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Mapping of Limestone Potential Using Landsat 8 Satellite Imageryin Some Areasof Timpeh

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ABSTRACT: Limestone potential is important information that can be obtained from remote sensing data which has advantages and speed in processing results. Remote sensing is a technology that can overcome the problemof measuring data for fast and accurate information. This research was carried out in some areas of the Timpeh sub-district,a n d Dharmasraya districtusing Landsat 8-OLI imagery with the aimof1) identifying the potential of limestone using the Band Ratio method. 2) How to apply remote sensing in mapping the potential of limestoneusing Landsat 8 Oli imagery.

This research was carried out in several stages, namely Pre Processing which included radiometric correction and atmospheric correction, image cropping according to the research area, and processing whichincluded making geological maps, making landform maps, making maps of river flow patterns and vegetationindex maps and limestone identification using the RGB band ratio method (5/4;6/3;4/2).

The results of field identification in potential limestone areas, where the RGB (Red Green Blue)composite of the band ratio 5/4;6/3;4/2 shows that the presence of limestone is characterized by the appearanceof greenish-brown colored objects. The average pixel value for limestone with a band ratio of 5/4 is 2.475, for a6/3 ratio is 1.275 and for a 4/3 ratio is 0.788. In this study, the potential area of limestone in the research areawasfound,whichwas approximately 2352,14564 ha.

Keywords:Remote Sensing Landsat 8 Imagery,Band Ratio

1. INTRODUCTION

Indonesia is a country rich in mining products, both metals and minerals. Various regions in Indonesia have mineral resources in the form of various types of mining materials. One of the minerals is limestone. Limestone is a mineral with enormous potential and is spread in almost all parts of Indonesia (Shubri and Armin, 2014). The potential of limestone in Indonesia is almost in all parts of Indonesia. According to data from Mediadipoera et al (1990), Indonesia's limestone reserves reach 28.7 billion tons. Of the total limestone reserves in Indonesia, around 23.23 billion tons or around 81.02% the reserves are in West Sumatra province, followed by West Java province with a total of 637.82 million tons.

One area that has the potential for limestone is the Timpeh sub-district, Dharmasraya district, West Sumatra. In the Timpeh sub-district, there is limestone in the form of a potential resource which is still at the general investigation stage (according to data on non-metallic minerals, West Sumatra Province). it is necessary to do the mapping in a precise and accurate way to determine the distribution of the Limestone.

Limestone in some Timpeh sub-districts is only used as a foundation for houses because of its sturdy structure and form and not easily destroyed, many people use this stone as the main raw material in paving. Even though the benefits of limestone are not only that, limestone is used as a raw material or mixed material for various industries such as cement, paint, steel manufacturing, paper industry, and rubber industry. Limestone is also widely applied to the food industry for milk, health supplements, the sugar industry, and even for cosmetic mixtures. This is because industry players do not know information about the presence of limestone in the Timpeh sub-district and the quality of the limestone that meets industry requirements.

This study will modify the previous research, namely processing Landsat 8 imagery and then analyzing and carrying out several interpretation methods regarding the distribution of limestone. The interpretation method used in Landsat 8 imagery is the Band Ratio method. They also performed parameter analysis landforms, river flow patterns, and geology and vegetation density for limestone mapping.

Through Remote Sensing it is hoped that it will facilitate the presentation of spatial information, especially related to the Potential of Limestone Using Landsat 8 Imagery data in parts of the Timpeh District. This research is expected to later be used as spatial data with a method that is faster and more efficient in identifying the potential of Limestone.

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2. THE METHODOLOGY

2.1 Research sites

This research was conducted in the Area of Interest (AOI) or parts of the Timpeh District, Dharmasraya Regency. This district is located at 0°47′ 07”- 1°00'00” South Latitude and 101°26'35” – 101°44'08” East Longitude. This district has boundaries namely; to the north with Riau Province, to the south by Sijunjung District, to the west by Sijunjung District and the east by Padang Laweh District, with an area of 323.01 Km².

