Comparison Effectiveness of Pixel Based Classification and Object Based Classification Using High Resolution Image In Floristic Composition Mapping (Study Case: Gunung Tidar Magelang City)

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Abstract. Developments of analysis remote sensing have same way with development of technology especially in sensor and plane. Now, a lot of image have high spatial and radiometric resolution, that’s why a lot information. Vegetation object analysis such floristic composition got a lot advantage of that development. Floristic composition can be interpreted using a lot of method such pixel based classification and object based classification. The problems for pixel based method on high spatial resolution image are salt and paper who appear in result of classification. The purpose of this research are compare effectiveness between pixel based classification and object based classification for composition vegetation mapping on high resolution image Worldview-2. The results show that pixel based classification using majority 5x5 kernel windows give the highest accuracy between another classifications. The highest accuracy is 73.32% from image Worldview-2 are being radiometric corrected level surface reflectance, but for overall accuracy in every class, object based are the best between another methods. Reviewed from effectiveness aspect, pixel based are more effective then object based for vegetation composition mapping in Tidar forest.

Keywords: Remote sensing, Object based classification, Pixel based classification, Worldview-2, Floristic composition, effectiveness

1. Introduction
Multispectral classification mostly being used for Landover and land use mapping. Forest study itself more emphasis on extensive mapping, monitoring, biophysical and structure. The classification for more detailed object such as floristic composition mapping still rarely performed. Floristic composition mapping is seen from the structure of the leaf and canopy appearance difference is very thin, between vegetation, so it’s needed remote sensing imagery with high spatial resolution and spectral resolution. Type of forest in tropical Indonesia, mostly heterogeneous with irregularity pattern grows in the forest. This heterogeneous manifold causes its own difficulties in mapping floristic composition using digital analysis.

Classification using high resolution image very good for visual interpretation because the object looks clear, but using digital classification such pixel based classification and object based classification
be trend for today. Every method have advantage and weakness in classification result. Visual interpretation will give accuracy but need a lot of time and effort especially if the large area of interest. Pixel based classification often being used than object based classification because pixel based classification only consider spectral value or one aspect for boundary class and that’s make this classification more easy and fast. The problems occur when pixel size and spatial resolution very detail so salt and paper will occur, which shadow effect or sun angel could make same object will be different because spectral value different.

Along with development of satellite technologies, occur new method classification that is object based classification. This classification not depend on one aspect in every pixel but this classification considering another aspect such texture, scale and color and also this method using cluster pixel or segment to classing information. Different characteristic between pixel based classification and object classification makes it possible produce different accuracy in classification result. Object based classification itself is also not perfect [5], object based classification still have problems when processing very large data. Even if the object based classification is more effective than pixel-based classification, segmentation process performed on the multispectral image pixel-based classification is a process that is too heavy. The processing time and different difficulty levels become considered in choosing the method of classification, which accuracy result will more significant or not, compare to time processing and difficulty level and can be declared as effective method for composition vegetation mapping.

2. Material and Study Area
2.1. Study area
Location of Tidar forest in middle of Magelang city with geographic location in 110°12'49.95"–110°13'22.99" eastern and 7°29'34.09"–7°30'7.85" southern (Figure 1). Tidar forest have purpose for forest city. Tidar forest was located in two district which are Magersari district and Jurangombo district. In 2008, Tidar forest have 701,673 m², but in 2013, but in 2013, area of Tidar forest got reduction to 690,526 m² because land conversion into golf area and settlement. Tidar forest are heterogeneous type forest because it consist of several different types vegetation just like in Table 1.

