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VEGETATION COVER AND ITS RELATIONSHIP WITH THE ENVIRONMENTAL COMFORT IN MEKARSARI BIODIVERSITY PARK

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ABSTRACT

Mekarsari Biodiversity Park (MBP) is a form of green open space owned by Aqua Golden Mississippi Inc. which the function is to improve environmental performance in the context of protecting biodiversity. Changes in the use of vegetation land into built-up land in MBP and surrounding areas is happened because of increased housing needs and industrial activities. Land cover analysis is used to determine the area of tree vegetation per block in MBP. The value of air comfort was analyzed using the Temperature Humidity Index equation, then a simple linear regression analysis to determine the relationship of the THI value with the temperature and humidity values. Qualitative descriptive analysis is done to determine the perceptions of respondents that consist of factory employees and the public of temperature and humidity of the air at the observation site outside the MBP with a range of distances that are close, medium, and far from MBP. The study results obtained regression equation THI = - 5.43 + 0.982 T + 0.0598 RH, which means an increase in air temperature (T) by 1 ° C will increase THI by 0.982. Increasing humidity (RH) by 1% will increase THI by 0.0598. Decreased air comfort when getting further away from the MBP is also seen based on measurements of temperature and humidity in the field and THI calculations. The more away from MBP, the THI value increases and falls into the uncomfortable category.

KEYWORDS: Air, comfort, microclimate, temperature humidity index.

INTRODUCTION

Climate change has become one of the many environmental concerned issues not only in Indonesia but also in various countries in the world. The perceived impact due to climate change based on Meiviana *et al* (2004) is an increase in the average surface temperature of the earth which causes changes in other climate elements, such as rising sea temperatures, increasing evaporation in the air, changes in rainfall and air pressure that ultimately changes the world's climate. One cause of climate change is land use change. Factors considered to contribute greatly to changes in global-scale land use according to Yusuf *et al*. (2018) are economy, social, population, and natural hazard. Pribadi *et al*. (2006) states, the rapidly increasing development causes changes to land use and function patterns, where the built space increasingly dominates and urges natural spaces such as Green Open Space, mangrove forests, lakes, and other natural spaces. The climate change and the land use change potentially become important drivers to the future discharge fluctuation Indonesia (Tarigan and Faqih 2019).

The change in the use of vegetation land to developed land or non-vegetation land, causing a reduction in the Green Open Space area. Even though one of the efforts to improve the environment in the industrial area is green open space. Green Open Space is a form of land use in an area intended for reforestation (Febrianti and Sofan 2014). Green Open Space through its role as a regulator of microclimate can reduce surface temperatures which directly affect the distribution of air temperatures and can improve the comfort of people's lives.

Environmental comfort is determined by the interrelationships between factors of air temperature, air humidity, light, and wind movement. The results of the study of Setyowati and Sri (2010) show that the presence of green open space in urban areas is needed, to reduce micro-weather conditions and control environmental conditions polluted by air. One form of green space declared by the Ministry of Environment and Forestry is the Biodiversity Park as Biodiverity Park. Biodiversity Park is a local biological natural resource reserved area outside the forest area that has an in situ and / or ex situ conservation function, especially for plants pollinating

and / or spreading their seeds must be assisted by animals with the structure and composition of their vegetation that can support the preservation of animals seed pollinators and scatterers. One form of Taman Biodiversity found in West Java is Mekarsari Biodiversity Park (MBP) owned by PT. Aqua Golden Mississippi which the function is to improve environmental performance in the context of protecting biodiversity.

Interaction between the environment associated with factors within and outside the individual will determine the form of a person's behavior. Community participation and support is needed in improving the quality of the environment. Community participation in this case is a community evaluation of the environment's comfort, especially air (temperature and humidity). In order to create a comfortable environment, especially the microclimate for the community around Mekarsari Biodiversity Park (MBP), the condition of the local microclimate and community participation in the form of perception of air comfort conditions are needed. MBP is felt to be appropriate because it has the opportunity to be developed with the community because of its location which is directly adjacent to residential areas. Thus, the influence and effectiveness of the existence of MBP on the perception of the level of comfort of the community needs to be known in order to be a reference in environmental management efforts.

