EXPLAINABLE MACHINE LEARNING MODEL FOR PARAMETER INFLUENCE ASSESSMENT OF LANDSLIDES USING XGBOOST-SHAP

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Background

Traditionally, many AI systems operate as "black boxes," meaning that they take in input data, process it in some way, and produce output, but it is not always clear how the output was derived. This can make it difficult for humans to understand how the AI system arrived at its conclusions and to trust its output.

Explainable AI for landslide susceptibility models is important for ensuring that the model's outputs are trustworthy, interpretable, and transparent, which can help improve the model's effectiveness and reliability.

It can also help to identify potential errors or biases in the model and to improve its performance.

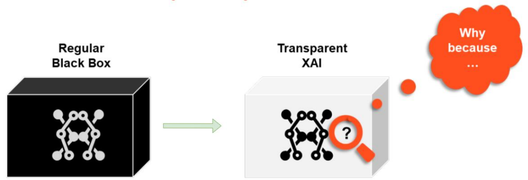


Fig. 1. Why XAI?

➢The study area lies around an artificial reservoir.
➢Numerous landslides have been caused in the rim area due to reservoir drawdown conditions, other anthropogenic factors, and natural terrain-related causes.
➢Hence, studying Landslide Susceptibility in the area becomes very important.

Methodology

Landslide Susceptibility Modeling has been done using XGBoost model

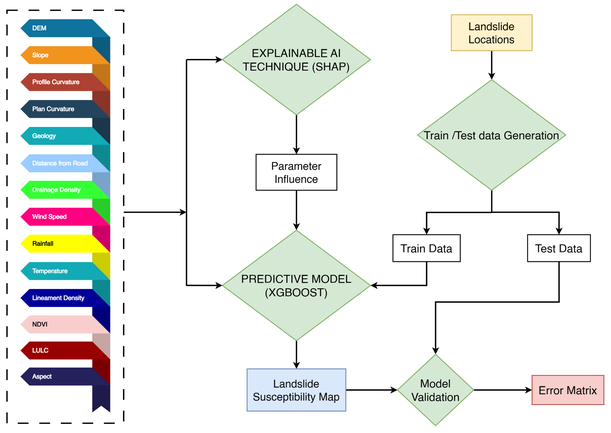


Fig. 2. Methodology Adopted for Processing

Study Area

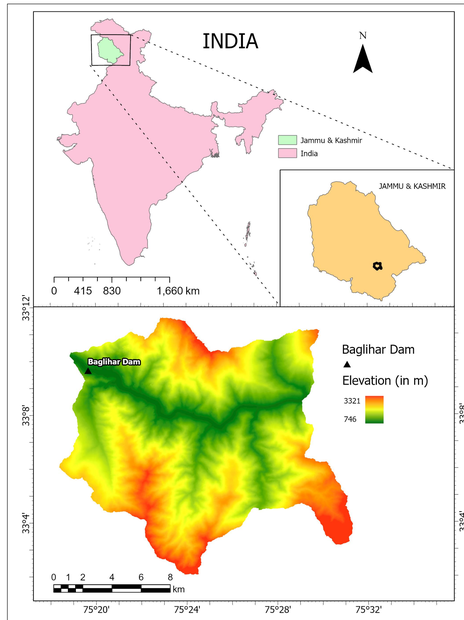


Fig. 3. Location of the study area

The Baglihar Dam Reservoir is situated in the Indian-administered territory of Jammu and Kashmir and lies on the river Chenab.

Two National Highways: The Jammu-Srinagar Highway (NH-44) and Batote-Doda-Kishtwar National Highway (NH-1B/ NH 244), the only road link between Doda and Kishtwar, pass through the study area.

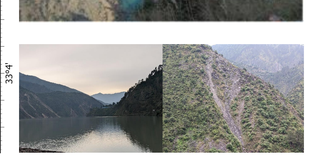


Fig. 4. Landslides in the Study Area

Data Used

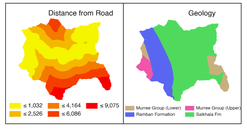
14 types of Landslide Influencing factors were used.

