Int.J.Curr.Microbiol.App.Sci (2020) *9*(9): 1353-1361

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 9 Number 9 (2020)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2020.909.165

Assessment of Meteorological Drought in Damoh District, M. P., India

Rajesh Khavse* and R. K. Dwivedi

Krishi Vigyan Kendra Damoh, JNKVV, Jabalpur, India

**Corresponding author*

Keywords

Meteorological Drought, Rainfall and Damoh

Article Info

Accepted:
12 August 2020
Available Online:
10 September 2020

A B S T R A C T

In rainfed agriculture, rainfall has a crucial role to play for suitable crop planning. One hundred nineteen years (1901-2019) annual rainfall data has been analysed to find out yearly meteorological drought occurrence at Damoh district shows that maximum rain 1874.6 mm is in1990 and minimum rainfall is 614 mm in 1993. Annual average rainfall is 1196 mm. Based on rainfall analysis, it was found that during 119 years no severe and extreme drought year was experienced. However, there was 15 moderate drought (1913, 1918, 1941, 1965, 1966, 1987, 1988, 1989, 1991, 1992, 1993, 2006, 2007, 2014 and 2017) and 45 mild drought (1901, 1902, 1903, 1904, 1905, 1907, 1908, 1909, 1910, 1911, 1912, 1914, 1920, 1921, 1924, 1927, 1928, 1930, 1950, 1952, 1953, 1954, 1957, 1964, 1968, 1972, 1974, 1975, 1979, 1981, 1984, 1986, 1995, 1996, 1997, 1998, 2000, 2001, 2002, 2004, 2009, 2012, 2015, 2018 and 2019) years. The decreasing trend in damoh district and coefficient of determination R^2=0.004 indicating only 0.4% of the variation in annual rainfall can be explained by the regression model. To reduce the problem of water scarcity in drought years, proper rain water harvesting must be done.

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. It is one of the most important and governing factor in the planning and operation strategies of any agricultural programme for any given area. Agricultural development largely depends upon the management of natural resources. India receives adequate amount of rainfall annually through the four seasons *viz.*, south–west monsoon (74%), north-east monsoon (3%), pre-monsoon (13%) and post-monsoon (10%) (Dabral *et al.*, 2009). In rainfed farming, the crop planning and its success depend upon the amount and distribution of rainfall. For planning of agricultural operations weekly data are more useful than monthly, seasonal and annual rainfall.

According to Indian Meteorological Department (IMD), a meteorological subdivision (part of India) can be considered as affected by drought, if it receives total seasonal rainfall less than 75% of the normal value. The occurrence of drought on a continuous basis leads to reduced availability of fodder, decline in agricultural production, livestock wealth and badly affect the people inhabiting these areas. Drought produces both direct and indirect impacts. Direct or primary impacts are usually physical / material and include reduced agricultural production, increased fire hazards, deplete water level, higher livestock and wildlife mortality rates, and damage to wildlife and fish habitats. Even though drought affects large areas worldwide and has serious impacts on society, environment and economy; it is still one of the least understood of all the weather phenomena.

As such no general method is available which can be applied for the drought prediction (Salas, 1986). Meteorological drought is the condition when a region receives less than half the amount of normal precipitation (IMD, 1971). In spite of having good potential of rain water, Damoh faces the problem of water scarcity during the maximum part of year (Kumar and Rajput, 2013). Shrivastava *et al.*, (2008) assessed meteorological drought in north Lakhimpur district of Assam and Lala I P Ray *et al.*, in Barapani of Meghalaya. Kumar and Kumar (1989), Dabral (1996) analysed weekly, monthly, seasonally and yearly rainfall data for drought situation at Pantnagar and Ranchi station respectively. Damoh city is the district place of Madhya Pradesh state is located between 23^{o} 50'20.59" North and 79^{o}26' 27.69" East. The average annual rainfall of Damoh district is 1196.0 mm. Damoh district received maximum rainfall during southwest monsoon period i.e. June to September. About 90.7% of the annual rainfall received during monsoon season. Only 9.2% of the annual rainfall takes place between October to May period. Thus, surplus water for ground water recharge is available only during the southwest monsoon period. The normal maximum temperature received during the month of May is 42.0°C and minimum during the month of December/January is 9.7°C. The normal annual means maximum and minimum temperatures of Damoh district is 32.6° and 18.9°C respectively. During the southwest monsoon season the relative humidity generally exceeds 88% (August month). In the rest of the year it is drier. The driest part of the year is the summer season, when relative humidity is less than 31%. May is the driest month of the year. It is at an average elevation of 595 meters (1,952 ft). The district of Damoh has an area of 7,306 square km (2,821 sq mi).