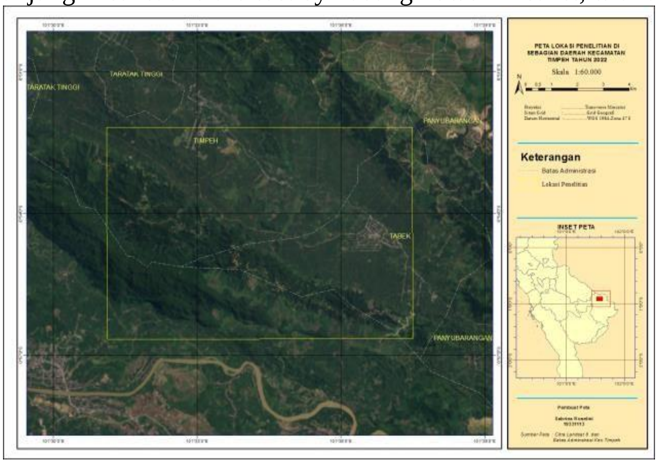

Fig 1. Location Research

Data and Equipment

1) Data

• Citra Landsat 8 Oil Year 2022
• Digital Elevation Model (DEM) Imagery
• Geological shop
• Landform shop
• Coordinate data for limestone locations

2.2 Processing Stage

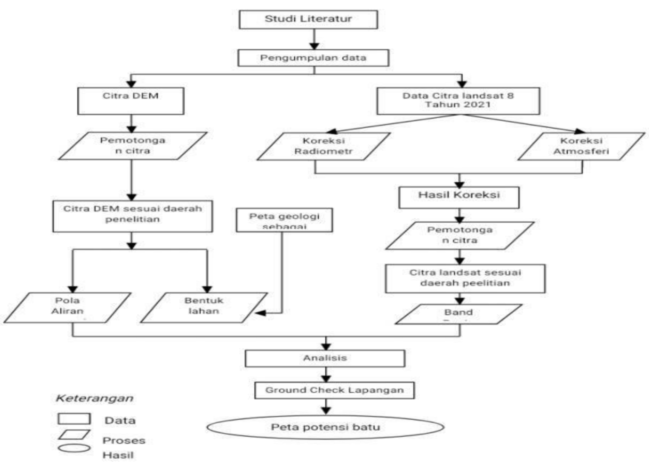

Fig. 2 stage processing

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1) The image used is the Landsat 8 OLI image acquired in 2022 with an image accuracy of 30 meters.
2) Cropping is done to obtain digital images that only cover the Area Of Interest (AOI) area
3) Radiometric correction is carried out to improve pixel values in satellite images due to radiometric errors and to improve image visualization.
4) Atmospheric correction to restore the image, the reflected value of the image recorded by the sensor is disturbed so that the reflected pixel value no longer matches the value of the original object.
5) Make geological maps, landform maps, and river flow pattern map with vegetation index map.
6) Identification of limestone by band ratio RGB method (5/4;6/3;4/2).
7) Preparation of sample point accuracy test is a process carried out to check between the results of processing in the image and measurements in the field. The land cover accuracy test obtained results of 3%.
8) Analysis Phase
The analysis was carried out on geological maps, landforms, river flow patterns, vegetation index and the results of band ratio processing. The result of the band ratio is the main parameter for making a model for identifying the potential of limestone.

3. RESULTS AND DISCUSSION

3.1 Geological map

Geological formation data was obtained in vector form with shapefile format covering the entire study area. From the Geological Formation data, the classification results and their area are as follows.

