EUROPEAN ACADEMIC RESEARCH
Vol. II, Issue 1/ April 2014

Impact Factor: 3.1 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

Rainfall Trend in Drought Prone Region in Eastern Part of Satara District of Maharashtra, India

BARAKADE ANKUSH JAGANNATH
Department of Geography
Karmaveer Bhaurao Patil Mahavidyalaya, Pandharpur
Dist - Solapur Maharashtra
India

Abstract:

In this paper the present study reveals the tahsilwise annual rainfall trend in Satara District of Maharashtra State during 1991 to 2011. The rainfall is one of the fundamental physical parameter among the climate as for the development of society is concern and it determines the drought as well as the environmental factors for the particular region. Thus annual rainfall conditions differ from region to region. The drought prone area in the district on annual rainfall occurs once in five years. The average annual rainfall is eastern part of the Man, Khatav, Khandala and Phaltan tahsils 473 mm, western part of the Satara district in Mahabaleshwar, Jawali and Patan tahsils 5000 mm. and middle and central part of the Satara, Wai, Karad and Koregaon tahsils 1200 mm.

Eastern part of the Satara district which has historically been most severely affected by drought. The failure of monsoon has had a disastrous affect on the districts sizable agriculture sector and a large share of the population dependent on agricultural for livelihood. This studies focus on the four (out of total 11) tahsils in Satara district which is particularly vulnerable to drought Man, Khatav, Phaltan, and Khandala tahsils. This article aims to studies pertaining to trends in rainfall eastern part of Satara district in Maharashtra. There are differences in the results of the tahsilwise studies and a clear and consistent picture of rainfall trend has variability in drought prone region. In a study on tahsilwise trend analysis four tahsils had decreasing trend in annual rainfall. Among seven tahsils showing

increasing trend, Mahabaleshwar tahsil shows highest rainfall trend. Most of the tahsils had the same direction of trend in annual rainfall and seasonal scale.

Key words: Annual Rainfall, Rainfall Variability, Drought Prone, Climate Change, Trend.

Introduction:

The amount of rainfall received over in district is an important factor in assessing the amount of water available to meet the various demands of agriculture, industry, irrigation, hydroelectric power generation, and other human activities. Agriculture is one of the most important activities engaging more than 70 per cent of the population in India. The problem of raising enough food for millions is of vital importance. Indian economy is inextricably linked with the monsoon and its prosperity is entirely dependent on amount of rainfall receive during monsoon. The success or failure of crops in any year is closely linked with the behavior of the monsoon most of the sub - divisions of India receive 90 to 95 per cent rain from south-west monsoon. In order to increase agricultural production effective utilization of water resources is of prime importance. The rainfall variations are largely because of relief variations, synoptic conditions, movement of the monsoon through. Rainfall in the greater part of India is uncertain, erratic, vagaries of monsoon and unevenly distributed. Rainfall is the major parameter influencing agriculture activity of man. Rainfall is the dominant single weather element influencing the intensity and location of farming system and the choice of enterprise.

Eastern part of the drought prone area in Man, Khatav, Phaltan, Khandala and some part of the Koregaon tahsil is heavily dependent on natural rainfall. The amount of temporal distribution of rainfall is thus the single most important

determinant of crop production levels from year to year, and rainfall in much of the district often erratic and unreliable. Rainfall variability and associated droughts have historically been major causes of food shortage, fodder shortage of cattle, shortage of water, and decline level of water, shortages of wages and famine in the district. Even though drought followed by food insecurity is not a new phenomenon in eastern part of drought prone region in Satara district, it's frequently of occurrence has increased during recent decades.

In Satara district is average annual rainfall is lot of affinity. The highest rainfall recorded in western part of the Satara district in Mahabaleshwar tahsils. The rainfall generally decreases first rapidly and then gradually from the Western Ghats towards the eastern boundary of the Satara district. The government of Maharashtra and Central government declared total five tahsil district drought prone areas. This attempt has been made 1991 to 2011 annual rainfall tabulation and use help of mean, standard deviation and coefficient of variation rainfall in Satara district. Eastern part of the drought prone region locale people perceptions that the total rainfall had decreased over the past 30-35 years because of the loss of summer any rainy monsoon.

Study Area:

The Satara district is one of the important districts of the Maharashtra state noted for agriculture development which has been selected purposefully selected for making a humble contribution to the field of Agricultural Geography. In addition, the agrarian and rural based cultural tradition and familiarity of the author, with all these motivated the researcher to undertake the present study.