In maximum part of the district water scarcity is the major problem during maximum part of year (Khan Seraj, 2009, Kumar A and Rajput PS, 2013). Present study aims to analyses the trend of annual rainfall of vital important in all activities which is the only resources of renewable water resource and analyze the cause of scarcity of water.

Materials and Methods

In the study to analyze the cause of water scarcity (Map) (Fig. 1), yearly precipitation values of Damoh have been obtained from State Metrological Service for meteorological drought analysis. Record intervals of precipitation values are listed in Table 2. Drought year: the annual rainfall is deficient by 20- 60 % of average yearly rainfall and if the deficient is more than 60 % of average yearly rainfall is known as scanty drought year (Dhar *et al.*, 1979). Yearly intensity of drought was also determined using the criteria suggested by IMD (1971) which is based on percentage deviation of rainfall from its long term mean and it is given by (Eq.)

$$Di = \frac{Pi - \mu}{\mu} X100$$

Where,

Di is the percentage deviation from the long term mean,

Pi is the annual rainfall, mm and

μ is the long term mean of annual rainfall, mm

Drought codification based on percentage departure of rainfall from normal is presented in Table 1. The percentage of deviation (Di) is then used to categories the drought. On the basis of percentage depature drought conditions are dividing into five categories as No drought (M0), Mild drought (M1), Moderate drought (M2), Severe drought (M3) and Extreme drought (M4).

Results and Discussion

Year wise, rainfall, long term mean, percent deviation and drought category is shown in table 2 and fig. 2. Meteorological records of Damoh district shows that maximum rain 1864 mm is in 1990 and minimum rainfall is 614 mm in 1993. Rainfall of 119 years has been studied and percentage deviation of rainfall is calculated and categorized as No Drought, Mild Drought, Moderate Drought, Severer Drought and Extreme Drought as respectively M0, M1, M2, M3 and M4. In 119 years, no drought/ normal rain years are 59, mild drought years are 45, moderate 15, severe and extreme is nil (Table 3 and Fig. 3). The decreasing trend in damoh district and coefficient of determination R^2=0.004 indicating only 0.4% of the variation in annual rainfall can be explained by the regression model in fig. 4.

Fig.1 Location map study area (Damoh District)

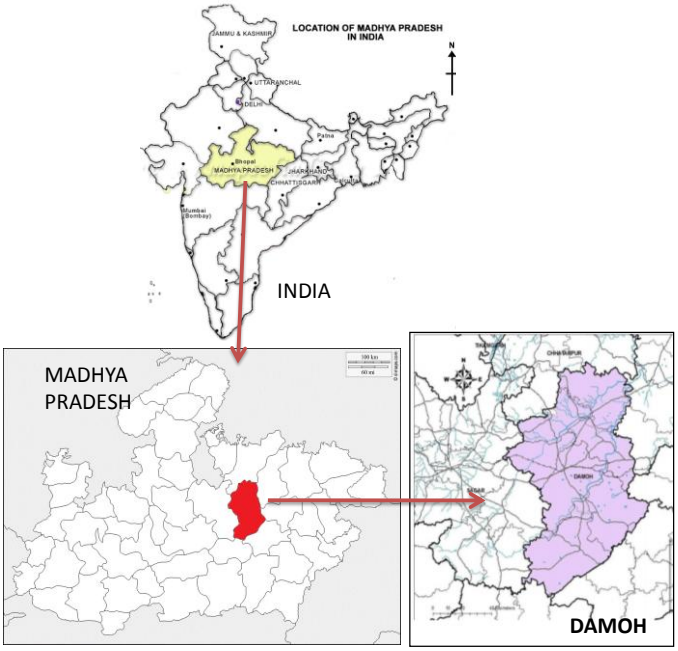

Table.1 Category of drought codification based on percentage deviation of rainfall from normal value (IMD, 1971)

Percentage departure of rainfall from normal	Category Intensity of Drought	Code
0.0 or above	No drought	M0
0.0 to -25.0	Mild drought	M1
-25.0 to - 50.0	Moderate drought	M2
-50.0 to -75.0	Severe drought	M3
-75.0 to less	Extreme drought	M4

