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Abstract

Longan has been one of the five key commercial fruits of Thailand for many decades especially in the Northern Part of Thailand. One of the economical problems of growing longan has been the over-supply of longan in the market which has brought down the price. Therefore, the comprehension of supply would lead to the profitable growing plan for longan farmers. This paper attempts to utilize satellite photograph to estimate the growing longan area in the north of Thailand hoping to be able to visualize the growing geographical area. The process of this study has taken the data from Landsat-8 Satellite and then categorize such image by remote sensing technique- QGIS application. Such technique would interpret image into the understand form whether such area is growing longan or not and in how many acres. The data was collected during January 2016 and this is cross-sectional. The data can be done anytime during the year as data was read by the color of longan leaves. The image has captured all the area in Chiang Mai Province, as it is well known that longan has been grown the most in this area. The categorization was based on color signature of longan by sensor receptor via temporal characteristic. One area of longan growing was selected and tested for accuracy. It is found that longan area has its own pattern and was proved to be 80% accurate-acceptable level. The implication of the result would assist the government in setting up related-supporting policy and longan farmer in planning the growing to ensure the size of supply. The success of this paper would expand to explore longan growing in the other part of Thailand.

Keywords: Longan Growing Area , Remote Sensing, longan growing, supply of longan, over-supply of longan

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1. Background

Longan is an important economic plant of Thailand with the third rank of export values in Thailand fruits market exporting to overseas. The export value of fresh longan in 2015 was about 9.7 billion baht with the average of domestic consumption about 25 percent. The average export of fresh longan was about 60 percent and the transformation for export was at 15 percent. As the longan is the economic plant with the high export values, the agriculturalists then turn to plant more longan. The characteristic of longan is the middle-sized fruit tree with the large bush width around 10 meters or more and height between 12-15 meters. It is named as "Longan" a fruit tree that can grow well at the temperature around 10 to 25 c and the moderate rain about 1,000 to 1,200 mm. per year with the planting areas in 36 provinces. The suitable areas for longan planting in Thailand are the provinces in northern part, especially Lampoon and Chiang Mai. Chiang Mai is the province that has the highest amount of production per rai in Thailand; the average production is at 696 kg. per rai.

At recent, longan planting and production technology has far more advanced that the agriculturalists can plant the longan though not in the season by forcing the longan to blossom and giving the fruits throughout the year. Longan planting is promoted by the government sector to make the good price of longan and distribute the production in each period throughout the year to prevent the problem of market overwhelming and to control the longan quality as well.

In planning to plant longan to distribute the production to yield in each period, it requires estimating the areas for longan planting since formerly the longan areas exploration was done by district agricultural officer but it consumes time and uses a lot of staff. Thus, there is the idea for remote sensing by the satellite picture; the satellite pictures come from the American planet surface exploration satellite Landsat8 selecting Chiang Mai areas as the key areas to plant longan as the case study to estimate the longan planting areas by the mentioned technique.

Landsat 8 satellite is the satellite that used to explore the world resources providing the photograph information from the satellite covers the areas of the study. It provides information from various temporal and suitable in the aspect of wave band to measure and support for the analysis of plantation. The pixel detail of the photograph is sufficient to analyze the areas for longan plantation. The data record of wave band by Landsat 8 satellite is done in 11 bands. The length of band that supports for the analysis of plantation is Band 5 with the spectral of 0.851-0.879 μm –NIR, detail pixel 30 meters. The band that can be seen by human eyes and presents the pattern that actually appears on earth. Band 2 with the spectral of 0.452-0.512 μm –Blue has the detail pixel of 30 meters, Band 3 with the spectral of 0.533-0.590 μm – Green and the detail pixel of 30 meters, Band 4 with the spectral of 0.636-0.673 μm – Red and the detail pixel of 30 meters.

