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Vegetation Inventory, Biomass and Carbon Stock in the Government Office Complex of Sleman Regency

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ABSTRACT. The government office complex of Sleman Regency has an important role that functions as a place to fulfill the needs of public services and public administration. The activity of using office equipment and dense transportation mobility is one of the places that needs to be controlled for the quality of the environment. Green open space which is dominated by plants in the Sleman Regency Office Complex is important for overcoming environmental problems. This study examines the inventory of tree stand vegetation, analyzes tree biomass and carbon stocks in the Government Office Complex of Sleman Regency. The data used are primary data and vegetation data sampling using the whole tree census method at the Government Office Complex of Sleman Regency. The tree species inventory records tree species and diameters, tree biomass is calculated using the Allometric Coefficient Value Formula and carbon stocks are derived from the calculation of the carbon content of the biomass. The results of the research on vegetation inventory from 19 offices in the Government Office Complex of Sleman Regency covering an area of 4.85 ha, there are 215 trees with 38 types of vegetation. The total tree biomass is 2,999,950.49 kg with a potential tree biomass per hectare of 618,546.49 kg/ha. Total carbon stock is 21,409,976.73 kg with potential carbon stock per hectare of 290,716.85 kg/ha. The larger the diameter of the tree, the greater the tree's biomass and carbon stock, the smaller the diameter of the tree, the smaller the tree's biomass and carbon stock.

Keywords: *Vegetation inventory, tree biomass, carbon stock, environmental quality*
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1. Introduction

Various kinds of human activities can reduce the quality of the environment that is spurring the emergence of various global environmental phenomena. In office complexes, various kinds of physical environmental problems such as air pollution from toxic gases can contribute to global warming. Global warming originating from office activities is the result of office activities originating from electrical machines such as heating, printers, air conditioners (AC) which can emit greenhouse gases such as CH_4, CO_2, Ozone, CFCs and the use of motorized vehicles that cause pollution produce toxic gases such as Pb, NOx, Sox. One way to reduce global warming is to reduce carbon emissions by maintaining carbon stocks in the office area. The existence of plants as a store of carbon reserves serves to reduce the concentration of CO_2 in the atmosphere. Through the process of photosynthesis, CO_2 is absorbed and converted by plants into organic carbon in the form of biomass. Biomass is a form of energy absorption that can be converted into carbon, alcohol, or wood. The amount of biomass potential is influenced by the ability of the tree to absorb carbon from the environment through the process of photosynthesis, known as the sequestration process. The results of the photosynthesis process minus respiration are accumulated in the tree biomass. The amount of tree biomass can affect the value of the carbon content of the tree (Satriani, 2021).

The government office complex of Sleman Regency has an important role that functions as a place to fulfill the needs of public services and public administration. As an office complex, which is vital and dense, office activities can reduce the quality of the environment. The activity of using office equipment and transportation mobility in the government office complex of Sleman Regency is one of the places that needs to be controlled for the quality of the environment. Green open space which is dominated by plants in the government office complex of Sleman Regency is important for overcoming environmental problems. Plants are very useful for absorbing carbon dioxide (CO_2), besides that they can engineer aesthetics, lower temperatures, reduce noise, reduce odors and can save ground water. Plants can absorb and store carbon as biomass. Controlling carbon concentration where organic carbon from photosynthesis is stored in standing biomass is one way to reduce the impact of global warming, especially in the Sleman Regency government office complex.

Research on the analysis of biomass and carbon stocks in green open spaces has been conducted by Utami & Ambarwati (2021) in the cities of Yogyakarta and Surabaya with the results showing that the Surabaya City RTHP has higher carbon storage and sequestration values than Yogyakarta City RTHP. Irundu et al, (2020) also conducted research on the potential of biomass and carbon stored in stands in the Green Open Space of Polewali City, West Sulawesi. On the other hand, similar

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research is rarely carried out in government office areas which are known to be full of activity. In the government office complex of Sleman Regency, no research has been carried out on the potential of biomass and carbon stocks, so that there is no data on vegetation that produces biomass. Therefore, the purpose of this study was to determine the inventory of species, biomass and potential carbon stocks of tree-level vegetation in the government office complex of Sleman Regency.

2. Materials and Methods

2.1 Location

This research is located in The Government Office Complex of Sleman Regency and it was held in January 2022. The data analysis method used in this study is a quantitative descriptive technique. The data obtained is the result of an in-depth search on the units of observation in the form of numbers which are then analyzed and presented in this study.

