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Rainy Season and Its Variability for Crop Planning in Aurad (Bidar Dist.) Region of Karnataka, India

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A B S T R A C T

Rainfall data for the period 1957 - 2015 is used to analyze *nakshatra*-wise, monthly, seasonal and annual variability of rainfall. The analysis of daily rainfall data (1957-2015) indicates that the average annual rainfall for the Aurad region will be 830.5 mm. The lowest and highest recorded annual rainfall was 280.4 and 1337.7 mm respectively. The annual rainfall at Aurad region was distributed as 660.2 mm, 101.1 mm, 59.8 mm and 9.4 mm in monsoon (June- September), post monsoon (October - December), summer (March - May) and winter (January - February) season respectively. The standard deviation and coefficient of variation for mean annual rainfall was 241.8 mm and 29.1 per cent respectively. The highest mean rainfall of 201.9 mm with coefficient of variation of 59.4 per cent was highest in August month followed by July (182.2 mm) with coefficient of variation of 62.5 per cent. However the lowest coefficient of variation of 58.4 per cent was noticed during June month with mean rainfall of 122.5 mm indicating lesser variability. Among the *nakshatras Makha nakshatra* has recorded the highest mean rainfall of 98.6 mm and the lowest rainfall (13.6 mm) was from *Swati nakshatra*. The coefficient of variation was highest in (164.4 per cent) *Chitta nakshatra* while *Pushya* and *Pubbha nakshatra* has recorded the lowest coefficient of variation of 76.8 per cent. The highest rainfall of 378.7 mm was recorded by the *Makha nakshatra* during 2003 and very lowest rainfall (113.2 mm) by *Swati nakshatra* during 1973.

Introduction

India's economy is dependent on the agricultural production, which in turn is dependent on the monsoon rainfall and its distribution. The year to year fluctuation in rainfall as well as the fluctuation within the monsoon season governs the crop growth, development and yield. Even in monsoon months the crops are subjected to moisture stress due to occasional dry spells. Although the rainfall is high, the distribution is erratic making the crop vulnerable even during

monsoon. Agriculture, especially in developing countries, is a sector which is vulnerable to risks of various types. Most importantly, weather related risks play a major role in affecting agricultural income. These would include extreme rainfall events which result in floods / droughts, as well as extreme temperature events. Poor and small farmers are especially susceptible to income variability because of weather – related risks to their crops.

The success or failure of the crops in any year is always viewed with great anxiety as they are closely linked with the behavior of the south west monsoon rains received during June to September. Thus for a rainfed crop, rainfall is the only source of water and thereby any fluctuation in rainfall pattern adversely affect the crop production and it tilts the food security of the country. Water is one of the crucial inputs in crop production and its excess or deficit availability/application adversely influences the yield. Rainfall analysis for crop planning was carried out in different regions of the country as reported by Ahmed *et al.,* (2009) in the Barak valley zone of Assam and Sarma *et al.,* (1996) in the hills zone of Assam. Saha *et al.,* (2004) reported rainfall distribution pattern of Cuttack and its implication in rainfed rice and other crop planning for coastal Orissa. Manorama *et al.,* (2007) reported rainfall analysis and crop planning for the Nilgiris. Jadav *et al.,* (1999) reported rainfall probability analysis for crop planning in scarcity zone of Maharashtra. Mahale and Dhane (2003) reported rainfall analysis for Panvel region.

In this context, a similar attempt was made at Krishi Vigyan Kendra, Bidar, to analyze the rainfall variability in *nakshatra*, month, season and annual wise for Aurad region of Karnataka state.

There is considerable traditional knowledge of variability of rainfall patterns, since rainfed cultivation has been carried out for several centuries in India. The periods used by the farmer are however, not weeks or months but so-called '*nakshatras*', which are 13- or 14-day periods based on the solar calendar. The *nakshatras* are constellations through which the sun passes in a year. There are 27 *nakshatras*; hence the period of each *nakshatra* is about 13–14 days (Subash *et al.,* 2011).

