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Report on hydrometeorology of Chitapur Taluk, Kalburgi district, and Karanataka, India

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Abstract
Rainfall data of past hundred 30 years of Chithapur taluk, source collected from Central Ground water board. The data revealed that the average rainfall of CGWB report is 1 mm spread over 30 years. Received from south west monsoon (June-September), north east (October-December), summer (March-May) and winter season (January -February) respectively. Rainfall receiving more than 100 mm of rainfall can be expected only at. The water scarcity and groundwater pollution are the major problems faced by the community of the Chithapur taluk. Shortage of rainfall, industrialization, urbanization, use of pesticides and fertilizers in agriculture results in poor quality and quantity of groundwater. The study area Chithapur with an average temperature of about 34^0c. The successive failure of rains occurred during the year 1972 and 1973, when large numbers of people were affected. We have to adopt necessary methods to conserve the quality and quantity of groundwater. To minimize the problems caused by water scarcity we have to follow certain technological procedures like irrigation, regulated consumption of ground water, sprinkler irrigation, contour farming, crop rotation, rainwater harvesting, recycling of drainage water etc. Rainfall is the most important natural hydrologic event and is a unique phenomenon varying both in space and time, the rainfall distribution is very uneven and it not only varied considerably from place to place but also fluctuates from year to year. The rainfall is one of the most important and governing factor in the planning and operation strategies of any agricultural programmer for any given area. As such, proper and specific information about the rainfall distribution pattern over a period for a particular place is inessential for proper and optimal planning of requisite irrigation system and cropping pattern. Indian subcontinent gets around 75% of annual rainfall during monsoon period, which lasts from June to September i.e. four months. Theme share of conjunctive water-need of the country during entire calendar year is met by the rainfall, which occurs in the monsoon period. There is large variation in distribution of rainfall from year to year. In our country swallowing floods and thirstily droughts at the results of spectacular extremities of the rainfall distribution.

Keywords: drought, flood, frequency, urbanization, groundwater

Introduction
Rainfall is the primary source of ground water recharge. Other sources are seepage from surface water bodies. The distribution of rainfall in time and space plays an important role in the occurrence and distribution of water resources. With increased urbanization and dependence on minor irrigation for agricultural production the need for scientific assessment and management of groundwater is very important. In this report an attempt is made to study rainfall, its distribution, and periodicity etc., based on statistical approach Rain water is the source of fresh water. The activity of collecting rainwater directly or recharging into the ground to improve ground water storage is called as Rain Water Harvesting. In earlier years, the areas around our homes and offices used to be unpaved and the rain falling on these areas would percolate into the soil and remain there for being drawn through shallow open wells. With the proliferation of flat complexes, not only have these areas been paved and percolation of rainwater into the soil almost totally stopped. But the quantity of water drawn from the soil below has increased manifold. Consequently open wells and not - so - deep bore wells started drying up. The reason is that no sincere attempt is made to replenish the ground water table with rainwater during the monsoon. An individual house, based on the roof area and the rainfall of the region, it is possible to harvest the rain water and use it for the purpose of drinking and other domestic uses.

Climate
The area experiences semi-arid climate with pleasant winter and hot dry summer. The temperature begins to rise steadily with the commencement of summer season from the middle of February. Simultaneously, humidity decreases day by day. The season lasts till the first week of June. Usually, May happens to be the hottest month of the year and on several days the maximum temperature shoots up to 47^0C. Towards the end of April and also during the month of May, there would be occasional showers accompanied by thunderstorms.
The wet or rainy season sets in June and lasts till the end of September. Thereafter, the months November and December mark the period of post-monsoon. During these two months quite often-northeast monsoon becomes active and there would be occasional showers. After October month the temperature would be more rapid. The period from December to mid February is regarded as winter season and intensity of cold increases towards the end of December month, which happens to be the coldest month of the year.
The area lies in which the rainfall is moderate to low, besides

being quite capricious as a result drought and scarcity conditions occur in the area quite frequently. The average annual rainfall is 667 mm and there would be an average of 47 rainy days spread over 6 months period. The amount of rainfall increases slightly from southwest to northeast. Sporadic pre-monsoon showers accompanied by thunderstorms occur during April and May months. SW monsoon, which accounts for 81% of annual precipitation usually sets in mid June and ends in September. Usually September month receives highest rainfall.

