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The community role in green area sustainability as a model of energy-efficient buildings in the humid tropical region

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Abstract. Green design models have the potential to improve the environment's microclimate and to decrease energy consumption in a building. The successful implementation of green design model is determined by government policy, the concern of architects and the role of the community. The role of the community is important because it has the potential to be the part of the green sustainability model; that is, to provide green spaces and follow up on the sustainability of green governance elements. The aims of this research are to describe the role of community in the understanding and implementation of green elements in buildings. In addition, it also aims to relate the understanding of the community with sustainability of the green design model in energy-efficient buildings. This research used descriptive methodology by purposive random sampling in three categories of society: low income, middle income and high income categories. The results of this research have brought contribution to theories of development in term of ecological architecture concept, and this concept can be done through the community involvement in the implementation of the green design models that are adaptable to humid tropical climate.

Keywords: community roles, green area sustainability, energy efficient buildings, humid tropical regions

1. Introduction
Each architectural work should consider environmental impacts. The implementation of green architecture design gives positive influence to the microclimate environment, among others in the decrease of building temperature. Decreasing the temperature of the building will directly contribute to the temperature decrease of the area and energy efficiency of the building. This positive contribution creates an artificial ecosystem environment that harmonizes with the natural environment, as it is the concept of ecological architecture. On a broader scale, Samir Younis [1] declares that development in the world should use ecologically constructive practices in building construction, agriculture, economic cooperation, and energy consumption; affecting the earth in the future. For architects, sustainable buildings should be the primary goal of sustainable urban development. For all humans, environmental sustainability is an existential goal that has implications for aspects of life in order for the earth to survive and sustain. Sustainability of the concept application of ecological architecture that emphasizes green design is determined by three contributors, namely government its policies, the architects with their design works, and the general public as the user. To that end, the background of this study considers the rationale of the research findings related to the role of society as one of the
success determinants of sustainable development and green design, as part of the embodiment of the concept of ecological architecture that takes into account the buildings energy efficiency.

According to Maria Ignatieva and Karin Ahrnè [2] the biodiversity approach to landscape architecture is based on the best achievement of innovative landscape design solutions, which will incorporate the flora and fauna components. The research and its implementation require interdisciplinary collaboration, including stakeholders, policy makers, and horticultural managers. Studying urban grass, green roofs and green walls should combine different perspectives; that is, social and ecological in planning, design, and management of sustainable city. Alternative potential sustainable solutions are unlikely to be found without understanding the social motives behind the strong attachment, from modern society to disguise unsustainable elements, such as grass from urban green areas or attractions of having green roofs and green walls. The research shows the role of community in the successful implementation of landscape architectural design.

On the other hand, Malik et al. (2017) conducted a study of urban space management approaches related to ecological functions, explaining how far the role of stakeholders in urban areas, which will further strengthen the importance of green open spaces. Specifically in the city of Depok, there are so many problems related to the provision and utilization of open space which need certain approaches. These approaches were initially applied to the private sectors through the provision of contributing applications, thus firstl used by the governments in managing public assets. The study used descriptive methods, at the beginning of the study that explained the existence of the city’s green open space realm as part of the urban space from the theoretical perspectives of space, functions, and the role of various problems that occur within it. The results showed that there are problems in the management of green open space in Depok. In asset management, it has provided important findings to accommodate the participation of existing stakeholders in the management of green open spaces. The asset management approach is a participatory approach by involving all parties. This approach also provides space for people who previously had difficulty in expressing their criticism and in accessing information [3]. The most important thing in this research is; it turns out that the optimization of open green space planning can be through asset management that accommodates stakeholders in development. The role of society can be gained by providing space for their opinions either individually or collectively within a community.

Luca Tricarico [4] studied of communities in development and found that the concept of community has maintained a constant and growing interest in urban studies and many related fields. The origins of this sustained interest seem to stem from the importance of community concepts in various forms of language and political interpretation in different planning practices. Contributions through analysis of various ethical and planning theories provide a framework for renewal of community action. Based on the purpose of this study, the argument will continue through literature reviews on four ethical theories and three key aspects related to spatial planning, as well as matching these theoretical analyses with practice examples. The ultimate goal is to provide genuine analysis of the movers and outcomes of various forms of community, raising common issues referring to spatial planning, social organization, and regulation [4]. This study further described how to use the role of communities in a society that contribute to development planning, especially in urban spatial planning. The research generally concludes that the community has a strategic role in the sustainable development.