METHODOLOGY

Time and Location
The study was conducted in November and December 2019. Data collection was carried out at the Mekarsari Biodiversity Park owned by PT. Aqua Golden Mississippi is located in Caringin Village, Cicurug District, Sukabumi Regency and surrounding areas. Data processing was carried out at the Laboratory of Environmental Analysis and Spatial Modeling, Faculty of Forestry, Bogor Agricultural University.

Instrument and Object
The tools used in this research are thermohygro air temperature and humidity gauges, Global Positioning System (GPS), anemometer, questionnaire, stationery, ArcGIS 10.5, Terra Incognita 2.39, Microsoft Office 2013, SPSS Statistics 24, and cameras. The objects studied were microclimate, factory employees of PT Aqua Golden Mississppi, and the people living around Mekarsari Biodiversity Park.

Method of Collecting Data
Land Cover Classification
Data regarding land cover classification was obtained using Terra Incognita Software 2.39. Retrieval of coordinates in the field is carried out to determine the coordinates of land use in the field which are then compared with coordinates on the map of interpretation. Land cover outside MBP will be classified into non-tree

vegetation cover, tree vegetation, water bodies, built-up land, and open land.

Microclimate
Actual microclimate data in the form of temperature, humidity, light intensity, and wind data obtained through direct measurements in the field. Measurements were taken in the morning (07.00-08.00 WIB), afternoon (13.00-14.00 WIB), and evening (16.00-17.00) with intervals every 10 minutes to measure daily temperature and humidity. Temperature and humidity data are taken inside MBP and outside MBP. Within the MBP, each observation point is in a bamboo, fruit, jungle and water body block. Outside MBP, temperature and humidity are measured in residential areas where the distance of residence from MBP is 0-50 m (near), 100-150 m (medium), and 200-250 m (far).

Public Perceptions of Air Comfort
Data on community perceptions of environmental comfort was obtained through a close ended questionnaire to respondents. Respondents consisted of factory employees of Aqua Golden Missssppi Inc. and the community around MBP who live around the observation point.

Data Analysis Method
Land Cover Analysis
Land classification is carried out after image restoration and subset images to focus on the study site. Image classification is carried out to determine the distribution and size of land cover types in the study area. Classification is done in the form of visual-manual classification method by optimizing the combination of RGB techniques, contrasting and interpretation keys.

Analysis of Micro Climate Comfort Standards
Micro climate comfort standards can be determined by using the Temperature Humidity Index (THI) equation that uses air temperature and humidity factors.

$$THI = 0{,}8T + \frac{RH \times T}{500}$$

T   : Air Temperature
RH   : Air Humidity

Based on microclimate data (temperature and humidity) obtained an air comfort level seen from the air comfort index. Emmanuel (2005) states that the comfort index value used to determine the comfort category is obtained by linking the assessment of human respondents in the following ranges, 100% of respondents feel comfortable ($21 \leq THI \leq 24$), 50% of respondents feel comfortable ($24 < THI \leq 27$), and 0% of respondents felt comfortable ($THI > 27$).

Linear Regression Analysis
The value of the THI's effect on temperature and humidity is analyzed using linear regression regression to determine the effect of the THI's percentage on

temperature and humidity. Here is a linear regression equation model:

$$Y = \alpha + \beta_1 x_1 + \beta_2 x_2 + \varepsilon$$

y : THI

α : Constant

β : Regression coefficient

x : Independent variable

ε : Error

Public Perceptions of Air Comfort

The data taken is data on community perceptions about the relationship between the availability of land cover for tree vegetation and air comfort. Data on people's perceptions of air comfort, people's perceptions about weather factors, people's perceptions of the benefits of green space, and people's motivations were analyzed descriptively qualitatively and presented in the form of tabulations then linked to several measured climate elements.

