Resiliency and affordability of housing design, Kampong Cieunteung-Bale Endah in Bandung Regency as a case study

Allis Nurdini*, Wanda Yovita, Patriot Negri
Housing and Settlement Research Group, School of Architecture, Planning and Policy Development, Bandung Institute of Technology

*Corresponding e-mail: allis@ar.itb.ac.id

Abstract. Recently the discussion about resiliency and housing design has been fast developed, including design for housing on riverfront as marginal area that usually occupied by low income people. The low income people generally will be the worst affected community in flood disaster situation, because of their un-affordability to achieve quality housing design. In other side, the funding support capacity especially from the local government is limited, so that the resilient environment also need to be supported by the community itself. In this context, the study about low income people’s affordability to achieve resilient housing design is essential. This study was conducted to identify two important points: the design choice and the affordability level of resilient housing from the community viewpoints. Kampong Cieunteung, in Bale Endah Area, Bandung Regency is chosen as a case study, because this area annually experience severe flood from overflow of the Citarum River branch. In preliminary research phase, approximately 60% of the Kampong Cieunteung’s resident need to stay and become indication that the community need resilient housing design to accommodate their live hood. The next phase, the contingent valuation method was implemented to gain resilient design choice and affordability perspective from the community. It is concluded that the community have ability to choose the resilient housing design based on their aspiration and based on their ability to pay. The result indicates that resilient housing design should have character of optional, module co-operational, and incremental to be afforded by the low income people.

Keywords: resiliency, affordability, housing design, kampong

1. Introduction
Resilience is the ability of a social or ecological system to respond a problem while maintaining the basic structure and ability to adapt the distractions and changes. One of the ideas emphasized in the principle of resilience is the need of urban or settlement systems, especially for low-income people who are often exposed to natural disasters, to increase their capacity to deal with the impact of the disaster (ARUP [1], Folke [2], Moench [3]). Resilience settlements means housing settlements that have the capacity to maintain their basic functions and structures so that communities who live and work in site, in particular low-income communities affected by disasters, can survive and adapt in the situation of distractions and changes, including climate change. From the resiliency agenda perspective, the low income people will become the important actor.

The plan and design concept of resilient settlement has grown widely today including the idea of adaptive settlements in locations that are often hit by floods like riverfront kampong. The low income people generally will be the worst affected community in flood disaster situation, because of their un-affordability to achieve quality housing design. In other side, the funding support capacity especially
from the local government is limited, so that the resilient environment also need to be supported by the community itself. In this context, the study about low income people’s affordability to achieve resilient housing design is essential.

In general, the idea of affordability related to the ability to pay of requested product by the user. It is still arguable that paying 30 percent of income an appropriate threshold for defining affordability, especially for the low income people (Vale, et. als, [4]). The rational way to understand affordability of specific product, especially built environment product, is directly measure the user preferences and their willingness to pay.

As the case study, Kampong Cieunteung in District of Bale Endah, Bandung Regency was selected. This location is in the riverfront area of the Citarum River. Several settlements or kampons have been growing for decades along the Citarum River and are dependent on this river for agricultural activities including Kampong Cieunteung. Along with the decreasing of rice field in Bale Endah and changing with the dense building around Bale Endah, this kampong experience annual flood and increasing intensity since 2000. This study was conducted to identify two important points: the design choice and the affordability level of resilient housing from the community viewpoints.

2. Methods

2.1. The Case Study

One of the early generation kampong that annually experience the worst flood is Kampong Cieunteung, located in District Bale Endah. This kampong is selected as the location of case study. Rain that fell within 10 to 30 minutes was able to cause flooding in this kampong. Flood height up to 30 cm is a common thing for the residents. The worst condition during the last decade is the flood that reaches 2 meters and could not recede for a week in 2014. The worst location in this village is in Block 20 (called as Rukun Warga/RW 20) (Figure 1).

Kampong Cieunteung RW 20 consists of 4 sub block (called as Rukun Tetangga/RT) or 350 families and is always affected by the worst floods since 2000. Based on preliminary research data (the research was conducted from 2014 until 2016), the majority of Kampong Cieunteung RW 20 residents refused to be relocated because they have been living in the area for decades (60%). In general, people are aware that their current settlement is a potential flood area. The residents generally argue that the floods that have been increasingly frequent in recent years caused by the Citarum River silting. In Figure 1, the condition of major houses in Kampong Cieunteung especially RW 20 has been in poor condition due to flood and some are not occupied by the owner. From the interview question, the majority of residents in RW 20 are land owners or get inheritance land from their parents. The majority of residents have worked at services or informal sector like as employees of textile factories located around Bale Endah, and there is no one become farmer as a main profession.

