Explainable AI-driven Digital Twin-Enabling Technologies for Developing Rainfall-Induced Landslides Forecasting Systems in Bangladesh

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Background

- All over the world, rainfall-induced landslides are recurrent and catastrophic disasters, with long-lasting impacts on people's lives, livelihoods, critical infrastructure, and sustainable development.

Rainfall-induced landslides a) debris flow, and b) rock slides in the study area

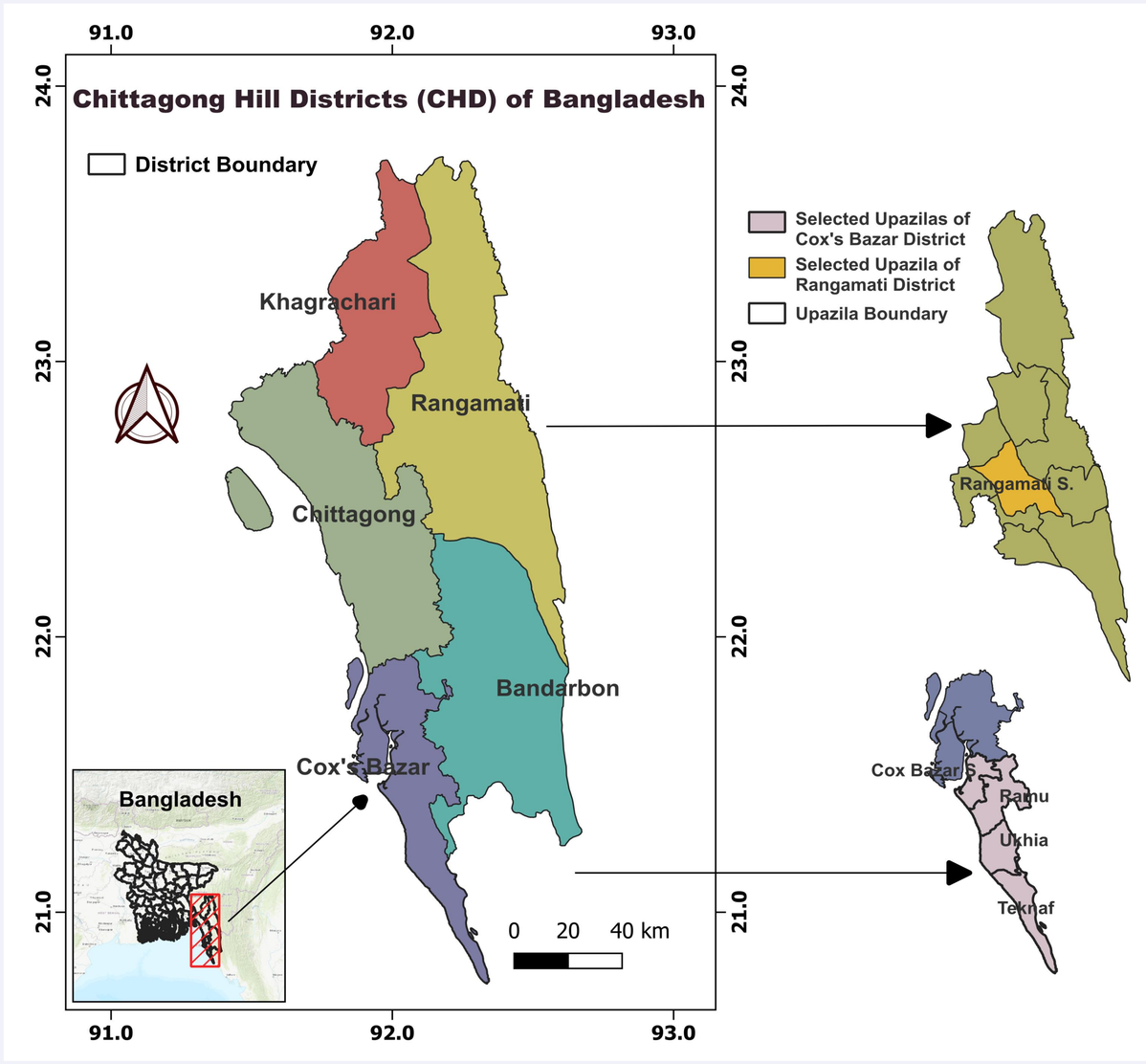
- A number of landslides forecasting systems (LFS) are operational in different parts of the world that help to minimize the overall loss and damage.
- Developing these LFS requires extensive data from various sources, such as meteorological, hydrological, geological, lithological, sensor data, and so on.
- However, many data sparse and rainfall-induced landslides-affected areas in the world lack an LFS because of the necessary data input to develop LFS, leaving people, their property, and the environment at high risk of landslide disasters.

