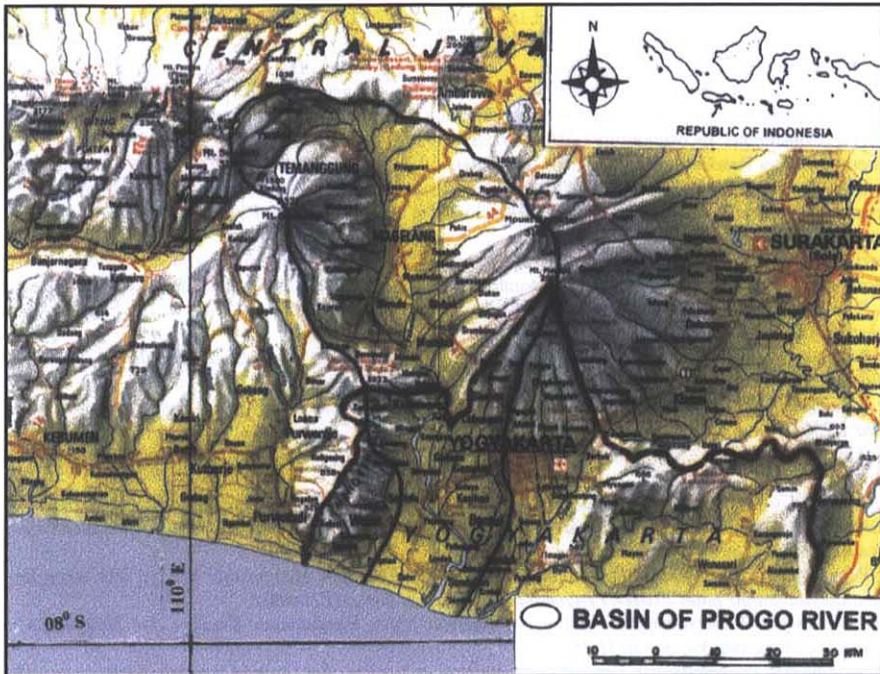


Kali Progo

Map of River



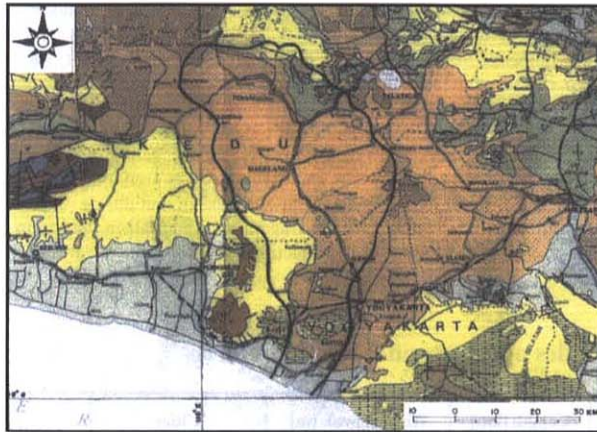
Java & Nusa Tenggara, Nelles Maps, CV Jaya Books, Indonesia

Table of Basic Data

Name: Kali Progo		Serial No. : Indonesia - 6
Location : Java Island, Indonesia	S 7°59'6" ~ 7°11'7"	E 110°11'18"~ 110°38'18"
Area : 2,380 km ²	Length of main stream : 140 km	
Origin : Mt. Sundoro (3,136 m)	Highest point : Mt. Sumbing (3,371 m)	
Outlet : Indian Ocean	Lowest point : River Mouth (0 m)	
Main geological features : Tertiary Marine Sediment, Holocene Volcanoes, Tertiary Volcanic Origin		
Main tributaries : Tingal River (47 km ³), Tangsi River (164 km ³), Elo River (383 km ³), Krasak River (35 km ³), Bedog River (120 km ³)		
Main reservoirs : None		
Main lakes : None	Main Marshes : None	
Mean annual precipitation : 2,300 mm		
Mean annual runoff : 87.05 m ³ /s at Bantar (2,008 km ³) (1992 - 1993)		
Population : 2,588,000 (1993)	Main cities : Temanggung, Magelang, Sleman, Yogyakarta	
Land use : Forest (3.75 %), Paddy field (45.34 %), Other agricultural field (31.95 %), Settlements (18.96 %) (1993)		