Materials and Methods

The daily rainfall data from Agro-meteorological Centre, Agricultural Research Station, Bidar years from 1957 to 2015 was used to analyze *Nakshatra*-wise rainfall distribution for Aurad region. Of the 27 *Nakshatras*, 12 *Nakshatras* from *Rohini* (May 25 to June 7) to *Swati* (October 24 to November 5) were considered for the analysis. The mean, standard deviation, coefficient of variation (CV%), minimum and maximum for *Nakshatra*-wise rainfall were calculated. The rainfall data were critically examined for annual, seasonal and monthly values following the procedure of Panse and Sukhatme (1985). The standard deviation (SD) and coefficient of variance (CV) of rainfall were worked out for the above periods.

Annual rainfall

The overall mean total annual rainfall of Aurad region for the past fifty eight years (1957-2015) was found to be 830.5 mm with a coefficient of variation of 29.1 per cent. This revealed that the rainfall was more or less stable over the years. The annual rainfall ranged from 280.4 to 1337.7 mm. The standard deviation for annual rainfall was with mean of 241.8 mm (Table 2).

Seasonal rainfall

The average seasonal rainfall and its variability during the seasons winter (January – February), summer (March- May), Monsoon (June - September) and Post monsoon (October – December) are presented in Table 2 and Figure 2. The highest rainfall was received during monsoon season (660.2 mm) followed by post monsoon season (101.1 mm) and the lowest by winter season (9.4 mm) (Fig. 1). The per cent contribution of seasonal rainfall to the total annual rainfall

was 79.5, 12.2, 7.2 and 1.1 by monsoon, post monsoon, summer and winter seasons respectively with the lowest CV during monsoon (33 %), followed by post monsoon (72 %) and summer (83 %) seasons. As Aurad region is highly benefited through southwest monsoon rainfall, the CV of the mean rainfall during monsoon season is the lowest.

Table.1 Monthly mean, highest and lowest rainfall along with SD and CV as observed at Aurad (1957-2015)

Month	Lowest (mm)	Highest (mm)	Mean (mm)	SD mm	CV (%)	% of annual
January	0.0	75.8	5.6	13.5	242.6	0.7
February	0.0	40.6	3.8	8.5	222.4	0.5
March	0.0	73.8	11.5	20.8	180.9	1.4
April	0.0	115.5	17.8	21.8	122.6	2.1
May	0.0	198.5	30.5	39.9	130.9	3.7
June	11.4	386.9	122.5	71.5	58.4	14.8
July	0.0	492.1	182.2	113.9	62.5	21.9
August	0.0	498.7	201.9	119.9	59.4	24.3
September	0.0	427.0	153.6	99.2	64.6	18.5
October	0.0	250.6	77.0	70.9	92.0	9.3
November	0.0	161.0	18.7	30.6	164.0	2.2
December	0.0	58.0	5.4	12.6	232.3	0.7

Table.2 Characteristics of annual and seasonal rainfall as observed at Aurad (1957-2015)

Year / Seasons	Lowest (mm)	Highest (mm)	Mean (mm)	SD mm	CV (%)	% of annual rainfall
Annual	280.4	1337.7	830.5	241.8	29.1	100.0
Winter	0.0	75.8	9.4	17.0	181.1	1.1
Summer / Pre-monsoon	0.0	198.5	59.8	50.0	83.6	7.2
Monsoon	90.0	1210.5	660.2	222.9	33.8	79.5
Post monsoon	0.0	279.2	101.1	73.2	72.4	12.2

Annual: January – December Winter: January – February Summer: March- May
Monsoon: June - September Post monsoon: October - December
SD: Standard Deviation CV: Coefficient of variation

