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Ajeet Kumar

Ph.D., Research Scholar,
Department of Agril.
Meteorology, A.N.D.U.A & T.
Kumarganj, Ayodhya, Uttar
Pradesh, India

AK Singh

Associate Professor and Head,
Department of Agronomy,
A.N.D.U.A & T. Kumarganj,
Ayodhya, Uttar Pradesh, India

Amit Kumar

Ph.D., Research Scholar,
Department of Agril.
Meteorology, A.N.D.U.A & T.
Kumarganj, Ayodhya, Uttar
Pradesh, India

RK Aryan

Ph.D. Research Scholar,
Department of Agril.
Meteorology, A.N.D.U.A & T.
Kumarganj, Ayodhya, Uttar
Pradesh, India

Kali Deen

Ph.D., Research Scholar,
Department of Agronomy,
A.N.D.U.A & T. Kumarganj,
Ayodhya, Uttar Pradesh, India

Corresponding Author:**Ajeet Kumar**

Ph.D., Research Scholar,
Department of Agril.
Meteorology, A.N.D.U.A & T.
Kumarganj, Ayodhya, Uttar
Pradesh, India

Studies on the influence of El-Nino on rainfall in eastern Uttar Pradesh

Ajeet Kumar, AK Singh, Amit Kumar, RK Aryan and Kali Deen

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Abstract

Increase in rainfall means a bumper crop production and erratic monsoon means a bad production of crops resulting into the loss of country's economy. The average rainfall for the El Nino years (strong and moderate El Nino) was compared with the normal rainfall for the years 1981 to 2016 during the four different seasons. The percentage change in seasonal rainfall during the El Nino years compared to normal rainfall was also computed for the seasons in different districts. Results revealed that the average rainfall during the S-W monsoon season during the El Nino years was less than the normal rainfall in all the district of Eastern UP. The departure was maximum in Barabanki district by 9.0 percent and lowest departure (0.4%) was recorded in Jaunpur districts. The average summer season rainfall during El Nino years from March to May was less than the normal rainfall in Eastern U.P. Maximum departure (20.3 percent) was recorded in Gorakhpur district and minimum departure (0.2%) over normal rainfall was recorded in Ballia district. The average rainfall during winter season during El Nino years from January to February was less than the normal rainfall in all the districts of Eastern U.P., The maximum departure (17.5%) was recorded in Ghazipur district. The average rainfall during the post monsoon (October to December) during El Nino years was almost less than the normal rainfall in Eastern U.P. during the years with El Nino compared to normal rainfall. El Nino unambiguously serves as a signal of deficit rainfall for the Eastern U.P. during the south west monsoon season and if it does not happen, leads to deficit annual rainfall. Analysis of long term data suggests an inverse relationship between El Nino and SW monsoon rainfall. However, there is no one to one relationship as El Nino years have not always produced severe drought. The average annual rainfall or S-W monsoon season rainfall were less than normal rainfall during the years with El Nino.

Keywords: El-Nino effect, normal rainfall, erratic monsoon, maximum departure and minimum departure

Introduction

The farmers are still depended on the monsoon which is unpredictable. Erratic monsoon brings bad production of crops resulting into the loss of country's economy. So, in India still farmers depends upon the monsoon neglecting the technology and advancement in the field of agriculture. The El-Nino effect on agriculture sector can be overcome by adopting the certain measures by the govt. The Govt. should keep their eyes open on the forecasting of meteorological dept. about the monsoon and direct the agencies to make aware about the monsoon to our farmers so that they accordingly sow only those crops which will stand in scanty of rainfall or those crops which nourishes by only available ground water.

El-Nino refers to a large-scale ocean-atmosphere climate interaction associated with the episodic warming in sea surface temperatures (SST) across the central and east-central Equatorial Pacific. La Nina is an opposite event of El Nino which is termed as the episodic cooling of ocean SST in the central and east-central equatorial pacific. El Niño events are mostly associated with warm and dry conditions in southern and eastern inland areas of Australia, as well as Indonesia, Philippines, Malaysia and central Pacific islands such as Fiji, Tonga and Papua New Guinea. The inter-annual variability of Indian summer monsoon rainfall (ISMR) has been linked to variations of Sea Surface Temperatures (SST) over the equatorial Pacific and Indian Oceans. ENSO events have a profound impact on summer monsoonal rainfall across India and most of the major droughts have occurred during El Nino events. However, its reverse is not always true. Previously El Niño had a strong association with droughts in India but this relationship has been weekend in recent years.