While in terms of building energy management, a study on the evaluation of building energy by [5] describing that methods for environmental assessment and ‘green’ certification of buildings are increasingly being adopted by local governments and other entities as a means to meet environmental objectives, related to energy. The literature of building and environmental assessment has examined how these tools are interpreted by stakeholders in design and construction, but it still receives little interest for the interpretation and use as policy objects although this position has a controlling role with enormous impact. The analysis shows that for policy makers, the importance of green building does not lie in terms of the assessment of a set of environmental benchmarks but as a standard that derives commercial value from policy objects. This research also conducts open discussion required on the logical thinking that encourages the use of green building tools in public policy and its goals.
The research focused on the performance of policy makers, and discussions are needed for encouraging the role of communities in energy management for green design. Therefore, this discussion was certainly not limited for policy makers alone, but it is also for public.

The research [6] concluded that energy efficiency is important, if carbon emissions are reduced significantly, then it is essential to consider the meanings and levels of service and the types of consumption and demand that continuous supportts in policies related to efficiency. Energy efficiency can be started from the households although these area are not the largest part of the world's energy consumer. Energy efficiency in households is determined by the role of society in managing the energy, and it can be done by providing green spaces that physically help to condition the environment. Therefore, in connection with the findings of Elizabeth Shove, this study aims to identify the level of public knowledge of the green elements benefits at home, and the community awareness in managing green elements to be more productive.

Elizabeth L. Hewitt et al [7] suggested several frameworks incorporating social and psychological elements of behaviour that are environmentally significant, with most considered cognitive and deliberate decision making. The behaviour of household energy consumption however, reaches the spectrum from being grounded and deliberate to unplanned and automatic. The purpose of the paper was to advance the knowledge of reasonable and unplanned behaviour in the context of pro-environmental action. Using the survey results provided to residents of a green residential urban building, this study explored five household consumption behaviours, and tested the hypothesis that unplanned behaviour would be poorly predicted by a behavioural framework based on values and reasons. The research findings indicated that the badly-planned behaviour will have an inefficient impact on building energy. This finding was used as a reference in building energy management for residential scale and necessary to educate the public to know the benefits of green space in the building. A deeper understanding of how unplanned, automated, or inefficient behaviour in society, can help policy makers and building designers more wisely to respond occupants’ behaviour and to consider the design performance.

The building sector is a major energy consumer, and empirical research reveals that carbon dioxide emissions from the building sector outweigh industrial and transportation sectors, as presented in [8]. Contextual alignment has generally been applied in designing new buildings in historical districts. In the field of design, a philosophy-based design approach requires objective measurement. When new glass buildings are considered, the question of greenhouse gas emissions becomes significant. To minimize energy consumption and to reduce solar glare, brise-soleil and horizontal shading fixed devices have been used as building façade elements. Currently, algae as part of constructing façade systems have been used in creating a healthier indoor environment. The use of secondary leather buildings with the role of plants, contributes to the decreasing of building temperatures, and it can also be significant contribution to both design approaches and associations with choice of building materials and provision of potential energy alternatives. Ultimately, the evidence can be used as a justification for eco-friendly principles for architectural design. The findings of green design applications are very important to be known to the public at large. The development of the research findings may be considered for the occupancy sector. When the green design innovation prototype is ready for implementation, it is necessary to communicate this design to the community. Conversely, when the green design is not communicated to the community properly, the community will not understand it certainly and impact on green design cannot be sustainable.

In terms of communication on green design, this research [9] stated that the development of green design can be realized through social learning. Social learning is an approach for some development actors. For successful development with green design concepts, the support from the policy makers is urgently needed. In this research, the policy makers are the important actors of the development. The approach was then implemented more extensively with the same method which resulted hence creating social learning to the community as green design users.
From the background of some research that has been done, it turns out that the role of society is very strategic in development, specifically for the sustainability of the green design as a model of energy efficient buildings. Therefore this study aims to obtain a relationship between the roles of society and the sustainability of green design in buildings. This research is useful to know how the correlation between the role of society and sustainability of green design model can be held optimally. The sustainability in the implementation of green architecture is important to contribute to the energy efficiency of buildings in humid tropical climates.

2. Methods
This research used quantitative descriptive method to show the relationship pattern between the successful implementation of green model in residential building and the community role. Data were collected through questionnaires by purposive random sampling. Questionnaires focused on three economic levels: low-income communities, middle-income communities, and high-income communities. The research location was in Indonesian humid tropical area of Central Java, particularly Surakarta City. The location was chosen because the city could present the urban residential characters in general.

