GROUND WATER QUALITY OF MAHARASHTRA

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INTRODUCTION

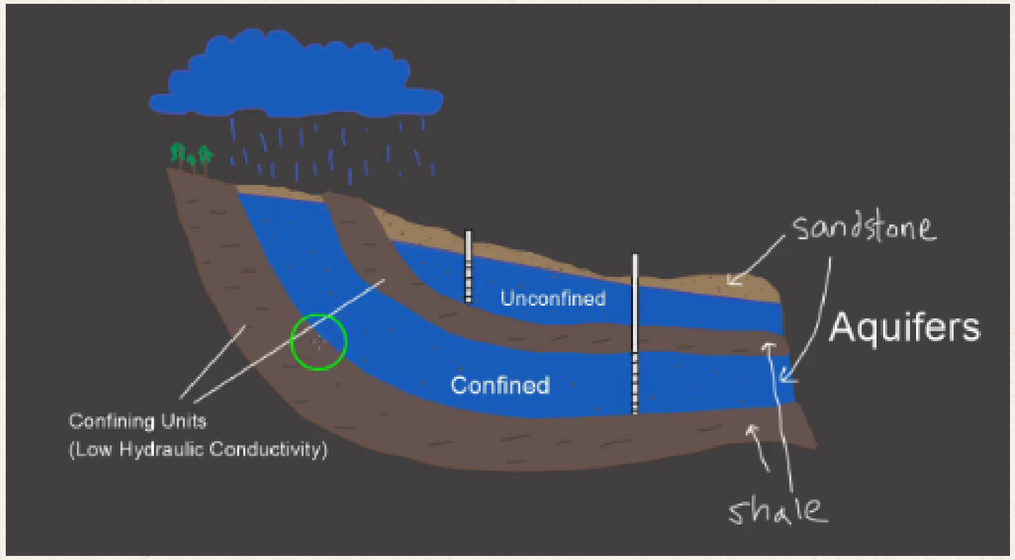
- **Personal Connection**: I grew up in Pune District, Maharashtra state in India, and witnessed groundwater contamination challenges firsthand.
- **Importance**: Maharashtra relies on rivers and reservoirs for domestic and agricultural needs.
- **Problem**: Rapid urbanization, industrialization, and farming have degraded groundwater quality.

DATASET

- Central Ground Water Board (CGWB), Maharashtra Groundwater Reports 2023 (Official Government Website)
- Includes chemical parameters from 1300+ village wells across districts.
- NO3, Fluoride (F), Uranium (U), SAR, RSC, TDS, pH, Aquifer type, Latitude/Longitude

DATA SCRAPING

- Tool Used - (Jupyter Notebook) Python
- Data was available in the PDF format
- Used **Camelot** library to extract the tabular data from PDF
- There were two datasets-
  - **Confined/semi-confined aquifers**: 137 instances
  - **Unconfined aquifers** : 1346 instances



