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FORECASTING OF DROUGHT AT TAHSIL LEVELS IN JALGAON DISTRICT OF MAHARASHTRA, (INDIA)

N. A. Patil D. S. Suryawanshi A. M. Kate

Abstract

Drought is one of the natural disasters that weakens the sustainable development of people and their resources. Shortage of rainfall coupled with its erratic distribution during rainy season causes severe water deficit conditions resulting in various intensities of droughts. Effective drought early warning systems are an integral part of efforts worldwide to improve drought preparedness. Timely and reliable data and information must be the cornerstone of effective drought policies and plans. Generally 90% of the annual rainfall in India falls in the months of June to September due to South West monsoon. Long breaks in the monsoon are abrupt resets of its disastrous to crops which produces droughts followed by famine in the district. In the present study based on the monsoon rainfall for 31 years (1980-2010) an attempt has been made to quantify the drought for all nine tahsils of Jalgaon district. South West monsoon rainfall deficit has been taken as prime factor in the drought analysis. The RS and GIS tools are used for the analysis. The results of the present study indicates that, the areas considered fall under semi-arid region. Within the analyzed time frame 2000 is found to be the worst drought in the study region.

Keywords: Forecasting, South –west monsoon, remote sensing, geographical information system, and polynomial curve.

Introduction

Drought is considered to be a strictly meteorological phenomenon. It is also a complex phenomenon whose severity depends on the precipitation amount, its time and space distribution, evapo-transpiration and on hydrological factors. For most parts of the world, drought remains as a threat that may occur with little or no warning. In spite of technological advancements made by India, the drought still continues to be a major factor of uncertainty. Sometimes it takes the form of national calamity creating serious crisis in drinking water, food production and power generation. By the experience of the past century the Indian arid and semi-arid zones experience drought situations once in alternate three years (Mohan, S and Mahesh, N 2004). Prolonged droughts are experienced about five times in a century, leading to severe scarcity of food fodder, fuel, fruits, and fiber. Ramdas and Mallik (1948) have defined 'drought week' as a week receiving rainfall equal to or less than half of the average rainfall of the week. Banerji and Bhhabra (1963) analyzed the drought conditions during the south-west monsoon season using the definitions on the basis of rainfall deficits from normal as; between 11 and 25 percent- slight drought; between 26 and 50 percent- moderate drought; and if it is greater than 50 percent –severe drought. Sharma et al. (1987) analyzed monthly and yearly drought study for agricultural planning.

Erratic and scanty rainfall, excessive depth to ground water, absence of perennial rivers, and porous nature of soils are interrelated. The major causes contributing to drought are increased pressure of both human and livestock population during the previous century, which had imposed tremendous pressure on natural resources particularly in the arid and semi-arid regions.

Objectives :

The Disaster Management Act 2005, Government of India reiterates paradigm shift in Disaster Management from rescue, relief centric approach to Preparedness, Early Warning approach. Thus, with the following Objectives & Activities (MSNDMC) Maharashtra State Natural Disaster Monitoring Centre is providing a formal common platform to achieve synergy in the field of disaster

management in Maharashtra. The main Objectives of MSNDMC may be classified as below:

4.1 To draw hazard mapping and vulnerability studies.

4.2 To Strengthen of Information Technology for Natural Disasters Management.

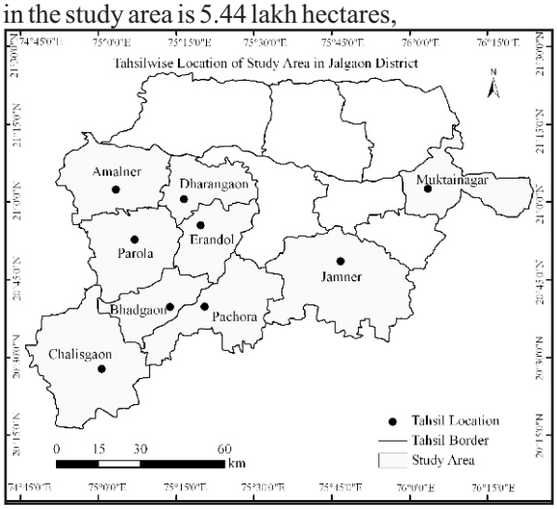
4.3 To study Monitoring and impact assessment of Natural Hazards.

