Adaptation and Mitigation Model for People to Restore Their Ecosystem from Flood in Semarang, Indonesia

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Abstract

The northern coast of Central Java province is considered as the critical area of flood path. Semarang as capital city of this province with its junction area of Kendal and Demak always suffering from flood due to rain and or high tide seawater. It is realised that infrastructures' capacity for flood control, awareness of people and other multi-factors are significantly contributed on the flood problem in these area. Mixed-methods of quantitative and qualitative are employed to analyze the data. The study found that there was a decline in quality of - people's life, environment and its ecosystem. Awareness and responsiveness of people and also the other stakeholders are not progressive to overcome the problem of flood. This study is trying to contribute in outlining a model of adaptation and mitigation for the people to restore their ecosystem from the perspective of economist.

Keywords: flood, climate-change, adaptation, mitigation
JEL Classification: Q51, Q54

Model Adaptasi dan Mitigasi untuk Masyarakat Dalam Pemulihan Ekosistem Akibat Banjir di Semarang, Indonesia

Abstrak

Pantai Utara di Provinsi Jawa Tengah dianggap sebagai daerah jalur kritis banjir. Semarang sebagai ibu kota Provinsi ini merupakan daerah persimpangan jalur Kendal dan Demak yang selalu mengalami banjir karena hujan dan atau pasang air laut. Disadari bahwa kapasitas infrastruktur untuk pengendalian banjir, kesadaran orang dan berbagai faktor lain sangat berperan bsar dalam persoalan banjir di daerah ini. Untuk menganalisis data dipergunakan metode campuran kuantitatif dan kualitatif. Hasil penelitian menunjukkan bahwa ada penurunan kualitas hidup masyarakat, lingkungan, dan ekosistem. Kesadaran dan respon dari orang-orang dan juga para pemangku kepentingan lain yang tidak progresif untuk mengatasi masalah banjir. Penelitian ini sedang mencoba untuk berkontribusi dalam menguraikan model adaptasi dan mitigasi bagi masyarakat untuk memulihkan ekosistem mereka dari sudut pandang ekonom.

Kata kunci: banjir, perubahan iklim, adaptasi, mitigasi
Klasifikasi JEL: Q51, Q54

1. Introduction

Indonesia is the six ranks in the world for flood risk and dangerous. On 1815 and 2013 year, Indonesia had flood experience for 5.233 times or 38.99% from the total of nature disaster in Indonesia (BNPB, 2014). Semarang is the capital city of Central Java province, has high frequency in flood. It lies at the northern coast of central java, its location is bordering with Kendal and Demak, both of them are the dangerous and risk flood area.

The main sources of flood water at Semarang city – Indonesia is raining and river, The high rain frequency and long duration is

caused river cannot receive rain water, so that, flood happened. Flood from the river water, besides influenced by rain water it also caused by narrowing river stream, damage dam, and river silting. Semarang position that lies in coastal area, often caused the river water can't flow to the ocean smoothly because the increasing of ocean water stream made a wide and high flood.

Flood at Semarang on 2009 – 2013 had very big impact, mainly 81 people to be the sac-rifices/victims, 61,192 people migrate, 45.686 Ha destroyed area, 139 km road broken and 1.782 houses had heavy broken (BNPB, 2014). Besides that, Harwitasari (2009) to add flood also gave impact to (1) Human resources loosing that can be renewed or improved (2) Areas damaged that are functioned as recreation park, and tourism, (3) Value and cultural sources loosing that can't be valued, and (4) Water and land quality decreasing for agriculture and fish-ery.

Many efforts have been done by the gov-ernment and society of Semarang city for reducing flood impact through adaptation and mitigation flood. Swart and Frank (2007) and Thomas *et al.* (2003) explaining adaptation and mitigation as two concepts that is aimed for reducing flood risk. **Flood mitigation** is defined as the effort for reducing the flood impact, such as: the amount of dead victims, amount of destroyed things and lost things. **Flood adaptation** is defined as the effort of natural and human being system Adaptation as the response towards the risk stimulus, mainly: the vulnerable that consists of: *(exposure), (sensivity),* and *(adaptive capacity) aspects.* Swart and Frank, (2007) explained that the flood impact as the concept of flood risk as function from danger, and the vulnerable, while the vul-nerable factor as the function of *exposure, sensivity,* and *adaptive capacity.*

