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Thermal Performance of Public Green Space using Palm Fiber Net-Based Green Canopy and Passion Fruit *(Passiflora Edulis)* Vegetation

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Abstract. *This study aims to evaluate the thermal performance of green canopies in public green spaces (RTH), both outdoors and indoors, as an environmentally friendly solution. The method involved measuring temperature and humidity over a five-month period with four observation intervals. The data were analyzed using the Temperature-Humidity Index (THI) and compared with thermal comfort standards based on the Indonesian National Standard (SNI). The results show that at 0% plant coverage, the THI values fall into the "comfortable to slightly uncomfortable" category during the period from 19:00 to 08:00. In contrast, at 81.25% plant coverage, THI values remain in the "comfortable to slightly uncomfortable" range from 21:00 to 09:00. Relative humidity met the SNI standard of 75%. Furthermore, the outdoor temperature decreased by 4.9 °C, while the indoor temperature decreased by 3.5 °C. These findings indicate that the presence of green canopies, particularly in private green spaces, significantly reduces both outdoor and indoor temperatures as the percentage of plant coverage increases.*

Keywords: Public Green Space, Green Canopy, Temperature Humidity Index, Indonesian National Standards

Introduction

In the current era of globalization, environmental and energy issues appear to be important issues that affect human life [1]. Electrical energy is an important need because almost all activities both in the industrial sector and daily life depend on electrical energy, so excessive consumption of electrical energy will have an impact on increasing the need for electrical energy every year and can reduce the supply of electrical energy [2].

Excessive consumption of electrical energy can be reduced by the use of electronic items such as fans and air conditioners by creating a green environment that can help in improving the thermal in the house [3]. Thermal comfort is very important for the body so that humans can carry out activities properly, both indoors and outdoors. A comfortable environment supports concentration, productivity and overall health. When temperatures are too high or low, daily activities can be disrupted, causing fatigue and lowering work effectiveness. Therefore, it is important to maintain appropriate temperature and humidity to support daily activities [4]. Gorontalo City is one of the areas in Gorontalo Province that has a fairly high temperature, according to BPS in 2024 the temperature in Gorontalo city reached 32 ºC [5], which cannot be categorized in the Indonesian National Standard (SNI) because the comfortable temperature range is at 25.8-27.1 ºC [6].

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As for some of the efforts that have been made to improve thermal comfort indoors and outdoors, namely, the use of *green curtain (Green Curtain)* as a solution to thermal comfort in residential homes and after the application of *green curtain* fan use is reduced by 59% [7], then the use of green roof *(Green Roof)* where the room with green roof entirely decreased in temperature [8] but the study did not use palm fiber nets. These previous studies used iron wire, but in this study used palm fiber nets where nets made from palm fiber are durable and can absorb heat [9].

Based on the previous explanation, the existence of a green environment is very important to improve thermal comfort indoors and outdoors. One of the things that can be done as an effort to overcome this is the use of Public Green Space(RTH).

Theoretical Background

Public Green Spaceis green open space whose use is only for limited circles, in the form of gardens, home or office yards and terraces of private or community-owned houses planted with plants [10]. Gorontalo City has 0.19% private green space from the area of Gorontalo City, if seen from this data Gorontalo City still really needs private green space of 9.81% of the area [11].

Private green space has a very important role, one of which is in residential houses without a terrace, because the sun's rays will come directly into the house, which results in the discomfort of residents in carrying out indoor activities. Therefore, to reduce solar radiation, the arrangement of vegetation by applying a *green* canopy [12].

Quantitatively comfort is expressed as Temperature Humidity Index (THI), an index to determine the effect of hot conditions on human comfort [13]. Temperature humidity index can be calculated using the following formula:

$$THI = 0.8 \times Ta + \frac{RH \times Ta}{500} \quad (1)$$

where:

THI = Temperature humidity index (%)

T_a = Air Temperature (ºC)

RH = Humidity (RH)

Table 1 shows the comfort categories of Temperature Humidity Index (THI).

Table 1. Temperature Humidity index

Temperature Humidity Index	Category
$21 \leq 24$	Cozy
$24 < 26$	Some are uncomfortable
> 26	Uncomfortable

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Materials and Methods

The method used in green canopy research is quantitative method. Quantitative method is a method to gain knowledge or solve problems systematically and the data collected is a series or collection of numbers. The research starts from the theoretical study stage about green open space, land use into built-up land so that the reduction of private green open space. In this research, green open space is applied in residential houses as a canopy, then outdoor and indoor temperature and humidity measurements are taken. Temperature and humidity data are analyzed using the Temperature Humidiiti Index (THI) while temperature and humidity data are analyzed by comparing the data obtained using the Indonesian National Standard (SNI). Measurement of temperature and humidity in the room is done to determine the effect of green canopy on temperature and humidity in the room. The research will take place after the nursery of passion fruit plants (*Passiflora Edulis*) until the formation of the canopy. The research location is in Griya Otolomo housing in Dembe 2 village, North City, Gorontalo City. The tools used in this research are Xiomi Mijia Thermometer Hygrometer 2. **Figure 1** shows the stages of the flowchart in this study.

