ISSN 2350-1049

International Journal of Recent Research in Interdisciplinary Sciences (IJRRIS)
Vol. 2, Issue 2, pp: (16-20), Month: April 2015 - June 2015, Available at: www.paperpublications.org

Rainfall Trend Analysis of Mandya District in Karnataka

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Abstract: **The daily rainfall data of Mandya district of Karnataka for last 37 years (1973-2009) were analyzed to study its variability. Being a part of the semi-arid region it receives mean annual rainfall of 684.4 mm with 29.5 per cent variability. The contributing from winter, pre-monsoon, monsoon and post monsoon period to the total rainfall was 1.3, 9.3, 44.8 and 32.1 per cent. Each standard meteorological week (SMW) from 21st to 44th receive a rainfall of above 20 mm with less variability (within 200%) indicating the crop growing period from 2nd fortnight of May to 2nd fortnight of October. The monthly mean rainfall was observed to be 85.2, 56.8, 49.0, 68.9, 132.4 and 159.2 for May, June, July, August, September and October months, respectively. The trend analysis of rainfall indicated that, the mean annual rainfall was more or less similar since 1971, however, the variability was showed increasing trend. Being a semi-arid climate, Mandya district was frequently affected by periodical drought and the study indicated out of past 37 years, 4 years were experienced the slight drought (-19 to -25% D from N) and 6 years were falls under moderate drought (-26 to -50% D from N). Whereas, year 1990 was affected due to severe drought with -56.5 deviation in rainfall than normal.**

Keywords: **Drought, Karnataka, Mandya, Rainfall, Trend, Variability**

I. INTRODUCTION

Rainfall variability is a major factor influencing the agricultural productivity and sustainability in tropics [6]. Rainfall pattern and the quantity decides the cropping system in the rainfed agriculture. Amount, distribution and intensity of rainfall mainly determine the choice of any particular crop and agronomic practices. Scientific study on the quantum and distribution of rainfall if made would enable the farming community to adjust or modify the cropping programme as well as the cultural operations to utilize the actual moisture available in the field for profitable crop production. Hence, a study was undertaken at Mandya district to understand the rainfall variability for crop planning purpose. Such analysis is helpful in prediction of annual and seasonal rainfall probability for the next one or two years, in turn crop planning. Similarly, rainfall variability analysis at Akola was done by [5]; [4] reported for Bihar and [2] for Kerala and [1] reported the rainfall variability in coastal district of Karnataka.

II. MATERIALS AND METHODS

Daily rainfall data of 37 years (1973-2009) collected from IMD, Bangalore met centre were used for analysis of probability and variability. The data were aggregated to weekly, seasonal and annual totals. The mean rainfall, standard deviation and coefficient of variation for annual seasonal and weekly period were also worked out. The annual rainfall received was classified based on IMD specification as normal (particular year that received +19 per cent of mean annual rainfall), excess (year that received more than 19 per cent of mean annual rainfall) and deficit (year that received less than 19 per cent of the mean annual rainfall).

III. RESULTS AND DISCUSSION

Annual Rainfall:

The data on mean annual rainfall, deviation from normal, coefficient of variation, standard deviation and its classification are given in Table 1 and 2. The mean annual rainfall of this region was 684.8 mm spread with coefficient of variation of

29.5%. The maximum rainfall was 1192.9 mm in 2005 followed by 1143.5 mm in 2000 and the minimum was 298.0 mm in 1990 and 362.8 mm in 1982. The normal range *i.e.* between ± 19 of mean annual rainfall was 645.0 to 804.8 mm. Out of 39 years, 8 years received excess of rainfall (19.23 – 46.63%). Whereas 4 years *viz.*, 1976, 1982 1984, 1985, 2002 and 2006 received less than -26 to -49% rainfall than the normal range and these five years are declared as moderate drought years. In general, the annual precipitation receipt in this region was normal.

The rainfall of 39 years (Table 2) ranged from 298.0 mm to 1192.9 mm with a mean of 684.8 mm. The standard deviation (SD) was moderately high (201.7) with a coefficient of variation (CV) of 29.5 per cent, indicating high variability and dependability on rainfall. The decadal analysis (Table 2) indicated that, the mean annual rainfall was more or less normal with a moderate coefficient of variation (<25 %). Over the decades the average rainfall increasing but, at the same time the coefficient of variation was also increasing resulted in poor dependability of rainfall in this region.

