width	: 0.6 m - 3.0 m
Height	: 0.8 m - 1.6 m
Side slope	: 1 : 1 and 1 : 1.5
Bank width	: 0.6 - 1.5 m in one side, 3.6 - 4.5 m in another side
Lining	: wet stone masonry of 0.2 m and 0.3 m in thickness
Tertiary development	: Mainly rehabilitation and provision of quarternary canals, existing canal; 32 km
Canal density	: 50 m/ha
Canal type	: Trapezoidal earth type

From the cropping acreages and the target unit yields, total agricultural productions with project are gained as follows.

Unit : tons

Area	Paddy	Soybean	Peanut	Maize	Sugar-cane
Widas extension	16,500	2,100	2,250	2,625	0
Beng	20,900	2,520	2,700	3,500	38,500
Gottan-Losari	20,900	2,520	2,700	3,500	132,000
Lesti left	-	2,800	3,000	7,000	22,000
Widas south/1	57,750	1,560	1,530	4,760	71,500

/1 : Production of polowijo crops is estimated based on the present yield since no additional water is expected for these crops due to water shortage

Table 1 IRRIGATION WATER REQUIREMENT
IN GOTTAN-LOSARI IRRIGATION PROJECT

Unit : m3/sec.

Month	Ten-Day	WSP /1	DSP /2	UDSP	Sub-Total	Sugar-cane	Polo-wijo	Sub-Total	Total
Jan	1	1.44	0		1.44	0	0	0	1.44
	2	0.97	0		0.97	0	0	0	0.97
	3	0	0		0	0	0	0	0
Feb	1	0	0		0	0	0	0	0
	2	3.51	0		3.51	0.68	0	0.68	4.19
	3	3.88	0		3.88	0.83	0	0.83	4.71
Mar	1	1.04	0.04		1.08	0	0	0	1.08
	2	0	0.05		0.05	0	0	0	0.05
	3	1.58	0.77		2.35	0.22	0	0.22	2.57
Apr	1	1.86	1.17		3.03	0.87	0.09	0.96	3.99
	2	1.09	1.45		2.54	0.84	0.26	1.10	3.64
	3	0.35	1.77		2.12	0.82	0.48	1.30	3.42
May	1	0	1.22		1.22	0.65	0.65	1.30	2.52
	2	0	1.26		1.26	0.58	0.89	1.47	2.73
	3	0	1.29		1.29	0.51	1.11	1.62	2.91
Jun	1	0	1.28		1.28	0.44	1.17	1.61	2.89
	2	0	1.29		1.29	0.41	1.20	1.61	2.90
	3	0	1.28		1.28	0.38	1.12	1.50	2.78
Jul	1	0	1.33		1.33	0.40	0.85	1.25	2.58
	2	0	1.12		1.12	0.38	0.44	0.82	1.94
	3	0	0.75		0.75	0.31	0.10	0.41	1.16
Aug	1	0	0.51		0.51	0.44	0.10	0.54	1.05
	2	0	0.16		0.16	0.46	0.29	0.75	0.91
	3	0	0		0	0.47	0.54	1.01	1.01
Sep	1	0	0		0	0.59	1.01	1.60	1.60
	2	0	0		0	0.67	1.50	2.17	2.17
	3	0	0		0	0.76	1.84	2.60	2.60
Oct	1	0	0		0	0.86	2.27	3.13	3.13
	2	0	0		0	0.91	2.44	3.35	3.35
	3	0	0		0	0.96	2.36	3.32	3.32
Nov	1	0.09	0		0.09	0.93	1.67	2.60	2.69
	2	0.12	0		0.12	0.96	1.11	2.07	2.19
	3	1.87	0		1.87	0.85	0.45	1.30	3.17
Dec	1	2.60	0		2.60	0.91	0.14	1.05	3.65
	2	1.56	0		1.56	0	0	0	1.56
	3	2.35	0		2.35	0	0	0	2.35

/1 : Wet season paddy

/2 : Dry season paddy

NOTE AI-13

PROPOSED IRRIGATION SYSTEM OF LESTI LEFT AREA

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NOTE AI-13 Proposed Irrigation System of Lesti left Area

The water resource available for the Lesti left area is the Lesti river. Pumping stations are proposed to lift up the river water instead of headworks, since the project area is located at elevation of 25m to 30 m above the river bed of the Lesti river. Four pumping stations will be provided in separate locations of the tributaries forming deep gorges, that is to say, so that the irrigation canal is not crossing these deep tributaries. Respective pumping stations serve the irrigation areas of 200 ha, 80 ha, 420 ha and 1,600 ha.

The water lifted up is to delivered through main canals and tertiary canals to field. All the irrigation system are to be newly constructed.

The maximum unit water requirement is estimated to be 0.77 l/s/ha and 1.76 m^3/s in total (See Table 1)

Main features of the irrigation facilities are as follows.

Pump Stations	: 4 pump stations
Head	: about 30 m
Installed capacity	: 9 m^3/min for P.S No.1 3 m^3/min for P.S No.2 18 m^3/min for P.S No.3 74 m^3/min for P.S No.4
Pump type	: Horizontal double suction volute pump
Pipe line	: Dia = 0.3 m, Length = 300 m for P.S No.1 Dia = 0.25 m, Length = 500 m for P.S No.2 Dia = 0.40 m, Length = 650 m for P.S. No.3 Dia = 0.90 m, Length = 300 m for P.S No.4
Main Canals	
Type	: Trapezoid line with wet stone masonry
Length	: 3 km for P.S No.1 irrigation area 1 km for P.S No.2 irrigation area 6 km for P.S No.3 irrigation area 18 km for P.S No.4 irrigation area
Canal base width	: 0.5 m for No.1 to No.3 area, 0.6 m to 1.0 No. 4 area
Canal height	: 0.6 - 1.2 m
Bank width	: 0.6 m in one side and 3.6 m in another side
Tertiary Development	
Canal density	: 50 m/ha
Canal type	: Trapezoidal earth type

Table 1 IRRIGATION WATER REQUIREMENT
IN LESTI LEFT IRRIGATION PROJECT

Unit : m^3/sec.

Month	Ten Day	Sugar-cane	Polowijo	Total
	1	0	0	0
Jan.	2	0	0	0
	3	0	0	0
	1	0	0	0
Feb.	2	0	0	0
	3	0.14	0.59	0.73
	1	0.14	0.93	1.07
Mar.	2	0.03	0.23	0.26
	3	0.10	0.93	1.03
	1	0.07	0.86	0.93
Apr.	2	0.16	1.60	1.76
	3	0	0	0
	1	0.07	0.16	0.23
May	2	0	0	0
	3	0.07	0.03	0.10
	1	0.03	0.11	0.14
June	2	0.03	0.18	0.21
	3	0.07	1.03	1.10
	1	0.07	1.36	1.43
July	2	0.03	1.07	1.10
	3	0.07	1.53	1.60
	1	0.10	1.60	1.70
Aug.	2	0.07	1.10	1.17
	3	0.07	0.56	0.63
	1	0.10	0.16	0.26
Sep.	2	0.10	0	0.10
	3	0.14	0	0.14
	1	0.14	0.10	0.24
Oct.	2	0.07	0	0.07
	3	0.07	0	0.07
	1	0	0	0
Nov.	2	0.10	0.70	0.80
	3	0	0	0
	1	0	0	0
Dec.	2	0	0	0
	3	0	0	0

NOTE AI-14

PROPOSED IRRIGATION SYSTEM OF WIDAS SOUTH IRRIGATION AREA

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NOTE AI-14 Proposed Irrigation System of Widas South Irrigation Area

1. Water Balance Calculation

The net irrigation area is 6,270 ha from the land resources. To clarify the scale of exploitation of water resources for irrigation or the aerial scale of the cropping area to be irrigated, the water balance calculation is made. As the results of the calculation, the wet season paddy of 5,500 ha and the dry season paddy of 5,000 ha only can be irrigated due to the insufficient storage capacity of the Kuncir dam. The effective storage is 22.5 x 10^6 m^3 at maximum due to the topographic condition at site. In this calculation, the tributary runoff from the catchment area of 150 km^2 is also taken into account.

The calculation data such as irrigation water requirement and runoff estimated by Tank Model method are shown in Table 1 and Table 2. The calculation results of required storage is shown in Table 3.

Calculation criteria of irrigation water requirement is mentioned in Note AI-17. Method of runoff estimate is stated in Section 3.2.

2. Kuncir Dam

The preliminary design is made in Section 3.7.

3. Irrigation System

Irrigation canal layout is made on the scale of 1 to 2,500 maps.

The irrigation water will be taken by the weirs existing on the Kuncir river and Bodor river. The main irrigation system will originate the Kedunggerit weir located on the Kuncir river. The water diverted at Kedunggerit is conveyed to the left area of 1,060 ha and the right area of 3,780 ha by canals to be newly constructed. The remaining areas are fed from Bodor river.

The proposed main canal is about 10.5 km in length and serves to the left area of 3,780 ha. The design discharge is about 5.5 m^3/sec at the canal head and 2.2 m^3/sec at the end. As for the secondary canals the total length is about 57 km of which 16 km will be newly constructed.

The primary features of irrigation facilities are as follows:

Headworks	: Existing headworks named Dam Kedung-gerit. Enlargement of intake stuctures and provision of sand trap ponds.
Sandflush sluice	: Provided with two roller gates of 3.5 m high into 3.5 m wide
Intake	: provide with two roller gates of 2.0 m x 2.0 m for main canal and one roller gate of 1.5 m x 1.5 m for secondary canal

Sand trap pond	: 75 m long, 2.5 m deep and 9m wide with side slope of 1 to 1 for main canal. 45 m long, 1.5 m deep and 4 m wide with side slope of 1 to 1 for seconadry canal.
Main canal	
Type	: Trapezoid lined with wet stone masonry
Length	: 10.5 km
Base width	: 1.3 - 2.0 m
Height	: 1.2 - 1.6 m
Side slope	: 1 : 1.5
Bank width	: 1.5 m
Lining	: Wet masonry, 0.3 m in thickness
Inspection Road along Main Canal	
Length	: 3.3 km
Total width	: 6 m
Effective width	: 3 m
Metalling	: Sand and gravel, 0.3 m in thickness
Secondary canals	: Rehabilitation & New Construction
Type	: Trapezoid lined with wet stone masonry
Total length	: 57 km
Base width	: 0.6 - 1.2 m
Height	: 0.8 - 1.2 m
Side slope	: 1 : 1
Band width	: 0.6 - 1.2 m in one side, 3.6 - 4.2 m in another side
Lining	: Wet masonry of 0.2 m in thickness
Tertiary development	: Mainly rehabilitation and provision of quarternary canals
Canal density	: 50 m/ ha
Canal type	: Trapezoidal earth type
Major Structures related to Main Canal	
Bridge	: 20 nos
Drain culvert	: 2 nos
Diversion	: 10 nos
Drop	: 11 nos
Spillway	: 2 nos

Table 1 IRRIGATION WATER REQUIREMENT
IN WIDAS SOUTH IRRIGATION PROJECT

Unit : m^3/sec.

Month	Ten Day	WSP /1	DSP /2	UDSP	Sub-Total	Sugar-cane	Polo-wijo	Sub-Total	Total
	1	0.57	0		0.57	0	0	0	0.57
Jan.	2	4.56	0		4.56	0.10	0	0.10	4.66
	3	0	0		0	0	0	0	0
	1	0	0.13		0.13	0	0	0	0.13
Feb.	2	0	0.17		0.17	0	0	0	0.17
	3	2.27	2.50		4.77	0	0	0	4.77
	1	1.09	2.59		3.68	0	0	0	3.68
Mar.	2	2.46	4.42		6.88	0.31	0	0.31	7.19
	3	1.83	6.15		7.98	0.49	0	0.49	8.47
	1	0.53	6.76		7.29	0.39	0	0.39	7.68
Apr.	2	0	8.45		8.45	0.47	0	0.47	8.92
	3	0	3.10		3.10	0	0	0	3.10
	1	0	6.87		6.87	0.38	0	0.38	7.25
May	2	0	6.48		6.48	0.29	0	0.29	6.77
	3	0	6.93		6.93	0.30	0	0.30	7.23
	1	0	1.60		1.60	0	0	0	1.60
June	2	0	4.99		4.99	0.52	0	0.52	5.51
	3	0	3.05		3.05	0.10	0	0.10	3.15
	1	0	2.82		2.82	0.24	0	0.24	3.06
July	2	0	1.65		1.65	0.22	0	0.22	1.87
	3	0.54	0.54		0.54	0.22	0	0.22	0.76
	1	0	0		0	0.24	0	0.24	0.24
Aug.	2	0	0		0	0.25	0	0.25	0.25
	3	0	0		0	0.26	0	0.26	0.26
	1	0	0		0	0.35	0	0.35	0.35
Sep.	2	0	0		0	0.40	0	0.40	0.40
	3	0	0		0	0.45	0	0.45	0.45
	1	0.14	0		0.14	0.49	0	0.49	0.63
Oct.	2	0.19	0		0.19	0.52	0	0.52	0.71
	3	3.16	0		3.16	0.55	0	0.55	0.71
	1	4.44	0		4.44	0.52	0	0.52	4.96
Nov.	2	5.75	0		5.75	0.54	0	0.54	6.29
	3	5.59	0		5.59	0.25	0	0.25	5.84
	1	6.06	0		6.06	0.20	0	0.20	6.26
Dec.	2	3.86	0		3.86	0	0	0	3.86
	3	1.53	0		1.53	0	0	0	1.53

/1 : Wet season paddy

/2 : Dry saeson paddy

Table 2(1) ESTIMATED RUNOFF OF K. KUNCIR

(Unit: 10^6 m^3)

