Participatory Mapping for Disaster Risk Reduction in Kotagede Cultural Heritage Area, Yogyakarta

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The definition of cultural heritage now includes historic urban areas, vernacular heritage, cultural landscapes (tangible heritage, which include natural and cultural sites), and even living dimensions of heritage and all aspects of the physical and spiritual relationship between human societies and their environment (intangible heritage). Therefore, the disaster related conservation of cultural heritage area become important part of disaster management. Kotagede, the historical old capital of the 16th century Mataram Empire, located in earthquake and fire hazard prone area. The area is densely populated area with narrow connecting road, which increases vulnerability. In the 2006 Yogyakarta earthquake, Kotagede was severely affected. A lot of people were killed and almost all historical building damaged and destroyed. Therefore, disaster risk reduction became an important thing that has to be integrated in the development planning of Kotagede cultural heritage area.

In the implementation of disaster risk reduction in development planning of Kotagede cultural heritage area, community participation become important factor. This is due to community participation in this will be improve the local capacity of the community itself so it can support prevention and conservation of cultural heritage from high risk. It's also urgent to integrate local wisdom such as gotong royong in this effort. This research aims to mapping the evacuation sites, evacuation route, hydrants placement, and vulnerable groups by involving local community. This study conducted in Jagalan Village, Sub District of

Banguntapan, Bantul Regency. The data collected by Focus Group Discussion method, and processed using GIS software. The result was integrative maps that can be used for determining disaster risk reduction planning.

The results shows that the evacuation sites and evacuation routes that can be designed in Kotagede cultural heritage area is limited. This is caused by the condition of area which categorized as densely populated area. Limited public space has caused limitation in designated evacuation sites, Distance between houses which is very close has caused accessibility for evacuation routes became difficult due to very narrow street. Therefore, a solution that can be used to solve evacuation is using the branching model for determining evacuation sites and route.

Keyword: participatory mapping, disaster risk reduction, Kotagede, cultural heritage area.

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Introduction

Mankind's cultural works have always been threatened not only by the ravages of time and by our own interventions, but also by natural disasters. Certain natural catastrophes have left a lasting mark on cultural history and historic consciousness; the destruction of Pompeii by the eruption of Vesuvius in 79 a. d. comes to mind in this context, as do the earthquakes in shaanxi (1556), lisbon (1755), tokyo (1649 and 1703) and san Francisco (1906), the floods of the Huang He (1887) and the Chang jiang (1911 and 1931) or the inundation of Florence in 1966. (Will and Meier, 2007)

As the signs that natural disasters will be increasingly frequent worldwide continue to accumulate, the question of preventive measures arises more and more often in the field of cultural heritage; immovable cultural property (historic buildings, historic cities and open spaces, cultural landscapes) is by nature particularly endangered by disasters. Indonesia as a country which has high vulnerability to disaster, has to preserve and conserve its cultural heritage sites from the threat of disaster. One of cultural heritage site in Indonesia that ever been affected by disaster is Kotagede.

Kota Gede is a heritage area that is based on the existence of archaeological data as the former capital of the kingdom of Mataram in 1582 - 1640 M. Physical limits boundary of the region refers to the physical site of old city, which is a region bounded by Baluwarti or walls along the moat outside it. Current site location approximately 6 km south-east from the Yogyakarta city center. Due to its status, formerly, there were a lot of facilities formerly associated with the role of Kotagede as a royal capital. Inside there are many archeological sites such as the ruins of fortress walls, ruins Cepuri, the king's throne, Gede Mosque, the tomb of the king and relatives, and indigenous kampong. In the reign for more than half a century, Kotagede has put itself on the stage of history and culture in Java. Based on historical data, in such a short period Kota Gede Kraton has a spatial and city components as usual the cities of the center of government of the Islamic kingdom. Kota Gede as the city the center of government evidenced by the archaeological remains, namely: palace, fortress, wall circumference, moat, Cepuri, mosque, market, settlement, and tombs. Kotagede uniqueness appears

through its kampong with historic buildings of traditional architecture and narrow alleys and roads which have a non-uniform width between 1-3 m. As a "capillary" way, the streets of Kotagede give an enormous influence in shaping the characteristics of the region. (UNESCO, 2007)