El Niño conditions mostly coincide with a period of weak monsoon and rising temperatures in India and thus the probability of drought occurrence surges during El Niño events that could be disturbing for Indian crop production and water supply. Moreover, El Niño resulting in deficit rainfall tends to lower the summer crops production such as rice, sugarcane, cotton and oilseeds and therefore the outcome might be seen in form of high inflation rates and lower GDP due to high contribution of agriculture sector in Indian economy. This paper describes the occurrence of El Niño events, its impact on climate in different parts of world with special reference to Indian monsoon and crop production. Keeping above facts in view, the present investigation was under taken.

Methods and materials

District wise monthly rainfall data for various districts of Eastern Uttar Pradesh were collected during the years 1981 to 2016 for present study. The rainfall totals for the summer (March to May), southwest monsoon (June to September), rabi (October - December) and winter (January - February) seasons were computed year wise for various districts of Eastern U.P

Crop data – District wise

Average rainfall, seasonal rainfall in the El Niño years was

worked out and comparison was made with overall average normal value for the purpose of weak, moderate or strong, the El Niño years were classified from 1951 to 2016 as follows:

| Intensity | Years |
|-----------|---|
| Weak | 1951 1963 1968 1969 1976 1977 2004 2006 |
| Moderate | 1986 1987 1994 2002 |
| Strong | 1957 1965 1972 1982 1991 1997 2009 2014 2015 |

During the period considered for the present study from 1981 to 2016, there were 10 moderate and strong and two weak El Niño events out of 36 years.

Result and Discussion

The average seasonal rainfall for the El Niño years (strong and moderate El Niño) was compared with the normal rainfall for the years 1981 to 2016 during the different seasons (Table-1). The percentage change in seasonal rainfall during the El Niño years compared to normal rainfall was also computed for the seasons in different districts. It is quite evident from the data that the average rainfall during the S-W monsoon season during the El Niño years was less than the normal rainfall in all the district of Eastern UP. The departure was maximum in Barabanki district by 9.0 percent followed by Sultanpur district (7.3%).

Table 1: Per cent change in average seasonal rainfall (mm) during El Niño years as compared to normal rainfall (mm) in Eastern Uttar Pradesh (1981-2016)

| Name of Districts | Winter (JAN-FEB) | | | Summer (MAR-MAY) | | | SW Monsoon (JUN-SEPT) | | | Post Monsoon (OCT-DEC) | | |
|-------------------|---------------------|--------|-------|---------------------|--------|-------|--------------------------|--------|-------|---------------------------|--------|-------|
| | El Niño | Normal | PC | El Niño | Normal | PC | El Niño | Normal | PC | El Niño | Normal | PC |
| | Jaunpur | 48 | 53.2 | -10.8 | 78 | 84.2 | -7.9 | 882 | 886.2 | -0.4 | 70 | 72 |
| Ghazipur | 40 | 47 | -17.5 | 62 | 74.5 | -20.1 | 910 | 929.8 | -2.1 | 45 | 66.5 | -47.7 |
| Ballia | 42 | 46.3 | -10.2 | 70 | 70.2 | -0.2 | 913 | 892.2 | 2.3 | 58 | 67.4 | -13.9 |
| Maharajganj | 51 | 52 | -1.9 | 130 | 140 | -7.6 | 962 | 970 | -0.8 | 100 | 112 | -10.7 |
| Gorakhpur | 55 | 57 | -3.6 | 187 | 155.9 | 16.6 | 1005 | 982.1 | 2.3 | 109 | 122.2 | -10.8 |
| Deoria | 65 | 61.5 | 5.3 | 120 | 130 | -8.3 | 1003 | 988.7 | 1.4 | 99 | 103 | -4.0 |
| Basti | 91 | 97.9 | -7.5 | 143 | 152.8 | -6.4 | 1010 | 1027.7 | -1.7 | 111.5 | 121.5 | -8.2 |
| Siddharthnagar | 89 | 97.1 | -8.3 | 147 | 152.8 | -3.8 | 1021 | 1041.2 | -1.9 | 104 | 119.5 | -13.0 |
| Azamgarh | 47 | 51.8 | -9.3 | 76 | 78.1 | -2.7 | 873 | 899.7 | -3.0 | 75 | 73 | 2.6 |
| Mau | 44 | 42 | 4.5 | 74 | 80 | -7.5 | 890 | 900 | -1.0 | 60 | 65 | -7.7 |
| Faizabad | 72 | 79.8 | -9.8 | 102 | 103.5 | -1.4 | 866 | 891.3 | -2.9 | 90 | 86.8 | 3.7 |
| Gonda | 76 | 82.7 | -8.1 | 140 | 136.6 | 2.5 | 1002 | 1011.8 | -1.0 | 120 | 117.6 | 2 |
| Bahraich | 61 | 67.5 | -10.6 | 100 | 103.8 | -3.7 | 947 | 994.5 | -4.8 | 90 | 88.7 | 1.5 |
| Sultanpur | 63 | 66.7 | -5.5 | 93 | 100.2 | -7.7 | 825 | 886 | -7.3 | 75 | 72.5 | 3.4 |
| Barabanki | 58 | 64 | -9.4 | 81 | 88.4 | -8.4 | 800 | 878.7 | -9.0 | 68 | 74.8 | -9.1 |
| Varanasi | 80 | 87.7 | -9.6 | 67 | 72.7 | -7.8 | 876 | 926.7 | -5.5 | 58 | 67.2 | -15.8 |
| Mirzapur | 380 | 400 | -5.0 | 88 | 86.6 | 1.5 | 900 | 935 | -3.8 | 62 | 68.8 | -9.9 |
| Sonbhadra | 130 | 140 | -7.6 | 87 | 90 | -3.3 | 842 | 876 | -3.9 | 60.5 | 65 | -7.4 |

