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Rainfall Probability and Variability Analysis for Semi Arid Region of Southern Tamil Nadu

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Time series rainfall data from Cotton Research Station, Tamil Nadu Agricultural University, Srivilliputtur, Virudhunagar District of Southern Tamil Nadu for the period of 26 years (1987 to 2012) had been collected and analysed for Standard Deviation (SD) and Coefficient of Variation (CV). The initial probability analysis was also worked at 30, 50 and 75 per cent level for weekly, monthly and seasonal rainfall. The results revealed that the North East Monsoon (NEM) season contributed the highest of 53.8 per cent to annual rainfall (818.8 mm) followed by summer and South West Monsoon season (SWM). The CV values were within 50 per cent for NEM and SWM indicating the higher dependability of rainfall. The CV values for April, May, August, September, October and November are lesser than the critical level of 100 per cent indicating lesser variability and higher dependability of rainfall than other months. The chance of getting mean seasonal rainfall for the SWM, NEM and summer seasons is once in alternate years. The monthly probability analysis indicated that the 50 per cent probability rainfall was almost equal to that of mean monthly rainfall during October and November only. The 50 per cent chance of receiving more than 20 mm rainfall was observed during the meteorological standard weeks from 41 to 47. The possibility of receiving more than 30 mm at 75 per cent probability level was noticed only during 44 and 45th standard weeks.

Key words : Rainfall probability, Variability, Semi arid region, Tamil Nadu

Rainfall is the only source to meet the water needs of living organisms in the earth. It is the most important natural resource for crop production and prime factor for agricultural planning. The study of temporal and spatial variations of rainfall would help to design a viable cropping pattern for a particular area. To exploit the available rainfall effectively, crop planning and management practices must be followed based on the rainfall amount and distribution at a place (Prakash and Rao, 1986). Scientific prediction of rains and crop planning done analytically may prove a significant tool on the hands of farmers for better economic returns (Bhakar *et al* 2008). The rainfall variability in terms of quantity and distribution can be understood by Coefficient of Variation (CV). The concept of rainfall probability analysis indicates the dependability of rainfall, which is extremely useful for field level operational planning in agriculture. Probability analysis of rainfall data enables us to determine the expected rainfall at various chances, such analysis helps in developing cropping plan and estimating the design flow rate for maximizing the crop production (Tomar and Ranade, 2001). The probability analysis of rainfall also used by design engineers and hydrologists for appropriate planning and design of small earthern and water conservation structures, irrigation and drainage systems (Manikandan *et al*., 2011). Therefore an attempt was made to analyze the rainfall data of Cotton Research Station, Srivilliputtur in terms of CV and initial probability level.

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Materials and Methods

Time series rainfall data of Cotton Research Station, Srivilliputtur, Virudhunagar District of Southern Tamil Nadu for the period of 26 years (1987 to 2012) had been used for the present investigation. The study area is located in 9º5' North latitude and 77º6' East longitude at an altitude of 137.59 m above MSL. It is a dry semi arid region and comes under East coast plains and Hill Region (XI) of India (as per Planning Commission) and Southern Agro Climatic Zone of Tamil Nadu (NARP). The collected daily rainfall data were analyzed for Mean and Standard Deviation (SD). Co - efficient of Variation (CV) was also worked out by the dividing SD with Mean and multiplying by 100. For computing initial probability, the time series rainfall data were arranged in descending order and worked out as follows,

Initial Probability = n x p / 100

Where n = sample size, p = probability required in percentage

The rainfall at 30, 50 and 75 per cent probability based on weekly, monthly and seasonal data were calculated.

Results and Discussion

Rainfall variability

Annual and seasonsal variability

The mean annual rainfall of Srivilliputtur was 818.8 mm and the annual CV was 21.2 per cent (Table 1). As the annual CV is less than the threshold level of 25.0 per cent, the annual rainfall variability is relatively lesser.

The seasonal rainfall analysis indicated that the highest rainfall of 440.9 mm was received during North East Monsoon (NEM) season which contributes to 53.8 per cent of annual rainfall. The mean Summer, South West Monsoon (SWM) and Winter seasonal rainfall were 176.3, 145.5 and 49.8 mm respectively which contribute 21.6, 17.8 and 6.1 per cent annual rainfall, respectively. The seasonal CV analysis showed that the CV values

Table 1. Mean, CV and probability of annual, seasonal and monthly rainfall of CRS, Srivilliputtur