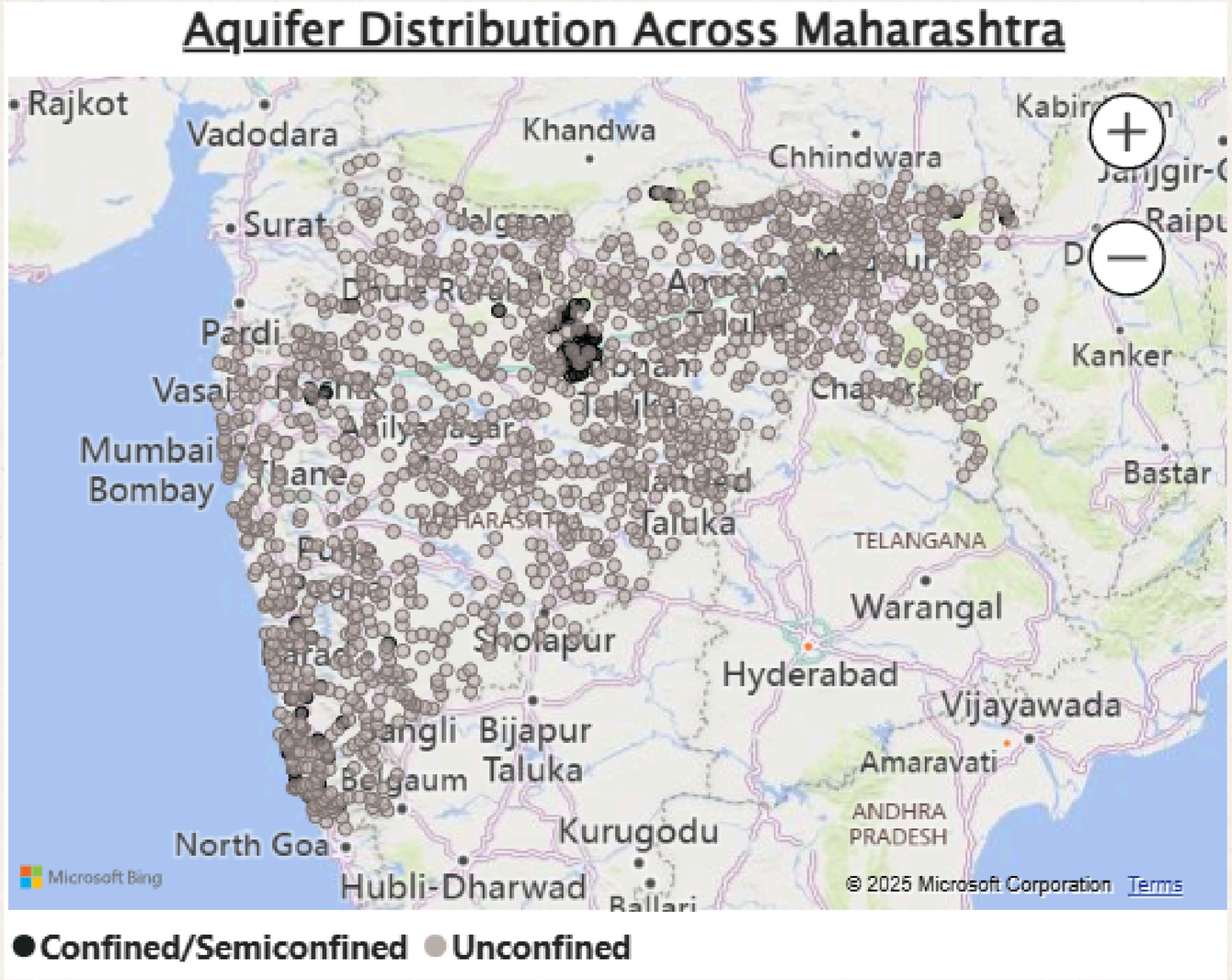
DATA CLEANING AND PREPARING

- Tool used - Microsoft Power BI
- Two datasets: Semiconfined and Unconfined aquifers
  - Added a column “Aquifer Type” to both before combining
  - Combined the files using “Append Queries” in Power BI
- Cleaned the data:
  - Changed the data type for the respective columns
  - Replaced missing or invalid values like “ND”, “BDL”, and ‘-” with null
  - Removed incorrect coordinates (e.g a well placed in South Africa)
  - Replaced blank “WellType” entries with ‘unknown”

AQUIFER DISTRIBUTION

- Unconfined aquifers (gray) cover most of Maharashtra, making groundwater more vulnerable to contamination

- Confined aquifers (black) are limited to small areas clustered in western coastal belts, likely due to geological structure and recharge zones.