The lowest departure (0.4%) was recorded in Jaunpur districts of Eastern U.P. The average summer season rainfall during El Niño years from March to May was less than the normal rainfall in Eastern U.P. Maximum departure (20.3 percent) was recorded in Gorakhpur district followed by 16.6% in Ghazipur district. The minimum departure (0.2%) over normal rainfall was recorded in Ballia district followed by Faizabad district (1.4%).

The average rainfall during winter season during El Niño years from January to February was less than the normal rainfall in all the districts of Eastern U.P. as evident in the Table 1. The maximum departure (17.5%) was recorded in

Ghazipur district followed by Jaunpur and Bahraich district. The average rainfall during the post monsoon (October to December) during El Niño years was almost less than the normal rainfall in Eastern U.P. during the years with El Niño compared to normal rainfall (Table -1).

The average annual rainfall or S-W monsoon season rainfall were less than normal rainfall during the years with El Niño. Hence, El Niño unambiguously serves as a signal of deficit rainfall for the Eastern U.P. during the south west monsoon season and if it does not happen, leads to deficit annual rainfall.

Table 2: Per cent change in district wise average annual rainfall (mm) during El Nino years as compared to normal rainfall years in Eastern Uttar Pradesh (1981 to 2016)

| Name of Districts | Rainfall (mm) | | Percentage change |
|-------------------|---------------|--------------|-------------------|
| | El Nino years | Normal years | |
| Jaunpur | 937 | 985 | -5.1 |
| Ghazipur | 1000 | 1034 | -3.4 |
| Ballia | 927 | 980 | -5.7 |
| Maharajganj | 1280 | 1350 | -5.4 |
| Gorakhpur | 1177 | 1225 | -4.0 |
| Deoria | 1162 | 1203 | -3.5 |
| Basti | 1146 | 1169 | -2.0 |
| Siddharthnagar | 1292 | 1376 | -6.5 |
| Azamgarh | 1003 | 1030 | -2.6 |
| Mau | 1049 | 1070 | -2.0 |
| Faizabad | 985 | 1002 | -1.7 |
| Gonda | 1125 | 1152 | -2.4 |
| Bahraich | 1113 | 1128 | -1.3 |
| Sultanpur | 999 | 1005 | -0.6 |
| Barabanki | 1044 | 1059 | -1.4 |
| Varanasi | 1080 | 1079 | 0.0 |
| Mirzapur | 978 | 1022 | -4.4 |
| Sonbhadra | 999 | 1015 | -1.6 |

The percentage change in district wise average annual rainfall during the El Nino years as compared to normal rainfall of different selected districts of Eastern U.P. has been given in Table 2. The average annual rainfall during El Nino years is less than normal years. Maximum departure (6.5%) was recorded in Siddharthnagar followed by Ballia district (5.7%) as evident in Table -2. The lowest departure of 1.3% was found in Bahraich district followed by Barabanki district (1.4%).

Summary and Conclusions

The inter-seasonal and intra-seasonal variability in weather is believed in recent years to outsmart the abilities of climatologist. El Nino is fundamentally a warming of the surface water of the tropical Eastern Pacific Ocean from South American coast to the International Date Line that persists for three or more seasons. It is a pervasive climatic phenomenon which was found to be associated with regional climate variations throughout the world. Analysis of long term data suggests an inverse relationship between El Nino and SW monsoon rainfall. However, there is no one to one relationship as El Nino years have not always produced severe drought. The average annual rainfall or South - West monsoon season rainfall were less than normal rainfall during the years with El Nino. Hence, El Nino unambiguously serves as a signal of deficit rainfall for the Eastern U.P. during the south west monsoon season and if it does not happen, leads to deficit annual rainfall. The average SW monsoon rainfall, summer rainfall, Winter rainfall and total annual rainfall received during the years with El Nino were found to be less compared to normal years, In general, it was observed that either the SW monsoon rainfall or the annual rainfall will be less during the El Nino years.

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