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Research Article

Study of the Application of Ecological Architecture in Housing on the Palm Oil Plantation of PT Agro Muara Rupit

(Case Study of Remban, Rawas Ulu District, North Musi Rawas Regency, South Sumatra Province)

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Abstract: South Sumatra is a province with high natural resource potential in the palm oil plantation sector. The increasing demand for palm oil has led to many companies operating in this sector. One such plantation company is PT. Agro Muara Rupit, located in Rawas Ulu District, North Musi Rawas Regency, South Sumatra Province. This research is important because plantations are not only assessed from a commercial perspective, but must also have a positive impact on environmental sustainability. One environmentally conscious design concept is ecological architecture. Ecological architecture plays a role in protecting ecosystems from damage and creating comfort for residents from a physical, social, and economic perspective. This research aims to create environmentally conscious residential designs by applying ecological architecture concepts, ensuring the preservation of the natural environment. The research method used is a qualitative descriptive method with stages namely problem identification, data collection, analysis, and concept development, then the concept is implemented into the design. The results of this study are the implementation of four aspects of the ecological architecture concept in residential environments, including through natural ventilation and lighting systems by creating openings in the building, energy savings by using solar panels, the use of natural materials in the building mass such as clay, wood and bamboo, and the application of a bio pore system as water absorption.

Keywords: Architecture Application; Ecological Architecture; Ecological Sustainability; Environmental Impact; Green Building.

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1. Introduction

Rawas Ulu is a sub-district in North Musi Rawas Regency, South Sumatra Province, Indonesia. Palm oil is a highly strategic commodity for development in Rawas Ulu. Palm oil plantations have become a vital commodity, driven by the positive benefits of economic growth felt by the community. PT Agro Muara Rupit is a company developing its business in the palm oil plantation industry. Ecological architecture is the study of the reciprocal relationship between living things and their environment (Frick & Suskiyatno, 2007). The ecological concept is the concept of managing the environment by utilizing natural resources with the use of environmentally friendly technology (Nelson , 2019). It can be said that

ecological architecture is a concept that considers harmony between humans and their environment. The main principle focuses on a positive reciprocal relationship between nature, buildings, and humans (Amna et al., 2017).

Human involvement in environmental and building management must be harmonious, with the application of the principles of ecological architecture according to Heinz Frick, namely; environmental adaptation to climate, topography, soil structure.

The climate conditions of rainfall in most areas of South Sumatra are more than 60% low CH (0 – 50 mm): one of them is Musi Rawas Regency (Staklim, Sumsel, BMKG, 2025)

Figure 1. Rainfall.
(staklim-sumsel.bmkg.go.id)

The average temperature in the summer lasts 4.6 months from March 13 to August 2, with an average daily maximum temperature exceeding 32° C. The hottest month of the year is May, with an average temperature of 25° C and a maximum temperature of 32°.

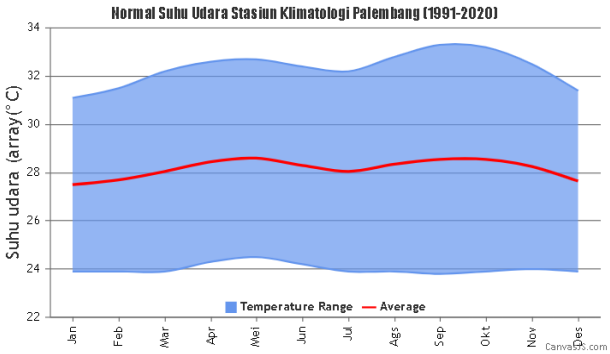

Figure 2. Average Temperature.
(staklim-sumsel.bmkg.go.id)

The prevailing wind direction is from the southeast. Wind speeds range from 0.5 to 9.7 knots. The average wind speed is 3.5 knots or 6.5 km/h. The average wind direction is indicated by the resultant vector, which is from the southeast (153° – 54%).