2. Geographical Information

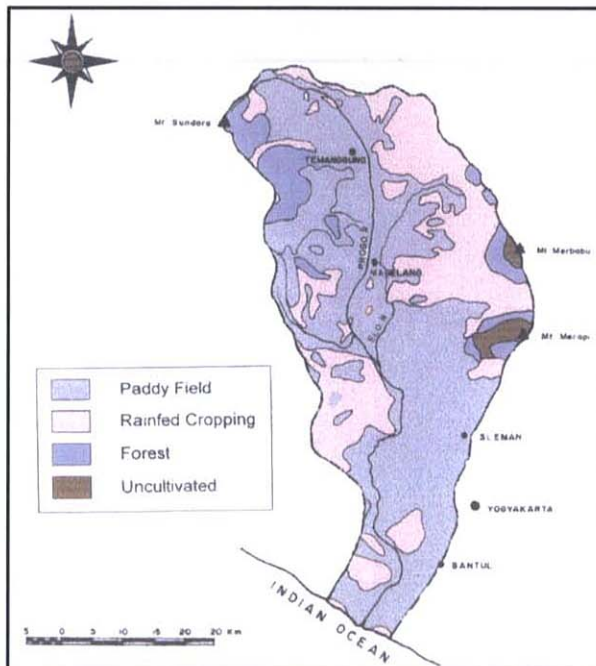
2.1 Geological Map



LEGEND

	Alluvium		Pliocene, volcanic facies		Gabbro, Peridotite, Serpentine
	Alluvium, volcanic facies		Miocene, Sedimentary facies		Undifferentiated volcanic products
	Pleistocene, sedimentary facies		Miocene, limestone facies		Old Quaternary volcanic products
	Pleistocene, volcanic facies		Eocene		Andesite, Basalt, Diabase
	Pliocene, sedimentary facies		Granite, Granodiorite, Diorite		Liparite, Dacite

2.2 Land Use Map



	Paddy Field
	Rainfed Cropping
	Forest
	Uncultivated

1. General Description

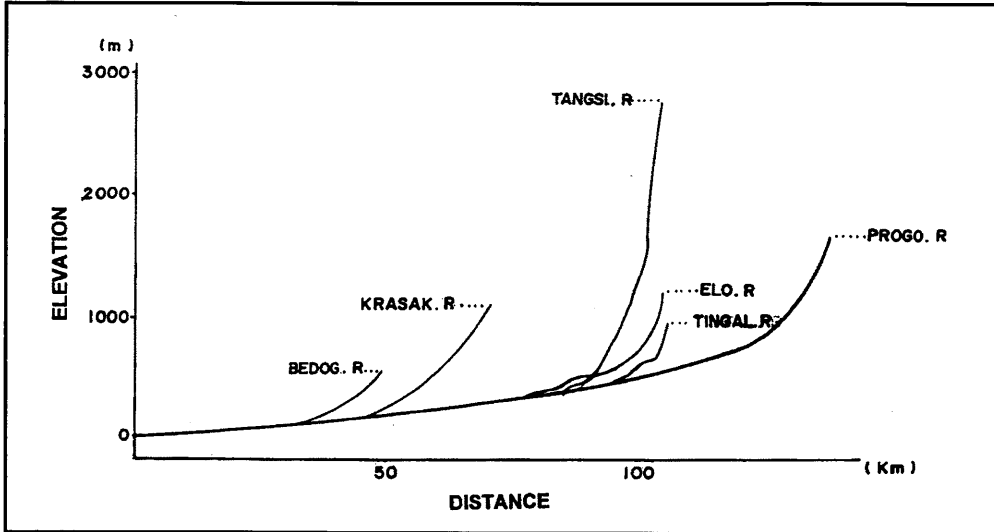
The Progo river has a catchment area of 2,380 km² and a length of 140 km. It runs through the Central Java and Yogyakarta Provinces and through several mountain ranges such as Sumbing, Sundoro, Merapi, Merbabu and Menoreh. The upper boundary of its catchment is formed by North Progo Hills, the west boundary by Mt. Sundoro and Mt. Sumbing holocene volcanoes, and the eastern boundary by Mt. Merbabu and Mt. Merapi holocene. The lower Progo crosses the low hills of Menoreh and Sentolo. The holocene volcanic sediment is comprised largely of ashes, sands and boulders of an andesitic type, derived from the volcanoes Merapi, Merbabu, Sumbing and Sundoro. Of these, Merapi and Sundoro are still active and the latter erupts very infrequently. Merapi on the other hand, is one of Indonesia's most active volcanoes, generally erupting at 3-7 year intervals. The monsoon climate characterized by distinct wet and dry seasons is predominant in the basin. During the wet season there is no shortage of water in the river system of the basin, but during the dry season the available supplies are almost fully utilized for irrigation. The average annual rainfall in the basin is 2,300 mm. More than 70 % of the basin area is utilized for agricultural production - tobacco and sugar cane in particular.