The case study of Chiang Mai province with the areas around 20,107 square kilometers locates on 16 north latitude and 99 east longitude about 310 meters height from the sea level, the width from the western to eastern part is about 138 kilometers and the length from the northern to southern part is about 428 kilometers. Data from satellite, one scene has the size of 170 kilometers from the north toward south and 183 kilometers from east toward west thus, the case study will use three data scenes.

2. Methodology

Remote Sensing is the recording or retrieving the news and information about the objects in the target areas by the sensor without touching to the objects by using the qualification of the electromagnet as the media to get the information in three forms; the spectral, spatial and temporal changes of things on the earth surface**.**

Methodology is to set for the factors to separate the areas of longan plantation; setting the target areas to represent for the data, placing the Class Hierarchy to get the factors of consideration and brining into the Object Based Classification by Fuzzy logic.

2.1 Satellite photograph information and areas of study

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The basic areas separation for longan plantation using the objects separation technique of Multispectral Classification which is the principle that used the reflection values of the electromagnet wave that measured from the longan plantation areas. This is necessary to set for the sample area to separate the longan plantation area to use as the area to set the value of the pixel group that represents for the longan plantation area to use for the statistical estimation to separate the pixel in other areas onward.

The sample areas for training data will be selected from one scene to cover the areas of Sarapee district with the following qualification.

- Clarity of the subject that needs to be separated, the clarity gained is the longan with more than 5 years old and the distance between the trees is very short. The longan trees with the similar ages and the layout pattern of longan tree must be in form of constant (4*4, 4*6, 6*6).
- Uniqueness of the objects to be separated if it is the sole area of longan plantation without other tree types contamination.
- The size of area that must correlate with the pixel detail. In case of using the information from Landsat 8 satellite has the detail pixel of 30 meters which means 1 Pixel of the satellite information will cover the 900 square meters of area.

2.2 The establishing of Class Hierarchy from the satellite data

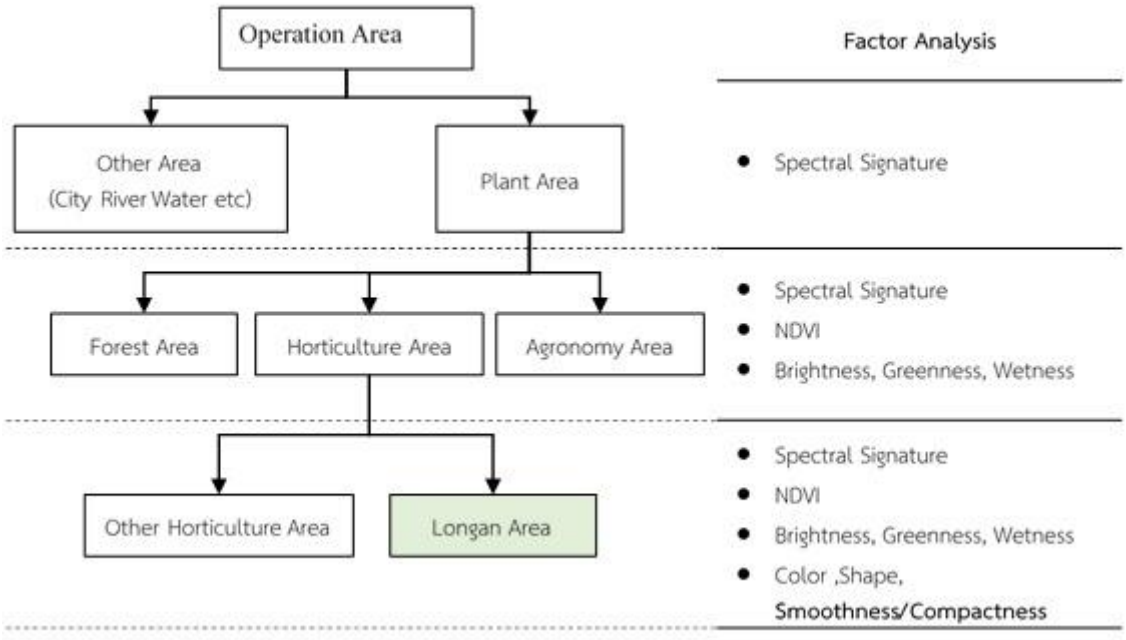

Figure 1: Class Hierarchy from the satellite data

Data from the distance exploration pay attention to the reflection value which is the ratio between power that fall on any surface and reflective power from that surface. The reflective value from the same type of objects will be varied up to the different spectral so called Spectral Reflectance.

