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Ecological Evaluation on Several Green Open Spaces in Jakarta

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Abstract

Urban development in the past until now tended to minimize the green open spaces and eliminate the natural feature. The condition of the urban environment become economically developed, but ecologically declined. Among environmental problems arise are rising urban air temperature, air pollution and declining soil absorption. This study aims to evaluate the environmental performance of the green space in the urban areas, especially in the Central and South of Jakarta, Indonesia. The area of study selected are considered the well-known green space in Jakarta, that is Menteng, and Suropati Parks in the Central Jakarta and Ayodya and Langsat Parks in the South of Jakarta. The study is carried out through secondary data and field survey. The study indicates that Suropati, Langsat and Park have a potential in filtering air pollution because of their trees inside. Otherwise, Ayodya and Menteng have less because their trees are not so dense that the two parks before. The Langsat Park also has a potential in facing floods because of its positions and river pass by. The other three parks have similar role that is only absorbs water when floods occur. The microclimate condition also stands for Langsat parks because of its geographical position and trees surrounding in the area and inside are enough for reducing air temperature.

Keywords: A Urban development; urban parks; environmental performance.

1. Introduction

Indonesia is often referred to as the world's largest archipelago, a name which aptly represents its 17,000 islands. These are scattered over both sides of the equator. The islands span more than 5000 km (around 3,200 miles) eastward from Sabang in Northern Sumatra to Merauke in Papua.

The archipelago of Indonesia is located between Asia and Australia continent and between Indian and Indonesia Ocean. Indonesia lies between latitudes 6°N and 11°S, and longitudes 95°E and 141°E.



Fig 1: Map of Indonesia (petabesar. blog spot.com)

The climate of Indonesia is almost entirely tropical. The main variable of Indonesia's climate is not temperature or air pressure, but rainfall. The area's relative humidity ranges between 70 and 90%. Winds are moderate and generally predictable, with monsoons usually blowing in from the south and east in June through September and from the northwest in December through March.

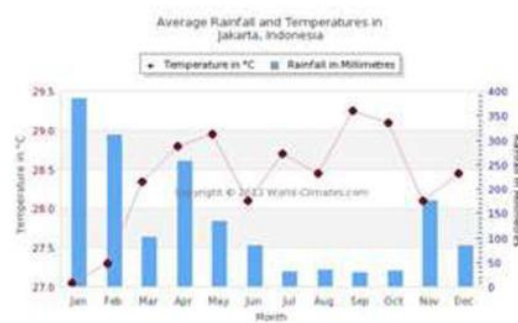


Fig 2: Average rainfall and temperatures in Jakarta, Indonesia (world climate.com)

The uniformly warm waters that make up 81% of Indonesia's area ensure that temperatures on land remain fairly constant, with the coastal plains averaging 28°C, the inland and mountain areas averaging 26°C, and the higher mountain regions, 23°C. Temperature varies little from season to season, and Indonesia experiences relatively little change in the length of daylight hours from one season to the next.

Jakarta is the capital city of Indonesia. It is one of the hottest and most humid capitals in the world. It is always hot and to some extent, and humid. The period from October to February is the wet season when at least some rain falls each day, often in short, torrential bursts. It rarely rains at all during the remaining months. Average daily temperatures range from 25°C to 31°C (80°F to 90°F).

Jakarta government continues to promote the expansion and development of green open space to meet the minimum standards required by Spatial Planning Legislation no. 26 year 2007. However, the presence of green open space now is need to be

evaluated in view of Jakarta ecological problems such as floods, environmental pollution and the increasing ambient temperature. According to Ministry of Public Works, green open space is defined as an elongated area/line or in groups, whose use is more open, place for growing crops, both of which grow naturally or are deliberately planted. Meanwhile, Green Open Space Urban Area is defined as part of an urban open space which is filled by plants and crops to support ecological, social, cultural, economic, and aesthetic benefits.

Moreover the regulation Ministry of Public Works (2008), stated that there are three function of the green open space that is ecological, social, cultural, aesthetics, and economical. All these function are needed by the residence of the city (The Ministry of Public Works Republic of Indonesia Legislation, 2008).

2. Location of the Study

Green open spaces selected are which popularly known and well visited in Jakarta Province. These locations are spread in three districts of Jakarta, which is The Central, West and South district of Jakarta. The green open spaces are as follows: Menteng and Suropati Park in the Central of Jakarta [7]; Cattleya Park and Srengseng Urban Forest in the West of Jakarta; Ayodya and Lansia Langsat in the South of Jakarta.