The Satara district is situated in west part in Maharashtra state. This district consists eleven tahsils covering 1,727 villages. The total area is covered by 10,480 sq.

km and extending between 17^0 5' and 18^0 11' North latitudes and 73^0 33' to 74^0 54' East longitudes. This district is confined by Pune district to North, Solapur district to East, Sangli district to South and Ratanagiri district and Raigarh district to West. Satara district has typical landscapes due to variations in relief, climate and vegetation. The variation of relief ranges from the pinnacles and high plateau of the main Sahyadrian range having heights over 1,200 meters above mean sea level to the subdued basin of Nira river with an average height of about 600 meters above mean sea level.

The climate ranges from the rainiest in the Mahabaleshwar region which has an average annual rainfall of over 6000 mm to the driest in Man, Phaltan, Khandala and Khatav tahsils where the average annual rainfall is about 500 mm. The vegetable about cover to varies from the typical monsoon forest in the west parts (Fig. 1).

Objectives:

The present study has been undertaken with following specific objectives.

1. To study the average annual rainfall during the year 1991 to 2011.
2. To find out coefficient of variation and shows the trends of rainfall.

Data Base and Methodology:

The present study is based on the rainfall data collected from Indian Metrological Department for 21 years. Agricultural Statistical Information State, Socio Economic Review Satara District and Agricultural District Office, The data has been collected from 1991 to 2011. The trend of rainfall is calculated and represent by mean, Standard Deviation, and Coefficient of Variation in percentage of rainfall in Satara District shows the

presentation of result chart, graph method is used. For the data analysis following formula has been used.

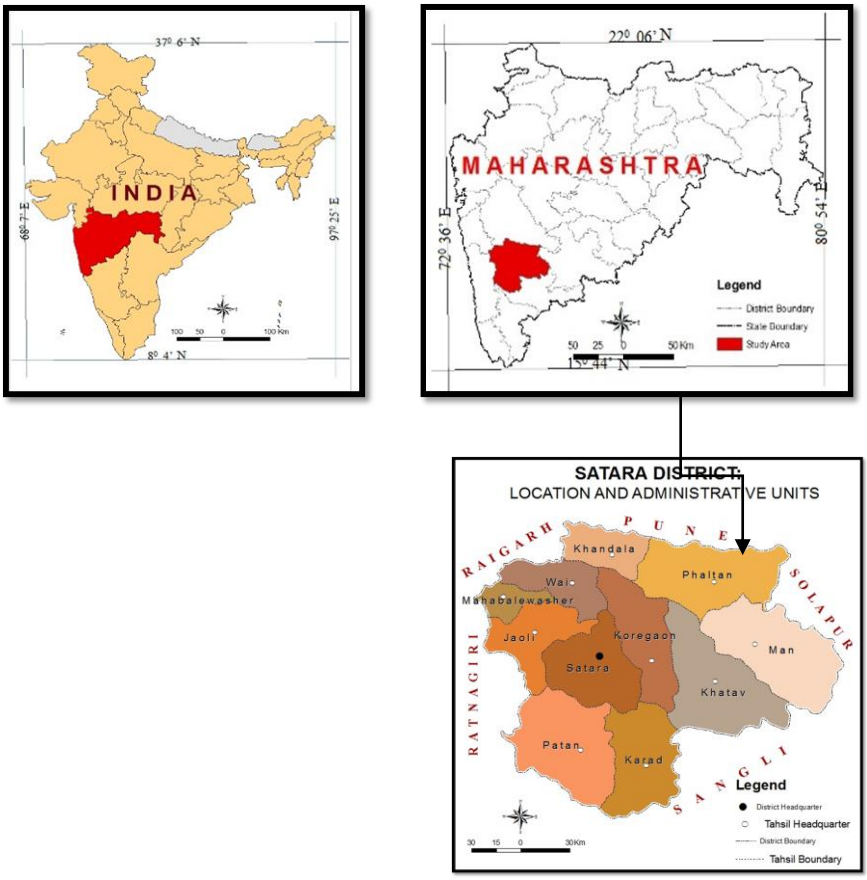

Fig. 1

Formula =

$$\text{Coefficient of Variation} = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100$$

Where,

C.V. = Coefficient of variability of Rainfall

S.D. = Standard Deviation of Rainfall

Mean = Mean of Rainfall

Annual Rainfall Distribution:

Rainfall is a prime important factor, considered by influences the agricultural economy of the region. It is also determine the cropping pattern, performance of different agricultural and cultural practices. The marked differences in its regional distribution have given rise to the disparity in the development of agriculture.

