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Rainfall variability at Faizabad, Uttar Pradesh

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Abstract
Rainfall data for the period 1971- 2010 is used to analyze the variability of annual and seasonal of deficit, normal, excess rainfall. The rainfall of 40 years ranged from 384.3 -1912.7 mm with annual mean of 1042.9 mm with 27.6 % variability, with standard deviation of 288.2 mm. The annual and seasonal rainfall showed a decrease in rainfall in recent decade (1991-2010). Trend of rainfall reflects a decrease in annual and seasonal during past 40 years where as no such specific trend was observed.

Keywords: Annual Rainfall; Seasonal Rainfall; Rainfall Variability.

Introduction
Rainfall variability is major factor influence agriculture productivity and sustainability in the semiarid. Recent work indicate that while representative rainfall series over past 176 years for India as while does not suggest any single trends (Sontakke, 1990).
The annual and seasonal rainfall received and the variability directly influence success or frailer of crops. Through its beneficial or adverse effect on growth and yield.Therefore, the study of the variability of annual and seasonal is essential in sectional of suitable crops and to take appropriate mitigating measures based on rainfall characteristics. Scientific study on the quantum and distribution of rainfall if made mould enable the forming community to adjust or modify the cropping programs.

Material and Methods
The annual and seasonal rainfall data for period between1971 - 2010 for 40 years at Faizabad district, Uttar Pradesh were studied for their variability and dependability. Faizabad is situated at $26^0$47' N latitude $82^0$12' E longitude and an altitude of 113 meters above mean sea level in the Indo Gangatic Plain. The data more aggregated as annual, seasonal and monthly rainfall. The mean rainfall, standard deviation and coefficient of variation for annual, seasonal and monthly periods were worked out as described by Deka *et al. (*2000).
The annual, seasonal, rainfall was classified based on Indian Meteorological Department specification as normal.

Result and Discussion
The rainfall of 40 years ranged from 384.3 - 1912.7 mm with a mean 1042.9 mm (Table 1). The standard deviation (SD) was 282 with a coefficient of variation 27.6% indicated the higher variability with lesser variability.
First decade better rainfall year 1971 to 1980 mean rainfall was higher (1202.7) with a higher SD (438.7) and CV (36.5) which indicated very high rainfall variation and occurrence of floods. During better years in faizabad, the rainfall during 1981to 1990 was loner rainfall 996.3to 1302.8 mm than last decade with high mean of 1129.0 mm and very low SD (85.79) and CV (7.7%) indicating least variability and more dependability. During 1991-2000 years was annual range of rainfall 806.0- 1193.3 mm with mean (973.0mm) and CV (13.4%) which indicate less variability of rainfall. On the century during last decade (2001-2010) the annual rainfall was high ranging from 384.3-1251.5 mm with a mean of 866.9 mm and SD (257.9) and a high CV (29.8) indicating high variability and less dependability. The variation of annual rainfall from 1971- 2010 has been shown in Fig1. From the fig1. it has been observed that the rate of rainfall decrease. Before 1990 the rainfall was highest from the average rainfall and after 1990 observed decrease rainfall from the average rainfall. The variation of SW monsoon rainfall (1971-2010) shown in feg.2. From the feg.2 the SW monsoon rainfall also observed decreasing trend.

Table 1: Annual rainfall (mm) variability between 1971-2010 at Faizabad, Uttar Pradesh

Year	Range	Mean	S.D.	CV (%)
1971-2010	384.3-1912.7	1042.9	288.2	27.6
1971-1980	563.8-1912.7	1202.7	438.7	36.5
1981-1990	996.3-1302.8	1129.0	86.4	7.7
1991-2000	806.0-1197.3	973.0	130.3	13.4
2001-2010	384.3-1251.5	866.9	257.9	29.8

