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Climatic Changes in Eastern Uttar Pradesh

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CLIMATIC CHANGES IN EASTERN UTTAR PRADESH

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Abstract

Gorakhpur is one of the major districts of Uttar Pradesh, India. Located on coordinates 26.765844° N and 83.364944° E, the population of Gorakhpur district is nearly 44,40,895 and geographical area about 3483.8 km^2. The major rivers flowing in Gorakhpur district are Rapti, Ami, Rohni and Ghaghra. Gorakhpur district is a flood prone area and about 26% of the population is affected by floods almost every year. The climate of Gorakhpur is composite, according to Energy Conservation Building Code of India, having temperately warm and humid during summers and severely cold during winters. This paper analyses the temperature, humidity and rainfall data of Gorakhpur area. It was found that the rate of rainfall is decreasing, temperature is increasing (both maximum and minimum temperatures) and relative humidity is increasing (both maximum and minimum relative humidity). It has been observed that there is very less amount of rainfall during winter season in comparison to summer season. The average temperature is about 25.5°C and average rainfall is about 1205mm (17 years). It has also been observed that the most of the occurring of rainfall takes place during the period of July to Sept., with the driest months being Nov.-December, May-June being the warmest and January the coldest month. There is rainfall difference of 340 mm in between minimum and maximum rainfall. Hence, it is concluded that there is a continuous increase in trend of reduction in rainfall. Due to this trend of climatic change, there is also a continuous decrease in groundwater level.

Keywords: *Temperature, Relative Humidity, Rainfall/Precipitation, Forest and Climate Change.*

Introduction

Climate is the information of weather over long periods of time. For a given region, variational patterns of meteorological variables like atmospheric particle count, wind, precipitation, humidity, atmospheric pressure, temperature etc. are used to measure climate. This paper discusses, the changes in climatic conditions observed in Gorakhpur of Uttar Pradesh region in terms of climatic variables like maximum and minimum temperature, precipitation, humidity etc. These climatic variables affect the weather conditions of the city and its outskirts in nearby areas of Gorakhpur district. Ecosystem also depends upon the weather for balancing the nature. In case of not controlling the imbalance of changing conditions, many species of ecosystem will be endangered while some will become extinct. On the other hand, some species will grow and develop vigorously. India is a developing country and a large number of people are engaged in agricultural activities which requires favorable climatic conditions. For agriculture, irrigation is the most important component which requires a huge quantity of water. Most of the agricultural land depends upon the rainfall especially during monsoon. Gorakhpur has large areas of agricultural lands which depend upon the natural rainfall for irrigation purposes and require the favourable intensity of rainfall for paddy crops. Determination of the net aftermath of climate change is done by variation in rainfall and different forms of precipitation which is one of the most critical factors. Humidity also plays an important role in agriculture, as it helps in photosynthesis and influences numerous properties of air. Water Vapour is one of the important greenhouse gases and is an important influencer on both weather and climate. The body feels discomfort

when the relative humidity in the air is high or too low. The reason behind this is slow sweat evaporation from our body due to which the heat from our body is not dissipated properly because of disrupted working of the cooling system of our body whereas during winters, the relative humidity is too low that the moisture content in our body gets lost and skin becomes too dry. Humidity is strongly intensified by changes in temperature of air and land-surface. It plays a very important role in defining the weather. It falls when temperature increases as hot air contain fewer amounts of water particles. If the relative humidity of the air below clouds is high, the evaporation would not remove much of the water from raindrops. However, if the humidity of the air is low, the evaporation can remarkably lower the quantum of water in falling raindrops therefore, reduced rainfall.

Temperature of a location can affect the weather of the place by which other components of ecosystem may also change as they all are interdependent on each other. Flora and fauna of a region thrive best in their local conditions as they become adaptable to them. A little change in the climatic conditions will lead to change in the patterns of temperature, rainfall, humidity, etc. This will lead to a disturbance in their living conditions as it becomes difficult for them to adapt easily to the new environment, thus affecting not just their daily lives but their entire life span. Some of them may even lose their lives, thereby misbalancing the ecosystem. In agriculture, the quality of crops depends upon the favourable temperature, rainfall, humidity and other climatic conditions. In Gorakhpur too, the variation in climatic conditions affect the growth of crops. Gorakhpur experiences mainly two seasons for growing crops namely Kharif and Rabi. Kharif crops include rice, maize, sorghum, pigeon-pea, moong beans and pearl millet whereas Rabi includes wheat, mustard, rapeseed, Bengal gram, green peas and lentil. Principal crops being rice and wheat. Starting in May and ending in January, Kharif crops require favorable climatic conditions and are dependent upon the intensity of rainfall. Too much or too less rainfall or odd-timing of rainfall can also ruin the crops. Starting in mid-November and ending in April/May, Rabi crops depend on the water that has percolated into ground or irrigated water. Good rainfall may prove to be detrimental to Rabi crops especially during winter. The main cash crop in Gorakhpur region is sugarcane. The quality and quantity of sugarcane depends upon the favourable climatic conditions. The temperature for the sugarcane cultivation is 27°C, rainfall, ideal rainfall is 1000-1750 mm but frost is responsible for stunted growth of sugarcane.

Gorakhpur has 8 towns Bansgaon, Pipiganj ,Pipraich, Gola Bazar, Mundera Bazar, Sahjanwa, Kasba Sangrampur urf Unwal and Barhalganj. There are three sugar mills present around its vicinity namely Dhuriapar Kisan Sugar Mills Ltd. Deidiha, U.P. State Sugar, Cane Deve. Corpn. Ltd. Pipraich and Saraya Sugar Mills Sardarnagar. A large population of Gorakhpur region is dependent on agricultural sources for their income and a large part of economy is shared by both food and cash crops. Hence climate control is very important in Eastern Uttar Pradesh as shown in Fig. 1. Hence, climatic conditions are important for balancing the nature so as to control the alteration of climate. We need to see the pattern of change and recognize the sources responsible for it and take actions to diminish the sources as much as possible. Climate change is often misunderstood for Global Warming and is used as an alternative term for it. It has been evidenced by various scientists that the global temperatures have risen since the Industrial Revolution or so. Technically speaking, global warming can be taken as a subset of climate change as not only the global temperatures have risen but an irregularity in precipitation patterns, rise in sea levels etc have been practically observed.

