

## ANALYSIS OF GREEN OPEN SPACE NEEDS IN PEKANBARU CITY BASED ON THE THERMAL COMFORT INDEX "THI"

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### ABSTRACT

*In 2017 the Mayor of Pekanbaru issued a Letter of Interest in Participating in the Green City Development Program (P2HK). In the letter, it is said that Pekanbaru is ready to fulfill the mandate of law number 26 of 2007. The purpose of this study is to determine and analyze the need for green open space based on the thermal comfort index. The study of this RTH is located in Pekanbaru City, Riau Province. The research tools used consist of hard work (Hardware) and software (Software) which function to retrieve and process data. The hardware used are; laptops, stationery, mobile phones, GPS, and digital hygrometers. The software used are ArcMap 10.3, R Studio, Mr. Word, Mr. Excel, AutoCad, and Photoshop applications. The conclusion obtained is that the area in Pekanbaru is still a lot of green, but in some districts it has a very minimal RTH and is not balanced with other land cover and the districts that are the priority for the next RTH are in Pekanbaru Kota district, Sukajadi, and also Sail District, while for the districts that are not a priority are the East Rumbai district, Rumbai Barat, and the Tenayan Raya area, but because according to the Pekanbaru City RTRW in 2020-2040 the area will be for industrial areas and also residential areas must be carefully planned, especially for city RTH. The most effective addition of green coverage to achieve comfort with a THI value of 26.2 which is 46% at every 62,500m<sup>2</sup>*

**KEYWORDS** Green City, open space, development



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### INTRODUCTION

In 2017 the Mayor of Pekanbaru issued a Letter of Interest in Participating in the Green City Development Program (P2HK). In the letter, it is said that Pekanbaru is ready to fulfill the mandate of law number 26 of 2007. The city government will

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form a self-management team for the implementation of activities, and is ready to issue a regional budget for implementation and is ready to prepare a Green City Action Plan (RAKH) (Pekanbaru Mayor's Letter 760 / PUPR / 58), on the website of creation works regarding the P2HK concept, one of its attributes is *Green open space*.

In the expedition to develop the protected area of Pekanbaru City until 2015, there has been a change of land use for protected areas into built-up areas such as settlements, trade, industry, plantations, and shrubs. This protected area is a secondary forest. The shift in the presence of RTH in Pekanbaru City can make Pekanbaru City uncomfortable, one of which is indicated by the high temperature in Pekanbaru City reaching 34 o C- 35°C (Noer *et al.* 2015) , the construction of shop houses (shophouses) (Riatno and Mashur 2017) then there was also an increase in the construction of houses and housing complexes (Fitri, 2011). Pekanbaru City is also experiencing the development of a transportation system, especially transportation in the growing 4.0 era (Badri 2019).

The temperature in Pekanbaru City has the potential to continue to increase due to daily urban and human activities that produce carbon dioxide (Suryansayah 2019). From BMKG data in March 2022, the air temperature is quite high because the sun is at the equator followed by changes in wind patterns. The air temperature reaches 33.8°C to 34.0°C, in addition to that, Riau Province is currently entering a transition period with a tendency to decrease rainfall intensity (BMKG Pekanbaru (29/3/2022)), a gar does not have the same fate as other cities that lack RTH, the Mayor of Pekanbaru changed the concept of development from building a Inner City Park to building a City In a Park. This concept change is carefully prepared to achieve a *green* city-based Pekanbaru City. Determination of Green Open Space can be done by using remote sensing methods with the help of image data to calculate the temperature and areas that are the next RTH priority.

The purpose of this study is to find the next priority area for green area development and calculate the most optimal area for the development of green areas in Pekanbaru City that can provide thermal comfort. This research can later be an input and advice for the city government in adding green areas.

Noer Aini *et al.* 2015 and Lina *et al.* 2019 who examined the thermal comfort of the people of Pekanbaru City, mentioned that the THI value index for thermal comfort is 26.20, which is at the limit threshold Quite Comfortable, this is what will be the benchmark of the area of RTH that the city must meet for its people.

