

SPATIO-TEMPORAL ANALYSIS ON RAINFALL TREND AND VARIABILITY OF KALABURAGI DISTRICT, KARNATAKA, INDIA - THROUGH GEOGRAPHICAL INFORMATION SYSTEM – GIS

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ABSTRACT

This study is mainly focused on spatio-temporal rainfall statistical data from 11 taluks of Kalaburagi district to analyse the spatial variation of monthly, periodically and yearly rainfall patterns changes between 2006 and 2022. The mean rainfall was calculated using simple mathematical formulas. The findings showed seasonal and yearly variability of rainfall in all taluks of Kalaburagi district by using thematic statistics analysis with based on metrological stations of all taluks. Due to geographical and climatic fluctuations, the district of Kalaburagi experienced an annual received mean rainfall of 797 mm. several taluks, such as Yadrami, Afzalpura and Sedam are received minimum rainfall of 472 during in the pre and south west monsoon. In the post monsoon lowest rainfall recorded in Kalaburagi and sedam taluks. Higher mean rainfall was recorded in Kalaburagi, Aland, Kamalapura, Jevargi, Shahabad, Kalagi and Chittapara taluks. While Kalaburagi, Yadmi and Jevargi taluks are demonstrated remarkable fluctuation trends of rainfall in the pre and post monsoon seasons respectively. In the water- scarce taluks of Kalaburagi district, this work is important for policymakers addressing impact of climate change on agriculture and water resource management.

Keywords: Spatio-temporal, Rainfall variability, Trend and pattern, Thematic

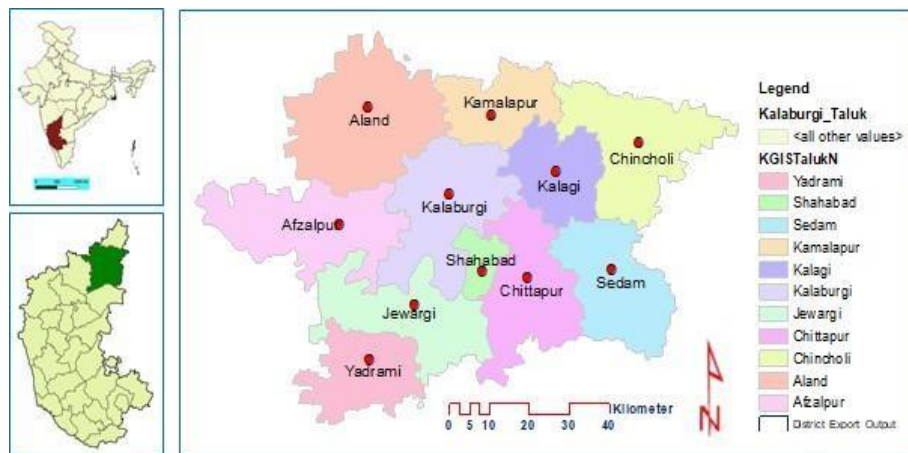
1.1 Introduction

Agriculture is a one of the primary occupation for survival of both human being and also livestock. It will generate plenty of employments for livelihoods. Therefore we should give much more attention to the sustainability of agriculture. As we know, agriculture is influenced by many physical aspects like erratic climate, fluctuation of rainfall. From this point of view many uncertainties productions are found in the agriculture. Thus, the main objective of this study is to focus on calculate and prepare the model of the spatio-temporal rainfall trend and variability for improve the agriculture sustainability. The rainfall model is developed based on the rainfall measurement obtained from different rain gauge stations around the

Kalaburgi district.

1.2 Research Method and design: For the detailed study of the district, the various meteorological data were collected. The average monthly rainfall data of all the eleven taluks from 2005 to 2024 (20 years) were collected. The entire study is based on the IMD rainfall data from 2005 to 2024 and district statistical glance. Taluks wise rainfall data were also collecting from 48 rain gauge station, over the 20 years. Cartography techniques were used through GIS environment for the different thematic outcomes.