RESULTS AND DISCUSSION

Tree vegetation land cover in MBP

The Mekarsari Biodiversity Park area before being released by Aqua Golden Mississppi Inc. is arable land in the form of a garden owned by the local people. After switching ownership to PT. Aqua Golden Mississippi, some plants are left alive and become biodiversity of the flora of the liver. Mekarsari Biodiversity Park has four blocks inside, bamboo blocks, fruit blocks, jungle blocks and water body blocks. The results of land cover analysis of the area of non-tree vegetation in MBP are presented in Figure 1.
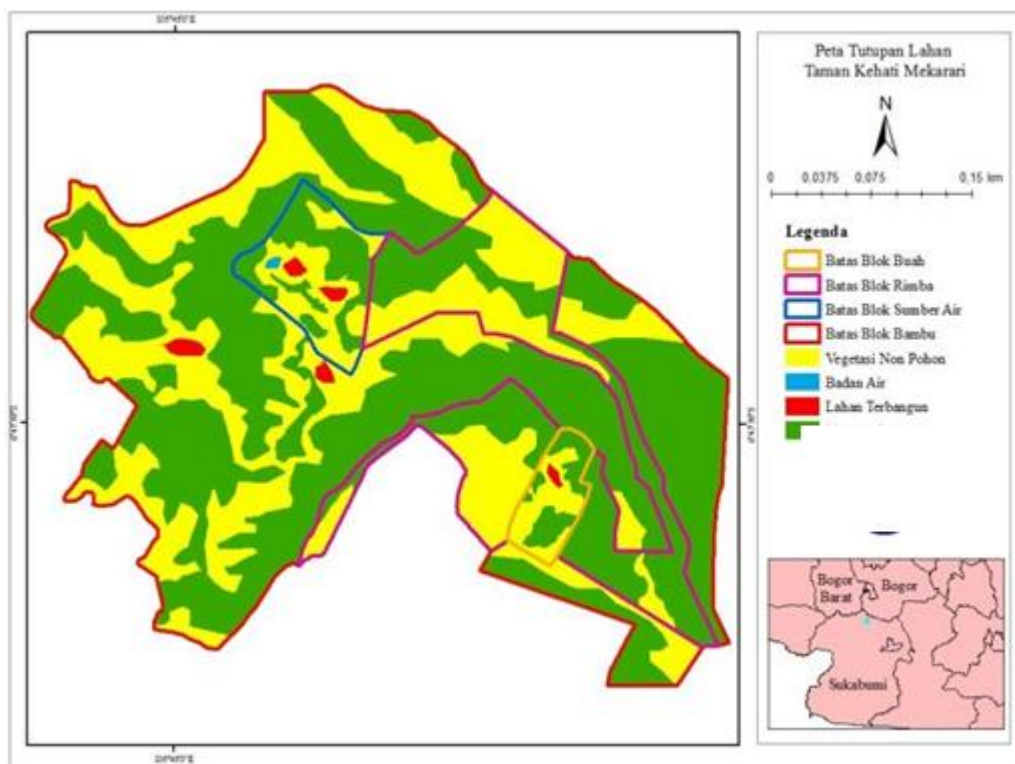

Figure 1: Map of Mekarsari biodiversity park land cover.

Land use in MBP that is found is the land cover of tree vegetation, non-tree vegetation in the form of shrubs, fields, fields, built land, and water bodies. Bamboo Block is the block that has the largest area compared to other blocks, which is 7.22 Ha. The results of land cover classification indicate the area of tree vegetation contained in bamboo blocks is 5.93 Ha or 64.7% of the total area. Bamboo planting is intended to strengthen cliffs and river banks. So that most of the bamboo is located on steep sloped land (Gunawan *et al* 2014).

Tabel 1: Temperature dan Humidity value based on average temperature and daily humidity.

Location	Temperature (^{o}C)	Humidity (%)
Jungle Block	25,33	87,01
Fruit Block	25,38	87,43
Bamboo Block	25,08	87,11
Water body Block	25,66	88,88

The temperature value during the day in MBP with the lowest temperature is in the bamboo block. This is in accordance with the condition of the vegetation land cover in the bamboo block which has the largest area of vegetation cover compared to other blocks. The absorption of solar radiation energy by the plant canopy system will spur plants to increase their rate of transpiration, especially to maintain plant temperature stability. The amount of energy used to evaporate water in the process of transpiration, then only a little heatremaining to be emitted into the surrounding air. This caused the air temperature around the plant to be lower and not to increase dramatically during the day (Lakitan 1994).

Microclimate and Comfort in the MBP and Surrounding Areas
Microclimate is a climatic condition in a very limited space, up to a limit of approximately two meters from the ground. Temperature and humidity are climate parameters commonly used to study air comfort issues expressed in the form of the Temperature Humidity Index (THI) (Gates 1972 and Brooks 1988). Based on the average daily temperature and humidity, the value of THI obtained shows the difference when the location of the observation point is farther away from the Mekarsari Biodiversity Park (MBP).

Table 2: MBP comfortable value and surrounding area based on average temperature and daily humidity.

