STUDY OF RAINFALL TRENDS AND VARIABILITY, A CASE STUDY OF BELGAUM DISTRICT

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Abstract

The study of precipitation trends is critically important for a country like India whose food security and economy are dependent on the timely availability of water. The monsoon months of June to September account for more than 80% of the annual rainfall. The majority of Taluka in Belagavi district showed very little change in rainfall in non-monsoon months. Agriculture would be seriously affected by increased variability and trends in the seasonal characteristics of rainfall in an environment. The analysis carried in the present study is based on the series of tests designed to determine if the annual rainfall data is consistent, random and trend free. In this paper, annual trends of Belagavi district rainfall have been analyzed using monthly data series of 46 years (1970–2016) from 42 rain gauge stations located in the district will be carried out and is discussed considering the parameters such as rainfall. Depending upon the taluk awise rainfall, it showed that both decrease and increase in rainfall trend from the normal rainfall in the study area due to climate variability and global climate change. Some parts of Belagavi district receive annual rainfall less than 750 mm and hence are drought prone. The different variability will be determined for all talukas of Belgavi district. The study concludes with the description of the structural characteristics and temporal and spatial variations of the annual rainfall data

Key words: climate change; precipitation; rainfall trends; test

INTRODUCTION

Rainfall is an end product of a number of complex atmospheric processes, and it forms the input to all the hydrological studies. Rainfall patterns usually have temporal and spatial variability. This temporal and spatial variability of rainfall is due to seasonal atmospheric phenomenon and geographical (topographical) factors respectively. In this direction, an attempt has been made to study the spatial and temporal behavior of rainfall in the Belagavi districts of Karnataka state. This has been achieved by considering historical data of 40 rain gauge stations which are situated in this region. World Meteorological Organization (2000) has recommended a number of statistical techniques for climatologically analysis. Using some of these methods, rainfall in the Belagavi district has been analyzed to study presence of any trend in the rainfall series.

Rainfall forms the input of all hydrological studies. Apart from the quantum of rainfall, its time distribution plays a critical role in the planning and management of water resources. Peak rainfall data are used in designing storm water management systems and in determining the flooding potential of various storm events. Daily or hourly data are

Required in continuous hydrologic simulation procedures Monthly and Seasonal data are used in determining supplementary irrigation water requirements, and in engineering studies related to storage analyses, water supply, and reservoir management. The variability in rainfall may affect the agricultural production, water supply, transportation, the entire economy of a region, and the existence of

its people. In regions where the year-to-year variability is high, people often suffer great calamities due to floods or droughts. The damage due to extremes of rainfall cannot be avoided completely, a fore-warning could certainly be useful and it's possible from analysis of rainfall data.

OBJECTIVES OF PRESENT STUDY

1. To apply statistical techniques to historical data and characterize rainfall occurrence in Belagavi district.
2. To carry out trend analysis of historical rainfall time series.
3. To study variability of annual rainfall in Belagavi district.
4. To check the cycle pattern the 3 years moving average curve is computed for Belgavi district

LITERATURE REVIEW

Rainfall and its Classification;

The term Precipitation denotes all forms of water that reaches the earth from the atmosphere [1]. The usual forms are rainfall, snowfall, drizzle, ice, hail, diamond dust, snow grains, snow pellets, ice pellets, rime, glaze, frost and dew, and any deposit from fog. Of all these, only first two contributes more significant amounts of water. Rainfall being the predominant form of precipitation causing stream flow, especially flood flow in Majority Rivers of India. The term 'rain' instead of 'precipitation' will be used here for simplicity.

The term rainfall is used to describe the precipitations in the form of water drops of sizes larger than 0.5mm. The maximum size of rain drop is about 6mm.

Importance of Analysis of Rainfall

Agricultural Planning

Agricultural production is controlled by monsoon rainfall, which is the primary source for soil moisture for dry land crops. In Agricultural Planning, rainfall variability analysis aids to take farm decisions on times of sowing, inter culture operations, fertilizers application etc [2]. The economy of the country depends upon the agricultural production. Since Variation of the yields of most of the major crops to a large extent is due to the variations of the rainfall amounts and of their distribution in time, studies of rainfall variability are of great importance.

