6 River Maintenance Flow

(1) Composition of River Maintenance Flow

The Brantas river basin is supporting not only the supply of domestic uses including drinking water, agriculture, plantation, fishery and industry but also hydropower and so on. This utilization of water resources is stipulated on the Governor Decree of East Java Province No.316, 1988, in accordance with general order of importance.

In addition to the authorized water utilization, various beneficial uses of river water peculiar to the river itself and their future potential, such as water quality conservation, recreation and ablution, aesthetic uses (landscape), preservation of biota, inland navigation and so on, should be taken into consideration.

At present, the beneficial uses above mentioned are relatively limited in scope due to a poor water quality and quantity in the rivers during the dry season. Therefore, the river maintenance flow is herein defined as the minimum water flow, which shall satisfy concurrently following compositions for beneficial uses during the dry season :

- Water quality : Assimilative capacity of the rivers
- Recreation and ablution : Water depth for dabbling, boating, etc.
- Aesthetics : Water surface in the rivers
- Preservation of biota : Water depth for aquatic life in the rivers
- Navigation : Water depth for ferryboats

The reasons why the above compositions of the river maintenance flow are selected are summarized bellow :

(a) Water quality

The water quality during the dry season, the rivers are being deteriorated mainly due to the low flow conditions combined with the high pollution loads from domestic and industrial waste water. In order to reach the target level set above, it is necessary to increase the receiving stream's assimilative capacity by means of the river maintenance flow.

(b) Recreation and ablution

Recreational uses such as boating, swimming and/or dabbling in water, recreational fishing and/or fish capture are relatively limited in scope due to a poor water quality and quantity during the dry season. There are a few recreational activities in the rivers, such as yearly festivities that take place on the Surabaya river, near the Gunungsari barrage, boat regatta along the river banks in Mojokerto city. In addition, an ablution can be seen in and around various reaches in the Brantas river basin. Therefore, useful water depth for the recreations and ablution is required.

(c) Aesthetics

Little aesthetic use has been made of the river water in the past. However, the Mas river improvement project which was carried out currently at the expense of PJT and Surabaya municipality constructed a green belt, parks along the riversides in the Surabaya city center. This kind of project will be made under PROKASIH together with ADIPURA before long and will produce a greatly improvement of aesthetic uses of the rivers, especially in the central area of Surabaya city. Widened water surface is desirable for aesthetic uses of the rivers.

(d) Preservation of biota

Aquatic life in the rivers has been reduced to the most hardy of flora and fauna such as water hyacinth, small invertebrates and fish living in the very shallow areas. It can be considered that a number of benthic flora and fauna species and communities have totally disappeared from various reaches of the rivers, mainly due to a poor water quality and quantity (see 8.2). Therefore, the water depth which can keep habitats in better condition is necessary.

(e) Navigation

Although minor inland navigation occurs on the river channels, the local ferryboats can be seen between the river banks for local people, mostly in the Surabaya river and the Mas river. Therefore, enough water depth is required for them.

(2) Water Requirement

(a) Water quality

The water quality is a significant factor to determine the water requirement for the river maintenance flow. Because an improvement of water quality in the rivers cloud also play a certain role on remaining beneficial uses, such as recreational and aesthetic uses, and provide a better condition for an aquatic life in the rivers. Water requirement to reach the target level on water quality (less than 6 mg/l of BOD) is as shown in III.4.

(b) Recreation and ablution

In the upper and middle reaches, from Malang to Mojokerto, swimming and/or dabbling in water and ablution are selected to set the target depth of water in the river streams. It is said that desirable water depth for dabbling in water and ablution is from 0.1 to 0.5 m. As for swimming, desirable water depth for it can be kept by deep pools (swimming holes) in the river channels. Therefore, the water depth of 0.3 m on the average in the river streams is required for recreational uses and ablution in these reaches.

In the downstream area, especially in the Surabaya river, attention should be paid on boating including river festivities. Draught of boats being used by recreational activities are about 0.5 m. Therefore, more than 0.5 cm of depth of water in the river streams is required in this area. In fact, the slices, especially the Gunungsari barrage, deepens the rivers for recreational activities.

(c) Aesthetics

According to the study concerning aesthetics around the rivers made by the Ministry of Construction, Japan (MOC), there would be a correlation between width of water surface in the rivers and river landscape. The above study reveals that a desirable water surface in the rivers for keeping better landscape, ratio of width of water surface (W) to of river (B) is as follows :

- W/B : more than 0.3

For keeping W/B more than 0.3, about 0.3 m of water depth would be necessary. Therefore, more than 0.3 m of depth of water in the river streams is desirable for better river landscape.

(d) Preservation of biota

A fish is selected as a representative of aquatic life (biota) in the rivers to set the river maintenance flow. Because a fish is the largest living thing in the rivers. As a result of biodiversity inventory survey by the Study team (see 8.2), the size (body depth) of fishes caught during the survey are less than 0.1 m. Therefore, in order to ensure useful depth to keep habitat for moving and breeding, at least 0.2 m of water depth in the river streams is necessary.

(e) Navigation

Useful water depth for navigation can be established by considering draught of ferryboats. Judging from the size of ferryboats, draughts of them in the Surabaya and Mas rives are considered to be about 0.5 m. Therefore, at least 0.5 m of water depth in the river streams is necessary for navigation.

Table A4-36 shows the required water flow and depth in the rivers streams for each composition of the river maintenance flow.

(3) Water Requirement in 2020

Summarized water requirement shown in Table A4-37. Among them, maximum at each control point is chosen for river maintenance flow. Required water flow for the river maintenance flow at each control point in 2020 is as follows :

No.	Location	River or Canal	Required water flow (m^3/s)	Key compositions
1	Bumiayu Bridge	Brantas river	21	Water quality
2	Demangan Bridge	Brantas river	10	Water quality
3	Jogbiru Bridge	Brantas river	16	Water quality
4	Padangan Bridge	Brantas river	22	Water quality
5	Canggu Tambangan	Surabaya river	10	Water quality
6	Karangpilang	Surabaya river	14	Water quality
7	Ngagel	Surabaya river	24	Water quality
8	Kayoon	Mas river	8	Water quality
9	Pelayaran	Pelayaran canal	3	Water quality
10	Porong	Porong canal	0.3	Recreation

(4) Operation & Maintenance

(a) Operation & maintenance activities

Providing required water flow for increasing the receiving stream's assimilative capacity and other beneficial uses can be made by modifying the time pattern and/or locations of water flow or some combination of the two. The most common method is to increase the water flow during the dry season by controlled releases from the reservoir storage, and modify the pattern of water discharge and so on.

Until now, little O&M activities related river maintenance flow from the view point of river environment has been made. To ensure enough river maintenance flow at each river channel, a precise water flow management should be made by PJT.

In addition, it is necessary to enact a new operation rule for the river maintenance flow by PJT and related agencies.

(b) Management organization and staffing

Management of the river maintenance flow can be made as a part of low flow management. This matter is within the jurisdiction of the Planning and Controlling Bureau of PJT. Therefore, assignment of authority, establishment of section and reinforcement of staff in duty of management of the river maintenance flow in this bureau should be taken into consideration. A specific section which is in charge of management of the river maintenance flow should be founded under the Chief of Technical Planning and Controlling Department. A specialized staff who is well versed in management of river maintenance flow is required in this section.

(c) Annual O&M cost

Most of O&M cost related the river maintenance flow consists of personnel expenses. Annual O&M cost would be estimated at 2 million Rp./capita/year.

Table A4-1 Irrigation Area in the Brantas Basin in 1996

Branch Irrigation Service Office	Type of Irrigation Area			
	Tech.	Semi-T.	Non-T.	Total
Malang	13,623	1,433	745	15,801
Kepanjen	16,493	5,420	5,303	27,216
Kediri	20,547	2,060	7,680	30,287
Tulungagung	15,585	6,072	1,747	23,404
Trenggalek *1	6,257	2,395	3,721	12,373
Blitar	23,984	2,880	6,086	32,950
Jombang	22,785	0	810	23,595
Mojoagung	22,070	0	1,509	23,579
Pare	18,700	0	1,072	19,772
Nganjuk	33,725	2,864	2,079	38,668
Mojokerto	20,877	7,353	3,315	31,545
Sidoarjo	27,073	765	602	28,440
Wonokromo/ Surabaya *2	744	725	0	1,469
Basin total	242,463	31,967	34,669	309,099
East Jawa Total	715,494	94,116	98,058	907,668
Basin/East Jawa	33.9%	34.0%	35.4%	34.1%

Source: Daftar Penetapan Baku Sawah Jawa Timur Dinas Pekerjaan Umum Pengairan Daerah Propinsi Daerah Tingkat I Jawa Timur 1996

Notes: Tech. = Technical irrigation area
- Where water distribution up to the tertiary canal head is conducted by the DPU Pengairan

Semi-T.= Semi technical irrigation area
- Where the source and some time primary canal is controlled, but distribution is left to farmers.

Sederhana = Simple irrigation area
- Where the water is used by farmers without any control by the DPU Pengairan; generally few permanent intakes or distribution structures are provided; these areas are usually small.

*1 : Trenggalek was under jurisdiction of Tulungagung in 1980.

*2 : Irrigation area commanded by Cabang Seksi Duduksampean is located outside of the Basin and excluded in the above table.

Table A4-2 Cropping Intensity Irrigated by the Brantas River

Average extent of cultivated area in 1994/95 and 1995/96 Unit: ha

Name of irrigation area	Rainy season paddy	Dry season paddy with permission	Dry season paddy without permission	Sugar cane	Polowijo 1 (Rainy season)	Polowijo 2 (Dry season)	Polowijo 3 (Second dry season)	Cotton	Tobacco/ Apple	Others	Total area
Brantas Atas	223	136	112	0	570	657	533	0	409	12	1,239
Brantas Bawah	1,069	183	872	183	14	42	42	0	0	0	1,407
Molek	3,347	1,833	319	279	279	1,514	2,231	40	0	0	3,984
Lodo agung	6,900	5,175	493	3,080	1,725	2,587	7,393	0	493	123	12,321
Mrican Kanan	12,414	6,534	1,960	4,247	1,797	9,310	0	0	0	0	16,334
Warujayeng - Kerto.	10,307	5,279	2,691	2,263	377	2,137	9,553	0	0	0	12,570
Brantas Kediri Kiri	422	11	352	85	0	37	53	0	0	0	534
Jatimlerek-Bunder	1,456	246	574	574	21	267	554	0	349	0	2,050
Menturus Rubber dam	848	102	136	2,476	170	644	746	0	0	0	3,392
Jatikulon	563	217	347	31	0	12	99	0	0	0	619
Brantas Delta	18,333	13,955	0	8,482	1,094	3,010	4,925	0	0	0	27,362
Surabaya	984	749	0	455	59	162	264	0	0	0	1,469
Total	56,865	34,419	8,055	22,156	6,105	20,380	26,394	40	1,250	136	83,281

Average cropping intensity in 1994/95 and 1995/96

Name of irrigation area	Rainy season paddy	Dry season paddy with permission	Dry season paddy without permission	Sugar cane	Polowijo 1 (Rainy season)	Polowijo 2 (Dry season)	Polowijo 3 (Second dry season)	Cotton	Tobacco/ Apple	Others	Total intensity
Brantas Atas	0.18	0.11	0.09	0.00	0.46	0.53	0.43	0.00	0.33	0.01	2.14
Brantas Bawah	0.76	0.13	0.62	0.13	0.01	0.03	0.03	0.00	0.00	0.00	1.71
Molek	0.84	0.46	0.08	0.07	0.07	0.38	0.56	0.01	0	0.00	2.47
Lodo agung	0.56	0.42	0.04	0.25	0.14	0.21	0.60	0	0.04	0.01	2.27
Mrican Kanan	0.76	0.40	0.12	0.26	0.11	0.57	0.00	0.00	0.00	0.00	2.22
Warujayeng - Kerto.	0.82	0.42	0.23	0.18	0.03	0.17	0.76	0.00	0.00	0.00	2.61
Brantas Kediri Kiri	0.79	0.02	0.66	0.16	0.00	0.07	0.10	0.00	0.00	0.00	1.80
Jatimlerek-Bunder	0.71	0.12	0.28	0.28	0.01	0.13	0.27	0.00	0.17	0.00	1.97
Menturus Rubber dam	0.25	0.03	0.04	0.73	0.05	0.19	0.22	0.00	0.00	0.00	1.51
Jatikulon	0.91	0.35	0.56	0.05	0.00	0.02	0.16	0.00	0.00	0.00	2.05
Brantas Delta	0.67	0.51	0.00	0.31	0.04	0.11	0.18	0.00	0.00	0.00	1.82
Surabaya	0.67	0.51	0.00	0.31	0.04	0.11	0.18	0.00	0.00	0.00	1.82
Total	0.68	0.41	0.10	0.27	0.07	0.24	0.32	0.00	0.02	0.00	2.11

Source : Keadaan Irigasi; analyzed by JICA Study Team

Table A4-3 Inventory or Irrigation and Drainage Facilities in the Brantas Basin

Cabang Dinas Pengairan	Irrigation area (ha)	Intake structures (no.)				Canals (m)					Density of irrigation canal (m/ha)
		Dam/Barrage		Free Intake	Pump	Irrigation Canals					
		Closing dike	Gated weir			Primary	Secondary canal	Tertiary	Supply canal	Gendong	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Malang	15,801	142	0	44		3,450	60,842				3.9
Kepanjen	27,216	194	0	28		70,150	157,580		20,430		6.5
Kediri	30,287	176	13	75	39	0	55,090	32,340	1,760		2.9
Blitar	32,950	429	15	262	8	27,670	411,320	1,637	7,108	212	12.8
Tulungagung	23,404	39	20	104	0	15,962	162,027	250,623	0		17.6
Trenggalek	12,373	33	1	101	0	13,275	48,537	423,410	110		38.2
Jombang	23,595	12	11	33	2	52,636	168,469		2,500		7.2
Mojoagung	23,579	16	12	111	14	45,618	228,982	408,022	0		27.0
Pare	19,772	98	54	35	58	130,741	80,607	340,918	9,699		21.8
Nganjuk	38,668	79	8	78	55	32,817	375,103	40,600	36,103	12,378	12.0
Mojokerto	31,545	87	32	168	53	38,032	224,065	22,000	3,660	24,624	8.7
Sidoarjo	28,440					78,030	402,151	764,753	0		41.0
Surabaya	1,469	11	6	47		89,950	52,790	1,050	2,000		38.0
Basin total	309,099	1,316	172	1,066	229	598,331	2,427,763	2,285,353	83,370	37,214	15.6

Cabang Dinas Pengairan	Drain (m)	Related structures									
		Regulators				Culvert	Aqueduct	Drop	Spillway	Others	Total
		Bifurcation	Bifurcation with turnout	Trunout	Total						
(1)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
Malang		1	2	65	68	15	7	31	39	18	110
Kepanjen	14,438	194	31	155	380	89	14	125	37	65	330
Kediri	18,080	85	4	84	173	22	21	19	7	87	156
Blitar	79,005	45	49	193	287	397	27	247	12	19	702
Tulungagung	232,847	26	35	135	196	33	17	46	9	163	268
Trenggalek	5,311	18	26	39	83	35	11	4	5	104	159
Jombang	189,714	18	60	202	280	49	16	57	0	48	170
Mojoagung	32,364	12	15	292	319	45	12	13	2	64	136
Pare	43,973	14	4	265	283	28	10	69	18	34	159
Nganjuk	103,865	35	181	168	384	56	15	38	8	232	349
Mojokerto	104,704	47	65	375	487	161	45	365	32	238	841
Sidoarjo	451,575	11	20	713	744	5	8		5		18
Surabaya	91,745	8	50	162	220	36	7		19	27	89
Basin total	1,367,621	514	542	2,848	3,904	971	210	1,014	193	1,099	3,487

Source: Pengairan Dalam Angka Tahun 1996

Table A4-4 Present Situation of WUAs in the Brantas Basin

Name of Kabupaten	Name of municipality	Numbe of Desa/ Kelurahan	Number of WUA	Evaluation		
				Not yet developed well	Under being developed	Well developed
Malang		406	406	56	305	45
	Malang	57	32	11	12	9
Mojokerto		364	304	90	199	15
Jombang		306	306	3	265	38
Kediri		344	344	74	252	18
	Kediri	46	38	2	29	7
Tulungagung		271	268	0	248	20
Blitar		248	214	117	65	32
	Blitar	20	19	11	5	3
Trenggalek		157	157	45	84	28
Sidoarjo		353	335	92	241	2
Nganjuk		277	277	72	183	22
	Mojokerto	18	11	0	11	0
	Surabaya	163	7	2	5	0
Total		3030	2718	575	1904	239
				21%	70%	9%

Source: Rencana Perluasan IPAIR Dalam Java Irrigation Improvement Project (JIWMP) Tahun 1995/1996 S/D 1997/1998 Di Java Timur

Table A4-5 Harvested Area, Unit Yield and Production of Major Food Crops in East Java

Description	Harvested area (ha)			Yield rate (ton/ha)			Production (ton)		
	Year			Year			Year		
	1985	1990	1995	1985	1990	1995	1985	1990	1995
Wetland paddy *2									
Basin total *1	416,937	395,163	386,290	5.12	5.49	5.71	2,164,278	2,177,426	2,233,160
East Jawa total	1,493,842	1,502,708	1,533,061	4.98	5.33	5.60	7,442,375	8,011,535	8,582,532
Basin/EastJawa	27.9%	26.3%	25.2%	102.9%	103.0%	101.9%	29.1%	27.2%	26.0%
Dryland paddy *2									
Basin total	13,471	11,656	13,401	3.41	2.64	3.26	39,186	31,793	44,953
East Jawa total	78,346	86,752	97,534	2.37	2.57	3.19	185,327	223,179	310,652
Basin/EastJawa	17.2%	13.4%	13.7%	144.2%	102.5%	102.5%	21.1%	14.2%	14.5%
Maize *3									
Basin total	216,671	210,618	219,114	2.27	2.19	2.90	589,437	485,813	659,362
East Jawa total	1,002,030	1,122,900	1,187,136	1.99	2.30	2.75	1,998,203	2,578,286	3,267,786
Basin/EastJawa	21.6%	18.8%	18.5%	113.9%	95.5%	105.3%	29.5%	18.8%	20.2%
Cassava *4									
Basin total	94,807	70,241	60,261	10.77	12.16	15.68	1,139,974	861,291	919,376
East Jawa total	365,167	303,862	263,859	10.58	12.21	14.98	3,864,962	3,710,594	3,952,412
Basin/EastJawa	26.0%	23.1%	22.8%	101.7%	99.6%	104.7%	29.5%	23.2%	23.3%
Sweet potatoes *4									
Basin total	5,858	5,075	5,289	9.38	9.81	10.76	64,119	54,118	62,335
East Jawa total	32,128	23,244	22,405	8.51	10.65	11.30	273,329	247,431	253,421
Basin/EastJawa	18.2%	21.8%	23.6%	110.3%	92.2%	95.2%	23.5%	21.9%	24.6%
Peanuts *3									
Basin total	36,173	28,247	27,256	1.00	1.04	1.04	37,595	29,930	28,934
East Jawa total	135,248	139,862	150,585	0.99	1.05	1.04	134,119	147,040	151,246
Basin/EastJawa	26.7%	20.2%	18.1%	100.6%	99.0%	99.9%	28.0%	20.4%	19.1%
Soyabeans *3									
Basin total	82,685	80,437	82,635	0.91	1.19	1.09	83,304	96,104	97,178
East Jawa total	353,596	390,418	416,223	1.01	1.21	1.21	357,547	471,495	503,025
Basin/EastJawa	23.4%	20.6%	19.9%	90.3%	98.3%	90.3%	23.3%	20.4%	19.3%
Mungbeans *3									
Basin total	8,185	8,974	9,442	0.60	0.70	0.82	5,330	6,754	8,863
East Jawa total	68,823	91,412	83,143	0.67	0.81	0.93	46,158	74,327	77,359
Basin/EastJawa	11.9%	9.8%	11.4%	88.9%	86.3%	88.3%	11.5%	9.1%	11.5%
Total									
Basin total	874,787	810,411	803,688				4,123,224	3,743,229	4,054,161
East Jawa total	3,529,180	3,661,158	3,753,946				14,302,020	15,463,887	17,098,433
Basin/EastJawa	24.8%	22.1%	21.4%	106.6%	97.1%	98.5%	28.8%	24.2%	23.7%

*1 Total of 10 Kabupatens namely Trenggalek, Tulungagung, Blitar, Kediri, Malang, Sidoarjo, Mojokerto, Jombang, Nganjuk, and Surabaya, including municipalities.

