Sustainability and affordability analysis for One Million Housing Program a case in Cileungsi District Bogor Regency West Java

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Abstract. To spur economic growth, the Indonesian government initiates regional development, which include naming Cileungsi District Bogor Regency West Java as industrial area, which causing migration level to this area to increase. An efficient industrial area considers the housing for its employees, unfortunately, the fulfilment of housing is still a considerable problem in Cileungsi District. One Million Housing Program is a program by the government to accommodate the growing needs of affordable housing for low-income workers. However, the housing provided through this program is still considered unsustainable. This paper aims to analyse the sustainability and affordability of these housings and give improvement to the housing that can be implemented. The research used questionnaires, interviews, and observation. The data acquired through questionnaires is processed by using validity and reliability test. The houses that are being analysed are not entirely sustainable and affordable. There are several aspects of the house that are not sustainable such as the accessibility, energy and water efficiency, material and quality, and house size. These housings are only affordable for those who have an income of > IDR 4,000,000.

Keywords: Sustainability, Affordability, Low Income Housing, Indonesia

1. Introduction
As an initiative to spur economic growth [1], the Indonesian government has been intensively developing regional area, specifically centralizing industrial activities in an industrial area. One chosen area that is developed into an industrial area is Cileungsi District in Bogor Regency, the center of development in the Eastern part of Bogor Regency, which caused the region to become a strategic location for the development of industrial activities causing hundreds of industries have grown in this region. The rapid growth of industrial sector certainly attracts the interest of productive-age community to obtain employment, therefore, causing the level of migration to increase, especially in this region [2]. Consequently, the need for proper housing is also increasing due to the incoming migrants [3].

The fulfilment of housing is still a considerable problem in Cileungsi District. The need for housing may not be an obstacle for company directors, but for low-income communities (LIC), affording a house is a problem that needs to be considered [4]. To accommodate that, government with the help of
local developer through One Million Housing Program provides affordable and decent housing for LIC. Although the programs of affordable housing have been put into action, there is still an exchange of views on whether the affordability has been improved [5]. For instance, living in affordable housing might increase the expenses on healthcare [6], energy bill [7], and transportation cost [8]. Therefore, in improving the affordability of housing, economic viability is not the only attribute to be evaluated [9]. Other important issues such as housing design, neighborhood environment, location, routes of transportation, and opportunities for work, which classified as component for sustainability, is also important [8]. Making it essential to cooperate sustainability in planning the construction of affordable housing programs [10].

Despite the great attempt to ensure the success of affordable housing programs, very minimal recognition has been gained on the sustainability of affordable housing [5]. Therefore, this paper aims to analyse the sustainability and affordability of One Million Housing Program in Cileungsi industrial area and give recommendation regarding sustainable and affordable housing to solve the needs for adequate housing for low-income household, as well as helping the stakeholders involved in decision-making process regarding the One Million Housing Program.

2. Literature Review

In 2015, the Government of Indonesia launched One Million Housing Program as an aim to reduce housing backlog. According to the Ministry of Finance, housing backlog is the quantity of houses that have not been handled or provided and is calculated based on the concept of one housing unit per household or the head of the family. One of the main targets of this program is LIC. Small construction companies can carry out the construction of the housing and must follow the government’s regional spatial plan and standards. Additionally, the government offers Housing Loan Program (HLP) due to the lack of people’s purchasing power and high inflation rate per year. The loan offers fixed-rate interest and is intended for earners between Rp1.000.000.- to Rp2.500.000.- per month.

2.1. Sustainable and Affordable Housing

Sustainable housing often considered as units or clusters of self-sufficient green buildings, but also as socially-enhancing and environmentally-friendly residential practices which integrates to the wider urban/settlement systems [11]. Therefore, the aim of sustainable housing is to create housing that is affordable, accessible, and less damaging to the environment which is a result of economic, social, and environmental sustainability from planning to implementation phase [12].

Affordable housing is widely defined as a house where it is adequate in quality and location and does not prohibit its occupants to meet other basic living costs or pressurize their enjoyment of basic human rights due to the housing cost [13]. While there is no universal agreement of standard that comprise affordable housing, Dermographia Index, the result of the International Housing Affordability Survey, defined the concept used to measure affordability is residual income affordability (RIA), which explains that the affordability of house depends on the size of the household’s residual income. The smaller the residual value, the harder for a household to afford housing. This concept of affordability is usually used by governments or institutions that take care of housing for low-income people.

