ABSTRACT

The objective of this research are (a) determine land cover type based on NDVI and (b) RVI transformation model on landsat image, (c) land cover type determination using the threshold model approach.

The research method used is Landsat TM image interpretation digitally by using spectral value transformation (Normalized Differenced Vegetation Index/NDVI) and determination of land cover type using threshold model approach and field check.

The results indicated there are five types of land cover, ie (i) those are (i) bare land and waterproof surface, (ii) herbaceous and shrubs, (iii) low density vegetation, (iv) Medium density vegetation and (v) High density vegetation. There is a significant correlation between RVI and NDVI, with vegetation density, this is indicated by r² values of 0.809 and 0.948 respectively. Transformation of RVI and NDVI on Landsat TM5 with threshold model approach can be used to obtain land cover information with relatively high accuracy. The accuracy test showed overall accuracy of NDVI was 93.0%, while the overall accuracy of RVI was 88.9%.

INTRODUCTION

Remote sensing is a variety of techniques developed to gain and analysis data about the earth. The data are electromagnetic radiation that is reflected or emitted from the earth's surface (Lindgren, 1985 in Sutanto, 1986). The recorded
data in the form of remote sensing data which in its application is called remote sensing image.

The image of the remote sensing sensor record contains variety information of objects on the earth's surface. Each object on the earth surface has specific reflectance values. The interaction of electromagnetic waves with objects on the earth surface is what will become the basis of the introduction of objects.

Remote sensing products called remote sensing images are now widely used to study land cover/land use, spatial design, areas of disease outbreaks, etc. Remote sensing satellite imagery plays an important role in providing information on forest cover, vegetation type and land use (Houghton and Woodwell 1981; Botkin et al., 1984; Malingreau 1991; Roy 1993 in Jha et al., 2004).

Each type of remote sensing image has level of detail information this is closely related to its resolution. Sutanto (1986) suggests there are four resolutions, namely spatial resolution, spectral resolution, radiometric resolution, and temporal resolution. Resolution is the ability of an electronic-optical system to distinguish information spatially or spectrally similar (Swain and Davis, 1978). Spectral resolution is the ability of the sensor to distinguish objects based on the spectral reflection of the object itself. The concept of resolution is closely related to the quality of spatial data in remote sensing. The wavelength variations of Landsat images are used as the basis for the introduction of vegetation on the surface of the earth.

This research was conducted to study land cover type in Peninsula Leihitu Ambon City based on spectral transformation of landsat image. The purposes of this study are determined land cover type based on transformation model of NDVI and RVI vegetation index on Landsat image, and determination of land cover class using threshold model approach.

**METHODS**

This research was conducted in Peninsula Leihitu Ambon City, Ambon Island (3°35’55” – 3°43’125” S and 128°02’10”BT – 128°15’55”E) covering an area of 2157 Ha (Figure 1).

The method used in this research is spectral transformation of Landsat satellite digital image and field check. The image data used is Landsat TM5 image (path/row 109/062), November 23th, 2009 from National Aeronautics and Space Agency (LAPAN) with 1G data level. Nevertheless, this research is still being done image correction.

The vegetation index was analyzed using Normalized Differenced Vegetation Index (NDVI) and Ratio Vegetation Index (RVI) vegetation index transformation model while land cover type class using threshold model approach while the classification of land cover using threshold model approach. Field observation was conducted on October 2012 to February 2013 to verify the result of transformation vegetation index and land cover type. The transformation of the vegetation index is a combination of the technique of increment with image reduction techniques with the math band procedure on ENVI 4.5 software. Transformation Ratio Vegetation Index (RVI) analysis using formula 1, while the transformation of Normalized Difference Vegetation Index NDVI using formula (2) (Danoedoro, 2012).

![Figure 1. Location Map](image-url)
The accuracy test of classification result is done pixel by pixel based on predetermined accuracy test sample point. Accuracy parameters tested were Producer’s Accuracy, User’s Accuracy, Omission Error, Commission Error, Overall Accuracy, Overall Error dan Kappa Coefficient (Stehman and Czaplewsky, 1997). The process of confusion matrix analysis and calculation of accuracy parameters is fully done by ENVI 4.5. The course of research is presented in the form of a flow chart (Figure 2).