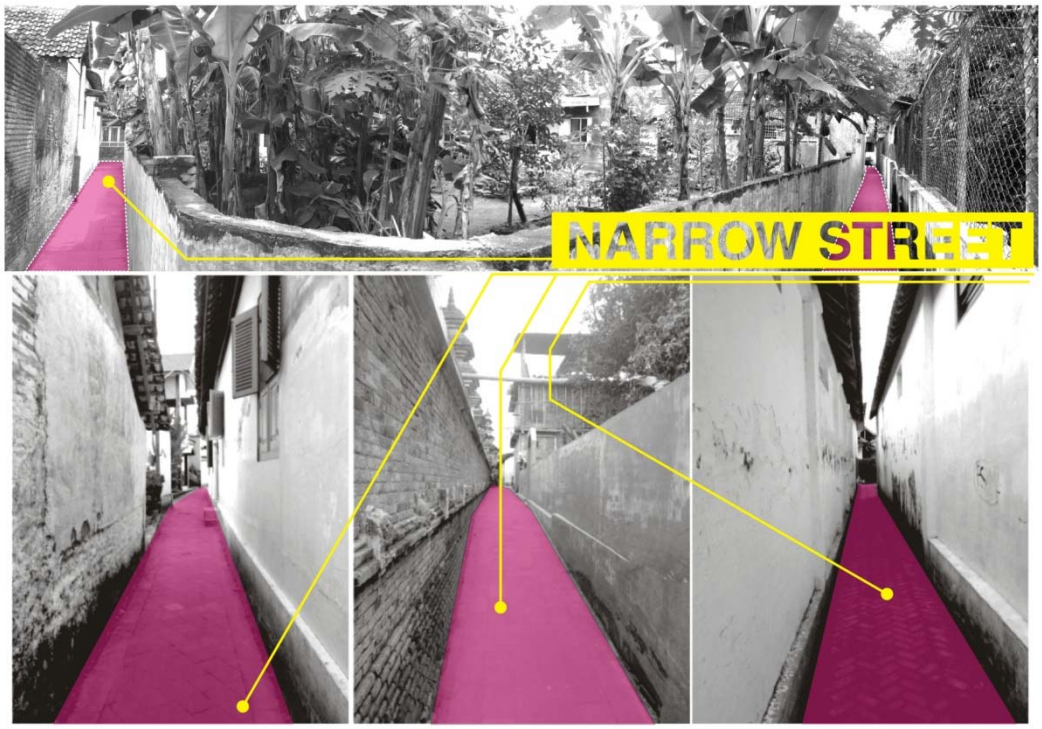

Figure 1. Narrow street in Kotagede

Kotagede located in earthquake and fire hazard prone area. The area is densely populated area with narrow connecting road, which increases vulnerability. In the 2006 Yogyakarta earthquake, Kotagede was severely affected. Some people were killed and almost all historical building damaged and destroyed. So, disaster risk reduction became important to be integrated in the development planning of Kotagede cultural heritage area. Therefore, this research aims to mapping the evacuation sites, evacuation route, hydrants placement projection, and vulnerable groups as by involving local community as part of disaster risk reduction effort.

Methodology

The research model which used to attain objectives is qualitative model. So, this research using focus group discussion to collect and verify data. Focus group discussion involves several key person and local stakeholder with this following

social structure:

Table 1. Forum group discussion participant

Local government	Local Non-Governmental Organization	Civil Society
Sub district representative	NGO Kantil	School Officer
Dusun representative	NGO Joglo	Mosque Officer
Neighboring Unit Representative	Disable group	Market Officer
Police	Housewives group	Community Officer
Social Security Officer	Youth group	Traditional House Officer

During forum group discussion, participant should regroup into two based on the administrative division (Dusun Bodon and Sayangan). In order to assist participatory mapping process, each group was given a large scale thematic map and a high resolution satellite imagery. Then, the focus group discussion process was done based on following steps:

