Changes in Land use Pattern due to Mining in Faridabad (Haryana)

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Abstract:
The conventional methods of survey provide smaller view of the area and are generally practiced for small extent of area. But for a larger view of the area remote sensing and the GIS techniques gives a better view of the area and can provide cross checked facilities by the way of spectral signatures etc. Remote sensing images provide land cover information with high temporal frequency and high-quality spatial resolution for land cover mapping.

The present study was carried out in Faridabad district of Haryana State using Landsat and IRS P6 satellite data to delineate the study area into different thematic layers. A lot of legal/illegal mining has been carrying out in the study area for the last few decades. This mining activity has changed the environment of the area. It has been noticed and reported that the surface water bodies are diminishing at a very fast rate in the area. The study area is classified into the land cover features using the multispectral satellite data. The techniques of image classifications are used. Training sites were selected within each scene and land cover classes were assigned. Having prepared the temporal land use map of the study area, the land use changes were quantified. These changes were correlated with the mining activities carried out in the area. The DEM of the study area was also generated and was correlated with the urbanization.

Key Words: Land use, ArcGIS, Satellite image, sand mining, DEM
Introduction

The study of urbanisation is of great interest for a wide range of experts. The multidisciplinary approach of the subject invokes the interest from ecologists to urban planners and civil engineers. This is because of the multitude of activities and processes that take place in the urban ecosystems every day. Therefore the land cover / land use changes pattern are very dynamic in nature and have to be monitored at regular intervals for sustainable environment development. Remote Sensing data is very useful because of its synoptic view, repetitive coverage and real time data acquisition (Burrough, 1986).

Many studies have been carried out to prepare land use/land cover maps using satellite image processing. The studies have concentrated to prepare accurate maps using different kind of satellite data. Some of the studies have made use of these maps for environment pollution studies. They have tried to develop relationships between land use changes and the quantity and quality of surface and ground water. Sim et al. (2007) have done the land cover mapping with the help of Alao Palsar data for the Penang Island (Malaysia). Their study concluded the increase in accuracy in land cover identification in case of multimode data with respect to single band input data. Mustapa et al. (2003) utilized the remote sensing technique for land cover assessment over desert area of Makkah, Mina and Arafah and concluded that the maximum likelihood classification produces the highest level of accuracy for the township planning and development purpose. Gargi upadhay et al. (2006) used the remote sensing technique in derivation of crop phenological parameters in Punjab and presented the methodology of generating various Phenological metrics using high temporal resolution data and concluded that the metrics which are derived provide a large number of information which could be useful in identifying various crops which differs in phenology. Farooq and Ahmad (2006) used the techniques of remote sensing and GIS for urban sprawl development around Aligarh city and concluded that most of the land use activity in urban area sprawls irreversible changes and a balance is required for future needs. Vasantha and Bhagavanulu (2007) used the technique of remote sensing in studying the effect of deforestation on landslides in Nilgiris district using temporal data and concluded that the land estates without considering the proper drainage and slope would results in loss of ecosystem and frequent landslides. Many researchers found that the agricultural lands produced the highest nutrient concentrations (Lenat et a., 1994; Fisher et al., 2000). Bolstad et al. (1997) reported that there were consistent changes in water quality variables with land use change. Changing land use is therefore regarded as one of the main factor in altering the hydrological system, causing changes in runoff (Mander et al., 1998), as well as the quality of receiving water (Changnon and Demissie, 1996).

Although there have been some studies on the impacts of land use changes on water quantity and quality in many countries, the complex relationships of sand mining on water quantity is yet to be explored in India. The present study is carried out in Faridabad district of Haryana which is not only affected by rapid urban growth but also by change in natural topography by sand mining. The shortage of surface water has been reported in the area. In the present study an attempt has been made to correlate land use changes and mining activities with surface water bodies.

Study Area

A study site is some extent of core mining belt of the Aravali Hills district FARIDABAD of HARYANA, India. The topography of the study area is undulating. The Faridabad district lies between the latitudes 27° 51’ 15” and 28° 30’ 52” north and the longitudes 77° 04’ 39” and 77° 32’ 50” east. The Faridabad district is attached by Delhi on the north, Gurgaon district of Haryana State on the west, Gautam Budh nagar district on the east and Mathura district in the south of Uttar Pradesh State. Faridabad district spreads over an area of 2,151 sq kms. Delhi-Mathura National Highway No. 2 i.e. the Shershah Suri Marg passes from north to south direction through the centre of the Faridabad district.
After Independence in 1947, Faridabad was developed as a small town on the outskirts of Delhi and expanded to a well flourished urban area. Due to opening of large number of Industries there the demand of accommodation increased manifold resulting in Faridabad turning into a full fledged city and its population crossing 10 lakh by the year 2001. Due to continuous urban and industrial activities in and around Faridabad the earlier town which was free from pollution had started to generate so much pollution that even the Supreme Court of India had to issue directive to stop all construction and mining activities within a radius of 5km of Aravali Range.

Mining in the Aravali range provides stone ballast and stone dust of very good quality which is basic need for all construction activities. It also provides livelihood to a large section of our society through various activities connected with mining at Faridabad. Hence, there is need to assess the situation arising as a result of complete ban on mining, being a pollution hazard or to retain status quo situation.

DATA SOURCE

The satellite data of 1970 and 2006 with the details given in Table 1 was acquired to determine the changes in the landuse. The toposheets from Survey of India bearing numbers 53H/14, 53H/15, 53D/14 were obtained to prepare the base map of the study area. The Landsat image of 1970 has a spatial resolution of 57 m while IRS-1D P6 LISS III resolution was 24 m.