**RESULTS**

It has been proposed that satellite images used are images with 1G data level. This means that the image has been corrected systematically. However in this study radiometric and geometric corrections remain to be done in order to get better image quality. The radiometric correction process is intended to improve the image quality, so that the pixel values represent the actual object value. Figure 3 shows the Landsat image before correction (3a) and Landsat image after correction (3b).
Landsat TM5 Image, 2009

Figure 3. Radiometric Correction of Landsat Image TM5 2009; (a) before correction, (b) after correction. (Source: analysis result).

The geometric correction process uses image to map method of Landsat TM 2009 image based on RBI digital Map (1:50000). Image coordinate transformation to map coordinate is done by order 3 polynomial method. Ground control points used in this correction is 12 points GCP. RMS Error value for image geometric correction result is 0.15181. The results of the geometric correction of the imagery are shown in Figure 4.

Figure 4. Geometric Correction Result of Landsat TM5 Image 2009 with RBI Map (1:50,000).

Vegetation Index Transformation

Assessment of land cover can not be separated from the assessment of vegetation cover. The vegetation index is a model with a simple ratio of multiple satellite imagery channels, especially the ratio of the near infrared and red spectrum channels designed to separate or stretch the pixel value to the image's appearance, it is used as an indicator of vegetation cover and biomass (Eastman and Thiam, 2001; Liwa, 2006 in Utomowati, 2011).

Transformation of vegetation indices used in this study is RVI and NDVI transformation. The transformation histogram of each vegetation index is presented in Figure 5, while the results of statistical analysis are presented in Table 1.

Figure 5. The NDVI and RVI histogram of Landsat TM5 Image, 2009. (Source: Analysis result).

<table>
<thead>
<tr>
<th>Vegetation Indices</th>
<th>Min 2009</th>
<th>Max 2009</th>
<th>Mean 2009</th>
<th>Deviation std 2009</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>RVI</td>
<td>1,068</td>
<td>95,064</td>
<td>10,961</td>
<td>3,929</td>
<td>Up</td>
</tr>
<tr>
<td>NDVI</td>
<td>0,032</td>
<td>0,979</td>
<td>0,791</td>
<td>0,131</td>
<td>Up</td>
</tr>
</tbody>
</table>

Source: Analysis result of Landsat TM5 Image, 2009.

The minimum, maximum, mean and standard deviation of vegetation index value indicated the direction of vegetation index influence. Based on the statistical analysis result (Table 1), high vegetation index
values are indicative of high density vegetation, and low vegetation index values are indicative of low density vegetation.

![Graph of vegetation index and percent of vegetation cover.](image)

Figure 6. Two Dimensional Matrix Relationship between Vegetation Index and Percent of Vegetation Cover. (Source: Analysis result).

Statistically there is significant correlation between vegetation indices with vegetation density. This is reflected of R² value between vegetation index and vegetation density ranging between -1 and +1 as shown in Table 2 and Figure 6.

Table 2. Correlation of R² Value of RVI and NDVI Vegetation indices with Vegetation Density.

<table>
<thead>
<tr>
<th>Vegetation Indices</th>
<th>R² Value 2009</th>
<th>Relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>RVI</td>
<td>0.809</td>
<td>Very strong</td>
</tr>
<tr>
<td>NDVI</td>
<td>0.948</td>
<td>Very strong</td>
</tr>
</tbody>
</table>

Source: Analysis result

Land cover classification is done by approach of threshold model based on histogram RVI and NDVI pattern. In the threshold model, the determination of the spectral value distribution in RVI and NDVI are different because the classes are determined based on the range of values in the histogram pattern (Figure 7).

![Histograms of RVI and NDVI values.](image)

Figure 7. Determination of Land Cover Class based on (a) RVI Histogram, and (b) NDVI Histogram on Landsat TM5 Image (2009) with Threshold Model Approach (Source: Analysis result).
Based on the threshold model approach, the land cover in the research area is classified into five land cover types. The range of spectral values of each image vegetation index is presented in Table 3.

