

**Assessing Sustainability of Low-Cost Housing Project through
Post-Occupancy Evaluation
(Case Study: Housing for Civil Servants in Salatiga City, Indonesia)**

Fery Setyo Nugroho

**Graduate School of Media and Governance
Keio University**

ABSTRACT

In 2019, Indonesia was experiencing a housing backlog of around 7.6 million housing that must be met by providing new houses. Therefore there was a policy to overcome it through “one million housing” program. Salatiga City is one of the cities in Indonesia as a pilot project which has constructed provision of low-cost housing. While the current problem condition that happens is some facilities and infrastructure were unconstructed yet. Low-cost housing provision is just focused on housing units neglecting housing facilities and infrastructure that provided services for residents in post-occupancy. This research aims to assess the performance of residential housing and examine the gap factors influencing sustainability from a post-occupancy evaluation (POE) of low-cost housing projects. This research was conducted by assessing performance factors influencing sustainability by POE to value the quality of the residential environment. Meanwhile, the degree of importance level of sustainable housing factors was ranked by expert choice through AHP analysis.

The result showed that factors including utility conditions; safety comfortability; social interactions; and access to workplace have good performance. While other factors have not met the score for good performance. This research has known that low-cost housing for civil servants can be said as unsustainable. The environmental aspect had an important role in the sustainability of low-cost housing. Building unit condition and infrastructure are factors with a big gap that have a high level of importance in influencing sustainability but have low performance. Therefore, these factors need to get the main attention in the government’s next low-cost housing development projects in supporting one million housing program policy.

Keywords: *Low-Cost Housing, Post-Occupancy Evaluation, AHP, Performance, Sustainability*

INTRODUCTION

Background

In developing countries, urban population growth often occurs due to urbanization which has led to building density and limited land (Daldjoeni, 1992). Housing should be seen as basic human needs providing all community activities including physical and social environment and community (Dwijendra, 2013). Important aspect on housing that should be provided are affordability, suitability and supply demand balance which means no housing backlog. In 2019, Indonesia had a housing gap around 7.6 million¹ that must be met by providing new houses. This figure indicates that many people do not have access to homeownership yet and difficulties in obtaining it (Bramantyo, 2012). To meet the balance of home ownership, the government continues to establish housing development policies. During the leadership of President Joko Widodo, the government has set a policy of "satu juta rumah" (one million housing), especially through the construction of low-cost housing and the provision of subsidies for low-income people, including civil servants who do not yet have a house (Parmadi, 2018).

Salatiga City is one of the city in Indonesia as pilot project which has constructed provision of low cost housing. The construction of low-cost housing aims to meet housing needs in the Salatiga City for middle-low income people, especially for civil servants who do not have a home yet in Salatiga City (Sunarti et al., 2018). While the current problem condition that happen are some facilities and infrastructure were unconstructed yet. Some buildings have been changed with full of building coverage (or no open space) and lack of public transportation access.

Research of Ibem (2014) stated that affordable housing is just focused on housing unit neglecting housing facilities and infrastructure. This condition has similarity with low cost housing project in salatiga in post occupancy. Therefore, this research conduct post occupancy evaluation on looking and evaluating the sustainability of low-cost housing project performances.

Post-Occupancy Evaluation (POE) is an evaluation process that is used to see the performance of a design after the building has been built and operated by residents during specific periods focusing on the building and the needs (Preiser, 1988). POE has the advantage of identifying and finding solutions to problems from an existing facility in residential areas. Research related to Post-Occupancy Evaluation has been carried out on assessments and measurements of building performance values after being inhabited (Nawawi, 2008 and Yuwono, 2016). POE related to housing could assess settlement facilities in green (Lussetyowati, 2014). Meanwhile, if reviewed based on housing affordability for low-income people, POE has also done in assessing the performance level of satisfaction in a single building (vertical building) and single used of building against shared use (Sepriyadi, 2016 and Hidayati, 2017). At the same time, Ilham (2008) reviews the post-occupancy of landed housing for low-income people who have a broader regional character and allows for changes in the physical quality of multi-dwelling by individual homeowners without concerning on sustainability's dimension. Study of Ibem et al. (2015) on public housing sustainability using the POE approach in Nigeria measure on physical and economic characteristic and result in affordability as

¹ Kompas.com. "Per 8 Maret 2019, Backlog Rumah 7,6 Juta unit". 11 March 2019. Retrieved from <https://properti.kompas.com/read/2019/03/11/104252821/per-8-maret-2019-backlog-rumah-76-juta-unit?page=all>

sustainable factor. Meanwhile, research using the POE approach to see the determinant performances and AHP method to see the significances of influencing sustainability factors of low-cost housing in Indonesia has not been widely carried out. The combination of POE and AHP method could assess more complex about the existing condition and ideally expected factor influencing housing sustainability. Therefore, this research will look at post-occupancy from low-cost landed housing with the perspective of sustainability and look at the gap in the sustainability factors that occurs. In addition, post-occupancy evaluation has never been carried out in Salatiga City. So it needs to be assessed because it does not rule out the possibility that construction and provision of low-cost housing for low-income people will be carried out under the current government policy program. Regarding, following the one million housing program will be implemented as an alternative to meeting the gap fulfillment of affordable and expectation of sustainable, low-cost housing project.

Research Objective and Research Significance

The objective of this research that is to assess the performance of residential housing and to examine the gap factors influencing sustainability from post occupancy evaluation of low cost housing project. The significance for scientific field that is enriching the knowledge connecting the gap factor achieving housing sustainability in developing country. In addition, this research develops a housing sustainability assessment method that combines POE and AHP which could assess sustainability factors and identify gaps in factors as a main of concern. While for planning field, as input for housing development planning agency that can be used as a policy for granting new housing project permits considering aspect of sustainability regarding the urban infrastructure and facility complexity in urban spatial pattern.

LITERATURE REVIEW

The Concept of Sustainable Housing

Sustainable development is a multidimensional process in harmony between the environmental, social, economic, and culture that are interrelated and work together (Habitat, 2012). Sustainable development is currently also being applied to housing development, which was used only to solve global problems (Goldie et al., 2015).