4.4 Natural Disaster Early Warning System for the study region.

Study Region:

The region selected for the study is the drought-prone tahsils. They are located in the Jalgaon district of Maharashtra State. There are 09 drought-prone tahsils identified by V. Subramaniam, (Review Committee, 1987). These tahsils are Amalner, Dharangaon, Parola, Erandol, Chalisgaon, Bhadgaon, Pachora, Jamner and Muktainagar. Looking into its delicate ecology and poor socio- economy, the study region is one of the most vulnerable regions of Maharashtra State. The topography of the region is hilly, plateau, undulating and rolling. The degraded soils with exposed rocks resulted from severe erosion is the common landscape. It lies between 20o11 to 21o13 North latitudes and 74o46 to 76o24 East longitudes (Fig.1). The average annual rainfall is 682.8 mm and it is bimodal in nature by spreading over 6 months from June to November. The South-West monsoon season contributes about 89 per cent of the annual rainfall. August is the rainiest month, and the district gets little rain during the later part of the summer and post monsoon months. However, South-West monsoon season period is not the period of continuous rainfall. There may be breaks of about a week, month or more with no rainfall activity. So for in the study region, details studies using Remote Sensing & Geographical Information system have not been carried out to analyze the drought severity, intensity and duration considering the South West monsoon period. The study region having the total area around 6994.54 sq.km and accounts 2.27 per cent of the Maharashtra state area. The forest area is only 72419 hectare (Census Handbook, 2011). There are 1002 villages in the study region and the population of the study region is 21, 21,832 as per recent census. The climate of the study region is sub-tropical, semi-arid type with moderate to severe summer, moderate winter and having erratic The temperature starts rising after the month of February and reaches its maximum in the month of May with a mean daily maximum of 43º Celsius and mean minimum of 22º Celsius (A Report, on Statistics of the Jalgaon district, 2006). In 31 years of study the highest annual rainfall of 1640 mm was recorded at Amalner in the year 1992. The year 2000 received the lowest rainfall of 267 mm at Erandol tahsil. The total cultivated area in the study area is 5.44 lakh hectares,

Study Area : Location Map



Source : Census of India 2001

Rabi area is 0.38 lakh hectares. The study region normally has two cropping seasons namely (Contingency plan for Drought Relief Work, 2000) Kharip and Rabi. The principal crops grown in the study region are Jowar, Bajara, Pulses, Cotton, Oilseeds, Sugercane and Fruits. Cotton is the single mono crop, occupying the highest area in the state and in the country. The study region has a total of 7, 63,860 small and marginal farmers. The study region is economically backward with 80 per cent of the population depending on the agriculture. Most of the families reside in villages. The study region has a long history of continuous droughts. The study region also has very poor human development index. The total number of agricultural labours is 11, 24,571. At present, out of total cultivated area only 7 per cent is under irrigation. The rest of the cultivated area totally depends on rainfall only.

6.0 Materials and Methods:

The average monthly rainfall data in all the nine tahsils of the study region have collected from 1980 to 2010 (31 years) all available rain gauge stations in the study region from Drought Monitoring Cell IMD, Pune are used for the analysis. With the advancement of new remote sensing and geographical information system technology, the monitoring and management of drought on integrated basis provides detailed information about the onset and withdrawal of drought, and also to certain extent provides relief from its impact. In this context a detailed study of drought monitoring and management in the study region using remote sensing and geographical information system has been analyzed by collecting rainfall and other parameters for the period of 31 years from 1980 to 2010. Three year moving average polynomial curve has also worked out to ascertain the trend line for forecasting drought for all tahsils of the study area.

Results And Discussion :

The study region has a long history of droughts and on an average is suffering by drought once in three years. However, in present times, this situation has further aggravated due to continuous failure of monsoon for the last few years. Hence, a detailed study of the drought conditions in the study region is required. The study region is situated in rain shadow area. The rainfall in the study area is mainly depends on depressions in the Arabian Sea near the Maharashtra coast. The drought conditions in the region are the result of sharp climatic variations in rainfall distribution and occurrence of breaks. There is a great variability in monsoon rain from year to year or in time and space in any one year.

The increasing trend of rainfall is observed from 1981 to 1992. The rainfall in all tahsils approximately showed the negative deviation starting from 1980 and it reaches minimum value up to 267 mm in 1982 on-wards. Increasing trend of rainfall is observed from 1983 it continued up to 1990. Again rainfall trend decreases from 1992 to2002. The rainfall increases slightly from 1983 to 1990. Again decreasing trend starts 1991 onwards it continues up to 2002. From 1982 the yearly fluctuation from positive to negative trend in the rainfall is observed up to 2010 (fig.2). The study of 5 years moving average cure shows that the decreasing trend of rainfall has observed from 1991 up to 2000. From the year 2004.

