Global Journal of Research and Review (GJRR)
www.gjrr.org

Original Article

Assessment of Meteorological Drought- "A Case Study of Solapur District, Maharashtra, India"

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ABSTRACT

Meteorological drought is a big disaster for any type planning of agriculture in India. By the analysis of 60 years rainfall data of Solapur district, which is taken by agricultural department, maximum years have no drought, in relation to deviation from long term average rainfall (±19 %, no draught, moderate drought between deficiency -20 to -59 % and deficiency more than -60 % severe droughts). Severe drought occurred only in three years, moderate drought occurred in about ten years and for maximum years no draught intensity of rainfall condition has occurred. To get the intensity of drought, parameters are used which are suggested by IMD, 1971. Minimum intensity of rainfall is found in 1968 and maximum intensity of rainfall in 1956. In spite of having normal rainfall for maximum years, Solapur faces water scarcity problem for maximum part of the year. It is necessary to prepare a management plan for the development of water resources to reduce water scarcity.

Keywords: Meteorological drought, Rainfall, Deviation index, Solapur.

INTRODUCTION

Agriculture is one of the most important activities, engaging more than 70 percent populations in India. Indian economy is inextricably linked with the agriculture and its prosperity is entirely dependent on the amount of rainfall received. The rainfall is one of the most important and governing factor in the planning and operation strategies of any agricultural activity for any area. The rainfall patterns have high intra seasonal variability. Also, there is high spatial variability of rainfall over districts of Maharashtra[1,2]. It is very important to study the changing trend of annual precipitation to analyze the cycle of rainfall and drought[3]. The changing pattern of rainfall is also investigated by computing seasonality Index

of rainfall. The relative seasonality of rainfall represents the degree of variability in monthly rainfall throughout the year[4-7]. Factors effecting runoff is evapotranspiration and infiltration[8-12].

Drought is a threat to the food security and human mortality all around the world. On an average 18% of the geographical area of India is vulnerable to droughts. Meteorologically ± 19% deviation of rainfall from the long term mean is considered as normal in India. Deficiency in the range of 20 to 59 % represents moderate and more than 60 % severe drought[13].

Solapur is an administrative district of Maharashtra in India. It lies in between 17^0 10' to 18^0 32' north latitudes and 74^0 42' to 76^0 15' east longitudes and covers an area of 14,895 sq. km. It is divided into 11 tehsils and total population of 43, 15, 527 as per 2011 census. The climate of Solapur district is dry as daily mean maximum temperature range between 30^0c to37^0c and minimum temperature range between 18^0c to 21^0c with the highest temperature about 45^0c in the month of May.

The annual average rainfall is 561.78 mm (last one decade) in Solapur district. Rainfall is uncertain and scanty. The monsoon period is from the second week of June to end of September bringing rains from the south-west monsoon. The major river in the district is Bhima and Sina, Nira, Mann and Bhogawati are its tributaries. The Bhima and Sina run towards the southeast from north-west. The Nira and Mann flow towards nearly east. During the dry season all the rivers are nearly dry. The district is situated on the south east fringe of Maharashtra state and lies entirely in the Bhima and Seena basins. The whole of the district is drained either by Bhima river or its tributaries.

MATERIALS AND METHOD

The present study is based on the rainfall data collected for sixty years from Agricultural Statistical Information State, Socioeconomic Review Solapur District. Yearly intensity of drought is 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.)

$$Di = \left(\frac{Pi - \mu}{\mu}\right) \times 100$$

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.

RESULTS

Solapur**,** district of Maharashtra falls in semiarid region and average rainfall is 553.01 mm (previous 6 decades). Interpretation of rainfall data of 6 decades is carried out for analysis of drought intensity in the area. According to deficiency index, every years is categorized into three category e i. No drought (M_0), moderate drought (M_1) and severe drought (M_2) (Table 1). Rainfall trend (Fig 1) and table 2 shows that maximum years (48 years) have no drought (±19 % deficiency from long term average rainfall). Ten years have moderate drought (-20 to -59 % deficiency from long term average rainfall) and severe drought has occurred only during three years. This shows that Solapur has a normal rainfall.