The rainfall analysis for the period 1991 - 2011 reveals that the normal annual rainfall over the district varies from 495.55 to about 5555.19 mm. In the eastern part of the district around Man, Khatav, Phaltan, Khandala taluka it is minimum and increases towards the west and reaches maximum around Mahabaleshwar. The study also reveals that entire eastern, north eastern and south eastern parts of the district comprising almost entire Man, Khatav, Phaltan, Khandala tahsils and parts of Koregaon and Karad tahsils in the plains which experienced droughts for more than 20% of the years can be categorized as "Drought Area". The average rainfall data for the period (1991-2011) are presented in Table 1.

The average annual rainfall for Satara district is 1441 mm. It is found that high rainfall recorded in Mahabaleshwar tahsil 5555.19 mm, Patan 1802.52 mm, and Jawali 1714.76 mm. Medium rainfall in central and middle part of the Satara 1009.47 mm, Wai 982.85 mm, Karad 784. 33 mm and Koregaon 797.04 mm and decreasing rapidly towards eastern part of the Khandala 605.42 mm, Khatav 568.30 mm, Phaltan 542.05 mm and Man tahsil 495.55 mm, The Coefficient of variation is 34.44 per cent Patan, 34,42 per cent Jawali tahsil. While western Ghat of the Mahabaleshwar tahsil 24.49 per cent comes variability of rainfall the Satara tahsil 32.11 per cent, Phaltan tahsil 31.78 per cent and results comes to Man, Khatav, Khandala Karad, and Wai tahsils respectively 29.22, 27.87, 21.18, 25.80, 27.01 per cent.

Table No 1 Rainfall Trend in Drought Prone Region in Eastern Part of Satara District of Maharashtra: India

Average Annual Rainfall in Satara District 1991 to 2011 (in mm)

Year	M'war	Jawali	Patan	Wai	Satara	Karad	Koregaon	Khandala	Phaltan	Khatav	Man
1991	5863	1744	1800	958	1032	1046	851	638	470	544	468
1992	4901	1505	1503	856	724	722	580	500	430	340	337
1993	6358	1840	1837	1104	978	880	767	831	619	584	568
1994	8002	1829	3259	1262	1365	912	1025	600	205	442	349
1995	3948	1496	1421	790	979	725	776	542	499	519	465
1996	5472	1694	1653	1195	828	850	913	737	603	775	667
1997	6198	2258	2163	978	908	647	566	631	430	464	365
1998	4979	1609	1485	1050	902	761	891	687	855	801	779
1999	5483	1610	1705	1102	1104	604	883	465	519	592	561
2000	4298	920	1231	644	933	539	605	438	376	387	315
2001	4501	1092	1203	678	1031	655	519	349	478	518	357
2002	5094	1320	1244	561	341	467	586	NA	344	398	353
2003	4441	1191	987	541	583	419	393	NA	NA	NA	NA
2004	6506	1103	1612	1129	1092	777	987	760	764	951	534
2005	6824	3679	3250	1574	1849	1230	1435	735	471	684	572
2006	8669	2760	2851	1510	1676	1070	1345	786	689	602	558
2007	6265	1679	2220	1033	1231	1025	895	685	725	593	595
2008	5604	1520	1239	836	764	880	568	440	342	419	455
2009	2553	1894	1875	937	1091	797	752	584	652	566	627
2010	4244	1530	1511	1029	1011	872	904	662	1028	814	761
2011	6456	1737	1804	873	777	593	497	433	342	373	225
Total	116659	36010	37853	20640	21199	16471	16738	11503	10841	11366	9911
Max.	8689	3679	3259	1574	1849	1230	1435	831	1028	951	779
Min.	2553	920	987	541	341	419	393	349	205	340	225
Mean	5555.19	1714.76	1802.52	982.85	1009.47	1784.33	797.04	605.42	542.05	568.30	495.55
S.D.	1361.02	590.38	620.92	265.49	324.17	202.42	259.76	128.28	172.28	158.41	144.82
C.V. in %	24.49	34.42	34.44	27.01	32.11	25.80	32.59	21.18	31.78	27.81	29.22

Source: Compiled By Researcher

It is found that very high rainfall two decade in mean annual rainfall Mahabaleshwar tahsil, Standard deviation come result 1361.02, Medium rainfall recorded in two decade Patan tahsil 620.92 and Jawali tahsil 590.38 in western part of the Satara district. Normal rainfall is studied during the year 1991 to 2011 Standard Deviation comes Satara tahsil 324.17, Wai tahsil 265.49, Koregaon tahsil 259.76 and Karad tahsil 202.42. In eastern part of drought prone region result comes of Phaltan 172.28, Khatav 158.41, Man 144.82 and Khandala tahsil 128.28. It is very interesting to note that or drought prone tahsils recorded low rainfall.

