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Correlation of climatic factors with cereals crops yields in Eastern Uttar Pradesh (District Azamgarh)

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ABSTRACT

The present study is based on the secondary sources of information on temperature, rainfall and

Productivity of two major cereals (Rice and Wheat) in Azamgarh district of Eastern Uttar Pradesh. A total of 20 years data (2000-2020) on yield of crops, annual total rainfall, annual mean Maximum temperature and annual mean minimum temperature is analysed. The suitability analysis of crops shows that all the two cereals found to be suitable for cultivation in temperature range of Azamgarh district, whereas irrigation is required in addition to recorded rainfall in case of rice and wheat. The analysis of correlation coefficient shows that maize yield and minimum temperature have strong positive correlation (0.7755). At individual climatic factors level, yield of maize and wheat were significantly related with annual mean minimum temperature. The yield of these crops can be increased by crop management mainly by altering the planting time, varieties and irrigation practices.

Key words: temperature, (maximum and minimum), rainfall, cereals, correlation, yield.

1. INTRODUCTION

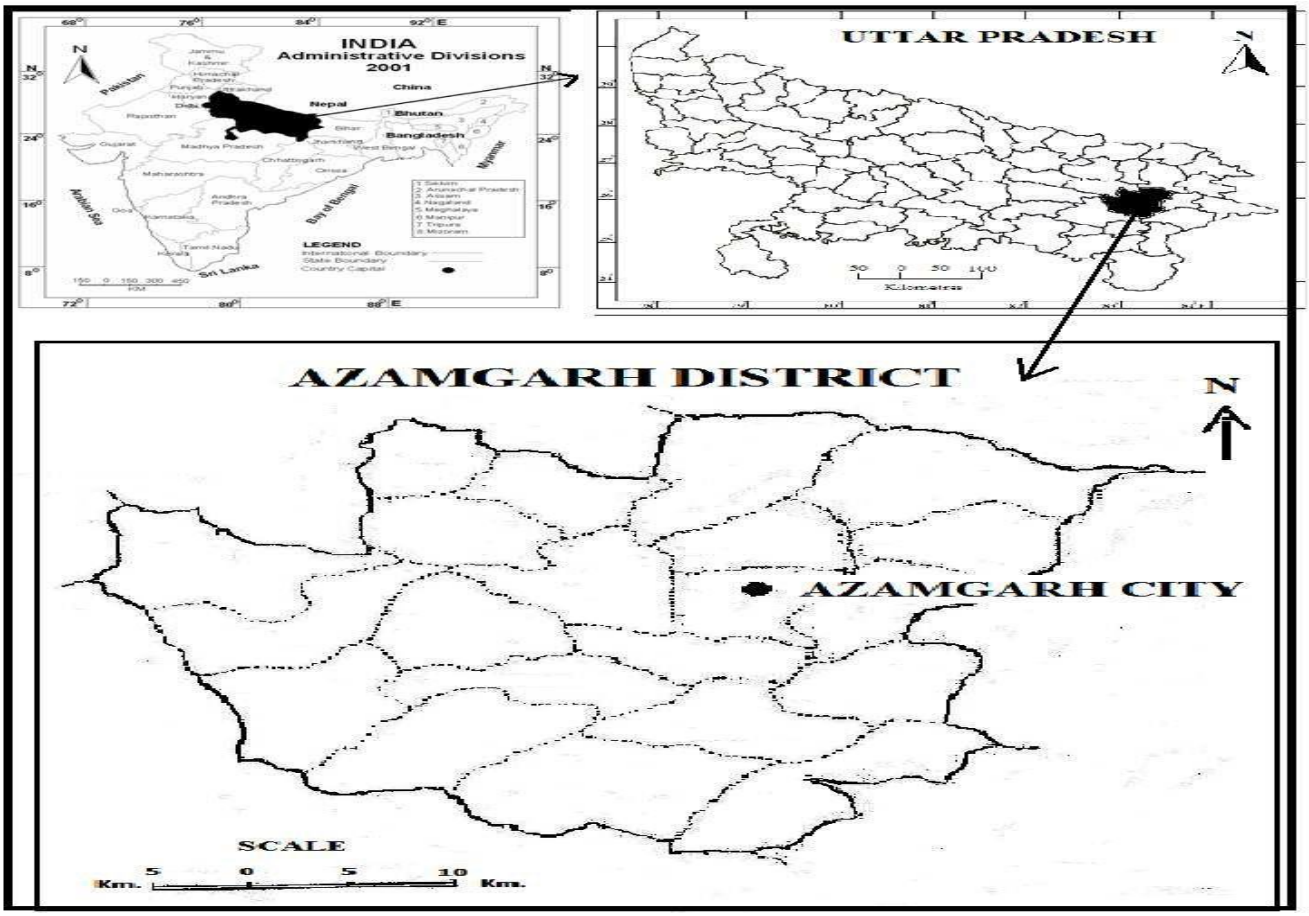
Global climate change may alter long-term rainfall patterns, impacting water availability and increasing the risks of droughts and floods. Changes in climate, particularly the Southwest (SW) monsoon over the Indian region, would have significant effects on agricultural production, water resource management, and the overall economy of the country. The heavy concentration of rainfall during the monsoon months (June-September) leads to water scarcity in many parts of the country during non-monsoon periods. Changes in rainfall patterns due to global warming, particularly since the 1990s (post-industrialization), may affect the hydrological cycle. This necessitates a reassessment of water demand, hydrological design, and agricultural practices. Therefore, long-term trend analysis of rainfall and other weather parameters across different spatial scales is crucial for developing future strategies for crop planning and management **(Jain & Kumar, 2012)** with these considerations in mind, the present investigation was undertaken. Globally, numerous initiatives have been undertaken in the agricultural sector to enhance farming technology and crop management practices. These efforts aim to increase crop productivity to ensure food security for the growing population. Climatic factors have always played a crucial role in crop productivity, drawing the attention of agriculturists, especially in the context of global warming and climate change.