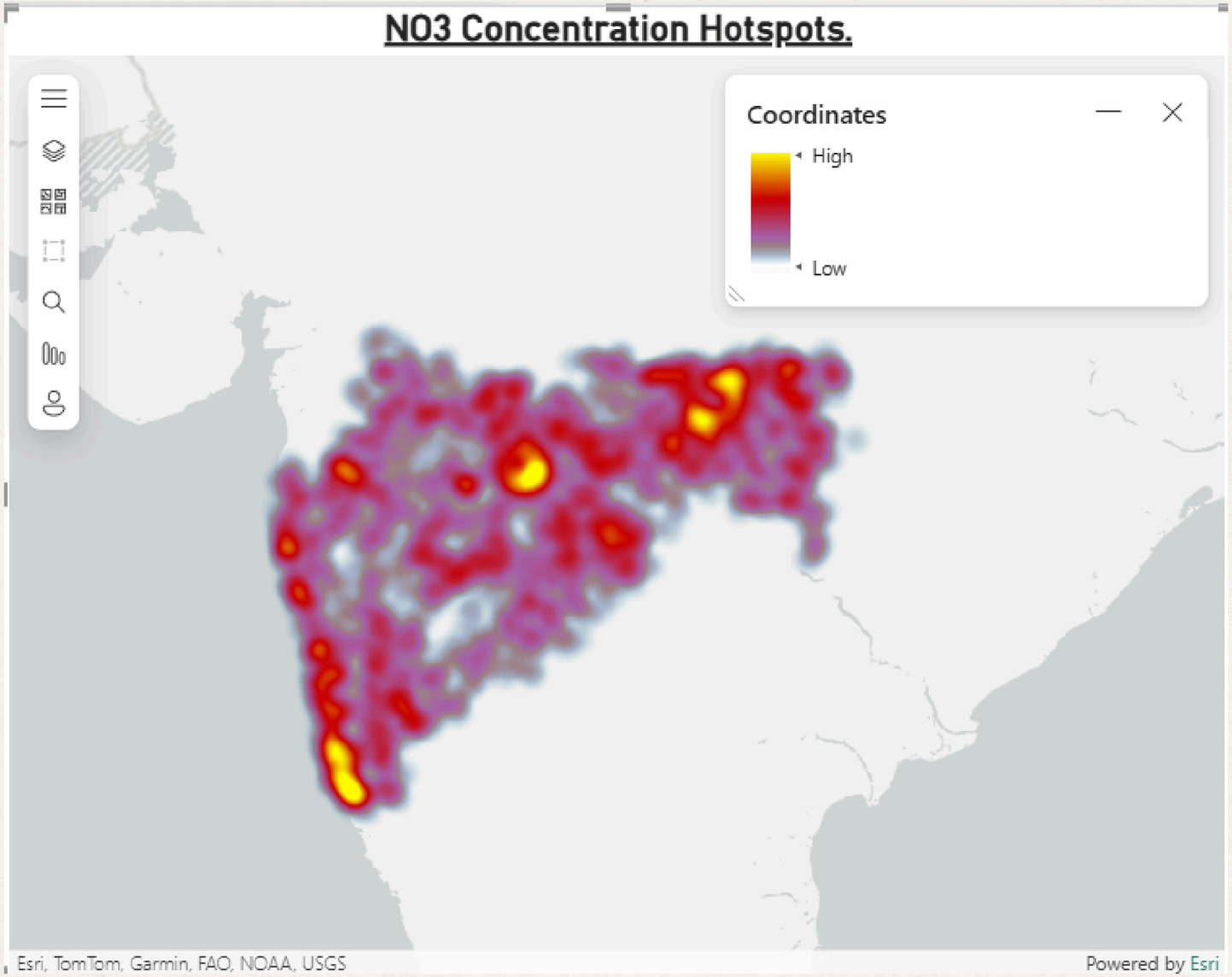


NO3 HEATMAP (CONCENTRATION HOTSPOTS)

- High NO3 level exceed 45 mg/L concentrations are found in coastal and northern Maharashtra

