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Housing Adjustment Phenomena in the Coastal Area of Muara Angke, North Jakarta, Indonesia

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ABSTRACT

In the early 1970s, the Government of Jakarta developed Muara Angke, a delta located at the north coast of the city as a new settlement to accommodate housing facilities for the local fishery community members. Muara Angke was an area vulnerable to flooding. During the year 1977 to 2012, ten significant floods had occurred at Muara Angke, causing damages to people's houses and degrading the quality of their lives. Consequently, from time to time the residents had to adjust their houses and surrounding environments to overcome the critical conditions. The objective of this study was to investigate the housing adjustments made by the residents in response to the threat of flood.This research was carried out using interview and field observation methods. Four housing blocks in Muara Angke, namely block H, L, K and Bermis were selected as the objects of study.120 households were purposefully selected as respondents, to represent each housing block or sub-population proportionately. The research findings show that the flood incidents had forced the residents to 1) raise the elevation of the ground floor, to avoid water intrusion into their houses, and hence to prevent any damage to the exterior as well as the interior of the house. 2) heighten the ceiling clearance, to anticipate the effect of land subsidence for many years to come. 3) build additional floor levels as family refuge area in case a flood incident occurred. Also, depending on their financial ability, the residents increase the level of privacy and improve the physical standard of their living space, by 1) expanding floor area, 2) improving spatial configuration, and 3) adding income generating unit such as rental rooms and small-shop.
KEYWORDS: housing adjustment phenomena, coastal area, Muara Angke

INTRODUCTION

The coastal flood is a potential problem for Jakarta, the capital city of Indonesia [14]. It occurs due to several factors including land subsidence, sea level rise, tidal waves, storm surges, higher rainfall or water runoff from the hinterland, and sediment deposition on the river bed and estuaries. The rate of land subsidence varied between 3 to 15 cm/year [1]. Meanwhile, sea level rise average was 1.45cm/year during the years of 2005 to 2011 [6].

Muara Angke, a delta locatedat the north coast of Jakarta, is surrounded by Asin River in the east, Adem River in the west, and Jakarta Bay in the north. Initially, this wetland was dominated by mangroves. In the early 1970s,the Government of Jakarta decided to develop Muara Angke as a new settlement to accommodate the local fishery community members, including fishermen, boat owners, crews, and traders [13]. Since then Muara Angke had grown rapidly, covering residential areas, seaport, fish market, seafood center, cold storages, and salted fish production facilities. The concentration of human population and expansion of socio-economic activities had aggravated the land subsidence and increase the vulnerability of the delta, due to excessive groundwater extraction, heavy building structure load, and extensive infrastructure development [12]. Not surprisingly, flood incidents repeatedly struck Muara Angke in the year1977, 1984, 1985, 1994, 1996, 1999, 2002, 2007, 2011, and 2012, with water level ranging from 30 cm to 200 cm.

To mitigate the coastal flood, the government of Jakarta since the year 1984 to 1999 had subsequently built a polder system, two retention ponds, two pump stations each fortified by four pumps, and a dike system. However, despite such technical solutions, flood incidents still occurred occasionally but no longer on a massive scale.

Flood incidents had caused disruption to people's daily activity, degraded their quality of life, and instigated significant impacts on property, infrastructure, and well-being of the people (stress, anxiety, trauma) [8]. When the rainy season comes, people start to worry about flood incidents which might occur and cause

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damages to their belongings (furniture, electronic goods, glassware, and clothes) [5]. In such critical situation, people are forced to cope with all pressures or threats to achieve a minimum standard of safety and comfort [7].

The critical situation eventually triggers housing stress that demands immediate actions of the residents [2],to bring back housing conditions into new equilibrium [11] that meet their specific needs and cultural norms [4, 10]. In other words, the residents had to make necessary adjustments in order to bring their housing condition back into conformity with family's needs, expectations and aspirations [9]. All in all, housing adjustment is a strategy to bridge the gaps between actual conditions and desired conditions. Unfortunately, not all individuals or groups of individuals are able to make adjustment according to their desires for many reasons, such as psychological barriers, organizational weakness, limitation of resources, market distortions, racial and gender discriminations [3].

