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Topic of Research: Impact of Cyclone on Residential Buildings: Vulnerability and Risk in Indian Sundarbans

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Findings

The analysis of land use and land cover (LULC) changes during the pre- and post-cyclone periods of Cyclones Sidr, Aila, Bulbul, and Amphan in the Sundarbans reveals significant impacts on the region's landscape. Cyclone Sidr led to substantial increases in water-logged and swamp areas by approximately 38.18 km² and 21.22 km², respectively, while sand/beach areas decreased by about 26.31 km². Water bodies and settlements saw declines of approximately 83.14 km² and 269.32 km², respectively, with open forest areas increasing significantly by about 408.03 km². Cyclone Aila's impact included increases in water-logged and swamp areas, with water bodies and settlements decreasing by approximately 3.82 km² and 52.30 km², respectively, and open forest areas increasing by about 128.47 km². Cyclone Bulbul resulted in a notable rise in water-logged areas by approximately 101.19 km² and a surge in water bodies by about 119.01 km², while settlement areas decreased by approximately 69.29 km². Cyclone Amphan caused a decrease in dense forest areas from 1896.60 km² to 1170.63 km² and an increase in wasteland from 998.12 km² to 1087.33 km², with significant increases in agricultural land and wetlands. The conversion of fallow land to agricultural land was particularly notable.

The vulnerability assessment categorized levels into four classes: low, medium, high, and very high. Among surveyed houses, 12% were classified as low vulnerability, 33% as medium, 32% as high, and 12% as very high vulnerability. Blocks like Basanti, Patharpratima, Sagar, and Namkhana showed very high vulnerability, while others like Hingelgange, Mathurapur I, Kultali, and Sagar indicated high vulnerability. The majority of buildings fell within the low to medium vulnerability range. The hazard distribution using six indicators—wind speed, wind

pressure, distance from the coast, distance from the cyclone's path, LULC, and NDVI—revealed approximately 32.17% of the area as highly vulnerable, especially in southern and eastern parts. Building hazard levels were classified as low (22.28%), medium (27.02%), high (30.18%), and very high (20.53%), with Namkhana and Sagar having a higher proportion of buildings in the 'Very High' hazard category.

The risk assessment, combining hazard analyses, categorized risks into Very High (4.21%), High (11.75%), Medium (33.86%), and Low (50.18%). High-risk zones like Sagar, Namkhana, and Gosaba demand targeted interventions, while low-risk zones like Haroa I, Canning I, Jaynagar I, and Jaynagar II showcase better preparedness or advantageous geographical positioning. Susceptibility mapping conducted by various models provided insights into the region's vulnerability to storm surge flood scenarios, with very low susceptibility zones covering significant areas in 1-meter to 4-meter inundation scenarios. Coastal areas like Sagar, Namkhana, Hingalganj, and Basanti exhibited very high vulnerability due to their exposure to storm surges. In response to these escalating challenges, strategic policy implications include sustainable land use planning, integrated coastal zone management, mangrove reforestation, insurance mechanisms, global collaboration, and strengthened early warning systems. Policy measures for building vulnerability emphasize community-based resilience programs, resilient construction practices, infrastructure improvements, and community involvement in decision-making. This multifaceted strategy is necessary for effective governance and to enhance resilience in the Sundarbans region.