Analyzing Land Use Change of Urban Environment in Kathmandu Valley

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Urbanization in Kathmandu is growing rapidly, creating extensive urban landscapes. Many of the farmlands and forestlands have been transformed into human settlements during the past five decades. Almost everyone has seen these changes to their local environment without a clear understanding of their impacts. Study of these landscape changes from a spatial perspective with a time scale of decade to measure the changes could be an important mean for monitoring of ongoing environmental consequences in the Nepalese capital. Kathmandu metropolitan region is a bowl-shaped valley contains some of the oldest human settlements in the central Himalayas where it has been experiencing many environmental problems. This research aims to analyze spatio-temporal patterns of land use change in Kathmandu valley by applying remote sensing and GIS techniques.

The study area is delineated from 20-meter DEM based on watershed principles. The valley extends over 68,500 hectare of area making a living home for 1.5 million people. Multi-temporal satellite images from high resolution (CORONA, SPIN and IKONOS) to moderate resolution (LANDSAT: MSS, TM) were processed since 1967. Four maps were prepared from the images for the year 1967, 1978, 1991 and 2000. A set of landscape metrics: number of patch (NP), largest patch index (LPI), landscape shape index (LSI), Euclidian nearest neighbor distance mean (ENN_MN), area weighted mean patch fractal dimension index (AWMPFD), contagion index (CONTAG) and Shannon's diversity index (SHDI) were computed to evaluate the land use dynamics at class and landscape levels. The selection of the spatial metrics was based on their value in representing specific landscape characteristics as already explored in previous researches on urban areas. Erdas Imagine 9.1, ArcGIS 9.2 and Fragstats 3.3 software were used for processing and analyzing the land changes.

The urban area in the valley increased from 3% in 1967 to 13% in 2000 where the shrubs lands decreased from 20% to 9% and forest lands from 23% to 17% in the same periods. This trend was more escalated since 1978. The statistics of agricultural lands seem somewhat stable in the whole study period but the locations are changed in fringe and rural areas. Sprawling trend has been found mostly in the urban and agricultural land uses. In the valley floor, the agricultural land changed to urban lands whereas in rural areas much of the shrubs and forest lands were transformed into agricultural land. The trend of water area remained almost constant while the open space was slightly increased in 2000.

Urban development in Kathmandu valley is observed as multiple-nuclei pattern. The urban expansion trend is mostly confined in the existing built-up periphery. However, the numbers of patch in the study area were increased from 595 in 1967 to 776 in 1991 showing rapid increase (1090) in 2000. The AWMPFD slightly increased reporting the shape of the patches is still simple (1.26, 1.28, and 1.32 in the corresponding years). However, it shows the landscape in the valley getting fragmented in later years, especially in city fringes. The decreasing trend of the ENN_MN, the distance between the patches, CONTAG, the degree of contiguity, and SHDI, the degree of diversity show the improving homogeneity by clumping trend of patches for each class in the landscape. Constructing commercial and more planned residential housing in the city and agriculture expansion over the shrubs and forest lands in rural areas helped to decrease landscape heterogeneity in the later years. These observations might represent useful evidence to infer underlying social, economic, and political processes driving the urban land use patterns in the Kathmandu metropolitan region.