Assessment of Aboveground Biomass and Temperature in the Tropical Rainforest of Malaysia

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Abstract*: The relation between tropical rainforest to the climate variability is very important. This research aims to determine the relationship between aboveground biomass which prefer tree in the tropical rainforest and surrounding temperature. Diameter at breast height (DBH) of ten tree species and surrounding temperature collected data were taken to measure the correlation between the two variables by using statistical test. Furthermore, forest biomass estimation is also important towards the assessment of the productivity, structure and forest condition. The analysis in this research shows that simple linear regression model can be used to predict the future value of DBH for each species. The findings may help the reduction of greenhouse gas emissions with proper conservation and sustainable management.

***Keywords* : Correlation Analysis, Diameter at Breast Height (DBH), Linear Regression, Rainforest, Temperature.**

I. INTRODUCTION

United Nation Framework Convention on Climate Change (UNFCCC) has listed Malaysia, a developing country with tropical rainforest, to become the focus in implementing the Reducing Emission from Deforestation and Forest Degradation (REDD) [1]. REDD is constructed under the UNFCCC through Intergovernmental Panel on Climate Change (IPCC) which mainly aim at mitigating the climate change. Climate change and forest are highly correlated, as forest is an area covers with large number of trees especially the tropical rainforest as one ha plot of tropical rainforest contain up to 300 tree species [2].

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Biomass can be defined as the quantification of the forest structure and function that include both, the live and dead components [3]. Throughout this paper, the term biomass is used to refer to the biomass of a tree. Tree biomass is very important in understanding the potential future changes of the climate system [4] as the biomass and carbon storage in forest ecosystems play significant role in the global carbon cycle [5].

There has been growing interest in the study of biomass and carbon stock of a forest. Many methods have been used to estimate the forest biomass such as regression analysis [6], multivariate relevance vector regression [7], geographically weighted regression and machine learning with Sentinel imagery [8]. However, tropical forest responses to global climate variability and change are poorly understood [9]. Climatic variation in temperature, precipitation and carbon dioxide does contribute in stem growth and been unravel the climate effects by tree growth model (IBTREE) [10]. Therefore, this research aims to determine the relationship between biomass and the surrounding temperature in the rainforest by using correlation analysis and simple linear regression.

II. MATERIAL AND METHOD

The data used in this study was obtained from Forest Research Institute Malaysia (FRIM) for five years. The location of the tropical rainforest is at Lesong, Pahang, Malaysia as in Fig. 1. It consists of 10 species of tree, which are Meranti, Damar Hitam, Nyatoh, Bintagor, Penarahan, Medang, Rengas, Kelat, Kekatong, and Perah. The purpose of this study is to determine the growth trend for each species, followed by measuring the correlation between two variables from the collected data that are diameter at breast height (DBH) of the tree and surrounding temperature in the rainforest. Statistical test was used to measure the correlation between the two variables where the independent variable is set to be the surrounding temperature in the rainforest and the dependent variable is the DBH of each species.

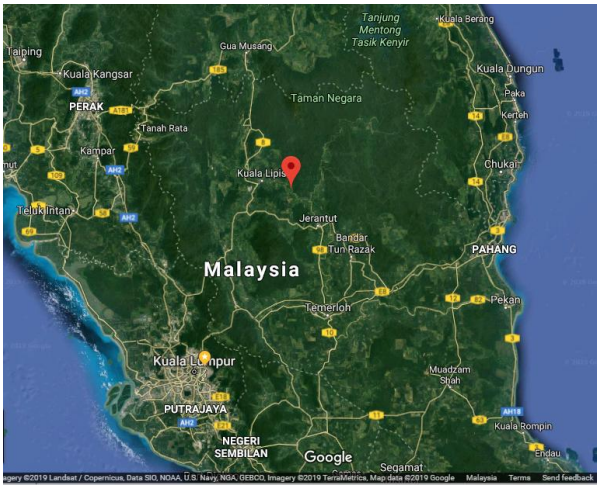

Fig. 1. The location of study area. The map image is from Google Maps.

III. RESULT AND DISCUSSION

A. Growth Trend

Fig. 2 below shows the growth trend for each species for five years. The trend is based on the value of DBH for each species measuring in centimeter (cm).

