POTENCY ESTIMATION ON OXYGEN PRODUCTION OF TREE STAGE VEGETATION AT THE HIMBA KAHUI URBAN FOREST IN PALANGKA RAYA

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ABSTRACT

The research aims to (a) know the composition and structure of tree stage vegetation, (b) calculate the estimation of biomass stock, carbon and CO_2 sequestration on the tree stage vegetation, (c) calculate the estimation of O_2 produced from the tree stage vegetation, (d) analyze O_2 supply needed by Palangka Raya residents related to the number of O_2 produced by the tree stage vegetation. The research was conducted on Himba Kahui Urban Forest in Palangka Raya, located administratively at Petuk Katimpun, Bukit Tunggal and Palangka Sub-District on Jekan Raya District and also at Rungan Sub-District, Pahandut District. The object to study was the tree stage vegetation (stem diameter ≥ 20 cm), meanwhile the measurement estimation on biomass stock, carbon, and CO_2 sequestration and O_2 potential was worked with non destructive method using equation by Krisnawati, et. al. (2012), SNI 7724 (2011) and IPCC (2006). The result of this research indicates the number of the tree stage vegetation variants from 13 families and the dominance of Perupuk tree variant (Lophopetalum multinervium) with Important Value Index (IVI) at 36.65%. The highest vegetation density was dominated by diameter class of 25-29 cm (horizontal structure) and height class of 13-15 m dominated by vertical structure. The biomass stock, CO_2 sequestration and O_2 potential production of tree stage vegetation is 39.58 ton/ha, 18.60 tonC/ha, 68.28 tonCO_2/ha and 49.84 tonO_2/ha respectively. The need of O_2 supply for Palangka Raya residents in 2014 was 217.82 tonO_2/day or 217.820 kgO_2/day and can be supplied by the O_2 produced by the tree stage vegetation at Himba Kahui City Forest in Kota Palangka Raya.

Keywords: *city forest, Palangka Raya, oxygen, trees*

INTRODUCTION

Construction development in urban areas emerges particular problems, such as the increasing intensity on built up area and decreasing numbers of green spaces. It affects on the downturn of the urban environment quality which is indirectly impacting on the urban living quality. Green space is an extended and/or clustered area/track, which use is more to open space, plant growing area, both natural and planted by purpose (Law of the Republic of Indonesia Number 26 of

2007). Dahlan (2004), urban forest is namely a part of urban green space which consists of tree vegetated area which is reinforced as the urban city area and non urban city green space such as forest, farm, bushes, and grass areas. The existence of the green urban forest in urban areas is significant to support city continuity reviewed from ecological aspects such as carbon dioxide (CO_2) sequestration and oxygen (O_2) supply, where oxygen is the basic need which is absolutely needed by a city for its residents, motorcycles, cattles, and industries

Rapid development and economy increase in Palangka Raya bring positive impacts on the society welfare. Nevertheless, on the other side, the development and economy increase noticed from more new settlements, shopping blocks, transportation and other supporting facilities, have the effect to decreasing environment quality. The negative effects among others are the shrinking of vegetated land covers therefore it influences the availability of O_2 and the inclining rate of carbon dioxide (CO_2). The presence of urban forest in Palangka Raya, Himba Kahui, which is established by the Decree of Palangka Raya Major Number 98 of 2010 dated on 17 April 2010 for about ± 1.635 ha, is expected to be able to increase the life quality in society that is considered potential in producing O_2 indirectly. However, until this time, any data about O_2 rate that can be produced by tree stage vegetation of urban forest in Palangka Raya has not yet been available.

The objectives of this research are (a) to know the composition and structure of tree stage vegetation, (b) to calculate the estimation of biomass stock, carbon and CO_2 sequestration on the tree stage vegetation, (c) to calculate the estimation of O_2 produced from the tree stage vegetation, (d) to analyze O_2 supply needed by Palangka Raya residents related to the number of O_2 produced by the tree stage vegetation at the Himba Kahui Urban Forest in Palangka Raya.

METHODS

Location and Period

The research is located at Petuk Katimpun, Bukit Tunggal and Palangka Sub-District on Jekan Raya District and also at Rungan Sub-District, Pahandut District administratively. The period of research was conducted on November 2016. Research location map is describer on Figure 1 as follows.

