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Analysis of Spatio Temporal Change of Land Use of Chrysanthemum Farm in Semarang Regency Using Landsat Image 8 OLI

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Agriculture is a business issue that has long existed and will likely continue to exist throughout the ages. Similarly, on the issue of agricultural land use chrysanthemum that needs to be developed method of analysis using technology approach and computer science. This research intends to analyze and develop effective and efficient methods of chrysanthemum land use. The satellite imagery data covering pre-processing, processing and post processing in this research is mostly done with QGIS software. Satelite image used in this research is LANDSAT 8 OLI and band used are band 6, bang 5, band 2 and band 8. Stages of working this research include image cutting in the research area of all bands and all temporal images involved in research, pansharpening using "Orfeo toolbox", image classification with "semi-automatic clasification", then completed with analysis of land use change using "molusce". The result of this research is spatio-temporal data of two images of land use chrysanthemum in April 2017 and August 2017. The result of mathematical research is a statistical table of changes of agricultural land use on two temporal of image used as research object. In addition to the two results of the analysis data, this study also describes the digital image analysis method of agricultural land use chrysanthemum which is expected to be useful for remote sensing research on other research object or extension to this research.

Keywords **:** ***chrysanthemum, land use, pansharpening, classification, molusce*****.**

I. INTRODUCTION

Agriculture products are an important commodity that naturally will continues to experience the development. It is aimed equally with the dynamic needs of society. Starting from the fulfillment of food and clothing needs, agricultural products continue to experience the development of variety. The demand for the fulfillment of aesthetic needs, such as flower products, is now also an important agriculture commodity issue that helped enliven the community's economy.

Chrysanthemum flower at this time is an important commodity and exactly prestigious among agribusiness actors. Of course it is because driven by the high interest and needs in the community. Like other agricultural products, the product distribution from its current production area has exceeded the provincial, even country boundaries [15] [9].

Referring to information on the agriculture, plantation and forestry offices of Semarang Regency, agricultural products in the Bandungan district area, precisely in the Jetis Sub-Terminal of Agribusiness (STA), have been marketed to various provinces in Indonesia, some of which have been exported abroad [13]. Suppliers of agricultural products to the market of this Jetis STA also came from various regions, including from outside the province [13].

Chrysanthemums currently dominate the many flower / ornamental plants and are most often available in the region. Each year it can produce an average of over one hundred million stalks in the range of one and a half million square meters of land [14,16,17]. Due to the lack of media and information providers related to marketing and product availability, price fluctuations occur very sharply [18]. Even often the price changes by the difference of tens of thousands rupiah's of bonds in a matter of hours. This is mainly due to the unbalanced number of traders who will buy compared to the number of products brought by the farmers to the market. Remember, the

most demanding sales / revenue model most farmers receive is that it is traded with direct consumers or out-of-town traders [4]. Outside the city where the buyer is a buyer who most lack of information about the production capabilities in the region.

A common cause of price fluctuations is the unbalanced supply and demand . A projection analysis of supply and demand in 2014 to 2019 in Indonesia measured by export volume, import volume and production volume indicates that trade volume will be deficit thousands of pieces per year, even will reach hundreds of thousands of pieces in the fifth year (2019) [15]. While in fact there are some export demands, such as from South Korea that actually can not be fulfilled by producers or exporters from Indonesia [19].

The problems of supply and demand inbalance are caused by limited land registration and marketing of chrysanthemum flowers [15]. Limitations of farmland data on chrysanthemum flowering have also resulted in inaccurate government policies or lack of government assistance to farmers [8].

In certain cases sometimes the supply of local needs to chrysanthemum flowers can not be fulfilled. As happened in Tulung Agung, so the related government felt the need to increase the motivation and support to the farmers to cultivate this flower plant which is considered to have considerable potential [2]. This may also be due to the limitations of the existing survey system, which is based on interviews with farmers who planted chrysanthemum flowers so that related government policies are less targeted and less appropriate to the latest dynamics of the development of chrysanthemum farming, both individual and land use.

Chrysanthemum farming is cultivated in enclosed space with plastic housing [7]. In *Google Earth* satelite imagery This land looks quite clear, especially when compared to other objects such as open farms, trees or settlements. Because the image of *Google Earth is* less *up to date* and does not display *time series* image data consistently, the available imagery is less able to describe the condition of the existing land area in a certain area at a certain time. However, *Google Earth* imagery can be utilized to help interpret satelite imagery available in *time series* in recognizing the extent or create *training sets* on earth-surface objects that have been surveyed into the field.

