Annals of Plant and Soil Research 18(3): 280-283 (2016)

ANALYSIS OF RAINFALL FOR DROUGHT OCCURRENCES IN MAYURBHANJ, ODISHA

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Received: April, 2016; Revised accepted: July, 2016

ABSTRACT

Assessment of drought occurrence is one of the most important steps in risk management of drought analysis. Drought is mostly the result of a decrease in precipitation in comparison with the mean value and would affect the quantities of soil moisture and water resources. It is, therefore, necessary to study the rainfall analysis for developing farming system which may help to increase and stabilize agriculture production through better use of natural resources. The analysis of 19 years (1979-2015) daily rainfall data of Mayurbhanj, Odisha has been carried out to determine the occurrence of drought. Based on weekly rainfall analysis, it was found that during 19 years, 51 % weeks were drought, 37 % normal and 12 % abnormal weeks. The results of the monthly rainfall analysis showed that about 64% of total number of months was normal. This analysis will help for crop planning and for design of soil and water conservation structure for future need.

Key words: Abnormal rainfall, crop planning, drought, rainfall analysis, normal

INTRODUCTION

Rainfall is the most important natural hydrologic event and is a unique phenomenon varying both in space and time. Rainfall distribution is very uneven and it not only varies considerably from place to place but also fluctuates from year to year. As a general rule, different regions assume a certain level of water shortage based on the long-term climatic conditions experienced by it. Therefore, any deviation from these levels creates either a conditions of drought or flood, depending on the intensity and duration of these deficits or surplus. Thus drought conditions vary among regions of differing climates should therefore be studied within a regional context (Demuth and Stahl 2001). Drought is a major natural hazard having severe consequences in regions all over India. The range of drought impacts is related to drought occurring in different stages of the hydrological cycle and usually different types of droughts are distinguished. The origin is a meteorological drought, which is defined as a deficit in precipitation. The basis of drought indices mostly depends on measurements as the deviations of precipitation values from the long-term mean value during a particular period of time. In response to the different impacts of drought in different regions, a large number of quantitative drought characteristics have been developed. The published summaries can be found (Heim 2002, Smakhtin and Hughes 2004 Hayes 2005). In the past many drought indices have been developed, as an useful and simple method for monitoring and assessment various categories of drought (Mishra *et al.,* 2010). In India, large parts of the country perennially reel under recurring drought. Over 68% of the total area is vulnerable to drought. The 'chronically drought-prone areas' is around 33% and receive less than 750 mm of rainfall, while 35%, classified as 'drought-prone' receive rainfall of 750-1,125mm. Several workers have done meteorological analyses based on rainfall data. Meteorologically a day is considered dry when it receives rainfall less than 2.5 mm (Chowdhary, 1979). According to the India Meteorological Department (IMD), meteorological drought occurs when the seasonal rainfall received over an area is less than 75% of its long-term average value. (Satapathy *et al.* 1998; 1999; Sharma *et al.* 1979, 1987a. and 1987b) analysed the rainfall using the definition of drought month as a month in which the actual rainfall is less than 50% of the average monthly rainfall. Sharma and Verma (1983) analyzed the drought using the definition of drought month, drought week and drought year for different regions as receiving actual rainfall equals to the 50% of the average rainfall.

MATERIALS AND METHODS

The study place, Mayurbhanj has an area of 10,418 km², and is located at 22.0087° N

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latitude and 86.4187° E longitude with an altitude of 559 m above mean sea level. Daily rainfall data of 19 years (1997-2015) was collected from India Meteorological Department (IMD) Pune to analyse the drought occurrence in the district. The daily rainfall data for each standard metrological week was added to compute the weekly rainfall. Similarly, the daily rainfall in each month was added to compute the monthly rainfall in a particular year. Also the annual rainfall was computed by adding the monthly rainfall in that particular year.The drought estimation was made by considering definition of different terms. Drought week/month was defined as receiving rainfall less than 50 % of the average weekly/monthly rainfall whereas normal week/month receiving rainfall in between 50–200% of average rainfall. Abnormal week /month was defined as any week receiving rainfall more than twice the average weekly rainfall.Sharma *et al.* (1978) had also defined yearly criteria for determination of drought years as any year receiving rainfall less than or equal to X-SD, Normal year is any year receiving rainfall in between the limits of X-SD to X+SD and abnormal year is the year receiving rainfall more than or equal to X+SD, where