**Table 3. Land Cover classification based on Relative Calibration of RVI and NDVI Value.**

<table>
<thead>
<tr>
<th>No</th>
<th>RVI</th>
<th>NDVI</th>
<th>Land Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1,1 – 5.1</td>
<td>0.43 - 0.57</td>
<td>Open land and waterproof surface</td>
</tr>
<tr>
<td>2</td>
<td>5.1 – 9.1</td>
<td>0.57 - 0.72</td>
<td>Herbs and shrubs</td>
</tr>
<tr>
<td>3</td>
<td>9.1 – 13.0</td>
<td>0.72 – 0.79</td>
<td>Low density vegetation</td>
</tr>
<tr>
<td>4</td>
<td>13.0 – 17.0</td>
<td>0.79 - 0.85</td>
<td>Medium density vegetation</td>
</tr>
<tr>
<td>5</td>
<td>17.0 – 21.0</td>
<td>0.85 - 0.98</td>
<td>High density vegetation</td>
</tr>
</tbody>
</table>

Source: Analysis result

**Land Cover**

The result of vegetation transformation index shows the area of bare land and waterproof surface is detected by RVI transformation equal to 12.4% while NDVI transformation is 11.3% of the study area. Low density vegetation area was detected by the RVI transformation of 23.0% while the NDVI transformation was 22.6% of the study area. The area of land cover type of RVI and NDVI transformation detection is presented in Table 4 while the distribution is shown in Figures 9 and 10.

**Table 4. Numbers of Vegetation Index RVI and NDVI Value on Each Type of Land Cover of Landsat TM5 Image 2009.**

<table>
<thead>
<tr>
<th>Land Cover</th>
<th>Number of Pixels</th>
<th>RVI</th>
<th>%</th>
<th>NDVI</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open land and waterproof surface</td>
<td>685</td>
<td>11.8</td>
<td>655</td>
<td>11.3</td>
<td></td>
</tr>
<tr>
<td>Herbs and shrubs</td>
<td>1245</td>
<td>21.5</td>
<td>1264</td>
<td>21.9</td>
<td></td>
</tr>
<tr>
<td>Low density vegetation</td>
<td>1328</td>
<td>23.0</td>
<td>1305</td>
<td>22.6</td>
<td></td>
</tr>
<tr>
<td>Medium density vegetation</td>
<td>1323</td>
<td>22.9</td>
<td>1382</td>
<td>23.9</td>
<td></td>
</tr>
<tr>
<td>High density vegetation</td>
<td>1163</td>
<td>20.1</td>
<td>1143</td>
<td>19.8</td>
<td></td>
</tr>
<tr>
<td>Unclassified</td>
<td>40</td>
<td>0.7</td>
<td>35</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>5784</td>
<td>100</td>
<td>5784</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Source: Analysis result.

**Image Interpretation Accuracy**

Accuracy test is inseparable from image interpretation. The accuracy of the interpretation results is the suitability between the results of image interpretation and field test results. The smaller the difference between the results of image interpretation with the actual situation on the ground means more accurate interpretation (Sutanto, 2013).

![Image 8](Image)  
*Figure 8. Land Cover based on the RVI Index Transformation model.*
Based on the condition of the research area, the number of samples used in the accuracy test is different for each land cover type. Bare land and waterproof surface are 23 sample points, Herbaceous and shrubs are 52 sample points, Low density vegetations are 43 sample points, Medium density vegetations are 37 sample points, High density vegetation ares 30 sample points. The accuracy test showed overall accuracy of NDVI was 93.0%, while the overall accuracy of RVI was 88.9%.

The research does not study the causes of differences in transformation values of RVI and NDVI, but examines the relationship between RVI and NDVI transformation index values with land cover.

CONCLUSION

1. Based on the transformation of RVI and NDVI there are five types of land cover, those are (i) bare land and waterproof surface, (ii) herbaceous and shrubs, (iii) low density vegetation, (iv) Medium density vegetation and (v) High density vegetation.

2. There is significant correlation between vegetation indices with vegetation density.

3. Transformation of RVI and NDVI on Landsat TM5 with threshold model approach can be used to obtain land cover information with relatively high accuracy. The accuracy test showed overall accuracy of NDVI was 93.0%, while the overall accuracy of RVI was 88.9%.

REFERENCES