

Statistical analysis of long term climatic data of Eastern Uttar Pradesh

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KEYWORDS

Agroclimatic zones, climatic variability, post-monsoon and sustainable agriculture.

Received on: 02-06-2025

Accepted on: 04-07-2025

Published on:

15-07-2025

ABSTRACT

The study analyzes long-term climatic variability in Eastern Uttar Pradesh, focusing on seasonal and annual variations in maximum and minimum temperatures and rainfall across three agroclimatic zones: Eastern Plain, North Eastern Plain, and Vindhyan Zone. Results indicate significant fluctuations, particularly in post-monsoon and winter seasons, where higher coefficients of variation were recorded for both temperatures and rainfall. Maximum temperature variability ranged from 0.3% to 6.3%, while minimum temperature variability reached up to 14.2%, especially in winter months. Annual rainfall also showed considerable variation, with coefficients ranging from 0.1% to 43.8% across zones and years. These climatic irregularities are likely to impact key crops like rice and wheat, increasing vulnerability during critical growth stages. The findings underline the urgency for adopting climate-resilient agricultural practices, improved irrigation management, and region-specific crop planning. Addressing this rising agroclimatic instability is essential to ensure sustainable agricultural productivity and food security in Eastern Uttar Pradesh.

Introduction:

Eastern Uttar Pradesh (EUP), located in the middle Indo-Gangetic Plain, is one of India's most densely populated and agriculturally intensive regions, where climatic variability has profound implications for food security and rural livelihoods. In recent decades, the region has experienced noticeable shifts in temperature patterns, erratic rainfall, and an increase in the frequency of extreme weather events, necessitating a comprehensive statistical evaluation of long-term climatic data (Sinha *et al.*, 2010; Mall *et al.*, 2011; Sharma & Rai, 2012). The agricultural productivity of EUP is intricately linked to seasonal rainfall and thermal regimes, both of which have shown significant fluctuations over the past two decades (Mishra *et al.*, 2013; Kumar & Gautam, 2014; Tiwari *et al.*, 2015). Statistical tools such as the Mann-Kendall trend test, Sen's slope estimator, and linear regression have been employed in recent studies to detect subtle but consistent changes in climate trends (Singh & Tripathi, 2016; Gupta *et al.*, 2017; Verma & Chatterjee, 2018). Findings reveal a steady increase in minimum temperature and a shift in monsoon onset and duration, posing new challenges to agricultural planning (Yadav *et al.*, 2019; Srivastava *et al.*, 2020). Integration of

Geographic Information Systems (GIS) and remote sensing has further improved the spatial analysis of climatic variability (Singh *et al.*, 2021; Kumar *et al.*, 2021). Recent literature emphasizes the importance of long-term datasets for developing predictive models and formulating adaptation strategies in the face of climate change (Pandey & Singh, 2022; Yadav *et al.*, 2022). Therefore, the present study undertakes a statistical analysis of long-term (2000–2023) climatic data—specifically temperature and rainfall—in the major agroclimatic zones of EUP, aiming to identify significant trends, evaluate spatio-temporal variability, and provide scientific insights for sustainable agricultural and water resource management (Jaiswal *et al.*, 2023; Verma *et al.*, 2023).

Materials and Methods:

An experiment was conducted using 20 years climatic data viz., Temperature (max. and min.) and rainfall from 2004 to 2023 of eastern Uttar Pradesh at Acharya Narendra Deva University of Agriculture & Technology, Narendra Nagar (Kumarganj), Ayodhya, Uttar Pradesh. Eight major districts viz., Ayodhya, Azamgarh, Varanasi, Ghazipur, Sonbhadra, Mirzapur, Kushinagar and Deoria was included in Eastern Uttar Pradesh. The data collected from the eastern Uttar Pradesh zone was analysed by using the mean, standard deviation (SD) and coefficient of variance (CV), which are commonly applied in climatological studies to evaluate variability and trends (Khavse *et al.*, 2015; Verma & Chatterjee, 2018; Singh, Tiwari, & Verma, 2021). The mean, SD, and CV of rainfall and temperatures were calculated to assess seasonal and annual patterns of climatic variability (Pandey & Singh, 2022).

