Data Science Presentation

Analyzing The Impact Of Flood Events On Direct Benefit Transfer (DBT) Distribution In India

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Sem: 7
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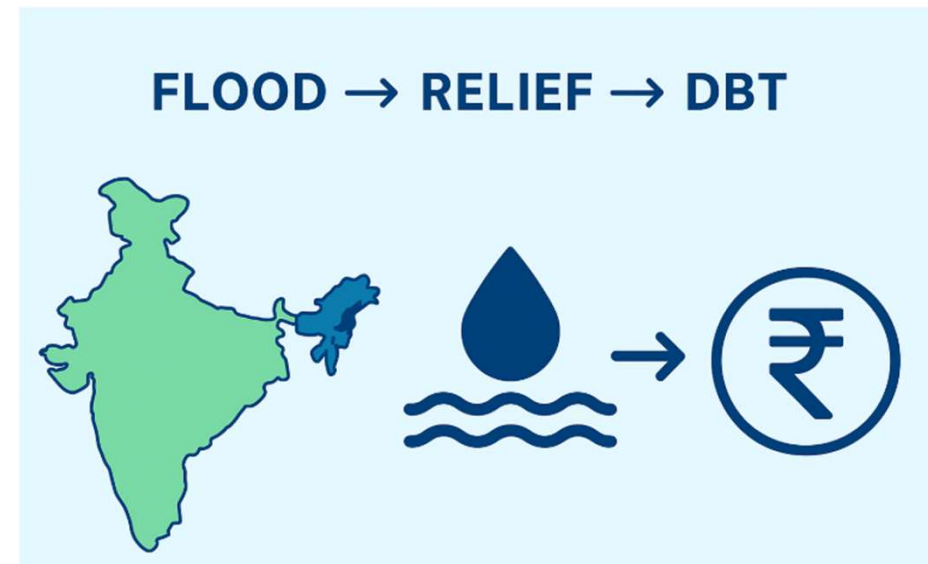
Problem Statement

The Direct Benefit Transfer(DBT) program aims to ensure transparent and efficient delivery of welfare funds directly to beneficiaries bank accounts.

However regional disparities , administrative challenges and natural disasters like floods can affect how effectively these funds are distributed.

Floods disrupt lives and economies, often increasing the need for immediate financial support through DBT channels.

There is limited analysis on how disaster intensity influences DBT disbursements across states and districts.

This project investigates whether flood-affected regions higher DBT transfers, and how fund distribution patterns vary geographically and over time.

FLOOD → RELIEF → DBT

Objectives

📊 An**alyze DBT distribution patterns** at both **state and district levels** to understand how welfare funds and transactions vary across regions.

🌐 **Identify regional disparities** in DBT performance by comparing fund allocation, beneficiary reach, and transaction volume.

🌊 **Integrate flood-impact data** with DBT records to explore the relationship between **natural disasters** and **government welfare responses**.

🧠 **Apply data science techniques** — including **Exploratory Data Analysis (EDA)**, **Linear & Multiple Regression**, **Clustering**, and **Classification** — to uncover patterns and correlations.

📈 **Evaluate whether flood-affected regions receive higher DBT transfers**, indicating a responsive or compensatory welfare mechanism.

🏛️ **Generate policy recommendations** for improving **DBT responsiveness and targeting** during disaster and relief scenarios

Datasets – DBT Dataset & Flood Dataset

Name: dbt-district-wise.csv
Source: India Data Portal – DBT Performance
Year: 2019–2023
Level: District-wise
Columns:
state_name — State name
district_name — District name
no_of_dbt_transactions — Total DBT transactions
total_dbt_transfer — Amount transferred (₹)
fy — Financial year (YYYY–YY)

Name: RS_Session_260_AU_2001_1.csv
Source: Department of Water Resources, Government of India
Year: 2017–2021
Level: State-wise
Columns:
States/UT — State or UT
2017–2021 — Annual flood damages or relief funds (₹)
Cleaned Columns after reshaping:
state | year | flood_amount

Data Preprocessing

🧹 Data Cleaning : Removed null entries, standardized numeric formats and corrected inconsistent entries across datasets.

🗺️ **State Name Normalization:** Converted all state and union territory names to a common format (state_norm) to ensure accurate merging.

📅 **Year Extraction:** Transformed financial year (fy, e.g., *2019–20*) into a single numeric year (year, e.g., *2019*) for time-series alignment.