Affordability index (AI) based on the concept of affordability of residual income shows the value of residual household income (RHI) obtained after household income (HI) is reduced by housing expenditure (HE) and non-housing expenditure (NHE). The AI - RIA calculation formula is as follows:

$$AI - RIA = HI - HE - NHE$$ (1)

After reviewing various journals containing the criteria for sustainability and affordability of housing, several criteria were chosen to be the reference in developing research in Table 1.
## Table 1. Variables of Sustainable and Affordable Housing

| Indicator                  | Code | Criteria                                                                 | Reference |
|----------------------------|------|--------------------------------------------------------------------------|-----------|
| **Affordability**          | A1   | Household income                                                         | [14]      |
|                            | A2   | Housing expenditure                                                      | [14]      |
|                            | A3   | Non-housing expenditure                                                  | [14]      |
| **Economic Sustainability**| EC1  | Poverty Level                                                            | [11]      |
|                            | EC2  | Interest rates and mortgage availability                                 | [11]      |
|                            | EC3  | Other non-housing related costs.                                         | [15]      |
|                            | EC4  | Reduced energy bills.                                                    | [6]       |
|                            | EC5  | Commuting cost from the location of housing to public facilities        | [16]      |
| **Environmental Sustainability** | EV1  | Mixed land using                                                        | [17]      |
|                            | EV2  | Energy efficiency of housing                                             | [17],[18] |
|                            | EV3  | Water efficiency.                                                        | [19]      |
|                            | EV4  | Adequate living spaces within small size unit.                           | [17],[20] |
|                            | EV5  | Comfortable and healthy indoor environment.                              | [17],[21] |
|                            | EV6  | Quality of housing                                                       | [17],[18] |
|                            | EV7  | Aesthetically pleasing view of completed house                          | [22]      |
|                            | EV8  | Safety-incidence of crime                                                | [17],[18],[23] |
|                            | EV9  | Using ecological low-energy and affordable building materials and technology. | [11] |
|                            | EV10 | Resilient to sustain potential natural disasters and climatic impacts.  | [11]      |
|                            | EV11 | Connected to efficient, decent, safe and affordable energy, water, sanitation, recycling facilities. | [11],[17],[23] |
|                            | EV12 | Not polluting the environment and protected from external pollutions.   | [11]      |
| **Social Sustainability**  | SC1  | Access to employment opportunities.                                      | [17],[23] |
|                            | SC2  | Access to public transport services.                                     | [17],[23] |
|                            | SC3  | Access to good quality schools.                                          | [23]      |
|                            | SC4  | Access to shops.                                                         | [23]      |
|                            | SC5  | Access to health services.                                               | [23]      |
|                            | SC6  | Access to leisure facilities.                                            | [23]      |
|                            | SC7  | Access to open green public space.                                       | [17],[18],[23],[24] |
|                            | SC8  | Cultural and heritage conservation.                                      | [21],[25] |
|                            | SC9  | Diversified housing types.                                               | [17]      |
|                            | SC10 | Social acceptability.                                                    | [20],[21] |
|                            | SC11 | Suitability.                                                             | [26]      |
|                            | SC12 | Harmonious social relationships.                                         | [9],[21]  |
|                            | SC13 | Increased consciousness of environmental protection.                    | [9]       |
|                            |     | Properly integrated into and enhancing the social, cultural, and economic fabric of the local neighbourhood and the wider urban areas. | [11] |
|                            | SC14 |                                                                         |           |
3. Research Methodology

This research used questionnaire as a quantitative approach and interviews and survey as a qualitative approach to measure the sustainability and affordability of the housing. Literature studies and analysis were also done to construct the variables which also used to create the questionnaire. The research also used interview to get further data and background of the residents. Questions like how long they have been living there, if they consider living in the housing reduce their expenses, what components can be improved, and if they see themselves living in the housing for a long time. 352 units of housing with occupants are chosen to be the sample. Generally, the process of the research can be seen in Figure 1.