The objective of this study is to investigate the housing adjustments made by the residents of Muara Angke, in response to the threat of flood since 1977 to 2017. This study will identify housing adjustment strategies adopted by the residents, and transformation of the physical elements of their houses. As a ground-breaking study, it will focus on physical aspects of housing adjustment, rather than behavioural and cultural aspects of the residents. The impacts of physical aspects on behavioural and cultural aspects, vice versa, will be scrutinized in the next cycle of study. The results of this study will provide accurate empirical data needed by the government and other stakeholders involved in housing development along the north coastal area of Java island.

MATERIALS AND METHODS

This research is carried out using quantitative and qualitative approaches. 120 households were purposefully selected as respondents, to represent each housing block or sub-population respectively. Quantitative method is used to measure and analyze the percentage of physical changes made to the houses. Qualitative method is used to describe and explain the motives and reasons behind the physical changes of the houses. Research data were collected through field observation, building measurement, and direct interview with respondents. Four housing blocks are purposefully selected as objects of study, namely block H, L, K and Bermis in Muara Angke housing estate (Figure 1).

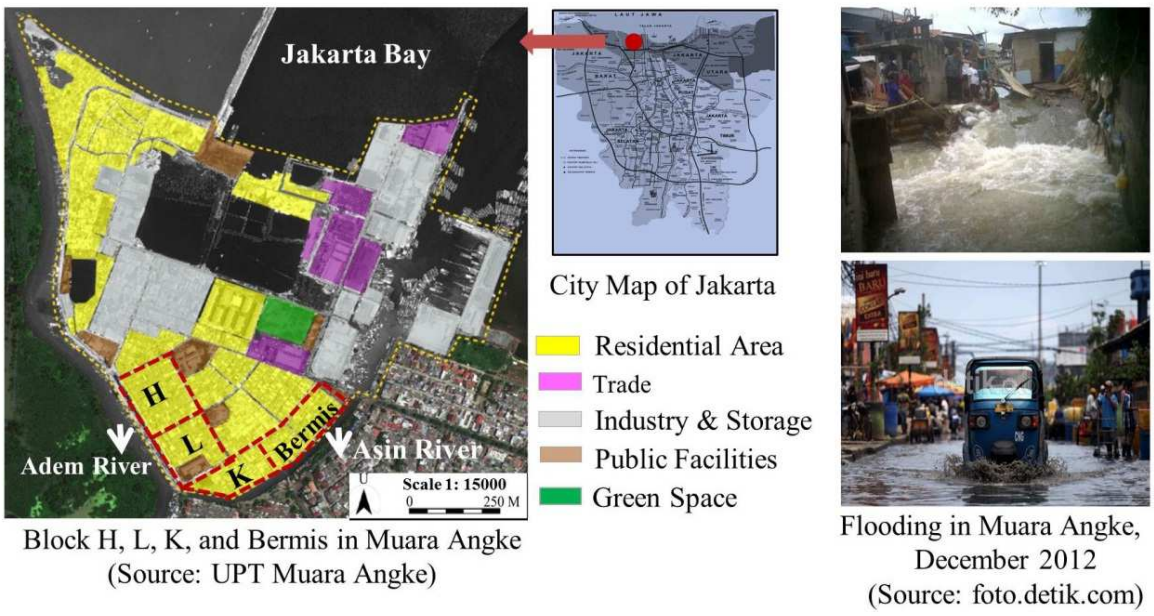

Figure 1. Block H, L, K and Bermis in Muara Angke, North Jakarta

The respondent comprised of 37 households (31.6%) from Block H, 24 (20%) from Block L, 28 (23.3%) from Block K, and 31 (25%) from Block Bermis. The numbers of respondent for each block are determined proportionately according to the total number of housing units in each block (220 in Block H, 140 in Block L, 164 in Block K, and 184 in Block Bermis). They are selected based on the following sampling criteria: 1)

the respondents have occupied their house for more than ten years, and 2) the respondents have renovated their houses at least within the last two years.