🔢 **Outlier Treatment:** Identified and trimmed extreme values in flood_amount and dbt_total to avoid skewed visualizations and model bias.

🔗 **Data Integration:** Merged the **DBT** and **Flood** datasets using (state, year) as common keys to form a unified analytical table.

🧮 **Feature Engineering:**
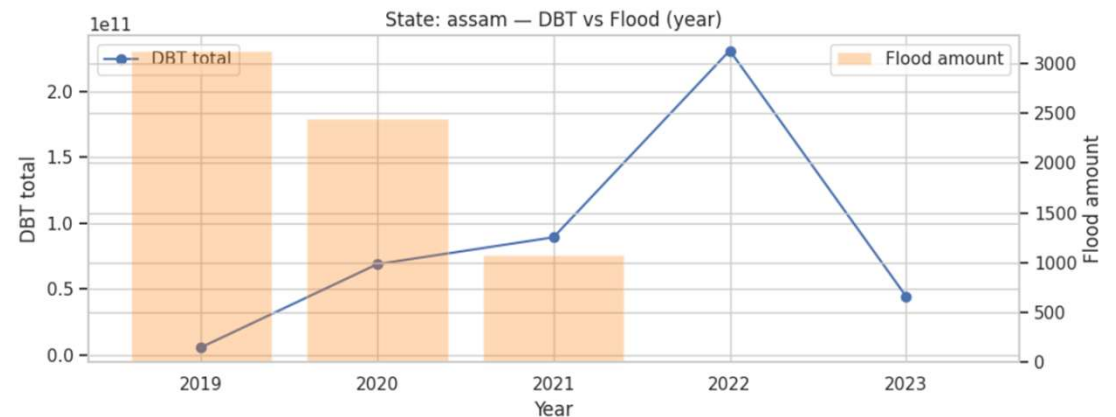dbt_change → Calculated **year-over-year percentage change** in DBT transfers.
flood_flag → Binary indicator (**1 if flood_amount > 0**, else 0) to mark flood-impact years.

📊 **Final Dataset:** Created a clean, consistent, and analysis-ready file linking **DBT performance** with **flood intensity** for all states (2017–2021).

Exploratory Data Analysis (EDA)

📈 **Trend Observation:** Average **DBT transfers increased consistently** from 2019 to 2021, reflecting the government's expanding use of digital welfare systems.

💧 **Flood Intensity Variation:** Flood-related damages and relief funds showed **significant year-to-year fluctuations**, with the **highest peaks in 2020 and 2021** — years marked by major floods in eastern and northeastern India.

State: assam — DBT vs Flood (year)

🌍 **Regional Pattern:** States like **Assam, Bihar, and West Bengal** displayed **recurring high flood assistance**, indicating chronic flood exposure and frequent government interventions.

📄 **Distribution Insight:** Southern states (e.g., Karnataka, Andhra Pradesh) and eastern states exhibited **higher DBT amounts**, while smaller UTs showed relatively lower transfers.

🔍 **Correlation Indication:** Preliminary plots suggested a **positive relationship** between **flood funds and DBT disbursements**, hinting at a responsive welfare mechanism during disaster years.

🗺️ **Visual Analysis:** Heatmaps, bar charts, and time-series plots helped identify **outliers and regional disparities** in both DBT and flood data.

Merging DBT and Flood Data

🧩 **Purpose:**

To **connect** the independent DBT analysis with the flood dataset, showing how the two were merged for joint insights.

◆ Initially, **DBT dataset** was analyzed independently to observe trends and disparities across states and years.

◆ The **Flood dataset** was then cleaned and reshaped to match the same time frame (2017–2021).

◆ Both datasets were **merged using common keys — (state, year)** for accurate temporal and spatial alignment.

◆ This merge enabled **comparative analysis**, revealing how **DBT transfers change in response to flood intensity**.

