

Monsoon onset over Kerala (India): 1870-2004

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ABSTRACT

Statistical analysis has been carried out using the long series of data available on onset of monsoon and its rainfall over Kerala, the Gateway of monsoon over India, for the period from 1870 to 2004. There was no change in onset of monsoon (1^{st} June \pm 7 days) over a period of time and 28.2 per cent of the years only fell under early or late monsoon years, indicating that the onset of monsoon was normal and ranged from 25^{th} May to 8^{th} June. The early monsoon was seen in 1918 (11^{th} May) and belated monsoon in 1972 (18^{th} June). It also appeared that the monsoon rainfall is likely to be deficit rather than excess if the monsoon is early and no such trend was seen when the monsoon was late. Overall, there was a decrease of 131.4 mm in monsoon rainfall over a period of time, indicating a decline of 6.8 per cent against the normal rainfall of 1933 mm. However, the deficit was more evident in monsoon rainfall since last sixty years. Of the 21 occasions between 1871-2004 when monsoon onset over Kerala was delayed by 7 days or more, 10 cases were associated with El Nino episodes and 3 years with La Nina episodes. Delays/early monsoon onset occurred preferentially in the year +1 El Nino /La Nina.

Key words: Southwest monsoon, Onset dates, monsoon management

High rainfall from June to September followed by a prolonged dry spell is the characteristic feature of the tropical monsoon climates. Even in such climates, the occurrence of intermittent prolonged dry spells is not uncommon during the southwest monsoon due to break or failure of monsoon. The intermittent breaks of monsoon may lead to no rainfall, thus indicating a dry spell. The recurrence of such dry spells is noticed very often across the country, which affects the seasonal crops adversely. In addition to dry spell, occurrences of floods are also common due to prolonged wet spell over Kerala. Keeping its importance in view,

Ananthkrishnan and Soman (1988 and 1989) studied the monsoon events in detail utilising the data up to 1980. Joseph *et al.*, (1994) studied the interannual variability of Indian summer monsoon and its association with El Nino and sea surface anomalies. El Nino/La Nina association with all-India summer monsoon rainfall was also studied by Kumar *et al.*, 2002. Biswas *et al.*, (1989) and Biswas *et al.*, (1998) also studied the synoptic and rainfall feature during the advance phase of Indian summer monsoon. Realising its importance, an attempt has been made to update the information on historical monsoon events over a record period of 135

Table 1: Normal onset of Southwest monsoon over Kerala

Year	Mean onset	The earliest onset	The most belated onset	Standard Deviation	Range of onset
1870-1900	1 st June	16 th May (1874)	12 th June (1895)	7	25 th May-8 th June
1901 -1931	4 th June	11 th May (1918)	15 th June (1915)	7	28 th May-11 th June
1931-1960	31 st May	14 th May (1960)	14 th June (1940)	8	23 rd May-8 th June
1961-2000	31 st May	17 th May (1962)	18 th June (1972)	7	24 th May-7 th June
1870-2004 (Normal)	1 st June	11 th May (1918)	18 th June (1972)	7	25 th May-8 th June

() Figures in parenthesis indicate the year in which the onset of monsoon falls.

years (1870 to 2004).

MATERIALS AND METHODS

The onset dates of southwest monsoon over Kerala from 1870 to 2004 were collected from the published reports of the India Meteorological Department, Govt. of India from time to time. The above data were verified from the results published by Ananthakrishnan and Soman (1988) and Joseph *et al.* (2001). The source of monthly rainfall (mm) over Kerala from 1871 to 1994 is from the IITM publication entitled "Monthly and seasonal rainfall series for all-India homogeneous regions and meteorological subdivisions: 1871-1994" (Parthasarathy *et al.*, 1995). From 1995 to 2004, the monthly rainfall data were collected from the daily weather reports published by the IMD, Trivandrum. The source of El Nino and La Nina data during 1871 - 2001 is from the publication "Climatic change and India-Issues, concerns and opportunities" (Kumar *et al.*, 2002).

Normal onset date of monsoon and its rainfall for the period as a whole (1870-2004) and sub-periods *viz.*, 1870-1900, 1901-1930, 1931-1960 and 1961-2000 were calculated. Time series analysis such as frequency distribution, moving averages, standard deviation and coefficient of variation were worked out for the above periods. The percentage contribution of rainfall through different months within monsoon was also worked out. The monthly and season-wise trends were also computed through a trend line.