2.3 Characteristics of River and Main Tributaries

No	Name of river	Length [km] Catchment Area [km ²]	Highest peak [m] Lowest point [m]	Cities Population [year]	Land use [%]
1	Progo (Main river)	140 2,380	Sundoro, 1,650 River mouth, 0.0	Temanggung 78,070 (1995) Magelang 116,468 (1995)	A(32), F(4), P(45), S(19)
2	Tingal (Tributary)	8 47	Sijambul, 957 475	-	A(58.2), F(33.7), P(8.1)
3	Tangsi (Tributary)	38 164	Sumbing, 2,775 250	-	A(27.5), F(57), P(15.5)
4	Elo (Tributary)	47 383	Merbabu, 1,357 232	Magelang 116,468 (1995)	A(45.3), F(4.9), P(43.9), S(5.9)
5	Krasak (Tributary)	24 35	Merapi, 1,073 120	Sleman 52,756 (1995)	A(2.8), F(4.9), P(65.5), S(26.8)
6	Bedog (Tributary)	42 120	Merapi, 556 21	Yogyakarta 469, 193 (1995)	A(52.6), F(3.9), P(43.5)

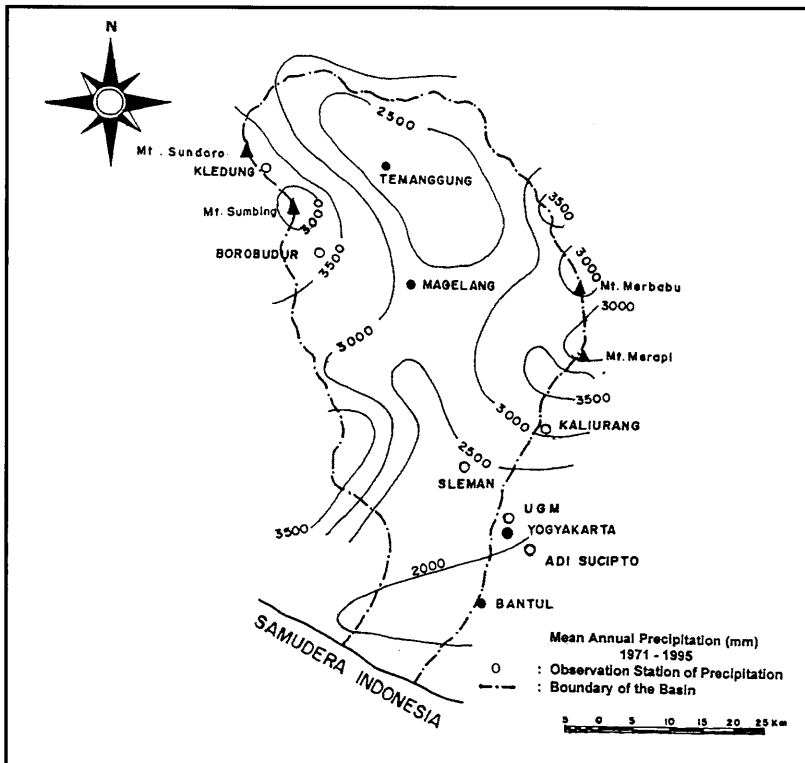
A: Other Agricultural Field, F: Forest, P: Paddy Field, S: Settlements.

2.4 Longitudinal Profiles



3. Climatological Information

3.1 Annual Isohyetal Map and Observation Stations



3.2 List of Meteorological Observation Stations

No	Station	Elevation [m]	Location	Observation period	Mean annual precipitation [mm]	Mean annual evaporation [mm]	Observation item
1	Kledung	1,399	S 07° 23' E 110° 01'	1971-1988	3,299	-	T,RH,P,WV
2	Borobudur	270	S 07° 37' E 110° 13'	1971-1995	2,226	26.4	T,RH,E,P,WV
3	Kaliurang	775	S 07° 37' E 110° 26'	1971-1988	2,548	-	T,RH,P,WV
4	UGM/ Yogya	137	S 07° 46' E 110° 23'	1971-1988	2,333	-	T,RH,P,WV
5	Adisucipto	122	S 07° 47' E 110° 26'	1971-1988	2,005	-	T,RH,P,WV
6	Seneng/ Magelang	380	S 07° 29' E 110° 14'	1971-1988	2,049	-	T,RH,P,WV