On the basis of this, the research team conducted a study on the analysis of agricultural land use of chrysanthemum flowers in a region that represents a large amount of chrysanthemum farming . In this case the researcher specifies the area of Bandungan Subdistrict, Semarang Regency, Central Java Province which is one of the regions with the highest chrysanthemum flower production in Indonesia [14,16,17], as the area to be the object of research . However, to facilitate the reach of researchers in obtaining and analyzing the image, the researchers determined the area of Kenteng Village , Bandungan District as the boundary of the more specific research area. Specific basis for determining the border area is because Kenteng Village has many chrysanthemum farmers and there are several studies on this area that discuss the marketing of chrysanthemum flowers, its economic impact for the community and various analyzes related to agribusiness of chrysanthemum flowers [3,5,11]. This research is expected to be a valid and useful informant reference for farmers, traders, government and other stakeholders in taking strategies and policies in chrysanthemum agribusiness related to land use in the area under study.

This land use analysis research is expected to produce a digital geographic information product that is valid, easy to develop, easy to use and easy to distribute in order to improve the effectiveness and efficiency of its utilization [10], both in terms of production and marketing of agricultural products, especially chrysanthemum flowers. This research is also expected to produce an effective and efficient method of agricultural land use analysis to produce valid data, especially for chrysanthemum farming. The chrysanthemum floral analysis method that is produced in this research is expected to be utilized in wider research area or applied to other research object related to digital image analysis.

II. RESEARCH METHODOLOGY

A. Research Data

1. Digital Image Source

Digital image data in this study was obtained for free via *www.earthexplorer.usgs.gov* which provides archives of various digital images from different satelite and *time series* , not least the LANDSAT 8 OLI image. The LANDSAT 8 OLI image is an image generated by the OLI (Operational Land Imager) image sensor. This image has 11 bands that can be composed as needed. Bands 1-9, 10 are color images that have a spatial resolution of 30 meters. Band 8 is a pan chromatic image (black and white) with a spatial resolution of 15 meters. As for band 10 has a spatial resolution of 100 meters [1].

Researchers also took imagery from *Google Earth* in specific areas surveyed to help interpret the extent of objects in the LANDSAT 8 OLI *satelite* image . This imagery is taken by using the *Google Earth application Version 6.0.3.2197* which provides high-resolution one-channel imagery.

2. The temporal limit of digital images

It takes at least two temporal data digital images to be able to analyze the pattern of increase or reduction of agricultural land use for the plantation of chrysanthemum flowers. This study used two digital imaging temporal data, which in April 2017 and in August 2017 for analysis.

3. Administrative boundaries

The use of farming land for chrysanthemum flowers in Semarang regency continued to increase in the range of 2010-2016 data collection, except for 2014-2015 which decreased [14,16,17]. Where the area produces the most chrysanthemum flowers is Bandungan Subdistrict. The data is based on non-spatial surveys. The research will be focused on spatial analysis on the region that represents the center of chrysanthemum production. The village of Kenteng located in the Bandungan subdistrict is a region in which it represents quite a lot of chrysanthemum farming. Therefore, this research will take digital image at the administrative boundary of Kenteng Village, Bandungan District.

Determination of administrative boundaries is used as a reference limitation digital image that will be used. From the provisions of the boundary area that has been determined then researchers do a search of data source administrative region that will be used as a digititation digit map reference to generate vector map with the right *mercator* in the relevant administrative region . In this case the researchers took reference Bandungan District map that contains administrative boundaries Kenteng Village. The maps are obtained from BPS publications containing Bandungan Sub-district statistics [20] .

B. Reseacrh Procedure

The procedure is described in the research stages and sub tahapa n to clarify the sequence of processes that are undertaken. Researchers used an open source software *tool* QGIS with various congenital existing and additional tools that are integrated with this *software,* either in the form of *plug-ins* or the form of *the tool box.*

1. Preprocessing data
   a. Digitization administrative boundary of Kenteng Village

This process begins with the *georeferencing,* ie the process of entering data georeferencing / coordinates on the map bitmap relevant area in order to position appropriate to coordinate the mapping standards. This process takes advantage of the *georeferencer* plugin that has been installed by default when installing the QGIS software . Coordinates given in this process at least 4 points with different positions , the more accurate the coordinates . For the *mercator* it was used in this study used the WGS 84 standard *mercator*. This process is very important so that when the map is stacked / *overlayed* with another map layer its position corresponds to the real condition on the mapped area.

