



## ONSET AND WITHDRAWAL PATTERN OF MONSOON AND LENGTH OF GROWING PERIOD IN NANDURBAR DISTRICT

*Shweta Gaikwad, Shradha Bagade, J. D. Jadhav and Krishna Kulkarni*

*Department of Agricultural Meteorology, College of Agriculture, Pune, Maharashtra*

Received: 16/08/2018

Edited: 23/08/2018

Accepted: 31/08/2018

**Abstract:** *The availability of water for crops in a season depends on the distribution and variability of rainfall. Hence, from crop management point of view, onset and withdrawal of monsoon is to be considered the ideal for crop planning, scheduling farm operations on land use operations and therefore the onset and withdrawal pattern of monsoon of each tahsil were worked out. Onset of monsoon in Nandurbar district was ranged between 23 to 25 MW while withdrawal of monsoon was noted from 41 to 44 MW.*

**Key words:** *Onset, Withdrawal, Monsoon, Nandurbar district, Maharashtra state.*

Agricultural production in India is closely related with rainfall. In India about 70 per cent of the total cropped area is rainfed and accounts for 45 per cent of food production. Crop production in this area is very uncertain due to erratic behavior of rainfall. The main reason for low and highly unstable yields in this area is the unavailability of adequate soil moisture during active growth period of crops (Anonymous, 2014). Once the farmer knows about probable onset and withdrawal of monsoon, farmer will be most benefitted.

Nandurbar district is bounded by 21° 00' to 22° 03' North and latitude 73° 31' to 74° 32' East longitude. Nandurbar district comprises six tahsils namely Akkalkuva, Nandurbar, Navapur, Shahada, Taloda, and Akrani. The district has total area of 5034.23 sq. km. In Nandurbar district the average of rainfall is 885.8 mm. The rainfall in the eastern part of the district is minimum and Shahada comes under this category. The rainfall increases in the westwards of the district Akkalkwa and Nawapur comes under the major rainfall area in the district.

The climate of Nandurbar District is generally hot and dry. As the rest of India, Nandurbar District has three distinct seasons; Summer, Monsoon /Rainy and the Winter season. Summer is from March to mid of June. Summers are usually hot and dry. During the month of May the

summer is at its peak. Temperatures can be as high as 45° C during the peak of Summer. The Monsoon sets in during the mid or end of June. During this season the weather is usually humid and hot.

### Materials and Methods

The important aspects like probable onset and withdrawal of monsoon in Nandurbar district of Maharashtra state is studied. The methodologies adopted are described in following paragraphs under appropriate heads.

The historical daily data of rainfall at each tahsil of Nandurbar district was collected from (1) India Meteorological Department, Pune (2) College of Agriculture, Pune and (3) Zonal Agricultural Research Station, Solapur.

The daily data collected for each tahsil was summed up on meteorological weekly monthly, seasonal and annual basis. For calculation of meteorological weekly basis, the year was partitioned as per meteorological calendar, starting from 1<sup>st</sup> January of each year and ending on 31<sup>st</sup> December of the same year. Calendar month wise data was processed and tabulated for further analyses.

The Weather Cock software developed by CRIDA, Hyderabad was used for analysis of different weather parameters *viz.*, probable pattern of onset and withdrawal of monsoon.

The daily rainfall data of 6 tahsils were available for last 56 years (1961-2016) and this data was used for further analysis and the result to that effect are presented.

The data collected for each tahsil of Nandurbar district were subjected to statistical analysis such as standard deviation, coefficient of variation, extreme lowest and the highest tahsil wise probable onset and withdrawal of monsoon were estimated by forward and backward accumulation from the computerized programme named Weather Cock developed by CRIDA, Hyderabad.

For determining onset and withdrawal of monsoon, the frequency analysis of weekly rainfall was carried out on the basis of daily data of 56 years. For deciding onset of monsoon weekly rainfall of 23 to 26 MW was considered. During this period the week which showed sudden rise in the rainfall is considered as onset of monsoon.

