Modeling spatial variation in stand volume of Acacia mangium plantations using geographically weighted regression


Abstract

Stand volume can be estimated from other stand variables by using multiple linear regression (MLR) or other ordinary regression models. MLR, however, only produces global parameter estimates that cannot reveal spatial variations in stand variables. In this study, we used a geographical weighted regression (GWR) method to investigate local spatial variations in the relationship between stand volume, stand age, and basal area of Acacia mangium plantations, and to examine whether a GWR model could provide better prediction accuracy than an MLR model. Stand data and geographical coordinates were obtained from 247 plantation sample plots. We analyzed the data using MLR and GWR methods by formulating a linear model that relates stand volume to stand age and basal area. Performance of the GWR model was compared with the MLR model in terms of their parameter estimates and goodness-of-fit statistics. We found that the GWR model was not only able to reveal local spatial variations in the relationship between stand volume, stand age, and basal area, but it also produced better prediction accuracy than the MLR model. The GWR model reduced AIC by 2%, increased $R^2_{adj}$ up to 3%, and reduced RMSE by 14%, compared with those of the MLR model. The GWR model, therefore, could be useful for modeling spatial variations in stand attributes that cannot be revealed by ordinary regression models.

Keywords: stand volume, spatial variation, geographically weighted regression (GWR)