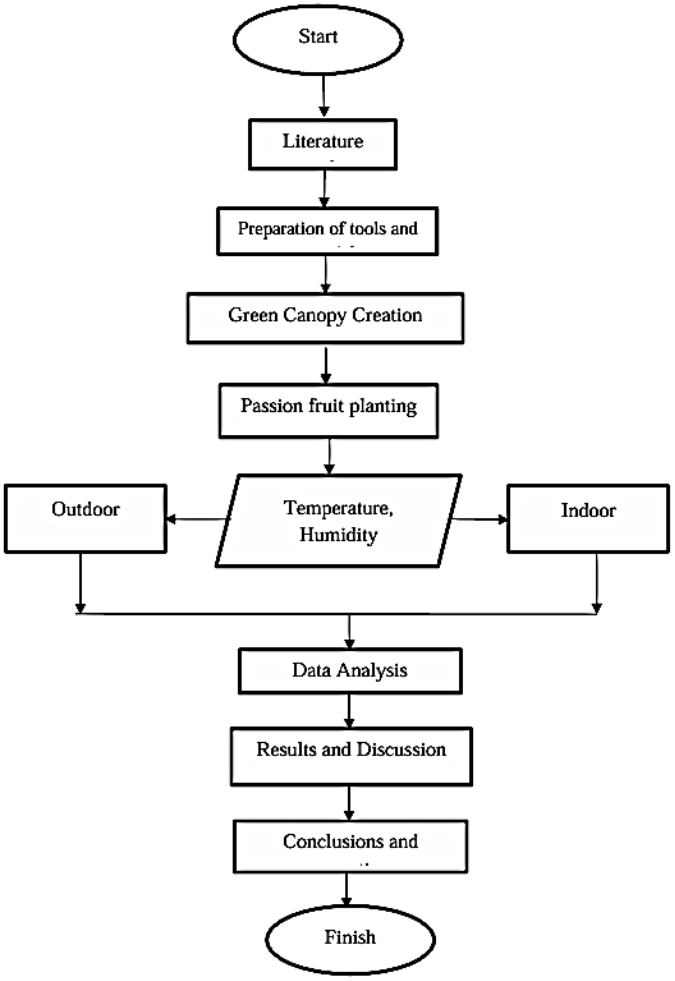

Figure 1. Flowchat Monte Carlo simulation stages

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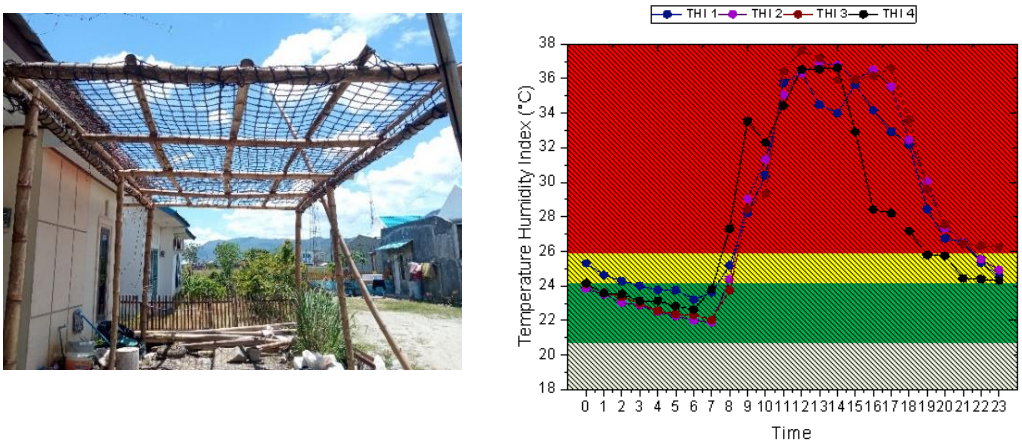
Results and Discussion

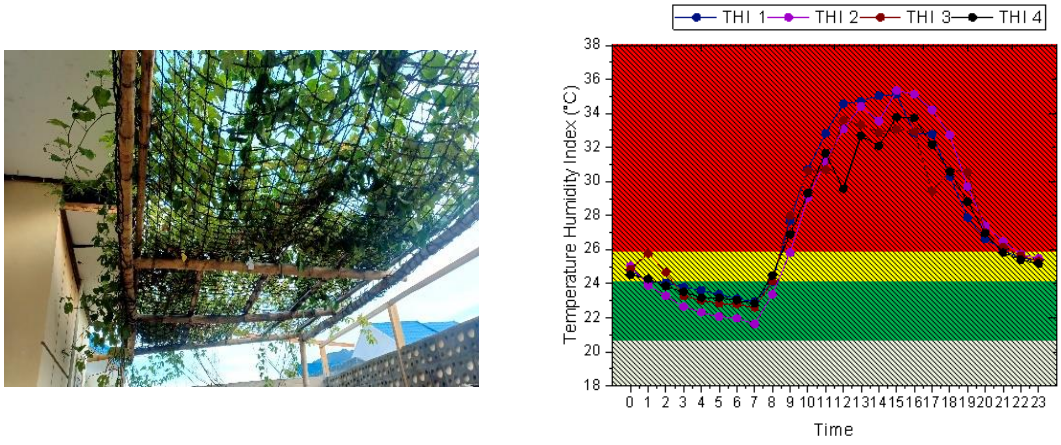
Temperature Humidity Index (THI) Analysis

