MODELLING AS AN APPROACH TO UNDERSTAND RESILIENCE OF URBAN KAMPUNG

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ABSTRACT

Resilience is an abstract concept of ability to spring back after disaster. There any various research about resilience on urban design study, because it related to sustainability of living space and human being. The aims of urban resilient are to build the capacity of urban area, to understand the vulnerability and exposure area, and to estimate the risk of the area. City and urban area become prone of disaster because the density of population. If the event and shock occur in the dense area, the lost is not only count on the value of the infrastructure but also casualties.

Kampung is one of the dense area in urban, it provide settlement that built by local people with their own knowledge, on limited space. Some kampung are located at the prone area of disaster, such as along the riverbank. These facts put kampung in a high risk and vulnerability. To understand the context of resilience of urban kampung, a set of measurement tools should be arranged in order to measure the elements of resilience.

This article reviews some measurement tools of resilience, understand the perspective of each tools and the possibility to be applied on urban kampung context. The important insight of this review is that in certain site context such as kampung has the local wisdom which will shape the application of urban resilience concept. Nowadays, kampung is struggling to survive with dynamic of urban situation. The challenge is to measure the movement from survival stage to resilience. The resilience ofurban kampung will emerge from measurement of their ability to build environment informally, their adaptation to the urban activities and limited used of infrastructure.

Keywords: urban resilience; urban kampung; resilience modelling

A. INTRODUCTION

Urban area has push and pulls factors for people to move from sub urban and live in the urban. The urban areaoffers variousoccupancies, jobs, and others opportunities. These are the reasons why urban area becomes wider, such as in East Asia, South East Asia, North Africa and Latin America that estimated to have 53% urban area on 20**15**-20**25** (Urban Agenda 21, Hall Ulrich, 2000). The urban area becomes denser because of urbanization.

There are some disaster that record as loss for the city, such as the attacked on WTC twin tower (11/9), New York (Foner, et al. 2005), earth quake and tsunami hit Banda Aceh and Western Coastal of Sumatra Island on 2004 (UNESCO, 2008), hurricane Katrina, New Orland USA on 2005 (Cutter & Gall, 2006), Yogyakarta earth quake on 2006 (Elnashai, et al. 2007), and Fukushima Earth quake and tsunami on 2011 (Fukurai, 2012). Especially Fukushima, the earth quake and tsunami are trigger for another disaster: the Fukushima nuclear disaster. These events are caused by both natural and social disaster, which each event is not only create environment catastrophe, but also caused huge loss of victims.

Indonesia has lines of volcanoes, called ring of fire. The ring of fire is formed by subduction of active tectonic plates; Eurasian Plate, Pacific Plate and Indo-Australian Plate. There are several natural disasters, such as earth quake and tsunami that hit the coastal area of Indonesia. The frequency of events is getting higher, as an example: the average of the earth quake in Aceh is once in two years, but after the 26th December 2004 earth quake and tsunami, the frequency is getting frequent, about more than 3 times a year (www.kompas.com, 2013). The phenomena of disaster become an embedded requirement for urban design and planning.

Indonesia is also indicated as high urbanizationarea;more than 50% of population live in the city. Urban kampung offer place for migrant from sub-urban area to settle; it is an informal settlement (Budiarto, 2003), dense settlement

(Nugroho, 2009). Urban kampung fill the city from the center to the periphery, supply settlement for people who live in the urban area. The condition of urban kampung is degenerative (Maharika, 2011), interstitial and marginal use (Dovey, 2015) but this area is affordable for migrant with less-skill and less-education because they only have few choices (Davoy, 2015).

The density of urban area and ring of fire perform a high risk area of disaster for cities in Indonesia. As a dense, non-standard and poverty area, urban kampung become a high vulnerability in term of disaster. According to Ernawati, et.al. (2013) urban kampung have a high risk of flood, rise of sea level. Some urban kampung also have risk of fire, land slide and epidemic.

Figure 1. Recycle Used of Tire for Play Ground, Kampung Karangawaru, Yogyakarta. (Source: Author)

Instead of its limitation, lack of infrastructure and poverty, urban kampung have capacity to grow according to the dynamic of urban area. The space is compact in human scale and in access (Roychansyah, 20011), expression of recycle could be seen on the buildings' material (Dovey, 2015) and opportunity to adopt to urban livelihood (Setiawan, 2010). The social framework of urban kampung build various informal job, make the possibility of resource circle among inhabitant; such as financial, service and assistant in local level (Newberry, 2008).