1. Identify hazards that exist in Kotagede (Earthquake, Fire)
2. Identify Vulnerabilities exist in Kotagede
3. Mapping the location for:
    a. Identification of Potential Fire and Earthquake Hazard
    b. Location-based evacuation route and evacuation site
    c. Location of vulnerable groups (Pregnant Women, Elderly, Disabled, Children / Toddler)
    d. Placement of hydrant

Figure 2. Focus group discussion process

Results and Discussion

Participatory mapping is an interactive approach that describes the knowledge of local communities, enabling participants to create visual and non-visual data to explore social issues, opportunities and questions (IVR, 2010). Participatory mapping is based on pragmatic needs for complete data and spatial information which is useful for participatory planning of natural resource management, conflict management and development partnership at various levels (Kusumedi, .2004). Community-based disaster risk reduction encourages the participation of affected communities in both the evaluation of risks (including hazard, vulnerability and capacity) and in its reduction efforts. For society, to delineated hazard-prone areas, participatory mapping is highly recommended to do (De Dios, 2002; Cronin et al, 2004a, b; Benson et al, 2007).

As the research was done to increase capacity of local community in disaster risk reduction, thus the focus group discussion highlighted on identification of risk area, possible evacuation route and sites, vulnerable group distribution within community and existing hydrant placement. Assisted by high resolution satellite imagery, local community had succeeded mapping the risk area, evacuation route and sites, vulnerable group distribution and hydrant placement. The risk map (figure 3) was made by community based on their previous experience. They identify that there were two type that threaten the area, which are earthquake (light magenta) and fire (red).

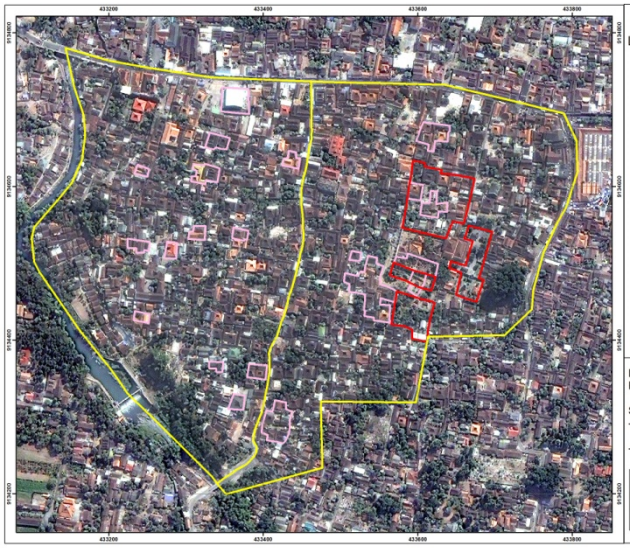

Figure 3. Risk map (figure not to scale)

The strong social bond within the community had enable them to identify distribution of vulnerable group within the area. Based on the map of vulnerable group which is presented in figure 4, the most numerous vulnerable group within the area is elderly (green), then group of people with disability (red), then paralyzed group (brown), and the last is group of people with mental disorders (blue).

Based on data from satellite imagery, Kotagede especially Dusun Jagalan is area with a very high density of buildings. Building typologies and condition which predominated by very old and obsolete buildings is an indicator of the high vulnerabilit the heritage area. Streets are very narrow and forms a winding street with very narrow alley with a width of only 1 – 1.5 meters. This is a problem which would obstruct evacuation process when disaster strike. Moreover, this condition was exacerbated by condition of area with has very dense population.

