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Health Analysis of Rice Plants Based on the Normalized Difference Vegetation Index (NDVI) Value in Image of Unmanned Aircraft (Case Study of Merauke - Papua Selatan)

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ABSRACT: Remote sensing technology uses various vehicles including satellites, helicopters, aircraft, and Unmanned Aerial Vehicles (UAV) and Drones. Remote sensing technology is often used in agriculture, especially for monitoring rice fields, helping the age of rice and so on. In the current technological era, drone devices are vehicles that are often used to monitor rice fields which are considered effective, considering that the data obtained is the latest data during flights, this is also balanced with current developments in various fields, especially for capturing air, drones be an alternative choice than other alternatives that are considered conventional. Rice is an important cultivated crop because it is a staple food for 90% of Indonesia's population, and also for the people of Papua in Merauke, which is a national food storage area. However, the obstacle that is often experienced is interference from rice diseases. Therefore a fast and accurate analysis of the health of rice plants is needed using the NDVI or Normalized Difference Vegetation Index which is a method for comparing the level of greenness of vegetation originating from drone imagery, with the value of the NDVI we can know the classification of the health of rice plants. In this study the classification of rice plant health was divided into 4 classes. Very good health is in the NDVI value range 0.721-0.92, for good health the NDVI value range is between 0.421-0.72, and normal health NDVI values are in the range 0.221-0.42, while in poor health the NDVI value is 0.11-0.22. With the utilization of drone device technology, it is possible to analyze rice plants per hectare with a normal health classification with an area of 14,877,315 Ha. Whereas in the good health classification the area is 9,846,833 Ha and in the very good health classification the area is 8,922,892.

KEYWORDS: Paddy, Drone, Normalized Difference Vegetation Index, Health Analysis

A. INTRODUCTION

Rice plants are one of the important cultivated plants in human civilization, rice is also a staple food for 90% of Indonesia's population, including the people of Papua in Merauke Regency which is also a national food self-sufficiency area. Therefore the fulfillment or self-sufficiency of rice or paddy is one of the fundamental roles in the political stability of a country. The obstacle currently faced is in terms of monitoring the growth of rice plants quickly and continuously so that productivity can be estimated which leads to local rice stocks. As an agricultural country, Indonesia must prioritize the agricultural sector in an effort to meet food needs, preserve natural resources, absorb labor, which at the same time increase the country's foreign exchange. Agriculture in Indonesia has a wide spread of food land and various kinds of rice fields from several types of food management such as soybeans, tubers and nuts. However, there is no system that visualizes the progress of food crop growth in various regions. Currently, when technology is growing rapidly, the availability of fast, accurate, and effective data is needed in every policy making by the government. Every year the government estimates agricultural production to anticipate the amount of agricultural production so that people's needs can be met. Basically, production estimation is closely related to the interests of the agencies that do it, this is the main reason that the methods, parameters and approaches are different.

NDVI or Normalized Difference Vegetation Index is a method used to compare the greenness of vegetation from drone images. The NDVI value is between -1 to +1, where the value (-) indicates water objects or dry and wet land and the value (+) indicates vegetation objects. This parameter is obtained by extracting the spectral values of the infrared band with the red band on the satellite imagery recordings. NDVI values are basic parameters derived from optical remote sensing data such as Landsat Thematic Mapper (TM) satellite images which are used to detect the greenness of vegetation including rice plants.

B. LITERATURE REVIEW

1. Food Plants

According to Law no. 2 of 1961 concerning expenditure and income and plant seeds, the meaning of plants is every type of plant in any condition and form. Meanwhile, according to the Letter of the Ministry of Agriculture No. 179/SDDP 166, Plants are each type of plant in a state of life or death in its original or non-original form or has been processed. Food is anything that can be eaten and can be put into the body as food while food plants are plants that are cultivated by humans because they are planted and maintained for the results.

Food crops are all kinds of plants, be it cereals, legumes or tubers that can produce carbohydrates and protein, for example: rice, wheat, corn, green beans, peanuts, soybeans, sweet potatoes and cassava. In the process of growing food crop production, it is necessary to know the specifications of food plant seeds to determine the production time and the condition of the plants planted in one planting period.