Table.2 Yearly intensity of drought for Damoh (Source: Ashwini *et al.*, 2007)

Year	Annual	Normal	Dev. (%)	Category	Code
1901	1179.7	1196.0	-1.4	Mild Drought	M1
1902	976.8	1196.0	-18.3	Mild Drought	M1
1903	1181.6	1196.0	-1.2	Mild Drought	M1
1904	1093.9	1196.0	-8.5	Mild Drought	M1
1905	856.4	1196.0	-28.4	Mild Drought	M1
1906	1212.2	1196.0	1.4	No Drought	M0
1907	963.3	1196.0	-19.5	Mild Drought	M1
1908	1154.8	1196.0	-3.4	Mild Drought	M1
1909	1093.6	1196.0	-8.6	Mild Drought	M1
1910	1094.9	1196.0	-8.5	Mild Drought	M1
1911	1092.1	1196.0	-8.7	Mild Drought	M1
1912	986.7	1196.0	-17.5	Mild Drought	M1
1913	824.5	1196.0	-31.1	Moderate Drought	M2
1914	1025.6	1196.0	-14.2	Mild Drought	M1
1915	1302.0	1196.0	8.9	No Drought	M0
1916	1274.9	1196.0	6.6	No Drought	M0
1917	1386.9	1196.0	16.0	No Drought	M0
1918	878.9	1196.0	-26.5	Moderate Drought	M2
1919	1512.7	1196.0	26.5	No Drought	M0
1920	965.6	1196.0	-19.3	Mild Drought	M1
1921	1130.7	1196.0	-5.5	Mild Drought	M1
1922	1266.1	1196.0	5.9	No Drought	M0
1923	1429.4	1196.0	19.5	No Drought	M0
1924	1069.7	1196.0	-10.6	Mild Drought	M1
1925	1325.3	1196.0	10.8	No Drought	M0
1926	1337.7	1196.0	11.8	No Drought	M0
1927	1189.3	1196.0	-0.6	Mild Drought	M1

1928	1021.2	1196.0	-14.6	Mild Drought	M1
1929	1424.4	1196.0	19.1	No Drought	M0
1930	1094.0	1196.0	-8.5	Mild Drought	M1
1931	1402.5	1196.0	17.3	No Drought	M0
1932	1207.1	1196.0	0.9	No Drought	M0
1933	1211.2	1196.0	1.3	No Drought	M0
1934	1699.0	1196.0	42.1	No Drought	M0
1935	1340.5	1196.0	12.1	No Drought	M0
1936	1245.7	1196.0	4.2	No Drought	M0
1937	1275.0	1196.0	6.6	No Drought	M0
1938	1371.0	1196.0	14.6	No Drought	M0
1939	1237.9	1196.0	3.5	No Drought	M0
1940	1274.6	1196.0	6.6	No Drought	M0
1941	766.1	1196.0	-35.9	Moderate Drought	M2
1942	1377.3	1196.0	15.2	No Drought	M0
1943	1263.6	1196.0	5.6	No Drought	M0
1944	1684.2	1196.0	40.8	No Drought	M0
1945	1369.7	1196.0	14.5	No Drought	M0
1946	1255.4	1196.0	5.0	No Drought	M0
1947	1668.3	1196.0	39.5	No Drought	M0
1948	1541.4	1196.0	28.9	No Drought	M0
1949	1387.8	1196.0	16.0	No Drought	M0
1950	1065.6	1196.0	-10.9	Mild Drought	M1
1951	1224.0	1196.0	2.3	No Drought	M0
1952	1088.5	1196.0	-9.0	Mild Drought	M1
1953	1065.5	1196.0	-10.9	Mild Drought	M1
1954	1160.1	1196.0	-3.0	Mild Drought	M1
1955	1582.9	1196.0	32.4	No Drought	M0
1956	1693.2	1196.0	41.6	No Drought	M0
1957	1041.2	1196.0	-12.9	Mild Drought	M1
1958	1257.7	1196.0	5.2	No Drought	M0
1959	1360.8	1196.0	13.8	No Drought	M0
1960	1465.8	1196.0	22.6	No Drought	M0
1961	1550.3	1196.0	29.6	No Drought	M0
1962	1515.8	1196.0	26.7	No Drought	M0
1963	1327.2	1196.0	11.0	No Drought	M0
1964	1092.3	1196.0	-8.7	Mild Drought	M1
1965	792.0	1196.0	-33.8	Moderate Drought	M2
1966	861.9	1196.0	-27.9	Moderate Drought	M2
1967	1297.2	1196.0	8.5	No Drought	M0
1968	980.8	1196.0	-18.0	Mild Drought	M1