The annual rainfall statistics reveal that the amount of rainfall as well as its distribution is quite often unpredictable. Both of these are subjected to a large amount of variation from year to year and place to place. Thus quite often results in drought and scarcity conditions and when this occurs in successive year's people would be put to untold hardship and shortage of drinking water and fodder. The successive failure of rains occurred during the year 1972 and 1973, when large numbers of people were affected.

The climatological data of Gulbarga Meteorological Station is presented in Table 1.

Table 1: Normal of climatological features of Gulbarga Meteorological Station

Month	Temperature		Humidity/ Relative Humidity (%)	Rainfall (mm)		Mean wind (kmph)	Evapotranspiration (mm)
	Max.	Min.		Monthly	Rainy days		
January	30.4	16.0	54/ 27	1.3	0.1	9.1	124.8
February	33.4	18.5	43/ 24	5.3	0.4	9.9	144.1
March	36.8	21.7	36/ 20	11.2	0.7	10.4	190.6
April	39.1	25.0	41/ 22	16.8	1.7	11.7	209.6
May	40.2	26.3	47/ 26	39.9	2.9	14.8	234.8
June	35.0	23.8	71/ 47	110.2	6.6	19.2	184.7
July	31.4	22.5	81/ 62	150.8	9.9	20.3	151.6
August	31.2	22.2	81/ 59	142.9	8.5	17.5	147.5
September	31.1	21.9	80/ 61	178.9	9.2	13.0	130.9
October	31.9	21.0	68/ 48	71.0	5.0	11.2	145.9
November	30.4	17.5	57/ 35	23.8	1.5	11.3	129.7
December	29.5	15.1	56/ 31	1.9	0.3	9.8	117.5
Average	33.4	21.0	60/ 39	75.33	46.8	13.2	1912.7

***Source*:** District Statistical Office, Gulbarga

The area is categorized as drought prone due to low annual precipitation. The minimum and maximum actual annual rainfall recorded at Chitapur rain gauge station in the last ten years are 592 mm and 1084 mm respectively (Table 2).

Temperature

The area experiences maximum temperature ranges from 29.5^{o} to 45.2o C and minimum from 15.1^{o} to 28.3^{0} C. The monthly minimum and maximum temperatures recorded at Gulbarga Meteorological Station are presented in the Table 1.

Humidity

The relative humidity in the area depends not only on the amount of water vapour in the atmosphere, but also on temperature. In the surveyed area, the humidity is generally high being over 81% in the monsoon and decreases in the post monsoon period. The driest part of the year is the period from January to May, when the relative humidity is about 36% (Table 2).

Wind velocity

The winds are generally light with some increase in force during late summer and monsoon seasons. The winds blow mainly from southwestern and west during the period from April to September and highest in July month. In October, winds blow commonly between North and Eastern directions but in some days these are from southwest and western directions.

During November and December months, these winds are mainly northeastern, easterly, and southwesterly and westerly appear in January and from February on wards. The westerly decrease in frequency and the afternoon winds begin to blow more and more towards southwest and west. By April, the winds blow predominantly for west and southwestern directions (Table 2).

Potential Evapotranspiration (PET)

The amount of water, which land area losses by PET depends upon the amount of precipitation received and other meteorological factors viz., temperature, wind condition, humidity, cloudiness etc., and the type, manner and extent of vegetation. The annual PET calculated by Penman's method is 1912.7 mm. The monthly PET of the area recorded at the Gulbarga Meteorological Station is presented in the Table 2. During August and September months the rainfall is excess.

Rainfall

There is a large spatial variation in quantum of annual rainfall received in Karnataka. It decreases from over 4000mm in the west to less than 400mm in the east over a distance of 400 Km. Physiographic ally the state is divided into four regions. These are, north interior plains, south interior plains both on the eastern side of the state, coastal area to the west of the Western Ghats and fourthly the hilly region. While in the coastal and hilly areas per humid to sub humid climate prevails, in the plains the climate is sub humid to semiarid in nature. A large part of the state, the area east of the ghats, being in the rain shadow, is semi arid in nature and hence drought prone. Agumbe in Shimoga district is the wettest place in the state. Annual rainfall of 10000mm is quite

common. Summer monsoon sets in the state by 1st week of June. As a consequence, copious rains are received along the west coast and on adjoining mountains and valleys. After crossing the mountains the monsoon current gradually weakens resulting in decrease in rainfall towards east. Southern parts of the state also receive good rainfall, over 1000mm and this decreases northwards. Sub humid conditions prevail in the north-northeastern parts of the state.

