

Rainfall-induced landslide susceptibility mapping using Frequency Ratio (FR) and Convolutional Neural Network (CNN): Case Studies in Davao de Oro and Albay, Philippines

*Kevin Lariosa Garas¹, Brylle San Agustin¹, Lalaine Correa¹, Ace Matthew Cantillep¹, Alfred Louie Panganiban¹, Alejandro Felipe Gorospe¹, Julius Vincent Umali¹, Karlo Queaño¹, Saro Lee²

1. Mines and Geosciences Bureau - Philippines, 2. Korea Institute of Geoscience and Mineral Resources - South Korea

Rainfall-induced landslides are among the common and more frequent hazards in the Philippines. Because of the significant socio-economic impacts of landslide occurrences, the Department of Environment and Natural Resources - Mines and Geosciences Bureau (DENR-MGB) launched the National Geohazard Assessment and Mapping Program (NGAMP) in 2006. The DENR-MGB is celebrating the 20th anniversary of the NGAMP, commemorating its contribution to the National Disaster Risk Reduction and Management (NDRRM) initiatives of the country. In line with this, the DENR-MGB is launching new data-driven methods in landslide hazard mapping using Frequency Ratio (FR) and Convolutional Neural Network (CNN).

Landslide inventory is the most crucial dataset to generate landslide susceptibility maps using these two methods. Landslide occurrences are delineated and inventoried using combined remote sensing (e.g. Landsat Sentinel 2, Google Earth imagery) and field observations, which are being compiled in a nationwide landslide inventory database. Several factor maps such as slope, elevation, aspect, distance to waterways, topographic wetness index, stream power index, distance to roads, geomorphology, distance to faults, soil type, geology, land cover, normalized vegetation index, planar curvature, and profile curvature, were used in generating landslide susceptibility maps. The new methods were pilot tested in Davao de Oro in Mindanao and Albay in Luzon. The predictive performance of the Frequency Ratio (FR) and Convolutional Neural Network (CNN) methodologies was assessed using the Area Under the Receiver Operating Characteristics (AUROC) curve.

These updated landslide maps are beneficial to the hazard prevention initiatives (e.g. land use planning, structural mitigation, nature-based solutions) and preparedness of vulnerable communities. The program also aims to produce impact-based forecasts and associated anticipatory actions to be implemented by local communities, DRRM officers, and other stakeholders. Hazard maps and risk information are crucial to the decision making process of local government units (LGUs) for sustainable development and safer communities.

Keywords: rainfall-induced landslide, Frequency Ratio, Convolutional Neural Network, Philippines