Abstract
Accurate and consistent land use change information for Bhindawas wetland and its catchment area have been downloaded from Landsat for the year of 2000 and 2009. Arcgis software is used to detect changes in various land use categories in the study area. The landscape pattern changes of wetland and catchment areas is calculated and analyzed spatiotemporally for research period. The results indicate that the agricultural land dominates the land use in the catchment area. Grasslands followed by water bodies are other largest categories of the land use in the wetland. Forested areas converted into water bodies and grasslands in the wetland area. A comprehensive and effective land use planning and management strategy is essential to conserve Bhindawas wetland.

1 Introduction
The interest in land uses analysis at regional and global scales has grown dramatically in the last two decades. It is an issue of the present time and responding to these changes, the field of land cover study has made significant progress in understanding, documenting and describing the driving forces that contribute towards these land uses changes in any wetland areas.

‘Land cover’ is the biophysical attribute of the earth surface and ‘land use’ is the human purpose applied to these attributes (Melendez-Pastor et al, 2010). Land use is a continuous as well as a normal process in wetland areas. Animals, birds, insects, reptiles, other small predators and human beings are essentially depending upon wetland land for a wider uses. Land use is described as utilization of land areas by human being for their purposeful objectives. Land use involves the management and modification of natural landscape or wilderness into built environment. Land use concerns the products and benefits obtained from use of the land as well as the land management actions carried out by human beings for their benefits. Human actions causes changes in the land use pattern, particularly in wetland areas. Land use practices vary considerably across the globe. Wetlands are an important component of the terrestrial landscape. Wetland performs significant ecosystem services such as climate regulation, pollutant reduction, flood storage, drought control, water supply, and biodiversity conservation on the earth.
Bhindawas wetland is a constructed one eco-system carved out from marshy saucer shaped depression, which receives water from Jawahar Lal Nehru Canal and drains its water into drain number 8. Bhindawas wetland also collects water from the vast stretches of agricultural field of twelve villages namely a few Chhadwana, Redhuwas, Bilochpura Nawada etc. Bhindawas wetland is composed by alluvial soils and falls in Yamuna river basin. The Bhindawas wetland is designated as bird sanctuary and falls into Eco-sensitive zone, notified by Ministry of Environment and Forest. This wetland spreads over 1074 acres located between 28°28' to 28°36' North latitude and between 76°28' to 76°38' East longitude in the Jhajjar district of Haryana.

The main objective of this paper is to provide a quantitative assessment of the change in land use pattern from 2000 to 2009 in the study area and to explore the causes of the changes in land uses pattern in the Bhindawas wetland area and provide information for the conservation and scientific use of wetlands resources in the studied area at strategic and local levels.

2 Materials and methods

2.1 Land use data preparation

The satellite imageries have been downloaded from the website http://glcfapp.glc.umd.edu/data/lands on 13/09/2014 for the year 2000 and second image has been downloaded from the same source and accessed on 14/09/2014 for the year 2009. Path and row of satellite were 147 and 40 respectively. The spatial resolutions of the images are 30 meters. Based on land use attributes, land resources and the spectral features of ground objects, land use is classified into the following seven stable classes: agriculture land, built up land, forest land, water bodies, grassland, open land and other land. Constructed roads and power lines also detected in the images of study area. The software package ArcGIS is used for data processing including pre-processing and false color composite. Land use change and land use conversion matrix of the study area from 2000 to 2009 are calculated. Field visits were also made to verify ground realities in the wetland area as well as in the catchment area.

2.2 Land use and classification

In this study, assessment of landscape change mainly focuses between 2000 and 2009. Six categories of land use are found in the study area. These land use categories are mainly agriculture land, built up land, forest land, water bodies, grassland, open land and other land in the Bhindawas area.

3 Results

The land use changes in full image of Bhindawas wetland including its buffer zone and catchment areas from 2000 to 2009 is displayed in Table 1.