The condition of urban kampung can be read as vulnerability or as capacity. The mapping of the vulnerability and capacity is necessary to measure the risk, the type of disaster and the action to reduce the risk, thus the mitigation will be arranged compatible with urban kampung context. Therefore, the risk of disaster must be measured base on the vulnerability, capacity and exposure of urban kampung. It contributes essential paradigm for urban planning, especially at urban kampung; how we design on limited but high demand area in the city base on disaster risk.

B. LITERATURE STUDY

Resilient is used in urban study as it close to sustainable issue. The term resilient is described as an condition after events and shocks from either internal and external; that build capability of socio-ecological to change, adopt and transform (Carpenter, et al., 2005), in dealing with changes in various scale and timeframe (Gunderson and Holling, 2002), which can occur to natural and built environment (Kinzig, et al., 2008) and contribute in social, economic and environmental strength (Raco& Sweet, 2009).

In urban study context, resilient need to be applied and useful to measure condition of urban area which have specific characteristic of risk and disaster. The elements to measure are potential of capacity, vulnerability, resilience (Gillard, 2010), hazard (Pasman, et al, 2008), and exposure (United Nation, 2012). The aims of the measurement is to calculate and build up the ability of area to face disaster, to reduce the risk that caused by disaster. The process is called as DRR (Disaster Risk Reduction). DRR is useful for disaster mitigation program, because the risk will reduce if urban area has well preparation that arrange based on the calculation of measurement of resiliency.

There are some elements that are used tomeasure the resilience of urban area and to arrange a set of indicators to calculate the degree of resiliency. It should be designed as a user friendly tool, so it can be easy to use and reach the understanding of the users. Resilience as a model is an approach to describe the measurement of all elements of resilience and to explain the connection among the indicators. Model is a simplifying of system, to build a base of calculation and to predict the future (Raisanen, 2006). The requirements of the systems to build a model are (1) form, (2) function and (3) utility of system (Boardman &Sauser, 2008). The elements of the system will produce various models if they arranged in different ways. Since the model must have a clear purpose, a high level of accuracy is required, so the proper arrangement of elements can be precise and confirmed (the form, the function and the utility).

Urban has systems that build the structure of urban area (Fleischauer in Pasman, et al, 2008), there are (1) physical/environmental structure, (2) socio-economic and (3) institutional structure. The

response of the systems in urban disaster context is put the systems in the resilience framework, with doing analysis on urban design, urban management and adoptions urban technical system (infrastructure) (Barroca and Serre, 2013).In other hand, each urban structure is unique and specific; it is formed by social and economic of the people, geographic and natural aspects, human activities and built environment of the area. These aspects contribute different variables and set varieties of indicators for vulnerability, capacity and exposure of disaster risk area.

Indigenous people have their local wisdom to prevent disaster, which is built from the dynamic of historical, social and cultural (Suyuti, 2014) of the people. The value of local wisdom should be appreciated as base of the urban planning mitigation. Participation is an approach to encourage people as an actor of planning. The collaboration of local wisdom of the indigenous, participation of people and the urban planning will generate urban resilience. The mitigation program is not only focus on understanding the disaster on the area, but also to build human knowledge and awareness to understand disaster on their area.

Figure 2. Community Gathering (Arisan) at Open Space, Kampung Ngampilan, Yogyakarta.
(Source: Author)

Urban Kampung supply settlement for urban area, the pattern describes people who live in there. The system of settlement combines the urban lifestyleand suburban livelihood (Setiawan, 2010). Urban kampung become the answer for the settler from suburban area, provide them place to live and face the challenge as urban resident on financial, social, and cultural pressure. The residents are struggle and survive in dynamic ofurban development.

Urban kampung become resource for historical information of the urban area, layers of fuction, symbols, and entity that use as requirement for developing contextual urban policies. Solid and void spaces, comparative open spaces, degree of the enclosure, access and circulation, proximity of the building height, sharing space and symbols of privacy are the architectural condition of the urban Kampung. Limited space with high demand of activities generatescreativity in density (Damanik, et al, 2016) and create comfortable place as the activities demanded. The esthetic aspect of place is organic and unique, which had done with empirical experience. The values of the space become optimal, in term of time sharing for owners and users, multy-function and esthetic. The atmosphere is well-known as *rukun*, meaning as peaceful; the function, symbol and entity of *rukun* not only about how to make or being*rukun*, but also as an agent to maintain mode of *rukun* (Rahmi, et al, 2001).

Figure 3. Wall full of plantation to keep green in limited area, Kampung Glintung, Malang, East Java.
(Source: Author)

Urban kampung has its own resistance to survive, so if we relate it with the risk of disaster, we have a basic capacity to build resilience. The function, symbol and entity should be measured in certain way for mitigation program. The uniqueness of urban kampung characters will direct to an appropriate model of urban resilience.

