Allometric Equation of local Bamboo for Estimating Carbon Sequestration of Bamboo Riparian Forest

Cahyo Prayogo [(1)], Cendekia Muthahar [(2)], Rizky Maulana Ishaq [(3)]

[(1)] Soil Science Department, Faculty of Agriculture, University of Brawijaya, Jl.Veteran No.1, Malang

[(2,3)] Graduate Student-Faculty of Agriculture, University of Brawijaya, Jl. Veteran No.1, Malang

corresponding author : c.prayogo@ub.ac.id

Introduction

The cause of global warming is the increasing of carbon concentration arising from the activities of industry, burning of fossil fuels, and land use change Bamboo is one of the most productive and very fast growing plants which has the potential as a carbon sink that can be considered. only a limited number of study which are interested on developing a specific allometric equation of local Bamboo species. The development of allometric equation is important to correct and instrument for carbon accounting method and at present there is lack of allometric equation for specific geographic location and position

Methods

The research was conducted in Bambang Village, Wajak District, Malang Regency, which is included in the Bangsri sub-watershed coverage. The area of study is positioned at 8° 8'14.42"S, 112°47'8.85"E, which located at 525 above sea level. The average of mean temperature is about 32ºC.This research method was carried out using a Randomized Block Design (RCBD) consisting of 4 different types of local bamboo (1.Apus bamboo *(Gigantochloa apus)*, 2.Javanese bamboo, 3.Petung bamboo (*Dendrocalamus asper)* and Rampal bamboo *(Schizostachyum zollingeri)* (Figure 1). This study were used local bamboo plot which were carried out in 3 replications, resulted in 12 experimental plots. Variable for measuring bamboo biomass was presented in Table 1. The determination of allometric equation for local bamboo were carried out using destructive sampling method (Figure 2). The descriptive statictical analysis were employed to determine the effect of different local bamboo plot of bamboo density and dominance. The exponential regression were used to derive relationship between bamboo height and or DBH (diameter at breast height) and bamboo stem dryweight. Estimation of total carbon sequestration were involving C pools in soil, bamboo biomass, nekromas, litter and understory.

Table 1. Variables for measuring bamboo biomass

A. Non-destructive method	**Bamboo diameter in DBH (diameter at breast height) or diameter at breast height measured at a height of 1.3 meters from the ground in centimeters (cm).**
B.Destructive method	The circumference of the bamboo stem in centimeters (cm)
	The length of the bamboo stem is in meters (m).
	The weight of the bamboo stem is in kilograms (kg).
	The weight of the bamboo stem sample is in grams (g).
	Dry weight of bamboo stem samples in grams (g).
	The wall thickness of the bamboo stem samples is in centimeters (cm).
	The volume of the bamboo stem sample is in cubic centimeters (cm3).

Figure 1. Types of local bamboo identified on research site

Figure 2. Destructive sampling method for determining local bamboo allometric equation

Result

The total number of local bamboo being identified were 1929 in total, which has different percentage of dominance in each sampling plot (Tabel 2). There was a significant differences on bamboo height ($P<0.05$) but not on bamboo diameter (Table 3)

Table 2. The differences on bamboo population and their dominance

Plot	Total number of population	% dominance
1. Apus bamboo *(Gigantochloa apus)*	185	86.5%
	173	100%
	216	64.8%
2.Javanese bamboo *(Gigantochloa atter)*	128	100%
	100	100%
	178	78.1 %
3.Rampal bamboo *(Schizostachyum zollingeri)*	208	100%
	167	65.2%
	132	70.4%
4.Petung bamboo *(Dendrocalamus asper)*	113	83.1%
	138	76.1%
	191	75.9%
TOTAL NUMBER OF BAMBOO	1929	

Table 3. The differences on bamboo height and their diameter

Type	Average	
	H(m)	DBH (cm)
Apus	12.2 a	6.24 a
Petung	19.9 c	9.52 b
Ampel	10.1 a	6.53 a
Rampal	13.1 ab	5.51 a
Javanese	12.4 a	6.56 a
Jabal	14.5 b	6.66 a

The relationship between bamboo diameter and stem dryweight following allometric equation Y = 0.6396 X $^{1.6162}$, which stronger than those relationship between height and bamboo stem dry weight following equation Y = 0.3128 X $^{1.4492}$ (Figure 3) and the total local bamboo carbon sequestration were in Tabel 4.

