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Determination of onset and withdrawal of monsoon for different tehsils in Jalgaon district in Maharashtra

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Abstract

India's dependence on monsoon rains is quite high. India has a predominantly agricultural economy. More significantly, over 60% of the population including several million small farming households, is dependent on agriculture as their primary source of income and land continues to be their main source of economic stability. Therefore, it is acceptable to say that India's monsoon does play a significant role. Rainfall activities varied between subregion at the time of onset. Rainfall actions during withdrawal can also be classified as sudden, slow, or weak. Hence, the current study, "Determination of onset and withdrawal of monsoon for different tehsils in Jalgaon district in Maharashtra". The long term, daily rainfall data of 61 years (1961-2021) were used to compute annual and monthly rainfall of fifteen tehsils of Jalgaon district. The onset and withdrawal of the rainy season were calculated using forward and backward accumulation method from mean weekly rainfall data. According to the assessment of weekly rainfall data, the mean week of the onset of monsoon has found to be 26 standard meteorological week for all of the tehsils in the Jalgaon district, except Muktainagar tehsil, where the mean onset was 27 standard meteorological week.

Keywords: Duration, monsoon, onset, rainfall, week, withdrawal

Introduction

India's economy is mainly based on agriculture and Indian farmers depend primarily on the monsoon rains for their livelihood. Agriculture is responsible for around 58% overall employment in the country. Additionally, the agriculture industry, farm growth and production in our country makes up around 18% of the GDP. Agriculture is the primary source of income for more than 50% of Indians. Monsoon is one of the most important seasons for farmers. The southwest monsoon irrigates a large portion of the agricultural land in India. Rainfall is necessary for the growth of crops like wheat, rice, pulses which are staples in Indian diets. But India's financial stability and economic growth might suffer significantly from a year with a poor monsoon. One major factor for the widespread farmer suicides in the country is crop failure or insufficient rainfall. Therefore, the monsoon is essential for Indian farmers. As much as 80% to 84% of agriculture in Maharashtra is rainfed, which implies that crops are entirely dependent on rainfall, however rainfall varies greatly across the state. One-third of the state is classified as semi-arid climatic zone with agriculture depending on the monsoon. Around 40% area of Maharashtra is drought prone. Crop failure and reduction in employment are caused by drought conditions. Every 5 years, there is insufficient rainfall, and every 8-9 years, there is occurrence of drought conditions.

Monsoon is the seasonal onset of heavy winds and rains. Major parts of the country receive 70-90% of its annual rainfall during the southwest monsoon season (June - September). The India Meteorological Department has traditionally established the dates of onset and withdrawal based on the relatively sharp increase and decrease indicated by the pentad means of rainfall and changes in the circulation. (Rao, 1976) [1]. The monsoon season begins on June 1st across the extreme south peninsula and moves into extreme northwest India by July 15th. The withdrawal begins in the northwest around September 1st and ends in the extreme south peninsula on October 15th. However, the start and withdrawal of the monsoon show significant inter annual variance across the country.

Material and Methods

Study Area

Jalgaon district is one of the districts of Khandesh Region (Nashik division) and situated in

north western part of Maharashtra.

It is situated in the northern part of the state adjoining Madhya Pradesh and lies between north latitudes 20°15' and 21°25' and east longitudes 74°55' and 76°28'. The total area of the district is 11,765 sq.km. The district is bounded on the north by Madhya Pradesh, on the east by Buldhana, on the west by Nashik and Dhule districts and on the south by Aurangabad district. The district is divided into 15 talukas viz., Amalner, Bhadgaon, Bhusawal, Bodhwad, Chalisgaon, Chopda, Dharangaon, Erandol, Jalgaon, Jamner, Muktainagar, Pachora, Parola, Raver and Yawal.

Climate and Rainfall

Climate

The climate of this district is generally dry except in the monsoon. December is the coldest month while May is the hottest month.