Month		1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
Jan.	1st	4.19	4.87	8.64	6.35	6.89	4.08	2.21	7.72	5.14	9.58
	2nd	6.12	6.17	8.72	8.48	5.40	9.68	4.39	7.37	8.51	11.44
	3rd	4.97	7.53	11.15	9.09	5.33	17.32	5.84	6.85	6.32	9.68
Feb.	1st	7.49	9.02	9.99	11.65	6.15	19.30	9.53	12.10	4.75	10.10
	2nd	6.16	7.81	9.82	13.60	5.26	20.83	12.33	14.18	7.98	9.84
	3rd	4.78	6.55	12.94	20.46	4.46	20.98	13.12	15.98	6.68	8.68
Mar.	1st	9.43	4.79	12.53	13.80	8.60	14.07	13.40	8.88	8.67	8.88
	2nd	11.43	6.35	14.17	10.64	12.14	13.32	11.48	9.28	8.33	14.96
	3rd	8.47	3.94	12.36	7.64	16.19	11.85	8.34	9.83	12.55	16.17
Apr.	1st	9.98	5.06	10.85	8.31	20.44	18.43	9.61	12.93	11.28	14.77
	2nd	13.96	2.83	6.69	5.63	14.29	17.11	9.76	10.20	8.89	12.18
	3rd	11.37	1.53	10.35	5.42	9.87	13.74	9.79	5.85	6.90	12.67
May	1st	8.49	1.11	7.82	2.51	10.98	8.85	8.34	3.34	9.16	13.64
	2nd	5.43	0.95	4.02	1.50	10.49	4.18	6.99	3.00	5.93	12.44
	3rd	3.17	0.80	1.69	0.92	8.36	1.89	7.31	2.61	2.35	8.93
Jun.	1st	1.93	0.83	1.56	0.84	6.92	1.30	5.49	2.91	1.46	5.59
	2nd	1.46	0.79	1.08	0.77	6.81	1.03	2.95	1.55	1.09	4.13
	3rd	1.07	0.75	0.91	0.72	6.37	0.92	1.55	1.12	0.94	1.95
Jul.	1st	0.92	0.71	0.83	0.69	4.60	0.86	1.09	0.96	0.87	1.13
	2nd	0.85	0.68	0.78	0.65	3.97	0.81	0.93	0.88	0.82	1.32
	3rd	0.73	0.59	0.67	0.57	2.85	0.70	0.77	0.75	0.71	0.96
Aug.	1st	0.76	0.62	0.71	0.60	1.62	0.73	0.80	0.79	0.74	0.92
	2nd	0.73	0.60	0.68	0.57	1.13	0.70	0.76	0.75	0.71	0.85
	3rd	0.63	0.52	0.59	0.50	0.87	0.61	0.66	0.65	0.62	0.73
Sep.	1st	0.66	0.55	0.62	0.53	0.87	0.64	0.69	0.68	0.65	0.76
	2nd	0.63	0.53	0.59	0.51	0.82	0.61	0.66	0.65	0.62	0.73
	3rd	1.27	0.51	0.57	0.49	0.78	0.58	0.63	0.62	0.59	0.81
Oct.	1st	8.39	0.49	0.55	0.47	0.74	0.56	0.60	0.60	0.57	0.71
	2nd	8.19	0.47	0.52	0.45	0.70	0.54	0.68	1.58	0.53	0.66
	3rd	4.98	0.41	0.46	0.40	0.61	0.47	0.50	5.12	0.48	0.57
Nov.	1st	7.92	0.44	0.48	0.42	3.47	0.50	0.66	5.48	0.51	1.47
	2nd	11.14	0.41	0.47	0.41	2.13	0.48	2.66	7.53	0.49	2.30
	3rd	8.14	1.01	0.45	0.40	3.32	0.46	3.09	6.24	0.47	1.25
Dec.	1st	4.42	0.38	0.44	3.46	2.99	1.39	1.93	5.39	2.26	5.52
	2nd	2.21	2.47	0.55	3.79	5.42	2.57	3.11	3.37	7.88	5.72
	3rd	3.66	6.98	0.42	4.07	4.49	2.68	7.19	4.55	7.98	2.95
Mean	1st	5.17	2.45	4.32	4.09	5.73	5.96	4.71	5.17	4.01	5.97

Table 2(2) ESTIMATED RUNOFF OF K. KUNCIR

(Unit: 10^6 m^3)

Month		1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	Mean
Jan.	1st	8.71	6.05	9.01	7.99	7.58	10.43	0.52	6.59	9.01	14.19	6.93
	2nd	10.79	4.97	10.10	9.50	8.64	10.73	4.47	9.22	13.14	17.05	8.74
	3rd	11.39	7.56	8.90	10.50	9.79	11.62	7.34	9.62	11.22	12.19	9.21
Feb.	1st	11.94	10.51	10.26	8.55	10.95	15.93	7.94	10.60	11.63	16.65	10.75
	2nd	13.77	12.88	9.05	7.54	18.24	14.74	8.11	9.34	11.19	17.70	11.51
	3rd	18.70	13.62	9.84	14.03	21.25	18.72	11.15	11.67	12.69	20.02	13.31
Mar.	1st	13.61	9.89	12.77	11.70	13.97	13.06	8.33	12.37	11.90	13.23	11.19
	2nd	11.56	10.57	9.52	12.35	17.40	10.67	6.99	12.17	12.51	22.76	11.93
	3rd	7.58	11.91	8.70	12.95	16.63	9.62	4.04	9.04	11.46	20.91	11.00
Apr.	1st	7.66	12.90	7.16	12.26	15.08	11.52	2.76	7.03	11.72	19.08	11.44
	2nd	5.86	14.62	4.79	8.00	12.03	14.01	3.79	5.28	10.54	15.40	9.79
	3rd	3.73	13.30	2.19	5.78	7.36	17.12	2.46	5.62	8.26	12.62	8.29
May	1st	4.19	10.80	1.34	2.94	6.37	15.05	1.32	6.32	4.31	12.86	6.98
	2nd	2.59	12.14	1.06	1.53	4.97	9.71	0.95	4.71	1.97	9.63	5.20
	3rd	1.91	9.40	0.86	1.00	4.68	5.10	0.74	1.91	1.12	8.99	3.68
Jun.	1st	1.31	5.97	0.88	3.11	5.42	5.58	0.75	1.26	0.93	6.08	3.00
	2nd	1.04	2.60	0.83	1.78	4.66	2.83	0.71	0.98	0.88	2.64	2.03
	3rd	0.93	1.48	0.79	1.15	5.42	1.56	0.68	1.49	0.82	1.44	1.60
Jul.	1st	0.87	1.11	0.75	0.93	7.37	1.15	0.65	1.27	0.78	1.05	1.43
	2nd	0.82	0.96	0.72	0.84	5.57	0.99	0.62	1.11	0.74	0.90	1.24
	3rd	1.61	0.81	0.63	0.72	2.62	0.83	1.39	0.86	0.64	0.76	1.00
Aug.	1st	1.22	0.84	0.66	0.75	1.74	0.86	0.89	0.84	0.68	0.78	0.87
	2nd	0.91	0.80	0.63	0.71	1.21	0.82	0.68	0.78	0.65	0.75	0.77
	3rd	0.72	0.69	0.55	0.62	0.92	0.71	0.55	0.68	0.56	0.65	0.65
Sep.	1st	0.73	0.73	0.58	0.65	0.93	0.74	0.57	0.72	0.59	0.68	0.67
	2nd	0.75	0.87	0.56	0.63	0.87	0.71	0.54	0.68	0.57	0.65	0.65
	3rd	0.69	0.74	0.54	0.60	0.83	0.68	0.52	2.18	0.55	0.62	0.74
Oct.	1st	1.85	3.28	0.52	0.58	0.79	0.65	0.50	1.13	0.53	0.60	1.20
	2nd	1.03	3.05	0.53	0.55	0.75	0.62	0.48	0.79	0.51	0.57	1.15
	3rd	2.11	5.18	0.46	0.49	0.65	0.54	0.43	0.61	0.44	2.75	1.38
Nov.	1st	1.29	6.35	0.49	0.51	1.34	0.57	0.46	0.62	0.47	3.28	1.83
	2nd	1.60	8.07	0.56	0.50	1.12	0.55	0.44	1.75	0.45	1.65	2.23
	3rd	2.85	7.13	4.26	0.49	1.38	0.53	3.54	3.69	0.44	1.66	2.54
Dec.	1st	6.27	7.92	4.71	0.78	3.39	0.51	3.37	6.42	3.39	2.52	3.33
	2nd	7.26	6.79	4.27	1.19	4.55	0.49	2.15	6.55	5.31	1.26	4.04
	3rd	5.18	3.85	3.57	5.00	8.97	0.43	4.00	4.66	7.14	3.76	4.47
Mean	1st	4.86	6.39	3.66	4.14	6.54	5.84	2.63	4.46	4.71	7.45	4.91

Table 3(1) STORAGE REQUIREMENT OF KUNCIR DAM

(Unit: 10^6 m^3)

Month	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
Jan. 1st	0.00	0.00	21.27	18.36	14.01	0.00	14.15	0.00	0.00	0.00
2nd	0.00	0.00	15.62	12.91	11.22	0.00	12.23	0.00	0.00	0.00
3rd	0.00	0.00	5.12	4.37	6.25	0.00	6.78	0.00	0.00	0.00
Feb. 1st	0.00	0.00	0.00	0.00	1.07	0.00	0.00	0.00	0.00	0.00
2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar. 1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3rd	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apr. 1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2nd	0.00	1.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3rd	0.00	1.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
May 1st	0.00	5.58	0.00	0.92	0.00	0.00	0.00	0.00	0.00	0.00
2nd	0.00	9.47	0.00	3.62	0.00	0.00	0.00	0.09	0.00	0.00
3rd	0.13	14.53	2.95	8.40	0.00	2.47	0.00	0.86	1.38	0.00
June 1st	0.00	14.52	2.30	8.38	0.00	2.05	0.00	0.00	0.82	0.00
2nd	1.69	17.66	4.81	11.56	0.00	4.67	0.00	1.49	3.31	0.00
3rd	2.19	18.85	5.66	12.81	0.00	5.49	0.00	1.88	4.09	0.00
July 1st	2.93	20.04	6.59	14.05	0.00	6.36	0.37	2.54	4.94	0.20
2nd	3.00	20.28	6.73	14.35	0.00	6.47	0.37	2.58	5.04	0.00
3rd	2.72	20.13	6.50	14.23	0.00	6.22	0.06	2.29	4.78	0.00
Aug. 1st	2.24	19.78	6.07	13.89	0.00	5.77	0.00	1.78	4.32	0.00
2nd	1.80	19.44	5.67	13.58	0.00	5.35	0.00	1.32	3.89	0.00
3rd	1.40	19.15	5.31	13.31	0.00	4.97	0.00	0.91	3.50	0.00
Sep. 1st	1.05	18.90	4.99	13.07	0.00	4.64	0.00	0.54	3.16	0.00
2nd	0.75	18.68	4.73	12.87	0.00	4.35	0.00	0.22	2.87	0.00
3rd	0.00	18.50	4.49	12.70	0.00	4.11	0.00	0.00	2.62	0.00
Oct. 1st	0.00	18.40	4.35	12.63	0.00	3.96	0.00	0.00	2.45	0.00
2nd	0.00	18.36	4.26	12.60	0.00	3.85	0.00	0.00	2.34	0.00
3rd	0.00	18.36	4.21	12.61	0.00	3.80	0.00	0.00	2.27	0.00
Nov. 1st	0.00	21.78	7.55	16.08	0.00	7.09	2.94	0.00	5.55	1.19
2nd	0.00	26.40	12.05	20.71	0.92	11.57	3.15	0.00	10.01	1.74
3rd	0.00	29.35	16.21	24.98	0.38	15.71	2.81	0.00	14.12	4.18
Dec. 1st	0.00	32.94	20.76	24.48	0.29	18.21	4.14	0.00	14.74	1.90
2nd	0.00	32.38	22.99	22.78	0.00	17.56	3.02	0.00	9.50	0.00
3rd	0.00	28.43	23.54	19.65	0.00	15.75	0.00	0.00	2.66	0.00

Table 3(2) STORAGE REQUIREMENT OF KUNCIR DAM

(Unit: 10^6 m^3)

Months	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Jan. 1st	0.00	0.00	0.00	8.50	11.07	0.00	18.60	14.13	0.00	0.00
2nd	0.00	0.00	0.00	2.17	5.48	0.00	16.61	8.04	0.00	0.00
3rd	0.00	0.00	0.00	0.00	0.00	0.00	9.73	0.00	0.00	0.00
Feb. 1st	0.00	0.00	0.00	0.00	0.00	0.00	3.01	0.00	0.00	0.00
2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar. 1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apr. 1st	0.00	0.00	0.00	0.00	0.00	0.00	0.76	0.00	0.00	0.00
2nd	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00
May 1st	0.00	0.00	3.45	0.33	0.00	0.00	3.65	0.00	0.00	0.00
2nd	0.45	0.00	7.10	2.96	0.00	0.00	7.53	0.00	1.68	0.00
3rd	2.87	0.00	12.02	7.55	0.00	0.00	12.74	2.42	5.98	0.00
June 1st	2.44	0.00	11.96	5.56	0.00	0.00	12.79	2.04	5.84	0.00
2nd	5.05	0.00	15.02	6.57	0.00	0.00	16.11	4.77	8.78	0.00
3rd	5.84	0.01	16.12	6.89	0.00	0.00	17.45	4.78	9.82	0.05
July 1st	6.70	0.35	17.23	7.61	0.00	0.26	18.77	4.94	10.86	0.51
2nd	6.79	0.32	17.41	7.69	0.00	0.21	19.14	4.79	11.03	0.54
3rd	5.68	0.00	17.23	7.42	0.00	0.00	18.23	4.39	10.84	0.23
Aug. 1st	4.80	0.00	16.84	6.95	0.00	0.00	17.64	3.84	10.43	0.00
2nd	4.20	0.00	16.48	6.52	0.00	0.00	17.24	3.35	10.05	0.00
3rd	3.72	0.00	16.16	6.14	0.00	0.00	16.92	2.91	9.72	0.00
Sep. 1st	3.31	0.00	15.88	5.80	0.00	0.00	16.65	2.51	9.43	0.00
2nd	2.90	0.00	15.63	5.49	0.00	0.00	16.42	2.16	9.18	0.00
3rd	2.57	0.00	15.43	5.24	0.00	0.00	16.23	0.54	8.97	0.00
Oct. 1st	1.30	0.00	15.31	5.06	0.00	0.00	16.13	0.00	8.84	0.00
2nd	0.77	0.00	15.21	4.95	0.00	0.00	16.07	0.00	8.76	0.00
3rd	0.00	0.00	15.17	4.88	0.00	0.00	16.06	0.00	8.73	0.00
Nov. 1st	1.58	0.00	18.48	8.15	1.47	3.14	19.44	3.03	12.09	0.00
2nd	3.65	0.00	22.79	12.59	4.57	7.47	24.01	4.77	16.64	1.95
3rd	3.51	0.00	21.44	16.66	6.73	11.46	23.28	3.91	20.82	3.50
Dec. 1st	0.59	0.00	19.86	20.47	6.29	15.85	22.86	0.86	20.38	3.81
2nd	0.00	0.00	17.75	21.32	3.93	18.21	22.57	0.00	17.37	4.51
3rd	0.00	0.00	15.09	17.31	0.00	18.74	19.51	0.00	11.32	1.68

