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Research paper

Vegetation Dispersion in Green Open Space of Universitas Pendidikan Indonesia

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Abstract

A study on the implementation of eco-campus in terms of vegetation suitability in green open spaces at Universitas Pendidikan Indonesia (UPI) had been conducted. The purposes of the study were to analyze the actual condition the vegetation in green open spaces at UPI and to analyze the suitable vegetation to be implemented in green open spaces at UPI to support eco-campus. The study employed a descriptive design using cross section approach which studies a certain object in a certain period of time. To distribute the plants, this study used block unit mapping with the help GPA and a program namely ArcGIS. The results of the study show that most (43.51%) of the existing plants at UPI were herbs; 32.82% of them were trees, 18.32% were shrubs, and 2.29% were bushes. In the meantime, in terms of the plants' function, most of the vegetation at UPI were decorative plants (34.35%), followed by medicinal plants (15.27%) and crops (14.5%). In addition to the aforementioned categories, there were 131 species of vegetation around UPI which mostly lied in the east side of the campus particularly around Isola building. Some of them were Filicium decipiens, Pinus merkusii, Barringtonia asiatica, Artocarpus altilis, Terminalia catappa, Agathis dammara, Lagerstoemia flos-reginae, Tabebuia capitata, Cassuarina equisettifolia, Mangifera indica, Delonix regi), Bougainvillea spectabillis, Muntingia callabura, and so on. Some were also plants that could only found in certain places such as Elaeocarpus grandiflorus, Mimusops elengi, Altingia exelsa, Elaeocarpus sphaericus, Pterocarpus indicus, Samanea saman, Claoxylon polot, Tectona grandis, Flacourtia inermis, Garcinia mangostana, Ponentia pinnata, Sandoricum koetjape, Brunfelsia uniflora, and Alstonia sholaris. Based on the results of the study, it was also proven that the distribution of the vegetation at UPI was uneven; it focused on certain areas such as gardens and main roads.

Keywords: *Vegetation dispersion green open space; UPI*

1. Introduction

Global warming has been believed to draw the world's attention since it affects the temperature that is influential to the environment and the weather. Unfortunately, human activities are considered "contributive", either directly or indirectly, to the greenhouse effect that plays a big role in global warming. Some of the impacts of this are long-lasting hot climate, abnormal rainfall intensity, flood, ecological issues, and heat stroke – related diseases and even death.

Eco-campus generally means campuses that have adequate understanding of its environment. Terminologically, "eco" derives from "oikos" which means house, environment, and nature. Thus, eco-campus can be defined as a campus that is also a house whose all related components in it feel comfortable and useful to each other. Eco-campus program, which is sometimes called green campus program, is an attempt to draw both local and global issues to campus activities. One of the efforts in this program is reforestation or tree planting within campus area to decrease global warming. In UPI, the efficiency of green open space use is in need of serious attention. A study by [1] reveals that UPI has 112 green open spaces in total which lie on a 24.124 Ha area (57.624% of green open space and 42.376% of non-green open space. Thus, based on the data, it can be concluded that the width of green open spaces at UPI exceeds the minimum required width of green open spaces (30%).

Green open spaces generally consist of a variety of plants or vegetation that have been selected so that they suitable to the area as well as to the purpose of the area as planned in advance. Meanwhile, vegetation usually contains various plants which interact with each other, either among each type of vegetation itself or with a system dynamically grows around the area [2].

At UPI, types of plants in the vegetation need further analysis so that it is in accordance with the physical condition and functions of the environment around UPI. The main functions green open spaces cover architectural, social, and economic aspects. Balance in ecological system in a metropolitan city will create more health and humanity [3]. Moreover the selection of plants in green open spaces should take several factors as temperature, humidity, and beauty of the surroundings into consideration [4, 5]. Previous study has found that the surface temperature caused by solar radiation in UPI is higher compare with the residential area in Tamansari and industrial area in Cigondewah. Even the proportion of vegetation ratio is higher, but it has not spread enough within the UPI's area [6].

