FORECASTING OF DROUGHT AT TALUKA LEVELS IN GULBARGA DISTRICT OF KARNATAKA, (INDIA)

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Abstract

Drought is one of the natural disasters that weaken 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. 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 48 years (1961-2008) an attempt has been made to quantify the drought for all ten talukas of Gulbarga 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 indicated that the areas considered fall under semi-arid region. Within the analyzed time frame 1972 is found to be the worst drought in Gulbarga district.

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1. 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 advancement 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, flowers 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 to 25 percent- slight drought; between 26 to50 percent- moderate drought; and if it is greater than 50 percent –severe drought. Sharma et al. (1987) analyzed monthly and yearly drought for agricultural planning. Above definitions were used to study the drought situation at different corner of the country e.g. Dabral; (1996); Kumar and Kumar, (1989); Ray et al. (1987); Ranade and Gupta, (1992). 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.

Gulbarga is one among the drought affected districts, in Karnataka. It has a long history of droughts and on an average the district 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 district is required. The district is situated in rain shadow area. The rainfall in the district mainly depends on depressions in the Bay of Bengal near Andhra Coast. The drought conditions in the districts 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 district is situated in rain shadow area. South-West monsoon season in the district is consisting of the two currents which originate in the south Bay of Bengal and the Arabian Sea during the hot weather season. Jay Rami Reddy. P (2004). It is in this South-West monsoon season that a major portion of the country receives more than 75 per cent of the rainfall. 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 Gulbarga district, 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.

2. STUDY AREA

Gulbarga district has been situated towards North-Eastern part of the State of Karnataka extended on latitude 16O 12' and 17O 46' north and longitude 76O 04' and 72O 42' east. The height from the mean sea level of the district is about 693 m. The district is divided into two agro climatic zones, namely North-Eastern transition zone, comprising Aland and Chincholi taluka and North-Eastern dry zone comprising remaining eight talukas, namely Afzalpur, Chithapur, Gulbarga, Jewargi, Sedam, Shahapur, Shorapur and Yadgir. Gulbarga district is the second biggest district of the state.

The district lies on Deccan plateau composed of basaltic, literate, sedimentary and other rock formations. The district is having four major soil types viz. deep and medium block soils are found in Sedam, Chithapur, Gulbarga, Afzalpur and Aland talukas. Red loamy and Sandy Loamy soils in Yadgir, part of Chincholi, Shahpur and Shorapur. The ground water in the district occurs under semi confined conditions in highly decomposed, weather and fractured zones of the formations. The ground water table in the district is steadily decreasing.

The Gulbarga district having the total area around 16, 240.0 sq.km and accounts 8.45 per cent of the Karnataka state area. The forest area is only 68,000 hectare (Director, 2005). There are 1378 villages in the district and the population of districts is 31, 30,922 as per recent census. The district shares the boundaries with Bidar and Usmanabad of Maharastra state (MS) at North, Medak and Mehaboobnagar of Andhra Pradesh (AP) and Raichur at South and Bijapur, Sholapur, (MS) at West. The State Highway No.19 passes through the central part of the district. The South Central Railway line passes through the district linking with Hyderabad, Delhi, Bangalore, Chennai and Mumbai cities Refer Fig.1. The district has been divided into 10 talukas for the purpose of administration. It comprises of 3 revenue sub divisions and 7 police sub divisions. Apart from, one Corporation (Gulbarga City), there is 12 Municipalities, 18 towns, 337 Gram Panchayats, 1360 inhabited villages, 77 Un-inhabited villages and 413 Thandas.

The climate of the Gulbarga district is sub-tropical, semi-arid type with moderate to severe summer, moderate winter and having low erratic rainfall. The average annual rainfall is 800 mm and it is bimodal in nature by spreading over 6 months from June to November. The South-West monsoon season contributes about 80 per cent of the annual rainfall. September is the rainiest month, and the district gets little rain during the later part of the summer and post monsoon months, mostly as a thunder showers. 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 Gulbarga district, 2006). In 48 years of study the highest annual rainfall of 1214 mm was recorded in the year 1975. The year 1972 received the lowest rainfall of 366 mm.