Originally houses in block H, L, K, and Bermis were all single-story buildings, but each block had its type in term of architectural design. House in Block H had 75 sqm plot with 40 sqm floor area, Block L had 62.5 sqm plot with 30 sqm floor area, Block K had 50 sqm plot with 24 sqm floor area, and Block Bermis had 60 sqm plot with 21 sqm floor area. Each house had front-yard and back-yard, entrance porch, living room, one or two bedrooms, kitchen, small bathroom, with building coverage ranged from 45% to 53% (Figure 2). Building materials used were: stucco and terrazzo for the floor, plastered brick for the wall (exposed brick for block K),and corrugated zinc sheet for the roof. The house had minimum standards of the space requirement to live in, so that the price of the house can be reached by fishery community members.

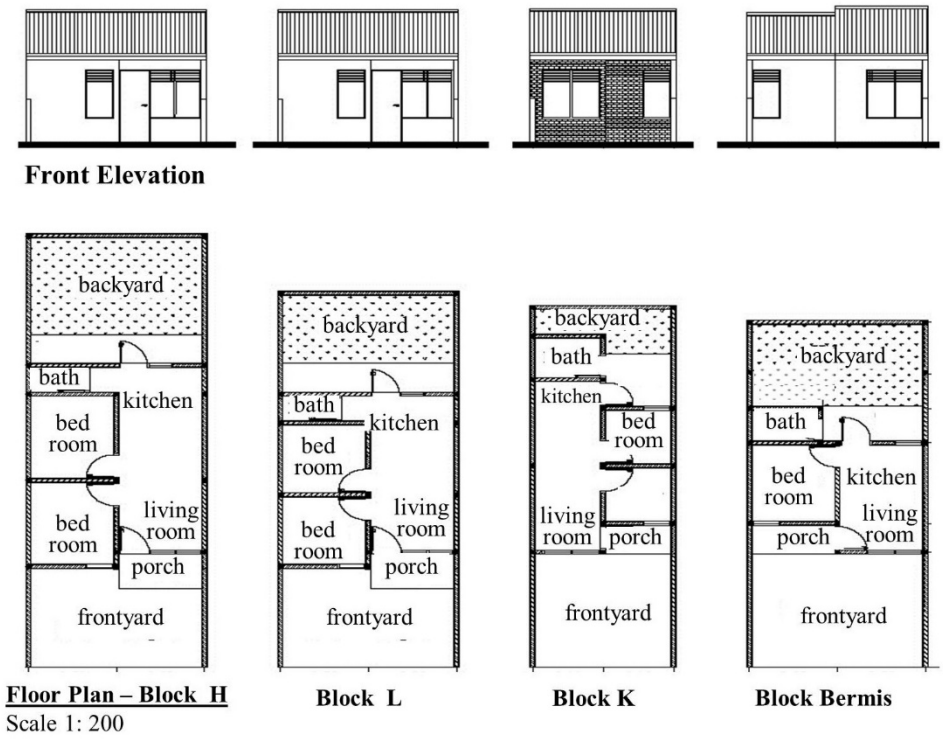

Figure 2. The original type of houses in Block H, L, K, and Bermis

RESULTS AND DISCUSSIONS

The analysis shows that family income level is the most influential factor that determines the ability of the residents to adjust their houses. Families with an income under 2.25 million rupiahs are usually facing financial difficulties in improving their houses (15.8%). Hence their houses belong to the category of "most vulnerable to flood."Family with income between 2.25 to 5.25 million rupiahs (64.2%) generally can afford to adjust their house up to the minimum standard hence their houses belong to the category of "safe from flood."Those who have income over 5.25 million rupiahs (20%) can afford to adjust their house up to the maximum standard hence their houses belong to the category "free from flood", while also to improve the safety and comfort of their living milieu.

Educational level of the head of household also plays an influential role in the ability of the residents to adjust their houses. High school and baccalaureate graduates (45%) were more knowledgeable and proficient in managing and executing housing adjustment plans than elementary and junior high school graduates (55%). As far as the cultural backgrounds are concerned, Buginese (32.5%) and Javanese (30%) belong to the dominant ethnic groups, but the analysis shows that socio-cultural attributes have no significant influence on the ability of the residents to adjust their houses.