Based on the main function of landscape in general that plants function as visual control, physical barriers, climate control, ero-

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sion control, and aesthetic values [7]. Furthermore, vegetation has several important factors of city forest such as gardens, green areas, river banks, sport fields, and funerals also need to be pain attention [8].

Considering the aforementioned reasons, this study investigates the implementation of eco-campus in terms of the vegetation suitability in green open spaces at UPI. The study mainly aims at investigating the actual condition of vegetation in green open spaces at UPI and analyzing the suitable vegetation to be implemented in green open spaces at UPI to support eco-campus.

2. Methodology

An easy way to comply with the conference paper formatting requirements is to use this document as a template and simply type your text into it. This study administers Cross Sectional research in which there is merely one-shot investigation of a certain object in a period of time. Based on this criterion, this study is a descriptive type trying to depict how big the issue is. Moreover, since this is a descriptive study, this paper aims at describing certain behaviors and factors of a particular population systematically, factually, and accurately. Meanwhile, the research design used in this study is a survey which gives quantitative explanations of either the population or sample of the study through the data collected from each vegetation plot. To collect the data, here are some instruments employed in this study: 1) literature study, as supporting data, 2) interview, as a direct communication technique to acquire data from the manager(s) of green open spaces at UPI, and 3) observation, as a direct field study to find out the suitability of the vegetation in each faculty and working unit at the campus.
Vegetation data are collected in each plot of the faculty, working unit, and green open spaces at UPI. The data themselves are based on plants' locations and names. To determine locations, this study uses GPS (Global Positioning System) and to map it out, this study uses a geographical information system application namely ArcGIS. This application works to synchronize the position on the map using satellite images.

3. Finding and Discussion

3.1. Site

The site of the research is a campus namely Universitas Pendidikan Indonesia (UPI) located at Jl. Dr. Setiabudhi, Bandung, Indonesia. The altitude of the campus is 930-967.5 m dpal and the coordinate is 6o 51' 26,81" LS – 6o 51' 53,23" LS and 107o 35' 15,15" BT- 107o 35' 46,12". The width of the campus is 37,3574 ha and the campus is mainly surrounded by settlement, business (trade) centers, and lodgings (dormitories).

3.2. Geophysical Condition of UPI

The distribution of vegetation is influenced by the climate condition around the area of vegetation such as temperature, rainfall intensity, soil, altitude, and other geophysical factors. Of all the factors mentioned above, climate plays the most important role in comparison with the others. Thus, Koppen [9] supposes that there is a similarity between the distribution of vegetation and that of climate. Temperature, in the meantime, is closely related to altitude. Some meteorological experts even divide the distribution of vegetation according to altitude, as Junghum [10] proposes.

Temperature and Rainfall Conditions: UPI's altitude lies between 930 – 967.5 M dpal. With this position, the temperature around the campus is categorized cold (about 250 Celsius). This freshness is also supported with green open spaces that are more than 30% of the campus area. Lying on that area are a variety of plantation so that in terms of radiation, it is very possible that more than half of the radiation is absorbed by the campus land. In relation to the rainfall, UPI reaches 2065 mm per year. These factors give contribution to the cold and fresh weather around the campus.

Topographical Condition: The contour of UPI is not flat. The lowest point is 930 M dpal and the highest one ie 967.5 M dpal; the difference between the lowest and the highest points is 37.5 M. In general, the north side of the campus is higher than the south one. Thus, UPI is supposed to have a good drainage system to avoid inundation.

