

(Field Note)**Regional Difference and Seasonality of Rainfall in Java,
with Special Reference to Bogor¹⁾**

Koji NAKAMURA Ecological Laboratory, Faculty of Science, Kanazawa University, Kanazawa 920-11,
Japan

Woro A. NOERDJITO Bogor Zoological Museum, Jl. Juanda 9, Bogor, Indonesia

Ahsol HASYIM Sukarami Research Institute for Food Crops, P. O. Box 34, Padang, Indonesia

Abstract Two sets of rainfall records previously published by Indonesian institutions were summarized to examine regional difference and seasonality of rainfall in Java, especially sites in and around Bogor.

Key word: rainfall seasonality / tropical seasons / Bogor / Java / Indonesia

The duration and intensity of tropical seasons vary considerably more than one might expect (Windsor, 1990). Long term climate records are vitally important for ecological studies in the tropics, especially in Indonesia, where climatic conditions are extremely diverse. There is no doubt that various government organizations of Indonesia have been keeping climate records on many localities for a long time. However, because the data often have not been printed for the public, ecologists, especially foreigners, working in Indonesia have difficulty in gaining access to these data. This article aims to examine regional difference and seasonality of rainfall in Java and Bogor. The data used here were originally published by the Bogor Research Institute for Food Crops (1980-1989, thereafter abbreviated as BORIF) and the Institute of Meteorology and Geophysics (1978, IMG). Although both data sets have some missing records, their analysis can be helpful for understanding the rainfall regime of this region.

Rainfall in Java

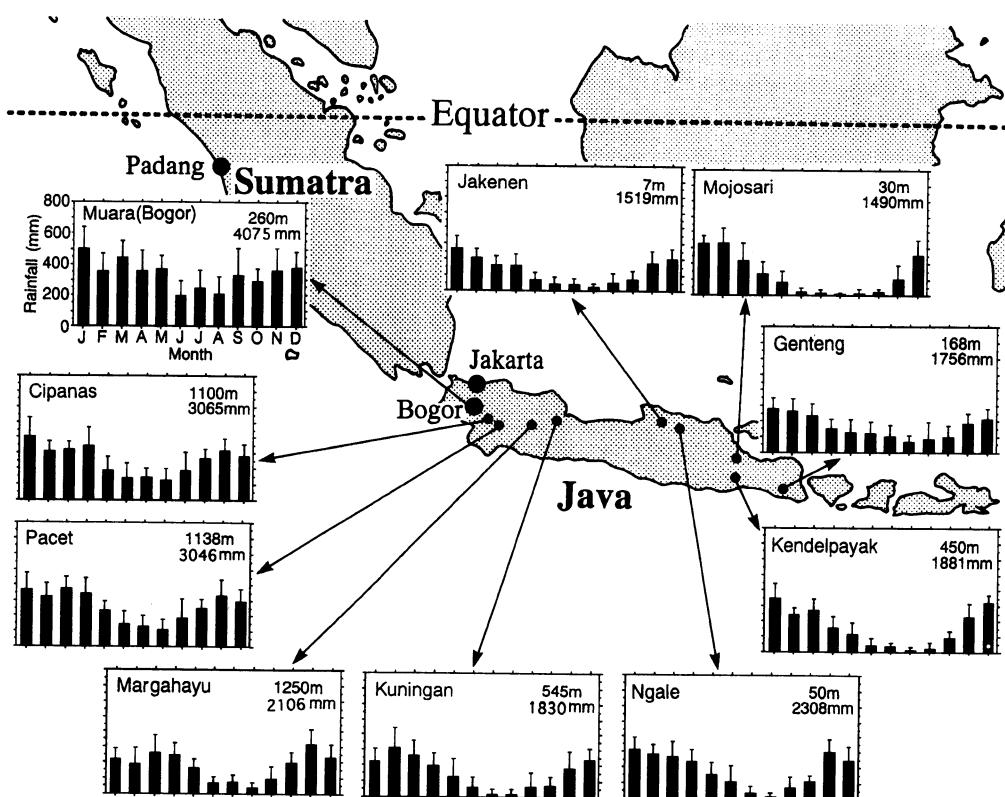
Figure 1 shows the regional variation of rainfall in Java, recorded at ten localities (Table 1) by BORIF from 1980 to 1989 (see also Appendix 1). The climate of Sumatra and the western part of Java is characterized by the typical features of the humid tropics: high and extremely constant temperature and abundant rainfall distributed throughout the year (Inoue and Nakamura, 1990). Bogor (represented by Muara in Fig. 1), located at the eastern fringe of the humid tropical climate range, has an annual rainfall of 4075 mm. The monthly rainfall of the driest month (June) was 198 mm (Appendix 1), far higher than the threshold for the onset of dry season conditions, i.e. 100 mm per month (Whitmore, 1984, and see the next section for

¹⁾ This study was carried out with the permission of Lembaga Ilmu Pengetahuan Indonesia (LIPI), and founded partly by the International Scientific Research Program of the Ministry of Education, Science and Culture, Japan (Nos. 02041033 & 05041086

Table 1. Localities of rainfall records by Bogor Research Institute for Food Crops (BORIF).