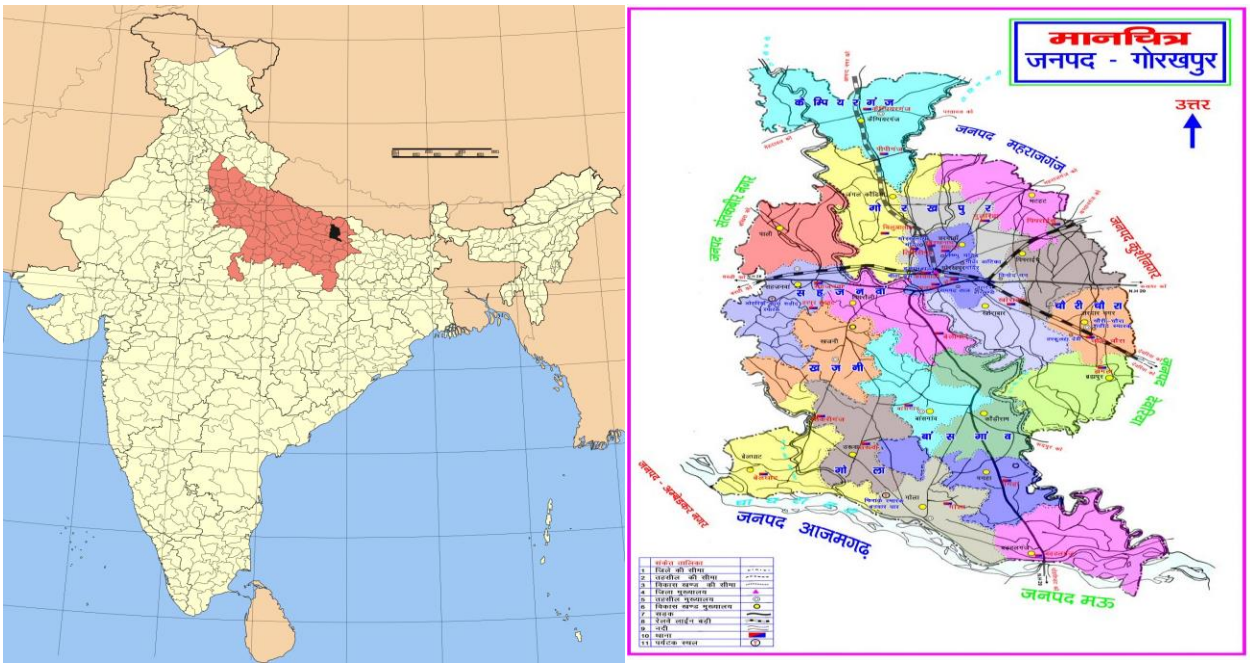


Fig. 1: Gorakhpur on Map of India and District Map of Gorakhpur

Data Collection and Source

In this paper, the data related to climate conditions changes from June 2011 to June 2018. Maximum Mean, Minimum Mean, Maximum (Minimum), Maximum (Maximum), Minimum(Minimum) & Minimum(Maximum) Temperature; Maximum, Average & Total rainfall and Maximum, Mean & Minimum Relative Humidity monthly wise are shown.

Data collection for shifting and variation in rainfall, humidity and temperature is done by the observed data of Indian Meteorological Station of Gorakhpur and the same source has been utilized in the paper.

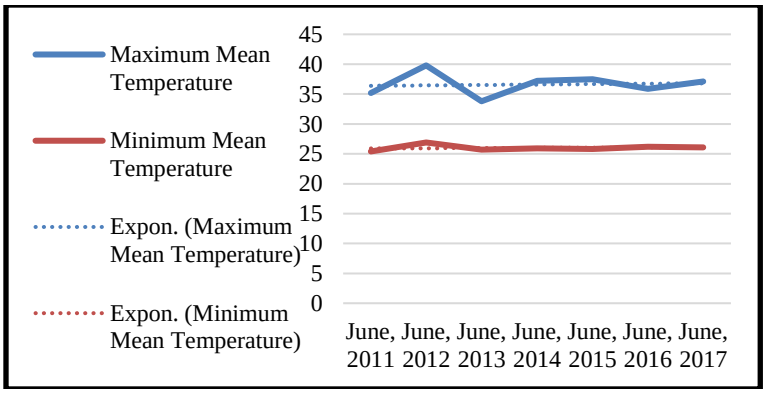
Maximum mean temperature in Gorakhpur region of Uttar Pradesh in June, 2012 is 39.8°C; in July, 2015 34°C; in August, 2016 34.1°C; in Sept., 2015 34.5°C; in October, 2017 33.4°C; in Nov., 2017 is 29.2°C; in December, 2016 is 23.4°C, in January, 2014 is 18.2°C; in February,2018 is 27°C; in March, 2018 is 33.7°C; in April, 2016 is 39.7°C; in May, 2012 is 40.5°C and Minimum Mean Temperature in June, 2011 is 25.4° C; in July, 2011 25.5°C; in August, 2011 25.3°C; in Sept., 2014 24.2°C; in October, 2012 is 18.6°C; in Nov., 2014 is 12.8°C; in December, 2011 is 9.8°C; in January,2013 6.8°C; in February, 2012 is 10.6°C; in March,2012 is 14.2°C; in April, 2014 19.4°C; in May, 2012 is 23.7°C.