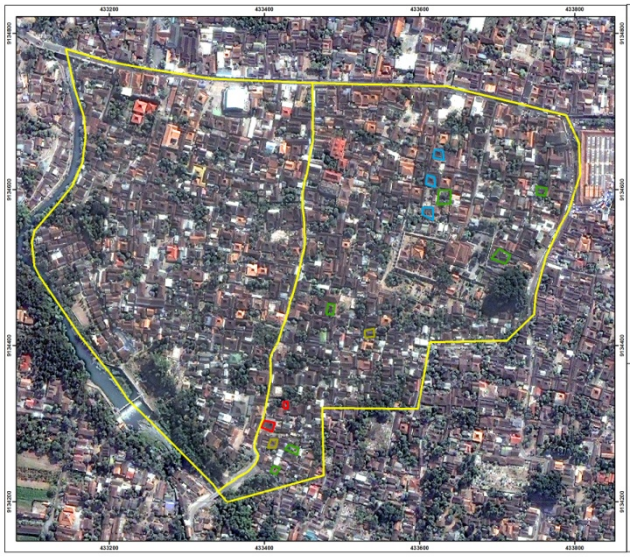

Figure 4. Distribution of vulnerable group (figure not to scale)

From the high resolution satellite imagery, the community also able to determine the location of placement as seen in figure 5 (represent by red point). This will create possibility to minimize the risk of fire in the area. Unfortunately, the existing hydrant can’t cover the whole area because all of them only located in Dusun Sayangan.

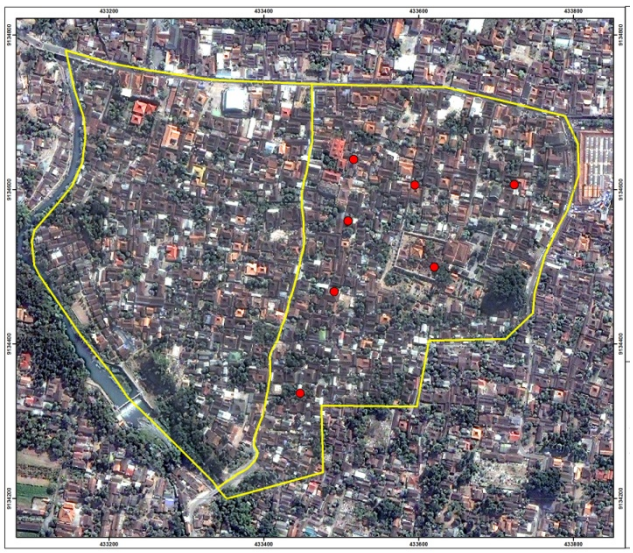

Figure 5. Distribution of existing hydrant (figure not to scale)

Based on previous experience in evacuating during Yogyakarta Earthquake 2006 and actual environmental condition, community had identified possible location for temporary evacuation sites and access (route) to the location. From the map drawn up (Figure 6), there were 11 meeting points and space (green) for the evacuation of residents. Evacuation paths which have been compiled by the community is in the form of a main local street (red) with width of 3 m and alternative pathways such as alleys that allow residents to evacuate.

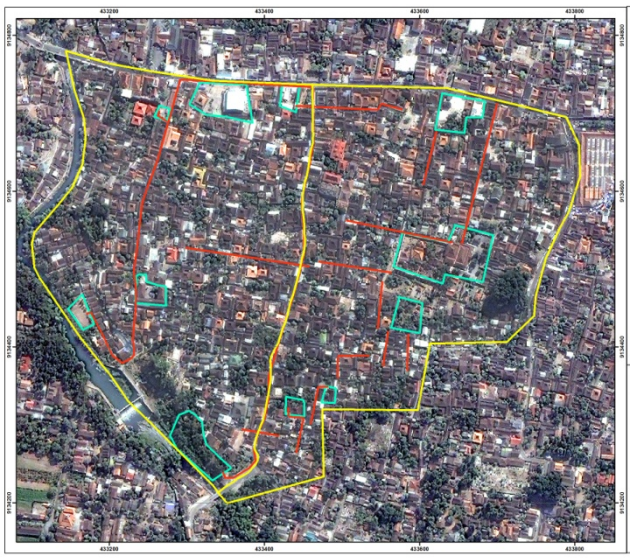

Figure 6. Evacuation sites and routes (figure not to scale)

The evacuation route which designed by the community can't covered the whole Jagalan Village area. Mainly, this is due to the condition of area which

have many narrow local street. Therefore, a solution that can be used to solve evacuation is using the branching model for determining evacuation sites and route.

