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SPECTRAL REFLECTANCE OF GEOTHERMAL AREA SURFACE AS FUNCTION OF ELECTROMAGNETIC WAVELENGTH WITH LANDSAT THEMATIC MAPPER

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ABSTRACT

Research in the field of geothermal energy that utilize remote sensing techniques specifically examine how the spectral characteristics of each parameter surface geothermal area, and determine the appropriate wavelength sensing to identify potential geothermal areas, is still lacking. This study aims to determine the spectral reflectance surface geothermal area as a function of electromagnetic wavelengths, using Landsat Thematic Mapper reflective channel.

For this purpose, this study used a single channel digital analysis method Landsat TM remote sensing for the acquisition of surface reflectance values geothermal area.
The test results indicate that not all single-channel Landsat TM can distinguish regional and local manifestations are not manifest. Thus, the area's geothermal potential is characterized by the of manifestations at the surface, and a generally closed vegetation, can be identified based on sensing the wavelength of green and near infrared.

Keywords: reflection, manifestation, geothermal

INTRODUCTION

Several researches in geothermal field that has been done in Indonesia, generally used geoscientific method which is a collaboration of geology, geochemistry, and geophysics. Remote sensing only used for mapping and geothermal geological structure appearance. Geothermal research in remote sensing that examine the spectral characteristic of every geothermal potential surface area parameter, and determine the wavelength sensing that match to be used in getting information about geothermal resource potential location, is very rare. Remote sensing system usually worked in wave's reflection length, therefore the characteristic of object reflection is very important to be examined.

BASIC THEORY AND METHODOLOGY

The amount of reflected energy is equal to the energy that affected by an object minus the energy that spared and transmitted by the object itself. Based on the relationship of energy balance, the reflected energy refers to equation number (1). However, the percentages of spectral object reflection refers to equation number (2).

$$E_R(\lambda) = E_I(\lambda) - E_A(\lambda) - E_T(\lambda) \qquad (1)$$

$$R(\lambda) = \frac{E_R(\lambda)}{E_I(\lambda)} x100\% \qquad (2)$$

The spectral reflection of an object in every remote sensing's electromagnetic sensor, can be represented by the spectral reflection curve as a function of wavelength. Configuration of reflection curve gives information about the characteristic of geothermal surface area spectral, which can gives recommendation of choosing spectral channel to inventoried geothermal potential. Landsat TM image used is shown in Figure 1, the Landsat TM wavelength channels are shown in Table 1, and research diagram showed in Figure 2.

hypothesis*:*
In every electromagnetic wavelength channel of Landsat Thematic Mapper, obtained reflectance difference between vegetation in manifestation area and non-manifestation area geothermal.

Table 1: EM channels of Landsat TM

Channel		spectral resolution (µm)	spatial resolution (µm)
1	Blue	0,45 – 0,52	30
2	Green	0,52 - 0,60	30
3	Red	0,63 – 0,69	30
4	NIR	0,76 – 0,90	30
5	MIR	1,55 – 1,75	30
6	TIR	10,4 – 12,5	120