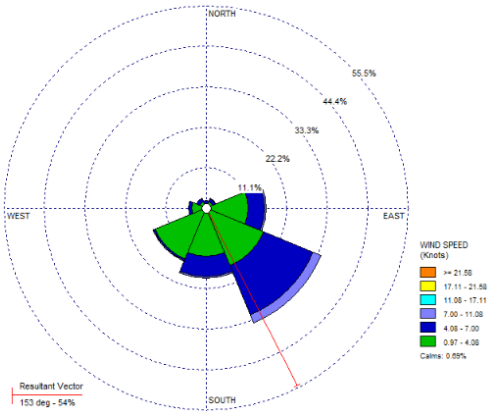

Figure 3. Wind Speed.
(staklim-sumsel.bmkg.go.id)

In August 2025, drought levels in most of South Sumatra are predicted to be normal. Southern Musi Banyuasin, eastern and southwestern Lahat, southern Pagar Alam, eastern Muara Enim, eastern OKU, southern East OKU, and eastern South OKU are predicted to be slightly wet to wet.

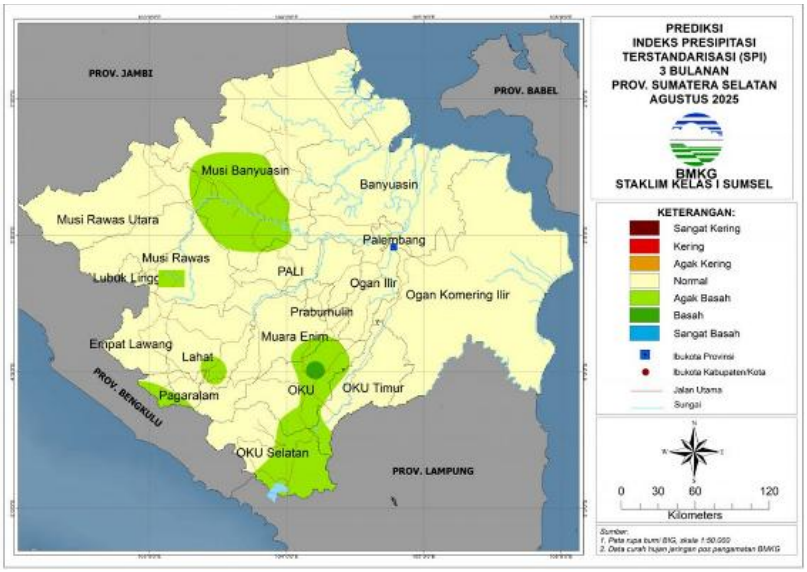

Figure 4. Soil Moisture.
(staklim-sumsel.bmkg.go.id)

According to (Fajriyansyah et al, 2024); The concept of ecological architecture emphasizes awareness and courage in design actions that respect the importance of the sustainability of natural ecosystems. This includes energy efficiency in utilizing existing natural resources, utilizing surrounding natural resources, including building materials, and maintaining the environment to maintain sustainability. This aims to protect ecosystems from damage and create comfort for users from a physical, social, and economic perspective. The aim of this research is to create an environmentally conscious design by applying ecological concepts. This study applies the concept of ecological architecture to housing design. Ecological architecture can create a sustainable built environment.

2. Proposed Method

This research uses a qualitative research approach with a descriptive method, which is a method whose function is to provide an overview of the research object (Moleong, 2000 in Nuraini 2024; Yin 2000 in Nuraini, 2019). The research focuses on the needs *(entities)* of a phenomenon (Subagyo,2023; Moleong, 2000 in Nuraini 2024; Yin 2000 in Nuraini, 2019). Several stages carried out include identifying problems, data collection, analysis, and concept development (Yin 2000, in Nuraini & Sudrajat, 2010; Moleong 2000 in Wisdianti, 2022). After the concept is formulated, the concept is then implemented into the design (Nuraini & Sudrajat, 2010). At the problem identification stage, primary data collection is carried out through observations at the local location and secondary data collection through literature studies, precedent studies, and studies of local government policies (Creswel 2000 in Wisdianti et al, 2024; Andriana et al, 2023). The analysis carried out includes climatology analysis, as well as material use in the design (Groat & Wang 2000 in Andriana & Taro, 2018; Yin 2000 dalam Permana et al, 2023). Then the concept development stage is obtained after a thorough analysis process is carried out with reference to ecological architecture (Moleong, 2000 in Nuraini 2024; Yin 2000 in Nuraini, 2019). Furthermore, the implementation of the concept in the design is in accordance with the concept of ecological architecture.

