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RESEARCH ARTICLE

Assessing the Changes of Wetness Episodes in the State of Tripura by Using Standardised Precipitation Index

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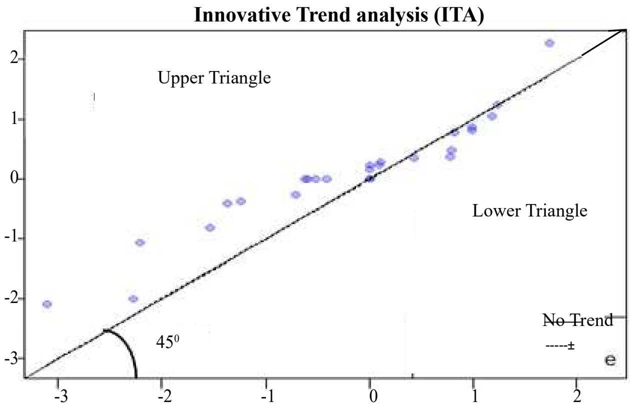
HIGHLIGHTS

- Identified wetness episodes in the state of Tripura by using Standardized Precipitation Index, which will help in monitoring floods for the region.
- An innovative trend analysis has been performed to observe the hypothetical significance trend in wetness episodes.
- Time series of rainfall data observed gradually decreasing since the last decade in the state of Tripura.

GRAPHICAL ABSTRACT



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ABSTRACT

Introduction: The amount of rainfall in a region affects a variety of socioeconomic activities, such as forestry, agriculture, and biodiversity; it also affects the management of water resources, industries, and tourism.

Context: It is commonly known that variations in rainfall patterns brought about by climate change may affect runoff and water availability. Significant flood may result in certain regions while recurrent drought may affect other regions.

Objectives: The aim of the study is to analyze the wetness episode over selected stations of Tripura using past precipitation data and an Innovative Trend Analysis (ITA) method.

Methods: In this study, the wetness episodes over three selected stations- Agartala (AG), Belonia (BL), and Dharmanagar (DN)-located in West Tripura, South Tripura, and North Tripura, respectively-are identified using the standardized precipitation index (SPI) based on rainfall. Additionally, using monthly rainfall data from 1971 to 2022, the SPI-1 month was used to identify the interval-arrival of wet episodes, which are characterized by three attributes: wetness, intensity, and duration. Also, an ITA has been performed to identify the trend and observed the significant trend.

Results and Discussion: The findings from the SPI-1 months analysis in Dharmanagar indicated that the most severe and (longest-lasting wet period) occurred for a duration of 13.23 from May 19996 to December 19996, spanning a total of 8 months (50-months from December 2009 to February 2014). While conducting ITA's of monthly time series, the results observed both significantly increasing (decreasing) trend in Agartala (Dharmanagar) except no trend found in December in Belonia rest the months observed significantly increasing trend (rising trend).

Significance: The research in this finding can be made available to provide data support to help the water resource managers in the wetness management in the state of Tripura, India.

One of the worst natural disasters in the world, floods annually have an impact on millions of people. The issue of flooding is getting worse due to climate change and human activities, resulting in not just property destruction but also enormous economic losses for entire towns (Latha *et al.,* 2024). For the evaluation and prevention of flood risk, dependable forecasting and mapping methods are crucial, drought also have same effect (Kokate *et al.* 2010; Golmohammadi, 2012). Flood modelling is a technique used to predict the effects of floods and mimic the behaviour of hydrological systems. In fact, topography is crucial in converting water surface heights into a flood map that identifies the essential locations that are at risk for a certain rainfall event (Endendijk *et al.,* 2023). This allows for the issuance of early warnings and the planning of mitigation strategies (Dympep *et al.,* 2016). In addition to being near rivers and streams, fisherman is engaged in fishing activities. The majority of them lack formal education and rely on their inherited knowledge and skills in fishing, which have been passed down through the centuries and the immense risk of flooding has an impact on their work and living (Singh and Haribhushan, 2022). Due to flash floods that bring dust into the water, persistent rains can contaminate drinking water supplies. As a result, rainwater collection is crucial as surface water cannot satisfy our needs and we must rely on groundwater (Singh *et al*., 2022). For effective water resources project planning, flood frequency prediction is a crucial responsibility Paras and Mathur, 2012. Flood frequency prediction for long return periods is crucial for appropriate planning when designing hydraulic infrastructure like dams, and spillways (Yan *et al.,* 2023). The method employed and the data accessibility have a major role in the accuracy of the flood frequency. Recently, many studied on flood analysis has been conducted on different region by many researchers and regional flood frequency analysis has been conducted over the world for estimation design effect of flood using various indices (Horsfall *et al.,* 2023; Hammami *et al.,* 2023; Hansana *et al.,* 2023) and in India flood analysis over various region namely by Jagtap and Medhe, (2022); Bhagawati, (2023); Miranda *et al*. 2023; etc. have done flood risk assessment over Nashik Tehsil; experimental analysis of women's life during flood pandemic over some areas of Assam; flood hydrograph; etc. Furthermore, in the event of a pandemic, a hazard alert recommendation is required (Jyothi *et al.,* 2010).