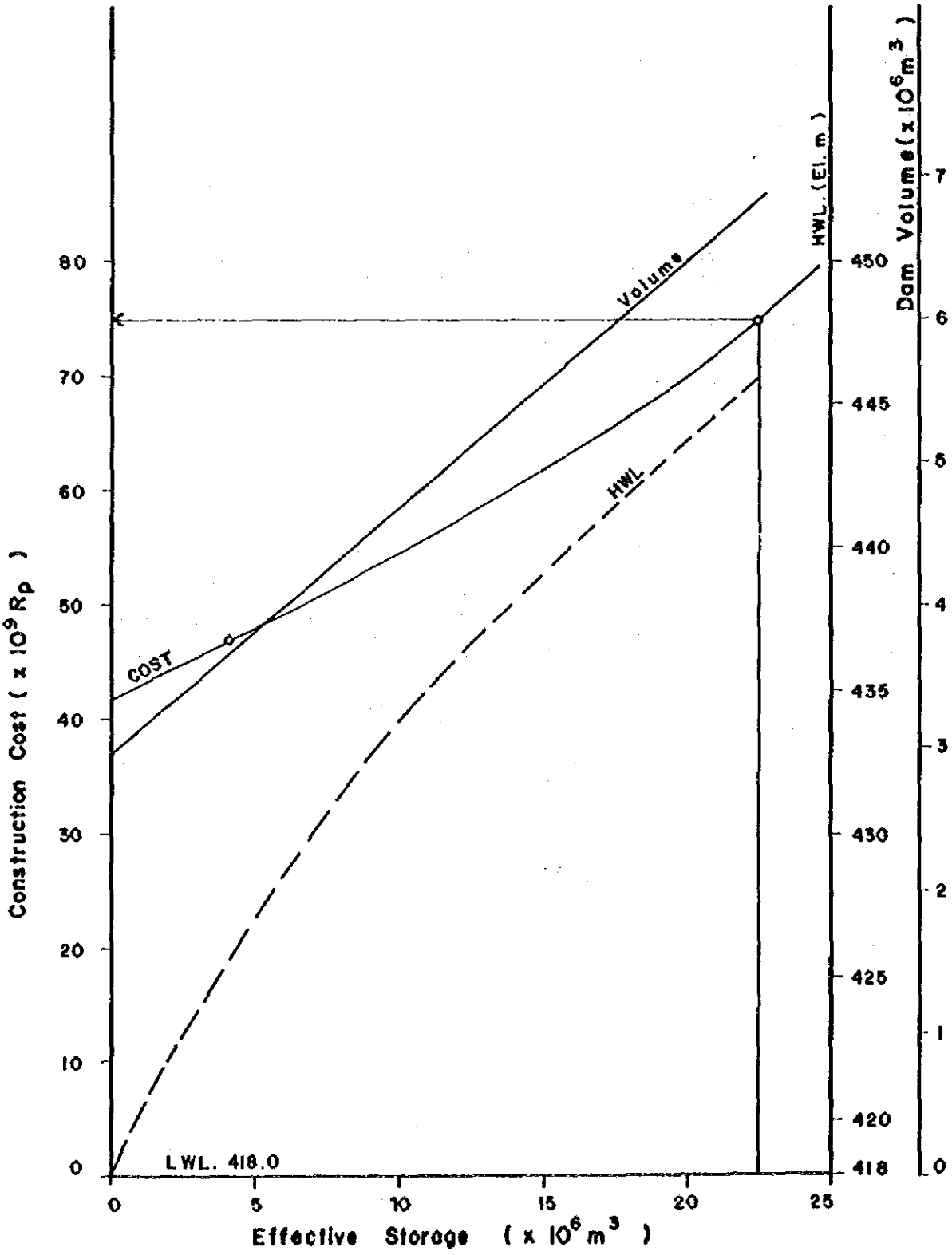

Fig. 1 RELATION BETWEEN EFFECTIVE STORAGE AND CONSTRUCTION COST OF KUNCIR DAM.

NOTE AI-15

COST ESTIMATE

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NOTE AI-15 Cost Estimate

1. Irrigation Facilities

The estimate of the construction cost for the irrigation facilities is made in accordance with the preliminary design. The unit construction cost is estimated based on the current cost as of October, 1984 collected from the Irrigation Service, BRBDEO and the Wonorejo Irrigation Project. The unit cost of major works are shown in Table 1.

The total construction costs of the irrigation facilities are estimated as follows.

Unit : 10^6 Rp.

Works	Widas Extension	Beng	Gottan-Losari	Widas South	Lesti Left
Headworks	-	262	-	183	
Pump Station	-	-	1,112	-	765
Main Canal	1,082	1,839	1,520	1,153	1,620
Inspection Road	240	508	-	75	-
Secondary Canal and Structures	583	768	410	2,050	-
Tertiary development	502	713	1,451	935	945
Contingency	361	614	674	659	500
Engineering and Administration	277	470	517	506	383
Total	3,045	5,175	5,683	5,560	4,213

Note: Drainage system construction cost for Gottan-Losari Area is included in the tertiary development cost.

More detailed estimate is shown in Table 2 to 6. The contingencies and the engineering and administration cost are estimated at 15% and 10% of the foregoing cost, repectively.

2. Dam

The construction costs of the Kedungwarak dam, the Semantok dam and the Kuncir dam are estimated based on the relationship between the reservoir water level and the effective storage as shown in Fig. 1 and 2 of Note AI-10 and Fig. 1 of the Note AI-14, which are prepared from the preliminary designs on 1 to 2,500 scale maps.

The total construction cost are as follows.

Kedungwarak dam	: Rp.	$5,100 \times 10^6$
Semantok dam	: Rp.	$45,000 \times 10^6$
Kuncir dam	: Rp.	$75,000 \times 10^6$

In case of the Beng Dam, the common cost to beneficiaries is allocated according to the ratio of the anticipated benefit. The cost to be borne by the irrigation scheme is estimated at Rp. 5,089 x 10^6 (Basic data, See Section 3.7)

3. Proposed Water Exploitation Cost

For the Gottan-Losari Irrigation Project and the Lesti Left Irrigation Project, the supposed water exploitation cost is taken into account in the economic evaluation, since the water stress in the Basin is increasing in the dry season of recent years and no water resources is expected without water exploitation in the dry season of a drought year.

The water exploitation cost is estimated based on the Wonorejo dam construction cost and on the assumption that the irrigation water increasing with project condition in the dry season from June to November relies on reservoirs as follows.

Wonorejo dam const. Common cost	Rp.	79,910 x 10^6
Effective storage		106 x 10^6 m^3
Unit exploitation cost		754 Rp/m^3
Increasing irrigation requirement (See Table 7)		
Lesti Left		9.4 x 10^6 m^3
Gottan-Losari		29.4 x 10^6 m^3
Supposed exploitation cost		
Lesti Left	Rp.	7,096 x 10^6
Gottan-Losari	Rp.	22,170 x 10^6

Table 1 UNIT CONSTRUCTION COST

(ECONOMIC)

Major Works	Unit Cost (Rp/m^3)
Hard excavation	2,400
Excavation	1,600
Embankment	2,000
Wet masonry	39,000
R. concrete	150,000
Gravel metalling	16,000
Steel gate	4,500 ($x10^3$ Rp/ton)

Estimated from data of EJIP, BRBDEO and Irrigation Service

Table 2 CONSTRUCTION COST OF WIDAS EXTENSION PROJECT

Item	Unit	Quantity	Unit cost	Amount ($x10^3$Rp.)
I. Main Works				
1. Main Canal				
Excavation	m^3	33,000	1,600	52,800
Embankment	m^3	41,000	2,000	82,000
Concrete	m^3	600	150,000	90,000
Wet masonry	m^3	19,000	39,000	741,000
Gates and Metal Works				17,400
Miscellaneous				98,300
2. Inspection road				
Embankment	m^3	21,000	1,600	33,600
Gravel metalling	m^3	6,400	16,000	102,400
Concrete	m^3	550	150,000	82,500
Miscellaneous				21,900
3. Secondary Canals				
Excavation	m^3	13,000	1,600	20,800
Embankment	m^3	55,000	2,000	110,000
Wet masonry	m^3	9,100		354,900
Gates and Metal Works				44,500
Miscellaneous				53,000
4. Tertiary development				
Excavation	m^3	14,000	1,600	22,400
Embankment	m^3	106,000	2,000	212,000
Masonry works	m^3	2,800	39,000	109,200
Gates and Metal Works				112,500
Miscellaneous				45,600
Sub-total				2,406,800
II. Contingencies (15%)				361,000
III. Engineering and Administration (10%)				276,800
Grand Total				3,044,600

Table 3 CONSTRUCTION COST OF BENG IRRIGATION PROJECT

Item	Unit	Quantity	Unit Cost	Amount ($\times 10^3$Rp)
I Main Works				
1. Head Works				
Excavation	m^3	3,000	2,400	7,200
Embankment	m^3	12,000	2,000	24,000
Masonry	m^3	3,500	39,000	136,500
Gate & Metal Works				71,000
Miscellaneous				23,900
2. Main Canal				
Excavation	m^3	77,000	1,600	123,200
Embankment	m^3	80,000	2,000	160,000
Concrete	m^3	900	150,000	135,000
Masonry	m^3	31,000	39,000	1,209,000
Gates & Metal Works				45,000
Miscellaneous				167,200
3. Inspection Road				
Embankment	m^3	43,500	2,000	87,000
Gravel metalling	m^3	13,000	16,000	208,000
Concrete	m^3	840	150,000	126,000
Masonry	m^3	1,040	39,000	40,600
Miscellaneous				46,200
4. Secondary Canal				
Excavation	m^3	17,000	1,600	27,200
Embankment	m^3	73,000	2,000	146,000
Wet masonry	m^3	11,800	39,000	460,200
Gate & Metal Works				65,000
Miscellaneous				69,800
5. Tertiaru Development				
Excavation	m^3	20,000	1,600	32,000
Embankment	m^3	150,000	2,000	300,000
Masonry	m^3	4,000	39,000	156,000
Gates & Metal Works				160,000
Miscellaneous				64,800
Sub-Total				4,090,800
II Contingencies (15%)				613,600
III Engineering & Administration (10%)				470,400
Grand-Total				5,174,800

Table 4 CONSTRUCTION COST OF COTTAN-LOSARI PROJECT

	Item	Unit	Quantity	Unit cost (Rp)	Amount ($\times 10^3$Rp)
I	Main Works				
1.	Pump Stations				
	Temporary Works				110,000
	Concreate	m^3	320	150,000	48,000
	Masonry	m^3	150	39,000	5,900
	Pump & Motor etc.				803,000
	Miscellaneous				145,000
2.	Main Canals				
	Excavation	m^3	39,000	1,600	62,400
	Embankment	m^3	53,000	2,000	106,000
	Masonry	m^3	29,900	39,000	1,166,100
	Gate & Metal Works				47,000
	Miscellaneous				138,200
3.	Secondary Canals				
	Excavation	m^3	9,000	1,600	14,400
	Embankment	m^3	36,000	2,000	72,000
	Masonry	m^3	5,800	39,000	226,200
	Gate & Metal Works				60,000
	Miscellaneous				37,300
4.	Tertiary Development				
	Excavation	m^3	23,000	1,600	36,800
	Embankment	m^3	180,000	2,000	360,000
	Masonry Works	m^3	4,900	39,000	191,100
	Gate & Metal Works				193,000
	Miscellaneous				78,100
5.	Drainage System				
	Excavation	m^3	220,000	1,600	352,000
	Masonry	m^3	1,700	39,000	66,300
	Gate & Metal Works				120,000
	Miscellaneous				53,800
	Sub total				4,492,600
II	Contingencies (15%)				673,900
III	Engineering & Administration (10%)				516,700
	Grand total				5,683,200

Table 5 CONSTRUCTION COST OF LESTI LEFT PROJECT

Item	Unit	Quantity	Unit cost (Rp)	Amount ($\times 10^3$Rp)
I. Main Works				
1. Pump Station & Delivery Pipe line				
Excavation	m^3	19,200	2,400	46,000
Backfill	m^3	8,200	1,700	13,900
Concrete	m^3	360	150,000	54,000
Masonry	m^3	2,600	39,000	101,400
Pump, Motor, Pipe	m^3			480,000
Miscellaneous				69,500
2. Main canal				
Excavation	m^3	73,000	1,600	116,800
Embankment	m^3	135,000	2,000	172,000
Masonry	m^3	23,600	39,000	920,400
Gate & Metal Works				163,000
Miscellaneous				148,000
3. Tertiary Development				
Excavation	m^3	40,900	1;600	65,400
Embankment	m^3	155,000	2,000	310,000
Masonry	m^3	8,200	39,000	320,000
Gate & Metal works				164,000
Miscellaneous				85,800
Sub-Total				3,330,200
II. Contingencies (15%)				499,500
III Engineering & Administration (10%)				382,900
Grand Total				4,212,600

