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Satellite Imagery Processing Using Color Pattern Analysis With Object Distribution Method Based On GRID To Predict Rice Fields

Chairuddin[1], Hendra Gunawan[2], Novi Rukhviyanti[3]

[1] Teknik Informatika, STMIK Indonesia Mandiri, [2, 3] Sistem Informasi, STMIK Indonesia Mandiri

Corresponding Author: Chairuddin

ABSTRACT: *Remote sensing technologythrough the object of image data obtained by satellite vehicles is an alternative decision maker in order to support and obtain information and the best solution in determining the process and steps that must be taken to determine a decision.Information generated from satellite image data is very dependent on how the image processing is good by using a good model or method to get results that have a high degree of accuracy. Satellite image data can be manipulated with a series of methods to interpret object patterns with color analysis contained in the image so that it can produce the information needed.The process of interpreting objects in the image in this study uses a division method based on the color distribution pattern with Grid implementation to determine and predict the distribution of rice fields in an area.*

KEY WORDS*: Artificial Intelligence (AI), Neural Network, Genetic Algorithm, Fuzzy Logic, model synthesis.*

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I. INTRODUCTION

Satellite imagery is image data generated from remote sensing technology,Satellite image extraction process is very necessary to interpret object patterns in an image,this is done so that the estimation of the object being observed can be accurately estimated.The information generated from satellite image data is very dependent on how the image processing is processed properly by using a good model or method to obtain results that have a high degree of accuracy.

The image consists of two types, namely continuous image and discrete image.A continuous image is produced from an optical system that receives analog signals,for example human eyes and analog cameras.Discrete images are generated through the digitization process of continuous images (Cahyanti, et al, 2016).Some optical systems are equipped with digitizing functions so as to produce discrete images,for example digital cameras and scanners, discrete images are also called digital images (Prasetyo,2011).Each image will produce a different RGB value for each image. The technique used to match the RGB value of each image is called similarity.

Image extraction implementation is one way to get information contained in the image depending on what information you want to get.The information content of the image is also very dependent on the level of resolution of the image you want to extract(chairuddin, et al.2016).

Satellite image extraction implementation in this study uses extraction object distribution method based on grid division,and the information to be obtained is identification of the distribution of three-month-old rice fields based on color identification in one grid unit.

The introduction of rice field object patterns identified in one grid unit is expected to determine the group or category of rice distribution patterns based on the characteristics of the pattern,the aim is to differentiate between rice field objects and other objects based on the pattern that the object has in the image.

The identification of rice field identification aims to find out the distribution of rice fields in order to monitor food sufficiency,because food is a very important thing in life, the fulfillment of food is the most important element for the survival of life on earth,especially in aspects of human life that make rice a staple food. To make it happen, a variety of systematic and continuous thoughts are needed in an effort to find the best solution so that the process of agricultural management can achieve optimal results(Chairuddin, 2016).

One solution that can be considered by policy makers is how to monitor the agricultural production process so that the quantity and quality of crops can be maximized.The concept of technology transfer that is remote sensing can be one of the right alternatives in the process of monitoring food crop productivity quickly,this technology can provide objects that are in accordance with real-world objects through information on images or photos taken through satellite vehicles.

II. METHODS

2.1. Digital Image

According to Kadir and Susanto (2012),there are three types of images commonly used in image processing. The three types of images are color images, gray scale images, and binary images.

A. Color image, or commonly called RGB image, is a type of image that presents colors in the form of components R (red), G (green), and B (blue).Each color component uses 8 bits (the value ranges from 0 to 255).Thus, the possibility of colors that can be presented reaches 255 x 255 x 255 or 16,581,375 colors.