Standard Deviation

Standard deviation of maximum, minimum temperature and rainfall has been calculated over seasonal and annual basis by using the expression

$$SD(\sigma) = \frac{\sqrt{\sum (X - \bar{X})^2}}{n - 1}$$

Where,

X= Rainfall frequency,

$\bar{X}$ = Mean Rainfall,

n = No. of years.

Coefficient variation

The phrase has been used to determine the coefficient of variation (CV) of rainfall, minimum temperature, and maximum temperature on a seasonal and yearly basis.

$$CV\% = (SD/Mean) \times 100$$

Mean

The average is calculated by dividing the total number of observations by the sum of the supplied observations.

Mean = Sum of the observation/ No. of Numbers

This approach provides a consistent and statistically reliable method to understand agroclimatic variability (Yadav, Singh, & Pandey, 2019).

Results and discussion:

The variation in long term climatic data of eastern U.P. of Temperature (Max. and Min.) and Rainfall has been analyzed into two categories namely seasonal variation and annual variation according to zone wise-

Seasonal and annual temperature (Max & Min) and rainfall variability of Eastern Plain Zone of U. P.

The data according to seasonal and annual of temperature (Max. and Min.) and rainfall are presented in Table: 1.

Temperature (Max. and Min.)

In Eastern plain zone, Seasonal variations in maximum mean temperature as well as its standard deviation (SD) were observed as 34.6°C with SD 0.7 and CV 2.1 % in summer, 30.9°C with SD 0.9 and CV 2.8 % during the southwest monsoon, 26.9°C with S.D. 0.7 and C.V. 2.8 % in the post-monsoon period and 24.2°C with S.D. 0.7 and C.V. 2.9 % in winter monsoon.

Seasonal variations in minimum mean temperature as well as its standard deviation (SD) were observed as 19.1°C with S.D. 0.5 and C.V. 2.6 % in summer, 25.2°C with S.D. 0.7 and C.V. 2.9 % during the southwest monsoon, 14.4°C with S.D. 0.7 and C.V. 4.6 % in the post-monsoon period and 11.6°C with S.D. 0.5 and C.V. 4.7 % in winter monsoon.

Regarding to the annual variation in the maximum mean temperature highest temperature 32.6°C was recorded in 2009 while lowest 30.6°C in 2014. The highest and lowest annual S.D. was observed 1.6 in 2023 and 0.1 in 2014 respectively while the highest and lowest annual C.V. was found 4.9 % in 2023 and 0.5 % in 2014 respectively.

In case of variation in minimum mean temperature highest temperature 20.4°C was recorded in 2010 while lowest 17.9°C in 2019. The highest and lowest annual S.D. was observed 2.1 in 2014 and 0.6 in 2022 respectively while the highest and lowest annual C.V. was found 11.6 % in 2015 and 3.1 % in 2022 respectively.

Rainfall

In Eastern plain zone, Seasonal variations in total rainfall and standard deviation (SD) as well as coefficient of variation (CV) were observed as 1170.2 mm with SD 94.0 and CV 8.0 % in summer, 14964.3 mm with SD 671.5 and CV 4.5 % during the southwest monsoon, 815.0 mm with SD 58.8 and CV 7.2 % in the post-monsoon period and 593.4 with SD 41.9 and CV 7.1 % in winter monsoon, (Table: 1).

Regarding to the annual variation in mean total rainfall, highest rainfall 1112.4 mm was recorded in 2019 while lowest 707.8 mm in 2017. The highest and lowest annual S.D. was observed 399.5 in 2016 and 31.5 in 2010 respectively while the highest and lowest annual C.V. was found 40.5 % in 2016 and 4.2 % in 2010 respectively.