$$\rho(\lambda)=\frac{E_R(\lambda)}{E_I(\lambda)}$$

$\rho(\lambda)$ = Spectral Reflectance at a particular spectral
$E_R(\lambda)$ = Reflect power from the object surface at a particular spectral
$E_I(\lambda)$ = Power affects to the surface a particular spectral

The object has the different characteristics of band since the interaction with the power from electromagnet wave but in the different spectral. When presenting in form of graph, it will reflect the specific unique characteristic of Spectral Signature in which this feature can be used for the best benefit in areas classification from the satellite data.

When capable to separate the data into any forms, the data extraction to get the information of planting types to be specific for the study using the technique of Vegetation Index; a kind of technique to operate between the pictures by calculating the related spectral to plant to make the ratio of each other. Then providing the outcomes of plants quantity classification from the high density areas to the non-planting areas; this then beneficial for the follow up of the increasing and decreasing of plants. The popular method that used to calculate the Vegetation Index is Normalized Difference Vegetation Index – NDVI which make the ratio between 2 bands that tuned to have the normal distribution forms using near infrared to erase by the Red visible band and divide by the sum of near infrared and Red visible band.

$$NDVI=\frac{NIR-RED}{NIR+RED}$$

When NDVI = The value of Vegetation Index adjust the difference
NIR = Reflective value of near infrared
RED = Reflective value of Red visible band

The process of picture adjustment by the spectral is another process that can bring to add more efficiency in planting classification. Tasseled Cap Transformation is the measurement of amount and size of electromagnet wave that can be recorded by the gauge via the information of various spectral that transform into new information to emphasize on the interesting characteristics or reducing the size of information or the overlapping information. This method is the new way of information management by the recent amount of band is equal to the old band that uses to study about the plant. The new information arrangement results on the three core information axis that giver the information about the element of plant.

There is the study on the reflection and seizing of light from any objects from LANDSAT-TM information for 6 bands and it is found that there is the information in three dimensions. They present about the plain of soil, plant and changing zone between the soil and plant that presents the relationship between soil humidity and the bush patterns of the plant. The coefficient value used in the Tasseled Cap equation of LANDSAT-8 is as follow.

Brightness = 0.3029*(B2) + 0.2786*(B3) + 0.4733*(B4) + 0.5599*(B5) + 0.508*(B6)+ 0.1872*(B7)

Greeness=-0.2941*(B2)-0.2430*(B3)-0.5424*(B4)+0.7276*(B5)+0.0713*(B6)-0.1608*(B7)

Wetness = 0.1511*(B2) + 0.1973*(B3) + 0.3283*(B4) +0.3407*(B5) - 0.7117*(B6)-0.4559*(B7)

Brightness value will give the overall weight for all bands and present the variance direction of the surface reflection. The Greenness value is 90 degrees to the brightness axis which is the difference between the near infrared spectral and the visible spectral. This axis associates with the amount of green color in the picture. The Wetness value is related to the bush patterns of the plant and the wetness of the soil. The circulation of new axis is set according to the picture information or up to the signal censoring device. But after establishing the type of signal censoring device, the coefficient in values transformation will be set and the axis circulation will be constant.