During 60 years of rainfall trend of Solapur district, one heavy rainfall and one high drought years has occurred in every decade (Fig. 2). Difference between adjacent heavy rainfall and high drought is around eight to twelve years. Frequency of M_0, M_1 & M_2 is shown in Fig. 3 which clearly shows M_0 to be very high and M_1 & M_2 are comparatively very low.

In spite of having normal rainfall (M_0), Solapur is facing water scarcity problem in maximum part of year due to the

maximum runoff of rainwater and over exploitation of ground water. The current situation, demands to prepare a management plan for water resources development.

CONCLUSION

By the interpretation of rainfall data and drought frequency, Solapur has a normal rainfall which fluctuates in between 442.41 to 663.61 mm annually and no drought in maximum years. Moderate and severe droughts have found in few countable years, which is a natural trend. The results suggest for preparation and execution of proper plan of rainwater harvesting and artificial recharging structures.

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Table 1. Drought codification based on percentage departure of rainfall from normal value

S. No	Deficiency index	Intensity of drought	Code
1	-19% or above	No drought	M_0
2	-20 to -59%	Moderate drought	M_1
3	More than -60%	Severe drought	M_2

Table 2. Yearly intensity of drought for Solapur

Y	R	LTM	DI	C	ID		1980	335.8	553.01	-39.28	M_1	MD
1950	502.4	553.01	-9.15	M_0	ND		81	739.6	553.01	33.74	M_0	ND
51	501.6	553.01	-9.30	M_0	ND		82	496.9	553.01	-10.15	M_0	ND
52	419.6	553.01	-24.12	M_1	MD		83	723.2	553.01	30.78	M_0	ND
53	645.2	553.01	16.67	M_0	ND		84	512.6	553.01	-7.31	M_0	ND
54	590.1	553.01	6.71	M_0	ND		85	356.5	553.01	-35.53	M_1	MD
55	716.5	553.01	29.56	M_0	ND		86	323.3	553.01	-41.54	M_1	MD
56	993	553.01	79.56	M_0	ND		87	596.8	553.01	7.92	M_0	ND
57	606.7	553.01	9.71	M_0	ND		88	722.9	553.01	30.72	M_0	ND
58	622.4	553.01	12.55	M_0	ND		89	653.8	553.01	18.23	M_0	ND
59	640	553.01	15.73	M_0	ND		1990	844.5	553.01	52.71	M_0	ND
1960	187.6	553.01	-66.08	M_2	SD		91	448.4	553.01	-18.92	M_0	ND
61	451.9	553.01	-18.28	M_0	ND		92	344.7	553.01	-37.67	M_1	MD
62	660.2	553.01	19.38	M_0	ND		93	612.1	553.01	10.69	M_0	ND
63	580.7	553.01	5.01	M_0	ND		94	199.8	553.01	-63.87	M_2	SD
64	705	553.01	27.48	M_0	ND		95	499	553.01	-9.77	M_0	ND
65	357.9	553.01	-35.28	M_1	MD		96	636.1	553.01	15.03	M_0	ND
66	447.9	553.01	-19.01	M_1	MD		97	495.1	553.01	-10.47	M_0	ND
67	528.5	553.01	-4.43	M_0	ND		98	841.4	553.01	52.15	M_0	ND
68	108.8	553.01	-80.33	M_2	SD		99	570.4	553.01	3.14	M_0	ND
69	588.2	553.01	6.36	M_0	ND		2000	550	553.01	-0.54	M_0	ND
1970	582.2	553.01	5.28	M_0	ND		01	474.7	553.01	-14.16	M_0	ND
71	436.9	553.01	-21.00	M_1	MD		02	429.9	553.01	-22.26	M_1	MD
72	504.5	553.01	-8.77	M_0	ND		03	275.2	553.01	-50.24	M_1	MD
73	661.8	553.01	19.67	M_0	ND		04	542.8	553.01	-1.85	M_0	ND
74	658.4	553.01	19.06	M_0	ND		05	816.4	553.01	47.63	M_0	ND
75	769.3	553.01	39.11	M_0	ND		06	536.14	553.01	-3.05	M_0	ND
76	496.9	553.01	-10.15	M_0	ND		07	649.79	553.01	17.50	M_0	ND
77	470.3	553.01	-14.96	M_0	ND		08	579.05	553.01	4.71	M_0	ND
78	664.6	553.01	20.18	M_0	ND		09	662.19	553.01	19.74	M_0	ND
79	513.7	553.01	-7.11	M_0	ND		2010	651.69	553.01	17.84	M_0	ND

