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Groundwater analysis in Telangana

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ABSTRACT:

Groundwater plays an important role in maintaining agriculture, domestic use and industrial development in Telangana. However, rising demand, climate change and irregular extraction have recorded a dangerous decline in the availability of ground water. The study presents an interactive, visualization-based approach to analyze groundwater trends from 2015 to 2025. Unlike traditional stable reports and spreadsheets, the proposed system converts complex dataset into attractive dashboard, allowing decision making, researchers and citizens to detect the diversity of water levels in districts and seasons. By integrating the rainfall data and groundwater comments, the system enhances the understanding of water stress areas and provides evidence for permanent management. Results suggest that visualization-monitoring analytics can improve community participation in awareness, policy decisions and groundwater conservation.

Keywords: groundwater, Telangana, data visualization, tableau, water resources management, stability

Introduction:

Groundwater is one of the most important natural resources, which serves as the primary source of drinking water and irrigation in India. In Telangana, a state with semi-oriented climatic conditions plays an important role in supporting groundwater agriculture and meeting domestic demands. However, the state is looking at the growing tension on its groundwater reserves due to population growth, urbanization, deforestation and highly variable rainfall patterns. Without adequate recharge, excessive decrease has accelerated the decrease, causing severe water scarcity in many districts.

Effective monitoring and analysis of ground water has become necessary. Traditional methods, such as government bulletins, spreadsheets and stable reports, although informative, often fail to provide actionable insights. They are usually complicated, take time to interpret, and non-technical bets such as farmers and local planners are inaccessible. This distinguishes between raw data availability and its practical use for durable management.

To bridge this difference, this study takes advantage of tableau-based interactive dashboard for analysis of groundwater in Telangana between 2015 and 2025. The project enables district-wise exploration to convert seasonal variations, rainwater linkage and prolonged decline trends into a luxurious view. The approach not only enhances clarity and access, but also supports data-driven decisions by government bodies, researchers and communities, eventually contributing to permanent water resources management.

Literature review

Several studies have examined groundwater across Telangana and all over India. The Central Ground Water Board (CGWB) and Telangana State Ground Water Department provides annual bulletin, fall and rainfall levels to the annual bulletin. However, they live in stable forms, limiting access. Educational functions such as physical chemical evaluation of Hyderabad's groundwater quality (Hari and Reddy, 2024) provide detailed scientific insights, but there is a lack of visual communication for the general public. Similarly, the hydro-seasons reflect the recreation of the Renfall Studies (IMD & TS Sarkar, 2020), but is difficult to interpret dynamically. Recent research trends emphasize the use of visualization platforms such as taback and power BIS for environmental monitoring. The project produces such trends by providing interactive, multi-level dashboard that combines water levels, rainfall and quality parameters.

Method / Approach	**Description**	**Strengths**	**Limitations**
Data Collection	Ground water and rainy data (2015-2025) gathered from CGWB and Telangana state reports.	The reliable government source, covers long -term gaps.	Data intervals and inconvenience exist.
Data Preparation	Clean and formatted using Excel and tableau prep (removed duplicate, standardized name).	Ensures accuracy and stability for analysis.	Time consuming; Errors are possible during cleaning.
Visualization	Tableau dashboard charts (bar, slopes, hemap, maps).	User -friendly, interactive, easy comparison in districts and years.	Tableau software and good system resources are required.
System Design & Analysis	Views developed with filters and tooltips for exploration and insights dashboard.	Increases engagement, helps the decision makers analyze trends.	Limited to static dataset, no forecast is yet modeling.

Methodology:

Existing system

Traditional groundwater monitoring in Telangana depends on static tables, reports and sometimes GIS mapping. They require expert interpretation and do not support the discovery of real -time. Public engagement remains minimal due to complexity and limited access to such methods.

Proposed system

The proposed system introduces the interactive tableau dashboard that improves access and engagement.