In achieving sustainable urban housing, the location and home design aspects are significant factors to see housing sustainability (Yakob, 2012). This location aspect is related to the facilities that support the majority of people's lives around the housing. Residential construction is also one of the keys to contribute to sustainable development. Housing should not be seen from a physical perspective. Moreover, there is an economic and social perspective to achieve sustainability. Sustainable housing offers opportunities to promote environmental management, economic improvement, quality of life, and social equality, and reduce problems related to slums, urbanization, climate change, economic uncertainty, and poverty (Habitat, 2012). Sustainable housing is not only a product to shelter but also a process that will create services in terms of social and economic activities for occupants more livable (Ibem, 2015).

Three aspects of sustainability, including environmental, economic, and social dimensions, should be in balance and encompasses local strategies for all stakeholders involved in the housing project who know the participant's key to elaborate the process (Tupenaite et al., 2017). Some researchers (Tanuwidjaja et al., 2009; Odebiyi, 2010; Ibem, 2015) on sustainable housing stated that three-dimensional aspects emphasized environmental, social, and economic dimensions. These three-dimensional aspects highlight used for describing housing sustainable housing in general.

The environmental aspect is considered the most influential factor in sustainability on housing projects than two other aspects (social and economic). According to Tanuwidjaja et al. (2009), environmental aspects including a healthy place free from pollution, adequate infrastructure (clean water, garbage, waste, and drainage) and energy saving in the environmental management of waste management. Housing condition (indoor and outdoor), material and waste management takes places high influence on environmental sustainability. Similarly, Ibem (2015) states that access to basic infrastructure is the essential factor to environmental sustainability in housing as well as neighborhood quality facilities of a housing estate, construction materials, and green areas. Besides the environment quality, building design innovation is also considered to enhance sustainability in the building unit through architectural functionality and adaptability (Tupenaite et al., 2017).

Social Aspect and Cultural aspect could be combined as the socio-cultural aspect that gives an improvement on the well-being of occupants through interaction, socialization, and affordability to access public facilities. The social aspect of housing sustainability could be seen by closeness to places of social interaction and places of worship, and the residential area could guarantee safeness from interference (Tanuwidjaja et al., 2009). Community and society level is part of the main housing concern in sustainability where occupants perceive negative and positive impacts on how they socialize (Hashim, 2003). Moreover, social sustainability should cover occupants' sense of safety feelings, comforts, privacy, and societies (Ibem, 2015).

Economic aspect, in general, stated that workplace as influencing factor. Tanuwidjaja et al. (2009) noted that access to the workplace is also an important factor in influencing sustainability. Everyone will undoubtedly travel and need travel or commuting costs to afford the workplace every day routinely. The costs or fees required to afford public facilities also contribute to determining economic sustainability. Ibem (2015) considers housing durability, housing tenure, and operational cost of housing as the attributes influencing economic sustainability on housing.

Sustainable Housing in Post-Occupancy

Perhaps sustainability assessment in the macro scale could be conducted through guidelines through LEED, BREAM, or DGNB certificate. In Criteria assessment (Hamedani, 2012) stated that DGNB emphasizes business and economy, process and construction management, meanwhile LEED emphasizes the element of urban planning and element and BREEM emphasizes environmental condition and project characteristics. Those all asses on a macro scale and need professionals to evaluate the performance (Meier et al., 2009). To Evaluate the housing neighborhood environment performance simply and its sustainability assessment

could be conducted through Post-Occupancy Evaluation. POE assesses user satisfaction and the proper functional area whether its function fits with the benchmark due to environment effectiveness, including indoor environment, building design, and outdoor environment (Zimring, 1980). POE could clarify the problems by assessing design, operation (by user or occupant), and the building environment system (Meier, 2009). POE inputs could describe feedback the building user to increase their environment achieving sustainability.

Improving the quality of the housing environment will succeed if there are substantial efforts at every stage of the process of building a residential environment. Each stage of sustainable development is measured through the stages of planning, development, and occupancy. According to Sudarwanto et al. (2014), the stage of occupancy of the environmentally influential housing environment aspects can be seen in physical changes in housing, physical changes in the environment, environmental health, residents' behavior, and accessibility.

METHOD

Basically, this study aimed to examine the post-occupancy evaluation of residential neighborhoods in Salatiga City by looking at the physical performance of the housing and the surrounding environment; revealed satisfaction feeling on the social aspect and economic aspect. In addition, this study compared the field conditions with the suitability of existing standards in meeting the needs of its inhabitants, whether there is conformity or not that will assess the completeness of the quality of the residential environment.

In the next step, this research would know the expectation of sustainable housing ideally by expert choice through AHP analysis. The result of performances through Post Occupancy Evaluation and the result of ideally sustainable housing viewed by planning and development stakeholder revealed the gap of condition of sustainability performances of low-cost housing.

This research used a positivistic approach with a deductive quantitative method, which in essence emphasizes matters that are concrete, empirical testing and real facts. While the deductive method was done by looking for variables derived from theory in order to formulate indicators as an empirical style in the field. Besides this research also used descriptive methods where it aims to describe what happens in the field based on data in the field and its classification.

Data collection in this research was carried out in two ways, namely primary data collection techniques through field observations, questionnaires and supporting interviews, and secondary collection techniques through document review.

In data processing, to analyze POE performance used weighting score from questionnaire result and observation result. Weighting was be scored from 0 to 1. For example from parameter that gives good or fulfilled condition got score 1. Then fair condition got 0.5 and bad condition got 0 score. From each variable were be calculated in total mean score whereas good category has value of 66.7% - 100%, while bad has value 0 – 33.3.

In data processing to analyze significance factor affecting housing sustainability of low cost-housing use ranking of importance from AHP analysis. AHP could reveal hirarchical

structure of most sustainable framework level. From value of ahp, ranking was be distributed normally, so that the most important factor got a value of “1”. Therefore the “high importance” factor was resulted of value 0.667 – 1.

RESULT AND DISCUSSION

Profile of Study Area

Prajamukti and Prajamulya are low-cost housing intended for civil servants who work in Salatiga City with the requirements for class II and III civil servants who do not own a house and have worked for at least five years. This housing development can be regarded as one of the pilot projects in Indonesia that uses land owned by the Salatiga City Government to be sold to civil servants. The subsidy is given by reducing house prices from 120 million rupiah (IDR) to 83 million rupiah (IDR) with a financing scheme of up to 15 years of payment.

