Region Wise Annual Rainfall Characteristics at Study Bhadra Command Area –A Case Study

DrK.Krishne Gowda
Assc. Professor in Civil Engg.
University B.D.T.College of
Engg.Davangere-577004

K. K. Kiran
Lecturer
B.D.T.College of
Engg.Davangere-577004

ABSTRACT

Rainfall is the most important natural hydrologic event and is a unique phenomenon varying both in space and time. For the sustainable development of water resources and for planning of agricultural operations in a given basin, basic knowledge of rainfall distribution during individual months, seasons and year is of vital importance. Rainfall, or lack of it, plays an important role in many of agricultural and non-agricultural operations. A comprehensive knowledge of the trend and persistence in rainfall of the area is of great importance because of economic implications of the rain sensitive operations. Rainfall data as observed by the Indian Meteorological Department (IMD) and Directorate of statistics Bangalore for the period 1975-2007 at 17 stations in the Shimoga and Davangere districts were used in the present study. In the study regions the ARF, NRD and MRI are not by and large stable but it has been found that rain fall intensity decreases from stations at head reach (Region-I) towards tail end stations (Region-III) with intensity as high as 1200mm to as low as 600mm values from southern transitional zone to Central dry zone. From the studies it is cleared that ARF pattern as well as NRD are not same over all the years as well as from region-I to region-III. It is slightly fluctuating not only from year to year and place to place but also from month to month. This clearly indicates that the uneven distribution of ARF and NRD over study BCA. The decreasing total annual rainy days and total annual rainfall over year indicates that in future higher intensity rainfall events with lesser rainy days are expected.

In the study regions the ARF, NRD and MRI are not by and large stable but it has been found that rain fall intensity decreases from stations at head reach (Region-I) towards tail end stations (Region-III) with intensity as high as 1200mm to as low as 600mm values from southern transitional zone to Central dry zone. From the studies it is cleared that ARF pattern as well as NRD are not same over all the years as well as from region-I to region-III. It is slightly fluctuating not only from year to year and place to place but also from month to month. This clearly indicates that the uneven distribution of ARF and NRD over study BCA. The decreasing total annual rainy days and total annual rainfall over year indicates that in future higher intensity rainfall events with lesser rainy days are expected. The rainfall & rainy days in near future there may be climate change due to human interventions like deforestations, urbanizations, industrialization and withdrawal of more ground water which leads to change of meteorological parameters over study area. Studies on soil fertility levels show that there are decreases of available soil macro & micro nutrients. Further study reveals that, the irrigated soil also becomes alkaline. This is mainly due to use of excess chemical fertilizers by farmers to get high yields which leads to slow poisoning (health hazardous) while consuming as a food & fodder by all living beings in coming days.

KEY WORDS: **Rainfall, Bhadra Command Area, irrigated area, Command area Regions, and Bhadra Reservoir.**

IMPORTANCE OF RAINFALL STUDIES

Rainfall is the most important natural hydrologic event and is a unique phenomenon varying both in space and time. For the sustainable development of water resources and for planning of agricultural operations in a given basin, basic

knowledge of rainfall distribution during individual months, seasons and year is of vital importance. Rainfall, or lack of it, plays an important role in many of agricultural and non-agricultural operations (Ananthakrishnan, et al.1961 &1973). A comprehensive knowledge of the trend and persistence in rainfall of the area is of great importance because of economic implications of the rain sensitive operations (Rao, 1991).

With the fast growing population and rapid urbanization, the forest cover has been drastically decreasing. The rate of depletion of forest cover, the World over, has been very high during the 20th century (Hegde, 2000), the scientific and technological advancement having a major role to play in this regard. People still believe strongly that depletion of forest cover over the land surface results in decreased rainfall and hence claim that rainfall has been decreasing steadily over the years. However, most of the hue and cry concerning reduced rainfall particularly in our country is based on feelings rather than on facts (Jackson, 1985). Biswas, (1993) & Sathyanarayana, et al. (1988) have studied annual rainfall characteristics of the district of Kodagu in Karnataka by carrying out trend analysis for various periods and regions within the district by plotting the time series and moving average rainfall series. The Bhadra Command Area (BCA) occupies an important position with regard to its contribution towards local water resources of the country. Studies on identifying the trend and persistence in the rainfall series have been carried out by various researchers in India. Koteshwaram and Alva (1969) and Ramasastri (1987) and Bansal (1973) studied the secular trends and periodicities in the monsoon and annual rainfall of selected stations in India.

