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Estimation of Carbon Storage in Public Green Open Space in Pekanbaru City

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Abstract: ***Green open space is one of the efforts in reducing CO_2 emissions of urban areas. Vegetation tree in a public green open space serves as an absorber of CO_2 in the form of stored carbon.It made the environmental balance. The purpose of this study is to determine the carbon stocks in public green open space of Pekanbaru. Data obtained with the survey and non-destructive method, and then analyzed using allometric equations. The results showed that the estimated reserves of carbon in Pekanbaru city public green spaces are 202 tons/Ha. It can be concluded that the carbon stocks in the city of Pekanbaru classified as moderate and included in range of carbon stocks contained in tropical forests generally so that it helps to actualize the environmental balance.***

Keywords: carbon storage, green open space

1. Introduction

Green open space is a place that has plants or vegetation in urban areas that provide environmental benefits [1].The types of green open space can be found as a green area of the city landscape, forest green areas of the city, city recreational green area, green area for sport activity, residential areas, agriculture, green lanes and yards [2]. Vegetation found in green open space can serve as an absorber of CO_2 in atmosphere in the form of stored carbon.It made a clean and comfortable air in the city as well as reducing the impact of global climate change [3] [4] [5] [6].

The process of carbon accumulation in the body of living plant is called sequestration process (C-sequestration). By measuring the quantity of carbon stored in the body of living plant (biomass) in the landscape describe the amount of CO_2 in the atmosphere which is absorbed by plants. Stored carbon measurements can be done by estimating the volume of a tree using non-destructive methods and analyzed using allometric equations. Volume was estimated at trunk diameter, measured at breast height [7] [8].

The capabilities of trees vegetation to absorb $CO_2$are different. Trees with large diameters and canopy cover can absorb CO_2 better than trees with small diameter and canopy cover [9] [10] [11] [12]. The forest has advantages in absorbing CO_2 than a city park. Forests occupy a wider expanse than the park, vegetation diversity of forest especially it'sheight strata, canopy cover and density of the leaves is bigger than the park [13].

Public green open space in Pekanbarucity must be maintained to keep the quality of the environment. Spacious public green open space at this time is amounted to 898.26 ha. Changes of spacious public green open space will affect to carbon stocks and reduced the ability to absorb CO_2. It increased emissions and global climate change.

Greenhouse gas emissions in the city of Pekanbaru in 2012 amounted to 68191.251 Gg CO_2eq (0.068 Gt CO2eq) [14]. Therefore, efforts are needed to reduce CO_2 emissions from atmosphere, one of them by providing public green open space area. The main objective of this study was to determine estimates of carbon stocks contained in the public green open space vegetation city of Pekanbaru.

2. Study Area

The study was conducted in the city of Pekanbaru, located between 101 ° 14'-101 ° 34 'east longitude and 0 ° 25'-0 ° 45' North latitude and an area of 632.26 km^2. The average daily temperature in the city of Pekanbaru is 35,2^{0}C and monthly rainfall is 190-215 mm. The research location are Forest Diponegoro, Chevron Conservation Forest, Riau University Arboretum, SMK Forestry Arboretum, TAHURA SSH, Rumbai Parks, Diponegoro Parks, Parks Grand Mosque, Alam Mayang, green belt and river border.

3. Methodology

This research is descriptive research with survey method. Measurement of tree biomass on the scale of the plot of some tree species is done by estimating the volume of a tree using non-destructive methods. Data were analyzed for carbon reserves estimation to calculate first tree biomass using allometric equations [15] [16] as follows:

$$\mathbf{Y = 0{,}0509 \times \rho \times DBH^2 \times T}$$

Information:

Y : the total biomass (kg)
ρ : density of wood (0.68 gram / cm^3)
DBH : diameter at breast height (m)
T : plant height (m)

All stand biomass data obtained in an area summed it will get the total biomass per area (kg/hectare), which can then be calculated biomass per hectare using the following formula:

$$W = \frac{\sum_{i=1}^{n} Wpi}{A} \times 10.000$$

Information:
W : total tree biomass (t/ha)
n : number of trees
Wpi : tree biomass (ton)
A : area (m^2)

Carbon stocks (C-stock) are calculated by using an approach biomass, carbon dioxide is absorbed by plants through photosynthesis is stored in the form of biomass. Carbon stocks stored in the form of biomass can be determined by multiplying the biomass with carbon fractions of the biomass, which generally amounted to 0.50 [17] [18] [19].

C = W x 0.5

Information:
C : carbon stocks stored (tons / ha),
W : biomass (tons / ha),
0.5 : the proportion of carbon

4. Result

Based on the survey results, the composition of standing trees on public green open space consists of 49 families, 139 species and 17.474 individuals. Fabaceae is the dominant famili which consist of several types, including: *Adenanther pavonina, Archidendron pauciflorum, Dalbergia latifolia, Parasirianthes falcataria, Pterocarpus indicus, Samanea saman, Senna Seamea, Delonix regia, Leucaena leucocephala, Erythrina lithosperma, Caesalpinia pulcherrina, Bauhinia purpurea, Intsia bijuga, Sacara asoca, Tamarindus indica, Dialium indum, dan Koompasia malacensis.*

Family Fabaceae is a common type of vegetation grown in the forest area of the city, city parks and green belt. Selection of this type is based on several factors, among others, have characteristicwhich are easy to grow and have a good aesthetic value and can absorb pollutant elements (pollutants) derived from motor vehicle fumes [13].

