Climatic variability in Jhansi region of Uttar Pradesh

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ABSTRACT

The daily rainfall and temperature data 1969-2000 of Jhansi were analyzed to know seasonal and annual variability. Three distinct crop growth seasons *kharif* (26-41 SMW), *rabi* (42-15 SMW) and summer (16-25 SMW) were characterized for seasonal trends. The stable rainfall period was worked out. The annual and *kharif* rainfall showed a decrease in rainfall in recent decade (1984-1993). Trend analysis on rainfall reflects a decrease of 0.89 and 1.12 mm per year in annual and *kharif* season during past 35 years whereas no such specific trend was observed for *rabi* and summer seasons. The temperature variability was small indicating only minor year-to-year variations. However, during recent decade, the minimum temperature showed an increase of 0.05 and 0.13 ° C per year during annual and *kharif* season.

Key words: Climatic variability, rainfall, temperature and trends

Climatic variability is the major factor influencing agricultural productivity and sustainability in the tropics (Virmani, 1994). Recent work indicates that while representative rainfall series over past 176 years for India as a whole does not suggest any significant trend (Sontakke, 1990), several aberrations have surfaced across some pockets of the country. Hundal and Kaur, (2002) reported an increasing trend of rainfall at different locations in the Punjab region.

There are indications of warming in India. The all India mean annual surface temperature based on 73 stations showed a significant warming of 0.4° C (Hingane *et al.,* 1985) over past 100 years. This warming trend is comparable to global mean trend of 0.5°C in the last 100 years. Recent climate models suggest that India may experience a further rise in temperature of 1°C by 2050, which is about 2-3 times the rate of warming over past 100 years. Regardless of any change in precipitation amount, this temperature rise is likely to decrease soil moisture availability as the evaporation increases. Anticipated climatic changes may have adverse implications for agriculture in India. Therefore, there is a need to quantify regional climatic variability to assess its effect on productivity. The change in temperature and rainfall shows regional and seasonal variation and thereby affecting the crop productivity. The present work is aimed at investigating the rainfall and temperature variability for optimizing crop production in a semi arid environment.

MATERIAL AND METHODS

The basic data used comprises of daily rainfall, maximum and minimum temperature data for Agromet observatory, Indian Grassland and Fodder Research Institute (IGFRI), Jhansi (Bundelkhand) for the period 1969-2003 collected from India Meteorological Department, Pune. The daily rainfall, maximum and minimum temperature data (1969-2003) was analyzed for annual as well as *kharif* (26-41 SMW) and *rabi* (42-25 SMW) seasons. The stable rainfall period was computed using weekly rainfall and coefficient of variation for the above database. Further, trends in rainfall and temperature and five year moving averages were determined. The start, end and length of rainy season have been worked out by forward and backward accumulation of weekly rainfall following Morris and Zandstra (1978).

RESULTS AND DISCUSSION

The normal rainfall for annual, *kharif, rabi* and summer seasons were 906.1, 816.5, 63.8 and 20.8 mm, (Table 1). The large SD and CV values of rainfall indicate variability in annual and seasonal rainfall. However on decadal basis (Table 2) the seasonal rainfall amounts during I, II, and III decades were 911.5, 739.1 and 809.3 mm, respectively for *kharif* season and 56.8, 75.8 and 63.1 mm, respectively for *rabi* season. The mean annual and *kharif* rainfall amount showed a reduction of 59.6 and 70.2 mm respectively in current decade (1994-2003) as compared to previous decade (1984-93). This reduced amount of rainfall during crop growing season in current decade may affect the production of traditional *kharif* crops in this region.

Trends

The rainfall shows a decreasing trend in annual (Y= -0.897 X + 917.3) and kharif (Y = -1.116 X + 836.7) seasons. However, no such specific trend was observed for rabi and summer seasons. Therefore, the trend analysis reflects that the annual and kharif rainfall over past 35 years indicates a slight decreasing trend.
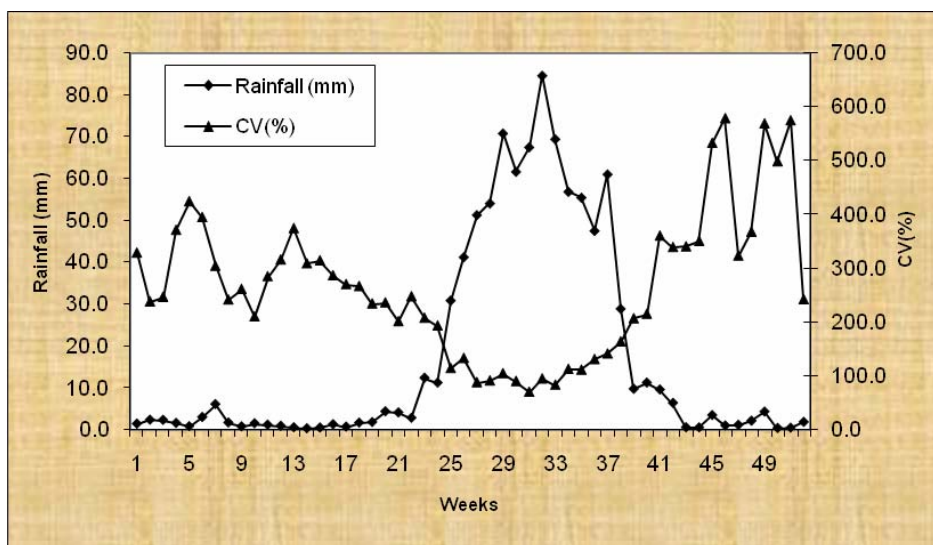
The analysis of start, end and length of rainy season