The total cultivated area in Gulbarga district is 12.55 lakh hectares, out of which Kharif area is 6.66 lakh hectares and Rabi area is 5.89 lakh hectares. The district normally has three cropping seasons namely (Contingency plan for Drought Relief Work, 2003) Kharif, Rabi and summer. The principal crops grown in the district are tur, bajra, ground nut, sunflower and Rabi jawar. Red gram is the single monocrop, occupying the highest area in the state and in the country. The district has a total of 2, 41,482 small and marginal farmers. The district is economically backward with 80 per cent of the population depending on the agriculture. Most of the families reside in

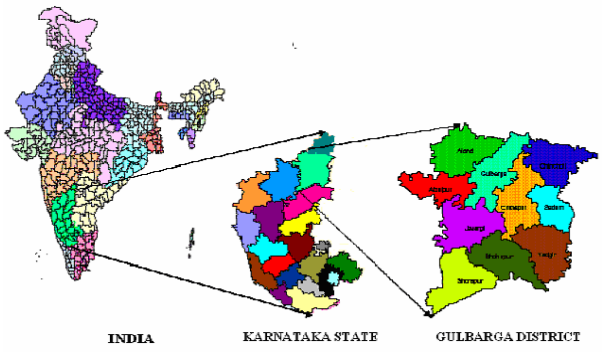

Fig.1 Location map of Gulbarga district, Karnataka, India

villages. The Gulbarga district has a long history of continuous droughts. The district also has very poor human development index. The total no of agricultural labours is 4, 44,440. There appears to be no end to problems associated with pending irrigation projects in this drought-prone district. Even after spending Rs. 722.30 crore so far, not a single acre of land had been provided for irrigation under the one major and two medium irrigation projects taken up in Gulbarga district (T.V. Sivanandan 2010). The original cost of these three projects put together was just Rs. 21.45 crore when they were given approval by the Government 37 years ago. Another Rs. 150.75 crore was required to complete the Bennethora Major Irrigation Project, the Amarja Medium Irrigation Project and the Lower Mullamari Irrigation Project. Now, their revised cost as per latest estimates is Rs. 868 crore. A sum of Rs. 722.30 crore has already been spent on these projects. At present, out of total cultivated area only 18 per cent is under irrigation. The balanced cultivated area totally depends on rainfall only. With the completion of ongoing irrigation projects like Bennethora, Gandorinala and Amarja, the area under irrigation will be increased to 35 per cent of cultivable area only.

2.1 Data Used

The average monthly rainfall data in all the ten talukas of the district is collected from 1961 to 2008 (48 years) all available rain gauge stations in the district from Drought Monitoring Cell Bangalore, were used for the analysis.

3. RESULTS AND DISCUSSION

The increasing trend of rainfall is observed from 1962 up to 1965. The rainfall in all talukas approximately showed the negative deviation starting from 1967 and it reaches minimum value up to 220 mm in 1972 on-wards. Increasing trend of rainfall is observed from 1973 it continued up to 1984. Again rainfall trend decreases from 1985 to1987. The rainfall increases slightly from 1988 to 1990. Again decreasing trend starts 1991 onwards it continues up to 1995. From 1996 the yearly fluctuation from positive to negative trend in the rainfall is observed up to 2008. The study of 5 years moving average cure shows that the decreasing trend of rainfall was observed from 1966 up to 1976. From the year 1977 the increasing trend of rainfall pattern was noticed it was up to 1993. Again from 1994 the decreasing trend was noticed it was up to 1998. Again the rainfall slightly increases in 1999 and decline started from the year 2002 it continues up to 2008. While observing the moving average annual rainfall trend line of the district, the results showed that the south- West monsoon rainfall decrease @ 3.40 mm per year (fig-2).The trend however be attributed to variation in above mentioned factors, decreasing forest cover and all other hydro metrological variation in the study area.