Table I. shows examples of colors and values of R, G, and B

Color	R	G	B
Red	255	0	0
Green	0	255	0
Blue	0	0	255
Black	0	0	0
White	255	255	255
Yellow	0	255	255

Color image mapping in three-dimensional space is implemented as shown below

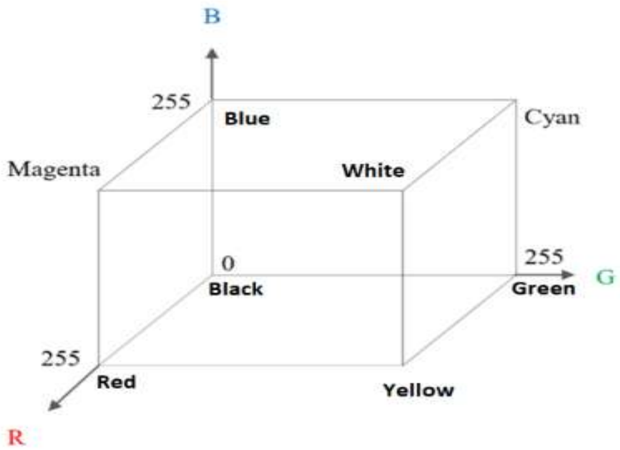

Figure 1. RGB color in three-dimensional space (Kadir and Susanto, 2012)

B. Gray Scale

As the name implies, this type of image handles black and white gradations,which produces a gray effect.In this type of image, color is expressed with intensity. the resulting intensity is between 0 and 255.A value of 0 represents black and a value of 255 denotes white.

C. Binary Image

Binary image is an image with each pixel only expressed by a value of two possibilities (ie 0 and 1).A value of 0 denotes black and a value of 1 denotes white.This type of image is often used for the sake of obtaining the edge shape of an object.

In Figure 2 is shown, the left part states that the image is grayish in color, while the right part is the result of conversion to binary image.

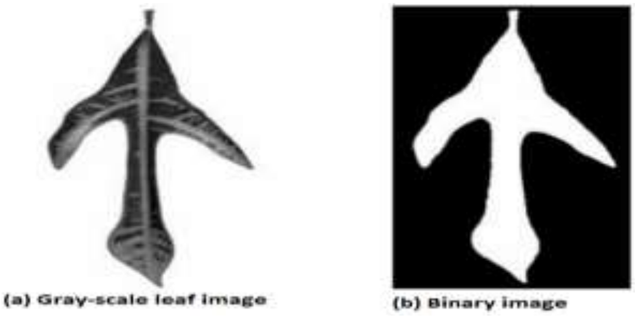

Figure 2. Gray image and binary image (Kadir and Susanto, 2012)

2.2. Digital Image Processing System

Digitization process of digital image is an image representation of a continuous function that becomes a discrete value.Generally digital images are rectangular in shape, and their dimensions are expressed as high * width (Munir, 2004).Digital images with a height of N, width of M, and having L degree of ignorance can be considered as functions (Sutedjo, 2002):

$$f(x,y)\begin{cases}0 \leq x \leq M\\ 0 \leq y \leq N\\ 0 \leq f \leq L\end{cases}$$

Digital image size of N x M is expressed by a matrix that measures N rows and M columns as follows (Munir, 2004)

$$f(x,y)\begin{bmatrix} f(0,0) & f(0,1) & \dots & f(0,M) \\ f(1,0) & f(1,1) & \dots & f(1,M) \\ \vdots & \vdots & & \vdots \quad \vdots \\ f(N-1,0) & f(N-1,1) & \dots & f(N-1,M-1) \end{bmatrix}$$

Index (i) for expressing rows and indexes (j) to indicate the column in the coordinate of the image point, f (i, j) which is the intensity of the gray degree at the coordinates of point i, j (Munir, 2004).

The elements in a digital image are called image elements, picture elements or pixels.So the image size of N x M has N and M pixels.The example put forward by Munir, 2004, represents an image measuring 256 x 256 pixels which has 65536 pixels numerically with a matrix consisting of 256 lines (indexed from 0 to 255) and 256 columns (indexed from 0 to 255) like an example

$$\begin{bmatrix} 0 & 134 & 145 & \dots & 231 \\ 0 & 167 & 201 & \cdots & 197 \\ 220 & 187 & 189 & \cdots & 120 \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ 221 & 219 & 213 & \cdots & 156 \end{bmatrix}$$

According to Munir (2004), from this example the first pixel at coordinates (0, 0) has an intensity value of 0 represented in black, the second pixel at coordinates (0, 1) has an intensity of 134 which means the color is between black and white, and so on.

