Analysis of Rainfall Distribution in Puri District of Odisha

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ABSTRACT: The distribution of rainfall always varies with time. As a result, there is occurrence of drought, abnormal and normal months with respect to amount of rainfall in different years. This necessitates the statistical assessment of rainfall probability. Puri district lies in the coastal region of Odisha. The study of rainfall pattern in Puri district is of utmost important for proper planning of the crops due to the random nature of rainfall pattern. The probability distribution of drought, normal and abnormal rainfall at Puri district of Odisha is studied monthly and seasonally from rainfall data for period of 20 years (1997-98 to 2016-17). The month in which the monthly rainfall is less than half of mean monthly rainfall is regarded as drought month. The month in which the monthly rainfall is more than twice the mean monthly rainfall is regarded as abnormal month and the month in which the monthly rainfall is in between half and twice of the mean monthly rainfall is regarded as normal month. During kharif season (June – September) the probability of normal rainfall remains high and the probability of occurrence of drought months is very low. The probability of drought months remains high in rabi season, whereas, in summer season the probability of abnormal months remains high. The Coefficient of Variation of rainfall is less in wet months i.e. months having more rainfall and is high in dry months i.e. months having very less rainfall. Thus, it can be concluded that the degree of uncertainty of rainfall increases in dry months and the wet months have high degree of certainty in occurrence of rainfall.

INTRODUCTION

The success of agriculture of a region depends greatly on the quantity and distribution of rainfall in the region. The random nature of rainfall distribution along with its time dependent nature creates a need for its statistical analysis on basis of its probability. Many workers (Sharma et al, 1999, Hooda and Thakur, 1998) have studied the occurrence of drought, normal and abnormal rainfall by using probability approach. Drought and floods being natural disasters have direct impact on socioeconomic condition of farmer and also on crop production. Thus it necessitates the study of occurrence of drought, normal and abnormal rainfall of a region. Puri

district, situated in eastern coastal part of Odisha has a tropical climate. Rice is the important crop grown in this district whose production is greatly affected by rainfall pattern. The study made an effort to examine the probability distribution of drought, normal and abnormal months and seasons at Puri district. The seasons are classified as Kharif (June – September), Rabi (October- January) and Summer (February – May).

MATERIAL AND METHODS

Monthly rainfall data from 1997-98 to 2016-17 has been collected from IMD, Bhubaneswar. The data are arranged monthly and according to seasons. Each month and season has 20 rainfall events corresponding to 20 years. Monthly and seasonal rainfall events were then classified as drought, normal and abnormal.

Determination of drought, normal and abnormal months:

Let $T_1 = \frac{\overline{Y}}{2}$; $T_2 = 2\overline{Y}$, where $\overline{Y}$ is the mean monthly rainfall;

If monthly rainfall is less than T_1, then it is defined as drought month.

If monthly rainfall lies between T_1 and T_2, then it is defined as normal month.

If monthly recovery rainfall is more than T_2, then it is defined as abnormal month.

Percentage of drought, normal and abnormal months is given by:

Percentage of drought, normal and abnormal months is given by: (No. of drought, normal and abnormal months / total no. of months in the entire period of study) X 100

Probability of occurrence of drought, normal and abnormal months is given by :

If a_i, b_i and c_i (i = 1, 2, …., 12) are the number of drought, normal and abnormal months, out of total number of drought (A), normal(B) and abnormal(C) months during the entire period of 20 years (1997-98 to 2016-17), then the probability of occurrence of drought, normal and abnormal months are given by: P(A) = a_i/A; P(B) = b_i/B and P(C) = c_i/C; i= 1, 2, 3,….., 12.

Calculation of probability of occurrence of drought, normal and abnormal seasons is given by:

If ai*, bi* and ci* (i = 1, 2,3) are the total number of drought, normal and abnormal months in the ith season, the estimated values of probability of occurrence of drought, normal and abnormal months falling in a given season are given by:

$P(A)* = a_i*/A$; $P(B)* = b_i*/B$ and $P(C)* = c_i*/C$; i= 1, 2, 3

The variability in rainfall is studied with the help of Coefficient of variation (Sarkar, et al, 2013).

$$C.V. \text{ of monthly rainfall} = \frac{\text{Standard Deviation of monthly rainfall}}{\text{Mean monthly rainfall}} \times 100$$

$$C.V. \text{ of seasonal rainfall} = \frac{\text{Standard Deviation of seasonal rainfall}}{\text{Mean seasonal rainfall}} \times 100$$

Correlation coefficient between mean monthly rainfall (X) and C.V. of monthly rainfall (Z) denoted by r(X,Z) is given by $r(X,Z) = Cov(X, Z)/(\sigma_X . \sigma_z)$

Standard error of the Correlation Coefficient is given by $SE(r) = \sqrt{\frac{1-r^2}{n-2}}$, where 'n' is the no. of observations. Here n = 12.