Table 6 CONSTRUCTION COST OF WIDAS SOUTH PROJECT

Item	Unit	Quantity	Unit Cost	($\times 10^3$ Rp)
I. Main Works				
1. Head Works				
Excavation	m^3	6,500	2,000	15,600
Embankment	m^3	1,000	2,000	2,000
Masonry	m^3	1,600	39,000	62,400
Gates and Metal Works				86,400
Miscellaneous				16,600
2. Main Canal				
Excavation	m^3	51,000	1,600	81,600
Embankment	m^3	80,000	2,000	160,000
Concrete	m^3	270	150,000	40,500
Masonry	m^3	18,200	39,000	709,800
Gates and Metal Works		-	-	56,100
Miscellaneous				104,800
3. Inspection Road				
Embankment	m^3	9,900	2,000	19,800
Gravel metalling	m^3	3,000	1,600	48,000
Miscellaneous	m^3			6,800
4. Secondary Canals				
Excavation	m^3	37,000	1,600	59,200
Embankment	m^3	119,000	2,000	238,000
Masonry	m^3	35,800	39,000	1,396,200
Gates and Metal Works				170,400
Miscellaneous				186,400
5. Tertiary Development				
Excavation	m^3	25,000	1,600	40,000
Embankment	m^3	197,000	2,000	394,000
Masonry	m^3	5,300	39,000	206,700
Gates and Metal Works				209,000
Miscellaneous				85,000
Sub - Total				4,395,300
II. Contingencies (15%)				659,300
III. Engineering and Administration(10%)				505,500
Grand Total				5,560,100

Table 7 INCREASING AMOUNT OF WATER REQUIREMENT WITH PROJECT CONDITION

		Lesti Left			Gottan-Losari			Papr-Peterongan		
		P	F	D	P /1	F	D	P /2	F	D
	1	0	0.14	-0.14	0.50	2.89	-2.39	4.61	11.47	-6.86
June	2	0	0.21	-0.21	0.40	2.90	-2.50	9.17	16.14	-6.97
	3	0	1.10	-1.10	0.50	2.78	-2.28	9.17	14.35	-5.18
	1	0	1.43	-1.43	0.40	2.58	-2.18	8.92	11.23	-2.31
July	2	0	1.10	-1.10	0.50	1.94	-1.44	7.63	7.63	0
	3	0	1.60	-1.60	0.40	1.16	-0.76	6.37	4.38	1.99
	1	0	1.70	-1.70	0.40	1.05	-0.65	6.22	2.02	4.20
Aug.	2	0	1.17	-1.17	0.50	0.91	-0.41	4.77	0.85	3.92
	3	0	0.63	-0.63	0.40	1.01	-0.61	3.19	0.89	2.30
	1	0	0.26	-0.26	0.40	1.60	-1.20	2.71	1.12	1.59
Sep.	2	0	0.10	-0.10	0.40	2.17	-1.77	2.45	1.29	1.16
	3	0	0.14	-0.14	0.50	2.60	-2.10	2.03	1.46	0.57
	1	0	0.24	-0.24	0.40	3.13	-2.73	2.14	1.62	0.52
Oct.	2	0	0.07	-0.07	0.40	3.35	-2.95	2.24	2.03	0.21
	3	0	0.07	-0.07	0.30	3.32	-3.02	2.43	2.21	0.22
	1	0	0	0	0.40	2.69	-2.29	2.37	9.13	-6.76
Nov.	2	0	0.80	-0.80	0.60	2.19	-1.59	7.10	12.44	-5.34
	3	0	0	0	0.70	3.17	-2.47	2.27	15.79	-6.52
T o t a l				-7.82 ($6.9 \times 10^6 m^3$)			-33.34 ($29.4 \times 10^6 m^3$)			-22.69 ($19.9 \times 10^6 m^3$)

P : Present intake
F : Future requirement
D : Difference

/1 : Average of present intake discharge for recent three years (1981 - 1983)

/2 : Estimated from present cropping patterns of irrigation section Jombang and Kediri.

NOTE AI-16

DEVELOPMENT PRIORITY STUDY

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NOTE AI-16 Development Priority Study

1. General

The on-going projects taken up in this study are :

Wonorejo Dam and Irrigation Project
Tugu Dam and Irrigation Project
Waru-Turi Irrigation Project
    Warujayeng sub-project
    Turi-Tunggorono sub-project
Waru-Turi-Papar-Peterongan Project (Waru-Turi Barrage)

The Waru-Turi-Paparpeterongan Project is an extension project of the Waru-Turi Irrigation Project.

Lodoyo Irrigation Project is not taken up in this study, since the project works are almost completed.

East Java Irrigation Project (EJIP) and East Java Ground Water Development Project (EJGDP) are also not taken up. Because the EJIP is aggregation of small irrigation rehabilitation schemes which cover the most of existing irrigation area except Lodoyo, Waru-Turi and Brantas delta areas and consecutive works from investigation to construction are being executed in each of small schemes. These works will continue up to near the year 2000. The EJGDP is also the aggregation of small irrigation schemes scattering in the Basin and the concecutive works from investigation to construction is being executed in each of schemes and will continue up to near the year 2000.

The references used with regard to the on-going irrigation project are as follows.

Wonorejo Dam and Irrigation Project

Revised Project Evaluation Report prepared by Nippon Koei, Nov. 1984

Tugu Dam and Irrigation Project

Feasibility Study Report prepared by Nippon Koei, Oct. 1984

Waru-Turi Irrigation Project

Feasibility Study Report prepared by Binnie and Partners, Aug.1981

Waru-Turi-Papar-Peterongan (Zone A+B) Project

Waru-Turi Barrage Study by PT. INDAH KARYA/Binnie and Partners, April 1982.

2. Economic Analysis of On-going Project

The economic analysis of on-going project is made by updating the project benefit and cost as follows.

Benefit is updated by use of the forecasted 1990 price at 1984 constant price based on the IBRD Report 1982. Table 1 to 5 show the project benefit of each irrigation project updated.

Capital cost consists of local currency portion and foreign currency portion. The local currency portion is updated by multiplying the price index of public works in agricultural sector issued by the BIRO PUSAT STATISTIK. The foreign currency portion is converted by the exchange rate between Indonesian Rupiah and US dollar.

The Wonorejo Dam and Irrigation Project and the Tugu Dam and Irrigation Project have not only irrigation schemes but also other beneficiaries. Thus, the dam construction cost common to beneficiaries is allocated by the rate of irrigation benefit to the total, assuming that the cost is borne by respective beneficiaries. The construction costs allocated to the irrigation sector are employed as they are, since the costs were estimated in late 1984.

Supposed water exploitation cost is taken into account for the economic analysis of the Waru-Turi-Paparpeterongan (Zone A + B) Irrigation Project in much the same way as in the Gottan-Losari or the Lesti Left Irrigation Project since the project has no water exploitation cost. Nevertheless, the irrigation water requirement by the Papar-Petorongan sub-project is over the present water intake during the dry season from June to November. The estimated criteria are mentioned in Note AI-15. In the estimation, the increasing amount of irrigation water requirement is supposed to be the difference between the present water requirement and the future water requirement in the dry season from June to November since the no reliable intake discharge data are available. The present water requirement is estimated based on the average cropping patterns in the Irrigation sections, Jombang and Kediri on the assumption that the polowijo crop II is not irrigated in the same way as in the proposed cropping pattern. The increasing amount of water requirement is estimated at 19.9×10^6 m^3 in the dry season as shown in Table 7 of Note AI-15. Thus the supposed water exploitation cost is Rp. $15{,}030 \times 10^6$.

Updating construction cost of Waru-Turi and Waru-Turi-Papar Peterongan Project is schemed in Table 6.

The disbursement schedule and the benefit appearance are the same as the original. Table 7 shows the economic cashflow. The project life is 50 years which is the same as that of the future projects identified in this study.

The calculation results are summarized in Table 8 and the details are shown in Table 9 to 13.

All the on-going project are economically viable with EIRR in excess of 12%.

3. Development Priority

The development priority ranking is put on irrigation projects in accordance with the following criteria.

At first, the EIRR are examined and classified into two groups in the border EIRR of 12%. Then, the development stages of projects are examined and projects are ranked in the sequence of design stage, faesibility study stage and pre-feasibility study. Finally, the projects are ranked by the present cropping intensity of paddy plus sugarcane in the border of 130%, i.e., high priority is given to the project having the present cropping intensity less than 130%. The results of the development priority are as follows.

Name of Project	EIRR (%)	Stage	Cropping intensity	Priority
Waru-Turi Irrigation				
Turi-Tunggorono	27	D/D	≧ 130%	I
Warujayeng	25	D/D	≧ 130%	I
Waru-Turi-Paparpeterongan/1 (Zone A+B)	18	D/D(F/S)	≧ 130%	I
Wonorejo Dam and Irrigation	18	D/D	≧ 130%	I
Tugu Dam and Irrigation	12	F/S	< 130%	II
Beng Irrigation	23	Study	< 130%	III.1
Lesti-Left	18	Study	< 130%	III.2
Gottan-Losari	13	Study	< 130%	III.3
Widas Extension				
Kedungwarak dam scheme	11	Study	< 130%	IV.1
Semantok dam scheme	0.5	Study	< 130%	IV.2
Widas South Irrigation	4	Study	≧ 130%	IV.3

D/D : Detail Desaign Stage, F/S : Feasibility Study Stage

/1 : This project is an extension project of Waru-Turi Irrigation Project covering Papar-Peterongan sub-project in addition to Waru-Turi area. Papar-Peterongan area is under F/S stage and its cropping intensity is less than 130%.

Table 1 INCREMENTAL BENEFIT
(Wonorejo Dam & Irrigation Project)

Item	With Project Area (ha)	With Project Profit/ha (10^3 Rp)	With Project Total Profit (10^6 Rp)	Without Project Area (ha)	Without Project Profit/ha (10^3 Rp)	Without Project Total Profit (10^6 Rp)
1. Direct Benefit Area						
W.S.P	6,420	1,004	6,446	5,759	655	3,772
D.S.P	3,210	988	3,171	2,849	459	1,308
Maize	1,926	348	670	993	139	138
Soybeans	-	381	0	395	63	25
Peanuts	7,704	681	5,246	267	195	52
Sub-Total			15,533			5,295
2. Pump Irrigation Area						
W.S.P	1,120	1,004	1,124	1,000	655	655
D.S.P	560	988	553	495	459	227
Maize	336	348	117	172	139	24
Soybeans	-	381	0	68	63	4
Peanuts	1,344	681	915	47	195	9
Sub-Total			2,709			919
3. Indirect Benefit Area						
W.S.P	1,700	1,004	1,707	1,505	655	986
D.S.P	850	988	840	744	459	341
Maize	510	348	177	260	139	36
Soybeans	-	381	0	104	63	7
Peanuts	2,040	681	1,389	68	195	13
Sub-Total			4,113			1,383
Total			22,335			7,597
Incremental Benefit			14,758			

Table 2 INCREMENTAL BENEFIT
(Tugu Dam & Irrigation Project)

Item	With Project Area (ha)	With Project Profit/ha (10^3 Rp)	With Project Total Profit (10^6 Rp)	Without Project Area (ha)	Without Project Profit/ha (10^3 Rp)	Without Project Total Profit (10^6 Rp)
W.S.P	3,820	1,014	3,873	3,060	664	2,032
B.S.P	3,820	1,014	3,862	1,010	469	474
Maize	-	-	-	340	140	48
Soybeans	-	-	-	2,230	64	143
Peanuts	3,820	196	749	220	196	43
Total			8,484			2,740
Incremental Benefit			5,744			

Table 3 INCREMENTAL BENEFIT

(Turi-Tunggorono Irrigation Project)

Item	With Project (year 5)			With Project (year 12)			Without Project		
	Area (ha)	Profit/ha (10^3 Rp)	Total Profit (10^6 Rp)	Area (ha)	Profit/ha (10^3 Rp)	Total Profit (10^6 Rp)	Area (ha)	Profit/ha (10^3 Rp)	Total Profit (10^6 Rp)
W.S.P	8,617	926	7,979	8,617	998	8,600	8,617	868	7,480
D.S.P (I)	5,893	420	2,475	7,979	998	7,963	5,893	439	2,587
D.S.P (II)	270	348	94	-	-	0	270	348	94
Maize	78	92	7	2,886	171	494	78	87	7
Maize	2,320	74	172	-	-	0	2,320	74	172
Soybeans	1,653	189	312	3,768	258	972	1,653	182	301
Soybeans	2,979	133	396	-	-	0	2,979	133	396
Sugar-cane	1,250	1,509	1,886	1,250	1,509	1,886	1,250	1,445	1,806
Total			13,321			19,915			12,843
Incremental Benefit			478			7,072			

Table 4 INCREMENTAL BENEFIT

(Warujayeng Irrigation Project)

Item	With Project (year 3)			With Project (year 10)			Without Project		
	Area (ha)	Profit/ha (10^3 Rp)	Total Profit (10^6 Rp)	Area (ha)	Profit/ha (10^3 Rp)	Total Profit (10^6 Rp)	Area (ha)	Profit/ha (10^3 Rp)	Total Profit (10^6 Rp)
W.S.P	11,124	925	10,290	12,176	998	12,152	11,124	820	9,122
D.S.P (I)	5,526	560	2,984	11,613	998	11,590	5,526	452	2,498
D.S.P (II)	1,050	420	441	-	-	0	1,050	420	441
Maize	600	108	65	2,965	171	507	600	91	55
Maize	3,875	74	287	-	-	0	3,875	74	287
Soybeans	5,400	224	1,210	6,599	258	1,703	5,400	186	1,004
Soybeans	4,400	133	585	-	-	0	4,400	132	581
Sugar-cane	1,300	1,509	1,962	1,300	1,509	1,962	1,300	1,358	1,765
Total			17,824			27,914			15,753
Incremental Benefit			2,071			12,161			

Table 5 INCREMENTAL BENEFIT
(Papar-Peterongan)
(Zone A + B)

	Area (ha)	Profit/ha (10^3 Rp)	Total Profit (10^6 Rp)	Area (ha)	Profit/ha (10^3 Rp)	Total Profit (10^6 Rp)	Area (ha)	Profit/ha (10^3 Rp)	Total Profit (10^3 Rp)
	With Project (year 1)			With Project (year 5)			With Project (year 10)		
W.S.P	11,812	757	8,941	12,558	878	11,052	12,588	998	12,563
D.S.P	5,119	757	3,875	11,076	878	9,724	11,076	998	11,054
Maize	1,626	171	278	455	171	27	115	171	20
Soybeans	4,877	258	1,258	344	258	89	344	258	89
Total			14,352			20,892			23,726
	Without Project (year 1)			Without Project (year 5)			Without Project (year 10)		
W.S.P	11,812	757	8,941	12,588	878	11,052	12,588	998	12,563
D.S.P	3,619	757	2,740	3,850	878	3,336	3,981	998	3,973
Maize	1,626	171	278	1,888	171	323	5,666	171	969
Soybeans	4,877	285	1,258	5,666	258	1,461	1,888	258	487
Total			13,217			16,172			17,992
Incremental Benefit			1,135			4,720			5,734

Table 6 UPDATING ECONOMIC CONSTRUCTION COST
(On-going Projects)

Item	Waru-Turi		Waru-Turi-Papar-Peterongan (Zone A + B)
	Warujayeng	Turi-Tunggorono	
1. Original Construction Cost	17,425 (1981)	7,506 (1981)	45,996 (1981)
2. Foreign Currency Portion	57%	56%	53%
3. Exchange Rate (Rp/1US$)	625	625	625
4. Updating Cost Conversion Factor to 1984			
- Local Currency	1 394	1 394	1 394
- Foreign Currency	1 648	1 648	1 648
5. Construction Cost (1984)			
- Local Currency	10,445	4,604	30,136
- Foreign Currency	16,368	6,927	40,175
6. Supposed Water Exploitation Cost/2	-	-	15,020
Total	26,813	11,531	85,341

Note : /1; Foreign Currency Portion of Papar-Peterongan is assumed to be as well as Turi-Tunggorono.