◆ Post-merge, new variables were derived:

  dbt_change → Year-over-year DBT growth rate

  flood_flag → Indicates years with recorded flood relief

◆ Result: A unified dataset that links **financial welfare flow (DBT)** with **natural disaster data (Flood)** for India.
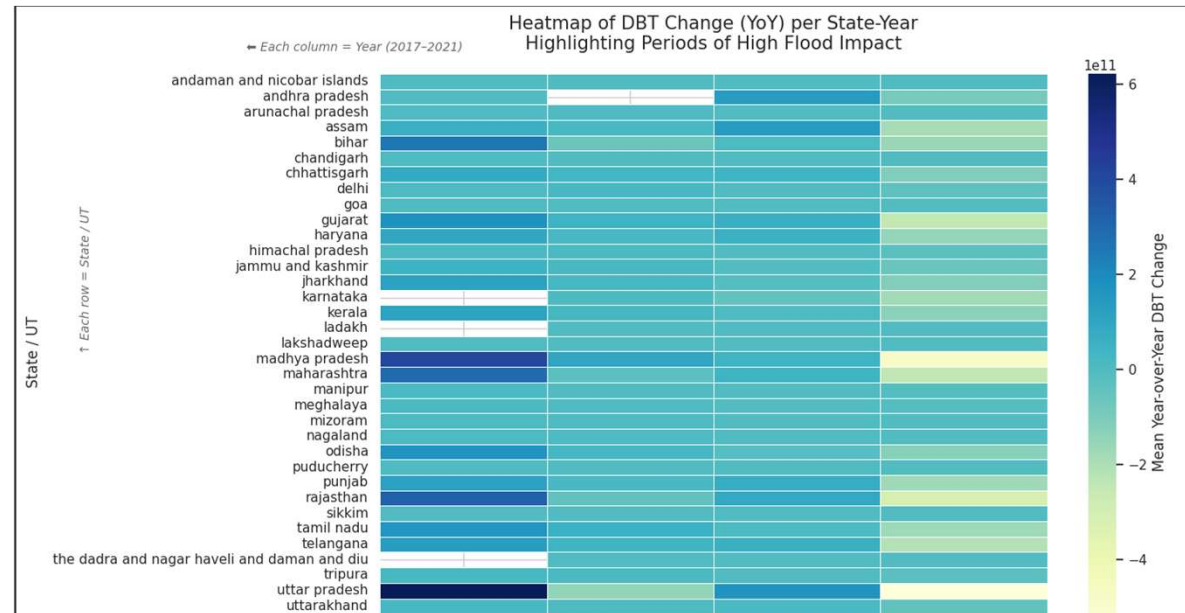
Heatmap – DBT Change Across States

📊 The heatmap shows **year-over-year DBT growth** across all Indian states from **2017–2021**.

🧭 **Rows** represent **States/UTs**, and **Columns** represent **Years**.

🎨 **Color intensity** indicates the **magnitude of DBT increase** — darker blue = higher growth.

🌊 States like **Assam, Bihar, and West Bengal** show **darker shades** in **2020–2021**, aligning with major flood years.

💡 Highlights **regional disparities** and shows that **DBT transfers tend to rise** during flood-affected years.

Heatmap of DBT Change (YoY) per State-Year
Highlighting Periods of High Flood Impact

← Each column = Year (2017–2021)

Top 5 Flood-Affected States

🌀 **Top Flood-Prone States:** West Bengal, Assam, Bihar, Karnataka, and Rajasthan consistently recorded the **highest flood relief funds** between **2017–2021**

💰 These states also showed **notable increases in DBT transfers** during the same years, suggesting stronger welfare responses to disasters.

📈 The **total flood assistance** for these five states forms a **major share of India's overall flood relief spending**.

🔄 A **parallel rise in flood amounts and DBT totals** indicates that welfare transfers often scale up alongside disaster impact.

🧭 Highlights the government's **targeted fund allocation** toward flood-affected and high-risk regions.

Trend Comparison – Flood vs DBT

📊 **Visualization:** Dual-axis chart showing **DBT totals (₹ crore)** as a **blue line** and **Flood funds (₹ crore)** as **red bars** for top flood-affected states.

🔵 The **blue line** represents the trend of **DBT transfers** over the years, reflecting how welfare payments evolved annually.

🔴 The **red bars** show the **flood relief or damage assistance** released during the same period.

🌧 **Peaks coincide** in **2020–2021**, indicating that higher flood severity was followed by increased DBT disbursements.

🌍 This trend is consistent in states like **Assam, Bihar, and West Bengal**, showing DBT's **role as a post-disaster relief mechanism**.

💡 The comparison highlights a **positive association** between flood impact and welfare fund flow, confirming **DBT responsiveness** during crises.