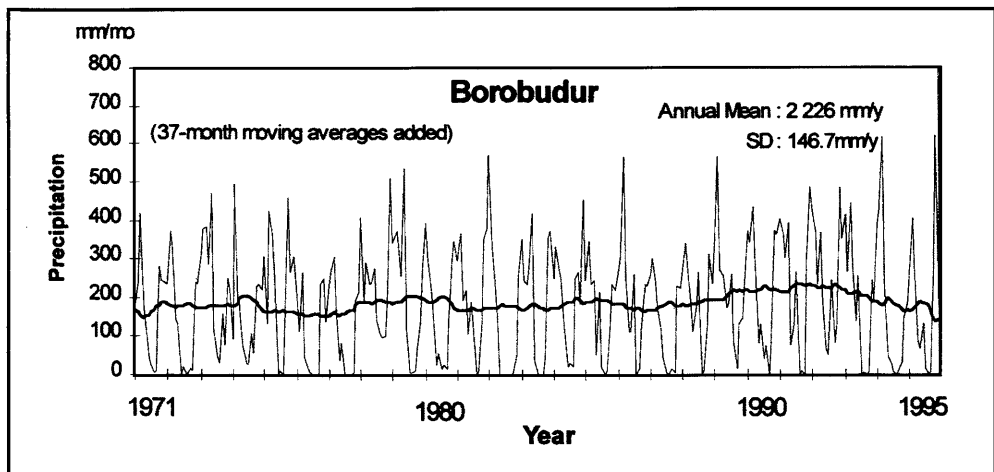
E = Evaporation, P = Precipitation, RH = Relative Humidity, T = Temperature, WV = Wind Velocity.

3.3 Monthly Climate Data

Station : Borobudur

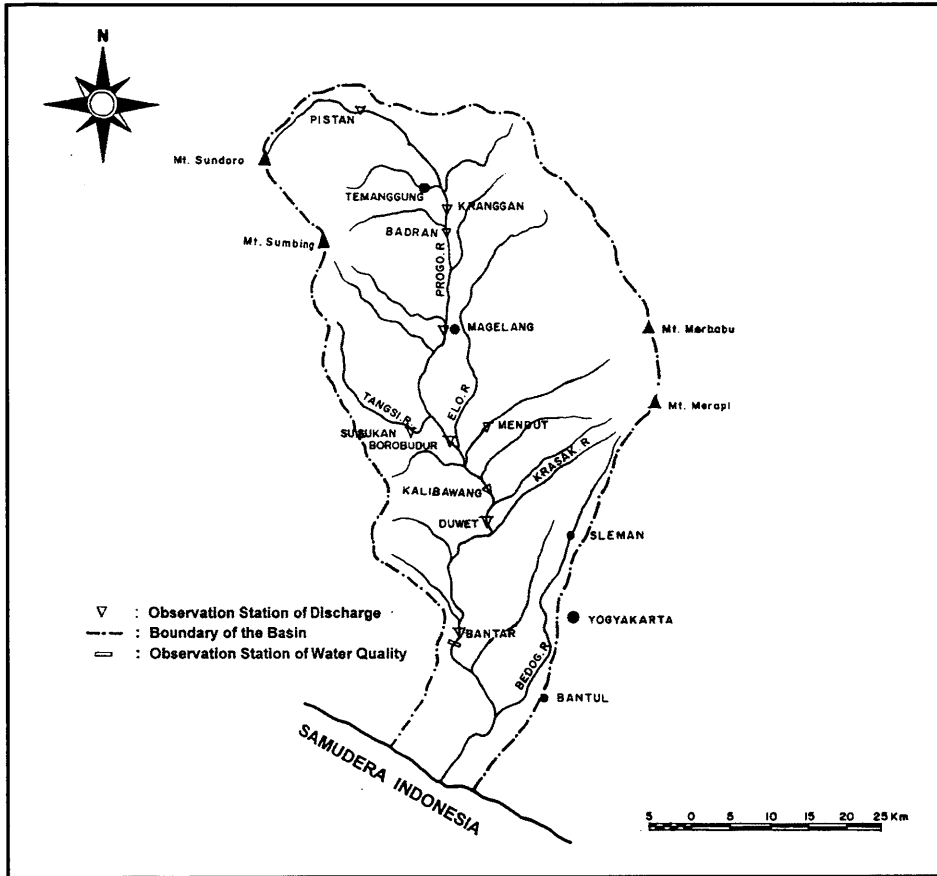
Observation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Period for the mean
Temperature [C°]	25.5	25.5	25.6	25.9	25.9	25.2	24.6	24.7	25.6	26.2	26.0	25.7	25.5	1971-1995
Precipitation [mm]	317	324	335	227	153	91	49	41	48	117	226	298	2226	1971-1995
Evaporation [mm]	59.6	56.6	59.9	60.1	67.1	65.6	73.5	85.5	87.7	83.5	69.8	65.0	829	1970-1996
Solar radiation [MJ/m ² /d]	7,164	8,223	8,064	7,954	8,209	7,926	8,297	8,396	8,768	8,935	8,318	4,076	8,191	1985-1996
Duration of sunshine [hr]	3.10	3.41	3.96	4.78	5.40	5.06	5.61	5.26	4.91	4.70	4.01	3.54	49.8	1971-1996