The questionnaire model included questions about the status of residential ownership having the opportunity to provide green spaces, knowledge of the benefits of green space at home, and the community's concern about the importance of green space in the dwelling. This research was also conducted with field observation on the phenomenon of green elements in residential area. Observations included the conditions and green layout model of urban residential buildings, and the green living conditions of residential areas at the questionnaire distribution sites. According to [10], research variables are determined by the nature or value of research objects having certain variation to be studied and examined, as a reference to determine the conclusions of the research undertaken. This research put dependent variables as the research object, namely the sustainability of green design as the energy building efficiency model that can have different values because influences from other variables. The independent variable was the role of society since the society is one of the determinants in the success of the development. Meanwhile, the moderator variable is the economic level of the community, the potential welfare of the community that can affect their active role the in development.

Data processing was done through inferential statistical analysis by disclosing the problem descriptively into the data level of public knowledge about the benefits of green space and community awareness to participate in the optimization of green space. The results of data analysis were used to verify the associative hypothesis on the formulation of associative problems in the form of causal relationships, namely the role of society and the success of the green building model.

3. Discussion
The role of society in development is a strategic part that can determine the success of the concept of development. No matter how good the policies issued by the government or how beautiful the building design is, when the inhabitants or building users do not play the expected role as specified by the government and the intend design by architectural then certainly the development is not as optimal as expected. Development can be sustainable with the support of policy makers, policy controllers, and development executors. Furthermore, the community, as one of the determinants of the sustainable development, should be able to support the success of development, both as the executor and the controller of development policy. Empirically, the development can be constrained due to the lack of community support and even resistance.

This study discusses the role of the community in the sustainability of green design in Indonesia, particularly in the city of Surakarta in which the location can be seen in Figure 2. Surakarta is located in the lowlands at an altitude of 105m above sea level and in the city centre 95m above sea level, with an area of 44.1 km² (0.14% of Central Java). The city of Surakarta lies between 110 45` - 110 45` East Longitude and 70`36` - 70` 56` South Latitude, and borders with; the Karanganyar Regency and Boyolali Regency in the north, the Karanganyar Regency and Sukoharjo Regency in the east and
west, and the Sukoharjo Regency in the south. Surakarta is divided into five sub-districts, each headed by a head of sub-district (camat), and 51 villages each headed by a head of vilage ( lurah). The five sub-districts in Surakarta are [11]: the sub-district of Pasar Kliwon (postal code 57110) consisting of nine villages; the sub-district of Jebres (postal code 57120) consisting of villages; the sub-district of Banjarsari (postal code 57130) consisting of thirteen villages; the sub-district of Laweyan (postal code 57140) consisting of eleven villages; and the sub-district of Serengan (postal code 57150) consisting of seven sub-districts.

Figure 1. Location of research: Kota Surakarta, Jawa Tengah, Indonesia

To obtain the community role, the research was conducted by collecting data through polling in questionnaires distributed to five sub-districts in Surakarta. The study identified targets in the kampong area based on the kampong potential, explicitly stated in [12], namely that the alleys within the kampong that can be used as a public space by applying adaptive design principles. The use of bamboo in the design is the right solution based on its construction and material properties. The problem of limited public space in the kampong can be overcome by applying adaptive architectural principles in the alleys or lanes. Public spaces can be customized to meet the conditions in this area. One good way is to provide an adaptive design alternative [12]. Therefore, the potential of kampong, which is the smallest ecosystem in the community, can be a benchmark of the quality of society's role related to the sustainable green design. Empirical land use data in 2017 shows that each district in Surakarta has similar pattern, mostly for housing as depicted in Figure 2.

Figure 2. The profile of land use in Surakarta based on Statistic of Surakarta Municipality [11]

The land use profiles in each district indicate that housing has an important role as the sector that should be targeted for the implementation of the green planning in Surakarta. The average percentage rate above 50% is already very strong indication for the success. It is important that the housings need layout, and the community as users is educated about the potential role in the sustainability of green design on the buildings, hence natural potential in tropical climates that can achieve building energy efficiency. These findings have been strengthened by the research of [6] which identified
energy efficiency in well-planned-based home activities. Added by [5] the government needs to play an optimal role as the policy maker and policy control tool in the implementation of green design. When energy management at the occupancy level can be controlled, the energy efficiency of buildings can be macro-suppressed. This goal can be achieved because the profile of the urban land use in humid tropics such as Indonesia is dominated by land use for the housing sectors. Energy consumption determinants for the housing sectors controlled within the policy determinant corridor can be implemented through consideration of the criteria of activities undertaken at home.

In different areas, Malcolm Miles [13], conducted a research in London about participation in housing where this housing tends to be seen as a sub-sector of the construction industry. In other areas, the opposite is true; housing is still considered to be an activity to meet basic needs for shelter. Thus, this process is often done by the users themselves in the informal settlements that surround most of the city. Although these settlements were once considered a threat to the urban order (or urbanization), there is now increasing recognition that self-sustaining and self-managed housing can meet the needs of urban development in a way that is usually more sustainable and also lower in cost than the standard housing scheme (both in the public or private sector). This is not seen as an example, but only two cases can be compared and contrasted in the field of the new approaches to building the city for the future [13]. This example clearly shows how the community plays a role in providing colour in development. Therefore, the housing sectors have enormous potential in the sustainability of green design.