Rainfall is the only phenomenon nature has bestowed man with, to bring him fresh water. Rainfall is absolutely necessary for life to survive on this planet (Vijaya Kumar, 2003). Rainfall adds to soil moisture which plants use to produce food, fodder and oxygen which are essential for the survival of all living beings. It feeds rivers and streams which distribute water to places where rainfall alone would not be sufficient. Rainfall also replenishes ground water-storage which contributes to flow in streams over long periods and provides water for drinking and irrigation even during extended dry periods (putty & Thipperudrappa, 20080). Although rainfall brings man plenty of water, it has not been possible for him to get it whenever and where ever he likes to.

Water is vital to man to survive and develop in all parts of the world. In third world countries where the agricultural sector plays a key role in their economic growth, the sustainable management of water resources is an item of high priority in their developmental activities.

The present study deals with the pattern and distribution of rainfall as well as soil characteristics over the study Bhadra command area (BCA) under Bhadra reservoir project (BRP). The major portions of the irrigated area under BRP is mainly consists of both the Shimoga and Davangere districts as shown in Figs.1 to 2 & Table 4 respectively. The location map of study region for sustainable water resources is shown in Fig.1 & the location of the rain gauge stations at the present study is shown in Table 4 respectively.

DESCRIPTION OF THE STUDY AREA SELECTED FOR ANALYSIS

The Bhadra Command Areas (BCA) is the area commanded by Bhadra reservoir which is constructed across Bhadra River near Lakkavanahalli village, Tarikere Taluk, Chikkamagalore district of Karnataka state at an elevation of 601.00m above msl. The dam is located at a latitude of 13°42'00"N and longitude 75°38'20"E. The BCA principally covers three districts of Karnataka namely Shimoga, Davangere and Chikkamagalore districts. The major portions of irrigated area of whole BCA cover both the Davangere and Shimoga districts only as given in Fig.1 & Table 4. The Bhadra Command Area (BCA) receives irrigation water by left and right bank canals of BRP & its area wise allotments as per BRP Dam authority of GOK. There are three well defined Climatic seasons in the region viz.Summer (mid March to May), monsoon (June to September) and winter (December to early March). The transition period between winter and summer is spring and that between monsoon and winter is autumn. Precipitation is received only in the form of rainfall. The catchment area of Bhadra reservoir is about 1968 sq km whereas the total irrigated area comes under this reservoir is 105570 ha

The Right Bank Canal (RBC) and Left Bank Canal (LBC) of Bhadra Command area (BCA) starts from the BRP dam across the Bhadra River as shown in the Figs.1 & 2. The total irrigation atchkat covered under alone BRP are 30.21% irrigation in Shimoga and 69.79% irrigation in Davangere districts only. Shimoga districts irrigated area is blessed by both Bhadra and Tunga rivers. But the Bhadra River is rightly called as "Life Line of Davangere".

For the present analysis 17 rain gauge stations in Bhadra Command Area (BCA) of the

BRP have been selected (Fig.1). These rain gauges are lies in both the Davangere and Shimoga districts (Fig.1 & Table 4). The details of the location and annual normal rainfall & branch wise irrigation water supply are considered.

DATA USED

Rainfall data as observed by the Indian Meteorological Department (IMD) and Directorate of statistics Bangalore for the period 1975-2007 at 17 stations in the Shimoga and Davangere districts were used in the present study. The rain gauges station in the present study area is shown in Fig. 1& Table 4. The list of stations along with average annual normal rainfall obtained from arithmetic method is given in Table 4 & Figs. 1 & 2 respectively.

RAINFALL IN BHADRA COMMAND AREA ATCHKAT

The whole study BCA at central part of Karnataka in South India receives rainfall due to all three types of precipitation's names 1) Convective precipitation 2) Orographic Precipitation 3) Cyclonic precipitation.

