Supplementary Information
Supplementary Information to: *Adaptive Multihazard Modeling Predicts Rainfall-Driven Dam Failure: A Case Study* — Mohammed Nasser, Eleyas Assefa, Siraj M. Assefa, Constantinos C. Sachpazis and Lysandros Pantelidis.

This Supplementary Information contains material that supports and extends the findings reported in the main manuscript. It includes:

1. **Additional Results** — supplementary figures and plots (Supplementary Fig. S1–S#)

All supplementary figures and tables are cited at the relevant points in the main text (for example: “see Supplementary Fig. S3”. If external data or third-party figures are reproduced, the original source and permission statement are provided in the relevant caption.

1. Location and Data Variability

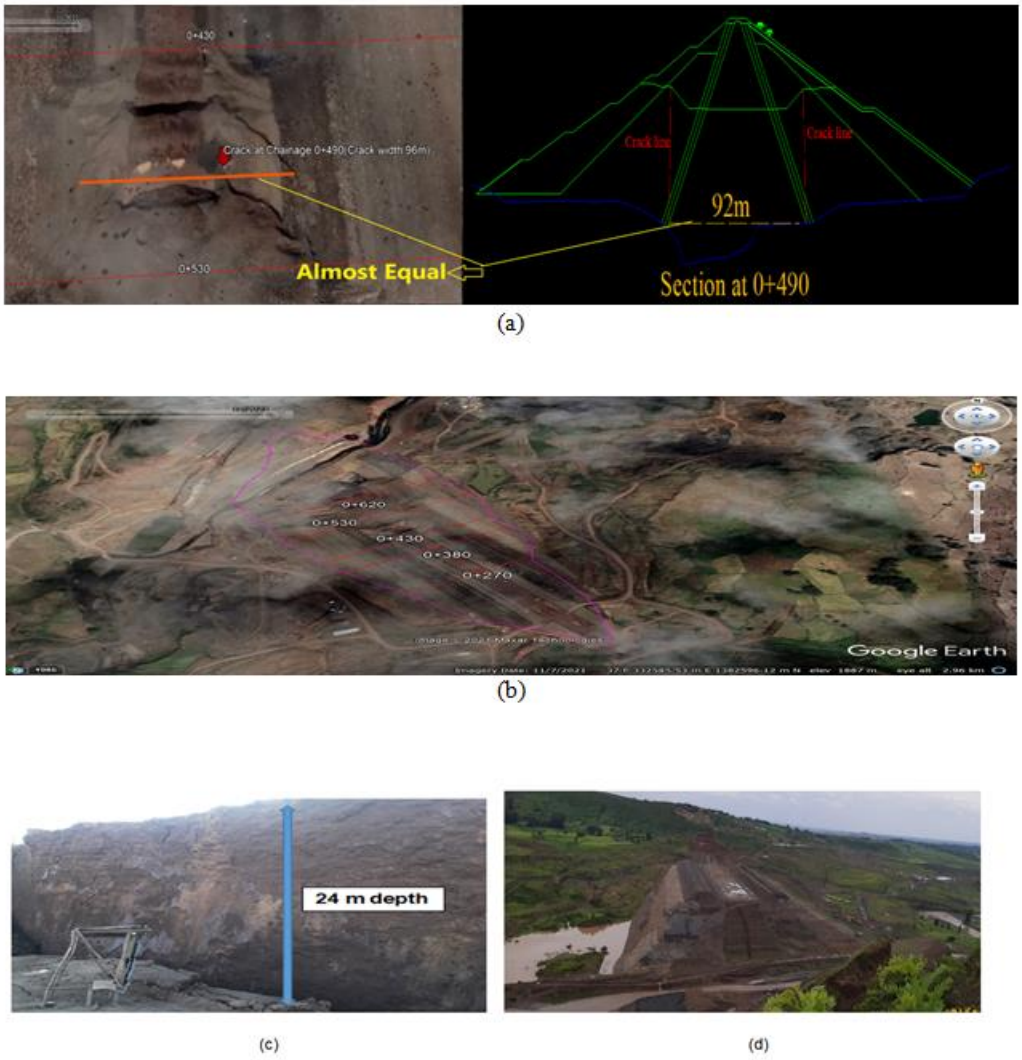