Similarly for deciding withdrawal of monsoon, the rainfall of 41 to 45 MW was considered during this period, the sudden drop in the rainfall frequency value is considered as withdrawal of monsoon. Length of growing period (LGP) can be count on the basis of onset and withdrawal useful in crop planning.

### Result and Discussion

The data presented in Table revealed that mean start of rainy season was 25 MW in most of tahsils. However, early arrival was noted at 23 MW in all the tahsils. Further, late arrival was observed from 25 to 28 MW. Mean termination of rainy season was noted during 41 to 44 MW. Early termination was observed during 34 to 39 MW in all the tahsils while late termination observed during 47 to 50 MW.

Mean duration of rainy season ranged from 18 to 20 MW. Minimum duration ranged between 13 to 16 MW in the district, while maximum duration of rainy season ranged between 22 to 29 MW.

In the district the length of growing period (LGP) ranged from 77 days to 200 days with maximum rainfall (1580.8 mm) in year 2006 and (473 mm) in year 2000. The average LGP for Akarni tahsil, was available for 84 to 198 days and the mean LGP was 126 days with maximum rainfall of (2003 mm) in year 2006 and minimum rainfall of (306.3 mm) in year 2000. Similarly, for Akkalkuna tahsil, the LGP ranged from 84 to 203 days with average of 121 days with maximum rainfall of (2097.9 mm) in year 2013 and minimum rainfall of (355.1 mm) in year 1968. For Nandurbar tahsil, the LGP ranged from 77 to 203 days and the average was 129 days with maximum rainfall of (1386 mm) in year 2006 and minimum rainfall of (306.3 mm) in year 1987.

For Navapur, the LGP ranged from 84 to 203 days and the average was 125 days with maximum rainfall of (2244 mm) in the year 1976 and minimum rainfall of (648.2 mm) in the year 2000. For Shahada tahsil, the LGP ranged from 63 to 196 days and the average was 127 days with maximum rainfall of (2166 mm) in the year 1981 and minimum rainfall of (287.3 mm) in the year 2000. For Taloda tahsil, the LGP ranged from 70 to 196 days and the average was 125 days with maximum rainfall of (1653 mm) in year 2006 and minimum rainfall of (415.2 mm) in year 1986.

Based on the average available length of growing period, the major *kharif* crops such as pearl millet, soybean, maize, cotton, groundnut, vegetables, pulses and fodder crops can be cultivated in all the tahsils whereas in *rabi* season sorghum, wheat, gram, onion etc. can be grown.

Similar study was carried out by Dhanawade (2016), Gangarde (2016), Patil (2017), Vende (2017), Suvarna (2017) and Pawar (2017) for Solapur, Pune, Kolhapur, Ahmednagar, Satara and Sangali districts of Maharashtra, respectively.