Depending on the time of the year in which the rainfall occurs and the direction of the movement of air masses three seasons of rainfall are usually recognized to contribute to the total annual rainfall in the study BCA.

Table 1: Computation of Annual Average Normal Rainfall (ARF in mm) by different methods over study Regions of BCA

Sl. No.	Region	Arithmetic Mean Method	Thiesson Polygon Method	Isohyetal Method
1	I	1070.00	1100.00	**1125.00**
2	II	772.00	**826.60**	1100.00
3	III	638.90	**645.50**	681.50

The first of these is the pre-monsoon season and two others are called monsoons.

MATERIALS AND METHODS

At the present study of BCA under BRP, the data as observed by the IMD stations at Shimoga, Davanagere and Directorate of Statistics,draught monitoring cell & WRDO Banagalore are collected for the analysis of annual rainfall (ARF) data from 1975-2007 at 17 stations and were statistically analyzed for average, stanadard deviations , standard error, percentage error, coeffiecent of variability (CV), kurtosis, skewness, percentage contributions, 5yearly and 10 yearly moving averages and regression equations. Similarly the same staticall analysis as above was carried out for annual rainy days(No.) over the study regions of all 17 raingauge stations over the years.The whole study BCA has been classified into three regions to give due representation to hilly area & plain area. According to the region wise the rainfall analysis study and comparisions have been made for both ARF & NRD.

RESULTS AND DISSCUSSIONS OF STUDY AREA ANALYSIS
RAINFALL ANALYSIS

The Average annual normal rainfall (ARF) over a BCA has been shown in Table 1. It can be observed that these values do not differ much from each other over the regions. In the analysis of annual rainfall pattern over study area has been carried out & it is found to be varies with both spatially and time over the different regions. The Isohyetal study indicates uneven distribution of rainfall pattern (Fig.1) over BCA as it consists of both hilly terrain & plain terrain & therefore the rainfall pattern have been studied by dividing the whole BCA into three regions (Fig.2).The decreasing total number of annual rainy days (NRD) and average annual number of rainy days (ANRD) and total annual rainfall as well as ARF per year indicates that in future higher intensity rainfall events with lesser rainy days are expected over the three regions (Region-I, Region-II & Region-III) from southern transition zone to central dry zone.

From the studies it has been noticed that ARF pattern as well as ANRD are not all same from region-I to region-III. It is fluctuating from year to year and place to place. The important to note that both ARF & ANRD having falling trend from (Region-I to Region-III) head reach (southern transition zone) to tail end region (central dry zone) from statistical analysis presented in Tables 2 & 3 respectively. Region I is consistent than other regions as seen from t-test results.

It can also be observed that the variation of mean rainfall intensity (MRI) which clearly indicates that there is uneven distribution of ARF and NRD over study regions. To conclude, it can be said that although not as much as people think rainfall has reduced drastically over the Century, but the considerable reduction must be there in the first and last study regions, as observed from the present study. The reduction of meteorological parameters may be due to global warming as observed in the present study and this analysis was confined to the study data 1975-2007 over the BCA. However the fact that there has been excess

rainfall during the last two years (2006 and 2007), this may go to prove that nothing can be told conclusively about the behavior of nature from the Results and Inferences also.

CONCLUSIONS:

- In the study regions the ARF, NRD and MRI are not by and large stable but it has been found that rain fall intensity decreases from stations at head reach (Region-I) towards tail end stations (Region-III) with intensity as high as 1200mm to as low as 600mm values from southern transitional zone to Central dry zone.
- From the studies it is cleared that ARF pattern as well as NRD are not same over all the years as well as from region-I to region-III. It is slightly fluctuating not only from year to year and place to place but also from month to month. This clearly indicates that the uneven distribution of ARF and NRD over study BCA. The decreasing total annual rainy days and total annual rainfall over year indicates that in future higher intensity rainfall events with lesser rainy days are expected.
- The studies show that increase in maximum & minimum temperatures but decrease of rainfall & rainy days in near future there must be climate change due to human interventions like deforestations, urbanizations, industrialization and withdrawal of more ground water which leads to change of meteorological parameters over study area.
- Studies on soil fertility levels show that there are decreases of available soil macro & micro nutrients. Further study reveals that, the irrigated soil also becomes alkaline. This is mainly due to use of excess chemical fertilizers by farmers to get high yields which leads to slow poisoning (health hazardous) while consuming as a food & fodder by all living beings in coming days.

