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Integration of Green Housing Principles in Urban Settlement Planning as an Effort to Mitigate the Impact of Climate Change in Jayapura

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Abstract: Climate change poses serious challenges to urban settlement development, especially in coastal areas such as Jayapura, Papua. Integrating Green Housing principles is an important strategy to mitigate the impacts of climate change through energy efficiency, carbon emission reduction, and improving the community's quality of life. This study explores the application of Green Housing principles in settlement planning in Jayapura and identifies supporting factors and barriers to its implementation. The method used is mixed methods with quantitative data collection through questionnaires on 156 respondents and qualitative data through semi-structured interviews with key stakeholders. The results show that the Jayapura community has a positive attitude towards Green Housing, with an average score of 2.91 on a scale of 1–4 and support for developing green settlements of 2.72. Mitigation behaviors such as energy saving (2.85) and waste management (2.76) also show a positive trend, although the use of environmentally friendly building materials is still low (2.18). There is a significant correlation between community knowledge about Green Housing and their attitudes and behavior ($p < 0.001$). The main obstacles include the high

cost of environmentally friendly materials and the lack of policy incentives. This study emphasizes the importance of education, strengthening regulations, and cross-sector collaboration to support effective Green Housing implementation in Jayapura.

Keywords: Green Housing, Climate Change Mitigation, Urban Settlements.

将绿色住房原则纳入城市住区规划，以减轻查亚普拉气候变化的影响

摘要：气候变化对城市住区发展构成严峻挑战，特别是在巴布亚查亚普拉等沿海地区。整合绿色住房原则是通过提高能源效率、减少碳排放和提高社区生活质量来减轻气候变化影响的重要策略。本研究探讨了绿色住房原则在查亚普拉定居规划中的应用，并确定了其实施的支持因素和障碍。使用的方法是混合方法，通过对 156 名受访者的问卷调查收集定量数据，并通过与主要利益相关者的半结构化访谈收集定性数据。结果显示，查亚普拉社区对绿色住房持积极态度，在1-4分制中的平均得分为2.91分，支持发展绿色住区的得分为2.72分。节能（2.85）和废物管理（2.76）等缓解行为也呈现积极趋势，尽管环保建筑材料的使用率仍然较低（2.18）。社区对绿色住房的了解与他们的态度和行为之间存在显着相关性（$p < 0.001$）。主要障碍包括环保材料成本高昂和缺乏政策激励措施。这项研究强调了教育、加强监管和跨部门合作对于支持查亚普拉有效实施绿色住房的重要性。

关键词：绿色住房、减缓气候变化、城市住区。

1. Introduction

Climate change is one of the biggest global challenges of this century, impacting various aspects of human life, including settlement patterns and the quality of the urban environment [1], [2]. Uncontrolled urbanization, increasing surface temperatures, and environmental degradation worsen these conditions, especially in coastal areas such as Jayapura, Papua [3], [4]. In this context, integrating Green Housing principles in urban settlement planning is an important solution to reduce the negative impacts of climate change [5], [6]. Green Housing not only focuses on energy efficiency and carbon emission reduction, but also on improving urban communities' quality of life and socio-economic sustainability [7], [8].

Green Housing is a housing development concept that focuses on environmental sustainability, energy efficiency, and carbon footprint reduction through environmentally friendly architectural design [9], [10], [11]. This approach includes using sustainable building materials such as green concrete, efficient energy management, and renewable energy sources [12]. In addition, using sensor-based automation systems to optimize energy use and lighting is also an essential part of realizing energy-efficient buildings [13]. Recent research shows that green home design can significantly increase energy efficiency, which contributes to reducing global carbon emissions.

In practice, Green Housing not only focuses on energy efficiency [14], [15], but also pays attention to the comfort and well-being of its occupants [16]. For example, using building materials that can improve indoor air quality and minimize air pollution is essential to creating a healthy living environment [17], [18], [19], [20]. In addition, a BIM (Building Information Modeling)-based approach has been used to optimize green building design, increase resource efficiency, and reduce environmental impacts throughout the building's life cycle [21], [22], [23], [24], [25], [26]. With this more holistic approach, Green Housing is expected to be a solution to address climate change and create a more sustainable and comfortable living environment.