Based on its motives, housing adjustment phenomena in Muara Angke can be differentiated into two interrelated categories, namely 1) housing adjustment in response to the thread of flood incidents, and 2) housing adjustment to increase privacy and comfort.

Housing Adjustment in Response to the Thread of Flood Incidents

The analysis shows that the thread of flood incidents had forced the residents of Muara Angke to 1) raise the elevation of the ground floor, to avoid water intrusion into their houses, and hence to prevent any damage to the exterior as well as the interior of the house. 2) heighten the ceiling clearance, to anticipate the effect of land subsidence for many years to come. and 3) build additional floor levels as family refuge area in case that flood incident occurred (Figure 3 and Table 1).

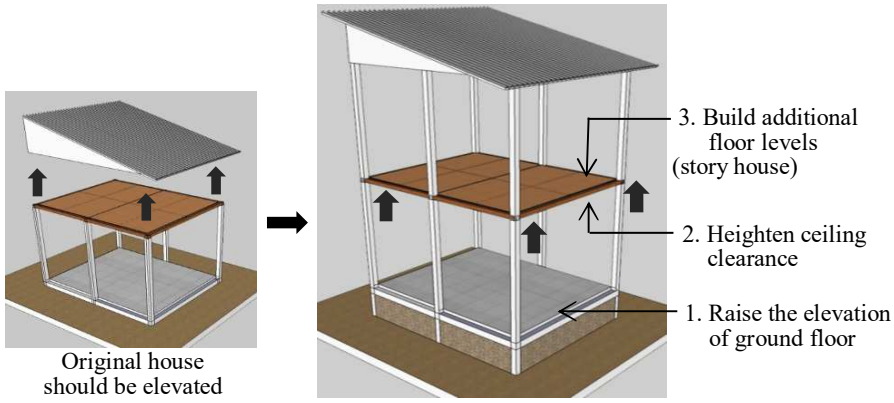

Figure 3. Three responses to the thread of flood incidents

Table 1. Housing adjustment in response to the thread of flood incidents

Housing Adjustment Patterns	Housing Blocks					Total Units	
	Block H	Block L	Block K	Block Bermis	Total	Total (n)	Percentage of 120 units
1) Raise the elevation of the ground floor							
None (< 0 cm, under street level)	20.8%	25.0%	25.0%	29.2%	100.0%	24	20.0%
1-35 cm (above street level)	42.9%	16.7%	23.8%	16.7%	100.0%	42	35.0%
36-70 cm (above street level)	22.6%	25.8%	9.7%	41.9%	100.0%	31	25.8%
>70 cm (above street level)	30.4%	13.0%	39.1%	17.4%	100.0%	23	19.2%
2) Heighten the ceiling clearance							
≤280 cm	32.5%	17.5%	22.5%	27.5%	100.0%	40	33.3%
281-370 cm	28.8%	26.9%	25.0%	19.2%	100.0%	52	43.3%
371-460 cm	32.1%	10.7%	21.4%	35.7%	100.0%	28	23.3%
3) Build additional floor levels							
None (One-story house)	31.1%	20.0%	26.7%	22.2%	100.0%	45	37.5%
One (Two-story house)	32.8%	19.4%	22.4%	25.4%	100.0%	67	55.8%
Two (Three-story house)	14.3%	28.6%	14.3%	42.9%	100.0%	7	5.8%
Three (Four-story house)	0.0%	0.0%	0.0%	100.0%	100.0%	1	0.8%

1) Raise the elevation of the ground floor

From the early 1970s to 2016, the residents of Muara Angke had raised the ground floor elevation of their houses up to five times, in response to the raises of street-level elevation made consecutively by the government in the year 1985, 1995, 2011, and 2014.

The latest flood incident occurred in December 2012 with the highest water level of 30 cm. Based on this water level figure, it can be predicted that those houses with the ground floor elevation below street level (20%) are"highly vulnerable to flood."Those houses with the ground floor elevation 1-35 cm above street level (35%) is"vulnerable to flood." Those houses with the ground floor elevation 36-70 cm above street level (25.8%) is considered "safe from the flood."And those houses with the ground floor elevation70 cm above street-level (19.2%) are considered as "the safest from the flood" (Figure 4). It should be noted that in general, the ground floor elevation of houses in Block Bermis is higher than houses in other blocks.

