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ANALYSIS OF BIOTIC–ABIOTIC COMPONENTS, BIOTHERMAL PARAMETERS, AND ENVIRONMENTAL SANITATION IN URBAN GREEN OPEN SPACE OF PALANGKA RAYA

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Abstract. *This study aims to analyze the relationship between biotic and abiotic components, biothermal parameters, and environmental sanitation in an urban green open space (RTH) in Palangka Raya. A descriptive observational method was employed using quadrat sampling (10 m²), physical measurements, and sanitation surveys. The results showed that soil and water were the dominant abiotic components supporting ecosystem functions. The biotic components included plant species such as* Leersia virginica *and* Cyperus rotundus*, as well as fauna like* Lumbricus terrestris *and* Oecophylla smaragdina*, which play significant ecological roles. Biothermal measurements indicated an increase in body temperature due to physical activity and sun exposure. Furthermore, sanitation conditions in the surrounding community were found to be below health standards, particularly regarding the distance between water sources and septic tanks. This study concludes that the interaction between biotic, abiotic, and sanitation factors significantly influences environmental quality and public health.*

Keywords: *biotic components, abiotic factors, biothermal, sanitation, ecosystem*

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INTRODUCTION

The environment is a complex and dynamic system composed of interactions between biotic and abiotic components that collectively maintain ecosystem balance. Biotic components include all living organisms such as plants, animals, and microorganisms, which play roles as producers, consumers, and decomposers (Wahyuni et al., 2025). Meanwhile, abiotic components consist of non-living physical and chemical factors, including soil, water, temperature, and sunlight, which provide the essential conditions for life to exist and develop (Makkulau et al., 2025). The interaction between these components forms a functional ecological system that supports biodiversity and ecosystem stability.

The balance of an ecosystem is highly dependent on the harmonious interaction between its biotic and abiotic elements. Any disturbance in one component can significantly affect the others, leading to ecological

imbalance (Rosawanti et al., 2025). For instance, changes in soil quality or water availability may directly influence plant growth, which in turn impacts herbivores and higher trophic levels. Therefore, understanding the structure and function of these components is crucial for maintaining environmental sustainability and preventing ecosystem degradation.

However, environmental balance is not solely determined by natural processes but is also significantly influenced by human activities. Anthropogenic factors, particularly those related to environmental sanitation, play a critical role in shaping ecosystem conditions. Poor sanitation practices, such as improper waste disposal and inadequate wastewater management, can lead to pollution of soil and water resources . This not only disrupts ecological interactions but also contributes to the spread of pathogenic microorganisms, thereby increasing the risk of disease transmission among humans and other living organisms.

In addition to ecological and sanitation aspects, biothermal factors are also important in understanding environmental dynamics. Biothermal conditions refer to the thermal interactions between living organisms and their surrounding environment, particularly how temperature variations affect physiological processes. Changes in environmental temperature can influence metabolic rates, energy balance, and overall health of organisms. In humans, for example, physical activity and exposure to sunlight can cause significant fluctuations in body temperature, reflecting the body's adaptive response to environmental conditions.

Based on these considerations, it is essential to conduct an integrated study that examines the relationship between biotic and abiotic components, biothermal parameters, and environmental sanitation. Such an approach provides a comprehensive understanding of how ecological and human-related factors interact to influence environmental quality . Therefore, this study aims to analyze these interrelated aspects within an urban green space in Palangka Raya, with the expectation of contributing to sustainable environmental management and improved public health outcomes.

METHOD

Study Area

The study was conducted at Pasuk Kameloh Urban Green Space and Kahayan Bridge, Palangka Raya, on January 4, 2025.

Data Collection Techniques

The participants of this study were undergraduate students enrolled in a biology education program at a university. A total of 80 students participated, divided into two groups: the experimental group (n = 40) and the control group (n = 40). The sampling technique used was purposive sampling, based on course enrollment and similar academic backgrounds.

Data were collected using:

a) Direct observation of biotic and abiotic components
b) Quadrat sampling method (10 m^2)
c) Physical measurements (length, mass, time, temperature)
d) Biothermal observation using thermometers
e) Environmental sanitation survey

Data Analysis

Data were analyzed descriptively by comparing field observations with ecological and environmental health theories.