REFERENCES:

1. ANANTHAKRISHNAN, R. (1973). "Some Aspects of the variability of daily, monthly and annual rainfall at neighboring pairs of stations and the nature of monsoon rainfall at Individual stations". Contributions from Indian Institute of Tropical Meteorology, Pune.
2. ANANTHAKRISHNAN, R. AND RAJAGOPALACHARI, P.J. (1961). "Pattern of Monsoon rainfall distribution over India and Neighborhood". Indian Meteorological Department.
3. ANONYMOUS, (2003). "Agronomic practices of different crops". University of Agricultural Sciences. Bangalore. pp 01-250.
4. ASHOKMISHRA AND CHANDRANATH CHATTERJEE (2009). "Temporal changes in rainfall occurrence and distribution in west Midnapore District of West Bengal". Journal of Indian water resources society vol. 29 no1, pp 38-48.
5. BAJWA, M.S. (2003). "Organic farming has high value enterprise". In Agriculture Tribune Publication, Chandigarh, India pp 01-10.
6. BISWAS, B. AND GUPTHA, K. (1993). "Variability of Southwest monsoon rainfall over West Bengal". Mausam, Vol. 44, No.4, pp 353-358.
7. HEGDE, N.G. (2000). "Sustainable Agriculture for Food Security". Proc. Of Indian Farming. 49(12). Mar. pp4-11.
8. JACKSON, I.J., (1985). "Relationships between rainy days mean daily Intensity and monthly rainfall in the Tropics". JL. of Climatology, Vol. 6, pp 117-134.
9. MUTREJA, K.N. (1986). "Applied hydrology". Tata Mc Graw –Hill Company, New Delhi.
10. RAMASASTRI, K.S. AND NIRUPAMA, P. (1986-87). "Statistical analysis of rainfall in Belgaum district Karnataka". Report no.TR-4, National Institute of Hydrology, Roorkee.
11. RAO, N.H. (1991). "Climatic Fluctuations and water resources development in India". JL of Indian water resources vol. 11 no-3 pp 32-36.
12. THIPPERUDRAPPA, N.M. AND PUTTY, M.R.Y. (2008). "Rainfall Trend in Karnataka over the Century". Proc. of National Convention of Civil Engineers on Water Resources Planning.Cnservation & Management IE (I) Mysore, August.12 pp 25-34.
13. VIJAY KUMAR (2003). "Rainfall characteristics of Shimla district". JL of India water resources society vol. 23, pp 36-42.

Table 2: Statistical Parameters of annual average normal rainfall for different regions over study BCA.

N	**Region-I**	**Region-II**	**Region-III**
	33	33	33
Total	34109.600	24634.645	21110.523
Mean	1033.624	746.504	639.713
Std Dev	195.852	129.815	180.546
Std Error	34.093	22.598	31.429
% Error	3.298	3.027	4.913
CV	18.948	17.390	28.223
Min	666.567	506.233	393.550
Max	1472.333	1052.909	1263.450
Median	1033.133	744.064	612.500
Kurt	-0.343	-0.019	3.267
Skewness	0.189	0.070	1.439
95% confi	66.822	44.291	61.600
LL	966.802	702.213	578.113
UL	1100.446	790.796	701.313
% Contrib.	42.715	30.849	26.436
t-test	0.057	0.086	0.062

Table 3: Statistical parameters of annual average normal rainy days for different regions over study BCA.

