Classification of Land Use and Land Cover Using Remotely Sensed Data for Parbhani City, Maharashtra, India

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Abstract: The use of remotely sensed data is an important method to indicate land use and land cover changes on earth’s surface. Remote sensing can provide a better picture of monitoring land use and land cover changes. In this study, Remote Sensing and Geographical Information System integration are used in order to analyze land cover of Parbhani city using LISS-IV high resolution data collected from NRSC, Hyderabad. GIS is systematic introduction of different disciplinary spatial and statistical data that can be used in inventoring the environment, observation of change and prediction based on current practices and management plans. This paper discusses the land cover of study area using classification of image. Digital image pre processing and image processing techniques are used for classification of land cover analysis. After image pre-processing, supervised image classification has been performed to classify the image into different land use categories. The study area, Parbhani city has been developing rapidly over the last decade, successful planning will require giving reliable information about land use/land cover distribution. This study illustrates that integration of remotely sensed data and GIS techniques are effective to provide such information. A good knowledge of the study area was achieved by a suitable image enhancement and literature studies.

Keywords: Land use/Land covers (LULC), Remote sensing, Geographical information system (GIS), maximum likelihood.

1. Introduction

The land use/land cover pattern of a region is an outcome of natural factors. Land cover is a fundamental parameter that describing the Earth’s surface. This parameter plays an important role to describe the physical features of environment. If the area is small then suitable land cover may be based on ground observation and surveys. But if area is large then it is difficult to access the information. Toposheets may be useful for reference but are generally outdated and too harsh for detailed analysis. With the improvement in computer technology, satellite remote sensing is being used for studies. The knowledge of spatial land cover information is essential for proper management, planning and monitoring of natural resources and considered as essential element for modeling and understanding the earth as a system. A classification process of Remote sensing data is a best technique to categorize land cover. The Classification workflow uses either unsupervised or supervised methods to categorize pixels in an image into many classes. You can perform an unsupervised classification without providing training data, or you can perform a supervised classification, where you provide training data and specify a classification method of maximum likelihood, minimum distance, Mahalanobis distance, or Spectral Angle Mapper (SAM) etc. The study area classification is done in ENVI (Environment for visualizing images). Geographical Information System provides a powerful tool for manipulation for land cover feature identification.

2. Study Area

The selected study area was Parbhani city in Marathwada region of Maharashtra State of India shown in Figure: 1. It is located between latitude 19°30’ N and 19.5°N and longitude 76°45’E and 76.75°E. Parbhani district occupies area 6,511.58 km² and has population 1,835,982(2011). Parbhani city is headquarters of this district. The Parbhani city also famous for store of Jowar in Marathwada region.

Figure 1: Study Area of Parbhani city
3. Technique used

Data Collection

Pre-processing of Image

Selection of Features

Choosing Training Sets

Restoring

Rectification

Mosaicing

Clip study area

Preprocessed image

N

Y

Classify pixels based on maximum likelihood classification Choosing Training sets

Classification Map

3.1 Data Collection

For analysis and study of Parbhani city, LISS-IV high resolution data were used. For study the multispectral satellite imagery of Dec-2013 is collected from National Remote Sensing Agency (NRSC) Hyderabad, India. Together with this satellite imagery a topographic map and existing land use maps were used to analyze the ground truth.

The LISS-IV sensor is a multispectral high resolution sensor, which operates within three spectral bands (B2, B3, B4). LISS-IV can be operated in either multi-spectral mode (MX), a swath of 23 Km (selectable out of 70 Km total swath) is covered in three bands, or in mono mode (Mono), the full swath of 70 Km can be covered in any one single band, which is selectable by ground command (nominal is B3 - Red band). The LISS-IV camera can be tilted in the across track direction thereby providing a revisit period of 5 days.

3.2 Preprocessing

In the analysis of imagery, the image pre-processing was carried out. Each preprocessing of an image consists of restoration and rectification of an image. In pre step of study image mosaicing technique is used. It is used to join two satellite images. After joining the images GIS clip tool is used to take appropriate clip of study area. To locate ground features of an image, image enhancement and extraction is used.

