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Assessment of Trends and Variability of Pre-Monsoon Rainfall for Some Selected Districts of Western Part of West Bengal

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Abstract Trends of Indian rainfall have been extensively studies by many researchers but the subject still remains complicated due to its high spatio-temporal variability. Pre-monsoon season in West Bengal broadly coincides with three months namely March, April and May. Entire pre-*kharif* crop cultivation in the state largely depend on the amount and distribution of pre-monsoon rainfall. In the present study an attempt has been made to identify the trend and variability of pre-monsoon rainfall by analyzing monthly rainfall data of these three months (March, April and May) from 1961 to 2010 of a part of western tract of West Bengal where rainfall is so called a limiting factor for the successful growth of agriculture.

Keywords Spatio-temporal variability, Surface run off, Water conservation, Rainfall anomaly.

Introduction

West Bengal is pre-dominantly an agrarian State. The State is characterized by diverse natural resources and varied climatic conditions which provide a congenial situation for cultivation of a wide range of crops. During the three months, from March to May the state receives an average rainfall varying from 135 mm at Kaliachak in the Southern end to 805 mm at Buxa Duar in the North-East corner of the sub-Himalayan West Bengal and 95 mm at Para in the Western part to 280 mm at Tehatta in the Eastern border of the Gangetic West Bengal which constitute 7 to 17% of the average annual rainfall (Mishra 2007).

The Western tract of West Bengal, extending between 21°47′ N–24°15′ N and 85°49′ E–88°2′ E covers 32% of the total area of the State. It actually spreads over 99 CD blocks located in 13 sub-divisions of 5 districts viz. Purulia, Bankura, Birbhum, Durgapur and Asansol sub-division of Bardhaman (now Paschim Bardhaman) and Paschim Medinipure excluding Ghatal sub-division (Mishra 2012a). But for the present study four districts have been selected namely Purulia, Bankura, Paschim Medinipure and Birbhum (Fig. 1). Western part of West Bengal is considered as dry as well as a backward region of the state where rainfall is so called a limiting factor for the successful growth of agriculture. After 70 years of independence, adverse climatic condition, land form and soil condition are generally blamed for this under development. Average annual rainfall of this region is 1446.4 mm which varies from 1218.8 mm at Burrabazar in Purulia to 1704.0 mm at Pingla in Paschim Medinipure. Average annual rainfall of this sub-division varies from 1316.3 mm at Purulia Sadar to 1636 mm in Kharagpur which comes in between 68 and 79 rainy days (Mishra 2012b).

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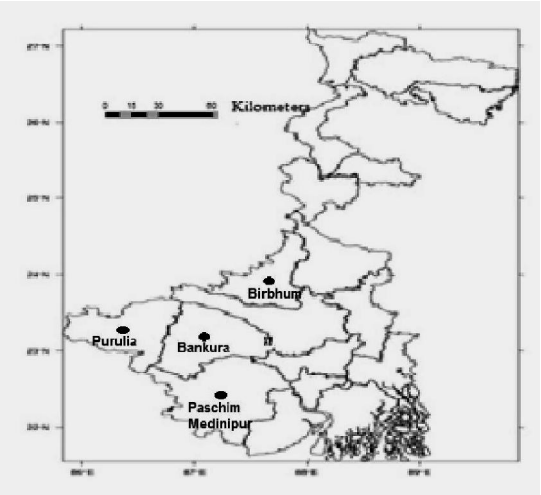

Fig. 1. Location map of the study area.

The weather and its variability are well known to the farming community and have great impact on crop production (Baweja 2011). The annual, seasonal and monthly rainfall analysis will be helpful in understanding general phenomenon of rainfall events of the region (Swetha et al. 2015). A number of studies have been carried out for the assessment of trend (Wani et al. 2017, Longobardi and Villani 2009, Soro et al. 2016, Lacombe and McCartney 2014, Mukherjee 2017, Merabtene et al. 2016, Nouaceur and Mursrescu 2016, Obot et al. 2010) and variability of rainfall (Shisanya et al. 2011, Steinke et al. 2017, Hossain et al. 2014). So, keeping the above points in view, in the present study an attempt has been made to identify the trend and variability of pre-monsoon rainfall of a part of western tract of West Bengal.