1969	1324.5	1196.0	10.7	No Drought	M0
1970	1359.4	1196.0	13.7	No Drought	M0
1971	1403.1	1196.0	17.3	No Drought	M0
1972	1005.0	1196.0	-16.0	Mild Drought	M1
1973	1513.6	1196.0	26.6	No Drought	M0
1974	1080.7	1196.0	-9.6	Mild Drought	M1
1975	1179.5	1196.0	-1.4	Mild Drought	M1
1976	1196.8	1196.0	0.1	No Drought	M0
1977	1377.8	1196.0	15.2	No Drought	M0
1978	1458.5	1196.0	22.0	No Drought	M0
1979	956.9	1196.0	-20.0	Mild Drought	M1
1980	1286.7	1196.0	7.6	No Drought	M0
1981	986.9	1196.0	-17.5	Mild Drought	M1
1982	1530.7	1196.0	28.0	No Drought	M0
1983	1437.8	1196.0	20.2	No Drought	M0
1984	915.6	1196.0	-23.4	Mild Drought	M1
1985	1319.6	1196.0	10.3	No Drought	M0
1986	967.7	1196.0	-19.1	Mild Drought	M1
1987	889.5	1196.0	-25.6	Moderate Drought	M2
1988	885.5	1196.0	-26.0	Moderate Drought	M2
1989	855.0	1196.0	-28.5	Moderate Drought	M2
1990	1847.6	1196.0	54.5	No Drought	M0
1991	752.2	1196.0	-37.1	Moderate Drought	M2
1992	720.8	1196.0	-39.7	Moderate Drought	M2
1993	614.6	1196.0	-48.6	Moderate Drought	M2
1994	1599.0	1196.0	33.7	No Drought	M0
1995	1053.8	1196.0	-11.9	Mild Drought	M1
1996	1063.5	1196.0	-11.1	Mild Drought	M1
1997	1026.6	1196.0	-14.2	Mild Drought	M1
1998	1182.8	1196.0	-1.1	Mild Drought	M1
1999	1282.4	1196.0	7.2	No Drought	M0
2000	1002.5	1196.0	-16.2	Mild Drought	M1
2001	1031.9	1196.0	-13.7	Mild Drought	M1
2002	903.5	1196.0	-24.5	Mild Drought	M1
2003	1593.6	1196.0	33.2	No Drought	M0
2004	1048.7	1196.0	-12.3	Mild Drought	M1
2005	1666.8	1196.0	39.4	No Drought	M0
2006	806.0	1196.0	-32.6	Moderate Drought	M2
2007	888.9	1196.0	-25.7	Moderate Drought	M2
2008	1259.4	1196.0	5.3	No Drought	M0
2009	927.3	1196.0	-22.5	Mild Drought	M1

2010	1254.8	1196.0	4.9	No Drought	M0
2011	1346.4	1196.0	12.6	No Drought	M0
2012	1110.9	1196.0	-7.1	Mild Drought	M1
2013	1721.9	1196.0	44.0	No Drought	M0
2014	850.8	1196.0	-28.9	Moderate Drought	M2
2015	914.6	1196.0	-23.5	Mild Drought	M1
2016	1707.3	1196.0	42.8	No Drought	M0
2017	757.5	1196.0	-36.7	Moderate Drought	M2
2018	949.8	1196.0	-20.6	Mild Drought	M1
2019	1160.9	1196.0	-2.9	Mild Drought	M1

Fig.2 Deviation Percentage of rainfall from normal for Damoh, M. P.

