Spatio-Temporal Landuse Change Monitoring of Surajpur Wetland through Remote Sensing and GIS

Harsh Vardhan Vashistha & Prafull Singh
Amity Institute of Geo-informatics and Remote Sensing,
Amity University, Sector 125 Noida, Uttar Pradesh

Abstract:
Wetlands are highly productive and supporting to the ecosystem for their balance. The diversity and changes in the wetlands are a continuous process due to natural and anthropogenic activities. The assessment and monitoring of wetland and extraction of reliable information on wetland are primary task for wetland management sustainably worldwide. The main objective of the present work is to assess the spatio-temporal changes in the Surajpur wetland which is located in Noida in the National Capital Region of Delhi using remote sensing and GIS techniques. The important information related to wetland was extracted from multi-temporal Landsat satellite images for the year of 2000 and 2013 using the ARC GIS software. The classified multi-temporal satellite image shows major changes in the spatial pattern in the wetland over 13 years in the area. It is also observed that the major changes and degradation of wetland is because of unplanned urbanization and degradation of natural drainage in the area. Finally through the work it is recommended that the wetlands needs detail mapping through the use of advance remote sensing techniques like microwave and LIDAR for restoration and management of wetland.

Key Words: Wetland Monitoring, Remote Sensing, ARC GIS, Surajpur, NCR.

About the Author:

Mr. Harsh Vardhan Vashistha
With a degree of masters in Geography and currently pursuing M.Tech in Geo-informatics and Remote Sensing. Main Interest lie in Geo-hazards, Climate Studies, Soil and Agriculture.

Dr. Prafull Singh
Working as an Assistant Professor in Amity Institute of Geo-Informatics and Remote Sensing, Amity university Noida his main research interest areas are water resource management, Groundwater pollution modeling and natural disaster mapping and monitoring using space and ground based techniques.

E mail ID: psingh17@amity.edu
Introduction

A wetland is a unique area which lies between terrestrial and aquatic ecosystem, which makes it quite unique. Due to this reason it embodies plant and animal species of both the habitats such as peatlands, mangroves, freshwater swamps and marshes (Mitsch et al., 2009). Wetlands are valuable land resources that fulfil diverse natural and, social and production functions. They also provide a lot of other ecosystem services. Even though wetlands occupy only about 6% of the earth surface, they are among the most productive ecosystems (Turner and Jones, 1991).

Surajpur wetland present in Greater Noida is an urban wetland. It is located in the national capital Region of India. This area is currently growing very quickly in urban terms i.e. heavy urbanization is taking place in this area. Thus this wetland provides a rare habitat for flora and fauna to flourish. As wetlands provide habitats from both aquatic and terrestrial ecosystems there is variety of food source which is available, this in-turn attracts migratory birds from different parts of the world to find shelter and build nests. Surajpur wetland has about 186 species of birds.

As the value of wetlands to society has become slowly but surely recognized, it is now important to conserve these valuable resources. The ability to stop surface runoff, store floodwaters, improve water quality, protect shorelines and recharge groundwater aquifers makes wetlands very valuable. (Daily 1997). The use of satellite remotely sensed data for land cover classification is less costly and consumes less time than aerial photography for large geographic areas. Remote sensing can be especially appropriate for making inventories of wetland and monitoring in developing countries, where funds are limited and where little information is available on wetland areas, neighboring land uses, and wetland losses over time (Ozesmi and Bauer, 2002).

Surajpur is the only wetland present in this region and due to constant anthropogenic activity in the area make a negative impact on the life and sustainability of this important wetland, this area was chosen for this study so that the impact of these activities on the wetland and the impact of change can be monitored.

Study Area

Surajpur wetland is situated near Surajpur village in the district of Gautam Budh Nagar which is in Dadri Tehsil and comes under the Greater Noida Development Authority, Uttar Pradesh. The study area lies between latitudes 28°27’ N - 28°31’ N Latitude and 77°22- 77°36’ E longitude and having elevation of 184.7m msl. This area is located 800m from Delhi-Noida-Dadri road and 6km from Dadri Railway Station, 26 km from Delhi, and 24km from Noida, 3km from Greater Noida city and 90km from Aligarh, Uttar Pradesh. The location of the study area shown in figure 1:
Data Used & Methodology

The Landsat 7 and Landsat 8 satellite data for the year 2000 and 2013 were used in the present study and temporal changes are analyzed. The standard satellite image classification techniques area used for the landuse / land cover mapping and change analysis. Both the Images from the same season were classified to make the maximum accuracy in the classified maps. ENVI and ARC GIS software’s are used in the classification and generation of final maps of the area.

