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LAND COVER SPECTRAL DATA CLASSIFICATION USING ARTIFICIAL NEURAL NETWORK (ANN)

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Abstract
Bamboo is one of the plants in the tropics which is also a lignocellulosic natural material which can be used as a substitute for wood. There are hundreds of types of bamboo in Indonesia, where each type has its own characteristics in its use so that bamboo has potential in the industrial sector where when combined with innovation and creativity it has high economic value and is in demand by domestic and foreign consumers. The use of "Remote Sensing" technology, especially in terms of identifying bamboo and vegetation and other objects, has been proven through research related to land cover classification. This study aims to classify land cover spectrum data using an Artificial Neural Network algorithm. Classification of 36 data consisting of light bamboo, dark bamboo, dry soil, wet soil, bricks, concrete, grass, and taro leaves was evaluated using accuracy techniques. The resulting accuracy is 94.45%.

I. INTRODUCTION

Bamboo is one of the plants in the tropics which is also a lignocellulosic natural material which can be used as a substitute for wood. Bamboo has many benefits from each part so that it is widely used by people for various purposes, including food, crafts and furniture, equipment to buildings. This causes the bamboo raw material-based industry to grow. It is estimated that 80% of bamboo in Indonesia is used for construction (including furniture), 10% packaging, raw materials for handicrafts (small industry) and 5% for agricultural facilities and others (eg: garment, paper) (Sutardi, 2015).

There are hundreds of types of bamboo in Indonesia, where each type has its own characteristics in its utilization (Ministry of Environment and Forestry, 2021), so that bamboo has potential in the industrial sector where when combined with innovation and creativity it has high economic value and is in demand by domestic and foreign consumers. country. With the potential of existing bamboo, Indonesia, which is the third largest producer of bamboo in the world, can become a basis for the development of the bamboo industry (Febriani, 2016).

In the development of bamboo-based industries, there are problems in the supply of raw materials in the form of bamboo. Provision of raw materials for bamboo-based industries is 1) preparation of the upstream sector through the provision of potential bamboo species; 2) development of bamboo plantations; 3) Government incentives in the upstream sector; and 4) mapping of bamboo distribution, for example: an inventory of bamboo with landsat imagery. The potential of bamboo in one region can support the bamboo industry in other areas. One of the potential areas for producing bamboo is West Java. Currently there is no strong supply chain in the bamboo industry. This needs to start with an inventory of bamboo raw materials to determine their availability (Author Team, 2015) (Hartono, 2016), by mapping the potential of bamboo spatially, especially in West Java, as the focus of the research area.

Remote Sensing is where one of its uses is using satellite imagery data technology for various purposes, especially in terms of identification of vegetation. Various area data have been mapped and analyzed to find solutions using image data, such as information on biodiversity (Roy, 2014), land use, to identification of natural resources, such as bamboo. MODIS satellite imagery data is one which is used to identify bamboo areas which are generally vegetation. The process carried out uses spectral analysis of forest types to identify bamboo which is mixed with forests, and combined (hybrid) knowledge in the form of classification techniques to distinguish bamboo species (Törmä, 2015), (Dong, 2020), (Ahmad, 2021), (Ghayour , 2021).

The big process which has been described in the previous paragraph certainly requires a small step as the initial step of the analysis stage. The first step which can be taken is to separate the types of objects, for example grass, brick, concrete, soil, bamboo, and so on. Separation of objects based on their features or characteristics is known as classification, where the main goal in this study is to classify or separate bamboo plants from other objects based on the spectrum data of these objects. The classification carried out in this study focuses on using the Artificial Neural Network (ANN) algorithm which has been widely used in classification research using spectral data which has been done by Ahmad et al Ahmad (Ahmad, 2021), Dong et al (Dong, 2020) and (Ghayour, 2021).

II. LITERATURE REVIEW

A. Theoretical basis

In Indonesia, there are 125 species of bamboo and 39 of them have been identified. From these, 11 species are classified as commercial species while the rest are local commercial species. Commercial types are generally large in diameter (more than 8 cm), and thick-walled (more than 8 mm). These commercial species come from three genera which are selected for development. Those are *Bambusa*, *Dendrocalamus* and *Gigantochloa*. The use of bamboo consists of traditional users (farmers, rural communities, craftsmen, religious/ cultural events) and industrial users (paper factories, chopsticks/ flower stick factories, bamboo cement board factories and canned bamboo shoots). The bamboo needs of traditional users can be fulfilled from community bamboo because the bamboo plants owned by the community are used for their own or local needs (Ministry of Environment and Forestry, 2021).