Seasonal Rainfall:

The data on mean seasonal rainfall, standard deviation, coefficient of variation and percentage contribution of seasonal rainfall are presented in Table 3. Highest amount of 307.1 mm of rainfall was received in south-west monsoon contributing to 44.8% per cent to total amount of rainfall with coefficient of variation of 41.2% indicating its dependability. For post-monsoon season, the rainfall received was 219.9 mm and thus contributing 32.1% to the total with coefficient of variation of 53.2%. Pre-monsoon rainfall also contributed substantially (63.7 mm), 9.3% of the total with 79.8% coefficient of variation, in winter, the rainfall was 8.8 mm are thus 1.3% to the total with coefficient of variation of 244.3%. The monthly rainfall analysis indicated that the crop growing period in Mandya district was started from May month and remains up to end of October. However, in the months of June and July the rainfall was very low (56.8 and 49.0 mm) with uneven distribution. But August onwards monsoon again pickup and continue up to end of October.

Weekly rainfall:

The weekly rainfall analysis was done for mean, standard deviation and coefficient of variation and the relevant data were presented Table 4. Each standard week from 21st to 44th received rainfall more than 20 mm. It indicated that from May III week onwards the crop season starts and extended up to October last week. However, in between many of the weeks rainfall was not equally distributed and many times there was a break in monsoon and received less than 20 mm of rainfall indicating the crop growing in this region during monsoon period was more risky and prone to drought and hence, sowing should delayed in dry lands. Early sowing should be encouraged when supplemental irrigation facilities are available. In dry lands short planting of finger millet, rice, pulses are advised in the month of August first week.

IV. CONCLUSION

On the basis above, it was concluded that Mandya district received mean annual rainfall of 684.8 mm with less coefficient of variation (21.85%) and there was no much deviation among the different years. This region received sizable amount of pre-monsoon rainfall (9.3% of total rainfall) and it was start from May II week (>10 mm rainfall in each week) and helped in land preparation and also in many places it is advisable to take up some short duration pre-monsoon crops like sesame, horse gram etc by utilizing this rainfall. . During monsoon season even though crop growing season starts from June I week (>20 mm rainfall in each week), but there was a break in monsoon and hence, monsoon crops suffer from want of moisture. Hence early sowing in the month of June should be avoided unless supplemental irrigation facilities available. On the other hand due to end season rainfall peak at September last week and October last week (35-40 mm of rainfall in both the weeks) due to N-W monsoon the growing period was extended. Hence, in this sowing are done in the month of July end or August first week to get maximum yield and returns.

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Table.1 Year wise mean rainfall and % rainfall departure from normal at Mandya district of Karnataka

Year	Mean	% RF departure from normal	Situation	Year	Mean	% RF departure from normal	Situation
1971	-	-	-	1991	906.0	32.3	E
1972	-	-	-	1992	628.0	-8.3	N
1973	650.1	-5.1	N	1993	642.8	-6.1	N
1974	685.2	0.1	N	1994	645.0	-5.8	N
1975	758.9	10.8	N	1995	650.0	-5.1	N
1976	382.1	-44.2	MD	1996	942.2	37.6	E
1977	804.8	17.5	N	1997	995.3	45.3	E
1978	826.8	20.7	E	1998	623.1	-9.0	N
1979	648.2	-5.3	N	1999	844.0	23.2	E
1980	548.9	-19.8	SD	2000	1143.5	67.0	E
1981	667.4	-2.5	N	2001	807.5	17.9	N
1982	362.8	-47.0	MD	2002	503.9	-26.4	MD
1983	616.1	-10.0	N	2003	748.5	9.3	N
1984	480.8	-29.8	MD	2004	929.5	35.7	E
1985	501.0	-26.8	MD	2005	1192.9	74.2	E
1986	702.0	2.5	N	2006	466.6	-31.9	MD
1987	856.4	25.1	SD	2007	517.4	-24.4	SD
1988	555.3	-18.9	N	2008	536.2	-21.7	SD
1989	646.7	-5.6	N	2009	621.9	-9.2	N
1990	298.0	-56.5	SEVD				

Mean = 684.8 mm IMD Classification: E= Excess RF (>19%), N = Normal RF (± 19%), SLD = Slight Drought (> -19 to -25%), MD =

Moderate Drought (-26 to -49%) and SD = Severe Drought (-50% & above)

Table.2 Annual Rainfall (mm) variability between 1973to 2009 (37 years) at Mandya

Decades	**1973-1982**	**1983-1992**	**1993-2002**	**2003-2009**
Mean	633.5	619.0	779.7	716.1
SD	160.0	178.4	201.2	263.6
CV%	25.3	28.8	25.8	36.8

