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Study of variability in weather parameters during different months in all districts of Chhattisgarh plain zone

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Abstract

The present investigation entitled “Study of variability in weather parameters during different months in all districts of Chhattisgarh plain zone” was carried out in the Department of Agricultural Meteorology, College of Agriculture, Raipur, during the year 2024–25. The study was undertaken to analyze the variability in weather parameters in different districts of Chhattisgarh Plain Zone. Based on the long-term data, 2017, 2000, 2013 and 2003 were found hottest year for the month of March, April, May and June, respectively. While, coolest year were noticed on 2022, 2012, 2018-2019 and 2011 for November, December, January and February month, respectively. Highest amount of heavy rainfall 187.8 mm in one day was observed in Durg district on 27/08/2020 followed by 173.7 mm rainfall was recorded in Balod and Dhamtari district on 29/06/2007 during rainy season. Whereas, lowest amount of heavy rainfall 107.4 mm was found in Rajnandgaon district on 07/08/2019 followed by 109.6 mm in Mahasamund district on 15/06/2004.

Keywords: Maximum temperature, minimum temperature and rainfall

Introduction

Rainfall is an important factor that needs serious attention as Indian agriculture is drastically affected due to consistency and distribution of this factor in rainfed agriculture. Rainfall is a single most important factor for success of crops in the farming areas. It is also one of the most composite and difficult elements of the hydrological cycle to understand due to the great range of variation over a wide range of scales both in space and time, Rainfall pattern governs the overall cropping pattern, productivity and sustainability of agriculture enterprise. The standard of living and well-being of human largely depends on rainfall intensity and frequency (Dore, 2005) [3]. Rainfall directly or indirectly affects agriculture production, human lifestyle, water resources management and ecosystem function and structure (Kumar and Gautam, 2014) [10]. Indian, agriculture continues to be a gamble of the vagaries of monsoon, rainfall being most critical because nearly 70% of the net sown area is still rain dependent (Narain *et al.* 2006) [11]. Temperature is one of the key meteorological factors affecting the growth and yield of crops. Several studies on climate change have indicated an increasing trend in temperature which may significantly affect cropping system and production of livestock. (Hingane *et al.* 1985) [6]. Temperature extremes would greatly affect production. The major impact of warmer temperatures was during the reproductive stage of development and in all cases grain yield in maize was significantly reduced by as much as 80-90% from a normal temperature regime. Pollination is one of the most sensitive phenological stages to temperature extremes across all species and during this developmental stage. Global temperature has increased by 0.3–0.6 °C since the late 19th century and by 0.2–0.3 °C over last 40 years. In the last 140 years, the 1990s was the warmest period (Jones and Briffa, 1992) [8]. In Indian context, Kothawale and Kumar (2002) [9] reported a rise of 0.5 °C in mean annual temperature over last century. However, no systematic change in mean minimum temperature was observed. The pattern of spatial and temporal changes in climatic variables due to global warming need more debate and studies are

being conducted globally (Chattopadhyaya and Hulme., 1977; Georgaidi *et al.*, 1991; Iglesias *et al.*, 1994; Feddema, 1999) ^[2, 5, 7, 4]. As a consequence of climatic changes, a significantly impact on hydrological parameters, viz. runoff, evapotranspiration, soil moisture, ground water etc. is expected (Bultot *et al.*, 1988) ^[11].

Data and Methodology

This study was conducted at Shaheed College of Agriculture, Raipur (Chhattisgarh) by using 24 years (2000-2021) daily maximum and minimum temperature data of all districts of Chhattisgarh Plain Zone. Maximum, minimum temperature, extreme rainfall and their frequency were worked out using weather cock software developed by CRIDA, Hyderabad (Rao *et al.*, 2011) ^[12].

Results and Discussion

1. Highest and lowest value of maximum temperature during the month i.e., March, April, May and June in different districts of Chhattisgarh Plain Zone

Table 1 showed that all districts reported highest value of

maximum temperature on 31/03/2017. However, highest value of maximum temperature 44.8 °C was observed in 4 districts Bemetara, Bilaspur, Durg and Mungeli, respectively. While, maximum temperature 42.8 °C during March month was found in Gariyaband district. In April month, highest value of maximum temperature 46.8 °C was recorded in Bilaspur and Mungeli districts on 29/04/2009 and 46.7 °C in Baloda Bazar district on 30/04/2001. While, maximum temperature 45.0° C was noticed on 28/04/2000 on Gariyaband district. However, Baloda Bazar district showed highest value of maximum temperature 48.5 °C on 24/05/2013 followed by 48.4 °C on Bilaspur and Mungeli districts on dated 24/05/2013 in the month of May. In June month, all districts reported highest value of maximum temperature on 04/04/2003. Highest value of maximum temperature 48.9 °C was recorded in Baloda Bazar district followed by 48.8 °C was noticed in Bilaspur and Mungeli districts, on date 31/03/2017 and 04/06/2003, respectively. Whereas, 2013 year was noticed hottest year for the month of May.