Prajamukti is built on an area of 59,207 m², of which 31,420 m² (53%) is used for housing, and 27,787 m² (47%) is used for infrastructure, utilities and housing facilities. The total area of housing units that have been built in Prajamukti is 400 units. Meanwhile, Prajamulya is built on a land area of 48,115 m², of which 28,765 m² (60%) is used for housing and 19,350 m² (40%) is used for the provision of infrastructure housing, utilities and facilities. The total housing units built in Prajamukti are 375 units.

Prajamukti and Prajamulya must have several supporting facilities and infrastructure in the scale of one housing environment. The facilities and infrastructure include sports fields, three parks/green open spaces, four playgrounds, one mosque, one communal wastewater treatment unit, one mini market, and one clean water pump unit. However, until now, not all of the planned facilities have been built in this residential area. Some of these facilities are still vacant land whose land status belongs to the Salatiga City Government.

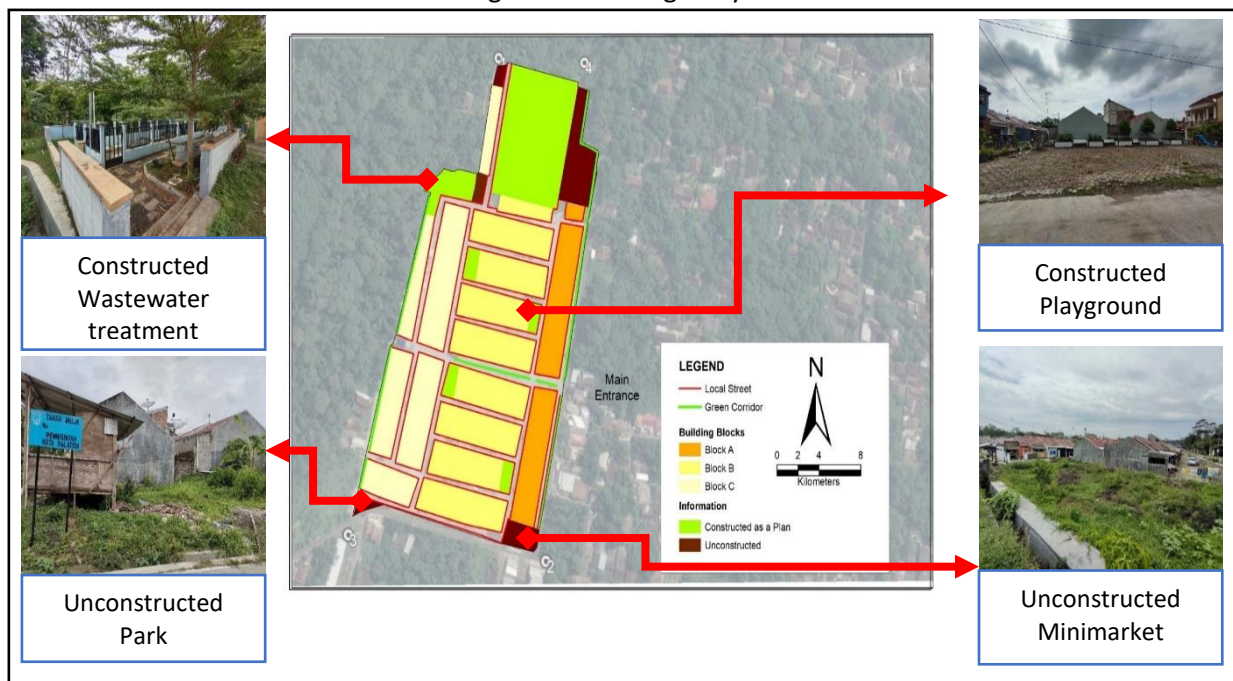


Figure 1. Existing Condition of Neighborhood Facilities and Infrastructure in Prajamukti

Source: Analysis, 2021

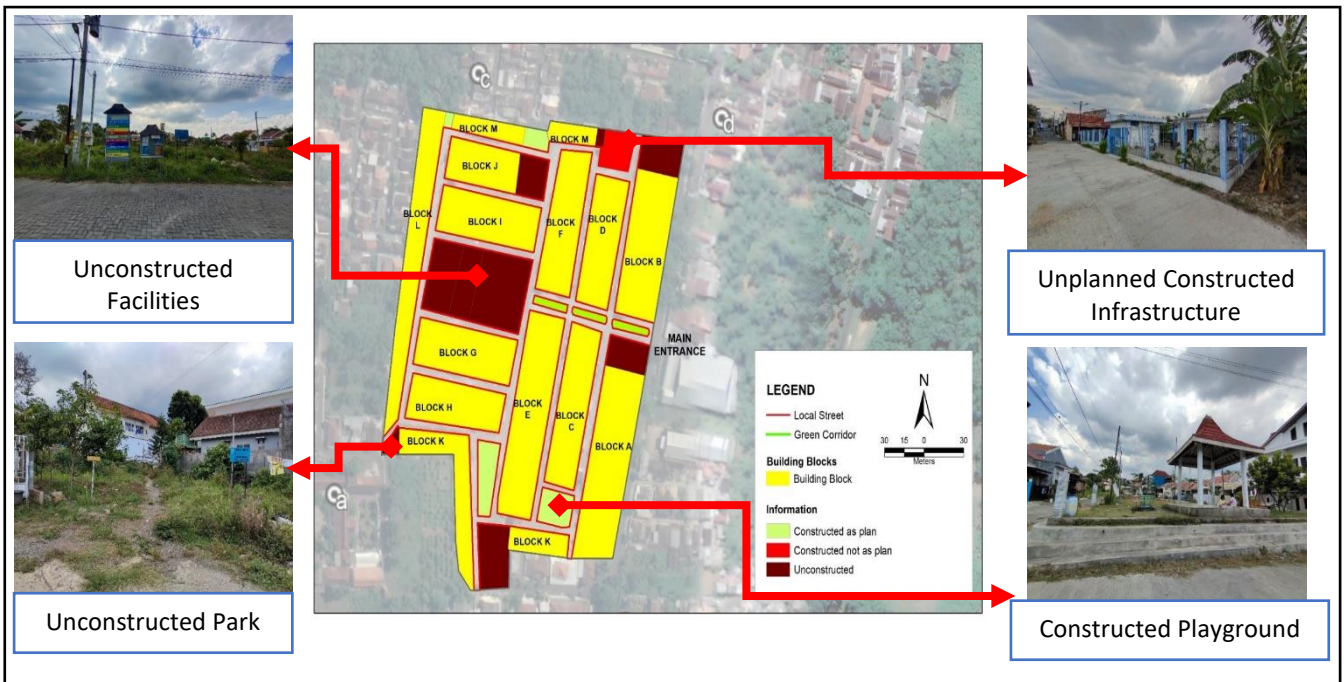


Figure 2. Existing Condition of Neighborhood Facilities and Infrastructure in Prajamulya
Source: Analysis, 2021

Influencing Factors on Environmental Aspect of Housing Sustainability

Physical and environmental aspects are the most important aspects in influencing the sustainability of housing. Tupenaite (2017) states that the environment is the main key in sustainable housing development. However, the environmental sustainability of low-cost housing in Salatiga City has not been fully fulfilled as sustainable due to its sufficient averaged performance value.

