From Black-Box Predictions to Trustworthy Landslide Susceptibility Mapping Using Explainable AI

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EGU26 GENERAL ASSEMBLY

Scan Abstract

This presentation participates in OSPP — Outstanding Student & PhD candidate Presentation contest

1. PROBLEM IDENTIFICATION

PROBLEM STATEMENT

- Landslide mapping in arid regions is highly uncertain.
- Multiple factors interact in complex ways.
- Most models act as black boxes.
- Irrelevant variables reduce model reliability

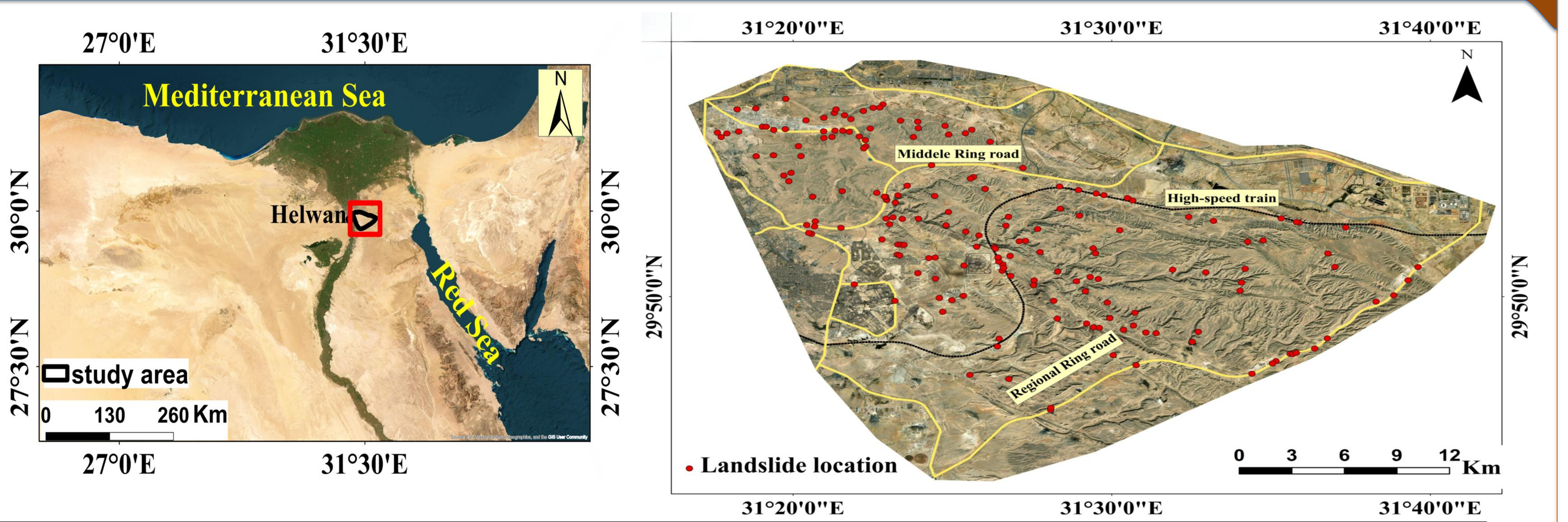
RESEARCH GAP

- High accuracy ≠ clear understanding.
- Key drivers are often unknown.
- Models lack physical interpretability.
- Limited support for decision-making.