Munir, 2004, revealed that the image digitization process has two stages,**First**, spatial digitization (x, y), which is often called sampling.Spatial Digitalization (Sampling) is a continuous image sampled in rectangular-shaped grids (grids in horizontal and vertical directions) as shown in Figure 3.

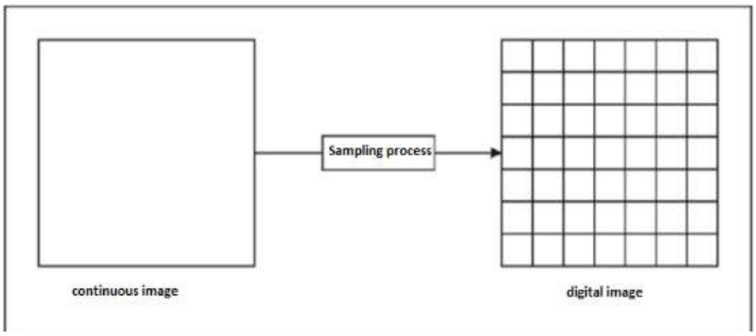

Figure 3. Digitizing spatially or sampling (Munir, 2004)

There is a difference between the coordinate of the image being sampled and the coordinates of the matrix(digitization results). The origin (0, 0) in the image and element (0, 0) on the matrix is not the same.The coordinates of x and y in the image start from the lower left corner, while the numbering of pixels on the matrix starts from the upper left corner as shown in Figure 4.

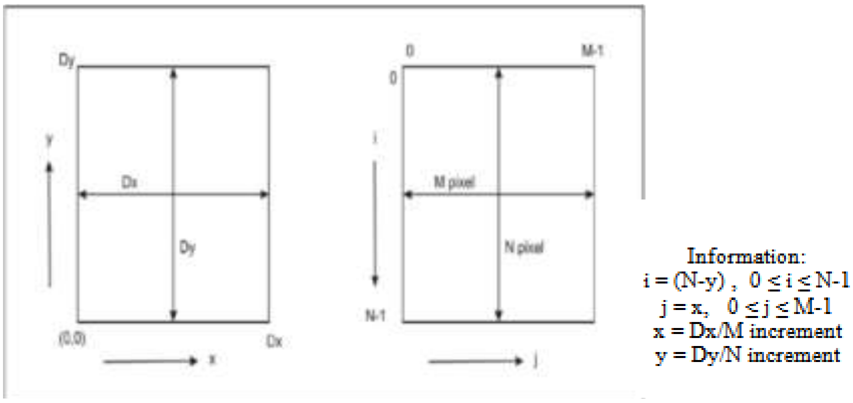

Figure 4. Relationship between image elements and matrix elements (Munir, 2004)

Second, digitizing the intensity of f (x, y), often referred to as quantization. The intensity digitization process (quantization) is carried out after the sampling process.The quantization process divides the gray scale (0, L) into G level level expressed by an integer price (integer).Usually G is taken from the second appointment,G = 2m, which in this case, G = gray level m = black positive integer is stated with the lowest gray level value, that is 0, while white is stated with the highest gray degree value, for example 15 for 16 levels.

The number of bits needed to represent the grayish pixel value is called the pixel depth. Images are often associated with pixel depth. So an 8-bit depth image is also called an 8-bit image (256-color image).In most applications, black and white images are quantized at 256 levels and require 1 byte (8 bits) to represent each pixel. Binary image is only quantized at two levels, namely 0 and 1.Each pixel in the binary image is simply represented by 1 bit, where bit 0 means black and bit 1 means white.

Table II. The relationship between gray scale and pixel depth

Gray Scale	Gray Range of Value	Pixel Depth
2^1 (2 values)	0 and 1	1 bit
2^2 (4 values)	0 to 3	2 bit
2^3 (8 values)	0 to 7	3 bit
2^4 (16 values)	0 to 15	4 bit
2^8 (256 values)	0 to 255	8 bit

The amount of gray level area used determines the brightness resolution of the image obtained. The more number of gray degrees (means the number of bits is increasing),then the better the image obtained because the gray level will be higher so that it approaches the original image.Digital image storage that is sampled to N x M pixels and quantized to G = 2m gray level level requires as much memory as b = N x M x m bits.Overall, the image resolution is determined by N and m. The higher the value of N (or M) and m, the better the quality of the resulting image. All stages of the digitization process (sampling and quantization) are known as analog-to-digital conversions, then the process results are stored in digital storage media.So digital image is a representative of the image taken by the machine in the form of an approach based on sampling and quantization.Sampling states the size of boxes arranged in rows and columns.Sampling in the image states the size of the point (pixel) in the image,and quantization states the magnitude of the brightness level expressed in gray level according to the number of binary bits used by the machine.Quantization in the image states the number of colors in the image.

