

# Mapping the Potential and Quality of Limestone Rocks Using Remote Sensing Method (Study Case: Semanding, Sub District Tuban)

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**Abstract**—The mine Exploration is an activity to find the points where an area could be mined and the area is still mined, for economic value. One of the most important in the work of mining is the calculation of the estimated potential of mine. Estimation of the potential mine played an important role in determining the amount of work the quality, production, how the mining is done, even to estimate the time required to do the mining. With the advancement of technology in the field of remote sensing, computation of the vast potential of the estimation and the quality of limestone can be done using high resolution satellite image data one is Quickbird. Satellite image data can be used for a wide range of research, such as the mapping of rock quality in relation to the exploration of natural resources. Vast potential of Cretaceous rocks in Semanding sub district is dominated by the high potential of an area of 5480,479 ha. To a limestone rock quality obtained based on limestone  $CaCO_3$  levels, the most high quality i.e. have levels of  $CaCO_3$  amounted to 6.81%.

**Keywords**—

## I. INTRODUCTION

Indonesia is a country which is rich in mining goods, both mineral and metal materials. Various areas in Indonesia have mineral resources in the form of various types of mines/minerals. Limestone ( $CaCO_3$ ) is one of the nonmetallic minerals industry that its potential is very large and spread across the region Indonesia [1]. Most of the content of these rocks in Indonesia is in West Sumatra, East Java, East Kalimantan and Central Kalimantan. One of the main producing areas of limestone is the Semanding Subdistrict, Regency of Tuban, East Java.

Sub Semanding is one town located to the North of the island of Java, in Tuban, East Java. Sub Semanding has a limited territory, namely the North, bordered by the Sub-District of Tuban, East bordering Subdistrict, South Cross borders the subdistricts of Plumpang and Sub Grabagan, while to the West the subdistrict is bordered by the Merakurak.

Mine exploration is an activity to find the points where an area could be mined and the area is still mined, for economic value. One of the most important in the work of mining is the calculation of the estimated potential of mine. Estimation of the potential mine played an important role in determining the amount of work the quality, production, how the mining is done, even to estimate the time required to do the mining.

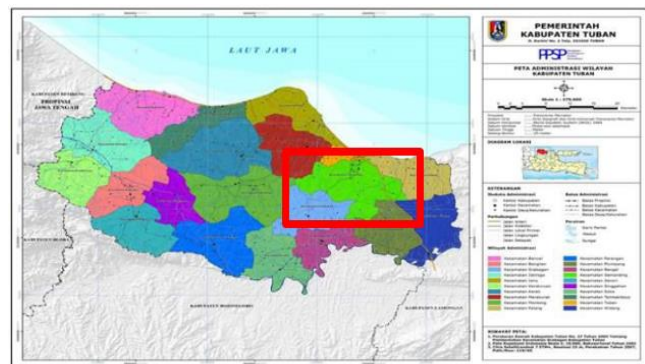
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With the advancement of technology in the field of remote sensing, computation of the vast potential of the estimation and the quality of limestone can be done using high resolution satellite image data one is Quickbird. Quickbird is a high-resolution satellite image that was released on October 18, 2001 in California, U.S.A. Data satellite imagery can be used for a wide range of research, such as the mapping of rock quality in relation to exploration natural resources. This research is expected to later can be used as a method of spatial data more quickly and efficiently in a broad estimate of the potential mapping and rock chalk without reducing the quality of the measurements in the field.

## II. METHODOLOGY

### A. Location

The location of the final project research was carried out in Semanding Subdistrict, Regency of Tuban, East Java astronomically lies in  $111^{\circ} 58' 0''$  -  $112^{\circ} 8' 45''$  BT and  $6^{\circ} 53' 44''$  -  $7^{\circ} 1' 24''$  LS.



**Figure 1.** Map of the Administration Area of Tuban (Tuban PPSP, 2017).

Sub Semanding has a limited territory, namely the North, bordered by the Sub-District of Tuban, East bordering Subdistrict, South Cross borders the subdistricts of Plumpang and Sub Grabagan, while to the West the subdistrict is bordered by the Merakurak.