THI measurement values with plant propagation percentage of 0%, and 81.25%, as shown in **Figure 2** and **Figure 3**, respectively. **Figure 2 (a)** shows the percentage of plant propagation of 0% which is the initial data of the study. **Figure 2 (b)** shows that the THI value of weeks 1, 2 and 3 at 09.00 AM - 09.00 PM is in the uncomfortable category and at 10.00 PM - 08.00 AM is in the comfortable and partially uncomfortable category. week 4 at 08.00 AM - 06.00 AM is in the uncomfortable category, at 07.00 AM - 11.00 PM is in the partially uncomfortable category and at 12.00 AM - 07.00 AM is in the comfortable category.



(a) (b)

Figure 2. (a) 0% plant propagation percentage, (b) THI value graph



(a) (b)

Figure 3. (a) Plant propagation percentage 81.25% (b) THI value graph

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Figure 3 (a) shows the percentage of plant propagation of 81.25%. **Figure 3 (b)** shows that the THI value in weeks 1, 2, 3 and 4 at 09.00 AM - 09.00 PM is in the uncomfortable category and at 10.00 PM - 08.00 AM is in the comfortable and partially uncomfortable category. The results of THI measurements with a plant propagation percentage of 0% and 81.25% show that the average temperature at night until morning is in the comfortable and partly uncomfortable category, while during the day and late afternoon is in the uncomfortable category. However, despite being in the uncomfortable category, the temperature decreased during the day.

Thermal comfort analysis according to Indonesian National Standard (SNI), shown in **Figure 4**. **Figure 4** shows that the highest outdoor temperature in February reached 40.2 ºC and the lowest was in January, namely 35.3 ˚C, resulting in a decrease in temperature of 4.9 ºC, while indoors the highest temperature was in February reaching 32 ˚C, the lowest temperature was in January, namely 28.5 ºC, resulting in a decrease in temperature of about 3.5 ºC. This shows that with the *green canopy, the* temperature outside and inside the room has decreased but has not reached the Indonesian National Standard (SNI). Humidity when compared to SNI, on average, has reached SNI of 75%.

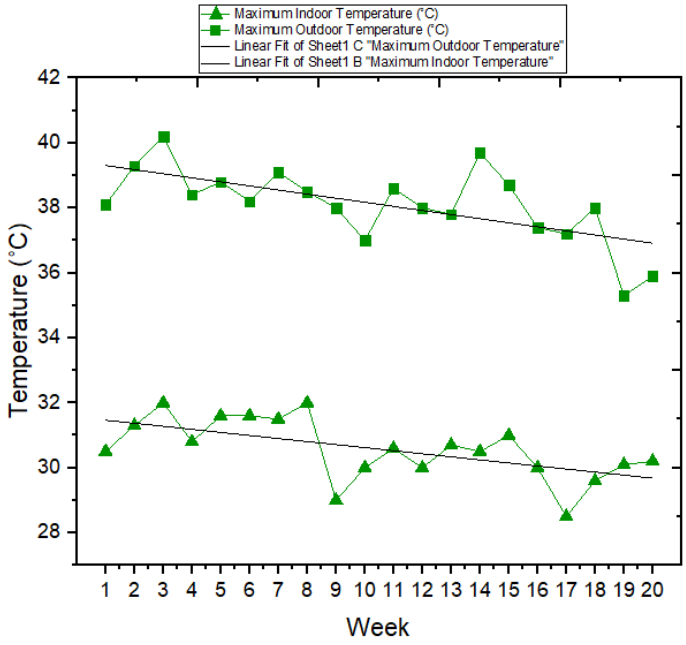

Figure 4. Graph of maximum outdoor and indoor temperatures

Conclusions

Based on the results of the research that has been done, it can be concluded that, with the presence of green canopy private green space, the temperature outdoors and indoors as a whole has decreased along with the increasing percentage of plant propagation. The THI value with a percentage of plant propagation of 0% in the comfortable category and partly uncomfortable is at 19.00 PM - 08.00 AM while with a percentage of plant propagation of 81.25% the THI value is in the comfortable category and partly uncomfortable at 21.00 PM - 09.00 AM. Humidity when compared to the Indonesian National Standard has reached the SNI of 75% while the outdoor

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temperature has decreased by 4.9 ºC and the indoor temperature has decreased by about 3.5 ºC.

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