Materials and Methods

For the present study, monthly rainfall data of the four districts namely Bankura, Purulia, Paschim Medinipure and Birbhum have been collected from Agricultural Meteorology Division of the State Agriculture Department, Government of West Bengal and India Meteorological Department through the Indian water-portal website (http: //www.indiawaterportal.org/). The datta was analyzed on monthly basis and statistical parameters like standard deviation, coefficient of variability (CV) were determined. Rainfall anomaly has been calculated to show monthly rainfall departure from the mean rainfall. Statistical techniques viz. moving average and semi average methods have been used to investigate how the trend of rainfall has sequentially changed over the time period of 50 years (1961–2010) during pre-monsoon.

Table 1. SD and CV of rainfall in the four districts (1961–2010).

Districts	Mar		Apr		May	
	SD	CV	SD	CV	SD	CV
Bankura	26.50	90.30	30.03	71.88	46.39	56.79
Purulia	20.68	95.26	22.34	74.48	40.34	61.96
Medinipur	33.58	100.21	40.77	74.78	59.67	58.12
Birbhum	25.07	87.52	31.36	78.91	42.39	51.22

Results and Discussion

Variability of rainfall

One of the most important features of the pre-monsoon rainfall is its inter annual variability. Inter annual variability of rainfall during pre-monsoon has been expressed in the inter annual time series plotes for the period 1961–2010. The degree to which rainfall amount vary across an area or over time is an important characteristics of the climate of an area (Wani et al. 2017). The average pre-monsoon rainfall of these four districts was found to be 50.96 mm which ranges from 38.94 mm (lowest) over Purulia to 63.57 mm (highest) over Medinipur with standard deviation of 34.93 mm and coefficient of variability (CV) of 75.12%. CV of rainfall indicates the reliability of rainfall expressed in percentage. Higher value of CV is associated to the lower reliability of rainfall. Highest values of CV during March, April and May are found over Medinipur (100.21%), Birbhum (78.91%) and Purulia (61.96%) respectively (Table 1).

Trend of pre-monsoon rainfall

These four districts, on an average, experienced ex-

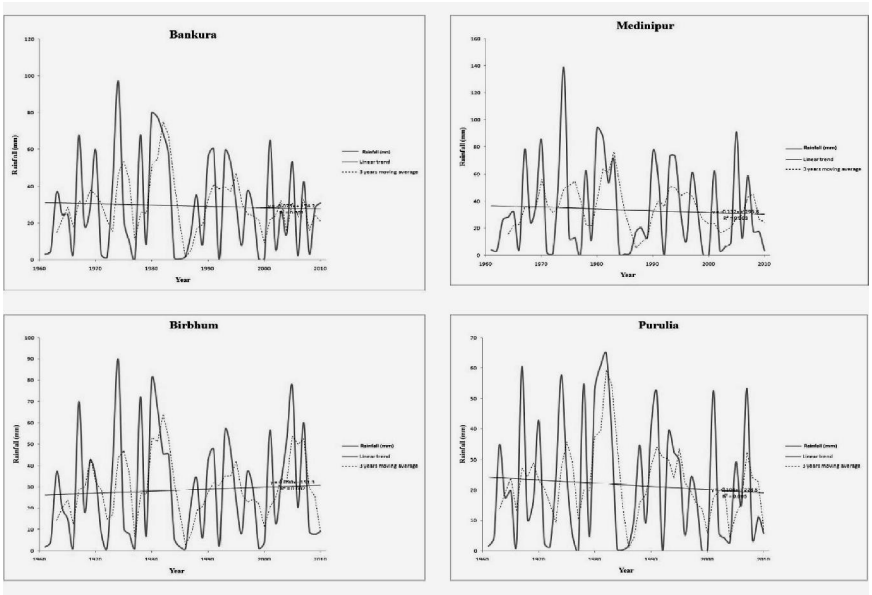

Fig. 2. Trend of rainfall in the month of March (1961–2010).

