Remote Sensing Analysis, Using Landsat 7ETM+ and 8 OLI for Supporting Energy Conservation Policy Based Vegetation in DIY

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Abstract. Energy conservation policy is one of the fundamental bases to take into account in the attempt of natural resources preservation nowadays. It is primarily underpinned by excessive resource exploration and uncontrolled development leading to disturbance of natural balance. In order to support the regulation of natural resource utilization there are various approaches to take into account, one of which is by using spatial approach. Thus, the purpose of this study is to conduct an analysis using remote sensing methods to support a vegetation-based energy conservation policy in the Special Region of Yogyakarta (DIY). On the basis of the research, it is noteworthy that the most rapidly increasing rate of energy utilization is by the general public and business actors. This is as clearly proven by an increase in the number of transportation modes of 2119575 vehicles, an increase of 6.03% in 2017. Projected increase in the amount of fuel utilization Oil for industrial sector activities amounted to 455975425 liters or 95.26%. The size of Green Open Space (RTH) land in recent years has not changed significantly. By using forecasting method, the projection of Green Open Space (RTH) is estimated to be 1,090.377 Ha increasing by 12.8% in 2017. Furthermore, remote sensing analysis using Landsat 7 ETM+ and 8 OLI data indicates that land use in Yogyakarta also undergoes significant changes.

1. Introduction

Energy is a viably vital input for economic development, and that its development has always been quite an essential issue for energy optimization and management [1]. Excessive use of energy may lead to environmental damage which disrupts natural balance. The largest consumption of energy utilization is by industrial sectors, both huge scale industry and home industries [2,3] to the mine goods processing industry [4,5,6]. The energy consumed by households for space heating and cooling, water heating, cooking and running appliances is a major component of national final energy use [7]. In addition, other industries such as paper industry [8] cement industry [9] and chemical industry [10] also consume considerable amount of energy.

In the attempt of achieving more efficient and effective energy utilization, it is vital to implement energy conservation. Current energy conservation is widely applied in various industries [11,12,13,14,15]. Energy conservation measures are important means of reducing operating costs and greenhouse emissions [16]. To support the regulation for more effective and efficient natural resource utilization through the conservation of vegetation-based energy there are various approaches, one of
which is spatial approach. It is viable to implement spatial approach by utilizing spatial data in the form of satellite image data which is feasible for analyzing land cover conditions [17,18,19] and land use of an area [20,21,22]. An example of this would be analyzing land use and land cover using satellite imagery as is illustrated in Figure 1.

![Figure 1](image_url)  
**Figure 1.** Land use of land cover map of (a) 1991; (b) 2010 in English Bazaar Urban Center (23)

Some notable variables for energy conservation efforts in a region is the variable of land use or land cover. Using remote sensing method based on spatial, it is possible to analyze land cover to get an overview of the vegetation area temporally. This research is conducted by using remote sensing method to know the extent of urban land use, to support vegetation based energy conservation policy in Yogyakarta Special Region (DIY).

2. Experimental Details

2.1. Regional Study

Yogyakarta Special Region (DIY) is an area that has diverse topography. The type of topography in each region affects the previously projected Regional Spatial Plan. DIY is administratively divided into 4 districts (Sleman Regency, Gunungkidul Regency, Bantul Regency and Kulonprogo Regency) and 1 City (Yogyakarta City). Sleman Regency has a hilly topography as it is located on the valley of Mount Merapi. Gunungkidul Regency located in the southeast of Yogyakarta has a hilly topography that is part of the Sewu Mountains. Bantul Regency is located in the southern part of DIY adjacent to the Indian Ocean. Topography of Bantul Regency is mostly low land area with some points of hilly terrains adjacent to Gunungkidul Regency. Kulonprogo Regency has a pretty diverse topography. In the north part lies a row of Menoreh mountains, in the middle part there is a hilly terrain, and the southern part is constituted of a lowland directly adjacent to the Indian Ocean. Meanwhile, the city of Yogyakarta has a flat topography, located south of Sleman regency.
Based on those widely varied topographic conditions, there should be distinct spatial plan (RT RW) for each district. However, it is possible to classify the overall pattern of existing spatial areas in each district and city in DIY into two classifications, namely the protected and cultivation areas. The pattern of land use in DIY constantly changes from time to time. One of the most rapid land use changes is the use of land for settlements and housing.