2.3 Object-oriented Classification

Object-oriented Classification is a technique in an Image Processing procedure that applied to use in the classification of satellite data. The classification of the information types in the Object-oriented Classification is to use the image object to calculate for the statistical value by replacing the image pixel with the similar color under the object frame, the similar areas in the pixel with the mixed reflection value cannot be classified. The group of pixel is called as “object”.

This is what happens during the Segmentation process when the separated image will become the group of pixel with the level of different values in the similar object. The factor of scale is the indicator for the object size by it is the basic variable of the object in the new object forming.

The forming of image object must consider on the relationship of information.

1. Scale is the determinant of the size of image object forming by the value to set for the ratio, the low value refers to the size of image object with the small size or high resolution. The more the small information, the higher of similarity while the high scale refers to the big object size; the information will have low similarity. This is because the larger size of information leads to the more contamination which required setting for the scale of the object and considers the suitable ratio for the size.

2. Shape or Color setting in the forming of image object will choose to give the probability value of the color or the shape. If considering more on the color, it should consider on the spectral reflectance that choose to do the mixed colors image.

3. Compactness or Smoothness value emphasizes on the essential of shape of the object, the probability value of the compactness into W2. The value of weight probability of smoothness is equal to 1-W2; the value of both compactness and smoothness mutually should not more than 1. Giving the probability value of the compactness will result on the change in the shapes of object in which will be used when two objects have the obvious differences, this means the image object has the low relationship of band.

When entering into the segmentation process, the factor analysis is set in the structure of Class Hierarchy from the satellite data. It will be brought to segment by the principle of fuzzy logic.

2.4 Comparison of statistical information

Bringing the data from the segmentation of longan plantation area from the satellite image to interpret from the detail pixel of 30 meters that refers to 1 pixel of satellite data will cover the area of 900 square meters. For the calculation to get the longan plantation area in Chiang Mai province with the statistical data that gathered by the Office of agricultural economics in 2015.

3. Conclusions

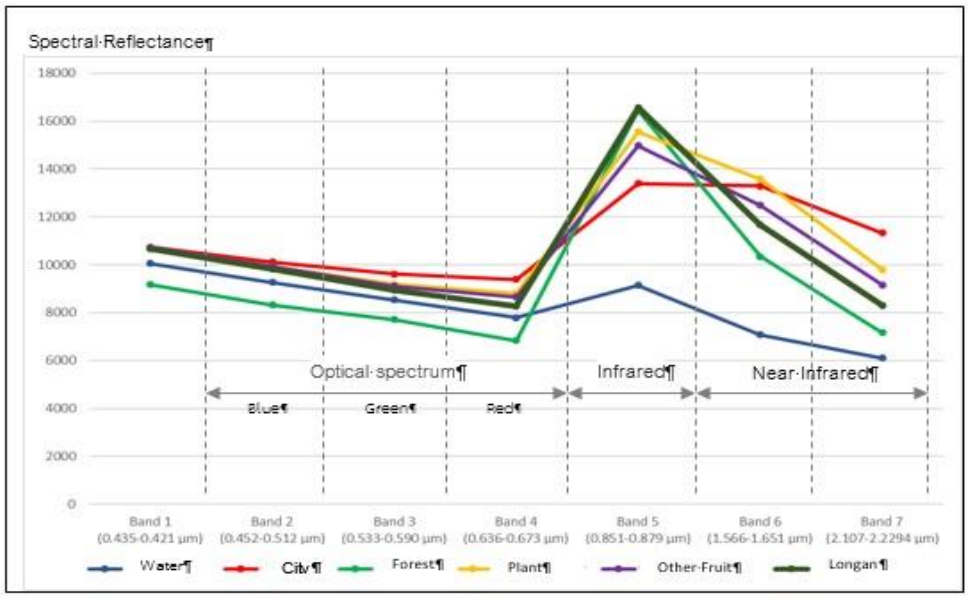

Figure 2: Comparison of the spectral reflectance between any forms of area

From the processing, it is found that longan plantation area has the spectral reflectance that different from the other fruits planting areas and the plantation areas in the infrared band that longan plantation area has the reflection value more than other area. Except when comparing to the forest areas; however the forest area does not have the reflect value in the near infrared that lower than longan plantation area. When considering other factors such as the different characteristic of areas, patterns of bush and sizes of area; these can be the factor to separate the forest area out of longan plantation area.