Fig.1: weekly rainfall and cv (%) at Jhansi

shows that the mean onset time of southwest monsoon is 27th week (July 2-8) in the current decade which reflects a delay of one week as compared to previous decade. The stable rainfall period for crop planning is presented in Fig.1. The peak value of average weekly rainfall (84.6 mm) occurs in 32nd week (Aug. 6-12) with a CV of 94.7 percent. The stable rainfall period was found to prevail from 27th to 37th SMW (July 2- Sept. 16). This reflects that for successful crop production during *kharif*, the crop duration should fit the above stable rainfall period when there is assured moisture regime.

Crop planning

In view of decrease in decadal rainfall, sorghum cropped area needs to be replaced by other short duration crop like seasame, blackgram, greengram etc. Moreover, soybean could be another crop that matures in about 90-100 days. The above results also indicate the feasibility of growing short duration fodder crop like pearlmillet, maize, cowpea, ricebean and clusterbean which can be harvested in almost 50-55 days. This will allow the soil to be recharged by late rains that will help in getting another crop during *rabi* season. *Rabi* crops which suit this type of rainfed crop sequence are mustard, toria, linseed and lentil. In all such cases, it is advocated that the early maturing variety may be used.

Temperature variability

The climatological normal (1969-2003) for annual mean, maximum and minimum temperature was 24.9°C, 32.5°C and 17.3°C respectively. The mean temperature variability (Table 2) showed a SD of 0.57, 0.69 and 0.69 mm and CV of 2.31, 2.12, and 3.97 percent indicating only

minor year-to-year variations. On seasonal basis also the mean temperature was relatively stable for different seasons.

The annual, *kharif, rabi* and summer mean temperature anomaly showed (Table 3) a variation in temperature from – 1.1 to 1.6°C, -1.6to 1.6°C, -1.1 to 1.9°C and –2.4 to 2.1°C respectively. The *kharif* and summer seasons mean temperature reflects greater year-to-year fluctuations as compared to annual and *rabi* seasons. The maximum temperature anomaly during kharif, rabi and summer reflects a variation from –1.7 to 2.7, -2.8 to 1.7 and –2.6 to 2.1°C respectively   (Table 2). However the minimum temperature anomaly exhibits greater year-to-year fluctuation during *kharif* as compared to other seasons.

Trend

The mean temperature pattern, trends and five years moving average were determined for annual and different seasons. No significant and systematic trend was observed in mean temperature for different seasons. In similar fashion the mean minimum and maximum temperature also do not exhibits any systematic and significant trends on annual and seasonal basis for past 35 years over the region.

On seasonal basis during current decade (1994-2003), the mean minimum temperature exhibits a slight increasing trend in annual and *kharif* season as compared to previous decade, while no such trend was observed during *rabi* season. The trend line shows as increase of 0.05 and 0.01°C per year during annual and *kharif* season in minimum temperature. The mean maximum temperature does not reflect any specific trends during different seasons.

Table 1: Annual and seasonal rainfall and temperature for Jhansi region from 1969-2003

Durations	Rainfall			Temperature		
	Total	CV	SD	Average	CV	SD
Annual	901.1	25.5	229.4	24.9	2.31	0.57
Kharif	816.5	27.8	227.3	30.0	2.48	0.74
Rabi	63.8	119.8	76.4	18.6	3.44	0.64
Summer	20.8	93.3	19.5	28.5	3.64	1.04

Table 2: Decadewise rainfall variability during different seasons for Jhansi region from 1974-2003

Durations	Normal Rainfall (1974-2003)	I (1974-83)	II (1984-93)	III (1994-2003)
Annual	910.5	990.5	836.2	895.8
Kharif	821.6	911.5	739.1	809.3
Rabi	65.9	56.8	75.8	63.1
Summer	23.0	22.2	21.4	23.3

Table 3: Annual and seasonal temperature anomaly (°C) range for Jhansi region from 1969-2003

Durations	T mean		Tmax.		Tmin.	
	Normal	Anomaly range	Normal	Anomaly range	Normal	Anomaly range
Annual	24.9	-1.1 to 1.6	32.5	-1.9 to 2.7	17.3	-1.4 to 1.6
Kharif	30.0	-1.6 to 1.6	34.9	-1.7 to 1.7	25.1	-2.4 to 3.1
Rabi	18.6	-1.1 to 1.9	27.2	-2.8 to 1.7	10.0	-1.7 to 2.6
Summer	28.5	-2.4 to 2.1	37.9	-2.6 to 2.1	19.1	-2.0 to 2.6

Therefore, the reduced duration of crop growing season and amount of rainfall in recent decade indicates lesser water availability period, thereby indicating possible climatic shift in the region.

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