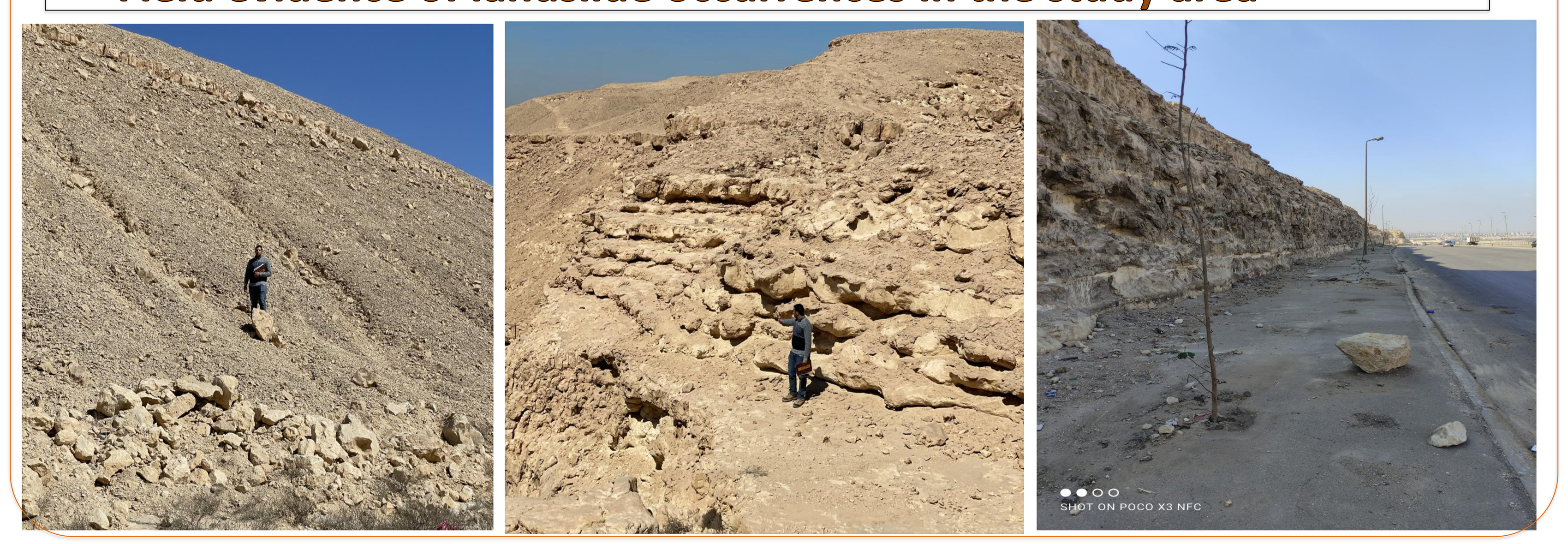
OBJECTIVE

- Apply SHAP-based explainable AI.
- Integrate with recursive feature elimination (RFE).Select the most relevant predictors.
- Improve transparency and performance.