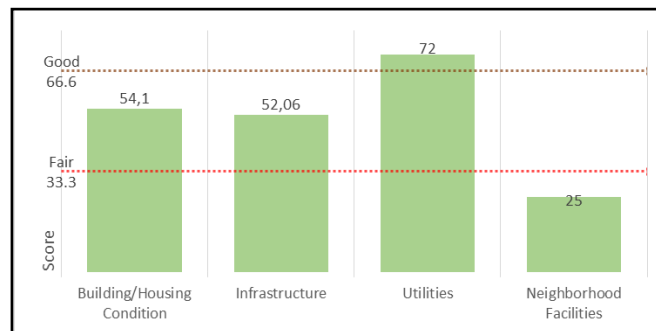


Figure 3. Performance Factor of Environmental Aspect on Low-Cost Housing Sustainability
Source: Analysis, 2021

From environmental aspect, only factor of utilities receiving a good score for sustainable performance due to good provision in clean water and electricity network. However, the absence of a fire hydrant reduces the performance of the utility factor in this residential area. It is important for low-cost housing because housing density makes fire prone highly in those area. Fire could be minimized and handled quickly with the presence of a fire hydrant as a means from protecting regional fires.

While the worst performance of environmental aspect is resulted from neighborhood facilities. This condition becomes poor due to lack access to playground, meeting halls, parking halls, and security post. Developers don't pay attention to the completeness of neighborhood facilities in supporting community life.

Meanwhile, the Building Condition and Infrastructure factors showed sufficient results. Zhang et al. (2014) stated that building measurement is an important factor in promoting a more sustainable environment. Building in indoor quality such as natural lighting and ventilation conditions (Nilashi et al., 2015); outdoor quality such as green open space and building envelope coverage (Sudarwanto et al., 2014) is an important variable in influencing the sustainability of housing. These variables are related to the energy saving of each existing building unit. Sustainability in the housing and building unit condition factor does not occur in low-cost housing for civil servants in Salatiga City because the condition of the building has sufficient value. Many housing units have been renovated or completely changed from the original buildings. The building configuration has been controlled by the owner providing little space, even no open space left on private housing land area. Whereas basically in the spatial planning regulations (Spatial Plan of Salatiga Municipality, 2011), unit buildings must leave at least 20% open space as water catchment areas and natural greenery. In addition, the waste management behavior of residents, most of whom still do not sort the organic and inorganic waste, creates unsustainability at the scale of each housing unit.

The infrastructure condition has a sufficient performance value due to the absence of waste collection points in the residential area. The existence of this infrastructure is important in residential areas because there is no estate management in managing environmental waste. There are some households who try to dispose of it themselves to the nearest waste collection points.

Influencing Factors on Social Aspect of Housing Sustainability

Housing should be seen as a residential process, including the social environment and community (Dwijendra, 2013). Social aspects in sustainable housing have an important role that will affect the quality of life and affect the housing environment's sustainability. The purpose of this social sustainability is to create more harmonious, cohesive, and development-oriented society with each other (Chiu, 2006). Suppose there is no good social sustainability in the housing environment. In that case, the behavior of the residents of the housing area will be indifferent to one another, and even this behavior will also have an impact on attitudes that do not care about the public environment in one community. This sustainability can be created through social factors to the internal and external environment of the region.

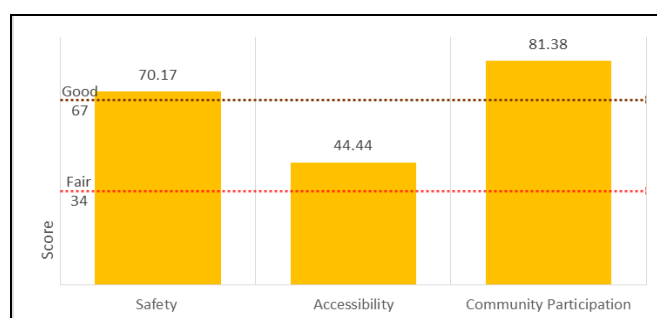


Figure 4. Performance Factor of Social Aspect on Low-Cost Housing Sustainability

Source: Analysis, 2021

The external environment could be seen by the social interaction of individuals in residential areas into external social public facilities from interference (Tanuwidjaja, 2009). At the same time, the internal social aspect is the social interaction of individuals in their community and society level where occupants perceive negative and positive impacts on how they socialize (Hashim, 2003).

One of the housing functions is to provide a sense of psychological comfort for a living (Roestamy, 2017). Therefore, housing should be able to provide a sense of security and comfort for its residents so that it can continue to grow and have privacy for each individual's space in it. The comfort and safety factors in low-cost housing for civil servants get a good performance. This factor is obtained from the perception of the value of occupant satisfaction with the experience and express a feeling of the occupants during post-occupancy to environmental conditions, neighboring conditions, and disturbances they have experienced. However, most of the residents accept their environment quite well without any disturbance or threat. Moreover, community participation also have good assessment results. They socialize with each other into a community that coexists and creates social harmony on an environmental scale.