Design of Storage Structures

Statistical and probability analysis of rainfall occurrences is usually carried out for planning and design of water conservation and recharge structures. Though rainfall pattern is erratic and varies temporally and spatially, it is predictable with reasonable amount of certainty for certain return periods that helps to design water conservation/recharge structures in particular area. Frequency analysis of rainfall is necessary and useful tool for solving various water management problems like planning and designing of structures for water conservation and recharge purpose.

Study the Trends in Rainfall Series

Water resources systems are designed and operated on assumption of stationary hydrology. Existence of trends and other changes in the data invalidates this assumption, and detection of the changes in hydrological time series should help us revise the approaches used in assessing, designing and operating our systems. Also the trend and step change studies help us understand the impact of man‟s activities (e.g. Urbanization, deforestation, dam construction, agricultural activities, etc.) on the hydrological cycle.

Planning and Management of the Regional Water Resources

For proper planning and management of water resources in a basin there is a need to constantly update the knowledge of temporal variability of rainfall in the basin.

Implications for Cropping

Some crops vary in plant water requirements (drought tolerance) and growing season (time of sowing and maturity duration). Better choices on which crop should be grown can be made with rainfall probability information. Information on rainfall probability is also important to make the choice to not grow a crop at all, due to potential seasonal conditions which would produce crop failure.

Study the Occurrences of Droughts and Floods

Frequency analysis of Rainfall can help to predict the occurrences of drought or floods with certain return period.

Structural Characteristics of Annual Rainfall

Rainfall records in a geographical region show a complex structure. Basic statistical information such as average, standard deviation, skewness, correlation structure, median value,

and range can be computed in a simple way from the rainfall records.

Additionally, structural characteristics of the time series can be derived. These characteristics include consistency, independence, randomness, and homogeneity as well as the presence of trends and jumps. Structural characteristics of hydro-meteorological variables (Rainfall) are important in modeling studies. For instance, if an autoregressive (AR) type model is to be applied to the observed time series of the variable, then the removal of any trend is required before applying the model. AR-type models, and many others, require the data to obey a predefined probability distribution function, such as a normal distribution. Information on the structural characteristics of precipitation data can also identify a climate change or variability signal. Such information can be exported from the trend analysis and/or jump analysis of the precipitation record.

DESCRIPTION OF STUDY AREA

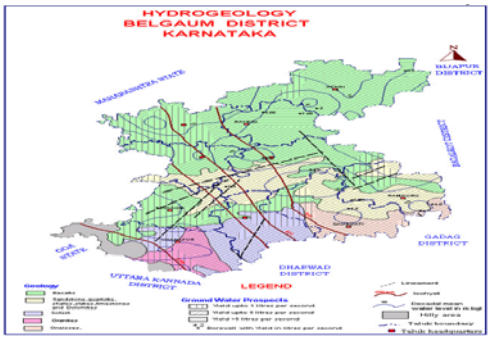

Fig1. Hydrogeology Map of Belagavi District Karnataka

Belagavi is among the 30 districts of Karnataka, situated in the Northwest part of the state. The district is bordered by Maharashtra state to the North, Bagalkot district in the East, Dharwad and UttaraKannada districts in the South, Goa and Maharashtra state in the west. There are ten taluks in the district namely Athani, Bailhongal, Belagavi, Chikkodi, Hukkeri, Khanapur, Raibag, Ramdurg and Saundatti. The district of Belagavi geographically comes in Malnad region and receives an average annual rainfall of nearly 2000 mm. Agro-climatologically the district can be divided into three zones i.e. high rainfall “Hilly zone”, “Northern transitional zone” and “Northern dry zone”. The district lies between 15°00‟ and 17°00‟ north latitudes and between 74°00 and 75°30‟ east longitudes. It is situated near the foothills of the Sahyadri mountain range (Western Ghats) andabout 100km from the Arabian Sea. The population was about 42 lakhs at the last census and the area of the district is about 13,415 km2. Of the totalgeographical area, 1927 km2 is under forest ,and 6273 km2 is nearly about 50% of the geographical area is normally under crops. The Belagavi district is Semi-arid in parts of Athani, Raibag, Gokak, Bailhongal, Ramdurg and Saudattitaluks. Climate in rest of the district ranges from sub-humid to humid towards west. Nearly 95 percent of the annual rainfall is received during the period April to October, because of the South-west monsoon. Most of the remaining rainfall is received during November and December under the influence of Northeast monsoon. The district has two major river systems Ghataprabha and Malaprabha which are tributaries of river Krishna. The other rivers Hiranyakesi and Markandeya are tributaries to Ghataprabha.There are two dams on Ghataprabha at Hidakal and on Malaprabha at Navilteerth.