Month/Season	Mean rainfall (mm)	Per cent to the total annual RF	SD	CV (%)	Probability Level (%)		
					30	50	75
Monthly Rainfall							
January	21.4	2.6	44.0	205.2	27.6	5.0	0.0
February	28.4	3.5	46.9	165.1	35.0	6.4	0.0
March	41.9	5.2	70.6	168.4	45.2	16.4	0.0
April	73.2	8.9	51.7	70.6	86.0	68.0	30.4
May	61.2	7.5	46.9	76.5	73.6	47.4	36.8
June	19.4	2.4	25.3	130.1	16.8	9.0	3.8
July	21.5	2.6	22.8	106.1	25.0	16.7	4.4
August	37.3	4.6	34.7	93.1	54.8	32.1	7.8
September	62.0	7.6	50.7	81.8	110.6	46.8	24.0
October	210.6	25.7	105.2	49.9	247.0	208.6	150.2
November	176.6	21.6	89.0	50.4	223.0	174.1	104.6
December	65.0	7.9	68.4	105.2	89.7	44.8	11.5
Seasonal Rainfall							
SWM (June -Sep)	145.5	17.8	68.7	47.2	165.0	134.8	93.5
NEM season (Oct-Dec)	440.9	53.8	167.5	38.0	494.8	432.6	348.5
Winter season (Jan-Feb)	49.8	6.1	58.6	117.7	63.2	35.2	7.0
Summer(Mar-May)	176.3	21.6	91.4	51.8	194.0	158.9	108.8
Annual	818.8	100.0	173.7	21.2	1034.3	675.3	373.5

were within 50 per cent for NEM and SWM indicating the higher dependability of respective seasonal rainfall. The NEM season which offers higher rainfall with less variability clearly indicated that successful crop production is possible with less risk during this season. The retrospective NEM rainfall with CV analysis for different districts of Tamil Nadu was already reported by Veeraputhiran and Balsubramanian (2000).

Monthly variability

The highest mean monthly rainfall of 210.6 mm was recorded during October followed by 176.6 mm in November (Table 1) and this was 25.7 and 21.6 per cent of annual rainfall, respectively. As the CV values for the months of April, May, August, September, October and November are lesser than the critical level of 100 per cent, these months have lesser variability and higher dependability for getting rainfall.

Weekly variability

With respect to weekly rainfall, more than 30 mm of mean weekly rainfall was observed in the standard weeks between 41 and 43 to 47 (Table 2). The standard weeks 43 to 45 had the lowest CV values of less than 100 per cent indicating the least variability. Lesser CV values of threshold level between 101 and 150 per cent were also associated with the standard weeks 14 to 19, 33, 37 to 40, 42, 46, 47 and 49, and this showed lesser rainfall variability with higher dependability. Similar rainfall variability analysis study was carried out for Coimbatore region of Tamil Nadu by Veeraputhiran *et al., (* 2003).

Rainfall Probability

Annual and seasonal probability

The initial probability of mean annual rainfall for 75, 50 and 30 per cent were 373.5, 675.3 and 1034.3 mm, respectively (Table 1). The 50 per cent probability rainfall was lesser than the annual average rainfall indicating the possibility of occurrence of average rainfall beyond alternate years. The seasonal probability rainfall showed that the probability of receiving 50 per cent mean rainfall for the SWM, NEM and summer seasons are nearer to the mean rainfall than winter seasons. This shows that the chance of getting mean monthly rainfall for