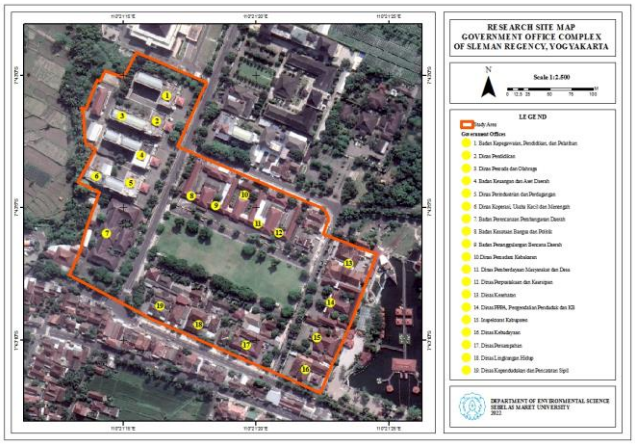

Fig. 1 Research site map for Government Office Complex of Sleman Regency, Yogyakarta

2.2 Sampling Method

The data used is primary data, by taking direct tree stand measurement data. Sampling of vegetation data used the census method, which was to record all trees in the Sleman Regency Government Office Complex. The criteria for the tree that became the object of the study were trees that had a diameter of chest height >20 cm. The materials and tools used in this study were stationery, drones, a set of computers with ArcMap 10.1 software, meter tape, tally sheets, cameras and other supporting tools. Data collection Vegetation inventory was carried out by recording the number, type and diameter of trees found in the research location. Measurement of tree biomass is carried out in a way that does not damage plant parts. Tree biomass was calculated using the Allometric Coefficient Value Formula (a and b). Tree biomass was determined based on the allometric formula for tropical wood species in Indonesia (Ketterings et al, 2001).

$$Y = a.D^b$$

Where:
Y : biomass content (kg)
D : tree diameter at chest height (cm)
a : 0.0661
b : 2,591

Calculation of carbon from biomass uses the following formula (SNI 7724, 2011):

$$Cb = B \times \% \text{ C organic}$$

Where:
Cb : carbon content of biomass, expressed in kilograms (kg)
B : total biomass expressed in kilograms (kg)
% C organic : percentage of carbon content, 0.47

Calculation of carbon stock per hectare uses the formula (SNI 7724, 2011):

$$C = \frac{\sum Cb}{A}$$

Where:
C : Potential Carbon Stock per Ha (tonnes/ha)
Cb : carbon content of biomass (tons)
A : The area of green open space in the Government Office Complex of Sleman Regency

3. Result and Discussion

The government office complex of Sleman Regency as a center for public and administrative services is a complex that is full of office activities and mobility. According to Sahri & Hutapea (2019), office buildings are one of the places where air quality needs to be controlled to keep the residents comfortable because most people spend their time working in office spaces. The number of activities and mobility of office occupants as well as equipment and room design in an office allows for a decrease in indoor air quality.

Therefore, green open space is very necessary in an area because it has the function of creating an effective air purifier, maintaining groundwater continuity, aesthetics, environmental preservation, and comfort in office complexes. From the results of the study, researchers have studied green open spaces dominated by tree-level plants in 19 offices covering an area of 4.85 hectares at the government office complex of Sleman Regency.

3.1 Vegetation inventory in the Government Office Complex of Sleman Regency

The results of research and data analysis regarding tree-level vegetation types in 19 offices at the Government Office Complex of Sleman Regency obtained the number of vegetation which is presented in Table 1.

Table 1
Vegetation inventory in the Government Office Complex of Sleman Regency

No	Office	Amount of Vegetation
1	Badan Kepegawaian, Pendidikan, dan Pelatihan	34
2	Dinas Pendidikan	18
3	Dinas Pemuda dan Olah Raga	11
4	Badan Keuangan dan Aset Daerah	15
5	Dinas Perindustrian dan Perdagangan	6
6	Dinas Koperasi Usaha Kecil dan Menengah	5
7	Badan Perencanaan Pembangunan Daerah	43
8	Badan Kesatuan Bangsa dan Politik	3
9	Badan Penanggulangan Bencana Daerah	1

No	Office	Amount of Vegetation
10	Dinas Pemadam Kebakaran	5
11	Dinas Pemberdayaan Masyarakat dan Desa	1
12	Dinas Perpustakaan dan Kearsipan	7
13	Dinas Kesehatan	0
14	Dinas PPPA, Pengendalian Penduduk dan KB	8
15	Inspektorat Kabupaten	24
16	Dinas Kebudayaan	5
17	Dinas Persampahan	9
18	Dinas Lingkungan Hidup	7
19	Dinas Kependudukan dan Pencatatan Sipil	13
	Total	**215**