	Region-I	**Region-II**	**Region-III**
N	21	21	21
Total	2076.867	1799.964	1794.667
Mean	98.843	86.189	86.133
Std Dev	13.403	8.952	9.760
Std Error	2.925	1.954	2.130
% Error	2.959	2.267	2.473
CV	13.560	10.387	11.331
Min	65.333	62.273	60.333
Max	118.000	98.509	101.333
Median	102.333	87.382	85.000
Kurt	1.064	0.776	0.950
Skewness	-1.115	-0.959	-0.517
95% confi	5.732	3.829	4.174
LL	93.111	82.360	81.959
UL	104.576	90.018	90.308
% Contrib.	36.451	31.785	31.764
t-test	-0.181	-0.271	-0.249

Table 4: Location of average annual normal rainfall (ARF) over the present study area (BCA) along with rain gauge stations

Sl.No	**Status**	**Taluk**	**District**	**Longitude(°E)**	**Latitude(°N)**	**mean sea level (m)**	**Normal Annual Rainfall (mm)**
1	Anaveri	Bhadravathi	Shimoga	75°-44'-38.4"	14°-3'-36.6"	590.31	724.0
2	Basavaptna	Chennageri	Davangere	75°-48'-7"	14°-12'-00"	644.78	731.0
3	Bhadravathi	Bhadravathi	Shimoga	75°-42'-54"	13°-51'-00"	594.33	842.8
4	B.R.P	Tarikere	Chikmagalur	75°-38'-20"	13°-42'-00"'	657.00	1170
5	Chennageri	Chennageri	Davangere	75°-56'-10"	14°-1'-2"	670.56	787.6
6	D.B.Halli	Bhadravathi	Shimoga	75°-40'-00"	13°-50'-00"	584.37	864.1
7	Davangere	Davangere	Davangere	75°-53'-30"	14°-28'-06"	586.94	635.8
8	Harihar	Harihar	Davangere	75°-49'-15"	14°-00'-22.8"	533.37	609.8
9	Holehonnur	Bhadravathi	Shimoga	75°-41'-31.8"	13°-59'-26.4"	566.42	756.0
10	Honnalli	Honnalli	Davangere	75°-38'-30"	14°-14'-33"	538.44	673.3
11	Joldal	Chennageri	Davangere	75°-85’-00”	13°--96’-0”	668.43	1033
12	Koodligere	Bhadravathi	Shimoga	75°-45'-30"	13°-55'-00"	591.43	742.0
13	Mallebennur	Harihar	Davangere	75°-44'-00"	14°-21'-00"	594.36	723.0
14	Santhebennur	Chennageri	Davangere	76°-00'-00"	14°-10'-00"	640.56	719.0
15	Sasvehalli	Honnalli	Davangere	75°-40'-00"	14°-03'-00"	558.39	722.0
16	Shimoga	Shimoga	Shimoga	75°-35'-00"	14°-56'-00"	602.48	974.7
17	Thyavanagi	Chennageri	Davangere	75°-58'-00"	14°-15'-00"	636.29	671.0