ISSN 2350-1049

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Table.3 Mean seasonal and annual rainfall of Mandya district of Karnataka

Month	Mean	SD	CV (%)	% of Total
January	2.1	8.1	385.7	0.3
February	6.7	20.1	299.2	1.0
March	17.7	36.2	205.0	2.6
April	46.1	40.1	87.1	6.7
May	85.2	55.9	65.6	12.4
June	56.8	51.7	91.1	8.3
July	49.0	34.1	69.5	7.2
August	68.9	57.9	84.1	10.1
September	132.4	77.6	58.6	19.3
October	159.2	98.3	61.8	23.2
November	47.1	41.0	87.0	6.9
December	13.7	20.1	146.8	2.0
Winter	8.8	21.5	244.3	1.3
Pre-monsoon	63.7	50.9	79.8	9.3
Monsoon	307.1	126.4	41.2	44.8
Post monsoon	219.9	116.9	53.2	32.1
Total	**684.8**	**201.7**	**29.5**	**100.0**

Table.4 Weekly rainfall analysis (1971to 2009) at Mandya district of Karnataka

SMW	Month and date	Mean RF (mm)	SD	CV%
1	1 - 7 Jan	0.0	0.1	608.3
2	8 - 14 Jan	0.2	0.7	401.6
3	15 - 21 Jan	0.4	2.1	526.0
4	22 - 28 Jan	1.3	7.7	608.3
5	29 Jan - 4 Feb	0.0	0.1	608.3
6	5 - 11 Feb	0.7	4.1	569.1
7	12 - 18 Feb	1.1	4.0	378.9
8	19 - 25 Feb	2.4	12.8	523.7
9	26 Feb - 4 Mar	1.5	6.2	410.6
10	5 - 11 Mar	6.2	23.9	385.8
11	12 - 18 Mar	3.2	9.3	294.2
12	19 - 25 Mar	6.5	20.4	315.1
13	26 Mar - 1 Apr	2.5	7.0	283.8
14	2 - 8 Apr	7.1	12.1	169.8
15	9 - 15 Apr	7.0	14.4	204.7
16	16 - 22 Apr	10.2	18.8	184.3
17	23 - 29 Apr	11.5	13.5	116.9
18	30 Apr - 6 May	16.0	20.1	125.5
19	7 - 13 May	18.9	25.1	132.8
20	14 - 20 May	17.5	23.0	131.9

ISSN 2350-1049

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21	21 - 27 May	22.5	33.5	149.0
22	28 May - 3 Jun	20.1	22.5	111.5
23	4 - 10 Jun	22.3	33.8	151.4
24	11 - 17 Jun	19.6	33.1	169.2
25	18 - 24 Jun	8.3	11.6	139.6
26	25 Jun - 1 Jul	7.2	12.6	175.7
27	2 - 8 Jul	5.2	7.7	147.7
28	9 - 15 Jul	14.6	21.9	150.2
29	16 - 22 Jul	8.5	9.7	113.5
30	23 - 29 Jul	14.3	17.3	120.8
31	30 Jul - 5 Aug	11.4	12.9	112.8
32	6 - 12 Aug	12.5	22.6	181.8
33	13 - 19 Aug	12.4	21.0	169.4
34	20 - 26 Aug	17.0	32.0	188.5
35	27 Aug - 2 Sep	18.3	26.5	144.9
36	3 - 9 Sep	17.3	26.2	151.5
37	10 - 16 Sep	27.9	42.1	151.2
38	17 - 23 Sep	40.9	48.6	118.9
39	24 - 30 Sep	37.1	45.2	121.8
40	1 - 7 Oct	36.4	40.9	112.4
41	8 - 14 Oct	36.6	43.6	119.0
42	15 - 21 Oct	32.8	30.5	92.9
43	22 - 28 Oct	37.6	40.5	107.7
44	29 Oct - 4 Nov	32.2	40.0	124.1
45	5 - 11 Nov	17.9	22.2	124.0
46	12 - 18 Nov	9.0	11.4	127.1
47	19 - 25 Nov	7.2	23.9	330.2
48	26 Nov - 2 Dec	9.4	21.1	225.2
49	3 Dec - 9 Dec	2.9	6.3	214.7
50	10 - 16 Dec	4.9	12.8	261.7
51	17 - 23 Dec	1.9	7.3	392.3
52	24 - 31 Dec	4.3	12.0	281.2