In a more detailed survey, the study determined one of the districts viewed in depth research, namely in the Jebres sub-district. The survey showed the opportunities of people who played roles in the provision of green space reached 100% as seen in Figure 3. The data survey analysis showed that the higher the economic level of society, the greater the potential role of society in green design sustainability. High-income communities have a 100% chance of providing green space for buildings, but these opportunities need to be assessed more directly by considering the willingness or the motivation of the community. Another point, the availability of plants owned by the community, shown in Figure 4, has the same profile, which is directly proportional to the economic level of the community, the higher the economic level of the community, the greater the chance of providing plants in the surrounding environment. The availability of plants is certainly an opportunity of the role of society. Both figures 3 and 4, describe the role of society that can be seen from the economic level; and therefore, the green design planning can be implemented optimally with cross subsidy model.

![Figure 3](image1.png)  ![Figure 4](image2.png)

**Figure 3.** Community potential provides green space based on community income.

**Figure 4.** Community potential provides plants based on the community income.

In line with [2,3,13] and et al [7] about community participation in development, the analysis of the research data in Surakarta, shown in figure 3 and figure 4, describes the existence of the dependence correlation forms; for instance, the provision of green space and the supply of plants to the community depending on the economic level of society. Therefore, it can be concluded that the role of society becomes important for the sustainability of space and green elements in buildings.
The results showed that the community responds based on economic level.

In terms of the further role of the community, research results show that 100% of the people have already known the benefits of green design for environmental sustainability. Several parameters to express community responses to green design sustainability showing that low, middle, and high-income people share the same view. The differences in community response are at the level of appreciation, maintenance, and assessment of green design productivity as seen in Figure 5. In low-income communities, the knowledge of green design and benefits is embedded, but the appreciation in the practice of daily life needs to be improved. Among the middle segment of society, the consideration about the values of green design productivity is lower, but their appreciation and willingness to maintain is higher. And for high-income people, green design has gained great attention and support from them.

With the pattern of responses obtained from the research on the role of society in green design sustainability, the result obtained is that there is a very significant relationship between the appreciations from the community on green design with environmental conditions around the dwelling; hence the higher the community’s appreciation, the better condition of green area environment. For urban tropical areas such as Surakarta, efforts to optimize sustainability of green design are likely in the housing sectors. While linked to the economic level of the community, sustainability of green design requires cross-subsidy management methods among communities that can be managed by them [4] with mentoring through social learning [9]. Finding that is useful in green design innovations, such as the finding of algae as a façade from Widjaja Martokusumo [8] is an example of a green design application that needs to be socialized to society by means of social learning. The middle class is the society that needs education about green design productivity that gives effect to the energy efficiency of the building. While low-income communities have the opportunity to make green design as a productive area, as well as providing knowledge about building energy efficiency through green design. For high-income communities, they are important asset in achieving green design sustainability in the humid tropics. The role of society needs to be managed and optimized through a community in order to have good relationship among determinants of successful development [3] [4].

In relation to building energy efficiency, low-income communities share the same view with high-income communities. As shown in Figure 5 lower income people consider green design as productive activity, hence a productive space. In more in-depth research, low-income communities perceive that the productive values of plants give benefits whereas for high-income communities, they consider green designs provide comfort space, fresh air that contributes to health and environmental improvement. Although the views are different, it is good to see these findings because they are rich with information.

From this discussion, it is clear that the community has a role in green design sustainability as a model of energy building in the humid and tropical regions.

4. Conclusion
The results showed the importance of involving the community in implementing the green plan model as a space that reduces the buildings’ heat in order to achieve building energy efficiency in humid tropical regions. The community’s role contributes to the success of green sustainability provided in
buildings, especially in urban areas with humid tropical climates such as Indonesia where the largest land uses are for residential areas. What needs to be improved is the community knowledge about the correlation of green building elements with building the energy efficiency, so that sustainability green design can target residential development. Community knowledge is directly proportional to the public awareness for the sustainability of the green plans in residential buildings. Construction of buildings and infrastructures, especially housings implementing green design, will be more optimal and sustainable with the optimization of society's role. In addition, it is necessary to educate energy management on buildings, so energy efficiency in buildings through green design, as the application of the ecological architecture concept in humid tropical climate areas, can be sustainable. The findings recommend the importance of further research related to optimizing and managing the potential power of communities in the tropics in the implementing green building model for energy efficiency of buildings in humid and tropical regions.

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