Location	Temperature (^{o}C)	Humidity (%)	THI	Category
Jungle block	27,88	81,55	26,85	Normal
Fruit block	28,71	82,86	27,73	Discomfort
Bamboo block	27,55	82,84	26,61	Normal
Water body block	28,12	86,49	27,36	Discomfort
50 m fromMBP	28,78	75,92	27,39	Discomfort
150 m from MBP	29,37	78,18	28,09	Discomfort
250 m from MBP	30,41	74,78	28,87	Discomfort

In Table 2 shows the different values of temperature, humidity, and THI at each observation point. It can be seen that the farther away from MBP, the temperature value increases, humidity decreases, and THI value increases until it falls into the uncomfortable category. Based on temperature and humidity data in the field, the following regression equation is obtained, THI = -5.43 + 0.982 T + 0.0598 RH. Positive coefficient means that the higher the temperature and humidity value, the higher the THI value. Increasing the air temperature (T) by 1 ° C will increase THI by 0.982. Increasing humidity (RH) by 1% will increase THI by 0.0598.

Based on THI values in Table 2, it can be seen that THI values in MBP and surrounding areas are in the range of THI 26 to 28. The comfort index in comfortable conditions ideal for Indonesian people is in the range of THI 20 to 27. Based on Emmanuel (2005) this comfort level is divided in 3 conditions namely comfortable

($21 \leq$ THI ≤ 24), moderate ($24 <$ THI ≤ 27), and uncomfortable (THI> 27). The results showed that the comfort index in the MBP and surrounding areas included in the category of discomfort that is during the day, especially in the location of the observation point outside the MBP with temperatures ranging between 28 ° C and 30 ° C or outside the air temperature criteria ideal. The temperature value exceeds the ideal climate according to Laurie (1986), where the ideal climate for humans is clean air at a temperature of 27-28 ° C.

The reduced cover of vegetation land to non-vegetation land is one of the causes of the decline in environmental quality at the study site. The existence of land cover is related to the intensity of sunlight received by the surface. The results of measurements of sunlight intensity measured without shade are presented in Table 3.

Table 3: Sunlight intensity values at each observation point.

Location	The intensity of sunlight (lux)		
	Morning	Afternoon	Evening
Jungle block	4454	27892	10090
Fruit block	5597	27868	7595
Bamboo block	2835	5331	4686
Water body block	3119	13370	4239
50 m from MBP	13464	31070	12180
150 m from MBP	13278	31235	14293
250 m from MBP	16626	37348	20900

The results of measurements of sunlight intensity that has the highest value are found at the measurement point of 250 m from MBP during the daytime. Kartasapoetra (2002) states that the more direct direction of sunlight

(daytime) will get hotter because the sun-heated place is narrower compared to the inclined incident ray (morning and evening).

In addition to temperature, humidity, and intensity of sunlight, the wind factor is one of the elements of climate which also influences environmental comfort conditions. The main factor that causes air movement is the difference in energy (temperature) naturally by a surface, causing a difference in air pressure (Sabaruddin 2012).

Wind velocity that occurred at the study site in the morning to afternoon ranged from 0.7 to 3.3 m / s. According to Papadakis (1996) for wind velocity of less than 1.8 m / s, the effects of the wind although small cannot be ignored. The largest wind velocity in the MBP occurs during the day between 13.00 and 15.00 which is 3.3 m / s. The lowest wind velocity occurs in the morning between 07.00 and 10.00 in the amount of 07 m / s. Calm wind in accordance with safe thresholds such as those found in MBP can be useful. The safe wind threshold is 17 m / s (Lakitan 1994).