X – Population mean I.E the mean yearly rainfall and

SD – Standard deviation with same unit as that of X

RESULTS AND DISCUSSION

Weekly analysis of rainfall data

The weekly rainfall data were analyzed to compute mean weekly rainfall, per cent drought, normal and abnormal weeks. The drought weeks were analyzed by using criteria as discussed earlier in methodology. The average maximum weekly rainfall was obtained in 28th M.W. (*i.e.* 114.47 mm).

Table 1: Weekly average rainfall and criteria for drought, normal and abnormal weeks

Meteorological week number	Average weekly rainfall (mm)	Number of weeks		
		Drought weeks	Normal weeks	Abnormal weeks
18	24.24	6	11	2
19	30.09	10	5	4
20	36.46	6	11	2
21	59.18	3	14	2
22	60.58	6	10	3
23	75.39	5	13	1
24	73.02	6	11	2
25	63.45	5	13	1
26	76.21	5	12	2
27	77.09	6	12	1
28	114.47	3	16	0
29	96.91	3	16	0
30	103.52	2	16	1
31	75.52	4	15	0
32	84.89	5	13	1
33	99.33	3	16	0
34	64.87	4	15	0
35	70.05	7	10	2
36	76.75	4	15	0
37	58.28	4	15	0
38	91.57	5	12	2
39	42.32	8	7	4
40	53.83	8	8	3
41	27.67	12	4	3
42	18.00	12	4	3
43	9.35	10	5	4
44	12.62	14	2	3
45	2.84	14	1	4
46	4.11	13	3	3
47	2.34	16	1	2
48	2.38	17	1	1
49	2.92	17	0	2
Total		243	307	58

The maximum number of normal weeks obtained in 28th, 29th, 30th and 33rd M.W. (*i.e.* 16 times) out of 15 years rainfall data. The meteorological weeks from 18th S.M. week to 44th S.M. weeks are major rainy weeks (Table 1). It was found that, during 19 years period of rainfall data, 51 % weeks were drought, 37 % normal and 12 % abnormal weeks The minimum number of drought weeks has occurred 2 times in 30th M.W, while the maximum numbers of droughts were observed in 17 times in 48th and 49th week during the 19 years rainfall data.

Analysis of monthly rainfall data

The normal, abnormal and drought months were analyzed on the basis of definitions explained in the methodology. The rainfall for a monthly data to be a drought, abnormal or normal with the average rainfall has been shown in Table 2. The average maximum monthly rainfall was about 429.93 mm in the month of July. The average monthly rainfall was 148.86 mm. It was seen that arrival of monsoon is mainly during the end of May and withdrawal of monsoon occurs during first week of October so the main rainy season is from June to September. The months from January to April, received very less rainfall, *i.e.* the drought occurrence was very high during these months. The results of the rainfall analysis showed that about 64% of total numbers of month were normal for 19 years period. It can be seen from Table 2 that about 49 % of normal month occurred during monsoon season *i.e.* June to September whereas one time in June drought occurred. It was also seen that 30 % total number of months was drought month during 19 years period. Most drought occurred from January to April as that time there was very little rainfall whereas months of July, August and September did not suffer from drought in 19 years period. Abnormal months occurred in the month of January, February and April with an average rainfall of 15.89 mm, 17.27 mm and 53.56 mm respectively. Only 3 % of total number of months was abnormal in 19 years period.