2.3. Grid System in Digital Image Processing

Mather (2004) states that digital images are arrays of numbers, which are presented as a row and column matrix.Image data alignment like this is included in the general class "raster data", which means that the cell or pixel (which contains the value of individual data) is not clearly related to the location on the earth's surface.The location of each data value in picture element (pixel) is applied by its position on the pixel array in the image (array) as in the following figure.

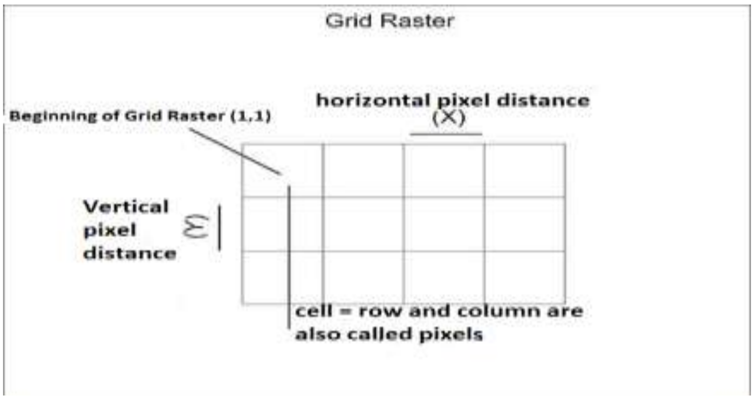

Figure 5. Grid raster (Mather, 2004)

The concept of raster data, the cell on the grid located at the top left is the beginning or starting point of the coordinate system (rows and columns).
Image processing implementation for remote sensing, usually using distance units such as meters in determining pixel size or grid cell. The position of pixels anywhere in the image can be calculated if the distance between horizontal and vertical pixels is known, and image coordinates can be known if the image coordinates of pixels (1,1) are known.So, if we know the UTM (Universal Transfor Mecator) pixel coordinates in the top left corner of the arrays or raster and the distance between pixels in meters then we can calculate the pixel position anywhere in the raster. As explained that each pixel has a value, values stored in raster data are located in a specific range, usually 0 - 255, which is associated with the color brightness range.A value of 0 indicates no color (red, green, or blue), and a brightness value of 255 indicates the intensity of color display (Mather, 2004).

2.4. Researchers who use Digital Image Processing with Grid Systems

Some researchers who have carried out digital image processing using a system of grouping object patterns in the image with the Grid method are:

1. M.H. Fitrianingrum et al. (2018), from UGM, the title of the research is "Utilization of High Resolution Imagery for the Study of Road Performance in the Pattern of the Surakarta Grid Road Network", using QuickBird imagery, with the results of the study showing that the level of accuracy of land use interpretation is 96.29%, level of accuracy geometric interpretation of the road is 89.99%. The existing grid pattern is very effective in spreading traffic volume. The result is the performance of the Surakarta City road in general including good.
2. M. Cahyanti et al. (2016),in the Information Technology Research Seminar (SRITI) in Gunadarma, with the research title "Image Processing Implementation for Color-Based Country Flag Image Recognition", the use of the grid in this study serves to display the RGB value of the country flag image that is input and to display the results of the process matching is the name of a country that has the same RGB value or is close to the RGB value stored in the database.The results obtained are the success rate of application testing reaching 99%, this result is obtained from the similarity of the name of the flag image that is inputted with the name of the flag of the image contained in the database.
3. P.Devabalan. (2014), in International Journal of Computer Science and Mobile Computing(IJCSMC), title “Satellite Image Processing On a Grid Based Computing Environment”, Conclusions, with accordance to Grid conformity heterogeneous computing sources, a Grid environment is built for the processing of remotely sensed images.
4. S. Arias et al. (2009), Proceedings of the Second EELA-2 Conference R. Mayo et al. (Eds.) CIEMAT 2009, title “Satellite Image Classification by Self-Organized Maps on GRID Computing Infrastructures”, Conclusions, In the classification the results are even better since with a Grid solution, a set of imagges can be sent in parallell for classification.
5. Q. Ye et al. (2009), in jurnal Progress in Natural Science, title “Use of a multi-temporal grid method to analyze changes in glacier coverage in The Tibetan Plateau”, Conclusions, The multi-temporal grid method results in abetter quantification of glacier variation.
6. Zs. Molnár et al. (2007). In jurnal Folia Geobotanica (FOLIA GEOBOT), title “A GRID-based, satellite-image supported, multi-attributed vegetation mapping method (MÉTA)”, Conclusions, grid mapping include the following: (1) the parallel mapping of many different attributes is easier; (2) areas with vegetation transitions and with differently scaled mosaics are easier to document (e.g. grasslands with encroachment of bushes). Disadvantages include the following: (1) the patterns finer than the grid are