RESULT

Abiotic Components

The results indicated that soil and water are the primary abiotic components in the study area. Soil functions as a fundamental medium for plant growth, providing mechanical support, essential nutrients, and habitat for various microorganisms. Its physical and chemical properties, such as texture, structure, and organic matter content, directly influence plant productivity and biodiversity. Meanwhile, water plays a crucial role in supporting metabolic processes, including nutrient transport, cellular activities, and photosynthesis in plants.

The interaction between soil and water significantly affects nutrient availability and overall ecosystem productivity. Soil acts as a reservoir that retains water and dissolved nutrients, while water facilitates the movement of these nutrients to plant roots. Variations in soil moisture can influence plant growth rates and microbial activity, thereby affecting ecological balance. In this context, the stability of abiotic components is essential for maintaining sustainable ecosystem functions.

Biotic Components

The observed biotic components consisted of a diverse range of plant and animal species that contribute to ecosystem functioning. Plant species such as *Leersia virginica* and *Cyperus rotundus* serve as primary producers, converting solar energy into chemical energy through photosynthesis. These plants form the base of the food chain and provide habitat and food resources for other organisms.

In addition, organisms such as earthworms (*Lumbricus terrestris*) play a vital role as decomposers by breaking down organic matter and improving soil fertility. Their activity enhances soil structure, aeration, and nutrient cycling. Ants (*Oecophylla smaragdina*) also contribute significantly to ecological processes, particularly in seed dispersal and biological pest control. The presence of these organisms indicates active ecological interactions, highlighting the complexity and interdependence of the ecosystem.

Measurement and Biothermal Analysis

The measurement results demonstrated variations in physical parameters such as length, mass, and speed, reflecting natural variability in biological and environmental samples. These measurements are essential for understanding the physical characteristics of organisms and their interaction with the environment.

Biothermal observations revealed that body temperature increased after physical activity and exposure to sunlight. This phenomenon reflects the physiological response of the human

body to external environmental conditions. Increased physical activity leads to higher metabolic rates, resulting in heat production, while solar radiation contributes to additional heat gain. These findings indicate a clear relationship between environmental conditions and physiological responses, emphasizing the importance of thermal regulation in maintaining human health and performance.

Environmental Sanitation

The sanitation assessment revealed several critical issues related to environmental health conditions in the study area. One of the main concerns is that the distance between water sources and septic tanks was found to be below the recommended standard of 10 meters. This condition increases the risk of groundwater contamination by pathogenic microorganisms and harmful substances.

Furthermore, the sanitation facilities, particularly toilets, were observed to be in poor condition and not properly maintained. This situation may contribute to the spread of disease vectors such as flies, bacteria, and parasites. Additionally, the proximity of waste disposal systems to water sources suggests a high potential for water contamination, which can adversely affect both environmental quality and human health.

Overall, these sanitation issues may significantly increase the risk of waterborne diseases and other environmental health problems. Therefore, improving sanitation infrastructure and promoting community awareness are essential steps toward achieving a healthier and more sustainable environment.

DISCUSSION

The findings of this study highlight the strong interdependence between abiotic and biotic components in maintaining ecosystem stability . Soil and water, as the dominant abiotic factors, play a fundamental role in supporting plant growth and sustaining biological processes (Ery Wijaya & Meilasari Sugiana, 2023; Lembrechts et al., 2018). The ability of soil to retain water and nutrients directly influences vegetation density and diversity, which in turn affects higher trophic levels. This result is consistent with ecological theory stating that abiotic conditions determine the distribution and productivity of living organisms within an ecosystem.

The presence of various plant species such as *Leersia virginica* and *Cyperus rotundus* indicates that the study area has sufficient environmental conditions to support primary productivity. These species function as the base of the food web, providing energy sources for consumers. Furthermore, the identification of decomposer organisms such as *Lumbricus terrestris* suggests active nutrient cycling processes within the soil. The role of ants (*Oecophylla smaragdina*) in seed dispersal and pest control further strengthens the evidence of complex ecological interactions occurring in the ecosystem. This demonstrates that biodiversity contributes significantly to ecosystem resilience and stability (Liu et al., 2023; Pitri et al., 2023).