RESULTS AND DISCUSSION

Indian summer monsoon (Southwest monsoon)

The normal date of onset of monsoon over Kerala is on 1st June with a standard deviation of seven days (Table 1), varying from 25th May to 8th June. Nevertheless, there was a delay (4th June \pm 7 days) in normal onset of monsoon during 1901-1930 though the standard deviation was the same

Table 2: Late and early onset of Southwest monsoon and amount of rainfall (mm) over Kerala during 1870-2004

Sl. No.	Early onset				Late onset			
	Year	Date	Rainfall (mm)	% Dev.	Year	Date	Rainfall	%Dev
1	1873	23 rd May	2005.1	3.8	1878	9 th June	2925.4	51.4
2	1874	16 th May	2300.7	19.0	1881	9 th June	1339.2	-30.7
3	1879	17 th May	1577.4	-18.4	1884	9 th June	1696.7	-12.2
4	1918	11 th May	1150.4	-40.5	1985	12 th June	1541.1	-20.3
5	1933	22 nd May	2303.8	19.2	1900	10 th June	2027.7	4.9
6	1936	19 th May	1854.9	-4.0	1903	12 th June	2074.6	7.3
7	1941	23 rd May	1866.1	-3.4	1905	10 th June	1687.1	-12.7
8	1949	23 rd May	2068.6	7.0	1906	14 th June	1724.0	-10.8
9	1952	20 th May	1432.2	-25.9	1908	11 th June	2050.0	6.1
10	1956	21 st May	1523.2	-21.2	1915	15 th June	2268.6	17.4
11	1960	14 th May	1867.9	-3.3	1923	11 th June	2666.0	37.9
12	1961	18 th May	2943.4	52.3	1935	12 th June	1565.3	-19
13	1962	17 th May	1948.9	0.8	1940	14 th June	2129.3	10.2
14	1969	17 th May	1849.9	-4.3	1942	10 th June	1944.6	0.6
15	1990	19 th May	1517.3	-21.5	1948	11 th June	2098.2	8.6
16	2001	23 rd May	1637.0	-15.3	1958	14 th June	1744.4	-9.7
17	2004	18 th May	1410.0	-27.0	1967	9 th June	2011.0	4.1
18					1972	18 th June	1573.5	-18.6
19					1979	13 th June	1868.4	-3.3
20					1983	11 th June	2054.0	6.3
21					1997	9 th June	2015.1	4.3

Mean rainfall (1871-2003) = 1932.6 ± 369.3

to that of normal. However, the earliest (11th May) monsoon was also noticed in 1918 during the above period. On nearly half of the occasions, the onset of monsoon was between 4th and 15th June from 1901 to 1930 (Fig. 1). It might be the reason for the delay in normal onset of monsoon during the above period. The earliest onset of monsoon was noticed on 11th May in 1918 while belated monsoon on 18th June in 1972. The onset of monsoon since last one-and-a-half decades showed that it occurred

after 1st June on many occasions. The trend in normal onset of monsoon also tends to be towards first week of June, revolving around 1st June. The onset of monsoon varied between 30th May and 3rd June in majority of years (32.6%), followed by June 4th - 8th (20.7% of the years) and May 25th - 29th (18.5% of the years). The chance of early occurrence of monsoon before 25th May was relatively less as less than six per cent of the years only fell under that category. Similar was the case in