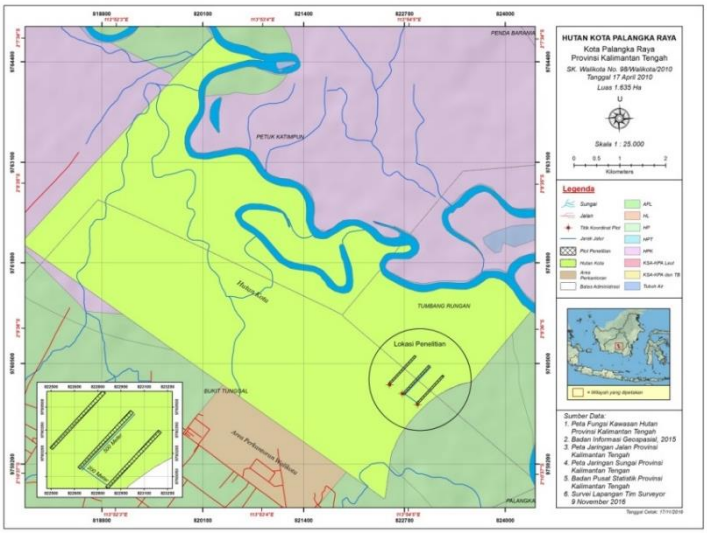

Figure 1. *Research location map*

Objects and Equipments

The object of research was tree stage vegetation (diameter ≥ 20 cm) located at the Himba Kahui Urban Forest in Palangka Raya. Materials and equipments consist of paint, ropes, compass, GPS, *phiband*, 50-meters gauge, hagameter, clinometer, altimeter, machet, wooden poles, permanent ink marker, large brush, stationery, camera, and *tally sheet*.

Procedure of Research

Data in the workfield was collected by survey method using vegetation analysis technique on Observation Sampling Plot. The plot measure was about 3 sampling plots (± 3 ha) of 20 m x 500 m with 200 m in between plots. The vegetation analysis applied the transect method extended for about 500 m each. The plot was located by using *purposive* sampling with recorded parameter consisting tree variants, stem diameter measured 1.3 m from the ground, total height and the numbers of trees.

The calculated data variable comprised of composition and structure, estimation on biomass stock, carbon, CO_2 sequestration and O_2 supply of tree stands using the formulation by Soerianegara and Indrawan (2005), Krisnawati, *et. al*., (2012), SNI 7724 (2011) and IPCC (2006).

RESULTS AND DISCUSSION

Composition and Structure

The Himba Kahui Urban Forest of Palangka Raya is an area of secondary peatland forest which always being inundated because of the tide of Kahayan and Rungan River on high rainfall season (Forestry and Plantation Agency of Palangka Raya, 2011). Based on the workfield identification, the number of the tree stages vegetation found at the urban forest is as many as 19 variants of 13 families. Data on the tree variants and families found at the Himba Kahui Urban Forest of Palangka Raya is depicted on Figure 2.

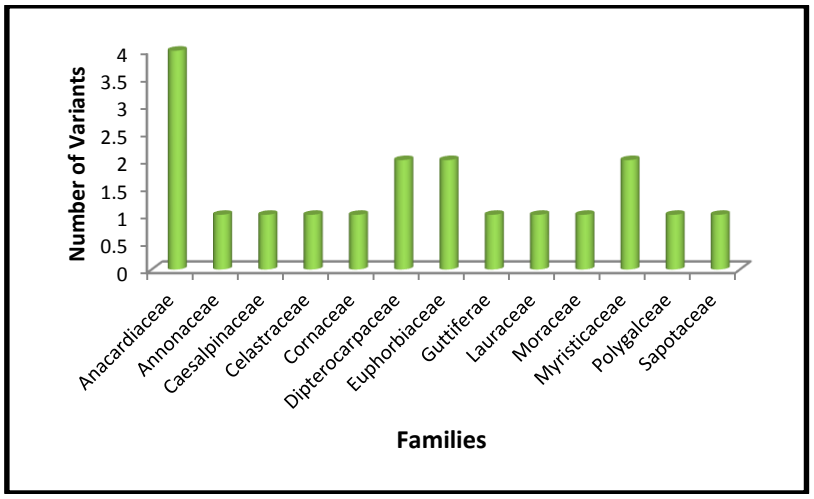

Figure 2. *Data on the tree variants and families found at the Himba Kahui Urban Forest of Palangka Raya*

The diversity on the tree stage vegetation found at the research site is included in low category if compared to the result of research by Sudaryanti, *et. al*. (2014) on peatland forest at Baning Natural Park, Sintang Regency, West Kalimantan as many as 39 variants with 3.64 ha of research plot area. The condition occurred since the peatland forest at the Himba Kahui Urbang Forest is the degraded area of former logging concession of PT. Kayon Timber yang kondisinya sudah *terdegradasi*. Tree stand dominance can be indicated from Importance Value Index (IVI). The variant of Perupuk tree (*Lophopetalum multinervium*) is the major variant at the research site with its IVI at 36.65 %. Anonymous (2013) states tthat the tree species dominating the rainfall or river inundated swamp is Perupuk (*Lophopetalum multinervium*), Terentang (*Campnosperma auriculata*) and Jambu-jambuan (*Eugenia muelleri*).