1.3 Study Area



Map – 1 Location map of Kalaburgi District

Kalaburagi district is lies in North Karnataka between 17°.12' to 17°.46' north latitude, and 76°.04' to 77°.42' east longitude. It's covering a geographical area of 10,951 km², with elevations various ranging from 300 to 750 meters above mean sea level. This district is bounded on the west by Bijapur district and Solapur district of Maharashtra state, on the north by Bidar district and Osmanabad district of Maharashtra state, on the south by Yadgir district, and on the east by Sangareddy and Vikarabad districts of Telangana state. (Map -1) Kalaburagi district was comprised of seven taluks, Afzalpur, Aland, Chincholi, Chittapur, Kalaburagi, Sedam, and Jevargi until in the year of 2019. In the year of 2020, four new taluks were newly formed. Kalagi from Chincholi, Yadrami from Jevargi, Kamalapur and Shahabad are derived from Kalaburagi taluk.

1.4 Climatic condition of Kalaburagi district

Kalaburagi is one of the drought prone districts of Karnataka State. All the eleven taluks of the Gulbarga district has identified as drought prone taluks. Kalaburagi district has hot semi-arid climate (BSH) bordering on a tropical wet and dry climate (Aw). The climate of the district is generally dry, with temperatures ranging from 8 °C to 45 °C the highest summer temperatures in (March to May). Kalaburagi

district has recovered annual mean rainfall of about 797 mm. Most rainfall occurs between June and September due to southwest monsoon winds, while October and November sees low amount of rain from northeast winds. Most of the rainfall in the district comes during the southwest monsoon season.

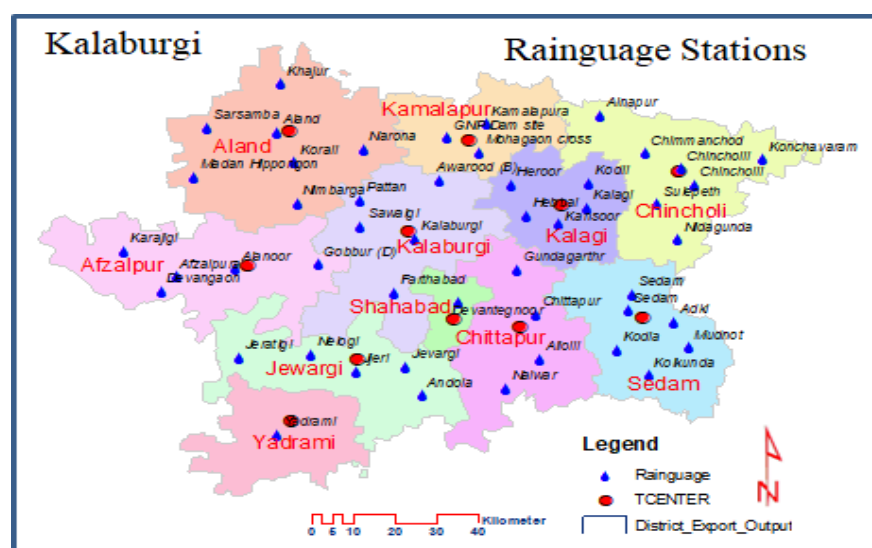
The seasonal and annual rainfall distribution for the Kalaburagi district as a whole indicates that, seventy one per cent of the annual normal rainfall is received during the southwest monsoon season, seventeen per cent during the post monsoon, and the remaining twelve per cent is received during the pre-monsoon period. Overall annual rainfall relatively low and approximately 750 mm has found throughout the district

1.5 Spatial distribution of rain gauge station in Kalaburagi district

Kalaburagi district has distributed 53 rain gauge stations along all taluks. (Table - 1)