<table>
<thead>
<tr>
<th>LANDSAT IMAGE</th>
<th>DATE OF PRODUCT</th>
<th>Resolution</th>
<th>SOURCE</th>
<th>IMAGE QUALITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>LANDSAT IMAGE</td>
<td>13/08/1970</td>
<td>57 m</td>
<td>USGS website</td>
<td>LANDSAT IMAGE</td>
</tr>
<tr>
<td>IRS-1D P6 LISS III</td>
<td>12/02/2006</td>
<td>24 m (MSS)</td>
<td>NRSA</td>
<td>IRS-1D P6 LISS III</td>
</tr>
<tr>
<td>Toposheet : 53H/14, 53H/15, 53D/14</td>
<td></td>
<td></td>
<td>Survey of India</td>
<td></td>
</tr>
</tbody>
</table>

Methodology

The study used the Landsat MSS (1970), IRS-P6 (2006) images as shown in Figure 1. Ancillary data such as Toposheet 1:50,000 were used for preparation of Base map and for help to create DEM, etc. All images were rectified with UTM projection system and enhanced using standard operating technique. The geographic information system (GIS) and image processing tools have been applied to determine the land cover/land use changes over a period of 35 years in Faridabad district. The ArcGIS 9.2 and ERDAS 9.1 software have been used for geographical analysis, integration, and presentation of the spatial and non-spatial data for land cover/land use change detection. The base map of the study area prepared from survey of India toposheet has been presented in Figure 2. It showed the location of roads, drainages, villages, etc. The features were vectorized using Arc-GIS 9.2. The contours were generated from shuttle radar topography mission (SRTM) data using 3D analysts in Arc-GIS and Digital elevation model (DEM) has been created as shown in Figure 3. These contours were verified with the contours from Survey India toposheet.
An unsupervised classification was performed on the images with the following land use classes:


The land use/land cover patterns of the study area both previous and existing were generated in vector format using Raster to Vector option in Arc-GIS. These have been compared and evaluated to the values generated by image classification and presented in Table 2 for comparison of the scenario.
Results and Discussion

Landuse is the important element of the global environment change process. The classified Landsat MSS image of 1970 was first evaluated for the land use/landcover pattern and compared to the land use/land cover pattern of 2006 using IRS-P6 MSS image as shown in Fig. 4. The both 1970 & 2006 land cover/land use statistics for the study area is presented in Table 2. The table also showed changes in land use/land cover that happened due to rapid urbanisation and mining over the period of 35 years.

Table 2. Land use / Land cover classes

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Classes</th>
<th>Area (m²)</th>
<th>%age Change in Area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1970</td>
<td>2006</td>
</tr>
<tr>
<td>1</td>
<td>Agriculture</td>
<td>41538.3125</td>
<td>24653.78</td>
</tr>
<tr>
<td>2</td>
<td>Vegetation</td>
<td>12521.1875</td>
<td>10496.33</td>
</tr>
<tr>
<td>3</td>
<td>Urban</td>
<td>1284.1875</td>
<td>5275.123</td>
</tr>
<tr>
<td>4</td>
<td>Forest</td>
<td>7739.8125</td>
<td>6057.792</td>
</tr>
<tr>
<td>5</td>
<td>Open</td>
<td>18798.4375</td>
<td>32079.11</td>
</tr>
<tr>
<td>6</td>
<td>Water</td>
<td>1218.5625</td>
<td>732.672</td>
</tr>
<tr>
<td>7</td>
<td>Mining</td>
<td>129.4375</td>
<td>890.4384</td>
</tr>
<tr>
<td>8</td>
<td>Rural</td>
<td>747.9375</td>
<td>4070.016</td>
</tr>
<tr>
<td>9</td>
<td>Riverbed</td>
<td>1018.375</td>
<td>489.7152</td>
</tr>
</tbody>
</table>

+ increase, - decrease
During the aforesaid period of 35 years the major changes that were observed were mostly in areas formerly occupied by vegetation, agriculture, and forest which were converted into residential use. These developments can be observed along the foot hills NW corner of the study area as shown in Fig. 5 with urban sprawl towards East & South of Faridabad. This showed that urban area of 2006 is increased to 310.8% as compared to 1970. Mining area both legal and illegal increased to 587.9%. This may be one of the major changes in urban sprawl of Faridabad. Many water bodies are not present now e.g. Surajkund Lake. A decrease of 39.9% in water bodies has been observed. Thus surface water which is the important source for the mankind is depleting in the region. Although the surface water does not depend only on one issue but it has a major contribution in depleting. The mining causes damage to the vegetation and surface water etc. The excessive withdrawal of water due to mining activity resulted in shortage of surface water. It is further noticed that agricultural area was reduced by 40.6% whereas there was rise in rural area by 444% compared to 1970s which is attributed to settlement of population from erstwhile village land. Surprisingly the open area has increased by 70.6%. This increase in open area may be on account of no construction zone /parks gardens or cleaning of forest area/ vegetation/agriculture etc.
Rapid habitation growth like high moderate and low over the study area is categorized based on the digital elevation model (DEM) as shown in Fig. 6. Major habitation growth is on surface having elevation from 191 to 198m.
Conclusion

The study demonstrated that the application of GIS and image processing helps in studying the changes in land use pattern in an area. The existing urban land use/land cover has been dynamic in nature from 1970 to 2006 in Faridabad district. Different types of human activities have resulted in vast changes in the natural cover especially due to mining in the study area. The surface water bodies have been depleting at faster rate which is a matter of great concern. These changes are likely to alter the structure, function and the complexity of the local ecology with critical implication for the maintenance of the biodiversity, genetic species and landscape.

References

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