Integrating Flood Susceptibility and Deforestation Mapping for Climate Vulnerability Assessment: A Geospatial and AI-Based Approach.

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Problem Statement

- The global climate system has intensified floods and droughts, the most destructive climate-induced disasters worldwide.
- In Nigeria, floods causes 80% of natural disasters while droughts pose severe risks to food security.

Figure 1: Image of drought and flood occurrences in Nigeria.

Introduction Cont'd

A geospatial approach is essential because these climate hazards are inherently location-based, requiring precise identification of vulnerable areas to provide better insights for targeted decision-making and resource allocation.

Related Papers

Table 1: Related Literature

Citation	Title of Paper	Paper Summary
Tsatsaris, A., Kalogeropoulos, K., Stathopoulos, N., Louka, P., Tsanakas, K., Tsesmelis, D. E., ... & Chalkias, C. (2021).	Geoinformation technologies in support of environmental hazards monitoring under climate change: An extensive review.	This review examines the state-of-the-art use of Geographic Information Systems (GIS), Remote Sensing (RS), and spatial data analysis tools for monitoring and managing various geo-hazards, including floods and droughts, within the context of climate change. It emphasizes the need for spatial information to support environmental monitoring and policy. .
Ghile, E. H., Shirakawa, H., & Tanikawa, H. (2022).	Application of GIS and Machine Learning to Predict Flood Areas in Nigeria.	This study developed a flood susceptibility map for the nation using GIS and two machine learning models: Artificial Neural Network (ANN) and Logistic Regression (LR), based on various conditioning factors like elevation, slope, and rainfall. ANN showed a superior performance (AUC of 76.4%).
Eguagie-suyi, P., Dada, B., & Okogbue, E. C. (2025).	Machine Learning Based Drought Prediction Using the Standardized Precipitation Evapotranspiration Index (SPEI) in Kebbi State, Nigeria.	This paper focuses specifically on using advanced machine learning models (Random Forest, XGBoost) to predict meteorological drought in a critical Nigerian region (Kebbi State) using the Standardized Precipitation Evapotranspiration Index (SPEI). It found that Random Forest models achieved the highest prediction accuracy. Relevance to :