Rainfall

It would be observed that the average annual rainfall of the district is about 826.8 mm and out of it about 75% is received during the monsoon alone. The rainfall is not uniform in all parts of the district. The district receives rainfall almost entirely from the South-west Monsoon during June-September

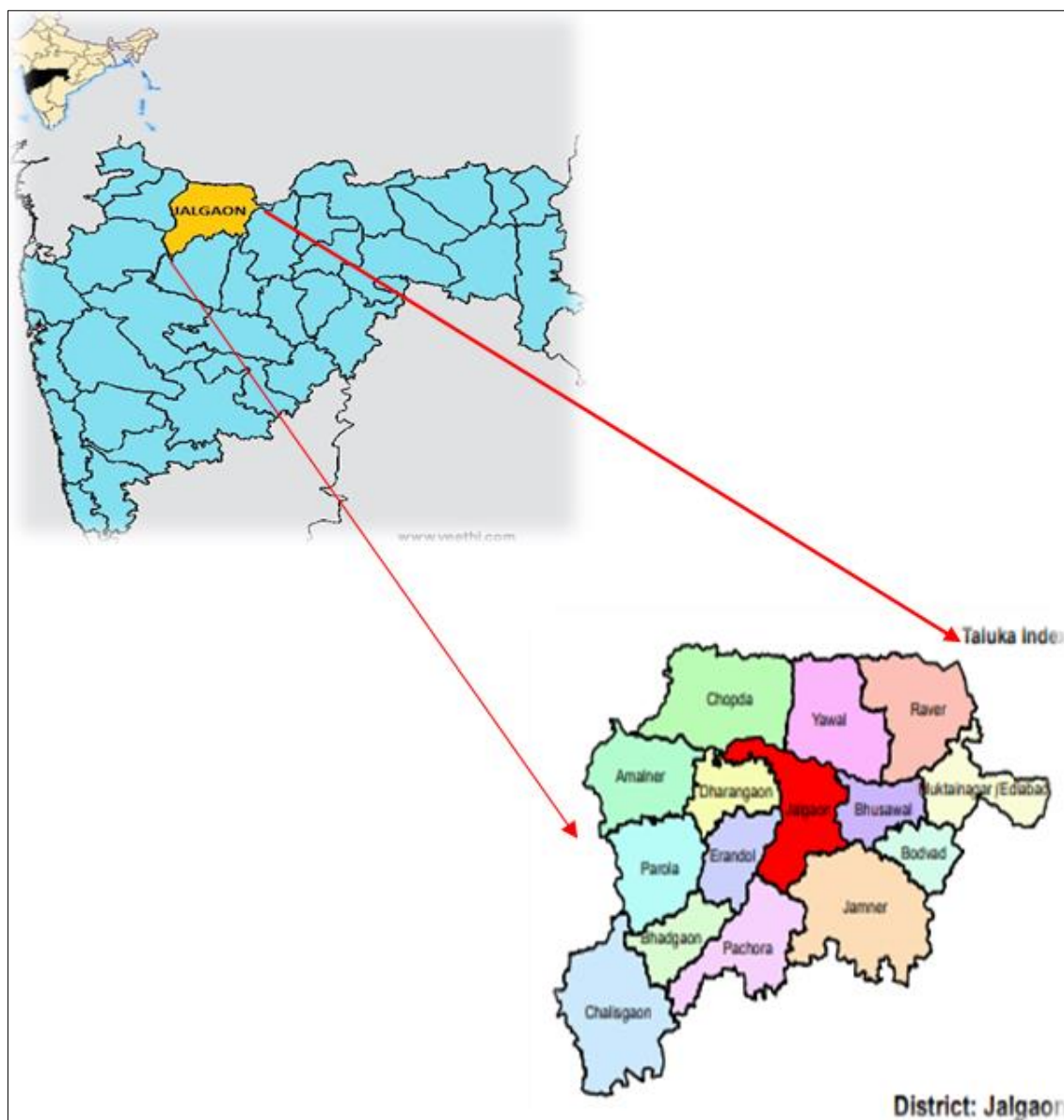


Fig 1: Map of Maharashtra state & Location of Jalgaon in map of Maharashtra

Data Acquisition

The daily rainfall data of all tehsils in Jalgaon district was collected from (Department of Agricultural Meteorology) College of Agriculture, Pune, State Agriculture Department, Pune, India Meteorological Department, Pune and Downloaded from www.maharain.gov.in (www.krishi.maharashtra.gov.in) from the month of January

to December. Rain gauges are located at the headquarters of tehsils.