### B. Data Processing

#### 1. Data collection

At this stage carried out data collection are used namely Imagery Quickbird, Semanding Subdistrict administrative boundary data, the geological formations of Semanding sub-district of data as well as data point GCP and ICP is measured using GPS Geodetic Hyper Pro dual frequency.







Made up of mud, grey, green and yellowish grey with interludes limestone and clay. concrescence and clay stone contain the local temple looks iron.

Limestone in the area there are many Tuban at Paciran formation, the formation of Kujung, and the formation of Tuban [5].

4. Quality Limestone

The quality of the limestone obtained from the results of laboratory analysis to obtain levels of CaCO<sub>3</sub> in the limestone obtained on areas of research. The higher the levels of CaCO<sub>3</sub> on limestone rocks, then the higher the quality. Testing the levels of CaCO<sub>3</sub> in the sample obtained in field of limestone is done with the method Kompleksometri.

Titration kompleksometri is a titration based on compound complex formation reactions between the metal ion with complex-forming substances. It turns out that when multiple metal ions present in an aqueous solution, so titration with EDTA would show the sum of all existing metal ions in solution [6].

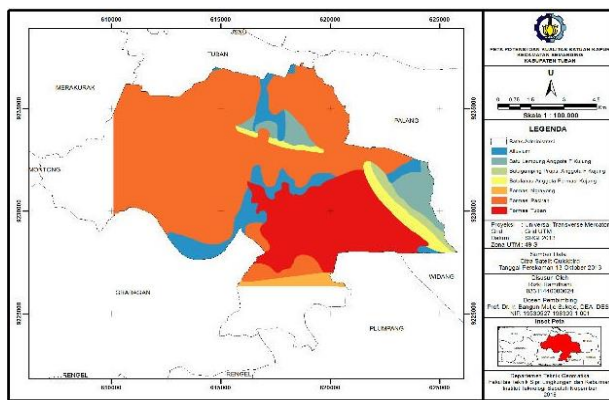


Figure 4. Geological Map.

Following are the results of the analysis of CaCO<sub>3</sub> obtained from Chemical Laboratory test results-ITS on 17 April 2018.

TABLE 5. RESULTS ANALYSIS OF CaCO<sub>3</sub> (CHEMICAL LABORATORY ITS, 2018) THE LIMESTONE SAMPLE SURVEY DATA

No	Point	Result Analysis (CaCO <sub>3</sub> )	Method
1	S1	5.95%	Kompleksometri
2	S2	6.81%	
3	S3	5.94%	
4	S4	6.27%	
5	S5	6.05%	
6	S6	6.06%	
7	S7	6.59%	
8	S8	4.54%	
9	S9	5.95%	
10	S10	6.06%	
11	S11	3.89%	

From the results of the analysis in Table 3.5 analysis results can be categorized into three levels of CaCO<sub>3</sub> category. The following Table of quality limestone rocks.

TABLE 6. TABLE OF QUALITY LIMESTONE

No	Limestone Quality	Content of CaCO <sub>3</sub> %
1	Low Quality	3.89-4.86
2	Medium Quality	4.86-5.83
3	High Quality	5.83-6.81

According to [7], based on the levels of clays in the limestone and its use in industry can be differentiated into:

- Chalk white, when 90% CaCO<sub>3</sub> >, clay < 10%
- Lime hydraulic, when 75% CaCO<sub>3</sub>-90%, clay 10%-25%
- Lime cement when CaCO<sub>3</sub> 70%-75% clay, 25%-30%
- Roman Limestone (Pozolan) when 60% CaCO<sub>3</sub>-70% clay, 30%-40%
- Portland cement when CaCO<sub>3</sub> 25%-60%, 40% clay-75%

Based on the levels of clays in the limestone under the classification of Effendy, limestone in Semanding does not match the use as industrial materials, but based on observation in the field, the limestone in the Semanding widely used as Kumbang Stone. Kumbang Stone is usually used as the Foundation of the building.