Y. Years
R. Rainfall
LTM. Long Term Mean
DI. Deficiency Index
C. Category
ID. Intensity of Drought

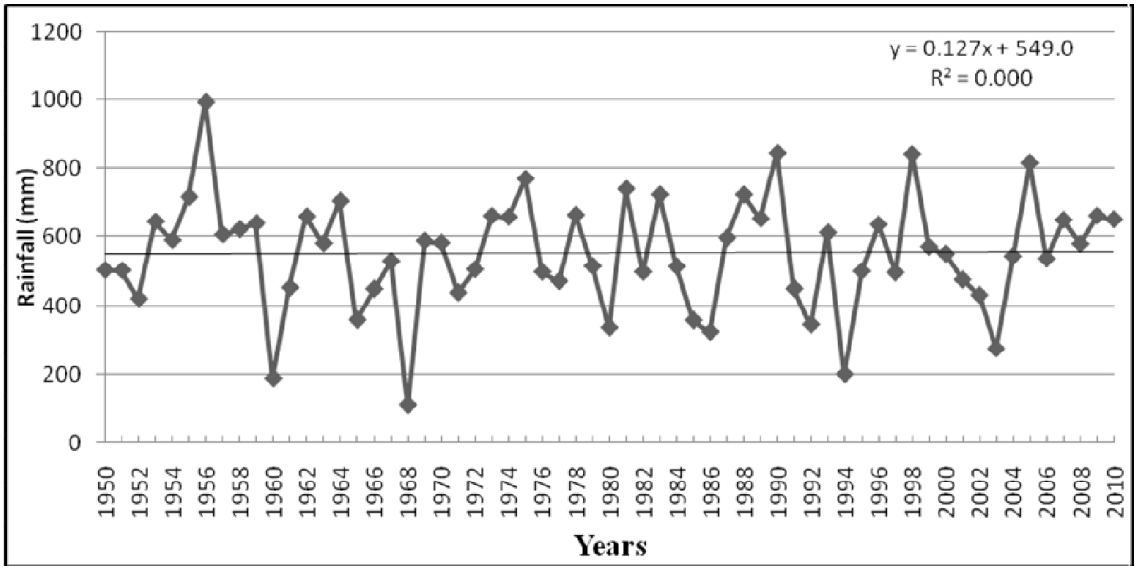

Figure 1. Yearly rainfall trend for Solapur, Maharashtra