Structure of forest stand is an aged distribution and or diameter and crown classes (Daniel, *et. al*., 1995) and generally consists of horizontal and vertical structure. The horizontal and vertical structure graphic is shown on Figure 3 and 4.

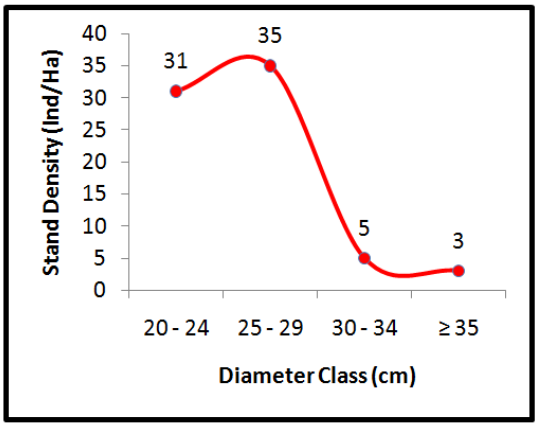

Figure 3. *Horizontal Structure of Tree Stand*

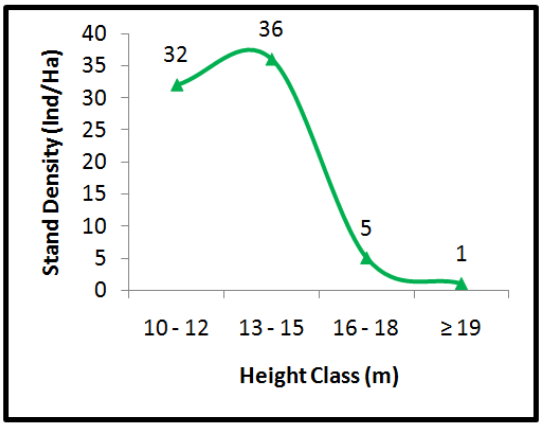

Figure 4. *Vertical Structure of Tree Stand*

The distribution on the diameter class of tree stage vegetation on Image 3 shows a fluctuating pattern where the density of the tree stage density dominated by 25-29 cm diameter class (35 ind/ha), followed by 20-24 cm diameter class (31 ind/ha), 30-34 cm diameter class (5 ind/ha) and the lowest density on ≥ 35 cm diameter class (3 ind/ha). The total density of the tree stage vegetation on the research site of 74 ind/ha with 12.62 m^2/ha basal area. The low density of the tree stage vegetation at the site is presumably happened because of disturbed peatland forest and slow recovery of the peatland therefore influence to the slow succession. Wibisono, *et. al*. (2009) states that peatland forest is a fragile ecosystem, by means the forest is prone to disturbance and damage, if being damaged it will be difficult to recover to its previous condition. Meanwhile the height class distribution on the tree stage vegetation (Figure 4) shows the close pattern to the diameter class distribution. The density of tree stage vegetation is mainly dominated by the height class 13-15 m (36 ind/ha), followed by 10-12 cm (32 ind/ha), 16-18 m (5 ind/ha) and the lowest density is at ≥ 19 m (1 ind/ha) height class.

Biomass and Carbon Stock

Data from biomass and carbon stock calculation on tree stage vegetation above ground level and below is shown in Table 1.

Table 1. *Biomass and carbon stock calculation on tree stage vegetation above ground level and below at the Himba Kahui Urban Forest of Palangka Raya*

Category	Above ground level (ton/ha)	Below ground level (ton/ha)	Total (ton/ha)
Biomass Stock	28.89	10.69	39.58
Carbon Stock	13.58	5.02	18.60

Percentage of biomass and carbon stock above the ground level on tree stage vegetation tend to be higher (± 73%) compared to the stock below the ground level/root (±27%). The high percentage of biomass and carbon above the ground is closely related to the production obtained from photosynthesis generally store in the stem. In general, the stem has more wood composition material than the other parts of tree. The wood composition material can cause the cell of the stem containing much of organic material as wood composition component than the water therefore the mass of biomass and carbon stock of the stem gets more substantial. Widyasari, *et. al.* (2010) states that the biggest biomass contribution is on the tree stem around 68,09-82,28 % from the total biomass of the tree.