In terms of biothermal analysis, the observed increase in body temperature after physical activity and exposure to sunlight reflects the adaptive physiological responses of humans to environmental conditions. This finding aligns with the concept of thermoregulation, where the human body

maintains internal temperature balance through metabolic adjustments. Environmental temperature and physical exertion are key factors influencing heat production and dissipation. Therefore, biothermal parameters can be used as indicators of environmental stress and human adaptability to changing environmental conditions.

However, despite the relatively stable ecological conditions, the sanitation assessment reveals significant environmental health concerns. The inadequate distance between water sources and septic tanks poses a serious risk of groundwater contamination. This condition is particularly critical in areas where communities rely on shallow groundwater for daily use. Contaminants such as pathogenic bacteria (e.g., *Escherichia coli*) can easily infiltrate water sources, leading to waterborne diseases.

Additionally, the poor condition of sanitation facilities indicates a lack of proper environmental management and public awareness. The presence of potential vectors such as flies and other insects further increases the risk of disease transmission. These findings suggest that human activities, particularly in sanitation practices, have a direct impact on environmental quality and ecosystem health. Therefore, improving sanitation infrastructure and promoting sustainable environmental practices are essential to reduce health risks and maintain ecological balance (Abidin et al., 2021).

Overall, this study demonstrates that environmental quality is influenced by a complex interaction between ecological components and human factors. While the ecosystem still shows functional ecological processes, the existing sanitation issues may gradually degrade environmental conditions if not properly managed. This highlights the importance of integrating ecological understanding with public health strategies in environmental management.

CONCLUSION

This study demonstrates that ecosystem stability in the urban green space of Palangka Raya is strongly influenced by the interaction between biotic and abiotic components. Soil and water were identified as key abiotic factors that support plant growth and regulate ecological processes, while various plant and animal species contribute to maintaining biodiversity and ecosystem functionality through roles as producers, consumers, and decomposers.

The findings also reveal that biothermal conditions, particularly changes in body temperature due to physical activity and environmental exposure, reflect the adaptive physiological responses of humans to their surroundings. This indicates that environmental conditions not only influence ecological processes but also directly affect human health and performance.

However, despite the presence of relatively functional ecological interactions, the study identified significant issues related to environmental sanitation. Inadequate distance between water sources and septic tanks, along with poor sanitation facilities, poses a high risk of environmental contamination and waterborne diseases. These findings highlight the critical role of proper sanitation management in maintaining environmental quality and public health.

Overall, this study emphasizes that environmental sustainability requires an integrated approach that considers ecological interactions, human activities,

and sanitation practices. Improving sanitation infrastructure and increasing community awareness are essential steps to ensure a healthier environment and sustainable ecosystem management.

RECOMMENDATIONS

Based on the findings of this study, several recommendations can be proposed to improve environmental quality and support sustainable ecosystem management.

First, it is essential to enhance community awareness regarding environmental sanitation. Educational programs and outreach activities should be conducted to inform local residents about the importance of maintaining proper sanitation practices, particularly in managing household waste and protecting water sources from contamination.

Second, improvements in sanitation infrastructure are urgently needed. This includes ensuring that the distance between water sources and septic tanks complies with the recommended health standards (minimum 10 meters). Additionally, sanitation facilities such as toilets should be upgraded to meet hygienic and safety requirements in order to reduce the risk of disease transmission.

Third, environmental monitoring should be conducted regularly to assess changes in abiotic and biotic components. Continuous monitoring can provide valuable data for early detection of environmental degradation and support evidence-based decision-making in ecosystem management.

Fourth, future research should incorporate more comprehensive quantitative approaches, including statistical analysis and laboratory testing of environmental samples (e.g., water quality analysis). This will strengthen the scientific validity of the findings and allow for more accurate assessment of environmental conditions.

Finally, an integrated approach that combines ecological management, public health strategies, and community participation is highly recommended. Collaboration between local government, academic institutions, and communities is crucial to achieving sustainable environmental management and improving overall ecosystem resilience.

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