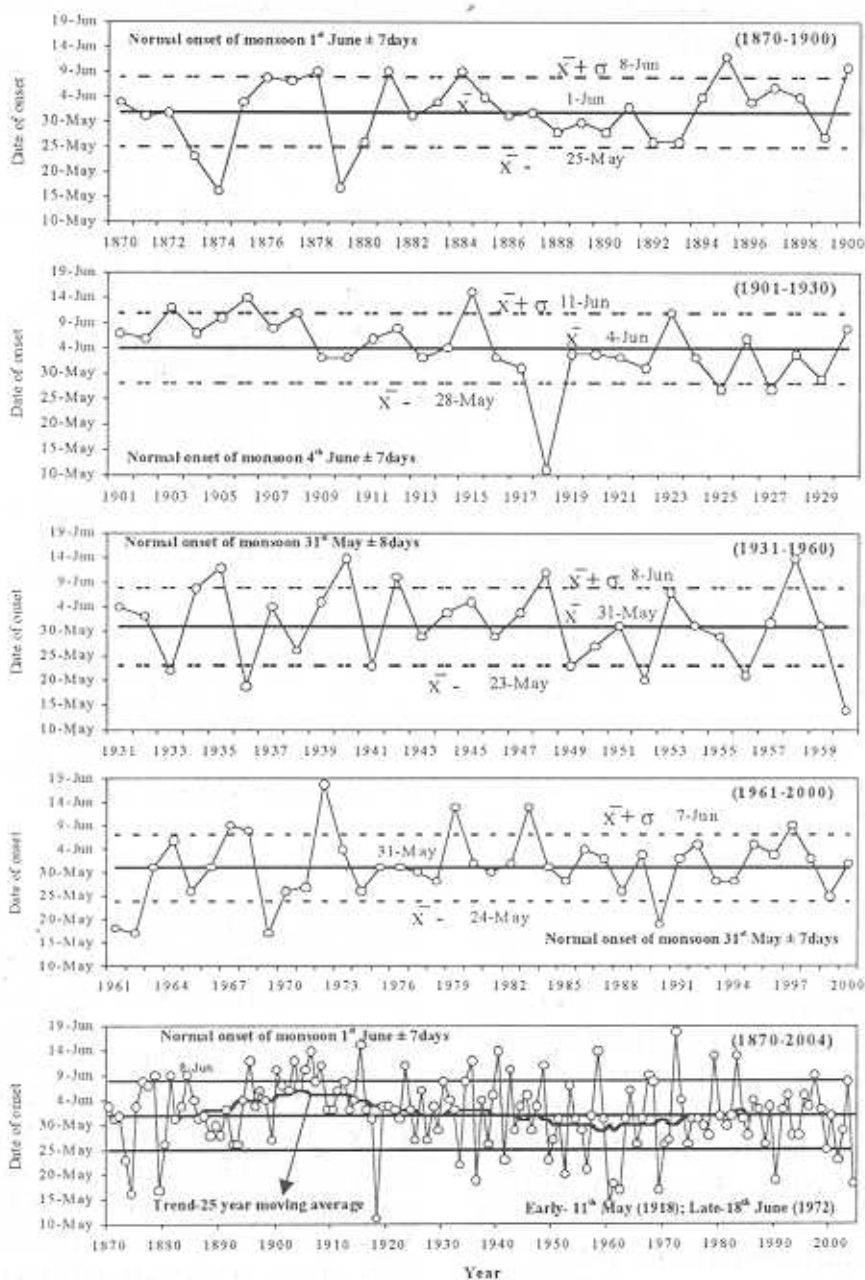


Fig. 1 : Onset of Southwest monsoon over Kerala during different periods from 1870 to 2004

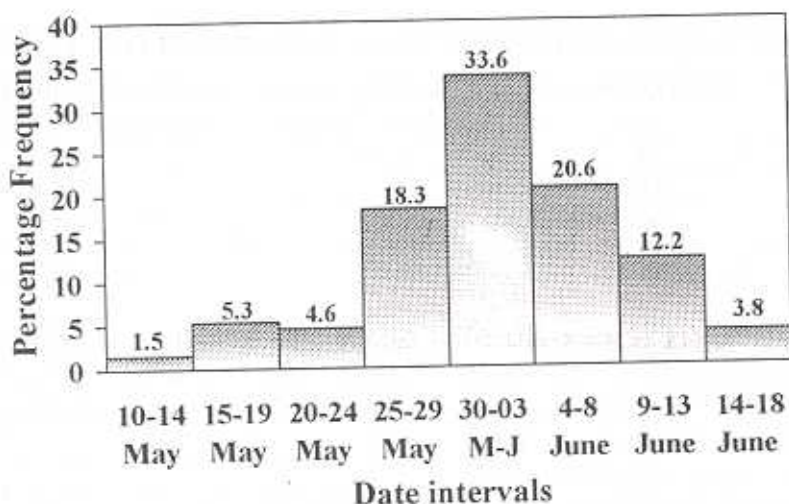


Fig. 2 : Percentage frequency distribution of onset of monsoon over Kerala (1870-2004)

occurrence of late monsoon beyond June 9th -13th as 11.9% of the years only fell under the category. Altogether, 71.8 per cent of the years fell between 25th May and 8th June (Fig. 2), indicating that there was no change in normal date of onset of monsoon since last 135 years.