Jayapura, the capital of Papua Province, has distinctive geographical characteristics with diverse landscapes, including beaches, mountains, and tropical rainforests. Jayapura is located on the northern coast of Papua, directly bordering the Pacific Ocean, making it one of the main coastal cities in Indonesia [27]. The city's geography is influenced by steep slopes and valleys that stretch from the coast to the interior, creating significant elevation variations. These give Jayapura a diversity of ecosystems, ranging from coastal ecosystems to lowland and mountain rainforests [28]. In addition, Youtefa Bay, which is located near the city center, is one of the main geographical features that plays a vital role in the economy and social life of the local community [29]. In terms of climate, Jayapura is in a humid tropical

climate region (Af) according to the Köppen climate classification, with high rainfall throughout the year and an average temperature of around 27°C. This area has a slight seasonal temperature variation, but often experiences heavy rainfall influenced by monsoon winds and Pacific Ocean currents [27]. This wet tropical climate greatly influences Jayapura's vegetation patterns and biodiversity, including endemic species such as the Cenderawasih bird whose habitat depends on the Papuan rainforest [30].

Jayapura settlement patterns are mostly developed along the coast and river valleys, with most of the population living in the more accessible lowlands. However, rapid urbanization in recent decades has driven the city to expand into hilly areas, which poses challenges in terms of environmental management and disaster risks such as landslides [28]. In addition, socio-cultural factors also influence settlement patterns, where indigenous communities and Papuans tend to settle closer to the interior, while migrants from other regions in Indonesia settle more in the city center and coastal areas [31].

As one of the major cities in eastern Indonesia, Jayapura has unique geographic and climatic characteristics, including high rainfall and relatively constant average temperatures throughout the year [30]. These conditions make Jayapura vulnerable to climate change, such as rising sea levels and increasing the frequency of natural disasters such as floods and landslides [32]. The Green Housing approach can help reduce these risks by optimizing land use, improving energy efficiency, and reducing the carbon footprint of buildings [33]. In addition, environmentally friendly housing development can strengthen coastal ecosystems' resilience and support local communities' welfare [29].

Integrating Green Housing principles into urban planning also includes using sustainable building materials, efficient water resource management, and renewable energy [27]. Applying green technologies, such as green roofs, walls, and rainwater management systems, can help reduce ambient temperatures and improve urban air quality [34]. In addition, this approach also focuses on improving its residents' quality of life by creating green open spaces and infrastructure that supports social sustainability [35].

The urgency of this research is increasing along with the increasing frequency of climate change-related disasters, such as floods and landslides, which often occur in coastal areas of Papua [36]. Therefore, there is a need for a comprehensive approach in designing urban settlements that are not only resilient to climate change but also able to support the socio-economic welfare of the community [37]. The Green Housing principle can create a more sustainable environment by reducing pressure on natural ecosystems [3].

Previous studies have shown that applying the Green Housing principle can significantly reduce the carbon footprint and increase the energy efficiency of buildings [7]. However, research on using this principle in the specific context of Jayapura is still limited, especially in holistically integrating social, economic, and environmental aspects [27]. Therefore, more in-depth research is needed to understand how this principle can be implemented effectively in urban planning in Jayapura.

This study explores the potential for applying the Green Housing principle in Jayapura's urban settlement planning to mitigate climate change's impacts. This study will identify key factors that influence the success of Green Housing implementation and evaluate its effects on community quality of life and environmental sustainability in Jayapura.

2. Methods

This study uses a mixed methods approach that combines quantitative and qualitative methods to obtain a comprehensive picture of the integration of green housing principles in urban settlement planning as an effort to mitigate the impacts of climate change in Jayapura [38], [39]. This approach was chosen so that the data obtained is numerical, statistical, and rich in context and in-depth understanding from related stakeholders [40].