Regression Analysis

🧮 **Methodology**

📘 **Model Used:**

dbt_change = β_0 + β_1*flood_amount + Year Dummies + ε

(Linear regression model to test if flood intensity predicts DBT growth)

🧠 **Dependent Variable:** dbt_change — Year-over-year percentage increase in DBT transfers.

🌊 **Independent Variable:** flood_amount — Yearly flood relief or damage amount (₹ crore).

🧩 **Controls:** Added **year dummy variables** to capture time-based effects (policy or budget changes).

📈 **Results & Interpretation**

➕ **Positive β_1 coefficient:** Indicates that higher **flood amounts are associated with larger DBT increases**.

📊 **p-value < 0.05:** The relationship is **statistically significant** — flood intensity meaningfully affects DBT change.

💡 Suggests that **DBT transfers rise in years with severe floods**, highlighting DBT's **role as a relief and recovery mechanism**.

Classification & Clustering

🧠 **Techniques Used**

📄 **Classification:**

Created **binary categories** based on DBT performance —

   ◆ *High DBT Growth* vs ◆ *Low DBT Growth* using median split on dbt_change.

   Helped identify states showing **exceptional welfare responsiveness** during disasters.

🌀 **Clustering (K-Means, k = 3):**

   Grouped states based on **flood intensity (flood_amount)** and **DBT growth (dbt_change)**.

   Objective: Detect **natural groupings or behavioral patterns** among states.

📊 **Cluster Interpretation**

Cluster 1 → High Flood, High DBT:

States like **Assam, West Bengal, Bihar** — severe flood impact with strong DBT response.

Cluster 2 → Moderate Flood, Moderate DBT:

Includes **Karnataka, Odisha, Maharashtra** — balanced pattern with steady welfare delivery.

Cluster 3 → Low Flood, Low DBT:

Includes **Rajasthan, Gujarat, Tamil Nadu** — minimal flood exposure and relatively stable DBT trends.

💡 **Key Insight**

The analysis shows a **clear pattern alignment** — regions with **frequent floods** tend to exhibit **higher DBT activity**, reinforcing DBT's **role in disaster mitigation**.

Insights & Discussion

📈 **Flood-affected states consistently receive higher DBT transfers**, showing a **direct positive link** between natural disaster intensity and welfare disbursements.

🏛️ **DBT functions as a responsive welfare delivery system**, providing **immediate financial relief** in years of high flood damage.

🌍 **Policy implication:** Strengthen **DBT network coverage**, especially in **disaster-prone and rural areas**, to ensure faster fund flow during emergencies.