2. Study area: East Cario, Egypt

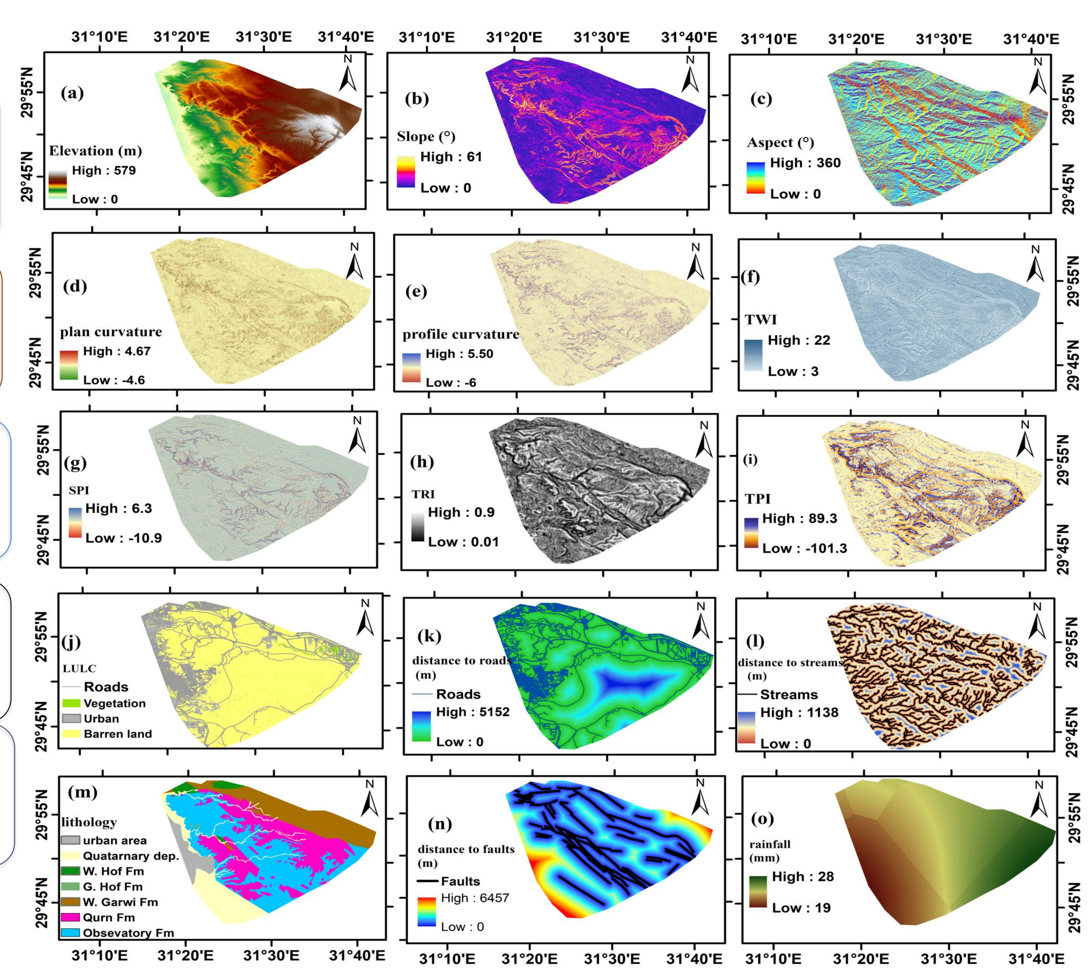


Field evidence of landslide