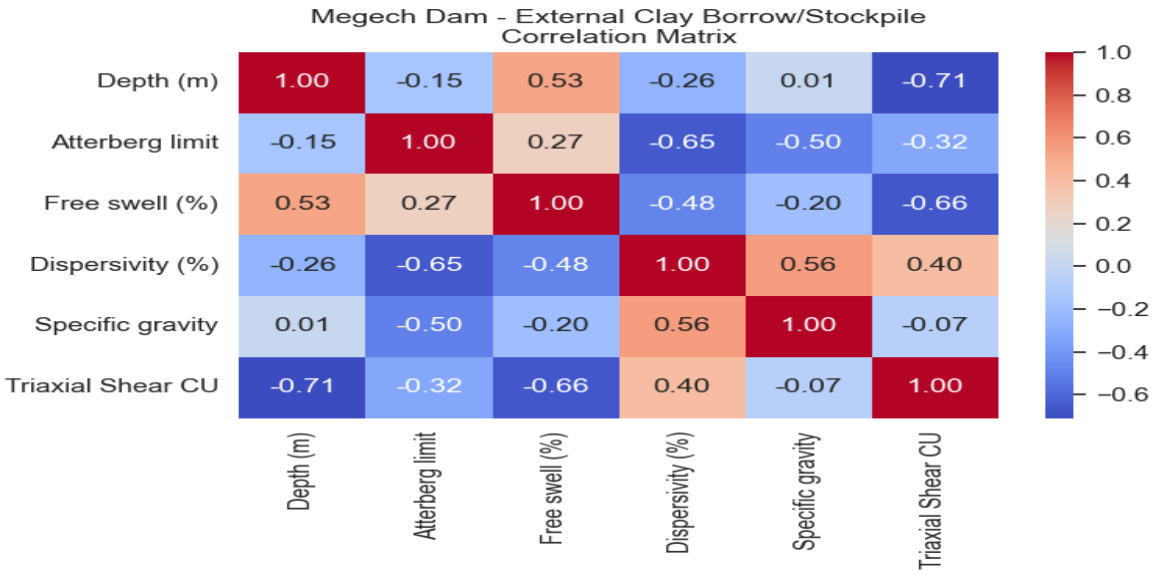
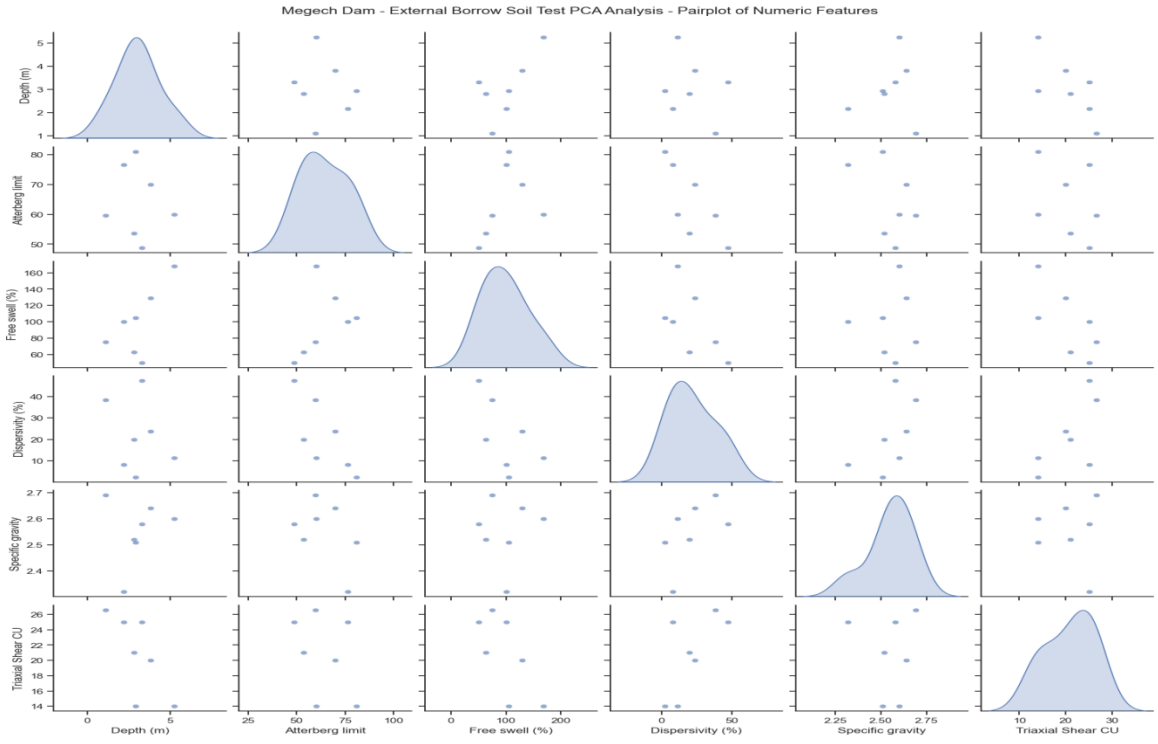


Figure S1: Field observations at Megech Dam showing progressive slope instability and corresponding mitigation efforts: (a) Stabilized clay core after 2020 tension cracks following >1,200 mm annual rainfall;; (b) Major 1.5 m-deep surface cracks on the core during the 2020–2021 wet season; (c) 2021 downstream slope slide displacing fill up to 3 m along chainage 0+420–0+640;d) 2022 emergency dyke diversion failed as reverse Megech River flow re-entered the embankment.



(a)



(b)

Figure S2 : PCA Analysis of Soil Properties for Megech Dam (a) Statistical Correlation of Atterberg Limits, Shear Strength, and Soil Quality Indicators (Megech Dam Clay Core Borrow).(b) External Borrow Soil Test PCA Analysis - Pairplot of Numeric Features.