RESULTS AND DISCUSSION

The study of Table 1 which shows the monthly rainfall statistics of Puri district reveals that the month of July has the highest mean monthly rainfall and the month of February has the lowest monthly rainfall. This shows that July is the wettest month and February is the driest month over the period of 24 years (1997-98 to 2016-17). Also from table 1 it is found that the wettest month i.e. July has the lowest C.V. and the driest month i.e. February has the highest C.V. Thus an inverse relationship is found to exist between mean and C.V. of monthly rainfall. The correlation coefficient between mean monthly rainfall and C.V. of monthly rainfall is highly negative and significant at 1% level of significance (r = -0.86** with standard error of 0.16). The frequency of normal months is more in wettest months and the frequency of drought months is more in drier months. The probability of normal months is more in wet months and the

probability of drought months is more in drier months. The month of December has the highest probability of drought month and the months of July and August has both highest probability of normal month. The probability of abnormal month is highest for the month of April.

The study of seasonal rainfall statistics as revealed from Table 3 shows that the C.V. of seasonal rainfall is lowest for Kharif season and highest for rabi season. Thus it is found that an inverse relationship between mean and C.V. of seasonal rainfall also exist in case of seasons. The probability of normal months is more in kharif season and the probability of drought months is more in rabi season.

CONCLUSION

It is found that the probability of normal months is highest for kharif season, which has highest mean rainfall of 1211.07 mm   Also the C.V. of rainfall in kharif being much lower (21.27 per cent) indicates more consistency in kharif rainfall. The wet months having low C.V. shows consistency in their rainfall pattern whereas the dry months show more variation in their rainfall pattern as the C.V. of rainfall for dry months is very high (99.39). This shows an inverse relationship between mean and C.V. of rainfall. (Fig. 1). The amount of rainfall in kharif season contributing 88.21 per cent to the mean annual rainfall is sufficient for paddy crop. So, paddy can be taken as the main crop in kharif season in Puri district. The probability of drought months is highest for the dry months of rabi season, whereas, the wet months i.e., July, August has highest probability of normal months.

REFERENCES

[1]. Hooda, B.K. and Thakur, B.C. 1998 Probability Analysis of Rainfall at Naini, Himachal Pradesh. *Indian Journal of Soil Conservation,* 26(2): 153-155

[2]. Sarkar, S., Kundu, D.K. and Mahapatra, B.S. 2013 Rainfall Probability Analysis of Western Odisha Plateau Region for Sisal (*Agave sisalana perrine eEugelm*) based cropping system . *Journal of Agricultural Physics*, 13(1): 62-70

[3]. Sharma, H.C., Chauhan, H.S. and Ram, Seva 1999 Probability Analysis of Rainfall for Crop Planning. *Journal of Agri. Engg*., 17(3): 38-44.

