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# Ability of Carbon Absorption in Urban Forest in Banda Aceh, Indonesia

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***Abstract:****The green open space in the urban area is diminishing, this situation will cause increased concentration of carbon dioxide and decrease the concentration of oxygen in the air. In order to prevent this condition from happening or at least be offset, a sufficient amount of green open space is needed so that the amount of carbon-absorbing vegetation is proportional to the amount of air pollutants, so the quality of the environment is well preserved. The benefits of green vegetation in the open space that is as producing oxygen and absorbing carbon dioxide through photosynthesis. Plants require carbon dioxide, water, and nutrients and sunlight for their survival. Plants convert carbon dioxide and water with the aid of sunlight (as a source of energy) to carbohydrates, oxygen, and water. These carbohydrates are stored in stems, leaves, flowers, twigs, and fruits, so that the carbon stored in plants (vegetation) can describe the amount of carbon dioxide absorbed by vegetation.*

***Keywords:****carbon, green open space, vegetation, absorption, forest*

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## I. Introduction

Banda Aceh is one of the cities in Aceh Province which has an area of 61.36 m2 with a population of 259,913 people (. As the capital of the province, Banda Aceh is notescape from all community activities. Increasing the number of high population (2.4% / year), will increase the need for housing and other construction and infrastructure facilities. The increase in the number of vehicles in Banda Aceh reaches 12,000-14,000 units per month. Increasing the number of these vehicles has an effect on increasing the use of fuel oil (Transportation Department of Banda Aceh City, 2017). Air pollution accompanied by increased CO2 in the air will be an unhealthy city environment, and can reduce human health, therefore CO2 gas concentration in the air should be attempted not to continue to increase. One way to reduce CO2 in urban areas is to reduce carbon emissions and build urban forests. Urban Forests are the most effective carbon sinks to reduce carbon emissions in the atmosphere. Plants contained in the forest City is able to do photosynthesis which is an important process in the role of carbon cycle and maintain CO2 in the atmosphere at the same time also play the cycle of oxygen.Based on information from the Gardening and Cleaning Agency of Kota Banda Aceh, the area of Green Open Space or City Forest available in 2015 is 612.06 Ha and the number of trees planted is 13,350 trees. The existence of green open space in the city of Banda Aceh is spread in some areas, but the existence of green open space has not been able to provide good ecological value to the air conditionThe results of the literature study found that the types of plants capable of storing large amounts of carbon to reduce the increase in CO2 emissions in the city of Banda Aceh is still very small. The type of plant grown in Banda Aceh City forest is not known to reduce CO2 capability, it is necessary to study the ability of urban forest as an anthropogenic CO2 gas absorbent (human activities), in order to maintain the clean air quality of Banda Aceh City in neutralizing the impact of air pollution for the achievement of quality air of clean Banda Aceh City.

## II. Data Collection Technique

Sample / tree sampling is done 2 times from each plant species repeated 2 times within 60 days (for significant changes in carbon storage) on the same tree. The design of field research using the Non Destructive Method (for upright plant) is one of the ways of estimating carbon without damaging plants by measuring the dry weight of tree biomass calculated using "allometric equation" based on stem diameter at breast height (1.3 m). In the first step of creating a plot size of 20m x 50m, which made the sub plot with a size of 10 m x 10 m (Hairiah 2007).According to Hairiah (2007), estimation of biomass above ground bias is measured using direct method (destructive) and indirect method (nondestructive). The indirect method is used to estimate tree biomass of $\geq$ 5 cm in diameter, whereas to predict tree biomass with diameter <5 cm (bottom vegetation) using direct method. To get the distribution of tree diameter (diameter $\geq$ 5 cm), then on the plot of 20m x 50m done census that enter the criterion of tree. After obtaining the description of the vegetation composition and the subsequent

diameter distribution selected a few trees Purposive which is expected to represent the spread of diameter and the existing type of location. Furthermore, the calculation of the biomass using non-destructive sampling methods, which do not damage it. Samples taken as much as 100 grams in each part of the vegetation component of the tree organ separating the young leaves with the old leaves (leaves and branches), then weighing the wet weight directly, then taken to the laboratory for drying using oven with temperature 800 C for 2x24 hour to obtain a constant dry weight and convert it to dry weight (biomass). Measurements and sampling are done twice in 60 days.