blurred, while (2) the patterns much coarser than the grid are documented redundantly cell by cell; (3) it is hard to visualize many different attributes at the same time.

7. D. Petcu et al. (2000), in jurnal International Scientific Journal of Computing, title "Satellite Image Processing On A Grid-Based Platform". Conclusions, Current Grid technologies provide powerful tools for remote sensing data sharing and processing.

Conclusions from several researchers who do image processing using the grid method, namely,that grouping object patterns with grid methods to obtain information contained in the image can be done to obtain information on the corresponding object pattern in the image.

III. DISCUSSION AND RESULTS

3.1. Introduction

The research objective was to develop the concept of Information Technology by utilizing Multitemporal Satellite Image Technology to produce information about the state of the distribution of paddy fields with image sampling in the West Java region using Landsat satellite imagery.

The concept of technology transfer that is remote sensing can be one of the right alternatives in the process of monitoring food crop productivity quickly, this technology can provide objects that are in accordance with real-world objects through information images or photos taken through satellite vehicles.

The results to be achieved in this study are, by applying a system of grouping and comparing the pattern structure using the grid method in the image, it is expected to be able to perform a classification process and estimate the distribution of rice fields per growth phase with other land objects.

3.2. Stages of Research

The research was carried out through the pre-image processing stage and the image extraction process to obtain the classification results in the form of information on rice field distribution per phase.Pre-processing is done from getting image data to determining the location point in the research area.The next process is image extraction, which is the process of grouping objects contained in the image based on the data of the parent object of the field of growth and not the rice fields that have been provided in the database,the introduction process of object matching is done using the grid method,so as to produce information on the type of classification of paddy field objects that have been classified as growth performance. The realization of the research stages is illustrated in Figure 6.

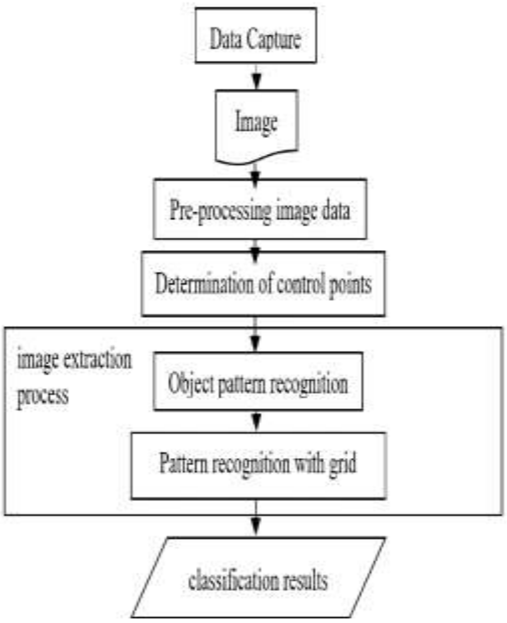

Figure 6. Stages of research

3.3. Research Area

The research area which is used as the research area is Rancaekek District, West Java Province, Indonesia, which is one of the centers of rice production and is a mainstay as a contributor to rice production in Bandung Regency (Distanbunhut, 2015),

Figure 7. Research Area
a. Rancaekek's administrative area (Abdurahman, 2015).
b. Landsat 8 Satellite Imagery in Rancaekek region

Image data used in this study are Landsat 8 satellite imagery,regional image data of Rancaekek Subdistrict was identified based on color parameters (RGB) by taking the value of vegetation clustering (Figure 8).