Landslide Inventory was developed from the Geological Survey of India inventory and studying Google Earth.

ALOS 12.5 m DEM was used as the source for elevation and its derivatives.

76 landslide incidences and 76 no incidences were used to train the network.

The Tropical Rainfall Measuring Mission (TRMM) satellite data, Landsat NDVI, etc., were extracted using Google Earth Engine for estimating the daily precipitation over the study area.



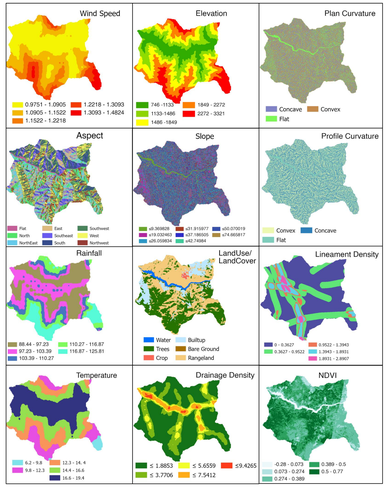


Fig. 5. Different Landslide Influencing Factors

Results

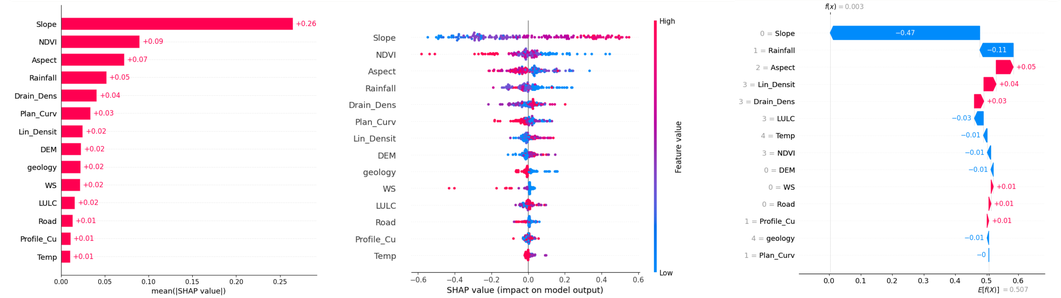


Fig. 6 (from left to right) influencing factors contribution ranking, Mean SHAP values, SHAP summary plot

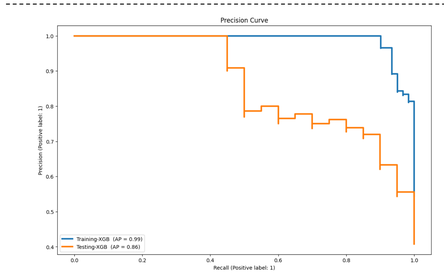


Figure 8. Precision-Recall (top) and ROC-AUC curves (bottom) derived

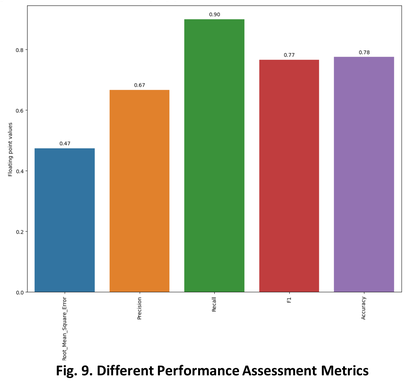


Fig. 9. Different Performance Assessment Metrics

Fig. 7. SHAP for Landslide Points

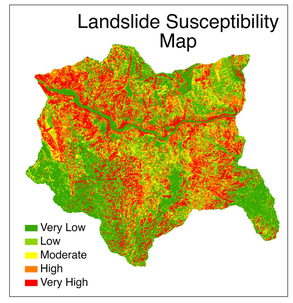


Fig. 10. Landslide Susceptibility Map

Conclusions

➢ The XGBoost model was able to predict the probability of landslide occurrence well
➢ The SHAP-XGBoost model-based integrated explanatory framework can quantify the importance and contribution values of factors

Acknowledgments

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