occurrences in the study area



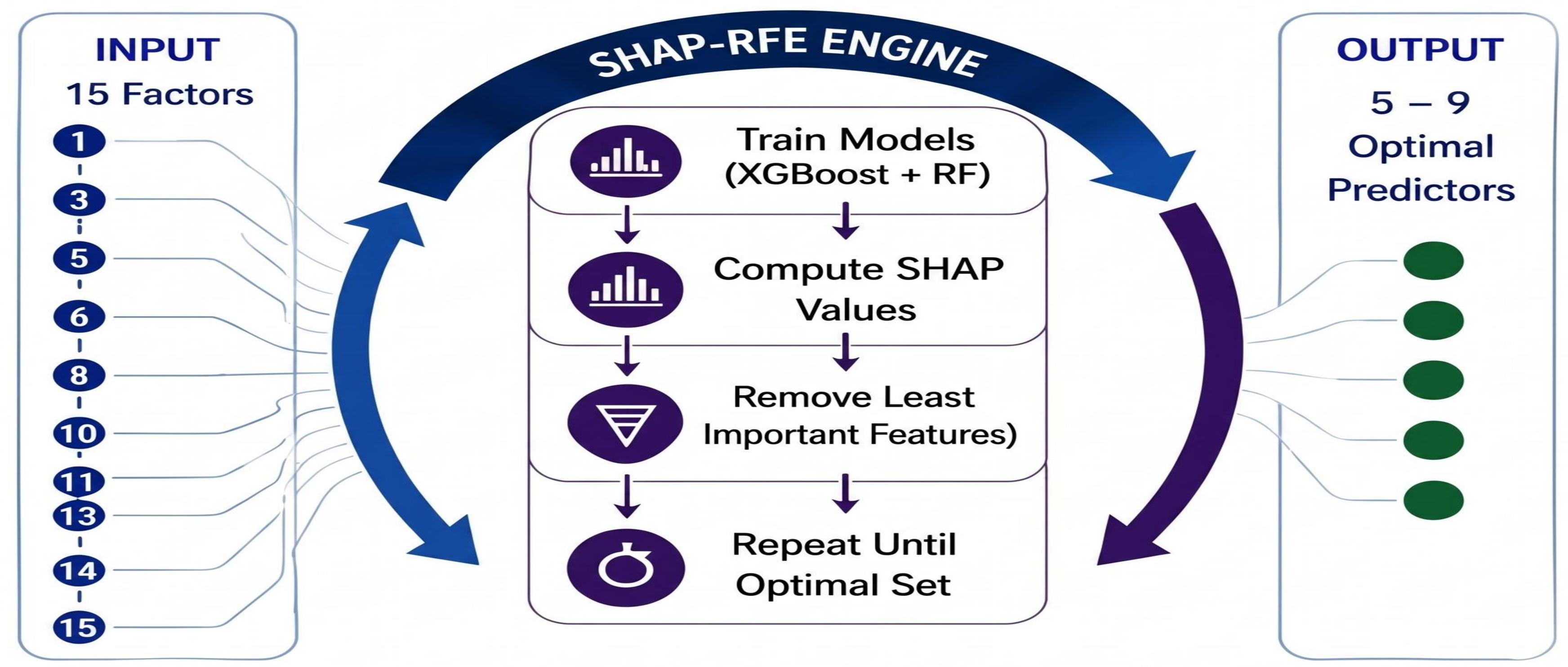
2. Conditioning Factors (15)