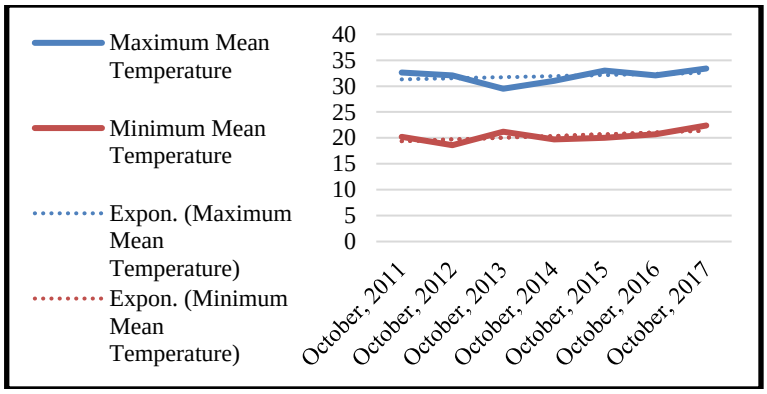
Table 1: Month-wise Max-Min Mean Temperature and Relative Humidity (2011-2017)

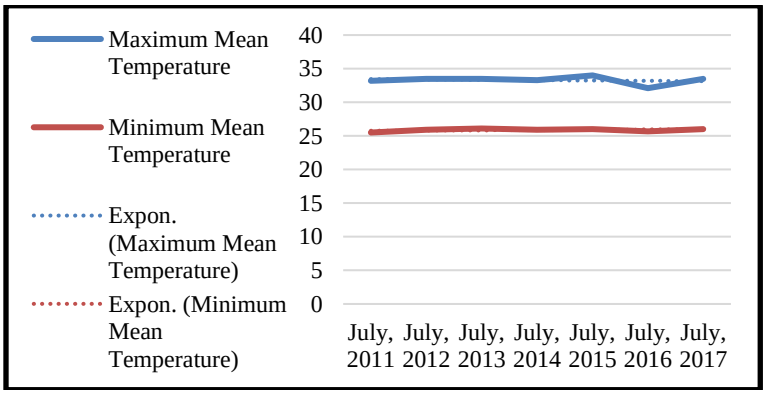
Month	Maximum Mean	Minimum Mean Temperature	Maximum Relative Humidity (%)	Minimum Relative Humidity (%)
June, 2011	35.2	25.4	81.00	51.00
June, 2012	39.8	26.9	71.00	33.20
June, 2013	33.8	25.7	84.00	60.80
June, 2014	37.2	25.9	78.80	47.30
June, 2015	37.5	25.8	77.20	44.20

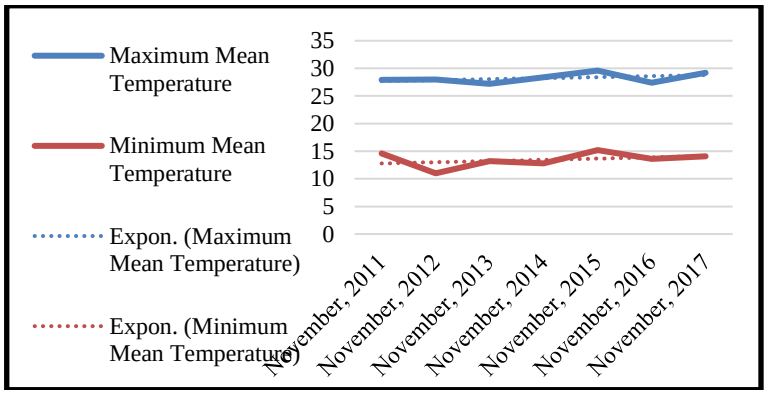
June, 2016	35.9	26.2	81.00	53.50
June, 2017	37.1	26.1	79.20	46.40
July, 2011	33.2	25.5	86.30	64.00
July, 2012	33.5	25.9	84.90	65.10
July, 2013	33.5	26.1	85.70	65.10
July, 2014	33.3	25.9	86.70	66.60
July, 2015	34.0	26.0	85.10	61.40
July, 2016	32.1	25.7	87.30	68.90
July, 2017	33.5	26.0	87.20	63.70
August, 2011	32.5	25.3	87.00	67.00
August, 2012	33.2	25.7	86.40	65.90
August, 2013	33.0	24.9	88.20	66.20
August, 2014	33.4	25.1	88.50	65.20
August, 2015	33.3	25.6	87.40	66.60
August, 2016	34.1	25.9	85.30	63.00
August, 2017	33.3	26.3	87.20	67.00
Sept., 2011	32.6	24.9	87.00	63.00
Sept., 2012	32.3	24.3	87.20	64.20
Sept., 2013	32.6	24.9	87.10	61.90
Sept., 2014	32.6	24.2	88.00	65.00
Sept., 2015	34.5	25.0	83.70	54.30
Sept., 2016	32.2	24.5	88.30	67.40
Sept., 2017	34.4	25.7	85.60	58.70
October, 2011	32.6	20.2	85.00	43.00
October, 2012	32.1	18.6	87.00	43.50
October, 2013	29.5	21.2	85.80	62.80
October, 2014	31.0	19.7	87.40	54.40
October, 2015	33.0	20	85.90	43.40
October, 2016	32.1	20.7	86.60	49.50
October, 2017	33.4	22.4	86.70	50.00
Nov., 2011	27.9	14.6	85.70	46.00
Nov., 2012	28.0	11.0	85.00	35.10
Nov., 2013	27.2	13.2	85.20	43.00
Nov., 2014	28.4	12.8	84.00	36.40
Nov., 2015	29.6	15.2	85.50	42.00
Nov., 2016	27.4	13.6	86.10	39.20
Nov., 2017	29.2	14.1	86.50	36.70
December,	20.5	9.8	86.00	58.00
December,	20.0	9.1	85.50	60.80
December,	22.8	9.8	85.50	48.50
December,	18.9	9.9	87.70	64.30
December,	23.3	9.5	85.50	43.90
December,	23.4	10.9	86.70	63.30
December,	23.3	11.0	87.80	48.10