Table 1 Study area: Year and Tahsil wise Rainfall in MM (1980 - 2010).

Tahsil / Year	Chalis - gaon	Pachora	Jamner	Dharan - gaon	Parola	Erandol	Amalner	Bhad - gaon	Muktai - nagar	Region
1980	668	640	1334	791	592	576	549	648	586	709
1981	991	1030	1178	695	887	799	650	738	683	850
1982	321	329	341	339	334	267	388	331	323	330
1983	822	1097	791	699	1170	741	681	926	698	847
1984	613	638	681	686	607	531	751	494	442	605
1985	527	509	757	460	621	467	511	817	629	589
1986	613	539	641	675	739	733	503	517	631	621
1987	627	830	726	712	532	661	683	840	681	699
1988	534	658	623	574	631	717	587	660	686	630
1989	1199	658	972	670	520	630	754	843	681	770
1990	1035	838	1053	783	907	1145	749	915	683	901
1991	349	382	621	572	338	650	507	670	686	530
1992	526	741	844	764	977	708	1640	863	609	852
1993	1391	587	678	587	524	680	513	632	621	690
1994	792	680	887	690	630	724	664	675	683	714
1995	506	776	759	490	988	522	430	614	605	632
1996	849	621	640	671	621	802	701	835	563	700
1997	653	805	843	766	550	574	559	661	699	679
1998	626	565	954	650	662	819	701	1138	920	782
1999	1183	716	795	698	1169	908	691	853	688	855
2000	316	334	316	336	336	327	321	334	326	327
2001	1092	670	1102	719	822	930	699	704	688	825
2002	646	744	673	702	645	543	522	654	540	630
2003	603	655	747	566	678	602	660	629	750	654
2004	1127	793	804	751	903	889	667	778	716	825
2005	345	327	530	565	323	335	333	456	468	409
2006	1051	675	678	630	880	679	712	916	693	768
2007	583	777	764	756	655	660	506	481	764	661
2008	926	681	665	539	673	664	622	837	470	675
2009	669	652	664	651	518	486	589	627	752	623
2010	684	753	820	686	982	912	690	694	818	782
Avg.	738	668	770	641	691	667	630	703	638	683

Source: I.M.D.,Pune, 1980 - 2010.

increasing trend of rainfall pattern was noticed it is up to 2010. Again the rainfall slightly increased in 1990 and decline started from the years 1999 it continues up to 2002.

While observing the moving average annual rainfall trend line of the region, the results showed that the south- West monsoon rainfall increase @ 14.06 mm per year (fig-10). It is because of north ward advance of ITCZ accompanying the onset of south west monsoon. The trend however be attributed to variation in above mentioned factors, stagnant forest cover and all other hydro metrological variation in the study area.

Three year moving average polynomial curve has also worked out to ascertain the trend line for forecasting drought for all tahsils of the study area (Fig.3). For Chalisgaon tahsil 3-years moving average trend increased at the rate of 3.89 mm per year without statistical significance. The polynomial curve trend found increased from 1981 to 1991 and the trend remains constant from 1983 to 1999. The curve trend slightly declined from 2002 to 2010, indicating below normal rainfall for the successive two to three years. Due to the absence of depressions or a change in their tracks results in deficit south west monsoon.

For Pachora tahsil moving average trend decreased at the rate of – 6.49 mm per year. The polynomial curve trend decreased from 1980 to 2002, again the curve indicated increasing trend up to 2003. From 1984 to 2002 the curve trend slightly declined indicating low rainfall may extend for two more years (fig.4).

For Jamner tahsil 3-years moving average curve trend found to decrease at the rate of – 62.63 mm per year. Also the trend of polynomial curve decreased from 1980 to 1990; again it started decreasing up to 2000 indicating future dry spells (drought) (fig.5). Due to EI-Nino and Southern Oscillation (ENSO) events rainfall is not only less but its coefficient of variation is also very high.

For Dharangaon tahsil 3-years moving average trend observed to be slightly decreasing at the rate of – 0.089 mm per year. The polynomial curve trend decreased from 1991 to 2002 and from 2005 onwards up to 2010 the trend remains constant. Again the decreasing trend has been observed since 2002 onwards up to 2008 indicating the future dry spells in the extend periods of two or more years (fig.6).

