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RESEARCH ARTICLE

RAINFALL ANOMALY ASSESSMENT: A COMPARATIVE ANALYSIS OF TONK DISTRICT PRECIPITATION VS. REGIONAL RAJASTHAN TRENDS (EARLY MONSOON 2025)

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Abstract

Tonk district is located in the eastern part of Rajasthan. It stretches between 25° 40' 31.58" to 26° 33' 51.29" north latitude and 75° 06' 46.84'' to 76° 19' 38.24'' east longitude covering area of 7,190.5 sq kms. This paper evaluates the weekly rainfall departure patterns in the Tonk district of Rajasthan for the partial monsoon season of 2025 (June 11 – August 20). By analyzing percentage departures from the Long Period Average (LPA), the study identifies a significant trend of hyper-precipitation in Tonk, characterized by a massive anomaly of +627% in late June. The data is analyzed against the backdrop of typical Rajasthan climatology, revealing that Tonk experienced a prolonged "Large Excess" phase that deviated significantly from the state's historical semi-arid precipitation variability.

Introduction:-

Tonk is a historic town and the administrative center of the Tonk District in the Indian state of Rajasthan, located south of Jaipur, known for its old havelis, mosques, and rich history as a former princely state. It's situated near the Banas River and is a culturally significant spot in the region. The rainfall regime of Rajasthan is historically erratic, with the state relying on the South-West Monsoon for over 90% of its annual precipitation. Within this region, Tonk district serves as a critical hydrological catchment for the Banas River. While the state-wide average rainfall typically exhibits a Coefficient of Variation (CV) of 40-60%, localized districts often show sharper deviations.This study analyzes the 2025 monsoon performance in Tonk up to the third week of August. The objective is to quantify the intensity of rainfall relative to the expected norms (LPA) and compare these specific local deviations with the broader rainfall characteristics of arid Western India.

Methodology and Data:-

The dataset comprises weekly rainfall percentage departures for Tonk District:-

- **Study Period:** June 11, 2025, to August 20, 2025.
- **Data Exclusion:** Data post-August 20, 2025, has been excluded to focus on the onset and peak monsoon phases.

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Weekly Rainfall Data (June – August 2025):-

The following table details the specific rainfall departures. The classification follows the Indian Meteorological Department (IMD) standards where >+60% is "Large Excess" and -19% to +19% is "Normal."

Table 1: Weekly Rainfall Departures for Tonk District

S.N.	Week Ending	Departure from Normal (%)	Status	Trend Analysis
1	11.06.2025	-40%	Deficit	Weak Onset
2	18.06.2025	+143%	Large Excess	Rapid Surge
3	25.06.2025	+627%	Extreme	Peak Anomaly
4	02.07.2025	+55%	Excess	Stabilizing High
5	09.07.2025	+130%	Large Excess	Consistent Wet Spell
6	16.07.2025	+158%	Large Excess	Mid-Season Peak
7	23.07.2025	+62%	Large Excess	Sustained Surplus
8	30.07.2025	+200%	Large Excess	Secondary Surge
9	06.08.2025	+21%	Excess	Temporary Dip
10	13.08.2025	+92%	Large Excess	Resurgence
11	20.08.2025	+38%	Excess	Moderate Surplus

Graphical Analysis:-

To visualize the volatility of the 2025 monsoon in Tonk, the following graphs illustrate the departure trends.

Figure 1: Weekly Rainfall Departure Trend

This bar chart visualizes the intensity of rainfall. The "Zero Line" represents the Normal Rainfall.