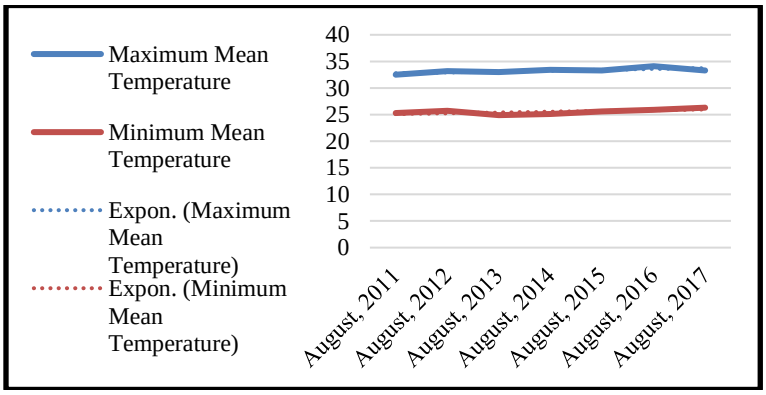
January, 2012	20.4	8.8	81.80	48.60
January, 2013	18.0	6.1	84.60	55.50
January, 2014	18.2	9.6	86.50	62.80
January, 2015	18.2	9.1	84.70	62.30
January, 2016	21.7	7.8	85.00	47.90
January, 2017	17.2	9.2	81.40	47.10
January, 2018	15.6	7.5	87.30	64.80
February, 2012	25.0	10.6	72.90	34.60
February, 2013	24.8	11.6	81.70	47.50
February, 2014	22.1	10.8	86.50	62.80
February, 2015	25.3	12.4	83.90	47.00
February, 2016	27.6	12.2	80.90	38.10
February, 2017	26.9	11.7	76.40	37.80
February, 2018	27.0	12.4	80.00	38.40
March, 2012	30.8	14.2	70.80	26.30
March, 2013	31.3	16.2	73.20	33.20
March, 2014	30.3	15.2	73.10	31.00
March, 2015	29.8	16.3	77.30	39.10
March, 2016	33.3	17.4	68.00	27.70
March, 2017	31.1	16.2	72.40	32.00
March, 2018	33.7	16.7	69.60	26.70
April, 2012	36.9	21.2	61.50	24.60
April, 2013	35.7	20.2	62.60	24.40
April, 2014	37.1	19.4	55.80	18.70
April, 2015	34.0	20.1	73.50	34.30
April, 2016	39.7	23.6	46.80	16.50
April, 2017	36.8	22.2	63.80	28.20
April, 2018	36.4	21.2	67.80	27.70
May, 2012	40.5	23.7	58.80	21.60
May, 2013	37.2	24.5	71.10	37.90
May, 2014	38.4	24.1	61.10	26.50
May, 2015	38.3	23.8	74.90	35.20
May, 2016	36.5	23.9	72.30	38.80
May, 2017	37.9	23.8	74.60	34.80
May, 2018	37.2	24.6	76.20	40.20