Rainfall and Climate:

The climate of the district as a whole can be termed as semi-arid. The variation in the maximum temperature during the year ranges from 270C to 35.70C and minimum from 13.90C to 20.60 C [3].

The district experiences pleasant winters and hot dry summers. The hot season extends from March to May, during which the daily maximum temperature often shoots up to 35.7 0C Agro-climatologically the district can be divided into three zones i.e. high rainfall “Hilly zone”, “Northern transitional zone” and “Northern dry zone” from southwest to northeast respectively. The normal rainfall in the district decreases from more than 1859 mm in Khanapur taluk in the southwest, to less than 491 mm in Raybag taluk towards northeasterly direction Those areas, that receive less than 750 mm annual rainfall are classified as semi-arid and thus drought prone. Hence, the entire district except, the southwestern part is categorized as semi-arid and drought prone. Total normal rainy days vary from 90 in Khanapur to 37 in Athani. Eastern and northeastern parts of the district are prone to drought of mild nature. The average annual rainfall during the period 1971 to 2016 recorded in the district is 769.1 mm. The standard deviation and Coefficient variation of rainfall

for the Belagavi district is 196.2 mm and 25.5% respectively. The highest mean annual rainfall recorded in the district was 1,064 mm in the year1975 and the lowest rainfall 455 mm in the year 2003. An analysis of the seasonal variation of rainfall indicates that bulk of the rainfall is received during southwest monsoon period (June to Sept) that is nearly71.6% of the annual. The contribution by the northeast monsoon or post monsoon (Oct to Dec) is nearly 17.3% and the rest 11.1% is the contribution of the dry weather and pre-monsoon period (Jan to May). The statistical analysis of the rainfall for the period 1971-2016 indicate that the coefficient of variation, for the district as a whole is around 25.5 %, for the south-western monsoon it is32.5% and for the north-eastern monsoon it is 56.5%. Thus the southwest monsoon is more reliable as compared to the northeast monsoon. Taluk wise computations were carried out for the mean annual rainfall for the period 1996-2005 in the district. It was deduced from these computations that on an annual basis, rainfall has been deficient during three successive years i.e., 2001, 2002 and 2003. It was normal during 2004 and excess during 2005. Saundattitaluk received deficit rainfall during 2001 to 2005. The year 2003 was really bad, as all the taluks had deficit rainfall. Bailhongal, Gokak and Hukkeritaluks had deficit rainfall during four successive years i.e. from 2001 to 2004. The precipitation from pre- monsoon had been a total failure in most parts of the district during the same period. The rainfall during monsoon period was meager during 2002 and 2003. Similarly during the post-monsoon period precipitation although the district as a whole received normal rainfall during the year 2016 on an annual basis; it experienced 24% excess rainfall during monsoon and53% deficient rainfall during post-monsoon period. The deficiency of rainfall during post-monsoon period was more than 60% in the taluks of Bailhongal, Belagavi, Chikkodi, Gokak, Hukkeri and Khanapur.

CLIMATE:

Belagavi is known for its pleasant climate so the best time to visit Belagavi is all through the year. Belagavi is at its coldest in winter (November - February temperatures dropping to 9 degrees Celsius, minimum temperature in Karnataka state is usually recorded in Belagavi), and experiences continuous monsoon during July to September. The annual average rainfall is over 1200 mm.

Summer season: Belagavi city is well known for its pleasing climate all around the year. Summer season is considered as humid as the temperature goes u to 40 degrees Celsius. Most of the tourists avoid travel towards city in summers as hot and humid days are unbearable.

Monsoon season: Belagavi experiences incessant monsoon during the month of July to September. And it witnesses the annual average rainfall of more than 1200 mm. It is nice to visit the city in monsoon but heavy rainfall can ruin your trip.

Winter season: Belagavi city welcome winters in between the months of November – February. Winters are considered as coldest season and sometime temperature drops to 9 degrees Celsius which is recorded as minimum temperature in the whole Karnataka state.