2. Seed Specifications

Selection of plant varieties on the assumption that farmers know superior varieties for the land where they are cultivated, can be carried out carefully based on the specifications of the seeds that are suitable for the environmental area where they are cultivated, so that the food plants that are cultivated can grow optimally which in turn can help increase the amount of food crop production. . Following are some food plant specification data based on food plant seed specification data. Based on table 1, the specifications of the seeds for each type of food crop each have differences starting from the age of the plant, average yield and yield potential. Apart from that, the seed specifications contain more detailed information about the types of plant seeds, such as selection number, origin of crosses, plant shape, plant height, grain shape, leaf color, stem color and so on.

Table 1. Rice Seed Specifications

No	Jenis Pan	Varietas	Umur (hari)	Hasil Rata-	Potensi
1.	Padi	Celebes	105 –	5,0	6,5
		Luk ulo	112 –	5,0	7,0
		Membera	115 –	6,5	7,5
		Pepe	120 –	7,0	8,1
		Cigeulis	115 –	5,0	8,0
		Ciherang	116 –	6,0	8,5
		Cimelati	118 –	6,0	7,5
		Mekongga	116 –	6,0	8,4
		Singkil	115 –	5,0	7,0

3. Rice Growth Phase

The rice growth phases can be described according to the type of rice planted, with an average age of rice growth that can be harvested between 100 to 125 days, which is divided into three phases namely the vegetative phase (various), the reproductive phase (35 days) and also the maturation phase with a range of 30 days.

There are several phases that rice plants go through from the initial growth phase to entering the harvest season with varying reflectance characteristics (spectral signatures) when viewed using Landsat TM satellite imagery, including.

- The initial phase of rice growth, where paddy fields are dominated by water due to flooding. In Landsat TM images with a true color composite (TCC) color composition, paddy fields will appear blue.
- The vegetative growth phase, marked by the denser leaves of the rice plants covering the entire paddy field. In this phase, land cover is dominated by green. This green color will appear green in the image.
- The generative growth phase, in which paddy fields which were originally dominated by green leaves will be replaced with pale yellow rice grains in TCC.
- Harvest phase. In this phase the land becomes fallow for a certain period of time. In this condition the paddy fields will appear reddish brown in the TCC color composition.

The harvesting phase can be estimated using Landsat satellite imagery when referring to the average rice age which ranges from 110 – 120 days. This can be done by first monitoring the initial planting phase, namely the change from the fallow phase (land preparation phase) to the water phase (soil processing/flooding) or by monitoring the change in the rice plant phase from the water phase to the vegetative phase.

4. Remote Sensing

Remote sensing or commonly called senses is defined as the process of obtaining information about an object without direct physical contact with the object. Information is obtained by detecting and measuring various changes in the land where the object is located. The process is carried out by feeling or recording the energy that is reflected or emitted, processing, analyzing and applying that information. Information is potentially captured at a height through the energy that builds up from the earth's surface, which is obtained in detail from the spatial, spectral and temporal variations of the land. Spatial, spectral and temporal variations provide additional complementary information. The distribution of straight line formations that form paths provides information on the existence of an activity in that location. Regular formations resembling a house add to the information that this location is also a place to live. These two information come from the existence of spatial variations of objects in the image. The brownish red color makes it clear

the difference between the collection of house objects and the location of the land covered with green vegetation.

This additional information comes from the existence of spectral variations which can in detail increase the accuracy of object identification. Changes in the number of objects at one location contained in two or more images will provide information about the growth of the phenomenon at that location. Information at the same location from two images at different recording times provides multi-temporal information. This multi-temporal information is very useful in analyzing changes in phenomena that occur over a certain period of time at that location.

5. Image interpretation

Image interpretation is the act of examining photographs and/or images with the intention of identifying objects and symptoms and assessing the importance of these objects and symptoms. So in image interpretation, the interpreter examines the image and attempts to recognize the object through the stages of activity, namely Detection, Identification and Analysis.

After going through these stages, the image can be translated and used for various purposes such as: geography, geology, environment, etc. Basically image interpretation activities consist of 2 processes, namely through object recognition through the process of detection and assessment of object functions. Interpretation of remote sensing images can be done in two ways, namely manual interpretation and digital interpretation. Manual interpretation is the interpretation of remote sensing data based on the recognition of spatial characteristics of objects.