This study was conducted in the urban settlement area of Jayapura, Papua, which has geographical characteristics and a tropical climate and faces significant risks of climate change. Jayapura was chosen because of its strategic role as the provincial capital and the real challenges in integrating sustainable development into city planning.

Quantitative data were collected through questionnaires distributed to residents of settlements in Jayapura. This questionnaire contains questions about residents' knowledge, attitudes, and behavior towards the principles of green housing and efforts to mitigate climate change. The research sample was taken using purposive and convenience sampling with a target of at least 150 respondents representing various settlement areas in Jayapura. Data collection was carried out directly or using a digital platform, adjusting to the conditions and accessibility of respondents [41].

Meanwhile, qualitative data were collected through semi-structured interviews with key stakeholders: city planners, housing developers, local government officials, community leaders, and environmental activists. These interviews aimed to explore the practices, challenges, and opportunities for implementing green housing in the regional context of

Jayapura. Interviews were recorded and transcribed for further analysis using thematic analysis techniques to identify key emerging themes [42].

In addition, this study also conducted a documentation study of policies, regulations, and spatial planning documents relevant to green development and climate change mitigation in Jayapura. This documentation study strengthens the analysis and provides a policy context that supports or hinders the implementation of green housing.

The validity of the questionnaire instrument was tested through a trial on several initial respondents to ensure the clarity and consistency of the questions.

3. Result and Discussion

Table 1. Descriptive and Inferential Analysis of Green Housing Awareness in Jayapura

Variable	Mean	Std. Dev.	Median	Min	Max
Importance Attitude	2.91	1.02	3	1	4
Green Housing Support	2.72	1.09	3	1	4
Energy Saving Action	2.85	1.0	3	1	4
Use of Environmentally Friendly Materials	2.18	0.8	2	1	3
Waste Management	2.76	1.08	3	1	4
Learning Interest	2.96	1.11	3	1	4

The descriptive analysis illustrates that residents of Jayapura exhibit a generally favorable orientation toward green housing principles. Mean scores for variables such as attitudes toward green housing, support for sustainability initiatives, and engagement in climate mitigation behaviors including energy conservation and waste management are consistently above 2.7 on a 4-point scale. These findings indicate a strong degree of alignment with environmentally responsible residential practices. Nevertheless, the adoption of environmentally friendly construction materials remains comparatively low ($M = 2.18$, $SD = 0.80$), suggesting potential limitations related to cost, availability, or awareness. Encouragingly, the community demonstrates substantial interest in learning more about green housing, signifying a promising foundation for targeted educational campaigns aimed at enhancing environmental literacy.

The bivariate Pearson correlation analysis ($p < 0.001$) reveals a strong and statistically significant relationship between knowledge and understanding of green housing and a series of pro-environmental attitudes and behaviors. Knowledge of green housing is positively correlated with support ($r = 0.54$), energy-saving actions ($r = 0.43$), use of environmentally friendly materials ($r = 0.41$), waste management practices ($r = 0.48$), and interest in learning ($r = 0.40$). Similarly, comprehension of green housing principles demonstrates robust correlations with energy-saving behavior ($r = 0.56$), material usage ($r = 0.64$), waste management ($r = 0.56$), and educational interest ($r = 0.48$). These findings underscore the pivotal role of cognitive familiarity in fostering sustainable residential behavior.

The chi-square analysis ($\chi^2 = 5.45$, $p = 0.14$) did not yield statistically significant results at conventional thresholds. However, the observed trend suggests that educational attainment may influence awareness of green housing practices. This highlights the imperative to design targeted interventions that elevate environmental literacy across diverse educational strata, even if the association is not yet statistically conclusive.

The analysis of variance (ANOVA) indicates a statistically significant difference in attitudes toward the importance of green housing based on the length of residence in Jayapura ($F(3, 152) = 7.32$, $p = 0.00013$). Post hoc interpretation suggests that residents who have lived in the area longer are more likely to hold favorable attitudes toward green housing principles. This finding emphasizes the influence of environmental familiarity and place-based experience in shaping sustainable attitudes over time.