Table 1: Highest value of maximum temperature (°C) during the month of March, April, May and June in different districts of Chhattisgarh Plain Zone

S. No.	District	March		April		May		June	
		Date	Tmax(°C)	Date	Tmax(°C)	Date	Tmax(°C)	Date	Tmax(°C)
1	Balod	31/03/2017	43.9	29/04/2009	45.5	23/05/2013	47.5	04/06/2003	47.8
2	Baloda Bazar	31/03/2017	44.3	30/04/2001	46.7	24/05/2013	48.5	04/06/2003	48.9
3	Bemetara	31/03/2017	44.8	27/04/2000	46.6	24/05/2013	47.8	04/06/2003	48.3
4	Bilaspur	31/03/2017	44.8	29/04/2009	46.8	24/05/2013	48.4	04/06/2003	48.8
5	Dhamtari	31/03/2017	43.0	27/04/2000	45.2	23/05/2013	46.6	04/06/2003	46.8
6	Durg	31/03/2017	44.8	27/04/2000	46.6	24/05/2013	47.8	04/06/2003	48.3
7	Gariyaband	31/03/2017	42.8	28/04/2000	45.0	24/05/2013	46.7	04/06/2003	46.7
8	Janjgir Champa	31/03/2017	44.1	30/04/2001	46.6	24/05/2013	48.2	04/06/2003	48.6
9	Kabirdham	31/03/2017	44.1	18/04/2010	45.9	21/05/2013	47.2	04/06/2003	47.6
10	Kanker	31/03/2017	44.0	01/04/2000	46.0	21/05/2013	48.3	04/06/2003	48.3
11	Korba	31/03/2017	43.8	29/04/2009	45.8	24/05/2013	47.2	04/06/2003	47.5
12	Mahasamund	31/03/2017	43.4	28/04/2000	46.1	24/05/2013	47.9	04/06/2003	48.0
13	Mungeli	31/03/2017	44.8	29/04/2009	46.8	24/05/2013	48.4	04/06/2003	48.8
14	Raigarh	31/03/2017	43.9	29/04/2009	46.2	24/05/2013	47.6	04/06/2003	48.1
15	Raipur	31/03/2017	43.4	28/04/2000	46.1	24/05/2013	47.9	04/06/2003	48.0
16	Rajnandgaon	31/03/2017	43.9	27/04/2000	46.2	23/05/2013	47.5	04/06/2003	47.8

Tmax = Maximum Temperature (°C)

Table 2: Lowest value of maximum temperature (°C) during the month of March, April, May and June in different districts of Chhattisgarh Plain Zone

S. No.	District	March		April		May		June	
		Date	Tmax(°C)	Date	Tmax(°C)	Date	Tmax(°C)	Date	Tmax(°C)
1	Balod	04/03/2014	26.5	13/04/2015	29.3	03/05/2023	30.9	15/06/2001	25.6
2	Baloda Bazar	04/03/2014	26.1	13/04/2015	29.2	02/05/2023	31.7	20/06/2001	27.8
3	Bemetara	04/03/2014	27.2	13/04/2015	27.9	03/05/2023	31.3	20/06/2001	26.6
4	Bilaspur	04/03/2014	28.2	13/04/2015	27.6	01/05/2023	30.9	30/06/2001	27.9
5	Dhamtari	24/03/2008	27.4	13/04/2015	29.8	03/05/2023	30.5	14/06/2001	23.9
6	Durg	11/03/2006	27.4	13/04/2015	27.9	03/05/2023	31.3	20/06/2001	26.6
7	Gariyaband	11/03/2006	26.2	17/04/2006	29.0	02/05/2023	31.3	14/06/2001	24.1
8	Janjgir Champa	03/03/2006	26.0	13/04/2015	28.2	01/05/2023	30.4	30/06/2001	27.8
9	Kabirdham	03/03/2006	26.9	13/04/2015	26.9	01/05/2023	29.9	20/06/2001	25.9
10	Kanker	31/03/2023	26.1	30/04/2023	29.8	03/05/2023	30.0	14/06/2001	24.6
11	Korba	21/03/2023	26.6	21/04/2013	27.6	01/05/2023	29.5	26/06/2001	27.7
12	Mahasamund	02/03/2015	27.4	17/04/2006	30.1	02/05/2023	31.2	15/06/2001	25.6
13	Mungeli	14/03/2020	27.6	13/04/2015	27.6	01/05/2023	30.9	30/06/2001	27.9
14	Raigarh	02/03/2014	27.0	13/04/2015	27.5	01/05/2023	30.9	28/06/2023	27.6
15	Raipur	23/03/2008	26.7	17/04/2006	30.1	02/05/2023	31.2	15/06/2001	25.6
16	Rajnandgaon	10/03/2014	26.7	13/04/2015	29.3	03/05/2023	30.9	15/06/2001	25.6

Tmax = Maximum Temperature (°C)

Lowest value of maximum temperature 26.0 °C was observed in Janjgir Champa district on 14/03/2020 during the month of March. In April month Kabirdham showed lowest value of 26.9 °C on dated 13/04/2015. Whereas, year 2023 showed lowest value of maximum temperature in most of all districts of Chhattisgarh plain zone in the month of May. Korba district reported the lowest maximum temperature 29.5 °C on 01/05/2023 in May month. In June month year 2001 showed lowest maximum temperature in most of all districts except Raigarh district. It reported lowest maximum temperature 27.6 °C on dated 28/06/2023. Whereas, Dhamtari reported lowest maximum temperature 23.6 °C on dated 14/06/2001.