Fig. 2 Aerial photo of Bappeda Office with the most vegetation

Fig. 3 Aerial photo of Dinas Kesehatan Office with the least vegetation

The results of the inventory of 19 offices in the Government Office Complex of Sleman Regency contained 215 tree-level vegetation. The highest amount of vegetation is found in the office of Badan Perencanaan Pembangunan Daerah (Bappeda), which is as many as 43 trees. Meanwhile, the least amount of vegetation or even no vegetation is found in the Office of Dinas Kesehatan. From the 215 tree-level vegetation in the Government Office Complex of Sleman Regency, there are various types which are presented in Figure 4.

From a total of 215 trees, 38 types of vegetation were found in the Government Office Complex of Sleman Regency. The most abundant vegetation types were Mango (*Mangifera indica*) with 32 trees and least vegetation types were Cempaka Putih (*Michelia alba*), Dadap merah (*Erythrina crista-galli*), Orange (*Citrus aurantifolia*), Cocoa (*Theobroma cacao*), Coconut (*Cocos nucifera),* Kluwek (*Pangium edule*), Sapu Tangan Tree (*Maniltoa grandiflora*), Bay-leaf (*Syzygium polyanthum*), Soursop (*Annona muricata*), Breadfruit (*Artocarpus altilis),* Tanjung (*Mimusops elengi*), and Wuni (*Antidesma bunius*) as many as 1 Tree.

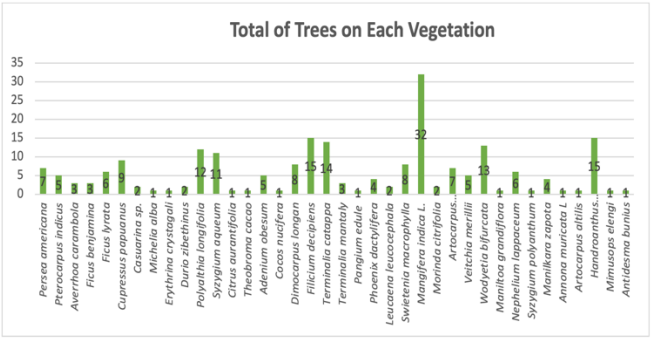

Fig. 4 Total of Trees on Each Vegetation in the Government Office Complex of Sleman Regency

3.2 Tree biomass in the Government Office Complex of Sleman Regency

The results of research and data analysis on tree-level vegetation biomass in the Government Office Complex of Sleman Regency obtained the results of biomass calculations which are presented in Table 2.

Table 2
Measurement of Tree Biomass in the Government Office Complex of Sleman Regency

No	Species Name	Latin Name	Family	Total Trees	Biomass (kg)
1	Avocado	*Persea americana*	*Lauraceae*	7	49516,70
2	Amboyna	*Pterocarpus indicus*	Fabaceae	5	100689,05
3	Star Fruit	*Averrhoa carambola*	Oxalidaceae	3	26744,70
4	Banyan	*Ficus benjamina*	Moraceae	3	1375468,07
5	Fiddle-leaf Fig	*Ficus lyrata*	Moraceae	6	52749,49
6	Cemara pua pua	*Cupressus papuanus*	Cupressaceae	9	39843,81
7	Cemara Rentes	*Casuarina sp.*	Casuarinaceae	2	10322,30
8	Cempaka putih	*Michelia alba*	Magnoliaceae	1	10850,82
9	Dadap Merah	*Erythrina crystagali*	Leguminoceae	1	11125,89
10	Durian	*Durio zibethinus*	Malvaceae	2	9243,88
11	Glodongan Tiang	*Polyalthia longifolia*	Annonaceae	12	25515,87
12	Water Apple	*Syzygium aqueum*	Myrtaceae	11	19404,39
13	Orange	*Citrus aurantifolia*	Rutaceae	1	1061,79
14	Cocoa	*Theobroma cacao*	Malvaceae	1	1197,81
15	Kamboja	*Adenium obesum*	Apocynaceae	5	7832,02
16	Coconut	*Cocos nucifera*	Arecaceae	1	2792,49
17	Longan	*Dimocarpus longan*	Sapindaceae	8	204601,37