Table 1. Table of classification and extent of geological formations

Kelas	Batuan penguin	Luas(ha)
1	Alluvium	611,922748
2	Ang.Bawah,Fm.Kuantan	3219,191491
3	AnggotaBatuGamping	806,208746
4	FormasiKuantan	5151,33404
6	Granit	3,582487

Based on the results of the classification, the rocks in the study area include:

1) Alluvium Formation
   This formation contains sand, clay, silt, and gravel. This formation is often found around rivers and coasts. Unit Alluvium is deposited on top of older rock units.
2) Formation of Limestone Members
   The limestone unit is characterized by gray-white crystalline limestone. The limestone outcrops in the study area occupy a steep hill morphology with a stroke and slope of N290oE/83o. This type of limestone has an open container with hard and compact physical properties. The compact limestone forms resistant outcrops, large blocks scattered over the surface.
3) Kuantan Formation
   The Kuantan formation is a Permo-Carbon-aged rock that is part of the West Sumatra Block and in the study area can be grouped into three units, namely the Metamorphic Unit, Shale Unit and Limestone Unit.
4) Granite Formation
   Granite is an igneous rock consisting mostly of quartz, feldspar, micas, and amphibole, as well as a mixture of additional minerals, consisting of 10% - 50% quartz and 65% - 90% feldspar. These minerals make granite have a wide variety of colors and textures as it exists today.

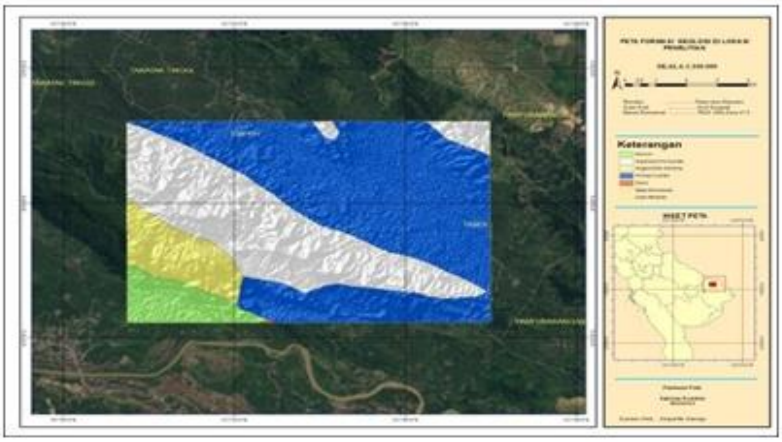

Fig. 3 Geological Map

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3.2 Landform Map

Based on the analysis of geological and topographical maps (patterns, contours and slope), and Landsat 8 imagery, the landform units in the study area are grouped into denudational landform units, structural landform units, karst landform units and fluvial landform units.

1) Denudational landform unit

Denudational landscapes are characterized by dendritic drainage patterns and slopes ranging from gentle to steep in the area. Denudational landform units include hills, which have a relatively moderate slope (flat to hilly forming gentle slopes or U-shaped valleys), which ranges from 25-40% with elevations ranging from 500-1300 m above sea level (asl). Marked the existence of contours that are quite tight. The geology that is arranged in this landform is the Kuantan Formation and the Telisa Formation. The area of the denudational landform unit is 5,305.86 ha.

2) Karst landform unit

The presence of karst landscapes in the study area is characterized by low hills with rounded contours (karst topography), irregular topography, and steep slopes as a characteristic of the topography formed by limestone.The karst landform units are plains and hills with an elevation of 200–700 m. The slope of slope is 25-40%. The geology that develops in this form unit is limestone and is included in the karst landscape. The area of the karst landform is 922.69 ha.

3) Fluvial landform units

Fluvial landforms are plains with an elevation of 100 m above sea level (asl). Slope 0% - 8%. The geology that develops in this unit is entirely composed of Alluvial and Granite formations. The area of the structural landform unit is 435.98 ha.

