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RESEARCH ARTICLE

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Rainfall and dry spell anaylasis for beed district

M. D. ABUJ, A.P. MAGAR, V.T. BOMBALE, P.G. POPALE AND S.A. BIRAJDAR

ABSTRACT

Efficient utilization of water resources is essential increasing agriculture production. Rainfall has a major role in rainfed agriculture. The important characters of rainfall influencing production from rainfed farming are the date of onset monsoon, the duration of rainy spells, the dates of occurrences and duration of intervening dry spell and distribution of weekly /minimum rainfall and number of rainy days. The daily rainfall and evaporation data of the beed district was obtained for the analysis from the collector office, Beed. This data was analyzed to find the minimum, maximum and normal monthly rainfall, average annual rainfall and number of rainy days .the dates of onset and end of effective monsoon were determined for individual years by applying the criteria stated by Ashok Raj (1979). Also mean dates of OEM and end of / monsoon with standard deviation were determined. Dry spells were found during every year. Mean dates of critical dry spells along with their mean duration were also determined. The average dates of starting and ending of wet spells were also determined. The present study revealed that, the average monthly rainfall for Beed was found to be varied from 4.39 mm to 190.41 mm. The average annual rainfall at Beed was / recorded as 758.23 mm. The 852/0average number of rainy days was found to be 37.6 days. The mean dates of OEM were found to be June 29. The mean date of end of monsoon was found to be October 9. The mean dates of critical dry spells were July 14 with duration of 21 days for first, August 21with mean duration of 23 days for second, August 27 with mean duration of 21 days third and September 24 with mean duration of 21 days for fourth CDS. The mean dates of wet spells were June 29 to July 13 for first, August 4 to August 20 for second and September 24 for third wet spells.

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Key words : Rainfall, Dry spell anaylasis

INTRODUCTION

Efficient utilization of water resources is essential in increasing agriculture production. The population unlike the water resources is increasing rapidly. Agriculture production of different region of India revel the low of production of different crops, as compared to most returns from our farm land is efficient utilization of water resources.

Address for correspondence :
M.D. ABUJ, Department of Soil and Water Conservation Engineering, Aditya College of Agricultural Engineering and Technology, BEED (M.S.)INDIA
E.mail : abujmd@yahoo.com

Authors' affiliations :
A.P. MAGAR, V.T. BOMBALE, P.G. POPALE AND S.A. BIRAJDAR, Department of Soil and Water Conservation Engineering, Aditya College of Agricultural Engineering and Technology, BEED (M.S.)INDIA
E.mail : abujmd@yahoo.com

Rainfall has a major role in rainfed agriculture. The rainfall distribution in our country is most uneven and varies considerably from region to region and rainfall is year to year. South-West monsoon is the chief source of rainfall and rainfall is concentrated during four monsoon months at most of the places. Crop planning is an important task an the part of the cultivator, in unirrigated land especially in dry land situation. In rainfed areas crop planning is solely dependent on the distribution pattern and amount of rainfall, particularly during *Kharif* season.

The important charachtres of rainfall influcing production from rainfed farming are the date of onset of monsoon, the duration of rainy spells, the date of occurrences and duration of intervening dry spells and distribution of weekly minimum rainfall and number of rainy days. The occurrence of certain amount of rainfall at times, can determine the success or faultier of crops. Drying of crops, germination of seeds, and disease control during growing periods, applying irrigation, fertilizers, pesticides are some important agriculture activates for which

probability of various sequences of wet and dry days may be useful to determine the possible economics gain and losses.

The average annual rainfall over plains of India is 119.4cm and the average far all the lands of the world put together is only 70 cm per year. Through India has 1.7 times the average annual of whole world, its agriculture production is at low level main reason behind this is that half of the total amount of rainfall falls in 15 to 20 hours distributed within 35 to 45 days. Being of high intensity, 3 to 5 cm per hour, this half the amount of total rainfall runs off the ground as runoff. So there is a great need to stroke this water received from short period occurs during important *Kharif* season. Hence, knowledge of dry spell analysis plays an important role in proper utilization of the resources.