Table: 1. Seasonal and annual mean value, standard deviation and coefficient of variation of maximum and minimum temperature and rainfall of Eastern Plain Zone during 2004 to 2023

Season	Temperature (°C)						Mean total Rainfall (mm)		
	T max.			T min.			Mean	SD	CV (%)
	Mean	SD	CV (%)	Mean	SD	CV (%)			
Summer monsoon (March to May)	34.6	0.7	2.1	19.1	0.5	2.6	1170.2	94.0	8.0
South west monsoon (Jun to Sep.)	30.9	0.9	2.8	25.2	0.7	2.9	14964.3	671.5	4.5
Post monsoon (Oct. to Nov.)	26.9	0.7	2.8	14.4	0.7	4.6	815.0	58.8	7.2
Winter monsoon (Dec. to Feb.)	24.2	0.7	2.9	11.6	0.5	4.7	593.4	41.9	7.1
Annual									
2004	31.4	0.5	1.5	17.8	1.8	10.1	662.8	131.9	19.9
2005	32.0	0.5	1.4	19.1	1.3	6.8	823.0	58.3	7.1
2006	31.9	0.4	1.4	18.3	0.8	4.5	927.4	83.0	8.9
2007	31.4	0.5	1.5	18.0	0.8	4.3	969.8	237.0	24.4
2008	31.1	0.6	1.8	18.6	0.9	4.9	967.1	92.2	9.5
2009	32.6	0.6	1.7	18.6	1.1	6.2	688.7	210.9	30.6
2010	31.3	0.7	2.1	20.4	0.7	3.5	749.6	31.5	4.2
2011	31.3	0.6	2.1	19.0	1.5	8.1	1069.9	118.0	11.0
2012	31.4	0.6	2.0	18.4	0.9	5.0	901.8	141.8	15.7
2013	31.2	0.9	3.0	18.6	1.2	6.6	949.4	247.9	26.1
2014	30.6	0.1	0.5	18.5	1.9	10.4	798.7	120.1	15.0
2015	31.2	0.4	1.2	17.9	2.1	11.6	847.9	225.7	26.6
2016	31.3	0.6	1.9	18.6	1.3	6.8	985.9	399.5	40.5
2017	31.7	0.5	1.6	18.6	0.9	5.0	707.8	123.3	17.4
2018	31.0	0.5	1.5	18.7	1.0	5.4	753.9	40.0	5.3
2019	30.9	0.4	1.1	17.9	0.8	4.6	1112.4	96.1	8.6
2020	31.1	1.0	3.3	18.7	1.1	6.0	1000.6	107.2	10.7
2021	31.5	0.8	2.5	18.3	0.6	3.4	977.7	257.6	26.3
2022	31.6	1.1	3.4	19.3	0.6	3.1	772.5	70.5	9.1
2023	31.8	1.6	4.9	18.5	1.2	6.6	832.3	186.4	22.4

Seasonal and annual temperatures (maximum & minimum) and rainfall variability North Eastern Plain Zone of U.P.

The data according to seasonal and annual of temperature (Max. and Min.) and rainfall are presented in Table: 2.

Temperature (Max. and Min.)

In North Eastern Plain Zone, Seasonal variations in maximum mean temperature as well as its standard deviation (SD) were observed as 35.6°C with SD 1.1 and CV 3.0 % in summer, 30.6°C with SD 0.2 and CV 0.7 % during the southwest monsoon, 26.8°C with SD 0.2 and CV 0.8 % in the post-monsoon period and 24.2°C with SD 0.1 and CV 0.3 % in winter monsoon.

Seasonal variations in minimum mean temperature as well as its standard deviation (SD) were observed as 19.3°C with SD 1.3 and CV 6.6 % in summer, 25.6°C with SD 1.6 and CV 6.1 % during the southwest monsoon, 14.6°C with SD 1.1 and CV 7.7 % in the post-monsoon period and 8.2°C with SD 0.9 and CV 11.3 % in winter monsoon.

