(IJRST) 2016, Vol. No. 6, Issue No. III, Jul-Sep e-ISSN: 2249-0604, p-ISSN: 2454-180X

INVENTORY OF LIMESTONE SITE AND ANALYSIS OF OPTIMAL TRANSPORT NETWORK USING LANSAT 8

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ABSTRACT

Limestone is an important ingredient in the Cement manufacturing process. Limestone of varying grades occurs in sedimentary and crystalline rocks. While the high grade deposits are directly utilized for the manufacture of cement and lime, the other varieties are blended with the high grade deposits and made usable. With depleting limestone resources, it is of significance that we explore and exploit all the grade of limestone. Using band ratio technique the occurrence of limestone is identified in Virudhunagar district. Pure limestone will reflect the visible and NIR energy, while SWIR energy in the 2.35µm region will be absorbed. So the ratio chose is7/6 in Landsat 8 data. The depth of absorption in the SWIR region will depend on the concentration of carbonates in the mineral. Hence, it is possible to quantify the purity of a limestone deposit by analyzing the visible and carbonate absorption SWIR bands in a satellite image. And for transporting the materials from the site to factory optimal route is identified using Network analysis.

Keywords: *limestone, cement production, SWIR, band ratio, Landsat 8, network analysis*

INTRODUCTION

Limestone in Tamil Nadu occurs as crystalline and non-crystalline (amorphous) varieties besides corals. The bulk of limestone deposits are found to the south of MoyarBhavani-Attur Lineament and thus the southern districts form the limestone province (Srinivasan, 1974). The crystalline limestones of Precambrian age are mainly distributed in parts of Salem, Tiruchirappalli, Karur, Madurai, Virudhunagar, Ramanathapuram, Nagapattinam, Tirunelveli, Tuticorin and Coimbatore Districts. Three bands of good quality limestone ranging in strike length from 1.5 to 6.5 km and upto 75m wide occur near Pandhalgudi, Palavanattam and Chinnaiyapuram of Virudhunagar District. Reserves in these deposits are estimated at about 17.20 million tones. In the Alangulam area, Virudhunagar District, three bands of good quality limestone extend over a strike length of upto 2.5 km. The reserves in these bands upto depth of 10 to 15 m are of the order of 6.31million tones. The objective of this study is to investigate the satellite data for

mapping the locations of limestone in Virudhunagar district and provide an optimal route for transporting the materials from the site to the factory.

STUDY AREA

Virudhunagar District is located in the southern part of Tamil Nadu. It is bounded on the north by the districts of Madurai and Sivagangai, on the east by the districts of Sivagangai and Ramanathapuram, on the south by the districts of Tuticorin and Tirunelveli and on the west by a portion of Kerala State and the district of Madurai. It has an area of 4432.55 sq.kms. The latitude and longitude extend of Virudhunagar district is 11ºN and 77º28'E, 12º N and 78º50'E the district boundary is shown in the figure 1.

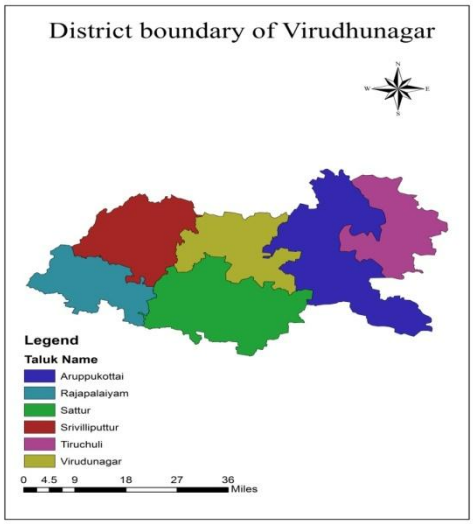

Figure 1 Location map of the study area

SATELLITE DATA

LANDSAT 8 is a North American Earth observation satellite launched on February 11, 2013. It is the eighth satellite in the Landsat program; the seventh to reach orbit successfully. The satellite was launched abroad an Atlas V 401 carrier rocket with an extended Payload Fairing.