cessive pre-monsoon rainfall in 1971, 1980, 1981 and 1990. Analysis of rainfall data of individual district revealed that three among four districts of the western part of West Bengal experience maximum amount of rainfall in May followed by April and March. The linear trend of pre-monsoon rainfall for the selected districts during the period 1961 to 2010 are represented in Figs. 2, 3 and 4. It is found that the pre-monsoon rainfall shows highest increasing and decreasing trend over Medinipur and Purulia respectively.

Pre-monsoon rainfall over Bankura shows a rising trend of 0.8 mm/year in the month of May while

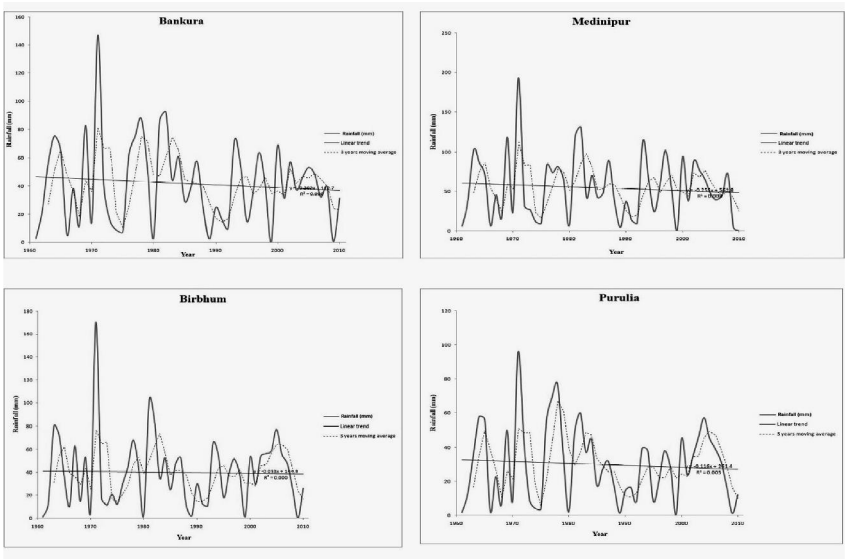

Fig. 3. Trend of rainfall in the month of April (1961—2010).

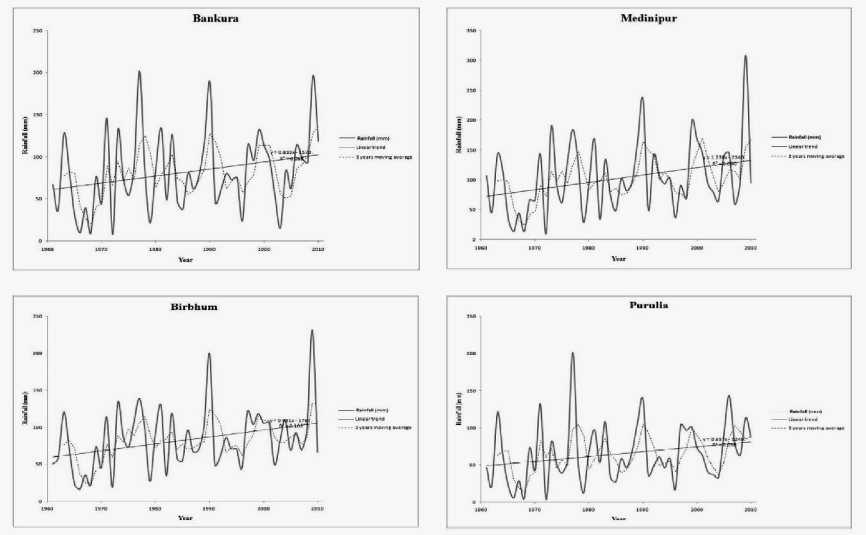

Fig. 4. Trend of rainfall in the month of May (1961–2010).

decreasing trend at the rate of -0.1 mm/year and -0.2 mm/year is noticed in the month of March and April respectively. It is found that the district Medinipur shows highest increasing trend of 1.2 mm/year over the other districts in May. While all the districts show decreasing trend at the rate of -0.07 mm/year, -0.13 mm/year and -0.1 mm/year in March over Bankura, Medinipur and Purulia respectively except Birbhum where increasing trend of 0.09 mm/year is noticed.