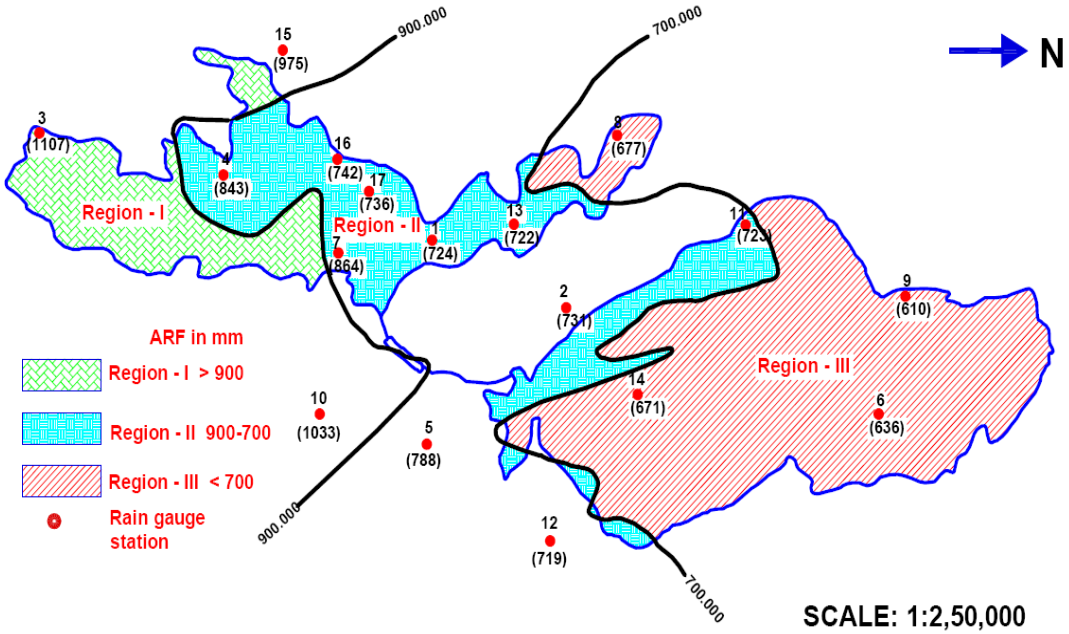

Fig.1: Location Map of Different Study Regions. (Figures within the bracket indicates ARF in mm)

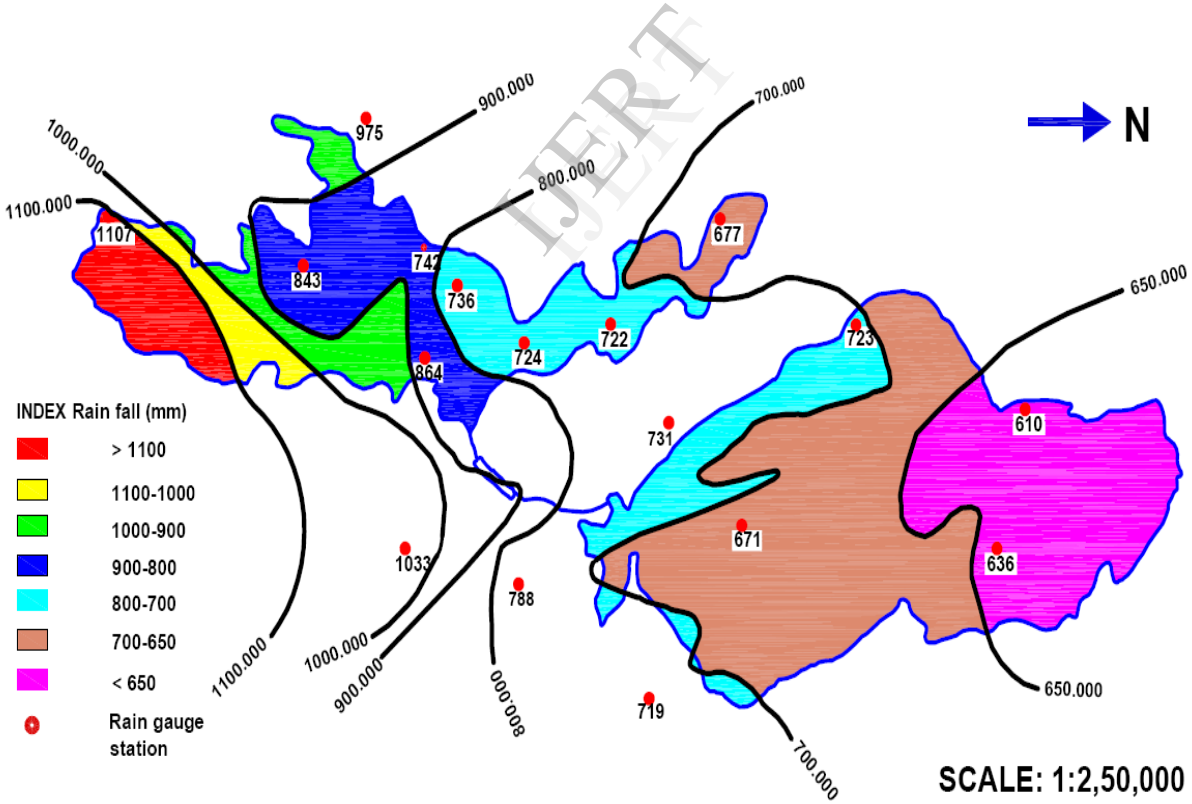

Fig.2: Rainfall Pattern over the Bhadra Command Area.