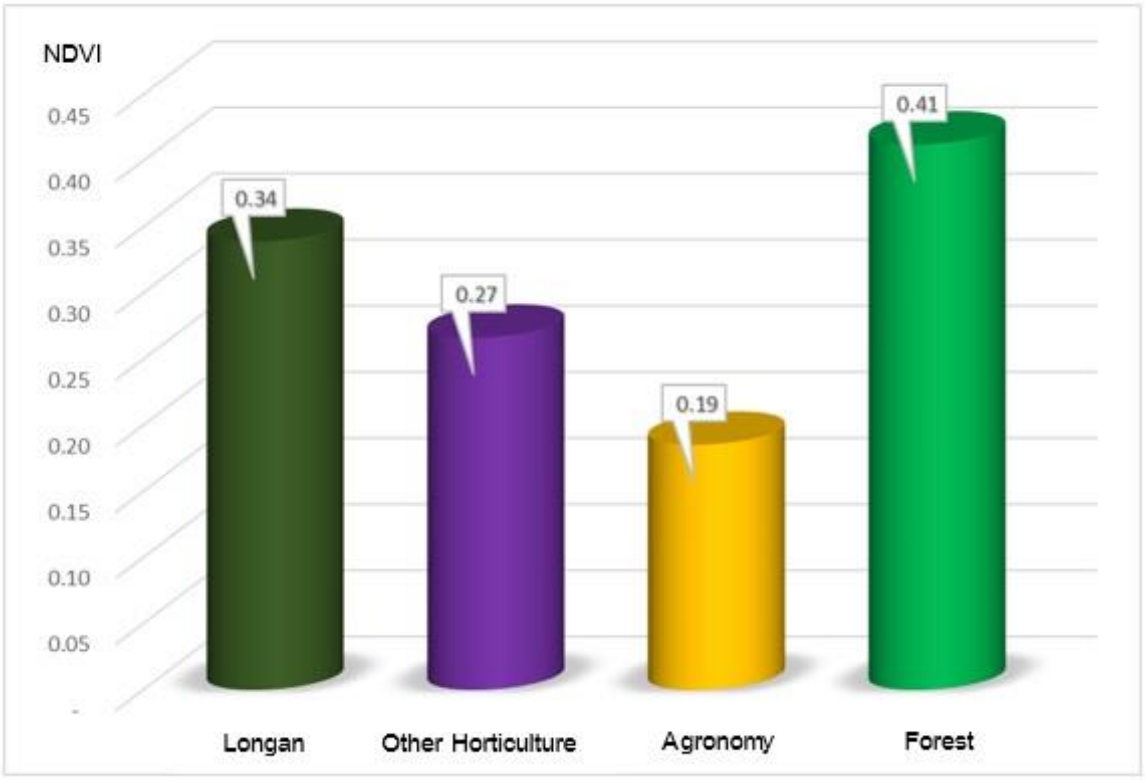

Figure 3: the analysis of Normalized Difference Vegetation Index (NDVI) is the Landsat 8 satellite data processing

According to the equation of NDVI analysis, the result gained from the processing shows that NDVI value of longan plantation area has the higher value than other gardening and farm areas. This reflects the specific characteristic of longan plantation area but the NDVI value of longan plantation area is lower than the forest area. This conforms with the reality since the forest area has more density of plants therefore; it has the highest NDVI among the group of areas with the plant elements.

