Chapter 65
Urban Sprawl Monitoring Using Remote Sensing and GIS Techniques of the City Jaipur, India

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ABSTRACT

The rapid increase in population of India forced people to migrate from rural areas and small towns to metropolitan cities for better employment, education, and, good lifestyle. Major cities of India were industrialized and required more work force in metropolitan cities, leading to uncoordinated and unplanned growth, often termed as urban sprawl. Urban sprawl destroyed the natural resources such as open green space, agricultural land, open water bodies and ground water. In this paper, an attempt has been made to monitor urban sprawl using Shannon's Entropy model, Remote Sensing, and GIS for city Jaipur, India. The changed entropy value during the years 1972–2013 proves more dispersed growth in the city. The built-up area of Jaipur has increased from 40 km2 in 1972 to 400 km2 in 2013. Land use percentage of urban settlement is doubled as compared to the urban population of Jaipur during 1972–2013. This study shows remarkable urban sprawl in fringe areas of Jaipur city in the last 41 years.

1. INTRODUCTION

Urbanisation is a demographic process to change from rural to urban associated with agriculture based economy with industry, service and technology based economy. Majority of World's population is existing in a city and it is reckoned that half of the world's population will be in cities. This rapid increment of the urban population will lead to uncontrolled, uncoordinated, unauthorised and unplanned urban

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growth, especially in fringe areas and along with highways of the city; emerges the situation of urban sprawl (Sudhira and Ramachandra, 2007). Urban sprawl has three major categories radial, ribbon and leap frog. Radial sprawl normally expends from city centre to fringe areas of the city in radial direction. Ribbon sprawl takes place with major communication lines like highways, railways. Leap frog sprawl follows the scattered or discontinuous development over the city (Barnes et al., 2001).

Many Studies on urban sprawl (Batty et al., 1999; Barnes et al., 2001; Banzhaf et al., 2009) is attempted in developed countries as well as developing countries like India (Jat et al., 2008; Shekhar, 2004; Lata et al., 2001; Jothimani, 1997; Sudhira et al., 2003). In India, 27.82% of total population already live in an urban area and it is projected that next 17 years, it will be 40% (assocham.org; censusindia.gov.in). This shows the rapid change in urban population that leads uncontrolled, unplanned and unauthorised urbanisation. This emerges the situation of urban sprawl in fringe or outer areas of the city. Urban sprawl destroyed the prime agriculture land and forest form city fringe areas.

The impact of urban sprawl felt not only prime agriculture land, but also of social life. Urban sprawl emerges the situation in which basic facilities like food, space, water, hospitals, electricity, sanitation etc. are not properly allocated. To quantify urban sprawl, built-up area is straight forward considered as a key parameter (Barnes et al., 2001; Torrens et al., 2000) and can be obtain from toposheets, field survey and data acquired remotely. Here, built up area refers as a residential house, commercial buildings, market, industries, roads, etc. Unfortunately, conventional mapping and monitoring technics are not accurate, time consuming and expensive. As a consequence, research interest directed to GIS and remote sensing (Epstein, 2002).

GIS and Remote Sensing has widely applied techniques for mapping, monitoring, evaluating and modelling urban sprawl. It is technically sound and cost effective (Sudhira et al., 2004). Urban change detection using Remote Sensing images has been done for nearly three decades (Jat et al., 2008; Yeh and Li, 2001). GIS is widely applied to calculate patchiness, patch density, diversity in order to characterised landscape properties (Civco et al., 2002). For urban growth Modelling, Cellular Automata (CA) is globally used techniques, but it is used mostly for growth model and simulation (Torrens and O'Sullivan, 2001). This technique fails to interact with casual factor that responsible for urban sprawl like population growth and availability of land nearby city centre or along with highways (Sudhira et al., 2004). Statistical techniques like regression techniques are used for determining the relationship between built-up areas and various other parameters that are responsible for urban sprawl such as population, population density and distance from the city centre, size of development etc.

In India, measuring of urban sprawl and its dynamics using GIS and Remote Sensing is far out from city planners. For a better urban planning, planner need to know urban sprawl dynamics, its practice, process, distribution and which way it is potential to be active in the future. Unfortunately, such studies are far away from city planners, especially in developing countries like India. In this context an attempt has been made to quantify urban sprawl dynamics using Shannon's entropy, remote sensing and GIS for detection of land use change in Jaipur (India) city

2. STUDY AREA

To study urban sprawl, Jaipur, the capital city of Rajasthan has been chosen (see Figure 1). Jaipur is 10th highest urban populated city and Jaipur is close to second highest populated city and country capital of India, Delhi. The study area extends from 26 92' N to 75 82' E and having an urban area of about 400 km^2. The urban population of Jaipur in 1971 and 2011 was 7, 13,790 and 34, 99,204.