The total stock of biomass and carbon on the tree stage vegetation at the Himba Kahui Urban Forest of Palangka Raya is much lower compared to the biomass and carbon stock at the urban forest in Pekanbaru; each for 87,114 ton/ha and 40,94 tonC/ha (Lubis, *et. al*. 2016).

Carbon dioxide Sequestration

Carbon dioxide (CO_2) is one of the materials in the plant photosynthetic process to produce carbohydrate. The produced carbohydrate will be distributed and stored up to all parts of tree stand components (leaves, branch, radials, stem, root, fruit, and flower) in the form of biomass. The vegetation biomass on the tree stage vegetation is the total materials of the tree stands that have 47 % organic carbon (SNI 7724, 2011). The organic carbon stock of the living tree stand can be used to depict the amount of CO_2 from the atmosphere absorbable by the tree stage vegetation (Hairiah, *et. al*, 2011).

Based on this research, the tree stage vegetation at Himba Kahui Urban Forest of Palangka Raya is able to sequestrate CO_2 for about 68.28 tonCO_2/ha. The amount of CO_2 sequestration is categorized to be lower if compared to the urban park and forest in Pekanbaru for about 79.99 tonCO_2/ha (Wulandari, 2016). The reason is that the estimation of the CO_2 sequestration calculation is only on the tree stage (stem diameter ≥ 20 cm), not mentioning ground, sampling and pole stage vegetation. However, the Himba Kahui Urban Forest in Kota Palangka Raya that extends for 1.635 Ha is predicted to be able to sequestrate CO_2 as much as 111.637,8 tonCO_2 (assumed that the tree stage vegetation condition in all location are almost similar with the research plot).

Oxygen Production Potential

Vegetation of forest composition is one of the oxygen producing factors which is essential for living creature on earth for viability. The tree stage vegetation is one of the forest compositions that have potential to produce O_2 through photosynthesis.

Based on this research, the tree stage vegetation at Himba Kahui Urban Forest in Palangka Raya is able to produce O_2 as much as 49.84 tonO_2/ha estimating each tree variant will produce 0,33 - 7,65 tonO_2/ha. Each tree variant has different capacity in supplying O_2, in which, the difference is influenced by biomass and carbon stock and CO_2 sequestration. The potential of O_2 production is positively correlated with the biomass and carbon stock and CO_2 sequestration. The higher are the biomass and carbon stock and CO_2 sequestration, the higher the potential of O_2 supply.

Analysis on the Oxygen Needs of the Residents in Palangka Raya

The Central Bureau of Statistic (Badan Pusat Statistik) of Palangka Raya (2016) states that the total residents of Palangka Raya in 2014 are 252.105 population with growth as much 6.49 %. Projected in 2016, the population will grow to be 267.757 people. The research by Herliani (2007) *in* Sesanti, *et. al*., (2011), human needs O_2 at daily basis for about 0.864 kg/person/day. Therefore, the O_2 needed by the residents in Palangka Raya in 2016 is as much as 231.342 kg/person/day atau 231.342 kg/person/day.

The range of the Himba Kahui Urban Forest in Palangka Raya is as large as 1,635 ha, with the O_2 production potential of the tree stage vegetation as much as 49.84 tonO_2/ha, moreover predicted to be able to supply O_2 as much a 81,488.4 tonO_2/day (assumed that the tree stage vegetation at the Himba Kahui has similar condition to the research plot). In other words, the need of O_2 for the residents of Palangka Raya can be achieved with the O_2 produced by the tree stage vegetation at the Himba Kahui Urban Forest.

CONCLUSION AND SUGGESTION

Conclusion

a. The number of the tree stages vegetation found at the Himba Kahui Urban Forest of Palangka Raya is as many as 19 variants of 13 families and dominated by the variant of Perupuk tree (*Lophopetalum multinervium*).
b. The biomass and carbon stock of the tree stage vegetation are 39,58 ton/ha and 18,60 tonC/ha, meanwhile the CO_2 sequestration is as much as 68,28 tonCO_2/ha respectively
c. The O_2 potential production of the tree stage vegetation is 49,84 tonO_2/ha
d. The O_2 needed by the Palangka Raya residents in 2016 can be supplied by the O_2 produced by the tree stage vegetation at the Himba Kahui Urban Forest.

Suggestion

Further study is needed related to the biomass and carbon stock, carbon dioxide sequestration and the oxygen supply potential of the tree stage vegetation of ground, sapling and pole stage at the Himba Kahui Urban Forest in Palangka Raya.

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