

Problems and Urban Sustainable Development in Wetlands based on The Thermal Conditions

by Akbar Rahman, M. Tharziansyah, M. Rizky, H S M Vita

Submission date: 12-Apr-2023 07:15PM (UTC+0700)

Submission ID: 2062465575

File name: able_development_in_wetlands_based_on_the_thermal_conditions.pdf (468.8K)

Word count: 2105

Character count: 11205

PAPER · OPEN ACCESS

Problems and urban sustainable development in wetlands based on the thermal conditions

To cite this article: A Rahman *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **780** 012022

View the [article online](#) for updates and enhancements.



ECS **240th ECS Meeting**
Digital Meeting, Oct 10-14, 2021
We are going fully digital!
Attendees register for free!
REGISTER NOW

Problems and urban sustainable development in wetlands based on the thermal conditions

A Rahman^{1,2,*}, M Tharzhiansyah¹, M Rizky¹ and H S M Vita¹

¹Program Studi Arsitektur, Fakultas Teknik, Universitas Lambung Mangkurat, Indonesia

²Co-Founder Zero Waste Kalimantan Selatan, Indonesia

*arzhi_teks@ulm.ac.id

Abstract. Indonesia's landscape surrounded by oceans causes weather anomalies from the Indian and Pacific oceans. In the dry season, drought causes frequent forest and land fires. Forest and land fire is a problem for the government and society. The causes of forest and land fires in 2019, according to BMKG, are El Nino and La Nina (ENSO), Indian Ocean Dipole (IOD), Sea Surface Temperature (SST), and the influence of wind movement (Monsoon). Forest and land fires are closely related to climate and weather conditions. WWF Indonesia said that fires in wetlands, especially peatlands, are alarming. In Sumatra and Kalimantan, peatland fires reached an average of 32.1% and 25.1%. Peat contains fuel (plant residues) below the surface, as a result, fires in peatlands spread below the surface of the soil slowly and are difficult to detect and cause thick smoke. The phenomenon of drought in wetlands especially peatlands has been proven to cause forest and land fires. Based on this condition, it is necessary to conduct research related to the thermal conditions of the peat environment, especially the surface thermal conditions in the swamp. This research is important to know the thermal characteristics of swamps so that urban problems due to thick smoke can be identified. This research is quantitative research based on measurement data collected from the field study. This research was conducted in 2 provinces and 3 cities in Kalimantan: Banjarmasin, Kapuas, and Pulang Pisau. This location was chosen because the city is located in wetlands and is often affected by forest and land fires. The measurement results show high thermal conditions during the day when the intensity of solar radiation is also high around 1400 watts / m².

1. Introduction

Climate and environmental aspects are one of the things that affect architectural products [1]. The climate, or average weather, is primarily a function of the sun. Climate word is used by scientists to divide the earth region based on the different seasons experienced. Countries with two seasons are grouped in tropical climates, and countries with four seasons are grouped in subtropical climates, and countries outside the group, categorized as cold countries. Scientists agree the air temperature of a region is the boundary between tropical climate and subtropical climate. Regions with the average temperature above 20°C are grouped in the tropical climate, and regions with the average temperature below 20°C are grouped in sub-tropical regions [2]. The climate of Indonesia is a humid tropical climate. This is due to the



Content from this work may be used under the terms of the [Creative Commons Attribution 3.0 licence](https://creativecommons.org/licenses/by/3.0/). Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.

Published under licence by IOP Publishing Ltd

geography and landscape of Indonesia. Indonesia is located on the equator and consists of many islands. As an archipelagic country, most of its land is surrounded by the sea. Its main characteristic, the sky is almost cloudy throughout the year due to high evaporation from seawater so that the intensity of rainfall is high and affects the high humidity at all times. That is why Indonesia has a humid tropical climate.

The city as a gathering place that interacts for a particular purpose has influenced the shape and visual of the city. The increasing population living in a city, causing the complexity of the problem, is no exception to the architecture and urban design. The density of buildings in a city has affected the urban microclimate. Urban get hotter than rural areas [3]. Urban planners need to pay attention to several aspects related to the solution to the design of the humid tropics. The relationship between design and rules is the first half of what architects and planners need to know, that is, how design meets the requirements of the rules [4]. For example, urban design should pay attention to the comfort of pedestrians. Pedestrians do not need to use an umbrella, shelter when it rains and the sun shines. Buildings must be connected, so the activity does not stop when it rains or the sun shines [5]. Creating an urban forest will minimize heat absorption on the outdoor surface. The goal is for the urban forest to anticipate high temperatures. Direct sun exposure to solid surfaces (asphalt, concrete, and other) should be avoided.