Similarly, north-eastern part of India like Tripura, Assam, Manipur Plain and Mizoram has witness vulnerable occurrence of flood every year (Bhattacharyya, 2005; Bhagawati, 2023), it erases many properties and life and many plain regions of India like Bihar, Kerela, Uttar Pradesh, West Bengal and so on, also get affected by flood due to intense monsoon rains and increases of water level of river (like Brahmaputra, Ganga etc.) (Kumari *et al.* 2018; Tripathy *et al.* 2023; etc.). In a recent case on 4th October, 2023, we have seen that state of Sikkim in north-east, India has also experienced a vulnerable flash flood due to continuous heavy rain and glacial lake outburst which was very unexperienced in that area where many lives and properties including arm personal has lose their life and an early alarming was predicted by Aggarwal *et al.,* 2017 and Sattar *et al*., 2021 for the region. Therefore, flood analysis is one of the crucial matters to understand and need to be study as earlier.

Looking forward to Tripura has natural disasters of all sizes and types, including as floods, bank erosion along rivers, droughts, hailstorms, and storms hit the state (Tripura) virtually every year. The occurrence of several of these catastrophes is largely caused by the geography, which is undulating and consisting of uplands and lowlands (hill and valley) (Bhattacharya, 2005). The catastrophes have been made worse by human activities such as the destruction of forests (Jhuming), the haphazard construction of highways, embankments, and urbanisation projects, among others (Sunanda et al. 2014; Goswami *et al*., 2023). Therefore, monitoring all the natural hazardous which hit the state (Tripura) an early study or analysis of flood and other naturally occurring hazardous is necessary.

In recent studied, Flood analysis over Tripura was proposed by Bhuyan and Borah, (2012) which based on L-moment method to overcome the vulnerable effect of flood on the region and Bhowmik *et al.,* 2017 state that West Tripura has adverse flood effect due to flash of two river Haor and Lohar Nala every year due to prolong heavy rain where more than 50 per cent of population and their belonging get affected and a Spatio-Temporal analysis of flood over West Tripura was conducted by Ganguly and De, (2015) in which they reveal highly increase in difference between surface height and flood level in the depressed zone of West Tripura.

In this studied, we have conducted a wetness/flood analysis over three sites of Tripura situated in the districts of Agartala (West), Belonia (South) and Dharmanagar (North Tripura), respectively for examining the flood condition and future status of flood occurrence using Standardized Precipitation Index (SPI) from 52 years of rainfall data for an early alarming of flood. SPI's is one of the easiest ways of finding wetness/ flood as well drought at different monthly time scale say 1-month, 2-months, etc., proposed by McKee *et al.,* 1993 and many researchers have used SPI for finding the wetness/flood indices (Du *et al.,* 2012; Fauzi *et al.,* 2017; etc.). The main objectives of this study are (a) to analyze the wetness/flood episode over selected station of Tripura and (b) to find out the trends by using Innovative Trend Analysis (ITA) method.