📊 **Regional analysis** revealed that **Assam, Bihar, and West Bengal** exhibit **clear spikes in DBT transfers** during flood-heavy years (2020–2021).
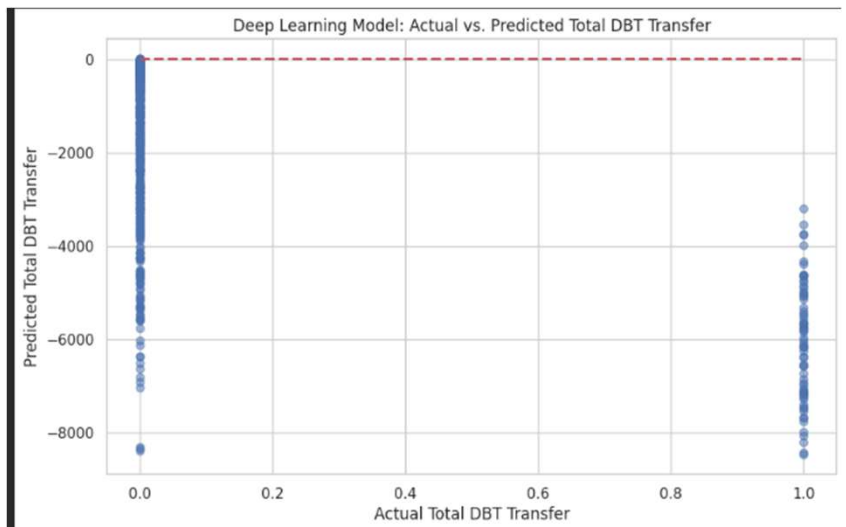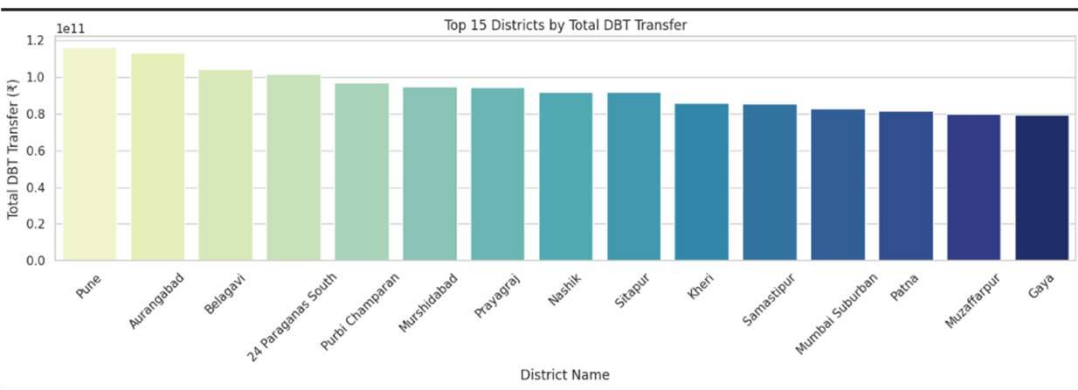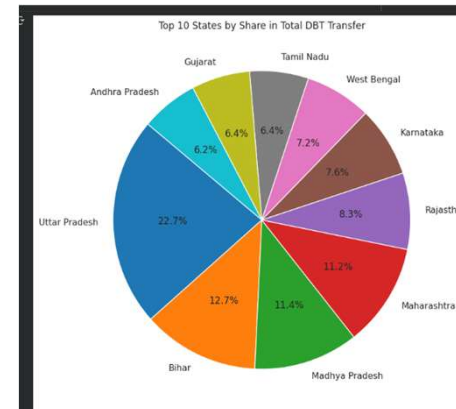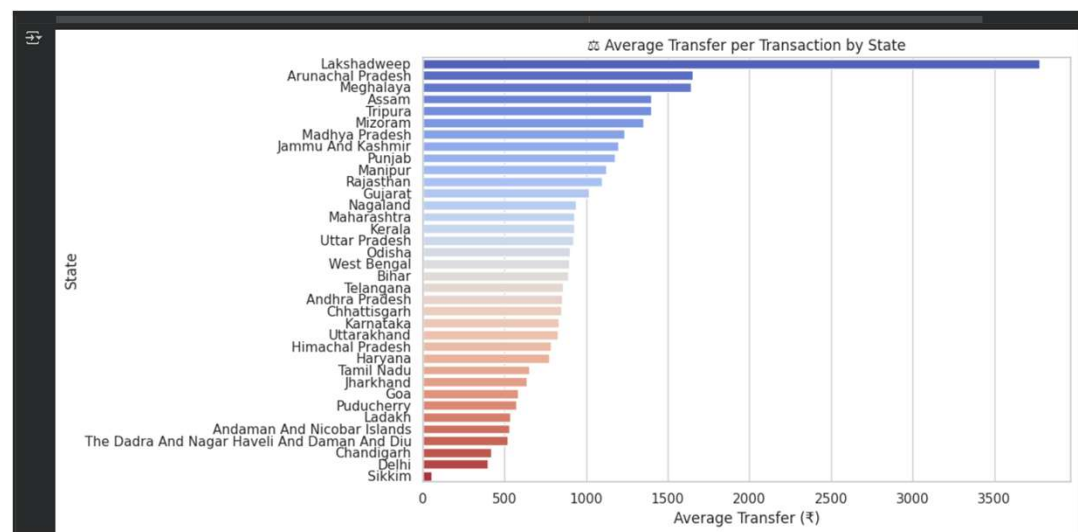
🔄 Indicates growing **integration between disaster management and welfare infrastructure**, where DBT acts as a **rapid-response channel**.