2. Highest and lowest value of minimum temperature for the month i.e., November, December, January and February in different districts of Chhattisgarh Plain Zone

All districts of Chhattisgarh Plain Zone reported highest value of minimum temperature on 13/11/2009 except Raigarh district. It exhibited highest value of minimum temperature on 02/11/2007. However, four districts i.e., Bilaspur, Mahasamund, Mungeli and Raipur showed the highest value of minimum temperature 22.9 °C on 30/11/2009. While, two districts like Baloda Bazar and Korba reported the minimum temperature 21.3 °C on 13/11/2009, Similarly all districts reported the lowest minimum temperature on 17/11/2012 during November month except two

districts i.e., Kabirdham (20/11/2022) and Rajnandgaon (16/11/2012). Whereas, lowest value of minimum temperature 8.5 °C was recorded in 17/11/2012 on Bilaspur and Mungeli districts, respectively (Table 3).

In December month, highest value of minimum temperature 18.8 °C was found on 02/12/2015 in Baloda Bazar district. While, four districts namely Bilaspur, Janjgir Champa, Korba and Mungeli reported the minimum temperature 18.1 °C on 05/12/2023, respectively. Whereas, Janjgir Champa district showed lowest minimum temperature 4.3 °C on 30/12/2018. Highest value of minimum temperature 19.5 °C

in January month was observed in Dhamtari district followed by 19.2 °C was noticed in Balod and Rajnandgaon districts on 01/01/2012. Whereas, minimum temperature 17.4 °C was found in Janjgir Champa district on 01/01/2012. However, lowest value of minimum temperature 3.1 °C was observed in Korba district on 11/01/2020 during the month of January.

In February month, highest value of minimum temperature 24.4 °C was observed in Durg district on 26/02/2016 followed by 24.3 °C was noticed in Kanker district on 25/02/2016. Whereas, minimum temperature 22.0 °C was found in Kabirdham district on 26/02/2016. However, minimum temperature 4.4 °C was observed in Janjgir Champa district on 10/02/2012 during the month of February.

Table 3: Highest value of minimum temperature (°C) during the months of November, December, January and February in different districts of Chhattisgarh Plain Zone

S. No.	District	November		December		January		February	
		Date	Tmin(°C)	Date	Tmin(°C)	Date	Tmin(°C)	Date	Tmin(°C)
1	Balod	13/11/2009	22.1	01/12/2006	18.7	01/01/2012	19.2	25/02/2016	24.0
2	Baloda Bazar	13/11/2009	21.3	02/12/2015	18.8	01/01/2012	18.2	27/02/2016	23.1
3	Bemetara	13/11/2009	22.3	02/12/2015	18.6	01/01/2012	18.4	26/02/2016	23.0
4	Bilaspur	13/11/2009	22.5	05/12/2023	18.1	30/01/2007	18.4	26/02/2016	22.6
5	Dhamtari	15/11/2009	21.7	31/12/2011	18.7	01/01/2012	19.5	25/02/2016	23.5
6	Durg	13/11/2009	22.3	02/12/2015	18.6	01/01/2012	18.4	26/02/2016	24.4
7	Gariyaband	13/11/2009	21.9	14/12/2015	18.5	01/01/2012	18.6	26/02/2016	22.9
8	Janjgir Champa	13/11/2009	22.0	09/12/2010	18.1	01/01/2012	17.4	26/02/2016	22.3
9	Kabirdham	13/11/2009	21.8	02/12/2015	18.5	25/01/2009	18.8	26/02/2016	22.0
10	Kanker	12/11/2010	22.1	01/12/2000	18.3	01/01/2012	17.6	25/02/2016	24.3
11	Korba	13/11/2009	21.3	05/12/2023	18.1	01/01/2012	16.9	26/02/2016	21.0
12	Mahasamund	13/11/2009	22.5	02/12/2015	18.7	01/01/2012	18.8	26/02/2016	23.8
13	Mungeli	13/11/2009	22.5	05/12/2023	18.1	30/01/2007	18.4	26/02/2016	22.6
14	Raigarh	02/11/2007	21.9	09/12/2010	18.2	30/01/2007	17.6	26/02/2016	22.3
15	Raipur	13/11/2009	22.5	02/12/2015	18.7	01/01/2012	18.8	26/02/2016	23.8
16	Rajnandgaon	13/11/2009	22.1	01/12/2006	18.7	01/01/2012	19.2	25/02/2016	24.0

Tmin = Minimum Temperature (°C)

Table 4: Lowest value of minimum temperature (°C) during the months of November, December, January and February in different districts of Chhattisgarh Plain Zone