METHODOLOGY

The wetness analysis was conducted over three district of Tripura, North-East-India, namely Dharmanagar (North Tripura), Belonia (South Tripura) and Agartala (West Tripura) shown in Fig.1. The total geographical area of the region about 10,491.69 Sq. Km along with international boundary with Bangladesh and Myanmar. The state is located between latitudes of 22°57′N to 24°33′ N and longitudes of 91°10′E to 92°20′E. It has different climate due to irregular and inter-hill valleys plains. It received average rainfall is about 2107 mm which increase between south-west to the north-west direction and has average temperature of 26.43ºC. The Geographical area of North Tripura district is 1422.19 Sq. Km and located between 24° 19′North to 92° 01′ East. The district mostly is hilly region and share boundary with Mizoram and Assam along international boundary with Bangladesh. Dharmangar has received the annual average rainfall of 2632 mm (1971-2022). The south district is having total geographical area of 1514.322 Sq. Km and located between 23.248976 North to 91.463005 East. It received average annual rainfall is about 2000 mm and the temperature may varies between of 35.23°C (maximum) to 7.43°C (minimum). While West Tripura has the geographical area of 3544 Sq.km2, located between latitude of 23° 16' N to 24° 14' N and longitude of 91o 09' E to 91o47' E. It received annual average rainfall of 2245 mm (1971-2022).

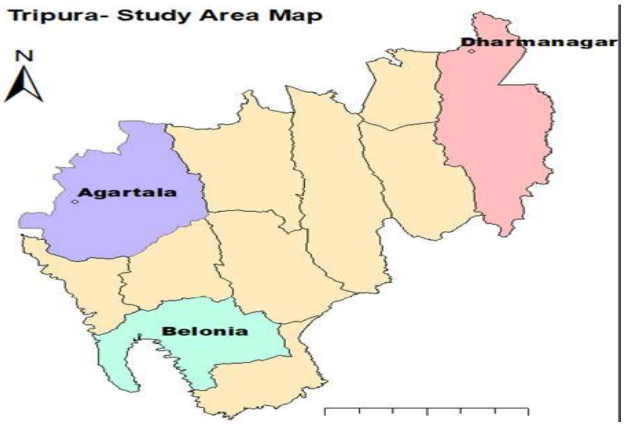


Fig. 1. Map of the study area

In this study, meteorological flood indicators from three selected Tripura districts were analysed to identify wetness episodes using monthly precipitation data from 1971 to 2022 using Standardised Precipitation Index (SPI) indices. SPI readings that are positive denote higher amount of precipitation (wet) resulting to flood, while those that are negative denote lower amount (dry) resulting to drought. The SPI may be used to monitor wet periods as well because it normalises SPI values, making it possible to depict both drier and wetter climates in an equivalent manner. The drier or wetter periods resulting from the SPI were defined by McKee et al. (1993) and others using the classification system in the SPI value, as seen in Table 1. Probability of novel trend analysis (Innovative Trend) were also used to identify changes in wetness from the past period as well as future trend. Each of the flood indices is briefly described below, along with a flowchart illustration, in Fig. 2.

Table 1. Classification of wetness

Wetness Characterization	SPI values
Extremely wet	2.00 and above
Severely wet	1.50 to 1.99
Moderately wet	1.00 to 1.49