Locality	Province	Longitude (E)	Latitude (S)	Elevation, m	Data
Muara	West Java	106.45	6.40	260	1980-1989
Margahayu	West Java	107.30	6.30	1250	1980-1989
Pacet	West Java	107.45	6.45	1138	1981-1989
Cipanas	West Java	107.81	6.45	1100	1980-1989
Kuningan	West Java	108.24	6.58	545	1980-1987
Jakenan	Central Java	111.10	6.45	7	1980-1989
Ngale	East Java	111.26	7.24	50	1980-1989
Kendelpayak	East Java	112.28	8.05	450	1980-1989
Mojosari	East Java	112.28	7.30	30	1980-1989
Genteng	East Java	114.13	8.22	168	1980-1989

more discussion). Therefore, seasonality in rainfall at this site is very weak on the average, but the average pattern can be misleading, as shown below. Going eastwards along Java, the amount of annual rainfall decreases and the cycles of the wet and dry seasons become more distinct. Annual rainfall at Kuningan, Jakenan, Kendelpayak, Mojosari and Genteng in central and east Java is < 2000 mm with 2-6 consecutive months of < 100 mm rainfall (Figs. 1 and 2). These regions are dominated by a savanna climate with one clear peak of rainfall brought on by the winter monsoon (Inoue and Nakamura, 1990).

**Fig. 1.** Regional variation of rainfall (mm) in Java (original data recorded by BORIF for 1980-1989).

Vertical bar shows the 95% confidential limit. Numerals in the figure show elevation (m) from sea level and annual rainfall (mm).

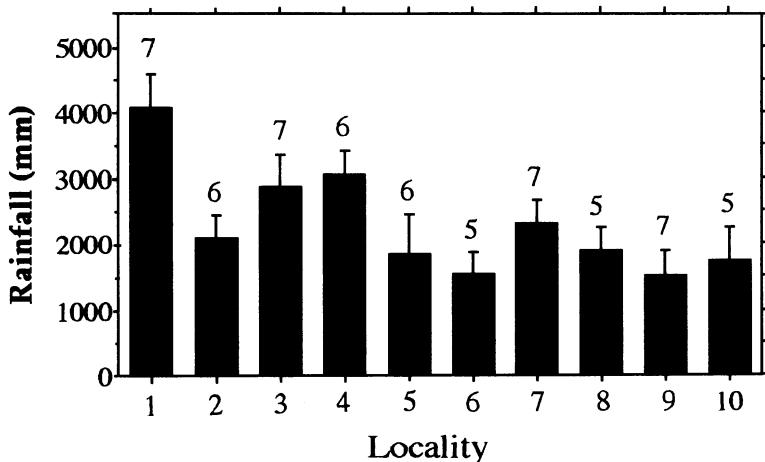


Fig. 2. Comparison of the average annual rainfall (mm) among the ten localities in Java (original data from BORIF for 1980-1989). Numeral above the column shows the number of years recorded. Vertical bar shows the 95% confidential limit. 1: Muara (Bogor), 2: Marugahayu, 3: Pacet, 4: Cipanas, 5: Kuningan, 6: Jakenan, 7: Ngale, 8: Kendelpayak, 9: Mojosari, 10: Genteng.

Rainfall in Bogor

(1) Seasonality

In addition to records kept at Muara by BORIF for 1980-1989 (Figs. 1 and 2), monthly rainfall records are available for six sites in Bogor from 1960 to 1976 (IMG, 1978) (Figs. 3-5). On the whole, rainfall in Bogor was seasonal. The driest months were from June to

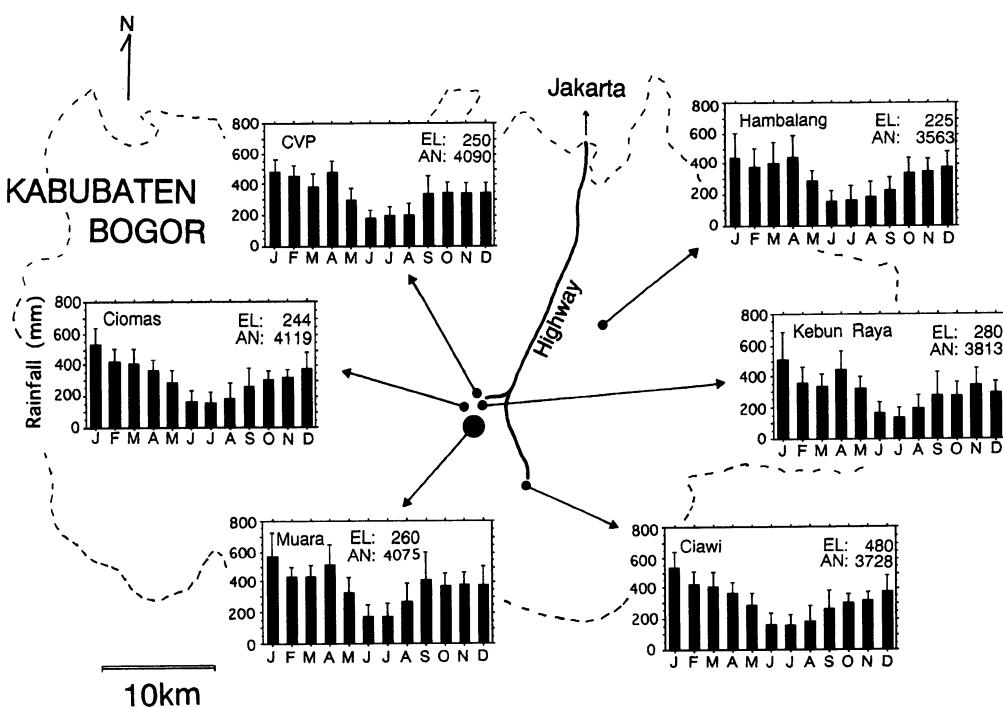


Fig. 3. Monthly rainfall (mm) on six localities in Bogor (original data from IMG for 1960-1976). Vertical bar shows the 95% confidential limit. Numeral in the figure shows the elevation from sea level (EL, m) and annual rainfall (AN, mm).