Early and late onset of summer monsoon versus monsoon rainfall over Kerala

The onset of monsoon was early (before 25th May) on 16 occasions (1873, 1874, 1879, 1918, 1933, 1936, 1941, 1949, 1952, 1956, 1960, 1961, 1962, 1969, 1990 and 2001) out of 135 years, accounting for 11.9 per cent of the years under early monsoon. Interestingly, the early onset of monsoon was seen only in 1990 (19th May) after a lapse of 20 years (17th May in 1969) in the recent past, followed by 2001 (23rd May) and 2004 (18th May). All the above three years recorded below normal rainfall

during the monsoon period. It reveals that the monsoon rainfall is likely to be deficit rather than excess if the monsoon is early (that is on or before 25th May) as 19 per cent of the years only recorded just above normal.

The belated onset of monsoon was noticed (after 8th June) on 21 occasions (1878, 1881, 1884, 1895, 1900, 1903, 1905, 1906, 1908, 1915, 1923, 1935, 1940, 1942, 1948, 1958, 1967, 1972, 1979, 1983 and 1997) out of 135 years, accounting for 15.6 per cent of the years under late monsoon. Out of 21 late onset of monsoon years, 42.8 per cent of the years (nine out of 21 years) only recorded below normal rainfall and the year 1881 was the only one that could be classified under meteorological drought year. The meteorological drought is defined when the annual rainfall was below 25 per cent of the normal annual rainfall. 57 per

Table 3: El Nino / La Nina associated with onset of monsoon over Kerala 1871-2004

Event	Total number of year	Number of late onset (Same year / +1 year)	Number of Early onset (Same year / + 1 year)
El Nino	27	10	1
La Nina	18	3	3
Neutral	90	8	13
Total	135	21	17

cent of the years (12 out of 21 years) noticed excess rainfall when compared to that of normal if the monsoon was late. Contrary to the above, Mathur (1986) observed that the late (early) arrival of monsoon over Punjab and Haryana indicate poor (good) rainfall during the monsoon season. It appears that the occurrence of deficit rainfall when compared to that of normal during the monsoon season was relatively high when the monsoon was early and no such trend was seen when the monsoon was late.

El Nina/La Nina association with monsoon onset over Kerala

During 1871-2004, there were 27 El Nino and 18 La Nina episodes (Table 3). Onset of monsoon was early on 17 occasions and late on 21 occasions. Of the 21 years between 1871-2004 when monsoon onset over Kerala was delayed by 7 days or more, 10 cases were associated with El Nino episodes and 3 years with La Nina episodes. Delays/ early monsoon onset occurred preferentially in the year +1 El Nino /La Nina. The late onset during El Nino years was about 37% which is higher than that during La Nina year (16.6%) and neutral phase years

(0.8%). The percentage of early onset was about 16.6%, 0.4% and 14.4% during La Nina, El Nino and neutral years respectively.

The occurrence of excess and deficit rainfall when compared to that of normal was seen in more or less equal number of years. As a whole, 33.6 per cent (45 years out of 134) of the years recorded either excess or deficit rainfall. Interestingly, the rainfall range was high during excess rainfall years when compared to that of deficit rainfall years. It is also quite interesting to notice that since last two decades there was no excess rainfall year except in 1981. At the same time, the occurrence of deficit rainfall was high in the recent past. Overall, there was a decrease of 131.4 mm in monsoon rainfall, indicating a decline of 6.8 per cent over the normal rainfall of 1933 mm. The above trend was more evident in the rainiest months of June and July. In addition to the above, the rainfall trend was seen revolving around the normal or below normal rainfall since last 60 years instead of excess rainfall. Interestingly, the decline in rainfall is insignificant towards north of Kerala when compared to south Kerala as reported by Joseph *et al.*, (2001). Altogether, it resulted in acute shortage of water during the summer months as the

water use was more due to increase in human population and more cropped area is brought under irrigation. At the same time, decline in rainfall was noticed over the period of time which is the primary water source. The year 2003-2004 was one of the unprecedented drought years, which was identical to 1982-1983 over the State of Kerala.

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