**2.1 Estimation of CO2 Absorption**

The estimated absorption of CO2 is carried out to determine the amount of carbon absorbed and stored in the tissues of a plant. Estimates of CO2 absorption through several stages of specific gravity, biomass, stored carbon, CO2 mass and absorption ability of each plant species.

**2.2 Measurement of Specific Weights**

Density of wood from each type of tree by cutting wood from one branch, then measure length, diameter, and weigh wet. Enter in the oven, at 80 $^{o}$C for 2x24 hours, and weigh dry weight. Calculate the volume and weight of wood type with the following formula:Value of tree stand biomass using formula (Mega, et.al. 2011):

$$Volume\ of\ Trees = \pi R^2 T$$

Where:
V = Volume Tree ($cm^3$)
R = The radius of the tree (cm)
T = Tree Height

**2.3 Biomass**

Biomass is an organic material produced by photosynthesis, both in the form of products and waste. Estimation of biomass stored in stands / trees using allometric equations (Ketterings 2001 in Hairiah 2007).

**2.4 Carbon Savings Measured**

After the biomass value in the tree has been found, next is the measurement of the stored carbon by determining the type of tree contained in the forest of Kota Benda Aceh. Estimates of stored carbon were carried out by formula (Brown, S. 1997 in Hairiah 2007):

CS = W x 0.46
Where:
CS = carbon stored in plants
W = Total Biomass

CO2 mass measurement is done by the formula:
CO2 Mass = Carbon Mass x 1.46

## III. Results And Discussion

Biomass content and carbon stocks have different amounts, this is due to uneven tree vegetation structure, ranging from tree species, growing places, planting forms that still accumulate, and uneven planting locations. According to Tyas (2008), Reduction of the number of trees per hectare does not reduce the amount of carbon uptake per hectare. This is due to the large increase in stem diameter, the number of leaves and the number of stomata. These differences greatly affect the absorption conditions of CO2 and stored carbon content. A land use system consisting of trees of a type with high wood density values, the biomass will be higher when compared to land of low density wood species (Hairiah et al, 2007).The many types of trees planted in an area can offset the amount of carbon that is free in the air.Carbon stock value reflects the carbon dynamics of different land use systems, which will be used to calculate the time averaged carbon above ground level on each system. Time averaged carbon depends on the rate of accumulation of carbon, maximum and minimum carbon stored in a land use system, time to achieve maximum carbon and rotation time (Hairiah et.al, 2007).

## IV. Conclusion

The amount of CO2 uptake is inseparable from the amount of biomass contained in the plant itself, because the organic material in the plant is not only contained in leaf organs, but in the stem organ also has

carbon stores, so the biomass in the stem has the largest contribution compared to the largest biomass other parts. This is because the stems store most of the stock of photosynthesis for plant growth. Each plant has different characteristics in absorbing certain gases in the air, so it can be a good buffer against air pollution. The process of CO2 absorption in plants occurs through the process of photosynthesis that occurs in plant organs containing chlorophyll. Plants require CO2 for their growth.Increasing the concentration of CO2 in the atmosphere, among others, will stimulate the process of photosynthesis, plants will reduce CO2 in the atmosphere through the process of photosynthesis and store it in plant tissue. Until the time carbon is refluxed into the atmosphere, the carbon will occupy one of a number of carbon bags. All components of the vegetation compounds both trees, shrubs, lianas and epiphytes are part of the top surface biomass (Riyadi, 2012). Carbon is also stored in dead organic materials and biomass-based products such as wood products both when used or already in the landfill. Carbon can be stored in carbon bags for long periods or only briefly.

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