Detection of Rice Fields in Sleman District using SVM (Support Vector Machine) Method

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Abstract. Remote sensing technology is very well used as a data for making land use maps, because mapping needs are increasingly high especially for detecting land use changes, especially for determining the area, especially rice fields in Sleman district. To obtain information on the area of the rice field from the interpretation of Landsat-8 OLI imagery, a special method is needed, especially for processing remote sensing image data digitally. One method of processing remote sensing images is the Support Vector Machine (SVM) method. This research is useful to implement the SVM method and support research in the geospatial field. This study aims to determine the area of Sleman district rice field with SVM and to determine the accuracy of the SVM method. The Support Vector Machine (SVM) method is a learning machine method that can classify patterns and recognize patterns from input or sample data provided and also includes supervised learning. The SVM method is used to classify segment polygons in which similar pixels.

1. Introduction

Land in Indonesia can be divided into several categories based on their use and utilization. The type of land used for vegetated areas can be divided into several categories based on the type of vegetation. Given the variety of plants that can grow in Indonesia is also not small. The type of plant producing staple food in the form of rice can grow well. Science or technology is used to obtain information from existing data to produce new things according to their purpose. As in the case of data collection related to the area of paddy fields can be applied with technology. Remote sensing as a technology uses its sensor to flap objects on the surface of the earth. Its utilization can be applied to observe rice fields in Indonesia.

Landsat 8 imagery OLI (Operational Land Imager) has a spatial resolution of 30 m and in one scene the image can cover 60-180 km² [2]. The area of observation that is quite wide and the level of object recognition is sufficient can provide an opportunity to make observations of the area of rice fields. In addition to the 2015 HKTI Farmers' Congress and National Working Meeting [1] the area of rice fields is abundant in Java, although the presence of rice fields on other islands is also potential. The area of observation of paddy field area in this study is the Sleman Regency in Yogyakarta which is also located in Java. The condition of the area on the slopes of Mount Merapi supports the abundance of rice fields.
Landsat 8 imagery OLI is a form of spatial data in the form of a raster image and needs to be defined the type of object in it. This will later form a data inventory related to the existence of land and also the area of land detected. Translating objects from raster images will be processed with the SVM (Support Vector Machine) algorithm. The object that is defined is the object of rice field and then the area of land is calculated.

Based on the background above the problem that is the focus of this research is how to use the Support Vector Machine (SVM) method to determine the area of rice fields by defining rice field objects in spatial data in the form of raster images in Sleman district.

The purpose of this research are 1) Knowing the distribution and area of rice fields detected by raster processing using SVM (Support Vector Machine) method on Landsat 8 OLI imagery. 2) Knowing the value of the accuracy of the results of the raster processing that is done to detect the rice field area on Landsat 8 OLI imagery.

2. Matter and A Method Of Approach

The data used in this study are: 1) Imagery Landsat 8 OLI with coverage time of April 16, 2018 in parts of Java Island. 2) Data on the Limits of District Areas in Sleman Regency.

Image correction

Landsat 8 imagery OLI which has been corrected radiometrically is needed to construct vegetation transformation. This is important for radiometric correction of images to eliminate the influence of the atmosphere.

Geometry in the image is not corrected. This is because the Landsat 8 image has been corrected at level 1T. Level 1T means it has been corrected in the field with the UTM coordinate system.

| Data Header               | Keterangan |
|---------------------------|------------|
| GEOMETRIC_RMSE_MODEL      | 6.933 M    |
| GEOMETRIC_RMSE_MODEL_X    | 5.122 M    |
| GEOMETRIC_RMSE_MODEL_Y    | 4.673 M    |

Based on the metadata of the RMSE Model Geometric imagery, the value is 6.933 meters, which means that the overall image shift is 6.933 meters or 7 m. based on the resolution that is owned by Landsat image is 30 m which means that one pixel covers 30 x 30 m, then with a 7 m disposition the image can be directly used. This is because the medium resolution owned by Landsat images can cover the 7 m shift. But in this study geometric correction is still done, although if you want to do further processing it is not problematic because the ability of Landsat imagery is at a medium resolution of 30 m.