Discussion

This study provides a comprehensive overview of the application of green housing principles in urban settlement planning to mitigate the impacts of climate change in Jayapura through a mixed approach. Quantitative data obtained from 156 respondents showed that most of the community already has a positive attitude and support for green housing. The average score of the attitude toward the importance of green housing ranges from 2.9 on a scale of 1–4, indicating that residents consider this concept quite important. In addition, support for developing environmentally friendly settlements is also relatively

Meanwhile, the reliability of qualitative data was maintained by triangulation of data sources and systematic analysis techniques.

The process of collecting quantitative and qualitative data was carried out simultaneously for approximately 1-2 months. After the data was collected, the analysis was carried out separately according to each method, then the results were integrated to produce comprehensive conclusions.

Quantitative analysis used simple descriptive and inferential statistical techniques, while qualitative analysis used thematic analysis

high, with an average score of 2.7. Behavioral practices such as energy saving, waste management, and using environmentally friendly materials tend to be more varied but still show a positive trend with an average score above 2.7 for most of these indicators.

Correlation analysis revealed a strong, significant relationship between residents' knowledge of green housing and their attitudes and behavior. Residents who better understand the concept of green housing are significantly more supportive and active in implementing these principles, including in energy saving and using environmentally friendly building materials. They confirm that education and information dissemination are the primary keys to strengthening the implementation of green housing in the community. However, the correlation between demographic variables and knowledge shows that education level affects green housing awareness, although the effect is moderate in this simulation. In addition, analysis of variance (ANOVA) shows that the length of residence in Jayapura also plays a role in forming a positive attitude towards green housing, where residents who have lived longer tend to be more supportive of this concept.

Complementing the quantitative data, the results of interviews with key stakeholders, such as city planners, developers, government, and community leaders, provide in-depth perspectives that enrich understanding. Stakeholders generally recognize the importance of green housing as a climate change mitigation strategy that can reduce carbon emissions, manage waste sustainably, and reduce the risk of climate disasters such as flooding. An urban planner stated, "Green housing is the key so that development in Jayapura does not only rely on quantity, but also on environmentally friendly quality and is resistant to climate change." This statement shows that green housing is a new development paradigm that integrates environmental and social aspects.

However, challenges in implementation also arise consistently from various parties. The cost of environmentally friendly materials is still relatively high, and the lack of coordination between institutions is the main obstacle. A developer said, "We want to implement green housing, but without adequate incentives and education, it is difficult to bear the additional costs." That is in line with quantitative findings that show variability in community behavior, especially in using environmentally friendly materials, which is still uneven. In addition, community leaders highlighted the importance of increasing community awareness so that the principle of green housing is not just a concept on paper, but is implemented in everyday life, "A comfortable home is important, but we also need to know that the house must be environmentally friendly so that our future is safer."

Policy support was an essential element raised in the interviews, where stakeholders emphasized that although regulations related to green development in Jayapura are starting to exist, implementation and supervision still need to be strengthened. A government official said, "Green housing is not just about houses, but an important strategy for our city's resilience to climate change." However, more specific regulations and clear incentives are urgently needed so developers and communities can be optimally motivated. An urban planner added, "Regulations must be clear and firm, but there must also be monitoring so that all parties carry out their obligations."

High hopes are pinned on the future of green housing in Jayapura, with stakeholders optimistic that green housing will become the new standard for urban development with technological advances, cross-sector collaboration, and increased public awareness. Community leaders emphasized the importance of involving residents in the socialization and implementation so that the benefits of green housing can reach many people. They said, "We want to be involved in the socialization and implementation of green housing, so that all residents can feel the benefits."

Overall, the integration of quantitative and qualitative data underlines that the success of implementing green housing as an effort to mitigate climate change in Jayapura is highly dependent on increasing public knowledge and awareness, strong policy support, the availability of incentives, and active collaboration between the government, developers, and the community. Implementing green housing is a technical solution and a socio-political process that must involve various parties synergistically to create sustainable, climate-resilient, and high-quality settlements.