For Parola tahsil 3-years moving average trend found to be decreased at – 1.47 mm per year. The polynomial curve trend showed that the rainfall decreased from 1981 to 2002, the trend remains constant from 1986 onwards up to 1996. But the decreasing trend has been noticed since 2000 onwards up to 2005. This will predict that decreasing trend will continue two more years in future leading to dry spells (fig.7). It is because of leeward side and irregular geographical location resulted deficit south west monsoon.

For Erandol tahsil 3-years moving average trend observed to be increased at the rate of 49.82 mm per year. The curve trend observed to be increased from 1981 to 1994. Again it decreased up to 2001 and the same trend continued up to 2008 indicating the same trend may continue in further two to three years (fig.8).

For Amalner tahsil 3-years moving average trend has been observed increasing at the rate of 66.73 mm per year. The curve trend increased from 1981 to 1992. It decreased up to 2001 and the same trend is continued up to 2008 indicating the same trend may continue in further two more years (fig.9).

For Bhadgaon tahsil 3-years moving average trend has been observed to get increased at the rate of 40.07 mm per year. The curve trend gradually decreased from 1992 to 2002. Hence it is predicted that the same decreasing trend continue two more years may leading to dry spells (drought) (fig.10).

For Muktainagar tahsil 3-year moving average trend increased at the rate of 36.72 mm

per year. The polynomial curve trend gradually increased from 1981 to 1991 and sudden decreasing trend observed up to 2002 indicating the dry spells (drought) may continue further up to two years (fig.11).

Study area: Tahsil wise 3 years moving average and polynomial curve of annual rainfall.