2.2. Analysis and Method

This study applies secondary data in the form of satellite image data and energy utilization data in DIY. Satellite images used are Landsat 7 ETM + year 2002 and Landsat 8 OLI coverage year 2017. The overall simple steps of the study are as illustrated in the following flow chart (Figure 3).

![Flowchart](image)

**Figure 3. Flowchart**

Source: analysis, 2017
3. Results and Discussion

3.1. Projection of Energy Utilization in DIY

It is negligible that the energy use in DIY is constantly on the rise year by year. Thus, it is vital to take into account some benchmarking variables which may cover an increasing user of transportation mode, increasing fuel consumption for the industrial sector and the change of land use either of Green Open Space (RTH) or urban land. The projected increase in these three variables is as depicted in Figure 4.

![Figure 4](image)

Figure 4. Graph of energy utilization projection. (a) projected increase in transportation mode (b) projected increase in fuel for industrial sector (c) change of green open space.

Source: Analysis, 2017

The number of vehicles in DIY (Figure a) was always on the rise throughout the period of 2011 to 2015. The increasing percentage in motorcycle users from 2011 to 2015 amounted to 6.03% (Figure a). Although the consumption of Fuel (BBM) for industrial sector in DIY (Figure b) underwent a decrease in 2013, it experienced a considerable leap to 95.26% in 2015. Changes in the area of green open space (Figure c) increased in width from 2013 to 2014. Meanwhile, headground presentations were only 1.28% until 2017.

Of the three variables in general it can be concluded that the energy consumption of fuel in particular has a tendency to rise. The most significant increase occurred in the utilization of fuel energy for consumption of the industrial sector. This is in line with the real conditions, an awful lot of industries such as hospitality and culinary appeared on DIY. The addition of wide open green space also needs to be done to reduce the high emissions which may cause air pollution.

| NO | Energy Consumption        | Amount/ area         |
|----|---------------------------|----------------------|
|    |                           | 2016                 |
|    |                           | 2017                 |
| 1  | Fueled mode of transportation | 2066696 unit        |
|    |                           | 2119575 unit         |
| 2  | Industry                  | 344411105,7 lt      |
|    |                           | 455975425 lt         |
| 3  | Open Green Space          | 1083,132 Ha          |
|    |                           | 1090,377 Ha          |

Source: Analysis, 2017

The projection of energy consumption until 2017 can be observed in Table 1. It is projected that the energy consumption in DIY increases year by year. In 2017, it is estimated that the increase of motorcycle users is 2119575 units, followed by the use of Fuel Petroleum (BBM) for industrial industry sector in DIY which is expected to reach 455975425 liter and the area of green open space (RTH) of about 1090,377 Ha.
3.2. Satellite Imagery Utilization to Support Energy Conservation Policy in DIY

The energy conservation policy in DIY is one of the positive measurements to take in order to keep the balance and maintain the sustainability of natural resources. Satellite imagery may be used to identify the growing urban land use in DIY (Figure 5).

Using Landsat 7 ETM+, then done process digitation on screen. Landsat 7 ETM+, consists of 8 bands and has a spatial resolution 30M. With sharpening image, it can obtain images with a resolution of 15m. The composite image process is done using band number 7, 5 and 3. band number 7 and number 5 has similar information, that is about humidity and color difference between open ground with other objects. While band number 3, has information about the difference between vegetation and non-vegetation, so it can be used to analyze the urban areas.

![Figure 5.](image)

**Figure 5.** (a) Urban land use in DIY from Landsat 7 ETM+ coverage in 2002
(b) Landsat 8 OLI coverage in 2017

Landsat 8 OLI is the development of Landsat 7 ETM+. Landsat 8 OLI has a spatial resolution of 30M. But if done image sharpening then get spatial resolution 15M. Landsat 8 OLI consists of 9 Bands as well as Thermal Sensor InfraRed Sensors (TIRS) consisting of 2 bands. Bands used in this analysis are band number 7, 6 and 4.

Land use change look significant at the center of Yogyakarta city. Based on the results of the interpretation of the data using satellite imagery, land use change from 2002 until 2017 is 1201 Ha.

4. Conclusion

Remote Sensing are feasible analytical methods to support energy conservation efforts. Remote sensing data such as Landsat 7 ETM+ and Landsat 8 OLI is pivotal for an analysis of land use change, especially for urban areas. On the basis of the analysis, it is essential to take heed on the attempt towards energy conservation in DIY, especially for border and periphery areas, and bordering areas in between the urban districts where land use change is more significant.

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