/2; Supposed water exploitation cost is taken into account

Table 7 ECONOMIC CASH FLOW
(On-going Project)

(Unit: 10^6 Rp)

Project	1	2	3	4	5	6	7	8	9	10	11	12
1. Wonorejo												
- Capital Cost	3,907	10,155	16,029	18,217	12,830	1,783	-	-	-	-	-	-
- Recurrent Cost	-	-	-	63	63	164	264	264	264	264	264	264
- Irrigation Benefit (Pump)	-	-	-	1,432	1,610	1,790	1,790	1,790	1,790	1,790	1,790	1,790
- " (Gravity)	-	-	-	-	-	10,375	11,671	12,968	12,968	12,968	12,968	12,968
- Negative Benefit	-10	-10	-10	-10	-40	-40	-40	-40	-40	-40	-40	-40
2. Tugu												
- Capital Cost	7,764	6,834	5,967	11,879	8,549	-	-	-	-	-	-	-
- Recurrent Cost	-	-	-	-	-	172	172	172	172	172	172	172
- Irrigation Benefit	-	-	-	-	-	4,595	5,170	5,744	5,744	5,744	5,744	5,744
- Negative Benefit	-47	-47	-47	-47	-112	-112	-112	-112	-112	-112	-112	-112
3. Warujayeng												
- Capital Cost	3,016	11,679	10,264	1,847	-	-	-	-	-	-	-	-
- Recurrent Cost	31	46	138	431	523	523	523	523	523	523	523	523
- Irrigation Benefit	-	-	2,071	3,512	4,593	6,394	7,835	9,276	10,717	12,161	12,161	12,161
4. Turi-Tunggorono												
- Capital Cost	210	430	1,214	5,377	4,301	-	-	-	-	-	-	-
- Recurrent Cost	16	31	47	62	127	195	195	195	195	195	195	195
- Irrigation Benefit	-	-	-	-	478	1,420	2,362	3,304	4,246	5,188	6,130	7,072
5. Waru-Turi-Papar-Peterongan (Zone A+B)												
- Capital Cost	1,299	5,891	15,296	14,722	15,403	28,422 /1	2,636	1,673	-	-	-	-
- Recurrent Cost /2	-	-	-	-	-	-	761	829	897	964	1,035	1,075
- Irrigation Benefit /3	1,135	2,031	4,998	7,335	9,791	12,736	15,321	17,906	20,491	23,083	24,025	24,967

Note: /1; Supposed water exploitation cost is taken into account
/2; 1 % of supposed water exploitation cost is added.
/3; Waru-Turi + zone A + B

Table 8 ON-GOING PROJECT BENEFIT AND EIRR.

Unit	Wonorejo	Tugu	Waru-Turi		Waru-Turi Papar Peterongan (Zone A + B)
			Waru-jayeng	Turi-Tunggorono	
1. Irrigation Benefit x 10^6 Rp/Y	14,758	5,744	12,161	7,072	24,967
2. Negative Benefit x 10^6 Rp/Y	40	112	-	-	-
3. Capital Cost x 10^6 Rp	62,921	33,702	26,813	11,531	85,341 /1
4. Recurrent Cost x 10^6 Rp/Y	264	141	523	195	925
5. Construction Period.Year	6	5	4	5	8
6. B - C at DF= 12% x 10^6Rp	25,175	961	33,576	16,802	37,164
7. EIRR. %	18	12	25	27	18

/1 : Water cost, Rp 15,030 x 10^6 is included for Papar-Peterongan area

Table 9 BENEFIT-COST RATIO AND NET PROFIT OF WONOREJO DAM & IRRIGATION PROJECT

Discount Rate (%)	Present Worth Cost ($x10^6$ Rp)	Present Worth Benefit ($x10^6$ Rp)	N.P.V. ($x10^6$ Rp)	B/C
0	76199	734972	658773	9.65
2	66315	418169	351854	6.31
4	59651	259316	199665	4.35
6	54628	172934	118306	3.17
8	50551	122238	71687	2.42
10	47083	90401	43318	1.92
12	44049	69224	25175	1.57
14	41348	54457	13109	1.32
16	38916	43757	4841	1.12
18	36708	35762	-946	0.97
20	34692	29636	-5056	0.85
22	32845	24845	-8000	0.76
24	31145	21034	-10111	0.68
26	29576	17959	-11617	0.61
28	28125	15446	-12679	0.55
30	26779	13372	-13407	0.50

Table 10 BENEFIT-COST RATIO AND NET PROFIT OF TUGU DAM & IRRIGATION PROJECT

Discount Rate (%)	Present Worth Cost ($x10^6$ Rp)	Present Worth Benefit ($x10^6$ Rp)	N.P.V. ($x10^6$ Rp)	B/C
0	40753	279577	238824	6.86
2	35683	158494	122811	4.44
4	32309	97836	65527	3.03
6	29791	64896	35105	2.18
8	27758	45601	17843	1.64
10	26035	33511	7476	1.29
12	24530	25491	961	1.04
14	23189	19916	-3273	0.86
16	21981	15890	-6091	0.72
18	20883	12892	-7991	0.62
20	19878	10604	-9274	0.53
22	18955	8822	-10133	0.47
24	18104	7410	-10694	0.41
26	17316	6275	-11041	0.36
28	16586	5353	-11233	0.32
30	15907	4595	-11312	0.29

Table 11 BENEFIT-COST RATIO AND NET PROFIT OF WARUJAYENG IRRIGATION PROJECT

Discount Rate (%)	Present Worth Cost ($x10^6$ Rp)	Present Worth Benefit ($x10^6$ Rp)	N.P.V. ($x10^6$ Rp)	B/C
0	54125	604164	550039	11.16
2	41522	343243	301721	8.27
4	34629	212671	178042	6.14
6	30399	141849	111450	4.67
8	27516	100408	72892	3.65
10	25376	74464	49088	2.93
12	23681	57257	33576	2.42
14	22274	45288	23014	2.03
16	21067	36633	15566	1.74
18	20007	30174	10167	1.51
20	19061	25227	6166	1.32
22	18205	21357	3152	1.17
24	17424	18274	850	1.05
26	16706	15782	-924	0.94
28	16041	13741	-2300	0.86
30	15424	12050	-3374	0.78

Table 12 BENEFIT-COST RATIO AND NET PROFIT OF TURI-TUNGORONO IRRIGATION PROJECT

Discount Rate (%)	Present Worth Cost ($x10^6$ Rp)	Present Worth Benefit ($x10^6$ Rp)	N.P.V. ($x10^6$ Rp)	B/C
0	21822	334296	312474	15.32
2	16587	184709	168122	11.14
4	13590	110592	97002	8.14
6	11660	70951	59291	6.09
8	10286	48170	37884	4.68
10	9233	34214	24981	3.71
12	8382	25184	16802	3.00
14	7668	19068	11400	2.49
16	7055	14769	7714	2.09
18	6519	11654	5135	1.79
20	6045	9339	3294	1.54
22	5621	7582	1961	1.35
24	5240	6225	985	1.19
26	4896	5161	265	1.05
28	4583	4317	-266	0.94
30	4298	3639	-659	0.85

Table 13 BENEFIT-COST RATIO AND NET PROFIT OF WARU-TURI-PAPAR-PETERONGAN PROJECT

Discount Rate (%)	Present Worth		N.P.V. ($x10^6$ Rp)	B/C
	Cost ($x10^6$ Rp)	Benefit ($x10^6$ Rp)		
0	128038	1184123	1056085	9.25
2	101694	655890	554196	6.45
4	85665	394057	308392	4.6
6	74703	253911	179208	3.4
8	66503	173283	106780	2.61
10	59975	123807	63832	2.06
12	54560	91724	37164	1.68
14	49943	69941	19998	1.4
16	45935	54582	8647	1.19
18	42411	43411	1000	1.02
20	39284	35077	-4207	0.89
22	36490	28725	-7765	0.79
24	33979	23797	-10182	0.7
26	31713	19915	-11798	0.63
28	29659	16815	-12844	0.57
30	27792	14312	-13480	0.51

NOTE AI-17

CALCULATION OF IRRIGATION WATER REQUIREMENT

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NOTE AI-17 Calculation of Irrigation Water Requirement

1. Traditional Method

At present, the discharge diverted at a tertiary canal head is assessed by the traditional method. The actual cropping area of each crop is converted to the polowijo relative area by multiplying the cropping area by the following conversion factor.

Kind of crop	Conversion factor
Polowijo	1
Wet season paddy and authorized dry season paddy	
Nursery	20
Land preparation	6
Main field	4
Unlicenced dry season paddy	
All stages	1
Young sugarcane	1.5
Tobacco	1

Then, the water requirement at a tertiary canal head is calculated by multiplying the polowijo relative area by the factor known as the polowijo relative factor which is a duty of 0.15 to 0.25 ℓ/sec/ha. Based on the calculation a gate keeper controls the water diversion.

Table 1 shows the polowijo relative factor counted back from the intake discharge records at the tertiary canal heads and the cropping area. It can be said that the most of the area suffices the water in most of the seasons, however, the traditional method does not reflect upon the growing stage of the crops and the effective rainfall in the wet season, and also the polowijo relative factor of 0.15 to 0.25 ℓ/sec/ha is seemed to be small in comparison with the irrigation requirement estimated from the evapotranspiration and crop coefficient.

2. Calculation Method and Criteria of Irrigation Water Requirement

Following calculation method and criteria are employed to estimate the irrigation water requirement such as potential present water demand, the irrigation requirement for future irrigation projects and the future water demand of areas fed from the main Brantas river. The calculation results of irrigation requirement for future irrigation projects are compiled in NOTE AI-10 to 14.

(1) Unit Water Requirement

(a) Equation

Unit water requirement is calculated by the following equation :

$$I = CU + P + NR + L - ER$$

Where; I : unit water requirement
CU : crop consumptive use of water
P : percolation loss
NR : nursery requirement
L : puddling requirement
ER : effective rainfall

(b) Crop Consumptive Use of Water (CU)

CU is obtained as the products of potential evapo-transpiration (PET) and crop coefficient.

PET is calculated for each nine stations by the modified Penman method. Fig. 1 shows the Climatological Station. The basic data such as temperature, humidity, wind velocity and sunshine hours are tabulated in Table 2. The calculation results are tabulated in Table 3.

Crop coefficients of both traditional and high yielding varieties of paddy are derived from PROSIDA/NEDECO Study. Actually the average crop coefficients between the traditional and high yielding varities of paddy are used, because the traditional varieties still accounts for about 30% and the proportion is not expected to decrease in future owing to the attainment of the self-sufficiency of rice in near future and the shift from the quantity of the high yield variety to the quality of traditional variety.

Crop coefficients of polowijo and sugarcane are taken from the Irrigation and Drainage Paper No. 24, FAO. As for the water requirement calculation of polowijo, the average crop coefficients of soybeans, maize and groundnuts which prevail in the Brantas river basin ara adopted. Fig. 2 shows the crop coefficients.

The growing stages of the polowijo crops under the present condition can not be precisly estimated from the cropping data obtained from the Irrigation Service. Therefore the growing stage is not taken into account and the average crop coefficient of 0.64 is simply taken for the estimate of the water requirement.

(c) Percolation

The percolation rate in the puddled field was tested in the Nganjuk-Kediri area in 1971 and 1980 and also in the Blitar, Kediri and Mojokerto zone in 1983. The results are shown in Table 4. According to the test results, the avearge are :

2 mm/day in heavy soil
5 mm/day in medium soil
25 mm/day in light soil

Also,, the percolation rate adopted by on-going projects is examined.

The results are summarized in Table 5. They take 1 to 2 mm/day for heavy soil, 3 to 8 mm/day for medium soil and 10 to 13 mm/day for medium light soil.

The heavy soils extend over the flat alluvial plains and the medium soil area occupies some of the flat alluvial plains. The wet season paddy is cultivated on the heavy soil and some medium soil area and the dry season paddy is cultivated especially on the low-lying plain consisting of heavy soil.

Taking the above consideration into accounts, the percolation rates adopted by the on-going or studied projects are taken for these project areas and for other areas, 2mm/day or 3 mm/day are taken as percolation loss. Table 6 shows the percolation rate adopted on this Study.

(d) Nursery Requirement

The water requirement for nursery beds is uniformly estimated under the following assumptions, since the nursery requirement does not vary among the regions and the requirement is small compared with the requirement in main field.

Area required for nursery bed	: 5% of main field
Nursery period	: 30 days
Land preparation of nursery bed	: 150 mm
Percolation loss, 2 mm/day x 30 days	: 60 mm
Evapotranspiration	: 5 mm/day

Table 7 shows the nursery requirements to meet the transplanting periods to main field.

