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Rainfall Trend Analysis of Hassan District in Karnataka

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Abstract: **The daily rainfall data of Hassan district of Karnataka for last 39 years (1971-2009) were analyzed to study its variability. Being a part of the semi-arid region it receives mean annual rainfall of 784.6 mm with 28.2 per cent variability. The contributing from winter, pre-monsoon, monsoon and post monsoon period to the total rainfall was 0.8, 8.3, 56.5 and 23.3 per cent, respectively. Each standard meteorological week (SMW) from 18th to 45th receive a rainfall of above 20 mm with less variability (within 145%) indicating the crop growing period from 1st fortnight of May to 1st fortnight of November. The monthly mean rainfall was observed to be 87.2, 106.6, 126.3, 101.3, 109.0, 127.5 and 46.5 for May, June, July, August, September, October and November 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 from 1971-1980 to 2001-2009. Being a semi-arid climate, Hassan district was frequently affected by periodical drought and the study indicated out of past 39 years 5years were experienced the slight drought (-19 to -25% D from N), 5 years were falls under moderate drought (-26 to -50% D from N) and one year (1996) was severe drought with -72.3% deviation from Normal.**

Keywords: **Drought, Hassan, Karnataka 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 Hassan 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 39 years (1971-2009) 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 $\pm$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 784.6 mm spread with coefficient of variation of 28.2 %. The maximum rainfall was 1208.9 mm in 2005 followed by 1179.5 mm in 2008 and the minimum was 217.3 mm in 1996 and 420.2 in 1990. The normal range *i.e.* between ± 19 of mean annual rainfall was 707.1 to 904.0 mm. Out of 39 years, 12 years received excess of rainfall (19.23 – 46.63%). Whereas five years *viz.*, 1973, 1976, 1985, 1990 and 2009 received -26.0 to -49.0% rainfall than the normal range and these five years are declared as moderate drought years. During 1996 this district experienced a historic drought with -72.3% deviation in the rainfall than the normal and declared as a severe drought and caused huge crop losses and claimed many lives.

The rainfall of 39 years (Table 2) ranged from 217.3 mm to 1208.9 mm with a mean of 784.6 mm. The standard deviation (SD) was moderately high (221.2) with a coefficient of variation (CV) of 28.2 per cent, indicating moderate 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 (<32 %). In all the decades starting from 1971-2009 this district received normal rainfall except in the decades of 1981-1990 (687.7 mm). However, the coefficient of variation was showed increasing trend from first decade to (1971-1980) to last decade (2001-2009). This clearly indicated that over the years the dependability of rainfall in this region decreasing due to large variation in the amount and time of rainfall.

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 443.2 mm of rainfall was received in south-west monsoon contributing to 56.5% per cent to total amount of rainfall with coefficient of variation of 156.8% indicating its dependability. For post-monsoon season, the rainfall received was 182.7 mm and thus contributing 23.3% to the total with coefficient of variation of 72.3%. Pre-monsoon rainfall also contributed substantially (65.4 mm), 8.3% of the total with 245.2% coefficient of variation, in winter, the rainfall was 6.1 mm are thus contributing 0.8% to the total with coefficient of variation of 314.4%. the monthly rainfall analysis indicated that the crop growing period in Hassan district was started from May month and remain up to end of October as indicated by the less coefficient of variation (<70%) and more dependability of rainfall during these months.

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 18th to 45th received rainfall more than 20 mm. It indicated that from May I week onwards the crop season starts and extended up to November I 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 especially immediately after sowing. Hence, in this district sowing should be delayed up to June I fortnight and the pre-season rainfall in the month of May be utilized for growing of green manure crops.

IV. CONCLUSION

On the basis above, it was concluded that Hassan district received mean annual rainfall of 784.6 mm with less coefficient of variation (28.2%) and there was no much deviation among the different years. This region received reasonable amount of pre-monsoon rainfall (8.3% of total rainfall) and it was start from May I week (>20 mm rainfall in each week) and helped in land preparation and also growing of green manure crops like sunhemp, horse gram *etc.* at any cost avoid the early sowing of crops in the month of May due to uneven rainfall in the month of June. So, sowing in this region should be started from I fortnight of June. 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 and in that situation either supplemental irrigation or mid season corrections measures ensure good crop stand and yield. On the other hand due to end season rainfall peak at October, one should go for short duration pulses to utilize the remaining moisture.

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APENDIX

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

Year	Mean	% RF departure from normal	Situation	Year	Mean	% RF departure from normal	Situation
1971	788.7	0.5	N	1991	972.9	24.0	E
1972	942.4	20.1	E	1992	1039.2	32.4	E
1973	567.0	-27.7	MD	1993	778.7	-0.8	N
1974	603.8	-23.0	SD	1994	859.5	9.5	N
1975	841.3	7.2	N	1995	614.4	-21.7	SD
1976	571.5	-27.2	MD	1996	217.3	-72.3	SED
1977	1030.2	31.3	E	1997	707.1	-9.9	N
1978	1002.5	27.8	E	1998	911.5	16.2	N
1979	1104.1	40.7	E	1999	1060.7	35.2	E
1980	935.9	19.3	E	2000	724.1	-7.7	N
1981	612.6	-21.9	SD	2001	696.3	-11.3	N
1982	645.6	-17.7	N	2002	623.9	-20.5	SD
1983	644.7	-17.8	N	2003	601.5	-23.3	SD
1984	746.9	-4.8	N	2004	801.2	2.1	N
1985	430.6	-45.1	MD	2005	1208.9	54.1	E
1986	941.8	20.0	E	2006	767.5	-2.2	N
1987	756.1	-3.6	N	2007	1050.3	33.9	E
1988	764	-2.6	N	2008	1179.5	50.3	E
1989	914	16.5	N	2009	521.7	-33.5	MD
1990	420.2	-46.4	MD				