3.3 Community Perceptions Regarding Environmental Comfort

Factory employees and the community at the research location have a perception that a comfortable environment, especially air, is important for human life. The condition of air comfort at the location is based on the perception of the people who feel most uncomfortable during the day, which is located at a location of 250 m from MBP. The benefits of the presence of green space in the form of MBP can be in the form of noise reduction, natural scenery, cool air, oxygen suppliers, reducing stress, recreational facilities, pollution and dust filters, and biodiversity conservation. The benefits that were felt by many respondents from the MBP according to respondents' perceptions from factory employees in MBP, Kubang Jaya Village (50m point), and Pasir Dalem Village (150m and 250m points) that the benefits most felt by respondents from MBP were the cool air. Although there are many benefits felt by MBP for air comfort, but there are some respondents, especially at the point outside MBP who claim not to feel the benefits of air comfort from MBP. Respondents at three research locations outside MBP who did not feel the benefits of MBP were 16.67% at 50m, 43.33% at 150m, and 50% at 250m. Of all respondents, the most chosen effort to do to improve air comfort and to make the environment more comfortable is to plant trees.
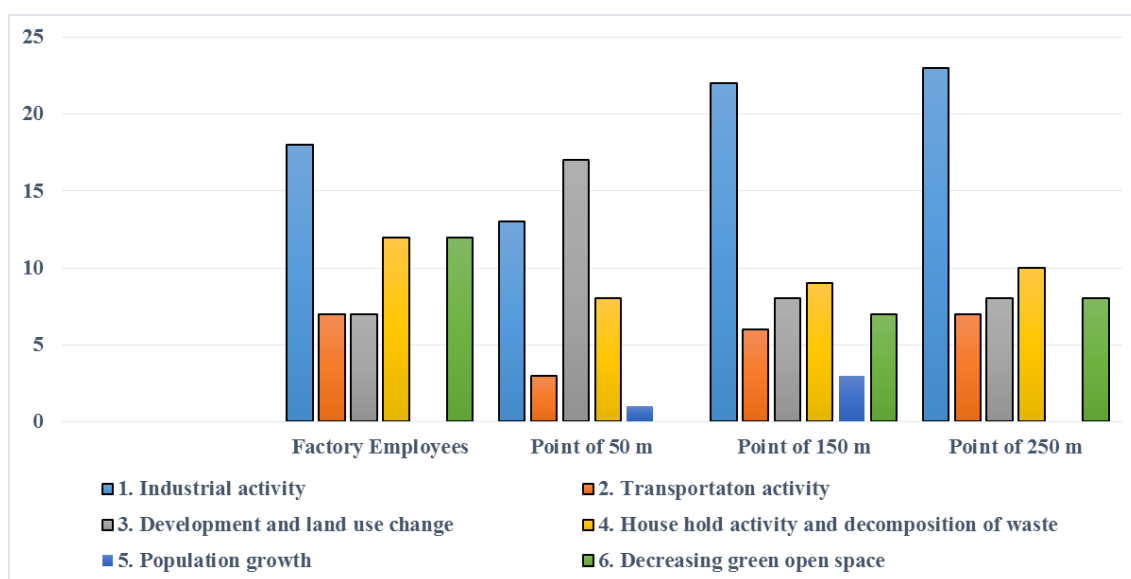

Figure 2: Perception about factors that decreasing environmental comfort.

The community at this time has begun to feel uncomfortable, especially during the day with the conditions at the study site. Respondents from factory employees at MBP, Kubang Jaya Village (50m point), and Pasir Dalem Village (150m and 250m points) have the perception that industrial activities that have an impact on increasing CO_2 gas are the most influential factors in decreasing environmental comfort, especially air (Figure 2). This can be seen because in addition to PT Aqua Golden Missessppi, in Caringin Village there are also other companies including PT Tri Banyan Tirta Tbk, PT Gunung Salak Sukabumi, and PT Asia Health Energy Beverages. Industrial activities related to development activities and land use change. Respondents mentioned that the agricultural area had been used for construction of factories and housing. Azmi's research (2018), shows that in the period 2000-2017 in Caringin Village, the location of MBP experienced a decrease in the area of vegetation land cover, while the land cover developed into land cover that always experienced an increase in area. Though vegetation land has an important role in improving and improving the quality of the environment to get a comfortable environment, especially air.

CONCLUSIONS

The existence of Mekarsari Biodiversity Park (MBP) can have a comfort impact on the surrounding environment. This is supported by the measurement results that the temperature of the air at the observation location the farther from the MBP will be higher. In addition, public perceptions stating that the further away from MBP, the benefits of MBP, especially for air comfort are diminishing. The reason for the decrease in environmental comfort according to respondents' perceptions was mostly due to industrial activities.

Reduced air comfort when getting further away from MBP is also seen based on measurements of temperature and humidity in the field and continued calculation of THI. The level of comfort in MBP and its surroundings which increasingly away from MBP, the THI value is increasing and included in the category of discomfort. Improvement of environmental comfort can be done by adding green space around the factory and utilizing the yard to plant trees / potted plants into businesses that can be done by the community

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