In most of states the percentage of irrigation is very low. In Maharashtra percentage of total irrigated area to cropped area is 12.82. In Maharashtra region this percentage of total irrigated area to total cropped area is only 10.13 leaving about 90 per cent area at the whim of monsoon. Maharashtra is generally known to be drought prone area in Maharashtra. Precipitation is very uncertain in this region and some times suffer from severe droughts.

The average annual rainfall of Maharashtra is 1200 mm whereas rainfall of Maharashtra varied between 550 mm to 1100 mm with an average of 774 mm, Beed district of Maharashtra region lie in moderately drought prone area of Maharashtra. Beed district receives average annual rainfall of 767 mm. Majority of population living in Beed district depend on the rain fed agriculture. Annual rainfall is comparatively low and its distribution is not uniform. In such a condition only the knowledge of average annual rainfall is not useful in deciding cropping pattern.

MATERIALS AND METHODS

Location:

The study is confined to the Beed district of Marathwada region of Maharashtra state. Marathwada comprises of eight district and geographically situated between 17^0 35' to 20^0 40'(N) latitude and 74^0 40' to 78^0 16'(E) longitude. The altitude ranges from 300 to 900 meters above MSL. Jowar, Soybean, Cotton etc. are the most important crops, grown on large scale all over Marathwada region. There are 56 rain gauge stations in Marathwada region. Amongst them, Beed station, located at district headquarters was selected for detailed analysis. The location of Beed station is 19^0 (N) latitude and 75^0 (E) longitudes.

Data collection:

The daily rainfall data evaporation data of the Beed station was obtained from the Collector Office, Beed. The daily rainfall data for 20 years from 1988 to 2007 were obtained for Beed station.

Analysis of rainfall data:

For making the daily rainfall data obtained for Beed station to be concise, total of rainfall in the month per year obtained. The number of rainy days for each month for every year was also obtained. From the monthly totals obtained, the normal rainfall for every month, the minimum and maximum rainfall and the average rainy days for each month for Beed station were computed.

Onset of effective monsoon (OEM):

There is a need for identifying "Effective Monsoon" as 'commencement of sowing rains' district from the premonsoon showers. Premonsoon rains cannot be considered as effective monsoon for agricultural operations, particularly because these rains are followed by long dry spells which may affect the germination of seeds resulting in crop failure if sowings are under taken immediately after these showers.

Determination of dates of OEM: The concept developed by Ashok Raj (1979) on onset of effective monsoon and dry spells was adopted in the present study. Effective monsoon is that monsoon which leaves enough moisture to support agricultural operation. If the average daily evaporation is 'e' mm and after a prolonged dry spell, if it rains on a particular day an amount of 'r' mm of rain, it is assumed that only (r-e) mm of rain will be available for the soil that day. If it rains on the subsequent days, the evaporation loss will be less than e mm. In the light of this , the rainfall of seven day period that leaves at least 10 mm of rain after meeting the evaporations demand, is designed as the effective monsoon. According the date of commencement of a 7 days spell satisfying the following criteria can be defined as the date of onset of effective monsoon.

– The first day's rain in the seven days spell should be more than average daily evaporation (e) of the place.

– The total rain during the seven days spell should not be less than (5e + 10) mm.

– At least four out of these seven days should be rainy days with not less than 2.5 mm of rain each day. A day is called a rainy day if the rainfall of that day is more than or equal to 2.5 mm.

The dates of onset of effective monsoon for every year for Beed station were determined by applying the

above three criteria. After identifying the date of onset of effective monsoon Xi (i=1,2,3,…….n) in the ith year for a station, the mean date M is computed as follows.

$$\mathbf{M} = \sum_{i=1}^{n} (\mathbf{xi/n})$$

where: **n** - number of years.