3.4 Long-term Variation of Monthly Precipitation



4. Hydrological Information

4.1 Map of Stream flow Observation Stations



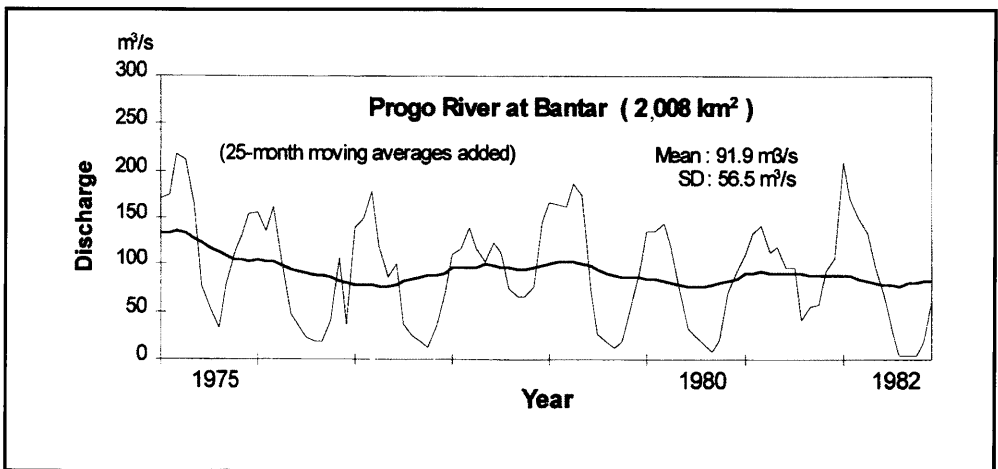
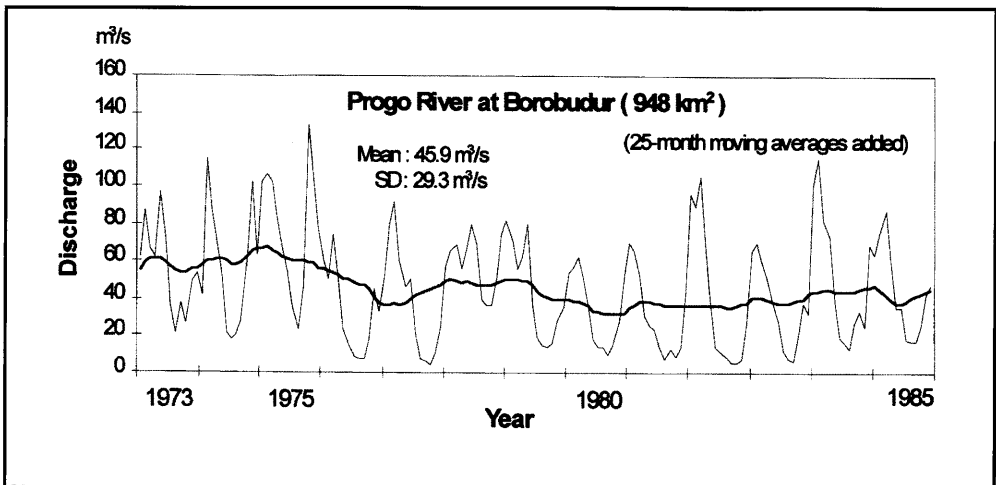
4.2 List of Hydrological Observation Stations

Station code	Station	Elevation [m]	Location	Catchment area [km ²]	Observation period	Observation items ¹⁾ (Frequency)
02-082-01-02	Kranggan	433	S 7°20'26" E 110°12'28"	423.0	1970-1994	Q(d)
02-082-01-06	Badran	425	S 7°24'49" E 110°12'50"	484.4	1984-1994	Q(d)
02-082-02-04	Borobudur	266	S 7°36'12" E 110°13'17"	948.0	1970-1994	Q(d)
02-082-02-06	Kalibawang	161	S 7°40'10" E 110°15'48"	1,676.0	1982-1994	Q(d)
02-082-03-02	Duwet	119	S 7°42'00" E 110°16'00"	1,762.7	1973-1994	Q(d)
02-082-04-01	Bantar	41	S 7°44'35" E 110°14'00"	2,008.0	1973-1994	Q(d)