Both internal factors related to security and social participation resulting from the perception and interaction of each occupant in low-cost housing have good values. However, the accessibility factor to public facilities has a fairly sustainable performance value. As in Turcotte's (2010) and Ibem's (2011) research stated that the development of neighborhood facilities is a factor that is less considered in providing sustainable housing. In contrast, this factor is one of the key factors to be sustainable. Lack of neighborhood facilities is considered unable to develop self-reliance and self-sustaining housing processes because residents who live in them will not develop socially and environmentally without social support facilities on an environmental scale. In low-cost housing in Salatiga City, the low accessibility performance is influenced by the lack of accessibility to public health and commercial areas. The site location selection for the construction of low-cost housing considers the aspect of land owned by the government so that it can reduce the selling price of the property, which is cheaper. However, this consideration has neglected the aspect of location that can afford the public infrastructure. To overcome this accessibility problem, it can be done by providing public transportation routes to facilitate access to public infrastructure. However, integrated public transport has not been able to reach low-cost housing to the city center properly. Even in Prajamukti, the current condition is not accessible at all by public transportation access to the area.

Influencing Factors on Economic Aspect of Housing Sustainability

Housing can be considered affordable if the monthly costs for transport, service fees, and housing costs do not exceed 30% of total income (Miles et al., 2000). From this, it can be seen that the cost at price component incurred from inhabiting a house will affect the level of economic sustainability of the occupants of the house itself. Often the costs in housing are so high that residents cannot meet other expenses other than home maintenance (Ganiyu, 2016). This condition certainly affects the economic sustainability of the residents of the house itself.

Affordability at prices is the most significant factor in the sustainability of the sustainable housing economy (Mulliner et al., 2013). The local government has provided this low-cost housing for civil servants at a very affordable price for the owner. Moreover, the government has provided subsidies to owners with the help of FLPP (Liquidity Facility for Housing Finance). So that the affordability factor in low-cost housing for civil servants has been able to meet a good value because of the financing aid from the government, and the construction of low-cost housing always gets subsidized assistance in mortgage and payment schemes.

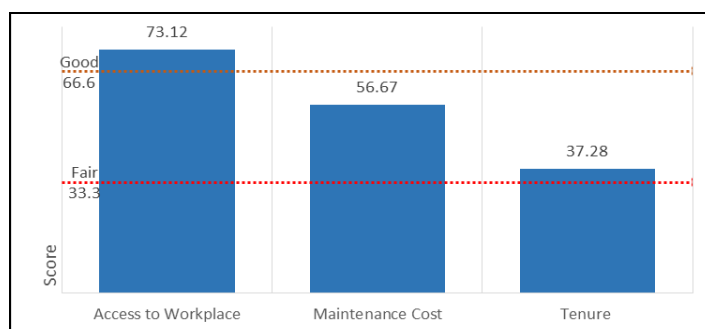


Figure 5. Performance Factor of Social Aspect on Low-Cost Housing Sustainability

Source: Analysis, 2021

Another factor that needs to be assessed for post-occupancy economic aspects in this study is the costs incurred by residents during post-occupancy, including access to the workplace and maintenance/expenses on building costs. Access to the workplace provides good value for economic sustainability. Most of the residents have used private vehicles to go to their workplaces and they think that the location to work can be easily reached. In addition, the transportation costs incurred by most residents are still considered within reasonable limits where most of the residents still spend transport costs of less than 10% of their total monthly income.

The maintenance costs factor in this housing can be seen as less sustainable due to the many cases of repairs made by residents during their stay, which have forced residents to pay their expenses for repairs to damaged buildings. The durability of the quality of the building itself is the key to the sustainability of the post-occupancy economic aspect. To create the sustainability of housing construction itself should be done with good management with the selection of local materials and good technology without compromising the quality of the building itself (Tam, 2011). But in reality, many residents have made repairs to damaged buildings in their homes.

The housing tenure factor also gives a less sustainable value in the economic aspect because many of the residents are not homeowners but are tenants. This condition shows that the beneficiaries of this low-cost housing assistance have abused the benefits they get from the low-cost housing program for civil servants. In addition, many of the homeowners do not have home insurance coverage that can guarantee home security in the future, considering that the low-cost housing area is a densely built area and is vulnerable to the risk of fire hazards.

Importance Level of Factor on the Housing Sustainability

Many studies state that the environmental sustainability aspect is the most significant factor affecting housing sustainability (Rahman et al., 2016; Tupenaite et al., 2017). It is also shown through this study. Factors or variables in the environmental aspect still have the most important dominant factor influencing the sustainability of low-cost housing in Salatiga City. The top 3 factors, namely utility, housing-building unit condition, and infrastructure, are significant factors affecting sustainability.

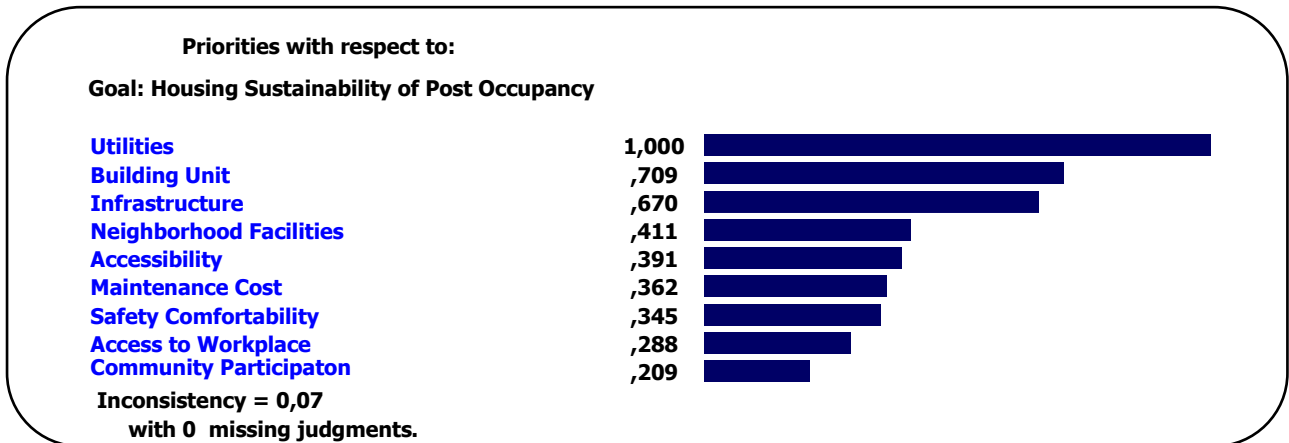


Figure 6. Level of Importance Factor on Low-Cost Housing Sustainability in Salatiga City

Source: Analysis, 2021

The following are factors based on the degree of importance resulting from the weighting through AHP in Salatiga City:

1. High Importance

This level is the factor that is considered the most influential in creating the sustainability of low-cost housing. The factors that are included in this high importance are three main factors that have an AHP rating exceeding the value of 67. These factors include Utilities, Building Units, and Infrastructure.

