A hybrid approach to mapping spatial patterns of urbanization in Kathmandu Valley using satellite remote sensing imageries

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This paper presents an integrated hybrid approach to map spatial patterns of urbanization in Kathmandu Valley using remote sensing techniques. Kathmandu, a river basin, lies in the bowl-shaped valley. The valley extends over 68,500 hectare of area and had a total population of 1.5 million in 2001 where 63% lived in urban area.

Multi-temporal satellite images: CORONA, LANDSAT MSS and TM, SPIN, and IKONOS were processed to map spatial patterns of the urban landscape since the 1960s. Because of the mountain terrain in the study area, the DEM datum was equally considered as an important source while preparing the land use maps. The satellite data are in image form and contain many details, but not in an objective thematic setting. The heterogeneity and complexity of the landscape in urban regions, for example, suburban residential areas forming a complex mosaic of trees, lawns, roofs, concrete, and asphalt roadways, require land use and land cover classification techniques that combine more than one approach to improve remote sensing-based mapping accuracies. Therefore, a hybrid approach with a series of steps was developed for mapping the land uses in the valley. Necessary data preparation, geometric correction, subsetting, and enhancement were performed as first step. ISODATA clustering technique was applied as second step to identify the groups of similar spectral pixels in the MSS and TM images. Clusters in each image were evaluated and labeled to the corresponding land use types. This method helped us to develop sufficient training samples for further classification of the images. Supervised classification method with maximum likelihood parameter was run for each image as the third step. The land use maps generated from the second and third steps were overlaid using union function and evaluated again as the fourth step. Confusion areas were detected mostly between the water area and shadows of mountain areas; bare lands, brick factories and construction sites; and golf course and shrubs lands. The confusion areas were further checked with DEM and road data to determine appropriate land use type. Editing and digitizing as the fifth step was carried out to resolve the all confusions and conflicts occurred in each maps. The maps derived from the fourth step considered as a final product that can be useddscape changes for different time periods.

As a result, four land use maps with twelve types of land uses were derived for the year 1967, 1978, 1991, and 2000, i.e., agricultural areas, forest, shrubs, open space, water, built-up areas, industrial areas, roads, airport, institutional areas, government secretariat area, and royal palace.