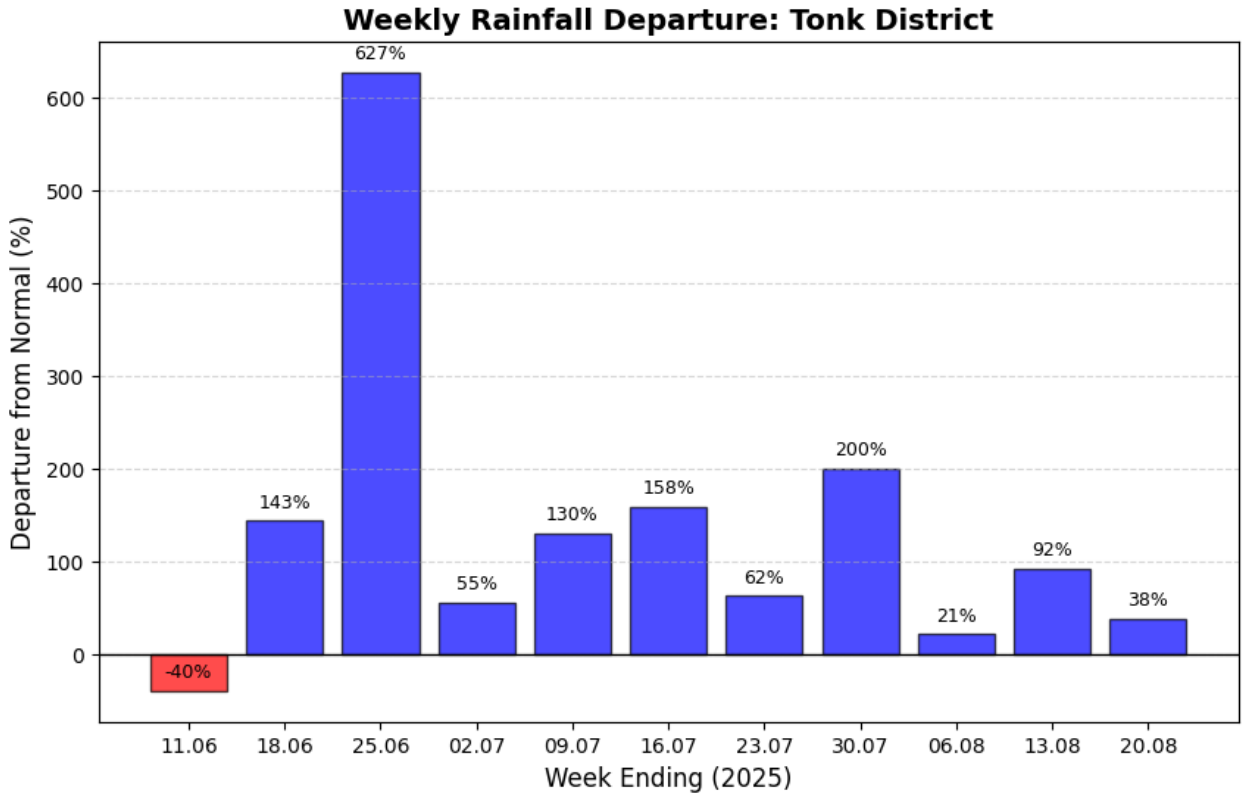
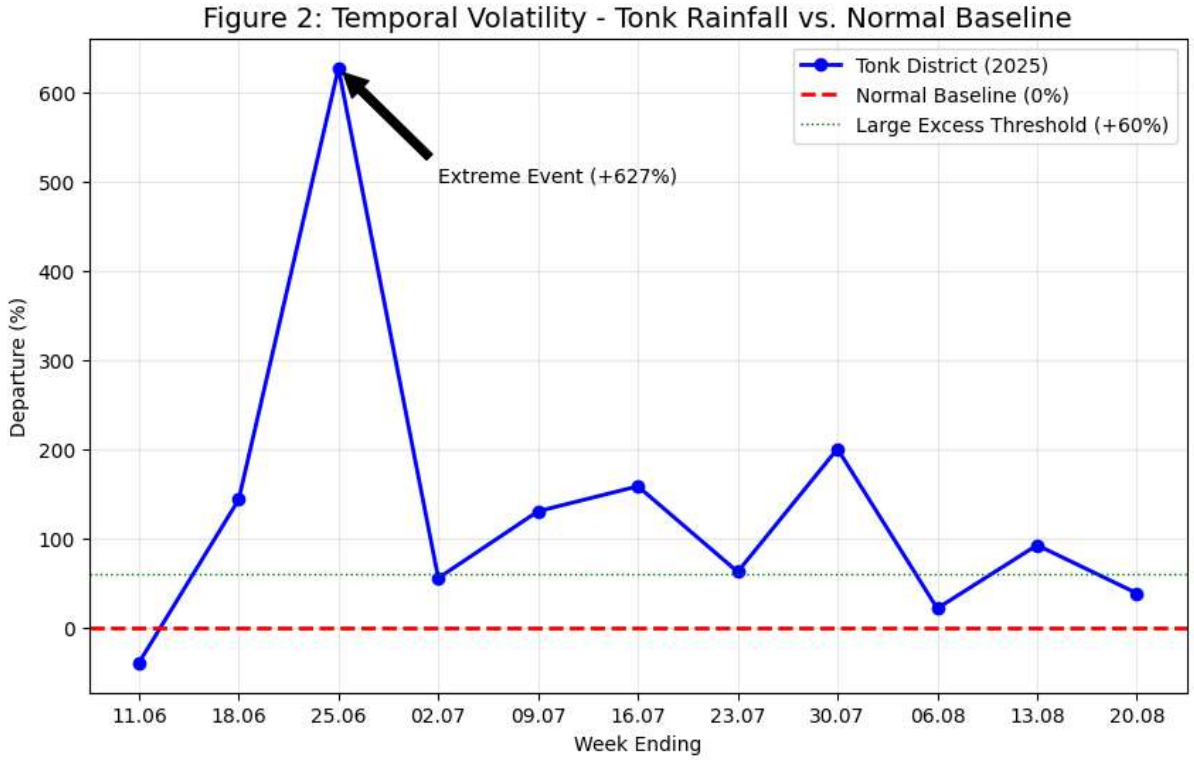
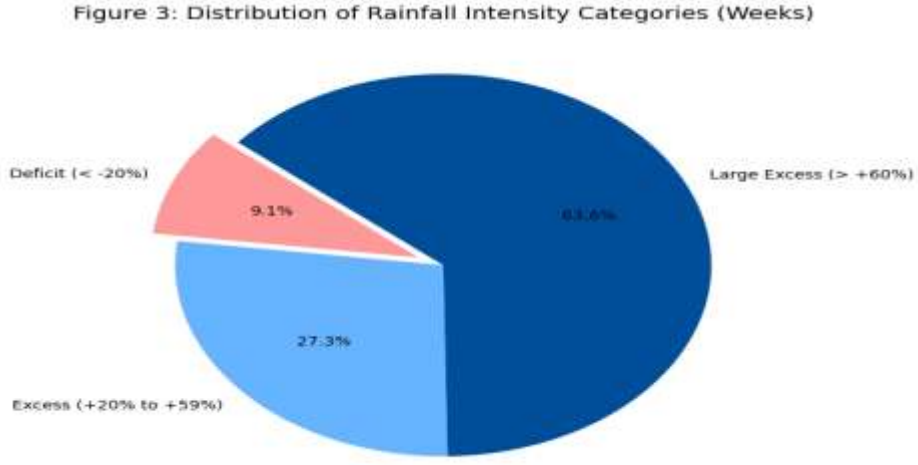