Species which are found in large numbers are: *Swietenia mahagoni*4,520 individuals, *Pterocarpus indicus*2,386 individuals and *acaciamangium*1,134 individuals. *Swietenia mahagoni*is a species that is found in entire public green space, it indicates that this plant has a fairly wide distribution level and shows good ecological status in vegetation communities.

Carbon stocks were determined by measurement of tree biomass. Carbon stocks are 50% of the measured biomass of trees. The results of measurements of biomass and carbon stocks in public green open space in Pekanbaru city can be seen in Figure 1.

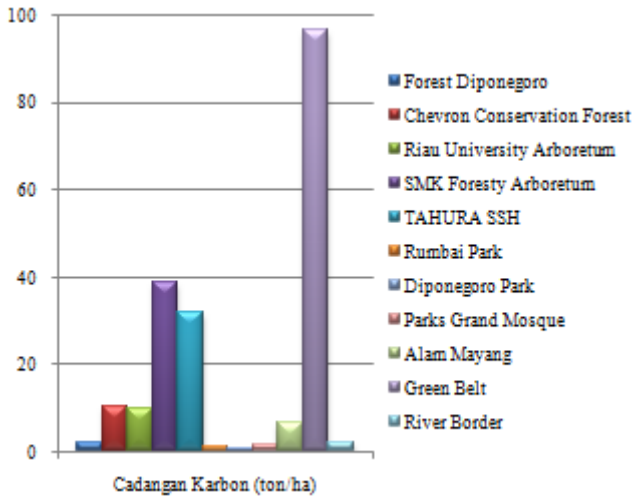

Figure 1: Total carbon stocks in public green open space of Pekanbaru.

Carbon stocks in public green open space ranged from 0.89 to 96.52 ton/ha. The green belt shows the highest of carbon stock of 96.52 ton/ha compared with other public green open space. This is related to the large number of individuals so thatit increases the value of basal area and affecting carbon stocks.

In addition to stem diameter, numbers of individual trees also affect the increase in carbon stocks through increased biomass [7]. Total carbon stocks are found 202.00 tons / ha. Thistotal of carbon stock is already including the carbon stocks in tropical forests. According to Murdiyarso [20], the numbers of carbon stock in tropical forests ranged between 161-300 tons/ha. Forestry Research and Development Agency [21], states that secondary forest carbon stocks ranged between 171.8 to 249.1 tons/ha. The results of the study from Japan International Cooperation Agency (JICA) [22],state that carbon storage in tropical forests of Asia is varying between 40-250 tons C / ha.

The huge numbers of average carbon stocks in vegetation are caused bythe dominant stands of tree which has varying diameters. The average oftress diameterscontributes to the amount of carbon stocks in stand of trees.

Carbon stock in a system of land use is influenced by the type of vegetation.Species that have a high value wood density, will have higher biomass when compared to land that has low wood density value [7]. The biomass will increase until a certain age (the increase in diameter is a reflection of increased age) and then increasingof biomass will decreaseuntilhalt in productivity (dead) [23].

The types of artificially planted vegetation or grow naturally in the forest demonstrate its ability to store carbon stocks in public green open spaces the city of Pekanbaru. *Swietenia mahagoni, Pterocarpus indicus, Shorea leprosula, Parasirianthes falcataria, Terminalia cattapa, Acacia mangium, Samanea saman, Mimusops elengi, Hopea mangarawan, dan Ixosanthes icosandra* are 10 types of vegetation that contribute to store carbon (Table 1).

Table 1: The types of vegetation that contribute greatly to the value of the carbon stock in a public green open space of Pekanbaru

No	Species Name	Total	Total W (ton/ha)	Total C (Ton/ha)
1	*Swietenia mahagoni*	4509	109,1	54,55
2	*Pterocarpus indicus*	2383	53,05	26,52
3	*Shorea leprosula*	73	41,16	20,58
4	*Parasirianthes falcataria*	119	36,99	18,5
5	*Terminalia cattapa*	744	15,68	7,84
6	*Acacia mangium*	1128	15,3	7,65
7	*Samanea saman*	407	9,44	4,72
8	*Mimusops elengi*	536	6,3	3,15
9	*Hopea mangarawan*	41	5,85	2,92
10	*Ixosanthes icosandra*	58	5,01	2,5

In an effort to reduce CO_2 emissions ofPekanbaru city, the vegetation that has good potential for creating environmental balance conditions is needed.It helps tocreate a carrying capacity of the region to function as a carbon sequestration while maintaining forests, parks, green belt as carbon sinks.It has duty as potential forlarge enough carbon reserves to create environmental capacity better.The types of vegetation which have a better potential for reducing air pollution level in the city of Pekanbaru by storing them as carbon sequestration.It also helps to maintain the balance of the environment so it would be able toreduce the effect of climate change.

5. Conclusion

Total carbon stocks in public green open space Pekanbaru City classified as moderate and included a range of carbon stocks contained in tropical forests generally. Maintaining and increasing the carbon stocks in public green open space in Pekanbaru city can be used as an effort to reduce CO_2 emissions from the atmosphere which is able to actualize the balanced environment.

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