Forest Vegetation Analysis and Land Cover Assessment in Tan Sub Watershed of Hasdeo River Basin, Chhattisgarh, India

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What is a Forest?

The forest is a complex ecosystem consisting mainly of trees that buffer the earth and support a myriad of life forms.

FAO Forest Definition

- The FAO defined forest as land with tree crown cover (or equivalent stocking level) of more than 10 percent and area of more than 0.5 hectare.
- The trees should be able to reach a minimum height of 5 m at maturity in situ.

Forests are further subdivided into plantations and natural forests.

Natural forests are forests composed mainly of indigenous trees not deliberately planted.

Plantations are forest stands established by planting or seeding, or both, in the process of afforestation or reforestation.
Role of Forest

The trees help create a special environment which, in turn, affects the kinds of animals and plants that can exist in the forest.

They clean the air, cool it on hot days, conserve heat at night, and act as excellent sound absorbers.

Forests are the most valuable natural resources available to the mankind on planet earth. Trees are an important component of the environment.

On the one hand, they are the essential source of livelihood for the poor and marginalized sections of the society; it also they provide furniture and other items of desire for the rich.

Contd…..

Role of Forest

Plants provide a protective canopy that lessens the impact of raindrops on the soil – reducing soil erosion.

The layer of leaves that fall around the tree prevents runoff and allows the water to percolate into the soil. Roots help to hold the soil in place.

Dead plants decompose to form humus, organic matter that holds the water and provides nutrients to the soil.

Plants provide habitat to different types of organisms. Birds build their nests on the branches of trees, animals and birds live in the hollows, insects and other organisms live in various parts of the plant.

They produce large quantities of oxygen and take in carbon dioxide. Transpiration from the forests affects the relative humidity and precipitation in a place.
Agro-Climatic Conditions

Forests can develop wherever the average temperature is greater than 10 °C in the warmest month and rainfall exceeds 200 mm annually.

In any area having conditions above this range there exists a variety of tree species grouped into a number of forest types that are determined by the specific conditions of the environment there, including the climate, soil, geology, and biotic activity.

TOTAL FOREST COVER OF THE WORLD
= 4 BILLION HECTARES
= 30.3% (FAO report, 2005)
IMPORTANT FACTS ABOUT THE WORLD FOREST:

- World has about 4 billion ha or about 40 million sq km or 30.3% of total land area forest
- Forest area per capita is 0.62 ha
- 64 countries have less than 10% of their total land area under forest
- 45 countries have more than 50% of their total land area under forest
- Each year about 13 million ha of the world forest are lost due to deforestation
- Forests are home to 300 million peoples around the world
- In developing countries about 1.2 billion peoples rely on agro forestry farming system that help to sustain life
- Global employment in the farm forestry sector: 17 Million peoples.
- Forest provide habitat to about 2/3 of all spices on the earth.
- Deforestation accounts for up to 20% of the global greenhouse gas emissions that causes global warming.

Most primary forest cover in World:

1. BRAZIL 415,890
2. RUSSIAN FEDERATION 255,470
3. CANADA 165,424
4. UNITED STATE OF AMERICA 104,182
5. PERU 61,065
6. COLOMBIA 53,062
7. INDONESIA 48,702
8. MEXICO 32,850
9. BOLIVIA 29,360
10. PAPUA NEW GUINEA 25,211
Country/area | Land area | Natural forest | plantation | area 2000 | Total forest | Area change 1990-2000/total forest |
<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>13,017</td>
<td>709</td>
<td>625</td>
<td>1,334</td>
<td>10.2</td>
<td>n.s.</td>
</tr>
<tr>
<td>Bhutan</td>
<td>4,701</td>
<td>2,995</td>
<td>21</td>
<td>3,016</td>
<td>64.2</td>
<td>1.5, n.s.</td>
</tr>
<tr>
<td>India</td>
<td>297,319</td>
<td>31,535</td>
<td>32,478</td>
<td>64,113</td>
<td>21.6</td>
<td>0.1, n.s.</td>
</tr>
<tr>
<td>Maldives</td>
<td>38</td>
<td>1</td>
<td>1</td>
<td>3.3</td>
<td>n.s.</td>
<td>n.s.</td>
</tr>
<tr>
<td>Nepal</td>
<td>14,300</td>
<td>3,767</td>
<td>133</td>
<td>3,900</td>
<td>27.3</td>
<td>0.2, -78, -1.8</td>
</tr>
<tr>
<td>Pakistan</td>
<td>77,067</td>
<td>1,361</td>
<td>960</td>
<td>2,361</td>
<td>3.1</td>
<td>n.s., n.s., n.s.</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>6,463</td>
<td>1,925</td>
<td>316</td>
<td>1,940</td>
<td>30.0</td>
<td>0.1, -35, -1.6</td>
</tr>
<tr>
<td>Total</td>
<td>412,917</td>
<td>42,013</td>
<td>34,652</td>
<td>76,665</td>
<td>18.6</td>
<td>0.1, -98, -0.1</td>
</tr>
<tr>
<td>Total World</td>
<td>1,306,390</td>
<td>36,82,722</td>
<td>1,86,733</td>
<td>36,69,455</td>
<td>30.6</td>
<td>0.6, -9,391, -0.2</td>
</tr>
</tbody>
</table>

