

Identifying the Trend of Meteorological Drought in Purulia District of West Bengal, India

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Received 4 October 2018; Accepted 8 November 2018; Published on 29 November 2018

Abstract Purulia district of West Bengal is considered as dry as well as a backward region of the state where rainfall is considered as 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. Though the district receives considerable amount of rainfall (1100 mm to 1500 mm) but drought is a recurrent phenomenon here. In this paper, applying the criteria of India Meteorological Department, an attempt has been made to identify the trend of meteorological drought of Purulia district in West Bengal from June to September which are basically the monsoon months. Geographical Information System (GIS) has been used to generate drought occurrence map of the district. The result shows that droughts pose highest risk to the middle and southern portion of Purulia.

Keywords Meteorological drought, Rainfall anomaly, Water conservation, Surface run off.

Introduction

Agriculture is a primary activity which depends on physical conditions such as temperature, rainfall and humidity (Climatic factors), soil (edaphic factor), height, slope and aspect of the landform. Purulia district of south western part of West Bengal is generally identified as the most backward and under developed region of the state due to adverse climatic condition of the region which generally satisfies the following points : So called low rainfall, Drought proneness, Extremity of weather and climate and Unfavorable climate for agriculture.

If the average per capita income, number of persons living below the poverty level, crop production and cropping intensity are taken into account, the sign of backwardness is everywhere (Mishra 2012). Average annual rainfall of the district varies between 1100 and 1500 mm which is sometimes higher compared to the Gangetic alluvial and coastal saline zone of West Bengal. Many studies have been done to identify the nature, characteristics and impacts of different types of droughts (Ziolkowska 2016, Mishra 2012) and assessment and monitoring of droughts (Seshasai et al. 2016, Wilhelmi and Wilhite 2002). Several studies used Standardized Precipitation Index (SPI) for monitoring and analysis of drought (Shahid and Behrawan 2008, Kar et al. 2012, Palchoudhuri and Biswas 2013). In the present study, applying the criteria of India Meteorological Department, an

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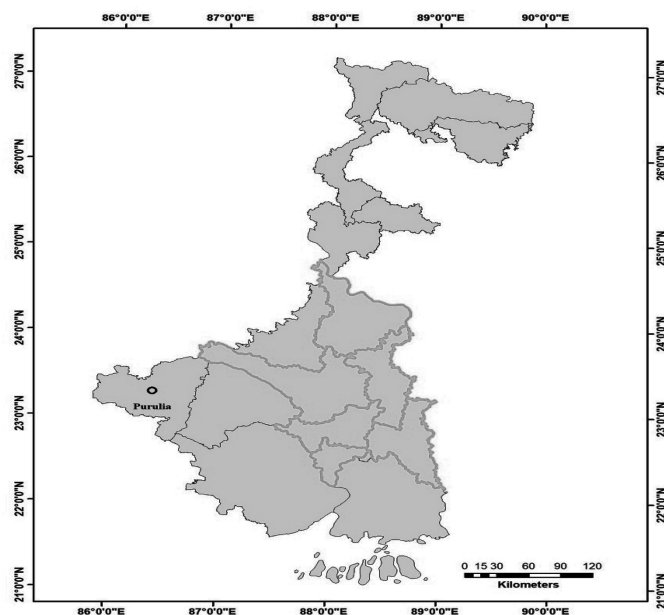


Fig. 1. Location map of the study area.

attempt has been made to identify the nature and trend of meteorological drought from 1908 to 2009 of Purulia district, West Bengal (Fig.1).

Materials and Methods

The district lies between 22°4' to 23°45' North Latitude and 85°55' to 86°55' East Longitude with elevation of about 240 m. Purulia district is characterized by sub-tropical climate with high evaporation and low precipitation. Summers are hot and dry with temperature more than 48°C. The relative humidity

is high in monsoon season (more than 75%). The soil of the district is mainly reddish with high iron content and characterized by low fertility due to high erosion. Adopting the criteria of meteorological drought by the India Meteorological Department (rainfall anomaly is $\geq 26\%$ of its long term normal), monthly rainfall data was analyzed to identify the meteorological drought characteristics of Purulia district. The study is based on both secondary as well as primary sources of data. Relevant data viz. water conservation, crop calendar have been collected through field survey and published literatures in the form of books and journals.

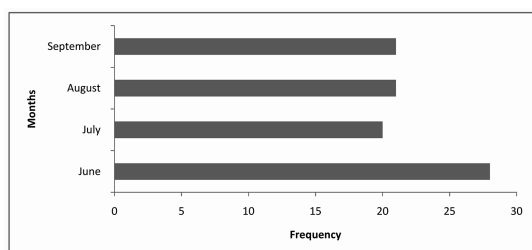


Fig. 2. Frequency of meteorological drought in Purulia.

The preliminary knowledge about the study area has been collected from district Gazetteer. For the purpose of identifying the trend of meteorological drought, rainfall data 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/>). Due to lack of rainfall data in the eastern portion of purulia, rainfall data of 3 rain gauge stations of Bankura district namely Saltora, Ranibandh and Susunia have been used. Statistical techniques viz.