S. No.	District	November		December		January		February	
		Date	Tmin(°C)	Date	Tmin(°C)	Date	Tmin(°C)	Date	Tmin(°C)
1	Balod	17/11/2012	7.9	30/12/2019	5.8	07/01/2023	4.7	10/02/2012	5.1
2	Baloda Bazar	17/11/2012	7.8	30/12/2019	5.3	08/01/2023	3.8	10/02/2012	4.7
3	Bemetara	17/11/2012	8.5	30/12/2019	5.2	07/01/2023	4.4	10/02/2012	5.1
4	Bilaspur	17/11/2012	8.9	21/12/2021	5.0	14/01/2012	4.3	10/02/2012	5.8
5	Dhamtari	17/11/2012	7.7	30/12/2018	6.3	25/01/2006	5.4	10/02/2012	6.5
6	Durg	17/11/2012	8.5	30/12/2018	4.4	07/01/2023	4.4	01/02/2000	6.1
7	Gariyaband	17/11/2012	7.4	29/12/2014	6.2	17/01/2011	5.8	10/02/2012	6.7
8	Janjgir Champa	17/11/2012	7.5	30/12/2018	4.3	11/01/2020	3.7	10/02/2012	4.4
9	Kabirdham	20/11/2022	9.3	30/12/2018	5.1	07/01/2023	4.8	10/02/2012	4.9
10	Kanker	17/11/2012	9.1	31/12/2023	5.6	14/01/2012	5.7	10/02/2019	7.3
11	Korba	17/11/2012	8.0	29/12/2018	4.4	11/01/2020	3.1	02/02/2008	4.5
12	Mahasamund	17/11/2012	7.3	29/12/2018	4.9	08/01/2023	3.9	10/02/2012	5.0
13	Mungeli	17/11/2012	8.9	30/12/2019	5.1	14/01/2012	4.3	10/02/2012	5.8
14	Raigarh	17/11/2012	7.6	29/12/2014	5.6	11/01/2020	4.3	02/02/2008	5.8
15	Raipur	17/11/2012	7.3	31/12/2018	5.0	08/01/2023	3.9	10/02/2012	5.0
16	Rajnandgaon	16/11/2012	8.8	18/12/2014	6.3	07/01/2023	4.7	10/02/2012	5.1

Tmin = Minimum Temperature (°C)

Heavy rainfall in one day during rainy season at different districts of Chhattisgarh Plain Zone

Table 5 revealed that highest amount of heavy rainfall 187.8 mm in one day was observed in Durg district on 27/08/2020 followed by 173.7 mm rainfall was recorded in Balod and

Dhamtari district on 29/06/2007 during rainy season. Whereas, lowest amount of heavy rainfall 107.4 mm was found in Rajnandgaon district on 07/08/2019 followed by 109.6 mm in Mahasamund district on 15/06/2004.

Table 5: Maximum Heavy Rainfall (mm) in one day during rainy season in different districts of Chhattisgarh Plain Zone

S. No.	Districts	Date	RF(mm)
1	Balod	29/06/2007	173.7
2	Baloda Bazar	27/08/2020	160.2
3	Bemetara	27/08/2020	168.3
4	Bilaspur	27/08/2020	109.5
5	Dhamtari	29/06/2007	173.7
6	Durg	27/08/2020	187.8
7	Gariyaband	29/06/2007	169.6
8	Janjgir Champa	27/08/2020	114.2
9	Kabirdham	16/05/2020	142.6
10	Korba	15/06/2004	109.6
11	Kanker	06/29/2007	131.3
12	Mahasamund	27/08/2020	169.8
13	Mungeli	20/07/2017	119.1
14	Raigarh	20/07/2017	120.2
15	Raipur	07/08/2019	144.9
16	Rajnandgaon	07/08/2019	107.4

4. Frequency of extreme temperature during the month of March, April, May and June

Temperature ranges both 44 to 45 °C, two times in 5 districts i.e., Baloda Bazar, Bemetara, Mahasamund and Mungeli during the March month in the year 2017 (Table 6). While, it was recorded only one time in Janjgir Champa district on March, 2017. However, 10 districts namely Baloda Bazar, Bemetara, Bilaspur, Dhamtari, Kabirdham, Kanker, Korba, Mahasamund, Mungeli and Raigarh reported 43 to 44 °C temperature, two times in the March, 2017 and 2010, respectively. While, rest of the other districts experienced only one time in 2017. However, temperature both 42 to 43 °C was recorded 8 times in Janjgir Champa and Kanker districts during the March, 2020 followed by 7 times, in Bemetara, Bilaspur and Mungeli districts in the March, 2017. Whereas, temperature 41 to 42 °C was observed 7 times in Balod, Kabirdham, Korba and Raipur Districts, 6 times in Rajnandgaon district and 5 times in Dhamtari, Durg and Raigarh districts, respectively. However, 40 to 41 °C temperature was recorded 7 times in Gariyaband district during the March, 2010 (Table 6).

In April month, temperature both 46 to 47 °C was observed 5 times in Baloda Bazar district, followed by 4 time in Bemetara, Bilaspur and Mungeli districts and 3 times in Janjgir Champa district during the year 2000. However, temperature between 45 to 46 °C was recorded 6 times in Janjgir Champa district in April 2016 and 5 times in Kabirdham, Kanker and Korba districts on 2000. Whereas, three districts namely Dhamtari, Kanker and Raigarh reported 10 times occurrence of 44 to 45 °C temperature during the month of April 2010. While, Bilaspur and Mungeli districts showed 8 times occurrence of 44 to 45 °C temperature in 2010 and two districts namely Durg and Janjgir Champa reported 7 times. However, temperature 43 to 44 °C was recorded highest 19 and 17 times in Bemetara and Baloda Bazar districts, respectively during the year 2017. Whereas, 42 to 43 °C temperature was noticed 8 times in Kabirdham and Korba and 7 times in Raipur, Baloda Bazar and Gariyaband district in 2017 (Table 6).