## RESEARCH METHOD

The study of this RTH is located in Pekanbaru City, Riau Province. The research tools used consist of hard work (Hardware) and software (Software) which function to retrieve and process data. The hardware used are; laptops, stationery, mobile phones, GPS, and digital hygrometers. The software used are ArcMap 10.3, R Studio, Mr. Word, Mr. Excel, AutoCad, and Photoshop applications. The research time, namely from February 2022 to August 2022, starts from taking Citra data, taking data from related agencies, and processing and writing research drafts.

### **Data collection**

Primary data collection is using the USGS website to obtain Landsat 8 OLI / TIRS Image data and also direct survey data in the field with different types of land cover of at least 40 points (Danoedoro 2015). Secondary data are administrative maps and City RTRW from Pekanbaru City PUPR, and also thermal comfort threshold values from literature sources.

### **Data processing**

This research continues from research (Rizqiyah et al. 2022) regarding areas that are a priority for Green Open Space in Pekanbaru City, Pekanbaru City to create a City in a Park, so it must improve the quality of RTH in the city. The laying of the RTH location should also not only be placed, and the districts that are the priority for the next RTH are in Pekanbaru Kota, Sukajadi, and also Sail districts, while for districts that are not a priority are the East Rumbai, West Rumbai, and Tenayan Raya areas, but because according to the Pekanbaru City RTRW in 2020-2040 the area will be for industrial areas and also residential areas must be carefully planned, especially for city RTH. This study explains the amount of additional Green Open Space that is suitable for achieving thermal comfort in Pekanbaru City.

### **Green Area Needs**

The effect of Green Open Space on temperature drops. In analyzing this relationship, it uses a 250m x 250m grid where the bound variables are Broad, and the free variables, the value of ESG, Air Temperature, Humidity, and THI values taken from the average t point so that the influence of the area value on the decrease in temperature can be obtained by conducting a simple regression analysis with the linear regression equation model as follows:

$$y = \alpha + \beta x$$

Information:

Y = THI value (dependent)

X = Green Area Area (independent)

$\alpha$  = Constants

$\beta$  = Regression coefficient (slope)

With a picking point, namely a grid of 250 m x 250 m (Liong, 2021) with different land cover.

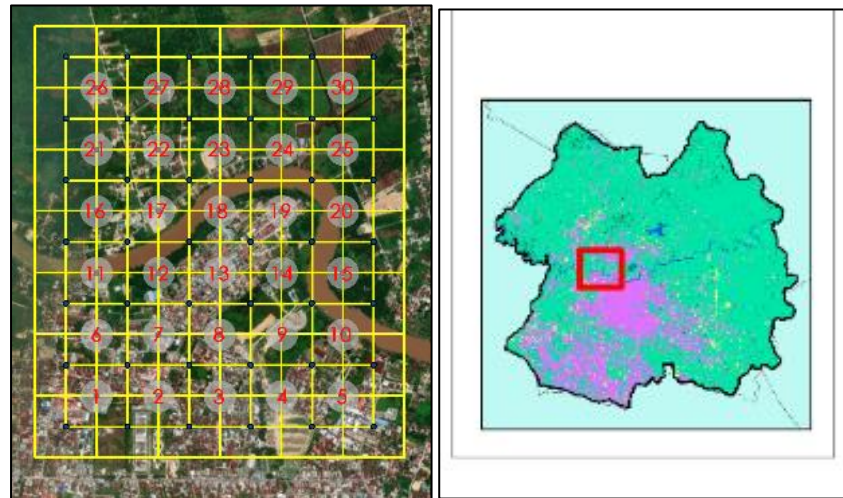


Figure 1 Comparison Grid

## RESULT AND DISCUSSION

### Identify Priority Areas Of Open Space Hijau

Rizqiyah et al. 2022, in their research mentioned the priority areas for RTH development after an overlay analysis to get a score, where what was added up were the NDVI, ESG values, air temperature, humidity and, and THI values. The lowest score value is the most priority area for the development of green areas.