Regarding to the annual variation in the maximum mean temperature highest temperature 32.5°C was recorded in 2006 while lowest 29.4°C in 2021. The highest and lowest annual S.D. was observed 0.9 in 2006 and 0.1 in 2018 respectively while the highest and lowest annual C.V. was found 2.8 % in 2006 and 0.2 % in 2018 respectively.

In case of variation in minimum mean temperature highest temperature 20.6°C was recorded in 2010 while lowest 17.5°C in 2021. The highest and lowest annual S.D. was observed 1.2 in 2022 and 0.1 in 2020 respectively while the highest and lowest annual C.V. was found 6.8 % in 2022 and 0.4 % in 2020 respectively.

Rainfall

In North Eastern Plain Zone, Seasonal variations in total rainfall and standard deviation (SD) as well as coefficient of variation (CV) were observed as 1704.1 mm with SD 139.5 and CV 8.2 % in summer, 18286.1 mm with SD 1412.1 and CV 7.7 % during the southwest monsoon, 1032.8 mm with SD 140.0 and CV 13.6 % in the post-monsoon period and 517.2 with SD 139.7 and CV 27.0 % in winter monsoon, (Table: 2).

Regarding to the annual variation in mean total rainfall, highest rainfall 1672.4 mm was recorded in 2021 while lowest 632.5 mm in 2015. The highest and lowest annual S.D. was observed 70.7 in 2020 and 0.4 in 2010 respectively while the highest and lowest annual C.V. was found 9.0 % in 2005 and 0.1 % in 2023 respectively.

Table: 2. Seasonal and annual mean value, standard deviation and coefficient of variation of maximum and minimum temperature and rainfall of North Eastern Plain Zone during 2004 to 2023

Season	Temperature (°C)						Mean total Rainfall (mm)		
	T max.			T min.			Mean	SD	CV (%)
	Mean	SD	CV (%)	Mean	SD	CV (%)			
Summer monsoon (March to May)	35.6	1.1	3.0	19.3	1.3	6.6	1704.1	139.5	8.2
South west monsoon (Jun to Sep.)	30.6	0.2	0.7	25.6	1.6	6.1	18286.1	1412.1	7.7
Post monsoon (Oct. to Nov.)	26.8	0.2	0.8	14.6	1.1	7.7	1032.8	140.0	13.6
Winter monsoon (Dec. to Feb.)	24.2	0.1	0.3	8.2	0.9	11.3	517.2	139.7	27.0
Annual									
2004	31.5	0.6	2.0	19.2	0.1	0.4	999.5	13.4	1.3
2005	32.2	0.5	1.5	19.6	0.1	0.4	785.9	70.7	9.0
2006	32.5	0.9	2.8	19.8	0.7	3.6	885.5	0.5	0.1
2007	31.6	0.7	2.2	19.0	0.1	0.7	1578.9	70.7	4.5
2008	31.3	0.2	0.7	19.3	0.1	0.4	1062.4	16.3	1.5
2009	32.3	0.4	1.1	20.1	0.8	3.9	802.5	9.9	1.2
2010	32.1	0.1	0.2	20.6	0.7	3.4	832.6	0.4	0.1
2011	31.1	0.1	0.5	19.7	0.7	3.6	1078.3	70.4	6.5
2012	31.8	0.1	0.4	19.6	0.7	3.6	1130.5	0.6	0.1
2013	31.7	0.6	2.0	19.1	0.1	0.7	748.6	0.5	0.1
2014	31.3	0.3	0.9	19.2	0.1	0.7	835.2	21.2	2.5
2015	31.8	0.4	1.1	19.6	0.2	1.1	632.5	31.1	4.9
2016	32.0	0.2	0.7	20.0	0.7	3.5	835.8	33.2	4.0
2017	31.8	0.4	1.3	19.8	0.1	0.4	955.2	51.7	5.4
2018	31.3	0.1	0.2	19.2	0.1	0.4	740.6	42.4	5.7
2019	30.7	0.3	0.9	19.6	0.1	0.4	1111.3	70.7	6.4
2020	29.5	0.6	1.9	19.3	0.1	0.4	1543.2	70.7	4.6
2021	29.4	0.4	1.2	17.5	0.8	4.8	1672.4	7.1	0.4
2022	29.7	0.8	2.6	17.6	1.2	6.8	984.8	7.1	0.7
2023	30.7	0.6	1.8	19.7	0.4	1.8	866.5	0.6	0.1

Seasonal and annual temperatures (maximum & minimum) and rainfall variability Vindhyan Zone of U.P.