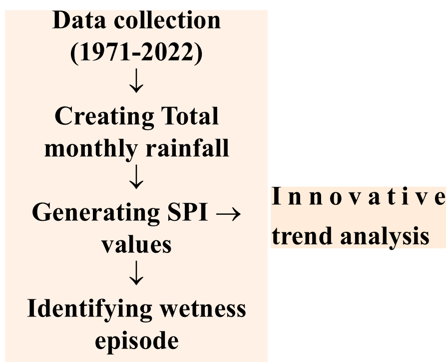


Fig. 2: Flow chart of meteorological wetness episode

Standardised Precipitation Index: An example of a Flood Index (FI) that has been used by numerous researchers utilising SPI in different parts of the world. It can be approximated over a range of timescales, starting from one month to twelve months, and encompassing SPI-1, SPI-2,….,SPI-12, and other durations that characterise different wetness situations. Whatever rain gauge station's SPI is established using historical long-term precipitation data. The formulas and other information can be found in the publication by McKee *et al.* (1993), which estimates the SPI values using the SPI-1 time scale in this work. The publication drawn by McKee *et al.* (1993) has done on the basis of drought frequency and duration of time frame. But due to the simplicity many researchers were extensively adopting the used of SPI in their studies base flood analysis at numerous time scale (SPI-1, SPI-2, …., SPI-12) (Seiler *et al.,* 2002; Karavitis *et al.,* 2011). The short-term scale (say SPI-1) demonstrates the presence of moisture in the short and medium term. The longest-term scale shows evidence of long-term precipitation prior to the occurrence of a flood (Fauzi *et al.,* 2017; Guerreiro *et al.,* 2008). The SPI-1 analysis is particularly expressive of the significant historic flood episodes and strong rains leading to extreme, moderate and severe wet (Table 3) that happened in monsoon. SPI serves as a marker for meteorological drought, which is mostly brought on by a lack of precipitation. Because of this, its computation necessitates a minimum 30-year consecutive data record duration (Li *et al.,* 2014). It has been discovered that the SPI is useful for predicting meteorological and hydrological floods, including flash floods, groundwater floods, and dam bursts (Olanrewaju and Reddy, 2022). The climatic type can also be classified as either exceedingly dry or excessively wet using the SPI. SPI has been successfully applied in many regions of the world due to its dependability and ability to handle floods over a variety of timescales (Du *et al.,* 2012; Kumari *et al.* 2018; Miranda *et al.,* 2023). After the generation of SPI values, the wetness episode are severity, duration and wetness arrival time were defined to observed occurrence of maximum likelihood of wetness from SPI values. Table 1. presents the classification of the wetness (flood) into three categories: moderate, severe, and extreme (range from 1 to 2 and above).

Innovative Trend Analysis of Trend Slope (ITA's): Sen (2012) created the non-parametric method known as ITA, which was used to identify patterns that changed across several datasets. Unlike the most popular trend identification methods, such as the Mann-Kendal test, the ITA method does not require assumptions such as serial correlation in the dataset, normal distribution of the variables, and number of variables (Singh *et al.,* 2021). Most of the recent studies of trend analysis are being employed into innovative trend analysis (Cui *et al.,* 2017; Akçay *et al.,* 2022; Hussain *et al.,* 2022) can be used for both climatic and non-climatic data and are highly adoptable. The classical and innovative trend analysis (ITA) was conducted by Birpınar *et al.* (2023) for analysing annual precipitation data methodology. According to a homogeneity study of meteorological data by Körük *et al.* (2023) at a 99 per cent confidence interval, ITA is more sensitive than conventional trend analysis. In-depth and flexible analysis using various statistical parameters is made possible by innovative methods; trend identification is found to be more successful with graphical innovative trend analysis methods than with Mann Kendall methods, and the results of these methods have much higher visual inspection and linguistic interpretation possibilities. The time series data set is arranged in ascending order, and the total dataset is divided into two equal pieces. The two series were plotted using the Cartesian coordinate system, where the first half of the series was represented by an abscissa (x-axis) and the second part by an ordinate (y-axis) (Caloiero, 2018). In the event where the data sets are accumulated along the 1:1 line at 45°, there is no trend. Data sets that are dispersed over the upper triangle will show a rising trend, while data sets that are gathered in the lower triangle will show a descending trend (Fig.3). The positive (negative) values of trend slopes will

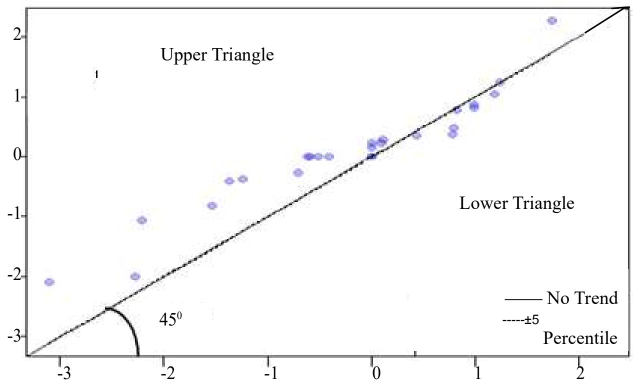


Fig. 3. Graphical representation of Innovative Trend analysis (ITA)

(Note: Marks inside the triangles are trend values) indicate increasing (decreasing) trend in the SPI values. ITA is defined at critical value of 1 per cent, 5 per cent, and 10 per cent significance level (SL) of trend slope. The trend is accepted when Trend slope $(T_s) > (UCL/LCL)_{(1-SL)}$.