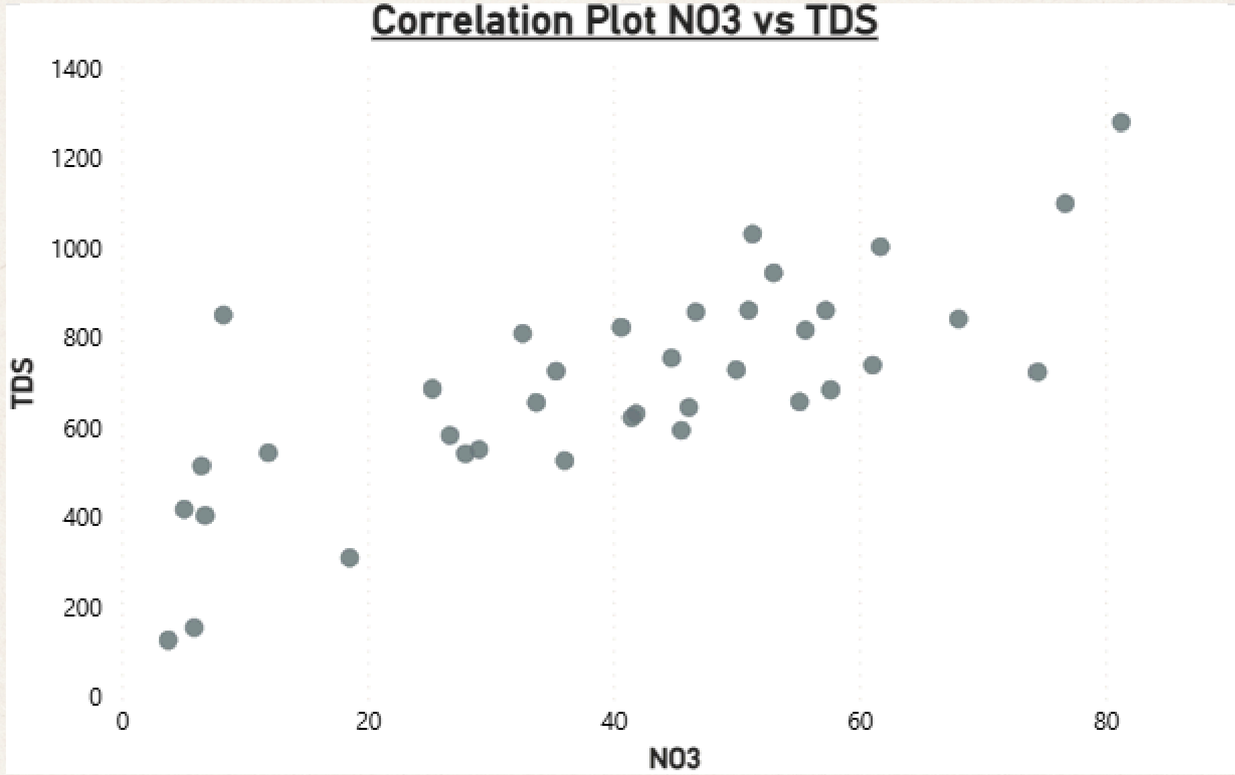
- like Nashik and Jalgaon - Because this part is agricultural hubs, extensive use of nitrogen-based fertilizers leads to nitrate leaching into groundwater

- like Ratnagiri, from agriculture (mango, rice), tourism, untreated sewage, and rapid leaching due to high rainfall and permeable laterite geology.