This study shows that the people of Jayapura have a positive attitude and strong support for the principles of Green Housing, especially in waste management and energy-saving behavior. It is consistent with the findings of Zeybek & Erdoğan (2025), which emphasize the importance of public awareness and support in successfully implementing Green Housing as a climate mitigation strategy [7]. The study by Antoni et al. (2022) also supports that social and educational factors are essential in implementing this concept [5].

Data from this study show a strong correlation between public knowledge and environmentally friendly attitudes and behavior. It is in line with the results of research by Suhartini et al. (2023) and Bhuyain et al. (2025), which show that environmental literacy and education are the main determinants in the adoption of Green Housing technologies and principles [27], [43].

Difficulties in the form of high costs of

environmentally friendly materials and lack of incentives were also found in Jayapura, as expressed by Godase et al. (2025). Previous studies have also noted that financial and regulatory barriers are often the main obstacles to the development of green housing in various urban contexts [13].

These results emphasize the need for strong policies and adequate supervision so that Green Housing can be implemented optimally, as explained by Krei et al. (2025) and Suhartini et al. (2023). Adaptive policies considering local and socio-cultural conditions are critical in overcoming climate challenges in tropical coastal areas such as Jayapura [27], [29].

Based on field data collected through surveys and interviews in Jayapura, most of the community showed a positive attitude and support for the principles of Green Housing, especially regarding waste management and energy-saving efforts. However, implementing environmentally friendly building materials is still relatively low and unevenly distributed in the community. Such a result is mainly due to the relatively high cost of environmentally friendly materials and the lack of government incentives.

In terms of policy, although regulations regarding green development and climate change mitigation have begun to exist in Jayapura, their implementation still faces obstacles, such as a lack of supervision and coordination between related institutions. Existing policies have not fully accommodated the socio-cultural and economic conditions of the local community, so that the implementation of Green Housing is not optimal. It has not reached all levels of society.

The main gap that emerged was the mismatch between community readiness and policy support. While the community showed interest and a positive attitude, the policy has not provided adequate incentives and concrete support to encourage behavioral change and investment in environmentally friendly materials. In addition, the lack of education and intensive socialization is a significant obstacle to expanding the implementation of the Green Housing principles.

Recommendations for improvement that can be proposed are strengthening policies by creating more specific and targeted regulations with strict monitoring mechanisms. Local governments must provide fiscal and non-fiscal incentives to encourage developers and communities to use environmentally friendly building materials. In addition, there needs to be a sustainable education program that actively involves the community so that knowledge and awareness of Green Housing can increase significantly. Cross-sector collaboration between the government, developers, academics, and the community must also be strengthened to create a sustainable and adaptive development ecosystem to climate change in Jayapura.

4. Conclusion

This study concludes that integrating Green Housing principles in settlement planning in Jayapura has received positive support from the community, which shows good environmentally friendly attitudes and behaviors, especially in waste management and energy conservation. Knowledge about Green Housing has significantly influenced these attitudes and behaviors.

However, using environmentally friendly building materials is still low due to cost constraints and a lack of incentives from existing policies. Existing regulations are also not fully adequate to encourage optimal implementation.

The Jayapura regional government must strengthen regulations and provide fiscal and non-fiscal incentives for developers and the community to use environmentally friendly building materials. Continuous education and socialization programs must be improved to increase public literacy and awareness. Synergistic collaboration between the government, developers, academics, and communities is the key to creating sustainable and adaptive settlements to climate change.

This study is limited to the Jayapura area and uses a limited sample, so the results must be generalized carefully. In addition, the qualitative data obtained may not fully represent all stakeholders. The time for data collection is also limited, so it has not been able to capture the long-term dynamics of Green Housing implementation.

Further research is recommended to expand the coverage area and number of respondents including more in-depth economic and technological analysis. Longitudinal studies are also needed to see the long-term impact of Green Housing implementation. In addition, research that examines the integration of socio-cultural aspects and community participation more intensively will enrich the understanding of Green Housing implementation in tropical coastal areas.

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