MEASUREMENT OF RAINFALL

Precipitation is expressed in terms of depth to which rainfall water would stand on an area if all the rain were collected on it. The precipitation is collected and measured in a rain gauge. The instrument used to collect and measure the precipitation is called rain gauge [3].

1. Non-Recording gauges.
2. Recording gauges.

Methodology

The data of 46 years from 1970-2016 for Belagavi district are collected, which are in monthly pattern of every talukas. From the daily rainfall data monthly average is calculated of each talukas. Then from the monthly rainfall data annual average is calculated of every talukas. For annual we took all 12 months. Then yearly avearage rainfall is calculated of Belagavi district. And carried out the trend analysis of historical rainfall time series. And moving average curve is obtained.

GROUND WATER SCENARIO OF THE DISTRICT:

Hydrogeology

Water table generally follows the topography of the area and is at greater depths in the water divides and topographic highs, but becomes shallower in the valleys and topographic lows

and therefore, groundwater moves down and follows the gradient from the higher to lower elevations, that is, from recharge area to discharge area. Therefore, locally direction of flow from higher elevations is towards the rivers [4]. Overall, the general flow direction of ground water in the District is generally towards the east The district is underlain by gneisses, schist, limestone, sandstone, basalts, alluvium etc. Deccan basalts cover an area of 7,650 Sq.Kms. In the northern part of the district and have a maximum thickness of around 256 m, which gradually thins out in the southern direction Hard rocks occupy a major part of the district; majority of which are basaltic lava flows. Most of these rocks have poor capacity of storing and transmitting water, except through favourable zones and at favourable locations. Aquifer systems encountered are therefore limited in nature. Ground water occurs both in weathered and fractured zones. Ground water occurs in all weathered formations of the district under phreatic conditions and in fractured and jointed formations under semi-confined conditions**.** Deccan basalts act as a multilayer aquifers having low to medium permeability. In Deccan basalts that comprise different flows, fractures and interstitial pore spaces of vesicular zones, are good repositories of ground water. Groundwater occurs under phreatic conditions in weathered zone of these basalts and under semi-confined to confined conditions in inter-trapeans and also In joints and fractures at deeper levels. In limestone, solution cavities are considered to be more potential than weathered and fractured ones. In gneisses and schist, weathered zone varies From 7 to 12 m and water-bearing zones extend down to 80m.The aquifers occurring within the shallow depth range of 0 to 20m bgl are mainly weathered and fractured formations. Groundwater occurs in these formations under phreatic conditions and the average thickness of these aquifers ranges from 5 to 15m. In general, 60% area of the district is having the weathered thickness in the range of 5 to 10 m. About 25% of the district area has weathered thickness in the range of 10 to 15m and 15% in the range of 15 to 20m.In the major parts of the district, the decadal mean of depth to water level generally ranged between 5 to 20 m bgl (Figure-3). During pre-monsoon period i.e. May 2006, 8%, 28%, 37%, and 27% of the wells had depth to water level ranges between 0-2, 2-5, 5-10 and 10-20m bgl respectively (Figure-4). There was a rise of water level in 30%, 20% and 30% of the wells during post monsoon period i.e. November 2006 in the range of 0-2, 2-4 and more than 4m respectively. On the other hand 12%, 5% and 3% of the wells showed a fall in water levels in the ranges of 0-2, 2-4 and more than 4m respectively. Therefore more than half of the district had depth to water level between 2-5m bgl during post-monsoon period i.e. November 2006 and the overall depth to water level in the district was between 0 to 10m bgl, except in a small strip towards southern part of Ramdurg taluk where it is more than 10m bgl.The long-term pre-monsoon water level trend (1996-2005) shows a rise in 53% of the wells, while there is a fall in 47% of the wells. On the other hand during post-monsoon period, 68% of the wells show falling trend, while there is a rising trend in 32% of the wells. Over all the annualized trend shows a fall in 61% of the wells and rise in 39% of the wells [**5**].Based on the pumping test data of the dug wells, it is inferred that there is a progressive increase in the permeability exceeding >100m/ day in the water table phreatic zones of basaltic aquifers towards the east, even though the area falls in the northern dry and transitional zone having low to moderate rainfall. Similar is the case with other lithologic units. On the other hand in Khanapur Taluk, though it falls in high rainfall hill zone agro-climatically, the permeability of the principle water table aquifers of schists and gneisses range from < 25 to 50m/day. Analyses of Pumping test data of exploratory borewells show that wells have yielded discharges in the range of 0.02 to 7.58 lps and the draw down ranged between 0.068 to 32.44 m. The transmissivity (T) computed was between 1 and 2,220 m2/day.