3.3. Condition of Vegetation at UPI in Terms of Its Habitus and Benefits

In an attempt to promote eco-campus, such aspects as habitus and benefits of the vegetation need to take a look at. There needs to be a variety of trees and shrubs to meet the diversity of species in the area. In addition, the needs also the be plants with various benefits to support the eco-campus.
Habitus: In botany, habitus is believed to show the architecture of plants. In UPI, the distribution of habitus comprises herbs, bushes, shrubs, and trees. Shrubs are a type of plants which is quite short and having strong wooden stems sustaining other parts. Bushes, in the meantime, are categorized into plants having equal stems. This type of plants is generally less than 8 M. Herbs are a type of plants with a little or even no secondary parts (without woods/ stems) but still standing strong. Trees; however, are a type of plants with strong woods or stems. Some of them are dicotyledonous, which can split into a lot of pieces, and some others are monocots, which can only split into one piece. The table below shows that the most species of plants at UPI is herbs (43.51%) followed by trees (32.82%), shrubs (18.32%), and bushes (2.29%). The fact that herbs as the most frequently-found type of plant at UPI is understandable since this type appears as a decorative plant and smaller than trees and either are shrubs. From the results above, it can also be seen that the composition of the plant species at UPI, in terms of habitus, is balanced. Bushes, as the least frequently-found type of plant at UPI vegetation, were considered non-decorative plants. This might be one of the strongest reasons, it is the least frequently-found plant at UPI.

Table 1: Habitus of Planes at UPI in 2013

No	Habitus	Frequency	Percentage (%)
1	Herbs	57	43.51
2	Shrubs	24	18.32
3	Trees	43	32.82
4	Bushes	3	2.29
5	Uncategorized	4	3.05
Total		131	100

Benefits of Plants: In an eco-campus, the consideration of the plant selection should not only refer to aesthetic aspects but also the benefits of the plants. Surely decorative plants will be pleasing in the eye; however, several plants with benefits will also enrich the types of the plants in an eco-campus. The diversity of the plants around UPI can also be useful for becoming learning resources. Based on a field study, the benefits of plants at UPI are presented in Table 2. Based on the table below, it is obvious that number one benefit of plants at UPI is as decorative plants (34.35%), followed by medicinal plants (15.27%), and crops (14.5%). Species of plants with other benefits still come with low percentage. The data on Table 2 actually show adequate diversity of plants species around UPI; however, decorative plants predominantly place the highest percentage so that plants with other benefits need to be taken into consideration.

Table 2: Benefits of A Variety of Plant Species at Upi In 2013

No	Usability	Frequency	Persentage %
1	Construction material	1	0.76
2	Biofuel material	1	0.76
3	Industrial material	9	6.87
4	Foodstuffs and construction	2	1.53
5	Foodstuffs	19	14.50

6	Pesticide material	1	0.76
7	Perfumes and medicines	1	0.76
8	Decorative plants	45	34.35
9	Fertilizer producers	1	0.76
10	Ornamental plants/ food-stuffs	1	0.76
11	Ornamental plants/medicines	4	3.05
12	Ornamental plants/animal feed	1	0.76
13	Ornamental plants/wood production	2	1.53
14	Medicinal plants	20	15.27
15	Herbal plants/ornamental plants	1	0.76
16	Big tree	6	4.58
17	Unknown	16	12.21
	Total	131	100

3.4. Distribution of Vegetation at UPI

As a campus, UPI becomes a habitat for certain plant species. A survey proves that there are at least 131 species of plants around the campus. Even though buildings keep coming, the amount of vegetation in the campus is still quite plenty. The area with a large amount of vegetation is the east side of the campus, especially around Isola building, main road, and gardens nearby Isola.

The distribution of vegetation at UPI, as mentioned before, is based on block unit. Each block consists of an area with certain width limited by the main road of the campus. Certain blocks are actually a combination of two blocks due to the limitation of the area width or the number of the species available around the area. In accordance with the block unit at UPI, there are nineteen blocks whose vegetation is analyzed.

