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Analysis of Thermal Conditions in the Wamanggu Market

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ABSTRACT

The purpose of this study was to determine the thermal conditions inside and outside of buildings in the Wamanggu market. In this study using descriptive methods, the data analyzed include; building area, ventilation size, area of stall/booth inside the heat, and thermal measurements (temperature, humidity and wind speed in the market. Thermal measurements are carried out in 2 places; 1). Outside the building (taken about 5 m from the building), 2). Inside the building (measured by 2 heights, on the floor surface, height 70 cm and 160 cm). measurements were taken on the 2nd floor of the Wamanggu market. Thermals measured include; 1). Temperature, 2). Humidity and 3). Wind velocity. Currently, the temperature conditions in the Wamanggu market are included in the Warm Comfortable category with an average temperature of 28.7ºC, outside the market building, an average temperature of 29.4ºC. The humidity in the space in the market is in the Optimal Comfortable category, the average humidity in the building is 66.8% - 83.3% with an average of 74.6%, outside the building 64.8% - 77.9% with an average humidity of 71.9%, measuring height 70 cm. Wind speed in buildings between 0.1 m/s - 0.8 m/s with an average of 0.4 m/s, outside the building ranges from 1.3 m/s - 3.1 m/s an average of 2.1 m/s. The temperature in the Wamanggu market is quite high because the air circulation is not going well, due to the placement of merchandise sellers who occupy the aisles/roads between the kiosks.
KEYWORDS: Thermal Comfort, Wamanggu market, Merauke

1. INTRODUCTION

Papua is one of the regions in Indonesia that has great potential in developing trade businesses. One of the regencies located in Papua province, Merauke, is the regency with the greatest potential in food development, which previously during the Dutch colonial administration was once developed into a granary for the South Pacific region through the Kumbe Rice in 1939-1958. Besides being well-known as a rice-producing district in Papua, Merauke Regency is also famous as a producer of bananas because of the large number of bananas produced. In 2010, banana production reached 10,901.30 tons from a harvest area of 771 ha.

In the field of horticulture, Merauke Regency also has great potential. In 2010, the harvested area for vegetables in Merauke Regency was 434.35 ha. Horticultural commodities that have potential in Merauke Regency are; shallots, chillies, cabbage, cabbage, tomatoes, eggplant, water spinach, long beans, spinach and cucumbers. From the harvested area, long bean harvested area is the largest, reaching 83.50 ha (19.23 percent), so long beans are the most vegetable production which reaches 813.88 tons. Of the many agricultural production in Merauke, the most products are marketed in two places, namely the temporary market Jl. Merauke Youth and big market / parent Wamanggu Jalan Paulus Nafi Merauke.[8]

Wamanggu Market is a market that opened in the city of Merauke on April 25, 2013. This market has a semi-mall market concept that combines the concepts of traditional markets and modern markets. This market is on a land with a total area of 21,167 m2 and a building area of 15,030 m^2, this building consists of 3 floors with 4 blocks intended for various types of merchandise. The total number of kiosks / stalls is 1,140 units, 714 units on the 1st floor, 410 units on the 2nd floor and 16 units on the 3rd floor.[8]

2. LITERATURE REVIEW

A. Market definition

The market has a very close relationship with the economic activities of society, both production, distribution and consumption. In this case the market can be interpreted as an arena of distribution or exchange of goods, where the interests of producers and consumers meet and in turn determine the continuity of economic activity of the people. Ginanjar (1980) argues that the market is a place to sell and market goods or as a form of collecting trading activities. In the beginning the market was a turnaround and a meeting between inventory and supply of goods and services. The market can be defined as an institution or mechanism where buyers (who need it) and sellers (who produce) meet and jointly exchange goods and services [5]. The market is as people who have needs to be satisfied, have money to spend and a willingness to spend money. The market is where the

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buyer meets the seller, the goods or services offered for sale and then the transfer of ownership occurs. Look at the meaning of the market in several ways, including:

1. In its original sense, the market is a physical place where buyers and sellers gather to exchange goods and services.
2. For an economist, the market implies all buyers and sellers who sell and conduct transactions on certain goods / services. In this case economists are indeed more interested in the structure, behavior and performance of each of these markets.
3. For a market marketer is a set of all real buyers and potential buyers of a product.