| No. | Vegetation latin name | Nama Daerah Tumbuhan |
|-----|-----------------------|----------------------|
| 1   | Delonix regia         | Flamboyan            |
| 2   | Swietenia macrophylla | Mahoni               |
| 3   | Albitzia lopanha      | Sengon jowo          |
| 4   | Albitzia paraserianthes | Sengon laut      |
| 5   | Leucaena glauca       | Lamtoro, manding    |
| 6   | pteris enchyformis    | Pakis                |
| 7   | Glyseridia sp         | Kleresida            |
| 8   | Ficus benyamina       | Beringin             |
| 9   | Tamarindus indica     | Asem Jawa            |
| 10  | Pinus mercusii        | Pinus                |
| 11  | Bischofia javanica    | Gadog (Meranti Putih)|
| 12  | Hibiscus similis Bl   | Waru gombong         |
| 13  | Calliandra calothyrsus| Kaliandra            |
| 14  | Spathodea campanulata | Sepatu Dia           |

Source: Field survey, June 2013

Figure 1. Study area Tidar forest
3.1. Preparing data
Preparing primary data such Worldview-2 image and secondary data such statistic data and administration boundary. Before using Worldview-2 image, first step to do was doing geometric and radiometric correction and make a boundary for area interest. Geometric correction needed because research location have hill topography so the position not like a real condition.

| Class | Floristic Composition | Vegetation Species Description (Local name) |
|-------|-----------------------|---------------------------------------------|
| A     | Pinus                 | Mahoni                                      |
| B     | Beringin              | Sengon                                      |
| C     | Gombong               | Aren                                        |
| D     | Kaliandra             | Gadog                                       |
| E     | Sepatu Dea            | Klereside                                   |

3.2. Pre-survey data
This step is make a tentative map for mapping unit field survey and class floristic composition (Table 2). The method for make tentative map are visual interpretation because when use unsupervised classification the result will came salt and paper just like Figure 2.

![Figure 2](image_url)

**Figure 2.** Pre-Survey maps (a) Using Unsupervised (ISODATA) method, and (b) Using Visual Interpretation
3.3. Field Survey
The field survey aim is to verification floristic composition in field for input data classification and accuracy assessment. Sampling method using stratified random sampling (Figure 3). Information which take from field survey is:
1. Coordinate sample using GPS
2. Floristic composition sample such leaf, density pattern and dominant vegetation.
3. Sketch of Composition vegetation sample location
4. Field photo

![Figure 3. Location of samples](image)

3.4. Pixel Based Classification
The algorithm for pixel based classification using MLC (Maximum likelihood). This method are supervised classification which needed sample for classification. Input sample got from field survey. Step of pixel based classification is:
a. Training area : This step is to prepare key interpretation
b. Classification : Every pixel compare with sample for every category
c. Output : Layouting for result classification

3.5. Object Based Classification
Object based classification method not only see from spectral aspect but also from shape and texture. Object based classification using segmentation method. This method divide spectral to be segment-segment. Step of object based classification are:
a. Make Segment : This step is to divide pixel to cluster pixel
b. Training segment : Segmentation process depend on network level-level from parameter scale.
c. Classification : This function is classing the segment depend on classification result

3.6. Assessment Accuracy
Accuracy assessment using confusion matrix table to count accuracy result (producer accuracy), user accuracy and overall accuracy.
4. Result and Discussion
Class of floristic composition got reduction from 21 class be 13 class with 10 class of floristic composition and 3 class of non-floristic composition. Input image of both classification from 3 kind of radiometric correction. Before do the classification, sample must be do separability with every image. Class B and C have the smallest separability 0.8 because the similarity of both composition canopy. Pixel based classification using non correction data have 63.56% for overall accuracy. Class J have small accuracy for individual class floristic composition accuracy that is 2.22%. Pixel based using TOA reflectance image have better overall accuracy than non-correction 65.09% and pixel based classification using surface reflectance image have the best accuracy 66.22% but for class J reduce to be 1.80%. From 3 different input radiometric correction, the result show the best accuracy from surface reflectance but that’s still not improve accuracy for a few class such class J and I. Class J with species Mahoni have small accuracy because this vegetation was not to dominant in this location so input sample very few and Mahoni canopy looks same like (Figure 4)

![Figure 4. Pixel based classification result (a) Non radiometric correction, (b) Surface reflectance, (c) TOA reflectance](image)