The park of Menteng, Suropati, Cattleya and Ayodya are planned green spaces. While, Srengseng Urban Forest and Lansia Langsat are unplanned green space (natural green spaces). The location of Menteng and Suropati Park are relatively close each other, that is only 200 meters away. These two parks are always well-visited weekdays. In weekend many people visit these locations especially in the morning and afternoon for recreation and sports.



Fig 3: The location of Menteng park in the Central of Jakarta. (source: <http://www.streetdirectory.com/indonesia/jakarta/>)



Fig 4: The location of Suropati park also in the Central of Jakarta. (source: <http://www.streetdirectory.com/indonesia/jakarta/>)



Fig 5: The location of Cattleya park in the West of Jakarta. (source: <http://www.streetdirectory.com/indonesia/jakarta/>)



Fig 6: The location of Srengseng park also in the West of Jakarta. (source: <http://www.streetdirectory.com/indonesia/jakarta/>)



Fig 7: The location of Lansia and Ayodya park also in the South of Jakarta. (source: <http://www.streetdirectory.com/indonesia/jakarta/>)

On the other hand, Srengseng Urban Forest and Cattleya Park is located 15 km away from Suropati and Menteng Park. However, Cattleya Park and Srengseng Urban Forest are divided by 10 km away. The Cattleya Park is a newly developed park, while Srengseng Urban Forest is the old park.

The location of the parks in the South of Jakarta are also 15 kilometers away from the parks in the Central of Jakarta. The location of Ayodya and Lansia Langsat Park are very close each other. These two parks are only divided by Barito Road.

3. Methodology

The methodology of collecting data in this study is divided into two, namely primary and secondary. The primary data obtained from the field or sources directly, while secondary data is the data that is retrieved from a second source.

Methods of collecting primary data is carried out by field observation. Secondary method data collection is carried out by searching for relevant literature in the form of previous studies on

green open space and related studies to obtain performance indicators to assess the ecological functions of green space as a form of micro-climate control cooling and water absorbent.

4. Result and Discussion

Physical Analysis

The urban park of Menteng and Suropati has the area of 3 Ha and 5 Ha each. The characteristics of the park of Menteng are generally divided into two parts, vegetated area and field area. The park of Suropati is dominated by huge and old trees like Mahagoni and Kechik. The small trees are intended to replace the old trees in the future. The characteristics of the ground cover are paved open spaces and earth surfaces. Lansia Langsat and Ayodya Park has the area of 3.8 Ha and 0.68 Ha. The characteristics of Lansia Langsat Park is dominated by shade trees and shrubs and other green area. Facilities available here as jogging track, children's playground, foot therapy, a fish pond and others. It is also characterized by the river which divides the park. Trees that are available in Lansia Langsat Park are Flamboyan, Kupu-Kupu, Dadap Merah, Karet Jati mas, Beringin, Ketapang, Trembesi, Sawo Kecil, Bisbul, Angsana, Tanjung Kaya, Glodogan. The number of shade trees are 576 trees. The area is 38,344.77 m².

Table 1.: Value coefficient of soil permeability

Closure type land	Avoid water seepage rain	Coefficient Run-off
Street asphalt, concrete, nts	70% - 95%	0.70 - 0.95
Street rocky (paving block)	50% - 70%	0.50 - 0.70
Rocky road with 50% grass in between (grass block)	60%	0.60
Gravel roads	50%	0.50
Useful plants, plant city	5% - 15%	0.05 - 0.15

Cattleya Park and Srengseng Urban Forest has the area of 3.8 Ha and 15 Ha. Cattleya Park is dominated by green area, shrubs and trees from various species. Moreover Srengseng Urban Park is mostly of forest look like where many varieties of plant species grow here, from lowland to highland plants.

Cattleya Park is located in S Parman Road, the West of Jakarta. It is developed in 2006. Trees that are available in Cattleya Park are Trembesi (*Samanea saman*); Jakaranda (*Jacaranda acutifolia*); Kecrut (Spathodea campanulata); Beringin (*Ficus benjamina*); Yangliu; Glodogan Tiang (*Sarraca* sp)

Comfort analysis

Vegetation contained in each park is different in terms of the amount and the type and formation. However, in general gardens urban forest characteristics that become the object of study have the percentage of vegetation with the type of trees that are more than the other types such as bushes, shrubs, and palms. Trees growing in gardens consist of height and width of the rod is diverse. The most shady park is Srengseng Urban Forest, Lansia Langsat, then Ayodya, Suropati, Cattleya Parks, and lastly Menteng Parks. Similarly, the shape and type of leaf canopy and rooting. However, when seen in the field and based on data from the plant species and Cemetery Office of Jakarta and other park managers, it can be seen that most of the trees have root riding. Meanwhile, the vegetation that grows on Suropati park is dominated by species of palm, shrubs, and some bamboo and trees.