The data according to seasonal and annual of temperature (Max. and Min.) and rainfall are presented in Table: 3.

Temperature (Max. and Min.)

In Vindhyan Zone, Seasonal variations in maximum mean temperature as well as its standard deviation (SD) were observed as 35.5°C with SD 0.5 and CV 1.4 % in summer, 29.8°C with SD 0.7 and CV 2.4 % during the southwest monsoon, 24.0°C with SD 0.1 and CV 0.6 % in the post-monsoon period and 22.8°C with SD 0.4 and CV 1.9 % in winter monsoon.

Seasonal variations in minimum mean temperature as well as its standard deviation (SD) were observed as 20.9°C with SD 0.1 and CV 0.3 % in summer, 25.9°C with SD 0.2 and CV 0.8 % during the southwest monsoon, 15.3°C with SD 0.1 and CV 0.9 % in the post-monsoon period and 8.6°C with SD 0.1 and CV 0.8 % in winter monsoon.

Regarding to the annual variation in the maximum mean temperature highest temperature 32.9°C was recorded in 2018 while lowest 30.3°C in 2006. The highest and lowest annual S.D. was observed 1.1 in 2015 and 0.1 in 2013 respectively while the highest and lowest annual C.V. was found 3.5 % in 2015 and 0.2 % in 2023 respectively.

In case of variation in minimum mean temperature highest temperature 19.8°C was recorded in 2019 while lowest 17.5°C in 2021. The highest and lowest annual S.D. was observed 1.3 in 2016 and 0.1 in 2010 respectively while the highest and lowest annual C.V. was found 7.1 % in 2016 and 0.4 % in 2008 respectively.

Rainfall

In Vindhyan Zone, Seasonal variations in total rainfall and standard deviation (SD) as well as coefficient of variation (CV) were observed as 958.1 mm with SD 85.4 and CV 8.9 % in summer, 15280.4 mm with SD 601.4 and CV 3.9 % during the southwest monsoon, 815.8 mm with SD 93.3 and CV 11.4 % in the post-monsoon period and 745.8 with SD 56.3 and CV 7.6 % in winter monsoon, (Table: 3).

Regarding to the annual variation in mean total rainfall, highest rainfall 1026.9 mm was recorded in 2021 while lowest 742.3 mm in 2007. The highest and lowest annual S.D. was observed 343.8 in 2008 and 9.9 in 2023 respectively while the highest and lowest annual C.V. was found 43.8 % in 2008 and 1.1 % in 2015 respectively.

Table: 3. Seasonal and annual mean value, standard deviation and coefficient of variation of maximum and minimum temperature and rainfall of Vindhyan Zone during 2004 to 2023

