

## RAINFALL PROBABILITY ANALYSIS OF PARBHANI, MAHARASHTA

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### INTRODUCTION

Agriculture is mostly dependent on the monsoon. Drought constitutes a major hazard in the Marathwada region. Intermittent gaps in precipitation and, moisture stress during the monsoon season gives rise to serious setback in production during kharif season, which is the main stay of agriculture in the region. Several rainfall related risk analysis have been reported by several authors for different agro climatic conditions of India with the help of incomplete gamma distribution (Thom, 1958) as well as Markov Chain Method. In most of the studies the scientist have suggested cropping pattern considering the rainfall amount at different probability levels. Keeping this in view, agricultural drought, meteorological drought, seasonal rainfall and rainfall probability at Parbhani in Maharashtra state were analyzed using Markov Chain Model.

### METHODOLOGY

The daily rainfall for the period 1981-2015 ( 35 years) Parbhani station was collected from meteorological observatory of the Vasant Rao Naik Marathwada Krishi Vidyapeeth Parbhani and have been used for the analysis. According to National Commission on Agriculture, 1976 Agricultural drought is the period of at least four consecutive weeks receiving less than half of the normal rainfall (> 5 mm) during kharif season.

According to India Meteorological Department there are three types of droughts based on rainfall deficit from normal

1. Mild : 0-25% deficit
2. Moderate : 26-50% deficit
3. Severe : > 50% deficit

### RESULTS

Analysis of 35 years weather data of Parbhani showed that kharif season drought was observed during the 21 years out of 35 years.( Table 1)

**Table 1: Agricultural Drought at Parbhani during Kharif (1981-2015)**

Year	Drought Weeks	Year	Drought Weeks
1984	32 - 36	1998	28 - 33
1986	25 - 28	2000	36 - 42
	33 - 37	2001	25 - 28
	39 - 42		35 - 38
1987	35 - 39	2002	37 - 40
1988	37 - 42	2003	35 - 38
1989	35 - 38	2004	39 - 42
1991	34 - 42	2006	33 - 37

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1992	26 - 30	2009	29 - 33
	36 - 40	2011	23 - 26
1994	38 - 41		39 - 42
1995	31 - 34	2014	37 - 40
	38 - 41	2015	26 - 31
1997	28 - 33		39 - 42

***Meteorological drought analysis***

The average rainfall of the district is 859.68 mm. It was observed that, among 35 years average annual rainfall was below normal rainfall for 23 years and was above normal rainfall for 12 years. Out of 35 years moderate drought was observed for the 6 years (17%). (Table 2)

**Table 2: Meteorological drought at Parbhani (1981-2015)**

Sn.	Year	Annual RF(mm)	Deviation (%)	Drought Condition
1.	1981	825.30	-3.9995	No Drought
2.	1982	679.10	-21.0058	No Drought
3.	1983	1353.50	57.4417	No Drought
4.	1984	651.30	-24.2396	No Drought
5.	1985	663.80	-22.7855	No Drought
6.	1986	604.80	-29.6485	Moderate
7.	1987	775.20	-9.8273	No Drought
8.	1988	1260.50	46.6237	No Drought
9.	1989	905.80	5.3644	No Drought
10.	1990	1254.60	45.9374	No Drought
11.	1991	637.80	-25.8099	Moderate
12.	1992	727.60	-15.3642	No Drought
13.	1993	660.70	-23.1461	No Drought
14.	1994	668.10	-22.2854	No Drought
15.	1995	730.60	-15.0152	No Drought
16.	1996	846.60	-1.5219	No Drought
17.	1997	575.70	-33.0335	Moderate
18.	1998	575.70	-33.0335	Moderate
19.	1999	876.80	1.9910	No Drought
20.	2000	853.90	-0.6727	No Drought
21.	2001	1333.00	55.0571	No Drought
22.	2002	1142.30	32.8745	No Drought
23.	2003	872.50	1.4909	No Drought
24.	2004	678.40	-21.0872	No Drought
25.	2005	1762.92	105.0662	No Drought
26.	2006	994.60	15.6938	No Drought
27.	2007	853.80	-0.6844	No Drought
28.	2008	648.10	-24.6118	No Drought
29.	2009	672.90	-21.7270	No Drought
30.	2010	1295.60	50.7066	No Drought
31.	2011	677.50	-21.1919	No Drought
32.	2012	688.20	-19.9473	No Drought

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33.	2013	1217.10	41.5754	No Drought
34.	2014	550.80	-35.9299	Moderate
35.	2015	573.80	-33.2545	Moderate

No Drought = 29 years (83%)

Moderate Drought = 6 years (17%)

**SEASONAL RAINFALL ANALYSIS**

It is seen from Table 3 that the average annual rainfall and rainy days at Parbhani was 859.68mm and 43.11 days respectively. The rainfall amount and rainy days for different season namely Winter, Summer, South West and North East were respectively 1.23, 3.09, 80.04 and 11.59 % of the total rainfall and 1.46, 4.38, 81.86 and 12.59 % of total rainy days, The coefficient of variation of seasonal rainfall was highest (184.79%) during winter followed by summer(158.21%), North East(90.30%). Coefficient of variation of seasonal rainfall was lowest (36.91 %) for South West season. Likewise coefficient of variation of seasonal rainy days was highest (173.419%) during summer followed by winter (159.49%), North East (79.54%). Coefficient of variation of seasonal rainy days was lowest (21.23 % ) for South West season.