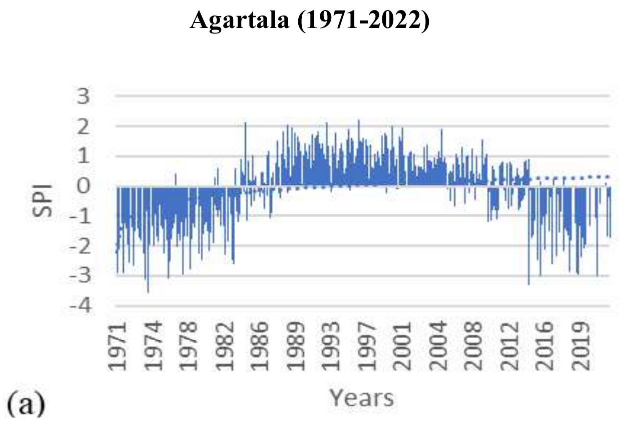
The ITA of trend slope (T_s) can be computed by:

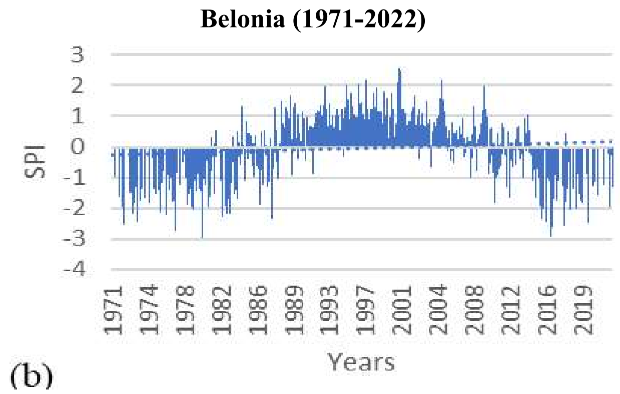
$$Ts = \frac{2(H_2 - H_1)}{n}$$

Where T_s is the trend slope, n is the number of data sets, H_1 is the first half of the data series, H_2 is the second half data series, UCL is upper confident limit, LCL is lower confident limit and so on.

RESULTS

Standardized Precipitation Index: After analysis of SPI-1, the yearly time series plot reveals that there was initially low rainfall (Agartala, Belonia and Dharmanagar) say from 1971 to 1978 and from 1979 to 2012 there was high rainfall occurred and then gradually decreasing since now (2013-2022) as seen in Fig.4. But as we know the rainfall is not permanent to occurred for whole year, it has a variation by the time, so when we see in monthly time scale there is huge rainfall in some months characterizing by moderate wet, very wet and extreme wet.





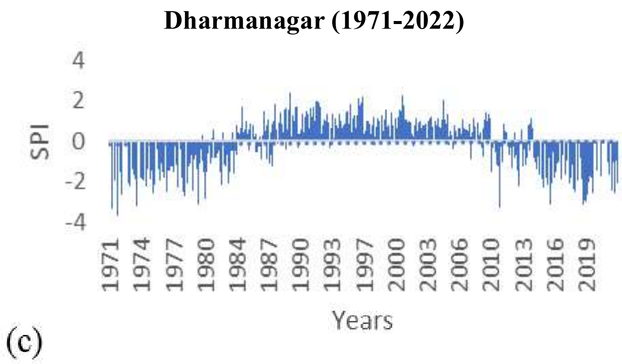
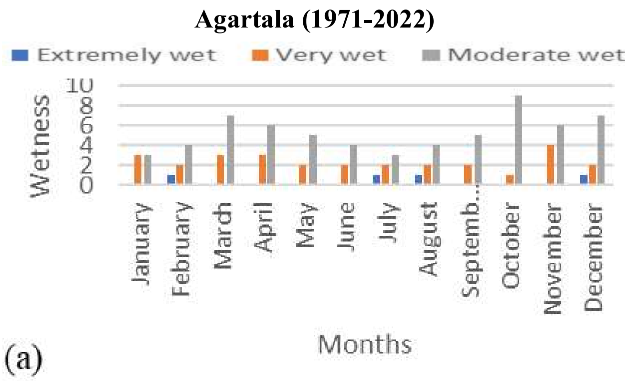
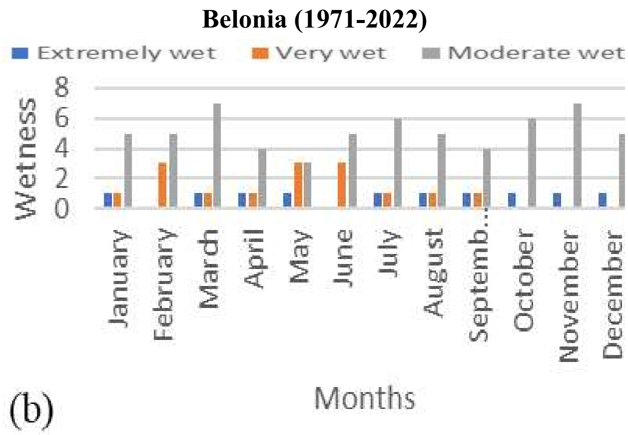