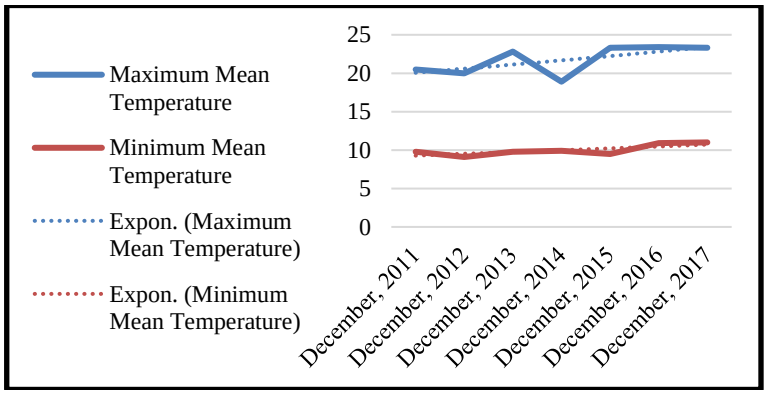


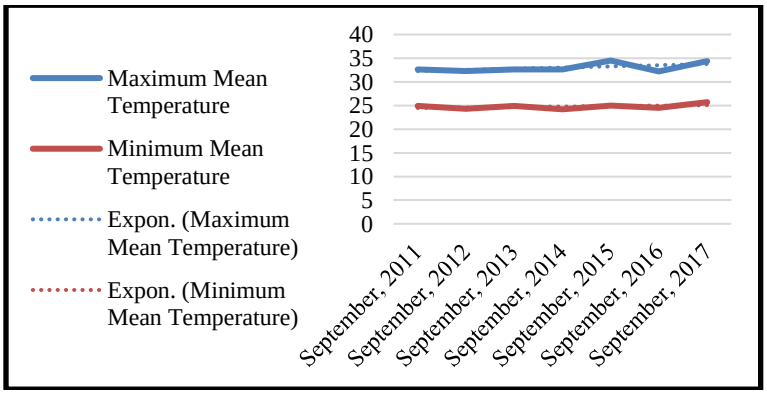












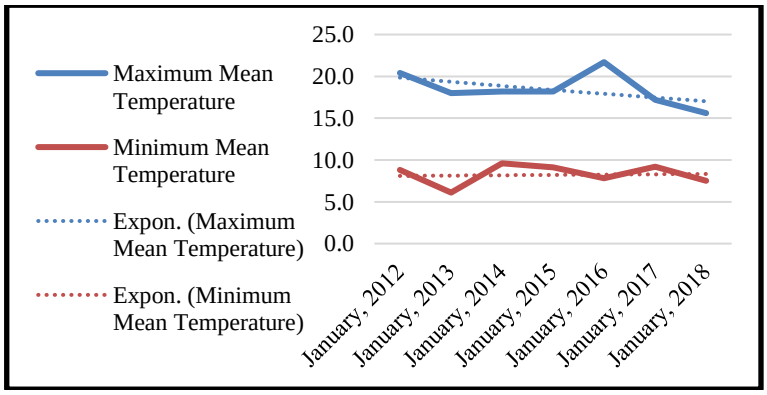
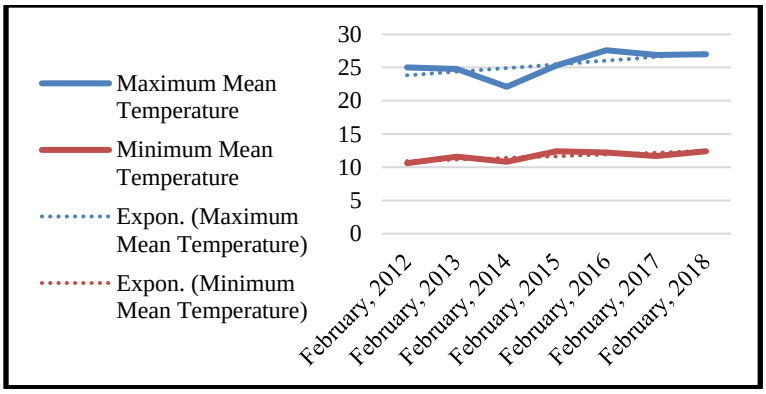
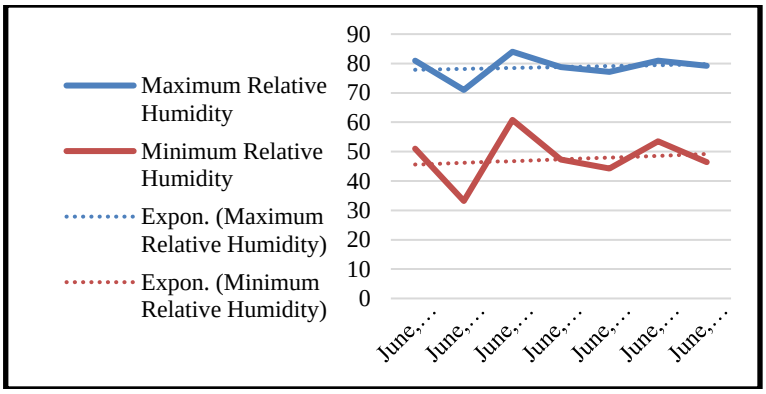
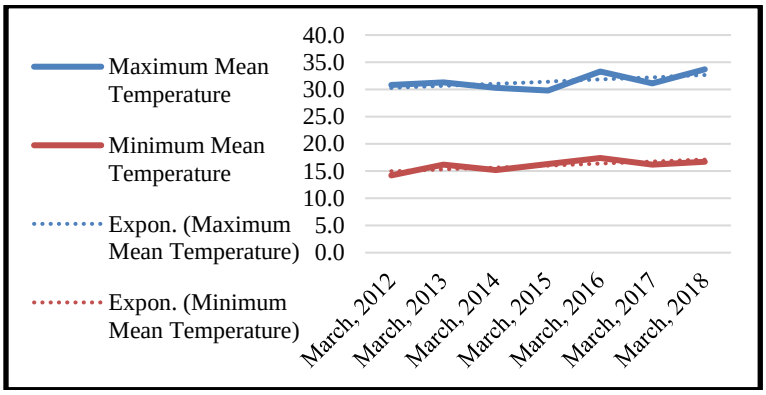
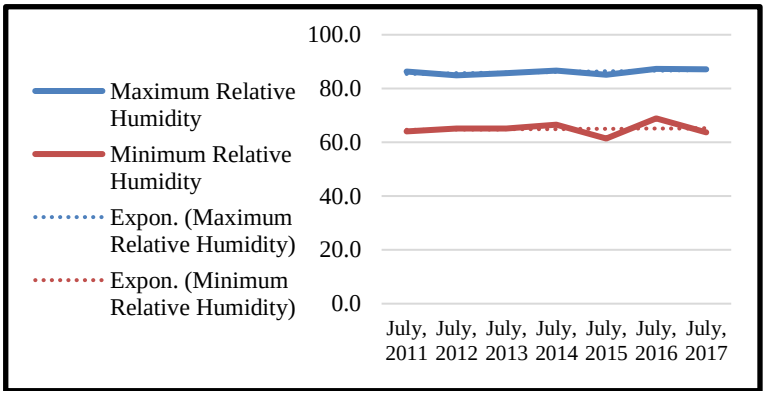


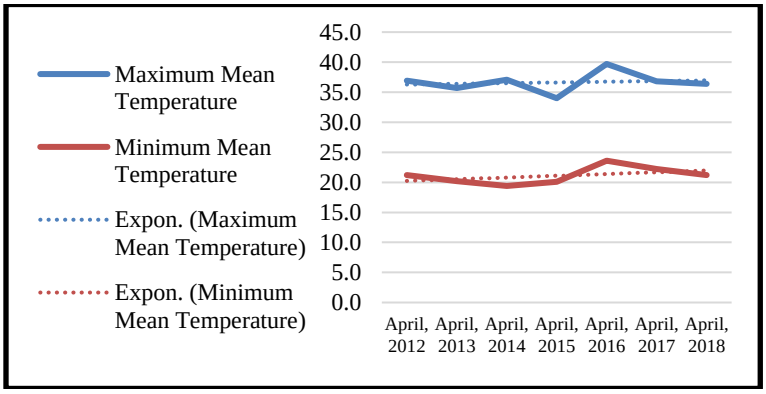
Fig. 2 (a): Showing Variation of Temperature from June to January

