Satellite Remote Sensing & GIS for Rainfall-Runoff Modelling

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Case Study

Estimation of Surface Runoff for Warasgaon Dam Catchment

Mose river (near Pune)

Source
Estimation of Surface Runoff using Rainfall – Runoff Modeling of Warasgaon Dam Catchment
A. A. Kulkarni, S.P. Aggarwal and K.K. Das
Map India Conference 2004, GIS Development, New Delhi
Materials and Methods

- Satellite images of IRS – IC LISS III (4th February 2002) & IRS – IC PAN (30th January 2002) were used for land use/land cover mapping.
- Digital Elevation Model (DEM) was created using contour map for deriving slope map of Mose river catchment in GIS domain.
• The runoff is estimated with help of following equation

\[ Q = \frac{(P - I_a)^2}{(P - I_a + S)} \]

Where,

\[ Q = \text{Accumulated storm runoff, mm.} \]
\[ P = \text{Accumulated storm rainfall, mm.} \]
\[ I_a = \text{Initial abstraction, \((=\sim 0.2S)\)} \]
\[ S = \text{Maximum Potential retention by the soil.} \]

• For daily rainfall, \( S \) values are derived from the CN values using the following formula as

\[ S = 25.4 \left( \frac{1000}{CN} - 10 \right) \]

Where, \( CN \) is function of watershed hydrologic land use/land cover units, hydrologic soil groups and antecedent moisture conditions.
Methodology for Rainfall – Runoff Modeling
Rainfall (mm) for each Theissen Polygon
Land Use/ Land cover Classes

<table>
<thead>
<tr>
<th>Land Use/Land Cover Classes</th>
<th>Area (sq.km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scrub/Grassland</td>
<td>28.68</td>
</tr>
<tr>
<td>Current S.C.</td>
<td>5.52</td>
</tr>
<tr>
<td>Medium Dense Forest</td>
<td>37.48</td>
</tr>
<tr>
<td>Abandoned S.C./Open Forest</td>
<td>26.23</td>
</tr>
<tr>
<td>Dense Forest</td>
<td>6.70</td>
</tr>
<tr>
<td>Agricultural Land</td>
<td>9.27</td>
</tr>
<tr>
<td>Settlement</td>
<td>0.23</td>
</tr>
<tr>
<td>Dry River Bed</td>
<td>4.67</td>
</tr>
<tr>
<td>Water Body</td>
<td>15.93</td>
</tr>
</tbody>
</table>
Classified Slope Map

Legend

- High (> 35 %)
- Med. (15 - 35 %)
- Low (<10 %)
Estimating Surface Water Flow at Ungaged Locations

- Stream Channels
- Corrected Channels
- Burned DEM
- Filled DEM
- Flow Area Accumulation
- Stream Network
- Area, CN, Rain Accumulation
- Flow Distribution Parameters
- Original datasets
- CN and Avg. Rain
- Control Points
- DEM

- CN and Avg. Rain
- Control Points
- DEM

- Estimating Surface Water Flow at Ungaged Locations
Estimated Surface Runoff for each Sub watershed
Surface Runoff for Each Sub watershed

The bar chart shows the surface runoff for each subwatershed. The runoff values (in mm) for each subwatershed are as follows:

- SW1: 2551.14
- SW2: 1215.74
- SW3: 995.85
- SW4: 460.7
- SW5: 1565.6
- SW6: 1467.64
- SW7: 1382.18
- SW8: 320.93
- SW9: 1489.52
- SW10: 1213.82
- SW11: 3914.76
- SW12: 1837.16
- SW13: 2315.2
- SW14: 930.9
- SW15: 1350.15

The subwatershed number is listed on the x-axis, and the runoff value is on the y-axis.