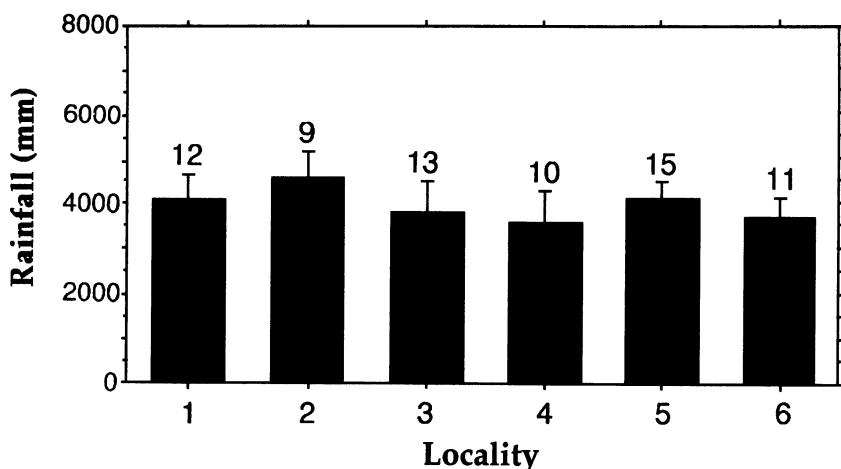


Fig. 4. Annual rainfall on six localities in Bogor (original data from IMG for 1960-1976). Vertical bar shows the 95% confidential limit. Numeral on the column shows the number of years recorded.
1: Ciomas, 2: Empang, 3: Kebun Raya, 4: Hambalang, 5: C.V.P., 6: Ciawi.

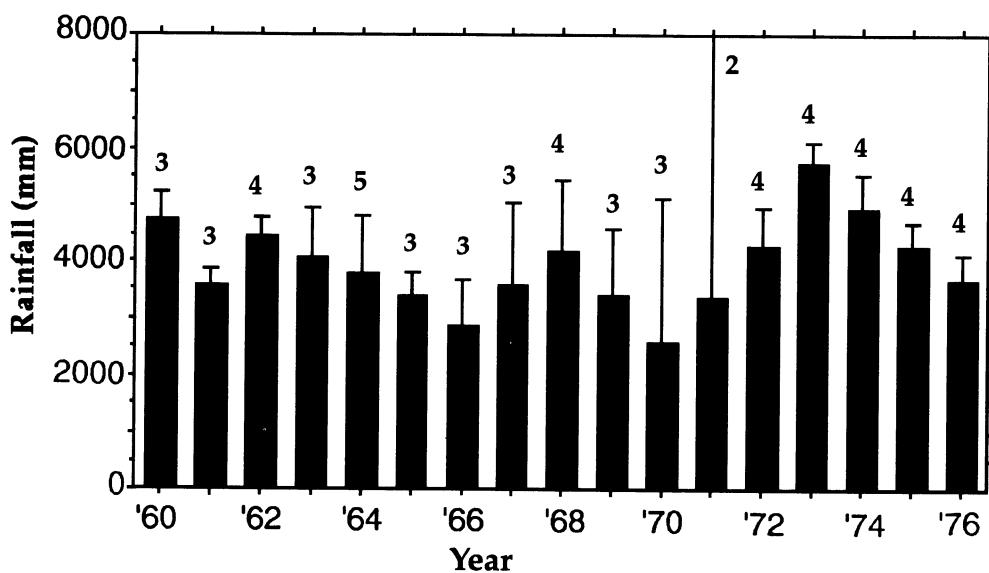


Fig. 5. Change in annual rainfall (mm) in Bogor (original data from IMG for 1960-1976). Vertical bar shows the 95% confidential limit. Numeral on the column shows the number of localities averaged.

August and the wettest from November to January (Figs. 1 and 3). However, the seasonal cycle is not as pronounced as in central and eastern Java (Fig. 1). In Figure 3, the maximum monthly rainfall exceeded 500 mm at four sites and 400 mm at two other sites. The minimum was between 150 and 200 mm for 1960-1976, which was much more than the dry season threshold. However, actual monthly rainfall in particular years was often far below this level and, yet, in other years, heavy rainfall occurred in the typically driest months. In Kebun Raya Bogor (the Bogor Botanical Gardens), for example, from 14 years of record, monthly rainfall totaled less than 100 mm in the month of June 5 times, of July 8 times and of August 4 times.

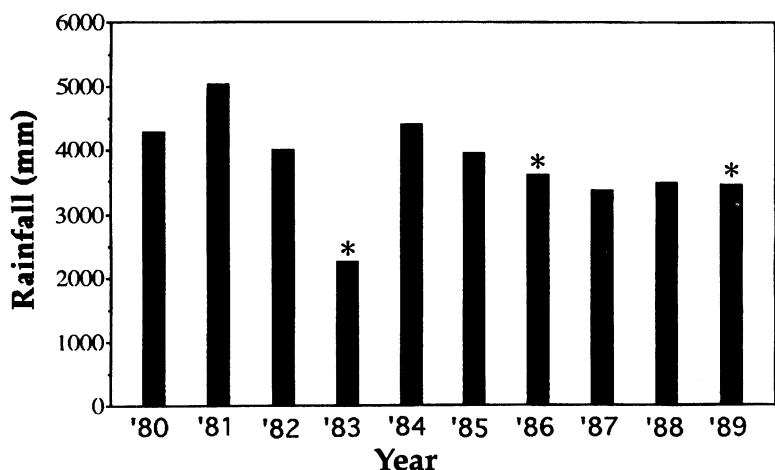


Fig. 6. Change in annual rainfall (mm) in Muara, Bogor (original data from BORIF for 1980-1989). The years with missing records are asterisked.