![Research Process Diagram](image)

**Figure 1.** Research Process

Based on the survey, there are a few houses provided through One Million Housing Program in Cileungsi. The houses chosen in this paper are the ones who have been inhabited. Although similar, Table 2 shows the comparison between each house.

| Name                      | Profile                                  | Structural Description                                      |
|---------------------------|------------------------------------------|------------------------------------------------------------|
| **Puri Harmoni 9**        | Developer: Vista Land Group              | 1. Foundation: shallow foundation                           |
| **& Extension**           | Location: Klapanunggal District          | 2. Wall: masonry brick                                      |
| **(PH9)**                 | Type: 26/60 (2 Bed, 1 Bath)              | 3. Roof structure: lightweight steel                       |
| **Puri Harmoni**          | Developer: Vista Land Group              | 4. Plafond: painted GRC                                     |
| **(PH10)**                | Location: Klapanunggal District          | 5. Windows/Door frame: Borneo wood                         |
|                           | Type: 26/60 (2 Bed, 1 Bath) and 30 (2-3 Bed, 1 Bath) | 6. Toilet: tub and lavatory                               |
|                           |                                          | 7. Plumbing: electrical pump                               |
|                           |                                          | 8. Electricity: 1300W / based on PLN.                      |
| **Nirwana Bojong Residence (NBR)** | Developer: Star Nusa Prima                 | 1. Foundation: shallow foundation                           |
|                           | Location: Klapanunggal District          | 2. Wall: masonry brick                                      |
|                           | Type: 29/60 (2 Bed, 1 Bath)              | 3. Roof structure: lightweight steel                       |
|                           |                                          | 4. Plafond: painted GRC                                     |
|                           |                                          | 5. Windows/Door frame: Borneo wood and Aluminium           |
|                           |                                          | 6. Toilet: tub and lavatory                               |
|                           |                                          | 7. Plumbing: electrical pump                               |
|                           |                                          | 8. Electricity: 1300W / based on PLN.                      |
4. Result and Discussion

4.1. Questionnaire and Interview Result

The research was conducted by giving a questionnaire to the respondents who are the residents of PH9, PH10, and NBR, housing complexes in Cileungsi. The total of respondents obtained is 185 with the number of respondents in PH9, PH10, and NBR are 126, 70, and 62, respectively.

Based on the questionnaire result and calculation of affordability index by residual income affordability approach, the affordability index of residents of PH9 and PH10 are similar. There are 42% and 53%, respectively, of the resident who results in negative residual income which means that their expenditure is exceeding their income. This 42% is those who have approximately only IDR 3.000.000 per month as their income. To fully afford the housing and still live decently, a minimum of IDR 4.000.000 must be fulfilled. While in NBR, there are 64% of residents who have monthly income of nearly IDR 4.000.000 result in negative residual income, a minimum of IDR 4.500.000 monthly income must be fulfilled.

According to the result from the questionnaire that measures sustainability of the house, it is seen that the residents are not in favour of spending so much on household needs, which include transportation cost. They also think that their housing complex is quite far from basic public services, such as traditional market and hospital. The residents also think that the house should be bigger to be able to accommodate all family members. The house durability should be improved since it was constructed using low-grade materials. The location of the house also decreases the opportunities for employment since it is quite far from other facilities.

From the interview, it is seen that the residents moved to Cileungsi particularly in their respective housing complex due to the job they have. They acquired their houses by agreeing to pay with installment for 10 to 20 years depends on their state of financial. The house is fragile and missing some basic facility such as a kitchen. Therefore, some residents constructed a wall at the back of their house as a kitchen. The housing complex also quite far from basic public facilities therefore increases their expenses on transportation. They also choose to live there for approximately 10 years or until they finished paying off the installment.

The observation of the area shows that the three housing is located on the same main road, Jalan Raya Bojong Klapanunggal and only separated approximately 3 km between each other. On the same road, there is also many minimarkets and mosques that can be used by the residents living in the area using their own transportation or minibus. There are also approximately four elementary to secondary schools and two gas stations located on the same road. The main disadvantage of living in this area is that it is far from health services such as hospital, although having a small clinic nearby NBR, the clinic might not be sufficient to fulfil the patient needs. Train station is also located more than 10 km away.