*2 Dry unhusked rice

*3 Dry shelled

*4 Fresh roots

Source: Jawa Timur Dalam Angka 1985, 1990 and 1995

Table A4-6 Estimate of Conversion from Irrigation Area to Other Uses

Branch Irrigation Service Office	Irrigation area by year (ha) *1				Balance 1990-1985	Annual rate (%)	Balance 1996-1990	Annual rate (%)	*Estimated by JICA Study Team for 2020*		
	1980	1985	1990	1996					*Ratio 1996/2020*	*Area in 2020 (ha)*	*Converted area (ha)*
Malang	18,022	16,712	16,254	15,801	-458	-0.55	-453	-0.47	*89.3%*	*14,000*	*1,801*
Kepanjen	27,429	28,294	28,235	27,216	-59	-0.04	-1,019	-0.61	*86.3%*	*23,000*	*4,216*
Kediri	29,211	29,808	29,851	30,287	43	0.03	436	-0.40	*90.9% *2*	*27,000*	*3,287*
Tulungagung	30,182	21,751	24,828	23,404	3,077	2.68	-1,424	-0.98	*79.0%*	*18,000*	*5,404*
Trenggalek		12,848	12,761	12,373	-87	-0.14	-388	-0.51	*98.4%*	*10,000*	*2,373*
Blitar	35,792	35,006	33,039	32,950	-1,967	-1.15	-89	-0.04	*98.9%*	*32,000*	*950*
Jombang	24,314	24,216	24,388	23,595	172	0.14	-793	-0.55	*87.6%*	*20,000*	*3,595*
Mojoagung	23,222	23,914	23,599	23,579	-315	-0.26	-20	-0.01	*99.7%*	*23,000*	*579*
Pare	19,300	19,298	19,927	19,772	629	0.64	-155	-0.13	*96.9%*	*19,000*	*772*
Nganjuk	38,728	39,508	39,437	38,668	-71	-0.04	-769	-0.33	*92.4%*	*35,000*	*3,668*
Mojokerto	32,217	32,024	31,870	31,545	-154	-0.10	-325	-0.17	*96.0%*	*30,000*	*1,545*
Sidoarjo	32,609	31,284	30,363	28,440	-921	-0.60	-1,923	-1.08	*77.0%*	*21,000*	*7,440*
Wonokromo/ Surabaya	4,976	2,979	1,708	1,469	-1,271	-10.53	-239	-2.48	*54.7%*	*0*	*1,469*
Basin total	316,002	317,642	316,260	309,099	-1,382	-0.09	-7,161	-0.38	*91.2%*	*272,000*	*37,099*
East Jawa Total	924,246	930,718	934,242	907,668	3,524	0.08	-26,574	-0.48	*89.1%*	*808,000*	*99,668*
Basin/EastJawa	34.2%	34.1%	33.9%	34.1%						*33.7%*	

*1 Source: Daftar Penetapan Baku Sawah Jawa Timur Dinas Pekerjaan Umum Pengairan Daerah Propinsi Daerah Tingkat I Jawa Timur

*2 Average of annual rate in Blitar, Tulungagung, Jombang, Mojoagung

Table A4-7 Wetland Paddy Field by Kabupaten Estimated by the Plan 2008

(unit; ha)

Branch Irrigation Service Office	Paddy field in 1990					Paddy field in 2008				
	Irrigated paddy field in 1990			Rainfed paddy field	Total paddy field	New irrigation area by 2008			Rainfed paddy field	Total paddy field
	Dinas Peng.	Non Dinas Peng.	Total in 1990			Developed from rainfed	Converted from other land use	Total in 2008		
Malang	47,209	2,523	49,732	1,800	51,532	714	206	50,652	1,086	51,738
Kepanjen										
Kediri	45,071	2,252	47,323	3,920	51,243	524	725	48,572	776	49,348
Tulungagung	23,494	0	23,494	197	23,691	2,122	1,652	27,268	683	27,951
TrenggalekK	8,687	768	9,455	2,131	11,586	73	30	9,558	2,053	11,611
Blitar	32,209	1,165	33,374	1,274	34,648	10	297	33,681	1,261	34,942
Jombang	42,739	170	42,909	5,044	47,953	148	419	43,476	4,893	48,369
Mojoagung										
Pare										
Nganjuk	37,750	1,003	38,753	4,325	43,078	1,436	582	40,771	2,886	43,657
Mojokerto	31,428	1,267	32,695	5,831	38,526	1,215	369	34,279	4,569	38,848
Sidoarjo	29,241	150	29,391	63	29,454	58	443	29,892	0	29,892
Wonokromo/ Surabaya	1,212	225	1,437	2,971	4,408	0	0	719	1,441	2,160
Basin total	299,040	9,523	308,563	27,556	336,119	6,300	4,723	318,868	19,648	338,516
East Jawa Total	848,900	47,392	896,292	272,477	1,168,769	31,196	12,499	933,050	235,725	1,168,775
Basin/EastJawa	35.2%	20.1%	34.4%	10.1%	28.8%	20.2%	37.8%	34.2%	8.3%	29.0%

Source: "Rencana Tata Ruan Wilayah Propinsi Daerah Tingkat I Jawa Timur 2008" Pemerintah Propinsi Daerah Tingkat I Jawa Timur 1993/1994. The area was forecasted by Kabpaten and Kotamadya. The boundary of those, however, does not always coincide with boundary of Cabang Dinas PU Pengairan.

Note: Irrigated paddy field in 1990 do not coincide with those in Table III.7.2.6. The reason is unknown.

Table A4-8 Future Cropping Intensity and Cultivated Area Irrigated by the Brantas River

Name of irrigation area	Rainy season paddy	Dry season paddy with permission	Dry season paddy without permission	Sugar cane	Polowijo 1 (Rainy season)	Polowijo 2 (Dry season)	Polowijo 3 (Second dry season)	Cotton	Tobacco /Apple	Others	Total intensity
Brantas Atas	0.18	0.11	0.00	0.00	0.46	0.53	0.52	0.00	0.33	0.01	2.14
Brantas Bawah	0.76	0.13	0.00	0.13	0.06	0.46	0.17	0.00	0.00	0.00	1.71
Molek	0.84	0.46	0.00	0.07	0.07	0.46	0.56	0.01	0	0.00	2.47
Lodo agung	0.56	0.33	0.00	0.25	0.14	0.34	0.60	0	0.04	0.01	2.27
Mrican Kanan	0.73	0.35	0.00	0.26	0.00	0.38	0.50	0.00	0.00	0.00	2.22
Warujayeng - Kerto.	0.82	0.42	0.00	0.18	0.03	0.40	0.76	0.00	0.00	0.00	2.61
Brantas Kediri Kiri	0.79	0.35	0.00	0.16	0.00	0.40	0.10	0.00	0.00	0.00	1.80
Jatimlerek-Bunder	0.71	0.12	0.00	0.28	0.01	0.41	0.27	0.00	0.17	0.00	1.97
Menturus Rubber dam	0.25	0.03	0.00	0.73	0.05	0.23	0.22	0.00	0.00	0.00	1.51
Jatikulon	0.91	0.35	0.00	0.05	0.00	0.58	0.16	0.00	0.00	0.00	2.05
Brantas Delta	0.67	0.51	0.00	0.31	0.04	0.11	0.18	0.00	0.00	0.00	1.82
Surabaya	0.67	0.51	0.00	0.31	0.04	0.11	0.18	0.00	0.00	0.00	1.82

Future cultivated area Unit: ha

Name of irrigation area	Rainy season paddy	Dry season paddy with permission	Dry season paddy without permission	Sugar cane	Polowijo 1 (Rainy season)	Polowijo 2 (Dry season)	Polowijo 3 (Second dry season)	Cotton	Tobacco /Apple	Others	Total area
Brantas Atas	200	120	0	0	510	590	580	0	370	10	1,110
Brantas Bawah	960	160	0	160	80	580	210	0	0	0	1,260
Molek	2,890	1,580	0	240	240	1,580	1,930	30	0	0	3,440
Lodo agung	5,630	3,320	0	2,510	1,410	3,420	6,030	0	400	100	10,050
Mrican Kanan	11,300	5,420	0	4,020	0	5,880	7,740	0	0	0	15,480
Warujayeng - Kerto.	9,520	4,880	0	2,090	350	4,640	8,820	0	0	0	11,610
Brantas Kediri Kiri	390	170	0	80	0	200	50	0	0	0	490
Jatimlerek-Bunder	1,280	220	0	500	20	740	490	0	310	0	1,800
Menturus Rubber dam	820	100	0	2,380	160	750	720	0	0	0	3,260
Jatikulon	540	210	0	30	0	340	90	0	0	0	590
Brantas Delta	14,120	10,750	0	6,530	840	2,320	3,790	0	0	0	21,070
Surabaya	0	0	0	0	0	0	0	0	0	0	0
Total	47,650	26,930	0	18,540	3,610	21,040	30,450	30	1,080	110	70,160

Table A4-9 (1) Monthly Mean Climatological Data in the Brantas Basin

Malang (Unibraw)

Latitude : 7 deg. 58 min. S Longitude : 112 deg. 37 min. E Altitude : 505 m

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Temperature (℃)	24.5	24.6	24.7	25.0	24.9	24.4	23.7	24.0	24.7	25.2	25.3	24.9
Relative humidity (%)	81	81	81	79	76	76	75	73	72	75	75	78
Wind velocity (km/hr)	6.0	5.1	5.5	5.1	5.6	6.0	6.6	6.8	6.5	6.5	5.7	5.4
Sunshine hours (hrs/day)	3.8	4.1	4.7	5.1	5.4	5.7	5.6	6.1	6.0	5.6	5.3	4.4
Solar radiation (cal/cm2/day)	304	323	356	407	412	392	397	421	433	452	395	360
Evaporation (mm/day)	2.4	2.4	2.7	3.1	3.4	3.2	3.4	3.7	3.8	3.7	3.3	2.6

Selorejo

Latitude : 7 deg. 53 min. S Longitude : 112 deg. 21 min. E Altitude : 637 m

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Temperature (℃)	23.2	23.3	23.5	24.0	23.8	23.3	22.6	22.8	23.4	24.1	24.0	23.7
Relative humidity (%)	83	83	81	81	77	75	74	73	73	74	78	79
Wind velocity (km/hr)	1.7	1.9	2.0	1.9	2.1	2.5	3.2	3.9	4.2	4.1	2.9	2.1
Sunshine hours (hrs/day)	3.0	3.3	3.8	4.6	5.5	5.8	6.1	6.2	5.8	5.3	4.4	3.7
Evaporation (mm/day)	3.0	2.8	3.5	3.9	4.0	4.4	4.8	5.5	6.0	5.9	4.4	4.0

Karangkates

Latitude : 8 deg. 09 min. S Longitude : 112 deg. 27 min. E Altitude : 222 m

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Temperature (℃)	26.2	26.2	26.1	26.3	26.1	25.4	25.3	25.2	26.0	26.7	26.8	25.9
Relative humidity (%)	86	81	86	85	83	82	81	79	79	80	83	85
Wind velocity (km/hr)	2.2	0.8	1.5	1.4	1.9	2.1	2.9	2.4	3.3	2.7	1.7	1.4
Sunshine hours (hrs/day)	4.6	5.1	5.1	5.8	6.5	6.5	7.0	6.9	6.8	6.2	5.2	5.3
Evaporation (mm/day)	1.5	1.7	1.8	1.7	1.9	1.9	2.2	2.5	2.6	2.6	1.9	1.6

Wlingi

Latitude : 8 deg. 8 min. S Longitude : 101 deg. 54 min. E Altitude : 173 m

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Temperature (℃)	25.7	26.1	25.7	26.1	26.1	25.6	24.9	25.2	25.4	26.2	26.4	26.1
Relative humidity (%)	82	82	82	82	80	80	78	77	76	78	80	82
Wind velocity (km/hr)	5.1	4.3	3.9	3.4	3.7	3.9	4.9	5.6	6.1	5.6	4.8	4.5
Sunshine hours (hrs/day)	4.0	4.1	4.4	5.3	6.1	5.7	5.8	6.0	5.7	5.6	4.9	4.5
Evaporation (mm/day)	2.8	3.1	3.1	2.9	3.2	3.1	3.2	3.8	4.1	3.7	3.8	2.9

Mrican

Latitude : 7 deg. 47 min. S Longitude : 112 deg. 00 min. E Altitude : 60 m

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Temperature (℃)	26.3	26.8	27.1	27.8	27.7	27.3	26.7	27.2	27.5	27.2	28.0	27.0
Relative humidity (%)	79	79	78	76	72	72	70	69	69	69	72	74
Wind velocity (km/hr)	5.0	4.9	4.9	4.9	5.3	5.0	5.2	5.7	6.1	6.4	5.3	5.0
Sunshine hours (hrs/day)	4.4	4.6	5.1	6.3	6.1	6.0	7.0	7.1	7.2	6.6	5.9	4.8
Evaporation (mm/day)	3.7	3.3	3.6	4.5	4.0	4.6	4.5	5.7	5.6	5.8	5.0	4.3

Bulakmojo

Latitude : 7 deg. 35 min. S Longitude : 111 deg. 55 min. E Altitude : 50 m

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Temperature (℃)	26.3	26.0	26.3	26.8	26.9	26.1	26.0	25.9	26.7	27.4	27.3	26.7
Relative humidity (%)	88	88	85	84	79	81	81	78	78	79	81	86
Wind velocity (km/hr)	2.6	2.0	2.0	2.4	2.9	4.5	6.7	6.9	8.2	7.2	5.5	2.9
Sunshine hours (hrs/day)	4.0	4.6	5.1	6.0	6.3	6.6	7.3	7.1	7.0	6.6	6.1	4.8
Solar radiation (cal/cm2/day)	453	376	356	445	417	473	420	467	539	603	533	439
Evaporation (mm/day)	4.1	3.6	4.2	4.4	4.8	4.6	5.3	5.7	6.2	6.5	5.7	5.0

Table A4-9 (2) Monthly Mean Climatological Data in the Brantas Basin

Mojoagung

Latitude : 9 deg. 34 min. S Longitude : 112 deg. 20 min. E Altitude : 28 m

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Temperature (Åé)	27.4	28.0	27.6	28.3	28.1	27.3	27.1	28.1	27.6	28.1	28.9	28.2
Relative humidity (ÅÒ)	82	82	84	83	78	81	75	73	73	75	78	83
Sunshine hours (hrs/day)	4.3	4.8	4.8	5.8	5.4	5.7	6.0	6.3	6.5	6.6	5.4	5.0
Evaporation (mm/day)	2.2	1.9	3.7	3.0	2.1	2.7	2.8	2.6	2.2	2.2	2.1	1.9

Juanda Air Port (Surabaya)

Latitude : Longitude : Altitude : 10.5 m

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Temperature (℃)	27.0	26.8	27.5	27.7	27.6	27.1	26.5	26.5	26.5	28.5	28.7	27.8
Relative humidity (%)	84	84	83	82	79	79	77	74	70	69	73	80
Wind velocity (km/hr)	3.5	3.5	3.3	3.3	3.4	3.7	3.9	4.2	4.1	3.9	3.5	3.4
Sunshine hours (hrs/day)	4.3	4.0	5.0	5.8	6.3	6.0	7.5	7.5	7.4	6.8	5.9	4.6

Dam Bendo

Latitude : 8 deg. 06 min. S Longitude : 111 deg. 45 min. E Altitude : 94 m

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Temperature (℃)	26.2	26.2	26.3	26.5	26.2	25.5	25.5	25.5	25.6	25.6	27.3	26.3
Relative humidity (%)	83	84	85	85	80	84	83	83	85	155	85	83
Sunshine hours (hrs/day)	4.4	4.7	5.2	5.9	6.5	6.4	6.5	6.5	6.5	6.9	5.3	4.9
Evaporation (mm/day)	2.9	3.0	2.9	3.5	3.2	3.0	2.8	3.2	3.0	3.9	3.5	3.2

Bening dam

Latitude : Longitude : Altitude :

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Temperature (℃)	26.1	26.1	26.4	26.9	27.2	26.8	26.6	26.9	27.5	28.7	27.9	26.5
Relative humidity (%)	86.8	85.7	84.2	81.3	80.3	78.4	75.7	73.9	71.7	73.8	78.5	84.9
Wind velocity (km/hr)	9.1	9.8	7.6	5.1	4.8	6.4	7.2	8.3	9.4	8.9	6.5	7.6
Sunshine hours (hrs/day)	3.8	3.9	4.7	5.4	6.1	5.9	6.6	6.5	6.7	6.4	5.1	4.4
Evaporation(Otom mm/day)	3.8	4.1	4.2	4.5	4.7	4.5	5.4	6.5	7.0	7.3	6.1	4.4

Source : PJT

Table A4-10 Reference Crop Evapotranspiration

Station Name	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Malang	4.01	4.09	4.19	4.06	3.87	3.71	3.79	4.37	4.79	4.86	4.73	4.26
Selorejo	3.37	3.50	3.60	3.58	3.49	3.37	3.54	4.00	4.35	4.45	4.01	3.68
Karangkates	4.04	4.26	4.06	3.98	3.81	3.55	3.83	4.16	4.70	4.76	4.33	4.19
Wlingi	4.09	4.14	4.05	4.02	3.90	3.55	3.72	4.23	4.61	4.79	4.48	4.22
Mrican	4.36	4.50	4.61	4.79	4.44	4.11	4.47	5.03	5.58	5.63	5.28	4.67
Bulakmojo	3.78	3.97	4.13	4.18	4.01	3.85	4.27	4.72	5.32	5.39	5.00	4.12
Mojoagung	4.30	4.50	4.40	4.40	3.70	3.60	3.80	4.40	4.80	5.10	4.70	4.50
Juanda Air Port	4.06	3.98	4.30	4.28	4.07	3.74	4.20	4.66	5.11	5.38	5.00	4.30
Dam Bendo	4.20	4.40	4.40	4.40	4.20	3.80	3.90	4.40	4.70	5.10	4.50	4.30
Bening Dam	3.95	4.12	4.32	4.28	4.11	3.97	4.39	4.94	5.70	5.85	4.87	4.22

Estimated by JICA Study Team

Table A4-11 Crop Coefficient of Rice and Polowijo

Crop Coefficient for Rice (0.5month)

Month	Local	HYV	Average
0.5	1.10	1.10	1.10
1	1.10	1.10	1.10
1.5	1.10	1.05	1.08
2	1.10	1.05	1.08
2.5	1.10	0.95	1.03
3	1.05	0.00	0.53
3.5	0.95		0.48
4	0.00		0.00

Source : Irrigation Design Standards Design Criteria Volume Irrigation System Design KP-01 1st edition DGWRD

Converted Crop Coefficient for Rice (10days)

Month	day	Local	HYV	Average
0	0			
	10	1.10	1.10	1.10
	20	1.10	1.10	1.10
1	0	1.10	1.10	1.10
	10	1.10	1.07	1.09
	20	1.10	1.05	1.08
2	0	1.10	1.05	1.08
	10	1.10	0.98	1.04
	20	1.08	0.32	0.86
3	0	1.05	0.00	0.53
	10	0.98		0.49
	20	0.32		0.16
4	0	0.00		0.00

Estimated by JICA Study Team

Crop Coefficients for Polowijo

Month	Soybeans (85 days)	Maize (80 days)	Peanuts (130 days)	Onions (70 days)	Green Beans (75 days)	Cotton (195 days)
0						
0.5	0.50	0.50	0.50	0.50	0.50	0.50
1	0.75	0.59	0.51	0.51	0.64	0.50
1.5	1.00	0.96	0.66	0.69	0.89	0.58
2	1.00	1.05	0.85	0.90	0.95	0.75
2.5	0.82	1.02	0.95	0.95	0.88	0.91
3	0.45	0.95	0.95			1.04
3.5			0.95			1.05
4			0.55			1.05
4.5			0.55			1.05
5						0.78
5.5						0.65
6						0.65
6.5						0.65

Source : Irrigation Design Standards Design Criteria Volume Irrigation System Design KP-01 1st edition DGWRD

Crop Coefficients for Polowijo

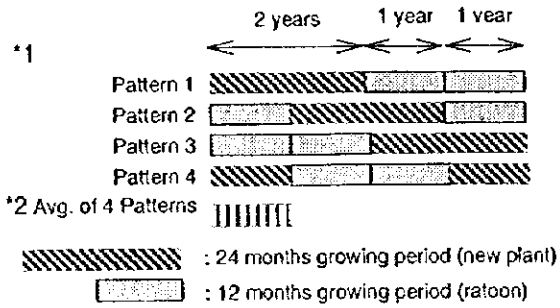
month	day	Soybeans (85 days)	Maize (80 days)	Peanuts (130 days)	Onions (70 days)	Green Beans (75 days)	Cotton (195 days)
0	0						
	10	0.50	0.50	0.50	0.50	0.50	0.50
	20	0.58	0.53	0.50	0.50	0.55	0.50
1	0	0.75	0.59	0.51	0.51	0.64	0.50
	10	0.92	0.84	0.61	0.63	0.81	0.55
	20	1.00	0.99	0.72	0.76	0.91	0.64
2	0	1.00	1.05	0.85	0.90	0.95	0.75
	10	0.88	1.03	0.92	0.95	0.90	0.86
	20	0.64	1.00	0.95		0.29	0.95
3	0	0.27		0.95			1.04
	10			0.95			1.05
	20			0.82			1.05
4	0			0.55			1.05
	10			0.55			1.05
	20						0.96
5	0						0.78
	10						0.69
	20						0.65
6	0						0.65
	10						0.65
	20		Ave. Kc for Polowijo e		0.73		0.33

Estimated by JICA Study Team

Table A4-12 Crop Coefficient of Sugarcane

Month	Pattern *1	Pattern 2	Pattern 3	Pattern 4	Avg. of 4 patterns *2
0.5	0.55	0.55	0.55	1.05	0.68
1	0.55	0.55	0.55	1.05	0.68
1.5	0.55	0.80	0.80	1.05	0.80
2	0.55	0.80	0.80	1.05	0.80
2.5	0.55	0.90	0.90	1.05	0.85
3	0.80	1.00	1.00	1.05	0.96
3.5	0.80	1.00	1.00	1.05	0.96
4	0.90	1.00	1.00	1.05	0.99
4.5	0.90	1.05	1.05	1.05	1.01
5	1.00	1.05	1.05	1.05	1.04
5.5	1.00	1.05	1.05	0.80	0.98
6	1.00	1.05	1.05	0.80	0.98
6.5	1.05	1.05	1.05	0.80	0.99
7	1.05	1.05	1.05	0.80	0.99
7.5	1.05	1.05	1.05	0.80	0.99
8	1.05	1.05	1.05	0.80	0.99
8.5	1.05	1.05	1.05	0.80	0.99
9	1.05	1.05	1.05	0.80	0.99
9.5	1.05	1.05	1.05	0.80	0.99
10	1.05	1.05	1.05	0.80	0.99
10.5	1.05	0.80	0.80	0.60	0.81
11	1.05	0.80	0.80	0.60	0.81
11.5	1.05	0.00	0.00	0.00	0.26
12	1.05	0.00	0.00	0.00	0.26

Source : Irrigation Design Standards Design Criteria
Volume Irrigation System Design KP-01 1st edition



Month		Avg. of 4 patterns
1	1	0.68
	11	0.68
	21	0.68
2	1	0.68
	11	0.72
	21	0.80
3	1	0.80
	11	0.82
	21	0.85
4	1	0.93
	11	0.96
	21	0.96
5	1	0.98
	11	1.00
	21	1.01
6	1	1.03
	11	1.02
	21	0.98
7	1	0.98
	11	0.98
	21	0.99
8	1	0.99
	11	0.99
	21	0.99
9	1	0.99
	11	0.99
	21	0.99
10	1	0.99
	11	0.99
	21	0.99
11	1	0.99
	11	0.93
	21	0.81
12	1	0.26
	11	0.26
	21	0.26

Estimated by JICA Study Team

Table A4-13 Crop Coefficient of Citrus and Apple

Month	Citrus (Fruit tree)	Apple
1	0.65	0.00
2	0.65	0.00
3	0.60	0.80
4	0.60	0.90
5	0.60	1.00
6	0.55	1.10
7	0.55	1.10
8	0.55	1.10
9	0.55	1.05
10	0.55	0.85
11	0.60	0.80
12	0.60	0.00

Source : Crop Water Requirements, FAO 1977

Month	day	Citrus (Fruit tree)	Apple
1	1	0.62	0.00
	11	0.63	0.00
	21	0.65	0.00
2	1	0.65	0.00
	11	0.65	0.00
	21	0.65	0.00
3	1	0.63	0.27
	11	0.62	0.53
	21	0.60	0.80
4	1	0.60	0.83
	11	0.60	0.87
	21	0.60	0.90
5	1	0.60	0.93
	11	0.60	0.97
	21	0.60	1.00
6	1	0.58	1.03
	11	0.57	1.07
	21	0.55	1.10
7	1	0.55	1.10
	11	0.55	1.10
	21	0.55	1.10
8	1	0.55	1.10
	11	0.55	1.10
	21	0.55	1.10
9	1	0.55	1.08
	11	0.55	1.07
	21	0.55	1.05
10	1	0.55	0.98
	11	0.55	0.92
	21	0.55	0.85
11	1	0.57	0.83
	11	0.58	0.82
	21	0.60	0.80
12	1	0.60	0.53
	11	0.60	0.27
	21	0.60	0.00

Estimated by : JICA Study Team

Table A4-14 Percolation Rate

Irrigation Area	Percolation Rate (mm/day)
Lodoagung	4.4 for RSP 2.6 for DSP
Warujayeng-Kertosono	3.5
Brantas Delta	2.0
Other Paddy Field	3.0

