Exploring the Nexus between Urban Vulnerability and Slum Populations in Kolkata Municipal Boroughs

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Introduction: The city of Kolkata, a vibrant metropolis in eastern India, is characterized by a rich cultural heritage and a diverse urban landscape. Within the Kolkata Municipal Area, the city is administratively divided into 16 boroughs, each contributing uniquely to the city's dynamics. These boroughs collectively encapsulate the essence of Kolkata's urban life, accommodating a significant portion of its population.

The focus of this scientific study is a comprehensive exploration of the interplay between slum populations and various environmental factors across the 16 boroughs of Kolkata. Our investigation delves into the correlation between slum demographics and key variables, including the Flood Vulnerability Index (FVI), Urban Water Availability Index, Average Temperature, and the Urban Water Quality Index.

Methodology: To conduct this study, we employed a multi-faceted methodology, drawing data from diverse sources. The geographical information was obtained from an open-source GitHub repository, utilizing shapefiles to delineate the boundaries of the Kolkata municipal boroughs.

Additionally, we leveraged insights from research papers such as "An Integrated Quantitative Assessment of Urban Water Security of a Megacity in the Global South" by Subham Mukherjee, Trude Sundberg, P. K. Sikdar, and Brigitta Schütt. The study provided valuable information on urban water security, enriching our analysis.

Furthermore, we integrated findings from "Flood Vulnerability and Slum Concentration Mapping in Indian City of Kolkata: A post-Amphan analysis" by Alokananda Banerjee Mukherjee and Suchandra Bardhan, Department of Architecture, Jadavpur University, Kolkata, India. This post-Amphan analysis offered critical insights into flood vulnerability and slum concentrations.

To augment our dataset, we incorporated information from the City Disaster Management Plan of Kolkata, as documented by the West Bengal Disaster Management Authority. This comprehensive plan outlined crucial aspects of disaster management within the city, informing our understanding of the broader context.

For the visualization of our findings, we utilized Dash, a Python library, to create interactive maps. The correlation between slum populations and environmental variables, such as FVI, average temperature, Urban Water Quality Index, and water availability, was vividly depicted. Circles representing slum population sizes were juxtaposed with color-coded representations of the aforementioned factors, offering a visual narrative of their interrelationships.

In the subsequent sections of this report, we present our findings, analyze the observed correlations, and discuss the implications of our study on urban planning and resilience in Kolkata.

Results :

1. Average Temperature Variation: Our analysis reveals significant variations in average temperatures across the 16 boroughs of the Kolkata Municipal Area. Boroughs 10 and 11 experience the highest average temperatures, reaching up to 28 degrees Celsius. In contrast, Boroughs 14 and 15 exhibit the lowest average temperatures, providing a stark contrast within the municipal area.

2. Urban Water Quality Index Distribution: The Urban Water Security Index (UWSI) exhibits notable disparities among the boroughs. Borough 1 stands out with the highest UWSI, reflecting excellent water quality. Conversely, Boroughs 10, 11, 12, 13, 14, and 15 register the lowest UWSI values, indicating challenges in water quality in these areas.

3. Water Availability Index Disparities: Our investigation into the Water Availability Index demonstrates varying levels of water accessibility across the boroughs. Borough 1 enjoys the highest water availability, while Boroughs 15, 16, 11, and 13 face challenges with the lowest water availability. This highlights a critical aspect of urban infrastructure that demands attention for equitable resource distribution.

4. Flood Vulnerability Index Peaks: The Flood Vulnerability Index (FVI) exhibits noteworthy patterns, with Boroughs 7 and 14 registering the highest vulnerability. Understanding the heightened risk in these areas is crucial for effective disaster preparedness and mitigation strategies.

These findings underscore the heterogeneous nature of environmental variables across Kolkata's municipal boroughs, signifying the importance of context-specific interventions for sustainable urban development and resilience. The observed disparities in average temperature, urban water quality, water availability, and flood vulnerability emphasize the need for tailored strategies to address the unique challenges faced by each borough. In the subsequent sections, we delve deeper into the correlations between these environmental factors and the slum populations, offering insights that can inform urban planning and resource allocation strategies.

Conclusion:

Our study has provided a comprehensive understanding of the intricate relationship between slum populations and key environmental variables across the 16 boroughs of the Kolkata Municipal Area. The observed variations in average temperature, urban water security, water

availability, and flood vulnerability underscore the complex interplay between urbanization, climate, and infrastructure.

The identification of high-temperature zones in Boroughs 10 and 11, coupled with disparities in water quality and availability, highlights the need for targeted interventions in specific regions. The elevated flood vulnerability in Boroughs 7 and 14 emphasizes the importance of integrating resilience measures into urban planning, especially in areas prone to environmental hazards.

These findings have broader implications for urban development strategies, necessitating context-specific policies to address the unique challenges faced by each borough. As cities strive for sustainable growth, our study underscores the importance of considering environmental justice and resilience in shaping urban landscapes.

As we move forward, it is imperative to use these insights to inform evidence-based policy decisions, promoting inclusive urban development that addresses the needs of vulnerable populations, particularly those residing in slum areas. By integrating environmental considerations into urban planning, we can work towards creating more resilient, equitable, and sustainable cities.

References:

1. Mukherjee, S., Sundberg, T., Sikdar, P. K., & Schütt, B. (2022). "An Integrated Quantitative Assessment of Urban Water Security of a Megacity in the Global South."

2. Banerjee Mukherjee, A., & Bardhan, S. (2021). "Flood Vulnerability and Slum Concentration Mapping in Indian City of Kolkata: A post-Amphan analysis." Department of Architecture, Jadavpur University, Kolkata, India.

3. West Bengal Disaster Management Authority. (2021). "City Disaster Management Plan of Kolkata."

4. Wards of Kolkata Municipal Corporation - Wikipedia.

5. Kolkata Municipal Corporation Portal