Table 1: Monthly Rainfall Statistics of Puri District of Odisha

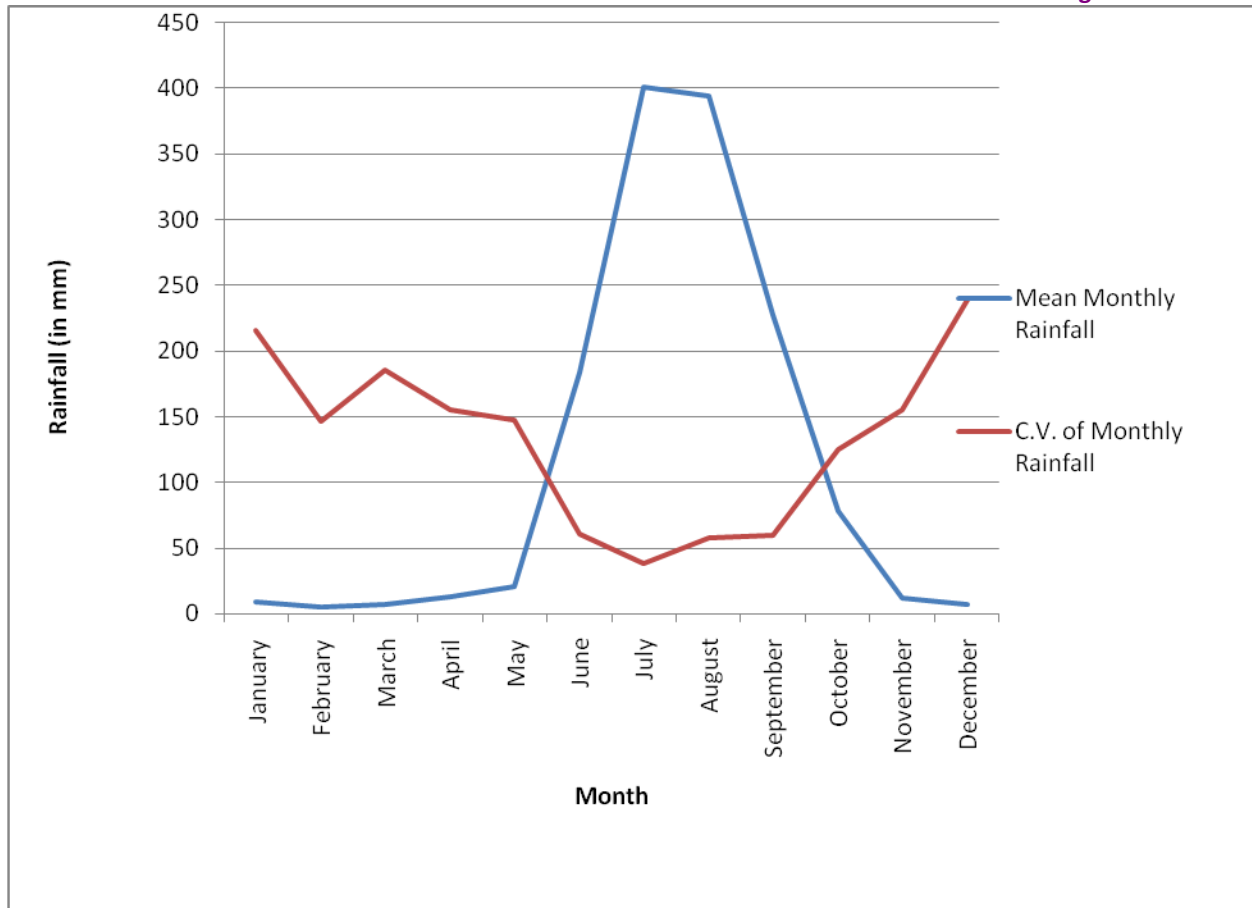| Month	Mean monthly rainfall (in mm)	Mean monthly rainfall as % of mean annual rainfall	C.V.	A_1	A_2	No. of drought/normal/abnormal months		
						a_i	b_i	c_i
January	8.52	0.64	216.22	4.46	17.44	18	2	4
February	5.27	0.39	145.61	2.64	10.56	16	6	2
March	7.12	0.52	185.98	3.56	14.24	14	2	8
April	12.91	0.95	155.75	6.46	25.82	16	0	8
May	20.82	1.53	147.61	10.51	41.64	14	6	4
June	183.93	13.55	60.63	92.02	368.06	2	20	2
July	400.92	29.51	38.66	200.56	801.84	0	24	0
August	394.45	29.03	57.78	197.23	788.9	2	20	2
September	227.56	16.75	60.13	113.88	455.12	4	18	2
October	78.05	5.74	125.26	38.98	155.9	10	10	4
November	12.17	0.9	156.03	6.09	24.34	16	2	6
December	7.25	0.53	239.34	3.63	14.5	20	0	4
					Total	132	110	46

Table 2:   Probability of drought, normal and abnormal months in a year for Puri District of Odisha

Month	Drought month		Normal month		Abnormal month	
	P(A)	Percentage of months having a given month as drought month	P(B)	Percentage of months having a given month as normal month	P(C)	Percentage of months having a given month as abnormal month
January	0.15	75	0.03	8.33	0.13	16.67
February	0.15	66.67	0.04	25	0.06	8.33
March	0.11	58.33	0.04	8.33	0.19	33.33
April	0.07	66.67	0.05	0	0.25	33.33
May	0.05	58.33	0.12	25	0	16.67
June	0.05	8.33	0.11	83.33	0.06	8.33
July	0.02	0	0.15	100	0	0
August	0.02	8.33	0.15	83.33	0	8.33
September	0.02	16.67	0.14	75	0.06	8.33
October	0.03	41.67	0.12	41.67	0.06	16.67
November	0.15	66.67	0.05	8.33	0.06	25
December	0.18	83.33	0	0	0.13	16.67

Table 3:   Seasonal Rainfall Statistics and Probability of Drought, Normal and Abnormal Months in a Year for Puri District of Odisha

Season	Mean rainfall (in mm)	Mean monthly rainfall as percentage of mean annual rainfall	C.V.	Probability		
				P(A)*	P(B)*	P(C)*
Kharif (June-September)	1211.07	88.21	21.27	0.11	0.51	0.38
Rabi (October-January)	108.98	8.12	8875	0.55	0.19	0.26
Summer (February-May)	50.24	3.77	98.39	0.13	0.38	0.49

Figure 1: Mean and C.V. of Monthly Rainfall in Puri District of Odisha