The seasonal rainfall variability (Table 2) during the last 20 years (1991-2010) indicating that SW monsoon rain were deficit in 16 years (2.5-64.4 %) and excess in two years (22.5-31.1 %) as against the normal rainfall of 932.5 mm. During months of SW monsoon (June -Sept), the rainfall ranged from the lowest 331.7 mm in 2006. The highest rainfall was 1222 mm in 2008 as against the normal rainfall. Rainfall was deficit alternate years up to range from 2.5% to 64.4% indicating severe drought like condition. Drought intensity was classified as per IMD. Rainfall was more than 16.9% and 31.1% of normal in 1998 and 2008 indicating excess rainfall. During the month of Post monsoon (Oct-Nov), the rainfall ranged from the lowest 0.5 mm in 2002 to the highest 183.8 mm in 2009 as against the normal post monsoon rainfall of 42.8 mm but where, no rainfall in six year viz. 1991,1993,2005,2006,2007 deficit upto 100% indicating reduced rainfall compared to normal. In post monsoon season which many affect the Rabi crops. Winter season rain were deficit 13 year (39.2% to 100% and excess during five year (1994 to 1997 and 2003), three year severe drought continuously (2006 to 2008) that indicates the normal rainfall. Rainfall to beneficial for rabi season at critical stage of moisture stress. Pre monsoon rainfall was excess during five year in alternated while continuously normal rainfall during the years (1998 to 2000) and continuously three years no rainfall (2007 to 2010), Seven years severe deficit (upto 97.1%) of which one year moderate drought (upto 36.1%) during 1994 and one year slight moderate (2002). Similarly, Sheoran *et al* (2008) observed weekly rainfall variability in lower foothills of Punjab. Sahu (2008) reported annual and seasonal variability of climate in South Saurastra Agroclimateic Zone. Parmar *et al*. (2005) and Krishnakumar and Prasad Rao (2008) reported rainfall variability in Gujarat and Kerala state, respectively.

The rainfall pattern and seasonal distribution is changing over time. This information is helpful in the preparation and modification of cropping plans and management practice to cope up with aberrant weather for enhancing the productivity of agriculture and allied sectors more so in rainfed areas.

Table 2: Seasonal rainfall variability during 1991 to 2010 at faizabad, Uttar Pradesh

Season	Normal	1991*	1992*	1993	1994	1995*	1996	1997	1998	1999	2000	2001	2002*	2003*	2004	2005*	2006	2007	2008#	2009*	2010*
1.SW Monsoon (june-Sept)	932.3	807.9	644.9	879.2	909	775.9	633.9	870.1	1089.6	839.4	1142.1	985.9	480	736.2	901.5	887.4	331.7	884.2	1222.5	698.1	747.1
Deviation (%)	-	-13.3	-30.8	-5.7	-2.5	-16.8	-32.0	-6.7	16.9	-10.0	22.5	5.7	-48.5	-21.0	-3.3	-4.8	-64.4	-5.2	31.1	-25.1	-19.9
2.Post Monsoon (Oct-Nov)	42.8	0	139.7	0	19.8	36.3	162.7	36.4	18.1	68.4	0	71	0.5	1.6	32.2	0	0	0	29	183.8	61.9
Deviation (%)	-	-100	226.4	-100	-53.7	-15.2	280.2	-14.9	-57.7	59.8	-100.0	65.9	-98.8	-96.3	-24.8	-100.0	-100.0	-100.0	-32.2	329.5	44.6
3.Winter (Dec-Feb)	32.7	32.8	10	5.6	61	50.8	102.1	56.9	33.1	18.8	17.4	6.9	18.3	35.1	19.9	19.3	0	3	0	6.7	23.7
Deviation (%)	-	0.2	-69.5	-82.9	86.4	55.2	211.9	73.8	1.1	-42.6	-46.8	-78.9	-44.1	7.2	-39.2	-41.0	-100.0	-90.8	-100.0	-79.5	-27.6
4. Pre Monsoon (March-May)	35.0	11.8	11.4	90	22.4	2.7	1	13.5	36.4	41	37.8	50.3	31.2	2.1	59.7	11.9	52.6	73.8	0	0	0
Deviation (%)	-	-66.3	-67.5	156.9	-36.1	-92.3	-97.1	-61.5	3.9	17.0	7.9	43.6	-10.9	-94.0	70.4	-66.0	50.1	110.7	-100.0	-100.0	-100.0
5. Yearly Total	1042.9	852.5	806	974.8	1012.2	865.7	899.7	976.9	1177.2	967.6	1197.3	1114.1	530	775	1013.3	918.6	384.3	961	1251.5	888.6	832.7
Deviation (%)	-	-18.3	-22.7	-6.5	-2.9	-17.0	-13.7	-6.3	12.9	-7.2	14.8	6.8	-49.2	-25.7	-2.8	-11.9	-63.2	-7.9	20.0	-14.8	-20.2
Category	-	SLD	SLD	N	N	SLD	N	N	N	N	N	N	MD	MD	N	SLD	S	N	E	SLD	SLD

* Deficit rainfall years, # Excess Rainfall years, N- Normal (Mean±10%), E- Excess, D- Deficit.
Drought intensity (IMD)- SLD- Slight drought (-11to-25%), MD- Moderate drought (-26to-49%), S- Severe drought (-50% & above).

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