The location of rain gauge station, geographical area, location and availability of data is given in Table 1. Out of 15 tehsils, 12 tehsils were having 61 years of rainfall data and 3 tehsils were having 24 years of rainfall data.

Table 1: The location of rain gauge station, Geographical area, location and availability of data

Sr. No	Rai gauge station	Geographical area (km ²)	Latitude	Longitude	Period (year)		No of years
					From	To	
1	Amalner	783.31	21°05'N	75°09'E	1961	2021	61
2	Bhadgaon	443.07	21°40'N	74°05'E	1961	2021	61
3	Bhusawal	440.05	21°04'N	75°45'E	1961	2021	61
4	Bodhwad	372.31	20°09'N	76°01'E	1998	2021	24
5	Chalisgaon	1192.33	20°33'N	75°10'E	1961	2021	61
6	Chopda	1147.58	21°15'N	75°18'E	1961	2021	61
7	Dharangaon	497.21	21°01'N	75°16'E	1998	2021	24
8	Erandol	509.99	20°54'N	75°23'E	1961	2021	61
9	Jalgaon	11765	21°00'N	75°45'E	1961	2021	61
10	Jamner	1308.94	20°47'N	75°47'E	1961	2021	61
11	Muktainagar	497.21	21°01'N	75°16'E	1998	2021	24
12	Pachora	807.74	20°42'N	75°29'E	1961	2021	61
13	Parola	780	20°53'N	75°07'E	1961	2021	61
14	Raver	906.09	21°15'N	76°03'E	1961	2021	61
15	Yaval	891.96	21°10'N	75°42'E	1961	2021	61

Determination of Onset and Withdrawal of Monsoon Season

Forward and backward accumulation method was used for computation of onset and withdrawal of rainy season from weekly rainfall data. In this method weekly rainfall was summed by forward accumulation (20+21+...+52 weeks) until a certain amount of rainfall was accumulated. 75 mm of rainfall accumulation has been considered as the onset time for the growing season of dry seeded crops and land preparation (Babu and Lakshminarayana, 1997; Panigrahi and Panda, 2002) ^[2, 3]. The withdrawal of rainy season was determined by backward accumulation of rainfall (48+47+46+...+30 weeks) data. 20 mm of rainfall accumulation was chosen for the end of rainy season, which is sufficient for ploughing of fields after harvesting the crops

(Babu and Lakshminarayana, 1997) ^[2].

By considering prevailing rainfall condition of selected area 50 mm of rainfall accumulation has been considered as the onset time and 10 mm rainfall accumulation has been considered as the withdrawal time.

Results and Discussion

Variation of Annual Rainfall in Jalgaon District

The average annual rainfall for the Jalgaon district was 698.8 mm, as shown in Table 2. It ranged from 632.27 mm in Parola to 754.04 mm at Jamner. Bodhwad had the highest standard deviation (275.27mm) with 40.3 per cent variation, while Parola had the lowest standard deviation (632.27 mm) with 33.48 per cent variation.

Table 2: Tehsil wise annual rainfall variation in Jalgaon district

Tehsil	Maximum Rainfall		Minimum Rainfall		Mean Rainfall (mm)	S.D.	C.V. (%)
	Rainfall (mm)	Year	Rainfall (mm)	Year			
Jalgaon District							
Amalner	1639.6	1992	311.1	2017	660.72	257.98	39.05
Bhadgaon	1142.6	1975	364.8	2012	730.73	228.27	31.24
Bhusawal	1420.6	2006	172.7	1968	674.95	206.46	30.59
Bodhwad	1277.2	2006	375.8	2012	683.08	275.27	40.3
Chalisgaon	1329.29	2021	336.4	2000	738.02	228.23	30.92
Chopda	1475	2006	373.4	1981	707.42	228.7	32.33
Dharangaon	1425.8	2006	356.2	2012	693.92	271.62	39.14
Erandol	1334.1	2006	267	1982	686.78	200.32	29.17
Jalgaon	1915.55	1989	320.2	2012	718.49	259.85	36.17
Jamner	1395	1979	283.7	1972	754.04	247.99	32.89
Muktainagar	1306	2006	365.2	2012	678.61	251.32	37.03
Pachora	1215.5	1998	249.8	1985	723.95	239.13	33.03
Parola	1441.6	2006	316.6	1968	632.27	211.7	33.48
Raver	1250	1970	335	2000	718.42	213.18	29.67
Yaval	1458.4	2006	360.4	1973	679.89	222.21	32.68
District average					698.8	236.1	33.8