RSP; Rainy season paddy
DSP; Dry season paddy

Source : Final Report for the Study of Widas Flood Control and Drainage Project Part-1 Study

Table A4-15 Irrigation Requirement During Land Preparation in the Paddy Field

(Unit : mm/day)

Irrigation Area		January	February	March	April	May	June	July	August	September	October	November	December
Brantas Atas	RSP	16.62	16.62	16.66						17.11	17.09	16.96	16.64
	DSP		16.62	16.66	16.55	16.49	16.29	16.49	16.90	17.11			
Brantas Bawah	RSP	16.62	16.62	16.66						17.11	17.09	16.96	16.64
	DSP		16.62	16.66	16.55	16.49	16.29	16.49	16.90	17.11			
Molek	RSP	16.27	16.40	16.44						17.06	17.15	16.76	16.54
	DSP		16.40	16.44	16.67	16.63	16.47	16.59	16.82	17.06			
Lodoagung	RSP	17.50	17.43	17.42						17.78	18.00	17.68	17.61
	DSP		16.45	16.46	16.36	16.28	16.05	16.03	16.47	16.79			
Mrican Kanan	RSP	16.80	16.81	16.83						17.38	17.42	17.29	16.92
	DSP		16.81	16.83	16.94	16.56	16.44	16.73	17.03	17.38			
Warujayeng-Kertosono	RSP	17.09	17.12	17.14						17.61	17.81	17.51	17.30
	DSP		17.12	17.14	17.32	16.87	16.74	17.02	17.25	17.61			
Brantas Kediri Kiri	RSP	16.87	16.81	16.88						17.63	17.57	17.49	17.02
	DSP		16.81	16.88	17.11	16.85	16.66	16.94	17.28	17.63			
Jatimlerek-Bunder	RSP	16.72	16.81	16.77						17.13	17.27	17.09	16.81
	DSP		16.81	16.77	16.77	16.26	16.22	16.52	16.77	17.13			
Menturus Rubber Dam	RSP	16.72	16.81	16.77						17.13	17.27	17.09	16.81
	DSP		16.81	16.77	16.77	16.26	16.22	16.52	16.77	17.13			
Jatikulon	RSP	16.72	16.81	16.77						17.13	17.27	17.09	16.81
	DSP		16.81	16.77	16.77	16.26	16.22	16.52	16.77	17.13			
Delta Brantas	RSP	15.95	15.96	16.12						16.68	16.94	16.62	16.12
	DSP		15.96	16.12	16.07	15.97	15.77	16.08	16.40	16.68			

RSP : Rainy Season Paddy

DSP : Dry Season Paddy

Estimated by JICA Study Team

Table A4-16 Annual Rainfall

Year *	Name of Rain Gauge (mm)									
	Malang (Kayu tangan)	Kepanjen	Blitar (Lodoyo)	T'agung (Kali Dawir)	Kediri (Kediri)	Nganjuk (Kertosono)	Jombang (Cab Dinas)	Mojokerto (Cab Dinas)	Tapen	Juanda (Surabaya)
1981 - 1982	1,552	1,972	1,276	1,480	1,937	1,561	1,258	1,992	2,619	2,229
1982 - 1983	1,718	2,102	1,339	2,534	1,958	1,637	1,450	1,479	1,784	1,945
1983 - 1984	1,834	3,793	1,839	2,041	2,208	2,285	2,135	1,953	2,537	2,140
1984 - 1985	2,173	2,101	1,607	1,328	1,872	1,916	1,842	894	1,984	1,960
1985 - 1986	1,899	2,335	1,284	1,606	1,534	2,253	1,828	966	1,997	2,365
1986 - 1987	1,673	2,417	874	887	1,427	1,548	1,146	679	1,645	1,784
1987 - 1988	1,816	2,117	1,592	1,017	1,968	1,647	1,400	685	1,765	1,627
1988 - 1989	2,031	1,893	1,638	1,336	1,944	1,757	1,746	849	2,176	2,271
1989 - 1990	1,399	2,059	1,152	1,541	1,693	1,414	1,987	1,262	1,859	1,579
1990 - 1991	1,359	1,603	1,147	1,244	1,570	1,864	1,521	1,433	2,756	2,181
1991 - 1992	2,194	2,115	1,249	1,674	2,019	1,773	2,243	1,367	2,667	2,463
1992 - 1993	2,649	1,804	1,286	1,656	1,782	1,351	1,586	1,378	1,549	2,046
1993 - 1994	1,988	2,111	1,438	1,394	1,807	1,680	1,855	1,232	1,519	1,977
1994 - 1995	1,944	2,351	1,148	1,335	2,077	2,868	2,421	1,887	2,182	1,973
1995 - 1996	1,921	3,056	918	978	2,227	1,477	1,744	1,438	1,510	2,013

* year : From October to September

Source : PJT, Missing Data are Interpolated by JICA Study Team

Table A4-17 Probable Annual Rainfall

Dependability (Return Period in Year)		Name of Rain Gauge (mm/year*)									
		Malang (Kayu tangan)	Kepanjen	Blitar (Lodoyo)	T'agung (Kali Dawir)	Kediri (Kediri)	Nganjuk (Kertosono)	Jombang (Cab Dinas)	Mojokerto (Cab Dinas)	Tapen	Juanda (Surabaya)
50%	(2)	1,851	2,112	1,312	1,402	1,882	1,714	1,737	1,292	1,999	2,048
80%	(5)	1,584	1,813	1,083	1,100	1,671	1,459	1,427	922	1,640	1,824
90%	(10)	1,467	1,727	973	987	1,555	1,375	1,276	742	1,480	1,704

* year : From October to September

Estimated by JICA Study Team

Table A4-18 80% Dependable Rainfall by 10-day

Month		Name of Rain Gauge (mm)									
		Malang (Kayu tangan)	Kepanjen	Blitar (Lodoyo)	Tagung (Kali Dawir)	Kediri (Kediri)	Nganjuk (Kertosono)	Jombang (Cab. Dinas)	Mojokerto (Cab. Dinas)	Tapen	Juanda (Surabaya)
Oct	E	10	65	6	9	3	3	0	6	10	10
	M	10	36	10	9	2	49	0	8	38	31
	L	23	50	9	20	34	38	12	13	13	0
Nov	E	70	32	34	3	25	18	6	5	48	3
	M	81	92	44	25	17	29	33	26	57	3
	L	76	91	50	35	41	48	43	22	50	73
Dec	E	91	83	51	114	58	37	52	77	113	68
	M	73	78	19	47	57	70	98	36	137	50
	L	101	171	47	88	143	94	100	27	61	92
Jan	E	108	118	135	60	182	114	156	60	98	120
	M	48	72	118	66	122	81	81	45	138	140
	L	112	151	108	75	107	94	133	42	118	92
Feb	E	66	97	71	67	124	138	81	64	106	93
	M	107	52	76	58	87	115	76	54	114	138
	L	147	56	60	38	74	97	57	66	70	102
Mar	E	91	140	49	74	58	75	79	81	156	113
	M	76	104	59	40	70	63	99	31	60	95
	L	35	61	26	31	69	64	63	53	56	79
Apr	E	68	62	27	36	100	5	74	13	46	60
	M	58	52	15	31	50	95	28	62	41	67
	L	20	42	24	38	42	21	45	51	16	73
May	E	52	32	3	5	20	14	43	14	43	97
	M	10	12	11	21	2	9	32	12	16	50
	L	22	7	5	21	24	23	18	6	10	44
Jun	E	7	49	3	29	39	7	7	20	20	46
	M	0	12	1	40	54	15	8	4	5	18
	L	11	0	2	0	0	12	0	12	0	2
Jul	E	0	0	3	3	3	3	0	1	0	23
	M	5	0	0	0	0	1	3	11	0	6
	L	0	0	5	4	0	0	0	0	0	4
Aug	E	2	10	3	3	0	1	0	0	0	12
	M	0	1	6	5	30	3	0	0	0	0
	L	1	0	0	2	0	3	0	0	0	15
Sep	E	0	0	0	0	16	7	0	3	0	1
	M	0	0	0	1	9	0	0	1	0	0
	L	1	0	3	0	9	12	0	4	0	0
TOTAL		1,584	1,827	1,083	1,100	1,671	1,459	1,427	929	1,640	1,824

Table A4-19 (1) Potential Irrigation Water Requirements at Present by Areas (80% Dependability)

Unit ; m3/sec

Year	Month		Intake Name (m3/sec)											
			Brantas Atas	Brantas Bawah	Molek	Lodoyong	Mrican Kanan	Warujayeng Kertosono	Brantas Kediri Kiri	Jatimlerek	Menturus	Jatikulon	Delta Brantas	TOTAL
1994	Oct.	E	0.8	0.2	0.1	8.1	12.7	8.7	0.1	0.8	2.8	0.2	9.6	44.1
		M	0.7	0.2	0.8	7.5	8.3	0.8	0.0	0.3	2.3	0.1	10.3	31.3
		L	0.5	0.5	0.4	7.1	5.9	1.6	0.1	0.7	3.6	0.0	22.3	42.7
	Nov	E	0.0	0.4	0.6	11.9	6.3	6.2	0.1	0.1	2.4	0.0	24.5	52.5
		M	0.0	0.5	0.0	7.2	15.7	8.3	0.0	2.0	1.9	0.0	23.1	58.7
		L	0.1	0.9	0.9	7.0	29.4	7.9	0.0	5.1	2.3	1.0	13.8	68.4
	Dec	E	0.1	1.0	2.1	1.6	35.6	11.8	0.0	2.3	1.3	1.7	9.7	67.2
		M	0.2	1.7	3.3	9.9	21.4	11.1	0.5	0.4	1.1	1.4	20.3	71.3
		L	0.3	1.7	1.2	8.3	9.5	11.7	1.3	1.8	1.8	0.9	19.2	57.7
1995	Jan	E	0.3	1.1	3.8	10.1	6.1	10.3	0.7	1.8	0.9	0.6	13.0	48.7
		M	0.4	1.6	4.5	11.4	14.8	18.1	0.4	1.2	0.9	1.0	16.6	70.9
		L	0.2	1.0	0.6	13.8	12.9	14.8	0.6	0.8	1.1	1.1	25.3	72.2
	Feb	E	0.3	1.5	2.4	12.8	7.5	5.3	0.4	0.9	0.8	0.6	16.2	48.7
		M	0.2	0.9	4.6	11.8	15.2	6.6	0.2	1.6	0.7	0.7	8.8	51.3
		L	0.0	0.0	3.8	12.1	14.8	3.4	0.4	2.0	0.6	0.8	5.0	42.9
	Mar	E	0.2	0.7	0.6	9.4	17.2	5.5	0.7	0.0	0.0	0.8	5.3	40.4
		M	0.2	0.6	1.6	10.6	7.6	10.7	0.3	1.0	0.4	0.8	10.1	43.9
		L	0.5	0.9	3.4	13.4	9.0	11.7	0.1	0.5	0.0	0.5	6.1	46.1
	Apr	E	0.2	0.0	2.5	11.6	5.5	22.6	0.1	0.4	0.7	0.4	16.0	60.0
		M	0.2	0.0	2.0	12.3	8.1	9.1	0.0	0.6	0.0	0.0	3.0	35.3
		L	0.8	0.3	2.2	11.2	13.7	12.9	0.0	1.2	0.7	0.0	5.5	48.5
	May	E	0.3	0.4	2.7	17.4	17.8	14.1	0.1	0.5	0.8	0.2	9.9	64.2
		M	0.9	0.7	3.9	13.7	22.3	16.8	0.3	0.8	1.5	0.5	19.3	80.7
		L	0.8	0.5	5.0	14.9	24.3	12.6	0.2	1.1	2.1	0.7	24.4	86.6
	June	E	0.9	0.7	3.4	11.3	22.0	13.2	0.3	1.0	1.5	0.5	21.4	76.2
		M	1.1	1.2	4.6	8.0	18.7	10.0	0.2	1.3	2.3	0.5	32.4	80.3
		L	0.8	0.9	4.7	12.6	21.7	6.4	0.3	1.5	2.0	0.5	35.2	86.6
	July	E	1.1	1.2	4.4	11.5	21.9	5.8	0.4	1.4	2.6	0.7	32.2	83.2
		M	0.9	1.0	4.1	10.5	20.3	3.4	0.3	1.2	2.2	0.6	30.0	74.5
		L	0.9	1.2	3.5	8.8	17.8	3.2	0.2	1.1	2.5	0.6	32.1	71.9
	Aug	E	0.9	1.3	2.6	9.5	17.6	3.3	0.1	1.2	3.0	0.6	31.5	71.5
		M	1.1	1.3	2.9	7.0	13.1	2.7	0.1	1.2	3.1	0.6	32.8	65.9
		L	0.9	1.2	2.5	7.6	14.0	2.8	0.1	1.1	3.0	0.3	26.3	59.8
	Sep	E	1.1	1.1	2.5	7.9	10.7	2.8	0.1	1.1	3.1	0.2	28.8	59.4
		M	1.1	0.8	2.0	8.3	12.4	3.2	0.2	1.1	3.2	0.2	27.5	60.0
		L	1.0	0.6	1.9	12.2	12.1	2.6	0.1	1.1	3.0	0.2	24.2	59.0
	Oct	E	0.9	0.3	0.0	13.0	12.8	8.8	0.2	0.9	3.1	0.1	20.7	60.8
		M	0.9	0.2	0.7	12.1	8.4	0.7	0.0	0.4	2.1	0.1	16.8	42.4
		L	0.6	0.5	1.5	12.7	6.0	1.3	0.1	0.7	3.2	0.0	26.3	52.9
	Nov	E	0.2	0.4	2.6	15.8	6.3	2.9	0.1	0.1	2.6	0.0	24.1	55.1
		M	0.2	0.5	0.6	13.2	15.7	4.6	0.0	0.1	2.0	0.0	19.0	55.9
		L	0.3	0.9	1.3	13.5	29.4	8.8	0.0	1.2	2.5	0.0	7.3	65.2
	Dec	E	0.4	1.0	2.4	8.3	35.6	13.8	0.0	0.9	1.4	0.0	1.6	65.4
		M	0.3	1.7	3.2	15.4	21.4	12.6	0.5	0.5	1.7	0.5	10.2	68.0
		L	0.2	1.8	0.9	11.7	9.5	16.2	1.3	1.9	2.4	1.0	8.8	55.7
1995	Jan	E	0.2	1.1	2.6	10.3	6.1	15.5	0.7	1.1	0.9	0.7	4.4	43.6
		M	0.3	1.6	3.8	10.0	14.8	15.8	0.4	0.4	1.0	0.8	6.0	54.9
		L	0.1	1.0	0.6	9.5	12.9	13.7	0.6	0.9	1.1	0.8	15.2	56.4
	Feb	E	0.2	1.6	2.2	9.2	7.5	7.4	0.4	1.0	0.9	0.7	12.3	43.4
		M	0.0	1.0	3.7	7.2	15.2	8.9	0.2	0.8	0.8	0.8	4.7	43.3
		L	0.0	0.0	2.6	6.4	14.8	4.1	0.4	0.9	0.6	0.6	0.0	30.4
	Mar	E	0.0	0.7	0.0	3.2	17.2	6.8	0.7	0.0	0.0	0.5	0.0	29.1
		M	0.2	0.6	0.0	4.0	7.8	11.2	0.3	0.0	0.4	0.7	5.6	30.8
		L	0.7	0.9	1.2	3.5	10.8	9.7	0.1	0.0	0.0	0.4	8.2	35.5
	Apr	E	0.2	0.1	0.4	2.3	6.6	20.7	0.1	0.2	0.7	0.2	16.8	48.3
		M	0.1	0.4	0.6	13.8	8.4	9.0	0.0	0.4	0.0	0.0	8.8	41.5
		L	0.7	0.7	1.2	10.7	9.4	12.5	0.0	0.7	0.7	0.2	11.2	48.0
	May	E	0.2	0.4	1.9	13.2	8.1	13.9	0.1	0.3	0.7	0.4	14.0	53.2
		M	0.8	0.6	3.4	12.5	11.2	16.4	0.3	0.8	1.6	0.4	24.2	72.2
		L	0.7	0.6	4.4	12.8	12.7	12.5	0.2	1.0	1.9	0.7	29.3	76.8
	June	E	0.8	0.9	2.8	8.7	12.0	13.0	0.3	0.8	1.3	0.5	25.9	67.0
		M	1.1	1.1	5.3	6.1	10.1	9.8	0.3	1.1	2.0	0.6	30.2	67.7
		L	0.8	0.8	5.4	9.9	14.0	6.3	0.3	0.9	2.0	0.6	27.6	68.6
	July	E	1.0	1.1	4.9	6.8	13.4	6.7	0.5	0.9	2.4	0.6	26.7	65.0
		M	0.9	1.0	4.6	6.5	12.3	6.3	0.4	1.0	2.2	0.5	26.7	62.4
		L	1.1	1.1	4.4	4.4	10.9	8.0	0.3	1.0	2.5	0.6	28.3	62.5
	Aug	E	1.2	1.2	3.1	5.8	12.0	10.3	0.2	1.1	3.0	0.5	25.8	64.2
		M	1.3	1.1	3.7	5.7	9.1	9.7	0.2	1.1	3.0	0.2	27.3	62.4
		L	1.1	0.8	3.7	7.2	11.3	9.7	0.2	1.1	3.1	0.2	22.4	60.8
	Sep	E	1.2	0.7	3.4	8.7	11.1	9.7	0.2	1.2	3.3	0.0	23.9	63.4
		M	1.1	0.5	2.7	8.9	13.0	11.2	0.2	1.1	3.4	0.0	22.6	64.7
		L	1.1	0.4	2.2	9.8	12.6	8.1	0.2	1.1	3.3	0.0	20.5	59.3
	AVERAGE		0.6	0.8	2.5	9.8	13.8	9.1	0.3	1.0	1.8	0.5	18.0	58.0