Based on the management patterns used, the market can be divided into two major groups, namely:

a. Traditional Market, is a market that still uses a very simple management pattern with the characteristics that every trader has one type of business, there is interaction between sellers and buyers (bargaining prices), placement of goods is aligned less neatly arranged, comfort and safety are less heeded.
b. Modern Market, is a market that has adopted modern management patterns, with the characteristics of the type of merchandise carried out by one trader, fixed prices, layout of merchandise organized properly and neatly, comfort and safety have become the top priority.

In the Decree of the Minister of Industry and Trade No. 23 / MPP / Kep / 1/1998 concerning Trade Business Institutions, the market is defined as a place where the seller and buyer meet to carry out transactions where the buying and selling process is formed. Market according to the class of service can be classified into traditional markets and modern markets, while according to the nature of its distribution can be classified into retail markets and wholesale / wholesale markets. Traditional markets are defined as markets built by the government, private sector, cooperatives or non-governmental organizations with business premises in the form of shops, kiosks, booths and tents owned / managed by small and medium traders or cooperatives with small scale businesses and small capital through the buying and selling process through bargaining.

B. Protection of Traditional Markets

The protection referred to is based on the Regulation of the Minister of Trade of the Republic of Indonesia Number: 53 / MDAG / PER / 12/2008 Regarding Guidelines for Structuring and Guiding Traditional Markets of Modern Shopping Centers and Stores Article 1 paragraph 1-2, paragraph 3-5, Article 22 paragraph 8. Some The impact of market protection by the government on traders is as follows: 1) Economic impact a. The possibility of access to capital b. The possibility of an increase in income that encourages increased welfare of the community c. Possible opportunities for opening new businesses 2) Social impacts a. Possible emergence of more modern patterns of behavior of market traders b. The possibility of changes in the benchmark behavior of traditional market traders in the market c. Possibility of development of public facilities and facilities.

C. The Concept of Thermal Comfort

Architectural conditioning in the building can be done architecturally by considering the placement of buildings (the orientation of buildings to the sun and wind), the use of architectural and landscape elements and the use of materials / building materials that are in accordance with the character of the humid tropical climate. Through the four things above, the temperature in the room can be reduced several degrees without assistance.[4], [6]

1. Building Orientation
   a. Orientation to the Sun.
      The greater the area that receives direct solar radiation, the more heat the building receives.
   b. Wind Orientation (Cross Ventilation)
      A pleasant wind speed in the room is 0.1 - 0.15 m/s. The amount of air flow rate depends on:
      - free wind speed
      - Wind direction towards ventilation holes
      - Area of ventilation holes
      - The distance between the air inlet and outlet
      - Barriers in the room that block the air.
2. Architectural Elements
   - Sun visor
   The position of buildings in the East and West directions cannot be avoided, so a free view through the window on this side must be avoided because heat radiation directly entering the building (through openings / glass) will heat up the room and raise the temperature / air temperature in the room
3. Landscape Elements
   - Vegetation
   Landscape elements such as trees and vegetation can also be used as protection against solar radiation. The presence of trees directly / indirectly will reduce the temperature of the surrounding air, because solar radiation will be absorbed by the leaves for photosynthesis and evaporation.

However, if the laying of vegetation is not well ordered, it can hold the wind speed. Trees as 'windbreak' can reduce wind speed by more than 35% if the distance from the building is 5 x the height of the tree.

- Water element

The presence of water will reduce the temperature of the surrounding air due to the absorption of heat in the process of evaporation of water. In addition to lowering air temperature, the evaporation process will increase humidity.

4. Building Materials / Materials

The amount of solar radiation transmitted through the building envelope is affected by the building facade, which is the ratio of the area of the glass and the area of the wall of the whole building (wall to wall ratio). On the west side the temperature tends to be lower because during the day the west side is still exposed to shadows from the building itself, after the sun shifts from approximately 02.00 to 16.00 wita, the west wall is exposed to direct sunlight, solar heat radiation received by the east wall is bigger than the west wall [11].

The Standard of Procedures for Technical Planning for Energy Conservation in Buildings published by the LPMB-PU Foundation divides the comfortable temperature for Indonesians into three parts as follows:

Table 1. Comfortable Standards of Temperature and Humidity

Condition	Effective temperature	Humidity
Cool Comfortable **Upper threshold**	20°C – 22,8°C 24°C	90 % 80%
Optimal comfort **Upper threshold**	22,8°C – 25,8°C 28°C	70%
Warm Comfortable **Upper threshold**	25,8°C – 27,1°C 31°C	60%

Source: [3], [12]

5. Merauke Wamanggu Market

a. Wamanggu market capacity:

Table 2. The capacity of the Wamanggu market

Floor	Kiosk	Los
1	71	207
2	410	410
3	16	
Total	497	617
Total Kiosk dan Los		1,114

Source: [8]

b. Wamanggu market actual / real capacity:

As of October 2016, there are 783 units actively selling in the Wamanggu market, consisting of booths and kiosks.