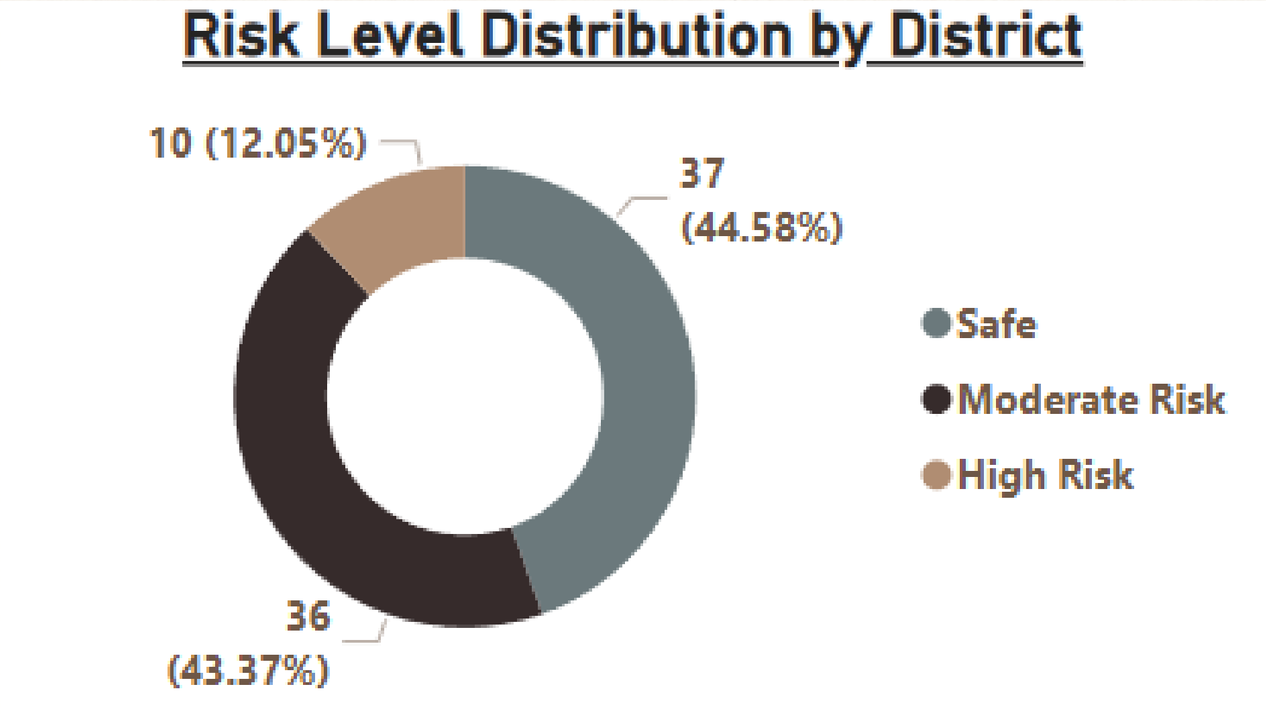


CORRELATION PLOT NO3 VS TDS (SCATTER PLOT)

- High NO3 levels (>50) often occur with high TDS (>800), showing a link between these contaminants.



RISK LEVEL DISTRIBUTION BY DISTRICT (DONUT CHART)

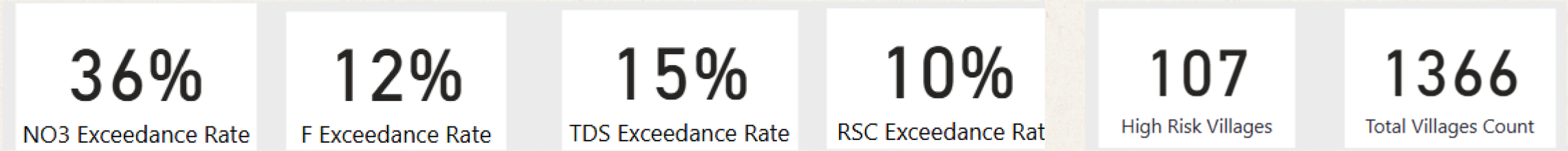


Districts with High Risk

District	RiskLevel
Wardha	High Risk
Parbhani	High Risk
Nashik	High Risk
Nagpur	High Risk
Gondia	High Risk
Dhule	High Risk
Chandrapur	High Risk
Buldhana	High Risk
Beed	High Risk
Amravati	High Risk

- Calculated by sum of risk score on the basis of Bureau of Indian Standards (BIS) limits
- 12.05% of districts (10 out of 83) are high risk, facing severe groundwater contamination issues
- 43.37% of districts (36 out of 83) are safe, but 44.58% (37 districts) have moderate risk, requiring monitoring