The building mass arrangement by optimizing the airflow around the building needs to be a concern. One way to improve thermal comfort in humid tropical climates is to optimize the airflow around (outdoor) and indoor buildings. Wind movement will be better in open space if the airflow is not blocked [6]. This research discusses thermal in wetlands. Nowadays, every summer there are forest and land fires. This condition is the failure of urban development related to the environment in the city area. Environmental improvement efforts are needed in order to provide a sense of comfort for city residents. The city residents on peatlands (wetlands) are always affected, for example, the impact of smoke on health. This research is important to do to determine the thermal characteristics of wetlands that cause forest and land fires. In addition, this research is also a development from previous research [7,8].

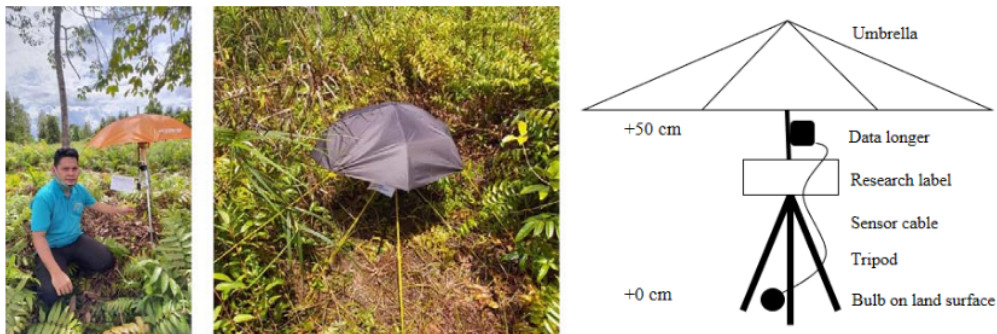


Figure 1. The collection data process.

2. Research methods

This research is quantitative research based on measurement data collected from the field study. This research was conducted in 3 cities at South Kalimantan and Center Kalimantan. The city is Banjarmasin, Kuala Kapuas, and Pulang Pisau. The measurement was conducted from April to July 2020. The collection data process (Figure 1):

- Observation, to know the actual condition or the field state. Implemented by direct measurement in the field. Measurements with measuring tools: solar meter, data logger, wind meter, tripod,

umbrella, bulb, and DSLR Camera with a wide-angle lens.

- Data measurement records: solar radiation (watt/m²), dry-bulb temperature (OC), relative humidity (%), wind speed (m/s), and sky condition.
- Interviews, to get oral data from sources related to the research.
- Documentation, to get graphical data as a matter of making a map or building drawings.

After all the data was collected, the researcher processed the data into graphs. Graph data is analyzed to see the thermal conditions on the marshland surface. From graphs and photographs, researchers observe and discover the thermal characteristics of wetlands.

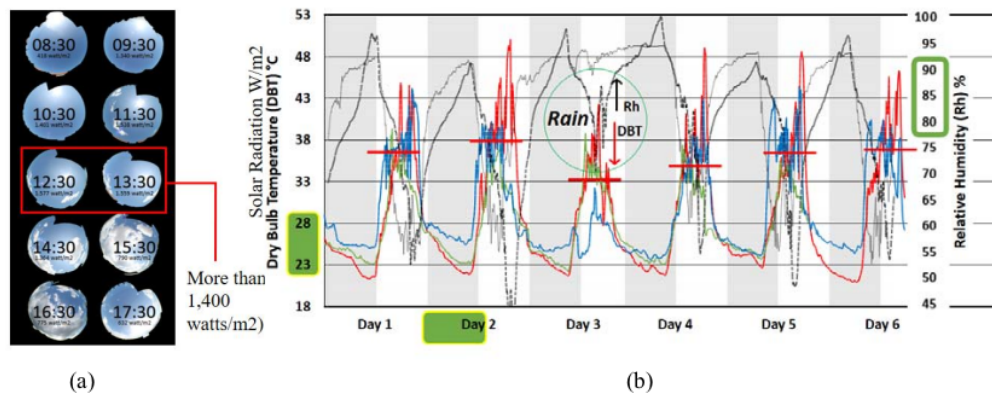


Figure 2. Measurement result: a) Solar radiation and b) thermal conditions.

3. Results and discussion

3.1. Solar radiation condition

Daytime solar radiation measurements at 3 research locations: Banjarmasin, Kuala Kapuas, and Pulang Pisau show solar radiation of around 1,400 W/m² between 11 AM – 1 PM (Figure 2.a). This value is relatively the same over several measurement days when the sky is cloudless (clear). However, when the sun is covered by clouds or overcast, solar radiation falls by around 300-400 W/m². The sun's altitude angle between 25-90 degrees causes high radiation between 900-1,400 W/m² or between 9 AM – 3 PM. Based on the research results, high solar radiation affects temperature and relative humidity. The surface temperature of wetlands during the day can reach up to 40°C, occurring almost the same at each study site. Meanwhile, the relative humidity during the day drops rapidly as radiation increases. The relative humidity between 1 PM – 2 PM ranges from 50-60%. Based on the interviews, when the wind speed was below 1 m/s, residents felt intense heat and sweat due to high solar radiation. This also proves that the heat in the wetlands is high when the solar radiation is high, especially if it continues. In addition, wetland conditions with minimal vegetation accelerate the increase in environmental heat and effect from the thermal condition.