Methodology

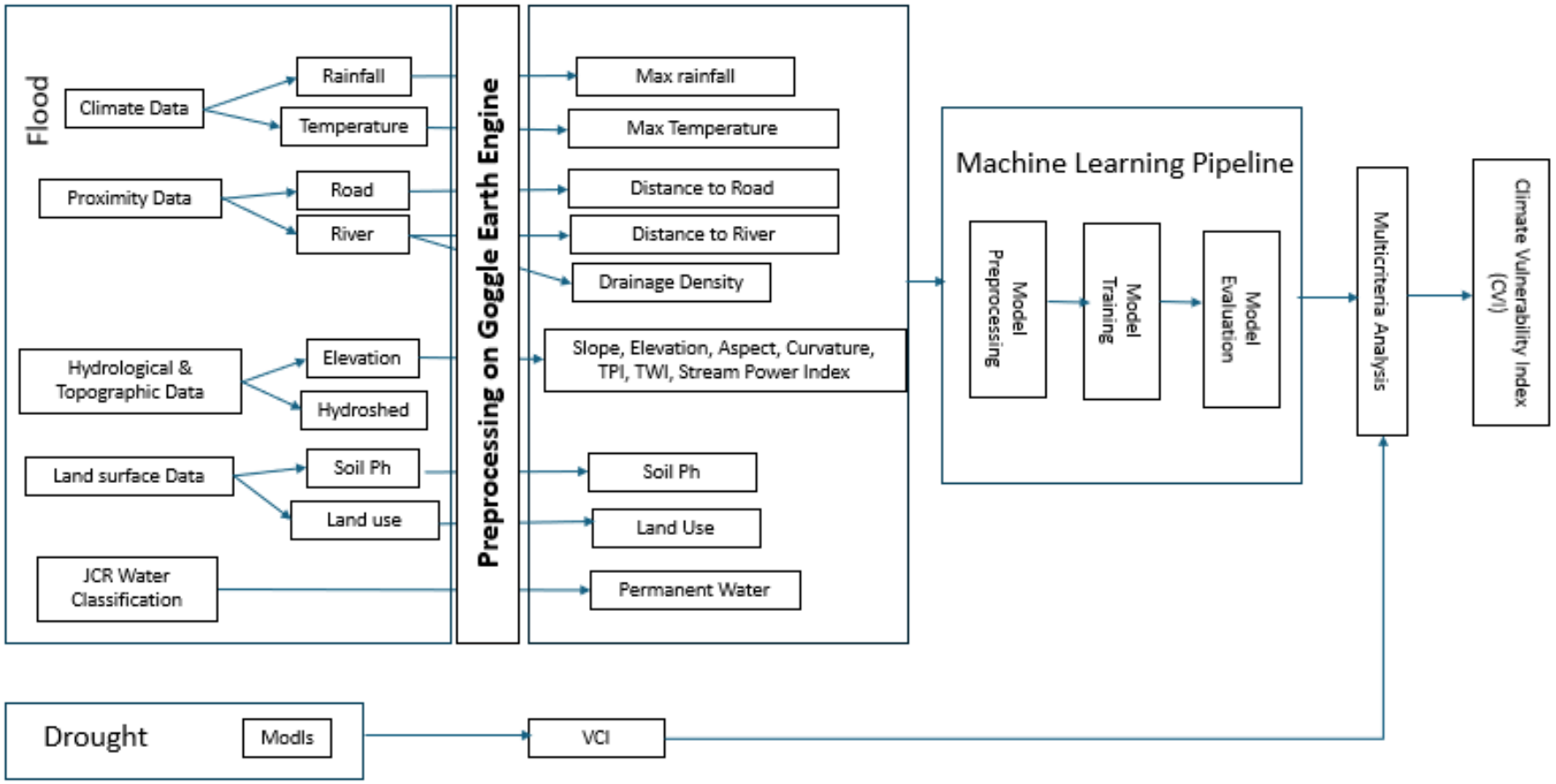

Figure 2: Methodology Flowchart

Methodology Cont'd

Datasets

Table 2: Summary of geospatial datasets used in the study

Group	Dataset	Source	Observation period / Last Updated	Format	Spatial resolution
Climate data	Rainfall	CHIRPS daily raster	2019 to 2024	Raster	5566 meters
	Temperature	TerraClimate	2019 to 2024	Raster	4638.3 meters
Proximity data	Roads	DivaGIS	April 2025	Shapefile	–
	Rivers	DivaGIS	April 2025	Shapefile	–
Hydrologic & Topographic data	Elevation	Shuttle Radar Topography Mission (SRTM)	2020	Raster	30 meters
	HydroSHEDS	WWF HydroSHEDS Flow Accumulation	2020	Raster	463.83 meters
Land surface data	NDVI	Modis Data	2018 to present	Raster	201 meters
	Soil pH	OpenLandMap	2018	Raster	250 meters
	Land Use	ESA WorldCover 10m v100	2021	Raster	10 meters
Administrative boundary data	Admin boundary (country, state, local)	DivaGIS	April 2025	Shapefile	–
Surface water data	Surface water	JRC Yearly Water Classification History	2022	Raster	30 meters

Methodology Cont'd

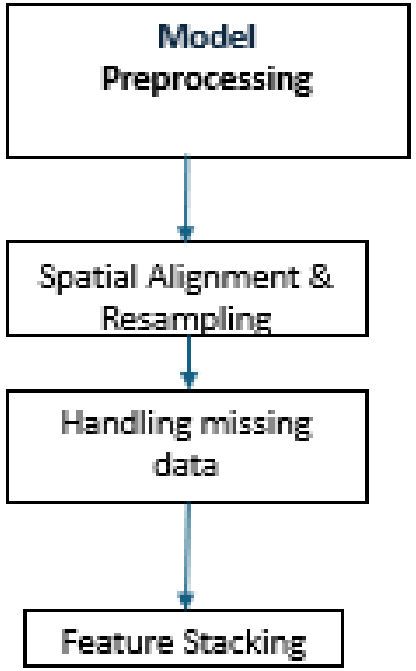

Figure 3: Flood dataset preprocessing for model training.