Sl. No	Name of the Taluk	Name of the Rain gauge station
1.	Chincholli – (07)	Ainapur
		Chimmanchod
		Konchavaram
		Sulepet
		Chincholli (A)
		Chincholli
		Vidgunda
2.	Kamalapura – (03)	G.N.P. Dam site
		Kamalapura
		Mohagaon cross
3.	Kalagi – (05)	Heroor
		Hebbal
		Kansoor
		Kalagi
		Kodlli
4.	Sedam – (06)	Kolkunda
		Mudnot
		Adki
		Kodla
		Sedam (A)
		Sedam
5.	Shahabad – (01)	Devantegnoor
6.	Yadrami – (01)	Yadrami
7.	Jevargi – (05)	Jeratigal
		Nelogi
		Jieri
		Jevargi
		Andola
8.	Afzalpura – (05)	Afzalpur
		Atantur
		Karajgi
		Devangaon
9.	Kalaburgi (T) – (05)	Gobbur(D)
		Awarad (B)
		Pattan
		Sewalgi
		Kalaburgi
10.	Aland – (07)	Farthabad
		Aland
		Khajuri
		Madana Hipparga
		Narona
		Nimbarga Tanda
		Korall
		Sarsanba
11.	Chittapura – (04)	Nalwara
		Allolli
		Chittapura
		Gundalgarthr

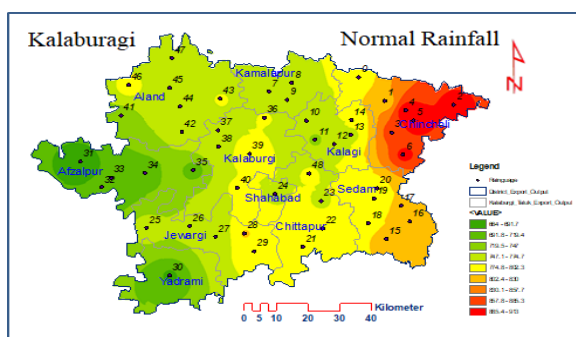
Source: District statistical office, Kalaburagi



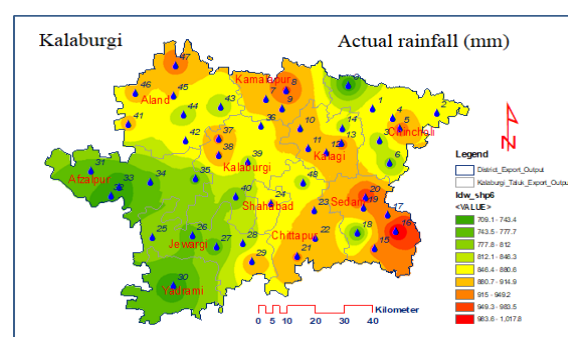
Map -2

Above mention table there are fifty three rainguage stations are located throughout the district (Map -2). Among these seven stations are not properly working. Chincholli have 07, Kamalapura - 03, Kalagi - 05, Sedam - 06, Shahabad – 01, Yadrami - 01, Jevargi - 05, Afzalpura - 05, Kalaburgi (T) have 05, Aland - 07 and Chittapura have included – 04 station are located. All these rainguage stations are provide the temporal rainfall date for the long period. Based on these data further analysis are made for the result.

In the Kalaburagi district having hot collimate condition through out the year. Rainfall distribution is generally depending on the monsoon seasons. The larger amount of rainfall is accruing in the southwest monsoon period. In the western part of the district like Chinchilli and Sedam taluqs are normally received more rainfall. But toward to the western part is gradually received less rain. While the actual rainfall has found in the left middle part of the district, it is mainly stich from north to south of the district. (Map - 3 and Map – 4)



Map -3



Map – 4

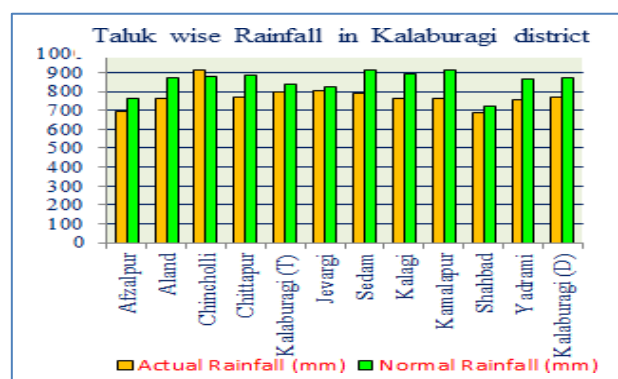
Actual rainfall is very unevenly found in throughout the district. Usually the large western part is very low rainfall experienced. While the south east to northern centre part having more rainfall, in the north east and middle part is moderate rainfall found (Map -4) below table is showing the various rainguage station having normal and actual rainfall in the entire Kalaburagi diastrict (Table – 2)