RESULTS AND DISCUSSION: In this chapter hydro-metrological data of Belagavi district has been analysed and discussed considering the parameters such as rainfall, ground water levels, temperature, humidity, sunshine hours, etc. Considering the talukas wise monthly rainfall from 1970-2016 and taking in to account pre-monsoon, south-west monsoon, north-east monsoon, and for annual periods, mild, moderate, severe, and extreme rainfall are classified. Depending upon the talukawise rainfall, ground water, temperature,

etc. and duration has been analysed and presented in this chapter.

As for the identification of time series changing points, a preliminary graphical inspection is highly instructive and meaningful. The annual rainfall time series, averaged over the whole dataset, is illustrated in Figures. The corresponding interpolated regression line is also plotted.

The annual series of the rainfall for all stations considered for the analysis are plotted. From the figures the variation of annual rainfall over the years for the data period can be easily seen. Some of the rainfall statistics of Belagavi district is shown below [6].

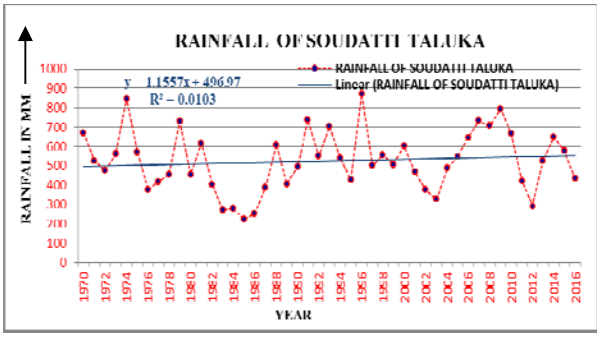

fig2: Rainfall of Soudatti taluka

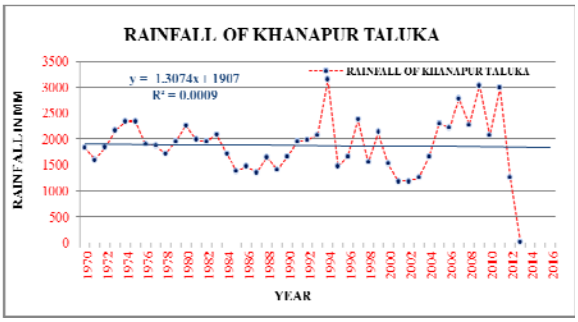

fig3:Rainfall of khanapur taluk

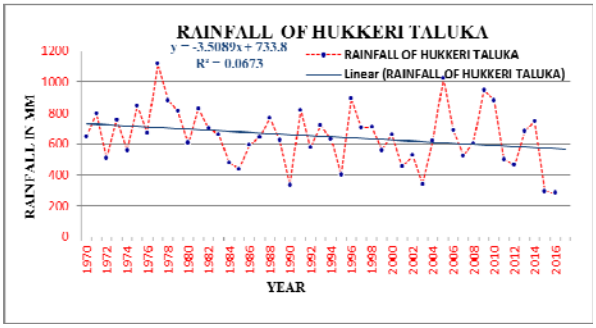

fig4:Rainfall of Hukkeri taluka

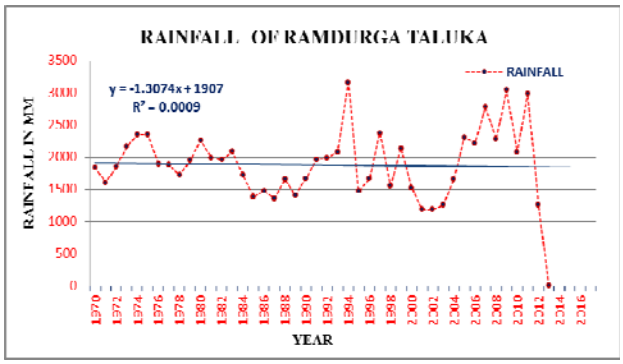

fig5:Rainfall of Ramdurga taluka

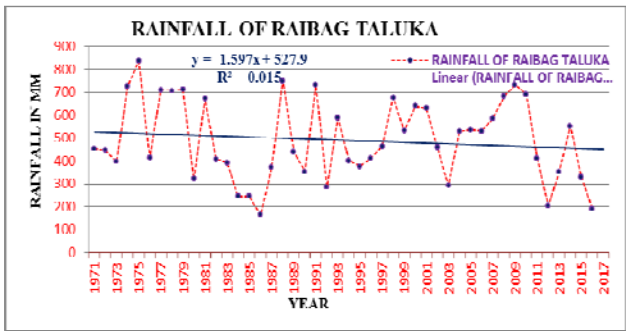

fig6:Rainfall of Raibag taluka

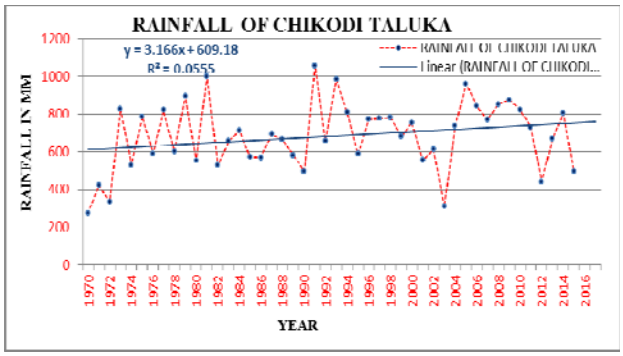

fig7:Rainfall of chikodi taluka

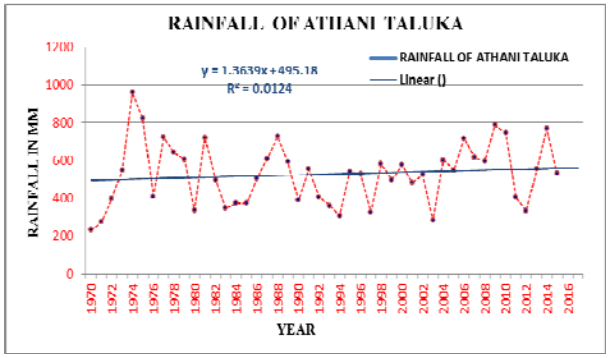

fig8:Rainfall of athani taluka

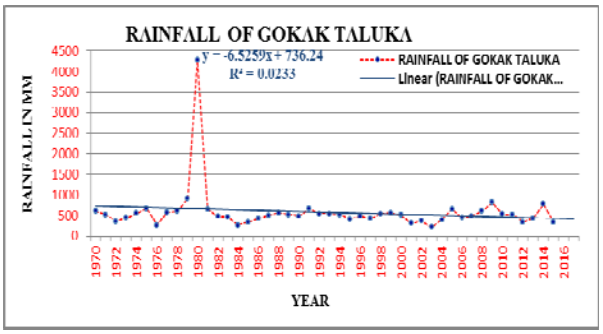

fig9:Rainfall of Gokak taluka

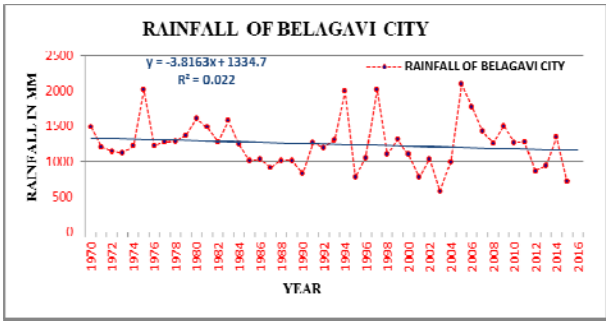

fig10:Rainfall of Belagavi taluka

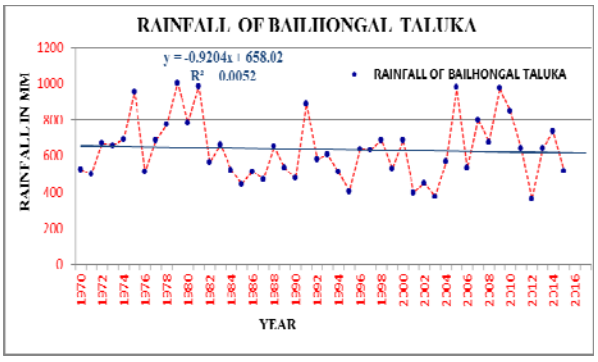

fig11:Rainfall of Bailhongal taluka