In a country like Nepal, where approximately 34% of the Gross Domestic Product (GDP) is derived from agriculture (MOF, 2014), studying climatic factors to understand their impact on crop yields is essential. Analyzing these factors reveals the relationship between climate and crop production. Furthermore, assessing the impacts of historical climatic trends on crop production helps to predict potential future impacts and evaluates the effectiveness of ongoing adaptation efforts and changes in production practices **(Lobell and Field, 2007; Lobell et al., 2011).** Rice and wheat are the major cereal crops of India. Therefore, primary food security concerns are focused on improving and sustaining their productivity. These two crops occupy a significant area in the IGP of South Asia, which extends from Pakistan in the west to Bangladesh in the east. The Climate change is a particular environmental concern for the region, as these have numerous direct and indirect links to agricultural production. Elevated CO2 increases yields of important crop of the region such as wheat and rice, but the degree of change is modulated by changes in temperature and rainfall. Often, these interactions may result in production decline. The

increased incidence of weather extremes such as onset of rainfall, and duration and frequencies of drought and floods will also have major effects, and preliminary reports indicate that the recent declines in yields of rice and wheat in the region could have been partly due to changes in weather extremes **(Aggarwal *et al*., 2004).**

2. Materials and Methods

Temperature and Rainfall data from the past 21 years (2000-2020) for Azamgarh, Uttar Pradesh, were collected and analyzed to observe historical trends in rainfall and temperature. Azamgarh is located at 26°07’ N latitude, 83°18’ E longitude, and at an altitude of 77.6 meters above mean sea level (MSL). It falls within the North Eastern Plain Zone of Uttar Pradesh, India. Eastern Uttar Pradesh is divided into three agro-climatic zones: the North Eastern Plain Zone (NEPZ), the Eastern Plain Zone (EPZ), and the Vindhyan Zone (VZ). As Eastern Uttar Pradesh extends from Northern India towards the east, the NEPZ experiences higher rainfall around 1270 mm compared to other regions in eastern Uttar Pradesh. The monsoon withdrawal also follows a similar trend, occurring earlier in the NEPZ. Trend analysis of various climatic parameters was conducted for the Azamgarh district within the EPZ region.



2.1 Meteorological data used

The daily and monthly weather data of maximum and minimum temperature and rainfall of Azamgarh collected for the period of 2000 - 2020 to study the climatic variability and trend and determining normal values of weather variables for these location.

