

Short Communication

Rainfall variability analysis over eastern agroclimatic zone of Haryana

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Monsoon rain displays significant large inter-annual variability leading to widespread drought and flood situations. Effect of drought is accentuated by the higher coefficient of variability over region of lower seasonal rainfall (Parthasarathy, 1984). In India, long-term time series of summer monsoon rainfall has no discernible trends, but decadal departures are found above and below the long time average alternatively for 3 consecutive decades and the same study employing non-parametric methods showed a decreasing trend for rainfall variables (Kothyari and Singh, 1998). Recent decades have exhibited an increase in extreme rainfall events over northwest India during the summer monsoon (Singh and Sontakke, 2004). Present investigation was carried out in the eastern agroclimatic zone of Haryana located in north-western part of India with representative locations being Karnal and Ambala for obtaining the long term trend and variability of rainfall.

The daily rainfall data of Ambala (29°59' N, 76°81' E, 276 MSL) and Karnal (29°43' N, 76°58' E, 245 MSL) stations were collected for the period from 1977 to 2008 from Haryana state Remote Sensing Application Centre and Central Soil Salinity Research Institute, respectively. Statistical analysis was done to work out annual, seasonal and monthly variability and trend by calculating different descriptive *viz.*, mean, standard deviation (SD), coefficient of variation (CV).

The long term trend was calculated on monthly, seasonal and annual for four periods *viz.*, 1st period (1977-1986), 2nd period (1987-1996), 3rd period (1997-2008) and 4th period (1977-2008). Seasonal trend was observed for five seasons *viz.*, summer (March to May), south-west monsoon (June to September), post monsoon (October and November), winter (December to February).

Rainfall analysis at Ambala

The monthly rainfall of Ambala varied between 9.4 to 289.7 mm. The lowest rainfall (9.4mm) is received in

month of November with highest CV (230.6%) and highest rainfall of 289.7 mm is received in July with lowest (52%) CV. Summer season contributed 89.9 mm rainfall with CV of 70% while monsoon season (June to September) contributes 748.5 mm with 35.6% of CV (Table 1).

Table 1 shows that summer season rainfall showed an increasing trend irrespective of period except 3rd period. A positive trend was noted for south-west monsoon with values of 12.19 and 42.74 mm per year during 1st and 2nd periods, whereas a negative trend with value of 20.89 mm per year during 3rd period. The post monsoon rainfall had also a decreasing trend during 3rd period (3.45 mm per year) with an overall decreasing trend (0.21 mm per year). The winter rainfall had increasing trend during 1st and 2nd period with respective value of 0.21 and 1.00 mm but decreasing during 3rd period by 3.10 mm per year. The seasonal trend during 1977-2008 indicated an increase in summer, and south-west monsoon season at a rate of 0.6, and 3.27 mm, respectively but decrease during post monsoon and winter by 0.21 and 1.90 mm per year, respectively. Monthly analysis indicated a significant decreasing trend in July with a value of 6.13 mm per year during 1st period but in 2nd period except May, November and December remaining months had increasing trend, a significant decreasing trend in July by 24.54 mm per year during 3rd period. Overall, a decreasing rainfall trend in November to April and July was noted.

Rainfall analysis at Karnal

The monthly rainfall at Karnal ranged between 6 mm in November to 204.6 mm in July. The CV percent and inversely related to rainfall. The CV percent are less than 90 in all the months of S-W monsoon season. S-W monsoon contribute about 588.1 mm rainfall followed by 78.2 mm winter season and 75.2 mm in summer season (Table 2).