7	MIR	2,08 – 2,35	30

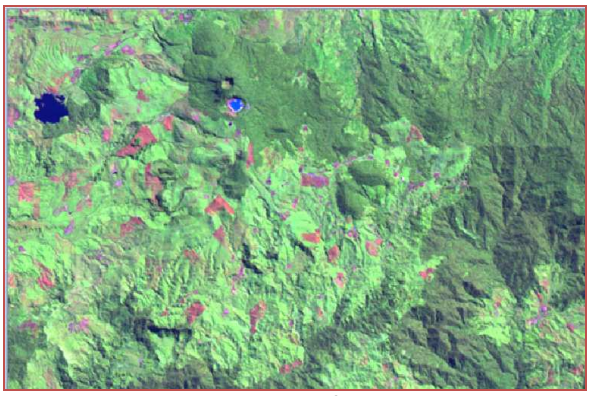

Figure 1: Composite image of the geothermal area X

RESULT AND DISCUSSION

The verification of differences of vegetation reflectance in manifestation and non-manifestation area of geothermal, shows different spectral opinion for some electromagnetic wavelength (Figure 3). The reflection of remote sensing green wavelength (channel 2) and infrared near (channel 4) shows that vegetation in manifestation area and non-manifestation area had a significant different reflection. However the blue wavelength (channel 1) and red (channel 3) shows no different in vegetation reflection between manifestation and non-manifestation geothermal area. Electromagnetic energy will interact with every appearance on earth surface with three main interaction possibilities, which are the part of energy that affected by reflected, spared, or transmitted object. Certain objects that spared more electromagnetic energy affected to it, will reflects a bit, on the other way, object that spared less will reflects more therefore it influence the brightness level of the object. The green wavelength (0,52 – 0,60 µm) and the reflection of infrared (0,76 – 0,90 µm) are the two wavelength that have a very contrast reflection to water object and vegetation. Green wavelength not spared by water however infrared wavelength spared by water. Therefore the water reflection in green channel is very high and decrease in near infrared channel. However vegetation spared many of green wavelength (near visible) and spared little infrared wavelength. Different with characteristic of water spectral. Vegetation has low reflection on green wavelength and increase on near infrared wavelength. Research area dominated by forest vegetation and garden, therefore will give high reflection to near infrared wavelength. However geothermal manifestation on the surface of research area dominated by manifestation crater and fumaroles which obtain many waters. Therefore will have high reflection on green and near visible spectrum. The Contrast between vegetation spectral and this water which possible brings reflection differences of

vegetation of manifestation and non-manifestation geothermal area.

CONCLUSION

Geothermal potential area that signed by appearance of manifestation surface, and generally closed off vegetation, can be identify based on remote sensing with green and near infrared wavelength. Vegetation reflection in non-manifestation are more higher than manifestation area.

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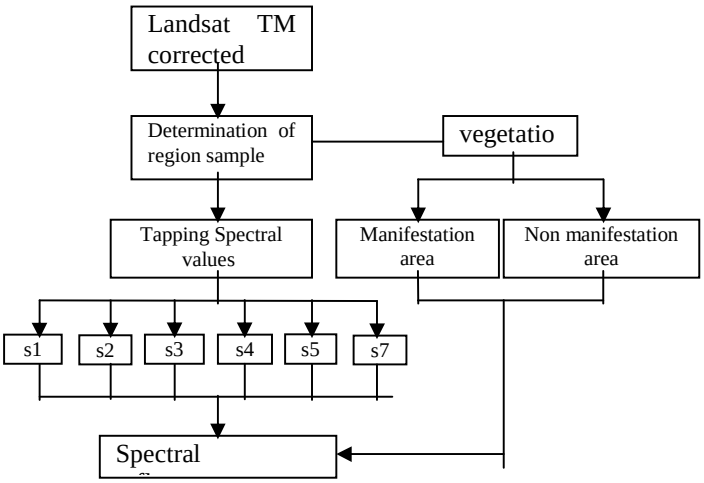

Figure 2: Flowchart of the study

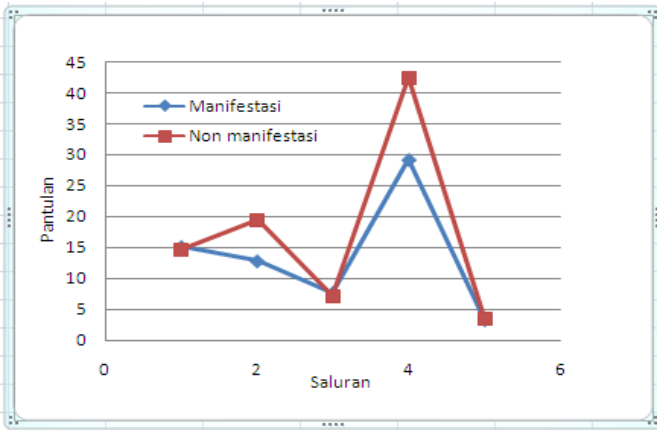

Figure 3: Vegetation reflectance curve in the manifestation and non-manifestation area