Three year moving average polynomial curve was also worked out to ascertain the trend line for forecasting drought for all talukas of the study area (Fig.1to 10). For Afzalpur taluka 3-years moving average trend decreased at the rate of -15.29 mm per year without statistical significance. The polynomial curve trend found decreased from 1961 to 1978 and the trend remains constant from 1979 to 2005. The curve trend slightly declined from 1978 to 2008, indicating below normal rainfall for the successive two to three years. For Aland taluka moving average trend decreased at the rate of -26.20 mm per year. The polynomial curve trend decreased from 1961 to 1978, again the curve indicated increasing trend up to 1990. From 1991 to 2008 the curve trend slightly declined indicating low rainfall may extend for two more years. For Chincholi taluka 3-years moving average curve trend found to increase at the rate of 58.51 mm per year. Also the trend of polynomial curve increased from 1961 to 1978, again it started decreasing up to 2008 indicating future dry spells (drought). For Chithapur 3-years moving average trend observed to be decreasing at the rate of -49.27 mm per year. The polynomial curve trend decreased from 1961 to 1978 and from 1979 onwards up to 2001 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. For Gulbarga taluka 3-years moving average trend found to be decreased at -20.68 mm per year. The polynomial curve trend showed that the rainfall decreased from 1961 to 1978, the trend remains constant from 1979 onwards up to 2001. But the decreasing trend has been noticed since 2002 onwards up to 2008. This will predict that decreasing trend will continue two more years in future leading to dry spells. For Chithapur taluka 3-years moving average trend observed to be decreased at the rate of -49.27 mm per year. The curve trend observed to be increased from 1961 to 1978. 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. For Jewargi taluka 3-years moving average trend has been observed increasing at the rate of 59.02 mm per year. The curve trend increased from 1961 to 1978. 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. For Sedam taluka 3-years moving average trend has been observed to get decreased at the rate of 8.51 mm per year. The curve trend gradually decreased from 1961 to 2008. Hence it is predicted that the same decreasing trend continue two more years may leading to dry spells (drought). For Shahapur taluka 3-year moving average trend increased at the rate of 17.23 mm per year. The polynomial curve trend gradually increased from 1961 to 1983 and sudden decreasing trend observed up to 2008 indicating the dry spells (drought) may continue further up to two years. For Shorapur taluka the 3-year moving average trend is found to be increased at the rate of 24.02 mm per year. Polynomial curve trend has been observed to be increased from 1961 to 1970 and gradually decreased from 2002 to 2008 indicating decreased rain in future. For Yadgir taluka the 3-year moving average trend increasied at the rate of 25.49 mm per year. The Polynomial curve trend increased from 1961 to 1977 and then started declining from 1978 to 2008 indicating the same declining trend in future

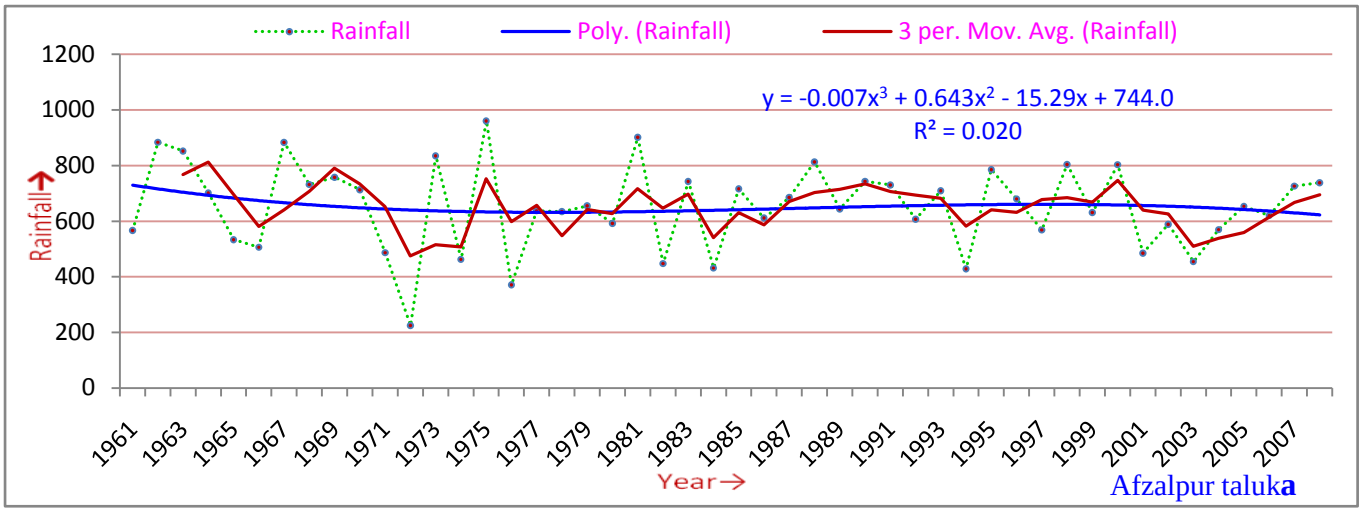

Fig. 1 Three years moving average and polynomial curve of annual rainfall for Afzalpur taluka

