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Simulating urban growth in Kathmandu, Nepal

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Urban growth is recognized as physical and functional changes due to the transition of rural landscape to urban forms. Kathmandu, the most populous metropolitan region in Nepal, is facing rapid urbanization since the last few decades. This research aims to trace the spatial pattern of urban growth since the 1960s and simulate the growth until 2030. Acquiring knowledge of historical spatial trends is very important to simulate future urban growth. Four time series land use maps derived from remote sensing and geographic information systems techniques were used for each decade until 2000. Land use transition rates were computed for the 1970s, 1980s and 1990s employing Markov chain property.

In the past decades, a highly dynamic spatial pattern of urban growth is observed in Kathmandu. The built-up areas had a slow trend of growth in the 1960s and 1970s but have grown rapidly since the 1980s. Prime agricultural land in the valley floor has been changed into built-up areas. Shrubs and forest landscapes in rural areas also contributed to the increase of built-up area. The land use transitions between the other land use types were very nominal. Therefore, in this study, three land-use categories, i.e., built-up land (industry, urban open space, institutional land, palaces, administrative area, airport, urban/built-up area including road), water area (river and lake), and non-built-up land (agricultural, shrubs, and forest) were prepared for urban growth simulation. Water area remained constant while non-built-up lands transforming to built-up.

We adapted Weight of Evidence method, which is based on a log-linear form of Bayes' rule and uses the prior probability distribution and the likelihood of the data to generate a posterior probability distribution. It is used for selecting the most important variables needed for the land-cover change analysis and creating transition rules. A local cellular automata model was implemented for simulating spatial patterns of the urban growth. The model was validated using fuzzy similarity analysis at multiple resolutions fitness. The model was run for 30 years, divided into annual time steps. Based on the interactions between landscape elements occurred in different ways, depending on local characteristics and transition rates, this model produced distinct spatial patterns of change. The simulated results show twice of the existing spatial pattern of urban growth in Kathmandu. A refill type of development is observed. The existing urban space is saturated in terms of resources, i.e., lands, green space, water, and other public facilities. What will happen if the real situation continues and becomes parallel to simulated results in the 2020s? The model will help to alert decision makers for controlling the urban growth of Kathmandu.

Keywords: Urban Growth, Land Use, Geosimulation, Weight of Evidence, Kathmandu, Nepal