For easy maintenance and esthetical reasons, the residents had also replaced the old ground floor materials (stucco or terrazzo) with ceramic tiles (82.5%) and granite tiles (5%). They also provided concrete stairs as regular access from street elevation to the ground floor of their houses, and a concrete ramp in the middle to provide easy access for a motorcycle to enter their houses.

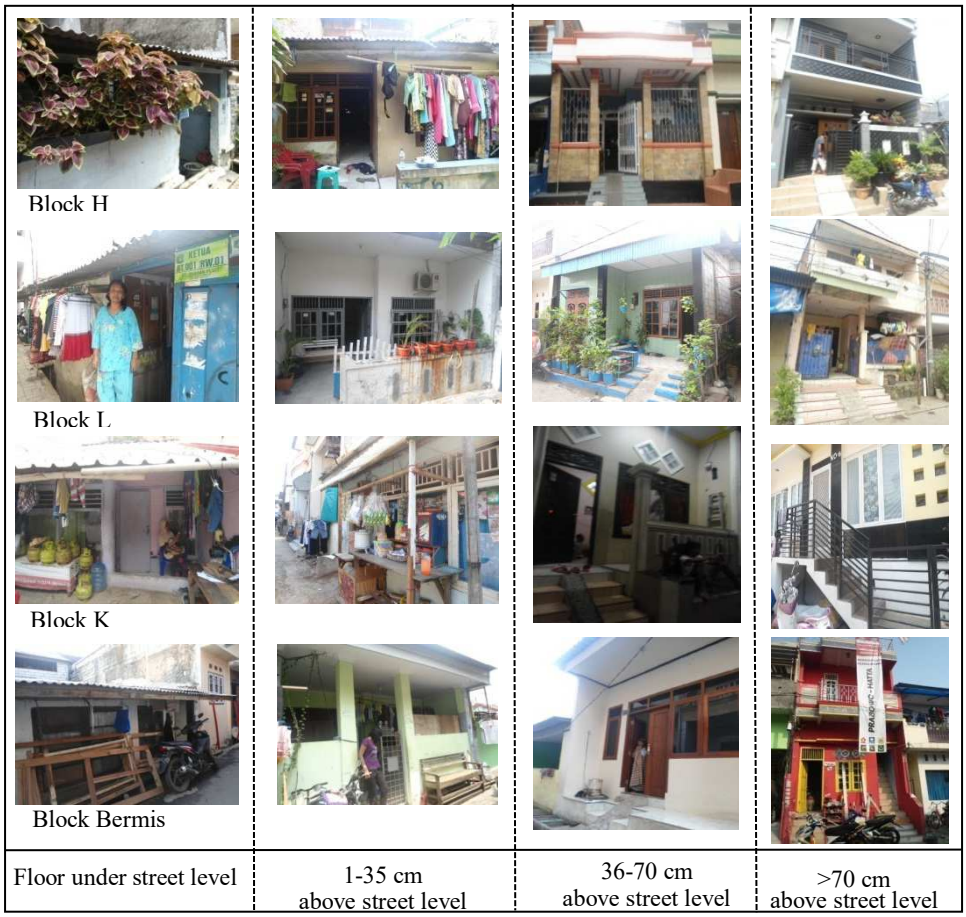

Figure 4. The elevation of ground floor: from "very vulnerable to flood" to "the safest from flood"

2) Heighten the ceiling clearance

To anticipate further land subsidence and street-level heightening project implemented by the government every 5 to 10 years interval, the residents heightened the ceiling clearance of their houses so that there remained spare clearance when they had to raise ground floor elevation of their houses in the next years to come. Data recorded during the field observation show conditions of ceiling clearance as follows (Table 1): low ceiling clearance, less than 280 cm (33.3%); high ceiling clearance between 281 to 370 cm (43.3%); and very high ceiling clearance between 371 cm to 460 cm (23.3%). It should be noted that in general, the ceiling clearance of houses in Block Bermis is higher than houses in other blocks.