Object characteristics can be recognized based on 9 elements of interpretation, namely shape, size, pattern, shading, hue/colour, texture, site, association and convergence of evidence. Digital interpretation is a quantitative evaluation of the spectral information presented in the image. The basis for digital image interpretation is the classification of pixel images based on their spectral values and can be done statistically. In digital image classification, it has a specific goal to automatically categorize every pixel that has the same spectral information by including spectral pattern recognition, spatial pattern recognition and temporal pattern recognition which ultimately form a particular class or spatial (spatial) theme..

C. METHOD

The research method used is the observation method, as well as data collection using unmanned aircraft. The following are the stages of implementing research activities:

1. Preparation Stage

The preparatory stage includes determining research locations, literature study and determining problem analysis methods.

2. Stage of preparation of tools and materials

The equipment needed to be able to carry out a damage survey is as follows:

a. laptops,
b. Vector Map,
c. drones,
d. survey form sheet,
e. Pilox, camera, memory card, pencil,
f. Plinth board, etc.

3. The image or image capture stage

In order to take this aerial photo, in addition to ensuring that the aerial camera is working properly, it is also necessary to ensure the weather conditions at the time the photo was taken. A cloudy sky or a very hot sun will certainly affect the image of the aerial photography.

4. System and tool design stage

Following are some of the stages in determining the design of systems and tools, namely: In carrying out a Value-Based Rice Plant Health Analysis (NDVI) on Imagery Using Unmanned Aircraft, after the preparation stage and the preparation stage for tools and materials have been carried out, it will then begin with a needs survey and conditions of supporting materials, such as the willingness to determine the longitude and latitude points in the research area to be taken as supporting data and test data as a support in producing maximum and accurate research results

5. Manufacturing and analysis stage

At this stage, if the previous stages have been completed, it will wait for the stages of the selection and announcement process, so that it can proceed at the manufacturing stage of the tool to be tested and applied, so that the weaknesses and strengths of the system to be known can be identified.

D. DISCUSSION AND RESULT

At the current discussion stage, shooting using drones has been carried out and the programming stage has been carried out which aims to determine the health analysis of rice plants.

1. Aerial photography steps The steps that must be carried out before taking aerial photos are two of them namely: Ground Test, Camera Calibration and Aerial Image Processing

• Ground Tests

After the preparations have been completed, the next step is testing the camera system on land (ground test). This is intended to determine the performance of the camera system as a whole, such as the camera's resistance to shock, the suitability of the shooting speed with the camera's shutter speed, the accuracy of coordinates on the ground test image results, and so on.

• Camera Calibration

The results obtained during the ground test are then used to recalibrate the camera system, both internally and externally. Internally means re-adjusting the camera's internals, such as focal length, focus number, camera shutter speed, exposure time, and so on. While externally, it means re-adjusting the camera layout or camera mount on the vehicle

• Image Processing of Aerial Photographs

In order for the aerial photographic images to be utilized by remote sensing image data users, the aerial photographic images must go through a processing (correction) process first. Thus, the image data from the aerial photographs are in accordance with the standard remote sensing image, namely the corrected image

2. Types of Pests in Rice Plants

A light trap is a pest trap that uses the light method to attract or catch pests in a trap. Based on observations, there are several types of insects trapped in light traps, including: green leafhopper (Nephotettix virescens), brown leafhopper (Nilaparvata lugens), true leaf roller moth (Chanaphalocrosis sp), false leaf roller moth (Chanaphalocrosis medinalis), white stem borer moth (Scirpophaga innotata), yellow stem borer moth (Scirpophaga incertulas), and stink bug (Leptocorixa acuta). The types of pests trapped are nocturnal pests, namely pests that are generally active at night. These pests are generally attracted to light, so they are attracted to approaching light traps. The types of rice plant pests that are caught in light traps include:

a. Nephotettix virescens

Green leafhopper (Nephotettix virescens) is one of the important pests in rice plants. Because these pests can cause viruses. Green leafhoppers during observation were found in light traps in rice plants which were found from the beginning of planting to harvest.

Figure 1. Nephotettix virescens

b. Nilaparvata Lugens

The brown planthopper (Nilaparvata lugens) is also an important pest in rice cultivation. This pest can cause rice plants to die dry and look like they are burnt or puso. The brown planthopper begins to attack from the beginning of planting until the rice is ripe for milk.