The lowest monthly rainfall, 17 mm occurred in August, 1961 and the second lowest, 28 mm occurred in September, 1976. The maximum value during June-August was 487 mm (June, 1973), followed by 422 mm (July, 1960). Among a total of 27 monthly records for June, July and August from 1980 to 1989 at Muara, 5 months were <100 mm and the minimum was 2 mm (August, 1987), and 8 months were > 300 mm with a maximum of 536 mm (August, 1984), followed by 510 mm (July, 1981)(Appendix 1). Thus the average monthly rainfall pattern can be misleading in that it conceals many months when rainfall may have been extremely low or high.

(2) Annual variation

The average annual rainfall of six sites in Bogor for 1960-1976 ranged from 3563 mm (Hambalang) to 4552 (Empang) (Fig. 4). In Kebun Raya Bogor, the average was 3813 mm for 13 years (data for 1966-1969 were missing), ranged from 2007 mm (1970)²⁾ to 5959 (1973). Figure 5 indicates the annual change of rainfall averaged for five sites in Bogor located on the elevation from 225 to 280 m (Ciawi, where is at 480 m elevation, was excluded from Fig. 5). Annual change in rainfall cannot be shown for individual sites because all sites have missing data for a few years. Since the average values and annual trends of these sites were similar, Figure 5 could represent the annual change of rainfall in Bogor at an elevation of around 250 m. The average thus derived ranged from 2610 mm (1970) to 5718 (1973) and averaged 3945 mm (Fig. 5). As shown above, the average annual rainfall at Muara (1980-1989) was 4075 mm and range from 3370 mm (1987) to 5025 (1981) (Fig. 6). In summary, it is considered that (1) the average annual rainfall of Bogor is about 4000 mm ranging between from 2000 to 5500 mm; (2) June to August tend to be the driest months of the year and November to January the wettest months. Cycles of dry and wet seasons are not prominent or regularly occurring. Compared to Padang located in a typical tropical humid climate, Bogor annually has less rainfall, greater seasonality and more months of drought.

²⁾ I suspect that this value is under estimated.

ACKNOWLEDGMENTS Dr. K. Syarifuddin, A., the former director of Bogor Research Institute for Food Crops (BORIF), kindly permitted us to use the data, and Dr. F. Muhamadjar (BORIF) helped us use the data. Dr. Soetikno Wirjoatmodjo, the director of Research and Development Centre for Biology (PUSLITBANG BIOLOGI) encouraged us during the study. Dr. D. Windsor (Smithsonian Tropical Research Institute) gave comments on and corrected English grammar of a draft of this manuscript. We deeply thank them.

REFERENCES

- Bogor Research Institute for Food Crops. 1980-1989. *Agro-climatology*. No. 51-60. Bogor, Indonesia.
- Inoue, T. & Nakamura, K. 1990. Physical and biological background for insect studies in Sumatra. In: Sakagami, S. F., Ohgushi, R. & Roubik, D. W. (eds.), *Natural History of Social Wasps and Bees in Equatorial Sumatra*, 1-11. Hokkaido University Press, Sapporo.
- Pusat Meteorologi dan Geofisika, Departemen Perhubungan Indonesia (The Institute of Meteorology and Geophysics, Department of Communications, Indonesia). 1978. *Pemerikasaan hujan di Indonesia* (Rain record in Indonesia). Curah hujan dan hari hujan bulanan (Monthly rainfall and number of rain days). No. 89. Jakarta, Indonesia.
- Windsor, D. 1990. Climate and moisture variability in a tropical forest: Long-term records from Barro Colorado Island, Panamá. *Smithsonian Contribution to the Earth Sciences*. No. 9.
- Whitmore, T. C. 1984. *Tropical Rain Forests of the Far East*. 2nd ed. Clarendon Press, Oxford.

Received June 15, 1994

Accepted June 25, 1994

中村浩二, Woro A. Noerdjito, Ahsol Hasyim ジャワ島における降雨の地域差と季節性、特にボゴール周辺について

(1) ボゴール中央食糧作物研究所 (BORIF) は、ジャワ島の 10 地点で気温と降雨量の観測を続けている。本報では、1980 年から 1989 年までの 10 年間のデータを用いて、年間総雨量と降雨の季節パターン（月あたり平均降雨量）を比較した。西部ジャワ州のボゴールの月あたり平均雨量は、200 ミリ（6 月）から 500 ミリ（1 月）まで変動し、年間降雨量は平均約 4000 ミリに達する。平均値から見ると乾季はないが、雨量の変動は不規則で、ときどき極端な乾燥月がある（最小値は 2 ミリ）。ジャワ島を西から東へ進むにつれて、数カ月間ほとんど雨が降らない非常に強い乾季が生じ、年間降雨量は 1500 ミリ以下まで減少する。

(2) BORIF（上記）による観測データとジャカルタにある気象・地球物理研究所 (The Institute of Meteorology and Geophysics) により出版されたデータ (1978) を用いて、ボゴール市内の 6 地点における年間総雨量と降雨の季節パターン（月あたり降雨量）を比較した。

Appendix 1. Record of monthly rainfall (mm) and mean monthly temperature (°C) at 10 localities in Java, 1980-1989 by Bogor Research Institute for Food Crops. (-): missing data.