Objectives

This research aims to develop the LFS with the available data by utilising explainable artificial intelligence (AI) and advanced geospatial techniques for the data sparse rainfall-induced landslides affected areas. As a case study, two districts of Bangladesh are selected (see the study area map). Therefore, the possible objectives of this research are:

1. To assess community perceptions towards landslides risks and forecasting system.
2. To estimate the rainfall threshold levels for the occurrence of landslides.
3. To explore the current landslide risk zones.
4. To develop a web-based LFS utilising explainable AI and advanced geospatial techniques, by incorporating community input.

Study Area



Map showing the geographical location of the study area

Data

Data will be collected from multiple sources for this work. The probable data and their sources are as follows:

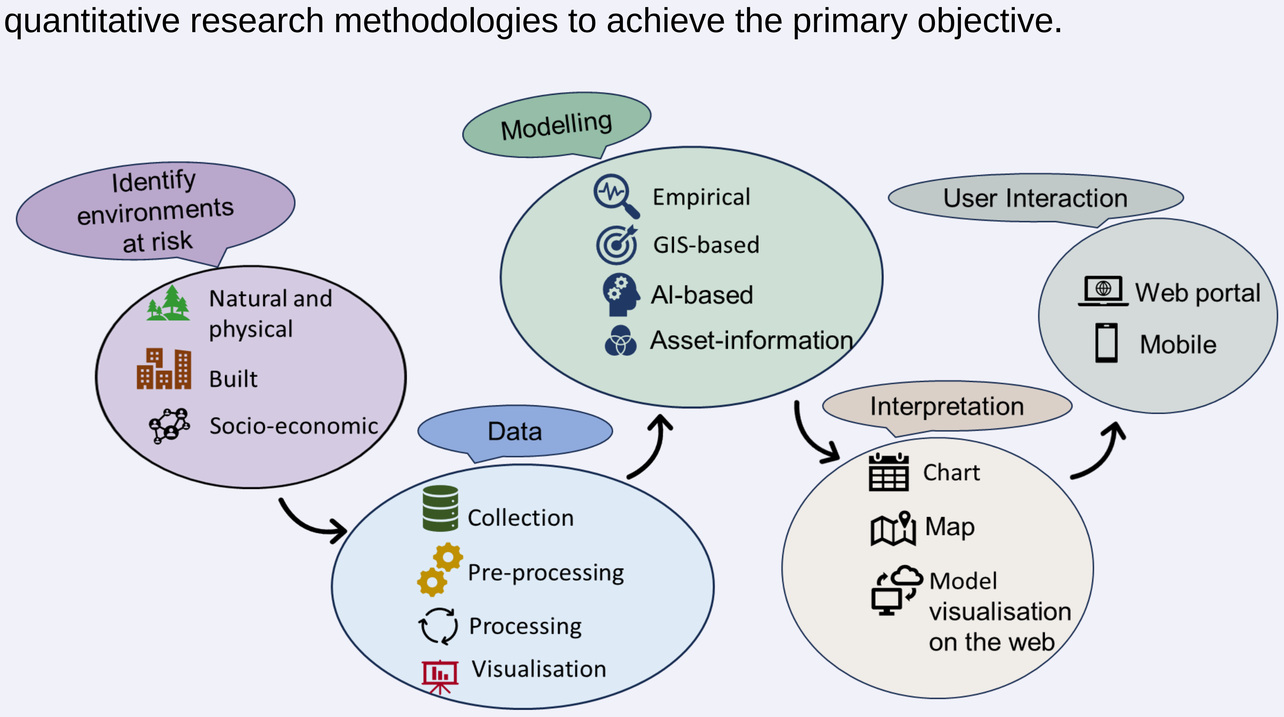
1. Qualitative data
- Community surveys
- Stakeholder interviews

2. Quantitative data
- Landslides inventories from field visits
- Historical rainfall and rainfall API from the Bangladesh Meteorological Department (BMD)

3. Remote sensing data
- Sentinel-2 from Copernicus Data Space Ecosystem
- Soil characteristics and Shuttle Radar Topography Mission (SRTM) derived digital elevation model (DEM) from NASA.

Methodology

This study will employ a mixed-methods approach, integrating both qualitative and quantitative research methodologies to achieve the primary objective.



The tentative methodological framework for developing LFS using explainable AI-driven digital twin-enabling technologies