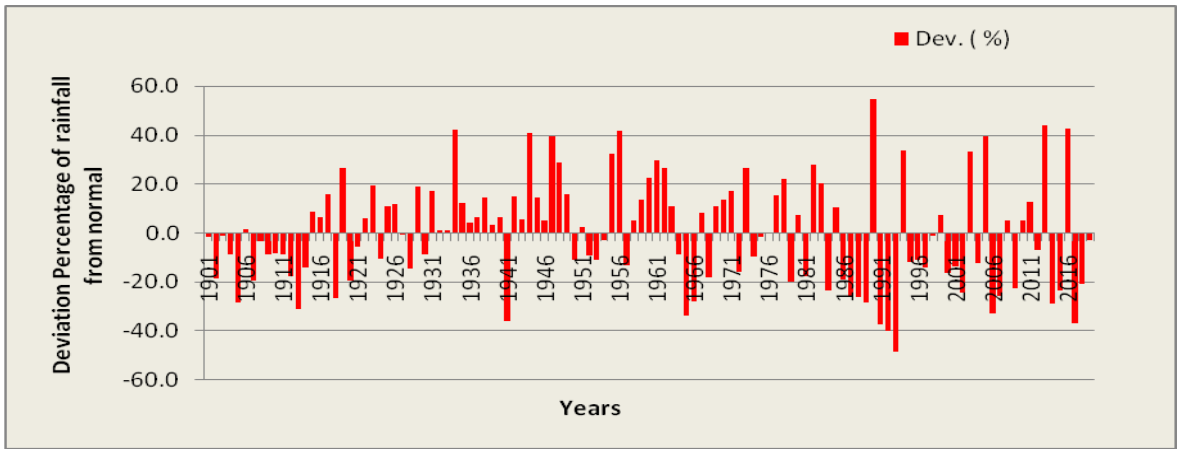

Fig.3 Drought frequencies for Damoh, M. P.

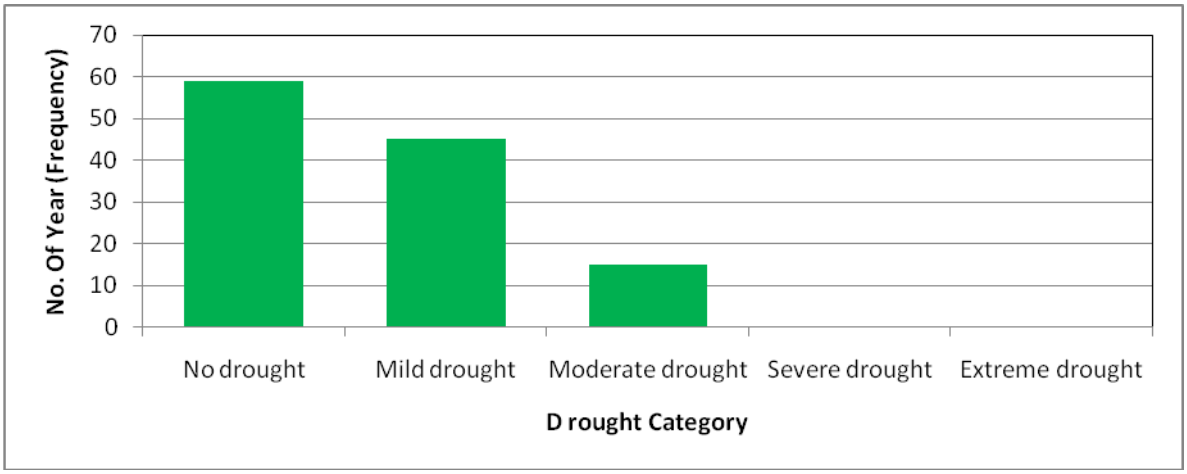

Fig.4 Annual rainfall trends for Damoh, M. P.