Location	Rainfall												Mean temperature														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
1980	407	252	402	364	305	137	195	242	434	459	564	515	4276	1980	24.8	25.8	26.2	26.8	27.2	27.4	27.1	26.5	26.8	26.4	26.3	25.4	
1981	479	388	797	520	516	414	510	150	442	250	194	365	5025	1981	24.3	25.0	25.4	26.4	26.3	26.5	26.1	26.5	26.3	26.5	25.9	25.2	
1982	989	318	350	550	388	144	91	140	45	174	467	352	4008	1982	23.8	25.1	25.4	25.6	26.7	26.3	25.9	25.9	26.6	26.5	26.4	25.7	
1983	396	418	403	180	377	106	113	90	155	-	-	-	1983	25.4	25.8	25.8	26.7	26.6	27.3	26.3	26.8	-	-	-	-		
1984	389	273	402	371	453	201	331	536	354	418	399	276	4403	1984	25.3	24.8	25.6	26.0	26.1	26.5	26.4	26.0	25.5	26.5	26.1	25.8	
Muara	1985	555	478	316	135	407	69	350	371	727	152	186	206	3952	1985	25.9	26.6	26.8	26.3	27.0	27.0	26.4	26.7	26.6	26.5	26.5	26.6
1986	304	108	428	-	-	-	360	250	636	294	693	547	-	1986	25.0	25.1	26.2	-	-	-	26.4	26.5	26.3	26.9	24.7	26.1	
1987	455	426	569	420	178	312	217	2	76	211	259	245	3370	1987	25.8	25.7	26.0	27.0	28.1	26.6	26.7	27.3	27.5	27.0	27.2	26.9	
1988	490	250	473	546	353	198	54	118	100	323	162	421	3488	1988	27.1	26.5	26.7	26.6	26.8	27.0	28.1	27.0	-	-	-	-	
1989	575	694	302	159	-	-	188	346	336	340	506	-	1989	-	-	-	-	-	-	26.5	27.2	27.0	26.9	26.0	26.0		
Avg	504	361	444	361	372	198	247	209	332	291	363	381	4075	Avg	25.3	25.6	26.0	26.4	26.8	26.8	26.5	26.5	26.8	26.7	26.3	26.0	
SD	189	160	146	167	101	114	151	153	237	105	185	124	564	SD	1.0	0.7	0.5	0.5	0.6	0.4	0.4	0.7	0.3	0.8	0.6	0.6	
Max	989	694	797	550	516	414	510	536	727	459	693	547	5025	Max	27.1	26.6	26.8	27.0	28.1	27.4	27.1	27.3	28.1	27.0	27.2	26.9	
Min	304	108	302	135	178	69	54	2	45	152	162	206	3370	Min	23.8	24.8	25.4	25.6	26.1	26.3	25.9	25.9	25.5	26.4	24.7	25.2	
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
	1980	129	77	250	275	81	40	84	58	179	333	515	368	2389	1980	20.3	20.6	20.3	19.7	20.5	20.3	20.3	20.5	20.4	20.4	20.1	20.3
1981	94	68	390	175	102	132	136	47	76	195	340	149	1904	1981	19.8	20.2	20.1	20.0	20.5	19.9	19.6	19.9	20.0	20.4	20.3	20.6	
1982	253	67	-	375	59	104	8	33	145	456	-	1982	20.4	20.0	-	20.3	19.8	19.7	19.6	19.4	19.6	20.4	20.6	20.4			
1983	195	490	317	234	265	1	67	0	9	318	359	203	2458	1983	20.1	19.9	20.3	20.3	20.1	19.7	19.8	19.4	20.0	20.2	20.5	20.5	
1984	291	295	206	383	171	18	108	94	327	99	187	158	2337	1984	20.5	20.5	20.6	20.3	20.5	20.0	20.0	19.9	20.3	20.2	20.2	20.2	
Marga	1985	313	292	83	153	170	54	56	27	95	127	124	179	1673	1985	20.3	19.7	20.6	20.7	20.8	20.6	20.6	19.8	20.0	20.4	20.3	20.8
-hayu	1986	185	132	-	-	-	64	123	176	248	395	207	-	1986	20.9	20.3	-	-	-	-	-	19.6	19.5	20.1	20.3	20.4	
1987	151	109	-	286	193	57	7	10	66	217	523	196	-	1987	20.4	20.7	-	20.9	20.9	21.5	20.4	20.6	21.1	21.7	21.0	20.4	
1988	398	60	315	87	243	57	55	44	0	244	286	83	1872	1988	20.8	21.4	21.0	21.2	21.7	21.7	20.9	21.0	21.5	21.2	20.7	21.3	
1989	209	282	-	268	222	157	204	21	68	197	320	354	-	1989	20.3	20.8	-	21.3	20.9	20.5	20.2	20.0	20.8	20.7	21.2	20.6	
Avg	222	187	260	248	167	69	79	43	100	201	319	235	2106	Avg	20.4	20.4	20.5	20.6	20.6	20.5	20.1	20.0	20.3	20.6	20.5	20.6	
SD	93	145	107	98	73	52	59	40	102	94	139	117	329	SD	0.3	0.5	0.3	0.5	0.6	0.7	0.5	0.6	0.5	0.6	0.4	0.3	
Max	398	490	390	383	265	157	204	123	327	333	523	456	2458	Max	20.9	21.4	21.0	21.3	21.7	21.7	21.0	21.5	21.7	21.2	21.3	21.3	
Min	94	60	83	87	59	1	7	0	33	124	83	1673	Min	19.8	19.7	20.1	19.7	19.8	19.7	19.8	19.6	19.4	19.6	20.2	20.1		