Result and Discussion.

Random Forest model had the highest AUC

Table 3: Comparative Model Performance using Area Under Curve (AUC)

Model	Area Under Curve (AUC)
Random Forest	0.85
XGBoost	0.79
LightGBM	0.76

Result and Discussion Cont'd

Elevation, rainfall, and temperature are the top contributors to flooding.

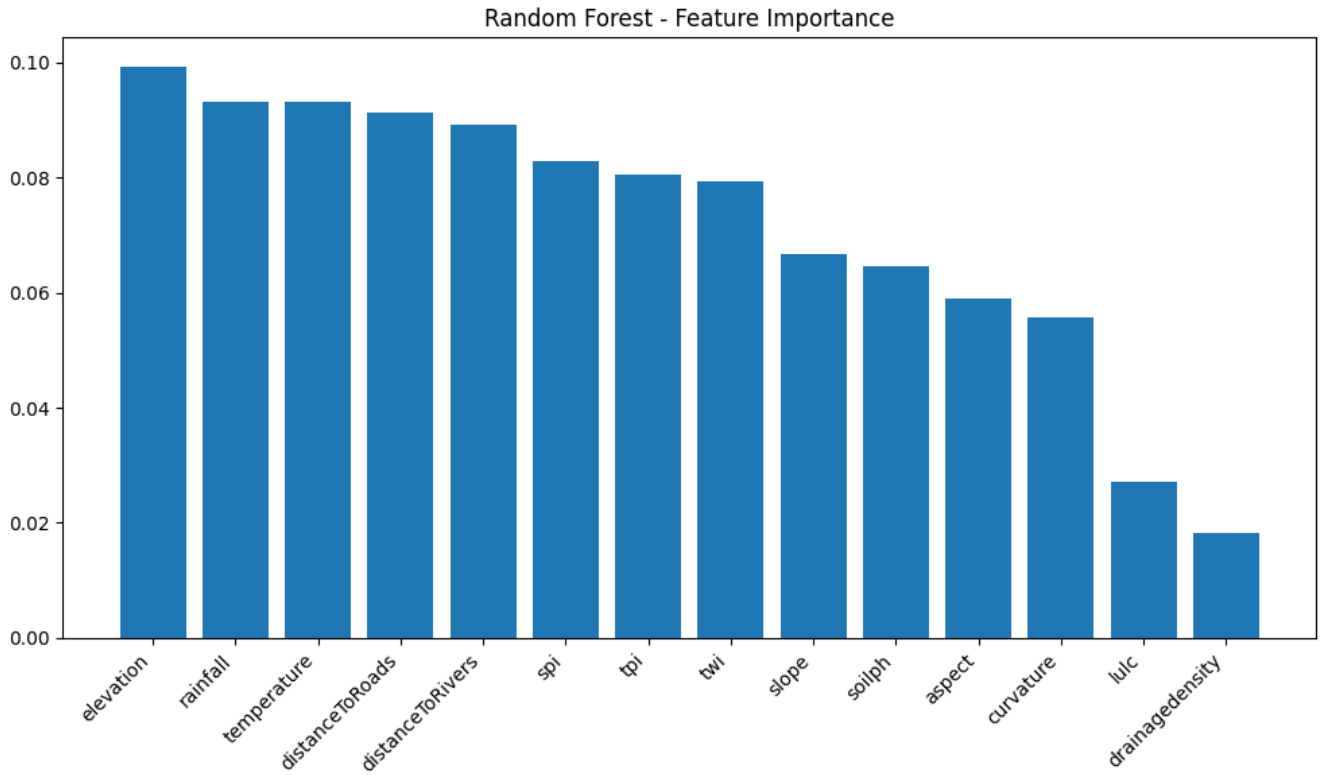

Figure 4: Feature importance for Random Forest

Result and Discussion Cont'd

States in the Northeastern and central parts regions exhibit the highest climate vulnerability index.