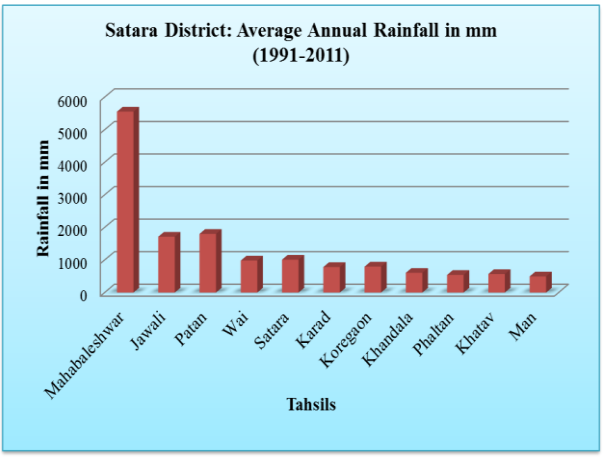

Fig.2

Table No 1 and Fig No 2 shows that the western part of the Satara district Mahabaleshwar tahsil highest recorded average rainfall during the 1991 to 2011 years. Jawali, Patan, Wai and Satara tahsil normal rainfall recorded in during the year. Then Karad, Koregaon recorded medium rainfall. Easter part of the Satara district Khandala, Phaltan, Khatav and Man tahsils shows the clear picture less amount of rainfall during the 21 years. The observed some of the results are thus mainly dependent on local scale climatic controls, physiographical condition, rather than large scale climatic forcing.

Rainfall Trend in Satara District of the Drought Prone Region:

The data obtained on the average annual rainfall of Satara district for the period in two decade viz; 1911 to 2011 were analyzed by simple tabular method. The proportion were estimated for each of the below years to know the variation in the rainfall of the Satara district for period under the study. The least square method, which corresponds to the problem of finding an actual line and trend line curve best, fits a set of data in the standard formulation. A set N pairs of observations

{Yi, Xij}is used to find a function giving the value of the dependent variable (Y) from the values of the independent variable (X).

Table No 2. Satara District: Average Annual rainfall Trend in mm (1991-2011)

Sr. No	Year	Average Annual Rainfall in mm	Trend of Rainfall in mm
1	1991	1401.27	1336.952
2	1992	1127.09	1339.681
3	1993	1487.81	1342.411
4	1994	1750	1345.141
5	1995	1105.45	1347.87
6	1996	1398.81	1350.6
7	1997	1418.9	1353.33
8	1998	1345.36	1356.059
9	1999	1329.81	1358.789
10	2000	971.45	1361.518
11	2001	1034.63	1364.248
12	2002	1070.8	1366.978
13	2003	1222.14	1369.707
14	2004	1474.09	1372.437
15	2005	2027.54	1375.167
16	2006	2046.9	1377.896
17	2007	1540.54	1380.626
18	2008	1187.9	1383.356
19	2009	1120.72	1386.085
20	2010	1306	1388.815
21	2011	1282	1391.544

Source: As seen Table No 1, Compiled by the Researcher

The rainfall variability is one variable and a linear function, the prediction is calculating by the following formula.

Formula =

$$y = a + bx$$

$$a = \Sigma y/n$$

$$b = \Sigma xy/\Sigma X^2$$

As the result of the rainfall variability in the Satara district. During the period 1991-2011, the difference of the actual

average rainfall and trend of the rainfall in Satara district of eastern part of the drought prone region. The above Table No 2 and Fig No 3 show that the actual line and trend line of increasing is positive. This means that the trend is positive rainfall variability of 1993, 1994, 2005 and 2006. The trend line is during 1992, 1995, 2000, 2001, 2002, 2003, 2009, 2010 and 2011negative mainly caused due to drought area. In this year low rainfall received in rainy season. The shortage of the drinking water, decreasing level of water, shortage of fodder for cattle, food shortage, effects of agriculture, population migrated searching of water another district. The application of the dynamic least square model also suggests that the variability of rainfall of the Satara district is decreasing in drought prone area. The above figure of the trend of rainfall variability is indicated curve trend line and actual line is variation then, it is clear that balanced rainfall in this study region. These results also indicated that for the analyzed time period, there was no climate in the region of western Satara district. The tahsils with significant annual rainfall trends are evenly distributed to the eastern region showed negative trends.