Table – 2 . Rainguage station and actual and normal rainfall (mm) in Kalaburagi district

Sl. NO	Rainguage Station in Kalaburgi District	Normal Rainfall (mm)	Actual Rainfall (mm)	Sl. NO	Rainguage Station in Kalaburgi District	Normal Rainfall (mm)	Actual Rainfall (mm)
1	Kalaburgi	770	847	24	Farhatabad	779	793
2	Afzalpur	692	762	25	Pattan	772	924
3	Afzalpur	692	709	26	Jevargi	805	821
4	Atanur	707	771	27	Jewargi	805	807
5	Karajgi	664	776	28	Andola	792	911
6	Aland	763	874	29	Nelogi	753	712
7	Aland	763	884	30	Sedam	791	911
8	Khajuri	757	933	31	Sedam	791	984
9	Madana Hipparga	735	889	32	Adki	807	938
10	Narona	766	818	33	Kodla	799	762
11	Nimbarga Tanda	761	876	34	Mudhol	807	1018
12	Chincholi	913	879	35	Kalagi	766	891
13	Chincholi	913	946	36	Kalagi	766	934
14	Ainapur	783	721	37	Kodli	774	829
15	Sulepet	874	822	38	Gundgurti	773	835
16	Kodli Chincholi	896	797	39	Kamalapura	762	915
17	Chittapura	771	887	40	Kamalapur	762	956
18	Chittapur	771	883	41	Mahagaon Tanda	772	914
19	Gundgurti	777	833	42	Narona	770	924
20	Nalavara	791	918	43	Ainapur	780	821
21	Kalaburagi	794	837	44	Yadrami	687	723
22	Kalaburagi	794	861	45	Ijjeri	750	765
23	Aurad	777	849	46	Shahbadha	758	864

Kalaburagi district has annually received 750 mm rainfall. Yadrami, Afzalpura taluks are received 600 to 700 mm rain in the western part. While Chinchilli and Sedam taluks are receiving nearly above 900 mm. But in the remaing taluks are receving between 700 mm to 800 mm. (Table- 3)

Sl. No	Taluks Name	Actual Rainfall (mm)	Normal Rainfall (mm)
1	Afzalpur	692	762
2	Aland	763	874
3	Chincholli	913	879
4	Chittapur	771	887
5	Kalaburagi (T)	794	837
6	Jevargi	805	821
7	Sedam	791	911
8	Kalagi	766	891
9	Kamalapur	762	915
10	Shahbad	687	723
11	Yadrami	758	864
12	Kalaburagi (D)	770	874



Pre- Monsoon Rainfall of Kalaburagi district

The Pre-Monsoon Rainfall maps for Kalaburagi district are presented in three panels. The 'Mean Rainfall' map uses a color scale from 0 to 15 mm, with higher rainfall concentrated in the central and southern regions. The 'Standard deviation' map shows values from 0 to 20 mm, with higher variability in the central and southern parts. The 'Coefficient variation' map displays values from 0 to 100, with higher variability in the central and southern parts. Each map includes a legend, a north arrow, and a scale bar.

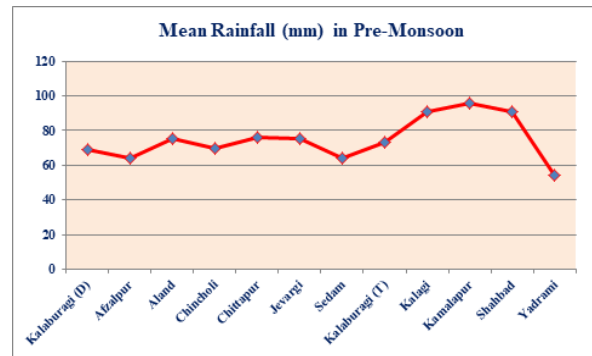
Southwest monsoon Rainfall in Kalaburagi district