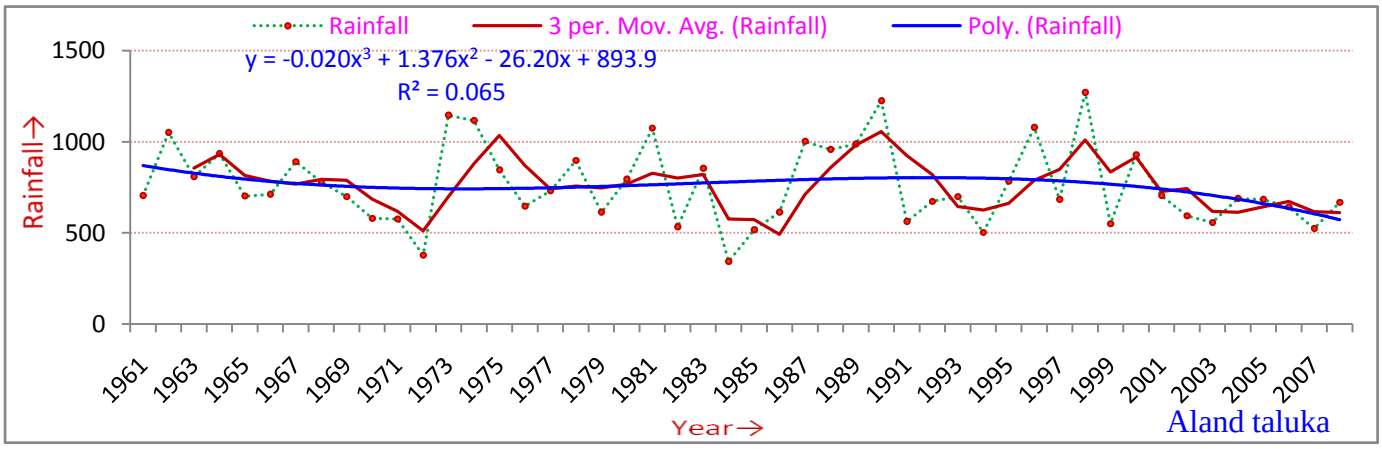

Fig. 2 Three years moving average and polynomial curve of annual rainfall for Aland taluka

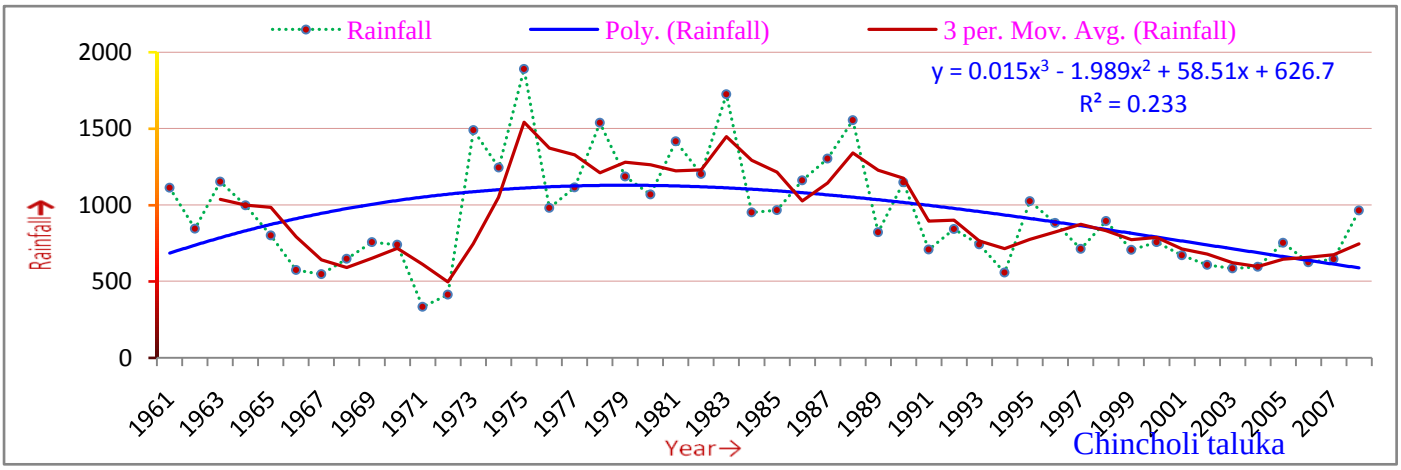

Fig. 3 Three years moving average and polynomial curve of annual rainfall for Chincholi Taluka