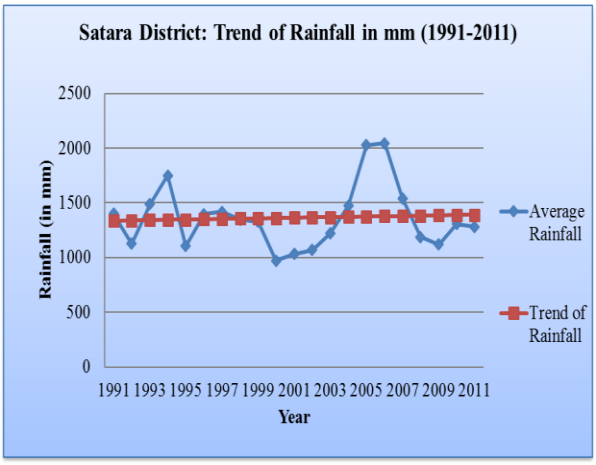

Fig. No 3

Conclusion:

The study has presented a detailed analysis of rainfall variability and trend of rainfall in the drought prone area in eastern part of the Satara district. By using 21 years recoded of rainfall in eleven tahsils, the study examined the temporal and spatial variation of rainfall on a western, central and eastern part of the Satara district. The main findings of the study are summarized below.

1. Annual rainfall in the Satara district varies from about 5555.19 mm in Mahabaleshwar (western part) to 495.55 mm in eastern part of the Man tahsil.
2. Trend analysis of annual average rainfall indicators shows to fluctuations in 21 years. During the period of 1992, 1995, 2000, 2001, 2002, 2003, 2004, 2009, 2010, 2011 shows decreasing trends in drought prone region. In 1995, 2005 and 2006 shows pattern of increasing trends in heavy rainfall in western part of the study region.

The focus in this study has been to describe rainfall variability as a basis for improving the understanding of crop climate relationships in this drought prone region. In a follow up paper, I analyze impacts of rainfall variability of yields of staple crops and investigate the benefits of rainwater harvesting as a livelihood strategy. In conclusion, this study has shows that there are significant intra-regional differences in rainfall amount, variability and trend. In general, rainfall amount is higher and its variability lower, in the western part of the region than in the eastern part. The observed trends in some of the results are thus mainly dependent on local scale climatic controls, rather than large scale climatic forcing. The results also suggest the need for further investigation local anthropogenic intervention in the environment, which could be one of the major causes of climate change in drought prone regions.

BIBLIOGRAPHY:

Anantakrishnan. 1970. "Some features of the space and Time Variation of rainfall over India and Neighborhood." Pre. Publication Science Report No 118. India Metrological Department.

Barakade, A.J. and Sule, B.M. 2012. "Rainfall Variability in Solapur District of Maharashtra: A Geographical Study."

Das, H. P. and Chaudhary, A. 1992. "Variability in rainfall Dispersion in Madhya Pradesh." *Mausam* 43(1): 29-36.

Ingale, S.R. 1995. *Rainfall Characteristics of Goa*. Submitted to M.Phil Dissertation, University of Pune.

Mankar G. 2008. "A Study of Rainfall Characteristics of Satara District Maharashtra State." *The Deccan Geographer* 46(2): 39-48.

Salave, A. 2009. "A Study of Assured Rainfall Characteristics in Pune District, Maharashtra State." *The Deccan Geographer* 46(2): 81-88.

Sarkar R., Biswas, B. and Kambete, N. 1982. "Probability Analysis of short period rainfall in Dry Farming Tract in India." *Mausam* 33: 269-289.

Singh, R.S., Ramkrishna and Purohit, R.S. 1991. "Rainfall characteristics analysis of Kutch (Gujarat) region of India." *Annals of Arid Zone* 30(2): 93-100.

Sinha. 1952. "Space Distribution of rainfall." *Indian Journal Metrology* 3: 1.

Soybam H.S. 1990. *Rainfall characteristics of Pune District*. M. Phil. Unpublished dissertation, University of Pune.

Thiruvengadthan. 1972. "Poona District Rainfall." *Indian Journal Metrology* 23: 2.

Zende, M.A., Nagarajan, R., and Atal, K.R. 2012. "Rainfall Trend in Semi Arid Region- Yerala River Basin of Western Maharashtra, India." *Journal of Advancement in technology*. 3(3): 137-145.