Figure 5 shows houses with low ceiling clearance (less than 280 cm) compared to houses with high (281 to 370 cm) and very high ceiling clearance (more than 371to 460 cm). The residents can take benefits from higher ceiling clearance regarding thermal comfort, air circulation, and spatial volume.

Figure 5. The ceiling conditions: from "low clearance" to "very high clearance"

3) Build additional floor level

The residents had learned some lessons from previous flood incidents that occurred in Muara Angke. They are very reluctant to evacuate to refuge places and abandon their houses because they are concerned with the safety of their property and belongings. The best solution for them is to build additional floor levels so that when the flood incident occurred, they only had to evacuate to the upper floors and wait until the flood ceased. Although the residents just need one additional floor level as a refuge place, but in realities depend on their economic level, some of the residents can afford to build up to 3 other floor levels.

Table 1 shows that 37.5% of the residents cannot afford to build any additional floor level, 55.8% can afford to make one additional floor level, 5.8% can afford to build two other floor levels, and only 0.8% can afford to build three other floor levels. The distribution of other floor levels in four blocks can be seen in Figure 6.

The residents tended to use low-cost and light-weight materials for upper flooring and roofing because such materials can be easily dismantled and re-assembled whenever needed.Preferred materials for upper flooring are thick plywood (38.3%), concrete (18.3%), and steel decking (4.2%), while preferred materials for roofing are corrugated cement board (82.5%), roof tiles (12.5%), and corrugated zinc sheet (2.5%).

Figure 6. Distribution of additional floor levels: from "none" to "three."

Housing Adjustment to Increase Privacy and Comfort

The analysis also shows that depending on their financial ability, the residents were eager to increase the level of privacy and comfort of their living space, by 1) expanding floor area, 2) improving spatial configuration, and 3) adding income generating unit such as rental room and small-shop (Table 2).

Table 2. Housing adjustment to increase the level of privacy and comfort

Housing Adjustment Patterns	Housing Blocks					Total Units	
	Block H	Block L	Block K	Block Bermis	Total	Total (n)	Percentage of 120 units
a) Expanding floor area							
≤ 80 m²	26.7%	20.0%	35.6%	17.8%	100.0%	45	37.5%
81-140 m²	26.8%	19.5%	22.0%	31.7%	100.0%	41	34.2%
141-200 m²	56.5%	17.4%	8.7%	17.4%	100.0%	23	19.2%
> 200 m²	9.1%	27.3%	9.1%	54.5%	100.0%	11	9.2%
c) Improving spatial configuration							
Parallel configuration	27.3%	25.5%	23.6%	23.6%	100.0%	55	45.8%
Un-parallel configuration	33.8%	15.4%	23.1%	27.7%	100.0%	65	54.2%
b) Adding income generating unit							
With income generating	25.8%	22.6%	27.4%	24.2%	100.0%	62	51.7%
Without income generating	36.2%	17.2%	19.0%	27.6%	100.0%	58	48.3%

1) Expanding floor areas

The residents expanded floor areas of their houses to provide ample and convenient spaces for their family member activities, including the addition of new bedrooms, family room, kitchen and bathrooms. Extra spaces are particularly needed when their children had grown up and other extended family members joined in into the house.

Data recorded during the field observation show conditions of floor areas as follows (Table 2): 37.5% of houses have floor area less than 80 sqm; 34.2% have between 81 to 140 sqm; 19.2% have between 141 to 200 sqm; and 9.2% have more than 200 sqm. It should be noted that houses in Block Bermis on average have bigger floor area compared to houses in other blocks, indicating that the residents of Block Bermis relatively belong to higher income group.

The expansion of floor areas of the house indeed can improve the level of privacy and comfort, but unfortunately at the expense of the loss of green open space, particularly the disappearance of front-yards and back-yards.

