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TOPIC OF RESEARCH: IMPACT ASSESSMENT OF FLOOD UNDER CLIMATE CHANGE SCENARIO: A STUDY OF URBAN WATERSHED, GUWAHATI, ASSAM

FINDINGS

This doctoral research presents a comprehensive assessment of urban flood risks under climate change scenarios in the Guwahati urban watershed, Assam, India. Spanning approximately 340.67 km², the study area includes six sub-watersheds Bharalu, Silsako, Kalmoni, Deepor Beel, Foreshore, and North Guwahati characterized by complex terrain, high rainfall, and rapid unplanned urban expansion. The region is highly vulnerable due to its location in the Brahmaputra floodplain and ongoing ecological degradation.

A multidisciplinary methodology integrating geospatial techniques, statistical modelling, machine learning, and socio-economic analysis was employed. Satellite data from 1991 to 2020 were used to map land use/land cover (LULC) changes, revealing a 425% increase in built-up areas and a 45% decline in wetlands particularly the Ramsar-listed Deepor Beel—signifying intense anthropogenic pressure. Soil erosion was modelled using the Revised Universal Soil Loss Equation (RUSLE), and watershed prioritization was conducted based on morphometric and NDVI analyses to identify erosion-prone zones.

Hydro-climatic trends were evaluated using the Mann-Kendall test and Sen's slope estimator. Results indicated statistically significant warming trends and increasing variability in rainfall patterns. River discharge analyses showed declining annual flows but increasing monsoonal peaks, suggesting intensified flood risks due to more concentrated runoff events.

Flood susceptibility mapping was performed using advanced machine learning algorithms such as Random Forest (RF), Support Vector Machines (SVM), and deep neural networks. Metaheuristic feature selection techniques (Genetic Algorithm, Boruta, Recursive Feature Elimination) identified rainfall, elevation, and LULC as the most influential conditioning parameters. Among all models, GA-RF yielded the highest predictive accuracy (AUC = 0.892), with SVM showing robust classification performance. Deep learning models further enhanced the sensitivity analysis and revealed complex interdependencies among variables.

Social vulnerability was assessed through household surveys across flood-prone wards, infrastructural mapping, and participatory observations. The Social Vulnerability Index (SVI), developed using the

Analytical Hierarchy Process (AHP), highlighted that the Bharalu and Silsako sub-watersheds faced the highest risk due to low plinth heights, lack of early warning systems, inadequate drainage, and socio-economic marginalization. Violin-jitter plots revealed stark disparities in preparedness and exposure among communities.

Future flood scenarios were simulated under four Representative Concentration Pathways (RCPs 2.6, 4.5, 6.0, and 8.5) using projected rainfall from General Circulation Models (GCMs). Results showed a significant spatial expansion of flood-susceptible areas by 2100, particularly under high-emission scenarios (RCP 8.5), with the eastern and northern sectors of the city becoming increasingly vulnerable.

In conclusion, the findings highlight that unregulated urban growth, coupled with climate-induced hydrometeorological extremes, is driving Guwahati toward higher flood risk. This study advocates for integrative flood management strategies—encompassing land-use regulation, wetland restoration, early warning systems, and climate-resilient infrastructure—to build urban resilience and safeguard the socio-ecological fabric of the city.