**Table 1: Tahsilwise onset and withdrawal of monsoon in Nandurbar district (1961-2016)**

Year	Akrani					Akkalkuva					Nandurbar				
	Start	End	Duration	Rainfall	LGP	Start	End	Duration	Rainfall	LGP	Start	End	Duration	Rainfall	LGP
1961	25	41	16	965	114	25	41	16	1198.7	112	25	41	16	764.1	112
1962	27	49	22	691	152	27	49	22	1039.3	154	27	49	22	614.4	154
1963	24	42	19	741	131	23	48	25	741.9	175	26	42	16	530	112
1964	25	42	16	668	114	26	38	12	691.7	84	26	41	15	500.8	105
1965	27	45	19	616	131	25	40	15	612.1	105	27	48	21	561.9	147
1966	27	42	15	566	107	29	41	12	470.6	84	26	45	19	442.4	133
1967	24	42	18	506	124	25	40	15	368.1	105	24	51	27	915.5	189
1968	26	42	16	560	114	24	46	22	342.1	154	27	40	13	675.8	91
1969	25	37	12	1230	86	23	37	14	1933.2	98	24	50	26	778	182
1970	24	40	16	1188	114	23	41	18	1653.5	126	24	38	14	730.9	98
1971	24	41	17	603	121	23	39	16	684.4	112	23	40	17	454.3	119
1972	25	39	14	482	98	25	37	12	670.5	84	24	37	13	439.1	91
1973	24	41	17	1024	119	24	39	15	1335.7	105	23	40	17	847.6	119
1974	26	42	16	637	110	26	42	16	730	112	26	42	16	554.2	112
1975	24	42	18	846	124	24	41	17	1080	119	24	44	20	501.5	140
1976	23	47	24	1400	168	23	47	24	2038.2	168	23	47	24	1350	168
1977	24	48	24	1075	166	24	48	24	1469	168	24	48	24	1105.5	168
1978	24	48	24	850	168	24	48	24	1123	168	24	48	24	690.7	168
1979	26	48	22	898	152	26	48	22	1133.2	154	25	47	22	659.8	154
1980	23	51	28	690	198	23	52	29	789	203	23	51	28	605	196
1981	26	45	19	1328	133	26	44	18	1341	126	26	51	25	708.4	175
1982	24	47	22	634	156	25	44	19	706.6	133	25	45	20	677.9	140
1983	24	41	17	1112	117	25	41	16	1239	112	24	41	17	703.6	119
1984	24	40	16	750	110	24	40	16	894	112	23	41	18	666.7	126
1985	28	41	13	479	93	27	41	14	624	98	29	41	12	356.4	84
1986	25	40	15	422	105	25	40	15	494.2	105	25	36	11	544.1	77
1987	24	49	25	460	175	24	46	22	421.6	154	24	50	26	275.2	182

Table 10 contd...

**Table 1: Tahsilwise onset and withdrawal of monsoon in Nandurbar district (1961-2016)**

Year	Akrani					Akkalkuva					Nandurbar				
	Start	End	Duration	Rainfall	LGP	Start	End	Duration	Rainfall	LGP	Start	End	Duration	Rainfall	LGP
1988	25	41	16	965	114	24	40	16	1093.6	112	24	40	16	1001.5	112
1989	27	49	22	691	152	24	40	16	1154	112	23	40	17	707.5	119
1990	24	42	19	741	131	24	47	23	1184	161	24	48	24	841.7	168
1991	23	39	16	714	112	24	39	15	845	105	23	35	12	532.8	84
1992	25	42	17	697.4	119	25	37	12	852.3	84	25	41	16	645	112
1993	24	36	12	770	84	25	43	18	1065.5	126	25	47	22	868.8	154
1994	24	45	21	1011	147	23	37	14	1377	98	23	37	14	944	98
1995	25	42	17	816	119	28	42	14	846	98	28	42	14	592	98
1997	24	43	19	985	133	24	43	19	731	133	23	43	20	681	140
1998	24	49	25	1339	175	25	49	24	1081	168	24	49	25	1246	175
1999	24	42	18	946	126	24	44	20	1207.2	140	24	38	14	1034	98
2000	25	42	17	592	119	25	41	16	500.5	112	25	41	16	567	112
2001	23	39	16	304.3	112	23	39	16	506.5	112	23	52	29	607	203
2002	23	41	18	878	126	23	41	18	884	126	23	41	18	900.5	126
2003	26	39	13	931	91	24	39	15	664.8	105	24	36	12	968.9	84
2004	24	39	15	1118	105	24	39	15	1024	105	25	39	14	1260	98
2005	24	40	16	1325	112	24	41	17	1003	119	23	40	17	954	119
2006	25	39	14	898	98	26	40	14	1152.1	98	25	39	14	1282	98
2007	25	40	15	1975	105	25	40	15	1652	105	25	40	15	1334	105
2008	25	44	19	1106	133	24	44	20	1689.5	140	24	40	16	1034	112
2009	23	41	18	922	126	24	41	17	1512	119	24	41	17	744	119
2010	27	51	24	597	168	27	46	19	895	133	26	51	25	711	175
2011	25	47	22	692	154	24	47	23	907	161	24	47	23	753	161
2012	27	39	12	776	84	23	37	14	1123	98	24	38	14	570	98
2013	27	39	12	701	84	25	39	14	843.4	98	25	40	15	514	105
2014	24	42	18	1423.1	126	24	41	17	2075.3	119	23	41	18	846.9	126
2015	29	46	17	630.9	119	29	37	8	899.5	56	28	46	18	401.1	126
2016	24	43	19	745.4	133	24	38	14	870.5	98	24	38	14	637.2	98

