Forest fire vulnerability assessment using geospatial technique: A case study of Uttarakhand

Presented by Manoj Singh*

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INTRODUCTION

• Important threat to biodiversity conservation and other ecosystem services.
• Extent of forest land tending to fire every year ranges from 33-90%.
• Classes on the basis of their causative agents:
  (i) natural causes,
  (ii) deliberately/deliberately created by man and
  (iii) unintentionally/coincidentally brought about by man
• 80% of the fires are result of anthropogenic activities.
• Forest fire prone zone maps preparation is accordingly the first venture to prevent tragic and harming occurrences of forest fire.
• Preparation of forest fire prone zone outline incorporating a satellite picture, geological and other auxiliary information from a geographic data framework (GIS) for the state of Uttarkhand, India.
• Remote sensing and GIS procedures are useful for making a suitable system for forest fire prone zone mapping.
• Maps will help the forest department to anticipate or minimize fire hazard activities.
• Policy makers, forest managers and conservationists are making efforts to prevent burning of forests.
Methodology

Study Area : Uttarakhand

- SOI toposheet (1:50000 Scale)
- SRTM data
- Forest Survey India observation data
- ESRI ARC GIS 9.3 was used to generate the following variables used:
- Forest fire relies on numerous elements:
  - vegetation sort/thickness,
  - dampness of the territory,
  - vicinity of settlements and separations from the streets.
- Vegetation: coniferous forest, subalpine, subtropical pine and broadleaf forest
- Proximity from streets: study area are navigated by numerous streets, permitting nearby individuals and graziers
- Vicinity to settlements: not many settlements are placed inside the forest in the study range
**Forest fire zone mapping using weighted variables**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Classes</th>
<th>Weightage</th>
</tr>
</thead>
</table>
| **Vegetation** | 1) Semi-evergreen Forest  
2) Deciduous Forest  
3) Agriculture/ Fellow land  
4) Grass/Grazing | 10        |
| **Elevation**  | 1) >3600m  
2) 3600-2800m  
3) 2800-1600m  
4) 1600-177m | 4         |
| **Slope**      | 1) >25°  
2) 25°-18°  
3) 18°-11°  
4) 11°-3°  
5) <3° | 10        |
| **Aspect Ratio**| 1) East Facing  
2) N-E, S-E Facing  
3) West facing  
4) N-W, S-W Facing  
5) North, South Facing | 10        |
| **Road Variables** | 1) 2 Km  
2) 6 Km  
3) 12 Km  
4) 18 Km | 10        |
| **Settlement** | 1) 2 Km  
2) 6 Km  
3) 12 Km  
4) 18 Km | 10        |
Procedural steps for forest fire risk zone mapping

1. Satellite Imagery
   - Georeferenced, Classified (LULC), Aspect, Slope, And Elevation map generation

2. SOI-TOPOSHEET
   - Georeferenced & Digitized for Road and Settlements Features

3. Reclassed and weightage assignment for Fire Risk assessment

4. Integrated Tool analysis and post processing of fire risk area

5. Forest Fire Risk zone/Area Map and statistical analysis
Results

Showing different variables effecting forest fire
Forest fire risk map and Fire Points Distribution pattern captured by integrated tool analysis of Uttarakhand State

<table>
<thead>
<tr>
<th>Fire Risk Map</th>
<th>Fire Event Count</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Very High</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>79</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Unclassified</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>140</td>
<td></td>
</tr>
</tbody>
</table>
## District list with fire risk area

<table>
<thead>
<tr>
<th>District</th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
<th>Very High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nainital</td>
<td>9.69</td>
<td>954.05</td>
<td>2399.68</td>
<td>135.70</td>
</tr>
<tr>
<td>Champawat</td>
<td>37.39</td>
<td>639.73</td>
<td>807.28</td>
<td>48.46</td>
</tr>
<tr>
<td>Garhwal</td>
<td>77.54</td>
<td>2039.66</td>
<td>2198.90</td>
<td>92.77</td>
</tr>
<tr>
<td>Dehradun</td>
<td>2.77</td>
<td>916.67</td>
<td>952.67</td>
<td>34.62</td>
</tr>
<tr>
<td>Uttarkashi</td>
<td>69.23</td>
<td>1474.70</td>
<td>3158.49</td>
<td>204.93</td>
</tr>
<tr>
<td>Bageshwar</td>
<td>4.15</td>
<td>376.64</td>
<td>1308.54</td>
<td>81.70</td>
</tr>
<tr>
<td>Almora</td>
<td>26.31</td>
<td>1046.83</td>
<td>1566.09</td>
<td>54.00</td>
</tr>
<tr>
<td>Pithoragarh</td>
<td>36.00</td>
<td>702.04</td>
<td>1607.63</td>
<td>167.55</td>
</tr>
<tr>
<td>Rudraprayag</td>
<td>8.31</td>
<td>423.72</td>
<td>1049.60</td>
<td>65.08</td>
</tr>
<tr>
<td>Chamoli</td>
<td>59.54</td>
<td>1193.61</td>
<td>2053.50</td>
<td>120.47</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>351.71</td>
<td>11961.00</td>
<td>21973.72</td>
<td>1200.53</td>
</tr>
</tbody>
</table>
Conclusion

• Fire risk in our study shows the areas prone to forest fire

• Weightage analysis shows the significance of other factors even if forest type has a low risk weighting.

• Comparison of fire risk zone map with the actual sites affected by fire.

• Starting points of fire were concentrated in areas adjacent to settlements, roads, etc.

• Most of the points representing burnt areas were located in the very high and high-risk zones predicted from the model.

• Advantageous to have a fire risk map to avert possible disasters.

• Helpful to the Forest Department to set up an appropriate fire-fighting infrastructure in the areas more prone to fire damage.
Discussion/ Q & A
Valuable suggestion Email: msingh.jnu@gmail.com