Onset and Withdrawal of monsoon

For all tehsils of Jalgaon district 50 mm rainfall accumulation has been considered for deciding the onset of monsoon. Whereas 10 mm of rainfall accumulation was chosen for the end of rainy season, which is sufficient for ploughing of fields after harvesting the crops.

Onset and withdrawal of monsoon for Amalner Tehsil

Table 3 shows the onset, withdrawal and duration of the rainy

season. From the analysis of 61 years of weekly rainfall data (1961-2021) of Amalner tehsil, the mean week of monsoon onset was 26 MW, while the mean week of withdrawal was 40 MW. As a result, the average length of the rainy season was determined to be 15 weeks (105 days), including rainfall from both the south-west and north-east monsoons. The earliest and latest week of rainy season onset were 23 and 31 MW, respectively. Similarly, the earliest and latest weeks of rainy season withdrawal were 33 and 50 MW, respectively.

As a result, the start of monsoon in Amalner tehsil is most likely between June 11 and July 1.

Onset and withdrawal of monsoon for Bhadgaon Tehsil

Table 3 shows the onset, withdrawal and duration of the rainy season. From the analysis of 61 years of weekly rainfall data (1961-2021), the mean week of monsoon onset was 26 MW, while the mean week of withdrawal was 42 MW. As a result, the average length of the rainy season was determined to be 16 weeks (112 days), including rainfall from both the south-west and north-east monsoons. The earliest and latest week of rainy season onset were 23 and 34 MW, respectively. Similarly, the earliest and latest weeks of rainy season withdrawal were 32 and 52 MW, respectively. As a result, the start of monsoon in Bhadgaon is most likely during June 18 and July 1.

Onset and withdrawal of monsoon for Bhusawal Tehsil

Table 3 shows the onset, withdrawal and duration of the rainy season. From the analysis of 61 years of weekly rainfall data (1961-2021), the mean week of monsoon onset was 26 MW, while the mean week of withdrawal was 41 MW. As a result, the average length of the rainy season was determined to be 15 weeks (105 days), including rainfall from both the south-west and north-east monsoons. The earliest and latest week of rainy season onset were 23 and 30 MW, respectively. Similarly, the earliest and latest weeks of rainy season withdrawal were 28 and 52 MW, respectively. As a result, the start of monsoon in Bhusawal tehsil is most likely between June 18 and July 1.

Onset and withdrawal of monsoon for Bodhwad Tehsil

Table 3 shows the onset, withdrawal and duration of the rainy season (difference between onset and withdrawal time) as well as its variability in Bodhwad. From the analysis of 24 years of weekly rainfall data (1998-2021), the mean week of monsoon onset was 26 MW, while the mean week of withdrawal was 41 MW. As a result, the average length of the rainy season was determined to be 15 weeks (105 days), including rainfall from both the south-west and north-east monsoons. The earliest and latest week of rainy season onset were 23 and 30 MW, respectively. Similarly, the earliest and latest weeks of rainy season withdrawal were 33 and 50 MW, respectively. As a result, the start of monsoon in Bodhwad tehsil is most likely between June 11 and July 1.

Onset and withdrawal of monsoon for Chalisgaon Tehsil

Table 3 shows the onset, withdrawal and duration of the rainy season (difference between onset and withdrawal time) as well as its variability in Chalisgaon. From the analysis of 61 years of weekly rainfall data (1961-2021), the mean week of monsoon onset was 26 MW, while the mean week of withdrawal was 42 MW. As a result, the average length of the rainy season was determined to be 16 weeks (112 days), including rainfall from both the south-west and north-east monsoons. The earliest and latest week of rainy season onset were 23 and 34 MW, respectively. Similarly, the earliest and latest weeks of rainy season withdrawal were 35 and 52 MW, respectively. As a result, the start of monsoon in Chalisgaon tehsil is most likely between June 18 and July 1.