**Table 1: Tahsilwise onset and withdrawal of monsoon in Nandurbar district (1961-2016)**

Year	Navapur					Shahada					Taloda				
	Start	End	Duration	Rainfall	LGP	Start	End	Duration	Rainfall	LGP	Start	End	Duration	Rainfall	LGP
1961	28	41	13	647.9	91	23	41	18	819.2	126	26	41	15	876	105
1962	27	44	17	765	119	28	49	21	378.1	147	27	49	22	656.2	154
1963	23	48	25	1385	175	24	43	19	645	133	24	36	12	836.5	84
1964	25	44	19	1259	133	25	39	14	623.4	98	25	48	23	688.8	161
1965	27	48	21	1285.5	147	28	48	20	515.7	140	27	48	21	719.7	147
1966	24	39	15	986.5	105	27	41	14	567.2	98	25	45	20	661.1	140
1967	25	47	22	1138	154	24	50	26	721.2	182	23	35	12	427.8	84
1968	24	39	15	1344	105	27	41	14	582.1	98	27	40	13	756	91
1969	23	37	14	1969	98	26	38	12	726	84	26	37	11	1031	77
1970	24	41	17	1807	119	24	38	14	768	98	24	41	17	1143.4	119
1971	23	42	19	1172	133	25	42	17	558.5	119	23	42	19	564.8	133
1972	25	37	12	931.2	84	25	43	18	319.7	126	25	37	12	456.1	84
1973	24	40	16	830.1	112	23	43	20	924	140	24	40	16	811.8	112
1974	27	42	15	634	105	27	42	15	612.2	105	26	42	16	569.1	112
1975	23	43	20	1214.8	140	23	42	19	717	133	25	42	17	739.9	119
1976	23	47	24	2244	168	23	47	24	852.4	168	23	47	24	1308.5	168
1977	25	48	23	1720	161	25	48	23	766	161	24	48	24	988.5	168
1978	23	35	12	709	84	24	48	24	660	168	24	48	24	768.1	168
1979	25	47	22	1071.9	154	26	48	22	729.4	154	26	47	21	832.8	147
1980	23	51	28	722	196	23	51	28	590	196	23	51	28	689.9	196
1981	25	41	16	921.7	112	26	51	25	2164	175	27	41	14	479.7	98
1982	24	45	21	925.4	147	23	51	28	632.6	196	25	45	20	563.3	140
1983	25	41	16	1288.8	112	24	41	17	1123.9	119	24	41	17	971.7	119
1984	24	41	17	869.3	119	25	39	14	617.6	98	24	41	17	738	119
1985	26	41	15	762.6	105	29	41	12	335	84	27	41	14	477.6	98
1986	23	38	15	778.2	105	25	40	15	388.2	105	25	40	15	383.2	105
1987	24	50	26	698.5	182	24	50	26	490	182	23	50	27	468	189

Table 10 contd...