For spatial improvements, the Bandung Regency Government implement building control such as demolish a number of buildings attached to the Citarum River area and in collaboration with the Board of River Territory (Balai Besar Wilayah Sungai/BBWS) to handle the siltation. In 2014, land acquisition from BBWS has begun for the construction of polder or river water retention ponds in Kampong Cieunteung which is at the lowest contour land and directly adjacent to the Citarum River. The majority of people whose land and houses are not affected by this polder acquisition area are the respondents for further study. In reality, they are still affected by floods until nowadays, choose to stay in the kampong and have to survive on site with self-improvement quality. The residents’ housing option to stay at this location is further studied with the Contingent Valuation Method approach.
2.2. Contingent Valuation Method as a Study Approach

Contingent valuation method (CVM) is a valuation method of a product based on user preferences. This method is used to assess commodities that do not have an approximate market price. The user or community is perceived as having aspirations or preference for the commodity and transforming it to value. An example of this method application is the assessment of goods such as the beauty of a natural environment or the quality of the built environment. This method is widely used in the assessment of built environment quality because of the difficulty of determining the value of its products through market mechanisms (Tresnadi [5], Edwin Chan [6], and Timmermans [7]).

CVM generally uses questionnaires and interview respondents directly about their willingness to pay (WTP) about specific built environment design or product. In this case study, the value of housing that adaptive to flood condition is highly dependent on the respondent’s aspiration. In general, the CVM method consists of three stages: the identification of design options for changes in the quality of occupancy, assessing the economic ability of respondents to know the affordability level and the socioeconomic information of respondents. With CVM method, the views of the residents as respondents are more sought out to accept a specific housing design, as well as reduce the value of compensation (material/goods) from outsiders, to improve the quality of their living environment with their own participation.

2.3. The Research Phases

The data collected from the residents consisted of social, economic, existing housing condition, assessment of current occupancy condition and aspiration to adaptive flood housing design model. Fifty two (52) respondents were interviewed in Kampong Cieunteung.

The question technique used is bidding choice, which is in first phase, the respondent was asked to choose the preference of housing model according to his wish and in the second phase, the respondent was asked to choose the housing model according to his ability to pay (Manalang [8], Christine [9]). When some adaptive flood housing model was offered, respondents were asked for their preference and reason for the selection of the model. At the initial offer, the respondent did not know the value or the cost of the model, so it was expected to collect the ultimate preference data from the respondent without being affected by his or her personal ability. Then, the question continues with the respondent...
was offered or informed the price (construction / production) of each housing model. At this stage, respondents would re-select the housing model based on the price and knowledge they know from the initial question.

3. Analysis and Discussion

This study offers a flood adaptive housing design in Kampong Cieunteung that is affected by flooding. The latest conditions, the remaining floods in the form of hardened mud have damaged the houses of the residents as high as 2m from the height of the road and became the basis for the development of adaptive flood design. The two main housing design types offered. The first type, the conventional two-story house design with the ground floor is used for public activities (called as the 1st type). The second one, the amphibious house designs that can float up during floods. The amphibious house is divided into two variants: the design is equipped with exterior and interior walls (called as the 2nd type design) and a wall-less design that only columns, beams, and roofs structure (called as the 3rd type design). The second variants is offered to reduce development costs and the community can develop their own home layouts.

It is assumed that both types need land consolidation as a pre-requisites to rearrange total area and infrastructure. The main differences principles between the conventional house and the amphibious house is that the amphibious house need a co-operational and modular housing structure to optimize the buoyant (amphibious) foundation, utilities and basic infrastructure performance. The three alternatives of housing design model can be seen in Figure 2.

The size of the building and the area of land for the building is assumed to be standardize in accordance with the average residential unit in this Cieunteung Kampong. The 1st type is a conventional house building with two-story in concrete construction. The ground floor can be used for flexible needs. The land area is approximately 36m2 and the building area is 22m2 for each household. Estimated price of this building is Rp. 2,500,000/m2.

The 2nd type is a house that can float with steel construction, equipped with the wall. Total building are is about 21 m2. The house will be lifted if water goes through the drainage due to the pontoon deck that will make the house become floating. The use of steel in the column of buildings together with the foundation to make the house can rise and fall with the roll system on the sides of the floor plate of the building. This model is estimated to cost around Rp. 4,000,000- Rp. 5,000,000/m2. The 3rd type is a floating house with steel construction but not equipped by the walls. The walls or home lay out could be incrementally modified by the owner. Similar with the 2nd type, this type uses a pontoon deck that will make the building floating. It is estimated to cost around Rp. 2,500,000/m2.

At the first phase, respondents were given all three options without being given pricing information. From 52 respondents, 50% of respondents chose the 1st type because the building is considered more secure, more stable, the ground floor that can be used, and easier maintenance. While the other 46% of respondents chose the 2nd type because it more comfortable, flexible, practical, and attractive design. While the 3rd type is the least selected type (4%) because the respondent considers the building is incomplete as a house.

