Chapter 31
Measuring and Monitoring Urban Sprawl of Jaipur City Using Remote Sensing and GIS

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ABSTRACT

The world's population increased drastically and forced people to migrate from rural area to major cities in search of basic amenities. The majority of the World's population are already living in the major cities and it is continuously increasing. The increase in population forced the major cities to expand. Expansion of cities acclaimed more unplanned settlement that leads unplanned growth. This is a global phenomenon that has a direct impact on natural resources. It is the biggest challenge for urban planners to achieve sustainable development. Developing countries like India, where the population is increasing at an alarming pace, require more attention towards this problem. In this study, an attempt has been made to measure and monitor urban sprawl in Jaipur (Capital, State of Rajasthan, India). Built-up area with corresponding population has been analysed over a period of 41 years (1972-2013). Remotely sensed images of 1972-2013 (MSS, TM and ETM+) have been classified using Supervised Maximum Likelihood Classification (MLC) for digital image processing. Shannon's entropy has been used to quantify the degree of urban sprawl, and eight landscape metrics have also been used to quantify urban sprawl and its pattern.

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INTRODUCTION

The current population of the world is 7.2 billion and it is expected to be 8.1 billion till the year 2025 and 9.6 billion till the year 2050. It is estimated that population of the developed countries will remain the same i.e., 1.3 billion during the period of 2013 to 2050; whereas, the population of developing countries will increase from 5.9 billion in 2013 to 8.2 billion in 2050 (World population, 2002). Especially, in India increase in population is a major problem.

The increased population requires more space, food, water, electricity, medical, education, jobs and other elemental facilities. This enforces people to migrate from small towns and rural areas to major cities, so that they could avail more facilities. It creates a situation of uncontrolled, unauthorised, and unplanned growth, especially in the outer areas of major cities, including highways and other major communication lines; this is often termed as the urban sprawl (Sudhira, & Ramachandra, 2007).

Urban sprawl can be categorised into three major forms as (a) *Radial (b) Ribbon and (c) Leapfrog sprawl* (Urban sprawl simulation, 2005). Figure 1 shows the different forms of urban sprawl. Radial sprawl expends outside, around and fringe areas of the city. Ribbon sprawl follows the major communication lines like roads, highways and railways. Leapfrog sprawl is scattered, discontinuous, and widely separated from the city.

Urban sprawl is a complex phenomenon that has a direct impact on social life, environment and other factors. The major impact of urban sprawl are felt on agricultural land, open green space, forest, water bodies and other natural resources. Urban sprawl is a major obstacle for urban planners to achieve sustainable development. Planners are facing the problem to meet demands of basic amenities like water, electricity, land utilisation, sanitation and other facilities for present and future planning.

Mapping and monitoring of urban growth are helpful for the detection of change in two time periods (Epsteln et al., 2002; Yeh, & Li, 2001). The most common technique has been used in these studies are to measure built-up area and its pattern over the different time period. Built-up areas like (road, residential area, commercial area, industrial area, and market) may be considered as a parameter to quantify urban sprawl (Torrens, 2008; Barnes et al., 2001). Many techniques have been used to measure the built-up area to quantify urban sprawl, but most of these techniques are time consuming and expensive.

Nowadays, Remote Sensing (RS) and Geographical Information System (GIS) along with secondary and ground truth data are widely used for the analysis of urban areas. It is cost effective and technically preferred rather than conventional techniques (Fazal, 2000; Webster, 1996). Many research studies have

Figure 1. Form of urban sprawl (Urban sprawl simulation, 2005)