Tree Diversity and Carbon Stock in Bungkirit Urban Forest, Kuningan District

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Abstract. One of the functions of urban forests is to absorb and store carbon through processes carried out by vegetation. Bungkirit urban forest, Kuningan Regency, is the forerunner of the urban forest in Kuningan Regency, with an area of 2 ha. The purpose of this study ware to analyze the diversity and carbon stored in trees in Bungkirit urban forest. The census method was used to identify tree species. Diameters were measured in class ≥ 5 cm. The storage carbon analysis ware carried out using an allometric equation based on the biomass storage value. The results showed that there were 420 individual trees from 38 species and 25 families. The dominant species found were *Gmelina arborea*, *Samanea saman*, and *Tectona grandis*. The total stored carbon is 13.03t/ha. Carbon storage in dominant tree species, namely *Gmelina arborea* (3.08t/ha), *Samanea saman* (2.5.1t/ha)), and *Tectona grandis* (2.21t/ha). Shown significant correlation between carbon stock and number of trees.

Keyword: Urban Forest; Tree; Carbon Stock

1 Introduction

Urban forest is an ecosystem dominated by trees located in or around settlements (Endreny, 2018). Urban forests play an important role in improving the comfort, environmental quality, and welfare of the surrounding communities (Dobbs et al., 2018). Urban forest tree communities provide environmental service benefits, namely in the form of cultural, provisioning, regulating, and supporting services (Brink et al., 2009; Endreny, 2018). Oslomarka's urban forest in Norway during the period 1970-2020 has provided environmental service benefits in the form of three provisioning services, namely food, water, and wood; five cultural services, namely recreation and tourism, cultural and art inspiration, spiritual experience, sense of place, and education; one regulating service, namely climate regulation; and one habitat service, namely the provision of habitat (Berglihn et al., 2021).

Carbon storage is one of the urban forest ecosystem services with the regulating service mechanism (Berglihn et al., 2021; Davies et al., 2011; Endrenya et al., 2017; Lwasa et al., 2014; Nowak et al., 2013; Nowak et al., 2007; Zuo et al., 2017). Carbon storage in the form of biomass is important to the adaptation and mitigation of climate change (Davies et al., 2011). Research in Beijing, Buenos Aires, Cairo, Istanbul, Los Angeles, Mexico City, Moscow, Mumbai, and Tokyo, showed that the economic value of carbon storage was $7.9 billion (Endrenya et al., 2017).

Trees Urban forests are components that carry out carbon storage and sequestration (Strohbach et al., 2012). The process of photosynthesis is the ability of trees to make and store

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food by absorbing carbon dioxide CO_2 (Nowak et al., 2013). During tree growth, CO_2 will be stored in plant tissues in the form of biomass, either above ground or in the soil in different amounts (McPherson, 1998). One urban forest tree can storage 1.57 tons of biomass or the equivalent of 0.79 tons of carbons (Dangulla et al., 2021). Trees of Bungkirit urban forest ability to store carbon is not much known. The objectives of the research are therefore to assess the diversity of Bungkirit urban forest trees, estimate their carbon storage potentials, and determine whether or not, carbon storage correlation between the number of the tree.

2 Methodology

Bungkirit urban forest is located in Kuningan Regency, West Java (6°58'28.12"S Latitude 108°27'49.17"E Longitude). The area of the urban forest are 2 ha (fig. 1). The mean annual rainfall is 1000 - 5000 mm/year while mean monthly temperatures range between 18-32 ^{0}C.

Figure 1. Location of Hutan Kota Bungkirit

Trees diameter was measured in diameter class ≥ 5cm by the census method. Basal Area (BA) was determined using the equation as follows

$$BA = \frac{1}{4}\,\pi\,D^2$$

Where BA = Basal Area, D = Diametere, and π = 3.14

Species composition, diversity, mean structural characteristics (DBH and basal area), biomass and carbon stock were computed for preliminary analysis. Species diversity determined with the Shannon-Weiner's (H′) was determined using the equation as follows

$$H' = -\sum_{i=1}^{k} pi \ln pi$$

Where H'= Species Diversity, k = Number of species, pi = Proportional abundance of the species.

Aboveground Biomass (AGB) and Aboveground Carbon (AGC) in this study were estimated using the general allometric equation (Hairiah et al., 2001) follows.

$$AGB = 0{,}11\ \rho\ D^{0.62}$$

Where AGB = Aboveground Biomass, ρ = Wood Density, and D = Diameter

The wood density (ρ) for all species were obtained from the World Agroforestry database (http://db.worldagroforestry.org/wd). Regression and Correlation Analysis in determining the direction of the relationship between carbon storgae and the number of trees.

3 Result and Discussion

3.1. Trees Diversity

The results of the study recorded 420 trees from 36 species and 25 familiesThe diversity index is 6.04. the species with the highest number and diversity index are *Gmelian arborea* (94 and 1.35), *Samanea saman* (84 and 1.21), and *Tectona grandis* (73 and 1.05).