Utilities and infrastructure factors are the most important factors because these two variables support the most basic housing needs, such as utility factors including clean water provision and electricity networks and infrastructure factors including road and drainage networks. While the building unit factor is an essential factor for the sustainability of the area because each building and household that occupies it has a significant contribution in supporting the sustainability of the housing area. Such as the availability of open space in each housing unit, the quality of indoor buildings (ventilation and lighting) and waste management which will contribute to energy efficiency in the sustainability of the area.

2. Middle-low Importance

This level is a factor that is considered quite important in creating the sustainability of low-cost housing based on the degree of importance which has an AHP rating of between 0-66. Factors that have this value include Facilities, Accessibility, Maintenance Cost, Safety-Comfortability, Access to the workplace, and Community Participation.

Community participation and access to the workplace are the lowest factors that are considered less important in the degree of importance in the construction of low-cost housing in Salatiga City. Access to the workplace is considered less influential because the location from Salatiga City is considered accessible by private vehicles. It can be said that all residents reach the workplace with their private vehicles so that this factor is considered less significant in determining housing sustainability.

The Gap of Performance and Importance Level

Gap performance and importance level occur when the performance condition is not good, but the level of importance is considered to have a high level of significance. The biggest gap will occur if the level of importance is high, but the performance has a bad rating. Based on the importance level diagram classification, the Building unit and Infrastructure factors have a high level of importance. Still, their performance is considered less than optimal, so it can be said that the two factors have a big gap. Both of these factors are important to get main priorities for development because these factors are considered very important in influencing the sustainability of low-cost housing but their performance is not optimal.

In addition, the performance importance gap also occurs in the Facility Neighborhood, Accessibility and Maintenance Cost factors. These three factors also need enough attention but not as big as the building unit and infrastructure factor. The existence of a neighborhood facility can be considered as an important factor in influencing sustainability. Still, its performance in the case of low-cost housing in Salatiga City did not perform well. The facility's construction is currently delayed due to a lack of development funds that are not allocated simultaneously to the housing unit planning so that the construction is not complete until the post-occupancy period. The Salatiga Municipality Government has planned the construction of the facilities with a multi-year scheme. Still, up to 5 years after occupancy, the development has not been carried out so that the site location which is planned for the construction of environmental facilities becomes abandoned in the form of vacant land. This condition makes environmental facilities less sustainable in low-cost housing for civil servants in Salatiga City.

| | | | |
|-------------------|-------------|---|---|
| IMPORTANCE | High | <ul style="list-style-type: none"> - Building Unit - Infrastructure | <ul style="list-style-type: none"> - Utilities |
| | Low | <ul style="list-style-type: none"> - Maintenance Cost - Facilities - Accessibilities | <ul style="list-style-type: none"> - Community participation - Access to workplace - Safety-Comfortability |
| | | Low | High |
| | | PERFORMANCE | |

Figure 7. Quadrant of Gap Performance and Importance on Low-Cost Housing Sustainability in Salatiga City

Source: Analysis, 2021

CONCLUSION

This research has conducted an assessment by looking at post-occupancy from low-cost landed housing with the perspective of sustainability. By this research, an examination of the gap factors influencing sustainability from a post-occupancy evaluation of low-cost housing projects by the government for civil servants was also conducted by looking at the performance and importance of sustainability factors for the sustainability of low-cost housing in Salatiga City.

The construction of low-cost housing in salatiga cannot be said as sustainable. The environmental aspect is the most dominant factor influencing the unsustainability. Hindering factor in sustainability performance of environmental aspect are building housing conditions, infrastructure, and neighborhood facilities. Hindering factor from social aspect is accessibility to public facilities, due to no access of public transportation supporting the residents. Hindering factor from economic aspect are maintenance expenses and housing tenure.

Based on weighting through AHP, it can be seen that the factors of utilities, building unit and infrastructure as the top three significance factors affecting housing sustainability, respectively. Building unit and infrastructure factors take place as the highest gap level of importance and performance. So, these factors are important to get the main priorities for development.

RECOMMENDATION

Some recommendation that can be made from this research are:

1. The construction of low-cost housing should comply with the existing guidelines to achieve adequate housing.
2. Low-cost housing provision should pay attention to the completion of the existing infrastructure, environmental facilities and concern the quality of the building materials that are durable and environmentally friendly.
3. In spatial planning, in terms of low-cost housing provision, determining the location of housing project needs to pay attention to access to urban facilities such as health, education, trade, and commercial facilities with the support of public transportation that can serve the mobility of the population to afford these urban services regarding spatial structure.
4. It is necessary to monitor and control periodically the utilization of post-occupancy housing.
5. Estate management for residents in their areas is required by involving occupants actively who are able to educate each other in the management and maintenance of public facilities and infrastructure in order to achieve environmental sustainability in post-occupancy.
6. Residents should be involved actively to apply the concept of 3R (reduce, reuse, recycle) by sorting waste on a household scale.

REFERENCES

- Apparicio, P., and Seguin, A. 2006. *Measuring the Accessibility of Services and Facilities for Residents of Public Housing in Montreal*. *Urban Studies*, 43(1), 187–211. DOI: <https://doi.org/10.1080/00420980500409334>.