Table A4-19 (2-1) Comaprison of Irrigation Water Requirements

Unit ; m³/sec

Month-	Brantas Atas/ Bawah		Molek				Lodoagung				Mrican Kanan				Mrican Kiri			
10-day	Actual	Potential at present	Requested by Dinas	Planned by PJT	Actual	Potential at present	Requested by Dinas	Planned by PJT	Actual	Potential at present	Requested by Dinas	Planned by PJT	Actual	Potential at present	Requested by Dinas	Planned by PJT	Actual	Potential at present
91Oct1	2.04	1.00			4.51	0.10	5.65	5.50	5.51	8.10	5.62	5.10	5.06	12.70	4.00	5.60	5.93	8.70
91Oct2	2.04	0.90			4.03	0.80	5.64	5.50	5.50	7.50	5.57	5.10	5.12	8.30	3.96	5.80	5.91	0.80
91Oct3	2.04	1.00			3.28	0.40	6.25	6.00	5.83	7.10	4.74	5.10	5.09	5.90	3.37	5.80	5.93	1.60
91Nov1	2.04	0.40			3.82	0.60	12.02	10.00	5.97	11.90	5.41	5.50	5.56	6.30	3.79	5.60	5.70	6.20
91Nov2	2.04	0.50			3.09	0.00	17.04	12.50	8.00	7.20	10.74	7.00	5.57	15.70	8.36	7.00	5.69	8.30
91Nov3	2.04	1.00			5.75	0.90	20.95	14.50	8.00	7.00	15.37	8.00	5.58	29.40	11.97	8.00	5.69	7.90
91Dec1	2.04	1.10			6.41	2.10	11.35	9.06	9.06	1.60	14.69	6.95	11.02	35.60	15.30	6.74	11.48	11.80
91Dec2	2.04	1.90			5.83	3.30	10.96	8.69	8.69	9.90	20.35	10.91	13.50	21.40	18.14	10.57	12.50	11.10
91Dec3	2.04	2.00			6.62	1.20	10.46	7.70	7.70	8.30	17.38	9.69	13.04	9.50	16.02	9.39	12.02	11.70
95Jan1	2.04	1.40			6.29	3.80	10.13	9.52	9.52	10.10	16.63	12.89	12.47	6.10	15.01	12.50	11.26	10.30
95Jan2	2.04	2.00			6.37	4.50	9.84	9.17	9.14	11.40	15.50	9.95	11.63	14.80	14.67	9.64	11.00	18.10
95Jan3	2.04	1.20			7.13	0.60	9.74	8.13	8.13	13.80	15.91	9.95	11.93	12.90	14.29	9.61	10.72	14.80
95Feb1	2.04	1.80			6.12	2.40	9.62	7.63	7.63	12.80	15.17	9.95	11.38	7.50	14.28	9.64	10.71	5.30
95Feb2	2.04	1.10			6.10	4.60	9.41	7.83	7.83	11.80	15.16	9.95	11.37	15.20	14.05	9.61	10.54	6.60
95Feb3	2.04	0.00			6.89	3.80	9.34	7.14	7.14	12.10	15.17	9.95	11.38	14.80	12.82	9.64	9.62	3.40
95Mar1	2.04	0.90			6.17	0.60	9.06	7.11	7.11	9.40	15.79	10.05	10.00	17.20	14.97	9.73	10.00	5.50
95Mar2	2.04	0.80			6.25	1.60	9.54	7.06	7.06	10.60	15.57	9.97	10.00	7.60	14.67	9.66	10.00	10.70
95Mar3	2.04	1.40			6.89	3.40	8.93	7.52	7.52	13.40	13.80	9.16	10.00	9.00	17.32	8.88	10.00	11.70
95Apr1	2.04	0.20			6.40	2.50	8.96	8.94	8.94	11.60	11.88	9.16	8.90	5.50	12.55	8.69	9.41	22.60
95Apr2	2.04	0.20			6.30	2.00	10.27	8.62	8.62	12.30	11.16	9.16	8.37	8.10	10.21	8.88	7.66	9.10
95Apr3	2.04	1.10			6.21	2.20	10.81	8.59	8.59	11.20	9.42	9.16	7.07	13.70	9.73	8.88	7.30	12.90
95May1	2.04	0.70			5.45	2.70	8.84	7.02	7.02	17.40	9.08	9.16	6.81	17.80	9.85	8.88	7.39	14.10
95May2	2.04	1.60			6.09	3.90	9.20	6.97	6.97	13.70	7.77	9.16	5.83	22.30	9.44	8.88	7.08	16.80
95May3	2.04	1.30			6.58	5.00	9.01	6.97	6.97	14.90	7.68	9.16	5.76	24.30	9.25	8.88	6.94	12.60
95Jun1	2.04	1.60			6.67	3.40	10.12	7.00	9.95	11.30	15.43	6.50	8.92	22.00	11.53	6.00	9.21	13.20
95Jun2	2.04	2.30			6.69	4.60	10.12	5.00	10.00	8.00	14.98	3.80	6.80	15.70	10.81	3.80	6.40	10.00
95Jun3	2.04	1.70			6.07	4.70	10.10	5.00	10.00	12.60	14.92	3.80	6.55	21.70	10.76	3.80	6.09	6.40
95Jul1	2.04	2.30			6.65	4.40	10.35	9.00	9.57	11.50	14.93	7.00	7.56	21.90	10.39	6.50	6.07	5.60
95Jul2	2.04	1.90			6.51	4.10	9.37	8.00	7.57	10.50	14.64	7.00	6.55	20.30	11.16	6.00	6.07	3.40
95Jul3	2.04	2.10			6.37	3.50	8.02	6.00	6.05	8.80	11.65	7.00	6.79	17.80	10.89	5.00	5.60	3.20
95Aug1	2.04	2.20			5.84	2.60	7.04	6.00	6.00	9.50	12.30	5.00	5.04	17.50	8.03	5.00	5.03	3.30
95Aug2	2.04	2.40			5.78	2.90	6.24	6.00	6.00	7.00	9.12	4.00	4.07	13.10	6.51	4.00	4.10	2.70
95Aug3	2.04	2.10			5.40	2.50	6.31	6.00	6.00	7.60	7.49	4.00	4.02	14.00	6.10	3.50	4.08	2.80
95Sep1	2.04	2.20			5.67	2.50	6.31	6.00	6.00	7.90	7.02	4.00	4.03	10.70	6.63	3.50	4.08	2.80
95Sep2	2.04	1.90			5.76	2.00	6.31	6.00	6.00	8.30	6.89	3.50	4.03	12.40	6.39	4.00	5.59	3.20
95Sep3	2.04	1.60			6.48	1.90	6.31	6.00	6.00	12.20	5.40	3.50	4.02	12.10	5.72	4.00	5.59	2.60
95Oct1	2.04	1.20			5.16	0.00	5.65	6.00	6.00	13.00	5.62	3.00	3.43	12.80	4.00	3.00	3.49	8.80
95Oct2	2.04	1.10			5.97	0.70	5.64	6.00	6.00	12.10	5.57	3.00	3.10	8.40	3.96	3.00	0.91	0.70
95Oct3	2.04	1.10			5.50	1.50	6.25	6.00	6.00	12.70	4.74	3.00	3.10	6.00	3.37	3.00	2.77	1.30
95Nov1	2.04	0.60			6.12	2.60	12.02	7.00	6.97	15.80	5.41	3.00	3.78	6.30	3.79	3.00	1.55	2.90
95Nov2	2.04	0.70			5.63	0.60	17.04	10.00	9.83	13.20	10.74	7.00	7.74	15.70	8.36	7.00	6.85	4.60
95Nov3	2.04	1.20			6.27	1.30	20.95	12.50	12.43	13.50	15.37	10.00	12.33	29.40	11.97	10.00	10.79	8.80
95Dec1	2.04	1.40			6.05	2.40		9.06	9.51	8.30		6.95	12.57	35.60		6.74	12.55	13.80
95Dec2	2.04	2.00			5.90	3.20		8.68	8.62	15.40		10.91	10.98	21.40		10.57	12.54	12.60
95Dec3	2.04	2.00			6.25	0.90		7.70	7.72	11.70		6.69	12.37	9.50		9.39	12.54	16.20
96Jan1	2.04	1.30			6.25	2.60		9.52	9.50	10.30		12.89	12.91	6.10		12.50	12.59	15.50
96Jan2	2.04	1.90			6.19	3.80		9.17	9.21	10.00		9.95	10.06	14.80		9.64	9.75	15.80
96Jan3	2.04	1.10			6.95	0.60		8.13	8.03	9.50		9.95	9.98	12.90		9.64	9.73	13.70
96Feb1	2.04	1.80			6.54	2.20		7.63	7.70	9.20		9.95	10.00	7.50		9.64	9.74	7.40
96Feb2	2.04	1.00			7.07	3.70		7.83	7.77	7.20		9.95	9.99	15.20		9.64	9.73	8.90
96Feb3	2.04	0.00			6.33	2.60		7.14	7.28	8.40		9.95	10.01	14.80		9.64	9.75	4.10
96Mar1	2.04	0.70			7.01	0.00		7.11	7.01	3.20		10.05	9.85	17.20		9.73	9.50	6.80
96Mar2	2.04	0.80			7.15	0.00		7.06	7.00	4.00		9.97	10.00	7.80		9.66	9.75	11.20
96Mar3	2.04	1.60			7.14	1.20		7.52	7.35	3.50		9.16	9.65	10.80		8.88	9.39	9.70
96Apr1	2.04	0.30			6.15	0.40	7.24	8.94	8.96	2.30	13.27	9.16	9.24	6.60	12.55	8.86	8.93	20.70
96Apr2	2.04	0.50			6.43	0.60	10.51	8.62	8.63	13.80	12.16	9.16	9.29	8.40	10.21	8.88	8.93	9.00
96Apr3	2.04	1.40			6.78	1.20	11.65	8.59	8.60	10.70	10.15	9.16	9.24	9.40	9.73	8.88	8.96	12.50
96May1	2.04	0.60			6.05	1.90	10.54	7.02	7.05	13.20	9.51	9.15	9.23	8.10	9.56	8.88	8.96	13.90
96May2	2.04	1.40			6.50	3.40	9.18	6.97	7.00	12.50	8.73	9.16	9.22	11.20	9.44	8.88	8.96	16.40
96May3	2.04	1.30			6.56	4.40	9.18	6.97	8.47	12.80	8.66	9.16	9.23	12.70	9.25	8.88	8.97	12.50
96Jun1	2.04	1.70			5.78	2.80	10.00	9.00	9.00	8.70	9.05	8.14	8.25	12.00	9.33	8.40	8.47	13.00
96Jun2	2.04	2.20			6.23	5.30	10.00	9.00	9.00	6.10	8.98	8.08	8.16	10.10	9.20	8.28	8.01	9.80
96Jun3	2.04	1.60			6.21	5.40	9.98	9.00	9.00	9.90	9.03	8.12	8.13	14.00	8.21	7.39	7.45	6.30
96Jul1	2.04	2.10			5.56	4.90	10.46	9.50	9.50	8.80	9.24	8.31	8.32	13.40	7.44	6.69	6.73	6.70
96Jul2	2.04	1.90			6.30	4.60	10.95	9.50	9.50	6.50	8.69	7.82	7.89	12.30	5.57	5.01	5.13	6.30
96Jul3	2.04	2.20			6.14	4.40	10.05	9.50	9.50	4.40	7.71	6.94	7.04	10.90	5.25	4.73	4.89	8.00
96Aug1	2.04	2.40			5.67	3.10	11.64	9.50	9.50	5.80	6.27	5.65	5.94	12.00	5.21	4.69	4.87	10.30
96Aug2	2.04	2.40			5.43	3.70	10.69	9.50	9.50	5.70	4.89	4.40	4.79	9.10	5.25	4.72	4.88	9.70
96Aug3	2.04	1.90			4.87	3.70	7.91	7.00	7.08	7.20	5.04	4.54	4.59	11.30	5.28	4.75	4.88	9.70
96Sep1	2.04	1.90			5.63	3.40	6.84	6.00	6.00	8.70	5.51	4.95	5.02	11.10	4.92	4.43	4.27	9.70
96Sep2	2.04	1.60			5.57	2.70	6.84	6.00	6.00	8.90	5.52	4.97	5.05	13.00	4.94	4.45	4.45	11.20
96Sep3	2.04	1.50			5.37	2.20	6.84	6.00	6.00	9.80	5.58	5.02	5.05	12.60	4.91	4.42	4.45	8.10
Ave	**2.0**	**1.4**			**6.1**	**2.7**	**9.6**	**7.6**	**7.8**	**9.9**	**10.7**	**7.7**	**8.2**	**13.9**	**9.6**	**7.4**	**7.9**	**9.5**
Max	**2.0**	**2.4**			**7.2**	**5.4**	**21.0**	**14.5**	**12.4**	**17.4**	**20.4**	**12.9**	**13.5**	**35.6**	**18.1**	**12.5**	**12.6**	**22.6**

Source: PJT

Note: "Potential at present" is estimated by JICA Team

Table A4-19 (2-2) Comaprison of Irrigation Water Requirements

Unit : m³/sec

Month-10-day	BTS Kr Kediri				Jatimlerek				Menturus				Jatikulon			
	Requested by Dinas	Planned by PJT	Actual	Potential at present	Requested by Dinas	Planned by PJT	Actual	Potential at present	Requested by Dinas	Planned by PJT	Actual	Potential at present	Requested by Dinas	Planned by PJT	Actual	Potential at present
94Oct1				0.10	0.60	0.70	0.97	0.80	3.79	1.10	1.36	2.80				0.20
94Oct2				0.00	0.59	0.70	0.95	0.30	3.86	1.10	1.26	2.30				0.10
94Oct3				0.10	0.50	0.70	0.94	0.70	3.93	1.10	1.20	3.60				0.00
94Nov1				0.10	0.57	1.25	0.91	0.10	4.02	2.20	2.21	2.40				0.00
94Nov2				0.00	1.33	1.25	1.02	2.00	4.15	2.20	2.24	1.90				0.00
94Nov3				0.00	1.91	1.25	1.29	5.10	4.29	2.20	2.26	2.30				1.00
94Dec1	0.27	0.45	0.27	0.00	1.84	2.16	1.84	2.30	4.18	1.58	2.51	1.30	0.98	0.50	0.98	1.70
94Dec2	0.66	0.72	0.66	0.50	1.89	1.92	1.83	0.40	4.05	1.96	2.43	1.10	0.98	0.53	0.98	1.40
94Dec3	0.73	0.64	0.73	1.30	1.98	1.73	1.98	1.80	4.40	2.20	2.64	1.80	0.98	0.70	0.98	0.90
95Jan1	0.86	0.85	0.86	0.70	1.85	1.73	1.85	1.80	4.40	2.75	2.64	0.90	0.98	0.60	0.98	0.60
95Jan2	0.95	0.66	0.95	0.40	1.84	1.73	1.84	1.20	4.59	2.84	2.75	0.90	0.79	0.71	0.79	1.00
95Jan3	0.56	0.66	0.56	0.60	1.82	1.73	1.82	0.60	4.68	2.72	2.81	1.10	0.70	0.74	0.70	1.10
95Feb1	0.56	0.66	0.56	0.40	1.83	1.73	1.83	0.90	5.02	1.99	1.99	0.80	0.36	0.68	0.36	0.60
95Feb2	0.54	0.66	0.54	0.20	1.82	1.73	1.82	1.60	4.27	1.99	1.99	0.70	0.42	0.58	0.42	0.70
95Feb3	0.54	0.66	0.54	0.40	1.82	1.37	1.82	2.00	3.38	1.87	1.87	0.60	0.42	0.48	0.42	0.80
95Mar1	0.58	0.66	0.58	0.70	1.67	0.98	1.25	0.00	3.34	1.69	1.69	0.00	0.26	0.44	0.26	0.80
95Mar2	0.58	0.66	0.58	0.30	1.49	0.81	1.12	1.00	3.08	1.78	1.78	0.40	0.26	0.56	0.26	0.80
95Mar3	0.58	0.60	0.58	0.10	1.41	0.54	1.06	0.50	2.73	1.58	1.58	0.00	0.26	0.56	0.26	0.50
95Apr1	0.53	0.60	0.53	0.10	1.44	0.54	1.08	0.40	2.95	1.58	1.58	0.70	0.27	0.56	0.27	0.40
95Apr2	0.53	0.60	0.53	0.00	0.91	0.54	0.68	0.60	3.05	1.58	1.58	0.00	0.30	0.56	0.30	0.00
95Apr3	0.49	0.60	0.49	0.00	0.74	0.54	0.56	1.20	2.96	1.58	1.58	0.70	0.36	0.56	0.36	0.00
95May1	0.41	0.60	0.41	0.10	0.70	0.54	0.53	0.50	2.86	1.58	1.58	0.80	0.40	0.56	0.40	0.20
95May2	0.15	0.60	0.15	0.30	0.67	0.54	0.50	0.80	2.86	1.58	1.58	1.50	0.40	0.56	0.40	0.50
95May3	0.15	0.60	0.15	0.20	0.64	0.54	0.48	1.10	2.86	1.58	1.58	2.10	0.40	0.56	0.40	0.70
95Jun1				0.30	1.51	1.00	1.04	1.00	3.55	1.50	1.86	1.50	1.04			0.50
95Jun2				0.20	1.42	0.60	1.37	1.30	3.73	0.80	1.83	2.30	0.93			0.50
95Jun3				0.30	1.11	0.60	1.24	1.50	3.95	0.80	1.81	2.00	0.91			0.50
95Jul1				0.40	1.10	1.00	1.20	1.40	4.06	2.00	0.00	2.60	0.90			0.70
95Jul2				0.30	1.10	1.00	0.65	1.20	4.05	2.00	1.80	2.20	0.88			0.60
95Jul3				0.20	0.95	0.80	0.83	1.10	3.88	2.00	1.89	2.50	0.81			0.60
95Aug1				0.10	1.05	0.70	0.78	1.20	3.70	2.00	1.84	3.00	0.72			0.60
95Aug2				0.10	1.16	0.60	0.00	1.20	3.38	1.50	1.80	3.10	0.61			0.60
95Aug3				0.10	1.05	0.50	0.00	1.10	2.89	1.50	1.73	3.00	0.45			0.30
95Sep1				0.10	1.04	0.50	0.00	1.10	2.66	1.20	1.34	3.10	0.39			0.20
95Sep2				0.20	1.03	0.50	0.00	1.10	2.63	1.20	1.44	3.20	0.32			0.20
95Sep3				0.10	0.98	0.50	0.40	1.10	2.78	1.00	1.00	3.00	0.34			0.20
95Oct1				0.20	0.60	0.40	0.89	0.90	3.79	1.00	0.98	3.10	0.34			0.10
95Oct2				0.00	0.59	0.40	0.93	0.40	3.86	1.00	1.07	2.10	0.34			0.10
95Oct3				0.10	0.50	0.40	0.95	0.70	3.93	1.00	1.27	3.20	0.34			0.00
95Nov1				0.10	0.57	0.40	0.58	0.10	4.02	1.00	1.40	2.60	0.34			0.00
95Nov2				0.00	1.33	0.80	0.64	0.10	4.15	1.00	1.39	2.00	0.34			0.00
95Nov3				0.00	1.91	1.20	2.05	1.20	4.29	1.00	1.37	2.50	0.34			0.00
95Dec1				0.00		2.16	2.06	0.90		1.72	1.64	1.40				0.00
95Dec2				0.50		1.92	1.37	0.50		1.96	3.93	1.70				0.50
95Dec3				1.30		1.73	0.40	1.90		2.20	3.65	2.40				1.00
96Jan1				0.70		1.73	2.11	1.10		2.75	4.01	0.90				0.70
96Jan2				0.40		1.73	1.94	0.40		2.84	4.05	1.00				0.80
96Jan3				0.60		1.73	1.77	0.90		2.72	4.12	1.10				0.80
96Feb1				0.40		1.73	0.84	1.00		1.99	4.12	0.90				0.70
96Feb2				0.20		1.73	1.61	0.80		1.99	4.11	0.80				0.80
96Feb3				0.40		1.37	1.45	0.90		1.87	4.07	0.60				0.60
96Mar1				0.70		0.98	0.74	0.00		1.69	4.12	0.00				0.50
96Mar2				0.30		0.81	1.37	0.00		1.78	4.21	0.40				0.70
96Mar3				0.10		0.54	1.72	0.00		1.58	4.58	0.00				0.40
96Apr1	0.53			0.10	1.09	0.54	1.22	0.20	2.96	1.58	4.41	0.70	0.32			0.20
96Apr2	0.53			0.00	0.93	0.54	1.80	0.40	2.96	1.58	4.22	0.00	0.36			0.00
96Apr3	0.49			0.00	0.84	0.54	1.47	0.70	2.96	1.58	4.24	0.70	0.37			0.20
96May1	0.91			0.10	0.79	0.54	0.99	0.30	2.96	1.58	3.37	0.70	0.37			0.40
96May2	0.65			0.30	0.72	0.54	1.71	0.80	2.96	1.58	2.74	1.60	0.38			0.40
96May3	0.65			0.20	0.73	0.54	1.28	1.00	2.85	1.58	2.30	1.90	0.38			0.70
96Jun1	0.66			0.30	0.74	0.74	1.18	0.80	2.69	1.67	1.99	1.30	0.38			0.50
96Jun2	0.66			0.30	0.75	0.75	0.85	1.10	2.71	1.69	1.88	2.00	0.39			0.60
96Jun3	0.61			0.30	0.76	0.76	0.85	0.90	2.75	1.72	1.85	2.00	0.41			0.60
96Jul1	0.64			0.50	0.88	0.88	0.86	0.90	2.65	1.83	1.85	2.40	0.43			0.60
96Jul2	0.64			0.40	0.83	0.83	0.84	1.00	2.96	1.93	1.83	2.20	0.33			0.50
96Jul3	0.70			0.30	0.67	0.67	0.85	1.00	2.96	1.93	1.16	2.50	0.20			0.50
96Aug1	0.69			0.20	0.52	0.52	0.88	1.10	2.96	1.93	1.94	3.00	0.19			0.50
96Aug2	0.69			0.20	0.67	0.67	0.89	1.10	2.96	1.93	1.94	3.00	0.19			0.20
96Aug3	0.69			0.20	0.64	0.64	0.83	1.10	2.92	1.89	1.96	3.10	1.83			0.20
96Sep1	0.69			0.20	0.67	0.50	0.76	1.20	2.77	1.31	1.48	3.30	0.18			0.00
96Sep2	0.66			0.20	0.79	0.59	0.78	1.10	2.64	1.21	1.48	3.40	0.18			0.00
96Sep3	0.63			0.20	0.80	0.60	0.74	1.10	2.53	1.13	1.48	3.30	0.14			0.00
Ave	**0.6**	**0.6**	**0.5**	**0.3**	**1.1**	**1.0**	**1.1**	**0.9**	**3.4**	**1.7**	**2.3**	**1.7**	**0.5**	**0.6**	**0.5**	**0.5**
Max	**1.0**	**0.9**	**1.0**	**1.3**	**2.0**	**2.2**	**2.1**	**5.1**	**5.0**	**2.8**	**4.6**	**3.6**	**1.8**	**0.8**	**1.0**	**1.7**

Table A4-19 (2-3) Comaprison of Irrigation Water Requirements

Unit : m3/sec

Month-	Delta Brantas						Basin total			
10-day	Total request by Dinas	Industry	Irrigation & fishery	Planned by PJT	Actual	Potential at present	Requested by Dinas	Planned by PJT	Actual	Potential at present
94Oct1	22.28	7.72	14.56	14.00	18.28	9.60	34.22	32.20	43.65	44.10
94Oct2	25.20	7.72	17.48	14.00	13.67	10.30	37.10	32.20	44.47	31.30
94Oct3	32.25	7.72	24.53	14.00	14.51	22.30	43.32	32.70	38.80	42.70
94Nov1	41.12	7.72	33.40	19.40	11.99	24.50	59.21	43.95	38.23	52.50
94Nov2	48.65	7.72	40.93	22.00	13.42	23.10	82.55	51.95	41.07	58.70
94Nov3	48.76	7.72	41.04	25.00	16.53	13.80	95.53	58.95	47.14	69.40
94Dec1	53.60	7.72	45.88	29.45	34.84	9.70	91.49	56.90	80.45	67.20
94Dec2	53.70	7.72	45.98	33.62	34.91	20.30	103.01	68.92	83.43	71.30
94Dec3	53.60	7.72	45.88	32.66	34.84	19.20	97.83	64.71	82.59	57.70
95Jan1	43.94	6.64	37.30	34.14	32.96	13.00	87.16	75.18	80.87	48.70
95Jan2	43.94	6.64	37.30	34.14	32.96	18.60	85.48	68.84	79.47	70.90
95Jan3	43.94	6.64	37.30	34.14	32.96	25.30	85.00	67.68	78.85	72.20
95Feb1	40.17	6.64	33.53	28.71	30.13	16.20	80.37	60.99	72.75	48.70
95Feb2	37.94	6.64	31.30	28.05	28.45	8.80	76.97	60.43	71.11	51.30
95Feb3	37.94	6.64	31.30	27.86	28.45	5.00	74.79	58.97	70.18	42.90
95Mar1	21.70	6.64	15.06	26.77	16.29	5.30	60.73	57.43	55.38	40.40
95Mar2	24.60	6.64	17.96	25.91	18.45	10.10	63.15	56.44	57.54	43.90
95Mar3	33.45	6.64	26.81	22.34	25.09	6.10	71.84	51.18	65.02	46.10
95Apr1	29.45	6.64	22.81	22.34	22.34	16.00	61.37	52.60	61.49	60.00
95Apr2	38.88	6.64	32.24	22.34	22.34	3.00	68.67	52.28	58.41	35.30
95Apr3	38.35	6.64	31.71	22.34	22.34	5.50	66.22	52.25	58.54	48.50
95May1	40.70	6.64	34.06	22.34	22.34	9.90	66.20	50.68	53.97	64.20
95May2	39.10	6.64	32.46	22.34	22.34	19.30	62.95	50.63	52.98	80.70
95May3	38.10	6.64	31.46	22.34	22.34	24.40	61.45	50.63	53.24	86.60
95Jun1	47.32	6.64	40.68	17.00	41.00	21.40	83.86	39.00	80.69	76.20
95Jun2	49.56	6.64	42.92	15.00	49.76	32.40	84.91	29.00	84.89	80.30
95Jun3	52.67	6.64	46.03	13.00	42.74	35.20	87.78	27.00	78.51	86.60
95Jul1	48.03	6.64	41.39	23.00	44.29	32.20	83.12	48.50	77.39	83.20
95Jul2	44.33	6.64	37.69	21.00	29.31	30.00	78.89	45.00	60.50	74.50
95Jul3	44.33	6.64	37.69	21.00	39.52	32.10	73.89	41.80	69.09	71.90
95Aug1	40.73	6.64	34.09	21.00	33.04	31.50	66.93	39.70	59.61	71.50
95Aug2	37.89	6.64	31.25	18.00	29.11	32.80	58.27	34.10	52.90	65.90
95Aug3	31.57	6.64	24.93	16.00	29.39	26.30	49.22	31.50	52.66	59.80
95Sep1	21.48	6.64	14.84	11.00	21.53	28.80	38.89	26.20	44.69	59.40
95Sep2	21.48	6.64	14.84	10.00	13.55	27.50	38.41	25.20	38.41	60.00
95Sep3	15.04	6.64	8.40	8.00	14.45	24.20	29.93	23.00	39.98	59.00
95Oct1	22.28	6.64	15.64	8.00	12.01	20.70	35.64	21.40	34.06	60.80
95Oct2	25.20	6.64	18.56	8.00	20.30	16.80	38.52	21.40	40.32	42.40
95Oct3	32.25	6.64	25.61	11.00	23.77	26.30	44.74	24.40	45.40	52.90
95Nov1	41.12	6.64	34.48	13.00	24.01	24.10	60.63	27.40	45.45	55.10
95Nov2	48.65	6.64	42.01	15.00	30.59	19.00	83.97	41.60	64.77	55.90
95Nov3	48.76	6.64	42.12	16.00	34.55	7.30	96.95	50.70	81.83	65.20
95Dec1				29.45	39.36	1.60	0.00	56.08	85.78	65.40
95Dec2				33.62	39.34	10.20	0.00	67.66	84.72	68.00
95Dec3				32.68	39.34	8.80	0.00	60.39	84.51	55.70
96Jan1				34.14	42.67	4.40	0.00	74	92.08	43.60
96Jan2				34.14	43.23	6.00	0.00	67	86.47	54.90
96Jan3				34.14	39.87	15.20	0.00	66	82.49	58.40
96Feb1				28.71	43.92	12.30	0.00	60	84.90	43.40
96Feb2				28.05	44.82	4.70	0.00	59	87.14	43.30
96Feb3				27.86	43.21	0.00	0.00	58	90.14	30.40
96Mar1				26.77	48.77	0.00	0.00	56	89.04	29.10
96Mar2				25.91	25.23	5.60	0.00	55	68.75	30.80
96Mar3				22.34	40.18	8.20	0.00	50	82.05	35.50
96Apr1	31.41	3.2	28.21	22.34	41.45	16.80	66.17	51.44	82.45	48.30
96Apr2	39.63	3.2	36.43	22.34	32.85	8.80	74.09	51.12	74.25	41.50
96Apr3	35.97	3.2	32.77	22.34	33.17	11.20	69.16	51.09	74.50	48.00
96May1	41.67	3.2	38.47	22.34	45.45	14.00	73.10	49.52	83.14	53.20
96May2	32.25	3.2	29.05	22.34	36.76	24.20	61.09	49.47	74.93	72.20
96May3	31.98	3.2	28.78	22.34	35.98	29.30	60.48	49.47	74.83	76.80
96Jun1	32.23	3.2	29.03	23.47	32.64	25.90	61.88	51.42	69.55	67.00
96Jun2	30.61	3.2	27.41	22.25	30.41	30.20	60.10	50.06	66.52	67.70
96Jun3	30.37	3.2	27.17	22.07	26.67	27.60	58.92	49.06	62.20	68.60
96Jul1	28.01	6.2	21.81	18.95	25.02	26.70	53.74	46.18	59.88	65.00
96Jul2	25.48	6.2	19.28	17.18	24.78	26.70	49.24	42.27	58.31	62.40
96Jul3	21.22	6.2	15.02	14.20	25.32	28.30	42.55	37.97	56.94	62.50
96Aug1	17.97	6.2	11.77	12.77	23.36	25.80	39.26	35.06	54.18	64.20
96Aug2	19.39	6.2	13.19	11.07	37.25	27.30	38.52	32.29	86.72	62.40
96Aug3	23.07	6.2	16.87	11.07	27.94	22.40	41.18	29.89	54.19	60.80
96Sep1	27.61	6.2	21.41	10.67	25.37	23.90	42.99	27.87	50.57	63.40
96Sep2	34.98	6.2	28.78	10.21	21.65	22.60	50.34	27.43	47.02	64.70
96Sep3	28.83	6.2	22.63	8.37	21.65	20.50	44.06	25.54	46.78	59.30
Ave	**35.5**	**6.1**	**29.5**	**21.7**	**31.2**	**18.1**	**64.9**	**48.3**	**67.8**	**58.8**
Max	**53.7**	**7.7**	**46.0**	**34.1**	**49.8**	**35.2**	**103.0**	**75.2**	**92.1**	**86.6**