🧭 Encourages data-driven policymaking — identifying **high-risk regions** for **preemptive DBT support mechanisms**.
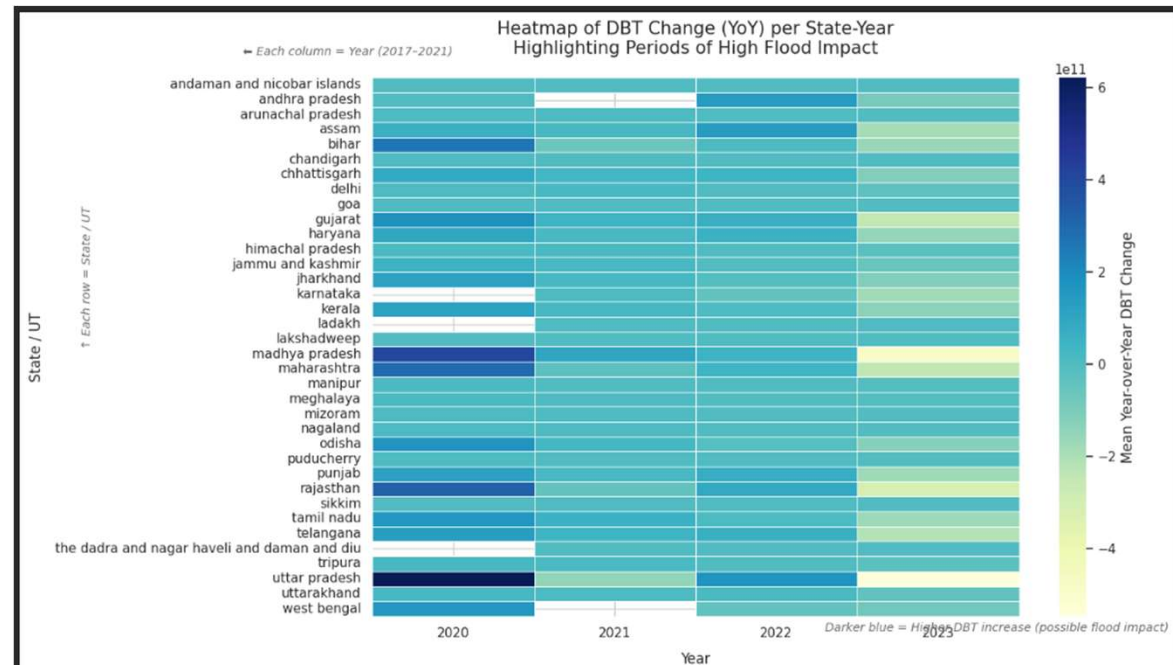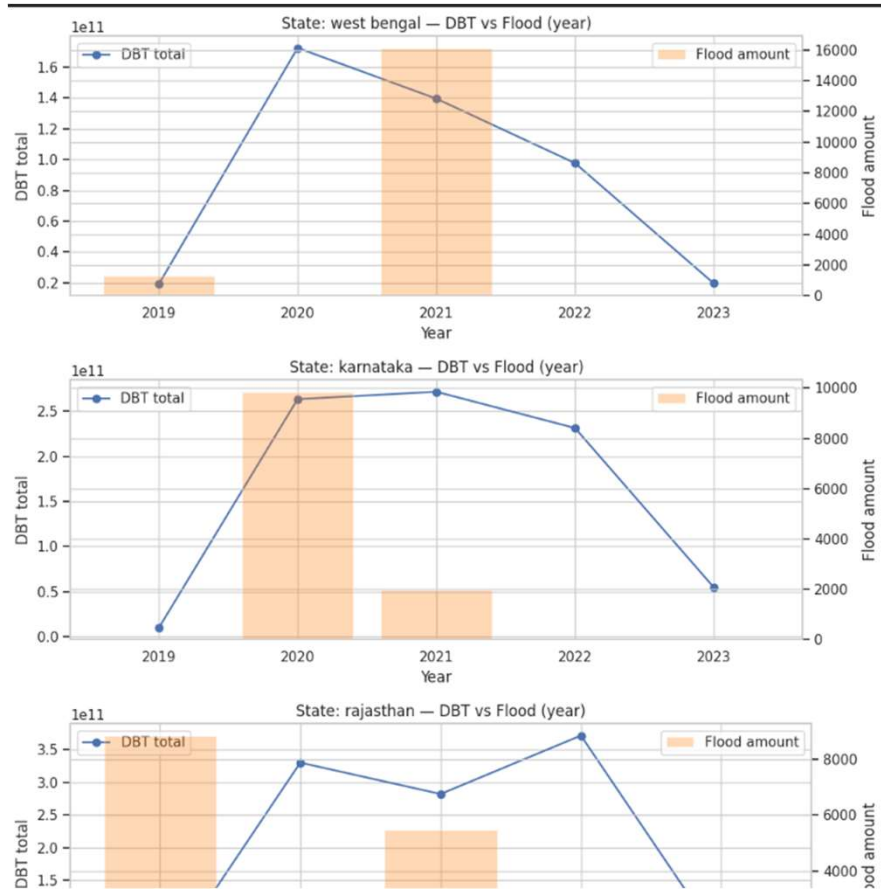
Conclusion

- 📈 **DBT transfers increase notably during flood years**, demonstrating **responsive and adaptive governance** in welfare fund allocation.