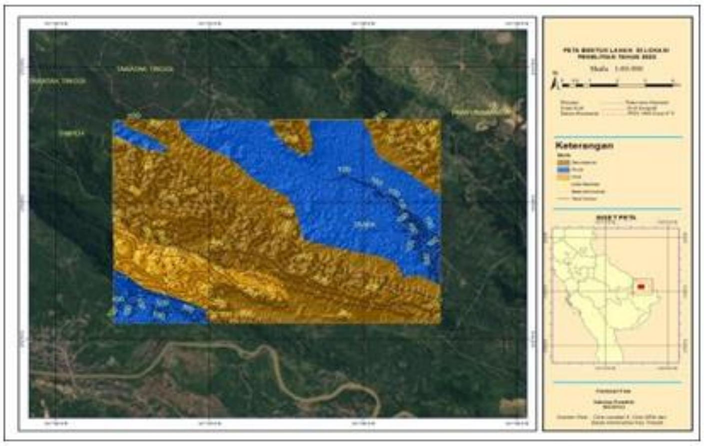

Fig 4. Landform Map

3.3 Flow Pattern Map

There are two river drainage patterns in the study area, namely the Dendritic Flow Pattern controlled by homogeneous lithology. Where this river flow pattern has a flow structure that is controlled by the type of rock. In the dendritic flow pattern there is a distribution of Alluvium formations, Granite formations and Limestone member formations. Flow Pattern Parallel is a flow system created by steep and steep slopes.

This happens because of the steep morphology of the slopes, so a river flow is formed that is straight in the direction of the slope with relatively few river branches. In the Parallel flow pattern there is a distribution of the Kuantan formation and the Ang.Bawang.Fm formation. Kuantan.

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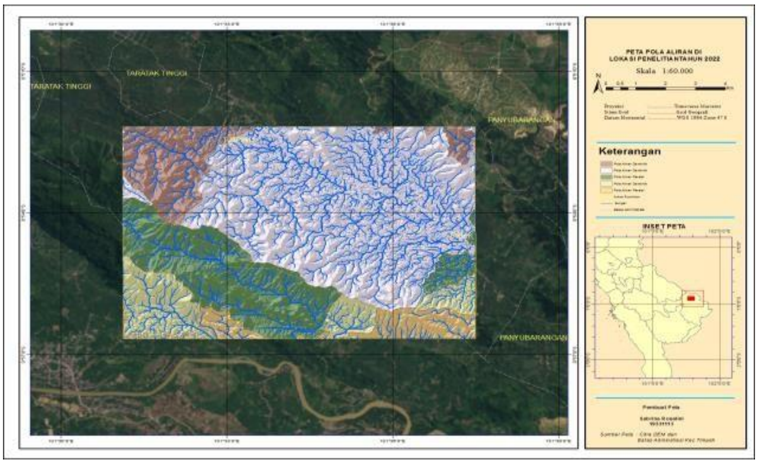

Fig 5. Flow Pattern Map

3.4 Vegetation Index Map

The Vegetation Index map was made from data sources from Landsat 8 Oli satellite imagery which had been corrected by radiometric and atmospheric corrections. Map making is done by calculating the NDVI algorithm. From NDVI processing in the study area, the lowest value was -0.177064 and the highest value was 0.612239. Determination of the vegetation index class in the NDVI algorithm is based on Permen No: P.12/Menhut-II/2012 which divides into five classification classes namely land with no vegetation, very low greenness, low greenness, medium greenness, and high greenery with a range of values as follows:

Table 15. Classification of Vegetation Density (Permen

Kelas	Kisaran nilai NDVI	Tingkat Kerapatan
1	-1s/d-0,03	LahanTidak Bervegetasi
2	-0,03s/d0,15	Kehijauan Sangat Rendah
3	0,15s/d0,25	KehijauanRendah
	0,25s/d0,35	KehijauanSedang
5	0,35s/d1	Kehijauantinggi

The following is the result of a vegetation index map using the NDVI algorithm.