Data collection is essentially an operational activity to ensure that the actions align with the true meaning of the research (Moleong, 2000 in Nuraini 2024; Yin 2000 in Nuraini, 2019; Aris et al, 2024). Data is the embodiment of information that is intentionally studied and collected to describe an event or other activity. Therefore, data collection requires several instruments as tools to obtain data (Aziizah et al, 2024; Wardani et al, 2024).

3. Results and Discussion

The project is located in Rawas Ulu, a sub-district in North Musi Rawas Regency, South Sumatra Province. The 10-hectare plot of land consists of housing, a warehouse, and a production area. The land is surrounded by oil palm plantations.

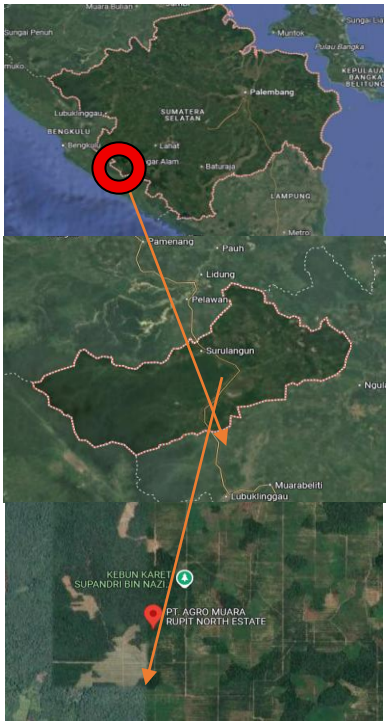

Figure 5. Land Location.
(Source: Google Earth, 2025)

The housing design must be easily accessible, visible, and have safe circulation to ensure employees feel comfortable while living on-site. The following is the existing housing development at the PT. Agro Muara Rupit oil palm plantation, along with the master plan and site plan for the employee housing complex.

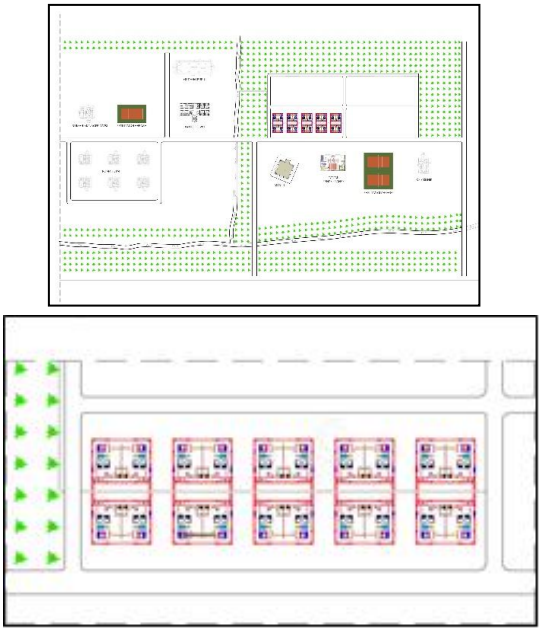

Figure 6. Existing Building, Master Plan & Site Plan.
(Author's Data, 2025)

Housing design with the application of ecological architecture, the principles applied include through ventilation systems and natural lighting (environmental adaptation and utilization of natural resources), energy savings through the use of solar panels (energy efficiency), the use of natural materials in the building mass (utilization of surrounding natural resources), and the implementation of a biopore system for water absorption (environmental preservation). This aims to produce a design that can conserve natural resources and minimize negative impacts on the surrounding environment.