Remote Sensing is the process of detecting and monitoring the physical characteristics of an area by measuring reflections and radiation output from a distance. This process usually uses satellites or planes. The camera used is a special camera which collects image data, in an effort to help researchers see the earth. Examples are satellite cameras which capture images of the earth's surface and sonar systems on ships to capture images of the seabed surface (USGS, 2021).

B. Related research

There have been many studies related to mapping the distribution of bamboo, especially those using Remote Sensing data. Huaqiangdu et al used multisource remote sensing data combined with investigative data, statistics and literature to identify the distribution of bamboo in China (H. Du 2018). Similar work was also carried out by Guang Liu et al (Liu G, 2017). By performing multisource remote sensing data fusion, they used the Bidimensional Empirical Mode Decomposition method which extends the review of data in two dimensions for the application of integral transformation techniques. The research was also conducted in China. Periodic mapping of changes in distribution has also been carried out by Yangguang Li et al (Yi L, 2018) to estimate changes in distribution in the future based on distribution information from several previous years. The method used is stepwise regression based on data from 32 Landsat TM and OLI images taken from several different years. The research was also conducted in China, precisely in Zhejiang Province.

In several countries besides China, research on the distribution of bamboo has also been carried out, among others, in India. Shalabh P. Bharadwaj et al used GIS and remote sensing to calculate the distribution of bamboo in Northeast India. The GIS database contains market, financial institutions, socio-economic data at the village level (Bharadwaj, 2003). In Cameroon, research on the distribution of bamboo has also been carried out by Barnabas Neba Nfornkah et.al, using remote sensing. Data retrieved from Landsat 8/ORI-TIRS and the Thermal Infrared Sensor (TIRS) instrument (Nfornkah, 2020). In Vietnam, the same thing has been done (Cat, Tuong, 2019).

Ahmad et al (Ahmad, 2021) conducted research related to reducing redundant data and feature selection so that only using spectral bands: 491 nm, 541 nm, 641 nm, 722 nm, 772 nm, 852 nm, 942 nm, 1047 nm, 1132 nm , 1443 nm, and 2475 nm. Ahmad et al used Artificial Neural Network (ANN) and Support Vector Machine (SVM). Ahmad et al produced an accuracy of 86.45% and an SVM of 86.75%.

III. RESEARCH METHODS

In general, the overall method of this research can be seen in Figure 1.

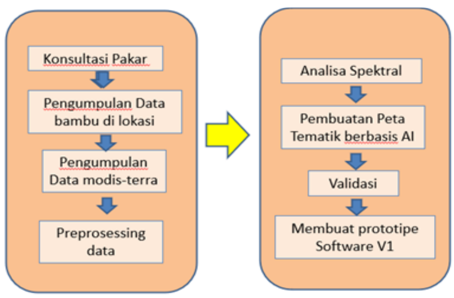

Figure 1. Research Methods

From figure 1, the research conducted and described in this publication only includes the Bamboo Ground Truth Data Processing section (marked with a red circle). The data used in this study consists of 36 sample spectrum data as follows:

1. Dark Bamboo: 5 data
2. Bright Bamboo: 5 data
3. Grass: 5 data
4. Taro Leaves: 5 data
5. Brick: 3 data
6. Concrete: 3 data
7. Dry Land: 5 data
8. Wetlands: 5 data

Spectrum data (wavelength and reflectance) were obtained in collaboration with the lending of a spectrometer tool to BRIN (LAPAN). The data collection location is in a bamboo plantation in Bojongmangu, Bekasi, which can be seen in Figure 2 below:

Figure 2. Location of Ground Truth data collection

The spectrometer used is ASD handled and ASD fieldspek4 with *blabbal* specifications. Pick up times range from 9:50am to 10:58am. An example of a spectrum data graph can be seen in Figure 3 below:

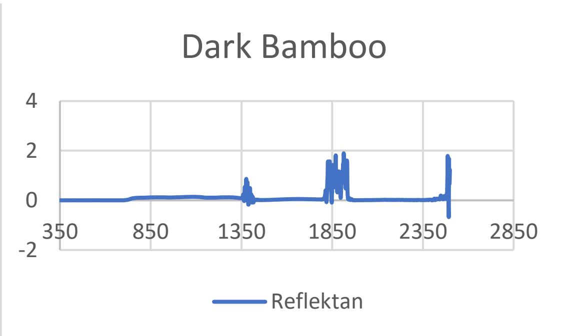

Figure 3. Spectrum of bamboo data

The recorded reflectance data has a wavelength range from 350 nm to 2500 nm. But in this study, using only wavelengths up to 989 nm is associated with an advanced process to match the *Maxar* data.