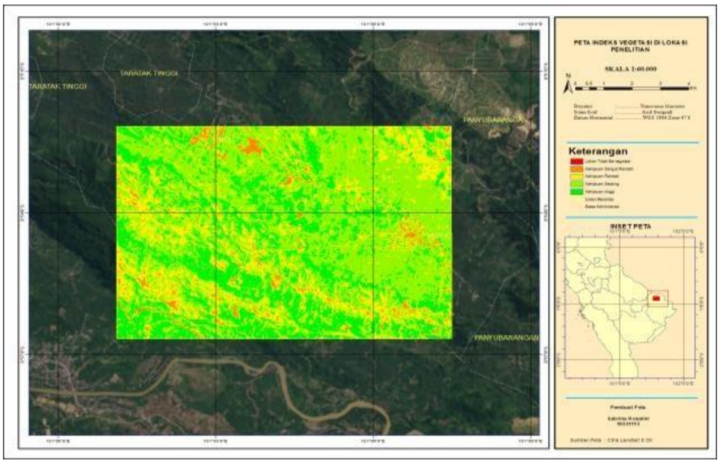

Fig 6. NDVI map

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The following is a table of land cover classifications and their area

Table 16. Classification of vegetation index and its area

Kelas	Kisaran Nilai NDVI	Tingkat Kerapatan	Luas (ha)
1	-1s/d-0,03	LahanTidak Bervegetasi	0,508508
2	-0,03s/d0,15	Kehijauan Sangat Rendah	307,911153
3	0,15s/d0,25	Kehijauan Rendah	1853,31087
4	0,25s/d0,35	Kehijauan Sedang	5125,600264
5	0,35s/d1	Kehijauan Tinggi	2560,019204

If viewed from the parameter of vegetation density, it states that one of the conditions for the formation of karst areas (dominated by limestone and dolomite) is to have high-density land cover vegetation.
Limestone Identification Using Band Ratio Method To determine the potential of limestone used the Band ratio method. The use of the band ratio method is very much, it can be used to highlight vegetation objects, water or the boundary between land and sea. The band ratio method is very good for geological mapping.

On the limestone potential map, the presence of limestone can be identified by taking several band combinations that have a high reflectance to limestone, namely band 5 with a length (0.85 - 0.87 µm), band 4 with a wavelength (0.63-0.67 µm), bands 6 with a wavelength (1.56-1.65 µm), band 3 with a wavelength (0.53 -0.59) and band 2 with a wavelength (0.45-0.51 µm) where the potential of this limestone can be determined using the band ratio method After the composite band ratio is done, we can see the pixel value of the limestone. The pixel values for limestone with a band ratio of 5/4 are 2.475 for a ratio of 6/3 which is 1.275 and for a ratio of 4/3 which is 0.788.

In the spectral reflection curve, the Y axis shows the percentage of the reflectance value that is reflected by the object. While the X-axis shows the range of wavelengths used. The variation in the reflection value along the wavelength range then forms a curve that is differentiated based on the type of object
The objects on the reflection curve below are limestone, vegetation and water. The red color chart is limestone, and the green color chart is vegetation and the blue color chart is water objects.
The higher the reflectance value of the object in limestone, the more area has a high potential for limestone.

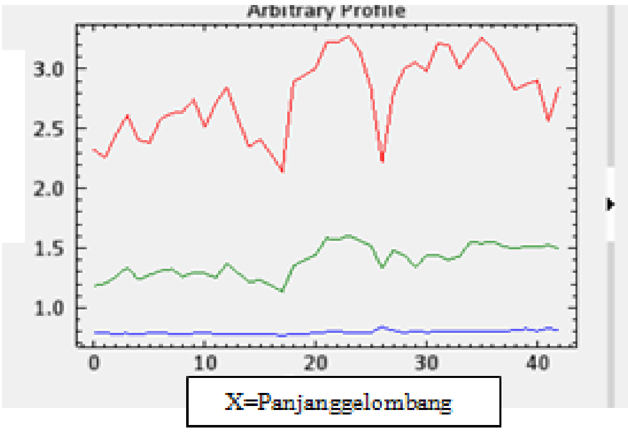

Fig 7. spectral reflection curve

The higher the reflection value of the object on the limestone, the area has a fairly high limestone potential