LANDSAT 8 SPECIFICATION

Pixel sizes available in Landsat 8 are 15m-panchromatic, 30m -multispectral, 100m-thermal infrared. Accuracy in the data is OLI: 12m circular error and 90%confidence, TIRS: 41m circular error and 90% confidence. The available band lists in Landsat 8 are:

Table I Landsat 8 band specification

BANDS	WAVELENGTH
Band 1(coastal aerosol)	0.43 to 0.44
Band 2 (blue)	0.45 to 0.51
Band 3 (green)	0.53 to 0.59
Band 4(red)	0.64 to 0.67
Band 5(NIR)	0.85 to 0.88
Band 6(SWIR)	1.57 to 1.65
Band 7(SWIR)	2.11 to 2.29
Band 8(PAN)	0.50 to 0.68
Band 9(cirrus)	1.36 to 1.38
Band 10(TIRS)	10.0 to 11.19
Band 11(TIRS)	11.5 to 12.51

METHODOLOGY

The location of Limestone has to be mapped along with the suitable transport network for transporting the materials to the factory. Band ratio can be simply generated by dividing the reflectance value of each pixel in one band by the reflectance value of the same pixel in another band. The flow chart for methodology is shown in figure 2.

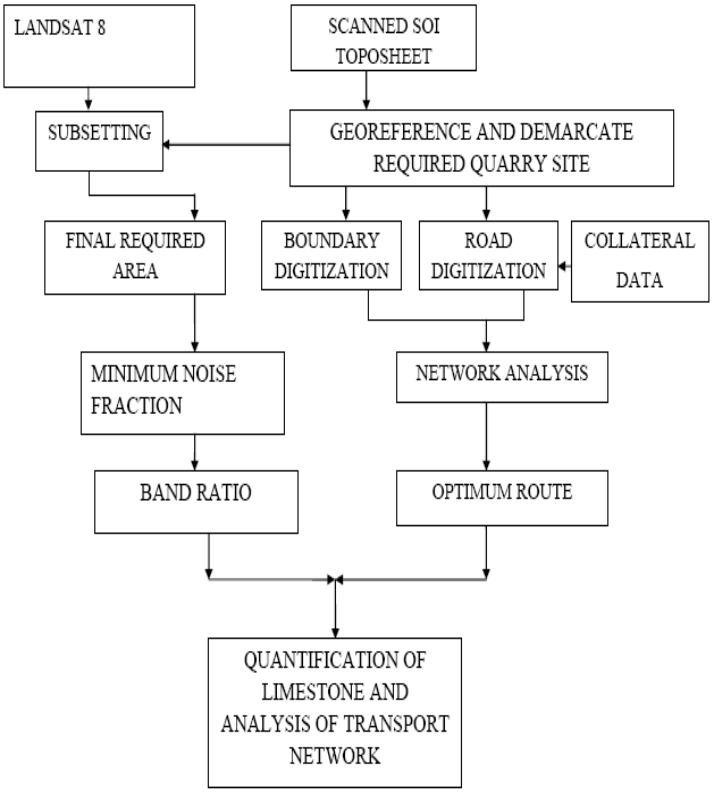

Figure 2 Methodology flowchart

The location of existing mines and the current transport network has been mapped and shown in the figure 3.