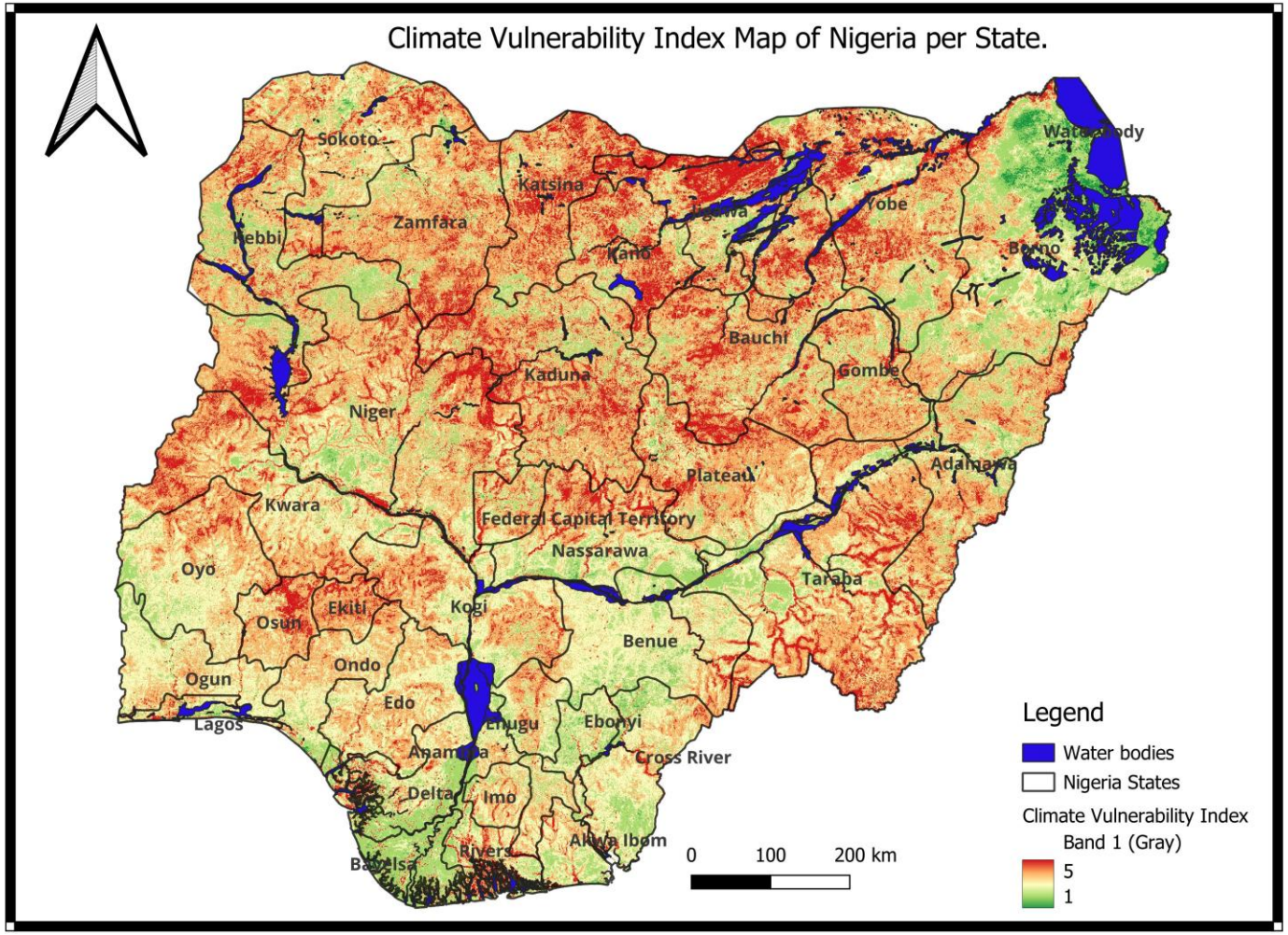

Figure 5: Climate Vulnerability Index map of Nigeria, per State.

Conclusion

We successfully developed the Climate Vulnerability Index (CVI) by integrating flood and drought risk assessments using Google Earth Engine (GEE) and artificial intelligence. This innovation provides valuable insights for decision-makers and investors, enabling them to identify priority areas and strategically channel resources for effective emergency response and resilience planning.

Thank You

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