The Southwest monsoon Rainfall maps for Kalaburagi district are presented in three panels. The 'Mean Rainfall' map uses a color scale from 0 to 15 mm, with higher rainfall concentrated in the central and southern regions. The 'Standard deviation' map shows values from 0 to 20 mm, with higher variability in the central and southern parts. The 'Coefficient variation' map displays values from 0 to 100, with higher variability in the central and southern parts. Each map includes a legend, a north arrow, and a scale bar.

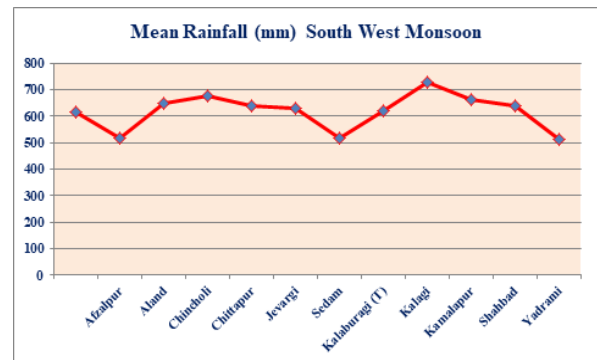
Post-Monsoon Rainfall in Kalaburagi district

The Post-Monsoon Rainfall maps for Kalaburagi district are presented in three panels. The 'Mean Rainfall' map uses a color scale from 0 to 15 mm, with higher rainfall concentrated in the central and southern regions. The 'Standard Deviation' map shows values from 0 to 20 mm, with higher variability in the central and southern parts. The 'Coefficient variation' map displays values from 0 to 100, with higher variability in the central and southern parts. Each map includes a legend, a north arrow, and a scale bar.

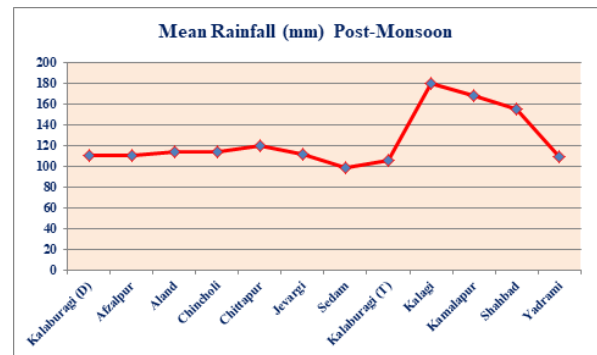
Sl. No	Taluks	Pre – Monsoon		
		Mean	SD	CV
1	Kalaburagi (D)	69	26.89	8.88
2	Afzalpur	64	20.85	32.57
3	Aland	75	35.00	46.66
4	Chincholi	70	25.52	36.45
5	Chittapur	76	31.90	41.97
6	Jevargi	75	31.12	14.49
7	Sedam	64	28.56	44.62
8	Kalaburagi (T)	73	87.86	120.35
9	Kalagi	91	48.28	53.10
10	Kamalapur	96	22.73	23.67
11	Shahbad	91	48.28	5.7
12	Yadrami	54	3.08	53.3



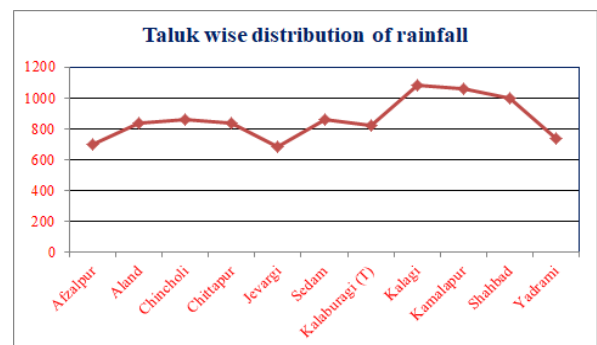
Sl. No	Taluks	South west - Monsoon		
		Mean	SD	CV
1	Kalaburagi (D)	615	15.93	25.84
2	Afzalpur	516	134.33	26.30
3	Aland	649	153.52	23.65
4	Chincholi	675	174.41	25.83
5	Chittapur	640	172.16	26.9
6	Jevargi	630	134.21	21.3
7	Sedam	519	167.18	32.21
8	Kalaburagi (T)	618	146.43	21.5
9	Kalagi	727	191.71	26.37
10	Kamalapur	661	66.62	10.07
11	Shahbad	640	98.17	15.31
12	Yadrami	510	3.67	0.71