Table.3 Statistical characteristics of *nakshatra*-wise rainfall in Aurad

Season	*Nakshatra*	Period	Rainfall			Highest rainfall	
			Mean (mm)	SD (mm)	CV (%)	Amount (mm)	Year
Pre-monsoon	*Rohini*	May 25-Jun.7	29.1	33.4	114.5	152.4	1960
	Mrigashira	Jun.8-Jun.21	58.5	50.4	86.2	210.4	1992
Monsoon	*Aridhra*	Jun.22-Jul.5	66.4	45.2	68.0	149.4	1995
	Punarvasu	Jul.6-Jul.19	79.3	71.7	90.5	309.0	1965
	Pushya	Jul.20-Aug.2	93.7	72.1	76.9	293.1	1989
	Ashlesha	Aug.3-Aug.16	86.8	76.8	88.5	358.0	1990
	Magha	Aug.17-Aug.30	98.6	97.8	99.2	378.7	2003
	Purva	Aug.31-Sept.12	75.3	57.9	76.9	189.2	1998
	Uttara	Sept.13-Sept.26	77.1	62.8	81.4	232.4	1983
Post-monsoon	*Hasta*	Sept.27-Oct.10	50.1	51.0	101.7	213.7	2012
	Chitta	Oct.11-Oct.23	29.5	48.5	164.4	207.8	1974
	Swati	Oct.24-Nov.5	13.6	22.0	161.6	113.2	1973

Fig.1 Monthly average rainfall (mm) as recorded at Aurad
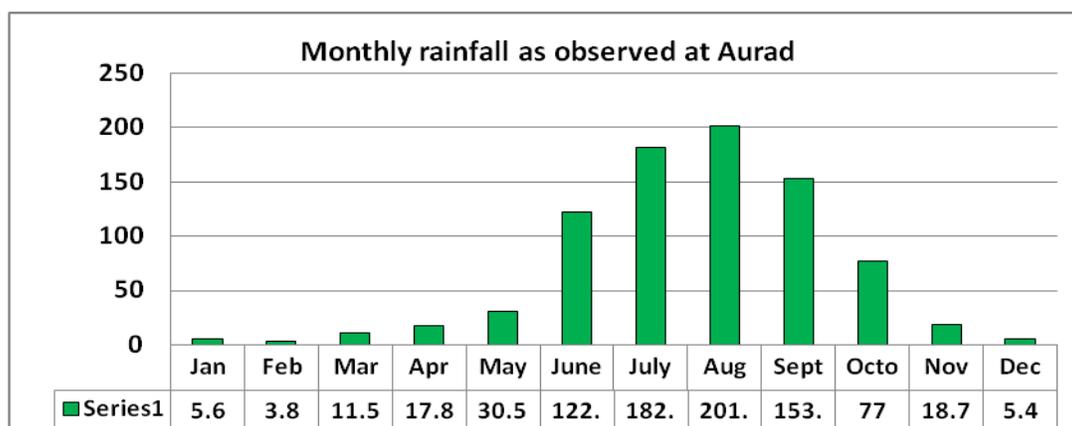
Fig.2 Average season wise rainfall (mm) as observed at Aurad

Characteristics of *nakshatra*-wise rainfall in Aurad

29.1 | 58.5 | 66.4 | 79.3 | 93.7 | 86.8 | 98.6 | 75.3 | 77.1 | 50.1 | 29.5 | 13.6