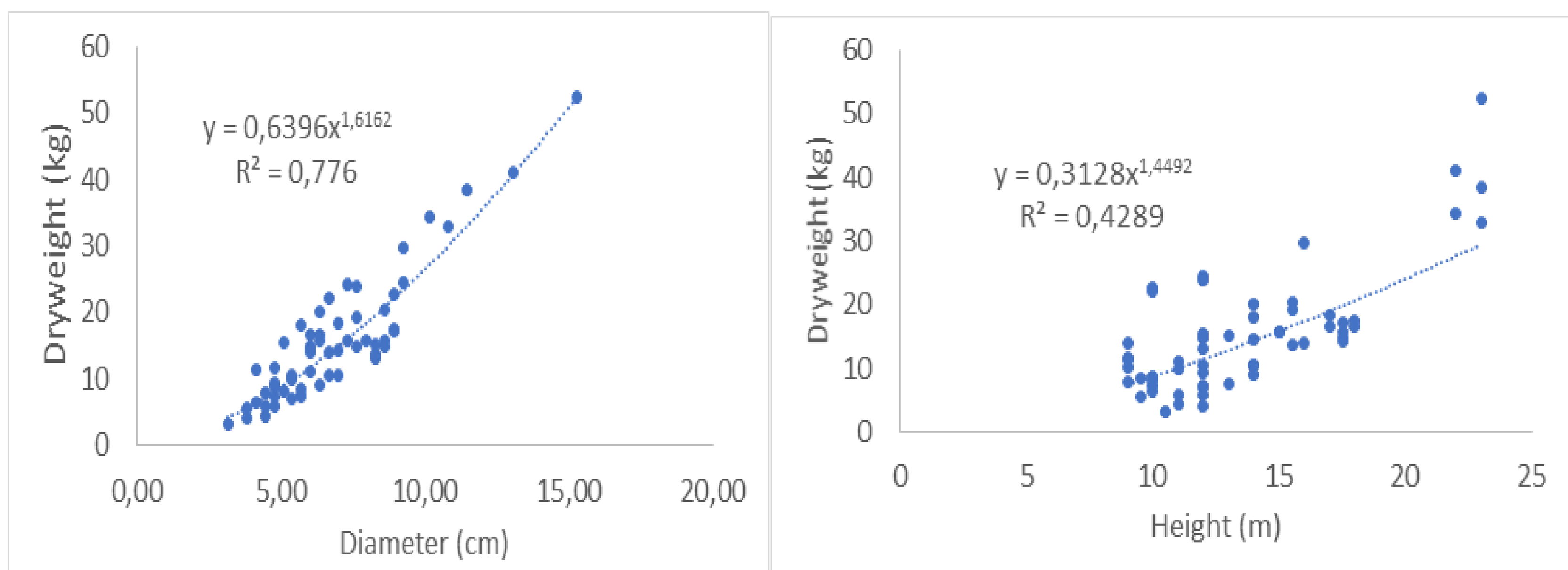

Figure 3. The relationship between local bamboo diameter/height and bamboo stem dryweight following exponential regression

Table 4. Total carbon sequestration local bamboo

Plot	Leaf litter (tons C ha^{-1})	Branch litter (tons C ha^{-1})	Understory (tons C ha^{-1})	Soil (tons C ha^{-1})	Bamboo biomass (ton C ha^{-1})	Total carbon stock (ton C ha^{-1})
Apus	2.49 a	1.15 ab	3.35 b	16.31 a	105.38 a	128.68
Petung	4.26 a	0.57 a	2.99 ab	17.82 a	189.84 b	215.48
Rampal	4.07 a	1.20 ab	0.71 a	11.36 a	63.96 a	81.30
Javanese	4.05 a	2.10 b	0.64 a	11.59 a	85.22 a	103.60

Conclusion

The relationship between dry weight and D (diameter) has a better level than the relationship between dry weight and H. Plant diameter is a good choice and easy to determine plant biomass and carbon content. Measurement of diameter is easier and more accurate in the field when compared to measuring the variable height so that it produces the following allometric equation Y = 0.6396 X $^{1.6162}$. Using this equation, it was found that the largest biomass value was in the Petung bamboo *(Dendrocalamus asper)* of 189.84 ton C ha^{-1}, and the smallest biomass content was in the plot of Rampal bamboo *(Schizostachyum zollingeri)* of 63,96 ton C ha^{-1} which was only 1/3 from Petung bamboo. The total C stock of riparian bamboo forest at Bambang village were ranges between 81 to 215 ton C ha^{-1} (Table 4).