Natural Ventilation and Lighting System

As building users, humans need a harmonious environment to support their activities. In this regard, the interaction between the building and the surrounding climate is crucial to creating the desired environment. The role of climate in buildings is crucial because the impact of climate adaptation can potentially regulate natural ventilation and lighting, reducing the costs of artificial ventilation and lighting. The placement of a building's mass will influence the amount and direction of sunlight entering each building mass.

Figure 7. Building Orientation.
(Author's Data, 2025)

Buildings that pay attention to the orientation of the sun and wind can utilize natural lighting and ventilation. By creating ventilation in the right direction, the building will have cool air conditioning and good lighting because it has natural ventilation properties. The use of a roster wall on the front of the building can maximize air exchange through cross ventilation in the room, roster also acts as a light breaker that enters the dark room by providing an aesthetic form according to the motif on the roster. The roster used for ventilation uses granite roster, where the granite roster is made from natural stone. The process of making granite roster is done by cutting and then forming holes with the desired pattern.

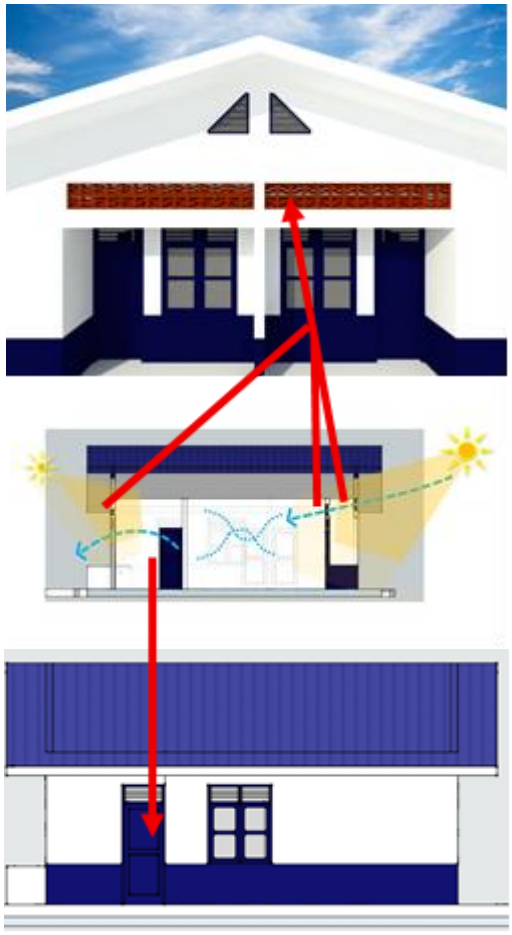

Figure 8. Ventilation.
(Author's Data, 2025)

Utilization of Solar Energy

Solar panels are used to harness sunlight and convert it into electricity. During the day, the panels absorb sunlight and convert it into electricity, which is then stored in batteries. This stored electricity can be used to power lamps, which act as the primary source of illumination. The lamps automatically charge during the day and can be turned on at night.

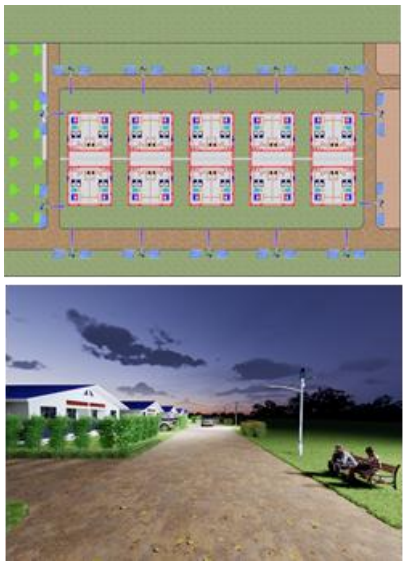

Figure 9. Use of solar panels.
(Author's data, 2025)

Use of Environmentally Friendly Natural Materials

Some of the design materials utilize natural materials, such as bamboo. Bamboo is an example of an environmentally friendly natural material that can be found in and cultivated around residential areas. Bamboo plants are often used as natural fences between garden areas and public paths. Their small, dense leaves help repel dust and dampen sound. Ornamental bamboos that can be used as hedges include Chinese bamboo : *Bambusa multiplex* (Werdiningsih, 2022).

