Gender-Based Vulnerability: Combining Pareto ranking and geostatistics to model gender-based vulnerability in Rohingya refugee settlements in Bangladesh

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Abstract
Background: The Rohingya refugee crisis in Bangladesh continues to outstrip humanitarian resources and undermine the health and security of over 900,000 people. Spatial, sector-specific information is required to better understand the needs of vulnerable populations, such as women and girls, and to target interventions with improved efficiency and effectiveness. This study aimed to create a gender-based vulnerability index and explore the geospatial and thematic variations in gender-based vulnerability of Rohingya refugees residing in Bangladesh by utilizing pre-existing, open source data.

Methods: Data sources included remotely-sensed REACH data on humanitarian infrastructure, United Nations Population Fund resource availability data, and the Needs and Population Monitoring Survey conducted by the International Organization for Migration in October 2017. Data gaps were addressed through probabilistic interpolation. A vulnerability index was designed through a process of literature review, variable selection and thematic grouping, normalization, and scorecard creation, and Pareto ranking was employed to rank sites based on vulnerability scoring. Spatial autocorrelation of vulnerability was analyzed with the Global and Anselin Local Moran’s I applied to both combined vulnerability index rank and disaggregated thematic ranking.

Results: Twenty-four point one percent of settlements were ranked as ‘most vulnerable,’ with 30 highly vulnerable clusters identified predominantly in the upazila of Sadar. Five settlements in Dhokkin, Somitapara, and Pahartoli were categorized as less vulnerable outliers amongst highly vulnerable neighboring sites. Security- and health-related variables appear to be the most significant drivers of gender-specific vulnerability in Cox’s Bazar. Clusters of low security and education vulnerability measures are shown near Kutupalong.

Conclusion: The humanitarian sector produces tremendous amounts of data that can be analyzed with spatial statistics to improve research targeting and programmatic intervention. The critical utilization of these data and the validation of vulnerability indexes are required to improve the international response to the global refugee crisis. This study presents a novel methodology that can be utilized to not only spatially characterize gender-based vulnerability in refugee populations, but can also be calibrated to identify and serve other vulnerable populations during crises.
Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the manuscript can be downloaded and accessed as a PDF.

Figures

Figure 1

Methodological process for creating a gender-based vulnerability index and subsequent geostatistical analysis
Figure 2

A two-dimensional illustration of Pareto ranking in which each data point (in our study, settlement site) has two thematic component scores. Those data points represented as circles are considered the most vulnerable rank, in that each site is non-dominated. Those represented as ‘X’s are second-most vulnerable, and those represented by squares are least vulnerable.
Figure 3

Total gender-based vulnerability index rankings of Rohingya refugee settlements in
Bangladesh wherein 1=least vulnerable and 6=most vulnerable.
Gender-Based Vulnerability in Rohingya Refugee Settlements

Cluster Analysis with Anselin Local Moran’s I

Figure 4

Cluster analysis with Anselin Local Moran’s I of gender-based vulnerability in Rohingya Refugee settlements in Bangladesh
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Outlier Analysis with Anselin Local Moran's I

Figure 5

Outlier analysis with Anselin Local Moran’s I of gender-based vulnerability in Rohingya Refugee settlements in Bangladesh
Cluster analysis of gender-based vulnerability in Rohingya refugee settlements as disaggregated by thematic components, including education, WASH, security, and health