Table 3. Survey results of the number of market traders in Wamanggu Merauke

No	Group name	Tracers location
		Wamanggu market
1	Clothes and shoes	131 units
2	Electronic, broken, mixed	48 units
3	Spices, Vegetables, Fish, Meat, Fish, Groceries	604 units
Amount		**783 units**

Source: [8]

3. METHODS

In this study using the method of observation, the data analyzed include; building area, ventilation size, stall / booth area in the heat, and thermal measurements (temperature, humidity and wind speed in the market. Thermal measurements are carried out in 2 places; 1). outside the building (taken approximately 5m from the building), 2). Inside the building (measured by 2 heights, on the surface of the floor, height 70cm and 160cm). measurements were taken on the 2nd floor of the Wamanggu market. Thermals measured include; 1). Temperature, 2). Humidity and 3). Wind velocity. Useful method was provided in [9].

4. RESULTS AND DISCUSSION

Wamanggu Market is a market that opened in the city of Merauke on April 25, 2013. This market has a semi-mall market concept that combines the concepts of traditional markets and modern markets. This market is located on the street Paulus Nafi Merauke District, on land with a total area of 21,167 m^2 and building area of 15,030 m^2, this building consists of 3 floors with 4 blocks intended for various types of merchandise. The total number of kiosks / booths is 1.1140 units, 714 units on the 1st floor, 410 units on the 2nd floor and 16 units on the 3rd floor. On the 2nd floor of the Wamanggu market there are 410 kiosk / booths with a corridor width of 2m. Stalls / booths on the 2nd floor are intended for sales: 1). Shoes and sandals, 2). Clothing and fabric, 3). Furniture, 4). Jewelry, 5). Cosmetics and 6). Electronics

From the results of thermal measurements carried out to find out; 1). Temperature, 2. Humidity and speed of the air, measured both inside and outside the building. For measurement buildings, there are 8 measuring points, placing the measuring points in the selling and lobby areas. While outside the building there are 2 measuring points namely beside the left and right buildings taken 5 m from the edge of the building. Height measurement of 70 cm (according to the height of the table where it sells) and height measurement of 160 cm (height of the average human standing).

A. Effect of air temperature

The results of measurements at a height of 70 cm obtained a temperature in the building between the hours of 08:00 to 17:00 CET temperatures between 27.4ºC - 30.1ºC with an average temperature of 28.7ºC enter in comfortable warm conditions. While outside temperatures between 27.9ºC - 31.9ºC with an average temperature of 29.4ºC for temperature conditions, both inside and outside enter the warm comfortable category. Measurement data at a height of 70 cm can be seen in table 4.

Table 4. Indoor and outdoor temperature measuring height 70 cm

No	Time	Temperature (ºC)	
		Indoor	Outdoor
1	8:00	28.3	28.77
2	9:00	28.3	28.97
3	10:00	28.4	29.07
4	11:00	29.1	30.17
5	12:00	29.4	30.57
6	13:00	30.1	31.87
7	14:00	29.1	29.57
8	15:00	29.1	29.27
9	16:00	27.8	27.87
10	17:00	27.4	28.07

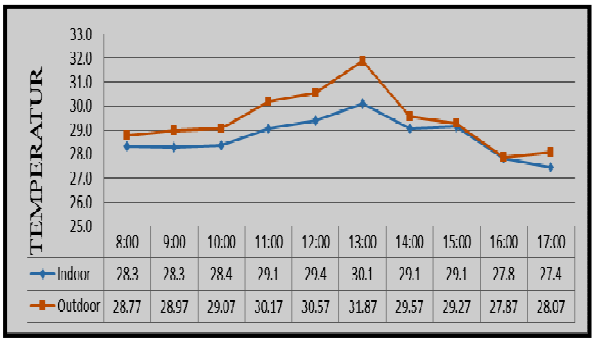

Figure 1. Temperature at a height of 70 cm

Whereas for measurements inside buildings with a height of 160 cm the temperature is between 27ºC - 30.8ºC with an average of 28.7ºC, for outside the building the temperature is between 28.3ºC - 31ºC with an average of 29.4ºC, temperature information can be seen in table 5. The highest temperature is good inside or outside the building occurs at 12.00 - 13.00 WIT