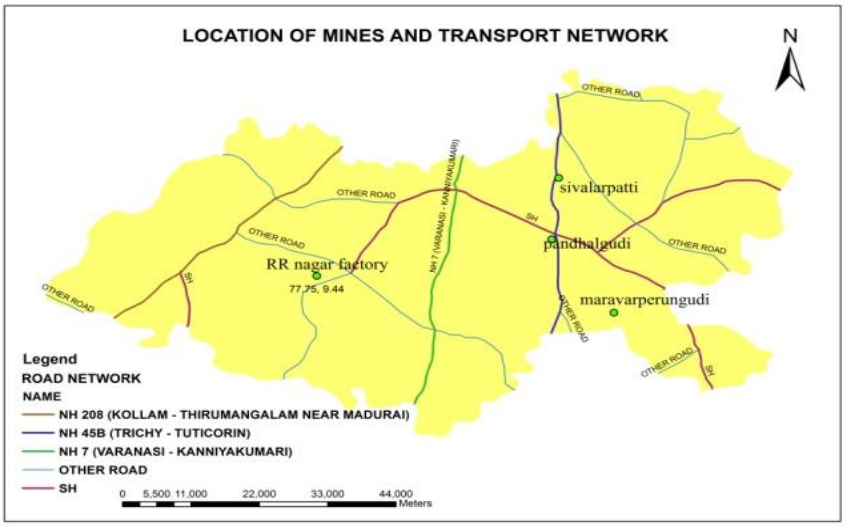

Figure 3 Existing location of mines and transport network

RESULT AND DISCUSSION

BAND RATIO

In the present study, Landsat 8 bands are used to generate the ratio images using ENVI 4.7 software. Visual inspection of the generated band ratio images revealed that 7/6, 7/2 and 5/2 band ratio images are the most informative ratios for rock discrimination at the study area. The information contained in the above three band ratio images are integrated into one false color composite ratio images(7/6:R, 7/2:G and 5/2:B) in the figure 4 the RGB combination for the ratio 7/,7/2,5/2 is shown.

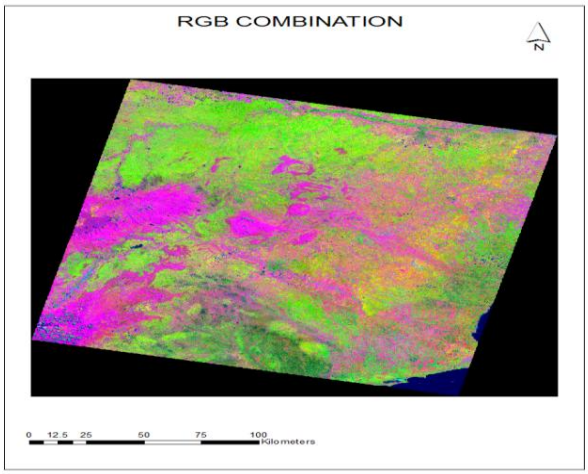

Figure 4 RGB combinaton for the ratio 7/6, 7/2,5/2

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DENSITY SLICE

Density slice to select data ranges and colors for highlighting areas in a gray scale iamge. The density slicing range is shown in the figure 5.

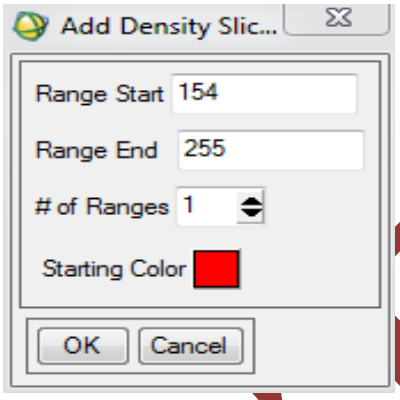

Figure 5 Density slice range

The threshold value 154 reflects the locations of limestone in the study area. The Threshold value is calculated using the mean and standard deviation derived from the statistics calculation and it has been shown in figure 5. The histogram generation shows the statistics data. The occurance of limestone in the study area is shown in the figure 6.

The formula used in calculating the threshold value is :