Mean = 784.6 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)

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Table: 2. Annual Rainfall (mm) variability between 1971to 2009 (39 years) at Hassan

Decades	**1971-1981**	**1981-1990**	**1991-2000**	**2001-2009**
Mean	838.7	687.7	788.5	817.5
SD	199.2	175.3	249.1	244.1
CV%	23.7	25.5	31.6	29.9

Table: 3. Mean seasonal and annual rainfall of Hassan district of Karnataka

Month	**Mean**	**SD**	**CV (%)**	**% of Total**
January	1.5	5.3	366.7	0.2
February	4.7	12.3	262.2	0.6
March	14.4	33.0	228.3	1.8
April	51.0	43.5	85.3	6.5
May	87.2	51.7	59.3	11.1
June	106.6	62.8	59.0	13.6
July	126.3	72.8	57.6	16.1
August	101.3	56.0	55.3	12.9
September	109.0	68.9	63.2	13.9
October	127.5	92.7	72.8	16.2
November	46.2	38.8	84.0	5.9
December	9.1	15.1	166.0	1.2
Winter	6.1	8.8	314.4	0.8
Pre-monsoon	65.4	22.6	245.2	8.3
Monsoon	443.2	38.2	156.8	56.5
Post monsoon	182.7	47.6	72.3	23.3
Total	**784.6**	**221.2**	**28.2**	**100.0**

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

SMW	**Month and date**	**Mean RF (mm)**	**SD**	**CV%**
1	1 - 7 Jan	0.2	0.9	390.9
2	8 - 14 Jan	0.7	4.2	624.5
3	15 - 21 Jan	0.5	3.2	624.5
4	22 - 28 Jan	0	0	-
5	29 Jan - 4 Feb	0	0.2	442.8
6	5 - 11 Feb	0.2	1.2	501.6
7	12 - 18 Feb	2.1	10.3	489.6
8	19 - 25 Feb	1.7	5.6	327.6
9	26 Feb - 4 Mar	1.7	9.5	567.4
10	5 - 11 Mar	6.1	28	461.9
11	12 - 18 Mar	0.8	2	239.9
12	19 - 25 Mar	2.8	11.5	412.3
13	26 Mar - 1 Apr	1.8	5.5	298.5
14	2 - 8 Apr	6.1	11.6	189.1

15	9 - 15 Apr	6.5	13	201.1
16	16 - 22 Apr	14.9	20.2	135.9
17	23 - 29 Apr	13	16.9	129.2
18	30 Apr - 6 May	21.4	28.1	131.7
19	7 - 13 May	19.6	23.1	117.8
20	14 - 20 May	16.9	21	124
21	21 - 27 May	18.6	23.4	125.5
22	28 May - 3 Jun	23	26.6	115.6
23	4 - 10 Jun	18.4	22.3	121.3
24	11 - 17 Jun	24	25.8	107.3
25	18 - 24 Jun	29.5	31	105.2
26	25 Jun - 1 Jul	26.5	28.1	106
27	2 - 8 Jul	27.1	28.6	105.8
28	9 - 15 Jul	31.9	30.8	96.6
29	16 - 22 Jul	24.1	30.8	127.6
30	23 - 29 Jul	28.8	30.6	106
31	30 Jul - 5 Aug	26.6	37.6	141.1
32	6 - 12 Aug	24	23.6	98.6
33	13 - 19 Aug	26.1	23.2	89
34	20 - 26 Aug	22.6	23.8	105.3
35	27 Aug - 2 Sep	20.5	36.3	176.8
36	3 - 9 Sep	16.5	26.6	161.3
37	10 - 16 Sep	11.4	15.8	138.9
38	17 - 23 Sep	24.9	28.1	113
39	24 - 30 Sep	42.7	56.4	132
40	1 - 7 Oct	32.9	33.4	101.5
41	8 - 14 Oct	33	39	118.3
42	15 - 21 Oct	25.3	33.7	133.2
43	22 - 28 Oct	21.2	29.2	137.5
44	29 Oct - 4 Nov	33	35.3	107
45	5 - 11 Nov	22	31.4	142.8
46	12 - 18 Nov	12	18.8	156.8
47	19 - 25 Nov	7.7	14.1	182.7
48	26 Nov - 2 Dec	3.1	6.8	221.1
49	3 Dec - 9 Dec	2.5	6.9	278.6
50	10 - 16 Dec	2.3	6.6	288.5
51	17 - 23 Dec	2.3	6.7	289.8
52	24 - 31 Dec	3	11.4	385