Fig. 4. Time series plot of SPI (a) Agartala, (b) Belonia and (c) Dharmanagar





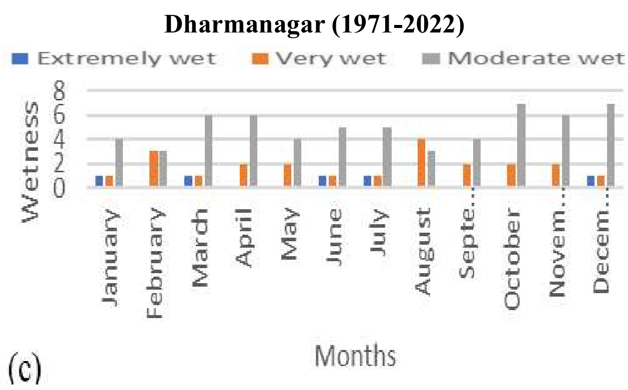


Fig. 5. Graph show Wetness Characteristics of (a) Agartala, (b) Belonia and (c) Dharmanagar

Table 2. Wetness event in monthly time series

	Wetness Characteristics								
	1	2	3	1	2	3	1	2	3
	Agartala			Belonia			Dharmanagar		
January	3	3	0	5	1	1	4	1	1
February	4	2	1	5	3	0	3	3	0
March	7	3	0	7	1	1	6	1	1
April	6	3	0	4	1	1	6	2	0
May	5	2	0	3	3	1	4	2	0
June	4	2	0	5	3	0	5	1	1
July	3	2	1	6	1	1	5	1	1
August	4	2	1	5	1	1	3	4	0
September	5	2	0	4	1	1	4	2	0
October	9	1	0	6	0	1	7	2	0
November	6	4	0	7	0	1	6	2	0
December	7	2	1	5	0	1	7	1	1

Note: 1-Moderate wet, 2. Very wet. 3.Extreme wet

In Agartala (Fig. 5a), all the months showed moderate and very wet while extreme wet observed in only February, July, August, and December. The month of October observed the highest moderate rainfall (moderate wet) for the period of 9-months (Table 2). While Belonia (Fig. 5b) observed highest moderate wet in March (November) and has observed of extreme wet almost all the month except February (June). Dharmanagar (Fig. 5c) has observed highest moderate wet in October (December) and very wet normally observed in all months and extreme wet reveal in few months (Table 2), respectively.

Estimation of maximum wetness episode - Severity, Duration and Interval: The wetness episode observed in Agartala reveal the maximum severity of 9.8 for the duration of 7 months i.e., September-March (2000-2001) and wetness interval period of 19 months i.e., April to October (2005-2006). Station Belonia (South Tripura) observed the maximum severity of 14.2 for the duration of 7 months i.e., September to March (2000-2001) and observed the highest arrival interval time among the three station of 52 months i.e., November to February (2009-2014) while station Dharmanagar reveal the highest severity wetness of 13.2 with 8 months duration May to December (1996) and highest arrival interval time of 50 months i.e., January-2010 to February-2014, respectively (Table 3).

Table 3. Highest drought severity, duration, and interval occurrence

Wetness Attributes	Agartala	(Year & Months)	Belonia	(Year & Months)	Dharmanagar	(Year & Months)
Wetness Severity	9.8	2000-2001 Sept-Mar	14.2	2000-2001 Sept-Mar	13.2	1996 Mar-Dec
Wetness Duration (month)	7		7		8	
Wetness Interval (month)	19	2005-2006 April-2006	52	2005-2006 April-2006	50	2010-2014 Jan-Feb

Result of ITA-Trend Slope: The ITA-Trend slope of SPI-1 was tested in prior to three statistical confident limits (CL) (90%, 95% & 99%) as shown in Table 4. In which Agartala observed the significantly decreasing trend slope of -0.009 in July at 99 per cent CL and in August no significantly decreasing trend has occurred while all other months observed significantly increasing trend slope (rising trend) at 99 per cent CL as shown in Table 4.