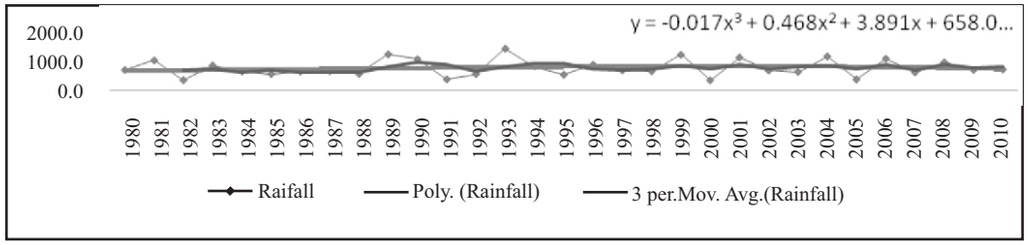


Fig.2 Study area

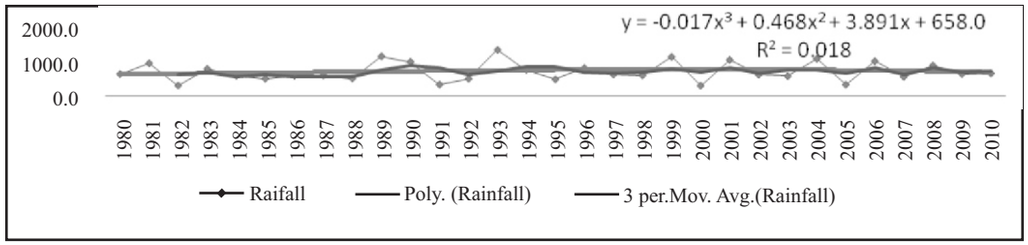


Fig. 3 Chalisgaon

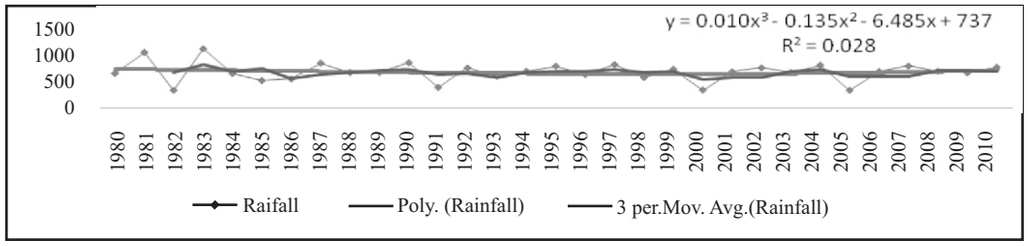


Fig.4 Pachora

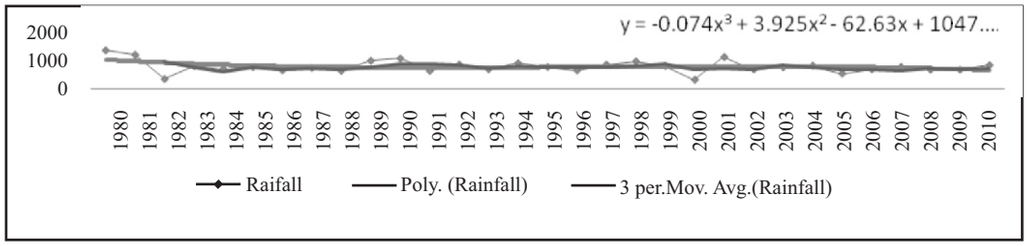


Fig.5 Jamner

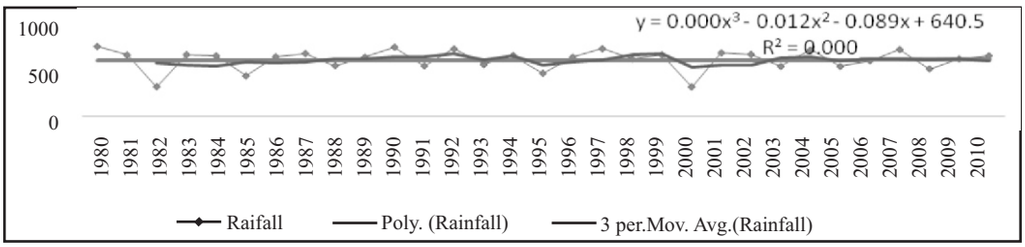


Fig.6 Dharangaon

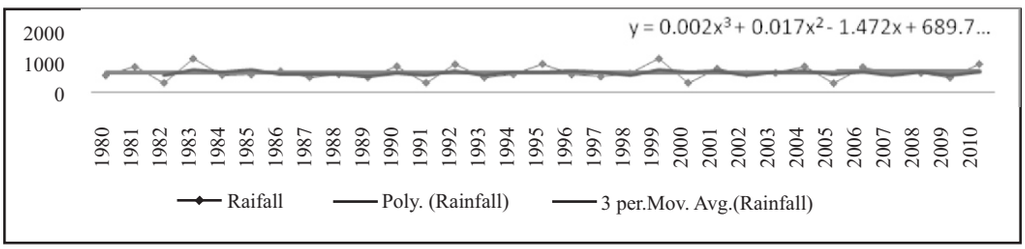


Fig.7 Parola

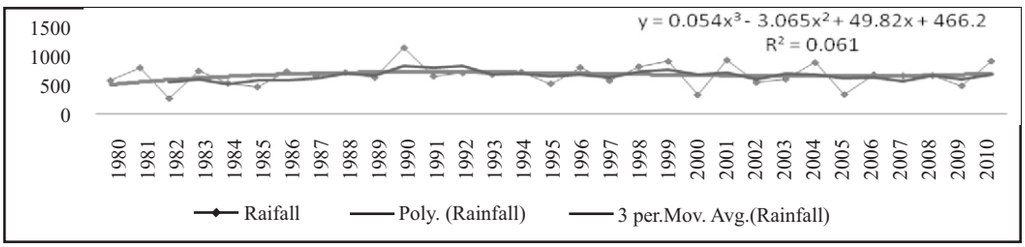


Fig.8 Erandol

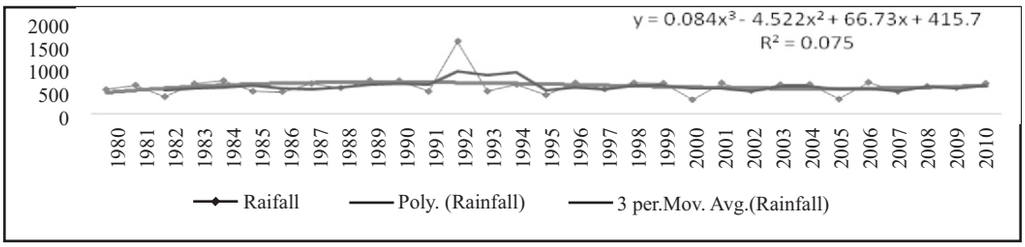


Fig. 9 Amalner

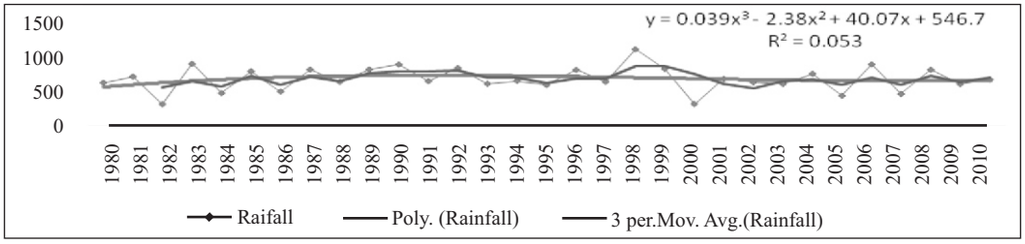


Fig. 10 Bhadgaon

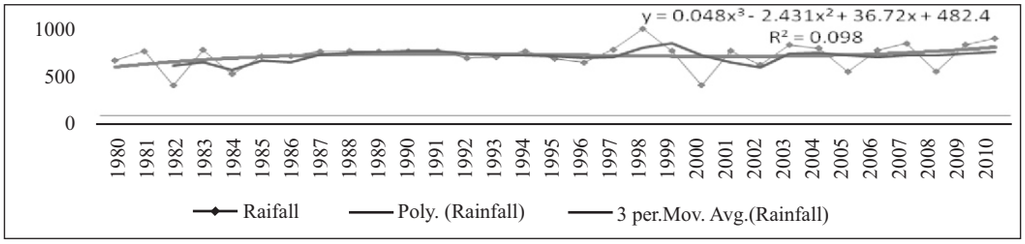


Fig. 11 Muktainagar

8.0 Conclusions

With the advancement of new remote sensing and geographical information system technology, the monitoring and management of drought on integrated basis provides detailed information about the onset and withdrawal of drought, and also to certain extent provides relief from its impact. The south-west monsoon rainfall occurred in the months of June, July, August and September. The break or long breaks in the monsoon resulted in drought situations in the study region. The number of dry spells has in general more than the wet spells. This trend indicates that on short term basis, the occurrence of drought is more apparent in this region. Hence, the analysis of short term rainfall data must be used for better crop planning in the region. The coefficients of variation of annual rainfall of all tahsils are observed to be quite high and this means the variation in annual rainfall is relatively greater. This confirms that the study area is a drought prone area. Based on 3-year moving average polynomial curve for rainfall trend fitted for the study area forecasting of the continuous dry spells of 2 to 3 years can be done. The key elements of an effective national drought policy include planning, proactive mitigation, risk management, resource stewardship, and public education. All of these elements require detailed knowledge of observational data and research products that form the foundation for efforts to reduce drought impacts on society.