Table A4-20 (1) Future Water Demands by Areas (Case 1)

Irrigation efficiency = 50% Unit ; m3/sec

Year		Intake/Area Name											
Month		Brantas Atas	Brantas Bawah	Molek	Lodoagung	Mrican Kanan	Warujayeng -Kertosono	Brantas Kediri Kiri	Jatimlerek-Bunder	Menturus Rubber Dam	Jatikulon	Delta Brantas	TOTAL
Oct.	E	0.6	1.1	0.0	7.1	8.1	7.2	0.1	0.8	2.9	0.1	9.3	37.3
	M	0.9	1.7	2.7	10.2	9.3	1.9	0.3	0.3	1.9	0.0	6.8	36.0
	L	0.8	2.0	3.3	10.8	15.3	10.6	1.0	2.0	3.3	0.6	16.8	66.5
Nov	E	0.4	1.5	4.5	13.5	20.2	15.8	1.3	2.8	3.3	1.4	24.9	89.6
	M	0.3	1.9	3.8	14.2	21.0	17.4	0.9	3.3	3.0	1.6	24.9	92.3
	L	0.3	1.6	4.7	15.1	23.7	19.7	0.7	2.7	2.6	1.3	19.9	92.3
Dec	E	0.2	0.9	3.7	7.8	25.1	23.6	0.7	1.2	0.9	0.7	19.4	84.2
	M	0.3	1.3	3.4	11.3	16.6	16.1	0.6	0.8	1.0	1.0	28.9	81.3
	L	0.2	1.1	0.8	8.8	12.3	12.9	0.5	2.0	1.9	1.0	20.8	62.3
Jan	E	0.1	0.5	1.4	8.3	4.8	8.9	0.3	1.3	1.0	0.8	11.6	39.0
	M	0.1	1.0	2.0	6.0	10.9	11.3	0.4	0.7	0.9	0.9	10.9	45.1
	L	0.0	0.0	0.0	4.2	4.9	7.3	0.1	0.8	0.8	0.8	14.4	33.3
Feb	E	0.1	0.1	0.0	2.6	1.0	0.0	0.0	0.0	0.1	0.2	6.1	10.2
	M	0.2	0.2	1.1	2.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	3.6
	L	0.1	0.2	1.2	3.2	1.2	0.0	0.2	0.1	0.0	0.1	0.0	6.3
Mar	E	0.2	0.2	0.3	3.3	4.1	3.8	0.4	0.2	0.1	0.3	1.3	14.2
	M	0.2	0.2	1.7	6.0	5.3	6.1	0.3	0.5	0.4	0.6	8.3	29.6
	L	0.3	0.4	3.1	8.1	9.4	8.9	0.3	0.4	0.2	0.4	11.5	43.0
Apr	E	0.2	0.2	2.5	6.2	11.2	15.8	0.6	0.4	0.9	0.4	20.3	58.7
	M	0.2	0.2	2.4	6.6	9.5	6.8	0.2	0.6	0.2	0.3	18.4	45.4
	L	0.6	0.6	2.5	6.0	10.7	12.0	0.4	1.0	1.0	0.3	14.7	49.8
May	E	0.1	0.2	2.9	9.5	11.6	12.6	0.4	0.3	1.0	0.5	13.1	52.2
	M	0.7	0.7	3.2	6.5	14.0	13.4	0.5	0.9	1.7	0.6	18.3	60.5
	L	0.4	0.5	3.1	6.0	11.7	9.8	0.3	1.1	2.1	0.6	19.4	55.0
Jun	E	0.5	0.5	0.7	3.5	10.7	10.2	0.3	0.6	1.3	0.3	12.0	40.6
	M	0.6	0.6	1.3	0.8	8.0	7.6	0.0	0.8	2.1	0.3	15.1	37.2
	L	0.4	0.3	1.7	4.9	9.7	5.1	0.1	0.7	1.8	0.1	13.8	38.6
Jul	E	0.7	0.6	1.4	4.1	10.0	6.6	0.1	0.6	2.1	0.1	8.6	34.9
	M	0.5	0.5	1.4	4.8	8.8	6.3	0.1	0.5	1.9	0.1	7.5	32.4
	L	0.7	0.5	1.5	4.7	9.6	7.1	0.1	0.6	2.3	0.1	7.7	34.9
Aug	E	0.8	0.4	1.3	6.3	11.0	8.4	0.1	0.9	2.9	0.1	8.1	40.3
	M	0.8	0.6	1.6	6.0	8.9	8.7	0.1	0.9	2.9	0.1	9.7	40.3
	L	0.8	0.6	1.6	6.7	10.3	8.8	0.1	0.9	2.9	0.1	8.6	41.4
Sep	E	0.9	0.6	1.9	7.5	10.3	8.8	0.1	1.0	3.2	0.1	10.5	44.9
	M	0.8	0.5	1.6	6.5	10.0	10.2	0.1	1.0	3.2	0.1	10.8	44.8
	L	0.6	0.5	1.3	5.8	8.0	6.7	0.1	1.0	3.1	0.1	10.6	37.8
AVERAGE		0.4	0.7	2.0	6.8	10.5	9.3	0.3	0.9	1.7	0.4	12.9	46.0
MAX.		0.9	2.0	4.7	15.1	25.1	23.6	1.3	3.3	3.3	1.6	28.9	92.3

Table A7-20 (2) Future Water Demands by Areas (Case 2)

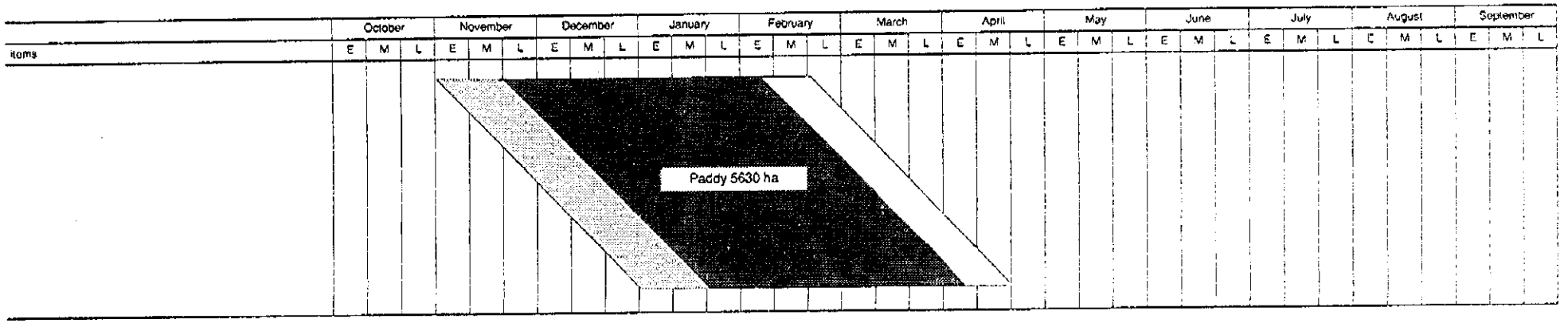
Irrigation efficiency = 50% Unit ; m3/sec

Year		Intake/Area Name											
Month		Brantas Atas	Brantas Bawah	Molek	Lodoagung	Mrican Kanan	Warujayeng -Kertosono	Brantas Kediri Kiri	Jatimlerek-Bunder	Menturus Rubber Dam	Jatikulon	Delta Brantas	TOTAL
Oct.	E	0.7	0.4	0.0	6.3	11.6	9.9	0.1	0.8	2.9	0.1	9.9	42.7
	M	0.6	0.4	0.4	5.4	7.4	1.9	0.0	0.4	2.1	0.1	7.9	26.6
	L	0.3	0.3	0.1	3.6	4.9	3.1	0.1	0.8	2.8	0.1	10.4	26.5
Nov	E	0.1	0.0	0.9	7.4	5.0	4.1	0.1	0.1	1.8	0.1	9.4	29.0
	M	0.3	0.6	0.7	7.3	6.5	4.5	0.5	0.1	0.9	0.0	7.0	28.4
	L	0.5	1.0	1.6	8.3	10.8	8.2	0.8	1.0	1.8	0.6	3.4	38.0
Dec	E	0.3	1.2	2.6	4.7	12.7	12.6	1.1	1.6	1.2	0.9	5.6	44.5
	M	0.3	1.9	4.1	12.3	11.4	11.3	0.7	2.1	1.8	1.5	15.5	62.9
	L	0.2	1.3	2.4	11.7	14.6	14.5	0.5	2.4	2.3	1.2	16.1	67.2
Jan	E	0.2	0.7	2.3	9.9	10.9	13.9	0.3	1.3	1.0	0.8	16.0	57.3
	M	0.3	1.5	3.4	8.9	14.4	14.2	0.5	0.7	0.9	0.9	19.0	64.7
	L	0.2	0.9	1.1	8.8	10.9	12.3	0.5	1.2	1.1	0.9	18.9	56.8
Feb	E	0.2	1.0	2.3	8.5	10.3	6.7	0.2	1.2	1.0	0.8	13.1	45.3
	M	0.0	0.3	2.7	6.9	11.2	7.9	0.2	1.1	1.0	0.8	10.1	42.2
	L	0.0	0.0	1.3	5.6	6.7	3.6	0.0	1.1	0.0	0.5	6.9	25.7
Mar	E	0.0	0.0	0.0	2.4	5.8	5.6	0.0	0.0	0.0	0.1	3.9	17.8
	M	0.2	0.3	0.1	4.0	1.5	4.0	0.1	0.0	0.2	0.1	5.8	16.3
	L	0.4	0.5	1.4	5.1	3.3	3.2	0.3	0.2	0.1	0.2	2.8	17.5
Apr	E	0.2	0.3	1.8	5.0	5.2	11.9	0.6	0.5	0.9	0.5	10.2	37.1
	M	0.2	0.2	2.8	7.0	7.0	4.3	0.3	0.7	0.3	0.5	8.1	31.4
	L	0.4	0.4	3.4	7.4	11.8	12.0	0.3	0.7	0.8	0.4	11.1	48.7
May	E	0.2	0.2	3.1	9.6	13.5	13.5	0.4	0.3	0.7	0.4	16.5	58.4
	M	0.7	0.7	3.6	7.6	13.3	13.1	0.5	0.9	1.5	0.4	23.7	66.0
	L	0.6	0.5	4.0	8.2	12.8	11.0	0.4	1.0	1.8	0.5	21.4	62.2
Jun	E	0.8	0.8	2.1	6.3	13.9	13.2	0.4	0.8	1.2	0.5	16.4	56.4
	M	0.8	0.9	3.0	4.1	12.7	12.1	0.4	1.1	2.1	0.6	22.0	59.8
	L	0.7	0.6	3.2	7.6	14.4	10.7	0.3	1.3	2.1	0.4	22.3	63.6
Jul	E	0.7	0.7	2.9	6.4	14.2	11.3	0.3	1.1	2.4	0.4	18.7	59.1
	M	0.5	0.6	2.2	5.5	13.5	10.2	0.2	1.0	2.1	0.3	17.2	53.3
	L	0.7	0.5	1.7	4.3	11.7	8.5	0.2	0.7	2.2	0.2	16.4	47.1
Aug	E	0.7	0.6	0.9	4.8	11.6	8.1	0.1	0.7	2.5	0.2	11.5	41.7
	M	0.8	0.6	1.5	4.5	8.3	6.8	0.1	0.6	2.5	0.1	11.2	37.0
	L	0.7	0.6	1.6	5.8	10.6	7.4	0.1	0.7	2.7	0.1	7.5	37.8
Sep	E	0.9	0.6	1.9	7.4	10.4	7.5	0.1	0.9	3.1	0.1	9.8	42.7
	M	0.9	0.6	1.9	7.3	11.1	10.2	0.1	0.9	3.2	0.1	10.5	46.8
	L	0.8	0.6	1.9	7.4	10.3	8.0	0.1	1.0	3.1	0.1	10.6	43.9
AVERAGE		0.4	0.6	2.0	6.8	10.2	8.9	0.3	0.9	1.6	0.4	12.4	44.5
MAX.		0.9	1.9	4.1	12.3	14.6	14.5	1.1	2.4	3.2	1.5	23.7	67.2

Table A4-20 (3) Lodoagung Diversion Requirements (Case 2)

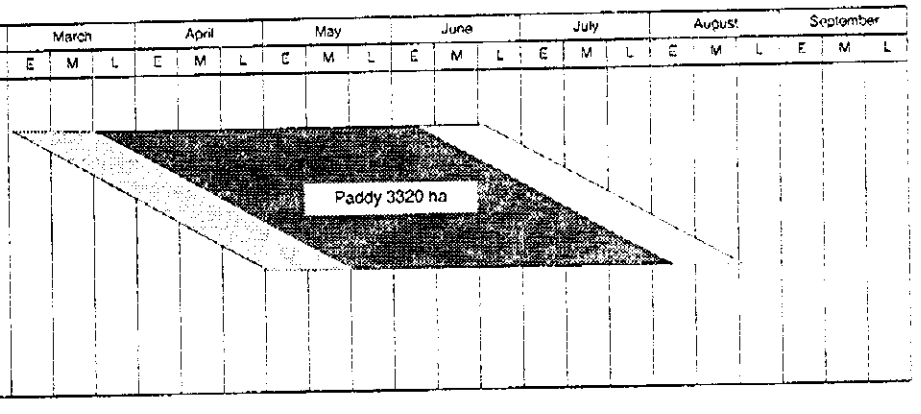
		October			November			December			January			February			March			April			May			June			July			August			September		
		E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L
Rainy Season Paddy 5630ha																																					
A. Net Field Water Requirement	(l/sec/ha)	0.00	0.00	0.00	0.30	0.52	0.65	0.42	1.05	1.04	0.88	0.79	0.78	0.76	0.61	0.50	0.21	0.11	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Irrigation Efficiency		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
C. Unit Diversion Requirement	(l/sec/ha)	0.00	0.00	0.00	0.60	1.04	1.30	0.83	2.10	2.07	1.76	1.58	1.57	1.52	1.22	0.99	0.42	0.22	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Diversion Reruirement	(m3/sec)	0.0	0.0	0.0	3.4	5.9	7.3	4.7	11.8	11.7	9.9	8.9	8.8	8.5	6.9	5.6	2.4	1.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dry Season Paddy 3320ha																																					
A. Net Field Water Requirement	(l/sec/ha)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.61	0.70	0.97	1.06	1.04	0.87	0.87	0.73	0.50	0.58	0.45	0.24	0.10	0.00	0.00	0.00	0.00	0.00	0.00
B. Irrigation Efficiency		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
C. Unit Diversion Requirement	(l/sec/ha)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.77	1.22	1.40	1.93	2.11	2.09	1.74	1.74	1.46	1.00	1.16	0.90	0.48	0.21	0.00	0.00	0.00	0.00	0.00	0.00
D. Diversion Reruirement	(m3/sec)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	4.0	4.6	6.4	7.0	6.9	5.8	5.8	4.8	3.3	3.8	3.0	1.6	0.7	0.0	0.0	0.0	0.0	0.0	0.0
Polowijo 1410ha																																					
A. Net Field Water Requirement	(l/sec/ha)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Irrigation Efficiency		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
C. Unit Diversion Requirement	(l/sec/ha)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Diversion Reruirement	(m3/sec)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Polowijo 3420ha																																					
A. Net Field Water Requirement	(l/sec/ha)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.13	0.20	0.12	0.05	0.30	0.24	0.21	0.13	0.10	0.02	0.00	0.00	0.00	0.00
B. Irrigation Efficiency		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
C. Unit Diversion Requirement	(l/sec/ha)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.26	0.40	0.24	0.11	0.59	0.48	0.41	0.26	0.19	0.03	0.00	0.00	0.00	0.00
D. Diversion Reruirement	(m3/sec)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.9	1.4	0.8	0.4	2.0	1.6	1.4	0.9	0.7	0.1	0.0	0.0	0.0	0.0
Polowijo 6030ha																																					
A. Net Field Water Requirement	(l/sec/ha)	0.33	0.26	0.13	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.08	0.16	0.19	0.29	0.39	0.38	0.39
B. Irrigation Efficiency		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
C. Unit Diversion Requirement	(l/sec/ha)	0.66	0.52	0.26	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.15	0.31	0.39	0.57	0.78	0.76	0.77
D. Diversion Reruirement	(m3/sec)	4.0	3.1	1.6	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.9	1.9	2.3	3.4	4.7	4.6	4.7
Fruit Tree 100ha																																					
A. Net Field Water Requirement	(l/sec/ha)	0.25	0.25	0.20	0.26	0.11	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.04	0.08	0.03	0.23	0.12	0.13	0.06	0.00	0.22	0.22	0.23	0.21	0.25	0.23	0.26	0.29	0.28	0.29
B. Irrigation Efficiency		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
C. Unit Diversion Requirement	(l/sec/ha)	0.49	0.50	0.40	0.51	0.22	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.07	0.15	0.06	0.45	0.24	0.26	0.12	0.00	0.45	0.43	0.47	0.42	0.50	0.46	0.52	0.59	0.57	0.58
D. Diversion Reruirement	(m3/sec)	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
Sugarcane 2510ha																																					
A. Net Field Water Requirement	(l/sec/ha)	0.47	0.46	0.40	0.45	0.28	0.20	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.13	0.08	0.12	0.07	0.29	0.18	0.20	0.14	0.08	0.35	0.36	0.38	0.37	0.43	0.42	0.46	0.52	0.51	0.52
B. Irrigation Efficiency		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
C. Unit Diversion Requirement	(l/sec/ha)	0.93	0.92	0.79	0.90	0.56	0.40	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.27	0.16	0.25	0.15	0.58	0.37	0.40	0.27	0.17	0.71	0.71	0.77	0.73	0.86	0.83	0.91	1.04	1.02	1.05
D. Diversion Reruirement	(m3/sec)	2.3	2.3	2.0	2.3	1.4	1.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.7	0.4	0.6	0.4	1.5	0.9	1.0	0.7	0.4	1.8	1.8	1.9	1.8	2.2	2.1	2.3	2.6	2.6	2.6
Total Diversion Requirement	(m3/sec)	6.3	5.4	3.6	7.4	7.3	8.3	4.7	12.3	11.7	9.9	8.9	8.8	8.5	6.9	5.6	2.4	4.0	5.1	5.0	7.0	7.4	9.6	7.6	8.2	6.3	4.1	7.6	6.4	5.5	4.3	4.8	4.5	5.8	7.4	7.3	7.4

Table A4-20 (4) Future Water Requirement for Rainy Season Paddy 5630ha (Lodoagung) Case 2