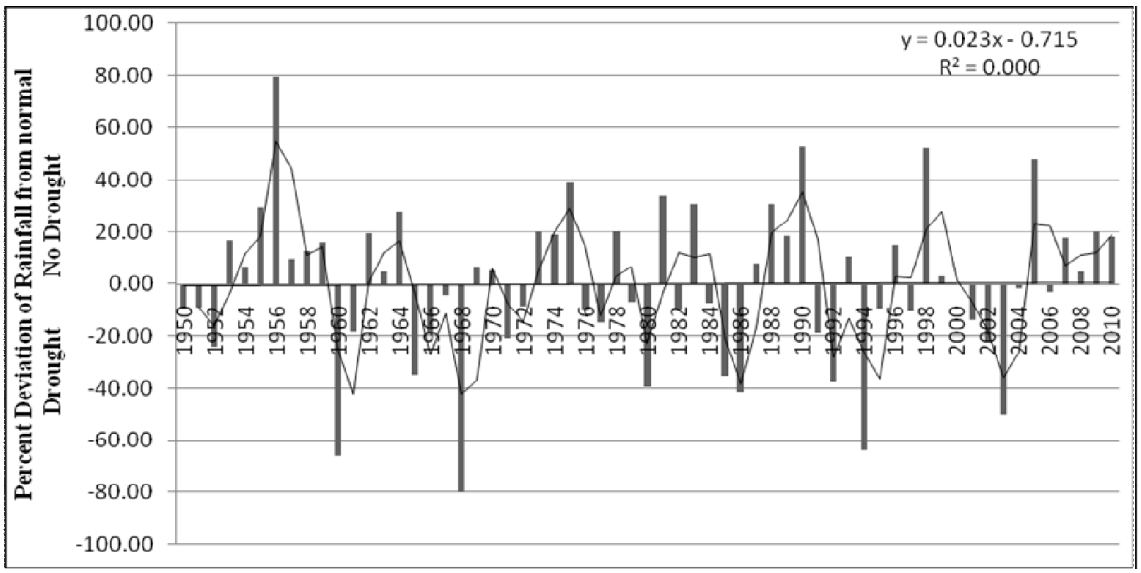

Figure 2. Drought analysis for Solapur, Maharashtra

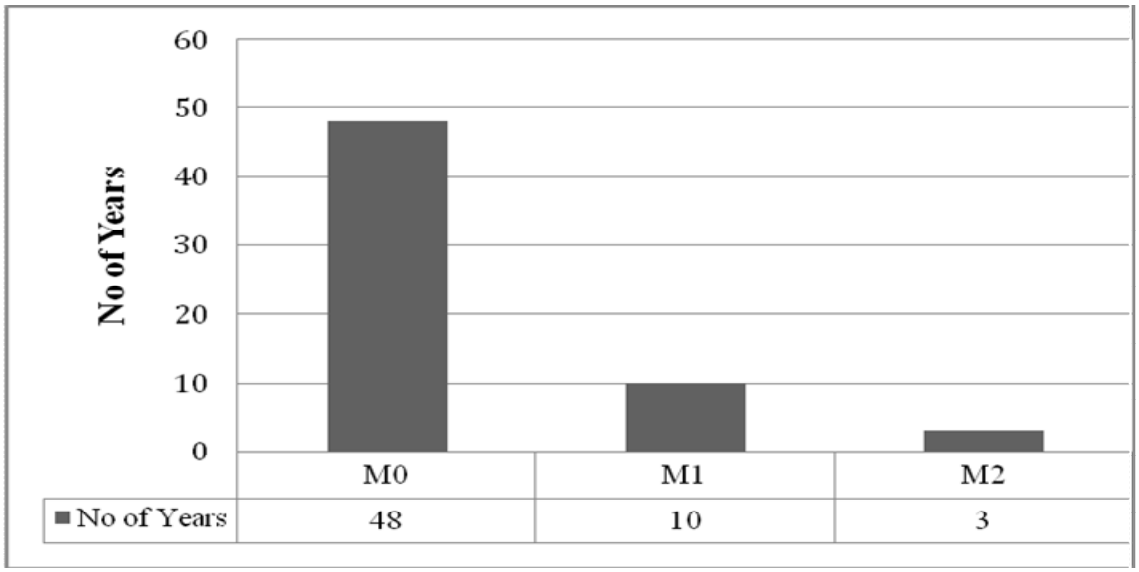

Figure 3. Frequency of drought intensity for Solapur, Maharashtra