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Rainfall and dry spell analysis for Wardha district

[1]Pawar A.S.,[2]Satpute G.U., [3]Apturkar S.M.
[1]M. TechStudent, [2]Professor (CAS) and Head,Department of Soil and Water Conservation Engineering, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra.
[3]Associate Scientist, Maharashtra Remote Sensing Application Centre, Department of Planning, Nagpur, Maharashtra.

Abstract
The amount of rainfall and its distribution is very important characteristics that affects the agriculture productivity. The timing of the monsoon onset and knowledge about the occurrence of dry spells during monsoon period has vital importance in the agricultural sector. The study was undertaken with specific objectives of rainfall analysis at taluka level for onset of effective monsoon (OEM), dry spells and withdrawal of monsoon in Wardha district according to Ashok Raj (1979) criteria. The daily rainfall data of 21 years (1998 to 2018) at Wardha was used for this study. The average monsoon seasonal rainfall in different taluka stations in Wardha district varied from 781.4 to 941.0 mm with coefficient of variation of 15.6 to 32.5 per cent. The mean dates of onset and withdrawal of effective monsoon varied from 18th June to 25th June and 24th September to 03rd October respectively at different taluka places in Wardha district. The average starting date of critical dry spell in different monsoon months varied from 21st to 27th June, from 17th to 22ndJuly, from 17th to 19th August and from 6th to 17th September. The study of onset and withdrawal of effective monsoon as well as dry spell can be used for contingency planning, management of water resources and agricultural development.
Key words: *Onset, withdrawal, dry spell, Monsoon, Agriculture*

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I. Introduction

The total land area of India is 329 million hectares of which 144 million hectares is arable land, of these 94 million hectares fall under drylands**.**Dryland agriculture occupies 68 % of India's cultivated area and supports 40 % of the human and 60 % of the livestock population. It produces 44 % of food requirements, thus has and will continue to play a critical role in India's food security (Singh *et al.* 2004). More than 85 per cent of rainfall is received from southwest monsoon in India is a four-month long affair from June till September. In rainfed agriculture, the adequate rainfall to meet the water requirements of crops and other consumptive and non-consumptive water needs is a basic requirement(Anil *et al*.2017).The rainfall distribution in our country is most uneven and varies considerably from region to region and year to year (Abuj*et al*.2017). Drought is one of the major disasters, which affects agriculture. It is climatic anomaly characterized by deficient supply of moisture. occurrence of drought is a recurring phenomenon in different parts of Vidarbha region in Maharashtra. If there is long dry spell during the critical stage of crop growth, it is urgent need of water for saving the crop during the dry spell. Normal dates of onset effective monsoon and its withdrawal, period and time of occurrence of critical dry spell is useful for contingent crop planning and planning of in-situ rainwater conservation measures.

II. Materials and Methods

Location of study Area

The current study area of dry spells in Wardha district of Vidarbha region in Maharashtra state is situated between 20°18' and 21°21' north latitudes and 78°4' and 79°15' east longitudeshaving geographical area 6310 sq.km.

Data collection

Daily rainfall data from 1998 to 2018 recorded at 08 stations in Wardha district were obtained from the website of Maharashtra State Government (http://www.mahaagri.gov.in/rainfall). Pan evaporation data for 21 years (1998 to 2018) were obtained from Agro-meteorological, Observatory of Department of Agronomy, College of Agriculture, Nagpur.

Determination of onset of effective monsoon (OEM)

The date of onset and withdrawal of effective monsoon was estimated by using daily rainfall data for all study stations separately. The concept developed by Ashok Raj (1979), for onset of effective monsoon and dry spells

was adopted. According to this concept the date of commencement of seven days spell satisfying following three criteria was taken as the date of onset of effective monsoon.

i. The first day's rain in the seven day spell should be more than the average daily evaporation (e) mm of the place.
ii. The total rain during the seven days spell should be at least 5e + 10 mm.
iii. At least four out of these seven days should be rainy day(s) having rainfall more than or equal to 2.5 mm.

Determination of dry spells

The dry spells were determined using the criteria suggested by Ashok Raj (1979). The interval between the end of onset effective monsoon and another rainy day with 5e mm or more of rain or the commencement of another 7 day rainy spell satisfying the third criteria stated earlier, with a total rainfall of 5e mm or more during this spell is called as the first dry spell. If the duration of this dry spell exceeds a certain value depending on the crop-soil complex of the region, this dry spell is called as the first critical dry spell; otherwise, this spell is included in the first wet spell.