4.2. Housing Facilities

In terms of housing facilities, PH9 and PH10 have the same facilities including a kindergarten, a playground, a mosque, security cameras, and security post, since both housings were constructed by the same developer. While at NBR, in terms of facilities, this housing is still expanding, so it is not as equipped as PH9 and PH10, only a mosque and a field that are currently available. Additionally, the developer claims the housing is equipped with several surrounding facilities such as hospitals, schools, markets, malls, and train stations. However, the surrounding facilities mentioned are significantly far from the housing complex in which public transportation available is only minibus.
4.3. Economic Sustainability

Referring to the questionnaire result, most of the residents do mind if the cost for their household exceeds their own standard. As for the cost of energy, the money that they spend every month is still within their standard. In terms of transportation cost, they agree that they must go far to fulfil their household needs, therefore, it increases their transportation cost.

4.4. Environmental Sustainability

Environmental sustainability variables of the housing outline these six major criteria.

1. Mixed Land Using

Mixed land in residential is the concept of combining residential, commercial, and education in one big zone or area. Mixed-use land is advised to be applied so that it reduces the cost for transportation. Based on the observation, all housing complex has incorporated their land for not only residency, but also infrastructure for entertainment such as green open spaces (parks and fields), kindergarten, and mosques. Especially in PH9, they offer shop houses next to the entrance gate, unlike PH10 and NBR. However, some residents open stalls which sell snacks and a few household needs.

2. Energy Efficiency and Water Efficiency
In terms of energy efficiency of the housing, since all the housing is the same type, the supply of the electricity comes from national electricity company that is flowed to each houses’ electricity meter. Every household buys the token to be able to turn on the electricity at home. Therefore, there is a standard cost for the electricity set by housing management. The cost of electricity is entirely is the responsibility of each household.

As for the criteria of water efficiency, the housing uses water pump that is used for each house, so each house has its own water pump. During certain times, this results in groundwater drought caused by each house is pumping water for themselves. Due to the proximity of the houses, it may worsen the groundwater drought.

3. Adequate Living Space

Most respondents agree that their house is not enough to accommodate all family members. This house may be adequate for residents who live alone or does not have kids. The residents of these housings are having the average of 1 to 2 kids; therefore, a bigger size of house may be needed. According to the Indonesia Statistical Bureau, the minimum floor area per person is the quotient of the needs of fresh air per person per hour in units of cubic meter divided by the minimum ceiling height. It is known that adults need 16-24 m³ of fresh air per hour while children need 8-12 m³ per hour. From these results, with a ceiling height of 2.5 m, the minimum floor area per person is 9.6 m² for adults and 4.8 m² for children.

4. Comfortable and Healthy Indoor Environment and Quality of Housing

The residents agree that their house may feel stuffy. The stuffiness is may be caused by the poor air flow inside the house. Although the house is bright during the day, there is not enough air circulation. It can also be caused by the abundant use of air conditioning and not enough windows opening. The placement of the furniture also adding the stuffiness factor. As for the criteria of quality of housing, the material used to construct the house is also responsible in making the house feel stuffy.

5. Using Ecological and Sustainable Material

The material used for constructing the house is brickworkblocks which is a mix of cement, water, and fly ash. The walls of the brickwork are strong and waterproof, but they also store heat. Therefore, building a house with this brick can give the impression of a hot and musty dwelling. Using red brick or lightweight brick is better.

6. Connected to Recycling Facilities and Not Polluting the Environment

In terms of recycling facilities, each housing does not have their own recycling facilities. The waste of each household is being collected possibly once every two days and transferred to a bigger dumping area. When being asked if the residents are willing to sort their own trash into three categories, they agree. However, without being facilitated with the trash bin or the appeal, the residents could not do much.

4.5. Social Sustainability

1. Accessibility

The three housing is located on the same main road; however, the public facilities might not be sufficient. There is one small clinic nearNBR, but it might be far from PH9. As for education facilities, there are several elementary schools located on the same road, but not high schools or vocational schools. As for worship facilities, there are many mosques available on the same road, however, there are no worship facilities for non-Moslem found in the area. Unfortunately, for safety facilities such as police station, there is not even one police station on the same road. As for recreation, such as green space, in every housing complex, there is at least one park or playground available to use.