Figure 2. Nilaparvata Lugens

c. Leafroller Moth

The leaf roller moth is divided into two types, namely the original leaf roller moth, which is one of the pests found in light traps. This pest was found when the rice plants were 1 week after planting until harvest. However, the intensity of this leaf roller pest attack is not very significant. As well as the false leaf roller moth which is also one of the pests found in light traps. This pest was also found when the rice plants were 1 week old after planting until harvest. The intensity of leaf roller pest attacks found in the field is insignificant.

Figure 3. Scirpophaga innotata

d. Leptocorixa Acuta

Walang sangit (Leptocorixa acuta) is one of the main pests that attack rice plants. This pest is found when the rice begins to ripen milk. Walang sangit sucks plant fluids from flower stalks (paniculae) and also rice fruit juices which are still at the milk-cooking stage, causing plant nutrient deficiencies and yellowing (chlorosis)..

Figure 4. a. Leptocorixa acuta, b. Attack Symptoms

3. RESULTS

The image used in this study is the DJI Phantom 4 Drone Image, data with a resolution of 2 meters was taken on October 20, 2023 in the Merauke Regency, South Papua. Image cropping is done to focus more on data processing according to the research area.

Figure 5. Drone Image Capture

a. Atmospheric Correction

This process aims to eliminate the influence of atmospheric particles which cause the digital image value to increase in proportion to the particle content to a certain digital value. This Atmospheric Correction is performed with the Quick Atmospheric Correction (QUAC) function on ENVI. QUAC is an atmospheric correction method for multispectral and hyperspectral imagery via VNIR and SWIR waves.

Figure 6. Atmospheric Correction Image

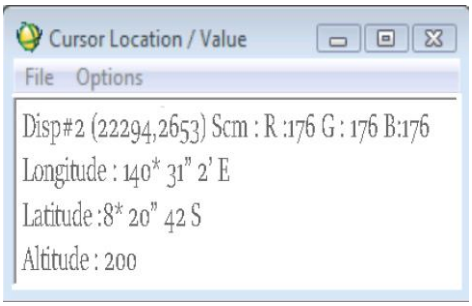

Figure 7. Value Atmospheric Correction

b. NDVI Value Calculation

In calculating the NDVI value using the Band Math function in ENVI. Band Math is a function to easily enter math functions in ENVI. In this study band math is used to obtain the NDVI value of ASTER images. The function used is:
(float(b3)-float(b2))/(float(b3)+float(b2)).
Description: b3 = reflectance value of the near infrared spectral channel
b2 = red spectral channel reflectance value

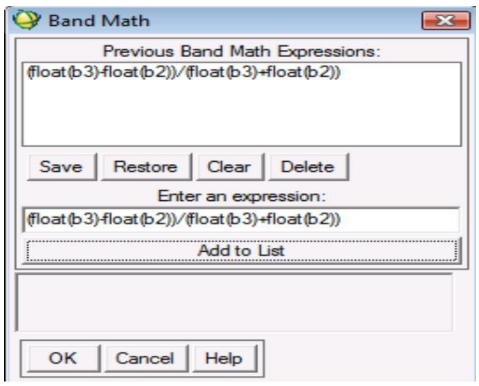

Figure 8. Band Math

c. Relationship between NDVI value of drone imagery and rice growth phase

NDVI Value of ASTER Image with Rice Growth Phase is closely related. This can be seen in Figure 15. below. It can be seen that the more the rice plant growth phase increases or the older the rice plant is, the lower the NDVI value of the rice plant. This is because the green level of the rice plants will decrease as the phase or age of the rice plants increases.

E. CONCLUSION

1. UAV with RGB sensor is able to analyze the growth of rice plants through the ExG vegetation index approach. This approach is carried out through the analysis of variations in spectral values. The variation in spectral values is based on the age of the rice plant.
2. The use of ArcGIS for the detection of rice health using drone imagery can be done, although it must be improved to make the image even better.

3. Very good health is in the NDVI value range 0.721-0.92, for good health the NDVI value range is between 0.421-0.72, and normal health NDVI values are in the range 0.221-0.42, while in poor health the NDVI value is 0.11-0.22.

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