UNIVERSITI TEKNOLOGI MARA

MODELLING OF ABOVE GROUND BIOMASS (AGB), STAND VOLUME AND CARBON STOCKS OF EUCALYPTUS PLANTATIONS USING WORLDVIEW-2 IMAGERY IN SABAH, MALAYSIA

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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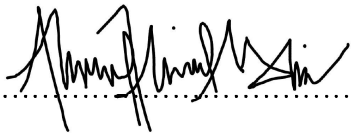
Signature of Student	:	
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ABSTRACT

Eucalyptus is one of forest plantation species established to provide sustainable timber supply to meet market demand for wood-based industries. However, managing an extensive area of forest plantation can be labour intensive and time consuming. Remote sensing provides effective tools to gather stand information for plantation planning, management and sustainable development. The objectives of this study were (i) to determine the relationships between the spectral radiance recorded from WorldView-2 satellite imagery and stand attributes of *Eucalyptus* plantations (ii) to develop predictive models for estimating stand volume, above ground biomass (AGB) and carbon stocks of *Eucalyptus* plantations, and (iii) to demonstrate the application of predictive model developed for AGB in an independent *Eucalyptus* plantation. Field inventory was conducted to provide ground data for *Eucalyptus grandis* and *E. pellita* plantations managed by Sabah Forest Industries (SFI) in four locations namely Sipitang, Mendulong, Basio and Ketanon, Sabah, Malaysia. Randomly selected quadrat plots measuring at 30 m × 30 m were established in a total of 65 sampled stands. They were then split randomly into two independent data sets, with 42 for building the models and the remaining 23 for validating the models. Within each plot, diameter at breast height (DBH in cm), total height (m), crown width (cm) and crown closure (%) were measured. Multiple linear regression procedures were applied to develop predictive models for estimating the stand volume, AGB and carbon stocks of *Eucalyptus*. The spectral bands extracted from WorldView-2 imagery and several published vegetation indices were used as predictor variables in the regression analysis. The "good' candidate models were selected by studying the residual plots and calculating the coefficient of determination (R^2), adjusted coefficient of determination (Adj. R^2), standard error of estimate (SE_E), Mallow's Cp (Cp), Akaike information criterion (AIC) and significance level (α=0.05). The means of DBH, height, crown closure and crown width were positively correlated with Bands 6 – 8 with Pearson's correlation (r) values range from 0.67 to 0.75 ($p \leq 0.05$). However, these stand attributes were negatively correlated with Bands 1 – 5 (r values range from -0.43 – -0.88). From the model building and validation, the "best" selected predictive models were, $\widehat{AGB} = e^{-4.57+792.95\,(rb3)-0.21\,(RDVI)+14.06(WVVI)}$ ($p \leq 0.001$, R^2=0.83), stand volume, $\hat{v} = [-2.16 + 441.60\,(rb3) - 0.11\,(RDVI) - 5.38\,(WVVI)]^2$, ($p \leq 0.001$, R^2=0.85) and stand carbon stocks, $\hat{c} = 10^{-4.86+590.94(rb3)-4.39(MTVI2)+0.01(RDVI)}$ ($p \leq 0.001$, R^2=0.82). The predictive models developed in this study may provide a convenient tool to assist with the planning and management of *Eucalyptus* plantations in fulfilling their roles in providing sustainable wood-based resources and ecosystem function in carbon sequestration.

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