2) Improving spatial configuration

Originally parallel spatial arrangement of the houses in Muara Angke did not consider the privacy of their residents. Living and dining activities were accommodated in an open-layout space, adjacent to bedrooms on the left or right side, and service area on the back side. Any guest who comes to visit the family cannot avoid witnessing all kind of happenings in that house. To improve the level of privacy of their space, the residents reorganize their internal living space by making an un-parallel spatial configuration so that more private activities can be concealed from outsiders (Figure 7). More than half of the respondents (54.2%) had succeeded to improve the level of privacy of their houses.

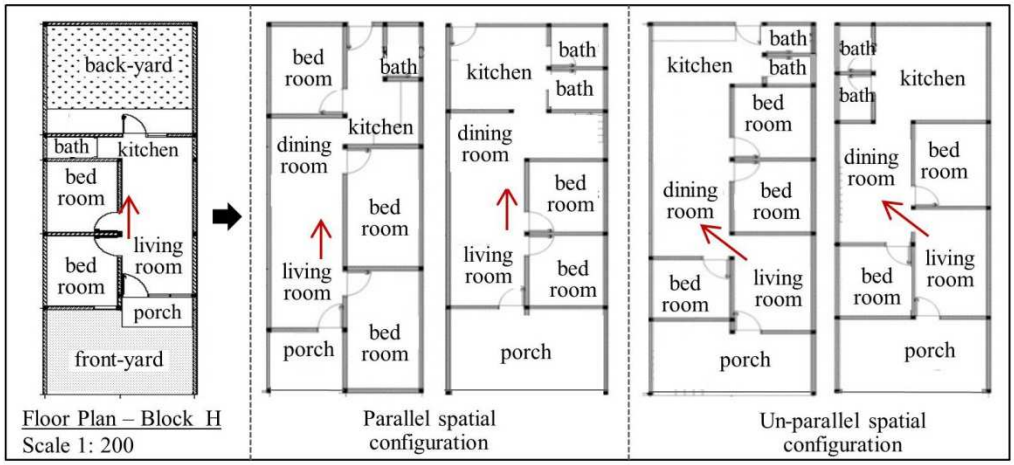

Figure 7. Improvement of spatial configuration

3) Adding income generating unit

In conjunction with the fast-growing commercial and industrial activities in the north-coast of Jakarta during the last few decades, Muara Angke has become an alternative housing accommodation for low-wage migrant workers who find their jobs in the respective areas. The demand for rental bedrooms had increased considerably so that the residents with the financial ability (51.7%) take this market opportunity by adding income generating unit such as rented bedrooms and small-shops while they adjusted their houses (Figure 8). The income generating units provide financial security to the heads of household who already entered the retirement age but still have to support the life of their extended families, 84.6% of the heads of household are over 50 years old.

Although this income generating units contributed significantly to the financial sources of the family, however, some of the heads of household complained that the existence of strangers in their houses to a certain degree tend to reduce their level of privacy and security.

Figure 8. Addition of income generating unit: small shop and rental bedrooms

CONCLUSION

Housing adjustment phenomena in Muara Angke characteristically exemplify how the residents who resided in coastal areas vulnerable to flooding had to constantly cope with various environmental challenges and bear the incessant financial burden, in order to stay put with their only houses. The worse housing adjustment phenomena might also be encountered in other settlements along the north coast of Java, such as Tambak Lorok in the city of Semarang. Without adequate financial support, the residents are unable to make the necessary adjustment to their houses and accordingly failed to cope with various environmental challenges. Eventually, they will be displaced to other worst locations.

Residents with a higher level of income and education tend to succeed in overcoming various environmental challenges, and increasing level of privacy and comfort of their living spaces. They also tend to have a strong attachment to their houses, community, and environment. By adding income generating units such as small-shop and rental rooms, the heads of household who are already over 50 years old managed to establish a small business and gain some passive income to support their family life.

Muara Angke may not be an ideal settlement to live, but for a certain period the residents had already invested their money, energy, emotion, and memory for the betterment of their houses and surroundings. Now, that they have no other choice than to stay put and continue their livelihood, and hoping for the best to come. Involvement of the government and other stakeholders in public awareness (flood mitigation, environmental health and sustainability, community participation) and financial facilities (banking services, co-op) is a requisite if Muara Angke deserves to have a better future.

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