The average annual rainfall of the raingauge stations in Belagavi district ranges from 346.48 mm (sarapur) to 5976.02 mm (kanakumbi) indicating a wide variation from one station to the another station. It can be seen that the maximum rainfall occurred at station chapoli with 7654.7 mm in the year 1987 in standard deviation varies between 118.543 mm to 1259.072 mm for station hidkal dam and the chapoli respectively. It is observed that the maximum variation in the annual rainfall occurs at station Bugate alur with a coefficient of variation of 47% and minimum at the station hidkal dam with a coefficient of variation is around 18%.which the minimum occurred at the station sarapur with rainfall of 117 mm in the year 1988. The average coefficient of variation is around 30% indicating the rainfall varies reasonably from one year to the next. Most of the stations have kurtosis coefficient negative indicating that a distribution is more flat than the normal distribution. Only one station kudachi has a kurtosis coefficient greater than 5 indicating that low rainfall values are observed more often than high rainfall values. The skewness coefficients for most of the stations are positive indicating that the low rainfall happens frequently whereas the high value rainfall happens rarely. For some of the stations the skewness

coefficient is equal to or nearly equal to zero indicating the data follows a normal distribution.

From the study it is indicated that the district rainfall depended mainly on depressions in Arabian Sea and Bay of Bengal currents and the district was located in a rain shadow area. It also indicated that the rainfall distribution with space and time was not uniform. There was a lot of spatial variation in the occurrence of rainfall in the district. The lowest rainfalls observed to be 428.66, 484.6, 536.71mm in 2003, 2012, 1985 respectively, and the highest rainfall received is 1141.9, 1114.93, 1068.07 mm in 1980,2009 and 1975 respectively. From the study of rainfall it is observed that there was rainfall during the deficit years, and due to lack of timely rainfall, the available rainfall was not much use to the farmers. Study of annual average rainfall indicated

