Research Paper

Land Use Changing Scenario at Kerniganj Thana of Dhaka District Using Remote Sensing and GIS

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Abstract

As Dhaka city is expanding day by day proper land use planning is an urgent need for its peripheral areas like Keraniganj Thana. Rapid land use change has taken place in many regions Keraniganj Thana over the past two decades due to accelerated industrialization and urbanization. The study was conducted to investigate the land-use pattern change of the Keraniganj Thana at Dhaka district over a period of 10 years (1997-2006) by using remote sensing and Geographical Information System (GIS) technologies. The images were processed using ERDAS Imagine 8.4. Both supervised and unsupervised approaches were applied and ground control points were collected using a GPS. Maps were prepared using GIS software. The paper presents the data, methods for land use change detection and results from land cover change detection. The attributes of classified image of 1997 showed only 3487.73 acres of built-up areas, but in 2006 a rapid increase of built-up areas were found and it was around 4137.05 acres. Urbanization in this area have been mostly unplanned, chaotic and irregular which have led to alarming land, water, air and noise pollution resulting in much deterioration of environment.

Keywords: Land Use Change, Urbanization, GIS, Remote Sensing

1. Introduction

The most intensive interactions between human beings and the environment take place in cities and their peripheries. Urbanization causes land use /cover changes, while at the same time it brings increments in environmental loads in the form of expanding use of energy and resources and impacts on human health and ecosystems. The vigorous ever-increasing pressure of population and demand of land for various uses have resulted a constant shrinking of our limited land resources. Land use / land cover inventories are assuming increasing importance in various sectors like agricultural planning, urban planning and infrastructural development (Imura et al, 1999). Recent years, urbanization is a major trend in big city all around the world (Weber, 2003). The main change of land use in these areas can be described as other type of land use converting into urban land. The land use change in large city area is a complicated process; several factors have influences on this process, including both physical and human aspects. On the one hand, accelerated urban expansion is usually associated with and driven by the social-economic factors; on the other hand, the process of urbanization has a considerable impact on the economics of the society in that area (Epstein et al, 2002 and He et al, 2006). So the detection of urban land change is important for officials and planner in the local government. The conventional survey and mapping techniques are expensive and time consuming for the estimation of urban expansion and such information is not available for most of the urban centres, especially in developing countries. As a result, increased research interest is being directed to the monitoring of urban growth using GIS and remote sensing technique. Remote sensing is increasingly used for detection and analysis of urban expansion since it is cost-effective and technologically efficient (Liu & Zhu, 1999).
In developing countries satellite Remote Sensing was initially used for surveying, identifying, classifying, mapping and monitoring natural resources. More recently, planners and researchers in developing countries have investigated the ability of satellite data to provide timely and up-to-date information on the urban environment, especially for urban land use mapping (UNESCAP/UNDP, 1985; 1987 and Gastellu-Etchegorry, 1988). A study in Indonesia used digital SPOT-XS data to create an up-to-date land use map for Yogyakarta and its surroundings (Gastellu-Etchegorry, 1988). The study showed that simple spectral classification of SPOT data was faster, more convenient and resulted in better cartographic documents. Mahavir & Galema (1991) used SPOT data to monitor the growth pattern of Chiangmai, Thailand. They visually interpreted panchromatic print of a SPOT image of 1:20000 scale. They reported that they achieved an overall accuracy of 92.7 percent in the interpretation of the SPOT image. According to the study of Kam (1994) mentioned that SPOT data are a useful data source for quick and overall assessments of urban growth trends, both quantitatively and qualitatively.

Satellite data can also be used to monitor areas experiencing rapid urban sprawl. A study in Barranquilla, Colombia compared SPOT satellite imagery taken in May 1986 with a 1982 city map of Barranquilla to highlight land use changes detection (Brouwer et al, 1990). The result of the study helped planners to receive data quickly and to redirect their resources at required areas. In addition the satellite data facilitated a quick and accurate urban growth assessment to be carried out, not by a computer or Remote Sensing expert, but by a town planner having only a modest knowledge of Remote Sensing. Still, most of the applications of satellite data made by urban planning agencies in developing countries are experimental (Kam, 1994).