Onset and withdrawal of monsoon for Chopda Tehsil

Table 3 shows the onset, withdrawal and duration of the rainy season (difference between onset and withdrawal time) as well as its variability in Chopda. From the analysis of 61

years of weekly rainfall data (1961-2021), the mean week of monsoon onset was 26 MW, while the mean week of withdrawal was 41 MW. As a result, the average length of the rainy season was determined to be 15 weeks (105 days), including rainfall from both the south-west and north-east monsoons. The earliest and latest week of rainy season onset were 23 and 29 MW, respectively. Similarly, the earliest and latest weeks of rainy season withdrawal were 33 and 50 MW, respectively. As a result, the start of monsoon in Chopda tehsil is most likely between June 11 and July 1.

Onset and withdrawal of monsoon for Dharangaon Tehsil

Table 3 shows the onset, withdrawal and duration of the rainy season (difference between onset and withdrawal time) as well as its variability in Dharangaon. From the analysis of 24 years of weekly rainfall data (1998-2021), the mean week of monsoon onset was 26 MW, while the mean week of withdrawal was 41 MW. As a result, the average length of the rainy season was determined to be 15 weeks (105 days), including rainfall from both the south-west and north-east monsoons. The earliest and latest week of rainy season onset were 23 and 30 MW, respectively. Similarly, the earliest and latest weeks of rainy season withdrawal were 34 and 50 MW, respectively. As a result, the start of monsoon in Dharangaon tehsil is most likely between June 11 and July 1.

Onset and withdrawal of monsoon for Erandol Tehsil

Table 3 shows the onset, withdrawal and duration of the rainy season. From the analysis of 61 years of weekly rainfall data (1961-2021), the mean week of monsoon onset was 26 MW, while the mean week of withdrawal was 41 MW. As a result, the average length of the rainy season was determined to be 15 weeks (105 days), including rainfall from both the south-west and north-east monsoons. The earliest and latest week of rainy season onset were 23 and 31 MW, respectively. Similarly, the earliest and latest weeks of rainy season withdrawal were 34 and 50 MW, respectively. As a result, the start of monsoon in Erandol tehsil is most likely between June 18 and July 1.

Onset and withdrawal of monsoon for Jalgaon Tehsil

Table 3 shows the onset, withdrawal and duration of the rainy season. From the analysis of 61 years of weekly rainfall data (1961-2021), the mean week of monsoon onset was 26 MW, while the mean week of withdrawal was 42 MW. As a result, the average length of the rainy season was determined to be 16 weeks (112 days), including rainfall from both the south-west and north-east monsoons. The earliest and latest week of rainy season onset were 23 and 34 MW, respectively. Similarly, the earliest and latest weeks of rainy season withdrawal were 33 and 51 MW, respectively. As a result, the start of monsoon in Jalgaon tehsil is most likely between June 11 and July 1.

Onset and withdrawal of monsoon for Jamner Tehsil

Table 3 shows the onset, withdrawal and duration of the rainy season. From the analysis of 61 years of weekly rainfall data (1961-2021), the mean week of monsoon onset was 26 MW, while the mean week of withdrawal was 42 MW. As a result, the average length of the rainy season was determined to be 16 weeks (112 days), including rainfall from both the south-west and north-east monsoons. The earliest and latest week of rainy season onset were 23 and 30 MW, respectively.

Similarly, the earliest and latest weeks of rainy season withdrawal were 33 and 52 MW, respectively. As a result, the start of monsoon in Jamner tehsil is most likely between June 11 and July 1.

Onset and withdrawal of monsoon for Muktainagar Tehsil

Table 3 shows the onset, withdrawal and duration of the rainy season. From the analysis of 24 years of weekly rainfall data (1998-2021), the mean week of monsoon onset was 27 MW, while the mean week of withdrawal was 41 MW. As a result, the average length of the rainy season was determined to be 14 weeks (98 days), including rainfall from both the south-west and north-east monsoons. The earliest and latest week of rainy season onset were 23 and 30 MW, respectively. Similarly, the earliest and latest weeks of rainy season withdrawal were 33 and 46 MW, respectively. As a result, the start of monsoon in Muktainagar tehsil is most likely between June 18 and July 8.