- Bramantyo. 2012. *Efektivitas Regulasi Perumahan Di Indonesia Dalam Mendukung Penyediaan Rumah Bagi Masyarakat Bepenghasilan Rendah (MBR)/ Effectivity of Housing Regulation in Indonesia to Support Housing Provision*. Widyariset, 243-248. DOI: <http://dx.doi.org/10.14203/widyariset.15.1.2012.243-248>.
- Budihardjo, Eko dan Sujarto, Djoko. 2009. *Sustainable City*. Bandung: PT. Alumi.
- Bratt, Rachel G. 1989. *Rebuilding a Low-Income Housing Policy*. Philadelphia, the USA: Temple University Press.
- Cao, J., and Cao, X. 2017. *Comparing Importance-Performance Analysis and Three-Factor Theory in Assessing Rider Satisfaction with Transit*. Journal of Transport and Land Use, 10(1). DOI:<https://doi.org/10.5198/jtlu.2017.907>
- Chiu, Rebecca L.H., 2006. *Socio-cultural Sustainability of Housing: a Conceptual Exploration*. Theory and Society, 21:2, 65-76. DOI:10.180/14036090410014999
- Coulson, N. E., & Fisher, L. M. 2009. *Housing Tenure and Labor Market Impacts: The search goes on*. Journal of Urban Economics, 65(3), 252-264. DOI:<http://dx.doi.org/10.1016/j.jue.2008.12.003>.
- Daldjoeni, N. 1992. *Seluk Beluk Masyarakat Kota*. Bandung: Penerbit Alumi.
- Dwijendra, Ngakan Ketut A. 2013. *Quality of Affordable Housing Projects by Public and Private Developers in Indonesia: The Case of Sarbagita Metropolitan Bali*, Indonesia. Journal of Geography and Regional Planning, vol.6(3), pp. 69-81, 2013. DOI:[10.5897/JGRP12.050](https://doi.org/10.5897/JGRP12.050).
- Gan, X., Fernandez, I.C., Guo, J., Wilson, M., Zhao, Y., Zhou, B., Wu, J. 2017. *When to Use What: Methods for Weighting and Aggregating Sustainability Indicators*. Ecological Indicators, 81, pp. 491-502. DOI:<https://doi.org/10.1016/j.ecolind.2017.05.068>
- Gan, X., Zuo, J., Wu, P., Wang, J., Chang, R., Wen, T., 2017. *How Affordable Housing Becomes More Sustainable? A Stakeholder Study*. Journal of Cleaner Production 162 (2017), pp. 427- 437. DOI: <https://doi.org/10.1016/j.jclepro.2017.06.048>
- Ganiyu, B., Fapohunda, J., Haldenwang, R. 2015. *Construction Approaches to Enhance Sustainability in Affordable Housing in Developing Countries*. Conference: 2015 World Congress on Sustainable Technologies (WCST), pp 101-107. DOI:10.1109/WCST.2015.7415129
- Gibson, R. B., Hassan, S., Holtz, S., Tansey, J., Whitelaw, G. 2010. *Sustainability Assessment: Criteria and Processes*. London, UK: Earthscan.
- Goldie, A. G. S., R. U. Farhodi, Ezat and A. Ezati. 2015. *The Study of Effective Factor in Sustainable Urban Renewal Process (Case Study, IRAN; Mashhadcity)*. Research Journal of Fisheries And Hydrobiology 10(13): 15.
- Habitat, UN. 2012. *Sustainable Urbanizing in Asia, A Source Book for Local Government*, United Nations Human Settlements Programme.
- Hamedani, A. Zeinal and Huber, F. 2012. *A Comparative Study of DGNB, LEED and BREEAM Certificate Systems in Urban Sustainability*. WIT Transactions on Ecology and The Environment, Vo. 155 pp. 121-132. DOI:10.2495/SC120111
- Hashim, A.H. 2003. *Residential Satisfaction and Social Integration in Public Low Cost Housing in Malaysia*. Pertanika Journal of Social Science and Humanity 11(1) 1-10.

- Hidayati, Masturina K. (2017). *Evaluasi Pasca Huni Pembangunan Rusunawa di Kota Surakarta*. (Thesis). Yogyakarta: Universitas Gadjah Mada.
- Ibem, E.O. and Azuh, D.E. 2011. *Framework for Evaluating the Sustainability of Public Housing Programmes in Developing Countries*. Journal of Sustainable Development and Environmental Protection (JSDEP). 1(3), pp 24-39. <http://eprints.covenantuniversity.edu.ng/id/eprint/745>
- Ibem, Eziyi. O. 2013. *Accessibility of Services and Facilities for Residents in Public Housing in Urban Areas of Ogun State, Nigeria*. Urban Forum, 24(3), 407–423. DOI:<https://doi.org/10.1007/s12132-012-9185-6>.
- Ibem, Eziyi O., Aduwo, Egidario B., Ayo Vaughan, Emmanuel K. 2015. *Assessment of the Sustainability of Public Housing Projects in Ogun State, Nigeria: A Post Occupancy Evaluation Approach*. Mediterranean Journal of Social Science MCSER Publishing, Rome-Italy Vol 6 No.4 S2 pp 523 – 535, July 2015. Doi:10.5901/mjss.2015.v6n4s2p523.
- Ilham, Novri. (2008). *Evaluasi Pasca Huni Lingkungan Perumahan Mojosongo Solo*. (Thesis). Yogyakarta: Universitas Gadjah Mada.
- Indrianingrum, Lulut. 2017. *Housing Ownership and Affordability Among Low-Income Society in the Poorest Sub-District of Semarang, Central Java, Indonesia*. AIP Conference Proceedings 1818, 020019. DOI:<https://doi.org/10.1063/1.4976883>.
- Iwamura, Kazuo. 2017. *Sustainability of Housing, Embedded in the Local Context*. Yokohama: Faculty of Environmental and Information Studies, Tokyo City University.
- Kuswartojo, Tjuk. 2005. *Perumahan dan Permukiman Indonesia*. Bandung: ITB.
- Lussetyowati, T. 2014. *Evaluasi Purna Huni pada Ruang Terbuka Publik di Perumahan Bukit Sejahtera Palembang*. Proceeding Temu Ilmiah IPLBI 2014 pp. 19-26.
- Martilla, J. A., and James, J. C. 1977. *Importance-Performance Analysis*. Journal of Marketing, 41(1), 77–79. DOI:10.2307/1250495
- Meir, Isaac A. and Cicelsky, Alex. 2009. Post-Occupancy Evaluation: An Inevitable Step Toward Sustainability. Advances in Building Energy Research 2009, Volume 3 pp. 189-220. DOI:10.3763/aber.2009.0307
- Miles, M.E., Weiss, M.A., and Berens, G. 2000. *Real Estate Development: Principles and Process, 3rd ed*. Washington DC, USA: Urban Land Institute.
- Mulliner, E., Smallbone, K., Maliene, V. 2013. *An Assessment of Sustainable Housing Affordability Using a Multiple Criteria Decision Making Method*. Omega, 41, pp 270–279. DOI: <https://doi.org/10.1016/j.omega.2012.05.002>
- Nawawi (2008), Abdul H. 2008. *Post-Occupancy Evaluation Correlated with Building Occupants's Satisfaction: An Approach to Performance Evaluation of Government and Public Buildings*. Journal of Building Appraisal 4(2) pp 59-69. DOI:10.1057/jba.2008.22
- Nilashi, M., Zakaria, R., Ibrahim, O., Majid, M.Z.A., Zin, R.M., Chughtai, M.W., Abidin, N.I.Z., Sahamir, S.R., Yakubu, D.A. 2015. *A Knowledge-Based Expert System for Assessing the Performance Level of Green Buildings*. Knowledge-Based Syst, 86, 194–209. DOI:<https://doi.org/10.1016/j.knosys.2015.06.009>