**Table 3: Seasonal rainfall analysis of Parbhani (1981-2015)**

Season		Winter	Summer	South West	North East	Annual
Rainfall	Mean	10.55	26.61	722.86	99.67	859.68
	SD	19.49	42.02	266.79	90.01	291.04
	CV	184.79	158.21	36.91	90.30	33.85
Rainy days	Mean	0.63	1.89	35.29	5.43	43.11
	SD	1.00	3.27	7.49	4.23	8.54
	CV	159.49	173.41	21.23	79.54	19.8

Table 4 shows highest rainfall event in a year with date (on which date) and amount of rainfall. In the year 2005 heave rainfall of 301.0m was observed at Parbhani

**Table 4 : Maximum Heavy Rainfall Events at Pabhani ( 1981-2015)**

Date	Rainfall (mm)	Date	Rainfall (mm)
9/20/1981	54.9	9/08/1999	76.0
9/24/1982	53.3	8/28/2000	88.0
8/10/1983	92.2	10/01/2001	211.0
6/14/1984	56.1	6/26/2002	132.5
8/15/1985	81.6	7/15/2003	79.0
7/18/1986	84.4	7/26/2004	67.5
6/16/1987	68.7	7/27/2005	301.0
8/30/1988	107.4	8/06/2006	234.0
7/24/1989	169.0	9/02/2007	71.2
9/25/1990	105.0	9/21/2008	82.0
6/09/1991	108.0	8/25/2009	103.5
6/21/1992	152.2	8/07/2010	136.6
7/30/1993	114.8	9/16/2011	47.0

9/12/1994	152.8	7/18/2012	64.0
6/29/1995	39.2	9/17/2013	55.5
8/16/1996	70.0	7/10/2014	60.0
9/23/1997	52.8	4/17/2015	60.2
9/23/1998	52.8		

**PROBABILITIES OF WET SPELLS OF CONSECUTIVE WEEKS**

It is the probability of getting two or three or four weeks as a wet week consecutively for a given amount of rainfall. Probability of two, three and four consecutive wet weeks with different amounts( 30mm, 40 mm and 50 mm) of weekly total rainfall is presented in Table 5.

**Table 5: Probabilities of Wet Spells of Consecutive Weeks(Markov chain probability) for Parbhani (1981-2015)**

SMW	Consecutive 2 wet weeks			Consecutive 3 wet weeks			Consecutive 4 wet weeks		
	30mm	40mm	50mm	30mm	40mm	50mm	30mm	40mm	50mm
23	0.2286	0.1429	0.0857	0.1029	0.0510	0.0286	0.0480	0.0235	0.0143
24	0.2571	0.1429	0.1143	0.1200	0.0659	0.0571	0.0514	0.0264	0.0127
25	0.2000	0.1714	0.1429	0.0857	0.0686	0.0317	0.0504	0.0366	0.0144
26	0.1714	0.1143	0.0571	0.1008	0.0610	0.0260	0.0560	0.0218	0.0080
27	0.2857	0.2286	0.1429	0.1587	0.0816	0.0440	0.0992	0.0565	0.0264
28	0.2857	0.1429	0.1143	0.1786	0.0989	0.0686	0.0992	0.0495	0.0320
29	0.2857	0.2571	0.1714	0.1224	0.1286	0.0800	0.0700	0.0536	0.0267
30	0.2857	0.2286	0.2000	0.1587	0.0952	0.0667	0.0680	0.0476	0.0370
31	0.1714	0.1429	0.1143	0.0980	0.0714	0.0635	0.0551	0.0390	0.0381
32	0.2286	0.1714	0.1429	0.1286	0.0935	0.0857	0.0714	0.0385	0.0303
33	0.2571	0.1714	0.1714	0.1429	0.0706	0.0605	0.0756	0.0380	0.0275
34	0.2857	0.2000	0.1714	0.1513	0.1077	0.0779	0.0801	0.0685	0.0390
35	0.2571	0.2000	0.1429	0.1361	0.1273	0.0714	0.0942	0.0587	0.0390
36	0.2571	0.2000	0.1429	0.1780	0.0923	0.0779	0.0468	0.0264	0.0167
37	0.2571	0.1714	0.1714	0.0677	0.0490	0.0367	0.0376	0.0140	0.0073
38	0.1429	0.1143	0.0857	0.0794	0.0327	0.0171	0.0144	0.0036	0.0000
39	0.1429	0.0571	0.0286	0.0260	0.0063	0.0000	0.0000	0.0000	0.0000

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40	0.0571	0.0286	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
41	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
42	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
43	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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