(e) Puddling Requirement

Paddy fields require the water for puddling and land preparation before transplanting young paddy. The water requirement is usually estimated by taking into account the soil vapor phase, soil moisture before puddling, evaporation and percolation during the time between puddling and transplanting. Since the water requirement of the puddling is not so much different between the on-going and studied projects, the puddling requirement is estimated to be 150 mm. The land preparation period between the puddling and the transplanting is assumed to be 10 days, and the water requirement during this 10 day-period is estimated as same manner as the estimate of the main field water requirement after transplanting on the assumption that the crop coefficient is1.0.

(f) Effective Rainfall

The basic year for estimating the water requirement is set at the drought year corresponding to that of 80% dependability the same as that adopted for on-going projects.

The effective rainfall is estimated on the following assumptions :

(i) Daily rainfall less than 5 mm is ineffective.
(ii) 80% of daily rainfall ranging 5 mm to 80 mm is effective.
(iii) Daily rainfall over 80 mm, 64 mm is effective.

The calculation results are tabulated in Table 8 on the annual basis.

The frequency of annula effective rainfall is estimated by the Gumbel method. The results are shown in Table 9.

According to the calculation of the frequency, the basic year for each rain gauge station is decided as shown in Table 10. Annual effective rainfall of the drought year of 80% dependability ranges from 896 mm to 1,194 mm. The upstream basin of the Brantas river is most abundant in the rainfall and the Tulungagung area is lowest. The basin from middle to lower reaches of the Brantas river is around 950 mm. The average annual effective rainfall on the Brantas river basin is 1,070 mm and the simple average of rain gauge stations is 989 mm. The difference is little between them. Thus the effective rainfall at each of the rain gauge station is used as a representative for the surrounding irrigation area for estimate of water requirement. Table 11 shows the effective rainfall for the basic year on 10-day basis.

Besides the effective rainfall in the basic year, average 10-day effective rainfalls in drought year of 80% dependability are calculated by allocating the annual effective rainfalls on 10-day basis according to the average distribution pattern of rainfall. These effective rainfall data are used to find the optimum planting calender from the view point of the water saving (See Table 12).

(2) Diversion Water Requirement

(a) Equation

The diversion water requirements are calculated by the following equation :

$$GI = A.\ I/Ei = A.\ I/Ec/Ea$$

Where, GI : diversion water requirement
A : irrigation area
I : unit water requirement
Ei : irrigation efficiency
Ec : conveyance efficiency
Ea : application efficiency

(b) Efficiency

The conveyance efficiency depends on the condition of canals and soil features on the canal routes. The application efficiency depends on the accuracy of discharge measurement and water distribution and,

water management on the field and is affected by the field soil texture. This study simply takes the irrigation efficiency of 0.64 for paddy cropping and 0.56 for polowijo cropping except Lodoyo area. The Lodoyo area is well-developed. The most of the irrigation canals are provided with lining and the canal density reaches around 80 m/ha. Thus, the irrigation efficiency is set at 0.70 for paddy and sugarcane and 0.64 for polowijo.

The irrigation efficiency will be gradually improved by rehabilitation and upgrading of irrigation facilities and introducing proper water management conducted by the Irrigation Service under the implementation of the Waru-Turi Irrigation Project and East Java Irrigation Project.

This study, for the future water demand calculation, takes the irrigation efficiency of 0.7 for paddy and sugarcane and 0.64 for polowijo which is the same as in the Lodoyo area on the assumption that the East Java Irrigation Project works and Waru-Turi Project works are to be completed by year 2000.

3. Potential Irrigation Water Requirement at Present Condition

Present cropping patterns in each of the area fed from the main Brantas river are illustrated in the series of Fig. 3. However, polowijo cropping pattern is not illustrated since the pattern cannot be clearly recognized from the cropping data "Keadaan Irigasi" obtained from Irrigation Service Surabaya. Thus, the water requirement of polowijo crops is estimated without consideration of its growing stages. The input data of cropping area are compiled in Data Book.

The calculation results of potential water requirement at present cropping condition in the areas fed from the main Brantas river are summarized in Table 13 and the breakdowns in the series of Table 14.

4. Future Irrigation Water Requirement

(1) Future Land Use

As already stated in, the Brantas river basin has been already reclaimed at the maximum possible extent from the view point of land resources. It may fairly be said that the reclamation in hilly and mountaneous areas should be prohibited to maintain these areas as water conservation and breeding area. While, the low alluvial plain is main active area in agriculture commerce, industry and settlement area of inhabitants. In future, it is forecasted to be more and more difficult to maintain the agricultural area because the commercial and industrial activities increase in the basin. The phenomenon has already revealed in the area adjacent to the Surabaya city such as the Wonokromo and Sidoarjo irrigation areas.

These irrigation areas decreased from 6,700 ha to 2,990 ha by 3,710 ha and from 33,300 ha to 31,600 ha by 1,700 ha during 15 years from 1970 to 1984, respectively. The respective annual decreasing rates reach upto 5.7% and 0.4%. According to the "Urban Development Planning Study on Gerbong - Kertosusilo Region" prepared by JICA, 1983,

the concentration of the population to the Surabaya region and the urbanization of the outskirts are forecasted to further accelerate in future. Accordingly, in the moderate estimate, at least, it is assumed that the both irrigation areas change into industrial, commercial or settlement areas with the rates of 5.7% per annum and 0.4% per annum. In these cases, the Wonokromo irrigation area will decrease by 1,820 ha then become 1,150 ha in 2000. The Sidoarjo irrigation area will decrease by 2,080 ha and become 29,520 ha in 2000.

(2) Cropping Pattern and Crop Intensity

The future cropping patterns principally following the present prevailing patterns, i.e., are shown by three basic patterns such as paddy - paddy - polowijo, paddy - polowijo - polowijo and sugarcane only.

As for the cropping intensities, except the areas of the Lodoyo and the Waru-Turi Irrigation Projects, the present planting acreages are adopted for paddy and sugarcane and the remaining areas are planned to be planted with polowijo crops taking the followings into account.

(a) It is expected to attain the self-sufficiency of rice in near future
(b) The GOI is planning to proceed further diversification of crop from rice
(c) Water demands will remarkably increase in future in the industrial and domestic sectors especially in Surabaya.
(d) Polowijo crops are superior to paddy in the water productivity

As for the Lodoyo and Waru-Turi projects' areas, the cropping intensities proposed by the Projects are taken for the estimate of the water demand, however, the transplanting period of paddy; one month and planting period of polowijo crops; one month proposed in the Waru-Turi Project are changed to two months, because present transplanting period prevailing in the area is two months or more.

Future cropping patterns of each irrigation areas fed from the main Brantas river and the Surabaya river are shown in the series of Fig. 4.

(3) Future Water Demand

(a) Calculation

The irrigation efficiency is set at 0.70 for paddy and 0.64 for polowijo crops on the assumption that the studied and on-going irrigation projects are completed and rehabilitation and upgrading of existing facilities together with the tertiary development are accomplished up to the year 2000 and then the level of the irrigation systems reaches to that of the Lodoyo Irrigation Project.

The calculation is made for three cases by slightly changing of the cropping calender to find the optimum cropping calender to save the irrigation water especially in the dry season from June to November inclusive.

This calculation is based on average effective rainfalls in the drought year of 80% dependability allocated on the 10-day basis in accordance with the average distribution pattern of effective rainfall.

The calculation results are compiled in Data Book.

(b) Optimum Cropping Calender to Save Water

Fig. 5 shows the relation between the starting period of wet season paddy cropping and the average water demand in the dry season calculated on the above. The optimum starting period in each area are summarized as follows.

Area	Optimum Starting Period of Wet Season Paddy
Molek	Middle to Late October
Lodoyo	
Warujayeng (Mrican)	Late to Early November
Turi-Tunggorono	Early November
Jatimlerek-Bunder	Early November
Jatikulon	Early November
Mangetan	Middle November to Early December
Porong	Middle November to Early December
Wonokromo	Middle November to Early December

Note: Besuk area is included in Warujayeng area

(c) Future Water Demand

Based on the optimum cropping calender, the irrigation water demand in the drought year corresponding to the frequency of 80% dependability are calculated for each irrigation area. The total water demand of the areas fed from the Brantas river and Surabaya river is shown below.

Unit : m^3/sec

Jun.	July	Aug	Sept.	Oct.	Nov.
71.2	45.8	30.1	39.4	45.0	45.6

Note: Water requirement of the Lesti left bank area is included.

The more details are shown in the series of Table 15.

Table 1 POLOWIJO RELATIVE FAKTOR OF AREA FED FROM K.BRANTAS

Unit : l/sec/ha.pol.

Year / Month	Ten-days	Intake Name: Molek	Lodoyo	Mrican	Besuk	Turi-Tunggo-rono	Bunder Jati-mlerek	Gottan Etc.	Jati-Kulon	Porong	Mangetan	Wonokromo
1982												
	1	0.46	-	0.30	0.25	0.27	0.21	0.23	0.10	0.31	0.38	0.29
Jan.	2	0.43	-	0.27	0.30	0.27	0.22	0.24	0.11	0.32	0.37	0.28
	3	0.44	-	0.30	0.25	0.29	0.20	0.28	0.11	0.34	0.36	0.28
	1	0.47	-	0.25	0.27	0.29	0.20	0.29	0.12	0.32	0.37	0.31
Feb.	2	0.47	-	0.28	0.27	0.29	0.20	0.28	0.11	0.32	0.38	0.27
	3	0.48	-	0.30	0.27	0.31	0.20	0.27	0.12	0.30	0.38	0.28
	1	0.48	-	0.11	0.30	0.33	0.23	0.28	0.13	0.34	0.41	0.26
Mar.	2	0.46	-	0.30	0.30	0.30	0.33	0.30	0.13	0.33	0.42	0.30
	3	0.41	-	0.23	0.30	0.36	0.30	0.30	0.23	0.34	0.40	0.29
	1	0.43	-	0.32	0.20	0.28	0.30	0.30	0.23	0.38	0.42	0.29
Apr.	2	0.43	-	0.23	0.29	0.24	0.30	0.30	0.23	0.29	0.41	0.22
	3	0.43	-	0.32	0.30	0.19	0.33	0.28	0.13	0.35	0.42	0.26
	1	0.40	-	0.25	0.17	0.25	0.29	0.27	0.09	0.38	0.48	0.29
May	2	0.42	-	0.22	0.17	0.22	0.31	0.33	0.09	0.35	0.45	0.29
	3	0.46	-	0.22	0.17	0.24	0.36	0.29	0.11	0.31	0.47	0.45
	1	0.48	-	0.22	0.15	0.23	0.29	0.27	0.11	0.27	0.46	0.44
Jun.	2	0.50	-	0.25	0.15	0.24	0.23	0.23	0.14	0.24	0.40	0.50
	3	0.52	-	0.22	0.08	0.22	0.25	0.23	0.17	0.25	0.39	0.49
	1	0.58	-	0.22	0.15	0.21	0.21	0.22	0.18	0.23	0.38	0.36
Jul.	2	0.57	-	0.25	0.15	0.21	0.35	0.28	0.18	0.22	0.29	0.39
	3	0.57	-	0.23	0.08	0.19	0.30	0.21	0.18	0.26	0.32	0.40
	1	0.58	-	0.27	0.26	0.26	0.37	0.19	0.12	0.19	0.34	0.36
Aug.	2	0.53	-	0.23	0.26	0.22	0.37	0.21	0.12	0.18	0.32	0.41
	3	0.59	-	0.25	0.25	0.28	0.27	0.19	0.12	0.23	0.35	0.49
	1	0.59	-	0.24	0.15	0.19	0.18	0.13	0.12	0.32	0.37	0.67
Sept.	2	0.67	-	0.26	0.26	0.20	0.18	0.13	0.20	0.24	0.38	0.57
	3	0.69	-	0.26	0.15	0.19	0.19	0.13	0.39	0.24	0.41	0.62
	1	0.64	-	0.20	0.11	-	0.16	0.11	0.39	0.26	0.40	0.61
Oct.	2	0.55	-	0.29	0.19	0.17	0.15	0.12	0.39	0.29	0.41	0.75
	3	0.56	-	0.10	0.15	0.18	0.15	0.12	0.39	0.30	0.37	0.83
	1	0.40	-	0.20	0.15	0.17	0.11	0.12	1.93	0.28	0.39	0.86
Nov.	2	0.43	-	0.07	0.10	0.19	0.16	0.11	1.93	0.25	0.38	0.49
	3	0.51	-	0.06	0.20	0.16	0.16	0.15	0.24	0.26	0.29	0.56
	1	0.55	-	0.17	0.15	0.15	0.16	0.15	0.14	0.22	0.25	0.71
Dec.	2	0.41	-	0.17	0.19	0.15	0.18	0.20	0.14	0.41	0.42	0.60
	3	0.47	-	0.17	0.19	0.20	0.23	0.14	0.12	0.41	0.45	0.40