Table 7 revealed that Baloda Bazar district observed 47 to 48 °C temperature 6 times and 5 districts namely Bemetara, Bilaspur, Dhamtari, Kanker and Mungeli reported 4 times occurrence

during the month of May, 2013. Whereas, 46 to 47 °C temperature was noticed 10 times in Mahasamund district during the year 2010 and year 2002 reported 9 times in 7 districts i.e., Baloda Bazar, Bemetara, Bilaspur, Dhamtari, Kanker, Mungeli and Raigarh districts. However, temperature 45 to 46 °C was occurred highest 13 times in Kabirdham district followed by 7 times in Balod, Baloda Bazar, Bemetara, Bilaspur, Dhamtari, Kanker, Raipur, Mungeli and Raigarh districts during the year 2002. However, temperature 44 to 45 °C was noticed 12 times in Raipur district and 10 times in Durg, Rajnandgaon and Mahasamund districts in the year 2002. While, Gariyaband district reported 43 to 44 °C temperature 8 times in the year 2017.

In June month, Baloda Bazar district recorded temperature both 46 to 47 °C, highest 8 times followed by 7 times in Bemetara, Bilaspur, Janjgir Champa & Mungeli districts and 6 times in Raigarh, Kanker & Raipur districts during the year 2003. While, Durg and Rajnandgaon districts reported 7 and 6 times occurrence of temperature both 45 to 46 °C, respectively. However, Balod, Gariyaband and Mahasamund districts showed 4 times occurrence of temperature both 45 to 46 °C during the year 2003. While, 6 times occurrence of temperature ranges both 44 to 45 °C was noticed in 4 districts i.e., Bemetara, Bilaspur, Janjgir Champa and Mungeli in 2005 followed by 5 times in Gariyaband district in 2023. However, Kabirdham and Korba districts reported 6 times occurrence of temperature both 43 to 44 °C. While, Raipur, Kanker and Raigarh districts reported 4 times in the year 2005. Dhamtari, Durg and Rajnandgaon districts recorded temperature both 42 to 43 °C, 4 times in the year 2023 and 2005, respectively. While, Balod, Bilaspur, Kanker, Mahasamund and Mungeli reported 3 times occurrence of temperature both 42 to 43 °C. Gariyaband district recorded 41 to 42 °C, 5 times in 2023. While, 8 districts namely Balod, Bemetara, Bilaspur, Dhamtari, Janjgir Champa, Mahasamund, Raipur and Rajnandgaon districts were noticed 3 times occurrence of temperature 41 to 42 °C. However, Durg reported 6 times occurrence of temperature both 41 to 42 °C during the year 2009 and 4 times in Kabirdham, Korba and Raigarh (Table 7).

Table 6: Occurrence of extreme values of maximum temperature during March and April months in different districts of Chhattisgarh Plain Zone

S. No.	Districts	March						April					
		Normal (°C)	Range of temperature					Normal (°C)	Range of temperature				
			40-40.9°C	41-41.9°C	42-42.9°C	43-43.9°C	44-44.9°C		42-42.9°C	43-43.9°C	44-44.9°C	45-45.9°C	46-46.9°C
1	Balod	36.5	-	7(2010)	3(2010)	1(2017)	-	41	6(2000)	11(2000)	4(2010)	4(2000)	1(2000)
2	Baloda Bazar	36.9	3(2004)	2(2010)	5(2010)	2(2017)	2(2017)	41.5	7(2000)	17(2017)	1(2010)	2(2000)	5(2000)
3	Bemetara	36.9	2(2004)	1(2004)	7(2010)	2(2017)	2(2017)	41.4	4(2000)	19(2017)	2(2010)	4(2000)	4(2000)
4	Bilaspur	36.7	2(2004)	1(2004)	7(2010)	2(2010)	2(2017)	41.4	4(2000)	9(2017)	8(2010)	4(2000)	4(2000)
5	Dhamtari	35.6	1(2010)	5(2010)	4(2010)	-	-	40.1	5(2000)	5(2010)	10(2010)	4(2016)	2(2009)
6	Durg	36.9	2(2010)	5(2010)	4(2010)	-	-	41.4	5(2010)	10(2010)	7(2010)	3(2000)	1(2000)
7	Gariyaband	35.8	7(2010)	2(2017)	1(2017)	-	-	40	7(2010)	7(2010)	4(2000)	1(2000)	-
8	Janjgir Champa	35.8	1(2010)	1(2010)	8(2010)	1(2017)	1(2017)	41	4(2000)	7(2017)	7(2010)	6(2016)	3(2000)
9	Kabirdham	36.2	1(2010)	7(2010)	1(2017)	2(2017)	-	40.7	8(2017)	10(2010)	3(2017)	5(2000)	-
10	Kanker	37.8	4(2010)	4(2010)	8(2010)	2(2022)	-	41.8	4(2000)	16(2000)	10(2010)	5(2000)	2(2000)
11	Korba	35.3	1(2010)	7(2010)	1(2017)	2(2017)	-	40.3	8(2017)	10(2010)	3(2016)	5(2000)	-
12	Mahasamund	36.9	2(2004)	2(2010)	5(2010)	2(2017)	2(2017)	41	6(2000)	11(2000)	4(2010)	4(2000)	1(2000)
13	Mungeli	36.7	2(2004)	1(2004)	7(2010)	2(2010)	2(2017)	41.4	4(2000)	9(2017)	8(2010)	4(2000)	4(2000)
14	Raigarh	35.6	1(2010)	5(2010)	4(2010)	2(2017)	-	40.8	5(2000)	5(2010)	10(2010)	4(2016)	2(2009)
15	Raipur	36.3	-	7(2010)	3(2010)	1(2017)	-	41	7(2000)	9(2000)	6(2000)	4(2000)	1(2000)
16	Rajnandgaon	36.5	2(2010)	6(2010)	3(2010)	1(2017)	-	41	5(2000)	10(2010)	6(2010)	4(2000)	1(2000)