Flood adaptation and mitigation can be done through (1) Structural and non-structural (Changzhi Li, *et al.*, 2012; Wedawatta and Ingi-rige, 2012; Lawson *et al.* 2011)), (2) Identifica-tion and reducing the vulnerable from physical, environment, social and economic aspects (Moser, *et al.,* 2010; Florina, 2007; Chaliha, 2012, Balica, *et al*, 2012), (3) vulnerable identi-

fication of exsposure *sensivity,* and *adaptive capacity* aspects. (Smit and Wandel, 2006; Turner *et al.*, 2003; and Brenkert and Malone, 2005), (4) Improvement and development pro-gram through the increasing of education level, income, insurance and poverty reducing (Chan, 1997; and Eziyi, 2011), (5) The increasing of society capacity (Yuniartanti, 2012; Hardoyo, 2011; Maharani, 2012), (6) the increasing of society participation (Olofsson, 2007; Fordham, 1998; Quarantelli, 2005), and (7) The increasing of society recognizing and capacity (Suryanti *et al.,* 2010; and Zein, 2010).

Flood adaptation and mitigation at Semarang city had done a lot but the flood im-pact keeps still high. It is regarded because flood model of adaptation and mitigation has not optimum. It is influenced by (1) the model of adaptation and mitigation that have not opti-mum; (2) there are still many people/society that regards flood as "*Acts of God"* and also as external aspect beyond human being ability. As *acts of God,* Flood is regarded as punishment, warning or examination from GOD, (3) Society viewed flood as external aspect beyond people ability, so that, it is needed technology innova-tion to reduce flood risk. Therefore, local wis-dom in reducing flood is often ignored.

The research aims are: (1) to identify flood impact at Semarang city – Central Java - Indo-nesia, (2) to identify the society and government awareness and response towards flood at Sema-rang city – Central Java - Indonesia, and (3) to formulate the model of flood adaptation and mitigation at Semarang city – Central Java – Indonesia.

2. Research Method

Research Population is societies that have expe-rienced of flood at Semarang city – Central Java - Indonesia in the last three years. Sample choosing is the *key persons* by using *purposive sampling* like which have been applicated by Susilowati (2013). *Key person* is chosen by using *snowball sampling,* mainly taking sample that is choosen at the beginning is one respondent, then, it is completed by other respondents, who are viewed know and able to complete the exist data until reach up the saturation point. It means that; when the answer is taken have

similar experience, so informant taking will be stopped.

This research used *mixed method approach*. Data gathering used interview and *Focus Group Discussion* (FGD). Interview is conducted by asking straightly to respondent by using questionnaire. FGD is used for collecting information, attitude, opinion, and respondents group decision. Analysis descriptive quantitative is used to describe the flood impacts, awareness, and response from society and government towards flood at Semarang city – Central Java - Indonesia. Then, to arrange the model of flood adaptation and mitigation at Semarang city – Central Java - Indonesia, by using *content analysis*, that is; to analyse the meaning of FGD results and interview. In this analysis is also explained how is the participants of stakeholder in reducing flood risk, both before flood (preventive), on disaster (emergency response) or after the flood (recovery and reconstruction).

