Land Use Change Factors in Kathmandu Valley
~A GWR Approach~

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1. Motivation

Kathmandu Valley (Fig 1), most populous metropolitan region in Nepal, has been facing rapid land use change (LUC) over the last three decades. Identifying relationship between the LUC and associated factors is essential for understanding the urbanization process in the valley. This paper aims to explore LUC factors in the valley applying Geographically Weighted Regression (GWR).

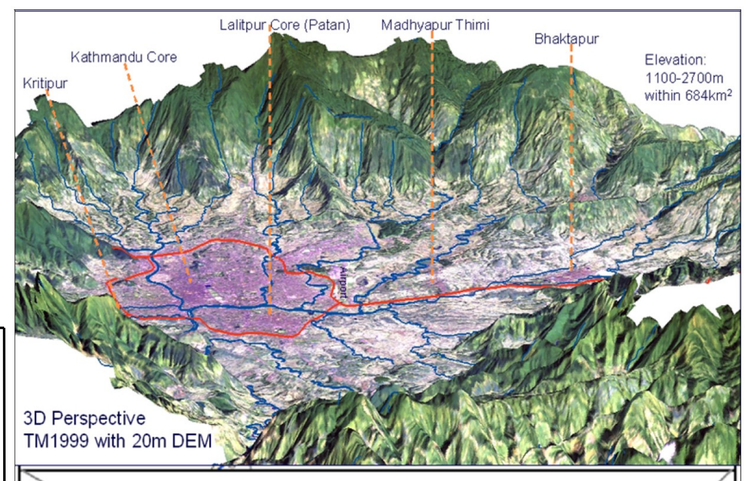

Fig 1. Study Area — Kathmandu Valley, Nepal

2. Method

2.1 Data: Land use maps (1991, 2000), DEM 20m, Population census (1991, 2001), Water, Road (1991)

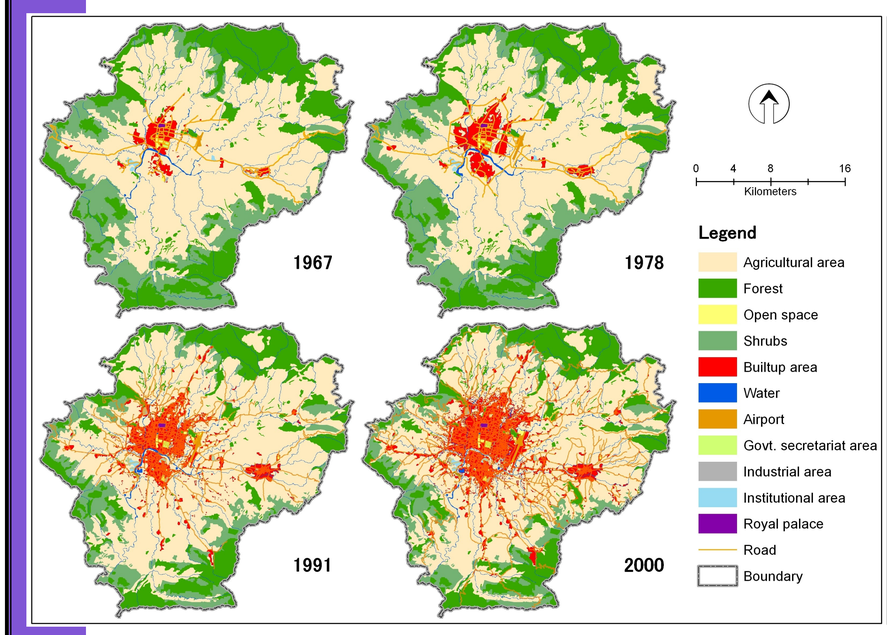

Fig 2. Land use maps (1967-2000)

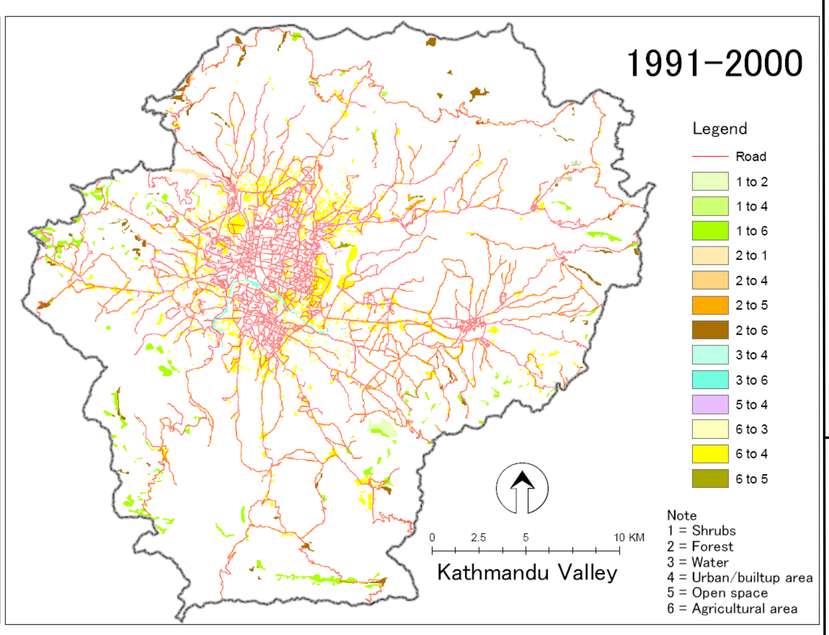

Fig 3. Land use change (1991-2000)

The Fig.1 & 2 are taken from Thapa, R. B. (2009). Spatial process of urbanization in Kathmandu Valley, Nepal. University of Tsukuba, PhD Dissertation.