- Topographic (9): Elevation, Slope, Aspect, Plan Cur., Profile Cur.,TWI, SPI, TRI, TPI)
- Geological (2): Lithology, Distance to Faults
- Hydrological (1): Distance to Streams
- Anthropogenic (2): LULC, Distance to Roads
- Triggering (1): Mean Annual Rainfall



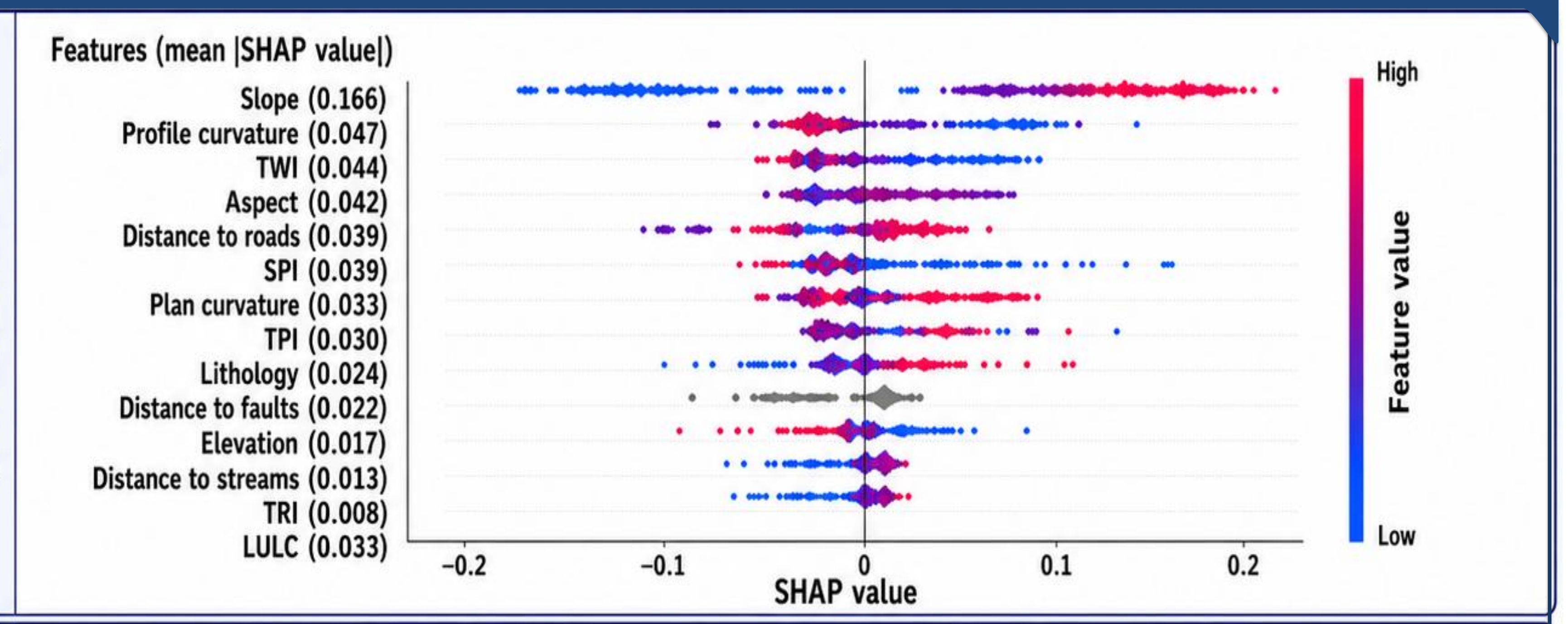
4 METHODOLOGY: SHAP-RFE ENGINE

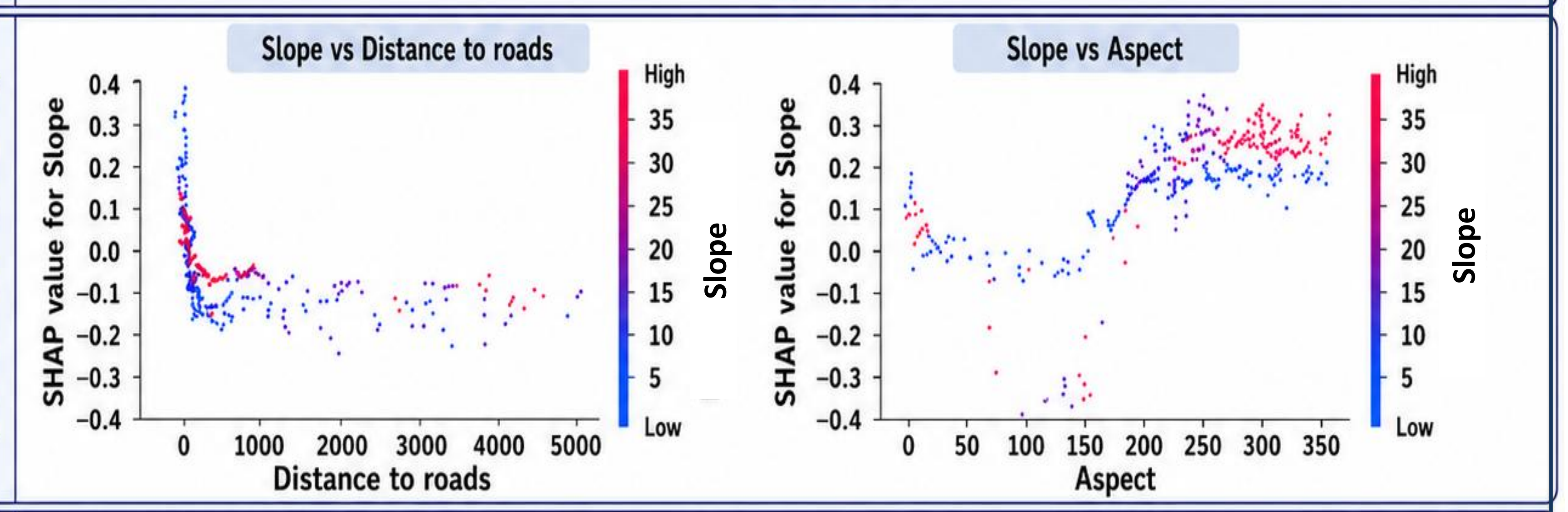
Recursive Feature Elimination guided by SHAP values to identify 5–9 optimal predictors.