Sl. No	Taluks	Post – Monsoon		
		Mean	SD	CV
1	Kalaburagi (D)	110	41.85	37.7
2	Afzalpur	110	56.68	51.52
3	Aland	114	63.73	55.20
4	Chincholi	114	46.54	40.84
5	Chittapur	120	51.64	43.30
6	Jevargi	112	49.76	44.42
7	Sedam	99	53.64	54.21
8	Kalaburagi (T)	105	57.62	54.87
9	Kalagi	179	36.04	20.13
10	Kamalapur	168	34.02	20.13
11	Shahbad	155	33.51	28.52
12	Yadrami	109	31.90	21.61



Sl. No	Taluks	Mean Rainfall	SD	CV
1	Kalaburagi (D)	797	189.2	23.7
2	Afzalpur	698	160.3	22.9
3	Aland	838	169.6	20.4
4	Chincholi	860	195.3	22.7
5	Chittapur	838	211.2	25.1
6	Jevargi	682	210.3	30.8
7	Sedam	859	217.9	25.3
8	Kalaburagi (T)	818	214.6	26.3
9	Kalagi	1086	186.6	17.1
10	Kamalapur	1056	207.8	19.6
11	Shahbad	995	120.9	12.1
12	Yadrami	737	115.1	15.6



Source: District Statistical hand book, Kalaburagi

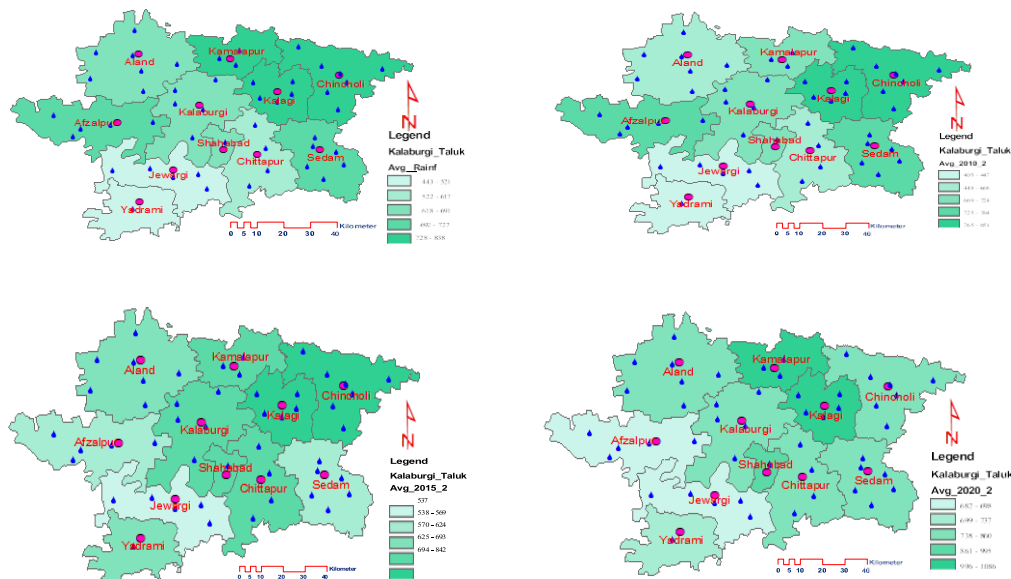
1.6 Spatio-temporal analysis of rainfall:

