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Ability of Vegetation Absorption to CO_2 Emissions at the Campus of Universitas Negeri Padang

*Indra Yuzandi[1], Azwir Anhar[2]

[1]Master Program of Environmental Science, Postgraduate School – Universitas Negeri Padang
[2]Professor of Biology, Faculty of Mathematics and Natural Sciences – Universitas Negeri Padang
*E–mail: iin.yuza@gmail.com

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ABSTRACT

Green Open Space (GOS) is an elongated/lined area and/or clustered, where plants grow, either growing naturally or intentionally planted. Plants or vegetation function as absorbers of Carbon dioxide (CO_2) in the atmosphere and can be absorbed by trees through the process of photosynthesis. For this reason, the purpose of this study was to determine the amount of vegetation, to determine the amount of vegetation absorption of CO_2. This study used the census method by measuring all vegetation stands. For data analysis, calculate the diameter of the tree at chest height (DBH), calculate tree biomass, calculate the estimated carbon stored, and calculate the amount of carbon dioxide absorbed by the vegetation. The results showed that the potential for CO_2 absorption at Padang State University was found to be 1348 tree species. The ability of vegetation to absorb CO_2 is 1,697,812.70 kg/year.

Keywords: GOS, Vegetation, CO_2 Absorption, Universitas Negeri Padang.

INTRODUCTION

Climate change is one of the environmental problems experienced by the world today. One of the causes of climate change is global warming. Global warming is caused by greenhouse gas emissions. One of the Green House Gases (GHG) that has a major effect on increasing the earth's surface temperature is (CO_2) carbon dioxide (Rinjani, 2016). One of the causes of the Increase in GHG is the use of transportation which produces CO_2 gas residue. If there is no absorption by plants, it will result in an increase in the average temperature on earth in the long term (Lutfi & Priyana, 2020).

Prevention of the impact of climate change and potential disasters can start with environmental conservation and planting vegetation, area expansion, and conservation of protected forests. The development of vegetation and green forests can absorb CO_2 which is a problem in global warming (Ismail & Aulia, 2017). CO_2 if accumulated in large quantities can cause the air temperature to increase (global warming). One of the efforts to reduce the concentration of CO_2 in the air is the application of green areas or known as the GOS concept (Mulyadin & Gusti, 2013). The GOS is part of the open spaces of an area or urban area filled with plants and vegetation (Handika et al., 2020). The distribution of green open space has been determined in Law No.26/2007 on spatial planning, stating that a city is required to provide 30% green open space with a composition of 20% public and 10% private. The GOS is one of the efforts to minimize the impact of global warming. The importance of the existence of campus green space as a CO_2 emission absorption has been proven in several studies. One of them is Brawijaya University, which is a campus that

produces CO_2 emissions from motorized vehicle users. Emissions resulting from transportation are 2,591,812.45 Kg/year. The ability of green open space to absorb CO_2 in one year is 45,228,279.66 Kg/year. The existence of green open space on campus can absorb CO_2 emissions as a whole (Suharto et al., 2017).

Universitas Negeri Padang (UNP) is a Leading University in Padang City, West Sumatra, and continues to be the best university at national and international levels. To achieve this, UNP prepares strategies and policies until 2021 which are included in the Research Master Plan (RIP) for 2016-2020. One of the policies that UNP has improved is by repairing and adding physical buildings and complementing existing infrastructure (LP2M, 2016). The problem found at UNP is the lack of green open space (Umar et al, 2017). Based on the results of research Sari (2021), currently, UNP has a total green open space area of 23% so it does not meet the ideal requirements in every city to have 30% green open space. Based on this background, the purpose of this study was to determine the ability of trees to absorb CO_2 emissions on the main campus of UNP.