- Odebiyi, S.O. 2010. *Sustainable Housing Development in Africa: Nigerian Perspective*. International Business and Management (1) pp. 22-30. DOI: <http://dx.doi.org/10.3968/j.ibm.1923842820100101.005>
- Parmadi, A.A. 2018. *Implementasi Kebijakan Program Rumah Bersubsidi di Kecamatan Banjar Kabupaten Buleleng*. Public Inspiration: Jurnal Administrasi Publik Vol 3 pp.34 – 45.
- Pemerintah Daerah Kota Salatiga. Peraturan Daerah Kota Salatiga No.4 Tahun 2011 Tentang Rencana Tata Ruang Wilayah Kota Salatiga 2010 – 2030. Salatiga: Bappeda Kota Salatiga.
- Peraturan Menteri Perumahan Rakyat Republik Indonesia. 2011. Permen Perumahan Rakyat No.25 tahun 2011 Tentang Pedoman Penyelenggaraan Rumah Murah. Jakarta: Kementerian Perumahan Rakyat RI.
- Preiser, W.F.E, Robinowitz, H.Z, and White, E.T. 1998. *Post Occupancy Evaluation*. Ney York: Von Nortstand Reinhold Company.
- Rahman Abdul, H., Wang, C., Ebrahimi, M. 2016. *Integrating and Ranking Sustainability Criteria for Housing*. Proceedings of the Instituion of Civil Engineers-Engineering, Vol 169 pp. 3–30. DOI: <https://doi.org/10.1680/ensu.15.00008>
- Roestamy, Martin. 2017. *Providing Affordable Housing for Low-Income People in Indonesia (Development of Model on Housing Law)*. IJASOS-International E-Journal of Advances in Social Science, Issue 9, Pg. 1094-1103.
- Saaty, T.L. 1980. *The Analytic Hierarchy Process: Planning, Priority Setting, Resource Allocation*. McGraw-Hill: New York, USA.
- Sepriyadi, A. 2016. *Evaluasi Purna Huni Rumah Susun Sew Pudai di Kota Kendari*. (Thesis). Yogyakarta: Universitas Gadjah Mada.
- Standart Nasional Indonesia 03-1733-2004 Tentang Tata Cata Perencanaan Lingkungan Perumahan di Perkotaan.
- Sudarwanto, B., Padelaki, E., Soetomo, S., 2014. *Pencapaian Perumahan Berkelanjutan 'Pemilihan Indikator Dalam Penyusunan Kerangka Kerja Berkelanjutan'*. Jurnal MODUL UNIP Vol. 14, pp. 105-102. DOI: <https://doi.org/10.14710/mdl.14.2.2014.105-112>.
- Sunarti, S., Yuliasuti, N., Indiasjario. 2018. *Stakeholder Collaboration in Provision of Housing for Low Income Community in Salatiga City*. Jurnal TATA LOKA Planologi Undip Volume 20, pp 455-471. DOI: <https://doi.org/10.14710/tataloka.20.4.455-471>.
- Sunarti, S., Yuliasuti, N. Tyas, W.P., Sari D.P.P. 2020. *Housing Facilities Provision in KORPRI Salatiga Housing: Reality and Neighborhood Unit Concept*. Jurnal TATA LOKA Planologi Undip Volume 20 (2), pp 249-260. DOI: <https://doi.org/10.14710/tataloka.20.2.249-260>.
- Tam, V.W.Y. 2011. *Cost Effectiveness of Using Low Cost Housing Technologies in Construction*. Procedia Engineering, Elsevier vol.14: pp 156-160. DOI:10.1016/j.proeng.2011.07.018
- Tanuwidjaja, G. Mustakim, Hidayat, M., Sudarman, A. 2009. *Integrasi Kebijakan Perencanaan dan Desain Rumah Susun yang Berkelanjutan, dalam Konteks Pembangunan Kota yang Berkelanjutan*. Seminar Nasional Universitas Kristen Maranatha, Bandung. Retrieved from <http://repository.petra.ac.id/id/eprint/15566>.

- Tupenaite, Laura., Lill, Irene., Geipele, I., Jurga Naimaciviene. 2017. *Ranking of Sustainability Indicators for Assessment of the New Housing Development Projects: Case of the Baltic States*. Journal of MDPI Resources 2017, 6,66. DOI:10.3390/resources6040055
- Turcotte, David and Geiser, Ken. 2010. *A Framework to Guide Sustainable Housing*. Housing and Society vol. 37 (2) pp. 87-117. DOI:<https://doi.org/10.1080/08882746.2010.11430582>
- Turner, John F.C. 1972. *Housing by People*. London: Marion Boyars Publisher Ltd.
- Yakob, Hamizah F.Y., Hazlina Hamdanb. (2012). *Land Use Regulations towards a Sustainable Urban Housing: Klang Valley Conurbation*. Procedia-Social and Behavioral Sciences 68, 578-589.
- Yuwono, Astrid A. 2016. *Evaluasi Pasca Huni Bangunan Braga City Walk Bandung*. Serat Rupa Journal of Design 1(2):222. DOI:10.28932/srjd.v1i2.451
- Zhang, X., Wu, Y., Shen, L., Skitmore, M. 2014. *A Prototype System Dynamic Model For Assessing the Sustainability of Construction Projects*. International Journal of Project Management 32 pp. 66–76. DOI: <https://doi.org/10.1016/j.ijproman.2013.01.009>
- Zimring, C.M., Reizenstein, J.E. 1980. Post-Occupancy Evaluation: An Overview. Environment and Behaviour 12, 429–450. DOI:10.1177/0013916580124002