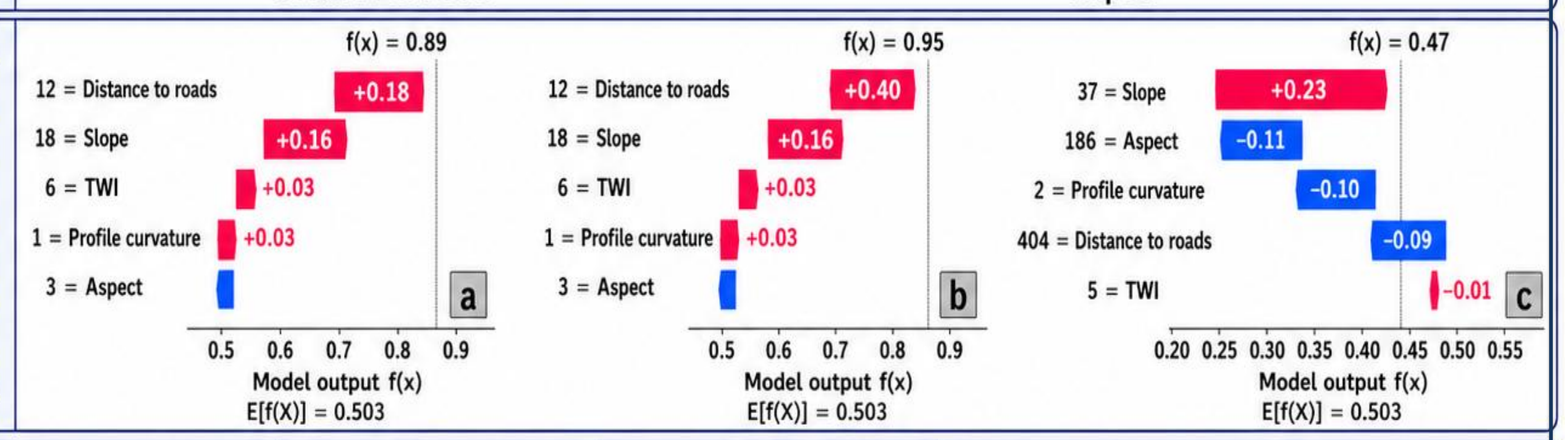


- Models (XGBoost + RF)
- Explainer (SHAP)
- Selector (RFE)
- Goal (Transparency)