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	-	-	278	242	173	145	132	124	216	265	272	-
1982	566	331	217	550	120	28	109	54	31	173	194	430
1983	260	434	430	367	275	299	47	39	19	261	400	2803
Pacet	1984	468	362	338	468	321	159	77	309	418	225	282
1985	354	226	422	190	196	211	130	101	447	213	225	3113
1986	483	319	405	-	-	283	109	312	253	593	200	-
1987	231	317	370	356	226	59	38	0	105	195	473	320
1988	244	161	510	254	175	45	90	103	127	413	277	140
1989	352	456	336	285	326	225	274	134	83	304	274	466
Avg	370	326	379	344	235	150	133	109	185	250	331	292
SD	125	98	86	118	71	97	90	87	164	72	131	103
Max	566	510	550	326	299	283	309	447	413	593	466	3660
Min	231	161	217	190	120	28	38	0	19	173	194	140
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	377	267	387	268	156	106	175	173	146	366	355	445
1981	525	205	355	299	228	236	198	97	164	196	302	229
1982	657	276	238	543	75	17	80	33	14	230	190	404
Cipanas	1983	302	426	258	361	286	28	70	61	64	424	413
1984	492	380	294	586	251	141	87	346	402	249	252	207
1985	250	289	327	213	88	250	178	120	430	196	237	271
1986	561	284	425	-	-	240	112	293	317	484	231	-
1987	229	385	367	-	-	-	-	-	-	1986	19.1	20.3
1988	-	-	274	58	-	83	71	156	417	274	147	-
1989	306	-	315	242	350	225	226	177	34	188	376	295
Avg	411	314	330	348	187	143	149	132	189	267	320	284
SD	152	75	61	141	108	98	68	93	153	82	94	348
Max	657	426	425	586	350	250	240	346	430	417	484	445
Min	229	205	238	213	58	17	70	33	14	188	190	147
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	20.8	21.1	20.8	21.1	21.4	22.0	22.0	21.6	16.2	21.0	21.0	20.9
1981	19.81	19.6	20.7	21.7	22.0	22.6	21.7	21.3	21.4	21.3	21.8	21.0
1982	19.82	20.5	20.5	21.1	21.3	21.6	21.4	20.2	20.3	20.3	20.8	22.8
1983	19.83	22.3	22.3	22.4	22.3	22.3	21.9	21.3	20.0	20.7	21.0	21.2
1984	19.84	20.6	20.6	20.4	20.6	21.6	21.6	20.8	21.1	20.6	21.1	21.3
1985	19.85	20.4	21.0	20.4	20.7	20.8	20.4	19.0	20.4	20.4	20.6	20.3
1986	19.86	19.86	19.1	20.1	20.3	-	-	-	19.6	19.8	20.3	20.7
1987	19.87	20.1	20.2	20.8	-	-	-	-	-	-	-	-
1988	-	-	1988	-	-	-	-	21.0	20.9	-	20.7	20.4
1989	19.89	21.0	19.8	20.4	20.9	21.2	20.9	20.7	21.1	21.3	21.0	20.4
Avg	20.6	20.8	21.0	21.5	21.6	21.0	19.9	20.6	20.9	21.3	21.3	21.0
SD	0.8	0.8	0.8	0.7	0.6	0.6	0.6	0.6	0.6	0.5	0.4	0.5
Max	22.3	22.4	22.3	22.3	22.3	22.3	22.3	21.7	21.3	21.4	21.5	22.8
Min	19.6	19.8	20.3	20.7	20.8	20.2	16.2	19.8	20.3	20.6	20.7	20.3

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	102	94	112	141	69	2	30	94	61	55	97	210
1981	167	414	253	245	188	177	99	52	109	23	329	388
1982	351	443	397	343	28	59	5	0	4	62	344	2036
1983	288	448	393	120	393	19	5	0	0	143	446	312
Kuningan	-	-	-	-	-	-	-	-	-	-	-	-
1984	338	413	290	-	96	-	43	24	330	157	154	196
1985	-	-	-	-	-	-	0	36	184	208	-	1985
1986	196	286	263	182	66	109	12	14	26	168	107	169
1987	221	206	174	197	133	24	3	0	13	0	166	131
Avg	238	269	205	139	65	28	26	67	73	193	245	1830
SD	92	138	81	123	67	35	35	113	71	130	91	619
Max	351	448	397	343	393	177	99	94	330	168	446	388
Min	102	94	112	120	28	2	3	0	0	0	62	131
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	147	122	80	145	10	14	70	31	6	124	74	328
1981	430	288	158	209	134	86	90	18	41	29	233	212
1982	320	195	250	336	90	8	2	27	0	4	35	157
1983	236	307	153	238	206	-	23	0	-	196	206	208
1984	283	272	259	115	64	52	26	39	137	62	176	79
Jaknenan	1985	257	229	191	95	24	33	-	0	175	59	255
1986	200	144	-	-	-	82	91	87	62	338	169	-
1987	420	146	71	118	-	63	51	0	0	-	249	204
1988	282	150	205	27	66	37	93	55	36	132	136	307
1989	122	282	160	210	55	155	-	-	-	-	-	-
Avg	270	214	170	166	79	55	48	29	60	84	189	214
SD	102	71	66	92	59	47	40	30	66	63	95	77
Max	430	307	259	336	206	155	93	91	175	196	338	328
Min	122	122	71	27	10	8	0	0	0	4	35	79
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	24.4	24.7	25.4	25.4	25.9	25.5	24.9	24.1	24.5	25.6	25.3	25.2
1981	23.9	24.6	25.0	25.0	25.3	25.2	24.9	24.9	24.7	27.5	24.5	24.9
1982	24.4	24.4	25.2	25.2	25.3	25.3	24.5	24.5	23.5	24.6	25.4	25.2
1983	24.8	24.4	24.9	24.8	24.9	24.4	24.9	24.7	24.1	23.9	24.8	24.5
Avg	23.8	23.1	24.5	-	-	24.6	-	24.2	-	24.5	28.0	27.8
SD	0.4	0.7	0.3	0.3	0.5	0.3	0.3	0.4	0.6	1.2	1.5	1.1
Max	24.8	24.7	25.4	25.4	25.9	25.5	24.9	24.9	27.6	28.8	27.9	27.0
Min	23.8	23.1	24.5	24.6	24.7	24.1	23.5	24.5	25.3	24.5	24.5	24.5