**IN INDIA:**

- Forest Cover (in hectares): 67,701,000
- Forest Cover (as % of total land area): 22.8%
- Other wooded land (in hectares): 4,110,000
- Other land with tree cover (in hectares): 815,000
- Total land area (in hectares): 328,726,500

(IRS-P6 LISS III 2008)
India has a large and diverse forest resource. The country's very large population means that intense demands are placed on its forests.

India’s forest types vary from tropical rainforest in north-eastern to desert and thorn forests in Gujarat and Rajasthan; mangrove forests in West Bengal, Orissa and other coastal areas and dry alpine forests in the western Himalaya.

The most common forest types are tropical moist deciduous forest, tropical dry deciduous forests found in Madhya Pradesh and Chhattisgarh and wet tropical evergreen forests.
CHHATTISGARH FOREST AREA

- Reserved Forests: 25782.167 Sq.Km.
- Protected Forests: 24036.100 Sq.Km.
- Undemarcated Protected Forest: 9954.122 Sq.Km.

Total Forests: 59772.389 Sq.Km.

**Introduction of Hasdeo River Basin**

- In Chhattisgarh, Mahanadi river has three major tributaries like Sheonath river, Hasdeo river and Mand river.

- Hasdeo river basin is one of the major basins in the northern and central Chhattisgarh region. It is located between the $21^\circ45'\text{N}$ to $23^\circ37'\text{N}$ latitude and $82^\circ00'\text{E}$ to $83^\circ04'\text{E}$ longitude.

- It flows from north to south direction and meets in Mahanadi after covering the length of 330 kms. It has 10,405.99 sq kms catchment area.

- The Hasdeo river basin has eight main sub watersheds namely, Upper Hasdeo, Bamni, **Tan**, Gej, Ahiran, Chornai, Lower Hasdeo and Lower Basin Mahanadi *(Source: Central Ground Water Board, India)*.

- The Upper Hasdeo, Gej, Tan and Chornai sub watersheds were identified as those that could benefit most of the upper part of the basin and occupying 47% of the total area, together they account for 68% of the sediment and 73% of the water supplied by the eight sub watersheds of the Hasdeo River.
Introduction of Tan Sub Watershed

• Tan sub watershed is situated in western part of the Hasdeo basin in between 22°34’ N to 22°47’ N latitude and 82°00’ E to 82°37’ E longitude.

• This sub watershed covers 870.44 sq km area.

• The total population of the area is 2.67 lacs (Census of India, 2001). The area consists of hilly and mountainous terrain with minimum elevation of 423 m to maximum elevation of 702 m in the sub watershed.

• The climate is generally sub-tropical characterized by summer and rainy months. The whole area is depending upon the monsoon.

• The temperature varies from 24.7°C to 44°C in summer and 11.4°C to 26.4°C in winter and the relative humidity recorded 25.5 to 93% in the area.

• The geological structure of the sub watershed is gondwana super rock which covers most part of the sub watershed. The soil of the area is almost fine – loamy and rest area has clays soil.

• Rich forest biodiversity in the area.
MATERIAL AND METHOD USED FOR FOREST LAND USE/ LAND COVER STUDY IN TAN SUB WATERSHED

• Images obtained from IRS P6 LISS III dated 26.10.2008 path 102 rows 55/56 is used.

Following hardware and software were used for image processing and GIS analysis:
• Hardware:
  During present study the image processing was carried out in a system with Pentium Processor, 4GB RAM and 24 bits Graphics Windows acceleration Board with resolution of 1024 x 768.
• Software:
  ➢ ArcGIS 9.3 (ESRI)
  ➢ ERDAS IMAGINE 9.5 (Leica) software for image processing
  ➢ MS Office XP: MS-Excel, Ms-Word for word processing

PRELIMINARY INTERPRETATION:
The study is primarily based on topographical sheets on scale 1:50,000/1:25,000 published by the Survey of India (SOI).
IRS P6 LISS III image of Hasdeo river basin

Tan sub watershed catchment and its LULC pattern
**Forest vegetation land cover distribution in Tan sub watershed (IRS-P6 LISS III Dated 26.10.2008)**