After the georeferencing process is done correctly, followed by a digitization process in the administrative area to be involved in the research. The digitized results of this process are polygon objects in the administrative area of Kenteng Village. This polygon will then be stored and used in its continuous processes.

b. LANDSAT 8 OLI Image Cutting with administrative boundaries

Satellite images obtained from imaging archival providers generally cover a wide range of areas. In this case the researchers get the image of LANDSAT 8 OLI covering the area of Central Java. Therefore it is necessary to first cut the area involved in the research in order to accelerate and simplify the process of interpreting the image.

In this process, the researcher utilizes the semi-automatic classification plugin added to QGIS. Part of this plugin which is used for image-cutting process is "multiple raster clips" contained in the preprosessing tab. By taking advantage of this tool, the cutting work will be faster because the cutting is done simultaneously on the band involved by using administrative map poligon shapefile of Kenteng Village which has been produced in the previous step. The bands involved in this study were bands 6,5,2 and 8. Band 6,5,2 will be used to produce colorful composite images which are suitable for agricultural land analysis while band 8 will be used for pan-sharpening process.

c. Band Combination

The band combination process is performed to produce the colored composite cotra required in the study. In this case the channel band used is channel 6, 5 and 2 which is the result of cutting the image in the previous stage. This process utilizes raster merge tools to combine band combinations with "sparate band" conditioning. The resulting composite image can then set its sequence of bands to obtain the desired image combination. In addition to combining and adjusting band combinations, at this stage also performed smoothing the image of each band with the loading of average and standard deviation to fill the maximum and minimum value. The goal is to get a smoother image.

d. Pansharpening

Panchromatic Sharpening or Pansharpening process is one of the process of combining satellite image data to get higher resolution. The process involves combining a low resolution (30 meters) color image with a high resolution (15 meters) panchromatic (band 8) or black-and-white image. Merging the two images is done to obtain the color image and have high resolution [6].

The process at this stage utilizes the processing tool of Orfeo Toolbox tool that has been added by researchers as an extension of tool processing on QGIS. The process is through two stages. The first stage is super impose sensor, namely the process of converting the projection of geometry of an image into another image geometry projection form. In this case the projected image is a color composite image that has been produced in the previous stage, while the image used as a reference is the image of the band 8. The process is done on both composite image produced, the composite image of April 2017 and composite image in August 2017.

The above process will produce a colored composite image that has been projected into the band image 8. Then proceed with pansharpening process with Reserved Channel Scheme (RCS) algorithm. Where the colored composite image that has been projected with band 8 enhanced its resolution from 30 meters to 15 meters. This process is performed on both temporal images that will be involved in the study. This image will then be interpreted for each color / wavelength at a later stage.

2. Data processing

a. Entry Google Earth imagery in the region surveyed

This step is done before starting the classification process. Satellite imagery available in Google Earth on the scope of the survey is marked on all four corners as a Georeferencer reference when going into the QGIS project. Scope of the survey in this study include the object of agricultural land of chrysanthemum flowers, trees, settlements and open agricultural land.

Entry process into the QGIS project via georeferencing tool to ensure that this image can be overlaid in exact coordinates with other maps previously existing or will be incorporated into the project in the next process. This Google Earth imagery will be used to assist in the interpretation of objects in the pansharpening color composite image that has been done in the previous stage.

b. Creating *Region of Interest* (ROI)

This process aims to mark, identify and identify each of the existing colors on the composite image that has been enhanced by its resolution. Every object that has been surveyed and viewed in Google Earth is tagged with a ROI polygon according to the researcher's interpretation and stored as an identifier for the overall classification of image data. Each object is tagged with one ROI identifier. The input of the introduction information in this process is C_ID (class id) and class information (C info).

c. Spatial classification execution

After the objects in the survey are marked and kept their recognition in the introduction list, then classification execution is performed. The classification execution process by default generates bitmap data with tif format that already includes classification data according to the introductory list. The output of this process can also generate vector maps with table classification based on C_ID. This vector map can also be used for vector-based classification process. This process is performed on both the temporal imagery involved in the classification.