TH=M+2*SD

TH= Threshold value

M = Mean

SD = Standard deviation

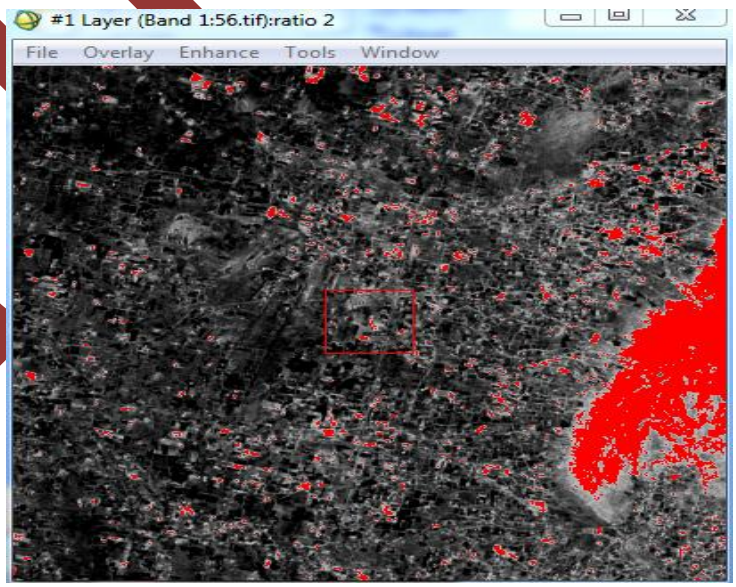

Figure 6 Occurrence of Limestone in the study area

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RASTER TO VECTOR CONVERSION

The obtained image is in rater format. In order to calculate the area and volume raster format has to be converted to vector format so that it gives the area in polygon feature. As a next step vector topology is created for the vector file.

MODEL BULIDER

The created vector file is processed in Arc GIS10.1 version by running a model. The tool used in the model contains Clip (Data management and Analysis). By running this model it clips the study area with the location of limestone and it is shown in the figure 7.

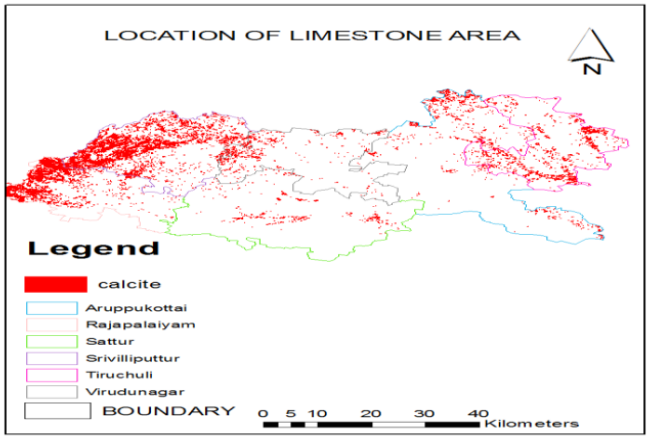

Figure 7 Location of limestone in Virudhunagar District

NETWORK ANALYSIS

It is a type of line analysis which involves set of interconnected lines. Railways, highways, transportation routes, rivers etc are examples of networks.

OPTIMAL ROUTING

Optimal routing is the process of finding out the best route to go from one location to another location. Since high grade limestone is present in Rajapalayam Taluk the route has been suggested from the site (Rajapalayam) to factory. The optimal route for transporting the materials is shown in the figure 8.

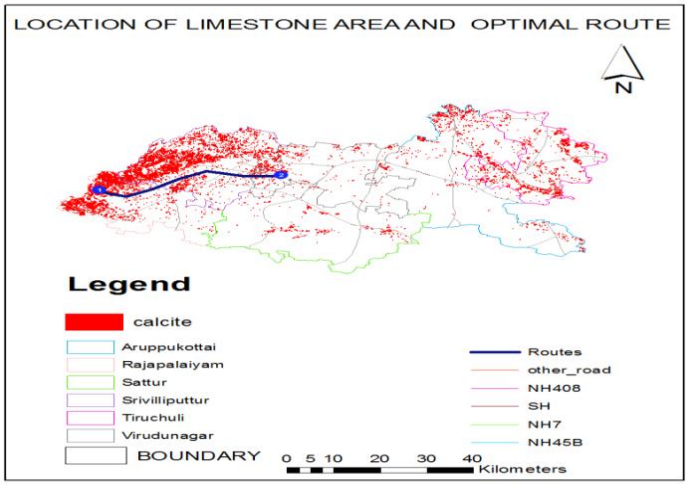

Figure 8 Optimal route for transporting materials

CONCLUSION

It has been proved feasible that mineral detection can be done using satellite imagery. Short wave infrared (SWIR) band is the effective band for the mineral detection. Limestone identification has been done for Ramco Cement using Band Ratio technique. The optimal route also has been provided for the transportation from the site to the factory using GIS techniques.

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