In general, branching models used to structure and create a temporary evacuation spaces in one area. Where specifically, in the process using the garden or yard of the house which transformed to a temporary safe space for disaster victim within a certain radius. To determine this, there were some parameters that have been determined beforehand. These parameters include the amount of garden area (temporary evacuation space), time which is directly related to the radius can be achieved, the width of the street, and several other components such as the number of individuals per family and streets condition around the area.

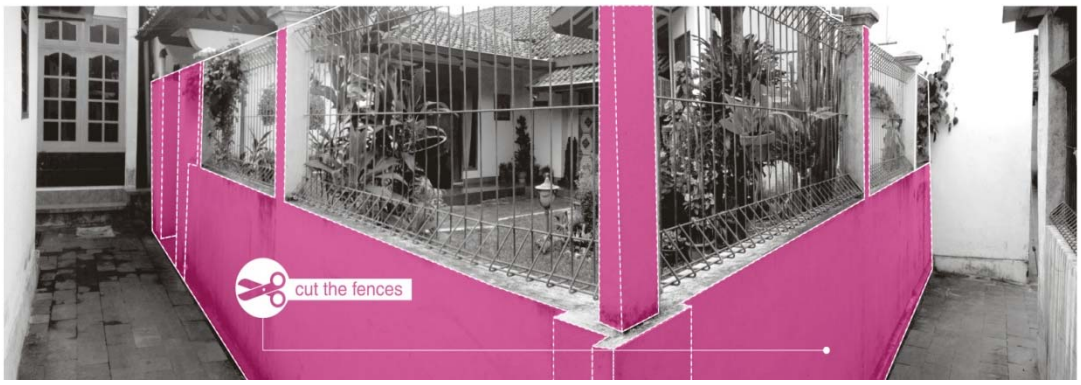

Figure 7. Example of garden that can be used as temporary safe area

This system requires some stages in determining the temporary evacuation spaces. Stages include namely, a) Voronoi diagram, b) collective points, c) connect the nodes. In the case of Kotagede, an area that had been used as evacuation space then processed again using the Voronoi diagram to determine the maximum limit / outer limit of each evacuation chamber. This in turn will facilitate the distribution of materials, and basic needs and also make it easier to determine the amount of required temporary evacuation space at a later stage.

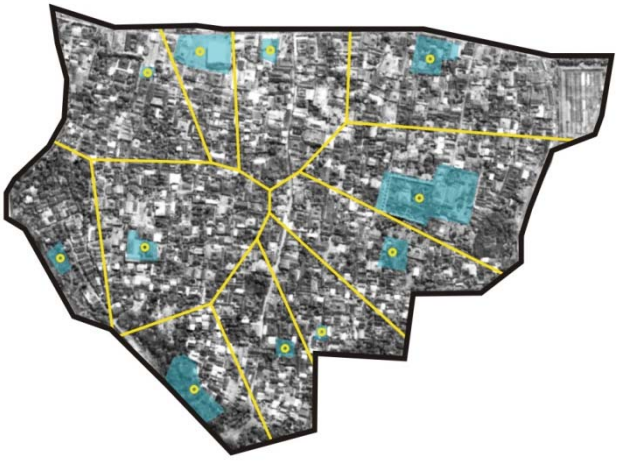

Figure 8. Application of Voronoi diagram in Kotagede

After knowing the magnitude and imaginary boundaries of each evacuation point, then the next step is determine a temporary evacuation based on parameters that have been described previously.

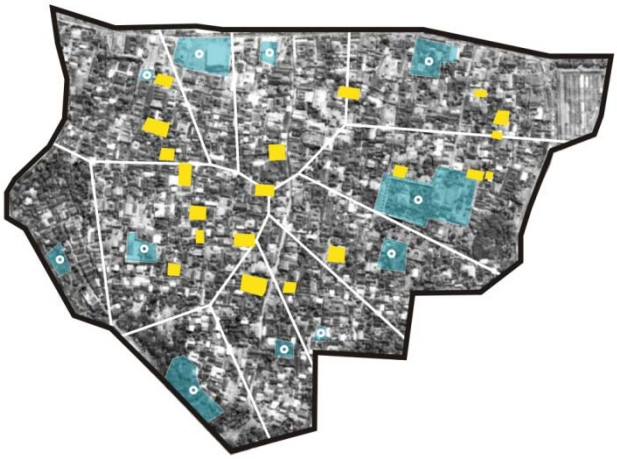

Figure 9. Temporary evacuation sites (yellow)

Figure 10 is the concept of the home yard area that will be used as a temporary evacuation by eliminating or tear down the fence / barrier between the home yard with the street. Thereby, it can facilitate the achievement of the evacuation area at the time of panic.

