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Planning of urban slum settlement in adaptation to landslide disaster

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Abstract. The need for dwellings in urban areas that are increasing and not parallel by the availability of land has caused the lower middle economic class to ignore the importance of a livable environment for settlement, which also means to avoid disaster risk. The growth of settlements with these reasons not only endangers the residents, but also causing the emerge a slum settlement. The form of settlement proposed in this study is through spatial and non-spatial planning with the mitigation of landslide disasters, where landslides have become part of the Kampung Muara settlement area for a long time. Planning is carried out through internal relocation with the aim that the economic and social systems that have been formed in the community do not experience a decline in quality and to provide a livable environment also living space that are formed into a master plan.

1. Introduction

One form of the urban slum settlement can be seen in Kampung Muara located in Kelurahan Pasirjaya, which distance is about two kilometers from the center of Bogor City, Kecamatan Bogor Tengah. At first glance it can be clearly seen that the population density and buildings in the location are in the category of 'very high', accompanied by the irregularities of the buildings in cause of the landslide-prone environments brings Kampung Muara to be set as one of the slum settlements and become one of the priority settlement area to be handled in the area of Bogor City [1] along with the other criteria for ideal settlements that the low income class cannot afford [2], [3], makes them unable to compete to form and build their own settlement environment in locations that are not in the right zoning also in disaster-prone locations that later may cause health problems and harm the residents of the settlement. This study aims to produce plan based on the physical (spatial) and social (non-spatial) scope that involves local communities in knowing and achieving the needs and desires of the community that are synthesized with the government policies.

2. Method

Through a qualitative approach, data collection techniques based on purposive sampling are carried out through a focus group discussion (FGD) with the sample that has been determined by the researcher, namely BKM Sugih Mukti as a community representative of Kelurahan Pasirjaya. In addition, to obtain a real physical picture of the area, field observations were



carried out accompanied by literature studies as a reference in developing the framework and steps in the research, related to topography, type of land use and facilities at the area and surroundings, government policies, ownership status, and requirements also the needs of the community.

The use of questionnaire in this study was intended to obtain data on public knowledge of the risks of the living location and the willingness of the community to be involved in reducing and anticipating disaster risks also the limited availability of land with characteristics that are not vulnerable through settlement environment planning.

3. Results and discussion

3.1 Kampung Muara Settlement Area: Location, Physical Conditions, Legality, and Resident of the Settlement Characteristics

Kampung Muara settlement area is located in Kelurahan Pasirjaya, Kecamatan Bogor Barat, Bogor City, which is approximately three kilometers from the center of Bogor City (Bogor Botanical Gardens and its surroundings). Based on 7 indicators of slum areas set by the Ministry of Public Works and Public Housing [2], Kelurahan Pasirjaya has 20,215 hectares (RW 07, 08, 09, 10, 11, and 14) which included as the slum settlement area listed [4]. The total number of population in this delineated area is 7.623 people or 2.164 households; with the number of MBR is 823 households. Population density in this settlement area reaches 377 people/hectare which in the category of 'high density' with the physical conditions as follows:

a) Topography

Kelurahan Pasirjaya is in a hilly land with the range of slope: 0-15% and above 15% on the border of the Cisadane, Cikaret, and Cipinang Rivers.

b) Geology

Based on the soil type mapping by Bogor City Bappeda, the type of soil that forms the land in Bogor City is entirely reddish brown latosol soil. This type of soil is spread in several areas with high rainfall, high humidity level, and the content of aluminum and iron causes this soil to be infertile, so it is not suitable for use in farming/agriculture. This type of soil is slightly sensitive to erosion.

c) Hydrology

Kelurahan Pasirjaya is bordered with 3 rivers namely Cisadane, Cikaret, and Cipinang Gading Rivers.

3.2 Physical analysis (spatial)

Due to the safest settlement development should be done at a slope level of less than 25% [5], [6] then the analysis and calculation of contour lines in the study area are compared to the landslides hazard level based on the slope percentage are carried out to get the size number of area which become the main concern for planning for security of the settlement.

Table 1. Area and total building at the landslide-prone zone

Land slope	Area (hectare)	Area percentage (%)	Number of buildings in the area	Security level for settlements
Low prone 0 – 15%	15,825 hectare	78%	1.546 buildings	Safe to build housing
Medium prone >15 –25%	0,610 hectare	3%	93 buildings	Half safe to build housing
Heavy prone	3,780 hektar	19%	327 buildings	Not safe/

Land slope	Area (hectare)	Area percentage (%)	Number of buildings in the area	Security level for settlements
>25%				dangerous to build housing

The reddish brown latosol soil is classified slightly sensitive to erosion because of the soil aggregation percentage value is considered poorly aggregated so that it increases infiltration [7]. The level of ground cover contact is very important especially on steep slopes, using plants to cover the ground as to provide more time for the soil to infiltrate or by planting taproot plants to bind the soil or tillage according to the contour lines in the form of physical action to resist the fall of the soil due to saturated water along with the construction of retaining walls.