**Table 1: Tahsilwise onset and withdrawal of monsoon in Nandurbar district (1961-2016)**

Year	Navapur					Shahada					Taloda				
	Start	End	Duration	Rainfall	LGP	Start	End	Duration	Rainfall	LGP	Start	End	Duration	Rainfall	LGP
1988	24	40	16	1128.9	112	24	40	16	897.7	112	23	40	17	1198.3	119
1989	24	38	14	1014.4	98	26	38	12	936.1	84	24	40	16	763.4	112
1990	24	47	23	1045.4	161	24	41	17	723.9	119	24	48	24	833.9	168
1991	23	36	13	792.4	91	25	34	9	364.6	63	23	36	13	734	91
1992	24	41	17	1137.2	119	25	41	16	595	112	24	42	18	947.2	126
1993	24	43	19	1350.1	133	24	42	18	650	126	25	39	14	968.4	98
1994	23	37	14	1425.3	98	23	38	15	861	105	24	43	19	1121.1	133
1995	28	42	14	877	98	26	42	16	402.7	112	28	38	10	641.1	70
1996	24	43	19	1207.4	133	24	43	19	612.1	133	24	45	21	839.1	147
1997	24	49	25	1316	175	25	49	24	533.9	168	25	49	24	960.5	168
1998	24	42	18	1491.7	126	24	41	17	768.6	119	24	49	25	1058.1	175
1999	25	41	16	1077	112	25	41	16	324.1	112	25	41	16	418.5	112
2000	23	52	29	648.2	203	26	52	26	263.1	182	23	39	16	469.6	112
2001	23	41	18	789	126	23	41	18	537.3	126	23	41	18	797	126
2002	26	45	19	748.2	133	26	45	19	393.3	133	24	36	12	569	84
2003	25	41	16	1237	112	24	39	15	887	105	25	39	14	1034	98
2004	23	40	17	1720	119	24	40	16	576	112	23	40	17	880	119
2005	26	39	13	2102	91	26	39	13	570	91	26	42	16	1087.3	112
2006	26	40	14	1403	98	26	45	19	1190	133	26	45	19	1575	133
2007	24	44	20	1509	140	25	44	19	828.4	133	24	44	20	1197	140
2008	24	40	16	1269	112	23	40	17	724	119	24	41	17	922	119
2009	28	46	18	801	126	25	51	26	627	182	25	51	26	783	182
2010	23	47	24	1043	168	24	47	23	616	161	24	47	23	900	161
2011	23	37	14	857	98	24	37	13	542	91	24	37	13	766	91
2012	27	40	13	834	91	27	40	13	585	91	27	41	14	768.6	98
2013	23	41	18	1526.4	126	23	41	18	1031.8	126	23	41	18	1567	126
2014	29	46	17	652.8	119	28	46	18	483.1	126	28	46	18	516	126
2015	24	38	14	703.6	98	24	38	14	525.3	98	24	38	14	799.7	98
2016	25	41	16	845.6	112	25	41	16	452.4	112	25	41	16	725.3	112

### Literature Cited

- Anonymous, 2014. [www.docnet.nic.in./former/new/doc/district.asp](http://www.docnet.nic.in/former/new/doc/district.asp)
- Dhanawade (2016), Characterization of rainfall for crop planning in Scarcity zone of Solapur district of Maharashtra. Mahatma Phule Agricultural University, Rahuri, Msc (Agril.) Thesis
- Gangarde (2016), Characterization of rainfall for crop planning in Pune district of Maharashtra state. Mahatma Phule Agricultural University, Rahuri, Msc (Agril.) Thesis
- Pawar (2017) Characterization of rainfall for crop planning in Sangli district of Maharashtra Mahatma Phule Agricultural University, Rahuri, Msc (Agril.) Thesis
- Patil (2017), Characterization of rainfall for crop planning in Kolhapur district of Maharashtra Mahatma Phule Agricultural University, Rahuri, Msc (Agril.) Thesis
- Suvarna (2017) Characterization of rainfall for crop planning in Satara district of Maharashtra Mahatma Phule Agricultural University, Rahuri, Msc (Agril.) Thesis
- Vende (2017), Characterization of rainfall for crop planning in Ahmednagar district of Maharashtra Mahatma Phule Agricultural University, Rahuri, Msc (Agril.) Thesis