Dynamic Vulnerability and Multi-Hazard Risk Assessment: A Case of Visakhapatnam Metropolitan Region

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ABSTRACT

The Visakhapatnam Metropolitan Region (VMR) exemplifies the complexities of vulnerability as a dynamic phenomenon shaped by its geography and socio-economic evolution. Flanked by the Eastern Ghats and the Bay of Bengal, the region benefits from natural barriers to external risks and economic opportunities. However, these same features amplify risks from coastal hazards, urban sprawl, and industrial activities, highlighting the need for a nuanced understanding of vulnerability to manage multi-hazard risks effectively.

Vulnerability is shaped by a dynamic interplay of physical, social, economic, and environmental factors. Beyond physical exposure, inequality in access to resources, governance, and social networks significantly influences susceptibility. Adaptive capacity, rooted in resource availability, effective governance, and community cohesion, is key to mitigating vulnerability. This multidimensional perspective highlights the need for holistic approaches addressing both immediate risks and systemic drivers to enhance resilience against evolving hazards.

Dynamic vulnerability in the VMR arises from urbanization, economic inequality, and environmental degradation, creating varying susceptibilities across spatial and temporal scales. Consecutive or compound disasters, such as cyclones triggering floods, intensify these vulnerabilities, especially for marginalized communities, by overwhelming infrastructure and socio-economic systems. Coastal and low-lying areas are disproportionately impacted due to dense populations and industrial pressures, while vulnerabilities shift over time with demographic changes, land-use transitions, and repeated hazard exposure. Moreover, adaptations to past disasters, while aimed at reducing immediate risks, can inadvertently create new exposure patterns or redistribute vulnerabilities, emphasizing the need for forward-thinking and adaptive planning.

This study adopts a multi-hazard assessment framework that integrates spatial, temporal, and social dimensions to identify risk hotspots and prioritize interventions. This research is

particularly significant in the face of escalating extreme weather events driven by climate change. By analyzing the dynamic interplay between vulnerabilities and hazards, it presents a robust and adaptable framework for risk management, resilience-building, and sustainable development. Although centered on the VMR, the findings have broader relevance, offering actionable insights and strategies for other regions confronting similar challenges globally.

Keywords: Dynamic Vulnerability, Multi-Hazard Risk, Spatial and Temporal Dimensions, Community Resilience, Disaster Risk Management