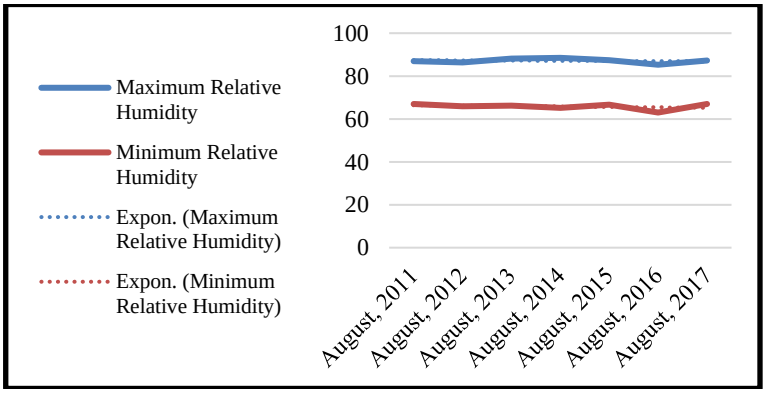


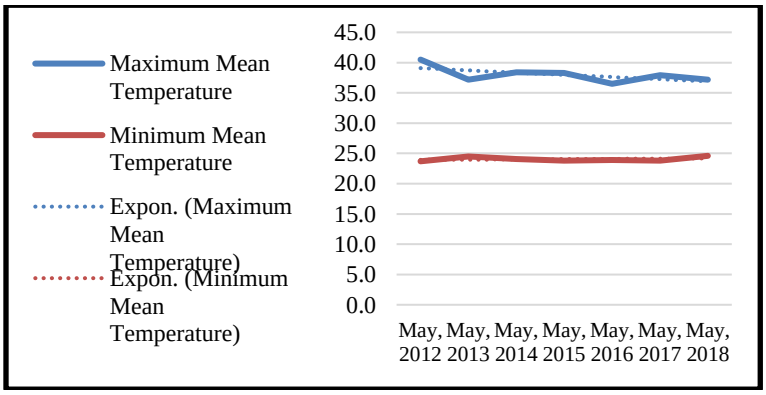












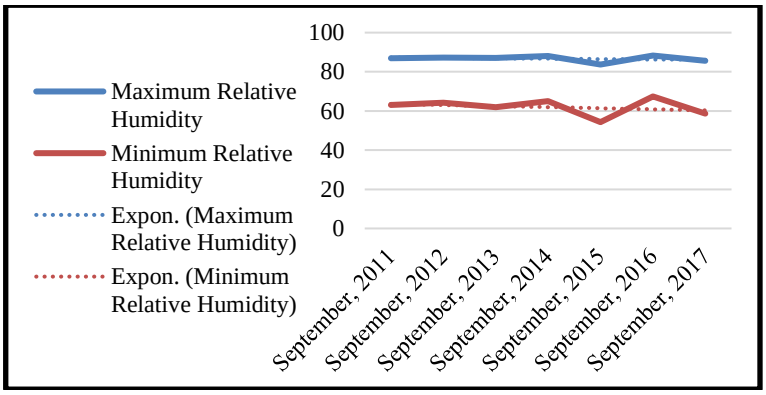
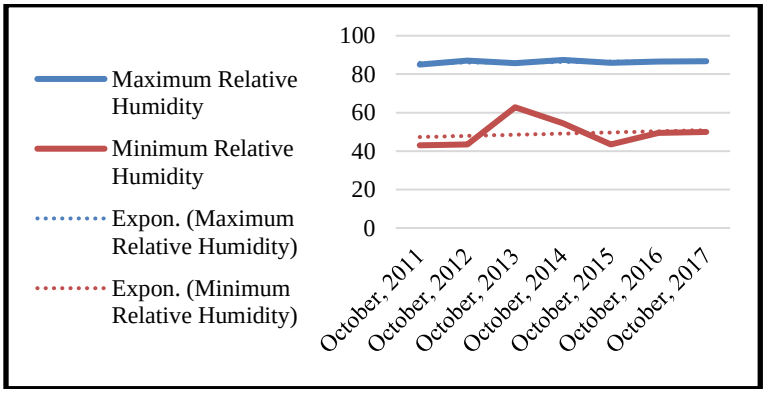
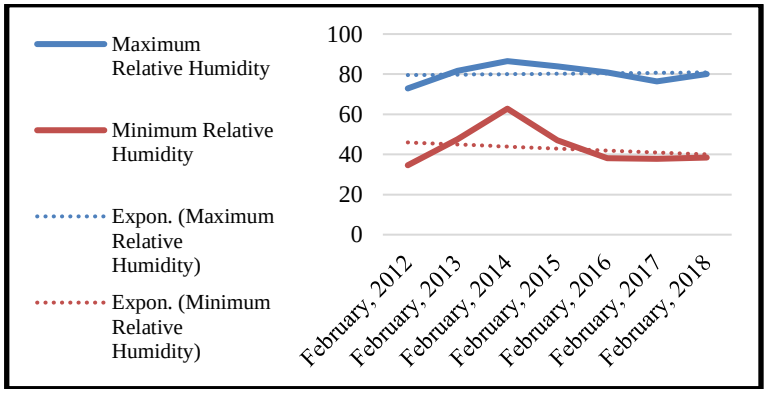
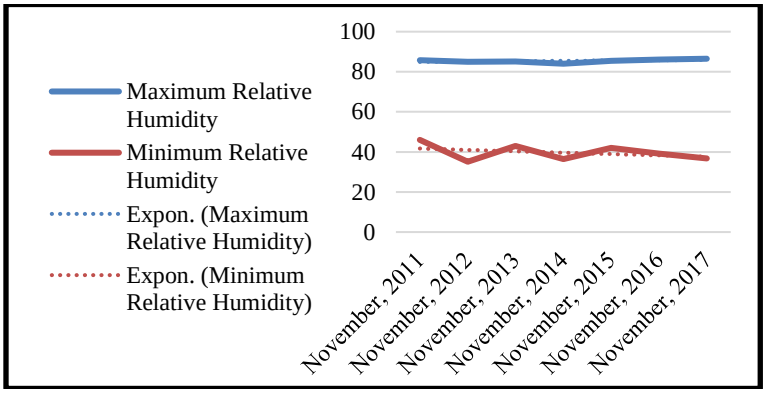