There is one rain gauge located in Chitapur taluk (Table 1). The data in respect of this station from the year 1970 to 2000 is analyzed and presented in the following. Data of this station is of long term, presumed to be authentic and considered representative.

Table 2: Rain gauges and their location in Chitapur Taluk, Gulbarga District

Sl. No	Station	Latitude	Longitude	Altitude
1	Chitapur	17.12	77.08	741.5

Seasonal Distribution of Rainfall

The year may broadly be classified into four seasons. Given in the Table 3 are district averages and seasonal rainfall as percentage of the annual. Dry weather period (Jan-Feb) contribution is insignificant, the percentage around 1. The premonsoon (Mar- May) rainfall constitutes over 6 percent to 8 percent of the annual. The summer monsoon (Jun-Sep) accounts for over 74 percent to 78 percent of the annual over the district. The winter monsoon (Oct-Dec) accounts for nearly 15 percent to 17 percent of the annual in the district, bulk of it occurring in the month of October. The seasonal distribution of rainfall, in the district, indicates that the rainfall increases from east to western parts. August is the wettest month in the district with rainfall over 164 mm at Humnabad to 200 mm at Bidar. The driest month is February.

Statistical Analysis of Rainfall

In the Table 3 is given the results of statistical analysis of seasonal and annual rainfall. The premonsoon rainfall has a Coefficient of variation Ranges from 72% at Humnabad to 97% at Aurad, which is very high and indicating a highly inconsistent rainfall. The monsoon season rainfall is rather even, in that Coefficient of variation is above 30 percent in all the stations except in Bhalki where, it is 29 percent. The Coefficient of variation during the post monsoon period is around 60 percent in all the stations, which is high. On the whole, the annual Coefficient of variation ranges from 25 to 30 percent. This indicates that, deficiency in one season is normally made good in other seasons. In the Anexures 1 to 5 are given the results of statistical analysis of monthly, seasonal and annual rainfall of all the 5 stations in the district. The monthly Coefficient of variation is lowest when the rainfall is highest that is during the monsoons. It is highest when the rainfall is lowest during the dry season.

Drought

Drought occurs due to reduction in precipitation over an extended period of time, usually a season or more in length. Droughts can be classified as meteorological, hydrologic, agricultural, and socioeconomic. Droughts are one of the most complex of all natural hazards, as it is difficult to determine their precise beginning or end.

In general terms, drought means scarcity of water. This scarcity could be a result of either scanty rainfall or its erratic distribution in time and space. Meteorological drought is a significant drop of rainfall as compared to the normal. Semiarid areas (annual rainfall between 400 and 750mm) are considered to be drought prone. Arid areas are commonly termed as drought stricken. Wherever irrigational facilities are made available the impact of scarcity or drought is mitigated to a large extent.

Inadequacy of rainfall

According to Irrigation Commission, drought is a situation when annual rainfall is less than 75 percent of the normal. When drought as defined above, has occurred in 20 percent or more of the years that area is declared as drought prone. In case where the percentage number of years is 40 or more the area is said to be perpetually drought stricken.

Agriculture Commission has classified drought, based on percentage negative departures of annual rainfall from normal annual rainfall. On this basis, mild drought conditions are said to prevail if the departure is up to 25 percent. Departure between 25 and 50 percent gives rise to normal drought conditions. Severe drought conditions are expected if the departure is above 50 percent.

India Meteorological Department has classified rainfall, also based on departures. If the rainfall departure is between +19 and -19 percent it is considered to be normal. When the percentage departure is between -20 and -59 the rainfall is said to be deficient. Departures above -60 percent give rise to scanty conditions.

Isolated years of deficient rainfall may not be much of concern. Two or more successive years of deficit rainfall will certainly cause drought conditions. All these approaches are based on annual or seasonal rainfall and their departure from respective normal. It is assumed that rains have occurred uniformly throughout the year. In the semi-arid and arid areas, the rainfall is in the form of short duration intense spells. In such cases most of the rainfall is lost as surface runoff, leading to drought conditions.