That the maximum rainfall was in the year 1994 (3149.8mm) in Khanapur taluk. During the Pre-monsoon period the minimum annual average rainfall was 189.2 mm (2016) in Raibag taluka. It is indicated that high variations in the annual rainfall distribution occurrence in the district. The monsoon months of June to September account for more than 80% of the annual rainfall. During June and July, the number of Taluka in Belagavi district showing increasing rainfall is almost equal to those showing decreasing rainfall. In August, the number of Taluka in Belagavi district showing an increasing trend exceeds those

showing a decreasing trend, whereas in September, the situation is the opposite. The majority of Taluka in Belagavi district showed very little change in rainfall in non-monsoon months. The seasonal and annual rainfall distribution for the Belagavi district as a whole indicated that, 76 per cent of the annual normal rainfall was received during South-West

monsoon season, 13per cent during North-East monsoon, and the remaining 11 per cent was received during Pre-monsoon period. The study revealed that there had been an increase in the rainfall trend up to 2002 in all talukas of the district and the downward trend of rainfall indicated from 2003 which continued up to 2012. In 2003 and 2012 extremely low rainfall was observed. The increasing trend of rainfall again noticed from the year 2006 with little fluctuation, and followed the same trend up to 2014. From the year 2013 again decreasing trend of rainfall was noticed in few of the talukas of the district .The study showed that deficit rainfall in one year is generally compensated by excess rain in another. Also the study indicated that the rainfall was light during January and February, the monthly average rainfall does not exceed more than 50-60 mm. Also the same pattern was observed in North East monsoon period with average rainfall between 80-110 mm.