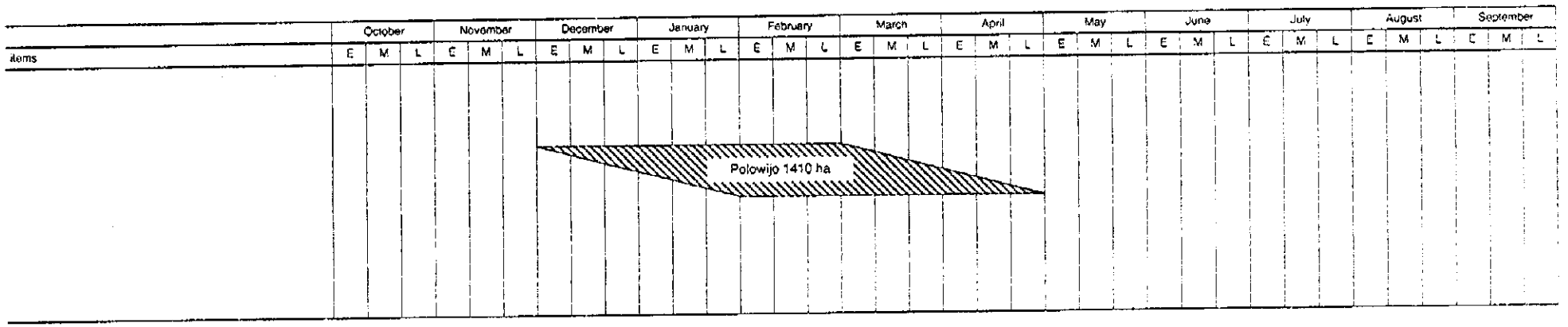
Items		October			November			December			January			February			March			April			May			June			July			August			September		
		E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L
A. Land Preparation Requirement																																					
1. Land Preparation Intensity					1/6	1/3	1/3	1/3	1/3	1/3	1/6																											
2. Land Preparation Requirement	(mm/day/area)	18.00	18.00	18.00	17.68	17.68	17.68	17.61	17.61	17.61	17.50	17.50	17.50	17.43	17.43	17.43	17.42	17.42	17.42	17.34	17.34	17.34	17.25	17.25	17.25	17.19	17.19	17.19	17.20	17.20	17.20	17.63	17.63	17.63	17.73	17.73	17.73
	(mm/day)				2.95	5.89	5.89	5.87	5.87	5.87	2.92																											
3. Water Layer Replacement Intensity									1/6	1/6	1/6	1/3	1/3	1/3	1/6	1/6	1/6																					
4. Water Layer Replacement Requirement	(mm/day/area)								5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00																					
	(mm/day)								0.83	0.83	0.83	1.67	1.67	1.67	0.83	0.83	0.83																					
5. Total Requirement for Land Preparation	(mm/day)				2.95	5.89	5.89	5.87	6.70	6.70	3.75	1.67	1.67	1.67	0.83	0.83	0.83																					
B. Crop Water Requirement																																					
1. Crop Intensity								1/6	1/3	1/2	2/3	5/6	1	1	1	1	5/6	2/3	1/2	1/3	1/6																	
2. Crop Coefficient								1.10	1.10	1.10	1.07	1.05	1.05	0.98	0.32	0.00																					
(HYV)									1.10	1.10	1.10	1.07	1.05	1.05	0.98	0.32	0.00																					
										1.10	1.10	1.10	1.07	1.05	1.05	0.98	0.32	0.00																					
											1.10	1.10	1.10	1.07	1.05	1.05	0.98	0.32	0.00																				
												1.10	1.10	1.10	1.07	1.05	1.05	0.98	0.32	0.00																		
Weighted average								1.10	1.10	1.10	1.09	1.08	1.08	1.06	0.93	0.75	0.68	0.59	0.43	0.16	0.00																
3. Potential ET (ETo)	(mm/day/area)	4.79	4.79	4.79	4.46	4.46	4.46	4.22	4.22	4.22	4.09	4.09	4.09	4.14	4.14	4.14	4.05	4.05	4.05	4.02	4.02	4.02	3.90	3.90	3.90	3.55	3.55	3.55	3.72	3.72	3.72	4.23	4.23	4.23	4.61	4.61	4.61
4. Consumptive Use (ETc)	(mm/day/area)						4.93	4.64	4.64	4.61	4.43	4.41	4.33	3.84	3.08	2.62	2.38	1.76	0.65	0.00																	
5. Percolation	(mm/day/area)						4.40	4.40	4.40	4.40	4.40	4.40	4.40	4.40	4.40	4.40	4.40	4.40	4.40	4.40																	
6. Crop Water Requirement	(mm/day/area)						9.33	9.04	9.04	9.01	8.83	8.81	8.73	8.24	7.48	7.22	6.78	6.16	5.05																		
	(mm/day)						1.55	3.01	4.52	6.01	7.36	8.81	8.73	8.24	7.48	6.01	4.52	3.08	1.66																		
C. Effective Rainfall	(mm/day)	0.46	0.47	0.05	0.35	1.39	1.85	5.29	2.15	3.75	3.49	3.64	3.62	3.36	3.03	2.65	3.55	2.14	1.39	1.76	1.45	1.82	0.23	0.96	0.87	1.26	1.74	0.01	0.14	0.02	0.17	0.13	0.27	0.07	0.00	0.06	0.02
D. Net Field Water Requirement	(mm/day)	0.00	0.00	0.00	2.60	4.51	5.60	3.59	9.06	6.96	7.02	6.84	6.77	6.55	5.29	4.29	1.80	0.94	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(l/sec/ha)	0.00	0.00	0.00	0.30	0.52	0.65	0.42	1.05	1.04	0.88	0.79	0.78	0.76	0.61	0.50	0.21	0.11	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Irrigation Efficiency		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
F. Unit Diversion Requirement	(l/sec/ha)	0.00	0.00	0.00	0.60	1.04	1.30	0.83	2.10	2.07	1.76	1.58	1.57	1.52	1.22	0.99	0.42	0.22	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G. Diversion Requirement	(m3/sec)	0.0	0.0	0.0	3.4	5.9	7.3	4.7	11.8	11.7	9.9	8.9	8.8	8.5	6.9	5.6	2.4	1.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table A4-20 (5) Future Water Requirement for Dry Season Paddy 3320ha (Lodoagung) Case 2



Items		October			November			December			January			February			March			April			May			June			July			August			September		
		E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L
A. Land Preparation Requirement																	1/6	1/3	1/3	1/3	1/3	1/3	1/6															
1. Land Preparation Intensity																																					
2. Land Preparation Requirement	(mm/day/area)	16.83	16.83	16.83	16.68	16.68	16.68	16.44	16.44	16.44	16.33	16.33	16.33	16.45	16.45	16.45	16.46	16.46	16.46	16.36	16.36	16.36	16.28	16.28	16.28	16.05	16.05	16.05	16.03	16.03	16.03	16.47	16.47	16.47	16.79	16.79	16.79
	(mm/day)																2.74	5.49	5.49	5.45	5.45	5.45	2.71															
3. Water Layor Replacement Intensity																					1/6	1/6	1/6	1/3	1/3	1/3	1/6	1/6	1/6									
4. Water Layer Replacement Requirement	(mm/day/area)																				5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00									
	(mm/day)																				0.83	0.83	0.83	1.67	1.67	1.67	0.83	0.83	0.83									
5. Total Requirement for Land Preparation	(mm/day)																2.74	5.49	5.49	5.45	6.29	6.29	3.55	1.67	1.67	1.67	0.83	0.83	0.83									
B. Crop Water Requirement																							1/6	1/3	1/2	2/3	5/6	1	1	1	1	5/6	2/3	1/2	1/3	1/6
1. Crop Intensity																							1.10	1.10	1.10	1.07	1.05	1.05	0.98	0.32	0.00					
2. Crop Coefficient																								1.10	1.10	1.10	1.07	1.05	1.05	0.98	0.32	0.00				
(HYV)																									1.10	1.10	1.10	1.07	1.05	1.05	0.98	0.32	0.00			
																										1.10	1.10	1.10	1.07	1.05	1.05	0.98	0.32	0.00		
																											1.10	1.10	1.10	1.07	1.05	1.05	0.98	0.32	0.00	
																												1.10	1.10	1.10	1.07	1.05	1.05	0.98	0.32	0.00
Weighted average																							1.10	1.10	1.10	1.09	1.08	1.08	1.06	0.93	0.75	0.68	0.59	0.43	0.16	0.00
3. Potential ET (ETo)	(mm/day/area)	4.79	4.79	4.79	4.48	4.48	4.48	4.22	4.22	4.22	4.09	4.09	4.09	4.14	4.14	4.14	4.05	4.05	4.05	4.02	4.02	4.02	3.90	3.90	3.90	3.55	3.55	3.55	3.72	3.72	3.72	4.23	4.23	4.23	4.61	4.61	4.61
4. Consumptive Use (ETc)	(mm/day/area)																			4.46	4.42	4.42	4.39	4.23	4.21	4.13	3.30	2.64	2.41	2.19	1.61	0.60	0.00				
5. Percolation	(mm/day/area)																			2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60					
6. Crop Water Requirement	(mm/day/area)																			7.06	7.02	7.02	6.99	6.83	6.81	6.73	5.90	5.24	5.01	4.79	4.21	3.20					
	(mm/day)																			1.18	2.34	3.51	4.66	5.69	6.81	6.73	5.90	5.24	4.18	3.19	2.11	1.07					
C. Effective Rainfall	(mm/day)	0.45	0.47	0.85	0.36	1.39	1.85	5.29	2.15	3.75	3.49	3.64	3.62	3.36	3.03	2.56	3.55	2.14	1.39	1.76	1.45	1.82	0.23	0.96	0.87	1.26	1.74	0.01	0.14	0.02	0.17	0.13	0.27	0.07	0.00	0.06	0.02
D. Net Field Water Requirement	(mm/day)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.35	5.27	6.04	8.35	9.13	9.01	7.51	7.53	6.30	4.24	5.00	3.89	2.08	0.89	0.00	0.00	0.00	0.00	0.00	0.00
	(l/soc/ha)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.61	0.70	0.97	1.06	1.04	0.87	0.87	0.73	0.50	0.58	0.45	0.24	0.10	0.00	0.00	0.00	0.00	0.00	0.00
E. Irrigation Efficiency		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
F. Unit Diversion Requirement	(l/sec/ha)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.77	1.22	1.40	1.93	2.11	2.09	1.74	1.74	1.46	1.00	1.16	0.90	0.48	0.21	0.00	0.00	0.00	0.00	0.00	0.00
G. Diversion Requirement	(m3/sec)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	4.0	4.6	6.4	7.0	6.9	5.8	5.8	4.8	3.3	3.8	3.0	1.6	0.7	0.0	0.0	0.0	0.0	0.0	0.0

Table A4-20 (6) Future Water Requirement for Polowijo 1410ha (Lodoagung) Case 2



Items		October			November			December			January			February			March			April			May			June			July			August			September		
		E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L
A. Crop Water Requirement																																						
1. Crop Intensity								1/6	1/3	1/2	2/3	5/6	1	1	1	1	5/6	2/3	1/2	1/3	1/6																	
2. Crop Coefficient								0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73																	
3. Potential ET (ETo)	(mm/day/area)	4.79	4.79	4.79	4.48	4.48	4.48	4.22	4.22	4.22	4.09	4.09	4.09	4.14	4.14	4.14	4.05	4.05	4.05	4.02	4.02	4.02	3.90	3.90	3.90	3.55	3.55	3.55	3.72	3.72	3.72	4.23	4.23	4.23	4.6*	4.61	4.61
4. Consumptive Use (ETc)	(mm/day/area)							3.08	3.08	3.08	2.99	2.99	2.99	3.02	3.02	3.02	2.96	2.96	2.96	2.93	2.93																	
7. Crop Water Requirement	(mm/day)							0.51	1.03	1.54	1.99	2.49	2.99	3.02	3.02	3.02	2.46	1.97	1.48	0.98	0.49																	
B. Effective Rain	(mm/day)	0.00	0.00	0.00	0.00	0.00	0.00	6.51	2.77	4.69	4.35	4.52	4.50	4.13	3.75	3.19	4.40	2.72	1.81	2.23	1.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Net Field Requirement	(mm/day)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(l/sec/ha)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Irrigation Efficiency		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
F. Unit Diversion Requirement	(l/sec/ha)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G. Diversion Requirement	(m3/sec)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table A4-20 (7) Future Water Requirement for Polowijo 3420ha (Lodoagung) Case 2

Items		October			November			December			January			February			March			April			May			June			July			August			September		
		E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L
A. Crop Water Requirement																				1/6	1/3	1/2	2/3	5/6	1	1	1	1	5/6	2/3	1/2	1/3	1/6				
1. Crop Intensity																				0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73				
2. Crop Coefficient																				4.02	4.02	4.02	3.90	3.90	3.90	3.55	3.55	3.55	3.72	3.72	3.72	4.23	4.23	4.23	4.61	4.61	4.61
3. Potential ET (ETo)	(mm/day/area)	4.79	4.79	4.79	4.48	4.48	4.48	4.22	4.22	4.22	4.09	4.09	4.09	4.14	4.14	4.14	4.05	4.05	4.05																		
4. Consumptive Use (ETc)	(mm/day/area)																			2.93	2.93	2.93	2.85	2.85	2.85	2.59	2.59	2.59	2.72	2.72	2.72	3.09	3.09				
7. Crop Water Requirement	(mm/day)																			0.49	0.98	1.47	1.90	2.37	2.85	2.59	2.59	2.59	2.26	1.81	1.36	1.03	0.51				
B. Effective Rain	(mm/day)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.23	1.86	2.31	0.32	1.26	1.14	1.57	2.13	0.02	0.19	0.04	0.24	0.20	0.38	0.00	0.00	0.00	0.00
C. Net Field Requirement	(mm/day)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.58	1.11	1.71	1.02	0.46	2.57	2.07	1.78	1.11	0.83	0.13	0.00	0.00	0.00	0.00
	(l/sec/ha)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.13	0.20	0.12	0.05	0.30	0.24	0.21	0.13	0.10	0.02	0.00	0.00	0.00	0.00
E. Irrigation Efficiency		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
F. Unit Diversion Requirement	(l/sec/ha)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.26	0.40	0.24	0.11	0.59	0.48	0.41	0.26	0.19	0.03	0.00	0.00	0.00	0.00
G. Diversion Requirement	(m3/sec)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.9	1.4	0.8	0.4	2.0	1.6	1.4	0.9	0.7	0.1	0.0	0.0	0.0	0.0

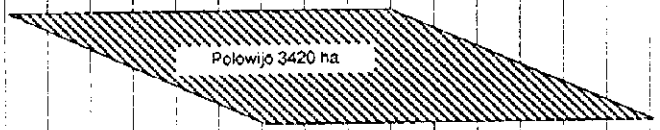
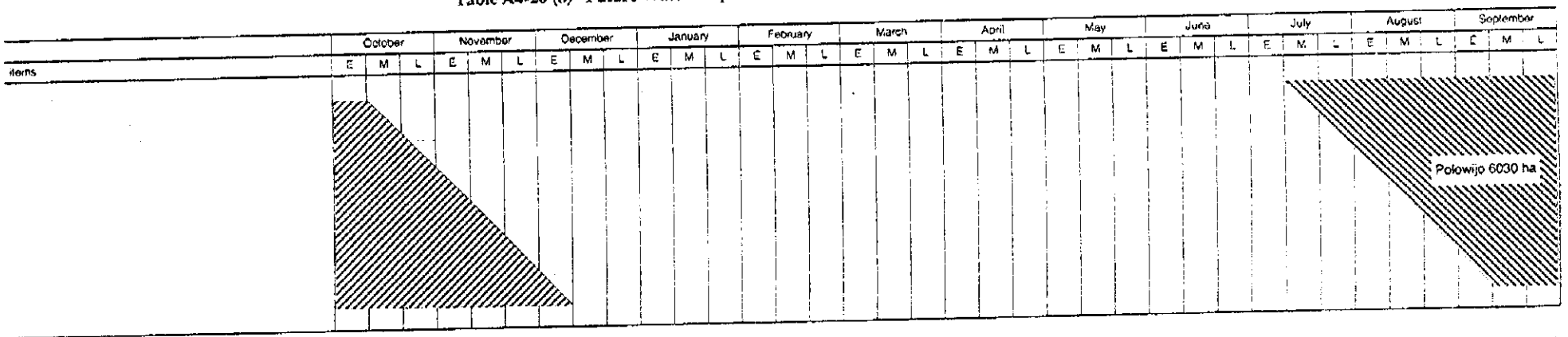


Table A4-20 (8) Future Water Requirement for Polowijo 6030ha (Lodoagung) Case 2



Items		October			November			December			January			February			March			April			May			June			July			August			September		
		E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L
A. Crop Water Requirement																															1/6	1/3	1/2	2/3	5/6	1	1	1
1. Crop Intensity		1	5/6	2/3	1/2	1/3	1/6																						0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73
2. Crop Coefficient		0.73	0.73	0.73	0.73	0.73	0.73																														
3. Potential ET (ETo)	(mm/day/area)	4.79	4.79	4.79	4.48	4.48	4.48	4.22	4.22	4.22	4.09	4.09	4.09	4.14	4.14	4.14	4.05	4.05	4.05	4.02	4.02	4.02	3.90	3.90	3.90	3.55	3.55	3.55	3.72	3.72	3.72	4.23	4.23	4.23	4.61	4.61	4.61
4. Consumptive Use (ETc)	(mm/day/area)	3.50	3.50	3.50	3.27	3.27	3.27																						2.72	2.72	3.09	3.09	3.09	3.37	3.37	3.37
7. Crop Water Requirement	(mm/day)	3.50	2.91	2.33	1.64	1.09	0.55																						0.45	0.91	1.54	2.06	2.57	3.37	3.37	3.37
B. Effective Rain	(mm/day)	0.65	0.68	1.20	0.49	1.84	2.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.24	0.20	0.38	0.10	0.00	0.10	0.03
C. Net Field Requirement	(mm/day)	2.85	2.23	1.14	1.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.66	1.35	1.67	2.47	3.37	3.27	3.33
	(mm/day)	0.33	0.26	0.13	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.08	0.16	0.19	0.29	0.39	0.38	0.39
	(l/sec/ha)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
E. Irrigation Efficiency		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.10	0.15	0.31	0.39	0.57	0.78	0.76	0.77
F. Unit Diversion Requirement	(l/sec/ha)	0.66	0.52	0.26	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.15	0.31	0.39	0.57	0.78	0.76	0.77
G. Diversion Requirement	(m3/sec)	4.0	3.1	1.6	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.9	1.9	2.3	3.4	4.7	4.6	4.7

Table A4-20 (9) Future Water Requirement for Fruit Tree 100ha (Lodoagung) Case 2

Items		October			November			December			January			February			March			April			May			June			July			August			September		
		E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L
A. Crop Water Requirement																																						
1. Crop Intensity		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2. Crop Coefficient		0.57	0.58	0.60	0.60	0.60	0.60	0.62	0.63	0.65	0.65	0.65	0.65	0.63	0.62	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.58	0.57	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
3. Potential ET (ETo)	(mm/day/area)	4.79	4.79	4.79	4.48	4.48	4.48	4.22	4.22	4.22	4.09	4.09	4.09	4.14	4.14	4.14	4.05	4.05	4.05	4.02	4.02	4.02	3.90	3.90	3.90	3.55	3.55	3.55	3.72	3.72	3.72	4.23	4.23	4.23	4.61	4.61	4.61
4. Consumptive Use (ETc)	(mm/day/area)	2.73	2.78	2.87	2.69	2.69	2.69	2.62	2.66	2.74	2.66	2.66	2.66	2.61	2.57	2.48	2.43	2.43	2.43	2.41	2.41	2.41	2.26	2.22	2.15	1.95	1.95	1.95	2.05	2.05	2.05	2.33	2.33	2.33	2.54	2.54	2.54
7. Crop Water Requirement	(mm/day)	2.73	2.78	2.87	2.69	2.69	2.69	2.62	2.66	2.74	2.66	2.66	2.66	2.61	2.57	2.48	2.43	2.43	2.43	2.41	2.41	2.41	2.26	2.22	2.15	1.95	1.95	1.95	2.05	2.05	2.05	2.33	2.33	2.33	2.54	2.54	2.54
B. Effective Rain	(mm/day)	0.60	0.64	1.13	0.46	1.74	2.28	6.19	2.64	4.53	4.19	4.36	4.34	3.95	3.58	3.00	4.14	2.50	1.70	2.10	1.75	2.17	0.30	1.17	1.04	1.44	1.95	0.02	0.18	0.03	0.22	0.18	0.35	0.09	0.00	0.09	0.03
C. Net Field Requirement	(mm/day)	2.13	2.14	1.75	2.22	0.95	0.41	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.73	0.31	0.66	0.24	1.96	1.05	1.10	0.52	0.00	1.93	1.87	2.01	1.82	2.14	1.97	2.23	2.54	2.45	2.51
	(l/sec/ha)	0.25	0.25	0.20	0.26	0.11	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.04	0.08	0.03	0.23	0.12	0.13	0.06	0.00	0.22	0.22	0.23	0.21	0.25	0.23	0.26	0.29	0.28	0.29
E. Irrigation Efficiency		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
F. Unit Diversion Requirement	(l/sec/ha)	0.49	0.50	0.40	0.51	0.22	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.07	0.15	0.06	0.45	0.24	0.26	0.12	0.00	0.45	0.43	0.47	0.42	0.50	0.46	0.52	0.59	0.57	0.58
G. Diversion Requirement	(m3/sec)	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1

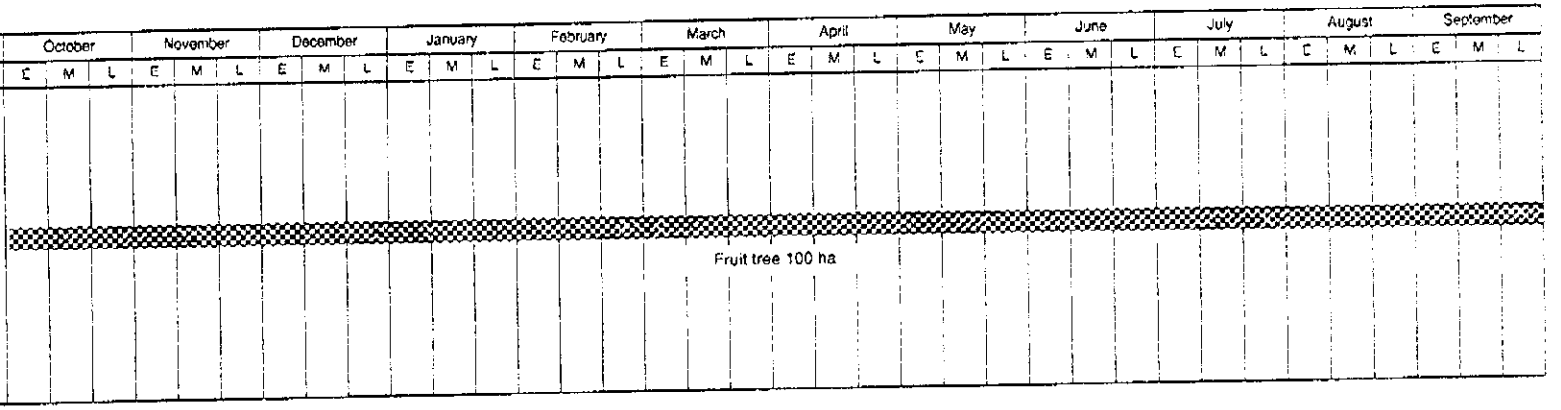


Table A4-20 (10) Future Water Requirement for Sugarcane 2510ha (Lodoagung) Case 2