2.2 LUC Factors selection process:

Step 1: Scatter plot evaluation—removed highly correlated factors

Step 2: Ordinary Least Square (OLS) test

Step 3: If selected factors are statistically significant, no multicollinearity (VIF<7.5), low AIC, no spatial autocorrelation Moran's-I, then ready for GWR modelling.

Step 4: Factors: Population change (1991-2001), agricultural area (1991), forest and shrubs (1991), slope, distance to water area, and distance to road (1991)

OLS:

$$y_i = \beta_0 + \sum_k \beta_k x_{ik} + \varepsilon_i$$

GWR:

$$y_i = \beta_0(u_i, v_i) + \sum_k \beta_k(u_i, v_i) x_{ik} + \varepsilon_i$$

3. GWR Results

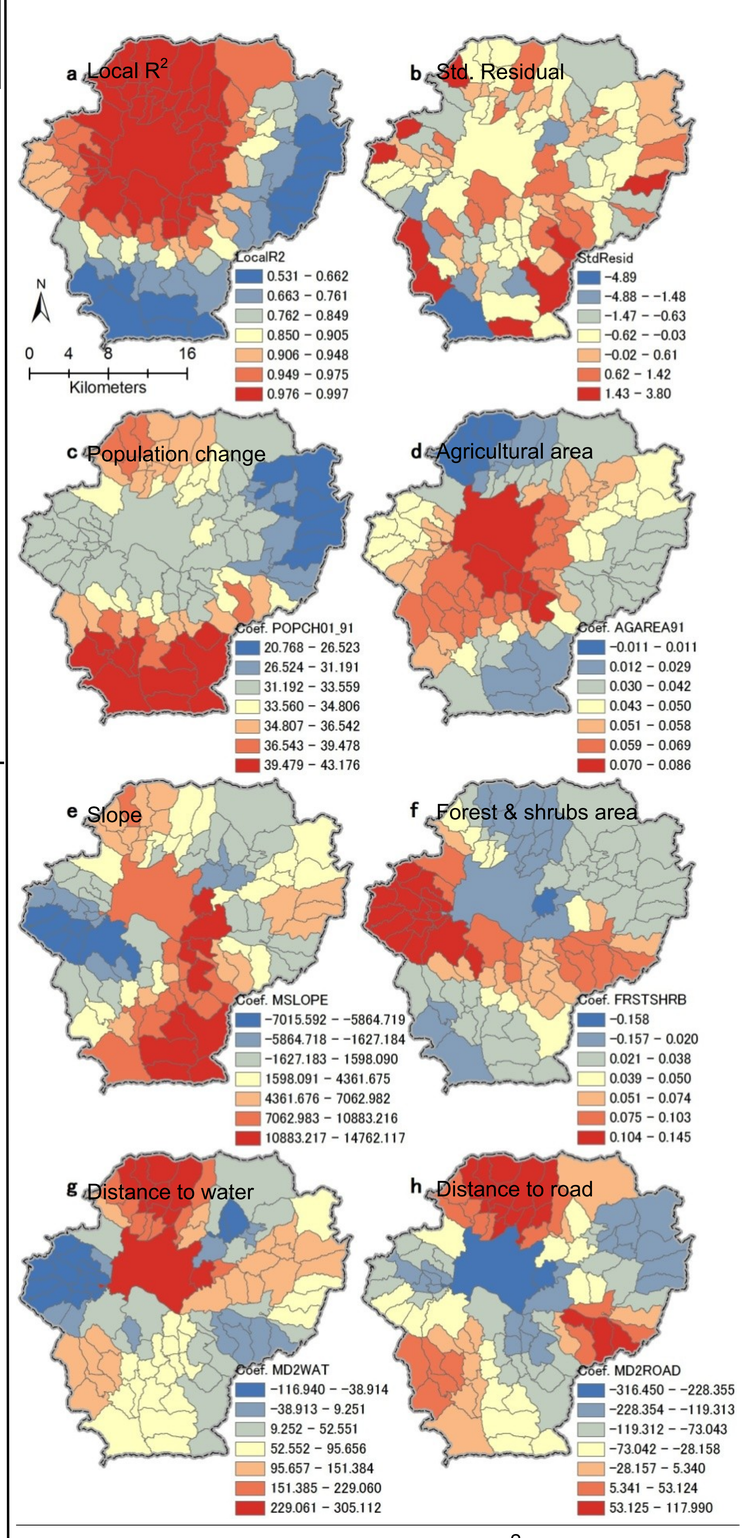

Fig 4. Parameter estimates: Local R^2, Std Residuals, and coefficients of the corresponding factors

4. Discussion and conclusions

☛ The changing landscape of the urban structure in the valley was influenced by the population change, available agricultural, forest and shrubs lands, slope, access to water and roads which welcomed development projects in the 1990s and changed the landscape mostly to built-up surface.

☛ The selected factors have the highest explanatory power (R^2>0.97) in the urban centres and adjacent northern villages while the eastern and southern villages have the lowest (<0.66) explanatory power (Fig 4.a). The residuals of over and under predictions (Fig 4.b) are randomly distributed as confirmed by the Moran's I (0.01).

☛ Looking at the spatial patterns of each factor coefficients in the Fig 4.c-h, the LUC in the urban centers and adjacent southern villages is mainly influenced by population growth, availability of agricultural area, slopes, and access to water. The LUC in the western villages are mainly influenced by the forest and shrubs lands in 1991. Agriculture encroachment over forest and shrubs lands occurred during the period.

☛ The LUC in far northern villages is promoted by road, water (river), and slope. The slope and population change are observed as major factors of LUC in the southern villages.

Acknowledgement

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