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Forest Change Detection at Recreational Sites in Conservation Area

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1. Introduction

The Protected Natural Area / Conservation Area (CA) could generates local economy through ecotourism development. Nature-based tourism can provide both economic opportunity and protection of nature/forest resources. Indonesia government planning to robust ecotourism development on Conservation Area (CA) sites as tourist destination. CA will be set to attract and facilitate approximately 20 million (domestic) and 1.5 million (international) arrivals until 2019. (Indonesia Ministry of environment and forestry, 2015). The increased popularity in ecotourism sector will have positive impacts also its drawbacks with variety of factors that influence in scale and intensity. In the end, further exploitation of existing zones potentially delivers more pressure for some on the already over-stressed regions. To set the balance is what important in sustainability principle to develop our future tourism.

Geographical Information System (GIS) could assist Managers as a decision support system in planning process to protect the forest and its ecosystem also develop tourism in a sustainable planned way. The outputs will bring better understanding on the impacts of natural phenomena and human activities of the area. Furthermore, the detection of changes using remote sensing will give an advancement in planning process to monitor changes in long-terms periods required for monitoring and controlling changes in such conservation areas. This research corresponds on temporal basis to monitor transformational condition of forest coverage due to tourism activity in CA.

2. Methods

2.1. Procedure and method

The research study area image extraction is at Conservation Area which situated in West of Java Province, Indonesia. Those areas were chosen, considering those spots are tourist destination that reachable from the urban area and some sites already attract tourist for over 2 decades.

For change detection, we will need spatial imagery data collection from Landsat satellite (TM 5, OLI 8), which were acquired online from earth explorer website (https://earthexplorer.usgs.gov) which provide the raw material of multi-temporal satellite image of 2005, 2009, 2013 and 2017. as the main data source. Landsat data is spatially explicit and can be generated for quantifying gross forest loss and gain also providing multi-time loss / gain information.

2.2. Analysis

For the remotely sensed satellite data gathered, prior step before carrying out analysis was data preparation / pre-processing that is necessary for detailed posterior analysis. It involves geometric correction, atmospheric correction, cloud and shadow detection and removal. The Landsat Thematic Mapper (TM) and OLI's sensors needs to be convert first to Top of Atmosphere (ToA) Reflectance. Atmospheric correction was conducted for seeing vegetation change over time.

To evaluate the extent and the rate of change, multi-temporal spatial analysis and spectral bands and indexes (Normalized difference vegetation index / NDVI) method which use uses the NIR and red channels, will be carried out to perform change detection analysis using remote sensing satellite imagery. The Landsat satellite sensor images will be analyze using pre-classification change detection method: Two maps are generated for understanding the changes in indexes (NDVI = NIR -Red) / (NIR + Red)) for two different time points. After that we compared the output to detect changes in forest coverage, which are the area of forest land and non-forest land (Differenced NDVI). After obtaining multi-temporal images, next process is to combine them into a single data file then process the file to estimate change and no change categories directly to further calculate the area of each category of change (or "activity data") within the subset area.

The number of visitors cause recreational pressure as an artificial pressure that are not environment caused. Whether if tourism contribute to alteration in those location is also examined by comparing the forest cover change and the tourism activity (volumes of visitors) on each site, and then calculate it. To find out the causal effect of one variable upon another variable regression analysis was conducted with forest coverage changes magnitude as its response variables and tourist number as the predictor variable.

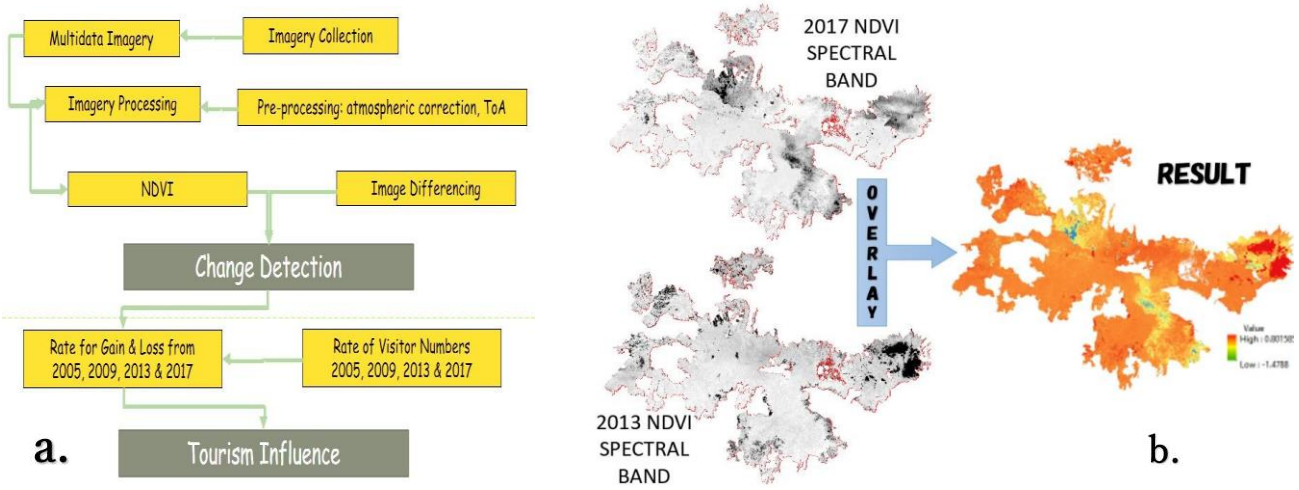

Fig. 1 Multi-temporal satellite imagery analysis for monitoring forest coverage changes and tourism impact
a. Work flow of the Analysis; b. Current result of DNDVI between 2017 and 2013 NDVI spectral channel.

3. Result and Benefit

The final goal is of this research is to understand the influence of tourism activities over the recreational park area. The current process is still in the middle way to reach it. We manage to conduct spatial image analysis to obtain the NDVI spectral band and then overlaid it and found there are some alteration on the forest coverage. Though, in the process cloud cover becoming major gaps due to some technical limitation which occur when calculating the rate of changes. Removing the cloud would be another challenge to obtain more reliable output.

Satellite remote sensing approaches contribute essential role in providing effective alternative when obtaining more information. It gives solution in managing Conservation Areas and other forest ecosystem that are complex. Park Supervisors can obtain more spatial information on vegetation changes within each its territory including their recreational site for developing tourism along with maintaining the forest and nature. The tools are useful for authorities when planning how resources should be utilized also for monitoring and evaluating purposes including on those destinations with high tourism volume of visitors and activities. Those location needs more efficient planning so the nature still has a chance to recover itself from the pressure that arise.

Key Conservation Area, forest cover change, GIS, NDVI, tourism effect