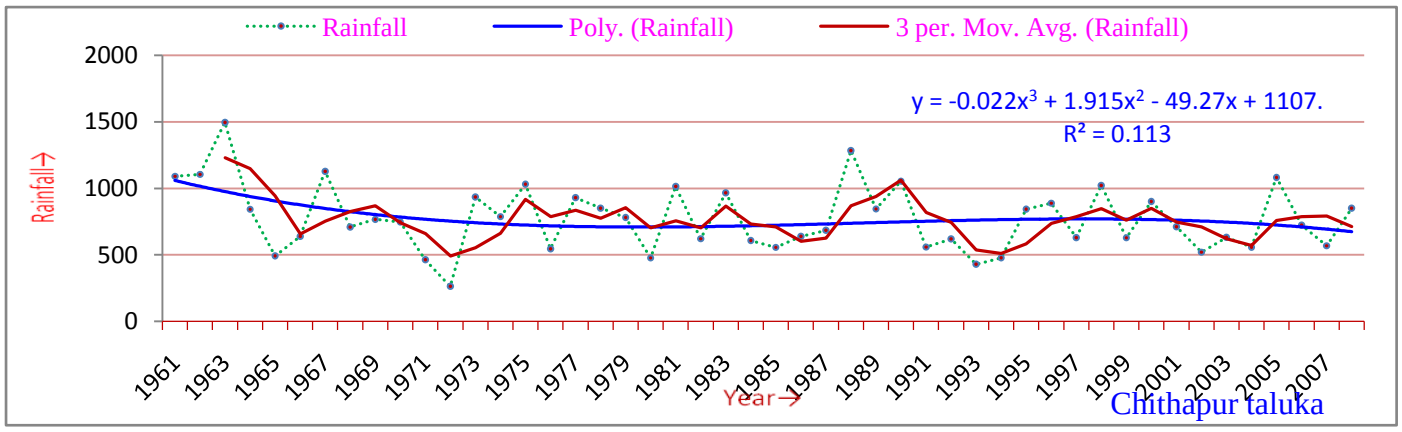

Fig.4 Three years moving average and polynomial curve of annual rainfall for Chithapur Taluka