METHODS

This research was conducted at the campus of UNP, Street. Prof. Hamka, North Padang Sub-district, Padang City - West Sumatra Province. The data used in this study consisted of primary data, namely, the calculation of the amount of vegetation in GOS was carried out directly. The collection of data on vegetation is taken on the paths and parks traversed by vehicle users. Meanwhile, tree species were calculated based on the literature on plant species. Absorption of Trees: Calculation of the absorption capacity of trees is carried out by taking into account the stored carbon stocks (Ketterings, 2001). Calculating DBH:

$$dbh = K/\Pi$$

Notes:
DBH : diameter at chest height
Π : 3.14
K : around the tree

Calculating tree biomass with the formula:

$$W = 0.11 \times BJ \times D^{2.62}$$

Notes:
W : biomass
BJ : specific gravity
D : tree diameter (Ministry of Environment, 2012).

Adding up the biomass of both small and large trees, so that the total tree biomass (Wt). the carbon concentration in the biomass is about 46% so the estimated stored carbon (Wtc) is.

$$Wtc = Wt \times 0.46$$

Notes:
Wtc : stored carbon estimation (kg/year)
Wt : the total amount of biomass (kg/year)
0.46 : carbon concentration in organic matter

Calculating the amount of carbon dioxide absorbed by trees is:

$$WCO_2 = Wtc \times 3.67$$

Notes:
WCO_2 : the amount of carbon dioxide absorbed by trees (CO_2 kg/year)
Wtc : estimated carbon stored (kg/year)
Wt : the total amount of biomass (kg/year)
3.67 : conversion from carbon to carbon dioxide

RESULTS AND DISCUSSIONS

3.1 Analysis Results

The GOS data is obtained from direct field identification. The survey conducted was to calculate the amount of vegetation based on its type and a minimum tree diameter of 21 cm. The trees that are counted are the trees that are in the road chart and parks of the UNP. CO_2 measurements were carried out directly in the field for 30 days. Measurements were carried out every morning from 08.00 WIB, until 15.00 WIB. The survey data on the type and number of trees at UNP can be seen in Table 1 below.

Table 1. Tree species and number data of UNP

No	Tree	Amount	Total
1	*Tanjung (Mimusops elengi L.)*	401	
2	*Ketapang Kencana (Terminalia mantaly)*	185	
3	*Pucuk Merah (Syzygium myrtifolium)*	162	
4	*Glodok* Tiang *(Polyalthia longifolia Sonn.)*	125	
5	*Mahoni (Swietenia marcrophylla)*	93	
6	*Ketapang (Terminalia catappa)*	77	
7	*Angsana (Pterocarpus indicus Willd.)*	62	
8	Mangga *(Mangifera indica)*	38	
9	Bringin *(Ficus Benjamina)*	36	
10	*Trembesi (Samanea saman Merr.)*	32	1384
11	Kerai Payung *(Filicium decipiens)*	31	
12	Cemara Laut *(Casuarina equisetifoliaL.)*	25	
13	Dadok/dadap *(Erythrina variegata L.)*	23	
14	Jambu *(Syzgium aqueum)*	16	
15	Manggis *(Garcinia mangostana L.)*	12	
16	Salam *(Syzygium polyanthum)*	11	
17	Kamboja *(Plumeria sp.)*	6	
18	Kelor *(Moringa oleifera L.)*	6	
19	Sawo *(Manilkara zapota)*	5	

No	Tree	Amount	Total
20	Seri *(Muntingia calabura L.)*	5	
21	Nangka *(Arthocarpus integra Merr.)*	5	
22	Tusam *(Pinus Merkusii)*	4	
23	Jati *(Tectona grandis)*	2	
24	Akasia *(Acacia mangium)*	2	
25	Rambutan *(Nephelium Lappaceum)*	2	
26	Alpukat *(Persea americana)*	2	
27	Belimbing *(Averrhoa carambola L.)*	2	
28	Mengkudu *(Morinda citrifolia L.)*	2	
29	Petai cina *(Leucaena leucocephala)*	2	
30	Jambu biji *(Psidium guajava)*	1	
31	Kapuk *(Ceiba pentandra L.)*	1	

Note: Data analysis, 2022.