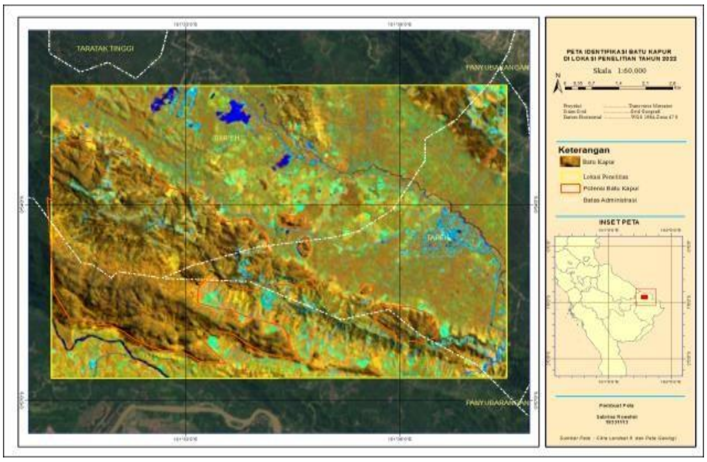

Fig. 8 object on the limestone

3.5 Lime Potential

The limestone potential map was made by analyzing 4 map parameters (geological map, landform map, vegetation index map and river flow pattern map). The band ratio method can show the distribution of limestone based on color and texture identification from Landsat 8 imagery in the study area, in addition to validating the presence of limestone in the field to show the appearance of limestone. The potential area of limestone in the study area is approximately 2352.14564 ha.

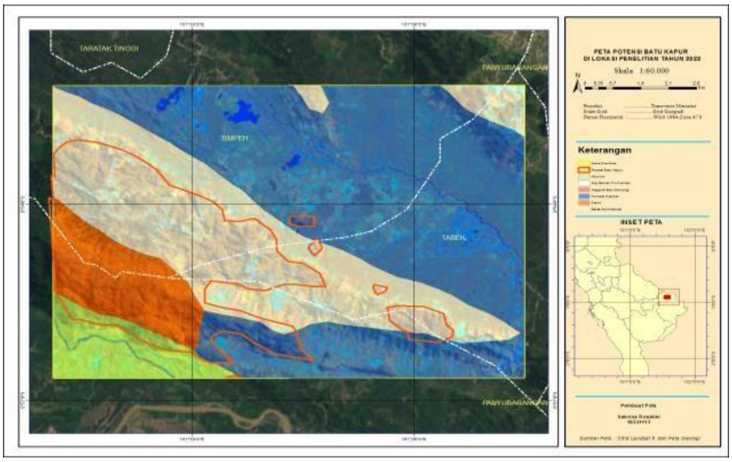

Fig. 9 Lime Potential

3.6 Field Check Ground (Accuracy Test)

Sampling was carried out randomly at as many as 20 points at different locations. This number is considered sufficient to represent the entire research area. True and false from the distribution of sample points are then entered into the suitability table which is useful for facilitating the process of calculating the accuracy value

The calculation of overall accuracy is as follows:

Perhitungan akurasi keseluruhan sebagai berikut :

$$\textit{Tingkat Kebenaran Interpretasi} = \frac{\textit{Jumlah Titik Benar}}{\textit{Jumlah titik yang disurvey}} \times 100\% = \frac{17}{20} \times 100\% = 85\%$$

The overall calculation accuracy of the results of the field survey is 85%. This value is by the minimum limit that has been set as a condition for accuracy. the level of accuracy rating used must be not less than 85%.

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4. CONCLUSIONS

1. The results of identification in the field in areas that have the potential for limestone, where the RGB composite of band ratios 5/4;6/3;4/2 shows that the presence of limestone is marked by the appearance of greenish-brown colored objects. The average pixel value for limestone with a band ratio of 5/4 is 2.475, for a ratio of 6/3 is 1.275 and for a ratio of 4/3 is 0.788.

2. The application of remote sensing is needed in mapping the potential of limestone, because it is seen from the spectral response of the object. The results show that Landsat 8 oil has an extraordinary ability to generate spectral information to identify carbonate minerals for exploration purposes. This research shows the potential area of limestone in the study area, which is approximately 2352.14564 ha.

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