The result of pixel based classification will be majority for post classification too reduce salt and paper effect and see the accuracy improvement. The kernel windows be used for majority is 3x3, 5x5 for every input image of pixel based classification result. The accuracy improve more than 6 % (Table 3)

| Pixel Based Classification (Majority Analysis) | Original | Toa Reflectance | Surface Reflectance |
|-----------------------------------------------|----------|-----------------|---------------------|
| 3x3                                          | 70.75%   | 69.94%          | 71.16%              |
| 5x5                                          | 72.75%   | 69.94%          | 73.32%              |

Second classification is object based classification. This classification have 2 step, first is segmentation process and second is classification process. Every wavelength have different respond for every object, for vegetation green, yellow, red edge, NIR and NIR2 have sensibility for vegetation. In segmentation every spectral column can be given different weight.
Figure 5. Image every wavelength for vegetation (a) Cyan, (b) Blue, (c) Green, (d) Yellow, (e) Red, (f) Red Edge, (g) NIR1, (h) NIR2

The weight every wavelength can be subjective depend on user from try and error. In this research weight for segmentation can be seen in Table 4. Mean and variance weighted use comparison 2:8, because object of interpretation very detailed.

| Band     | Cyan | Blue | Green | Yellow | Red | Red Edge | NIR1 | NIR2 |
|----------|------|------|-------|--------|-----|----------|------|------|
| Weighted | 0,005| 0,005| 0,005 | 0,245  | 0,005| 0,245    | 0,245| 0,245|

Parameter for segmentation not only from weighted every wavelength but also similarity tolerance, mean and variance. Value of similarity tolerance will make different result of segment. Smaller the value of similarity tolerance, more detailed the segment result. A few value of parameter segment was be tried to found the best segment for represented floristic composition (Figure 6)
Segmentation is unit analysis for object based classification, just like pixel for pixel based classification. The best segment value is 9 because not too general in the border of segment proportional. Post classification for object based classification using maximum-likelihood. Sample for classification using same sample like pixel based classification so it can be compared (Figure 7).

There is different result for object based classification. The best accuracy from image without radiometric correction 70.24%. This show that radiometric correction not always give better accuracy for classification because sometime if not accurately correction will make pixel change (Table 5).
Effectivity of classification can be seen from 3 parameter is, accuracy assessment, difficulty and processing time. Even object based can give better accuracy assessment but it’s need more processing time and more difficult than pixel based classification. (Table 6)

**Table 5.** Accuracy assessment object based classification

| Object Based Classification | Non Correction | TOA Reflectance | Surface Reflectance |
|----------------------------|----------------|-----------------|---------------------|
|                            | 70,24%         | 69,63%          | 67,72%              |

**Table 6.** Effectiveness classification method from (a) accuracy assessment, (b) time processing and (c) difficulty level

| (a) | Pixel Based | Object Based |
|-----|-------------|--------------|
|     | Non Correction | TOA Reflectance | Surface Reflectance | Non Correction | TOA Reflectance | Surface Reflectance |
| Overall Accuracy Value | 63,56% | 65,09% | 66,22% | 70,24% | 69,63% | 67,72% |
| (b) | Time cost | Qualitative | Quantitative | Value |
| Pixel Based | Fast | 10 Days | 2 |
| Pixel Based (Majority Analysis) | Fast | 12 Days | 2 |
| Object Based | Long | 20 Days | 1 |
| (c) | Difficulty |
| Pixel Based | Easy | 3 |
| Pixel Based (Majority Analysis) | Medium | 2 |
| Object Based | Hard | 1 |

5. **Conclusion**
The best overall accuracy assessment for floristic composition is 73.32% using pixel based with majority 5x5. Total class of floristic composition is 10 class and 3 class for non-floristic composition. The dominant vegetation is *Pinus mercusii* about 62% in Tidar forest. Pixel based classification with majority 5x5 more effective then object based. Salt and paper problems from pixel based classification can be minimalized using majority.
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