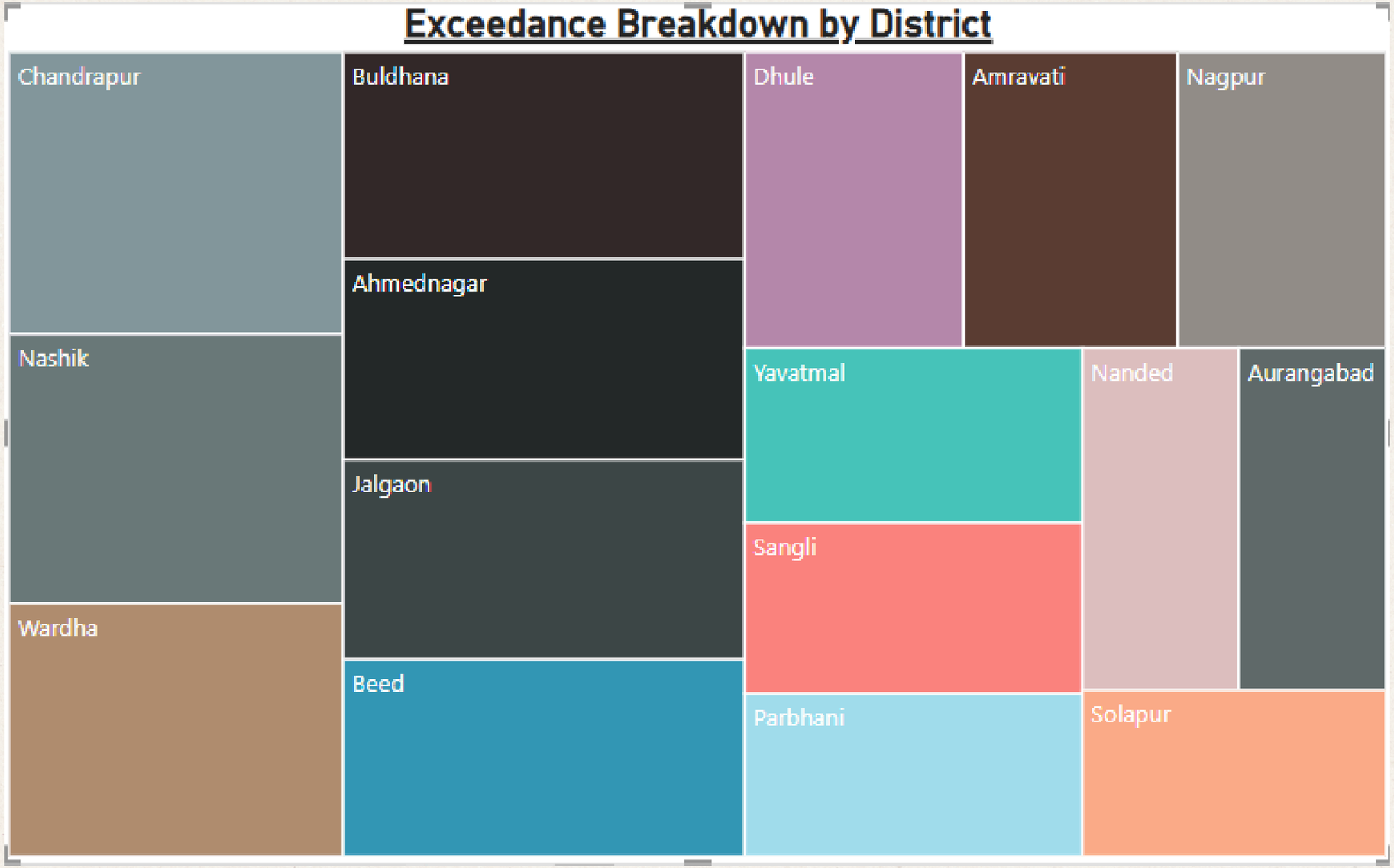
KPI CARDS (F, TDS, RSC, NO3, HIGH RISK VILLAGES, TOTAL VILLAGES)



- RiskScore_BIS, based on Bureau of Indian Standards (BIS) limits (e.g., NO3 ≤ 45 mg/L), is calculated by determining exceedance ratios for NO3, F, TDS, RSC, and U.
- 36% of samples exceed the NO3 limit (>45), the highest rate, posing risks like blue baby syndrome
- 12% of samples exceed the F limit (>1.0), risking dental and skeletal fluorosis in affected areas
- 15% of samples have TDS >1000, affecting water taste and quality for drinking
- 10% of samples exceed the RSC limit (>1.25), which can harm soil quality and reduce crop yields

