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Spatial Clustering of Dengue Fever Incidence and Its Association with Land Use and Land Cover: A study in Kolonnawa Divisional Secretariat, Sri Lanka

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Abstract

Land use and Land cover changes, a major constituent of global environmental change, potentially has significant consequences for human health in relation to mosquito-borne diseases. Especially, Land use change can influence mosquito habitat, and therefore the distribution and abundance of vectors, and land use mediates human–mosquito interactions, including biting rate. Land use such as Settlements, water bodies or certain construction works have been identified as likely risk factors for dengue because of the provision of suitable habitats for the vector. With more than 105,049 cases reported by the Epidemiology unit of Ministry of Health, the dengue outbreaks from 2011 to 2019 seriously impacted the outer region of Colombo, Sri Lanka. This study aims to assess the spatial autocorrelation of the dengue fever (DF) outbreak in Kolonnawa divisional secretariat from May to September in 2019, and to further understand the effects of Land use (such as Settlements, Water bodies, Construction sites and forest areas) allocation on DF. In this study, two different greenness indexes were used. The first green metric, the normalised difference vegetation index (NDVI), was provided by the long-term NASA MODIS satellite NDVI database, which quantifies and represents the overall vegetation greenness. The 2004 land use survey GIS database completed by the Survey department was obtained and updated to access another metric, land use in Kolonnawa. Spearman's rank correlation coefficient used to find out the relationship between DF and green space, and then four spatial autocorrelation methods, including Global Moran's I, Nearest Neighborhood analysis, high/low clustering, and Hot Spot were employed to assess the spatial autocorrelation of DF outbreak. Results of spatial autocorrelation analysis showed a high aggregation of dengue epidemic in western parts of the Kolonnawa DS division, and the urban areas were the main hotspots. These hotspots were directly associated with Kolonnawa Canal, Construction sites and slums areas. Results of correlation analysis also showed a positive correlation between Water bodies and dengue fever. The forest areas and marsh lands metrics and other land cover types revealed a negative association with DF. The results indicate a high spatial variability suggesting that risk of exposure is spatially heterogeneous and varies according to land cover and land use. These findings may be an important asset for improving surveillance and control interventions of dengue in the region.

Keywords: Dengue, Land Use, NDVI, Autocorrelation