Full scene size Landsat 8 OLI imagery is 192 X 196 KM and its area reaches 37,855 km2. The main study in this study was Sleman Regency so that the minimum required area was 574,858 KM2. Reducing the size of the image in accordance with research needs can facilitate data processing technically reducing the amount of data processed by the computer.
Figure 1. Images of Landsat 8 OLI imagery in the study area

Selection of classes on ROI adjusts to the characteristics of objects in the image. The number of classes used are 7 classes, namely: built land, forest, pre-harvested rice fields, post-harvest rice fields, other high vegetation, other low vegetation, open land. Sand, and no data. Class selection is based on the characteristics of the area in Sleman Regency. Besides that, the number of classes is inversely proportional to the accuracy value. So that in this study only use a small number of classes and the scope of this processing output is on a scale of 1: 250,000 which is considered capable with the use of medium resolution imagery.

SVM classification is supported by the establishment of ROI in the previous stage for determining the best hyperplane that separates classes or groups. The kernel type used is a linear kernel and can be formulated as follows:

$$K(x_i, x_j) = x_i \cdot x_j$$

Supribadi et al., 2014 [2] explained the parameters in using SVM, namely the higher penalty value parameter will increase the classification results but the continuous addition of values will reduce the classification quality, the 0 value on the pyramid level will produce good accuracy and require a long time for the number of parameters many, high high probability probability classifications will decrease, and bias in kernel functions with values less than 1 results in high accuracy.

3. Results and Discussion

Class determination in this study initially used 7 modified land use classes. This is to include non-rice field classes into various other types of classes that are defined. Initially the SVM definition was to divide two different classes, namely paddy fields and non-paddy fields. But in non-land classes there are a variety of pixel variations that can blend the determination of the class. So that from the 7 modified land use classes formed then divided into non paddy fields. The area of paddy fields was chosen and used as the focus of this method.
Figure 2. SVM processing in 7 classes

Characteristics of objects which are paddy fields are seen from several aspects and then carried out classification with the SVM method. These characteristics are having a square shape with patched patterns, colors tend to be bright green or brownish yellow, slightly rough textured, associated with rivers and lowlands / ramps.

The SVM method in the linear type kernel that was used resulted in the determination of the rice field area in Sleman Regency in 18 districts. The highest area of paddy fields is in Ngaglik District 19.78 KM2, while the lowest area is Turi 2.14 KM2. Besides that, the total area obtained in Sleman Regency is 165.6KM2. Each sub-district has the rice field area detected from this method as follows: Cangkringan District 3.11 KM2, Pakem District 5.96 KM2, Kecamatan Tempel 8.69 KM2, Kecamatan Sleman 8.03KM2, Kecamatan Ngemplak 15.92 KM2, Ngaglik Subdistrict 19.78 KM2, Seyegan Subdistrict 6.04 KM2, Mlati 10.56 KM2 Subdistrict, Minggir Subdistrict 12.62 KM2 Depok Subdistrict 14.42 KM2, Godean Subdistrict 10.78 KM2, Gamping Subdistrict 8.5 KM2, Moyudan District 8.95 KM2, Berbah District 7.97 KM2, Prambanan District 11.28 KM2 District Kalasan 10.91 KM2.

Figure 3. SVM processing results on Landsat 8 OLI imagery to determine the extent and distribution of paddy fields
Based on the results of SVM processing on Landsat 8 OLI imagery to determine the extent and distribution of paddy fields in Sleman Regency, the accuracy value can be calculated. The accuracy calculation includes the value of overall accuracy, producer accuracy, user accuracy and kappa coefficient value. The total accuracy obtained is 53% with a kappa coefficient of 0.32. In the non rice field class, the value of the high accuracy is 90% with a minimum error of 10%. Rice field classes have a low manufacturing value of 43% and high error omission with a value of 57%. whereas on the user's accuracy the paddy field is 94% which is quite large with a 6% error commission. Non-paddy field classes have low user accuracy with a value of 30% and a high error commission of 70%.

4. Conclusion
The conclusions in this study are as follows:

- **Rice field** area detected from SVM processing is spread in 18 sub-districts in Sleman Regency or covers all districts, namely 165.6KM2 for paddy fields. The largest area of rice fields is in Ngaglik District 19.78 KM2 while the smallest area is in Turi District with an area of 2.14 KM2.
- **The overall accuracy value on SVM processing results** is 53% with a kappa coefficient of 0.32. the accuracy of the maker in determining the appropriate rice field area is only 43% but the accuracy of the user in translating the rice field area is quite high reaching 90%.

5. References
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