Table 1. Number of Trees and Diversity Index

No	Spesies	Indv. Num	H'	No	Spesies	Indv. Num	H'
1	*Acacia mangium*	1	0,01	19	*Mangifera foetida*	5	0,07
2	*Albizia chinensis*	1	0,01	20	*Mangifera indica*	8	0,12
3	*Aleurites moluccana*	4	0,06	21	*Manglietia glauca*	1	0,01
4	*Annona muricata*	4	0,06	22	*Manglietia glauca* Bl	1	0,01
5	*Artocarpus heterophyllus*	12	0,17	23	*Muntingia calabura*	1	0,01
6	*Canarium indicum*	1	0,01	24	*Nephelium Lappaceum*	1	0,01
7	*Ceiba pentandra*	1	0,01	25	*Paraserianthes falcataria*	1	0,01
8	*Durio zibethinus*	1	0,01	26	*Persea americana*	11	0,16
9	*Dysoxylum gaudichaudianum*	1	0,01	27	*Pinus merkusii*	4	0,06
10	*Ficus annulata*	8	0,12	28	*Pithecellobium jiringa*	3	0,04
11	*Ficus carica*	5	0,07	29	*Samanea saman*	84	1,21
12	*Ficus hispida*	4	0,06	30	*Schima wallichii*	2	0,03
13	*Filicium decipiens*	31	0,45	31	*Swietenia*	19	0,27

					macrophylla		
14	*Gmelina arborea*	94	1,35	32	*Syzygium aromaticum*	1	0,01
15	*Gnetum gnemon*	12	0,17	33	*Syzygium polyanthum*	2	0,03
16	*Lagerstroemia speciosa*	1	0,01	34	*Tectona grandis*	73	1,05
17	*Leucaena leucocephala*	18	0,26	35	*Terminalia catappa*	2	0,03
18	*Macaranga tanarius*	1	0,01	36	*Vernonia amygdalina*	1	0,01
					Total	**420**	**6,04**

3.2. Biomassa and Carbon Stok

The estimated total biomass in Bungkirit City Forest trees is 5.44 t/ha or the equivalent of 13.03 t/ha carbon. The species with the highest total biomass were *Gmelian arborea* (13.14 and 3.09), *Samanea saman* (10.69 and 2.51), and *Tectona grandis* (9.41 and 2.51).

Table 2. Biomass and Carbon Stok

No	Spesies	Biomassa (t/ha)	Carbon (t/ha)	No	Spesies	Biomassa (t/ha)	Carbon (t/ha)
1	*Acacia mangium*	0,16	0,04	19	*Mangifera foetida*	0,49	0,12
2	*Albizia chinensis*	0,02	0	20	*Mangifera indica*	1,04	0,25
3	*Aleurites moluccana*	1,42	0,33	21	*Manglietia glauca*	0,2	0,05
4	*Annona muricata*	0,13	0,03	22	*Manglietia glauca Bl*	0,04	0,01
5	*Artocarpus heterophyllus*	0,66	0,15	23	*Muntingia calabura*	0,09	0,02
6	*Canarium indicum*	0,05	0,01	24	*Nephelium Lappaceum*	0,06	0,01
7	*Ceiba pentandra*	0,01	0	25	*Paraserianthes falcataria*	0,12	0,03
8	*Durio zibethinus*	0,46	0,11	26	*Persea americana*	0,76	0,18
9	*Dysoxylum gaudichaudianum*	0,15	0,03	27	*Pinus merkusii*	0,4	0,09
10	*Ficus annulata*	0,24	0,06	28	*Pithecellobium jiringa*	0,47	0,11
11	*Ficus carica*	0,25	0,06	29	*Samanea saman*	10,69	2,51
12	*Ficus hispida*	0,3	0,07	30	*Schima wallichii*	0,15	0,04
13	*Filicium decipiens*	5,78	1,36	31	*Swietenia macrophylla*	2,19	0,52
14	*Gmelina arborea*	13,14	3,09	32	*Syzygium aromaticum*	0,17	0,04
15	*Gnetum gnemon*	1,21	0,28	33	*Syzygium polyanthum*	0,32	0,08
16	*Lagerstroemia speciosa*	0,04	0,01	34	*Tectona grandis*	9,41	2,21

17	*Leucaena leucocephala*	4,7	1,1	35	*Terminalia catappa*	0,05	0,01
18	*Macaranga tanarius*	0,03	0,01	36	*Vernonia amygdalina*	0,02	0
				Total		**55,44**	**13,03**

The regression and correlation analysis found a significant correlation between carbon and the number of trees (f=954.004 p>0.000). The regression equation is y = – 0.011 + 0.032x with R^2 value 0.965 and standar error 0.14

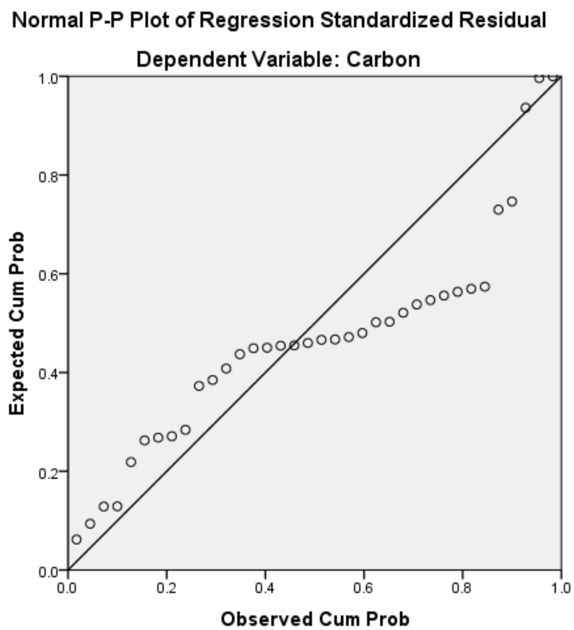

Figure 2. Histogram of Normality and Probability Plot

4 Conclussion

The results showed 420 individual trees from 36 species and 25 families. The dominant species found were *Gmelina arborea* (H'=1.35), *Samanea saman* (H'=1.21), and *Tectona grandis* (H'=1.05). The total stored carbon is 13.03t/ha. Carbon storage in dominant tree species, namely *Gmelina Arborea* (3.08 t/ha), *Samanea saman* (2.51 t/ha)), and *Tectona grandis* (2.21 t/ha). The regression and correlation analysis found a significant correlation between carbon and the number of trees.

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