In the Table 1 above, there are data on tree species and the number in UNP totaling 1384 trees. Furthermore, the total vegetation and CO_2 absorption results in UNP can be seen in Table 2 below.

Table 2. Total vegetation and CO_2 absorption

No	Location of GOS	Number of Tress	Absorption (kg/year)
1	UNP Rectorate Building	157	237.493,63
2	Old Rectorate Building	26	43.269,97
3	UNP Auditorium	2	31.206,52
4	Graduate School	98	268.078,71
5	Faculty of Science Education	69	177.010,69
6	Faculty of Economics	6	32.990,47
7	Faculty of Social Sciences	14	17.540,50
8	Integrated Building A	37	2.592,70
9	Integrated Building B	32	2.016,00
10	Faculty of Tourism and Hospitality	5	56.837,17
11	Faculty of Engineering	139	143.185,41
12	faculty of Language and Arts	87	95.179,06
13	Faculty of Sports Science	214	249.878,26
14	Faculty of Math and Natural Sciences	205	144.250,96
15	Student Activity Center Building	15	9.981,62
16	Al-Azhar Mosque	85	82.472,49
17	Hospitality UNP	9	20,628.72
18	Rector's House	81	54.021,70
19	MKU	17	9.981,62
20	UNP School of Development	96	19.197,47
Total		1384	1.697.812,70

Note: Data analysis, 2022.

3.2 Discussion

The concentration of CO_2 is the main ingredient in the photosynthesis process. Plants will absorb the CO_2 concentration and then distribute it to all parts of the tree (Putra et al., 2017; Sa'iedah, 2018). The distribution of trees on the UNP campus is 1348 trees. The total

absorption capacity that UNP can produce is 1,697,812.7 kg/year. The tree species planted the most are *Tanjung*, *Ketapang Kencana*, *Pucuk Merah*, *Glodok*, *Mahoni*, and *Angsana*. The tree is a tree that is able to absorb the most CO_2, in accordance with the Regulation of the Minister of Public Works No. 05/Prt/M/2012 concerning "Guidelines for Planting Trees", for public spaces that function to reduce CO_2 concentrations.

Selection of tree species needs to be done, because each type of tree has a different ability to absorb CO_2 and the ability to produce different O_2. The ability of the cape tree has the advantage of not being easily damaged by dust pollution. The dense leaf shape can muffle noise and dust. This plant has resistance to dust and cement contamination as well as a very high ability to absorb dust and cement pollution. *Ketapang Kencana* is a tree that has a function as a filter from the sun during the day, so it can be cool. The main function is as a filter for pollution in the surrounding environment (Prasetio et al., 2021). *Angsana* is a shade tree that is usually on the roadside, due to its dense canopy and faster growth (Samsoedin & Waryono, 2010; Husrin et al., 2015). Able to absorb elements of air pollution from motorized vehicles (Yulius et al., 2014). *Acacia* is a tree that is very good at absorbing CO_2 and producing oxygen (Dahlan, 2008). *Trembesi* is a plant that has a canopy resembling an umbrella, so it can be used as a shade. This tree is able to absorb CO_2 very large as much as 28,488.39 kg CO_2/tree. and releases a lot of oxygen, absorbs water very quickly in the rainy season (Bashri et al., 2018). The characteristics of trees that are capable of producing oxygen are trees that have leaves that are dark green and shiny. The number of leaves also affects the production of oxygen, the denser a tree, the higher it produces oxygen. Trees that do not bear fruit and flower will produce high oxygen. Because trees that bear fruit, oxygen produced by trees will be divided into flower and fruit parts, so that oxygen yields are decreasing (Husrin et al., 2015).

CONCLUSION

Based on the results of the analysis of vegetation that grows and spreads at UNP there are 1348 vegetation. The total CO_2 absorption capacity of vegetation is 1,697,812.7 kg/year. Where there is a need for further research by calculating CO_2 absorption for shrubs and grasses and further research on the analysis of the addition of vegetation in the UNP parking area.

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