Rainfall anomaly

Figs. 5, 6 and 7 depict the trend of rainfall anomaly for the period 1961 to 2010. Trend of rainfall anomaly is

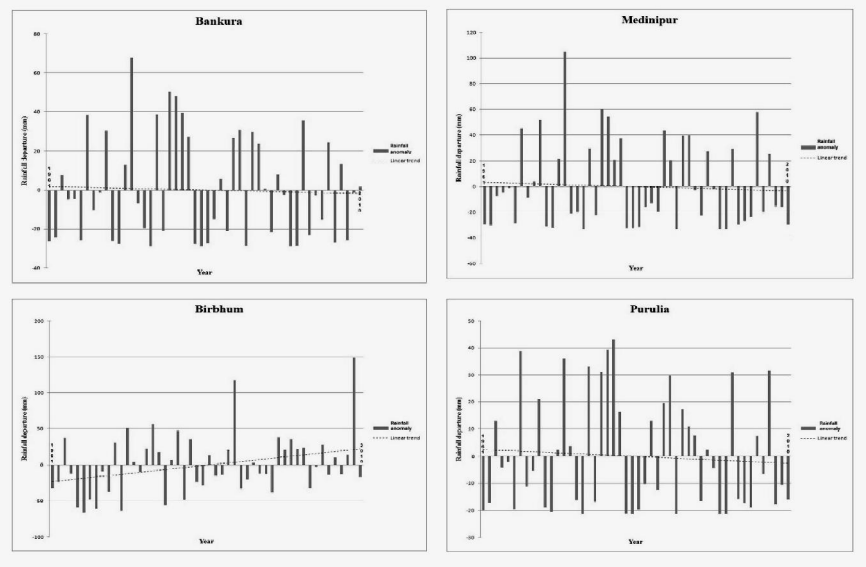

Fig. 5. Trend of rainfall anomaly in the month of March (1961—2010).

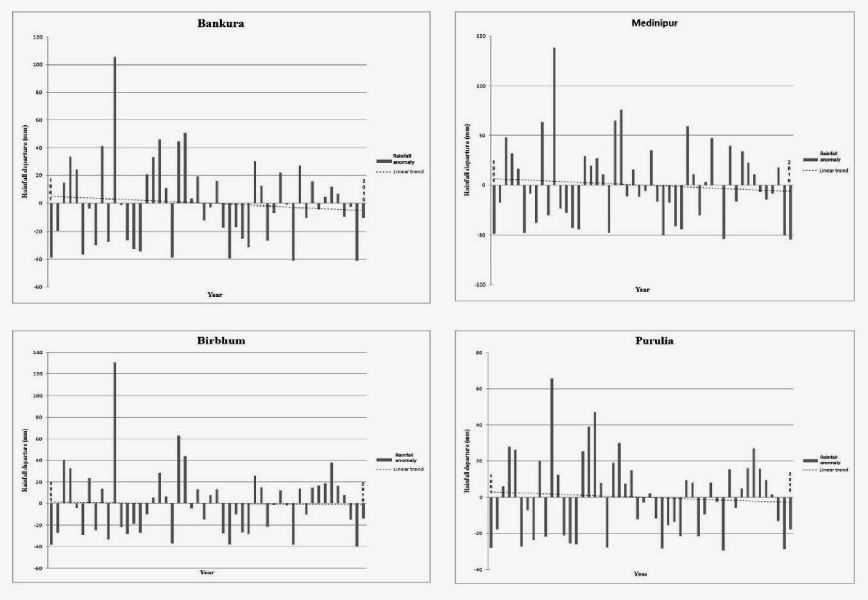

Fig. 6. Trend of rainfall anomaly in the month of April (1961–2010).

inversely proportional to the success in crop cultivation. All the districts show decreasing trend of rainfall anomaly during March and April while rising trend is noticed in May over the studied districts of western part of West Bengal (Table 2).