5. Map the Potential and Quality of Limestone

Map the potential and quality of limestone rocks created by overlaying against 3 maps (a map of land cover, vegetation index map and geological map) and the results of the laboratory test levels of CaCO<sub>3</sub> on 11 samples of the rock chalk. On the map is done Scoring 3 in each class, the higher score then the area more and potentially the presence of limestone rocks, the higher the levels of CaCO<sub>3</sub> high quality limestone rocks. Here is the Table that contains the Scoring of each parameter of the existence of potential rock chalk and limestone grade Table.

TABLE 7. SCORING PARAMETER DETERMINATION OF THE POTENTIAL OF CRETACEOUS ROCKS

No	Parameters	Class	Score	Weighting (%)
1	Vegetation	Green High	1	20
		The Greens Are	2	
		The Low-Green	3	
		The Greenery is Very Low	4	
2	Land	Land Is Not Vegetation	0	30
		Body of Water	1	
		The settlement	2	
		Rice fields	3	
3	Geological Map	The Bush/Jungle	4	50
		Open Land/Moor	1	
		Alluvium	2	
		Formation	3	
		Batulanau Member	4	
		Kujung Formation	4	
		Member Kujung	4	
		Formation of Tuban	5	
		Paciran Formation	6	

No	Parameters	Class	Score	Weighting (%)
Limestone Formations, The Members of Pruru Kujung				

TABLE 8.  
 TABLE OF QUALITY LIMESTONE

Point	Result Analysis	Quality
S11	3.89%	Low Quality
S8	4.54%	
S3	5.94%	
S1	5.95%	
S9	5.95%	High Quality
S5	6.05%	
S6	6.06%	
S10	6.06%	
S4	6.27%	
S7	6.59%	
S2	6.81%	

Overlay is performed using the method of intersection. Stacking is a method of an Intersection between two graphic data, but if the outer boundary of the two graphic data are not the same, then the processing is performed only on the shoulder. After that continued with the calculation of the amount of dignity and appropriate intervals anniversary classification specified by the following formula:

$$\text{Interval} = \frac{\text{max value} - \text{min value}}{\text{total class}} \quad (1)$$

The classification is divided into five classes so that the interval of calculation is like the following Figure.

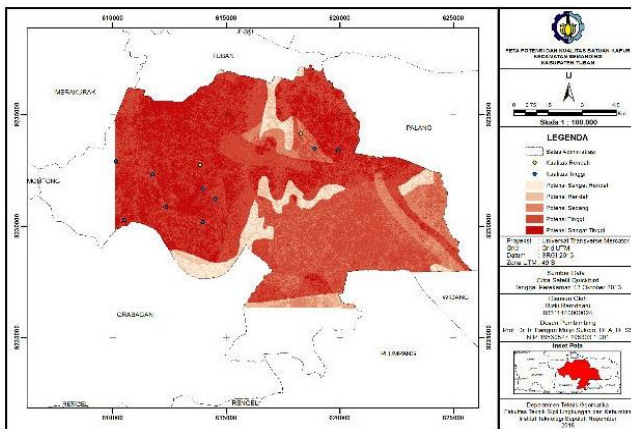


Figure 5. Map the Potential and Quality of Limestone.

From the results obtained as a broad classification of each potential class of rocks such as limestone the following table.

TABLE 9.  
 CLASSIFICATION, EXTENTS, AND THE PERCENTAGE OF POTENTIAL LIMESTONE

Category	Extent (ha)	Percentage (%)
Very Low Potential	536.274	4.880
Low Potential	494.327	4.499
Medium Potentials	1287.499	11.717
High Potential	5480.479	49.876
Very High Potential	3189.694	29.028

From the results of extensive calculations and the percentage obtained that Semanding dominated by high levels of potential with an area of 5480,479ha.

A. Analysis of the Results of The Processing

1. Test the accuracy of land Coverage

The results of the classification accuracy of test caps need to be performed to Test the accuracy of checking between the results of processing in image and measurement in the field. Test the accuracy of this using a random sample of 79 point spread on location based on GCP and ICP point area. Data retrieval using handheld GPS by noting coordinates and its land cover categories. Measurements carried out on 30 March-1 April 2017.

By doing the calculation accuracy of land coverage of trials, obtained accuracy of 86%. Geospatial Information Agency Head rules the number of 15 years has set 2014 test thoroughness of land cover should have carefulness > 85%.