3. Results and Discussion

Based on the city planning of Semarang city in 2011-2031 year is mentioned that flood area risk of Semarang city is spread out in ten districts, Those are: North Semarang, West Semarang, East Semarang, Tugu, Candisari, Gunungpati, Gayamsari, Pedurungan, Tembalang, and Genuk. Flood frequency, pool width and pool length in general much happened at Gayamsari, Peduruangan and Genuk districts. On the last three years, the society of Semarang city has got flood experience among 1 - 4 times every year. Society that has flood experience 2 - 3 times in a year is 69, 40%, Society that has flood experience 3 times in a year is 20, 70%, and Society that has flood experience 1 time in a year is 9, 90%. The pool high of flood water can be classified to be 3; those are: less than 0.5 meter, between 0.5-1 meter and more than 1 meter. Societies that have flood experience with high pool less than 0.5 meter is 48, 60%, followed high pool between 0.5-1 meters is 44.10%
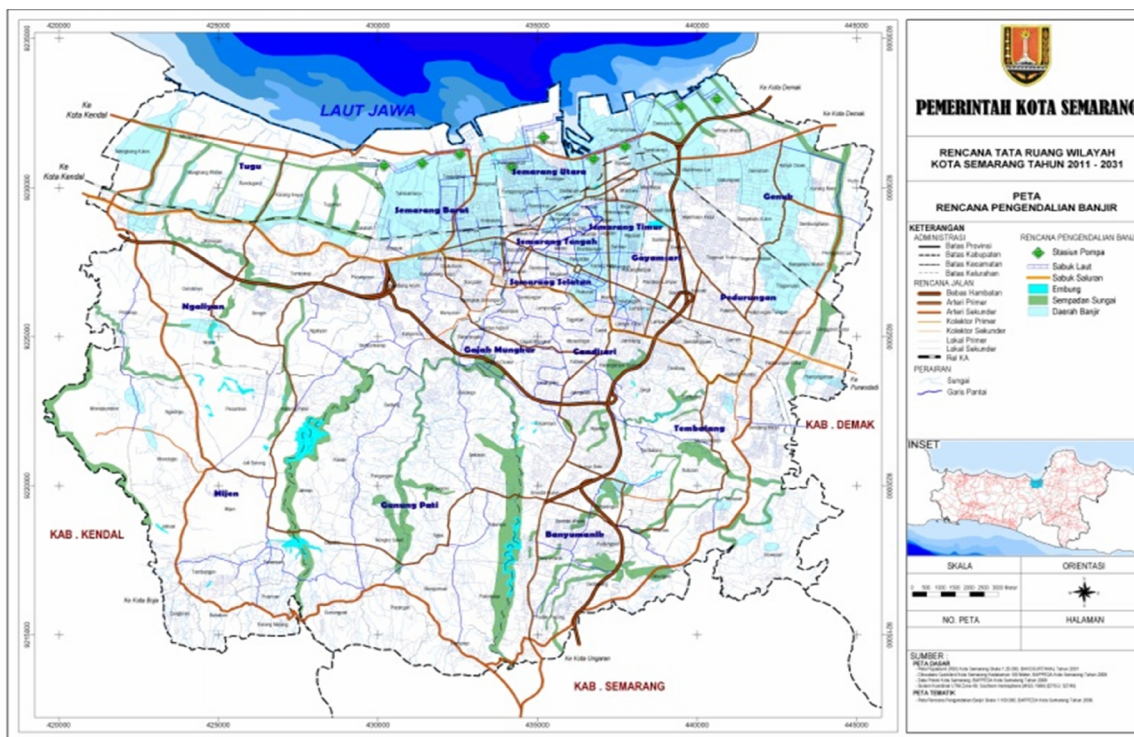

Figure 1. Disaster Risk Mapping at Semarang City – Central Java – Indonesia

Source: RTRW at Semarang city between 2011-2013 year.

and high pool more than 1 meter is 7, 20%. Then, the lengths of flood pools are variants between less than one day until more than one week. The most length of pool between 1 day untill 1 week, that is 91.00%, followed more than one week and less than one day is 4.50% each.

Flood at Semarang city has impact towards the decreasing of life society quality, such as: health, refugees, loosing job, and migrate. In one time flood, society that needs medicine in 2 - 3 times is around 65.8%, followed one time need medicine is around 24.30% and need medicine more than 3 times is around 9.90%. Every times flood happened the society that need to refuge is around 38.70%. They refuge at Masjid, school, and dam that are used as flood refuge. Societies that have lost their job is 2.70%, generally they work in informal sector. Society that doing migrate to the other area is 33. 30%.

Flood at Semarang city also gave impact in reducing environment quality. When flood happened, there was 45.90% society has difficulty in getting clean water. For getting clean water in one time flood, every family should pay between IDR 50,000 and IDR 500,000. That is much money.

The awareness of Semarang city society towards flood is still low. Society that has been doing information access from electronic, printing media and internet are not so much. Based on the interview result was explained that around 59,5% society is rarely to access flood information, while society that is often access flood information is around 13,5% and society that is always access flood information is only 8.1%. Then, the society participation on insurance is also still small, is around 20.7%. Insurance that they followed is mostly in health and labour.