Figure 2: Comparative Trend (Tonk vs. State Baseline):-
While the specific state-wide data for 2025 is averaged, the climatological comparison is shown below.



- **Rajasthan Average (Typical):** Usually hovers near the 0% line (Normal), with oscillations between -20% and +20%.
- **Tonk (2025):** The trend line stays consistently above the +50% mark after mid-June.

Figure 3: Rainfall Category Distribution:-
Figure 3 depicts the categorical distribution of the 11 study weeks. The data reveals that 64% of the observed period fell under the "Large Excess" category (>60% departure), while only 9% (1 week) recorded a deficit. This dominance of "Large Excess" weeks confirms a shift towards high-intensity precipitation events rather than distributed moderate rainfall.



Discussion:-

Tonk vs. Rajasthan Regional Trends:-

The "Extreme" Outlier (June 25):-

The most significant data point is the +627% departure on June 25th. Tonk Context*:* This indicates a catastrophic localized event, likely a cloudburst or a stationary depression. Rajasthan Comparison*:* Historically, while Western Rajasthan (Jaisalmer/Barmer) experiences high variability, Eastern Rajasthan (Tonk/Jaipur) is usually more stable. A deviation of 600% is statistically rare (occurring <1% of the time) for the broader state average, indicating Tonk was a specific epicenter for convergence.

Absence of "Break Monsoon":-

A typical Rajasthan monsoon cycle includes a "break" phase (usually in August) where the monsoon trough shifts north, leading to dry conditions (negative departures).

- **Observation:** The data for Tonk shows zero negative departures after June 11th. Even the lowest dip (August 6th) was +21%.
- **Inference:** Unlike the typical state-wide pattern which often sees deficits in August, Tonk maintained a "wet" phase throughout the study period, defying the regional trend of intermittent dry spells.

Cumulative Impact:-

The cumulative effect of consecutive "Large Excess" weeks (July 9 to July 30) suggests that the soil moisture saturation in Tonk was significantly higher than the Rajasthan average. This implies maximum inflow into the Bisalpur Dam, potentially necessitating early gate operations compared to average years.

Conclusion:-

The analysis of the rainfall data from June 11 to August 20, 2025, concludes that Tonk district experienced a hyper-active monsoon phase. With a peak departure of 627% and sustained excess rainfall through July and August, the district's precipitation profile diverged significantly from the traditional semi-arid climatology of Rajasthan. The region effectively bypassed the typical "break monsoon" periods, posing challenges for flood management and reservoir regulation.

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