Ngale												Kendel-payak														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
1980	180	158	107	342	17	21	70	20	6	158	512	198	1789	1980	26.9	27.2	27.6	27.9	28.5	28.4	28.6	29.5	29.5	28.2	27.4	
1981	161	234	357	307	171	112	84	1	242	76	170	130	2045	1981	26.3	26.9	27.9	28.0	27.6	28.4	27.7	28.7	29.3	29.9	28.0	27.9
1982	282	368	251	376	68	6	1	1	7	18	167	525	2070	1982	26.5	26.8	27.7	28.0	28.3	28.1	28.3	28.8	30.1	31.3	30.7	28.5
1983	419	280	194	254	294	366	1	0	0	113	338	379	2638	1983	27.8	27.6	28.1	28.0	27.0	27.8	28.3	29.5	30.6	30.0	27.9	27.8
1984	326	372	260	272	85	66	3	69	229	125	265	292	2364	1984	26.3	26.2	27.4	27.7	27.6	27.1	28.1	28.6	27.8	29.2	28.6	27.2
1985	535	342	576	188	269	45	18	68	98	131	468	183	2921	1985	27.0	27.2	27.5	28.4	28.0	28.0	28.3	29.2	29.7	28.3	27.3	27.3
1986	347	306	338	-	-	1	15	112	148	252	214	-	-	1986	26.5	26.7	26.9	-	-	28.2	28.4	29.4	28.9	29.4	27.5	28.2
1987	266	382	329	149	132	-	56	0	0	69	349	151	-	1987	26.7	26.7	27.9	28.8	28.4	-	28.4	28.4	30.7	31.7	29.6	27.4
1988	317	137	160	81	162	86	-	38	12	192	316	181	-	1988	27.5	27.4	27.7	28.6	28.7	27.4	-	28.8	29.9	28.9	27.7	27.0
1989	337	314	191	251	253	198	148	3	17	149	207	261	2329	1989	26.8	26.0	27.2	27.6	27.7	27.4	27.9	27.9	29.1	28.9	28.4	27.7
Avg	317	289	276	247	161	113	42	22	72	118	304	251	2308	Avg	26.8	26.9	27.6	28.0	28.0	27.8	28.2	28.6	29.6	29.8	28.5	27.6
SD	109	87	133	94	96	119	51	28	95	51	117	121	384	SD	0.5	0.5	0.4	0.4	0.6	0.5	0.5	0.3	0.4	0.8	1.0	0.5
Max	535	382	576	376	294	366	148	69	242	192	512	525	2921	Max	27.8	27.6	28.1	28.8	28.7	28.4	28.6	29.5	30.5	31.7	30.7	28.5
Min	161	137	107	81	17	6	1	0	0	18	167	130	1789	Min	26.3	26.0	26.9	27.5	27.0	27.1	27.7	27.9	27.8	28.9	27.5	27.0
Kendel-payak												Ngale														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
1980	251	207	78	218	123	0	20	4	3	106	253	339	1602	1980	27.8	28.0	27.4	28.2	28.9	28.7	28.0	27.9	28.4	27.9	-	26.5
1981	216	244	334	110	57	43	73	4	145	136	236	239	1887	1981	25.8	26.6	27.3	27.3	27.0	26.1	26.9	27.7	28.1	26.4	26.4	26.5
1982	238	232	372	208	0	3	29	1	0	0	100	407	1590	1982	25.5	25.7	26.8	28.2	27.6	26.7	26.9	26.1	26.5	28.5	29.0	27.0
1983	378	267	232	264	259	5	0	0	0	164	-	301	-	1983	26.5	25.8	26.4	26.8	26.5	26.7	26.4	27.7	28.5	28.8	28.0	28.0
1984	501	298	362	282	101	57	20	35	-	141	122	295	-	1984	27.7	26.8	28.9	28.8	26.9	28.0	26.3	26.6	28.5	27.5	28.8	26.9
1985	337	342	285	101	-	62	4	34	-	291	321	-	-	1985	27.2	26.7	27.0	27.4	28.2	27.1	26.8	28.8	-	-	-	-
Avg	357	253	280	160	121	47	38	16	24	94	238	333	1881	Avg	26.9	26.5	27.1	27.7	27.5	27.5	27.8	27.5	28.3	27.5	-	-
SD	129	51	102	95	88	55	38	23	49	57	108	68	298	SD	1.1	0.7	0.8	0.7	0.8	0.7	0.7	0.9	0.6	0.7	1.2	1.3
Max	635	342	421	282	259	177	99	69	145	164	446	449	2191	Max	28.7	28.0	28.9	28.8	28.7	28.0	28.5	28.8	29.2	29.2	30.1	30.1
Min	216	185	78	37	0	0	0	0	0	100	239	1590	Min	25.5	25.7	25.8	26.7	26.5	26.7	26.0	26.1	26.5	27.2	26.2	27.0	