2. Vegetation Index Value Correlation Test

The results of the vegetation index value to do test the correlation. This correlation test is performed with compare value of NDVI in the image with the value NDVI obtained in field. This correlation test using 20 points samples taken randomly and evenly spread on the area of research. Data retrieval is performed using a camera shooting with NDVI by noting the sample point coordinates. Data retrieval is performed on 30 March-1 April 2017. The following is the graph of the correlation of image data with a data field for the value of vegetation index.

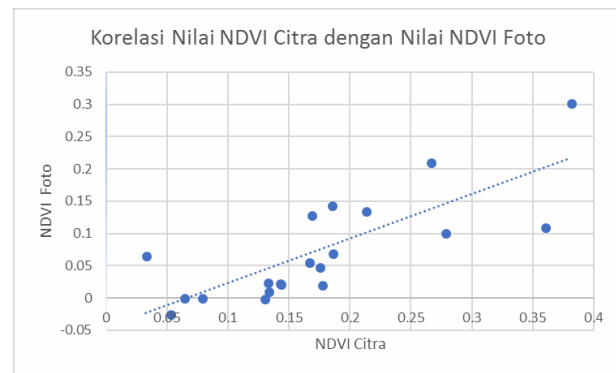


Figure 6. The Graph of The Correlation of NDVI.

Image Quickbird and NDVI Photos As indicated by the graph above, the value of NDVI image processing measurement results have a different value to the value of NDVI in the field. This is done to find out the extent of correlation or a proximity value of NDVI image processing measurement results with the value NDVI results photo camera NDVI. The correlation values range from 1 to -1, the value of getting closer to 1 or -1 means the relationship between two variables is increasingly strong. Conversely, if a value close to 0 means the relationship between two variables is getting weak. Positive values indicate a direct relationship (X, then Y ride up) while a negative value indicates reverse relationship (X, then Y ride down). The data used in the partial correlation usually have a scale interval or

ratio. The following is an analysis of the correlation coefficient for [8]. 0.00-0.199 = very low

0.20-0.399 = low

0.40-0.599 = moderate

0.60-0.799 = strong

0.80-1.000 = very strong

Test results correlation yields a value of correlation (R) by 0.781. This value specifies the correlation value of NDVI Image Quickbird with cameras NDVI categories include stronger so it can be concluded the processing of Quickbird imagery on NDVI is in compliance.

#### B. Analysis of the Potential and Quality of Limestone

The results of the map the potential and quality of limestone rocks Subdistrict Semanding obtained the broad potential of Cretaceous rocks is dominated by the high potential of an area of 5054.96 ha. To a limestone rock quality obtained based on limestone CaCO<sub>3</sub> levels, the most high quality i.e. have levels of CaCO<sub>3</sub> amounted to 6.81%.

From the results of a map of the potential and quality of limestone rocks of Semanding Subdistrict, the magnitude of the potential high on Sub-district Semanding due to the formation of the Geological Map at Paciran. Where this formation contains limestone, limestone and dolomite dolomite. Another factor is the low vegetation index and land cover in the form of open land/Moor. For the quality of limestone rocks dominated by high quality, value levels of CaCO<sub>3</sub> was at 5.83% range – 6.81%.

#### IV. CONCLUSION

Based on the results of research on Mapping the potential and quality of Limestone Rocks Using remote sensing Methods in district Semanding, Tuban by utilizing satellite imagery Quickbird, then obtained some final conclusions, namely:

1. Data of Quickbird satellite imagery can be used for map making potential and the quality of the limestone rocks in Semanding Subdistrict, Tuban.
2. Sub Semanding is dominated by high levels of potential with an area of 5054.96 ha, while for very low potential level 536,274 ha, low potential 494,327 ha, 1287,499 ha are potential and a very high potential of 3189,694 ha.
3. The quality of the limestone Semanding Subdistrict have a high percentage of the most quality levels of CaCO<sub>3</sub> i.e. 6.81% and lowest quality with value percentage of CaCO<sub>3</sub> levels i.e. 3.89%.

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