Testing the Performance of Spatial Interpolation Techniques for Mapping Tropical Forest Attributes in Berau District, East Kalimantan, Indonesia

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Abstract : Obtaining continuous information on forest attributes such as stem volume is one of the fundamental aspects in managing forest production in Indonesia. Currently, most reliable technique that still widely used to represent forest attributes is by establishing sample plot in the field. By measuring DBH and tree height, stem volume of trees can be obtained in plot basis. In order to produce continuous information of stem volume over certain area, several methods are available. Two most common methods are (1) integrating plot data with remote sensing data and (2) spatial interpolation. Both methods have benefits and weaknesses. Remote sensing data in tropics is frequently lack by cloud existence. On the other hands, correlating remote sensing data and plot data as prerequisite to generate continuous maps were sometimes not successful. Most remote sensing studies in predicting forest attributes were successful in conifer forest or monoculture forest instead of tropical dense forest. The spatial interpolation method is another well-known technique to predict un-known location attributes where sampling does not exists by incorporating surrounding known or sampled location. However, spatial interpolation need several factors to be fulfill before prediction generate best result such as data normality and auto-correlation.

In case of Indonesia forest production management, a new forest inventory design was implemented in 2007 to estimate actual stand volume in forest concession scale. A systematic sampling design was adopted so that variation of forest structure and landscape could be well represented. In this study, we tested performance of 2 spatial interpolation methods i.e. inverse distance weighted (IDW) and kriging to generate continuous map of forest stem volume of a-50,000 ha of *PT. Karya Lestari* forest concession in *Berau* district, East Kalimantan province, Indonesia. 530 plots (20 x 125 m in size) were successfully established during 2010 field campaign following systematic sampling design. The average volume per plot is 79.68 m^3 or equal to 445.2 m^3 per ha comprise of all species from 10 cm of DBH. Descriptive statistics exhibited our data was skewed therefore required to be normalized prior to kriging interpolation.

To determine the best spatial interpolation techniques, mean error (ME) and root mean square (RMS) error were evaluated. We used 30% of our data for validation while another 70% used as training data. Our results found that RMS error of kriging interpolation consistently higher than IDW interpolation. We tested the interpolation to different neighbor number involved in the calculation (5, 10, 15, 20, 25 and 30 neighbors). Kriging interpolation has minimum RMS error 42.43 m^3 reached by using 5 neighbors while IDW minimum RMS error is 36.02 m^3

using 30 neighbors. Mean error of IDW interpolation also showed smaller than kriging (-2.167 vs 3.18). This study suggested that IDW interpolation is better than kriging in predicting forest attributes especially stem volume. However, these findings is site specific and different result might be found for other sites (Robinson and Matternicht, 2006).

Keywords : forest inventory, geographical information system, IDW interpolation, kriging interpolation