Table 2. Mean, SD, CV and probability of Weekly rainfall of CRS, Srivilliputtur

Std Week no	Month and date	Mean rainfall (mm)	SD	CV(%)	Probability Level (%)		
					30	50	75
1	Jan01-07	4.9	13.9	284.5	0.0	0.0	0.0
2	Jan08-14	10.6	35.1	329.7	0.4	0.0	0.0
3	Jan15-21	3.0	7.0	228.8	0.0	0.0	0.0
4	Jan22-28	2.3	8.0	353.6	0.0	0.0	0.0
5	Jan29-Feb04	2.7	6.1	228.1	1.0	0.0	0.0
6	Feb5-11	14.3	27.1	190.2	7.0	0.0	0.0
7	Feb12-18	3.6	11.2	309.1	0.0	0.0	0.0
8	Feb19-25	7.7	21.8	284.5	0.0	0.0	0.0
9	Feb26-Mar4	3.2	10.5	323.4	0.0	0.0	0.0
10	Mar5-11	7.9	17.1	217.9	1.8	0.0	0.0
11	Mar12-18	11.4	20.9	182.9	12.6	0.0	0.0
12	Mar19-25	15.7	50.7	324.0	3.8	0.0	0.0
13	Mar26-Apr1	6.7	15.8	237.5	4.2	0.0	0.0
14	Apr2-8	18.8	26.1	139.0	26.0	8.0	0.0
15	Apr9-15	22.9	32.8	143.4	28.2	16.4	0.0
16	Apr16-22	16.5	18.5	112.0	19.4	13.0	0.0
17	Apr23-29	11.9	16.8	141.8	18.0	3.6	0.0
18	Apr30-May6	22.3	28.5	127.7	30.2	15.4	1.8
19	May7-13	12.1	17.3	142.5	24.6	2.6	0.0
20	May14-20	12.6	20.6	164.3	13.6	1.2	0.0
21	May21-27	11.3	18.2	160.1	14.4	3.0	0.0
22	May28-June 3	7.7	17.1	220.8	7.0	0.0	0.0
23	June4-10	7.3	12.2	165.7	5.4	2.0	0.0
24	June11-17	0.9	2.7	306.4	0.0	0.0	0.0
25	June18-24	2.6	8.0	301.7	0.0	0.0	0.0
26	June25-July1	1.3	2.8	209.1	1.2	0.0	0.0
27	July2-8	4.0	11.8	293.2	0.0	0.0	0.0
28	July9-15	4.2	8.0	190.9	3.6	0.0	0.0
29	July16-22	8.9	17.9	199.7	7.0	1.6	0.0
30	July23-29	3.2	5.7	176.4	3.4	0.4	0.0
31	July30-Aug5	5.6	10.6	191.2	5.0	0.0	0.0
32	Aug6-12	4.9	11.2	229.2	2.8	0.0	0.0
33	Aug13-19	9.1	13.7	149.8	8.5	0.8	0.0
34	Aug20-26	8.6	15.3	178.3	9.6	0.8	0.0
35	Aug27-Sep2	7.7	13.3	171.9	4.6	0.0	0.0
36	Sep3-9	9.1	18.6	205.8	6.0	0.0	0.0
37	Sep10-16	23.7	23.9	101.1	36.0	19.8	1.0
38	Sep17-23	17.5	23.3	133.2	29.6	5.0	0.0
39	Sep24-30	19.1	24.6	128.9	24.0	13.8	0.0
40	Oct1-7	21.7	27.1	124.8	25.0	12.0	0.0
41	Oct8-14	36.8	30.9	84.0	58.6	40.2	5.6
42	Oct15-21	46.2	46.8	101.3	60.4	38.2	6.6
43	Oct22-28	71.9	49.2	68.4	98.2	71.6	32.4
44	Oct29-Nov4	71.9	59.1	82.3	89.5	66.0	31.0
45	Nov5-11	55.6	53.9	96.8	79.6	53.2	10.0
46	Nov12-18	27.0	31.6	117.0	33.0	24.8	0.0
47	Nov19-25	34.4	41.3	120.2	49.2	23.0	3.0
48	Nov26-Dec02	23.4	40.0	171.0	25.2	0.0	0.0
49	Dec03-09	15.1	18.7	124.0	30.0	6.0	0.0
50	Dec10-16	13.6	34.8	256.6	8.2	0.9	0.0
51	Dec17-23	18.6	35.5	191.3	13.0	0.0	0.0
52	Dec24-31	15.0	45.0	300.4	3.5	0.0	0.0

these seasons is once in alternate years. Singh *(*2001) predicted the probability analysis of annual maximum rainfall of Eastern Himalaya regions.

Monthly Probability

The monthly probability analysis clearly indicated that the 50 per cent probability rainfall was almost equal to that of mean monthly rainfall during October

and November months only. This shows that the chance of getting average rainfall during these months is in alternate years. This was closely followed by July, August and April. Similar monthly initial probability study for Coimbatore region was documented by Veeraputhiran *et al., (* 2003). .

Weekly probability

The analysis of initial probability of weekly rainfall (Table 2) revealed that the standard weeks 41 to 46 could get the mean weekly rainfall during alternate years and this was closely followed by the standard weeks 15, 16, 18 and 37. The 50 per cent chance of receiving more than 20 mm rainfall was observed between the standard weeks 41 and 47. The possibility of receiving more than 30 mm at 75 per cent probability level was noticed only during 44 and 45th standard weeks.

Thus, it can be concluded from the rainfall analysis that higher dependability and lesser variability of rainfall was associated with April, May, August, September, October and November months. The irrigated crop production with short duration crops may be successfully carried out with supplemental irrigation during April and May months. For rainfed cultivation, the 50 per cent chance of receiving more than 20 mm rainfall was observed during the standard weeks from 41 to 47.

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