The standard deviation **Xi** (**i** = 1, 2, 3, ….., n) dates of effective monsoon is calculated as follows.

$$\sigma = \left[\frac{\sum xi^2 - (\sum xi)^2/n}{n-1} \right]^{1/2}$$

where,

= standard deviation (days)

= number of years

Determination of dry and wet spells:

The dry spells were found out by applying the criteria stated by Ashok Raj (1979).The interval between the end of 7 days spell, beginning with the onset of effective monsoon and another rainy days with 5e mm or more of rain or the commencement of another 7 days rainy spell satisfying the third criteria stated in above paragraph, with a total rainfall of 5e mm or more during this spell is called as the first dry spell. Similarly the other dry spells were found.

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 of prolonged rain with possible intervening dry spells of duration less than the value depending on crop-soil complex of the region, which makes the dry spell critical.

Critical dry spell (CDS):

If the duration of the dry spell occurred during monsoon season exceeds a certain period depending on the crop-soil complex of the region, the dry spell is called the first critical dry spell. Duration of 10 days was considered to classify the dry spell as critical during this study (Pujari, 2005).There may occur more than one critical dry spell during every year. The critical dry spells for Beed station were applying the same criteria. The mean dates of starting of critical dry spells were obtained by the same procedure adopted for obtaining the mean dates of OEM.

RESULTS AND ANALYSIS

Records of daily rainfall data for 20 years for Beed district was obtained from the Collector Office, Beed. Data was analyzed to determine the rainfall characteristics that include mean monthly rainfall, maximum and minimum monthly rainfall and average annual rainfall. Daily rainfall and average annual evaporation data for 20 years were used for determining the dates of onset of effective monsoon, critical dry spells and wet spells.

Analysis of rainfall data:

Daily rainfall data of 20 year from 1988-2007 were analyzed to find out the minimum, maximum and average monthly rainfall, average annual rainfall and number of rainy days. Table 1 furnishes values of minimum, maximum and average monthly rainfall for Beed district for 20 years rainfall data. It is seen from Table 1, that the minimum monthly rainfall values varies from a minimum of 0 mm January, February , March , April , May, October , November and December to maximum of 36.1 in the month of June during 20 years. Maximum monthly rainfall varied in the range of 0.0 to 688.6 mm. Maximum monthly values for the period of June to September are higher than the values obtained for the remaining months. From the Table 1, it is observed that the total of average monthly rainfall for the month from June to September is 642.88 mm, which is 84.79 % of the annual rainfall. Thus it is concluded that the maximum amount of rainfall is received during the month June to September of the year. It can be also seen from table that average number of rainy days are minimum *i.e.* 0 days for the months of January, February and March and maximum in August *i.e.* 8.6 days. The total number of rainy days is 37.55 days in period of one year.

Table 1: Monthly observed minimum, maximum and average rainfall and rainy days (Rain gauge Station: Beed).

Sr. No.	Month	Average number of rainy days	Rainfall (mm)		
			Minimum rainfall (mm)	Maximum rainfall (mm)	Average rainfall (mm)
1.	January	0.0	0.0	0.0	0.0
2.	February	0.0	0.0	0.0	0.0
3.	March	0.0	0.0	0.0	0.0
4.	April	0.3	0.0	53.8	4.93
5.	May	1.0	0.0	161.8	13.6
6.	June	7.0	36.1	298.6	144.41
7.	July	7.1	3.6	688.6	144.25
8..	August	8.6	20.2	388.2	163.81
9.	September	8.4	29.6	537.2	190.41
10.	October	4.2	0.0	240.2	81.59
11.	November	0.75	0.0	81.8	10.84
12.	December	0.2	0.0	87.8	4.39
	Total	37.55			758.23

The variation in annual rainfall and number of rainy days of Beed for 20 years is presented in Table 2. Data from Table 2 shows that the annual rainfall averaged over 20 years for Beed station is 758.23 mm.The minimum rainfall of 337.2 mm was recorded during 1991 and maximum rainfall of 1265.8 mm was recorded during 1989. The number of rainy days varied from a minimum of 22 days during 1991 to a maximum of days during 1988 with annual average of 37.6 days for 20 years (1988-2007).