3. Post processing data

Post-processing of the data in question is to produce a mathematical analysis of two temporal images that have been generated in the previous stages. This process utilizes mollusce plugin to analyze land use change, in this case chrysanthemum farm. The reason for using this plugin is that this plugin was once and successfully used in a study of land use settlement changes in Johor Baru, Malaysia [10]. Utilization of this plugin is able to produce mathematical data comparing two temporal images that have a similar geometry.

The result is a comparison of mathematical and spatial two different time images.

To clarify the research method of farm land use analysis of chrysanthemums in Kenteng Village below presented a chart describing the processes or stages:

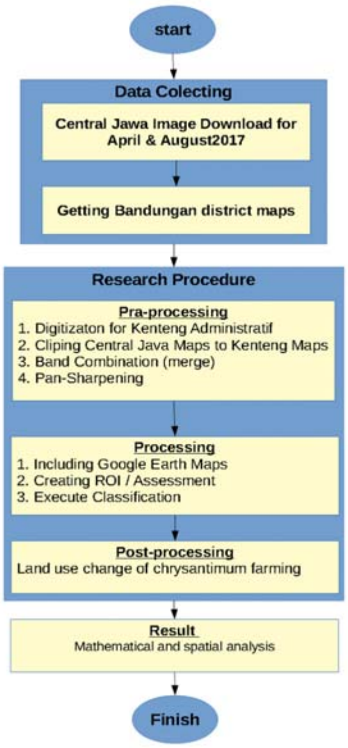

***Figure 1**. Research method chart*

III. RESULTS AND DISCUSSION

From the process of research explained in chapter II, this study produces spatial and mathematical analysis. Here is the discussion of each analysis data generated in the research.

The first analysis data presented in this research is spatial-temporal analysis data in the form of two temporal picture of April and August 2017 that describe the agriculture land use and various other objects which are in the related area. Here are the two images:

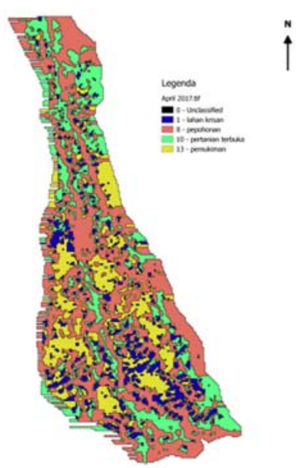

***Figure 2**. Classification of chrysanthemum land use of April 2017*

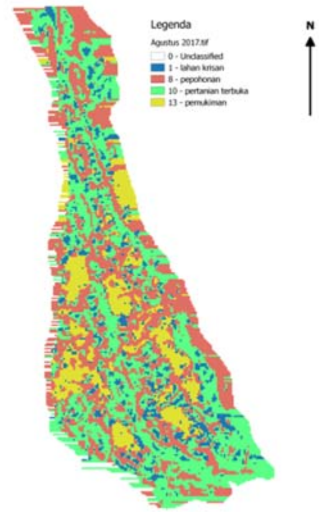

***Figure 3**. Classification of chrysanthemum land use of August 2017*

From the two images, it can be seen that in the period of April 2017 to August 2017 the use of agricultural land for the cultivation of chrysanthemum flowers experienced negative growth or experienced shrinkage. Chrysanthemum agricultural land which is marked with pink color seems to shrink, while open agricultural land marked with light green hues looks even wider.

This data can be a comparison with interview-based survey data published periodically on an annual basis by BPS, where in the publication shows a decrease in the area of chrysanthemum land each year (2011-2016) [17]. Likewise, spatial analysis per 4 months also shows the decrease of farmland area of chrysanthemum. Here it is enough to see that this spatial analysis is superior in its ability to provide information with a shorter time and cheaper cost span compared to the data from interviews conducted by BPS which certainly requires more cost, energy, time and costs so that only willing or able to provide land data every year.

The availability of data on changes in chrysanthemum land that is shorter in period will make it easier for the government to take more appropriate policies, both momentum and needs, to reduce ineffectiveness and inefficiency of policy making. Which, as the export-import reference and local needs in other areas of the demand for chrysanthemum flower is often a deficiency [2,15]. As for if the problems of cultivation and marketing of chrysanthemum flowers are not given the right solution then it is unfortunate potential of this chrysanthemum farming to be neglected.