Table 7: Occurrence of extreme values of maximum temperature during May and June months in different districts of Chhattisgarh Plain Zone

S. No.	Districts	May						June							
		Normal (°C)	Range of temperature					Normal (°C)	Range of temperature						
			43-43.9°C	44-44.9°C	45-45.9°C	46-46.9°C	47-47.9°C		40-40.9°C	41-41.9°C	42-42.9°C	43-43.9°C	44-44.9°C	45-45.9°C	46-46.9°C
1	Balod	42.6	6(2000)	6(2002)	7(2002)	7(2013)	3(2013)	37.1	-	3(2003)	3(2005)	2(2005)	3(2003)	4(2003)	3(2003)
2	Baloda Bazar	43.2	3(2008)	4(2002)	7(2002)	9(2002)	6(2013)	37.1	3(2009)	2(2009)	2(2023)	3(2005)	3(2005)	-	8(2003)
3	Bemetara	43.0	4(2008)	3(2002)	7(2002)	9(2002)	4(2013)	36.5	1(2009)	3(2009)	-	2(2005)	6(2005)	1(2003)	7(2003)
4	Bilaspur	43.1	4(2008)	3(2002)	7(2002)	9(2002)	4(2013)	36.3	2(2009)	3(2009)	3(2009)		6(2005)	1(2003)	7(2003)
5	Dhamtari	41.5	4(2008)	3(2002)	7(2002)	9(2002)	4(2013)	37.0	3(2009)	3(2023)	4(2023)	2(2005)	-	6(2003)	3(2003)
6	Durg	43.0	4(2002)	10(2002)	1(2002)	7(2009)	3(2013)	36.5	6(2009)	1(2009)	4(2005)	1(2005)	-	7(2003)	3(2003)
7	Gariyaband	41.4	8(2002)	7(2002)	4(2002)	3(2013)	-	36.3	3(2023)	5(2023)	-		5(2023)	4(2003)	2(2003)
8	Janjgir Champa	42.8	7(2002)	8(2002)	5(2002)	1(2013)	-	37.0	2(2009)	3(2009)	-	2(2005)	6(2005)	1(2003)	7(2003)
9	Kabirdham	42.3	2(2002)	9(2022)	13(2002)	-		37.6	4(2009)	-	1(2005)	6(2005)	2(2005)	7(2003)	1(2003)
10	Kanker	43.3	5(2003)	9(2019)	7(2002)	9(2002)	4(2013)	36.5	1(2023)	-	3(2023)	4(2005)	4(2005)	3(2005)	6(2005)
11	Korba	42.0	2(2002)	9(2002)	6(2002)	6(2002)	1(2002)	35.0	4(2009)	-	1(2005)	6(2005)	2(2005)	-	1(2003)
12	Mahasamund	42.7	4(2002)	10(2002)	1(2002)	10(2009)	3(2013)	37.6	-	3(2003)	3(2005)	2(2005)	3(2003)	4(2003)	3(2003)
13	Mungeli	43.1	4(2008)	3(2002)	7(2002)	9(2002)	4(2013)	37.3	1(2009)	-	3(2009)	2(2005)	6(2005)	1(2003)	7(2003)
14	Raigarh	42.5	3(2002)	3(2002)	7(2002)	9(2002)	3(2002)	37.5	4(2009)	2(2009)	1(2005)	4(2005)	2(2005)	2(2003)	6(2003)
15	Raipur	42.7	-	12(2002)	7(2002)	7(2013)	3(2013)	35.0	2(2009)	3(2003)	1(2023)	4(2005)	-	3(2003)	6(2003)
16	Rajnandgaon	42.6	4(2019)	10(2002)	5(2002)	6(2013)	3(2013)	36.8	3(2009)	3(2023)	4(2023)	2(2005)	-	6(2003)	3(2003)

Occurrence of extreme values of minimum temperature during the month November, December, January and February in different districts of Chhattisgarh Plain Zone

Temperature ranges both 10 to 12 °C was occurred highest 21 times in 2 districts i.e., Kabirdham and Korba in November, 2005 followed by 20 times in Janjgir Champa district and 18 times in Baloda Bazar during the year 2008. However, temperature both 7 to 10 °C was observed 13 times in the month of November, 2008 in Baloda Bazar district. While, 6 times recorded in Kabirdham and Korba district on 2016 and 5 times in Janjgir Champa district in the year 2022 (Table 8).