9.0 References

1 Banerji, S & Bhhabra B.M (1963) Drought conditions in the Telangana division (Andhra Pradesh) during the southwest monsoon season, Indian J. Metrology and Geophysics, 14(4), PP. 403-415.

2 Census Handbook of Jalgaon District, 2010.

3 Central Water Commission, 1982 report on identification of drought prone areas of 99-districts. New Delhi, India.

4 Dabral P. P. (1996) Metrological drought analysis based on rainfall data. Indian J. soil Cons., 24(1), 37-40.
5 Director, 2010 Report, on Statistics of the Jalgaon district, published by Z.P Jalgaon.
6 Kumar D, & Kumar S, (1989), Drought analysis based on rainfall data. Indian J. soil Cons., 17(1), pp. 55-60.
7 Mohan S & Mahesh. N (2004), Dependability of Irrigation and Hydropower during Drought, of Indian water resources society, Vol. 24, no3, pp 1-11
8 Ramdas L.A & Mallik A. K (1948) Agricultural situations in India, Technical Bulletin, ICAR, New Delhi.
9 Ranade .D. H & Gupta. R. (1992), Drought Analysis of Barwaha, Indian J. soil cons., 20(1&2), pp. 83-85
10 Ray C.R et al. (1987), investigation of drought from rainfall data at Gopalau, Orrisa, Indian j. Soil cons., 15(1), pp. 15-19.
11 Report, (2010) Statistics of The Jalgaon District, published by Z.P. Jalgaon.
12 Sharma H.C. et al.(1987) Analysis of Rainfall Data for Agricultural Planning, Journal, institution of engineers (India)- AG, 68: 1-6.
13 Subramaniam, V. (1987): Review Committee appointed by the Maharashtra State Government.

***Namdeo Arjun Patil**
Dept. of Geography,
Research Scholar NYNC College,
Chalisgaon, Dist- Jalgaon (M.S.), PIN-424101

****Dnyaneshwar Shivaji Suryawanshi**
Director, Research Supervisor,
ACEES, North Maharashtra University,
Jalgaon, (M.S.) 425001

*****Asha M. Kate**
Assistant Professor,
VWS, College, Dhule,
Dist – Dhule (M.S.), PIN – 424001