Table 1. Trend of meteorological drought and rainfall anomaly in Purulia.

Months	Frequency (Out of 102 years)	Decadal trend (1908-2009)	Trend of rainfall anomaly (1908-2009)
Jun	28	Rising	Remain same
Jul	20	Rising	Negative
Aug	21	Declining	Negative
Sept	21	Declining	Positive

moving average and semi average methods have been used to investigate how the trend of drought has sequentially changed over the time period of 102 years (1908—2009) during June, July, August and September (monsoon months). Rainfall anomaly was calculated to show how rainfall in the 4 months (June, July, August and September) has deviated from the mean value of rainfall (Table 1). Geographical Information System (GIS) has been used to generate drought occurrence map of the district.

Results and Discussion

Frequency of meteorological drought in Purulia (1908-2009)

An attempt has been made to identify the frequency of meteorological drought in Purulia during June,

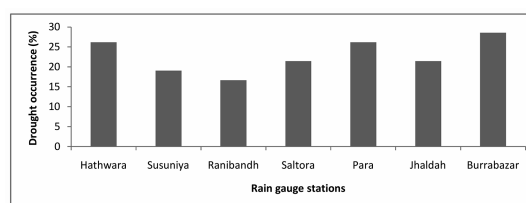


Fig. 3. Occurrences of meteorological drought in Purulia district of West Bengal.

July, August and September which are basically the monsoon months. In the month of June, the district experiences drought in 28 years out of last 102 years (1908-2009). The situation improves in the month of July when the district faces meteorological drought in 20 years from 1908 to 2009. Second half of monsoon (August and September) maintains a steady condition in terms of occurrence of meteorological drought. The frequency of meteorological drought is 21 for both the months (Fig.2).

Drought is an inevitable phenomenon in Purulia district of western tract of West Bengal vis a vis the undulating red and lateritic zone of West Bengal. Southwest monsoon is the main source of rainfall in Purulia like the other parts of the state from June to September. The analysis of meteorological drought

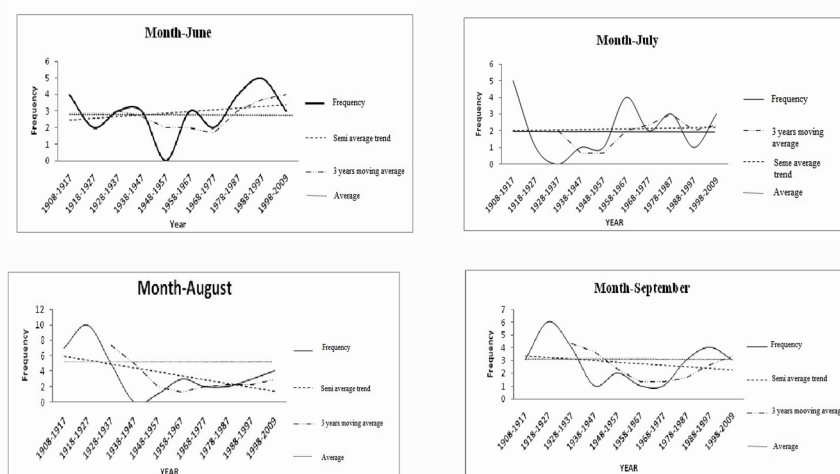


Fig. 4. Decadal trend of meteorological drought in Purulia (1908-2009).

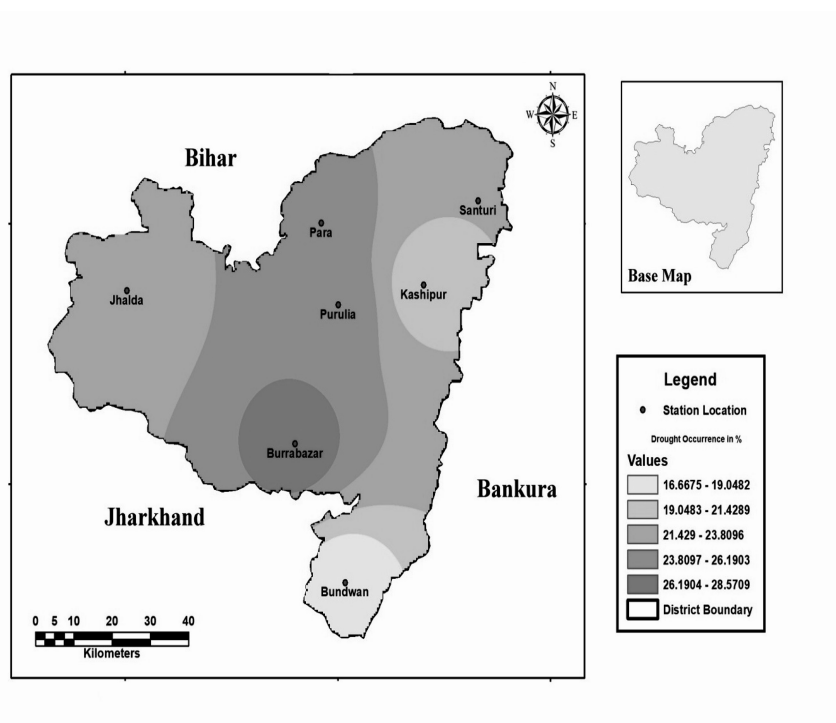


Fig. 5. Spatial extent of meteorological drought occurrence in Purulia during monsoon season (June–September).

in the last 102 years (1908—2009) brings out the fact that the frequency of meteorological drought is maximum for the month of June. This month experiences 28 years of meteorological drought during last 102 years. The decadal trend of meteorological drought shows a rising trend for the month of June during the span of 102 years (Fig. 3).