Table 8 revealed that temperature ranges both 7 to 10 °C was found highest 21 times in 4 districts i.e., Baloda Bazar, Kabirdham, Korba and Mahasamund districts during December 2016 followed by 19 times in Bemetara, Bilaspur, Mungeli and Raigarh districts during the year 2005 and 17 times in Durg and Rajnandgaon during the year 2005. Temperature both 5 to 7 °C

was observed 8 times in two districts i.e., Kabirdham and Korba during the month of December, 2014 and 6 times in Baloda Bazar, Dhamtari and Mahasamund in same year. Whereas, Kabirdham and Korba districts showed ≤ 5 °C temperature was occurred 4 times in 2019 and 3 times in 5 districts namely Baloda Bazar, Bemetara, Bilaspur, Mahasamund and Mungeli in December, 2018 and only one time observed in Balod district on 2019.

In January month, Kabirdham and Korba districts reported highest 24 times occurrence of 7 to 10 °C temperature followed by 23 times in Janjgir Champa and 22 times in Raigarh in the year 2018. Whereas, Baloda Bazar reported 5 to 7 °C, highest 9 times in 2011 and 8 times in 5 districts i.e., Bemetara, Bilaspur, Janjgir Champa, Mungeli and Raigarh. Temperature ≤ 5 °C was observed, 5 times in Janjgir Champa district followed by 4 times in Dhamtari, Kabirdham, Korba and Mahasamund districts and 3 times in Baloda Bazar district during the year 2011.

Table 8: Occurrence of extreme values of minimum temperature during November and December months in different districts of Chhattisgarh Plain Zone

S. No.	Districts	November			December			
		Normal (°C)	Range of temperature		Normal (°C)	Range of temperature		
			10 to 12°C	7 to 10 °C		7 to 10 °C	5 to 7 °C	≤ 5 °C
1	Balod	15.4	8(2005)	2(2012)	12.0	16(2005)	3(2014)	1(2019)
2	Baloda Bazar	14.8	18(2008)	13(2008)	11.3	21(2016)	6(2014)	3(2018)
3	Bemetara	14.9	15(2016)	4(2009)	11.6	19(2005)	5(2019)	3(2018)
4	Bilaspur	14.8	15(2016)	4(2009)	11.4	19(2005)	5(2019)	3(2018)
5	Dhamtari	15.5	8(2005)	2(2022)	12.3	16(2005)	6(2014)	2(2014)
6	Durg	14.9	8(2005)	2(2022)	11.6	17(2005)	3(2014)	2(2019)
7	Gariyaband	15.6	9(2022)	2(2012)	12.5	14(2005)	4(2014)	2(2019)
8	Janjgir Champa	14.6	20(2005)	5(2022)	11.0	16(2011)	4(2011)	
9	Kabirdham	14.9	21(2005)	6(2016)	11.8	21(2016)	8(2014)	4(2019)
10	Kanker	15.8	10(2005)	2(2012)	12.9	16(2005)	3(2018)	
11	Korba	14.1	21(2005)	6(2016)	10.7	21(2016)	8(2014)	4(2019)
12	Mahasamund	15.4	15(2005)	2(2022)	12.1	21(2016)	6(2014)	3(2018)
13	Mungeli	14.8	15(2016)	4(2009)	11.4	19(2005)	5(2009)	3(2018)
14	Raigarh	15.1	15(2005)	2(2012)	11.5	19(2005)	4(2012)	2(2019)
15	Raipur	15.4	12(2005)	2(2022)	12.1	16(2005)	5(2014)	2(2014)
16	Rajnandgaon	15.4	8(2005)	2(2022)	12.0	17(2005)	3(2014)	2(2019)

Table 9: Occurrence of extreme values of minimum temperature during January and February months in different districts of Chhattisgarh Plain Zone

S. No.	Districts	January				February			
		Normal (°C)	Range of temperature			Normal (°C)	Range of temperature		
			7 to 10 °C	5 to 7 °C	≤ 5 °C		7 to 10 °C	5 to 7 °C	≤ 5 °C
1	Balod	11.6	13(2011)	1(2011)	2(2011)	14.7	5(2022)	1(2019)	
2	Baloda Bazar	10.8	21(2010)	9(2011)	3(2011)	14.0	11(2020)	4(2004)	1(2012)
3	Bemetara	11.1	21(2018)	8(2011)	2(2011)	14.3	11(2020)	3(2008)	
4	Bilaspur	10.9	21(2018)	8(2011)	2(2011)	14.2	8(2020)	3(2020)	
5	Dhamtari	12.2	5(2011)	7(2011)	4(2011)	15.2	7(2020)	7(2004)	
6	Durg	11.1	16(2011)	7(2015)	1(2011)	14.3	8(2020)	2(2004)	
7	Gariyaband	12.2	12(2011)	4(2011)		15.2	5(2004)	1(2008)	
8	Janjgir Champa	10.4	23(2018)	8(2011)	5(2011)	13.5	11(2020)	5(2008)	1(2012)
9	Kabirdham	11.2	24(2018)	7(2011)	4(2011)	14.3	4(2020)	1(2008)	
10	Kanker	13.0	10(2011)	3(2011)		14.0	8(2008)	2(2004)	
11	Korba	10.1	24(2018)	7(2011)	4(2011)	13.2	9(2020)	4(2020)	1(2008)
12	Mahasamund	11.6	5(2011)	7(2011)	4(2011)	14.6	8(2008)	2(2004)	
13	Mungeli	10.9	21(2018)	8(2011)	2(2011)	14.2	11(2020)	3(2004)	
14	Raigarh	10.8	22(2018)	8(2011)	2(2020)	14.0	11(2020)	3(2004)	
15	Raipur	11.6	21(2011)	7(2011)	2(2023)	14.6	7(2008)	2(2004)	
16	Rajnandgaon	11.6	17(2011)	7(2015)	2(2023)	14.7	7(2008)	2(2004)	