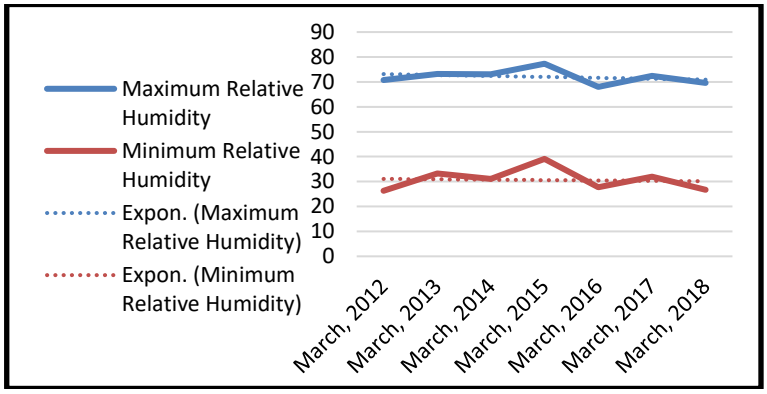
Fig 2 (b): Showing Variation of Temperature from February to May

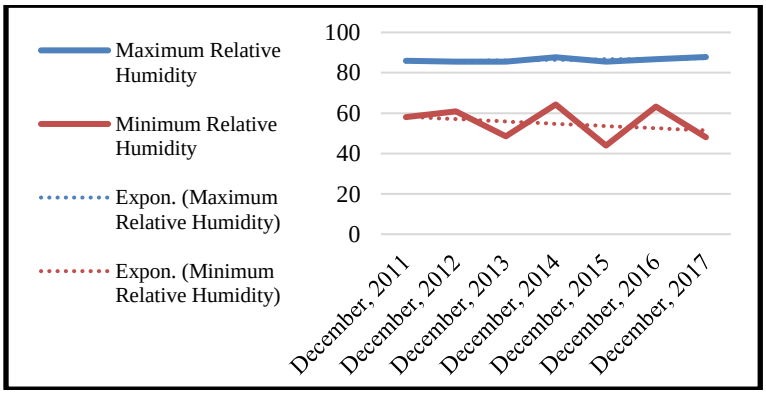
Fig 3 (a): Showing Variation of Relative Humidity from June to September

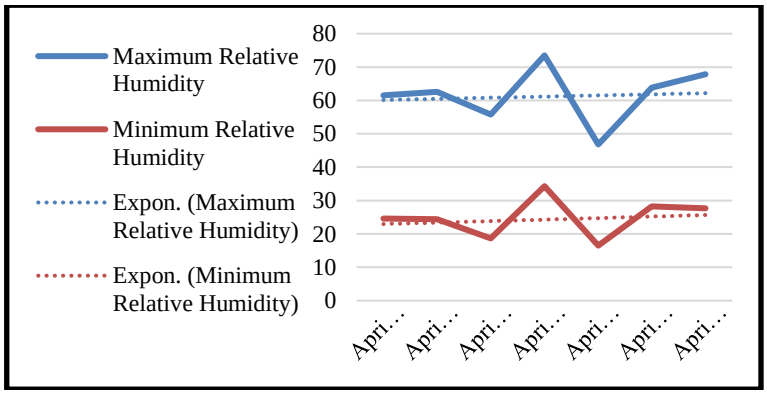


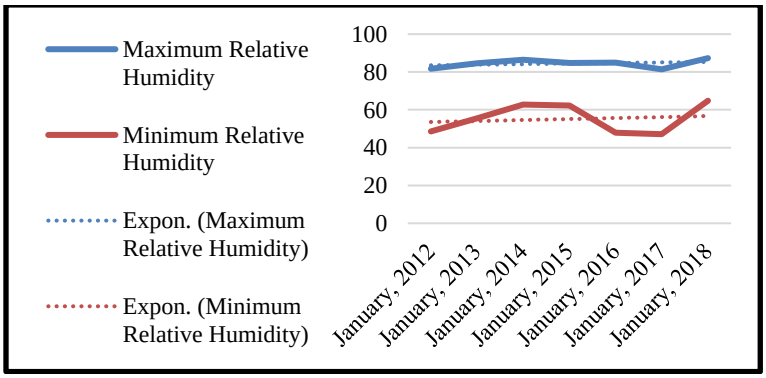












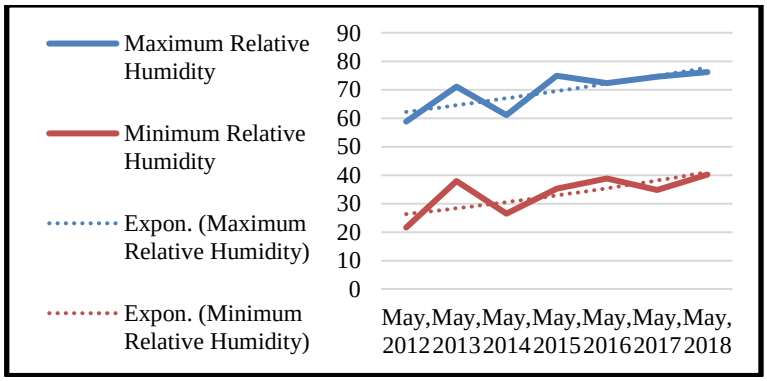


Fig 3 (b): Showing Variation of Relative Humidity from October to May

Table 2: Month-wise Max.-Min. and Max.-Max. Temperature (2011-2017)