In the month of July, the frequency of meteorological drought declines to 20 out of last 102 years. Decadal trend of meteorological drought was found to be increasing in the month of July. August and September months of second half of monsoon exhibit a clear declining decadal trend of meteorological drought for the time period of last 102 years (Fig. 4).

Fig. 5 depicts the occurrence of drought in the different portions of Purulia district of West Bengal. The result shows that droughts pose highest risk to the middle and southern portion of the district.

Mitigation of water scarcity by scientific use of natural resource

For the successful growth of agriculture there is requirement of adequate water, favorable temperature regime, fertile soil and adequate sunshine. Chakraborty et al. (1990) discussed the impact of rainfall on cropping pattern in Hooghly district of West Bengal. It is true that this region is not favorable for rice cultivation throughout the year but to make the highly diversified soil, undulating terrain and harsh climate favorable for the cultivation of a wide range of crops some steps are to be taken which include : Water conservation during monsoon and its proper utilization. Checking of soil erosion by adopting proper techniques in the field. Scientific use of land according to their slope and undulation.

Nature has created some ideal conditions for the cultivation of different crops in different areas. But the use of natural resources depends on the technological knowhow of that area. Fig. 6 depicts the trend of

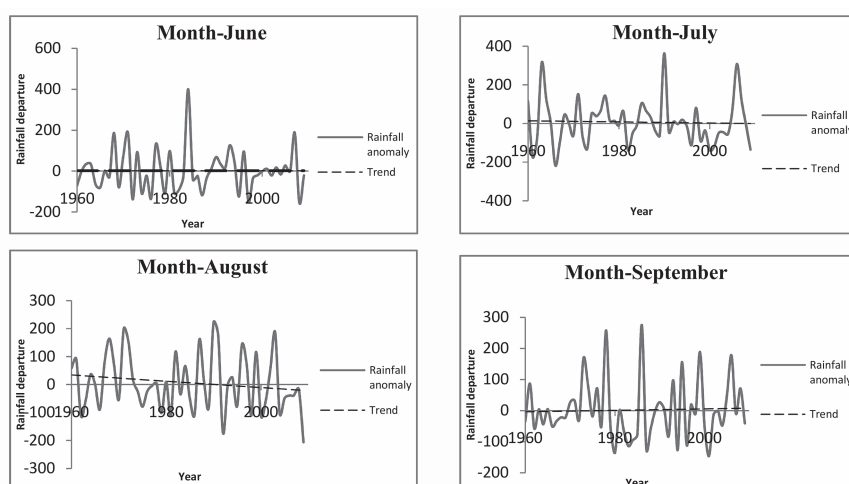


Fig. 6. Rainfall anomaly of Purulia during monsoon season.

rainfall anomaly from the year 1908 to 2009. Trend of rainfall anomaly is inversely proportional to the success in crop cultivation. In the mid monsoon months i.e. July and August, trend of rainfall anomaly is negative which is congenial for the successful growth of different types of crops. Mishra (2006) found that the area is not suitable for rice cultivation throughout the year but the climate and topographic condition of the area provide an ideal condition for cotton cultivation. so, it is very essential to provide climate data and information to the farming community so that they can take the necessary steps for the cultivation of crops. Otherwise there will be a huge gap between the estimated and actual productivity.

Conclusion

Detailed knowledge of rainfall of an area is helpful for the planning of crop calendar. Since drought is a natural phenomenon, its occurrence cannot be stopped. Rather the trend analysis of last 102 years indicates that the frequency is likely to increase in the coming years. It is, therefore, necessary to take appropriate long and short term measures to address this crisis. Mallick et al. (2014) identified promising, very early rice genotypes for the red and lateritic zone of West Bengal. At the very outset we should keep it in mind that West Bengal is fortunate in terms of getting rainfall from south west monsoon. The position of

monsoon axis gives torrential rainfall in the state. Purulia district of undulating red and lateritic zone receives considerable amount of rainfall throughout the season but after a short spell of heavy shower water moves as surface run off making top soil dry very soon. So, the main strategy of mitigation should be the scientific use of water resource.

Acknowledgement

The author is grateful to State Agriculture Department, Government of West Bengal and India Meteorological Department for providing valuable data of monsoon rainfall for the time period of 102 years. The author would also like to offer his deepest sense of gratitude to Dr. Ashis Kr. Paul (Professor, Dept. of Geography and EM, Vidyasagar University) for giving valuable guidance and supervision during his entire field study.

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