The area that elements with plants mostly segmented from the very first process then separated into the areas of forest, garden and farm. The key factors that used to basically consider are the signature of band though the three areas have the same signatures of band but the reflection from each spectral is different. This is because the areas of forest, garden and farm have the different types of plant and plants density. Besides, we also consider on the Vegetation Index in form of difference adjustment and the values from the Tasseled Cap Transformation processing in which retrieved from the representative data as follows:

Brightness = 22991.70119
Greeness = -1702.725342
Wetness = 1612.142073

Figure 4: exploration routes and point of exploration at Sarapee district, Chiang Mai

The gardening areas will be segmented into other gardening areas and longan plantation area considering together with other co-factors of land characteristics, planting areas characteristic, size of planting space and the association with the longan planting environment as well as it may include with the patterns of longan bush.

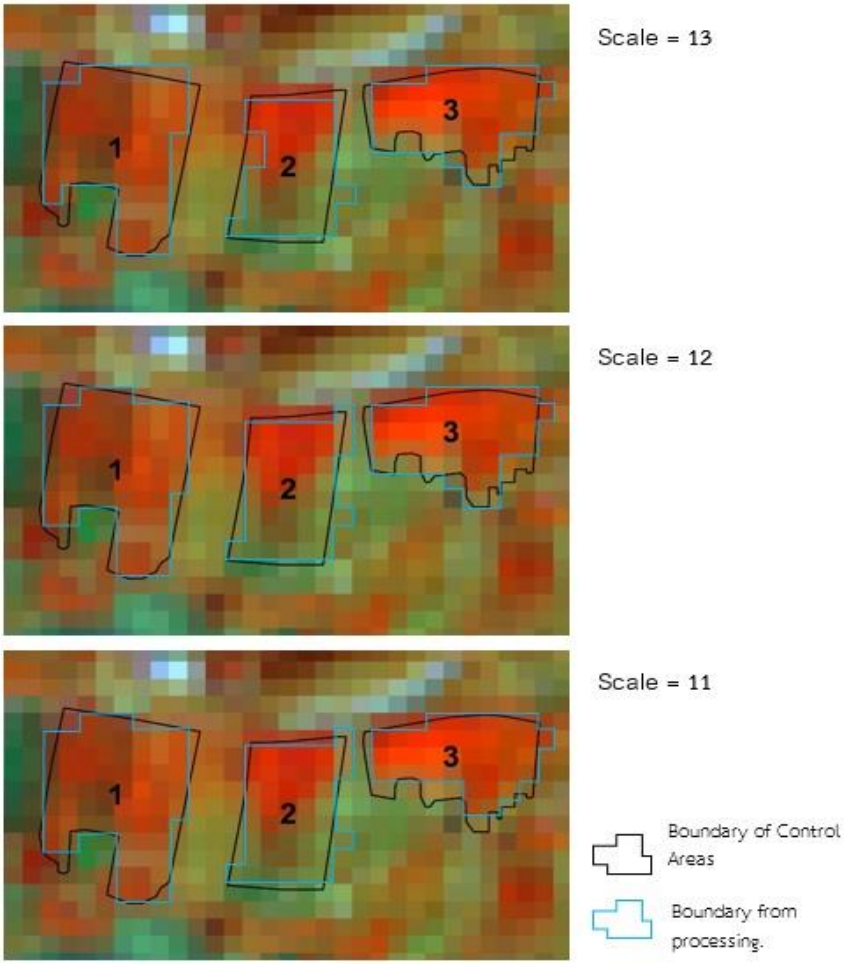

Figure 5: result from the change of Scale

Setting for the shape and color: the intention is paid more on the color and tested by setting the value of shape at 0.1 to place more importance on color.

For the compactness or smoothness value, it can be seen that longan plantation area has the planting characteristic on the restricted landscape line with the definite form and most of the planting area will plant only the longan; therefore, there is the high compactness. Thus, it is to consider setting the smoothness value at 0.1 to place more importance on compactness.