The Artificial Neural Network (ANN) algorithm used in this study is the Multilayer Perceptron with an epoch of 500.

IV. RESULTS AND DISCUSSION

This study produces an accuracy value of 94.44% with the Confusion Matrix as follows:

```
=== Confusion Matrix ===
 a b c d e f g h   <-- classified as
 5 0 0 0 0 0 0 0 | a = Dark Bamboo
 0 4 0 0 0 1 0 0 | b = Bright Bamboo
 0 0 3 0 0 0 0 0 | c = Brick
 0 0 1 2 0 0 0 0 | d = Concrete
 0 0 0 0 5 0 0 0 | e = Taro Leaves
 0 0 0 0 0 5 0 0 | f = Grass
 0 0 0 0 0 0 5 0 | g = Wet Land
 0 0 0 0 0 0 0 5 | h = Dry soil
```

It can be seen in the confusion matrix above that of the 36 data, there are 2 misclassed data, 1 light bamboo which is considered as grass, and 1 concrete data which is considered as brick. Misclassing in the light bamboo data is very likely to occur because the reflectance value of bamboo is very similar to that of grass. It's different with dark bamboo which has a lower reflectance value than light bamboo and grass (See figure 4-6).

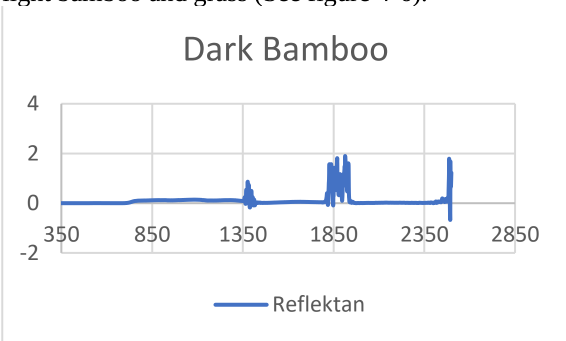

Figure 4. Graph of dark bamboo reflectance

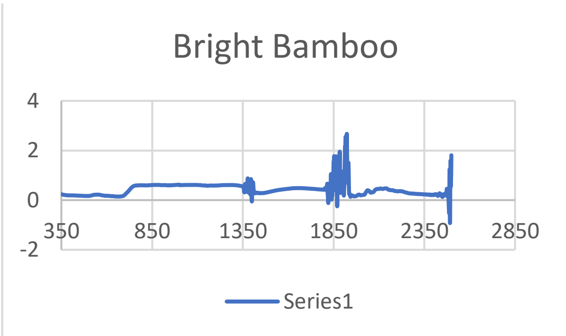

Figure 5. Graph of bright bamboo reflectance

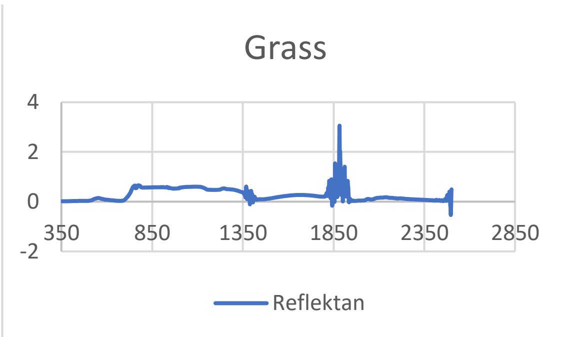

Figure 6. Graph of grass reflectance

From Figure 4-6, it can be seen that the reflectance values of the vegetation in the Near Infra-Red (NIR) waves are very similar so that they are difficult to distinguish. The difference can only be seen in the visible light. Those are Blue, Green, and Red. The reflectance values of blue, green and red visible light on dark bamboo tend to be low because most of the light is absorbed so it looks dark. This is what can distinguish between grass and dark bamboo.

V. CONCLUSION

This research results in an accuracy value of 94.44%, where out of 36 data, 2 of them are misclassed. The misclassification which occurs between the bright bamboo and grass data is very likely due to the difficulty in distinguishing the reflectance values produced by the two types of vegetation. As a suggestion for the continuation of this research, it is necessary to increase the amount of data and the diversity of data so that the graphical patterns of reflecting vegetation and other objects can be distinguished. In addition, the addition of the Wavelength feature up to 2500 nm may need to be done in the hope of increasing accuracy. However, it should also be considered that using the entire reflectance value up to a wavelength of 2500 nm can cost a lot, both memory and processing time.

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