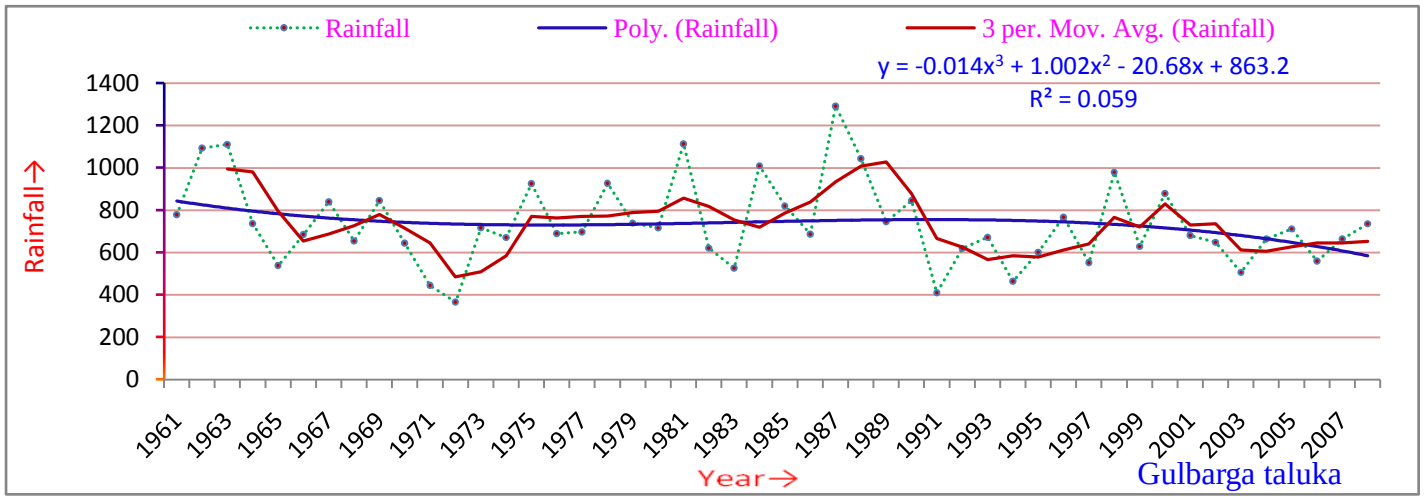

Fig.5 Three years moving average and polynomial curve of annual rainfall for Gulbarga taluka

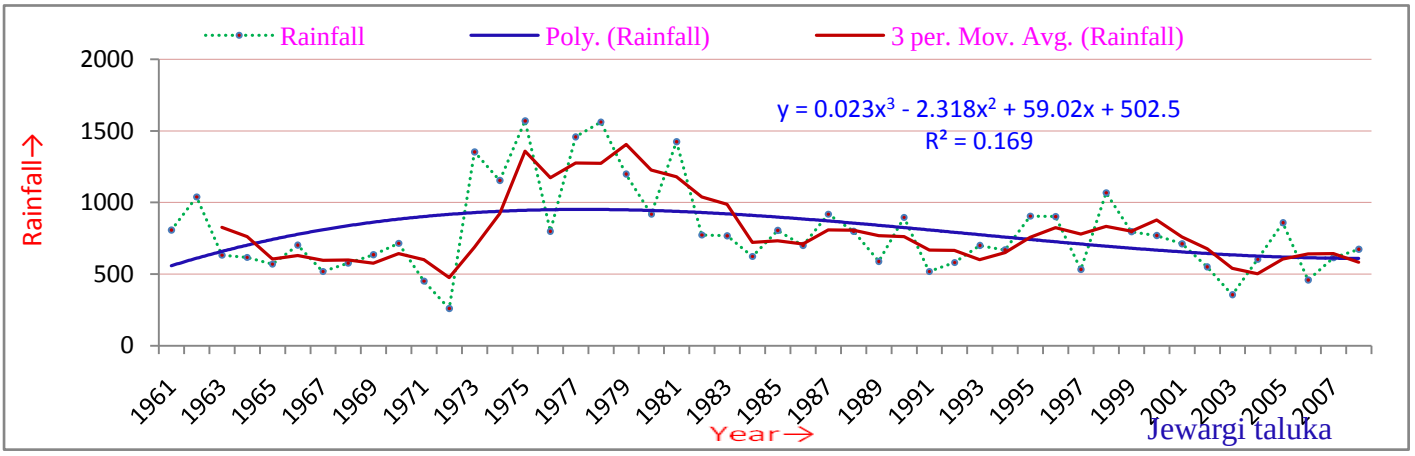

Fig.6 Three years moving average and polynomial curve of annual rainfall for Jewargi taluka