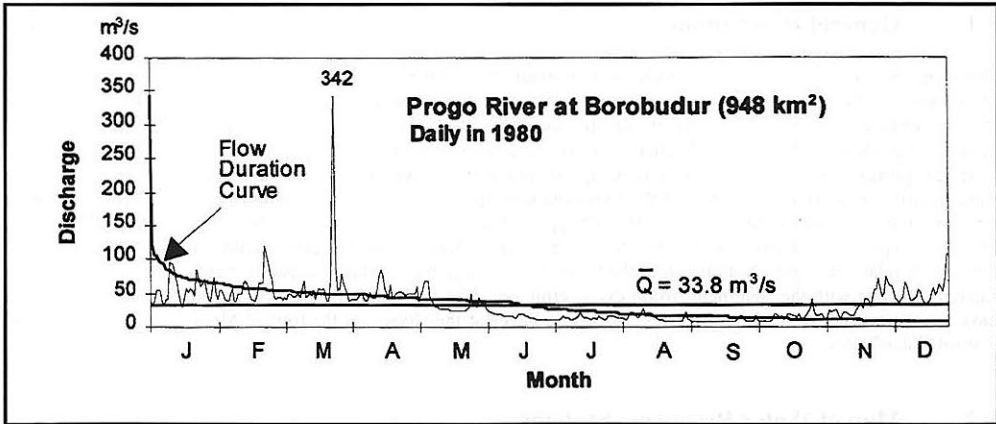
No.	\bar{Q} ²⁾ [m ³ /s]	Q _{max} ³⁾ [m ³ /s]	\bar{Q}_{max} ⁴⁾ [m ³ /s]	\bar{Q}_{min} ⁵⁾ [m ³ /s]	\bar{Q}/A [m ³ /s/100km ²]	Q _{max} /A [m ³ /s/100km ²]	Period of statistics
1	14.35	322.0	238.64	2.73	0.1435	3.220	1973 ~ 1994
2	12.80	68.4	68.40	2.10	0.1280	0.684	1993 ~ 1994
3	45.90	1,042.0	533.67	12.69	0.4590	10.420	1973 ~ 1994
4	50.30	152.7	152.70	29.22	0.5030	1.527	1993 ~ 1994
5	67.00	348.0	259.15	1.91	0.6700	3.480	1993 ~ 1994
6	89.30	596.0	596.00	9.00	0.8930	5.960	1992 ~ 1994

- 1) Q(d) : Daily Discharge
- 2) Mean Annual Discharge
- 3) Maximum Discharge
- 4) Mean Maximum Discharge
- 5) Mean Minimum Discharge

4.3 Long-term Variation of Monthly Discharge



4.4 Annual Pattern of Discharge



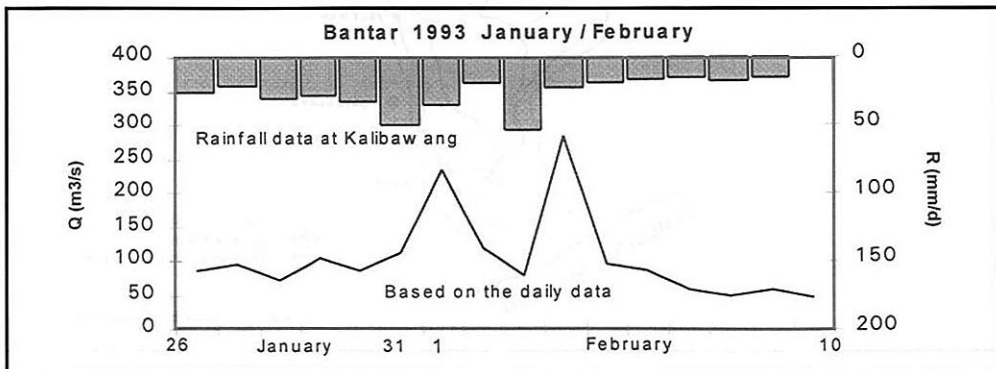
4.6 Annual Maximum and Minimum Discharges

At Borobudur [948 km²]

Year	Maximum ¹⁾		Minimum ²⁾		Year	Maximum ¹⁾		Minimum ²⁾	
	Date	Discharge [m ³ /s]	Month	Discharge [m ³ /s]		Date	Discharge [m ³ /s]	Month	Discharge [m ³ /s]
1973	6.11	763	10	11.40	1985	11.28	450	8	13.40
1974	2.01	534	8	13.00	1992	1.19	109	8	10.20
1975	1.09	593	12	41.90	1993	1.30	1,042	11	3.30
1977	2.08	598	10	4.15	1994	3.24	272	10	7.60
1979	5.04	442	10	9.30					