Table 2: Variation in annual rainfall and number of rainy days

Sr. No.	Year	Total rainfall (mm)	Number of rainy days
1.	1988	1135.2	58
2.	1989	1265.8	41
3.	1990	1095.8	52
4.	1991	337.2	22
5.	1992	693.6	30
6.	1993	656.6	46
7.	1994	424.8	27
8.	1995	652.4	33
9.	1996	948.4	50
10.	1997	680.2	41
11.	1998	987.4	45
12.	1999	504.2	33
13.	2000	1040.2	39
14.	2001	671.8	32
15.	2002	603.4	29
16.	2003	577.2	39
17.	2004	609.5	37
18.	2005	867.6	36
19.	2006	665.8	32
20.	2007	671.4	34
	Average	758.23	37.6

Onset and end of effective monsoon:

Daily evaporation and rainfall data of 20 years for Beed station from 1988-2007 were analyzed to determined dates of onset of effective monsoon (OEM) and dates withdrawal of monsoon during individual years. The criteria stated by Ashok Raj (1979) were used in the analysis. From the Table 3 it is seen that monsoon starts from first week of June to second week of August It can be seen that mean date of onset of effective monsoon is June 29 with standard deviation of 22 days. It is also observed that effective monsoon ends in between first week of September and last week of October. Mean date of withdrawal of monsoon is found to be October 9.

Table 3. Dates of onset and end of effective monsoon for Beed station.

Year	Effective monsoon	
	Onset	End on
1988	June 18	September 29
1989	June 25	September 23
1990	June 05	October 27
1991	June 06	September 18
1992	June 18	September 06
1993	June 28	October 20
1994	June 04	October 07
1995	June 27	October 18
1996	July 04	October 29
1997	July 01	October 29
1998	July 22	October 16
1999	June 14	October 13
2000	June 01	September 30
2001	June 07	October 13
2002	August 01	October 17
2003	August 09	October 01
2004	July 27	October 12
2005	July 17	October 17
2006	June 18	October 05
2007	June 20	September 23
Mean	June 29	October 09

Mean date of OEM = June 29 Standard deviation =22 days

Dry spell analysis:

The dates of commencement and duration of dry spells were determined during every year from daily rainfall and evaporation data of the Beed station by using criteria suggested by Ashok Raj (1979). Table 4 shows the dates and duration of dry spells determined during every year after the commencement of effective monsoon. From Table 4, it is clear that there are at least two dry spells during every year. Two dry spells were occurred during 1988, 1991 and 2003, where as four dry spells were occurred during 1990, 1994, 1998,1999,2000,2005 and 2006. Three dry spells were occurred during remaining years. The dry spell with highest duration of 72 days was occurred during 1991.The duration of the remaining dry spells ranged between 4 to 45 days . Total 64 dry spells were observed during the period of 20 years.

Average dates of starting of CDSand length:

First CDS – July 14 – Length 21 days
Second CDS – August 21 – Length 23 days
Third CDS – August 27 – Length 21 days
Fourth CDS – Septeber 24 – Length 21 days

Mean dates of wet spells:

First wet spell — June 29 to July 13

Table that mean number of critical dry spell is two CDS ranged from one to four during every year. It is also observed that only one CDS occurred during 1988, 1998 and 2003. Maximum four CDS occurred during 2005. Data in Table 5, also present the mean dates of commencement