A. System architecture

I.data collection: groundwater levels and rainfall (2015–2025)

ii.data preparation: Cleaning with Excel/Tableau

iii.visualization layer: tableau dashboard (observation + insight)

Iv.user Interaction: Filter, Tooltips, and Chart for Better

B. Algorithm is used

While the future machine learning models were not applied in the current stage, it depends on the project:

i.data cleaning algorithm (duplicate removal, stability check)

ii. VISUALIALIZATION WARE

iii. In TABLOUT (for Trend Analysis and Rainfall-Water Correlation)

c. Workflow

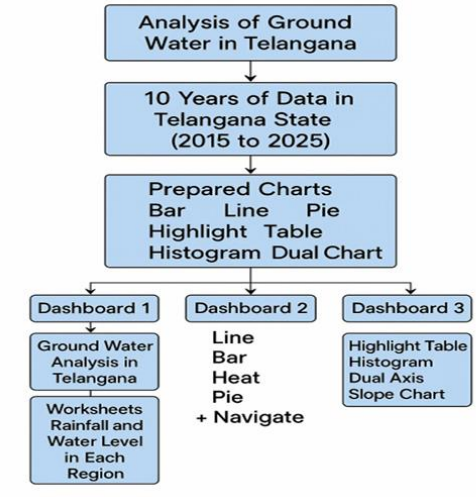


Fig1

D. Evaluation Metrics

- Accuracy of Representation (data consistency after cleaning)
- Performance (dashboard loading times)
- Utility (ease of navigation by diverse users)
- Engagement (extent of interactivity, e.g., use of filters)

Results

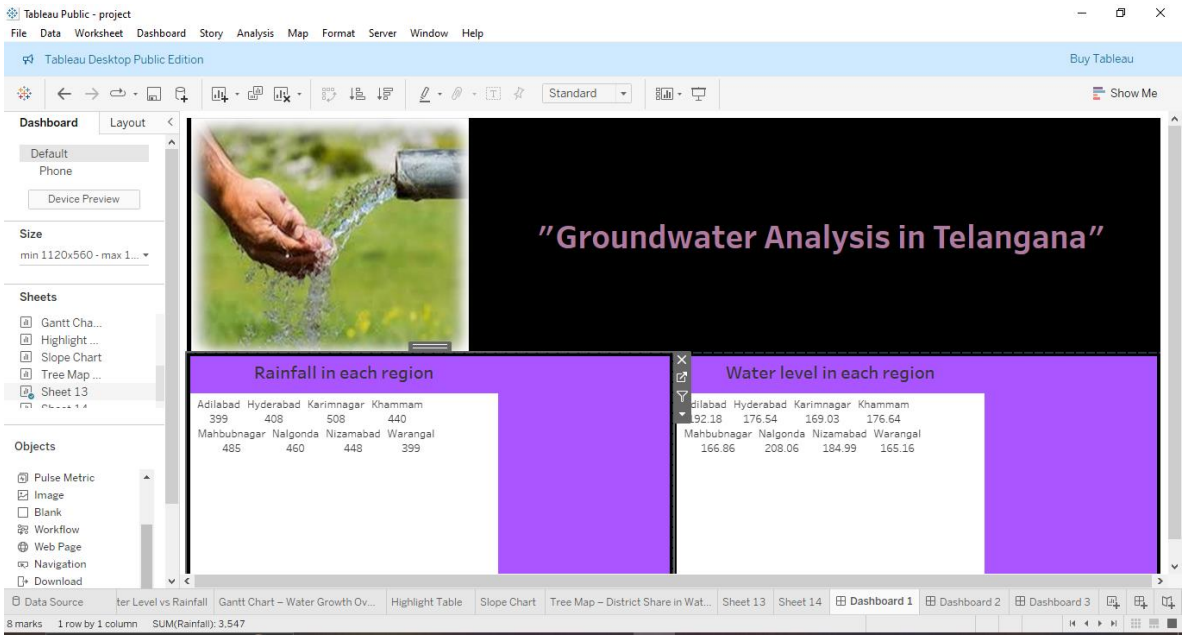
The project successfully developed two interactive tableau dashboard for groundwater analysis:

VOVEVIEW Dashboard-District and Year-War Tendency

It shows changes in groundwater levels and rainfall through dashboard bar chart, line graph, maps and heat. Interactive filters allow users to see data for specific years or districts, making the analysis more flexible.