The next spatial analysis is shown in the map of land use change as shown in the figure below:

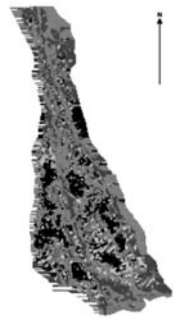

***Figure 4**. Changes in land use on April - August 2017*

In Figure 4 shows a map of the chrysanthemum agricultural land that has changed the function of land from chrysanthemum agriculture to open or non-chrysanthemum agricultural land indicated by dark gray color. Even though in a small amount, there were quite a lot of land converted.

The mathematical analysis shows the change in the area of each land cover as shown in the table below:

Table 1. Changes in land use

Classification	Apr-17 (ha)	Aug-17 (ha)	(Δ)	(Δ)%
Unclassified	618.98	619.04	0.07	0.00632591093117
chrysantemum	**50.40**	**44.73**	**-5.67**	**-0.531376518219**
trees	208.49	169.20	-39.28	-368.168.016.194
Open farmland	102.80	175.28	72.47	67.919.197.031
Settlement	86.38	58.79	-27.59	-258.518.893.387

Table 1 shows the predicted decrease in land area in one quarter. In one quarter, there was a decrease in land area of around 0.53%. If it happens continuously without any improvement in conditions that can improve the competitiveness of chrysanthemum farming and solve existing problems, it is not impossible that within a year of agricultural land area of chrysanthemum flowers will occur shrinkage up to 1.6%. And it could be continued in the next five years where chrysanthemum farming in this region will experience shrinkage up to about 8%, especially if the condition does not change or repair. Whereas the potential of this flower farm is actually quite profitable for farmers [5] and has an ever-increasing market potential [15].

Next is shown the matrix of land use change of chrysantemum farm in the research area as shown in the table below :

Table 2. Land use matrix

	0-unclassified	1-chrysantemum	8-trees	10-open farmland	13-settlement
0-unclassified	1.000.000	0.000000	0.000000	0.000000	0.000000
1-chrysantemum	0.000000	0.529911	0.071429	0.289732	0.108929
8-trees	0.000324	0.016728	0.637060	0.333261	0.012627
10-open farmland	0.000000	0.078792	0.154738	0.755308	0.011162
13-settlement	0.000000	0.074499	0.195363	0.156812	0.573326

Table 2, the chrysanthemum matrix of changes in chrysanthemum area indicates that the most functional conversion of chrysanthemum land area is overturning into open agricultural land, which is about 0.3%. That is, from the farmers actually did not experience a decrease in motivation to continue farming. The gradual conversion of land from cultivated land of chrysanthemum to open agricultural land may be due to factors of marketing problems and diseases of chrysanthemum interest, not because of the declining interest in agricultural production business as in agricultural conditions in Poland [12].

The final analysis result is Transition Potential Modeling using analysis neural network (ANN) method shown as the graph below:

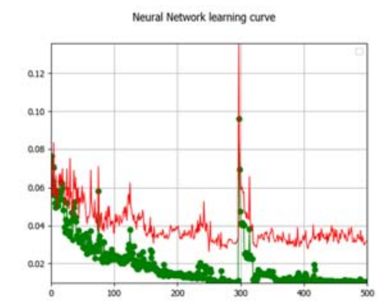

Figure 5. ANN analysis result

ANN analysis shows that the samples involved in this study are evenly distributed. All the spatial aspects that exist in the digital image are well known in the analysis process. This is indicated by the green colored curve whose height always follows the height of the red curve. This means that the results of the analysis done have the possibility of a very small unknown failure.

IV. CONCLUSIONS AND RECOMMENDATION

This study result temporal spatial and matetatical analysis of the two temporal images involved. An analysis of agricultural land use shows a decrease in agricultural land area in the area studied in the period April 2017 to August 2017. The results of this study show the same trend with the data of BPS which shows the decrease of annual land area. But in this research is able to present data and information broadly change of land area more detail in time and spatial (position and land area). The methods in this research can be used and further developed in broader, more rigorous, and cheaper implementations, especially to provide information on changes in farmland area of chrysanthemum.

The image used in this research is LANDSAT 8 OLI which is optimized using pan-sharpening method to produce color image in 15 meter resolution. The processed image when processed classification is sufficient to correctly indicate the places that are the object of farmland of chrysanthemum. However, for extensive measurement there is an indication that it is less precise because of the fact that on the farm field chrysanthemums sometimes only have a width of less than 10 meters. The researcher suggested to use another satelite image of higher resolution in order to get more valid land area analysis.

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