2. Cultural and Heritage Conservation

One culture that is still alive among residents is community services in cleaning the neighbourhood. Based on the questionnaire answer, most of the residents are happy to join in the community service that is held every Sunday.

3. Diversified Housing Types
Since the type of housing is a complex, there is not much of variety in terms of housing types. The type of the house is landed house with similar designs and land, however, between each housing complex the design and size of the house are different. The houses that located on the corner of the rows are bigger house and land size, in addition to that it also more expensive.

4. Social Acceptability
The frequency of socializing and the pleasure of socializing with the neighbours, which most residents answered that they often and enjoy interacting with their neighbours. This shows the residents’ satisfaction of the neighbourhood and acceptance from the people of surrounding areas.

5. Environmental Awareness
There are community services on cleaning the neighbourhood every Sunday. There may not be any signs or posters telling the residents to recycle their trash, however, every house has been equipped with their own trash bin and every month they also pay for cleaning fee (for their trash to be taken to larger dumping area). Therefore, in terms of environmental consciousness, the residents are aware to keep their neighbourhood clean.

4.6. Sustainability and Affordability Improvement
The first thing that can be improved is the source of water for every house. Currently, each house is equipped with its own water pump which located at the backyard of the house. Residents often complain about not having water. The availability of water can run out because the source of water in area is not too much and there is no supply from rain due to a long drought. The one pump for each house system is not economical. As a solution, the developer could use the concept water system in an apartment, where they keep water in a tank underground which being pumped to each unit and the residents only must pay monthly to the management.

The next thing that can be improved according to the residents is the quality of the wall or a material problem. The material to construct the wall is not as strong as expected and it does not do a good job in containing noise and easily cracks. The material generates heat; therefore, a more environmental-friendly and non-heat-generating material is needed. According to [27] the alternative of sustainable materials for housing is using lightweight(fly ash) bricks as it is strong and sustainable.

Additionally, the residents agree that the house is too small. The average area of the house is 6 m x 4.5 m which is 27 m$^2$ with the average person living in the house is 3, thus each person is only getting a minimum 9 m$^2$ of area. Wazir (2017) took the optimum area is around 11.5 m$^2$ for each person since 10-13 m$^2$ is the optimum value of human space, therefore, creating a total of 34.5 m$^2$ for a house.

Another important thing that can be improved is the location of the housing, the residents feel the house is far from public facilities such as hospitals, malls, high schools, and police stations. Therefore, developers must consider implementing a mixed-use concept on the land.

4.7. Other Alternatives
One Million Housing Program does not only provide landed house, it also provides a vertical housing option in the capital city of Jakarta. The idea of creating a vertical living is due to limited land available and it might reduce the cost for transportation since the construction is putting forward the idea of mix-use. There are two types of vertical housing provided, which are low rate flats or apartments, both are subsidized. The development of subsidized apartments in urban areas aimed at middle-income and lower-income communities designed with centres of economic activities.

One thing that the government and developers should consider is to build a vertical living as part of One Million Housing Program in the Jakarta suburban area, including in Cileungsi. With a reasonable price, the vertical housings will surely be chosen as an option for settlement. Although a feasibility study must be done in advance.

The government should create regulations or standard operating procedure for One Million Housing Program so that they can closely manage the developers and contractors doing the houses. The developers and contractors might suppress the budget by substituting the supposed material with cheaper ones that may not have the same quality to gain more profit from the project. Routine
supervision must be implemented so mischievous things done by the developers and contractors can be minimized.

5. Conclusion
The houses that are being analysed are not entirely sustainable and affordable. These housings are only affordable for residents with an income more than IDR 4,000,000. There are several aspects of the house such as the accessibility, energy and water efficiency, quality of material, and house size that can be improved. Such improvements are implementing the concept of mixed-use zone in the complex, which can incorporate house-shop/store, incorporating vertical housing water system and using sustainable materials especially using red bricks or lightweight brick instead of brickwork blocks. Additionally, the government and developers should consider building subsidized apartment to minimize the cost of transport since most apartments nowadays have implemented the concept of mixed-use.

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