Items		October			November			December			January			February			March			April			May			June			July			August			September		
		E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L
A. Crop Water Requirement																																					
1. Crop Intensity		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2. Crop Coefficient		0.99	0.99	0.99	0.99	0.99	0.98	0.94	0.89	0.85	0.84	0.82	0.80	0.79	0.77	0.76	0.75	0.74	0.73	0.73	0.73	0.73	0.73	0.73	0.74	0.78	0.83	0.87	0.88	0.90	0.92	0.93	0.95	0.96	0.97	0.98	0.99
3. Potential ET (ETo)	(mm/day/area)	4.79	4.79	4.79	4.48	4.48	4.48	4.22	4.22	4.22	4.09	4.09	4.09	4.14	4.14	4.14	4.05	4.05	4.05	4.02	4.02	4.02	3.90	3.90	3.90	3.55	3.55	3.55	3.72	3.72	3.72	4.23	4.23	4.23	4.61	4.61	4.61
4. Consumptive Use (ETc)	(mm/day/area)	4.74	4.74	4.74	4.44	4.44	4.39	3.97	3.76	3.59	3.44	3.35	3.27	3.27	3.19	3.15	3.04	3.00	2.96	2.93	2.93	2.93	2.85	2.85	2.89	2.77	2.95	3.09	3.27	3.35	3.42	3.93	4.02	4.06	4.47	4.52	4.56
7. Crop Water Requirement	(mm/day)	4.74	4.74	4.74	4.44	4.44	4.39	3.97	3.76	3.59	3.44	3.35	3.27	3.27	3.19	3.15	3.04	3.00	2.96	2.93	2.93	2.93	2.85	2.85	2.89	2.77	2.95	3.09	3.27	3.35	3.42	3.93	4.02	4.06	4.47	4.52	4.56
B. Effective Rain	(mm/day)	0.71	0.75	1.31	0.54	2.03	2.65	7.04	2.94	4.92	4.54	4.69	4.63	4.24	3.81	3.23	4.43	2.73	1.81	2.23	1.86	2.01	0.32	1.26	1.14	1.60	2.22	0.02	0.20	0.04	0.26	0.21	0.42	0.11	0.00	0.11	0.03
C. Net Field Requirement	(mm/day)	4.03	3.99	3.43	3.89	2.41	1.74	0.00	0.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	1.15	0.70	1.07	0.63	2.53	1.59	1.74	1.17	0.73	3.07	3.07	3.31	3.16	3.72	3.60	3.95	4.47	4.41	4.53
	(l/sec/ha)	0.47	0.46	0.40	0.45	0.28	0.20	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.13	0.08	0.12	0.07	0.29	0.18	0.20	0.14	0.08	0.35	0.36	0.38	0.37	0.43	0.42	0.46	0.52	0.51	0.52
E. Irrigation Efficiency		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
F. Unit Diversion Requirement	(l/sec/ha)	0.93	0.92	0.79	0.90	0.56	0.40	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.27	0.16	0.25	0.15	0.58	0.37	0.40	0.27	0.17	0.71	0.71	0.77	0.73	0.86	0.83	0.91	1.04	1.02	1.05
G. Diversion Requirement	(m3/sec)	2.3	2.3	2.0	2.3	1.4	1.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.7	0.4	0.6	0.4	1.5	0.9	1.0	0.7	0.4	1.8	1.8	1.9	1.8	2.2	2.1	2.3	2.6	2.6	2.6

Sugarcane 2510 ha

Table A4-21 Concrete Lining and Related Earthfill Works in Lodoagung

Totla length m	Design discharge m3/sec	Bc m	Hc m	Concrete m2	Earth fill m3
Main canal 31,745	15.5 to 5.5	12.0 to 6.0	1.55 to 1.23	494,300	156,900
Sec. Aryo Jeding 3,894	0.41 to 0.31	1.8 to 1.5	0.54 to 0.48	13,000	1,300
Sec. Campur darat 3,356	0.30 to 0.22	1.2 to 0.8	0.51 to 0.42	9,100	1,100
Sec. Rejotangan dan Rawaremang 8,438	0.81 to 0.14	2.5 to 0.8	0.66 to 0.45	34,400	4,200
Sec. Kacangan 9,088	1.79 to 0.88	3.6 to 0.5	0.84 to 0.57	41,700	6,700
Suplesi Kali dawir 17,445	3.65 to 0.1	4.4 to 0.2	1.12 to 0.55	90,900	16,900
Sec. Karangrejo 3,650	1.30 to 1.25	2.7 to 2.5	0.60	20,100	3,600
Sec. Boyolangu 6,887	2.55 to 0.67	3.3 to 1.6	1.04 to 0.73	31,700	195,200
Total 84,503				735,200	385,900

Bc = Canal bed width

Hc = Canal height

Concrete block thickness = 7cm

Table A4-22 Construction Cost Estimate for Lodoagung

Item	Unit	Quantity	Unit price (Rp.)	Amount (1000Rp.)
Mobilization of heavy equipment	no.	20	2,000,000 *1	40,000
Canal survey & setting out	km	84.5	145,140 *1	12,265
Earth fill with selected material	m3	385,900	8,090 *1	3,121,931
Concrete block lining	m2	735,200	25,980 *1	19,100,496
Miscellaneous works (10%)	L.S	1		2,222,243
Other rehabilitaion works*2	L.S	1	360,000,000	360,000
Sub total				24,856,934
Administration cost (5%)				1,242,847
Detailed design and construction supervision (10%)				2,485,693
Total				28,585,475
			Say=	28,585,000

*1 Source; Engineering Estimate (EE) Pekerjaan Perbaikan Jaringan Irigasi Tahun Anggaran 1997/1998 Surabaya Maret 1997

*2 Planned and estimated by Cabang Dinas Pengairan Tulungagung. This work includes construction of check a dam in Kali Timo, excavation of bypass drain, etc.

Table A4-23 Canal Lining Cost in the Area Irrigated by Main Brantas River

Name of area	Irrigation area (ha)	Canal lining cost (million Rp.)
Brantas Atas	1,170	3,200
Bratas Bawah	1,330	3,638
Molek	3,710	10,147
Lodoagung	11,180	28,585
Mrican Kanan	15,907	43,506
Warujayeng-Kertosono	12,090	33,066
Brantas Kiri Kediri	510	1,395
Jatimlerek	1,920	5,251
Menturus	3,320	9,080
Jatikulon	600	1,641
Delta Brantas	24,210	66,214
Sub total		205,723
Physical contingency (15%)		30,858
Total	75,947	236,581

Including administration, engineering service costs

Table A4-24 (1) Potential Irriation Potential in the Brantas Basin

Name of system	Lesti Irrigation Project
Water source	Lesti river
Irrigation area	200 ha irrigated by P.S No. 1, 80 ha irrigated by P.S No. 2, 420 ha irrigated by P.S No. 3, 1,600 ha irrigated by P.S No. 4
Pump stations	4 pump stations, run-of-the-river type
Head	about 30 m for each
Installed capacity	9 m3/min for P.S No. 1 3 m3/min for P.S No.2 18 m3/min for P.S No.3 74 m3/min for P.S No.4
Pump type	Horizontal shaft double suction volute pump
Pipe line	Dia. = 0.3 m, L = 300 for P.S No.1 Dia. = 0.25 m, L = 500 for P.S No.2 Dia. = 0.40 m, L = 650 for P.S No.3 Dia. = 0.90 m, L = 300 for P.S No.4
Main canals	
Type	Trapezoidal cross section with wet stome masonry 3 km for P.S No. 1 1 km for P.S No. 2 6 km for P.S No. 3 18 km for P.S No. 4
Canal base width	0.5 m for No. 1 to No. 3 areas, 0.6 m to 1.0 m No. 4 area
Canal height	0.6 - 1.2 m
Bank width	0.6 m in one side and 3.6 m in the other side
Tertiary development	
Canal density	50 m/ha
Canal type	Trapezoidal earth type
Main crop	Sugarcane Polowijo

Total irrigation requirement (m3/sec)

Jan E	0.00	May E	0.23	Sep E	0.26
Jan M	0.00	May M	0.00	Sep M	0.10
Jan L	0.00	May L	0.10	Sep L	0.14
Feb E	0.00	June E	0.14	Oct E	0.24
Feb M	0.00	June M	0.21	Oct M	0.07
Feb L	0.73	June L	1.10	Oct L	0.07
Mar E	1.07	July E	1.43	Nov E	0.00
Mar M	0.26	July M	1.10	Nov M	0.80
Mar L	1.03	July L	1.60	Nov L	0.00
Apr E	0.93	Aug E	1.70	Dec E	0.00
Apr M	1.76	Aug M	1.17	Dec M	0.00
Apr L	0.00	Aug L	0.63	Dec L	0.00

Project cost (as of October 1984)	million Rp.
Direct construction cost	3,330
Contingency	500
Engineering and administraion	383
	4,213

Source: Final Report for the Study of Widas Flood Control and Drainage Project Part-I Study July 1985

Table A4-24 (2) Potential Irriation Potential in the Brantas Basin

Name of system	Widas Extension Project
Water source	Kedungwarak dam and Semantok dam
Irrigation area	950 ha irrigated by Kedungwarak dam, 1,300 ha irrigated by Semantok,
Intake	Gondang dam
Main canal	(Including connecting canals from Semantok dam and Gondang dam)
Type	Trapezoidal cross section with wet stome masonry
Length	9.5 km
Canal base width	2.2 m - 1.0 m
Canal height	1.6 m - 1.5 m
Side slope	1 to 1.5
Bank width	1.5 m
Lining	Wet stone masonry 0.3 m in thickness
Inspection road along with main canal	
Length	7 km
Total width	6 m
effective width	3 m
Metalling	Sand and stone, 0.3 m in thickness
Secondary Canal	
Length	17 km
Base width	0.6 m - 1.0 m
Canal height	0.8 m - 1.0 m
Side slope	1 to 1.0
Bank width	0.6 - 1.0 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
Structure related to main canal	
Bridge	5 nos.
Drain culvert	5 nos.
Diversion	5 nos.
Spillway	5 nos.
Main crop	Rainy seson paddy - Dry season paddy - Polowijo

Total irrigation requirement (m3/sec)

Jan E	0.35	May E	2.17	Sep E	2.30
Jan M	1.92	May M	1.91	Sep M	2.23
Jan L	0.00	May L	1.86	Sep L	1.70
Feb E	0.03	June E	0.21	Oct E	1.20
Feb M	0.04	June M	0.87	Oct M	0.69
Feb L	0.96	June L	0.30	Oct L	2.11
Mar E	0.66	July E	0.36	Nov E	2.74
Mar M	0.98	July M	0.45	Nov M	3.47
Mar L	1.87	July L	0.75	Nov L	3.35
Apr E	1.49	Aug E	1.22	Dec E	2.08
Apr M	2.03	Aug M	1.54	Dec M	0.62
Apr L	0.50	Aug L	1.81	Dec L	0.00

Project cost (as of October 1984)	million Rp.
Direct construction cost	2,407
Contingency	361
Engineering and administraion	277
	3,045

Source: Final Report for the Study of Widas Flood Control and Drainage Project Part-I Study July 1985

Table A4-24 (3) Potential Irrigation Potential in the Brantas Basin

Name of system	Beng Irrigation Project
Water source	Beng dam
Irrigation area	3,200 ha
Headworks	
Weir	Run-of-the-river type
Width	25 m
length	52 m including downstram protection
height	3.0 m
Sandflushing gates	3.5 m wide x 3.5 m high x 2 nos.
Intake gates	2.0 m wide x 2.0 m high x 2 nos.
	0.5 m wide x 0.5 m high x 1 no.
Sandflushing pond	Wet stone masonry
Design particle	catching fine sand of 2.0 mm particle size
Length	60 m
Depth	2 m
Width	10 m
Main canal	
Type	Trapezoidal cross section with wet stone masonry
Length	14.5 km
Canal base width	2.5 m - 4.0 m
Canal height	1.5 m - 1.7 m
Side slope	1 to 1.5
Bank width	1.5 m
Lining	Wet stone masonry 0.3 m in thickness
Inspection road along with main canal	
Length	14.5 km
Total width	6 m
effective width	3 m
Metalling	Sand and stone, 0.3 m in thickness
Secondary Canals	
Type	Trapezoidal cross section with wet stone masonry
Length	21 km
Base width	0.6 m - 1.0 m
Canal height	0.8 m - 1.0 m
Side slope	1 to 1.0
Bank width	0.6 - 1.0 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.
Main crop	Rainy seson paddy - Dry season paddy - Polowijo, sugarcane

Total irrigation requirement (m3/sec)

Jan E	4.29	May E	1.85	Sep E	2.02
Jan M	4.39	May M	2.03	Sep M	2.39
Jan L	4.45	May L	2.16	Sep L	2.70
Feb E	4.58	June E	0.99	Oct E	2.82
Feb M	0.03	June M	1.83	Oct M	2.47
Feb L	0.05	June L	1.48	Oct L	1.97
Mar E	1.89	July E	1.18	Nov E	3.15
Mar M	0.56	July M	0.83	Nov M	3.46
Mar L	0.55	July L	0.62	Nov L	3.89
Apr E	1.45	Aug E	0.68	Dec E	2.49
Apr M	2.44	Aug M	0.93	Dec M	1.44
Apr L	2.35	Aug L	1.36	Dec L	1.15

Project cost (as of October 1984)	million Rp.
Direct construction cost	4,090
Contingency	614
Engineering and administraion	470
	5,174

Source: Final Report for the Study of Widas Flood Control and Drainage Project Part-I Study July 1985

Table A4-24 (4) Potentai Irriation Potential in the Brantas Basin

Name of system	Widas South Irrigation Project			
Water source	Kunoir dam			
Irrigation area	5,500 ha			
Headworks	Existing head works named Dam Kedunggerit, enlargement of intake structures and provision of sand trap ponds			
Sandflushing sluice	Provided with two roller gates of 3.5 m wide x 3.5 m high			
Intake gates	Provided with two roller gates of 2.0 m wide x 2.0 m high for main canal and one roller gate of 1.5 m x 1.5 m for secondary canal			
Sand trap pond	Wet stone masonry			
Design particle	catching fine sand of 2.0 mm particle size			
for main canal		for secondary canal		
Length	75 m	Length	45 m	
Depth	2.5 m	Depth	1.5 m	
Width	9 m	Width	4 m	
Side slope	1 to 1	Side slope	1 to 1	
Main canal				
Type	Trapezoidal cross section with wet stone masonry			
Length	10.5 km			
Canal base width	1.3 m - 2.0 m			
Canal height	1.2 m - 1.6 m			
Side slope	1 to 1.5			
Bank width	1.5 m			
Lining	Wet stone masonry 0.3 m in thickness			
Inspection road along with main canal				
Length	3.3 km			
Total width	6 m			
effective width	3 m			
Metalling	Sand and stone, 0.3 m in thickness			
Secondary Canals	Rehabilitation and new construction			
Type	Trapezoidal cross section with wet stone masonry			
Length	57 km			
Base width	0.6 m - 1.2 m			
Canal height	0.8 m - 1.2 m			
Side slope	1 to 1.0			
Bank width	0.6 - 1.2 m in one side, 3.6 - 4.2 m in other side			
Lining	Wet masonry, 0.2 m in thickness			
Tertiary development	Mainly rehabilitation and provision of quarternary			
Canal density	50 m/ha			
Canal type	Trapezoidal earth type			
Major structures related to main canal (Irrigation area only)				
Bridge	20 nos.			
Drain culvert	2 nos.			
Diversion	10 nos.			
Drop	11 nos.			
Spillway	2 nos.			
Main crop	Rainy seson paddy - Dry season paddy - Polowijo, sugarcane			

Total irrigation requirement (m3/sec)

Jan E	0.67	May E	7.25	Sep E	0.35
Jan M	4.66	May M	6.77	Sep M	0.40
Jan L	0.00	May L	7.23	Sep L	0.45
Feb E	0.13	June E	1.60	Oct E	0.63
Feb M	0.17	June M	5.51	Oct M	0.71
Feb L	4.77	June L	3.15	Oct L	0.71
Mar E	3.68	July E	3.06	Nov E	4.96
Mar M	7.19	July M	1.87	Nov M	6.29
Mar L	8.47	July L	0.76	Nov L	5.84
Apr E	7.68	Aug E	0.24	Dec E	6.26
Apr M	8.92	Aug M	0.25	Dec M	3.86
Apr L	3.10	Aug L	0.26	Dec L	1.53

Project cost (as of October 1984)	million Rp.
Direct construction cost	4,396
Contingency	659
Engineering and administraion	506
	5,561

Source: Final Report for the Study of Widas Flood Control and Drainage Project Part-I Study July 1985

Table A4-25 World Development Index and Per Capita Food Supply in Major Asian Countries

Description	Lower middle Income Country			Upper Middle Income Country	High Income Economy
	Indonesia	Philippines	Thai	Malaysia	Japan
Population middle 1994 (million persons)	190.4	67.0	58.0	19.7	125.0
Area (1000 km2)	1,905	300	513	330	378
GNP per capita 1994 (US$)	880	950	2,410	3,480	34,630
GNP annual growth rate1985-94 (%)	6.0	1.7	8.6	5.6	3.2
Remaining life time at birth (year)	63	65	69	71	79
Illiteracy rate of adult (%)	16.0	5.0	6.0	17.0	less than 5%
GDP annual growth rate 1990-94 (%)	7.6	1.6	8.2	8.4	1.2
Agriculture (%)	3.0	1.6	3.1	2.8	-2.8
Industry (%)	9.8	0.9	10.9	9.8	0.7
Service (%)	7.6	2.1	7.4	9.1	2.6
Export, non-factor services (%)	10.8	8.0	14.6	12.9	4.0
Total domestic investment (%)	7.5	2.3	9.3	14.9	-0.4
GDP in 1994 (million US$)	174,640	64,162	143,209	70,626	4,590,971
Share of GDP in 1994					
Agriculture (%)	17.0	22.0	10.0	14.0	2.0
Industry (%)	41.0	33.0	39.0	43.0	40.0
Service (%)	42.0	45.0	50.0	42.0	58.0

Source: World Development Report 1996 (IBRD)

Item		Indonesia	Philippines	Thai	Malaysia	Japan
Cereals total	kg/year	204.8	156.7	157.7	147.1	146.1
Rice (paddy)	kg/year	169.7	105.0	146.6	103.7	75.4
Vegetables	kg/year	23.6	63.3	30.3	28.9	106.5
Fruit	kg/year	32.7	67.7	92.3	51.9	58.7
Meat	kg/year	8.2	22.7	21.0	45.9	39.7
Milk	kg/year	5.7	18.3	16.7	25.9	68.2
Eggs	kg/year	2.4	4.7	6.8	14.3	19.9
Fish and seafood	kg/year	15.8	34.7	25.7	28.5	66.7
Vegetable oils	kg/year	7.9	5.2	5.1	15.8	4.4
Animal fats	kg/year	0.5	1.5	0.8	1.5	2.4
Calorie grand total	Cal./day	2,609	2,371	2,365	2,782	2,890

Source: Food Balance Sheets 1992-94 average (Food and Agricultural Organization of the United Nations Rome, 1996)

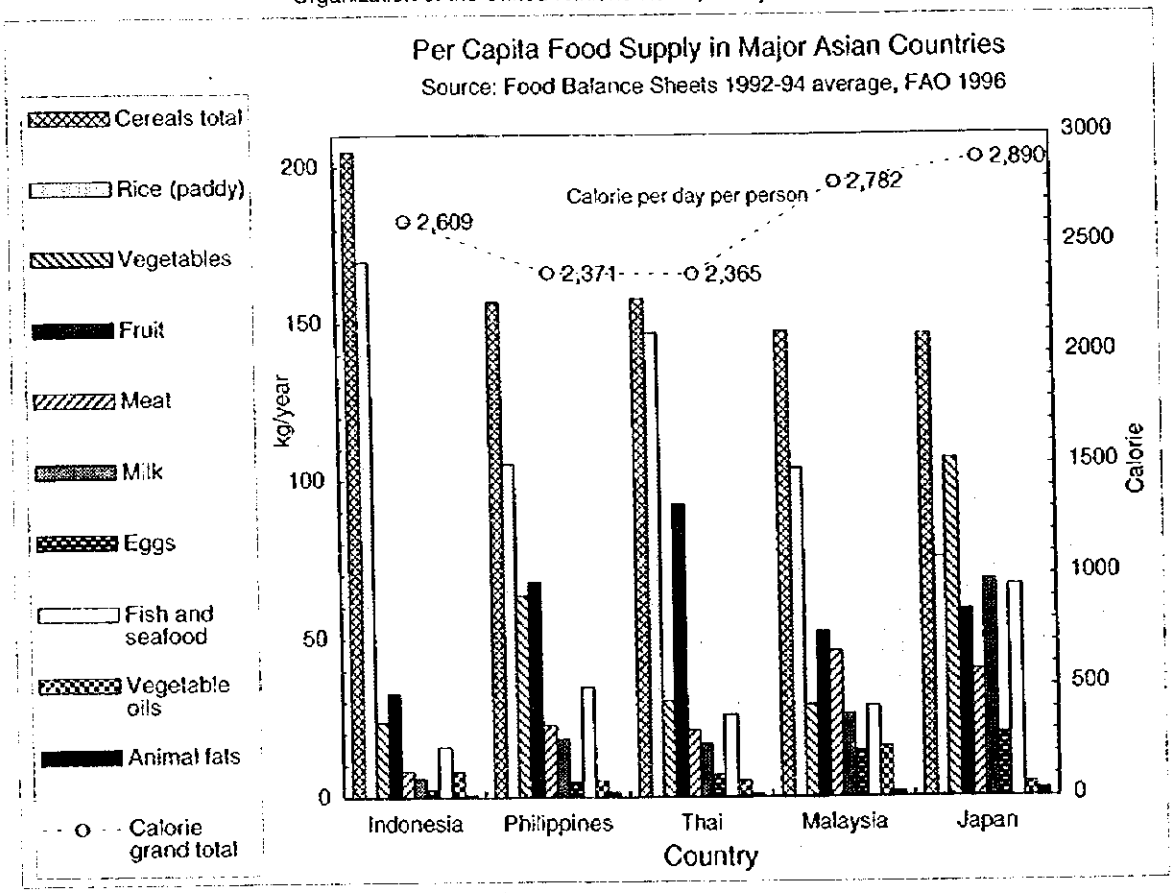


Table A4-26 Domestic Water Supply by PDAM

Regency/ Municipality	a. Average number of household members	b. Number of household connections	c. Population receiving PDAM service	d. Amount of water received (m^3/year)	e. Ratio of unaccounted - for water (%)	f. Population in 1994	g. Service coverage c/f (%)	h. Average water consumption per capita (d/365/c)*1000 (liter/capita/day)	Remarks
(Rengency)									
Sidoarjo	4.18	18,201	76,080	3,876,000	31	1,079,446	7.0	140	323,000m^3/month (*)times12 months. (*) December 1996 figure.
Mojokerto	4.12	5,877	24,213	735,869	20	818,383	3.0	83	
Malang	3.79	49,536	187,741	8,738,205	24	2,231,564	8.4	128	
Blitar	4.26	7,942	33,833	1,192,332	34	1,059,883	3.2	97	derived from data of June 1997
Kediri	4.43	8,131	36,020	920,611	54	1,315,630	2.7	70	
Nganjuk	4.33	8,135	35,225	1,526,751	19	957,949	3.7	119	
Jombang	4.37	6,531	28,540	1,241,304	25	1,065,106	2.7	119	
Tulungagung	4.37	10,689	46,711	2,182,101	24	917,356	5.1	128	
Trenggalek	3.93	4,280	16,820	621,504	33	641,318	2.6	101	4,280 m3/month (*)times12 months. (*) May 1997 figure
(Municipality)									
Surabaya	4.45	182,382	811,600	66,443,470	33	2,294,148	35.4	224	Figures are total of 1996.
Mojokero	4.42	4,568	20,191	679,947	43	102,116	19.8	92	
Malang	4.85	53,164	257,845	13,829,456	40	699,853	36.8	147	Figures are total of 1996.
Kediri	3.92	6,682	26,193	1,253,713	28	232,685	11.3	131	
Blitar	4.61	6,308	29,080	870,366	32	118,753	24.5	82	
Total	-	372,426	1,630,094	104,111,629	33	13,534,190	-	-	