In Bangladesh this technique can be used for urban land use monitoring and forecasting future land use. Traffic management and planning in an already developed city like Dhaka is very difficult. In this case high resolution satellite image can help to select necessary measures. Encroachment of open space in urban area can be identified applying Remote Sensing. This paper presents a framework for analyzing the interrelations between land-use/cover changes and environmental impacts of urbanization. Therefore, in this report, we took plain region of Keraniganj Thana as an example, based on remotely sensed data (LANDSAT TM) in two years (1997 and 2006), detecting land use/land cover change (Table1). The main objectives of this paper are to highlight the importance of remote sensing and GIS technology in the study of urban areas. For this purpose, it aims:

- To identify possible application and prospect of Remote Sensing in land use change analysis and urban planning

2. Study Area and Data Used

2.1. Study Area

In this paper the study was conducted at Keraniganj Upazila, situated on the southern part of Dhaka district at latitude 23° 36’ to 23° 47’ and longitude of 90° 13’ to 90° 29’ (Figure 1). Keraniganj Upazial (Dhaka District) with an area of 166.87 sq. km. There are 530,174 people in Keranigan according to the statistics of 1991 (BBS, 2002). It contains 3,175 people in every sq. kilometre area meaning its 0.03 hector land belongs to per person. The rate of increase in population during 1974 to 1981 is about 5.7% and during 1981 to 1991 is about 4.7% (BBS, 2002).

2.2. Data Used and Software

The main spatial data sources used in this study include:

- LANDSAT TM image of the study area of 1997 (Data source: SPARRSO)
- LANDSAT TM image of the study area of 2006 (Data source: SPARRSO)

Data on the land use changing pattern, here which have been focused on the built-up area has been extracted using ERDAS 8.4 image processing software. GIS analysis has been carried out using Arc Info software and the map output has been generated using ERDAS Imagine software. In the present study, the satellite data were processed using ERDAS Imagine (version 8.4) image processing software for Windows NT platform. The raw data were converted into ERDAS imagine image format and processed to classify and identify the encroachment of built-up area into the Buriganga River and the changing scenario of the built-up area of Keraniganj Thana.

2.3. Data Generation and Analysis

Flow-chart given on next page, shows the data processing and analysis scheme used for the study.

3. Result, Analysis and Discussion

3.1. Land Use/Cover Change Analysis

3.1.1. Analysis for Built-up Areas (Figure 2) of LANDSAT TM Image of 1997 Terminated into the Following
River Buriganga on the east and river Dhaleswari is flowing on the west borders of the Thana. The Buriganga originated from the Dhaleswari on the north and these two rivers again joined on the south (border of Munshiganj district). River Buriganga has an elongated meandering course, which is called the 'Dhaka Reach'. The inland and fluvial water bodies are hydraulically connected through these open water body. Part of Keraniganj developed as a mixed residential area. The total built-up area is measured as 3487.73 acres.

3.1.2. Analysis for Built-up Areas of LANDSAT TM Image of 2006 Terminated as Follows

The coverage of water bodies in the eastern part of city is reduced and become sporadic. Built-up areas are gradually increasing with time from 1997 to 2006 (Figures 3-4) by replacing and destroying small settlements, agricultural fields and rivers and river channels.

Table 1. Shows a Summary of the Major Land Use/Cover Conversions that have been Taken Place from 1997 to 2006

<table>
<thead>
<tr>
<th>Total Area (Acre)</th>
<th>Land Cover Types</th>
<th>1997</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>41,216.89</td>
<td>Built-up Area</td>
<td>Area (acre)</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3,487.73</td>
<td>8.46</td>
</tr>
</tbody>
</table>

Figure 1. Map Showing Study Area (Banglapedia, 2006)
4. Discussion

Change detection and monitoring involve the use of multi-data images or aerial photos to evaluate differences in land cover due to environmental conditions and human actions between the acquisition dates of images. Change detection (Figure 2) has shown that the rural areas around the city have decreased and built-up areas have increased between 1997 and 2006 to about 639 acres. In the 1970 and 1980s, major development occurred on the cultivated lands and by filling up of water bodies. However, recent development is being taken place in the low-lying areas. Other land use/cover classes including water bodies, cultivated land, low-lying lands and vegetation have been reduced greatly and converted to built-up areas. The main reason for the decline in water body, natural settlement and vegetation, is the conversion of these features into building area.
4. Conclusion

Land use/cover change analysis was performed using topographic maps and multi-temporal remotely sensed data. A maximum likelihood of supervised classification was employed to quantify land use/cover changes at the study area. Water bodies, low-lying lands and agricultural lands at Keraniganj Thana have been transformed at a substantial rate and being converted to built-up lands. As a result, most urban settlements in this area are characterized by shortfalls in housing and water supply, insufficient sewerage, traffic congestion and social conflict making urban governance a difficult task. So study on the mechanisms of land-use change associated with the industrialization and urbanization is vital for formulating sustainable development strategies on the local scale. Change detection studies can be useful for managers and policy makers to recognize susceptible areas in which the possibility of urbanization and degradation of natural land cover are more than the other areas. Also, suitable strategies can be considered to protect unplanned, haphazard and irregular urbanization and to perform sustainable yield management in these areas.

References


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