No	Species Name	Latin Name	Family	Total Trees	Biomass (kg)
18	Kerai Payung	*Filicium decipiens*	Sapindaceae	15	101898,11
19	Ketapang	*Terminalia catappa*	Combretaceae	14	145217,72
20	Ketapang Kencana	*Terminalia mantaly*	Combretaceae	3	6461,64
21	Kluwek	*Pangium edule*	Achariaceae	1	19834,84
22	Date Palm	*Phoenix dactylifera*	Arecaceae	4	48611,01
23	Lamtoro	*Leucaena leucocephala*	Fabaceae	2	2844,74
24	Mahogany	*Swietenia macrophylla*	Meliaceae	8	123086,77
25	Mango	*Mangifera indica L.*	Anacardiaceae	32	236204,75
26	Mengkudu	*Morinda citrifolia*	Rubiciae	2	2468,13
27	Jackfruit	*Artocarpus heterophyllu*	Moraceae	7	75827,47
28	Palm	*Veitchia merillii*	Arecaceae	5	20688,28
29	Ekor Tupai Palm	*Wodyetia bifurcata*	Arecaceae	13	84833,37
30	Sapu Tangan Tree	*Maniltoa grandiflora*	Fabaceae	1	8562,01
31	Rambutan	*Nephelium lappaceum*	Sapindaceae	6	56527,55
32	Bay leaf	*Syzygium polyanthum*	Myrtaceae	1	1755,96
33	Sapodilla	*Manilkara zapota*	Sapotaceae	4	49427,56
34	Soursop	*Annona muricata L*	Annonaceae	1	1583,07
35	Breadfruit	*Artocarpus altilis*	Moraceae	1	33421,15
36	Tabebuya	*Handroanthus chrysotrichus*	Bignoniaceae	15	22440,13
37	Tanjung	*Mimusops elengi*	Sapotaceae	1	1197,81
38	Wuni	*Antidesma bunius*	Phyllanthaceae	1	8097,96
Total				**215**	**2999950,49**
Biomass potential/Ha					**618546,49**

Based on the table above, it can be seen that the total tree biomass in the Government Office Complex of Sleman Regency is 2,999,950.49 kg. The potential for tree biomass per hectare is 618,546.49 kg/ha which is obtained from the total tree biomass divided by the area of the study area of 4.85 ha. The largest tree biomass is the Banyan Tree (*Ficus benjamina*) which is 1,375,468.07 kg, although there are only 3 trees, the diameter of the Banyan Tree is very large so that the biomass content of the banyan tree is the largest. While the lowest tree biomass is Soursop (*Annona muricata*) which is 1,583.07 kg with 1 tree.

The presence of trees > 30 cm in diameter in a land type, contributes significantly to the total carbon stock in tree biomass. The more trees that make up a land > 30 cm in diameter, the higher the carbon stock in the land (Hanafi & Bernardianto, 2012). The amount of biomass is determined by diameter, plant height, wood density and soil fertility (Manafe et al, 2016).

3.3 Carbon Stock in Government Office Complex of Sleman Regency

The results of research and data analysis on tree-level vegetation carbon stocks in the Government Office Complex of Sleman Regency obtained the results of the calculation of carbon stocks which are presented in Table 3.

Table 3
Calculation of Carbon Stock in the Government Office Complex of Sleman Regency