The interval between the OEM and the beginning of the first critical dry spell is called the first wet spell. The subsequent wet spells are defined as the interval between two critical dry spells. Thus, the wet spells are spells of prolonged rain with possible intervening dry spells of the duration less than the value, which makes the dry spells critical. Thus, dry spells for every year and for each station/ taluka were determined.

Determination of withdrawal of monsoon

The withdrawal of monsoon was decided as the end of last wet spell in the last week of September, which may sometimes extend upto middle of October.

III. Results and Discussion

The daily rainfall data for 21 years period (1998 to 2018) of 08 taluka places in Wardha district were analyzed for identification of onset of effective monsoon, dry spells and withdrawal of monsoon by Ashok Raj (1979) criteria.

Rainfall analysis

The average seasonal rainfall in different talukas of the Wardha district is shown in Table 1, it is revealed that average seasonal rainfall ranges from 781.4 to 941.0 mm with coefficient of variation in the range of 15.6 to 32.5 per cent. Arvi experiences highest seasonal rainfall (1956.2 mm) during 2000 followed by Seloo (1639.1 mm) during 2007. The highest average seasonal rainfall was observed at Hinganghat (941.0 mm) followed by Seloo (913.1 mm) and lowest in Ashti (781.4 mm). Amongst different talukas, Arvi shows highest coefficient of variation of 32.5 percent followed by Seloo (30.2%), Samudrapur (25.7%), Hinganghat (24.2%).

Table 1. Seasonal rainfall (mm) at different talukas in Wardha district

Year	Arvi	Ashti	Deoli	Hinganghat	Karanja	Samudrapur	Seloo	Wardha
1998	696.6	885.4	677.4	697.1	797.7	872.2	937	852.5
1999	948.9	1151.2	1075.6	1030.7	917.7	913.9	1096.2	630.2
2000	1956.2	877.1	755.4	1163.8	843.9	844.5	723.3	741.8
2001	885.4	807.2	662.9	1009.8	858.6	666.6	613.7	679.1
2002	692.7	599.4	770.2	819.4	669.3	836.9	1118.1	739.5
2003	799.6	639.8	903.4	1039.3	880.4	1015.9	928	876.2
2004	741	667.8	598	669.6	747.4	592.4	777.9	659.1
2005	960.5	822.2	900.8	1094	825.4	972.7	1138	916.4
2006	915.8	657.1	993.8	965.6	862.3	1101	885.9	801.9
2007	1125.5	1191.3	1061	1382.1	1047.6	1367.9	1639.1	1129.9
2008	916.2	542.6	657.3	959.2	689.9	685.3	959.6	858.1
2009	518.8	481.6	446	684.5	582.2	676.2	622.3	476
2010	1046.7	772.2	1131.6	1372.2	1097.9	1322.7	1195.7	1266.7
2011	1101.4	811	1013.8	899.4	919.6	1082.5	976	922.9
2012	1096.7	752.9	730.9	986.4	818.1	974.2	469	875.9
2013	787.8	1023.8	1092.3	1216	899.5	1227.8	1362.5	1108.9
2014	806.2	703.5	807.6	609.9	790.9	594.4	701.9	657.4
2015	749.4	822.7	728.6	769.1	889.9	790.7	680.2	838.8
2016	780	944.4	978.2	866.4	816	786.7	812.1	838
2017	697.4	671	606.7	587.4	674.8	687	747.2	567.7
2018	650	586.1	760.6	939	623.9	722.9	791	678.5
Average	898.7	781.4	826.3	941.0	821.6	892.1	913.1	815.0
SD	291.6	187.2	191.4	228.0	128.4	229.1	275.7	191.2
CV	32.5	24.0	23.2	24.2	15.6	25.7	30.2	23.5

Onset and withdrawal of effective monsoon

Daily rainfall data of different taluka place of Wardha district for 21 years (1998 to 2018) were analyzed for onset of effective monsoon (OEM) and its withdrawal in different years. The criterion suggested by Ashok Raj (1979) was used in the analysis. The average dates of onset and withdrawal of effective monsoon is depicted in Table 2. The onset of effective monsoon (OEM) varies in between 18th June to 25th June whereas withdrawal of monsoon varies in between 24th Sept to 3rd Oct. Early onset on 18th June in Samudrapur and Wardha talukas of Wardha district and late onset on 25th June in Ashti taluka of Wardha district was observed. Early withdrawal of monsoon 24th Sept in Ashti and Deoli talukas of district whereas late withdrawal on 3rd Oct in karanja taluka of Wardha district was observed. It is indicates that there is no much variation in onset and withdrawal of monsoon between different talukas of district.