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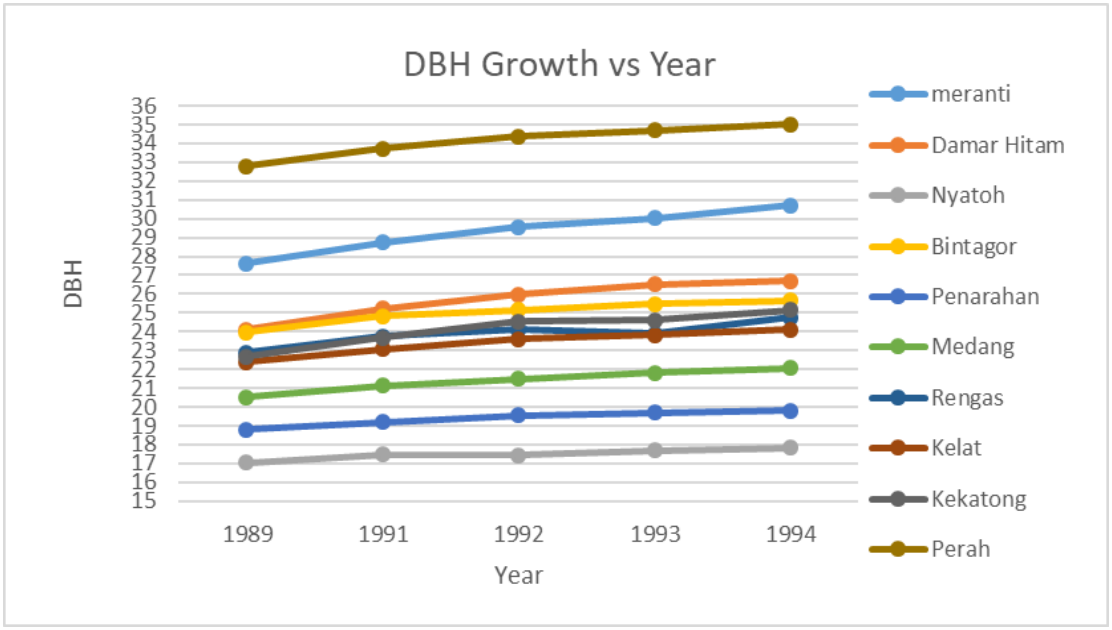

Fig. 2. Growth trend for ten species for five years

Based on the result in Fig. 2, the growth for each tree is increasing by year. The growth trend of Meranti and Perah species shows a rapid growth for the first three years while others increased in small range. Based on the growth trend, we can assume that there is an influence factors that affecting the growth of each tree. Hence, we choose the surrounding temperature as the influence factor influencing the growth of each species in this study.

B. Correlation Analysis

Table I shows the result for correlation analysis for each species where the correlation between independent variable and the dependent variable were investigated. The strength was measured using Pearson's correlation coefficient and supported by the result of p-value.

Table- I: Pearson Correlation Coefficient strength

Species	Pearson's Correlation, *r*	P-value
Meranti	0.964	0.008
Damar Hitam	0.928	0.023
Nyatoh	0.980	0.003
Bintagor	0.951	0.013
Penarahan	0.921	0.026
Medang	0.963	0.009
Rengas	0.952	0.012
Kelat	0.940	0.017
Kekatong	0.935	0.020
Perah	0.945	0.015

The p-value obtained from the result in Table I is basically testing the null hypothesis that there is no correlation between two variables, where a low p-value (< 0.05) shows that the null hypothesis can be rejected. Meaning that if the p-value is low, we can conclude that there is a correlation between two variables. From the result shows

in Table I, the DBH for all species are correlated with the surrounding temperature in the rainforest since each species shows a low p-value that is less than 0.05.

Pearson's Correlation, r is used to check the strength of correlation between the DBH for each species and the surrounding temperature in the rainforest. If the value is more than 0.9, it shows a strong positive linear correlation between the independent and dependent variable. From the result in Table I, the DBH for all the species has a strong positive linear correlation with the surrounding temperature since the value is more than 0.9.

C. Modelling using Simple Linear Regression

Simple linear regression is a method that are widely used in modelling a relationship between two variables. In this study, the independent variable is set to be the surrounding temperature in the rainforest while the dependent variable is the DBH of each species. In order to obtain the best fitted model, the value of coefficient of determination r^2 is measured where the range will be between 0 to 100%. Each percentage indicates that the variation in the dependent variable are explained by the relationship with the independent variable. Table II below shows the result of the modelling using simple linear regression for each species of trees.

Table- II: Coefficient of Simple Linear Regression and Coefficient of Determination

DBH of Species	Constant, A	Surrounding Temperature, B	Coefficient of Determination, r^2
Meranti	-260.5	9.80	92.94
Damar Hitam	-219.4	8.29	86.19
Nyatoh	-55.83	2.479	96.04
Bintagor	-134.9	5.41	90.49
Penarahan	-77.3	3.268	84.91
Medang	-124.7	4.940	92.67
Rengas	-136.3	5.42	90.72
Kelat	-136.7	5.41	88.36
Kekatong	-203.9	7.71	87.47
Perah	-176.0	7.10	89.35

As shown in Table II, the modelling for each species are obtained and the value of B (which represent the slope) for all species shows a positive value. It means that when the surrounding temperature increase by one unit, the value of DBH of the tree will also increase. For instance, every one-unit increase in surrounding temperature, will increase the DBH of Meranti by 9.80 cm. For the value of Coefficient of Determination , r^2, all values are more than 80%. It means that the variation in the DBH of each species is more than 80% explained by the relationship with surrounding temperature. This value also shows that the simple linear regression model is best fitted hence it can be used to predict the future value of DBH for each species.

IV. CONCLUSION

Surrounding temperature is one of variable that been study in this paper as influencing factor that relate to the tree growth trend variable. The two variables are strongly related as the p-value is less than 0.05 for all 10 species been studied. It is also being supported by simple linear regression modelling. These results suggest that subtle differences in temperature among forests have important implications for the climate sensitivity of the tree growth in this tropical rainforests. It is hope that this study can contribute in mitigating the climate change and managing forest. Furthermore, with proper conservation and sustainable management, it also may help the reduction of greenhouse gas emissions.

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