Table 2.: Run-off coefficient value on some land cover

Type of soil	Permeability coefficient soil
Grave	7.0 cm / sec
Sand	10 - 0.01 cm /sec
Silt	0.01 - 0.00001 cm/sec
Clay	<0.00001 cm/sec

A good tree canopy to absorb heat is a dense tree canopy, can be seen to intersect between the canopy and the six objects continue. Trees studied generally have editorial meetings and continuous contact with diverse forms such as spreads, round and dome with the leaf surface width and dense.

Furthermore, based on criteria such as the aspects under consideration is known that five of the six green open space which is the object of study has been able to function well in controlling the temperature and absorb heat. Five green open space that is the Suropati, Cattleya, Lansia Langsat, and Ayodya Parks as well as Srengseng Urban Forest; while Menteng Park not fulfill that function because it is dominated by the hard surface field. On the other hand, the trees still short so that heat absorption is not too pronounced. In terms of ability to absorb water, whole green open space are meet the specified criteria. This can be seen from soil permeability and absorption capability on land cover other.

Trees characteristics

Vegetation that has the largest CO₂ absorption capability which is contained in the object is Trembesi the absorption ability of 28488.00 kg /tree/ year. Vegetation grows in Park Menteng and the Lansia Langsat. Mahagoni next vegetation that has CO₂ absorption capability of 295.73 kg /tree/ year growing at Suropati Park. Jati (*Tectona grandis*) 135.27 kg/tree/year in Menteng Park and Lansia Langsat Park. Besides, there are also vegetation Sawo Kecil (*Manilkara kauki*) with the absorption of 36.19 kg / tree/ year in Surapati Park and Lansia Langsat Park. . Other vegetation that has high CO₂ absorption rate that grows on the sixth of this park is Mahogany with absorption of 295.73 kg / year; Teak with absorption of 135, 27 kg / year, jackfruit with the absorption of 126.51 kg / year, Johar with the absorption of 116.25 kg / year; Acacia with absorption of 48.68 kg / year; Flamboyant with absorption of 42.20 kg / year; and Angsana with the absorption of 11.12 kg / year. In Ayodya Park and Langsat Srengseng Urban Forest. Srengseng managed to absorb CO₂ of 88.15 tonnes / ha of atmospheric city with srengseng tree carbon stocks by 24.04 tonnes / ha.

Green open space can reduce greenhouse gas emissions such as CO₂ caused by various activities in urban areas. It absorbs the gas and converts it into oxygen through photosynthesis process with the use of sunlight. Each one hectare green space planted with trees, shrubs, and ground cover with the amount of leaf surface of about 5 hectares, there will be imbibing around 900 kg of CO₂ and O₂ release about 600 kg within 12 hours [2]. By doing so, the increase in heat occurs can be reduced. In addition, Green Open Space also has ecological function like water catchment areas.

Green open space with an area of at least half a hectare can hold runoff as a result of rain and seep water into the ground as much 10. 219 m³ per year [3]. The plant roots system on the green open space can restrain the rate of ground water and reduce erosion rates with reduce the flow of surface and groundwater in maintaining environmental conditions. In a rainy season, the flow rate can be controlled by the surface vegetation contained in the green open space, whereas in the dry season, available soil water potential can be reserves of water for the urban environment and reduce the occurrence of drought.

Vegetation on green open space can provide coolness in areas of warming due to the reflection of the sun's heat that originates from buildings, asphalt, steel, and other things. Vegetation in urban design is an important factor to be considered related to issue of environmental degradation such as soil, water, air, and the city weather quality [4].

5. Conclusion

The aim of this study was to assess the ecological functions of green open space in urban areas in an effort to decrease the temperature and the absorption of water in urban areas, in this case is Jakarta. Based on these objectives, there are three objectives supporting research to achieve the objectives that have been formulated. The study was conducted by analyzing the criteria and benchmarks and is determined using a checklist to determine whether the object of research has met the criteria set.

From the study can be concluded that :

1. Parks studied have the potential to absorb CO₂ from the atmosphere because they have specific and number tree;
2. Parks have a good water absorption because they have area which sufficient to absorb rainwater into the ground
3. The park which has more pavement areas, the process of water infiltration can be executed well with biopori

The parks which have wide canopies and meet each other on the top will be able to lower environmental air temperature.

Acknowledgements

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