Table.2 Average dates of onset and withdrawal of effective monsoon in different talukas of Wardha district

Sr. No	Taluka place	Onset	Withdrawal
1	Arvi	21-June	27-September
2	Ashti	25-June	24-September
3	Deoli	20-June	24-September
4	Hinganghat	19-June	28-September
5	Karanja	20-June	03-October
6	Samudrapur	18-June	30-September
7	Seloo	19-June	30-September
8	Wardha	18-June	29-September

Dry spell analysis

The mean starting dates and mean duration of critical dry spell (CDS) of more than 15 days duration (greater than 2 weeks) at different taluka places of Wardha district are presented in Table 3. The mean date of starting of different category CDS in different monsoon months varies during 21th to 27th June, 17th to 22ndJuly, 17th to 19th August and 6th to 20th September at different taluka places. The results indicates that there is not much variation in the mean starting dates of dry spells at different taluka stations of Wardha district during different monsoon months. The mean duration of CDS during June, July, August and September varies from 17 to 23 days, 17 to 22 days, 22 to 28 days and 18 to 30 days respectively at different taluka places of Wardha district. Also, the total number of dry spell events during 21 years study periodvariesfrom 3 to 9 during June, 5 to 9 during July, 10 to 15 during August and 3 to 6 during September month. However, the number of CDS events during monsoon months indicates a specific trend of higher number of events in the month of August followed by July, June and September.

Table.3 Mean starting date and duration of critical dry spells during monsoon months in different talukas of Wardha district

Taluka place	Date and duration of critical dry spell (CDS) during monsoon months								Avg. No of CDS per year
	June		July		August		September		
	Date	Days	Date	Days	Date	Days	Date	Days	
Arvi	23-Jun	19(5) *	17-Jul	19(9) *	19-Aug	24(13) *	17-Sept	23(3) *	2
Ashti	22-Jun	20(3) *	18-Jul	21(9) *	17-Aug	28(10) *	06-Sept	22(4) *	1
Deoli	27-Jun	20(9) *	22-Jul	17(5) *	18-Aug	24(13) *	08-Sept	20(6) *	1
Hinganghat	23-Jun	23(4) *	19-Jul	18(6) *	19-Aug	24(13) *	20-Sept	24(3) *	1
Karanja	22-Jun	21(5) *	19-Jul	17(8) *	19-Aug	24(11) *	14-Sept	24(5) *	1
Samudrapur	22-Jun	23(5) *	20-Jul	21(8) *	19-Aug	22(12) *	13-Sept	18(6) *	1
Seloo	21-Jun	23(4) *	18-Jul	20(8) *	17-Aug	24(13) *	15-Sept	22(4) *	1
Wardha	21-Jun	17(4) *	17-Jul	22(8) *	18-Aug	23(15) *	09-Sept	30(3) *	2

*Figures in parenthesis indicate total number of dry spell events during study period

IV. Conclusion

The average seasonal rainfall in different talukas of the Wardha district ranges from 781.4 to 941.0 mm with coefficient of variation in the range of 15.6 to 32.5 per cent. The onset of effective monsoon (OEM) varies in between 18th June to 25th June whereas withdrawal of monsoon varies in between 24th Sep to 3rd Oct. The mean date of starting of different category CDS in different monsoon months varies during 21th to 27th June, 17th to 22ndJuly, 17th to 19th August and 6th to 20th September at different taluka places.The mean duration of CDS during June, July, August and September varies from 17 to 23 days, 17 to 22 days, 22 to 28 days and 18 to 30 days respectively at different taluka places of Wardha district. The total number of dry spell events during 21 years study period varies from 3 to 9 during June, 5 to 9 during July, 10 to 15 during August and 3 to 6 during September month. The knowledge of normal dates of onset of effective monsoon (OEM), its withdrawal, and dry spells during the monsoon period is essential to the farmers, planners and development agencies for successful planning of rainfed farming.

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