RAINFALL TREND DETECTION – A REVIEW

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Abstract: This paper aims to review the rainfall trend and different approaches for trend detection. Non – parametric Mann Kendall test were used for trend analysis and Sen's slope is helpful for finding magnitude. The different review shows the variation of rainfall all over the world and also discuss the auto – correlation effect in hydrological data. It was observed that rainfall trend is vary from location and also depend on other factor like topography of region.

Index Terms - Rainfall, Trend analysis, Mann – Kendall test, Sen's slope, Modified Mann – Kendall Test.

Introduction

 Rainfall is important hydro-metrological parameter, which has played a vital role in hydrological cycle and change in pattern directly affect the water resources of specific region (Padhiary 2018). The rainfall data can be analyzed in different forms like trend analysis, frequency analysis and extreme event analysis.

 Trend analysis is process to determine the spatial – temporal variation for different hydro – metrological parameters (Kaamun 2019, Jaiswal 2018). Trend show a monotonic or step trend. Monotonic trend shows a gradual change over the time and step trend shows abrupt change at a point (Donald 2011). The monthly 30 years data utilized for monthly and seasonal trend detection (Tank 2021). The rainfall trend analysis is helpful for detection of future drought and flood prone areas, help for manage water resources and also help for manage agriculture field according to monsoon trend (Jaiswal, 2021). Understanding rainfall trend is essential for optimization of water resources (Herath 2004). Future trend detection is helpful for strategic water resources planning and management and also helpful for hydrological modelling purpose (Jaiswal 2021, Kumar 2021).

 The various studies have useful to understand the rainfall trend in our country. These studies have analyzed trends on regional scale, individual station and also review the trend detection methods.

1. APPROACHES FOR TREND DETECTION –
I. Statistical approach without considering auto correlation effect

Statistical approach includes parametric and non-parametric test. Slope based test (Linear Regression & Sen's slope estimator) in parametric and rank based test (Mann – Kendall and Spearman correlation) in non-parametric for trend detection (Sonali 2013).

II. Statistical approach with considering auto correlation/ Serial correlation effect

Consider auto correlation effect in hydrological data because due to improper assumption of independent observation could result in error. Rainfall data often show autocorrelation, as high values tend to follow high values and low values follow low values. The serial correlation effect removed using Modified Mann – Kendall test (Ahmad 2015, Hamed 1997).

III. Least squares linear regression test

It is a parametric test and applied with normality check. This test is helpful for finding out the linear trend in time series (Sonali 2013).

IV. Mann – Kendall test

Mann -Kendall is a rank based non parametric test. This test is helpful for finding out of monotonic trend (Kendall 1975, Mann 1945). The test is used to detect trends & spatial variation in hydroclimatic series i.e. meteorological and hydrological time series (Silvio 2020).

V. Sen's slope estimator

Sen's slope estimator has been used in hydro-meteorological time series for estimation of magnitude of slope or rate of change (Sen 1968). The Sen's slope estimator is a non-parametric, linear slope estimator that works most effectively for monotonic data.

2. LITERATURE REVIEW

Hamed & Rao (1998), analyzed the auto correlation effect in hydrological data. When auto correlation effect is present in data then Mann – Kendall test shows a large error compare to significance level. Modified Mann Kendall test is used for removal of auto correlation effect.

Ramesh & Goswami (2007), studied about the shrinkage of Indian summer monsoon. They used 53 years daily gridded rainfall data for trend analysis. The decreasing trend show in early as well as late monsoon period and also a rainy day decreases in India.

Nyatuame (2014), analyzed the rainfall trend in Ghana using linear regression analysis (statistical analysis). The mean monthly rainfall showed mixed upward and downward trend, so it was indicated that there was weak correlation between rain and monthly rainfall.