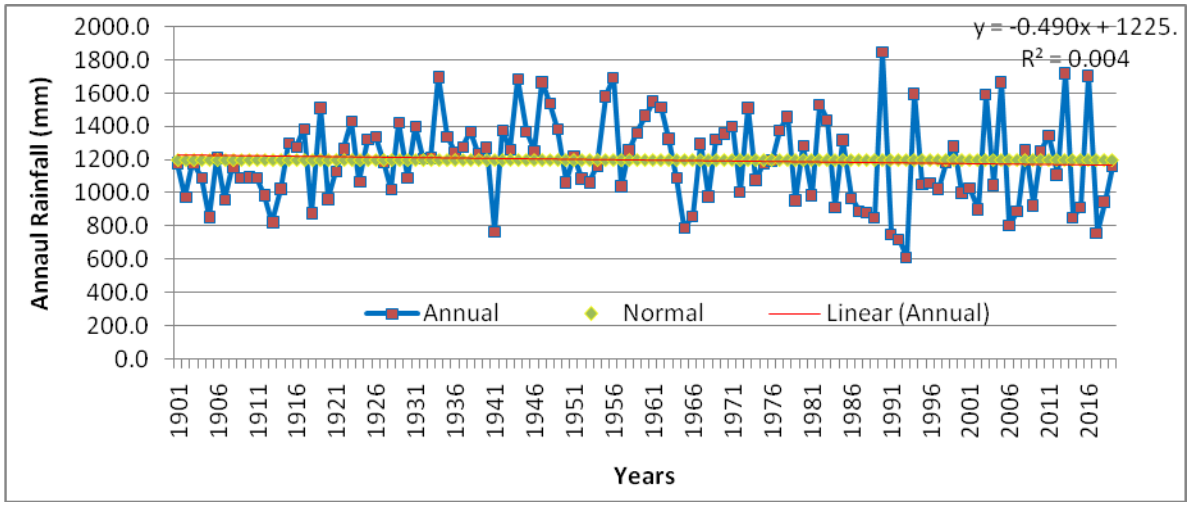

Table.3 Drought codification based on percentage deviation of rainfall

Category Intensity of Drought	Code	No of years (1901-2019)	%
No drought	M0	59	50
Mild drought	M1	45	38
Moderate drought	M2	15	13
Severe drought	M3	Nil	Nil
Extreme drought	M4	Nil	Nil

Obtained data clearly shows that out of 119 years, number of drought years of different drought intensity is shown in Table 3 and represented in Figure 3. No drought (M0) years which are above the normal average rainfall are 50 %. No of years of different intensities of drought are M1 38%, M2 13 %, M3 and M4 Nil. Within 10 years (every decade) 3 to 4 years face good rain (no drought) & 4 to 5 years are faces normal / near normal rain (Mild drought) and 1 to 2 year face Severe to extreme drought (Table 3).

Conclusion of the study is as follows:

In Damoh district annual rainfall equally deviates ±25 % from normal average yearly rainfall. The yearly rainfall is good but scarcity of water during maximum part of the year and flood situation during monsoon needs proper management of water resources

References

Ashwini A. Ranade, Nityanand Singh, H.N. Singh and N.A. Sontakke (2007) "Characteristics of Hydrological Wet Season over Different River Basins of India", Indian Institute of Tropical Meteorology Pune.

Berkat, O. and M. Tazi, (2006) "Country Pasture/Forage Resource Profiles MOROCCO".

Dabral P. P. (1996) "Meteorology drought analysis on rainfall data" Ind. J. Soil Cons., 24 (1) 37- 40.

Dhar D. N., Rakheha P. R. and Kulkarni A.

K. (1979) "Rainfall Study of Serves Drought Years of India", Drought, Vol. I, p. 314, New Delhi.

India Meteorological Department (IMD) (1971) "Climate Diagnostic Bulletin" of India- June, July, August 1971; Rep. No 88, 89 and 90, National Climate Center, IMD, Pune.

Khan Seraj (2009), District Ground Water Information Booklet of Damoh District Madhya Pradesh

Kumar Ajay and Rajput Pushpendra Singh (2013) "Water harvesting potential of Damoh river basin of Damoh M.P.", Bioved, 24(1): 1–7

Kumar Ajay and Rajput Pushpendra Singh (2013) "Water harvesting potential of Damoh river basin of Damoh M.P.", Bioved, 24(1): 1–7

Kumar D. and Kumar S. (1989) "Drought analysis based on rainfall data", Ind. J. Soil Cons., 17 (1) 50- 60.

Lala I. P. Ray, P. K. Bora, V. Ram, A. K. Singh, R. Singh and S. M. Feroze (2012) "Meteorological Drought Assessment in Barapani, Meghalaya", J of Ind. Water Res. Soc, 32 (1), 56- 61.

Raju N. Janardhana, (2007), Hydro geochemical parameters for assessment of groundwater quality in the upper Gunjanaeru river watershed, Cuddapah district, Andhra Pradesh, South India. Environmental Geology 52, 1067- 1074

Salas J. D. (1986) "State of the art of statistical technique for describing drought characteristic WARRDCC, International seminar on Drought Analysis.

Shrivastava S. K., Rai R. K., Pandey A. (2008) "Assessment of meteorological in north Lakhimpur district of Assam", J of Ind. Water Res. Soc., 28 (2) 26- 31.

How to cite this article:

Rajesh Khavse and Dwivedi, R. K. 2020. Assessment of Meteorological Drought in Damoh District, M. P., India. *Int.J.Curr.Microbiol.App.Sci.* 9(09): 1353-1361.
doi: https://doi.org/10.20546/ijcmas.2020.909.165