The weather data on maximum and minimum temperatures, rainfalls of recent 21 years of Azamgarh obtained from Acharya Narendra Deva University of Agriculture and Technology Kumarganj Ayodhya Uttar Pradesh.

2.2 Weather Parameters

1. Maximum Temperature (°C)
2. Minimum Temperature (°C)
3. Rainfall (mm)

2.3 Yield data

The yield data of Rice and Wheat crop for Eastern Uttar Pradesh were taken from DACNET (Directorate of Economics and Statistics, Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare) for 21 years (2000-2020).

2.3 Correlation analysis

Correlation analysis was conducted to determine the strength of the association between two variables. In this study, the relationships between crop yield and various weather parameters—such as rainfall, relative humidity, temperature, and wind speed—were assessed using Karl Pearson's correlation coefficient, calculated as follows:

r(x, y) = Cov (X, Y)/ σ2x σ2y. In case of bivariate distribution

$$\text{Cov}(X, Y) = \frac{\sum (X_i - \bar{X})(Y_i - \bar{Y})}{n-1}$$

$$\sigma_x^2 = \frac{\sum (X_i - \bar{X})^2}{n-1}$$

$$\sigma_y^2 = \frac{\sum (Y_i - \bar{Y})^2}{n-1}$$

Where,

r (x,y) is the correlation coefficient between X and Y.

Xi is the first variable and Yi second variable.

is the mean of the variable Xi and $\bar{x}$ is the mean of the variable Yi.

3.3 Result and Discussion

Impact of weather parameters on major crops (Rice & Wheat) of Azamgarh District.

The Yield of rice& wheat was considered as dependent variables and weather parameters viz., maximum temperature, minimum temperature, and rainfall were considered as independent variables. Further statistical analysis carried out using correlation coefficient analysis to know the effect of above selected weather parameters on the yield of rice& wheat.

Table no. 3.1 Correlation between yield of rice and weather parameters at Azamgarh during 2000-2020.

Parameter	Yield(t/h)	Tmax.	Tmini.	Rainfall
Yield(t/h)	1			
Tmax.	-0.255	1		
Tmini.	-0.383	0.264	1	
Rainfall	0.224	-0.232	-0.266	1

*** Significance of r<0.444 at 5%, **significance of r<0.561 at 1%.**

In case of rice, the analysis revealed that correlation coefficient between rice yield and annual rainfall, annual mean maximum temperature and mean minimum temperature had negative correlation with maximum temperature (-0.255), minimum temperature (-0.383) & positive correlation with rainfall (0.224). In this way, maximum and minimum temperatures had negative impact on the rice crop in Azamgarh district while rainfall has had positive impact on the rice during the period between 2000 to 2020. (Table 3.1)

Table no. 3.2 Correlation between yield of wheat and weather parameters at Azamgarh during 2000-2020.

Parameters	Yield(t/h)	Tmax.	Tmini.	Rainfall
Yield(t/h)	1			

Tmax.	-0.532*	1		
Tmini.	0.263	0.445*	1	
Rainfall	-0.401	-0.014	-0.319	1

*** Significance of r<0.444 at 5%, **significance of r<0.561 at 1%.**

In case of wheat, the analysis revealed that correlation coefficient between wheat yield and annual rainfall, annual mean maximum temperature and mean minimum temperature had negative correlation with maximum temperature (-0.532), rainfall (-0.401) & positive correlation with minimum temperature (0.263). In this way, maximum and rainfall had negative impact on wheat crop in Azamgarh district while minimum has had positive impact on the wheat during the period between 2000 to 2020. (Table 4.3.4)

4. CONCLUSION

In this study the climatic variability and effect of weather parameters on yield of rice and wheat crop were studied. Weather parameters play an important in rice and wheat yield in Azamgarh district of Eastern Plain Zone of Eastern Uttar Pradesh during 2000-2020. Rainfall positively correlated and maximum temperature, minimum temperature negatively correlated with yield of rice and maximum temperature and rainfall negatively correlated and minimum temperature positively correlated with yield of wheat at Azamgarh district.

Similar results were reported by Jagtap *et al.* (2016), Mahajan *et al.* (2009) and dhaliwal *et al.* (2006).

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