Figure 10. Use of natural materials.
(Author's data, 2025)

Application of Biopore System

In response to soil conditions at the design site, caused by the relatively high rainfall, a biopore system was implemented as a preventative measure.

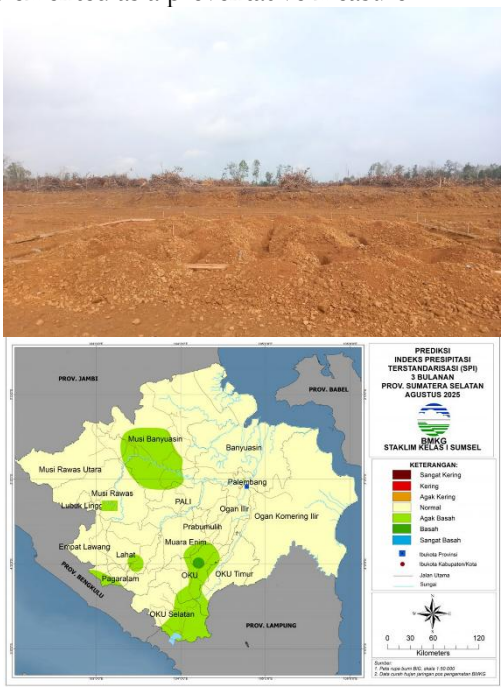

Figure 11. Soil Conditions.
(Author's Data, 2025)

Biopore holes are an effective method for increasing water infiltration into the soil by creating vertical holes filled with organic waste. These holes, called biopore infiltration holes, help reduce the risk of flooding, improve groundwater quality, and process organic waste.

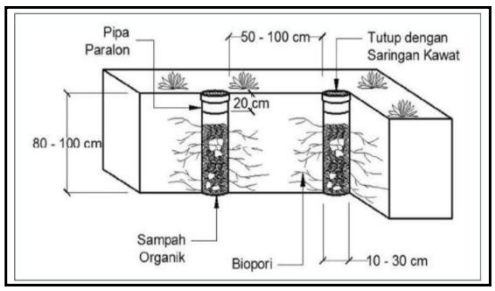

Figure 12. Biopore system.
(Source: id.pinteres)

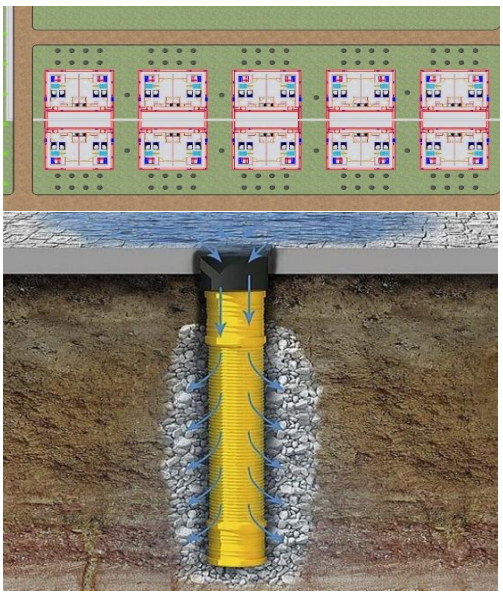

Figure 13. Biopore Application Points.
(Source: id.pinteres)

4. Conclusions

The conclusion of this study is that the increasing development of industrial estates in Indonesia has led to an increase in the number of plantation companies, which will ultimately lead to increased industrial estate development. An industrial estate is a centralized area where industrial activities are concentrated, equipped with infrastructure and other supporting facilities provided by the company for employee benefits. However, among the many existing companies, some still lack adequate infrastructure and supporting facilities, resulting in untidy residential areas. However, the availability of infrastructure and supporting facilities plays a significant role in the operation and progress of a company. Furthermore, proper ecological management will also help preserve the area without polluting the surrounding environment.

Suggestion

It is hoped that these points and suggestions for housing development with an ecological approach can make a significant contribution to realizing more sustainable and environmentally friendly settlements.

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