Rohini | Mrigashira | Aridhra | Punarvasu | Pushya | Ashlesha | Magha | Purva | Uttara | Hasta | Chitta | Swati
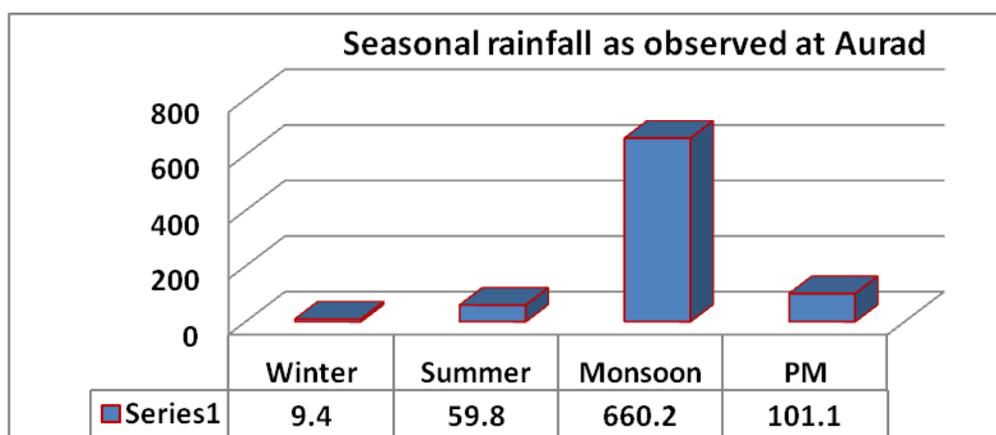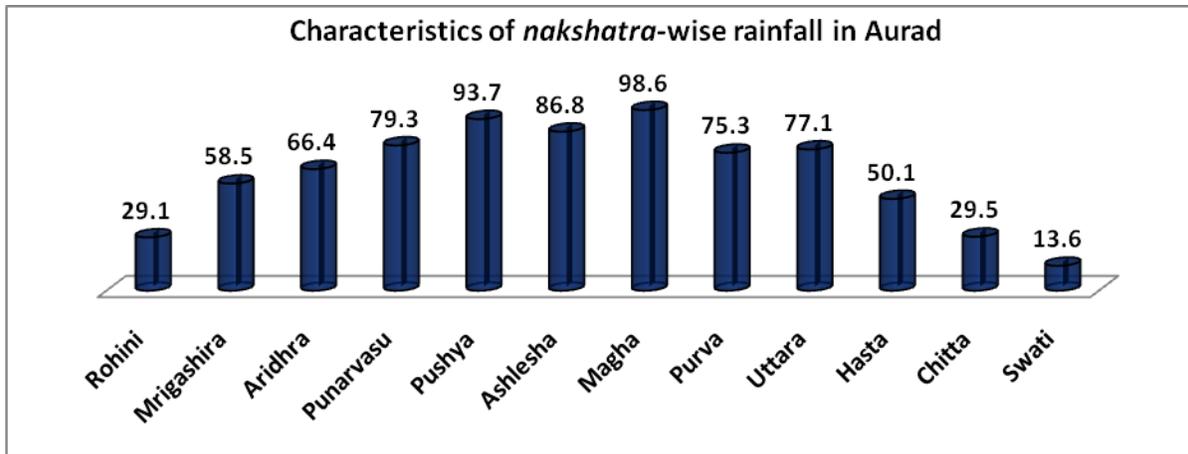
Monthly rainfall

From Table 1, it could be observed that rainfall in this region increases from April month onwards, attains a peak during August and then falls down reaching the lowest value of 3.8 mm during February month. Mean monthly rainfall is highest in August (201.9 mm) with its contribution of 24.3 per cent to the total annual rainfall. It is observed that there is higher dependability of rainfall from the month of June to October (CV 58 - 92 %). Hence, a successful cultivation of pigeon pea based cropping system under rainfed condition with medium or long duration varieties is possible during that period.

The highest rainfall during Nakshatra periods are presented in Table 3. The rainfall during *Nakshatra* periods ranged from 149.4 mm to 378.7 mm. *Magha Nakshatra* received the highest rainfall of 378.7 mm during 2003 followed by *Ashlesha Nakshatra* of 358.0 mm. The lowest rainfall of 149.4 mm was recorded for *Aridhra* during 1995.

The average rainfall during monsoon season (660.2mm) with its highest contribution of 79.5 per cent to the total annual rainfall revealed that during the season, a major part of rainfall amount is generally lost through runoff which can be stored through water harvesting structures such as farm ponds and

lakes and used during the winter season for growing *rabi* crops. Also it can be utilized as life saving irrigation particularly in years of low rainfall. During post monsoon season, which contributes to 12.2 per cent of the total annual rainfall, an average amount of 101.1 mm rainfall could satisfy the cultivation of less water requiring crops such as pulses (Chickpea), sunflower, safflower crops. About 7.2 per cent of total annual rainfall received during summer season (March-May) would be helpful for land preparation particularly for summer ploughing operation during the season.

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