C. METHODOLOGY

The methodology of this paper is comparative of resilience models by investigating several references, for guiding framework to build a model for urban kampung resilience. The context of urban kampung should be read on the model, so it should has indicator and parameter that express function, symbol and entity. In other words, the suitable and effective urban kampung model should be

arrangedby certain assessment to measure vulnerability, capacity and exposure of the risk area. The aimof the research is to build the assessment of resilience model so it can be used to measure the degree of urban kampung resilience.

D. RESULTS AND DISCUSSION

Holling (1973) developed resilience theory on two basic categories, as technical resilience and ecological resilience. Urban planning responds the resilience theory as urban systems approach on disaster issue. Technical system of urban design use resilience on analysis of (1) design of urban area, (2) urban management and (3) adopting technical system (Barroca & Serre, 2013).Resilience seen in context of ecology will guide resilience as idea and concept, which giving motivation, thinking framework and new perspective of disaster. It is used to build transformation, adaptation and resistance to absorb shock and stress. As technical, urban resilience concern about application that bridge thinking framework to a set of indicators according the context of society. The indicator is used to appraisal the degree of resilience according to components, units and scale of analysis, dynamic of disaster cycles, method, data, validation and operating system (Irafajar, 2013).

Urban kampung has potential as ecological resilience based on the local wisdom that society use to survive on the limited site. In other hand, as technical resilience, we need to work on indicators that can be used as a set of tools to measure the existing condition that show the degree of resilience. Pickett, et al. (2004) mention it as 'human ecosystem framework' to describe the social resource and social process in the society. It is used as a guideline to set the specification of structure and function of resilience model.

Map of capacity, vulnerability, exposure, and hazard is to tract the four fundamental aspects of resilience (Walter, et al. 2004), (1) latitude; the threshold between danger and vulnerable, (2) resistance; the ability of the system to hold stress and shocks, (3) precariousness, condition between secure and vulnerability and (4) panarchy; express the networks and interaction between systems.

In this paper study on sevenresilience model with different emphasis in order to find the most appropriate variables to urban kampung condition. The model will be described by the background of inventor, focus of research, component and unit analysis.

Table 1. Comparison of Resilience model

Model & Inventor	Focus of Analysis	Component of Analysis	Unit Analysis
D – disaster R – Resilient O – Of P – Place Invented by Cutter, et al. (2008) University of South California	Disaster resilience Indicator for Bench-marking Baseline condition	Social resilience Economic resilience Institutional resilience Infrastructure resilience Community resilience	Community
B – Baseline R – Resilience I – Indicator C – Community Invented by Singh-Peterson, et al. (2014) University of the Sunshine Coast, Queensland, Australia	Translation and Evaluation the Baseline for Community Resilience. Developed from DROP.	Social resilience Economic resilience Institutional resilience Infrastructure resilience Community resilience	Community
Risk Driver Indicator Invented by: UNISDIR (2013) Towards the Post-2015 Framework for Disaster Risk Reduction	Global Hazard Model: An innovative exposure proxy and appropriate vulnerability function	Economic & Fiscal Structure Poverty & Social Vulnerability Environmental degradation & climate change Urbanization Coping Capacity Overall Government	State (Country)
S – Social E – Ecology S – System Invented by Gaugaard, J.D (2012) University of East Anglia, Norwich, UK.	A tool for building community resilience: • Building modular structure • Increasing Capacity	a. Economic Localization Infrastructure Uses Changing b. Social Community building Awareness raising Values attitude Local identity Well-being Function c. Environ-ment Ecological footprint Sustainable Consumption Environmental side-effects	Community
4R R – Robustness R – Redundancy R – Resource-fulness R – Rapidity Invented by Breneau, et al. (2004) University of Buffalo, NY	A framework to quantitatively assess and enhance the seismic resilience of community	T – Technical O – Organiza-tional S – Societal E – Economic	Community, specifically made for earthquake engineering
Flexibility Redundancy Resourcefulness	Measuring resilience in	Well being Infrastructure	City, Urban Area

Model & Inventor	Focus of Analysis	Component of Analysis	Unit Analysis
Safe failure Responsiveness Capacity to learn Invented by Silva. J. Da. Et al. (2012) International Development ARUP, London, UK	context of simplified system model	Institutions Knowledge Ecosystem	
Climate Disaster Resilient Village (CDRV) Human Development Business Development Resource Development Environment & Structure Development Disaster Mitigation Development Invented by Directorate of Coastal and Maritime (2012), Ministry of Maritime and Fishery Affairs.	*Pengembangan Desa Pesisir Tangguh*(PDPT) (Resilience Development of Coastal Village)	Variable of General Character (Fix): Ethnic, Age, Job, Education, Healthy Service, Government Service, Financial. Specific Variables: Disaster Preparedness, Early Warning System (EWS), Morality and Capability on Crisis, networking, protection, natural degradation, deforestation, politic and safety, infrastructure, clean water, physical of building, density.	Coastal Village and Small Island

(Source: Author 2017)

The variables of all sevenresilience model are arranged as below (Figure 1), showingwhich variablesthat being used the most in resilience model.