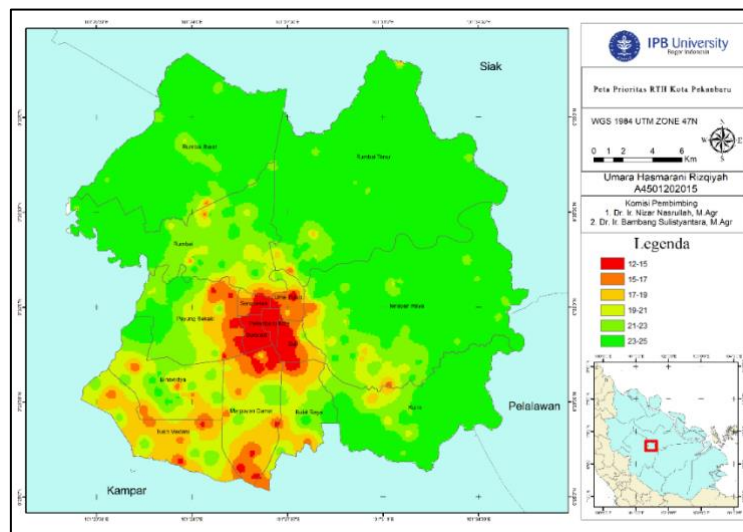
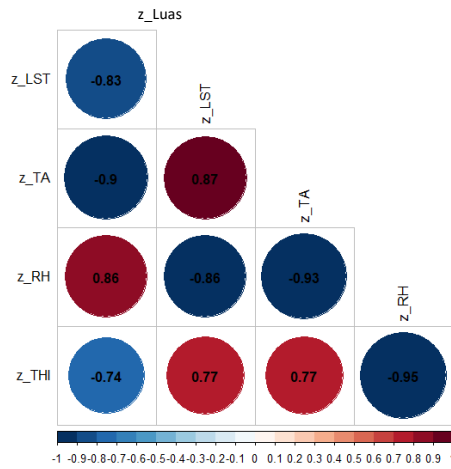


Figure 2 RTH Priority

Source: Rizqiyah et al. 2022

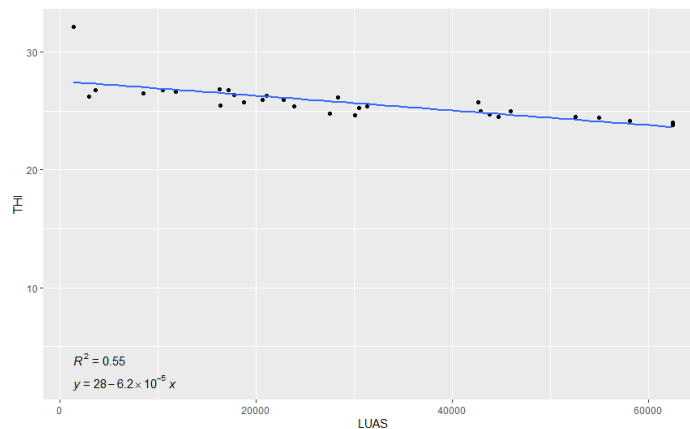
### Regression and Correlation Results

250 m x 250 m grid to determine the most effective area for determining the area that lowers the temperature. The area taken consists of several land covers, where plantations and forests become areas of vegetation, water bodies, and also non-vegetation areas, namely built-up and vacant land.



**Figure 3 Heatmap Grid**

To achieve thermal comfort THI 26.2, regression is carried out on the value of the canopy area and also the THI value of each point in the grid.

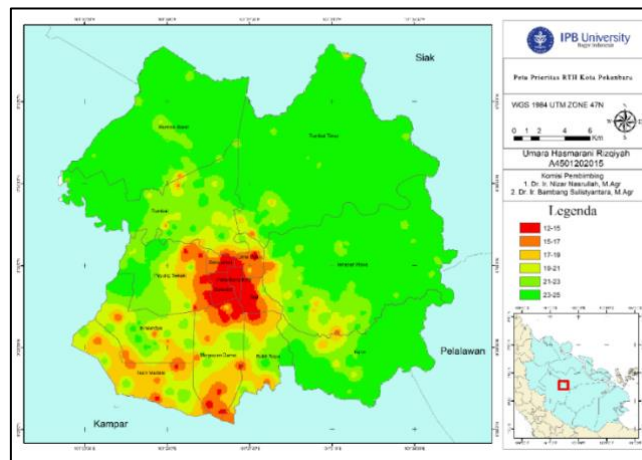


**Figure 4 Regression of RTH and THI Area Values**

So to achieve comfort the THI value of 26.2 requires an additional canopy area of 46% every 62,500m<sup>2</sup>, or 29,000m<sup>2</sup>.