Seasonal trend of rainfall depicted in Table 2 shows that there was decreasing trend during summer of the order of 5.46, 5.21 and 2.42 mm per year in 1st, 2nd and 3rd

Table 1 : Seasonal and monthly mean and trend of rainfall at Ambala

Periods	1977-80		1987-96		1997-2008		Over 1977-2008	
	Mean	Trend	Mean	Trend	Mean	Trend	Mean	Trend
Seasonal								
Summer	103.30	0.86	56.60	-3.57	106.50	6.85	89.90	0.60
South-West monsoon	652.70	12.19	864.50	42.74	731.80	-20.89	748.50	3.27
Post monsoon	35.30	1.59	13.50	0.25	31.40	-3.45	27.00	-0.21
Winter	104.00	0.21	123.60	1.00	65.40	-3.10	95.70	-1.90
Monthly								
January	35.10	-1.00	37.80	4.73	19.60	-1.66	30.20	-0.67
February	34.70	-0.67	66.90	0.88	33.40	2.70	44.30	-0.02
March	49.40	-2.70	23.30	0.75	36.80	3.66	36.60	-0.36
April	28.80	1.61	11.40	1.61	20.80	-2.00	20.30	-0.30
May	25.10	1.96	21.90	-5.93	48.90	5.20	33.00	1.21
June	89.00	0.11	90.70	5.56	111.10	-3.88	97.80	0.94
July	291.00	-6.14	304.40	15.30	276.50	-24.55	289.70	-1.70
August	182.00	15.84	292.50	12.30	227.50	4.27	233.60	2.67
September	90.80	2.38	176.90	9.60	116.70	3.26	127.40	1.36
October	20.80	2.71	5.50	0.86	24.00	-1.67	17.60	0.26
November	14.40	-1.12	8.00	-0.61	6.50	-1.79	9.40	-0.47
December	32.00	3.07	18.90	-4.60	12.40	-4.14	20.60	-1.08

Table 2 : Seasonal and monthly mean and trend of rainfall at Karnal

Periods	1977-80		1987-96		1997-2008		Over 1977-2008	
	Mean	Trend	Mean	Trend	Mean	Trend	Mean	Trend
Seasonal								
Summer	98.10	-5.46	47.90	-5.21	78.70	-2.42	75.20	-1.12
South-West monsoon	561.50	-23.58	703.00	27.30	514.60	-23.21	588.10	-3.68
Post monsoon	19.60	1.43	11.20	1.15	30.20	-6.89	20.90	-0.21
Winter	63.50	1.41	94.80	4.70	76.60	2.21	78.20	0.76
Monthly								
January	24.00	-0.62	33.10	7.22	28.20	-0.67	28.40	0.32
February	23.00	2.50	44.20	1.70	37.50	5.70	35.10	0.98
March	42.70	-6.18	21.40	-0.57	25.90	-0.82	29.70	-0.91
April	23.70	0.29	8.10	-1.40	14.10	-2.59	15.20	-0.53
May	31.70	0.43	18.50	-3.26	38.70	1.00	30.20	0.32
June	74.80	8.77	89.00	5.49	110.10	-2.59	92.50	1.80
July	254.00	-27.03	229.70	-0.46	142.50	-11.80	204.60	-6.26
August	168.20	3.98	243.30	16.94	155.30	-11.30	186.80	-0.80
September	64.50	-9.31	141.00	5.34	106.80	2.47	104.20	1.59
October	10.60	2.15	6.70	1.63	25.20	-6.41	14.90	0.44
November	9.10	-0.72	4.50	-0.48	4.90	-0.48	6.10	-0.23
December	16.50	-0.46	17.50	-4.23	10.90	-2.80	14.7	-0.54

period, respectively. In south-west monsoon season there was decreasing trend of 23.58 and 23.31 mm during 1st and 3rd period but in 2nd period it was increasing by 27.30 mm per year. Post monsoon trend was of decreasing during 3rd period only but it was increasing during 1st and 2nd period. Rainfall trend of winter was increasing during the whole study periods with annual value of 0.76 mm. Finally there were decreasing trend of rainfall of summer, south-west and post monsoon during 1977-2008 with values of 1.12, 3.68 and 0.21 mm per year, respectively.

Thus it is concluded that the during S-W monsoon season rainfall is increacasing at Ambala while it is decreasing at Karnal.

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