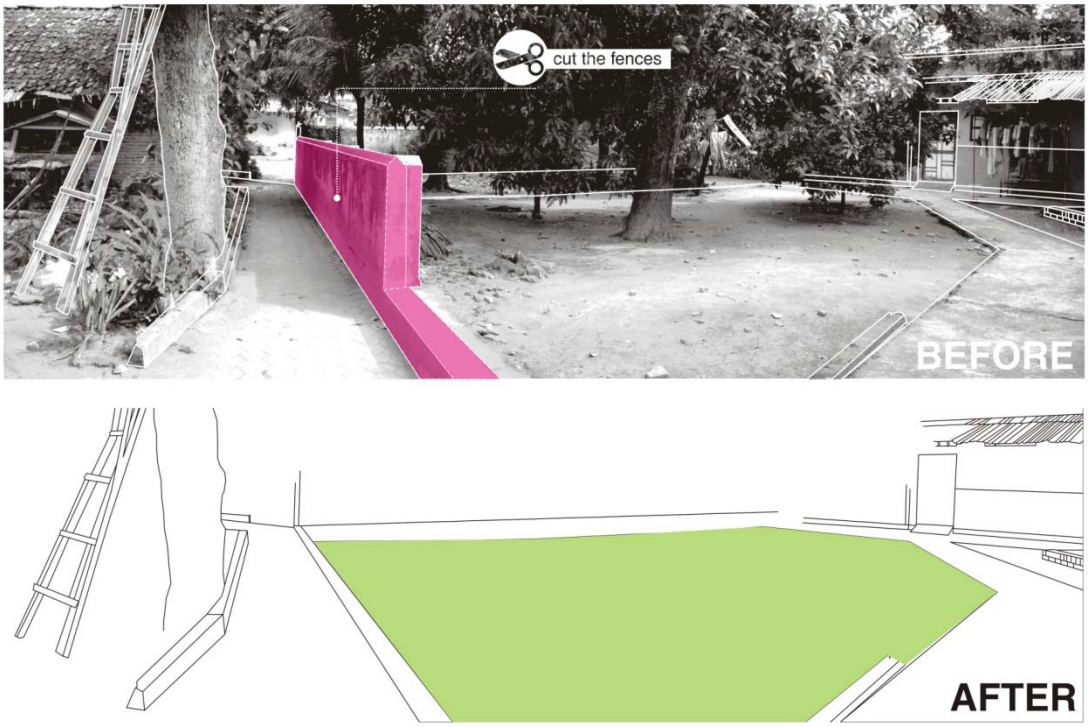

Figure 10. Home yard that will be used as temporary evacuation sites (top : before, below : after - modeled)

The last stage is done by connecting a temporary evacuation with center evacuation space in a linear mechanisms. Of course pathways that connect these systems is determined based on Voronoi diagram. Then the distribution and monitoring of the surrounding environment can be maximized. In addition, these systems can minimize the time needed to reach the evacuation spaces when disaster occur.

Conclusion

By participatory mapping, the community in Jagalan Village, Kotagede can map risk area based on previous disaster experience, possible evacuation route and sites, vulnerable group distribution within community and existing hydrant placement. The evacuation sites and evacuation routes that can be designed in Kotagede cultural heritage area is limited. This is caused by the condition of area which categorized as densely populated area. Limited public space has caused limitation in designated evacuation sites, Distance between houses which is very close has caused accessibility for evacuation routes became difficult due to very narrow street. Therefore, a solution that can be used to solve evacuation is using

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