3.5. Scarcity of Plants at UPI

One of the considerations to determine species of plants labeled as eco-campus is the scarcity of the plants. An eco-campus functions also as a conservation place; it aims to conserve scarce plants, very scarce plants, even almost extinctive ones. This mission is also evidence that the campus pays attention to a global issue which, in this context, is biological diversity. The more scarce plants present in the campus, the more biological diversity is actually saved. In terms of the plants scarcity at UPI, they are categorized into very scarce, scarce, and abundant. Table 3 reveals that the most dominant plants in terms of scarcity are scarce (47.33%) followed by abundant (35.11%) and very scarce (9.92%). The data prove that the number of scarce plants around the campus is quite high; however, the number of abundant plants is also not low. Therefore, there needs to be more scarce, very scarce, even almost extinctive plants around the campus. Unfortunately, a species of plants that is about to extinct is not found in the campus. Figure 1 shows the dispersion of vegetation in UPI.

Tabel 3: Scarcity of Plants At Upi In 2013

No	Status	Frequency	Percentage (%)
1	Very Scarce	13	9.92
2	Scarce	62	47.33
3	Abundant	46	35.11
4	Unidentified	10	7.63
	Total	131	100



Fig. 1 : Vegetation Dispersion at UPI. It shows the distribution of vegetation is uneven. The landscaping has not based on the planning, but the purpose mainly is for shadowing.

4. Conclusion

Based on the data of this study, there are several points of conclusion as follows.
UPI has geophysical characteristics that are suitable for certain species of plants to grow. The temperature is around 250 C and the average of the rainfall is 2065mm per year. The contour of the campus is actually not plat. The lowest point is 930 M dpal and the highest one is 967.5 M dpal. Thus, the difference is 37.5 M.

There are at least 131 species of plants around the campus. The vegetation distribution around the campus is relatively uneven since it dominated with plants around gardens, main road, and gardens around buildings. In terms of habitus, the species composition around the campus is even. In terms of the plants' benefits, the vegetation around the campus is quite various. The species of plants around the campus have not fully supported the conservation criteria. There are actually a lot of scarce plants at UPI yet abundant types of plants are also plenty.

Despite the fact above, the plants around campus are actually quite supportive to create comfortable micro climate and to support hydrological function related to infiltration. Even though UPI has planned the vegetation distribution per block unit, it has not met the ideal eco-campus requirements yet.

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References

[1] Sugito, N.T., Pemetaan Dan Penyusunan Basisdata Ruang Terbuka Hijau (RTH) Menggunakan Sistem Informasi Geografis Dalam Kerangka Pengembangan Eco Campus Upi Bandung. , LPPM, Editor. 2011, UPI Bandung.
[2] Marsono, D.J., Potensi dan Kondisi Hutan Hujan Tropika Basah di Indonesia in Buletin Instiper 1991, Institut Pertanian Stiper.: Yogyakarta.
[3] Wolch, J.R., J. Byrne, and J.P. Newell, Urban green space, public health, and environmental justice: The challenge of making cities 'just green enough'. Landscape and Urban Planning, 2014. 125: p. 234-244.
[4] Schneider, A., et al., A new urban landscape in East–Southeast Asia, 2000–2010. Environmental Research Letters, 2015. 10: p. 14.
[5] Wong, E., Reducing Urban Heat Islands: Compendium of Strategies. Urban Heat Island Basics. 2008.
[6] Paramita, B. and H. Fukuda, Heat Intensity of Urban Built Environment in Hot Humid Climate Region. American Journal of Environmental Sciences, 2014. vol. 10: p. 210-218.
[7] Rustam Hakim, H.U., Komponen Perancangan Arsitektur Lansekap: Prinsip - Unsur dan Aplikasi Disain. 2004, Jakarta: Bumi Aksara.
[8] HAKIM., R., Aspek Keberadaan Ruang Terbuka Hijau Sebagai Nilai Tambah Pada Kawasan Perumahan Perkotaan, in https://rustam2000.wordpress.com/karya-tulisku/. 2007: Jakarta.
[9] McKnight Darrel, T.L.H., Physical Geography: A Landscape Appreciation. . Climate Zones and Types: The Köppen System 2000.
[10] Junghuhn, F.W., Java, seine Gestalt, Pflanzendecke und Innere Bauart. 1809-1864, Leipzig: Arnold.