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Title : MODELLING OF CARBON SEQUESTRATION POTENTIAL IN RUBBER TREE (*Hevea brasiliensis*) SAPLINGS AND PLANTATIONS IN MALAYSIA

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The climate change and global warming occurred due to excessive build-up of greenhouse gases (GHGs) especially CO_2 in the atmosphere. In order to stabilize the GHGs, the forest has to be conserved because the terrestrial ecosystems are vital carbon sink that store large amount of atmospheric CO_2. Rubber plantation is man-made forest and is classified as forest plantation. In the Southeast Asia, increasing demand on natural rubber and rubber wood industry are factors that contribute to the expansion of rubber plantations which is predicted to replace the secondary forests in 2050. Thus, the ecosystem functions of rubber in sequestering carbon have to be studied in order to determine the potential of rubber plantation in mitigating climate change. The objectives of this study were (1) to determine the total of biomass in rubber tree saplings using destructive sampling method and to estimate carbon sequestration potential in rubber plantations using allometric equations, (2) to investigate the trend of diameter (D), height (HT), stomatal conductance (SC), chlorophyll content (CC), photosynthesis rate (PN), transpiration rate (TRPT) and leaf area index (LAI) for rubber saplings and plantations at the age ranges between 45 days to 28 years, (3) to study the relationships between biomass for rubber tree saplings and carbon sequestration for rubber plantations and selected morphological and physiological variables used in this study, (4) to develop biomass predictive model for rubber tree saplings for the range age of 45 to 225 day) based on morphological and physiological variables and, (5) to develop carbon sequestration predictive model for rubber plantations within the age ranges from 1to 28 years based on morphological and physiological variables. Biomass (W) of rubber tree saplings were obtained through oven-dried method while for rubber plantation the W and carbon sequestration (CS) were obtained using published allometric equation. Then, the predictive models were developed based on morphological variables (i.e., D, HT and AG) and physiological variables (i.e., SC, CC, PN, TRPT and LAI) of rubber tree saplings and plantations. Means of biomass of rubber tree saplings at five different growth stages were 0.02, 0.06, 0.11, 0.19 and 0.30 kg/tree, respectively. For rubber plantations, the means of carbon sequestration of 14 different ages were 7.62, 68.42, 52.88, 116.38, 167.72, 184.22, 233.80, 274.09, 453.49, 504.91, 522.07, 588.84, 644.84 and 1239.70 tC/ha, respectively. From Analysis of Variance (ANOVA), the ages of rubber tree saplings were significantly affected all variables, i.e., CS, D, HT, SC, CC, TRPT and LAI ($P \leq 0.05$) except for PN ($P \geq 0.05$). All variables in rubber plantations are significantly affected by ages ($P \leq 0.05$). The highest positive correlations in both saplings and plantations were recorded for CS versus DBH followed by CS versus HT, AG, LAI, CC. However, CS versus PN, SC and TRPT were inversely correlated with CS. From the model building and model validation analysis, the results showed that Model 5 appeared to be the best allometric equation for biomass of rubber tree saplings, i.e., $\log_{10} w = 0.184 + 0.050 \log_{10} D + 0.734 \log_{10} HT + 0.003 \log_{10} AG$ (R^2=0.96; P= 0.0001) whereas Model 3 was the best performing model, $\ln Y = -1.108 + 1.494 \ln DBH + 0.813 \ln HT$, ($R^2$=0.99; P=0.0001) among seven selections candidate models for rubber plantation. The predictive models developed provide a convenient and useful tool and may assist in the development of policy recommendations, strategies and management plan to address the climate change agenda.