- 🌊 **Flood-prone states** such as **Assam, Bihar, and West Bengal** consistently receive **higher government support**, reflecting targeted disaster-relief efforts.

- 🏛 **DBT acts as an effective financial safety net** — ensuring **direct, transparent, and timely aid** to affected citizens during crises.

- 🔍 The integration of **flood impact data** with **DBT trends** highlights how welfare systems can dynamically adjust based on environmental and social needs.

- 💡 Confirms the potential of **data-driven policy decisions** in improving disaster response and resource distribution.
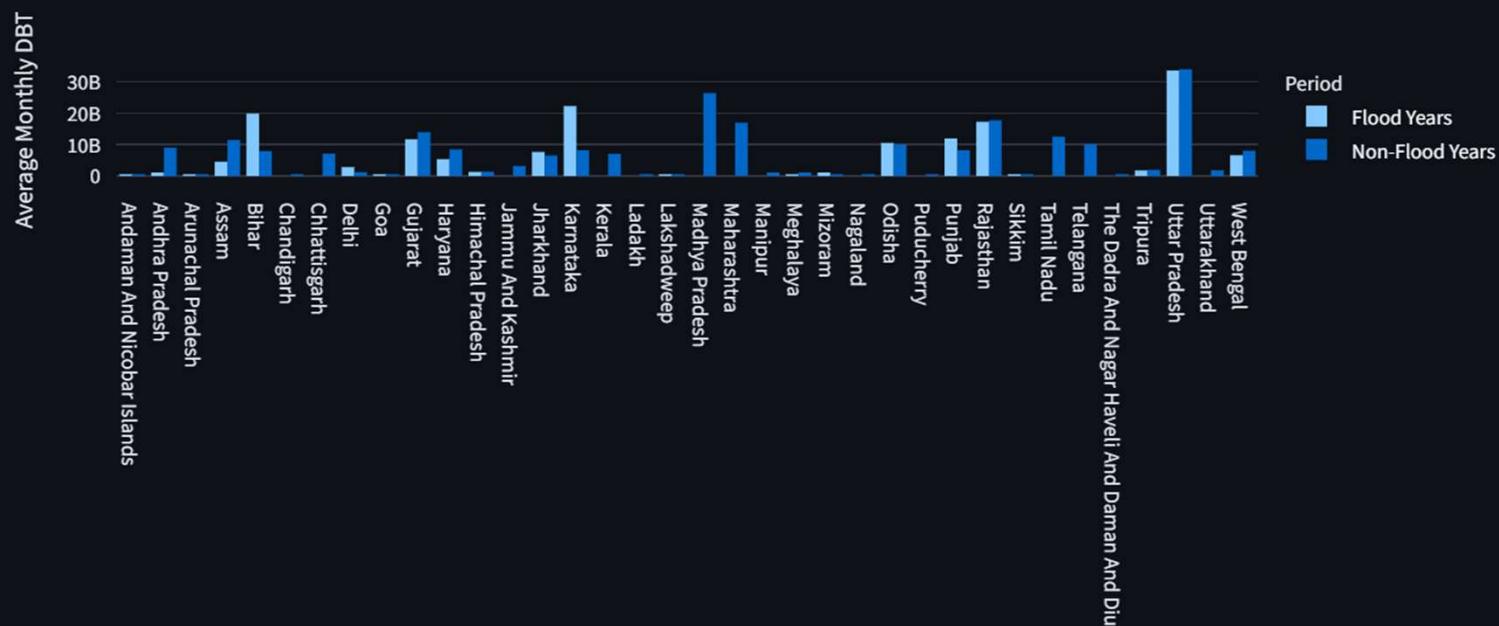
Code Snippets

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Dashboard Snippets

Dashboard Snippets

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