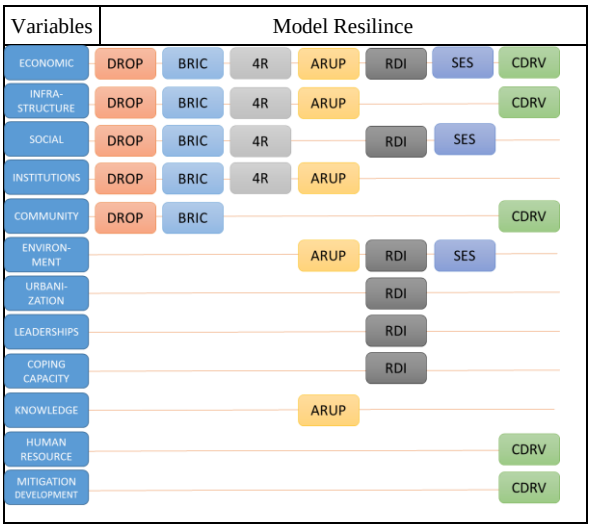

Figure 4. Mapping of Variables of Six Resilience model.

(Source: Author)

Table 1 and figure 4, resilience models have some dominant variables, as following:

01. Economic; all models mention economic as variable that need to measure, the data is about economic activities, fiscal, creative economic to fulfill daily need. It also shows the level of operating service and user target/unit of economic activities.
02. Infrastructure; the content of technical facilities, structure and built environment. Only five models use data of infrastructure, but RDI and SES use carrying capacity and nature environment, which are have connectivity with infrastructure.
03. Social; used by five models, the content is about human interaction. Instead of using social, CDVR and ARUP use human resource and local knowledge.
04. Institutions; variable describe organization that exist in the community, both formed by stimulus from the government, or community-initiated organizations. RDI, CDRV and SES use leadership and mitigation disaster development, which also lead to institutions in community.

Beside the variable, the table also gives description about research unit and scale which lead to the aims of resilience model:

01. Model to measure existing resilience and the result is used as baseline of resilience of the community; (1) DROP (Disaster Resilience of Place, Cutter. Et al. 2012) and (2) BRIC (Baseline Resilience Indicator Community, Singh-Peterson, et al. 2014). The value of resilience can be used as reference to build community resilience for urban planning.
02. The model that concern to the scale of disaster (global – local);
    a. Disaster on state/country level; Risk Driver Indicator (UNSDIR, 2013) focus on comparison of the value's system of resilience on states. The value of resilience will be compared in equal level
    b. Typology of disaster; 4R (Breneau, et al. 2004) is a model for measuring for earthquake; phase pre-disaster, emergency and evaluation on post-disaster. The thinking-frame is focus on quantitative approach on the capacity of community to respond on earthquake. The CDRV (Directorate of Coastal and

Maritime, 2012) is focus on climate change's impact on coastal area and small island of Indonesia. This model works on natural resource and communities' assets to set a mitigation on disaster that caused by climate change.

03. Model of functional system; the model measure the limit of condition/the threshold of disaster.
    a. ARUP (Silva, J.Da, et al. 2012) has seven system of resilience that should works comprehensively.
    b. SES (Gaugaard, 2012) is focus on system on environment, food capacity and local value. The model give additional attention to transformation behavioral of the community as response to disaster.

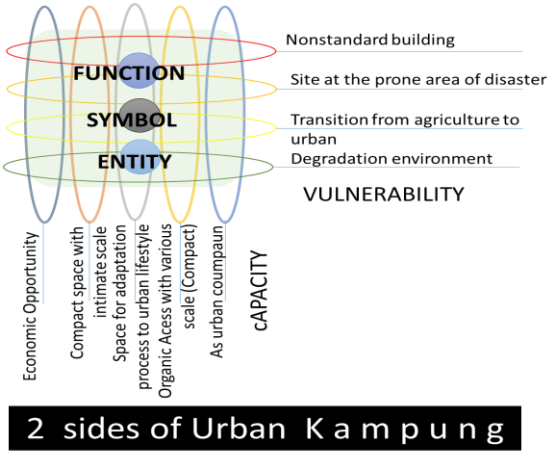

Figure 5. Vulnerabilities and Capacities of Urban Kampung.
(Source: Author)

The vulnerabilities show the risk of hazard because of the condition of urban kampung, such as flood for urban kampung that grow along the river bank, fire because of density, epidemic because of degradation of environment, the nonstandard building will be ruin because of earthquake and typhoon, and social conflict because of gap of economic ability.