Conclusion

The present study has examined trends in the monthly and seasonal rainfall for the four districts of western part of West Bengal. A large data set was used, con-

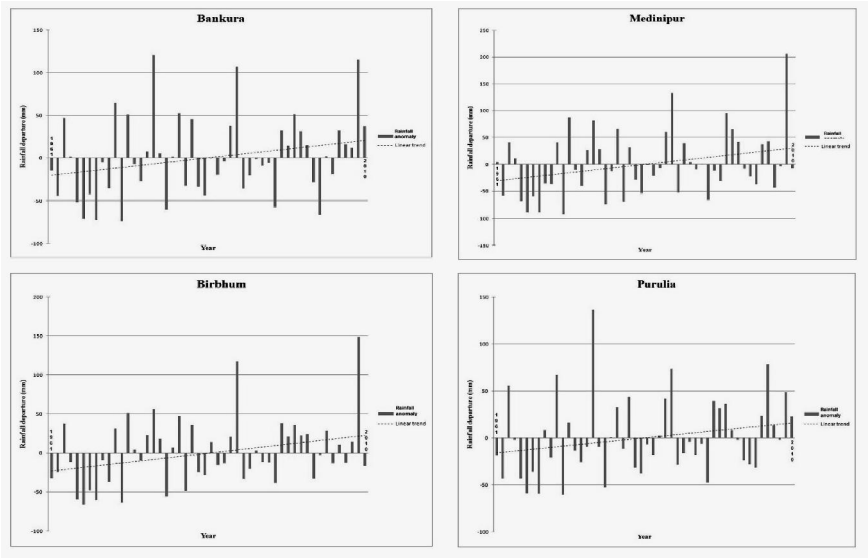

Fig. 7. Trend of rainfall anomaly in the month of May (1961—2010).

Table 2. Trend of rainfall and its anomaly in the study area (1961–2010).

Dis-tricts	Trend of rainfall			Trend of rainfall anomaly		
	Mar	Apr	May	Mar	Apr	May
Bankura	Slight decline	Sharp decline	Sharp rise	Slight decline	Moderate decline	Sharp rise
Purulia	Sharp decline	Moderate decline	Sharp rise	Moderate decline	Slight decline	Sharp rise
Medinipur	Slight decline	Slight decline	Sharp rise	Slight decline	Slight decline	Sharp rise
Birbhum	Slight increase	Slight decline	Sharp rise	Slight decline	Slight decline	Sharp rise

sisting of four districts with the length of data series of 50 years. One of the most important features of the pre-monsoon rainfall is its inter annual and spatial variability. Nearly all the studied districts show rising and decreasing trend of rainfall in the month of May and March respectively. Though the area receives considerable amount of rainfall throughout the year but drought is a recurrent phenomenon here. According to the criteria followed by the India Meteorological Department, this region can not be termed as drought prone. But the dryness of the region is the hard reality. After a short spell of heavy shower water moves as surface run off making the top soil dry very soon. So, the main strategy of mitigation should be the conservation of excess water which moves as surface run off after satisfying the need of evapotranspiration and its scientific use. Detailed knowledge of rainfall of an area is helpful for the planning of crop calendar. While success of the cultivation of *rabi* crops in the state during winter depend on favorable temperature regime and abundant sunshine, cultivation of pre-*kharif* depend on adequate summer rain. Broadly speaking, entire pre-kharif crop cultivation largely depend on the amount and distribution of pre-monsoon rainfall. Cultivation of boro paddy, jute, aush paddy, maize and a large number of vegetables depend on the amount and distribution of pre-monsoon rainfall.

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