Belonia observed most of all significantly increasing trend slopes at 99 per cent CL in January (0.020), February (0.016), March (0.012), April (0.027), May (0.011), June (0.013), August (0.005), October (0.012) and November (0.010) whereas only July, September and December has no significant trend observed (shown in Table 4). Now illustrating the study of Dharmanagar we have observed both positive and negative significant trend in which March (-0.005), September (-0.004), November (-0.007) and December (-0.010) observed significantly decreasing trend slope at 99 per cent CL and August (-0.004) at 95 per cent CL, respectively, whereas significantly increasing trend slope observed in January, April and October at 99 per cent CL and June and July at 95 per cent CL and no significant trend slope observed in the month of February and May as shown in Table 4 and the graph plotted is shown in Fig. 8. Significantly increasing trend indicating the possibility of getting wetness periods (rain) and decreasing trend slope indicating no wetness periods (no rain), respectively. As revealed by the results we have observed Agartala (West Tripura) and Belonia (South Tripura) will received significant amount of rain as the trend is in significantly increasing since some of the months. While Dharmanagar (North Tripura) will have a little or moderate rain as most of the months showing significantly decreasing trend in monthly trend analysis.

DISCUSSION

The SPI was used first employed by McKee et al (1993) to identified drought frequency. Due to its (SPI) simplicity the used of SPI is very popular used by many

Table 4. Trend analysis using an Innovative Trend Slope (ITA's)

Time	Trend slope	Cinfident limit Upper limit (+) Lower limit (-) 90%(*)	95%(**)	99%(***)	Time	Trend slope	Cinfident limit Upper limit (+) Lower limit (-) 90%(*)	95%(**)	99%(***)	Time	Trend slope	Cinfident limit Upper limit (+) Lower limit (-) 90%(*)	95%(**)	99%(***)
		Agartala					Belonia					Dharmanagar		
Jan	0.022***	±0.003	±0.004	±0.005	Jan	0.020***	±0.003	±0.003	±0.004	Jan	0.011***	±0.003	±0.003	±0.004
Feb	0.010***	±0.004	±0.005	±0.006	Feb	0.016***	±0.003	±0.004	±0.005	Feb	0.002	±0.004	±0.005	±0.006
Mar	0.019***	±0.003	±0.004	±0.005	Mar	0.012***	±0.002	±0.002	±0.003	Mar	-0.005***	±0.002	±0.003	±0.003
Apr	0.009***	±0.003	±0.004	±0.005	Apr	0.027***	±0.003	±0.003	±0.004	Apr	0.014***	±0.004	±0.005	±0.006
May	0.018***	±0.001	±0.002	±0.002	May	0.011***	±0.003	±0.004	±0.005	May	-0.002	±0.003	±0.003	±0.004
Jun	0.010***	±0.005	±0.006	±0.008	Jun	0.013***	±0.004	±0.005	±0.006	Jun	0.007**	±0.004	±0.005	±0.007
Jul	-0.009***	±0.004	±0.005	±0.006	Jul	0.001	±0.002	±0.002	±0.003	Jul	0.006**	±0.004	±0.005	±0.007
Aug	-0.011	±0.003	±0.004	±0.005	Aug	0.005***	±0.002	±0.002	±0.003	Aug	-0.004**	±0.003	±0.003	±0.004
Sep	0.017***	±0.002	±0.003	±0.003	Sep	0.001	±0.002	±0.003	±0.003	Sep	-0.004***	±0.002	±0.002	±0.003
Oct	0.018***	±0.003	±0.004	±0.005	Oct	0.012***	±0.003	±0.004	±0.005	Oct	0.007***	±0.002	±0.003	±0.004
Nov	0.005***	±0.002	±0.003	±0.003	Nov	0.010***	±0.003	±0.004	±0.005	Nov	-0.007***	±0.003	±0.003	±0.005
Dec	0.011***	±0.002	±0.003	±0.003	Dec	0.000	±0.003	±0.003	±0.004	Dec	-0.010***	±0.002	±0.003	±0.004