Semarang city government does not serious in handling flood problem. That problem has linked with government effort in handling river condition, dam, and water door, evacuation path route, houses distance to evacuate location, the existence of flood risk road mapping, flood emergency service, early warning, flood socialization and training. Semarang city society said that river condition, dam, and water door unmaintenance is only about 52,30%, and then followed is about 41,40% society that has stated unmaintenance and around 6.30% society said in good maintenance. Then for flood victims/sacrifices evacuation path route, is 79.3% society answered that the condition is damaged and 20.7% society explained that the condition is good. The distance from home to location of flood victims' evacuation is variants. The evacuate location distance that is more than 1 km is 11,7%, the distance between 100 m until 1 km is 67,7% and distance that less from 100m is 18.00%.

The government of Semarang city has not done maximally for handling the flood. It is around 82.00% society said that the government of Semarang city did not do flood emergency service. Flood risk mapping at Semarang city did not socialize until grass root society level. That mapping only lies at village, district, and BPBD offices. It is around 66.70% society did not know about flood risk mapping existence at their own area. For kinds of flood early warning, is done by using microphone and kentongan or hitting electricity stake. This warning did not understand by the society well, there is around 78.40% society explained that there is no early warning at the time of flood happened in their area.

Flood training and socialization are still limited and not so much done by the government of Semarang city. Activity like the way to overcome flood, emergency response, refuge and general kitchen have not understood by society. This is strengthen by the society attitude 97.30% explained that there is no training flood managing and 95.50% society that explained there is no flood socialization by the government and the other institutions.

Flood adaptation and mitigation activity that is conducted at Semarang city usually *adhocly* and unplanning in systematically and continually. The kinds of flood adaptation is conducted by Semarang city society are: (1) to make higher environment path, (2) to make higher houses terraces in their own houses, (3) to make dam at their own houses terrace for blocking water to enter their houses, (4) to improve water door, and (5) to improve the damaged river dam in village area.

Table 1. Stakeholders Role in Flood Managing at Semarang City

No	The Conducting of Flood Managing	Stakeholders role			
		A	B	C	G
	Before - Flood				
1.	Situation No Flood	5.4	5.3	6.2	6.9
2.	Situation Flood Potential	5.3	5.4	6.5	6.8
	Emergency Response	6.3	6.5	7.5	7.7
	After Flood				
1.	Rehabilitation	5.3	6.2	7.2	7.6
2.	Reconstruction	5.2	5.7	7.2	7.3
	Average Totally	5.6	5.8	6.8	7.3

Source: Data Printer (2015)

Flood mitigation at Semarang city for this time being is done through structural, non-structural activity, and society participation. Structural activity that have been done, such as: (1) Dam improvement, drainage, and river, (2) to block the source of flood water by using sand that entering to sacks, and (3) to make drainage system for wasting disposal. Non-structural that have been done, such as; (1) Evacuation training for checking society preparation, BPBD, and evacuation equipment, also the refuge/shelter preparation and the accomplishment, (2) to set up flood shelter and general kitchen for flood victims, (3) to provide logistic that is needed for activity and effort for emergency response, (4) to prepare district map of flood risk that is completed by route for refugees, location the refuge and shelter, and (5) to form the links of intra institutions/sectors and NGO that gave closed attention and care about disaster/flood, also mass media both electronic or printing (TV and Radio stations) for conducting campaign to take care of disaster/flood to all of societies including the delivery of flood information.

Flood mitigation through society role activity, those are: (1) throwing the rubbish at the right place and not throw away in river, the stream and drainage system; (2) following training and socialization flood mitigation effort, and (3) conducting cooperation and working together in cleaning drainage system in their own environment.

To know how far the stakeholders role in conducting flood managing, both pre flood, emergency response, after flood is conducted evaluation by giving value academic participation (A), Business (B), Community (C) and Government (G) by giving score between 1-10. stakeholders role in flood managing at Semarang city is variant. Government is the most dominate role in flood managing, followed by society, businessmen/women and the last is university.

BPBD as government institution that carry out flood adaptation and mitigation as new institution that is formed based on UU No. 24, 2007 year, about disaster overcoming. So that, based on that regulation, reducing activity of flood risk at national level is conducted by Disaster Overcoming National Institution/ Badan Nasional Penanggulangan Bencana (BNPB), and for province and districts level is conducted by District Disaster Overcoming Institution/Badan Penanggulangan Bencana Daerah (BPBD).