LULC Mapping and Change Analysis

LULC change analysis (Figure 2 and 3) results are presented in Table 1 & 2 represents the area of each land use/land cover category of the different years. The object based classification results shows that the seven land use categories such as Barren Land. Fallow Land, Settlement, Agricultural Land, Vegetation has changed significantly in the study area during the last 13 years period.
Change Detection

One can see considerable differences in the images below. The image of year 2000 shows a much larger and the area which was calculated using Arc GIS is 995.373 hectares and the perimeter 47509 meters calculated is while the image of year 2013 shows a much smaller area. The area calculated is 695.998 hectares and the perimeter is 55390 meters. The Figure (4) below shows the change analysis map of Surajpur which was created using both the supervised images and using the Image difference tool in ARC Map to give the output.
The area of this image been calculated through raster zones of unsupervised images. It was calculated using zonal as geometry as table tool and the output values were exported to Microsoft excel and these were depicted in the tables and pie charts found below in the following images.

Table: 1 showing area of classified features (2000)

<table>
<thead>
<tr>
<th>Name</th>
<th>AREA (2000) in hectares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barren Land</td>
<td>5,423.85</td>
</tr>
<tr>
<td>Settlement</td>
<td>4,594.882</td>
</tr>
<tr>
<td>Agricultural Land</td>
<td>10,792.507</td>
</tr>
<tr>
<td>Vegetation</td>
<td>5,141.16</td>
</tr>
<tr>
<td>Total</td>
<td>31,376.25</td>
</tr>
</tbody>
</table>

Fig: 4 Map showing Wetland of Surajpur of year 2000

Fig: 5 Map showing Wetland of Surajpur year 2013

Fig: 7 Pie Chart showing area (2000)
Impact of anthropogenic activities on Surajpur wetland

Urbanization has become one of the major cause of degradation and loss of wetlands throughout the world. Change in land cover and the effect of land use can be seen on the environment. Construction in and around wetlands have had many direct impacts on wetlands such loss of habitats, change in water quality and other hydrologic changes. Pollution form industries, vehicles, urban centers have had a significant influence towards the wetlands and in some cases have affected the nutrient cycles of the wetlands. Changes in land cover due to practices such deforestation and converting of forest land into urban areas or agriculture areas have also affected unique habitat present in the wetlands.

In the case of Surajpur the effect of anthropogenic activities on the wetland can be clearly seen. These activities along with extensive loss of the original land cover has led to degradation of the wetland have affected the flora and fauna in the area. The habitat of the wetland has suffered greatly and species of both plants and animals have been lost. Moreover, the wetland has undergone change in size and has reduced in total area. This change in the wetland and continues anthropogenic activities in the area may affect the plant community which can lead to change in the pH value of the soil and can cause loss to indigenous species. Furthermore, this can also lead to increase in surface runoff of water which may cause further erosion and degradation of the wetland.

Conclusion

Wetlands are unique areas which provide vital habitat for numerous types of flora and fauna. These areas are very important as they help control the environment and provide and create a unique habitat which is home to many kinds of plant and animal species.
Protecting wetlands especially in urban area has become very important as these areas are degrading and conservation efforts are not enough. It is by keeping this in mind of that there arises a need to not only conserve wetland but also to get a deeper understanding of the area, thus monitoring and mapping of wetland has become important.

Surajpur wetland is situated in Greater Noida and provides habitat to unique species of birds, animals and plants. In this study, effort has been made to monitor and map this area and calculate the change that has occurred in this area through remote sensing and GIS techniques. After acquiring satellite images from USGS the area was interpreted with the help of numerous remote sensing techniques such as creating FCC, unsupervised classification, Principal Component Analysis. It was found after the interpretation of this area that due to urbanisation and other anthropogenic activities the area of the wetland in 13 years has shrunk considerably. Not only has this affected the flora and fauna of the wetland but this has also had an indirect effect in the local environment, temperature and climate.

To conclude, it safe to say that the Surajpur wetland is an area with unique characteristics and the semi-arid region of Noida and Greater Noida this wetland provides shelter to many different species of flora and fauna. This area has undergone degradation but recently efforts have been made to protect this area from further degradation. The main cause of loss of area of this wetland has been rapid urbanization in Noida and Greater Noida which has led to an increase in anthropogenic activities in the vicinity of the wetland. These activities have caused great damage to the wetland.

It is recommended that further studies of this area should be carried and the local government should be made aware of the situation. Awareness among the local population about the importance of the wetland ought to be spread. With the help local stakeholders and government and private sectors steps can be taken to increase the area and not only stop the area from further degradation but also restore it to its former glory.

References