

Spatio-temporal analysis of earthquake disaster risk: A case study in Sumida Ward, Tokyo

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According to The Headquarters for Earthquake Research Promotion Investigation Committee, there is a 70% chance of probability, that earthquakes with a magnitude of Richter scale of 7 will be occurring in southern Kanto area within the next 30 years. Understanding of disaster risks in a spatiotemporal perspective helps to reduce the potential damages of disasters effectively. Thus, this study aims to assess disaster risks in both spatial and temporal perspective in Sumida Ward, which is one of the 23 special wards in Tokyo. A large number of wooden buildings and structures, high population density, geographical location, and urban spatial structure have higher level of vulnerability and damages for disaster in this area.

In this study, the Geographic Information System (GIS) and Data Envelopment Analysis (DEA) technique were integrated to achieve the main objective of the study. A set of indicators including critical facility infrastructure, earthquake resistance standards of construction, roads, women population ratio, etc. is provided to assess the vulnerability. These indicators were developed and presented based on 50m × 50m grid scale using ArcGIS and the assigned relative weight by DEA. However, assessing disaster risks are not only inclusive of vulnerability but also exposure. The data of daily movement of people are used to determine the population exposure within 24 hours.

The results show that depending on the time and area, the disaster risk can vary in the study area. The northern part of Sumida Ward has higher disaster risk due to its building and urban spatial structure. Compared to the northern part of Sumida, the southern part has a lower disaster risk. However, the probability of the disaster risk in some areas of the southern part of Sumida increases during daytime. The disaster risks at different times of the day and is presented at hourly level. The methodology used and presented in this study is very important to ease policymaking and decision support in the region. This method can be applied for other related case studies and can also be developed further by employing various data sources.

Keywords: Disaster risk , GIS, Sumida ward