Year	Mojosari												Genteng													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1980	283	276	135	167	21	0	8	0	0	54	-	177	-	1980	27.8	28.0	27.4	28.2	28.9	28.7	28.0	27.9	28.4	27.9	-	26.5
1981	283	297	92	134	118	59	13	2	107	8	247	284	1644	1981	25.8	26.6	27.3	27.3	27.3	27.0	26.1	26.9	27.7	28.1	26.4	26.5
1982	379	114	99	76	9	0	0	12	0	0	352	1041	1982	25.5	25.7	26.8	28.2	27.6	26.7	26.9	26.1	26.5	28.5	29.0	27.0	
1983	302	323	331	236	263	10	0	0	0	0	234	98	1797	1983	26.5	25.8	26.4	26.8	26.5	26.7	26.4	27.7	28.5	28.8	28.0	28.0
1984	458	400	74	105	107	43	42	31	5	37	52	327	1681	1984	27.7	26.8	28.9	28.8	26.9	28.0	26.3	26.6	28.5	27.5	28.8	26.9
Mojosari	1985	323	393	420	82	1	6	37	0	-	-	-	-	1985	27.2	26.7	27.0	27.4	28.2	27.1	26.8	28.8	-	-	-	-
1986	325	554	527	-	-	0	0	1	14	-	-	-	-	1986	26.4	25.9	25.8	-	-	27.9	27.5	28.3	27.5	-	-	-
1987	225	379	172	55	37	0	5	0	0	0	75	164	1112	1987	28.7	26.5	27.1	28.1	28.0	27.5	26.5	27.9	27.8	27.4	29.2	27.8
1988	391	118	144	21	12	0	0	3	0	26	102	215	1032	1988	27.8	26.8	27.2	26.7	26.8	28.5	26.0	28.8	27.6	29.2	26.2	25.7
1989	295	426	211	331	177	62	64	35	0	49	39	434	2123	1989	25.9	26.1	26.9	28.2	27.4	27.5	26.9	27.6	27.9	27.2	28.3	30.1
Avg	326	328	221	134	83	20	17	8	13	21	107	256	1490	Avg	26.9	26.5	27.1	27.7	27.5	26.8	27.6	27.9	28.0	28.0	27.3	27.3
SD	67	136	154	98	91	27	23	14	35	21	97	112	430	SD	1.1	0.7	0.8	0.7	0.7	0.9	0.6	0.7	0.9	0.6	0.7	1.3
Max	458	554	527	331	263	62	64	35	107	54	247	434	2123	Max	28.7	28.0	28.9	28.8	28.7	28.0	28.8	28.5	29.2	29.2	29.2	30.1
Min	225	114	74	21	1	0	0	0	0	0	0	98	1032	Min	25.5	25.7	25.8	26.7	26.5	26.0	26.1	26.5	27.2	26.2	25.7	25.7
Jan	201	179	50	138	60	7	69	50	5	204	179	301	1543	1980	27.5	27.5	27.6	27.1	26.1	26.2	25.6	26.6	27.4	27.8	27.6	
Feb	297	317	130	50	151	152	340	107	356	122	345	110	2477	1981	27.1	26.9	27.3	27.4	26.9	26.7	25.7	25.8	26.3	27.5	27.3	
Mar	261	298	369	218	18	20	1	31	0	1	3	228	1448	1982	27.2	26.9	26.4	27.0	26.5	26.2	25.4	24.9	25.8	27.4	29.0	
Apr	197	-	313	254	438	158	88	20	1	307	263	297	-	1983	27.6	-	27.7	27.7	26.7	26.0	24.9	25.2	26.2	27.5	27.3	
May	484	447	224	231	59	212	45	48	295	165	127	-	-	1984	26.8	26.4	26.5	27.0	27.0	26.0	25.3	25.4	26.4	27.4	27.8	
Genteng	1985	212	212	242	109	165	245	60	50	-	18	209	217	-	1985	27.8	27.1	26.8	27.2	27.4	26.6	25.3	25.6	25.9	27.4	26.8
1986	303	250	-	64	-	156	110	67	99	197	152	-	1986	26.6	27.3	-	27.1	-	25.3	24.5	25.9	26.0	27.2	27.8		
1987	228	265	116	82	115	39	97	44	9	17	260	358	1630	1987	26.7	27.2	27.5	27.6	26.9	25.6	24.6	25.9	27.0	26.9	26.3	
1988	386	90	391	85	124	30	15	171	77	45	179	89	1682	1988	26.1	27.0	27.2	27.4	26.8	25.3	24.8	25.6	28.1	25.9	26.6	
1989	185	301	286	228	72	225	165	-	30	89	165	219	-	1989	26.2	25.5	28.0	29.2	28.8	28.5	27.4	-	28.8	28.5	29.3	
Avg	284	237	155	127	121	104	70	93	107	193	219	1756	Avg	27.0	26.8	27.2	27.5	27.2	26.6	25.6	26.3	27.4	27.6	27.5		
SD	93	100	111	78	119	97	49	135	97	91	90	413	SD	0.6	0.6	0.5	0.7	0.6	0.8	0.7	0.5	0.9	0.7	1.0		
Max	484	447	391	254	438	245	340	171	356	307	345	358	2477	Max	27.8	27.5	28.0	29.2	28.8	28.5	27.4	25.8	28.8	28.5	29.3	
Min	90	50	50	18	7	1	20	0	1	3	89	1448	Min	26.1	25.5	26.0	27.0	26.5	26.0	24.9	24.5	25.6	26.0	25.9	26.3	