3.2. Characters of thermal in wetlands

The thermal characteristics in the wetlands show the results as shown in Figure 2.b. Measurements carried out every day non-stop, at 3 research locations, also show the same characteristics. The measurement tool records the thermal conditions in the morning, afternoon, evening, and night. As a result, humidity and

temperature conditions have values in opposite directions, when the temperature increases, the relative humidity decreases. Meanwhile, the wind speed during the day is relatively high compared to at night and the wind speed increases when it is going to rain. The surface temperature of wetlands is increasing day by day when the relative humidity also decreases. The temperature increases per day when conditions are dry between 0.8-1°C, while the relative humidity decreases between 4% -7% per day (Figure 3.b). However, this condition can change when it rains between 1-2 hours and will drop the temperature by 5°C the next day. Field surveys also show that peatlands that are only overgrown with shrubs without dense trees cause the land to burn easily when the surface temperature of the peatlands is above 40°C. Shrubs that grow on peat with a height of 100-200 centimeters, cause direct sunlight to the surface of the peat and facilitate the burning of dry leaves and branches. This condition causes cities with swampy (peat) soil conditions to become uncomfortable due to high heat conditions and in hot summers. The peatlands burn easily and cause respiratory problems for residents due to smoke.

4. Conclusion

The forest and land fires on peat are caused by very high soil surface temperatures. Even though the measurements were made during the rainy season, the results show an extremely high temperature greater than 40°C. Based on the research results, high solar radiation affects temperature and relative humidity. The surface temperature of wetlands during the day can reach up to 40°C, occurring almost the same at each study site. Meanwhile, the relative humidity during the day drops rapidly as radiation increases. The temperature increases per day when conditions are dry between 0.8-1°C, while the relative humidity decreases between 4% -7% per day. Besides that, based on observations during the survey and measurement, the peatlands condition in the research place requires vegetation planting or afforestation from the local government. Shrubs that grow on peat with a height of 100-200 centimeters, cause direct sunlight to the surface of the peat and facilitate the burning of dry leaves and branches. This condition causes cities with swampy (peat) soil conditions to become uncomfortable due to high heat conditions and in hot summers. This is important for environmental sustainability and preventing forest and land fires.

References

- [1] Rapoport A 1969 *House Form And Culture* (Prentice-Hall Englewood Cliffs New Jersey)
- [2] Lippsmeier G 1997 *Bangunan Tropis* (Erlangga Jakarta)
- [3] Roth M 2013 *Handbook of Environmental Fluid Dynamics: Urban Heat Islands*. (CRS Press/Taylor and Francis Group) **2** pp 143-160
- [4] Al-Bishawi M Ghadban S 2011 International Journal of Architectural Research: A Methodological Approach for Reading Urban Open Space *ArchnetIJAR* **5**(1) pp 73-85
- [5] Karyono T H, 2001 *Dimensi Teknik Arsitektur: Wujud Kota Tropis di Indonesia: suatu pendekatan iklim, lingkungan dan energi* **29**(2) pp 141-146
- [6] Lechner N 2000 *Heating, Cooling, Lighting (Metode Desain Arsitektur)* (Raja Grafindo Persada Jakarta)
- [7] Rahman A Kojima S 2017 Study of Indoor and Outdoor Thermal Comfort for Public Space and Houses in Around River, Case Study: Banjarmasin City *Indonesia Advances in Engineering: an International Journal (ADEIJ)* **2**(1) pp 29-41
- [8] Rahman A Kojima S 2017 *Proc. Int. Conf. on Innovation in Civil, Architecture, Environment and Materials Engineering (CAEME-17): Analysis of Thermal Comfort SNI 03-6572 In Green Open Space Siring Tendean Banjarmasin-Indonesia* (Paris (France)) pp 40-44

Problems and Urban Sustainable Development in Wetlands based on The Thermal Conditions

ORIGINALITY REPORT

10%

SIMILARITY INDEX

9%

INTERNET SOURCES

6%

PUBLICATIONS

2%

STUDENT PAPERS

MATCH ALL SOURCES (ONLY SELECTED SOURCE PRINTED)

3%

★ Submitted to University of Sheffield

Student Paper

Exclude quotes Off

Exclude matches < 2%

Exclude bibliography Off