Onset and withdrawal of monsoon for Pachora Tehsil

Table 3 shows the onset, withdrawal and duration of the rainy season. From the analysis of 61 years of weekly rainfall data (1961-2021), the mean week of monsoon onset was 26 MW, while the mean week of withdrawal was 42 MW. As a result, the average length of the rainy season was determined to be 16 weeks (112 days), including rainfall from both the south-west and north-east monsoons. The earliest and latest week of rainy season onset were 23 and 33 MW, respectively. Similarly, the earliest and latest weeks of rainy season withdrawal were 32 and 51 MW, respectively. As a result, the start of monsoon in Pachora tehsil is most likely between June 11 and July 1.

Onset and withdrawal of monsoon for Parola Tehsil

Table 3 shows the onset, withdrawal and duration of the rainy season. From the analysis of 61 years of weekly rainfall data (1961-2021), the mean week of monsoon onset was 26 MW,

while the mean week of withdrawal was 40 MW. As a result, the average length of the rainy season was determined to be 15 weeks (105 days), including rainfall from both the south-west and north-east monsoons. The earliest and latest week of rainy season onset were 23 and 30 MW, respectively. Similarly, the earliest and latest weeks of rainy season withdrawal were 33 and 51 MW, respectively. As a result, the start of monsoon in Parola tehsil is most likely between June 11 and July 1.

Onset and withdrawal of monsoon for Raver Tehsil

Table 3 shows the onset, withdrawal and duration of the rainy season. From the analysis of 61 years of weekly rainfall data (1961-2021), the mean week of monsoon onset was 26 MW, while the mean week of withdrawal was 42 MW. As a result, the average length of the rainy season was determined to be 16 weeks (112 days), including rainfall from both the south-west and north-east monsoons. The earliest and latest week of rainy season onset were 23 and 29 MW, respectively. Similarly, the earliest and latest weeks of rainy season withdrawal were 33 and 52 MW, respectively. As a result, the start of monsoon in Raver tehsil is most likely between June 11 and July 1.

Onset and withdrawal of monsoon for Yaval Tehsil

Table 3 shows the onset, withdrawal and duration of the rainy season. According to analysis of 61 years of weekly rainfall data (1961-2021), the mean week of monsoon onset was 26 MW, while the mean week of withdrawal was 41 MW. As a result, the average length of the rainy season was determined to be 15 weeks (105 days), including rainfall from both the south-west and north-east monsoons. The earliest and latest week of rainy season onset were 23 and 30 MW, respectively. Similarly, the earliest and latest weeks of rainy season withdrawal were 33 and 51 MW, respectively. As a result, the start of monsoon in Yaval tehsil is most likely between June 11 and July 1.

Table 3: Mean week of onset and withdrawal of rainfall in all tehsils of Jalgaon district

Tehsils	Mean week of Start of rainfall			Mean week of End of rainfall			Duration (Days)
	Start (MW)	Early (MW)	Late (MW)	End (MW)	Early (MW)	Late (MW)	
Amalner	26	23	31	40	33	50	105
Bhadgaon	26	23	34	42	32	52	112
Bhusawal	26	23	30	41	28	52	105
Bodhwad	26	23	30	41	33	50	105
Chalisingaon	26	23	34	42	35	52	112
Chopda	26	23	29	41	33	50	105
Dharangaon	26	23	30	41	34	50	105
Erandol	26	23	31	41	34	50	105
Jalgaon	26	23	34	42	33	51	112
Jamner	26	23	30	42	33	52	112
Muktainagar	27	23	30	41	33	46	98
Pachora	26	23	33	42	32	51	112
Parola	26	23	30	40	33	51	105
Raver	26	23	29	42	33	52	112
Yaval	26	23	30	41	33	51	105

As a result, we suggested sowing of *kharif* crops i.e., cotton, groundnut, pigeon pea etc. in the 25 and 26 MW. Long-season crops i.e., pigeon pea can also be grown during this period. To take *rabi* season crops i.e., chickpea, wheat etc., sowing of short duration crops such as green gram and black gram should be done during this period to take advantage of

maximum moisture for efficient germination. Land preparation should be done in summer, 3-4 weeks before sowing, by utilizing pre-monsoon shower moisture. Conserve extra moisture throughout the monsoon season for utilization during critical growth stages of field crops and *rabi* crop production.