In another side, the capabilities of urban kampung built the wide threshold and such a solid resistance as local wisdom of disaster risk reduction (DRR). The compactness of access and organic arrangement is not only for functional purposes, but also as spatial configuration to maintain security of the area. Sense of belonging of the place to make a better place for living is priority, that is why the interaction among people in urban kampung run between individual, among communities and spiritual organization, that are conceptualized as harmony (Guiness, 1991) and *rukun* (peaceful) (Rahmi, 2001).

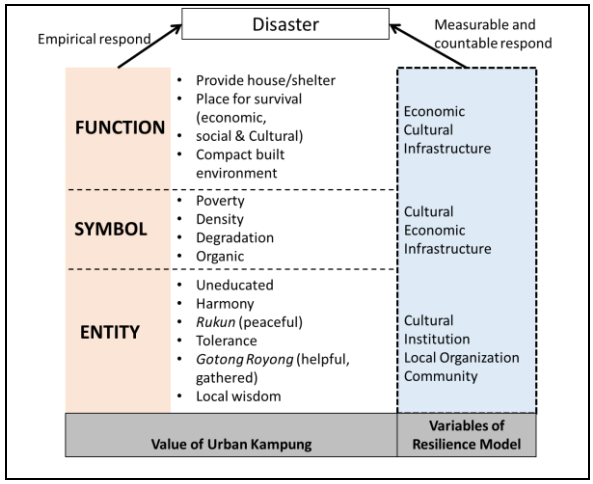

Figure 6. The Proposed Model for Resilience of Urban Kampung.
(Source: Author)

Urban Kampung Resilience Model (UKRM) is a movement from empirical experience of society to respond disaster to countable and measurable of disaster risk reduction for more comprehensive respond. Figure 3 describes how the values of urban kampung meet the variables of resilience model from figure 1. The resilience model defines both the capacity and vulnerability aspects, as a base line to generate disaster mitigation based on local wisdom, participation of society and the uniqueness of the site.

Urban kampung uses community as unit analysis, because center of vulnerabilities and capacities is the capability of the urban kampung society; human and human interaction. Resilience model must explain the function, symbol and entity work on the community, creating the character of the urban kampung, as; (1) Place for Adaptation, (2) Place for Settle, (3) Place for Economic, (4) Place for Social, (5) Place for Cultural.

Figure 7. Landslide at Gajahwong River, Yogyakarta.

(Source: Documentation from Kampung Tangguh Bencana, Pandean, Yogyakarta)

The image of urban kampung is also depended on the site, especially the natural environment have connection with the type of natural disaster. Urban kampung that lies along riverbanks with contour have different natural disaster if compared with urban kampung that grow on flat area. For example, riverbank with extreme contour is in a high vulnerability to the landslide. The built environment is seen as translation of various typologies between house/shelter, path/street, public-private facilities, open space and enclosure. All the typologies will lead of the carrying capacity and set the threshold of the disaster. The social and cultural is formed by job opportunities, spiritual and believe of the people and government administration. It will express the openness and readiness of urban kampung people about transformation because of shock and stress after disaster.

E. CONCLUSION

Urban kampung is informal settlement, grows according to the dynamic of the city, with enhancing its uniqueness of urban kampung's values that formed by function, symbol and entity. Disaster in urban kampung context iscaused by natural and social. The values help the society in response to the disaster that seen as behavioral in using space, in designing space and in defining place. The manifestation of value of urban kampung should be learnt and studied for deep understanding about vulnerability, capacity and exposed area. This is the main resource for designing an Urban Kampung Resilience Model (UKRM).

As a Model, UKRM is capable to measure the vulnerability, capacity and exposure area with the sense of local wisdom of urban kampung. The value of urban kampung is a basic requirement to set variables and arranging the indicators of resilience model. The UKMR presents the system of society knowledge as a reference and manage the system to become a relevant analysis framework for Disaster Risk Reduction, support the application of resilience program and give awareness to unpredictable situation.

The aim of UKMR is not to avoid disaster, but to drive capacities to work optimally, to understand the vulnerabilities and thresholds of urban kampung to keep them latent and to mark the site of the hazard. The UKMK develop local knowledge, enhance functional system of community, and build correlation with technology.

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