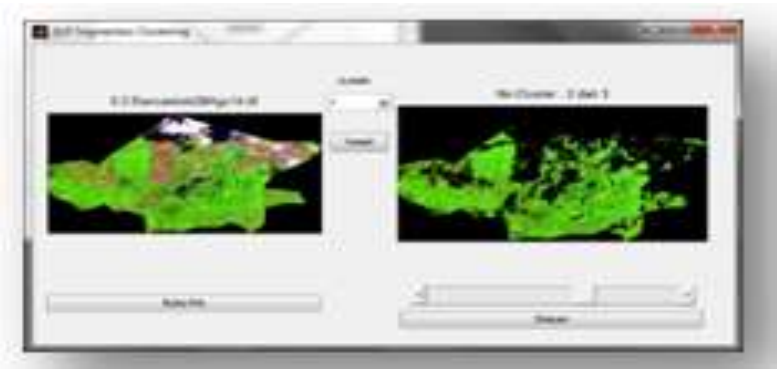

Figure 8. Results of segmentation of vegetation clustering.

3.4. Implementation of Classification System with Grid

The classification system module is a determination system module that can produce final information in research.This system module integrates from the model that is built that is identification of objects with texture analysis with the grid.This is done because between the texture analysis system module, segmentation and classification has a process connection based on visualization of colors and objects in the image.

The classification process module that has been built has several stages of process in identifying the object of rice plant growth phase based on the texture and color produced by the image in the form of area units per pixel,the results of the process are identified in units of area that is a collection of pixels into one grid.The identification process is presented as Figure 9.

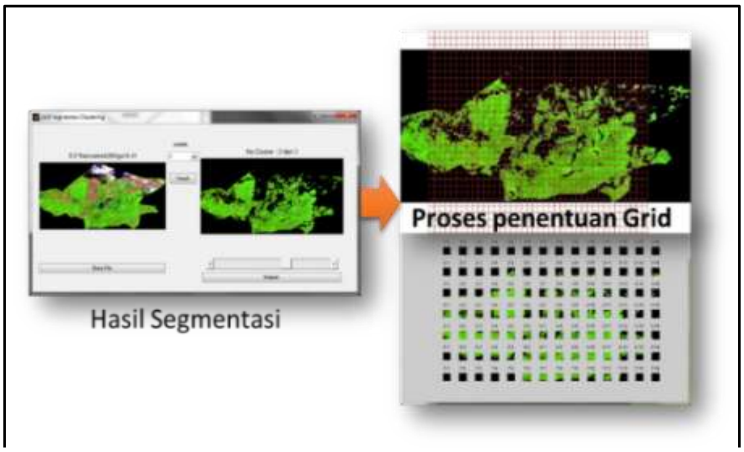

Figure 9. Texture identification process with grid.

The use of grid / cell analysis for texture identification is as a reader of objects contained in an image with a homogeneous structure in one grid.Each cell in the system has a size that can be adjusted depending on the needs of the analysis. Each grid / cell will be tested for sufficient area.Unused areas are different colors. The grid used must have an area of at least 10 percent. Examples of object identification using grid / cell analysis are presented in illustrations in Figure 10.

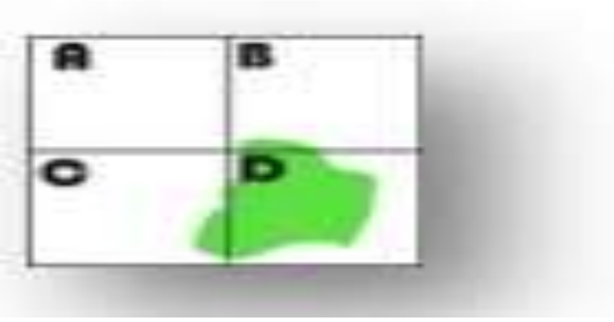

Figure 10. Illustration of object identification with a grid.