No	Species Name	Latin Name	Family	Total Trees	Carbon stock (kg)
1	Avocado	*Persea americana*	*Lauraceae*	7	23272,85
2	Amboyna	*Pterocarpus indicus*	Fabaceae	5	47323,85
3	Starfruit	*Averrhoa carambola*	Oxalidaceae	3	12570,01
4	Banyan	*Ficus benjamina*	Moraceae	3	646469,99
5	Fiddle-leaf Fig	*Ficus lyrata*	Moraceae	6	24792,26
6	Cemara pua pua	*Cupressus papuanus*	Cupressaceae	9	18726,59
7	Cemara Rentes	*Casuarina sp.*	Casuarinaceae	2	4851,48
8	Cempaka putih	*Michelia alba*	Magnoliaceae	1	5099,89
9	Dadap Merah	*Erythrina crystagali*	Leguminoceae	1	5229,17
10	Durian	*Durio zibethinus*	Malvaceae	2	4344,62
11	Glodongan Tiang	*Polyalthia longifolia*	Annonaceae	12	11992,46
12	Water Apple	*Syzygium aqueum*	Myrtaceae	11	9120,06
13	Orange	*Citrus aurantifolia*	Rutaceae	1	499,04
14	Cocoa	*Theobroma cacao*	Malvaceae	1	562,97
15	Kamboja	*Adenium obesum*	Apocynaceae	5	3681,05
16	Coconut	*Cocos nucifera*	Arecaceae	1	1312,47
17	Longan	*Dimocarpus longan*	Sapindaceae	8	96162,64
18	Kerai Payung	*Filicium decipiens*	Sapindaceae	15	47892,11
19	Ketapang	*Terminalia catappa*	Combretaceae	14	68252,33
20	Ketapang Kencana	*Terminalia mantaly*	Combretaceae	3	3036,97
21	Kluwek	*Pangium edule*	Achariaceae	1	9322,37
22	Date Palm	*Phoenix dactylifera*	Arecaceae	4	22847,17
23	Lamtoro	*Leucaena leucocephala*	Fabaceae	2	1337,03
24	Mahogany	*Swietenia macrophylla*	Meliaceae	8	57850,78
25	Mango	*Mangifera indica L.*	Anacardiaceae	32	111016,23
26	Mengkudu	*Morinda citrifolia*	Rubiciae	2	1160,02
27	Jackfruit	*Artocarpus heterophyllu*	Moraceae	7	35638,91
28	Palm	*Veitchia merillii*	Arecaceae	5	9723,49
29	Ekor Tupai Palm	*Wodyetia bifurcata*	Arecaceae	13	39871,68
30	Sapu Tangan Tree	*Maniltoa grandiflora*	Fabaceae	1	4024,14
31	Rambutan	*Nephelium lappaceum*	Sapindaceae	6	26567,95

No	Species Name	Latin Name	Family	Total Trees	Carbon stock (kg)
32	Bay leaf	*Syzygium polyanthum*	Myrtaceae	1	825,30
33	Sapodilla	*Manilkara zapota*	Sapotaceae	4	23230, 95
34	Soursop	*Annona muricata L*	Annonacea e	1	744,04
35	Breadfruit	*Artocarpus altilis*	Moraceae	1	15707, 94
36	Tabebuya	*Handroanthus chrysotrichus*	Bignoniace ae	15	10546, 86
37	Tanjung	*Mimusops elengi*	Sapotaceae	1	562,97
38	Wuni	*Antidesma bunius*	Phyllanthac eae	1	3806,0 4
Total				**215**	**14099 76,73**
Potential Carbon Stock/Ha					**29071 6,85**

Based on the table above, it can be seen that the total carbon stock in the Government Office Complex of Sleman Regency is 21,409,976.73 kg. The potential carbon stock per hectare is 290.716.85 kg/ha which is obtained from the total tree biomass divided by the area of the study area of 4.85 ha. The largest tree carbon stock is the Banyan Tree (*Ficus benjamina*) which is 646,469.99 kg, although there are only 3 trees, the diameter of the Banyan Tree is very large so that the Banyan Tree contains the largest carbon stock. While the lowest carbon stock is Soursop (*Annona muricata*) which is 744.04 kg with 1 tree.

Carbon is an element that is absorbed from the atmosphere through the process of photosynthesis and stored in the form of biomass. The amount of CO_2 absorption is directly proportional to the diameter of a tree, the larger the diameter, the greater the CO_2 absorbed (Dharmawan and Siregar, 2008), this is corroborated by the opinion of Chanan (2012) which states that every increase in biomass content will be followed by an increase in carbon content. This explains that carbon and biomass have a positive correlation so that anything that causes an increase or decrease in biomass will cause an increase or decrease in carbon content. so that an office that has green open space with a large amount of vegetation is able to absorb emissions in the office environment compared to green open space with a small amount of vegetation

4. Conclusion

The Government Office Complex of Sleman Regency has a green open space which is dominated by plants. The results of the research on vegetation inventory from 19 offices in the government office complex of Sleman Regency covering an area of 4.85 ha, there are 215 trees with 38 types of vegetation. The total tree biomass is 2,999,950.49 kg with a potential tree biomass per hectare of 618,546.49 kg/ha. The total carbon stock is 21,409,976.73 kg with a potential carbon stock per hectare of 290,716.85 kg/ha. The larger the diameter of the tree, the greater the tree's biomass and carbon stock, the smaller the diameter of the tree, the smaller the tree's biomass and carbon stock.

The recommendation that can be done is to plant planting to increase green open space as an emission absorber in the office environment. It is hoped that further research on the potential of carbon in other carbon sources such as soil biomass, dead trees and litter is expected. In addition, it is necessary to add environmental parameters such as temperature, pH, salinity, and humidity because they affect the estimation of carbon stocks in a forest area.

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