Table : 2 CLIMATE

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec
(1) Malang												
Mean temperature (°C)	24.0	24.1	24.3	24.4	24.3	23.6	23.0	23.4	23.9	24.8	24.8	24.2
Mean relative humidity (%)	82.1	82.8	82.5	80.2	78.5	78.3	76.7	74.5	73.4	74.4	77.9	80.7
Sunshine hours (hrs)	3.8	4.2	4.4	4.7	5.8	6.4	6.4	6.6	6.1	5.0	5.2	4.4
Wind velocity (km/hr)	7.4	5.9	6.5	5.2	6.3	6.7	7.5	7.3	7.2	6.8	6.5	6.4
(2) Karangkates												
Mean temperature (°C)	26.7	26.5	26.5	27.6	26.2	25.6	24.9	25.5	26.0	26.8	27.3	26.4
Mean relative humidity (%)	85.6	84.7	84.8	83.8	83.0	81.3	79.4	78.3	77.9	79.5	82.6	85.5
Sunshine hours (hrs)	5.4	5.7	5.6	6.3	6.5	7.2	7.3	7.3	6.9	6.4	6.4	5.6
Wind velocity (km/hr)	5.5	3.3	3.4	3.5	3.9	5.4	7.4	7.6	8.2	7.1	5.1	4.2
(3) Wlingi												
Mean temperature (°C)	25.9	25.5	25.4	25.4	25.1	25.1	24.4	24.9	24.9	25.6	25.2	25.5
Mean relative humidity (%)	74.0	82.5	81.6	81.4	80.4	79.7	78.2	76.3	77.7	78.7	81.1	82.2
Sunshine hours (hrs)	4.4	4.3	4.2	4.9	5.8	6.4	5.7	6.3	5.6	5.4	4.5	4.8
Wind velocity (km/hr)	8.9	6.3	6.5	5.7	6.2	6.7	7.1	7.7	8.4	7.5	7.2	7.1
(4) Bendo												
Mean temperature (°C)	26.0	26.0	26.3	26.4	25.9	25.2	24.7	25.4	25.4	25.4	26.2	26.5
Mean relative humidity (%)	82.5	83.1	84.1	84.7	83.9	83.7	82.9	82.3	83.5	84.9	84.3	83.4
Sunshine hours (hrs)	4.3	4.6	4.9	6.9	6.1	6.1	6.4	6.4	6.6	6.9	4.8	4.6
Wind velocity (km/hr)	-	-	-	-	-	-	-	-	-	-	-	-
(5) Mrican												
Mean temperature (°C)	26.2	27.1	27.3	28.2	28.1	26.9	26.9	27.3	27.0	27.2	27.8	27.3
Mean relative humidity (%)	79.2	78.7	77.8	73.8	73.5	69.7	71.0	70.4	69.4	69.4	71.1	74.1
Sunshine hours (hrs)	7.6	4.2	4.7	6.2	5.7	6.3	7.0	7.6	7.6	6.2	5.8	5.1
Wind velocity (km/hr)	1.9	1.6	2.5	2.5	3.9	3.4	3.8	4.9	5.1	6.6	3.7	2.8
(6) Selorejo												
Mean temperature (°C)	22.8	23.0	23.4	24.4	23.5	23.2	22.5	22.7	23.2	24.0	24.0	23.7
Mean relative humidity (%)	83.5	83.4	81.7	80.5	78.4	75.5	76.2	75.2	74.2	76.1	77.9	79.5
Sunshine hours (hrs)	2.8	3.3	3.9	4.5	4.6	5.9	5.9	6.3	5.8	4.8	4.2	3.8
Wind velocity (km/hr)	1.3	2.3	1.2	1.8	2.6	2.3	2.9	3.8	3.7	3.6	2.9	1.9
(7) Bulakrejo												
Mean temperature (°C)	26.3	26.0	26.1	26.7	27.2	25.6	26.0	25.9	27.1	27.3	26.9	26.3
Mean relative humidity (%)	86.5	87.1	84.9	83.3	82.6	78.7	78.4	75.6	73.3	74.0	79.3	84.1
Sunshine hours (hrs)	4.4	5.2	5.3	6.3	6.2	7.0	7.4	7.3	7.3	7.0	5.8	5.0
Wind velocity (km/hr)	2.6	2.0	1.9	2.4	2.9	4.6	6.7	6.9	8.2	7.2	5.6	2.9
(8) Mojosgung												
Mean temperature (°C)	27.2	27.4	27.3	27.9	27.9	26.8	26.9	28.6	27.9	27.5	27.7	27.3
Mean relative humidity (%)	83.2	83.6	85.5	83.5	83.9	80.9	79.8	77.3	77.0	74.4	78.0	83.1
Sunshine hours (hrs)	4.1	4.8	5.0	5.7	5.3	5.7	6.3	6.7	6.8	6.1	5.3	4.6
Wind velocity (km/hr)	-	-	-	-	-	-	-	-	-	-	-	-
(9) Porong												
Mean Temperature (°C)	25.4	25.7	26.1	26.9	26.4	26.6	26.2	25.9	26.6	27.9	28.4	27.2
Mean relative humidity (%)	76.6	79.6	79.4	78.0	79.1	78.8	79.6	79.8	77.4	79.4	77.2	77.7
Sunshine hours (hrs)	4.6	4.8	5.9	5.4	6.6	7.0	6.7	6.3	6.8	7.2	6.8	5.2
Wind velocity (m/sec)	2.5	2.3	1.8	1.9	2.0	2.4	2.5	3.0	3.3	3.0	2.0	2.4

Note: Sunshine hours from 8:00 to 16:00

Table 3 POTENTIAL EVAPOTRANSPIRATION

Name of Station	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec
Malang	4.4	4.4	4.3	4.1	4.1	3.9	4.0	4.5	4.8	4.8	4.8	4.3
Karangkates	5.2	5.2	4.9	4.8	4.2	4.1	4.3	4.8	5.2	5.4	5.4	4.8
Wlingi	4.8	4.6	4.4	4.2	4.1	4.0	3.9	4.5	4.7	4.8	4.5	4.6
Bendo	4.7	4.6	4.5	4.7	4.0	3.7	3.8	4.2	4.7	5.2	4.5	4.5
Mrican	4.8	4.6	4.6	4.9	4.4	4.2	4.4	5.1	5.8	5.8	5.5	5.0
Selorejo	3.6	3.8	3.9	3.8	3.5	3.6	3.6	4.1	4.4	4.4	4.2	3.9
Bulakmojo	4.5	4.7	4.6	4.6	4.2	4.1	4.5	4.9	5.8	5.7	5.2	4.7
Mojoagung	4.6	4.8	4.5	4.5	3.9	3.7	4.1	4.8	5.3	5.4	5.0	4.5
Porong	4.7	4.6	4.8	4.4	4.2	4.1	4.0	4.2	4.9	5.6	5.6	4.8

Table 4. COMPARATIVE PERCOLATION RATE ON PUDDLED FIELD

Unit: mm/day

Soil	Kediri 3A 1980	Nganjuk-Kediri Study 1971	EJGDP 1983
Very light	40.9	10.0	-
Light	15.0	7.5	8.8 - 19.0
Medium	8.5	2.5	0.9 - 4.7
Heavy	2.8	0	1.7 - 3.3

Table 5 PERCOLATION RATE ADOPTED BY ON-GOING PROJECT

Name of Project	District	Soil Type	Area (%)	Percolation Rate (mm/day)
Lodoyo	Tulungagung/Blitar	Class 1	37	1
		" 2	10	2
		" 3	30	5
		" 4	23	10
Waru-Turi	Warujayeng	Heavy	75	2
		Medium	25	8
	Turi-Tunggorono	Heavy	85	2
		Medium	15	8
Wonorejo	Tulungagung	Heavy	100	1 for wet season 2 for dry season

AI - 74, 75, 76, AI - 93

Table 6 PERCOLATION RATE ADOPTED ON THIS STUDY

District	Percolation Rate (mm/day)	Remarks
Lodoyo	4.4 for WSP 2.6 for DSP	All the areas are planted with paddy Class 1 to 3 areas are planted with paddy.
Warujayeng	3.5	8 x 0.25 + 2 x 0.75 = 3.5
Turi-Tunggorono	2.9	8 x 0.15 + 2 x 0.85 = 2.9
Tulungagung Wonorejo	1.0 for WSP 2.0 for DSP	
Brantas Delta	2.0	
Other paddy field	3.0	Assuming that most of paddy fields are located at heavy soil area and partially at medium soil area.

Table 7 NURSERY REQUIREMENT OF PADDY

Unit: (mm/10 days *0.05)

10 - Day	Transplanting Period (days)								
	30	40	50	60	70	80	90	100	110
1	3.1	2.3	1.9	1.5	1.3	1.2	1.0	0.9	0.8
2	4.3	3.2	2.6	2.1	1.8	1.6	1.4	1.3	1.2
3	5.4	4.1	3.3	2.7	2.3	2.0	1.8	1.6	1.5
4	2.9	4.5	3.6	3.0	2.6	2.3	2.0	1.8	1.6
5	1.8	2.2	3.6	3.0	2.6	2.3	2.0	1.8	1.6
6	0.6	1.3	1.8	3.0	2.6	2.3	2.0	1.8	1.6
7		0.4	1.1	1.5	2.6	2.3	2.0	1.8	1.6
8			0.4	0.9	1.3	2.3	2.0	1.8	1.6
9				0.3	0.8	1.1	2.0	1.8	1.6
10					0.3	0.7	1.0	1.8	1.6
11						0.2	0.6	0.9	1.6
12							0.2	0.5	0.8
13								0.2	0.5
14									0.2

Table 8 ANNUAL EFFECTIVE RAINFALL

Unit : mm

YEAR	Name of Rainf. Station	MALANG (Kayutangan)	KEPANJEN (Kepanjen)	BLITAR (Lodoyo)	T. AGUNG (Kant.Sekai)	KEDIRI (Kediri)	PARE (Kant.Sekai)	NGANJUK (Nganjuk)	JOMBANG (Jombang)	MOJOKERTO (Kant. Sekai)	SURABAYA (Perak)
1950		1,742	-	751	-	-	-	762	-	-	-
1951		1,646	973	832	984	-	-	908	-	-	-
1952		2,083	1,268	1,522	1,573	-	-	1,185	-	1,382	-
1953		1,359	1,140	881	909	-	-	1,172	-	1,431	-
1954		1,992	2,373	1,271	1,642	-	-	1,516	-	1,316	-
1955		1,449	2,078	2,192	1,680	1,617	-	1,408	-	1,536	1,286
1956		1,341	1,602	1,630	1,106	1,314	-	1,055	-	977	986
1957		1,119	1,588	1,070	1,054	1,498	-	990	-	1,411	1,138
1958		1,508	1,817	1,209	1,160	1,211	-	1,538	-	1,769	1,134
1959		1,541	2,025	1,290	1,425	1,675	-	1,937	1,538	1,844	1,324
1960		1,348	1,618	1,522	1,241	1,533	-	1,273	1,116	1,555	1,047
1961		1,222	1,266	918	802	1,034	-	1,109	678	986	867
1962		1,844	1,754	1,184	1,524	1,207	1,428	1,122	1,292	1,220	1,059
1963		1,008	1,140	1,359	832	1,210	1,172	1,048	1,137	1,298	818
1964		1,503	1,553	1,330	1,456	1,406	1,255	1,337	1,428	1,215	1,216
1965		1,079	1,393	1,021	728	701	950	517	1,001	950	1,000
1966		1,276	1,572	1,650	1,162	1,289	1,272	1,042	968	1,476	1,158
1967		1,469	1,079	836	384	910	1,059	1,210	1,068	878	928
1968		1,442	2,033	1,318	1,579	1,402	1,777	1,175	1,585	1,503	1,564
1969		1,305	1,238	1,358	1,020	-	1,071	745	934	706	1,104
1970		868	1,174	1,570	1,155	452	1,288	1,154	1,091	1,235	1,246
1971		1,714	1,386	1,663	1,131	1,429	1,982	1,141	948	2,010	635
1972		853	888	1,191	870	981	1,924	844	970	1,139	1,125
1973		1,593	2,250	1,807	1,670	1,362	1,582	1,324	1,539	1,775	-
1974		913	1,755	1,304	1,180	424	1,306	1,428	1,219	1,192	1,114
1975		1,438	2,264	1,774	1,558	1,742	1,336	1,588	1,858	1,809	1,300
1976		859	1,221	930	553	939	1,070	1,005	979	840	-
1977		1,382	1,149	923	894	1,032	968	770	1,482	932	1,043
1978		1,428	2,121	1,896	1,660	1,517	1,254	1,355	1,259	800	1,603
1979		1,512	1,539	1,237	1,235	1,396	1,153	1,057	790	1,238	-
1980		1,490	1,565	1,065	896	1,415	1,290	1,396	1,243	324 *	1,155
1981		1,694	1,681	1,095	1,178	2,085	1,450	1,231	1,069	507	1,273
1982		1,105	1,022	759	828	1,158	935	722	263 *	1,292	-
1983		1,732	2,071	1,260	1,362	1,486	1,301	1,510	1,460	1,422	-

* : These figures are excluded in the calculation of probable rainfall.

Table 9 FREQUENCY OF ANNUAL EFFECTIVE RAINFALL

Unit : mm

Return Period	MAlang (Kayutangan)	Kepanjen (Kepanjen)	Blitar (Lodoyo)	T.Agung (K.Sekat)	Kediri (kediri)	Nganjuk (Nganjuk)	Pare (K.Sekat)	Jombang (Jombang)	Mojokerto (K.Sekat)	Surabaya (Perak)	Brantas basin
2	1,357	1,501	1,230	1,130	1,210	1,120	1,231	1,155	1,225	1,099	1,246
3	1,231	1,333	1,088	1,002	1,059	1,001	1,122	1,036	1,079	1,010	1,149
4	1,167	1,248	1,017	938	983	941	1,066	976	1,005	965	1,101
5	1,126	1,194	971	896	934	903	1,031	937	958	936	1,070
6	1,069	1,155	938	866	899	876	1,005	910	924	915	1,048
7	1,073	1,125	913	843	872	854	986	888	898	899	1,031
8	1,055	1,101	892	825	850	837	970	871	877	887	1,018
9	1,040	1,081	875	810	832	823	957	857	859	876	1,006
10	1,027	1,063	861	797	816	811	945	845	844	867	997
11	1,016	1,049	849	785	803	801	936	835	831	859	988
12	1,006	1,036	838	776	791	792	927	825	820	852	981
13	998	1,024	828	767	781	783	920	817	810	846	974
14	990	1,014	819	759	772	776	913	810	801	841	968
15	983	1,004	811	752	763	769	907	803	793	836	963
16	976	996	804	745	756	763	901	797	785	831	958
17	970	988	797	739	748	758	896	791	779	827	954
18	965	981	791	734	742	753	891	786	772	823	950
19	960	974	786	728	736	748	887	782	766	819	946
20	955	968	780	724	730	744	883	777	761	816	942

Table 10 ANNUAL EFFECTIVE RAINFALL

IN 80% DEPENDABILITY

Name of Station	Annual effective Rainfall	Corresponding Year
	mm	
Malang (Kayutangan)	1,126	1957
Kepanjen (Kepanjen)	1,194	1970
Blitar (Lodoyo)	971	1976
Tulungagung (Kantor Seksi)	896	1980
Kediri (Kediri)	934	1976
Nganjuk (Nganjuk)	903	1951
Pare (Kantor Seksi)	1,031	1972
Jombang (Jombang)	937	1969
Mojokerto (Kantor Seksi)	958	1965
Surabaya (Perak)	936	1967
Average	989	-
Brantas Basin	1,070	1977