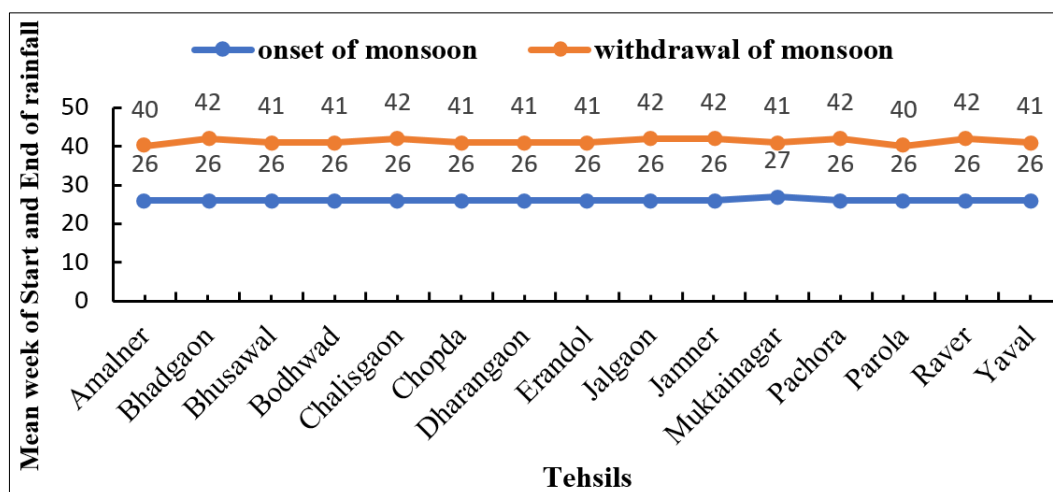


Fig 2: Onset and withdrawal of monsoon in Jalgaon district

Conclusions

According to the study of weekly rainfall data, it was observed that the mean week of the monsoon onset was 26 standard meteorological week for all the tehsils in the Jalgaon district, with the exception of Muktainagar tehsil, where the mean onset was 27 standard meteorological week. For Bhusawal, Bodhwad, Chopda, Dharangaon, Erandol, Muktainagar and Yaval tehsils a mean week of monsoon withdrawal was 41 MW, while it was noted 40 MW for Amalner and Parola tehsils and 42 MW for Bhadgaon, Chalisgaon, Jalgaon, Jamner, Pachora and Raver tehsils. The average length of the rainy season for Amalner, Bhusawal, Bodhwad, Chopda, Dharangaon, Erandol, Parola and Yaval tehsils has determined to be 15 weeks (105 days), which includes both south-west and north-east monsoon precipitation. Maximum mean length of rainy season i.e., 16 weeks (112 days) has observed for Bhadgaon, Chalisgaon, Jalgaon, Jamner, Pachora and Raver tehsils. Muktainagar recorded minimum length of rainy season i.e., 14 weeks (98 days). Various field operations can be carried out depending on the onset and withdrawal of the rainy season.

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References

1. Rao YP. South west monsoon, Meteorol. Monogr., Synoptic Meteorol. 1/1976, Indian Meteorol. Dep., Delhi, India; c1976.
2. Babu PN, Lakshminarayana P. Rainfall analysis of a dry land watershed- Polkepad: A case study. Journal of Indian Water Resources Society. 1997;17(3):34-38.
3. Panigrahi B, Panda SN. Dry spell probability by markov chain model and its application to crop planning. Indian Journal of Soil Conservation. 2002;30:95-100.
4. Website: www.maharain.gov.in
5. Anonymous, STENDRF. EXE software used developed by CRIDA, Hyderabad.