Table 2: Number of drought, normal and abnormal months in 19 years period

Sr. No.	Average monthly rainfall (mm)	Number of months		
		Drought	Normal	Abnormal
January	15.89	11	5	3
February	17.27	10	8	1
March	24.03	10	9	0
April	53.56	9	9	1
May	181.55	2	17	0
June	302.04	1	18	0
July	429.93	0	19	0
August	360.07	0	19	0
September	283.28	0	19	0
October	95.65	6	11	2
November	15.13	8	10	3
December	7.95	13	2	4
Total		70	146	14

Analysis of yearly rainfall data

In Mayurbhanj district, the average annual rainfall was 1808.2 mm and value of S.D. were found to be 199.06. The drought, normal and abnormal years was determined by criteria as discussed earlier. Therefore, any year receiving rainfall less than or equal to 1609.14 mm will be drought year. Distribution of annual rainfall was shown in Table 3. Thus, as per the above definitions, 11% years (*i.e.* 2009 and 2010) were drought years. Any year receiving rainfall equal to or greater than 2007.26 mm will be abnormal. Thus, 26 % of total years for the period studied. The years receiving rainfall in between 1609.14 to 2007.26 mm will be normal years. Thus, remaining 63% of years (1997, 1998, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2012, 20014 and 2015) are the normal years for the period studied. Rainfall is the most important component in agriculture production and its spatial and temporal distribution is uneven uncertain and erratic in nature.

Table 3: Yearly intensity of drought in 19 years period

Year	Average rainfall (mm)	Category
1997	1700.2	Normal
1998	1631.9	Normal
1999	2174.4	Abnormal
2000	1739.3	Normal
2001	1800.4	Normal
2002	1804.3	Normal
2003	1803.8	Normal
2004	1750.3	Normal
2005	1705.2	Normal
2006	1898.6	Normal
2007	2025	Abnormal
2008	2055.7	Abnormal
2009	1557.3	Drought
2010	1498	Drought
2011	2083.4	Abnormal
2012	1631.4	Normal
2013	2122.1	Abnormal
2014	1627.2	Normal
2015	1747.3	Normal

More than 75% of rainfall occurs during 22nd to 42nd week . There is a good amount of rainfall in May which is considered as pre monsoon shower and helps in seed bed preparation. Thus crop planning is suggested based on 70% rainfall along with onset of effective monsoon and drought, normal and abnormal periods. This requirement is completed by rainy season and excess water may be stored for growing *Rabi* season crops.

REFERENCES

Chawdhary, A., Gokhale, S.S. and Rentala, Q.S, (1979) Dry and wet spells related to agricultural drought in India. Mausam 30 (4) : 501-510.

Demuth S. and Stahl, K. (2001) Assessment of the Regional Impact of Droughts in Europe. Final Report to the European Union, ENV-CT97-0553. Institute of Hydrology, University of Freiburg, Germany.

Heim, Jr., R. R. (2002) A review of twentieth-century drought indices used in the United States, BAMS 83(8): 1149–1165,

Mishra K., Singh P. (2010) A review of drought concepts, *Journal of Hydrology*, 391/1-2: 202-216.

Satapathy, K.K, Jena, S.K, and Choudhury, D.D. (1998) Characteristics of monsoon and rainfall pattern at Umiam, Meghalaya. Indian *Journal of Soil and water Conservation* 42: 151-161.

Satapathy, K.K., Jena, S.K., Choudhury, D.D. and Bundela, D.S. (1999) Climate and its variation at Umiam, Meghalaya. Indian *Journal of Soil Conservation.* 27 (2): 166-170.

Sharma, H.C., Chauhan, B.S. and Ram, S. (1979) Probability analysis of rainfall for crop planning. *Journal of Agricultural Engineering.* XVI (3):22-28.

Sharma, H.C., Shrivas, R.N. and Tomar, R.K.S. (1987a) Agricultural planning on the basis of rainfall. *Journal of Indian Water Resources Society* 7(2):17-27.

Sharma, H.C., Tiwari, Y.D., Shrivas, R.N.and Chouskey,R.S. (1987b).Analysis of rainfall data for agriculture planning. *Journal of Institute of Engineers* 68:1-6.

Sharma, P.S.B and Verma, H.N. (1983) Analysis of short duration rainfall for planning rainfed crops. *Journal of Agricultural Engineering* ISAE. 25 (3).

Smakhtin, V. U. and Huges, D. A. (2004) Review, automated estimation and analyses of drought indices in South Asia, Working Paper 83, International Water Management Institute, Colombo, Sri Lanka.