Table 4: Observed dry spells during 1988-2007 at Beed station

Year	DRY SPELLS							
	First		Second		Third		Fourth	
	Date	Days	Date	Days	Date	Days	Date	Days
1988	June 26	05	July 28	20	---	---	---	---
1989	July 02	06	July 26	10	August 27	11	---	---
1990	June 29	37	August 24	04	September 09	15	October 16	09
1991	June 13	16	July 07	72	---	---	---	---
1992	June 25	16	July 19	20	August 17	10	---	---
1993	August 07	23	September 07	07	September 28	13	---	---
1994	June 15	14	July 01	04	July 15	45	September 07	28
1995	July 11	.10	September 04	07	September 17	27	---	---
1996	July 12	40	September 22	05	October 06	15	---	---
1997	July 08	31	September 10	09	September 25	24	----	---
1998	August 28	04	September 13	10	September 30	04	October 05	07
1999	June 25	11	July 18	13	August 03	35	September 15	09
2000	June 17	13	July 14	25	August 15	06	September 01	27
2001	June 21	42	August 26	20	September 18	07	---	---
2002	August 13	11	August 26	06	September 07	40	---	---
2003	August 16	06	August 29	25	---	---	---	---
2004	August 07	29	September 12	10	September 29	09	---	---
2005	July 31	11	August 25	10	September 11	10	September 24	21
2006	June 25	04	July 06	30	August 12	11	August 30	14
2007	June 29	26	August 01	24	September 08	06	---	---

Table 5: Critical dry spells (CDS) during the year for beed station

Year	CRITICAL DRY SPELLS								Total
	First		Second		Third		Fourth		
	Date	Days	Date	Days	Date	Days	Date	Days	
1988	June 28	20	---	---	---	0	---	0	01
1989	July 26	10	Aug 27	11	---	0	---	0	02
1990	June 29	37	Sept.09	15	---	0	---	0	02
1991	June 13	16	July 07	72	---	0	---	0	02
1992	June 25	16	July 19	20	Aug. 17	0	---	0	03
1993	Aug. 07	23	Sept. 28	13	---	0	---	0	02
1994	June 15	14	July 15	45	Sept. 07	28	---	0	03
1995	July 11	10	Sept.17	27	---	0	---	0	02
1996	July 12	40	Sept.17	27	---	0	---	0	02
1997	July 08	31	Sept.25	24	---	0	---	0	02
1998	Sept.13	10	---	0	---	0	---	0	01
1999	June 25	11	July 18	13	Aug.03	35	---	0	03
2000	June 17	13	July 14	25	Sept.01	27	---	0	03
2001	June 21	42	Aug.26	20	---	0	---	0	02
2002	Aug.13	11	Sept.07	40	---	0	---	0	02
2003	Aug.29	25	---	0	---	0	---	0	01
2004	Aug.07	29	Sept.12	10	---	0	---	0	02
2005	July 31	11	Aug. 25	10	Sept. 11	10	Sept.24	21	04
2006	July 06	30	Aug.12	11	Aug.30	14	---	0	03
2007	June 29	26	Aug.01	24	---	0	---	0	02
Mean	July 14	21	Aug.21	23	Aug.27	21	Sept.24	21	

Critical dry spell: when length of dry spell exceeds 10 days, Average number of CDS: 2

of CDS and their mean duration. Average dates of commencement and end of wet spells are also given as above.

Conclusion:

– The average monthly rainfall for Beed was found to be varied from 4.39 mm to 190.41 mm.

– The average annual rainfall at Beed was recorded as 758.23 mm.

– The average number of rainy days was found to be 37.6 days.

– The mean date of OEM was found to be June 29.

– The mean dates of end of monsoon were found to be October 9.

– The mean dates of critical dry spells were July 14 with duration of 21 days for first, August 21 with duration of 23 days for second, August 27 with mean duration of 21 days for third and September 24 with mean duration of 21 days for fourth CDS.

– The mean dates of wet spells were June 29 to July 13 for first, August 4 to August 20 for second and September 18 to September 24 for third wet spells.

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