So the proper land use change is in accordance with the recommended slope percentage of lands that is under 25%, is the settlements located in the low risk zone, and the medium risk zone is still allowed with certain safeguards [5], [6]. Whereas the inappropriate land conversion function here is the residential buildings which take place on the river border area as well on the steep lands. This improper land conversion function can result in the suppression of landslides, especially on these steep lands.

Based on data collection conducted by BKM Sugih Mukti, there are 1,966 lands in the delineated settlement area of Kampung Muara where 485 lands or about 25% of them have government-recognized letters in form of property rights certificates (house), building rights (shops), and usufructuary rights (burial land), whereas 1,481 land or other 75% with letters which are not recognized by the government. With the large amount of land whose ownership rights have not been registered, matters related to the implementation of habitable settlements in this area can be carried out without violating regulations. Guidance and control of land stewardship to land rights holders is also carried out by providing incentives namely land rights holders who voluntarily make adjustments to land use and impose disincentives on land rights holders who have not yet adjusted their land use. The government is also responsible for implementing the restructuring of land rights holders from the weak economic class.

Land use irregularities (based on the Bogor City Spatial Plan and existing land use) can be seen from the absence of river borders on the Ciliwung - Cisadane River, due to the use of the land as an expansion of settlement development. Whereas based on the Regulation of the Minister of Public Works and Public Housing [8], there should be at least 15 meters borderline which located from the edge of the riverbed. It was found that a total of 136 buildings were included in the river border area.

The characteristics of settlements are carried out by observing and examining the form of settlements, which are based on the architecture and typology of the building, access to and inside the settlement area, and the affordability of existing facilities and infrastructure in the settlement area. From the analysis it was found that:

- a) The shape of the building in this settlement area is entirely a permanent building with building intensity or KDB is 100%, the height of the building varies from 1 to 2 floors. Some non-permanent buildings are in the form of small buildings that are used as home industries, which have the potential to cause problems in carrying out production activities, including negligence that causes production goods not to be stored properly (unclean) to fires due to flammable building materials.
- b) The density of buildings in a settlement will have an impact on the lack of fulfillment of

- public and social facilities in a residential area. In accordance with the total population of 7.623 people and the delineated area is 20,215 hectares, the population density of residential areas reaches 377 people/hectare or categorized as 'high density'.
- c) Judging from the number of houses, the distance between houses, and the number of people, the land in steep topography has a more irregular pattern compared to sloping land. This is because development on sloping land tends to be difficult so that people with steep terraced land build their houses with spread patterns following the slope line. Whereas a more gentle area facilitates the development of more flexible housing.
 - d) The types of settlements in this area are irregular, the houses built tend to have their backs facing the river, and the landfills located not in each RW (only in RW 07, 11 and 14) make people have a culture to dispose of household waste and waste of home industry production carelessly into the river.
 - e) Access to the residential area can be reached through a collector road which borders RW 07 to a part of the RW 08 area, Jalan Kapten Yusuf. With the existence of public transport passing through this settlement area (at Jalan Kapten Yusuf), the city economic facilities can be accessed more easily. There are 8 roads which can be used to the settlement area, most of which can only be passed by motorbikes, but only a few can be passed by cars and public transportation. Especially in RW 07 and 08, because the characteristics of the land tend to be steeper than the other four RWs, which stairs are used as the access, making it difficult for motorbikes to go in and out of settlements. In addition to the roads, there are 2 pedestrian bridges connecting the settlements to the main road on the east side of Jl. Sedane, Kecamatan Bogor Selatan. This pedestrian bridge is an infrastructure that is utilized by the local community to go to the Ledeng Market which is the place for the community to trade. Therefore it can be seen that the existence of this pedestrian bridge is very important as a liaison of settlements to the main road and the trade area which is an economic facility separated by the Cisadane River from the settlement area.
 - f) There are various facilities in the settlement area, namely educational facilities, religious facilities, as well as health facilities. There are also buildings that are vital to the economy of a number of local residents (home industry) that are spread throughout the RW. The large number of tofu and oncom-producing industries that dispose of wastewater directly into the river has disrupted, as well as the spreading location of industrial activities that have less controlled environmental pollution.