Season	Temperature (°C)						Mean total Rainfall (mm)		
	T max.			T min.			Mean	SD	CV (%)
	Mean	SD	CV (%)	Mean	SD	CV (%)			
Summer monsoon (March to May)	35.5	0.5	1.4	20.9	0.1	0.3	958.1	85.4	8.9
South west monsoon (Jun to Sep.)	29.8	0.7	2.4	25.9	0.2	0.8	15280.4	601.4	3.9
Post monsoon (Oct. to Nov.)	24.0	0.1	0.6	15.3	0.1	0.9	815.8	93.3	11.4
Winter monsoon (Dec. to Feb.)	22.8	0.4	1.9	8.6	0.1	0.8	745.8	56.3	7.6
Annual									
2004	31.1	0.6	2.0	18.6	0.3	1.5	1016.7	19.8	1.9
2005	31.2	0.8	2.7	18.6	0.5	2.7	1031.7	230.0	22.3
2006	30.3	0.4	1.2	17.5	0.2	1.2	967.4	256.0	26.5
2007	31.2	0.5	1.6	18.8	0.6	3.0	742.3	77.8	10.5
2008	31.5	0.2	0.7	18.3	0.1	0.4	785.4	343.8	43.8
2009	30.9	0.9	3.0	18.2	0.9	5.1	825.3	121.4	14.7
2010	30.7	0.8	2.8	18.8	0.1	0.8	969.3	122.0	12.6
2011	30.4	0.1	0.2	18.9	0.4	2.2	988.4	215.5	21.8
2012	31.4	0.7	2.3	18.6	0.4	2.3	1000.5	15.1	1.5
2013	31.6	0.4	1.1	19.3	0.3	1.5	1026.5	33.6	3.3
2014	30.8	0.3	0.9	19.2	0.7	3.7	941.0	121.1	12.9
2015	31.9	1.1	3.5	17.9	1.1	5.9	1007.9	10.7	1.1
2016	31.8	0.8	2.4	19.1	1.3	7.1	908.6	105.2	11.6
2017	32.5	0.2	0.7	19.3	1.1	5.9	970.3	14.6	1.5
2018	32.9	0.1	0.2	18.9	0.2	1.1	867.3	32.1	3.7
2019	32.6	0.3	0.9	19.8	0.4	1.8	907.1	33.7	3.7
2020	31.4	0.7	2.3	19.0	0.7	3.7	942.2	83.3	8.8
2021	30.7	0.2	0.7	17.5	0.6	3.2	1026.9	61.4	6.0
2022	31.8	0.2	0.7	18.5	0.6	3.1	887.7	26.6	3.0
2023	32.0	0.1	0.2	17.9	1.1	5.9	819.7	9.9	1.2

Seasonal and annual temperatures (maximum & minimum) and rainfall variability of Eastern U.P.

The data according to seasonal and annual of temperature (Max. and Min.) and rainfall are presented in Table: 4.

Temperature (Max. and Min.)

In of Eastern U.P., Seasonal variations in maximum mean temperature as well as its standard deviation (SD) were observed as 32.2°C with SD 0.5 and CV 1.5 % in summer, 30.4°C with SD 0.6 and CV 1.9 % during the southwest monsoon, 25.9°C with SD 1.6 and CV 6.3 % in the post-monsoon period and 23.7°C with SD 0.8 and CV 3.4 % in winter monsoon.

Seasonal variations in minimum mean temperature as well as its standard deviation (SD) were observed as 19.7°C with SD 1.0 and CV 4.9 % in summer, 25.6°C with SD 0.3 and CV 1.2 % during the southwest monsoon, 14.8°C with SD 0.5 and CV 3.1 % in the post-monsoon period and 9.1°C with SD 1.3 and CV 14.2 % in winter monsoon.

Regarding to the annual variation in the maximum mean temperature highest temperature 32.0°C was recorded in 2017 while lowest 30.5°C in 2021. The highest and lowest annual S.D. was observed 1.4 in 2022 and 0.2 in 2012 respectively while the highest and lowest annual C.V. was found 4.7 % in 2022 and 0.5 % in 2008 respectively.

In case of variation in minimum mean temperature highest temperature 19.9°C was recorded in 2010 while lowest 17.8°C in 2021. The highest and lowest annual S.D. was observed 1.2 in 2006 and 0.2 in 2017 respectively while the highest and lowest annual C.V. was found 5.3 % in 2014 and 1.2 % in 2018 respectively. Similar findings were recorded by Kumar *et al.* (2011).

Rainfall

In of Eastern U.P., Seasonal variations in total rainfall and standard deviation (SD) as well as coefficient of variation (CV) were observed as 1277.5 mm with SD 384.4 and CV 30.1 % in summer, 16176.9 mm with SD 1833.4 and CV 11.3 % during the southwest monsoon, 887.9 mm with SD 125.5 and CV 14.1 % in the post-monsoon period and 618.8 with SD 116.4 and CV 18.8 % in winter monsoon, (Table: 4).