**Green Area Development Priorities**

To identify the priority areas of RTH, scoring is carried out where the summed values are NDVI, ESG, Air Temperature, Humidity and THI values.



**Figure 5 RTH Priority**

RTH priorities are in Pekanbaru Kota, Sukajadi, Senapelan and also Sail districts. Meanwhile, the districts that are not a priority are the East Rumbai, West Rumbai, and Tenayan Raya areas.

According to the Pekanbaru City RTRW for 2020-2040, the Tenayan Raya area and the Rumbai sub-district area will be even though it is not currently a priority area for RTH but will become an industrial area and also for settlements, so it must be prepared early for its green area so that Pekanbaru's dream of becoming a City in the Park can be realized.

**Table 1 Canopy Area Needs**

District Name	Pekanbaru City	Sukajadi	Sail	Senapelan
District Area (m <sup>2</sup> )	2260000	3760000	3260000	6650000
Existing RTH (m <sup>2</sup> )	48156	28901	69229	38115
Jumlah Grid	36.16	60.16	52.16	106.4
Minimum Area of Each Grid (46%)	29000	29000	29000	29000
The Overall Area of the Canopy	1048640	1744640	1512640	3085600
Area Less Canopy	1000484	1715739	1443411	3047485
Percent Addition	44%	76%	64%	135%

The results of the regression analysis of the need for green areas in accordance with the THI value of the people of Pekanbaru City to achieve comfort of 26.2 require an increase in canopy area to reach 46% every 62,500m<sup>2</sup>, or 29,000m<sup>2</sup>. The expansion of the RTH area can be divided into, various kinds, one of which is the addition of RTH road sections, then can be used on the rooftop, vertical garden, and especially in the central green area offices and shopping.

### **Pekanbaru City Green Open Space Planning Recommendations**

To improve the quality and quantity of RTH in Pekanbaru City, here are some theories that can be suggestions for the development of RTH in the middle of a city with a densely populated area, by notarizing the area shaded can lower the temperature by 0.33 o C-0.84 °C and this will later affect the humidity of the air, by multiplying the type of vegetation it will increase the ability to bind water (Broom et al. 2010). Increasing the percentage of open areas and minimizing built-up areas in kators and shopping areas is also effective in lowering surface temperatures (Bernatzky 1978) and by replacing pavements with paving the block will have the best water catchment system (Andini, 2016), by reducing the number of paved areas also reducing the heat effect because there is a negative relationship between the area of RTH and surface temperature (Vargas-Hernández et al. 2018). Walls covered with plants can also lower surface temperatures (Pérez-Urrestarazu et al. 2015). The high temperature is caused by CO pollutants, so it is necessary for plants that have a high ability to absorb CO, namely the tree species is the Ganitri plant type (*Elaeocarpus sphaericus*), the shrub type is *Impatien* sp), and the *Philodendron* bush type (*Philodendron* sp) (Kusminingrum, 2008). Marginal heat reduction increases when roof greening coverage is higher than 40%, and should be the minimum value for roof greening especially in densely populated areas (Zhuang and Zhongming 2021).

### **CONCLUSION**

The area of the next RTH location must have a clear goal, for example, the RTH must be able to increase the thermal comfort of the community, then what must be improved is the quantity and quality of the RTH. There are still many areas in Pekanbaru that are green, but in some districts have very minimal RTH and are not balanced with other land cover and the districts that are the priority for the next RTH are in Pekanbaru Kota, Sukajadi, and also Sail districts, while for districts that are not a priority are East Rumbai, West Rumbai districts, and the Tenayan Raya area, but because according to the Pekanbaru City RTRW in 2020-2040 the area will be for industrial areas and also residential areas must be carefully planned, especially for city RTH. The addition of green coverage is the most effective way to achieve comfort with a THI value of 26.2 which is 46% at every 62,500m<sup>2</sup>.

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