Variability of rainfall

It is observed that erratic nature of rainfall caused by few and far between wet spells give rise to drought conditions. An approach based on variability of annual/monthly/seasonal rainfall is suggested to classify droughts. This variability is measured in terms of coefficient of variation (CV). If the annual or seasonal CV is 30 percent or more or monthly CV is more than 50 percent, the rainfall is said to be erratic and the area declared as drought prone. Thus even if the rainfall is 750 mm or more if the CV is in excess of 30 percent drought conditions may prevail. This approach seems to be better as compared to the earlier one, which depend on the total rainfall rather than on its variability.

Assessment of Drought

Indian Meteorological Department (IMD 1971) and National Commission on Agriculture (NCA 1976) have classified the droughts of the country based on annual rainfall deficiency into four classes (Table 1). The criteria based upon the

percentage of negative departure are given by long term mean.

$$D_i = \left(\frac{P_i - P_m}{P_m}\right) * 100$$

Where, D_i = Percentage of deviation from long term mean
P_i = the annual rainfall in mm
P_m = Long term mean of annual rainfall in mm

Rainfall data of Chithapur taluk, Gulbarga district has been analyzed for 30 years using IMD method. The results of the classification are listed in the Table 1. It is observed that the Chithapur taluk has experienced alternating no drought to mild (normal) drought conditions over the years.

Table 1: Classification of drought and its recurrence (IMD, 1971)

% Deviation (D_i)		>0	0 to -25	-25 to -50	< -50	Probability of drought occurrences
Category		No drought	Mild (Normal)	Moderate	Severe	
		Years				
Taluk	Chithapur	40	23	18	4	Once in 4 years

The details of the drought assessment are discussed as herein under. Out of 85 years of analysis in Chithapu taluk, 47% of years showing "No Drought" condition, 27% of years showing "Mild Drought", 21% of years are "Moderate Drought" and 5% of years showing severe drought conditions.

Table 2: Normals of monthly, seasonal and annual rainfall, chitapur taluk, gulbarga district

Station	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Chitapur	4.4	3.7	8.6	23.3	36.3	102.8	144.9	146.8	165.4	91.2	18.6	3.1	749.0

Table 3: Statistical Analysis, Seasonal and Annual Rainfall, CHITAPUR TALUK, GULBARGA District

Station	Mean Std. Coef. Dev. Var. mm%	Mean Std. Coef. Dev. Var. mm%	Mean Std. Coef. Dev. Var. mm%	Mean Std. Coef. Dev. Var. mm%
	Jan-May	Jun-Sep	Oct-Dec	Annual
Chitapur	76.2 57.1 75	559.9 181.8 32	112.9 79.5 70	749 204.4 27

Result and Discussion

The data on mean annual rainfall, deviation from normal, coefficient of variation, standard deviation and its classification are given in Table 3. The mean annual rainfall of this region was 733.2 mm spread with coefficient of variation of 29.5%. The maximum rainfall was 1462.3 mm in 1970 followed by the minimum was 318.8 mm in 1990. The normal rain fall varies from 5.5 at Chithapur station to 136.7

Conclusion

The severity and reoccurrence of drought can be known beforehand is proper and detailed analysis and rainfall data is made. In a present study an attempt has been analyze the rainfall data of Chithapur taluk for 30 years. The results indicated that the severity of drought was optimum in the year 1972. There were chances of drought occurrence once in every two year. During 30 years there were 4 years of drought was expedited at Chithapur taluk. On the basis of rainfall data analysis, it was concluded that Chithapur district received mean annual rainfall of 684.8 mm with less coefficient of variation (41.85%) and there was no much deviation among the different years. This region received sizable amount of pre-monsoon rainfall and it was start from May 2nd week and helped in land preparation and also in many places it is advisable to take up some short duration pre-monsoon crops like sesame, horse gram etc. by utilizing this rainfall. During monsoon season even though crop growing season starts from June 1stweek, but there was a break in monsoon and hence, monsoon crops suffer from want of moisture. Hence early sowing in the month of June should be avoided unless supplemental irrigation facilities available. On the other hand due to end season rainfall peak at September last week and October last week due to N-W monsoon the sowing period was extended. Hence, sowing should be done in the month of July end or August first week to get maximum yield and returns.

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