Table: Averagr rainfall data

SL .No	NAME OF TALUK	NO. OF. YEARS	MIN (mm)	MAX (mm)	AVG (mm)
1	Athani	46	232	960.1	528.78
2	Bailhongal	46	363.3	1002.2	633.07
3	Chikodi	46	273	1055.4	680.95
4	Gokak	46	214	901.4	582.97
5	Hukkeri	46	336.2	1116.6	649.59
6	Khanapur	46	1183.2	3149.8	1880.8
7	Raibag	46	189.2	836.44	490.86
8	Ramdurga	46	221.3	837	542.97
9	Soundatti	46	224.1	870.6	524.7
10	Belagavi	46	575	2095.1	1230.9

Courtesy: Meteorological Dept Belagavi

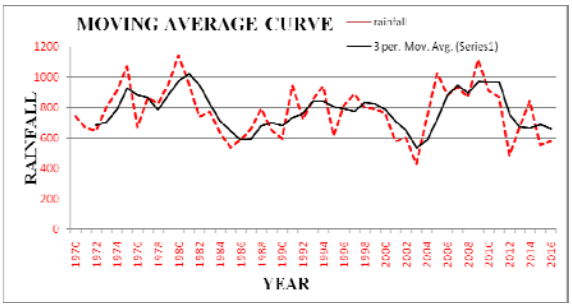

Fig 12: Moving average curve pattern of Belagavi District

CONCLUSION

From the study of "hydro metrological study" of Belagavi district the following are the broad conclusions derived.

1. The year 1980 is considered as the best year with maximum average rainfall of 1141.90 mm.
2. The year 2003 is considered as drought year with a minimum rainfall of 428.66 mm.
3. In Athani taluka it is observed that in the year 1974, maximum rainfall of 960.1 mm and in 1970 a minimum rainfall of 232 mm.
4. In Bailhongal taluka it is observed that maximum rainfall of 1002.2 mm and minimum of 363.3 mm in the year 1979 and 2012 respectively.
5. In Chikodi taluka it is observed that maximum and minimum of 1055.4 mm and 273 mm in the year 1991 and 1970 respectively.
6. In Gokak taluka in the year 1974 and 2003 the maximum and minimum rainfall observed as 901.4 mm and 214 mm respectively.
7. In Raibag taluka, in the year 1972 and 2016 the maximum and minimum rainfall observed as 836.4 mm and 189.2 mm respectively.
8. In Ramdurga taluka, in the year 2014 and 1980 the maximum and minimum rainfall observed as 837 mm and 221.3 mm respectively.
9. In Soudatti taluka, in the year 1996 and 1985 the maximum and minimum rainfall observed as 870.6 mm and 224.1 mm respectively.
10. In Belagavi taluka, in the year 2005 and 2003 the maximum and minimum rainfall

observed as 2095.1 mm and 575 mm respectively.

11. In Hukkeri taluka, in the year 1977 and 1990 the maximum and minimum rainfall observed as 1116.6 mm and 336.2 mm respectively.
12. In Khanapur taluka, in the year 1994 and 2002 the maximum and minimum rainfall observed as 3149.8 mm and 1183.2 mm respectively.
13. During these 46 years period (1970 to 2016) there was many occasions when a large number of areas in this district experienced moderate to severe drought condition.
14. The rainfall normally occurs in the month of June, July, August, and September. This is due to monsoon winds and its negligible small during the rest of the months.
15. On the basis of the last years data the mean maximum temperature is 31.34 ^{o}C in the month May, and mean minimum temperature of 24.95 ^{o}C in the month of November are existed.

Scope for Future Study

The hydro-metrological data study will helps in knowing the rising atmospheric concentrations of greenhouse gases which cause the change of temperature and precipitation pattern and thus change the vegetation response. The important social and economic decisions are being made today on long term projects-the major water resources management activities such as irrigation and hydro-power, drought relief, agricultural land use, structural designs and costal engineering projects, and energy planning's are all based on the assumption that the past climatic data, without modification, are a reliable guide to the future.

The developing countries like India are indeed making significant progress in limiting greenhouse gases emissions through adjusting various policies. Climatic changes, especially which of changes in the rainfall pattern .compound the conditions of uncertainty and risk in agricultural, thereby, further subjecting agriculture to an ecological crises. The impact of climate change may hinder development and delay progress in eradicating poverty, potentially aggravating social and environmental condition in the countries. The climate change impacts to poor developing countries rather than on limiting the cost of mitigation percent. A system needs to be guided by a better understanding of the potential economic impacts and other risk to developing countries which emanate from the climate change problems.

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