The Analysis is based on annual distribution of rainfall in the season wise. In the per-monsoon season period Kalaburagi accruing of rainfall having 74.83 mm varies from 54 mm to 97 mm. the more rainfall found in the Kamalapur, Kalagi and Shahabad, while Yadrami, Sedam, Afzalpura taluks are recived (54 mm) very less rainfall (Map – 5)

South-west monsoon is predominantly accruing more rainfall throughout the district. The southwest monsoon average rainfall is 616.66 mm, and it is varies from 727 mm to 510 mm. high rainfall found in the north-eastern part. Kalagi, Chincholli and Kamalapur taluks are received more than 650 mm rainfall. While the southwest part is normally receive less amount of rainfall (510 to 610 mm).

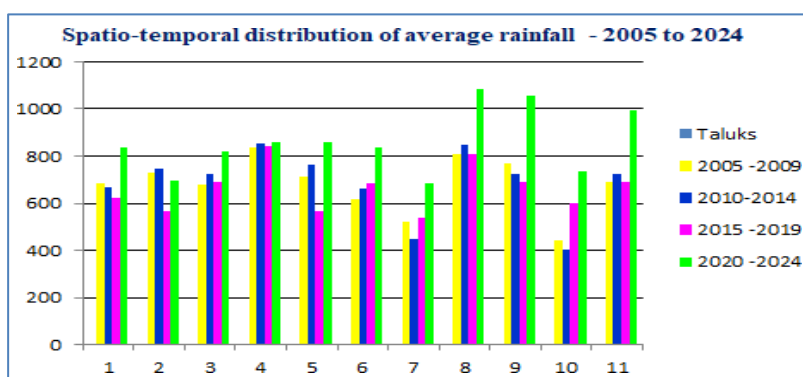
In the post monsoon season receving average rainfall is 114 mm. it is found in the Yadrami, Kamalapur, Kalagi and Shahabad (179 mm) and varies 110 mm. While Kalaburagi and Sedam taluks are received less rainfall (99 mm).

The above the pictures were give the annual periodically distributed of rainfall in the Kalaburagi district. Here very much clarity in the fluctuation find in the all the monsoon season. Therefore the climate change is effected on the spatial distribution of rainfall in many taluks of Kalaburagi district. This scenario is mainly affected on the agricultural productivity and also water resource management



Average rainfall distribution from 2005 to 2024 (Table – 3)

Sl. No	Taluks	2005 -2009	2010-2014	2015 -2019	2020 -2024
1	Aland	685	668	624	838
2	Afzalpur	727	748	564	698
3	Kalaburagi (T)	681	724	693	818
4	Chincholi	838	851	842	860
5	Sedam	710	764	569	859
6	Chittapur	617	662	687	838
7	Jevargi	521	447	537	682
8	Kalagi	806	847	810	1086
9	Kamalapur	771	724	693	1056
10	Yadrami	443	405	601	737
11	Shahbad	691	724	693	995



Above the table is representing the long term spatio-temporal distribution of rainfall in the Kalaburagi district from 2004 to 2024. Every five year decadal rainfall is very greater varies from one taluks another. From 2005 to 2009 the Chncholli, Sedam Kalagi, Kamalapura has receive more rainfall. But in the western part have receiving moderate and Chittapura, Jevargi, Yadrami has very low.

1.7 Conclusion

Kalaburagi is one of the drought prone districts of Karnataka State. Because the geographical it is located in rain shadow region of Karnataka. Therefore the entire district has semi-arid climate condition. The findings of the study would be very much useful to the planners and policy makers of the study area to identify the uneven distribution of spatio-temporal condition of rainfall. The trend of rainfall is play on the agriculture, because rainfall is unevenly distributed throughout the district. Many of taluks are having scarcity of rainfall in the rainy season. Yadrami and Afzalpura and Sedam taluks are experiencing frequently very low rainfall. But Chincholli Kamalapura, Kalagi and Chittapura are receiving more rainfall. The entire study is focus on distribution trend of rainfall in the Kalaburagi district. The study also throws light on future potentialities of increasing of agricultural productivity and water resource management

under different spatio-temporal of rainfall situations viz., with existing and recommended technology.

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