Month	Year	Maximum(Minimum) Temperature	Year	Maximum (Maximum) Temperature
June	2013	26.8°C	2012	44.2°C
July	2016	24°C	2012	39.2°C
August	2012	28°C	2013	37.1°C
Sept.	2013	24°C	2017	36.9°C
October	2013	21.8°C	2015	36.6°C
Nov.	2016	24.8°C	2015	32.8°C
December	2014	11.8°C	2011	29.3°C
January	2013	9.2°C	2013	25.8°C
February	2014	15.6°C	2017	31.4°C
March	2015	21.6°C	2017	37.8°C
April	2013	21.5°C	2016	42.5°C
May	2013	27.2°C	2017	43.7°C

Table 3: Month-wise Min.-Min. and Min.-Max. Temperature (2011-2017)

Month	Year	Minimum(Minimum) Temperature	Year	Minimum (Maximum) Temperature
June	2011	20.8°C	2017	29.3°C
July	2016	20.6°C	2012	28.9°C
August	2014	21.8°C	2012	27.9°C
Sept.	2014	20.2°C	2017	27.5°C
October	2012	12.5°C	2016	26°C
Nov.	2017	7.1°C	2013	19.8°C
December	2014	4.4°C	2016	16.8°C
January	2013	-1°C	2015	15.2°C
February	2012	5.4°C	2018	17.8°C
March	2012	8.1°C	2016	23.1°C
April	2014	15.3°C	2016	26.8°C
May	2012	18.3°C	2018	28.8°C

Table 4: Month-wise Maximum and Average Rainfall (2011-2017)

Year	Total Rainfall (in cm)	Month -Year	Maximum Rainfall (in cm)	Average Rainfall (in cm)
2011	1099.2	Jul-11	132.2	274.8
2012	1275.9	Sep-12	155.7	319.0
2013	1725.8	Jun-13	342.9	413.5
2014	1133.4	Oct-14	115.2	283.4
2015	1018.3	Aug-15	161.4	254.6
2016	1018.7	Jul-16	94.6	254.7
2017	1165	Aug-17	180.3	291.3

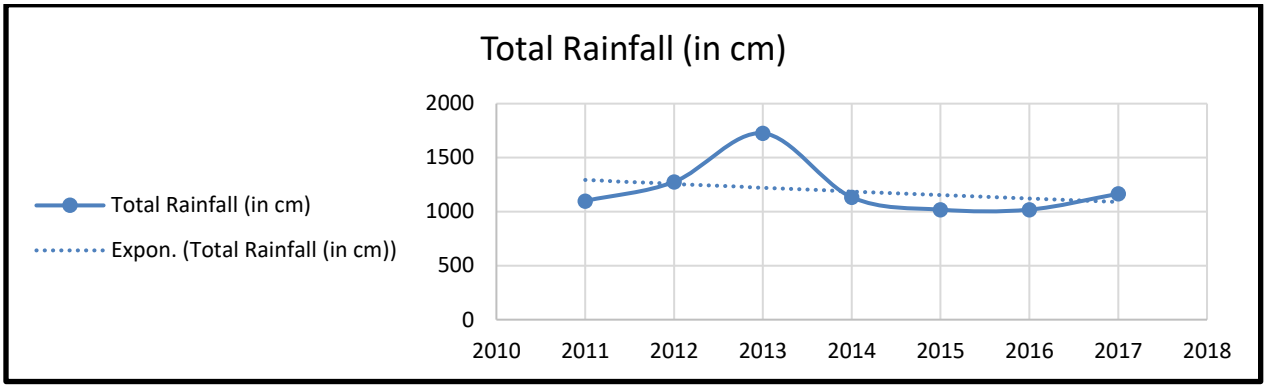


Fig. 2: Mean Annual Rainfall of Gorakhpur (2011-2017)

Result and Conclusion

In Eastern Uttar Pradesh region of Gorakhpur region the Maximum and Minimum Temperature, Relative humidity, precipitation and their impact are discussed it is conclude that by plotting graph and exponential trendline in month of August, Sept., October, Nov., December, February, March, April Maximum Mean Temperature slightly increases whereas in July, January and May slightly decreases and in month of June it is constant. The Minimum Mean Temperature in month of July, August, Sept., October, Nov., December, January, February, March, April and May slightly increases and in month of June it is nearly constant on period 2010-18; the Maximum Relative Humidity is slightly increases in month of June, July, October, Nov., December, January, February, April and May; slightly decreasing during month of August, Sept. and March; Minimum Relative Humidity slightly increases during month of June, July, October, Nov., January, April and May and slightly decreases in moth of August, Sept., December, February and March during same period of time. The Precipitation during year 2010-18 continuously slightly decreases in order. It is observed that the rainfall is decreasing in respective years and season are shifting due to which it affect the ecosystem cause decrease in cultivation of crops, extinct of flora and fauna, decrease in groundwater level and quality of groundwater it can be control by using alternate methods by which nature does not get disturb eliminate or cutoff the pollutant sources avoiding the anthropogenic activities by human being and planting more trees to hold groundwater which help in irrigation of crops.

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