3.3 *Economic and social analysis (non spatial)*

The domination of the population in the residential area with the total number of 579 people works as casual laborer [9] and the work take place around the settlement area and in the Kelurahan Cikaret area, Kecamatan Bogor Selatan where many local industries also stand, such as shoe, gas, and furniture factories, and many works as construction laborers. In addition to casual workers, many of them also work as traders (640 people) [9]. The majority of traders in this residential area choose the Bogor Market as the place to trade. The ease of transportation from the settlement area to the market is one of the reasons why the majority of the population works as traders. Not only to sell their goods, but also buying raw materials for the production process are done in this market. If one of the activities cycle is problematic, it will cripple the economic activities of the residents of Kampung Muara.

The main economic activity that moves in the middle of the Kampung Muara settlement area itself is home industry. Even though it only on the local scale, it can directly open jobs, especially because industrial workers are generally residents of the same settlement. That

way, these small industries can automatically help to improve the welfare of the community. Physically seen from the environment, the level of public awareness is still lacking, this is shown from the construction of houses on steep slopes. The community is still not aware that the existence of the settlement activities give weight to the land and increases the slope conditions to become critical. Not only that, there is no visible effort of vegetation by the community also. From the answers obtained from the residents who live at the landslide susceptibility zone (by questionnaire), therefor it is known that:

a) Characteristic of the community who lives at the landslide-prone zone

The average age of the people is over 40 years and already have family (82%), with the last level of education from elementary to junior high school (58%), the number of family members living in the same house is 3 to 4 people (62%), and the length of stay in vulnerable areas is more than 30 years or since born (90%).

b) Awareness and community's willingness to participate in the settlement planning

People who live in the area have experienced more than 1 time of landslides (94%). With this, the majority of the community knew that their homes were actually in landslide-prone areas (84%). The type of loss found when affected by landslides is in the form of building damage (98%). The community is willing to accept settlement arrangements vertically through the construction of lowland villages and flat towers so that the quality of life increases and the residential environment is safe (94%). In addition, through this development the community is also willing to be charged a rental fee to obtain a legal residence with clear ownership (72%).

3.4 Settlement area planning

A concept is needed to form a plan to structure the settlement area through a land use strategy with consideration of the disaster, so the concept points of structuring the Kampung Muara settlement area are:

a) Disaster mitigation

As known, the existence of permanent buildings on the landslide-prone zones will cause a burden on the slope, thus increasing the risk of landslides, therefore the resettlement of activities is needed to move to safer land (sloping) to reduce future casualties.

b) Consolidate with internal relocation

To avoid a decline in economic and social quality, maintaining what has been there is one alternative that can be lived. However, in line with staying in the same location, the planning must be done with internal relocation, where existing settlements are consolidated to create a more organized and attentive residential environment, one of which is by river oriented settlement development.

c) Formalization of ownership

The dominance of land used by the community is land without ownership, through this formalization it is hoped that land ownership will become clear and the land use is fair.

d) Environmental health improvement

A healthy settlement environment certainly takes into account the location, compactness and density of buildings, environmental cleanliness through the provision of adequate

infrastructure so as to reduce the risk of disease transmission, fire, and so on. So that compared to the environment that is laid out, paying attention to the quality of the building, equipped with adequate infrastructure would be healthier than the existing conditions.

The planning of settlement on the prone to landslides area is divided into 3 stages as follows:

a) Disaster mitigation

Spatial planning based on disaster mitigation is needed in solving this problem, especially because these settlements are on the landslide-prone zone.

b) Formalization of ownership

In general, there are 2 types of activities in Kampung Muara that use land without ownership, namely settlements and industries. Formalization of ownership which in this case is through rent, is expected to help the local community to stay and carry out their economic activities on land which then becomes the responsibility of the government to manage this.

c) Upgrading

Quality improvement of the settlement environment through the restoration and provision of infrastructure, low rise buildings for multifamily housing, namely through the construction of *kampung susun* and construction of *rusunawa* which is the medium rise building, and access to supporting facilities.

Table 2. Kampung Muara spatial planning

Space	Activity	Form of treatment
	Settlement	Space planning that pay attention to the river and the health of the settlement environment.
Cultivation	Production/economic	Centralized home industry.
	Facilities for the settlement area	Space planning for schools, mosques, musholla, and posyandu.
Conservation	Slope guarding	<ul style="list-style-type: none"> • Cut and fill • Construction of retaining walls • Vegetation planting • Use of areas with empty space
Evacuation	Shelter area	<ul style="list-style-type: none"> • Evacuation route • Temporary shelter

4. Conclusion

A form of arrangement is needed for the Kampung Muara settlement area for which takes notice of disaster and environmental health in order to be sustainable. So a long-term plan is needed for overall settlement planning accompanied by clarity on the ownership status of the land inhabited so that there are no matter for the people of the community to get a place to live and of course the settlement area with risks like this requires upgrading infrastructure as a safety support in dwelling activities.

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