Source :

(1) respective PDAM

(2) Penduduk Jawa Timur, Hasil Registrasi, 1994 (Kantor Statistik Propinsi Jawa Timur)

(3) Jawa Timur Dalam Angka 1990 and 1995, East Java Statistics Office

Table A4-27 Source of Water for PDAMs and Installed Capacities

Regency/ Municipality	Surface wter	Ground water	Spring	Other	Total
(Rengency)					
Sidoarjo	555.0	135.0	167.0	0.0	857.0
Mojokerto	0.0	27.2	33.4	0.0	60.6
Malang	48.0	4.0	679.0	0.0	731.0
Blitar	0.0	115.5		0.0	115.5
Kediri	0.0	88.0	23.0		111.0
Nganjuk	0.0	180.0	87.5	0.0	267.5
Jombang	0.0	167.5	0.0	0.0	167.5
Tulungagung	0.0	127.0	22.0	0.0	149.0
Trenggalek	15.0	27.5	2.5	2.5	47.5
(Municipality)					
Surabaya	5,100.0	0.0	330.0	0.0	5,430.0
Mojokero	120.0	55.0	0.0	0.0	175.0
Malang	0.0	40.0	1,484.0	0.0	1,524.0
Kediri	0.0	180.0	0.0	0.0	180.0
Blitar	0.0	65.0	0.0	0.0	65.0
Total	5,838.0	1,211.7	2,828.4	2.5	9,880.6
	59%	12%	29%	0%	100%

Source : respective PDAM

Table A4-28 (1)

Domestic Water Demand Projected for Year 2020 : PDAM Service Area (Urban Area)

Area	Present condition									Assumptions for 2020						Gross water demand	Net water demand in 2020		Total service coverage
	Population of regency/municipality				Service cov		Water	Rate	Amount	Total	Urban	Rate	Service	Water	Ratio of				
	a. Total population in 1996 (thousand)	b. Urban population in 1996 (thousand)	Rate of urbanization b/a (%)	c. Population served by PDAM in 1996 (thousand)	Total c/a (%)	Urban area c/b (%)	Consumption per capita in 1996 (lcd)	of un-accounted-for water (%)	of water received (thousand m3/year)	population in 2020 (thousand)	population in 2020 (thousand)	of urbanization (%)	coverage for urban area in 2020 (%)	consumption rate (lcd)	Un-accounted-for water (%)	(m3/day)	(m3/day)	(thousand m3/year)	(%)
(Regency)																			
Sidoarjo	1,130	436	39	76	7	17	140	31	3,876	1,955	1,001	51	100	200	20	200,269	250,336	91,373	51
Mojokerto	834	214	26	24	3	11	83	20	736	1,060	305	29	100	120	20	36,597	45,746	16,697	29
Malang	2,270	1,125	50	188	8	17	128	24	8,738	2,782	1,520	55	100	150	20	227,981	284,976	104,016	55
Blitar	1,066	182	17	34	3	19	97	34	1,192	1,141	201	18	100	120	20	24,086	30,107	10,989	18
Kediri	1,332	346	26	36	3	10	70	54	921	1,546	432	28	100	120	20	51,869	64,837	23,665	28
Nganjuk	968	214	22	35	4	16	119	19	1,527	1,091	257	24	100	150	20	38,558	48,197	17,592	24
Jombang	1,082	175	16	29	3	16	119	25	1,241	1,314	234	18	100	150	20	35,029	43,787	15,982	18
Tulungagung	926	184	20	47	5	25	128	24	2,182	1,043	219	21	100	150	20	32,885	41,106	15,004	21
Trenggalek	651	120	18	17	3	14	101	33	622	778	156	20	100	120	20	18,749	23,437	8,554	20
(Municipality)																			
Surabaya	2,364	2,364	100	812	34	34	224	33	66,443	3,360	3,360	100	100	250	20	840,000	1,050,000	383,250	100
Mojokerto	104	104	100	20	19	19	92	43	680	139	139	100	100	120	20	16,680	20,850	7,610	100
Malang	722	722	100	258	36	36	147	40	13,829	1,059	1,059	100	100	200	20	211,800	264,750	96,634	100
Kediri	237	237	100	26	11	11	131	28	1,254	288	288	100	100	150	20	43,200	54,000	19,710	100
Blitar	121	121	100	29	24	24	82	32	870	141	141	100	100	120	20	16,920	21,150	7,720	100
Total	13,808	6,545	47	1,630	12	25	175	33	104,111	17,697	9,312	53	100	193	20	1,794,623	2,243,278	818,797	53

Source : JICA study team

Notes :

1) 1996 population : derived based on 1994 population and growth rates of each area between 1988 and 1994

2) Urban population 1996 : Urban population in 1995 from Cipta Karya was modified to 1996 applying total population growth rates of each area between 1988 and 1996

3) Population served by PDAM / water consumption rates / ratio of un-accented-for-water : based on information from PDAM

4) Total population in 2020 : by JICA study team, applying growth rates between 1988 and 1994

5) Urban population in 2020 : derived based on 1996 urban population and growth rate of urban population (total population growth rate times 1.5 , which is the coefficient derived from experience of upper middle income countries

6) Service coverage in 2020 : assumed to be 100% for urban area by 2020. The World Bank project will achieve service coverage of 60 to 90% by year 2005.

7) Water consumption rates in 2020 : set at 120 lcd, 150 lcd, 200 lcd or 250 lcd based on past record and the figures planned in the World bank project.

8) Ratio of un-accounted-for water : set at 20% except in Nganjuk set at 15% where 20% is already achieved at present.

9) gross water demand ; without considering un-accounted-for- water / net water demand : including un-accounted-for-water

Table A4-28 (2)

Domestic Water Demand Projected for Year 2020 : Non-PDAM Service Area (Rural Area)

Area	Population		Water consumption		Water demand in 1995		Water demand in 2020	
	1996	2020	1995	2020				
	(thousand)	(thousand)	(lcd)	(lcd)	m3/day	million m3/year	m3/day	million m3/year
(Regency)								
Sidoarjo	694	954	60	60	41,658	15.2	57,219	20.9
Mojokerto	620	755	60	60	37,211	13.6	45,302	16.5
Malang	1,144	1,262	60	60	68,657	25.1	75,728	27.6
Blitar	884	940	60	60	53,066	19.4	56,417	20.6
Kediri	986	1,114	60	60	59,174	21.6	66,825	24.4
Nganjuk	754	834	60	60	45,223	16.5	50,037	18.3
Jombang	907	1,080	60	60	54,403	19.9	64,828	23.7
Tulungagung	742	824	60	60	44,527	16.3	49,426	18.0
Trenggalek	531	622	60	60	31,838	11.6	37,305	13.6
(Municipality)								
Surabaya	0	0	60	60	0	0.0	0	0
Mojokerto	0	0	60	60	0	0.0	0	0
Malang	0	0	60	60	0	0.0	0	0
Kediri	0	0	60	60	0	0.0	0	0
Blitar	0	0	60	60	0	0.0	0	0
Total	7,263	8,385	-	-	435,757	159	503,088	184

Table A4-29 Amount of Industrial Water Taken from Brantas River in 1996 by Area, Month and type of Product

(By Area) (Unit : m^3/year)

	Number of factories	Amount of water taken in 1996	(%)
Blitar	3	42,836	0.03
Gresik	12	22,533,691	17.25
Jombang	4	11,606,898	8.88
Kediri	2	11,690,000	8.95
Malang	8	12,425,925	9.51
Mojokerto	5	22,606,297	17.30
Nganjuk	1	4,716,400	3.61
Sidoarjo	23	34,970,641	26.76
Surabaya	36	5,730,479	4.39
Tulungagung	1	4,340,700	3.32
TOTAL	95	130,663,867	100.00

(By Type of Product) (Unit : m^3/year)

Type of product	Number of factories	Amount of water taken in 1996	(%)
Sugar and molasses	14	75,549,824	57.8
Paper	7	28,615,197	21.9
Monosodium glutamate	3	12,567,095	9.6
Fertilizer & other	1	4,928,139	3.8
Others	70	9,003,612	6.9
Total	95	130,663,867	100.0

(By Month) (Unit : m^3/year)

Month	Number of factories	Amount of water taken in 1996	(average=100)
January	-	4,704,486	43
February	-	4,333,601	40
March	-	5,073,346	47
April	-	4,876,916	45
May	-	6,335,833	58
June	-	16,640,939	153
July	-	17,984,030	165
August	-	17,862,530	164
September	-	17,349,970	159
October	-	18,362,968	169
November	-	11,500,440	106
December	-	5,638,808	52
Total	-	130,663,867	-
Monthly aver.(m3/m)	-	10,888,656	100

Source : PJT

Table A4-30 Present Industrial Water Supply by Ground Water

(Unit : thousand M3/year)

Regency/ municipality	Number of industries	Amount of water supplied	(%)	Remarks
Sidoarjo	564	3,991	5.9	source (c)
Mojokerto	24	1,382	2.0	source (a)
Malang	37	6,023	8.9	source (a)
Blitar	8	19,209	28.5	source (a)
Kediri	46	31,753	47.1	source (a)
Nganjuk	8	4,031	6.0	source (a)
Jombang	11	24	0.0	source (a)
Tulungagung	25	433	0.6	source (a)
Trenggalek	1	11	0.0	source (a)
Surabaya	n.a.	602	0.9	source (b)
Total	724	67,460	100.0	

Source : (a) East Java Mining Service : amount in terms of licensed amount
(b) A Water Quality Monitoring and Pollution Control Program for Brantas River Basin Master Plan by Brantas River Basin Development Executing Office with French \Technical Assistance of Beture Setame
(c) DISPENDA : not classify type of activity, therefore would include non-industrial use. Figure for Sidoarjo is derived by multiplying 12 month to June 1997 figure.
Note : Conversion to annual figures were made based on12 operating hours a day and 365 working days a year.

Table A4-31 Industrial Water Supply by PDAM

Regency/ Municipality	Number of factories receiving water from from PDAM	Amount of water received (m^3/year)	Amount of water used per factory		Share of industrial water supply (%)	Remarks
			(m^3/year)	(m^3/day)		
(Rengency)						
Sidoarjo	199	852,000	4,281	11.7	16.2	71,000m3/month (*)times12 months. (*) average of Jan. - May 1997
Mojokerto	40	33,373	834	2.3	3.0	Figures are total of 1996.
Malang	66	75,401	1,142	3.1	0.8	Figures are total of 1996.
Blitar	0	0	-	-	-	
Kediri	4	1,398	350	1.0	0.1	Figures are total of 1996.
Ngamjuk	8	n.a.	-	-	-	
Jombang	13	3,816	294	0.8	0.2	Figures are total of 1996.
Tulungagung	0	0	-	-	-	
Trenggalek	1	312	312	0.9	0.1	26 m3/month (*)times12 months. (*) May 1997 figure
(Municipality)						
Surabaya	783	4,263,496	5,445	14.9	4.1	Figures are total of 1996.
Mojokerto	7	2,957	422	1.2	0.4	Figures are total of 1996.
Malang	694	36,086	52	0.1	0.2	Figures are total of 1996.
Kediri	n.a.	94,290	-	-	5.0	Figures are total of 1996.
Blitar	0	0	-	-	-	
Total	1,815	5,363,129	2,955	8.1	3.8	

Source : respective PDAM

Table A4-32 Present Industrial Water Use by Type of Industry and Source of Water

(Unit : million m^3 / year)

Source	Sugar	Paper	Other	Total	
Brantas	76	29	26	131	61%
Ground water	34	17	16	67	31%
PDAM	0	0	5	5	2%
Other	7	3	2	12	6%
Total	117	49	49	215	100%
	54%	23%	23%	100%	

Source : PJT, East Java Mining Service, PDAMs

Table A4-33 Industrial Water Demand in Brantas River Basin Projected for Year 2020

Item	Unit	Sugar	Paper	Other	Total
Production in 1996	billion Rupiah	127	396	23,934	24,457
	%	0.5	1.6	97.9	100.0
	ton	710,000	580,000	n.a.	n.a.
Annual rate of change in production	%/year	0.0	6.3	8.3	8.3
Production in 2020	billion Rupiah	127	1,716	163,920	165,762
	ton	710,000	2,513,196	n.a.	n.a.
Water use in 1996	million M3/year	117	49	49	215
Coefficient (growth rate of water use / that in production)	-	0.55	0.51	0.90	0.53
Annual rate of change in water use	%/year	0.0	3.2	7.5	4.4
Gross water demand	million M3/year	117	104	278	499
Rate of recycling	%	45	43	52	-
Net water demand in 2020	million M3/year	64	59	133	257
Gross Unit Water Consumption (technology improvement)					
1996	m3/thousand Rupiah	921.3	123.7	2.0	8.8
2020	m3/thousand Rupiah	921.3	60.8	1.7	3.0
1996	m3/ product-ton	165	84	-	-
2020	m3/ product-ton	165	42	-	-
Net Unit water Supply (technology improvement + recycling)					
1996	m3/thousand Rupiah	921.3	123.7	2.0	8.8
2020	m3/thousand Rupiah	506.7	34.7	0.8	1.6
1996	m3/ product-ton	165	84	-	-
2020	m3/ product-ton	91	24	-	-
Gross water demand in Japan in 1991	m3/ product-ton	87	53	n.a.	n.a.
Net water demand in Japan in 1991	m3/ product-ton	48	30	n.a.	n.a.

Assumptions :

(1) Water use : compiled from data on existing water use classifying source of water into Brantas, ground water, PDAM and other.

(2) Growth rates of production
Sugar : 0.0 % per year based on judgement that sugar production is unlikely to grow in Brantas
Paper : 6.3 % per year based on coefficient in Japan (rate of change in GNP / that in production of paper)
Other : 8.3 % per year, same as the total growth rate at 8.3% per year

(3) Coefficient : showing the level of change in industrial water use in proportion to change in production level. The coefficients are derived based on the historical data in Japan.
Two factors would explain that coefficients are lower than " 1.0 " : economy of scale and improved production technology requiring less water for production.

(4) Growth rate in water use : derived from (2) and (3).

(5) Gross water demand : water demand before considering recycling.

(6) Rate of recycling :
Sugar / paper : rate as of 1991 in Japan
other : average rate in Japan in 1991 weighed by composition of type of industries likely to locate in Brantas. (Refer to the attached table.)

(7) Net water demand : water demand after considering recycling.

Table A4-34 Industrial Water Demand for Brantas River Projected for Year 2020

Item	Unit	Sugar	Paper	General	Total
Production in 1996	Index, 1996=100	100	100	100	100
Annual rate of change in production	%/year	0.0	6.3	8.3	8.3
Production in 2020	billion Rupiah	100	433	144	678
Water use in 1996	million M3/year	50	28	26	104
	m3/second	3.7	2.1	1.9	7.7
Coefficient (growth rate of water use / that in production)	-	0.55	0.51	0.90	0.53
Annual rate of change in water use	%/year	0.0	3.2	7.5	4.4
Gross water demand in 2020	million M3/year	50	60	147	257
Rate of recycling	%	45	43	52	49
Net water demand in 2020	million M3/year	28	34	71	132
	m3/second	2.0	2.5	5.2	9.8

Assumptions :

(1) Water use : amount of water taken from mainstream of Brantas and Surabaya Rivers

(2) Growth rates of production
Sugar : 0.0 % per year based on judgement that sugar production is unlikely to grow in Brantas
Paper : 6.3 % per year based on coefficient in Japan (rate of change in GNP / that in production of paper)
General : 8.3 % per year assumed at higher than the total growth rate at 8.3% per year

(3) Coefficient : showing the level of change in industrial water use in proportion to change in production level. The coefficients are derived based on the historical data in Japan.
Two factors would explain that coefficients are lower than " 1.0 " : economy of scale and improved production technology requiring less water for production.

(4) Growth rate in water use : derived from (2) and (3).

(5) Gross water demand : water demand before considering recycling.

(6) Rate of recycling :
Sugar / paper : rate as of 1991 in Japan
general : average rate in Japan in 1991 weighed by composition of type of industries likely to locate in Brantas. (Refer to the attached table.)

(7) Net water demand : water demand after considering recycling.

(8) Annual operating days : 312 days, operating hour : 12 hours/day

Table A4-35 Water Supply by PDAM for Social and Business Uses in 1996

Regency/ Municipality	Number of organizations receiving water from PDAM	Amount of water received (m^3/year)	Amount of water used per organization		Share in total water supply amount (%)	Remarks
			(m^3/year)	(m^3/day)		
(Rengency)						
Sidoarjo	4,480	1,007,448	225	0.6	17.3	83,954m^3/month (*)times12 months. (*) December 1997 figure
Mojokerto	635	330,894	521	1.4	30.1	
Malang	2,338	1,104,568	472	1.3	11.1	
Blitar	445	194,748	438	1.2	26.4	Figures in December 1996 times 12 months
Kediri	223	107,816	483	1.3	10.5	
Nganjuk	521	259,746	499	1.4	14.5	
Jombang	722	344,928	478	1.3	21.7	
Tulungagung	447	222,782	498	1.4	10.1	
Trenggalek	173	49,812	288	0.8	7.4	4,151 m^3/month (*)times12 months. (*) May 1997 figure
(Municipality)						
Surabaya	21,629	33,811,966	1,563	4.3	32.4	Figures are total of 1996.
Mojokerto	378	103,817	275	0.8	13.2	
Malang	3,339	6,704,516	2,008	5.5	32.6	Figures are total of 1996.
Kediri	679	543,762	801	2.2	28.7	
Blitar	315	116,511	370	1.0	11.8	
Total	36,324	44,903,314	1,236	3.4	-	

Source : respective PDAM

Table A4-36 (1) River Maintenace Flow for Each Composition (Recreation)

No.	Location	River or Canal	Width (m)	Depth (m)	Velocity (m/s)	Water requirement (m3/s)
1	Bumiayu Bridge	Brantas river	40	0.3	0.33	3.2
2	Demangan Bridge	Brantas river	70	0.3	0.33	5.6
3	Jogbiru Bridge	Brantas river	100	0.3	0.33	7.9
4	Padangan Bridge	Brantas river	200	0.3	0.29	13.7
5	Canggu Tambangan	Surabaya river	50	0.5	0.46	9.1
6	Karangpilang	Surabaya river	60	0.5	0.29	7.0
7	Ngagel	Surabaya river	30	0.5	0.29	3.5
8	Kayon	Mas river	30	0.5	0.23	2.8
9	Pelayaran	Pelayaran canal	10	0.3	0.17	0.4
10	Porong	Porong canal	7	0.3	0.17	0.3

Note : 1) Velocity is calculated by means of Manning's formula.
2) Water reqirement = width x depth x 0.8

Table A4-36 (2) River Maintenace Flow for each Composition (Aesthetics)

No.	Location	River or Canal	Width (m)	Depth (m)	Velocity (m/s)	Water requirement (m3/s)
1	Bumiayu Bridge	Brantas river	40	0.3	0.33	3.2
2	Demangan Bridge	Brantas river	70	0.3	0.33	5.6
3	Jogbiru Bridge	Brantas river	100	0.3	0.33	7.9
4	Padangan Bridge	Brantas river	200	0.3	0.29	13.7
5	Canggu Tambangan	Surabaya river	50	0.3	0.32	3.9
6	Karangpilang	Surabaya river	60	0.3	0.21	3.0
7	Ngagel	Surabaya river	30	0.3	0.21	1.5
8	Kayon	Mas river	30	0.3	0.17	1.2
9	Pelayaran	Pelayaran canal	10	0.3	0.17	0.4
10	Porong	Porong canal	7	0.3	0.17	0.3

Note : 1) Velocity is calculated by means of Manning's formula.
2) Water reqirement = width x depth x 0.8

Table A4-36 (3) River Maintenace Flow for each Composition (Preservation of Biota)

No.	Location	River or Canal	Width (m)	Depth (m)	Velocity (m/s)	Water requirement (m3/s)
1	Bumiayu Bridge	Brantas river	40	0.2	0.25	1.6
2	Demangan Bridge	Brantas river	70	0.2	0.25	2.8
3	Jogbiru Bridge	Brantas river	100	0.2	0.25	4.0
4	Padangan Bridge	Brantas river	200	0.2	0.22	7.0
5	Canggu Tambangan	Surabaya river	50	0.2	0.25	2.0
6	Karangpilang	Surabaya river	60	0.2	0.16	1.5
7	Ngagel	Surabaya river	30	0.2	0.16	0.8
8	Kayon	Mas river	30	0.2	0.13	0.6
9	Pelayaran	Pelayaran canal	10	0.2	0.13	0.2
10	Porong	Porong canal	7	0.2	0.13	0.1

Note : 1) Velocity is calculated by means of Manning's formula.
2) Water reqirement = width x depth x 0.8

Table A4-36 (4) River Maintenace Flow for each Composition (Navigation)

No.	Location	River or Canal	Width (m)	Depth (m)	Velocity (m/s)	Water requirement (m3/s)
1	Bumiayu Bridge	Brantas river	40	-	-	-
2	Demangan Bridge	Brantas river	70	-	-	-
3	Jogbiru Bridge	Brantas river	100	-	-	-
4	Padangan Bridge	Brantas river	200	-	-	-
5	Canggu Tambangan	Surabaya river	50	0.5	0.46	9.1
6	Karangpilang	Surabaya river	60	0.5	0.29	7.0
7	Ngagel	Surabaya river	30	0.5	0.29	3.5
8	Kayon	Mas river	30	0.5	0.23	2.8
9	Pelayaran	Pelayaran canal	10	-	-	-
10	Porong	Porong canal	7	-	-	-

Note : 1) Velocity is calculated by means of Manning's formula.
2) Water reqirement = width x depth x 0.8

Table A4-37 River Maintenance Flow

Unit : m3/s

No.	Location	River or Canal	Water Quality	Recreation and Ablution	Aesthetics	Biota	Navigation	Max
1	Bumiayu Bridge	Brantas river	21	3.2	3.2	1.6	-	21
2	Demangan Bridge	Brantas river	10	5.6	5.6	2.8	-	10
3	Jogbiru Bridge	Brantas river	16	7.9	7.9	4.0	-	16
4	Padangan Bridge	Brantas river	22	13.7	13.7	7.0	-	22
5	Canggu Tambangan	Surabaya river	10	9.1	3.9	2.0	9.1	10
6	Karangpilang	Surabaya river	14	7.0	3.0	1.5	7.0	14
7	Ngagel	Surabaya river	24	3.5	1.5	0.8	3.5	24
8	Kayon	Mas river	8	2.8	1.2	0.6	2.8	8
9	Pelayaran	Pelayaran canal	3	0.4	0.4	0.2	-	3
10	Porong	Porong canal	0	0.3	0.3	0.1	-	0.3