Yadav et al. (2014), done trend analysis by Mann Kendall test for both precipitation and temperature of Uttarakhand. Mann – Kendall test and Sen's slope estimator is used for finding the trend and slope magnitude. Decreasing trend show in January that affect Rabi crop and also pre monsoon trend decreases that affect kharif crop.

Jaiswal et al. (2015), analyzed the change point and trend detection in climate parameters of Raipur. The method used for change point detection are Pettitt's test, Von Neumann ratio test, Buishand's range test while includes non-parametric linear regression and Mann Kendall test applied for trend analysis.

Sharma (2017), analyzed rainfall trend and variability using rectilinear regression analysis (statistical analysis) in Punjab. Monthly and annual rainfall shows the decreasing trend.

Li et al. (2018), analyzed precipitation pattern using four datasets – gridded data, gauge observation, reanalysis data, high resolution regional climate data in western Himalaya. The variations were large in July & august and high elevation area. It was observed that summer is wetter and winter were drier.

Padhiary et al. (2018), observed rainfall trend in Brahmani river basin using Mann Kendall test. The annual rainfall and temperature show increasing trend.

Athwani & Pandey (2020), analyzed the rainfall trend in Uttar Pradesh and comparison of this trend with other state. The trend analysis is done through time series analysis of rainfall for a 50 years dataset. Non parametric Mann – Whitney U test is used for trend detection.

Caloriero et al. (2021), analyzed rainfall trend using gridded rainfall data over south Italy. This data is useful for analysis of monthly, seasonal and annual rainfall series with Mann Kendall and Theil Sen estimation. Decreasing trend shows for annual and winter and increasing trend for summer.

Namdev & Madan (2021), studied about rainfall variation in Parabhani district. Mean monthly pre cipitation data for 16 year is used for to identify the amount of variability. This study is helpful for future development project that depend on rainfall variability (surface and ground water resources).

3. CONCLUSION

In this review paper discuss the variation in rainfall. The change of rainfall trend affects the social and economic life across the country and also affect crop pattern. Mann Kendall and Sen's slope is helpful for know about the drought and flood pattern of region. Analyzing rainfall pattern helpful for understanding rainfall pattern crop planning and water availability of region.

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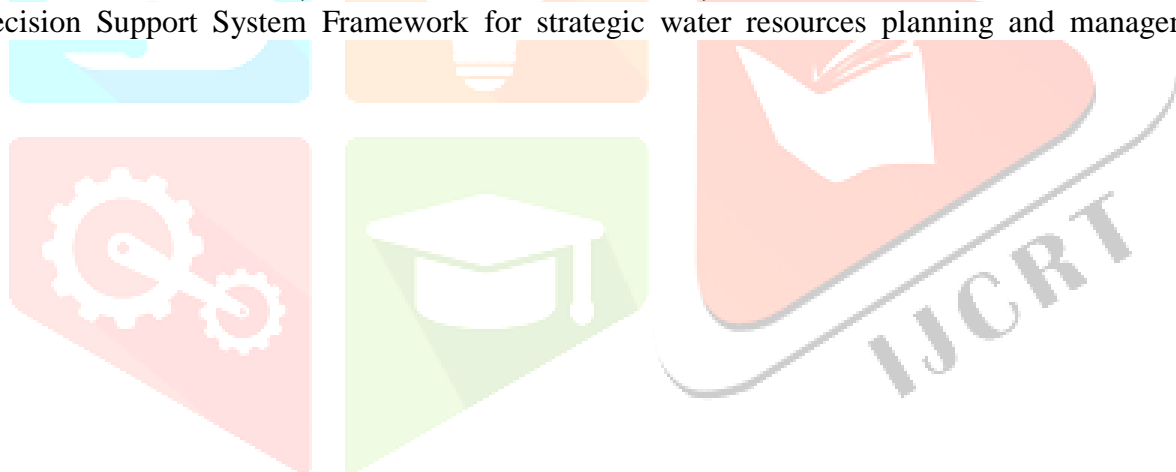
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