researchers in different regions for identifying flood (Seiler *et al.,* 2001; Karavitis *et al.,* 2011). The used of SPI in this study observed different characteristics of wet and wetness episodes. It is very identical to analysis wet as the region is very critical in flood occurrences every year (Bhuyan and Borah, 2012), many properties, household and populations get destructed due to the vulnerable effect of flood. The region faced main mainly flash flood due to prolong rainfall in the season. And there is sudden change in increasing the flood level from the surface. The occurrence of flash flood in the region is mainly due to the undulated surface and poor drainage systems. The result of flood is getting worse in every region due to sudden climate change, human activities, destruction of natural resources, etc. One must be aware the importance of flood monitoring in the region of facing vulnerable flood. In recent studies of Tripura's West district, there were three consecutive floods from 1993 to 2014, which were statistically analysed in terms of their temporal and geographical variations (Ganguly and De, 2015). Another study by Bhowmik *et al.*, 2017, the river Haora and the Sonai Gang are prone to flooding, flooding is a regular occurrence. Throughout the district, flooding affects around 60 per cent of the land and 55 per cent of the population. The intensity and duration of rainfall shown very high in every monsoon, which is the main region of flood occurrence in Tripura. East and West Tripura was observed relatively high severe flood with longest duration of rainfall commencing from September to March during 2000-2001 which was also fall in monsoon season. The potential of the ITA approach to examine trends in low, median, and high values of hydrometeorological timeseries with graphical representation has been noted by Ashraf *et al*. 2023 as a trustworthy and effective tool. Although the study was proposed to analysis drought but can be effectively used for monitoring trend analysis in any meteorological study. So, identifying of wetness from the past the data can be helpful in monitoring future flood. Also, the changes in climate can be monitor and identified by employing time series analysing from the past data. Hence, an innovative trend used in this study was shown helpful, identifying the statistical significance trend in SPI present in time series.

CONCLUSION

Based on monthly innovation trend analysis of SPI-1, the results show that Agartala (West Tripura) observed all significantly increasing trend at 99 per cent CL, except in July and August, where decreasing trend recorded. Belonia (South Tripura) observed the most significant increasing trend at 99 per cent CL, except in July, September and December no trend recoded. Dharmanagar (North Tripura) observed both significantly increasing (decreasing) trend over monthly time scale (Table. 4). So, there is possibility of getting wetness (flood) in West and South Tripura as revealed by the study. According to Ganguly and De's (2015) recent study, flooding in West Tripura is mostly caused by the abrupt increase in river banks during the monsoon season as a result of persistent rain. These two districts (West & South-Tripura) have comparatively high levels of moisture and eventually became a flood-prone area. The state's policy makers need to be informed about the possibility of flooding and take the appropriate action. Floods destroy a lot of things, like property loss, submerging lower land areas, and landside in river banks. The temporal variability of floods is mostly explained by precipitation; floods that occur often cause the greatest amount of damage to property and suffering to people. It is crucial and required to be able to quantify the damages caused by flood occurrences in order to assess alternative flood management strategies for the future. Once a flood begins, it is impossible to stop. Maps of flood danger zones are crucial in this regard. Any programme for regional action aimed at controlling flooding might begin with hazard mapping. One of the best methods to control floods and reduce damage caused by them is non-structural flood management. If policymakers use scientific methods, flooding can be controlled and harm in flood-prone areas may be minimised. Thus, studying the wetness period can aid in tracking the escalation of floods in the area and their potential recurrence in the future. The results of this study will also assist state policy makers in determining the frequency of floods and appropriate mitigation strategies.

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Appendix: Supplementary data: The supplementary data, table in jpeg format for online visibility to the readers are submitted as an appendix.

Authors contribution: First author conceptualized, operationalized, interpreted the data and visualized data for creating the original draft. Second author participated in contributing to the text and the content of the manuscript, including revisions and edits. Third author contributed to writing – review and editing. Fourth author helped in interpreting the data, theme identification and development, and debriefing. All authors of this paper have directly participated in this study's writing, editing, planning, analysis, and execution.

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