At the next phase, the respondent is given information about the estimated construction price of the three types offered, and is given the opportunity to change the choice. There was a considerable change in selection of respondents who initially chose the 2nd type to switch to the 1st type (become 66%) for reasons of the price was too expensive. Eight percent of respondents switched to the 3rd type due to cheaper building costs (become 12%). Therefore, the remaining was 22% of respondents who still choose the 2nd type. Illustration is in Figure 3.
Figure 2. Alternatives model of flood adaptive housing design
(Source: Researcher analysis)
This shift of preference is interesting to be analysed, because it is influenced by the land tenure, income levels and their knowledge of home building systems. The majority of the inhabitants of Kampung Cieunteng have occupied the land for 31-50 years (48%) make them difficult to leave long-established’s social and economic networks. This condition could be seen also at the income level that the low income residents is major (90%) which their income under 2.5 million rupiah per month. It make them more difficult to build a life in a new location. The design choices are closely related to the resident motives of housing maintaining and their knowledge to improve the dwelling to be adaptive to floods. This data can be seen on Table 1.

Table 1. Percentage of respondent’s year of occupancy, income, and willingness to maintain the house

| Year of occupancy | Percentage |
|-------------------|------------|
| < 10 years        | 6%         |
| 10-30 years       | 29%        |
| 31-50 years       | 48%        |
| > 50 years        | 17%        |

| Income level                  | Percentage |
|-------------------------------|------------|
| < Rp. 2,500,000               | 90%        |
| Rp. 2,500,000 - Rp. 5,000,000 | 4%         |
| Uncertain                     | 6%         |

| Willingness to maintain the house | Percentage |
|-----------------------------------|------------|
| Low                               | 21%        |
| Moderate                          | 59%        |
| High                              | 16%        |
| Very high                         | 8%         |

According to correspondences analysis, residents who categorized in informal job sector, the new resident (less than 10 years), the lowest income (like labourer, driver, or unemployment) and the lower education level tend to choose conventional design (the 1st type). The 1st type also reflect the common gradual/incremental housing. The 2nd type or “the complete unconventional type” was
chosen by the respondent with more stable jobs, more length of stay (30-39 years), more stable income and more higher education level. The 3rd type or “the gradual unconventional type” was chosen by the entrepreneur job, the youth resident (about 20-29 years length of stay), the highest income, and relatively could be accepted by every education level of residents. This analysis can be seen on Table 2. It could be identified that the lower the income and the lower the education or knowledge about housing construction (reflected both on education level and length of stay in site), correspondence to the higher need of incremental housing design.

Table 2. Correspondence analysis

| Correspondence analysis between job type and housing choice | Correspondence analysis between length of stay and housing choice | Correspondence analysis between income per month and housing choice | Correspondence analysis between education level and housing choice |
|------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|
| *Manager*                                                  | *10 years*                                                    | *Rp 2,500,000*                                               | *Graduate*                                                  |
| *Engineer*                                                 | *20-39 years*                                                 | *Rp 3,000,000*                                               | *Student high school*                                        |
| *Teacher*                                                  | *30-39 years*                                                 | *Rp 3,500,000*                                               | *Secondary school*                                          |
| *Government and enterprise*                                | *40-49 years*                                                 | *Rp 4,000,000*                                               | *Junior high school*                                        |
| *Private*                                                  | *50 years*                                                    | *Rp 5,000,000*                                               | *Elementary school*                                         |
| *Agriculture and enterprise*                               | *60 years*                                                    | *Rp 6,000,000*                                               |                                                              |
| *Housing and transportation*                               |                                                              |                                                              |                                                              |

(Source: Researcher analysis)

4. Conclusion

From this study, it is concluded about two important aspects: the community choice for resilient housing design and the affordability level of community for resilient housing design. Actually, the community have ability to choose the resilient housing design based on their aspiration and based on their ability to pay.

The community choices are determined by land ownership, income levels and knowledge of housing construction. Adaptive flood designs with amphibian systems (functioning both in normal and flood condition) are major selected when the residents evaluate the design as cost equivalent to their conventional construction. When the information of cost construction is issued, then the residents are divided into two options: the conventional two story house or the amphibious design without walls and free lay out in order to reduce the cost. This result indicates that there are actually open opportunities for various adaptive flood housing design schemes to be implemented involving partial funding participation from the communities themselves.

It is also concluded that the affordability level of community for resilient housing design is equal to their conventional cost construction of the existing house. To reduce the cost and to achieve affordability resilient housing for low income people, the design should consider some scheme like modularity of housing lay-out and land parcel, co-operative construction and maintenance, and also option for incremental/gradual house development.

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