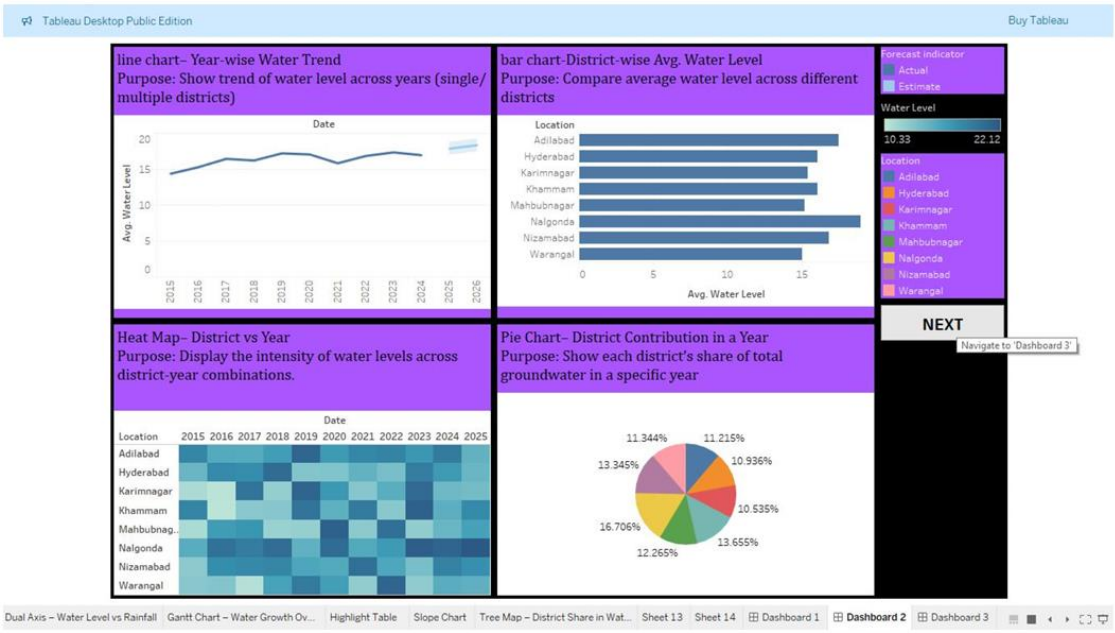
Insights Dashboard - Advanced Analysis

It provides deep insight by using dashboard donut charts, scattered plots, dual-axis graphs and highlight tables. It helps understand the correlation between rain and groundwater recharge, identifies high -rash areas, and compare changes in years.



Key findings include:

- Districts like Nalgonda, Mehbubnagar and Rangardi saw a steady decline in ground water, while some northern districts showed partial recovery after years of high rain.
- A strong link was found between rain and groundwater recharge, confirming that climate change plays an important role in water stability.
- The seasonal pattern showed a sharp decrease during summer, which highlighted the need for better irrigation scheme and rainwater harvesting.



Overall, the results suggest that interactive dashboards are more effective than stable reports, as they make complex data easier to understand. These tools can achieve clear insights into both experts and common public gains, can improve awareness, and support better decision making for groundwater management.

Conclusions:

This study highlights the importance of data visualization in groundwater monitoring and management. Using the tableau dashboard, ground water data for Telangana was converted from 2015-2025 to interactive and meaningful insight, which is dynamic and more dynamic for user-friendly systems than traditional stable reports.

The integration of rainfall data provided valuable references, helping stakeholders understand how climate change directly affects groundwater

availability. The dashboard effectively identified areas with prolonged decline, seasonal decrease and rainfall water correlations, providing useful conclusions to farmers, policy makers, researchers and environmental advocates.

Conclusions show that visualization-operated analytics can promote community participation in data-based decision making, transparency and groundwater conservation. Although the current system is based on a stable dataset, future growth may include real-time data integration, an-----up up future-function model and mobile platforms for broader access.

Overall, the task acts as a benchmark to implement data science to environmental challenges and shows how visualization can play a central role in permanent groundwater management and policy scheme.

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