3.3 Classification

Maximum likelihood: For analysis, an image classification technique is used. For image classification specific computer software was used like ENVI. The aim of image classification process is converting image data to thematic data. In classification process, classify pixels iteratively, redefine the criteria for each class, and classifies again. In supervised classification technique, the maximum likelihood algorithm will classify the image based on training sets provided by the user based on field knowledge. Training polygons were chosen from composite image and assign to various land features.

Maximum likelihood classification assumes that the statistics for each class in each band are normally distributed and calculates the probability that a given pixel belongs to a specific class. Unless a probability threshold is selected, all pixels are classified. Each pixel is assigned to the class that has the highest probability (i.e., the maximum likelihood).

A good knowledge of the study area was achieved by a suitable image enhancement and literature studies.

Table 1: Land cover classification scheme

<table>
<thead>
<tr>
<th>Land Cover Classes</th>
<th>Description</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fallow land</td>
<td>Hills Without vegetation</td>
<td>Brown</td>
</tr>
<tr>
<td>Built up Area</td>
<td>Residential, industrial, commercial, transportation etc.</td>
<td>Cyan</td>
</tr>
<tr>
<td>Water Bodies</td>
<td>River, lake etc.</td>
<td>Blue</td>
</tr>
<tr>
<td>Crop land</td>
<td>All farms, trees</td>
<td>Green</td>
</tr>
<tr>
<td>Non crop land</td>
<td>Uncultivated agricultural land</td>
<td>Red</td>
</tr>
</tbody>
</table>

Table 1 shows the different land cover classes of imagery. It also shows the description of classes and different classes is assigning separate color.

3.4 Experimental

The pre classification of image is done in ENVI software. In pre classification step above five classes are created. For classification of an image maximum likelihood algorithm was used. Post classification of an image is as shown in figure 3.

Figure 3: Classified image of Parbhani city

Figure 3 shows the classified image using five different classes. An agriculture is main occupation of the city, so most of the land covered with crop land which is indicated by green color in figure.
Table 2 : Statistic of Land use of Parbhani district

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Categories</th>
<th>Area in km²</th>
<th>Area in (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fallow land</td>
<td>481.7864</td>
<td>20.80</td>
</tr>
<tr>
<td>2</td>
<td>Built up Area</td>
<td>26.7032</td>
<td>1.15</td>
</tr>
<tr>
<td>3</td>
<td>Water body</td>
<td>6.531</td>
<td>0.261</td>
</tr>
<tr>
<td>4</td>
<td>Crop land</td>
<td>531.6436</td>
<td>22.96</td>
</tr>
<tr>
<td>5</td>
<td>Non crop land</td>
<td>374.4953</td>
<td>16.17</td>
</tr>
</tbody>
</table>

Area in Percentage = Category * 100 / (Sum of area of all classes)

Table 2 shows the statistical result of different classes of an imagery. The statistical result also shows that the city is mostly occupied by crop land.

4. Results and Discussions

One of the goal of remote sensing data analysis was to produce a land use map of Parbhani city. This paper indicates that how Remote Sensing and GIS techniques are integrated in order to establish land cover analysis in Parbhani city in the year December 2013. This was done using a maximum likelihood supervised classification algorithm using training areas chosen according to field knowledge and literature study. The classification finally gives the land use land cover image of area. Five land cover classes namely Fallow land, Built up area, Water Bodies, Crop land, Non crop land are identified in the study area. The classified images provide all the information to understand the land use land cover of the study area. Each class is assigning separate color. After classification the post classification was done and map is interpreted. The statistical analysis shows that the land is mostly occupied by crop land.

5. Conclusion

The present study of land use and land cover classification establishes the fact that accurate land use data can be obtained from the satellite imagery more efficiently and economically than by traditional method. By using image processing and Geographic Information System techniques the different land use classes are analyzed and mapped easily. In the field of education the Parbhani is known for the famous Marathwada agricultural university which is very helpful for the peoples residing all around. The classified image shows that the city mostly occupied by crop land.

References

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