In February month, Baloda Bazar, Bemetara, Janjgir Champa, Mungeli and Raigarh districts reported occurrence of 7 to 10 °C temperature, highest 11 times in the year 2020, followed by 9 times in Korba and 8 times in Bilaspur, Durg, Kanker and Mahasamund districts. Whereas, temperature 5 to 7 °C was occurred highest 7 times in Dhamtari district during the year 2004 and 5 times were observed in Janjgir Champa district. Temperature ≤ 5 °C was observed only 1 time in Baloda Bazar, Janjgir Champa and Korba districts during the year 2012 and 2008, respectively.

Sharma and Chaudhary (2012) ^[13] reported that number of days recorded under different ranges of maximum temperature is not in increasing pattern in this region. However, number of days recorded under different ranges of winter seasonal minimum temperature values are in significantly increasing pattern showing cooling trend. Number of days with minimum temperature ≤ 10 °C is found increasing in the months of December and January and statistically significantly at 1 per cent level. Number of days with ≤ 7 °C showed cooling trend in the months of December, January and February. Analysis of maximum temperature crossing certain threshold values ≥ 40 °C,

≥ 41 °C, ≥ 42 °C, ≥ 43 °C done lead to conclusion that trends shown by linear equations are all non-significant, indicating that number of such days are not on the increase. However, as an exception, maximum temperature crossed value of 40 °C in March 1996; in May 2003, there were 23 days which crossed 40 °C and June 2003 was comparatively warmer with 12 days crossing 40 °C, out of which 6 days crossed 41 °C.

Conclusion

Based on the long-term data, 2017, 2000, 2013 and 2003 were found hottest year for the month of March, April, May and June, respectively. While, coolest year were noticed on 2022, 2012, 2018-2019 and 2011 for November, December, January and February month, respectively. Highest amount of heavy rainfall 187.8 mm in one day was observed in Durg district on 27/08/2020 followed by 173.7 mm rainfall was recorded in Balod and Dhamtari district on 29/06/2007 during rainy season. Whereas, lowest amount of heavy rainfall 107.4 mm was found in Rajnandgaon district on 07/08/2019 followed by 109.6 mm in Mahasamund district on 15/06/2004.

References

1. Bultot F, Dupriez GL, Gellens D. Estimated annual regime of energy balance components, evapotranspiration and soil moisture for a drainage basin in case of a CO₂ doubling. *Climatic Change*. 1988;12:39-56.
2. Chattopadhyaya N, Hulme M. Evaporation and potential evapotranspiration in India under condition of recent and future climatic change. *Agricultural and Forest Meteorology*. 1977;87:55-73.
3. Dore MHI. Climate change and changes in global precipitation patterns, what do we know. *Environment International*. 2005;31:1167-1181.
4. Feddema JJ. Future African water resources: Interactions between soil degradation and global warming. *Climatic Change*. 1999;42(3):561-596.
5. Georgaidi AG, Ven FHM, Gutknecht D, Loucks DP, Salewicz KA. The change of the hydrological cycle under the influence of global warming. *Hydrology for the Water Management of Large River Basins, International Association of Hydrological Sciences*. 1991;201:119-128.
6. Hingane LS, Rupa Kumar K, Ramana Murty V. Long term trends of surface air temperature in India. *Journal of Climatology*. 1985;5:521-528.
7. Iglesias A, Corcoles HL, Canadas W, Minquez MI, Borin M, Sattin M. Current and future strategies for water use optimization in corn hybrids of different growth durations under climate change scenarios. In: *Proceedings of the Third Congress of the European Society for Agronomy*; 1994. p. 18-22.
8. Jones PD, Briffa KR. Global surface air temperature variations during the twentieth century: Part 1, spatial, temporal and seasonal details. *The Holocene*. 1992;2:165-179.
9. Kothawale DR, Kumar RK. Tropospheric temperature variation over India and links with the Indian summer monsoon: 1971-2000. *Mausam*. 2002;53:289-308.
10. Kumar R, Gautam HR. Climate change and its impact on agricultural productivity in India. *Journal of Climatology and Weather Forecasting*. 2014;2(1):109.
11. Narain P, Rathore LS, Singh RS, Rao AS. Drought assessment and management in arid Rajasthan by CAZRI Jodhpur and NCMRWF. Noida; 2006. p. 1-29.
12. Rao VUM, Rao AVMS, Rao GGSN, Satyanarayana T, Manikandan N, Venkateswarlu B, *et al.* Weather Cock (Version 15) software. Hyderabad: All India Coordinated Research Project on Agrometeorology, CRIDA; 2011.
13. Sharma S, Chaudhary JL. Trend analysis of maximum and minimum temperature in relation to climate variability. *Journal of Agrometeorology*. 2012;14(1):25-30.