Regarding to the annual variation in mean total rainfall, highest rainfall 1225.6 mm was recorded in 2021 while lowest 772.1 mm in 2009. The highest and lowest annual S.D. was observed 432.6 in 2007 and 24.2 in 2023 respectively while the highest and lowest annual C.V. was found 39.4 % in 2007 and 2.9 % in 2021 respectively. Similar findings were recorded by Kumar *et al.* (2011).

Table: 4. Seasonal and annual mean value, standard deviation and coefficient of variation of maximum and minimum temperature and rainfall of Eastern Uttar Pradesh during 2004 to 2023

Season	Temperature (°C)						Mean total Rainfall (mm)		
	T max.			T min.			Mean	SD	CV (%)
	Mean	SD	CV (%)	Mean	SD	CV (%)			
Summer monsoon (March to May)	35.2	0.5	1.5	19.7	1.0	4.9	1277.5	384.4	30.1
South west monsoon (Jun to Sep.)	30.4	0.6	1.9	25.6	0.3	1.2	16176.9	1833.4	11.3
Post monsoon (Oct. to Nov.)	25.9	1.6	6.3	14.8	0.5	3.1	887.9	125.5	14.1
Winter monsoon (Dec. to Feb.)	23.7	0.8	3.4	9.1	1.3	14.2	618.8	116.4	18.8
Annual									
2004	31.3	0.2	0.7	18.5	0.7	3.6	893.0	199.6	22.3
2005	31.8	0.5	1.6	19.1	0.5	2.6	880.2	132.5	15.1
2006	31.5	1.1	3.6	18.5	1.2	6.4	926.7	41.0	4.4
2007	31.4	0.2	0.7	18.6	0.6	3.0	1097.0	432.6	39.4
2008	31.3	0.2	0.5	18.7	0.5	2.7	938.3	140.7	15.0
2009	31.9	0.9	2.9	18.9	1.0	5.2	772.1	73.2	9.5
2010	31.4	0.7	2.2	19.9	1.0	4.9	850.5	111.0	13.0
2011	30.9	0.5	1.6	19.2	0.4	2.2	1045.5	49.7	4.7
2012	31.5	0.2	0.7	18.9	0.6	3.4	1010.9	114.7	11.3
2013	31.5	0.3	0.8	19.0	0.4	2.0	908.1	143.5	15.8
2014	30.9	0.4	1.2	19.0	0.4	2.1	858.3	73.9	8.6
2015	31.6	0.4	1.3	18.4	1.0	5.3	829.4	188.4	22.7
2016	31.7	0.3	1.1	19.2	0.7	3.7	910.1	75.1	8.2
2017	32.0	0.4	1.3	19.2	0.6	3.1	877.8	147.4	16.8
2018	31.7	1.0	3.2	18.9	0.2	1.2	787.3	69.6	8.8
2019	31.4	1.1	3.3	19.1	1.0	5.2	1043.6	118.2	11.3
2020	30.7	1.0	3.3	19.0	0.3	1.4	1162.0	331.4	28.5
2021	30.5	1.1	3.5	17.8	0.4	2.5	1225.6	387.7	31.6
2022	30.8	1.4	4.7	18.5	0.9	4.7	881.7	106.3	12.1
2023	31.5	0.7	2.1	18.7	0.9	4.9	839.5	24.2	2.9

Conclusion:

The present study reveals increasing agroclimatic variability in Eastern Uttar Pradesh, with notable fluctuations in temperature and rainfall across seasons and years. Winter and post-monsoon periods show higher temperature variability, raising risks for rabi crops, while erratic and uneven rainfall patterns threaten both rice and wheat production. These shifts highlight the need for climate-resilient farming practices, better water management, and adaptive crop strategies to sustain agricultural productivity in the region.

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