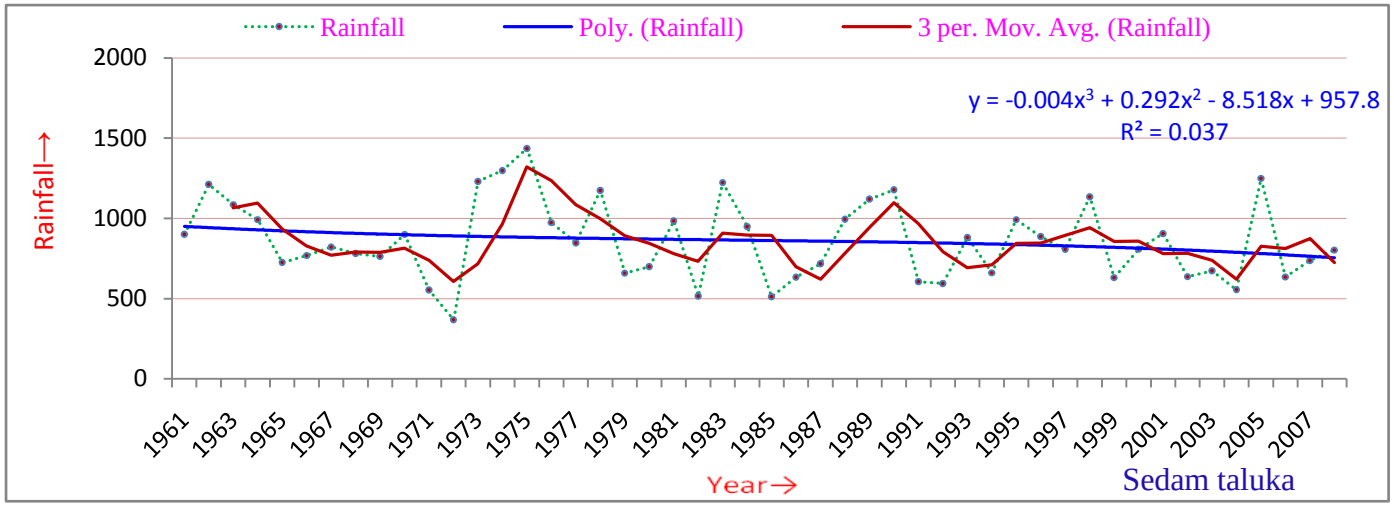

Fig. 7 Three years moving average and polynomial curve of annual rainfall for Sedam taluka

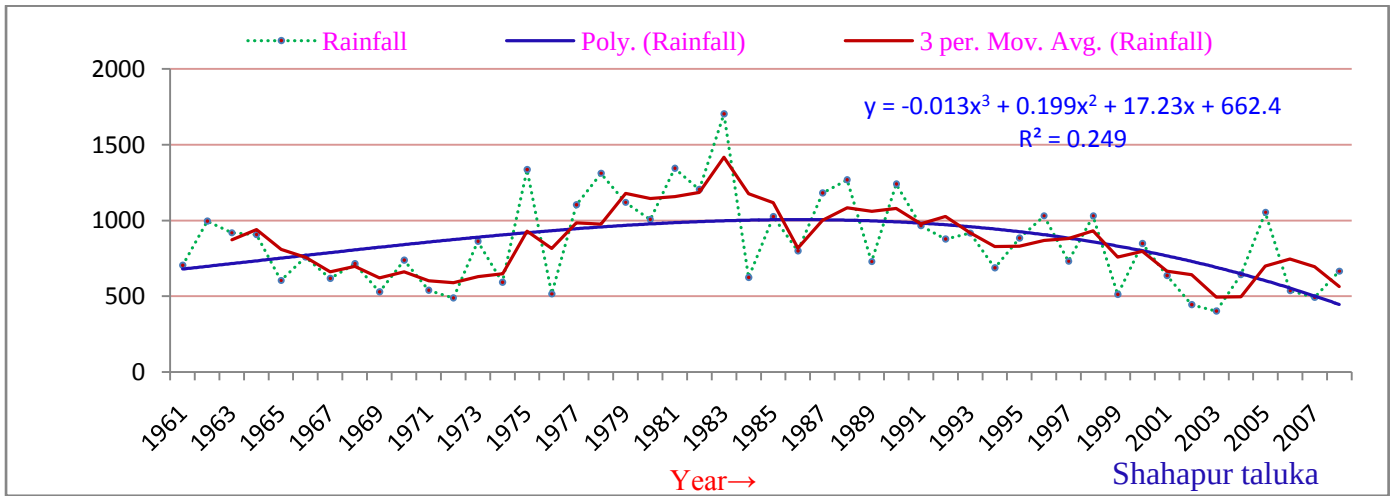

Fig.8 Three years moving average and polynomial curve of annual rainfall for Shahapur taluka