Table 11 10-DAY EFFECTIVE RAINFALL IN DROUGHT YEAR CORRESPONDING TO 80% DEPENDABILITY

Unit : mm

Month	10-day	Malang 1957	Kepanjen 1970	Blitar 1976	T.Agung 1980	Kediri 1976	Nganjuk 1951	Pare 1972	Jombang 1969	Mojokerto 1965	Surabaya 1967
Jan.	1	0	109	58	20	113	80	154	0	83	194
	2	30	65	179	75	90	38	38	0	62	64
	3	94	124	60	75	54	126	9	0	220	40
Feb.	1	36	109	61	69	30	102	103	0	174	94
	2	0	60	0	45	49	99	39	262	16	76
	3	91	8	0	23	66	43	10	74	6	21
Mar.	1	228	8	134	58	145	64	101	44	64	49
	2	66	36	68	14	65	18	31	108	131	55
	3	58	24	70	48	45	0	77	106	37	20
Apr.	1	65	24	32	26	14	8	72	27	0	0
	2	27	0	0	23	6	0	45	0	0	26
	3	6	52	0	11	34	49	27	0	0	16
May.	1	24	19	0	0	10	0	62	0	0	0
	2	0	47	0	0	0	6	48	0	0	23
	3	23	15	0	0	0	0	0	0	0	0
June	1	0	13	0	0	0	60	0	20	0	0
	2	0	16	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	16	0	0	0	0
July	1	0	0	0	0	0	0	0	0	0	0
	2	48	12	0	0	0	0	0	0	0	0
	3	47	0	0	0	0	0	0	0	0	0
Aug.	1	18	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0
	3	0	0	9	0	0	0	0	0	0	0
Sept.	1	8	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0
Oct.	1	0	4	13	0	0	0	0	0	0	0
	2	0	28	6	8	0	0	5	0	0	0
	3	0	31	9	10	91	0	0	0	0	50
Nov.	1	0	47	10	0	0	0	0	0	0	10
	2	32	18	99	19	30	0	6	0	0	34
	3	28	54	100	214	69	29	22	9	7	7
Dec.	1	26	56	0	71	22	29	8	47	0	26
	2	150	80	12	25	9	66	77	180	90	91
	3	14	112	11	62	0	77	91	64	55	33
Total		1,119	1,174	930	895	939	908	1,024	934	950	928

Table 12 AVERAGE 10-DAY EFFECTIVE RAINFALL IN DROUGHT YEAR OF 80% DEPENDABILITY

Unit : mm

Month	10-day	Malang	Kepanjen	Blitar	T.Agung	Kediri	Nganjuk	Pare	Jombang	Mojokerto	Surabaya
Jan.	1	68	67	62	49	69	45	62	58	61	69
	2	70	43	51	42	51	44	67	44	62	54
	3	54	60	62	56	49	44	58	54	67	61
Feb.	1	57	60	59	53	56	51	75	66	71	68
	2	57	62	54	54	50	49	63	79	59	53
	3	52	35	43	37	39	47	40	46	45	44
Mar.	1	57	49	47	52	60	47	67	54	61	52
	2	47	58	45	44	46	50	53	48	53	44
	3	58	68	51	45	53	46	49	58	63	39
Apr.	1	42	46	37	43	37	35	45	41	33	39
	2	29	32	18	23	33	31	34	29	31	26
	3	26	35	18	21	31	30	27	26	24	26
May	1	26	33	25	30	33	36	30	23	21	22
	2	18	29	15	17	19	22	20	13	19	22
	3	21	27	20	24	25	16	23	16	16	21
Jun.	1	16	16	10	18	10	12	15	9	10	11
	2	8	9	12	10	7	5	2	5	4	10
	3	13	9	7	8	7	6	14	3	3	6
Jul.	1	12	12	8	7	6	6	5	7	5	7
	2	5	12	7	13	7	3	4	6	4	9
	3	6	9	5	5	8	5	5	3	4	4
Aug.	1	3	4	2	3	3	4	3	5	1	5
	2	3	3	3	3	3	2	1	2	2	3
	3	3	5	3	4	4	1	2	2	1	3
Sept.	1	5	7	3	2	2	1	9	4	1	3
	2	8	6	3	7	4	2	10	3	3	3
	3	6	6	5	3	4	1	5	4	2	3
Oct.	1	12	13	16	9	7	7	9	9	7	8
	2	14	16	12	6	5	5	7	7	5	4
	3	24	32	24	21	17	17	23	8	9	10
Nov.	1	36	42	30	20	16	25	19	12	19	21
	2	43	39	27	24	21	18	33	21	20	20
	3	51	58	34	24	27	39	30	32	25	28
Dec.	1	57	61	44	38	39	45	42	44	37	36
	2	60	66	50	43	40	47	36	52	64	49
	3	60	66	59	39	46	58	43	44	47	55
Total		1.127	1,195	971	897	934	903	1.030	937	959	938

Table 13 PRESENT WATER DEMAND OF AREAS FED FROM THE K. BRANTAS

YEAR		Intake Name										
MONTH		Molek	Lodoyo	Mrican	Besuk	Turi Tunggo-rono	Bunder Jati-Mlerek	Cottan Lossi	Jati-Kulon	Wono-kromo	Porong	Mangetan	TOTAL
1981													
	1	1.92	7.72	9.01	(0.07)	(3.35)	(0.22)	2.10	0.81	(1.90)	6.39	11.52	44.36
Nov.	2	3.42	3.33	8.55	(0.09)	(2.85)	(0.24)	1.93	0.52	(1.07)	8.41	8.06	38.47
	3	2.25	3.33	6.51	(0.12)	(2.51)	(0.26)	1.42	0.65	(1.14)	10.93	14.62	43.74
	1	1.09	13.23	11.41	(0.38)	(0.24)	(0.70)	2.53	0.81	(0.48)	10.73	10.24	51.84
Dec.	2	0.18	13.22	16.15	(0.33)	(3.16)	(0.65)	1.04	0.35	(0)	3.52	3.65	42.25
	3	0	14.41	19.99	(0.44)	(3.66)	(0.80)	1.43	0.64	(0.08)	5.81	12.17	59.38
1982	1	0.08	5.35	4.92	0.58	13.66	1.87	4.08	0.01	1.00	3.33	3.65	35.53
Jan	2	2.01	0	0.63	0.59	15.59	1.46	1.62	0.27	1.37	5.01	5.74	34.29
	3	1.10	6.17	8.84	0.61	13.30	1.50	1.17	0	2.63	0.04	12.84	48.2
	1	1.11	5.13	12.64	0.64	13.97	1.59	1.07	0	0.92	0	0.04	37.11
Feb.	2	2.05	14.21	8.69	0	0	0	4.72	0.86	0.03	11.15	0.24	15.82
	3	4.68	12.93	3.99	0	0	0.01	4.55	0.93	2.71	12.76	12.41	54.77
	1	4.49	2.02	0.29	0.29	6.00	0.70	1.50	0.21	1.68	2.20	5.83	24.76
Mar	2	1.89	4.01	4.03	0	0.20	0	0	0	1.34	0.14	4.21	35.82
	3	2.56	3.81	11.47	0.02	0.24	0	2.52	0.27	3.06	5.30	12.94	42.19
	1	2.45	7.25	16.21	0.22	8.90	0.62	4.02	0.27	3.29	10.88	16.61	70.72
Apr	2	3.62	8.16	17.39	0.51	11.96	0.67	3.48	0.12	1.88	10.26	10.28	68.33
	3	2.11	8.26	10.46	0.57	11.74	0.93	3.11	0.05	2.12	9.80	11.83	60.98
	1	3.59	6.93	10.67	0.69	10.69	1.12	2.67	0.53	2.21	9.23	14.20	62.53
May	2	2.10	7.28	12.75	0.81	11.25	1.35	2.28	0.71	1.31	9.16	8.99	57.99
	3	2.76	7.61	13.00	0.94	9.00	1.60	1.85	0.87	1.53	10.47	13.29	62.95
	1	2.34	7.81	12.76	0.54	5.92	0.79	1.45	0.94	1.23	8.67	13.52	55.97
Jun	2	1.80	7.83	12.76	0.76	9.03	1.16	1.18	0.72	0.97	8.78	14.65	59.64
	3	2.25	7.78	12.64	0.78	9.19	1.19	1.23	0.73	0.93	8.86	15.57	61.15
	1	2.31	7.07	12.34	0.83	9.82	1.29	1.41	0.80	1.05	8.81	15.45	61.08
Jul	2	1.84	6.13	12.40	0.83	9.73	1.30	1.38	0.82	1.91	8.73	15.48	60.55
	3	2.51	5.22	11.12	0.82	8.63	1.28	1.21	0.80	2.25	7.63	13.56	55.03
	1	3.37	4.90	11.73	0.76	7.83	1.40	1.55	0.94	2.45	7.30	11.95	54.18
Aug	2	3.44	4.23	9.30	0.60	6.39	1.23	1.60	0.93	2.68	6.44	11.10	47.94
	3	3.45	2.70	8.53	0.42	5.17	0.92	1.61	0.91	2.89	5.84	10.17	42.41
	1	2.71	3.73	9.98	0.30	4.44	0.67	1.82	0.82	2.65	5.66	10.69	43.47
Sept	2	2.64	4.04	9.99	0.13	3.84	0.41	1.86	0.58	2.36	4.91	9.87	40.83
	3	2.78	4.40	9.91	0.06	4.12	0.31	1.93	0.36	2.47	4.77	9.09	40.20
	1	2.72	2.89	9.86	0.07	4.47	0.40	2.06	0.16	2.61	5.96	9.42	40.62
Oct	2	1.26	3.98	9.46	0.07	4.16	0.35	2.05	0.07	2.48	6.00	8.16	38.04
	3	2.45	3.60	0.42	0.07	3.91	0.29	2.04	0.08	1.14	2.81	0.35	17.16
	1	2.15	3.26	7.73	0.07	3.35	0.22	1.87	0.08	1.90	5.17	5.79	31.59
Nov	2	3.74	0.22	2.35	0.09	2.85	0.24	1.75	0.10	1.07	3.23	1.88	17.52
	3	2.20	2.81	0.45	0.12	2.51	0.26	1.34	0.10	1.14	4.94	6.23	22.10
	1	2.00	8.26	7.41	0.38	0.24	0.70	1.37	0.56	0.48	3.34	2.47	27.21
Dec	2	1.20	7.98	11.21	0.33	3.16	0.65	0.09	0.40	0	0.41	5.48	30.91
	3	1.19	9.27	14.30	0.44	3.66	0.80	1.22	0.54	0.08	5.63	9.32	46.45
1983	1	1.14	5.83	5.06	-	8.48	-	1.16	0.37	1.00	5.35	5.55	33.94
Jan	2	2.16	2.69	4.79	-	10.08	-	1.42	0.19	1.13	5.90	6.31	34.67
	3	0.01	7.67	11.67	-	11.70	-	1.15	0	1.93	5.03	11.89	51.05
	1	0	4.72	11.70	-	13.57	-	1.10	0	1.00	4.95	5.24	42.28
Feb	2	1.63	14.35	8.03	-	2.96	-	4.41	0.77	0.95	11.06	5.13	49.29
	3	4.93	14.58	3.85	-	0.05	-	4.20	0.86	3.07	13.16	13.52	58.22
	1	4.75	0	0.16	-	5.72	-	0.89	0.23	1.42	2.77	7.39	23.33
Mar	2	2.61	4.01	4.75	-	0	-	0	0	1.18	0	6.16	18.71
	3	3.72	4.14	10.54	-	0	-	2.49	0.43	2.96	8.66	17.39	50.33
	1	3.23	8.65	16.65	-	8.00	-	4.27	0.54	3.57	14.56	21.43	80.9
Apr	2	4.15	12.54	17.72	-	10.65	-	3.93	0.37	2.18	12.87	12.05	76.46
	3	0.94	11.76	11.91	-	12.70	-	3.36	0.19	2.27	10.38	12.88	66.39
	1	1.90	10.87	13.86	-	11.62	-	2.72	0.70	2.35	7.69	13.86	65.57
May	2	0.79	10.17	16.21	-	11.54	-	2.37	0.90	1.73	6.42	9.29	59.45
	3	2.49	9.41	14.49	-	11.40	-	2.03	1.12	2.08	7.21	14.01	64.24
	1	2.63	9.47	14.23	-	8.36	-	1.74	0.73	1.79	7.38	13.04	59.37
Jun	2	2.92	8.29	14.32	-	8.56	-	1.59	0.74	1.55	8.66	12.52	59.15
	3	3.28	8.70	14.23	-	8.87	-	1.57	0.77	1.34	9.88	13.09	61.73
	1	3.54	8.64	13.68	-	9.81	-	1.74	0.84	1.32	9.96	14.85	64.38
Jul	2	3.02	8.77	12.35	-	9.80	-	1.68	0.85	1.67	8.57	13.94	64.65
	3	3.79	8.89	11.86	-	9.68	-	1.44	0.81	1.95	8.36	14.86	64.86
	1	3.99	9.40	12.03	-	10.59	-	1.84	0.95	2.31	9.51	14.44	65.06
Aug	2	3.84	8.48	10.83	-	9.72	-	1.86	0.94	2.51	9.73	14.79	62.7
	3	3.53	6.30	9.07	-	8.20	-	1.83	0.89	2.72	9.84	15.53	57.91
	1	3.74	6.95	9.95	-	7.32	-	2	0.78	2.77	10.88	17.30	61.69
Sep	2	3.73	6.18	9.88	-	6.03	-	1.94	0.48	2.66	10.31	16.42	57.63
	3	3.49	5.45	9.82	-	4.96	-	1.89	0.20	2.39	9.32	14.79	52.31
	1	2.77	3.07	9.70	-	4.74	-	1.88	0.06	2.39	9.36	14.81	48.78
Oct	2	1.05	3.61	8.93	-	4.54	-	1.89	0.07	2.14	7.74	12.68	42.65
	3	0.81	3.29	0.44	-	4.37	-	1.92	0.07	0.89	2.99	2.06	16.84

Note: Figures of parenthesis are taken from the water requirement of 1982.