Table 5. Indoor and outdoor temperature measurements of 160 cm height

No.	Jam	Temperature (ºC)	
		Indoor	Outdoor
1	8:00	28.4	28.30
2	9:00	28.3	28.40
3	10:00	28.2	28.60
4	11:00	29.0	30.40
5	12:00	29.4	30.20
6	13:00	30.0	31.00
7	14:00	29.3	29.30
8	15:00	29.1	29.40
9	16:00	27.8	28.50
10	17:00	28.2	29.40

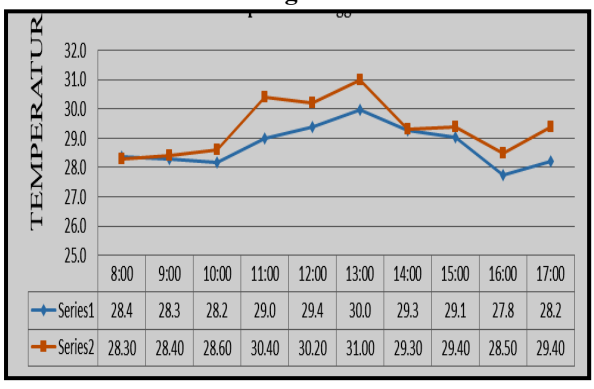

Figure 2. Temperature at a height of 160 cm

B. Effects of Air Humidity

Humidity measurement with a measurement height of 70 cm from the floor humidity between 66.8% - 83.3% with an average of 74.6%, with the humidity for space in the Wamanggu market or at the position of the seller's table in the Optimal Comfortable humidity category. For outside buildings with the same height humidity ranges between 64.8% - 77.9% with an average humidity of 71.9%. Moisture data on measurements of 70 cm can be seen in table 6.

Table 6. Indoor and outdoor humidity measurement height of 70 cm

No	Time	Humidity (%)	
		Indoor	Outdoor
1	8:00	28.4	76.7
2	9:00	28.3	76.4
3	10:00	28.2	74.7
4	11:00	29.0	72.2
5	12:00	29.4	67.5
6	13:00	30.0	64.8
7	14:00	29.3	65.1
8	15:00	29.1	67.8
9	16:00	27.8	75.8
10	17:00	28.2	77.9

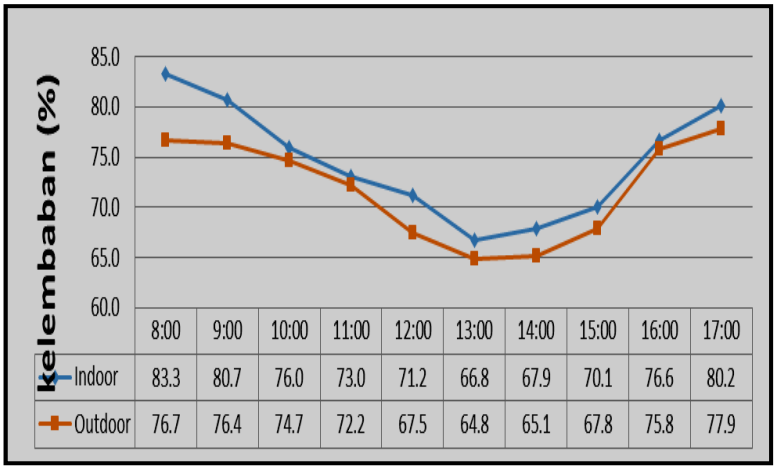

Figure 3. Humidity at a height of 70 cm

With a height measurement of 160 cm, inside the building the humidity is between 67.8% - 83.3% with an average of 74.7, for outside the building ranges from 64.8% - 76.7% with an average of 71.5%. The measurement results both inside and outside the building enter the Optimal Comfortable category. Data from the measurement of humidity at a height of 160 cm inside and outside the building can be seen in table 7.