1), 2) Instantaneous Observation by Recording Chart

4.7 Hyetographs and Hydrographs of Major Floods

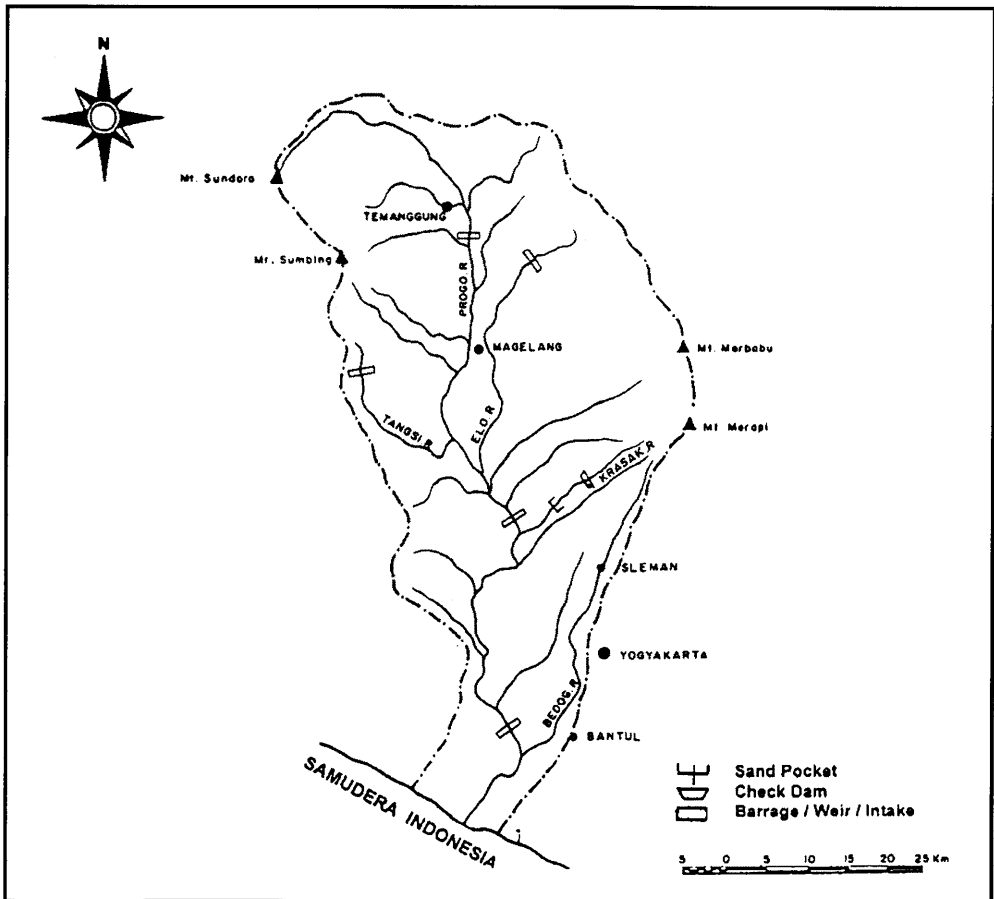


5. Water Resources

5.1 General Description

The Progo River has 2,380 km² catchment area or about 75 % of the extent of Yogyakarta Special Region Province (3,185 km²). The river flows through the provinces of Central Java and Yogyakarta Special Region. In the Progo tributaries numerous weirs divert all the available dry season supplies to irrigation systems. However there is a gradual build up of discharge in the incised rivers between weirs, made up mainly of the outflow from the groundwater reservoir which is being continuously recharged by deep percolation from irrigation. The water quality of the rivers is good and the rivers draining the volcanic catchments are rich in nutrients. Sediment concentration is usually in the range of 50-1,500 ppm. The lower Progo is affected by volcanic material from Mt. Merapi eruptions. "Lahar" flows do affect bridges and irrigation intakes periodically but in general debris damage is relatively light. Not only does the Progo have a large transportation capacity, but also has a large storage capacity to cope with the sediment from cyclic eruptions over the years. Numerous checkdams and sand pockets have been constructed in the tributaries of Progo River at the slope and the foot of Merapi volcano in order to control "lahar" flow.