<table>
<thead>
<tr>
<th>Class</th>
<th>Area In hectare 2000</th>
<th>Area In hectare 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural land</td>
<td>1804.5</td>
<td>1805.85</td>
</tr>
<tr>
<td>Built up land</td>
<td>35.1</td>
<td>49.68</td>
</tr>
<tr>
<td>Forest Land</td>
<td>212.31</td>
<td>130.5</td>
</tr>
<tr>
<td>Water bodies</td>
<td>114.12</td>
<td>177.93</td>
</tr>
<tr>
<td>Grass Land</td>
<td>295.47</td>
<td>305.82</td>
</tr>
<tr>
<td>Open land</td>
<td>45.27</td>
<td>36.99</td>
</tr>
</tbody>
</table>
The assessment results show that agricultural land, grassland and forest land were the three largest land use types in 2000 while agricultural was the main consumer of the land in 2009. Area under agriculture remained almost same between 2000 and 2009. During 2000 agricultural land was 1804.5 hectare while it has increased 1805.85 hectare in 2009. This little bit change was due to reclamation of saline areas. Forested area outside the wetland remains unchanged from 2000 to 2009 but area under forest land category has been decreased drastically. Largest consumers of forest land were water bodies and grassland. Water bodies snatched 109.17 hectare area from forest land. The water logged areas converted from forested area outside wetland was 109.17 hectare in 2009 while in the wetland area 100.62 hectare area of forest land converted into water bodies during the same year. In addition, 54.99 hectare area of forestry has been converted into grassland during research period, this includes catchment area also while in the sanctuary area 53.46 hectare of forested land converted into grassland. The assessment results of 2009 show that area under forest land has been decreased due to falling of Eucalyptus, Acacia Arabica and Acacia nilotica trees.

The area of forest land decreased continually is a matter of concern. Area under water bodies and grassland has been increased due to expansion of Eichhornia crassipes, Lemma minor and Salvinia Motesta and sedimentation of the wetland area. The area under water bodies was 114.12 hectare in 2000 while it has been increased upto 177.93 hectare including catchment areas in 2009. The area of water bodies converted into forested areas was 72.63 hectare in the image while water areas in main wetland area converted into forest land was 70.11 hectares.
The transformation from open land to build up land was the less remarkable land use change from 2000 to 2009. Area under built up category has been increased from 35.1 hectare to 49.68 hectare. Open land converted into built up land category due to population pressure. Construction of houses in nearby villages, conversion of open streets into cemented streets, establishment of educational institutes in the catchment area and Herbal Park within wetland embankments also used open land. Total 22.23 hectare land has been converted into built up land in the study area. Changes in the study area have the dual characteristic of fragmentation and shrinkage in land use pattern.

4. Suggestions

Bhindawas wetland stores huge amount of water in rainy season from drain no. 8 and reduces the load of water on the drain and indirectly it protects the drain from the damage. In this case wetland should be divided in 5 to 6 parts and only one part should be allowed to receive the water from drain no. 8. Zoning management is now the generally effective solution to control the land use of wetland areas. The growth of weed species such as Eichhornia crassipes, Salinia motesta, Poly fonum galbrum, and Typha angustifolia in the lake needs to be managed scientifically. Regular removal of these weeds will help sustain its habitant quality and species diversity, vegetation structure, water quality, salinity, etc. Initially physical removal of weeds may be necessary in the wetland area and its surrounding in the drain no. 8. Removal of these weeds certainly increases open areas which can be used by migratory bird for breeding. In those open areas, afforestation process can be done.

5. Conclusion

A total of 1074 hectare comprises six categories of land use in the study area. Catchment area is dominated by agricultural land category without any major change during research period. Forest land has been converted into grassland and water bodies into the wetland area. According to the landscape indicators of three land use types, the forest land and water bodies experienced a fragmentation process, and the dominant landscape was gradually converted from forest land into grassland and water bodies into forest land during the study period from 2000 to 2009.

References