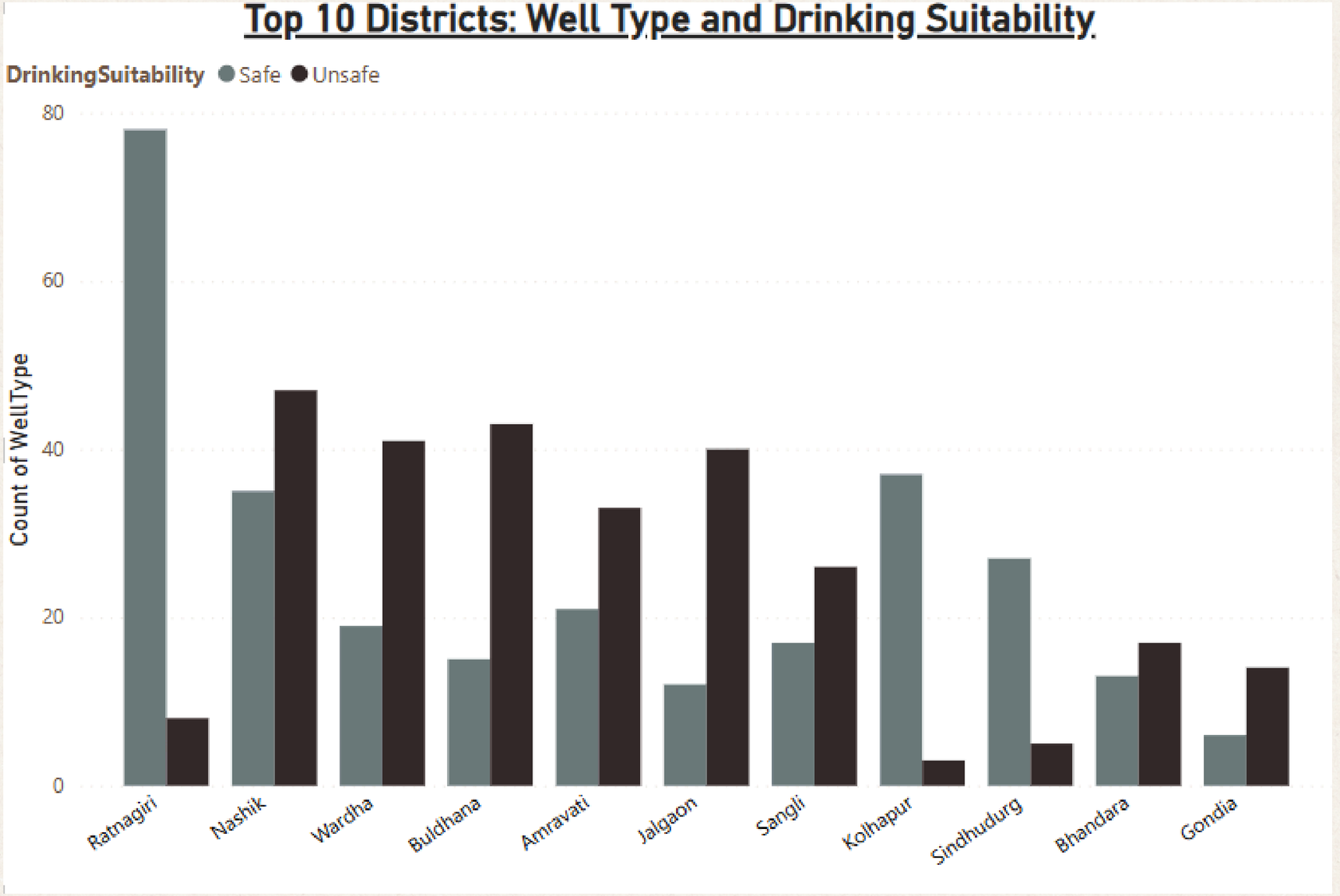
EXCEEDANCE BREAKDOWN BY DISTRICT (TREEMAP)

- Used total exceedance (NO3,F,TDS,RSC)
- Chandrapur ,Nashik needing urgent action



TOP 10 DISTRICTS: WELL TYPE AND DRINKING SUITABILITY (BAR CHART)

- Ratnagiri has the most wells (over 80)
- Nashik and Wardha also have high unsafe well counts (around 40 each), highlighting drinking water challenges.



CONCLUSION

- The groundwater quality analysis reveals that a significant portion of Maharashtra faces moderate to high contamination, particularly in unconfined aquifers.
- Actions need to be taken care for those hotspots region

THANK YOU!