Table 7. Indoor and outdoor humidity measurement heights of 160 cm

No	Time	Humidity (%)	
		Indoor	Outdoor
1	8:00	28.4	76.7
2	9:00	28.3	76.4
3	10:00	28.2	74.7
4	11:00	29.0	72.2
5	12:00	29.4	67.5
6	13:00	30.0	64.8
7	14:00	29.3	65.1
8	15:00	29.1	67.8
9	16:00	27.8	75.8
10	17:00	28.2	77.9

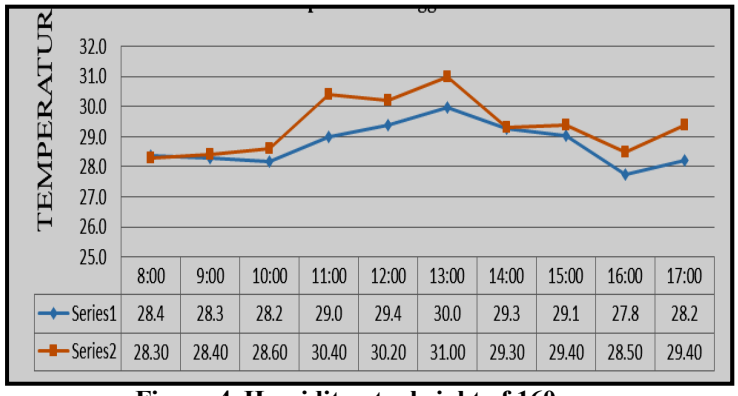

Figure 4. Humidity at a height of 160 cm

C. Effect of Wind Velocity

Measurement of wind speed is measured both inside the building and outside the building with a height of 100 cm from the surface of the floor, for inside the building the wind speed ranges from 0.1 m/s - 0.8 m/s with an average of 0.4 m/s, while for outside the building ranges between 1.3 m/s - 3.1 m/s average of 2.1 m/s measurements outside the category of weak wind but the movement of the wind can be felt by the body. The speed of wind outside is not comparable to inside because the openings in the Wamanggu market are not many, and the facilities provided as cross ventilation are mostly covered by merchandise at market sellers.

Table 8. Indoor and outdoor wind velocity height of 100 cm

No	Time	Wind velocity	
		Indoor	Outdoor
1	8:00	0.5	2.8
2	9:00	0.6	1.4
3	10:00	0.4	1.3
4	11:00	0.4	1.7
5	12:00	0.8	3.0
6	13:00	0.5	3.1
7	14:00	0.6	2.7
8	15:00	0.3	1.8
9	16:00	0.2	1.7
10	17:00	0.1	1.4

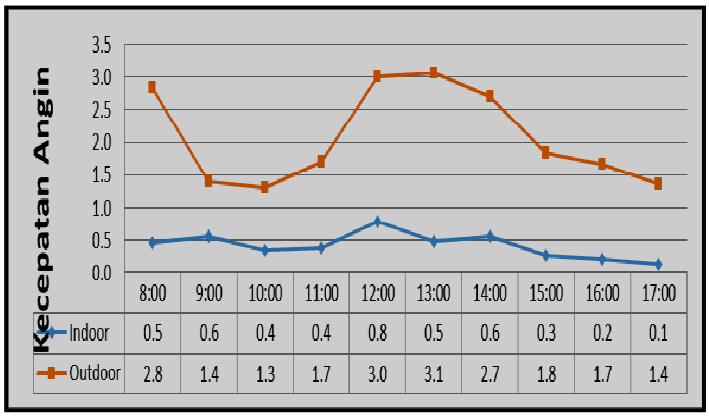

Figure 5. Wind velocity

5. CONCLUSION

Currently, the temperature conditions in the Wamanggu market are included in the Warm Comfortable category with an average temperature of 28.7ºC, outside the market building, an average temperature of 29.4ºC. does not rule out the fore future conditions in the building of Warm Comfort can increase in the Heat category because the number of sellers and buyers will increase. The humidity in the space in the market is in the Optimal Comfortable category, the average humidity in the building is 66.8% - 83.3% with an average of 74.6%, outside the building 64.8% - 77.9% with an average humidity of 71.9%, measurement height of 70 cm. Wind speed in buildings between 0.1 m/s - 0.8 m/s with an average of 0.4 m/s, outside the building ranges from 1.3 m/s - 3.1 m/s an average of 2.1 m/s.

The temperature in the Wamanggu market is quite high because the air circulation is not going well, due to the placement of merchandise sellers who occupy the aisles/roads between the kiosks. Besides that the condition of building openings is indeed not good (seen from the percentage of building openings with market floor area).

With high temperatures in the market and low humidity and low air circulation inside the building, these conditions make the conditions in the market building uncomfortable.

As suggestions: market manager need awareness of the seller so as not to place merchandise in the hallway / road between the kiosks. Structuring the space pattern in the market building needs to be done, to make the most of the space in the building column it would be better not to be in the middle of a kiosk (selling place). Market manager also need to install exhaust fans in several parts of the market, especially in the sale of fish and meat.

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