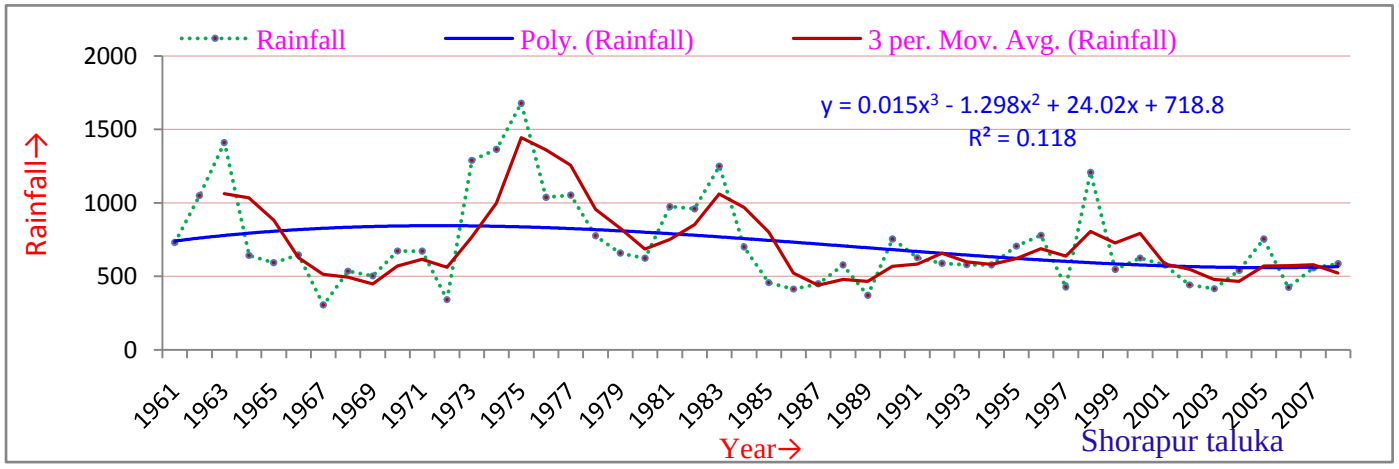

Fig.9 Three years moving average and polynomial curve of annual rainfall for Shorapur taluka

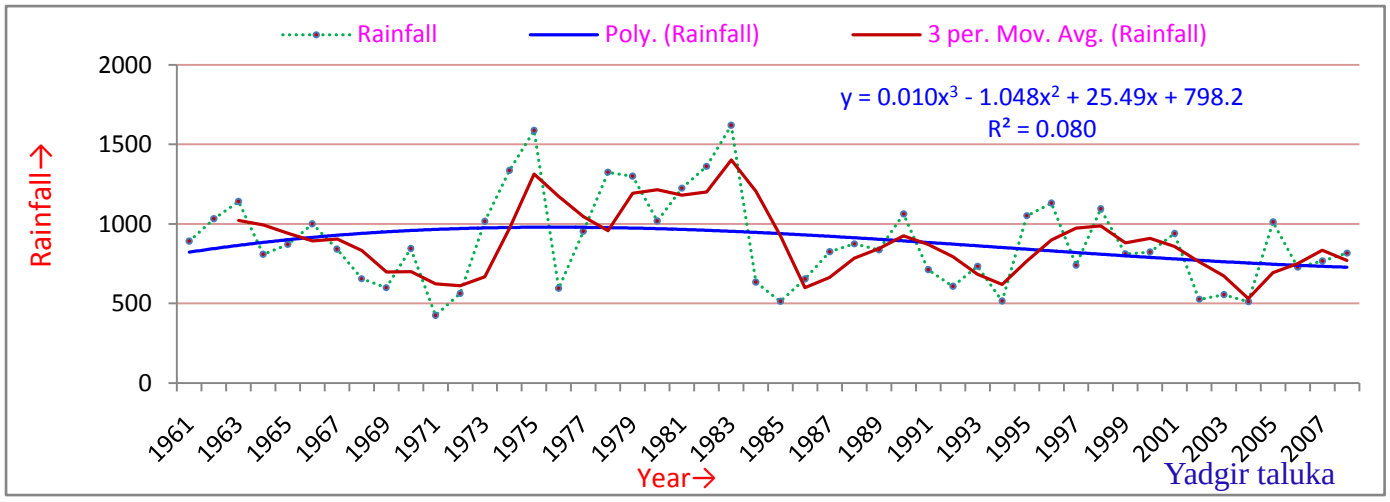

Fig.10 Three years moving average and polynomial curve of annual rainfall for Yadgir taluka

4. 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. In this context a detailed study of drought monitoring and management in Gulbarga district using remote sensing and geographical information system had been analyzed by collecting rainfall and other parameters for the period of 48 years from 1961 to 2008. 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 district. The coefficients of variation of annual rainfall of all Talukas are observed to be quite high and this means the variation in annual rainfall is relatively greater. This confirms 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.

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