One of the problems of flood adaptation and mitigation at Semarang city is model of flood adaptation and mitigation that has not optimum, in which that activity is only conducted by BPBD (government) whereas university, businessmen/women and society have very important role, but never been involved in that case actively. For optimizing the flood adaptation and mitigation is proposed model that can be accommodated by all the stakeholders.
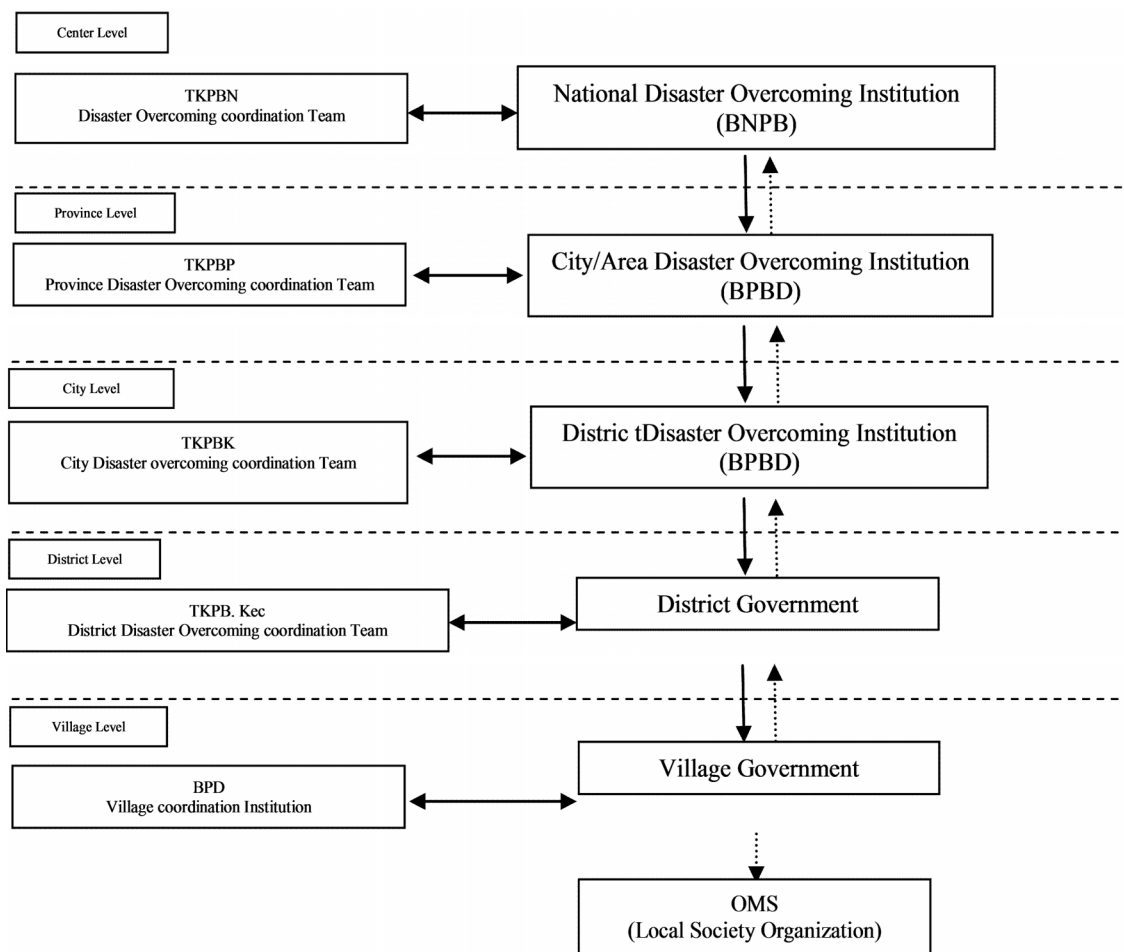
Figure 2. Flood Adaptation and Mitigation Model

4. Conclusions

The study result found that there was a decline in quality of - people's life, environment and its ecosystem. Awareness and responsiveness of people and also the other stakeholders are not progressive to overcome the problem of flood. Most of efforts to get rid of flood are in ad-hoc system and no grand-design in the perspective of ecosystem-based. This study is trying to contribute in outlining a model of adaptation and mitigation for the people to restore their ecosystem from the perspective of economist. Of course, it needs further research and trials to get a suitable model.

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