The Use of GIS and Remote Sensing
to Identify Areas at Risk from Erosion
in Indonesian Forests:
A Case Study in Central Java

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Massey University

Endang Savitri

2006
[Since they have become oblivious of God] corruption has appeared on land and in the sea as an outcome of what men's hands have wrought: and so He will let them taste [the evil of] some of their doings, so that they might return [to the right path]

Ar Ruum 30:41
ABSTRACT

Environmental degradation and soil erosion begins when production forests are harvested. Unfortunately, logging cannot be avoided in plantation forests and since this operation can render the land more susceptible to erosion, any negative impacts need to be addressed properly.

Erosion potential is predicted by evaluating the response of land cover, soil and slope to the impact of rainfall and human activities. The role of remote sensing and geographical information systems (GIS) in erosion prediction is to collect information from images and maps; combine and analyse these data so that it is possible to predict the erosion risk.

The objective of this study was to produce a method to identify areas most susceptible to erosion and predict erosion risk. It is intended that the method be used particularly by forestry planners and decision makers so that they can improve forest management, especially during logging.

The study area was within Kebumen and Banjarnegara districts of Central Java, Indonesia. Imagery used included a Landsat 7 satellite image (28th April 2001) and panchromatic aerial photos (5th July 1993). Other data was derived from topographical, soil, and geological maps, and 10 years of daily rainfall data from 17 rainfall stations.

Predicting erosion in this study was done by combining rainfall, slope, geology, and land cover data. The erosion risk was predicted using land cover and soil type and depth. A rainfall map was generated using a thin plate spline method. A slope map was derived from a DEM which was generated by digitizing contours and spot heights from topographic maps. A geological map was derived from Landsat image classification with assistance from a 1:100000 scale geological map; and a land cover map was produced from an interpretation of the Landsat image and aerial photographs.

A stratified classification technique was used to delineate land covers in the study area with an accuracy of 44%. The low accuracy could be attributed to the complexity of the area and the temporal variation in the data acquisition.
The analysis of erosion risk showed that mixed forests and monotype forest experienced high and moderately high erosion risk. This condition supported the contention that harvest plans must incorporate soil conservation measures.
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## ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>asl</td>
<td>above sea level</td>
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<tr>
<td>Bakosurtanal</td>
<td><em>Badan Koordinasi Survey dan Pemetaan Nasional</em> (National Coordinating Agency for Surveys and Mapping)</td>
</tr>
<tr>
<td>CRES</td>
<td>Centre for Resource and Environmental Studies</td>
</tr>
<tr>
<td>DEM</td>
<td>Digital Elevation Model</td>
</tr>
<tr>
<td>DN</td>
<td>Digital Number</td>
</tr>
<tr>
<td>DOS</td>
<td>Dark Object Subtraction</td>
</tr>
<tr>
<td>DPI</td>
<td>Dot per Inch</td>
</tr>
<tr>
<td>ETM</td>
<td>Enhanced Thematic Mapper</td>
</tr>
<tr>
<td>GCP</td>
<td>Ground Control Point</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographical Information System</td>
</tr>
<tr>
<td>IDW</td>
<td>Inverse Distance Weighted</td>
</tr>
<tr>
<td>ISODATA</td>
<td>Iterative Self-Organizing Data Analysis</td>
</tr>
<tr>
<td>ITTO</td>
<td>International Timber Trade Organization</td>
</tr>
<tr>
<td>LAI</td>
<td>Leaf Area Index</td>
</tr>
<tr>
<td>LIPi</td>
<td><em>Lembaga Ilmu Pengetahuan Indonesia</em> (Indonesian Institute of Sciences)</td>
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<tr>
<td>NDVI</td>
<td>Normalised Difference Vegetation Index</td>
</tr>
<tr>
<td>RGB</td>
<td>Red – Green – Blue</td>
</tr>
<tr>
<td>RMS Error</td>
<td>Root Mean Square Error</td>
</tr>
<tr>
<td>RTGCV</td>
<td>(Square) Root of Generalised Cross Validation</td>
</tr>
<tr>
<td>RTMSE</td>
<td>(Square) Root of Mean Square Error</td>
</tr>
<tr>
<td>SCS</td>
<td>Sun – Canopy – Sensor</td>
</tr>
<tr>
<td>SFM</td>
<td>Sustainable Forest Management</td>
</tr>
<tr>
<td>SJFCSP</td>
<td>South Java Flood Control Sector Project</td>
</tr>
<tr>
<td>SPOT</td>
<td><em>Satellite pour l’Observation de la Terre</em></td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>---------</td>
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<tr>
<td>STS</td>
<td>Sun – Terrain – Sensor</td>
</tr>
<tr>
<td>USLE</td>
<td>Universal Soil Loss Equation</td>
</tr>
<tr>
<td>UTM</td>
<td>Universal Transverse Mercator</td>
</tr>
<tr>
<td>WRS</td>
<td>World Reference System</td>
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