5. EXPLAINABILTY WITH SHAP

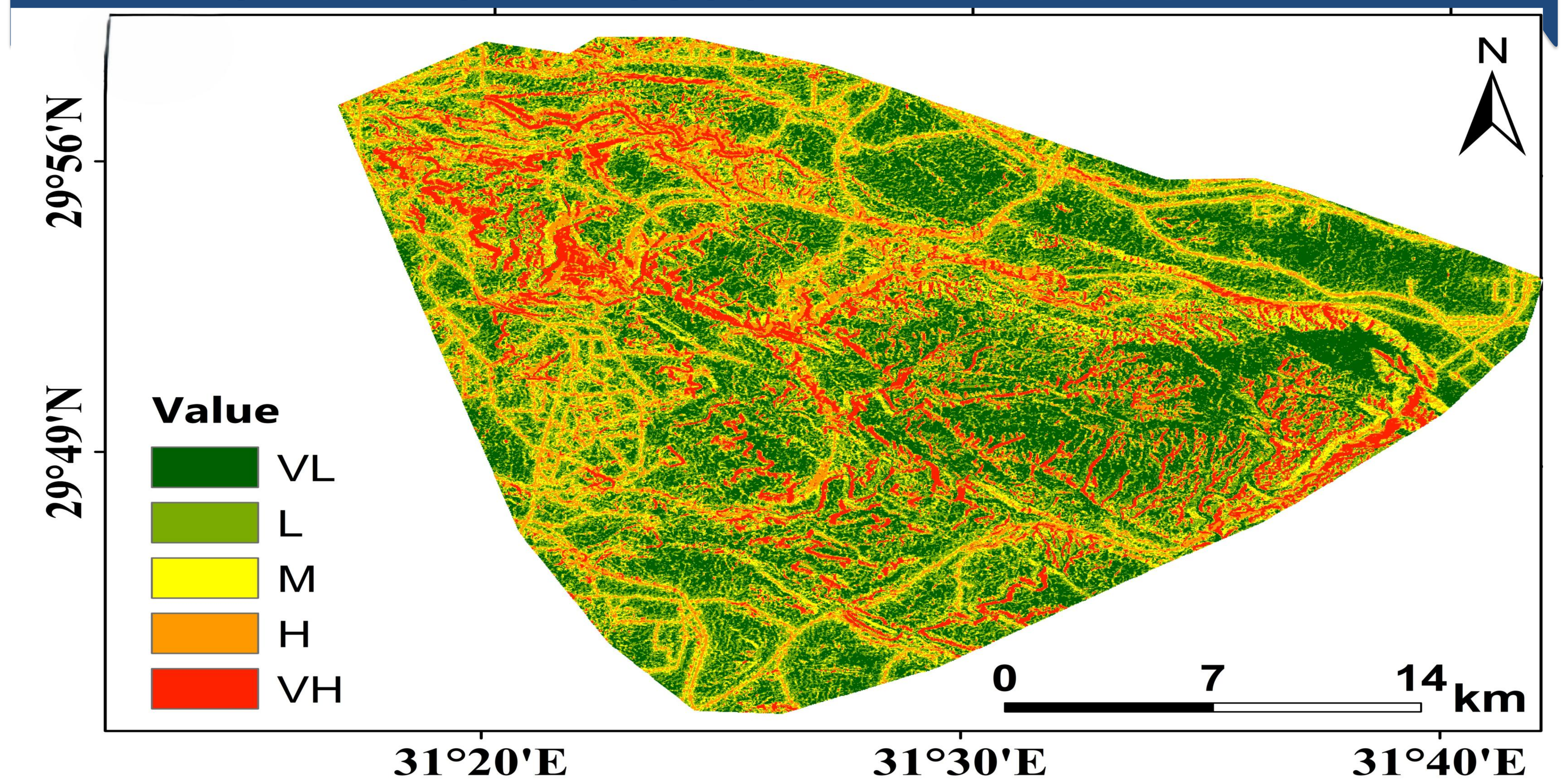






SHAP value (impact on model output): → Positive (increases susceptibility) → Negative (decreases susceptibility). Color scale (feature value): Low — High

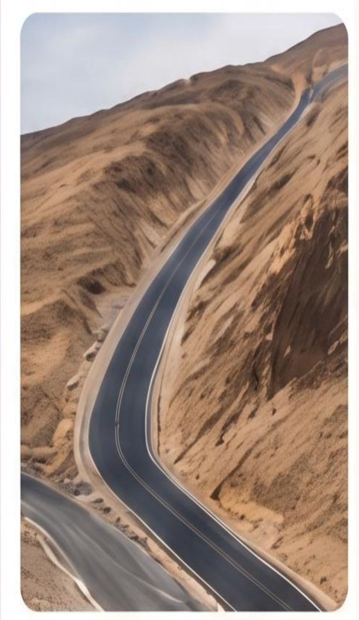
6. LANDSLIDE SUSCEPTIBILITY MAP



metrics	Accuracy	Recall	Specificity	F1	AUC
Best subset	0.91	0.92	0.91	0.91	0.96

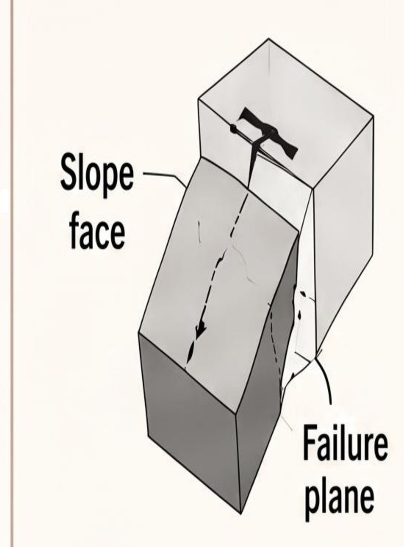
7. TYPICAL PROFILES

ROAD CUT SLOPE



✓ Common road cuts often trigger shallow rockfalls.

KINEMATIC SCENARIO (DIP SLOPE)



✓ Identifies slopes prone to toppling & planar failure in arid mountains.

8. KEY RESULTS / SUMMARY

- ✓ Distance to roads is the most dominant anthropogenic driver.
- ✓ Aspect (20°–30°) controls kinematic daylighting failures.
- ✓ SHAP reveals model transparency and interpretability.
- ✓ SHAP–RFE selects the most relevant predictors.
- ✓ Optimal results achieved with 5–9 key predictors.

9. APPLICATIONS

- Planning
- Risk Assessment
- Infrastructure Design
- Early Warning Systems

KEY MESSAGE

Explainable AI transforms black-box models into trustworthy decisions for landslide risk management

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