In the picture there are four grids / cells,the selected grid / cell is the one that has an object appearance of at least 10 percent.The following is an analysis of identification of objects in one grid, namely:

a. Grid A is not used because it has no green color
b. Grid B is also not used, because it only has an area of five percent
c. Grid C is used because it has a broad value of 15 percent
d. Grid D is used because it has a broad value of 95 percent

The results of the identification and analysis of the grid / cell are tested and not, distinguished from the color that is red indicating that the grid is not tested and the green grid will be tested or analyzed further.The identification results are then stored at the location of x, y, dimensions as reference points (Figure 11).

Figure 11. Identification results are distinguished by color.

The following is a comparison example of the results of grid identification using a size of 10 x 10 and 30 x 30.The difference in the size of the grid used is presented in Figure 12.

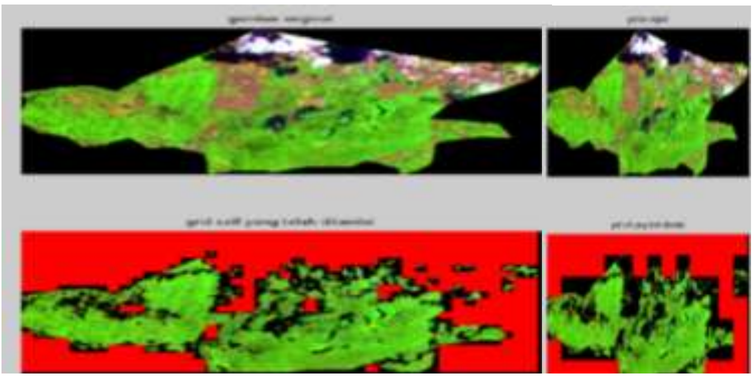

Figure 12. Comparison of results using grid sizes of 10x10 and 30x30.

The smaller the grid size will affect the next level of computing. Each cell grid will be analyzed for its features, then the normalization process is carried out followed by a classification process.

3.5. Results of Classification System Implementation with Grid

Visualization of the results of the classification process carried out for the entire grid shown in color based on the growth phase code is presented in Figure 13.

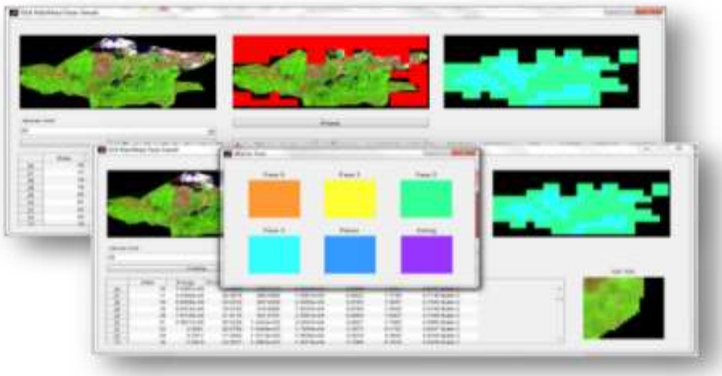

Figure 13. Visualization of the results of the classification process.

Based on the results of the analysis and calculation of the classification process, the grid / cell number is identified based on the growth phase. The identification results are used for the calculation and determine the estimated planted area and harvest in the next process. The identification results are used for the calculation and determine the estimated planted area and harvest in the next process. The results of the classification process are represented in the number of grid / cell based on the growth phase of the rice plant. The number of grids / cells produced will be multiplied by the number of pixels contained in one grid and multiplied by the spatial area in one pixel. This is done to get the actual area based on size in the field.

IV. CONCLUSION

1. Texture parameters generated from object feature extraction methods based on color intensity provide a good comparison element in the pattern recognition and segmentation process
2. Color intensity parameters namely Red, Green and Blue (RGB) are very good to be used as complementary values and amplifiers in the process of identifying objects in the image, because the pattern of objects in the image can be better known from the average color intensity generated from objects in each pixel.
3. The use of image extraction object distribution method based on grid division is very helpful in the process of analyzing the features of object features in the image and the calculation process for classification.
4. Extraction system model for texture analysis with object distribution method using grid is a system prototype that can be used for further development in the image extraction process using synthesis with other models.

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