Control Area	1	2	3
(1) Number of Pixel in Control Area	67	45	43
(2) Number of Pixel in Control Area ,Scale = 13	62	40	46
(3) Number of Pixel in Control Area ,Scale = 12	65	45	46
(4) Number of Pixel in Control Area ,Scale = 11	65	45	46
|(1)-(2)|	5	5	3
|(1)-(3)|	2	0	3
|(1)-(4)|	2	0	3

Table 1: checking the value of areas covering when adjusting the scale

Figure 6: sample area for the very obvious Longan Growing area segmentation

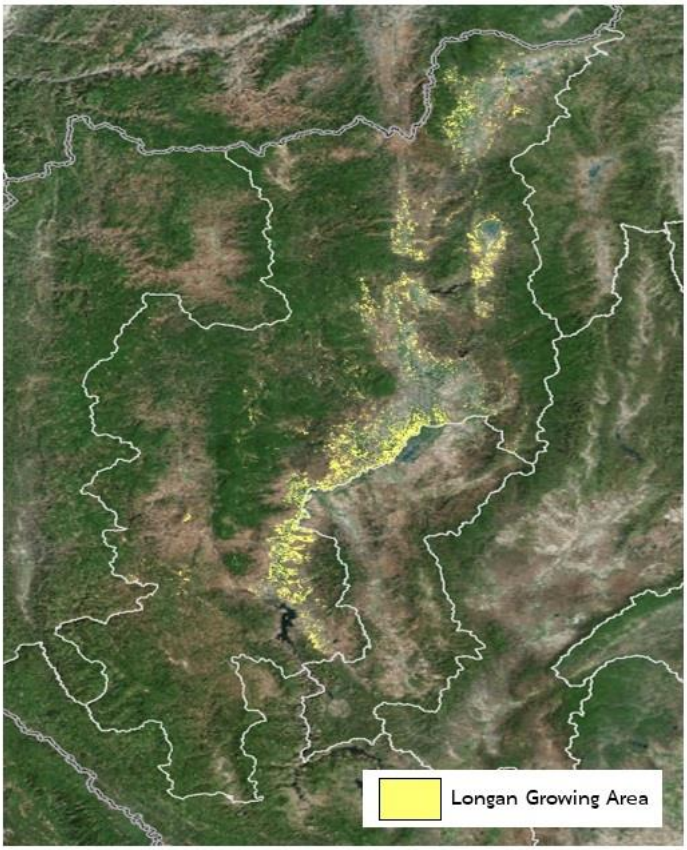

Figure 7: the processing of Longan Growing area

Table 1: The longan plantation area (square kilometers) in Chiang Mai

Processing area	longan plantation area (square kilometers)			
	1 Processing result	2 Department of agricultural economics in 2015	3 Office of agricultural economics in 2015	different result 1-2 / 1-3
Chiang Mai	600.54	504.88	501.43	95.66 / 105.11

The processing for the longan plantation area segmentation by satellite data in Chiang Mai province present the total 600.54 square kilometers of longan plantation area that distributed along Ping river basin, the density of longan plantation area in Sarapee district, Hangdong district, Sanpathong district, Maewang district, Chomtong district, Hod district and Doi tao district. Moreover, there are the general distributed areas in the plain land of Mae Rim district, Mae Tang district, Chaingdao district, Prow district, Chaiprakran district, Phang district and Maeai district.

4. Success achieved and issues for further research

We can estimate the longan plantation area in Chiang Mai by the distance exploration technique from the using of Landsat 8 satellite photograph which it is the resources exploration

satellite that opens to download the information for free with the 80% of precisely information. We can bring the information to use in the planning of longan production distribution into the market.

The return to take the photograph of Landsat 8 satellite is done in every 16 days round therefore, we can bring it to extend the scope of studying to find out the areas of longan blossom in order to estimate the amount of future production. This is also to form the model to estimate the amount of longan plantation area in the country from the factors as segmented in Chiang Mai province. This can extend the scope of study into the group of longan production countries in the future.

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