5.2 Map of Water Resources Systems



5.3 List of Major Water Resources Facilities

Major Reservoirs

Name of river	Facilities	Purpose ¹⁾	Capacity [m ³]	Year of completion
Kali Krasak	Check Dam	C	122,626	1977
	Check Dam	C	263,757	1975
Kali Putih	Sand Pocket	S	930,044	1992
	Sand Pocket	S	803,720	1992
Kali Batang	Sand Pocket	S	1,150,895	1992
	Sand Pocket	S	970,058	1992
	Diversion	C	536,690	1990
Kali Bebeng	Sand Pocket	S	1,400,220	1985
	Sand Pocket	S	1,134,839	1986
	Diversion	C	433,333	1986
Kali Blongkeng	Sand Pocket	S	596,263	1992
	Sand Pocket	S	254,841	1985

1) C : Control Sediment Discharge, S : Storage of Lahar Deposit

5.4 Major Flood and Drought Experiences

Major Floods at Krasak [Catchment area 35 km²]

Date	Peak discharge ¹⁾ [m ³ /s]	Rainfall [mm] Duration [hr]	Meteorological cause	Dead and missing	Major damage (Districts affected)
1976.11.26	-	281	Storm	28	Krasak, Kricak, Tempel, Nglumut, Mlati, Ngepos

1) Flood of Lahar

5.5 Groundwater and Water Quality

River Water Quality at Bantar in 1993

Date	May, 25	June, 25	July, 25	Aug. 25	Sept. 25	Oct. 25	Nov. 25	Dec. 28
pH	7.7	8.0	8.1	8.2	8.0	8.3	7.7	-
DO [mg/l]	-	-	-	8.2	5.8	7.2	6.1	7.5
COD [mg/l]	36	7.0	16	3.5	14.4	-	15.7	15.0
SS [mg/l]	88	45	58	68	44	42	402	-
Coliform *)	-	-	-	-	-	-	-	-
Discharge [m ³ /sec]**	67.7	54.0	46.0	57.6	97.2	111.0	322.0	48.0

*) Membrane Filter Method, Colories/100 ml

***) Discharge on the Observation Date

- No Data

5.6 Other Notable Features of Water Resources

Name of facility	Name of river	Agricultural use [ha]	Industrial use [ha]	Municipal water supply [10^6 m^3]
Galeh Weir	Kali Galeh	1,217	-	-
Badran Weir	Kali Progo	3,453	-	-
Sumberan Weir	Kali Elo	568	-	-
Tangsi Weir	Kali Tangsi	1,448	-	-
Pasekan Weir	Kali Pabelan	1,078	-	-
Kalibawang Free Intake	Kali Progo	2,156	-	-
Karang Talun Weir	Kali Progo	5,268	-	-
Pijenan Weir	Kali Bedog	2,494	-	-
Sapon Free Intake	Kali Progo	1,917	-	-

6. Socio-Cultural Characteristics

The Borobudur Temple is one of the world's most famous temples. It stands majestically on a hilltop overlooking lush green fields and distant hills. At the top is Great Stupa standing 42 m above the ground. Perhaps 10,000 workers took a century to build it, with over $2 \times 10^6 \text{ ft}^3$ of stone. It was built during the short Syailendra dynasty in Central Java between 778 and 856 AD, 300 years before Angkor Wat, 200 years before Notre Dame. Kraton Ngayogyakarta Hadiningrat, or Sultan's Palace covers one square km in Central Yogyakarta City. A walled city within a city, it has 30,000 residents, including artisans producing traditional craft like batik, silver wares, wayang puppets and masks. The construction began in 1755 and took nearly 40 years. About 27 km south of Yogyakarta City is a beach which is famous for its dunes of shifting gray sand. This is one of Yogyakarta's mystical spots, where annual ceremonies are performed in honor of Nyai Roro Kidul, the Goddess of the Southern Ocean.

7. References, Databooks and Bibliography

- Bappeda TK.I Jawa Tengah Kerja Sama dengan BPN (1993) : *Peta Penggunaan Tanah Prop. Dati I Jawa Tengah, skala 1:500 000* (In Indonesian).
- CV Jaya Books : *Nelles Maps, Indonesia 2, Java & Nusa Tenggara*, Scale 1 : 1 500 000.
- Departemen Perhubungan, Pusat Meteorologi dan geofisika : *Data Iklim di Indonesia 1971 - 1979*, Jakarta, 1971 - 1979.
- Departemen Perhubungan, Pusat Meteorologi dan geofisika : *Pemeriksaan Hujan di Indonesia no. 93 - 101*, Jakarta, 1971 - 1979.
- Direktorat Geologi (1989): *Peta Geologi Jawa dan Madura, skala 1 : 500 000, 3-rd edition*.
- Direktorat Agraria Propinsi DIY : *Peta Penggunaan Tanah Propinsi D I Yogyakarta, skala 1:100 000* (In Indonesian).
- Direktorat Geologi (1989): *Peta Topografi Yogyakarta, skala 1 : 25 000*, Bandung, cetakan ketiga.
- Sir. M. Donald & Partners (1971): *Kali Progo Basin Study*, Government of Indonesia, Ministry of Public Works and Power, Directorate General of Water Resources Development.