<table>
<thead>
<tr>
<th>Forest Land Cover Type</th>
<th>Area (in sq. Kms.)</th>
<th>% area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dense forest (DF)</td>
<td>308.808</td>
<td>35.48</td>
</tr>
<tr>
<td>Non Forest (NF)</td>
<td>218.357</td>
<td>25.09</td>
</tr>
<tr>
<td>Open Forest (OF)</td>
<td>186.406</td>
<td>21.42</td>
</tr>
<tr>
<td>Scrubland (SBL)</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Water bodies (WBD)</td>
<td>156.869</td>
<td>18.02</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>870.44</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

**Non Forest land cover distribution in sub watershed**

<table>
<thead>
<tr>
<th>Non Forest Land Cover Type</th>
<th>Area (in sq. Kms.)</th>
<th>% area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture land without Crop</td>
<td>164.738</td>
<td>75.44</td>
</tr>
<tr>
<td>Agriculture land with Crop</td>
<td>53.619</td>
<td>24.56</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>218.357</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Some snap shots of Tan sub watershed area
### FOREST LAND USE/LANDCOVER (LULC) IN HASDEO RIVER BASIN

Spatio-temporal variation in Forest land cover classes:

<table>
<thead>
<tr>
<th>Forest Land Use / Land Cover Class</th>
<th>1999</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Area (Sq.km.)</td>
<td>%</td>
<td>Area (Sq.km.)</td>
<td>%</td>
<td>Area (Sq.km.)</td>
</tr>
<tr>
<td>Dense Forest</td>
<td>2718.78</td>
<td>26.14</td>
<td>2688.19</td>
<td>25.83</td>
<td>2405.58</td>
</tr>
<tr>
<td>Non Forest</td>
<td>3256.21</td>
<td>31.34</td>
<td>3444.37</td>
<td>32.13</td>
<td>3653.63</td>
</tr>
<tr>
<td>Open Forest</td>
<td>1578.09</td>
<td>15.16</td>
<td>1595.36</td>
<td>15.33</td>
<td>1632.63</td>
</tr>
<tr>
<td>Scrubland</td>
<td>22.38</td>
<td>0.21</td>
<td>23.00</td>
<td>0.22</td>
<td>24.30</td>
</tr>
<tr>
<td>Water bodies</td>
<td>2830.33</td>
<td>27.25</td>
<td>2755.05</td>
<td>26.47</td>
<td>2689.65</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10405.99</strong></td>
<td><strong>100</strong></td>
<td><strong>10405.99</strong></td>
<td><strong>100</strong></td>
<td><strong>10405.99</strong></td>
</tr>
</tbody>
</table>

### TEMPORAL CHANGE DETECTION OF THE HASDEO RIVER BASIN IN FOREST POINT OF VIEW

**1999** - **2006** - **2007** - **2008** - **2009**

- **Dense Forest**
- **Non Forest**
- **Open Forest**
- **Scrubland**
- **Water Bodies**

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Forest Land Cover Change Detection in Hasdeo river basin between year 1999 to year 2009

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<tr>
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<tbody>
<tr>
<td>Sq kms</td>
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<td>Sq kms</td>
<td>Sq kms</td>
<td>Sq kms</td>
<td>Sq kms</td>
<td>Sq kms</td>
</tr>
<tr>
<td>Dense Forest</td>
<td>-386.79</td>
<td>-3.71</td>
<td>-382.61</td>
<td>-2.7</td>
<td>-318.93</td>
<td>-385.13</td>
</tr>
<tr>
<td>Non Forest</td>
<td>+285.89</td>
<td>+2.69</td>
<td>+309.26</td>
<td>+3.01</td>
<td>+212.09</td>
<td>+469.51</td>
</tr>
<tr>
<td>Open Forest</td>
<td>+255.48</td>
<td>+2.45</td>
<td>+17.32</td>
<td>+0.17</td>
<td>+37.27</td>
<td>+37.37</td>
</tr>
<tr>
<td>Scrubland</td>
<td>+9.77</td>
<td>+0.99</td>
<td>+0.42</td>
<td>+0.01</td>
<td>+0.55</td>
<td>+0.01</td>
</tr>
<tr>
<td>Water bodies</td>
<td>-164.35</td>
<td>-1.53</td>
<td>-75.26</td>
<td>-0.78</td>
<td>-65.42</td>
<td>-328.76</td>
</tr>
</tbody>
</table>

NB: (+) indicates increasement, (-) indicates decreasement

**CONCLUSION/SUGGESTION**

- Remote Sensing Technique is a gift for forest to find its status more accurately and think for the conservation and protection of the available or to increase the forest resources.
- GIS based method to estimate future forest land cover in any watershed and helps to make a management plan for the better livelihood protection.
- Forest is a good source of water and due to deforestation most of the rivers, waterholes are dried or dry in summer in all over the world.
THINK

Is forest deforestation is the best idea for modern development in the world?????????????

ACKNOWLEDGEMENT

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All the group members who working for this big project in Central India.
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